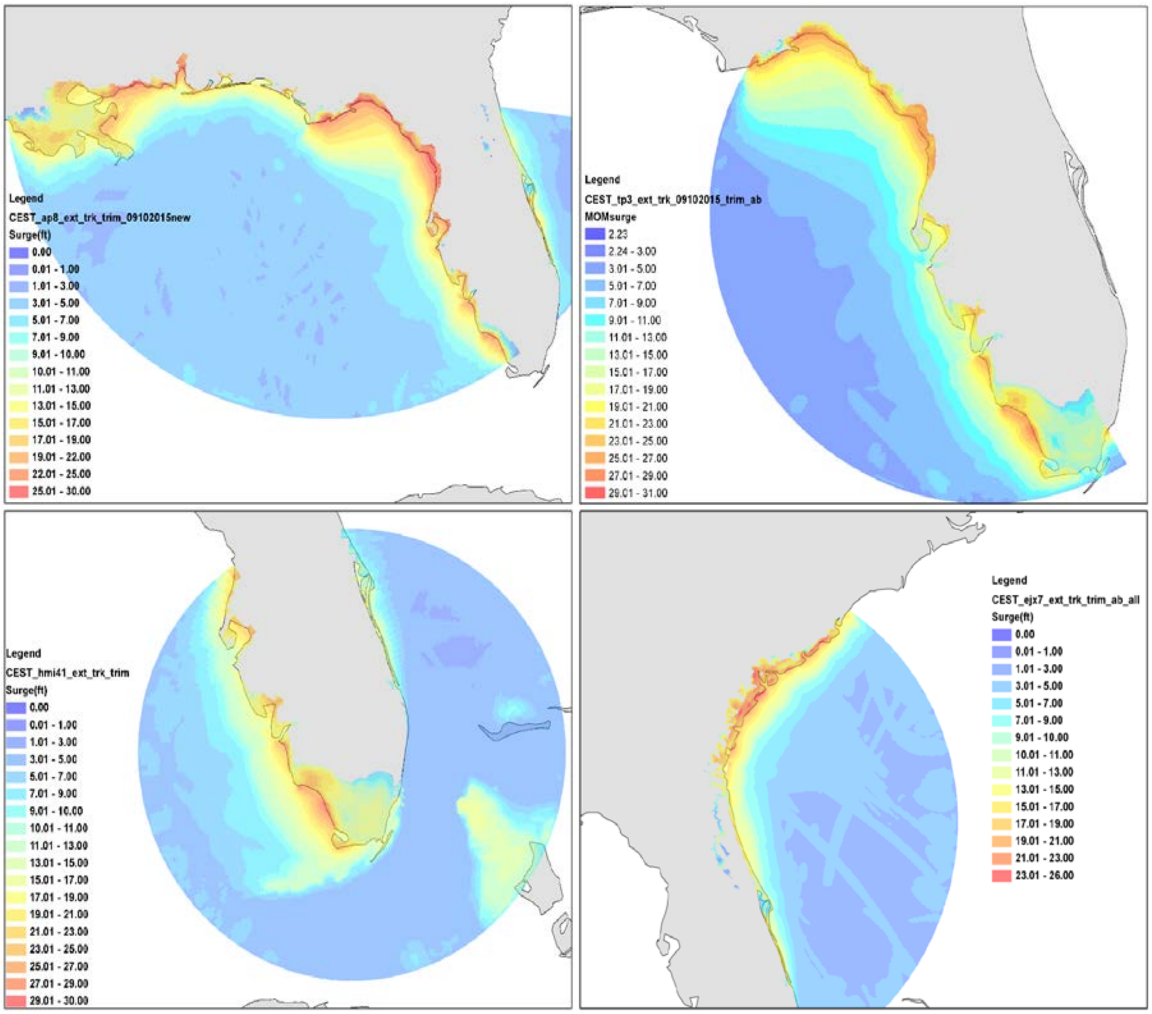
FLORIDA
PUBLIC FLOOD
LOSS MODEL V1.0

Submitted in compliance with the 2021 Standards of the
Florida Commission on Hurricane Loss Projection Methodology
Submitted on Jan. 30, 2024



Flood Model Identification

Name of Flood Model: Florida Public Flood Loss Model

Flood Model Version Identification: V1.0

Name of Modeling Organization: Florida International University

Street Address: Extreme Event Institute, 11200 SW 8th Street, AHC5, Room 220, FIU

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Date: January 30, 2024

January 30, 2024

Chair, Florida Commission on Hurricane Loss Projection Methodology
c/o Donna Sirmons
Florida State Board of Administration
1801 Hermitage Boulevard, Suite 100
Tallahassee, FL 32308

Dear Commission Chairman:

I am submitting version 1.0 of Florida Public Flood Loss Model for review by the Commission. Enclosed are 8 bound copies of our submission document. The FPFLM model has been reviewed by professionals having credentials and/or experience in the areas of meteorology, hydrology, coastal surge, engineering, statistics, actuarial science, and computer science; for compliance with the Standards, as documented by the expert certification forms GF1-GF8.

Sincerely,

S. Hamid

Shahid Hamid, Ph.D., CFA
Professor of Finance, and
Director, Laboratory for Insurance, Economic and Financial Research, Extreme Event Institute
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Statement of Compliance and Trade Secret Disclosure Items

The Florida Public Flood Loss Model 1.0 is intended to comply with each Standard of the 2021 Report of Activities released by the Florida Commission on Hurricane Loss Projection Methodology. The required disclosures, forms, and analysis are contained herein.

The source code for the loss model will be available for review by the Professional Team.

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GENERAL FLOOD STANDARDS

GF-1 Scope of the Flood Model and Its Implementation

A. The flood model shall project loss costs and probable maximum loss levels for primary damage to insured personal residential property from flood events.

The Florida Public Flood Loss Model estimates loss costs and probable maximum loss levels from storm and rain fall events for insured residential properties.

B. A documented process shall be maintained to assure continual agreement and correct correspondence of databases, data files, and computer source code to presentation materials, scientific and technical literature, and modeling organization documents.

The FPFLM members follow the process specified in the flowchart of Figure 1 in order to assure continual agreement and correct correspondence of databases, data files, and computer source code to presentation material, scientific and technical literature, and FPFLM documents.

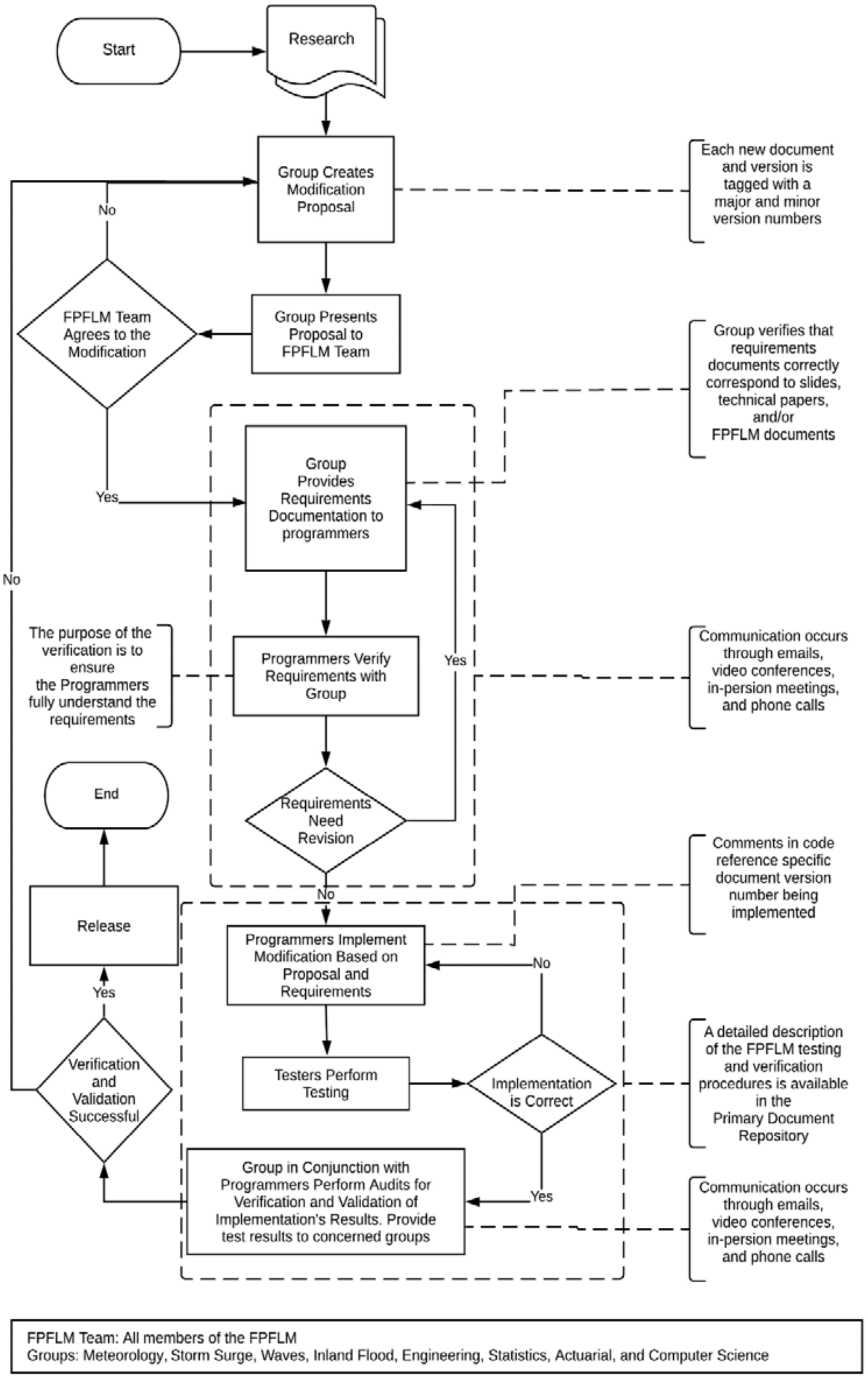


Figure 1. Process to assure continual agreement and correct correspondence of databases, data files, and computer source code to presentation material, scientific and technical literature, and modeling organization documents.

C. All software, data, and flowcharts (1) located within the flood model, (2) used to validate the flood model, (3) used to project modeled flood loss costs and flood probable maximum loss levels, and (4) used to create forms required by the Commission in the Flood Standards Report of Activities shall fall within the scope of the Computer/Information Flood Standards and shall be located in centralized, model-level file areas.

All software, data, and flowcharts used to validate the model, project insured loss cost and PML, and create forms required by the Commission are centrally maintained in the model hardware infrastructure and easily accessible by appropriate team members and comply with the Computer/Information Flood Standards.

D. Differences between historical and modeled flood losses shall be reasonable, given available flood loss data.

Within the constraints of given available flood loss data the difference between historical and modeled flood losses are reasonable.

E. Vintage of data, code, and scientific and technical literature used shall be justifiable.

The vintage of the model data meets or exceeds the requirements specified in the Standards. Examples include Land Use/Land Cover Data and Zip code data. Other auxiliary data sets have been updated or are otherwise reasonable given the availability of the data or the intended use of the data.

Model code is compliant with contemporary and widely used programming language standards that are well-supported by a variety of compiler/language vendors and open-source implementations.

Scientific and technical literature used or created by the model personnel reflects current understanding of the methods, concepts and results that are relevant to catastrophe modeling.

Disclosures

1. Specify the flood model version identification. If the flood model submitted for review is implemented on more than one platform, specify each flood model platform identifying the primary platform and the distinguishing aspects of each platform.

The model name is Florida Public Flood Loss Model (FPFLM). The version identification is 1.0

2. Provide a comprehensive summary of the flood model. This summary should include a technical description of the flood model, including each major component of the flood model used to project loss costs and probable maximum loss levels for insured primary damage to personal residential property from flood events causing damage in Florida. Describe the

theoretical basis of the flood model and include a description of the methodology, particularly the meteorology components, the hydrology and hydraulic components, the vulnerability components, and the insured flood loss components used in the flood model. The description should be complete and is not to reference unpublished work.

Meteorology Component

The meteorological input data for the FPFLM is obtained directly from the Florida Public Hurricane Loss Model (FPHLM). No modifications to the data have been made except that the storm tracks may be extended earlier in time prior to landfall in order to provide sufficient spin-up for the Coastal and Estuarine Storm Tide (CEST) surge model. This is achieved by simply pre-pending the corresponding historical track (from HURDAT2) of the storm seed used in generating the stochastic track. The wind model is the same as the one that is used in the FPHLM. In order to provide background material to facilitate the understanding of the FPFLM, we reproduced relevant descriptions of the FPHLM meteorological component here and elsewhere in this document. For more detail we encourage you to refer to the FPHLM submission documents which are available on the SBA website. For the present submission, the meteorological data was obtained from the FPHLM 8.2 version, which was accepted by the Commission in July, 2023.

Storm Track and Intensity

The storm track model generates storm tracks and intensities on the basis of historical storm conditions and motions. The initial seeds for the storms are derived from the HURDAT2 database. For historical landfalling storms in Florida and neighboring states, the initial positions, intensities, and motions are taken from the track fix 36 hours prior to first landfall. For historical storms that do not make landfall but come within 62 miles (100 km) of the coast, the initial conditions are taken from the track fix 36 hours prior to the point at which the storm first comes within 62 miles of the coast (threat zone) and has a central pressure below 1005 mb. Small, uniform random error terms are added to the initial position, the storm motion change, and the storm intensity change. The initial conditions derived from HURDAT2 are recycled as necessary to generate thousands of years of stochastic tracks. After the storm is initiated, the subsequent motion and intensity changes are sampled from empirically derived probability distribution functions over the model domain. The model domain and threat zone are shown in Figure 2.

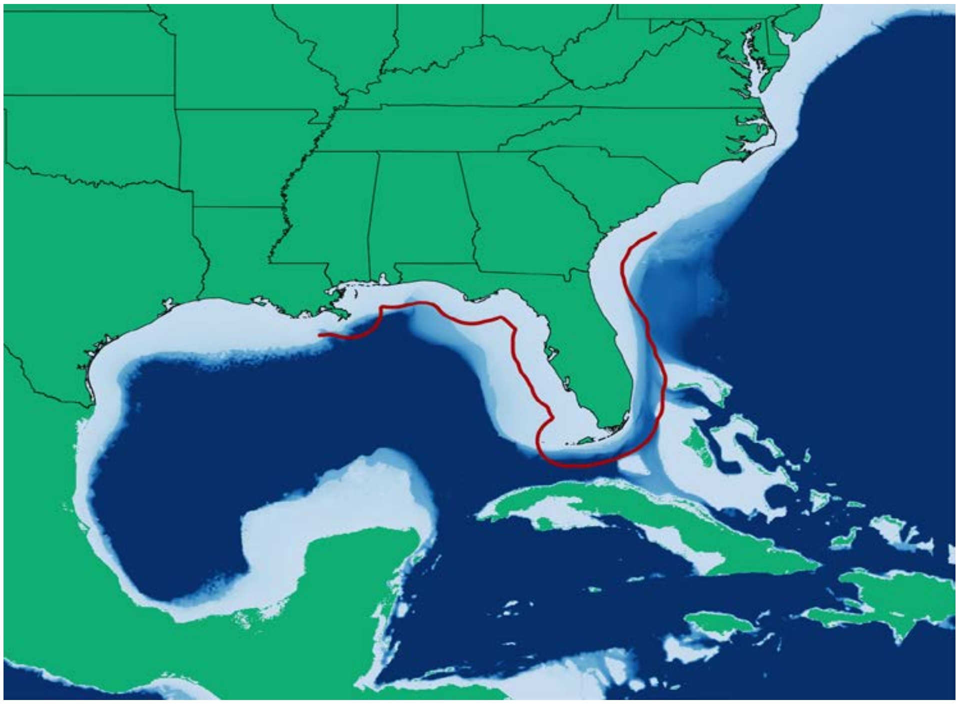


Figure 2. Florida Public Hurricane Loss Model domain. Threat zone is delineated by red line.

The time evolution of the stochastic storm tracks and intensity are governed by the following equations:

$$\Delta x = (c\, cos(\theta)\, \Delta t)/\cos(y) \quad \text{(HAZ-1)}$$

$$\Delta y = c\, sin(\theta)\Delta t \quad \text{(HAZ-2)}$$

$$\Delta p = w\Delta t \quad \text{(HAZ-3)}$$

where (x, y) are the longitude and latitude of the storm, (c, θ) are the storm speed and heading (in conventional mathematical sense), p is central pressure, w is the rate of change in p, and Δt is the time step. The time step of the model is currently one hour. The change in storm speed and direction $(\delta c, \delta\theta)$ are sampled at every 24-hour interval from a probability distribution function (PDF). The intensity change after the initial 24 hours of track evolution is sampled every six hours to capture the more detailed evolution over the continental shelf (shallow water). From the 24-hour change in speed and heading angle, we determine the speed and heading angle at each one-hour time step by assuming the storm undergoes a constant acceleration that gives the 24-hour sampled change in velocity. For changes in pressure, we first sample from a PDF of relative intensity changes, δr, for the six-hour period and then determine the corresponding rate of pressure change, w. The relative intensity is a function of the climatological sea surface temperatures and the upper tropospheric 100 mb temperatures. The PDFs of the changes $(\delta c, \delta\theta, \delta r)$ depend on spatial location, as well as the current storm motion and intensity. These PDFs are of the form

$$PDF(\delta a) = A(\delta a, a, x, y) \quad \text{(HAZ-4)}$$

where a is either c, θ, or r and are implemented as discrete bins that are represented by multi-dimensional matrices (arrays), $A(l,m,i,j)$. The indices (i,j) are the storm location bins. The model domain (100W to 70W, 15N to 40N) is divided into 0.5-degree boxes. The index m represents the bin interval that a falls into. That is, the range of all possible values of a are divided into discrete bins, the number of which depends on the variable, and the index m represents the particular bin a is in at the current time step. As with a, the range of all possible values of the change in a are also discretely binned. Given a set of indices (m,i,j), which represent the current storm location and state, the quantity $A(l,m,i,j)$ represents the probability that the change in a, δa , will fall into the l'th bin. When A is randomly sampled, one of the bins represented by the l index, e.g. l', is chosen. The change of a is then assigned the midpoint value of the bin associated with l'. A uniform random error term equal to the width of bin l' is added to δa, so that δa may assume any value within the bin l'.

The PDFs described above were generated by parsing the HURDAT2 database and computing for each track the storm motion and relative intensity changes at every 24- and 6-hour interval, respectively, and then binning them. Once the counts are tallied, they are then normalized to obtain the distribution function. For intensity reports for which pressure is not available, a wind pressure relation developed by Landsea et al. (2004) is used. In cases where there is no pressure report for a track fix in the historical data but there are two pressure reports within a 24-hour period that includes the track fix, the pressures are derived by linear interpolation. Otherwise the pressure is derived by using the wind-pressure relation. Extra-tropical systems, lows, waves, and depressions are excluded. Intensity changes over land are also excluded from the PDFs. To ensure a sufficient density of counts to represent the PDFs for each grid box, counts from nearest neighbor boxes, ranging up to 2 to 5 grid units away (both north-south and east-west direction), are aggregated. Thus, the effective size of the boxes may range from 1.5 to 5.5 degrees but are generally a fixed size for a particular variable. The sizes of the bins were determined by finding a compromise between large bin sizes, which ensure a robust number of counts in each bin to define the PDF, and small bin sizes, which can better represent the detail of the distribution of storm motion characteristics. Detailed examinations of the distributions, as well as sensitivity tests, were done. Bin sizes need not be of equal width, and a nonlinear mapping function is used to provide unequal-sized bins. For example, most storm motion tends to be persistent, with small changes in direction and speed. Thus, to capture this detail, the bins are more fine-grained at lower speed and direction changes.

For intensity change PDFs, boxes which are centered over shallow water (defined to be less than 656 ft deep) are not aggregated with boxes over deeper waters. Deeper waters may have significantly higher ocean heat content, which can lead to more rapid intensification [see, for example, Shay et al. (2000); DeMaria et al. (2005); Wada and Usui (2007)].

In Figure 3 we show a sample of tracks generated by the stochastic track and intensity model.

Figure 3. Examples of simulated hurricane tracks. Track colors correspond to storm intensity: red – Cat 4, orange – Cat 3, yellow – Cat 2, light blue – Cat 1, dark blue – TS.

The pressure field for the model is based on the *Holland B* pressure profile (Holland, 1980). When a storm is initiated, the parameters for radius of maximum winds and *Holland B* are computed and appropriate error terms are added as described below. The *Holland B* term is modeled as follows:

$$B = 1.74425 - 0.007915Lat + 0.0000084DelP^2 - 0.005024Rmax \qquad \text{(HAZ-5)}$$

where *Lat* is the current latitude (degrees) of the storm center, *DelP* is the central pressure difference (mb), and *Rmax* is the radius of maximum winds (km). The random error term for the *Holland B* is modeled using a Gaussian distribution with a standard deviation of 0.286. Figure 4 shows a comparison between the Willoughby and Rahn (2004) *B* dataset and the modeled results (scaled to equal the 116 measured occurrences in the observed dataset). The modeled results with the error term have a mean of about 1.38 and are consistent with the observed results. The figure indicates excellent agreement between model and observations.

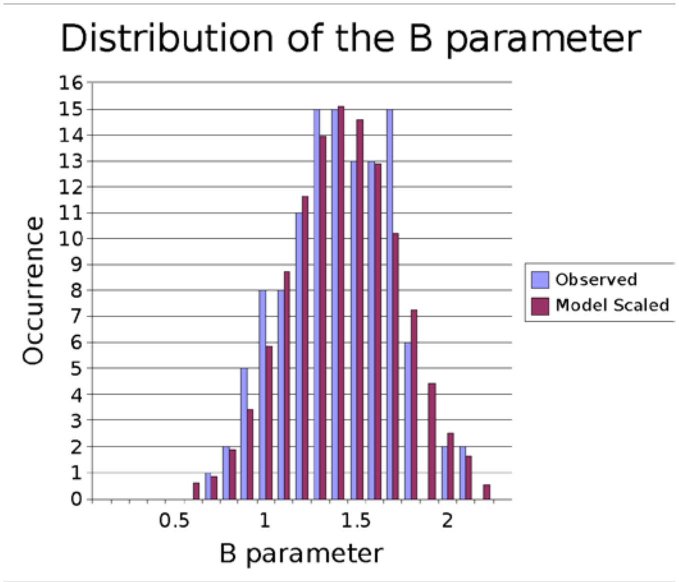


Figure 4. Comparison between the modeled and observed Willoughby and Rahn (2004) B dataset.

We developed an *Rmax* model using a landfall *Rmax* database, which includes more than 100 measurements for storms up to 2021. We have opted to model the *Rmax* at landfall rather than the entire basin for a variety of reasons. One is that the distribution of landfall *Rmax* may be different than that over open water. An analysis of the landfall *Rmax* database and the 1988–2007 DeMaria extended best track data shows that there appears to be a difference in the dependence of *Rmax* on central pressure (*Pmin*) between the two datasets (Demuth et al., 2006). The landfall dataset provides a larger set of independent measurements, more than 100 storms compared to about 31 storms affecting the Florida threat area region in the best track data. Since landfall *Rmax* is most relevant for loss cost estimation and has a larger independent sample size, we have chosen to model the landfall dataset.

We modeled the distribution of *Rmax* using a gamma distribution. Using the maximum likelihood estimation method, we found the estimated parameters for the gamma distribution, $\hat{k} = 4.875$ and $\hat{\theta} = 5.284$. With these estimated values, we show a plot of the observed and expected distribution in Figure 5. The *Rmax* values are binned in 5 mile intervals, with the *x*-axis showing the end value of the interval.

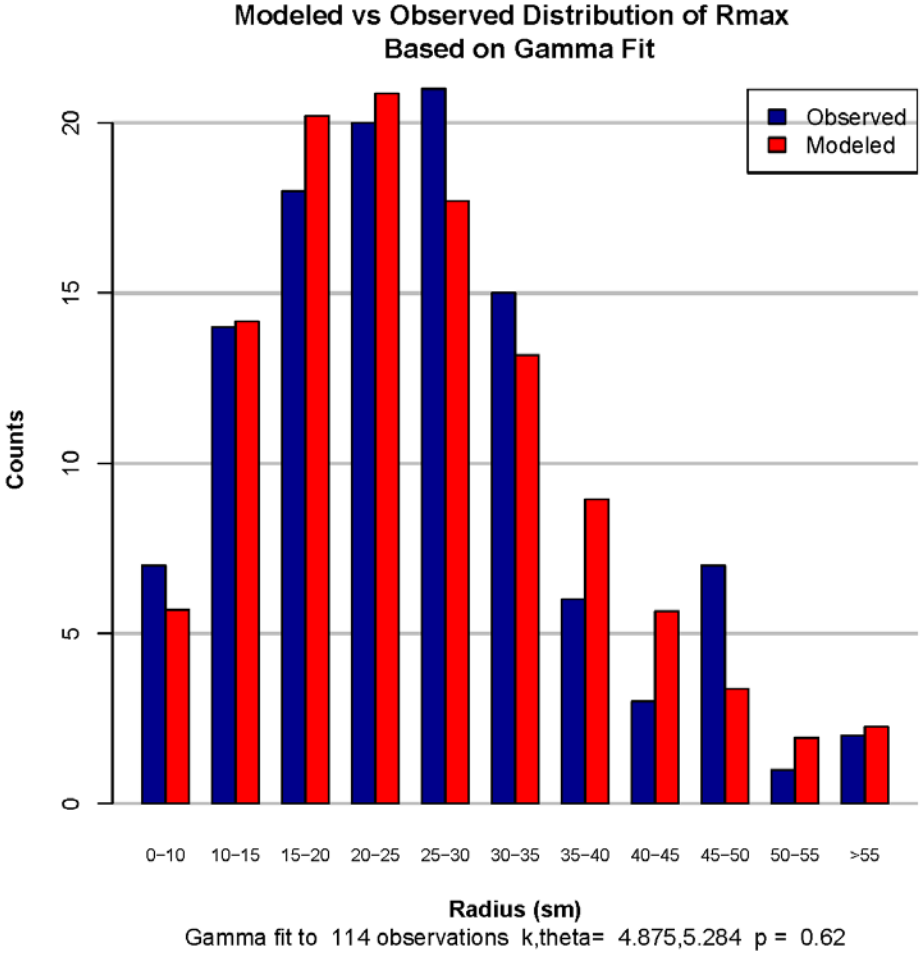


Figure 5. Observed and expected distribution for *Rmax*. The x-axis is the radius in statute miles, and the y-axis is the frequency of occurrence.

An examination of the *Rmax* database shows that intense storms, essentially Category 5 storms, have rather small radii. Thermodynamic considerations (Willoughby, 1998) also suggest that smaller radii are more likely for these storms. Thus, we model Category 5 (*DelP*>90 mb, where *DelP*=1013-*Pmin* and *Pmin* is the central pressure of the storm) storms using a gamma distribution, but with a smaller value of the θ parameter, which yields a smaller mean *Rmax* as well as smaller variance. We have found that for Category 1–4 (*DelP*<80 mb) storms there is essentially no discernable dependence of *Rmax* on central pressure. This is further verified by looking at the mean and variance of *Rmax* in each 10 mb interval. Thus, we model Category 1–4 storms with a single set of parameters. For a gamma distribution, the mean is given by $k\theta$, and variance is $k\theta^2$. For Category 5 storms, we adjust θ such that the mean is equal to the mean of the five Category 5 storms in the database: 1935 No Name, 1969 Camille, 1992 Andrew, 2018 Michael and 2019 Dorian. An intermediate zone between *DelP*=80 mb and *DelP*=90 mb is established where the mean of the distribution is linearly interpolated between the Category 1–4 value and the Category 5 value. As the θ value is reduced, the variance is likewise reduced. Since there are insufficient observations to determine what the variance should be for Category 5 storms, we rely on the assumption that variance is appropriately described by the rescaled θ, via $k\theta^2$.

For Category 5 and intermediate Category 4–5 storms, we use the property that the gamma cumulative distribution function is a function of (k, x/θ). Thus, by rescaling θ, we can use the same Gamma distribution with parameters described above, but just rescale x (*Rmax*). The rescaled *Rmax* will still have a gamma distribution but with different mean and variance.

The storms in the stochastic model will undergo central pressure changes during the storm life cycle. When a storm is generated, an appropriate *Rmax* is sampled for the storm. To ensure the appropriate mean values of *Rmax* as pressure changes, the *Rmax* is rescaled every time step as necessary. As long as the storm has *DelP* < 80 mb, there is in effect no rescaling. In the stochastic storm generator, we limit the range of *Rmax* from 4 mile to 120 mile.

Storm landfall and decay over land are determined by comparing the storm location (x, y) with a 0.6 mile resolution land-sea mask. This land mask is obtained from the U.S. Geological Survey (USGS) land use cover data, and inland bodies of water have been reclassified as land to avoid spurious landfalls. Landfall occurs every time the storm moves from an ocean point to a land point as determined by this land mask. During landfall, the central pressure is modeled by a filling model described in Vickery (2005) and is no longer sampled from the intensity change PDFs. The Vickery (2005) model basically uses an exponentially decaying, in time, function of the central pressure difference with the decay coefficients varying by region on the basis of historical data. The pressure filling model also takes into account the speed and size of the storm. When the storm exits to sea, the land-filling model is turned off and sampling of the intensity change PDFs begins again. A storm is dissipated when its central pressure exceeds 1011 mb.

Wind Field Model

The wind model is based on the slab boundary layer concept originally conceived by Ooyama (1969) and implemented by Shapiro (1983). Similar models based on this concept have been developed by Thompson and Cardone (1996), Vickery et al. (1995), and Vickery et al. (2000a). The model is initialized by a boundary layer vortex in gradient balance. Gradient balance represents a circular flow caused by balance of forces on the flow whereby the inward directed pressure gradient force is balanced by outward directed Coriolis and centripetal accelerations. The coordinate system translates with the hurricane vortex moving at velocity c. The vortex translation is assumed to equal the geostrophic flow associated with the large-scale pressure gradient. In cylindrical coordinates that translate with the moving vortex, equations for a slab hurricane boundary layer under a prescribed pressure gradient are

$$u\frac{\partial u}{\partial r}-\frac{v^2}{r}-fv+\frac{v}{r}\frac{\partial u}{\partial \phi}+\frac{\partial p}{\partial r}-K\left(\nabla^2 u-\frac{u}{r^2}-\frac{2}{r^2}\frac{\partial v}{\partial \phi}\right)+F(c,u)=0=\frac{\partial u}{\partial t} \qquad \text{(HAZ-6)}$$

$$u\left(\frac{\partial v}{\partial r}+\frac{v}{r}\right)+fu+\frac{v}{r}\frac{\partial v}{\partial \phi}-K\left(\nabla^2 v-\frac{v}{r^2}+\frac{2}{r^2}\frac{\partial u}{\partial \phi}\right)+F(c,v)=0=\frac{\partial v}{\partial t} \qquad \text{(HAZ-7)}$$

where u and v are the respective radial and tangential wind components relative to the moving storm; p is the sea level pressure, which varies with radius (r); f is the Coriolis parameter, which varies with latitude; ϕ is the azimuthal coordinate; K is the eddy diffusion coefficient; and $F(c,u)$,

$F(c,v)$ are frictional drag terms. All terms are assumed to be representative of means through the boundary layer. The motion of the vortex is determined by the modeled storm track. The symmetric pressure field $p(r)$ is specified by the Holland (1980) pressure profile with the central pressure specified according to the intensity modeling in concert with the storm track. The model for the *Holland B* pressure profile and the radius of maximum wind are described above. The wind field is solved on a polar grid with a 0.1 *R*/*Rmax* resolution. The input *Rmax* is adjusted to remove a bias caused by a tendency of the wind field solution to place *Rmax* one grid point radially outward from the input value. After the storm-relative wind components are derived, the storm translation motion vector is added to obtain the earth-relative wind.

Rain Model

The rain model provides estimates of the hourly rainfall accumulation due to tropical cyclones using the Atlantic Oceanographic & Meteorological Laboratory Hurricane Research Division (AOML/HRD) R-CLIPER rain algorithm for stochastic and historical storm events as input to the inland flood model. The rain amounts are computed for all horizontal grid points in the inland flood model. The rain model uses the storm track files to determine the location and intensity of the storms at hourly track intervals. The R-CLIPER algorithm requires the peak wind of the storm and the distance to the target location to the center of the storm at one hour time intervals. The peak wind is estimated using a wind-pressure relation since the track file only includes central pressure (the track file is also input for the wind model). The distance from storm center to target location is estimated using the Haversine formula. A brief description of the R-CLIPER (Lonfat et al., 2004; Lonfat et al., 2007) follows.

The R-CLIPER model is a statistical fit of observational rainfall climatology. R-CLIPER was initially based on U.S. rain gauge data, but has been updated using global satellite-based TRMM microwave imager (TMI) data.

TRMM rainfall data from 1 January 1998 to December 2002 were used to develop the rainfall climatology for R-CLIPER. These data include 3979 storm events over the globe. Figure 6 shows a subset (storms prior to 31 December 2000) of the storm event locations.

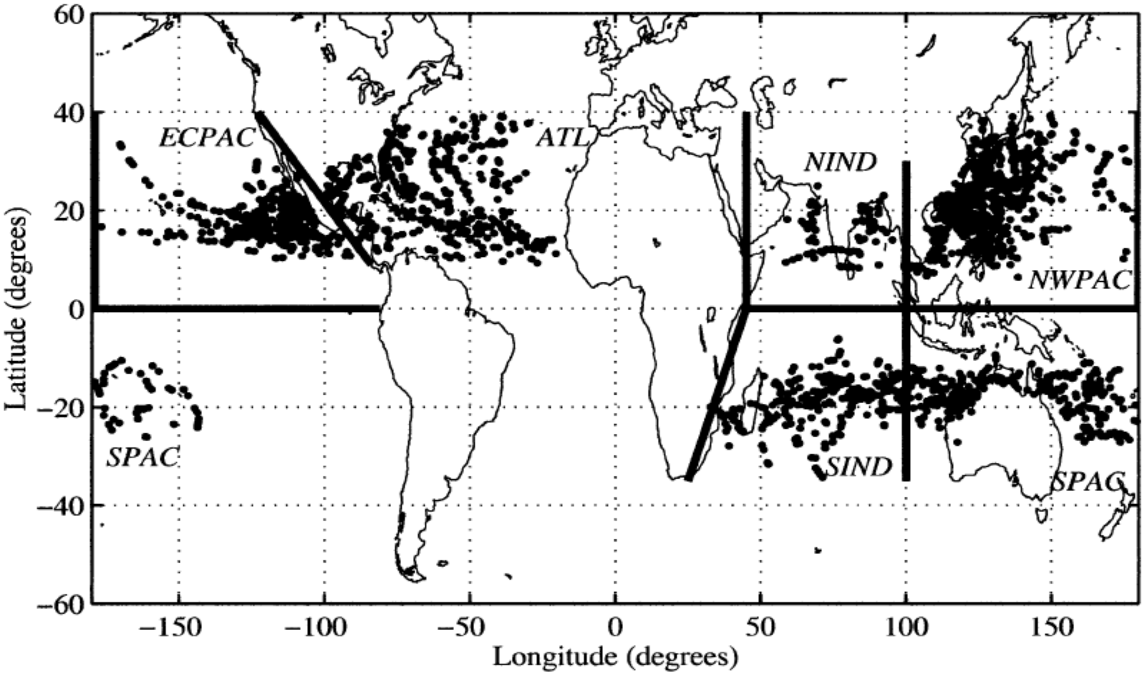


Figure 6. Tropical cyclones observed by TMI during the period 1 Jan 1998 to 31 Dec 2000. Each dot represents one TRMM observation. (From Lonfat et al, 2004).

The rainfall data were combined with operational best track data in order to link the rain data to characteristics of the associated storm. Lonfat et al (2004) showed that the azimuthally averaged rainfall of a storm depends strongly on the distance to the storm center and the maximum intensity of the storm. Figure 7 shows the TMI-based rainfall climatology for different categories of storms.

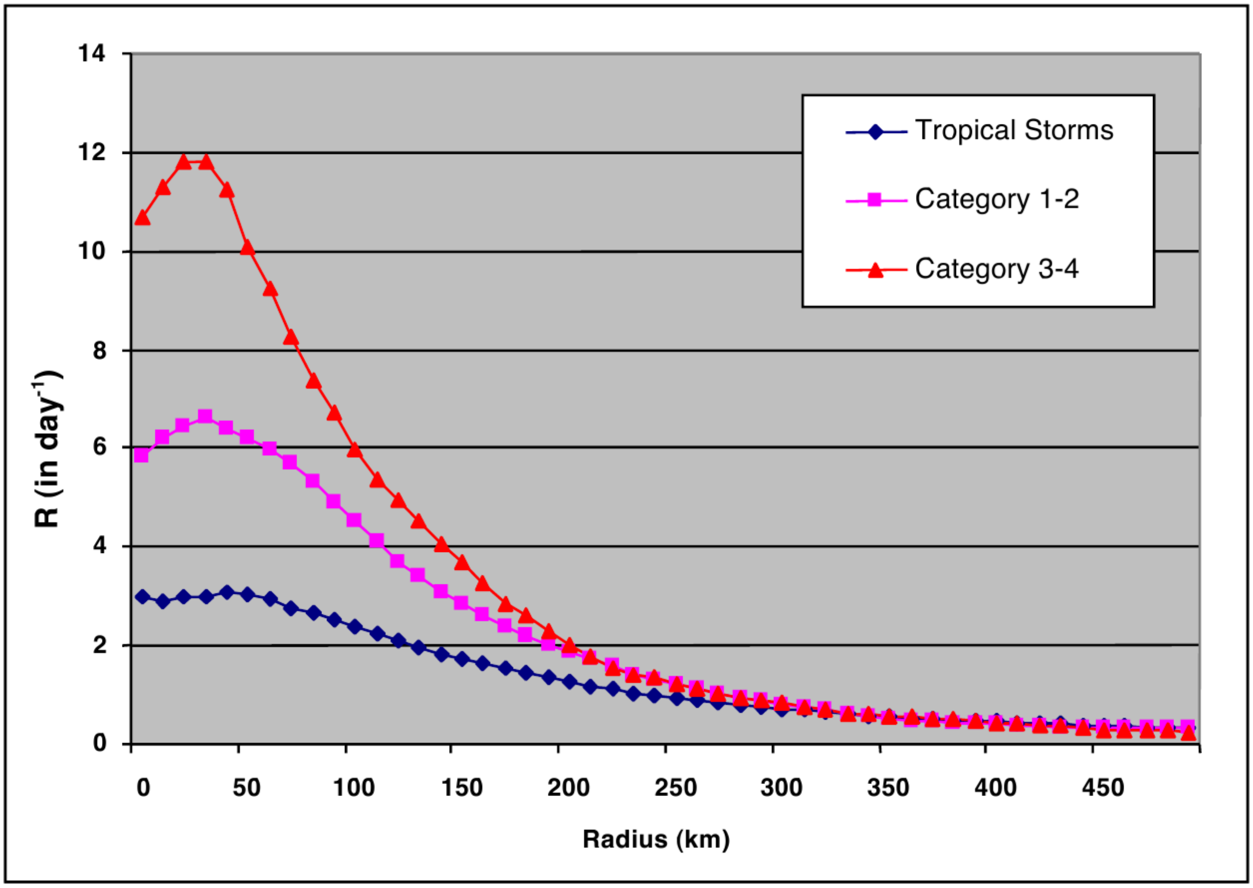


Figure 7. TMI-based rainfall climatology. (Based on data from Lonfat et al, 2004).

Thus, the R-CLIPER model uses a functional form which depends on the distance to the storm center and maximum intensity (wind speed) of the storm. The function has the following form:

$$\begin{aligned} R(r) &= t_0 + (t_m - t_0)(r/R_{\max}) && r < R_{\max} \\ &= t_m \exp(-(r - R_{\max})/r_e) && r > R_{\max} \end{aligned} \qquad \text{(HAZ-8)}$$

where R is rainfall rate, r is distance to storm center, R_{max} is radius of maximum winds, t_0 is rain at storm center, t_m is the rain at the radius of maximum winds, and r_e is the rain extent. The terms t_0, t_m and r_e are determined by a regression equation as a function of the storm maximum intensity at a given instant of time based on the TMI climatology and best track data. The output is the mean rain rate at the target location. Due to the TMI measuring method, the rain rates are more representative of 3-hour averages.

Coastal Storm Surge Component

The State of Florida has the longest coastline in the nation and is the state most impacted by hurricanes based on historical records. Most of Florida's coastal areas are vulnerable to storm surge flooding because of low elevation. Several densely populated areas such as Miami, the Florida Keys, Cape Coral, Tampa Bay, and Pensacola are extremely vulnerable to storm surge flooding because of their unique coastline configuration (Figure 8). Therefore, in addition to wind induced damage, it is essential to include the property damage caused by storm surge and storm wave in estimating the property damage from a hurricane.

Figure 8. The populated areas (red rectangles) along the Florida coast where severe storm surge flooding could occur when a large and intense hurricane makes landfall. The coverage of Light Detection And Ranging (LiDAR) data from the Florida Department of Emergency Management (FDEM) is also displayed.

The Coastal and Estuarine Storm Tide (CEST) model is used to compute storm surge parameters, which are the inputs of damage functions for estimating property loss from a hurricane, using the wind field data generated by the wind model of Florida Public Hurricane Loss Model (FPFLM) (Figure 9).

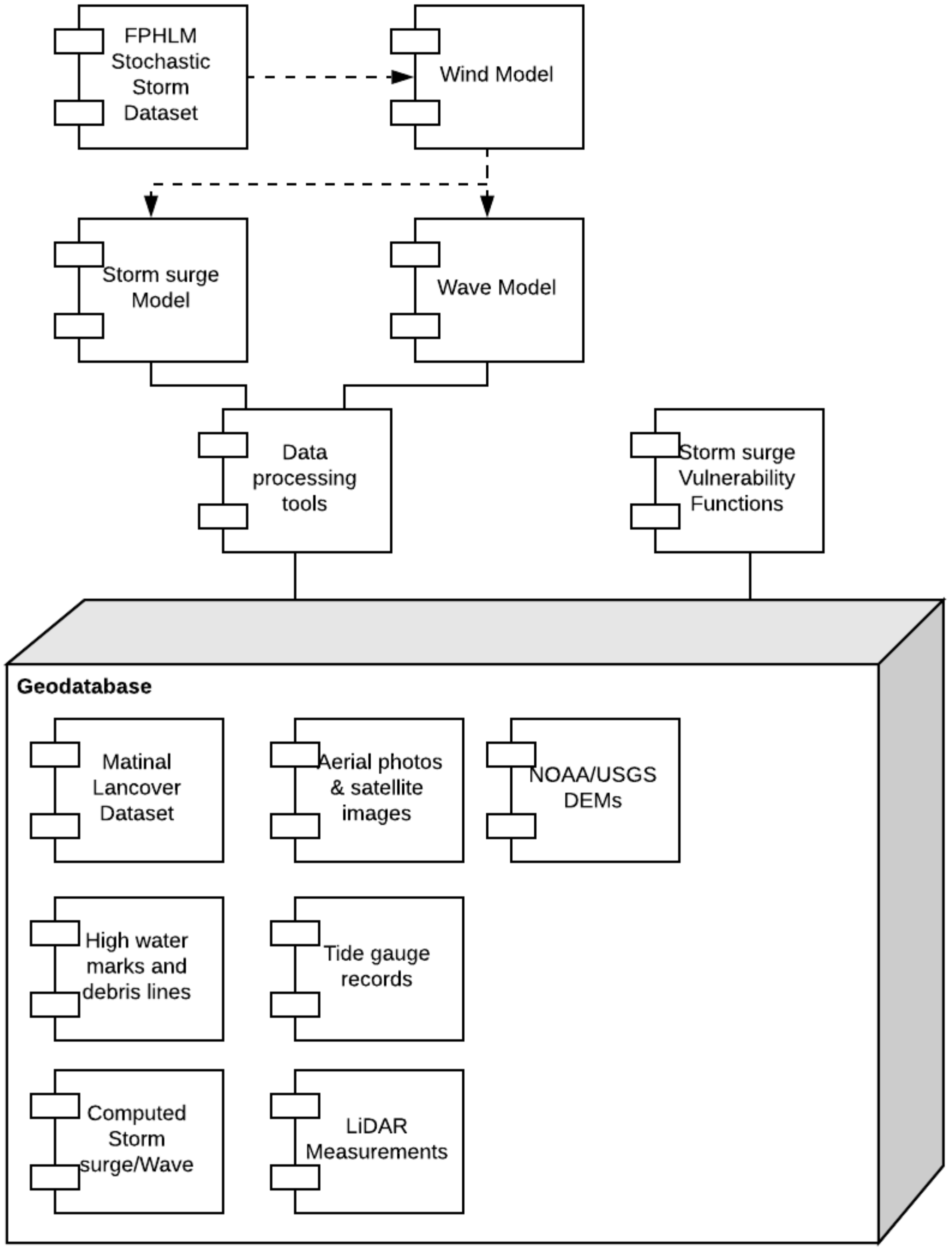


Figure 9. Component diagram of FPFLM with the storm surge.

Summary of CEST model

The National Hurricane Center (NHC) of National Weather Service (NWS) employs a numerical storm surge model, Sea, Lake, and Overland Surges from Hurricanes (SLOSH) to conduct real-time storm surge forecasts during the hurricane season to provide critical information for evacuation decision making in response to storms that threaten the US coastline. The CEST model which improves the physics and algorithm of SLOSH will be used to compute storm surges for FHPLM (Zhang et al. 2013). The CEST model solves the continuity and full momentum equations which are forced by winds, atmospheric pressure drops, and astronomical tides or a time series of water levels at open boundaries. The depth-integrated 2D CEST model over orthogonal curvilinear grids was used to examine the effect of the basin size on the computation of storm surge.

Governing Equations

The 2D depth-integrated continuity equation in an *x*, *y*, and *z* coordinate system with the *z*-axis perpendicular to the still water level is:

$$\frac{\partial \zeta}{\partial t} + \frac{\partial HU}{\partial x} + \frac{\partial HV}{\partial y} = 0 \qquad \text{(HAZ-9)}$$

and the momentum equations along the *x* and *y* directions are:

$$\begin{aligned} \frac{\partial HU}{\partial t} + \frac{\partial HU^2}{\partial x} + \frac{\partial HUV}{\partial y} &= fHV - g\frac{\partial}{\partial x}\left(\zeta + \frac{\Delta P_a}{\rho g}\right) \\ &\quad - \frac{\tau_b^x}{\rho} + \frac{\tau_s^x}{\rho} + A_h\frac{\partial^2 HU}{\partial x^2} + A_h\frac{\partial^2 HU}{\partial y^2} \end{aligned} \qquad \text{(HAZ-10)}$$

$$\begin{aligned} \frac{\partial HV}{\partial t} + \frac{\partial HUV}{\partial x} + \frac{\partial HV^2}{\partial y} &= -fHU - g\frac{\partial}{\partial y}\left(\zeta + \frac{\Delta P_a}{\rho g}\right) \\ &\quad - \frac{\tau_b^y}{\rho} + \frac{\tau_s^y}{\rho} + A_h\frac{\partial^2 HV}{\partial x^2} + A_h\frac{\partial^2 HV}{\partial y^2} \end{aligned} \qquad \text{(HAZ-11)}$$

where, H is the water depth from the still water level to the bottom, ζ is the water surface elevation reference to the still water level, U and V are depth-integrated velocities along the x and y directions, f is the Coriolis parameter, g is the gravitational acceleration, ΔP_a is air pressure drop, ρ is the water density, A_h is the horizontal eddy diffusivity. The bottom friction forces τ_b^x and τ_b^y are given by a quadratic drag law:

$$\tau_b^x = \rho C_b \sqrt{U^2 + V^2}\,U \qquad \text{(HAZ-12)}$$

$$\tau_b^y = \rho C_b \sqrt{U^2 + V^2}\,V \qquad \text{(HAZ-13)}$$

where C_b is the coefficient based on the Chezy formula (LeMehaute 1976; Zhang et al. 2012b):

$$C_b = \frac{gn^2}{H^{1/3}} \qquad \text{(HAZ-14)}$$

where n is the Manning's coefficient. The surface wind stresses τ_s^x and τ_s^y are given by a similar formulation:

$$\tau_s^x = \rho_a C_s \sqrt{(U_a - U)^2 + (V_a - V)^2}\,(U_a - U) \qquad \text{(HAZ-15)}$$

$$\tau_s^y = \rho_a C_s \sqrt{(U_a - U)^2 + (V_a - V)^2}\,(V_a - V) \qquad \text{(HAZ-16)}$$

where ρ_a is the air density and U_a, V_a are the wind velocities at the 10-m height above the still water level along the *x* and *y* directions. C_s is the drag coefficient which is calculated using the modified formula of Large and Pond (1981) based on Powell et al. (2003).

$$C_s = \begin{cases} 0.00114 & \sqrt{U_a^2 + V_a^2} \le 10 \\ (0.49 + 0.0065\sqrt{U_a^2 + V_a^2})10^{-3} & 10 < \sqrt{U_a^2 + V_a^2} \le 38 \\ 0.003 & \sqrt{U_a^2 + V_a^2} > 38 \end{cases} \qquad \text{(HAZ-17)}$$

CEST Model Setup

The 2D CEST model is discretized on an orthogonal curvilinear grid based on the modified C-grid with velocity components on the four edges of a grid cell and the water depths at the center and four edges (Zhang et al. 2013). The radiation open boundary condition was employed to allow waves to propagate out of the model domain (Blumberg and Kantha 1983). In order to improve the computational efficiency and stability of the model, a semi-implicit scheme is employed to produce a discrete form of the control equations (Casulli and Chen 1992). The water pressure gradient and bottom friction items are solved implicitly, and the remaining terms are treated explicitly. With varying cell sizes, the curvilinear grid is flexible in generating fine grid cells at the coast and coarse ones at the open ocean. The CEST model uses a mass-balanced algorithm based on accumulated water volume to simulate the wetting-drying process and includes the land cover effect in the overland flooding. The model can also run on conformal grids such as those used by SLOSH without modification of the numerical algorithms. The inputs and outputs of the CEST model are in NetCDF (http://www.unidata.ucar.edu/software/netcdf/). A set of tools in Matlab have been developed to convert input files created in ArcGIS (www.esri.com) into NetCDF files and to convert output NetCDF files into ArcGIS shapefiles for displaying and analyzing simulated surges.

The CEST model was verified by comparing calculated surges from historical storms such as Hurricanes Andrew, Camille, Hugo, and Wilma with field observations (Zhang et al. 2012b; Zhang et al. 2008). The measured maximum high water mark elevations from hurricanes Andrew, Camille, Hugo, and Wilma are about 5 m, 7 m, 6 m, and 5 m above NAVD88, respectively. The root mean square differences (RMSD) between computed and observed high water levels for these four hurricanes are 0.44 m, 0.58 m, 0.47 m, and 0.39 m, respectively. The CEST model has also been employed to perform preliminary real-time forecasts of storm surges based on advisory tracks for Hurricanes Isabel in 2003, Katrina in 2005, Hurricanes Irene in 2011, Hurricanes Isaac and Sandy in 2012. The comparison of computed surges with tidal gauge records and high water mark measurements indicates that the model largely reproduced the inundation pattern generated by these hurricanes.

- **Topographic and bathymetric data and calculation of grid cell elevation**

The bathymetric and topographic data are required for calculating the water depths and elevations of the grid cells in a model basin. The topographic data used in this study mainly come from the US Geological Survey (USGS), and the bathymetric data come from NOAA. Water depths for grid cells at the open ocean were calculated based on the ETOPO1 global relief dataset from NOAA, which has a resolution of 1 arc minute (~1.8 km). Water depths for grid cells in coastal areas were interpolated from the U.S. coastal relief dataset from NOAA with a resolution of 3 arc second (~90 m) (http://www.ngdc.noaa.gov/mgg/gdas/gd_designagrid.html). The USGS 90 m, 30 m, 10 m, and 3 m digital elevation models (DEM) were used to calculate the elevation of grid cells on the land (http://viewer.nationalmap.gov/viewer/) in terms of the sizes of grid cells. USGS DEMs are periodically updated with new data from various federal, state, and local government agencies. For example, advances in airborne Light Detection And Ranging (LiDAR) technology in the past ten years have allowed for a rapid mapping of topology over a large area with a vertical resolution of 0.15 m and horizontal resolution of one meter (Zhang et al. 2012a). The State of Florida has completed LiDAR data collection for coastal areas vulnerable to surge flooding at a cost of $25 million (Figure 8). Most of the high-resolution topographic data have been incorporated into the DEMs created by USGS.

In order to support the National Tsunami Hazard Mitigation Program, the hurricane storm surge forecast, and to study the impacts of long-term sea-level rise on coastal ecosystems, NOAA has developed the integrated models of coastal reliefs for various areas along the US Atlantic and Gulf coasts in recent years (http://www.ngdc.noaa.gov/mgg/coastal/). The bathymetric and topographic data were merged and adjusted to a consistent vertical datum (e.g. NAVD88) in an integrated model of coastal relief, and important hydrological features such as main navigation channels are maintained.

The elevation of a CEST grid cell was calculated by averaging the pixel elevations of the digital bathymetric and topographic elevation models which are falling within the grid cell. All the topographic and bathymetric data were adjusted to NAVD 88 vertical datum before calculation. The following procedure was used to calculate the grid cell elevation and handle the overlaps between different bathymetric and topographic datasets.

(1) NOAA ETOPO1 global relief dataset was used to calculate the cell elevations of the model grid. In the deep ocean area that is covered by ETOPO1, but not covered by the bathymetric and topographic data with finer resolutions, a grid cell should include at least one data point from ETOPO1 for elevation calculation. If not, a new relief dataset with a pixel size of half the ETOPO1 pixel size was generated by interpolating ETOPO1 using the nearest neighbor method. The interpolation was conducted continuously by reducing the pixel size half every time until each grid cell in the deep ocean contains at least one data point from the interpolated relief dataset.

(2) NOAA coastal relief dataset was used to calculate the cell elevations and replace the elevations from ETOPO1 in the continental shelf and coastal areas. If the cell size of a model grid is less than the pixel size of the coastal relief dataset. The new coastal relief dataset was generated for the calculation of the grid cell elevation using the same procedure to interpolate the ETOPO1 dataset.

(3) USGS 90 m, 30 m, 10 m, and 3 m DEMs were used to calculate the elevations of the model grid cells on the land. The model grid cells on the land and on the ocean were separated using the

shoreline dataset extracted from the LiDAR surveys or digitized from the aerial photographs. The selection of 90 m, 30 m, 10 m, and 3 m DEMs were determined by the cell size of a model grid. A grid cell has to contain at least one data point from the DEM dataset used for the elevation calculation.

(4) NOAA integrated models of coastal reliefs were used to calculate and replace the depths of the grid cells in the coastal water. If the USGS DEM on the land is older than the elevation data in the integrated model of coastal relief, the elevations of the grid cell on the land were also calculated and replaced.

(5) The water depths and elevations of the grid cell were updated using the most recent data which are often the LiDAR surveys provided by local government agencies through the flood map modernization program sponsored by the Federal Emergency Management Agency.

The high-quality shoreline dataset including the boundaries of the coastal lagoons, inlets, and barrier islands, and river streams is essential for separating the grid cells on the land and the ocean and preserving the connectivity of the coastal hydrological features. Fortunately, the digital shorelines can be extracted from the LiDAR surveys for coastal areas vulnerable to storm surge flooding in Florida. However, there are many topological errors such as dangles, intersections, and self-overlaps in the LiDAR shorelines (Figure 10). These errors were corrected through the manual editing in ArcGIS (www.esri.com) by setting up appropriate topological rules. The corrected shoreline vector data were converted into polygons by adding lines connecting start and ending points and used to separate the land and ocean cells of a model grid.

Figure 10. Topologic errors in the shoreline dataset derived from the LiDAR surveys for Franklin County in Florida.

- **Calculation of Manning's coefficients using land cover data**

The CEST model uses the Chezy formula (LeMehaute 1976; Zhang et al. 2012b) with a Manning's roughness coefficient to calculate bottom stresses. The Manning's coefficients for ocean grid cells are computed by an empirical formula based on the water depth (*H*):

$$n_w = \begin{cases} 0.02 & 0 < H < 1\,(\mathrm{m}) \\ 0.01/H + 0.01 & H \geq 1 \end{cases} \qquad \text{(HAZ-18)}$$

or set up to be constants, e.g.,

$$n_w = C \qquad \text{(HAZ-19)}$$

where *C* ranges from 0.01 to 0.03. Manning's coefficients for grid cells over the land were estimated according to the 2006 national land cover dataset (NLCD) created by the U.S. Geological Survey (USGS) (Fry et al. 2011). A modified table of Manning's coefficients (Table 1) corresponding to different land cover categories proposed by Mattocks and Forbes (2008) was employed in this study. Since the spatial resolution of NLCD is 30 m which is usually smaller than the cell size of a CEST grid, an average Manning's coefficient (n_a) for a grid cell was calculated using

$$n_a = \frac{\sum_{i=1}^{N}(n_i \alpha) + n_w \beta}{N\alpha + \beta} \qquad \text{(HAZ-20)}$$

where n_i is the Manning's coefficient value of a NLCD pixel within a model grid cell, α is the area of a NLCD pixel, N is the total number of NLCD pixels within a model cell, n_w is the Manning's coefficient for the oceanic area β that are not covered by NLCD pixels.

Table 1. Manning's coefficients for various categories of land cover.

NLCD Class Number	NLCD Class Name	Manning Coefficient
11	Open Water	0.020
12	Perennial Ice/Snow	0.010
21	Developed Open Space	0.020
22	Developed Low Intensity	0.050
23	Developed Medium Intensity	0.100
24	Developed High Intensity	0.130
31	Barren Land (Rock/Sand/Clay)	0.090
32	Unconsolidated Shore	0.040
41	Deciduous Forest	0.100
42	Evergreen Forest	0.110
43	Mixed Forest	0.100
51	Dwarf Scrub	0.040
52	Shrub/Scrub	0.050
71	Grassland/Herbaceous	0.034
72	Sedge/Herbaceous	0.030
73	Lichens	0.027
74	Moss	0.025

NLCD Class Number	NLCD Class Name	Manning Coefficient
81	Pasture/Hay	0.033
82	Cultivated Crops	0.037
90	Woody Wetlands	0.140
91	Palustrine Forested Wetland	0.100
92	Palustrine Scrub/Shrub Wetland	0.048
93	Estuarine Forested Wetland	0.100
94	Estuarine Scrub/Shrub Wetland	0.048
95	Emergent Herbaceous Wetlands	0.045
96	Palustrine Emergent Wetland (Persistent)	0.045
97	Estuarine Emergent Wetland	0.045
98	Palustrine Aquatic Bed	0.015
99	Estuarine Aquatic Bed	0.015

- **Wind field computation**

Both parametric models and time series of wind fields (H*Wind) generated by the Hurricane Research Division of NOAA based on field measurements (Houston et al. 1999; Powell et al. 1998) can be used to compute wind stresses. H*Wind provides snapshots of the wind field every 2-6 hours, but the instantaneous wind field is needed for storm surge computation by the model at each time step. Thus, the wind fields between two adjacent H*Wind fields are generated using a bilinear interpolation in space and a linear interpolation in time based on the center positions of two H*Wind fields and the values of H*Wind fields. The parametric wind model used by the FPFLM was employed to estimate the hurricane wind field when H*Wind data was not available. To account for the terrain effect on the wind, two different drag coefficients are used to compute the wind field on the terrain and extreme shallow waters and the wind field on the ocean, which are referred to as lake wind and ocean wind, respectively. The effects of vegetation on the wind field have also been accounted for in a way similar to the SLOSH model (Jelesnianski et al. 1992). The wind speed is adjusted using a coefficient C_T based on the ratio of the surge water depth ($D=H+\zeta$) to the vegetation height (H_T):

$$C_T = \left\{ \begin{array}{ll} \dfrac{D}{H_T} & D < H_T \\ 1 & \mathrm{D} \geq \mathrm{H_T} \end{array} \right\} \qquad \text{(HAZ-21)}$$

The effect of trees on the wind speed decreases based on this equation as the water submerges the vegetation gradually. In this study, the land areas covered by dense vegetation and development were classified into the "Tree" category and assigned an average vegetation height of 8 m, the same as the one used by SLOSH for the Florida basins. When a storm surge floods low-lying areas, it often forms a thin layer of water over land. An extinction coefficient C_E is applied to the wind speed to reduce its effect on the thin layer of water (Jelesnianski et al. 1992).

$$C_E = \begin{cases} \dfrac{D}{0.3} & D < 0.3\ m \\ 1 & D \geq 0.3\ m \end{cases} \qquad \text{(HAZ-22)}$$

- **Boundary Conditions**

The “Sommerfield” radiation condition (Blumberg and Kantha 1983) was used at the open boundaries for a variable φ which can be either water level or velocity:

$$\frac{\partial \phi}{\partial t} + \hat{c}\frac{\partial \phi}{\partial n} = 0 \qquad \text{(HAZ-23)}$$

where $\hat{c}$ is the velocity which includes wave propagation and advection. The water level elevation at the open boundary was generated using seven tidal constituents M2, S2, N2, K1, O1, K2, and Q1. These constituents were obtained from the U.S. Army Corps of Engineers’ (USACE) East Coast 2001 database of tidal constituents (Mukai et al. 2002). The detailed information of 7 tidal constituents is listed in Table 2.

Table 2. Tidal constituents used in CEST.

Symbol	Species	Period (hour)	Speed (degree/hour)
M2	Principal lunar semidiurnal	12.42	28.98
S2	Principal solar semidiurnal	12.00	30.00
N2	Larger lunar elliptic semidiurnal	12.66	28.44
K2	Lunisolar semidiurnal	11.97	30.08
K1	Lunar diurnal	23.93	15.04
O1	Lunar diurnal	25.81	13.94
Q1	Larger lunar elliptic diurnal	26.87	13.40

- **Three set of Florida basins**

There are a total of 3 sets of basins established for the storm surge simulation covering the whole coastal area of Florida (Figure 11).

1. West Florida basin (WF1) mainly covers the north and west Florida coastal area;
2. South Florida basin (SF1) mainly covers the south Florida coastal area and Keys;
3. North Florida basin (NF1) covers the North-East Florida coastal area.

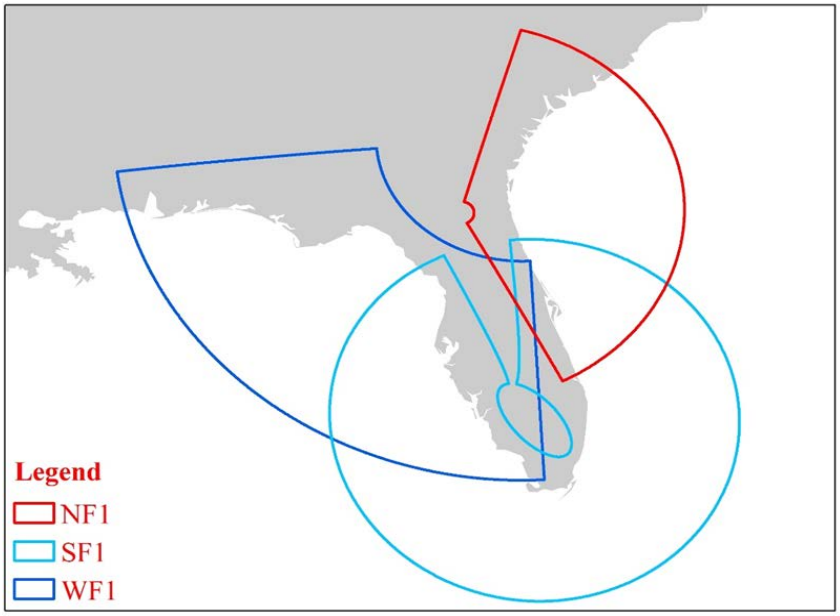


Figure 11. Three Florida Basins that are used by the CEST Model.

The overlap area of the above four set basins is relatively large, sometimes even half of the basin area. The reason for overlap is consideration between the large domain size and variable fine resolution of the grid for the area of interest.

For each basin, the high resolution grid was verified and calibrated for historical hurricanes. The comparison of time series of water level showed that the CEST model can produce reasonable storm surge at selected NOAA tidal gauges with the H*WIND wind field. The grid resolution depends upon the accuracy and computational time.

Wave Model

The wave model used is STWAVE, a US Army Corps of Engineers program for computing nearshore wave transformation. The model solves the spectral wave action equations over a regular grid, assuming steady-state conditions. From the STWAVE Manual (Massey et al., 2011):

"STWAVE (STeady-state spectral WAVE), a nearshore spectral wave model, was developed by the U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL) to accurately simulate nearshore wave propagation and transformation including refraction, shoaling, breaking, and wind-wave generation. Recently, CHL has further enhanced STWAVE to include both half-plane and full-plane capabilities within a single executable; improved and streamlined file formats; and made it Earth System Modeling Framework (ESMF) compliant, which allows for easier coupling to other models. STWAVE now runs in serial mode as well as parallel in time or space on both personal computing (PC) and high-performance computing (HPC) systems".

Assumptions made in STWAVE are:

"1. Phase-averaged. STWAVE is based on the assumption that relative phases of the spectral components are random, and phase information is not tracked. In order to resolve detailed near-field reflection and diffraction patterns near coastal structures, a phase-resolving model should be applied.
2. Mild bottom slope and negligible wave reflection. Waves reflected from the shoreline or from steep bottom features are neglected.
3. Steady-state waves, currents, and winds. STWAVE is formulated as a steady-state model, which reduces computation time and is appropriate for wave conditions that vary more slowly than the time it takes for waves to transit the domain. For wave generation, the steady-state assumption means that the winds have remained steady sufficiently long for the waves to attain fetch-limited or full-developed conditions (waves are not limited by the duration of the winds).
4. Linear refraction and shoaling. STWAVE incorporates linear wave refraction, shoaling, and propagation, and thus, does not represent wave asymmetry or other nonlinear wave features. Model accuracy is reduced (e.g., underestimated wave heights) at large Ursell numbers.
5. Depth-uniform current. The wave-current interaction in the model is based on a current that is constant throughout the water column; the modification of refraction and shoaling due to strong vertical gradients is not represented."
6. Linear radiation stress. Radiation stress is calculated based on linear wave theory".

The present work does not use the full capabilities of STWAVE, but instead a subset to allow computation of tens of thousands of scenarios over the entire coastline of Florida. The model is run with directional capabilities, but only around the peak frequency. Computations are only made for a relatively short distance near the shoreline, and use parametric hindcast relations (Young and Verhagen, 1996) to provide the wave height and period at the offshore boundary. For nearshore locations, wave breaking uses Thornton and Guza (1983) relations instead of the standard depth-limited cutoff. Other than this, there are no changes to the model.

Inland Flood Component– Fluvial Flooding

The riverine model component is based on the EF5 (Ensemble Framework for Flash Flood Forecasting, Flamig et al. 2020). EF5 is the core modeling platform of NOAA's FLASH (Flooded Locations and Simulated Hydrographs project, Gourley et al. 2017) that is used by the National Weather Service to provide operational flash flood forecasts for the contiguous United States.

The water balance component of EF5, implemented in this work, is a version of the Coupled Routing and Excess Storage (CREST) distributed hydrologic model (Wang et al., 2011). The CREST model simulates the spatio-temporal variation of water and energy fluxes and storages on a regular grid with the grid cell resolution being user-defined, thereby enabling global- and regional-scale applications. The scalability of CREST simulations is accomplished through sub-grid scale representation of soil moisture storage capacity (using a variable infiltration curve). Formulation of the main processes involved within the EF5/CREST model are provided below:

Effective evapotranspiration at time t (EET_t) is parameterized as a function of potential evapotranspiration (PET_t) using a configurable scalar parameter K_e according to

$$\mathrm{EET}_t = K_\mathrm{e} \cdot \mathrm{PET}_t \tag{HAZ-24}$$

Potential evapotranspiration and precipitation (P_t) are the two meteorological input variables required by EF5/CREST. The effective rainfall (EP_t) is calculated according to

$$\mathrm{EP}_t = \begin{cases} 0, & \text{for } \mathrm{EET}_t \geq P_t \\ P_t - \mathrm{EET}_t, & \text{for } \mathrm{EET}_t < P_t \end{cases} \tag{HAZ-25}$$

Part of EP_t becomes direct runoff (DP_t) from impervious surfaces and part of it reaches the soil (SP_t) according to

$$\begin{aligned} \mathrm{DP}_t &= \mathrm{EP}_t \cdot I_m \\ \mathrm{SP}_t &= \mathrm{EP}_t \cdot (1 - I_m) \end{aligned} \tag{HAZ-26}$$

where I_m is a scalar parameter representing the percent impervious area.

Infiltration (I_t)is modeled using

$$I_t = \begin{cases} 0, \\ \text{for } P_t \leq \mathrm{EET}_t \vee \mathrm{SM}_t \geq W_\mathrm{m} \\ W_\mathrm{m} - \mathrm{SM}_t, \\ \text{for } (i_t + \mathrm{SP}_t) \geq I_m \\ W_\mathrm{m} - \mathrm{SM}_t - W_\mathrm{m} \cdot [1 - \frac{i_t + \mathrm{SP}_t}{i_\mathrm{m}}]^{1+b}, \\ \text{for } (i_t + \mathrm{SP}_t) < I_m \end{cases} \tag{HAZ-27}$$

where W_m represents the maximum soil water capacity, SM_t is the soil moisture state variable, and b represents the exponent of the variable infiltration curve. i_m represents the maximum infiltration capacity defined by

$$i_\mathrm{m} = W_\mathrm{m} \cdot (1 + b) \tag{HAZ-28}$$

The infiltration capacity (i_t) at time t, is defined as

$$i_t = i_\mathrm{m} \cdot \left[1 - \left(1 - \frac{\mathrm{SM}_t}{W_\mathrm{m}} \right)^{\frac{1}{1+b}} \right] \tag{HAZ-29}$$

The effective precipitation is partitioned into excess rainfall (ER_t) based on infiltration

$$\mathrm{ER}_t = \begin{cases} 0, & \text{for } \mathrm{SP}_t = 0 \vee \mathrm{SP}_t \leq I_t \\ \mathrm{SP}_t - I_t, & \text{for } \mathrm{SP}_t > I_t \end{cases} \tag{HAZ-30}$$

The excess rainfall is then divided into overland (OER_t) and subsurface (SER_t) flow components

$$\mathrm{SER}_t = \begin{cases} 0, & \text{for } \mathrm{EP}_t = 0 \\ \mathrm{temX}_t, & \text{for } \mathrm{ER}_t > \mathrm{temX}_t \\ \mathrm{ER}_t, & \text{for } \mathrm{ER}_t \leq \mathrm{temX}_t \end{cases}, \quad \text{(HAZ-31)}$$

with $temX_t$ defined as

$$\mathrm{temX}_t = \begin{cases} \frac{\mathrm{SM}_t + W_t}{2W_\mathrm{m}} \cdot F_\mathrm{c}, & \text{for } \mathrm{EP}_t > 0 \\ (\mathrm{EET}_t - P_t) \cdot \frac{\mathrm{SM}_t}{W_\mathrm{m}}, & \text{for } \mathrm{EP}_t = 0 \end{cases}, \quad \text{(HAZ-32)}$$

with F_c representing the hydraulic conductivity and W_t defined as

$$W_t = \begin{cases} 0, & \text{for } \mathrm{EP}_t = 0 \\ W_\mathrm{m}, & \text{for } \mathrm{SM}_t + I_t \geq W_\mathrm{m} \\ \mathrm{SM}_t + I_t, & \text{for } \mathrm{SM}_t + I_t < W_\mathrm{m} \end{cases} \quad \text{(HAZ-33)}$$

The overland flow component is calculated by taking the difference between the amount that infiltrates and the excess rain plus adding in the direct runoff

$$\mathrm{OER}_t = \begin{cases} 0, & \text{for } \mathrm{EP}_t = 0 \\ \mathrm{ER}_t - \mathrm{SER}_t + \mathrm{DP}_t, & \text{for } \mathrm{EP}_t > 0 \end{cases} \quad \text{(HAZ-34)}$$

Flow routing in EF5 configuration is based on the kinematic wave routing for overland and channel flow (Flamig et al. 2020; Vergara et al. 2016). Subsurface flow is routed using linear reservoirs (Wang et al. 2011; Flamig et al. 2020).

Similar to many distributed hydrological models, CREST represents a region by dividing it into a number of regular spatial elements, commonly referred to as the “grid”. Given the large spatial extent of our study domain (involving basins draining into Florida but extending well beyond the state’s boundaries) we decided to adopt a grid resolution of 3 arcsec (~90m). Figure 12 below presents a) the extent of our riverine model domain and corresponding coverage of the HUC06 USGS basins (Figure 12a), and b) the drainage network derived from digital elevation model at 90m resolution (Figure 12b).

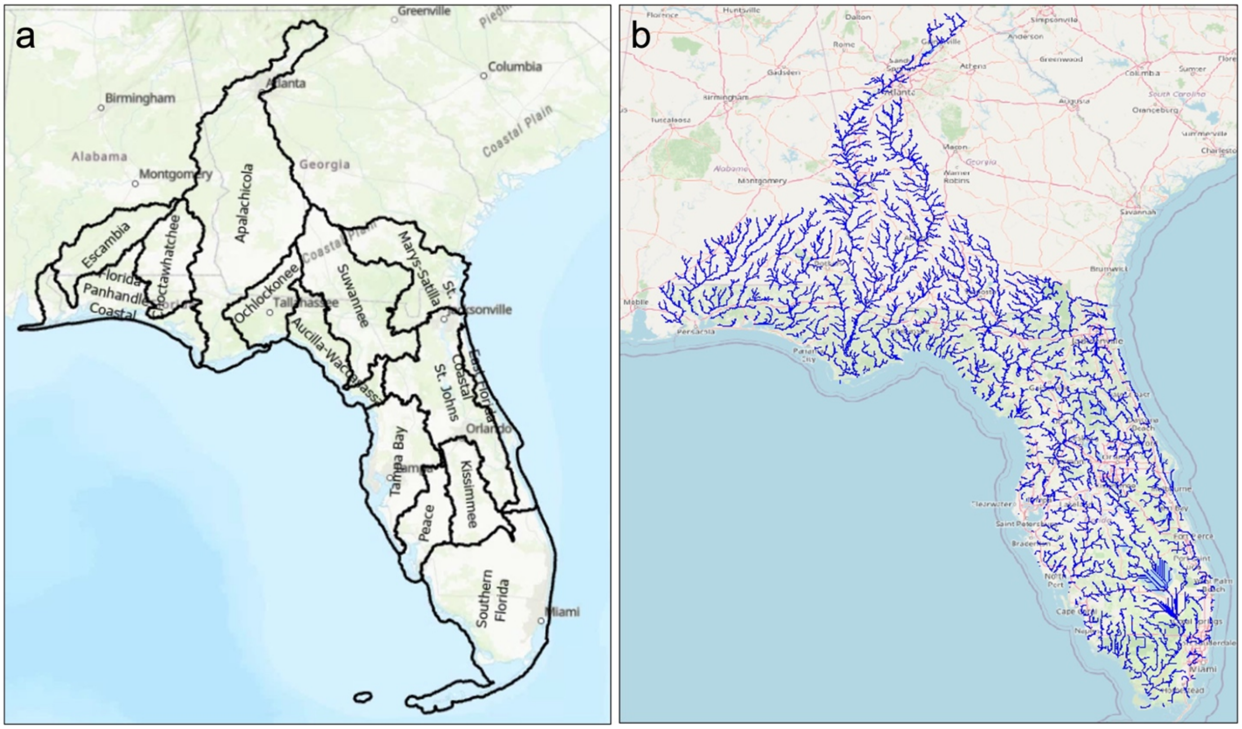


Figure 12. a) Spatial extent and boundaries of the 13 HUC06 USGS basins comprising our model domain. b) drainage network used within the EF5 model derived from a 90m digital elevation model.

Inland Flood Component – Pluvial Flooding

The pluvial flood maps used in the FPFLM were produced by the PLUV2D model. The PLUV2D model was inspired by the cellular automata models described in Guidolin et al. (2016) and Ghirmire (2013). These models use simplified rules for distributing water to neighboring cells in flood simulations rather than solving the full hydro-dynamical equations. The cellular automata models have been shown to produce reasonable results for pluvial flooding and are much more computationally efficient, enabling them to be suitable for risk calculations which require a large number of simulations at high resolution. The PLUV2D model differs from these models in that the flow between cells is governed by Manning’s equation and follows a time-stepping method. This allows the model to account for frictional surface effects. The equation for the velocity of the flow *v* between a source cell and a neighbor cell is

$$v = \frac{1}{n} d^{2/3} s^{1/2} \qquad \text{(HAZ-35)}$$

where *n* is the Manning’s coefficient, *d* is the hydraulic radius (taken to be the depth of water in the source cell), and *s* is the slope of the water level gradient. Flow ceases when the source cell is dry (*d*=0) or if the neighboring cell has a higher water elevation (*s*<0). If a cell becomes dry during a given time step, the flow is adjusted accordingly. The velocity is proportional to the inverse of the Manning’s coefficient, (1/*n*). For smooth surfaces, *n* is small, resulting in high velocity flow whereas when *n* is large, the frictional effects impede the flow velocity. Manning’s coefficient is based on land surface characteristics, which we identify from Land Use/Land Cover (LULC) data. We adopt a table that is commonly used in the HEC-RAS 2D model to map the MRLC NLCD 2016 classification codes to a Manning coefficient [FEMA (2019)].

The model computational grid is defined by the input DEM raster. For the current version of the model, the input DEM obtained from USGS has a grid spacing of approximately 30 meters, or 99 ft.

Soil infiltration is taken into account by using a modified Horton method. Horton's original equation is transformed to

$$f_p = f_c + \frac{dS}{dt} \qquad \text{(HAZ-36)}$$

where

$$\frac{dS}{dt} = rk(S_{max} - S) \qquad \text{(HAZ-37)}$$

where f_p is the net infiltration rate, f_c is the soil drainage rate, *rk* is the infiltration decay rate, *S* is the soil water content, and *Smax* is the maximum soil water content (when exceeded saturation occurs) and depends on soil type and is defined as

$$S_{max} = \frac{f_o - f_c}{rk} \qquad \text{(HAZ-38)}$$

where f_o is the initial infiltration rate for dry conditions. Here we see that the modified Horton equation does not explicitly depend on time, but instead on the relative soil water content. The modified Horton method differs from the original implementation in that the infiltration may cease when the source cell is dry. Infiltration may resume at a later time when the source cell becomes wet. The original Horton method assumes that ponding conditions are persistent during the simulation period. The primary advantage of the modified method is that the antecedent soil moisture conditions can be specified. This is done by specifying an initial value of *S* in the above equations. The PLUV2D model allows the initial value of *S* to be set by a coefficient defined as *amc*=*S*/*Smax*, so that *S*=*amc***Smax* at the initial time. A value of *amc*=0 indicates "bone dry" conditions, whereas *amc*=1 indicates fully saturated conditions. A value of *amc*=0.7 is indicative of moist conditions. Typical conditions in Florida suggest *amc* ranges from 0.3 to 0.7.

The initial soil infiltration and drainage parameters, f_o and f_c, are based on suggested values that are recommended in the SWMM model and are dependent on soil type. The PLUV2D model modifies soil infiltration rates based on the fraction of impervious cover. For 100% impervious cover, there is no soil infiltration. Details of these parameter values and sources of the data are provided in the disclosures in the HHF Standards.

The primary input to the PLUV2D model is the spatial and temporal variation of surface precipitation. One option is to provide the total accumulated precipitation of the event along with a temporal curve which specifies the percent of total accumulation as a function of time over the rainfall duration period. During the PLUV2D simulation, the instantaneous rain rate is derived at each time step using the specified total accumulation and corresponding temporal curve. The

PLUV2D model can run longer than the rainfall duration period to take into account any latent post-event flooding.

For historical events, any gridded rainfall product may be used as input to the model. For a large number of stochastic or hypothetical simulations, flood maps based on a set of return period rainfall amounts are first created. The return period rainfall is derived from the NOAA Atlas 14 intensity-duration product [NOAA (2013)]. The NOAA Atlas 14 product includes spatial maps of return period rainfall accumulation and distributions of temporal curves. Return period flood maps of 1, 2, 5, 10, 25, 50, 100, 200, 500 and 1000 years are thus computed. Once these maps have been created, at high resolution, typically 30 m (99 ft), a rainfall vs flood depth curve can be established for any potential property location. This enables a very fast computation of flood depths for a large number of policies and simulated rainfall events, such as those produced from the R-CLIPER model for thousands of tropical cyclone events.

Vulnerability Component

The engineering team of the FPFLM has published several peer-reviewed journal articles describing aspects of the model (Baradaranshoraka et al., 2017; Baradaranshoraka et al., 2019; Paleo-Torres et al., 2020; Pinelli et al., 2020; Paleo-Torres et al., 2022). For the sake of clarity, and to provide a complete narrative describing the personal residential flood vulnerability model of the FPFLM, these papers have been combined, abridged and presented below. The subsequent disclosure responses in the VF standards will then refer as needed to this narrative.

Three main sections are presented below: development of the vulnerability of residential structures to coastal flood, development of vulnerability of residential structures to inland flood, and development of manufactured housing to inland and coastal flood.

Vulnerability of site-built residential structures to Coastal Flood

- **Introduction and background**

In general, fragility and vulnerability functions are either empirical models derived from post-disaster damage assessments and/or claims data, engineering-based models derived from structural behavior principles, models based on expert opinion, or some combination of these three. Statistical analysis of the observed performance of structures, from large observational datasets are the basis of the empirical models. The development of engineering-based models requires an understanding of the loads, structural response and resistance, load path, and environmental uncertainties. Expert-based models rely on the consensus of opinions from a team of professionals with subject expertise. These expert opinions are commonly informed by a combination of personal observations, modeling and field data.

This report presents a semi-engineering approach, which adapts a procedure proposed in Barbato et al. (2013) to translate empirical tsunami fragility functions from Suppasri et al. (2013) into coastal flood fragility functions, based on engineering principles. Following Baradaranshoraka et al. (2019), the coastal flood fragility functions are translated into coastal flood vulnerability functions for different types of residential structures common in the state of Florida. Claims data and expert-based models are employed for validation.

The engineering team strategy was to adapt a large body of tsunami related building fragility curves, especially the work developed by Suppasri et al. (2013), to coastal flood, and to adapt the work of the US Army Corp of Engineers (USACE, 2006, 2015) for inland flood. The engineering model output consists of building vulnerability curves that estimate the mean building damage ratio as a function of inundation height relative to ground level (Baradaranshoraka et al., 2017). The building damage ratio is defined herein as the cost of repair of a damaged building divided by the replacement value of the building.

This report discusses the tsunami damage field dataset, the nonlinear translation of the tsunami fragilities to coastal flooding (surge) fragilities via force equivalency analysis, the quantification of the damage states, the conversion of coastal flood fragilities to vulnerability functions, and results and validation for a single family slab on grade timber and masonry structure using an independently derived model and claims data. In the FPFLM, on grade structures are classified as non-elevated as long as their foundation consists of slabs or crawl spaces with a Finished First Floor Elevation (FFE) between 0 and 3 ft above ground.

- **Tsunami damage dataset**

The 2011 Great East Japan tsunami affected hundreds of thousands of buildings, including residential and commercial structures. Suppasri et al. (2013) used a dataset of more than 250,000 damaged buildings to develop empirical fragility functions related to the water inundation depth. These fragility functions are stratified by structural characteristics such as construction material and number of stories, resulting in one of the most comprehensive such studies ever conducted.

Suppasri et al. (2013) utilized information obtained by the Ministry of Land, Infrastructure and Transportation of Japan (MLIT) from post-disaster field surveys. The surveys information related the assessment of different levels of damage per building to the tsunami inundation depths at the structure's location. The data was grouped in 0.5 m increments of tsunami inundation depths. The MLIT classified the observed damage into six levels of severity, or physical Damage States (DS): (1) minor damage, (2) moderate damage, (3) major damage, (4) complete damage, (5) collapse and (6) washed away. The MLIT classification of damage was based on observed physical damage in different structural and non-structural components of the buildings, and damage ratios dr_i can be assigned to each damage state DS_i (details in the next section). The buildings were classified according to their number of stories and their structural material, such as reinforced concrete, steel, timber and other materials. Based on the characteristic of the buildings and the damage states, Suppasri et al. (2013) used a least squares regression method and the lognormal cumulative distribution function to derive fragility functions for each damage state for the different building classes (BC). Equation ENG-1 describes the shape of the tsunami fragility functions resulting from regression analysis, where the function P is the probability of a damage ratio DR meeting or exceeding a damage state DSi characterized by a damage ratio dr_i given a certain water inundation depth relative to ground level d_{s_j} at any given point, and a certain building class bc_l. Φ is the standard normal distribution function. The variables μ' and σ' are the mean and standard deviation for the lognormal function, specific to the building class and the damage state.

$$P(d_{s_j}) = \Phi\left[\frac{ln\, d_{s_j} - \mu'}{\sigma'}\right] \qquad \text{(ENG-1)}$$

Table 3 lists the parameters used as input in Equation ENG-1 to describe the tsunami fragility functions for timber and reinforced concrete (RC) residential structures (Suppasri et al. 2013).

Table 3. Tsunami fragility curves parameters per DSi for timber and reinforced concrete residential structures (from Suppasri et al., 2013).

	DS 1		DS 2		DS 3		DS 4		DS 5		DS 6	
Structure	μ'	σ'	μ'	σ'	μ'	σ'	μ'	σ'	μ'	σ'	μ'	σ'
Timber 1-story	-1.73	1.15	-0.86	0.94	0.05	0.71	0.69	0.53	0.81	0.59	1.17	0.58
Timber 2-story	-2.01	1.19	-0.87	0.91	0.04	0.74	0.78	0.52	0.95	0.57	1.36	0.47
Timber 3-story	-2.19	1.32	-0.86	1.22	0.11	0.84	0.80	0.47	1.27	0.62	1.77	0.37
RC 1-story	-1.88	1.19	-0.82	1.06	0.16	0.82	0.89	0.84	1.66	0.90	2.42	0.87
RC 2-story	-2.26	1.25	-0.95	1.04	0.20	0.75	0.93	0.69	1.78	0.72	2.44	0.66
RC 3-story	-2.78	1.66	-0.98	1.02	0.15	0.66	1.14	0.80	2.35	0.79	2.71	0.50

- **Coastal flood fragilities**

The authors assume that the probability of meeting or exceeding a given damage state for residential structures in Japan is similar, but not identical, to the probability of meeting or exceeding the same damage state for a residential structure in Florida under water-induced forces of similar magnitudes. Under this assumption, the key element to translate the tsunami fragility curves into coastal flood fragility curves is the calculation of the different inundation depths that correspond to equivalent water loading forces for tsunami and surge. Deviations from this similar damage state assumption are then corrected in the model calibration stage through adjustments to the cost ratios assigned to the building components. The next section describes this water loading force equivalency calculation.

  - **Coastal flood and Tsunami water forces**

The FPFLM coastal flood model considers the effect of different wave conditions during coastal flood. Storm surge waves (coastal flood) and tsunamis belong to the class of long gravity waves. The wavelengths of tsunamis are large in deep ocean and present small amplitudes, but as it approaches shallow waters, the tsunami slows down causing the wave to compress and increase in amplitude. Similar to tsunami waves, coastal flood waves amplify considerably in shallow waters and on wide continental shelves (Nirupama et al., 2006).

The conversion of the fragility functions from tsunami to coastal flood relies on the calculation of the different coastal flood and tsunami inundation depths that produce equivalent water-forces. The forces considered are the resultant lateral horizontal forces acting on the vertical walls of the structures. These forces vary depending on the severity of the wave state associated with the coastal flood condition. The FPFLM model discretizes the continuum of wave intensity relative to water depth into three coastal flood (CF) conditions: coastal flood with minor waves (CF1), with moderate waves (CF2), and with severe waves (CF3). Table 4 shows how the ratio of the wave height (H_w), distance from trough to crest, to still water inundation depth (d_s), H_w/d_s, defines the boundaries of the coastal flood conditions. Waves are assumed to break when the ratio is more than 0.78, (FEMA 2011).

Table 4. Definitions of three coastal flood conditions.

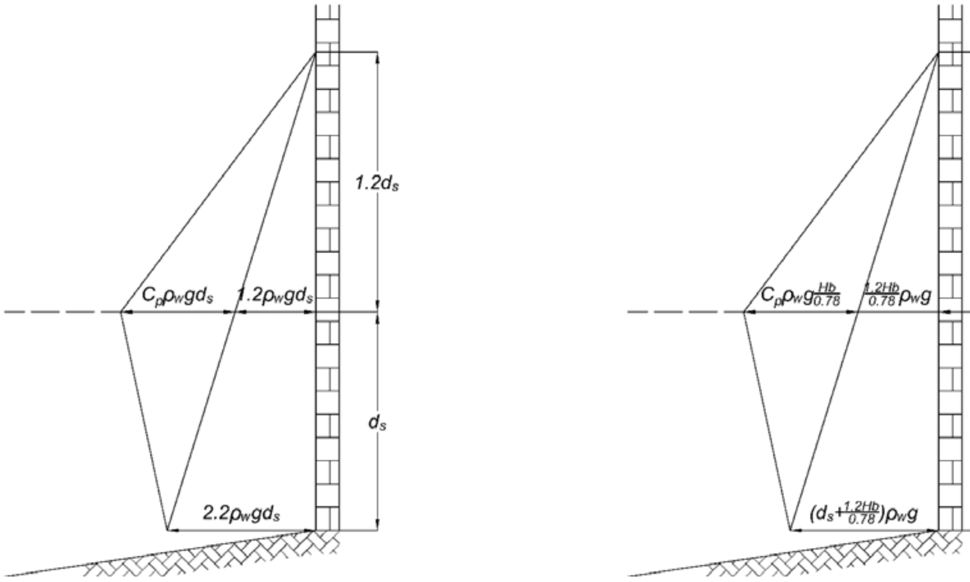
	Coastal Flood Conditions	Wave Height Range
CF1	Minor Waves	$0 < H_w/d_s \leq 0.3$
CF2	Moderate Waves	$0.3 < H_w/d_s \leq 0.6$
CF3	Severe Waves	$0.6 < H_w/d_s \leq 0.78$

ASCE (2010) and FEMA (2011) recommend Equation ENG-2 to calculate the breaking wave load $\mathrm{F}_{\mathrm{wave}}$ per unit length (l) on a vertical wall. This equation is from Walton et al. (1989), who reference Homma and Horikawa (1965). Figure 13-a shows the pressure diagram utilized to develop this equation through the calculation of the areas. The formula has two parts: a dynamic slamming load (first term) and a hydrostatic load (second term). Both terms assume a total affected depth at the wall of $2.2d_s$ (or $1.2d_s$ above the still water level) which results from the wave run-up and reflection. Dynamic pressure increases linearly from zero at the upper limit to the maximum value of $C_p\rho_w g d_s$ at the stillwater flood elevation (d_s), where C_p is a dimensionless dynamic pressure coefficient equal to 1.6, ρ_w is the density of saltwater and g is the gravitational acceleration constant. The dynamic pressure decreases linearly from its maximum value to zero at the toe of the wall.

$$F_{wave}/l = 1.1C_p\rho_w g d_s^2 + 2.4\rho_w g d_s^2 \qquad \text{(ENG-2)}$$

Equation ENG-2 applies for breaking waves only, as described in FEMA (2011). It was necessary to modify Equation ENG-2 to capture all three of the coastal flood conditions described in Table 4.

Considering a breaking wave height of $H_b = 0.78d_s$, and setting Equation ENG-2 in terms of H_b, the $1.2d_s$ above the stillwater level (Figure 13-a), due to the waves, is equivalent to $1.2H_b/0.78$ (Figure 13-b). The maximum value for the dynamic component in terms of H_b is equal to $C_p\rho_w g H_b/0.78$ (Figure 13-b).



(a) *(b)*

Figure 13. a) Pressure distribution based on Walton et al. (1989); b) Pressure distribution in terms of the breaking wave height.

Figure 13-b shows the pressure diagram presented in Figure 13-a, but here the terms affected by the dynamic effects of the wave are expressed in terms of the breaking wave height H_b. For a case of coastal flood with non-breaking waves, all of the assumptions are kept, but H_b is replaced by H_w. The calculation of the areas in Figure 13-b, but considering H_w instead of H_b results in Equation ENG-3, which now captures minor, moderate and severe wave states.

$$F_{CF} = F_{wave}/l = \frac{1}{2} C_p \rho_w g \frac{H_w}{0.78}(d_s + \frac{1.2H_w}{0.78}) + \frac{1}{2}\rho_w g (d_s + \frac{1.2H_w}{0.78})^2 \qquad \text{(ENG-3)}$$

For the case of breaking waves, i.e. $H_w = H_b = 0.78d_s$, Equation ENG-3 reverts to the ASCE formula (Equation ENG-2), and for the case of no waves, it becomes the standard hydrostatic pressure of the still water depth. In this study, Equation ENG-3 is used to express the lateral horizontal forces acting on the structures due to coastal flood. The hydrostatic internal pressure of the water entering the structures is not subtracted from the resultant hydrodynamic external force. The model assumes that the water level inside the structure does not immediately reach d_s, with a worst-case scenario of a maximum d_s outside the structure and no water inside.

The tsunami water depth-force relationship is also needed for the development of the coastal flood fragility functions. Palermo et al. (2009), suggest Equation ENG-4 to estimate the tsunami surge force per unit length, where d_s in this case is the tsunami inundation depth, C_d is a drag coefficient and u is the flow velocity.

$$F_{ts}/l = \frac{1}{2}\rho_w g {d_s}^2 + \frac{1}{2} C_d \rho_w u^2 d_s \qquad \text{(ENG-4)}$$

When C_d is taken as 2 (infinitely long walls) and u is assumed equal to $2\sqrt{gh}$, Equation ENG-4 becomes Equation ENG-5. The City and County of Honolulu building code (CCH, 2000) suggests the use of Equation ENG-5 to estimate the tsunami surging force per unit length, generated by a bore-like wave based upon the results of Dames and Moore (1980). Palermo et al. (2013a) describes a triangular pressure distribution as the origin of Equation ENG-5, as illustrated in Figure 14. In Equation ENG-5, d_s is the inundation depth, which is the hazard intensity metric adopted in this study.

$$F_{Tsu} = F_{ts}/l = 4.5\rho_w g {d_s}^2 \tag{ENG-5}$$

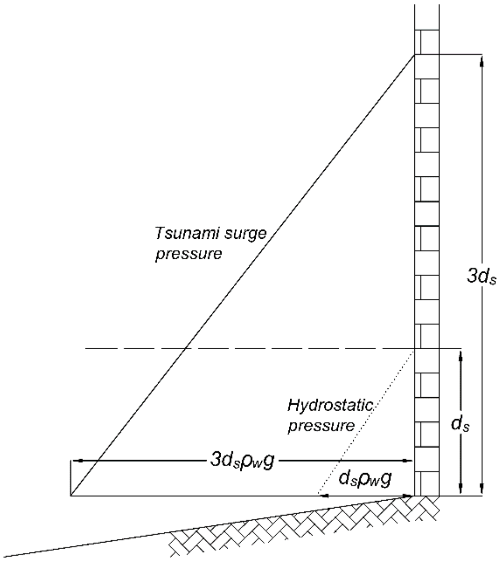


Figure 14. Tsunami surge pressure distribution, reproduced based on Palermo et al. (2013a).

Figure 15 presents the resultant water forces for tsunami (Equation ENG-5) and the three wave states being considered (Equation ENG-3 and Table 4). The coastal flood forces approach the tsunami forces as the severity of the wave increases. The upper limit value from Table 4 is assigned to each of the three different wave scenarios, i.e. H_w for minor waves is equal to $0.3d_s$, $0.6d_s$ for moderate waves, and $0.78d_s$ for severe waves (breaking waves).

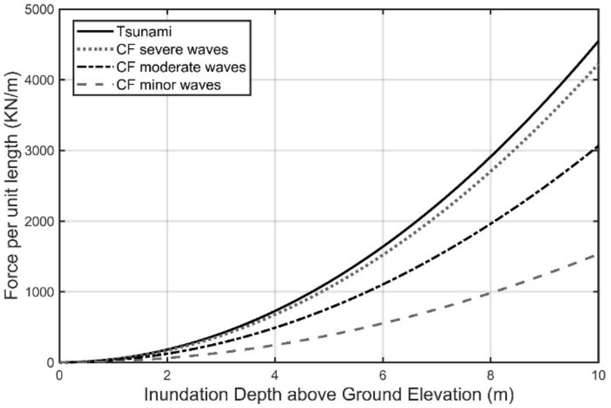


Figure 15. Tsunami and Coastal Flood (CF) water forces.

o Fragility function conversion

This study adapted the methodology in Barbato et al. (2013) for the conversion of tsunami fragility functions into coastal flood fragility functions via force equivalency. The procedure is conceptually illustrated in Figure 16, where d_s is the inundation depth, F is the lateral horizontal water forces exerted on a unit width of building, $P(DR \geq dr_i|F)$ is the fragility as a function of force, and $P(DR \geq dr_i|d_s)$ is the fragility as a function of inundation depth.

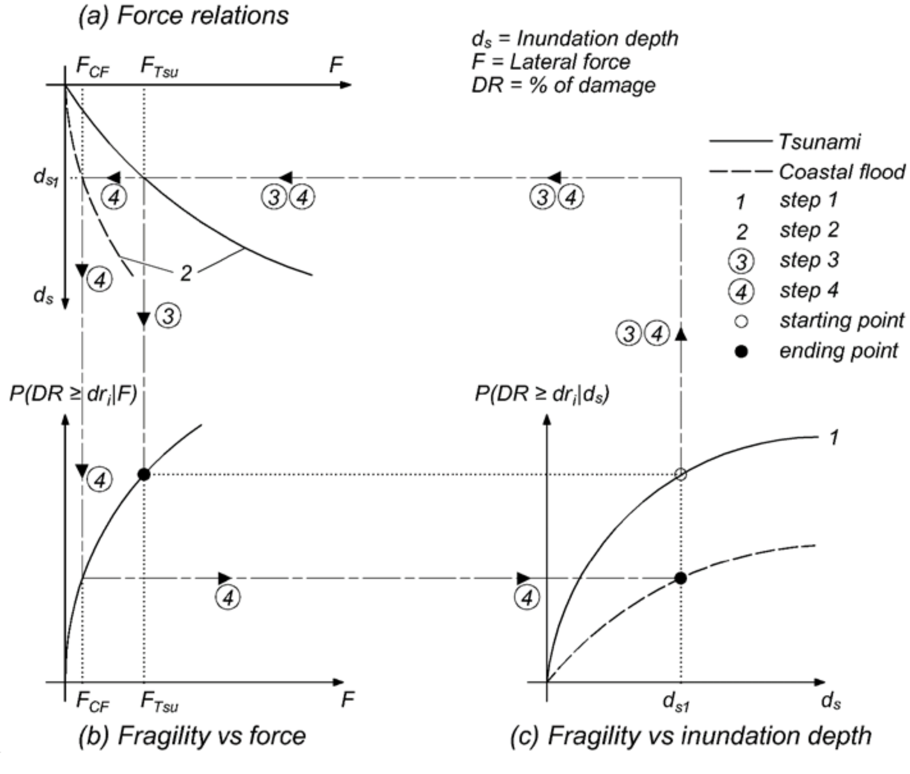


Figure 16. Conversion of a tsunami fragility function to a surge fragility function.

Table 5 conceptualizes mathematically the process described in Figure 16.

Table 5. Mathematical description of the fragility conversion process.

Tsunami Fragility function of $d_s \Longrightarrow$	Fragility function of $F \Longrightarrow$	CF Fragility function of d_s
Tsunami Force function of d_s	CF Force function of d_s	
$(from\ Eq.\text{ENG}-1)$ $P(DR \geq dr_i \vert d_s) = \Phi(d_s)$ $(from\ Eq.\text{ENG}-5)$ $x(d_s) = F_{Tsu}$	$P(DR \geq dr_i \vert F) = \Phi(x^{-1}(F))$	$P(DR \geq dr_i \vert d_s) = \Phi(x^{-1}(y(d_s)))$
	$(from\ Eq.3)$ $y(d_s) = F_{CF}$	

The following walk-through of the procedure corresponding to Figure 16 illustrates the conversion of tsunami fragility for one damage state (DS) to fragility corresponding to one coastal flood condition for that same DS. In the full implementation of this method, fragility for each of the six tsunami DS (Table 3) is converted to the three coastal flood conditions (Table 4). This conversion is repeated for each building class (BC) considered. Each collection of six fragilities (per BC, per coastal flood condition) is then converted to a single vulnerability function that models mean damage ratio as a function of inundation depth.

Step 1: Initialize the conversion by selecting the tsunami fragility function (Equation ENG-1 and Table 3) to be converted. This produces the solid line in Figure 16-c, tsunami fragility as a function of inundation depth.

Step 2: Calculate the coastal flood force F_{CF} and tsunami force F_{Tsu} as a function of inundation depth d_s using Equations ENG-3 and ENG-5, respectively, to produce the force relations in Figure 16-a.

Step 3: Map tsunami fragility as a function of inundation depth to fragility as a function of force $P(DR \geq dr_i|F)$ by following the step 3 path in Figure 16. It is equivalent to plugging the inverse function of Equation ENG-5 into Equation ENG-1. This produces Figure 16-b. This expression of fragility is independent of the source of the force (tsunami or coastal flood), and provides the map for the final step.

Step 4: The desired coastal flood fragility as a function of inundation depth (Figure 16-c, dashed line) is now produced by following the step 4 path in Figure 16. This begins with tsunami fragility at a given inundation depth in Figure 16-c, and ends with the corresponding coastal flood fragility at that same inundation depth. This is repeated over a series of inundation depths to map tsunami fragility to coastal flood fragility as a function of inundation depth. It is equivalent to replacing the force F in the fragility equation $P(DR \geq dr_i|F)$ by its expression from Equation ENG-3.

From the above, each combination of building class (BC) and coastal flood condition (Table 4) results in a set of eight coastal flood fragility curves:

$$P\left(DR \geq dr_i \middle| D_S = d_{s_j}, H_{w_j}/d_{s_j} \in CF_m, BC = bc_l\right) \equiv P(DR \geq dr_i|D_S, CF, BC) \qquad \text{(ENG-6a)}$$

With index j varying between 0 and 6, with

$$\mathrm{P}(\mathrm{DR} \geq \mathrm{dr}_0 = 0 | \mathrm{D_S}, CF, \mathrm{BC}) = 1 \qquad \text{(ENG-6b)}$$

and

$$\mathrm{P}(\mathrm{DR} \geq \mathrm{dr}_7 = \mathrm{dr}_{\max} | \mathrm{D_S}, CF, \mathrm{BC}) = 0 \qquad \text{(ENG-6c)}$$

where $\mathrm{dr}_{\max}$ can be greater than 100% due to the cost of debris removal and disposal. Figure 17 shows an example of a set of fragilities for the case of a one-story slab on grade reinforced masonry structure subject to coastal flood with severe waves.

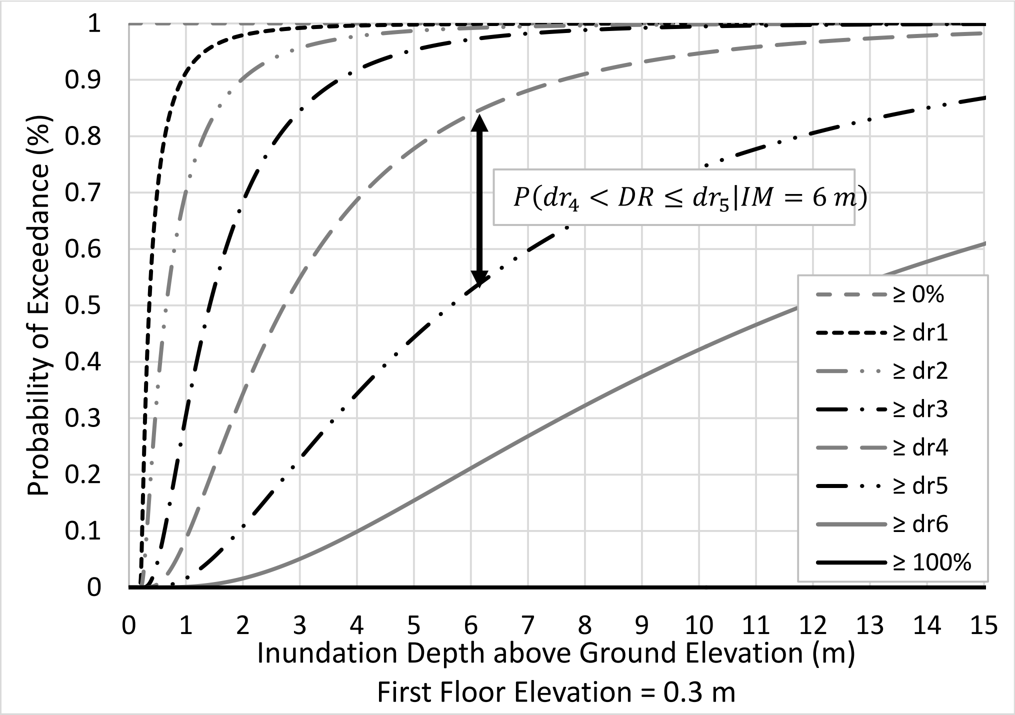


Figure 17. Example of Coastal Flood Fragility Curves.

- **Quantification of the damage states**

Post event surveys discretize the continuum of damage by categorizing different discrete states. In the discretization process it is necessary to define a sufficient but limited number of damage states to cover the continuum of damage from no damage to extreme or total damage.

Prior to converting the coastal flood fragility functions (qualitative: damage state exceedence) to coastal flood vulnerability functions (quantitative: damage ratio), it is necessary to transform the physical descriptions of the damage states into monetary measures in terms of a cost ratio between the cost to repair or replace a component or building back to its original condition and the original cost of the entire building. The purpose of this section is to present a method to transform field observations of physical damage states into monetary-based damage states through cost analyses.

The section presents a flexible, multi-component method to characterize and quantify the qualitative physical descriptions of the damage states. The next section will then demonstrate how the monetary description of the damage states is used to derive vulnerability curves from the fragility curves.

A critical component of this effort was the quantification of the damage states described in Suppasri et al. (2013). The first step was the characterization of the damage states based on the work of Friedland (2009) and Tomiczek et al. (2017). Friedland (2009) uses a component-by-component qualitative approach to develop a combined wind and water damage scale. Engineering judgment was used to develop this scale, based on the damage descriptions of HAZUS-MH Hurricane Model Residential Damage Scale (FEMA, 2015), which itself was developed following an approach similar to that used by Vann and MacDonald (1978). The components were the roof (roof cover, roof deck, roof structure), window/door, foundation, appurtenant structure, wall (wall cladding, wall structure), and structural damage, but it does not consider interior damage due to water intrusion. Friedland’s proposed damage scale defined seven damages states starting from no damage to collapse. Each damage state for each component has a qualitative description. Pre-defined critical indicators determine the overall damage state. Tomiczek et al. (2017) modified the components into six categories, added damage to the interior, and classifies the damage into seven damage states. For each damage state and component, they provided damage descriptions approximately corresponding to those described by Friedland (2009) and assigned the overall damage state of a building based on the maximum of any individual component damage state. The FPFLM methodology uses a combination of the damage states defined in Tomiczek et al. (2017) and Suppasri et al. (2013).

The following six step methodology calculates the expected mean damage ratio for a specific damage state (dr_i). This approach requires a comprehensive description of damage states and corresponding repair tasks needed to restore the building to an undamaged condition.

Step 1: Break down a building into five components. They are:

1. Roof including roof cover, roof sheathing and soffits, and roof truss and wall connections
2. Exterior walls including wall structure and wall cover
3. Openings including garage doors, windows, doors, and sliders
4. Foundation works including site work, footing, slabs, piers or piles
5. Interior including the floor covering, ceilings, drywall, stairway, cabinets, plumbing, mechanical, and electric systems

Step 2: Provide a detailed qualitative physical description of each damage state (based on Suppasri et al., 2013; and Tomiczek et al., 2017). Each cell of Table 6 includes qualitative descriptions of the physical damages to each component for a given damage state. The first damage state represents zero damage ($dr_0 = 0\%$) to all components, and the last damage state represents 100% physical damage ($dr_7 = dr_{max} = 100\%$) to all components. These two are not included in Table 6.

Step 3: Allocate a normal distribution function of physical damage and its respective mean value and standard deviation to each description. The underlying concept of a fragility curve is the probability of meeting or exceeding a certain damage ratio. Therefore, the team decided to use the lower bound of physical damage in the qualitative description as the mean value of the assigned PDF of damage. For example, for DS2, the description states that "Significant amount of roof covering missing (greater than 40%)"; therefore, for DS2 40% is used as the mean value of the normal distribution of roof damage. In order to define the standard deviation of each distribution for each damage state and component (σ_{DS_i,C_j}) the team used Equation ENG-7:

$$\sigma_{DS_i,C_j} = \left[\frac{\left(\mu_{DS_{i+1},C_j} - \mu_{DS_{i-1},C_j}\right)}{6}\right] \tag{ENG-7}$$

where μ_{DS_{i+1},C_j} is the allocated mean for the normal distribution of the next neighboring damage state for the same component and μ_{DS_{i-1},C_j} is the allocated mean for the normal distribution of the previous neighboring damage state for the same component. The team chose to limit the distribution of the damage ratio within the two neighboring damage states, such that $\left(\mu_{DS_{i+1},C_j} - \mu_{DS_{i-1},C_j}\right)$ is the range of the normal distribution. Since the tails of the normal distribution are unbounded, three standard deviations on each side of the mean (μ_{DS_i,C_j}) capture 99.73% of the probability ($\mu_{DS_i,C_j} \pm 3\sigma_{DS_i,C_j}$) that the normally distributed damage ratio is within a certain damage state (DS_i). Hence the denominator in Equation ENG-7. The assumptions behind allocating the mean and standard deviation of the normal distributions are based on engineering judgment, lessons learned from the FPHLM (wind model), and descriptions of damage for each damage state included in Suppasri et al. (2013). Table 7 shows an example of the resulting distributions for each cell for the case of a one-story slab on grade reinforced masonry structure.

Step 4: Convert the normal distributions to beta distributions, which are bounded between 0% and 100%. Beta distributions are commonly used to represent the uncertainty in the probability of occurrence of an event over a bounded region (Morgan et al., 1992) and have been validated and employed in seismic economic losses studies (e.g. Dolce et al. 2006). Equations ENG-8 and ENG-9 calculate the parameters of a beta distribution (α and β):

$$\alpha = \left(\frac{1-\mu}{\sigma^2} - \frac{1}{\mu}\right) \times \mu^2 \tag{ENG-8}$$

$$\beta = \alpha \times \left(\frac{1}{\mu} - 1\right) \tag{ENG-9}$$

where μ is the mean value and σ is the standard deviation used in the normal distribution.

Step 5: Define the cost ratios for each component and for the total building. The cost ratio of a component (CR_j) is the ratio between the cost to repair or replace a component back to its original condition and the original cost of the entire building. The cost ratio of a building (CR_{Total}) is the summation of all CR_j.

The cost ratios are developed through a detailed cost analysis of different building types. The FPFLM team defined 72 different building types based on the number of stories (1-3 stories), structure type (timber or masonry), roof shapes, and roof cover, and elevated or on grade. A building has 76 components, and the cost of repair and replacement of these components for each building type is calculated using publicly available construction cost sources such as RSMeans Residential Cost Data (2008a, 2012, 2015a), RSMeans Square Foot Costs (2008b), and RSMeans Contractor's Pricing Guide: Residential Repair and Remodeling Costs (2015b); as well as consultations with local general contractors who work in the business of constructing residential buildings in Florida (Baradaranshoraka et al. 2019). After calculating the cost ratio for each building type, the average for different number of stories, structure types, and building elevation (elevated or on grade) is calculated. The cost variations in the roof cover and roof shape did not affect the results; therefore, they were not included in the building delineation. The CR_{Total} adds up to more than 100% due to the costs of removing the debris and preparing the site for the construction of a new component.

Step 6: With the information of steps 3, 4, and 5, calculate the mean and range of each damage ratio corresponding to each damage state using the damage PDFs and the cost ratios for each component for a certain building class (BC) and coastal flood condition (CF) via Monte Carlo (MC) simulations, Equation ENG-10:

$$dr_i = E[DR|DS = ds_i, CF, BC] = \sum_{j=1}^{5} E[PDR|DS = ds_i, CF, BC] \times CR_j \qquad \text{(ENG-10)}$$

where dr_i is the expected monetary damage ratio at the *i*th damage state; $E\left[PDR|DS = ds_{i,}, CF, BC\right]$ represents the expected physical damage ratio (PDR) of the *j*th component for the *i*th damage state.

A MC simulation produces the expected damage ratio and other statistical properties corresponding to each damage state. The simulation uses the distributions defined in Table 7, and the cost ratios from step 5 as input. The output is the expected damage ratio corresponding to each overall damage state. Each simulation randomly samples a physical damage value based on the assigned damage distributions for all damage states and components from Table 7, converting the distributions into sample data. Using Equation ENG-10 and the appropriate cost ratios from step 5, the expected damage ratio of each damage state is calculated. The total number of simulations is selected so that the results are within a margin of error equal to or less than 1% of all output means with a 95% confidence level (Palisade, 2015).

Table 6. Qualitative description of six coastal flood damage states.

	Coastal Flood Damage States					
Component	DS 1	DS 2	DS 3	DS 4	DS 5	DS 6
Roof	Minor roof cover damage (greater than 20% of roof area); No roof sheathing or roof truss damage	Significant amount of roof covering missing (greater than 40%); Minor roof sheathing damage (greater than 20%); No roof truss damage	Extensive roof cover damage (greater than 60%); Significant roof sheathing damage (greater than 40%); Minor roof trusses damage (greater than 20%)	The majority of roof covering missing (greater than 80%); Extensive roof sheathing damage (greater than 60%); Many roof trusses damaged (greater than 50%)	Roof damage greater than 95%	Entire roof missing
Exterior Walls	Minor wall siding removal (greater than 20%) Small scratches; Cracks in breakaway wall	Wall siding has been removed from greater than 40% of multiple walls; Minor wall sheathing damage (greater than 20%); Minor cracks in many walls; Breakaways walls damaged or removed	Extensive damage to wall siding (60% of walls); Partial loss of wall sheathing caused by water or debris; Large and extensive cracks in most walls; Minor wall frame damage	Large holes due to floodborne debris; Extensive loss of wall sheathing; Reparable wall frame damage	Exterior wall damage greater than 95%	Overall wall system has collapsed
Interiors	Water infiltration damage to floor covering & items below the first floor; Light damage to plumbing, mechanical and electric systems; Minor water damage to utility and cabinets	Water marks 0 to 0.6 m above the first floor; Significant interior damage, including plumbing and electrical systems; Dampness on greater than 25% of dry wall (Mold)	Water marks 0.6 to 1.2 m above the first floor; Water damage to interiors at high level; Interior stairway damaged or removed; Dampness on greater than 60% of dry wall (Mold)	Water marks 1.2 to 1.8 m above the first floor; Interior damage greater than 80%	Interior damage greater than 95%	Interior completely damaged
Foundation	Slight scour; Evidence of weathering on piles	Slab and piles experience extensive scour without apparent building damage	Slab and piles sustain significant scour with repairable structural damage; Moderate slab crack	Structure shifted off the foundation or overturning foundation; Piles: racking; Slab: undermining leads to significant deformation	Foundation damage greater than 95%	Buildings has collapsed
Openings	A few windows or doors are broken (glass only); Screens may be damaged or missing	Many windows are broken; Damage to frames of doors and windows	Extensive damage to openings	Damage to openings greater than 80%	Damage to openings greater than 95%	All openings damaged

Table 7. Normal distribution parameters of the component physical damage based on qualitative description. One story slab on grade reinforced masonry structure.

	Coastal Flood Damage States					
Component	DS 1	DS 2	DS 3	DS 4	DS 5	DS 6
Roof	Roof cover (μ = 0.20; σ = 0.067); Roof sheathing (μ =1E-04; σ = 1E-04); Roof truss (μ = 1E-04; σ = 1E-04)	Roof cover (μ = 0.40; σ = 0.067); Roof sheathing (μ = 0.20; σ = 0.067); Roof truss (μ = 1E-04; σ = 1E-04)	Roof cover (μ = 0.60; σ = 0.067); Roof sheathing (μ = 0.40; σ = 0.067); Roof truss (μ = 0.20; σ = 0.083)	Roof cover (μ = 0.80; σ = 0.058); Roof sheathing (μ = 0.60; σ = 0.092); Roof truss (μ = 0.50; σ = 0.125)	Roof cover (μ = 0.95; σ = 0.032); Roof sheathing (μ = 0.95; σ = 0.065); Roof truss (μ = 0.95; σ = 0.082)	Roof cover (μ = 0.99; σ = 0.008); Roof sheathing (μ = 0.99; σ = 0.008); Roof truss (μ = 0.99; σ = 0.008)
Exterior Walls	Wall cover (μ = 0.20; σ = 0.067); Wall structure (μ = 0.10; σ = 0.033)	Wall cover (μ = 0.40; σ = 0.067); Wall structure (μ = 0.20; σ = 0.05)	Wall cover (μ = 0.60; σ = 0.067); Wall structure (μ = 0.40; σ = 0.067)	Wall cover (μ = 0.80; σ = 0.058); Wall structure (μ = 0.60; σ = 0.067)	Wall cover (μ = 0.95; σ = 0.032); Wall structure (μ = 0.80; σ = 0.065)	Wall cover (μ = 0.99; σ = 0.008); Wall structure (μ = 0.99; σ = 0.033)
Interiors	Interior (μ = 0.20; σ = 0.067)	Interior (μ = 0.40; σ = 0.067)	Interior (μ = 0.60; σ = 0.067)	Interior (μ = 0.80; σ = 0.058)	Interior (μ = 0.95; σ = 0.032)	Interior (μ = 0.99; σ = 0.008)
Foundation	Foundation (μ = 0.20; σ = 0.067)	Foundation (μ = 0.40; σ = 0.067)	Foundation (μ = 0.60; σ = 0.067)	Foundation (μ = 0.80; σ = 0.058)	Foundation (μ = 0.95; σ = 0.032)	Foundation (μ = 0.99; σ = 0.008)
Openings	Openings (μ = 0.20; σ = 0.067)	Openings (μ = 0.40; σ = 0.067)	Openings (μ = 0.60; σ = 0.067)	Openings (μ = 0.80; σ = 0.058)	Openings (μ = 0.95; σ = 0.032)	Openings (μ = 0.99; σ = 0.008)

- **Coastal flood vulnerability function development**

Vulnerability and fragility curves are different simplified representations of a full set of damage information. The vulnerability curve is expressed as a building or component expected damage ratio for a specific hazard intensity measure, coastal flood condition, and building class E[DR$|IM, CF, BC$]:

$$E[DR|IM, CF, BC] = \int_0^{dr_{max}} dr f_{DR}(dr|IM, CF, BC) d(dr) \qquad \text{(ENG-11)}$$

where dr is a specific damage ratio, dr_{max} is the maximum damage ratio, $f_{DR}(dr|IM, CF, BC)$ is the conditional probability density function (PDF) of dr given a particular intensity measure *(IM)*, and the product $f_{DR}(dr|IM, CF, BC)d(dr)$ is the probability of occurrence of dr. A vulnerability curve is the plot of $E[DR|IM, CF, BC]$ as a function of IM. The damage ratio is the percentage of the building or component which is damaged as a function of *IM*. This percentage can be expressed as either a physical percentage or as a percentage of the value of the building (monetary damage). If this percentage is expressed as a physical damage dr_{max} would be equal to 100%. If it is expressed as monetary damage dr_{max} could exceed 100% due to the additional cost of removal and disposal. The total damage is the damage ratio times the building value.

Equation ENG-11 can be discretized using the total probability theorem in Equation ENG-12 (Rosseto et al., 2013):

$$\begin{aligned} E\left[DR|im_j < IM \leq im_{j+1}, CF, BC\right] \\ \approx \sum_{i=0}^{k-1} E[dr_i < DR \leq dr_{i+1}] \times P\big(dr_i < DR \leq dr_{i+1}|im_j < IM \\ \leq im_{j+1}, CF, BC\big) \end{aligned} \qquad \text{(ENG-12)}$$

where: $E[dr_i < DR \leq dr_{i+1}]$ is the building expected damage ratio (DR), within a damage ratio interval bounded by the damage states i (dr_i) and *i+1* (dr_{i+1}); and, $P\big(dr_i < DR \leq dr_{i+1}|im_j < IM \leq im_{j+1}, CF, BC\big)$ represents the probability of occurrence of that damage ratio, given that the hazard intensity measure within a certain interval. That probability corresponds to the probability differences between adjacent fragilities for damage states i (dr_i) and *i+1* (dr_{i+1}). To simplify notation, the paper refers to the hazard intensity measure interval ($im_j < IM \leq im_{j+1}$) as IM. In the current study with 8 fragilities, k=7.

Figure 17 illustrates the concept for a case with eight damage states, where the first damage state is the case of zero damage ($dr_0 = 0\%$), i.e. the upper horizontal line with 100% probability of exceedance and the last damage state is the case of 100% damage ($dr_7 = dr_{max} = 100\%$), i.e. the lower horizontal line with 0% probability of exceedance. As an example, Figure 17 shows the probability difference between the damage ratio corresponding to damage state 4 and 5 when the hazard intensity (inundation depth above ground elevation) is equal to 6 meters.

Ideally, if the PDF of damage were available, the correct solution for the $E[dr_i < DR \leq dr_{i+1}]$, at a certain IM, is the DR corresponding to the centroid of the interval of the PDF bounded by dr_i and dr_{i+1}. Typically, the PDFs of damage at any hazard intensity are unknown, and they are discretized in histograms, with constant values in each interval of damage. The number of fragility curves governs the discretization of the PDF into a histogram. If the number of fragility curves is sufficiently high, the histogram can be a very good approximation of the actual PDF. This is generally the case when the fragilities are derived analytically or numerically, where any number of them can be generated. This is the case of the wind vulnerability model of the FPFLM, where an engineering component approach generates a 32-interval probability distribution histogram, with damage ratio intervals of 2% to 4%, evenly spaced (Pinelli et al., 2011). However, when the fragilities are based on the field surveys accessed for this study, the number of fragilities does not exceed 8, which results in a 7-interval histogram, unevenly spaced, with some damage ratio intervals as wide as 20%.

With a sufficiently high number of fragility curves, a mid-point assumption for the location of the centroid of the interval is reasonable. With few fragility curves, a mid-point assumption can introduce larger uncertainty and produce distortions of the model. For example, at low intensity of hazard, the difference in probabilities of exceedance between DS0 and DS1 is very large. If that difference is spread over a large interval (between dr_0 and dr_1), and the centroid of that interval is estimated to be at the interval mid-point, Equation ENG-12 will lead to an erroneously large value of the overall expected value of damage at that low intensity. Equation ENG-13 introduces an adjustment function f intended to minimize that distortion.

$$E[dr_i < DR \leq dr_{i+1}] = dr_i + (dr_{i+1} - dr_i) \times f(IM, dr_i) \qquad \text{(ENG-13)}$$

where $f(IM, dr_i)$ is a function whose value should vary between zero and one depending on the hazard intensity, and whether dr_i is to the left or the right of the mean of the PDF.

The resulting Equation ENG-14 provides the translation of coastal flood fragility curves into coastal flood vulnerability curves.

$$\begin{aligned} E[DR|IM, CF, BC] \\ &= \sum_{i=0}^{k-1} \{[dr_i + (dr_{i+1} - dr_i) \times f(IM)] \qquad \text{(ENG-14)} \\ &\times [\mathrm{P}(DR \geq dr_i|IM, CF, BC) - P(DR \geq dr_{i+1}|IM, CF, BC)]\} \end{aligned}$$

The quantification of the damage states $[dr_i]$ values and the fragility curves $P(DR \geq dr_i|IM)$ values is critical to the translation process.

Equation ENG-15 was developed as the adjustment function $f(IM)$.

$$f(IM) = \left(\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\left(\frac{\frac{IM}{0.3048} - \mu}{\sigma} \right)} e^{-\frac{v^2}{2}} dv \right) (ul - ll) + ll \qquad \text{(ENG-15)}$$

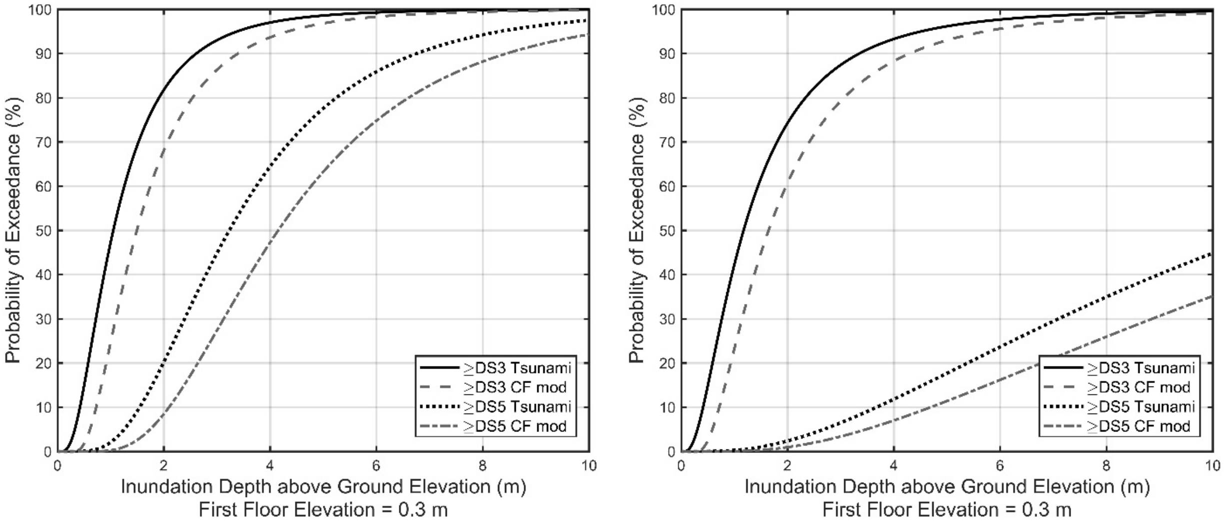
where μ and σ are equal to 2.0 for the weak models (older structures), and equal to 4.0 for the strong models (newer structures), ul (upper limit) equal to 1.0 and ll (lower limit) equal to -0.2, and v is a dummy variable of integration. IM must be input in meters. A Gaussian cumulative distribution function (CDF) is the basis for Equation 16 due to its flexibility and sigmoid behavior. The parameter values were based on expected behavior at low and high *IM* values.

- **Results and validation**

The building classes in the FPFLM library include timber and masonry structures with one to three stories, for both slab on grade and elevated structures. To reflect the evolution of building codes in Florida, a weak and strong version of each model was developed, and the differences in the vulnerability curves are based on the assigned probability of damage per component. This section presents model outputs for the weak version of a one-story slab on grade timber and the strong version of a one-story slab on grade reinforced masonry structure, as well as validation against an independently derived model and insured claims data.

o Fragility functions

Figure 18 shows examples of the tsunami fragility functions and the resultant coastal flood fragility functions after the translation process. To avoid overcrowding the plots, the figure shows only the fragility functions for DS_3 (major damage) and DS_5 (collapse) for the case of tsunami and coastal flood with moderate waves. The coastal flood fragilities show lower probability of exceeding a given damage state at a given d_s than their equivalent tsunami fragilities, as expected.



(a) *(b)*

Figure 18. Fragility functions for tsunami and moderate coastal flood condition (CF mod): a) 1-story on-grade timber; b) 1-story on-grade reinforced masonry. Damage states 3 and 5 included.

o Initiation of damage in the vulnerability curves

The finished First Floor Elevation (FFE) of a structure (above ground level) can vary depending on requirements related to building location and age of construction. The coastal flood vulnerability curves reflect this by initiating accumulation of damage when the wave crest reaches the FFE. The calculation of d_s when the wave crest reaches FFE is based on the diagram presented in Figure 19, from Kjeldsen and Myrhaug (1978), which illustrates the dimensions of a breaking wave in shallow water. The maximum height of the wave above the inundation depth is described by ηH_b, where η is equal to 0.7 (e.g. Peng, 2015; USACE, 2015). Equation ENG-16 calculates the inundation depth (d_{s0}) when the wave crest first reaches FFE. The breaking wave height H_b is substituted by H_w for the case of minor or moderate waves. The term H_w/d_s depends on the severity of the coastal flood, defined in Table 4.

$$d_{s0} = \frac{FFE}{(1 + 0.7 * \frac{H_w}{d_s})} \tag{ENG-16}$$

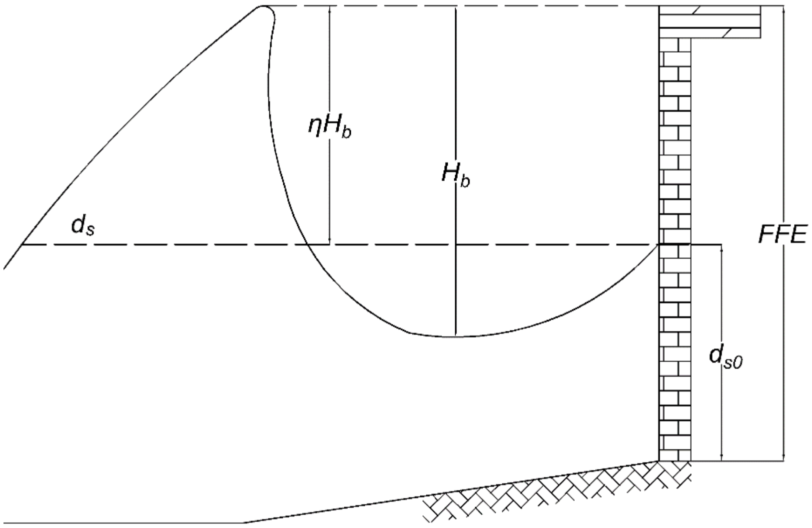


Figure 19. Breaking wave dimensions, based on Kjeldsen and Myrhaug (1978).

o Comparison with USACE model

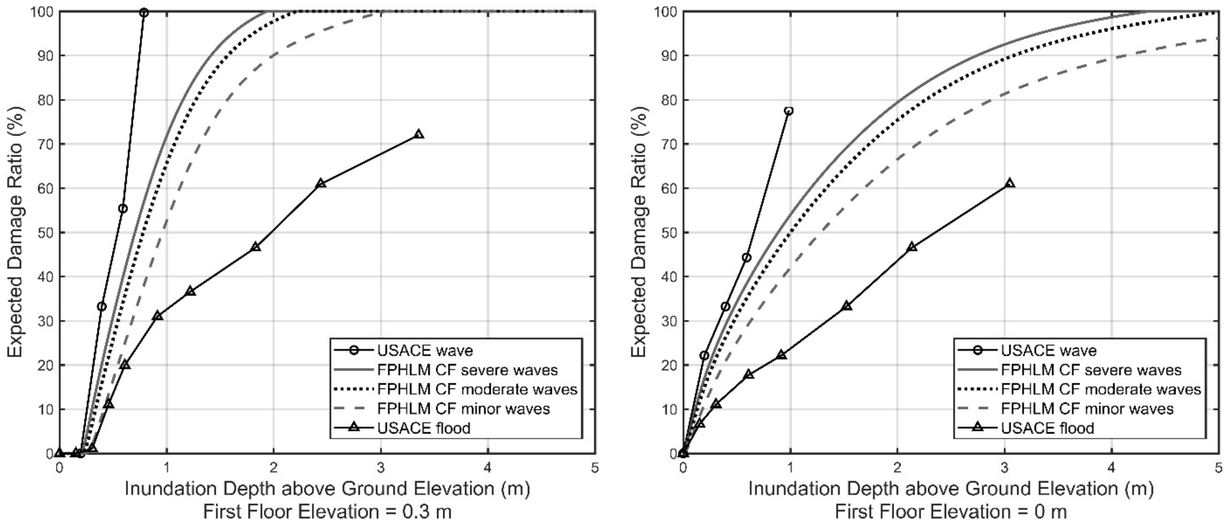
Figure 20 presents the results from this study and the USACE (2015) vulnerability curves for wave (i.e. coastal flood) and inland flood. The USACE (2015) developed a set of vulnerability curves for different structures based on expert opinions informed in part by post-disaster damage assessments. The structures selected from the USACE report are a single-story timber frame house with slab foundation and FFE of 0.3 m above ground level, and a single-story reinforced masonry house with slab foundation and FFE of zero. The ages of these structures were described in USACE (2015) and correspond to an older (weak) timber model and a newer (strong) masonry model within the FPFLM model inventory.

USACE (2015) presents vulnerability curves for damage due to inland flood inundation (slow-rising flood) as a function of inundation depth, and damage due to coastal flood with waves as a function of wave height above FFE. The FPFLM model uses inundation depth at the hazard frame of reference for both flood and coastal flood with waves. It was therefore necessary to convert the USACE (2015) inland and coastal flood vulnerability curves to this same frame of reference, as described in Baradaranshoraka et al. (2019). The wave state in USACE (2015) is reported to be breaking waves. In Equation ENG-16, when substituting FFE by the wave crest plus FFE, it allows the conversion of the abscissas from wave height above FFE to d_s above ground using $H_w/d_s = 0.78$ (breaking waves). For the ordinate, the USACE (2015) report presents the results in terms of physical damage (up to 100%), while the FPFLM uses expected damage ratio. A factor equal to the Building CR derived from the cost analyses was applied to the USACE values for each comparable structure.

Figure 20-a presents the USACE timber vulnerability model (severe waves and slow rising flood) along with the comparable FPFLM weak timber model (minor, moderate and severe waves). The USACE envelope of no waves and severe waves appears to bound the FPFLM outputs. The most relevant comparison is the ‘USACE wave’ and the ‘FPFLM CF severe waves’ as described in the legend. Both models show rapid damage accumulation with increasing inundation. The USACE model is more vulnerability that the FPFLM model, and the difference between models becomes larger with increasing inundation depth. Secondarily, the ‘USACE flood’ and the ‘FPFLM CF minor waves’ show good agreement at low inundation levels where minor wave magnitudes are very small.

Figure 20-b presents the USACE masonry vulnerability model (severe waves and slow rising flood) along with the comparable FPFLM strong masonry model (minor, moderate and severe waves). Again, the most relevant comparison is the ‘USACE wave’ and the ‘FPFLM CF severe waves’ as the legend describes. The USACE results estimate more vulnerability, but show close agreement with FPFLM within the first meter of inundation.

These comparisons show that the FPFLM model predicts less vulnerability than the USACE model for like structures subject to severe waves, with the difference between models increasing with inundation depth. While the USACE (2015) models are a valid source of comparison, they do not represent an ‘exact solution’, nor were they used in the development or calibration of the FPFLM models. One can judge the FPFLM and USACE model outputs to be different, but cannot assign superior performance to either, based on Figure 20 alone. The next section employs an analysis of National Flood Insurance Program (NFIP) claims data to complement Figure 20 with a record of actual losses.



(a) *(b)*

Figure 20. FPFLM Coastal flood (CF) vulnerability and USACE (2015) vulnerability relative to the ground elevation a) 1-story slab on-grade weak timber ,0.3 m FFE; b) 1-story slab on-grade strong masonry, 0 m FFE.

o Validation against claims data

The Florida Office of Insurance Regulation provided NFIP claims data to the FPFLM team. The claims database contains more than 150,000 claims between July 1975 and January 2014 for 126 different events. The NFIP claims data were cross-referenced with tax appraiser databases at the county level. These efforts produced a more complete set of building descriptors for each policy in the NFIP (e.g. masonry or timber frame construction). The team analyzed the claims data locations and loss dates to associate a specific hazard to each claim. The following analysis focuses on the claims from Hurricane Ivan (2004) in the Florida Panhandle.

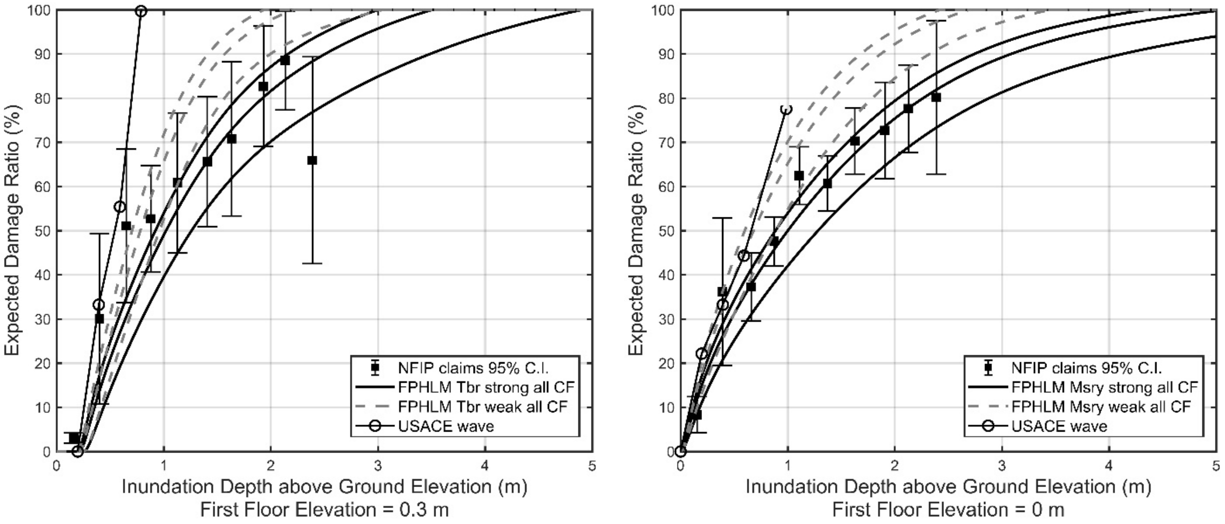
The FPFLM hazard teams employed FEMA water marks collected in post-Ivan studies to estimate a surge and wave height assignment to each NFIP Ivan claim based on its location. With the NFIP database enhanced with hazard data and building construction details, it is possible to produce empirical building vulnerability values to validate FPFLM outputs (Pinelli et al., 2019).

The NFIP Ivan claims were categorized by structure type to create subsets corresponding to single family residential slab on-grade single-story timber and masonry structures. This resulted in 132 individual claims for the timber structures, and 376 individual claims for the masonry structures. Each building damage claim was divided by the building value, also provided in the claims data, to produce a building damage ratio per claim. The claims were then binned by coastal flood inundation height using 0.25 m intervals. The mean damage ratio for a given inundation interval is the average of all claim damage ratios within the interval. Finally, the number of claims and the standard deviation among claims in each interval yield the 95% confidence interval for each claims-derived mean damage ratio.

Further stratification of the timber and masonry structure claims by age, FFE and wave severity were attempted, but this rendered the number of claims per stratification too low. Thus, the mean damage ratios from claims data include multiple coastal flood conditions and FFE values, and both old (weak) and new (strong) construction.

Figure 21-a and Figure 21-b presents the same USACE (2015) and FPFLM timber and masonry model outputs utilized in Figure 20-a and Figure 20-b, respectively. In addition, the FPFLM strong timber and weak masonry model outputs were added given the mixed age of the claims data. All three coastal flood conditions were included for both weak and strong FPFLM model outputs (denoted ‘all CF’ in the legend), and the USACE model represents breaking waves. Finally, the claims-derived mean data damage ratios and their 95% confidence intervals were included. These confidence intervals provide a frame of reference regarding both the number of claims and their standard deviation at different inundation depth intervals.

The claims data mean damage ratios generally exhibit the expected trend of increased damage with increasing inundation depth. The exception is the highest inundation depth for timber claims data, where the comparatively large confidence interval indicates significant uncertainty due to few samples and a large standard deviation. Given the aggregation of age, FFE and wave state within the claims data, direct comparison of the claims data to any one of the six FPFLM model outputs or the USACE models is not appropriate. However, the 95% confidence intervals generally lie within or partially overlap the swath of FPFLM model outputs over the available range of inundation depth, while the 95% confidence intervals diverge from the USACE models before reaching 1m of inundation. The NFIP claims data was not used to develop or calibrate the FPFLM vulnerability models. It is therefore encouraging that the claims data falls within the swath of FPFLM models for both timber and masonry, particularly at the higher inundation depths where the difference between the FPFLM and USACE models is more drastic.



(a) *(b)*

Figure 21. FPFLM Coastal flood (CF) vulnerability, USACE (2015) vulnerability, and Hurricane Ivan 2004 NFIP claims-derived vulnerability relative to the ground elevation a) 1-story slab on-grade timber, 0.3 m FFE; b) 1-story slab on-grade reinforced masonry, 0 m FFE.

Vulnerability of site-built residential structures to Inland Flood

The methodology to adapt tsunami fragility functions was not appropriate for the case of inland flooding. Therefore, the residential vulnerability functions for inland flood were developed separately from the vulnerability functions for coastal flood. The fundamental premise was to adapt the USACE (2015) inland flood vulnerability functions to account for varying FFE.

Table 8 and Table 9 present examples of the data used for the development of the Inland Flood vulnerability curves for residential buildings, based on USACE (2015).

Table 8. Single Story Residence, No Basement, Building Characteristics (Table 55, USACE 2015).

	Most Likely	Minimum Damage	Maximum Damage
Stories	1	1	1
Foundation	Slab	Slab	Crawl Space
Age	15-30	0-10	Old – unknown codes
Structure	Wood frame	Masonry, reinforced per code	Wood frame
Height of Finished Floor Above Grade	1’-0”	0’-0”	3’-0”
Condition	Fair/Good	Good	Poor

Table 9. Single Story Residence, No Basement, Inundation Damage – Structure (Table 56, USACE 2015).

Flood Depth (ft)	Min (%)	Most Likely (%)	Max (%)
-1.0	0	0	0
-0.5	0	0	5
0.0	0	1	10
0.5	6	10	20
1.0	10	18	30
2.0	16	28	40
3.0	20	33	45
5.0	30	42	60
7.0	42	55	94
10	55	65	100

For the case of timber structures, the most likely case was selected from the above tables, and for the case of masonry structures, the minimum damage case was selected. USACE (2015) provides information for one and two story structures. For three-story residences, 90 percent of the two-story damage ratio was assumed to develop the vulnerability curves. The damage to two-story and three-story residences would be similar, but the total cost for the three-story residences is higher than that for two-story residences, thus, the damage ratio for three-story residences should be lower.

The adaptation of the USACE (2015) flood model to the FPFLM model consists of the following four steps:

Step 1:
Use the inundation damage curves for structure damage in USACE 2015 as the initial proxy. The reference level of USACE inundation damage curves is the finished first floor elevation (FFE), while the FPFLM reference is ground level.

Step 2:
The FPFLM library of non-elevated models includes FFEs from zero to three feet in one-foot increments. To align the appropriate USACE model, the equivalent wetting depth is determined.

Step 3:
The reference level of the Inland flood damage curve is changed to ground level. The process is equivalent to shift the original curve with an offset equal to the FFE of the library model.

Step 4:
The shifted Inland flood damage curve is then fitted with a lognormal CDF function. The data from USACE, 2015 was only available up to 10 ft of inundation depth. To produce the curves up to 50 ft for the models, an extra point with a 100% damage was added. The inundation depth for this point was selected to ensure that the inland flood model remains less vulnerable than the coastal flood model for the same structure.

Figure 22 shows an example of the fitting result for the case of a two-story on grade reinforced masonry structure with a 2 ft FFE. Figure 23 shows the inland flood model for a one-story masonry with a 2 ft FFE, along with the models for the three coastal flood conditions. The reduced vulnerability to inland flood relative to coastal flood is a consistent characteristic for all FPFLM models.

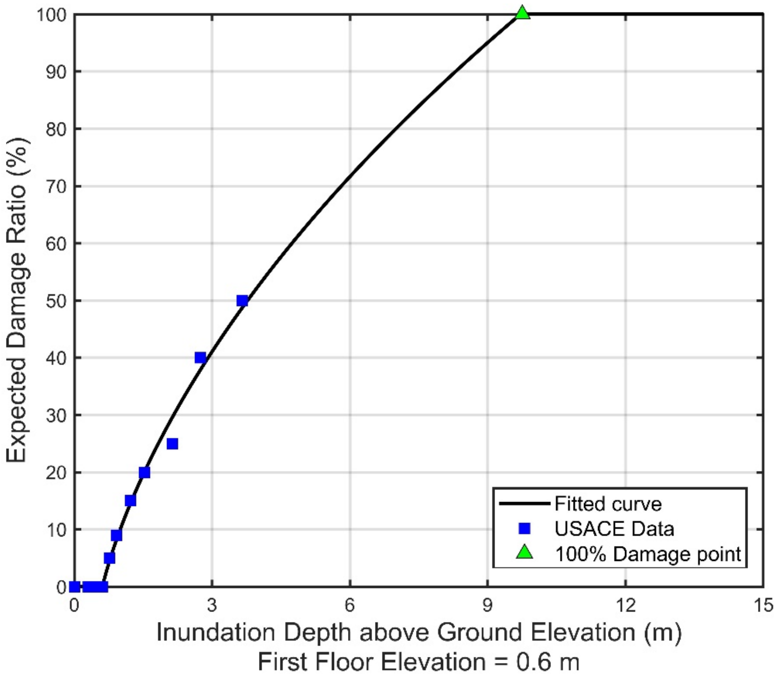


Figure 22. Fitted curve based on USACE data. Two-story masonry, 2 ft FFE.

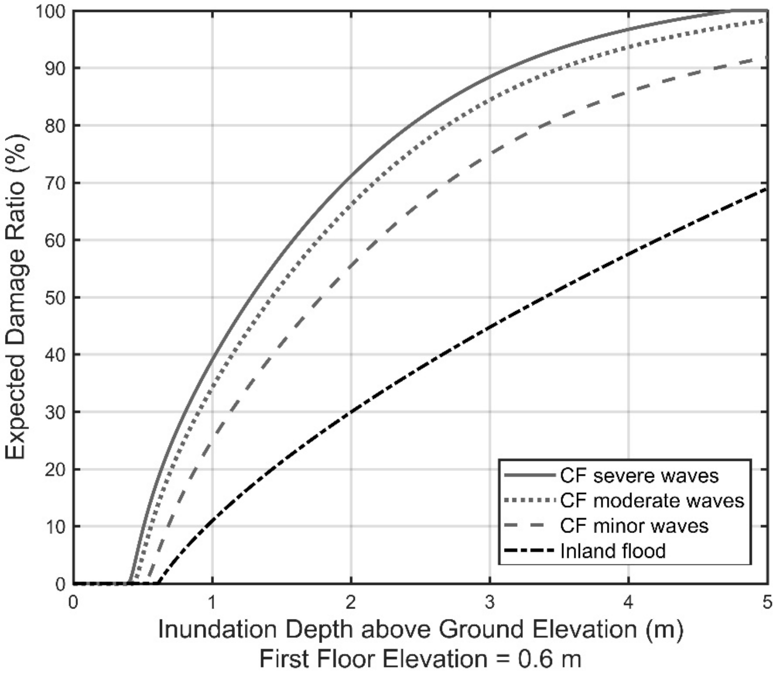


Figure 23. Inland and Coastal Flood Vulnerability Curves. One-story masonry, 2 ft FFE.

Vulnerability of manufactured housing to Inland and Coastal Flood

USACE reports (1992, 2006) provide vulnerability observations for manufactured homes subject to slow rising flood events. These observations are used as the basis of development for the manufactured housing (MH) vulnerability functions. The FPFLM model considers two foundation types (tied- and not tied-down), as illustrated in Figure 24.

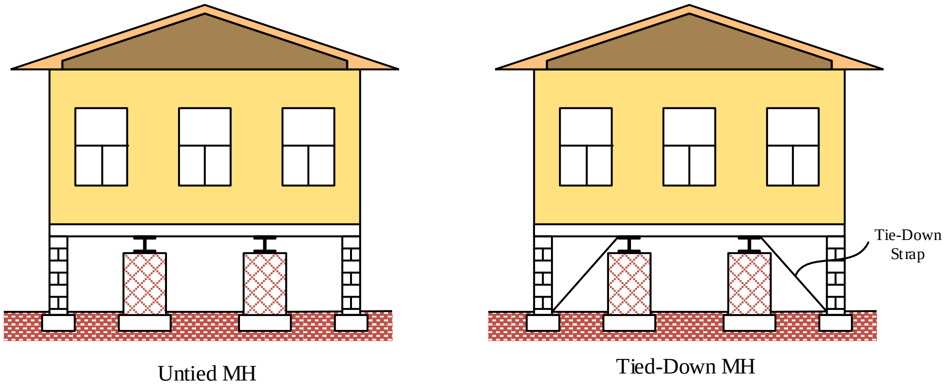


Figure 24. Two types of manufactured homes (MH).

The fundamental assumption, backed by field observation and experts, is that in most cases, water entering the living space of a manufactured home results in very rapid accumulation of damage of the structure. The damage does not necessarily indicate physical destruction of the structure, but rather the cost of repair exceeding the cost of replacement. Water entering the living space necessarily destroys the ground level contents, and more significantly results in the loss of floor level systems (e.g. electrical), the need for mold and corrosion remediation, and the likely replacement of the structural floor system due to warping. The associated cost typically approaches replacement cost. Thus, the floor elevation of manufactured homes is deemed to be a critical inundation depth.

Typical manufactured home construction sets the unit on a foundation elevated 2-3 feet above grade. Damage can also result from water approaching but not entering the elevated living space. If a home is not tied down, the rising water can displace the foundation, typically dry-stack masonry or concrete piers, causing shifting or collapse of the structure. This is mitigated if the structure is properly anchored.

USACE (1992) presents a comprehensive catalog of residential depth-damage functions used by Corps of Engineers district offices. These damage functions were derived based either upon National (or site-specific) flood damage records or upon synthetic flood damage estimates from residential and non-residential structure owners. This report provides a basis for the development of vulnerability functions for manufactured houses. USACE (2006) also provides a set of MH flood depth damage functions. Developing vulnerability functions based on observations allows the flexibility of using any well-documented source and reasonable judgement to make adjustments to fit the curves to the situation in the region of interest.

Figure 25 summarizes the available existing depth damage curves as a function of inundation depths relative to first floor. Untied houses are the weakest building type among manufactured homes. For this reason, we used a normal distribution (blue solid line in Figure 25) enveloping the existing dataset to represent the damage functions for this type of building. Tied-down manufactured homes are relatively more resistant against horizontal water forces, as compared to the untied structures. Thus, a lognormal distribution (blue dashed line in Figure 25) representing the modified mean level of the available depth-damage curves is deemed to be appropriate for tied MH vulnerability functions.

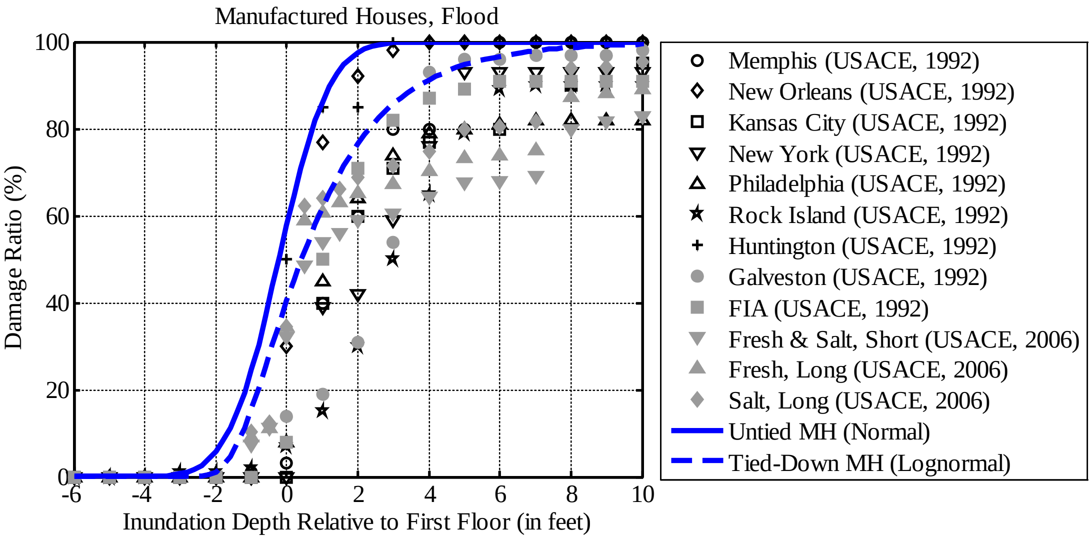


Figure 25. Inland Flood vulnerability curves and existing flood depth-damage data.

Depending on the FFE of the MH being modeled, the resulting vulnerability curves are shifted to reflect this elevation.

For the case of coastal flood with waves, the derived inland flood vulnerability curves are taken as the starting point and translated considering the wave heights and lateral forces. Since most of the damage to the manufactured homes is associated with water entering the living space, the presence of waves affects the inundation depth that initiates damage, shifting the inland flood vulnerability to the left. Additionally, the force required to slide or cause a shear failure in the foundation of the house is estimated and compared to the force produced by the coastal flood with waves. Sliding or shear failure occurs when horizontal forces exceed the friction force or strength of the foundation. The building fails by sliding off its foundation, shear failure of components transferring loads to its foundation, or the foundation sliding. The resultant inundation depth when the house slides or fails is taken as the boundary, and therefore the damage goes to 100% when the water reaches this height.

Actuarial Component

The actuarial component consists of a set of algorithms. The process involves a series of steps: rigorous check of the input data; selection and use of the relevant output produced by the coastal surge and inland flood hazard components; selection and use of the appropriate coastal and inland flood vulnerability functions for building structure, contents, and additional living expenses; running the actuarial algorithm to produce expected losses; aggregating the losses in a variety of manners to produce a set of expected annual flood losses; and produce probable maximum losses for various return periods. The expected losses can be reported by construction type (e.g., masonry, frame, manufactured homes), by geographic zone, county or ZIP Code, by rating territory, and combinations thereof.

Expected annual losses are estimated for individual policies in the portfolio. They are estimated for building structure, contents, and ALE on the basis of their exposures and by using the respective vulnerability functions for the construction types and hazard type. For each policy, losses are estimated for all the storms in the stochastic set by using appropriate damage functions and policy exposure data. The losses are then summed over all storms and divided by the number of years in the simulation to get the annual expected loss. These are aggregated at the ZIP Code, county, territory, geographic zone, or portfolio level and then divided by the respective level of aggregated exposure to get the loss costs. This is a computationally demanding method. Each portfolio must be run through the entire stochastic set of storms.

The distribution of losses is driven by both the distribution of damage ratios generated by the engineering component and by the distribution of inundation depth generated by the coastal and the hydrology components. The meteorology component uses more than 70,000 year simulations to generate a stochastic set of storms. For each location grid the coastal surge and inland flood models produce flood depth which is applied to the appropriate vulnerability function to generate damages. The vulnerability component outputs are used as input in the actuarial model.

The starting point for the computations of personal residential losses is the vulnerability function. Appropriate vulnerability matrices are applied separately for building structure, content, and ALE.

The ground up loss is computed, the appropriate deductibles and limits are applied, and the loss net of deductible is calculated. The expected losses are then adjusted by the appropriate expected demand surge factor. The demand surge factors are estimated by a separate model and applied appropriately to each storm in the stochastic set.

After the losses are adjusted for demand surge, they are summed across all structures of the type in the grid and also across the grids to get expected aggregate portfolio loss. The model can process any combination of policy type, construction type, deductibles, coverage limits, etc.

Another function of the actuarial algorithms is to produce estimates of the probable maximum loss for various return periods. The PML is produced non-parametrically using order statistics of simulated annual losses. Suppose the model produces N years of simulated annual losses. The annual losses L are ordered in increasing order so that $L(1) \leq L(2) \leq . . . \leq L(N)$. For a return period of Y years, let p = 1-1/Y. The corresponding PML for the return period Y is the pth quantile of the ordered losses. Let k = (N)*p. If k is an integer, then the estimate of the PML is the kth order statistic, L(k), of the simulated losses. If k is not an integer, then let k* = the smallest integer greater than k, and the estimate of the pth quantile is given by L(k*).

Computer System Architecture

The FPFLM is a large-scale system that is designed to store, retrieve, and process a large amount of historical and simulated hurricane data. In addition, intensive computation is supported for hurricane damage assessment and insured loss projection. To achieve system robustness and flexibility, a three-tier architecture is adopted and deployed in our system. It aims to solve a number of recurring design and development problems and make the application development work easier and more efficient. The computer system architecture consists of three layers: the user interface layer, the application logic layer, and the database layer. The interface layer offers the user a friendly and convenient user interface to communicate with the system. To offer greater convenience to the users, the system is prototyped on the web so that the users can access the system with existing web-browser software.

The application logic layer activates model logic based on the functionality presented to the user, processes data, and controls the information flow. This is the middle tier in the computer system architecture. It aims to bridge the gap between the user interface and the underlying database and to hide technical details from the users.

The database layer is responsible for data modeling to store, index, manage, and model information for the application. Data needed by the application logic layer are retrieved from the database, and the computational results produced by the application logic layer are stored back to the database.

Software, Hardware, and Program Structure

The user-facing part of the system consists of a collection of Linux command line scripts written in Bash and Python. These interface scripts call the core components, which are written in C++, MATLAB, and Python. The system uses a PostgreSQL database that runs on a Linux server. Server-side software requirements are the IMSL library CNL 5.0, JDBC 3, JNI 1.3.1, and JDK 1.6.

The end-user workstation requirements are minimal. Any current version of Internet Explorer, Firefox, Chrome, or Safari running on a currently supported version of Windows, Mac, or Linux should deliver an optimal user experience. Typically, the manufacturer's minimal set of hardware features for the current version of the web browser and operating system combination is sufficient for the optimal operation of the application.

Translation from Model Structure to Program Structure

The FPFLM uses a component-based approach in converting from model to program structure. The model is divided into the following components or modules: Storm Track Generator, Wind Field Module, Storm Surge Model, Waves Model, Rain Model, Inland Flood Model, Damage Estimation Module, and Loss Estimation Module. Each of these modules fulfills its individual functionality and communicates with other modules via well-defined interfaces. The architecture and program flow of each module are defined in its corresponding use case document following software engineering specifications. Each model element is translated into subroutines, functions, or class methods on a one-to-one basis. Changes to the models are strictly reflected in the software code.

3. Provide a flowchart that illustrates interactions among major flood model components.

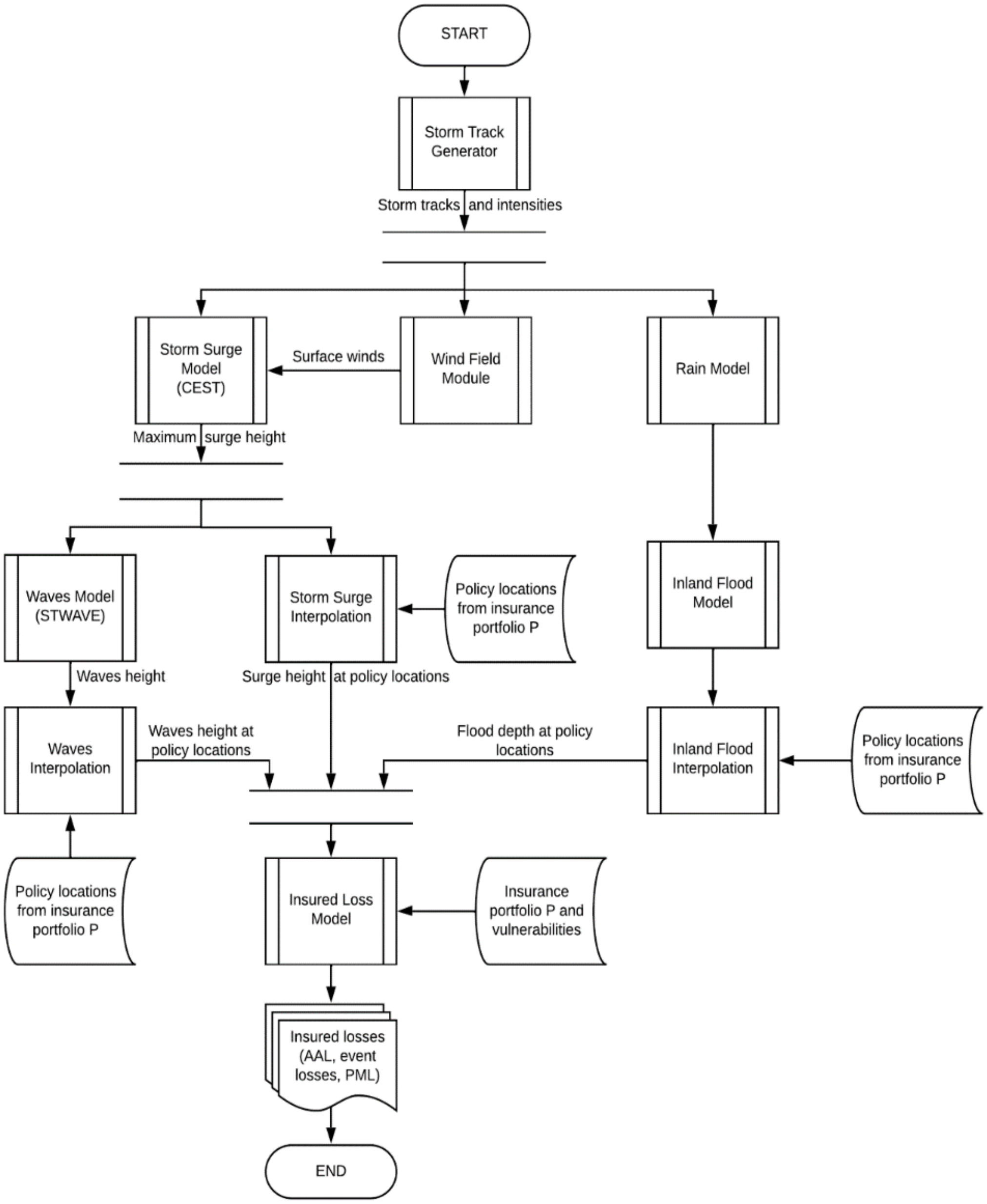


Figure 26. Interactions among major flood model components.

4. Provide a diagram defining the network organization in which the flood model is designed and operates.

Our model is designed and operates on a computing cluster of 58 servers that are interconnected by routers V17, V2000, and V2064 as shown in Figure 27, marked by red squares. The hardware configurations of each server are listed in Table 10 shown below. This includes their hostname, the router immediately connected to the server, the allocated network bandwidth, the model and main frequency of CPU, the number of threads, memory size, and the Operating System (OS) installed on the server, and server's usage. Note that all the servers use different versions of Enterprise Linux (EL), specifically, CentOS/SL, as the OS.

Table 10. Hardware configuration of servers.

Hostname	Router	Network Bandwidth	CPU	#Threads	Memory	OS	Usage
alex-a	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
alex-b	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
alex-c	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
alex-d	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
betsy	V17	10G	Opteron 6380	64	512G	EL6	compute server
camille	V17	10G	Opteron 6380	64	512G	EL6	compute server
carla	V17	10G	Opteron 6380	64	512G	EL6	compute server
david	V17	10G	Xeon L7555 1.87GHz	64	512G	EL6	compute server
donna	V17	10G	Opteron 6380	64	512G	EL6	compute server
dora	V17	10G	Opteron 6380	64	512G	EL6	compute server
earl-a	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
earl-b	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
earl-c	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
earl-d	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
easy	V17	10G	Opteron 6380	64	512G	EL6	compute server
eloise-a	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
eloise-b	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server

Hostname	Router	Network Bandwidth	CPU	#Threads	Memory	OS	Usage
eloise-c	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
eloise-d	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
fabian-a	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL8	compute server
fabian-b	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
fabian-c	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
fabian-d	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
floyd	V17	10G	Xeon X5650 2.67GHz	24	96G	EL5	compute server
frances-a	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
frances-b	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
frances-c	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
gaston-a	V17	10G	Xeon E5-2680 2.5GHz	56	256G	EL6	compute server
gaston-b	V17	10G	Xeon E5-2680 2.5GHz	72	192G	EL6	compute server
irma	V17	10G	Xeon Gold 6126 2.6GHz	48	128G	EL7	compute server
harvey	V17	10G	Xeon Gold 6348 2.60GHz	224	354G	EL6	Compute server
ivan-a	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
ivan-b	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server

Hostname	Router	Network Bandwidth	CPU	#Threads	Memory	OS	Usage
ivan-c	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
ivan-d	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
jeanne-a	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
jeanne-b	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
jeanne-c	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
jeanne-d	V17	10G	Xeon E5-2680 2.5GHz	48	256G	EL6	compute server
king	V17	10G	Xeon E5-2690 2.6GHz	56	512G	EL7	compute server
runway	V17	10G	Xeon Silver 4116 2.1GHz	48	128G	EL7	compute server
sandy	V17	10G	Opteron 6380	64	512G	EL6	compute server
wilma	V17	10G	Xeon Silver 4208 2.1GHz	16	48G	EL8	storage server
wilma-backup	V17	1G	Xeon Silver 4208 2.1GHz	16	48G	EL8	backup storage server
hugo-a	V2000	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
hugo-b	V2000	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
hugo-c	V2000	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
hugo-d	V2000	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
agnes-a	V2064	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
agnes-b	V2064	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server

Hostname	Router	Network Bandwidth	CPU	#Threads	Memory	OS	Usage
agnes-c	V2064	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
agnes-d	V2064	10G	Xeon E5-2680 2.5GHz	48	256G	EL7	compute server
charley	V2064	10G	Opteron 6320	16	128G	EL6	storage server
charley-backup	V2064	1G	Opteron 6320	16	128G	EL6	backup storage server
mitch	V2064	10G	Opteron 6212	16	128G	EL8	storage server
mitch-backup	V2064	1G	Opteron 6212	16	128G	EL8	backup storage server
opal	V2064	10G	Xeon X5650 2.67GHz	12	96G	EL5	compute server
stan	V2064	10G	Xeon X5650 2.67GHz	24	96G	EL5	compute server

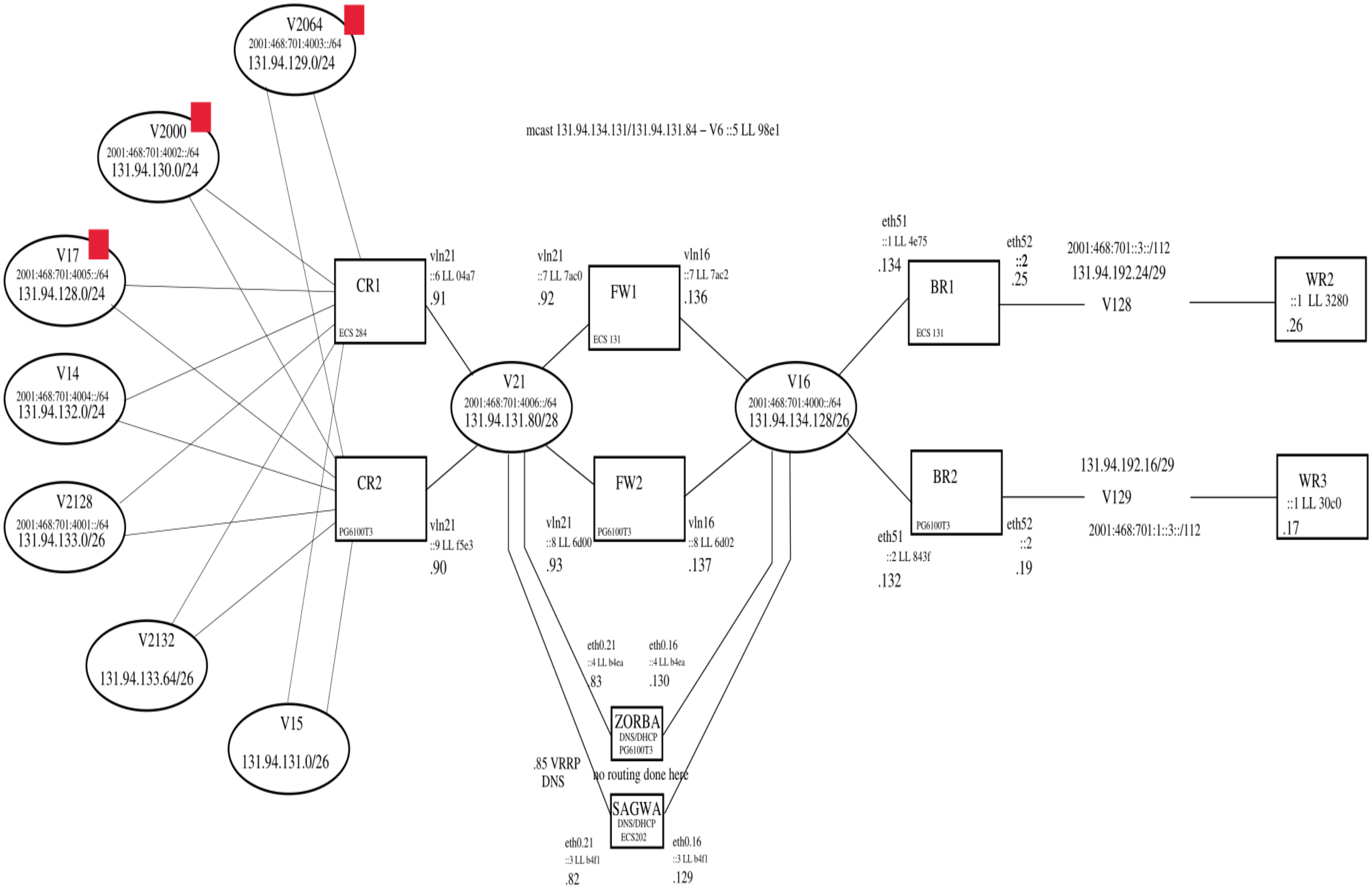


Figure 27. Network Diagrams for Logical Layer.

5. Provide detailed information on the flood model implementation on more than one platform, if applicable. In particular, submit Forms VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage; AF-1, Zero Deductible Personal Residential Standard Flood Loss Costs; AF-4, Flood Output Ranges; and AF-8, Flood Probable Maximum Loss for Florida, from each platform including additional calculations showing no differences.

All the hurricane model implementation is based on Linux *CentOS/SL* operating system.

6. Provide a comprehensive list of complete references pertinent to the submission by flood standard grouping using professional citation standards.

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7. Identify and describe the modeling-organization-specified, predetermined, and comprehensive exposure dataset used for projecting personal residential flood loss costs and flood probable maximum loss levels.

The exposure data were sourced from NFIP's 2012 exposure file for Florida, augmented by the 2019 exposure of manufactured home insurer whose policies include flood coverage, and post-2012 construction located in coastal ZIP codes as reported by the FL-OIR to the modelers for 2019 stress testing. The latter two sources were assumed to be insured to value. The NFIP policies were matched to county tax assessor databases in order to determine the current property value. For unmatched exposure the building limit was assumed to be property value,

8. Provide the following information related to changes in the flood model from the currently accepted flood model to the initial submission this year.

A. Flood model changes:

1. A summary description of changes that affect the personal residential flood loss costs or flood probable maximum loss levels,

2. A list of all other changes, and

3. The rationale for each change.

B. Percentage difference in average annual zero deductible statewide flood loss costs based on the modeling-organization-specified, predetermined, and comprehensive exposure dataset for:

1. All changes combined, and

2. Each individual flood model component change.

C. Color-coded maps by rating area or zone reflecting the percentage difference in average annual zero deductible statewide flood loss costs based on the modeling-organization-specified, predetermined, and comprehensive exposure dataset for each flood model component change.

D. Color-coded map by rating area or zone reflecting the percentage difference in average annual zero deductible statewide flood loss costs based on the modeling-organization-

specified, predetermined, and comprehensive exposure dataset for all flood model component changes combined.

Not applicable.

9. Provide a list and description of any potential interim updates to underlying data relied upon by the flood model. State whether the time interval for the update has a possibility of occurring during the period of time the flood model could be found acceptable by the Commission under the review cycle in this Flood Standards Report of Activities.

Not applicable.

GF-2 Qualifications of Modeling Organization Personnel and Consultants Engaged in Development of the Flood Model

A. Flood model construction, testing, and evaluation shall be performed by modeling organization personnel or consultants who possess the necessary skills, formal education, and experience to develop the relevant components for flood loss projection methodologies.

The model was developed, tested, and evaluated by a multi-disciplinary team of professors and experts in the fields of hydrology, coastal surge, coastal engineering, meteorology, structural engineering, computer science, statistics, finance, and actuarial science. The experts work primarily at Florida International University, Florida Institute of Technology, Florida State University, University of Florida, Rutgers University, University of Miami, Notre Dame University, Hurricane Research Division of NOAA, and AMI Risk Consultants.

B. The flood model and flood model submission documentation shall be reviewed by modeling organization personnel or consultants in the following professional disciplines with requisite experience: hydrology and hydraulics (advanced degree or currently licensed Professional Engineer, with experience in coastal and inland flooding), meteorology (advanced degree), statistics (advanced degree or equivalent experience), structural engineering (currently licensed Professional Engineer, with experience in the effects of coastal and inland flooding on buildings), actuarial science (Associate or Fellow of Casualty Actuarial Society or Society of Actuaries), and computer/information science (advanced degree or equivalent experience and certifications). These individuals shall certify Expert Certification Forms GF-1 through GF-7 as applicable.

The model has been reviewed by modeler personnel and consultants in the required professional disciplines. These individuals abide by the standards of professional conduct as adopted by their profession.

Disclosures

1. Modeling Organization Background

> ***A. Describe the ownership structure of the modeling organization engaged in the development of the flood model. Describe affiliations with other companies and the nature of the relationship, if any. Indicate if the modeling organization has changed its name and explain the circumstances.***

The model was developed independently by a multi-disciplinary team of professors and experts. The lead university is the Florida International University. The model was commissioned by the Florida Office of Insurance Regulation.

> ***B. If the flood model is developed by an entity other than the modeling organization, describe its organizational structure and indicate how proprietary rights and control over***

the flood model and its components are exercised. If more than one entity is involved in the development of the flood model, describe all involved.

The Florida Office of Insurance Regulation (OIR) contracted and funded Florida International University to develop the Florida Public Flood Loss Model. The model is based at the Laboratory for Insurance, Financial and Economic Research, which is part of the Extreme Event Institute at Florida International University. The OIR did not influence the development of the model. The model was developed independently by a team of professors, experts, and graduate students working primarily at Florida International University, Florida Institute of Technology, Florida State University, University of Florida, Rutgers University, Notre Dame University, University of Miami, Hurricane Research Division of NOAA, and AMI Risk Consultants. The copyright for the model belongs to OIR.

The coastal flood surge model, Coastal and Estuarine Storm Tide (CEST) model, was developed by FPFLM project experts at Florida International University. The coastal flood model uses the wave program STWAVE for modeling the wave part of the coastal flood. This was developed by the US Army Corps of Engineers, which is a branch of the US Federal government. All components of the model are freely available, including source code. The STWAVE model may be used without needing additional rights or compensation.

The source code of EF5, which is the hydrologic modeling platform used to develop the riverine model, was developed by the Hydrometeorology and Remote Sensing Laboratory at the University of Oklahoma. The code is open source (https://github.com/HyDROSLab/EF5) and is distributed under the Unlicense license, which means that EF5 is free and unencumbered software released into the public domain. Anyone is free to copy, modify, publish, use, compile, sell, or distribute this software, either in source code form or as a compiled binary, for any purpose, commercial or non-commercial, and by any means. Apart from the source code, all other configuration files, calibration/validation procedures etc., that are required for the successful setup of EF5 for the state of Florida, were developed by the modeling organization.

The pluvial model was developed independently of the FPFLM project by Dr. Cocke, but he has granted permission to the project to use the flood model output for its purposes and allow the code to be reviewed, and will coordinate any changes in the model code as needed. Software to process inland flood model outputs, such as interpolating flood depths or elevation to property locations, were developed by model organization personnel.

C. If the flood model is developed by an entity other than the modeling organization, describe the funding source for the development of the flood model.

The model was funded by the state legislature at the request of the Florida Office of Insurance Regulation.

D. Describe any services other than flood modeling provided by the modeling organization.

The modeling organization provides hurricane wind loss modeling service.

E. Indicate if the modeling organization has ever been involved directly in litigation or challenged by a governmental authority where the credibility of one of its U.S. flood model versions for projection of flood loss costs or flood probable maximum loss levels was disputed. Describe the nature of each case and its conclusion.

None.

2. Professional Credentials

A. Provide in a tabular format (a) the highest degree obtained (discipline and university), (b) employment or consultant status and tenure in years, and (c) relevant experience and responsibilities of individuals currently involved in the acceptability process or in any of the following aspects of the flood model:

1. Meteorology
2. Hydrology and Hydraulics
3. Statistics
4. Vulnerability
5. Actuarial Science
6. Computer/Information Science

Table 11. Professional credentials.

Key Personnel	Degree/ Discipline	University	Employment Status	Tenure	Experience
Meteorology					
Dr. Steve Cocke	Ph.D. Physics	Univ. Texas Austin	Scholar/Scientist FSU, Dept of Meteorology	28	Meteorology track, intensity, roughness models, pluvial flood
Dr. Dongwook Shin	Ph.D. Meteorology	Florida State University	FSU/COAPS, Associate Research Scientist	23	Meteorology, pluvial flood
Dr. Bachir Annane	M.S. Meteorology, M.S. Mathematics	Florida State University	Meteorologist, Univ. of Miami	30	Meteorology
Coastal Flood					
Dr. Yuepeng Li	Ph. D. Marine Science	The College of William and Mary	Senior Research Scientist Extreme Event Inst. FIU	20	Storm Surge, coastal flooding, marine science, remote sensing, water quality
Dr. Keqi Zhang (deceased)	Ph. D. Marine Science	University of Maryland	Professor of Earth and Environment, FIU	23	Lidar, Storm Surge, coastal flooding, marine science
Dr.Andrew Kennedy	Ph.D. Mechanical Engineering	Monash Univ., Australia	Professor, Dept. of Civil & Environmental Engineering & Earth Sciences	16	Waves, Surge, Coastal Science & Engineering
Dr. Qiang Chen	PhD Civil Eng,	University of Bath UK	Coastal Research Specialist, EEI at FIU	5	Storm surge, coastal flooding, coastal engineering, wave

Key Personnel	Degree/ Discipline	University	Employment Status	Tenure	Experience
Peng Hou	MS Computer Science	Florida International University	Research Specialist, EEI at FIU	10	Computer Scientist
Inland Flood					
Dr. Efthymios Nikolopoulos	Ph.D. in Env. Engineering	University of Connecticut	Associate Professor, Civil and Environmental Engineering, Rutgers University	13	Hydrology and hydrologic modeling
Dr. Steve Cocke	Ph.D. Physics	Univ. Texas Austin	Scholar/Scientist FSU, Dept of Meteorology	28	Meteorology track, intensity, roughness models, pluvial flood
Dr. Dongwook Shin	Ph.D. Meteorology	Florida State University	FSU/COAPS, Associate Research Scientist	23	Meteorology, pluvial flood
Dr. Humberto Vergara	Ph.D. in Civil Engineering	University of Oklahoma	Assistant Professor, Civil and Environmental Engineering, University of Iowa	8	Hydrologic and hydraulic modeling
Dr. Marika Koukoula	Ph.D. in Env. Engineering	University of Connecticut	Research Scientist, University of Lausanne, Switzerland	3	Hydrologic modeling
Zimeena Rasheed	M.S. in Civil Engineering	Florida Institute of Technology	Doctoral student, Civil and Environmental Engineering, Rutgers University	4	Hydrology and hydrologic modeling
Statistics					
Dr. Sneh Gulati	Ph.D. Statistics	University of South Carolina	Professor, Statistics , FIU	33	Served on the Florida Commission on Hurricane Loss Projection Methodology 2000 –2008; Statistician for Florida Public Hurricane Loss Model (FPHLM)
Dr. B. M. Golam Kibria	Ph.D. Statistics	University of Western Ontario	Professor of Statistics, FIU	24	Statistician for Florida Public Hurricane Loss Model (FPHLM) since 2006
Dr. Wensong Wu	Ph.D. Statistics	University of South Carolina	Associate Professor, Statistics, FIU	13	Statistician for Florida Public Hurricane Loss Model (FPHLM) since 2015
Engineering					

Key Personnel	Degree/ Discipline	University	Employment Status	Tenure	Experience
Dr. Jean-Paul Pinelli	Ph.D. Civil Engineering	Georgia Tech	Professor, CE Florida Institute of Technology	29	Vulnerability model development
Dr. Kurt Gurley	Ph.D. Civil Engineering	University of Notre Dame	Professor, University of Florida	25	Vulnerability model development
Dr. Andres Paleo-Torres	PhD Civil Eng.	University of Florida	Currently Associate Director, Impact Forecasting, AON	8	Vulnerability model development
Christian Bedwell	BS Civil Engineering	Florida Institute of Technology	Ph.D. Candidate in Civil Engineering, University of Florida	4	Vulnerability model development
Dr. Mohammad Baradaran Shoraka	PhD Civil Engineering	Florida Institute of Technology	Currently Senior Research Engineer, Verisk	8	Vulnerability model development
Actuarial/Finance					
Dr. Shahid Hamid Project Manager, PI	Ph.D. Economics (Financial), CFA	University of Maryland	Professor of Finance Florida International University	36	Insurance and finance
Gail Flannery	FCAS, Actuary	CAS	VP, AMI Risk Consultants	39	Reviewer, demand surge, actuarial analysis
Aguedo Ingco	FCAS, Actuary	CAS	President, AMI Risk Consultants	49	Reviewer, demand surge
Joeffrey Somera	B.S Chemical Engineering	University of the Philippines	Actuarial Analyst, AMI Risk	5	Actuarial Analysis
Computer Science					
Dr. Shu-Ching Chen	Ph.D. Electrical and Computer Engineering	Purdue University	Professor of Computer Science, University of Missouri Kansas City	24	Software and database development
Dr. Mei-ling Shyu	Ph.D. Electrical and Computer Engineering	Purdue University	Professor of Electrical and Computer Engineering, University of Missouri Kansas City	24	Software quality assurance
Dr. Tianyi Wang	Ph.D. Computer Science	University of Missouri Kansas City	Computer Scientist, Extreme Event Institute, FIU	7	Software and database development
Numuun Lkhagvadorj	BBA	National University of Mongolia	MS student at University of Missouri Kansas City	1	Software and database development
Ayushman Das	BSc Computer Science	University of Missouri Kansas City	PhD Candidate Computer Science, University of Missouri Kansas City	3	Software and database development
Odai Athamneh	BSc Computer Science	University of Missouri Kansas City	PhD Candidate Computer Science, University of Missouri Kansas City	3	Software and database development

B. Provide visual business workflow documentation connecting all personnel related to flood model design, testing, execution, maintenance, and decision-making.

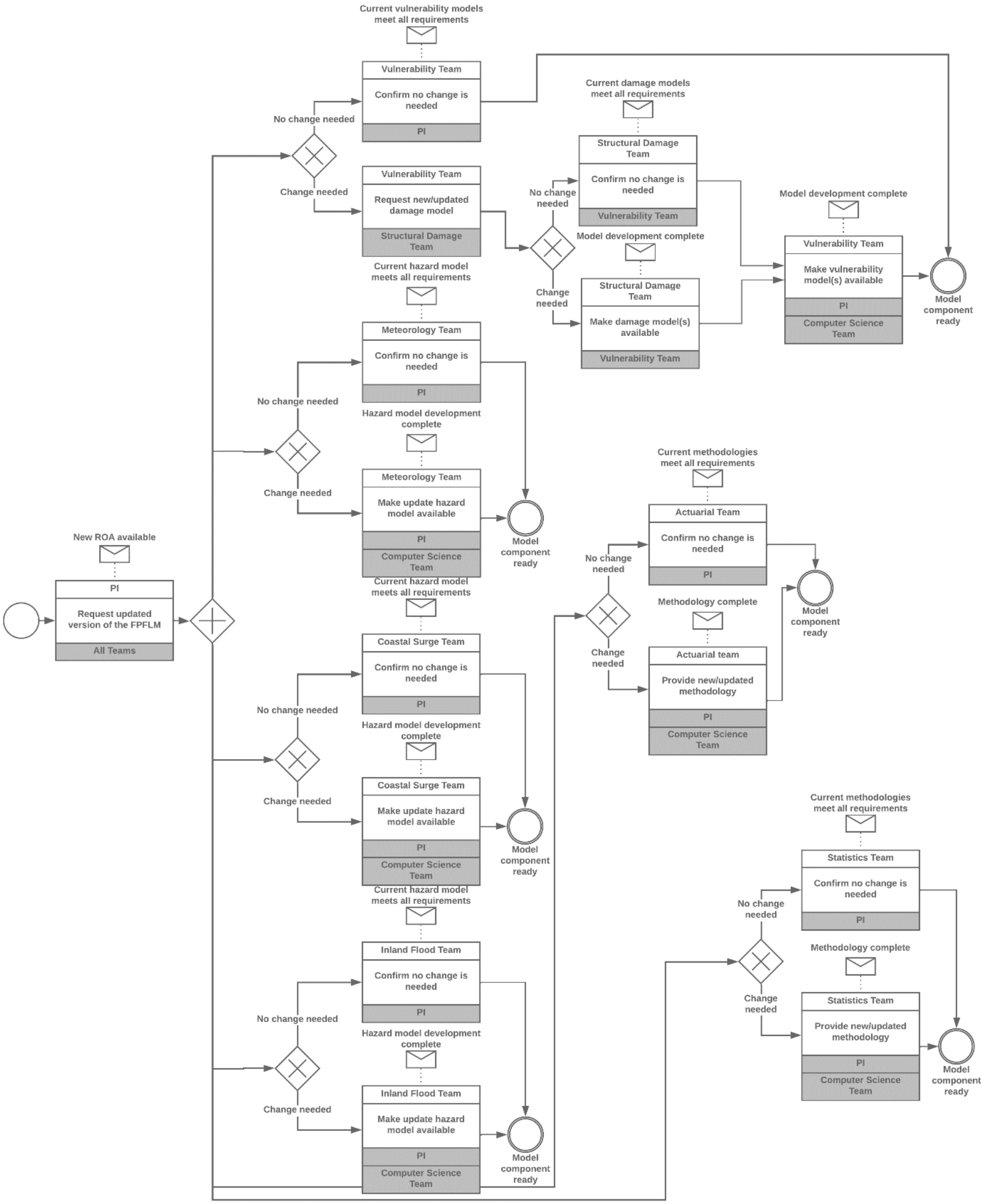


Figure 28. Florida Public Flood Loss Model workflow – Part 1

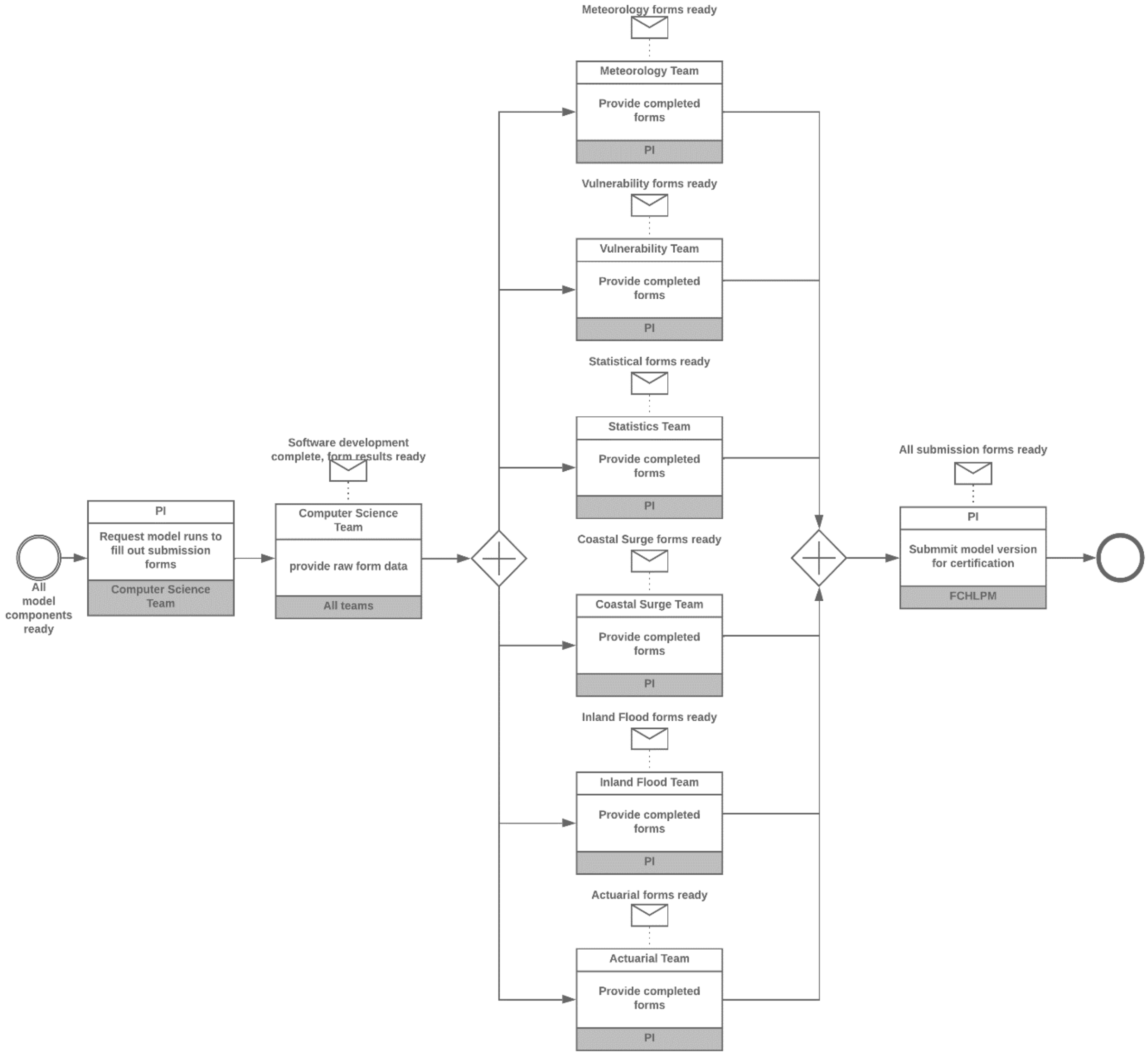


Figure 29. Florida Public Flood Loss Model workflow – Part 2

3. Independent Peer Review

A. Provide reviewer names and dates of external independent peer reviews that have been performed on the following components as currently functioning in the flood model:

1. Meteorology

The peer review for the meteorology component was provided by Dr. Gary Barnes, professor of meteorology at University of Hawaii in 2007. The current version was reviewed by modeler personnel.

The peer review for the coastal flood model was provided in February 2020 by Arthur Taylor, Physical Scientist and SLOSH modeling POC, NOAA, NWS, Meteorological Development Lab.

The coastal flood model (CEST) was also reviewed by National Hurricane Center of NOAA in March 2020 and accepted for use in its operation and flood forecast.

2. Hydrology and Hydraulics

The inland flood components were reviewed by the modeler personnel.

3. Statistics

The statistical components were reviewed by the modeler personnel.

4. Vulnerability

The vulnerability components were reviewed by the modeler personnel.

5. Actuarial Science

Gail Flannery FCAS, and Aguedo Ingco, FCAS, actuaries and vice president and president, respectively, of AMI Risk Consultants in Miami, performed the external review of the actuarial component and submission. Gail Flannery was also involved in the development of the demand surge model and the residential model.

6. Computer/Information Science

The computer/information components were reviewed by the computer/information personnel.

B. Provide documentation of independent peer reviews directly relevant to the modeling organization responses to the flood standards, disclosures, or forms. Identify any unresolved or outstanding issues as a result of these reviews.

The written independent reviews by Arthur Taylor and Gary Barnes, and Gail Flannery are presented in the appendix. No unresolved outstanding issues remain after the review. The letter from National Hurricane Center of NOAA is also included in the appendix.

C. Describe the nature of any on-going or functional relationship the modeling organization has with any of the persons performing the independent peer reviews.

Arthur Taylor and Gary Barnes have no on-going or functional relationship to FIU or the modeling organization, other than as an independent reviewer. They did not take part in the development or testing of the model.

4. Provide a list of rating agencies and insurance regulators that have reviewed the flood model. Include the dates and purpose of the reviews.

None.

5. Provide a completed Form GF-1, General Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

See Form GF-1.

6. Provide a completed Form GF-2, Meteorological Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

See Form GF-2.

7. Provide a completed Form GF-3, Hydrological and Hydraulic Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

See Form GF-3.

8. Provide a completed Form GF-4, Statistical Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

See Form GF-4.

9. Provide a completed Form GF-5, Vulnerability Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

See Form GF-5.

10. Provide a completed Form GF-6, Actuarial Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

See Form GF-6.

11. Provide a completed Form GF-7, Computer/Information Flood Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

See Form GF-7.

GF-3 Insured Exposure Location

A. ZIP Codes used in the flood model shall not differ from the United States Postal Service publication date by more than 48 months at the date of submission of the flood model. ZIP Code information shall originate from the United States Postal Service.

The FPFLM uses ZIP Code data exclusively from a third-party developer, which bases its information on the ZIP Code definitions issued by the United States Postal Service. The version we used has a USPS vintage of July 2022.

B. Horizontal location information used by the modeling organization shall be verified by the modeling organization for accuracy and timeliness and linked to the personal residential structure where available. The publication date of the horizontal location data shall be no more than 48 months prior to the date of submission of the flood model. The horizontal location information data source shall be documented and updated.

The FPFLM uses commercial software to geo-locate the personal residential structures, and it was verified for accuracy and timeliness.

C. If any flood model components are dependent on databases pertaining to location, a logical process shall be maintained for ensuring these components are consistent with the horizontal location database updates.

The exposure locations depend on the geocoding engine listed in Disclosure 1. No other components of the flood model depend on a horizontal location database.

D. Geocoding methodology shall be justified.

The FPFLM uses an enterprise class geocoding engine for converting street addresses to latitude and longitude values.

E. Use and conversion of horizontal and vertical projections and datum references shall be consistent and justified.

For the surge model CEST, the horizontal locations of data are all converted to the UTM system "NAD_1983_UTM_Zone_17N" within the model, using the open-source Proj4 C++ code that originated from the U.S. Army Topographic Engineering Center. The vertical elevation data are all converted to NAVD88 if needed, using the tool Vertcon 2.1 developed by NOAA.

The inland model uses well-known horizontal and vertical projections, such as WGS 84 and NAVD88. Widely used peer-reviewed tools are used as needed if any conversion is required, such as the commonly used GDAL tools.

Disclosures

1. List the current location databases used by the flood model and the flood model components to which they relate. Provide the effective dates corresponding to the location databases.

The Insured Loss Module of the FPFLM uses two location databases: The U.S. ZIP Code Database from zip-codes.com effective July 2022 and the Esri StreetMap Premium North America locators effective May 2023.

2. Describe in detail how invalid ZIP Codes, parcels, addresses, and other location information are handled.

When a valid street address or coordinates are not available for an exposure, the policy is not modeled. Clients are notified of unmodeled policies because of missing location information.

Invalid ZIP Codes are corrected using the value returned by the geocoding engine provided that the street address of the exposure is valid.

3. Describe any methods used for subdividing or disaggregating the location input data and the treatment of any variations for populated versus unpopulated areas.

The FPFLM does not subdivide or disaggregate the location input data.

4. Describe the data, methods, and process used in the flood model to convert between street addresses and geocode locations (latitude-longitude).

The FPFLM uses the REST API of the ArcGIS Server with the ESRI StreetMap Premium for ArcGIS locators to geocode street addresses. A request containing the given street address, city, state, and ZIP Code is sent to the server. The server processes the request and sends a response containing the status, the location, and the standardized address. The location and address fields of the response are empty when the status is unmatched.

5. Describe the use of geographic information systems (GIS) in the process of converting among street address and geocode locations, and the generation of insured exposure locations.

The FPFLM uses the GIS software tool mentioned above to convert street addresses of exposure locations to longitude and latitude.

6. List and provide a brief description of each database used in the flood model for determining geocode location.

The ESRI StreetMap Premium North America locators data files include all necessary information for determining geocode locations.

7. Describe the process for updating flood model geocode locations as location databases are updated.

The locators data files are downloaded from the vendor and updated annually.

8. Describe in detail the methods by which ground elevation data at the insured exposure location (e.g., building) is associated with the location databases and how this associated data is used in the flood model.

The geocoded latitude and longitude of the exposure are used to extract the ground elevation from a high resolution (5 m) lidar-based DEM using standard GIS tools using nearest neighbor approach. The coastal surge, riverine and pluvial flood components of the model produce a flood elevation (using NAVD88 datum) in the vicinity of the property location from which the ground elevation is subtracted in order to obtain the flood depth.

For the wave model, all building locations have a latitude and longitude associated with them. These locations in the exposure dataset are mapped onto corresponding grid locations in the wave model, or to a null grid if they are not in the wave grids (e.g. inland flooding). The grid locations are then saved to a file, and each location is queried for each run of the wave model to determine wave properties at the insured location.

9. For each parameter used in the flood model, provide the horizontal and vertical projections and datum references, if applicable. If any horizontal or vertical datum conversions are required, provide conversion factors and describe the conversion methodology used.

For the surge model CEST, the horizontal locations of the data are all converted to the UTM system "NAD_1983_UTM_Zone_17N" within the model, using the open-source Proj4 C++ code that originated from U.S. Army Topographic Engineering Center. The vertical elevation data are all converted to NAVD88 if needed, using the tool Vertcon 2.1 developed by NOAA.

Vertical datum: NAVD 88
The property elevation data are all converted to NAVD88. For example, if the vertical datum of DEM or bathymetry data are National Geodetic Vertical Datum of 1929 (NGVD 29), the tool Vertcon 2.1 is used to compute the difference in orthometric height between the North American Vertical Datum of 1988 (NAVD 88) and the National Geodetic Vertical Datum of 1929 (NGVD 29) for a given location specified by latitude and longitude. This tool is developed by NOAA, and can be downloaded from https://www.ngs.noaa.gov/PC_PROD/VERTCON/.

Horizontal projection:
GCS_North_American_1983
SPHEROID: "GRS_1980", 6378137.0, 298.257222101,
PRIMEM: "Greenwich", 0.0,
UNIT: "Degree", 0.0174532925199433

The STWAVE model runs in (x,y) meters coordinates. Each point on the STWAVE grids is converted into geographical space with coordinates latitude, longitude (both NAD83), and elevation (NAVD88) using Matlab coordinate transformation routines. Topography, bathymetry, Manning’s n and all other appropriate properties are determined in geographic coordinates at the grid locations, and then used in the model.

The riverine and pluvial models use geographic projection of WGS84 for the horizontal and NAVD88 vertical datum. For the riverine model, all flood model parameters that are spatially distributed were at 3 arc-sec spatial resolution with the horizontal datum World Geodetic System 1984 (WGS84) and the North America Vertical Datum of 1988 (NAVD88).

GF-4 Independence of Flood Model Components

The meteorology, hydrology and hydraulics, vulnerability, and actuarial components of the flood model shall each be theoretically sound without compensation for potential bias from other components.

The meteorology, coastal surge, hydrology, vulnerability, and actuarial components of the model are theoretically sound and were developed independently before being integrated. The model components were tested individually.

GF-5 Editorial Compliance

The flood model submission and any revisions provided to the Commission throughout the review process shall be reviewed and edited by a person or persons with experience in reviewing technical documents who shall certify on Form GF-8, Editorial Review Expert Certification, that the flood model submission has been personally reviewed and is editorially correct.

The current submission document has been reviewed and edited by persons who are qualified to perform such tasks. Future revisions and related documentation will likewise be reviewed and edited by the qualified individual listed in Form GF-8.

Disclosures

1. Describe the process used for document control of the flood model submission. Describe the process used to ensure that the paper and electronic versions of specific files are identical in content.

All submission document revisions are passed to the Editor prior to inclusion in the document. The editor is responsible for the electronic version of the document and the technical software issues. Several Microsoft Word tools are utilized to automate the process of formatting and editing the document. For example, we used the consistent formatting via styles for standards, forms and disclosures, cross-references to cite figures and tables, and multi-level lists to ensure consistent numbering. In addition, Microsoft Word's track changes tool is used to keep track of modifications to the document since the initial submission. An export filter to PDF format is used to export the document directly to PDF format, which subsequently is printed directly to paper via a printer. The PDF and printed document should be identical barring unforeseen bugs in the PDF export plug-in or PDF printing software.

2. Describe the process used by the signatories on the Expert Certification Forms GF-1 through GF-7 to ensure that the information contained under each set of flood standards is accurate and complete.

Each signatory was responsible for doing a final review of the standards related to their expertise prior to submission to verify the accuracy and completeness of the information in the submission document. A technical editor performs a thorough edit of the document. All signatories were required to proof-read a PDF version of the document to ensure accuracy and completeness. On-site meetings were held to perform a thorough review of the final version of the document.

3. Provide a completed Form GF-8, Editorial Review Expert Certification. Provide a link to the location of the form [insert hyperlink here].

See Form GF-8.

METEOROLOGICAL FLOOD STANDARDS

MF-1 Flood Event Data Sources

A. The modeling of floods in Florida shall involve meteorological, hydrological, hydraulic, and other relevant data sources required to model coastal and inland flooding.

The flood model uses a large volume of meteorological, hydrological, hydraulic and other relevant data sources to estimate potential coastal and inland flooding.

B. The flood model shall incorporate relevant data sources in order to account for meteorological, hydrological, and hydraulic events and circumstances occurring either inside or outside of Florida that result in, or contribute to, flooding in Florida.

The coastal surge model CEST simulates the coastal surge induced by hurricanes making landfall along or near the Florida coastal region. In other words, even if the hurricanes made landfall at George or Louisiana, the CEST model still can simulate the surge induced by hurricane wind along the Florida coastal region.

For the riverine model, the hydrological basins extend into neighboring states to account for upstream flow that may enter the Florida region.

C. Coastal and inland flood model calibration and validation shall be justified based upon historical data consistent with peer reviewed or publicly developed data sources.

For the coastal flooding team, there are three types of data used to calibrate and validate the coastal surge model. First is water elevation time series data (https://tidesandcurrents.noaa.gov/) along the Florida coastal region. The water elevation data was directly downloaded from National Oceanic and Atmospheric Administration (NOAA), Units: Meters, Timezone: GMT, Datum: MSL, Interval 1 hour or 6 min (if available). Second is the High Water Mark (HWM) data, the reports, published by United States Geological Survey (USGS) or Federal Emergency Management Agency (FEMA) related to each historical hurricane required by standards, are extracted or digitalized. For the High Water Mark (HWM) data, data above NAVD88 are used. Third is the Inundation maps or debris line, (https://www.fema.gov/hurricane-ivan-surge-inundation-maps).

The riverine flood model has been calibrated and validated against historical observations of hourly streamflow data obtained from USGS.

D. Any trends, weighting, or partitioning shall be justified and consistent with current scientific and technical literature.

We conduct no trending, weighting, or partitioning.

Disclosures

1. Specify relevant data sources, their release dates, and the time periods used to develop and implement flood frequencies for coastal and inland flooding into the flood model.

For the coastal flooding team, the flood control measures information is collected from different federal and state agents, U.S. Army Corps of Engineers, Federal Emergency Management Agency, from National Oceanic and Atmospheric Administration, and Florida Division of Emergency Management.

For the historical hurricanes data, the following reports are used to calibrate or validate the coastal surge model:

- Mitchell H. Murray (1992). Storm-Tide Elevations Produced by Hurricane Andrew Along the Southern Florida Coasts. U.S Geological Survey Open-File Report 96-116.
- Michael Baker Jr., Inc. Alexandria, VA (1995). Hurricane Opal Florida Panhandle Wind and Water Line Survey.
- U.S. Army Corps of Engineers, Mobile District, Coastal, Hydrology, and Hydraulic Design Section in cooperation with the United States Geological Survey; Alabama, Florida, and Mississippi Districts (1998). Hurricane Georges Storm Surge September.
- U.S. Army Corps of Engineers Jacksonville District (1998). South Florida High Water Marks – Post Georges.
- U.S. Department of Commerce National Ocean Service Center for Operational Products and Services (2004). Hurricane CHARLEY Preliminary Water Levels Report.
- URS Group, Inc. 200 Orchard Ridge Drive Suite 101 Gaithersburg, MD 20878 (2005). Hurricane Frances Rapid Response Florida Coastal High Water Mark (CHWM) Collection FEMA-1545-DR-FL.
- NOAA National Oceanic and Atmospheric Administration (2004). Hurricane FRANCES Preliminary water Levels report.
- Mobile District Engineering Division Hydrology and Hydraulics Branch (2004). Tide Gage Data for Hurricane Ivan.
- NOAA National Oceanic and Atmospheric Administration (2004). Hurricane IVAN Preliminary Water Levels Report.
- URS Group, Inc. 200 Orchard Ridge Drive Suite 101 Gaithersburg, MD 20878 (2004). Hurricane Ivan Rapid Response Alabama and Mississippi Coastal High Water Mark (CHWM) Collection FEMA-1549-DR-AL & 1550-DR-MS.
- URS Group, Inc. 200 Orchard Ridge Drive Suite 101 Gaithersburg, MD 20878 (2004). Hurricane Ivan Rapid Response Florida Coastal High Water Mark (CHWM) Collection FEMA-1551-DR-FL.
- URS Group, Inc. 200 Orchard Ridge Drive Suite 101 Gaithersburg, MD 20878 (2004). Hurricane Jeanne Rapid Response Florida Riverine High Water Mark (RHWM) Collection FEMA-1561-DR-FL.
- NOAA National Oceanic and Atmospheric Administration (2004). Hurricane Jeanne Preliminary Water Levels Report.
- RS Group, Inc. 200 Orchard Ridge Drive Suite 101 Gaithersburg, MD 20878 (2004). Hurricane Dennis Rapid Response Florida Coastal High Water Mark (CHWM) Collection FEMA-1595-DR-FL.

- NOAA National Oceanic and Atmospheric Administration (2005). Hurricane Dennis Preliminary Water Levels.
- Mark E. Luther, Clifford R. Merz, Jeff Scudder, Stephen R. Baig, LT Jennifer Pralgo, Douglas Thompson, Stephen Gill & Gerald Hovis (2007). Water Level Observations for Storm Surge.
- URS Group, Inc. 200 Orchard Ridge Drive Suite 101 Gaithersburg, MD 20878 (2006). Final Coastal High Water Mark Collection for Hurricane Wilma in Florida FEMA-1609-DR-FL, Task Order 460.
- NOAA National Oceanic and Atmospheric Administration (2005). Hurricane Wilma Preliminary Water Levels Report.
- Thomas J. Smith III, Gordon H. Anderson, and Ginger Tiling (2005). A Tale of Two Storms: Surges and Sediment Deposition from Hurricanes Andrew and Wilma in Florida's Southwest Coast Mangrove Forests.
- Lars E. Soderqvist and Michael J. Byrne (2005). Monitoring the Storm Tide of Hurricane Wilma in Southwestern Florida.

Inland flood model data sources with release dates and time periods are tabulated below:

Table 12. Inland flood model data sources.

Data type	**Data source**	**Release date**	**Time periods used**
Elevation	USGS National Elevation Dataset	2020	1992-2022
Rainfall	PRISM	1992 – 2020	1992 – 2022
	Mosaic NEXRAD (MRMS Reanalysis)	2018	2004 - 2013
	MRMS – Current	2016 – 2020	2016 – 2022
	NOAA Atlas 14 Intensity-Duration	2013	
Potential Evapotranspiration (ET)	https://github.com/HyDROSLab/EF5-US-Parameters/tree/master/PET	2020	1992-2022
Percent Imperviousness	MRLC Impervious Cover 2016	2018	2015-2017
Soil properties	Global Hydrological Soil Groups 1566 (HYSOGs250m)	2018/2020	2017
Streamflow	U.S. Geological Survey	2004-2017	2004-2017
Water Level			
LULC	MRLC NLCD 2016	2018	2015-2017

References:

- Dr. Jian Zhang and Dr. Jonathan Gourley. (2018). *Multi-Radar Multi-Sensor Precipitation Reanalysis (Version 1.0)*. Open Commons Consortium Environmental Data Commons. https://doi.org/10.25638/EDC.PRECIP.0001

- Zhang, Jian et al. (2016). MULTI-RADAR MULTI-SENSOR (MRMS) QUANTITATIVE PRECIPITATION ESTIMATION Initial Operating Capabilities. 97(4). https://doi.org/10.1175/bams-d-14-00174.1
- PRISM Climate Group, Oregon State University, https://prism.oregonstate.edu, data created 1992-2020, accessed 2021-2023.

2. Where the flood model incorporates modification, partitioning, or adjustment of the historical data leading to differences between modeled climatological and historical data, justify each modification and describe how it is incorporated.

The model does not incorporate any modifications, partitioning or adjustments that lead to differences between modeled climatological and historical data.

3. Describe how historical sea-level rise is treated in the flood model validation. If sea-level rise is not used in flood model validation, justify its omission.

The validation of the model is based on relatively recent events, where differences in sea level relative to the current sea level are not expected to be large.

4. Describe if and how future projected sea-level rise is treated in the flood model.

The model does not incorporate projected sea level rise.

5. Describe any assumptions or calculations used in the flood model relating to future conditions (e.g., changes in precipitation patterns, changes in storm frequency or severity).

The model does not make any assumptions or calculations based on projected future conditions.

6. Describe if and how historical changes in topography, bathymetry, and land use land cover are treated in the flood model validation.

Currently, any historical changes in topography, bathymetry or land use land cover are not taken into account in flood model validation.

7. If precipitation is explicitly modeled for either inland or coastal flooding, then describe the underlying data and how they are used as inputs to the flood model.

Rain is explicitly modeled using a rain model as described in Standard GF-1.2. The modeled rain rates are based on a regression against TRMM satellite rainfall estimates and are a function of the maximum intensity of the storm at a given point in time and distance to the center of the storm. Hourly estimated rainfall is produced by the rain model using historical or stochastic track information.

8. Provide citations to all data sources used to develop and support bottom friction for storm surge modeling, including publicly developed or peer reviewed information.

- Mattocks, C., & Forbes, C. (2008). A real-time, event-triggered storm surge forecasting system for the state of North Carolina. *Ocean Modelling, 25*, 95-119

- Zhang, K., Li, Y., Lui, H., Rhome, J., & Forbes, C. (2013). Transition of the Coastal and Estuarine Storm Tide Model to an operational forecast model: A case study of Florida. *Weather and Forecasting, DOI:10.1175/WAF-D-12-00076.1*

- Zhang, K., Liu, H., Li, Y., Xu, H., Shen, J., Rhome, J., & Smith III, T.J. (2012b). The role of mangroves in attenuating storm surges. *Estuarine, Coastal, and Shelf Science*, *102-103*, 11-23

9. State whether the model includes flooding other than coastal and inland flooding. State whether the other flooding types are independent of the minimum required sub-perils of coastal and inland flooding.

The model does not include flooding other than coastal or inland flooding.

MF-2 Flood Parameters (Inputs)

A. The flood model shall be developed with consideration given to flood parameters that are scientifically appropriate for modeling coastal and inland flooding. The modeling organization shall justify the use of all flood parameters based on information documented in current scientific and technical literature.

The coastal surge model CEST includes several parameters, such as surface wind drag, bottom Manning's Coefficient, parameters and equations to calculate tidal elevation at open boundary, and other parameters. All these parameters are from the scientific and technical literature. All the detailed information is presented at GF-1 and disclosures of MF-1 and MF-2.

The inland models include parameters that are well established in the literature to be related to flooding, including, either explicitly or implicitly but not limited to, soil infiltration, impervious cover, terrain roughness, and terrain slope. In addition, the models take into account important characteristics of the inputs, primarily the time evolution of precipitation and initial conditions.

B. Differences in the treatment of flood parameters between historical and stochastic events shall be justified.

In order to keep the consistency of the historical and stochastic events, all the parameters in the coastal surge model CEST are the same. In other words, there is no difference of surface drag, bottom friction, depth, elevation, or other parameters between historical and stochastic events.

The same inland flood model parameters were used for both the historical and stochastic events.

C. Grid cell size(s) used in the flood model shall be justified.

For the coastal flooding model, there are three sets of basins with different grid cell sizes are established for coastal surge model covering the whole Florida region: (1) West Florida basin (WF1) majorly covers the north and west Florida coastal area, (2) South Florida basin (SF1) majorly covers the south Florida coastal area and Keys, (3) North Florida basin (NF1) covers the North-East Florida coastal area.

Through calibrations and verifications for different cell sizes, the medium grid cell size (300 – 500 meters along the coastline) is the optimal choice considering both accuracy and computational efficiency. The detailed basin description and statistics are presented in Disclosure 12.

The grid resolution for the wave model is 40 meters, which was selected due to the resolution of data available. The coastal bathymetry data is 3 arc second data which is approximately 90 meter resolution and the onshore data was 1/3 arc second or 10 meter resolution. Therefore, higher resolution onshore is possible, yet would not be necessary for resolving the offshore features considering the input conditions to also be coarser. Sensitivity tests were performed using 20m resolution data, and the results were almost identical to those using the 40m resolution. Because a 20m model would take 4 times longer to run, and the wave model already takes weeks to run the entire stochastic system.

Disclosures

1. For coastal and inland flood model components, identify and justify the various flood parameters used in the flood model.

Surface wind drag

The CEST model uses C_s the drag coefficient which is calculated using the modified formula of Large and Pond (1981) based on Powell et al. (2003).

$$C_s = \begin{cases} 0.00114 & \sqrt{U_a^2 + V_a^2} \le 10 \\ (0.49 + 0.0065\sqrt{U_a^2 + V_a^2})10^{-3} & 10 < \sqrt{U_a^2 + V_a^2} \le 38 \\ 0.003 & \sqrt{U_a^2 + V_a^2} > 38 \end{cases} \qquad \text{(MF2-1)}$$

Calculation of Manning's Coefficients Using Land Cover Data

The CEST model uses the Chezy formula (LeMehaute 1976; Zhang et al. 2012b) with a Manning's roughness coefficient to calculate bottom stresses. The Manning's coefficients for ocean grid cells are computed by an empirical formula based on the water depth (H):

$$n_w = \begin{cases} 0.02 & 0 < H < 1\,(\mathrm{m}) \\ 0.01/H + 0.01 & H \ge 1 \end{cases} \qquad \text{(MF2-2)}$$

or set up to be constants, e.g.,

$$n_w = C \qquad \text{(MF2-3)}$$

where C ranges from 0.01 to 0.03. For three Florida basins, C = 0.015 on the water cell is used. Manning's coefficients for grid cells over the land were estimated according to the 2006 national land cover dataset (NLCD) created by the U.S. Geological Survey (USGS) (Fry et al. 2011). A modified table of Manning's coefficients (Table 1) corresponding to different land cover categories proposed by Mattocks and Forbes (2008) was employed in this study. Since the spatial resolution of NLCD is 30 m which is usually smaller than the cell size of a CEST grid, an average Manning's coefficient (n_a) for a grid cell was calculated using

$$n_a = \frac{\sum_{i=1}^{N}(n_i\alpha) + n_w\beta}{N\alpha + \beta} \qquad \text{(MF2-4)}$$

where n_i is the Manning's coefficient value of a NLCD pixel within a model grid cell, α is the area of a NLCD pixel, N is the total number of NLCD pixels within a model cell, n_w is the Manning's coefficient for the oceanic area β that are not covered by NLCD pixels.

The only adjustable parameter in the wave model is the Manning's n coefficient. These are taken from the NCLD 2011 database. Land use/land cover values are converted into Manning's n following Bunya et al. (2010).

The inland flood model parameters include:

Table 13. List of parameters for the pluvial and riverine model.

Pluvial model parameters	**Description**
soil moisture	Used for defining initial soil moisture conditions
soil infiltration rates	Used for defining the infiltration rate for each soil type
Manning Coef.	Manning's roughness coefficient, based on LULC
Impervious Cover	Used for defining the fraction of impervious area
Vegetative Cover	Used for defining the fraction of vegetative area
Soil Type	Used for defining soil type which is important for infiltration rate
Riverine model parameters	**Description**
W_m	Water capacity of soil
F_c	Saturated hydraulic conductivity
b	Exponent parameter of the variable infiltration curve that controls surface runoff generation
I_m	Percentage impervious area
K_e	Factor for converting potential evapotranspiration to actual
I_{wu}	Percentage of initial soil saturation

2. For coastal and inland flood model components, describe the dependencies among flood model parameters and specify any assumed mathematical dependencies among these parameters.

There are no dependencies among the parameters of the coastal and inland flood model components.

3. For coastal and inland flood model components, describe the dependencies that exist among the flood model components.

There is no direct interaction between coastal and inland flood model components. The coastal and inland flood model components are performed on different grids. If the same locations are both flooded by coastal and inland components, the component with maximum inundation depth will be used.

Wave properties do not affect wind, surge, or inland flood properties. Wave properties rely on surge levels, local bathymetry and topography, winds, and land cover.

4. Identify whether physical flood parameters are modeled as random variables, functions, or fixed values for the stochastic flood event generation. Provide rationale for the choice of parameter representations.

All the coastal surge model parameters are from scientific literature and technical reports. They are mostly fixed values or calculated from equations presented in the supporting literature. All the values and equations are presented in Section GF-1, MF-1, and MF-2.

The inland flood model parameters are fixed values for the stochastic flood event generation or are a function of the model state variables.

The meteorological variables, in particular the storm tracks, and wind field characteristics (radius of maximum winds and Holland pressure profile parameter) are modeled as random variables in the Florida Public Hurricane Loss Model, which is used to provide input to the flood loss model for coastal and inland flood losses. A full description of these meteorological variables is available in the FPHLM submission documents that are available on the SBA web site.

5. Describe if and how any physical flood parameters are treated differently in the historical and stochastic flood event sets, and provide rationale.

In the flood models the same physical parameters were used for the historical and stochastic flood events.

6. If there is explicit modeling of precipitation-driven flooding, then describe how rainfall extent, duration, and rate are modeled. If the effects of precipitation are implicitly incorporated into the flood model, describe the method and implementation.

The rain model uses the R-CLIPER rain algorithm which determines the rainfall extent and rain rate for a target location. Rainfall duration is included since the rain model incorporates track motion information obtained from the input track file. More details on the rain model can be found in Standard GF-1.2.

7. For coastal flood analyses, describe how the coastline is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

There are a total of 3 sets of basins established for the storm surge simulation covering the whole coastal area of Florida (Figure 11):

1. West Florida basin (WF1) mainly covers the north and west Florida coastal area;
2. South Florida basin (SF1) mainly covers the south Florida coastal area and Keys;
3. North Florida basin (NF1) covers the North-East Florida coastal area.

The overlap area of the above three set basins is relatively large, sometimes even half of the basin area. This ensures that there is sufficient resolution over the entire modeled region, including the overlapping regions.

For the wave model, 116 subgrids were partitioned around the state in areas likely to be impacted by wave action, including open coasts, inlets, bays, and wetlands. Areas not likely impacted by substantial wave action were not modeled for waves.

8. For coastal flooding, describe how astronomical tides are incorporated and combined with storm surge to obtain storm tide.

In the tide simulation, a Dirichlet-type (clamped) condition is generally used at the open boundary, where the surface elevation is set to the specific known value as follows:

$$\zeta = \hat{\zeta} \qquad \text{(MF2-5)}$$

where the right-hand side is elevation specified at the open boundary.

In the case of including astronomical tide simulation, initial transients are damped by bottom friction and there are no internal flows driven by atmospheric or wind forcing (Bills, 1991). As an open boundary condition for tide elevation, the equilibrium tidal potential is expressed as follows (Reid,1990):

$$\zeta(\phi,\lambda,t) = \sum_{n,j} C_{jn} f_{jn}(t_0) L_j(\phi) \cos\left[\frac{2\pi(t-t_0)}{T_{jn}} + j\lambda + v_{jn}(t_0)\right] \qquad \text{(MF2-6)}$$

where,

t = time relative to t_0 (the reference time),

C_{jn} = a constant characterizing the amplitude of a tidal constituent n of species j,

f_{jn} = the time-dependent nodal factor,

v_{jn} = the time-dependent astronomical argument,

j = 0, 1, 2 are the tidal species (j=0 declinational; j=1 diurnal, j=2 semidiurnal),

$L_0 = 3\sin^2\phi, L_1 = \sin(2\phi), L_2 = \cos^2\phi$

T_{jn} = the period of a constituent n for species j.

At the open boundaries, the tidal elevation generated by seven constituents (M2, S2, N2, K1, O1, K2, and Q1) are specified.

9. Describe if and how any flood parameters change or evolve during an individual flood life cycle (e.g., astronomical tide, representation of Manning's roughness varying with flood depth).

For the coastal flooding model, during an individual flood life cycle, the inundation depth changes as surge propagates on the land. To account for the terrain effect on the wind, two different drag coefficients are used to compute the wind field on the terrain and extreme shallow waters and the wind field on the ocean, which are referred to as lake wind and ocean wind, respectively. The effects of vegetation on the wind field have also been accounted for in a way similar to the SLOSH model (Jelesnianski et al. 1992). The wind speed is adjusted using a coefficient C_T based on the ratio of the surge water depth ($D=H+\zeta$) to the vegetation height (H_T):

$$C_T = \begin{cases} \dfrac{D}{H_T} & D < H_T \\ 1 & \mathrm{D} \geq \mathrm{H_T} \end{cases} \qquad \text{(MF2-7)}$$

The effect of trees on the wind speed decreases based on this equation as the water submerges the vegetation gradually. The land areas covered by dense vegetation and development are classified into the "Tree" category and assigned an average vegetation height of 8 m, the same as the one used by SLOSH for the Florida basins. When a storm surge floods low-lying areas, it often forms a thin layer of water over land. An extinction coefficient C_E is applied to the wind speed to reduce its effect on the thin layer of water (Jelesnianski et al. 1992).

$$C_E = \begin{cases} \dfrac{D}{0.3} & D < 0.3\ m \\ 1 & D \geq 0.3\ m \end{cases} \qquad \text{(MF2-8)}$$

The flood parameters used in the wave model do not evolve or change over any surge event.

Most inland flood parameters do not change during the simulated lifecycle of the storm. However, there are some parameters, such as the soil infiltration parameters, that depend on the state variables of the model. In the case of soil infiltration, the infiltration rates depend on soil moisture conditions that change over the lifecycle of the storm.

10. For coastal modeling, describe any wave assumptions, calculations or proxies and their impact on flood elevations.

Waves at the offshore boundary are assumed to be a steady-state snapshot at the time of max surge, or max wind, so that more tractable systems can be solved. Wave heights at the offshore boundary (usually several km offshore) are computed from depth-dependent hindcasts using analytic wind-wave relations of Young and Verhagen (1996). Wave setup is computed as a fixed fraction (0.1) of the significant wave height at the offshore boundary. Wave transformation in the nearshore and overland is computed for directional waves but with one frequency only to keep run times tractable. Wave heights around the insured are largely depth-limited and depend much more on the local flooded water depths.

11. Provide the source, resolution, datum, and accuracy of the topography and bathymetry throughout the flood model domain.

The elevation of a CEST grid cell was calculated by averaging the pixel elevations of the digital bathymetric and topographic elevation models which are falling within the grid cell. All the topographic and bathymetric data were adjusted to NAVD 88 vertical datum before calculation. The following procedure was used to calculate the grid cell elevation and handle the overlaps between different bathymetric and topographic datasets.

(1) NOAA ETOPO1 global relief dataset was used to calculate the cell elevations of the model grid. In the deep ocean area that is covered by ETOPO1, but not covered by the bathymetric and

topographic data with finer resolutions, a grid cell should include at least one data point from ETOPO1 for elevation calculation. If not, a new relief dataset with a pixel size of half the ETOPO1 pixel size was generated by interpolating ETOPO1 using the nearest neighbor method. The interpolation was conducted continuously by reducing the pixel size by half every time until each grid cell in the deep ocean contains at least one data point from the interpolated relief dataset.

(2) NOAA coastal relief dataset was used to calculate the cell elevations and replace the elevations from ETOPO1 in the continental shelf and coastal areas. If the cell size of a model grid is less than the pixel size of the coastal relief dataset. The new coastal relief dataset was generated for the calculation of the grid cell elevation using the same procedure to interpolate the ETOPO1 dataset.

(3) USGS 90 m, 30 m, 10 m, and 3 m DEMs were used to calculate the elevations of the model grid cells on the land. The model grid cells on the land and on the ocean were separated using the shoreline dataset extracted from the LiDAR surveys or digitized from the aerial photographs. The selection of 90 m, 30 m, 10 m, and 3 m DEMs were determined by the cell size of a model grid. A grid cell has to contain at least one data point from the DEM dataset used for the elevation calculation.

(4) NOAA integrated models of coastal reliefs were used to calculate and replace the depths of the grid cells in the coastal water. If the USGS DEM on the land is older than the elevation data in the integrated model of coastal relief, the elevations of the grid cell on the land were also calculated and replaced.

(5) The water depths and elevations of the grid cell were updated using the most recent data which are often the LiDAR surveys provided by local government agencies through the flood map modernization program sponsored by the Federal Emergency Management Agency.

The high-quality shoreline dataset including the boundaries of the coastal lagoons, inlets, and barrier islands, and river streams is essential for separating the grid cells on the land and the ocean and preserving the connectivity of the coastal hydrological features. Fortunately, the digital shorelines can be extracted from the LiDAR surveys for coastal areas vulnerable to storm surge flooding in Florida.

Two major sources of bathymetry and topography data are used for wave grids. For bathymetry, The National Centers for Environmental Information (NCEI) 3 arc second data (~90 meter resolution) coastal relief model is used, with sea level datum converted to NAVD88 and NAD83 horizontal datum. For topography above sea level, the United States Geological Survey National Elevation Dataset 1/3 arc second (~10 meter resolution) is used with NAVD88 vertical datum and NAD83 horizontal datum. Both sources are interpolated to create wave grids.

The details of topography dataset are provided below for the inland flood model:

Source: USGS National Elevation Dataset (NED)

Horizontal Resolution: 1/3-arc-second DEM has a ground spacing of approximately 10 meters north-south, but the spacing varies towards east-west direction depending on the latitude.

Datum: North American Datum of 1983 (NAD 1983)

Horizontal Accuracy: In most cases, the horizontal accuracy of seamless DEM coverage produced from 3DEP technologies is expected to be 1 meter or better (Gesch et al., 2014).

Vertical Datum: North American Vertical Datum of 1988 (NAVD 1988).

Vertical Accuracy: The relative vertical accuracy of the 1/3-arc-second DEM dataset is 0.81 meter (Gesch et al., 2014).

12. Describe the grid geometry used in the coastal flood model.

There are a total of 3 sets of basins established for the storm surge simulation covering the whole coastal area of Florida (see Figure 11):

1. West Florida basin (WF1) mainly covers the north and west Florida coastal area;
2. South Florida basin (SF1) mainly covers the south Florida coastal area and Keys;
3. North Florida basin (NF1) covers the North-East Florida coastal area.

Table 14 shows the grid parameters for the three basins.

Table 14. Basin description and statistics for the three basins.

Basin Name	**WF1**	**SF1**	**NF1**
Domain Description	CEST Basin	CEST Basin	CEST Basin
Size	Large	Large	Large
Resolution (m)*	500	450	300
Total Number of Cells	660k	640k	570k
Time Step (s)	30	20	30
Computation Time of 4 days (minutes)**	120-130	80-90	100-110
* The resolution of the model basin varies spatially. The resolution in the table represents the approximate edge size of a grid cell at the coastal area.			
** Computational time was derived by recording the simulation time using a single processor in a Dell PC workstation with four 2.5 GHZ Intel Xeon processors and 12GB of RAM.			

The wave model used 116 separate regular 40m grids of varying coverage that together cover all relevant nearshore areas.

13. Describe if and how flood model parameters are based on or depend on National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM) or other Flood Insurance Study (FIS) data.

The flood model parameters are not based or dependent on NFIP FIRM or FIS data.

MF-3 Wind and Pressure Fields for Storm Surge

A. Modeling of wind and pressure fields shall be employed to drive storm surge models due to tropical cyclones.

The wind and pressure fields for tropical cyclones are modeled and are used to drive the storm surge models.

B. The wind and pressure fields shall be based on current scientific and technical literature or developed using scientifically defensible methods.

The wind and pressure fields are based on methods that are published in accepted scientific and technical literature. The wind model is the same as used in the FPHLM wind loss model.

C. Physically-based simulation of atmosphere-ocean interactions resulting in storm surge shall be conducted over a sufficiently large domain that storm surge height has converged.

Tests were performed with varying domain sizes to ensure convergence is achieved for storm surge height.

D. The features of modeled wind and pressure fields shall be consistent with those of historical storms affecting Florida.

The wind and pressure fields are consistent with historical storms affecting Florida. Validation of the wind model for Florida storms can be found in the FPHLM submission documents.

Disclosures

1. Describe the modeling of the wind and pressure fields for tropical cyclones. State and justify the choice of the parametric forms and the parameter values.

The wind model and simulated pressure fields are described in Standard GF-1.2. A description and justification of the parameters used in the model are described below.

Tropical cyclone parameters used in the model include storm track (translation speed and direction of the storm), radius of maximum wind (*Rmax*), Holland surface pressure profile parameter (*B*), the minimum central sea level pressure (*Pmin*), and the pressure decay as a function of time after landfall.

The storm's initial position and motion are modeled using the HURDAT2 database. Initial storm positions and motion changes derived from HURDAT2 are modified by the addition of small uniform random error terms. Subsequent storm motion change and intensity are obtained by sampling from empirically derived PDFs as described in Standard GF-1.2.

For pressure decay we use the Vickery (2005) decay model. Vickery developed the model on the basis of pressure observations in HURDAT and NWS-38 (Ho et al., 1987), together with *Rmax* and storm motion data as described in the publication.

The radius of maximum winds at landfall is modeled by fitting a gamma distribution to a comprehensive set of historical data published in NWS-38 by Ho et al. (1987) and supplemented by the extended best track data of DeMaria (Pennington et al., 2000), the HURDAT Reanalysis Project (Landsea et al., 2004), NOAA HRD research flight data, and NOAA-AOML-HRD H*Wind analyses (Powell & Houston, 1996; Powell et al., 1996; Powell & Houston, 1998; Powell et al., 1998).

Additional research was used to construct a historical landfall *Rmax-Pmin* database using existing literature (Ho et al., 1987), extended best track data, HRD Hurricane field program data, and the H*Wind wind analysis archive (Demuth et al., 2006). We developed an *Rmax* model using the compiled landfall *Rmax* database, which includes more than 100 measurements for hurricanes up to 2012. We have opted to model the *Rmax* at landfall rather than the entire basin for a variety of reasons. One is that the distribution of landfall *Rmax* may be different than that over open water. An analysis of the landfall *Rmax* database and the 1988–2007 extended best track data shows that there appears to be a difference in the dependence of *Rmax* on central pressure (*Pmin*) between the two datasets (Demuth et al., 2006). The landfall dataset provides a larger set of independent measurements (more than 100 storms compared to about 31 storms affecting the Florida threat area region in the best track data). Since landfall *Rmax* is most relevant for loss cost estimation and has a larger independent sample size, we have chosen to model the landfall dataset. Since *Rmax* is nonnegative and skewed, we model the distribution using a gamma distribution. As described in Standard GF-1.2, the maximum likelihood estimates of the parameters of the gamma distribution were obtained and were found to be a good fit.

Recent research results by Willoughby and Rahn (2004) based on the NOAA-AOML-HRD annual hurricane field program and Air Force reconnaissance flight-level observations are used to create a model for the "*Holland B*" parameter. Ongoing research on the relationship between horizontal surface wind distributions (based on Stepped Frequency Microwave Radiometer observations) to flight level distributions (Powell et al., 2009) is used to correct the flight-level *Rmax* to a surface *Rmax* when developing a relationship for the *Holland B* term. We multiply the flight-level *Rmax* from the Willoughby and Rahn (2004) dataset by 0.815 to estimate the surface *Rmax* (based on SFMR, flight-level maxima pair data). This adjustment keeps the Holland pressure profile parameter consistent with a surface *Rmax* and because of the negative term in the equation produces a larger value of *B* than if a flight-level value of *Rmax* were used. This is consistent with the concept of a stronger radial pressure gradient for the mean boundary layer slab than at flight level (due to the warm core of the storm), which agrees with GPS dropsonde wind profile observations showing boundary layer winds that are stronger than those at the 10,000 ft flight level, which is the level for most of the *B* data in Willoughby and Rahn (2004). The *B* adjustment for a surface *Rmax* produces an overall stronger surface wind field than if *B* were not adjusted. In addition, surface pressures from the "best track" information on HURDAT are used to associate a particular flight-level pressure profile *B* with a surface pressure. A regression model for *B* was obtained as described in Standard GF-1.2. The random error term for the *B* parameter is modeled as a normal distribution with zero mean. A comparison of modeled and fitted values of *B* can be found in Standard GF-1.2.

HRD wind modeling research initiated by Ooyama (1969) and extended by Shapiro (1983) has been used to develop the HRD wind field model. This model is based on the concept of a slab boundary layer model, a concept pioneered at NOAA-AOML-HRD and now in use by other modelers for risk applications (Thompson & Cardone, 1996; Vickery & Twisdale, 1995; Vickery et al., 2000b). The HURDAT2 historical database is used to develop the track and intensity model. Historical data used for computing the potential intensity is based on the National Centers for Environmental Prediction (NCEP) sea surface temperature archives and the NCEP reanalysis for determining the upper tropospheric outflow temperatures. Monthly geographic distributions of climatological sea surface temperatures (Reynolds et al., 2002) and upper tropospheric outflow temperatures (Kanamitsu et al., 2002) are used to determine physically realistic potential intensities that help to bound the modeled intensity.

2. Provide the historical data used to estimate parameters and to develop stochastic storm sets.

The historical data used to estimate parameters and develop stochastic storm sets are provided in the previous disclosure. For the current version of the flood model, the version of HURDAT2 that was used is the April 19, 2022 version.

3. Provide a tangential (y-axis) versus radial (x-axis) plot of the average or default wind and pressure fields for tropical cyclones used in the flood model, and justify the choice of the wind and pressure fields used. Provide such plots for non-tropical cyclones, if non-tropical cyclones are modeled explicitly. If the wind and pressure fields represent a modification from the currently accepted flood model, plot the previous and modified wind and pressure fields on the same figure using consistent axes. Describe variations between the previous and modified wind and pressure fields with references to historical tropical cyclones.

See Figure 30 and Figure 31.

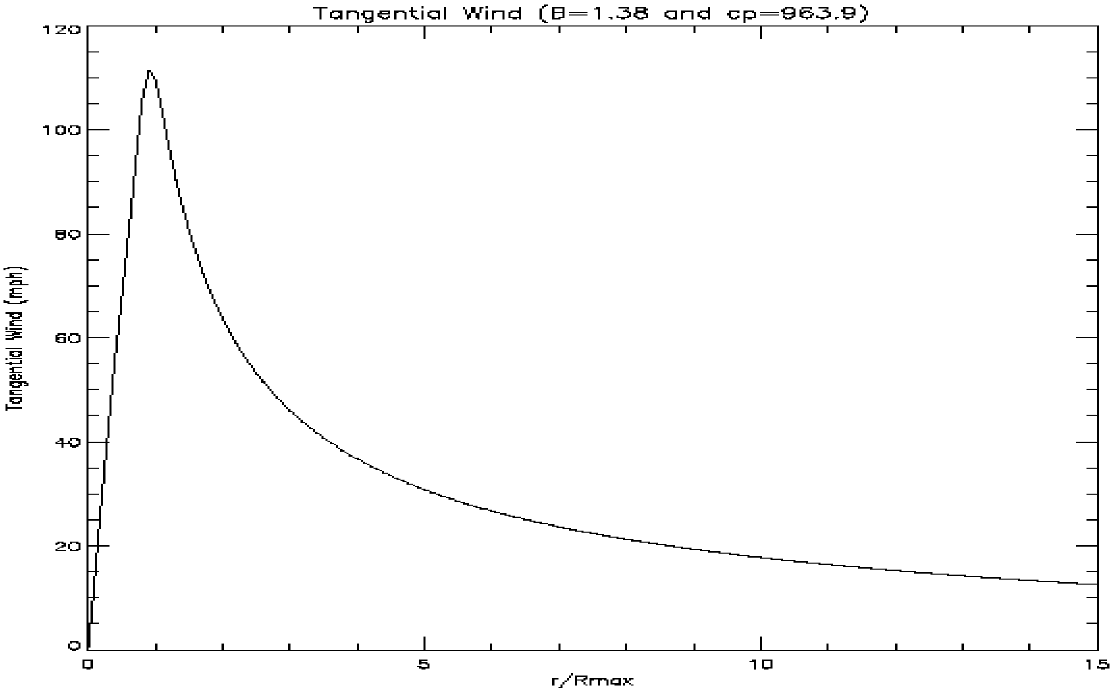


Figure 30. Axisymmetric rotational wind speed (mph) vs. scaled radius for B = 1.38, DelP = 49.1 mb.

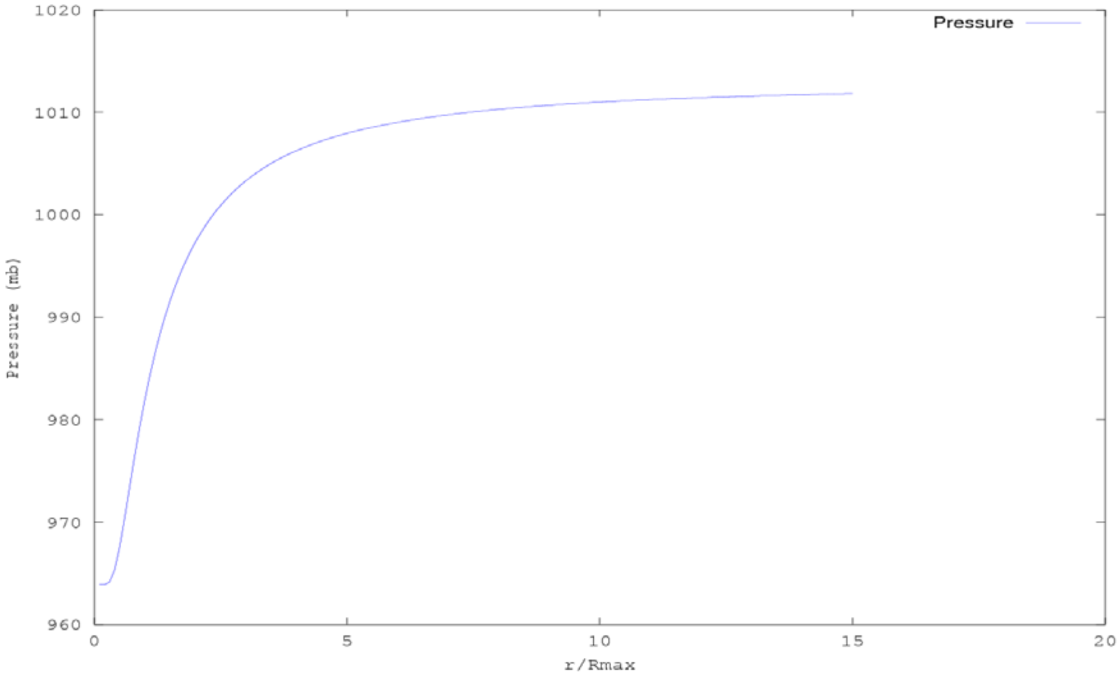


Figure 31. Plot of pressure profile corresponding to the parameters used in the previous figure.

4. If wind and pressure fields are modeled above the surface and translated to the surface to drive storm surge, then describe this translation; e.g., via planetary boundary layer models or empirical surface wind reduction factors and inflow angles. Discuss the associated uncertainties.

The wind field is not modeled above the surface, but as a mean slab surface layer. The conversion of the mean layer wind to the 10 m wind, and associated uncertainties for the conversion, are described below.

The mean boundary layer winds computed by the model are adjusted to the surface using results from Powell et al. (2003), which estimated a mean surface wind factor of 77.5% on the basis of over 300 GPS sonde wind profile observations in hurricanes. The surface wind factor is based on the ratio of the surface wind speed at 10 m to the mean wind speed for the 0–500 m layer (mean boundary layer wind speed or MBL) published in Powell et al. (2003). This ratio is far more relevant to a slab boundary layer model than using data based on higher, reconnaissance aircraft flight levels. The depth of the slab boundary layer model is assigned a value of 450 m, which is the level of the maximum mean wind speed from GPS sonde wind profiles published in Powell et al. (2003). The uncertainty of the surface wind factor is ~8%, based on the standard deviation of the measurements, but no attempt is made to model this uncertainty. No radial distance from center or intensity dependent variation of reduction factor is used at this time because of a lack of dependency on these quantities based on examination of GPS dropsonde data (see Figure 32).

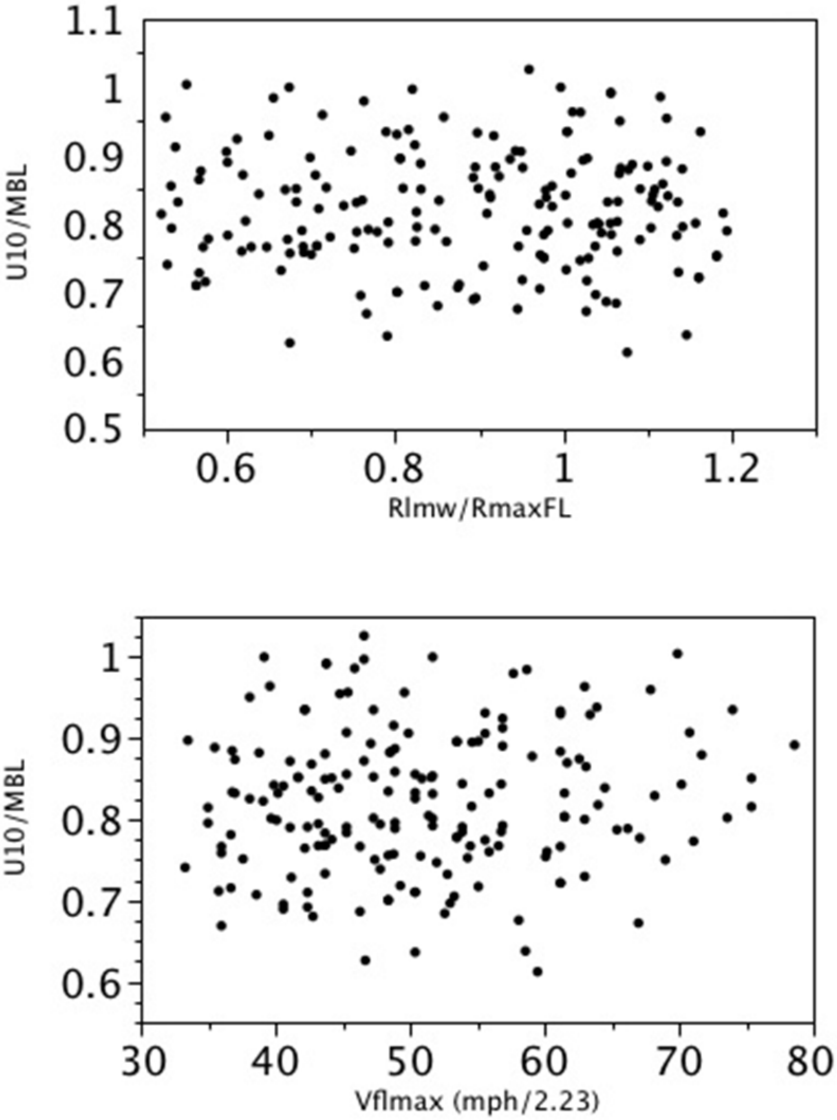


Figure 32. Analysis of 742 GPS dropsonde profiles launched from 2-4 km with flight-level winds at launch greater than hurricane force and with measured surface winds. Upper figure: Dependence of the ratio of 10 m wind speed (U10) to the mean boundary layer wind speed (MBL) on the scaled radius (ratio of radius of last measured wind (Rlmw) to the radius of maximum wind at flight level (RmaxFL). Lower figure: Surface wind factor (U10/MBL) dependence on maximum flight level wind speed (Vflmax, in units of miles per hour / 2.23).

5. If applicable, describe how the inverse barometer effect is modeled.

The inverse barometer effect is not modeled in CEST.

6. Describe how storm translation is accounted for when computing surface wind and pressure fields.

The incorporation of storm translation in the wind model is described in Standard GF-1.2. In particular, it is included in the frictional drag term in the wind model equation, as well as in the translating coordinate system in which the wind model and pressure calculations are performed.

7. Describe how storm surge due to non-tropical cyclones is accounted for in the flood model. If it is not accounted for, explain why.

Non-tropical cyclones are currently not accounted for in the model. There is only one non-tropical event that has produced a potentially significant storm surge in Florida in recorded history, the so-called “Storm of the Century” in March, 1993. An examination of NFIP claims data reveals that the cause of loss, whether surge versus accumulation of rainfall, is highly unreliable. Thus, we do not have sufficient or reliable data to attempt to model non-tropical cyclone surge events or even assess whether those losses might be associated with surge only. In addition, we have examined inundation estimates from SLOSH Maximum of Maximums (MoM) simulation output from NHC combined with high resolution LIDAR DEM data (a detailed data set provided by the Florida Division of Emergency Management), and found that there are very few locations in Florida that are susceptible to flood due to surge for tropical cyclones below hurricane strength. Since non-tropical cyclones in Florida are generally much weaker than hurricanes, we cannot conclude that there will be significant surge due to non-tropical events.

8. Describe and justify the averaging time of the windspeeds used to drive the storm surge model.

The wind fields generated by the wind model are assumed to be 10-minute averaged winds. The wind model does not incorporate the effects of short gusts or other transitory turbulence, so shorter averaging times would not be appropriate for representing the wind field. For longer averaging times, the effects of storm motion would impact the wind speeds and thus not be appropriate.

9. For methods in which storm surge is produced by physically-based simulation of atmosphere-ocean interactions and where the methodology has not been documented in the scientific and technical literature, describe the process for verifying convergence of storm surge height as a function of domain size. State the convergence criteria.

In order to verify the storm surge height convergence at different domain sizes, two basins, HGL and AP, with larger sizes were generated to simulate Hurricane Ike, Ivan, and Dennis (Figure 33 and Figure 34). The purpose of these two large domains is to further examine the effect of domain size on computing storm surge. The extra-large domain EGM3 is the largest domain for the Gulf of Mexico (Figure 35).

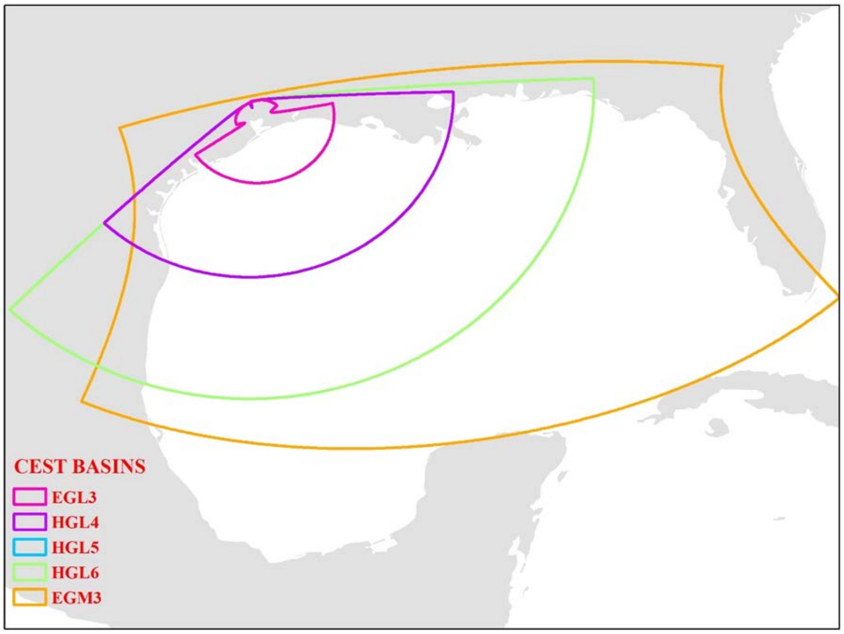


Figure 33. Location of EGL3, HGL4, HGL5, and HGL6 basins for Hurricane Ike.

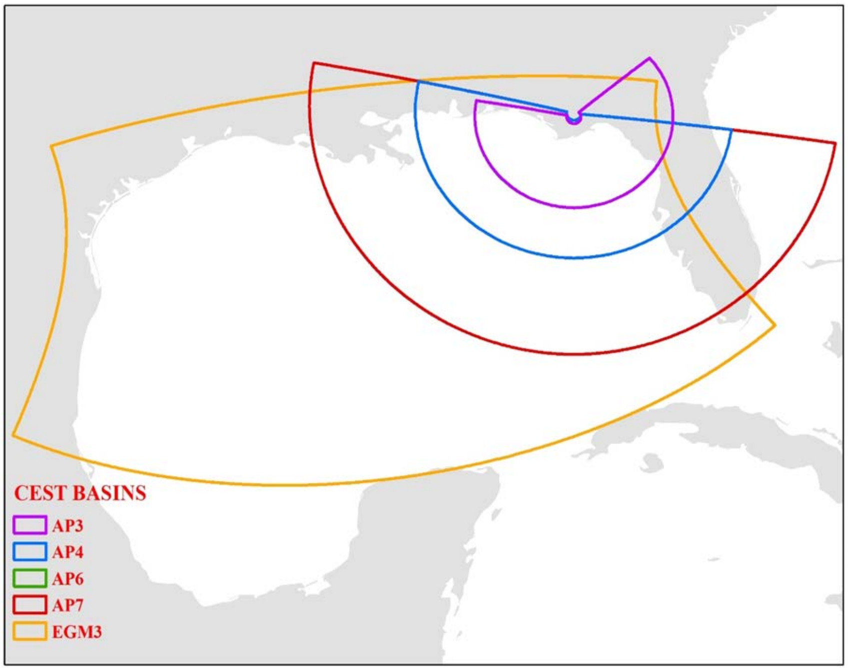


Figure 34. Location of AP3, AP4, AP6, AP7, and EGM3 basins for Hurricanes Ivan and Dennis.

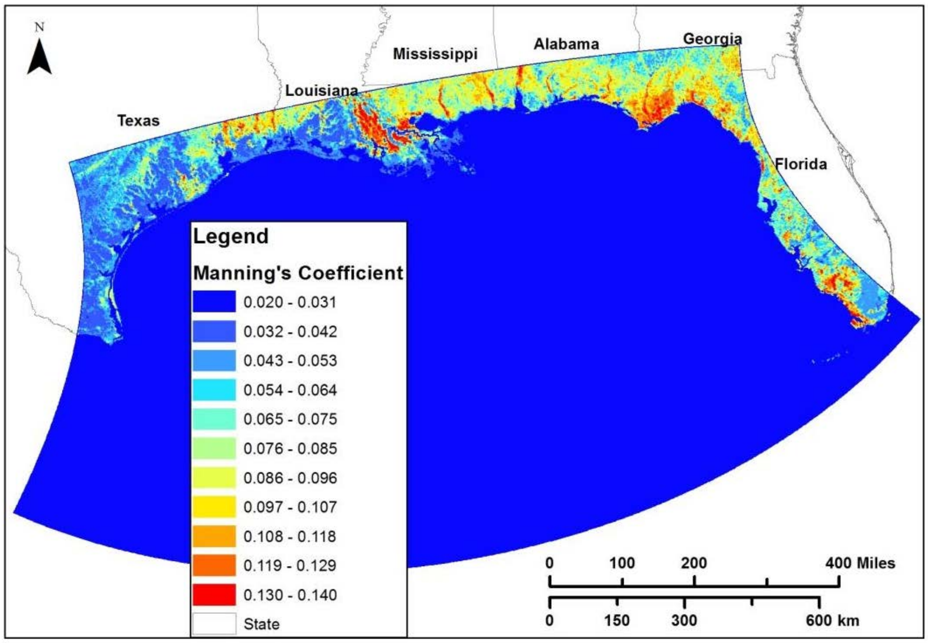


Figure 35. Extra Large domain EGM3 with Manning Coefficient.

Figure 33 Shows the domain size for the newly generated basin HGL6 for Hurricane Ike with EGL3, HGL4, and HGL5 basins. The HGL6 basin spans the whole Texas coast and west coast of Florida, covering 682,000 km^2 and with an average cell size of 200 m on the land. The HGL6 basin covers much more area than the HGL5, but with the same resolution of HGL5 (Table 15).

Comparison of observed and computed storm tides of Hurricane Ike indicates that the HGL6 basin produces storm surge agreeing better with observations than other basins (Figure 36 and Figure 37). The largest EGM3 basin over-predicts peak storm tides at stations Galveston Bay Entrance, Galveston Pier 21, Y, W, and Z. The HGL6 basin generates better peak storm surges at the above 5 stations. The shape of storm tide from HGL6 is also comparable with the shape of observed storm tide. The largest basin EGM3, the large basin HGL6, and intermediate size basins HGL4 and HGL5 capture the forerunners from IKE, thus producing storm tides matching better with field observations. It appears that the high-resolution HGL6 produces the storm tide which agrees with observed storm tide best (Table 15).

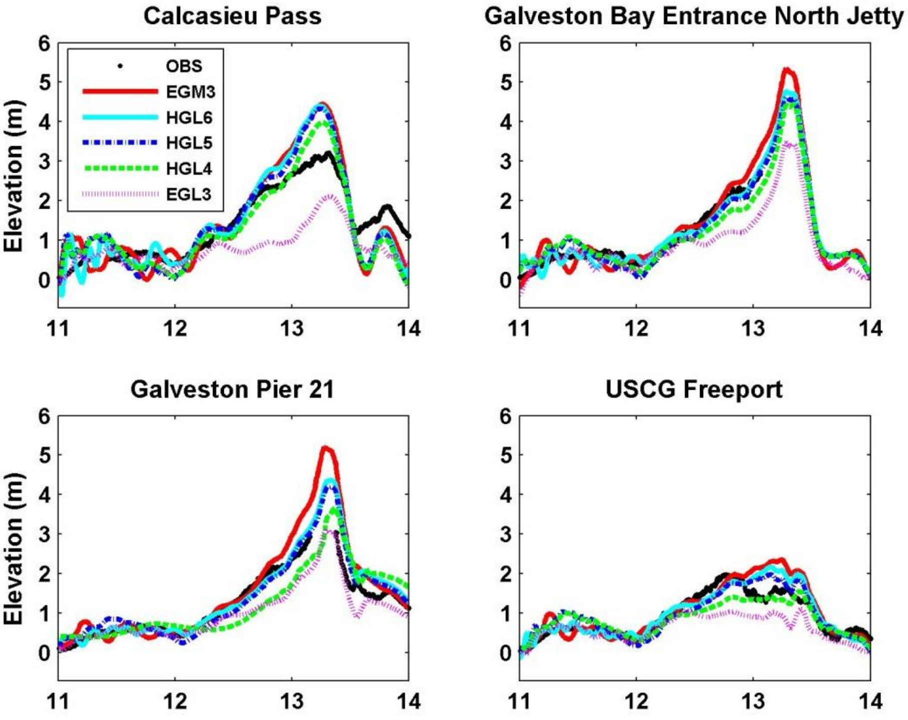


Figure 36. Observed and computed water levels at 4 NOAA tide gauges.

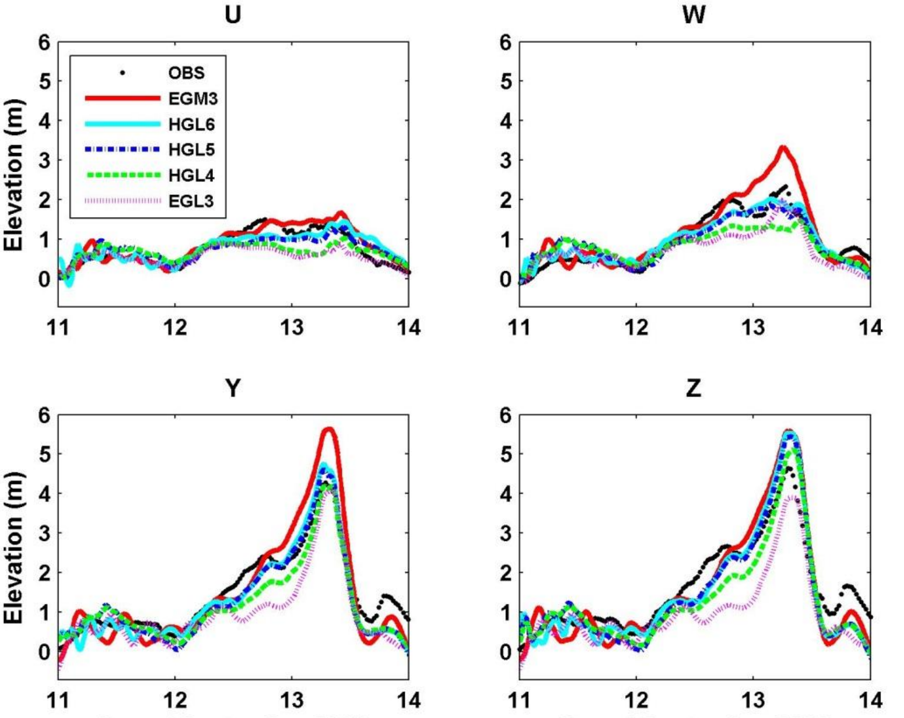


Figure 37. Observed and computed water levels at 4 stations established by Kennedy (replace with u,w,y,z).

Table 15. Basin description for Hurricane Ike with additional large Basin HGL6.

Basin Name	**EGL3**	**HGL4**	**HGL5**	**HGL6**	**EGM3**
Description	SLOSH Basin	CEST Basin	CEST Basin	CEST Basin	SLOSH Basin
Size	Small	Medium	Medium	Large	Extra Large
Resolution (m)	700	1,200	200	200	2,700
Dimension	243*192	251*172	998*682	1143*694	329*569
Total Number of Cells	46,656	43,172	680,636	793,242	187,201
Time Step (s)	30	30	30	30	30
Computation Time of 4 days (minutes)	3-5	3-4	105-120	170-180	38-45
RMSD (m, Andrew)	0.69	0.54	0.41	0.41	0.42
RMSD (m, NOAA)	0.70	0.46	0.42	0.40	0.37

Figure 34 shows the domain size for the newly generated basin AP7 with AP3, AP4, and AP6 basins. The AP7 basin spans the almost whole Florida coast and west coast of Louisiana, covering 564,000 km^2 and with an averaged cell size of 200 m on the land. The AP7 basin covers a larger area than the AP6, but with the same resolution (Table 16 and Table 17).

Comparison of observed and computed storm tides of Hurricane Ivan indicates that the peak storm tides from AP7 have the best agreement with the observed ones at all stations (Figure 38). The shapes of storm tides from AP7 are most similar to the shapes of observed ones.

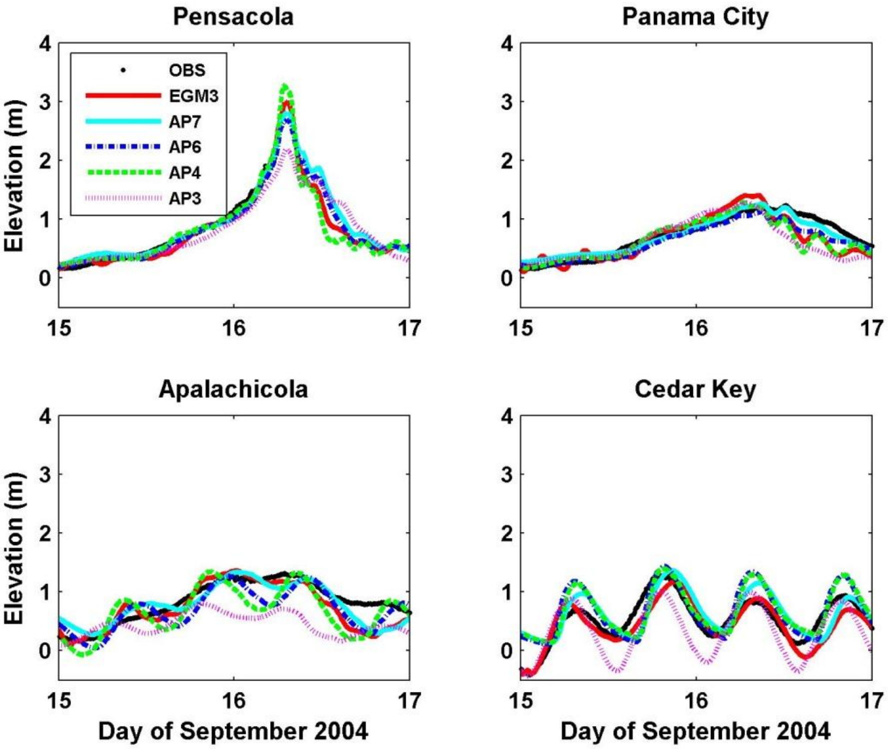


Figure 38. Computed peak storm tide heights for Hurricane Ivan.

Table 16. Basin description for Hurricane Ivan with additional large Basin AP7.

Basin Name	AP3	AP4	AP6	AP7	EGM3
Description	SLOSH Basin	CEST Basin	CEST Basin	CEST Basin	SLOSH Basin
Size	Small	Medium	Medium	Large	Extra Large
Resolution (m)	400	400	100	100	2,700
Dimension	142*226	167*179	662*710	772*710	329*569
Total Number of Cells	32,092	29,893	470,020	548,120	187,201
Time Step (s)	30	30	30	30	30
Computation Time of 4 days (minutes)	2-3	3-5	92-100	120-130	46-50
RMSD (m, NOAA)	0.36	0.25	0.21	0.17	0.19

Comparison of observed and computed storm tides of Hurricane Dennis indicates that the peak storm tides from AP7 have the best agreement with the observed ones for stations Pensacola, Panama City, and Apalachicola (Figure 39 and Table 17). The shapes of storm tides from AP7 are most similar to the shapes of observed ones. The difference between computed and observed storm tides at Cedar Key is relatively large, probably due to the complicated bathymetry around this station. There is a possibility to improve the simulation through adjustment of topographic and bathymetric data around this area.

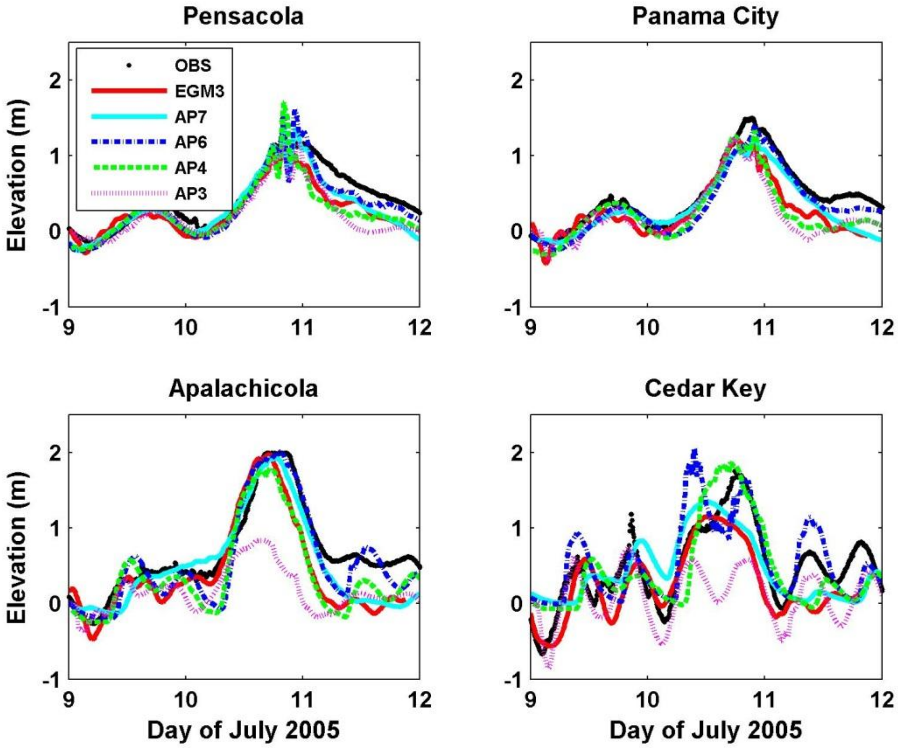


Figure 39. Computed peak storm tide heights for Hurricane Dennis.

Table 17. Basin description for Hurricane Dennis with additional large Basin AP7.

Basin Name	**AP3**	**AP4**	**AP6**	**AP7**	**EGM3**
Description	SLOSH Basin	CEST Basin	CEST Basin	CEST Basin	SLOSH Basin
Size	Small	Medium	Medium	Large	Extra Large
Resolution (m)	400	400	100	100	2,700
Dimension	142*226	167*179	662*710	772*710	329*569
Total Number of Cells	32,092	29,893	470,020	548,120	187,201
Time Step (s)	30	30	30	30	30
Computation Time of 4 days (minutes)	2-3	3-4	85-95	110-120	35-40
RMSD (m, NOAA)	0.39	0.27	0.25	0.22	0.27

The effect of the basin size on storm tide computation is examined by two new large basins HGL6 and AP7. With the proper domain size and resolution, CEST can capture the forerunner and produce peak surges comparable with observations. The utilization of the large basins with a high-resolution grid improves the simulation accuracy, but increases computation time by 20-30% in comparison to the usage of intermediate size basins. It took one processor about 120 minutes to complete a 4 day simulation on the large size CEST basin, and 95 minutes on the intermediate size CEST basin.

MF-4 Flood Characteristics (Outputs)

A. Flood extent and elevation or depth generated by the flood model shall be consistent with observed historical floods affecting Florida.

For the coastal surge model, please refer to Form HHF-1 for model validation.

B. Methods for deriving flood extent and elevation or depth shall be scientifically defensible and technically sound.

For the coastal surge model, there are three outputs related to the flood extent and elevation or depth can be used to derive the flood extent and elevation or depth:

1. storm*_env.nc: maximum surge height (m) at each grid location;
2. storm*_mwspd_r_el: maximum wind speed associated surge (m);
3. storm*_first_t.nc: time of first inundation (m).

The maximum surge height (m) at each grid location can be directly used to extract maximum flood extent and elevation caused by hurricane surge tide. The flooding depth can be derived from the elevation minus the ground elevation extracted from high resolution Lidar data. The other two outputs can be used to estimate the flooding duration and moment.

C. Methods for modeling or approximating wave conditions in coastal flooding shall be scientifically defensible and technically sound.

The wave model uses the well-known program STWAVE to compute wave heights and directions on a 40 meter grid that covers the coast of Florida with insurable properties.

D. Modeled flood characteristics shall be sufficient for the calculation of flood damage.

For the coastal surge model, each simulation (both historical and stochastic storm events), 8 surge and wind related information are directly output in NETCDF format:

1. storm*_env.nc: maximum surge height (m) at each grid location;
2. storm*_hwm_r_wind.nc: maximum surge height associated wind (m/s);
3. storm*_msurge_t.nc: time of maximum surge (s);
4. storm*_mwpsd.nc: maximum wind speed(m/s);
5. storm*_mwspd_r_el: maximum wind speed associated surge (m);
6. storm*_mwspd_t.nc: time of maximum wind speed (m/s);
7. storm*_first_t.nc: time of first inundation (m);
8. storm*_first_w.nc: wind speed at that time (m/s).

This information is required by the engineering team, and is sufficient to calculate the flood damage.

The inland flood damage during a flood event is estimated from the inland flood model predicted flood depths at the inundated locations for the respective flood event.

Disclosures

1. Demonstrate that the coastal flood model component incorporates flood parameters necessary for simulating storm-tide-related flood damage in Florida. Provide justification for validation using any historical events not specified in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps.

For the coastal surge model, each simulation (both historical and stochastic storm events), 8 surge and wind related information are directly output in NETCDF format:

1. storm*_env.nc: maximum surge height (m) at each grid location;
2. storm*_hwm_r_wind.nc: maximum surge height associated wind (m/s);
3. storm*_msurge_t.nc: time of maximum surge (s);
4. storm*_mwpsd.nc: maximum wind speed(m/s);
5. storm*_mwspd_r_el: maximum wind speed associated surge (m);
6. storm*_mwspd_t.nc: time of maximum wind speed (m/s);
7. storm*_first_t.nc: time of first inundation (m);
8. storm*_first_w.nc: wind speed at that time (m/s).

In Form HHF-1, the specified Hurricane Jeanne (2004) was replaced by Hurricane Frances (2004), Tropical Storm Fay (2008) was replaced with Hurricane Katrina (2005), and the two unnamed storms were replaced with Hurricanes Hermine (2016) and Dorian (2019). It is noted that Hurricane Frances (2004) has a very similar track to that of Jeanne (2004), and Hurricane Katrina (2005) impacted the southwest coastline of Florida very close to that struck by storm Fay (2008). Furthermore, very limited data can be found for the two unnamed storms, and they are mainly rainfall events. Hence, the replacement with Hurricane Hermine (2016) and Dorian (2019).

2. For coastal flooding, describe how the presence, size, and transformation of waves are modeled or approximated.

Waves are modeled using the US Army Corps of Engineers program, STWAVE. The program was modified slightly to include bulk Thornton and Guza (1983) type wave breaking rather than a strict depth-dependent limit. Other than this, there are no modifications to the program. Waves are computed on 116 subgrids using local topobathy, provided surge levels, local land use/land cover data, and provided winds as input. Wave heights and periods at the offshore boundaries are computed using maximum winds over each storm and either the maximum surge, or the surge at time of maximum wind. Constant wave parameters are applied.

3. For coastal modeling, describe if and how the flood model accounts for flood velocity, flood duration, flood-induced erosion, floodborne debris, salinity, and contaminated floodwaters.

The CEST model simulates flood velocity, and the output can be recorded for the flood duration for each storm at given locations. However, flood velocity is not used in calculating losses. In addition, flood-induced erosion, floodborne debris, salinity, and contaminated floodwaters are not considered in the current model.

4. For coastal flood waters, describe the factors that affect inland propagation and how they are modeled.

The most important factor is likely the land cover, which is modeled using a comprehensive manning coefficient map in CEST. Other factors include the geometry of the coastline (e.g. a funnel-shaped estuary could increase surge level and inland propagation) and topography characteristics inland (e.g. channel networks can either increase or decrease inland propagation); these are modeled through applying the DEM data.

5. Describe if and how inland flood affects the inland propagation of coastal flood. Describe if and how coastal flood propagation affects inland flood.

Inland flood does not affect the propagation of coastal flood nor does coastal flood propagation affect inland flood. The two models are executed independently.

6. Describe if and how the coincidence and interaction of inland and coastal flooding is modeled.

The inland and coastal flooding are separately simulated, and there is no interaction between the two models currently. The coastal and inland flood model components are performed on different grids. If the same locations are flooded by coastal and inland components, the maximum inundation depth will be used.

7. Provide a flowchart illustrating how the characteristics of each flood model component are utilized in other components of the flood model.

Figure 40 and Figure 41, respectively, present the flowcharts illustrating the coastal surge model and inland flood model with other components of the FPFLM.

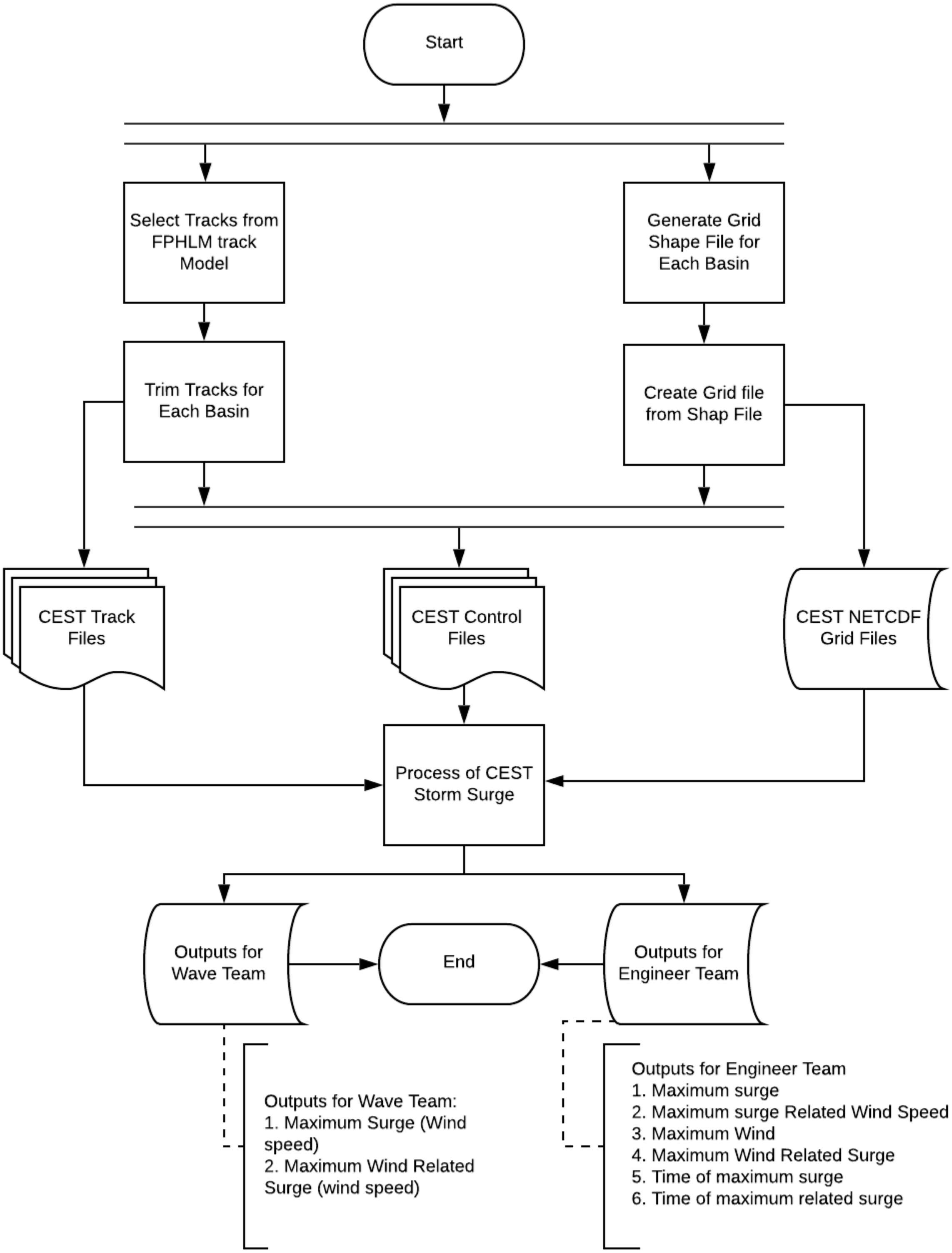


Figure 40. The flowchart illustrates the coastal surge model with other components of the FPFLM.

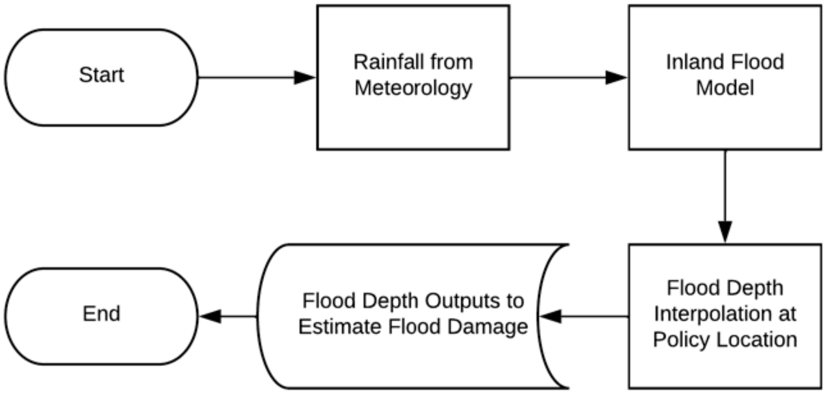


Figure 41. The flowchart illustrating the inland flood model components of the FPFLM.

8. Describe and justify the appropriateness of the databases and methods used for the calibration and validation of flood extent and elevation or depth.

For the coastal flooding team, there are three types of data used to calibrate and validate the coastal surge model. First is water elevation time series data (https://tidesandcurrents.noaa.gov/) along the Florida coastal region. The water elevation data was directly downloaded from National Oceanic and Atmospheric Administration (NOAA), Units: Meters, Timezone: GMT, Datum: MSL, Interval 1 hour or 6 min (if available). Second is the High Water Mark (HWM) data, the reports, published by United States Geological Survey (USGS) or Federal Emergency Management Agency (FEMA) related to each historical hurricane required by standards, are extracted or digitalized. For the High Water Mark (HWM) data, data above NAVD88 are used. Third is the Inundation maps or debris line, (https://www.fema.gov/hurricane-ivan-surge-inundation-maps)

9. Describe any variations in the treatment of the flood model flood extent and elevation or depth for stochastic versus historical floods, and justify this variation.

There are no variations in the treatment of flood model flood extent and elevation or depth for the stochastic versus historical floods.

10. Describe the effects of storm size, bathymetry, and windspeed on storm surge height and its variation along the coast for the coastal flood model.

For the coastal surge model, we conducted the study to provide the first analysis of the modeling sensitivity runs on the relationship between storm size and storm surge heights. Storm surge height is calculated with the Radius of Maximum Wind (RMW) of 20 and 35 miles. The results indicate that the storm sizes are correlated with storm surge heights.

Storm surge heights are also calculated at four different bathymetries using the Apalachicola Bay Basin (AP3) (see MF-3 Disclosure 9), with 0.5, 1.0, 1.5, and 2.0 times of the original depth. The results indicate that the bathymetry correlated with storm surge heights, and shallower bathymetry may generate higher surge than deeper ones.

Furthermore, the CEST model was employed to simulate nine different hurricane forward directions at the AP3 basin (see MF-3 Disclosure 9). For each different forwarding direction, simulations included 80 mph (Wind 1), 100 mph (Wind 2), 120 mph (Wind 3), and 140 mph (Wind 4) maximum onshore wind speeds with exactly the same initial surge-tide level, same hurricane track information, same grid setup, same time step, and same Manning coefficient. In other words, only the onshore wind speed varied, and all other factors held constant. It is found that higher wind speed produces higher surge in most cases.

Wave heights and periods at the offshore wave boundaries increase with wind speed, fetch, and depth according to Young and Verhagen (1996) hindcast relations, and to computed bulk setup. Wave properties are not impacted by wind duration, as steady-state relations are used.

The detailed information is presented below.

Relationship between storm surge heights and storm size

To conduct a thorough comparison for the relationship between storm surge height and storm size, we conduct the CEST simulations for nine different hurricane forward directions at AP3 basin (Figure 42). For each different forwarding direction, simulations include 20 mile and 35 mile Radius of Maximum Wind, with the same initial surge tide level, and the same hurricane track information, the same grid setup, the same time step, and the same Manning coefficient. In other words, only the storm size varied, and all other factors held constant.

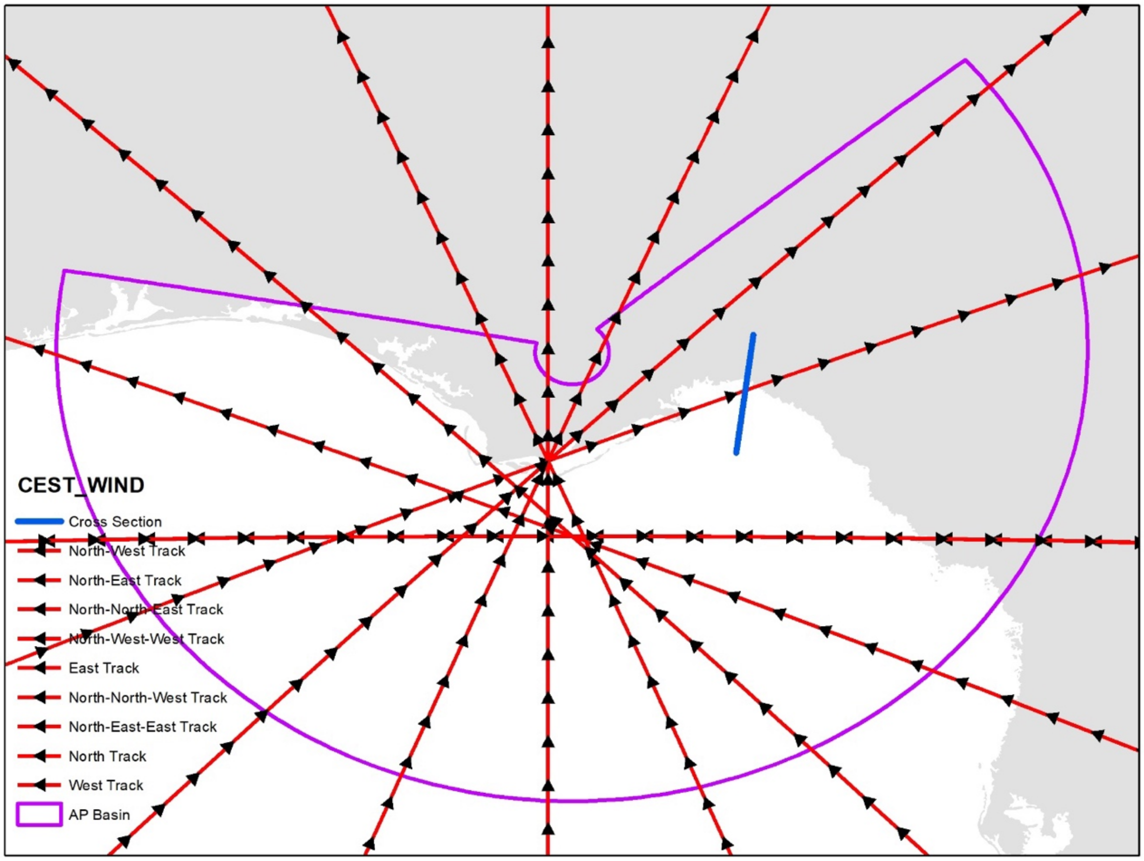


Figure 42. AP3 basin domain, cross section, and North-West, North-East, North-North-East, North-West-West, East, North-North-West, North-East-East, North, and West direction Hurricanes.

Figure 43 and Figure 44 present the maximum surge height profiles on the same selected cross section at AP3 (see Figure 42) for North-West, North-East, North-North-East, North-West-West, East, North-North-West, North-East-East, North, and West direction Hurricanes with 20 and 35 mile Radius of Maximum Wind. The maximum surge profiles further indicate that the surge height of 35 mile RMW is higher than the 20 mile.

Figure 45 and Figure 46 present the time series at four NOAA tide stations at AP3 basin for North-West, North-East, North-North-East, North-West-West, East, North-North-West, North-East-East, North, and West direction Hurricanes with 20 mile and 35 mile RMW. For most of the time, surge height of 35 mile RMW is higher than the 20 mile one.

Figure 47 and Figure 48 present the scatter plots of surge heights with 20 and 35 mile RMW at AP3 basin under North-West, North-East, North-North-East, North-West-West, East, North-North-West, North-East-East, North, and West direction Hurricanes. For all cases the surge height with 35 mile RMW is higher than 20 mile, which is indicated by b>1, where b is the regressed slope. But there are some points below the purple dash line, which means that the surge height by the 20 mile RMW is rarely higher than 35 mile RMW.

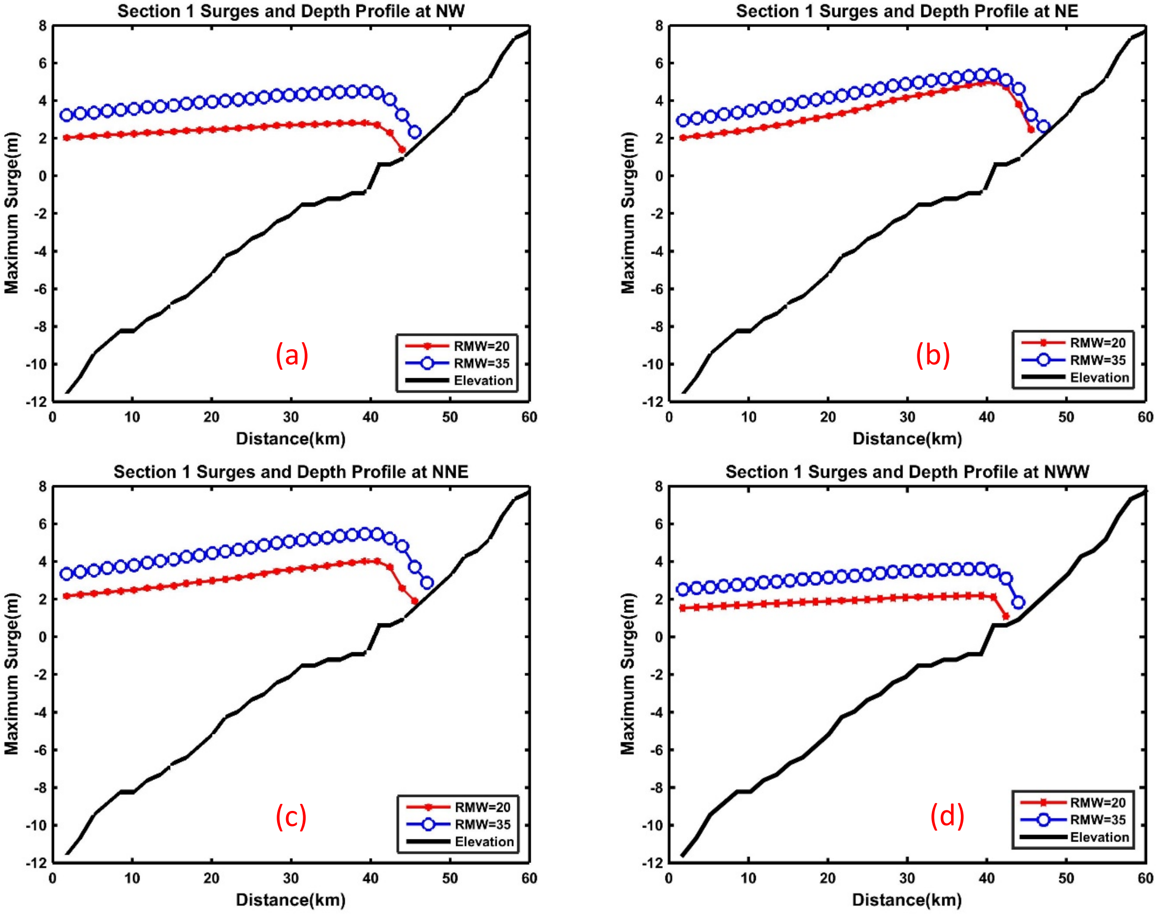


Figure 43. Cross section surge and depth profiles with Radius of Maximum Wind (RMW) 20 and 35 miles of Apalachicola Bay Basin (AP3) for North-West (a), North-East (b), North-North-East (c), and North-West-West (d) forwarding directions.

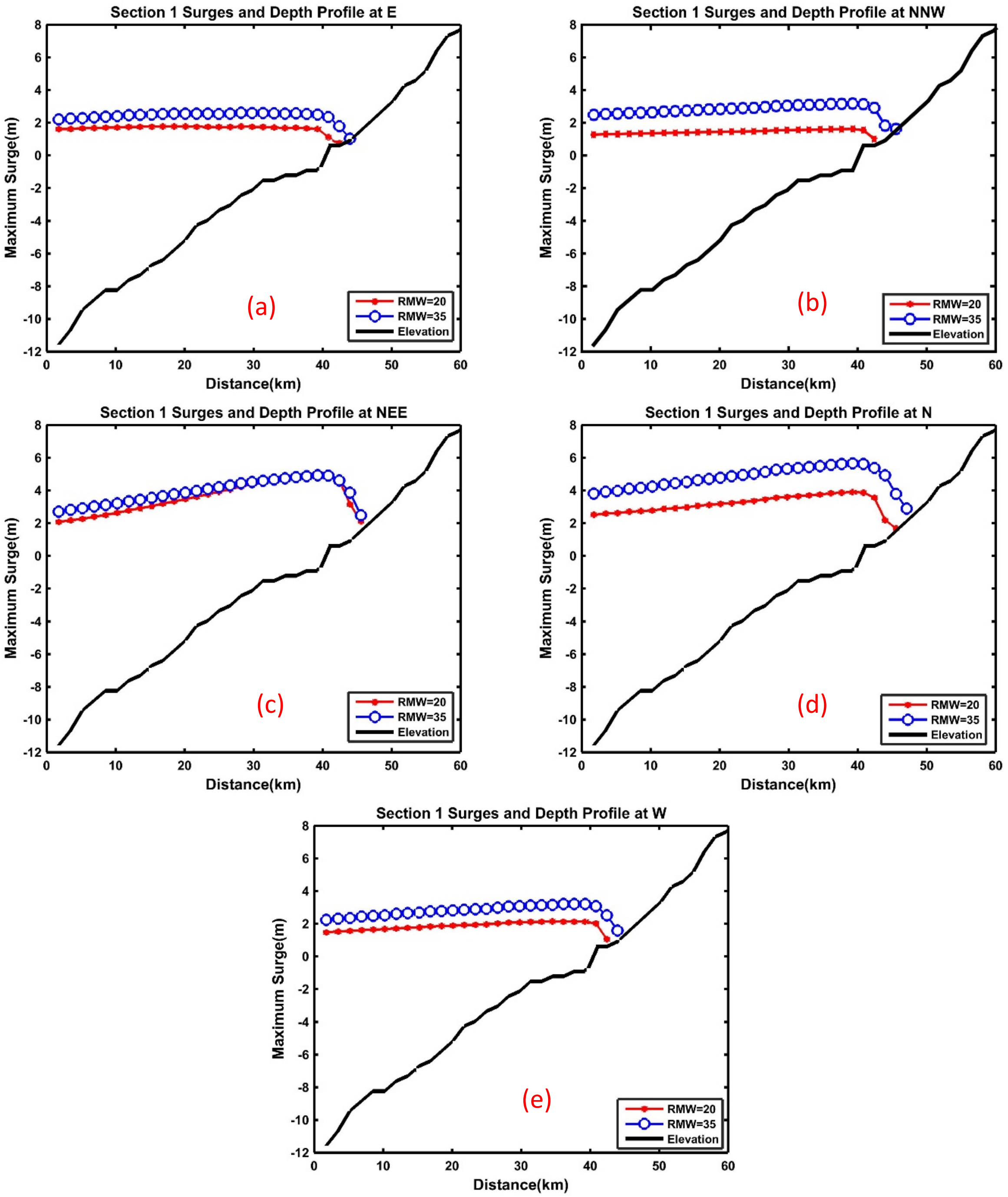


Figure 44. The same as Figure 43 but for East (a), North-North-West (b), North-East-East (c), North (d), and West (e) forwarding directions.

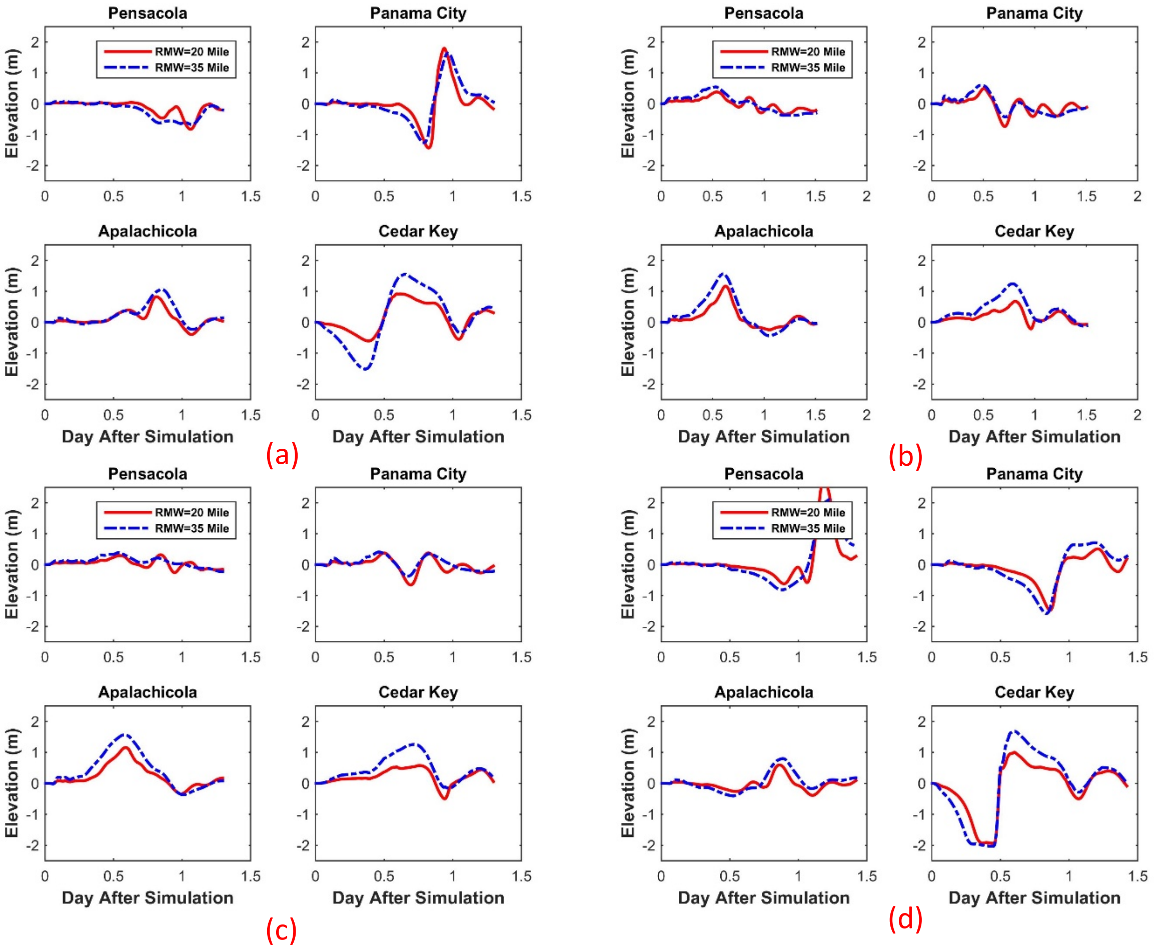


Figure 45. Time series comparison at 4 NOAA Tide Stations with Radius of Maximum Wind (RMW) 20 and 35 miles of Apalachicola Bay Basin (AP3) for North-West (a), North-East (b), North-North-East (c), and North-West-West (d) forwarding directions.

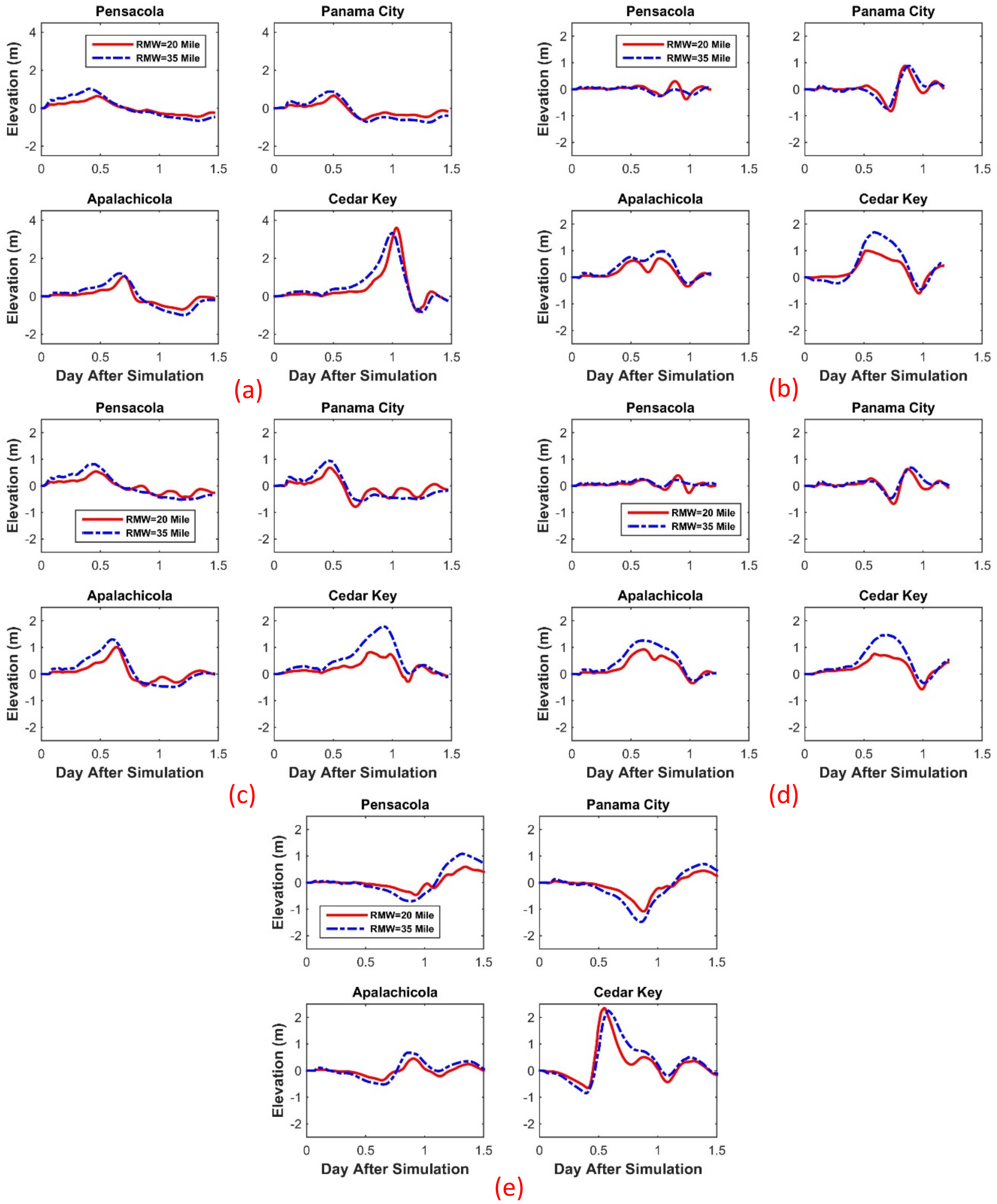


Figure 46. The same as Figure 45 but for East (a), North-North-West (b), North-East-East (c), North (d), and West (e) forwarding directions.

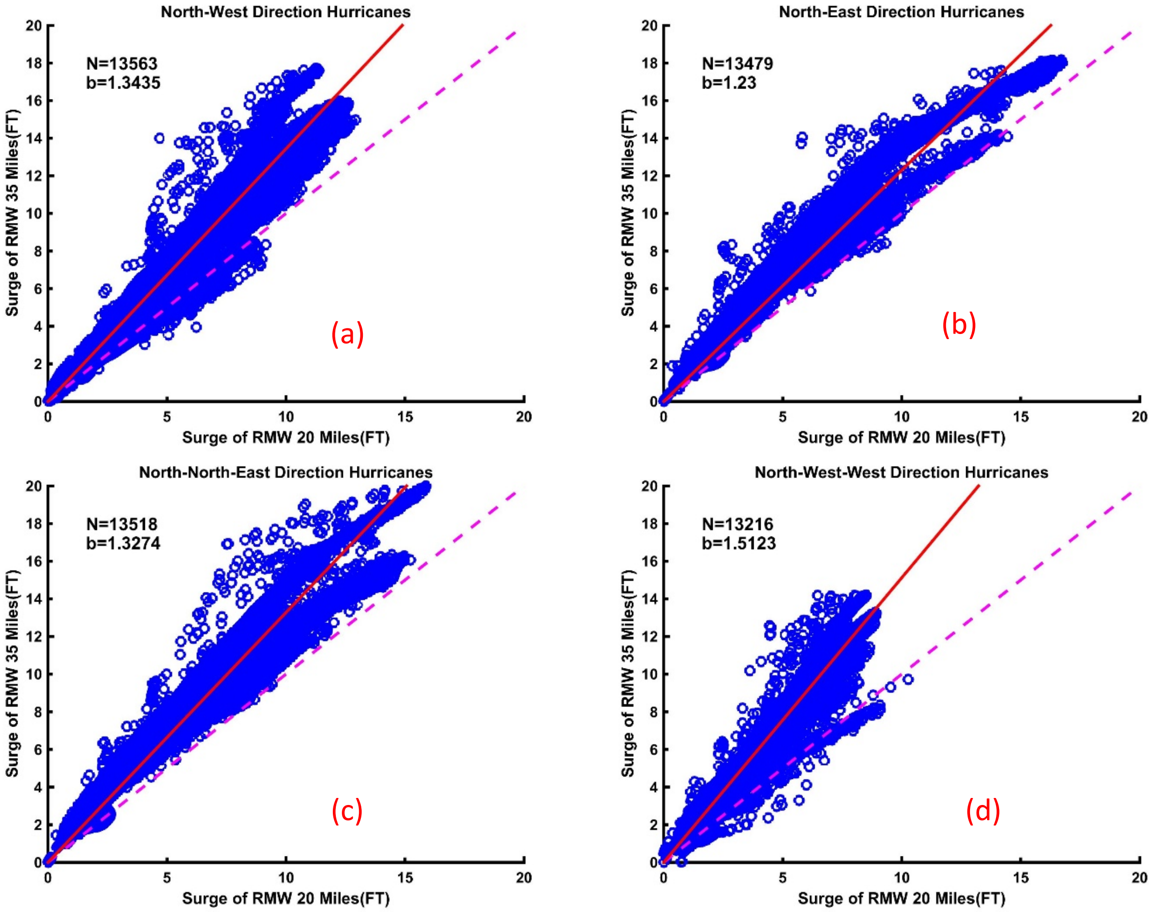


Figure 47. Maximum surge scatter plots between Radius of Maximum Wind (RMW) 20 and 35 miles of Apalachicola Bay Basin (AP3) for North-West (a), North-East (b), North-North-East (c), and North-West-West (d) forwarding directions. The purple dash line is the perfect fit line, and the red line is linear regression line.

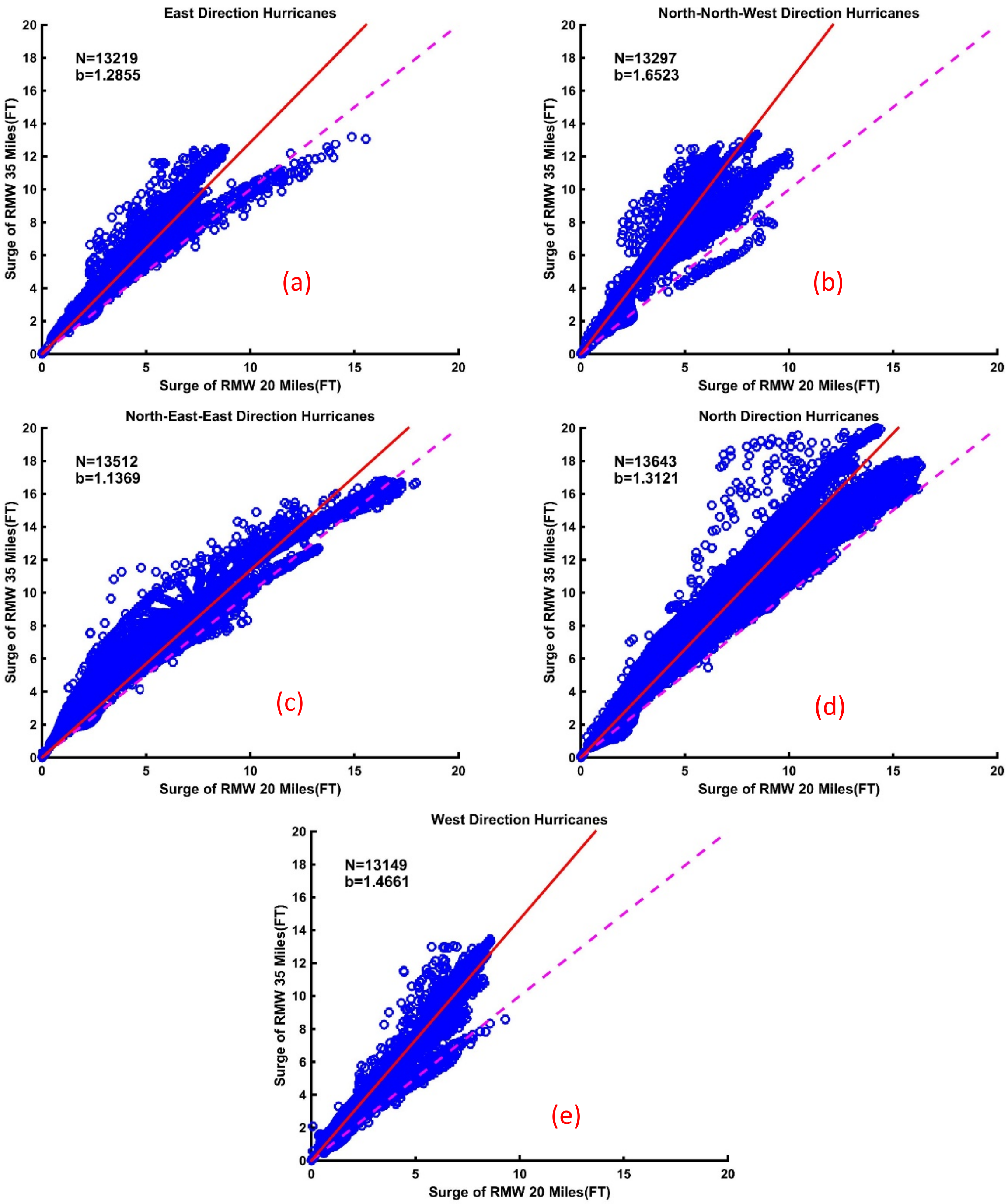


Figure 48. The same as Figure 47 but for East (a), North-North-West (b), North-East-East (c), North (d), and West (e) forwarding directions.

Table 18 describes the maximum Envelope of High Water (EOHW) with 20 (small) and 35 (large) miles RMW storm from nine different directions. It is indicated that the storm sizes correlated with storm surge heights. Table 19 describes the inundation area comparison with 20 (small) and 35 (large) miles storm from nine different direction. The inundations area is highly correlated with storm size also. The statistical analysis of the linear regression results is presented in Table 20. The slope of maximum surge heights between 35 and 20 miles RMW are all larger than 1.2, and R2 are all larger than 0.9, except for the North-North-West direction. This demonstrates that large storm size hurricanes induce higher surge.

Table 18. Comparison of maximum EOHW simulated with 20 (small) and 35 (large) miles RMW storms from nine different directions.

Historical Hurricanes	Maximum EOHW Small Size (ft)	Maximum EOHW Large Size (ft)
North-West	13	17
North-East	16	18
North-North-East	15	19
North-West-West	9	14
East	12	13
North-North-West	9	12
North-East-East	17	16
North	15	20
West	8	12

Table 19. Comparison of the inundation area simulated with 20 (small) and 35 (large) miles RMW storms from nine different directions.

Historical Hurricanes	Inundation Areas Small Size ($10^3 km^2$)	Inundation Areas Large Size ($10^3 km^2$)
North-West	0.985	1.50
North-East	0.892	1.43
North-North-East	0.870	1.48
North-West-West	0.599	1.14
East	1.01	1.30
North-North-West	0.63	1.38
North-East-East	1.18	1.57
North	1.03	1.63
West	0.664	1.03

Table 20. Relationship between maximum EOHW simulated with 20 (small) and 35 (large) miles RMW storms from nine different directions.

Direction	Slope	Mean Square Error	R^2
North-West	1.34	0.72	0.92
North-East	1.23	0.43	0.97
North-North-East	1.33	0.51	0.96
North-West-West	1.51	0.29	0.94
East	1.29	0.31	0.93
North-North-West	1.65	0.48	0.86
North-East-East	1.14	0.44	0.97
North	1.31	0.82	0.95
West	1.47	0.17	0.96

Relationship between storm surge and bathymetry

In this section, for each hurricane forwarding direction (see Figure 42), simulations include 4 different bathymetries of 0.5, 1.0, 1.5, and 2 times of the original depth, with the exactly same simulation start and ending time, and same hurricane track information, same time step, and same Manning coefficient. In other words, only the bathymetry linearly changed, and all other factors held constant.

Figure 49 and Figure 50 present the maximum surge height profiles on the selected cross section at Apalachicola Bay Basin (AP3) for North-West, North-East, North-North-East, North-West-West, East, North-North-West, North-East-East, North, and West direction Hurricanes with 0.5 (a), 1.0 (b), 1.5 (c), and 2.0 (d) times of the original depth respectively. For most cases, the blue line (shallowest) is above the red, purple, and green lines (deepest). For the North-West (Figure 49 a) and North-West-West directions (Figure 49 d), the red line (original depth) is above the blue, purple, and green lines. For the North-North-West (Figure 50 b) direction, the red line (original depth) is almost merged with the blue line (0.5 time of the original depth). The maximum surge profiles demonstrate that shallow water does not enhance the storm surge under certain directions (North-West, North-West-West, North-North-West).

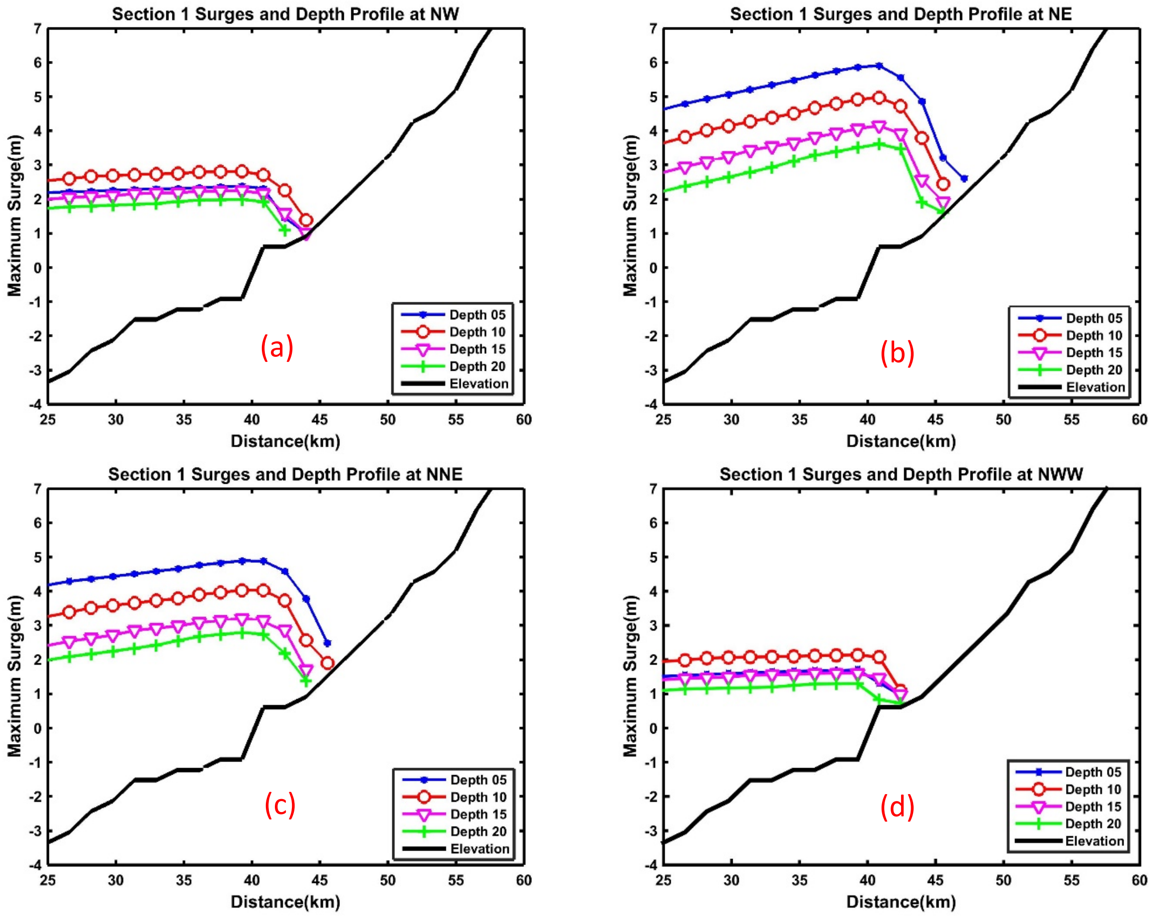


Figure 49. Cross section surge and depth profiles with 0.5 (depth 05), 1.0 (depth 10), 1.5(depth 15), and 2.0 (depth 20) times of original depth at Apalachicola Bay Basin (AP3) for North-West (a), North-East (b), North-North-East (c), and North-West-West (d) forwarding directions.

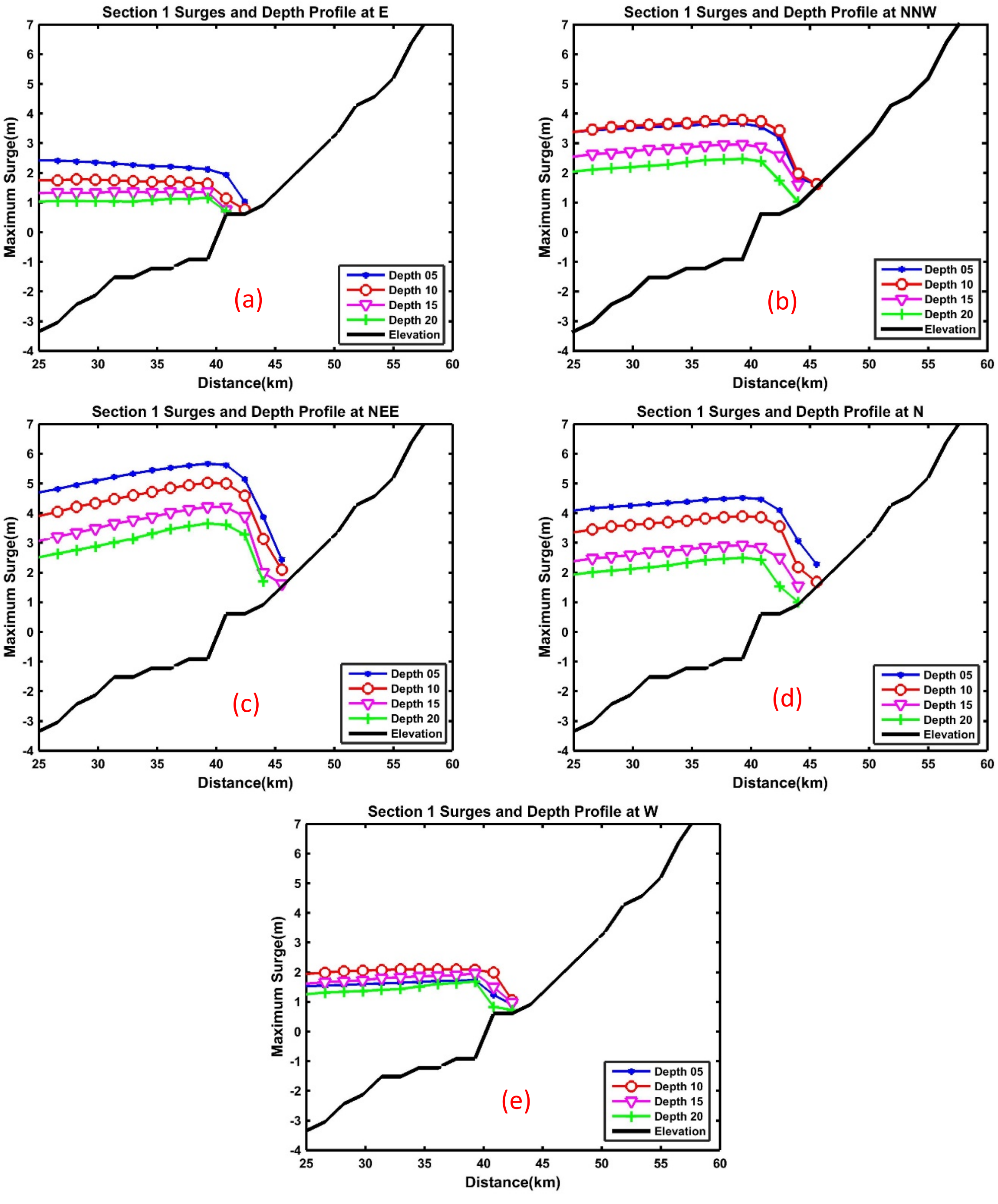


Figure 50. The same as Figure 49 but for East (a), North-North-West (b), North-East-East (c), North (d), and West (e) forwarding directions.

Table 21 describes the maximum EOHW with 0.5, 1.0, 1.5, and 2.0 times of the original depth driven by storms from the nine different directions. It indicates that the bathymetry correlates with storm surge heights. Table 22 presents the inundation areas with 0.5, 1.0, 1.5, and 2.0 times of the original depth driven by the storms from nine different directions. The results indicate that more inland areas are flooded with the shallower bathymetry, except the North-West, North-West-West, North-North-West and West directions.

Table 21. Comparison of maximum EOHW simulated with different depths for the nine storm moving directions.

Historical Hurricanes	Maximum EOHW 0.5 d (ft)	Maximum EOHW 1.0 d (ft)	Maximum EOHW 1.5 d (ft)	Maximum EOHW 2.0 d (ft)
North-West	14	13	11	9
North-East	19	17	13	12
North-North-East	19	16	12	11
North-West-West	11	10	8	8
East	15	15	10	8
North-North-West	17	17	13	11
North-East-East	20	18	14	12
North	19	16	12	10
West	9	9	8	7

Table 22. Comparison of inundation areas simulated with different depths for the nine storm moving directions.

Historical Hurricanes	Inundation Areas 0.5 d ($10^2 km^2$)	Inundation Areas 1.0 d ($10^2 km^2$)	Inundation Areas 1.5 d ($10^2 km^2$)	Inundation Areas 2.0 d ($10^2 km^2$)
North-West	9.42	10.24	9.99	9.37
North-East	12.43	10.29	8.34	7.35
North-North-East	12.91	9.89	7.64	6.49
North-West-West	6.49	7.01	6.06	5.14
East	12.52	10.93	9.07	7.88
North-North-West	11.26	11.74	9.86	8.18
North-East-East	14.87	12.81	10.71	8.90
North	13.15	11.01	7.99	6.62
West	7.32	7.48	7.02	6.27

Relationship between storm surge heights and onshore wind speed

In this section, for each different forwarding direction, simulations include 80 mph (Wind 1), 100 mph (Wind 2), 120 mph (Wind 3), and 140 mph (Wind 4) maximum onshore wind speeds with the same initial surge tide level, same hurricane track information, same grid setup, same time step, and same Manning coefficient. In other words, only the onshore wind speed varied, and all other factors held constant.

Figure 51 and Figure 52 present the maximum surge height profiles on the same selected cross section at AP3 for North-West, North-East, North-North-East, North-West-West, East, North-

North-West, North-East-East, North, and West direction Hurricanes with 80 mph (Wind 1), 100 mph (Wind 2), 120 mph (Wind 3), and 140 mph (Wind 4) maximum onshore wind speeds. For all nine cases, the green line (highest onshore wind speed) is above purple, red, and blue lines (lowest onshore wind speed). The maximum surge profiles further indicate that the higher onshore wind speed generates higher storm surge.

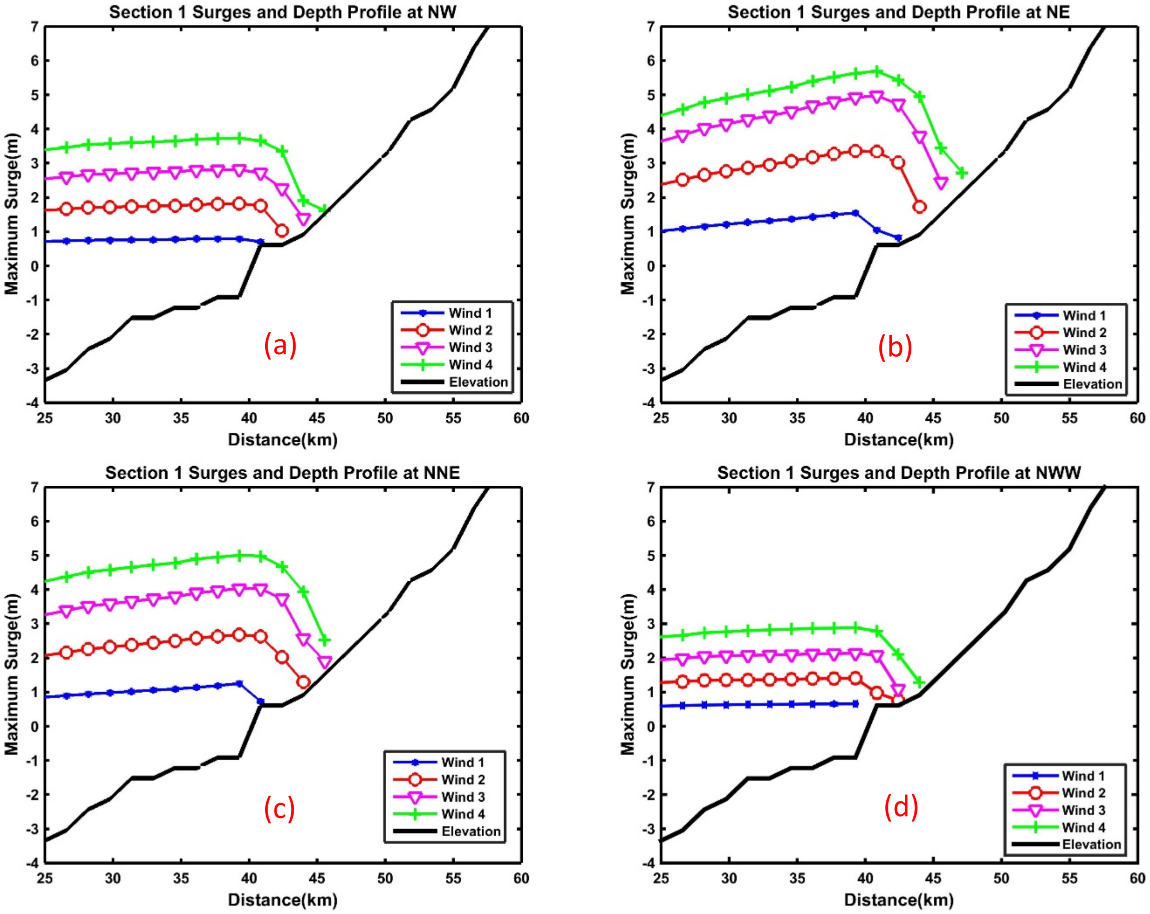


Figure 51. Cross section surge and depth profiles with 80 mph (wind 1), 100 mph (wind 2), 120 mph (wind 3), and 140 mph (wind 4) at Apalachicola Bay Basin (AP3) for North-West (a), North-East (b), North-North-East (c), and North-West-West (d) forwarding directions.

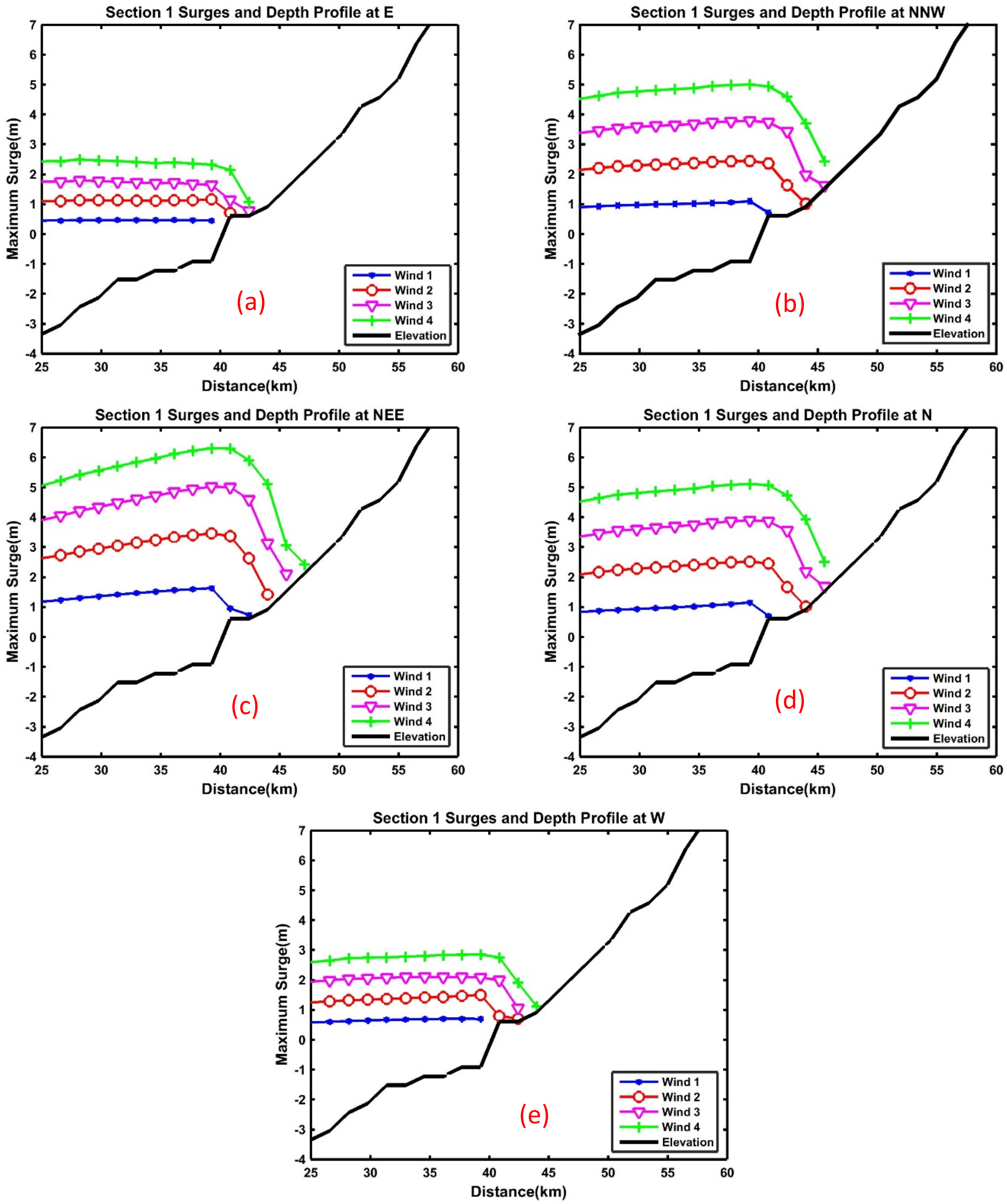


Figure 52. The same as Figure 51 but for East (a), North-North-West (b), North-East-East (c), North (d), and West (e) forwarding directions.

Table 23 and Table 24 show the maximum EOHW and inundation area at Apalachicola Bay Basin (AP3) with 80 mph (Wind 1), 100 mph (Wind 2), 120 mph (Wind 3), and 140 mph (Wind 4) maximum onshore wind speeds. For all nine cases, higher onshore wind speed generates higher storm surge and larger inundation area.

Table 23. Comparison of maximum EOHW simulated with different onshore wind speeds for the nine storm moving directions.

Historical Hurricanes	Maximum EOHW (ft) Wind 1	Maximum EOHW Wind 2 (ft)	Maximum EOHW Wind 3 (ft)	Maximum EOHW Wind 4 (ft)
North-West	4	9	13	16
North-East	5	10	17	19
North-North-East	4	10	16	19
North-West-West	3	6	10	12
East	3	7	15	15
North-North-West	5	11	17	20
North-East-East	5	11	18	21
North	4	10	16	20
West	3	5	9	11

Table 24. Comparison of inundation areas simulated with different onshore wind speeds for the nine storm moving directions.

Historical Hurricanes	Inundation Areas($10^2 km^2$) Wind 1	Inundation Areas($10^2 km^2$) Wind 2	Inundation Areas($10^2 km^2$) Wind 3	Inundation Areas($10^2 km^2$) Wind 4
North-West	1.55	6.18	10.24	12.87
North-East	2.04	5.95	10.29	13.63
North-North-East	1.27	5.28	9.89	13.63
North-West-West	0.627	3.59	7.01	10.18
East	1.94	6.51	10.93	14.03
North-North-West	1.37	6.31	11.74	15.66
North-East-East	2.37	7.27	12.81	16.22
North	1.33	5.64	11.01	12.41
West	0.62	4.07	7.48	11.61

11. Describe the effects of windspeed, depth, fetch, and wind duration on locally generated wave heights or wave proxies for the coastal flood model.

Wave heights and periods at the offshore wave boundaries increase with wind speed, fetch, and depth according to Young and Verhagen (1996) hindcast relations, and to computed bulk setup. Wave properties are not impacted by wind duration, as steady-state relations are used.

12. Describe if and how model flood characteristics are based on or depend on NFIP FIRM or other FIS data.

The flood model characteristics are not based or dependent on NFIP FIRM or FIS data.

13. Provide a completed Form HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability. Provide a link to the location of the form [insert hyperlink here].

Link to Form HHF-2.

14. Provide a completed Form HHF-3, Coastal Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item), if not considered as Trade Secret. Provide a link to the location of the form [insert hyperlink here].

Link to Form HHF-3.

MF-5 Flood Probability Distributions

A. Flood probability, its geographic variation, and the associated flood extent and elevation or depth shall be scientifically defensible and shall be consistent with flooding observed for Florida.

For the coastal surge model, please refer to Form HHF-1 for model validation.

B. Flood probability distributions for storm tide affected areas shall include tropical, and if modeled, non-tropical events.

Flood probability distributions for storm tide affected areas include tropical storms and hurricanes only.

C. Probability distributions for coastal wave conditions, if modeled, shall arise from the same events as the storm tide modeling.

Wave conditions arise from the same probability distribution as is used for the storm tide modeling.

D. Any additional probability distributions of flood parameters and modeled characteristics shall be consistent with historical floods for Florida resulting from coastal and inland flooding.

The coastal surge model parameters are from scientific literature and technical reports. These parameters are mostly fixed values or calculated from equations presented in the supporting literature. All the values and equations are presented in Section GF-1, MF-1, and MF-2. There are no probability distributions used in the coastal surge model.

The inland flood models are deterministic models; therefore, probability distributions were not used in any parameterization.

Disclosures

1. Describe how non-tropical and tropical event coastal storm tide flood probability distributions are combined, if applicable. Provide an example demonstrating the process.

For the current coastal surge model setup, there is no non-tropical event simulation.

2. Provide the rationale for each of the probability distributions used for relevant flood parameters and characteristics.

The coastal surge model parameters are taken from the scientific literature and technical reports. There are no probability distributions used in the coastal surge model.

The inland flood models are deterministic models and thus no probability distributions were used in parameterizing the flood parameters.

3. Demonstrate that simulated flood elevation or depth frequencies are consistent with historical frequencies.

For the storm surge model, the historical hurricane events calibration and validation are presented in Form HHF-1. The results indicate that the simulated flood elevation frequencies are consistent with historical frequencies.

The comparison of historical observations and corresponding model predicted streamflow is documented in SF-1. The values of model performance metrics indicate that model predictions are consistent with historical streamflow frequencies.

HYDROLOGICAL AND HYDRAULIC FLOOD STANDARDS

HHF-1 Flood Parameters (Inputs)

A. Treatment of land use and land cover (LULC) effects shall be consistent with current scientific and technical literature. Any LULC database used shall be consistent with the National Land Cover Database (NLCD) 2016 or later. Use of alternate datasets shall be justified.

The pluvial model uses MRLC NLCD 2016 LULC to estimate the value of the Manning coefficient, which takes into account surface roughness. In addition, the pluvial model used the MRLC NLCD 2016 Impervious Cover data set to modify soil infiltration based on impervious cover.

The riverine flood model accounts for LULC effects through model parameters that are calibrated.

B. Treatment of soil effects on inland flooding shall be consistent with current scientific and technical literature.

In the riverine model, parameters that address the treatment of soil effects (e.g. hydraulic conductivity), are calibrated and are consistent with the current scientific and technical literature.

For the pluvial model, a modified Horton method is used. The Horton method is one of the most commonly used methods in hydrology for infiltration and has been tested in a number of comparative studies and found to be competitive, despite its simplicity (Duan et al. 2011).

C. Treatment of watersheds and hydrologic basins shall be consistent with current scientific and technical literature.

The treatment of watersheds and hydrologic basins in the riverine flood model is consistent with current scientific and technical literature. All basins draining into the state of Florida (Figure 12) are delineated based on the flow accumulation and flow direction grids created from the digital elevation model used for the model setup. The D8 flow method was used for defining drainage direction and connectivity between the model grids.

D. Treatment of hydraulic systems, including conveyance, storage, and hydraulic structures, shall be consistent with current scientific and technical literature.

To the extent that hydraulic systems and structures can be incorporated through modifications of the DEM, they can be included directly in the model simulations to estimate impact on flow and subsequent flooding.

Disclosures

1. For inland flood analyses associated with riverine and lacustrine flooding,

a. Describe how the rivers, lakes, and associated floodplains are segmented (or partitioned) in determining the parameters for flood frequency used in the flood model,

Within the riverine model the entire area of the land surface is discretized according to the spatial resolution of the digital elevation model used and the flood processes are modeled in a spatially distributed manner without any further segmentation.

b. Describe how the interaction between riverine and lacustrine components are represented in the flood model, and

Within the riverine model, lakes are represented as flat topographical features, according to the digital elevation model, and river flow is routed through them without accounting for interaction between river discharge and water level in the lake.

c. If groundwater is accounted for in the flood model, describe how the interaction between groundwater and inland flooding is represented.

The riverine model does not explicitly account for groundwater dynamics but subsurface flow (flow from deeper soil layers) contribution is modeled. Water from a deeper layer reservoir contributes to downstream areas and is routed using a linear reservoir scheme (Wang et al. 2011; Flamig et al. 2020).

2. For inland flood analyses associated with surface water flooding, describe how the affected area is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

There is no explicit partitioning or segmentation used for determining parameters for flood frequency. Flood frequencies are based on simulations of two dimensional flow on a high resolution grid over Florida. For computational purposes, some calculations may be split over tiles to allow efficient parallel computation.

3. Describe any assumptions or calculations used in the inland flood model relating to initial and boundary conditions (e.g., groundwater levels, lake levels, river flows and discharge locations, tides, river confluences, soil moisture).

Soil moisture distribution derived from NLDAS (North America Land Data Assimilation System [NLDAS Project, 2022; Xia et al., 2012]) provided an estimate of the initial soil water present prior to a number of historic storms. The average initial soil water from 33 historic storms is assumed representative for defining initial soil moisture conditions for the riverine model.

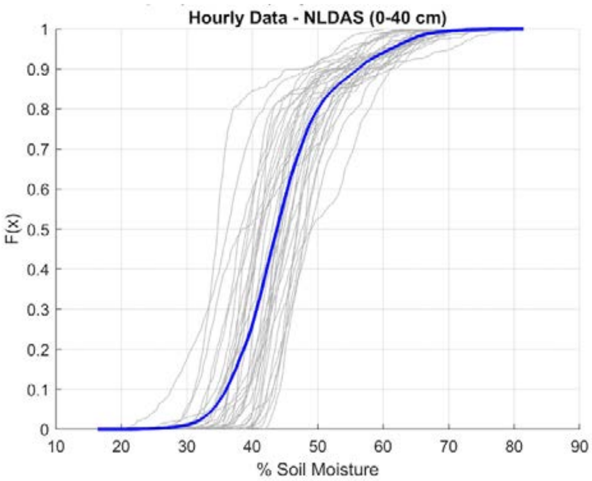


Figure 53. Empirical CDF plot of antecedent soil moisture values for 33 historic storms. Soil moisture estimates are based on NLDAS data extracted for the entire state of FL.

4. Document the sensitivity of the flood model results to assumptions for values of initial and boundary conditions, including soil moisture, lake level, and tide height if relevant.

Initial soil water was varied for a selected domain (downstream of the Caloosahatchee River, Glades County) and selected storm (Hurricane Frances, 2004) in the riverine model. The initial conditions describe a low (20%), moderate (50%) and high (70%) soil water percentage prior to the modeled storm, Frances (2004). Expectedly, flood depths increased with increasing initial soil water conditions (see Figure 54 below).

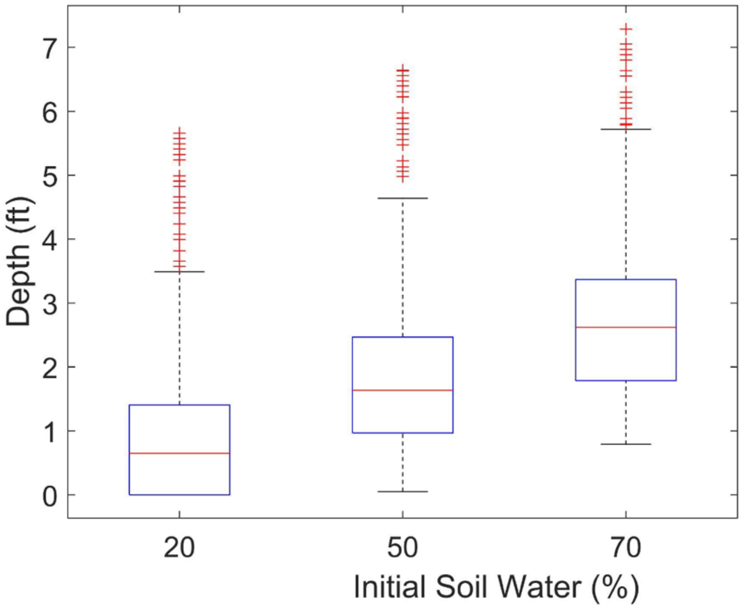


Figure 54. Boxplots of modeled flood depths for the three initial soil moisture scenarios examined.

5. Describe the source and representation of topography in the flood model. Describe the horizontal resolution and the vertical accuracy of the topographic representation. Identify the horizontal and vertical datum of the topographic information. Describe any modeling organization modifications to the topographic representation. Describe the sensitivity of simulated floods to uncertainties in the topographic representation.

The riverine model aggregated the DEM (USGS) from one arc-second (~30 m) to three arc-seconds (~90 m) for the Florida domain. The DEM undergoes hydrologic conditioning where any localized depressions or pits are filled to account for artifacts in the DEM and ensure continuity of flow paths. The horizontal coordinate system used is WGS84 and the DEM retains the vertical datum reference from USGS, NAVD88 with elevation in meters. No other modifications were applied to the DEM. Riverine model results are to a certain degree sensitive to the accuracy and spatial resolution of the DEM used. To improve representation of flood model output at an original three arc-sec resolution, the riverine flood results are downscaled using as reference a 5-m, LIDAR-based DEM that has been mosaicked for the domain (FGDL, Aug 2020).

The pluvial model used a DEM of one arc-second (~30 m) resolution using WGS84 Latitude-Longitude coordinates. The vertical datum is NAVD88 with units of meters. The flood results are downscaled to a resolution of 5 m using a mosaic of DEM LIDAR-based products over the State of Florida. Currently no modifications of the DEM have been done. However, modifications may be necessary at some point in the future to implement flood control measures or to correct errors in the DEM.

The pluvial model results are sensitive to the uncertainties in the DEM, especially due to the underlying resolution of the DEM. The effective resolution of the DEM may not necessarily be representative of the actual grid resolution, especially if LIDAR data has not been incorporated. We have an ongoing effort to migrate all DEM to more recent LIDAR-based products.

6. Provide the grid resolution or other area partitioning used to model the inland flood extent and depth and how the hydrological and hydraulic characteristics are determined on these scales.

The grid resolution for the riverine flood model was at 3 arcsec (~90m) resolution. All basic grids such as the Digital Elevation Maps (DEM), Flow Direction and Flow Accumulation Grids are provided to the model at this resolution. Hydrologic and hydraulic parameters were obtained via parameter calibration.

The flood maps produced by the pluvial model were done at 1 arcsec (~30m) resolution based on the DEM used. The pluvial model uses the input DEM raster as the computational grid. The associated characteristics, such as roughness, imperviousness, soil type, etc. are determined by using high resolution datasets that have been interpolated, typically using a “nearest-neighbor” approach, to the model grid.

7. Describe any assumptions or calculations used in the inland flood model relating to flood-induced erosion or topographic changes.

Flood-induced erosion is not specifically addressed in the inland flood models. The Digital Elevation Maps (sourced from the USGS 1-arc-second products) and its derivatives (flow direction and flow accumulation maps) are the basic grids which are provided to the models as they are updated and verified.

8. Provide citations to all data sources used to develop and support the land-use evaluation methodology, including publicly-developed or peer-reviewed information.

Dewitz, J., 2019, National Land Cover Database (NLCD) 2016 Products (ver. 3.0, November 2023): U.S. Geological Survey data release, https://doi.org/10.5066/P96HHBIE.

9. Provide the collection and publication dates of the LULC and soil data used in the flood model, and justify the applicability and timeliness of the data for Florida.

The pluvial model used the 2016 MRLC NLCD to determine the Manning's n coefficient. Soil types are based on the Global Hydrologic Soil Group 1566, released April 22, 2020 by the Oak Ridge National Laboratory.

10. Describe the methodology used to convert LULC information into a spatial distribution of hydrological parameters, including roughness coefficients, throughout the flood model domain.

In the pluvial model, the LULC type was mapped to a roughness coefficient using a table adopted from the well-known HEC-RAS 2D model.

11. Describe the methods used to account for soil infiltration and percolation rates and soil moisture conditions in the inland flood model, if applicable. Provide citations to all data sources used to develop and support the soil infiltration and percolation rates and soil moisture conditions methodology, including publicly-developed or peer-reviewed information. Justify the selection of antecedent soil conditions.

The pluvial model uses a modified Horton method to account for soil infiltration. The original Horton equation was modified to include a term to take into account antecedent soil moisture conditions. The soil infiltration parameters are those recommended for use in the SWMM model's implementation of the Horton Method (https://help.innovyze.com/display/xps/Infiltration). The soil infiltration parameters depend on soil type, which is based on the hydrologic soil group. The database used for the soil group was obtained from the Oak Ridge National Laboratory (https://daac.ornl.gov/SOILS/guides/Global_Hydrologic_Soil_Group.html). For historical event simulation, the NLDAS can be used to obtain estimates of the initial soil moisture condition. For stochastic simulations, currently we use an "average risk" initial condition where the antecedent soil moisture parameter is set to 0.5. Sensitivity tests confirm that a value of 0.5 produces loss costs that are close to the average of loss costs over a uniform range of likely soil moisture conditions.

For the riverine model, infiltration is parameterized according to a variable infiltration capacity curve, which has been widely used and as a concept originates from Xinanjiang model (Liang et al. 1996; Liu et al. 2009). Parameter values for the infiltration capacity curve were calibrated using the DREAM (Differential Evolution Adaptive Metropolis) method (Vrugt et al. 2009) following recommendations on their range of values from EF5's development team (http://ef5.ou.edu). Initial soil moisture conditions were either calibrated (for historic storms) or similar to pluvial, a value was determined from NLDAS dataset, (NLDAS, [NLDAS Project, 2022; Xia et al., 2012]), to characterize normal wetness conditions that were used for the stochastic set. All other soil parameters were calibrated in the riverine model.

References

Liang, X., Lettenmaier, D. P., & Wood, E. F. (1996). One-dimensional statistical dynamic representation of subgrid spatial variability of precipitation in the two-layer variable infiltration capacity model. Journal of Geophysical Research: Atmospheres, 101(D16), 21403-21422.

Liu, J., Chen, X., Zhang, J., & Flury, M. (2009). Coupling the Xinanjiang model to a kinematic flow model based on digital drainage networks for flood forecasting. Hydrological Processes: An International Journal, 23(9), 1337-1348.

NLDAS project (2022), NLDAS Noah Land Surface Model L4 Monthly 0.125 x 0.125 degree V2.0, Edited by David M. Mocko, NASA/GSFC/HSL, Greenbelt, Maryland, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: [06/21/2023], 10.5067/WB224IA3PVOJ

Vrugt, J. A., Ter Braak, C. J. F., Diks, C. G. H., Robinson, B. A., Hyman, J. M., & Higdon, D. (2009). Accelerating Markov chain Monte Carlo simulation by differential evolution with self-adaptive randomized subspace sampling. International journal of nonlinear sciences and numerical simulation, 10(3), 273-290.

Xia, Y., K. Mitchell, M. Ek, J. Sheffield, B. Cosgrove, E. Wood, L. Luo, C. Alonge, H. Wei, J. Meng, B. Livneh, D. Lettenmaier, V. Koren, Q. Duan, K. Mo, Y. Fan, and D. Mocko (2012). Continental-scale water and energy flux analysis and validation for the North American Land Data Assimilation System project phase 2 (NLDAS-2): 1. Intercomparison and application of model products. J. Geophys. Res., 117, D03109, doi:10.1029/2011JD016048

12. Describe the methods used to develop watershed and hydrologic basin boundaries, and the hydrologic connectivity in the flood model, or any assumptions used in lieu of representing watersheds and hydrologic basins in the flood model.

In the inland models, the entire land surface is modeled using a distributed approach based on a grid with cells that are connected according to the overland flow paths. Therefore, no specific boundaries are provided as input to segment the model domain into watersheds.

13. Describe the methods used to develop the hydraulic network (e.g., riverine, lacustrine) in the flood model, the treatment of hydraulic structures (e.g., bridges, culverts) within the hydraulic network, and any assumptions used in lieu of the physical representation of hydraulic structures in the flood model.

The stream network for the riverine model was delineated from the flow accumulation map for the FL domain and compared against the NHD network (USGS) for consistency (to ensure that pertinent river paths were captured).

Hydraulic structures, such as levees, are represented to the degree that they are captured by the topographic data used. Culverts are not currently incorporated into the model.

14. Characterize the hydrologic and hydraulic mathematical models used, and the corresponding sources and citations.

The pluvial model uses Manning's equation for flow velocity, and the Horton method for soil infiltration (Chow et al. 1988).

The riverine model, EF5 (https://github.com/HyDROSLab/EF5) is open source and is based on the CREST model for the water balance (Flamig et al. 2020), a linear reservoir routing scheme for subsurface flow routing (Wang et al. 2011) and the kinematic wave routing for overland flow routing (Vergara et al. 2016).

References

Chow, V.T., Maidment, D. R., & Mays, L. W. (1988). *Applied hydrology*.

Flamig, Z.L., Vergara, H. and Gourley, J.J., 2020. The ensemble framework for flash flood forecasting (EF5) v1. 2: Description and case study. Geoscientific Model Development, 13(10), pp.4943-4958.

Vergara, H., Kirstetter, P.E., Gourley, J.J., Flamig, Z.L., Hong, Y., Arthur, A. and Kolar, R., 2016. Estimating a-priori kinematic wave model parameters based on regionalization for flash flood forecasting in the Conterminous United States. Journal of Hydrology, 541, pp.421-433.

Wang, J., Hong, Y., Li, L., Gourley, J.J., Khan, S.I., Yilmaz, K.K., Adler, R.F., Policelli, F.S., Habib, S., Irwn, D. and Limaye, A.S., 2011. The coupled routing and excess storage (CREST) distributed hydrological model. Hydrological sciences journal, 56(1), pp.84-98.

15. Describe if and how flood model parameters are based on or depend on NFIP FIRM or other FIS data.

The flood model parameters are not based or dependent on NFIP FIRM or FIS data.

HHF-2 Flood Characteristics (Outputs)

A. Flood extent and elevation or depth generated by the flood model shall be consistent with observed historical floods affecting Florida.

The flood extent and depths are consistent with observed historical floods in Florida and were validated through various means such as those described in Disclosure 7.

B. Methods for deriving flood extent and depth shall be scientifically defensible and technically sound.

The methods for deriving flood extent and depth are scientifically defensible and technically sound. The riverine model is based on EF5 which serves as the core of the U.S. National Weather Service operational flash flood forecasting service, and is widely used and studied by the community. The pluvial model utilizes the well-known Manning's equation, a modified Horton method, and incorporates a number of important physical effects such as duration, roughness, and soil moisture.

For the storm surge model CEST, the flood extent and depth are directly derived from the surface elevation (that is solved for in the model) and the DEM data (the ground elevation). This is a common method for most of the storm surge models found in the literature.

C. Modeled flood characteristics shall be sufficient for the calculation of flood damage.

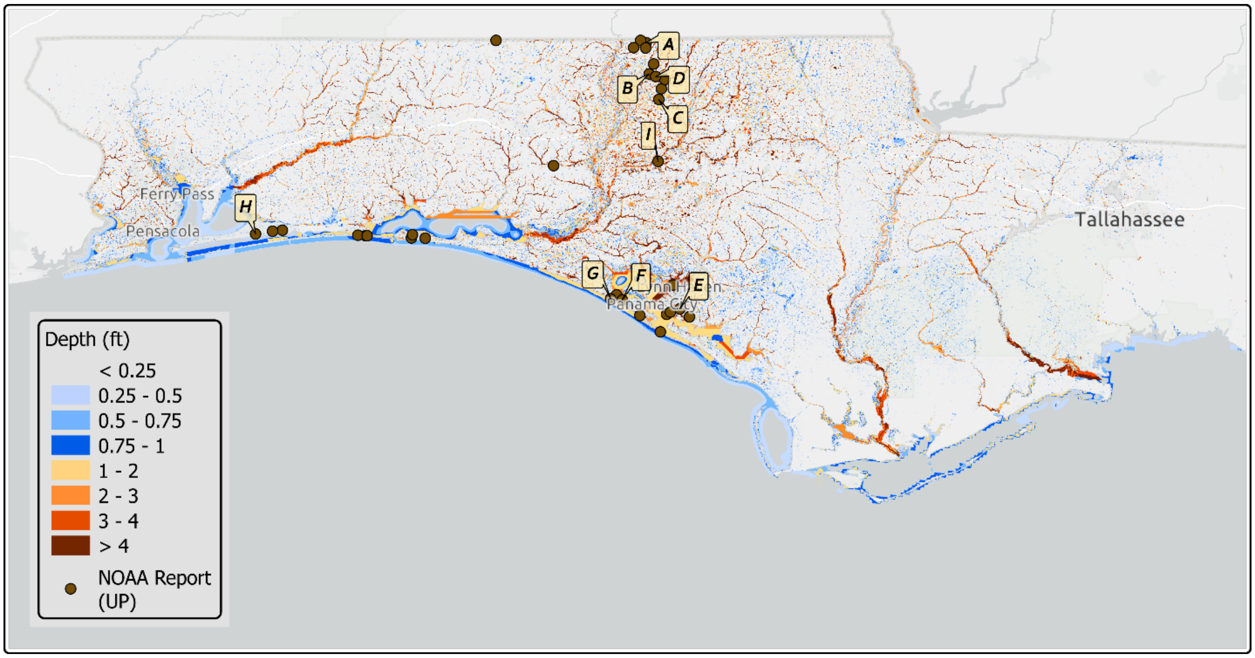
The inland model components produce a time-dependent flow and accumulation of water during an event at high spatial resolution (property level). The maximum flood depth is retained for the calculation of damage. The vulnerability functions for inland flood depend solely on the peak flood depth at a property location. This is also the case for the coastal flood model, which outputs the maximum water elevations all over the computational domain during a storm event.

Disclosures

1. Provide comparisons of the modeled and historical flood extents and elevations or depths for the storm events listed in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps. For any storms where sufficient data are not available, the modeling organization may substitute an alternate historical storm of their choosing. Describe how each substituted storm provides similar coastal and inland flooding characteristics to the storm being replaced.

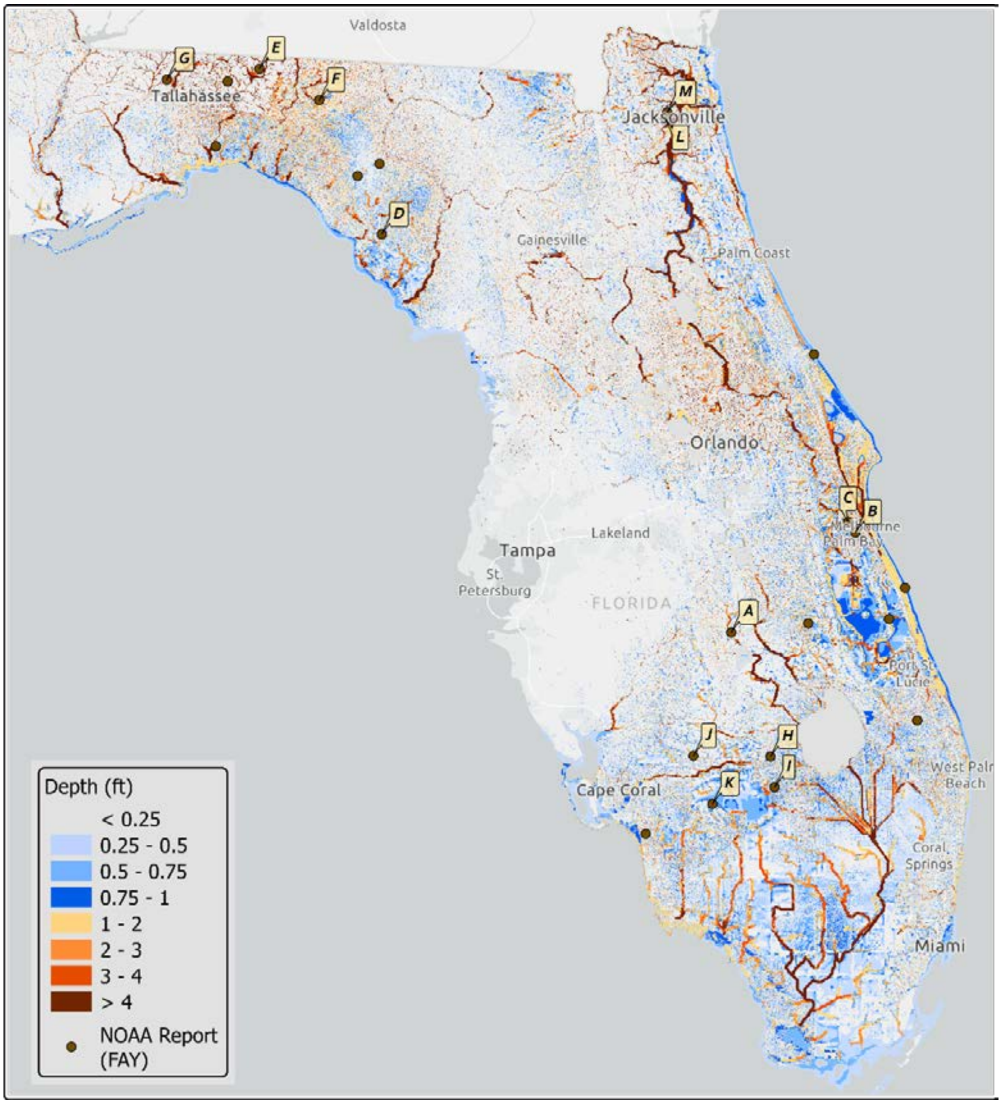
All storms are presented in Form HHF-1. A sample set only is included for this disclosure.

Specifically, the three cases are shown: (1) the Unnamed Storm in Panhandle (2013); (2) Tropical Storm Fay (2008) and (3) Hurricane Irma (2017). NOAA Reports for each storm which mostly includes broad descriptions of flood episodes for each event and some measurements of depths were used for comparison.



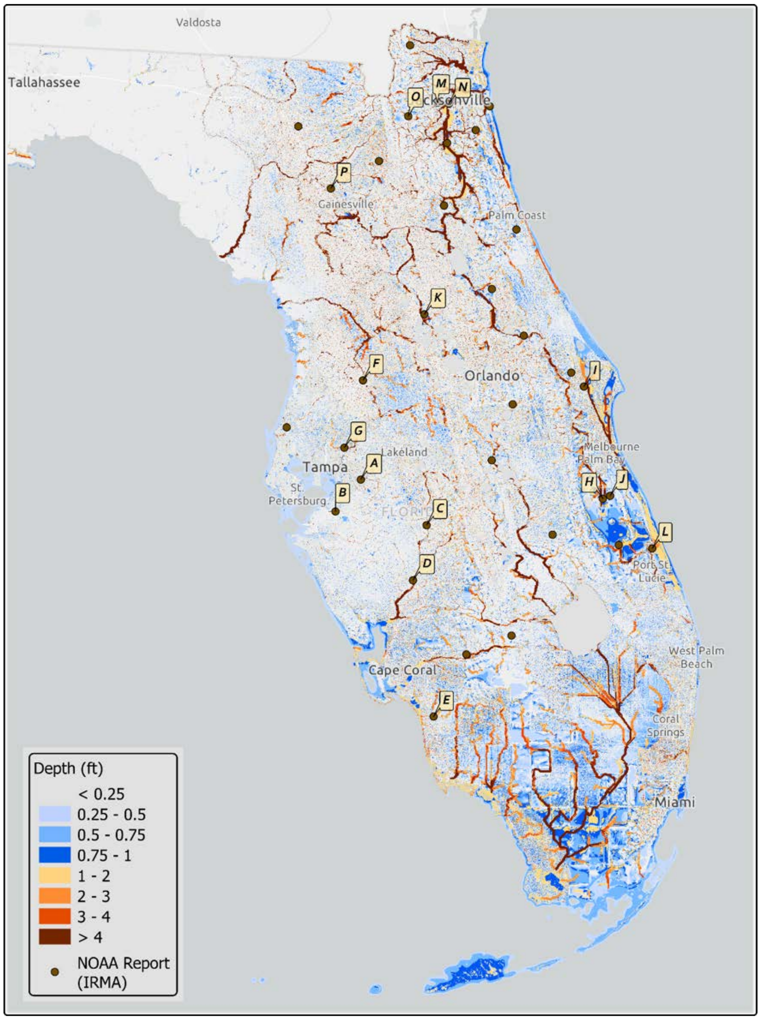
TAG	Latitude	Longitude	NOAA Report (UP)	Modeled Depth
A	30.983	-85.748	Wa Clark Rd, Holmes closed	3+ ft
B	30.888	-85.740	Tup McWaters Rd, Holmes closed	0.5 to 3+ ft
C	30.811	-85.710	Water atop East Longround Bay Road	~3 ft water along the said road, adjacent to channel
D	30.880	-85.719	Howell Williams Rd flooded at the bridge	>2 ft spilling over Little and Tenmile Creeks near the road
E	30.175	-85.646	Knee deep water at corner of Frank Nelson Dr and Mercedes Ave	0.5 to 1.67 ft
F	30.202	-85.821	0.5 ft initially that rose as rains continued for hours	0.5 to 2.5 ft
G	30.206	-85.856	1.5 ft at Front Beach Rd	1.25 to 2.1 ft
H	30.403	-86.935	0.5+ ft ; Northbound lane of Sunrise Drive at U.S. Highway 98 closed	0.4 to 0.83 ft
I	30.623	-85.712	Water entered homes in/around Vernon;	1 to 2 ft

Figure 55. Modeled Flood Extent/Depth with NOAA Reported Validation for Unnamed Storm in Panhandle (2013).



TAG	Latitude	Longitude	NOAA Report (Fay)	Modeled Depth
A	27.505	-81.341	Homes along Arbuckle Creek flooded.	0.5 to 0.83ft; 2.5ft near banks
B	28.054	-80.659	1600+ homes flooded in Brevard County	W. Melbourne: ~0.5 to 3.75+ ft
C	28.111	-80.700	N. John Rhodes Blvd, Melbourne closed	0.6 to 2 ft
D	29.690	-83.259	Roads (US Highway 19/27) Streets closed	0.83 to 2 ft
E	30.599	-83.932	Road/low-lying areas flooded	1 to 3 ft
F	30.426	-83.603	US Highway 90 flooded – pond overflow	1.5 to 3 ft
G	30.539	-84.440	Areas near Ochlockonee River flooded	0.83 to 3 ft
K	26.564	-81.444	Heavy rains inundate parts Felda, Hendry	0.5 to 1.4 ft
I	26.655	-81.103	Extensive flooding in Montana, Hendry	0.5 to 1.4+ ft
J	26.828	-81.548	Homes flooded in Muse, Glades	0.3 to 2.3+ ft
M	30.360	-81.692	Moncrief Creek overflow to nearby areas	0.75 to 2.6+ ft beyond banks
L	30.3244	-81.701	McCoys Creek overflow to nearby areas	1.2 to 2.5+ ft beyond banks
H	26.823	-81.125	Homes inundated in Moore Haven, Glades	0.6 to 2 ft

Figure 56. The same as Figure 55 but for Tropical Storm Fay (2008).

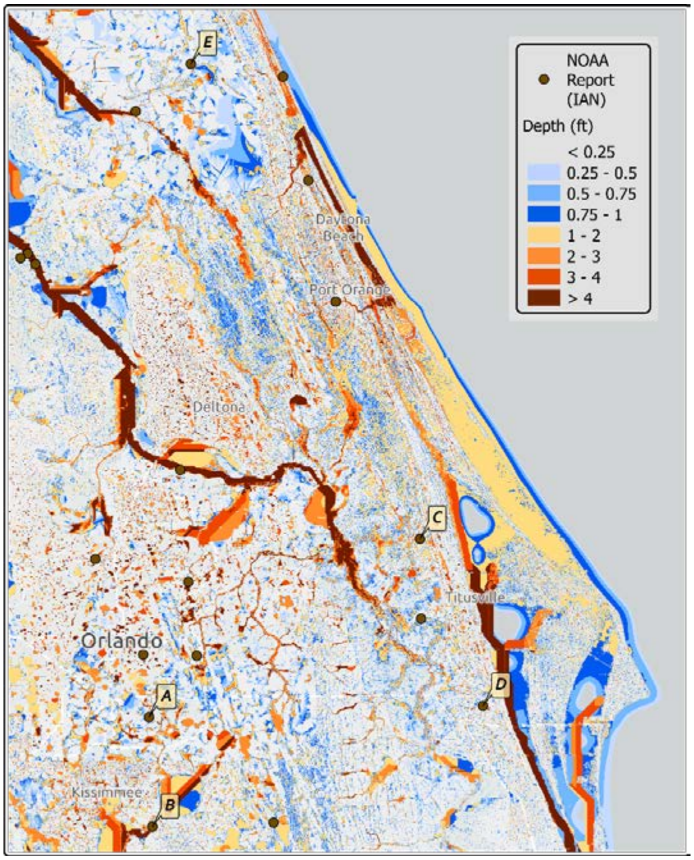


TAG	Latitude	Longitude	NOAA Report (Irma); *MFT = Major Flood threshold	Modeled Depth (ft)
A	27.874	-82.228	Alafia River at Lithia; 3.79ft > MFT	2.5 to 3.3+
B	27.667	-82.391	Little Manatee River, Wimauma 0.69ft > MFT	0.5 to 3+
C	27.578	-81.801	Peach River at Zolfo Spring; 1.85ft > MFT	1 to 2.5+
D	27.221	-81.890	Peace River at Arcadia 3.20ft > MFT	2 to 3.3+
E	26.338	-81.757	Homes flooded near Imperial River	0.5 to 3+
F	28.517	-82.213	Withlacoochee River, Trilby; 1.17ft > MFT	0.5 to 2.6+
G	28.081	-82.334	Homes/Bridges inundated near Hillsborough R.	0.3 to 2.5+
H	27.749	-80.659	Flood near Fellsmere; overflow from ponds	0.5 to 3.3+
I	28.477	-80.783	US Highway 1, Port St. John & N Merritt Island, roads flood	0.6 to 2.6
J	27.769	-80.613	Flood near Fellsmere Elementary School	0.5 to 1
K	28.945	-81.816	Overflowing ponds	0.5 to 1.6
L	27.427	-80.340	4ft in front of Ft. Pierce Police Station on US Highway 1	2.5 to 4.2+
M	30.317	-81.730	Home flooded near Murray Hill, Jacksonville	0.4 to 1.6+
N	30.310	-81.657	Historic flooding near San Marco	> 9
O	30.229	-81.920	Yellow Water Ck, Normandy Blvd overflowed	2.5+
P	29.760	-82.422	Turkey Ck overflowed to NW Creek Dr	1+

Figure 57. The same as Figure 55 but for Hurricane Irma (2017).

2. Demonstrate that the inland flood model component incorporates flood parameters necessary for simulating inland flood damage and accommodates the varied geographic, geologic, hydrologic, hydraulic, and LULC conditions in Florida. Provide justification for validation using any historical events not specified in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps.

The inland flood model incorporates the model parameters presented in section 4 below, which are spatially distributed and thus account for spatial variations in geologic, hydrologic, hydraulic, and LULC conditions in Florida. A map of modeled flood depth for the case of hurricane Ian, not included in historical events in Form HHF-1, is presented in Figure 58. Modeled flood depths are compared against flood depth information from NOAA reports as a form of validation.



TAG	Latitude	Longitude	NOAA Report	Modeled Depth (ft)
A	28.418	-81.335	3-5ft water north of MCO	2.75 to 5+
B	28.241	-81.329	> 3ft along Highway near St. Cloud	2.5 to 4+
C	28.706	-80.897	> 3ft in Mims & Scottsmoor residential areas	2 to 3.75+
D	28.436	-80.795	> 3ft in communities in/near Cocoa & Port St. John	2 to 2.3
E	29.474	-81.267	0.5 - 1 ft flood water covers State Road 100	0.4 to 1.25

Figure 58. Modeled Case of Hurricane Ian in North/East Florida. A comparison with reported flood depths from the NOAA Flood database is shown in the table for all tags in the figure.

3. For each of the storm events in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps, resulting in inland flooding, provide a comparison of the modeled flood flow to recorded flow data from selected USGS or FWMD gauging stations. Provide the rationale for gauging station selections.

The USGS gauging stations selected were:
1. Located in a reported area affected by inland flooding.
2. There were no flags from USGS indicating missing data or notable potential error for the duration of the modeled storm event.

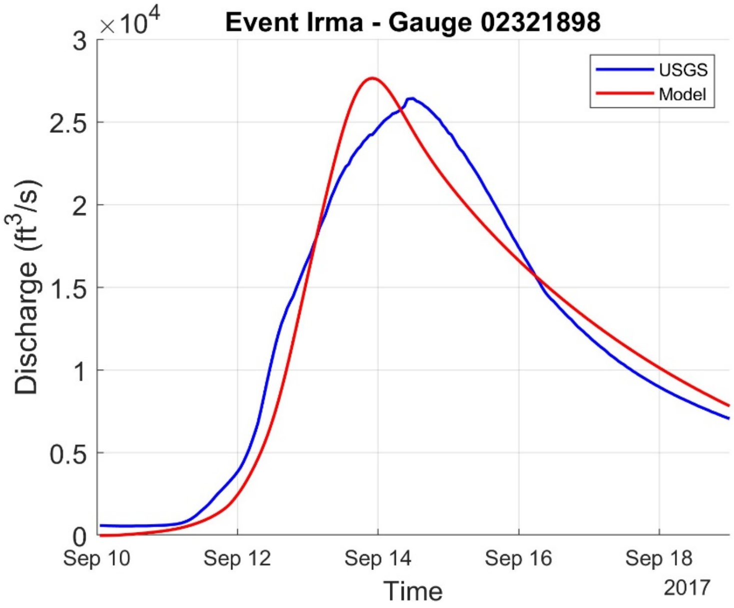


Figure 59. Comparison of the modeled riverine flood flow to recorded flow data for Hurricane Irma (2017) from selected USGS gauging station 02321898 located at Santa FE River at O'leno State Park.

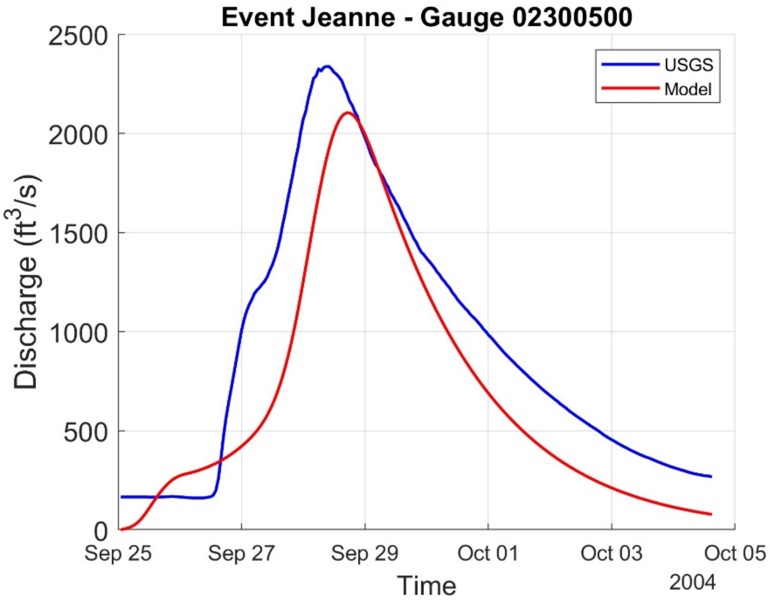


Figure 60. Comparison of the modeled riverine flood flow to recorded flow data for Hurricane Jeanne (2004) from selected USGS gauging station 02300500 located at Little Manatee River at US 301 Near Wimauma.

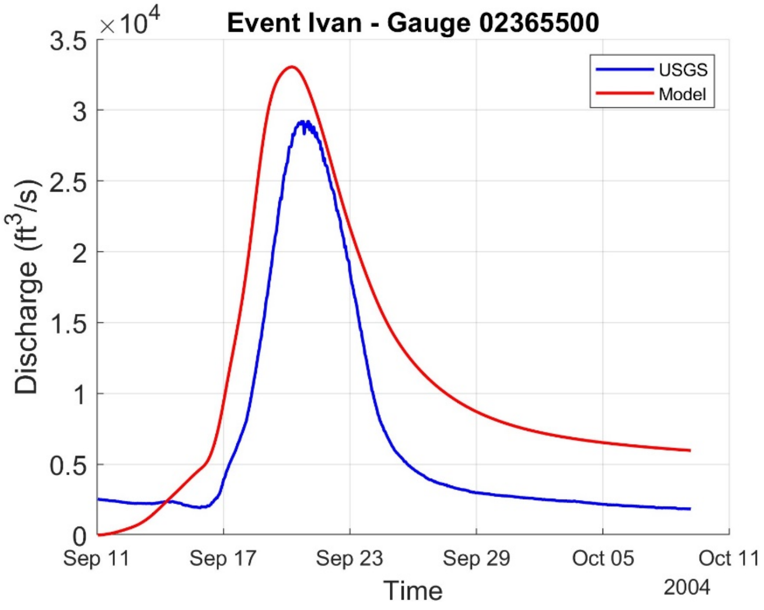


Figure 61. Comparison of the modeled riverine flood flow to recorded flow data for Hurricane Ivan (2004) from selected USGS gauging station 02365500 located at Choctawhatchee River at Caryville.

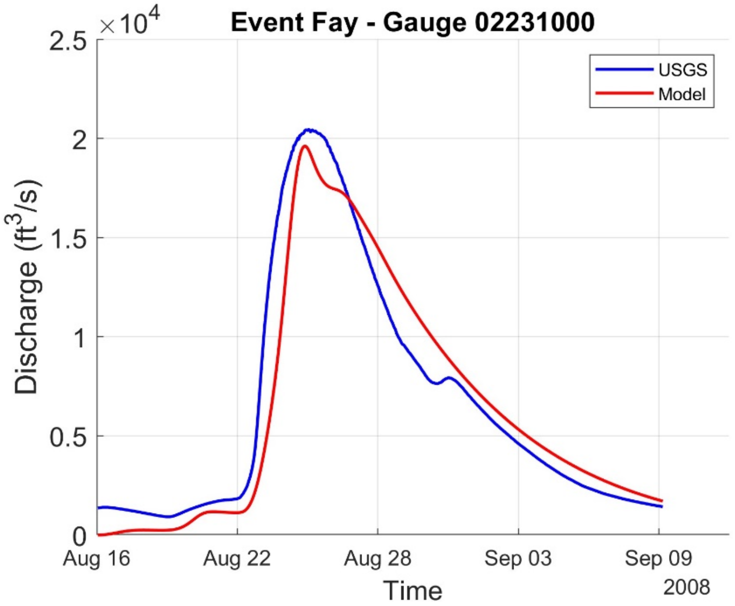


Figure 62. Comparison of the modeled riverine flood flow to recorded flow data for Tropical Storm Fay (2008) from selected USGS gauging station 02231000 located at St. Mary's River Near Macclenny.

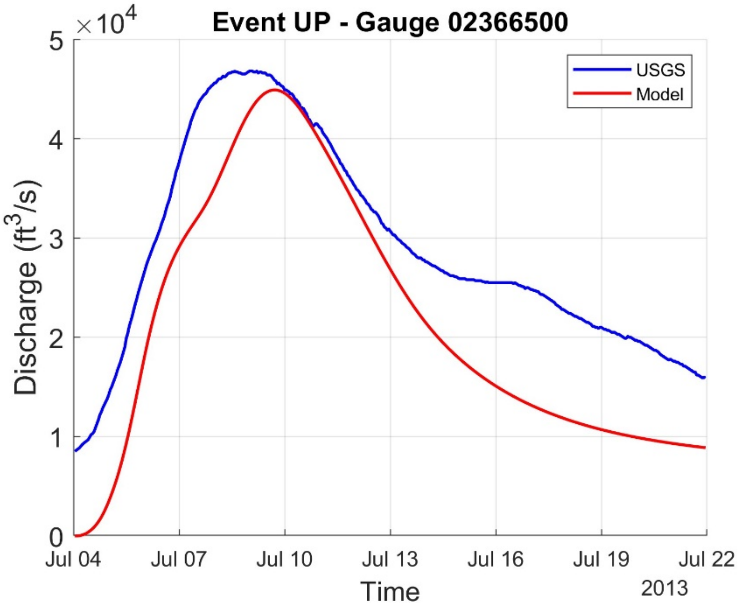


Figure 63. Comparison of the modeled riverine flood flow to recorded flow data for Unnamed Storm in the Panhandle (2013) from selected USGS gauging station 02366500 located at Choctawhatchee River NR Bruce.

4. Identify all hydrological and hydraulic variables that affect the flood extent, elevation, depth, and other flood characteristics. Provide the units of these variables.

Hydrological and Hydraulic Variables	**Units**
Precipitation depth	mm
Precipitation duration	hours
soil moisture	fraction of saturation
soil infiltration rates	mm/h
Manning Coef.	$s/m^{1/3}$
Impervious Cover	fraction
Vegetative Cover	fraction
Soil Type	category
Water capacity of soil	mm
Saturated hydraulic conductivity	mm/h
Exponent parameter of the variable infiltration curve that controls surface runoff generation	-
Potential evapotranspiration	mm
Slope (overland and channel)	m/m
Stage-Discharge power law parameters	-
Digital Elevation Model	m
Channel/Hillslope area threshold	m^2

5. For inland flood modeling, describe if and how the flood model accounts for flood velocity, flood duration, flood-induced erosion, floodborne debris, and contaminated floodwaters.

Currently, the inland model does not account for flood velocity (calculated internally, but not retained for loss calculation), erosion, debris or contamination. However, the model does account for duration by considering the time variation of the input precipitation. Both the pluvial and fluvial components compute the time evolution of the surface water flow with varying input precipitation, though only the maximum flood depth for an event is retained for loss calculation.

6. Describe the effect of any assumptions or calculations relating to initial and boundary conditions on the flood characteristics.

For the pluvial model, the initial soil wetness can be specified via the antecedent soil moisture parameter, which can vary from “0” (“bone dry”) to “1” (“fully saturated”). Similarly, for the riverine model initial soil moisture conditions are specified via the initial soil saturation (%) parameter that varies from “0” (“bone dry”) to “100” (“fully saturated”). In Florida, we find that these values are typically in a smaller range: 0.3-0.7 (or equivalently 30-70%). In wet conditions, soil infiltration capacity is reduced, which can lead to higher generation of surface runoff.

For the surge model, the tidal boundary conditions are generated using seven tidal constituents M2, S2, N2, K1, O1, K2, and Q1, which are obtained from the U.S. Army Corps of Engineers (USACE) East Coast 2001 database of tidal constituents. When the storm surge peak coincides with the high tide, the tide boundary accuracy could have an effect on the coastal flood characteristics.

7. Describe and justify the appropriateness of the databases and methods used for the calibration and validation of flood extent and elevation or depth.

In the case of pluvial flooding, direct observation of flood depth and extent are nearly non-existent at this time. For validation of the pluvial model, we have indirectly validated the flood depths and/or extents in the following ways: (1) comparison with NFIP flood zones (100 yr flood plain), (2) comparison of modeled flooded locations with NFIP claims data (up to 2014), (3) comparison with other state-of-the-art flood models (e.g. "LISFLOOD"), (4) NOAA and other reports.

For the riverine model, simulated discharge is compared against observed flow records at several USGS stream gauges. Comparison of flood depths and extents is carried out against NFIP flood zones and NOAA reports.

For the storm surge model, three types of data are used to validate the model: (1) time series at NOAA tide and current gauges (https://tidesandcurrents.noaa.gov/), (2) inundation maps or debris line (https://www.fema.gov/hurricane-ivan-surge-inundation-maps), and (3) High Water Mark (HWM) collected by different agents like FEMA, URS, or USGS.

8. Describe any variations in the treatment of the flood model flood extent and elevation or depth for stochastic versus historical floods, and justify this variation.

The output from the Inland flood model (flood depth and extent) are used in the same manner for stochastic and historical flood simulations. This is also the case for the storm surge model.

9. Identify whether flood characteristics are based on or depend on NFIP FIRM or other FIS data.

The modeled flood characteristics are not based or dependent on NFIP FIRM or FIS data.

10. Provide a completed Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps. Provide a link to the location of the form [insert hyperlink here].

Link to Form HHF-1.

11. Provide a completed Form HHF-4, Inland Flood Characteristics by Annual Exceedance Probability. Provide a link to the location of the form [insert hyperlink here].

Link to Form HHF-4.

12. Provide a completed Form HHF-5, Inland Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item), if not considered as Trade Secret. Provide a link to the location of the form [insert hyperlink here].

Link to Form HHF-5.

HHF-3 Modeling of Major Flood Control Measures

A. The flood model's treatment of major flood control measures and their performance shall be consistent with available information and current state-of-the-science.

Major flood control measures are consistent with state-of-the-science and available information. Within the inland model, flood control measures are treated as barriers along the floodplain. Elevation profiles from the USGS DEM data were taken at the location of major levees (identified from the National Levee Database) to verify the topographic signature and representation of these barriers in our model input.

B. The modeling organization shall have a documented procedure for reviewing and updating information about major flood control measures and if justified, shall update the flood model flood control databases.

A database with information of all levees in Florida, as described in the National Levee Database, is maintained and if needed it will be updated according to CIF-7, part A.

C. Treatment of the potential failure of major flood control measures shall be based upon current scientific and technical literature, empirical studies, or engineering analyses.

Treatment of potential failure of flood control measure is based on scientific and technical literature.

Disclosures

1. List the major flood control measures incorporated in the flood model and the sources of all data employed.

All major levees, manifested as height barriers in the DEM data used in the inland model, are incorporated. Information on the levees is obtained from National Levee Database (https://levees.sec.usace.army.mil/#/). Few notable examples, based on their design flow include:

Table 25. Example list of major levees incorporated in the inland flood model.

NAME	DESIGN FLOW (CFS)	LEVEE MILES	BEGIN LONGITUDE	BEGIN LATITUDE	END LONGITUDE	END LATITUDE
L29 Sec 2 - US41	32000	9.75	-80.82991885	25.76145185	-80.67414485	25.76145185
L67 A	32000	25.87	-80.58417375	25.76263093	-80.67354129	25.76263093
L-36	17930	11.40	-80.29877665	26.35548335	-80.29771905	26.35548335
L-38 East Sec 1	17930	8.79	-80.46034589	26.33497465	-80.53697435	26.33497465
L6 Interior	17930	10.89	-80.45213915	26.46400575	-80.45256245	26.46400575
L-6 Exterior	17930	10.97	-80.53757315	26.46988435	-80.44543895	26.46988435

NAME	DESIGN FLOW (CFS)	LEVEE MILES	BEGIN LONGITUDE	BEGIN LATITUDE	END LONGITUDE	END LATITUDE
L-35 B Sec 2	17930	10.66	-80.44802335	26.22923325	-80.29851645	26.22923325
L-38 Section 2	16700	3.74	-80.46024005	26.22975205	-80.46030635	26.22975205
L-38 East Section 3	16700	1.87	-80.44802335	26.14985005	-80.44218845	26.14985005
L-75	6000	10.59	-80.70727565	27.69948405	-80.67490735	27.69948405
L-13	4600	1.20	-80.40744795	26.68464625	-80.39085215	26.68464625
L-12 Section 1	4600	9.20	-80.50423164	26.68591685	-80.38893545	26.68591685
L-10	4600	10.17	-80.63076085	26.76892136	-80.50423202	26.76892136

2. Describe the methodology to account for major flood control measures in the flood model and indicate if these measures can be set (either to on or off) in the flood model.

The model accounts for flood control measures using a "with versus without" approach. The set of DEM modifications which include or exclude the measures can be selected as needed.

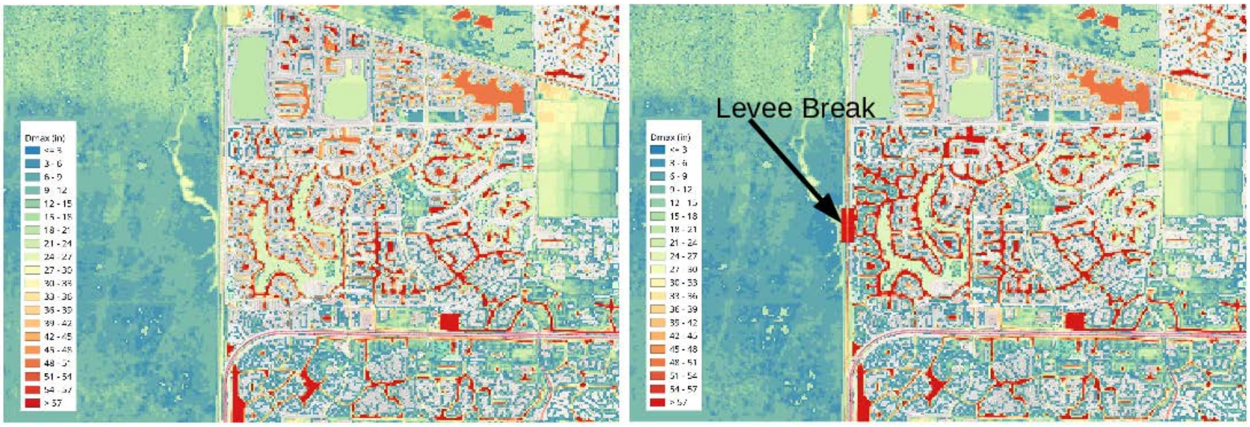
3. Describe if and how major flood control measures that require human intervention are incorporated into the flood model.

Flood control measures that require human intervention are not incorporated in the model.

4. Describe and justify the methodology used to account for the potential failure or alteration of major flood control measures in the flood model and if the level of failure can be adjusted in the flood model.

The flood model accounts for flood control measures through DEM modification. The level of failure can only be adjusted to the extent that the DEM can be modified at an appropriate level.

5. Provide an example of the flood extent and elevation or depth showing the potential impact of a major flood control measure failure.



(a) with levee (b) with broken levee

Figure 64. An example of the flood extent and depth showing the impact of levee failure.

HHF-4 Logical Relationships Among Flood Parameters and Characteristics

A. At a specific location, water surface elevation shall increase with increasing terrain roughness at that location, all other factors held constant.

In the pluvial model, water surface elevation calculation relies on Manning's equation, which dictates that for increasing roughness, all other parameters kept equal, the wetted cross-sectional area (or equivalently water surface elevation) shall increase.

In the riverine model, the water surface elevation is derived from simulated discharge based on a rating curve that follows a power law similar to Manning's equation. Changes in the power law multiplier for increasing roughness results in an increase of water surface elevation.

B. Rate of discharge shall increase with increase in steepness in the topography, all other factors held constant.

Increase in steepness in the topography, which translates in increase of overland surface and channel slope, results in higher discharge (all other factors held constant) according to Manning's equation used in the pluvial model and the kinematic wave routing used in riverine model.

C. Rate of discharge shall increase with increase in imperviousness of LULC, all other factors held constant.

Increase in imperviousness of LULC results in decrease in infiltration and increase in direct surface runoff in both pluvial and riverine models.

D. Inland flood extent and depth associated with riverine and lacustrine flooding shall increase with increasing discharge, all other factors held constant.

For increasing discharge, all other factors held constant, water surface elevation is increasing according to Manning's equation.

E. The coincidence of storm tide and inland flooding shall not decrease the flood extent and depth, all other factors held constant.

The coincidence of storm tide and inland flooding does not decrease the flood extent or depth. We assign the maximum depth/extent from coastal and inland model outputs.

Disclosures

1. Provide a sample graph of water surface elevation and discharge versus time associated with inland flooding for modeling-organization-defined locations within each region in Florida identified in Figure 1. Discuss how the flood characteristics exhibit logical relationships.

A series of simulation experiments were carried out to demonstrate the logical relationships of the flood characteristics in the riverine model. Results are shown in the sections below contrasting the original model simulations (control) versus scenarios that involve increased roughness, steepness, imperviousness, and discharge. Table 26 below summarizes the information for the selected locations in the five regions of Florida.

Table 26. Information for the five selected locations analyzed in this section.

Regions	County	Stream	Close to USGS	USGS ID	Lat	Lon
Panhandle	Leon	Ochlockonee river	Y	2329000	30.554484	-84.384401
North Florida	Columbia	Santa Fe river	Y	2322500	29.8491	-82.714568
East Florida	Osceola	Shingle Creek	Y	2264495	28.269317	-81.446477
Southwest Florida	DeSoto	Peace river	Y	2296750	27.221181	-81.87647
Southeast Florida	Broward	Shark river slough	N	-	26.1059	-80.7293

Increased Roughness

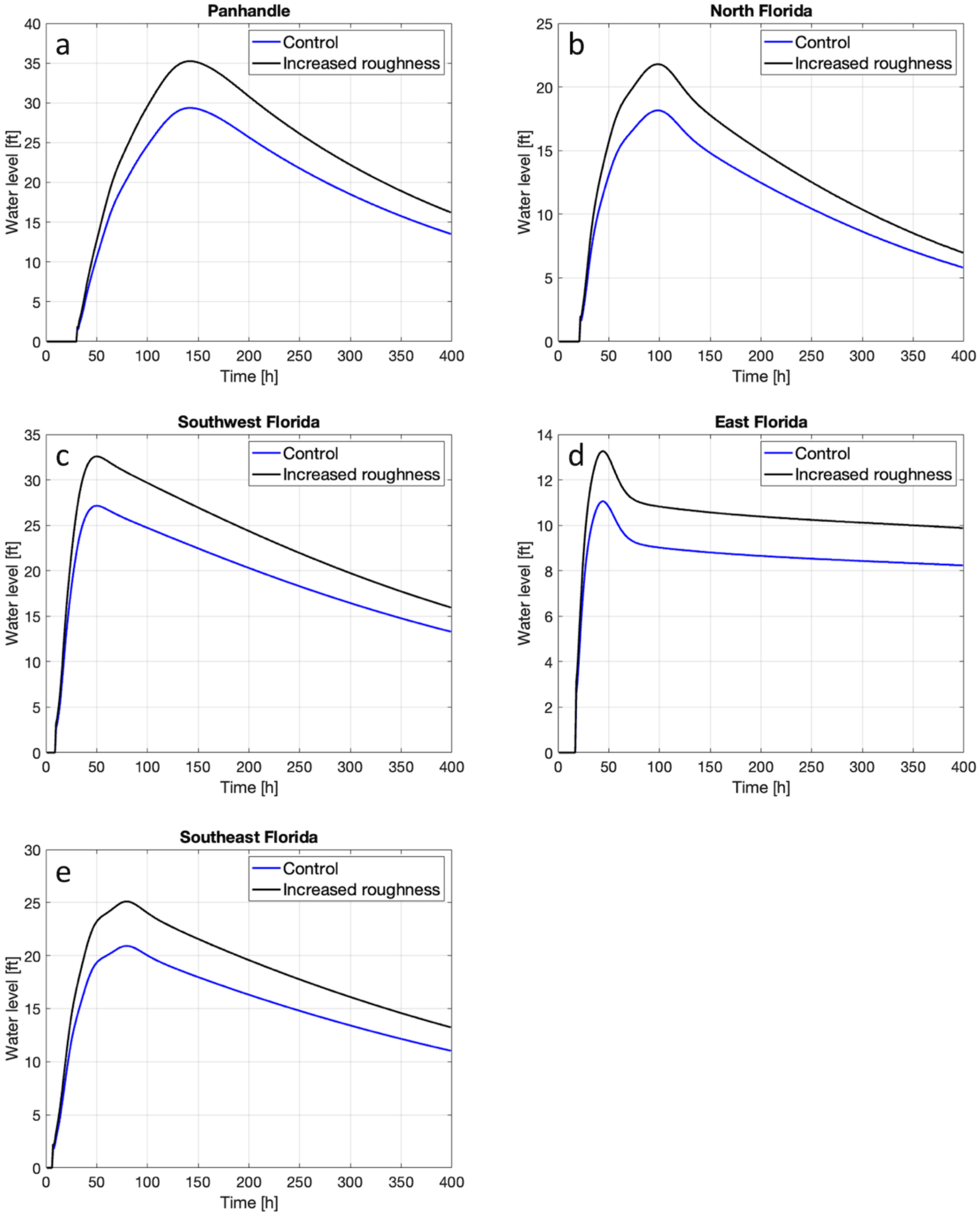


Figure 65. Simulation results showing the logical relationship of model parameters to water surface level by increasing terrain roughness in different regions: (a) Panhandle, (b) North Florida, (c) Southwest Florida, (d) East Florida, and (e) Southeast Florida.

Increased Steepness

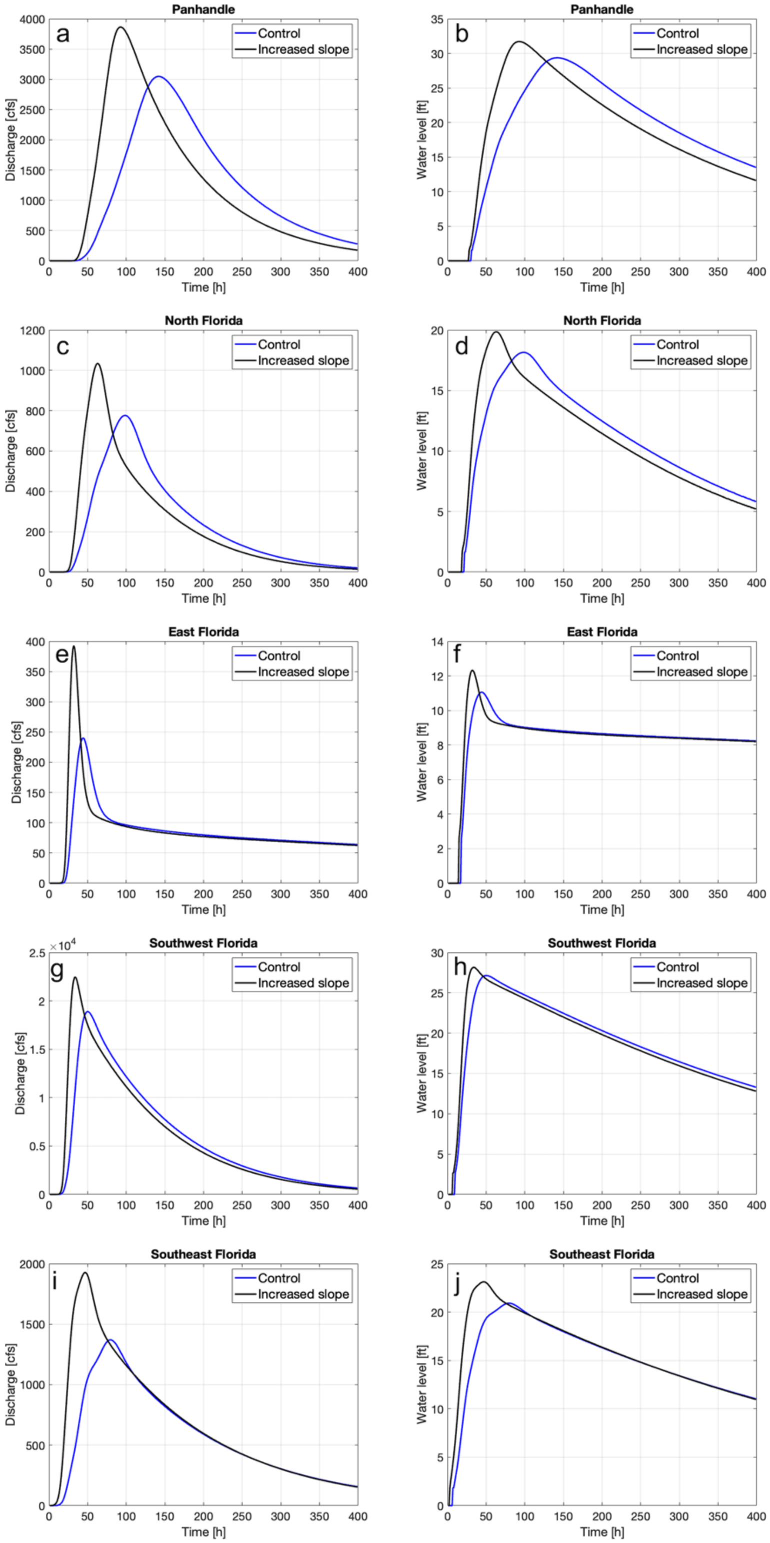


Figure 66. The same as Figure 65 but for discharge (left) and water surface level (right) by increasing terrain slope.

Increased Imperviousness

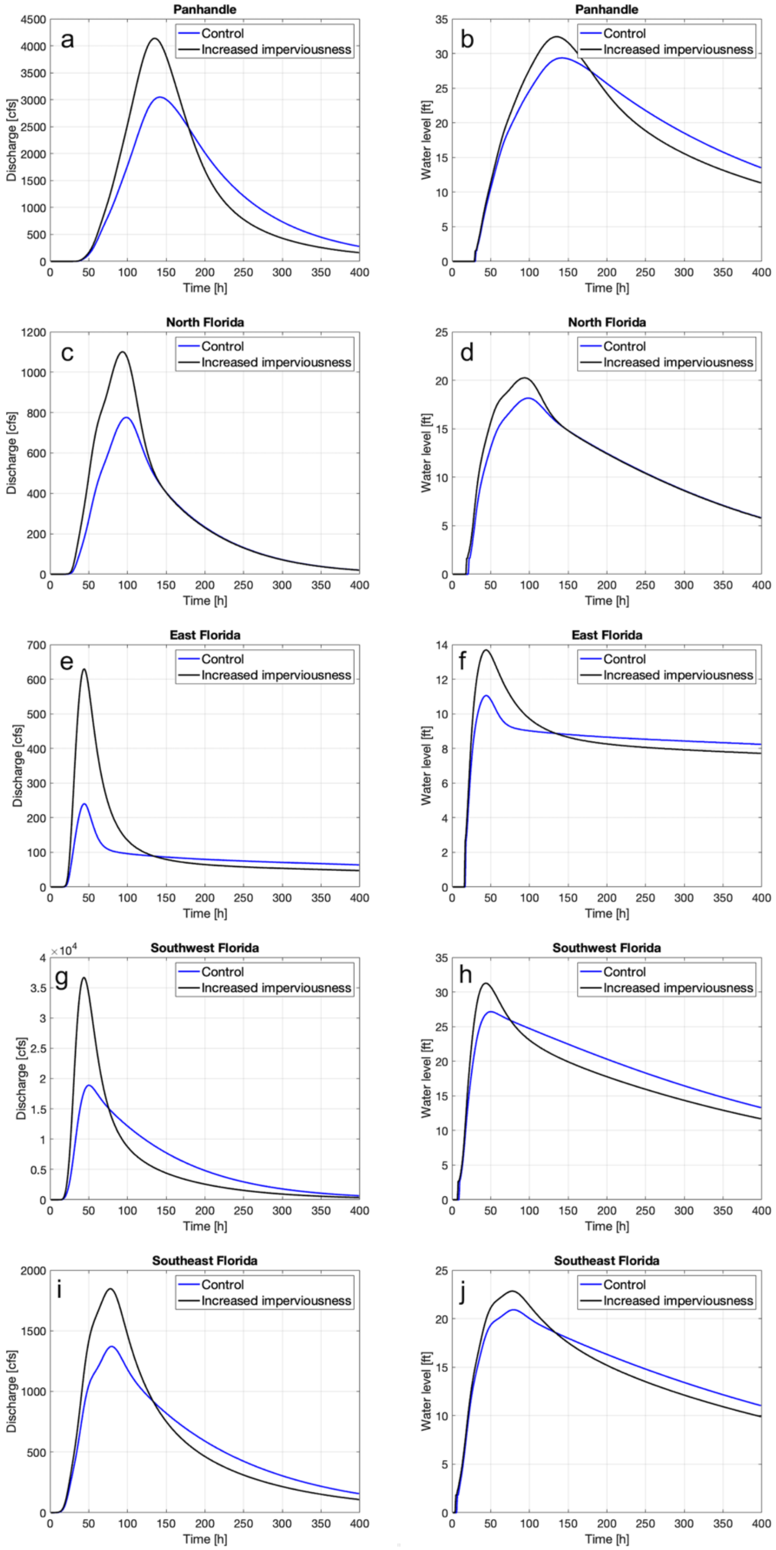


Figure 67. The same as Figure 65 but for discharge (left) and water surface level (right) by increasing imperviousness.

Increased Discharge

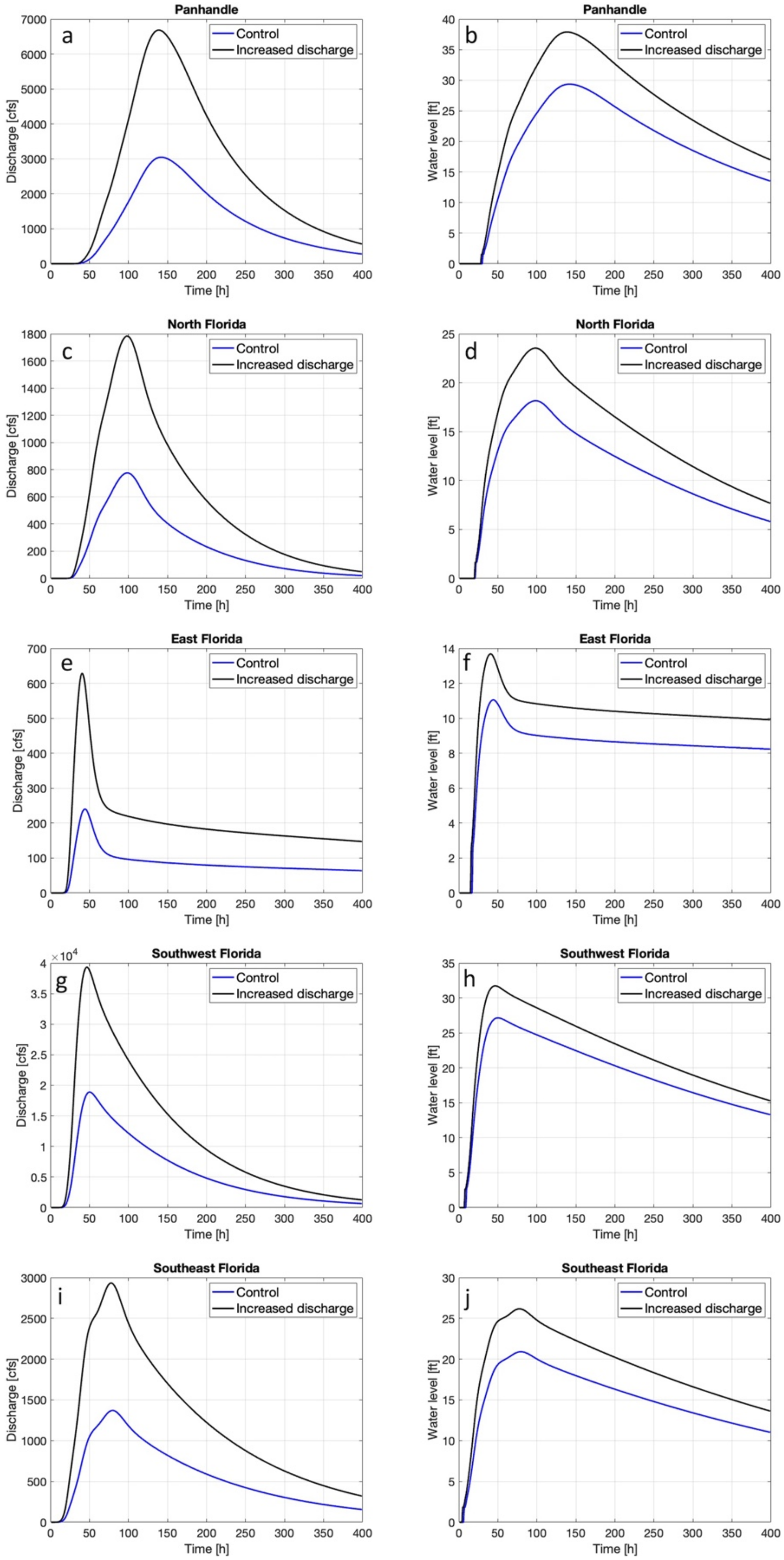


Figure 68. The same as Figure 65 but for discharge (left) and water surface level (right) by increasing discharge.

2. Describe the analysis performed in order to demonstrate the logical relationships in this standard.

In the riverine model, water level (*H*) is estimated from simulated discharge (Q) using a stage-discharge relationship of a power law form

$$H = \alpha \, Q^{\beta} \qquad \text{(HHF4-1)}$$

This power law relationship constitutes the so-called stage-discharge rating curves, which are widely used by USGS and several others (Manfreda, 2018; Petersen-Øverleir, 2005). The power law form is the most widely used model of such curves and has been shown to be directly related to hydraulic theory and well-established empirical relationships such as Manning's (Petersen-Øverleir, 2005). The effect of roughness is embedded in the value of parameter α, and therefore to demonstrate the logical relationships of flood characteristics to increasing roughness, the rating curve parameter α was increased with respect to the control simulations and the resulted water level values are shown in Figure 65.

In a similar manner, the parameters of kinematic wave routing were modified to account for increase in the overland and channel slope values and the results of increasing steepness are shown in Figure 66.

Increased imperviousness in an area results in an increase of direct runoff and an overall decrease in infiltration due to reduced hydraulic conductivity. To demonstrate the discharge and water level response to increased imperviousness (Figure 67), the imperviousness ratio and hydraulic conductivity were modified. To demonstrate changes with increasing discharge, keeping all other factors constant, the control simulation was repeated but with increased precipitation (Figure 68).

STATISTICAL FLOOD STANDARDS

SF-1 Modeled Results and Goodness-of-Fit

A. The use of historical data in developing the flood model shall be supported by rigorous methods published in current scientific and technical literature.

The historical data were modeled (when appropriate) using scientifically accepted methods that have been published in accepted scientific literature.

B. Modeled results and historical observations shall reflect statistical agreement using current scientific and statistical methods for the academic disciplines appropriate for the various flood model components or characteristics.

Modeled and historical results are in agreement as indicated by appropriate statistical and scientific tests. Some of these results are discussed below.

Disclosures

1. Provide a completed Form SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland). Identify the form of the probability distributions used for each function or variable, if applicable. Identify statistical techniques used for estimation and the specific goodness-of-fit evaluations applied along with appropriate metrics. Describe whether the fitted distributions provide a reasonable agreement with available historical data. Provide a link to the location of the form [insert hyperlink here].

The flood model is deterministic, and no statistical distributions were fit to the flood parameters. However, since the flood model depends on FPHLM v8.2 stochastic track data, Form SF-1 at the end of this section identifies the form of the probability distribution used in the FPHLM v8.2 track data for wind model for each parameter with a brief justification for the fit. The fits are described in detail in the FPHLM v8.2 document and are summarized in Standard GF-2.

Link to Form SF-1.

2. Describe the insurance flood claims data used for validation and verification of the flood model.

The data used for validation and verification of the flood model is the unredacted NFIP exposure and claims data up to 2014. Exposure sets were prepared for 2004 and 2012 using NFIP exposure data.

3. Provide an assessment of uncertainty in flood probable maximum loss levels and in flood loss costs for flood output ranges using confidence intervals or other scientific characterizations of uncertainty.

The confidence intervals for some of the probable maximum losses are presented in Form AF-8 and are reproduced here in Table 27. While the model does not automatically produce confidence intervals for the output ranges or the losses, the data do allow for the calculation of confidence intervals. We calculated the mean and the standard deviation of the losses for each zone used in Standard SF4, and it was found that the standard errors were within 5% of the means for all zones. We also calculated the coefficient of variation (CV) for all the zones and drew a histogram which is provided in Figure 69. The range of the CVs was between 3.92 and 11.07. We also computed 95% confidence intervals for the average loss for some of the counties in the output ranges. Some of these intervals are reproduced in Table 28 and Table 29.

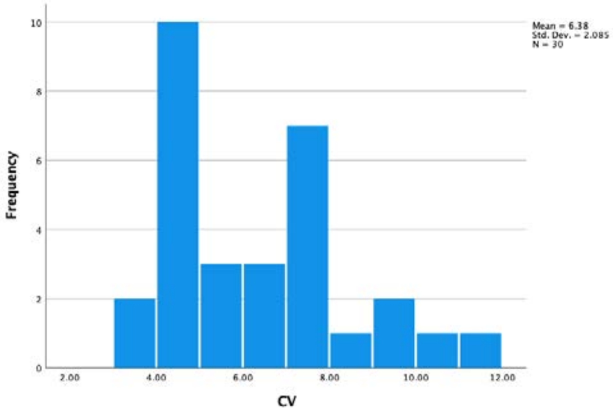


Figure 69. Histogram for the CV's of the 30 zones.

Table 27. Confidence Intervals for Selected Probable Maximum Losses.

Annual Exceedance Probabilities	Expected Flood Loss Level (in Billions)	10% Loss Level (in Billions)	90% Loss Level (in Billions)
0.0001	25.38	24.02	29.11
0.0002	23.16	22.37	25.03
0.0005	18.83	16.99	19.66
0.001	14.98	14.43	15.65
0.002	11.57	10.92	12.17
0.004	8.14	7.82	8.49
0.01	4.61	4.43	4.79
0.02	2.57	2.51	2.67
0.05	0.96	0.94	0.98
0.1	0.41	0.4	0.42
0.2	0.12	0.12	0.13

Table 28. 95% Confidence Intervals for Flood Loss Costs (Frame) per $1,000 for 0% deductible for selected counties.

County	Mean	SD	Interval
Broward	0.3888	1.003	(0.1220, 0.6556)
Duval	1.9348	4.6858	(0.3824, 3.4872)
Hillsborough	2.4379	5.3199	(1.0057, 3.8702)
Lee	4.8776	6.7523	(2.5737, 7.1814)
Miami Dade	1.8434	2.8352	(1.2221, 2.4647)
Orange	0.7701	1.5695	(0.2710, 1.2691)
Palm Beach	0.2071	0.4886	(0.0755, 0.3386)
Pinellas	2.8792	4.3638	(1.6696, 4.0888)

Table 29. 95% Confidence Intervals for Flood Loss Costs (Masonry) per $1,000 for 0% deductible for selected counties.

County	Mean	SD	Interval
Broward	0.2177	0.6635	(0.0600, 0.3754)
Duval	1.6155	3.3914	(0.5076, 2.7233)
Hillsborough	1.4947	2.8000	(0.7547, 2.2346)
Lee	3.9036	7.2610	(1.5317, 6.2756)
Miami Dade	1.4027	3.0808	(0.7799, 2.0255)
Orange	0.3238	0.6163	(0.1457, 0.5019)
Palm Beach	0.0790	0.1551	(0.0391, 0.1190)
Pinellas	2.2946	3.4027	(1.3871, 3.2022)

4. Justify any differences between the historical and modeled results using current scientific and statistical methods in the appropriate disciplines.

Modeled Results are consistent with historical results as shown in the disclosure below.

5. Provide graphical comparisons of modeled and historical data and goodness-of-fit evaluations. Examples to include are flood frequencies, flow, elevations or depths, and available damage.

We conducted validation studies on parameters in the riverine and the surge model. Some examples are given below:

Riverine Stream Flow: Simulated and observed streamflow were compared at 97 different USGS locations for six different hurricanes. Figure 70 shows the scatter plot of the simulated (Qsim) versus observed (Qobs) streamflows while Figure 71 gives the box plot of the relative difference between the two for the different hurricanes. The graphs show reasonable agreement between the two with no systematic bias.

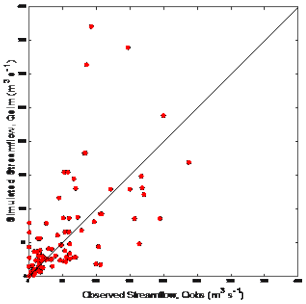


Figure 70. Scatter Plot of Simulated vs Observed Streamflow.

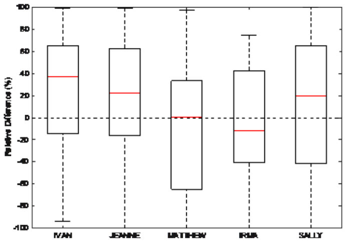


Figure 71. Box Plots of the Relative Difference between Simulated and Observed Streamflow. Note that relative difference is defined as RD% = 100* (Qsim – Qobs)/Qobs.

Coastal Surge Model: Extensive validation studies were conducted for the coastal surge model and are presented in Form HHF-1. Scatter plots of simulated vs observed elevation of depth are presented in Form HHF-1 C. Some of those plots are presented below and show reasonable agreement between simulated and observed depths:

1. Hurricane Andrew (1992)

The high water mark elevations collected by FEMA in Florida were used to verify the Hurricane Andrew inundation on the land (Figure 117 in Form HHF-1 C). The comparison of observed and computed storm surges indicates that the computed peak surges are comparable with observed ones (Figure 72). The Root Mean Square Errors is 0.36 m (1.20 ft).

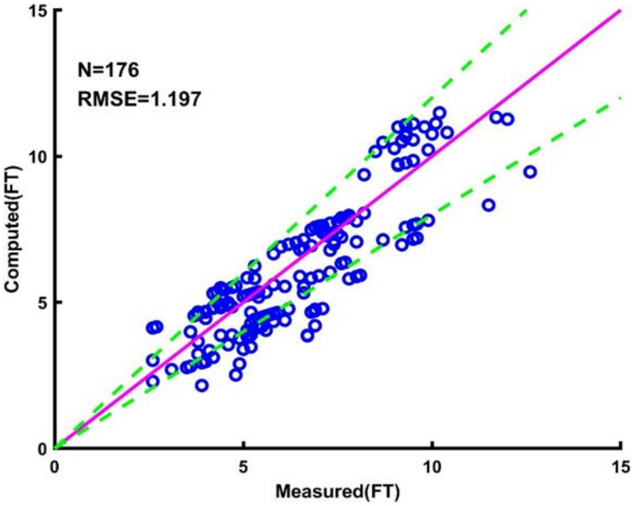


Figure 72. Scatter plots of observed peak surge heights versus simulated ones of Hurricane Andrew generated from SF1 Basin with H*Wind. The purple solid line represents perfect simulations and the green dashed lines represent the boundaries of ±20% of perfect simulations. Both computed and observed peak surge heights are referenced to the NAVD88.

2. Hurricane Katrina (2005)

The high water mark elevations collected by FEMA near the Mississippi coastal area were used to verify the Hurricane Katrina inundation on the land (Figure 123 in Form HHF1-C). The comparison of observed and computed storm surges indicates that the computed peak surges are comparable with observed ones at MS8 basin (Figure 73). The Root Mean Square Errors are 0.85m (2.83 ft) near the Mississippi coastal area.

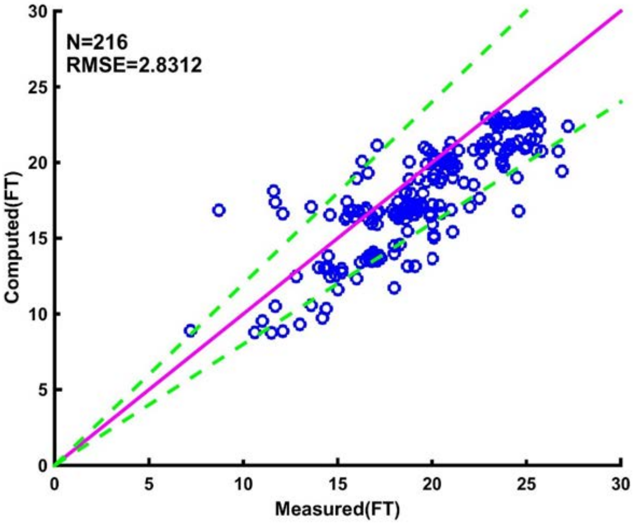


Figure 73. The same as Figure 72 but for Hurricane Katrina.

3. Hurricane Dorian (2019)

The high water mark elevations collected by USGS Flood Event Viewer were used to verify the Hurricane Dorian inundation on the land (Figure 135 in Form HHF1-C). The comparison of observed and computed storm surges indicates that the computed peak surges are relatively comparable with observed ones (Figure 74), the Root Mean Square Errors are 0.38 m (1.26 ft).

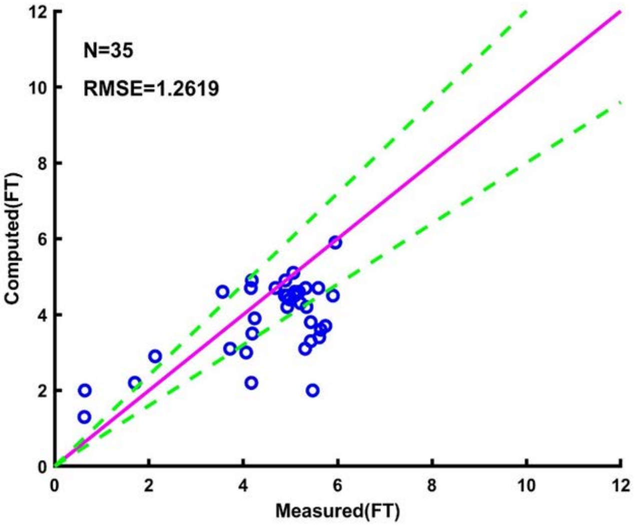


Figure 74. The same as Figure 72 but for Hurricane Dorian 2019.

6. Provide a completed Form SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined). Provide a link to the location of the form [insert hyperlink here].

Link to Form SF-2.

SF-2 Sensitivity Analysis for Flood Model Output

The modeling organization shall have assessed the sensitivity of temporal and spatial outputs with respect to the simultaneous variation of input variables using current scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action.

We have performed sensitivity analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods. These analyses were performed separately for the different components of the models and are described below:

Disclosures

1. Identify the most sensitive aspects of the flood model and the basis for making this determination.

Sensitivity Analysis for the Fluvial Model:

For the Fluvial component of the model, we examined the effects of three input parameters on the loss costs on a specific domain (Downstream of the Caloosahatchee River, Glades (Figure 75). We considered about 571 points along the Caloosahatchee River.

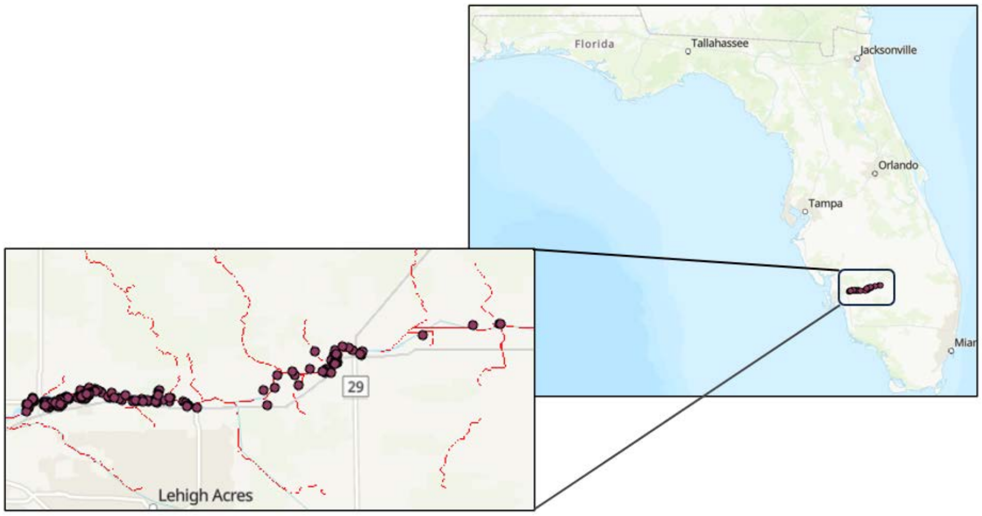


Figure 75. Locations considered for the Fluvial Model.

The approach of analyzing the flood response under three scenarios was taken: a reasonable estimate of the low, moderate and high values of each parameter of interest. The moderate value of each parameter and therefore scenario reflects the average value or the most expected value. The three key parameters and the considered values are:

1. ***WM:*** The maximum soil water capacity (depth integrated pore space) of the soil layer (mm). Low = 100mm | Moderate = 150mm | High = 200mm

2. ***IWU:*** The initial value of soil water. This is a percentage of the WM. (% between 0 and 100). Low = 20% | Moderate = 50% | High = 70%
3. ***PREC:*** Precipitation. For the selected storm event, which is supplied to the fluvial model as hourly, gridded estimates (in mm) for the entire duration of the storm, we considered this default data, the moderate case. For the low scenario, we decreased precipitation by 50% (i.e. 0.5x) and for the high scenario, we increased precipitation by 50% (i.e. 1.5x).

Twenty-seven unique runs were completed as each parameter and each scenario was varied, one at a time with losses computed for each component. To measure the effect of each input variable on the losses, we modeled the losses as a function of the three input variables and computed the corresponding standardized regression coefficients. The resulting linear regression showed a curvilinear/ piecewise linear relationship, so a Box-Cox transformation was performed on the data fitting the loss raised to 0.3838384 as a function of the input variables. The standardized regression coefficients (SRC's) for the input variables were obtained as:

Input	SRC
Precipitation	= 0.9416122
WM	= -0.1017863
IWU	= 0.2811286

As detailed in Iman, Schroeder and Johnson (2000a), the losses are most sensitive to the variable with the highest SRC. Hence for the Fluvial Model, the losses are most sensitive to precipitation. This result is consistent with the plot of the data in Figure 76:

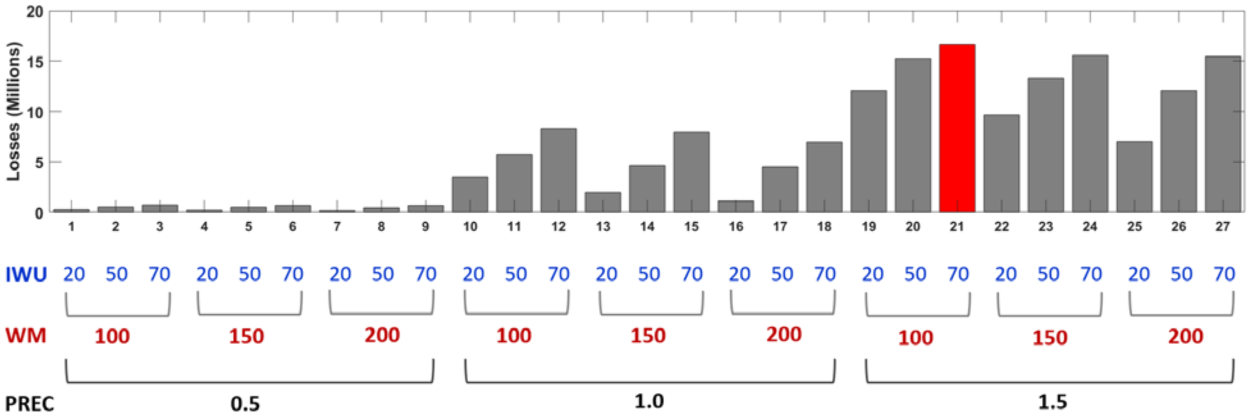


Figure 76. Losses as a function of the three input parameters.

Sensitivity Analysis for the Pluvial Model

As with the Fluvial Model, we examined the effects of three input variables on the loss costs. These input variables are:

1. Rainfall for return periods of 50, 100 and 200 years.

2. Duration (short, medium and long)
3. Antecedent Soil Moisture Condition. (dry, medium and wet)

Losses were modeled as a linear function of the three input parameters and the standardized regression coefficients were computed for the variables as with the Fluvial model. The SRC's for the input parameters are:

Input	SRC
Rainfall	= 0.8501810
Duration	= -0.4548866
Soil Moisture	= 0.1112669

Hence losses are most sensitive to rainfall.

2. Identify other input variables that impact the magnitude of the output when the input variables are varied simultaneously. Describe the degree to which these sensitivities affect output results and illustrate with an example.

As illustrated in Disclosure 1, the sensitivity of the losses depends on the model. For the Fluvial model, the losses are also sensitive to initial soil water and to soil water capacity. Hydrologic reasoning tells us that all else in equilibrium, we expect that more precipitation leads to greater flood depths and possible flood extent. For any given precipitation scenario, we also expect that an increase in soil water capacity means that there is that much more pore space to accommodate infiltration before water accumulates to significant flood depth. Finally, an increase in the initial soil moisture for a given soil water capacity and precipitation event, will mean an increase in flood depths and therefore losses. This is borne out in the analysis present in Disclosure 1. Similarly, for the pluvial model, losses are also sensitive to duration and initial soil moisture.

3. Describe how other aspects of the flood model may have a significant impact on the sensitivities in output results and the basis for making this determination.

Sensitivity studies were also carried out on the coastal surge model. Four input variables were selected for the study; tide depth, radius of maximum winds and central pressure and forward speed of the storm. The analysis was performed on Hurricane Michael. The input variables were varied one at a time and their effect on maximum surge height was measured. The analysis showed that the surge height (and consequently) the losses are sensitive to all the input variables except for forward speed.

4. Describe and justify action or inaction as a result of the sensitivity analyses performed.

No actions were performed as a result of this analysis. The input variables are not controllable, and the results are what we would have expected to see.

SF-3 Uncertainty Analysis for Flood Model Output

The modeling organization shall have performed an uncertainty analysis on the temporal and spatial outputs of the flood model using current scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action. The analysis shall identify and quantify the extent that input variables impact the uncertainty in flood model output as the input variables are simultaneously varied.

We have performed uncertainty analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods. These analyses were performed separately for the different components of the models and are described below:

Disclosures

1. Identify the major contributors to the uncertainty in flood model outputs and the basis for making this determination. Provide a full discussion of the degree to which these uncertainties affect output results and illustrate with an example.

Uncertainty Analysis for the Fluvial Model:

For the Fluvial component of the model, we examined the effects of three input parameters on the loss costs on a specific domain (Downstream of the Caloosahatchee River, Glades (Figure 75). We considered about 571 points along the Caloosahatchee River.

The approach of analyzing the flood response under three scenarios was taken: a reasonable estimate of the low, moderate and high values of each parameter of interest. The moderate value of each parameter and therefore scenario reflects the average value or most expected value. The three key parameters and the considered values are:

1. ***WM:*** The maximum soil water capacity (depth integrated pore space) of the soil layer (mm). Low = 100mm | Moderate = 150mm | High = 200mm
2. ***IWU:*** The initial value of soil water. This is a percentage of the WM. (% between 0 and 100). Low = 20% | Moderate = 50% | High = 70%
3. ***PREC:*** Precipitation. For the selected storm event, which is supplied to the fluvial model as hourly, gridded estimates (in mm) for the entire duration of the storm, we considered this default data, the moderate case. For the low scenario, we decreased precipitation by 50% (i.e. 0.5x) and for the high scenario, we increased precipitation by 50% (i.e. 1.5x).

Twenty-seven unique runs were completed as each parameter and each scenario was varied, one at a time with losses computed for each component. To measure the effect of each input variable on the losses, we modeled the losses as a function of the three input variables. The resulting linear regression showed a curvilinear/ piecewise linear relationship, so a Box-Cox transformation was performed on the data fitting the loss raised to 0.3838384 as a function of the input variables. To compute the contribution of each input variable to the uncertainty in the losses, we computed the proportion of the total variability in the losses explained by the variable given all other input variables were in the model (say, an extra R^2). Note that if a regression model (with dependent variable Y) has n input variables, $X_1, X_2, \ldots\ldots, X_n$, then we define this extra R^2 for input variable X_i as follows:

$$R^2_{X_i} = \frac{SSR(X_i|X_i,..,X_{i-1},X_{i+1},...,X_n)}{SST} \qquad \text{(SF3-1)}$$

where $SSR(X_i|X_i,..,X_{i-1},X_{i+1},...,X_n)$ is the total variability in Y explained by X_i given all other input variables are in the model and SST is the total variability in Y. Thus $R^2_{X_i}$ is the proportion variability in Y explained by X_i, given all other variables are in the model. It stands to reason then that the variable with the highest extra R^2 will be biggest contributor to the uncertainty of Y.

The extra R^2 values for the input variables are given as follows:

Input	extra R^2
Precipitation	= 0.88663348
WM	= 0.01036045
IWU	= 0.07903331

Hence Precipitation is the biggest contributor to the uncertainty in the loss costs for the Fluvial Model.

Uncertainty Analysis for the Pluvial Model

As with the Fluvial Model, we examined the effects of three input variables on the loss costs for the pluvial model. These input variables are:

1. Rainfall
2. Duration
3. Antecedent (initial) Soil Moisture

The domain of the study was Pensacola, Florida.

Losses were modeled as a linear function of the three input parameters and the extra R^2 was computed for each of the input variables as follows:

Input	extra R^2
Rainfall	= 0.72280773
Duration	= 0.20692181
Initial Soil Moist.	= 0.01238032

Thus rainfall is the biggest contributor to the uncertainty in the pluvial model.

2. Describe how other aspects of the flood model may have a significant impact on the uncertainties in output results and the basis for making this determination.

As illustrated in Disclosure 1, the uncertainty in the losses depends on the model. For the Fluvial model, WM and IWU do not appear to contribute significantly to the uncertainty in the loss costs. However, for the pluvial model, in addition to rainfall, duration appears to contribute significantly to the uncertainty in the loss costs. While a formal uncertainty analysis has not been conducted on the surge model, since losses are sensitive to tide depth, central pressure and to Radius of Maximum winds, we expect these variables to also contribute to the uncertainty in the loss costs.

One of the largest sources of uncertainty is the first floor elevation (FFE) of the building. When the flood depth exceeds the FFE, the losses grow rapidly, as only a few inches of inundation can cause very significant damage. For the Comprehensive exposure set that we use, as well as historical exposure sets for validation, there are many policies with unknown FFE. This occurs most frequently when the house was built pre-FIRM, when there was no requirement or recording of FFE. The sensitivity of losses to FFE were found from controlled model runs.

3. Describe and justify action or inaction as a result of the uncertainty analyses performed.

Based on the large sensitivity and uncertainty of losses to FFE, improved methods were derived to estimate the likely FFE of older homes.

SF-4 Flood Model Loss Cost Convergence by Geographic Zone

At a modeling-organization-determined level of aggregation utilizing a minimum of 30 geographic zones encompassing the entire state, the contribution to the error in flood loss cost estimates attributable to the sampling process shall be negligible for the modeled coastal and inland flooding combined.

The error in the zone level loss costs induced by the sampling process can be quantified by computing standard errors for the zone level loss costs. These loss costs have been computed for all the thirty zones using 73,200 years of simulation. The results indicate that the standard errors are less than 5% of the average loss cost estimates for all zones.

Disclosures

1. Describe the sampling plan used to obtain the average annual flood loss costs and flood output ranges. For a direct Monte Carlo simulation, indicate steps taken to determine sample size. For an importance sampling design or other sampling scheme, describe the underpinnings of the design and how it achieves the required performance.

We used a Monte Carlo Simulation to obtain average annual flood loss costs and flood output ranges. Our aim was to achieve convergence using 30 geographic zones. Geographic zones for the model were defined by a selection of coastal locations along the Florida coast. Each zone was determined by proximity to a specified coastal location. A policy was determined to be in a zone if the policy was closer to the specified zone coastal location than any other zonal coastal location. The basic procedure to determine the zone for a given policy was to loop through all the specified zone locations and choose the one that was closest by distance.

Once we determined the zones, the number of simulation years was determined through the following process:

The average flood, $\bar{X}_Y$, and standard deviation S_Y, were determined for each zone Y using an initial run of 73,200-year simulation. Then the maximum error of the estimate will be 5% of the estimated mean loss cost, if the number of simulation years for county Y is:

$$N_Y = \left(\frac{S_Y}{0.05\bar{X}_Y}\right)^2 \qquad \text{(SF4-1)}$$

Based on this initial 73,200-year simulation runs, the maximum number of simulation runs was determined to be 49,046 (for Zone 15). Since 73,200 exceeds 49,046, we decided to use the losses generated by the initial run as our stochastic set.

2. Describe the nature and results of the convergence tests performed to validate the expected flood loss projections generated. If a set of simulated flood events or simulation trials was used to determine these flood loss projections, specify the convergence tests that were used and the results. Specify the number of flood events or trials that were used.

Losses were generated using 73,200 runs. For each zone, the mean $\bar{X}_Y$ and the standard deviation S_Y of these losses were computed. The standard error was then computed as $\frac{S_Y}{\sqrt{73,200}}$ for each zone and verified to be within 5% of the mean for all zones.

SF-5 Replication of Known Flood Losses

The flood model shall estimate incurred flood losses in an unbiased manner on a sufficient body of past flood events, including the most current data available to the modeling organization. This standard applies to personal residential exposures. The replications shall be produced on an objective body of flood loss data by county or an appropriate level of geographic detail.

We estimate losses in an unbiased manner and the losses show reasonable agreement with historical losses as indicated in Disclosure 1 below.

Disclosure

1. Describe the nature and results of the analyses performed to validate the flood loss projections generated for personal residential losses. Include analyses for the events listed in Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps.

To validate flood loss cost projections, the model computed loss costs for eleven different events and compared the total observed claim loss vs total modeled claim loss. Table 30 gives the observed and modeled losses by event, while Figure 77 gives a scatter plot of the same. Both show a reasonable agreement between the observed and modeled losses. This was also supported by the various statistical tests described below.

Table 30. Comparison of Total Claim Losses vs Modeled Total Loss.

Storm Name	Observed	Modeled
Charley	49428794.99	36551660.98
Frances	106816340.9	82832641.23
Jeanne	90507217.47	121600395.7
Wilma	355266831.6	408716040.6
Irma	978182609.8	628626284.4
Debby	42881213.1	115408737.3
Fay	53952421.4	154858019.2
Irene	117785317	123231132
Gabrielle	30589202	35671442.83
Leslie	157750001	73255095.69
April 2014	97774776	19041951.23

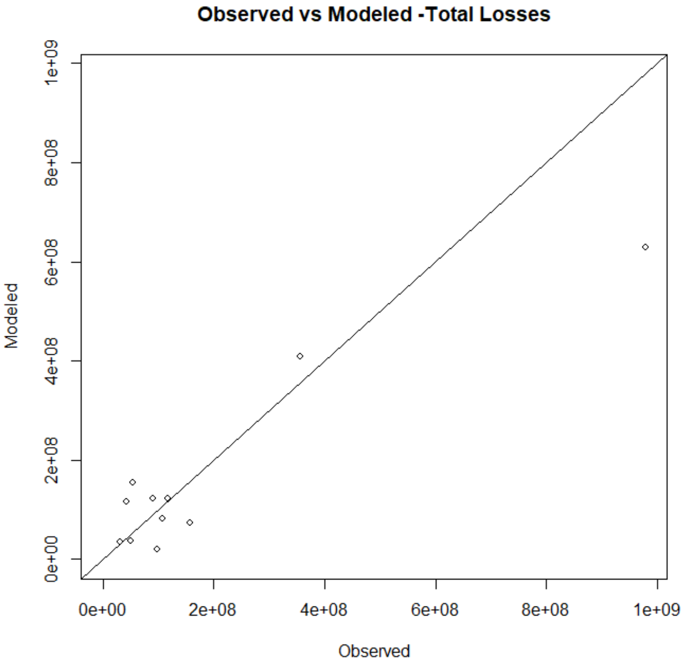


Figure 77. Scatter Plot of Total Actual Claimed Losses vs Total Modeled Claims.

As is evident from the plot, the model losses estimate the actual losses in an unbiased manner. The Pearson's correlation coefficient between the actual and the modeled losses is 0.934 and the p value for the Wilcoxon signed rank test is 0.898 showing a very strong agreement between the two losses.

VULNERABILITY FLOOD STANDARDS

VF-1 Derivation of Building Flood Vulnerability Functions

A. Development of the building flood vulnerability functions shall be based on two or more of the following: (1) rational structural analysis, (2) post- event site investigations, (3) scientific and technical literature, (4) expert opinion, (5) laboratory or field testing, and (6) insurance claims data. Building flood vulnerability functions shall be supported by historical and other relevant data.

The building flood vulnerability functions are based on (1) rational structural analysis, (2) post-event site investigations, (3) scientific and technical literature, (4) expert opinion, and (6) insurance claims data.

The development of the coastal flood vulnerabilities is based on a combined engineering and empirical approach, which translates empirical tsunami fragility functions into coastal flood fragility functions, based on engineering principles. The coastal flood fragility functions translate into coastal flood vulnerability functions for different types of residential structures common in the state of Florida. The characterization of the damage states corresponding to each fragility function, based on a detailed cost analysis provides the basis for the translation of the fragilities into vulnerabilities.

The inland flood vulnerabilities are derived from the work of the US Army Corp of Engineers (USACE) vulnerability curves, based on expert opinion and informed by engineering principles.

Claims data and expert-based models validated both the coastal and inland flood models.

B. The derivation of building flood vulnerability functions and the treatment of associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.

The conversion of the fragility functions from tsunami to coastal flood relies on the calculation of the different inundation depths that produce equivalent water-forces. The forces considered are the resultant lateral horizontal forces acting on the vertical walls of the structures. Both the tsunami and the coastal flood water depth-force relationships needed for the development of the coastal flood fragility functions were adopted from well-recognized engineering literature.

Uncertainties in the derivation of the tsunami fragility functions used in the derivation result from the empirical development of these functions. The tsunami fragility uncertainties transfer to the coastal flood fragility curves. The FPHLM team estimated these uncertainties involved in the conversion from coastal flood fragility curves to coastal flood vulnerability curves, including the uncertainty attached to the damage states quantification.

C. Residential building stock classification shall be representative of Florida construction for personal residential buildings.

Detailed exposure studies (Pinelli et al., 2020; Michalski, 2014) defined the most prevalent construction types and characteristics in the Florida residential building stock. The corresponding models represent each of the identified common structural types. In the case of the residential model, the models include differing wall types (wood and masonry) of varying strengths (weak or strong), and one to three story houses, as applicable, as well as manufactured homes.

D. The following flood characteristics shall be used or accounted for in the derivation of building flood vulnerability functions: depth above ground, and in coastal areas, damaging wave action.

The vulnerability functions for all personal residential models (site-built residential, and manufactured homes,) are derived as a function of inundation depth. In coastal areas, these depth-to-damage functions incorporate damaging wave action.

E. The following primary building characteristics shall be used or accounted for in the derivation of building flood vulnerability functions: lowest floor elevation relative to ground, foundation type, construction materials, number of stories, and year of construction.

The various personal residential models reflect the construction materials, timber or masonry, as well as the lowest floor elevation relative to ground, and the foundation type (slab on grade with FFE ranging from 0 to 3 ft; or elevated with piles, posts or columns with FFE ranging from 4 to 12 ft). The structural models also allow the representation of year of construction. Two models exist for each structural type: weak construction, and strong construction. For example, each model for wood frame homes has weak and strong versions. The assignment of a given strength level depends on the age of the home being modeled and the available information on construction practice in that region of the state in that era of construction. Separate models also exist for manufactured housing constructed based on pre- and post-1994 HUD regulations and for different flood conditions. Lowest floor elevation relative to ground is explicitly represented for each model type in 1 ft increments, and interpolation is employed between these increments. For example, the weak timber frame on-grade models include separate outputs for 0, 1, 2 and 3 ft lowest floor elevations. If a property has a known elevation of 2.6 feet, interpolation between the 2 ft and 3 ft model outputs is employed.

F. Flood vulnerability functions shall be separately derived for personal residential buildings and manufactured homes.

Flood vulnerability functions were separately derived for personal residential buildings and manufactured homes. As described in detail within, personal residential buildings vulnerability functions to coastal flood are derived based on an adaptation of tsunami fragility functions to reflect coastal flood forces. Personal residential Inland flood and Manufactured home vulnerability functions (both coastal and inland) are adapted from USACE reports.

Disclosures

1. Describe any modifications to the building vulnerability component of the flood model since the currently accepted flood model.

Not applicable.

2. Provide a flowchart documenting the process by which the building flood vulnerability functions are derived and implemented.

The flow charts below summarize the procedure used to develop the coastal flood and the inland flood vulnerability functions for the different structural types of personal residential buildings.

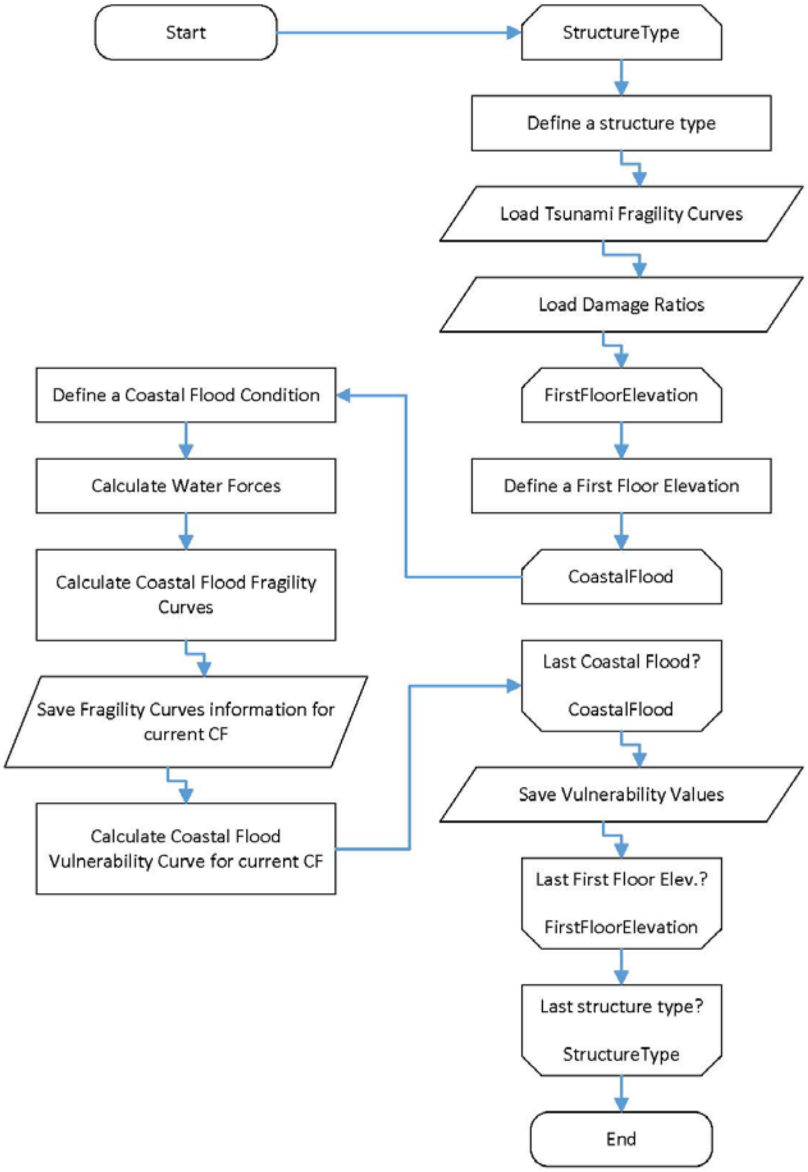


Figure 78. Coastal flood vulnerability for residential structures.

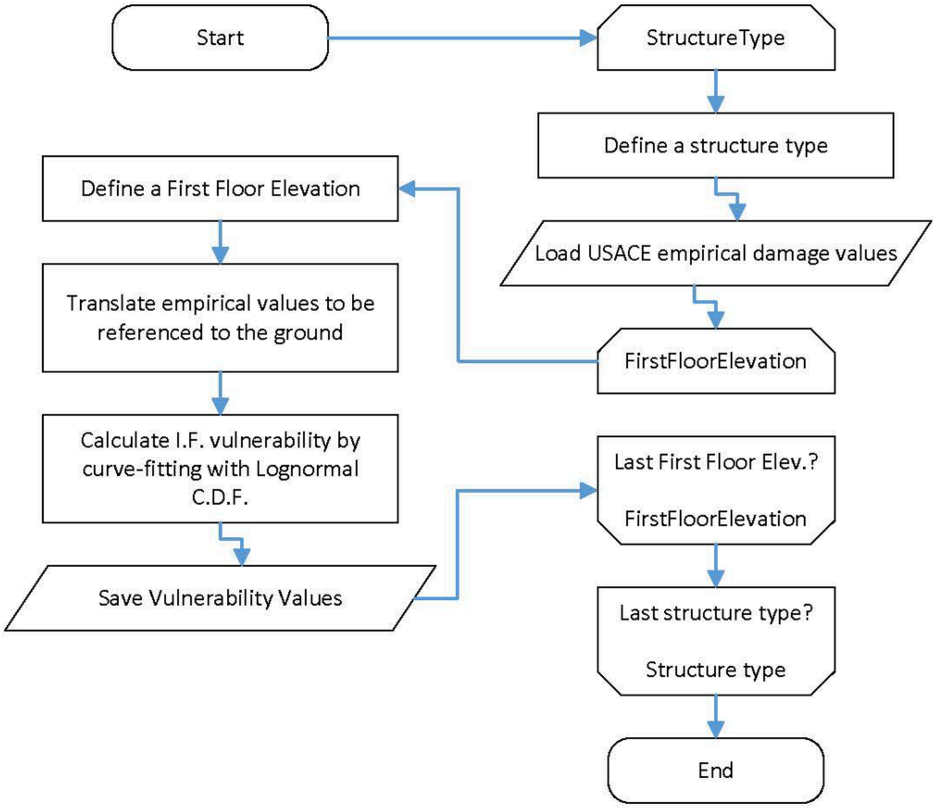


Figure 79. Inland flood vulnerability for residential structures.

3. Describe the assumptions, data, methods, and processes used for the development of the building flood vulnerability functions.

GF-1, Disclosure 2 calls for a 'comprehensive summary' of the flood model, including a technical description and methodology of the vulnerability component. Our response of GF-1 Disclosure 2 includes the assumptions, data, methods and processes used for the development of the building flood vulnerability functions.

<u>Site-Built Homes</u>

The assumptions, data, methods and processes used for the development of the building coastal flood vulnerability functions are detailed in the GF-1 Disclosure 2 standard under the section entitled: **Vulnerability of site-built residential structures to Coastal Flood.**

The assumptions, data, methods and processes used for the development of the building inland flood vulnerability functions are detailed in the GF-1 Disclosure 2 standard under the section entitled: **Vulnerability of site-built residential structures to Inland Flood.**

Manufactured Homes

The assumptions, data, methods and processes used for the development of the manufactured home structure coastal and inland flood vulnerability functions are detailed in the GF-1 Disclosure 2 standard under the section entitled: **Vulnerability of manufactured housing to Inland and Coastal Flood.**

4. As applicable, describe the nature and extent of actual insurance company flood claims data used to develop the building flood vulnerability functions. Describe in detail the breakdown of data into number of policies, number of insurers, dates of flood loss, amount of flood loss, and amount of dollar exposure, separated into personal residential and manufactured homes.

FLOIR provided the National Flood Insurance program (NFIP) claims and exposure portfolios to the FPFLM team. The exposure data covers 1992 to 2012 and contains close to 22 million records. The claims database contains 153,751 claims between July 1975 and January 2014 for 126 different events. A subset of 64,161 personal residential claims were isolated, corresponding to twelve hurricane events with the most claims. Table 31 summarizes, where the twelve hurricane events referred to in the last row are provided in Table 32. Table 32 provides a detailed summary of the personal residential NFIP claims for these 12 hurricane events, including date of loss, number of claims, exposure, total damage incurred and damage paid. Table 33 provides a detailed summary of the manufactured home NFIP claims.

The NFIP claim files contain information such as the date of loss, policy number, physical address, cause of damage, total property value, financial damage to building and contents, and replacement cost. Fields are present in the files for structural information such as exterior wall type and foundation type, but do not contain values for 97% of the claims. The exposure files contain policy number, flood zone, address, original construction date, base flood elevation, and other data, but no structural building information is provided.

Table 31. NFIP claim and exposure datasets.

Description	Number of Records
NFIP Exposure Portfolios (by year, 1992-2012)	~ 22 million
NFIP Claims Portfolio (all events)	153,751
NFIP Claims Portfolio (12 hurricane events)	58,551

Table 32. NFIP claims for personal residential structures for 12 major hurricanes.

Storm Name	Date of Loss	Number of Claims	Total Exposure	Total Damage	Total Paid Damage
Andrew	08/22/1992	2,752	$ 707,158,859	$ 130,724,380	$ 113,384,613.73
Charley	08/11/2004	1,586	$ 1,639,257,201	$ 22,978,410	$ 20,265,252.36
Dennis	07/06/2005	2,881	$ 3,737,860,643	$ 73,343,821	$ 67,497,098.46

Storm Name	Date of Loss	Number of Claims	Total Exposure	Total Damage	Total Paid Damage
Elena	08/27/1985	5,796	$ 472,432,782	$ 78,947,004	$ 57,719,754.21
Frances	09/01/2004	3,961	$ 7,662,710,052	$ 105,262,694	$ 97,932,672.95
Georges	09/22/1998	4,125	$ 56,085,304,192	$ 49,772,804	$ 43,813,298.05
Irene	10/12/1999	12,465	$ 1,514,259,401,954	$ 100,742,538	$ 86,073,936.64
Ivan	09/13/2004	8,187	$ 26,304,671,759	$ 742,288,128	$ 682,965,045.29
Jeanne	09/23/2004	3,241	$ 761,176,548	$ 65,685,645	$ 59,878,132.16
Katrina	08/22/2005	5,029	$ 5,331,719,556	$ 99,667,343	$ 94,251,570.56
Opal	10/01/1995	6,167	$ 20,904,248,432	$ 225,760,520	$ 191,822,782.80
Wilma	10/21/2005	7,971	$9,213,752,391	$284,737,435	$266,998,663.75
Total		64,161	$ 1,647,079,694,369	$1,979,910,722	$1,782,602,820.96

Table 33. NFIP claims for manufactured homes for 12 major hurricanes.

Storm Name	Date of Loss	Number of Claims	Total Exposure	Total Damage	Total Paid Damage
Andrew	08/22/1992	6	$184,304	$24,136	$17,664.37
Charley	08/11/2004	206	$5,921,856	$1,912,498	$1,611,844.10
Dennis	07/06/2005	83	$4,106,208	$1,142,801	$1,017,013.30
Elena	08/27/1985	36	$561,128	$125,918	$81,302.48
Frances	09/01/2004	192	$6,891,140	$2,019,906	$1,809,022.11
Georges	09/22/1998	533	$13,150,779	$5,589,862	$4,647,725.96
Irene	10/12/1999	157	$4,131,420,030	$844,026	$667,022.85
Ivan	09/13/2004	81	$76,891,707	$3,022,452	$2,560,889.99
Jeanne	09/23/2004	453	$14,238,066	$3,660,577	$3,158,689.93
Katrina	08/22/2005	71	$3,361,003	$591,424	$534,632.07
Opal	10/01/1995	33	$1,313,971	$440,999	$286,319.59
Wilma	10/21/2005	934	$37,918,719	$15,062,142	$13,303,552.53
Total		2,785	$4,295,958,911	$34,436,741	$29,695,679.28

5. Describe any new insurance company flood claims datasets reviewed since the currently accepted flood model.

Not applicable.

6. Summarize post-event site investigations, including the sources, and provide a brief description of the resulting use of these data in the development or validation of building flood vulnerability functions.

Tsunami damage dataset

The FPHLM team adopted an engineering approach, which adapts a procedure proposed in Barbato et al. (2013) to translate empirical tsunami fragility functions from Suppasri et al. (2013) into coastal flood fragility functions, based on engineering principles. The tsunami fragilities are the result of a post-event field investigation. See GF-1 Disclosure 2 standard under the section entitled: **Vulnerability of site-built residential structures to Coastal Flood.** Therein, section 2 describes the tsunami dataset, section 3 describes the use of these data, and section 6 presents an example of the resultant outputs as well as validation against claims data. Paleo-Torres et al. (2019) provides additional peer-reviewed details.

US Army Corps of Engineers Vulnerability Curves

US Army Corps of Engineers (USACE, 2015) developed a set of vulnerability curves for different structures based on expert opinions informed in part by post-disaster damage assessments. See GF-1 standard Disclosure 2 under the section entitled: **Vulnerability of site-built residential structures to Coastal Flood.** Therein, section 6.3 describes the USACE data, and how it was used for validation of the coastal flood vulnerabilities. Paleo-Torres et al. (2019) provides additional peer-reviewed details. GF-1 standard Disclosure 2 under the section entitled: **Vulnerability of site-built residential structures to Inland Flood** describes its use in the development of inland flood vulnerabilities.

FEMA Estimates of Flood Elevations for Hurricane Ivan

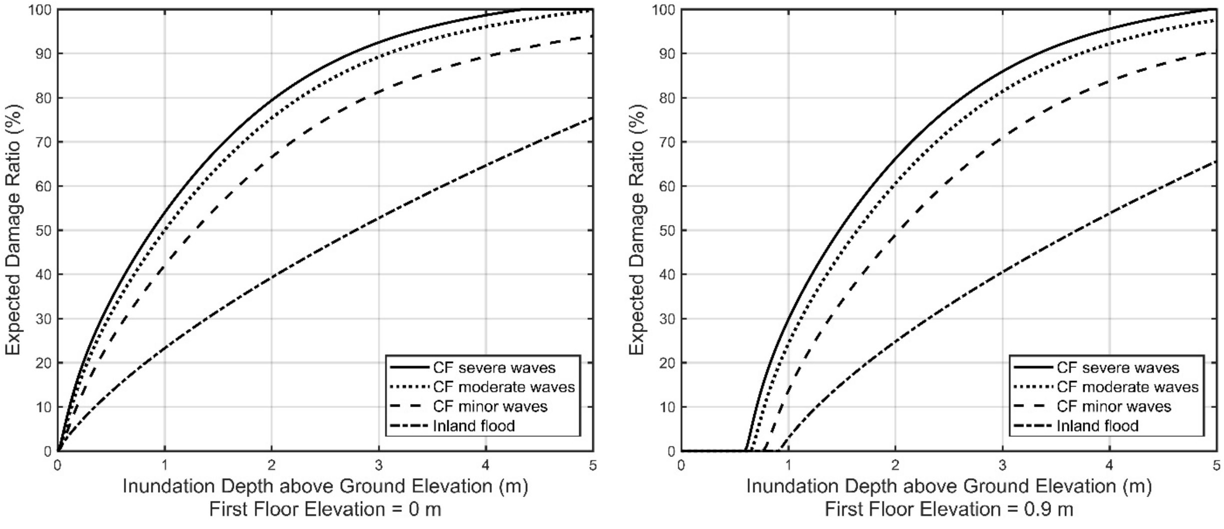
There are relatively few observations of flood elevation and wave conditions for historical flood events, particularly at the resolution of claims data. For Hurricane Ivan (2004), FEMA has published some resources on flood elevation for this event. These include high water marks, flood surge height contours and an inundation map (available at https://www.fema.gov/geographic-information-systems-data as of 10/22/19). High water marks along with engineering judgment form the basis for the flood contour lines. The inundation maps indicate all locations that experienced flooding, regardless of surge height. These data are highly correlated to observed flood damage. The FPHLM team derived estimated surge heights at NFIP claims data locations for Ivan by using an interpolation algorithm between the closest points to the FEMA surge contour elevations and the target claim location. The method used an inverse distance squared weighting method when the target location was between two contours, and a nearest neighbor extrapolation otherwise. The domain of the FEMA data, which covers 3 counties, Escambia, Okaloosa and Santa Rosa, was divided into zones, so that interpolation was not done across contours that were in separate regions divided by dry land masses.

The FEMA data combined with the NFIP database described in Disclosure 3, enhanced with building construction details from the tax appraiser databases, was used to validate the FPHLM outputs as described in GF-1 standard Disclosure 2 under the section entitled: **Vulnerability of site-built residential structures to Coastal Flood,** withing Section 6.4, and peer reviewed in Paleo-Torres et al. (2019).

7. Describe how the building flood vulnerability functions incorporate depth of flooding (above ground and above lowest floor) and damaging wave action (in coastal areas). For coastal areas, define the thresholds indicating the presence of damaging wave action for buildings and manufactured homes. Describe the area over which building flood vulnerability functions for damaging wave action or wave proxies are applied.

The vulnerability functions are derived as a function of hazard intensity in the form of flood depth above ground. Vulnerability outputs for any given structural model include results for each of several finished first floor elevations (FFEs) above ground. For example, the model representing one-story masonry on-grade construction includes outputs for 0, 1, 2, and 3 foot FFE. For each FFE, vulnerability as a function of flood depth above ground is derived for four separate hydrologic states: slow rising flood (no waves), flood with minor waves, flood with moderate waves, and flood with severe waves. Thus, the one-story masonry on-grade model vulnerability is represented by 16 possible outputs as a function of flood depth above ground. These consist of four FFEs (0, 1, 2, 3 ft), each with four possible hydrologic states. Figure 80 shows a comparison of Inland and Coastal Flood vulnerability results for a one-story slab on-grade reinforced masonry structure at 0 and 3 ft FFEs.

For cases where the structure's known FFE is not 0, 1, 2 or 3 feet, interpolation is employed between these increments. For example, if a property has a known elevation of 2.6 feet, interpolation between the 2 ft and 3 ft model outputs is employed. Thus, the library of outputs discretized in 1 ft increments can be converted to a continuum of FFE values.



(a) (b)

Figure 80. FPHLM Inland and Coastal flood vulnerability, a) 1-story slab on-grade reinforced masonry, 0 m FFE; b) 1-story slab on-grade reinforced masonry, 0.9 m FFE

The thresholds indicating the presence of damaging wave action are determined within the hazard models rather than the vulnerability model. That is, the inland flood, surge and wave hazard model outputs are used to determine the most appropriate among the four hydrologic states for a given structure. This assignment then dictates which of the four separate vulnerability functions (one for each hydrologic state, shown in VF-1.3) to employ for damage projection.

8. State if the following flood characteristics are considered in the development of the building flood vulnerability functions, and if so, how; if not, explain why:

- ***a. Flood velocity,***
- ***b. Flood duration,***
- ***c. Flood-induced erosion,***
- ***d. Flood-borne debris,***
- ***e. Salinity (saltwater versus freshwater flooding), and***
- ***f. Contaminated floodwaters.***

The FPHLM flood vulnerabilities do not explicitly include any of the above parameters. The hazard models for coastal and inland floods do not quantify these parameters. They provide flood depth and wave height. However, the descriptions of the coastal flood damage states (Table 6, located in GF-1 standard Disclosure 2 under the section entitled: **Vulnerability of site-built residential structures to Coastal Flood**) do qualitatively include damage from flood-borne debris. Additionally, all field data that was utilized implicitly includes flood-borne debris, erosion, velocity and salinity. This applies to both the tsunami fragility functions used as the basis of the coastal flood model and the NFIP claims data used for validation.

9. Describe how the building flood vulnerability functions incorporate the following primary building characteristics:

- ***a. Lowest floor elevation relative to ground,***
- ***b. Foundation type,***
- ***c. Primary construction materials,***
- ***d. Number of stories, and***
- ***e. Year of construction.***

Lowest floor elevation: Output for any given structural model is derived separately for a series of first floor elevations (FFEs). This is not a simple shift of the same vulnerability curve. For example, the 3 ft FFE output is not equivalent to shifting the 1 ft FFE curve by 2 feet. Rather, the combination of flood depth and wave state at which a structure will begin to experience wetting of the FFE is explicitly calculated.

Foundation type: on-grade and elevated foundation types are modeled separately. The vulnerability of the foundation type is incorporated within the building vulnerability via the component cost analysis described in Section 4 of GF-1, Disclosure 2, within the ENG-VULNERABILITY COMPONENTS.

Primary construction materials: Models were derived separately for timber frame and masonry construction materials. The tsunami fragilities based on field data were stratified by material type. Conversion to coastal flood models were separately performed based on material type. Timber frame models are more vulnerable than masonry models, all other parameters equal (number of stories, age, FFE, hazard intensity).

Number of stories: the FPHLM provides separate on-grade and elevated 1, 2, and 3 story structures. This stratification by story was included within the tsunamic fragility dataset.

Year of construction: For both material types (timber frame and masonry), a weak and strong version of these models was derived to reflect changes in construction methods over time. The current level of granularity in the model uses 2002 as the separation date between weak (older) and strong (newer) models, as this reflects the statewide adoption of the Florida Building Code. Weak and strong models differ by the assignment of damage ratios during the conversion from coastal flood fragility to coastal flood vulnerability.

10. State if the following building characteristics are considered in the development of the building flood vulnerability functions, and if so, how; if not, explain why:

a. Use of each story (e.g., habitable space, parking, storage, other),

No. No field or claim data was available to validate the incorporation of this parameter.

b. Presence of basement,

No. A modification to incorporate basements was investigated but not developed. During the initial investigation, NFIP claims data were analyzed to identify a target nominal difference in damage between like structures with and without basement (e.g. one story single family on-grade). The claims data were stratified accordingly and damage ratios (ratio of claim to building value) produced for single family structures, with and without basement. The resultant frequency of claims as a function of damage ratio were essentially identical for no-basement and with-basement. Given that the vulnerability model output is a damage ratio, development of a separate basement model was not justified or necessary since the claims analysis reveals that the target output should be the same. This is not a statement that a house without a basement and an identical house with a basement would suffer the same nominal loss at the same location for the same event. On the contrary, the house with basement would suffer a larger loss. However, the building value of the house with basement is necessarily larger than the identical house without basement. As such, the larger nominal loss for the house with basement is proportionally offset by the larger building value, thus the equivalent damage ratios observed in the NFIP claims analysis. Finally, the NFIP claims data shows that only ~ 0.6% of the single family homes in Florida have a basement.

c. Replacement value of building,

Yes. The building replacement value is the denominator of the damage ratio.

d. Structure value by story,

No. No field or claim data is available to validate the incorporation of this parameter.

e. Square footage of living area,

Yes. The cost analysis includes consideration of the square footage. The replacement value of a home is partially a function of the square footage.

f. Other construction characteristics, as applicable, and

Those listed in the previous disclosure 9.

g. Distance from building to flood source(s) (e.g., river, lake, coast).

The vulnerability of the structure is a function of its distance to the flood source. This is captured in two ways: 1) By the hazard component intensity as a function of geographic proximity to flood sources, 2) By the FFE assignment to select the appropriate building vulnerability output. This assignment is informed by data sources such as BFE, NFIP exposure data, etc.

11. Describe the process by which local construction practices, statewide and local building code, and floodplain management regulation adoption and enforcement are considered in the development of building flood vulnerability functions.

The influence of construction practices, building codes and floodplain management regulations are incorporated within the building flood vulnerability functions by two characteristics: first floor elevation relative to ground and model strength.

As described previously, each structural model is developed for each of multiple FFEs in increments of 1 foot, and interpolation is used to capture FFE values between these increments. During model execution, the appropriate FFE is determined based on one of two possible scenarios. The first scenario accesses the NFIP exposure data field that defines the FFE relative to NAVD 88. A 5m DEM map from the Florida Geographic Data Library (FGDL, 2012) is used to convert this FFE to the local ground elevation frame of reference. This then directly defines the appropriate FFE for direct model use or interpolation. The second scenario is engaged if the first scenario fails, either because the NFIP data field is not filled in, or if the resultant FFE relative to ground is not realistic (e.g. 20 feet). In such cases, base flood elevation (BFE) from FEMA FIRM maps is used to assign a FFE to a given property. The address and age of the property in the exposure is used to determine whether that structure was built before or after BFE maps were assigned to that region. If built after, the FFE is assigned to BFE (referenced to local elevation) plus one foot. If built before, the FFE is assigned to the average of similar structures that did have a FFE field in the NFIP exposure. This same process is also used to delineate on-grade vs elevated structures.

The age of the property is used to assign a strength of either weak or strong to delineate between pre- and post-2002 Florida Building Code statewide enforcement.

12. Provide the total number of building flood vulnerability functions available for use in the flood model. Describe which building flood vulnerability functions are used for personal residential buildings, manufactured homes, condo unit owners, and apartment renters.

Table 34. Available Flood Vulnerability Functions

Residential on-grade	2 Models: Timber Masonry	2 Strengths: Weak Strong	3 Stories: 1-story 2-story 3-story	4 FFE Elevations: 0 ft 1 ft 2 ft 3 ft	4 Flood conditions: I.F. C.F. minor waves C.F. moderate waves C.F. severe waves	192
Residential elevated	2 Models: Timber Masonry	2 Strengths: Weak Strong	2 Stories: 1-story 2-story	9 FFE Elevations: 4 ft 5 ft 6 ft 7 ft 8 ft 9 ft 10 ft 11 ft 12 ft	4 Flood conditions: I.F. C.F. minor waves C.F. moderate waves C.F. severe waves	288
Manufactured housing		2 Strengths: No Tied down Tied down		8 FFE Elevations: 1 ft 2 ft 3 ft 4 ft 5 ft 6 ft 7 ft 8 ft	4 Flood conditions: I.F. C.F. minor waves C.F. moderate waves C.F. severe waves	64
					Total	544

Different building flood vulnerability functions are used for various building classes of personal residential building structures, and manufactured homes, as the above Table 34 details. Note that during execution these model outputs can be interpolated to non-feet-integer values for FFE. Therefore, this library of 544 discrete functions represents a continuum constrained by the available resolution of FFE information for any given property.

The building flood vulnerability functions used for condo unit owners are the building flood vulnerability functions for personal residential buildings.

The apartment unit renters are only insured for contents damage. This is addressed in disclosure 5 of Standard VF-2.

13. Describe the assumptions, data, methods, and processes used to develop building flood vulnerability functions when:

- ***a. personal residential construction types are unknown, or***
- ***b. one or more primary building characteristics are unknown, or***
- ***c. building input characteristics are conflicting.***

The parameters defining an FPFLM personal residential vulnerability model for site-built structures, for a given hydrological state or flood condition are the construction type (i.e. exterior wall type), strength (weak or strong) based on year built, number of stories, building type (on grade or elevated), and first floor elevation (FFE).

The NFIP exposure data is the main source of input for the flood model. Data regarding building characteristics might be missing in the NFIP data set, including construction type, number of stories, and FFE. To make up for the missing, i.e. unknown data, the FPHLM team assigns the missing parameters based on available statistics. These statistics can vary by era and by location, and the FPHLM team has already compiled them for the wind model from the county property tax appraiser databases, and the history of the building code, and complemented them with statistics from NFIP.

For the single family manufactured homes, the weighting scheme will be the same as the one currently used in the wind model (FPHLM), using the same stats.

If building input characteristics are conflicting, the FPFLM team developed a set of rules to resolve the conflict.

14. Describe similarities and differences in how the building flood vulnerability functions are developed and applied for coastal and inland flooding.

The building flood vulnerability functions were developed for coastal and inland flooding using entirely different methodologies. Coastal flood vulnerabilities were derived by translation of tsunami fragility functions to coastal flood vulnerability functions as described in the GF-1 Disclosure 2 standard under the section **Vulnerability of site-built residential structures to Coastal Flood**, with example outputs provided in Figure 20, Figure 21, Figure 23 and Figure 80**.**

Inland flood vulnerabilities were derived by adapting USACE (2015) flood vulnerabilities as described in the GF-1 Disclosure 2 standard under the section entitled: **Vulnerability of site-built residential structures to Inland Flood**, with example outputs provided in Figure 22, Figure 23 and Figure 80.

15. Describe if and how building flood vulnerability functions are based on or depend on NFIP FIRM or other FIS data.

The development of the flood vulnerability functions was not dependent upon NFIP or FIRM. However, during model execution, the selection of the appropriate vulnerability function to employ (specifically the correct FFE to choose from the library of vulnerability model outputs) is informed by either NFIP or FIRM Maps, as described in VF-1 Disclosure 11 (above). The complete library of vulnerability outputs was developed to represent the building inventory of Florida (Table 34), whereas only a small subset of that library may be appropriate to employ for a specific region in Florida (e.g. a barrier island dominated by elevated structures). NFIP and/or FIRM are used to determine such a regionally appropriate subset.

16. For a building in an area subject to coastal and inland flooding, describe how the flood model calculates and reports flood damage.

The vulnerability model provides outputs for both inland flooding and coastal flooding for every modeled structure type. Whether a building is subject to coastal or inland flooding during any given event that property is exposed to, is determined by the hazard model. The combination of hazard and vulnerability results in damage, which the actuarial model transforms in an insured loss.

17. Describe the treatment of uncertainties associated with the building flood vulnerability functions.

Coastal flood vulnerabilities were derived by translation of tsunami fragility functions to coastal flood vulnerability functions as described in the GF-1 Disclosure 2 standard under the section **Vulnerability of site-built residential structures to Coastal Flood**, with example outputs provided in Figure 20, Figure 21, Figure 23 and Figure 80**.** In this process, both the input data and the modeling process are sources of uncertainty. The treatment and quantification of these uncertainties is described in (Baradaranshoraka et al., 2019).

The uncertainties caused by the conversion process come from the following sources: 1) the number *k* of fragilities (which represent the degree of granularity of the discretization of the PDF of damage into a histogram); 2) the uncertainty attached to the quantification of the dr_i values for each damage state; and 3) the estimation of the mean damage ratio for each damage interval of the histogram. In addition, there is uncertainty attached to the estimation of the probabilities of exceedance as a result of the field survey and the translation process from tsunami to coastal flood curves.

To quantify the uncertainty from the first two sources, a MC simulation converts the input data (the damage distributions and damage states dr_i values) into random sample data and calculates the variation in the output (vulnerability curves). In addition, other sources of uncertainty are briefly addressed.

Uncertainty due to the discretization of the PDF's of damage

The number of damage states, and hence of fragility curves, represent the degree of granularity of the discretization of the PDF of damage. Reducing the epistemic uncertainty (Der Kiureghian and Ditlevsen, 2009) attached to the number of damage states requires a finer granularity. However, considering the inherent difficulties and limitations of field observations such as limited access to buildings, surveyor subjectivity and partial knowledge, and time limitations, a finer granularity is not realistic. The result is the discretization of the PDFs of damage in very coarse histograms, which leads to large uncertainties. The MC simulations provide a means of evaluating this uncertainty. In each simulation, for each hazard intensity (IM), instead of computing the mean damage with [ENG-14] in GF-1/2, the damage is randomly selected from the histogram of damage, at IM.

Figure 81 shows the vulnerability curve from the MC simulation, and the 5% and 95% percentiles. The standard deviation ranges from 0-24% with an average of 11%, the coefficient of variation ranges from 4% - 627% with an average of 16% and the 5% to 95% percentile boundary range from 0% - 85% with an average of 29%. The discountinuties in the piecewise constant behavior in the 5% and 95% percentile curves, shown in Figure 81, correspond to a hazard intensity where the 5% and 95% percentiles change from one dr_i to another in Equation [ENG-14] in GF-1/2. The standard deviation and the CV both point to the high impact the granularity of the damage states has on the uncertainty of the vulnerabilitycurves, which is to be expected.

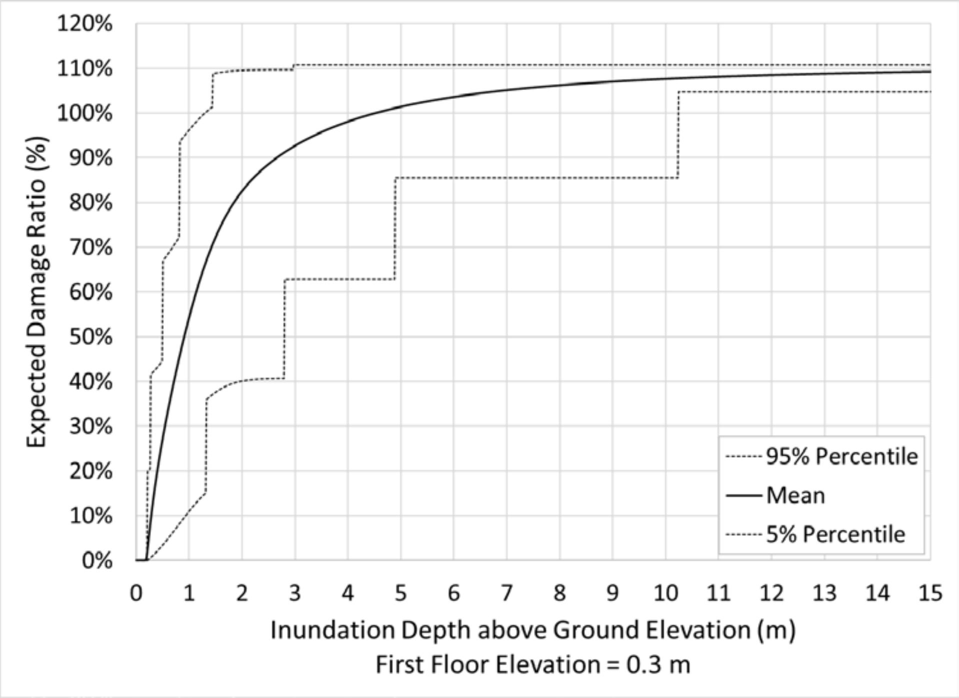


Figure 81. Variability in the vulnerability curves due to the discretization of the PDF for a one-story on-grade masonry structure (coastal flood with severe waves)

Uncertainty due to the quantification of the damage state dr_i values

The uncertainty in the dr_i values, which characterize the damage states, is due to the qualitative physical descriptions of the damage states, defined by the field investigators, and their subsequent quantitative monetary evaluations, including the cost analyses, described in GF-1/2. A similar MC simulation was employed to measure the influence of that source of uncertainty on the vulnerability curves. Figure 82 shows the resulting vulnerability curve and the 5% and 95% percentiles. The standard deviation ranges from 0-2% with an average of 1%, the coefficient of variation ranges from 0% - 21% with an average of 1% and the 5% to 95% percentile boundary range from 0% - 7% with an average of 3%. A key source of this uncertainty is the variability in the assigned damage distributions for each damage state and component. These values shows that both the percentile boundary and the CV have small values, which represents a small variability. Therefore the uncertainty due to the quantifications of the dr_i values is limited. The uncertainty in the dr_i values is due to the qualitative descriptions of the damage states, and their subsequent quantitative evaluations, including the cost analyses, described in GF-1/2. However, a study by Miller (2016) showed that the cost variability has little impact on the uncertainty of the building vulnerability outputs.

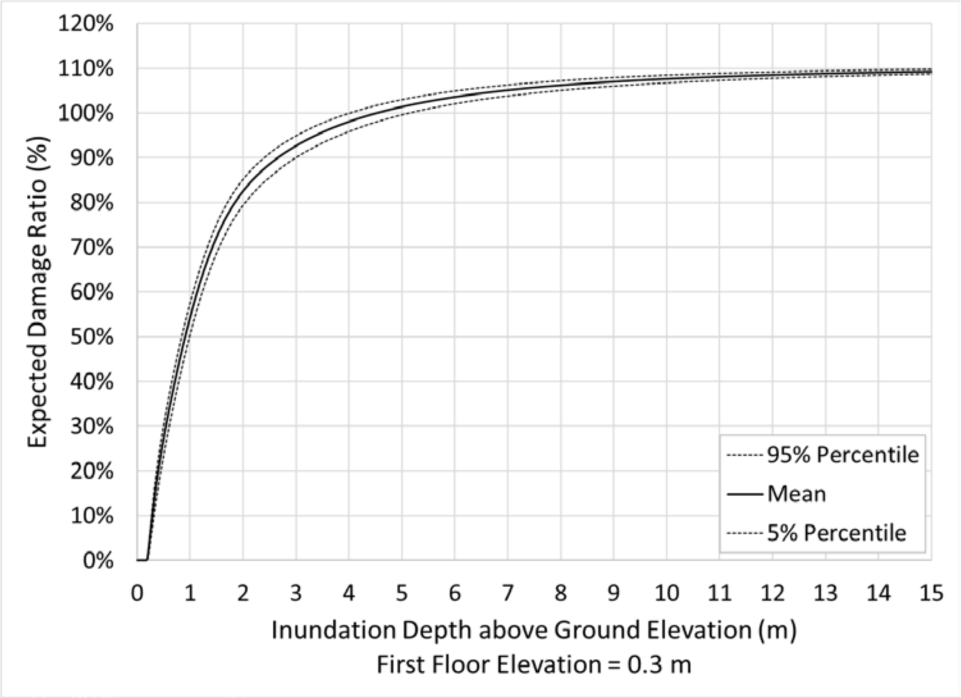


Figure 82. Variability in the vulnerability curves due to the damage states characterization process for a one-story on-grade masonry structure subjected to coastal flood with severe waves.

Uncertainty due to the estimate of the mean damage ratio within each damage interval

Equation [ENG-13] proposes a method to estimate the value of the mean damage within each damage interval of the probability distribution histogram. The uncertainty in equation [ENG-14] from the estimate of that mean value depends on the expression for the adjustment function *f*. To evaluate this uncertainty, the modelers used the wind vulnerability model of the FPHLM as a case study. Because of the granularity of the wind model (32 intervals histogram), the wind vulnerability curve is considered to be an “exact” solution. The wind model probability histograms were converted into 7 intervals, to mimic the flood model, and different functions $f(IM)$ were tested to produce the wind vulnerability curves and were compared to the vulnerability curve produced using the 32 intervals histogram. The different f functions assigned the centroid of the intervals to the lower, upper, or average boundaries of the intervals, or computed the triangular and trapezoid centroid, or finally adopted a Gaussian cumulative distribution function (CDF) $f(IM)$. This analysis showed that a gaussian distribution had the least error, depending on the values of the Gaussian function parameters. The root mean square error for the different methods are: 0.0003 (Gaussian CDF), 0.0097 (lower boundary), 0.0043 (upper boundary), 0.001 (average boundary), and 0.0006 (triangular). The Gaussian CDF parameters, in the case of coastal flood, were adopted based on engineering judgement and calibrated with the results from (USACE, 2015).

Other sources of uncertainty

There are other sources of uncertainty in fragility and vulnerability models, derived from field surveys, for example the uncertainty in the field damage assessments. This uncertainty could be due to uncertainty in the hazard information or due to the reliability in the damage determinations (e.g., inconsistent damage evaluations of similar structures by different evaluators).

Another source of uncertainty is the estimation of the probabilities of exceedance for the fragilities, usually produced from goodness-of-fit on each of the damage distributions. Since the goodness-of-fit is the result of a statistical analysis of the observed data, the uncertainty depends on the size of the field dataset.

18. Provide a completed Form VF-1, Coastal Flood with Damaging Wave Action. Provide a link to the location of the form [insert hyperlink here].

See Form VF-1.

19. Provide a completed Form VF-2, Inland Flood by Flood Depth. Provide a link to the location of the form [insert hyperlink here].

See Form VF-2.

VF-2 Derivation of Contents Flood Vulnerability Functions

A. Development of the contents flood vulnerability functions shall be based on some combination of the following: (1) post-event site investigations, (2) scientific and technical literature, (3) expert opinion, (4) laboratory or field testing, and (5) insurance claims data. Contents flood vulnerability functions shall be supported by historical and other relevant data.

The development of the contents flood vulnerabilities is based on insurance claims data, informed by expert opinion.

B. The relationship between building and contents flood vulnerability functions shall be reasonable.

The relationship between the modeled building and the contents flood vulnerability functions is reasonable, on the basis of the relationship between historical structure and contents flood losses.

Disclosures

1. Describe any modifications to the contents vulnerability component of the flood model since the currently accepted flood model.

Not applicable.

2. Provide a flowchart documenting the process by which the contents flood vulnerability functions are derived and implemented.

The flow chart below summarizes the procedure used to develop the flood contents vulnerability functions for the different types of personal residential buildings.

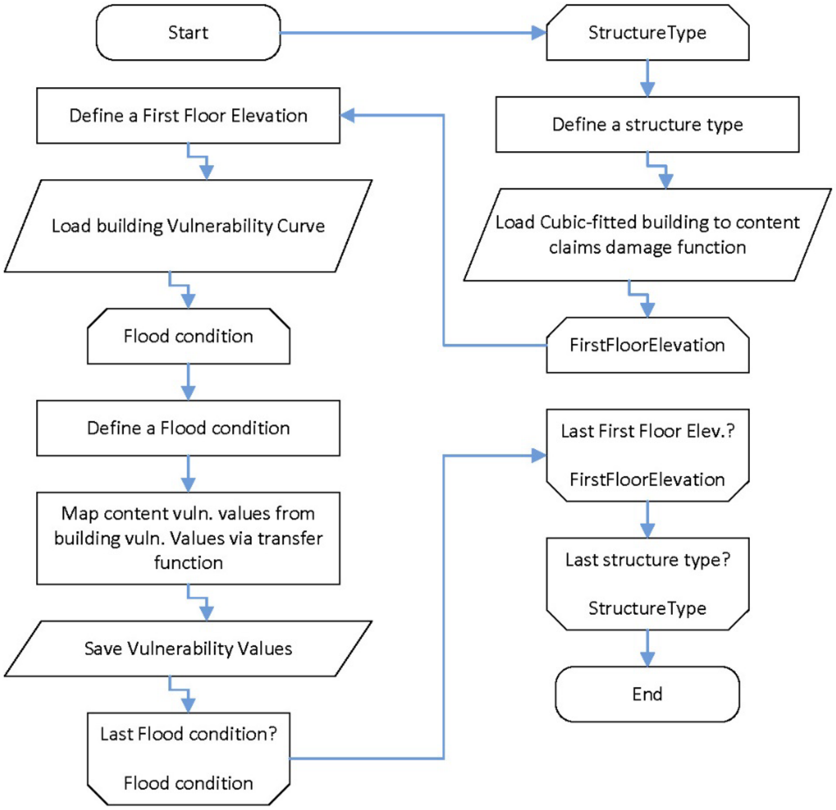


Figure 83. Content vulnerability for buildings.

3. Describe the relationship between contents and building flood vulnerability functions.

The contents flood vulnerability functions were derived from the building flood vulnerability functions, in a 3-step process described in detail in Disclosure 4 (next), based on claim data. This ensures consistency between the two types of functions.

4. Describe any assumptions, data, methods, and processes used to develop and validate the contents flood vulnerability functions.

NFIP claims data is used for the development of the coastal and inland flood model content damage vulnerabilities. For each claim, the building damage ratio (building damage to building value) and content damage ratio (content damage to content value) were calculated using the available information in the NFIP claim data. NFIP reports the building property value, building coverage and the content coverage. To calculate the content value, a factor resulting from the ratio between the building property value and the building coverage is applied to the content coverage. Table 35 shows a sample subset of the NFIP claims data (first five columns), and the values calculated from this data and appended (last three columns, grey shaded). In any row: Content value = Content coverage * (Building value/Building coverage); Building damage ratio = Building damage / Building value; Content damage ratio = Content damage / Content value.

Table 35. Sample of NFIP claim data and damage ratio calculations.

Building damage ($)	Content damage ($)	Building value ($)	Building coverage ($)	Content coverage ($)	Content value ($)	Building damage ratio (%)	Content damage ratio (%)
33,646	2,222	164,939	250,000	100,000	65,976	20.40	3.37
23,194	0	101,435	121,000	44,100	36,969	22.87	0.00
61,988	52,706	249,097	250,000	100,000	99,639	24.89	52.90
42,631	6,400	232,790	250,000	100,000	93,116	18.31	6.87
48,249	6,766	123,105	125,000	50,000	49,242	39.19	13.74

For all claims, the building and content damage ratios are paired, where the x-axis refers to the building damage ratio and the y-axis to the content damage ratio. Discrete building damage ratio intervals are defined along the x-axis. Within each interval, the average of the data along both axes yields the coordinates of the empirical building to content relationship. The result is illustrated in Figure 84, where the size of the intervals is 2.5% along the x-axis. The contents damage ratio is thus a function of the building damage ratio, rather than a direct function of the hazard intensity. This is referred to as a type 2 vulnerability function. The database used corresponds to the twelve-storm claim database described in standard VF-1.

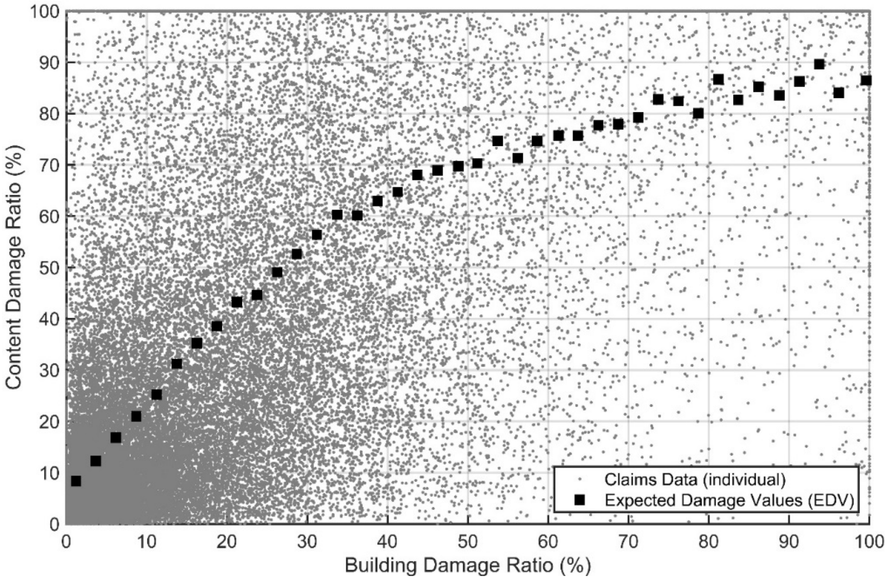


Figure 84. Type 2 vulnerability function relating content damage to building damage.

The empirical type 2 content vulnerability function was fitted with a 3-order polynomial as illustrated in Figure 85. The resulting polynomial equation (Equation VF2-1) becomes the transfer function to obtain the content vulnerability function as a function of building vulnerability. The coefficient of determination R^2 of the 3-order polynomial with respect to the expected values is 0.9938.

$$cont(bldg) = 1.26bldg^3 - 2.95bldg^2 + 2.58bldg \qquad \text{(VF2-1)}$$

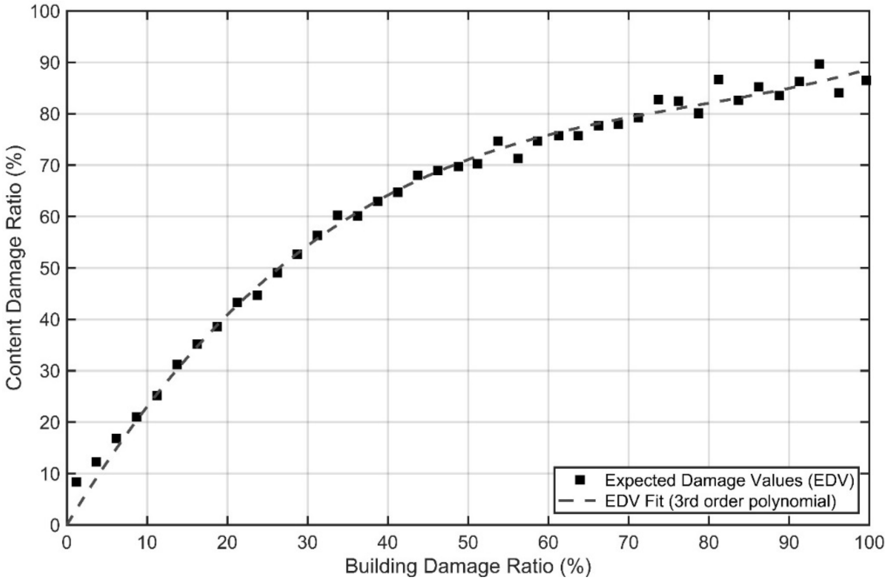


Figure 85. Transfer function of building to content vulnerability. Polynomial fit of empirical Type 2 vulnerability function relating content damage to building damage.

The transfer function converts the building vulnerability to the content vulnerability at the same inundation depth. This mapping procedure is illustrated in Figure 86, where the transfer function is Equation VF2-1.

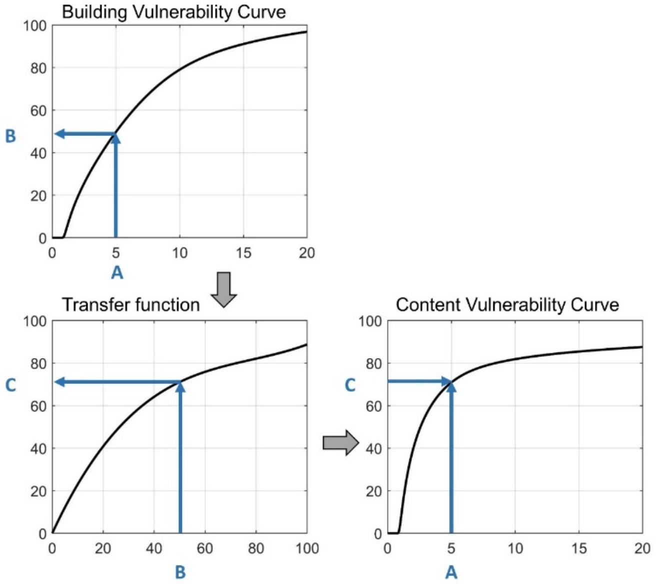


Figure 86. Content vulnerability function derivation.

This procedure ensures compatibility between the building vulnerability model, the claims data, and the resulting content vulnerability model. Figure 87 presents an example of content vulnerability function for the case of a one-story on grade reinforced masonry structure with 1 foot first floor elevation. All the flood conditions are presented.

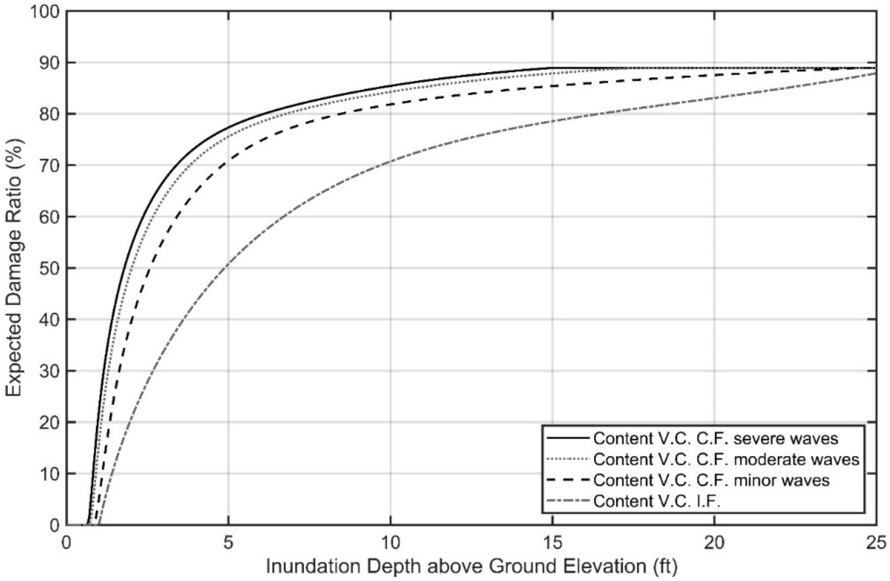


Figure 87. Content vulnerability function. One-story on grade reinforced masonry 1 ft FFE.

5. As applicable, describe the nature and extent of actual insurance company flood claims data used to develop the contents flood vulnerability functions. Describe in detail the breakdown of contents flood claims data into number of policies, number of insurers, dates of flood loss, amount of flood loss, and amount of dollar exposure, separated into personal residential buildings and manufactured homes.

The actual insurance claims data used to develop the contents flood vulnerability functions is described in VF-1 Disclosure 4, VF-2 Disclosure 4, and GF-1 Disclosure 2 (see Section 6 within **Vulnerability of site-built residential structures to Coastal Flood**)

6. Describe any new contents flood claims datasets used in the flood model since the currently accepted flood model.

Not applicable.

7. Provide the total number of contents flood vulnerability functions available for use in the flood model. Describe whether different contents flood vulnerability functions are used for buildings, manufactured homes, unit location for condo owners and apartment renters, and various building classes.

A content vulnerability function was produced for each of the building vulnerability functions listed in VF-1 Disclosure 12, Table 34. Since each of the 544 building vulnerability functions are unique, there are 544 corresponding content vulnerability functions. During execution these model outputs can be interpolated to non-feet-integer values for FFE. Therefore, this library of 544 discrete functions represents a continuum constrained by the available resolution of FFE information for any given property.

8. Describe any relationships between flood characteristics and contents flood vulnerability functions.

Since the contents flood vulnerability functions are derived from the building vulnerability functions, as described in VF-2 Disclosure 4, the relationship between flood characteristics and contents flood vulnerability functions are the same as those with personal residential building flood vulnerability functions. These relationships are described in VF-1 Disclosure 3.

9. State the minimum threshold, if any, at which contents flood damage is calculated (e.g., contents flood damage is estimated for building damage greater than x percent or flood depth greater than y inches). Provide documentation of assumptions and available validation data to verify the approach used.

The content loss is initiated at the inundation depth consistent with the initiation of building damage. This corresponds to the inundation depth at which water reaches the FFE. This depth is dependent on the flood condition, as illustrated in Figure 87, where content damage is initiated at an inundation depth lesser than the FFE for the coastal flood conditions (due to waves reaching FFE) and at inundation depth equal to FFE for inland flood. See also VF-1 Disclosure 6 (Figure 80 (b)) and GF-1 Disclosure 2 (Figure 20 and Figure 21).

10. Describe similarities and differences in how contents flood vulnerability functions are developed and applied for coastal and inland flooding.

Both coastal and inland flood vulnerability functions are derived from the building vulnerability functions using the same transfer function (VF-2 Disclosures 3 and 4).

11. Describe if and how contents flood vulnerability functions are based on or depend on NFIP FIRM or other FIS data.

The development of the contents flood vulnerability functions was not dependent upon NFIP or FIRM. However, during model execution, the selection of the appropriate vulnerability function to employ (specifically the correct FFE to choose from the library of vulnerability model outputs) is informed by either NFIP or FIRM Maps, as described in VF-1 Disclosure 11.

VF-3 Derivation of Time Element Flood Vulnerability Functions

A. Development of the time element flood vulnerability functions shall be based on one or more of the following: (1) post-event site investigations, (2) scientific and technical literature, (3) expert opinion, (4) laboratory or field testing, and (5) insurance claims data.

The development of the time element flood vulnerability functions is based on expert opinion, informed by insurance claims data for wind.

B. The relationship among building, contents, and time element flood vulnerability functions shall be reasonable.

The relationship between the modeled building, contents, and time element flood vulnerability functions is reasonable, on the basis of similar relationship for wind losses.

C. Time element flood vulnerability functions derivations shall consider the estimated time required to repair or replace the property.

The time element flood vulnerability functions derivations do consider the time required to repair the property.

Disclosures

1. Describe any modifications to the time element vulnerability component of the flood model since the currently accepted flood model.

Not Applicable.

2. Provide a flowchart documenting the process by which the time element flood vulnerability functions are derived and implemented.

The flow chart below summarizes the procedure used to develop the flood time element vulnerability functions for the different types of personal residential buildings.

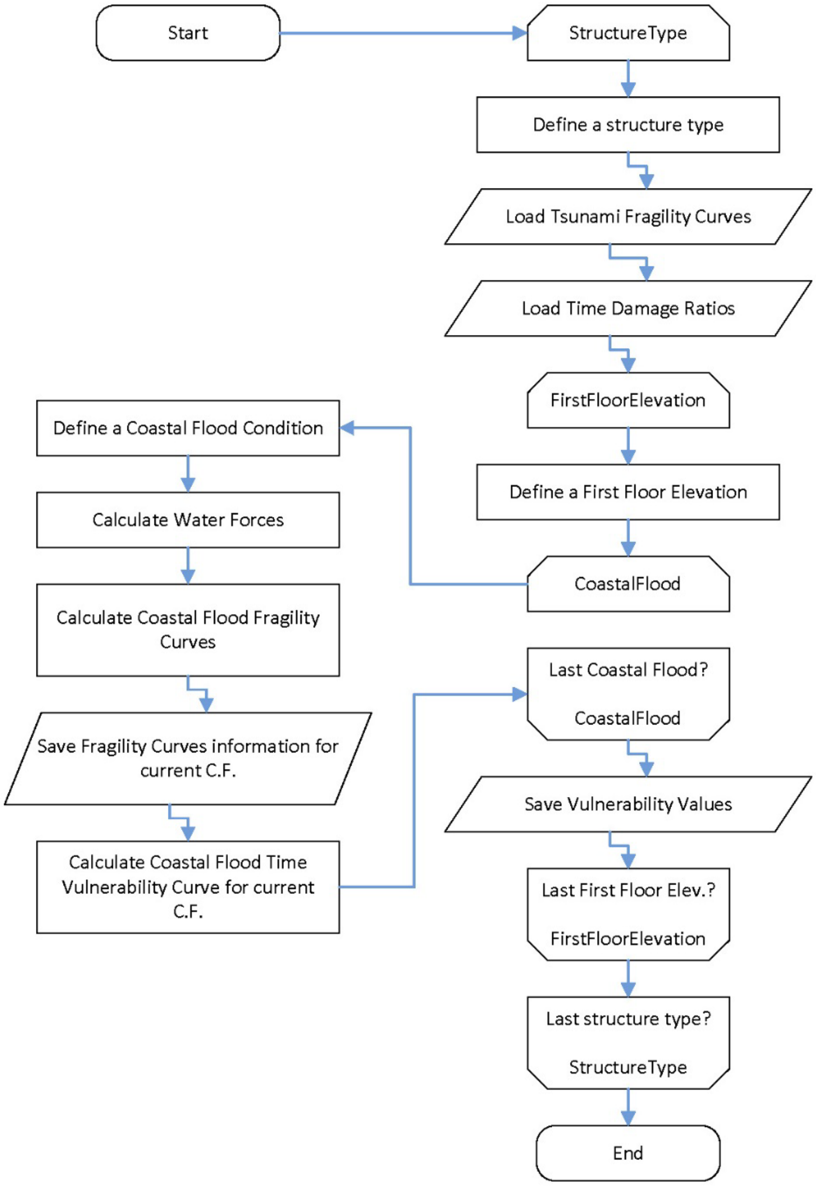


Figure 88. Coastal flood time element vulnerability for buildings.

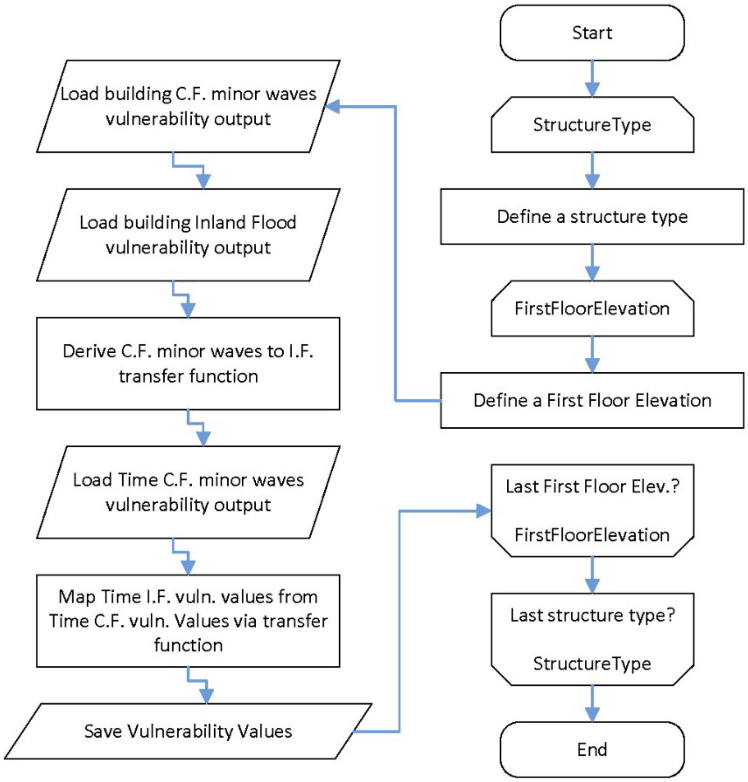


Figure 89. Inland flood time element vulnerability for buildings.

3. Describe the assumptions, data, methods, and processes used to develop and validate time element flood vulnerability functions.

- **Development of coastal flood time element vulnerability**

The definition of the time an event forces a house occupant to live outside their dwelling controls the methodology for calculating additional living expenses (ALE). The ALE ratio is a percentage of the ALE coverage, as follows:

$$\text{ALE Ratio (ALER)} = \frac{\text{Cost of living outside a dwelling}}{\text{Total ALE coverage}} \cong \frac{\text{Time of living outside a dwelling for a specific event}}{\text{Maximum amount of time allowed by the ALE coverage}} \qquad \text{(VF3-1)}$$

In Equation VF3-1, the *cost* of living outside a dwelling is approximated by the *time* spent living outside the dwelling. It is reasonable to assume that the time an owner is forced to live outside their house is directly related to the time it takes to repair a house, which is directly linked to the damage itself. The following section explains the relationship between building damage and time of repair.

Developing the ALE vulnerability functions, which express the expected ALE ratio for a given hazard intensity, starts with the building fragility functions, which are the basis for the building damage vulnerability functions as well. Disclosure 2 of Standard GF-1 documents the fragility to vulnerability function conversion. In the case of the ALE, the fragility functions express the probability of meeting or exceeding a specific ALE ratio instead of the expected damage ratio. For the case of the building:

Fragility function: $P(\mathrm{DR} \geq \mathrm{dr}_i|\mathrm{IM}) = \int_{\mathrm{dr}_i}^{\mathrm{dr}_{\max}} f_{\mathrm{DR}}(\mathrm{dr}|\mathrm{IM})\mathrm{d}(\mathrm{dr})$ → Vulnerability function:

$$\mathrm{E}[\mathrm{DR}|\mathrm{IM}] = \sum_{i=1}^{k} \frac{\mathrm{dr}_i + \mathrm{dr}_{i+1}}{2} . (\begin{cases} 1 - P(\mathrm{DR} \geq \mathrm{dr}_{i+1}|\mathrm{IM}) & i = 1 \\ P(\mathrm{DR} \geq \mathrm{dr}_i|\mathrm{IM}) - P(\mathrm{DR} \geq \mathrm{dr}_{i+1}|\mathrm{IM}) & 1 < i \leq k-1 \\ P(\mathrm{DR} \geq \mathrm{dr}_i|\mathrm{IM}) & i = k \end{cases}) \qquad \text{(VF3-2)}$$

For the case of ALE, the equations are the same with the difference that all the damage ratios (DR) will change to ALE ratios (ALER) and the damage ratio representing each damage state (dr_i) will change to the ALE ratio representing each damage state (aler_i). The methodology for calculating the values for ALER and aler_i are explained in the next sections. The methodology described for the development of building damage fragility function to vulnerability function is adapted to the case of ALE. Each damage state (DS_i) is associated with an average time occupants are forced outside their dwelling and an ALE ratio. The fragility function for each building damage state can then be reformulated to give the probability of meeting or exceeding the assigned ALE ratio. The resulting set of ALE fragility functions yields an ALE vulnerability function. The conversion method between fragilities and vulnerability is the same as the one explained in disclosure 2 of Standard GF-1.

The first step of the ALE fragility function development is to identify the average time the occupants are forced outside their dwelling. This time is divided into two categories, the delay time and the repair time.

Delay time

The delay time is up to the point that repairs start. It has three components:

- Evacuation time, whether mandatory or not, previous to the event.
- The event time, which is the time it takes for the hurricane to pass over the house location.
- Processing time, which is an accumulation of all tasks that need to be done before the repairs can start. Some of the tasks include adjusters visiting for assessment, finding a contractor, accessibility (e.g., infrastructure integrity), claim processing time, and many other factors.

For each time and damage state, using engineering judgment, the FPFLM team selected different statistical distributions. The delay time is not building specific; therefore, the same delay times are used for all residential building types. The basis of the engineering judgment is:

- For the evacuation time, it was assumed that the damage states were correlated to the hurricane magnitude. It was assumed that on average, the higher damage states happen during a more extreme hurricane event. Therefore, the higher the damage state, the bigger the mean values of the distributions for evacuation time (e.g., the mean value of the distribution of the evacuation time for damage state 1 and 2 is one day and for damage state 5 and 6 is three days).

- For the event time, it was assumed that regardless of the damage state, on average, it would take a whole day for the hurricane to pass a location.
- For the processing time, it was assumed that the bigger the damage state, the bigger the damage, and therefore the more time it would take to process such a building.

The values of the delay time mean values (μ) and standard deviation (σ) for various damage states are used for the development of the ALE model. The mean value and standard deviation stated for each delay time and damage state are then used to calculate beta distribution parameters α and β.

Repair time

The repair time is from the time the repair starts until the owner can re-occupy the structure. This includes the time to repair or remove and replace the damaged components. For the repair time, similar to the cost analysis, the team performed an analysis to see how long it will take to repair various components of different typical houses. This started with 36 different building types based on the number of stories (1–3 stories), structure type (timber or masonry), roof types (hip or gable), and roof cover (shingles, tiles, or metal). A building has 17 components, and the time to completely repair these components for each building type is calculated using publicly available construction cost and repair sources such as RSmeans Residential Cost Data 2015 (RSMeans, 2015b) and RSMeans Contractor's Pricing Guide Residential Repair & Remodeling Costs 2015 (RSMeans, 2015a). The component repair times are then averaged based on the number of stories and structure type. The structure type does not influence the component repair time; therefore, the selecting factor was the number of stories. The summation of the repair times of each component will be the total repair time.

Equation VF3-3 shows how the repair time of each damage state is calculated:

$$\text{Repair time}_i = \sum_{j=1}^{k} E[\text{PDR}|\text{DS} = \text{ds}_i] \times \text{RT}_j \qquad \text{(VF3-3)}$$

where

- Repair time_i = repair time (in days) at the *i*th damage state;
- $E[\text{PDR}|\text{DS} = \text{ds}_i]$ = the expected physical damage ratio (PDR) of the *j*th component for the *i*th damage state;
- RT_j = time of repair of the *j*th component.

Equation VF3-3 shows the relationship between the physical damage and the repair time of a component for a specific damage state. The time to repair a partially damaged component is the percentage the component has been damaged multiplied by the total time it takes to completely repair that given component. The procedure to calculate $E[\text{PDR}|\text{DS} = \text{ds}_i]$ is the same as in disclosure 2 of Standard GF-1.

ALE ratio representing each damage state (aler_i)

The next step is to assign an ALE ratio to each damage state, which is the summation of the repair time of each component plus the delay time of that specific damage state.
The ALE ratio of a given damage state (aler_i) can be defined as:

$$\mathrm{aler}_i = \frac{\mathrm{Delay\ Time_i\ + Repair\ Time_i}}{\mathrm{Maximum\ Delay\ Time\ + Maximum\ Repair\ Time}} = \frac{\mathrm{Delay\ Time_i\ + Repair\ Time_i}}{\mathrm{Maximum\ Additional\ Living\ Time}} \qquad \text{(VF3-4)}$$

where

- $\mathrm{Delay\ Time}_i$ = summation of the different components of the delay time of the *i*th damage state;
- $\mathrm{Repair\ Time}_i$ = repair time of the *i*th damage state (using Equation VF3-3);
- Maximum Delay Time = maximum delay time used in the model. This is the summation of the 95% percentile of different components of the damage state 6 delay time;
- Maximum Repair Time = maximum time it takes to repair the house. This is total time of repair;
- Maximum Additional Living Time = summation of the two maximum delay and repair times. This is equal to the ALE coverage.

The model uses a Monte Carlo simulation to calculate the ALE ratio that characterizes each damage state (aler_i). The simulation uses the physical damage distributions, delay time distributions, and repair time distributions as input to Equation VF3-4, and the output is the expected ALE ratio corresponding to each damage state. In each simulation run, the simulation randomly samples a physical damage value based on the assigned damage distributions for all damage states and components, as well as randomly sampling an evacuation, event, and processing time based on the assigned delay time distributions for all damage states, converting the distributions into sample data. For each simulation, using Equation VF3-3 and the appropriate time of completely repairing a component, the repair time is calculated. The calculated repair time in addition to the sampled delay times are used in Equation VF3-4 to calculate the expected ALE ratio corresponding to each overall damage state. The Monte Carle simulation performs these process for a total of 100,000 simulations. The mean value of all simulations is used as the ALE ratio of a given damage state (aler_i). In each simulation, if the repair time is zero, the processing time is changed to zero; however, the evacuation and event time can be nonzero and cause ALE.

Converting ALE fragility functions into ALE vulnerability functions

This conversion uses the same approach as converting the building fragility to vulnerability functions. Equation VF3-5 is similar to Equation VF3-1, converted from building damage to ALE:

$$E[\mathrm{ALER}|\mathrm{IM}] = \sum_{i=1}^{k} \frac{\mathrm{aler}_i + \mathrm{aler}_{i+1}}{2} . \left(\begin{cases} 1 - P(\mathrm{ALER} \geq \mathrm{aler}_{i+1}|\mathrm{IM}) & i = 1 \\ P(\mathrm{ALER} \geq \mathrm{aler}_i|\mathrm{IM}) - P(\mathrm{ALER} \geq \mathrm{aler}_{i+1}|\mathrm{IM}) & 1 < i \leq k-1 \\ P(\mathrm{ALER} \geq \mathrm{aler}_i|\mathrm{IM}) & i = k \end{cases} \right) \qquad \text{(VF3-5)}$$

where

- $E[\text{ALER}|\text{IM}]$ = expected ALE ratio for a given hazard intensity (IM),
- aler_i = expected ALE ratio representing damage state *i*. This is calculated using the Monte Carlo simulation explained above. For $i = k$ the $aler_{i+1}$ is equal to 1;
- $P(A\text{LER} \geq \text{aler}_i|\text{IM})$ = probability of occurrence or exceedance of damage state i at a given hazard intensity (IM). This is equal to the fragility curve value of damage state *i* at a given hazard intensity (IM).

For any given damage state, characterized by a damage ratio and an ALE ratio, the probability of exceeding the ALE ratio is the same as the probability of exceeding the damage ratio. Therefore, the ALE and building damage fragility functions are identical. However, the resulting vulnerability functions differ.

➢ Development of inland flood time element vulnerability

The inland flood building vulnerability curves were derived following a different procedure than the coastal flood, as explained in standard GF-1 disclosure 2. Therefore, the methodology for coastal flood time element vulnerability (section 2.1 above) cannot be applied for inland flood time element vulnerability. The inland flood time element vulnerability is derived by applying a transfer function to the minor wave coastal flood time element vulnerability. The transfer function is the ratio of inundation depth of the inland flood building vulnerability function to the inundation depth of the minor wave coastal flood building vulnerability function at a series of discrete damage ratios. This transfer function is then used to map the minor wave coastal flood time element vulnerability to the inland flood time element vulnerability. This transfer function and resulting time element vulnerability is unique for each of the 544 building type variations listed in Table 34 in standard VF-1, disclosure 12.

4. Describe the relationships among building, contents, and time element flood vulnerability functions.

The building vulnerability functions are derived based on fragility functions. The content vulnerability functions are indirectly derived from the fragility functions, because these are derived based on the building vulnerability functions along with the relation between building and content damage ratios from claim data. The time element vulnerability functions are derived by either directly using the same fragility functions as the building vulnerability (VF-3 coastal flood, section 3.1 disclosure 3) or by mapping (VF-3 inland flood, section 3.2, disclosure 3).

5. As applicable, describe the nature and extent of actual insurance company flood claims data used to develop the time element flood vulnerability functions. Describe in detail the breakdown of time element flood claims data into number of policies, number of insurers, dates of flood loss, amount of flood loss, and amount of dollar exposure, separated into personal residential buildings and manufactured homes.

Since NFIP does not cover time related expenses, there is no NFIP claim data related to time related expenses.

6. Describe any new time element flood claims datasets used in the flood model since the currently accepted flood model.

Not applicable.

7. Provide the total number of time element flood vulnerability functions available for use in the flood model. Describe whether different time element flood vulnerability functions are used for personal residential, manufactured homes, unit location for condo owners and apartment renters, and various building classes.

A time element vulnerability function was produced for each of the building vulnerability functions listed in disclosure 12 of standard VF-1. The time element vulnerability functions used for condo unit owners and apartment unit renters are the time element vulnerability functions for personal residential buildings, as explained in disclosure 10 of standard V-1.

8. Describe similarities and differences in how time element flood vulnerability functions are developed and applied for coastal and inland flooding.

See Disclosure 2. Section 2.1 describes coastal flood time element functions, and section 2.2 describes inland flood time element functions.

9. Describe whether and how building classification and characteristics, and flood characteristics, are incorporated into the time element flood vulnerability functions.

A time element vulnerability function was produced for each of the building vulnerability functions listed in disclosure 12 of standard VF-1. Thus, all structure classification and characteristics, and flood characteristics are incorporated into the time element functions in the same manner as they are incorporated in the structure vulnerability functions.

10. Describe whether and how time element flood vulnerability functions take into consideration the damage to local and regional infrastructure, or time element vulnerability resulting from a governmental mandate associated with flood events (e.g., evacuation and re-entry mandates).

Time element losses for personal residential buildings are based on estimation of delay and repair times of damage to the structure. These times take indirectly into account potential damage to the infrastructure. For example, more severe flood events result in more delay time, in part due to possible damage to infrastructure.

VF-4 Flood Mitigation Measures

A. Modeling of flood mitigation measures to improve flood resistance of buildings, and the corresponding effects on flood vulnerability and associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include design, construction, and retrofit techniques that affect the flood resistance or flood protection of personal residential buildings.

The modeled flood mitigation measures improve the resistance of personal residential buildings and reduce their vulnerability relative to their like-building without the mitigation measures. Engineering principles were employed to develop and implement the mitigation measures.

B. The modeling organization shall justify all flood mitigation measures considered by the flood model.

All the flood mitigation measures considered by the flood model have a beneficial impact on the building and contents vulnerability. All mitigation measures required in this standard have been implemented in the model. Different measures reduce vulnerability in different ways and to different degrees, and the influence of combined mitigations are not a superposition of vulnerability reductions from individual mitigations.

C. Application of flood mitigation measures that affect the performance of personal residential buildings and the damage to contents shall be justified as to the impact on reducing flood damage whether done individually or in combination.

The mitigation measures described in disclosure 2 may be implemented individually or in combination. Reductions in building vulnerability result in a reduction in content damage.

Disclosures

1. Describe any modifications to flood mitigation measures used by the flood model since the currently accepted flood model.

Not applicable.

2. Describe the procedures used to calculate the impact of flood mitigation measures, including software, its identification, and current version. Describe whether or not such procedures have been modified since the currently accepted flood model.

VF-4 Disclosure 4 describes the types of flood mitigation measures as well as their concepts and calculations. The procedure used to calculate the impact of flood mitigation measures was to conduct a comparative analysis of inundation depth-dependent damage functions with and without individual and combined mitigations measures. Consistent with the entirety of the vulnerability component, MATLAB was the programming language.

3. Provide a completed Form VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage. Provide a link to the location of the form [insert hyperlink here].

Link to Form VF-3.

4. Provide a description of all flood mitigation measures used by the flood model, whether or not they are listed in Form VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage.

The following is an abridged version of the peer reviewed paper Paleo-Torres at al. (2021). Fundamentally, the implementation of a given mitigation measure results from an adjustment to the damage ratios (see standard GF-1, Disclosure 2) assigned to those components influenced by the mitigation measure to reflect a reduced probability of damage to the affected components. The methodology considers the influence of mitigation measures before and after the water inundation depth overcomes the given mitigation. When inundation has not yet reached the height of the mitigation, the adjusted damage ratios are employed. When inundation has reached the height of the mitigation, the model transitions to the unmitigated damage ratios. Figure 90 shows a conceptual comparison of mitigated and unmitigated vulnerability. The mitigation reduces but does not eliminate damage, and the mitigation is effective until the inundation height overcomes it.

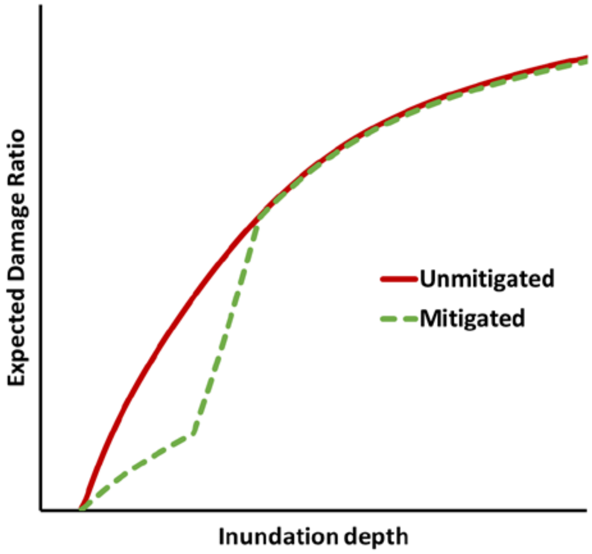


Figure 90. Conceptual illustration of mitigated vs unmitigated vulnerability.

The model currently considers the following mitigation measures, described in detail below: elevating utilities, wet floodproofing, dry floodproofing, flood openings, and elevated building.

Elevating Utilities

This mitigation considers elevating or otherwise protecting the equipment and utilities to a specified height. The equipment and utilities are mechanical, electrical and plumbing used within or on the exterior of a building. The mitigation measures for equipment and utility include elevating or protecting for 1, 2, or 3 feet above FFE.

The method implements the effect of mitigation by using a combination of the original interior damage distributions and modified interior damage distributions. The modified interior damage distributions are used for water height lower than the mitigation height; the original distributions are used for water height above the mitigation height. However, considering the costs associated with elevating the equipment, the cost ratios are slightly different (less than 1%). For illustration, Table 36 shows the damage distributions of three subcomponents for the case of a 1-story single family on grade reinforced masonry (strong) building. Notice that only the utilities component is affected by this mitigation measure. The water level relative to the mitigation height is used to determine whether the top row or bottom row assignment is employed when creating the vulnerability function. Using these distributions with the cost ratios for each component for a certain building type yields the Damage Ratio per Damage state, for the cases when the water is below and above the mitigation height.

Table 37 shows the damage ratio representing each damage state for water level below the mitigation height and above the mitigation height for the case of a one story on-grade masonry building. When the water reaches the mitigation height, a transition occurs from using the mitigated DR to using the unmitigated DR, as illustrated conceptually in Figure 90.

Table 36. Distribution of component damage for different damage states, one story on-grade reinforced masonry building.

Elevating utilities	DS1	DS2	DS3	DS4	DS5	DS6
Water above mitigation height	Interior: Normal (μ=0.2,σ=0.07) Utilities: Normal (μ=0.2,σ=0.07) Foundation: Normal (μ=0.2,σ=0.07)	Interior: Normal (μ=0.4,σ=0.07) Utilities: Normal (μ=0.4,σ=0.07) Foundation: Normal (μ=0.4,σ=0.07)	Interior: Normal (μ=0.6,σ=0.07) Utilities: Normal (μ=0.6,σ=0.07) Foundation: Normal (μ=0.6,σ=0.07)	Interior: Normal (μ=0.8,σ=0.06) Utilities: Normal (μ=0.8,σ=0.06) Foundation: Normal (μ=0.8,σ=0.06)	Interior: Normal (μ=0.95,σ=0.03) Utilities: Normal (μ=0.95,σ=0.03) Foundation: Normal (μ=0.95,σ=0.03)	Interior: Normal (μ=0.99,σ=0.01) Utilities: Normal (μ=0.99,σ=0.01) Foundation: Normal (μ=0.99,σ=0.01)
Water below mitigation height	Interior: Normal (μ=0.2,σ=0.07) Utilities: No damage Foundation: Normal (μ=0.2,σ=0.07)	Interior: Normal (μ=0.4,σ=0.07) Utilities: No damage Foundation: Normal (μ=0.4,σ=0.07)	Interior: Normal (μ=0.6,σ=0.07) Utilities: No damage Foundation: Normal (μ=0.6,σ=0.07)	Interior: Normal (μ=0.8,σ=0.06) Utilities: No damage Foundation: Normal (μ=0.8,σ=0.06)	Interior: Normal (μ=0.95,σ=0.03) Utilities: No damage Foundation: Normal (μ=0.95,σ=0.03)	Interior: Normal (μ=0.99,σ=0.01) Utilities: No damage Foundation: Normal (μ=0.99,σ=0.01)

Table 37. Expected damage ratios representing each damage states above and below mitigation heights, one story on-grade reinforced masonry building.

Building type	Expected damage ratio	dr_1	dr_2	dr_3	dr_4	dr_5	dr_6	dr_{max}
1st-M	Water above mitigation height	19.9%	40.7%	62.5%	84.7%	103.3%	108.2%	109.2%
	Water below mitigation height	14.1%	29.4%	45.8%	62.7%	77.6%	81.4%	

Wet floodproofing

Wet floodproofing does not protect against hydrodynamic forces from moving water. Rather, the interior of the dwelling is constructed using materials that are less susceptible to water damage and can recover from wetting with minimal need for replacement (e.g. tile flooring rather than wood).

After consulting with a Florida local contractor, common practice for wet floodproofing a masonry home consists of:

1. waterproofing the interior block with paint to eliminate the possibility of mold growing on the interior masonry;
2. using non-wood (e.g., metal) furring strip boards
3. using cement boards instead of drywall;
4. using plastic or vinyl base boards;
5. using tile or terrazzo flooring;
6. elevating mechanical equipment;
7. using PVC or composite frames for the opening
8. Placing electric plugs above 3 or 4 ft.

The extra cost of the first four measures to mitigate the interior walls is $5.75 per sq. ft of wall. The cost of using tile or terrazzo vs. hardwood is the same. The cost of elevating mechanical equipment is $500 per unit. Using PVC or composite frames is slightly cheaper than wood frames. And the cost of placing the electric plugs at a higher elevation is the same as lower elevations. Since all these mitigation measures are performed on the interior, the calculated costs will be added to the interior section of the cost analysis. Also, since the mitigation measures are performed only on the first floor, all extra costs (repair and replacement) are added to the cost analysis of the first floor. However, given that these extra costs change the cost analysis of the entire building, regardless of the number of stories of the building, the cost ratio of all the components change.
The cost of mitigating interior components increases the ratio of interior cost to cost of the entire house. These modifications do not add to the strength of a building but reduce the need to replace some components and therefore result in less loss for the building.

Following the procedure explained in section 4.1, damage distributions are altered for the components influenced by wet floodproofing (interior and utilities).

Dry floodproofing

Dry floodproofing is a method that makes the dwelling watertight from the ground level up to a designated height (1, 2, 3 feet) via use of waterproof coatings or membranes, watertight gates around low entryways, and protecting utilities to that same height. According to FEMA 551, common practice for dry floodproofing a building consists of:

1. Waterproofing a concrete block or brick-faced wall by applying a polyethylene sheet or other impervious material and covering with a facing material such as brick;
2. Acrylic latex wall coating;
3. Caulking/sealant – a high performance electrometric “urethane” sealant is recommended.

Since the mitigation measures are performed only on the first floor, all extra costs (repair and replacement) are added to the cost analysis of the first floor. Given that the mitigation costs change the cost analysis of the entire building, regardless of the number of stories of the building, the cost ratio of all the components changes.

Following the procedure explained in section 4.1, damage distributions are altered for the affected components. For the case of dry floodproofing, when the water is below the mitigation height, the interior and the utilities components are considered to be undamaged.

Flood Openings in foundation wall

Flood openings are used as a mitigation measure where the water is allowed to flow in and out of an elevated foundation. The procedure to model this mitigation measure is similar to the ones described for the previous cases. As seen in Table 36, the foundation is one of the components considered. The flood openings mitigation is reflected by reducing the mean of the pdf of damage of the foundation relative to the unmitigated case.

Elevated building

Elevated residential buildings are common in coastal regions. The methodology to develop personal residential vulnerability functions for elevated buildings is the same as described in standard GF-1 disclosure 2, where tsunami fragility curves are used as a basis and then translated into coastal flood fragility functions via force equivalency calculations. With the damage states quantification, the vulnerability functions are derived from the fragility functions. The only difference in the procedure (with respect to on grade buildings) is in the way the forces are calculated. Instead of directly using the coastal flood force equations, only the pressure acting on the superbuilding is integrated to calculate the resulting lateral force acting on the elevated building, as shown (shaded) in Figure 91. Damage begins to accumulate at the inundation height associated with wave crest reaching the lowest horizontal structural member, followed by rapid accumulation of damage with increasing depth due to larger wave forces at deeper inundation depths.

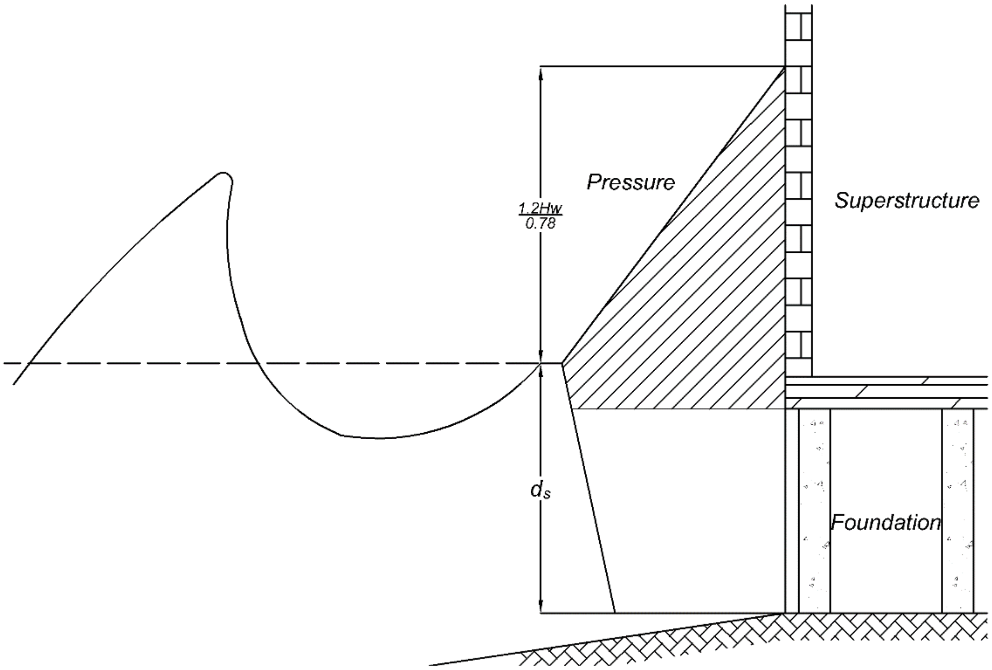


Figure 91. Pressure acting on elevated building.

Combined mitigation: utility equipment elevated 2 feet and wet floodproofing 2 feet

Combining mitigations is a matter of implementing more than one mitigation method within the model simultaneously. The combinations performed involve wet floodproofing and elevated utility equipment from 1 to 3 feet. The resultant combination is derived by selecting the appropriate distributions for utilities and interior. The resultant combined mitigation is not a linear superposition of individual mitigations.

5. Describe how time element flood losses are affected by performance of flood mitigation measures. Identify any assumptions.

Standard VF-3 explains that time element losses are related to building damage. Therefore, any given mitigation that reduces building damage will reduce time element losses.

6. Describe how building and contents damage and the treatment of associated uncertainties are affected by flood mitigation measures. Identify any assumptions.

The implementation of mitigation measures directly influences one or more components of the building damage as discussed in VF-4 Disclosure 4. Standard VF-2 explains that contents damage is a function of building damage. Therefore, any given mitigation that reduces building damage will reduce contents damage over the same range of inundation depths.

Each of the mitigation measures implemented in the model involves assumptions regarding the precise nature of the mitigation measure, its influence on additional cost (both installation and repair), and the level of protection provided. For example, wet floodproofing has a very broad definition. Disclosure 4 discusses the interpretation employed in this model in terms of physical mitigation as well as its influence on cost, repair and vulnerability. Therefore, both the interpretation and implementation of any given mitigation or combination introduce uncertainty.

7. Describe how the effects of multiple flood mitigation measures are combined in the flood model and the process used to ensure that multiple flood mitigation measures are correctly combined.

Please refer to the last section of VF-4 Disclosure 4. Combined mitigation vulnerabilities are graphically compared to the unmitigated building as well as that building with individual mitigations implemented to ensure an expected logical relationship.

8. Provide a completed Form VF-4, Differences in Flood Mitigation Measures. Provide a link to the location of the form [insert hyperlink here].

Link to Form VF-4.

ACTUARIAL FLOOD STANDARDS

AF-1 Flood Model Input Data and Output Reports

A. Adjustments, edits, inclusions, or deletions to insurance company or other input data used by the modeling organization shall be based upon generally accepted actuarial, underwriting, and statistical procedures.

All adjustments, edits, inclusions, or deletions to insurance company input or other input data are based upon accepted actuarial, underwriting, and statistical procedures.

B. All modifications, adjustments, assumptions, inputs and input file identification, and defaults necessary to use the flood model shall be actuarially sound and shall be included with the flood model output report. Treatment of missing values for user inputs required to run the flood model shall be actuarially sound and described with the flood model output report.

Model input data is provided by an insurance company or the Florida Office of Insurance Regulation to staff at Florida International University. Any modification to the inputs, including the treatment of missing values, is actuarially sound and disclosed in the model output report.

Disclosures

1. Identify insurance-to-value assumptions and describe the methods and assumptions used to determine the property value and associated flood losses. Provide a sample calculation for determining the property value.

The model provides separate inputs for building value and building limit and bases the loss calculation on the building value. Property Value = Building Value.

2. Identify depreciation assumptions and describe the methods and assumptions used to reduce insured flood losses on account of depreciation. Provide a sample calculation for determining the amount of depreciation and the actual cash value (ACV) flood losses.

There is no depreciation assumption applied to modeled losses. Depreciation = $0.

3. Describe the different flood policies, contracts, and endorsements as specified in s. 627.715, F.S., that are modeled.

Losses are currently modeled for the Standard Flood Policy and for Additional Living Expenses/Time Element coverage. Other policies, contracts and endorsements are not modeled.

4. Provide a copy of the input form(s) used by the flood model with the flood model options available for selection by the user for the Florida flood model under review. Describe the process followed by the user to generate the flood model output produced from the input form. Include

the flood model name, version identification, and platform identification on the input form. All items included in the input form should be clearly labeled and defined.

Table 38. Expected Input File Format for OIR Data Processing

Florida Public Flood Loss Model: Version 1.0, Platform N/A
Input Data File Format Specifications

Personal Residential Policies

Input files containing personal residential policies to be processed through the Florida Public Flood Loss Model should adhere to the format specifications **contained** in this document.

Observe the following when preparing the input file:
- (a) Provide one policy per line in a comma-separated values file (.csv).
- (b) Do not use comma within the fields' values (e.g., as thousand separators or within addresses).
- (c) Include the name of each field in the first line of the file.
- (d) For fields that require a code, enter the code that most closely represents the data value.
- (e) Only include policies with flood coverage.

Each policy should contain a total of 35 attributes. Always provide all 35 attributes.

1. Policy Coverage Type

The type of coverage for each policy. Encode the data to one of the following:

This policy includes coverage for:	Code
Primary flood only	1
Excess flood only	2

2. Policy ID

A unique identifier for this policy in the data file. An alphanumeric text.

3. ZIP Code

The ZIP Code where this building is located. A 5-digit number.

4. Latitude

The latitude where this building is located. Format: YY.YYYYY. If not known, enter UNKNOWN.

5. Longitude

The longitude where this building is located. Format: XX.XXXXX. If not known, enter UNKNOWN.

6. County

The name of the county where the building is located.

7. Address

The street address of the building.

8. City

The name of the city where the building is located.

9. Year Built

The year in which the building was built. A 4-digit number or UNKNOWN.

10. Year Retrofitted

The 4-digit year when the building was retrofitted (brought up to code).
If only the year of roof replacement is known, enter the 4-digit year when the roof was replaced followed by R (i.e. if the roof was replaced in 1999, enter 1999R).
If not retrofitted enter NA. If not known enter UNKNOWN.

11. Residence Type

The type of the residence covered by the policy. Encode the data to one of the following:

Value	Code
Single family residence, townhouse, or rowhouse	1
Condo unit	2
Rental unit in a multi-family building	3
Other or Unknown	4

12. Construction Type

The construction type of the building. Encode the data to one of the following:

Value	Code
Frame, Timber, Wood	1
Masonry	2
Manufactured home – not tied-down	3
Manufactured home – partially tied-down	4
Manufactured home – tied-down	5
Manufactured home – unknown	6
Other	7
Unknown	8

13. Elevation

Encode the data to one of the following:

Value	Code
Slab on-grade	1
Crawlspace – open	2
Crawlspace – closed	3
Elevated	4
Unknown	5

14. First Floor Elevation

The elevation (ft.) of the first floor of the building with respect to ground elevation. If not known, enter UNKNOWN.

15. Number of Stories

Number of stories in the building (e.g., 1, 2, 3, etc.) or UNKNOWN.

16. Elevated or Protected Utility

As a mitigation measure, indicate whether the utilities are elevated or protected.

Value	Code
No	0
Protected or elevated by 1 foot	1
Protected or elevated by 2 feet	2
Protected or elevated by 3 feet	3
Unknown	4

17. Floodproofing

As a mitigation measure, indicate whether the building is floodproofed.

Value	Code
No	0
Wet floodproofed by 1 foot	1
Wet floodproofed by 2 feet	2
Wet floodproofed by 3 feet	3
Dry floodproofed by 1 foot	4
Dry floodproofed by 2 feet	5
Dry floodproofed by 3 feet	6
Unknown	7

18. Location of Unit

The story in which the unit is located (e.g., 1, 2, 3, etc.) or UNKNOWN. Only applicable to units in a multi-family building, e.g., condo or rental units. Enter NA for all other policy types.

19. Building or Unit Area

The total square feet of the insured unit or of all floors of the insured building. If not known, enter UNKNOWN.

20. Building or Unit Value

The dollar amount value of the insured building or unit. If not known, enter UNKNOWN.

21. Contents Value

The dollar amount value of the insured contents. If not known, enter UNKNOWN.

22. Building Coverage

The building coverage amount in dollars. Enter 0 if none.

23. App. Coverage

Future use only. Enter 0. Submit separate record for Appurtenant Structures to be modeled as buildings.

24. Contents Coverage

The contents coverage amount in dollars. Enter 0 if none.

25. ALE Coverage

The additional living expenses (ALE) coverage amount in dollars. Enter 0 if none.

26. Structure Deductible

The flood structure deductible amount in dollars (convert percentages to dollar amounts).

27. Contents Deductible

The flood contents deductible amount in dollars (convert percentages to dollar amounts).

28. Building Settlement Option

The settlement option on the building. Encode the data to one of the following:

Value	Code
Replacement Cost	R
Actual Cash Value	A

29. Contents Settlement Option

The settlement option on the contents. Encode the data to one of the following:

Value	Code
Replacement Cost	R
Actual Cash Value	A

30. Form

The policy form number or prefix, if applicable. Otherwise enter N/A.

31. Program Code

Use one uppercase letter to represent each company program.

32. Territory Code

Use the territory codes reflected in your rate manual.

33. Increased Cost of Compliance/Law & Ordinance

Whether the policy includes Increased Cost of Compliance coverage.

Value	Code
Does not include coverage	0
Includes coverage	1
Coverage does not apply	NA

34. Water Intrusion Other than Flood

Whether the policy includes coverage for water intrusion other than flood.

Value	Code
Does not include coverage	0
Includes coverage	1
Coverage does not apply	NA

35. Supplemental Flood Coverage

If the policy includes supplemental flood coverage for jewelry, fine art, or other specified personal effects, enter the coverage limit, otherwise enter NA.

Example data file:

```
PolicyCoverageType,PolicyID,ZIPCode,Latitude,Longitude,County,Address,City,YearBuilt,
YearRetrofitted,ResidenceType,ConstructionType,Elevation,FirstFloorElevation,NumberOfSt
ories,ElevatedOrProtectedUtility,FloodProofing,LocationOfUnit,BuildingOrUnitArea,Buildin
gOrUnitValue,ContentsValue,BuildingCoverage,AppCoverage,ContentsCoverage,ALECover
age,StructureDeductible,ContentsDeductible,BuildingSettlementOption,ContentsSettlementO
ption,Form,ProgramCode,TerritoryCode,ICC,WaterIntrusion,SupplementalFloodCoverage1,
ABC100,33143,28.04747,-80.66522, Miami-Dade,123
MainStreet,Miami,1981,NA,1,2,1,2,1,0,0, NA,
UNKNOWN,160000,50000,160000,0,20000,8000,1000,1000,R,R,NA,F,01,1,0,5000
```

The user submits an exposure file as specified above. The model run is executed by the Model's staff. No other options are available to the user.

5. Disclose, in a flood model output report, the specific inputs required to use the flood model and the options of the flood model selected for use in a personal residential property flood insurance rate filing in Florida. Include the flood model name, version identification, and platform identification on the flood model output report. All items included in the flood model output report should be clearly labeled, highlighted, and defined.

Table 39. Output Report for OIR Data Processing

Florida Public Flood Loss Model: Version 1.0, Platform NA
Output Report for OIR Processing

OIR Data Processing Results: <Company Name: OIR Filing Number>

The Report consist of multiple files:

1. Summary of the exposure data and modifications, if any, to that data.
2. Exposure pre-processing results.
3. Policy count distributions by Construction Type and Region and by Construction Type and Year-Built.
4. Average Annual Loss (AAL) by policy.
5. Probable Maximum Loss (PML) for various return times.

6. Total modeled losses by stochastic storm and year.

7. Multiple summaries of exposures, modeled losses and loss cost by coverage. Examples:

- By Construction Type
- By Construction Type and Territory
- By County
- By County and Construction Type
- By County, Construction Type and Territory
- By County and Territory
- By Policy Form
- By Program
- By Territory
- By First Floor Elevation
- By Elevation
- By Floodproofing
- By Elevated or Protected Utility
- By Zipcode
- By Zipcode and Construction Type
- By Zipcode Construction Type and Territory
- By Zipcode and Territory

6. Provide a list of all options available (e.g., flood event data source, vulnerability functions) to the user. Identify the specific options acceptable for a Florida rate filing.

The user provides the exposure input as specified in Disclosure #4. There are no additional options available to the user.

7. Explain the differences in data input and flood model output required for coastal and inland flood modeling.

There is no difference in exposure input requirements between coastal and inland areas. The model output does not vary between coastal and inland areas.

8. Describe actions performed to ensure the validity of insurer or other input data used for flood model inputs or for validation/verification.

The pre-processing of exposure inputs is outlined below.

Table 40. Pre-processing of Exposure Inputs

Data Attribute	Pre-processing Steps
Policy ID	Not used in processing. Included in Model Output.
Model ID	Numeric ID assigned by model.
Policy Coverage Type	Replace empty, NULL, and out-of-range values with the value Unknown. Replace numeric codes with corresponding description.

Data Attribute	Pre-processing Steps
Zip Code	Replace empty and NULL values with the value Unknown. Remove the last five characters (dash and four digits) from ZIP 5+4 values. Exposures without a valid ZIP Code are not modeled.
Year Built	Replace empty and NULL values with the value Unknown. Set to Unknown values smaller than 1800 or larger than the current year. Impute Unknown values using county statistics.
Construction Type	Remove any character that is not a digit. Replace empty and NULL values with the value Unknown. Replace numeric codes with corresponding descriptions. Replace out-of-range numeric codes with the value Other.
Structure, App. Structures, Contents, and TE Coverages	Remove any character that is not a digit or a dot. Replace with 0 any value that is not a correct representation of a real number. Exposures with 0 total coverage are not modeled.
Structure and Contests Deductibles	Remove any character that is not a digit, a dot, or a percent sign. Replace with 0 any value that is not a correct representation of a real number. Replace with the corresponding dollar value any value that is expressed as a percentage of the exposure (values between 0 and 1). Report zero and high (> 10%) deductible policies.
Building Settlement Option	Replace empty, N/A, and NULL values with the value Unknown.
Contents Settlement Option	Replace empty, N/A, and NULL values with the value Unknown.
County	Remove any character that is not a lowercase or uppercase letter, a dot, a whitespace, or a dash. Ensure that the first letter of every word in the county name is capitalized and the rest are not. Replace empty, N/A, and NULL values with the value Unknown. Correct county name spelling. Ensure correct assignment based on ZIP Code.
Address	Remove any character that is not a lowercase or uppercase letter, a digit, a dot, or a whitespace. Replace empty, N/A, and NULL values with the value Unknown.
Longitude and Latitude	Remove any character that is not a digit, a dot, or a dash. Replace empty and NULL values with the value 0. Assign location of ZIP Code centroid if Unknown and ZIP Code information is available. Exposures without a location are not modeled.
City	Remove any character that is not a lowercase or uppercase letter, a dot, or a dash. Replace empty, N/A, and NULL values with the value Unknown.
Form	Replace empty, N/A, and NULL values with the value Unknown.
Program	Unused during processing. Included in model output. Replace empty, N/A, and NULL values with the value Unknown.
Territory	Unused during processing. Included in model output. Replace empty, N/A, and NULL values with the value Unknown.
Year Retrofitted	Replace empty, N/A, and NULL values with the value Unknown.
Number of Stories	Replace with the value Unknown any value that is not an integer number between 1 and 99. Ensure Manufactured policies have one story. Ensure Frame buildings have at most three stories. Ensure non-unit PR policies have one or two stories. Ensure the number of stories is at least the location of unit for unit policies. Impute Unknown values using county statistics.

Data Attribute	Pre-processing Steps
Location of Unit	Replace with the value Unknown any value that is not either an integer number between 1 and 99, Unknown, or NA.
Water Intrusion Other than Flood	Not used in processing. Included in Model Output. Remove any character that is not a digit. Replace empty, NULL and out-of-range numeric codes values with the value NA. Replace numeric codes with corresponding descriptions.
Increased Cost of Compliance	Not used in processing. Included in Model Output . Remove any character that is not a digit. Replace empty, NULL and out-of-range numeric codes values with the value NA. Replace numeric codes with corresponding descriptions.
Supplemental Flood Coverage	Not used in processing. Included in Model Output. Remove any character that is not a digit. Replace empty, NULL and out-of-range numeric codes values with the value NA. Replace numeric codes with corresponding descriptions.
Residence Type	Remove any character that is not a digit. Replace empty and NULL values with the value Unknown. Replace numeric codes with corresponding descriptions. Replace out-of-range numeric codes with the value Other.
Elevation	Remove any character that is not a digit. Replace empty and NULL values with the value Unknown. Replace numeric codes with corresponding descriptions. Replace out-of-range numeric codes with the value Other.
First Floor Elevation	Remove any character that is not a digit. Replace empty and NULL values with the value Unknown.
Elevated or Protected Utility	Remove any character that is not a digit. Replace empty and NULL values with the value Unknown. Replace numeric codes with corresponding descriptions. Replace out-of-range numeric codes with the value Other.
Floodproofing	Remove any character that is not a digit. Replace empty and NULL values with the value Unknown. Replace numeric codes with corresponding descriptions. Replace out-of-range numeric codes with the value Other.
Building or Unit Area	Replace empty, N/A and NULL values with the value Unknown.
Building or Unit Value	Replace empty, N/A and NULL values with the value Unknown.

9. Disclose if changing the order of the flood model input exposure data produces different flood model output or results.

If exposure inputs having missing or invalid items are randomly assigned during pre-processing based on available statistics, changing the order of the input data could impact the model output.

10. Disclose if removing or adding policies from the flood model input file affects the flood model output for the remaining policies.

If exposure inputs having missing or invalid items are randomly assigned during pre-processing based on available statistics, adding or removing policies from the input file could impact the model output.

AF-2 Flood Events Resulting in Modeled Flood Losses

A. Modeled flood loss costs and flood probable maximum loss levels shall reflect insured flood related damages from both coastal and inland flood events impacting Florida.

Modeled flood losses are produced for both coastal and inland flood events impacting Florida.

B. The modeling organization shall have a documented procedure for distinguishing flood-related losses from other peril losses.

The procedure for distinguishing flood-related losses from other peril losses is documented.

Disclosures

1. Describe how damage from flood model generated floods (originating either inside or outside of Florida) is excluded or included in the calculation of flood loss costs and flood probable maximum loss levels for Florida.

No events in the stochastic set of storms are excluded from the calculation of flood loss costs and probable maximum loss levels. However, based on the hydrological state and inundation depth at a particular location, the damage ratio may be zero.

2. Describe how wind losses associated with coastal and inland flooding are treated in the calculation of flood loss costs and flood probable maximum loss levels for Florida.

Wind losses are not included in the calculation of flood loss costs and flood probable maximum loss levels.

3. Describe how the flood model considers the correlation and potential overlap of flood losses associated with coastal and inland flooding.

If both coastal and inland flooding impact a location for a single storm, the model determines separate damages for each, and selects the larger damage.

4. Other than coastal and inland flooding, state whether any other types of flooding events are modeled. If so, describe how damage resulting from these flood type events is treated in the calculation of flood loss costs and flood probable maximum loss levels for Florida.

Only coastal and inland flooding are modeled and included in flood loss costs and flood probable maximum loss levels.

5. Describe which non-flood water losses are considered flood losses from water intrusion. Describe how water intrusion losses are considered in the calculation of flood loss costs and flood probable maximum loss levels for Florida.

Non-flood water losses from water intrusion are not included in the model’s calculation of flood loss costs and flood probable maximum loss levels for Florida.

AF-3 Flood Coverages

A. The methods used in the calculation of personal residential structure flood loss costs, including the effect of law and ordinance coverage, shall be actuarially sound.

The Model calculates building loss costs separately from other coverages. The methods used in the calculation of building flood loss costs are actuarially sound.

B. The methods used in the calculation of personal residential appurtenant structure flood loss costs shall be actuarially sound.

The Model calculates appurtenant structure loss costs separately from other coverages. The methods used in the calculation of appurtenant structure flood loss costs are actuarially sound.

C. The methods used in the calculation of personal residential contents flood loss costs shall be actuarially sound.

The Model calculates contents loss costs separately from other coverages. The methods used in the calculation of contents flood loss costs are actuarially sound.

D. The methods used in the calculation of personal residential time element flood loss costs shall be actuarially sound.

The Model calculates time element loss costs separately from other coverages. The methods used in the calculation of time element flood loss costs are actuarially sound.

Disclosures

1. Describe the methods used in the flood model to calculate flood loss costs for residential structure coverage associated with personal residential properties.

The model includes a set of vulnerability matrices for personal residential buildings. The matrices specify the expected percent damage for a given hydrological state and inundation depth. The applicable matrix for each building is determined by the building's characteristics.

This percentage damage to the building is determined for each storm in the stochastic set. The resulting damages, adjusted for policy limits, deductibles and demand surge, are aggregated across all storms to calculate the loss cost per $1,000 of exposure.

2. Describe the methods used in the flood model to calculate flood loss costs for appurtenant structure coverage associated with personal residential properties.

Appurtenant structure exposures are provided as separate buildings and modeled as such, similar to the NFIP approach.

3. Describe the methods used in the flood model to calculate flood loss costs for contents coverage associated with personal residential properties.

A vulnerability matrix is applied to determine an exposure’s expected percent contents damage for a given hydrological state and inundation depth. The applicable matrix depends on the characteristics of the building housing the contents.

The percentage damage to the contents is determined for each storm in the stochastic set. The resulting damages, adjusted for policy limits, deductibles and demand surge, are aggregated across all storms to calculate the loss cost per $1,000 of exposure.

4. Describe the methods used in the flood model to calculate flood loss costs for time element coverage associated with personal residential properties.

A vulnerability matrix is applied to determine an exposure’s expected percent time element loss for a given hydrological state and inundation depth. The applicable matrix depends on the characteristics of the building.

The percentage of loss is determined for each storm in the stochastic set. The resulting damages, adjusted for policy limits and demand surge, are aggregated across all storms to calculate the loss cost per $1,000 of exposure.

5. Describe the methods used in the flood model to account for law and ordinance coverage associated with personal residential properties.

A provision for Law and Ordinance coverage is embedded in the vulnerability matrices.

AF-4 Modeled Flood Loss Cost and Flood Probable Maximum Loss Level Considerations

A. Flood loss cost projections and flood probable maximum loss levels shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

The model does not include expenses, risk load, investment income, premium reserves, taxes, assessments or profit margin in the calculation of loss costs and probable maximum loss levels.

B. Flood loss cost projections and flood probable maximum loss levels shall not make a prospective provision for economic inflation.

The model does not make a prospective provision for economic inflation in the calculation of loss costs and probable maximum loss levels.

C. Flood loss cost projections and flood probable maximum loss levels shall not include any explicit provision for wind losses.

The model does not include any explicit provision for wind losses in the calculation of loss costs and probable maximum loss levels.

D. Damage caused from inland and coastal flooding shall be included in the calculation of flood loss costs and flood probable maximum loss levels.

The model includes damage from inland and coastal flooding in the calculation of loss costs and probable maximum loss levels.

E. Flood loss cost projections and flood probable maximum loss levels shall be capable of being calculated from exposures at a geocode (latitude- longitude) level of resolution including the consideration of flood extent and depth.

The model allows for the loss cost and probable maximum loss calculations at the geocode level of resolution.

F. Demand surge shall be included in the flood model's calculation of flood loss costs and flood probable maximum loss levels using relevant data and actuarially sound methods and assumptions.

Demand surge is included in the model's calculation of loss costs and probable maximum loss levels based on an analysis of construction cost indices before and after historical storms.

Disclosures

1. Describe the method(s) used to estimate annual flood loss costs and flood probable maximum loss levels and the treatment of associated uncertainties. Identify any source documents used and any relevant research results.

To estimate annual loss costs and probable maximum loss levels, losses are estimated for individual policies in the portfolio for each event in a stochastic set of storms. Losses are estimated separately for structure, contents, and time element coverage.

For each event the hydrological state and inundation depth is determined for coastal and/or inland flooding.

A vulnerability matrix is assigned to the exposure based on the characteristics of the exposure. The matrix specifies the percent damage for a given hydrological state and inundation depth. If both coastal and inland flooding applies to the exposure for a given event, the matrix is read twice, and the larger damage ratio is selected.

The estimated damages are reduced by applicable deductibles, increased to allow for the impact of demand surge on claim costs and subjected to policy limits.

The modeled insured losses can then be summed across all properties in a ZIP Code or across all ZIP Codes in a county to obtain expected aggregate loss. The losses can also be aggregated by policy form, construction type, rating territories, etc.

Finally, modeled insured losses are divided by the number of years in the simulation and by the total amount of insurance to estimate annual loss costs.

To estimate Probable maximum loss on an “annual aggregate” basis modeled losses for storms occurring in the same year of the simulation are summed to produce annual storm losses. Probable maximum loss levels are calculated from the ordered set of annual losses as described in Standard A-6, Disclosure # 11.

To estimate Probable maximum loss on an “annual occurrence” basis the ordered set consists of the largest loss in each year of the simulation.

The following source was used in the research:

Wilkinson, M. E. (1982). Estimating Probable Maximum Loss with Order Statistics. *Casualty Actuarial Society, LXIX*, pp. 195-209.

2. Identify all possible resolutions available for the reported flood output ranges. Identify the finest level of resolution (i.e., the most granular level) for which flood loss costs and flood probable maximum loss levels can be provided.

Loss costs and probable maximum loss levels can be produced at the geocode level for an individual exposure. Both can be aggregated to ZIP code, county, rating territory, construction type or any characteristic provided in the exposure input.

3. Describe how the flood model incorporates demand surge in the calculation of flood loss costs and flood probable maximum loss levels. Indicate if there are any differences in the manner that demand surge is incorporated for coastal and inland flooding.

Demand surge factors by coverage are calculated for each event in the stochastic set and are applied to the estimated losses for that event. Demand surge is assumed to be a function of coverage and the storm's estimated statewide losses before consideration of demand surge.

4. Provide citations to published papers, if any, or modeling-organization studies that were used to develop how the flood model estimates demand surge.

No published papers were used to develop the model's demand surge factors. The factors were based on an analysis of construction cost indices before and after historical storms.

5. Describe how economic inflation has been applied to past insurance experience to develop and validate flood loss costs and flood probable maximum loss levels.

No adjustments were applied to past NFIP experience in validating modeled flood losses. Both exposure and claim data for past years were available.

AF-5 Flood Policy Conditions

A. The methods used in the development of mathematical distributions to reflect the effects of deductibles, policy limits, and flood policy exclusions shall be actuarially sound.

The methods used by the model to reflect the effects of deductibles, policy limits and policy exclusions are actuarially sound.

B. The relationship among the modeled deductible flood loss costs shall be reasonable.

The relationship among modeled deductible loss costs is reasonable.

C. Deductible flood loss costs shall be calculated in accordance with s. 627.715, F.S.

The model's loss costs are calculated in accordance with the stated statute.

Disclosures

1. Describe the methods used in the flood model to treat deductibles, policy limits, policy exclusions, loss settlement provisions, and insurance-to-value criteria when projecting flood loss costs and flood probable maximum loss levels. In particular, specify the loss settlement options available for manufactured homes.

The model allows for both flat and percentage deductibles, separately for structure and contents. Modeled losses are capped by policy limits for each coverage. The input record requires building value and contents value in addition to the limits. The loss settlement options are the same for manufactured and site-built homes and are discussed in Disclosure #2 below.

2. Describe if and how the flood model treats policy exclusions and loss settlement provisions.

The model can calculate losses for policies that exclude one or more major coverages. Furthermore, the vulnerability functions were calibrated using NFIP exposures and losses, and therefore implicitly contemplate exclusions inherent in the NFIP standard flood policy.

The calibration to NFIP experience also drives the model's underlying loss settlement provision which is a mix of ACV and replacement cost on the building and almost exclusively ACV on contents. The effective loss settlement provision for any one modeled exposure, however, will also be influenced by the values of the building and contents as reported in the input record. For example, the replacement cost value for contents or the ACV of an older manufactured home may be reported in the input record and used as the basis for calculating the modeled loss.

3. Describe if and how the flood model treats annual deductibles.

Annual deductibles are not modeled.

AF-6 Flood Loss Outputs and Logical Relationships to Risk

A. The methods, data, and assumptions used in the estimation of flood loss costs and flood probable maximum loss levels shall be actuarially sound.

The methods, data and assumptions used by the model in the estimation of loss costs and probable maximum loss levels are actuarially sound.

B. Flood loss costs shall not exhibit an illogical relation to risk, nor shall flood loss costs exhibit a significant change when the underlying risk does not change significantly.

The model's loss costs exhibit a logical relationship to risk and do not vary significantly for similar underlying risks.

C. Flood loss costs cannot increase as the structure flood damage resistance increases, all other factors held constant.

The model's loss costs do not increase as the structure's resistance to flood damage increases, all other factors held constant.

D. Flood loss costs cannot increase as flood hazard mitigation measures incorporated in the structure increase, all other factors held constant.

The model's loss costs do not increase as flood hazard mitigation measures increase, all other factors held constant.

E. Flood loss costs shall be consistent with the effects of major flood control measures, all other factors held constant.

The model's loss costs are consistent with the effects of major flood control measures, all other factors held constant.

F. Flood loss costs cannot increase as the flood resistant design provisions increase, all other factors held constant.

The model's loss costs do not increase as flood resistant design provisions increase, all other factors held constant.

G. Flood loss costs cannot increase as building code enforcement increases, all other factors held constant.

The model's loss costs do not increase as the building code enforcement increases, all other factors held constant.

H. Flood loss costs shall decrease as deductibles increase, all other factors held constant.

The model's loss costs decrease as deductibles increase, all other factors held constant.

I. The relationship of flood loss costs for individual coverages (e.g., personal residential structure, appurtenant structure, contents, and time element) shall be consistent with the coverages provided.

The relationship of the model's loss costs among coverages is consistent with the coverage provided.

J. Flood output ranges shall be logical for the type of risk being modeled and apparent deviations shall be justified.

The model's output ranges are logical by type of risk, and apparent deviations can be justified.

K. All other factors held constant, flood output ranges produced by the flood model shall in general reflect lower flood loss costs for personal residential structures that have a higher elevation versus those that have a lower elevation.

The model's output ranges reflect lower loss costs for structures with a higher elevation, all other factors held constant.

L. For flood loss costs and flood probable maximum loss level estimates derived from and validated with historical insured flood losses or other input data and information, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, and (3) contractual provisions shall be appropriate based on the type of risk being modeled.

The model's assumptions in the derivations concerning construction characteristics, policy provisions and contractual provisions are appropriate based on the type of risk modeled.

Disclosures

1. Provide a completed Form AF-1, Zero Deductible Personal Residential Standard Flood Loss Costs. Provide a link to the location of the form [insert hyperlink here].

See Form AF-1.

2. Provide a completed Form AF-2, Total Flood Statewide Loss Costs. Provide a link to the location of the form [insert hyperlink here].

See Form AF-2.

3. Provide a completed Form AF-3, Personal Residential Standard Flood Losses by ZIP Code. Provide a link to the location of the form [insert hyperlink here].

See Form AF-3.

4. Provide a completed Form AF-4, Flood Output Ranges, using the modeling-organization-specified, predetermined, and comprehensive exposure dataset. Provide a link to the location of the form [insert hyperlink here].

See Form AF-4.

5. Provide a completed Form AF-5, Percentage Change in Flood Output Ranges. Provide a link to the location of the form [insert hyperlink here].

Not applicable.

6. Provide a completed Form AF-6, Logical Relationships to Flood Risk (Trade Secret Item), if not considered as Trade Secret. Provide a link to the location of the form [insert hyperlink here].

See Form AF-6.

7. Provide a completed Form AF-7, Percentage Change in Logical Relationships to Flood Risk. Provide a link to the location of the form [insert hyperlink here].

Not applicable.

8. Explain any assumptions, deviations, and differences from the prescribed exposure information in Form AF-6, Logical Relationships to Flood Risk (Trade Secret Item), and Form AF-7, Percentage Change in Logical Relationships to Flood Risk. In particular, explain how the treatment of unknown is handled in each sensitivity exhibit.

The time element limit was assumed to be 20% of Coverage A for Owners and Manufactured Homes and 40% of Coverage B for Renters and Condo.

In the Deductible Sensitivity test, the deductible for Owners and Manufactured Homes was applied to the building loss only. The model assumes separate deductibles for building and contents in line with the NFIP approach. For Renters and Condo the deductible was applied to contents.

In the Foundation Type Sensitivity test, the 1-Story Basement was modeled with the same vulnerability as Slab-on-Grade. The model does contemplate a Basement type foundation.

In the Foundation Type Sensitivity test, the Unknown foundation type for Manufactured Homes was modeled as Partially Tied-Down.

In the Foundation Type Sensitivity test, the elevated exposures assume an FFE of 8 feet.

9. Provide a completed Form AF-8, Flood Probable Maximum Loss for Florida. Provide a link to the location of the form [insert hyperlink here].

See Form AF-8.

10. Describe the calculation of uncertainty intervals.

The uncertainty intervals were determined as approximate 80% confidence intervals for the PML at each return period.

Let $X1, X2, \ldots, XN$ be the ordered set of annual losses produced by the simulation with $X(1) \leq X(2) \leq \ldots \leq X(N)$. (Or alternatively for part C the ordered set of the largest loss from each year of the simulation.)

Since the sample is large enough to assume a normal approximation for the pth quantile of the ordered set, an approximate 80% confidence interval for the PML is given by $(X(r), X(s))$, where

$$r = Np-1.28\sqrt{Np(1-p)} \qquad \text{(AF6-1)}$$

$$s = Np+1.28\sqrt{Np(1-p)} \qquad \text{(AF6-2)}$$

and N and p are defined as N = number of years in the simulation and $p = 1 - 1 / \text{return period}$.

If r and/or s are not integers, let r* be the smallest integer greater than r and let s* be the smallest integer greater than or equal to s. The 80% approximate confidence interval is given by $(X(r^*), X(s^*))$.

11. Describe how the flood model produces flood probable maximum loss levels.

Probable maximum loss is produced non-parametrically using order statistics of simulated annual losses.

The model produces N simulated annual losses, represented by $X_1, X_2, \ldots, X_N$. The data are ordered so that $X_{(1)} \leq X_{(2)} \leq \ldots \leq X_{(N)}$.

For a return period of Y years, let $p = 1-1/Y$. The corresponding PML for the return period Y is the pth quantile of the ordered losses.

Let $k = (N)*p$. If k is an integer, then the estimate of the PML is the kth order statistic, $X_{(k)}$, of the simulated losses. If k is not an integer, then let k* = the smallest integer greater than k, and the estimate of the pth quantile is given by $X_{(k^*)}$.

Probable Maximum Loss on an Annual Occurrence Basis

Probable maximum loss on an annual occurrence basis is determined similarly to probable maximum loss on an annual aggregate basis. The set of N losses, $X_1, X_2, \ldots, X_N$, consists of the largest event loss in each simulated year, ordered from smallest to largest.

12. Provide citations to published papers, if any, or modeling-organization studies that were used to estimate flood probable maximum loss levels.

Wilkinson, M. E. (1982). Estimating Probable Maximum Loss with Order Statistics. *Casualty Actuarial Society*, *LXIX*, pp. 195-209.

13. Explain any differences between the values provided on Form AF-8, Flood Probable Maximum Loss for Florida, and those provided on Form SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined).

The two forms agree.

14. Provide an explanation for all flood loss costs that are not consistent with the requirements of this standard.

In the Year-Built test, for Owners, Renters and Condo the loss costs for 1960 are equal to those for 1981, and the loss costs for 2012 are equal to those for 2018. This result is consistent with the model's vulnerability assumptions regarding construction eras.

In the Year-Built test, for Manufactured Homes the loss costs for 1974 are equal to those for 1992, and the loss costs for 2004 are equal to those for 2012. This result is consistent with the model's vulnerability assumptions regarding construction eras.

In the Foundation Type test, for Frame Owners in Franklin County, the loss costs for Elevate 1, Elevate 2 and Elevate 3 are all equal. This result arises from the particular flood depths associated with this exposure in the stochastic set of events. At those depths, 6 – 15 feet above ground level, the vulnerability assumptions are identical.

In the Foundation Type test for Manufactured Homes in Franklin County, the loss costs for Weak, Medium and Strong are all equal. As with Frame Owners, the flood depths above ground level in the stochastic set result in identical vulnerability assumptions.

In the Lowest Floor Elevation test for Manufactured Homes in Franklin County the loss costs for 2, 4 and 6 feet are all equal. There are no stochastic flood depths above ground level less than 6 feet for this one location. At these depths the Manufactured Home vulnerabilities are equal.

15. Provide an explanation of the differences in flood output ranges between the currently accepted flood model and the flood model under review.

Not applicable.

COMPUTER/INFORMATION FLOOD STANDARDS

CIF-1 Flood Model Documentation

A. Flood model functionality and technical descriptions shall be documented formally in an archival format separate from the use of correspondence including emails, presentation materials, and unformatted text files.

The Florida Public Flood Loss Model (FPFLM) formally documents the model functionality and technical descriptions in the primary document repository, an archival format separate from the use of correspondence including emails, presentation materials, and unformatted text files. The primary document repository uses standard software practices to formally describe the model's requirements and complete software design and implementation specifications. All documentation related to the model is maintained in the project's primary document repository, a central location that is easily accessible.

B. A primary document repository shall be maintained, containing or referencing a complete set of documentation specifying the flood model structure, detailed software description, and functionality. Documentation shall be indicative of current model development and software engineering practices.

The FPFLM maintains a primary document repository to satisfy the aforementioned requirements. In addition, the FPFLM maintains a user manual, designed for the end user, which provides a high-level introduction and a step-by-step guide to the entire system. All the documents are available for inspection on the project's primary document repository. Current software engineering best practices are used to render all the documents more readable, self-contained, consistent, and easy to understand. Every component of the system is documented with standard use case, class, data flow, sequence diagrams, etc. The diagrams describe in detail the structure, logic flow, information exchange among submodules, etc. of each component and increase the visibility of the system. The diagrams describing the component functionality and structure also make each component of the system reusable and easily maintainable.

C. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the flood model shall be consistently documented and dated.

The primary document repository contains all of the required documentation organized in chapters and sections linked to one another on the basis of their mutual relationships. Thus, the entire document can be viewed as a hierarchical referencing scheme in which each module is linked to its sub-module, which ultimately refers to the corresponding codes.

D. The following shall be maintained: (1) a table of all changes in the flood model from the currently accepted flood model to the initial submission this year, and (2) a table of all substantive changes in the flood model since this year's initial submission.

This table is maintained and documented and will be available for review.

E. Documentation shall be created separately from the source code.

The aforementioned primary document repository, created and maintained according to the requirements specified in this standard, is separate from source code and source code documentation.

F. A list of all externally acquired currently used flood model-specific software and data assets shall be maintained. The list shall include (1) asset name, (2) asset version number, (3) asset acquisition date, (4) asset acquisition source, (5) asset acquisition mode (e.g., lease, purchase, open source), and (6) length of time asset has been in use by the modeling organization.

We created and maintain a list of all the externally acquired currently used flood model-specific software and data assets. The list will be available for review.

CIF-2 Flood Model Requirements

A complete set of requirements for each software component, as well as for each database or data file accessed by a component, shall be maintained. Requirements shall be updated whenever changes are made to the flood model.

The FPFLM is divided into several major modules, each of them providing one or more inputs to other modules. Requirements of each of the modules, including input/output formats, are precisely documented. In addition to maintaining a detailed documentation of each module of the system using standard software practices, several other documents are maintained as part of a large-scale project management requirement, including a quality assurance document, a system hardware and software specification document, a training document, a model maintenance document, a testing document, a user manual, etc. Moreover, detailed documentation has been developed for the database consisting of the schema and information about each table. Additionally, information about the format for each data file (in the form of an Excel or text file) accessed by different programs is documented. Whenever changes are made to a model, the corresponding requirements documentation is updated to reflect such changes.

Disclosure

1. Provide a description of the flood model and platform(s) documentation for interface, human factors, functionality, system documentation, data, human and material resources, security, and quality assurance.

The user interface, functionality requirements, and material resources of each of the modules are described in the relevant module documentation using formal modeling languages and representations. Database schema, table formats, security, software and hardware specifications, and training plans are separately documented for the whole system in the primary document repository. A separate software testing and quality assurance document describes the system quality, performance, and stability concerns. Additionally, a user manual and a human resource management document are maintained.

CIF-3 Flood Model Organization and Component Design

A. The following shall be maintained and documented: (1) detailed control and data flowcharts and interface specifications for each software component, (2) schema definitions for each database and data file, (3) flowcharts illustrating flood model-related flow of information and its processing by modeling organization personnel or consultants, (4) network organization, and (5) system model representations associated with (1)-(4) above. Documentation shall be to the level of components that make significant contributions to the flood model output.

Interface specifications for each of the software modules are included in the module's documentation. Diagrams are presented at various levels of the model documentation. High-level flowcharts are used to illustrate the flow of the whole system and the interactions among modules. More detailed diagrams are used in module-level descriptions.

The database schema is documented in the primary document repository. A detailed schema representation of the active database is documented with additional information such as database maintenance, tuning, data loading methodologies, etc. to provide a complete picture of the database maintained for the project.

Business process diagrams are used to illustrate the flow of model-related information and its processing by modeling organization personnel and consultants. Additionally, the organization of the network is documented in the primary document repository.

B. All flowcharts (e.g., software, data, and system models) in the submission or in other relevant documentation shall be based on (1) a referenced industry standard (e.g., UML, BPMN, SysML), or (2) a comparable internally-developed standard which is separately documented.

Diagrams documenting the FPFLM are created according to standards International Organization for Standards (ISO) 5807, BPMN 2, and UML 2.

Data flowcharts, program flowcharts, system flowcharts, program network charts, and system resources charts are created according to ISO 5807. Flowcharts illustrating model-related flow of information and its processing by team members follow BPMN 2. Other diagrams for both behavioral and structural object-oriented design documentation such as use case and class diagrams follow UML 2.

CIF-4 Flood Model Implementation

A. A complete procedure of coding guidelines consistent with current software engineering practices shall be maintained.

The FPFLM has developed and followed a set of coding guidelines that is consistent with accepted software engineering practices. These guidelines include policies for coding style, version control, code revision history maintenance, etc. Developers involved in the system development adhere to the instructions in these documents.

B. Network organization documentation shall be maintained.

The organization of the network is documented in the primary document repository.

C. A complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components shall be maintained.

The FPFLM uses a PostgreSQL database to store, pre-process, and post-process model input and output data. The procedures for creating and using these databases is formalized in the form of stored procedures, which are documented in-line and in the primary document repository. Data files are generated by different modules and used as data interfaces between modules. Several data verification steps are undertaken to ensure their correctness. These steps are formalized in the form of Linux shell scripts and documented as part of the primary document repository.

D. All components shall be traceable, through explicit component identification in the flood model representations (e.g., flowcharts) down to the code level.

Traceability, from requirements to the code level and vice versa, is maintained throughout the system documentation.

E. A table of all software components affecting flood loss costs and flood probable maximum loss levels shall be maintained with the following table columns: (1) component name, (2) number of lines of code, minus blank and comment lines, and (3) number of explanatory comment lines.

The FPFLM primary document repository includes a table of all software components affecting flood loss costs and flood probable maximum loss levels with the required columns.

F. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.

Computer code comments are consistently used throughout all of the model's codebase to ease the understanding of its logic. These code-level comments include a summary of important changes, names of developers involved in each modification, function headers, and in-line comments to explain potentially ambiguous software code.

G. The following documentation shall be maintained for all components or data modified by items identified in Flood Standard GF-1, Scope of the Flood Model and Its Implementation, Disclosure 8 and Audit 9:

> ***1. A list of all equations and formulas used in documentation of the flood model with definitions of all terms and variables.***
>
> ***2. A cross-referenced list of implementation source code terms and variable names corresponding to items within G.1 above.***

Tables mapping the equations and formulas used in the model's documentation to the source code terms and variable names are provided in the glossaries to the model's documentation, thus combining G.1 and G.2 into a single table. These tables enhance the model's documentation and include the equations and formulas for each module (not just the modified ones from the prior year's submission).

H. Flood model code and data shall be accompanied by documented maintenance, testing, and update plans with their schedules. The vintage of the code and data shall be justified.

All of the flood model's code and data is accompanied with documented maintenance, testing, and updated schedule plans. Through continuous documented maintenance, testing, and update plans with their schedules, the vintage of the code is justified up to date.

Disclosure

1. Specify the hardware, operating system, and essential software required to use the flood model on a given platform.

The user-facing part of the system consists of a collection of Linux command line scripts written in Bash and Python. These interface scripts call the core components, which are written in C++, MATLAB, and Python. The core programs are run on either an HPC or Spark cluster. The system uses a PostgreSQL database that runs on a Linux server. Server-side software requirements are the IMSL library CNL 5.0, JDBC 3, JNI 1.3.1, and JDK 1.6. The details of the FPFLM hardware infrastructure are included in the primary document repository.

CIF-5 Flood Model Verification

A. General

For each component, procedures shall be maintained for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. Verification procedures shall include tests performed by modeling organization personnel other than the original component developers.

The FPFLM software verification is done in three stages:

1. Code inspection and verification by the code developer.
2. Inspection of the input and validation of the output by the system modeler.
3. Review and extensive testing of the code by modeler personnel who are not part of the original component development.

The first level of verification includes code-level debugging, walking through the code to ensure a proper flow, inspection of internal variables through intermediate output printing and error logging, use of exception handling mechanisms, calculation crosschecks, and verification of the output against sample calculations provided by the system modeler.

In the second level of the verification, the modeler is provided with sample inputs and corresponding outputs. The modeler then conducts black-box testing to verify the results against his or her model. Finally, each component is rigorously tested by modeler personnel not responsible for original component development.

B. Component Testing

1. Testing software shall be used to assist in documenting and analyzing all components.

Component testing and data testing are done in the third level of verification. The system is rigorously checked for the correctness, precision, robustness, and stability of the whole system. Calculations are performed outside the system and compared against the system-generated results to ensure the system correctness. Extreme and unexpected inputs are given to the system to check the robustness. Wide series of test cases are developed to check the stability and the consistency of the system.

2. Unit tests shall be performed and documented for each updated component.

Unit testing is done at the first and third levels of verification. The developer tests all the units as the units are developed and modified. Then all the units are tested again by the external testing team. Both black-box and white-box tests are performed and documented in a separate testing document.

3. Regression tests shall be performed and documented on incremental builds.

Regression testing is performed for each module. In this kind of testing methodology, the modules that have undergone some changes and revisions are retested to ensure that the changes have not affected the entire system in any undesired manner.

4. Integration tests shall be performed and documented to ensure the correctness of all flood model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.

Integration testing is performed at all three levels of verification. Integration testing is performed by running each major module as a complete package. It is ensured that all components have been executed at least once during the testing procedure. All the test cases executed are described in the software testing and verification documentation.

C. Data Testing

1. Testing software shall be used to assist in documenting and analyzing all databases and data files accessed by components.

The FPFLM uses a PostgreSQL database to store the required data. Data integrity and consistency are maintained by the Relational Database Management System itself. Moreover, different queries are issued and PL/SQL is implemented to check the database. PostgreSQL has a very robust loader, which is used to load the data into the database. The loader maintains a log that depicts if the loading procedure has taken place properly and completely without any discrepancy. Data files are manually tested using commercial data manipulation software such as Microsoft Excel and Microsoft Access.

2. Integrity, consistency, and correctness checks shall be performed and documented on all databases and data files accessed by the components.

All the tests are well documented in a separate testing document.

Disclosures

1. State whether any two executions of the flood model with no changes in input data, parameters, code, and seeds of random number generators produce the same flood loss costs and flood probable maximum loss levels.

The model produces the same loss costs and probable maximum loss levels if it is executed more than once with no changes in input data, parameters, code, and seeds of random number generators.

2. Provide an overview of the component testing procedures.

The FPFLM software testing and verification is done in three stages.

[A] Code inspection and the verification by the code developer.
The code developer performs a sufficient amount of testing on the code and does not deliver the code until he or she is satisfied with the correctness and robustness of the code. The first level of verification includes code-level debugging, walking through the code to ensure proper flow, inspection of internal variables through intermediate output printing and error logging, use of exception handling mechanisms, calculation crosschecks, and verification of the output against sample calculations provided by the system modeler.

[B] Verification of results by the person who developed the system model.
Once the first level of testing is done, the developer sends the sample inputs and the generated results back to the modeler. Then the system modeler double-checks the results against his or her model. The code is not used in the production environment unless approved by the modeler.

[C] Review and extensive testing of the code by modeler personnel other than the original component developers. The system is rigorously checked by modeler personnel (testers) other than the original component developers for the correctness, precision, robustness, and stability of the whole system. Calculations are performed outside the system and compared against the system generated results to ensure the system correctness. Extreme and unexpected inputs are given to the system to check the robustness. Wide series of test cases are developed to check the stability and the consistency of the system. Unit testing, regression testing, and aggregation testing (both white-box and black-box) are performed and documented.

Any flaw in the code is reported to the developer, and the bug-corrected code is again sent to the tester. The tester then performs unit testing again on the modified units. Additionally, regression testing is performed to determine if the modification affects any other parts of the code.

3. Provide a description of verification approaches used for externally acquired data, software, and models.

The verification approaches used for externally acquired data, software, and models are documented in the primary document repository.

CIF-6 Human-Computer Interaction

A. Interfaces shall be implemented as consistent with accepted principles and practices of Human-Computer Interaction (HCI), Interaction Design, and User Experience (UX) engineering.

All the major components in the FPFLM interact with users using the command line interface (CLI) and all the major functions of FPFLM are performed using CLI by team members within the Computer Science team. To facilitate the execution of FPFLM, a set of configuration files have been implemented, and their interface design adheres to a well-known CLI design best practice by Aanand Prasad, et al ., which provides principles and guidelines to ensure the HCI, Interaction Design, and UX engineering, to have good compliance with modern CLI design. This guide is open-source and available at https://clig.dev/.

B. Interface options used in the flood model shall be unique, explicit, and distinctly emphasized.

The interface options used in FPFLM are unique, explicit, and distinctly emphasized in the following four ways:

- Each option used in FPFLM has its unique and distinct name;
- The usage of each option has been clearly and explicitly documented in both a help file and the user manual;
- Distinct environments are set up for each version of FPFLM by using separated directories with model version in the directory names to avoid confusion and misuse of models;
- All the options are provided to FPFLM projects via a distinct configuration file for each run. Templates of configuration file are prepared for producing model results in various scenarios, where all fixed and unchanged options for a given scenario have been explicitly specified as pre-defined values to avoid ambiguity and potential errors.

In the first mechanism, the option names are descriptive, which explicitly describe its usage in FPFLM.

In the second mechanism, the usage of all options in the help file provides comprehensive information about how they will be used in FPFLM while the usage of each option in user manual allows users to follow clear procedures to produce specific results and avoid errors.

The third mechanism utilizes distinct environments to assure that the correct models are being used to generate results and mitigate errors of using the incorrect version of FPFLM.

In the fourth mechanism, the templates of configuration files allow users to focus on the options needed to be changed and avoid potential errors. In addition, an outline file is provided for the currently accepted model version to guide the modeler in selecting the correct interface options in the configuration file. The outline file is maintained in the primary repository.

C. For a Florida rate filing, interface options shall be limited to those options found acceptable by the Commission.

All interface options are limited to acceptable options in accordance with the Commission for a Florida rate filing. The Florida rate filing is set up in a distinct environment where all the options have been configured and fixed on the configuration template to generate appropriate results.

Disclosure

1. Identify procedures used to design, implement, and evaluate interface options.

The procedures of design, implementation, and evaluation of interface options are highly integrated with the general procedures of FPFLM design, implementation, and verification. As part of the FPFLM workflow, Figure 92 provides an overview of the procedures to design, implement, and evaluate interface options.

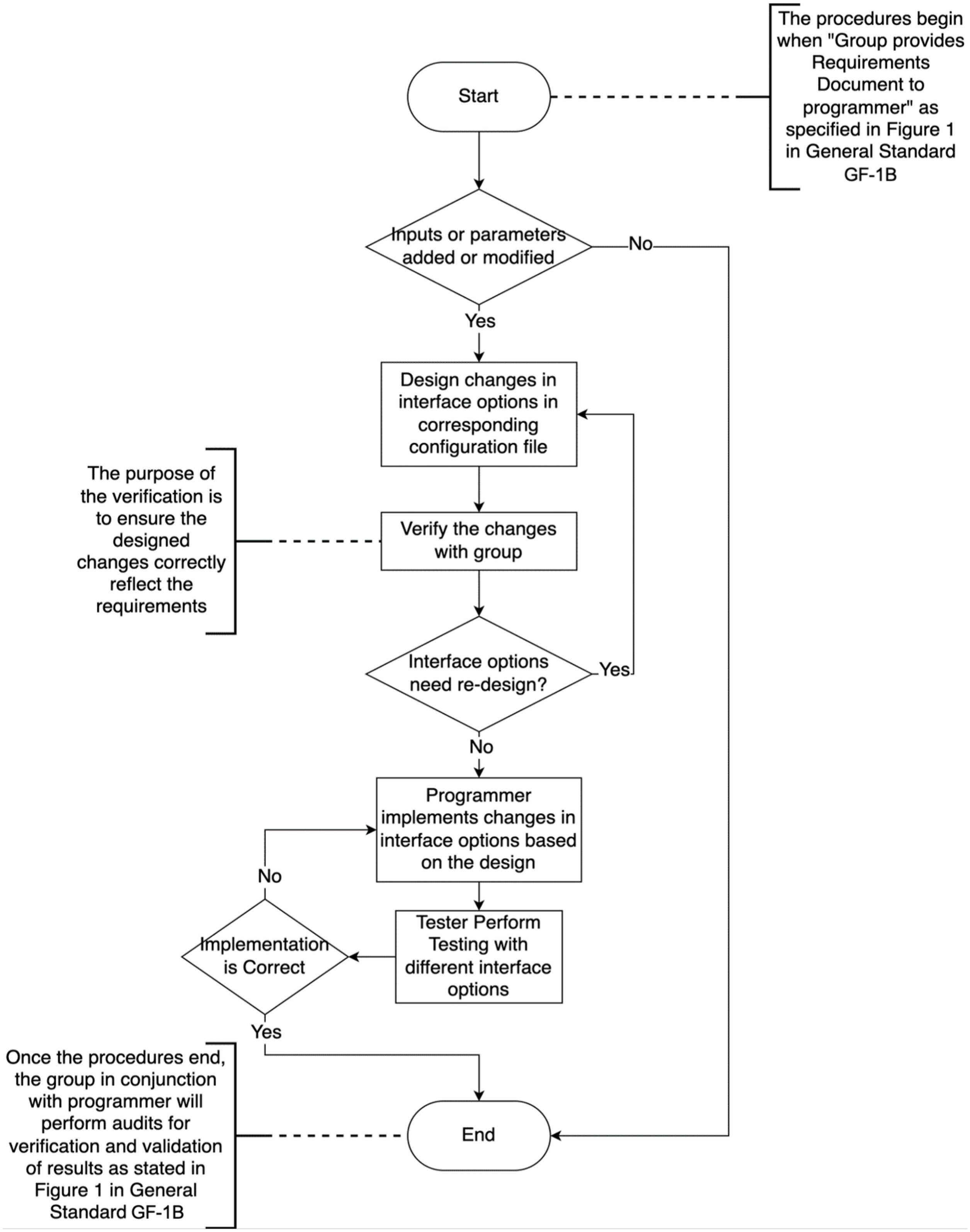


Figure 92. Overview of the procedures used to design, implement, and evaluate interface options.

CIF-7 Flood Model Maintenance and Revision

A. A clearly written policy shall be implemented for review, maintenance, and revision of the flood model and network organization, including verification and validation of revised components, databases, and data files.

The primary document repository contains a clear policy for model and network organization review, maintenance, and revision.

B. A revision to any portion of the flood model that results in a change in any Florida personal residential flood loss cost or flood probable maximum loss level shall result in a new flood model version identification.

Whenever a revision results in a change in any Florida residential flood loss cost or probable maximum loss level, a new model version identification will be assigned to the revision. Verification and validation of the revised units are repeated according to the model's verification procedures.

C. Tracking software shall be used to identify and describe all errors, as well as modifications to code, data, and documentation.

The FPFLM uses Subversion to identify and describe all errors as well as modifications to code, data, and documentation.

D. A list of all flood model versions since the initial submission for this year shall be maintained. Each flood model description shall have an unique version identification and a list of additions, deletions, and changes that define that version.

A list of all model versions since the initial submission is maintained as part of the model's documentation. Each model revision has a unique version number and a list of additions, deletions, and changes that define that version. The unique model version will consist of the scheme "V[major].[minor]." The terms "[major]" and "[minor]" are positive integers that correspond to substantial and minor changes in the model, respectively. A minor change in the model would cause the minor number to be incremented by one, and similarly, a major change in the model would cause the major number to be incremented by one with the minor reset to zero. The rules that prompt changes in the major and minor numbers are described in Disclosure 2.

Disclosures

1. Identify procedures used to review and maintain code, data, and documentation.

The FPFLM's software development team employs version control software for all software development. In particular, the FPFLM uses Subversion, an accepted and effective system for managing simultaneous development of files. Subversion maintains a record of the changes to each file and allows the user to revert to a previous version, merge versions, and track changes. This software is able to record the information for each file, the date of each change, the author of each change, the file version, and the comparison of the file before and after the changes.

2. Describe the rules underlying the flood model and code revision identification systems.

The model identification system consists of the scheme “V[major].[minor].” The terms "[major]" and "[minor]" are positive integers that correspond to major and minor changes in the model, respectively. A minor change causes the minor number to be incremented by one, and similarly, a major change causes the major number to be incremented by one with the minor number reset to zero. The rules that prompt major or minor changes in the model are the following:

Any of the following events will trigger a change in the major number:

- Major updates in any of the main modules of the FPFLM: major modification of the Storm Track Generator, Wind Field Module, Storm Surge Model, Waves Model, Rain Model, Inland Flood Model, Vulnerability Model, or Insured Loss Model.
- Addition or removal of options affecting how input data is processed by the model.
- Addition or removal of attributes in the model’s input data specification.

Any of the following events will trigger a change in the minor number:

- Minor changes to the Storm Track Generator, Wind Field Module, Storm Surge Model, Waves Model, Rain Model, Inland Flood Model, Vulnerability Model, or Insured Loss Model: minor updates such as a change in the Holland B parameter or any change to correct deficiencies that do not result in a new algorithm for the component.
- Updates to correct errors in the computer code: modifications in the code to correct deficiencies or errors such as a code bug in the computer program.
- Changes in the probability distribution functions using updated or corrected historical data, such as the updates of the HURDAT2 database: each year the model updates its HURDAT2 database with the latest HURDAT2 data released by the National Hurricane Center, which is used as the input in the Storm Generation Model.
- Updates of the ZIP Code list: every two years the ZIP Codes used in the model must be updated according to information originating from the United States Postal Service.
- Updates in the validation of the vulnerability matrices: the incorporation of new data, such as updated winds and insurance data, may trigger a tune-up of the vulnerability matrices used in the Insurance Loss Module.

If any change results in a change in loss costs estimates or probable maximum loss level, there will be at least a change in the minor revision number.

CIF-8 Flood Model Security

Security procedures shall be implemented and fully documented for (1) secure access to individual computers where the software components or data can be created or modified, (2) secure operation of the flood model by clients, if relevant, to ensure that the correct software operation cannot be compromised, (3) anti-virus software installation for all machines where all components and data are being accessed, and (4) secure access to documentation, software, and data in the event of a catastrophe.

The FPFLM maintains a set of security procedures to protect data and documents from deliberate and inadvertent changes. These procedures include both physical and electronic measures. A set of policies identifies different security issues and addresses each of them. All of the security measures are properly documented in the primary document.

Disclosure

1. Describe methods used to ensure the security and integrity of the code, data, and documentation. These methods include the security aspects of each platform and its associated hardware, software, and firmware.

Electronic measures include the use of different authorization levels, special network security enforcement, and regular backups. Each developer is given a separate username and password and assigned a level of authorization so that even a developer cannot change another developer's code. The users of the system are given usernames and passwords so that unauthorized users cannot use the system. External users are not allowed direct access to any of the data sources of the system. The network is extensively monitored for any unauthorized actions using standard industry practices. Since the system runs on a Linux server environment, which is maintained and up-to-date, minimal virus attacks are expected.

Any sensitive or confidential data (insurance data, for example) are kept on an unshared disk on a system that has user access control and requires a login. Screen locks are enforced whenever the machine is left unattended. In addition, for system security and reliability purposes, we also deploy a development environment besides the production environment. Modifications to the code and data are done in the development environment and tested by in-house developers. The final production code and data can only be checked into the production environment by the authorized personnel. The models resulting from the FPFLM project can only be used by the authorized users. Authorized user accounts are created by the project manager. Regular backups of the server are taken and stored in two ways: physically and electronically. Backups are performed daily and are kept for six weeks. Nightly backups of all Linux data disks and selected Windows data disks (at user requests) are performed over the network onto LT02 and LT03 tapes. The tape drives have built-in diagnostics and verification to ensure that the data is written correctly to the tapes. This ensures that if the tape is written successfully, it will be readable, provided no physical damage occurred to the tape. A copy of each backup is placed in a secure and hurricane-protected building. Additionally, the application server and the database server are physically secured in a secure server room with alarm systems. In case of disasters, we have implemented a set of preparation procedures and recovery plans as outlined in "FIU SCIS Hurricane Preparation Procedures."

APPENDICES

Expert Review Letters

For CEST --------------------

February 4, 2020
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Introduction

My review of the Coastal and Estuarine Storm Tide (CEST) model, which is the storm surge component of Florida International's (FIU) submission to the Florida Commission on Hurricane Loss Projection Methodology to meet the "2017 Hurricane Standards Report of Activities", is based on an examination of the submission draft provided to me in December as well as previous literature reviews of CEST.

GF-1 Scope of the Flood Model and Its Implementation

The intent of section GF-1 is to describe the model. FIU's response describes the model's underlying mathematics. It then answers the practical questions of: what type of computational grid; what are the boundary conditions; how are the pressure gradient and bottom friction resolved; and how it handles wetting and drying. It continues by describing how the bathymetric and topographic data are gathered and processed into a computational grid. This is followed by a description of the wind-field and how it is modified to account for terrain effects. In short, FIU's response from section 1 to 3 provides a good overview of the model.

FIU's response also contains a section 4 which describes the specific implementation of the CEST model for Florida in the form of 4 sets of computational grids that when combined cover the Florida coastline. Each set has a coarse, intermediate, and fine grid resolution. The reason for the different types of grid resolutions is to allow FIU to make an informed choice between run-time and accuracy. Their current choice of the intermediate resolution grids is reasonable based on run-time. This section is useful for detailing their implementation choices.

MF-1 Flood Event Data Sources

The intent of section MF-1 is to describe the data sources of the model as well as describe what observational data sources were used to calibrate or validate the model. FIU's response, from the storm surge model perspective, reiterated the bathymetry and topography information that was more fully covered in the GF-1 section.

It then covered the observational systems used for validation. The high water marks and NOS tide gauges are the established methods for observing storm surge. A third type of observation to consider would be the USGS's more recent efforts of pre-position storm surge sensors in the path of the storm. As this is a recent development, the data may not be available for the test storms.

MF-2 Flood Parameters (Input)

The intent of section MF-2 is to define and defend the model parameters (e.g. constants), as well as the grid cell size used by the model. FIU's response very thoroughly describes the model parameters and how they were derived. Section 4 from GF-1, which details the experiments used to choose the grid cell size, is repeated here and does a good job explaining why the intermediate grids were chosen.

MF-3 Wind and Pressure Fields for Storm Surge

The intent of section MF-3, from a storm surge perspective, is to make sure the computational area is large enough. If it isn't, then the model will miss the initial set-up of the storms. FIU's response focuses on a test of different size basins using Dennis-2005, Ivan-2004, and Ike-2008 as case-studies.

Dennis-2005 is a good test case, particularly for Florida, as it caused a coastally trapped wave to propagate along the west side of Florida. To properly capture it, the computational domain needs to somehow (via a large grid or via nesting) include the entire west coast of Florida. This is borne out in FIU's experiment with the basins AP3, AP4, AP6, AP7 and EGM3. AP3 and AP4 were not broad enough to capture the initial set-up, so did not perform well. EGM3, while broad, was not fine enough to calculate the surge near the stations. AP6 and AP7 were broad enough to capture the storm and fine enough at the stations so they performed the best.

Ivan-2004 is also a good test case as it went through an area that is highly susceptible to waves and was on the western side of the AP3, AP4, AP6, AP7 basins. As one would expect, AP7 performed the best, since it had the longest time to react to Ivan-2004 and yet was finer in resolution than EGM3. It is interesting that EGM3 performed better than AP6, which indicates that capturing the correct initial water condition is more important than having higher resolution.

Ike-2008 made landfall in Texas, so it is not a good choice for Florida. That said, the experiment does emphasize that basins can be too small to capture a storm. A general rule of thumb is that a basin needs to be 2.5 times the size of the storm. HGL5 and HGL6 satisfy that while also being finer in resolution than EGM3.

MF-4 Flood Characteristics (Outputs)

The intent of section MF-4 is to make sure the model results are consistent with the historic records. FIU's response references separated document for calibration and verification of Historical Hurricanes required by Flood Standard. I'm familiar enough with CEST to be confident that the verification of Historical Hurricanes agree well the historic record within reason.

MF-5 Flood Probability Distributions

The intent of section MF-5 is to make sure the probability distributions are reasonable. CEST is a diagnostic storm surge model, so doesn't directly have probabilities associated with it. Given a reasonable approximation to a storm's winds it can predict coastal flooding, but a different part of the proposal would deal with probability distributions associated with how those winds are selected.

That said, the section does ask about modeling of tropical and non-tropical events. FIU took this to mean 'tropical storm' strength events and did a study of TS-Fay-2008. They found that TS-Fay didn't create much flooding and concluded that Tropical Storm strength events normally doesn't induce significant surge. Before they conclude that, they could also review the impacts of TS-Gordon-2018, TS-Andrea-2013, TS-Lee-2011, and TS-Hermine-2010.

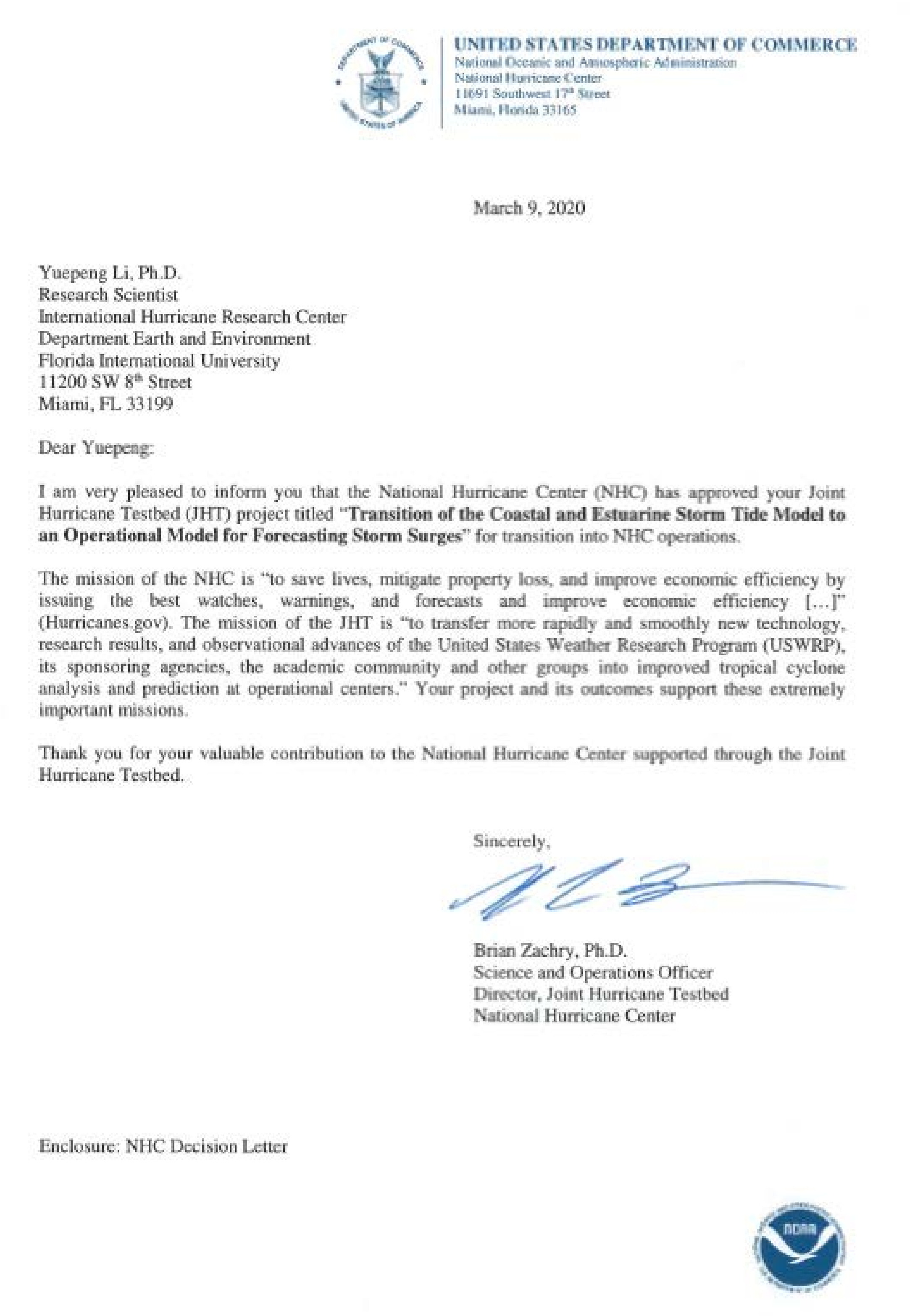
Summary

I am pleased to report that the issues that I have raised have received their attention and I believe that the model meets all the standards set forth by the commission.

Sincerely,

Arthur Taylor

Arthur Taylor



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Hurricane Center
11691 Southwest 17th Street
Miami, Florida 33165

March 9, 2020

Yuepeng Li, Ph.D.
Research Scientist
International Hurricane Research Center
Department Earth and Environment
Florida International University
11200 SW 8th Street
Miami, FL 33199

Dear Yuepeng:

I am very pleased to inform you that the National Hurricane Center (NHC) has approved your Joint Hurricane Testbed (JHT) project titled "**Transition of the Coastal and Estuarine Storm Tide Model to an Operational Model for Forecasting Storm Surges**" for transition into NHC operations.

The mission of the NHC is "to save lives, mitigate property loss, and improve economic efficiency by issuing the best watches, warnings, and forecasts and improve economic efficiency […]" (Hurricanes.gov). The mission of the JHT is "to transfer more rapidly and smoothly new technology, research results, and observational advances of the United States Weather Research Program (USWRP), its sponsoring agencies, the academic community and other groups into improved tropical cyclone analysis and prediction at operational centers." Your project and its outcomes support these extremely important missions.

Thank you for your valuable contribution to the National Hurricane Center supported through the Joint Hurricane Testbed.

Sincerely,

Brian Zachry, Ph.D.
Science and Operations Officer
Director, Joint Hurricane Testbed
National Hurricane Center

Enclosure: NHC Decision Letter

For wind --------------------

February 15, 2007
Gary M. Barnes
Professor, Department of Meteorology
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

Introduction

My review of the State of Florida Public Hurricane Model is based on a three day visit to Florida International University in December, and an examination of the submission draft provided to me in February. I have had full access to the meteorological portion of the model, access to the draft for the Florida commission, and access to prior submittals to the commission from several other groups in order to establish a sense of what is desired by the commission. I am pleased to report that the issues that I have raised have received their attention and I believe that the model meets all the standards set forth by the commission. Ultimately this model, when linked to engineering and actuarial components, will provide objective guidance for the estimation of wind losses from hurricanes for the state of Florida. It does not address losses from other aspects of a tropical cyclone such as storm surge, or fresh water flooding. I now offer specific comments on each of the six meteorological standards established by the commission to ascertain this model's suitability.

M-1 Official Hurricane Set

The consortium of scientists working on the Public model have adopted HURDAT (1900-2006) to determine landfall frequency and intensity at landfall. The NWS report by Ho et al. (1987), DeMaria's extension of the best track, H*Wind analyses (Powell & Houston, 1996, 1998; Powell et al. 1996, 1998) and NOAA Hurricane Research Division aircraft data are used to estimate the radius of maximum winds (RMW) at landfall. The strength of HURDAT is that it is the most complete and accessible historical record for hurricanes making landfall or passing closely by Florida. HURDAT weaknesses include the abbreviated record and questionable intensity estimates for those hurricanes early in the record, especially those that remain offshore. Evidence for the shortness of record is the impact of the last few hurricane seasons on landfall return frequency. The meteorological team has scrutinized the base set developed by the commission and made a number of adjustments to the dataset based on refereed literature and the HURDAT record. I have looked at several of these adjustments in detail and find the corrections to be an improvement over the initial base set.

M-2 Hurricane Characteristics

The model has two main components. The track portion of the model produces a storm with either an initial location or genesis point and an intensity that is derived from an empirical distribution derived from HURDAT (2006). Storm motion and intensity is then initialized by using a Monte Carlo approach, drawing from probability density functions (PDFs) based on the historical dataset to create a life for a bogus hurricane. Examination of the PDFs reveals that they are faithful to the observed patterns for storms nearing Florida, and the evolution of any particular hurricane appears realistic.

The second component of the meteorological model is the wind field generated for a given hurricane, which only comes into play when the hurricane comes close enough to place high winds over any given ZIP Code of Florida. To generate a wind field the minimum sea-level pressure (MSLP) found in the eye, the RMW at landfall, and a distant environmental pressure (1013 mb) are entered into the Holland (1980) B model for the axisymmetric pressure distribution around the hurricane. The behavior of the RMW is based on a variety of sources that include Ho et al. (1987), DeMaria's extension of the best track data, H*wind analyses, and aircraft reconnaissance radial wind profiles. The B coefficient is based on the extensive aircraft dataset acquired in reconnaissance and research flights over the last few decades. RMW and B use a random or error term to introduce variety into the model. The Holland pressure field is used to produce a gradient wind at the top of the boundary layer. The winds in the boundary layer are estimated following the work proposed by Ooyama (1969) and later utilized by Shapiro (1983) which includes friction and advection effects. These boundary layer winds are reduced to surface winds (10 m) using reduction factors based on the work of Powell et al. (2003). Maximum sustained winds and 3 second gusts are estimated using the guidance of Vickery and Skerlj (2005). Once the hurricane winds come ashore there are further adjustments to the wind to account for local roughness as well as the roughness of the terrain found upstream of the location under scrutiny. The pressure decay of the hurricane is modeled to fit the observations presented by Vickery (2005).

Gradient balance has been demonstrated to be an accurate representation for vortex scale winds above the boundary layer by Willoughby (1990) and is a fine initial condition. The slab boundary layer concept of Ooyama and Shapiro has been shown to produce wind fields much like observed once storm translation and surface friction come into play. The reduction to 10 m altitude is based on Powell et al. (2003); they use the state of the art Global Positioning System sondes to compare surface and boundary layer winds.

Perhaps the most questionable part of the wind portion of the model is the reliance on the estimates of the RMW at landfall. The scatter in RMW for a given MSLP is large; larger RMWs coupled with the B parameter control the size of the annulus of the damaging winds. The typical length of an aircraft leg from the eye is about 150 km so the choice of the B parameter is based on a small radial distance in the majority of hurricanes. The collection of quality wind observations over land in hurricanes remains a daunting task; therefore the actual response of the hurricane winds to variations in roughness is less certain. Applying roughness as a function of ZIP Code is a coarse approximation to reality. However, this is the approach chosen by the commission, and given the data limitations, a reasonable course to take.

M-3 Landfall Intensity

The model uses one minute winds at 10 m elevation to determine intensity at landfall and categorizes each hurricane according to the Saffir-Simpson classification. The model considers any hurricane that makes landfall or comes close enough to place high winds over Florida. Multiple landfalls are accounted for, and decay over land between these landfalls is also estimated. Maximum wind speeds for each category of the Saffir-Simpson scheme are reasonable as is the worst possible hurricane the model generates. Simulations are conducted for a hypothetical 60,000 years. Any real climate change would alter results, but maybe not as much as have an actual record of order of 1,000 years to base the PDFs on.

M-4 Hurricane Probabilities

Form M-1 demonstrates that the model is simulating the landfalls very well for the entire state, region A (NW Florida) and region B (SW Florida). There are subsections of the state where the historical and the simulated landfalls have a discrepancy. In region C (SE Florida) the observations show an unrealistic bias toward Category 3 storms. This is likely due to an overestimate of intensity for the hurricanes prior to the advent of aircraft sampling or advanced satellite techniques. The historical distribution for region C also does not fit any accepted distributions that we typically see for atmospheric phenomena. This discrepancy is probably due to the shortness of the historical record. I note that other models also have difficulty with this portion of the coast. I believe the modeled distribution, based on tens of thousands of years, is more defensible than the purported standard. Regions D (NE Florida) and E (Georgia) have virtually no distribution to simulate, again pointing to a very short historical record. There is no documented physical reason why these two regions have escaped landfall events. Perhaps a preferred shape of the Bermuda High may bias the situation, but this remains speculative.

M-5 Land Friction and Weakening

Land use and land cover are based on high resolution satellite imagery. Roughness for a particular location is then based on HAZUS tables that assign a roughness to a particular land use. There are newer assessments from other groups but the techniques were not consistently applied throughout the state, nor are the updated HAZUS maps for 2000 available yet. Winds at a particular location are a function of the roughness at that point and conditions upwind. A pressure decay model based on the work of Vickery (2005) produces weakening winds that are reasonable approximations of the observed decay rates of several hurricanes that made landfall in Florida in 2004 and 2005.

The maps (Form M-2) of the 100 year return period maximum sustained winds shows the following trends: (1) a reduction in the sustained winds from south to north, (2) a reduction of winds from coastal to inland ZIP Codes, and (3) the highest winds in the Keys and along the SE and SW coasts. The plotting thresholds requested by the commission partially obfuscate the gradients in wind speed, but Form M-2 produced with finer contours highlights the above trends clearly. The open terrain maps look logical; the actual terrain maps are perhaps overly sensitive to the local roughness. Convective scale motions, which cannot be resolved in this type of model, would probably be responsible for making the winds closer to the open terrain results.

M-6 Logical Relationships of Hurricane Characteristics

The RMW is a crucial but poorly measured variable. Making RMW a function of intensity and latitude explains only a small portion of the variance (~20%). Examination of aircraft reconnaissance radial profiles shows that RMW is highly variable. Currently there are no other schemes available to explain more of the variance. Form M-3 reflects the large range of RMW. Note that only the more intense hurricanes (MSLP < 940 mb) show a trend, and only with the upper part of the range. Even open ocean studies of the RMW show such large scatter.

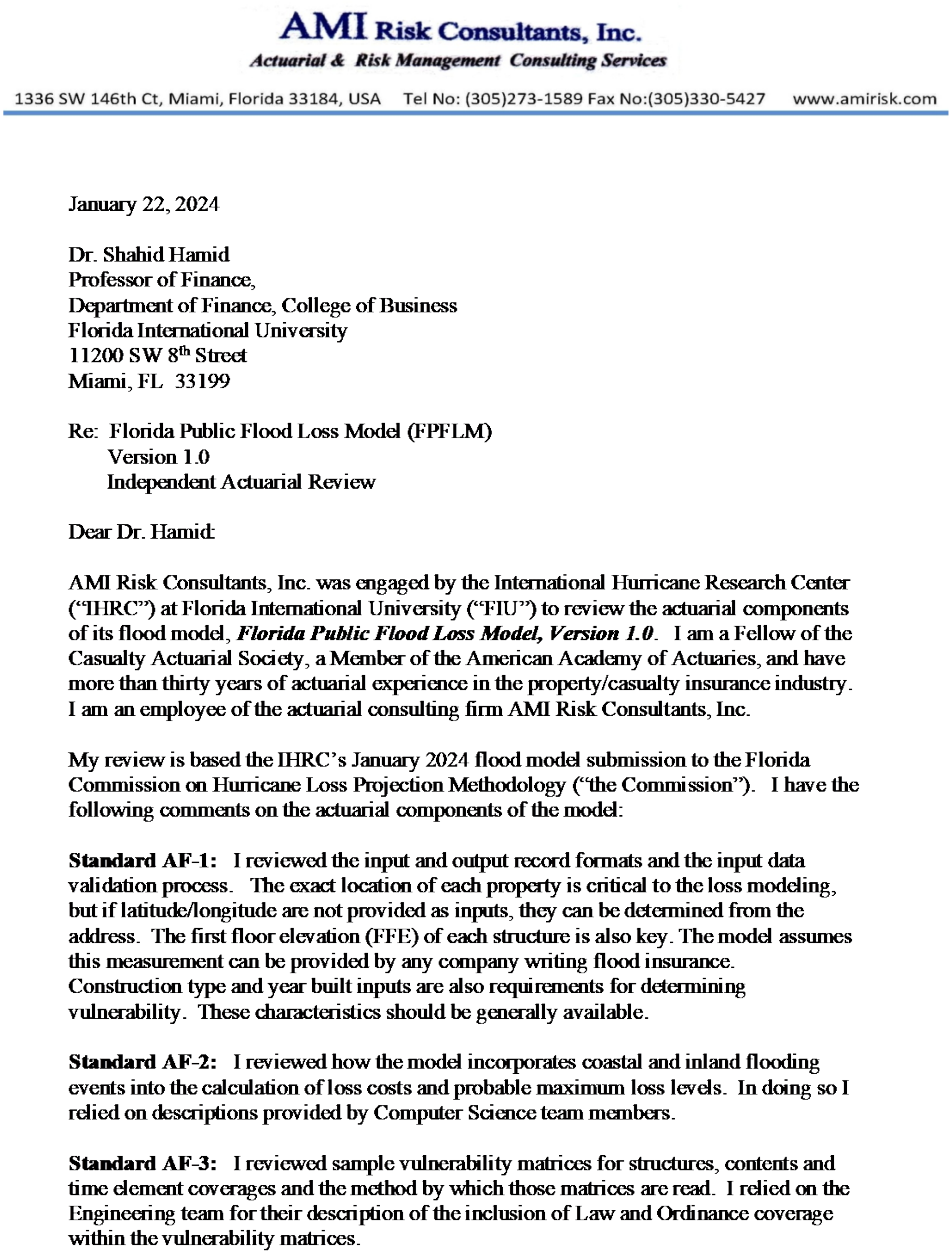
Tests done during my visits show that wind speed decreases as a function of roughness, all other variables being held constant. The evolution of the wind field as a hurricane comes ashore is logical.

Summary

The consortium that has assembled the meteorological portion of the Public Model for Hurricane Wind Losses for the State of Florida is using the HURDAT with corrections based on other refereed literature. These data yield a series of probability density functions that describe frequency, location, and intensity at landfall. Once a hurricane reaches close enough to the coast the gradient winds are estimated using the equations by Holland (1980), then a sophisticated wind model (Ooyama 1969, Shapiro 1983) is applied to calculate the boundary layer winds. Reduction of this wind to a surface value is based on recent boundary layer theory and observations. Here the consortium has exploited other sources of data (e.g., NOAA/AOML/HRD aircraft wind profiles and GPS sondes) to produce a surface wind field. As the wind field transitions from marine to land exposure changes in roughness are taken into account. Form M-1 (frequency and category at landfall as a function of coastal segment) and Form M-2 (100 year return maximum sustained winds for Florida) highlight the good performance of the model.

I suspect that the differences between the historical record and the simulation are largely due to the shortness and uncertainty of the record. If the consortium had the luxury of 1000 years of observations agreement between the record and the simulation would be improved. I believe that the meteorological portion of the model is meeting all the standards established by the commission. Tests of the model against H*Wind analyses and the production of wind speed swaths go beyond the typical quality controls of prior models and demonstrate that this model is worthy of consideration by the commission.

For actuarial --------------------



AMI Risk Consultants, Inc.
Actuarial & Risk Management Consulting Services
1336 SW 146th Ct, Miami, Florida 33184, USA Tel No: (305)273-1589 Fax No:(305)330-5427 www.amirisk.com

January 22, 2024

Dr. Shahid Hamid
Professor of Finance,
Department of Finance, College of Business
Florida International University
11200 SW 8th Street
Miami, FL 33199

Re: Florida Public Flood Loss Model (FPFLM)
Version 1.0
Independent Actuarial Review

Dear Dr. Hamid:

AMI Risk Consultants, Inc. was engaged by the International Hurricane Research Center ("IHRC") at Florida International University ("FIU") to review the actuarial components of its flood model, ***Florida Public Flood Loss Model, Version 1.0***. I am a Fellow of the Casualty Actuarial Society, a Member of the American Academy of Actuaries, and have more than thirty years of actuarial experience in the property/casualty insurance industry. I am an employee of the actuarial consulting firm AMI Risk Consultants, Inc.

My review is based the IHRC's January 2024 flood model submission to the Florida Commission on Hurricane Loss Projection Methodology ("the Commission"). I have the following comments on the actuarial components of the model:

Standard AF-1: I reviewed the input and output record formats and the input data validation process. The exact location of each property is critical to the loss modeling, but if latitude/longitude are not provided as inputs, they can be determined from the address. The first floor elevation (FFE) of each structure is also key. The model assumes this measurement can be provided by any company writing flood insurance. Construction type and year built inputs are also requirements for determining vulnerability. These characteristics should be generally available.

Standard AF-2: I reviewed how the model incorporates coastal and inland flooding events into the calculation of loss costs and probable maximum loss levels. In doing so I relied on descriptions provided by Computer Science team members.

Standard AF-3: I reviewed sample vulnerability matrices for structures, contents and time element coverages and the method by which those matrices are read. I relied on the Engineering team for their description of the inclusion of Law and Ordinance coverage within the vulnerability matrices.

Standard AF-4: I verified the requirements of this standard by manually calculating the loss cost for individual exposures and manually calculating the PML and uncertainty intervals for all exposures combined.

Standard AF-5: The model subtracts the deductible from the expected loss and limits the net loss to the coverage limit. Separate deductibles are applied to building and contents, as in the NFIP standard policy. The deductible test in Form AF-6 demonstrates that the relationship among deductibles is appropriate.

Standard AF-6: I reviewed the results of Form AF-6 and investigated the apparent anomalies. The Policy Form, Construction, Coverage and Number of Stories tests present without anomalies. The Franklin County exposure produced anomalies in the Foundation Type and Lowest Floor Elevation tests. These were caused by the particular distribution of flooding depths impacting this exposure in the stochastic set of storms.

All other anomalies in the Foundation Type and Year Built tests result from the model's underlying vulnerability assumptions. The model does not vary vulnerability between Basement and Slab Foundation exposures. Furthermore, the model's "weak" and "strong" year-built eras cause loss costs to be equal for some of the form's test years.

Conclusion:

My conclusion is that the Florida Public Flood Loss Model v1.0 reflects reasonable actuarial assumptions and meets the Commission's Standards AF-1 through AF-6.

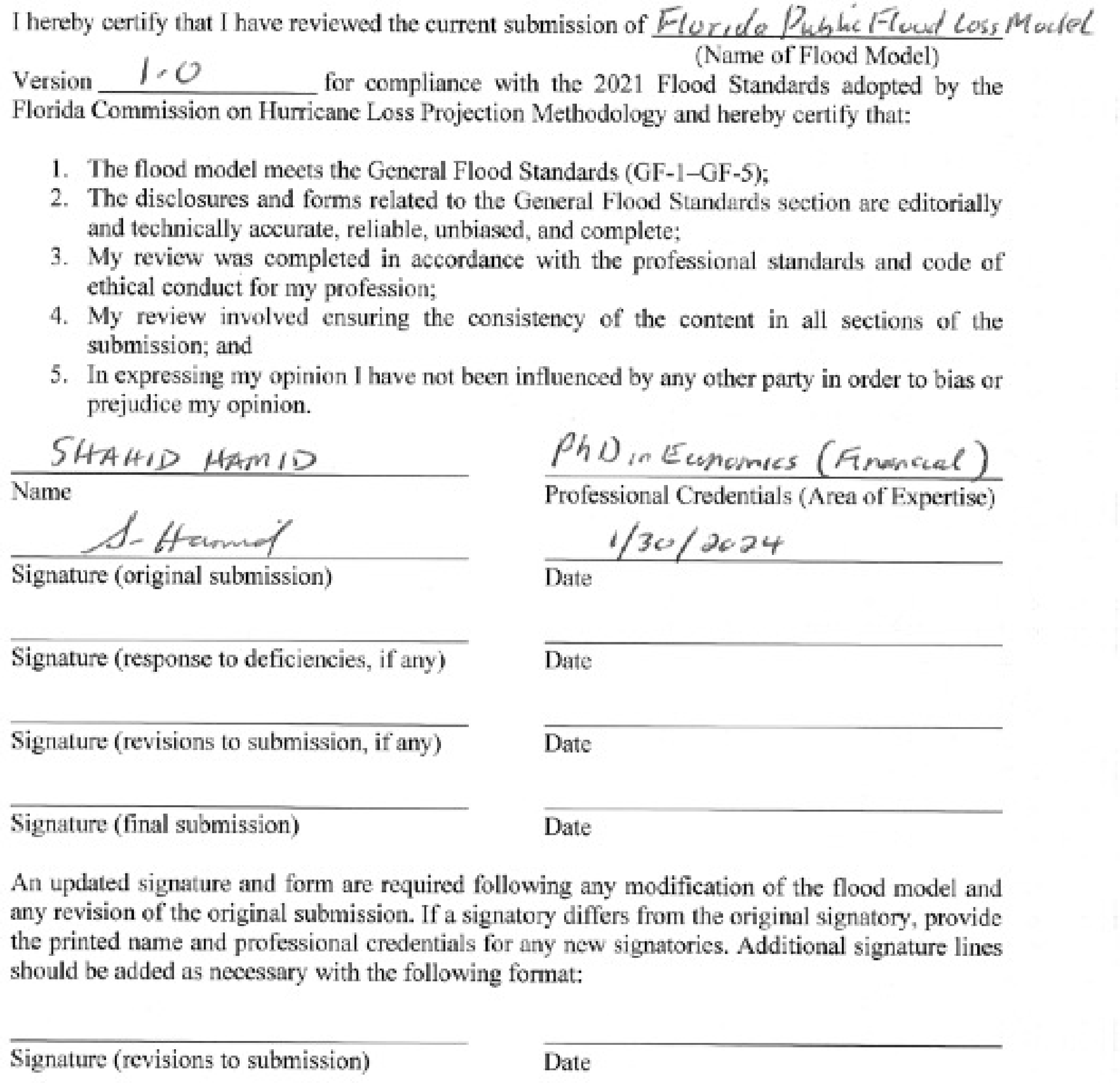
If you have any questions about my review, I would be happy to discuss them.

Sincerely,

Gail Flannery

Gail Flannery, FCAS, MAAA
Consulting Actuary

Form GF-1: General Flood Standards Expert Certification



I hereby certify that I have reviewed the current submission of Florida Public Flood Loss Model
(Name of Flood Model)
Version 1.0 for compliance with the 2021 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1. The flood model meets the General Flood Standards (GF-1–GF-5);
2. The disclosures and forms related to the General Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3. My review was completed in accordance with the professional standards and code of ethical conduct for my profession;
4. My review involved ensuring the consistency of the content in all sections of the submission; and
5. In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

SHAHID HAMID Name	PhD in Economics (Financial) Professional Credentials (Area of Expertise)
S. Hamid Signature (original submission)	1/30/2024 Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form are required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines should be added as necessary with the following format:

Signature (revisions to submission)	Date

Form GF-2: Meteorological Flood Standards Expert Certification

I hereby certify that I have reviewed the current submission of FPFLM
(Name of Flood Model)
Version 1.0 for compliance with the 2021 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1. The flood model meets the Meteorological Flood Standards (MF-1–MF-5);
2. The disclosures and forms related to the Meteorological Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3. My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4. In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Yuepeng Li	PHD in Marine Science
Name	Professional Credentials (Area of Expertise)
	01/30/2024
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

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Signature (revisions to submission)	Date

Form GF-3: Hydrological and Hydraulic Flood Standards Expert Certification

I hereby certify that I have reviewed the current submission of Florida Public Flood Loss Model
(Name of Flood Model)
Version 1.0 for compliance with the 2021 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1. The flood model meets the Hydrological and Hydraulic Flood Standards (HHF-1–HHF-4);
2. The disclosures and forms related to the Hydrological and Hydraulic Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3. My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4. In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Efthymios Nikolopoulos
Name

Ph.D., Environmental Eng./Hydrology
Professional Credentials (Area of Expertise)
State:________ Expiration Date:___________
Professional License Type:________________

Signature (original submission)

01/28/2024
Date

Signature (response to deficiencies, if any)

Date

Signature (revisions to submission, if any)

Date

Signature (final submission)

Date

Form GF-4: Statistical Flood Standards Expert Certification

I hereby certify that I have reviewed the current submission of FPFLM
(Name of Flood Model)
Version 1.0 for compliance with the 2021 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1. The flood model meets the Statistical Flood Standards (SF-1–SF-5);
2. The disclosures and forms related to the Statistical Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3. My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4. In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

SNEH GULATI	Ph.D IN STATISTICS
Name	Professional Credentials (Area of Expertise)
	01/28/24
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form are required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines should be added as necessary with the following format:

Signature (revisions to submission)	Date

Form GF-5: Vulnerability Flood Standards Expert Certification

I hereby certify that I have reviewed the current submission of Florida Public Flood Loss Model
(Name of Flood Model)
Version 1.0 for compliance with the 2021 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1. The flood model meets the Vulnerability Flood Standards (VF-1–VF-4);
2. The disclosures and forms related to the Vulnerability Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3. My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4. In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Jean-Paul Pinelli
Name

PhD, PE, Structural/Wind Engineering
Professional Credentials (Area of Expertise)
State: FL Expiration Date: 02/28/2025
Professional License Type:PE 53310

Signature (original submission)

1/24/2024
Date

Signature (response to deficiencies, if any)

Date

Signature (revisions to submission, if any)

Date

Signature (final submission)

Date

Form GF-6: Actuarial Flood Standards Expert Certification

I hereby certify that I have reviewed the current submission of the Florida Public Flood Loss Model
Version 1.0 for compliance with the 2021 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1. The flood model meets the Actuarial Flood Standards (AF-1–AF-6);
2. The disclosures and forms related to the Actuarial Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3. My review was completed in accordance with the Actuarial Standards of Practice and Code of Conduct; and
4. In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Gail Flannery	FCAS, MAAA
Name	Professional Credentials (Area of Expertise)
Gail Flannery	1/26/2024
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form are required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines should be added as necessary with the following format:

Signature (revisions to submission)	Date

Form GF-7: Computer/Information Flood Standards Expert Certification

I hereby certify that I have reviewed the current submission of FPFLM
(Name of Flood Model)
Version 1.0 for compliance with the 2021 Flood Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:

1. The flood model meets the Computer/Information Flood Standards (CIF-1–CIF-8);
2. The disclosures and forms related to the Computer/Information Flood Standards section are editorially and technically accurate, reliable, unbiased, and complete;
3. My review was completed in accordance with the professional standards and code of ethical conduct for my profession; and
4. In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Shu-Ching Chen	Ph.D. in Electrical and Computer Engineering MS in Computer Science
Name	Professional Credentials (Area of Expertise)
	1/15/2024
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form are required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines should be added as necessary with the following format:

Signature (revisions to submission)	Date

Form GF-8: Editorial Review Expert Certification

I hereby certify that I have reviewed the current submission of FPFLM
(Name of Flood Model)
Version 1.0 for compliance with the "Process for Determining the Acceptability of a Computer Simulation Flood Loss Model" adopted by the Florida Commission on Hurricane Loss Projection Methodology in its *Flood Standards Report of Activities as of November 1, 2021*, and hereby certify that:

1. The flood model submission is in compliance with the Notification Requirements and General Flood Standard GF-5, Editorial Compliance;
2. The disclosures and forms related to each flood standards section are editorially accurate and contain complete information and any changes that have been made to the submission during the review process have been reviewed for completeness, grammatical correctness, and typographical errors;
3. There are no incomplete responses, charts or graphs, inaccurate citations, or extraneous text or references;
4. The current version of the flood model submission has been reviewed for grammatical correctness, typographical errors, completeness, the exclusion of extraneous data/ information and is otherwise acceptable for publication; and
5. In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.

Steven Cocke	PhD Physics
Name	Professional Credentials (Area of Expertise)
	January 30, 2024
Signature (original submission)	Date
Signature (response to deficiencies, if any)	Date
Signature (revisions to submission, if any)	Date
Signature (final submission)	Date

An updated signature and form are required following any modification of the flood model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines should be added as necessary with the following format:

Signature (revisions to submission)	Date

Form HHF-1: Historical Coastal and Inland Event Flood Extent and Elevation or Depth Validation Maps

A. Provide color-coded contour or high-resolution maps with appropriate base map data illustrating modeled coastal and inland flood extents and elevations or depths for the following historical Florida flood events:

Hurricane Andrew (1992)
Hurricane Ivan (2004)
Hurricane Jeanne (2004)
Hurricane Wilma (2005)
Tropical Storm Fay (2008)
Unnamed Storm in East Florida (May 2009)
Unnamed Storm in Panhandle (July 2013)
Hurricane Matthew (2016)
Hurricane Irma (2017)
Hurricane Michael (2018)

For any storms where sufficient data are not available, the modeling organization may substitute an alternate historical storm of their choosing.

Coastal

There are totally 4 set of basins established for the storm surge calibration of historical hurricanes, covering the whole coastal area of Florida,

1. West North Florida basin, MS8, cover the north Florida coastal area (Figure 93);
2. West Florida basin, WF1, cover the west Florida coastal area (Figure 94);
3. South Florida basin, SF1, cover the south Florida coastal area with Key (Figure 95);
4. North Florida basin, NF1, cover the north-east Florida coastal area (Figure 96).

The actual historical storms reported in what follows are:

Hurricane Andrew (1992)
Hurricane Frances (2004)
Hurricane Ivan (2004)
Hurricane Wilma (2005)
Hurricane Katrina (2005)
Hurricane Hermine (2016)
Hurricane Matthew (2016)
Hurricane Irma (2017)
Hurricane Michael (2018)
Hurricane Dorian (2019)

The specified Hurricane Jeanne (2004) was replaced by Hurricane Frances (2004), Tropical Storm Fay (2008) was replaced with Hurricane Katrina (2005), and the two unnamed storms were replaced with Hurricanes Hermine (2016) and Dorian (2019). It is noted that Hurricane Frances (2004) has a very similar track to that of Jeanne (2004), and Hurricane Katrina (2005) impacted the southwest coastline of Florida very close to that struck by storm Fay (2008). Furthermore, very limited data can be found for the two unnamed storms and they are mainly rainfall events. Hence, the replacement with Hurricane Hermine (2016) and Dorian (2019).

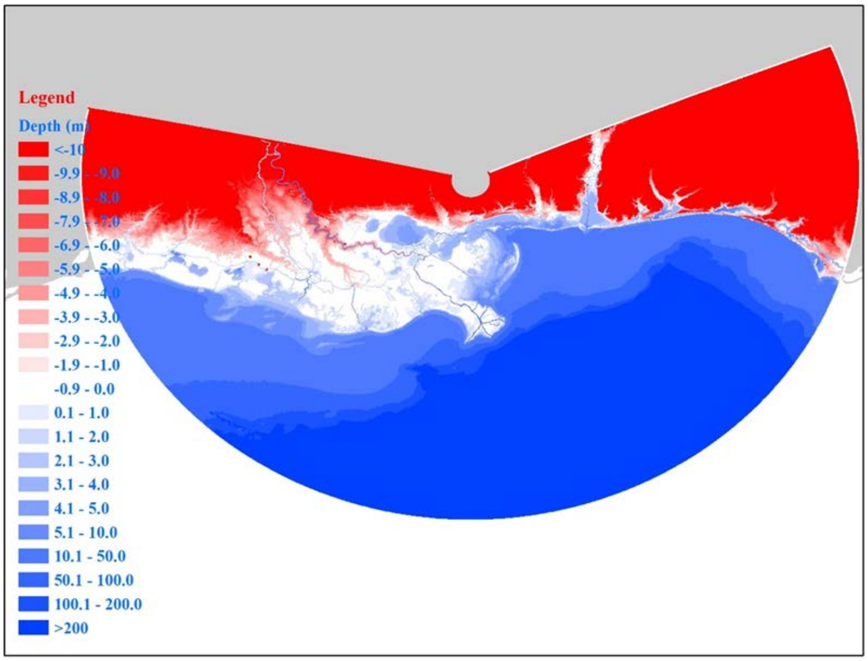


Figure 93. West North Florida Basin with the color presents the elevations/water depths of the center cells.

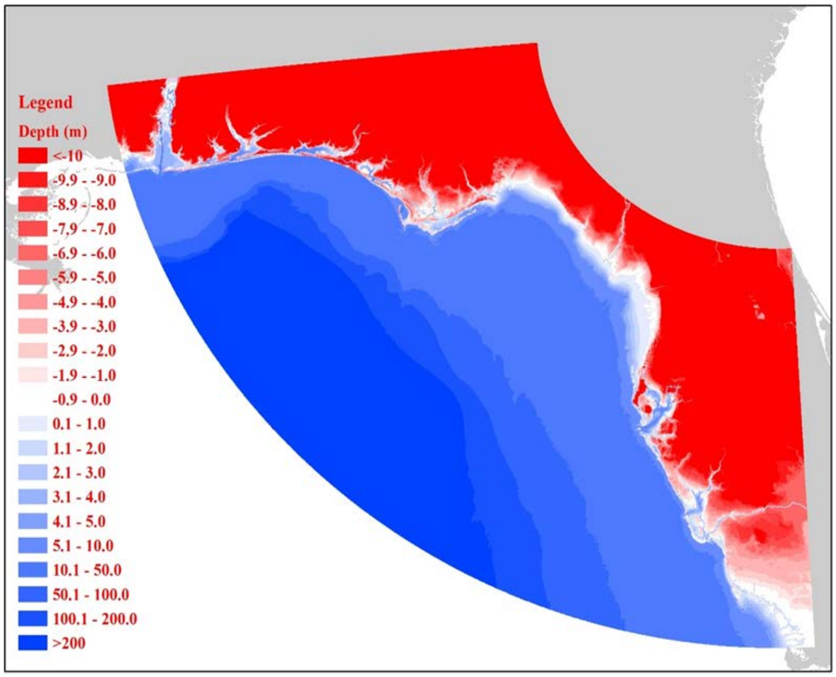


Figure 94. West Florida Basin with the color presents the elevations/water depths of the center cells.

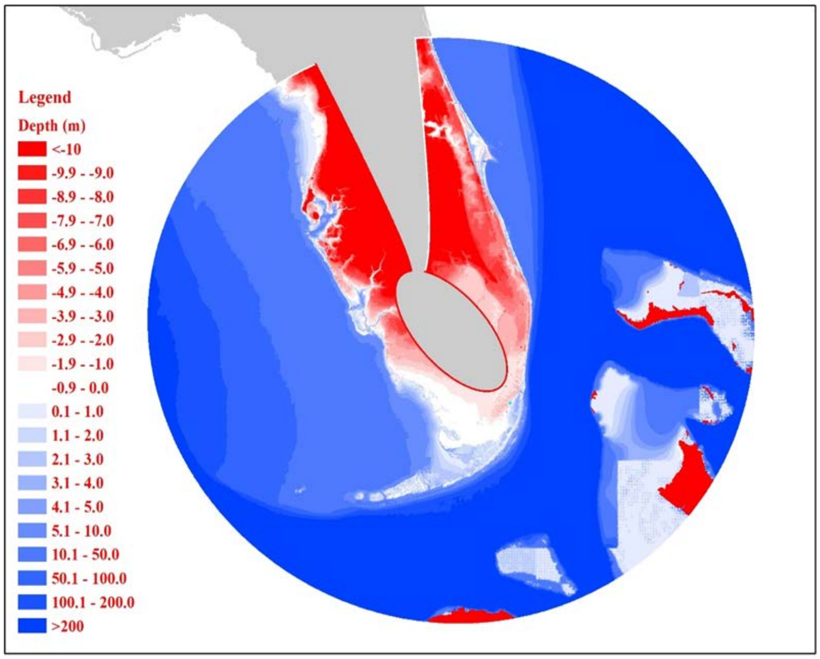


Figure 95. South Florida Basin with the color presents the elevations/water depths of the center cells.

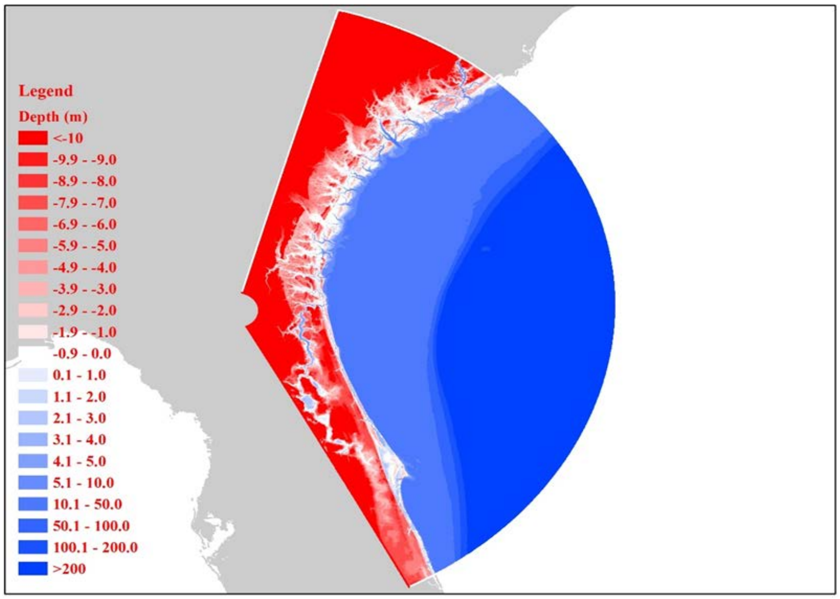


Figure 96. East North Florida Basin with the color presents the elevations/water depths of the center cells.

1. Hurricane Andrew (1992)

Storm tide simulations for Hurricane Andrew were conducted on South Florida basin SF1 with H*wind. Each simulation, starting at 0800 coordinated universal time (UTC) 23 August and ending at 2300 UTC 27 August 1992, continued for 4.625 days. The time step is 30 seconds. The initial water level was set to be 0 m above the NAVD88.

Figure 97 shows the peak storm tide heights above the NAVD 88 calculated by H*Wind. The maximum peak storm tide height, 13.9 feet, on the right side of the Hurricane track.

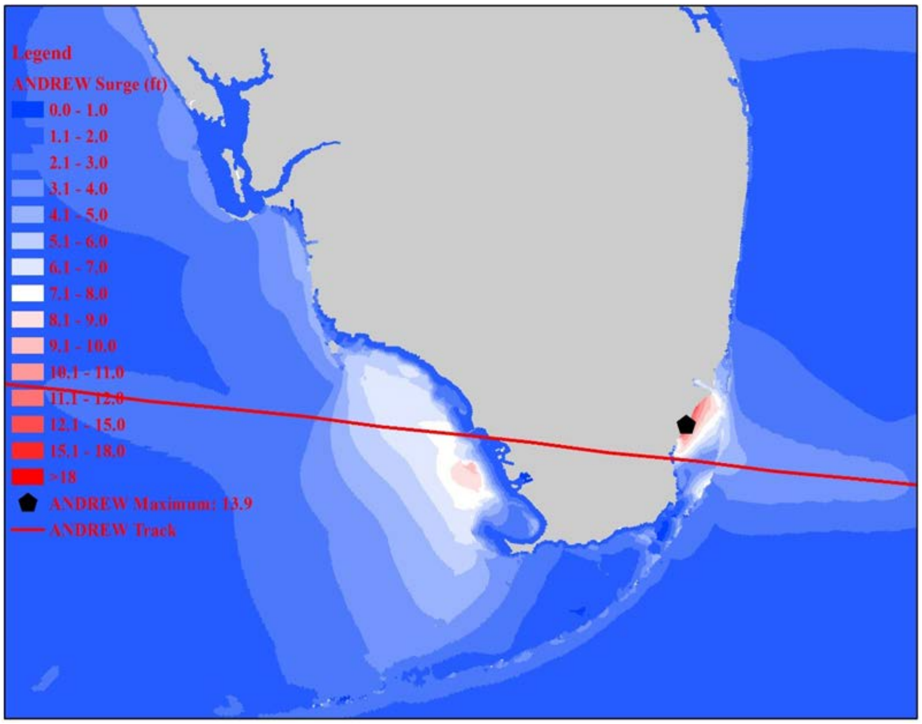
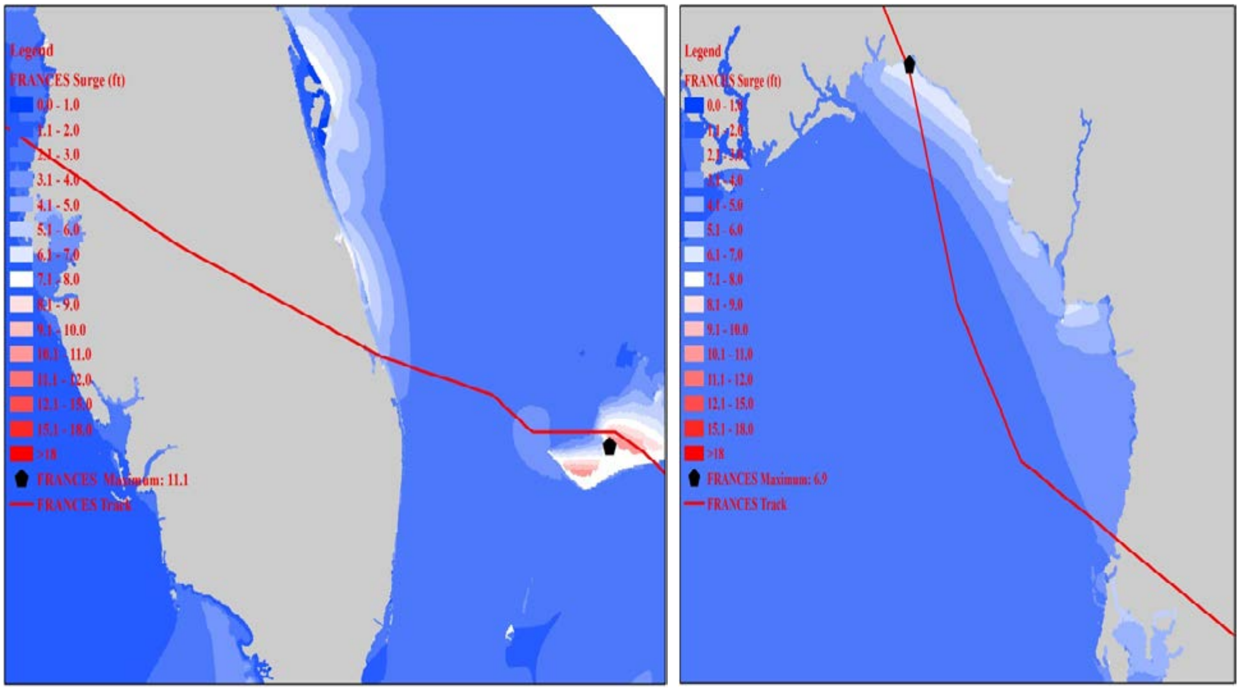


Figure 97. Computed peak storm tide heights for Hurricane Andrew by SF1 by CEST.

2. Hurricane Frances (2004)

Storm tide simulations for Hurricane Frances were conducted on South Florida Basin SF1 and West Florida WF1 with H*Wind, starting at 0900 coordinated universal time (UTC) 2 September and ending at 0500 UTC 8 September 2004, continued for almost 6 days. The time step is 30 seconds. The initial water level was set to be 0.3 m above the NAVD88 based on the analysis of tide gauge records in the basins prior to the passing of Frances.

Figure 98 shows the peak storm tide heights above the NAVD 88 calculated by H*Wind at (A) SF1 and (B) WF1. The maximum peak storm tide heights at South Florida Basin 11.1 feet near the Freeport, and 6.9 feet at West Florida Basin near the North-East coast.



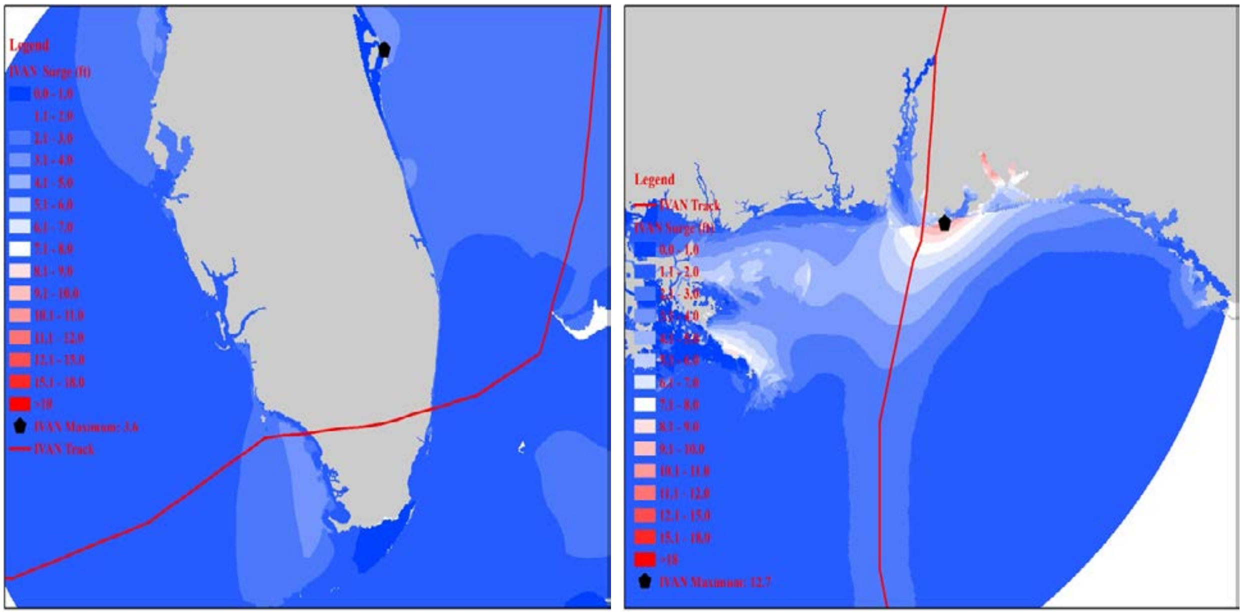
(a) (b)

Figure 98. Computed peak storm tide heights for Hurricane Frances 2004 by (a) SF1 and (b) WF1 with H*Wind.

3. Hurricane Ivan (2004)

Storm tide simulations for Hurricane Ivan were conducted on South and North Florida Basins with H*Wind. Each simulation, starting at 1800 coordinated universal time (UTC) 11 September and ending at 0400 UTC 24 September 2004, continued for almost 13 days. The time step is 30 seconds. The initial water level was set to be 0.2 m above the NAVD88 based on the analysis of tide gauge records in the basins prior to the passing of Ivan.

Figure 99 shows the peak storm tide heights above the NAVD 88 calculated by H*Wind at (A) SF1 and (B) MS8. The maximum peak storm tide heights at South Florida Basin 3.6 feet near Naples, and 12.7 feet at North Florida Basin near the landfall location at the right side of the track.



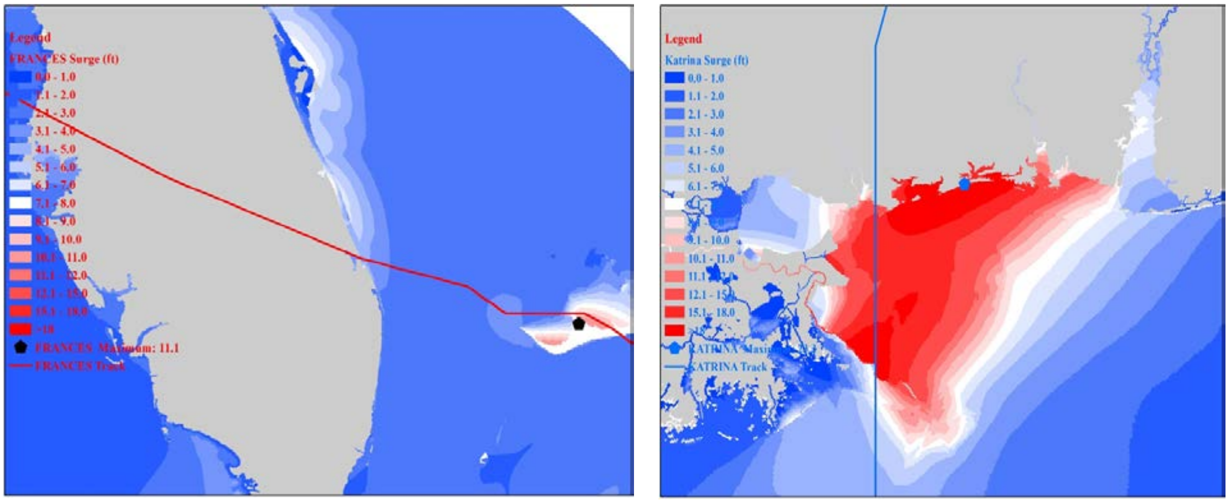
(a) (b)

Figure 99. Computed peak storm tide heights for Hurricane Ivan 2004 by (a) SF1 and (b) MS8 with H*Wind.

4. Hurricane Katrina (2005)

Storm tide simulations for Hurricane Katrina were conducted on South and North Florida Basins with H*Wind. Each simulation, starting at 1200 coordinated universal time (UTC) 24 August and ending at 0400 UTC 29 August 2005, continued for almost 5 days. The time step is 30 seconds. The initial water level was set to be 0.3 m above the NAVD88 based on the analysis of tide gauge records in the basins prior to the passing of Katrina.

Figure 100 shows the peak storm tide heights above the NAVD 88 calculated by H*Wind at (Upper Panel) SF1 and (Lower Panel) MS8. The maximum peak storm tide heights in the Florida Basin are 11.1 feet near Freeport and 28.3 feet near the landfall location on the right side of the track



(a) (b)

Figure 100. Computed peak storm tide heights for Hurricane Katrina 2005 by (a) SF1 and (b) MS8 with H*Wind.

5. Hurricane Wilma (2005)

Storm tide simulations for Hurricane Wilma were conducted on the South Florida Basin with H*Wind. Each simulation, starting at 0300 coordinated universal time (UTC) 20 October and ending at 0300 UTC 25 October 2005, continued for 5 days. The time step is 30 seconds. The initial water level was set to be 0.2 m above the NAVD88 based on the analysis of tide gauge records in the basins prior to the passing of Wilma.

Figure 101 shows the peak storm tide heights above the NAVD 88 calculated by H*Wind at SF1. The maximum peak storm tide heights at South Florida Basin 15.5 feet near the landfall location at the right side of the track.

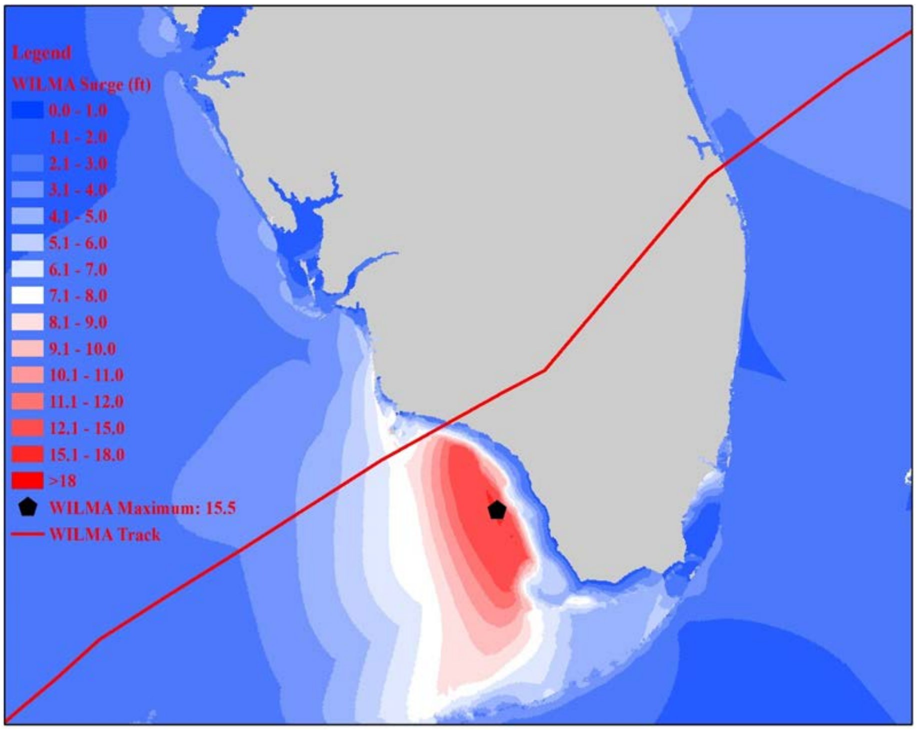


Figure 101. Computed peak storm tide heights for Hurricane Wilma 2005 by SF1 with H*Wind.

6. Hurricane Hermine (2016)

Storm tide simulations for Hurricane Hermine were conducted in the West Florida Basin. Each simulation, starting at 2100 coordinated universal time (UTC) September 4 and ending at 2100 September 8 2016, continued for 4 days. The time step is 30 seconds. The initial water level was set to be 0.3 m above the NAVD88 based on the analysis of tide gauge records in the basins prior to the passing of Wilma.

Figure 102 shows the peak storm tide heights above the NAVD 88 calculated by CEST. The maximum peak storm tide heights at West Florida Basin 14.4 feet near the landfall location at the right side of the track.

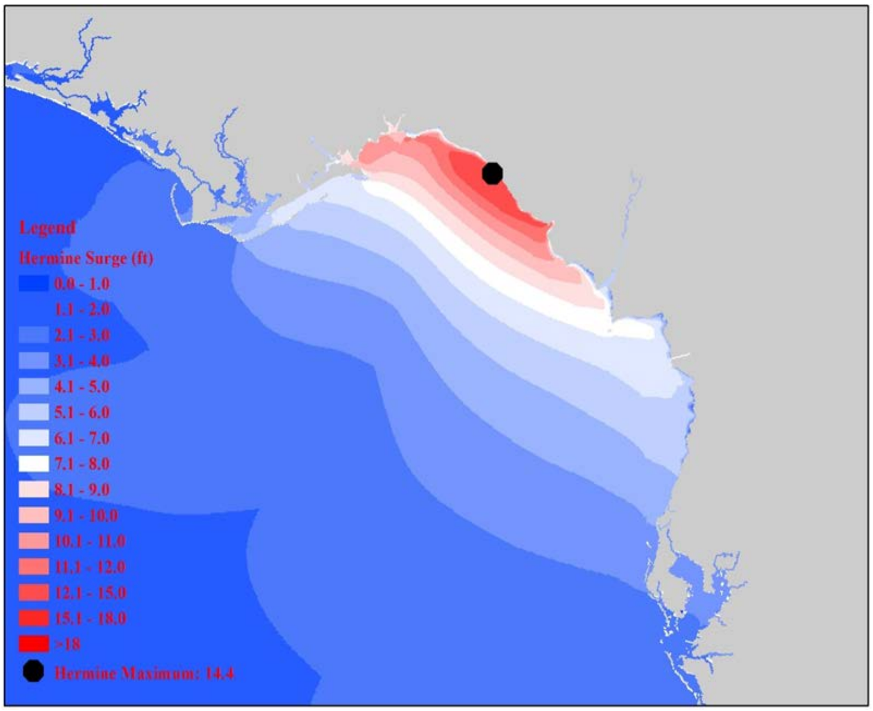


Figure 102. Computed peak storm tide heights for Hurricane Hermine 2016 by WF1.

7. Hurricane Matthew (2016)

Storm tide simulations for Hurricane Matthew were conducted in the North Florida Basin. Each simulation, starting at 1200 coordinated universal time (UTC) October 6 and ending at 1200 October 9 2016, continued for 4 days. The time step is 30 seconds. The initial water level was set to be 0.5 m above the NAVD88 based on the analysis of tide gauge records in the basins prior to the passing of Wilma.

Figure 103 shows the peak storm tide heights above the NAVD 88 calculated by CEST. The maximum peak storm tide heights at West Florida Basin 11.2 feet.

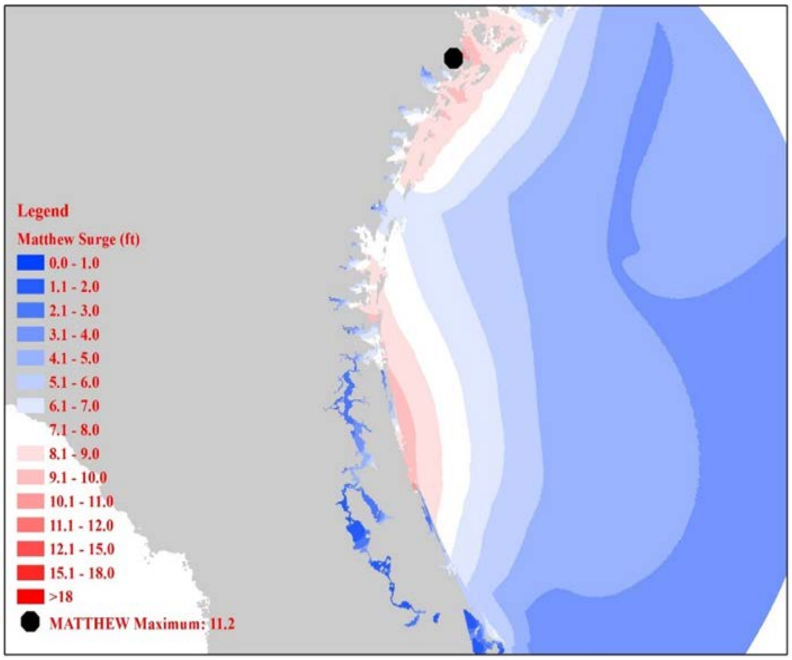


Figure 103. Computed peak storm tide heights for Hurricane Matthew 2016 by NF1.

8. Hurricane Irma (2017)

Storm tide simulations for Hurricane Irma were conducted in the South Florida Basin. Each simulation, starting at 00:00 UTC on 8 September 2017 and ending at 00:00 UTC on 12 September, continued for 4 days. The time step is 20 seconds. The initial water level was set to be 0.0 m above the NAVD88.

Figure 104 shows the peak storm tide heights above the NAVD 88 calculated by CEST. The maximum peak storm tide heights at South Florida Basin 10.8 feet near the landfall location.

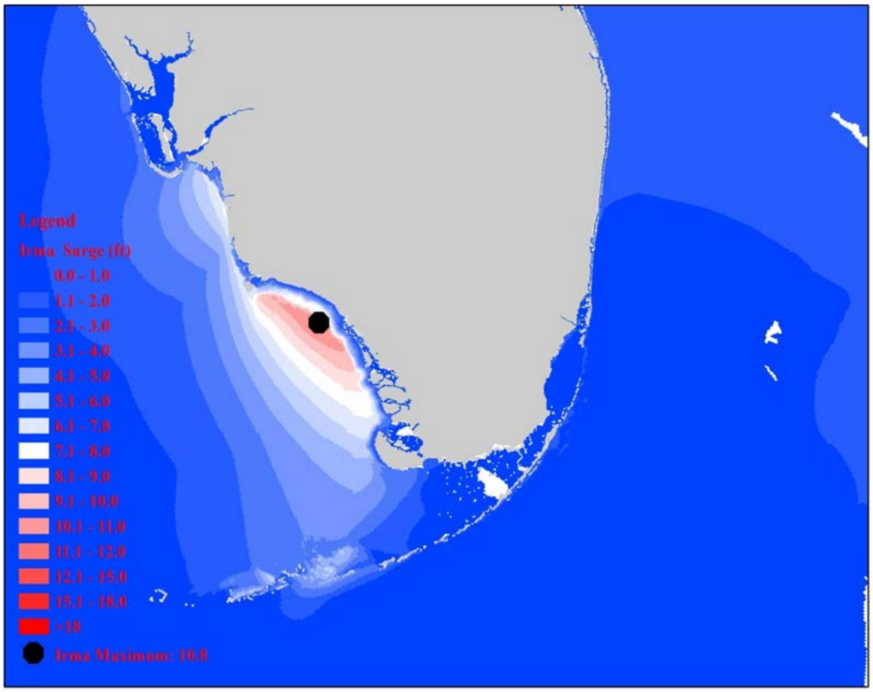


Figure 104. Computed peak storm tide heights for Hurricane Irma 2017 by SF1.

9. Hurricane Michael (2018)

Storm tide simulations for Hurricane Michael were conducted in the West Florida Basin. Each simulation, starting at 1200 coordinated universal time (UTC) October 9 and ending at 1200 October 12 2018, continued for 3 days. The time step is 30 seconds. The initial water level was set to be 0.2 m above the NAVD88 based on the analysis of tide gauge records in the basins prior to the passing of Wilma.

Figure 105 shows the peak storm tide heights above the NAVD 88 calculated by CEST. The maximum peak storm tide heights at West Florida Basin 14.5 feet near the Wakulla Beach.

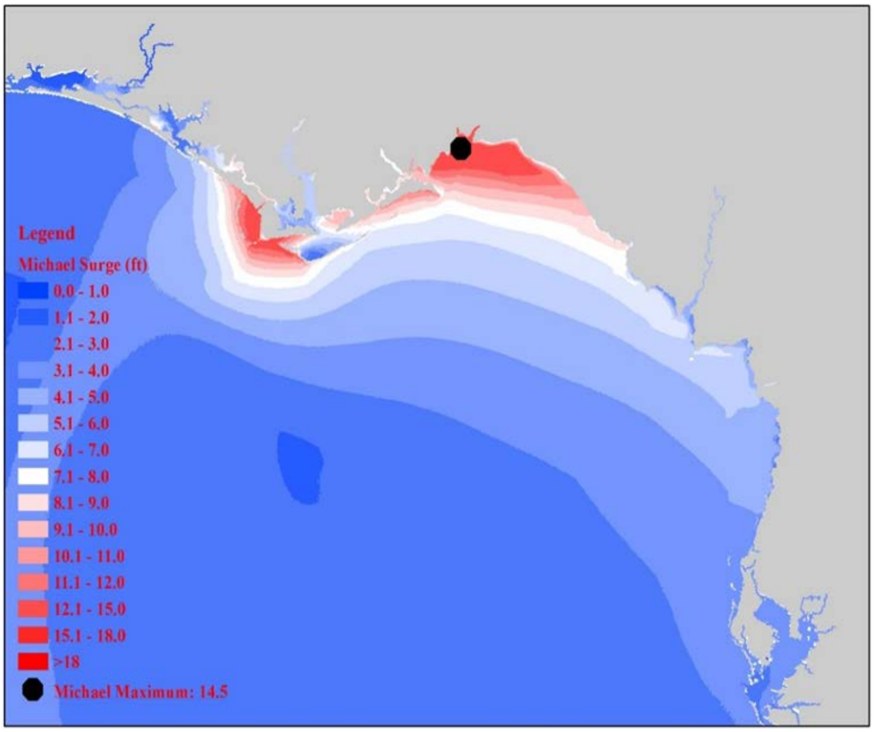


Figure 105. Computed peak storm tide heights for Hurricane Michael 2018 by WF1.

10. Hurricane Dorian (2019)

Storm tide simulations for Hurricane Dorian were conducted in the North Florida Basin. Each simulation, starting at 1200 coordinated universal time (UTC) September 1 and ending at 1200 September 6 2019, continued for 5 days. The time step is 30 seconds. The initial water level was set to be 0.5 m above the NAVD88 based on the analysis of tide gauge records in the basins prior to the passing of Wilma.

Figure 106 shows the peak storm tide heights above the NAVD 88 calculated by CEST. The maximum peak storm tide heights at West Florida Basin 7.4 feet.

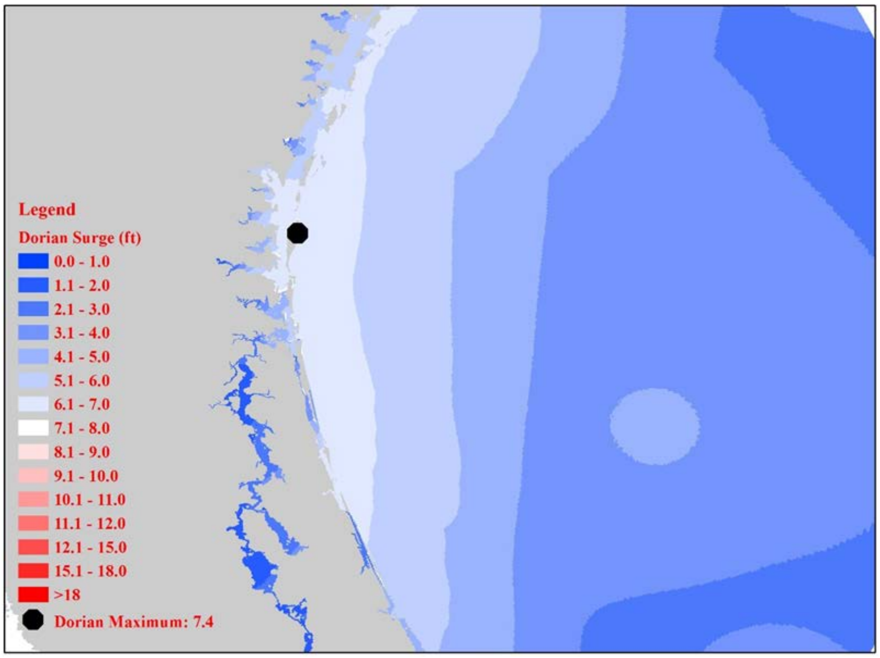


Figure 106. Computed peak storm tide heights for Hurricane Dorian 2019 by NF1.

Inland

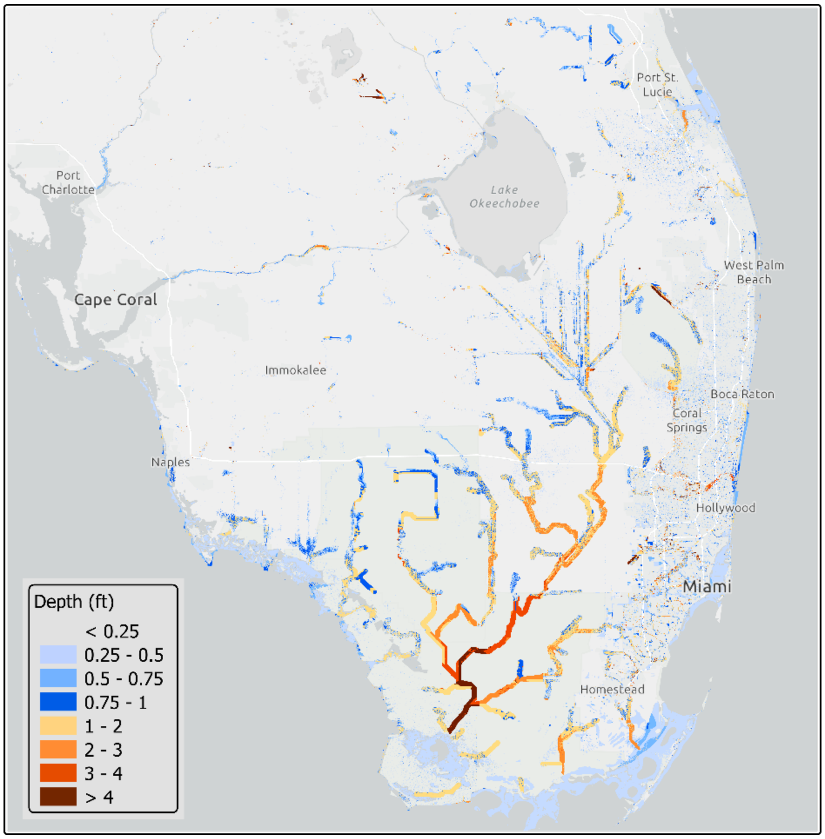


Figure 107. Modeled Flood Depth & Extent for Hurricane Andrew (1992).

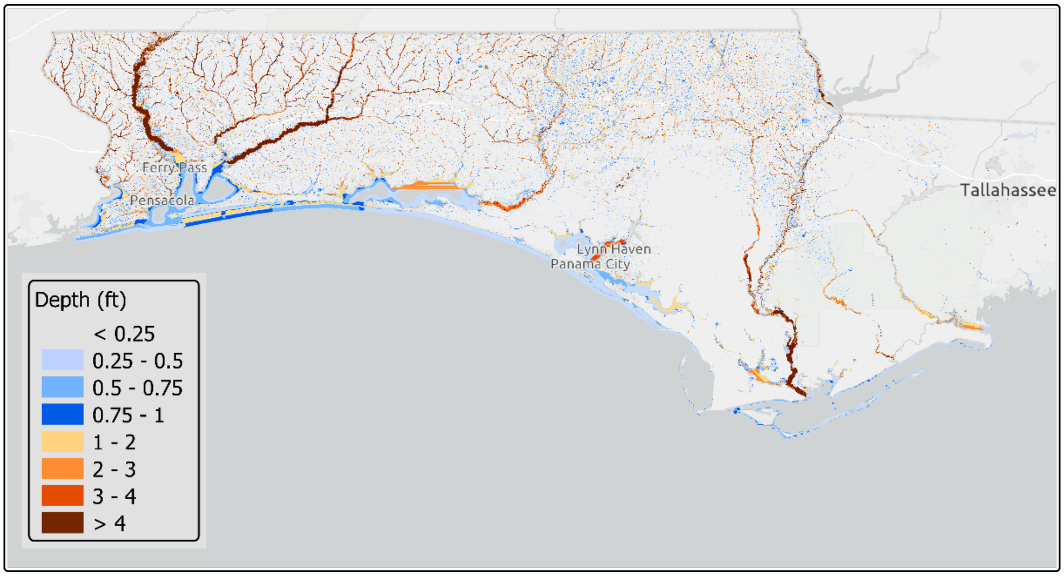
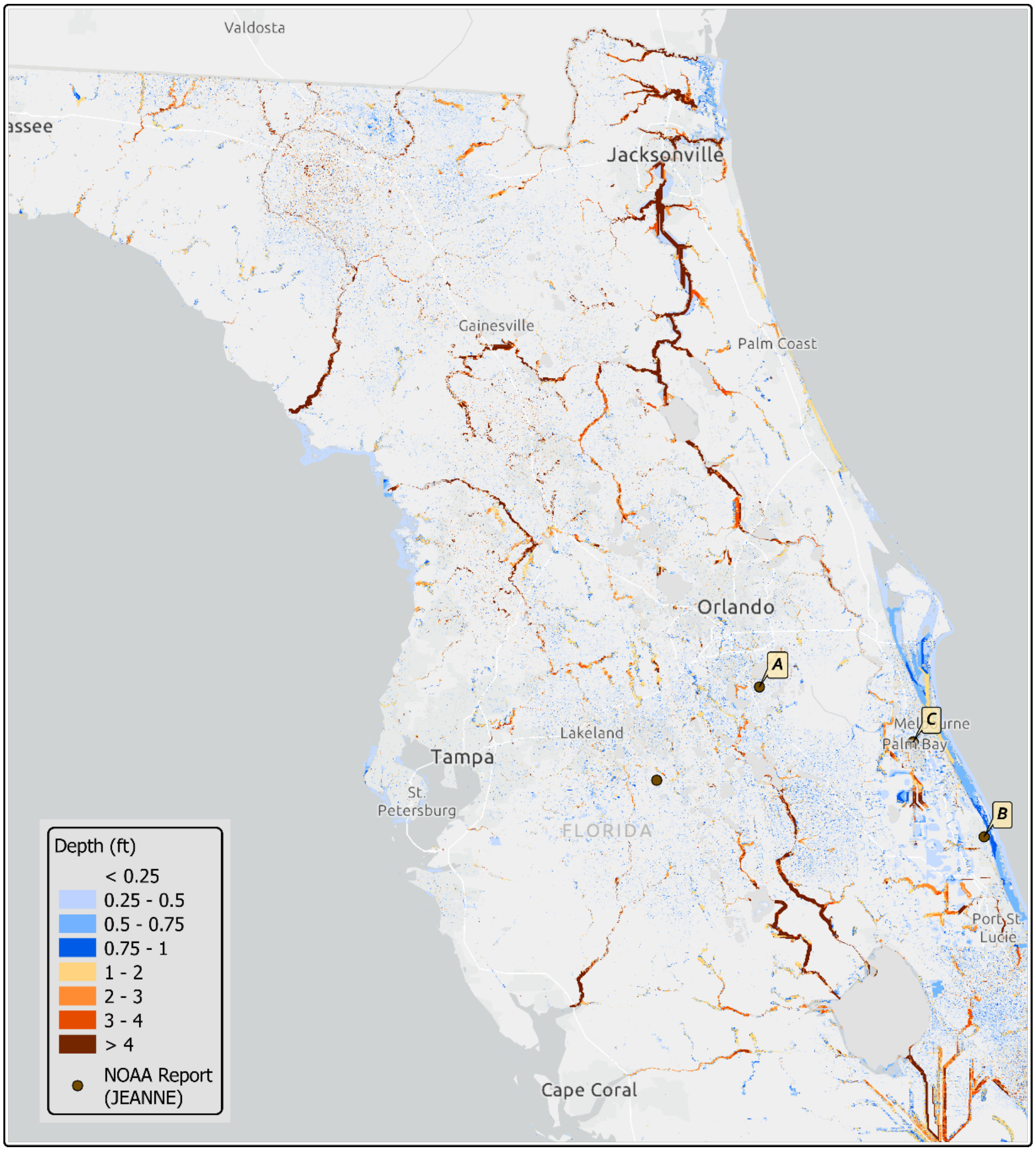
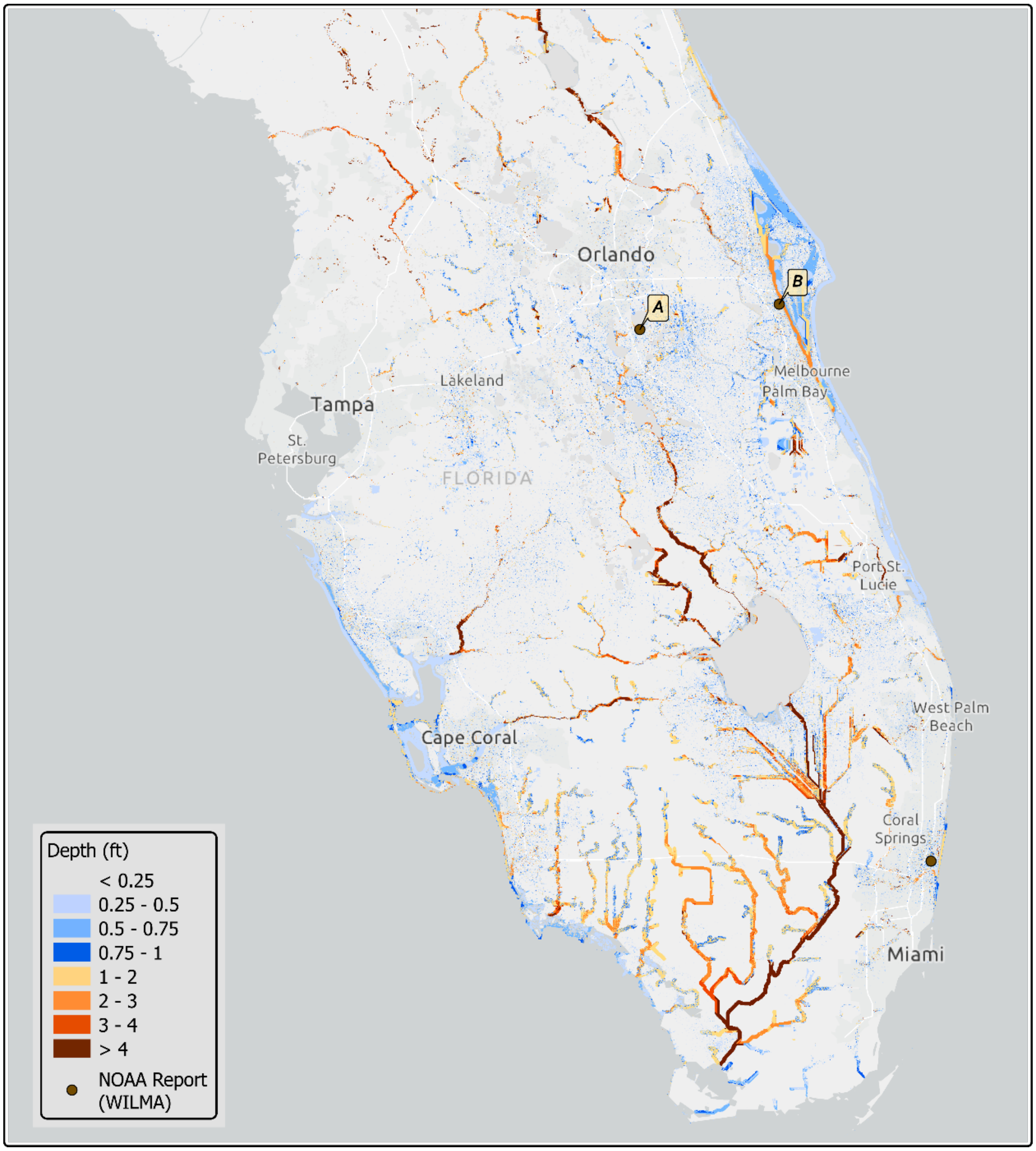


Figure 108. The same as Figure 107 but for Hurricane Ivan (2004).



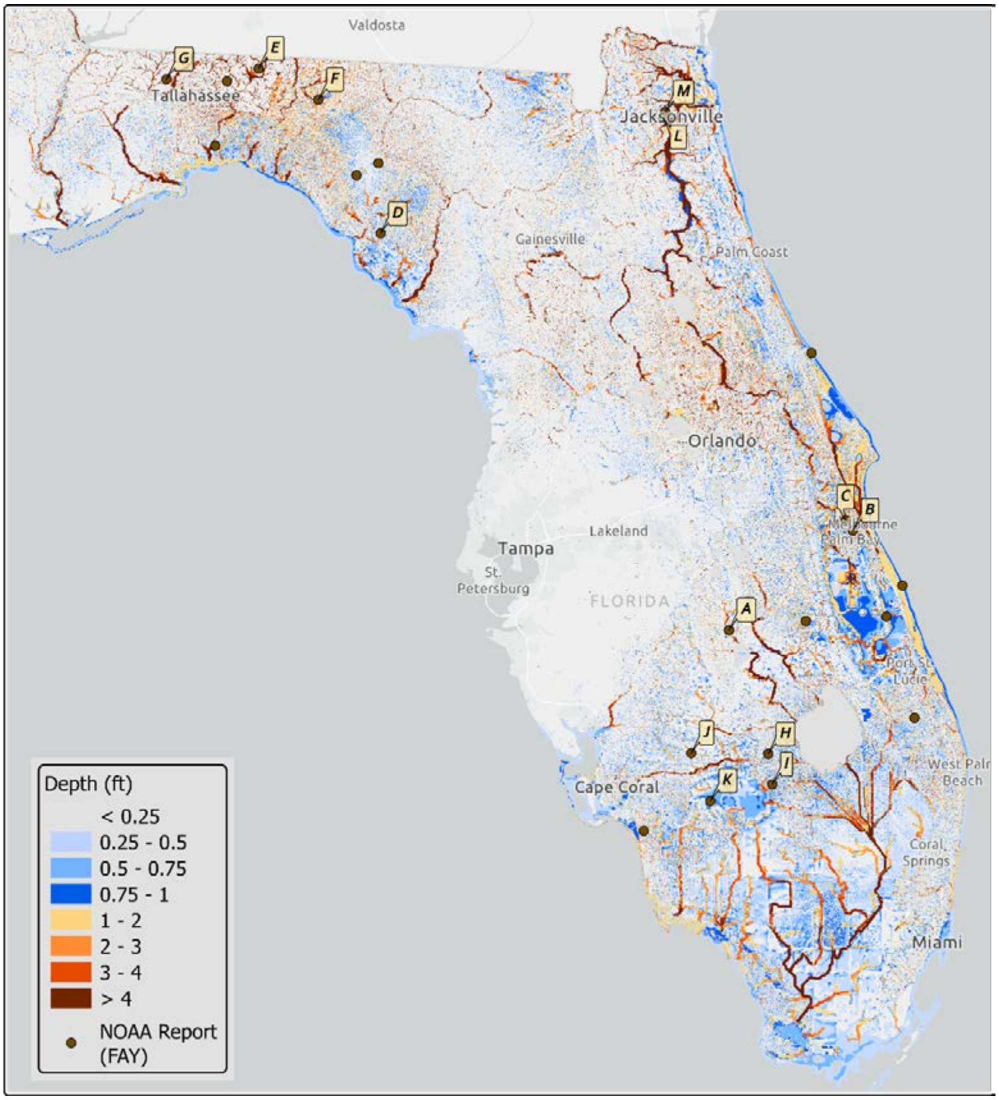
TAG	Latitude	Longitude	NOAA Report (Jeanne)	Modeled Depth (ft)
A	28.231	-81.285	Streets/Roads flooded; Highway 192 (St. Cloud) closed.	0.5 to 2.2+
B	27.639	-80.397	Streets/Roads flooded inland of Vero Beach	0.3 to 2
C	28.013	-80.677	Streets/Roads flooded South Brevard, Palm Bay Area	0.5 to 2

Figure 109. Modeled Flood Extent/Depth with NOAA Reported Validation for Hurricane Jeanne (2004).



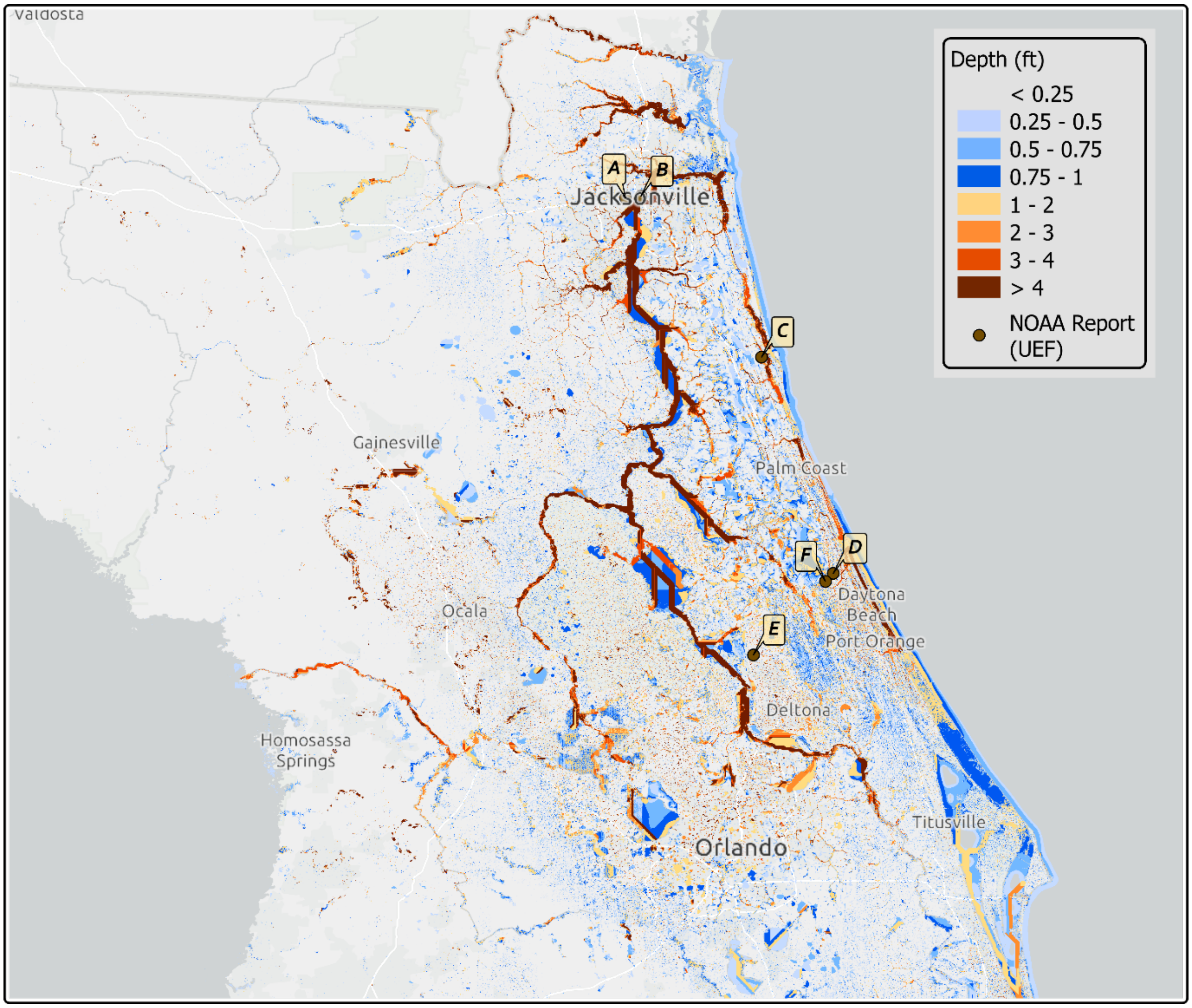
TAG	Latitude	Longitude	NOAA Report (Wilma)	Modeled Depth
A	28.250	-81.283	~12 homes flooded in St. Cloud, Osceola	1 to 1.2 ft
B	28.350	-80.733	~200 homes flooded in Cocoa	0.5 to 3+ ft flood depths simulated around the area

Figure 110. The same as Figure 109 but for Hurricane Wilma (2005).



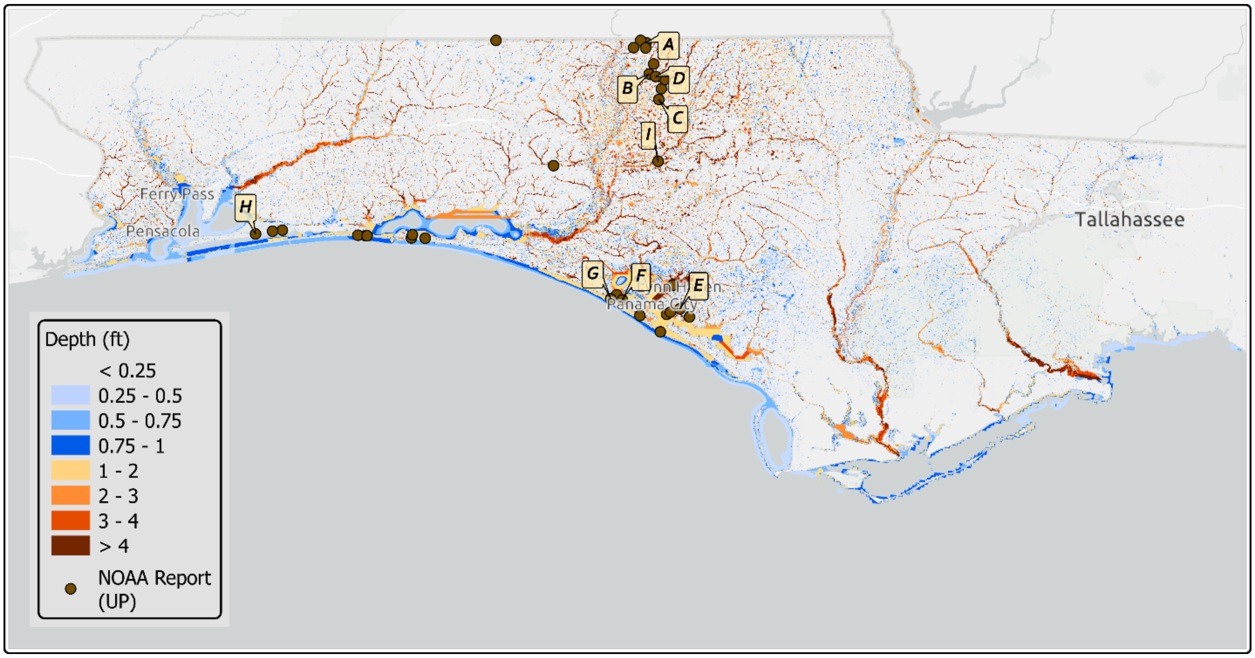
TAG	Latitude	Longitude	NOAA Report (Fay)	Modeled Depth
A	27.505	-81.341	Homes along Arbuckle Creek flooded.	0.5 to 0.83ft; 2.5ft near banks
B	28.054	-80.659	1600+ homes flooded in Brevard County	W. Melbourne: ~0.5 to 3.75+ ft
C	28.111	-80.700	N. John Rhodes Blvd, Melbourne closed	0.6 to 2 ft
D	29.690	-83.259	Roads (US Highway 19/27) Streets closed	0.83 to 2 ft
E	30.599	-83.932	Road/low-lying areas flooded	1 to 3 ft
F	30.426	-83.603	US Highway 90 flooded – pond overflow	1.5 to 3 ft
G	30.539	-84.440	Areas near Ochlockonee River flooded	0.83 to 3 ft
K	26.564	-81.444	Heavy rains inundate parts Felda, Hendry	0.5 to 1.4 ft
I	26.655	-81.103	Extensive flooding in Montana, Hendry	0.5 to 1.4+ ft
J	26.828	-81.548	Homes flooded in Muse, Glades	0.3 to 2.3+ ft
M	30.360	-81.692	Moncrief Creek overflow to nearby areas	0.75 to 2.6+ ft beyond banks
L	30.3244	-81.701	McCoys Creek overflow to nearby areas	1.2 to 2.5+ ft beyond banks
H	26.823	-81.125	Homes inundated in Moore Haven, Glades	0.6 to 2 ft

Figure 111. The same as Figure 109 but for Tropical Storm Fay (2008).



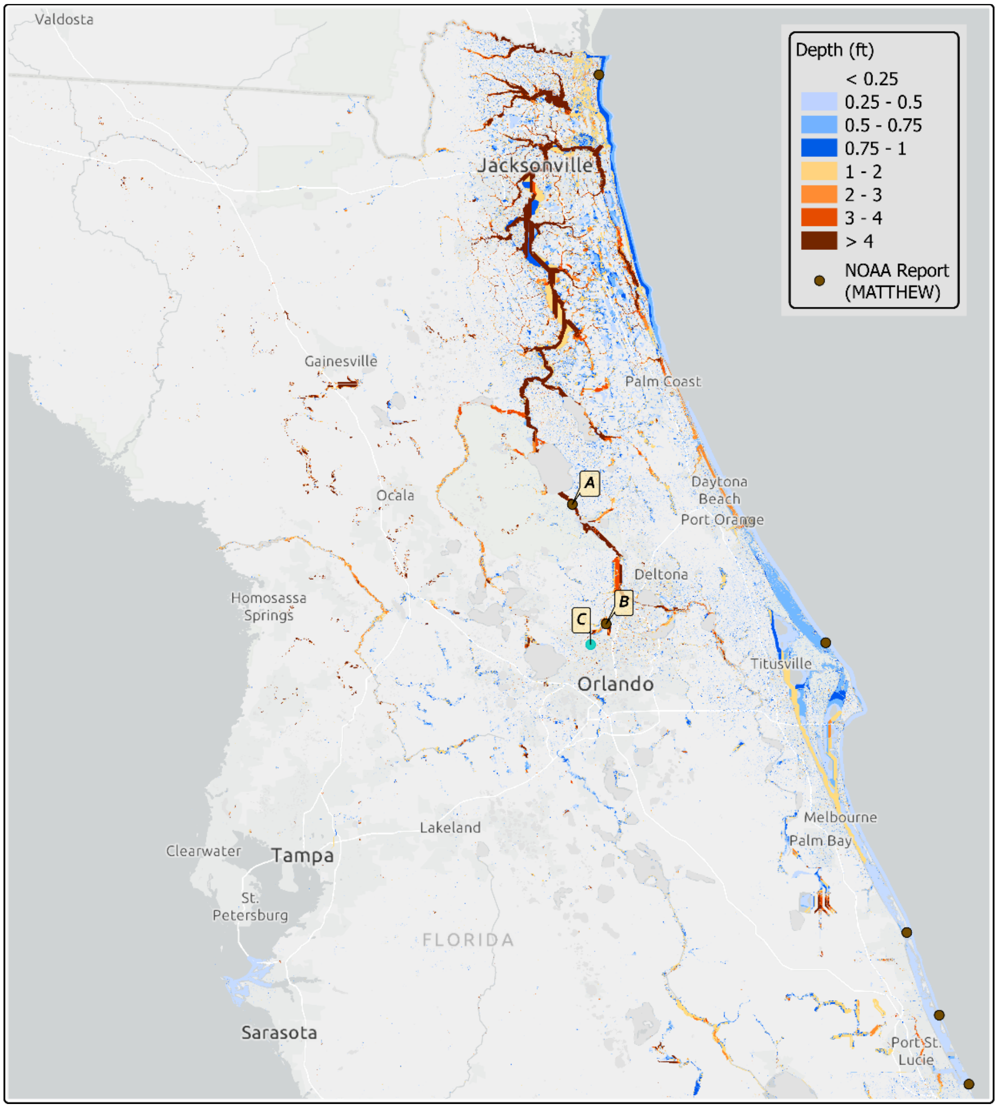
TAG	Latitude	Longitude	NOAA Report (UEF)	Modeled Depth
A	30.329	-81.697	McCoys Creek flooded; closed parts of McCoys Ck Rd & King's St	0.75 to 3+ ft
B	30.333	-81.654	Downtown Jacksonville along Market, Hubbard & Orange Streets closed	0.83 to 2.5 ft along noted areas
C	29.891	-81.323	Section of King St flooded	> 1.5 ft; some 2.5+ ft
D	29.297	-81.126	Several feet inundation from both rainfall accumulating & surge	1.3 to 4.2+ ft
E	29.073	-81.346	Standing water rising in parts of Volusia County; > 3ft flooding in homes	0.83 to 1.5 ft (3.3+ ft in some places)
F	29.275	-81.148	> 3ft flooding from heavy rains	1 to 2+ ft

Figure 112. The same as Figure 109 but for Unnamed Storm in East Florida (2009).



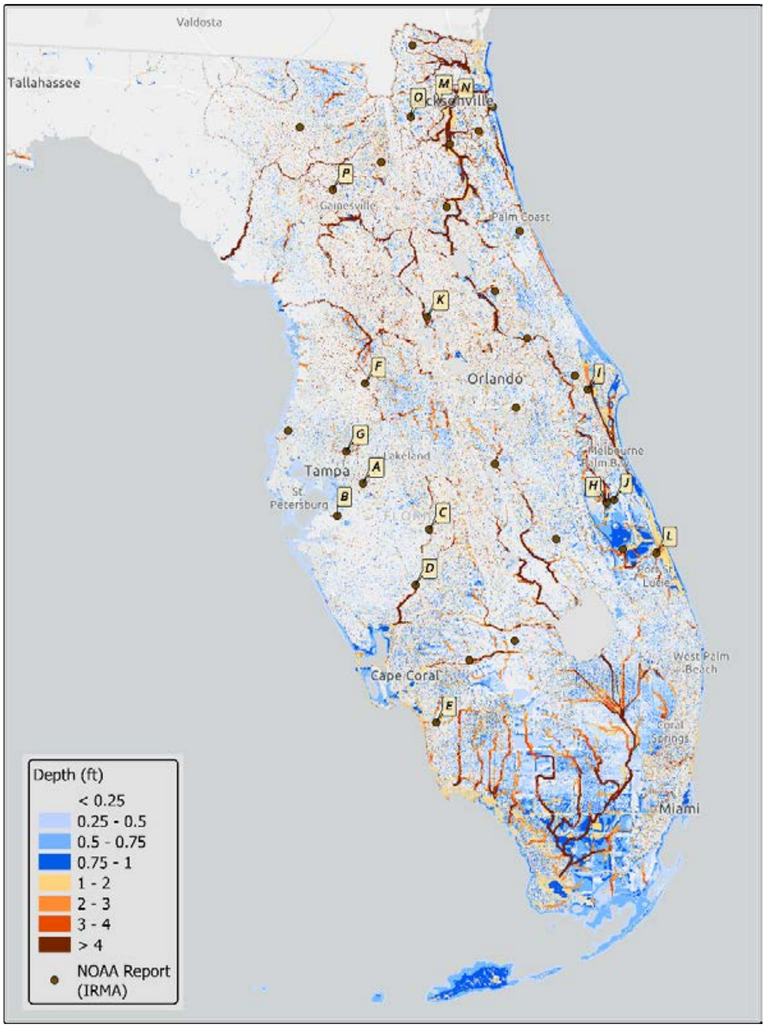
TAG	Latitude	Longitude	NOAA Report (UP)	Modeled Depth
A	30.983	-85.748	Wa Clark Rd, Holmes closed	3+ ft
B	30.888	-85.740	Tup McWaters Rd, Holmes closed	0.5 to 3+ ft
C	30.811	-85.710	Water atop East Longround Bay Road	~3 ft water along the said road, adjacent to channel
D	30.880	-85.719	Howell Williams Rd flooded at the bridge	>2 ft spilling over Little and Tenmile Creeks near the road
E	30.175	-85.646	Knee deep water at corner of Frank Nelson Dr and Mercedes Ave in Panama City	0.5 to 1.67 ft
F	30.202	-85.821	6 inches initially that rose as rains continued for hours	0.5 to 2.5 ft
G	30.206	-85.856	18 inches at Front Beach Rd	1.25 to 2.1 ft
H	30.403	-86.935	6+ inches; Northbound lane of Sunrise Drive at U.S. Highway 98 closed	0.4 to 0.83 ft
I	30.623	-85.712	Water entered homes in/around Vernon;	1 to 2 ft

Figure 113. The same as Figure 109 but for Unnamed Storm in Panhandle (2013).



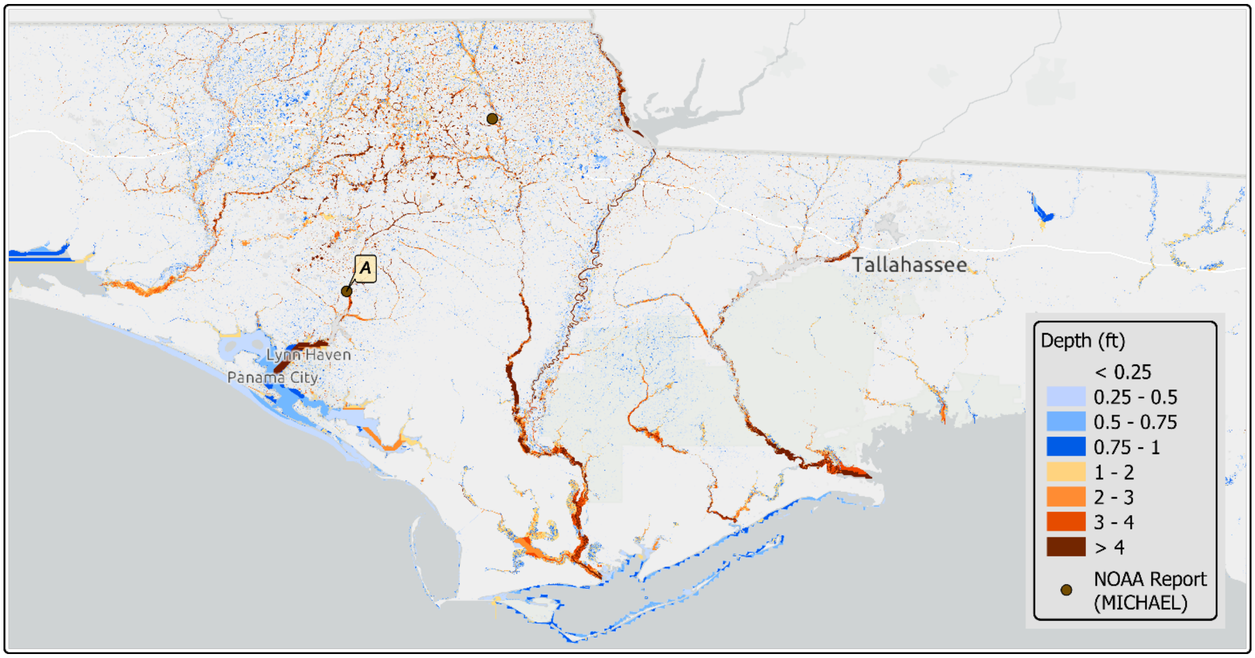
TAG	Latitude	Longitude	NOAA Report (Matthew)	Modeled Depth
A	29.163	-81.528	St. John's River near Astor, peaked just below moderate flood stage	0.25 to 2.5+ ft in the surrounding area near homes
B	28.751	-81.411	Rains cause minor urban, roadway and lowland flooding in Seminole County	0.5 to 1.25+ ft simulated
C	28.680	-81.464	Rains cause minor urban, roadway and lowland flooding in Orange County	0.5+ ft inundation simulated

Figure 114. The same as Figure 109 but for Hurricane Matthew (2016).



TAG	Latitude	Longitude	**NOAA Report (Irma);** *MFT = Major Flood threshold	Modeled Depth (in)
A	27.874	-82.228	Alafia River at Lithia; 3.79ft > MFT	2.5 to 3.3+
B	27.667	-82.391	Little Manatee River, Wimauma 0.69ft > MFT	0.5 to 3+
C	27.578	-81.801	Peach River at Zolfo Spring; 1.85ft > MFT	1 to 2.5+
D	27.221	-81.890	Peace River at Arcadia 3.20ft > MFT	2 to 3.3+
E	26.338	-81.757	Homes flooded near Imperial River	0.5 to 3+
F	28.517	-82.213	Withlacoochee River, Trilby; 1.17ft > MFT	0.5 to 2.6+
G	28.081	-82.334	Homes/Bridges inundated near Hillsborough R.	0.3 to 2.5+
H	27.749	-80.659	Flood near Fellsmere; overflow from ponds	0.5 to 3.3+
I	28.477	-80.783	US Highway 1, Port St. John & N Merritt Island, roads flood	0.6 to 2.6
J	27.769	-80.613	Flood near Fellsmere Elementary School	0.5 to 1
K	28.945	-81.816	Overflowing ponds	0.5 to 1.6
L	27.427	-80.340	4ft in front of Ft. Pierce Police Station on US Highway 1	2.5 to 4.2+
M	30.317	-81.730	Home flooded near Murray Hill, Jacksonville	0.4 to 1.6+
N	30.310	-81.657	Historic flooding near San Marco	> 9
O	30.229	-81.920	Yellow Water Ck, Normandy Blvd overflowed	2.5+
P	29.760	-82.422	Turkey Ck overflowed to NW Creek Dr	1+

Figure 115. The same as Figure 109 but for Hurricane Irma (2017).



TAG	Latitude	Longitude	NOAA Report (Michael)	Modeled Depth
A	30.384	-85.562	Quick rise in stage to Moderate Flood Stage at Econfina Creek at State Rd.	1.1 to 2.5 ft flood depth beyond banks

Figure 116. The same as Figure 109 but for Hurricane Michael (2018).

B. Plot the locations and values associated with validation points (e.g., maximum flood elevations or depths from observations such as gauge data, high-water marks) on each contour or high- resolution map for the historical events.

Coastal

Please refer to the high-resolution maps presented above in section A Coastal for the location and value of the maximum flood elevations.

Inland

Observations of inland flood extent and elevation or depth are not available. Modeled maps are compared with flooded locations extracted from NOAA reports. Please refer to maps and tables provided in section A.

C. Provide scatter plots of simulated versus observed elevation or depth at the validation points.

Coastal

1. Hurricane Andrew (1992)

The high water mark elevations collected by FEMA in Florida was used to verify the Hurricane Andrew inundation on the land (Figure 117). The comparison of observed and computed storm surges indicates that the computed peak surges are comparable with observed ones (Figure 118). The Root Mean Square Errors is 0.36 m (1.20 ft).

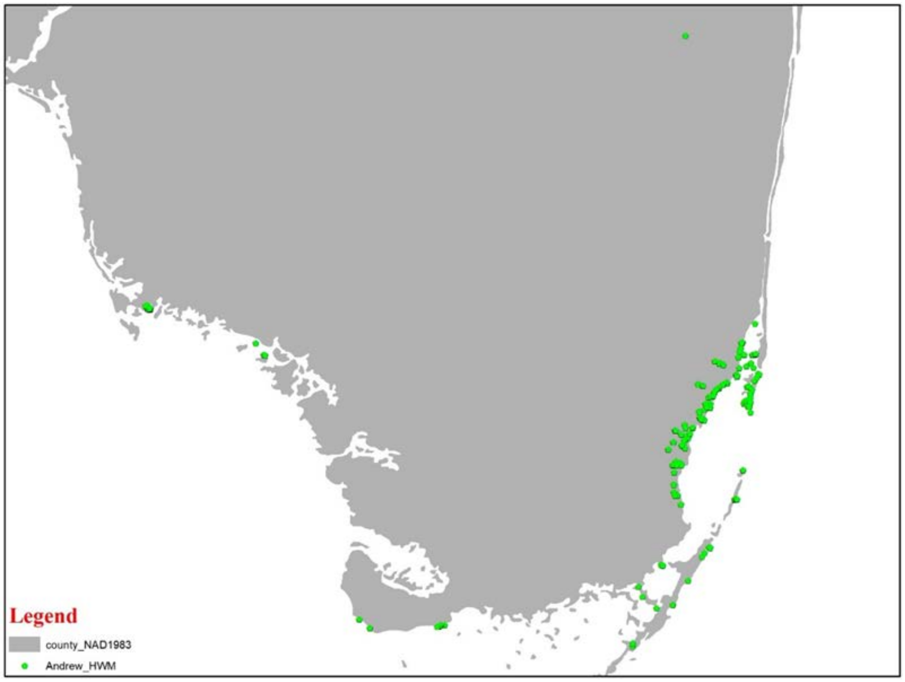


Figure 117. High Water Mark of Hurricane Andrew along Florida Coast.

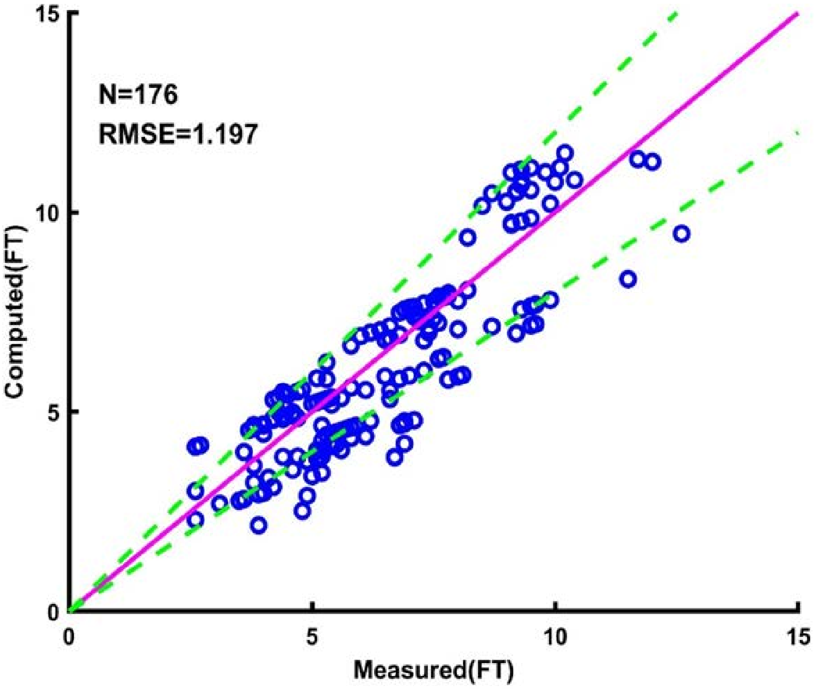


Figure 118. Scatter plots of observed peak surge heights versus simulated ones of Hurricane Andrew generated from SF1 Basin with H*Wind. The purple solid line represents perfect simulations and the green dashed lines represent the boundaries of ±20% of perfect simulations. Both computed and observed peak surge heights are referenced to the NAVD88 vertical datum.

2. Hurricane Frances (2004)

The high water mark elevations collected by FEMA in Florida were used to verify the Hurricane Frances inundation on the land (Figure 119). The comparison of observed and computed storm surges indicates that the computed peak surges are comparable with observed ones at SF1 basin (Figure 120 left panel) and WF1 (Figure 120 right panel). The Root Mean Square Errors are 0.44 m (1.45 ft) at South Florida basin, and 0.27 m (0.91 ft) at South Florida basin.

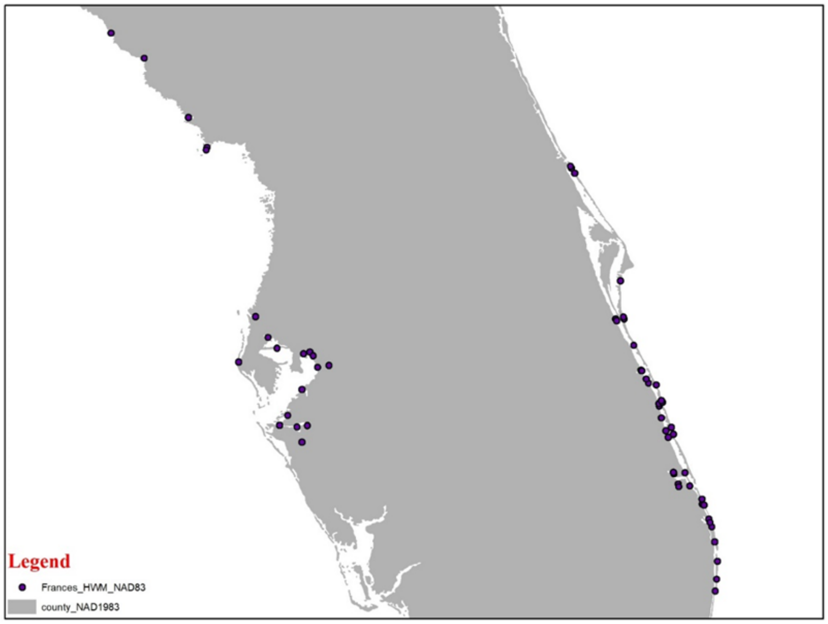


Figure 119. The same as Figure 117 but for Hurricane Frances.

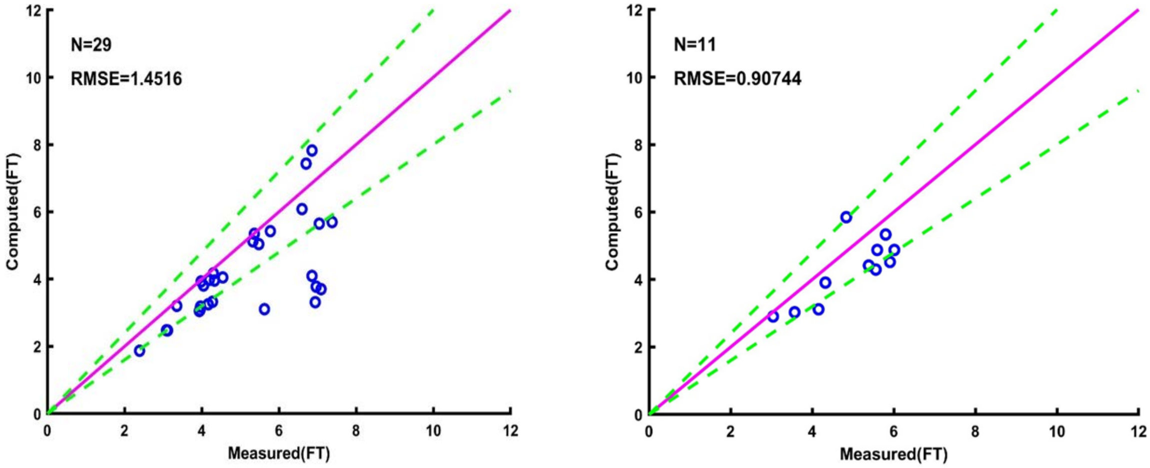


Figure 120. The same as Figure 118 but for Hurricane Frances from SF1 (left panel) and WF1 (right panel).

3. Hurricane Ivan (2004)

The high water mark elevations collected by FEMA in Florida (Wang and Manausa, 2005) was used to verify the Hurricane Ivan inundation on the land (Figure 121). The comparison of observed and computed storm surges indicates that the computed peak surges are comparable with observed ones at MS8 basin (Figure 122). The Root Mean Square Errors are 0.70 m (2.32 ft) at North Florida basin. Since there is no wave coupled in the CEST model, the overall HWMs computed by CEST are lower than the measured value, which included the wave effect.

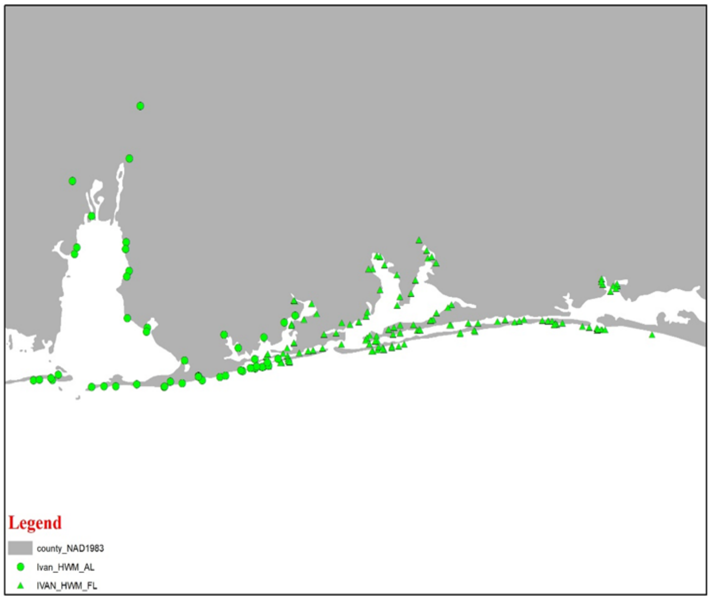


Figure 121. The same as Figure 117 but for Hurricane Ivan.

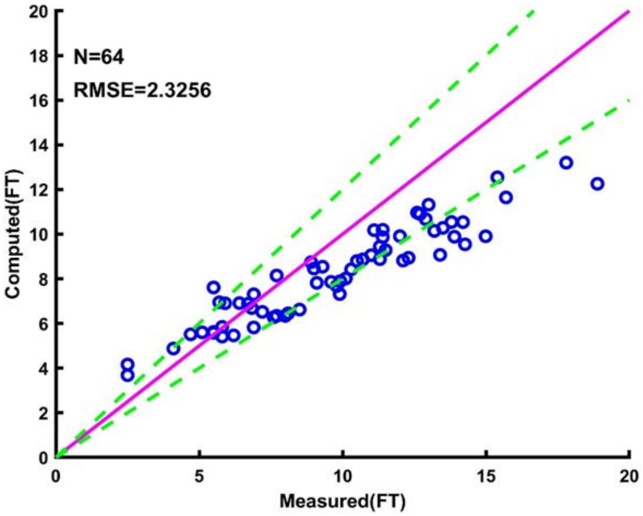


Figure 122. The same as Figure 118 but for Hurricane Ivan from MS8.

4. Hurricane Katrina (2005)

The high water mark elevations collected by FEMA near the Mississippi coastal area was used to verify the Hurricane Katrina inundation on the land (Figure 123). The comparison of observed and computed storm surges indicates that the computed peak surges are comparable with observed ones at MS8 basin (Figure 124). The Root Mean Square Errors are 0.85m (2.83 ft) near the Mississippi coastal area.

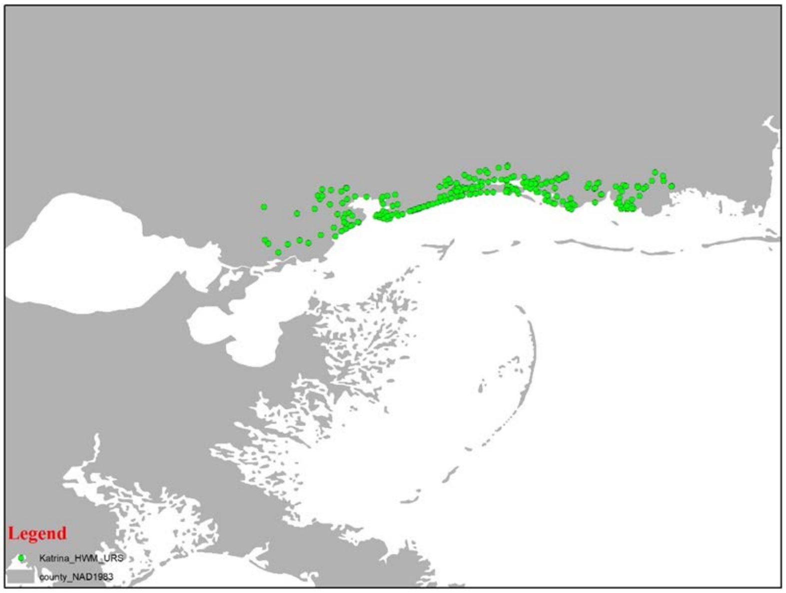


Figure 123. The same as Figure 117 but for Hurricane Katrina.

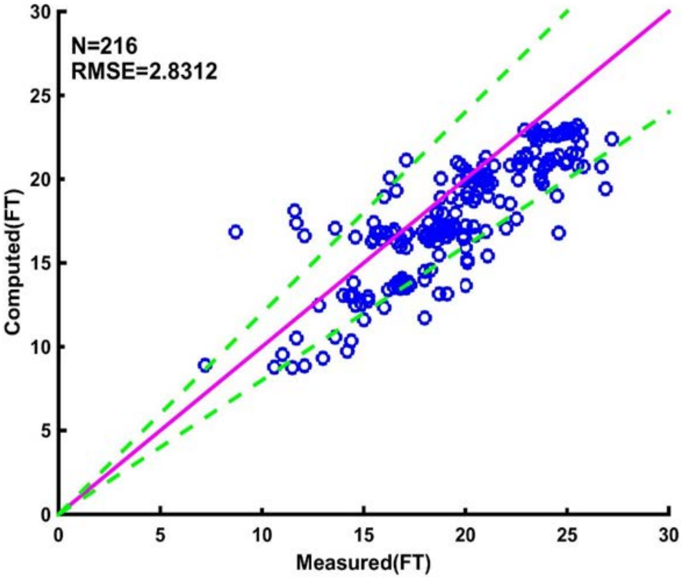


Figure 124. The same as Figure 118 but for Hurricane Katrina from MS8.

5. Hurricane Wilma (2005)

The high water mark elevations collected by Zhang et al. (2012) was used to verify the Hurricane Wilma inundation on the land (Figure 125). The comparison of observed and computed storm surges indicates that the computed peak surges are relatively comparable with observed ones (Figure 126 left panel), the Root Mean Square Errors are 0.31m (1.03 ft). From Figure 126 right panel, it is clear to see that the modeled peak surges are overestimated. This is caused by the HWM collected from the NOAA and USGS stations. If all the HWM at the measured gauges are removed, the Root Mean Square Errors are 0.21m (0.68 ft) showing on Figure 126 right panel.

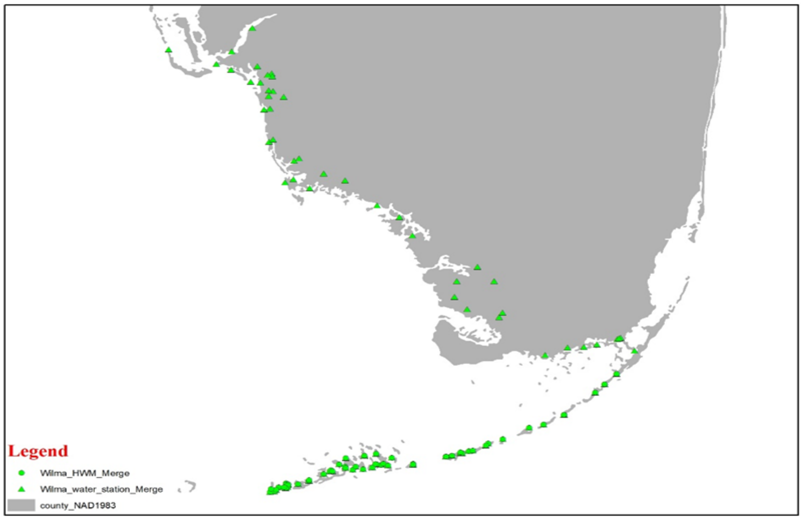


Figure 125. The same as Figure 117 but for Hurricane Wilma.

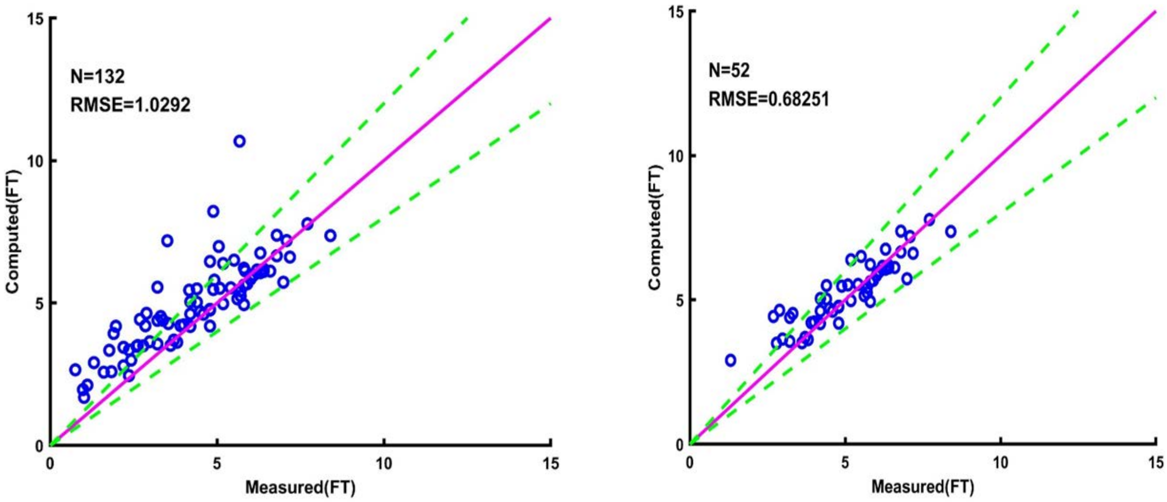


Figure 126. The same as Figure 118 but for Hurricane Wilma from SF1 at (left panel) and ALL HWM locations and (right panel) without measured stations.

6. Hurricane Hermine (2016)

The high water mark elevations collected by USGS Flood Event Viewer was used to verify the Hurricane Hermine inundation on the land (Figure 127). The comparison of observed and computed storm surges indicates that the computed peak surges are relatively comparable with observed ones (Figure 128), the Root Mean Square Errors are 0.46 m (1.51 ft).

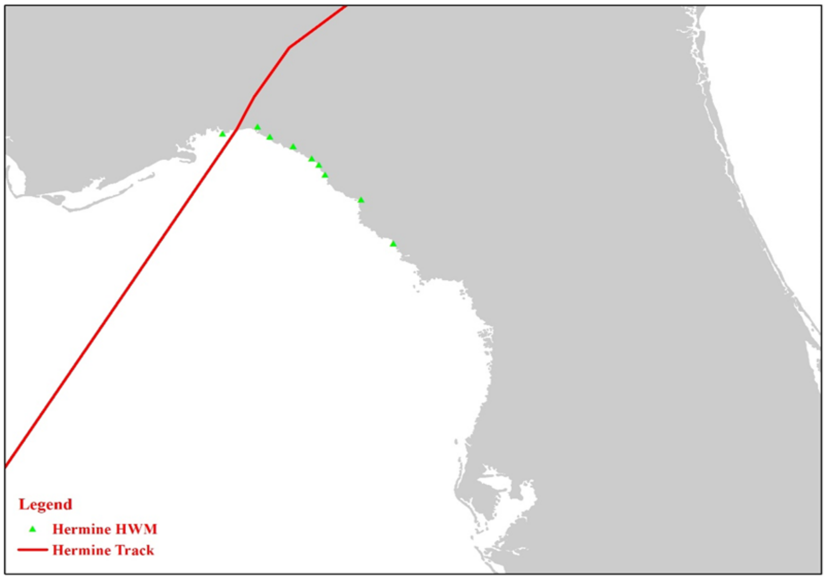


Figure 127. The same as Figure 117 but for Hurricane Hermine 2016.

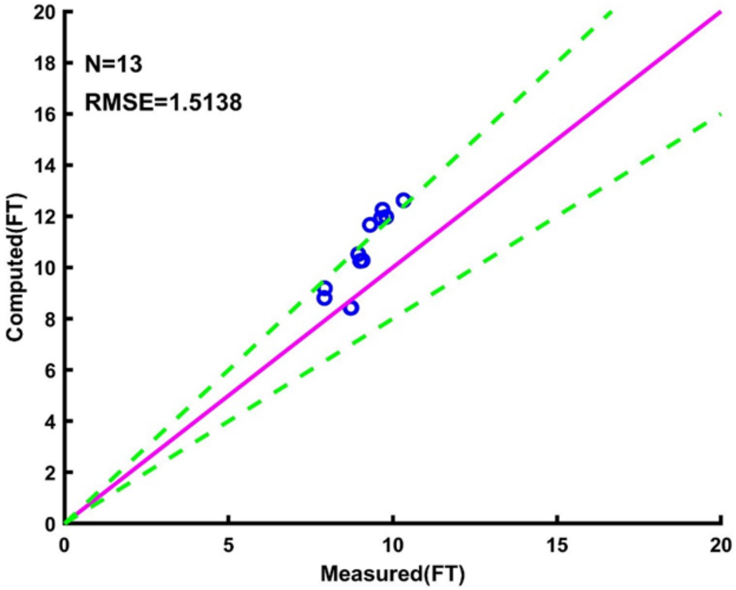


Figure 128. The same as Figure 118 but for Hurricane Hermine 2016.

7. Hurricane Matthew (2016)

The high water mark elevations collected by USGS Flood Event Viewer was used to verify the Hurricane Matthew inundation on the land (Figure 129). The comparison of observed and computed storm surges indicates that the computed peak surges are relatively comparable with observed ones (Figure 130), the Root Mean Square Errors are 0.45 m (1.49 ft).

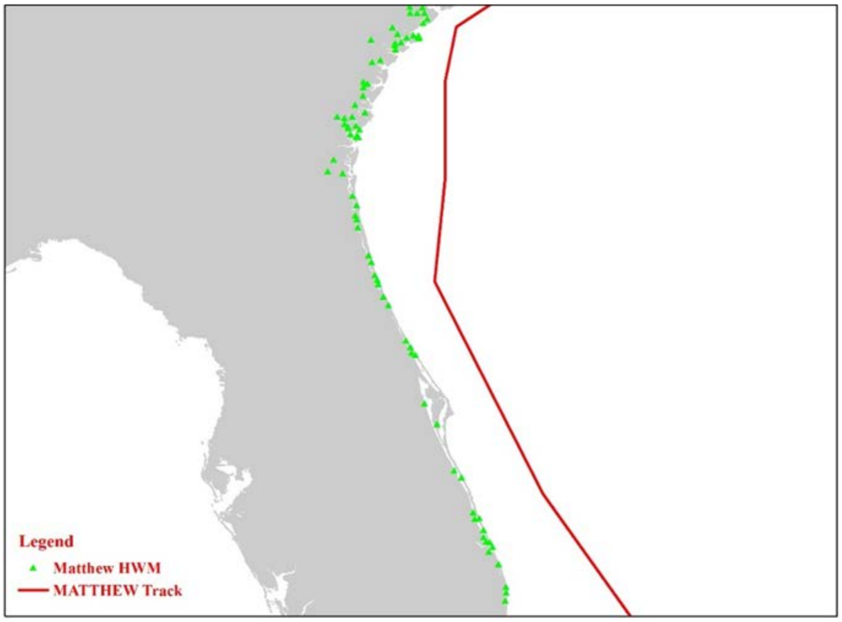


Figure 129. The same as Figure 117 but for Hurricane Matthew 2016.

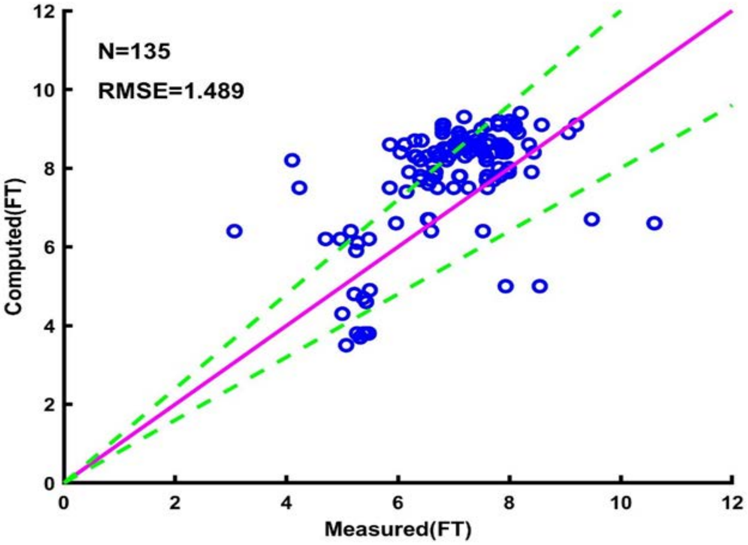


Figure 130. The same as Figure 118 but for Hurricane Matthew 2016.

8. Hurricane Irma (2017)

The high water mark elevations collected by USGS Flood Event Viewer was used to verify the Hurricane Irma inundation on the land (Figure 131). The comparison of observed and computed storm surges indicates that the computed peak surges are relatively comparable with observed ones (Figure 132), the Root Mean Square Errors are 0.48 m (1.59 ft).

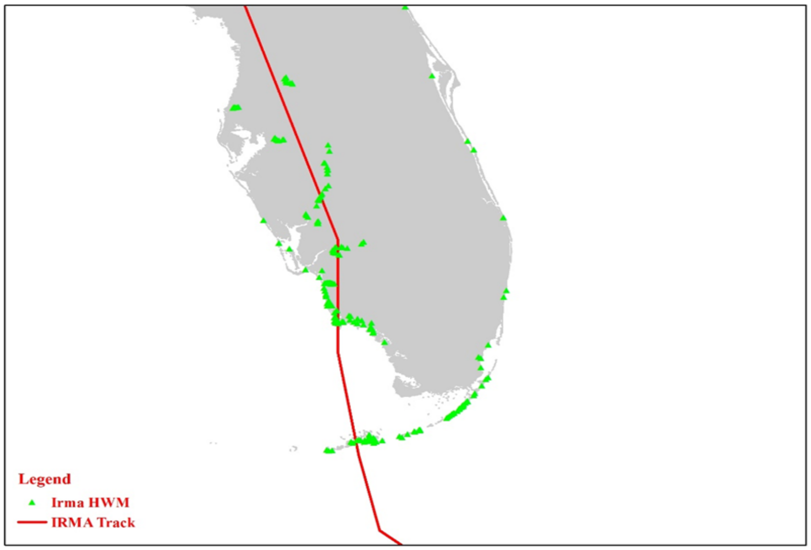


Figure 131. The same as Figure 117 but for Hurricane Irma 2017.

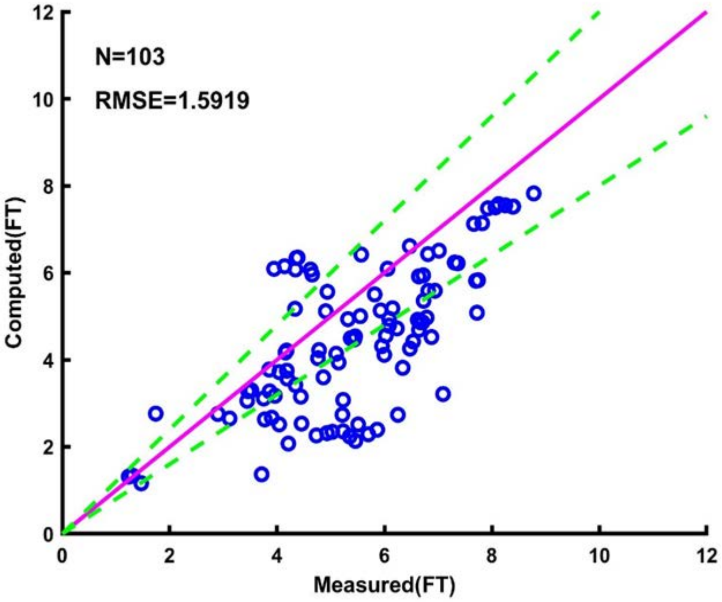


Figure 132. The same as Figure 118 but for Hurricane Irma 2017

9. Hurricane Michael (2018)

The high water mark elevations collected by USGS Flood Event Viewer was used to verify the Hurricane Michael inundation on the land (Figure 133). The comparison of observed and computed storm surges indicates that the computed peak surges are relatively comparable with observed ones (Figure 134), the Root Mean Square Errors are 0.74 m (2.43 ft).

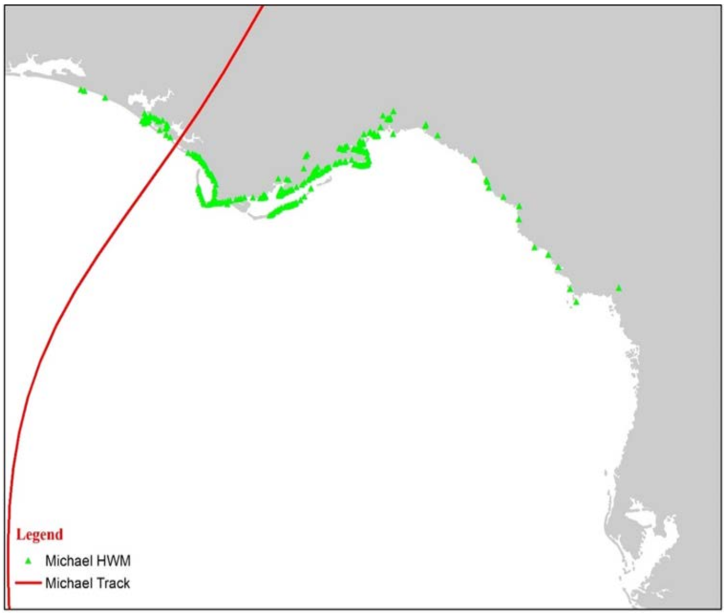


Figure 133. The same as Figure 117 but for Hurricane Michael 2018.

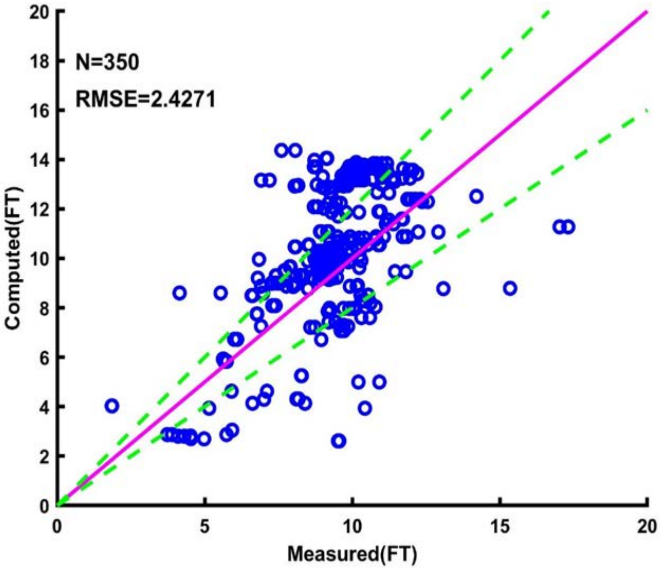


Figure 134. The same as Figure 118 but for Hurricane Michael 2018.

10. Hurricane Dorian (2019)

The high water mark elevations collected by USGS Flood Event Viewer was used to verify the Hurricane Dorian inundation on the land (Figure 135). The comparison of observed and computed storm surges indicates that the computed peak surges are relatively comparable with observed ones (Figure 136), the Root Mean Square Errors are 0.38 m (1.26 ft).

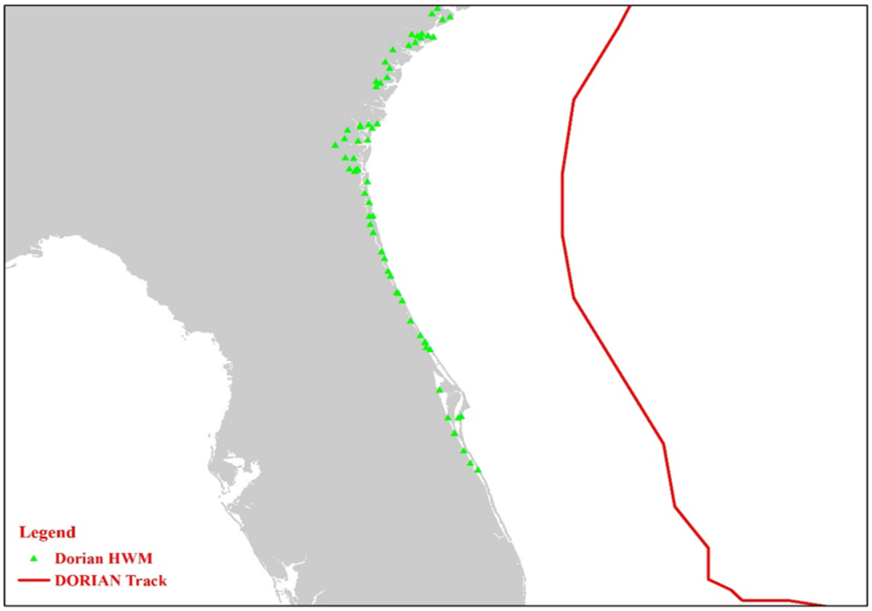


Figure 135. The same as Figure 117 but for Hurricane Dorian 2019.

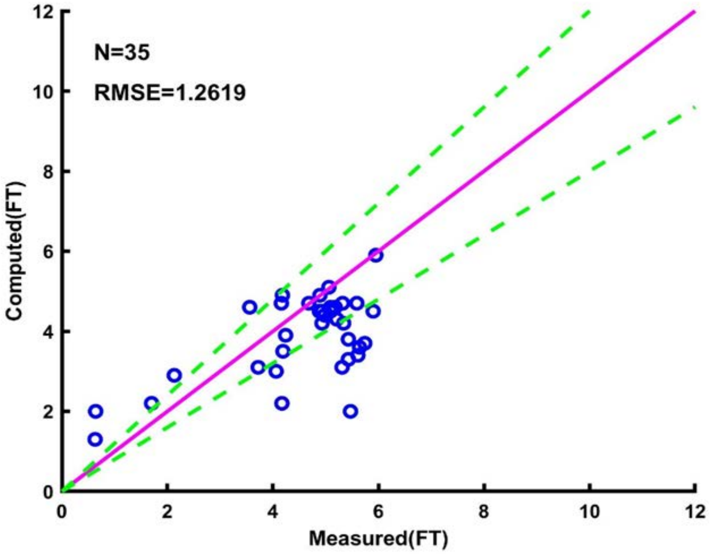


Figure 136. The same as Figure 118 but for Hurricane Dorian 2019.

Inland

The only information found in the NOAA reports, regarding flood depths, were descriptive around a broad area and not specific to a location, thus scatterplots were not possible to create.

D. Indicate the resolution of the flood model elevation or depth grid used on each contour or high- resolution map.

Coastal

1. West North Florida basin, MS8, cover the north Florida coastal area (Figure 93 in Section A Coastal): the grid size is set to approximately 1900 m × 1900 m in the deep ocean area and 400 m × 400 m near the shoreline, with the total number of grid cells being nearly 560,000.

2. West Florida basin, WF1, cover the west Florida coastal area (Figure 94 in Section A Coastal): the grid size is set to approximately 1100 m × 1100 m in the deep ocean area and 700 m × 700 m near the shoreline, with the total number of grid cells being nearly 660,000.

3. South Florida basin, SF1, cover the south Florida coastal area with Key (Figure 95 in Section A Coastal): the grid size is set to approximately 1500 m × 1500 m in the deep ocean area and 450 m × 450 m near the shoreline, with the total number of grid cells being nearly 640,000.

4. North Florida basin, NF1, cover the north-east Florida coastal area (Figure 96 in Section A Coastal): the grid size is set to approximately 1300 m × 1300 m in the deep ocean area and 300 m × 300 m near the shoreline, with the total number of grid cells being nearly 570,000.

Inland

High resolution flood depth maps are at 1 arc-second for the inland models.

E. Demonstrate the consistency of the modeled flood extent and elevation or depth with observed flood extent and elevation or depth for each historical event.

Coastal

For the consistency of the modeled elevation with observed data, please refer to Section C Coastal, where the root mean square errors are provided in each scatter plot. For the consistency of the flood extent, observation data for the following hurricanes were found and plotted in comparison with the modeled results.

1. Hurricane Andrew (1992)

To examine the simulated inundation pattern, the computed maximum surges by CEST are compared with the observed inundation extent (Figure 137). It is obvious that the inundation extends computed by CEST similar to the field observations.

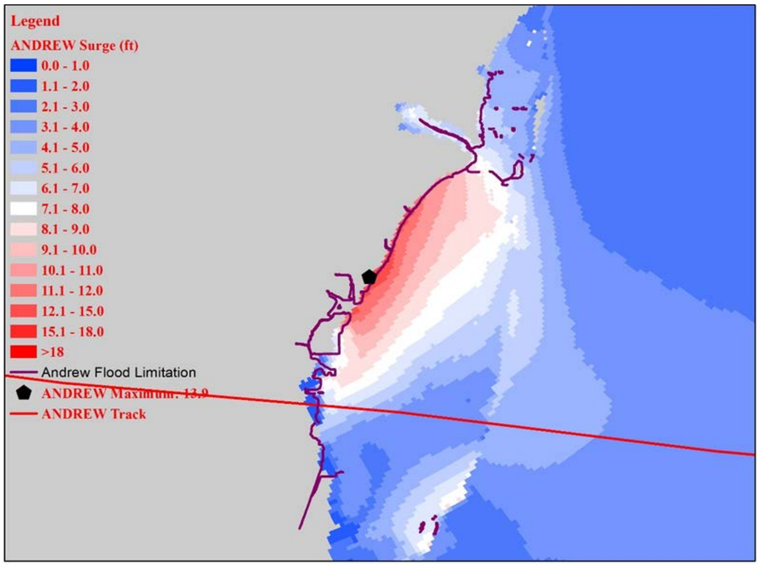


Figure 137. Comparison of simulated maximum surge with inundation extend (red line) for Hurricane Andrew 1992 by CEST.

2. Hurricane Ivan (2004)

To examine the simulated inundation pattern, the computed maximum surges by CEST is compared with the observed inundation extent (Figure 138) at the North Florida Basin. It is obvious that the inundation extends computed by CEST similar to the field observations.

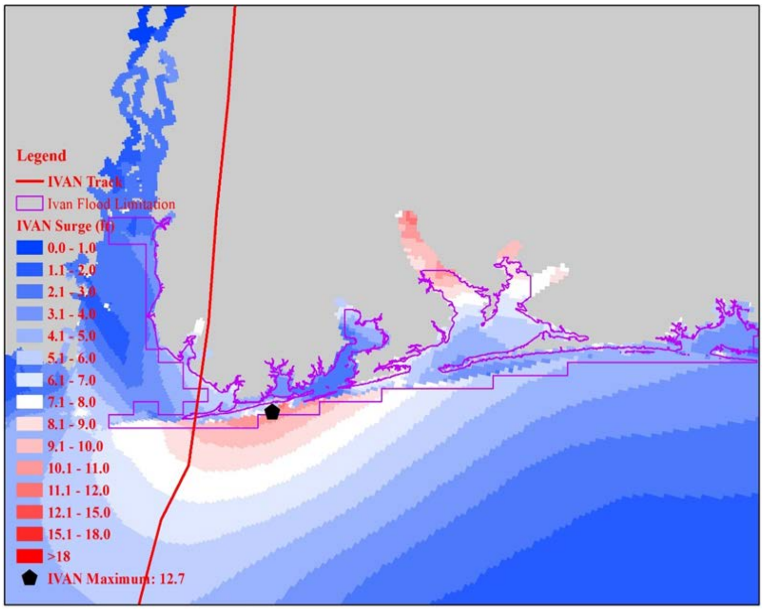


Figure 138. Comparison of simulated maximum surge with inundation extend (red line) for Hurricane Ivan 2004 by CEST.

3. Hurricane Katrina (2005)

To examine the simulated inundation pattern, the computed maximum surges by CEST is compared with the observed inundation extent (Figure 139) near the Mississippi coastal area. It is obvious that the inundation extends computed by CEST are very close to the field observations.

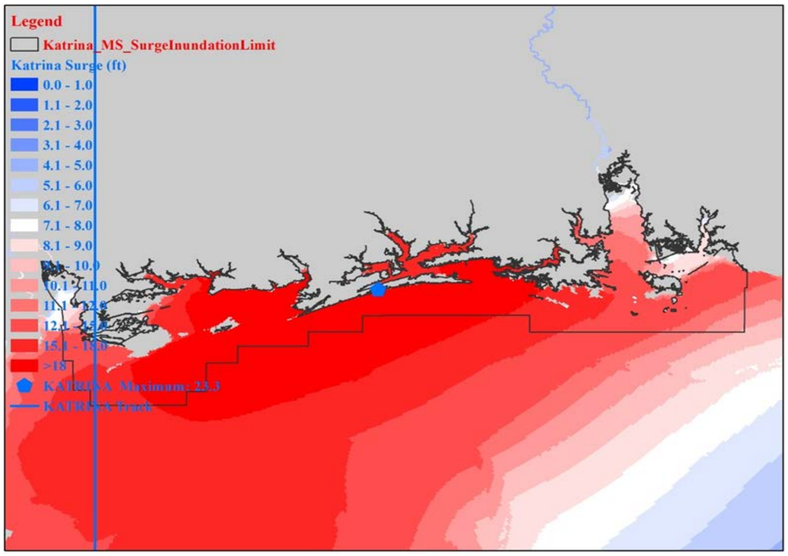


Figure 139. Comparison of simulated maximum surge with inundation extend (red line) for Hurricane Katrina 2005 by CEST.

Inland

For the historic events for which NOAA reports were available, we demonstrate the coincidence of flooded areas in NOAA reports and the modeled flood maps in section A.

F. Explain any differences between the modeled flood extent and elevation or depth and the historical floods observations. Include an explanation if the differences are impacted by major flood control measures.

Coastal

In general, the CEST model produces reasonable surge results in terms of the coastal flood extent and elevation, as seen from Sections B and E above. For those discrepancies between the modeled and observed data, the major source of errors likely include:

1. errors in the topography and bathymetry data;
2. insufficient grid resolution due to limited computational resources;
3. the model does not include wave components and wave-current interactions;
4. precipitation is not considered in the model;
5. the wind and pressure forcing are generated by a theoretical model.

Inland

Observations of inland flood extent and elevation or depth are not available. Modeled maps are compared with flooded locations extracted from NOAA reports. The modeled flood depth or elevation values were comparable to the values found in the NOAA reports. Any discrepancies can be attributed to errors in DEM and lack of bathymetric information.

G. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

No additional assumptions were necessary.

H. Include Form HHF-1, Historical Event Flood Extent and Elevation or Depth Validation Maps, in a submission appendix.

Form HHF-2: Coastal Flood Characteristics by Annual Exceedance Probability

A. Define one study area subject to coastal flooding within each of the five Florida geographic regions identified in Figure 1. The extent of each study area is to be determined by the modeling organization and should be large enough to encompass at least one county. The modeling organization is to create the underlying grid for this form.

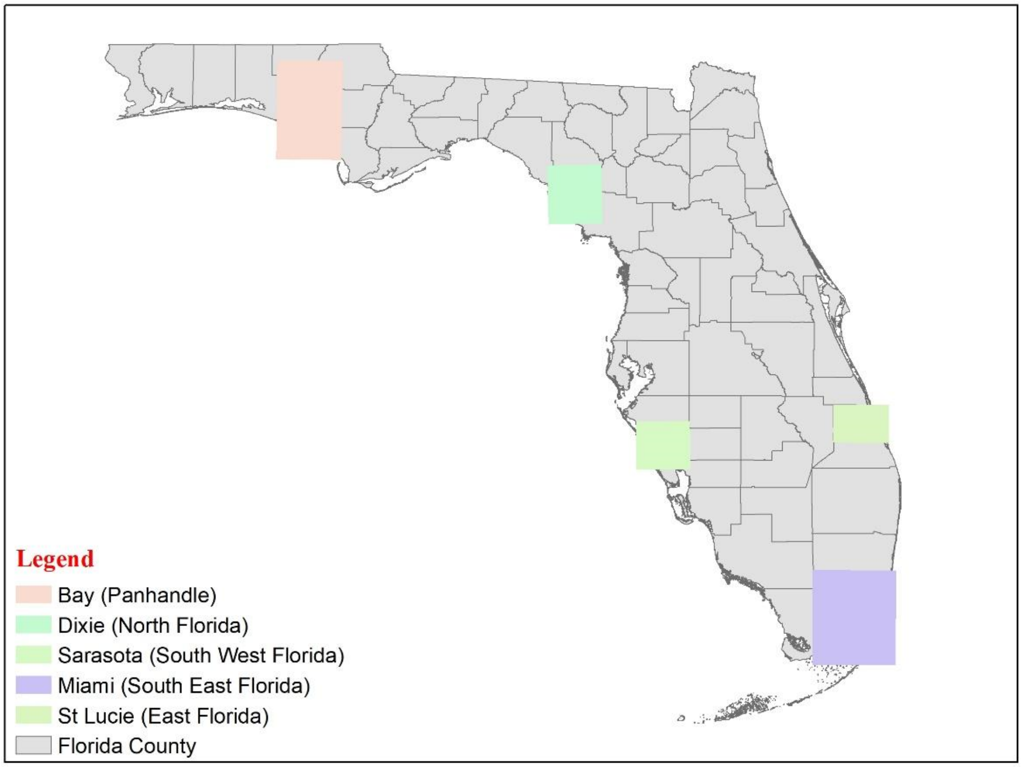


Figure 140. Five grids generated for five Florida geographic regions.

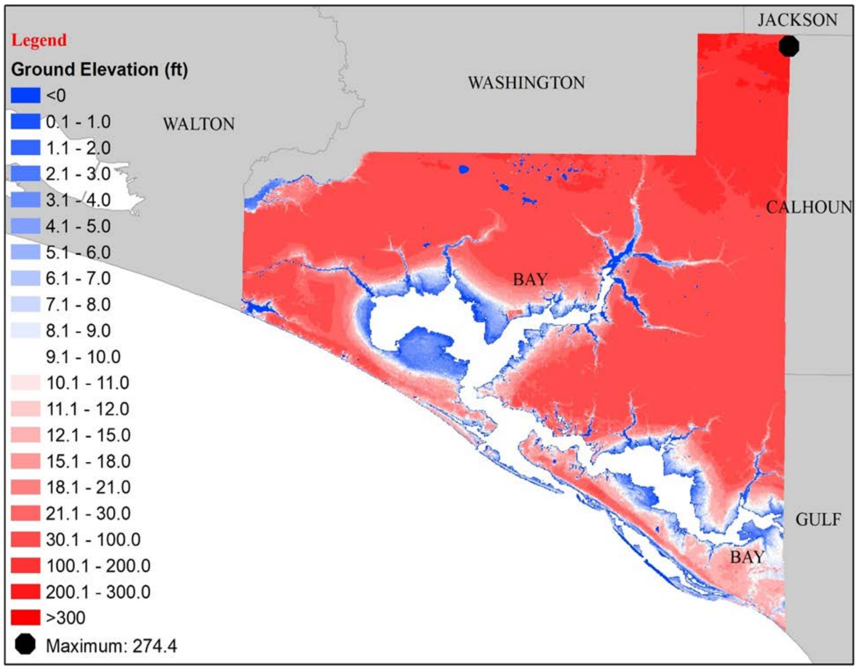


Figure 141. High resolution (100 meters) ground elevation at Bay County for Panhandle grid.

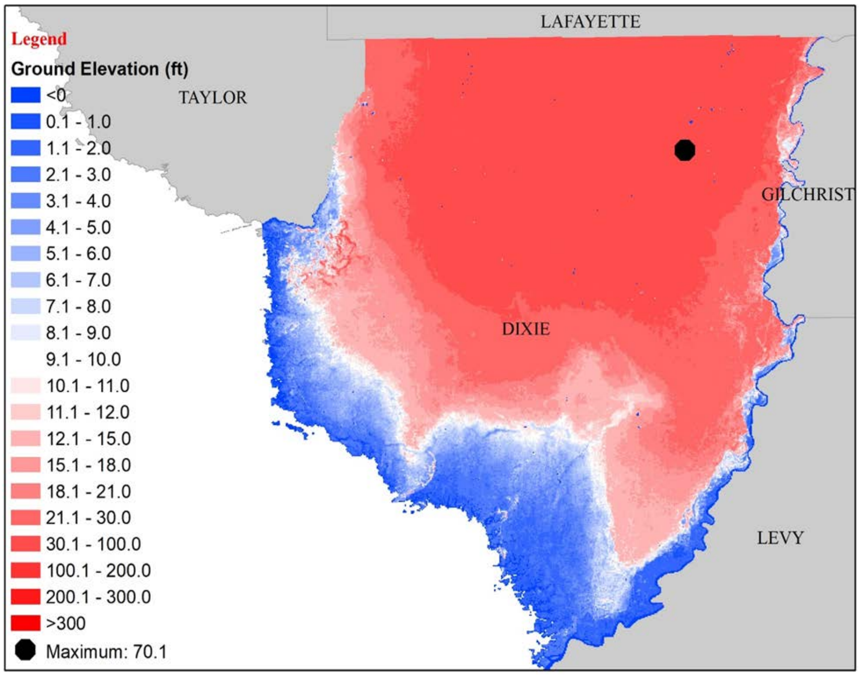


Figure 142. High resolution (100 meters) ground elevation at Dixie County for North Florida grid.

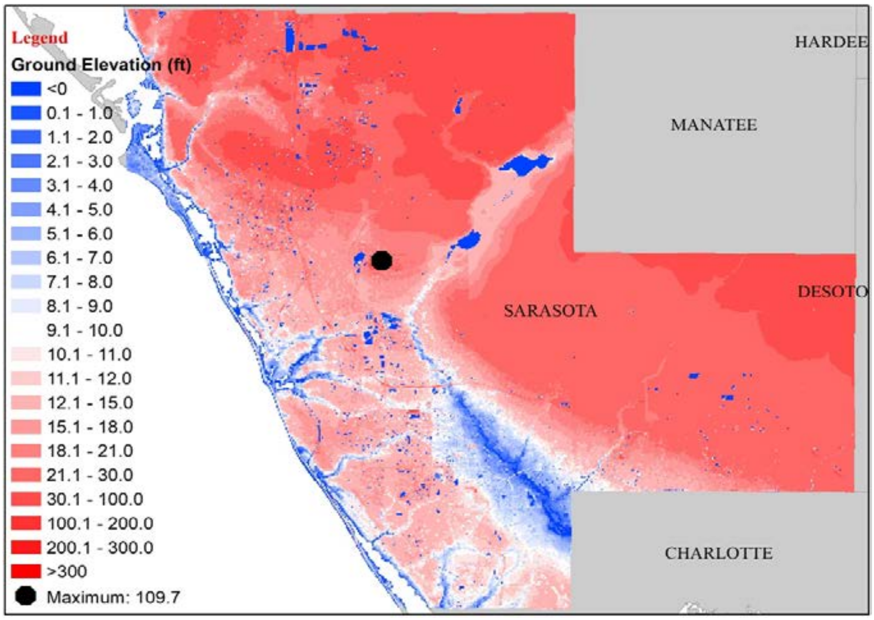


Figure 143. High resolution (100 meters) ground elevation at Sarasota County for South West Florida grid.

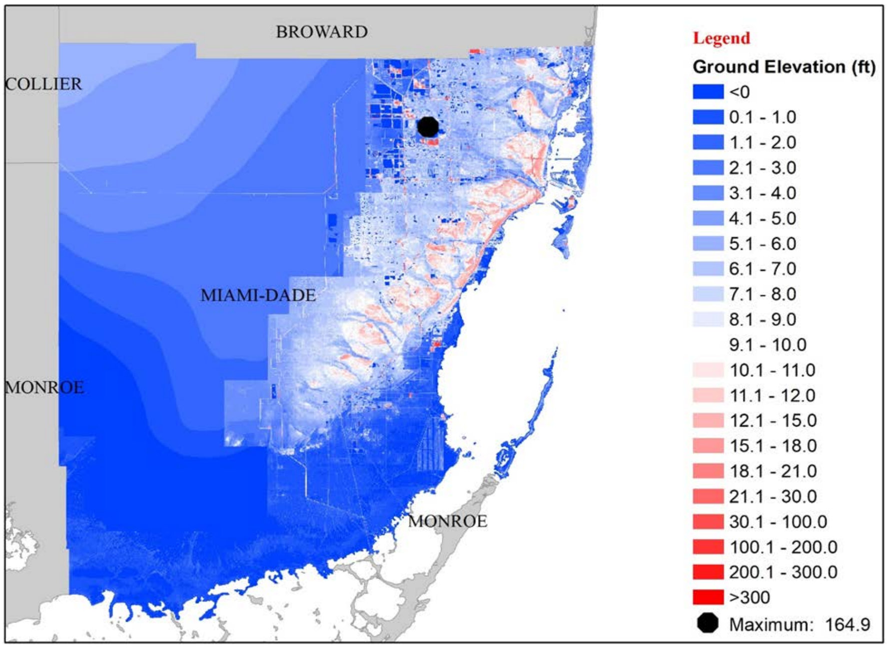


Figure 144. High resolution (100 meters) ground elevation at Miami-Dade County for South East Florida grid.

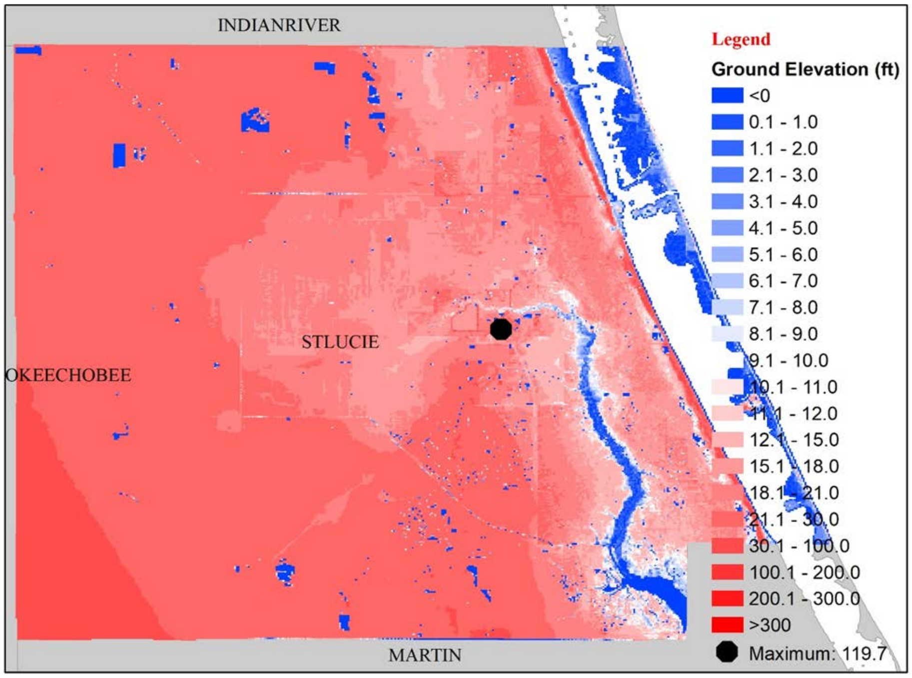


Figure 145. High resolution (100 meters) ground elevation at St. Lucie County for the east Florida grid.

B. Provide, for each study area, color-coded contour or high-resolution maps showing the modeled flood extent and elevation or depth corresponding to 0.01 annual exceedance probability. Flood extent and elevation or depth should incorporate waves or wave proxies, if modeled. For locations subject to both coastal and inland flooding, this information should reflect only coastal flooding.

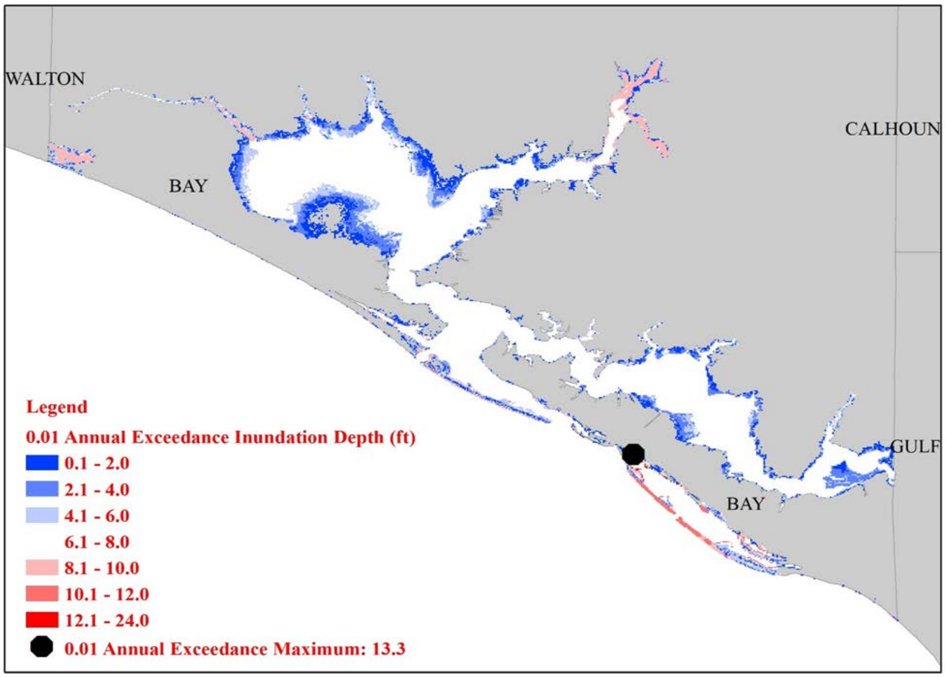


Figure 146. Color-coded contour showing the modeled flood extent and inundation depth corresponding to 0.01 annual exceedance probability at Bay County (Panhandle).

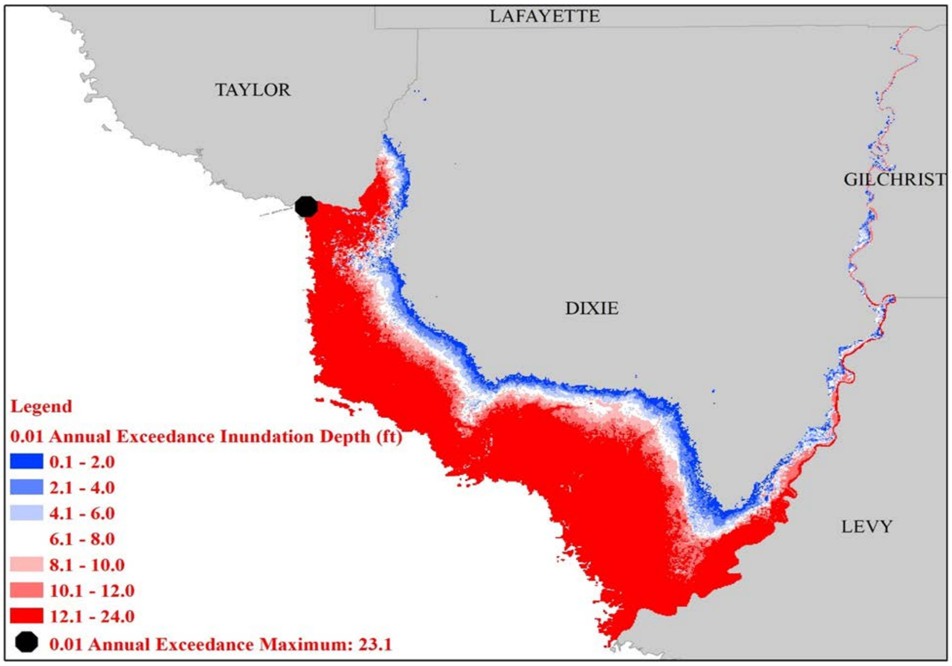


Figure 147. The same as Figure 146 but for Dixie County (North Florida).

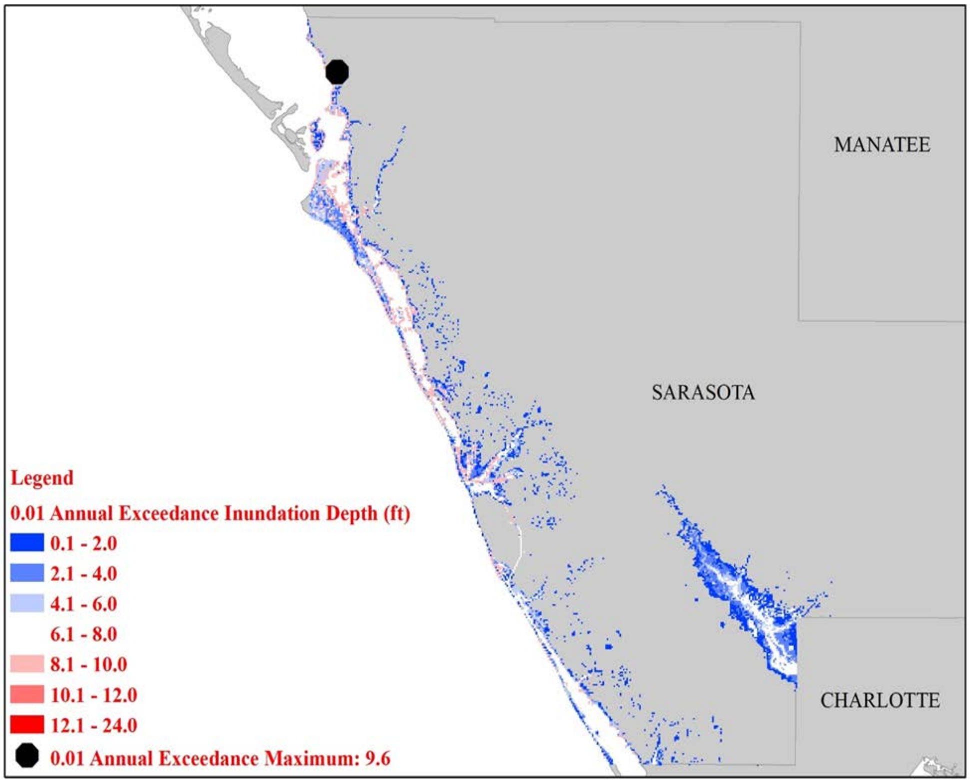


Figure 148. The same as Figure 146 but for Sarasota County (South West Florida).

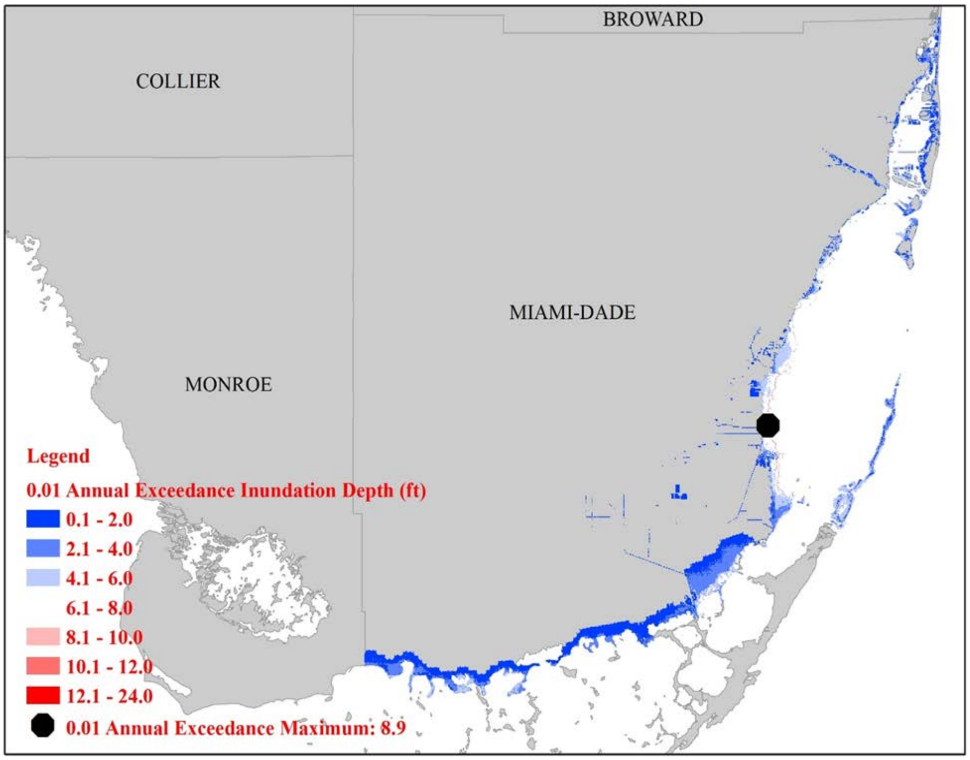


Figure 149. The same as Figure 146 but for Miami-Dade County (South East Florida).

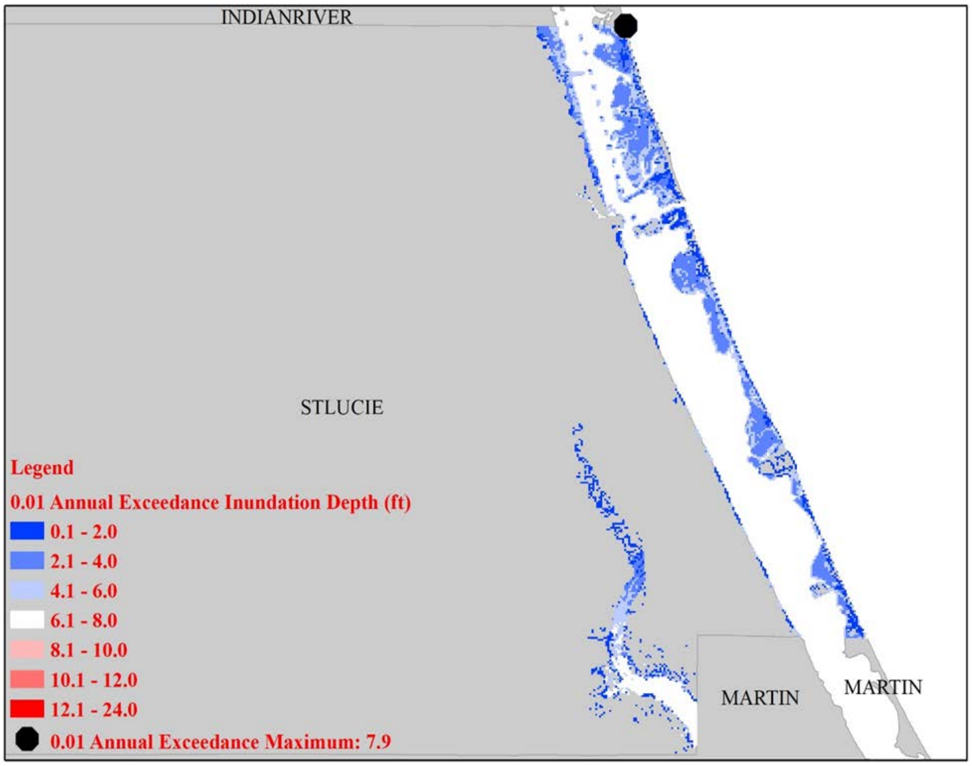


Figure 150. The same as Figure 146 but for St. Lucie County (East Florida).

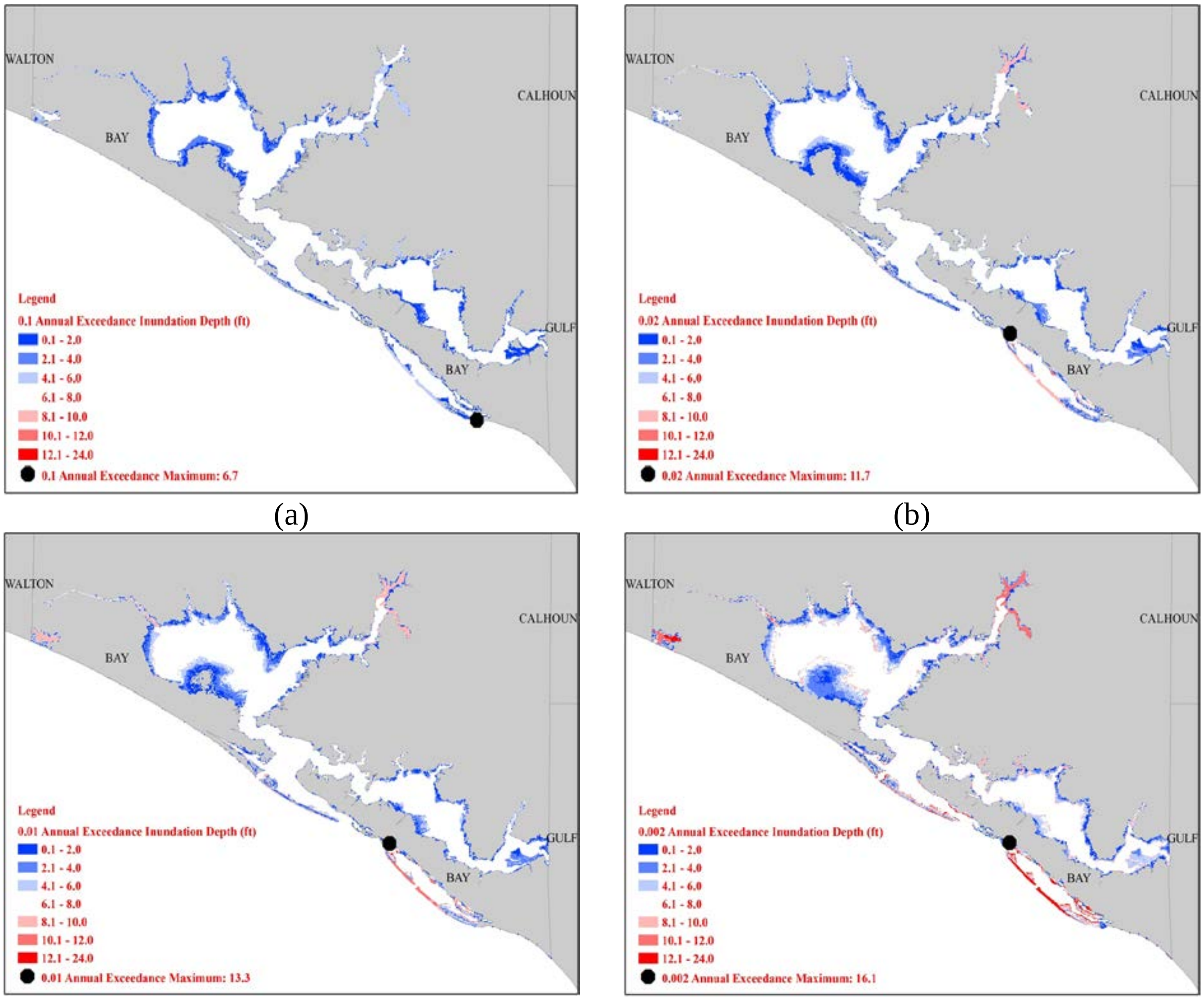
C. Include Form HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, in a submission appendix.

Form HHF-3: Coastal Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)

A. Provide, for each study area defined in Form HHF-2, Coastal Flood Characteristics by Annual Exceedance Probability, the following information. For locations subject to both coastal and inland flooding, this information should reflect only coastal flooding.

1. Study area color-coded contour or high-resolution maps showing modeled flood extent and elevation or depth corresponding to the 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities. Flood extent and elevation or depth should incorporate waves or wave proxies, if modeled.

Bay County (Panhandle)

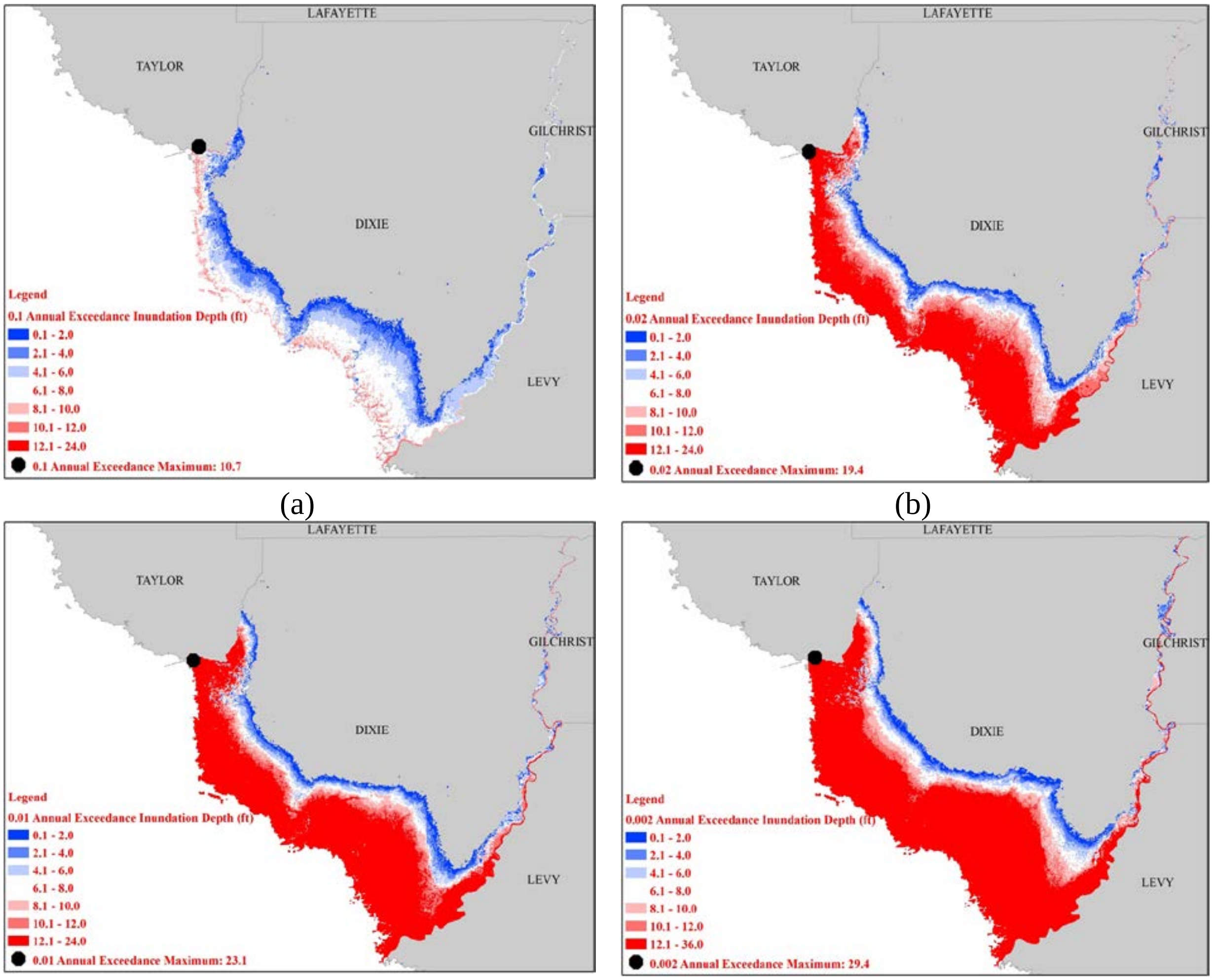


(a) (b)

(c) (d)

Figure 151. Modeled flood extent and inundation depth corresponding to (a) 0.1, (b) 0.02, (c) 0.01, and (d) 0.002 annual exceedance probability at Bay County (Panhandle)

Dixie County (North Florida)

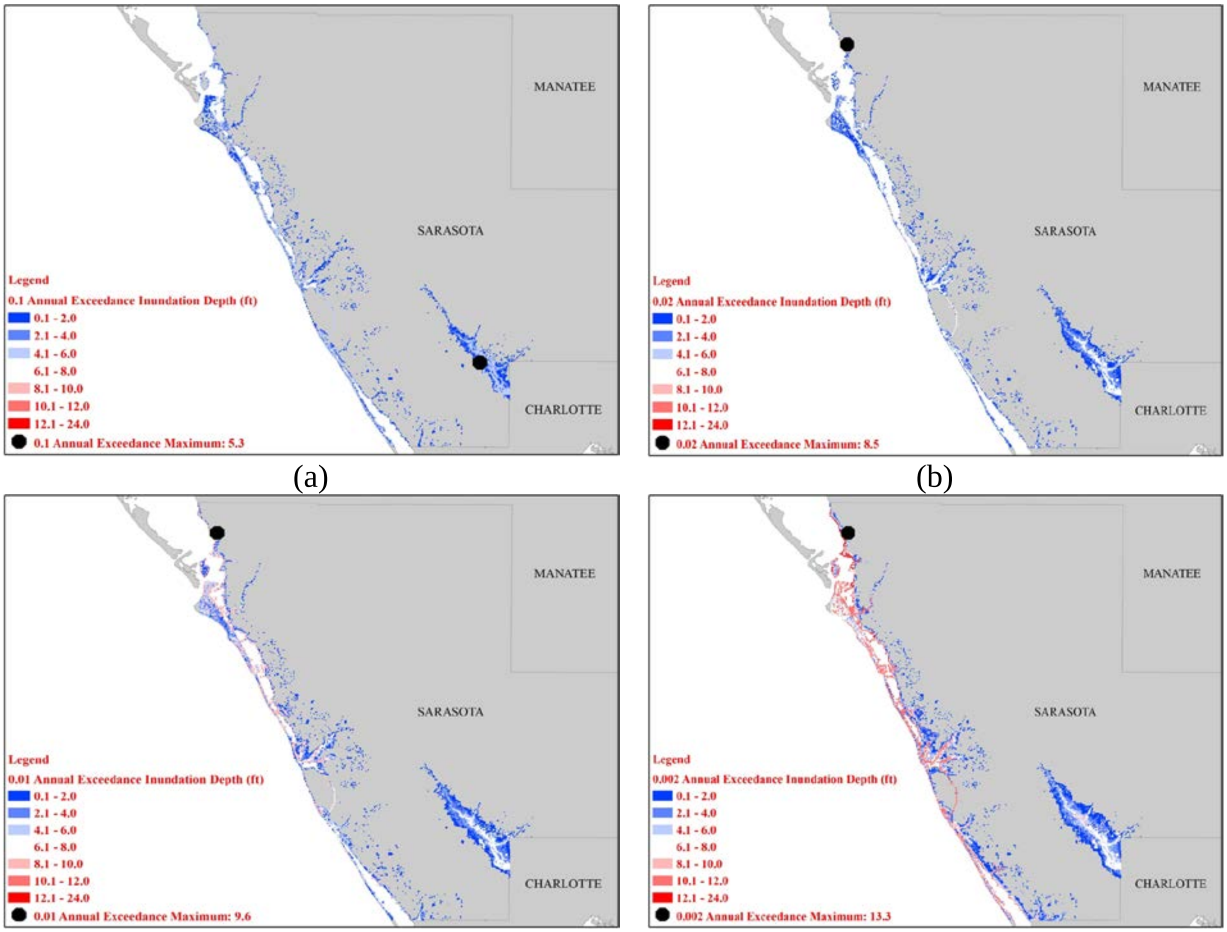


(a) (b)

(c) (d)

Figure 152. The same as Figure 151 but for Dixie County (North Florida).

Sarasota County (South West Florida)

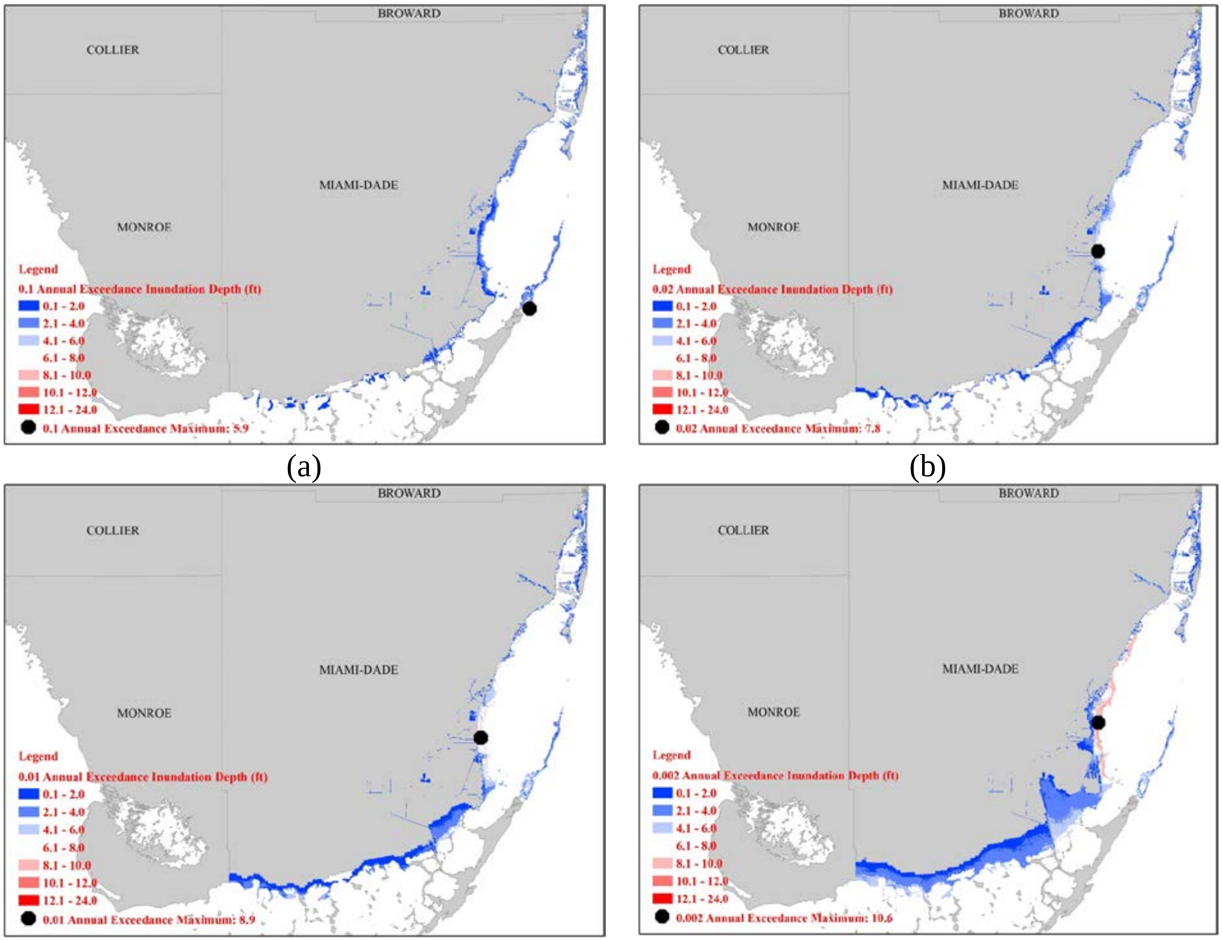


(a) (b)

(c) (d)

Figure 153. The same as Figure 151 but for Sarasota County (South West Florida).

Miami-Dade County (South East Florida)

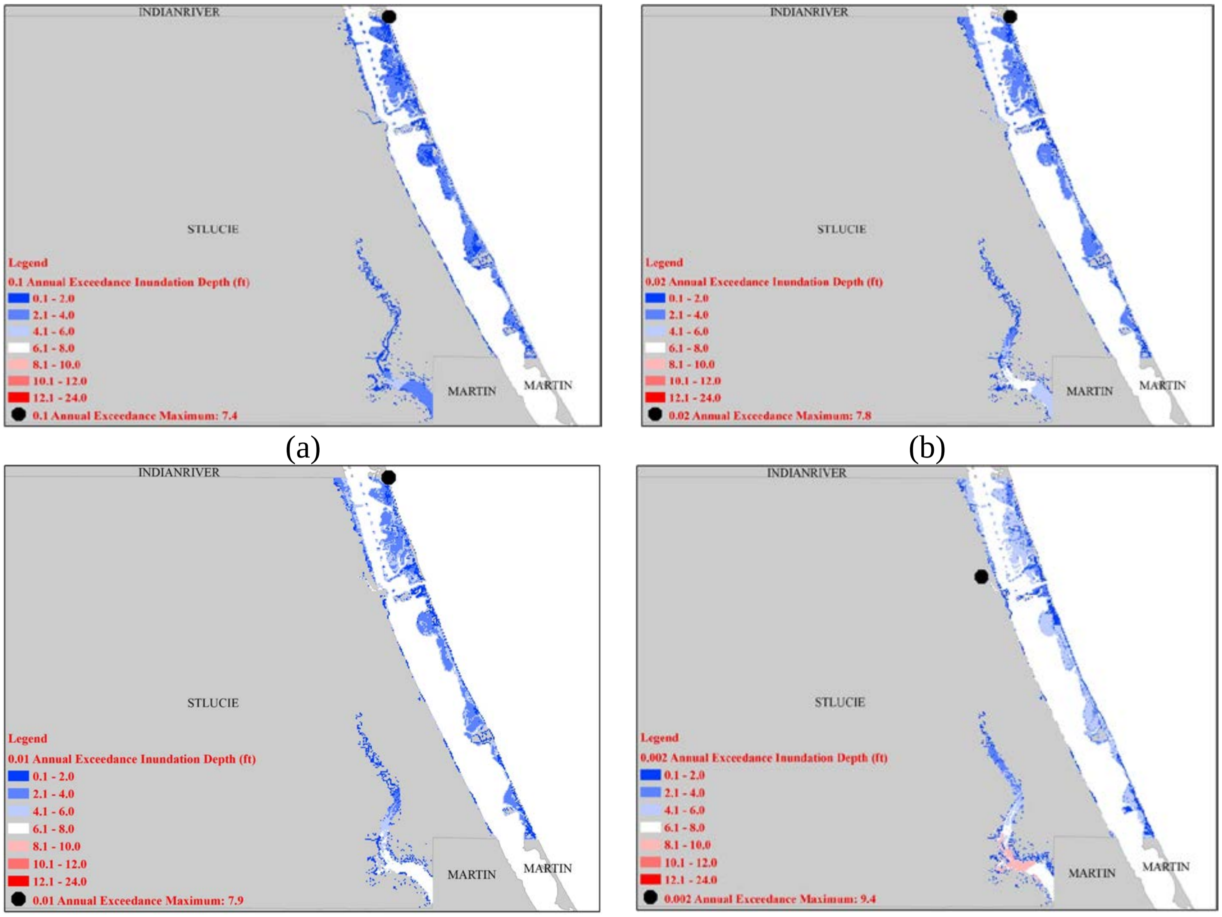


(a) (b)

(c) (d)

Figure 154. The same as Figure 151 but for Miami-Dade County (South East Florida).

St. Lucie County (East Florida)



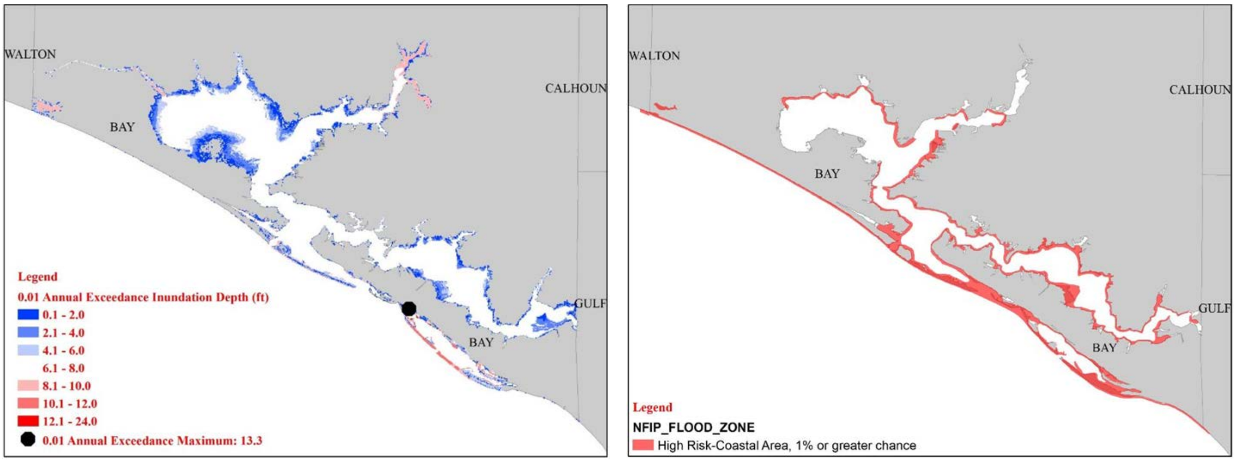
(a) (b)

(c) (d)

Figure 155. The same as Figure 151 but for St. Lucie County (East Florida).

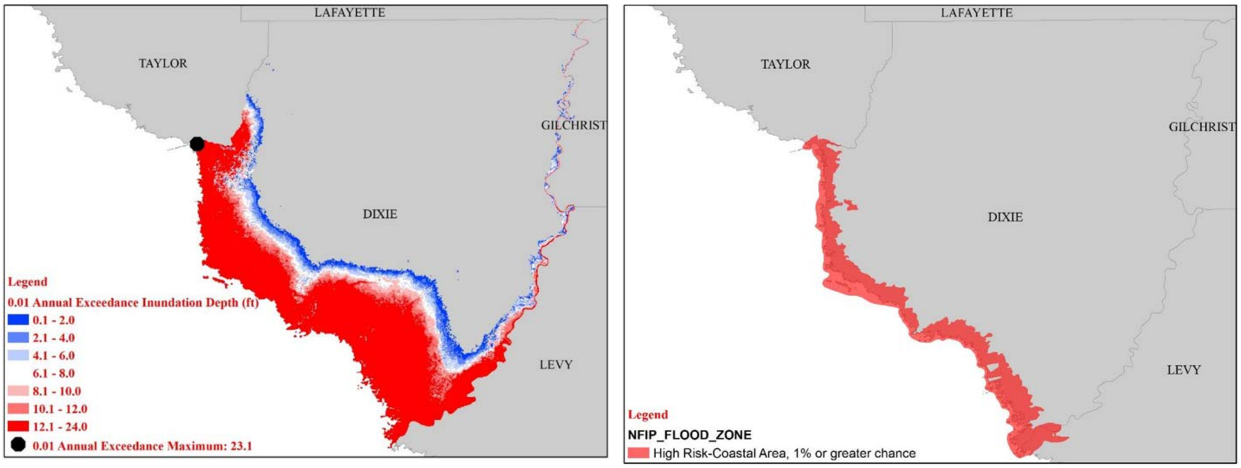
2. Study area color-coded contour or high-resolutions maps showing modeled flood extent corresponding to the 0.01 and 0.002 annual exceedance probabilities, compared with the NFIP flood extents.

The modeled and NFIP flood extents corresponding to the 0.01 annual exceedance probabilities are plotted separately for comparison below, along the coasts of the five selected counties. For the NFIP flood extents, only the High Risk-Coastal Area flood zones are displayed; NFIP flood zones that combine the coastal and inland flood are not used for comparison, as no effective method was found to separate these zones for only coastal flood zones. Also, no data for the NFIP High Risk-Coastal Area flood zones corresponding to 0.002 annual exceedance probability was found for comparison.



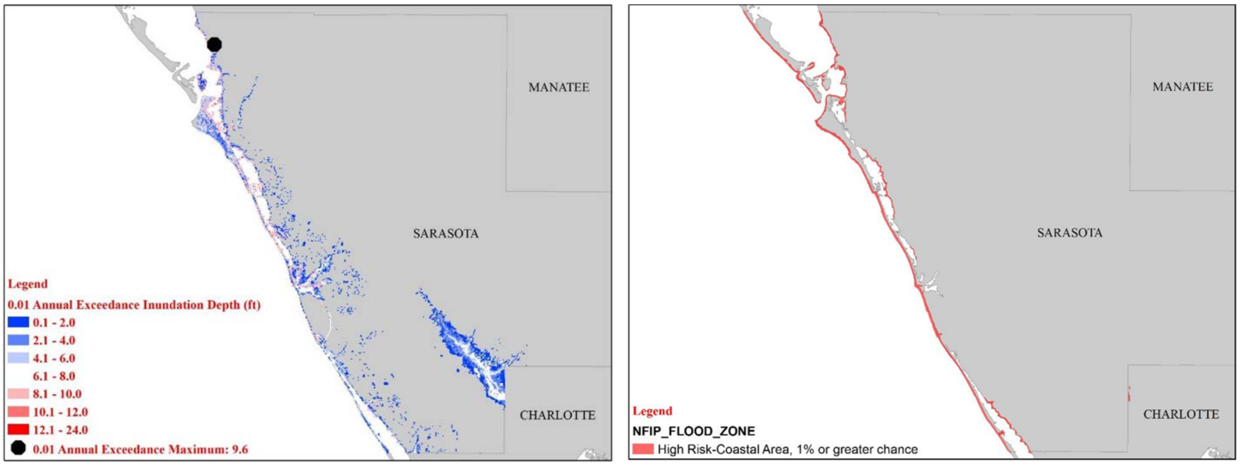
(a) (b)

Figure 156. Comparison between (a) the modeled flood extent and inundation depth and (b) the high risk-coastal NFIP flood extent (0.01 EP) at Bay County (Panhandle)



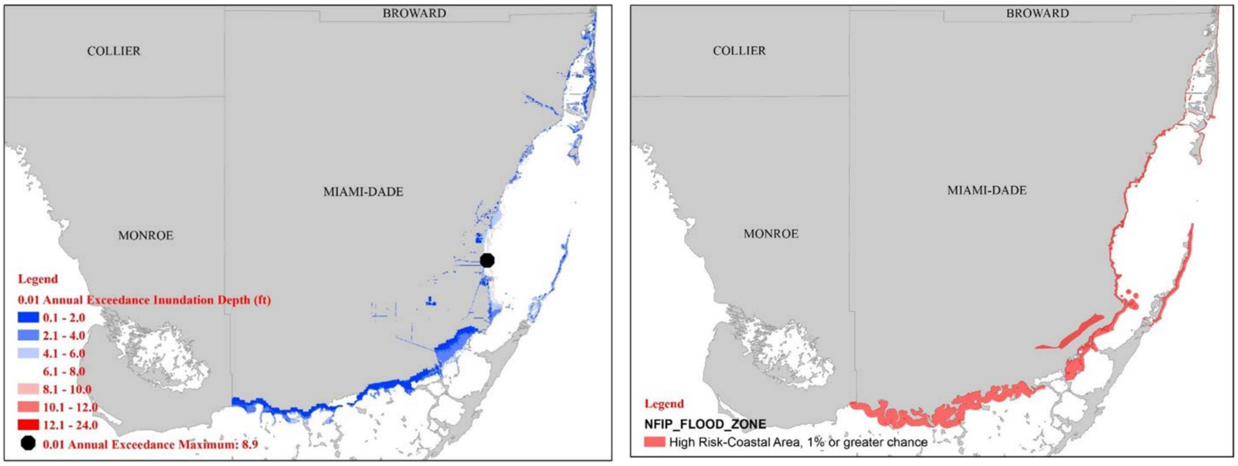
(a) (b)

Figure 157. The same as Figure 156 but for Dixie County (North Florida).



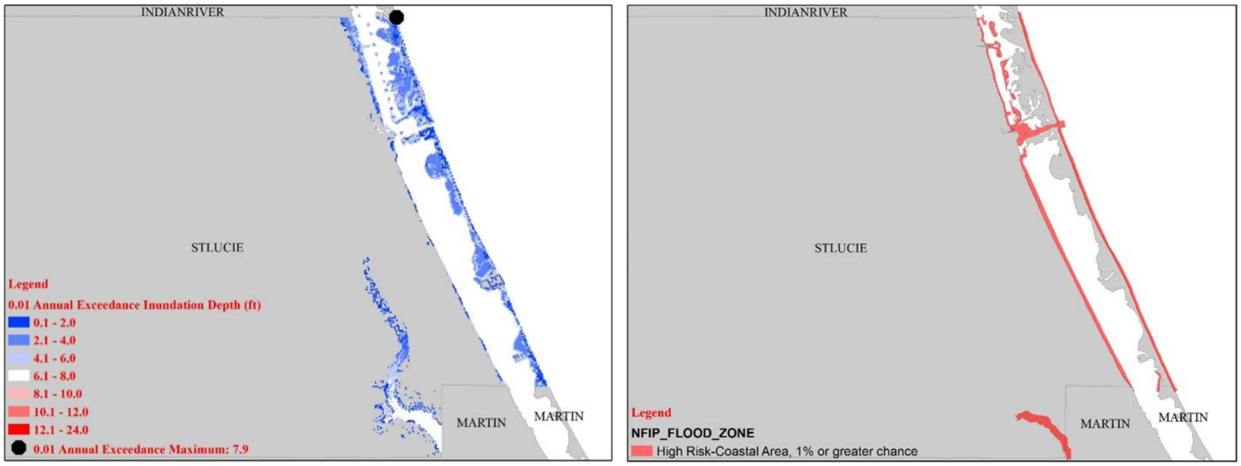
(a) (b)

Figure 158. The same as Figure 156 but for Sarasota County (South West Florida).



(a) (b)

Figure 159. The same as Figure 156 but for Miami-Dade County (South East Florida).



(a) (b)

Figure 160. The same as Figure 156 but for St. Lucie County (East Florida).

3. Graphs and tables showing flood model results at 10 or more locations within the study area and representative of the range of flood conditions in the study area. The following flood characteristics should be included for the 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities:

a. Stillwater flood elevations,
b. Coastal wave heights or wave proxies,
c. If the flood vulnerability model requires explicit representation of flood-induced erosion effects, the erosion depth (original ground elevation minus eroded ground elevation),
d. If the flood vulnerability model requires explicit representation of flow velocity effects, the flow velocities, and
e. If the flood vulnerability model requires explicit representation of flood inundation duration effects, the duration of flood inundation.

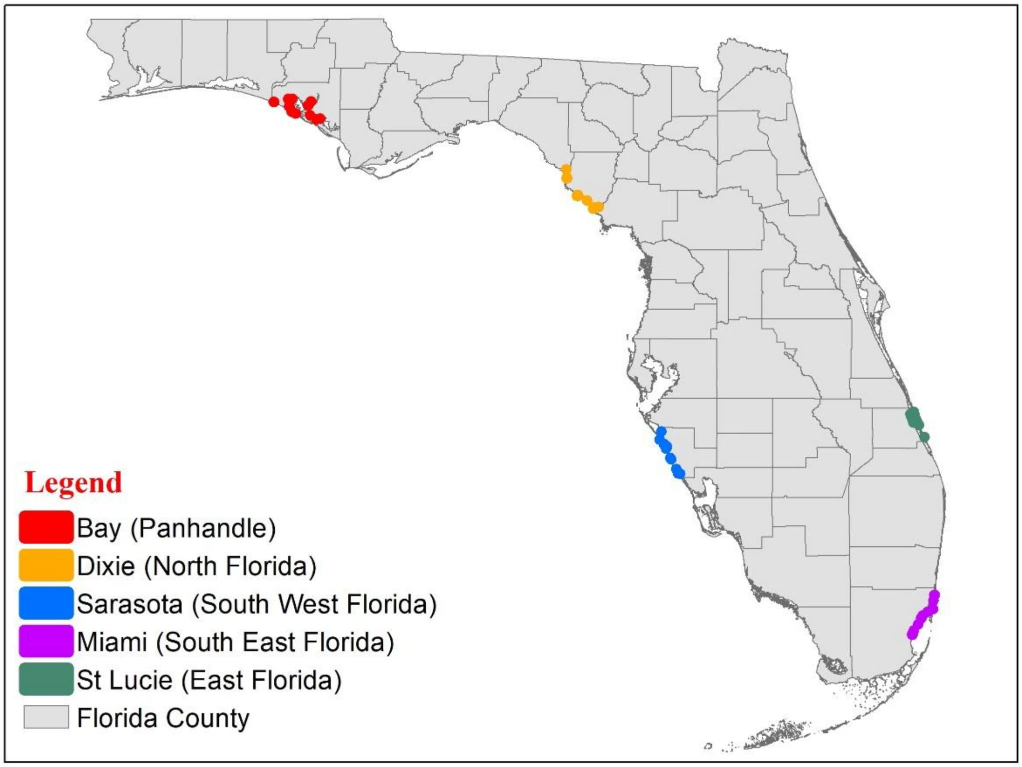


Figure 161. Selected 10 locations within the study area.

Table 41. Flood model results at 10 locations within five study areas (unit is feet).

Location	**County**	**GE**	**0.1 AE**	**0.02 AE**	**0.01 AE**	**0.002 AE**	**Max**	**Lat**	**Lon**
1	Bay	4.3	0.0	1.6	3.6	7.2	12.4	30.268453	-85.97809
2	Bay	0.0	2.3	7.1	8.6	12.0	17.2	30.167547	-85.78490

Location	County	GE	0.1 AE	0.02 AE	0.01 AE	0.002 AE	Max	Lat	Lon
3	Bay	0.0	3.1	5.4	6.5	8.4	11.0	30.115206	-85.60291
4	Bay	0.0	2.6	5.0	6.2	8.5	11.0	30.122054	-85.56856
5	Bay	1.7	1.1	3.5	5.1	7.8	11.7	30.152790	-85.65948
6	Bay	0.0	3.6	7.5	9.2	12.3	15.5	30.239580	-85.67597
7	Bay	0.1	2.7	7.0	8.9	12.3	15.9	30.273598	-85.64953
8	Bay	4.6	0.0	3.2	5.2	8.7	12.6	30.295038	-85.81352
9	Bay	3.6	0.0	4.8	7.0	10.3	14.0	30.293567	-85.85097
10	Bay	5.7	0.0	1.1	2.0	5.2	10.6	30.183207	-85.82006
11	Dixie	0.0	4.9	9.6	11.1	15.8	27.9	29.671267	-83.38909
12	Dixie	4.4	0.0	2.1	3.4	7.9	21.9	29.595578	-83.38421
13	Dixie	2.3	1.5	5.4	7.0	10.6	26.4	29.437471	-83.29496
14	Dixie	0.4	3.4	7.5	9.0	12.7	28.5	29.443872	-83.28995
15	Dixie	0.0	4.0	8.1	9.7	13.3	29.3	29.440353	-83.28472
16	Dixie	3.8	0.0	4.0	5.6	9.3	25.2	29.440282	-83.28884
17	Dixie	1.9	1.8	6.0	7.9	11.6	28.3	29.398385	-83.20548
18	Dixie	1.1	2.2	6.5	8.1	11.7	28.4	29.327108	-83.15041
19	Dixie	0	3.9	8.2	10.0	13.9	30.7	29.33726	-83.1362
20	Dixie	3.6	0.0	0.0	0.6	4.0	17	29.341375	-83.10437
21	Sarasota	3.8	0.0	0.1	0.5	2.9	11.5	27.28341	-82.56426
22	Sarasota	0.2	2.3	4.3	5.5	8.3	17	27.24321	-82.52633
23	Sarasota	0.4	2.2	4.0	4.9	7.6	17.3	27.203718	-82.50560
24	Sarasota	0.9	1.5	3.0	3.9	6.3	15.4	27.121962	-82.46920
25	Sarasota	1.1	1.2	3.0	3.9	6.3	15.3	27.110292	-82.46299
26	Sarasota	1.8	0.7	2.4	3.4	5.7	12.2	26.987276	-82.39893
27	Sarasota	0.8	1.6	3.5	4.6	6.8	14.2	26.981107	-82.38374
28	Sarasota	2.0	0.1	1.9	3.0	5.1	11.6	27.022316	-82.41549
29	Sarasota	3.8	0.0	0.5	1.7	4.6	14.2	27.220909	-82.5018
30	Sarasota	0.8	0.0	1.7	2.7	5.8	16.1	27.353995	-82.54807
31	Miami	2.1	0.0	0.0	1.0	6.0	11.1	25.560292	-80.32750
32	Miami	1.55	0.2	5.6	7.5	9.9	15.6	25.596346	-80.31336
33	Miami	5.5	0.0	0.8	2.5	5.1	14.7	25.649448	-80.27719
34	Miami	5.5	0.0	0.4	2.1	4.7	16.4	25.705285	-80.24795
35	Miami	5.0	0.0	1.0	2.7	5.4	16.6	25.728689	-80.23384
36	Miami	3.0	0.0	2.1	3.5	6.0	18.0	25.76186	-80.18976
37	Miami	1.7	0.0	0.0	0.0	1.4	16.6	25.784164	-80.14273
38	Miami	3.0	0.0	0.0	0.0	1.1	12.5	25.859991	-80.13919
39	Miami	3.0	0.0	0.0	1.3	2.4	11.7	25.909602	-80.13084
40	Miami	6.4	0.0	0.0	0.9	4.0	7.2	25.583728	-80.31841
41	St.Lucie	5.2	0.0	0.3	0.7	1.5	6.0	27.305172	-80.22035
42	St.Lucie	5.7	0.0	0.1	0.5	1.1	6.0	27.410157	-80.26918
43	St.Lucie	4.3	0.0	1.4	1.8	2.4	7.6	27.447258	-80.28613
44	St.Lucie	3.9	0.6	2.0	2.4	3.0	8.4	27.46719	-80.30010
45	St.Lucie	3.0	1.2	2.6	3.0	3.8	9.1	27.498821	-80.30706

Location	**County**	**GE**	**0.1 AE**	**0.02 AE**	**0.01 AE**	**0.002 AE**	**Max**	**Lat**	**Lon**
46	St.Lucie	2.5	1.3	2.5	2.9	3.8	11.4	27.509835	-80.34445
47	St.Lucie	3.6	1.0	2.7	3.2	3.9	8.1	27.529559	-80.31598
48	St.Lucie	3.2	1.3	2.7	3.1	3.8	10.2	27.488127	-80.33547
49	St.Lucie	4.3	0.0	1.2	1.5	3.1	10.6	27.456477	-80.32453
50	St.Lucie	3.4	1.1	2.6	3.0	3.0	11.4	27.433874	-80.31759

Form HHF-4: Inland Flood Characteristics by Annual Exceedance Probability

A. Define one study area subject to inland flooding within each of the five Florida geographic regions identified in Figure 1. The extent of each study area is to be determined by the modeling organization and should be large enough to encompass at least one county. The modeling organization is to create the underlying grid for this form.

The selected geographic regions and their extents are shown in Figure 162 below. The selected regions encompass at least one county.

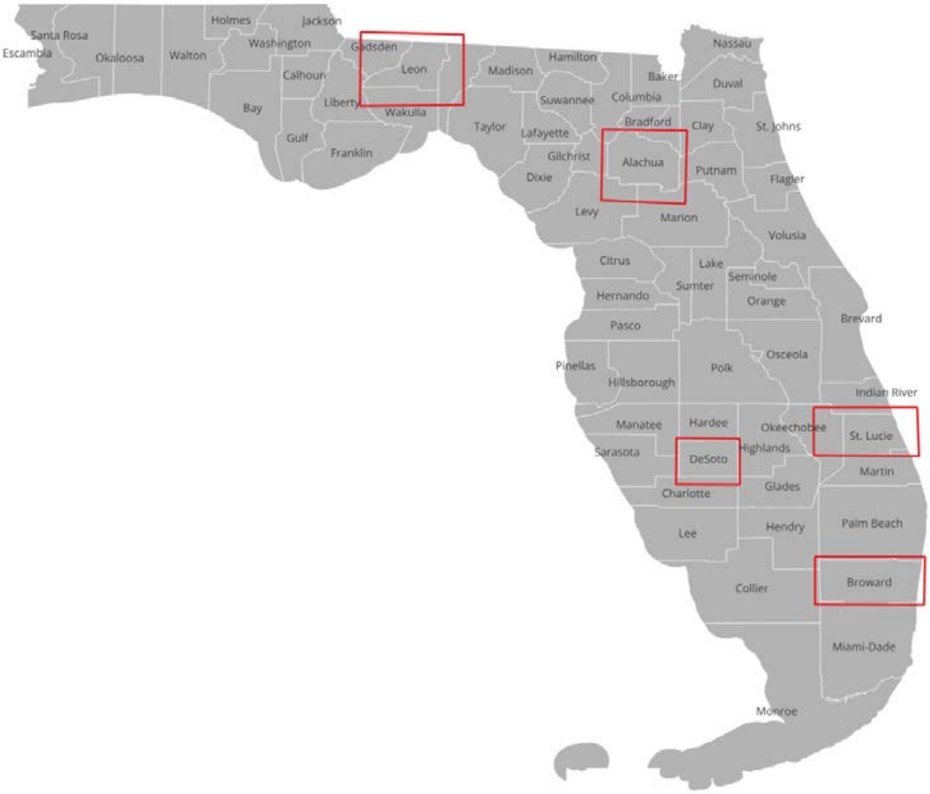


Figure 162. Inland study areas selected. Rectangles denote the geographic extent of each study area.

B. Provide, for each study area, color-coded contour or high-resolution maps showing the modeled flood extent and elevation or depth corresponding to the 0.01 annual exceedance probability. Flood extent and elevation or depth should incorporate the effects of flood-induced erosion, if modeled. For locations subject to both inland and coastal flooding, this information should reflect only inland flooding.

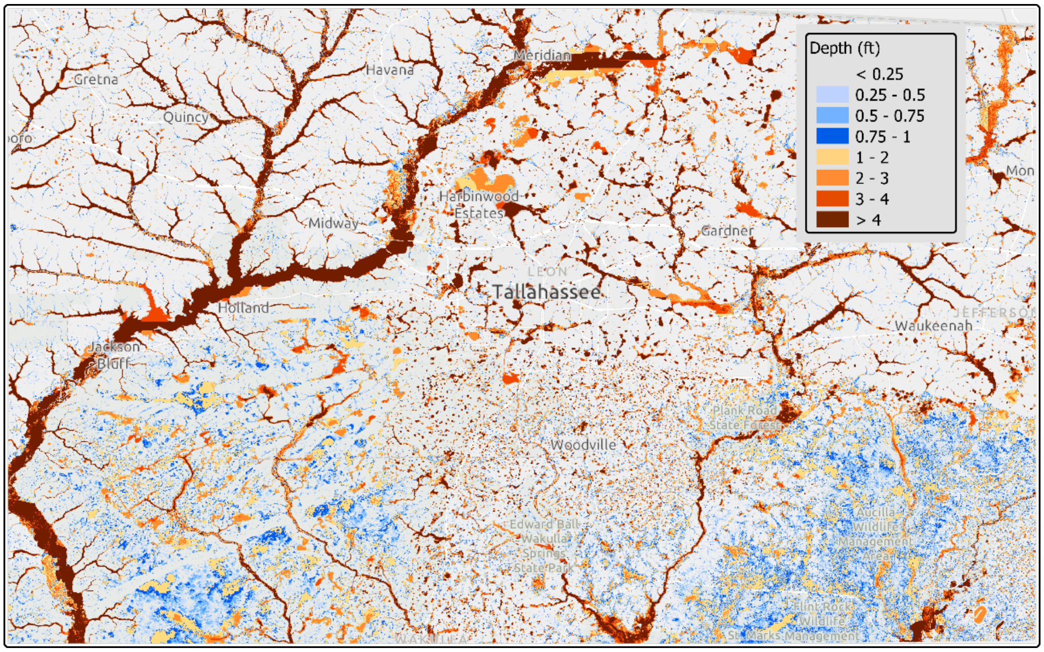


Figure 163. Inland Modeled flood extent and depth corresponding to 0.01 probability of annual exceedance for region selected in the Panhandle.

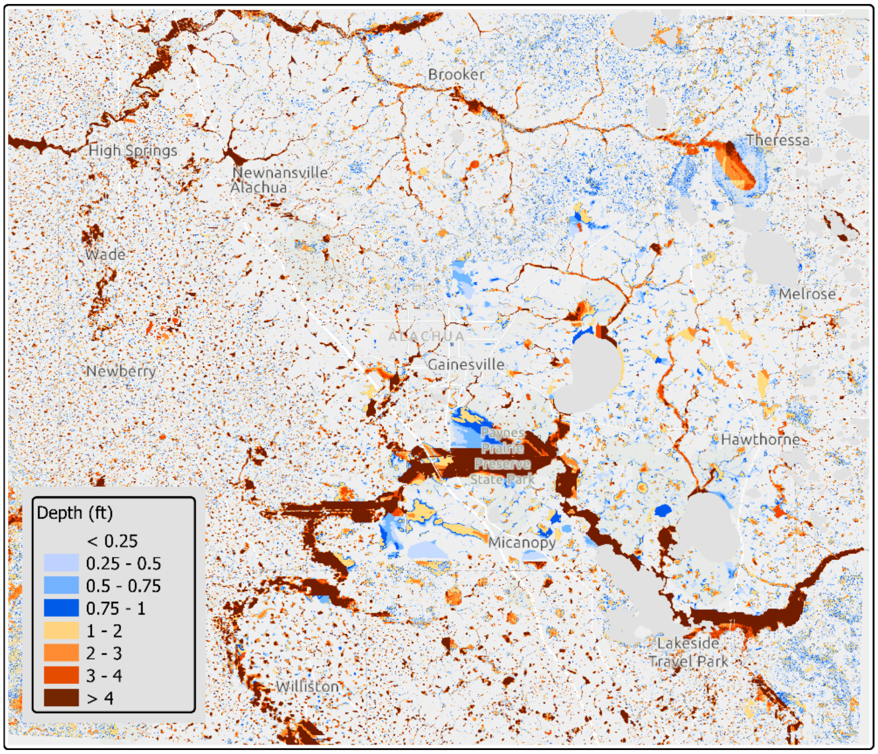


Figure 164. The same as Figure 163 but for region selected in North Florida.

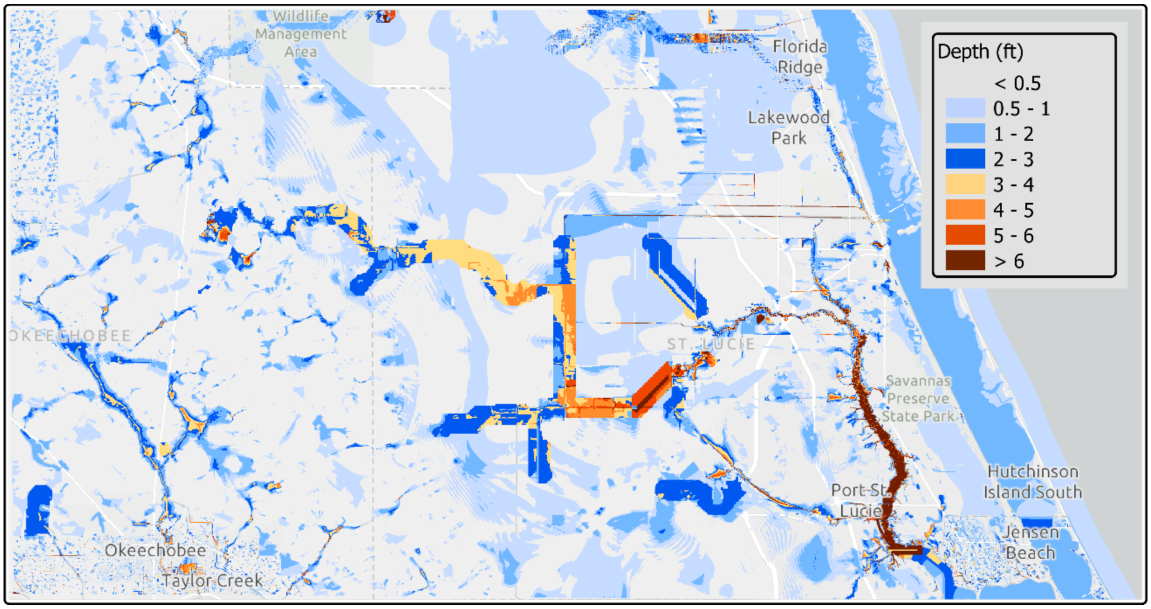


Figure 165. The same as Figure 163 but for region selected in East Florida.

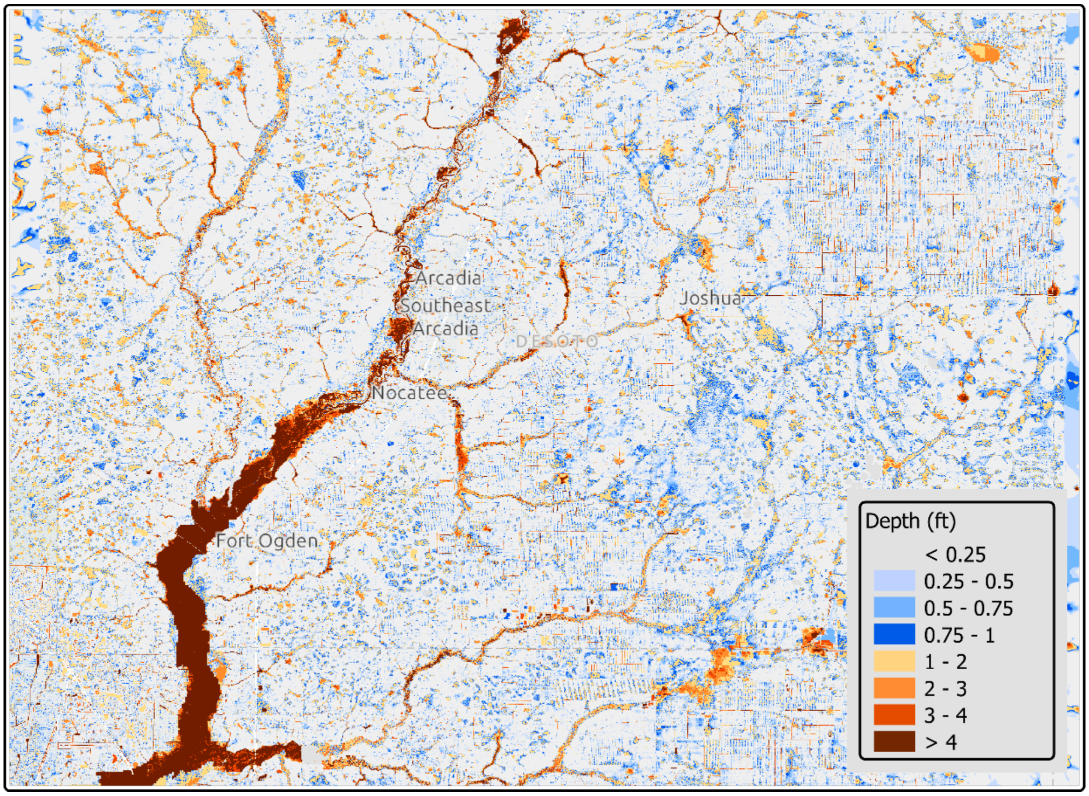


Figure 166. The same as Figure 163 but for region selected in Southwest Florida.

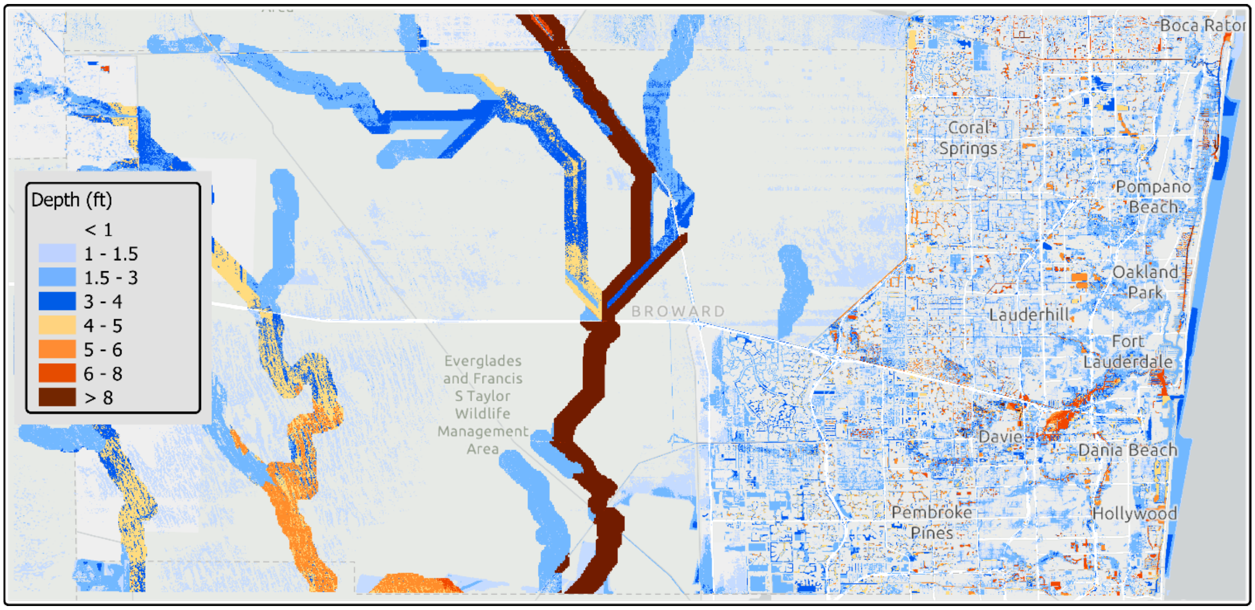


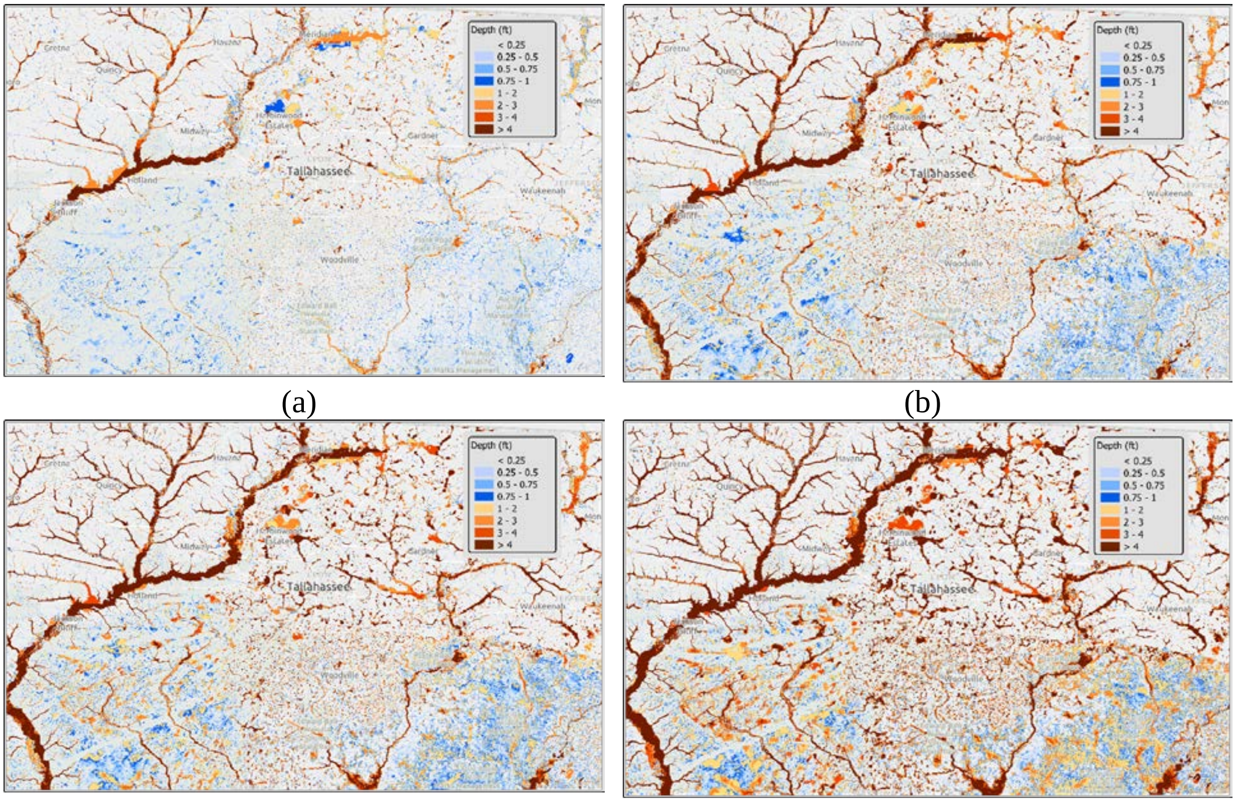
Figure 167. The same as Figure 163 but for region selected in Southeast Florida.

C. Include Form HHF-4, Inland Flood Characteristics by Annual Exceedance Probability, in a submission appendix.

Form HHF-5: Inland Flood Characteristics by Annual Exceedance Probabilities (Trade Secret Item)

A. Provide, for each study area defined in Form HHF-4, Inland Flood Characteristics by Annual Exceedance Probability, the following information. For locations subject to both inland and coastal flooding, this information should reflect only inland flooding.

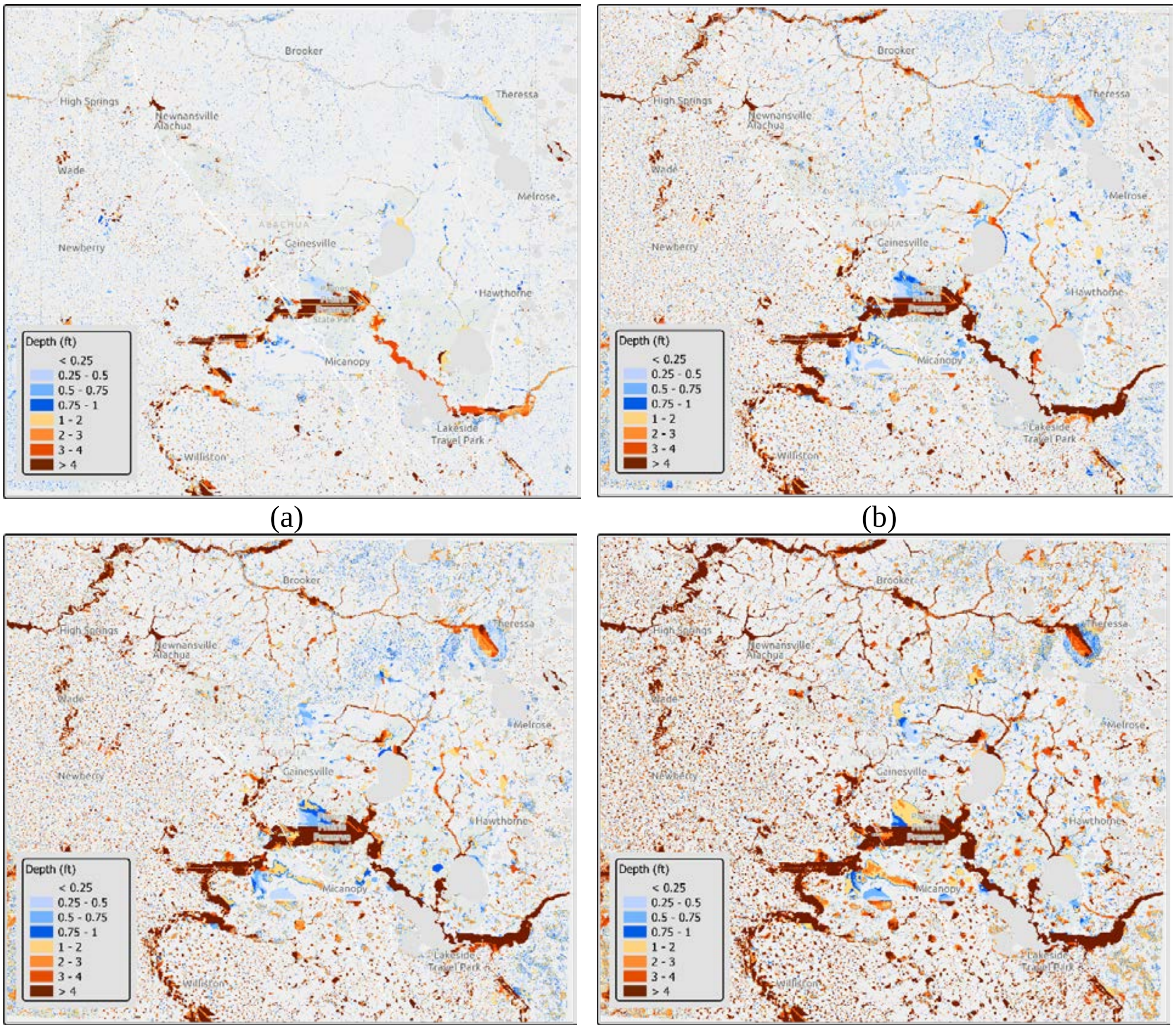
1. Study area color-coded contour or high-resolution maps showing modeled flood extent and elevation or depth corresponding to the 0.1, 0.02, 0.01, and 0.002 annual exceedance probabilities. Flood extent and elevation or depth should incorporate the effects of flood-induced erosion, if modeled.



(a) (b)

(c) (d)

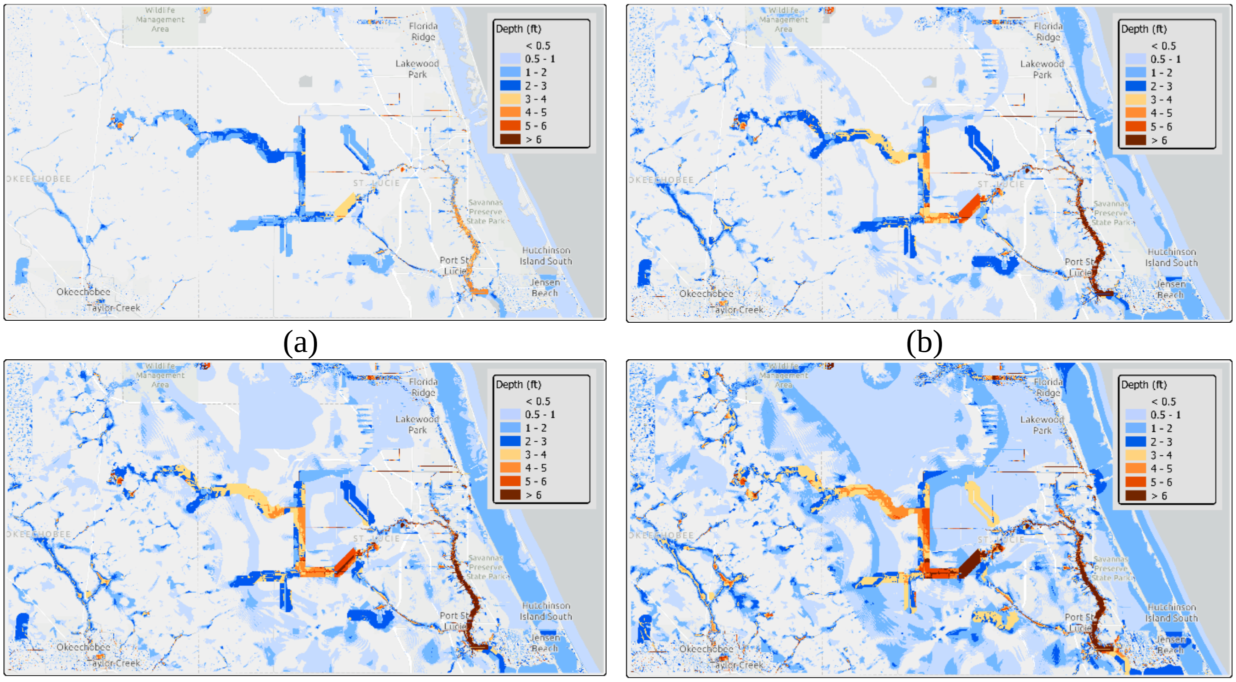
Figure 168. Modeled flood extent and depth corresponding to (a) 0.1, (b) 0.02, (c) 0.01, and (d) 0.002 annual exceedance probabilities (AEPs) for region selected in the Panhandle (Leon).



(a) (b)

(c) (d)

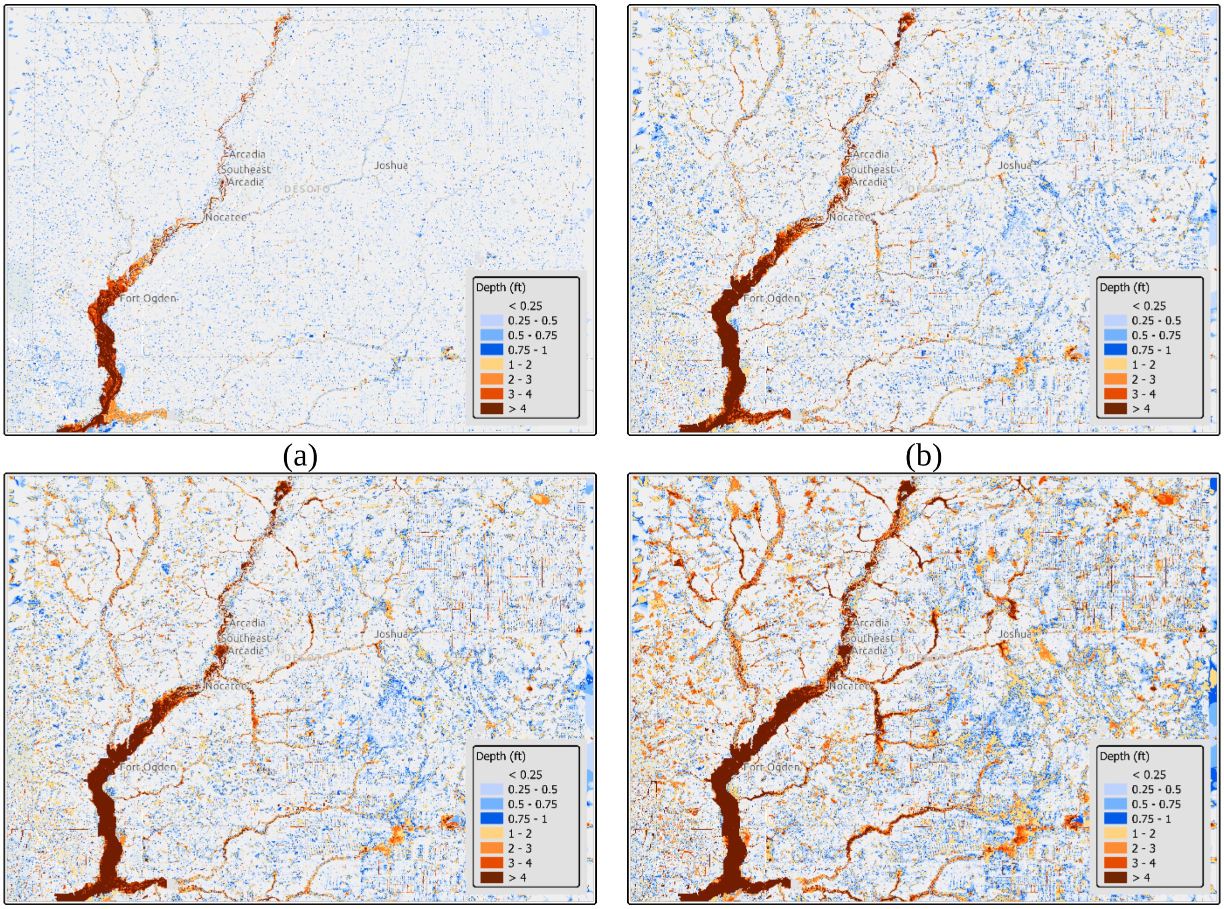
Figure 169. The same Figure 168 as but for region selected in North Florida (Alachua).



(a) (b)

(c) (d)

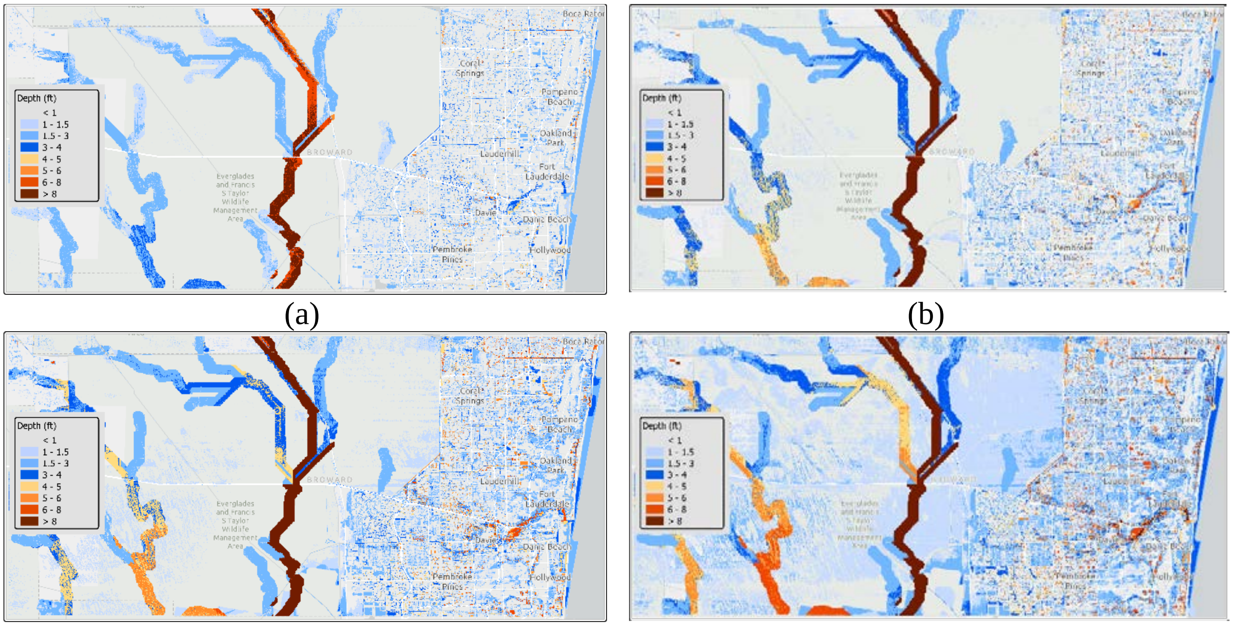
Figure 170. The same Figure 168 as but for region selected in East Florida (St. Lucie).



(a) (b)

(c) (d)

Figure 171. The same Figure 168 as but for region selected in Southwest Florida (DeSoto).

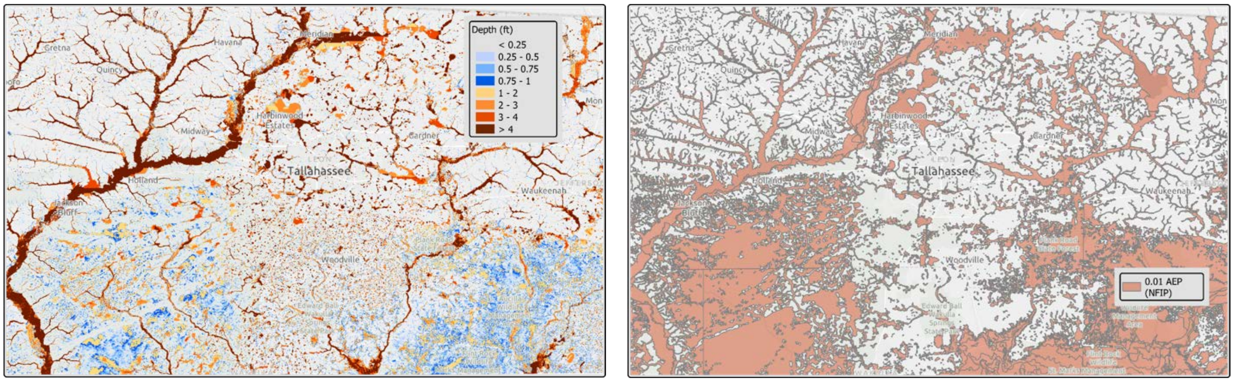


(a) (b)

(c) (d)

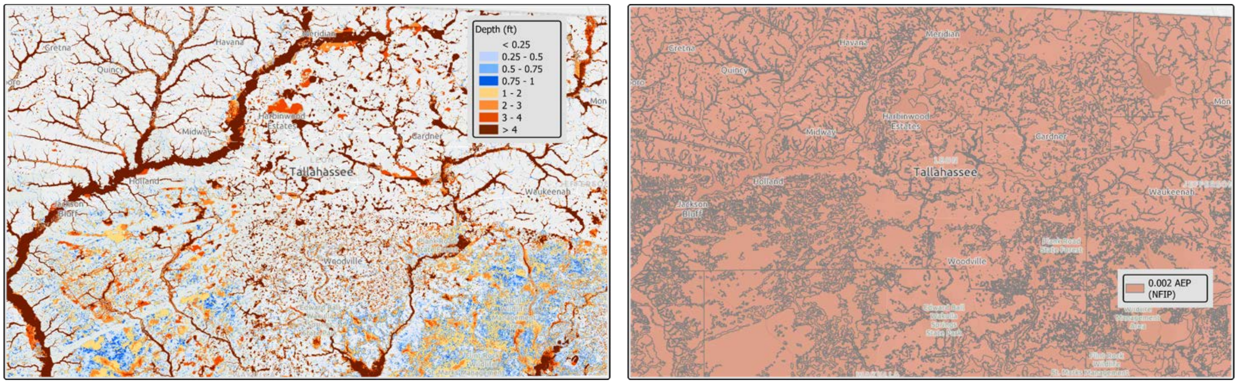
Figure 172. The same Figure 168 as but for region selected in Southeast Florida (Broward).

2. Study area color-coded contour or high-resolutions maps showing modeled flood extent corresponding to the 0.01 and 0.002 annual exceedance probabilities, compared with the NFIP flood extents.



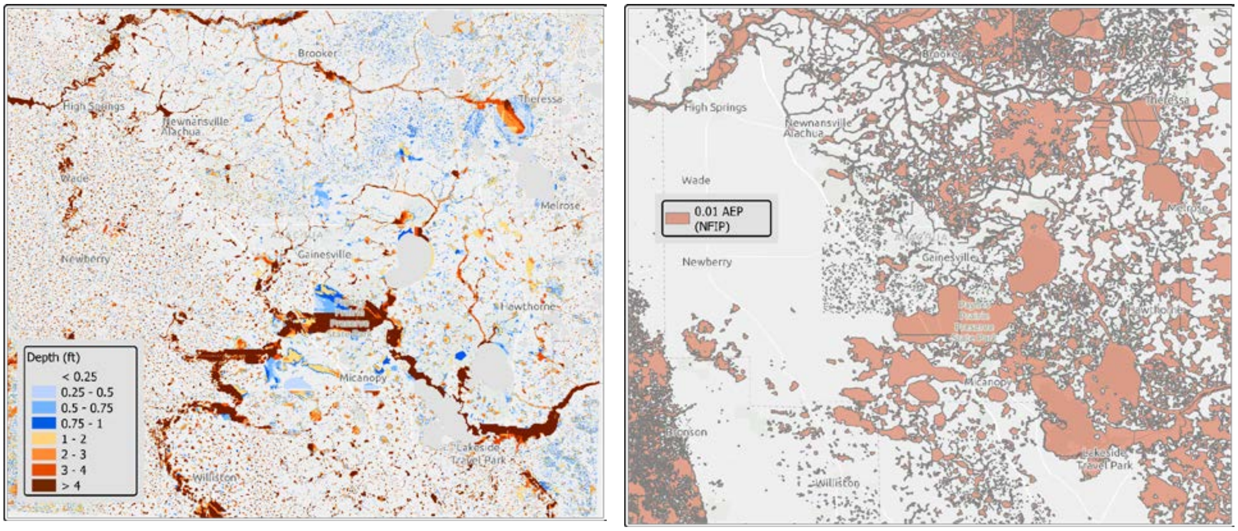
(a) (b)

Figure 173. Modeled flood extent and depth (a) and NFIP flood extents (b) corresponding to 0.01 annual exceedance probability (AEP) for region selected in the Panhandle (Leon).



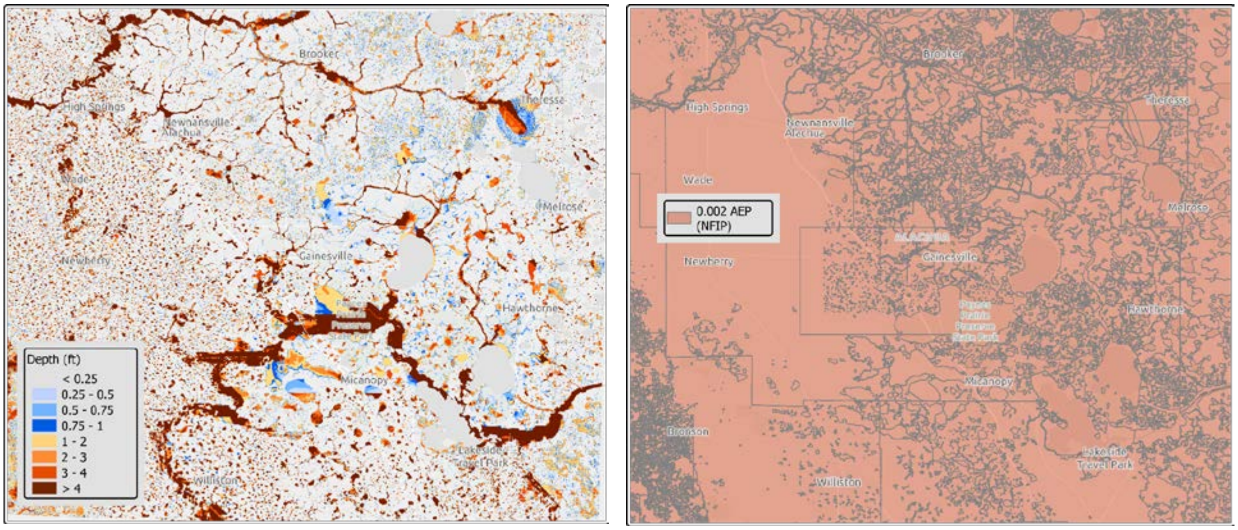
(a) (b)

Figure 174. Modeled flood extent and depth (a) and NFIP flood extents (b) corresponding to 0.002 annual exceedance probability (AEP) for region selected in the Panhandle (Leon).



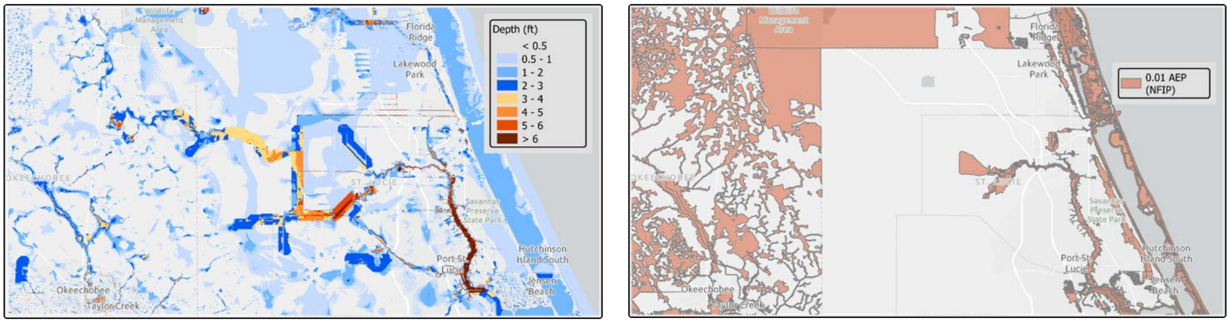
(a) (b)

Figure 175. The same as Figure 173 but for region selected in North Florida (Alachua).



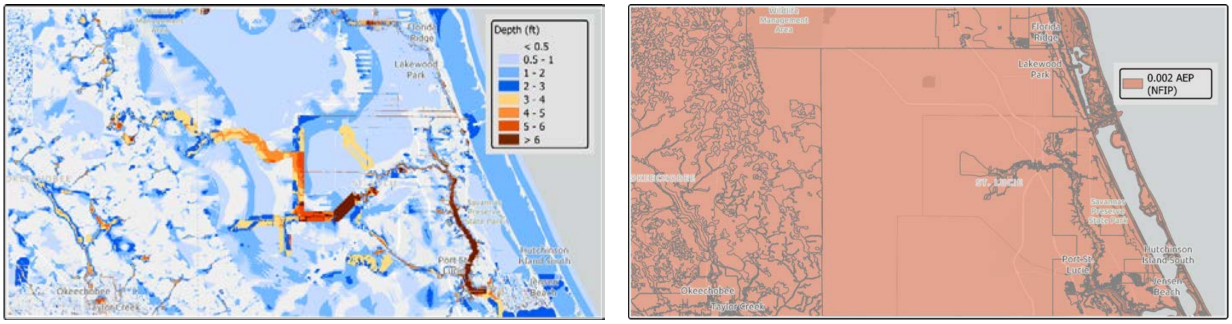
(a) (b)

Figure 176. The same as Figure 174 but for region selected in North Florida (Alachua).



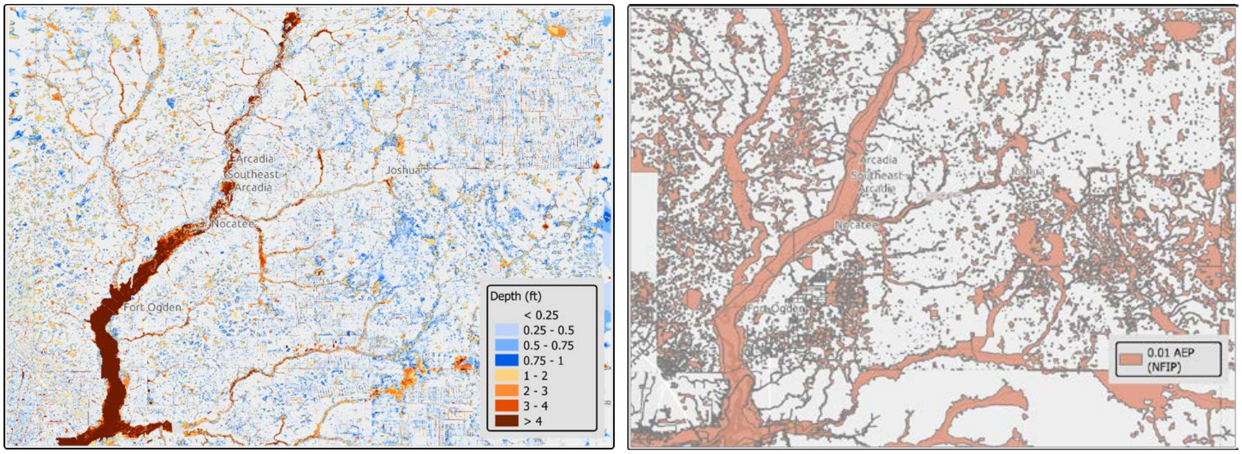
(a) (b)

Figure 177. The same as Figure 173 but for region selected in East Florida (St. Lucie).



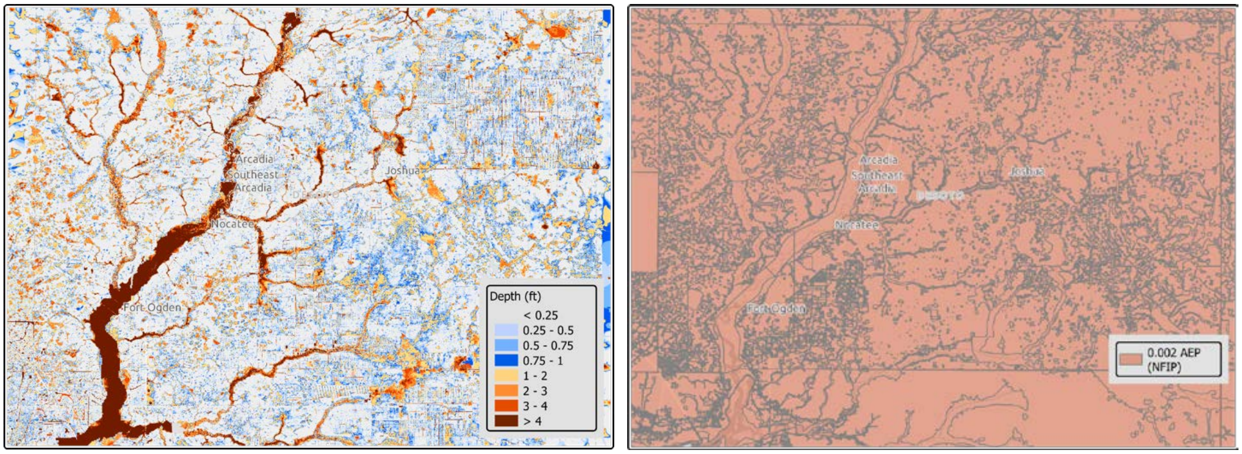
(a) (b)

Figure 178. The same as Figure 174 but for region selected in East Florida (St. Lucie).



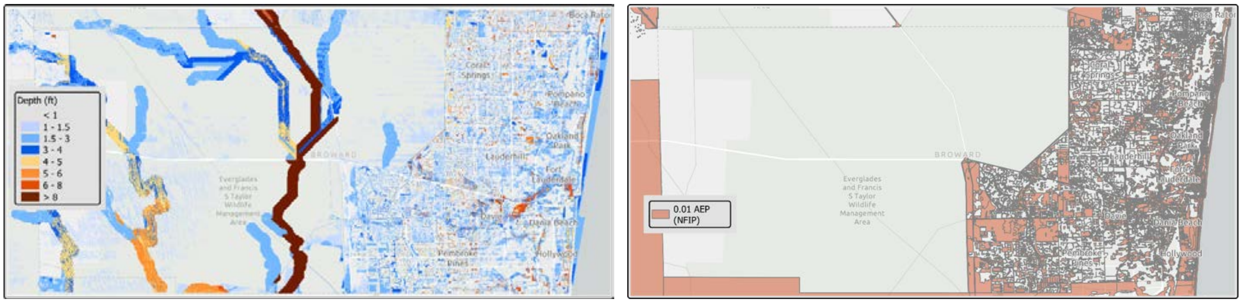
(a) (b)

Figure 179. The same as Figure 173 but for region selected in Southwest Florida (DeSoto).



(a) (b)

Figure 180. The same as Figure 174 but for region selected in Southwest Florida (DeSoto).



(a) (b)

Figure 181. The same as Figure 173 but for region selected in Southeast Florida (Broward).

(a) (b)

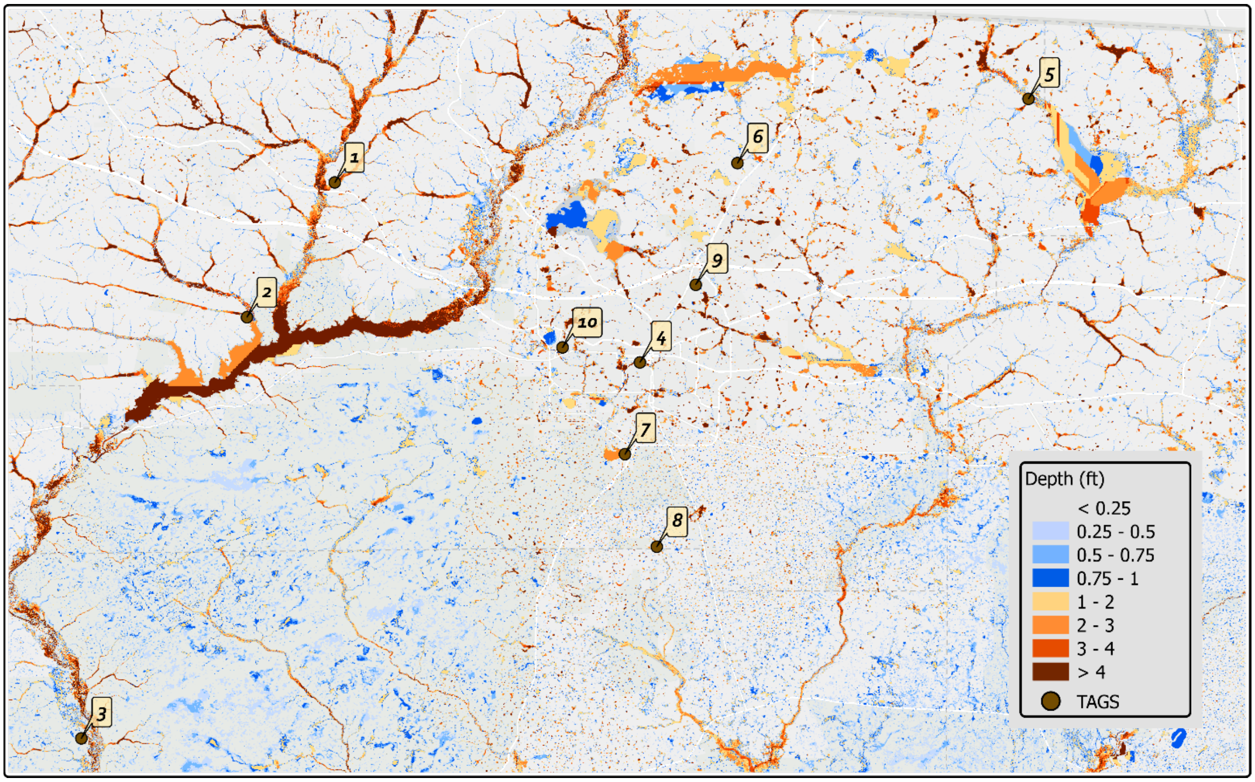
Figure 182. The same as Figure 174 but for region selected in Southeast Florida (Broward).

3. Graphs and tables, based on the underlying gridded data, showing flood model results at 10 or more locations within the study area and representative of the range of flood conditions in the study area. The following flood characteristics should be included for the 0.1 0.02, 0.01, and 0.002 annual exceedance probabilities:

a. Flood elevations,

a. Flood depths,

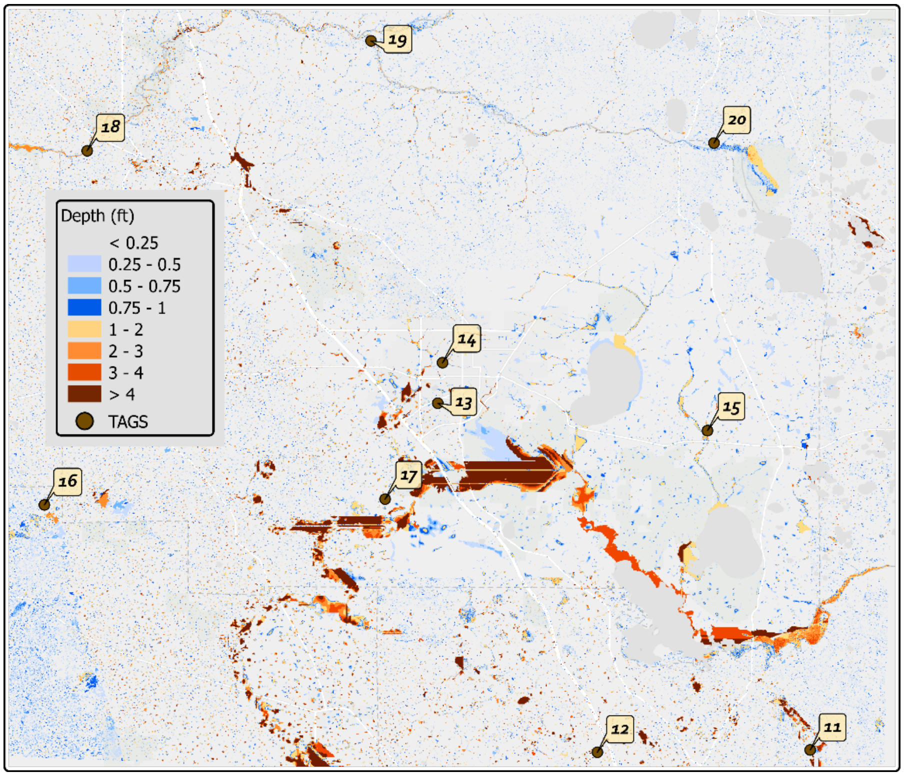
Region in Panhandle (Leon County)



Area: Panhandle			Depth (ft)			
TAGS	Longitude	Latitude	0.1 AEP	0.02 AEP	0.01 AEP	0.002 AEP
1	-84.503	30.559	0.58	2.42	3.33	5.42
2	-84.564	30.465	0.42	1.67	2.33	3.33
3	-84.680	30.171	0.33	2.50	4.42	9.08
4	-84.290	30.434	0.08	0.17	0.42	1.17
5	-84.019	30.618	0.08	0.17	0.75	2.75
6	-84.222	30.573	0.00	0.00	0.00	0.08
7	-84.300	30.369	0.00	0.08	0.08	1.25
8	-84.278	30.305	0.00	0.42	1.08	2.08
9	-84.251	30.488	0.08	0.08	0.08	0.25
10	-84.344	30.444	0.33	0.83	1.58	3.17

Figure 183. Flood model locations for selected region in the Panhandle (Leon) that represent a range of flood conditions.

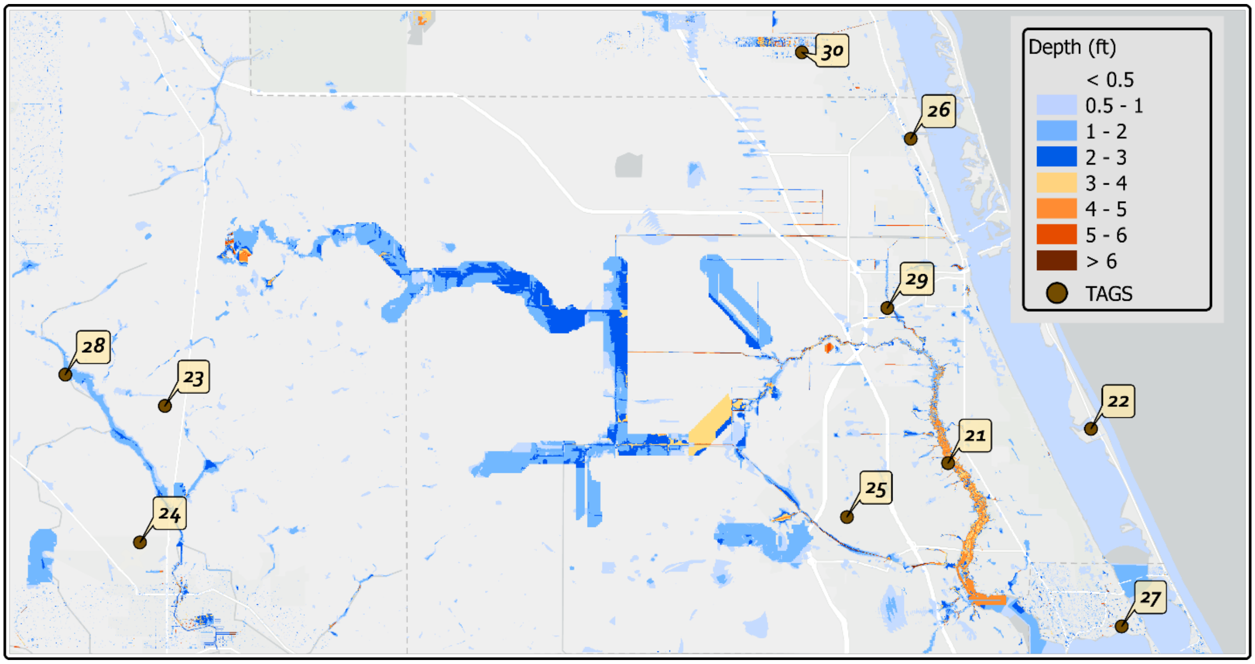
Region in North Florida (Alachua)



Area: North Florida			Depth (ft)			
TAGS	Longitude	Latitude	0.1 AEP	0.02 AEP	0.01 AEP	0.002 AEP
11	-82.063	29.356	0.00	0.00	0.00	0.00
12	-82.232	29.354	0.00	0.00	0.00	3.67
13	-82.359	29.631	0.00	0.00	0.00	0.00
14	-82.355	29.663	0.00	0.42	0.58	0.92
15	-82.145	29.609	0.58	2.17	3.17	4.17
16	-82.671	29.550	0.58	1.08	1.08	1.08
17	-82.401	29.555	0.17	2.92	3.42	5.25
18	-82.637	29.831	0.00	0.00	1.00	4.92
19	-82.412	29.918	0.00	0.00	0.00	0.42
20	-82.140	29.837	0.25	0.33	0.33	0.33

Figure 184. The same as Figure 183 but for North Florida (Alachua).

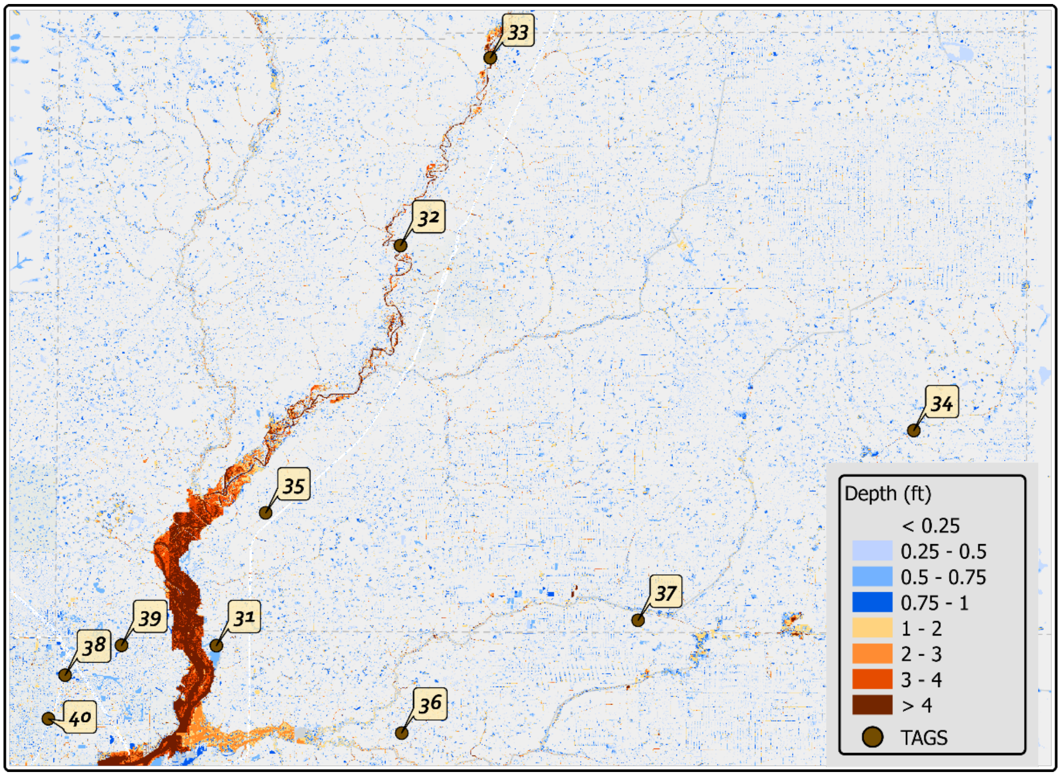
Region in East Florida (St. Lucie)



Area: East Florida			Depth (ft)			
TAGS	Longitude	Latitude	0.1 AEP	0.02 AEP	0.01 AEP	0.002 AEP
21	-80.336	27.327	0.00	0.08	0.75	2.00
22	-80.246	27.348	0.42	0.75	0.92	1.33
23	-80.831	27.363	0.08	0.17	0.33	0.83
24	-80.847	27.277	0.08	0.33	0.50	0.83
25	-80.400	27.293	0.58	0.75	0.83	1.08
26	-80.360	27.531	1.67	2.67	2.75	2.83
27	-80.227	27.223	0.00	0.75	1.25	2.67
28	-80.894	27.383	0.83	1.83	1.83	2.42
29	-80.375	27.424	0.17	0.50	0.92	1.58
30	-80.429	27.586	0.25	0.50	0.67	1.00

Figure 185. The same as Figure 183 but for East Florida (St. Lucie).

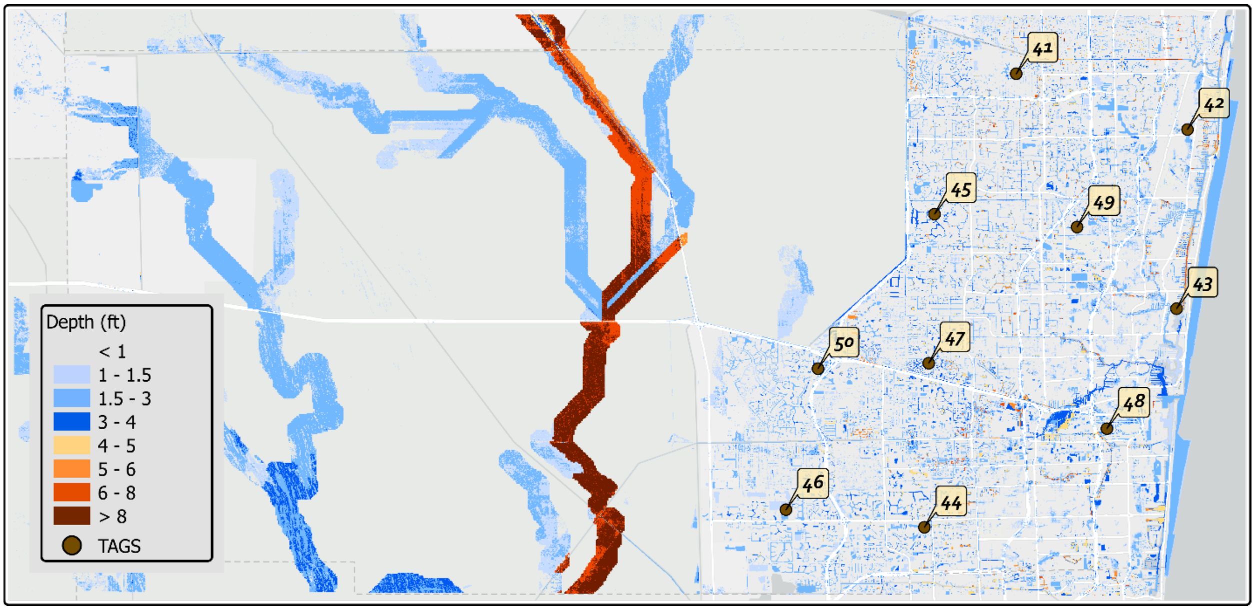
Region in Southwest Florida (DeSoto)



Area: Southwest Florida			Depth (ft)			
TAGS	Longitude	Latitude	0.1 AEP	0.02 AEP	0.01 AEP	0.002 AEP
31	-81.976	27.028	0.00	0.08	0.58	1.50
32	-81.882	27.232	0.00	0.00	0.00	0.67
33	-81.836	27.327	0.50	12.00	12.92	15.25
34	-81.620	27.137	0.00	0.42	0.75	1.08
35	-81.950	27.095	0.00	0.00	0.00	0.33
36	-81.881	26.983	0.33	0.67	0.75	0.92
37	-81.761	27.041	0.00	0.00	0.00	0.00
38	-82.053	27.013	0.08	0.17	0.17	0.50
39	-82.024	27.028	0.00	0.00	0.17	0.42
40	-82.061	26.990	0.08	0.17	0.42	0.67

Figure 186. The same as Figure 183 but for Southwest Florida (DeSoto).

Region in Southeast Florida (Broward)



Area: Southeast Florida			Depth (ft)			
TAGS	Longitude	Latitude	0.1 AEP	0.02 AEP	0.01 AEP	0.002 AEP
41	-80.221	26.318	0.08	0.83	0.92	1.42
42	-80.102	26.279	1.08	1.42	1.58	1.83
43	-80.110	26.155	0.50	0.58	0.75	1.67
44	-80.285	26.003	0.00	0.00	0.17	1.08
45	-80.278	26.221	0.00	0.25	0.58	1.58
46	-80.381	26.015	0.00	0.00	0.17	1.25
47	-80.282	26.117	0.25	0.92	1.25	2.58
48	-80.158	26.072	0.25	0.75	1.17	1.92
49	-80.179	26.212	0.75	1.58	1.83	2.50
50	-80.359	26.113	0.00	0.08	0.17	0.67

Figure 187. The same as Figure 183 but for Southeast Florida (Broward).

b. If the flood vulnerability model requires explicit representation of flood-induced erosion effects, the erosion depth (original ground elevation minus eroded ground elevation),

The flood vulnerability model does not require explicit representation of flood induced erosion effects.

c. If the flood vulnerability model requires explicit representation of flow velocity effects, the flow and flow velocities, and

The flood vulnerability model does not require explicit representation of flow velocity effects.

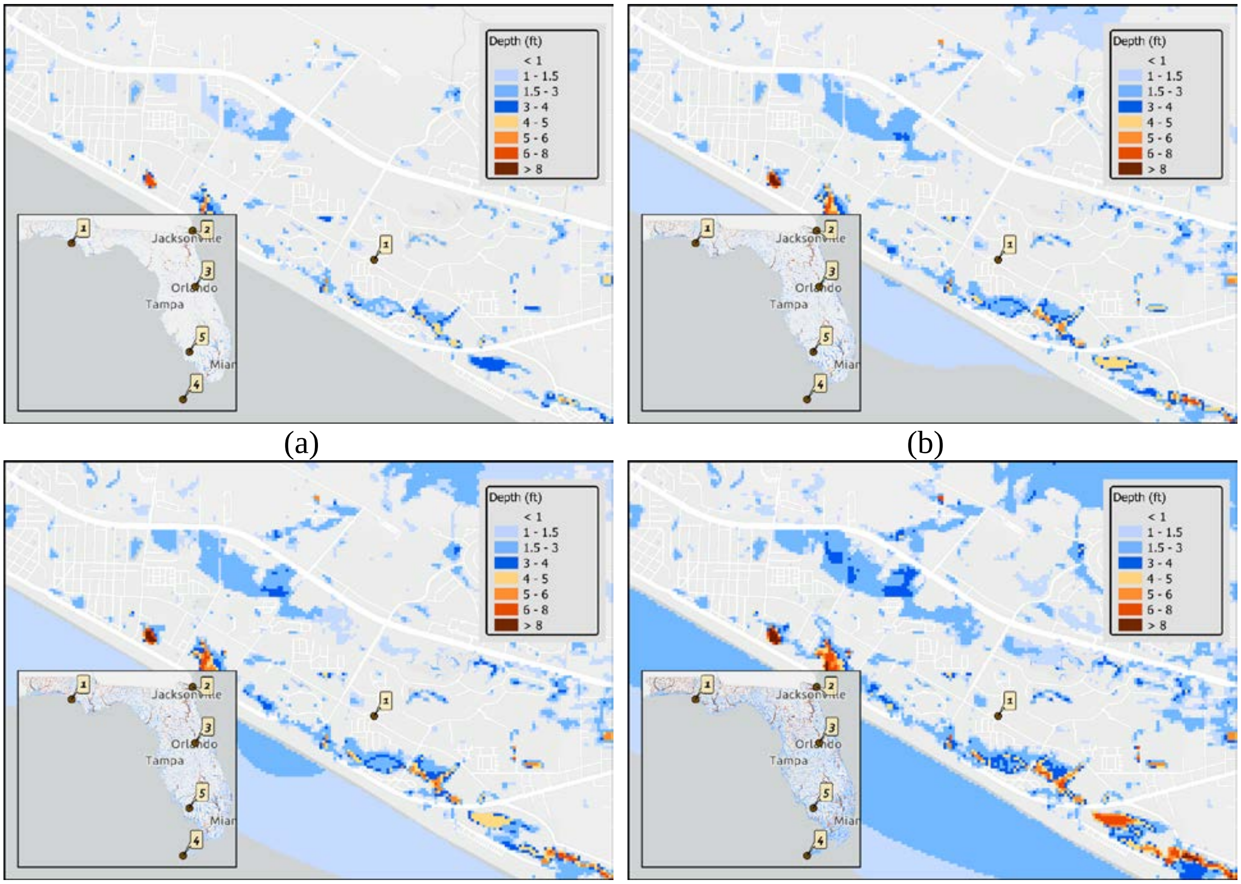
d. If the flood vulnerability model requires explicit representation of flood inundation duration effects, the duration of flood inundation.

The flood vulnerability model does not require explicit representation of flood inundation duration effects.

B. Provide color-coded contour or high-resolution maps for areas surrounding the following five locations, showing modeled flood extent and elevation or depth corresponding to the 0.1, 0.02, 0.01, 0.002 annual exceedance probabilities.

The extent of each area is to be determined by the modeling organization and should be sufficient to determine inland flooding conditions for the location. For locations subject to both inland and coastal flooding, this information should reflect only inland flooding. Flood extent and elevation or depth should incorporate the effects of flood-induced erosion, if modeled.

1. Panama City Beach (The Glades, 30.18685/-85.81320)

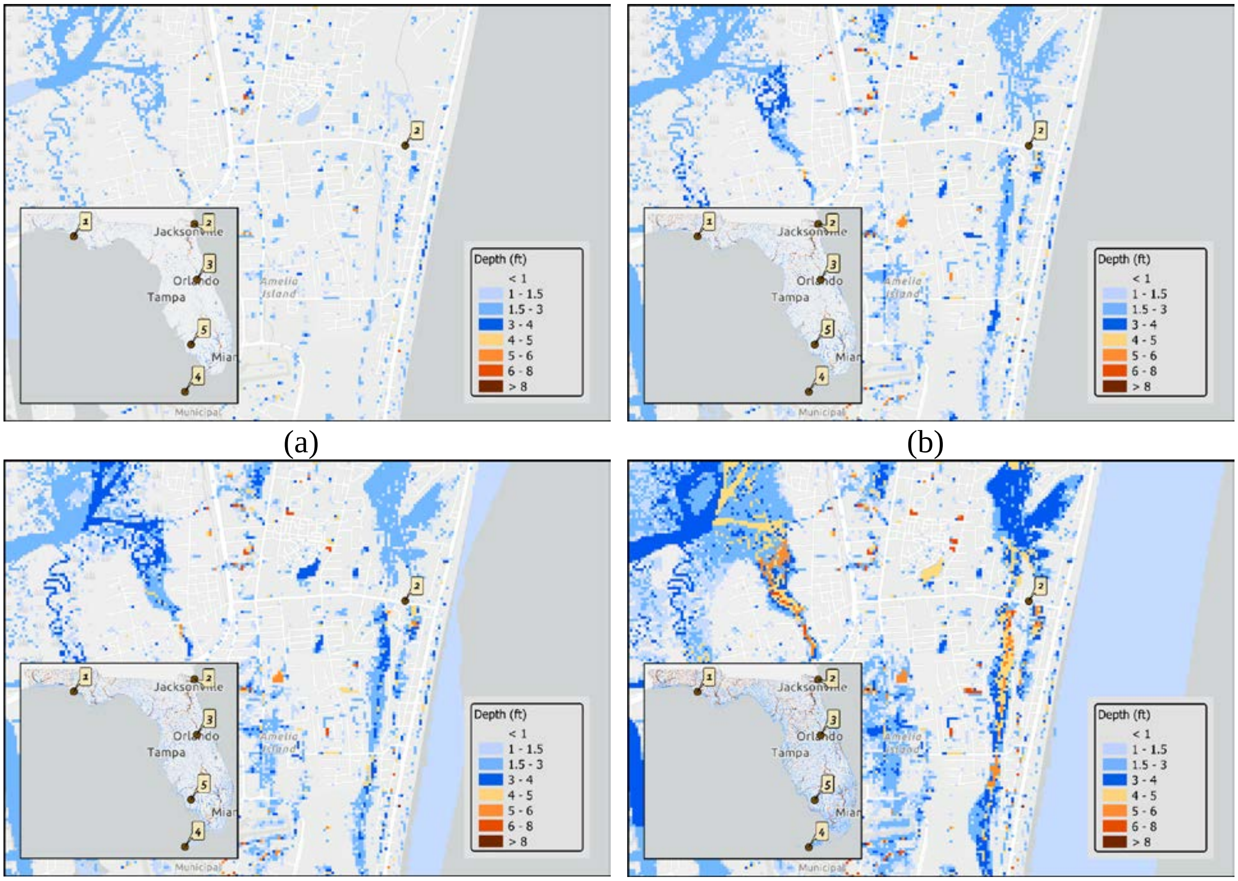


(a) (b)

(c) (d)

Figure 188. Modeled flood extent and depth for (a) 0.1, (b) 0.02, (c) 0.01, and (d) 0.002 annual exceedance probabilities for the area surrounding the Panama City Beach.

2. Fernandina Beach (Egans Creek, 30.63935/-81.44037)

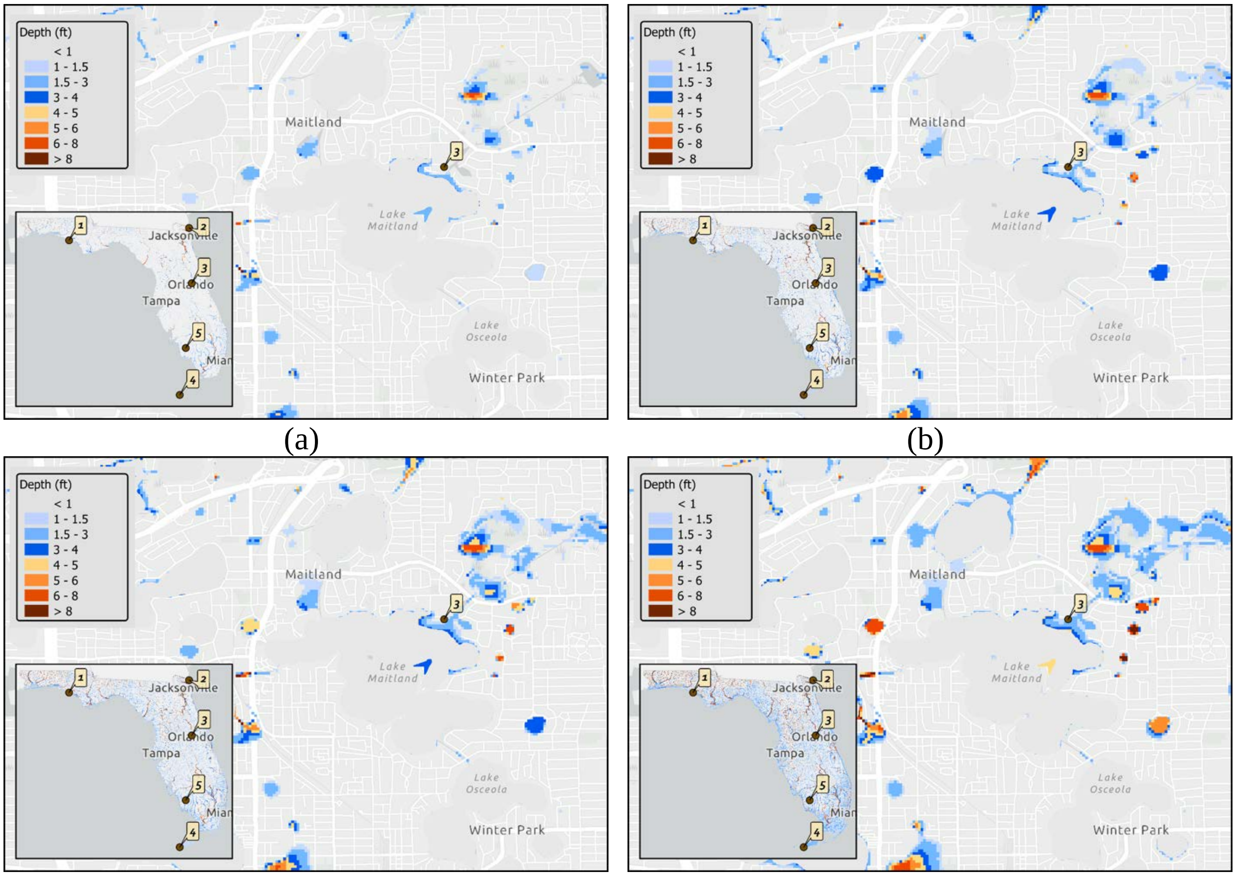


(a) (b)

(c) (d)

Figure 189. The same as Figure 188 but for Fernandina Beach.

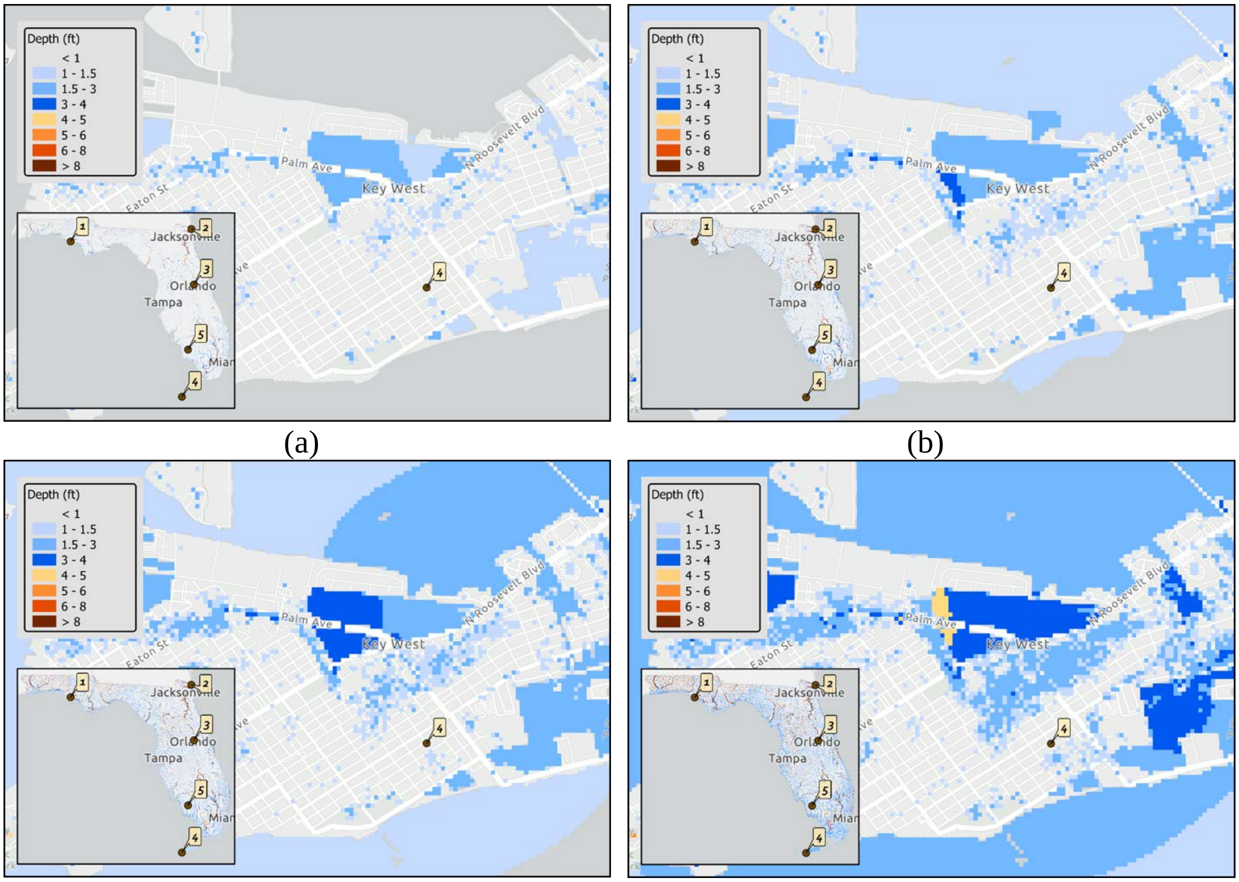
3. Winter Park (Chain of Lakes, 28.62245/-81.34538)



(a) (b) (c) (d)

Figure 190. The same as Figure 188 but for Winter Park.

4. Key West (District 5, 24.55319/-81.78150)

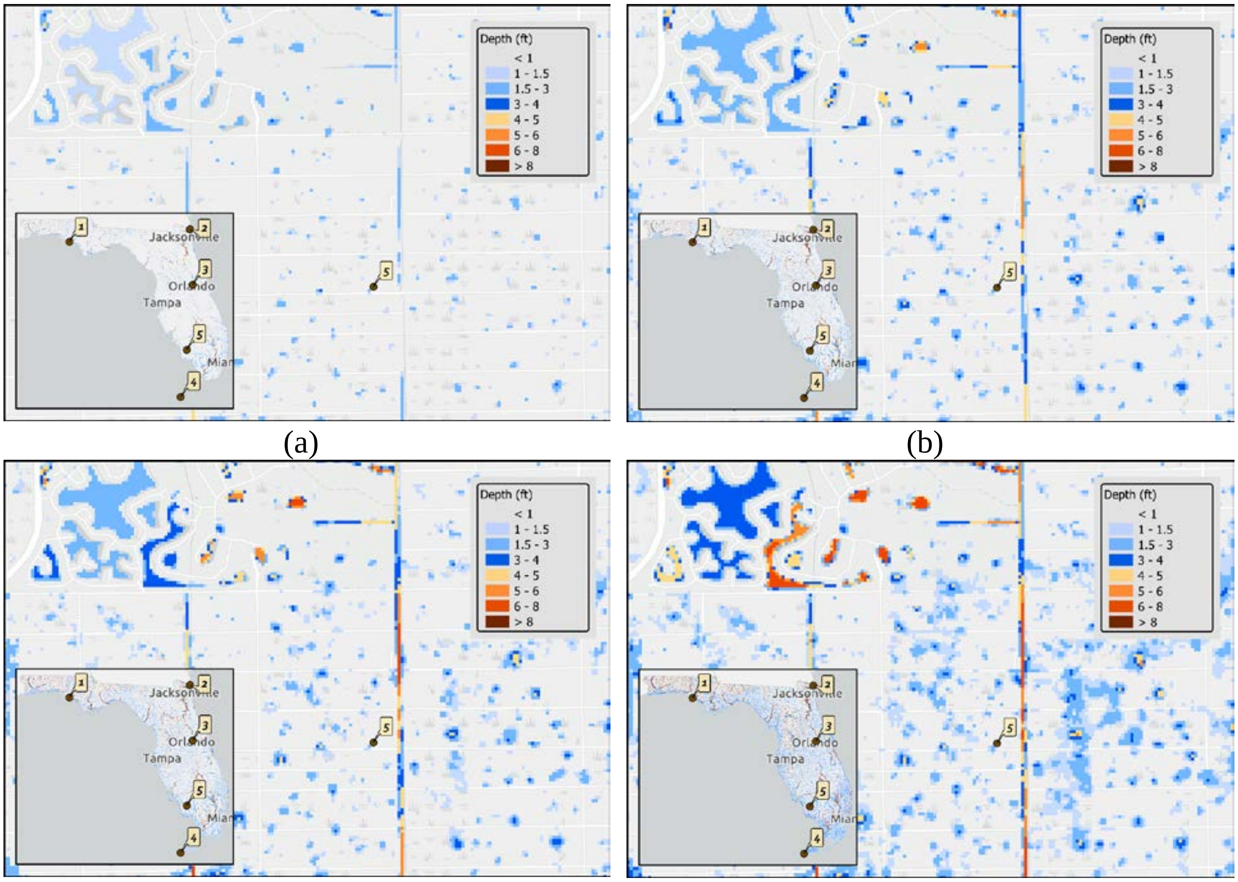


(a) (b)

(c) (d)

Figure 191. The same as Figure 188 but for Key West.

5. Naples (Golden Gate Estates, 26.263814/-81.564169)



(a) (b)

(c) (d)

Figure 192. The same as Figure 188 but for Naples.

Form SF-1: Distributions of Stochastic Flood Parameters (Coastal, Inland)

A. Provide the probability distribution functional form used for each stochastic flood parameter in the flood model (one each for coastal and inland flooding). Provide a summary of the justification for each functional form selected for each general classification. Specify the relevant classification (coastal or inland) for each distribution. Year Range Used for Fitting refers to the year range of data upon which the flood model distribution parameters are estimated. Year Range Used for Validation refers to the year range of data upon which the goodness-of-fit statistics are based.

Stochastic Hurricane Parameter (Function or Variable)	Functional Form of Distribution	Data Source	Year Range Used		Justification for Functional Form and Parameter Estimates
			For Fitting	For Validation	
Holland B Error term	Normal	Willoughby and Rahn (2004)	1977-2000	1977-2000	The Gaussian Distribution provided a good fit for the error term. See Standard SF-1, Disclosure 1.
Rmax	Gamma	Ho et al. (1987) , supplemented by the extended best track data of DeMaria (Penington 2000), NOAA HRD research flight data, and NOAA-HRD H*Wind analyses (Powell et al. 1996, 1998).	1901-2021	1901-2021	Rmax is skewed, nonnegative and does not have a long tail. So the gamma distribution was tried and found to be a good fit. We limit the range of Rmax to the interval (4, 120). See Standard SF-1, Disclosure 1.
Pressure decay Term	Normal	Vickery (2005)	1926-2004	1926-2004	From Vickery (2005)
Storm initial location perturbation	Uniform	N/A	N/A	N/A	Plausible variations in initial storm locations are assumed to be uniform
Storm initial motion perturbation	Uniform	N/A	N/A	N/A	Plausible variations in initial storm motion are assumed to be uniform
Storm change in motion and intensity distributions	Empirical	HURDAT2	1900-2021	1900-2021	Sampling from historical data

B. Include Form SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland), in a submission appendix.

Form SF-2: Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined)

A. One or more automated programs or scripts should be used to generate and arrange the data in Form SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined).

Automated scripts were used to generate data for Flood Loss Exceedance Estimates in Part A.

B. Provide estimates of the annual aggregate personal residential insured flood losses for various probability levels using a modeling-organization-specified, predetermined, and comprehensive exposure dataset justified by the modeling organization. Provide the total average annual flood loss for the loss exceedance distribution. If the modeling methodology does not allow the flood model to produce a viable answer for certain return periods, state so and why.

Part A

Return Period (Years)	**Annual Probability of Exceedance**	**Estimated Flood Loss Level Modeling Organization Exposure Dataset**
Top Event	N/A	32008385188.39
10000	0.0001	25376158935.87
5000	0.0002	23155003714.37
2000	0.0005	18831492632.34
1000	0.001	14982521534.86
500	0.002	11567120195.07
250	0.004	8135812861.50
100	0.01	4612965368.95
50	0.02	2573763856.10
20	0.05	964159143.20
10	0.1	409262234.92
5	0.2	122942514.63

Part B

Mean (Total Average Annual Loss)	233726570.62
Median	1611871.54
Standard Deviation	1078078168.36
Interquartile Range	70112158.73
Sample Size	73200

C. Include Form SF-2, Examples of Flood Loss Exceedance Estimates (Coastal and Inland Combined), in a submission appendix.

Form VF-1: Coastal Flood with Damaging Wave Action

A. Sample personal residential exposure data for 8 reference buildings as defined below and 26 stillwater flood depths (0-25 feet at 1-foot increments) are provided in the file named "VFEventFormsInput21.xlsx." Model the sample personal residential exposure data provided in the file versus the Stillwater flood depths, and provide the damage/exposure ratios summarized by flood depth and construction type. Estimated Damage for each individual flood depth is the sum of ground up loss to all reference buildings in the flood depth range, excluding demand surge. Personal residential contents, appurtenant structures, or time element coverages are not included.

Reference Buildings

Wood Frame	Masonry	Manufactured Home
#1 One story Crawlspace foundation Top of foundation wall 3 feet above grade	#4 One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls	#7 Manufactured post 1994 Dry stack concrete foundation Pier height 3 feet above grade Tie downs Single unit
#2 Two story Slab foundation Top of slab 1 foot above grade 5/8" diameter anchors at 48" centers for wall/slab connections	#5 Two story Slab foundation Top of slab 1 foot above grade Reinforced masonry exterior walls	#8 Manufactured post 1994 Reinforced masonry pier foundation Pier height 6 feet above grade Tie downs Single unit
#3 Two story Timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	#6 Two story Concrete pile foundation Concrete slab Top of pile 8 feet above grade Reinforced masonry exterior walls	

See form VF-1 below.

B. Confirm that the buildings used in completing the form are identical to those in the above table for the reference buildings.

The modelers do confirm that the buildings used in completing the form are identical to those in the table provided.

C. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a description of how they are included.

The form was filled for the case of coastal flood with severe waves.

D. Provide a plot of the stillwater flood depth versus estimated damage/subject exposure data.

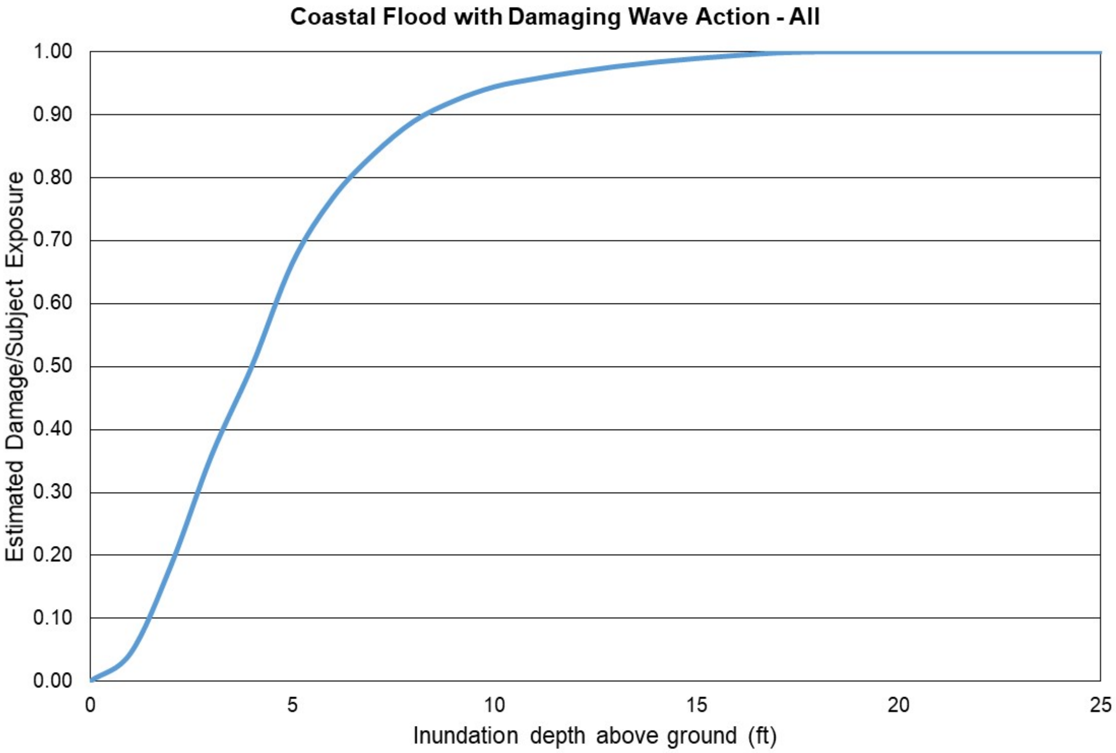


Figure 193. Coastal flood estimated damage vs inundation depth. All reference buildings combined.

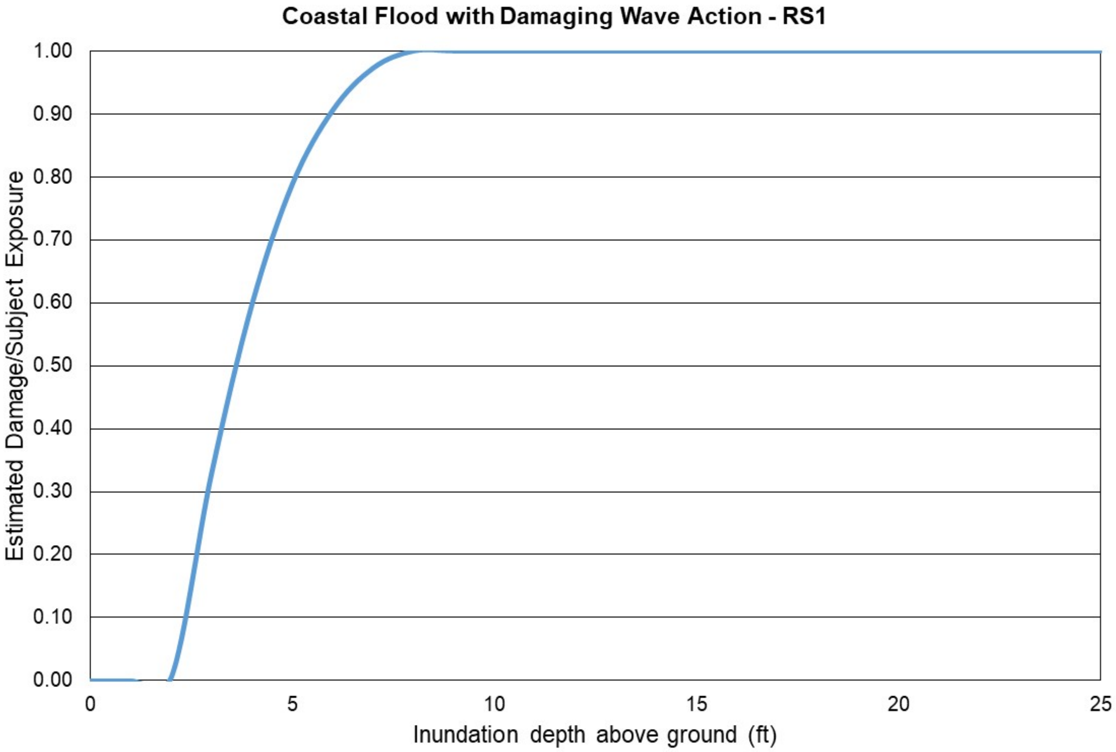


Figure 194. Coastal flood estimated damage vs inundation depth, Reference Building 1.

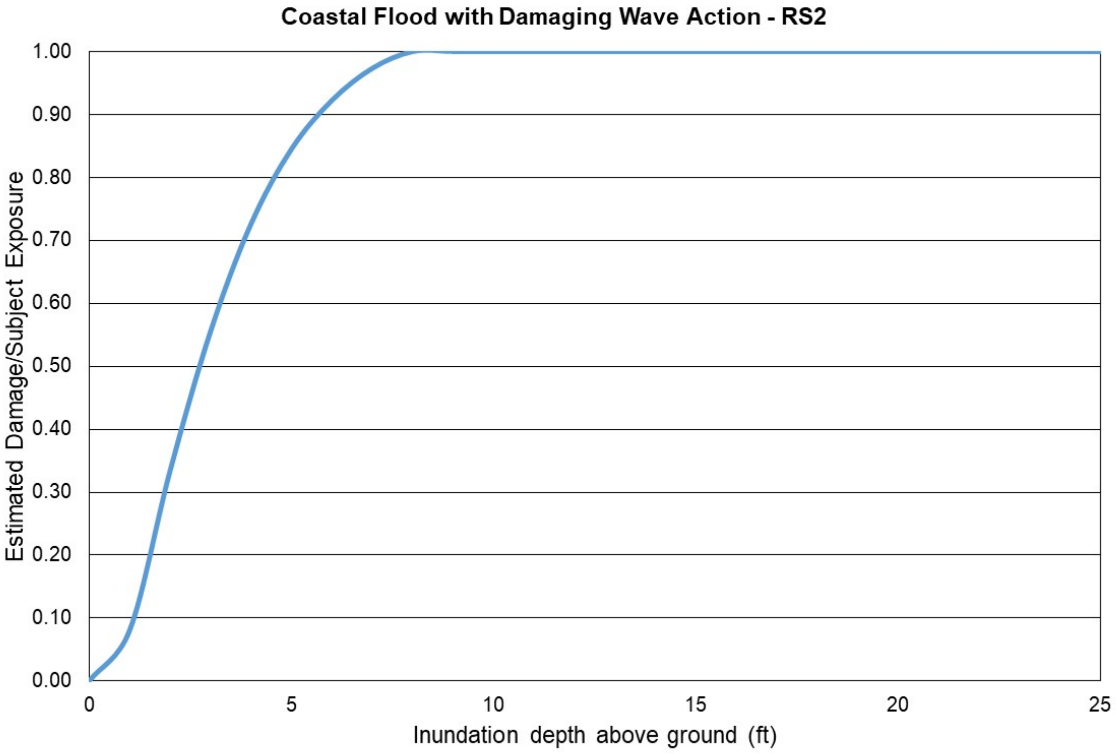


Figure 195. Coastal flood estimated damage vs inundation depth, Reference Building 2.

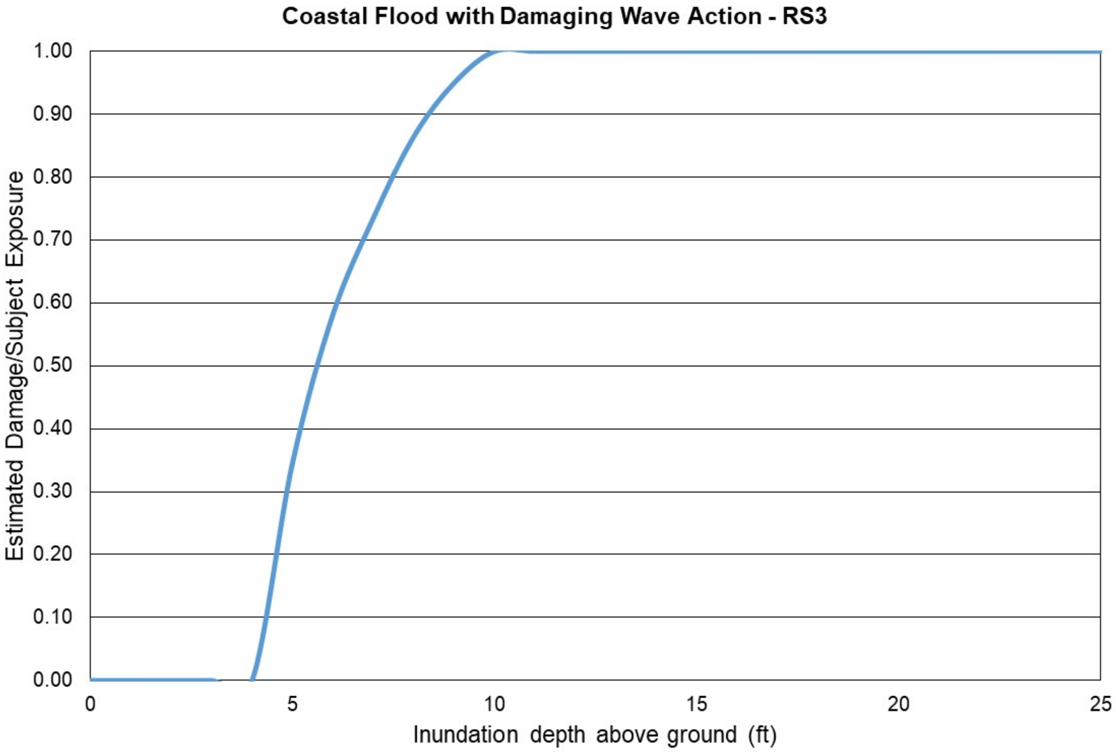


Figure 196. Coastal flood estimated damage vs inundation depth, Reference Building 3.

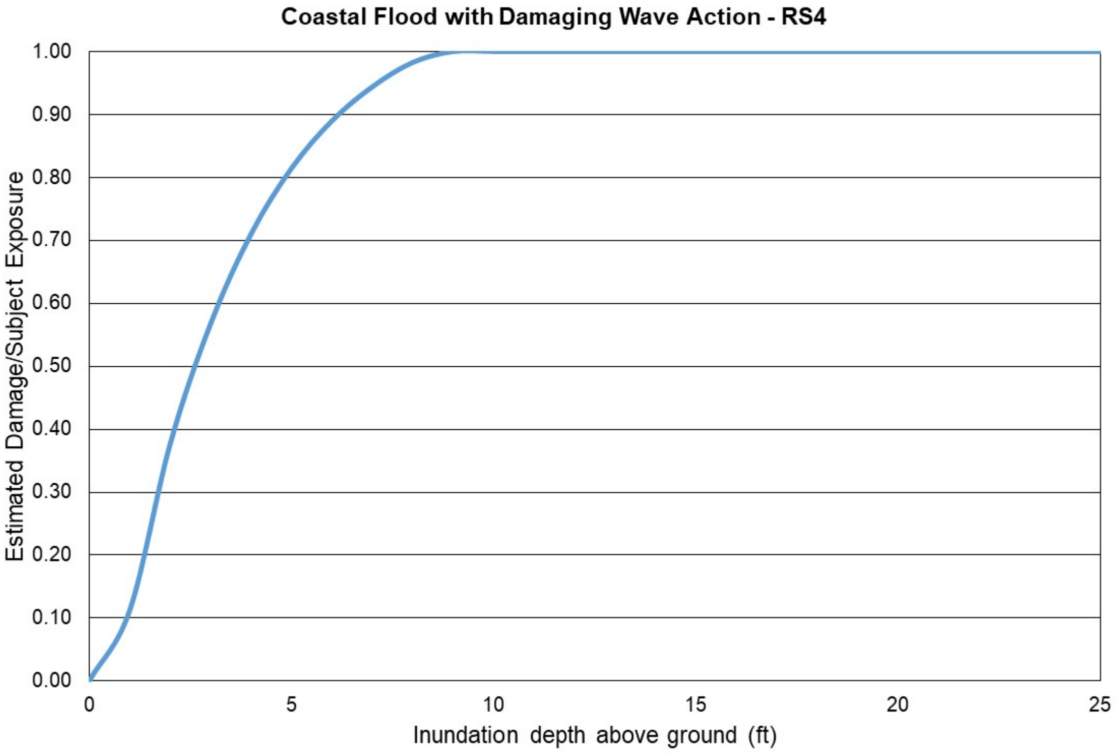


Figure 197. Coastal flood estimated damage vs inundation depth, Reference Building 4.

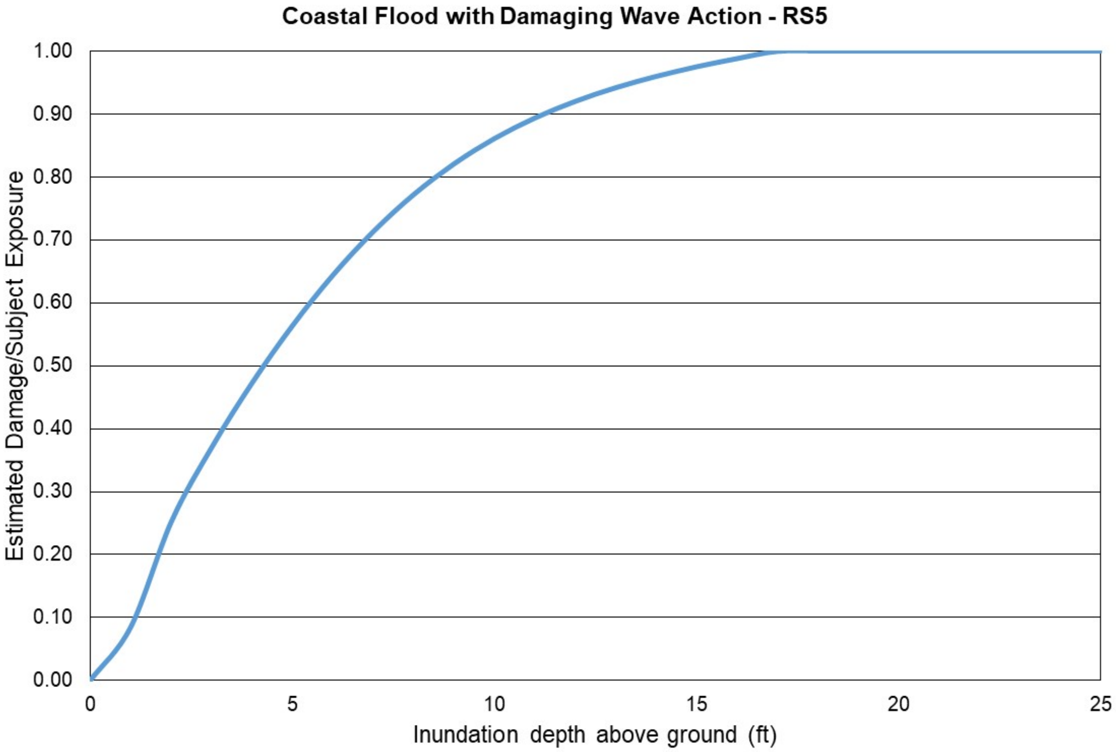


Figure 198. Coastal flood estimated damage vs inundation depth, Reference Building 5.

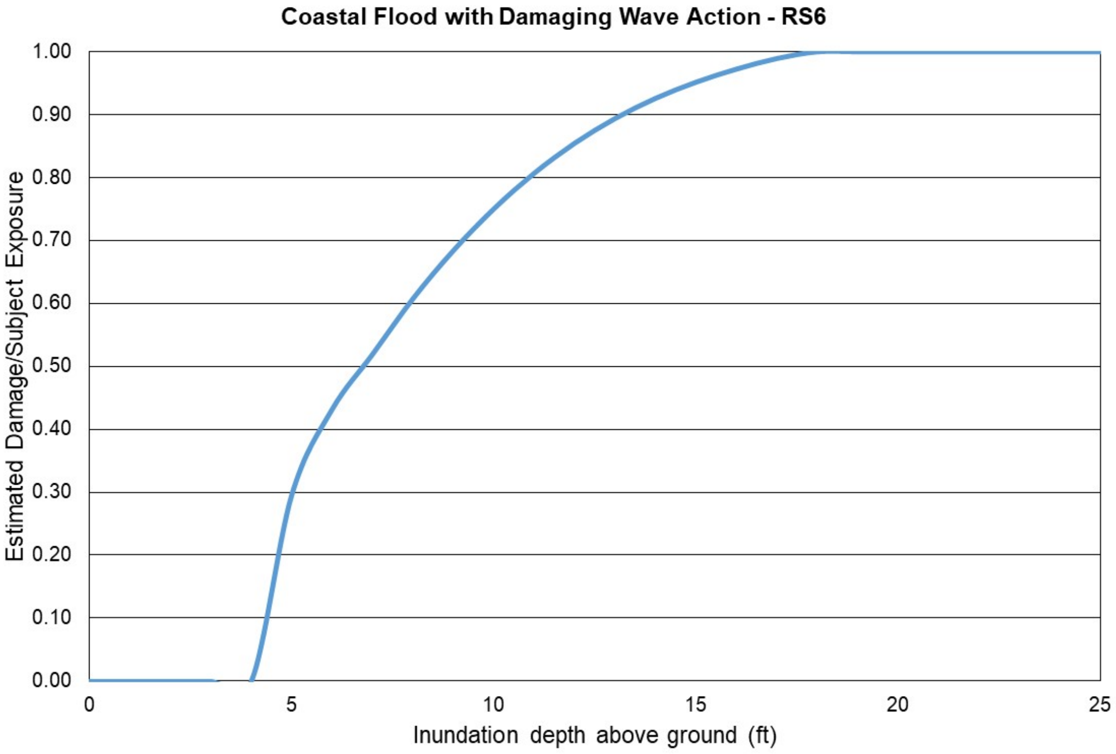


Figure 199. Coastal flood estimated damage vs inundation depth, Reference Building 6.

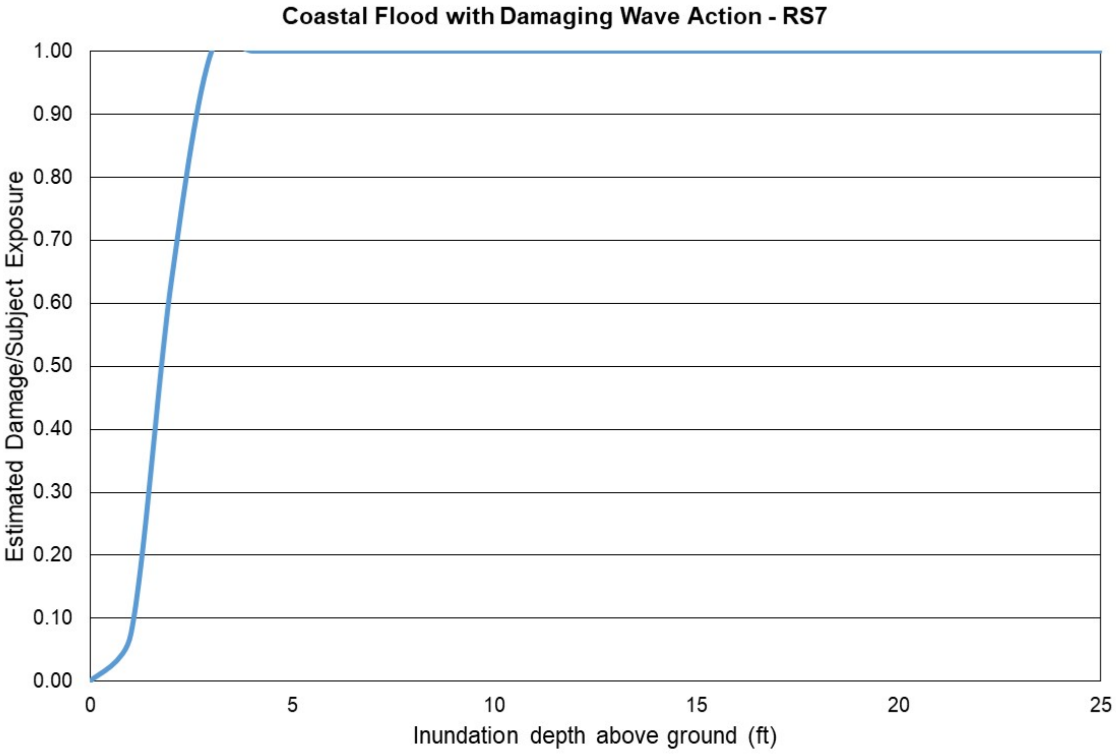


Figure 200. Coastal flood estimated damage vs inundation depth, Reference Building 7.

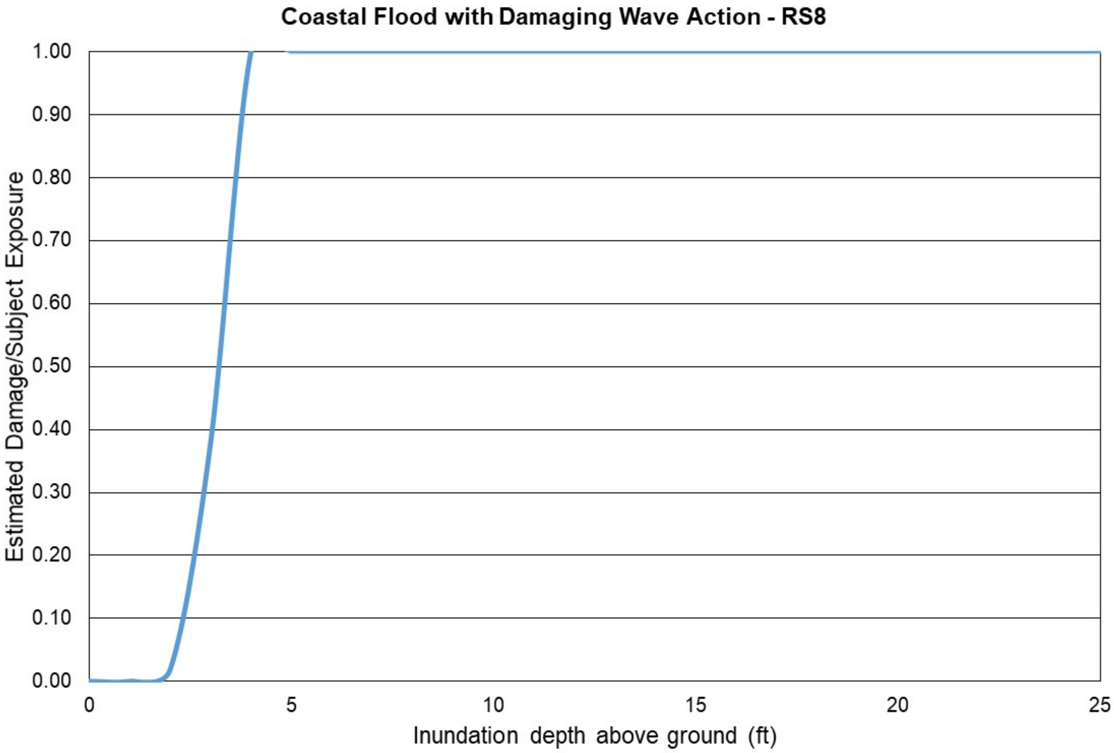


Figure 201. Coastal flood estimated damage vs inundation depth, Reference Building 8.

E. Include Form VF-1, Coastal Flood with Damaging Wave Action, in a submission appendix.

All reference buildings combined

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.04
2	0.18
3	0.36
4	0.50
5	0.66
6	0.77
7	0.84
8	0.89
9	0.92
10	0.94
11	0.96
12	0.97
13	0.98
14	0.98
15	0.99
16	0.99
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 1

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.00
2	0.01
3	0.33
4	0.60
5	0.79
6	0.91
7	0.97
8	1.00
9	1.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 2

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.08
2	0.33
3	0.56
4	0.73
5	0.85
6	0.92
7	0.97
8	1.00
9	1.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 3

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.00
2	0.00
3	0.00
4	0.00
5	0.35
6	0.58
7	0.73
8	0.86
9	0.95
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 4

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.11
2	0.38
3	0.57
4	0.71
5	0.81
6	0.89
7	0.94
8	0.98
9	1.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 5

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.08
2	0.25
3	0.37
4	0.47
5	0.56
6	0.64
7	0.71
8	0.77
9	0.82
10	0.86
11	0.89
12	0.92
13	0.94
14	0.96
15	0.97
16	0.99
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 6

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.00
2	0.00
3	0.00
4	0.00
5	0.30
6	0.43
7	0.52
8	0.61
9	0.68
10	0.75
11	0.81
12	0.85
13	0.89
14	0.93
15	0.95
16	0.97
17	0.99
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 7

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.07
2	0.63
3	1.00
4	1.00
5	1.00
6	1.00
7	1.00
8	1.00
9	1.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 8

Stillwater Flood **Depth (Feet) Above Ground Level**	**Estimated Damage/ Subject Exposure**
0	0.00
1	0.00
2	0.02
3	0.38
4	1.00
5	1.00
6	1.00
7	1.00
8	1.00
9	1.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Form VF-2: Inland Flood by Flood Depth

A. Sample personal residential exposure data for 8 reference buildings as defined below and 26 flood depths (0-25 feet at 1-foot increments) are provided in the file named "VFEventFormsInput21.xlsx." Model the sample personal residential exposure data provided in the file versus the flood depths, and provide the damage/exposure ratios summarized by flood depth and construction type. Estimated Damage for each individual flood depth is the sum of ground up loss to all reference buildings in the flood depth range, excluding demand surge. Personal residential contents, appurtenant structures, or time element coverages are not included.

Reference Buildings

Wood Frame	Masonry	Manufactured Home
#1 One story Crawlspace foundation Top of foundation wall 3 feet above grade	#4 One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls	#7 Manufactured post 1994 Dry stack concrete foundation Pier height 3 feet above grade Tie downs Single unit
#2 Two story Slab foundation Top of slab 1 foot above grade 5/8" diameter anchors at 48" centers for wall/slab connections	#5 Two story Slab foundation Top of slab 1 foot above grade Reinforced masonry exterior walls	#8 Manufactured post 1994 Reinforced masonry pier foundation Pier height 6 feet above grade Tie downs Single unit
#3 Two story Timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	#6 Two story Concrete pile foundation Concrete slab Top of pile 8 feet above grade Reinforced masonry exterior walls	

See form VF-2 below.

B. Confirm that the buildings used in completing the form are identical to those in the above table for the reference buildings.

The modelers do confirm that the buildings used in completing the form are identical to those in the table provided.

C. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a description of how they are included.

No assumptions were made filling this form.

D. Provide a plot of the flood depth versus estimated damage/subject exposure data.

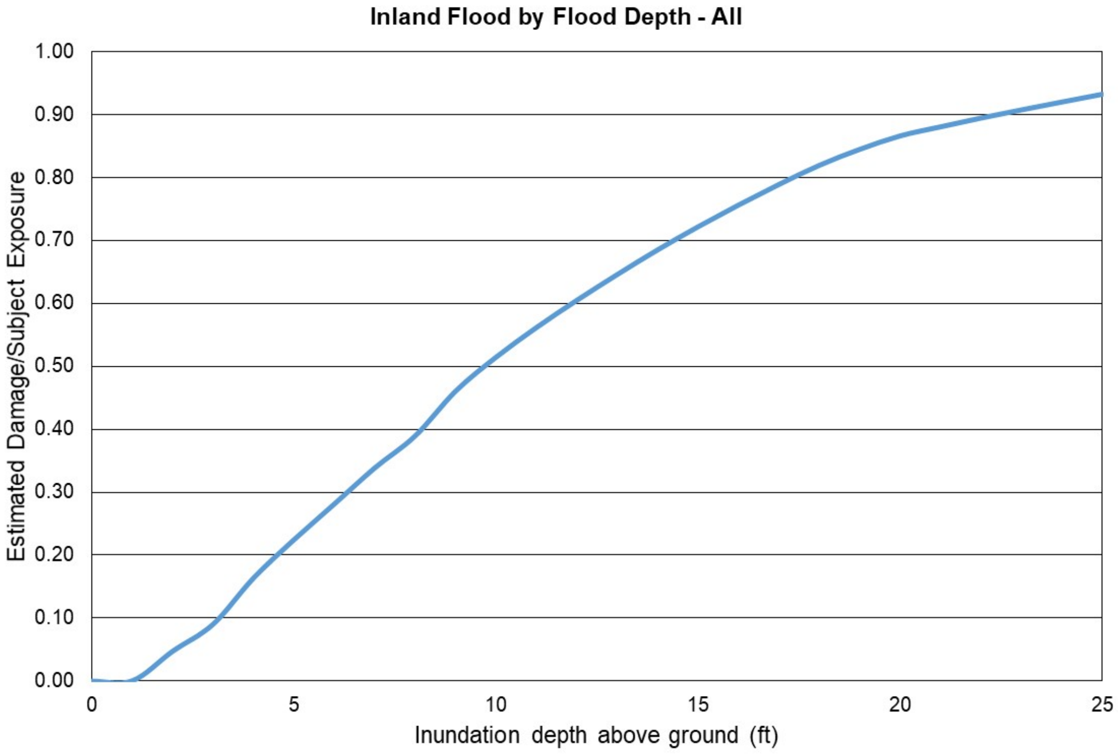


Figure 202. Inland flood estimated damage vs inundation depth – All reference buildings combined.

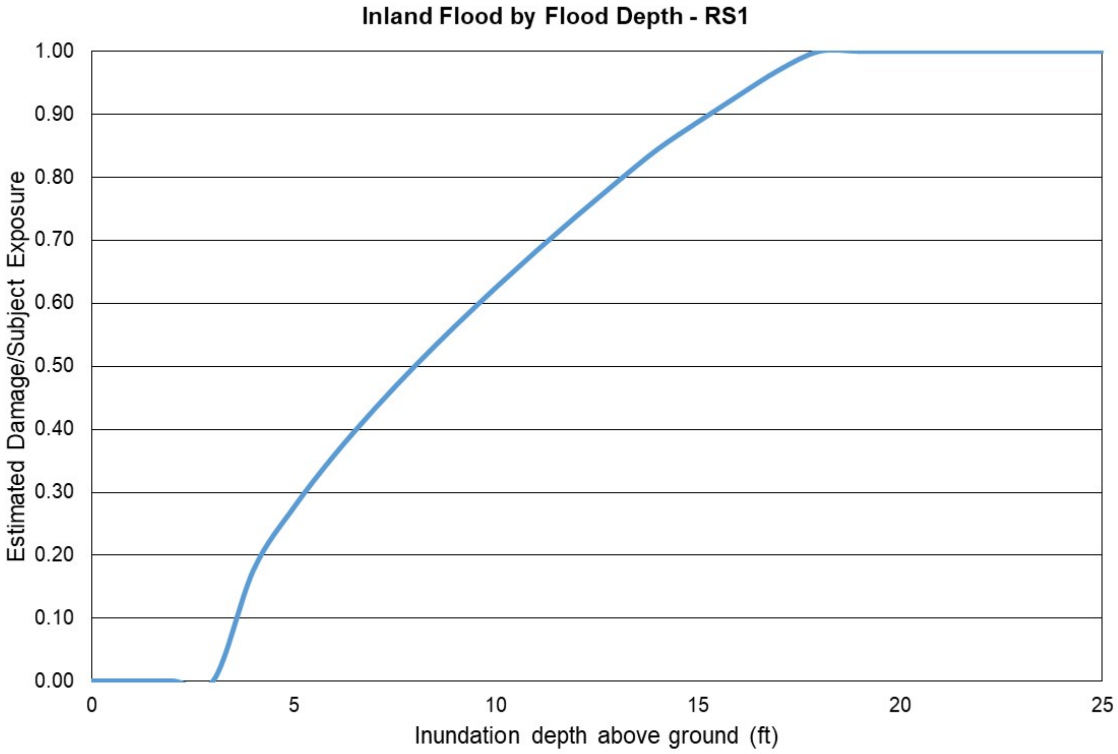


Figure 203. Inland flood estimated damage vs inundation depth, Reference Building 1.

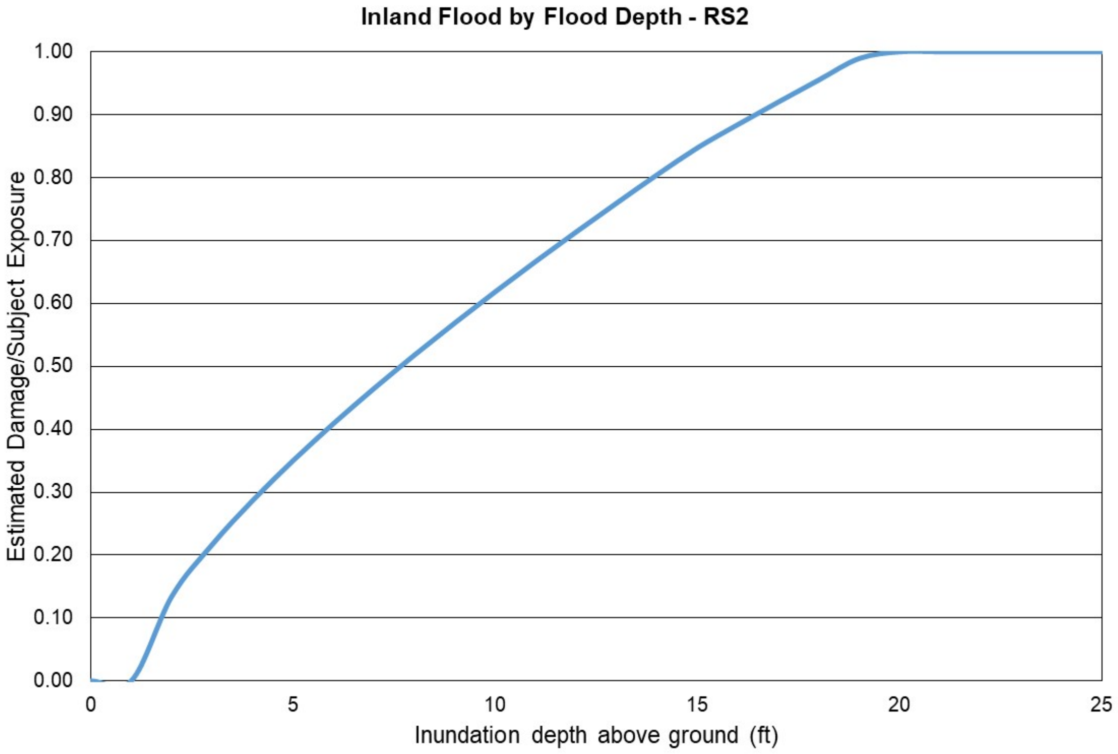


Figure 204. Inland flood estimated damage vs inundation depth, Reference Building 2.

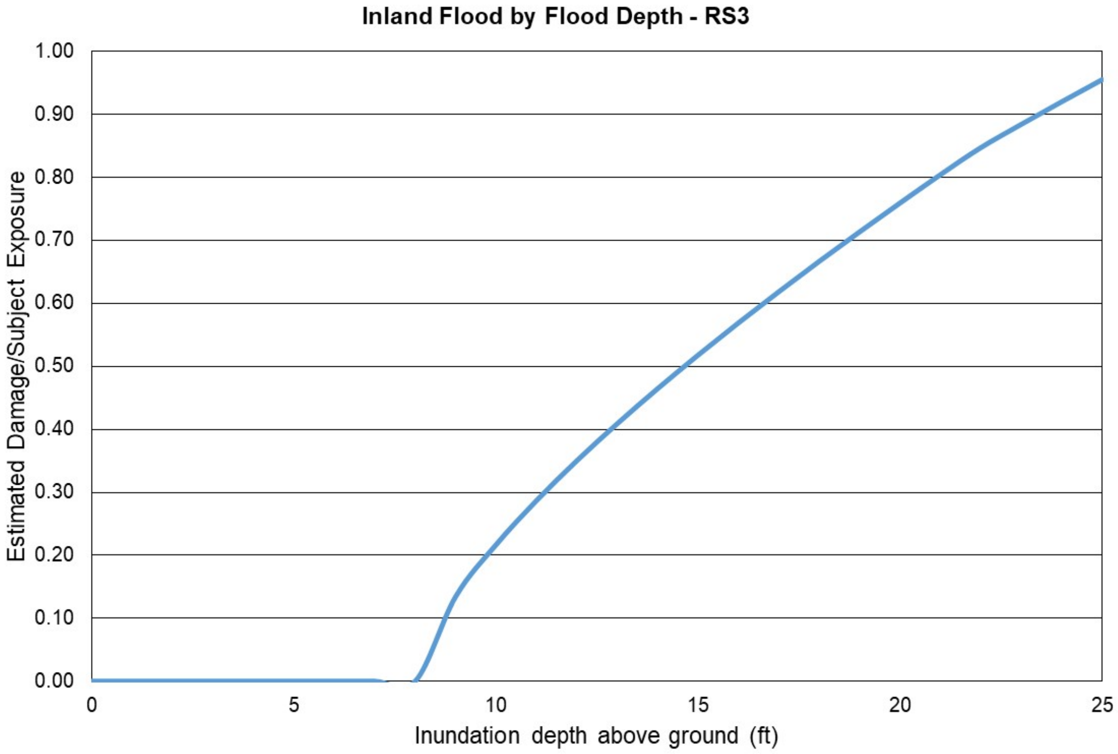


Figure 205. Inland flood estimated damage vs inundation depth, Reference Building 3.

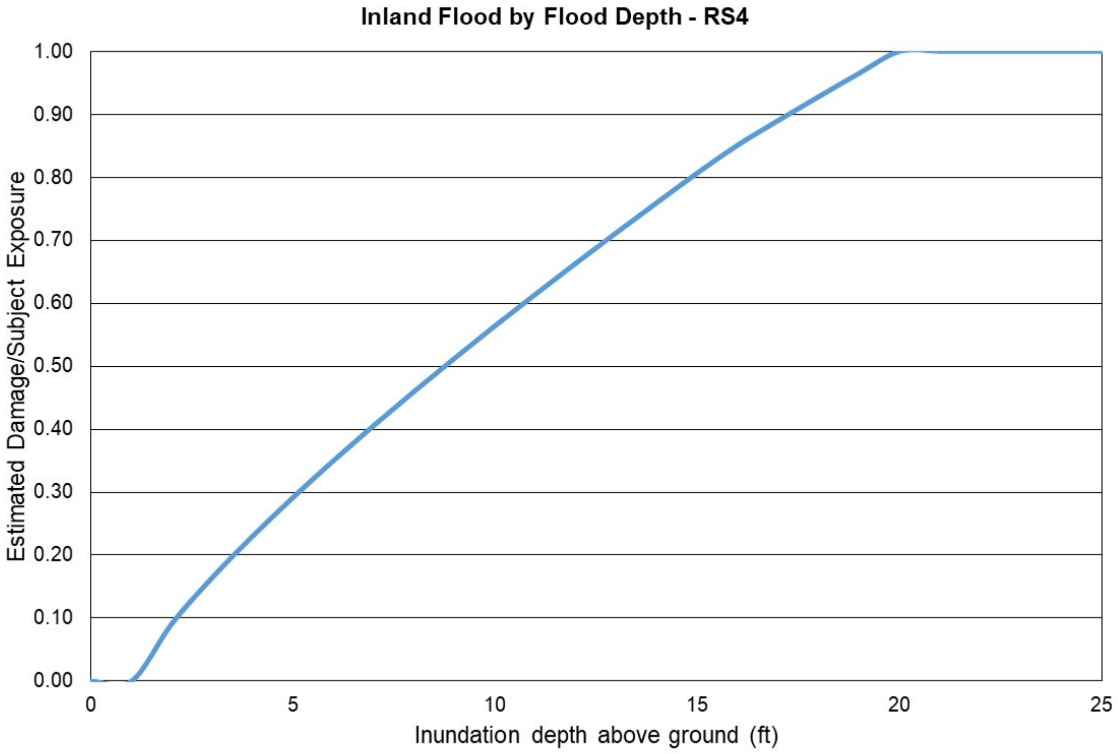


Figure 206. Inland flood estimated damage vs inundation depth, Reference Building 4.

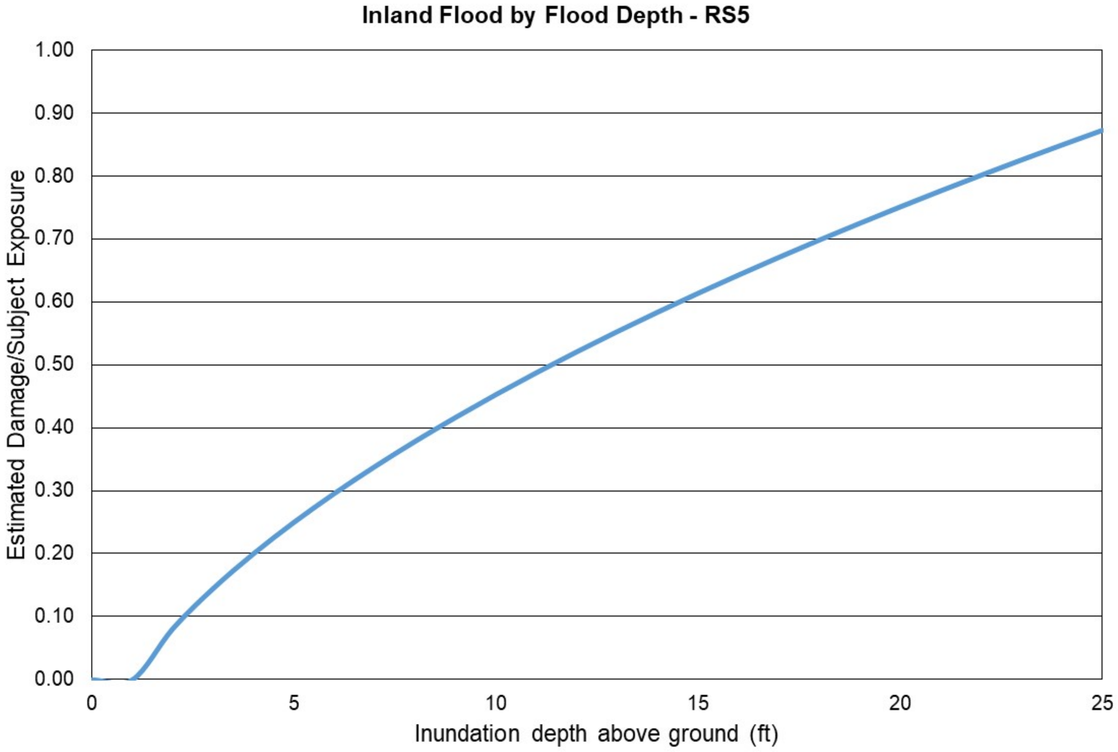


Figure 207. Inland flood estimated damage vs inundation depth, Reference Building 5.

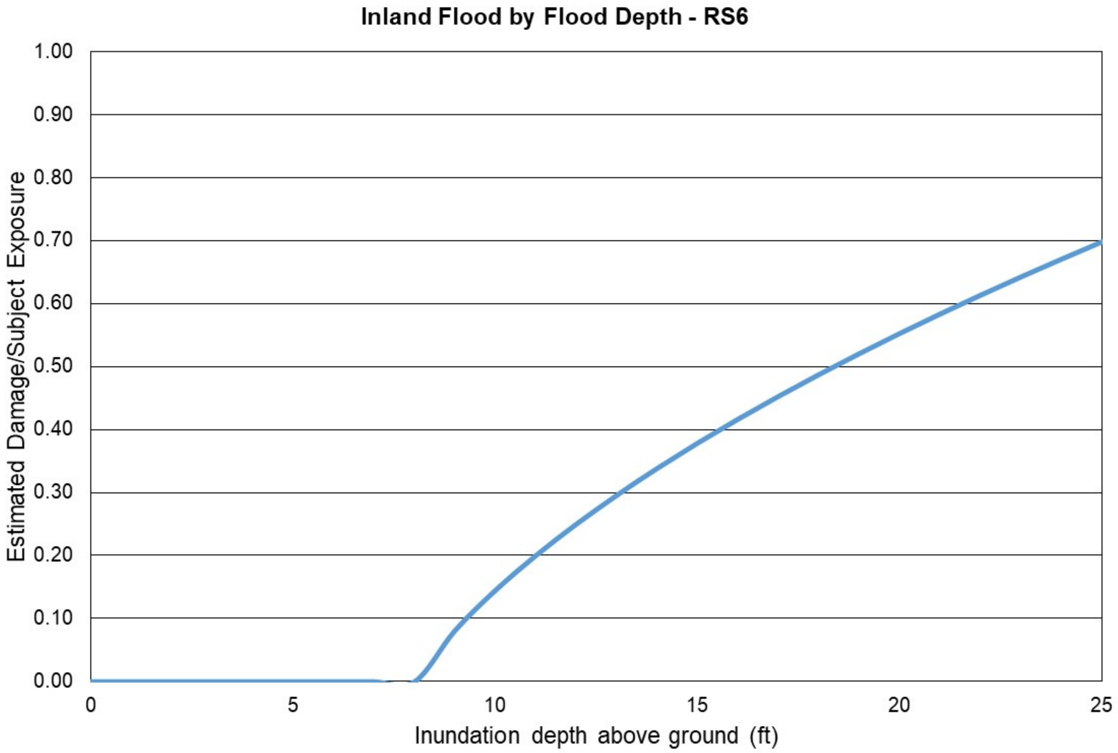


Figure 208. Inland flood estimated damage vs inundation depth, Reference Building 6.

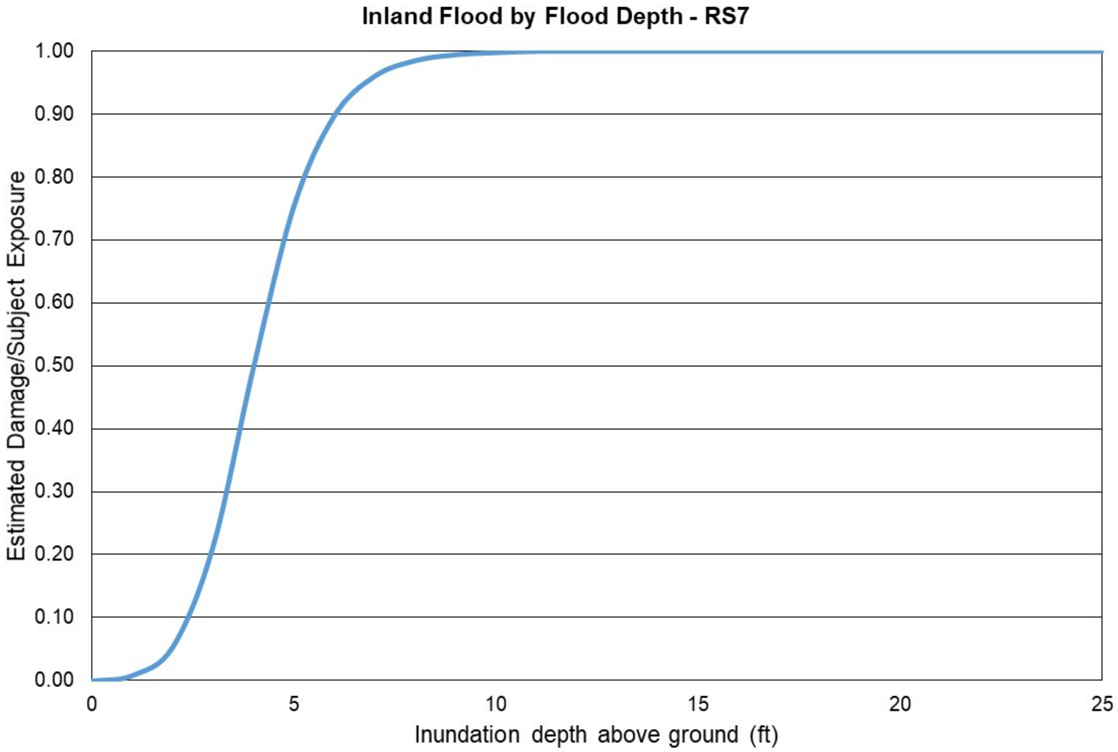


Figure 209. Inland flood estimated damage vs inundation depth, Reference Building 7.

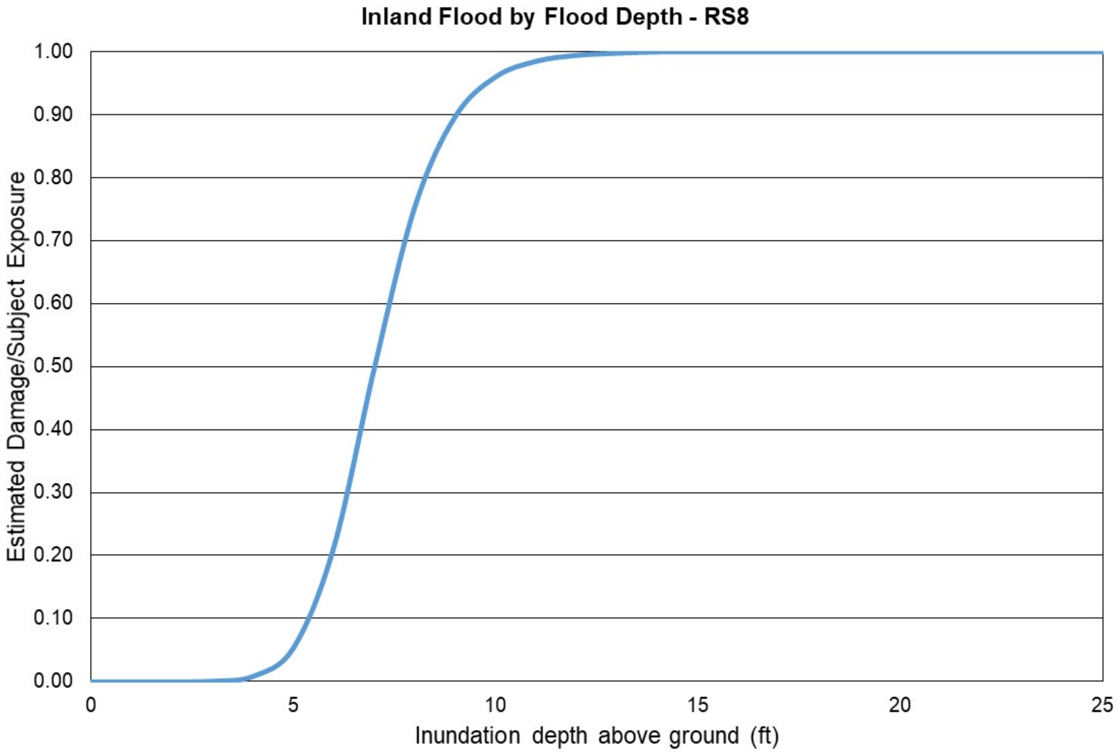


Figure 210. Inland flood estimated damage vs inundation depth, Reference Building 8.

E. Include Form VF-2, Inland Flood by Flood Depth, in a submission appendix.

All reference buildings combined.

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.00
2	0.05
3	0.09
4	0.16
5	0.22
6	0.28
7	0.34
8	0.39
9	0.46
10	0.51
11	0.56
12	0.60
13	0.65
14	0.69
15	0.72
16	0.76
17	0.79
18	0.82
19	0.84
20	0.87
21	0.88
22	0.89
23	0.91
24	0.92
25	0.93

Reference building 1

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.00
2	0.00
3	0.00
4	0.18
5	0.28
6	0.36
7	0.43
8	0.50
9	0.56
10	0.62
11	0.68
12	0.74
13	0.79
14	0.84
15	0.89
16	0.93
17	0.97
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 2

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.00
2	0.13
3	0.22
4	0.29
5	0.35
6	0.41
7	0.46
8	0.52
9	0.57
10	0.62
11	0.67
12	0.71
13	0.76
14	0.80
15	0.85
16	0.88
17	0.92
18	0.96
19	0.99
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 3

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.00
8	0.00
9	0.13
10	0.22
11	0.29
12	0.35
13	0.41
14	0.46
15	0.52
16	0.57
17	0.62
18	0.67
19	0.71
20	0.76
21	0.80
22	0.85
23	0.88
24	0.92
25	0.96

Reference building 4

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.00
2	0.09
3	0.16
4	0.23
5	0.29
6	0.35
7	0.41
8	0.46
9	0.51
10	0.56
11	0.61
12	0.66
13	0.71
14	0.76
15	0.81
16	0.85
17	0.89
18	0.93
19	0.97
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 5

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.00
2	0.08
3	0.14
4	0.20
5	0.25
6	0.30
7	0.34
8	0.38
9	0.42
10	0.45
11	0.49
12	0.52
13	0.55
14	0.58
15	0.61
16	0.64
17	0.67
18	0.70
19	0.72
20	0.75
21	0.78
22	0.80
23	0.82
24	0.85
25	0.87

Reference building 6

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.00
8	0.00
9	0.08
10	0.14
11	0.20
12	0.25
13	0.30
14	0.34
15	0.38
16	0.42
17	0.45
18	0.49
19	0.52
20	0.55
21	0.58
22	0.61
23	0.64
24	0.67
25	0.70

Reference building 7

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.01
2	0.05
3	0.21
4	0.50
5	0.75
6	0.90
7	0.96
8	0.99
9	0.99
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Reference building 8

Flood Depth (Feet) Above Ground Level	Estimated Damage/ Subject Exposure
0	0.00
1	0.00
2	0.00
3	0.00
4	0.01
5	0.05
6	0.21
7	0.50
8	0.75
9	0.90
10	0.96
11	0.99
12	0.99
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00
25	1.00

Form VF-3: Flood Mitigation Measures, Range of Changes in Flood Damage

A. Provide the change in the personal residential reference building damage ratio (not loss cost) for each individual flood mitigation measure listed in Form VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage, as well as for the combination of the flood mitigation measures. Personal residential contents, appurtenant structures, or time-element coverages are not included.

See Forms VF-3 below for both coastal and inland flood.

B. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

In the case of coastal flood, we filled the form for the case of coastal flood with severe waves, to ensure maximum differentiation between coastal and inland flood results.

C. Provide this form in Excel format without truncation. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form VF-3, Flood Mitigation Measures, Range of Changes in Flood Damage, in a submission appendix.

Reference Buildings

Wood Frame	Masonry
One story Crawlspace foundation Top of foundation wall 3 feet above grade	One story Slab foundation Top of slab 1 foot above grade Unreinforced masonry exterior walls
Two story Timber pile foundation Top of pile 8 feet above grade Wood floor system bolted to piles	

D. Place the reference buildings at the following locations, with latitude and longitude referenced to the World Geodetic System of 1984 (WGS84) datum, and provide the aggregated results.

<u>Gulf of Mexico</u>	***<u>St. Johns River</u>***
Latitude: 27.9957517	***Latitude: 29.3768881***
Longitude: -82.8277373	***Longitude: -81.6190223***

E. Provide the ground elevation used from the flood model elevation database for both reference points.

<u>Gulf of Mexico</u>	<u>St. Johns River</u>
Latitude: 27.9957517	Latitude: 29.3768881

Longitude: -82.8277373
Ground elevation: 1.91 m

Longitude: -81.6190223
Ground elevation: 1.65 m

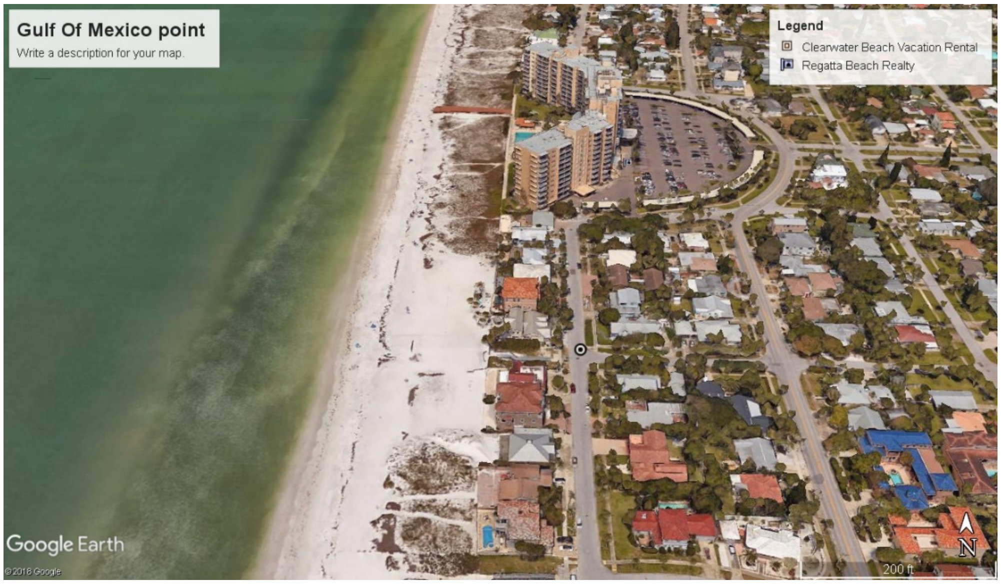


Figure 211. Gulf of Mexico location.

Figure 212. St. Johns River location.

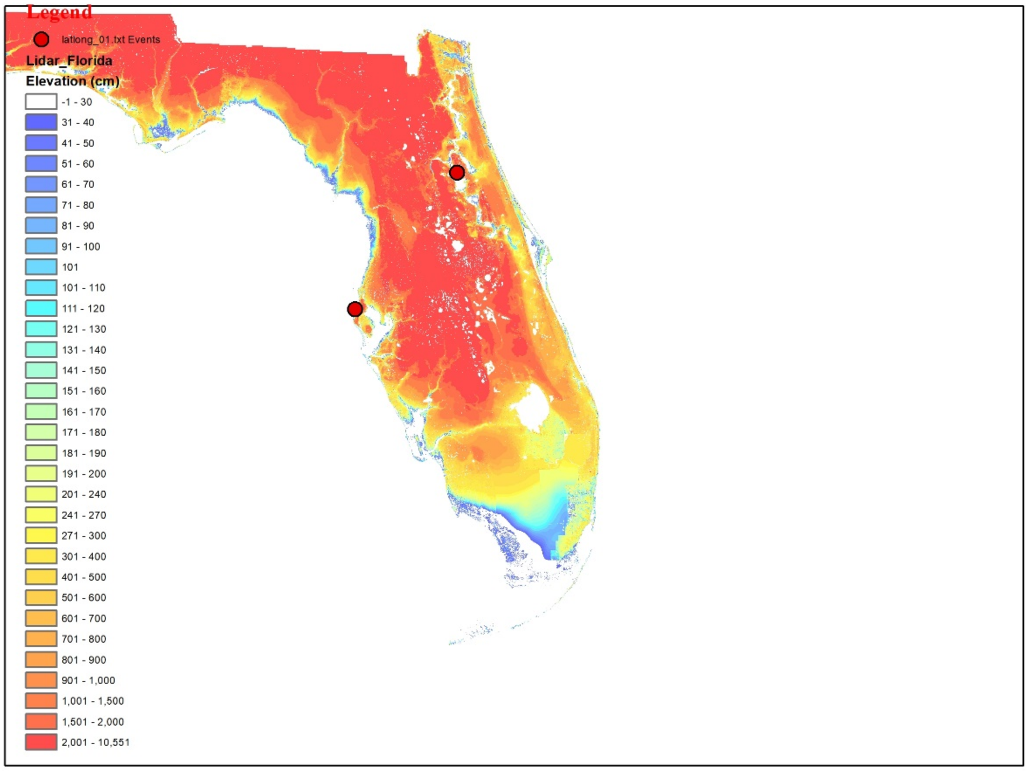


Figure 213. Elevations for the coastal and inland locations from a Digital Elevation Map.

COASTAL

INDIVIDUAL FLOOD MITIGATION MEASURES		PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100									
		TWO-STORY WOOD FRAME BUILDING					MASONRY BUILDING				
		FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND				
		7	9	11	13	15	1	3	5	7	9
	REFERENCE BUILDING	—	—	—	—	—	—	—	—	—	—
ELEVATE BUILDING	Elevate Floor 1 Foot	10%	4%	0%	0%	0%	—	—	—	—	—
	Elevate Floor 2 Feet	23%	10%	0%	0%	0%	—	—	—	—	—
	Elevate Floor 3 Feet	43%	15%	2%	0%	0%	—	—	—	—	—
UTILITY EQUIPMENT	Elevate or Protect 1 Foot	8%	0%	0%	0%	0%	24%	0%	0%	0%	0%
	Elevate or Protect 2 Feet	9%	3%	0%	0%	0%	24%	0%	0%	0%	0%
	Elevate or Protect 3 Feet	9%	5%	0%	0%	0%	24%	12%	0%	0%	0%
FLOODPROOFING	Wet 1 Foot	21%	1%	0%	0%	0%	42%	1%	1%	1%	0%
	Wet 2 Feet	28%	8%	0%	0%	0%	42%	1%	1%	1%	0%
	Wet 3 Feet	32%	13%	0%	0%	0%	42%	25%	1%	1%	0%
	Dry 1 Foot	—	—	—	—	—	58%	1%	1%	1%	0%
	Dry 2 Feet	—	—	—	—	—	58%	1%	1%	1%	0%
	Dry 3 Feet	—	—	—	—	—	58%	28%	1%	1%	0%
FLOOD OPENINGS		ONE-STORY WOOD FRAME BUILDING									
		FLOOD DEPTH (FT) ABOVE GROUND									
		1	3	5	7	9					
	Flood Openings in Foundation Walls	0%	11%	5%	3%	0%	—	—	—	—	—

FLOOD MITIGATION MEASURES IN COMBINATION	PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100									
	TWO-STORY WOOD FRAME BUILDING					MASONRY BUILDING				
	FLOOD DEPTH (FT) ABOVE GROUND					FLOOD DEPTH (FT) ABOVE GROUND				
	7	9	11	13	15	1	3	5	7	9
Elevate Utility Equipment 2 Feet Above Floor and Wet Floodproof Building to 2 Feet	30%	9%	0%	0%	0%	59%	1%	1%	1%	0%

INLAND

INDIVIDUAL FLOOD MITIGATION MEASURES		**PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100**									
		TWO-STORY WOOD FRAME BUILDING					**MASONRY BUILDING**				
		FLOOD DEPTH (FT) ABOVE GROUND					**FLOOD DEPTH (FT) ABOVE GROUND**				
		7	**9**	**11**	**13**	**15**	**1**	**3**	**5**	**7**	**9**
	REFERENCE BUILDING	—	—	—	—	—	—	—	—	—	—
ELEVATE BUILDING	Elevate Floor 1 Foot	0%	100%	24%	14%	10%	—	—	—	—	—
	Elevate Floor 2 Feet	0%	100%	53%	30%	21%	—	—	—	—	—
	Elevate Floor 3 Feet	0%	100%	100%	47%	32%	—	—	—	—	—
UTILITY EQUIPMENT	Elevate or Protect 1 Foot	0%	16%	0%	0%	0%	0%	0%	0%	0%	0%
	Elevate or Protect 2 Feet	0%	16%	0%	0%	0%	0%	18%	0%	0%	0%
	Elevate or Protect 3 Feet	0%	16%	16%	0%	0%	0%	18%	0%	0%	0%
FLOODPROOFING	Wet 1 Foot	0%	45%	0%	0%	0%	0%	0%	0%	0%	0%
	Wet 2 Feet	0%	45%	0%	0%	0%	0%	38%	0%	0%	0%
	Wet 3 Feet	0%	45%	45%	0%	0%	0%	38%	0%	0%	0%
	Dry 1 Foot	—	—	—	—	—	0%	0%	0%	0%	0%
	Dry 2 Feet	—	—	—	—	—	0%	43%	0%	0%	0%
	Dry 3 Feet	—	—	—	—	—	0%	43%	0%	0%	0%
FLOOD OPENINGS		**ONE-STORY WOOD FRAME BUILDING**									
		FLOOD DEPTH (FT) ABOVE GROUND									
		1	3	5	7	9					
	Flood Openings in Foundation Walls	0%	0%	6%	5%	4%	—	—	—	—	—

FLOOD MITIGATION MEASURES IN COMBINATION	**PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100**									
	TWO-STORY WOOD FRAME BUILDING					**MASONRY BUILDING**				
	FLOOD DEPTH (FT) ABOVE GROUND					**FLOOD DEPTH (FT) ABOVE GROUND**				
	7	**9**	**11**	**13**	**15**	**1**	**3**	**5**	**7**	**9**
Elevate Utility Equipment 2 Feet Above Floor and Wet Floodproof Building to 2 Feet	0%	52%	0%	0%	0%	0%	44%	0%	0%	0%

Form VF-4: Differences in Flood Mitigation Measures

A. Provide the differences between the values reported in Form VF-3, Flood Mitigation Measures, Range of Changes in Damage, relative to the equivalent data compiled from the currently accepted flood model.

Not applicable.

B. Provide a list and describe any assumptions made to complete this form.

Not applicable.

C. Provide a summary description of the differences.

Not applicable.

D. Provide this form in Excel format without truncation. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form VF-4, Differences in Flood Mitigation Measures, in a submission appendix.

Not applicable.

Form AF-1: Zero Deductible Personal Residential Standard Flood Loss Costs

A. Provide three maps, color-coded by rating areas or geographic zones (with a minimum of seven value ranges), displaying zero deductible personal residential standard flood loss costs per $1,000 of exposure for wood frame, masonry, and manufactured homes. Note: Standard Flood in Florida is equivalent to the NFIP. Rating areas or geographic zones are to be defined by the modeling organization.

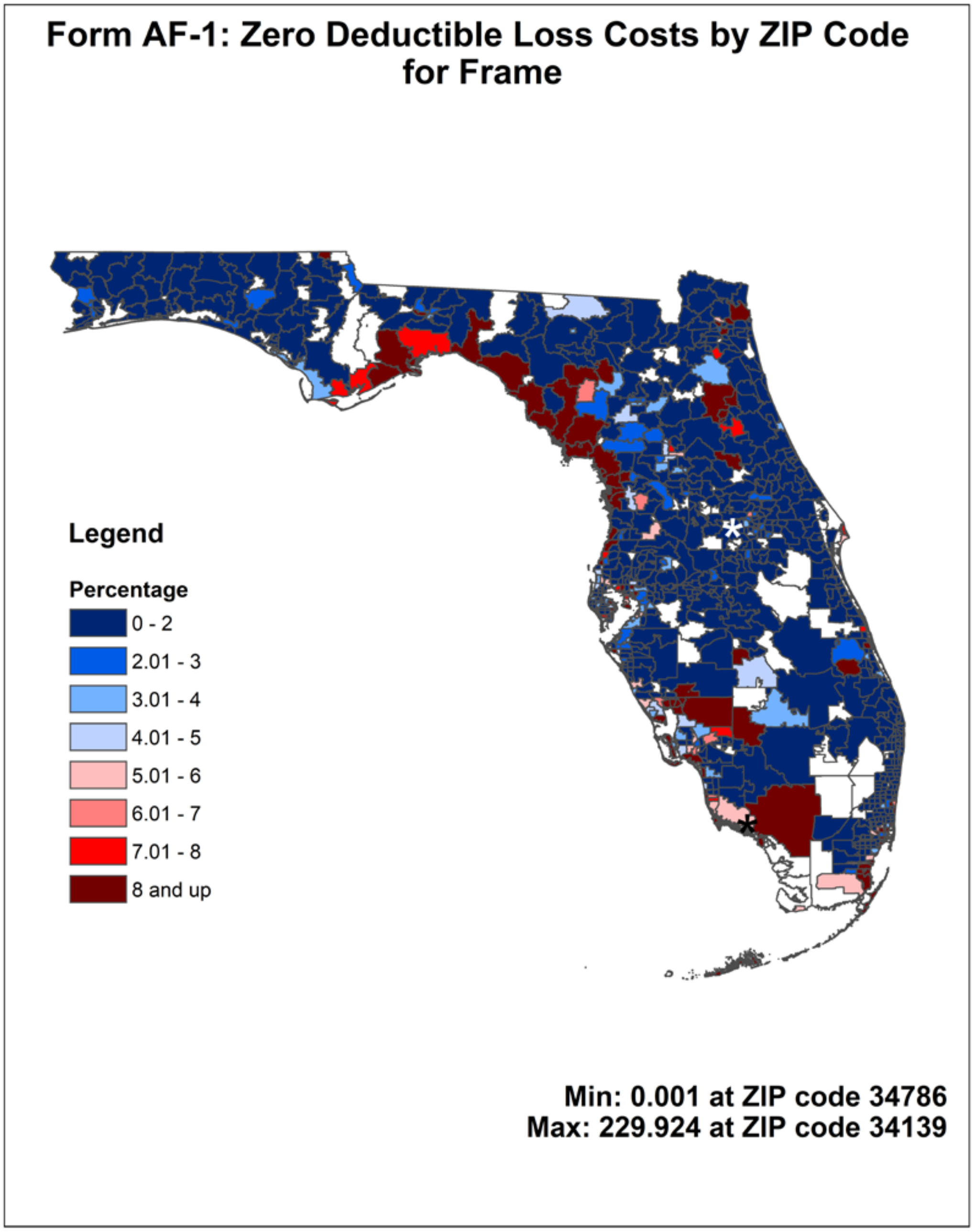


Figure 214. Zero deductible loss costs by ZIP code for frame.

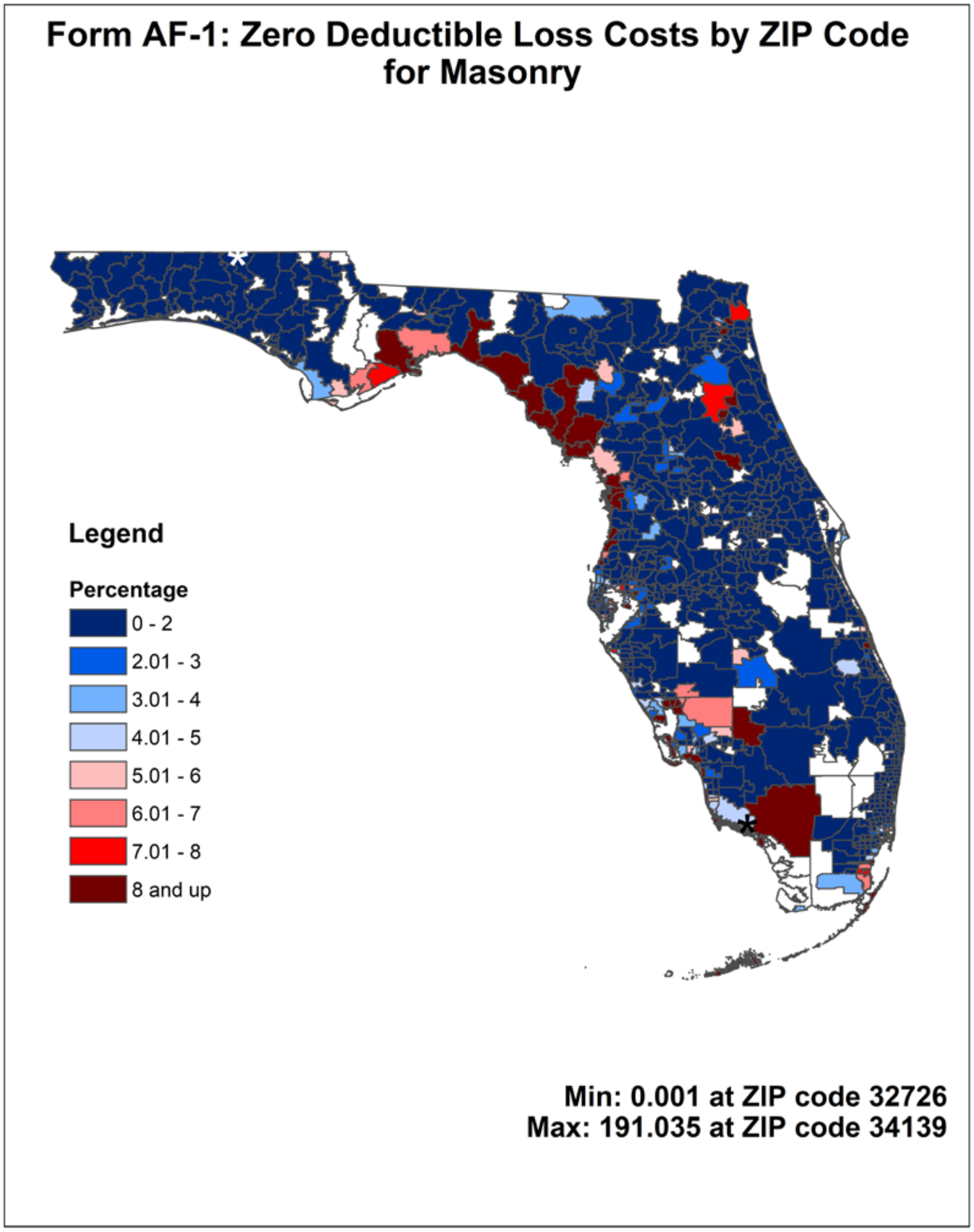


Figure 215. Zero deductible loss costs by ZIP code for masonry.

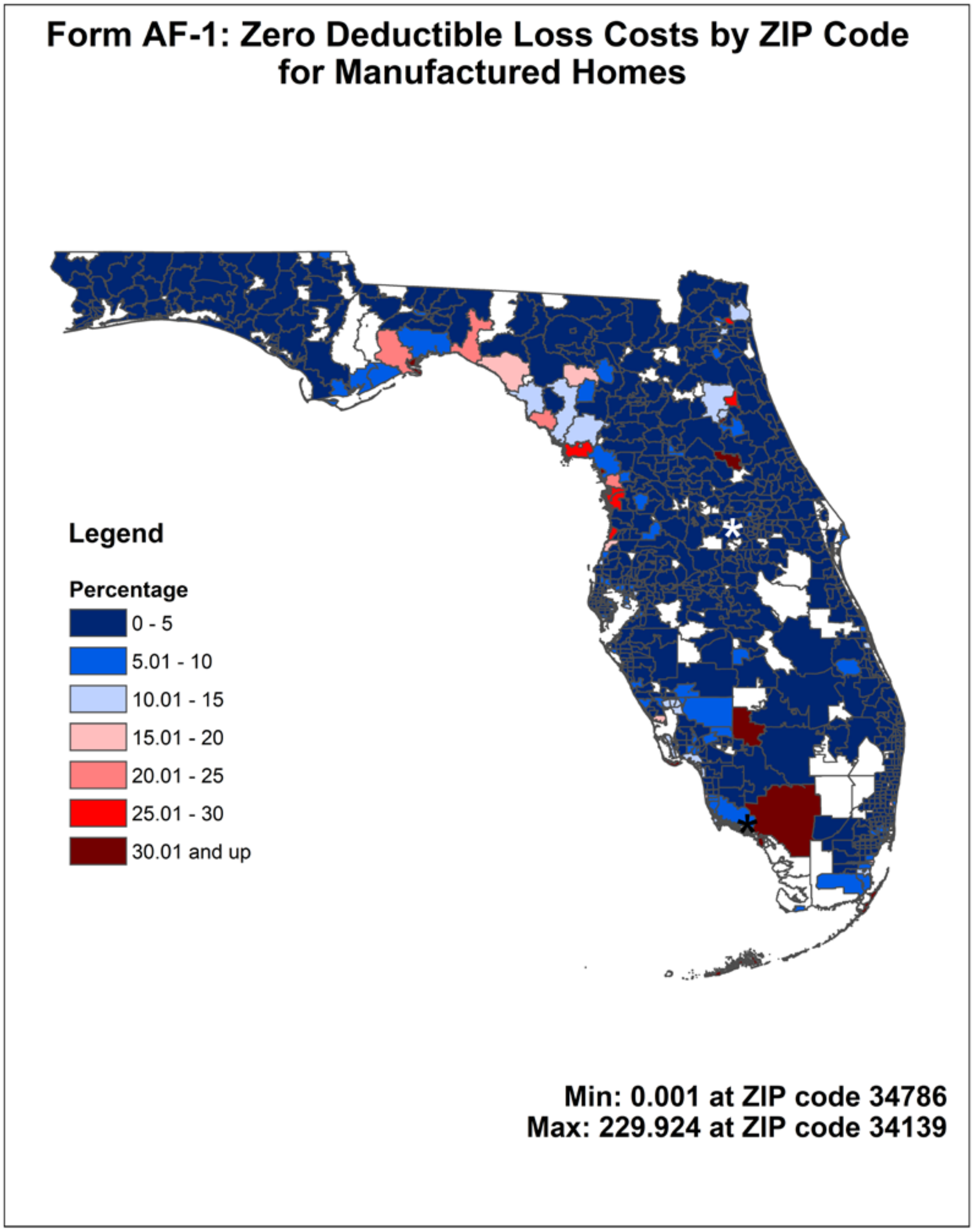


Figure 216. Zero deductible loss costs by ZIP code for manufactured homes.

B. Create exposure sets for these exhibits by modeling the frame and masonry building and manufactured homes from Notional Set 3 described in the file "NotionalInput21_Flood.xlsx" geocoded to each rating area or geographic zone in the state, as provided in the flood model.

Define the flood rating areas or geographic zones. Provide the predominant County name and the Federal Information Processing Standards (FIPS) Code (Figure 2) associated with each rating area or geographic zone. Refer to the Notional Standard Flood Policy Specifications below for additional modeling information. Explain any assumptions, deviations, and differences from the prescribed exposure information.

The exposure sets for these exhibits were created by modeling the frame, masonry, and manufactured home exposures from Notional Set 3 described in the file *"NotionalInput21_Flood.xlsx."* One exposure of each type (frame, masonry, manufactured) was placed at every location in the model's user-defined exposure set.

C. Describe if and how Law and Ordinance is included in this form.

A provision for Law and Ordinance coverage is embedded in the vulnerability matrices and is therefore reflected in the loss costs reported in this form.

D. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

Frame and Masonry exposures are assumed to be Weak one-story structures with First Floor Elevation of 1 foot.

Manufactured Home exposures are assumed to have a First Floor Elevation of 1 foot.

Time Element coverage limit is assumed to be 20% of the Coverage A limit.

E. Provide, in the format given in the file named "2021FormAF1.xlsx" in both Excel and PDF format, the underlying standard flood loss cost data, rounded to three decimal places, used for A. above. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name.

A completed Form AF-1 has been provided in both Excel and PDF formats.

Form AF-2: Total Flood Statewide Loss Costs

A. Provide the total personal residential insured flood loss assuming zero deductible policies for individual historical flooding events using a modeling-organization-specified, predetermined and comprehensive exposure dataset. The list of flooding events in this form should include meteorological and hydrological events and circumstances occurring inside or outside of Florida that resulted in or contributed to flooding in Florida included in the modeling organization flood-event dataset (e.g., Florida and by-passing hurricanes, tropical cyclones below hurricane strength that caused flood losses in Florida, rainfall events that caused flood losses in Florida).

The table below contains the tropical cyclones from HURDAT2 and rainfall events to be included in the modeling organization flood-event dataset. The modeling organization should populate the table with its own flood-event dataset. Each tropical cyclone and rainfall event has been assigned an ID number. For tropical cyclones resulting in zero loss, the table entry should be left blank. Additional tropical cyclones and rainfall events included in the modeling organization flood-event dataset should be added to the table in order of year and assigned an intermediate ID number within the bounding ID numbers. As defined, a by-passing hurricane (ByP) is a hurricane which does not make landfall on Florida, but produces minimum damaging windspeeds or greater on Florida. For the by-passing hurricanes included in the table only, the hurricane intensity entered is the maximum windspeed at closest approach to Florida as a hurricane, not the windspeed over Florida.

ID	Tropical Cyclone / Hurricane Landfall / Closest Approach Date	Year	Name	Hurricane Landfall Region as defined in Figure 3 - Category	Personal Residential Insured Flood Losses ($)
5	10/25/1921	1921	TampaBay06-1921	B-3	6,482,517,939
10	09/18/1926	1926	GreatMiami07-1926	C-4/A-3	1,455,895,426
15	09/17/1928	1928	LakeOkeechobee04-1928	C-4	400,195,937
20	09/03/1935	1935	LaborDay03-1935	C-5/A-2	3,411,786,106
25	08/31/1950	1950	Baker-1950	F-1/ByP-1	
30	09/05/1950	1950	Easy-1950	A-3	1,727,378,991
35	10/18/1950	1950	King-1950	C-4	202,888,196
40	09/26/1953	1953	Florence-1953	A-1	2,352,049
45	10/09/1953	1953	Hazel-1953	B-1	27,018,876
50	09/25/1956	1956	Flossy-1956	A-1	7,722,533
55	09/10/1960	1960	Donna-1960	B-4	1,746,876,912
60	09/15/1960	1960	Ethel-1960	F-1	54,386
65	08/27/1964	1964	Cleo-1964	C-2	103,265,258
70	09/10/1964	1964	Dora-1964	D-2	249,060,218
75	10/14/1964	1964	Isbell-1964	B-2	11,778,768
80	09/08/1965	1965	Betsy-1965	C-3	402,071,359
85	06/09/1966	1966	Alma-1966	A-1	182,569,018
90	10/04/1966	1966	Inez-1966	C-1	89,949,241
95	10/19/1968	1968	Gladys-1968	A-1	468,773,576
100	08/18/1969	1969	Camille-1969	F-5	
105	06/19/1972	1972	Agnes-1972	A-1	8,170,193
110	09/23/1975	1975	Eloise-1975	A-3	12,355,265
115	09/04/1979	1979	David-1979	C-2/E-2	96,004,303

ID	Tropical Cyclone / Hurricane Landfall / Closest Approach Date	Year	Name	Hurricane Landfall Region as defined in Figure 3 - Category	Personal Residential Insured Flood Losses ($)
120	09/13/1979	1979	Frederic-1979	F-3	17,292,313
125	09/02/1985	1985	Elena-1985	F-3/ByP-3	13,707,319
130	11/21/1985	1985	Kate-1985	A-2	3,393,041
135	10/12/1987	1987	Floyd-1987	B-1	16,342,889
140	08/24/1992	1992	Andrew-1992	C-5	783,601,124
145	08/03/1995	1995	Erin-1995	C-1/A-1	48,578,035
150	10/04/1995	1995	Opal-1995	A-3	81,424,238
155	07/19/1997	1997	Danny-1997	F-1	15,659,529
160	09/03/1998	1998	Earl-1998	A-1	27,391,988
165	09/25/1998	1998	Georges-1998	B-2/F-2	240,954,524
170	10/15/1999	1999	Irene-1999	B-1	190,498,037
175	06/04/2001	2001	Tropical Storm Allison- 2001	---	15,339,830
180	08/13/2004	2004	Charley-2004	B-4	64,460,690
185	09/05/2004	2004	Frances-2004	C-2	206,021,650
190	09/16/2004	2004	Ivan-2004	F-3/ByP-3	36,006,989
195	09/26/2004	2004	Jeanne-2004	C-3	314,811,507
200	07/10/2005	2005	Dennis-2005	A-3	5,672,009
205	08/25/2005	2005	Katrina-2005	C-1	2,956,549
210	09/20/2005	2005	Rita-2005	ByP-2	370,481
215	10/24/2005	2005	Wilma-2005	B-3	613,178,796
220	08/18/2008	2008	Tropical Storm Fay-2008	---	338,155,177
225	---	2009	Unnamed Storm in East Florida-May 2009	---	128,707,919
230	---	2013	Unnamed Storm in Panhandle-July 2013	---	21,525,211
235	09/02/2016	2016	Hermine-2016	A-1	149,855,963
240	10/07/2016	2016	Matthew-2016	ByP-3	124,607,697
245	09/10/2017	2017	Irma-2017	B-4	1,130,988,596
250	10/08/2017	2017	Nate-2017	F-1	4,156,378
255	10/10/2018	2018	Michael-2018	A-5	54,041,591
260	09/04/2019	2019	Dorian-2019	ByP-2	89,517
265	09/16/2020	2020	Sally-2020	F-2	163,171,794
270	10/28/2020	2020	Zeta-2020	ByP-3	1,196,922
275	11/11/2020	2020	Eta-2020	ByP-1	199,258,724
			Total		**22,102,101,576**

B. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

No additional assumptions were required.

C. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form AF-2, Total Flood Statewide Loss Costs, in a submission appendix.

A completed Form AF-2 has been provided in Excel format.

Form AF-3: Personal Residential Standard Flood Losses by ZIP Code

A. One or more automated programs or scripts should be used to generate and arrange the data in Form AF-3, Personal Residential Standard Flood Losses by ZIP Code.

Automated scripts were used to generate Form AF-3.

B. Provide the percentage of total personal residential zero deductible standard flood loss, rounded to four decimal places, and the modeled loss from the events listed below using the modeling-organization-specified, predetermined, and comprehensive exposure dataset.

Hurricane Andrew (1992)
Hurricane Ivan (2004)
Hurricane Jeanne (2004)
Hurricane Wilma (2005)
Tropical Storm Fay (2008)
Unnamed Storm in East Florida (May 2009)
Unnamed Storm in Panhandle (July 2013)
Hurricane Matthew (2016)
Hurricane Irma (2017)
Hurricane Michael (2018)

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
32003	Clay	0	0.0000%	0	0.0000%	5,436,638	1.7270%	0	0.0000%	4,801,704	1.4200%	6,920,029	5.3765%	0	0.0000%	7,054,525	5.6614%	30,219,429	2.6719%	0	0.0000%
32004	St. Johns	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32007	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32008	Suwannee	0	0.0000%	0	0.0000%	270,525	0.0859%	0	0.0000%	449,725	0.1330%	0	0.0000%	0	0.0000%	0	0.0000%	1,119,817	0.0990%	0	0.0000%
32009	Nassau	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	402	0.0001%	138	0.0001%	0	0.0000%	138	0.0001%	397	0.0000%	0	0.0000%
32011	Nassau	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	332	0.0001%	58	0.0000%	0	0.0000%	58	0.0000%	23,053	0.0020%	0	0.0000%
32024	Columbia	0	0.0000%	0	0.0000%	1,041	0.0003%	0	0.0000%	46,586	0.0138%	0	0.0000%	0	0.0000%	0	0.0000%	332,185	0.0294%	0	0.0000%
32025	Columbia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	129	0.0000%	0	0.0000%
32033	St. Johns	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	299	0.0001%	341	0.0003%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32034	Nassau	0	0.0000%	0	0.0000%	1,876,536	0.5961%	0	0.0000%	250,974	0.0742%	84	0.0001%	0	0.0000%	1,136,513	0.9121%	764,751	0.0676%	0	0.0000%
32035	Nassau	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32038	Columbia	0	0.0000%	0	0.0000%	1,420	0.0005%	0	0.0000%	5,720	0.0017%	0	0.0000%	0	0.0000%	0	0.0000%	466,544	0.0413%	0	0.0000%
32040	Baker	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	340	0.0001%	48	0.0000%	0	0.0000%	0	0.0000%	298	0.0000%	0	0.0000%
32042	Bradford	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32043	Clay	0	0.0000%	0	0.0000%	394,253	0.1252%	0	0.0000%	389,228	0.1151%	448,337	0.3483%	0	0.0000%	339,646	0.2726%	2,128,357	0.1882%	0	0.0000%
32044	Bradford	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32046	Nassau	0	0.0000%	0	0.0000%	140	0.0000%	0	0.0000%	691	0.0002%	0	0.0000%	0	0.0000%	127	0.0001%	660	0.0001%	0	0.0000%
32050	Clay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32052	Hamilton	0	0.0000%	0	0.0000%	2,789	0.0009%	0	0.0000%	14,121	0.0042%	0	0.0000%	0	0.0000%	0	0.0000%	76	0.0000%	0	0.0000%
32053	Hamilton	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32054	Union	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	19,320	0.0017%	0	0.0000%
32055	Columbia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	64,577	0.0057%	0	0.0000%
32058	Bradford	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	153	0.0000%	0	0.0000%
32059	Madison	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,193	0.0004%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32060	Suwannee	0	0.0000%	0	0.0000%	164,072	0.0521%	0	0.0000%	114,783	0.0339%	0	0.0000%	0	0.0000%	0	0.0000%	23	0.0000%	0	0.0000%
32061	Columbia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32062	Suwannee	0	0.0000%	0	0.0000%	210	0.0001%	0	0.0000%	619	0.0002%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32063	Baker	0	0.0000%	0	0.0000%	106	0.0000%	0	0.0000%	387	0.0001%	140	0.0001%	0	0.0000%	0	0.0000%	416	0.0000%	0	0.0000%
32064	Suwannee	0	0.0000%	0	0.0000%	280,579	0.0891%	0	0.0000%	13,044	0.0039%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32065	Clay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	133,842	0.0396%	103,295	0.0803%	0	0.0000%	0	0.0000%	184,784	0.0163%	0	0.0000%
32066	Lafayette	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	322	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32068	Clay	0	0.0000%	0	0.0000%	259,640	0.0825%	0	0.0000%	259,365	0.0767%	362,615	0.2817%	0	0.0000%	233,745	0.1876%	4,205,742	0.3719%	0	0.0000%
32071	Suwannee	0	0.0000%	0	0.0000%	1,672	0.0005%	0	0.0000%	308	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	20,512	0.0018%	0	0.0000%
32072	Baker	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32073	Clay	0	0.0000%	0	0.0000%	621,559	0.1974%	0	0.0000%	618,462	0.1829%	838,966	0.6518%	0	0.0000%	838,966	0.6733%	4,027,375	0.3561%	0	0.0000%
32079	Clay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32080	St. Johns	0	0.0000%	0	0.0000%	9,178,540	2.9156%	0	0.0000%	6,312	0.0019%	8,320	0.0065%	0	0.0000%	8,419	0.0068%	398,217	0.0352%	0	0.0000%
32081	St. Johns	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32082	St. Johns	0	0.0000%	0	0.0000%	2,194,702	0.6971%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	182,662	0.0162%	0	0.0000%
32084	St. Johns	0	0.0000%	0	0.0000%	6,178,786	1.9627%	0	0.0000%	867,058	0.2564%	454,041	0.3528%	0	0.0000%	1,215,575	0.9755%	1,603,861	0.1418%	0	0.0000%
32086	St. Johns	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	634,890	0.1878%	736,437	0.5722%	0	0.0000%	582,285	0.4673%	460,273	0.0407%	0	0.0000%
32087	Baker	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,521	0.0004%	0	0.0000%	0	0.0000%	0	0.0000%	1,347	0.0001%	0	0.0000%
32091	Bradford	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	403	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	35,312	0.0031%	0	0.0000%
32092	St. Johns	0	0.0000%	0	0.0000%	42,878	0.0136%	0	0.0000%	2,429,074	0.7183%	1,204,016	0.9355%	0	0.0000%	414,382	0.3325%	2,777,171	0.2456%	0	0.0000%
32094	Suwannee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32095	St. Johns	0	0.0000%	0	0.0000%	51,149	0.0162%	0	0.0000%	24,164	0.0071%	233	0.0002%	0	0.0000%	133,104	0.1068%	161,053	0.0142%	0	0.0000%
32096	Hamilton	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	30	0.0000%	0	0.0000%
32097	Nassau	0	0.0000%	0	0.0000%	71	0.0000%	0	0.0000%	17,234	0.0051%	395	0.0003%	0	0.0000%	13,312	0.0107%	15,535	0.0014%	0	0.0000%
32102	Lake	0	0.0000%	0	0.0000%	607,336	0.1929%	168,184	0.0274%	10,805,276	3.1954%	5,276,749	4.0998%	0	0.0000%	1,537,497	1.2339%	7,019,492	0.6207%	0	0.0000%
32110	Flagler	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	10,259	0.0030%	31,318	0.0243%	0	0.0000%	4,833	0.0039%	8,633	0.0008%	0	0.0000%
32111	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32112	Putnam	0	0.0000%	0	0.0000%	156,898	0.0498%	9,797	0.0016%	896,125	0.2650%	540,383	0.4199%	0	0.0000%	245,704	0.1972%	651,575	0.0576%	0	0.0000%
32113	Marion	0	0.0000%	0	0.0000%	507	0.0002%	0	0.0000%	10,357	0.0031%	5,413	0.0042%	0	0.0000%	0	0.0000%	90,636	0.0080%	0	0.0000%
32114	Volusia	0	0.0000%	0	0.0000%	106,713	0.0339%	0	0.0000%	47,966	0.0142%	2,954,352	2.2954%	0	0.0000%	6,946	0.0056%	25,546	0.0023%	0	0.0000%
32117	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	62,285	0.0184%	2,764,837	2.1481%	0	0.0000%	0	0.0000%	47,180	0.0042%	0	0.0000%
32118	Volusia	0	0.0000%	0	0.0000%	2,255	0.0007%	0	0.0000%	44,603	0.0132%	1,145,542	0.8900%	0	0.0000%	24,113	0.0194%	31,885	0.0028%	0	0.0000%
32119	Volusia	0	0.0000%	0	0.0000%	708,137	0.2249%	0	0.0000%	5,766	0.0017%	4,128,920	3.2080%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32124	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32126	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32127	Volusia	0	0.0000%	0	0.0000%	2,444,508	0.7765%	0	0.0000%	140,928	0.0417%	2,140,322	1.6629%	0	0.0000%	237,044	0.1902%	99,999	0.0088%	0	0.0000%
32128	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32129	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,110	0.0003%	828,217	0.6435%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32130	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32131	Putnam	0	0.0000%	0	0.0000%	1,197,381	0.3803%	0	0.0000%	10,241,719	3.0287%	4,959,478	3.8533%	0	0.0000%	1,441,885	1.1571%	8,129,148	0.7188%	0	0.0000%
32132	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	9,444	0.0028%	99,017	0.0769%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32134	Marion	0	0.0000%	0	0.0000%	22,439	0.0071%	0	0.0000%	27,109	0.0080%	27,109	0.0211%	0	0.0000%	17,342	0.0139%	41,856	0.0037%	0	0.0000%
32135	Flagler	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32136	Flagler	0	0.0000%	0	0.0000%	20,806,167	6.6091%	0	0.0000%	186,914	0.0553%	617,123	0.4795%	0	0.0000%	32,808	0.0263%	181,487	0.0160%	0	0.0000%
32137	Flagler	0	0.0000%	0	0.0000%	579,539	0.1841%	0	0.0000%	74,688	0.0221%	128,258	0.0997%	0	0.0000%	56,821	0.0456%	105,810	0.0094%	0	0.0000%
32139	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32140	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	212	0.0000%	0	0.0000%
32141	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	11,198	0.0033%	39,412	0.0306%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32143	Flagler	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32145	St. Johns	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	368	0.0001%	209	0.0002%	0	0.0000%	151	0.0001%	368	0.0000%	0	0.0000%
32147	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32148	Putnam	0	0.0000%	0	0.0000%	170	0.0001%	0	0.0000%	423	0.0001%	407	0.0003%	0	0.0000%	138	0.0001%	528	0.0000%	0	0.0000%
32157	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
32159	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	243,138	0.0719%	43,631	0.0339%	0	0.0000%	0	0.0000%	550,839	0.0487%	0	0.0000%
32162	Sumter	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,144,967	0.6343%	439,088	0.3412%	0	0.0000%	0	0.0000%	3,185,179	0.2816%	0	0.0000%
32163	Sumter	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	964,393	0.2852%	483,037	0.3753%	0	0.0000%	0	0.0000%	1,286,068	0.1137%	0	0.0000%
32164	Flagler	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32168	Volusia	0	0.0000%	0	0.0000%	635,494	0.2019%	0	0.0000%	110,765	0.0328%	1,309,132	1.0171%	0	0.0000%	1,046,480	0.8398%	41,800	0.0037%	0	0.0000%
32169	Volusia	0	0.0000%	0	0.0000%	3,313,049	1.0524%	0	0.0000%	88,998	0.0263%	486,051	0.3776%	0	0.0000%	817,456	0.6560%	0	0.0000%	0	0.0000%
32174	Volusia	0	0.0000%	0	0.0000%	200,742	0.0638%	0	0.0000%	1,231,336	0.3641%	5,091,954	3.9562%	0	0.0000%	145,954	0.1171%	137,852	0.0122%	0	0.0000%
32176	Volusia	0	0.0000%	0	0.0000%	16,912	0.0054%	0	0.0000%	107,509	0.0318%	1,486,964	1.1553%	0	0.0000%	0	0.0000%	46,348	0.0041%	0	0.0000%
32177	Putnam	0	0.0000%	0	0.0000%	529,837	0.1683%	0	0.0000%	3,951,957	1.1687%	2,236,817	1.7379%	0	0.0000%	821,590	0.6593%	3,656,369	0.3233%	0	0.0000%
32178	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32179	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	5,361	0.0016%	166	0.0001%	0	0.0000%	0	0.0000%	3,620	0.0003%	0	0.0000%
32180	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32181	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	11,404	0.0034%	92	0.0001%	0	0.0000%	0	0.0000%	21,958	0.0019%	0	0.0000%
32187	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	820	0.0002%	172	0.0001%	0	0.0000%	232	0.0002%	895	0.0001%	0	0.0000%
32189	Putnam	0	0.0000%	0	0.0000%	31,254	0.0099%	0	0.0000%	1,108,911	0.3279%	1,360,999	1.0574%	0	0.0000%	646,939	0.5192%	1,333,595	0.1179%	0	0.0000%
32190	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32192	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32193	Putnam	0	0.0000%	0	0.0000%	261,652	0.0831%	0	0.0000%	1,540,784	0.4556%	868,423	0.6747%	0	0.0000%	213,435	0.1713%	1,291,086	0.1142%	0	0.0000%
32195	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	28,792	0.0085%	0	0.0000%	0	0.0000%	0	0.0000%	41,494	0.0037%	0	0.0000%
32202	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	112,341	0.0332%	2,322	0.0018%	0	0.0000%	44,144	0.0354%	154,302	0.0136%	0	0.0000%
32203	Duval	0	0.0000%	0	0.0000%	1,456	0.0005%	0	0.0000%	10,765	0.0032%	0	0.0000%	0	0.0000%	0	0.0000%	10,765	0.0010%	0	0.0000%
32204	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	45,568	0.0135%	528	0.0004%	0	0.0000%	35,028	0.0281%	148,777	0.0132%	0	0.0000%
32205	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	434,766	0.1286%	61,025	0.0474%	0	0.0000%	124,224	0.0997%	350,245	0.0310%	0	0.0000%
32206	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32207	Duval	0	0.0000%	0	0.0000%	1,667,252	0.5296%	0	0.0000%	8,952,597	2.6475%	5,679,261	4.4125%	0	0.0000%	6,333,435	5.0827%	10,467,128	0.9255%	0	0.0000%
32208	Duval	0	0.0000%	0	0.0000%	179,267	0.0569%	0	0.0000%	2,047,404	0.6055%	735,295	0.5713%	0	0.0000%	1,797,042	1.4422%	3,348,142	0.2960%	0	0.0000%
32209	Duval	0	0.0000%	0	0.0000%	66,525	0.0211%	0	0.0000%	842,522	0.2492%	413,030	0.3209%	0	0.0000%	567,706	0.4556%	946,240	0.0837%	0	0.0000%
32210	Duval	0	0.0000%	0	0.0000%	27,855	0.0088%	0	0.0000%	4,922,381	1.4557%	2,511,703	1.9515%	0	0.0000%	3,062,481	2.4577%	6,486,619	0.5735%	0	0.0000%
32211	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	826,393	0.2444%	355,034	0.2758%	0	0.0000%	780,096	0.6260%	985,835	0.0872%	0	0.0000%
32216	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,382,556	0.4089%	500,953	0.3892%	0	0.0000%	928,276	0.7450%	1,334,575	0.1180%	0	0.0000%
32217	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	256,822	0.0759%	142,592	0.1108%	0	0.0000%	88,172	0.0708%	1,392,356	0.1231%	0	0.0000%
32218	Duval	0	0.0000%	0	0.0000%	46,960	0.0149%	0	0.0000%	2,026,300	0.5992%	233,264	0.1812%	0	0.0000%	1,536,131	1.2328%	2,087,772	0.1846%	0	0.0000%
32219	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	618,028	0.1828%	0	0.0000%	0	0.0000%	156,922	0.1259%	304,782	0.0269%	0	0.0000%
32220	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	77,631	0.0230%	162	0.0001%	0	0.0000%	595	0.0005%	74,146	0.0066%	0	0.0000%
32221	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	741,647	0.2193%	0	0.0000%	0	0.0000%	0	0.0000%	654,692	0.0579%	0	0.0000%
32222	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,523	0.0007%	2,139	0.0017%	0	0.0000%	2,059	0.0017%	3,061	0.0003%	0	0.0000%
32223	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,005,793	0.2974%	680,253	0.5285%	0	0.0000%	709,361	0.5693%	3,256,099	0.2879%	0	0.0000%
32224	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,489,073	0.4404%	83,389	0.0648%	0	0.0000%	921,069	0.7392%	2,581,603	0.2283%	0	0.0000%
32225	Duval	0	0.0000%	0	0.0000%	51,479	0.0164%	0	0.0000%	5,966,799	1.7645%	2,244,732	1.7441%	0	0.0000%	5,508,816	4.4209%	16,354,441	1.4460%	0	0.0000%
32226	Duval	0	0.0000%	0	0.0000%	10,248,825	3.2555%	0	0.0000%	33,614,080	9.9404%	24,568,795	19.0888%	0	0.0000%	36,501,232	29.2929%	53,480,955	4.7287%	0	0.0000%
32227	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32232	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32233	Duval	0	0.0000%	0	0.0000%	1,615,126	0.5130%	0	0.0000%	4,138,262	1.2238%	4,154,054	3.2275%	0	0.0000%	4,870,007	3.9083%	6,129,530	0.5420%	0	0.0000%
32234	Duval	0	0.0000%	0	0.0000%	162	0.0001%	0	0.0000%	336	0.0001%	249	0.0002%	0	0.0000%	0	0.0000%	772	0.0001%	0	0.0000%
32236	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32240	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32241	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	11,363	0.0528%	0	0.0000%	0	0.0000%	0	0.0000%
32244	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	111,676	0.0330%	51,578	0.0401%	0	0.0000%	38,648	0.0310%	109,471	0.0097%	0	0.0000%
32246	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	5,921	0.0018%	0	0.0000%	0	0.0000%	2,812	0.0023%	2,812	0.0002%	0	0.0000%
32247	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32250	Duval	0	0.0000%	0	0.0000%	107,175	0.0340%	0	0.0000%	1,503,866	0.4447%	3,093,931	2.4038%	0	0.0000%	7,025,800	5.6383%	20,703,199	1.8305%	0	0.0000%
32254	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	132,208	0.0391%	20,235	0.0157%	0	0.0000%	26,940	0.0216%	91,203	0.0081%	0	0.0000%
32256	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,653	0.0008%	1,023	0.0008%	0	0.0000%	824	0.0007%	5,777	0.0005%	0	0.0000%
32257	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	73,648	0.0065%	0	0.0000%
32258	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,387	0.0010%	7,918	0.0062%	0	0.0000%	39,873	0.0320%	850,016	0.0752%	0	0.0000%
32259	St. Johns	0	0.0000%	0	0.0000%	27,134	0.0086%	0	0.0000%	523,006	0.1547%	176,409	0.1371%	0	0.0000%	244,110	0.1959%	1,278,762	0.1131%	0	0.0000%
32260	St. Johns	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32266	Duval	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	304,272	0.0900%	469,020	0.3644%	0	0.0000%	759,632	0.6096%	2,169,192	0.1918%	0	0.0000%
32277	Duval	0	0.0000%	0	0.0000%	794,504	0.2524%	0	0.0000%	29,926,028	8.8498%	19,331,150	15.0194%	0	0.0000%	23,880,777	19.1648%	37,274,440	3.2957%	0	0.0000%
32301	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	4,378,220	1.2947%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32303	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	6,986,952	2.0662%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32304	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,815,109	0.8325%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32305	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,626,592	0.7767%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32307	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32308	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	9,866,270	2.9177%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32309	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	12,138,020	3.5895%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32310	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,241,446	0.3671%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32311	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	5,843,015	1.7279%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32312	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,251,118	0.9614%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	22,316	0.0413%
32314	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32317	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	328,370	0.0971%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32320	Franklin	0	0.0000%	115,256	0.3201%	0	0.0000%	0	0.0000%	713,913	0.2111%	0	0.0000%	74,489	0.3461%	0	0.0000%	0	0.0000%	82,599	0.1528%
32321	Liberty	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32322	Franklin	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	53,355	0.0987%
32323	Franklin	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32324	Gadsden	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	131	0.0000%	0	0.0000%	106	0.0005%	0	0.0000%	0	0.0000%	0	0.0000%
32326	Wakulla	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
32327	Wakulla	0	0.0000%	19,092	0.0530%	79	0.0000%	0	0.0000%	2,792,460	0.8258%	0	0.0000%	163	0.0008%	0	0.0000%	79	0.0000%	3,487,801	6.4539%
32328	Franklin	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32331	Madison	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32332	Gadsden	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32333	Gadsden	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	25,284	0.0075%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32334	Liberty	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32336	Jefferson	0	0.0000%	47,510	0.1319%	0	0.0000%	0	0.0000%	177,085	0.0524%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	130,083	0.2407%
32337	Jefferson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32340	Madison	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	16,655	0.0049%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32343	Gadsden	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32344	Jefferson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,169	0.0006%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32346	Wakulla	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,041,200	1.9267%
32347	Taylor	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	756,162	0.2236%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32348	Taylor	0	0.0000%	0	0.0000%	326,735	0.1038%	0	0.0000%	273,673	0.0809%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	693,117	1.2826%
32350	Madison	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32351	Gadsden	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	55,562	0.0164%	0	0.0000%	28,895	0.1342%	0	0.0000%	0	0.0000%	28,895	0.0535%
32352	Gadsden	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	88	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32355	Wakulla	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32357	Taylor	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32358	Wakulla	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,549,284	1.0496%	0	0.0000%	8,531	0.0396%	0	0.0000%	0	0.0000%	46,994	0.0870%
32359	Taylor	0	0.0000%	0	0.0000%	169,519	0.0538%	0	0.0000%	806,653	0.2385%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	20,772	0.0384%
32361	Jefferson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32362	Leon	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32401	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	314,094	1.4592%	0	0.0000%	0	0.0000%	0	0.0000%
32402	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32403	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,267	0.0152%	0	0.0000%	0	0.0000%	0	0.0000%
32404	Bay	0	0.0000%	119	0.0003%	0	0.0000%	0	0.0000%	241	0.0001%	0	0.0000%	996,794	4.6308%	0	0.0000%	0	0.0000%	159	0.0003%
32405	Bay	0	0.0000%	14,704	0.0408%	0	0.0000%	0	0.0000%	163	0.0000%	0	0.0000%	3,369,016	15.6515%	0	0.0000%	0	0.0000%	93,829	0.1736%
32407	Bay	0	0.0000%	164	0.0005%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,575,282	7.3183%	0	0.0000%	0	0.0000%	8,274	0.0153%
32408	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,270,735	5.9035%	0	0.0000%	0	0.0000%	32	0.0001%
32409	Bay	0	0.0000%	52,492	0.1458%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,850,796	8.5983%	0	0.0000%	0	0.0000%	39,172	0.0725%
32410	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	191,409	0.3542%
32411	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32412	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32413	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,516,114	7.0434%	0	0.0000%	0	0.0000%	0	0.0000%
32420	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32421	Calhoun	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32423	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	83	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	83	0.0002%
32424	Calhoun	0	0.0000%	6,309	0.0175%	0	0.0000%	0	0.0000%	4,754	0.0014%	0	0.0000%	2,964	0.0138%	0	0.0000%	0	0.0000%	0	0.0000%
32425	Holmes	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	262,785	1.2208%	0	0.0000%	0	0.0000%	0	0.0000%
32426	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32427	Washington	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32428	Washington	0	0.0000%	187	0.0005%	0	0.0000%	0	0.0000%	386	0.0001%	0	0.0000%	4,391	0.0204%	0	0.0000%	0	0.0000%	170	0.0003%
32430	Calhoun	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32431	Jackson	0	0.0000%	33	0.0001%	0	0.0000%	0	0.0000%	45	0.0000%	0	0.0000%	1,866	0.0087%	0	0.0000%	0	0.0000%	1,232	0.0023%
32433	Walton	0	0.0000%	300	0.0008%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	272	0.0013%	0	0.0000%	0	0.0000%	0	0.0000%
32435	Walton	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	472	0.0022%	0	0.0000%	0	0.0000%	0	0.0000%
32437	Washington	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32438	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	54	0.0000%	0	0.0000%	459	0.0021%	0	0.0000%	0	0.0000%	316	0.0006%
32439	Walton	0	0.0000%	37,004	0.1028%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	309	0.0014%	0	0.0000%	0	0.0000%	0	0.0000%
32440	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	167	0.0000%	0	0.0000%	6,598	0.0307%	0	0.0000%	0	0.0000%	167	0.0003%
32442	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32443	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	123	0.0000%	0	0.0000%	81	0.0004%	0	0.0000%	0	0.0000%	224	0.0004%
32444	Bay	0	0.0000%	4,912	0.0136%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,247,717	5.7965%	0	0.0000%	0	0.0000%	0	0.0000%
32445	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	15,162	0.0045%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	9,782	0.0181%
32446	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	58,881	0.1090%
32448	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	136	0.0006%	0	0.0000%	0	0.0000%	123	0.0002%
32449	Calhoun	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32452	Holmes	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32455	Walton	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	122	0.0000%	0	0.0000%	150	0.0007%	0	0.0000%	0	0.0000%	0	0.0000%
32456	Gulf	257,293	0.0328%	76,914	0.2136%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	122	0.0006%	0	0.0000%	0	0.0000%	47,939,632	88.7088%
32457	Gulf	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32459	Walton	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,483,107	6.8901%	0	0.0000%	0	0.0000%	0	0.0000%
32460	Jackson	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	14,132	0.0042%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32461	Walton	0	0.0000%	327,351	0.9091%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	538,110	2.4999%	0	0.0000%	0	0.0000%	0	0.0000%
32462	Washington	0	0.0000%	203	0.0006%	0	0.0000%	0	0.0000%	4,943	0.0015%	0	0.0000%	63,733	0.2961%	0	0.0000%	0	0.0000%	758	0.0014%
32464	Holmes	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32465	Gulf	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	243	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32466	Bay	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	20,263	0.0375%
32501	Escambia	0	0.0000%	249,124	0.6919%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	228,228	1.0603%	0	0.0000%	0	0.0000%	0	0.0000%
32502	Escambia	0	0.0000%	36,420	0.1011%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	28,874	0.1341%	0	0.0000%	0	0.0000%	0	0.0000%
32503	Escambia	0	0.0000%	28,993	0.0805%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	28,993	0.1347%	0	0.0000%	0	0.0000%	0	0.0000%
32504	Escambia	0	0.0000%	387,173	1.0753%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	434,199	2.0172%	0	0.0000%	0	0.0000%	0	0.0000%
32505	Escambia	0	0.0000%	455,018	1.2637%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	583,330	2.7100%	0	0.0000%	0	0.0000%	0	0.0000%
32506	Escambia	0	0.0000%	4,336,534	12.0436%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	74,171	0.3446%	0	0.0000%	0	0.0000%	0	0.0000%
32507	Escambia	0	0.0000%	8,624,473	23.9522%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	86,952	0.4040%	0	0.0000%	0	0.0000%	0	0.0000%
32508	Escambia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
32514	Escambia	0	0.0000%	1,198,610	3.3288%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,280,566	5.9491%	0	0.0000%	0	0.0000%	0	0.0000%
32526	Escambia	0	0.0000%	5,872,899	16.3104%	0	0.0000%	0	0.0000%	23,053	0.0068%	30,293	0.0235%	792,246	3.6806%	6,330	0.0051%	20,510	0.0018%	0	0.0000%
32530	Santa Rosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32531	Okaloosa	0	0.0000%	8,192	0.0228%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,084	0.0050%	0	0.0000%	0	0.0000%	0	0.0000%
32533	Escambia	0	0.0000%	1,561,398	4.3364%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,939,021	9.0081%	0	0.0000%	0	0.0000%	0	0.0000%
32534	Escambia	0	0.0000%	80,955	0.2248%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	321,845	1.4952%	0	0.0000%	0	0.0000%	0	0.0000%
32535	Escambia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32536	Okaloosa	0	0.0000%	34,051	0.0946%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	56,898	0.2643%	0	0.0000%	0	0.0000%	0	0.0000%
32538	Walton	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32539	Okaloosa	0	0.0000%	390	0.0011%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	404	0.0019%	0	0.0000%	0	0.0000%	0	0.0000%
32541	Okaloosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	397,952	1.8488%	0	0.0000%	0	0.0000%	0	0.0000%
32542	Okaloosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32544	Okaloosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32547	Okaloosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	276,044	1.2824%	0	0.0000%	0	0.0000%	0	0.0000%
32548	Okaloosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	113,733	0.5284%	0	0.0000%	0	0.0000%	0	0.0000%
32549	Okaloosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32550	Walton	0	0.0000%	95	0.0003%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	12,887	0.0599%	0	0.0000%	0	0.0000%	0	0.0000%
32561	Santa Rosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32563	Santa Rosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32564	Okaloosa	0	0.0000%	1,016	0.0028%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,866	0.0087%	0	0.0000%	0	0.0000%	0	0.0000%
32565	Santa Rosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32566	Santa Rosa	0	0.0000%	100,959	0.2804%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	67	0.0003%	0	0.0000%	0	0.0000%	0	0.0000%
32567	Okaloosa	0	0.0000%	185	0.0005%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	185	0.0009%	0	0.0000%	0	0.0000%	0	0.0000%
32568	Escambia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32569	Okaloosa	0	0.0000%	123,149	0.3420%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32570	Santa Rosa	0	0.0000%	306,895	0.8523%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32571	Santa Rosa	0	0.0000%	1,663,854	4.6209%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	10,964	0.0509%	0	0.0000%	0	0.0000%	0	0.0000%
32577	Escambia	0	0.0000%	16,234	0.0451%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32578	Okaloosa	0	0.0000%	491,374	1.3647%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32579	Okaloosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	167,101	0.7763%	0	0.0000%	0	0.0000%	0	0.0000%
32580	Okaloosa	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	53,434	0.2482%	0	0.0000%	0	0.0000%	0	0.0000%
32583	Santa Rosa	0	0.0000%	9,135,587	25.3717%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,157	0.0054%	0	0.0000%	0	0.0000%	0	0.0000%
32601	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32603	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32605	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	603,476	0.1785%	0	0.0000%	0	0.0000%	0	0.0000%	1,366,368	0.1208%	0	0.0000%
32606	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	546,584	0.1616%	0	0.0000%	0	0.0000%	0	0.0000%	1,954,779	0.1728%	0	0.0000%
32607	Alachua	0	0.0000%	0	0.0000%	175	0.0001%	0	0.0000%	484,507	0.1433%	0	0.0000%	0	0.0000%	0	0.0000%	2,057,388	0.1819%	0	0.0000%
32608	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	48,836	0.0144%	0	0.0000%	0	0.0000%	0	0.0000%	922,434	0.0816%	0	0.0000%
32609	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	29,076	0.0086%	0	0.0000%	0	0.0000%	0	0.0000%	79,777	0.0071%	0	0.0000%
32612	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32615	Alachua	0	0.0000%	0	0.0000%	63	0.0000%	0	0.0000%	78,718	0.0233%	0	0.0000%	0	0.0000%	0	0.0000%	262,922	0.0232%	0	0.0000%
32616	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32617	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	357	0.0001%	289	0.0002%	0	0.0000%	0	0.0000%	9,750	0.0009%	0	0.0000%
32618	Alachua	0	0.0000%	0	0.0000%	79,855	0.0254%	0	0.0000%	98,993	0.0293%	6,534	0.0051%	0	0.0000%	0	0.0000%	432,961	0.0383%	0	0.0000%
32619	Gilchrist	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	19	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	24	0.0000%	0	0.0000%
32621	Levy	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	37,724	0.0112%	0	0.0000%	0	0.0000%	0	0.0000%	969	0.0001%	0	0.0000%
32622	Bradford	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32625	Levy	0	0.0000%	0	0.0000%	241,729	0.0768%	0	0.0000%	96	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	42	0.0000%	0	0.0000%
32626	Levy	0	0.0000%	0	0.0000%	681,774	0.2166%	0	0.0000%	1,195,402	0.3535%	0	0.0000%	0	0.0000%	0	0.0000%	1,093,248	0.0967%	0	0.0000%
32628	Dixie	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,114	0.0003%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32631	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32634	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32640	Alachua	0	0.0000%	0	0.0000%	51	0.0000%	0	0.0000%	822	0.0002%	51	0.0000%	0	0.0000%	0	0.0000%	53,066	0.0047%	0	0.0000%
32641	Alachua	0	0.0000%	0	0.0000%	158	0.0001%	0	0.0000%	91,424	0.0270%	0	0.0000%	0	0.0000%	0	0.0000%	209,117	0.0185%	0	0.0000%
32643	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,763	0.0011%	0	0.0000%	0	0.0000%	0	0.0000%	346,778	0.0307%	0	0.0000%
32648	Dixie	0	0.0000%	0	0.0000%	119,148	0.0378%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	8,782	0.0163%
32653	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32655	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32656	Clay	0	0.0000%	0	0.0000%	108	0.0000%	0	0.0000%	1,077	0.0003%	246	0.0002%	0	0.0000%	0	0.0000%	3,099	0.0003%	0	0.0000%
32658	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32664	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32666	Putnam	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32667	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32668	Levy	0	0.0000%	0	0.0000%	30,191	0.0096%	0	0.0000%	30,651	0.0091%	0	0.0000%	0	0.0000%	0	0.0000%	165,145	0.0146%	0	0.0000%
32669	Alachua	0	0.0000%	0	0.0000%	626	0.0002%	0	0.0000%	443	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	21,379	0.0019%	0	0.0000%
32680	Dixie	0	0.0000%	0	0.0000%	761,481	0.2419%	0	0.0000%	1,084,964	0.3208%	0	0.0000%	0	0.0000%	0	0.0000%	871,518	0.0771%	6,846	0.0127%
32683	Levy	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32686	Marion	0	0.0000%	0	0.0000%	524	0.0002%	0	0.0000%	25,155	0.0074%	807	0.0006%	0	0.0000%	0	0.0000%	30,989	0.0027%	0	0.0000%
32692	Dixie	0	0.0000%	0	0.0000%	592,238	0.1881%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32693	Gilchrist	0	0.0000%	0	0.0000%	810	0.0003%	0	0.0000%	10,424	0.0031%	0	0.0000%	0	0.0000%	0	0.0000%	60,077	0.0053%	0	0.0000%
32694	Alachua	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	193	0.0000%	0	0.0000%
32696	Levy	0	0.0000%	0	0.0000%	55	0.0000%	0	0.0000%	33,031	0.0098%	0	0.0000%	0	0.0000%	0	0.0000%	85,841	0.0076%	0	0.0000%
32701	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	926,663	0.2740%	432,191	0.3358%	0	0.0000%	29,042	0.0233%	694,234	0.0614%	0	0.0000%
32702	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	66,291	0.0196%	0	0.0000%	0	0.0000%	0	0.0000%	11,804	0.0010%	0	0.0000%
32703	Orange	0	0.0000%	0	0.0000%	136	0.0000%	123	0.0000%	824,356	0.2438%	28,598	0.0222%	0	0.0000%	299	0.0002%	169,400	0.0150%	0	0.0000%
32707	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,417,814	0.4193%	54,281	0.0422%	0	0.0000%	0	0.0000%	346,918	0.0307%	0	0.0000%
32708	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,951,315	0.8728%	1,200,762	0.9329%	0	0.0000%	493,559	0.3961%	1,675,795	0.1482%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
32709	Orange	0	0.0000%	0	0.0000%	0	0.0000%	64	0.0000%	15,425	0.0046%	73	0.0001%	0	0.0000%	64	0.0001%	143	0.0000%	0	0.0000%
32710	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32712	Orange	0	0.0000%	0	0.0000%	126	0.0000%	0	0.0000%	2,155,543	0.6374%	433,269	0.3366%	0	0.0000%	43,799	0.0351%	821,299	0.0726%	0	0.0000%
32713	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,000,614	0.8873%	170,700	0.1326%	0	0.0000%	0	0.0000%	217,268	0.0192%	0	0.0000%
32714	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,315,499	0.3890%	481,357	0.3740%	0	0.0000%	15,016	0.0121%	923,044	0.0816%	0	0.0000%
32720	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,713,130	0.5066%	396,794	0.3083%	0	0.0000%	0	0.0000%	818,373	0.0724%	0	0.0000%
32724	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,084,894	0.3208%	168,299	0.1308%	0	0.0000%	323	0.0003%	524,074	0.0463%	0	0.0000%
32725	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	9,128,660	2.6995%	3,077,110	2.3908%	0	0.0000%	57,972	0.0465%	2,469,041	0.2183%	0	0.0000%
32726	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32727	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32728	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32730	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32732	Seminole	0	0.0000%	0	0.0000%	598	0.0002%	0	0.0000%	64,397	0.0190%	1,105	0.0009%	0	0.0000%	766	0.0006%	1,105	0.0001%	0	0.0000%
32735	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32736	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	296,833	0.0878%	395	0.0003%	0	0.0000%	0	0.0000%	268	0.0000%	0	0.0000%
32738	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	544,979	0.1612%	85,064	0.0661%	0	0.0000%	752	0.0006%	1,519	0.0001%	0	0.0000%
32739	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32744	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32746	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	807,285	0.2387%	105,894	0.0823%	0	0.0000%	10,006	0.0080%	197,090	0.0174%	0	0.0000%
32750	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	303,624	0.0898%	0	0.0000%	0	0.0000%	0	0.0000%	103,685	0.0092%	0	0.0000%
32751	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	253,526	0.0750%	20,018	0.0156%	0	0.0000%	0	0.0000%	86,211	0.0076%	0	0.0000%
32754	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	327	0.0001%	114,262	0.0338%	426	0.0003%	0	0.0000%	249	0.0002%	1,791	0.0002%	0	0.0000%
32757	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	198,141	0.0586%	0	0.0000%	0	0.0000%	0	0.0000%	5,499	0.0005%	0	0.0000%
32759	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	292	0.0001%	192	0.0001%	0	0.0000%	156	0.0001%	0	0.0000%	0	0.0000%
32763	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,413,001	0.4179%	209,797	0.1630%	0	0.0000%	5,829	0.0047%	379,821	0.0336%	0	0.0000%
32764	Volusia	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	106,734	0.0316%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32765	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,097,518	0.3246%	44,729	0.0348%	0	0.0000%	0	0.0000%	385,165	0.0341%	0	0.0000%
32766	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	16,688	0.0049%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32767	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32771	Seminole	0	0.0000%	0	0.0000%	38,026	0.0121%	24,249	0.0040%	5,417,669	1.6021%	1,080,962	0.8399%	0	0.0000%	227,068	0.1822%	2,179,595	0.1927%	0	0.0000%
32773	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	179,947	0.0532%	91,598	0.0712%	0	0.0000%	37,946	0.0305%	91,598	0.0081%	0	0.0000%
32775	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32776	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	649,970	0.1922%	162,451	0.1262%	0	0.0000%	0	0.0000%	196,355	0.0174%	0	0.0000%
32778	Lake	0	0.0000%	0	0.0000%	285,075	0.0906%	152,237	0.0248%	496,485	0.1468%	380,850	0.2959%	0	0.0000%	232,007	0.1862%	771,738	0.0682%	0	0.0000%
32779	Seminole	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,899,110	0.5616%	781,095	0.6069%	0	0.0000%	93,450	0.0750%	1,202,038	0.1063%	0	0.0000%
32780	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	653,146	0.1931%	0	0.0000%	0	0.0000%	0	0.0000%	129,499	0.0115%	0	0.0000%
32784	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	23,397	0.0069%	17,276	0.0134%	0	0.0000%	0	0.0000%	18,446	0.0016%	0	0.0000%
32789	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	284,454	0.0841%	0	0.0000%	0	0.0000%	0	0.0000%	60,192	0.0053%	0	0.0000%
32792	Orange	0	0.0000%	0	0.0000%	3,556	0.0011%	32,680	0.0053%	906,276	0.2680%	353,968	0.2750%	0	0.0000%	32,680	0.0262%	562,127	0.0497%	0	0.0000%
32796	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	12,450	0.0020%	261,024	0.0772%	9,962	0.0077%	0	0.0000%	4,095	0.0033%	75,818	0.0067%	0	0.0000%
32798	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32801	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	698,763	0.2066%	19,973	0.0155%	0	0.0000%	0	0.0000%	74,001	0.0065%	0	0.0000%
32803	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	315,238	0.0932%	0	0.0000%	0	0.0000%	0	0.0000%	3,978	0.0004%	0	0.0000%
32804	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	84,901	0.0251%	0	0.0000%	0	0.0000%	0	0.0000%	22,108	0.0020%	0	0.0000%
32805	Orange	0	0.0000%	0	0.0000%	0	0.0000%	2,624	0.0004%	12,146	0.0036%	10,482	0.0081%	0	0.0000%	0	0.0000%	12,146	0.0011%	0	0.0000%
32806	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,128,532	0.3337%	268,325	0.2085%	0	0.0000%	0	0.0000%	600,123	0.0531%	0	0.0000%
32807	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,284,902	0.3800%	258,034	0.2005%	0	0.0000%	0	0.0000%	699,599	0.0619%	0	0.0000%
32808	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	342,940	0.1014%	64,350	0.0500%	0	0.0000%	0	0.0000%	136,567	0.0121%	0	0.0000%
32809	Orange	0	0.0000%	0	0.0000%	26,877	0.0085%	18,750	0.0031%	55,963	0.0165%	49,163	0.0382%	0	0.0000%	18,666	0.0150%	88,789	0.0079%	0	0.0000%
32810	Orange	0	0.0000%	0	0.0000%	1,511	0.0005%	1,511	0.0002%	392,075	0.1159%	92,100	0.0716%	0	0.0000%	4,787	0.0038%	219,021	0.0194%	0	0.0000%
32811	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	147,136	0.0435%	60,393	0.0469%	0	0.0000%	0	0.0000%	82,338	0.0073%	0	0.0000%
32812	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	125,154	0.0370%	3,793	0.0029%	0	0.0000%	0	0.0000%	40,943	0.0036%	0	0.0000%
32814	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32817	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,742,472	0.8110%	51,784	0.0402%	0	0.0000%	0	0.0000%	929,315	0.0822%	0	0.0000%
32818	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	190,934	0.0565%	128,207	0.0996%	0	0.0000%	7,165	0.0058%	150,100	0.0133%	0	0.0000%
32819	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32820	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	599	0.0002%	0	0.0000%	0	0.0000%	0	0.0000%	52	0.0000%	0	0.0000%
32821	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32822	Orange	0	0.0000%	0	0.0000%	28,862	0.0092%	70,043	0.0114%	1,618,977	0.4788%	164,414	0.1277%	0	0.0000%	0	0.0000%	514,192	0.0455%	0	0.0000%
32824	Orange	0	0.0000%	0	0.0000%	17,084	0.0054%	166	0.0000%	96,758	0.0286%	33,742	0.0262%	0	0.0000%	0	0.0000%	74,467	0.0066%	0	0.0000%
32825	Orange	0	0.0000%	0	0.0000%	11,712	0.0037%	27,561	0.0045%	1,386,669	0.4101%	244,283	0.1898%	0	0.0000%	0	0.0000%	744,260	0.0658%	0	0.0000%
32826	Orange	0	0.0000%	0	0.0000%	453	0.0001%	0	0.0000%	181,971	0.0538%	33,569	0.0261%	0	0.0000%	324	0.0003%	63,255	0.0056%	0	0.0000%
32827	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32828	Orange	0	0.0000%	0	0.0000%	88	0.0000%	61	0.0000%	1,132,548	0.3349%	102,306	0.0795%	0	0.0000%	0	0.0000%	359,962	0.0318%	0	0.0000%
32829	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	336,049	0.0994%	11,659	0.0091%	0	0.0000%	0	0.0000%	47,888	0.0042%	0	0.0000%
32831	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	412	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	369	0.0000%	0	0.0000%
32832	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32833	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	31,655	0.0094%	0	0.0000%	0	0.0000%	0	0.0000%	373	0.0000%	0	0.0000%
32835	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,305	0.0004%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32836	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32837	Orange	0	0.0000%	0	0.0000%	8,453	0.0027%	0	0.0000%	10,666	0.0032%	9,961	0.0077%	0	0.0000%	0	0.0000%	10,656	0.0009%	0	0.0000%
32839	Orange	0	0.0000%	0	0.0000%	5,733	0.0018%	0	0.0000%	5,733	0.0017%	12,429	0.0097%	0	0.0000%	5,733	0.0046%	95,673	0.0085%	0	0.0000%
32857	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32868	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32886	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32901	Brevard	0	0.0000%	0	0.0000%	82,637	0.0262%	59,397	0.0097%	9,543,170	2.8221%	150,588	0.1170%	0	0.0000%	14,781	0.0119%	2,228,389	0.1970%	0	0.0000%
32903	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	23,819	0.0070%	0	0.0000%	0	0.0000%	0	0.0000%	3,163	0.0003%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
32904	Brevard	0	0.0000%	0	0.0000%	571	0.0002%	0	0.0000%	194,306	0.0575%	476	0.0004%	0	0.0000%	0	0.0000%	17,899	0.0016%	0	0.0000%
32905	Brevard	0	0.0000%	0	0.0000%	7,995	0.0025%	0	0.0000%	2,581,641	0.7634%	0	0.0000%	0	0.0000%	0	0.0000%	313,041	0.0277%	0	0.0000%
32906	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32907	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	4,387	0.0013%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32908	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32909	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	19,242	0.0057%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32910	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32920	Brevard	0	0.0000%	0	0.0000%	7,411,633	2.3543%	2,358	0.0004%	1,108,572	0.3278%	2,358	0.0018%	0	0.0000%	0	0.0000%	111,164	0.0098%	0	0.0000%
32922	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	469,038	0.1387%	0	0.0000%	0	0.0000%	0	0.0000%	289,629	0.0256%	0	0.0000%
32925	Brevard	0	0.0000%	0	0.0000%	32,778	0.0104%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32926	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	58	0.0000%	560,379	0.1657%	34	0.0000%	0	0.0000%	34	0.0000%	156,233	0.0138%	0	0.0000%
32927	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	372,494	0.1102%	0	0.0000%	0	0.0000%	0	0.0000%	125,547	0.0111%	0	0.0000%
32931	Brevard	0	0.0000%	0	0.0000%	24,741,487	7.8591%	0	0.0000%	417,784	0.1235%	0	0.0000%	0	0.0000%	269,408	0.2162%	55,180	0.0049%	0	0.0000%
32932	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32934	Brevard	0	0.0000%	0	0.0000%	191	0.0001%	0	0.0000%	662,593	0.1959%	191	0.0001%	0	0.0000%	0	0.0000%	768	0.0001%	0	0.0000%
32935	Brevard	0	0.0000%	0	0.0000%	456,079	0.1449%	0	0.0000%	6,428,930	1.9012%	156,216	0.1214%	0	0.0000%	0	0.0000%	709,504	0.0627%	0	0.0000%
32937	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	808,837	0.2392%	0	0.0000%	0	0.0000%	0	0.0000%	78,800	0.0070%	0	0.0000%
32940	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,676,891	0.4959%	9,853	0.0077%	0	0.0000%	0	0.0000%	14,588	0.0013%	0	0.0000%
32948	Indian River	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,312	0.0010%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32949	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	685,418	0.2027%	0	0.0000%	0	0.0000%	0	0.0000%	568,414	0.0503%	0	0.0000%
32950	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	70,158	0.0207%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32951	Brevard	0	0.0000%	0	0.0000%	116,072	0.0369%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32952	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,352,816	0.4001%	0	0.0000%	0	0.0000%	0	0.0000%	680,402	0.0602%	0	0.0000%
32953	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,274,570	0.3769%	0	0.0000%	0	0.0000%	0	0.0000%	197,454	0.0175%	0	0.0000%
32955	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	255,670	0.0756%	0	0.0000%	0	0.0000%	0	0.0000%	56,806	0.0050%	0	0.0000%
32956	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32957	Indian River	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32958	Indian River	0	0.0000%	250	0.0007%	6,898,048	2.1912%	1,095	0.0002%	9,815	0.0029%	250	0.0002%	0	0.0000%	471,665	0.3785%	510	0.0000%	0	0.0000%
32959	Brevard	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32960	Indian River	0	0.0000%	0	0.0000%	4,184,081	1.3291%	4,346	0.0007%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32961	Indian River	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32962	Indian River	0	0.0000%	0	0.0000%	16,341	0.0052%	0	0.0000%	108,295	0.0320%	0	0.0000%	0	0.0000%	0	0.0000%	841,959	0.0744%	0	0.0000%
32963	Indian River	2,043,984	0.2608%	0	0.0000%	10,572,908	3.3585%	11,621	0.0019%	0	0.0000%	0	0.0000%	0	0.0000%	3,010,173	2.4157%	0	0.0000%	0	0.0000%
32964	Indian River	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32966	Indian River	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32967	Indian River	0	0.0000%	0	0.0000%	6,042,117	1.9193%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,549,005	1.2431%	0	0.0000%	0	0.0000%
32968	Indian River	0	0.0000%	0	0.0000%	93,144	0.0296%	0	0.0000%	263,298	0.0779%	0	0.0000%	0	0.0000%	0	0.0000%	778,997	0.0689%	0	0.0000%
32970	Indian River	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32971	Indian River	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
32976	Brevard	0	0.0000%	0	0.0000%	387	0.0001%	0	0.0000%	5,236	0.0015%	0	0.0000%	0	0.0000%	0	0.0000%	1,371	0.0001%	0	0.0000%
33001	Monroe	0	0.0000%	0	0.0000%	147,741	0.0469%	2,443,580	0.3985%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	33,073	0.0029%	0	0.0000%
33004	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33009	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	111	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	111	0.0000%	0	0.0000%
33010	Miami-Dade	450,389	0.0575%	0	0.0000%	0	0.0000%	0	0.0000%	72,792	0.0215%	0	0.0000%	0	0.0000%	0	0.0000%	2,544,285	0.2250%	0	0.0000%
33011	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33012	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	8,037	0.0024%	0	0.0000%	0	0.0000%	0	0.0000%	17,333	0.0015%	0	0.0000%
33013	Miami-Dade	245,606	0.0313%	0	0.0000%	0	0.0000%	0	0.0000%	84,422	0.0250%	0	0.0000%	0	0.0000%	0	0.0000%	2,566,966	0.2270%	0	0.0000%
33014	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	70,914	0.0210%	0	0.0000%	0	0.0000%	0	0.0000%	130,153	0.0115%	0	0.0000%
33015	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33016	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	28,827	0.0085%	0	0.0000%	0	0.0000%	0	0.0000%	31,792	0.0028%	0	0.0000%
33017	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33018	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	5,869	0.0017%	0	0.0000%	0	0.0000%	0	0.0000%	38,995	0.0034%	0	0.0000%
33019	Broward	168,973	0.0216%	0	0.0000%	1,094,716	0.3477%	411,478	0.0671%	43,270	0.0128%	0	0.0000%	0	0.0000%	91,533	0.0735%	13,025	0.0012%	0	0.0000%
33020	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33021	Broward	18,566	0.0024%	0	0.0000%	48,119	0.0153%	38,796	0.0063%	11,197	0.0033%	0	0.0000%	0	0.0000%	14,929	0.0120%	2,019	0.0002%	0	0.0000%
33022	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33023	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	19,260	0.0057%	0	0.0000%	0	0.0000%	0	0.0000%	38,515	0.0034%	0	0.0000%
33024	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	6,508	0.0019%	0	0.0000%	0	0.0000%	0	0.0000%	77,062	0.0068%	0	0.0000%
33025	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33026	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33027	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33028	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33029	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33030	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	8,933	0.0026%	0	0.0000%	0	0.0000%	0	0.0000%	38,263	0.0034%	0	0.0000%
33031	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	8,414	0.0025%	0	0.0000%	0	0.0000%	0	0.0000%	42,715	0.0038%	0	0.0000%
33032	Miami-Dade	1,784,390	0.2277%	0	0.0000%	0	0.0000%	0	0.0000%	396,049	0.1171%	0	0.0000%	0	0.0000%	0	0.0000%	2,371,913	0.2097%	0	0.0000%
33033	Miami-Dade	428,233	0.0546%	0	0.0000%	0	0.0000%	0	0.0000%	51,019	0.0151%	0	0.0000%	0	0.0000%	0	0.0000%	2,327,305	0.2058%	0	0.0000%
33034	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	5,993	0.0005%	0	0.0000%
33035	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33036	Monroe	2,527	0.0003%	0	0.0000%	2,752,280	0.8743%	16,859,228	2.7495%	0	0.0000%	0	0.0000%	0	0.0000%	14,884	0.0119%	17,285	0.0015%	0	0.0000%
33037	Monroe	2,563,122	0.3271%	103	0.0003%	13,115,183	4.1660%	42,491,059	6.9296%	6,683	0.0020%	0	0.0000%	0	0.0000%	1,927,961	1.5472%	751,008	0.0664%	0	0.0000%
33039	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33040	Monroe	1,035	0.0001%	553	0.0015%	58,527	0.0186%	111,361,125	18.1613%	8,107	0.0024%	0	0.0000%	0	0.0000%	1,035	0.0008%	150,720,499	13.3264%	0	0.0000%
33041	Monroe	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33042	Monroe	79,190	0.0101%	0	0.0000%	617,553	0.1962%	37,195,254	6.0660%	39,448	0.0117%	0	0.0000%	0	0.0000%	1,766	0.0014%	50,538,198	4.4685%	0	0.0000%
33043	Monroe	177,319	0.0226%	4,650	0.0129%	156,792	0.0498%	37,964,157	6.1914%	179,391	0.0530%	0	0.0000%	0	0.0000%	3,067	0.0025%	54,216,388	4.7937%	0	0.0000%
33050	Monroe	14,605	0.0019%	0	0.0000%	2,976,970	0.9456%	88,476,552	14.4292%	0	0.0000%	0	0.0000%	0	0.0000%	36,713	0.0295%	29,023,380	2.5662%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	**County**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**
33051	Monroe	0	0.0000%	0	0.0000%	0	0.0000%	19,836,962	3.2351%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,754,054	0.1551%	0	0.0000%
33052	Monroe	0	0.0000%	0	0.0000%	0	0.0000%	115,823	0.0189%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	51,649	0.0046%	0	0.0000%
33054	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33055	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	9,857	0.0029%	0	0.0000%	0	0.0000%	0	0.0000%	19,834	0.0018%	0	0.0000%
33056	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33060	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	17,063	0.0050%	0	0.0000%	0	0.0000%	0	0.0000%	12,201	0.0011%	0	0.0000%
33062	Broward	1,292	0.0002%	0	0.0000%	161,391	0.0513%	5,319	0.0009%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33063	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	26,104	0.0023%	0	0.0000%
33064	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	64,169	0.0190%	0	0.0000%	0	0.0000%	0	0.0000%	33,876	0.0030%	0	0.0000%
33065	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	50,351	0.0045%	0	0.0000%
33066	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33067	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33068	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	72,556	0.0064%	0	0.0000%
33069	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33070	Monroe	43,174	0.0055%	0	0.0000%	1,728,414	0.5490%	24,716,378	4.0309%	0	0.0000%	0	0.0000%	0	0.0000%	83,815	0.0673%	113,849	0.0101%	0	0.0000%
33071	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,900	0.0009%	0	0.0000%	0	0.0000%	0	0.0000%	649,174	0.0574%	0	0.0000%
33073	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33075	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33076	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,052	0.0002%	0	0.0000%
33082	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33083	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33090	Miami-Dade	27,245	0.0035%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33097	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33101	Miami-Dade	531,528	0.0678%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33102	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33109	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33114	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33116	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33119	Miami-Dade	51,751	0.0066%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33125	Miami-Dade	6,390,902	0.8156%	0	0.0000%	15,694	0.0050%	112,796	0.0184%	85,155	0.0252%	0	0.0000%	0	0.0000%	0	0.0000%	134,277	0.0119%	0	0.0000%
33126	Miami-Dade	62,338	0.0080%	0	0.0000%	0	0.0000%	3,111	0.0005%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33127	Miami-Dade	9,790	0.0012%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,716	0.0003%	0	0.0000%
33128	Miami-Dade	7,917	0.0010%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33129	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33130	Miami-Dade	121,091	0.0155%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33131	Miami-Dade	499,102	0.0637%	0	0.0000%	0	0.0000%	62,671	0.0102%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33132	Miami-Dade	83,056	0.0106%	0	0.0000%	19,561	0.0062%	30,228	0.0049%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33133	Miami-Dade	45,842,957	5.8503%	0	0.0000%	352,741	0.1120%	4,374,510	0.7134%	1,040	0.0003%	0	0.0000%	0	0.0000%	0	0.0000%	4,366	0.0004%	0	0.0000%
33134	Miami-Dade	302,278	0.0386%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	14,332	0.0013%	0	0.0000%
33135	Miami-Dade	22,496	0.0029%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33136	Miami-Dade	1,755,074	0.2240%	0	0.0000%	0	0.0000%	68,817	0.0112%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33137	Miami-Dade	2,446,997	0.3123%	0	0.0000%	0	0.0000%	10,340	0.0017%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33138	Miami-Dade	5,734,559	0.7318%	0	0.0000%	0	0.0000%	2,339,506	0.3815%	16,300	0.0048%	0	0.0000%	0	0.0000%	0	0.0000%	654,733	0.0579%	0	0.0000%
33139	Miami-Dade	16,499,017	2.1055%	0	0.0000%	1,331,581	0.4230%	1,339,429	0.2184%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33140	Miami-Dade	829,635	0.1059%	0	0.0000%	1,420,465	0.4512%	9,871,405	1.6099%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33141	Miami-Dade	756,340	0.0965%	853	0.0024%	633,534	0.2012%	18,958,838	3.0919%	8,148	0.0024%	0	0.0000%	0	0.0000%	11,381	0.0091%	6,446	0.0006%	0	0.0000%
33142	Miami-Dade	1,353,894	0.1728%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33143	Miami-Dade	13,738,085	1.7532%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	36,994	0.0033%	0	0.0000%
33144	Miami-Dade	52,485	0.0067%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	307,092	0.0272%	0	0.0000%
33145	Miami-Dade	31,938	0.0041%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33146	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33147	Miami-Dade	408,863	0.0522%	0	0.0000%	0	0.0000%	27,113	0.0044%	597,489	0.1767%	0	0.0000%	0	0.0000%	0	0.0000%	5,813,508	0.5140%	0	0.0000%
33149	Miami-Dade	123,667,413	15.7819%	0	0.0000%	0	0.0000%	19,601,921	3.1968%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33150	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	594,277	0.0525%	0	0.0000%
33151	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33154	Miami-Dade	77,828	0.0099%	0	0.0000%	181,172	0.0575%	13,452,993	2.1940%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33155	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	4,932	0.0004%	0	0.0000%
33156	Miami-Dade	124,869,184	15.9353%	0	0.0000%	0	0.0000%	645,140	0.1052%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	7,885	0.0007%	0	0.0000%
33157	Miami-Dade	97,728,522	12.4717%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	5,090	0.0005%	0	0.0000%
33158	Miami-Dade	13,763,498	1.7564%	0	0.0000%	0	0.0000%	0	0.0000%	21,134	0.0062%	0	0.0000%	0	0.0000%	0	0.0000%	46,075	0.0041%	0	0.0000%
33160	Miami-Dade	76,974	0.0098%	0	0.0000%	440,529	0.1399%	580,697	0.0947%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33161	Miami-Dade	2,009,216	0.2564%	0	0.0000%	47,574	0.0151%	4,445,803	0.7250%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,582	0.0001%	0	0.0000%
33162	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33164	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33165	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	59,190	0.0097%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	270,079	0.0239%	0	0.0000%
33166	Miami-Dade	31,960	0.0041%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	799,771	0.0707%	0	0.0000%
33167	Miami-Dade	26,750	0.0034%	0	0.0000%	0	0.0000%	0	0.0000%	34,697	0.0103%	0	0.0000%	0	0.0000%	0	0.0000%	537,356	0.0475%	0	0.0000%
33168	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	10,623	0.0009%	0	0.0000%
33169	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,599	0.0001%	0	0.0000%
33170	Miami-Dade	104,922	0.0134%	0	0.0000%	0	0.0000%	0	0.0000%	54	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	16,679	0.0015%	0	0.0000%
33172	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	44,036	0.0039%	0	0.0000%
33173	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33174	Miami-Dade	75,400	0.0096%	0	0.0000%	0	0.0000%	0	0.0000%	3,802	0.0011%	0	0.0000%	0	0.0000%	0	0.0000%	2,429,581	0.2148%	0	0.0000%
33175	Miami-Dade	133,838	0.0171%	0	0.0000%	18,803	0.0060%	18,803	0.0031%	76,815	0.0227%	0	0.0000%	0	0.0000%	0	0.0000%	2,638,367	0.2333%	0	0.0000%
33176	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	33,552	0.0030%	0	0.0000%
33177	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33178	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
33179	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33180	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33181	Miami-Dade	148,750	0.0190%	0	0.0000%	0	0.0000%	5,403,485	0.8812%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33182	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33183	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33184	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,178	0.0002%	0	0.0000%
33185	Miami-Dade	15,209	0.0019%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33186	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	6,071	0.0005%	0	0.0000%
33187	Miami-Dade	284,857	0.0364%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	20,037	0.0018%	0	0.0000%
33188	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33189	Miami-Dade	252,967,421	32.2827%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	6,647	0.0006%	0	0.0000%
33190	Miami-Dade	38,776,168	4.9485%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	9,933	0.0009%	0	0.0000%
33191	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33192	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33193	Miami-Dade	109,531	0.0140%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33194	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33195	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33196	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33197	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33198	Miami-Dade	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33301	Broward	51,217	0.0065%	0	0.0000%	236,046	0.0750%	148,970	0.0243%	300,765	0.0889%	0	0.0000%	0	0.0000%	0	0.0000%	3,992,310	0.3530%	0	0.0000%
33302	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33303	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33304	Broward	0	0.0000%	0	0.0000%	475,120	0.1509%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33305	Broward	0	0.0000%	0	0.0000%	74,811	0.0238%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33306	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33307	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33308	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33309	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	58,052	0.0051%	0	0.0000%
33310	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33311	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	11,439	0.0010%	0	0.0000%
33312	Broward	46,025	0.0059%	0	0.0000%	0	0.0000%	0	0.0000%	410,496	0.1214%	16,065	0.0125%	0	0.0000%	0	0.0000%	6,836,315	0.6045%	0	0.0000%
33313	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,433	0.0002%	0	0.0000%
33314	Broward	122,523	0.0156%	0	0.0000%	0	0.0000%	2,202	0.0004%	303,199	0.0897%	60,800	0.0472%	0	0.0000%	0	0.0000%	2,578,622	0.2280%	0	0.0000%
33315	Broward	10,362	0.0013%	0	0.0000%	0	0.0000%	0	0.0000%	1,259,601	0.3725%	0	0.0000%	0	0.0000%	0	0.0000%	17,822,381	1.5758%	0	0.0000%
33316	Broward	0	0.0000%	0	0.0000%	98,045	0.0311%	0	0.0000%	399,702	0.1182%	0	0.0000%	0	0.0000%	0	0.0000%	10,296,651	0.9104%	0	0.0000%
33317	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	114,834	0.0102%	0	0.0000%
33318	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33319	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	108,071	0.0096%	0	0.0000%
33320	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33321	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	15,000	0.0044%	0	0.0000%	0	0.0000%	0	0.0000%	400,374	0.0354%	0	0.0000%
33322	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33323	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	11,155	0.0010%	0	0.0000%
33324	Broward	4,717	0.0006%	0	0.0000%	0	0.0000%	0	0.0000%	65,143	0.0193%	0	0.0000%	0	0.0000%	0	0.0000%	1,616,299	0.1429%	0	0.0000%
33325	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	41,349	0.0122%	0	0.0000%	0	0.0000%	0	0.0000%	1,969,627	0.1742%	0	0.0000%
33326	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33327	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33328	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	126,938	0.0375%	0	0.0000%	0	0.0000%	0	0.0000%	4,942,904	0.4370%	0	0.0000%
33329	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33330	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	11,874	0.0035%	0	0.0000%	0	0.0000%	0	0.0000%	183,204	0.0162%	0	0.0000%
33331	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	57,693	0.0051%	0	0.0000%
33332	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33334	Broward	0	0.0000%	0	0.0000%	0	0.0000%	1,276	0.0002%	1,276	0.0004%	0	0.0000%	0	0.0000%	0	0.0000%	7,202	0.0006%	0	0.0000%
33337	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33345	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33351	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	21,770	0.0019%	0	0.0000%
33355	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33401	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	15,472	0.0046%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33403	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33404	Palm Beach	0	0.0000%	0	0.0000%	31,784	0.0101%	0	0.0000%	6,432	0.0019%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33405	Palm Beach	0	0.0000%	0	0.0000%	45,838	0.0146%	0	0.0000%	17,294	0.0051%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33406	Palm Beach	0	0.0000%	0	0.0000%	2,254	0.0007%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33407	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33408	Palm Beach	0	0.0000%	0	0.0000%	13,447	0.0043%	34,414	0.0056%	13,447	0.0040%	0	0.0000%	0	0.0000%	0	0.0000%	102,657	0.0091%	0	0.0000%
33409	Palm Beach	0	0.0000%	0	0.0000%	235	0.0001%	0	0.0000%	309	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33410	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	661	0.0002%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33411	Palm Beach	0	0.0000%	6,182	0.0172%	247,586	0.0786%	22,719	0.0037%	247,586	0.0732%	0	0.0000%	0	0.0000%	22,719	0.0182%	127,602	0.0113%	0	0.0000%
33412	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33413	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33414	Palm Beach	0	0.0000%	0	0.0000%	164,889	0.0524%	0	0.0000%	176,704	0.0523%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33415	Palm Beach	0	0.0000%	0	0.0000%	266	0.0001%	0	0.0000%	178	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33417	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33418	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33422	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33425	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33426	Palm Beach	0	0.0000%	0	0.0000%	2,124	0.0007%	0	0.0000%	30,184	0.0089%	0	0.0000%	0	0.0000%	0	0.0000%	94,415	0.0083%	0	0.0000%
33428	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	428	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	892	0.0001%	0	0.0000%

		Hurricane Andrew (1992)		**Hurricane Ivan (2004)**		**Hurricane Jeanne (2004)**		**Hurricane Wilma (2005)**		**Tropical Storm Fay (2008)**		**Unnamed Storm in East Florida (May 2009)**		**Unnamed Storm in Panhandle (July 2013)**		**Hurricane Matthew (2016)**		**Hurricane Irma (2017)**		**Hurricane Michael (2018)**	
ZIP Code	**County**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**
33429	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33430	Palm Beach	0	0.0000%	205	0.0006%	41,991	0.0133%	25,058	0.0041%	67,503	0.0200%	0	0.0000%	0	0.0000%	0	0.0000%	75,720	0.0067%	0	0.0000%
33431	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33432	Palm Beach	0	0.0000%	0	0.0000%	14,668	0.0047%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33433	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33434	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33435	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	14,339	0.0042%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33436	Palm Beach	0	0.0000%	0	0.0000%	368	0.0001%	0	0.0000%	1,776	0.0005%	0	0.0000%	0	0.0000%	0	0.0000%	1,562	0.0001%	0	0.0000%
33437	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33438	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33440	Hendry	0	0.0000%	351	0.0010%	0	0.0000%	490	0.0001%	4,753	0.0014%	0	0.0000%	0	0.0000%	0	0.0000%	1,293	0.0001%	0	0.0000%
33441	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,250	0.0007%	0	0.0000%	0	0.0000%	0	0.0000%	2,250	0.0002%	0	0.0000%
33442	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33443	Broward	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33444	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33445	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	24,514	0.0072%	0	0.0000%	0	0.0000%	0	0.0000%	29,750	0.0026%	0	0.0000%
33446	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33449	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33455	Martin	201,511	0.0257%	0	0.0000%	422,520	0.1342%	0	0.0000%	428,688	0.1268%	0	0.0000%	0	0.0000%	0	0.0000%	660	0.0001%	0	0.0000%
33458	Palm Beach	0	0.0000%	0	0.0000%	11,659	0.0037%	60,184	0.0098%	41,606	0.0123%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33459	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33460	Palm Beach	0	0.0000%	0	0.0000%	44,590	0.0142%	11,266	0.0018%	5,182	0.0015%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33461	Palm Beach	0	0.0000%	0	0.0000%	619	0.0002%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33462	Palm Beach	0	0.0000%	0	0.0000%	404,422	0.1285%	0	0.0000%	8,783	0.0026%	0	0.0000%	0	0.0000%	0	0.0000%	94	0.0000%	0	0.0000%
33463	Palm Beach	0	0.0000%	0	0.0000%	1,640	0.0005%	0	0.0000%	1,204	0.0004%	0	0.0000%	0	0.0000%	0	0.0000%	662	0.0001%	0	0.0000%
33466	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33467	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33469	Palm Beach	0	0.0000%	0	0.0000%	180,846	0.0574%	29,793	0.0049%	150,314	0.0445%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33470	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33471	Glades	0	0.0000%	0	0.0000%	0	0.0000%	53	0.0000%	100,803	0.0298%	0	0.0000%	0	0.0000%	0	0.0000%	91,237	0.0081%	0	0.0000%
33472	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33473	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33475	Martin	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33476	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33477	Palm Beach	0	0.0000%	0	0.0000%	245,120	0.0779%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33478	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33480	Palm Beach	3,029	0.0004%	0	0.0000%	1,419,543	0.4509%	13,782	0.0022%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33482	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33483	Palm Beach	378,299	0.0483%	0	0.0000%	1,880,988	0.5975%	539,817	0.0880%	124,673	0.0369%	0	0.0000%	0	0.0000%	274,482	0.2203%	0	0.0000%	0	0.0000%
33484	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33486	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	31,199	0.0028%	0	0.0000%
33487	Palm Beach	0	0.0000%	0	0.0000%	22,817	0.0072%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33493	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33496	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33498	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33499	Palm Beach	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33509	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33510	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33511	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	69,243	0.0061%	0	0.0000%
33513	Sumter	0	0.0000%	0	0.0000%	206	0.0001%	0	0.0000%	77	0.0000%	77	0.0001%	0	0.0000%	0	0.0000%	52,481	0.0046%	0	0.0000%
33514	Sumter	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33521	Sumter	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33523	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	121,863	0.0108%	0	0.0000%
33524	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33525	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	37,626	0.0033%	0	0.0000%
33527	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	199,710	0.0177%	0	0.0000%
33534	Hillsborough	0	0.0000%	0	0.0000%	933,637	0.2966%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	10,101	0.0009%	0	0.0000%
33537	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33538	Sumter	0	0.0000%	0	0.0000%	25,287	0.0080%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,175,154	0.1039%	0	0.0000%
33540	Pasco	0	0.0000%	0	0.0000%	2,719	0.0009%	95	0.0000%	95	0.0000%	228	0.0002%	95	0.0004%	228	0.0002%	77,762	0.0069%	0	0.0000%
33541	Pasco	0	0.0000%	0	0.0000%	275	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	754	0.0001%	0	0.0000%
33542	Pasco	0	0.0000%	0	0.0000%	312	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	70,169	0.0062%	0	0.0000%
33543	Pasco	0	0.0000%	0	0.0000%	492	0.0002%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	567	0.0001%	0	0.0000%
33544	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33545	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,854	0.0002%	0	0.0000%
33547	Hillsborough	0	0.0000%	0	0.0000%	140	0.0000%	140	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	213	0.0000%	0	0.0000%
33548	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33549	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	80	0.0000%	0	0.0000%
33556	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33558	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33559	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33563	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33565	Hillsborough	0	0.0000%	0	0.0000%	75	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	642	0.0001%	0	0.0000%
33566	Hillsborough	0	0.0000%	0	0.0000%	54	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	877	0.0001%	0	0.0000%
33567	Hillsborough	0	0.0000%	0	0.0000%	164	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	7,292	0.0006%	0	0.0000%
33568	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33569	Hillsborough	0	0.0000%	0	0.0000%	532,844	0.1693%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	113,312	0.0100%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
33570	Hillsborough	0	0.0000%	0	0.0000%	256,291	0.0814%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	159	0.0000%	0	0.0000%
33572	Hillsborough	0	0.0000%	0	0.0000%	474,012	0.1506%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33573	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33576	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33578	Hillsborough	0	0.0000%	0	0.0000%	262,811	0.0835%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	16,423	0.0015%	0	0.0000%
33579	Hillsborough	0	0.0000%	0	0.0000%	39	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	44	0.0000%	0	0.0000%
33584	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	41	0.0000%	0	0.0000%
33585	Sumter	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33592	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	189	0.0000%	0	0.0000%
33594	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	157,572	0.0139%	0	0.0000%
33595	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33596	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	53,268	0.0047%	0	0.0000%
33597	Sumter	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33598	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	245	0.0000%	0	0.0000%
33601	Hillsborough	0	0.0000%	0	0.0000%	21,285	0.0068%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33602	Hillsborough	0	0.0000%	0	0.0000%	34,497	0.0110%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33603	Hillsborough	0	0.0000%	0	0.0000%	71,781	0.0228%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33604	Hillsborough	0	0.0000%	0	0.0000%	395,923	0.1258%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33605	Hillsborough	0	0.0000%	0	0.0000%	3,205,045	1.0181%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33606	Hillsborough	0	0.0000%	0	0.0000%	12,297,019	3.9062%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	4,147	0.0004%	0	0.0000%
33607	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,501	0.0001%	0	0.0000%
33609	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	167,109	0.0148%	0	0.0000%
33610	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	90	0.0000%	0	0.0000%
33611	Hillsborough	0	0.0000%	0	0.0000%	461,968	0.1467%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33612	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33613	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	4,981	0.0004%	0	0.0000%
33614	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33615	Hillsborough	0	0.0000%	0	0.0000%	19,882	0.0063%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	30,513	0.0027%	0	0.0000%
33616	Hillsborough	0	0.0000%	0	0.0000%	472,368	0.1500%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33617	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	11,465	0.0010%	0	0.0000%
33618	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33619	Hillsborough	0	0.0000%	0	0.0000%	1,021,437	0.3245%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	31,086	0.0027%	0	0.0000%
33621	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33624	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33625	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	94	0.0000%	0	0.0000%
33626	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,944	0.0003%	0	0.0000%
33629	Hillsborough	0	0.0000%	0	0.0000%	34,324	0.0109%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	4,500	0.0004%	0	0.0000%
33634	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33635	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33637	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33647	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33685	Hillsborough	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33701	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33702	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33703	Pinellas	0	0.0000%	0	0.0000%	132,482	0.0421%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33704	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33705	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33706	Pinellas	2,148,056	0.2741%	0	0.0000%	1,031,004	0.3275%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33707	Pinellas	0	0.0000%	0	0.0000%	43,893	0.0139%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33708	Pinellas	1,470,857	0.1877%	0	0.0000%	1,772,787	0.5631%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33709	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33710	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33711	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33712	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33713	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33714	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33715	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33716	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33733	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33747	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33755	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,500	0.0001%	0	0.0000%
33756	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33758	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33759	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,061	0.0001%	0	0.0000%
33760	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33761	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33762	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33763	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33764	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33765	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33767	Pinellas	0	0.0000%	0	0.0000%	71,825	0.0228%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33769	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33770	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33771	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33772	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33773	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33774	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
33776	Pinellas	12,995	0.0017%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33777	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33778	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33779	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33780	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33781	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33782	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33784	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33785	Pinellas	16,898	0.0022%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33786	Pinellas	0	0.0000%	0	0.0000%	68,577	0.0218%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33801	Polk	0	0.0000%	0	0.0000%	11,800	0.0037%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	48,971	0.0043%	0	0.0000%
33803	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,067	0.0001%	0	0.0000%
33805	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	6,546	0.0006%	0	0.0000%
33809	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33810	Polk	0	0.0000%	0	0.0000%	628	0.0002%	330	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,012	0.0002%	0	0.0000%
33811	Polk	0	0.0000%	0	0.0000%	155	0.0000%	171	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	171	0.0000%	0	0.0000%
33812	Polk	0	0.0000%	0	0.0000%	63,677	0.0202%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	79,518	0.0070%	0	0.0000%
33813	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33815	Polk	0	0.0000%	0	0.0000%	178	0.0001%	178	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	317	0.0000%	0	0.0000%
33823	Polk	0	0.0000%	0	0.0000%	682	0.0002%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	7,297	0.0006%	0	0.0000%
33825	Highlands	0	0.0000%	0	0.0000%	366	0.0001%	366	0.0001%	404	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	450	0.0000%	0	0.0000%
33827	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	8,656	0.0008%	0	0.0000%
33830	Polk	0	0.0000%	0	0.0000%	206	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	160,692	0.0142%	0	0.0000%
33834	Hardee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33837	Polk	0	0.0000%	0	0.0000%	135	0.0000%	89	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,171	0.0002%	0	0.0000%
33838	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33839	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33841	Polk	0	0.0000%	0	0.0000%	32	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	35	0.0000%	0	0.0000%
33843	Polk	0	0.0000%	0	0.0000%	195	0.0001%	0	0.0000%	195	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	296	0.0000%	0	0.0000%
33844	Polk	0	0.0000%	0	0.0000%	62,702	0.0199%	499	0.0001%	113	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	106,960	0.0095%	0	0.0000%
33848	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33849	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33850	Polk	0	0.0000%	0	0.0000%	19,883	0.0063%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	36,163	0.0032%	0	0.0000%
33851	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33852	Highlands	0	0.0000%	0	0.0000%	68,470	0.0217%	45,114	0.0074%	128,415	0.0380%	0	0.0000%	0	0.0000%	0	0.0000%	289,605	0.0256%	0	0.0000%
33853	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33854	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33855	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33857	Highlands	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	34	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	34	0.0000%	0	0.0000%
33859	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	141	0.0000%	0	0.0000%
33860	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33865	Hardee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33867	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33868	Polk	0	0.0000%	0	0.0000%	14,144	0.0045%	2,369	0.0004%	0	0.0000%	290	0.0002%	0	0.0000%	290	0.0002%	55,190	0.0049%	0	0.0000%
33870	Highlands	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	5,837	0.0017%	0	0.0000%	0	0.0000%	0	0.0000%	28,336	0.0025%	0	0.0000%
33872	Highlands	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	74	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	74	0.0000%	0	0.0000%
33873	Hardee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33875	Highlands	0	0.0000%	0	0.0000%	172,412	0.0548%	128,974	0.0210%	241,824	0.0715%	0	0.0000%	0	0.0000%	0	0.0000%	368,016	0.0325%	0	0.0000%
33876	Highlands	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33877	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33880	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33881	Polk	0	0.0000%	0	0.0000%	168	0.0001%	0	0.0000%	123	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	187	0.0000%	0	0.0000%
33884	Polk	0	0.0000%	0	0.0000%	188	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	7,334	0.0006%	0	0.0000%
33890	Hardee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33896	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33897	Polk	0	0.0000%	0	0.0000%	11,986	0.0038%	314	0.0001%	10,774	0.0032%	314	0.0002%	0	0.0000%	0	0.0000%	96,351	0.0085%	0	0.0000%
33898	Polk	0	0.0000%	0	0.0000%	37,661	0.0120%	20,070	0.0033%	166	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	160,554	0.0142%	0	0.0000%
33901	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33902	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33903	Lee	0	0.0000%	0	0.0000%	563,689	0.1791%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33904	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,400	0.0003%	0	0.0000%
33905	Lee	0	0.0000%	0	0.0000%	2,073,498	0.6586%	45,363	0.0074%	11,572,260	3.4222%	0	0.0000%	0	0.0000%	0	0.0000%	21,263,659	1.8801%	0	0.0000%
33907	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	22,120	0.0065%	0	0.0000%	0	0.0000%	0	0.0000%	22,120	0.0020%	0	0.0000%
33908	Lee	0	0.0000%	0	0.0000%	69,665	0.0221%	576,384	0.0940%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,986,333	0.1756%	0	0.0000%
33909	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33910	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33912	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,409	0.0007%	0	0.0000%	0	0.0000%	0	0.0000%	1,617	0.0001%	0	0.0000%
33913	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33914	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33916	Lee	0	0.0000%	0	0.0000%	106,507	0.0338%	16,228	0.0026%	14,724	0.0044%	0	0.0000%	0	0.0000%	0	0.0000%	46,393	0.0041%	0	0.0000%
33917	Lee	0	0.0000%	0	0.0000%	639,121	0.2030%	29,994	0.0049%	821,739	0.2430%	0	0.0000%	0	0.0000%	0	0.0000%	1,833,443	0.1621%	0	0.0000%
33918	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33919	Lee	0	0.0000%	0	0.0000%	0	0.0000%	5,461	0.0009%	10,897	0.0032%	0	0.0000%	0	0.0000%	0	0.0000%	16,987	0.0015%	0	0.0000%
33920	Lee	0	0.0000%	0	0.0000%	174,472	0.0554%	14,790	0.0024%	2,066,022	0.6110%	0	0.0000%	0	0.0000%	0	0.0000%	3,135,774	0.2773%	0	0.0000%
33921	Lee	0	0.0000%	0	0.0000%	24,021	0.0076%	135,293	0.0221%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	103,649	0.0092%	0	0.0000%
33922	Lee	0	0.0000%	0	0.0000%	109,109	0.0347%	71,577	0.0117%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33924	Lee	0	0.0000%	0	0.0000%	0	0.0000%	1,683,519	0.2746%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	393,479	0.0348%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
33927	Charlotte	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33928	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	154,931	0.0137%	0	0.0000%
33930	Hendry	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33931	Lee	0	0.0000%	0	0.0000%	4,900	0.0016%	4,604,854	0.7510%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	68,795,805	6.0828%	0	0.0000%
33935	Hendry	0	0.0000%	0	0.0000%	278,444	0.0884%	1,474,315	0.2404%	3,953,733	1.1692%	0	0.0000%	0	0.0000%	0	0.0000%	3,386,614	0.2994%	0	0.0000%
33936	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33945	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33946	Charlotte	0	0.0000%	0	0.0000%	180,229	0.0572%	317,059	0.0517%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	299,096	0.0264%	0	0.0000%
33947	Charlotte	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33948	Charlotte	0	0.0000%	0	0.0000%	48,738	0.0155%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	4,879	0.0004%	0	0.0000%
33949	Charlotte	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33950	Charlotte	0	0.0000%	0	0.0000%	2,644,645	0.8401%	46,595	0.0076%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	34,434	0.0030%	0	0.0000%
33952	Charlotte	0	0.0000%	0	0.0000%	514,471	0.1634%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33953	Charlotte	0	0.0000%	0	0.0000%	440,603	0.1400%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33954	Charlotte	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33955	Charlotte	0	0.0000%	0	0.0000%	112,714	0.0358%	125	0.0000%	138	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	852	0.0001%	0	0.0000%
33956	Lee	0	0.0000%	0	0.0000%	0	0.0000%	7,658	0.0012%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33957	Lee	0	0.0000%	0	0.0000%	0	0.0000%	1,631,062	0.2660%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,355,055	0.2082%	0	0.0000%
33960	Highlands	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	213	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	379	0.0000%	0	0.0000%
33966	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33967	Lee	0	0.0000%	0	0.0000%	0	0.0000%	7,158	0.0012%	114,793	0.0339%	0	0.0000%	0	0.0000%	0	0.0000%	78,661	0.0070%	0	0.0000%
33971	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33972	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33973	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33974	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33976	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33980	Charlotte	0	0.0000%	0	0.0000%	2,013,869	0.6397%	214,056	0.0349%	57,927	0.0171%	0	0.0000%	0	0.0000%	0	0.0000%	3,711,041	0.3281%	0	0.0000%
33981	Charlotte	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33982	Charlotte	0	0.0000%	0	0.0000%	253,472	0.0805%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	974	0.0001%	0	0.0000%
33983	Charlotte	0	0.0000%	0	0.0000%	46,648	0.0148%	5,891	0.0010%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	21,617,707	1.9114%	0	0.0000%
33990	Lee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
33991	Lee	0	0.0000%	0	0.0000%	0	0.0000%	37,277	0.0061%	40,606	0.0120%	0	0.0000%	0	0.0000%	0	0.0000%	126,334	0.0112%	0	0.0000%
33993	Lee	0	0.0000%	0	0.0000%	2,078	0.0007%	5,944	0.0010%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34101	Collier	0	0.0000%	0	0.0000%	0	0.0000%	11,051	0.0018%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	38,108	0.0034%	0	0.0000%
34102	Collier	0	0.0000%	0	0.0000%	0	0.0000%	23,463,502	3.8265%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	33,564,763	2.9677%	0	0.0000%
34103	Collier	0	0.0000%	0	0.0000%	0	0.0000%	18,685,541	3.0473%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	77,280,347	6.8330%	0	0.0000%
34104	Collier	0	0.0000%	0	0.0000%	0	0.0000%	958,152	0.1563%	15,765	0.0047%	0	0.0000%	0	0.0000%	0	0.0000%	1,099,579	0.0972%	0	0.0000%
34105	Collier	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34108	Collier	0	0.0000%	0	0.0000%	0	0.0000%	26,794,287	4.3697%	104,424	0.0309%	0	0.0000%	0	0.0000%	0	0.0000%	51,310,933	4.5368%	0	0.0000%
34109	Collier	0	0.0000%	0	0.0000%	0	0.0000%	56,121	0.0092%	19,273	0.0057%	0	0.0000%	0	0.0000%	0	0.0000%	80,954	0.0072%	0	0.0000%
34110	Collier	0	0.0000%	0	0.0000%	25,409	0.0081%	5,771,683	0.9413%	59,862	0.0177%	0	0.0000%	0	0.0000%	0	0.0000%	9,504,599	0.8404%	0	0.0000%
34112	Collier	0	0.0000%	0	0.0000%	5,711	0.0018%	5,937,246	0.9683%	8,299	0.0025%	0	0.0000%	0	0.0000%	0	0.0000%	3,004,995	0.2657%	0	0.0000%
34113	Collier	0	0.0000%	0	0.0000%	0	0.0000%	17,025,053	2.7765%	3,909	0.0012%	0	0.0000%	0	0.0000%	0	0.0000%	16,170,273	1.4297%	0	0.0000%
34114	Collier	0	0.0000%	0	0.0000%	0	0.0000%	847,413	0.1382%	12,398	0.0037%	0	0.0000%	0	0.0000%	0	0.0000%	5,611,211	0.4961%	0	0.0000%
34116	Collier	0	0.0000%	0	0.0000%	0	0.0000%	295,330	0.0482%	985,072	0.2913%	0	0.0000%	0	0.0000%	0	0.0000%	1,012,624	0.0895%	0	0.0000%
34117	Collier	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	22,431	0.0066%	0	0.0000%	0	0.0000%	0	0.0000%	100,428	0.0089%	0	0.0000%
34119	Collier	0	0.0000%	0	0.0000%	0	0.0000%	2,495	0.0004%	13,892	0.0041%	0	0.0000%	0	0.0000%	0	0.0000%	2,495	0.0002%	0	0.0000%
34120	Collier	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	328,257	0.0971%	0	0.0000%	0	0.0000%	0	0.0000%	888,873	0.0786%	0	0.0000%
34134	Lee	0	0.0000%	0	0.0000%	108,867	0.0346%	17,287,475	2.8193%	40,677	0.0120%	0	0.0000%	0	0.0000%	0	0.0000%	65,653,774	5.8050%	0	0.0000%
34135	Lee	0	0.0000%	0	0.0000%	0	0.0000%	4,764,155	0.7770%	142,744	0.0422%	0	0.0000%	0	0.0000%	0	0.0000%	7,950,746	0.7030%	0	0.0000%
34138	Collier	0	0.0000%	0	0.0000%	2,283	0.0007%	365,271	0.0596%	10,106	0.0030%	0	0.0000%	0	0.0000%	0	0.0000%	574,122	0.0508%	0	0.0000%
34139	Collier	0	0.0000%	0	0.0000%	252,207	0.0801%	1,449,909	0.2365%	434,246	0.1284%	0	0.0000%	0	0.0000%	0	0.0000%	2,163,014	0.1912%	0	0.0000%
34140	Collier	0	0.0000%	0	0.0000%	0	0.0000%	1,262,463	0.2059%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	6,026,129	0.5328%	0	0.0000%
34141	Collier	0	0.0000%	0	0.0000%	203,308	0.0646%	376,022	0.0613%	240,632	0.0712%	0	0.0000%	0	0.0000%	0	0.0000%	377,772	0.0334%	0	0.0000%
34142	Collier	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,130	0.0006%	0	0.0000%	0	0.0000%	0	0.0000%	26,550	0.0023%	0	0.0000%
34143	Collier	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34145	Collier	0	0.0000%	0	0.0000%	0	0.0000%	11,017,014	1.7967%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	34,644,772	3.0632%	0	0.0000%
34201	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34202	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34203	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34204	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34205	Manatee	0	0.0000%	0	0.0000%	90,766	0.0288%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34206	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34207	Manatee	0	0.0000%	0	0.0000%	343,133	0.1090%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34208	Manatee	0	0.0000%	0	0.0000%	3,505,394	1.1135%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34209	Manatee	281,933	0.0360%	0	0.0000%	1,656,305	0.5261%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	46,997	0.0042%	0	0.0000%
34210	Manatee	5,576	0.0007%	0	0.0000%	743,367	0.2361%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34211	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34212	Manatee	0	0.0000%	0	0.0000%	26,864	0.0085%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34215	Manatee	0	0.0000%	0	0.0000%	4,814	0.0015%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34216	Manatee	3,740,509	0.4773%	54,386	0.1510%	1,434,099	0.4555%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	77,226	0.0068%	0	0.0000%
34217	Manatee	3,982,192	0.5082%	0	0.0000%	824,916	0.2620%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	7,507	0.0007%	0	0.0000%
34218	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34219	Manatee	0	0.0000%	0	0.0000%	146,041	0.0464%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34221	Manatee	0	0.0000%	0	0.0000%	1,760,609	0.5593%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34222	Manatee	0	0.0000%	0	0.0000%	1,442,477	0.4582%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34223	Sarasota	1,744,569	0.2226%	0	0.0000%	15,715	0.0050%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
34224	Charlotte	0	0.0000%	0	0.0000%	19,983	0.0063%	17,541	0.0029%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	8,467	0.0007%	0	0.0000%
34228	Manatee	795,032	0.1015%	0	0.0000%	392,257	0.1246%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34229	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34230	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34231	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34232	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34233	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34234	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34235	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34236	Sarasota	92,007	0.0117%	0	0.0000%	41,283	0.0131%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34237	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34238	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34239	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34240	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34241	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34242	Sarasota	60,241	0.0077%	0	0.0000%	1,410,122	0.4479%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34243	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34250	Manatee	0	0.0000%	0	0.0000%	231,191	0.0734%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34251	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34260	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34264	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34266	De Soto	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	25,619	0.0023%	0	0.0000%
34269	De Soto	0	0.0000%	0	0.0000%	201,376	0.0640%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,597,116	0.1412%	0	0.0000%
34270	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34272	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34275	Sarasota	795,669	0.1015%	0	0.0000%	62,555	0.0199%	52,876	0.0086%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	116,621	0.0103%	0	0.0000%
34277	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34281	Manatee	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34285	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	66,453	0.0108%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	49,680	0.0044%	0	0.0000%
34286	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34287	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34288	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34289	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34291	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34292	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34293	Sarasota	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34295	Sarasota	108,661	0.0139%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34420	Marion	0	0.0000%	0	0.0000%	5,334	0.0017%	0	0.0000%	76,102	0.0225%	42,914	0.0333%	0	0.0000%	0	0.0000%	322,520	0.0285%	0	0.0000%
34423	Citrus	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34428	Citrus	0	0.0000%	68,728	0.1909%	6,854,150	2.1772%	0	0.0000%	178,200	0.0527%	0	0.0000%	0	0.0000%	0	0.0000%	169,639	0.0150%	0	0.0000%
34429	Citrus	0	0.0000%	198,438	0.5511%	11,566,039	3.6740%	0	0.0000%	449,055	0.1328%	0	0.0000%	0	0.0000%	0	0.0000%	100,247	0.0089%	47,546	0.0880%
34431	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	182,254	0.0161%	0	0.0000%
34432	Marion	0	0.0000%	0	0.0000%	13,692	0.0043%	0	0.0000%	205,657	0.0608%	415	0.0003%	0	0.0000%	0	0.0000%	254,591	0.0225%	0	0.0000%
34433	Citrus	0	0.0000%	0	0.0000%	337,065	0.1071%	0	0.0000%	14,960	0.0044%	4,697	0.0036%	0	0.0000%	0	0.0000%	1,588,747	0.1405%	0	0.0000%
34434	Citrus	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	29,380	0.0087%	0	0.0000%	0	0.0000%	0	0.0000%	405,231	0.0358%	0	0.0000%
34436	Citrus	0	0.0000%	0	0.0000%	48	0.0000%	0	0.0000%	244	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	249	0.0000%	0	0.0000%
34442	Citrus	0	0.0000%	0	0.0000%	10,603	0.0034%	0	0.0000%	53,593	0.0158%	0	0.0000%	0	0.0000%	0	0.0000%	349,952	0.0309%	0	0.0000%
34445	Citrus	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34446	Citrus	0	0.0000%	0	0.0000%	126,950	0.0403%	0	0.0000%	294,311	0.0870%	0	0.0000%	0	0.0000%	0	0.0000%	978,023	0.0865%	0	0.0000%
34447	Citrus	0	0.0000%	0	0.0000%	32,945	0.0105%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34448	Citrus	0	0.0000%	10,646	0.0296%	9,509,561	3.0207%	0	0.0000%	291,589	0.0862%	0	0.0000%	0	0.0000%	0	0.0000%	197,239	0.0174%	0	0.0000%
34449	Levy	0	0.0000%	0	0.0000%	156,830	0.0498%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,302,944	0.2036%	0	0.0000%
34450	Citrus	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	17,294	0.0051%	0	0.0000%	0	0.0000%	0	0.0000%	347,657	0.0307%	0	0.0000%
34452	Citrus	0	0.0000%	0	0.0000%	1,106	0.0004%	0	0.0000%	192,909	0.0570%	0	0.0000%	0	0.0000%	0	0.0000%	167,398	0.0148%	0	0.0000%
34453	Citrus	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	27,826	0.0082%	0	0.0000%	0	0.0000%	0	0.0000%	30,583	0.0027%	0	0.0000%
34460	Citrus	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34461	Citrus	0	0.0000%	0	0.0000%	417	0.0001%	0	0.0000%	140,712	0.0416%	0	0.0000%	0	0.0000%	0	0.0000%	160,889	0.0142%	0	0.0000%
34465	Citrus	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	29,527	0.0087%	0	0.0000%	0	0.0000%	0	0.0000%	60,426	0.0053%	0	0.0000%
34470	Marion	0	0.0000%	0	0.0000%	10,584	0.0034%	0	0.0000%	86,339	0.0255%	21,593	0.0168%	0	0.0000%	0	0.0000%	377,895	0.0334%	0	0.0000%
34471	Marion	0	0.0000%	0	0.0000%	312	0.0001%	0	0.0000%	307,184	0.0908%	154,630	0.1201%	0	0.0000%	0	0.0000%	821,434	0.0726%	0	0.0000%
34472	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,154	0.0009%	0	0.0000%	0	0.0000%	13,618	0.0012%	0	0.0000%
34473	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	6,995	0.0006%	0	0.0000%
34474	Marion	0	0.0000%	0	0.0000%	3,876	0.0012%	0	0.0000%	407,198	0.1204%	0	0.0000%	0	0.0000%	0	0.0000%	363,736	0.0322%	0	0.0000%
34475	Marion	0	0.0000%	0	0.0000%	26,002	0.0083%	0	0.0000%	72,743	0.0215%	22,652	0.0176%	0	0.0000%	0	0.0000%	224,808	0.0199%	0	0.0000%
34476	Marion	0	0.0000%	0	0.0000%	12,287	0.0039%	0	0.0000%	2,044,010	0.6045%	0	0.0000%	0	0.0000%	0	0.0000%	1,902,289	0.1682%	0	0.0000%
34479	Marion	0	0.0000%	0	0.0000%	80,764	0.0257%	0	0.0000%	91,500	0.0271%	69,016	0.0536%	0	0.0000%	0	0.0000%	343,883	0.0304%	0	0.0000%
34480	Marion	0	0.0000%	0	0.0000%	22	0.0000%	0	0.0000%	23,895	0.0071%	7,037	0.0055%	0	0.0000%	0	0.0000%	160,827	0.0142%	0	0.0000%
34481	Marion	0	0.0000%	0	0.0000%	278	0.0001%	0	0.0000%	474,048	0.1402%	185	0.0001%	0	0.0000%	0	0.0000%	580,188	0.0513%	0	0.0000%
34482	Marion	0	0.0000%	0	0.0000%	7,969	0.0025%	0	0.0000%	40,680	0.0120%	2,024	0.0016%	0	0.0000%	0	0.0000%	258,672	0.0229%	0	0.0000%
34484	Sumter	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	855	0.0003%	56	0.0000%	0	0.0000%	0	0.0000%	1,709	0.0002%	0	0.0000%
34487	Citrus	0	0.0000%	0	0.0000%	188,733	0.0600%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34488	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	604	0.0002%	615	0.0005%	0	0.0000%	0	0.0000%	9,499	0.0008%	0	0.0000%
34489	Marion	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	18,209	0.0016%	0	0.0000%
34491	Marion	0	0.0000%	0	0.0000%	956	0.0003%	0	0.0000%	175,503	0.0519%	21,285	0.0165%	0	0.0000%	0	0.0000%	504,131	0.0446%	0	0.0000%
34498	Levy	0	0.0000%	0	0.0000%	2,190,770	0.6959%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,988,898	0.3527%	0	0.0000%
34601	Hernando	0	0.0000%	0	0.0000%	5,542	0.0018%	0	0.0000%	1,143	0.0003%	0	0.0000%	0	0.0000%	0	0.0000%	76,648	0.0068%	0	0.0000%
34602	Hernando	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	55,236	0.0049%	0	0.0000%

		Hurricane Andrew (1992)		Hurricane Ivan (2004)		Hurricane Jeanne (2004)		Hurricane Wilma (2005)		Tropical Storm Fay (2008)		Unnamed Storm in East Florida (May 2009)		Unnamed Storm in Panhandle (July 2013)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
ZIP Code	County	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)	Personal Residential Standard Flood Modeled Loss ($)	Percent of Total Loss (%)
34604	Hernando	0	0.0000%	0	0.0000%	179	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	779	0.0001%	0	0.0000%
34606	Hernando	0	0.0000%	0	0.0000%	131,672	0.0418%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34607	Hernando	8,168	0.0010%	11,776	0.0327%	5,614,166	1.7833%	0	0.0000%	42,653	0.0126%	0	0.0000%	0	0.0000%	0	0.0000%	225,547	0.0199%	6,778	0.0125%
34608	Hernando	0	0.0000%	0	0.0000%	3,551	0.0011%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	31,498	0.0028%	0	0.0000%
34609	Hernando	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,084	0.0003%	0	0.0000%
34610	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	114	0.0000%	0	0.0000%
34613	Hernando	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	11,242	0.0010%	0	0.0000%
34614	Hernando	0	0.0000%	0	0.0000%	108	0.0000%	0	0.0000%	133	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	62,602	0.0055%	0	0.0000%
34637	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34638	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	269	0.0000%	0	0.0000%
34639	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	171	0.0000%	0	0.0000%
34652	Pasco	0	0.0000%	0	0.0000%	5,530,355	1.7567%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	39,039	0.0035%	0	0.0000%
34653	Pasco	0	0.0000%	0	0.0000%	259,288	0.0824%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34654	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34655	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	13,116	0.0012%	0	0.0000%
34660	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34661	Hernando	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34667	Pasco	0	0.0000%	0	0.0000%	18,523,647	5.8840%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,526	0.0003%	0	0.0000%
34668	Pasco	0	0.0000%	0	0.0000%	7,366,005	2.3398%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34669	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	781	0.0001%	0	0.0000%
34677	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	51,043	0.0151%	0	0.0000%	0	0.0000%	0	0.0000%	26,632	0.0024%	0	0.0000%
34679	Pasco	0	0.0000%	0	0.0000%	520,433	0.1653%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34680	Pasco	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34681	Pinellas	0	0.0000%	0	0.0000%	6,765	0.0021%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34683	Pinellas	0	0.0000%	0	0.0000%	1,040,557	0.3305%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34684	Pinellas	0	0.0000%	0	0.0000%	88,148	0.0280%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34685	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34688	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34689	Pinellas	62,893	0.0080%	0	0.0000%	2,782,944	0.8840%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	44,674	0.0040%	0	0.0000%
34690	Pasco	0	0.0000%	0	0.0000%	114,909	0.0365%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34691	Pasco	0	0.0000%	0	0.0000%	1,840,846	0.5847%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34695	Pinellas	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34698	Pinellas	0	0.0000%	0	0.0000%	912,783	0.2899%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	462,385	0.0409%	0	0.0000%
34705	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34711	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34714	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34715	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34731	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34734	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34736	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34737	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34739	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34741	Osceola	0	0.0000%	0	0.0000%	6,062	0.0019%	0	0.0000%	119,880	0.0355%	0	0.0000%	0	0.0000%	0	0.0000%	281,417	0.0249%	0	0.0000%
34743	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,830	0.0003%	0	0.0000%
34744	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34746	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	21,182	0.0063%	22,737	0.0177%	0	0.0000%	0	0.0000%	22,737	0.0020%	0	0.0000%
34747	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34748	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	72,634	0.0215%	38,932	0.0302%	0	0.0000%	0	0.0000%	81,373	0.0072%	0	0.0000%
34753	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34756	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34758	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	2,324	0.0002%	0	0.0000%
34759	Polk	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	28,446	0.0025%	0	0.0000%
34760	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34761	Orange	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34762	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34769	Osceola	0	0.0000%	0	0.0000%	271,989	0.0864%	106,541	0.0174%	161,786	0.0478%	0	0.0000%	0	0.0000%	0	0.0000%	511,291	0.0452%	0	0.0000%
34771	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	177	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	3,039	0.0003%	0	0.0000%
34772	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	323	0.0000%	0	0.0000%
34773	Osceola	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34785	Sumter	0	0.0000%	0	0.0000%	46	0.0000%	0	0.0000%	69,773	0.0206%	25,793	0.0200%	0	0.0000%	0	0.0000%	156,891	0.0139%	0	0.0000%
34786	Orange	0	0.0000%	0	0.0000%	17,449	0.0055%	0	0.0000%	17,449	0.0052%	17,449	0.0136%	0	0.0000%	0	0.0000%	17,449	0.0015%	0	0.0000%
34787	Orange	0	0.0000%	0	0.0000%	63,840	0.0203%	0	0.0000%	443,430	0.1311%	319,464	0.2482%	0	0.0000%	0	0.0000%	387,788	0.0343%	0	0.0000%
34788	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	44,198	0.0131%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34797	Lake	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34945	St. Lucie	0	0.0000%	6,355	0.0176%	42,632	0.0135%	0	0.0000%	69,133	0.0204%	0	0.0000%	0	0.0000%	0	0.0000%	101,848	0.0090%	0	0.0000%
34946	St. Lucie	0	0.0000%	0	0.0000%	5,452,757	1.7321%	155,750	0.0254%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	20,876	0.0018%	0	0.0000%
34947	St. Lucie	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	91,914	0.0272%	0	0.0000%	0	0.0000%	0	0.0000%	208,646	0.0184%	0	0.0000%
34949	St. Lucie	4,223,336	0.5390%	0	0.0000%	9,202,931	2.9233%	3,885	0.0006%	0	0.0000%	0	0.0000%	0	0.0000%	125,771	0.1009%	0	0.0000%	0	0.0000%
34950	St. Lucie	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	17,266	0.0015%	0	0.0000%
34951	St. Lucie	0	0.0000%	440	0.0012%	500	0.0002%	0	0.0000%	2,243	0.0007%	0	0.0000%	0	0.0000%	0	0.0000%	3,751	0.0003%	0	0.0000%
34952	St. Lucie	0	0.0000%	52,028	0.1445%	82,149	0.0261%	39,736	0.0065%	1,878,316	0.5555%	0	0.0000%	0	0.0000%	88	0.0001%	1,776,615	0.1571%	0	0.0000%
34953	St. Lucie	0	0.0000%	33,214	0.0922%	11,526	0.0037%	0	0.0000%	2,302,707	0.6810%	0	0.0000%	0	0.0000%	0	0.0000%	777,135	0.0687%	0	0.0000%
34954	St. Lucie	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34956	Martin	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	219	0.0001%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34957	Martin	2,333,056	0.2977%	0	0.0000%	619,169	0.1967%	0	0.0000%	739,713	0.2187%	0	0.0000%	0	0.0000%	99,427	0.0798%	402,612	0.0356%	0	0.0000%
34972	Okeechobee	0	0.0000%	258	0.0007%	4,278	0.0014%	6,825	0.0011%	61,808	0.0183%	0	0.0000%	0	0.0000%	0	0.0000%	78,519	0.0069%	0	0.0000%
34974	Okeechobee	0	0.0000%	0	0.0000%	0	0.0000%	294	0.0000%	2,687	0.0008%	0	0.0000%	0	0.0000%	0	0.0000%	823	0.0001%	0	0.0000%

		Hurricane Andrew (1992)		**Hurricane Ivan (2004)**		**Hurricane Jeanne (2004)**		**Hurricane Wilma (2005)**		**Tropical Storm Fay (2008)**		**Unnamed Storm in East Florida (May 2009)**		**Unnamed Storm in Panhandle (July 2013)**		**Hurricane Matthew (2016)**		**Hurricane Irma (2017)**		**Hurricane Michael (2018)**	
ZIP Code	**County**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**	**Personal Residential Standard Flood Modeled Loss ($)**	**Percent of Total Loss (%)**
34979	St. Lucie	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34981	St. Lucie	0	0.0000%	30,579	0.0849%	53,843	0.0171%	46,221	0.0075%	85,778	0.0254%	0	0.0000%	0	0.0000%	0	0.0000%	101,005	0.0089%	0	0.0000%
34982	St. Lucie	0	0.0000%	0	0.0000%	165,099	0.0524%	9,794	0.0016%	777,472	0.2299%	0	0.0000%	0	0.0000%	0	0.0000%	958,502	0.0847%	0	0.0000%
34983	St. Lucie	0	0.0000%	98	0.0003%	98	0.0000%	89	0.0000%	685,870	0.2028%	0	0.0000%	0	0.0000%	89	0.0001%	509,162	0.0450%	0	0.0000%
34984	St. Lucie	0	0.0000%	0	0.0000%	31,669	0.0101%	0	0.0000%	833,677	0.2465%	0	0.0000%	0	0.0000%	0	0.0000%	302,199	0.0267%	0	0.0000%
34985	St. Lucie	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34986	St. Lucie	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	354,047	0.1047%	0	0.0000%	0	0.0000%	0	0.0000%	14,699	0.0013%	0	0.0000%
34987	St. Lucie	0	0.0000%	110,768	0.3076%	241,526	0.0767%	158,178	0.0258%	2,143,762	0.6340%	0	0.0000%	0	0.0000%	0	0.0000%	1,267,527	0.1121%	0	0.0000%
34990	Martin	0	0.0000%	0	0.0000%	203,333	0.0646%	202,709	0.0331%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34991	Martin	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34992	Martin	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34994	Martin	0	0.0000%	0	0.0000%	92,102	0.0293%	0	0.0000%	455,201	0.1346%	0	0.0000%	0	0.0000%	0	0.0000%	131,437	0.0116%	0	0.0000%
34995	Martin	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%
34996	Martin	194,318	0.0248%	0	0.0000%	1,894,824	0.6019%	0	0.0000%	455,391	0.1347%	0	0.0000%	0	0.0000%	0	0.0000%	55,581	0.0049%	0	0.0000%
34997	Martin	0	0.0000%	0	0.0000%	205,753	0.0654%	0	0.0000%	370,827	0.1097%	0	0.0000%	0	0.0000%	0	0.0000%	113,690	0.0101%	0	0.0000%
Total	**Statewide**	**783,601,124**		**36,006,989**		**314,811,507**		**613,178,796**		**338,155,177**		**128,707,919**		**21,525,211**		**124,607,697**		**1,130,988,596**		**54,041,591**	

C. Provide maps color-coded by ZIP Code depicting the percentage total personal residential standard flood loss from each flood event using the following interval coding:

Red > 5%
Light Red > 2% to 5%
Pink > 1% to 2%
Light Pink > 0.5% to 1%
Light Blue > 0.2% to 0.5%
Medium Blue > 0.1% to 0.2%
Blue > 0% to 0.1%
White 0%

Maps are provided on the following pages.

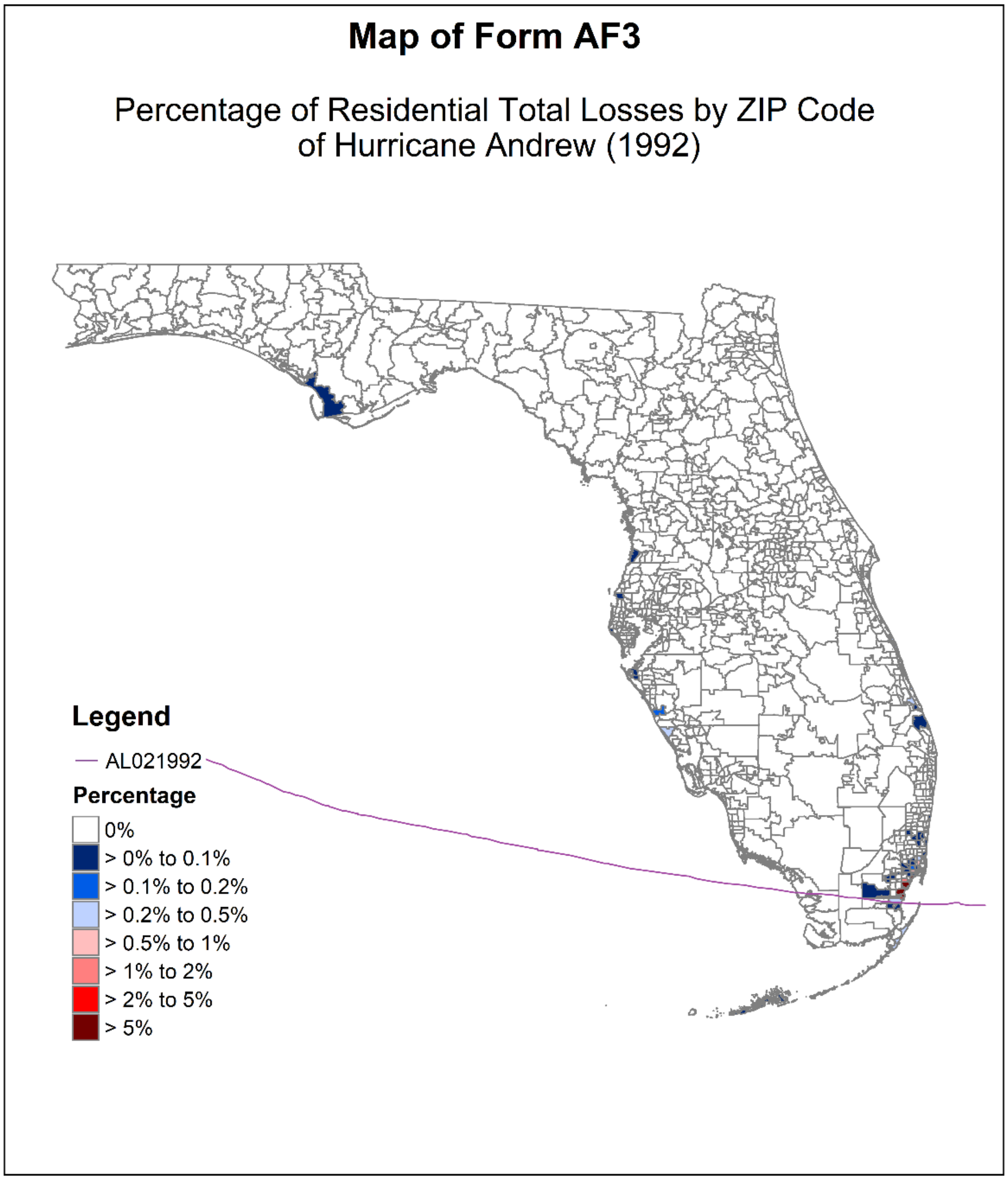


Figure 217. Percentage of residential total losses by ZIP code from Hurricane Andrew (1992).

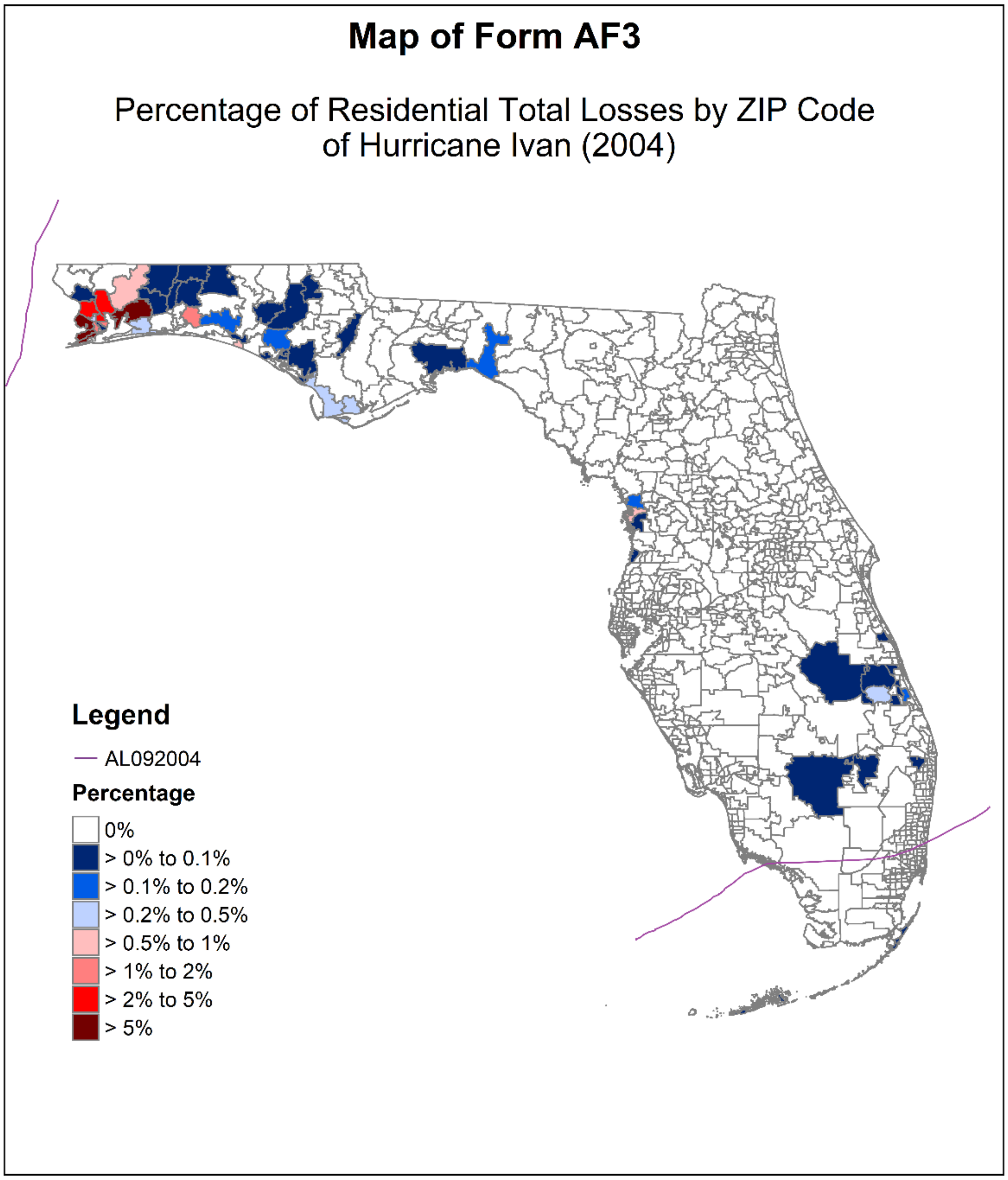


Figure 218. Percentage of residential total losses by ZIP code from Hurricane Ivan (2004).

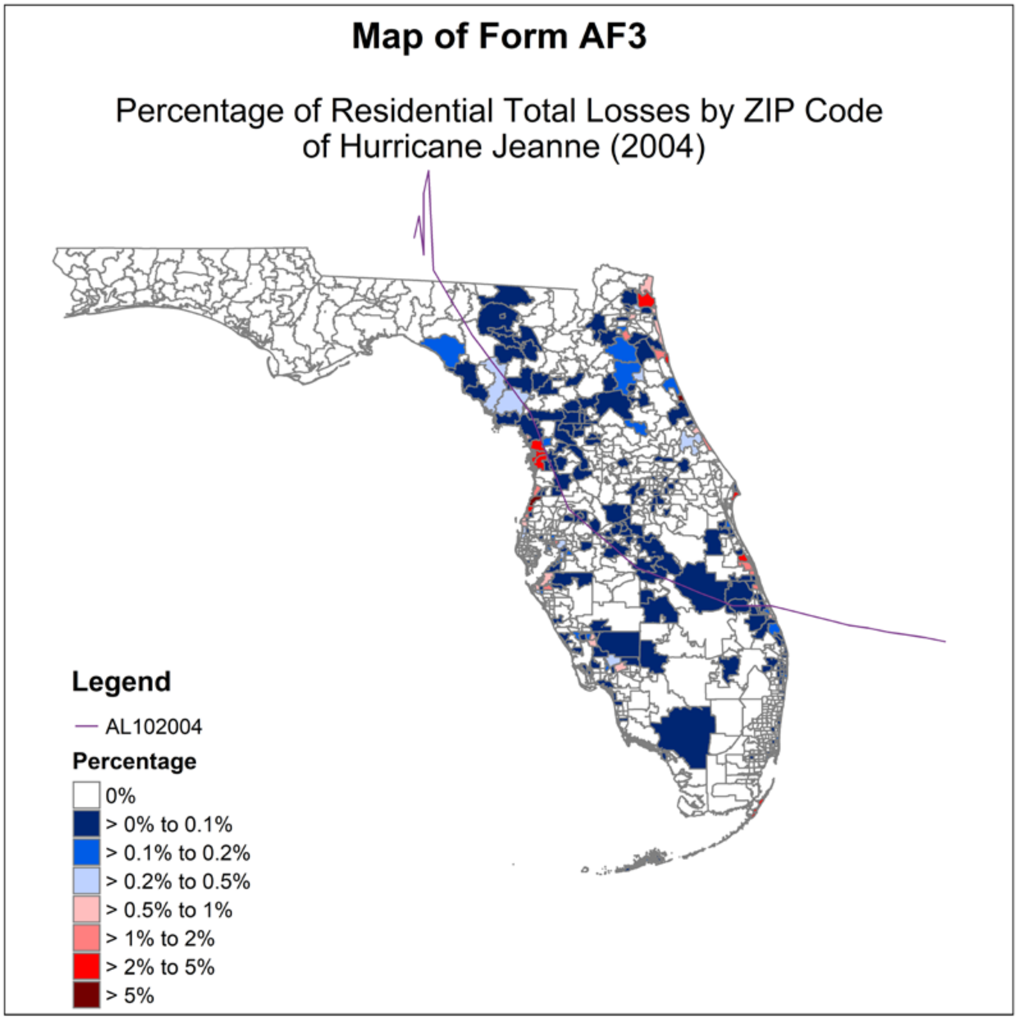


Figure 219. Percentage of residential total losses by ZIP code from Hurricane Jeanne (2004).

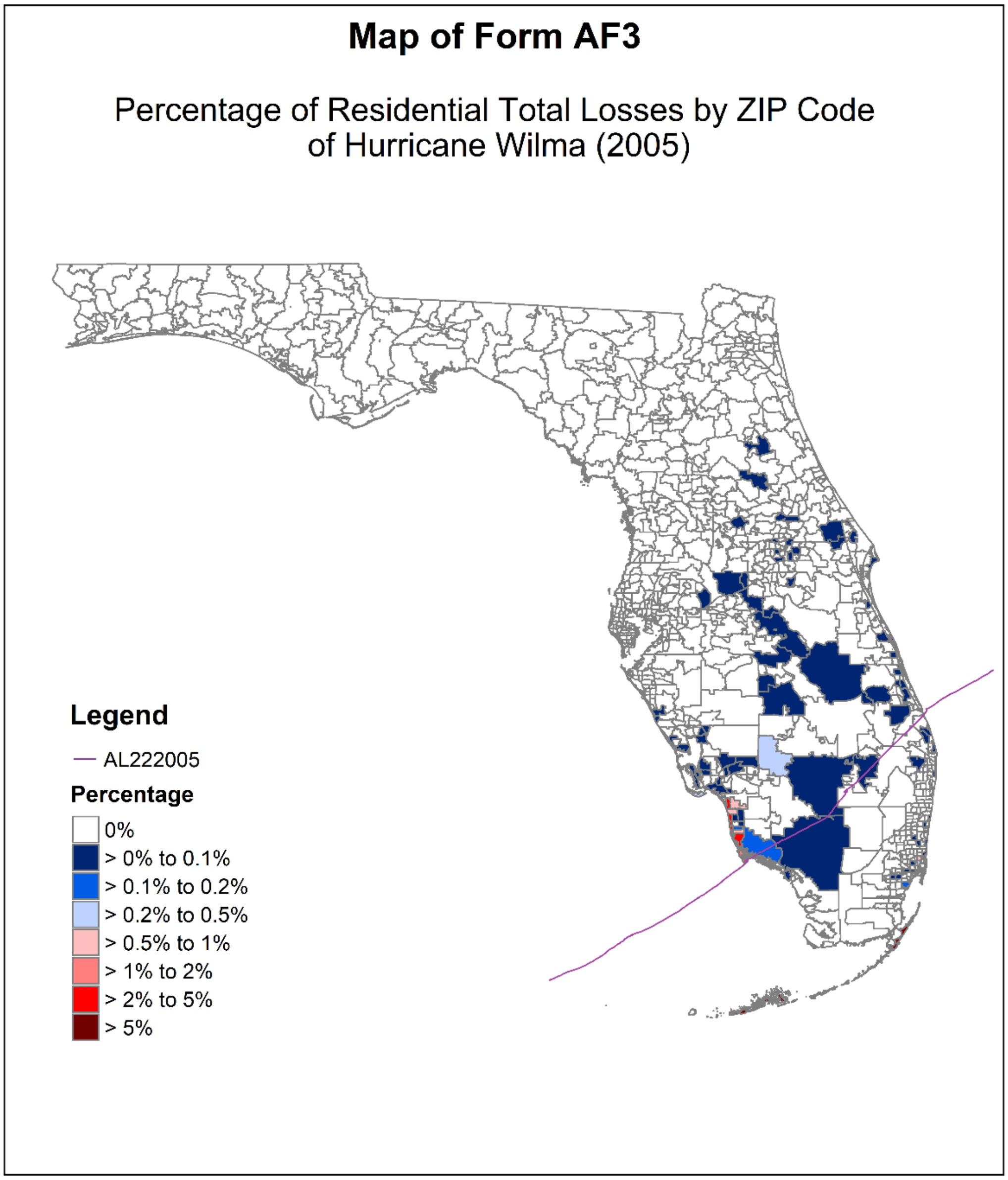


Figure 220. Percentage of residential total losses by ZIP code from Hurricane Wilma (2005).

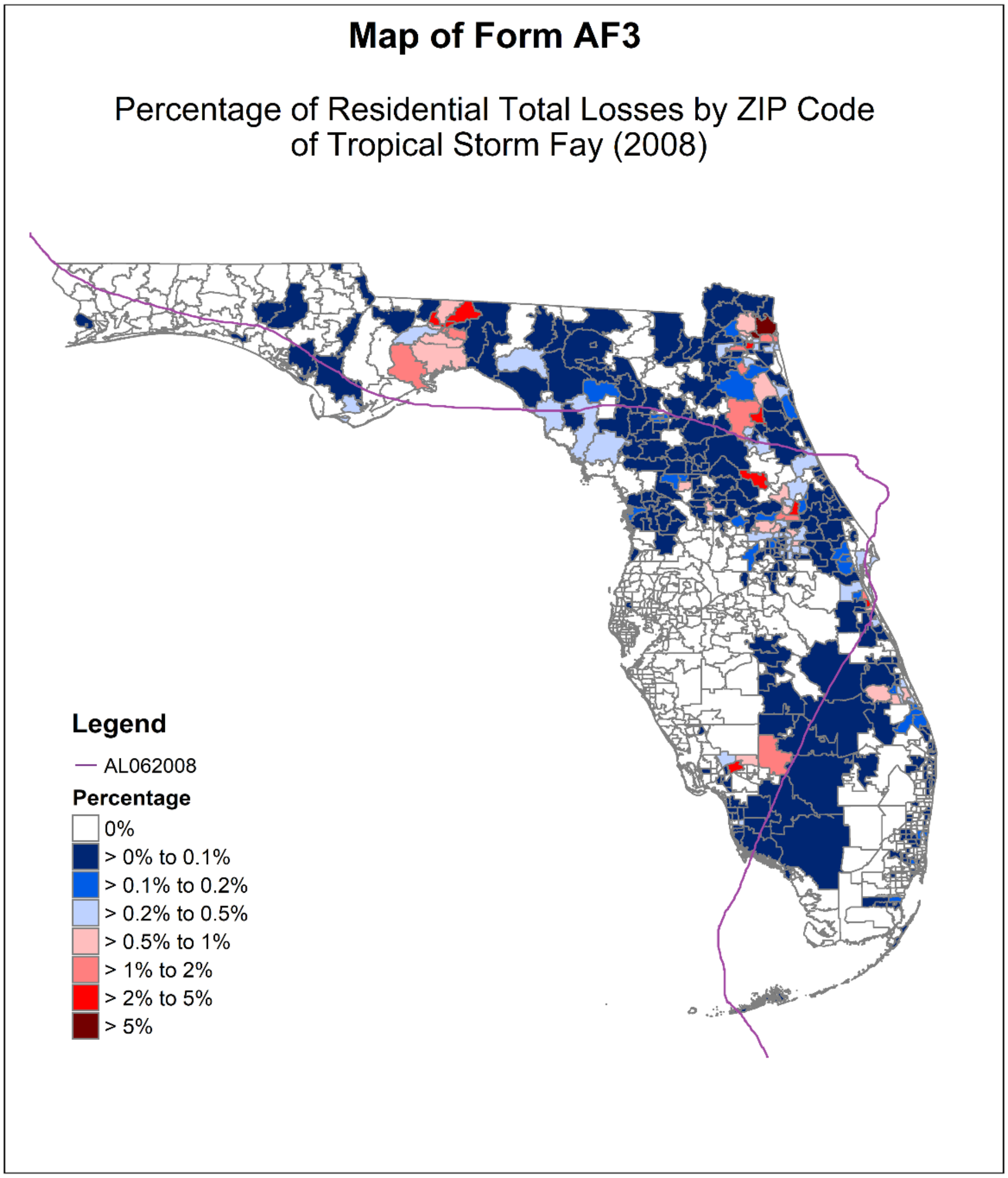


Figure 221. Percentage of residential total losses by ZIP code from Tropical Storm Fay (2008).

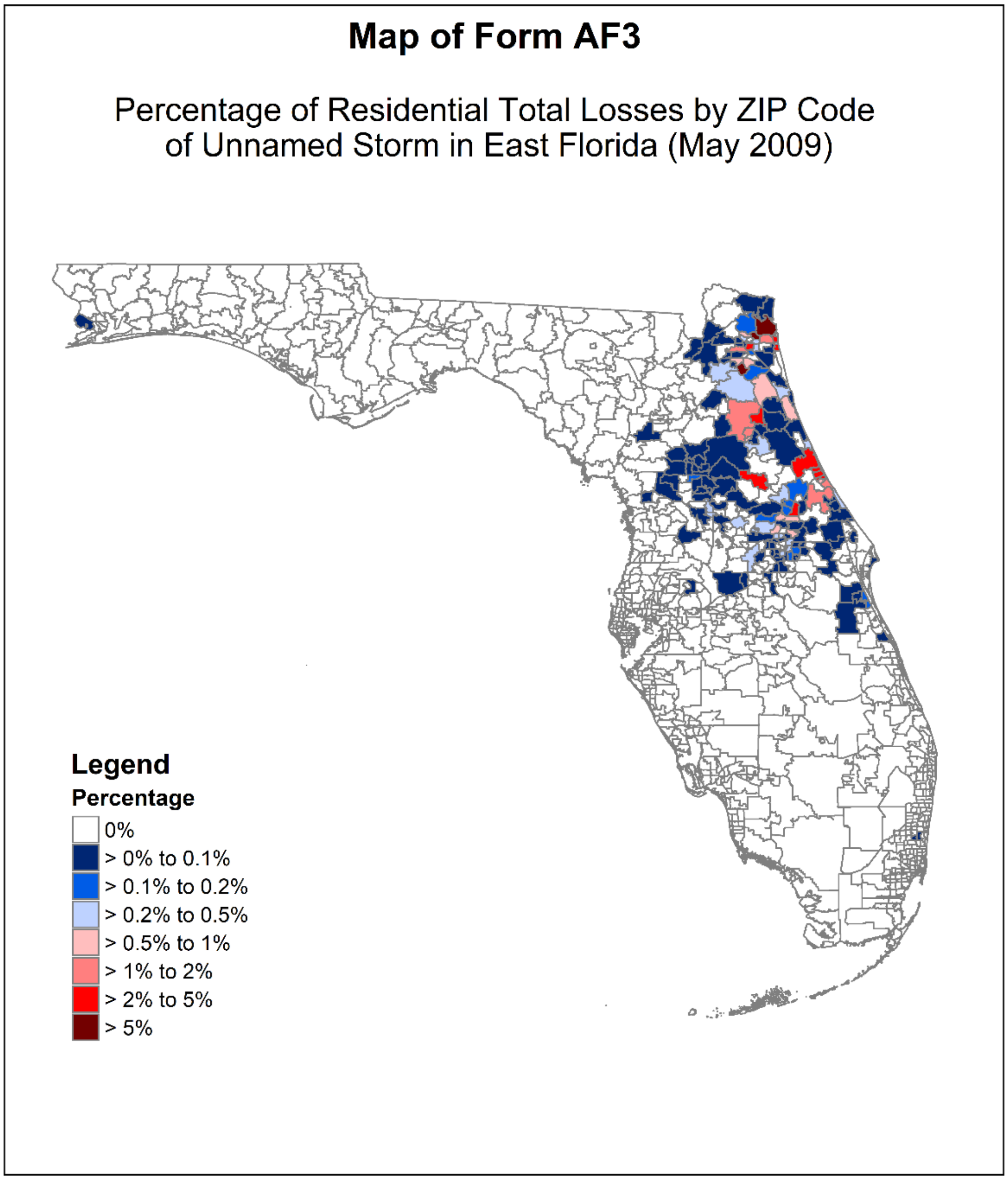


Figure 222. Percentage of residential total losses by ZIP code from Unnamed Storm in East Florida (May 2009).

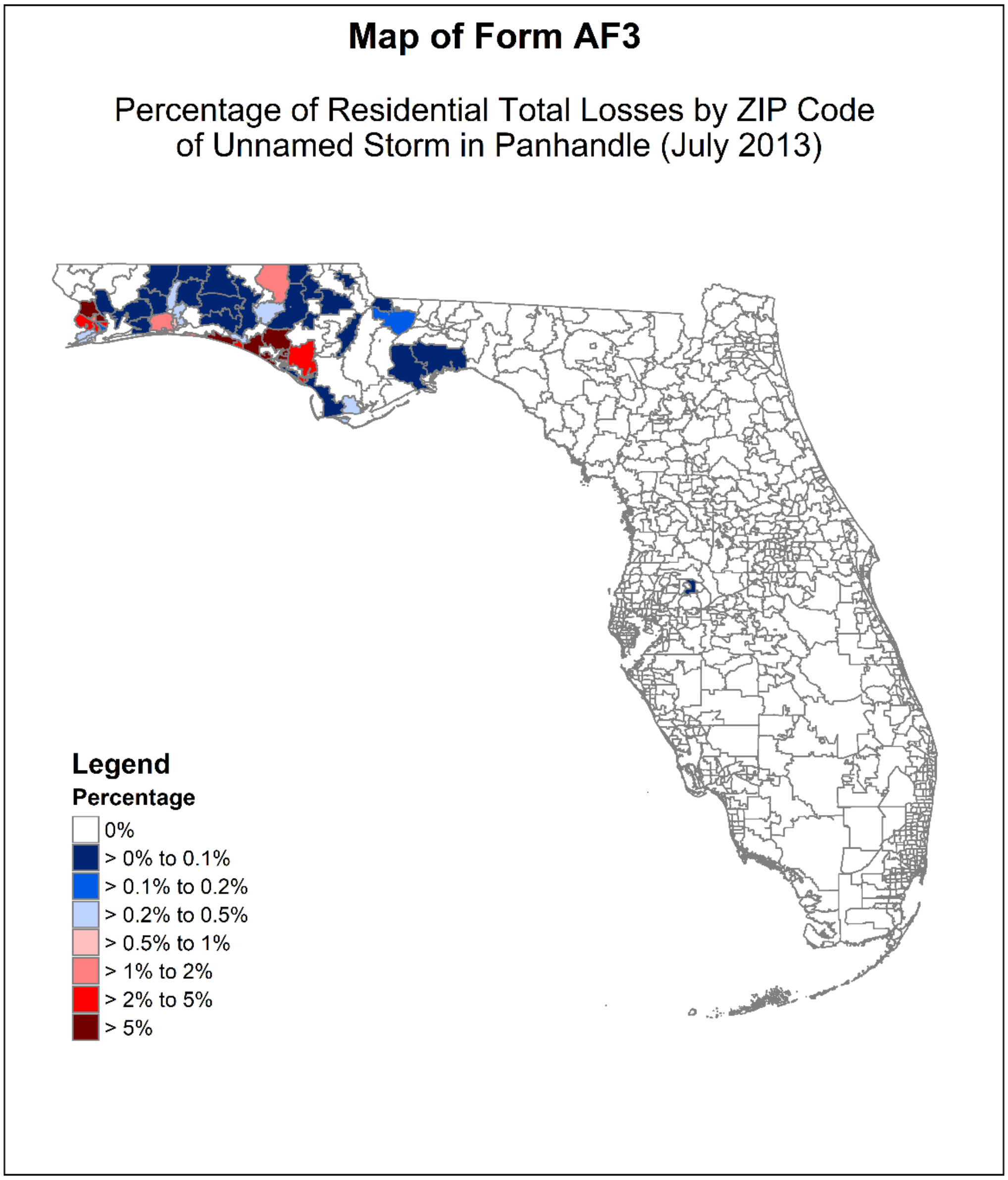


Figure 223. Percentage of residential total losses by ZIP code from Unnamed Storm in Panhandle (July 2013).

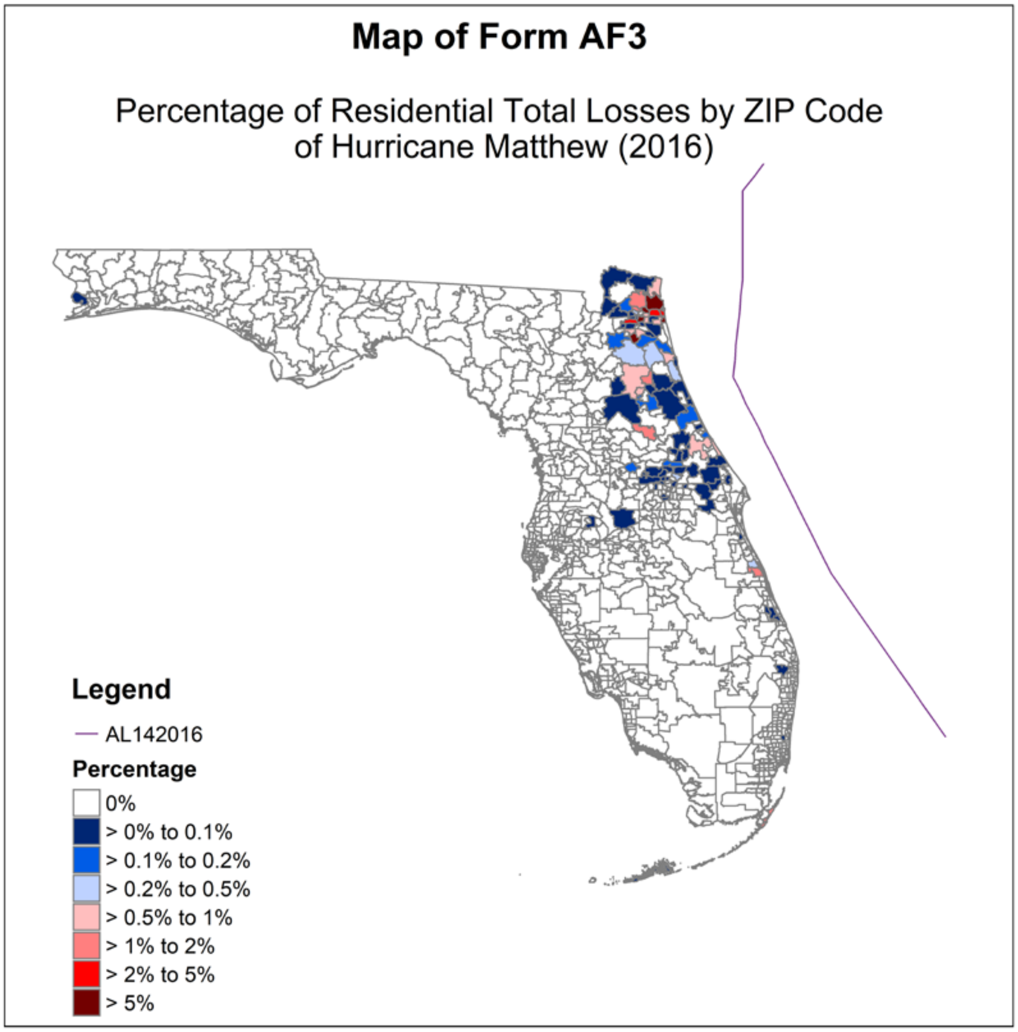


Figure 224. Percentage of residential total losses by ZIP code from Hurricane Matthew (2016).

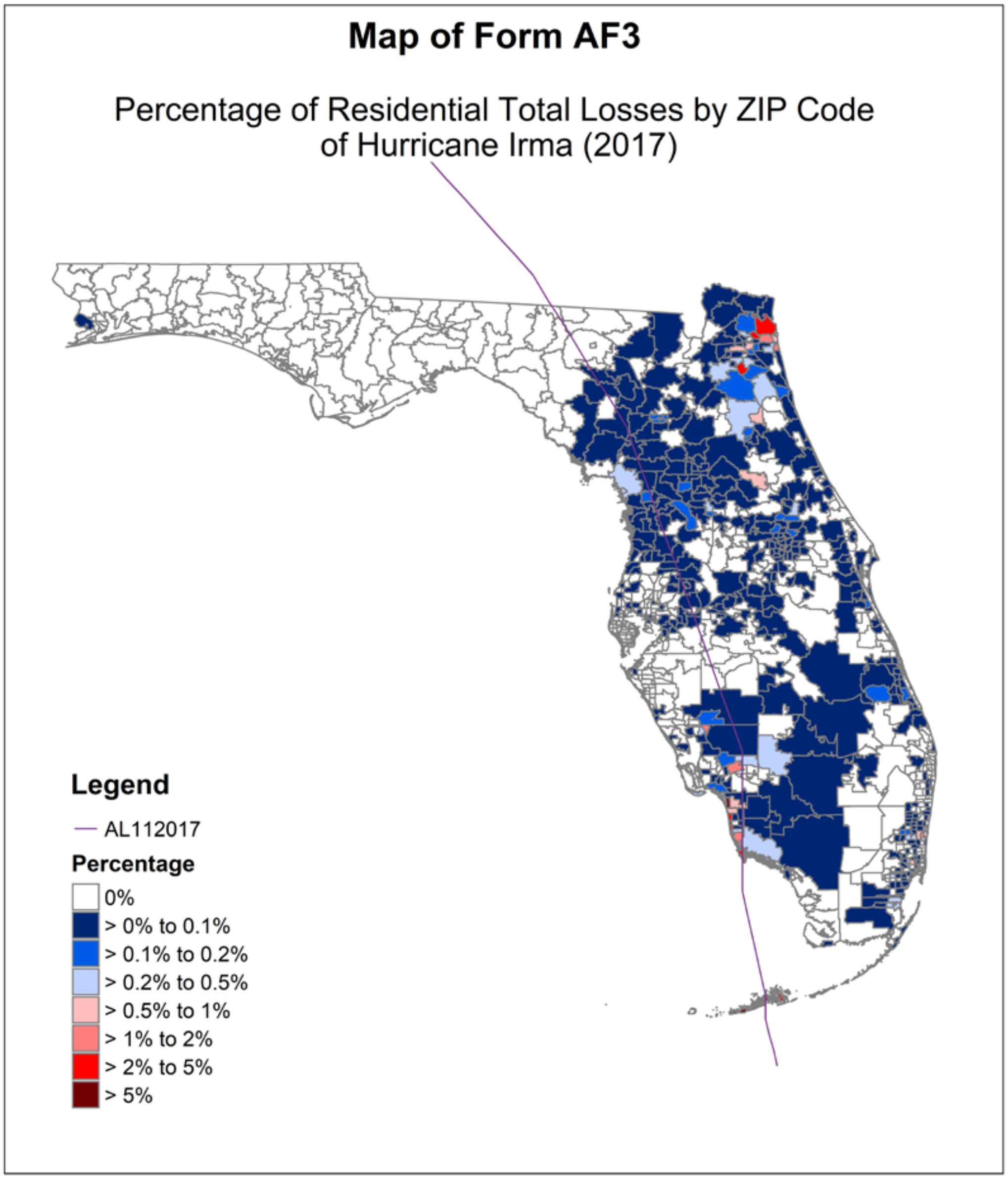


Figure 225. Percentage of residential total losses by ZIP code from Hurricane Irma (2017).

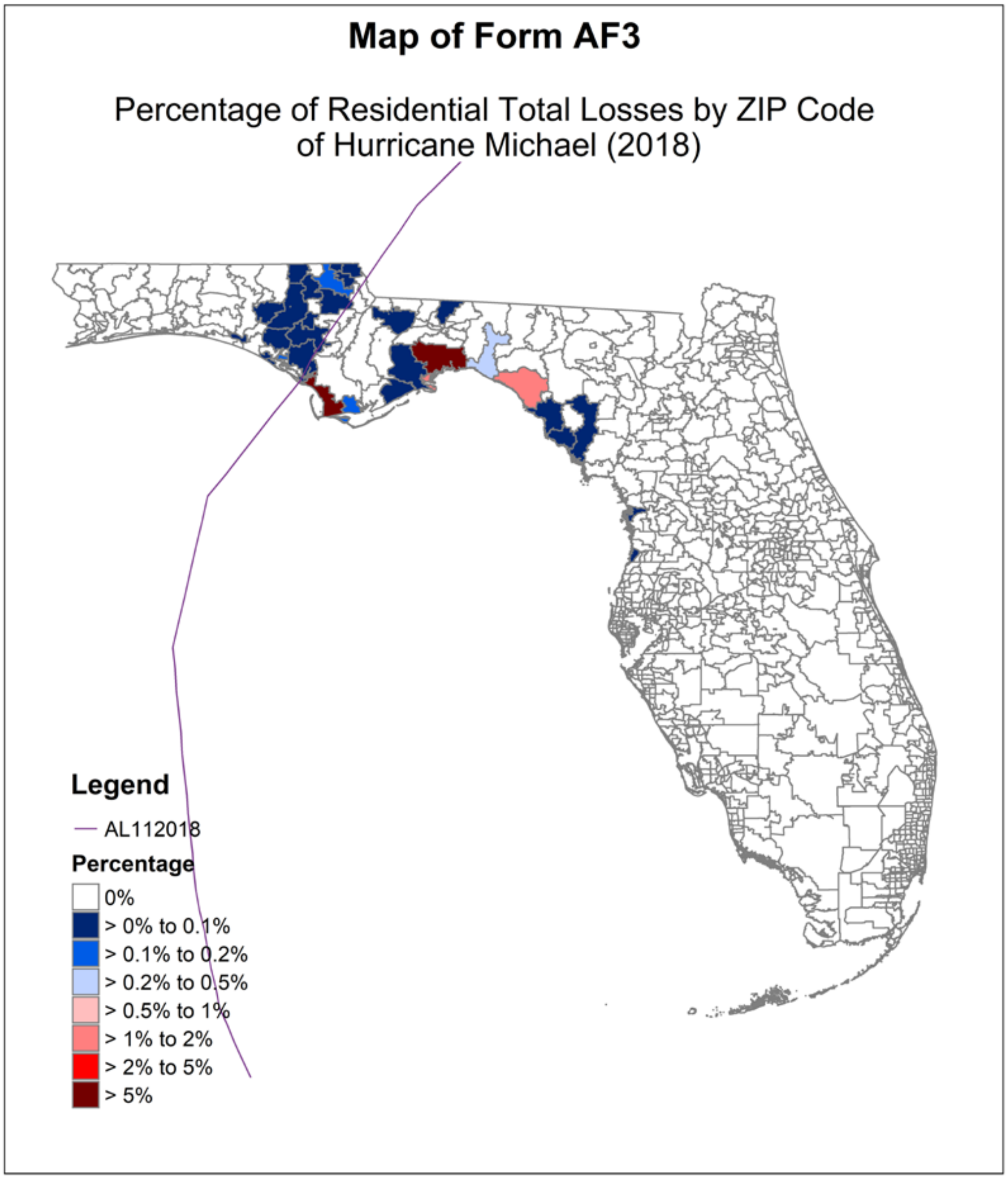


Figure 226. Percentage of residential total losses by ZIP code from Hurricane Michael (2018).

D. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

No additional assumptions were necessary to complete the form.

E. Provide, in the format given in the file named "2021FormAF3.xlsx" in both Excel and PDF format, the total flood losses by ZIP Code. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name.

A completed Form AF-3 has been provided in both Excel and PDF formats.

Form AF-4: Flood Output Ranges

A. One or more automated programs or scripts should be used to generate the personal residential flood output ranges in the format shown in the file named "2021FormAF4.xlsx."

Automated scripts were used to generate Form AF-4.

B. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form AF-4, Flood Output Ranges, in a submission appendix.

A completed Form AF-4 has been provided in Excel format.

C. Provide flood loss costs, rounded to three decimal places, by county (Figure 4). Within each county, flood loss costs should be shown separately per $1,000 of exposure for frame owners, masonry owners, frame renters, masonry renters, frame condo unit owners, masonry condo unit owners, and manufactured homes. For each of these categories using rating areas or geographic zones, the flood output range should show the highest flood loss cost, the lowest flood loss cost, and the weighted average flood loss cost. The aggregate personal residential exposure data for this form is to be developed from the modeling-organization-specified, predetermined, and comprehensive exposure dataset except for insured values and deductibles information. Insured values are to be based on the flood output range specifications given below. When calculating the weighted average flood loss costs, weight the flood loss costs by the total insured value calculated above. Include the statewide range of flood loss costs (i.e., low, high, and weighted average).

Flood Loss Costs per $1000 for 0% Deductible

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Alachua	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.395	0.905	0.459	0.000	0.000	0.714	0.000
	HIGH	6.069	2.506	3.525	0.000	0.000	3.077	0.000
Baker	LOW	0.000	0.000	0.021	NA	NA	NA	NA
	AVERAGE	0.026	0.000	0.037	NA	NA	NA	NA
	HIGH	0.038	0.000	0.077	NA	NA	NA	NA
Bay	LOW	0.000	0.000	0.002	0.001	0.000	0.000	0.000
	AVERAGE	0.396	0.286	0.146	0.054	0.000	0.112	0.548
	HIGH	1.042	1.011	2.290	8.358	0.011	1.402	0.888
Bradford	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.031	0.001	0.022	NA	NA	NA	NA
	HIGH	0.045	0.001	0.033	NA	NA	NA	NA
Brevard	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.282	0.153	0.103	0.121	0.080	0.079	0.247
	HIGH	9.402	3.464	0.516	0.716	0.895	0.708	1.395
Broward	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.367	0.129	1.268	0.000	0.243	0.124	0.219
	HIGH	4.988	4.799	9.066	0.003	1.519	2.765	3.523
Calhoun	LOW	0.000	0.000	0.000	NA	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	AVERAGE	0.233	0.129	0.015	NA	NA	NA	NA
	HIGH	0.267	0.155	0.058	NA	NA	NA	NA
Charlotte	LOW	0.252	0.127	0.307	2.642	0.000	1.403	0.024
	AVERAGE	7.738	5.436	6.989	3.720	3.597	6.146	4.782
	HIGH	17.121	8.835	8.880	4.528	6.047	9.724	8.557
Citrus	LOW	0.000	0.000	0.000	0.000	0.051	4.912	0.000
	AVERAGE	15.839	5.421	1.878	14.946	4.542	38.781	20.624
	HIGH	38.769	36.291	11.726	29.883	13.402	65.928	37.324
Clay	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	2.878	1.083	0.250	0.000	0.000	0.081	0.105
	HIGH	6.103	2.198	1.344	0.000	0.000	0.193	0.210
Collier	LOW	0.000	0.000	0.000	0.603	0.000	0.000	0.000
	AVERAGE	4.404	3.220	5.777	0.788	1.800	4.690	3.518
	HIGH	243.314	89.381	15.598	20.285	8.854	18.345	40.431
Columbia	LOW	0.060	0.000	0.006	0.000	NA	NA	NA
	AVERAGE	0.752	1.018	0.708	0.000	NA	NA	NA
	HIGH	4.218	5.153	2.388	0.000	NA	NA	NA
DeSoto	LOW	0.111	0.184	0.002	NA	NA	NA	0.000
	AVERAGE	1.934	3.008	0.002	NA	NA	NA	0.000
	HIGH	10.867	4.954	0.002	NA	NA	NA	0.000
Dixie	LOW	0.352	0.000	0.321	NA	NA	0.000	NA
	AVERAGE	14.831	3.017	0.918	NA	NA	38.842	NA
	HIGH	18.951	12.030	1.053	NA	NA	45.316	NA
Duval	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.941	1.035	0.608	0.232	0.016	0.920	0.075
	HIGH	24.375	13.220	7.918	0.772	0.028	68.413	0.645
Escambia	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.807	0.323	0.587	1.710	0.883	0.858	0.059
	HIGH	7.792	6.962	3.628	55.220	1.313	1.705	0.118
Flagler	LOW	0.000	0.002	0.388	0.194	0.102	0.000	0.078
	AVERAGE	0.507	0.296	0.806	0.194	0.924	0.241	0.678
	HIGH	2.442	1.435	6.580	0.194	9.964	0.323	1.378
Franklin	LOW	3.158	1.128	1.053	NA	NA	2.196	0.858
	AVERAGE	4.520	5.009	1.290	NA	NA	2.251	0.873
	HIGH	5.654	7.086	1.746	NA	NA	2.580	0.887
Gadsden	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.042	3.222	0.014	NA	NA	NA	NA
	HIGH	0.146	4.833	0.116	NA	NA	NA	NA
Gilchrist	LOW	1.032	0.057	0.384	NA	NA	NA	NA
	AVERAGE	2.929	2.251	1.346	NA	NA	NA	NA
	HIGH	4.750	2.597	1.900	NA	NA	NA	NA
Glades	LOW	0.000	0.504	0.145	NA	NA	NA	NA
	AVERAGE	0.000	0.504	0.145	NA	NA	NA	NA
	HIGH	0.000	0.504	0.145	NA	NA	NA	NA
Gulf	LOW	0.000	0.004	0.034	5.206	0.060	NA	0.267
	AVERAGE	2.258	1.982	0.061	5.206	0.060	NA	0.267
	HIGH	2.512	2.264	0.205	5.206	0.060	NA	0.267
Hamilton	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.040	9.435	0.097	NA	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	HIGH	0.113	11.322	0.336	NA	NA	NA	NA
Hardee	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.160	0.214	0.000	NA	NA	NA	NA
	HIGH	0.802	0.297	0.002	NA	NA	NA	NA
Hendry	LOW	0.000	0.000	0.126	NA	NA	0.000	0.000
	AVERAGE	9.666	3.591	1.814	NA	NA	0.000	0.000
	HIGH	23.402	8.952	7.202	NA	NA	0.000	0.000
Hernando	LOW	0.000	0.082	0.000	0.000	0.000	0.000	0.000
	AVERAGE	13.291	4.223	3.076	0.000	0.013	0.000	0.003
	HIGH	19.000	17.558	45.651	0.000	0.031	0.000	0.017
Highlands	LOW	0.000	0.000	0.000	NA	NA	1.311	0.000
	AVERAGE	2.196	0.454	0.102	NA	NA	1.311	0.407
	HIGH	9.588	1.236	0.343	NA	NA	1.311	0.815
Hillsborough	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.079	2.559	1.466	2.639	1.894	1.185	1.325
	HIGH	35.674	17.884	22.873	11.842	6.747	19.033	5.879
Holmes	LOW	0.000	0.007	0.000	NA	NA	NA	NA
	AVERAGE	1.807	0.007	0.060	NA	NA	NA	NA
	HIGH	2.169	0.007	0.084	NA	NA	NA	NA
Indian River	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.816	0.691	1.316	2.872	0.959	1.596	1.758
	HIGH	3.564	3.218	14.354	12.892	3.501	4.473	3.925
Jackson	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	1.374	3.589	0.373	NA	NA	NA	NA
	HIGH	17.335	12.687	1.879	NA	NA	NA	NA
Jefferson	LOW	0.000	0.000	0.003	0.000	NA	NA	NA
	AVERAGE	8.449	0.000	0.003	0.000	NA	NA	NA
	HIGH	24.037	0.000	0.004	0.000	NA	NA	NA
Lafayette	LOW	0.103	0.274	0.024	NA	NA	NA	NA
	AVERAGE	0.103	0.274	0.024	NA	NA	NA	NA
	HIGH	0.103	0.274	0.024	NA	NA	NA	NA
Lake	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.057	3.208	0.469	0.000	0.000	0.089	0.000
	HIGH	22.226	19.191	10.699	0.000	0.000	0.886	0.000
Lee	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	7.725	3.519	8.493	1.535	2.282	9.965	4.388
	HIGH	35.236	40.517	74.690	22.374	9.897	48.476	37.603
Leon	LOW	0.000	0.040	0.000	0.000	NA	0.000	NA
	AVERAGE	2.003	2.688	0.150	0.000	NA	0.408	NA
	HIGH	6.269	15.400	1.144	0.000	NA	1.613	NA
Levy	LOW	0.135	0.000	0.203	NA	0.000	6.432	NA
	AVERAGE	12.750	10.860	0.987	NA	0.000	6.432	NA
	HIGH	27.220	31.996	5.697	NA	0.000	6.432	NA
Liberty	LOW	0.000	NA	0.000	NA	NA	NA	NA
	AVERAGE	0.000	NA	0.001	NA	NA	NA	NA
	HIGH	0.000	NA	0.001	NA	NA	NA	NA
Madison	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.317	0.000	0.239	NA	NA	NA	NA
	HIGH	1.315	0.000	0.472	NA	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Manatee	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.255	3.860	3.913	1.182	1.997	4.140	3.055
	HIGH	38.003	28.158	68.688	25.089	18.843	18.110	33.614
Marion	LOW	0.000	0.000	0.000	NA	0.000	0.000	0.000
	AVERAGE	1.755	1.193	1.182	NA	0.000	0.000	0.161
	HIGH	17.173	5.197	5.115	NA	0.000	0.000	0.457
Martin	LOW	0.000	0.000	0.000	0.000	0.000	0.001	0.022
	AVERAGE	0.766	0.309	0.156	0.074	0.092	0.274	0.186
	HIGH	2.706	1.018	0.278	0.197	0.274	2.320	0.451
Miami-Dade	LOW	0.000	0.000	0.019	0.000	0.000	0.000	0.000
	AVERAGE	1.472	1.441	3.201	2.541	2.582	0.950	1.725
	HIGH	12.940	23.816	11.018	2.734	8.211	19.456	8.473
Monroe	LOW	7.344	2.777	55.852	1.946	3.807	0.034	1.146
	AVERAGE	17.707	19.420	83.060	9.160	16.335	8.868	15.822
	HIGH	20.897	28.393	143.972	12.781	34.694	16.987	52.461
Nassau	LOW	0.005	0.000	0.012	0.000	0.041	0.052	0.011
	AVERAGE	0.295	0.104	0.066	0.028	0.041	0.052	0.011
	HIGH	0.316	0.117	0.283	0.030	0.041	0.052	0.011
Okaloosa	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.565	0.389	0.142	0.208	1.231	1.414	2.399
	HIGH	1.431	3.792	0.417	1.478	5.640	8.039	68.916
Okeechobee	LOW	0.000	0.005	0.081	NA	NA	0.000	0.000
	AVERAGE	0.110	0.035	0.980	NA	NA	0.000	0.000
	HIGH	0.484	0.081	1.525	NA	NA	0.000	0.000
Orange	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.923	0.360	0.316	0.000	0.000	0.006	0.043
	HIGH	6.842	3.875	1.189	0.000	0.000	0.041	0.516
Osceola	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.773	0.202	0.035	0.000	0.000	0.022	0.020
	HIGH	3.110	1.700	0.243	0.000	0.000	0.034	0.176
Palm Beach	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.257	0.071	0.495	0.019	0.016	0.159	0.111
	HIGH	2.392	0.803	1.185	0.483	0.334	2.178	3.458
Pasco	LOW	0.000	0.000	0.000	0.508	0.000	0.000	0.000
	AVERAGE	3.690	4.353	1.444	5.049	0.674	12.653	3.655
	HIGH	62.994	47.239	9.436	36.837	6.183	26.493	10.240
Pinellas	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.812	3.426	0.991	3.003	1.362	2.925	2.999
	HIGH	20.765	17.184	7.143	13.270	9.983	15.303	11.964
Polk	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.431	0.049	0.133	5.256	0.000	2.169	0.025
	HIGH	6.791	1.458	13.852	10.511	0.000	6.506	0.125
Putnam	LOW	0.000	0.000	0.000	NA	NA	44.432	0.000
	AVERAGE	12.534	5.946	0.478	NA	NA	44.432	13.372
	HIGH	27.696	13.501	1.916	NA	NA	44.432	26.743
St. Johns	LOW	0.000	0.000	0.020	0.000	0.000	0.000	0.000
	AVERAGE	0.366	0.211	0.360	0.369	0.150	0.298	0.586
	HIGH	1.748	0.742	1.648	1.405	0.884	1.052	1.656

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
St. Lucie	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.811	0.810	0.596	1.620	2.619	0.430	0.800
	HIGH	9.513	5.572	1.218	8.912	18.254	2.624	3.486
Santa Rosa	LOW	0.010	0.000	0.000	0.000	0.000	0.000	0.031
	AVERAGE	0.240	0.112	0.754	0.003	0.008	0.571	0.263
	HIGH	1.255	0.559	1.412	0.049	0.028	1.702	1.425
Sarasota	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.911	1.737	2.340	1.464	2.188	5.011	3.614
	HIGH	32.461	13.426	6.239	11.706	6.102	14.724	10.399
Seminole	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.795	0.325	0.123	0.000	0.397	0.032	1.135
	HIGH	3.075	1.277	0.304	0.000	0.794	0.379	4.550
Sumter	LOW	0.000	0.008	0.000	NA	NA	NA	0.000
	AVERAGE	0.984	0.413	0.191	NA	NA	NA	0.000
	HIGH	2.791	1.110	0.519	NA	NA	NA	0.000
Suwannee	LOW	0.177	0.000	0.022	NA	NA	NA	NA
	AVERAGE	3.695	2.943	0.354	NA	NA	NA	NA
	HIGH	16.572	27.345	3.940	NA	NA	NA	NA
Taylor	LOW	0.000	0.126	0.043	0.124	0.000	41.592	NA
	AVERAGE	6.584	1.842	0.412	0.124	0.000	41.592	NA
	HIGH	13.346	3.746	1.435	0.124	0.000	41.592	NA
Union	LOW	0.277	0.000	0.001	NA	NA	NA	NA
	AVERAGE	0.277	0.000	0.001	NA	NA	NA	NA
	HIGH	0.277	0.000	0.001	NA	NA	NA	NA
Volusia	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.281	0.174	0.364	0.346	0.273	0.145	0.270
	HIGH	1.313	1.237	1.801	2.375	1.882	6.027	0.830
Wakulla	LOW	3.836	0.000	0.011	1.144	NA	24.976	18.806
	AVERAGE	6.096	15.224	1.913	6.006	NA	24.976	18.806
	HIGH	15.492	22.047	29.231	15.730	NA	24.976	18.806
Walton	LOW	0.006	0.000	0.014	0.000	0.000	0.000	0.000
	AVERAGE	0.285	0.088	0.070	0.014	0.002	0.039	0.006
	HIGH	0.911	0.167	0.484	0.095	0.003	0.135	0.081
Washington	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.672	0.497	0.119	NA	NA	NA	NA
	HIGH	1.072	0.638	0.144	NA	NA	NA	NA
Statewide	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	2.174	1.745	0.806	1.558	1.126	2.824	2.498
	HIGH	243.314	89.381	143.972	55.220	34.694	68.413	68.916

Flood Loss Costs per $1000 for 0% Deductible, Time Element

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Alachua	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.389	0.235	0.109	0.000	0.000	0.177	0.000
	HIGH	1.622	0.650	0.816	0.000	0.000	0.764	0.000
Baker	LOW	0.000	0.000	0.006	NA	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	AVERAGE	0.006	0.000	0.010	NA	NA	NA	NA
	HIGH	0.009	0.000	0.020	NA	NA	NA	NA
Bay	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.096	0.070	0.035	0.017	0.000	0.028	0.130
	HIGH	0.275	0.253	0.540	2.939	0.003	0.352	0.210
Bradford	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.006	0.000	0.006	NA	NA	NA	NA
	HIGH	0.009	0.000	0.008	NA	NA	NA	NA
Brevard	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.073	0.038	0.027	0.041	0.029	0.021	0.060
	HIGH	2.468	0.858	0.124	0.242	0.339	0.200	0.340
Broward	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.091	0.031	0.321	0.000	0.083	0.030	0.051
	HIGH	1.612	1.196	2.299	0.001	0.548	0.764	0.834
Calhoun	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.017	0.034	0.004	NA	NA	NA	NA
	HIGH	0.019	0.040	0.014	NA	NA	NA	NA
Charlotte	LOW	0.075	0.036	0.077	1.514	0.000	0.421	0.007
	AVERAGE	2.378	1.607	2.216	2.184	1.797	1.917	1.381
	HIGH	4.754	2.643	2.837	2.687	3.118	3.143	2.376
Citrus	LOW	0.000	0.000	0.000	0.000	0.021	1.459	0.000
	AVERAGE	4.597	1.448	0.511	6.516	1.873	10.945	5.583
	HIGH	11.799	9.989	3.331	13.028	5.693	18.220	9.333
Clay	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.826	0.281	0.064	0.000	0.000	0.020	0.024
	HIGH	1.757	0.569	0.352	0.000	0.000	0.049	0.047
Collier	LOW	0.000	0.000	0.000	0.265	0.000	0.000	0.000
	AVERAGE	1.345	0.918	1.744	0.358	0.799	1.424	0.950
	HIGH	68.043	29.069	4.610	9.696	4.176	5.682	12.723
Columbia	LOW	0.015	0.000	0.002	0.000	NA	NA	NA
	AVERAGE	0.208	0.281	0.157	0.000	NA	NA	NA
	HIGH	1.319	1.455	0.519	0.000	NA	NA	NA
DeSoto	LOW	0.035	0.051	0.001	NA	NA	NA	0.000
	AVERAGE	0.572	0.820	0.001	NA	NA	NA	0.000
	HIGH	3.199	1.350	0.001	NA	NA	NA	0.000
Dixie	LOW	0.049	0.000	0.086	NA	NA	0.000	NA
	AVERAGE	4.374	0.803	0.276	NA	NA	10.833	NA
	HIGH	5.587	3.216	0.319	NA	NA	12.638	NA
Duval	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.566	0.274	0.179	0.085	0.006	0.263	0.018
	HIGH	7.347	3.237	2.399	0.283	0.011	20.713	0.159
Escambia	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.210	0.078	0.138	0.619	0.296	0.209	0.014
	HIGH	1.935	1.822	0.843	19.730	0.451	0.418	0.028
Flagler	LOW	0.000	0.000	0.104	0.080	0.038	0.000	0.020
	AVERAGE	0.130	0.071	0.209	0.080	0.312	0.066	0.166
	HIGH	0.612	0.338	1.618	0.080	3.335	0.089	0.336
Franklin	LOW	1.098	0.442	0.344	NA	NA	0.527	0.212
	AVERAGE	1.365	1.490	0.399	NA	NA	0.668	0.246

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	HIGH	1.752	2.167	0.540	NA	NA	0.692	0.279
Gadsden	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.009	0.790	0.004	NA	NA	NA	NA
	HIGH	0.032	1.184	0.032	NA	NA	NA	NA
Gilchrist	LOW	0.290	0.015	0.089	NA	NA	NA	NA
	AVERAGE	0.896	0.635	0.313	NA	NA	NA	NA
	HIGH	1.478	0.733	0.441	NA	NA	NA	NA
Glades	LOW	0.000	0.123	0.040	NA	NA	NA	NA
	AVERAGE	0.000	0.123	0.040	NA	NA	NA	NA
	HIGH	0.000	0.123	0.040	NA	NA	NA	NA
Gulf	LOW	0.000	0.001	0.008	1.903	0.022	NA	0.067
	AVERAGE	0.617	0.530	0.015	1.903	0.022	NA	0.067
	HIGH	0.684	0.605	0.049	1.903	0.022	NA	0.067
Hamilton	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.008	2.689	0.025	NA	NA	NA	NA
	HIGH	0.023	3.227	0.085	NA	NA	NA	NA
Hardee	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.035	0.056	0.000	NA	NA	NA	NA
	HIGH	0.177	0.078	0.001	NA	NA	NA	NA
Hendry	LOW	0.000	0.000	0.035	NA	NA	0.000	0.000
	AVERAGE	2.646	0.911	0.454	NA	NA	0.000	0.000
	HIGH	6.405	2.271	1.792	NA	NA	0.000	0.000
Hernando	LOW	0.000	0.019	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.924	1.193	0.864	0.000	0.004	0.000	0.001
	HIGH	5.629	5.027	13.344	0.000	0.009	0.000	0.004
Highlands	LOW	0.000	0.000	0.000	NA	NA	0.272	0.000
	AVERAGE	0.542	0.111	0.028	NA	NA	0.272	0.095
	HIGH	2.372	0.304	0.096	NA	NA	0.272	0.191
Hillsborough	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.892	0.716	0.415	1.006	0.771	0.311	0.352
	HIGH	11.489	5.086	6.705	5.313	2.951	5.242	1.579
Holmes	LOW	0.000	0.002	0.000	NA	NA	NA	NA
	AVERAGE	0.462	0.002	0.014	NA	NA	NA	NA
	HIGH	0.555	0.002	0.019	NA	NA	NA	NA
Indian River	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.217	0.175	0.306	1.075	0.362	0.420	0.428
	HIGH	0.960	0.829	3.204	4.130	1.339	1.204	0.947
Jackson	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.379	0.987	0.090	NA	NA	NA	NA
	HIGH	4.705	3.046	0.458	NA	NA	NA	NA
Jefferson	LOW	0.000	0.000	0.001	0.000	NA	NA	NA
	AVERAGE	2.447	0.000	0.001	0.000	NA	NA	NA
	HIGH	6.963	0.000	0.001	0.000	NA	NA	NA
Lafayette	LOW	0.030	0.074	0.007	NA	NA	NA	NA
	AVERAGE	0.030	0.074	0.007	NA	NA	NA	NA
	HIGH	0.030	0.074	0.007	NA	NA	NA	NA
Lake	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.293	0.842	0.121	0.000	0.000	0.021	0.000
	HIGH	6.375	5.051	2.776	0.000	0.000	0.205	0.000

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Lee	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	2.380	1.014	2.832	0.740	1.008	3.098	1.222
	HIGH	11.338	12.528	26.421	11.882	5.413	15.704	11.221
Leon	LOW	0.000	0.010	0.000	0.000	NA	0.000	NA
	AVERAGE	0.543	0.701	0.039	0.000	NA	0.120	NA
	HIGH	1.632	4.813	0.316	0.000	NA	0.477	NA
Levy	LOW	0.029	0.000	0.049	NA	0.000	1.908	NA
	AVERAGE	3.861	3.131	0.249	NA	0.000	1.908	NA
	HIGH	8.357	9.426	1.594	NA	0.000	1.908	NA
Liberty	LOW	0.000	NA	0.000	NA	NA	NA	NA
	AVERAGE	0.000	NA	0.000	NA	NA	NA	NA
	HIGH	0.000	NA	0.000	NA	NA	NA	NA
Madison	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.092	0.000	0.058	NA	NA	NA	NA
	HIGH	0.389	0.000	0.111	NA	NA	NA	NA
Manatee	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.944	1.027	1.039	0.553	0.917	1.246	0.829
	HIGH	9.767	7.115	19.156	10.634	7.513	5.581	8.589
Marion	LOW	0.000	0.000	0.000	NA	0.000	0.000	0.000
	AVERAGE	0.469	0.293	0.296	NA	0.000	0.000	0.040
	HIGH	4.589	1.219	1.232	NA	0.000	0.000	0.111
Martin	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.005
	AVERAGE	0.195	0.076	0.041	0.013	0.031	0.062	0.042
	HIGH	0.687	0.242	0.077	0.035	0.092	0.537	0.104
Miami-Dade	LOW	0.000	0.000	0.005	0.000	0.000	0.000	0.000
	AVERAGE	0.416	0.386	0.855	1.033	0.996	0.267	0.437
	HIGH	3.901	5.704	3.079	1.110	3.184	6.015	2.222
Monroe	LOW	1.972	0.679	15.531	0.773	1.457	0.010	0.280
	AVERAGE	5.257	5.382	23.705	3.978	6.769	2.615	4.270
	HIGH	6.333	8.029	44.212	5.544	13.680	5.086	14.694
Nassau	LOW	0.001	0.000	0.003	0.000	0.014	0.015	0.003
	AVERAGE	0.076	0.026	0.017	0.011	0.014	0.015	0.003
	HIGH	0.081	0.029	0.071	0.011	0.014	0.015	0.003
Okaloosa	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.147	0.096	0.037	0.085	0.477	0.389	0.563
	HIGH	0.376	1.024	0.109	0.598	2.197	2.250	16.033
Okeechobee	LOW	0.000	0.001	0.022	NA	NA	0.000	0.000
	AVERAGE	0.030	0.008	0.226	NA	NA	0.000	0.000
	HIGH	0.131	0.018	0.349	NA	NA	0.000	0.000
Orange	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.190	0.086	0.086	0.000	0.000	0.000	0.010
	HIGH	1.828	0.993	0.331	0.000	0.000	0.003	0.111
Osceola	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.166	0.047	0.009	0.000	0.000	0.004	0.005
	HIGH	0.724	0.403	0.061	0.000	0.000	0.006	0.042
Palm Beach	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.059	0.017	0.131	0.006	0.005	0.036	0.025
	HIGH	0.560	0.188	0.314	0.156	0.119	0.485	0.780

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Pasco	LOW	0.000	0.000	0.000	0.236	0.000	0.000	0.000
	AVERAGE	1.085	1.242	0.410	2.348	0.310	3.548	1.010
	HIGH	19.789	14.036	2.971	17.136	2.666	7.399	2.833
Pinellas	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.082	0.934	0.265	1.274	0.565	0.766	0.812
	HIGH	5.825	4.792	2.007	7.133	4.295	4.529	3.407
Polk	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.109	0.012	0.033	1.896	0.000	0.456	0.006
	HIGH	1.965	0.379	3.365	3.792	0.000	1.367	0.023
Putnam	LOW	0.000	0.000	0.000	NA	NA	12.904	0.000
	AVERAGE	3.709	1.573	0.126	NA	NA	12.904	3.635
	HIGH	8.273	3.587	0.503	NA	NA	12.904	7.270
St. Johns	LOW	0.000	0.000	0.005	0.000	0.000	0.000	0.000
	AVERAGE	0.092	0.052	0.100	0.136	0.053	0.073	0.139
	HIGH	0.510	0.181	0.471	0.517	0.315	0.268	0.393
St. Lucie	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.201	0.197	0.160	0.595	1.041	0.113	0.192
	HIGH	2.684	1.378	0.340	3.271	7.262	0.694	0.832
Santa Rosa	LOW	0.002	0.000	0.000	0.000	0.000	0.000	0.008
	AVERAGE	0.058	0.026	0.169	0.001	0.003	0.156	0.066
	HIGH	0.325	0.141	0.308	0.010	0.009	0.460	0.359
Sarasota	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.210	0.506	0.655	0.792	1.062	1.536	1.039
	HIGH	9.482	4.028	1.532	6.810	3.084	4.200	2.886
Seminole	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.210	0.081	0.032	0.000	0.145	0.006	0.289
	HIGH	0.835	0.312	0.085	0.000	0.289	0.075	1.051
Sumter	LOW	0.000	0.002	0.000	NA	NA	NA	0.000
	AVERAGE	0.251	0.096	0.045	NA	NA	NA	0.000
	HIGH	0.765	0.260	0.126	NA	NA	NA	0.000
Suwannee	LOW	0.043	0.000	0.006	NA	NA	NA	NA
	AVERAGE	1.132	0.833	0.082	NA	NA	NA	NA
	HIGH	5.330	7.911	0.897	NA	NA	NA	NA
Taylor	LOW	0.000	0.030	0.010	0.036	0.000	11.605	NA
	AVERAGE	2.009	0.518	0.124	0.036	0.000	11.605	NA
	HIGH	4.154	1.101	0.436	0.036	0.000	11.605	NA
Union	LOW	0.072	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.072	0.000	0.000	NA	NA	NA	NA
	HIGH	0.072	0.000	0.000	NA	NA	NA	NA
Volusia	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.067	0.042	0.092	0.116	0.090	0.037	0.063
	HIGH	0.373	0.321	0.447	0.868	0.639	1.799	0.194
Wakulla	LOW	1.201	0.000	0.002	0.562	NA	8.962	5.871
	AVERAGE	1.901	4.671	0.537	3.097	NA	8.962	5.871
	HIGH	4.913	6.813	9.716	8.168	NA	8.962	5.871
Walton	LOW	0.002	0.000	0.004	0.000	0.000	0.000	0.000
	AVERAGE	0.068	0.021	0.017	0.005	0.001	0.009	0.002
	HIGH	0.222	0.040	0.133	0.031	0.001	0.031	0.019
Washington	LOW	0.000	0.000	0.000	NA	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	AVERAGE	0.176	0.131	0.031	NA	NA	NA	NA
	HIGH	0.287	0.169	0.038	NA	NA	NA	NA
Statewide	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.631	0.487	0.222	0.641	0.486	0.832	0.685
	HIGH	68.043	29.069	44.212	19.730	13.680	20.713	16.033

Flood Loss Costs per $1000 with Specified Deductibles

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Alachua	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.306	0.810	0.440	0.000	0.000	0.693	0.000
	HIGH	5.627	2.281	3.400	0.000	0.000	2.988	0.000
Baker	LOW	0.000	0.000	0.015	NA	NA	NA	NA
	AVERAGE	0.023	0.000	0.028	NA	NA	NA	NA
	HIGH	0.033	0.000	0.060	NA	NA	NA	NA
Bay	LOW	0.000	0.000	0.001	0.001	0.000	0.000	0.000
	AVERAGE	0.359	0.254	0.132	0.048	0.000	0.109	0.532
	HIGH	0.975	0.936	2.101	7.737	0.010	1.369	0.862
Bradford	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.027	0.000	0.018	NA	NA	NA	NA
	HIGH	0.039	0.000	0.027	NA	NA	NA	NA
Brevard	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.259	0.132	0.084	0.110	0.069	0.077	0.237
	HIGH	8.671	3.007	0.462	0.653	0.813	0.695	1.351
Broward	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.330	0.104	1.086	0.000	0.209	0.121	0.207
	HIGH	4.797	4.161	7.655	0.002	1.365	2.697	3.395
Calhoun	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.172	0.118	0.013	NA	NA	NA	NA
	HIGH	0.197	0.142	0.050	NA	NA	NA	NA
Charlotte	LOW	0.238	0.118	0.301	2.547	0.000	1.387	0.024
	AVERAGE	7.388	5.165	6.889	3.593	3.431	6.078	4.720
	HIGH	16.112	8.442	8.729	4.378	5.775	9.620	8.444
Citrus	LOW	0.000	0.000	0.000	0.000	0.048	4.849	0.000
	AVERAGE	14.953	5.005	1.812	14.258	4.278	38.189	20.233
	HIGH	36.826	33.721	11.539	28.508	12.636	64.852	36.562
Clay	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	2.718	0.991	0.235	0.000	0.000	0.078	0.100
	HIGH	5.771	2.010	1.320	0.000	0.000	0.188	0.199
Collier	LOW	0.000	0.000	0.000	0.575	0.000	0.000	0.000
	AVERAGE	4.196	3.038	5.639	0.751	1.712	4.631	3.458
	HIGH	226.241	85.857	15.343	19.267	8.478	18.128	40.021
Columbia	LOW	0.054	0.000	0.004	0.000	NA	NA	NA
	AVERAGE	0.704	0.944	0.678	0.000	NA	NA	NA
	HIGH	4.034	4.838	2.286	0.000	NA	NA	NA
DeSoto	LOW	0.105	0.169	0.001	NA	NA	NA	0.000
	AVERAGE	1.819	2.769	0.001	NA	NA	NA	0.000

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	HIGH	10.215	4.559	0.001	NA	NA	NA	0.000
Dixie	LOW	0.287	0.000	0.250	NA	NA	0.000	NA
	AVERAGE	14.198	2.844	0.867	NA	NA	38.352	NA
	HIGH	18.195	11.383	1.006	NA	NA	44.744	NA
Duval	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.835	0.955	0.591	0.217	0.014	0.904	0.072
	HIGH	23.206	12.052	7.833	0.722	0.025	67.548	0.624
Escambia	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.748	0.281	0.554	1.587	0.762	0.836	0.057
	HIGH	7.147	6.346	3.492	52.311	1.190	1.662	0.115
Flagler	LOW	0.000	0.001	0.303	0.184	0.093	0.000	0.076
	AVERAGE	0.463	0.253	0.703	0.184	0.807	0.237	0.651
	HIGH	2.223	1.212	6.208	0.184	8.654	0.317	1.323
Franklin	LOW	3.065	1.103	1.034	NA	NA	2.177	0.852
	AVERAGE	4.310	4.754	1.263	NA	NA	2.221	0.864
	HIGH	5.416	6.786	1.709	NA	NA	2.481	0.876
Gadsden	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.037	2.679	0.010	NA	NA	NA	NA
	HIGH	0.126	4.018	0.083	NA	NA	NA	NA
Gilchrist	LOW	0.975	0.053	0.366	NA	NA	NA	NA
	AVERAGE	2.788	2.116	1.298	NA	NA	NA	NA
	HIGH	4.529	2.442	1.835	NA	NA	NA	NA
Glades	LOW	0.000	0.434	0.104	NA	NA	NA	NA
	AVERAGE	0.000	0.434	0.104	NA	NA	NA	NA
	HIGH	0.000	0.434	0.104	NA	NA	NA	NA
Gulf	LOW	0.000	0.003	0.031	4.820	0.054	NA	0.256
	AVERAGE	2.128	1.851	0.053	4.820	0.054	NA	0.256
	HIGH	2.367	2.114	0.177	4.820	0.054	NA	0.256
Hamilton	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.033	8.877	0.093	NA	NA	NA	NA
	HIGH	0.093	10.653	0.327	NA	NA	NA	NA
Hardee	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.139	0.198	0.000	NA	NA	NA	NA
	HIGH	0.697	0.275	0.002	NA	NA	NA	NA
Hendry	LOW	0.000	0.000	0.091	NA	NA	0.000	0.000
	AVERAGE	9.020	3.189	1.728	NA	NA	0.000	0.000
	HIGH	21.839	7.950	6.953	NA	NA	0.000	0.000
Hernando	LOW	0.000	0.066	0.000	0.000	0.000	0.000	0.000
	AVERAGE	12.627	3.984	2.981	0.000	0.008	0.000	0.003
	HIGH	18.063	16.668	44.611	0.000	0.020	0.000	0.017
Highlands	LOW	0.000	0.000	0.000	NA	NA	1.258	0.000
	AVERAGE	1.991	0.380	0.073	NA	NA	1.258	0.377
	HIGH	8.698	1.050	0.247	NA	NA	1.258	0.755
Hillsborough	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	2.900	2.388	1.429	2.443	1.769	1.162	1.300
	HIGH	34.012	17.003	22.230	11.285	6.371	18.769	5.788
Holmes	LOW	0.000	0.006	0.000	NA	NA	NA	NA
	AVERAGE	1.632	0.006	0.054	NA	NA	NA	NA
	HIGH	1.958	0.006	0.076	NA	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Indian River	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.756	0.618	1.232	2.676	0.883	1.564	1.707
	HIGH	3.318	2.914	14.027	11.831	3.244	4.402	3.829
Jackson	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	1.288	3.241	0.340	NA	NA	NA	NA
	HIGH	16.245	10.148	1.783	NA	NA	NA	NA
Jefferson	LOW	0.000	0.000	0.003	0.000	NA	NA	NA
	AVERAGE	8.016	0.000	0.003	0.000	NA	NA	NA
	HIGH	22.807	0.000	0.003	0.000	NA	NA	NA
Lafayette	LOW	0.098	0.253	0.018	NA	NA	NA	NA
	AVERAGE	0.098	0.253	0.018	NA	NA	NA	NA
	HIGH	0.098	0.253	0.018	NA	NA	NA	NA
Lake	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.990	2.924	0.456	0.000	0.000	0.086	0.000
	HIGH	20.941	17.537	10.488	0.000	0.000	0.860	0.000
Lee	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	7.376	3.326	8.347	1.465	2.162	9.851	4.319
	HIGH	33.897	38.929	73.822	21.593	9.109	48.018	37.191
Leon	LOW	0.000	0.034	0.000	0.000	NA	0.000	NA
	AVERAGE	1.865	2.391	0.143	0.000	NA	0.403	NA
	HIGH	5.784	14.574	1.124	0.000	NA	1.592	NA
Levy	LOW	0.116	0.000	0.183	NA	0.000	6.355	NA
	AVERAGE	12.191	10.311	0.943	NA	0.000	6.355	NA
	HIGH	26.100	30.545	5.586	NA	0.000	6.355	NA
Liberty	LOW	0.000	NA	0.000	NA	NA	NA	NA
	AVERAGE	0.000	NA	0.000	NA	NA	NA	NA
	HIGH	0.000	NA	0.001	NA	NA	NA	NA
Madison	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.298	0.000	0.228	NA	NA	NA	NA
	HIGH	1.243	0.000	0.411	NA	NA	NA	NA
Manatee	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.068	3.564	3.819	1.119	1.893	4.088	3.006
	HIGH	34.762	25.568	67.581	23.390	17.515	17.894	32.729
Marion	LOW	0.000	0.000	0.000	NA	0.000	0.000	0.000
	AVERAGE	1.633	1.055	1.142	NA	0.000	0.000	0.157
	HIGH	15.974	4.522	4.969	NA	0.000	0.000	0.439
Martin	LOW	0.000	0.000	0.000	0.000	0.000	0.001	0.021
	AVERAGE	0.704	0.265	0.126	0.061	0.076	0.266	0.175
	HIGH	2.501	0.883	0.203	0.164	0.225	2.253	0.426
Miami-Dade	LOW	0.000	0.000	0.017	0.000	0.000	0.000	0.000
	AVERAGE	1.373	1.319	2.996	2.411	2.413	0.931	1.678
	HIGH	12.229	21.459	10.900	2.594	7.777	19.208	8.329
Monroe	LOW	6.871	2.535	54.314	1.825	3.597	0.034	1.120
	AVERAGE	16.731	18.096	80.921	8.728	15.337	8.744	15.545
	HIGH	19.720	26.918	140.187	12.225	32.274	16.787	51.615
Nassau	LOW	0.004	0.000	0.010	0.000	0.038	0.051	0.010
	AVERAGE	0.272	0.092	0.059	0.027	0.038	0.051	0.010
	HIGH	0.290	0.103	0.269	0.028	0.038	0.051	0.010

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Okaloosa	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.525	0.355	0.122	0.198	1.167	1.397	2.352
	HIGH	1.332	3.550	0.400	1.405	5.362	7.918	67.505
Okeechobee	LOW	0.000	0.004	0.063	NA	NA	0.000	0.000
	AVERAGE	0.103	0.024	0.924	NA	NA	0.000	0.000
	HIGH	0.453	0.056	1.447	NA	NA	0.000	0.000
Orange	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.805	0.278	0.238	0.000	0.000	0.006	0.040
	HIGH	6.372	3.511	0.858	0.000	0.000	0.036	0.469
Osceola	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.691	0.168	0.028	0.000	0.000	0.020	0.019
	HIGH	2.808	1.439	0.208	0.000	0.000	0.032	0.165
Palm Beach	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.227	0.055	0.395	0.017	0.012	0.153	0.104
	HIGH	2.107	0.610	0.963	0.435	0.256	2.092	3.284
Pasco	LOW	0.000	0.000	0.000	0.487	0.000	0.000	0.000
	AVERAGE	3.513	4.135	1.388	4.835	0.644	12.495	3.607
	HIGH	60.511	45.213	9.302	35.269	5.909	26.161	10.107
Pinellas	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.588	3.210	0.952	2.846	1.283	2.869	2.950
	HIGH	19.435	16.134	7.025	12.603	9.410	15.100	11.810
Polk	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.394	0.040	0.116	4.888	0.000	2.085	0.023
	HIGH	6.443	1.337	13.569	9.775	0.000	6.255	0.104
Putnam	LOW	0.000	0.000	0.000	NA	NA	43.744	0.000
	AVERAGE	11.880	5.487	0.462	NA	NA	43.744	13.111
	HIGH	26.305	12.502	1.886	NA	NA	43.744	26.222
St. Johns	LOW	0.000	0.000	0.015	0.000	0.000	0.000	0.000
	AVERAGE	0.335	0.183	0.350	0.345	0.136	0.290	0.566
	HIGH	1.649	0.640	1.625	1.314	0.800	1.029	1.600
St. Lucie	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.741	0.710	0.464	1.514	2.409	0.421	0.776
	HIGH	9.018	4.940	0.878	8.326	16.800	2.574	3.384
Santa Rosa	LOW	0.009	0.000	0.000	0.000	0.000	0.000	0.030
	AVERAGE	0.219	0.095	0.707	0.002	0.007	0.564	0.260
	HIGH	1.167	0.493	1.360	0.042	0.023	1.682	1.407
Sarasota	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.731	1.642	2.279	1.411	2.084	4.951	3.563
	HIGH	30.601	12.815	6.025	11.292	5.858	14.501	10.197
Seminole	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.733	0.278	0.099	0.000	0.364	0.030	1.106
	HIGH	2.867	1.101	0.257	0.000	0.727	0.363	4.390
Sumter	LOW	0.000	0.006	0.000	NA	NA	NA	0.000
	AVERAGE	0.915	0.356	0.172	NA	NA	NA	0.000
	HIGH	2.630	0.970	0.499	NA	NA	NA	0.000
Suwannee	LOW	0.158	0.000	0.018	NA	NA	NA	NA
	AVERAGE	3.513	2.737	0.334	NA	NA	NA	NA
	HIGH	15.910	25.918	3.803	NA	NA	NA	NA
Taylor	LOW	0.000	0.110	0.040	0.113	0.000	41.052	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	AVERAGE	6.297	1.739	0.387	0.113	0.000	41.052	NA
	HIGH	12.815	3.575	1.419	0.113	0.000	41.052	NA
Union	LOW	0.251	0.000	0.001	NA	NA	NA	NA
	AVERAGE	0.251	0.000	0.001	NA	NA	NA	NA
	HIGH	0.251	0.000	0.001	NA	NA	NA	NA
Volusia	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.252	0.147	0.327	0.314	0.229	0.142	0.259
	HIGH	1.239	1.129	1.627	2.208	1.679	5.954	0.797
Wakulla	LOW	3.669	0.000	0.011	1.103	NA	24.794	18.628
	AVERAGE	5.830	14.557	1.846	5.794	NA	24.794	18.628
	HIGH	14.855	21.079	28.930	15.175	NA	24.794	18.628
Walton	LOW	0.006	0.000	0.010	0.000	0.000	0.000	0.000
	AVERAGE	0.256	0.076	0.060	0.013	0.002	0.038	0.006
	HIGH	0.812	0.151	0.348	0.086	0.002	0.130	0.078
Washington	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.618	0.449	0.094	NA	NA	NA	NA
	HIGH	0.993	0.579	0.118	NA	NA	NA	NA
Statewide	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	2.050	1.629	0.771	1.463	1.059	2.785	2.455
	HIGH	226.241	85.857	140.187	52.311	32.274	67.548	67.505

Flood Loss Costs per $1000 with Specified Deductibles, Time Element

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Alachua	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.389	0.235	0.109	0.000	0.000	0.177	0.000
	HIGH	1.622	0.650	0.816	0.000	0.000	0.764	0.000
Baker	LOW	0.000	0.000	0.006	NA	NA	NA	NA
	AVERAGE	0.006	0.000	0.010	NA	NA	NA	NA
	HIGH	0.009	0.000	0.020	NA	NA	NA	NA
Bay	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.096	0.070	0.035	0.017	0.000	0.028	0.130
	HIGH	0.275	0.253	0.540	2.939	0.003	0.352	0.210
Bradford	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.006	0.000	0.006	NA	NA	NA	NA
	HIGH	0.009	0.000	0.008	NA	NA	NA	NA
Brevard	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.073	0.038	0.027	0.041	0.029	0.021	0.060
	HIGH	2.468	0.858	0.124	0.242	0.339	0.200	0.340
Broward	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.091	0.031	0.321	0.000	0.083	0.030	0.051
	HIGH	1.612	1.196	2.299	0.001	0.548	0.764	0.834
Calhoun	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.017	0.034	0.004	NA	NA	NA	NA
	HIGH	0.019	0.040	0.014	NA	NA	NA	NA
Charlotte	LOW	0.075	0.036	0.077	1.514	0.000	0.421	0.007
	AVERAGE	2.378	1.607	2.216	2.184	1.797	1.917	1.381

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	HIGH	4.754	2.643	2.837	2.687	3.118	3.143	2.376
Citrus	LOW	0.000	0.000	0.000	0.000	0.021	1.459	0.000
	AVERAGE	4.597	1.448	0.511	6.516	1.873	10.945	5.583
	HIGH	11.799	9.989	3.331	13.028	5.693	18.220	9.333
Clay	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.826	0.281	0.064	0.000	0.000	0.020	0.024
	HIGH	1.757	0.569	0.352	0.000	0.000	0.049	0.047
Collier	LOW	0.000	0.000	0.000	0.265	0.000	0.000	0.000
	AVERAGE	1.345	0.918	1.744	0.358	0.799	1.424	0.950
	HIGH	68.043	29.069	4.610	9.696	4.176	5.682	12.723
Columbia	LOW	0.015	0.000	0.002	0.000	NA	NA	NA
	AVERAGE	0.208	0.281	0.157	0.000	NA	NA	NA
	HIGH	1.319	1.455	0.519	0.000	NA	NA	NA
DeSoto	LOW	0.035	0.051	0.001	NA	NA	NA	0.000
	AVERAGE	0.572	0.820	0.001	NA	NA	NA	0.000
	HIGH	3.199	1.350	0.001	NA	NA	NA	0.000
Dixie	LOW	0.049	0.000	0.086	NA	NA	0.000	NA
	AVERAGE	4.374	0.803	0.276	NA	NA	10.833	NA
	HIGH	5.587	3.216	0.319	NA	NA	12.638	NA
Duval	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.566	0.274	0.179	0.085	0.006	0.263	0.018
	HIGH	7.347	3.237	2.399	0.283	0.011	20.713	0.159
Escambia	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.210	0.078	0.138	0.619	0.296	0.209	0.014
	HIGH	1.935	1.822	0.843	19.730	0.451	0.418	0.028
Flagler	LOW	0.000	0.000	0.104	0.080	0.038	0.000	0.020
	AVERAGE	0.130	0.071	0.209	0.080	0.312	0.066	0.166
	HIGH	0.612	0.338	1.618	0.080	3.335	0.089	0.336
Franklin	LOW	1.098	0.442	0.344	NA	NA	0.527	0.212
	AVERAGE	1.365	1.490	0.399	NA	NA	0.668	0.246
	HIGH	1.752	2.167	0.540	NA	NA	0.692	0.279
Gadsden	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.009	0.790	0.004	NA	NA	NA	NA
	HIGH	0.032	1.184	0.032	NA	NA	NA	NA
Gilchrist	LOW	0.290	0.015	0.089	NA	NA	NA	NA
	AVERAGE	0.896	0.635	0.313	NA	NA	NA	NA
	HIGH	1.478	0.733	0.441	NA	NA	NA	NA
Glades	LOW	0.000	0.123	0.040	NA	NA	NA	NA
	AVERAGE	0.000	0.123	0.040	NA	NA	NA	NA
	HIGH	0.000	0.123	0.040	NA	NA	NA	NA
Gulf	LOW	0.000	0.001	0.008	1.903	0.022	NA	0.067
	AVERAGE	0.617	0.530	0.015	1.903	0.022	NA	0.067
	HIGH	0.684	0.605	0.049	1.903	0.022	NA	0.067
Hamilton	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.008	2.689	0.025	NA	NA	NA	NA
	HIGH	0.023	3.227	0.085	NA	NA	NA	NA
Hardee	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.035	0.056	0.000	NA	NA	NA	NA
	HIGH	0.177	0.078	0.001	NA	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Hendry	LOW	0.000	0.000	0.035	NA	NA	0.000	0.000
	AVERAGE	2.646	0.911	0.454	NA	NA	0.000	0.000
	HIGH	6.405	2.271	1.792	NA	NA	0.000	0.000
Hernando	LOW	0.000	0.019	0.000	0.000	0.000	0.000	0.000
	AVERAGE	3.924	1.193	0.864	0.000	0.004	0.000	0.001
	HIGH	5.629	5.027	13.344	0.000	0.009	0.000	0.004
Highlands	LOW	0.000	0.000	0.000	NA	NA	0.272	0.000
	AVERAGE	0.542	0.111	0.028	NA	NA	0.272	0.095
	HIGH	2.372	0.304	0.096	NA	NA	0.272	0.191
Hillsborough	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.892	0.716	0.415	1.006	0.771	0.311	0.352
	HIGH	11.489	5.086	6.705	5.313	2.951	5.242	1.579
Holmes	LOW	0.000	0.002	0.000	NA	NA	NA	NA
	AVERAGE	0.462	0.002	0.014	NA	NA	NA	NA
	HIGH	0.555	0.002	0.019	NA	NA	NA	NA
Indian River	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.217	0.175	0.306	1.075	0.362	0.420	0.428
	HIGH	0.960	0.829	3.204	4.130	1.339	1.204	0.947
Jackson	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.379	0.987	0.090	NA	NA	NA	NA
	HIGH	4.705	3.046	0.458	NA	NA	NA	NA
Jefferson	LOW	0.000	0.000	0.001	0.000	NA	NA	NA
	AVERAGE	2.447	0.000	0.001	0.000	NA	NA	NA
	HIGH	6.963	0.000	0.001	0.000	NA	NA	NA
Lafayette	LOW	0.030	0.074	0.007	NA	NA	NA	NA
	AVERAGE	0.030	0.074	0.007	NA	NA	NA	NA
	HIGH	0.030	0.074	0.007	NA	NA	NA	NA
Lake	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.293	0.842	0.121	0.000	0.000	0.021	0.000
	HIGH	6.375	5.051	2.776	0.000	0.000	0.205	0.000
Lee	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	2.380	1.014	2.832	0.740	1.008	3.098	1.222
	HIGH	11.338	12.528	26.421	11.882	5.413	15.704	11.221
Leon	LOW	0.000	0.010	0.000	0.000	NA	0.000	NA
	AVERAGE	0.543	0.701	0.039	0.000	NA	0.120	NA
	HIGH	1.632	4.813	0.316	0.000	NA	0.477	NA
Levy	LOW	0.029	0.000	0.049	NA	0.000	1.908	NA
	AVERAGE	3.861	3.131	0.249	NA	0.000	1.908	NA
	HIGH	8.357	9.426	1.594	NA	0.000	1.908	NA
Liberty	LOW	0.000	NA	0.000	NA	NA	NA	NA
	AVERAGE	0.000	NA	0.000	NA	NA	NA	NA
	HIGH	0.000	NA	0.000	NA	NA	NA	NA
Madison	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.092	0.000	0.058	NA	NA	NA	NA
	HIGH	0.389	0.000	0.111	NA	NA	NA	NA
Manatee	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.944	1.027	1.039	0.553	0.917	1.246	0.829
	HIGH	9.767	7.115	19.156	10.634	7.513	5.581	8.589

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
Marion	LOW	0.000	0.000	0.000	NA	0.000	0.000	0.000
	AVERAGE	0.469	0.293	0.296	NA	0.000	0.000	0.040
	HIGH	4.589	1.219	1.232	NA	0.000	0.000	0.111
Martin	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.005
	AVERAGE	0.195	0.076	0.041	0.013	0.031	0.062	0.042
	HIGH	0.687	0.242	0.077	0.035	0.092	0.537	0.104
Miami-Dade	LOW	0.000	0.000	0.005	0.000	0.000	0.000	0.000
	AVERAGE	0.416	0.386	0.855	1.033	0.996	0.267	0.437
	HIGH	3.901	5.704	3.079	1.110	3.184	6.015	2.222
Monroe	LOW	1.972	0.679	15.531	0.773	1.457	0.010	0.280
	AVERAGE	5.257	5.382	23.705	3.978	6.769	2.615	4.270
	HIGH	6.333	8.029	44.212	5.544	13.680	5.086	14.694
Nassau	LOW	0.001	0.000	0.003	0.000	0.014	0.015	0.003
	AVERAGE	0.076	0.026	0.017	0.011	0.014	0.015	0.003
	HIGH	0.081	0.029	0.071	0.011	0.014	0.015	0.003
Okaloosa	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.147	0.096	0.037	0.085	0.477	0.389	0.563
	HIGH	0.376	1.024	0.109	0.598	2.197	2.250	16.033
Okeechobee	LOW	0.000	0.001	0.022	NA	NA	0.000	0.000
	AVERAGE	0.030	0.008	0.226	NA	NA	0.000	0.000
	HIGH	0.131	0.018	0.349	NA	NA	0.000	0.000
Orange	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.190	0.086	0.086	0.000	0.000	0.000	0.010
	HIGH	1.828	0.993	0.331	0.000	0.000	0.003	0.111
Osceola	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.166	0.047	0.009	0.000	0.000	0.004	0.005
	HIGH	0.724	0.403	0.061	0.000	0.000	0.006	0.042
Palm Beach	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.059	0.017	0.131	0.006	0.005	0.036	0.025
	HIGH	0.560	0.188	0.314	0.156	0.119	0.485	0.780
Pasco	LOW	0.000	0.000	0.000	0.236	0.000	0.000	0.000
	AVERAGE	1.085	1.242	0.410	2.348	0.310	3.548	1.010
	HIGH	19.789	14.036	2.971	17.136	2.666	7.399	2.833
Pinellas	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.082	0.934	0.265	1.274	0.565	0.766	0.812
	HIGH	5.825	4.792	2.007	7.133	4.295	4.529	3.407
Polk	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.109	0.012	0.033	1.896	0.000	0.456	0.006
	HIGH	1.965	0.379	3.365	3.792	0.000	1.367	0.023
Putnam	LOW	0.000	0.000	0.000	NA	NA	12.904	0.000
	AVERAGE	3.709	1.573	0.126	NA	NA	12.904	3.635
	HIGH	8.273	3.587	0.503	NA	NA	12.904	7.270
St. Johns	LOW	0.000	0.000	0.005	0.000	0.000	0.000	0.000
	AVERAGE	0.092	0.052	0.100	0.136	0.053	0.073	0.139
	HIGH	0.510	0.181	0.471	0.517	0.315	0.268	0.393
St. Lucie	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.201	0.197	0.160	0.595	1.041	0.113	0.192
	HIGH	2.684	1.378	0.340	3.271	7.262	0.694	0.832
Santa Rosa	LOW	0.002	0.000	0.000	0.000	0.000	0.000	0.008

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit
	AVERAGE	0.058	0.026	0.169	0.001	0.003	0.156	0.066
	HIGH	0.325	0.141	0.308	0.010	0.009	0.460	0.359
Sarasota	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	1.210	0.506	0.655	0.792	1.062	1.536	1.039
	HIGH	9.482	4.028	1.532	6.810	3.084	4.200	2.886
Seminole	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.210	0.081	0.032	0.000	0.145	0.006	0.289
	HIGH	0.835	0.312	0.085	0.000	0.289	0.075	1.051
Sumter	LOW	0.000	0.002	0.000	NA	NA	NA	0.000
	AVERAGE	0.251	0.096	0.045	NA	NA	NA	0.000
	HIGH	0.765	0.260	0.126	NA	NA	NA	0.000
Suwannee	LOW	0.043	0.000	0.006	NA	NA	NA	NA
	AVERAGE	1.132	0.833	0.082	NA	NA	NA	NA
	HIGH	5.330	7.911	0.897	NA	NA	NA	NA
Taylor	LOW	0.000	0.030	0.010	0.036	0.000	11.605	NA
	AVERAGE	2.009	0.518	0.124	0.036	0.000	11.605	NA
	HIGH	4.154	1.101	0.436	0.036	0.000	11.605	NA
Union	LOW	0.072	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.072	0.000	0.000	NA	NA	NA	NA
	HIGH	0.072	0.000	0.000	NA	NA	NA	NA
Volusia	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.067	0.042	0.092	0.116	0.090	0.037	0.063
	HIGH	0.373	0.321	0.447	0.868	0.639	1.799	0.194
Wakulla	LOW	1.201	0.000	0.002	0.562	NA	8.962	5.871
	AVERAGE	1.901	4.671	0.537	3.097	NA	8.962	5.871
	HIGH	4.913	6.813	9.716	8.168	NA	8.962	5.871
Walton	LOW	0.002	0.000	0.004	0.000	0.000	0.000	0.000
	AVERAGE	0.068	0.021	0.017	0.005	0.001	0.009	0.002
	HIGH	0.222	0.040	0.133	0.031	0.001	0.031	0.019
Washington	LOW	0.000	0.000	0.000	NA	NA	NA	NA
	AVERAGE	0.176	0.131	0.031	NA	NA	NA	NA
	HIGH	0.287	0.169	0.038	NA	NA	NA	NA
Statewide	LOW	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	AVERAGE	0.631	0.487	0.222	0.641	0.486	0.832	0.685
	HIGH	68.043	29.069	44.212	19.730	13.680	20.713	16.033

D. If a modeling organization has flood loss costs for a rating area or geographic zone for which there is no exposure, give the flood loss costs zero weight (i.e., assume the exposure in that rating area or geographic zone is zero). Provide a list in the flood model submission document of those rating areas or geographic zones where this occurs.

There were no instances of loss costs in an area with no exposure.

E. If a modeling organization does not have flood loss costs for a rating area or geographic zone for which there is some exposure, do not assume such flood loss costs are zero, but use only the exposures for which there are flood loss costs in calculating the weighted average flood loss costs. Provide a list in the flood model submission document of the rating areas or geographic zones where this occurs.

No zip codes with exposure were excluded.

F. NA should be used in cells to signify no exposure.

NA was used in cells to signify no exposure.

G. Describe how Law and Ordinance is included in the flood output ranges.

A provision for Law and Ordinance coverage is embedded in the vulnerability matrices.

H. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

Time element coverage was included at 20% of the Coverage A limit for Owners and Manufactured Homes and at 40% of the Coverage B limit for Renters and Condo.

Form AF-5: Percentage Change in Flood Output Ranges

A. One or more automated programs or scripts should be used to generate and arrange the data in Form AF-5, Percentage Change in Flood Output Ranges.

Not applicable.

B. Provide summaries of the percentage change in average flood loss cost output range data compiled in Form AF-4, Flood Output Ranges, relative to the equivalent data compiled from the currently accepted flood model in the format shown in the file named "2021FormAF5.xlsx." For the change in flood output range exhibit, provide the summary by regions as defined in Figure 1 (Panhandle, North Florida, Southwest Florida, East Florida, and Southeast Florida) and Statewide (overall percentage change). The East Florida Region boundary in Orange and Polk Counties is based on the South Florida Water Management District boundary.

Not applicable.

C. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include all tables in Form AF-5, Percentage Change in Flood Output Ranges, in a submission appendix.

Not applicable.

D. Provide color-coded maps by county reflecting the percentage changes in the average flood loss costs with specified deductibles for frame owners, masonry owners, frame renters, masonry renters, frame condo unit owners, masonry condo unit owners, and manufactured homes from the flood output ranges from the currently accepted flood model. Counties with a negative percentage change (reduction in flood loss costs) should be indicated with shades of blue, counties with a positive percentage change (increase in flood loss costs) should be indicated with shades of red, and counties with no percentage change should be white. The larger the percentage change in the county, the more intense the color-shade.

Not applicable.

Form AF-6: Logical Relationships to Flood Risk (Trade Secret Item)

A. One or more automated programs or scripts should be used to generate the exhibits in Form AF-6, Logical Relationships to Flood Risk (Trade Secret Item).

Automated scripts were used to generate Form AF-6.

B. Provide the logical relationship to flood risk exhibits in the format shown in the file named "2021FormAF5.xlsx."

Provided.

C. Create exposure sets for each exhibit by modeling all of the flood coverages from the appropriate Notional Set listed below at each of the locations in "Location Grid A" as described in the file "NotionalInput21_Flood.xlsx." Refer to the Notional Standard Flood Policy Specifications below for additional modeling information.

Exhibit	***Notional Set***
Deductible Sensitivity	***Set 1***
Policy Form Sensitivity	***Set 2***
Construction Sensitivity	***Set 3***
Coverage Sensitivity	***Set 4***
Year Built Sensitivity	***Set 5***
Foundation Type Sensitivity	***Set 6***
Number of Stories Sensitivity	***Set 7***
Lowest Floor Elevation of Residential Structure Sensitivity	***Set 8***

The exposure sets for each exhibit were created by modeling all of the flood coverages from the appropriate Notional Set listed above at each of the locations in "Location Grid A" as described in the file *"NotionalInput21_Flood.xlsx."*

D. Flood models are to treat points in Location Grid A as coordinates that would result from a geocoding process. Flood models should treat points by simulating flood loss at exact location or by using the nearest modeled parcel/street/cell in the flood model. Report results for each of the points in Location Grid A individually, unless specified. Flood loss cost per $1,000 of exposure should be rounded to three decimal places. Note: All flood deductibles are $0 except for the Deductible Sensitivity. The Coverage Sensitivity includes time element.

Deductible Sensitivity for frame owners building

Construction / Policy	Location	County	Flood Loss Cost at Different Deductibles, Standard						Ratios Relative to $0 Deductible					
			$0	$1,000	$1,500	2%	5%	10%	$0	$1,000	$1,500	2%	5%	10%
Frame Owners Building	1	ALACHUA	0.000	0.000	0.000	0.000	0.000	0.000						
	2	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	3	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	4	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	5	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	6	CALHOUN	0.000	0.000	0.000	0.000	0.000	0.000						
	7	CHARLOTTE	3.646	3.613	3.597	3.581	3.487	3.338	1.000	0.991	0.987	0.982	0.956	0.916
	8	CITRUS	10.744	10.606	10.537	10.468	10.062	9.425	1.000	0.987	0.981	0.974	0.937	0.877
	9	COLLIER	10.940	10.839	10.790	10.741	10.458	10.009	1.000	0.991	0.986	0.982	0.956	0.915
	10	COLLIER	169.378	167.553	166.640	165.728	160.426	152.492	1.000	0.989	0.984	0.978	0.947	0.900
	11	DIXIE	0.111	0.106	0.103	0.100	0.085	0.081	1.000	0.955	0.928	0.901	0.766	0.730
	12	DUVAL	0.000	0.000	0.000	0.000	0.000	0.000						
	13	ESCAMBIA	0.794	0.786	0.782	0.778	0.752	0.711	1.000	0.990	0.985	0.980	0.947	0.895
	14	FRANKLIN	4.107	4.085	4.074	4.062	3.995	3.883	1.000	0.995	0.992	0.989	0.973	0.945
	15	HERNANDO	20.598	20.389	20.287	20.187	19.604	18.696	1.000	0.990	0.985	0.980	0.952	0.908
	16	HIGHLANDS	244.813	241.597	239.989	238.380	228.732	213.487	1.000	0.987	0.980	0.974	0.934	0.872
	17	HILLSBOROUGH	14.359	14.208	14.132	14.057	13.608	12.871	1.000	0.989	0.984	0.979	0.948	0.896
	18	HOLMES	0.000	0.000	0.000	0.000	0.000	0.000						
	19	INDIAN RIVER	0.000	0.000	0.000	0.000	0.000	0.000						
	20	JACKSON	0.000	0.000	0.000	0.000	0.000	0.000						
	21	LEE	9.299	9.205	9.157	9.110	8.828	8.374	1.000	0.990	0.985	0.980	0.949	0.901
	22	LEON	10.170	10.032	9.963	9.894	9.498	8.883	1.000	0.986	0.980	0.973	0.934	0.873
	23	LEVY	5.864	5.784	5.743	5.703	5.470	5.121	1.000	0.986	0.979	0.973	0.933	0.873
	24	MANATEE	24.587	24.266	24.113	23.962	23.120	21.879	1.000	0.987	0.981	0.975	0.940	0.890
	25	MIAMI-DADE	0.054	0.053	0.053	0.053	0.051	0.049	1.000	0.981	0.981	0.981	0.944	0.907
	26	MIAMI-DADE	0.000	0.000	0.000	0.000	0.000	0.000						
	27	MONROE	56.526	55.809	55.451	55.092	52.994	49.770	1.000	0.987	0.981	0.975	0.938	0.880
	28	MONROE	236.379	231.509	229.074	226.640	212.937	196.682	1.000	0.979	0.969	0.959	0.901	0.832
	29	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	30	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	31	OKEECHOBEE	0.000	0.000	0.000	0.000	0.000	0.000						
	32	ORANGE	0.000	0.000	0.000	0.000	0.000	0.000						
	33	PALM BEACH	0.000	0.000	0.000	0.000	0.000	0.000						
	34	PASCO	0.000	0.000	0.000	0.000	0.000	0.000						
	35	PINELLAS	14.785	14.598	14.509	14.420	13.921	13.179	1.000	0.987	0.981	0.975	0.942	0.891
	36	PINELLAS	0.000	0.000	0.000	0.000	0.000	0.000						
	37	POLK	0.000	0.000	0.000	0.000	0.000	0.000						
	38	PUTNAM	3.121	3.031	2.985	2.940	2.669	2.321	1.000	0.971	0.956	0.942	0.855	0.744
	39	ST. JOHNS	0.011	0.011	0.011	0.011	0.010	0.009	1.000	1.000	1.000	1.000	0.909	0.818
	40	ST. LUCIE	0.399	0.388	0.382	0.376	0.346	0.312	1.000	0.972	0.957	0.942	0.867	0.782
	41	SARASOTA	0.000	0.000	0.000	0.000	0.000	0.000						
	42	SEMINOLE	2.133	2.066	2.033	2.000	1.823	1.619	1.000	0.969	0.953	0.938	0.855	0.759
	43	TAYLOR	0.000	0.000	0.000	0.000	0.000	0.000						
	44	VOLUSIA	1.022	0.988	0.971	0.955	0.863	0.759	1.000	0.967	0.950	0.934	0.844	0.743

Deductible Sensitivity for masonry owners building

Construction / Policy	Location	County	Flood Loss Cost at Different Deductibles, Standard						Ratios Relative to $0 Deductible					
			$0	**$1,000**	**$1,500**	**2%**	**5%**	**10%**	**$0**	**$1,000**	**$1,500**	**2%**	**5%**	**10%**
Masonry Owners Building	1	ALACHUA	0.000	0.000	0.000	0.000	0.000	0.000						
	2	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	3	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	4	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	5	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	6	CALHOUN	0.000	0.000	0.000	0.000	0.000	0.000						
	7	CHARLOTTE	3.315	3.283	3.266	3.250	3.155	3.006	1.000	0.990	0.985	0.980	0.952	0.907
	8	CITRUS	7.390	7.253	7.186	7.120	6.746	6.224	1.000	0.981	0.972	0.963	0.913	0.842
	9	COLLIER	10.009	9.908	9.858	9.809	9.523	9.071	1.000	0.990	0.985	0.980	0.951	0.906
	10	COLLIER	135.699	133.892	133.025	132.185	127.588	121.226	1.000	0.987	0.980	0.974	0.940	0.893
	11	DIXIE	0.041	0.036	0.034	0.032	0.031	0.030	1.000	0.878	0.829	0.780	0.756	0.732
	12	DUVAL	0.000	0.000	0.000	0.000	0.000	0.000						
	13	ESCAMBIA	0.616	0.607	0.603	0.599	0.574	0.533	1.000	0.985	0.979	0.972	0.932	0.865
	14	FRANKLIN	3.907	3.885	3.874	3.862	3.795	3.683	1.000	0.994	0.992	0.988	0.971	0.943
	15	HERNANDO	18.892	18.681	18.579	18.478	17.892	16.977	1.000	0.989	0.983	0.978	0.947	0.899
	16	HIGHLANDS	164.213	160.997	159.389	157.781	148.844	136.159	1.000	0.980	0.971	0.961	0.906	0.829
	17	HILLSBOROUGH	10.241	10.091	10.016	9.942	9.501	8.769	1.000	0.985	0.978	0.971	0.928	0.856
	18	HOLMES	0.000	0.000	0.000	0.000	0.000	0.000						
	19	INDIAN RIVER	0.000	0.000	0.000	0.000	0.000	0.000						
	20	JACKSON	0.000	0.000	0.000	0.000	0.000	0.000						
	21	LEE	7.157	7.063	7.016	6.970	6.701	6.293	1.000	0.987	0.980	0.974	0.936	0.879
	22	LEON	6.761	6.626	6.560	6.496	6.137	5.603	1.000	0.980	0.970	0.961	0.908	0.829
	23	LEVY	4.002	3.922	3.884	3.847	3.645	3.373	1.000	0.980	0.971	0.961	0.911	0.843
	24	MANATEE	22.783	22.461	22.305	22.154	21.305	20.051	1.000	0.986	0.979	0.972	0.935	0.880
	25	MIAMI-DADE	0.041	0.040	0.040	0.040	0.039	0.037	1.000	0.976	0.976	0.976	0.951	0.902
	26	MIAMI-DADE	0.000	0.000	0.000	0.000	0.000	0.000						
	27	MONROE	38.902	38.192	37.847	37.509	35.641	32.997	1.000	0.982	0.973	0.964	0.916	0.848
	28	MONROE	164.434	159.668	157.467	155.443	147.076	140.296	1.000	0.971	0.958	0.945	0.894	0.853
	29	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	30	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	31	OKEECHOBEE	0.000	0.000	0.000	0.000	0.000	0.000						
	32	ORANGE	0.000	0.000	0.000	0.000	0.000	0.000						
	33	PALM BEACH	0.000	0.000	0.000	0.000	0.000	0.000						
	34	PASCO	0.000	0.000	0.000	0.000	0.000	0.000						
	35	PINELLAS	13.690	13.502	13.411	13.322	12.816	12.062	1.000	0.986	0.980	0.973	0.936	0.881
	36	PINELLAS	0.000	0.000	0.000	0.000	0.000	0.000						
	37	POLK	0.000	0.000	0.000	0.000	0.000	0.000						
	38	PUTNAM	1.439	1.348	1.303	1.258	1.093	1.019	1.000	0.937	0.905	0.874	0.760	0.708
	39	ST. JOHNS	0.006	0.006	0.006	0.006	0.005	0.005	1.000	1.000	1.000	1.000	0.833	0.833
	40	ST. LUCIE	0.210	0.199	0.195	0.190	0.172	0.159	1.000	0.948	0.929	0.905	0.819	0.757
	41	SARASOTA	0.000	0.000	0.000	0.000	0.000	0.000						
	42	SEMINOLE	0.995	0.933	0.904	0.879	0.771	0.700	1.000	0.938	0.909	0.883	0.775	0.704
	43	TAYLOR	0.000	0.000	0.000	0.000	0.000	0.000						
	44	VOLUSIA	0.459	0.427	0.412	0.398	0.346	0.324	1.000	0.930	0.898	0.867	0.754	0.706

Deductible Sensitivity for manufactured homes

Construction / Policy	Location	County	Flood Loss Cost at Different Deductibles, Standard						Ratios Relative to $0 Deductible					
			$0	$1,000	$1,500	2%	5%	10%	$0	$1,000	$1,500	2%	5%	10%
Manufactured Homes	1	ALACHUA	0.000	0.000	0.000	0.000	0.000	0.000						
	2	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	3	BREVARD	7.655	6.994	6.664	6.994	6.003	5.497	1.000	0.914	0.871	0.914	0.784	0.718
	4	BROWARD	0.177	0.164	0.157	0.164	0.143	0.127	1.000	0.927	0.887	0.927	0.808	0.718
	5	BROWARD	0.025	0.022	0.021	0.022	0.019	0.018	1.000	0.880	0.840	0.880	0.760	0.720
	6	CALHOUN	0.000	0.000	0.000	0.000	0.000	0.000						
	7	CHARLOTTE	5.955	5.878	5.839	5.878	5.762	5.574	1.000	0.987	0.981	0.987	0.968	0.936
	8	CITRUS	21.936	21.565	21.379	21.565	21.008	20.095	1.000	0.983	0.975	0.983	0.958	0.916
	9	COLLIER	19.136	18.853	18.712	18.853	18.429	17.746	1.000	0.985	0.978	0.985	0.963	0.927
	10	COLLIER	392.625	382.382	377.260	382.382	367.017	343.763	1.000	0.974	0.961	0.974	0.935	0.876
	11	DIXIE	1.536	1.463	1.427	1.463	1.354	1.211	1.000	0.952	0.929	0.952	0.882	0.788
	12	DUVAL	0.000	0.000	0.000	0.000	0.000	0.000						
	13	ESCAMBIA	1.441	1.422	1.413	1.422	1.393	1.347	1.000	0.987	0.981	0.987	0.967	0.935
	14	FRANKLIN	4.238	4.193	4.171	4.193	4.126	4.014	1.000	0.989	0.984	0.989	0.974	0.947
	15	HERNANDO	39.014	38.410	38.108	38.410	37.505	36.073	1.000	0.985	0.977	0.985	0.961	0.925
	16	HIGHLANDS	505.740	497.553	493.459	497.553	485.271	465.356	1.000	0.984	0.976	0.984	0.960	0.920
	17	HILLSBOROUGH	48.172	46.178	45.181	46.178	43.187	40.214	1.000	0.959	0.938	0.959	0.897	0.835
	18	HOLMES	0.000	0.000	0.000	0.000	0.000	0.000						
	19	INDIAN RIVER	0.000	0.000	0.000	0.000	0.000	0.000						
	20	JACKSON	0.000	0.000	0.000	0.000	0.000	0.000						
	21	LEE	16.560	16.277	16.135	16.277	15.851	15.227	1.000	0.983	0.974	0.983	0.957	0.920
	22	LEON	29.761	28.862	28.412	28.862	27.513	25.833	1.000	0.970	0.955	0.970	0.924	0.868
	23	LEVY	13.084	12.825	12.696	12.825	12.437	11.829	1.000	0.980	0.970	0.980	0.951	0.904
	24	MANATEE	62.680	61.329	60.653	61.329	59.302	56.324	1.000	0.978	0.968	0.978	0.946	0.899
	25	MIAMI-DADE	0.092	0.091	0.090	0.091	0.089	0.085	1.000	0.989	0.978	0.989	0.967	0.924
	26	MIAMI-DADE	0.025	0.024	0.023	0.024	0.022	0.019	1.000	0.960	0.920	0.960	0.880	0.760
	27	MONROE	136.968	133.574	131.878	133.574	128.485	121.659	1.000	0.975	0.963	0.975	0.938	0.888
	28	MONROE	653.166	637.686	629.946	637.686	614.466	577.074	1.000	0.976	0.964	0.976	0.941	0.884
	29	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	30	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	31	OKEECHOBEE	15.027	13.657	12.972	13.657	11.603	10.690	1.000	0.909	0.863	0.909	0.772	0.711
	32	ORANGE	0.000	0.000	0.000	0.000	0.000	0.000						
	33	PALM BEACH	0.000	0.000	0.000	0.000	0.000	0.000						
	34	PASCO	0.000	0.000	0.000	0.000	0.000	0.000						
	35	PINELLAS	35.725	35.040	34.697	35.040	34.012	32.404	1.000	0.981	0.971	0.981	0.952	0.907
	36	PINELLAS	0.007	0.006	0.006	0.006	0.005	0.005	1.000	0.857	0.857	0.857	0.714	0.714
	37	POLK	6.143	5.582	5.302	5.582	4.741	4.320	1.000	0.909	0.863	0.909	0.772	0.703
	38	PUTNAM	38.237	36.576	35.746	36.576	34.086	30.417	1.000	0.957	0.935	0.957	0.891	0.795
	39	ST. JOHNS	0.029	0.029	0.029	0.029	0.028	0.027	1.000	1.000	1.000	1.000	0.966	0.931
	40	ST. LUCIE	8.570	8.030	7.759	8.030	7.219	6.414	1.000	0.937	0.905	0.937	0.842	0.748
	41	SARASOTA	0.000	0.000	0.000	0.000	0.000	0.000						
	42	SEMINOLE	19.228	18.200	17.686	18.200	16.659	15.088	1.000	0.947	0.920	0.947	0.866	0.785
	43	TAYLOR	0.000	0.000	0.000	0.000	0.000	0.000						
	44	VOLUSIA	8.630	8.229	8.028	8.229	7.627	6.887	1.000	0.954	0.930	0.954	0.884	0.798

Deductible Sensitivity for frame renters

Construction / Policy	Location	County	Flood Loss Cost at Different Deductibles, Standard						Ratios Relative to $0 Deductible					
			$0	$1,000	$1,500	2%	5%	10%	$0	$1,000	$1,500	2%	5%	10%
Frame Renters	1	ALACHUA	0.000	0.000	0.000	0.000	0.000	0.000						
	2	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	3	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	4	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	5	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	6	CALHOUN	0.000	0.000	0.000	0.000	0.000	0.000						
	7	CHARLOTTE	2.006	1.940	1.908	1.940	1.844	1.685	1.000	0.967	0.951	0.967	0.919	0.840
	8	CITRUS	6.623	6.348	6.210	6.348	5.934	5.254	1.000	0.958	0.938	0.958	0.896	0.793
	9	COLLIER	5.991	5.789	5.689	5.789	5.493	5.017	1.000	0.966	0.950	0.966	0.917	0.837
	10	COLLIER	94.619	90.968	89.143	90.968	85.494	76.547	1.000	0.961	0.942	0.961	0.904	0.809
	11	DIXIE	0.078	0.066	0.061	0.066	0.049	0.023	1.000	0.846	0.782	0.846	0.628	0.295
	12	DUVAL	0.000	0.000	0.000	0.000	0.000	0.000						
	13	ESCAMBIA	0.485	0.469	0.460	0.469	0.443	0.401	1.000	0.967	0.948	0.967	0.913	0.827
	14	FRANKLIN	1.957	1.912	1.889	1.912	1.845	1.733	1.000	0.977	0.965	0.977	0.943	0.886
	15	HERNANDO	11.576	11.156	10.951	11.156	10.548	9.569	1.000	0.964	0.946	0.964	0.911	0.827
	16	HIGHLANDS	154.737	148.305	145.088	148.305	138.656	122.575	1.000	0.958	0.938	0.958	0.896	0.792
	17	HILLSBOROUGH	8.803	8.500	8.349	8.500	8.046	7.297	1.000	0.966	0.948	0.966	0.914	0.829
	18	HOLMES	0.000	0.000	0.000	0.000	0.000	0.000						
	19	INDIAN RIVER	0.000	0.000	0.000	0.000	0.000	0.000						
	20	JACKSON	0.000	0.000	0.000	0.000	0.000	0.000						
	21	LEE	5.331	5.142	5.048	5.142	4.859	4.388	1.000	0.965	0.947	0.965	0.911	0.823
	22	LEON	6.520	6.244	6.106	6.244	5.830	5.166	1.000	0.958	0.937	0.958	0.894	0.792
	23	LEVY	3.632	3.471	3.391	3.471	3.230	2.837	1.000	0.956	0.934	0.956	0.889	0.781
	24	MANATEE	14.249	13.606	13.293	13.606	12.687	11.262	1.000	0.955	0.933	0.955	0.890	0.790
	25	MIAMI-DADE	0.030	0.029	0.029	0.029	0.028	0.025	1.000	0.967	0.967	0.967	0.933	0.833
	26	MIAMI-DADE	0.000	0.000	0.000	0.000	0.000	0.000						
	27	MONROE	34.541	33.107	32.390	33.107	30.956	27.436	1.000	0.958	0.938	0.958	0.896	0.794
	28	MONROE	143.710	133.968	129.099	133.968	119.363	96.022	1.000	0.932	0.898	0.932	0.831	0.668
	29	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	30	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	31	OKEECHOBEE	0.000	0.000	0.000	0.000	0.000	0.000						
	32	ORANGE	0.000	0.000	0.000	0.000	0.000	0.000						
	33	PALM BEACH	0.000	0.000	0.000	0.000	0.000	0.000						
	34	PASCO	0.000	0.000	0.000	0.000	0.000	0.000						
	35	PINELLAS	8.604	8.230	8.047	8.230	7.692	6.849	1.000	0.957	0.935	0.957	0.894	0.796
	36	PINELLAS	0.000	0.000	0.000	0.000	0.000	0.000						
	37	POLK	0.000	0.000	0.000	0.000	0.000	0.000						
	38	PUTNAM	2.155	1.974	1.883	1.974	1.702	1.250	1.000	0.916	0.874	0.916	0.790	0.580
	39	ST. JOHNS	0.007	0.007	0.007	0.007	0.006	0.005	1.000	1.000	1.000	1.000	0.857	0.714
	40	ST. LUCIE	0.266	0.243	0.231	0.243	0.208	0.157	1.000	0.914	0.868	0.914	0.782	0.590
	41	SARASOTA	0.000	0.000	0.000	0.000	0.000	0.000						
	42	SEMINOLE	1.468	1.335	1.268	1.335	1.134	0.836	1.000	0.909	0.864	0.909	0.772	0.569
	43	TAYLOR	0.000	0.000	0.000	0.000	0.000	0.000						
	44	VOLUSIA	0.706	0.639	0.606	0.639	0.539	0.385	1.000	0.905	0.858	0.905	0.763	0.545

Deductible Sensitivity for masonry renters

Construction / Policy	Location	County	Flood Loss Cost at Different Deductibles, Standard						Ratios Relative to $0 Deductible					
			$0	$1,000	$1,500	2%	5%	10%	$0	$1,000	$1,500	2%	5%	10%
Masonry Renters	1	ALACHUA	0.000	0.000	0.000	0.000	0.000	0.000						
	2	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	3	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	4	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	5	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	6	CALHOUN	0.000	0.000	0.000	0.000	0.000	0.000						
	7	CHARLOTTE	1.896	1.830	1.798	1.830	1.733	1.574	1.000	0.965	0.948	0.965	0.914	0.830
	8	CITRUS	4.744	4.470	4.335	4.470	4.070	3.437	1.000	0.942	0.914	0.942	0.858	0.724
	9	COLLIER	5.709	5.505	5.406	5.505	5.209	4.728	1.000	0.964	0.947	0.964	0.912	0.828
	10	COLLIER	76.210	72.583	70.811	72.583	67.422	59.580	1.000	0.952	0.929	0.952	0.885	0.782
	11	DIXIE	0.029	0.018	0.013	0.018	0.006	0.004	1.000	0.621	0.448	0.621	0.207	0.138
	12	DUVAL	0.000	0.000	0.000	0.000	0.000	0.000						
	13	ESCAMBIA	0.388	0.371	0.363	0.371	0.346	0.305	1.000	0.956	0.936	0.956	0.892	0.786
	14	FRANKLIN	1.906	1.861	1.839	1.861	1.794	1.682	1.000	0.976	0.965	0.976	0.941	0.882
	15	HERNANDO	11.015	10.592	10.386	10.592	9.982	8.999	1.000	0.962	0.943	0.962	0.906	0.817
	16	HIGHLANDS	108.422	101.990	98.774	101.990	92.341	77.285	1.000	0.941	0.911	0.941	0.852	0.713
	17	HILLSBOROUGH	6.618	6.316	6.167	6.316	5.869	5.134	1.000	0.954	0.932	0.954	0.887	0.776
	18	HOLMES	0.000	0.000	0.000	0.000	0.000	0.000						
	19	INDIAN RIVER	0.000	0.000	0.000	0.000	0.000	0.000						
	20	JACKSON	0.000	0.000	0.000	0.000	0.000	0.000						
	21	LEE	4.182	3.993	3.899	3.993	3.713	3.262	1.000	0.955	0.932	0.955	0.888	0.780
	22	LEON	4.537	4.265	4.134	4.265	3.876	3.266	1.000	0.940	0.911	0.940	0.854	0.720
	23	LEVY	2.583	2.424	2.346	2.424	2.197	1.853	1.000	0.938	0.908	0.938	0.851	0.717
	24	MANATEE	13.658	13.008	12.693	13.008	12.083	10.648	1.000	0.952	0.929	0.952	0.885	0.780
	25	MIAMI-DADE	0.025	0.024	0.023	0.024	0.022	0.020	1.000	0.960	0.920	0.960	0.880	0.800
	26	MIAMI-DADE	0.000	0.000	0.000	0.000	0.000	0.000						
	27	MONROE	24.889	23.464	22.766	23.464	21.409	18.248	1.000	0.943	0.915	0.943	0.860	0.733
	28	MONROE	99.311	89.707	85.132	89.707	76.861	61.517	1.000	0.903	0.857	0.903	0.774	0.619
	29	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	30	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	31	OKEECHOBEE	0.000	0.000	0.000	0.000	0.000	0.000						
	32	ORANGE	0.000	0.000	0.000	0.000	0.000	0.000						
	33	PALM BEACH	0.000	0.000	0.000	0.000	0.000	0.000						
	34	PASCO	0.000	0.000	0.000	0.000	0.000	0.000						
	35	PINELLAS	8.245	7.867	7.683	7.867	7.325	6.471	1.000	0.954	0.932	0.954	0.888	0.785
	36	PINELLAS	0.000	0.000	0.000	0.000	0.000	0.000						
	37	POLK	0.000	0.000	0.000	0.000	0.000	0.000						
	38	PUTNAM	1.014	0.833	0.743	0.833	0.562	0.236	1.000	0.821	0.733	0.821	0.554	0.233
	39	ST. JOHNS	0.004	0.004	0.003	0.004	0.003	0.003	1.000	1.000	0.750	1.000	0.750	0.750
	40	ST. LUCIE	0.142	0.120	0.110	0.120	0.092	0.059	1.000	0.845	0.775	0.845	0.648	0.415
	41	SARASOTA	0.000	0.000	0.000	0.000	0.000	0.000						
	42	SEMINOLE	0.700	0.572	0.515	0.572	0.408	0.215	1.000	0.817	0.736	0.817	0.583	0.307
	43	TAYLOR	0.000	0.000	0.000	0.000	0.000	0.000						
	44	VOLUSIA	0.324	0.259	0.229	0.259	0.172	0.075	1.000	0.799	0.707	0.799	0.531	0.231

Deductible Sensitivity for frame condo unit

Construction / Policy	Location	County	Flood Loss Cost at Different Deductibles, Standard						Ratios Relative to $0 Deductible					
			$0	$1,000	$1,500	2%	5%	10%	$0	$1,000	$1,500	2%	5%	10%
Frame Condo Unit	1	ALACHUA	0.000	0.000	0.000	0.000	0.000	0.000						
	2	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	3	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	4	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	5	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	6	CALHOUN	0.000	0.000	0.000	0.000	0.000	0.000						
	7	CHARLOTTE	2.170	2.105	2.072	2.105	2.008	1.849	1.000	0.970	0.955	0.970	0.925	0.852
	8	CITRUS	7.035	6.760	6.622	6.760	6.346	5.666	1.000	0.961	0.941	0.961	0.902	0.805
	9	COLLIER	6.486	6.284	6.184	6.284	5.988	5.512	1.000	0.969	0.953	0.969	0.923	0.850
	10	COLLIER	102.095	98.444	96.619	98.444	92.970	84.023	1.000	0.964	0.946	0.964	0.911	0.823
	11	DIXIE	0.081	0.070	0.064	0.070	0.053	0.027	1.000	0.864	0.790	0.864	0.654	0.333
	12	DUVAL	0.000	0.000	0.000	0.000	0.000	0.000						
	13	ESCAMBIA	0.516	0.499	0.491	0.499	0.474	0.432	1.000	0.967	0.952	0.967	0.919	0.837
	14	FRANKLIN	2.172	2.127	2.105	2.127	2.060	1.948	1.000	0.979	0.969	0.979	0.948	0.897
	15	HERNANDO	12.478	12.059	11.853	12.059	11.451	10.471	1.000	0.966	0.950	0.966	0.918	0.839
	16	HIGHLANDS	163.745	157.312	154.096	157.312	147.663	131.582	1.000	0.961	0.941	0.961	0.902	0.804
	17	HILLSBOROUGH	9.358	9.056	8.904	9.056	8.602	7.853	1.000	0.968	0.951	0.968	0.919	0.839
	18	HOLMES	0.000	0.000	0.000	0.000	0.000	0.000						
	19	INDIAN RIVER	0.000	0.000	0.000	0.000	0.000	0.000						
	20	JACKSON	0.000	0.000	0.000	0.000	0.000	0.000						
	21	LEE	5.728	5.539	5.445	5.539	5.255	4.785	1.000	0.967	0.951	0.967	0.917	0.835
	22	LEON	6.885	6.609	6.471	6.609	6.195	5.531	1.000	0.960	0.940	0.960	0.900	0.803
	23	LEVY	3.855	3.694	3.614	3.694	3.453	3.060	1.000	0.958	0.937	0.958	0.896	0.794
	24	MANATEE	15.283	14.639	14.326	14.639	13.720	12.296	1.000	0.958	0.937	0.958	0.898	0.805
	25	MIAMI-DADE	0.033	0.032	0.031	0.032	0.030	0.027	1.000	0.970	0.939	0.970	0.909	0.818
	26	MIAMI-DADE	0.000	0.000	0.000	0.000	0.000	0.000						
	27	MONROE	36.740	35.306	34.589	35.306	33.155	29.635	1.000	0.961	0.941	0.961	0.902	0.807
	28	MONROE	152.977	143.235	138.366	143.235	128.629	105.289	1.000	0.936	0.904	0.936	0.841	0.688
	29	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	30	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	31	OKEECHOBEE	0.000	0.000	0.000	0.000	0.000	0.000						
	32	ORANGE	0.000	0.000	0.000	0.000	0.000	0.000						
	33	PALM BEACH	0.000	0.000	0.000	0.000	0.000	0.000						
	34	PASCO	0.000	0.000	0.000	0.000	0.000	0.000						
	35	PINELLAS	9.222	8.848	8.665	8.848	8.310	7.467	1.000	0.959	0.940	0.959	0.901	0.810
	36	PINELLAS	0.000	0.000	0.000	0.000	0.000	0.000						
	37	POLK	0.000	0.000	0.000	0.000	0.000	0.000						
	38	PUTNAM	2.251	2.070	1.980	2.070	1.799	1.347	1.000	0.920	0.880	0.920	0.799	0.598
	39	ST. JOHNS	0.008	0.007	0.007	0.007	0.007	0.005	1.000	0.875	0.875	0.875	0.875	0.625
	40	ST. LUCIE	0.280	0.256	0.245	0.256	0.222	0.170	1.000	0.914	0.875	0.914	0.793	0.607
	41	SARASOTA	0.000	0.000	0.000	0.000	0.000	0.000						
	42	SEMINOLE	1.535	1.401	1.334	1.401	1.201	0.903	1.000	0.913	0.869	0.913	0.782	0.588
	43	TAYLOR	0.000	0.000	0.000	0.000	0.000	0.000						
	44	VOLUSIA	0.738	0.671	0.637	0.671	0.570	0.417	1.000	0.909	0.863	0.909	0.772	0.565

Deductible Sensitivity for masonry condo unit

Construction / Policy	Location	County	Flood Loss Cost at Different Deductibles, Standard						Ratios Relative to $0 Deductible					
			$0	$1,000	$1,500	2%	5%	10%	$0	$1,000	$1,500	2%	5%	10%
Masonry Condo Unit	1	ALACHUA	0.000	0.000	0.000	0.000	0.000	0.000						
	2	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	3	BREVARD	0.000	0.000	0.000	0.000	0.000	0.000						
	4	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	5	BROWARD	0.000	0.000	0.000	0.000	0.000	0.000						
	6	CALHOUN	0.000	0.000	0.000	0.000	0.000	0.000						
	7	CHARLOTTE	2.038	1.972	1.940	1.972	1.875	1.716	1.000	0.968	0.952	0.968	0.920	0.842
	8	CITRUS	5.009	4.734	4.599	4.734	4.335	3.701	1.000	0.945	0.918	0.945	0.865	0.739
	9	COLLIER	6.139	5.935	5.836	5.935	5.639	5.159	1.000	0.967	0.951	0.967	0.919	0.840
	10	COLLIER	82.159	78.532	76.760	78.532	73.370	65.529	1.000	0.956	0.934	0.956	0.893	0.798
	11	DIXIE	0.030	0.019	0.014	0.019	0.007	0.005	1.000	0.633	0.467	0.633	0.233	0.167
	12	DUVAL	0.000	0.000	0.000	0.000	0.000	0.000						
	13	ESCAMBIA	0.411	0.394	0.386	0.394	0.369	0.328	1.000	0.959	0.939	0.959	0.898	0.798
	14	FRANKLIN	2.106	2.061	2.039	2.061	1.994	1.882	1.000	0.979	0.968	0.979	0.947	0.894
	15	HERNANDO	11.803	11.380	11.174	11.380	10.769	9.787	1.000	0.964	0.947	0.964	0.912	0.829
	16	HIGHLANDS	114.002	107.569	104.353	107.569	97.920	82.864	1.000	0.944	0.915	0.944	0.859	0.727
	17	HILLSBOROUGH	6.980	6.679	6.529	6.679	6.232	5.497	1.000	0.957	0.935	0.957	0.893	0.788
	18	HOLMES	0.000	0.000	0.000	0.000	0.000	0.000						
	19	INDIAN RIVER	0.000	0.000	0.000	0.000	0.000	0.000						
	20	JACKSON	0.000	0.000	0.000	0.000	0.000	0.000						
	21	LEE	4.480	4.291	4.197	4.291	4.011	3.560	1.000	0.958	0.937	0.958	0.895	0.795
	22	LEON	4.760	4.488	4.357	4.488	4.098	3.488	1.000	0.943	0.915	0.943	0.861	0.733
	23	LEVY	2.725	2.566	2.488	2.566	2.339	1.994	1.000	0.942	0.913	0.942	0.858	0.732
	24	MANATEE	14.570	13.921	13.605	13.921	12.996	11.561	1.000	0.955	0.934	0.955	0.892	0.793
	25	MIAMI-DADE	0.026	0.025	0.025	0.025	0.024	0.022	1.000	0.962	0.962	0.962	0.923	0.846
	26	MIAMI-DADE	0.000	0.000	0.000	0.000	0.000	0.000						
	27	MONROE	26.290	24.865	24.167	24.865	22.811	19.650	1.000	0.946	0.919	0.946	0.868	0.747
	28	MONROE	105.824	96.219	91.644	96.219	83.374	68.029	1.000	0.909	0.866	0.909	0.788	0.643
	29	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	30	OKALOOSA	0.000	0.000	0.000	0.000	0.000	0.000						
	31	OKEECHOBEE	0.000	0.000	0.000	0.000	0.000	0.000						
	32	ORANGE	0.000	0.000	0.000	0.000	0.000	0.000						
	33	PALM BEACH	0.000	0.000	0.000	0.000	0.000	0.000						
	34	PASCO	0.000	0.000	0.000	0.000	0.000	0.000						
	35	PINELLAS	8.789	8.412	8.227	8.412	7.869	7.016	1.000	0.957	0.936	0.957	0.895	0.798
	36	PINELLAS	0.000	0.000	0.000	0.000	0.000	0.000						
	37	POLK	0.000	0.000	0.000	0.000	0.000	0.000						
	38	PUTNAM	1.057	0.876	0.785	0.876	0.605	0.278	1.000	0.829	0.743	0.829	0.572	0.263
	39	ST. JOHNS	0.004	0.004	0.004	0.004	0.003	0.003	1.000	1.000	1.000	1.000	0.750	0.750
	40	ST. LUCIE	0.149	0.127	0.117	0.127	0.099	0.066	1.000	0.852	0.785	0.852	0.664	0.443
	41	SARASOTA	0.000	0.000	0.000	0.000	0.000	0.000						
	42	SEMINOLE	0.729	0.601	0.544	0.601	0.437	0.245	1.000	0.824	0.746	0.824	0.599	0.336
	43	TAYLOR	0.000	0.000	0.000	0.000	0.000	0.000						
	44	VOLUSIA	0.337	0.272	0.243	0.272	0.186	0.088	1.000	0.807	0.721	0.807	0.552	0.261

Policy Form Sensitivity for owners

Policy	Location	County	Flood Loss Cost per Construction Type			Frame / Masonry	Manufactured Homes / Frame	Manufactured Homes / Masonry
			Masonry	Frame	Manufactured Homes			
Owners	1	ALACHUA	0.000	0.000	0.000			
	2	BREVARD	0.000	0.000	0.000			
	3	BREVARD	0.000	0.000	7.655			
	4	BROWARD	0.000	0.000	0.177			
	5	BROWARD	0.000	0.000	0.025			
	6	CALHOUN	0.000	0.000	0.000			
	7	CHARLOTTE	3.315	3.646	5.955	1.100	1.633	1.796
	8	CITRUS	7.390	10.744	21.936	1.454	2.042	2.968
	9	COLLIER	10.009	10.940	19.136	1.093	1.749	1.912
	10	COLLIER	135.699	169.378	392.625	1.248	2.318	2.893
	11	DIXIE	0.041	0.111	1.536	2.707	13.838	37.463
	12	DUVAL	0.000	0.000	0.000			
	13	ESCAMBIA	0.616	0.794	1.441	1.289	1.815	2.339
	14	FRANKLIN	3.907	4.107	4.238	1.051	1.032	1.085
	15	HERNANDO	18.892	20.598	39.014	1.090	1.894	2.065
	16	HIGHLANDS	164.213	244.813	505.740	1.491	2.066	3.080
	17	HILLSBOROUGH	10.241	14.359	48.172	1.402	3.355	4.704
	18	HOLMES	0.000	0.000	0.000			
	19	INDIAN RIVER	0.000	0.000	0.000			
	20	JACKSON	0.000	0.000	0.000			
	21	LEE	7.157	9.299	16.560	1.299	1.781	2.314
	22	LEON	6.761	10.170	29.761	1.504	2.926	4.402
	23	LEVY	4.002	5.864	13.084	1.465	2.231	3.269
	24	MANATEE	22.783	24.587	62.680	1.079	2.549	2.751
	25	MIAMI-DADE	0.041	0.054	0.092	1.317	1.704	2.244
	26	MIAMI-DADE	0.000	0.000	0.025			
	27	MONROE	38.902	56.526	136.968	1.453	2.423	3.521
	28	MONROE	164.434	236.379	653.166	1.438	2.763	3.972
	29	OKALOOSA	0.000	0.000	0.000			
	30	OKALOOSA	0.000	0.000	0.000			
	31	OKEECHOBEE	0.000	0.000	15.027			
	32	ORANGE	0.000	0.000	0.000			
	33	PALM BEACH	0.000	0.000	0.000			
	34	PASCO	0.000	0.000	0.000			
	35	PINELLAS	13.690	14.785	35.725	1.080	2.416	2.610
	36	PINELLAS	0.000	0.000	0.007			
	37	POLK	0.000	0.000	6.143			
	38	PUTNAM	1.439	3.121	38.237	2.169	12.252	26.572
	39	ST. JOHNS	0.006	0.011	0.029	1.833	2.636	4.833
	40	ST. LUCIE	0.210	0.399	8.570	1.900	21.479	40.810
	41	SARASOTA	0.000	0.000	0.000			
	42	SEMINOLE	0.995	2.133	19.228	2.144	9.015	19.325
	43	TAYLOR	0.000	0.000	0.000			
	44	VOLUSIA	0.459	1.022	8.630	2.227	8.444	18.802

Policy Form Sensitivity for renters

Policy	Location	County	Flood Loss Cost per Construction Type			Frame / Masonry	Manufactured Homes / Frame	Manufactured Homes / Masonry
			Masonry	Frame	Manufactured Homes			
Renters	1	ALACHUA	0.000	0.000				
	2	BREVARD	0.000	0.000				
	3	BREVARD	0.000	0.000				
	4	BROWARD	0.000	0.000				
	5	BROWARD	0.000	0.000				
	6	CALHOUN	0.000	0.000				
	7	CHARLOTTE	1.896	2.006		1.058		
	8	CITRUS	4.744	6.623		1.396		
	9	COLLIER	5.709	5.991		1.049		
	10	COLLIER	76.210	94.619		1.242		
	11	DIXIE	0.029	0.078		2.690		
	12	DUVAL	0.000	0.000				
	13	ESCAMBIA	0.388	0.485		1.250		
	14	FRANKLIN	1.906	1.957		1.027		
	15	HERNANDO	11.015	11.576		1.051		
	16	HIGHLANDS	108.422	154.737		1.427		
	17	HILLSBOROUGH	6.618	8.803		1.330		
	18	HOLMES	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000				
	20	JACKSON	0.000	0.000				
	21	LEE	4.182	5.331		1.275		
	22	LEON	4.537	6.520		1.437		
	23	LEVY	2.583	3.632		1.406		
	24	MANATEE	13.658	14.249		1.043		
	25	MIAMI-DADE	0.025	0.030		1.200		
	26	MIAMI-DADE	0.000	0.000				
	27	MONROE	24.889	34.541		1.388		
	28	MONROE	99.311	143.710		1.447		
	29	OKALOOSA	0.000	0.000				
	30	OKALOOSA	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000				
	32	ORANGE	0.000	0.000				
	33	PALM BEACH	0.000	0.000				
	34	PASCO	0.000	0.000				
	35	PINELLAS	8.245	8.604		1.044		
	36	PINELLAS	0.000	0.000				
	37	POLK	0.000	0.000				
	38	PUTNAM	1.014	2.155		2.125		
	39	ST. JOHNS	0.004	0.007		1.750		
	40	ST. LUCIE	0.142	0.266		1.873		
	41	SARASOTA	0.000	0.000				
	42	SEMINOLE	0.700	1.468		2.097		
	43	TAYLOR	0.000	0.000				
	44	VOLUSIA	0.324	0.706		2.179		

Policy Form Sensitivity for condo unit

Policy	Location	County	Flood Loss Cost per Construction Type			Frame / Masonry	Manufactured Homes / Frame	Manufactured Homes / Masonry
			Masonry	Frame	Manufactured Homes			
Condo Unit	1	ALACHUA	0.000	0.000				
	2	BREVARD	0.000	0.000				
	3	BREVARD	0.000	0.000				
	4	BROWARD	0.000	0.000				
	5	BROWARD	0.000	0.000				
	6	CALHOUN	0.000	0.000				
	7	CHARLOTTE	2.038	2.170		1.065		
	8	CITRUS	5.009	7.035		1.404		
	9	COLLIER	6.139	6.486		1.057		
	10	COLLIER	82.159	102.095		1.243		
	11	DIXIE	0.030	0.081		2.700		
	12	DUVAL	0.000	0.000				
	13	ESCAMBIA	0.411	0.516		1.255		
	14	FRANKLIN	2.106	2.172		1.031		
	15	HERNANDO	11.803	12.478		1.057		
	16	HIGHLANDS	114.002	163.745		1.436		
	17	HILLSBOROUGH	6.980	9.358		1.341		
	18	HOLMES	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000				
	20	JACKSON	0.000	0.000				
	21	LEE	4.480	5.728		1.279		
	22	LEON	4.760	6.885		1.446		
	23	LEVY	2.725	3.855		1.415		
	24	MANATEE	14.570	15.283		1.049		
	25	MIAMI-DADE	0.026	0.033		1.269		
	26	MIAMI-DADE	0.000	0.000				
	27	MONROE	26.290	36.740		1.397		
	28	MONROE	105.824	152.977		1.446		
	29	OKALOOSA	0.000	0.000				
	30	OKALOOSA	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000				
	32	ORANGE	0.000	0.000				
	33	PALM BEACH	0.000	0.000				
	34	PASCO	0.000	0.000				
	35	PINELLAS	8.789	9.222		1.049		
	36	PINELLAS	0.000	0.000				
	37	POLK	0.000	0.000				
	38	PUTNAM	1.057	2.251		2.130		
	39	ST. JOHNS	0.004	0.008		2.000		
	40	ST. LUCIE	0.149	0.280		1.879		
	41	SARASOTA	0.000	0.000				
	42	SEMINOLE	0.729	1.535		2.106		
	43	TAYLOR	0.000	0.000				
	44	VOLUSIA	0.337	0.738		2.190		

Construction Sensitivity

Location	County	Flood Loss Cost per Construction			Manufactured Homes / Frame Owners	Manufactured Homes / Masonry Owners
		Frame Owners	Masonry Owners	Manufactured Homes		
1	ALACHUA	0.000	0.000	0.000		
2	BREVARD	0.000	0.000	0.000		
3	BREVARD	0.000	0.000	7.655		
4	BROWARD	0.000	0.000	0.177		
5	BROWARD	0.000	0.000	0.025		
6	CALHOUN	0.000	0.000	0.000		
7	CHARLOTTE	3.646	3.315	5.955	1.633	1.796
8	CITRUS	10.744	7.390	21.936	2.042	2.968
9	COLLIER	10.940	10.009	19.136	1.749	1.912
10	COLLIER	169.378	135.699	392.625	2.318	2.893
11	DIXIE	0.111	0.041	1.536	13.838	37.463
12	DUVAL	0.000	0.000	0.000		
13	ESCAMBIA	0.794	0.616	1.441	1.815	2.339
14	FRANKLIN	4.107	3.907	4.238	1.032	1.085
15	HERNANDO	20.598	18.892	39.014	1.894	2.065
16	HIGHLANDS	244.813	164.213	505.740	2.066	3.080
17	HILLSBOROUGH	14.359	10.241	48.172	3.355	4.704
18	HOLMES	0.000	0.000	0.000		
19	INDIAN RIVER	0.000	0.000	0.000		
20	JACKSON	0.000	0.000	0.000		
21	LEE	9.299	7.157	16.560	1.781	2.314
22	LEON	10.170	6.761	29.761	2.926	4.402
23	LEVY	5.864	4.002	13.084	2.231	3.269
24	MANATEE	24.587	22.783	62.680	2.549	2.751
25	MIAMI-DADE	0.054	0.041	0.092	1.704	2.244
26	MIAMI-DADE	0.000	0.000	0.025		
27	MONROE	56.526	38.902	136.968	2.423	3.521
28	MONROE	236.379	164.434	653.166	2.763	3.972
29	OKALOOSA	0.000	0.000	0.000		
30	OKALOOSA	0.000	0.000	0.000		
31	OKEECHOBEE	0.000	0.000	15.027		
32	ORANGE	0.000	0.000	0.000		
33	PALM BEACH	0.000	0.000	0.000		
34	PASCO	0.000	0.000	0.000		
35	PINELLAS	14.785	13.690	35.725	2.416	2.610
36	PINELLAS	0.000	0.000	0.007		
37	POLK	0.000	0.000	6.143		
38	PUTNAM	3.121	1.439	38.237	12.252	26.572
39	ST. JOHNS	0.011	0.006	0.029	2.636	4.833
40	ST. LUCIE	0.399	0.210	8.570	21.479	40.810
41	SARASOTA	0.000	0.000	0.000		
42	SEMINOLE	2.133	0.995	19.228	9.015	19.325
43	TAYLOR	0.000	0.000	0.000		
44	VOLUSIA	1.022	0.459	8.630	8.444	18.802

Coverage Sensitivity for frame owners

Construction / Policy	Location	County	Flood Loss Cost per Coverage			Ratios Relative to Dominant Coverage		
			Coverage A Building	Coverage B Personal Property	Time Element	Coverage A Building	Coverage B Personal Property	Time Element
Frame Owners	1	ALACHUA	0.000	0.000	0.000			
	2	BREVARD	0.000	0.000	0.000			
	3	BREVARD	0.000	0.000	0.000			
	4	BROWARD	0.000	0.000	0.000			
	5	BROWARD	0.000	0.000	0.000			
	6	CALHOUN	0.000	0.000	0.000			
	7	CHARLOTTE	1.640	2.006	1.168	1.000	1.223	0.712
	8	CITRUS	4.120	6.623	3.235	1.000	1.608	0.785
	9	COLLIER	4.949	5.991	3.515	1.000	1.211	0.710
	10	COLLIER	74.759	94.619	57.258	1.000	1.266	0.766
	11	DIXIE	0.033	0.078	0.021	1.000	2.364	0.636
	12	DUVAL	0.000	0.000	0.000			
	13	ESCAMBIA	0.309	0.485	0.227	1.000	1.570	0.735
	14	FRANKLIN	2.151	1.957	1.604	1.000	0.910	0.746
	15	HERNANDO	9.022	11.576	6.380	1.000	1.283	0.707
	16	HIGHLANDS	90.076	154.737	71.401	1.000	1.718	0.793
	17	HILLSBOROUGH	5.557	8.803	4.470	1.000	1.584	0.804
	18	HOLMES	0.000	0.000	0.000			
	19	INDIAN RIVER	0.000	0.000	0.000			
	20	JACKSON	0.000	0.000	0.000			
	21	LEE	3.968	5.331	3.058	1.000	1.343	0.771
	22	LEON	3.650	6.520	2.889	1.000	1.786	0.792
	23	LEVY	2.232	3.632	1.743	1.000	1.627	0.781
	24	MANATEE	10.338	14.249	7.283	1.000	1.378	0.704
	25	MIAMI-DADE	0.023	0.030	0.018	1.000	1.304	0.783
	26	MIAMI-DADE	0.000	0.000	0.000			
	27	MONROE	21.985	34.541	17.687	1.000	1.571	0.805
	28	MONROE	92.670	143.710	66.502	1.000	1.551	0.718
	29	OKALOOSA	0.000	0.000	0.000			
	30	OKALOOSA	0.000	0.000	0.000			
	31	OKEECHOBEE	0.000	0.000	0.000			
	32	ORANGE	0.000	0.000	0.000			
	33	PALM BEACH	0.000	0.000	0.000			
	34	PASCO	0.000	0.000	0.000			
	35	PINELLAS	6.181	8.604	4.349	1.000	1.392	0.704
	36	PINELLAS	0.000	0.000	0.000			
	37	POLK	0.000	0.000	0.000			
	38	PUTNAM	0.967	2.155	0.733	1.000	2.229	0.758
	39	ST. JOHNS	0.004	0.007	0.003	1.000	1.750	0.750
	40	ST. LUCIE	0.133	0.266	0.098	1.000	2.000	0.737
	41	SARASOTA	0.000	0.000	0.000			
	42	SEMINOLE	0.665	1.468	0.489	1.000	2.208	0.735
	43	TAYLOR	0.000	0.000	0.000			
	44	VOLUSIA	0.315	0.706	0.231	1.000	2.241	0.733

Coverage Sensitivity for masonry owners

Construction / Policy	Location	County	Flood Loss Cost per Coverage			Ratios Relative to Dominant Coverage		
			Coverage A Building	Coverage B Personal Property	Time Element	Coverage A Building	Coverage B Personal Property	Time Element
Masonry Owners	1	ALACHUA	0.000	0.000	0.000			
	2	BREVARD	0.000	0.000	0.000			
	3	BREVARD	0.000	0.000	0.000			
	4	BROWARD	0.000	0.000	0.000			
	5	BROWARD	0.000	0.000	0.000			
	6	CALHOUN	0.000	0.000	0.000			
	7	CHARLOTTE	1.420	1.896	1.001	1.000	1.335	0.705
	8	CITRUS	2.645	4.744	2.010	1.000	1.794	0.760
	9	COLLIER	4.300	5.709	3.027	1.000	1.328	0.704
	10	COLLIER	59.489	76.210	44.056	1.000	1.281	0.741
	11	DIXIE	0.012	0.029	0.009	1.000	2.417	0.750
	12	DUVAL	0.000	0.000	0.000			
	13	ESCAMBIA	0.228	0.388	0.164	1.000	1.702	0.719
	14	FRANKLIN	2.001	1.906	1.434	1.000	0.953	0.717
	15	HERNANDO	7.877	11.015	5.522	1.000	1.398	0.701
	16	HIGHLANDS	55.791	108.422	42.873	1.000	1.943	0.768
	17	HILLSBOROUGH	3.624	6.618	2.790	1.000	1.826	0.770
	18	HOLMES	0.000	0.000	0.000			
	19	INDIAN RIVER	0.000	0.000	0.000			
	20	JACKSON	0.000	0.000	0.000			
	21	LEE	2.975	4.182	2.217	1.000	1.406	0.745
	22	LEON	2.223	4.537	1.713	1.000	2.041	0.771
	23	LEVY	1.418	2.583	1.075	1.000	1.822	0.758
	24	MANATEE	9.126	13.658	6.394	1.000	1.497	0.701
	25	MIAMI-DADE	0.016	0.025	0.012	1.000	1.563	0.750
	26	MIAMI-DADE	0.000	0.000	0.000			
	27	MONROE	14.014	24.889	10.893	1.000	1.776	0.777
	28	MONROE	65.122	99.311	47.457	1.000	1.525	0.729
	29	OKALOOSA	0.000	0.000	0.000			
	30	OKALOOSA	0.000	0.000	0.000			
	31	OKEECHOBEE	0.000	0.000	0.000			
	32	ORANGE	0.000	0.000	0.000			
	33	PALM BEACH	0.000	0.000	0.000			
	34	PASCO	0.000	0.000	0.000			
	35	PINELLAS	5.445	8.245	3.814	1.000	1.514	0.700
	36	PINELLAS	0.000	0.000	0.000			
	37	POLK	0.000	0.000	0.000			
	38	PUTNAM	0.424	1.014	0.346	1.000	2.392	0.816
	39	ST. JOHNS	0.002	0.004	0.002	1.000	2.000	1.000
	40	ST. LUCIE	0.068	0.142	0.053	1.000	2.088	0.779
	41	SARASOTA	0.000	0.000	0.000			
	42	SEMINOLE	0.295	0.700	0.236	1.000	2.373	0.800
	43	TAYLOR	0.000	0.000	0.000			
	44	VOLUSIA	0.135	0.324	0.108	1.000	2.400	0.800

Coverage Sensitivity for manufactured homes

Construction / Policy	Location	County	Flood Loss Cost per Coverage			Ratios Relative to Dominant Coverage		
			Coverage A Building	Coverage B Personal Property	Time Element	Coverage A Building	Coverage B Personal Property	Time Element
Manufactured Homes	1	ALACHUA	0.000	0.000	0.000			
	2	BREVARD	0.000	0.000	0.000			
	3	BREVARD	2.290	5.365	2.149	1.000	2.343	0.938
	4	BROWARD	0.054	0.124	0.051	1.000	2.296	0.944
	5	BROWARD	0.007	0.018	0.007	1.000	2.571	1.000
	6	CALHOUN	0.000	0.000	0.000			
	7	CHARLOTTE	3.004	2.951	2.431	1.000	0.982	0.809
	8	CITRUS	10.076	11.861	7.748	1.000	1.177	0.769
	9	COLLIER	9.427	9.709	7.605	1.000	1.030	0.807
	10	COLLIER	166.673	225.951	142.509	1.000	1.356	0.855
	11	DIXIE	0.497	1.039	0.435	1.000	2.091	0.875
	12	DUVAL	0.000	0.000	0.000			
	13	ESCAMBIA	0.715	0.726	0.533	1.000	1.015	0.745
	14	FRANKLIN	2.240	1.997	2.240	1.000	0.892	1.000
	15	HERNANDO	19.051	19.963	14.642	1.000	1.048	0.769
	16	HIGHLANDS	234.210	271.531	173.913	1.000	1.159	0.743
	17	HILLSBOROUGH	19.755	28.417	16.316	1.000	1.438	0.826
	18	HOLMES	0.000	0.000	0.000			
	19	INDIAN RIVER	0.000	0.000	0.000			
	20	JACKSON	0.000	0.000	0.000			
	21	LEE	7.839	8.722	6.411	1.000	1.113	0.818
	22	LEON	12.655	17.107	9.646	1.000	1.352	0.762
	23	LEVY	5.829	7.255	4.519	1.000	1.245	0.775
	24	MANATEE	28.391	34.289	21.153	1.000	1.208	0.745
	25	MIAMI-DADE	0.045	0.047	0.039	1.000	1.044	0.867
	26	MIAMI-DADE	0.008	0.017	0.007	1.000	2.125	0.875
	27	MONROE	60.553	76.414	49.284	1.000	1.262	0.814
	28	MONROE	262.724	390.441	212.911	1.000	1.486	0.810
	29	OKALOOSA	0.000	0.000	0.000			
	30	OKALOOSA	0.000	0.000	0.000			
	31	OKEECHOBEE	4.464	10.563	4.150	1.000	2.366	0.930
	32	ORANGE	0.000	0.000	0.000			
	33	PALM BEACH	0.000	0.000	0.000			
	34	PASCO	0.000	0.000	0.000			
	35	PINELLAS	16.513	19.212	12.185	1.000	1.163	0.738
	36	PINELLAS	0.002	0.005	0.002	1.000	2.500	1.000
	37	POLK	1.823	4.320	1.741	1.000	2.370	0.955
	38	PUTNAM	12.569	25.668	10.814	1.000	2.042	0.860
	39	ST. JOHNS	0.012	0.017	0.009	1.000	1.417	0.750
	40	ST. LUCIE	2.723	5.847	2.501	1.000	2.147	0.918
	41	SARASOTA	0.000	0.000	0.000			
	42	SEMINOLE	6.312	12.915	5.470	1.000	2.046	0.867
	43	TAYLOR	0.000	0.000	0.000			
	44	VOLUSIA	2.858	5.772	2.441	1.000	2.020	0.854

Coverage Sensitivity for frame renters

Construction / Policy	Location	County	Flood Loss Cost per Coverage			Ratios Relative to Dominant Coverage		
			Coverage A Building	Coverage B Personal Property	Time Element	Coverage A Building	Coverage B Personal Property	Time Element
Frame Renters	1	ALACHUA	0.000	0.000	0.000			
	2	BREVARD	0.000	0.000	0.000			
	3	BREVARD	0.000	0.000	0.000			
	4	BROWARD	0.000	0.000	0.000			
	5	BROWARD	0.000	0.000	0.000			
	6	CALHOUN	0.000	0.000	0.000			
	7	CHARLOTTE	0.000	2.006	0.467	0.000	1.000	0.233
	8	CITRUS	0.000	6.623	1.294	0.000	1.000	0.195
	9	COLLIER	0.000	5.991	1.406	0.000	1.000	0.235
	10	COLLIER	0.000	94.619	22.903	0.000	1.000	0.242
	11	DIXIE	0.000	0.078	0.008	0.000	1.000	0.103
	12	DUVAL	0.000	0.000	0.000			
	13	ESCAMBIA	0.000	0.485	0.091	0.000	1.000	0.188
	14	FRANKLIN	0.000	1.957	0.641	0.000	1.000	0.328
	15	HERNANDO	0.000	11.576	2.552	0.000	1.000	0.220
	16	HIGHLANDS	0.000	154.737	28.560	0.000	1.000	0.185
	17	HILLSBOROUGH	0.000	8.803	1.788	0.000	1.000	0.203
	18	HOLMES	0.000	0.000	0.000			
	19	INDIAN RIVER	0.000	0.000	0.000			
	20	JACKSON	0.000	0.000	0.000			
	21	LEE	0.000	5.331	1.223	0.000	1.000	0.229
	22	LEON	0.000	6.520	1.155	0.000	1.000	0.177
	23	LEVY	0.000	3.632	0.697	0.000	1.000	0.192
	24	MANATEE	0.000	14.249	2.913	0.000	1.000	0.204
	25	MIAMI-DADE	0.000	0.030	0.007	0.000	1.000	0.233
	26	MIAMI-DADE	0.000	0.000	0.000			
	27	MONROE	0.000	34.541	7.075	0.000	1.000	0.205
	28	MONROE	0.000	143.710	26.601	0.000	1.000	0.185
	29	OKALOOSA	0.000	0.000	0.000			
	30	OKALOOSA	0.000	0.000	0.000			
	31	OKEECHOBEE	0.000	0.000	0.000			
	32	ORANGE	0.000	0.000	0.000			
	33	PALM BEACH	0.000	0.000	0.000			
	34	PASCO	0.000	0.000	0.000			
	35	PINELLAS	0.000	8.604	1.740	0.000	1.000	0.202
	36	PINELLAS	0.000	0.000	0.000			
	37	POLK	0.000	0.000	0.000			
	38	PUTNAM	0.000	2.155	0.293	0.000	1.000	0.136
	39	ST. JOHNS	0.000	0.007	0.001	0.000	1.000	0.143
	40	ST. LUCIE	0.000	0.266	0.039	0.000	1.000	0.147
	41	SARASOTA	0.000	0.000	0.000			
	42	SEMINOLE	0.000	1.468	0.196	0.000	1.000	0.134
	43	TAYLOR	0.000	0.000	0.000			
	44	VOLUSIA	0.000	0.706	0.093	0.000	1.000	0.132

Coverage Sensitivity for masonry renters

Construction / Policy	Location	County	Flood Loss Cost per Coverage			Ratios Relative to Dominant Coverage		
			Coverage A Building	Coverage B Personal Property	Time Element	Coverage A Building	Coverage B Personal Property	Time Element
Masonry Renters	1	ALACHUA	0.000	0.000	0.000			
	2	BREVARD	0.000	0.000	0.000			
	3	BREVARD	0.000	0.000	0.000			
	4	BROWARD	0.000	0.000	0.000			
	5	BROWARD	0.000	0.000	0.000			
	6	CALHOUN	0.000	0.000	0.000			
	7	CHARLOTTE	0.000	1.896	0.400	0.000	1.000	0.211
	8	CITRUS	0.000	4.744	0.804	0.000	1.000	0.169
	9	COLLIER	0.000	5.709	1.211	0.000	1.000	0.212
	10	COLLIER	0.000	76.210	17.622	0.000	1.000	0.231
	11	DIXIE	0.000	0.029	0.003	0.000	1.000	0.103
	12	DUVAL	0.000	0.000	0.000			
	13	ESCAMBIA	0.000	0.388	0.066	0.000	1.000	0.170
	14	FRANKLIN	0.000	1.906	0.574	0.000	1.000	0.301
	15	HERNANDO	0.000	11.015	2.209	0.000	1.000	0.201
	16	HIGHLANDS	0.000	108.422	17.149	0.000	1.000	0.158
	17	HILLSBOROUGH	0.000	6.618	1.116	0.000	1.000	0.169
	18	HOLMES	0.000	0.000	0.000			
	19	INDIAN RIVER	0.000	0.000	0.000			
	20	JACKSON	0.000	0.000	0.000			
	21	LEE	0.000	4.182	0.887	0.000	1.000	0.212
	22	LEON	0.000	4.537	0.685	0.000	1.000	0.151
	23	LEVY	0.000	2.583	0.430	0.000	1.000	0.166
	24	MANATEE	0.000	13.658	2.558	0.000	1.000	0.187
	25	MIAMI-DADE	0.000	0.025	0.005	0.000	1.000	0.200
	26	MIAMI-DADE	0.000	0.000	0.000			
	27	MONROE	0.000	24.889	4.357	0.000	1.000	0.175
	28	MONROE	0.000	99.311	18.983	0.000	1.000	0.191
	29	OKALOOSA	0.000	0.000	0.000			
	30	OKALOOSA	0.000	0.000	0.000			
	31	OKEECHOBEE	0.000	0.000	0.000			
	32	ORANGE	0.000	0.000	0.000			
	33	PALM BEACH	0.000	0.000	0.000			
	34	PASCO	0.000	0.000	0.000			
	35	PINELLAS	0.000	8.245	1.526	0.000	1.000	0.185
	36	PINELLAS	0.000	0.000	0.000			
	37	POLK	0.000	0.000	0.000			
	38	PUTNAM	0.000	1.014	0.138	0.000	1.000	0.136
	39	ST. JOHNS	0.000	0.004	0.001	0.000	1.000	0.250
	40	ST. LUCIE	0.000	0.142	0.021	0.000	1.000	0.148
	41	SARASOTA	0.000	0.000	0.000			
	42	SEMINOLE	0.000	0.700	0.095	0.000	1.000	0.136
	43	TAYLOR	0.000	0.000	0.000			
	44	VOLUSIA	0.000	0.324	0.043	0.000	1.000	0.133

Coverage Sensitivity for frame condo unit

Construction / Policy	Location	County	Flood Loss Cost per Coverage			Ratios Relative to Dominant Coverage		
			Coverage A Building	Coverage B Personal Property	Time Element	Coverage A Building	Coverage B Personal Property	Time Element
Frame Condo Unit	1	ALACHUA	0.000	0.000	0.000			
	2	BREVARD	0.000	0.000	0.000			
	3	BREVARD	0.000	0.000	0.000			
	4	BROWARD	0.000	0.000	0.000			
	5	BROWARD	0.000	0.000	0.000			
	6	CALHOUN	0.000	0.000	0.000			
	7	CHARLOTTE	0.164	2.006	0.467	0.082	1.000	0.233
	8	CITRUS	0.412	6.623	1.294	0.062	1.000	0.195
	9	COLLIER	0.495	5.991	1.406	0.083	1.000	0.235
	10	COLLIER	7.476	94.619	22.903	0.079	1.000	0.242
	11	DIXIE	0.003	0.078	0.008	0.038	1.000	0.103
	12	DUVAL	0.000	0.000	0.000			
	13	ESCAMBIA	0.031	0.485	0.091	0.064	1.000	0.188
	14	FRANKLIN	0.215	1.957	0.641	0.110	1.000	0.328
	15	HERNANDO	0.902	11.576	2.552	0.078	1.000	0.220
	16	HIGHLANDS	9.008	154.737	28.560	0.058	1.000	0.185
	17	HILLSBOROUGH	0.556	8.803	1.788	0.063	1.000	0.203
	18	HOLMES	0.000	0.000	0.000			
	19	INDIAN RIVER	0.000	0.000	0.000			
	20	JACKSON	0.000	0.000	0.000			
	21	LEE	0.397	5.331	1.223	0.074	1.000	0.229
	22	LEON	0.365	6.520	1.155	0.056	1.000	0.177
	23	LEVY	0.223	3.632	0.697	0.061	1.000	0.192
	24	MANATEE	1.034	14.249	2.913	0.073	1.000	0.204
	25	MIAMI-DADE	0.002	0.030	0.007	0.067	1.000	0.233
	26	MIAMI-DADE	0.000	0.000	0.000			
	27	MONROE	2.199	34.541	7.075	0.064	1.000	0.205
	28	MONROE	9.267	143.710	26.601	0.064	1.000	0.185
	29	OKALOOSA	0.000	0.000	0.000			
	30	OKALOOSA	0.000	0.000	0.000			
	31	OKEECHOBEE	0.000	0.000	0.000			
	32	ORANGE	0.000	0.000	0.000			
	33	PALM BEACH	0.000	0.000	0.000			
	34	PASCO	0.000	0.000	0.000			
	35	PINELLAS	0.618	8.604	1.740	0.072	1.000	0.202
	36	PINELLAS	0.000	0.000	0.000			
	37	POLK	0.000	0.000	0.000			
	38	PUTNAM	0.097	2.155	0.293	0.045	1.000	0.136
	39	ST. JOHNS	0.000	0.007	0.001	0.000	1.000	0.143
	40	ST. LUCIE	0.013	0.266	0.039	0.049	1.000	0.147
	41	SARASOTA	0.000	0.000	0.000			
	42	SEMINOLE	0.067	1.468	0.196	0.046	1.000	0.134
	43	TAYLOR	0.000	0.000	0.000			
	44	VOLUSIA	0.032	0.706	0.093	0.045	1.000	0.132

Coverage Sensitivity for masonry condo unit

Construction / Policy	Location	County	Flood Loss Cost per Coverage			Ratios Relative to Dominant Coverage		
			Coverage A Building	Coverage B Personal Property	Time Element	Coverage A Building	Coverage B Personal Property	Time Element
Masonry Condo Unit	1	ALACHUA	0.000	0.000	0.000			
	2	BREVARD	0.000	0.000	0.000			
	3	BREVARD	0.000	0.000	0.000			
	4	BROWARD	0.000	0.000	0.000			
	5	BROWARD	0.000	0.000	0.000			
	6	CALHOUN	0.000	0.000	0.000			
	7	CHARLOTTE	0.142	1.896	0.400	0.075	1.000	0.211
	8	CITRUS	0.265	4.744	0.804	0.056	1.000	0.169
	9	COLLIER	0.430	5.709	1.211	0.075	1.000	0.212
	10	COLLIER	5.949	76.210	17.622	0.078	1.000	0.231
	11	DIXIE	0.001	0.029	0.003	0.034	1.000	0.103
	12	DUVAL	0.000	0.000	0.000			
	13	ESCAMBIA	0.023	0.388	0.066	0.059	1.000	0.170
	14	FRANKLIN	0.200	1.906	0.574	0.105	1.000	0.301
	15	HERNANDO	0.788	11.015	2.209	0.072	1.000	0.201
	16	HIGHLANDS	5.579	108.422	17.149	0.051	1.000	0.158
	17	HILLSBOROUGH	0.362	6.618	1.116	0.055	1.000	0.169
	18	HOLMES	0.000	0.000	0.000			
	19	INDIAN RIVER	0.000	0.000	0.000			
	20	JACKSON	0.000	0.000	0.000			
	21	LEE	0.297	4.182	0.887	0.071	1.000	0.212
	22	LEON	0.222	4.537	0.685	0.049	1.000	0.151
	23	LEVY	0.142	2.583	0.430	0.055	1.000	0.166
	24	MANATEE	0.913	13.658	2.558	0.067	1.000	0.187
	25	MIAMI-DADE	0.002	0.025	0.005	0.080	1.000	0.200
	26	MIAMI-DADE	0.000	0.000	0.000			
	27	MONROE	1.401	24.889	4.357	0.056	1.000	0.175
	28	MONROE	6.512	99.311	18.983	0.066	1.000	0.191
	29	OKALOOSA	0.000	0.000	0.000			
	30	OKALOOSA	0.000	0.000	0.000			
	31	OKEECHOBEE	0.000	0.000	0.000			
	32	ORANGE	0.000	0.000	0.000			
	33	PALM BEACH	0.000	0.000	0.000			
	34	PASCO	0.000	0.000	0.000			
	35	PINELLAS	0.545	8.245	1.526	0.066	1.000	0.185
	36	PINELLAS	0.000	0.000	0.000			
	37	POLK	0.000	0.000	0.000			
	38	PUTNAM	0.042	1.014	0.138	0.041	1.000	0.136
	39	ST. JOHNS	0.000	0.004	0.001	0.000	1.000	0.250
	40	ST. LUCIE	0.007	0.142	0.021	0.049	1.000	0.148
	41	SARASOTA	0.000	0.000	0.000			
	42	SEMINOLE	0.030	0.700	0.095	0.043	1.000	0.136
	43	TAYLOR	0.000	0.000	0.000			
	44	VOLUSIA	0.014	0.324	0.043	0.043	1.000	0.133

Year Built Sensitivity for frame owners

Construction / Policy	Location	County	Flood Loss Cost per Year Built				Ratios Relative to 1960 Year Built			
			Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018	Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018
Frame Owners	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	3.646	3.646	3.071	3.071	1.000	1.000	0.842	0.842
	8	CITRUS	10.744	10.744	10.071	10.071	1.000	1.000	0.937	0.937
	9	COLLIER	10.940	10.940	9.213	9.213	1.000	1.000	0.842	0.842
	10	COLLIER	169.378	169.378	154.012	154.012	1.000	1.000	0.909	0.909
	11	DIXIE	0.111	0.111	0.109	0.109	1.000	1.000	0.982	0.982
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.794	0.794	0.704	0.704	1.000	1.000	0.887	0.887
	14	FRANKLIN	4.107	4.107	3.632	3.632	1.000	1.000	0.884	0.884
	15	HERNANDO	20.598	20.598	17.360	17.360	1.000	1.000	0.843	0.843
	16	HIGHLANDS	244.813	244.813	230.489	230.489	1.000	1.000	0.941	0.941
	17	HILLSBOROUGH	14.359	14.359	13.424	13.424	1.000	1.000	0.935	0.935
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	9.299	9.299	8.451	8.451	1.000	1.000	0.909	0.909
	22	LEON	10.170	10.170	9.590	9.590	1.000	1.000	0.943	0.943
	23	LEVY	5.864	5.864	5.502	5.502	1.000	1.000	0.938	0.938
	24	MANATEE	24.587	24.587	20.695	20.695	1.000	1.000	0.842	0.842
	25	MIAMI-DADE	0.054	0.054	0.049	0.049	1.000	1.000	0.907	0.907
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	56.526	56.526	52.990	52.990	1.000	1.000	0.937	0.937
	28	MONROE	236.379	236.379	212.601	212.601	1.000	1.000	0.899	0.899
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	14.785	14.785	12.424	12.424	1.000	1.000	0.840	0.840
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	3.121	3.121	3.035	3.035	1.000	1.000	0.972	0.972
	39	ST. JOHNS	0.011	0.011	0.011	0.011	1.000	1.000	1.000	1.000
	40	ST. LUCIE	0.399	0.399	0.381	0.381	1.000	1.000	0.955	0.955
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	2.133	2.133	2.072	2.072	1.000	1.000	0.971	0.971
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	1.022	1.022	0.994	0.994	1.000	1.000	0.973	0.973

Year Built Sensitivity for masonry owners

Construction / Policy	Location	County	Flood Loss Cost per Year Built				Ratios Relative to 1960 Year Built			
			Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018	Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018
Masonry Owners	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	3.315	3.315	2.814	2.814	1.000	1.000	0.849	0.849
	8	CITRUS	7.390	7.390	7.009	7.009	1.000	1.000	0.948	0.948
	9	COLLIER	10.009	10.009	8.499	8.499	1.000	1.000	0.849	0.849
	10	COLLIER	135.699	135.699	122.282	122.282	1.000	1.000	0.901	0.901
	11	DIXIE	0.041	0.041	0.041	0.041	1.000	1.000	1.000	1.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.616	0.616	0.548	0.548	1.000	1.000	0.890	0.890
	14	FRANKLIN	3.907	3.907	3.409	3.409	1.000	1.000	0.873	0.873
	15	HERNANDO	18.892	18.892	16.063	16.063	1.000	1.000	0.850	0.850
	16	HIGHLANDS	164.213	164.213	156.705	156.705	1.000	1.000	0.954	0.954
	17	HILLSBOROUGH	10.241	10.241	9.717	9.717	1.000	1.000	0.949	0.949
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	7.157	7.157	6.492	6.492	1.000	1.000	0.907	0.907
	22	LEON	6.761	6.761	6.473	6.473	1.000	1.000	0.957	0.957
	23	LEVY	4.002	4.002	3.798	3.798	1.000	1.000	0.949	0.949
	24	MANATEE	22.783	22.783	19.359	19.359	1.000	1.000	0.850	0.850
	25	MIAMI-DADE	0.041	0.041	0.038	0.038	1.000	1.000	0.927	0.927
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	38.902	38.902	36.919	36.919	1.000	1.000	0.949	0.949
	28	MONROE	164.434	164.434	145.481	145.481	1.000	1.000	0.885	0.885
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	13.690	13.690	11.626	11.626	1.000	1.000	0.849	0.849
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	1.439	1.439	1.418	1.418	1.000	1.000	0.985	0.985
	39	ST. JOHNS	0.006	0.006	0.006	0.006	1.000	1.000	1.000	1.000
	40	ST. LUCIE	0.210	0.210	0.201	0.201	1.000	1.000	0.957	0.957
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.995	0.995	0.979	0.979	1.000	1.000	0.984	0.984
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.459	0.459	0.452	0.452	1.000	1.000	0.985	0.985

Year Built Sensitivity for manufactured homes

Construction / Policy	Location	County	Flood Loss Cost per Year Built				Ratios Relative to 1974 Year Built			
			Year Built 1974	Year Built 1992	Year Built 2004	Year Built 2012	Year Built 1974	Year Built 1992	Year Built 2004	Year Built 2012
Manufactured Homes	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	3.315	3.315	2.814	2.814	1.000	1.000	0.849	0.849
	8	CITRUS	7.390	7.390	7.009	7.009	1.000	1.000	0.948	0.948
	9	COLLIER	10.009	10.009	8.499	8.499	1.000	1.000	0.849	0.849
	10	COLLIER	135.699	135.699	122.282	122.282	1.000	1.000	0.901	0.901
	11	DIXIE	0.041	0.041	0.041	0.041	1.000	1.000	1.000	1.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.616	0.616	0.548	0.548	1.000	1.000	0.890	0.890
	14	FRANKLIN	3.907	3.907	3.409	3.409	1.000	1.000	0.873	0.873
	15	HERNANDO	18.892	18.892	16.063	16.063	1.000	1.000	0.850	0.850
	16	HIGHLANDS	164.213	164.213	156.705	156.705	1.000	1.000	0.954	0.954
	17	HILLSBOROUGH	10.241	10.241	9.717	9.717	1.000	1.000	0.949	0.949
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	7.157	7.157	6.492	6.492	1.000	1.000	0.907	0.907
	22	LEON	6.761	6.761	6.473	6.473	1.000	1.000	0.957	0.957
	23	LEVY	4.002	4.002	3.798	3.798	1.000	1.000	0.949	0.949
	24	MANATEE	22.783	22.783	19.359	19.359	1.000	1.000	0.850	0.850
	25	MIAMI-DADE	0.041	0.041	0.038	0.038	1.000	1.000	0.927	0.927
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	38.902	38.902	36.919	36.919	1.000	1.000	0.949	0.949
	28	MONROE	164.434	164.434	145.481	145.481	1.000	1.000	0.885	0.885
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	13.690	13.690	11.626	11.626	1.000	1.000	0.849	0.849
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	1.439	1.439	1.418	1.418	1.000	1.000	0.985	0.985
	39	ST. JOHNS	0.006	0.006	0.006	0.006	1.000	1.000	1.000	1.000
	40	ST. LUCIE	0.210	0.210	0.201	0.201	1.000	1.000	0.957	0.957
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.995	0.995	0.979	0.979	1.000	1.000	0.984	0.984
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.459	0.459	0.452	0.452	1.000	1.000	0.985	0.985

Year Built Sensitivity for frame renters

Construction / Policy	Location	County	Flood Loss Cost per Year Built				Ratios Relative to 1960 Year Built			
			Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018	Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018
Frame Renters	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	2.006	2.006	1.797	1.797	1.000	1.000	0.896	0.896
	8	CITRUS	6.623	6.623	6.329	6.329	1.000	1.000	0.956	0.956
	9	COLLIER	5.991	5.991	5.375	5.375	1.000	1.000	0.897	0.897
	10	COLLIER	94.619	94.619	89.470	89.470	1.000	1.000	0.946	0.946
	11	DIXIE	0.078	0.078	0.077	0.077	1.000	1.000	0.987	0.987
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.485	0.485	0.446	0.446	1.000	1.000	0.920	0.920
	14	FRANKLIN	1.957	1.957	1.841	1.841	1.000	1.000	0.941	0.941
	15	HERNANDO	11.576	11.576	10.327	10.327	1.000	1.000	0.892	0.892
	16	HIGHLANDS	154.737	154.737	147.784	147.784	1.000	1.000	0.955	0.955
	17	HILLSBOROUGH	8.803	8.803	8.376	8.376	1.000	1.000	0.951	0.951
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	5.331	5.331	5.040	5.040	1.000	1.000	0.945	0.945
	22	LEON	6.520	6.520	6.216	6.216	1.000	1.000	0.953	0.953
	23	LEVY	3.632	3.632	3.473	3.473	1.000	1.000	0.956	0.956
	24	MANATEE	14.249	14.249	12.620	12.620	1.000	1.000	0.886	0.886
	25	MIAMI-DADE	0.030	0.030	0.029	0.029	1.000	1.000	0.967	0.967
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	34.541	34.541	33.002	33.002	1.000	1.000	0.955	0.955
	28	MONROE	143.710	143.710	134.805	134.805	1.000	1.000	0.938	0.938
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	8.604	8.604	7.604	7.604	1.000	1.000	0.884	0.884
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	2.155	2.155	2.098	2.098	1.000	1.000	0.974	0.974
	39	ST. JOHNS	0.007	0.007	0.007	0.007	1.000	1.000	1.000	1.000
	40	ST. LUCIE	0.266	0.266	0.257	0.257	1.000	1.000	0.966	0.966
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	1.468	1.468	1.428	1.428	1.000	1.000	0.973	0.973
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.706	0.706	0.689	0.689	1.000	1.000	0.976	0.976

Year Built Sensitivity for masonry renters

Construction / Policy	Location	County	Flood Loss Cost per Year Built				Ratios Relative to 1960 Year Built			
			Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018	Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018
Masonry Renters	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	1.896	1.896	1.696	1.696	1.000	1.000	0.895	0.895
	8	CITRUS	4.744	4.744	4.558	4.558	1.000	1.000	0.961	0.961
	9	COLLIER	5.709	5.709	5.112	5.112	1.000	1.000	0.895	0.895
	10	COLLIER	76.210	76.210	71.806	71.806	1.000	1.000	0.942	0.942
	11	DIXIE	0.029	0.029	0.029	0.029	1.000	1.000	1.000	1.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.388	0.388	0.356	0.356	1.000	1.000	0.918	0.918
	14	FRANKLIN	1.906	1.906	1.788	1.788	1.000	1.000	0.938	0.938
	15	HERNANDO	11.015	11.015	9.815	9.815	1.000	1.000	0.891	0.891
	16	HIGHLANDS	108.422	108.422	104.233	104.233	1.000	1.000	0.961	0.961
	17	HILLSBOROUGH	6.618	6.618	6.336	6.336	1.000	1.000	0.957	0.957
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	4.182	4.182	3.958	3.958	1.000	1.000	0.946	0.946
	22	LEON	4.537	4.537	4.363	4.363	1.000	1.000	0.962	0.962
	23	LEVY	2.583	2.583	2.481	2.481	1.000	1.000	0.961	0.961
	24	MANATEE	13.658	13.658	12.096	12.096	1.000	1.000	0.886	0.886
	25	MIAMI-DADE	0.025	0.025	0.023	0.023	1.000	1.000	0.920	0.920
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	24.889	24.889	23.876	23.876	1.000	1.000	0.959	0.959
	28	MONROE	99.311	99.311	91.837	91.837	1.000	1.000	0.925	0.925
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	8.245	8.245	7.288	7.288	1.000	1.000	0.884	0.884
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	1.014	1.014	1.000	1.000	1.000	1.000	0.986	0.986
	39	ST. JOHNS	0.004	0.004	0.004	0.004	1.000	1.000	1.000	1.000
	40	ST. LUCIE	0.142	0.142	0.137	0.137	1.000	1.000	0.965	0.965
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.700	0.700	0.689	0.689	1.000	1.000	0.984	0.984
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.324	0.324	0.319	0.319	1.000	1.000	0.985	0.985

Year Built Sensitivity for frame condo unit

Construction / Policy	Location	County	Flood Loss Cost per Year Built				Ratios Relative to 1960 Year Built			
			Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018	Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018
Frame Condo Unit	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	2.170	2.170	1.925	1.925	1.000	1.000	0.887	0.887
	8	CITRUS	7.035	7.035	6.703	6.703	1.000	1.000	0.953	0.953
	9	COLLIER	6.486	6.486	5.759	5.759	1.000	1.000	0.888	0.888
	10	COLLIER	102.095	102.095	95.924	95.924	1.000	1.000	0.940	0.940
	11	DIXIE	0.081	0.081	0.080	0.080	1.000	1.000	0.988	0.988
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.516	0.516	0.472	0.472	1.000	1.000	0.915	0.915
	14	FRANKLIN	2.172	2.172	2.020	2.020	1.000	1.000	0.930	0.930
	15	HERNANDO	12.478	12.478	11.030	11.030	1.000	1.000	0.884	0.884
	16	HIGHLANDS	163.745	163.745	156.054	156.054	1.000	1.000	0.953	0.953
	17	HILLSBOROUGH	9.358	9.358	8.881	8.881	1.000	1.000	0.949	0.949
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	5.728	5.728	5.381	5.381	1.000	1.000	0.939	0.939
	22	LEON	6.885	6.885	6.553	6.553	1.000	1.000	0.952	0.952
	23	LEVY	3.855	3.855	3.676	3.676	1.000	1.000	0.954	0.954
	24	MANATEE	15.283	15.283	13.428	13.428	1.000	1.000	0.879	0.879
	25	MIAMI-DADE	0.033	0.033	0.031	0.031	1.000	1.000	0.939	0.939
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	36.740	36.740	35.001	35.001	1.000	1.000	0.953	0.953
	28	MONROE	152.977	152.977	142.584	142.584	1.000	1.000	0.932	0.932
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	9.222	9.222	8.086	8.086	1.000	1.000	0.877	0.877
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	2.251	2.251	2.192	2.192	1.000	1.000	0.974	0.974
	39	ST. JOHNS	0.008	0.008	0.008	0.008	1.000	1.000	1.000	1.000
	40	ST. LUCIE	0.280	0.280	0.269	0.269	1.000	1.000	0.961	0.961
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	1.535	1.535	1.493	1.493	1.000	1.000	0.973	0.973
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.738	0.738	0.719	0.719	1.000	1.000	0.974	0.974

Year Built Sensitivity for masonry condo unit

Construction / Policy	Location	County	Flood Loss Cost per Year Built				Ratios Relative to 1960 Year Built			
			Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018	Year Built 1960	Year Built 1981	Year Built 2012	Year Built 2018
Masonry Condo Unit	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	2.038	2.038	1.808	1.808	1.000	1.000	0.887	0.887
	8	CITRUS	5.009	5.009	4.803	4.803	1.000	1.000	0.959	0.959
	9	COLLIER	6.139	6.139	5.451	5.451	1.000	1.000	0.888	0.888
	10	COLLIER	82.159	82.159	76.854	76.854	1.000	1.000	0.935	0.935
	11	DIXIE	0.030	0.030	0.030	0.030	1.000	1.000	1.000	1.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.411	0.411	0.375	0.375	1.000	1.000	0.912	0.912
	14	FRANKLIN	2.106	2.106	1.950	1.950	1.000	1.000	0.926	0.926
	15	HERNANDO	11.803	11.803	10.440	10.440	1.000	1.000	0.885	0.885
	16	HIGHLANDS	114.002	114.002	109.480	109.480	1.000	1.000	0.960	0.960
	17	HILLSBOROUGH	6.980	6.980	6.674	6.674	1.000	1.000	0.956	0.956
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	4.480	4.480	4.211	4.211	1.000	1.000	0.940	0.940
	22	LEON	4.760	4.760	4.574	4.574	1.000	1.000	0.961	0.961
	23	LEVY	2.725	2.725	2.613	2.613	1.000	1.000	0.959	0.959
	24	MANATEE	14.570	14.570	12.822	12.822	1.000	1.000	0.880	0.880
	25	MIAMI-DADE	0.026	0.026	0.025	0.025	1.000	1.000	0.962	0.962
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	26.290	26.290	25.181	25.181	1.000	1.000	0.958	0.958
	28	MONROE	105.824	105.824	97.202	97.202	1.000	1.000	0.919	0.919
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	8.789	8.789	7.722	7.722	1.000	1.000	0.879	0.879
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	1.057	1.057	1.042	1.042	1.000	1.000	0.986	0.986
	39	ST. JOHNS	0.004	0.004	0.004	0.004	1.000	1.000	1.000	1.000
	40	ST. LUCIE	0.149	0.149	0.143	0.143	1.000	1.000	0.960	0.960
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.729	0.729	0.718	0.718	1.000	1.000	0.985	0.985
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.337	0.337	0.333	0.333	1.000	1.000	0.988	0.988

Foundation Type Sensitivity for frame owners

Construction / Policy	Location	County	Flood Loss Cost per Foundation Type					Ratios Relative to Basement Foundation				
			Basement	Slab Foundation	Elevate 1	Elevate 2	Elevate 3	Basement	Slab Foundation	Elevate 1	Elevate 2	Elevate 3
Frame Owners	1	ALACHUA	0.000	0.000	0.000	0.000	0.000					
	2	BREVARD	0.000	0.000	0.000	0.000	0.000					
	3	BREVARD	4.721	4.721	0.027	0.020	0.000	1.000	1.000	0.006	0.004	0.000
	4	BROWARD	0.132	0.132	0.001	0.000	0.000	1.000	1.000	0.008	0.000	0.000
	5	BROWARD	0.011	0.011	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000
	6	CALHOUN	0.000	0.000	0.000	0.000	0.000					
	7	CHARLOTTE	4.648	4.648	0.645	0.612	0.517	1.000	1.000	0.139	0.132	0.111
	8	CITRUS	15.498	15.498	0.986	0.922	0.731	1.000	1.000	0.064	0.059	0.047
	9	COLLIER	14.821	14.821	1.972	1.865	1.546	1.000	1.000	0.133	0.126	0.104
	10	COLLIER	325.164	325.164	54.611	53.610	50.647	1.000	1.000	0.168	0.165	0.156
	11	DIXIE	1.332	1.332	0.005	0.003	0.000	1.000	1.000	0.004	0.002	0.000
	12	DUVAL	0.000	0.000	0.000	0.000	0.000					
	13	ESCAMBIA	0.992	0.992	0.036	0.031	0.018	1.000	1.000	0.036	0.031	0.018
	14	FRANKLIN	4.161	4.161	3.053	3.053	3.053	1.000	1.000	0.734	0.734	0.734
	15	HERNANDO	29.553	29.553	3.295	3.109	2.552	1.000	1.000	0.111	0.105	0.086
	16	HIGHLANDS	343.720	343.720	7.784	6.333	1.975	1.000	1.000	0.023	0.018	0.006
	17	HILLSBOROUGH	35.639	35.639	0.815	0.705	0.376	1.000	1.000	0.023	0.020	0.011
	18	HOLMES	0.000	0.000	0.000	0.000	0.000					
	19	INDIAN RIVER	0.000	0.000	0.000	0.000	0.000					
	20	JACKSON	0.000	0.000	0.000	0.000	0.000					
	21	LEE	12.334	12.334	1.903	1.850	1.692	1.000	1.000	0.154	0.150	0.137
	22	LEON	21.143	21.143	0.187	0.140	0.000	1.000	1.000	0.009	0.007	0.000
	23	LEVY	9.447	9.447	0.453	0.416	0.306	1.000	1.000	0.048	0.044	0.032
	24	MANATEE	45.747	45.747	3.046	2.834	2.204	1.000	1.000	0.067	0.062	0.048
	25	MIAMI-DADE	0.070	0.070	0.012	0.011	0.011	1.000	1.000	0.171	0.157	0.157
	26	MIAMI-DADE	0.016	0.016	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000
	27	MONROE	99.015	99.015	3.369	2.946	1.675	1.000	1.000	0.034	0.030	0.017
	28	MONROE	521.876	521.876	19.798	18.053	12.823	1.000	1.000	0.038	0.035	0.025
	29	OKALOOSA	0.000	0.000	0.000	0.000	0.000					
	30	OKALOOSA	0.000	0.000	0.000	0.000	0.000					
	31	OKEECHOBEE	8.219	8.219	0.054	0.040	0.000	1.000	1.000	0.007	0.005	0.000
	32	ORANGE	0.000	0.000	0.000	0.000	0.000					
	33	PALM BEACH	0.000	0.000	0.000	0.000	0.000					
	34	PASCO	0.000	0.000	0.000	0.000	0.000					
	35	PINELLAS	25.585	25.585	1.569	1.438	1.045	1.000	1.000	0.061	0.056	0.041
	36	PINELLAS	0.005	0.005	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000
	37	POLK	3.737	3.737	0.022	0.017	0.000	1.000	1.000	0.006	0.005	0.000
	38	PUTNAM	33.690	33.690	0.113	0.085	0.000	1.000	1.000	0.003	0.003	0.000
	39	ST. JOHNS	0.020	0.020	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000
	40	ST. LUCIE	6.968	6.968	0.029	0.022	0.000	1.000	1.000	0.004	0.003	0.000
	41	SARASOTA	0.000	0.000	0.000	0.000	0.000					
	42	SEMINOLE	15.042	15.042	0.060	0.045	0.000	1.000	1.000	0.004	0.003	0.000
	43	TAYLOR	0.000	0.000	0.000	0.000	0.000					
	44	VOLUSIA	7.074	7.074	0.026	0.020	0.000	1.000	1.000	0.004	0.003	0.000

Foundation Type Sensitivity for manufactured homes

Construction / Policy	Location	County	Flood Loss Cost per Foundation Type					Ratios Relative to Weak Foundation				
			Weak	Medium	Strong			Weak	Medium	Strong		
Manufactured Homes	1	ALACHUA	0.000	0.000	0.000							
	2	BREVARD	0.000	0.000	0.000							
	3	BREVARD	16.287	11.971	7.655			1.000	0.735	0.470		
	4	BROWARD	0.369	0.273	0.177			1.000	0.740	0.480		
	5	BROWARD	0.055	0.040	0.025			1.000	0.727	0.455		
	6	CALHOUN	0.000	0.000	0.000							
	7	CHARLOTTE	6.692	6.336	5.955			1.000	0.947	0.890		
	8	CITRUS	26.804	24.389	21.936			1.000	0.910	0.818		
	9	COLLIER	22.957	21.100	19.136			1.000	0.919	0.834		
	10	COLLIER	543.115	468.013	392.625			1.000	0.862	0.723		
	11	DIXIE	2.768	2.152	1.536			1.000	0.777	0.555		
	12	DUVAL	0.000	0.000	0.000							
	13	ESCAMBIA	1.604	1.523	1.441			1.000	0.950	0.898		
	14	FRANKLIN	4.238	4.238	4.238			1.000	1.000	1.000		
	15	HERNANDO	47.888	43.524	39.014			1.000	0.909	0.815		
	16	HIGHLANDS	611.039	558.663	505.740			1.000	0.914	0.828		
	17	HILLSBOROUGH	74.753	61.527	48.172			1.000	0.823	0.644		
	18	HOLMES	0.000	0.000	0.000							
	19	INDIAN RIVER	0.000	0.000	0.000							
	20	JACKSON	0.000	0.000	0.000							
	21	LEE	19.805	18.207	16.560			1.000	0.919	0.836		
	22	LEON	42.399	36.084	29.761			1.000	0.851	0.702		
	23	LEVY	16.694	14.895	13.084			1.000	0.892	0.784		
	24	MANATEE	88.815	75.994	62.680			1.000	0.856	0.706		
	25	MIAMI-DADE	0.105	0.099	0.092			1.000	0.943	0.876		
	26	MIAMI-DADE	0.045	0.035	0.025			1.000	0.778	0.556		
	27	MONROE	183.726	160.541	136.968			1.000	0.874	0.746		
	28	MONROE	922.522	788.363	653.166			1.000	0.855	0.708		
	29	OKALOOSA	0.000	0.000	0.000							
	30	OKALOOSA	0.000	0.000	0.000							
	31	OKEECHOBEE	32.479	23.753	15.027			1.000	0.731	0.463		
	32	ORANGE	0.000	0.000	0.000							
	33	PALM BEACH	0.000	0.000	0.000							
	34	PASCO	0.000	0.000	0.000							
	35	PINELLAS	48.933	42.468	35.725			1.000	0.868	0.730		
	36	PINELLAS	0.014	0.010	0.007			1.000	0.714	0.500		
	37	POLK	13.369	9.756	6.143			1.000	0.730	0.459		
	38	PUTNAM	67.332	52.784	38.237			1.000	0.784	0.568		
	39	ST. JOHNS	0.039	0.034	0.029			1.000	0.872	0.744		
	40	ST. LUCIE	16.708	12.641	8.570			1.000	0.757	0.513		
	41	SARASOTA	0.000	0.000	0.000							
	42	SEMINOLE	35.033	27.130	19.228			1.000	0.774	0.549		
	43	TAYLOR	0.000	0.000	0.000							
	44	VOLUSIA	15.235	11.933	8.630			1.000	0.783	0.566		

Number of Stories Sensitivity for frame owners

Construction / Policy	Location	County / City	Flood Loss Cost by Number of Stories		Ratios Relative to 1 Story	
			1 Story	2 Story	1 Story	2 Story
Frame Owners	1	ALACHUA	0.000	0.000		
	2	BREVARD	0.000	0.000		
	3	BREVARD	0.000	0.000		
	4	BROWARD	0.000	0.000		
	5	BROWARD	0.000	0.000		
	6	CALHOUN	0.000	0.000		
	7	CHARLOTTE	3.646	3.241	1.000	0.889
	8	CITRUS	10.744	8.994	1.000	0.837
	9	COLLIER	10.940	9.743	1.000	0.891
	10	COLLIER	169.378	149.871	1.000	0.885
	11	DIXIE	0.111	0.080	1.000	0.721
	12	DUVAL	0.000	0.000		
	13	ESCAMBIA	0.794	0.675	1.000	0.850
	14	FRANKLIN	4.107	3.908	1.000	0.952
	15	HERNANDO	20.598	18.194	1.000	0.883
	16	HIGHLANDS	244.813	203.348	1.000	0.831
	17	HILLSBOROUGH	14.359	12.155	1.000	0.847
	18	HOLMES	0.000	0.000		
	19	INDIAN RIVER	0.000	0.000		
	20	JACKSON	0.000	0.000		
	21	LEE	9.299	8.096	1.000	0.871
	22	LEON	10.170	8.421	1.000	0.828
	23	LEVY	5.864	4.896	1.000	0.835
	24	MANATEE	24.587	21.410	1.000	0.871
	25	MIAMI-DADE	0.054	0.046	1.000	0.852
	26	MIAMI-DADE	0.000	0.000		
	27	MONROE	56.526	47.312	1.000	0.837
	28	MONROE	236.379	194.333	1.000	0.822
	29	OKALOOSA	0.000	0.000		
	30	OKALOOSA	0.000	0.000		
	31	OKEECHOBEE	0.000	0.000		
	32	ORANGE	0.000	0.000		
	33	PALM BEACH	0.000	0.000		
	34	PASCO	0.000	0.000		
	35	PINELLAS	14.785	12.853	1.000	0.869
	36	PINELLAS	0.000	0.000		
	37	POLK	0.000	0.000		
	38	PUTNAM	3.121	2.347	1.000	0.752
	39	ST. JOHNS	0.011	0.009	1.000	0.818
	40	ST. LUCIE	0.399	0.308	1.000	0.772
	41	SARASOTA	0.000	0.000		
	42	SEMINOLE	2.133	1.608	1.000	0.754
	43	TAYLOR	0.000	0.000		
	44	VOLUSIA	1.022	0.763	1.000	0.747

Number of Stories Sensitivity for masonry owners

Construction / Policy	Location	County / City	Flood Loss Cost by Number of Stories		Ratios Relative to 1 Story	
			1 Story	2 Story	1 Story	2 Story
Masonry Owners	1	ALACHUA	0.000	0.000		
	2	BREVARD	0.000	0.000		
	3	BREVARD	0.000	0.000		
	4	BROWARD	0.000	0.000		
	5	BROWARD	0.000	0.000		
	6	CALHOUN	0.000	0.000		
	7	CHARLOTTE	3.315	2.911	1.000	0.878
	8	CITRUS	7.390	6.861	1.000	0.928
	9	COLLIER	10.009	8.811	1.000	0.880
	10	COLLIER	135.699	125.350	1.000	0.924
	11	DIXIE	0.041	0.035	1.000	0.854
	12	DUVAL	0.000	0.000		
	13	ESCAMBIA	0.616	0.545	1.000	0.885
	14	FRANKLIN	3.907	3.660	1.000	0.937
	15	HERNANDO	18.892	16.560	1.000	0.877
	16	HIGHLANDS	164.213	152.329	1.000	0.928
	17	HILLSBOROUGH	10.241	9.546	1.000	0.932
	18	HOLMES	0.000	0.000		
	19	INDIAN RIVER	0.000	0.000		
	20	JACKSON	0.000	0.000		
	21	LEE	7.157	6.584	1.000	0.920
	22	LEON	6.761	6.271	1.000	0.928
	23	LEVY	4.002	3.713	1.000	0.928
	24	MANATEE	22.783	19.894	1.000	0.873
	25	MIAMI-DADE	0.041	0.038	1.000	0.927
	26	MIAMI-DADE	0.000	0.000		
	27	MONROE	38.902	36.129	1.000	0.929
	28	MONROE	164.434	144.357	1.000	0.878
	29	OKALOOSA	0.000	0.000		
	30	OKALOOSA	0.000	0.000		
	31	OKEECHOBEE	0.000	0.000		
	32	ORANGE	0.000	0.000		
	33	PALM BEACH	0.000	0.000		
	34	PASCO	0.000	0.000		
	35	PINELLAS	13.690	11.917	1.000	0.870
	36	PINELLAS	0.000	0.000		
	37	POLK	0.000	0.000		
	38	PUTNAM	1.439	1.283	1.000	0.892
	39	ST. JOHNS	0.006	0.006	1.000	1.000
	40	ST. LUCIE	0.210	0.188	1.000	0.895
	41	SARASOTA	0.000	0.000		
	42	SEMINOLE	0.995	0.890	1.000	0.894
	43	TAYLOR	0.000	0.000		
	44	VOLUSIA	0.459	0.408	1.000	0.889

Number of Stories Sensitivity for frame renters

Construction / Policy	Location	County / City	Flood Loss Cost by Number of Stories		Ratios Relative to 1 Story	
			1 Story	2 Story	1 Story	2 Story
Frame Renters	1	ALACHUA	0.000	0.000		
	2	BREVARD	0.000	0.000		
	3	BREVARD	0.000	0.000		
	4	BROWARD	0.000	0.000		
	5	BROWARD	0.000	0.000		
	6	CALHOUN	0.000	0.000		
	7	CHARLOTTE	2.006	1.843	1.000	0.919
	8	CITRUS	6.623	5.697	1.000	0.860
	9	COLLIER	5.991	5.515	1.000	0.921
	10	COLLIER	94.619	84.917	1.000	0.897
	11	DIXIE	0.078	0.056	1.000	0.718
	12	DUVAL	0.000	0.000		
	13	ESCAMBIA	0.485	0.425	1.000	0.876
	14	FRANKLIN	1.957	1.905	1.000	0.973
	15	HERNANDO	11.576	10.546	1.000	0.911
	16	HIGHLANDS	154.737	132.001	1.000	0.853
	17	HILLSBOROUGH	8.803	7.694	1.000	0.874
	18	HOLMES	0.000	0.000		
	19	INDIAN RIVER	0.000	0.000		
	20	JACKSON	0.000	0.000		
	21	LEE	5.331	4.738	1.000	0.889
	22	LEON	6.520	5.542	1.000	0.850
	23	LEVY	3.632	3.118	1.000	0.858
	24	MANATEE	14.249	12.752	1.000	0.895
	25	MIAMI-DADE	0.030	0.027	1.000	0.900
	26	MIAMI-DADE	0.000	0.000		
	27	MONROE	34.541	29.777	1.000	0.862
	28	MONROE	143.710	119.648	1.000	0.833
	29	OKALOOSA	0.000	0.000		
	30	OKALOOSA	0.000	0.000		
	31	OKEECHOBEE	0.000	0.000		
	32	ORANGE	0.000	0.000		
	33	PALM BEACH	0.000	0.000		
	34	PASCO	0.000	0.000		
	35	PINELLAS	8.604	7.697	1.000	0.895
	36	PINELLAS	0.000	0.000		
	37	POLK	0.000	0.000		
	38	PUTNAM	2.155	1.638	1.000	0.760
	39	ST. JOHNS	0.007	0.006	1.000	0.857
	40	ST. LUCIE	0.266	0.208	1.000	0.782
	41	SARASOTA	0.000	0.000		
	42	SEMINOLE	1.468	1.118	1.000	0.762
	43	TAYLOR	0.000	0.000		
	44	VOLUSIA	0.706	0.533	1.000	0.755

Number of Stories Sensitivity for masonry renters

Construction / Policy	Location	County / City	Flood Loss Cost by Number of Stories		Ratios Relative to 1 Story	
			1 Story	2 Story	1 Story	2 Story
Masonry Renters	1	ALACHUA	0.000	0.000		
	2	BREVARD	0.000	0.000		
	3	BREVARD	0.000	0.000		
	4	BROWARD	0.000	0.000		
	5	BROWARD	0.000	0.000		
	6	CALHOUN	0.000	0.000		
	7	CHARLOTTE	1.896	1.726	1.000	0.910
	8	CITRUS	4.744	4.450	1.000	0.938
	9	COLLIER	5.709	5.213	1.000	0.913
	10	COLLIER	76.210	71.930	1.000	0.944
	11	DIXIE	0.029	0.025	1.000	0.862
	12	DUVAL	0.000	0.000		
	13	ESCAMBIA	0.388	0.353	1.000	0.910
	14	FRANKLIN	1.906	1.847	1.000	0.969
	15	HERNANDO	11.015	9.982	1.000	0.906
	16	HIGHLANDS	108.422	101.349	1.000	0.935
	17	HILLSBOROUGH	6.618	6.226	1.000	0.941
	18	HOLMES	0.000	0.000		
	19	INDIAN RIVER	0.000	0.000		
	20	JACKSON	0.000	0.000		
	21	LEE	4.182	3.940	1.000	0.942
	22	LEON	4.537	4.235	1.000	0.933
	23	LEVY	2.583	2.421	1.000	0.937
	24	MANATEE	13.658	12.295	1.000	0.900
	25	MIAMI-DADE	0.025	0.023	1.000	0.920
	26	MIAMI-DADE	0.000	0.000		
	27	MONROE	24.889	23.341	1.000	0.938
	28	MONROE	99.311	89.684	1.000	0.903
	29	OKALOOSA	0.000	0.000		
	30	OKALOOSA	0.000	0.000		
	31	OKEECHOBEE	0.000	0.000		
	32	ORANGE	0.000	0.000		
	33	PALM BEACH	0.000	0.000		
	34	PASCO	0.000	0.000		
	35	PINELLAS	8.245	7.399	1.000	0.897
	36	PINELLAS	0.000	0.000		
	37	POLK	0.000	0.000		
	38	PUTNAM	1.014	0.907	1.000	0.894
	39	ST. JOHNS	0.004	0.004	1.000	1.000
	40	ST. LUCIE	0.142	0.128	1.000	0.901
	41	SARASOTA	0.000	0.000		
	42	SEMINOLE	0.700	0.627	1.000	0.896
	43	TAYLOR	0.000	0.000		
	44	VOLUSIA	0.324	0.288	1.000	0.889

Lowest Floor Elevation Sensitivity for frame owners

Construction / Policy	Location	County	Flood Loss Cost per First Floor Height Above Ground				Ratios Relative to First Floor 2 ft Above Ground			
			2 ft	4 ft	6 ft	8 ft	2 ft	4 ft	6 ft	8 ft
Frame Owners	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	2.724	2.209	1.070	0.517	1.000	0.811	0.393	0.190
	8	CITRUS	7.131	3.167	1.505	0.731	1.000	0.444	0.211	0.103
	9	COLLIER	8.161	6.741	3.518	1.546	1.000	0.826	0.431	0.189
	10	COLLIER	128.036	95.621	71.355	50.647	1.000	0.747	0.557	0.396
	11	DIXIE	0.008	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.559	0.228	0.041	0.018	1.000	0.408	0.073	0.032
	14	FRANKLIN	4.027	3.918	3.631	3.053	1.000	0.973	0.902	0.758
	15	HERNANDO	14.409	11.345	5.488	2.552	1.000	0.787	0.381	0.177
	16	HIGHLANDS	158.617	52.502	12.646	1.975	1.000	0.331	0.080	0.012
	17	HILLSBOROUGH	11.374	3.835	1.105	0.376	1.000	0.337	0.097	0.033
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	7.068	4.197	2.860	1.692	1.000	0.594	0.405	0.239
	22	LEON	7.057	0.340	0.000	0.000	1.000	0.048	0.000	0.000
	23	LEVY	3.835	1.822	0.744	0.306	1.000	0.475	0.194	0.080
	24	MANATEE	14.805	11.210	5.188	2.204	1.000	0.757	0.350	0.149
	25	MIAMI-DADE	0.046	0.029	0.015	0.011	1.000	0.630	0.326	0.239
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	38.481	17.548	6.805	1.675	1.000	0.456	0.177	0.044
	28	MONROE	100.175	83.054	40.201	12.823	1.000	0.829	0.401	0.128
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	8.893	6.551	2.757	1.045	1.000	0.737	0.310	0.118
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	0.066	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	39	ST. JOHNS	0.005	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	40	ST. LUCIE	0.081	0.024	0.000	0.000	1.000	0.296	0.000	0.000
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.000	0.000	0.000	0.000				
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.000	0.000	0.000	0.000				

Lowest Floor Elevation Sensitivity for masonry owners

Construction / Policy	Location	County	Flood Loss Cost per First Floor Height Above Ground				Ratios Relative to First Floor 2 ft Above Ground			
			2 ft	4 ft	6 ft	8 ft	2 ft	4 ft	6 ft	8 ft
Masonry Owners	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	2.482	2.053	0.996	0.485	1.000	0.827	0.401	0.195
	8	CITRUS	4.894	2.204	1.058	0.518	1.000	0.450	0.216	0.106
	9	COLLIER	7.444	6.220	3.286	1.461	1.000	0.836	0.441	0.196
	10	COLLIER	107.932	85.476	65.404	46.890	1.000	0.792	0.606	0.434
	11	DIXIE	0.005	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.421	0.222	0.039	0.016	1.000	0.527	0.093	0.038
	14	FRANKLIN	3.780	3.627	3.321	2.823	1.000	0.960	0.879	0.747
	15	HERNANDO	13.237	10.566	5.142	2.407	1.000	0.798	0.388	0.182
	16	HIGHLANDS	103.145	32.679	7.391	1.120	1.000	0.317	0.072	0.011
	17	HILLSBOROUGH	7.572	2.429	0.721	0.250	1.000	0.321	0.095	0.033
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	5.473	3.594	2.608	1.587	1.000	0.657	0.477	0.290
	22	LEON	4.387	0.078	0.000	0.000	1.000	0.018	0.000	0.000
	23	LEVY	2.657	1.235	0.495	0.197	1.000	0.465	0.186	0.074
	24	MANATEE	13.628	10.410	4.845	2.099	1.000	0.764	0.356	0.154
	25	MIAMI-DADE	0.035	0.021	0.011	0.007	1.000	0.600	0.314	0.200
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	26.448	11.670	4.261	0.961	1.000	0.441	0.161	0.036
	28	MONROE	89.360	76.078	37.787	12.323	1.000	0.851	0.423	0.138
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	8.206	6.118	2.590	1.005	1.000	0.746	0.316	0.122
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	0.028	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	39	ST. JOHNS	0.002	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	40	ST. LUCIE	0.052	0.023	0.000	0.000	1.000	0.442	0.000	0.000
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.000	0.000	0.000	0.000				
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.000	0.000	0.000	0.000				

Lowest Floor Elevation Sensitivity for manufactured homes

Construction / Policy	Location	County	Flood Loss Cost per First Floor Height Above Ground				Ratios Relative to First Floor 2 ft Above Ground			
			2 ft	4 ft	6 ft	8 ft	2 ft	4 ft	6 ft	8 ft
Manufactured Homes	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	1.434	0.001	0.000	0.000	1.000	0.001	0.000	0.000
	4	BROWARD	0.034	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	5	BROWARD	0.004	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	4.989	2.874	1.414	0.741	1.000	0.576	0.283	0.149
	8	CITRUS	15.535	6.914	3.158	1.553	1.000	0.445	0.203	0.100
	9	COLLIER	15.055	8.883	4.789	2.079	1.000	0.590	0.318	0.138
	10	COLLIER	237.675	129.964	90.190	63.098	1.000	0.547	0.379	0.265
	11	DIXIE	0.394	0.007	0.000	0.000	1.000	0.018	0.000	0.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	1.209	0.368	0.057	0.027	1.000	0.304	0.047	0.022
	14	FRANKLIN	4.238	4.238	4.238	3.848	1.000	1.000	1.000	0.908
	15	HERNANDO	29.793	14.930	7.316	3.473	1.000	0.501	0.246	0.117
	16	HIGHLANDS	363.407	142.129	41.401	8.285	1.000	0.391	0.114	0.023
	17	HILLSBOROUGH	26.295	10.316	3.152	0.979	1.000	0.392	0.120	0.037
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	12.522	6.685	3.957	2.221	1.000	0.534	0.316	0.177
	22	LEON	17.693	4.738	0.200	0.000	1.000	0.268	0.011	0.000
	23	LEVY	8.715	3.975	1.769	0.729	1.000	0.456	0.203	0.084
	24	MANATEE	38.598	15.174	7.045	3.116	1.000	0.393	0.183	0.081
	25	MIAMI-DADE	0.077	0.053	0.033	0.022	1.000	0.688	0.429	0.286
	26	MIAMI-DADE	0.006	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	27	MONROE	87.399	39.773	17.079	5.487	1.000	0.455	0.195	0.063
	28	MONROE	319.079	114.062	55.697	19.569	1.000	0.357	0.175	0.061
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	2.721	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	23.118	8.958	3.868	1.481	1.000	0.387	0.167	0.064
	36	PINELLAS	0.001	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	37	POLK	1.094	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	38	PUTNAM	10.338	0.170	0.000	0.000	1.000	0.016	0.000	0.000
	39	ST. JOHNS	0.016	0.001	0.000	0.000	1.000	0.063	0.000	0.000
	40	ST. LUCIE	2.007	0.060	0.003	0.000	1.000	0.030	0.001	0.000
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	5.179	0.090	0.000	0.000	1.000	0.017	0.000	0.000
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	2.388	0.040	0.000	0.000	1.000	0.017	0.000	0.000

Lowest Floor Elevation Sensitivity for frame renters

Construction / Policy	Location	County	Flood Loss Cost per First Floor Height Above Ground				Ratios Relative to First Floor 2 ft Above Ground			
			2 ft	4 ft	6 ft	8 ft	2 ft	4 ft	6 ft	8 ft
Frame Renters	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	1.522	1.249	0.600	0.294	1.000	0.821	0.394	0.193
	8	CITRUS	4.389	1.933	0.915	0.445	1.000	0.440	0.208	0.101
	9	COLLIER	4.509	3.778	1.998	0.882	1.000	0.838	0.443	0.196
	10	COLLIER	69.550	50.191	37.419	26.562	1.000	0.722	0.538	0.382
	11	DIXIE	0.006	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.358	0.144	0.024	0.010	1.000	0.402	0.067	0.028
	14	FRANKLIN	1.936	1.909	1.839	1.638	1.000	0.986	0.950	0.846
	15	HERNANDO	8.143	6.449	3.093	1.426	1.000	0.792	0.380	0.175
	16	HIGHLANDS	101.439	34.137	8.361	1.313	1.000	0.337	0.082	0.013
	17	HILLSBOROUGH	7.171	2.446	0.697	0.235	1.000	0.341	0.097	0.033
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	4.028	2.251	1.552	0.945	1.000	0.559	0.385	0.235
	22	LEON	4.648	0.243	0.000	0.000	1.000	0.052	0.000	0.000
	23	LEVY	2.367	1.138	0.468	0.196	1.000	0.481	0.198	0.083
	24	MANATEE	8.440	6.400	2.971	1.295	1.000	0.758	0.352	0.153
	25	MIAMI-DADE	0.026	0.017	0.009	0.007	1.000	0.654	0.346	0.269
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	23.626	10.989	4.374	1.104	1.000	0.465	0.185	0.047
	28	MONROE	55.076	46.696	23.447	7.709	1.000	0.848	0.426	0.140
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	5.140	3.793	1.594	0.611	1.000	0.738	0.310	0.119
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	0.046	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	39	ST. JOHNS	0.003	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	40	ST. LUCIE	0.052	0.015	0.000	0.000	1.000	0.288	0.000	0.000
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.000	0.000	0.000	0.000				
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.000	0.000	0.000	0.000				

Lowest Floor Elevation Sensitivity for masonry renters

Construction / Policy	Location	County	Flood Loss Cost per First Floor Height Above Ground				Ratios Relative to First Floor 2 ft Above Ground			
			2 ft	4 ft	6 ft	8 ft	2 ft	4 ft	6 ft	8 ft
Masonry Renters	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	1.438	1.202	0.580	0.285	1.000	0.836	0.403	0.198
	8	CITRUS	3.134	1.403	0.673	0.331	1.000	0.448	0.215	0.106
	9	COLLIER	4.283	3.620	1.930	0.860	1.000	0.845	0.451	0.201
	10	COLLIER	59.440	45.983	35.344	25.411	1.000	0.774	0.595	0.428
	11	DIXIE	0.003	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.274	0.142	0.023	0.010	1.000	0.518	0.084	0.036
	14	FRANKLIN	1.876	1.839	1.758	1.575	1.000	0.980	0.937	0.840
	15	HERNANDO	7.754	6.214	2.994	1.385	1.000	0.801	0.386	0.179
	16	HIGHLANDS	68.675	22.043	5.042	0.766	1.000	0.321	0.073	0.011
	17	HILLSBOROUGH	4.980	1.602	0.469	0.158	1.000	0.322	0.094	0.032
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	3.167	1.983	1.470	0.917	1.000	0.626	0.464	0.290
	22	LEON	3.006	0.056	0.000	0.000	1.000	0.019	0.000	0.000
	23	LEVY	1.715	0.805	0.325	0.132	1.000	0.469	0.190	0.077
	24	MANATEE	8.067	6.162	2.872	1.267	1.000	0.764	0.356	0.157
	25	MIAMI-DADE	0.021	0.013	0.007	0.005	1.000	0.619	0.333	0.238
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	17.017	7.638	2.847	0.654	1.000	0.449	0.167	0.038
	28	MONROE	51.267	44.497	22.721	7.564	1.000	0.868	0.443	0.148
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	4.917	3.663	1.542	0.600	1.000	0.745	0.314	0.122
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	0.020	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	39	ST. JOHNS	0.002	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	40	ST. LUCIE	0.034	0.014	0.000	0.000	1.000	0.412	0.000	0.000
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.000	0.000	0.000	0.000				
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.000	0.000	0.000	0.000				

Lowest Floor Elevation Sensitivity for frame condo unit

Construction / Policy	Location	County	Flood Loss Cost per First Floor Height Above Ground				Ratios Relative to First Floor 2 ft Above Ground			
			2 ft	4 ft	6 ft	8 ft	2 ft	4 ft	6 ft	8 ft
Frame Condo Unit	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	1.642	1.345	0.647	0.316	1.000	0.819	0.394	0.192
	8	CITRUS	4.663	2.056	0.974	0.473	1.000	0.441	0.209	0.101
	9	COLLIER	4.874	4.074	2.150	0.949	1.000	0.836	0.441	0.195
	10	COLLIER	75.399	54.734	40.813	28.971	1.000	0.726	0.541	0.384
	11	DIXIE	0.006	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.378	0.152	0.026	0.011	1.000	0.402	0.069	0.029
	14	FRANKLIN	2.145	2.110	2.019	1.779	1.000	0.984	0.941	0.829
	15	HERNANDO	8.769	6.938	3.333	1.539	1.000	0.791	0.380	0.176
	16	HIGHLANDS	107.157	35.974	8.789	1.379	1.000	0.336	0.082	0.013
	17	HILLSBOROUGH	7.591	2.585	0.738	0.249	1.000	0.341	0.097	0.033
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	4.332	2.445	1.683	1.020	1.000	0.564	0.389	0.235
	22	LEON	4.888	0.252	0.000	0.000	1.000	0.052	0.000	0.000
	23	LEVY	2.514	1.206	0.496	0.207	1.000	0.480	0.197	0.082
	24	MANATEE	9.076	6.881	3.193	1.386	1.000	0.758	0.352	0.153
	25	MIAMI-DADE	0.028	0.018	0.010	0.007	1.000	0.643	0.357	0.250
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	25.111	11.645	4.617	1.161	1.000	0.464	0.184	0.046
	28	MONROE	59.586	50.332	25.123	8.220	1.000	0.845	0.422	0.138
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	5.515	4.069	1.711	0.654	1.000	0.738	0.310	0.119
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	0.048	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	39	ST. JOHNS	0.003	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	40	ST. LUCIE	0.055	0.016	0.000	0.000	1.000	0.291	0.000	0.000
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.000	0.000	0.000	0.000				
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.000	0.000	0.000	0.000				

Lowest Floor Elevation Sensitivity for masonry condo unit

Construction / Policy	Location	County	Flood Loss Cost per First Floor Height Above Ground				Ratios Relative to First Floor 2 ft Above Ground			
			2 ft	4 ft	6 ft	8 ft	2 ft	4 ft	6 ft	8 ft
Masonry Condo Unit	1	ALACHUA	0.000	0.000	0.000	0.000				
	2	BREVARD	0.000	0.000	0.000	0.000				
	3	BREVARD	0.000	0.000	0.000	0.000				
	4	BROWARD	0.000	0.000	0.000	0.000				
	5	BROWARD	0.000	0.000	0.000	0.000				
	6	CALHOUN	0.000	0.000	0.000	0.000				
	7	CHARLOTTE	1.543	1.287	0.621	0.305	1.000	0.834	0.402	0.198
	8	CITRUS	3.310	1.483	0.711	0.350	1.000	0.448	0.215	0.106
	9	COLLIER	4.599	3.880	2.066	0.920	1.000	0.844	0.449	0.200
	10	COLLIER	64.289	49.933	38.350	27.559	1.000	0.777	0.597	0.429
	11	DIXIE	0.004	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	12	DUVAL	0.000	0.000	0.000	0.000				
	13	ESCAMBIA	0.288	0.150	0.025	0.010	1.000	0.521	0.087	0.035
	14	FRANKLIN	2.066	2.018	1.914	1.700	1.000	0.977	0.926	0.823
	15	HERNANDO	8.303	6.649	3.209	1.488	1.000	0.801	0.386	0.179
	16	HIGHLANDS	72.122	23.107	5.277	0.802	1.000	0.320	0.073	0.011
	17	HILLSBOROUGH	5.239	1.685	0.494	0.167	1.000	0.322	0.094	0.032
	18	HOLMES	0.000	0.000	0.000	0.000				
	19	INDIAN RIVER	0.000	0.000	0.000	0.000				
	20	JACKSON	0.000	0.000	0.000	0.000				
	21	LEE	3.398	2.144	1.584	0.984	1.000	0.631	0.466	0.290
	22	LEON	3.144	0.058	0.000	0.000	1.000	0.018	0.000	0.000
	23	LEVY	1.809	0.848	0.342	0.138	1.000	0.469	0.189	0.076
	24	MANATEE	8.623	6.587	3.069	1.350	1.000	0.764	0.356	0.157
	25	MIAMI-DADE	0.023	0.014	0.008	0.005	1.000	0.609	0.348	0.217
	26	MIAMI-DADE	0.000	0.000	0.000	0.000				
	27	MONROE	17.960	8.042	2.989	0.684	1.000	0.448	0.166	0.038
	28	MONROE	55.076	47.655	24.228	8.040	1.000	0.865	0.440	0.146
	29	OKALOOSA	0.000	0.000	0.000	0.000				
	30	OKALOOSA	0.000	0.000	0.000	0.000				
	31	OKEECHOBEE	0.000	0.000	0.000	0.000				
	32	ORANGE	0.000	0.000	0.000	0.000				
	33	PALM BEACH	0.000	0.000	0.000	0.000				
	34	PASCO	0.000	0.000	0.000	0.000				
	35	PINELLAS	5.245	3.908	1.647	0.640	1.000	0.745	0.314	0.122
	36	PINELLAS	0.000	0.000	0.000	0.000				
	37	POLK	0.000	0.000	0.000	0.000				
	38	PUTNAM	0.021	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	39	ST. JOHNS	0.002	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	40	ST. LUCIE	0.036	0.015	0.000	0.000	1.000	0.417	0.000	0.000
	41	SARASOTA	0.000	0.000	0.000	0.000				
	42	SEMINOLE	0.000	0.000	0.000	0.000				
	43	TAYLOR	0.000	0.000	0.000	0.000				
	44	VOLUSIA	0.000	0.000	0.000	0.000				

E. Provide graphical summaries to demonstrate the sensitivities for each Notional Set. Figure 5 illustrates an example graphical representation of deductible sensitivities using the 2019 Florida Public Hurricane Loss Model data for frame owners from Notional Data Set 1.

Figure 5 data is from the Florida Public Hurricane Loss Model Version 8.1 acceptable under the 2019 Hurricane Standards. Curves plotted are ratios of loss costs for specified deductibles to the corresponding zero deductible for each of the 40 locations in Location Grid A. The locations along the x-axis are given left to right in decreasing order of their zero-deductible loss cost.

See following sensitivity graphs.

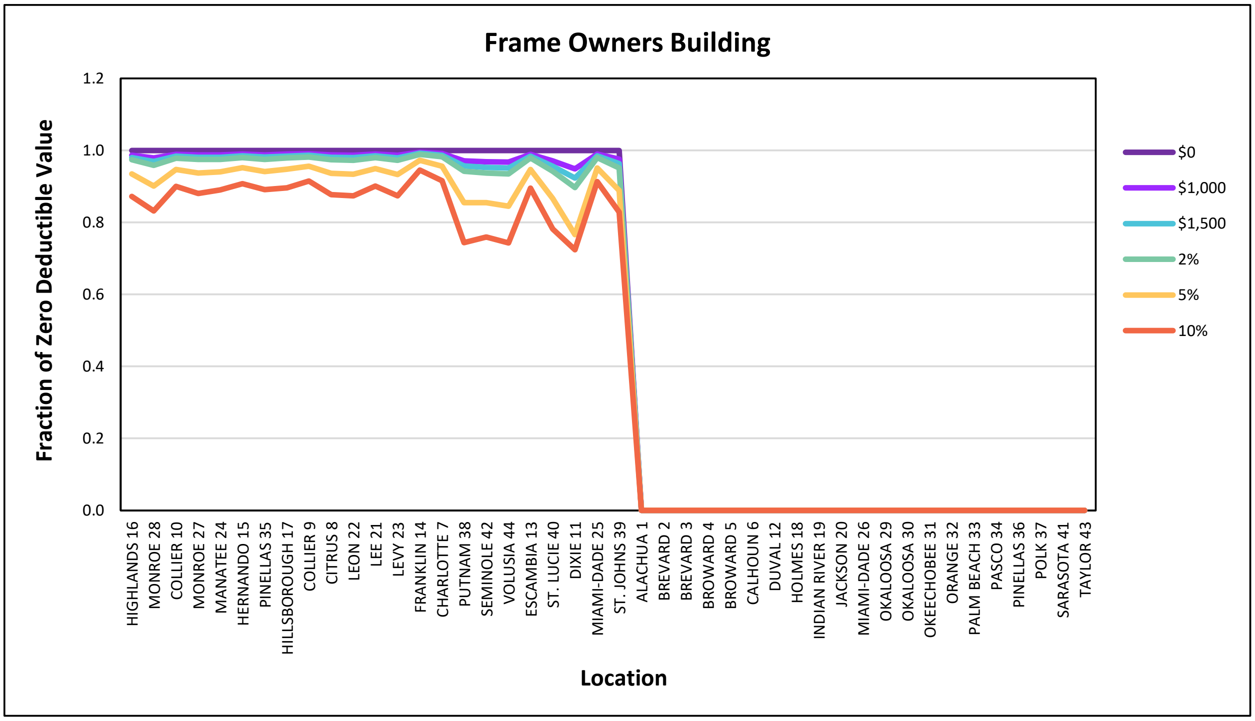


Figure 227. Flood Loss Costs by Deductible - Frame Owners.

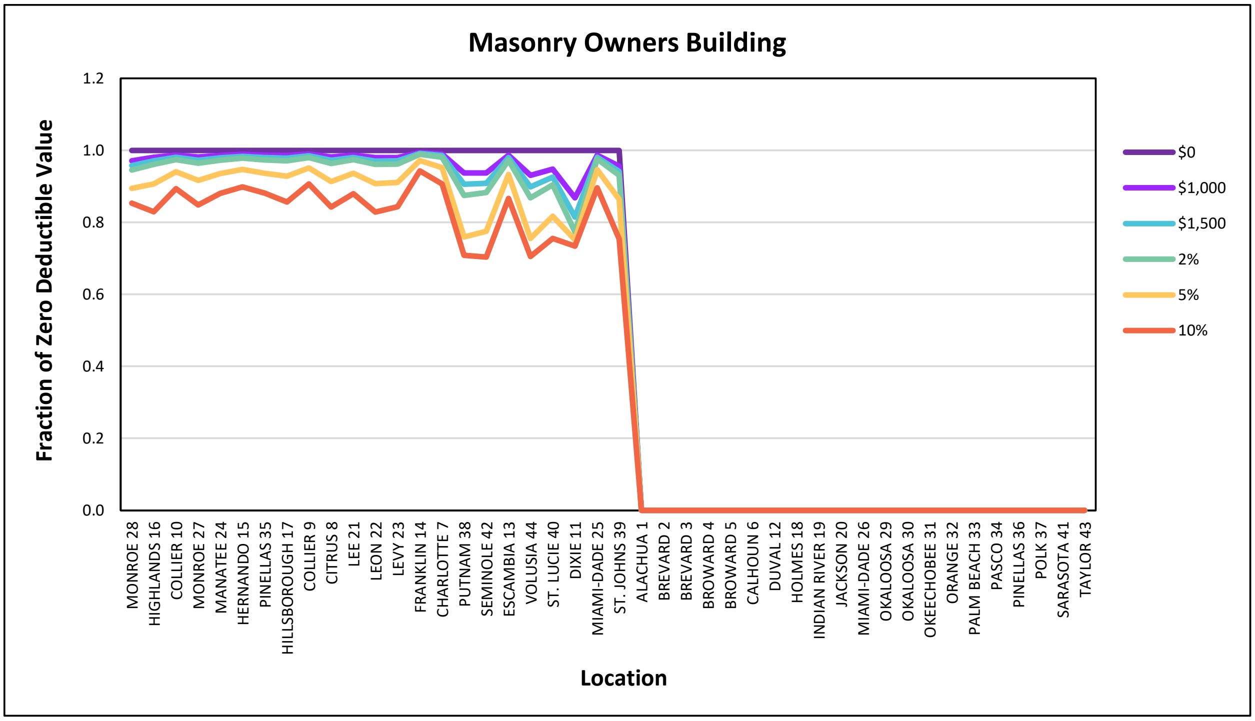


Figure 228. Flood Loss Costs by Deductible - Masonry Owners.

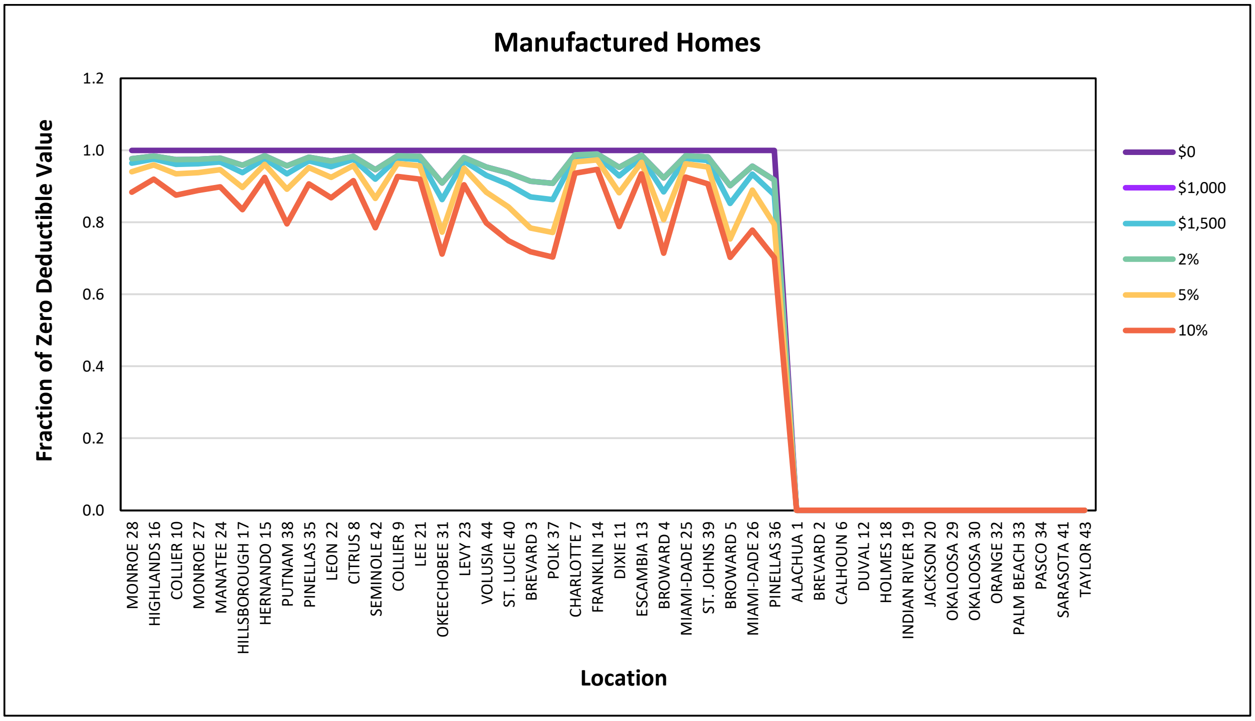


Figure 229. Flood Loss Costs by Deductible - Manufactured Homes.

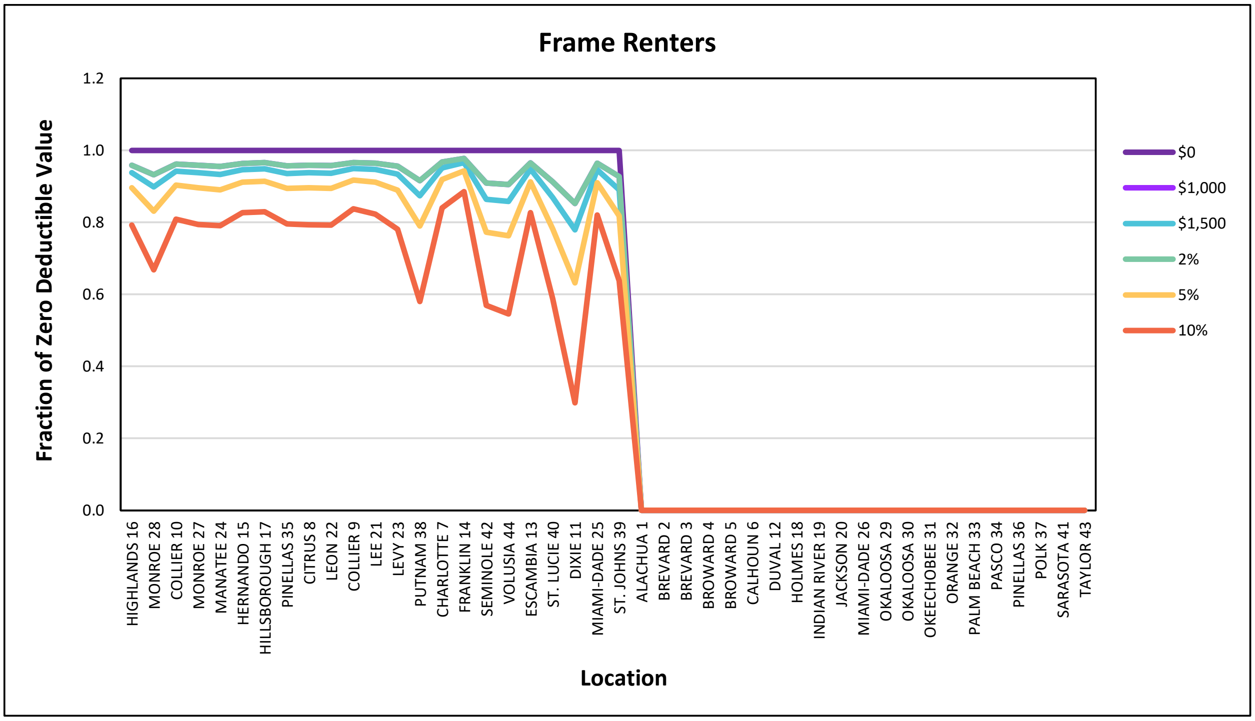


Figure 230. Flood Loss Costs by Deductible - Frame Renters.

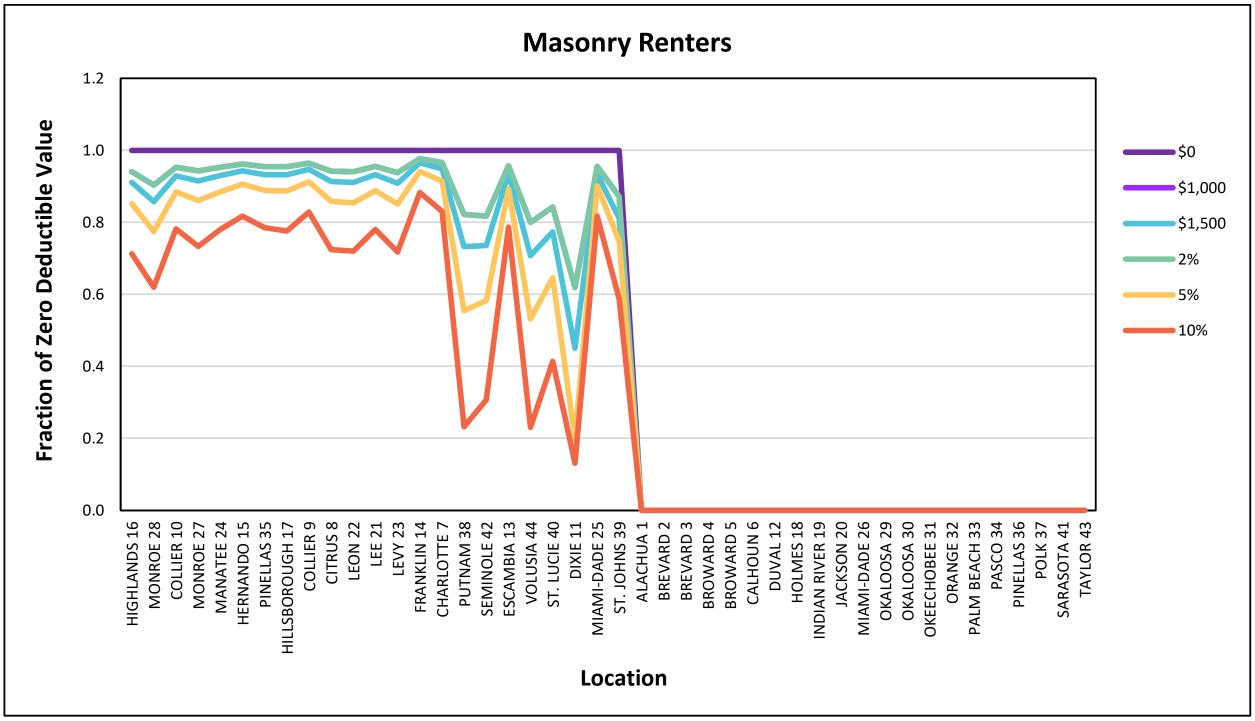


Figure 231. Flood Loss Costs by Deductible - Masonry Renters.

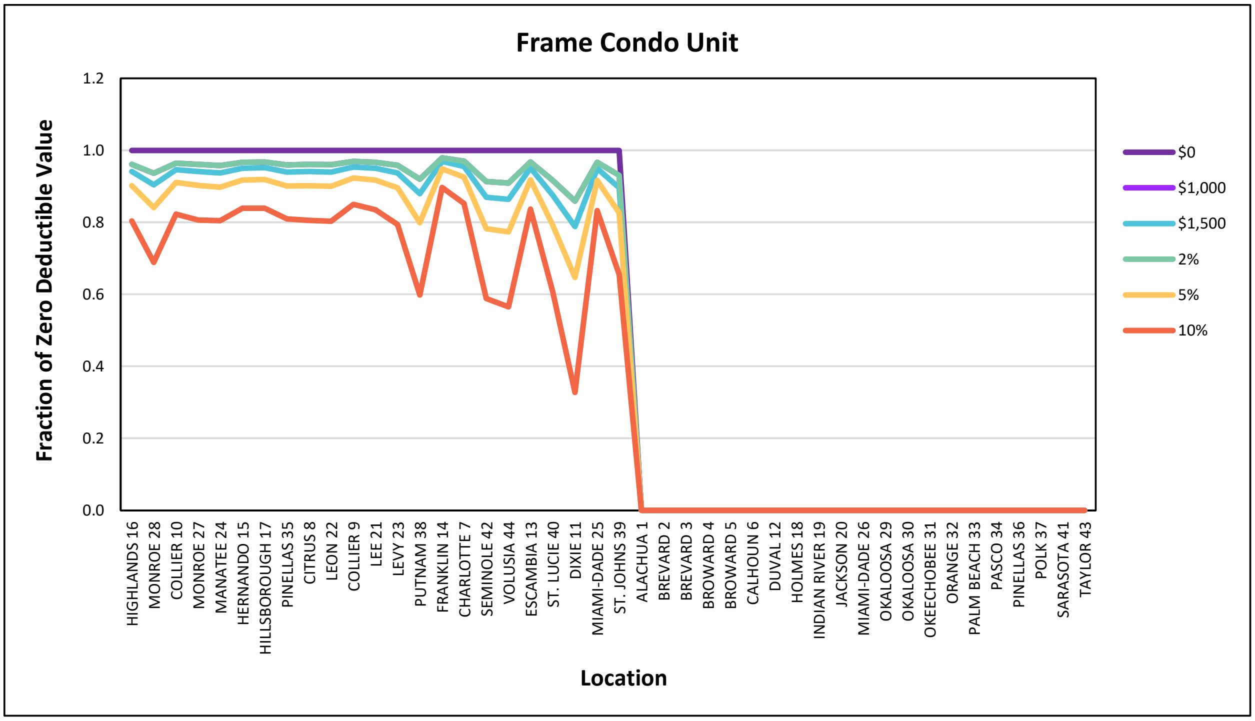


Figure 232. Flood Loss Costs by Deductible - Frame Condo Unit.

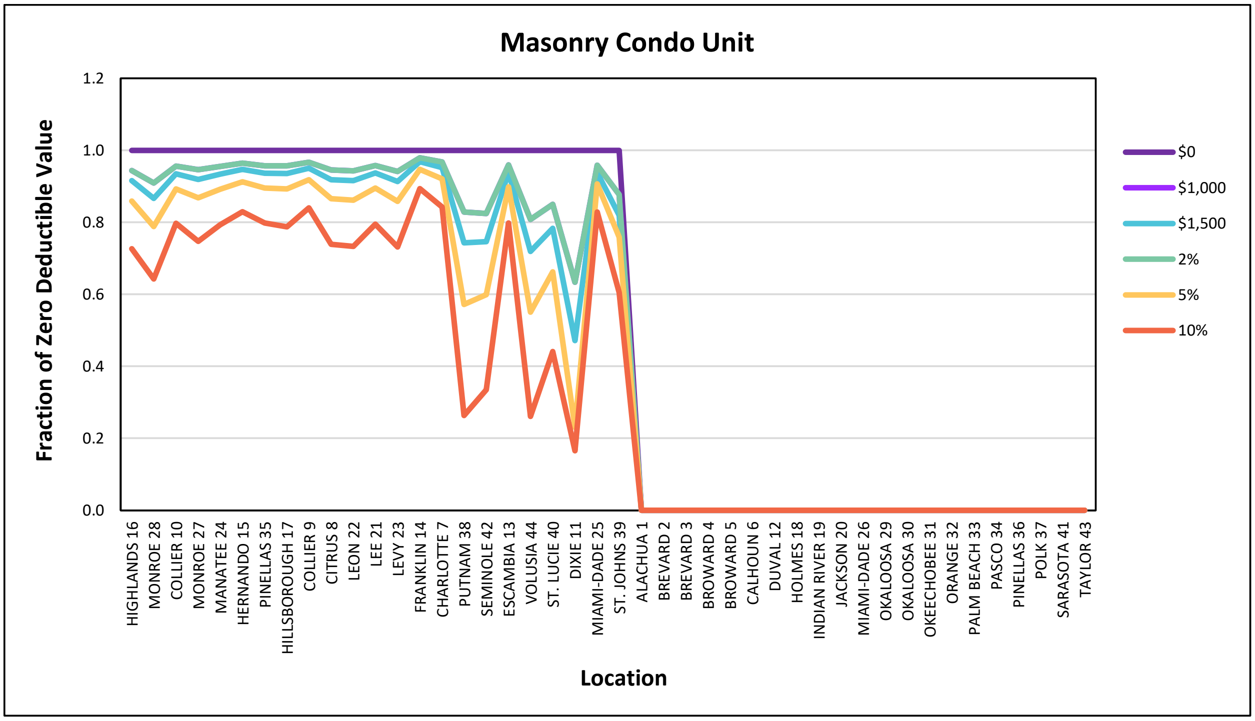


Figure 233. Flood Loss Costs by Deductible - Masonry Condo Unit.

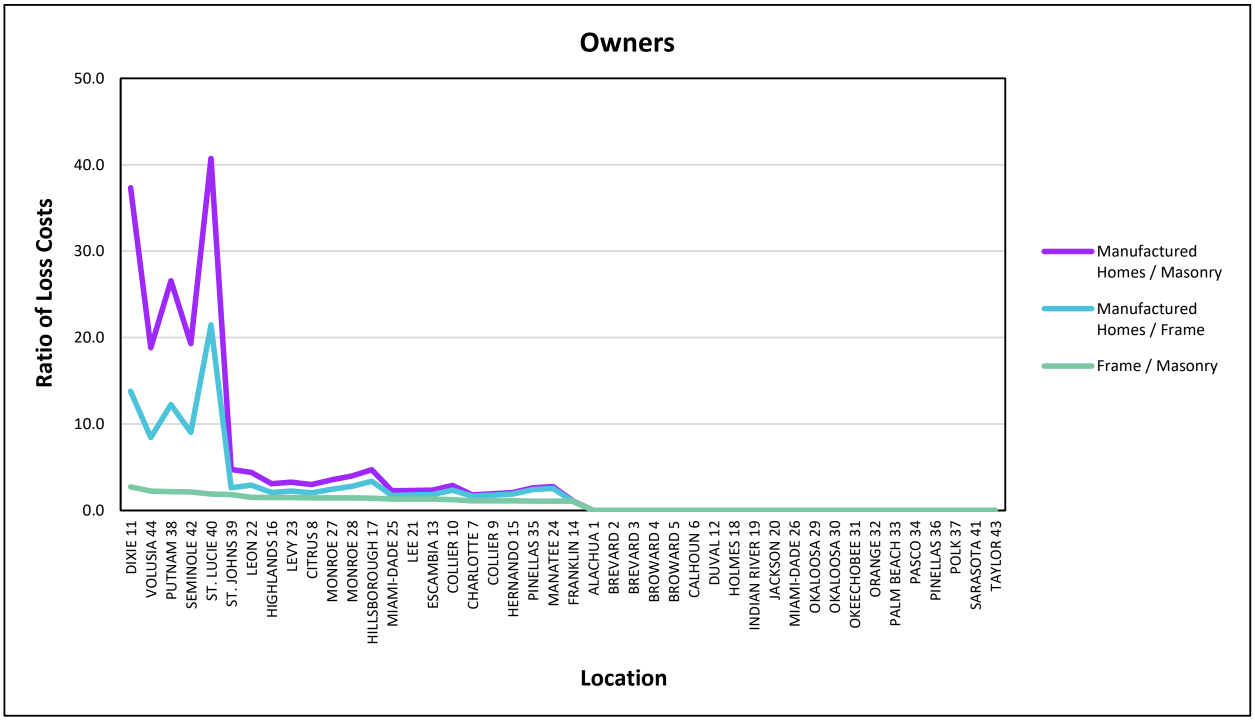


Figure 234. Flood Loss Costs by Policy Form - Owners.

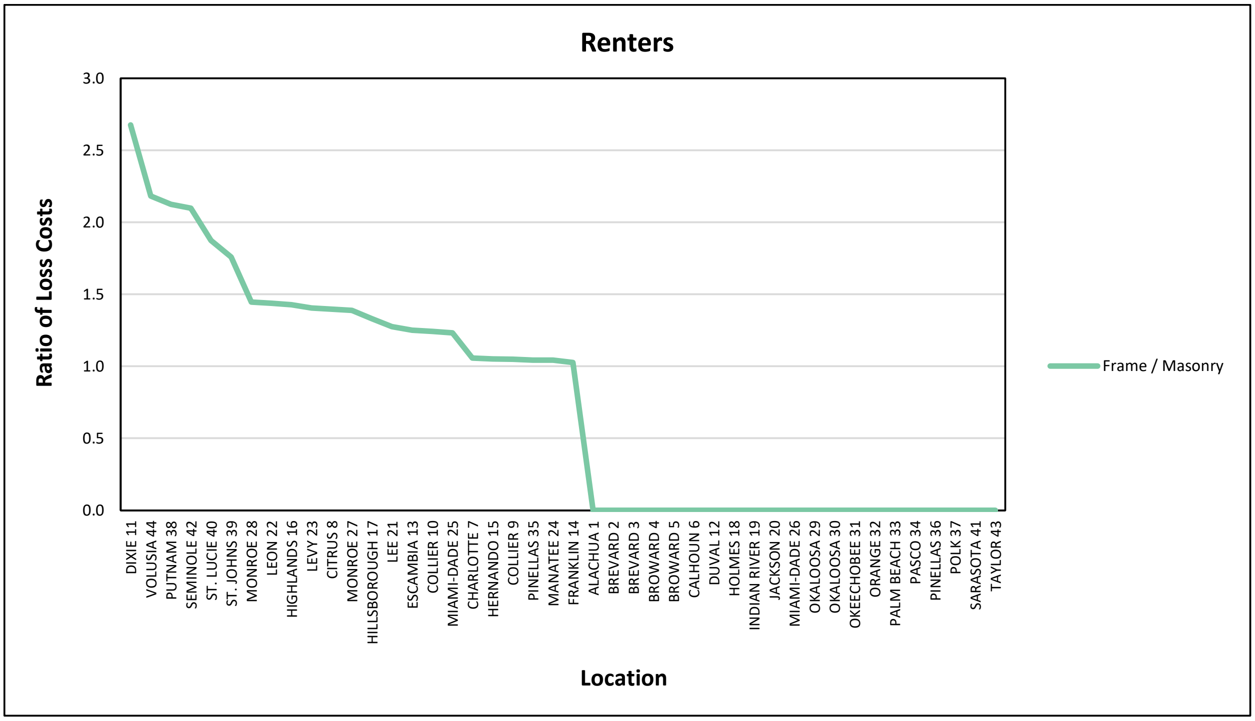


Figure 235. Flood Loss Costs by Policy Form - Renters.

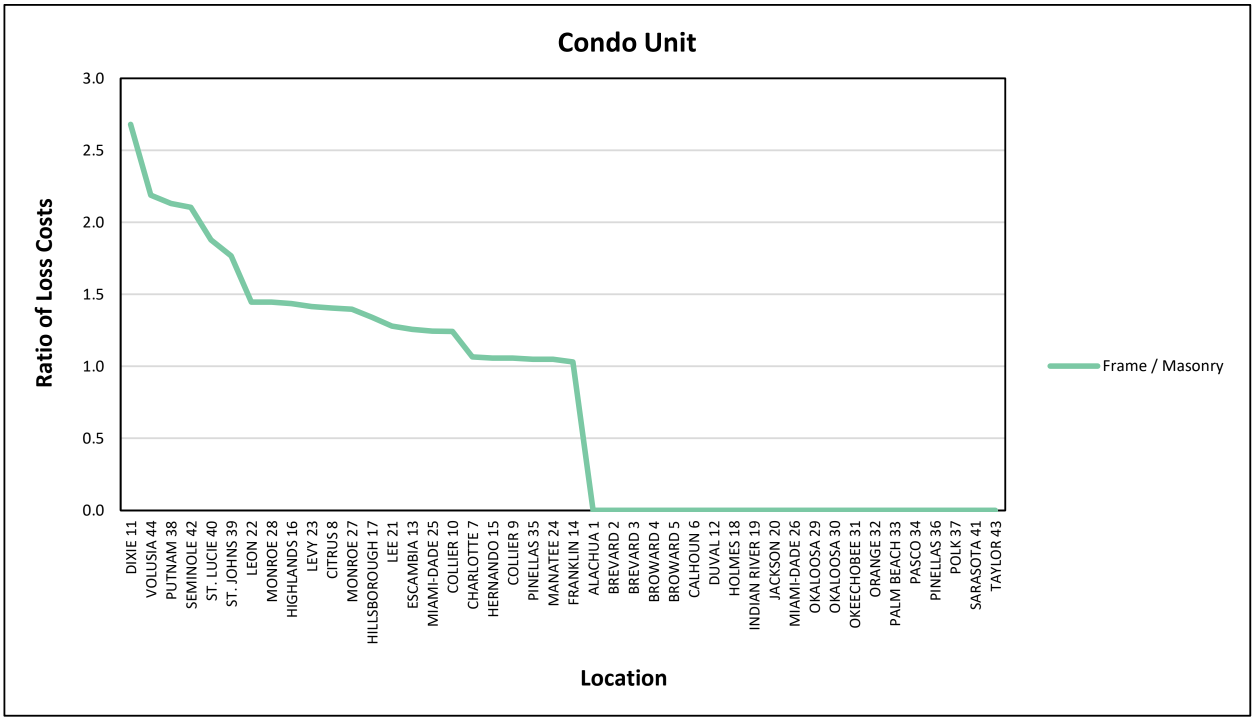


Figure 236. Flood Loss Costs by Policy Form - Condo Unit.

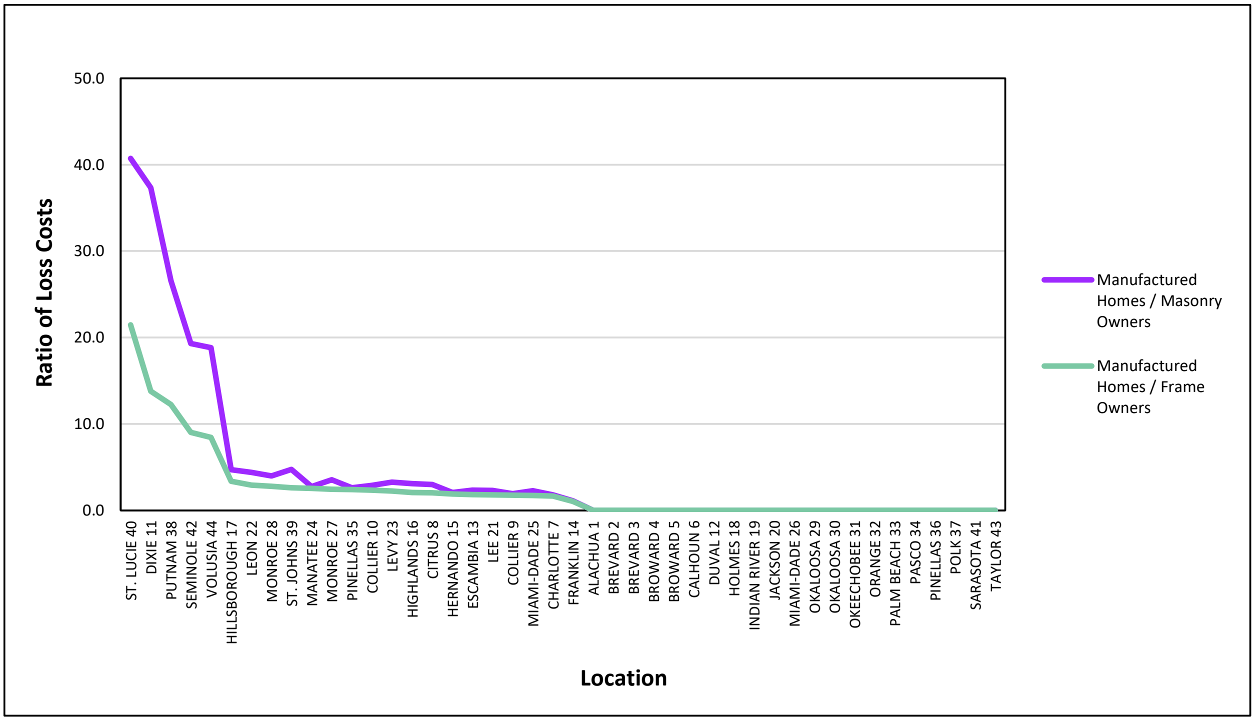


Figure 237. Flood Loss Costs by Construction.

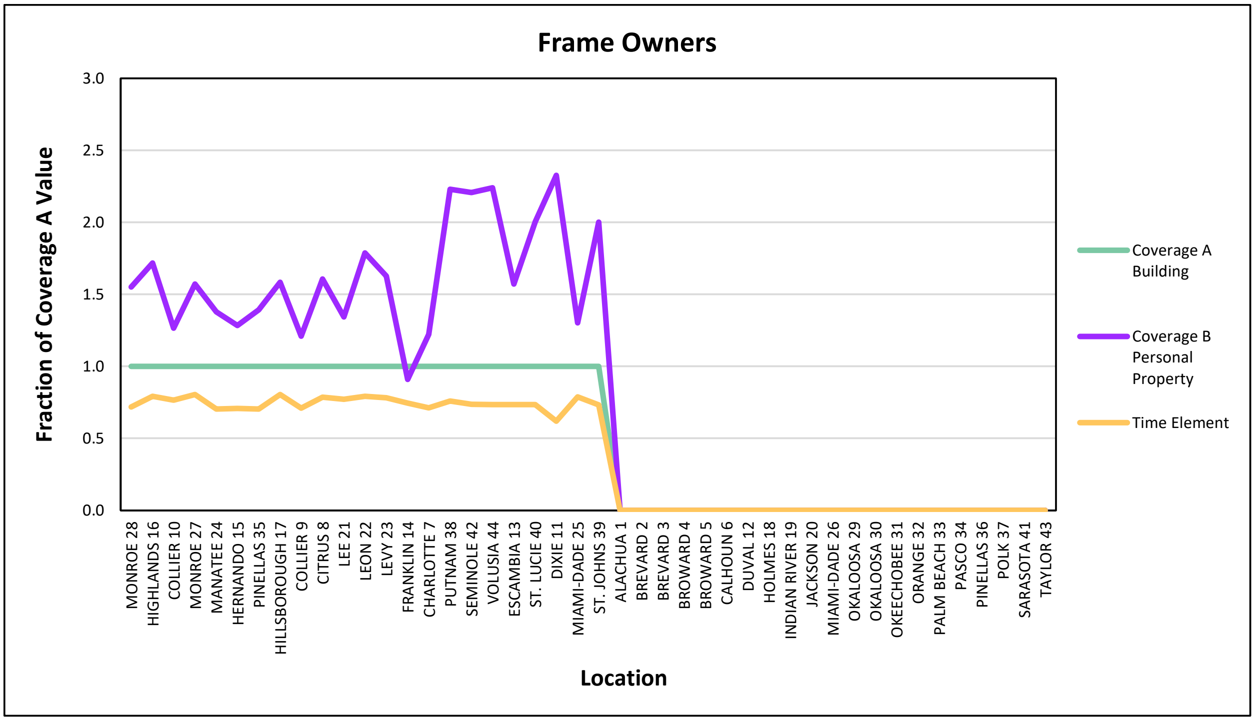


Figure 238. Flood Loss Costs by Coverage - Frame Owners.

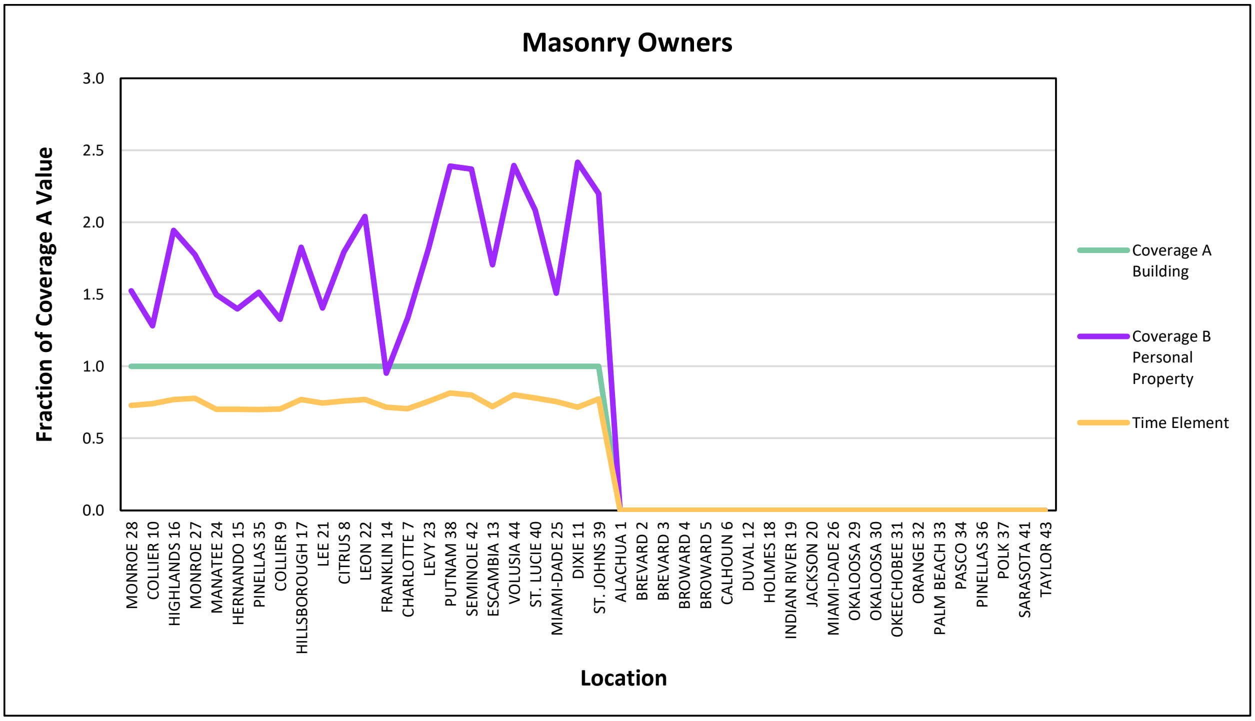


Figure 239. Flood Loss Costs by Coverage - Masonry Owners.

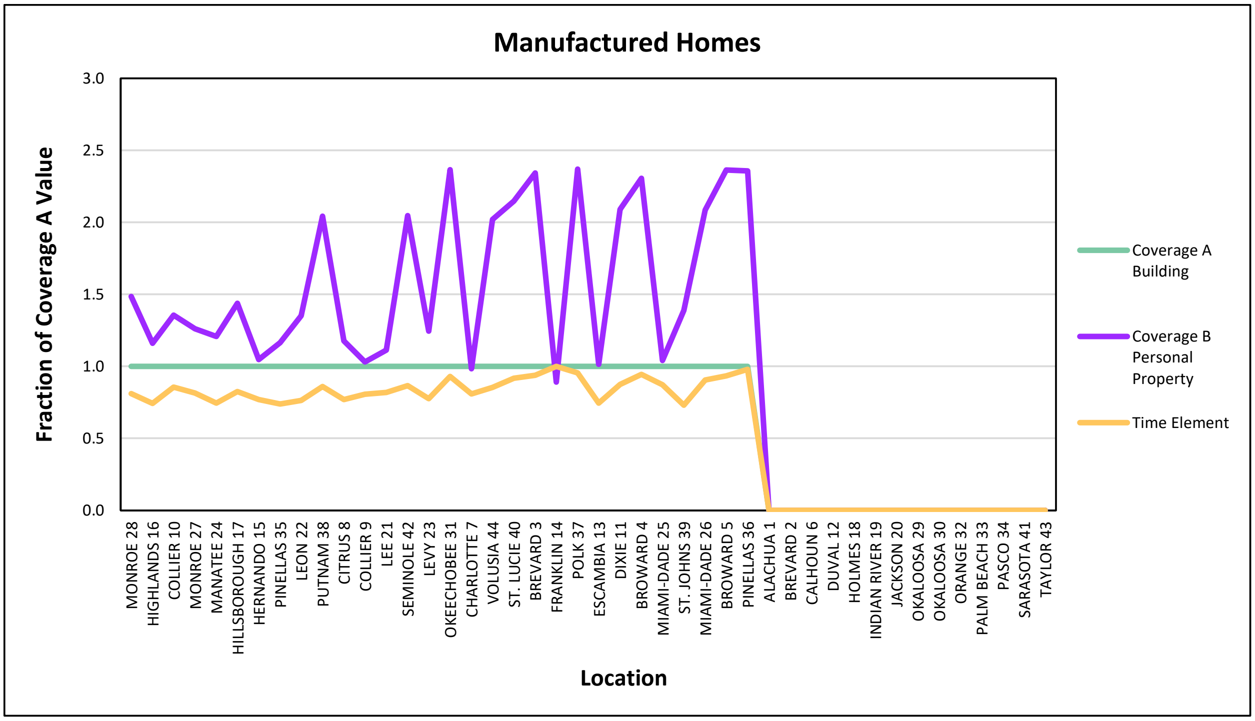


Figure 240. Flood Loss Costs by Coverage - Manufactured Homes.

Figure 241. Flood Loss Costs by Coverage - Frame Renters.

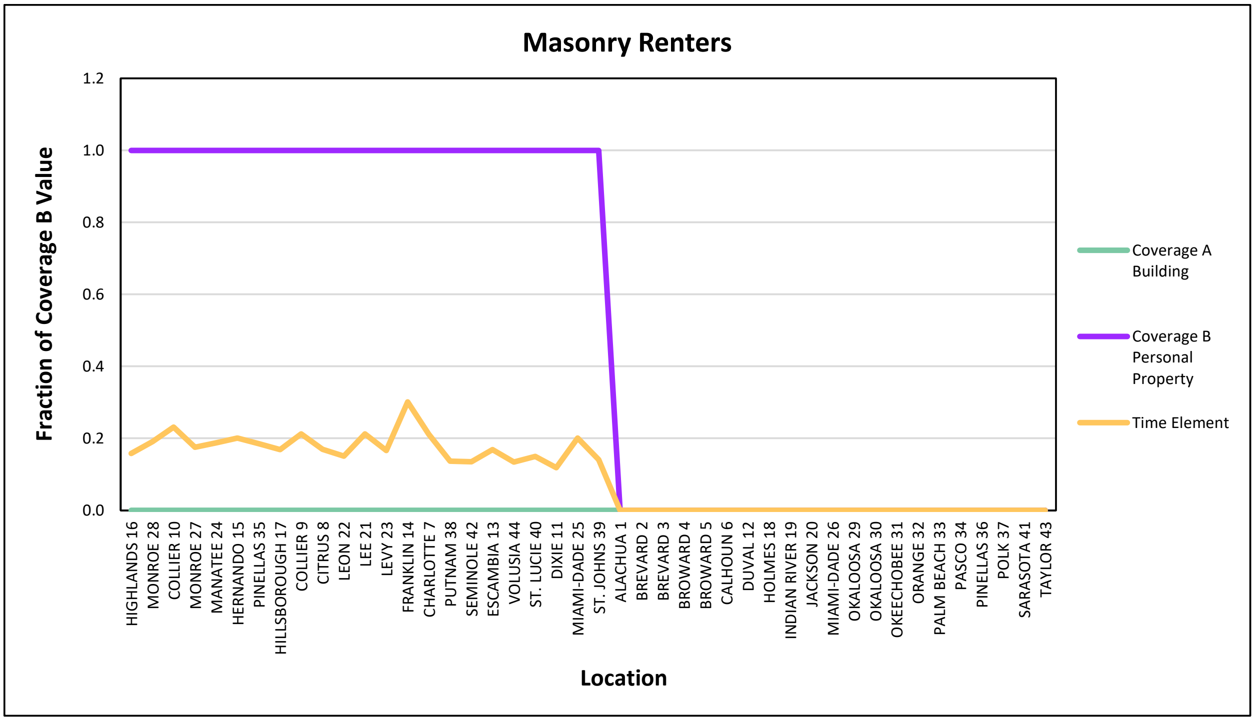


Figure 242. Flood Loss Costs by Coverage - Masonry Renters.

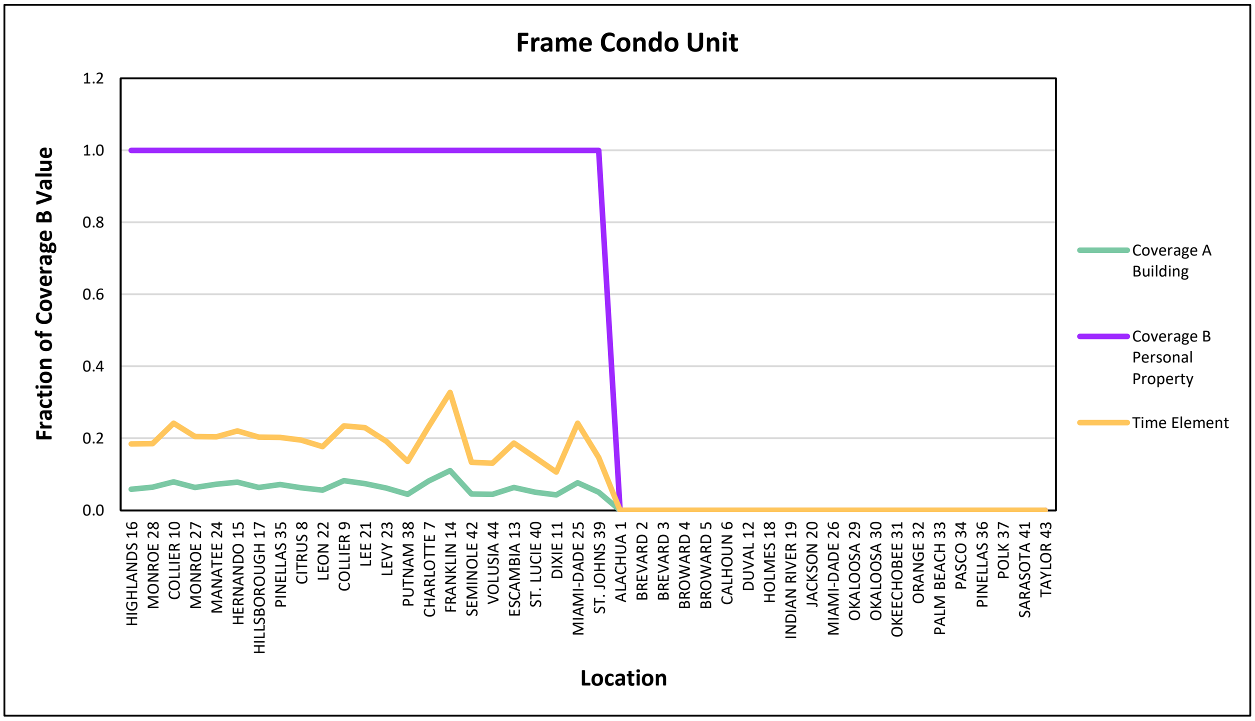


Figure 243. Flood Loss Costs by Coverage - Frame Condo Unit.

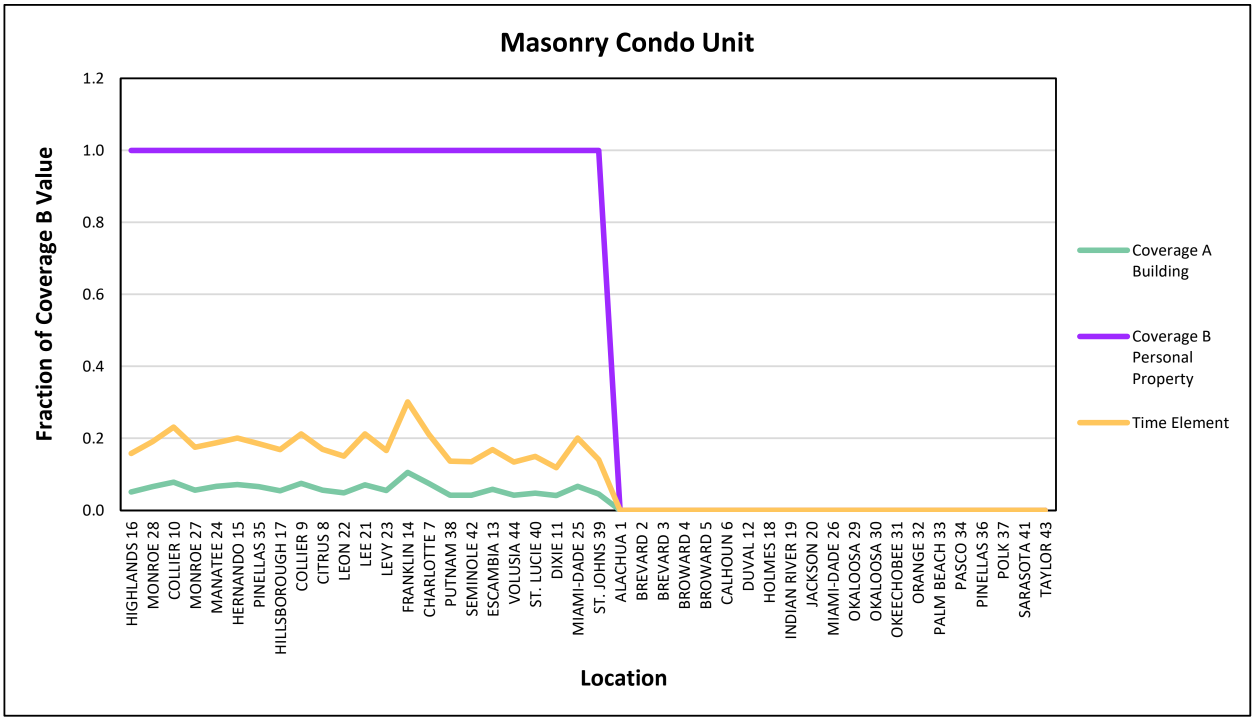


Figure 244. Flood Loss Costs by Coverage - Masonry Condo Unit.

Figure 245. Flood Loss Costs by Year Built - Frame Owners.

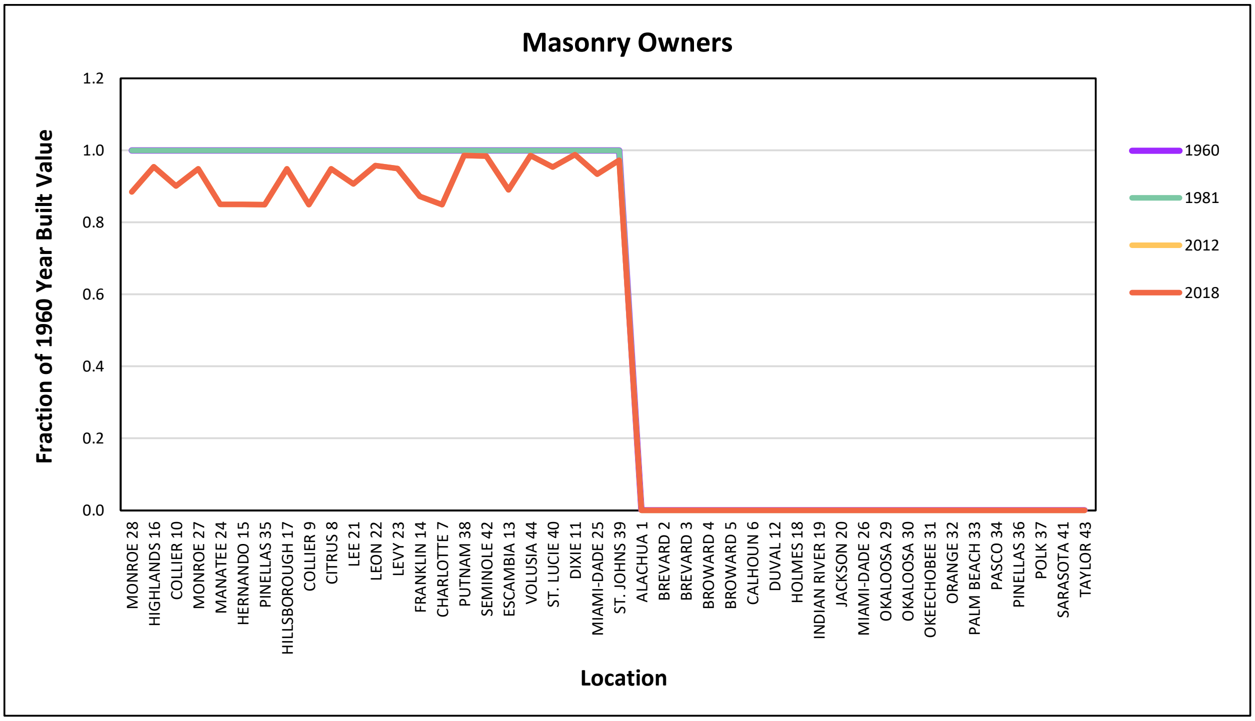


Figure 246. Flood Loss Costs by Year Built - Masonry Owners.

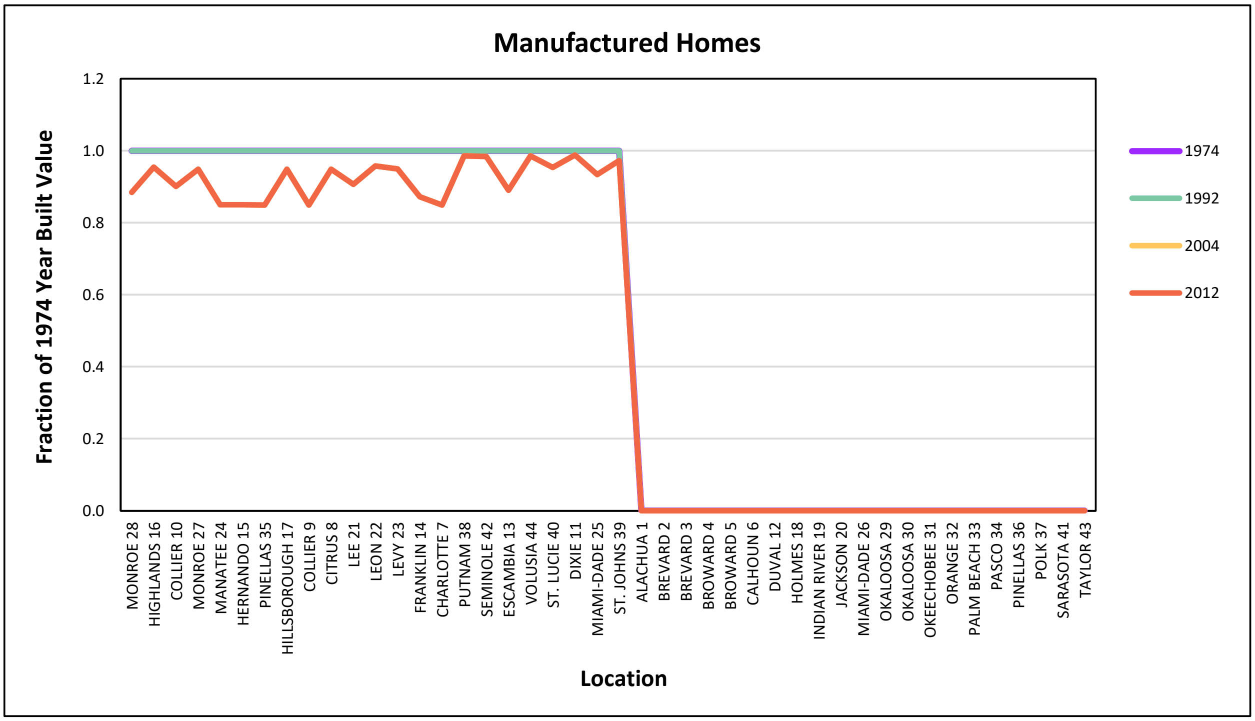


Figure 247. Flood Loss Costs by Year Built - Manufactured Homes.

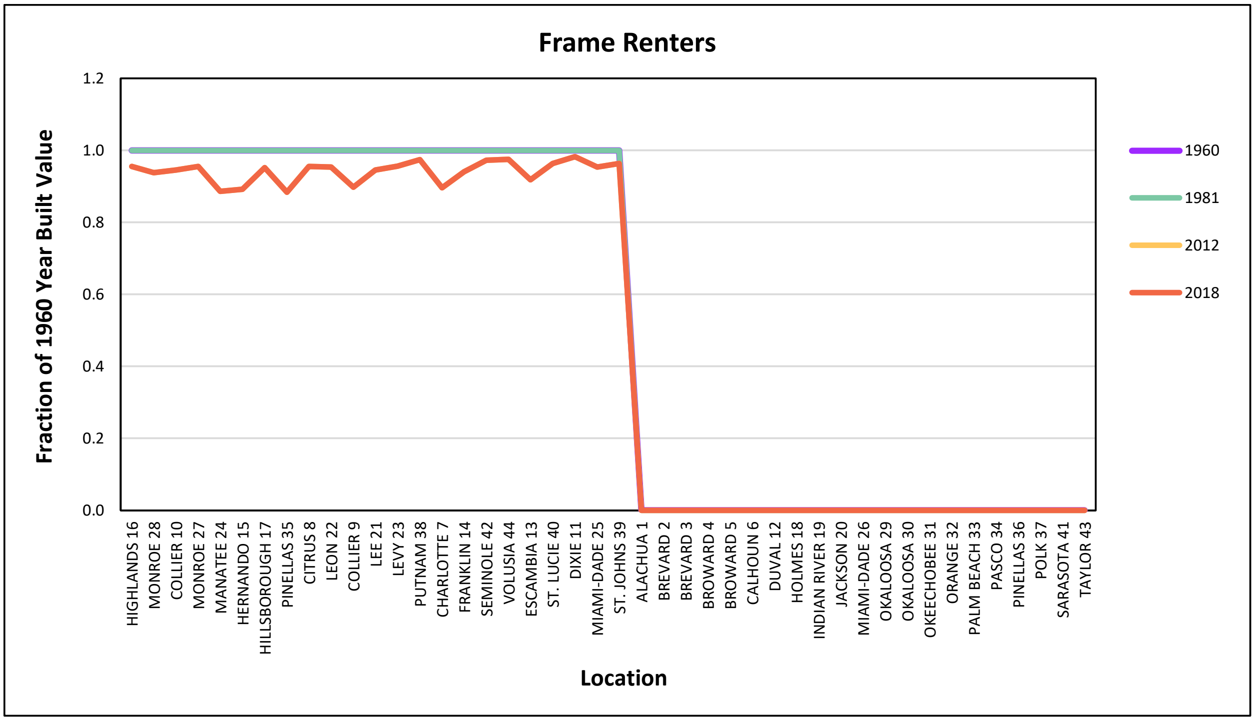


Figure 248. Flood Loss Costs by Year Built - Frame Renters.

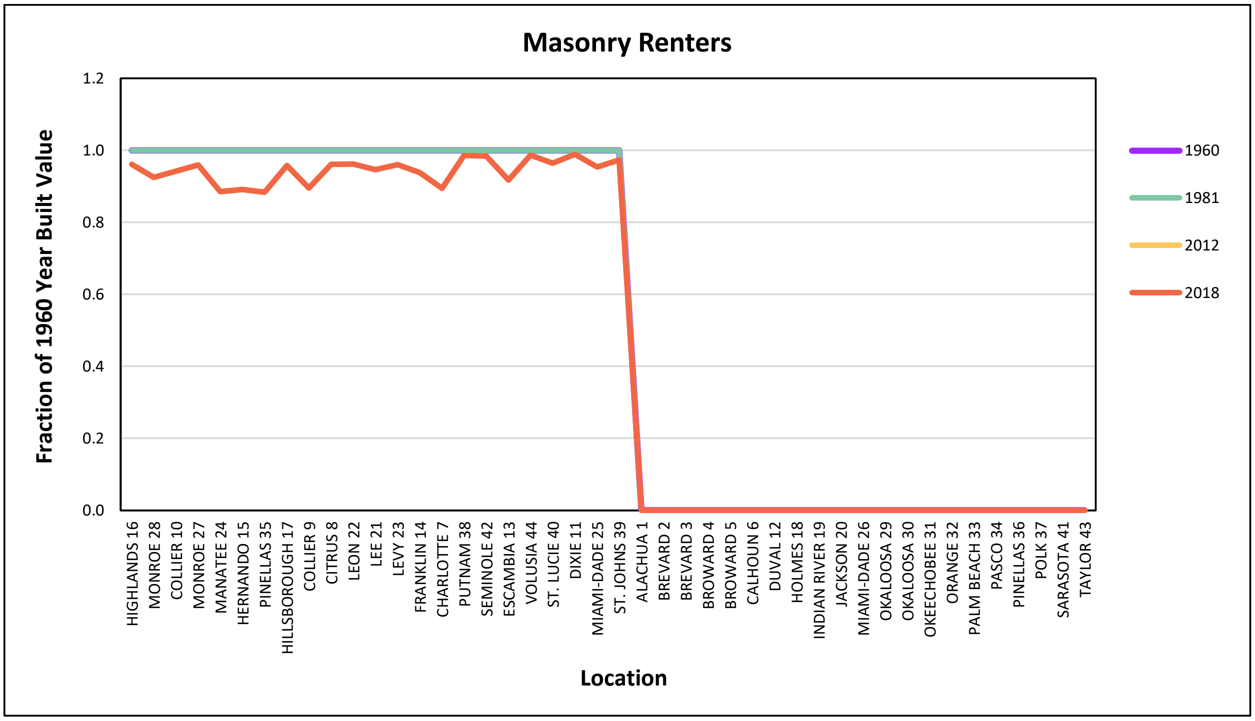


Figure 249. Flood Loss Costs by Year Built - Masonry Renters.

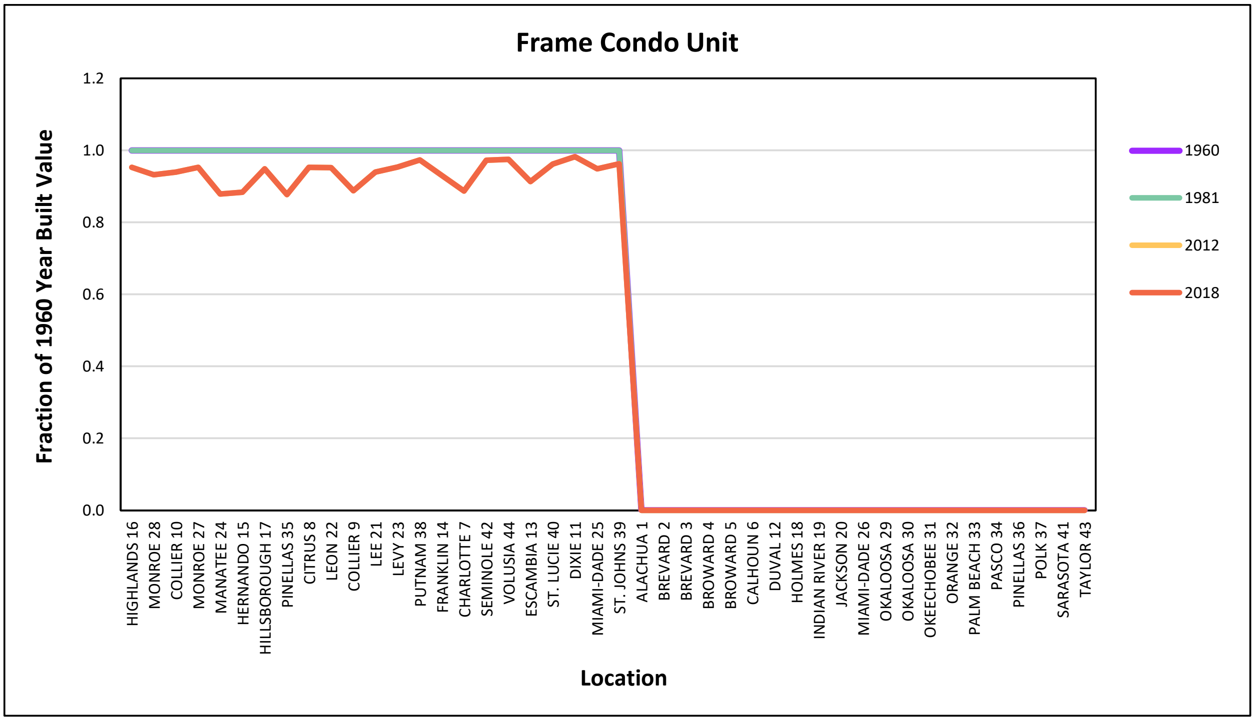


Figure 250. Flood Loss Costs by Year Built - Frame Condo Unit.

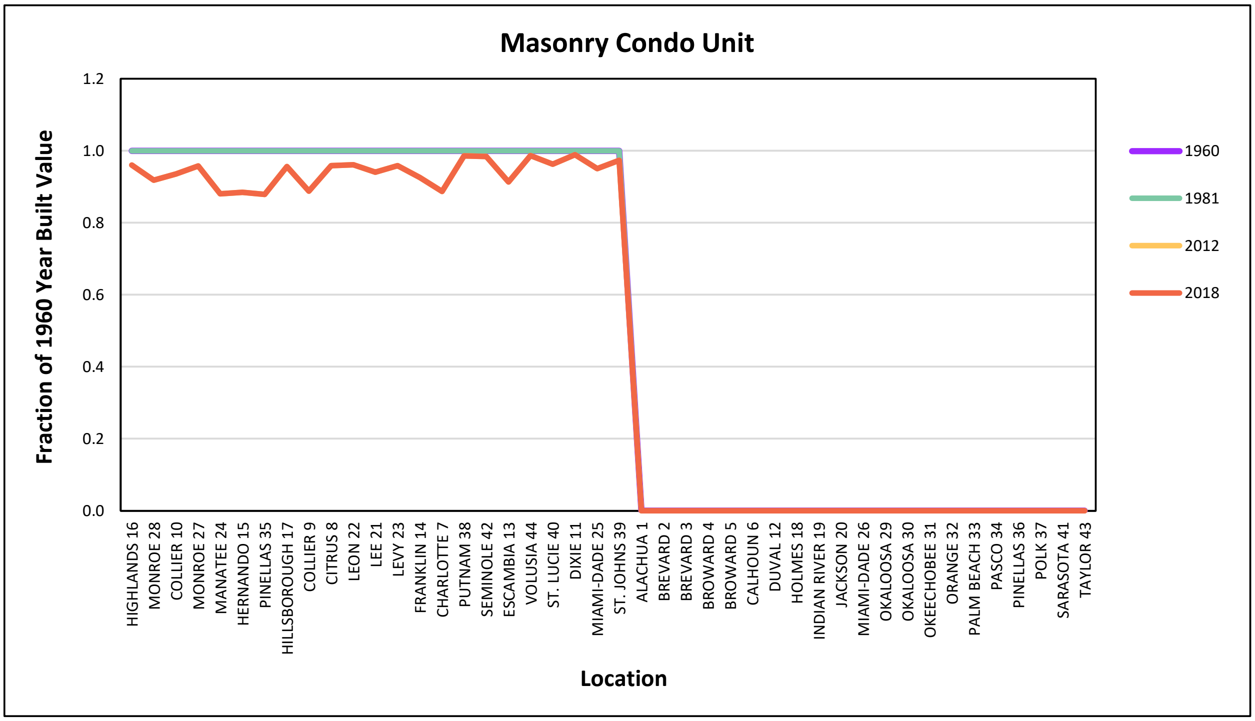


Figure 251. Flood Loss Costs by Year Built - Masonry Condo Unit.

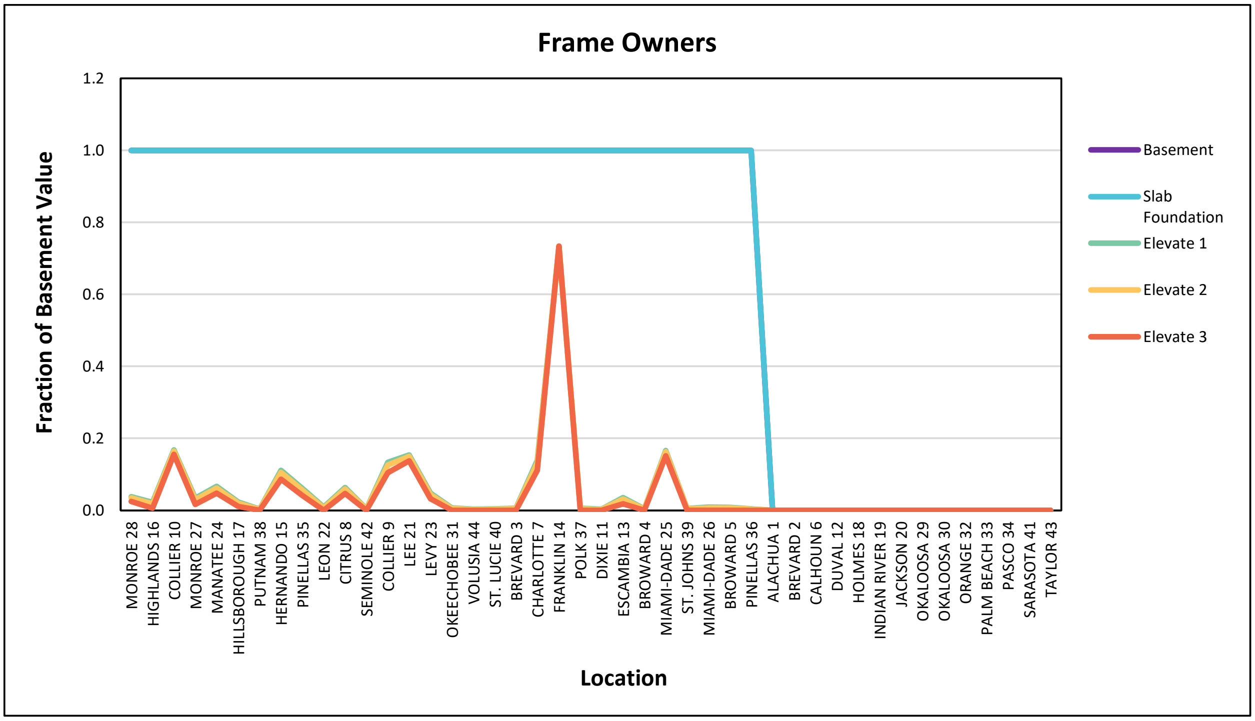


Figure 252. Flood Loss Costs by Foundation Type - Frame Owners.

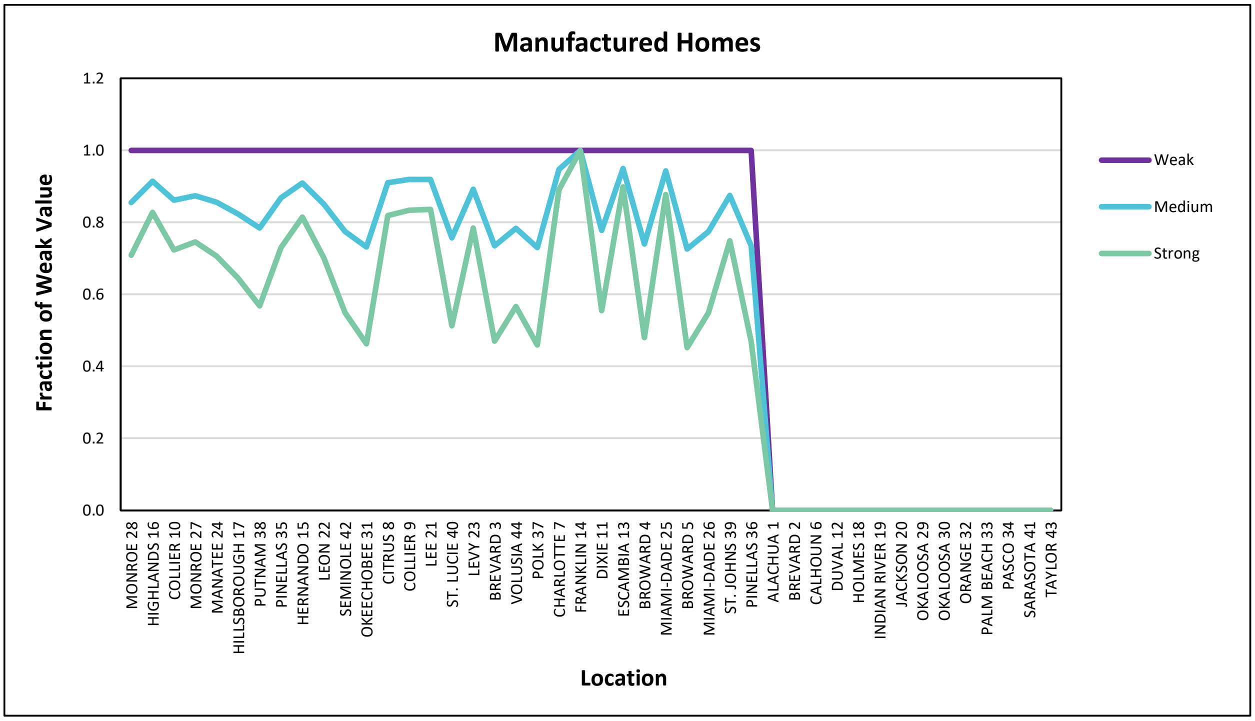


Figure 253. Flood Loss Costs by Foundation Type - Manufactured Homes.

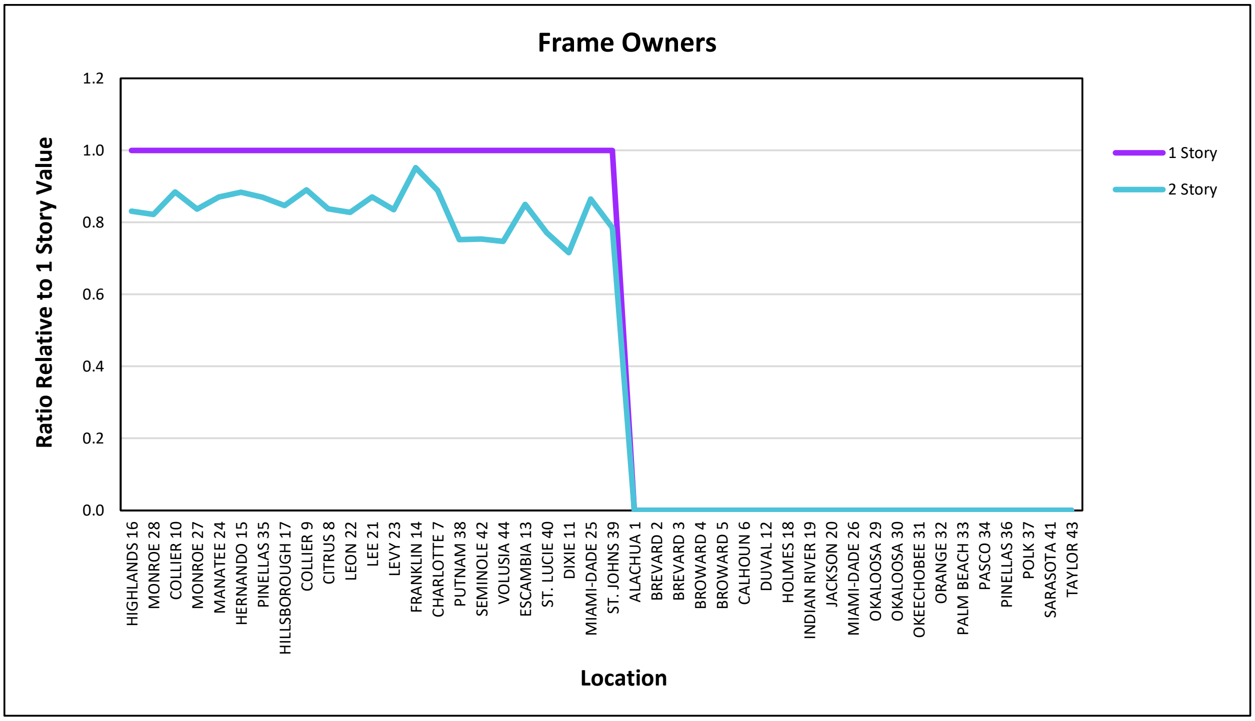


Figure 254. Flood Loss Costs by Number of Stories - Frame Owners.

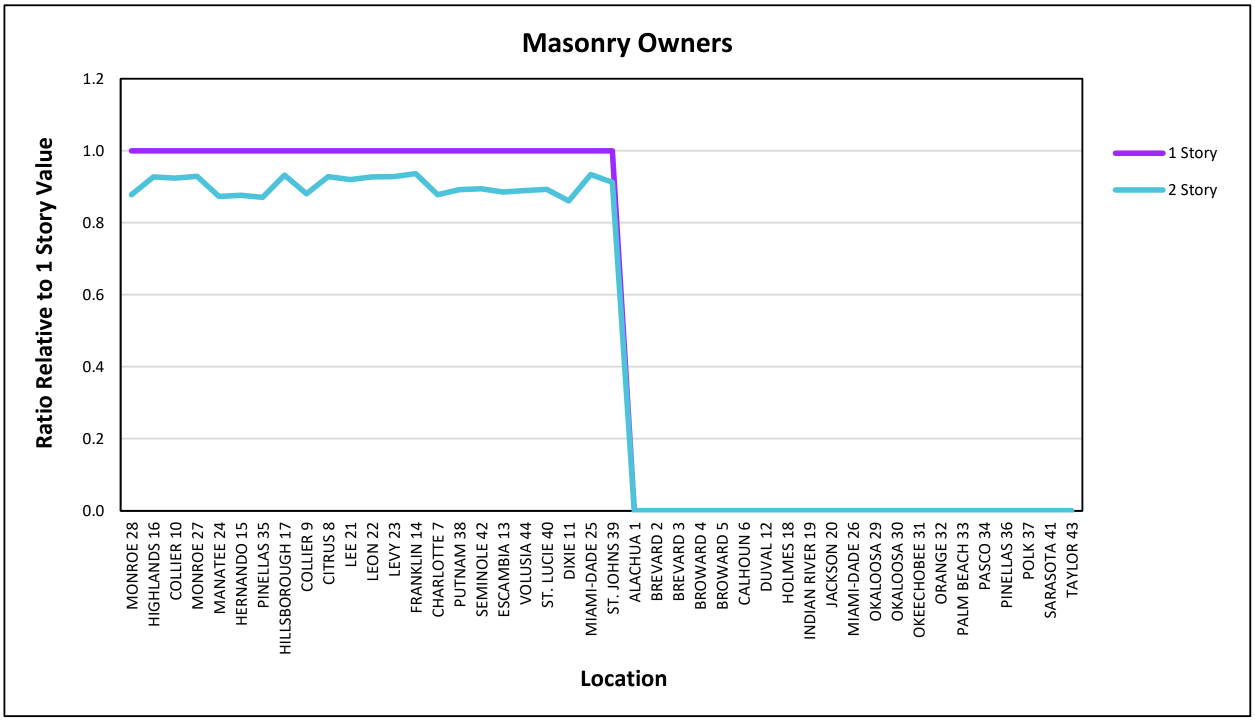


Figure 255. Flood Loss Costs by Number of Stories - Masonry Owners.

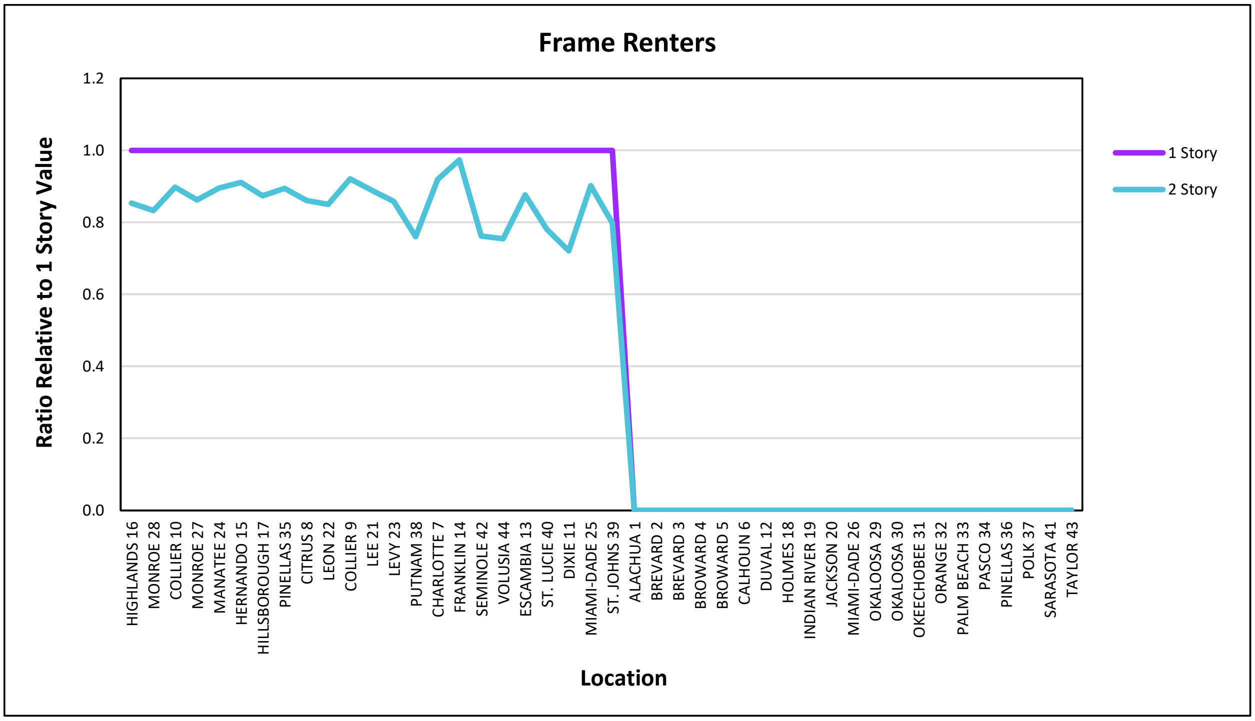


Figure 256. Flood Loss Costs by Number of Stories - Frame Renters.

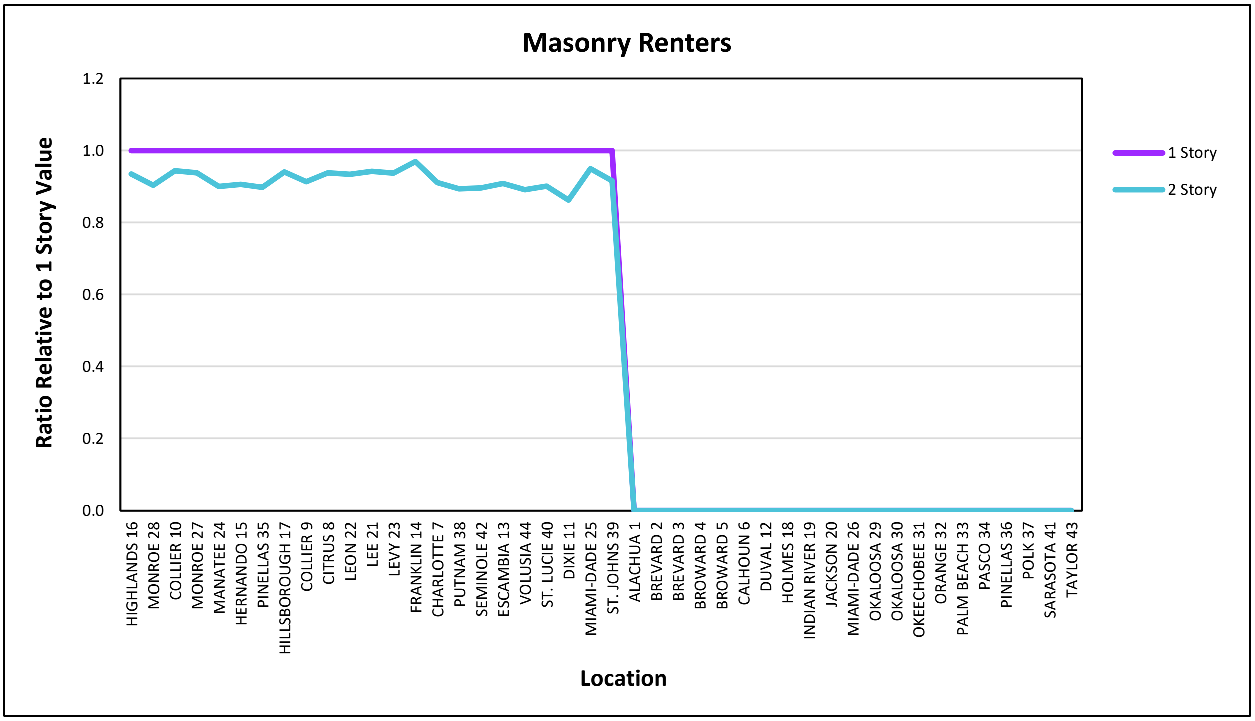


Figure 257. Flood Loss Costs by Number of Stories - Masonry Renters.

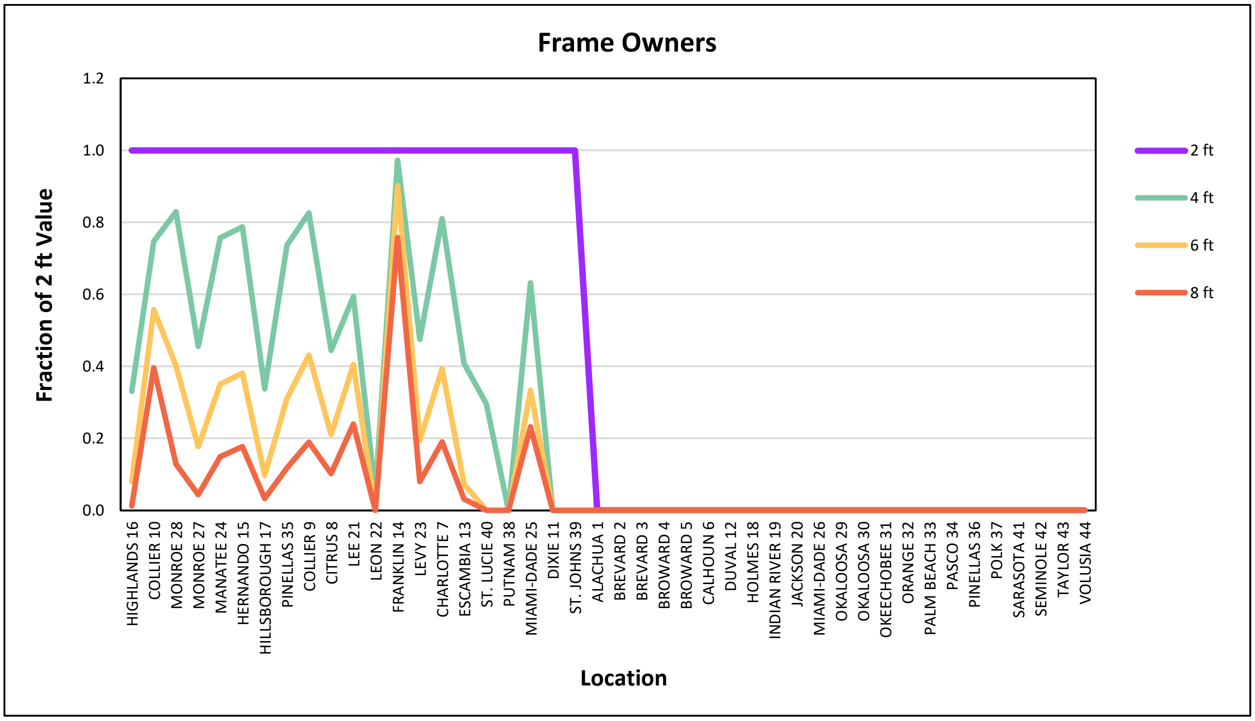


Figure 258. Flood Loss Costs by Lowest Floor Elevation - Frame Owners.

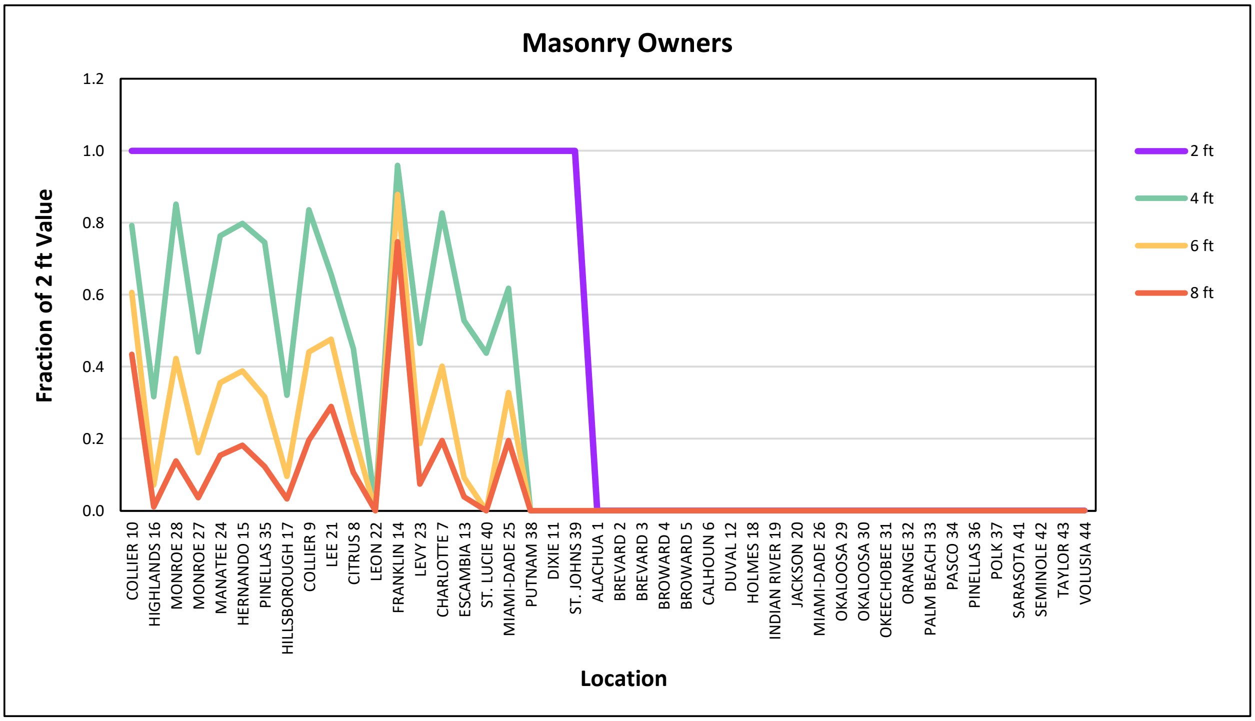


Figure 259. Flood Loss Costs by Lowest Floor Elevation - Masonry Owners.

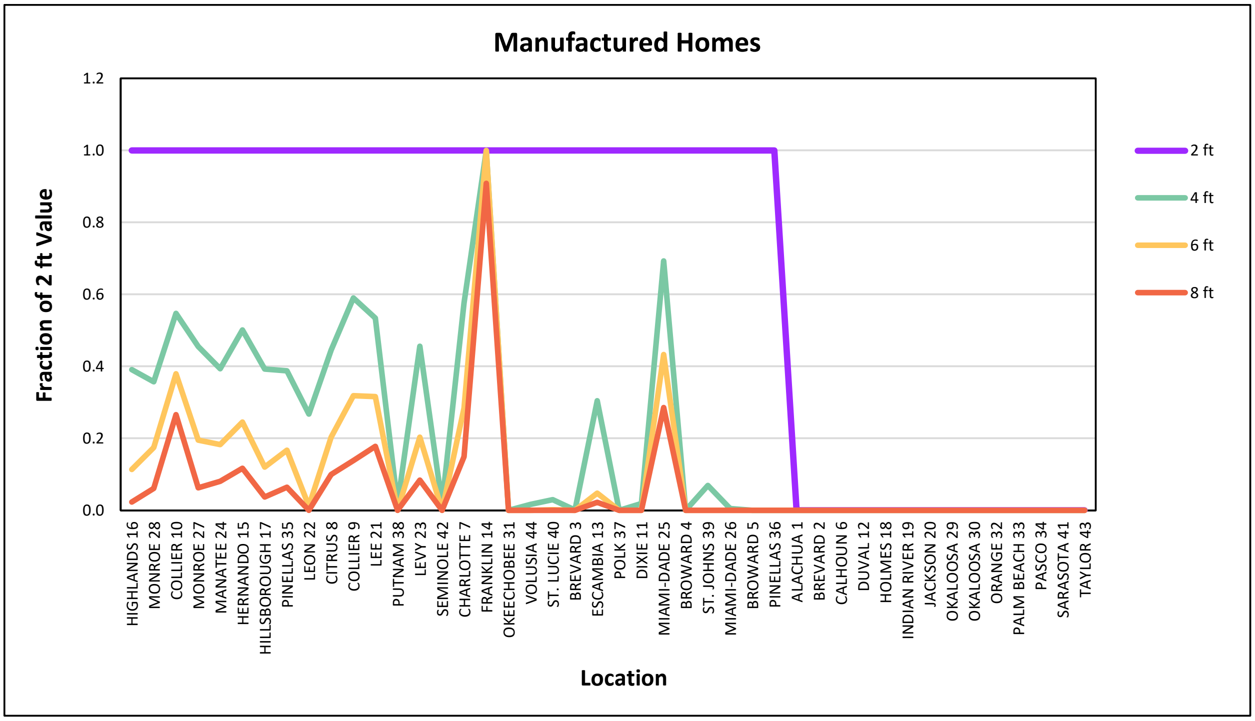


Figure 260. Flood Loss Costs by Lowest Floor Elevation - Manufactured Homes.

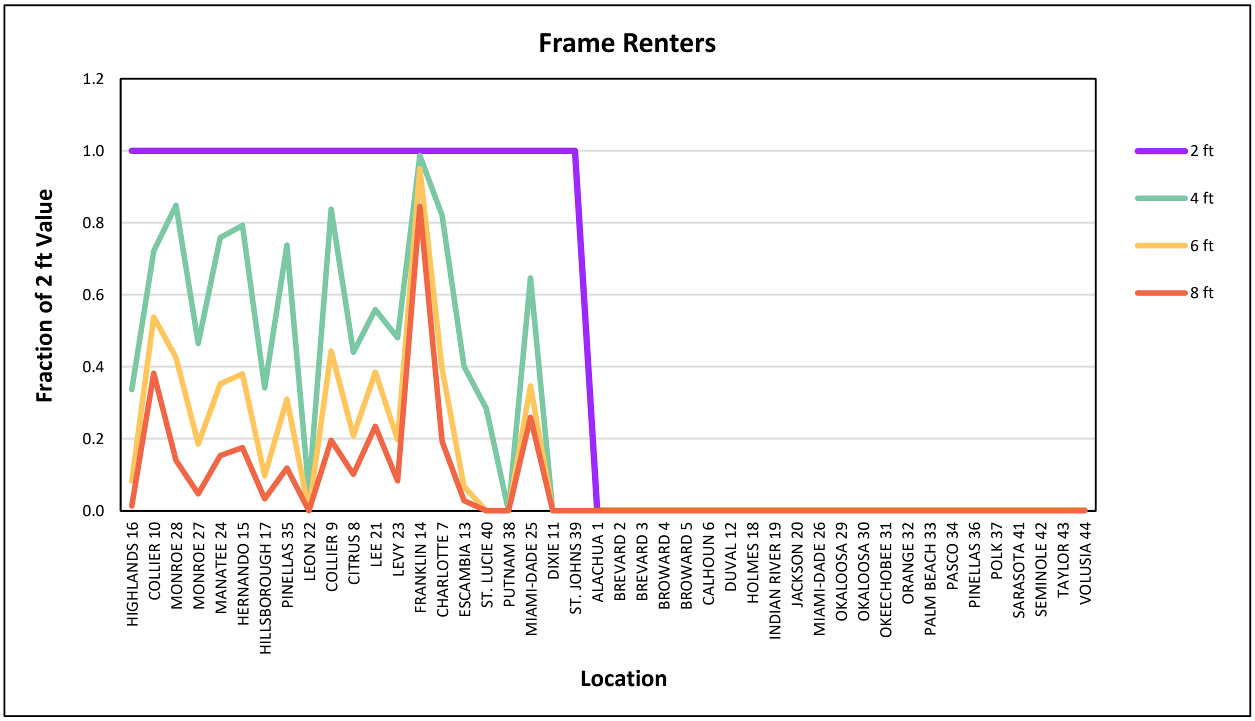


Figure 261. Flood Loss Costs by Lowest Floor Elevation - Frame Renters.

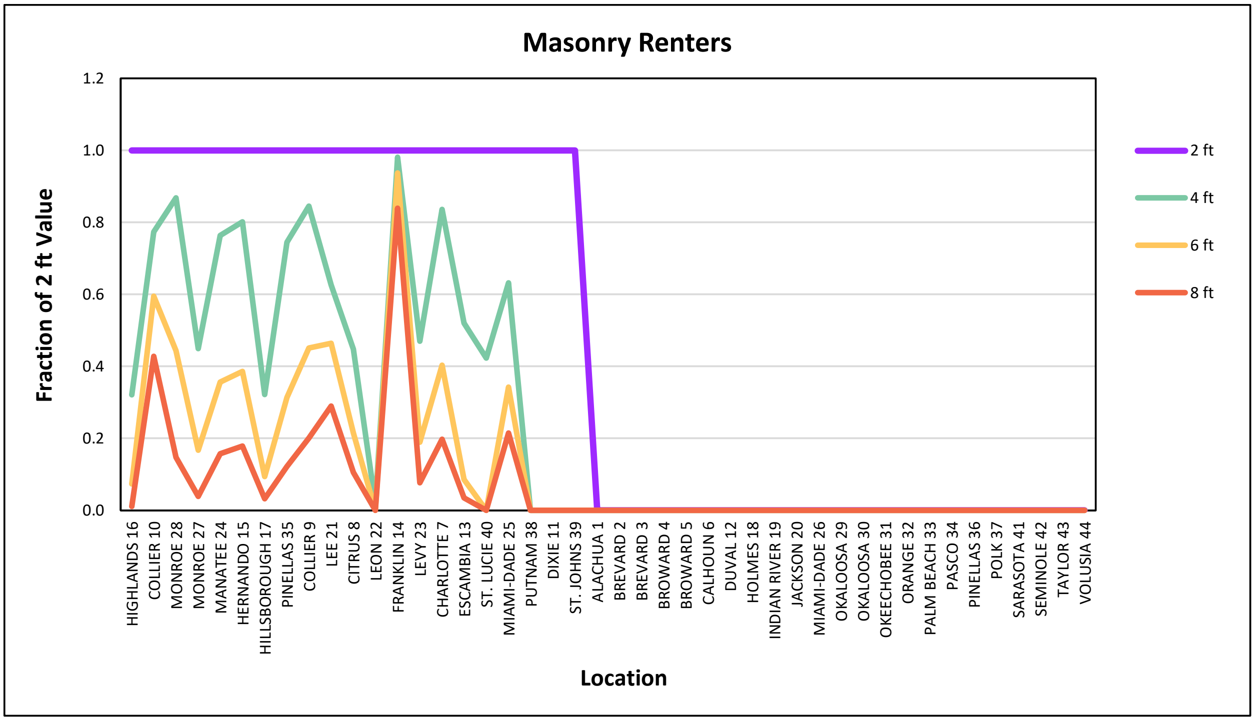


Figure 262. Flood Loss Costs by Lowest Floor Elevation - Masonry Renters.

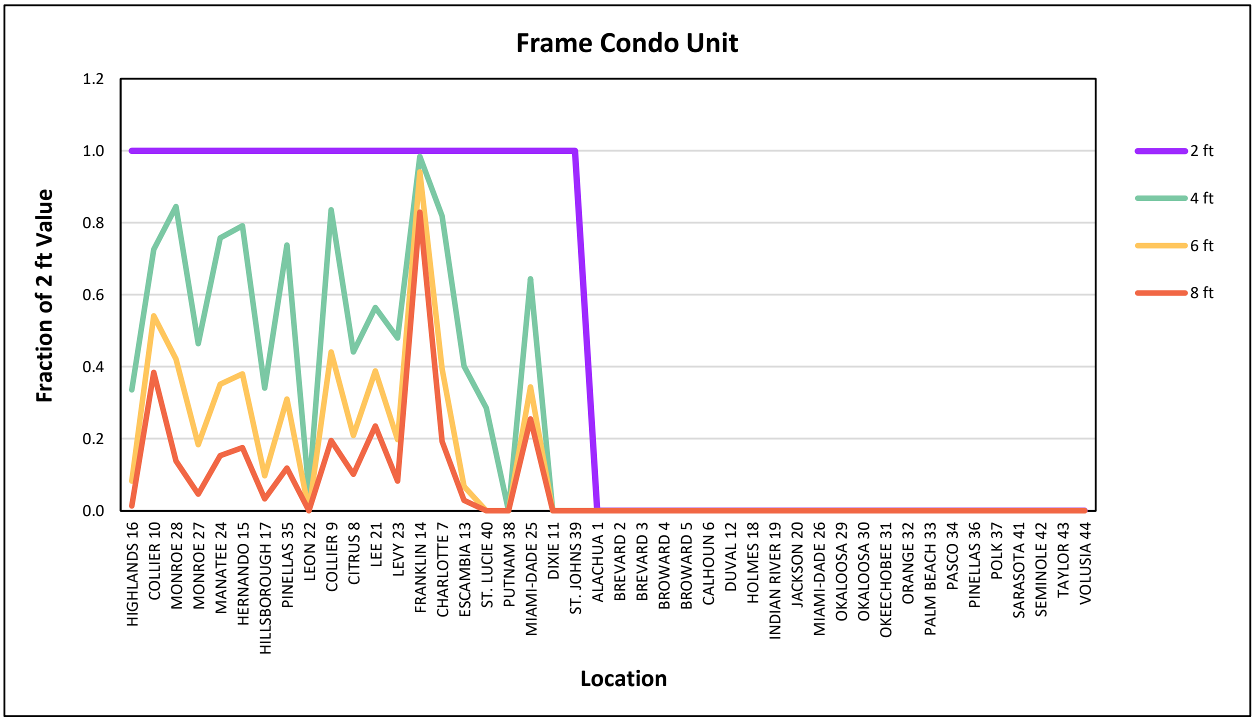


Figure 263. Flood Loss Costs by Lowest Floor Elevation - Frame Condo Unit.

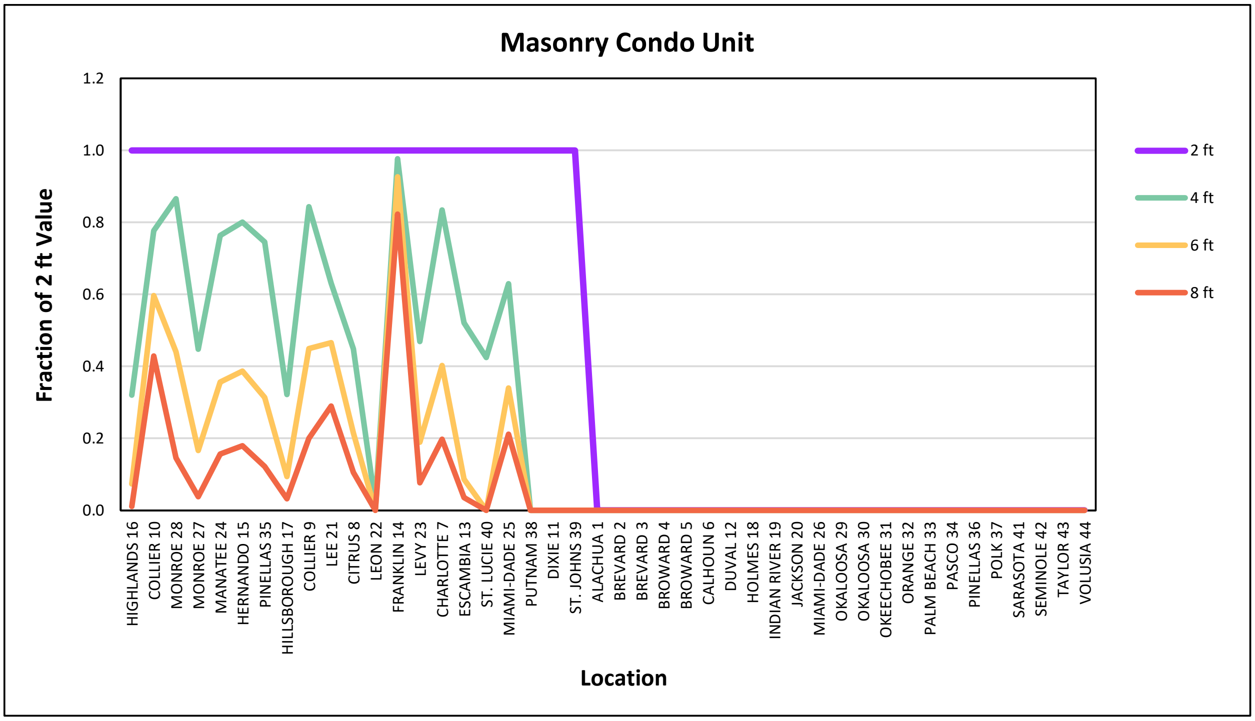


Figure 264. Flood Loss Costs by Lowest Floor Elevation - Masonry Condo Unit.

F. Create an exposure set and report flood loss cost results for slab foundation owners frame buildings (Notional Set 6) for each of the points in Location Grid B as described in the file "NotionalInput21_Flood.xlsx."

The flood loss costs for slab foundation owners frame buildings are presented in the following charts.

G. Provide a color-coded contour or high-resolution map of the flood loss costs for coastal flooding. Provide a scatter plot of the flood loss costs (y-axis) against distance to closest coast (x-axis).

See following charts.

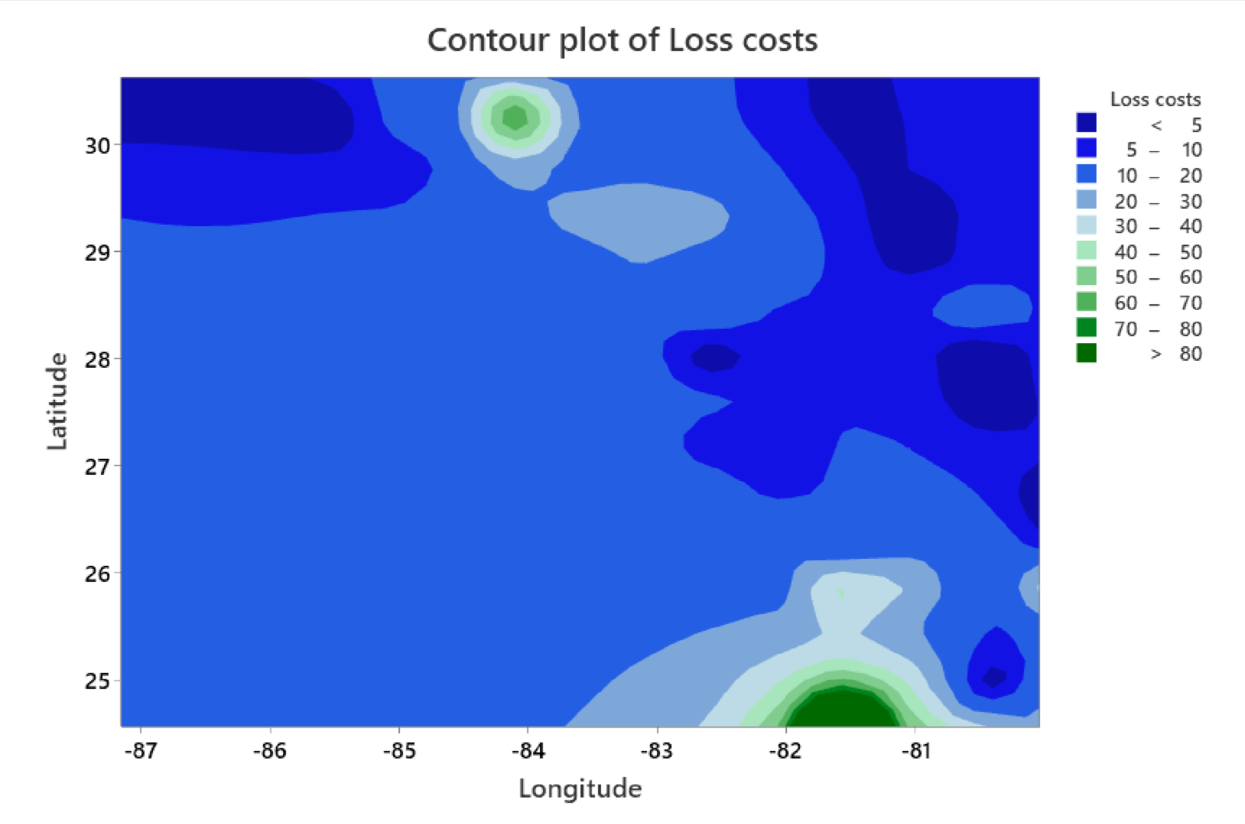


Figure 265. Flood Contour Plot of Loss Costs.

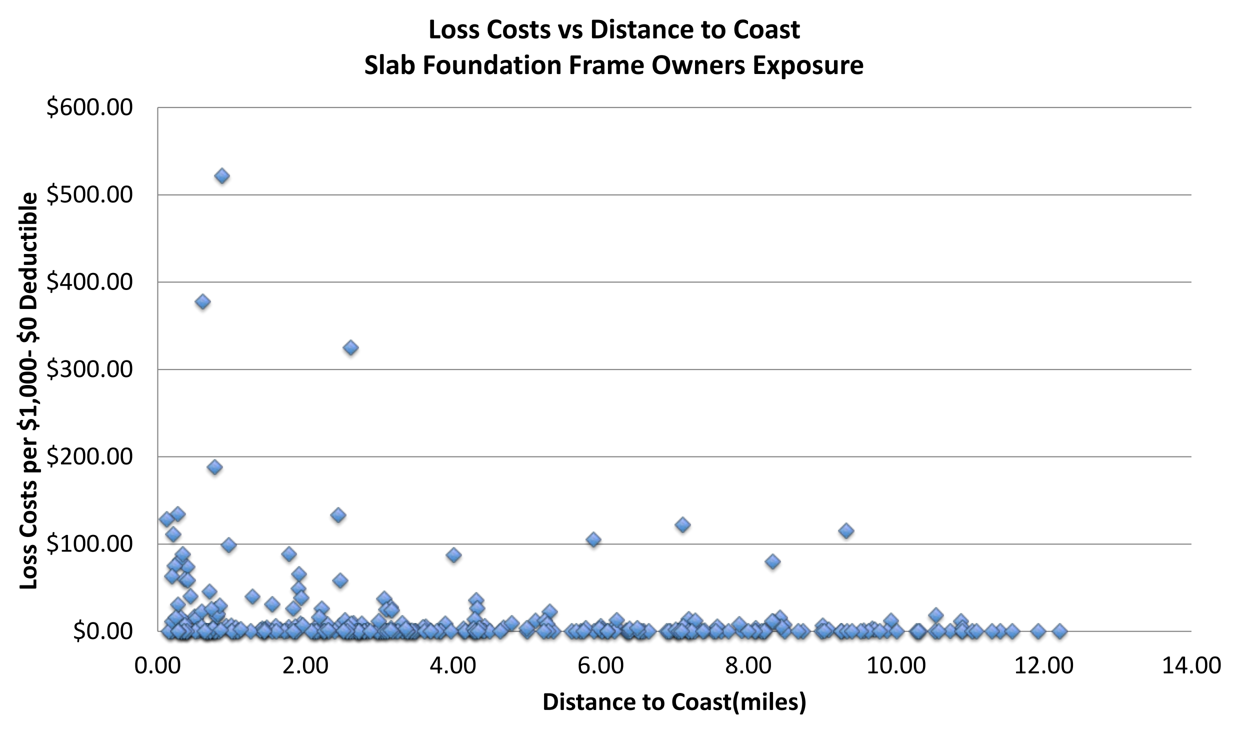


Figure 266. Flood Loss Costs vs. Distance to Coast.

H. Describe how Law and Ordinance is included in the flood loss costs.

A provision for Law and Ordinance coverage is embedded in the vulnerability matrices and is therefore reflected in the loss costs reported in this form.

I. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

The time element limit was assumed to be 20% of Coverage A for Owners and Manufactured Homes and 40% of Coverage B for Renters and Condo.

In the Deductible Sensitivity test, the deductible for Owners and Manufactured Homes was applied to the building loss only. The model assumes separate deductibles for building and contents in line with the NFIP approach. For Renters and Condo the deductible was applied to contents.

In the Foundation Type Sensitivity test, the 1-Story Basement was modeled with the same vulnerability as Slab-on-Grade. The model does contemplate a Basement type foundation.

In the Foundation Type Sensitivity test, the Unknown foundation type for Manufactured Homes was modeled as Partially Tied-Down.

In the Foundation Type Sensitivity test, the elevated exposures assume an FFE of 8 feet.

Form AF-7: Percentage Change in Logical Relationships to Flood Risk

A. One or more automated programs or scripts should be used to generate the exhibits in Form AF-7, Percentage Change in Logical Relationships to Flood Risk.

Not applicable.

B. Provide summaries of the percentage change in logical relationship to flood risk exhibits from the currently accepted flood model in the format shown in the file named "2021FormAF7.xlsx."

Not applicable.

C. Create exposure sets for each exhibit by modeling all of the coverages from the appropriate Notional Set listed below at each of the locations in Location Grid B as described in the file "NotionalInput21_Flood.xlsx." Refer to the Notional Hurricane Policy Specifications provided in Form AF-6, Logical Relationships to Flood Risk (Trade Secret Item), for additional modeling information.

Deductible Sensitivity Set 1
Policy Form Sensitivity Set 2
Construction Sensitivity Set 3
Coverage Sensitivity Set 4
Year Built Sensitivity Set 5
Foundation Type Sensitivity Set 6
Number of Stories Sensitivity Set 7
Lowest Floor Elevation of Residential Structure Sensitivity Set 8

Not applicable.

D. Flood models are to treat points in Location Grid B as coordinates that would result from a geocoding process. Flood models should treat points by simulating flood loss at exact location or by using the nearest modeled parcel/street/cell in the flood model. Provide the results statewide (overall percentage change) and by the regions defined in Form AF-5, Percentage Change in Flood Output Ranges.

Not applicable.

E. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include all exhibits in Form AF-7, Percentage Change in Logical Relationships to Flood Risk, in a submission appendix.

Not applicable.

Form AF-8: Flood Probable Maximum Loss for Florida

A. One or more automated programs or scripts should be used to generate and arrange the data in Form AF-8, Flood Probable Maximum Loss for Florida.

Automated scripts were used to generate Form AF-8.

B. Provide the expected flood loss and 10% (lower bound) and 90% (upper bound) flood loss levels for each of the Personal Residential Annual Exceedance Probabilities given in Part A, Annual Aggregate and Part B, Annual Occurrence. Describe how the uncertainty in flood vulnerability functions has been propagated to the uncertainty in portfolio loss and how it relates to the 10% and 90% flood loss levels. If the modeling methodology does not allow the flood model to produce a viable answer for certain exceedance probabilities, state so and why.

The uncertainty of the vulnerability functions is informed by the probabilities of damage ratios. The expected value of the portfolio loss and its standard error are functions of these probabilities. Therefore, any change of vulnerability functions would affect the expected loss and its standard error and therefore, it will impact the confidence intervals of flood loss levels.

Part A – Personal Residential Flood Probable Maximum Loss for Florida – Annual Aggregate

Annual Exceedance Probability	Expected Flood Loss Level ($ Billion)	10% Loss Level ($ Billion)	90% Loss Level ($ Billion)
Top Event	32.01	-	-
0.001	14.98	14.43	15.65
0.002	11.57	10.92	12.17
0.004	8.14	7.82	8.49
0.01	4.61	4.43	4.79
0.02	2.57	2.51	2.67
0.05	0.96	0.94	0.98
0.10	0.41	0.4	0.42
0.20	0.12	0.12	0.13

Part B – Personal Residential Flood Probable Maximum Loss for Florida – Annual Occurrence

Annual Exceedance Probability	Expected Flood Loss Level ($ Billion)	10% Loss Level ($ Billion)	90% Loss Level ($ Billion)
Top Event	32.01	-	-
0.001	15.27	14.75	16.11
0.002	11.88	11.21	12.36
0.004	8.25	7.93	8.68
0.01	4.71	4.52	4.88
0.02	2.6	2.54	2.7
0.05	0.95	0.92	0.97
0.10	0.41	0.4	0.42
0.20	0.14	0.14	0.15

C. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

No additional assumptions were needed to complete this form.

D. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the flood standards year, and the form name. Also include Form AF-8, Flood Probable Maximum Loss for Florida, in a submission appendix.

A completed Form AF-8 has been provided in Excel format.

List of Acronyms

Acronym	Full Name
ACV	Actual Cash Value
ACV S/ACV C	Structure Actual-Cash-Value, Contents Actual-Cash-Value
ACV S/RC C	Structure Actual-Cash-Value, Contents Replacement-Cost
AFRES	Air Force Reserves
ALE	Additional Living expenses
AOML	Atlantic Oceanographic and Meteorological Laboratory
AP	Appurtenant
APA	American Psychological Association
ASCE	American Society of Civil Engineers
ASHARE	American Society of Heating, Refrigeration and Air Conditioning
CDFs	Cumulative Distribution Functions
CDO	Cost of Damage to Openings
CLR	Commercial Low-rise Model
CNL	C Numerical Library
COV	Coefficient of Variation
CP	Central Pressure
CPTA	County Property Tax Appraiser
CR	Commercial Residential
CVS	Concurrent Versions System
DA	Damage Array
DR	Damage Ratio
EDR	Expected Damage Ratio
EDV	Expected Damage Value
EIDR	Expected Interior Damage Ratio
EL	Equilibrium Layer
EPR	Expected Percentage Reduction
ERS	European Remote Sensing
ESDU	Engineering Sciences Data Unit
FBC	Florida Building Commission
FDFS	Florida Department of Financial Services
FEMA	Federal Emergency Management Agency
FFP	Far Field Pressure
FHCF	Florida Hurricane Catastrophe Fund
FPFLM	Florida Public Hurricane Loss Model
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
HRA	High Risk Accounts
HRD	Hurricane Research Division
HUD	Housing and Urban Development
HURDAT	Hurricane Database
HURDAT2	Hurricane Database version 2
HVHZ	High Velocity Hurricane Zone
IBHS	Insurance Institute for Business and Home Safety
IBL	Internal Boundary Layer
ID	Interior Damage Ratio
IMSL	International Mathematical and Statistical Library
ISO	Insurance Services Office
JDBC	Java Database Connectivity
JNI	Java Native Interface
JSP	Java Server Pages

Acronym	Full Name
LB	Low-rise Commercial Residential Building
LULC	Land Use Land Cover
M00	Base Medium Model
M01	Retrofitted Medium Model (Re-roof and Re-nailed decking)
M10	Modified Medium Model. Weaker Decking Connection
MBL	Mean Boundary Layer
MFR	Multi-Family Residential Building
MH	Manufactured Home
MHB	Mid and High-rise Building
MPH	Miles Per Hour
MRLC	Multi-resolution Land Characteristics Consortium
NAHB	National Association of Home Builders
NCEP	National Centers for Environmental Prediction
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NLCD	National Land Classification Database
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OIR	Florida Office of Insurance Regulation
OSB	Oriented Strand Board
PBL	Planetary Boundary Layer
PDF	Probability Density Function
Pmin	Minimum Central Pressure
PML	Probable Maximum Loss
PR	Personal Residential
PRB	Personal Residential Single-Family Home Buildings
R2W	Roof to Wall Connections
R-CLIPER	Tropical Cyclone Rainfall Climatology and Persistence Model
RC S/ACV C	Structure Replacement-Cost, Contents Actual-Cash-Value
RC S/RC C	Structure Replacement-Cost, Contents Replacement-Cost
RES	Residential Building Model
Rmax	Radius to Maximum Winds
S00	Base Strong Model Inland
S00-OP	Base Strong Model with Metal Shutters
S02	Strong Inland Model with Metal Roof
S02-OP	Strong Inland Model with Metal Roof and Metal Shutters
S01	Modified Strong Model for HVHZ
SBC	Standard Building Code
SFBC	South Florida Building Code
SFMR	Stepped Frequency Microwave Radiometer
SQL	Structured Query Language
SSM/I	Special Sensor Microwave Imager
SV S/RC C	Structure Stated-Value, Contents Replacement-Cost
SV S/SV C	Structure Stated-Value, Contents Stated-Value
TE	Time Element
TECDO	Total Expected Cost of Damage to Openings
TRMM	Tropical Rainfall Measuring Mission
UML	Unified Modeling Language
USGC	United States Geological Survey
USPS	United States Postal Service
VT	Translational Velocity
W00	Base Weak Model

Acronym	Full Name
W01	Retrofitted Weak Model (Re-roof and Re-nailed Decking)
W10	Modified Weak Model. Stronger Decking Connection
WBDR	Wind-borne Debris Region
WDR	Wind Driven Rain
WDR1	Wind Driven Rain variable #1
WDR2	Wind Driven Rain variable #2
WSC	Wind Speed Correction
WMD	Water Management District