The Florida Public Hurricane Loss Model
Version 8.3
May 2025

Model Overview

Florida Office of Insurance Regulation | FIU | UF | Florida Tech | Florida State University 1851 | Miami | NOAA | University of Notre Dame | Rutgers | UMKC | AMI Risk Consultants, Inc.

- The FPHLM (hurricane loss model) development project for personal and commercial residential properties was funded by the FL-Office of Insurance Regulation.
- We are currently funded to operate, update and maintain the model at Florida International University.
- Model is operated by a team of experts in computer science, actuarial science, finance, statistics, meteorology and engineering.
- Our major client is the FL-OIR
- Since 2009, as required by the Florida legislature, we have provided hurricane modeling services to over thirty clients in the insurance industry.
- Model development was not influenced by either FL-OIR or the insurance industry

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- The model was first activated in March 2006. This version was used to process the insurance company data on behalf of the Florida Office of Insurance Regulation.
- In Summer 2007 a revised and updated version 2.6 of the model was accepted by the Florida Commission on Hurricane Loss Projection Methodology and put to immediate use.
- Another revised and updated version 3.0 was accepted by the Commission in June 2008.
- Another revised and updated version 3.1 was accepted by the Commission in June 2009.
- Version 4.1 and 5.0 and 6.1, 6.2, 7.0, and 8.1 were accepted by the Commission in 2011, 2013, 2015, 2017, 2019, 2021 respectively.
- The latest version 8.2 was accepted by the Commission in Summer 2023 and is in use.

General Comments

- The model is transparent in the sense that we make available technical reports, flowcharts etc. on the assumptions, methods, theories, component designs, and tests.
- In fact much has already been published in refereed journals and proceedings.
- Technical documents are available at the project website: https://fphlm.cs.fiu.edu/
- The source code, however, is not open.

Participating Institutions

- Florida International University/ IHRC (lead institution)
- Florida State University
- Florida Institute of Technology
- Hurricane Research Division, NOAA
- University of Florida
- University of Miami
- University of Missouri Kansas City
- AMI Risk Consultants

About 20 professors and experts and dozens of student assistants were involved in the development and operation of the model.

Meteorology Team

- Dr. Steven Cocke — Dept of Meteorology, FSU — Team leader
- Dr Dong-Wook Shin — Dept of Meteorology, FSU
- Dr. Bachir Annane — University of Miami – CIMAS

Engineering Team

- Dr. Jean Paul Pinelli — Dept of Civil Engineering, FIT — Team leader
- Dr. Kurtis Gurley — Dept of Civil Eng, UF
- Graduate students

Computer Science Team

- Dr. Shu-Ching Chen* School of Computer Science, FIU until June 2022
  University of Missouri KC since July 2022
  Team Leader
- Dr. Mei-Ling Shyu Dept. of Electrical and Computer Engineering, Previously Univ of Miami. Currently UMKC
- Tianyi Wang PhD in CS
- Dr. Yudong Tao PhD in CS (consultant)
- Daniel Martinez Technical Editor (consultant)
- Multiple graduate and undergraduate students at UMKC and FIU

Actuarial/Finance Team

• Dr. Shahid Hamid	Dept of Finance and IHRC/EEI, FIU PI and Project Director
• Gail Flannery	Actuary, FCAS, AMI Risk Consultant
• Bob Ingco	Actuary, FCAS, AMI Risk Consultant
• Joeffrey Somera	Actuarial Analyst, AMI Risk Consultant

Statistics Team

• Dr. G. Kibria	Dept. of Statistics, FIU
• Dr. Wensong Wu*	Dept. of Statistics, FIU

Publications

- The project team has generated over five dozen papers. Some of these have been published in top science, engineering and computer science journals and proceedings and conferences.
- Some of the publication outlets are:

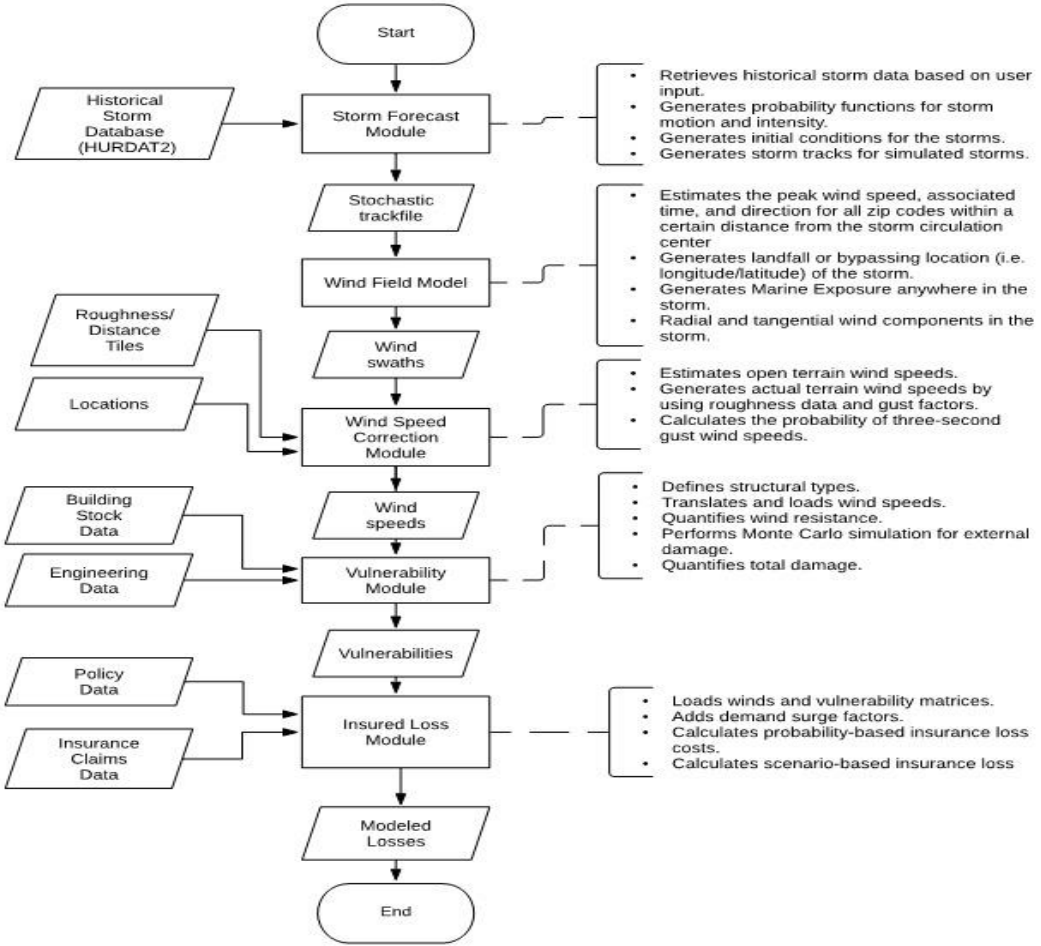
  - Nature
  - ASCE Journal of Structural Engineering
  - Software Practice and Experience
  - Natural Hazard Review
  - Numerous IEEE Proceedings
  - Journal of Wind and Industrial Engineering Aerodynamic
  - Intl Wind Engineering Proceedings
  - Reliability Engineering and System Safety Journal

Publications (continued)

- Government Information Quarterly
- Statistical Methodology
- Statistical proceedings of ASA
- Wind and Structures
- Journal of Risk and Uncertainty in Engineering Systems
- Theoretical and Applied Climatology
- Journal of Modern Applied Statistical Methods
- Various Meteorology conferences
- Numerous engineering conference proceedings

Model Design

- The model consists of three major components: wind hazard (meteorology), vulnerability (engineering), and insured loss cost (actuarial).
- The major components were developed independently before being integrated.
- The computer platform is designed to accommodate future hookups of additional sub-components or enhancements.


Start
Historical Storm Database (HURDAT2)
Storm Forecast Module
Retrieves historical storm data based on user input.
Generates probability functions for storm motion and intensity.
Generates initial conditions for the storms.
Generates storm tracks for simulated storms.
Stochastic trackfile
Wind Field Model
Estimates the peak wind speed, associated time, and direction for all zip codes within a certain distance from the storm circulation center
Generates landfall or bypassing location (i.e. longitude/latitude) of the storm.
Generates Marine Exposure anywhere in the storm.
Radial and tangential wind components in the storm.
Roughness/ Distance Tiles
Wind swaths
Locations
Wind Speed Correction Module
Estimates open terrain wind speeds.
Generates actual terrain wind speeds by using roughness data and gust factors.
Calculates the probability of three-second gust wind speeds.
Building Stock Data
Wind speeds
Engineering Data
Vulnerability Module
Defines structural types.
Translates and loads wind speeds.
Quantifies wind resistance.
Performs Monte Carlo simulation for external damage.
Quantifies total damage.
Vulnerabilities
Policy Data
Insurance Claims Data
Insured Loss Module
Loads winds and vulnerability matrices.
Adds demand surge factors.
Calculates probability-based insurance loss costs.
Calculates scenario-based insurance loss
Modeled Losses
End

Computer System Architecture

- The FPHLM is a large-scale system 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.
- A three-tier architecture is adopted and deployed in our system
  - User interface layer
  - Application logic layer
  - Database layer

Hardware and Software Structure

- The FPHLM is designed and operates on a computing cluster of 60 servers interconnected by network routers
  - 2,412 total CPU cores
  - 509TB storage
- Regular backups of the server are performed
  - Physically and electronically
  - Backups are performed daily

Hardware and Software Structure Cont.

- The user-facing part of the system consists of a web-based application hosted on a Tomcat web application server
- Backend probabilistic calculations are coded in C++
- The system uses a PostgreSQL database that runs on a Linux server
- Minimal end-user workstation requirements
  - Any current version of Internet Explorer, Firefox, Chrome, or Safari running on a currently supported version of Windows, Mac or Linux should deliver the optimal user experience

Changes to the model include:

Meteorological component

- We updated to a recent version of HURDAT2 (5/11/2024) which includes storms up through the 2023 season. This change updates the probability distribution functions used in the storm track generator.

- We updated the ZIP Code database to the April 2024 ZIP Code boundaries as per Standard G-3. The update of the ZIP Code database resulted in the update of the following ZIP Code-based databases: (1) population-weighted centroids of each ZIP Code, (2) population-weighted roughness for each ZIP Code, (3) populated-weighted distance to coast of each ZIP Code, (4) list of 2001 FBC WBDR ZIP Codes and list of 2007 FBC WBDR ZIP Codes and list of 2010 FBC WBDR ZIP Codes, and (5) classification of coastal/inland for each ZIP Code.

Rationale for the changes

- Change made to update empirical probability distribution functions to the latest version of HURDAT2 (5/11/2024) to include more recent events.
- Roughness update as per Standards G-3.

The statewide impacts for Personal and Commercial Residential combined on $0 deductible loss costs based on 2017 exposure were:

- +4.2% due to updated HURDAT
- 0% due to revised roughness
- Personal Residential loss costs were also impacted by -3.5% due to additional exposures which, due to their age, now qualify for lower retrofitted vulnerabilities. Although not a result of a model change or update, this feature of the model impacts loss costs