Volume I. Florida Public Flood Loss Model

Florida Public Flood Loss Model

FPFLM

Primary Document

General Description of FPFLM Model

The Florida Public Flood Loss Model (FPFLM) is a probabilistic model designed to estimate damage and insured losses due to storm and rainfall events. The FPFLM estimates the full probabilistic distribution of damage and loss for any significant storm and rainfall event. The modeling methodology can be partitioned into seven major components:

- Storm Track Generator

- Wind Field Model
- Storm Surge Model
- Waves Model
- Inland Flood Model
- Damage Estimation Module
- Loss Estimation Module

The high-level flowchart is shown in Figure 1.1:

Figure 1.1: Model flowchart

Computer Model and Implementation

Use Case View of the System

Use case diagrams are UML diagrams used to model the dynamic aspects of a system and are central to modeling the behavior of a system, a subsystem, or a class. Figure 1.2 presents the use case diagram of our computer model, which shows a set of use cases and actors and their relationships.

A. Actors:

There are two actors in this system, the scientists and the statisticians, who can access and interact with the modules.

B. Use Cases:

Use Case III: Storm Track Generation

Use Case III generates the storm tracks for simulated storms based on random historical initial conditions (data obtained from HURDAT2 database) and stochastic algorithms.

Use Case IV: Wind Field Generation

Use Case IV generates storm wind fields based on the data generated in Use Case III.

Use Case V: Surge Height Generation

Use Case V generates surge height using the storm surge model based on the data generated in Use Cases III and IV.

Use Case VI: Wave Height Generation

Use Case VI generates wave heights using the wave model based on data generated in Use Case V.

Use Case VII: Flood Depths Generation

Use Case VII generates the flood depth using the wave model based on data generated in Use Case III.

Use Case VIII: Damage and Vulnerabilities

Use Case VIII generates the damage matrices for the different types of buildings modeled and the corresponding vulnerability matrices/curves.

Use Case IX: Insurance Loss Module

Use Case IX is used to calculate the expected loss values.

C. Use Case Diagram

Figure 1.2: Use case diagram of the system

D. System Network Diagram

Figure 1.3: Network diagram of the system

System Architecture Design

Figure 1.4 gives a high-level system architecture abstraction, which follows the popular three-layer

architecture.

Figure 1.4: The three-layer system architecture

1. User Interface (Presentation Layer):
User Interface is the first layer of the system and also the only layer visible to the user. In FPFLM, the users use the Linux command line interface (CLI) to access the system.

2. Application Logic (Application Layer):
The second layer is used to glue the user interface and the underlying database. Shell scripting, C++ and Python are utilized in the second layer.

3. Database (Data Layer):
The database layer adopts the PostgreSQL database due to its advanced features in compatibility, extensibility, scalability, high performance, and management.

System Design and Implementation

Our system manages the production usage of an active and long-term research project. Consequently, both the application domain requirements and the solution domain technologies change frequently. Requirements evolve as new research findings, data, and regulations are incorporated into the underlying model, while the solution domain changes as new implementation technologies become available. Our system needs to be flexible and extensible to keep up with this changing environment without compromising stability and robustness. We designed our system following a three-tier software architecture pattern, supporting independent and easily maintainable tiers. The popularity of the three-tier architectural pattern provides the added benefit of smoother continuity as personnel leave and join the team that develops and maintains the system. Figure 1.5 provides a high-level overview of the system architecture.

The presentation tier, the topmost level of the application, encapsulates the common boundary objects

through which users interact with the system. In our system, these objects are standard Linux Command Line Interface (CLI).

The logic tier of our application is made up of a series of shell scripts, Python and C++ programs that provide all the functionality of the system.

The data tier of our system is composed of PostgreSQL RDBMS and several file servers. The RDBMS houses the databases, one for each insurance dataset processed through the FPFLM. Each database contains several processing stages of the exposure data, auxiliary information, and scripts used during the data preprocessing. Since data requests for the same database come from several users over short periods, a database connection pool is used to boost the system's responsiveness.

Figure 1.5 FPFLM system architecture

Model-related Flow of Information

The following diagrams illustrate model-related information flow among modeling organizational personnel or teams. All the diagrams follow standard BPMN 2.0 and were created with Lucid Chart.