CASE STUDY FAST – Flood Assessment Structure Tool

ND, Minot

Purpose

This case study is to demonstrate usage of the FAST for the ND, Minot dataset. The Minot dataset has >12K recs with a wide variety of occupancy types and provides a good case study to assess the speed and accuracy of FAST. In addition, the data includes a series of 4 flood hazard sources including 100- and 500-year depth grids from the Pacific Northwest National Labs (PNNL) and 100 and 500 year depth grids developed by Hazus using 100 and 500 year discharges for the Souris River.

Challenges

Currently, under Hazus we can perform loss estimations for a flood at block level. A structure-based analysis is possible by preparing and inputting UDF data through CDMS into the state database.

Solution

FAST allows for rapid analysis, an accurate intersection of the structure with water depth and use of detailed structure information that improves the ability to model losses. FAST leverages open source technologies and reads and writes basic .csv file inputs and outputs for ease of use. The tool functions in two parts: a pre-processing tool and the analysis tool. The pre-processing tool helps the user assign the structure, content and inventory depth damage functions (DDFs) based on Occupancy Type, Foundation Type and number of stories and flood type if the user does not already have the DDF IDs identified. The analysis tool uses the pre-processed dataset and calculates the losses for each structure and creates a results dataset.

Are there any differences?

The main differences between FAST and the Hazus FL model UDF loss calculations are:

1. FAST handles 33 occupancy types (like Hazus). The assignment of the DDF from the pre-defined lookup tables which makes the processing less time consuming, more accurate and very easy to edit, if the formulae are modified in the future.
2. Speed: The Hazus flood model takes several hours to calculate losses for the NYC User Defined Facility (UDF) dataset of 800K+ records. It also takes several days to input such a large dataset into the Hazus state database using CDMS.
   FAST processes 10,000 records per second. It achieves a significant improvement in performance by avoiding the geoprocessing and area weighting of the flood depth grid(s) and bypasses the Comprehensive Data Management System (CDMS) for the UDF import process into the state database. It works by querying the flood depth using Python based GDAL libraries at all building locations and implements the Hazus flood loss methodology to

calculate the losses. The pre-processing tool preps the data faster as it uses pre-defined tables to assign the appropriate damage function ids.

3. Debris Calculations: FAST provides debris estimates for each building in tons of finish and structural debris, as well as estimates minimum and maximum restoration times in days, which are not currently provided by the Hazus UDF module.
4. Relatively small differences in the losses between FAST and Hazus are due to Hazus rounding the First Floor Height to the nearest 0.5 of foot, which can underestimate losses in many scenarios as described by DOGAMI: https://www.oregongeology.org/pubs/ofr/O-18-04/O-18-04_user_guide.pdf
5. The Hazus UDF approach currently includes the ability to perform average annualized loses (AAL) and the support the use of relational database management systems.

Results

In addition to testing speed, the Minot data provides an opportunity to test against various hazard sources. Below are all based on 1/3 arcsecond depth grids developed by Pacific Northwest National Lab (PNNL) and by Hazus using the same 100- and 500-year discharge values for the Souris River that was used in the PNNL products. Therefore, the differences are based entirely on the differences in hydraulic model approaches:

Minot Flood Losses - Multiple Sources	Building USD	Content USD	Total USD	Count	Inventory USD	Total Debris (tons)
Minot v1.0 PNNL 100yr Riverine	$ 235,952,224	$ 135,578,410	$ 371,530,634	3,463	$ 2,226,612	64,925
Minot v1.0 Hazus 100yr Riverine	$ 122,337,259	$ 71,392,138	$ 193,729,397	2,652	$ 1,134,955	32,074
Minot v1.0 PNNL 500yr Riverine	$ 304,411,319	$ 173,593,258	$ 478,004,578	3,757	$ 2,908,869	80,520
Minot v1.0 Hazus 500yr Riverine	$ 191,314,688	$ 111,783,960	$ 303,098,648	3,062	$ 1,767,438	41,238