CASE STUDY FAST – Flood Assessment Structure Tool
New York City

Purpose

This case study is to demonstrate usage of the FAST for the New York City dataset. The NYC dataset is a large site-specific building dataset with over 800K records and provides a good case study to assess the speed of FAST helping confirm the goal of 10K records a second is achieved. The input hazard data consists of a high resolution lidar based depth grid representing the latest FEMA 100 year (1% chance) flood hazard.

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 or study region and running a UDF analysis in Hazus.

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. 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

default DDFs based on building attributes and flood type to assign the appropriate damage function ids.

2. 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.
3. 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
4. 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 NYC data provides an opportunity to test against type of flooding (Riverine, Coastal V and Coastal A). The preprocessing tool uses these flood types to help select DDFs. If the user has already identified DDFs, no change would be noted. However, Coastal A and V zone damage functions assume wave action and results in overall higher losses that Riverine DDFs. Little change is noted between Coastal A and V since most structure types do not have specific Coastal A functions, therefore, Coastal V are assigned by default. The use of Riverine DDFs assigned by the pre-processing tool can result in significant decreases in losses and in the case of NYC that difference is about 20%. In these cases, more accurate losses can be obtained by assignment of coastal DDFs for those structures that could be impacted by coastal flooding and wave action and use of riverine where wave action is not expected.

NYC Flood Losses - 100 year	Building USD	Content USD	Total USD	Count	Inventory USD	Total Debris (tons)
FAST v1.0 Losses Coastal A	$ 24,251,925,854	$ 19,866,230,790	$ 44,118,156,644	34,774	$ 85,582,329	4,274,043
FAST v1.0 Losses Coastal V	$ 24,109,548,289	$ 19,866,230,790	$ 43,975,779,078	34,774	$ 85,582,329	4,274,043
FAST v1.0 Losses Riverine	$ 17,957,791,692	$ 17,378,158,394	$ 35,335,950,086	34,774	$ 85,541,365	4,274,043