Hazus-MH Coastal Surge Model

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FEMA

HAZUS®
EARTHQUAKE • FLOOD • WIND
Hazus-MH Coastal Surge Model

Objectives:

Implement a coupled storm surge and wave hazard modeling capability in Hazus-MH using existing, publicly available models:

- SLOSH for storm surge
- SWAN for wave heights

Develop a new capability for combining currently available Hazus-MH wind-only and flood-only loss estimates into an overall estimate of combined coastal wind and flood losses for a single hurricane event
User Work Flow

Define/Select Hurricane Scenario

Run Analysis with Surge-Only or Surge & Waves

Display Wind-Only Losses

Display Combined Losses

Select Coastal Surge

Define Topography (DEM)

Define Scenario

Delineate Floodplain

Run Flood-Only Analysis

Run Combined Loss Analysis

Display Combined Losses

Hurricane Model

Flood Model
Hurricane Scenario Definition Options

- Probabilistic
- Historic
- H*Wind Import
- User-Defined
- HurrEvac Import
- Hazus Import

Pre-Defined Wind Fields

Wind Fields Computed from Hurricane Track Parameters

✓ = Coastal surge analysis allowed
X = Coastal surge not supported
Coastal Surge Hazard Modeling Options

Surge with coupled deep water and near shore waves (SLOSH + SWAN)

Surge with coupled near shore waves (SLOSH+SWAN)

Surge only (SLOSH Only)

FEMA
# SLOSH Basins

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**Map Notes:**
- Black: NGVD 1929
- Red: NAVD 1988

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Deep Water (red) and Near Shore (blue) Domains Used in SWAN Runs
Initial Water Level

Pre-storm tide anomaly is the difference between the observed tide and the predicted tide approximately two days before landfall (i.e., before the effects of storm surge or waves reach the study region)

Vertical Datum: NAVD 1988*

* Text in initial water level dialog should be “NAVD 1988” instead of “mean sea level”. The wording will be corrected in the next release.
Flood Hazard Type and User Data

Coastal surge Hazard Type (FL) will become enabled upon completion of Coastal Surge Hazard (HU), slide #5.

NOTE: Don’t forget the DEM 😊

The Flood model will find the SLOSH and SWAN water surfaces (.FLT) produced by the Hurricane model in the Scenario folder.
Delineate Floodplain

Still Water Elevation (SWEL)
- Using the surge surface from SLOSH, subtract the DEM to determine the SWEL grid

Wave Height determination
- Using the wave surface from SWAN, which is generally accurate in offshore grid cells but not in grid cells that are intersected by the coastline or landward of the coastline, sample wave heights along the transects up to 1 km off the shoreline

Wave Heights (continued)
- Determine Wave Height grid using simplified Wave Height Analysis for FIS (WHAFIS) model
  - NO Dune Erosion
  - NO Wave Run-up
  - NO Regeneration
  - NO Dissipation

Zone determination
- A-zone: waves <1.5’
- Coastal A-zone: [1.5’, 3’]
- V-zone: waves > 3’
Damage Estimates

Damage estimated for

- General Building Stock (GBS)
  - Flood-only
    - Combined wind and flood
- Essential facilities
- Bridges
- Selected utility facilities
- Vehicles
- Agriculture products
Combined Wind and Flood Losses

Compatible with existing wind-only and flood-only loss methodologies

Losses combined at the building sub-assembly loss level

Addresses order in which losses accumulate
  • Wind and flood losses are not independent
    ▪ Wind → Top-down
    ▪ Flood → Bottom-up

Relative contributions of foundation and exterior wall sub-assembly flood losses relative to interiors is higher when wave action is present (V-zone or CA-zone)
Coastal Surge Analysis Demonstration
Hurricane Katrina
Hancock County, MS
Modeled vs. Observed Inundation Limits

Blue area shows the modeled inundation levels for Hancock County, Mississippi using Hazus 2.0

Yellow area shows the actual observed limits of inundation

Hazus 2.0 estimations closely resemble the actual inundation outcome of the hurricane.
Inundation Limits
Building Exposure ($k)
Wind-Only Building Loss
Combined Wind and Flood Loss
### Direct Economic Loss Table

#### Combined FL/HU Surge Direct Economic Losses For Full Replacement Value

Results for
- Scenario: Hancock_Katrina_NoWaves
  - Return period: Mix0

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**Close** | **Map** | **Print**
Hazus Coastal Storm Surge Methodology Summary

Methodology bridges gap between existing Hazus Hurricane Wind and Hazus Coastal Flood models

Uses a single, consistent hurricane wind field model to drive storm surge (SLOSH), waves (SWAN), and wind damage (Hazus Hurricane)

Surge and wave models are coupled

Wind and flood building losses are apportioned to building sub-assemblies and then combined by sub-assembly

Capability now available in Hazus 2.0
Questions?