COASTAL RESILIENCE CENTER
A U.S. Department of Homeland Security Center of Excellence

Experimental and Numerical Study to Improve Damage and Loss Estimation due to Overland Wave and Surge Hazards on Near-Coast Structures:

Evaluation of Building Fragilities and Mitigation Alternatives for HAZUS-MH, including Engineering with Nature for Surge and Wave Attenuation

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Other Participants/Partners: Robert Twilley, LSU; Carol Friedland, LSU; Ismael Pagan-Trinidad, UPRM; Carla Lopez, UPRM

SHORT DESCRIPTION

We will demonstrate the effectiveness of the new damage functions developed in Year 1-6 for predicting hurricane surge and wave impacts to residential and commercial structures. We will validate with observed damage data from Hurricane Michael impacts to Mexico Beach, Florida. We will collaborate with LSU and UPRM to incorporate Engineering with Nature (mangroves) in mitigation planning and stakeholder engagement.

ABSTRACT

We will build on our Year 1-6 effort to create physics-based damage and loss functions for residential and commercial structures to improved damage and loss models such as Hazus-MH. We are assembling a hindcast for the Mexico Beach, Florida, community impacted by Hurricane Michael in 2018. The data set includes detailed descriptions of buildings (structural properties, first floor elevations, assessed value and) and hurricane conditions (surge, wave, wind). The activities will a detailed hindcast to validate the new fragilities at each parcel of land. We will aggregate the results and compare to existing Hazus-MH methodology and quantify the uncertainty and improvements with the new method. We will consider mitigation alternatives to illustrate the decision-support capability of the improvements to HAZUS-MH. The following mitigation alternatives will be considered:

Alternative 1: Structural improvements such as the elevation of structures to current code and proposed code changes to ASCE 7-22

Alternative 2: Engineering with Nature alternatives such as the establishment of coastal greenbelts (e.g., mangroves) to reduce surge and wave effects

Alternative 3: A hybrid approach of green/gray infrastructure combining Alt 1 and 2.

Alternative 4: Zoning changes, such as construction setbacks and buyouts

These alternative scenarios will be conducted in collaboration with other members of the center, including Robert Twilley (LSU), who will provide expertise on the parameters for the mangroves such as mangrove type, density, and expected growth, and survivability to large storms and Carol Friedland (LSU) to quantify the average annual losses to estimate the risk reduction benefits. The team will work with Ismael Pagan-Trinidad (UPRM) and Carla Lopez (UPRM) for SUMREX students and engineering with nature for hazard mitigation. The team will work with members of the center who are working with ADCIRC to quantify surge reduction due to mangroves. SWAN and/or XBeach will be used to quantify the wave reduction.

Figure 1: Left: Storm track of Hurricane Michael (2018) making landfall at Mexico Beach, FL. Right: Building damage states from detailed field reconnaissance and aerial imagery (inset) developed during year 6 of this project.