

ABSTRACT

Title: Tsunami Flood Map Development for Puerto Rico

As part of the Puerto Rico component of the National Tsunami Hazard Mitigation Program a new generation of tsunami flood maps were prepared for Puerto Rico. The tsunami model used was NOAA's MOST model. The bathymetry/topography was obtained from the Puerto Rico DEM prepared in 2007 by NGDC. The tsunami sources used were the same as for the 2003 maps, 269 hypothetical local tsunamis, augmented by six additional sources for "historical" events. Regional and far-field tsunamis were not included. The methodology was as follow. Each of the 275 fault scenarios is modeled. The inundation outer grid has a resolution of 60 arc sec, while the intermediate grid has 9 arc sec resolution. For the inundation inner grids the island was broken down into three parts: West, Central, and East. Each with a computational cell size of 1 arc second (approximately 30x30 meters). Results are output for each part, and then a mosaic is created by joining the three parts.

Output of results is presented in several formats. For the propagation modeling (no inundation):

- Bottom deformation
- Maximum Sea Surface Elevation relative to MSL all over the propagation grid.
- Movie showing the propagation in the propagation grid.

For the inundation modeling, for each island part (West, Central, and East) the following is output in each inundation grid(West, Central, and East):

- A figure showing Maximum Envelope Of Waters relative to MSL (MEOH).
- A figure showing the same as above but relative to terrain elevation (called Local Water Depth (LWD) – shown only inland of MSL shoreline.
- A figure showing the maximum water particle velocity all over the computational grid
- Same as above, but just inland of MSL shoreline.
- Google Earth KMZ of LWD and Particle Velocity (just inland of MSL shoreline)
- Movie of wave propagation.

For the mosaic of results from each of the 275 tsunami scenarios, based on all three parts put together:

- A figure showing Maximum Sea Surface Elevation relative to MSL
- A figure showing the same as above but relative to terrain elevation (called Local Water Depth (LWD) – shown only inland of MSL shoreline.
- Same as above but with streets overlaid on top.
- A figure showing the maximum water particle velocity all over the computational grid
- Same as above, but just inland of MSL shoreline.
- A Google Earth KMZ of LWD
- For each mosaic we also produce a figure showing the sea surface elevation in the surrounding areas stratified into three elevations: 0 to 0.3 m (blue), 0.3 – 1.0 m (gold - ADVISORY), and > 1 m (red - WARNING).
- Same as above (ADVISORY AND WARNING) but just for inland flooding (Local Water Depth).
- Same as above (ADVISORY AND WARNING) but in KMZ format.
- Next we go through all of the output MEOHW's and we get the Maximum of the Maximums (MOM) to get one final map showing the inland extension, and elevations, of the tsunamis. This is presented as KMZ and shapefiles. The MOM collapses all maps into just one showing the highest water depth at each computational cell irrespective of the tsunami scenario that produces it.
- The databank of modeled tsunamis can serve as the starting set of more scenarios that can be used to make more specific real-time Advisories and Warnings.

ADDITIONAL WORK AS PART OF NTHMP:

- We have already had two weeks of training by Dr. Juan Horrillo on the use of the coupled models TSUNAMI-3D and NEOWAVE for modeling landslide tsunamis. Tested with what could be a submarine landslide that occurred as a consequence of the 1918 Puerto Rico earthquake. The USGS has identified additional slides along the Puerto Rico Trench, and also along the south coast (in cooperation with Spanish scientists). This is the next phase of work.

FUTURE WORK:

- Must include variable roughness, especially along coastlines protected by fringing reefs, mangrove forests, and very dense vegetation.
- Include the built infrastructure
- Improve bathymetry and topography once the geoid in Puerto Rico is upgraded
- Include non-hydrostatic/dispersive effects
- Include regional and far-field scenarios, not only for earthquake but also for landslide tsunamis