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# High-Resolution Tsunami Simulations including Land Use-Dependent Variable Friction Along Puerto Rico's Coast

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This study integrates high-resolution tsunami simulations with land use-dependent variable friction across the entire coastal region of Puerto Rico. By using the Tsunami-HySEA model, developed by the EDANYA Research group at the University of Malaga, this research transcends traditional practices, exploring the interplay between terrain characteristics and tsunami dynamics through the incorporation of variable friction. The execution of high-resolution simulations covering the entire coast of Puerto Rico represents a computational and scientific challenge unprecedented in prior research, reinforcing the applicability of this study.

Computational topo-bathymetric grids are constructed to create a coherent model, smoothing irregularities in topo-bathymetric data. Provided by the Puerto Rico Seismic Network, these data have been processed for optimized numerical simulations. The study employs five sets of nested grids, corresponding to different regions (Northeast, Northwest, East, West, and South) of Puerto Rico, and within each configuration, four nested grids with resolutions ranging from 480 meters to 7.5 meters facilitate simulations with varying levels of detail. This strategy optimizes computational resources and ensures precise results in specific coastal areas. The high-resolution discretization, at 7.5 meter per pixel, spans the entire 1,100 km coastline of Puerto Rico. Additionally, simulations have been conducted for 29 distinct seismic sources, comparing this approach to the traditional constant friction approach with Manning coefficient set at 0.03.

The influence of the Manning coefficient is evident in its effects on velocities, momentum flux, and, on the inundation area extension. Understanding the different land uses is crucial for accurately analyzing the effects of a tsunami on the coast and predicting the magnitude of the resulting inundation. The topography, vegetation, and structures built in coastal areas can significantly modulate wave propagation and water depth inland. Identifying these variations in land uses allows for a more precise planning of tsunami mitigation and response measures, as well as a detailed assessment of vulnerable areas.

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