Spanish Tsunami Early Warning System: Enhancing Maximum Wave Height Predictions via Neural Networks

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Abstract:

Tsunami Early Warning Systems (TEWS) are crucial for mitigation and highly reducing the impact of tsunamis on coastal communities worldwide. In the NEAM region (North-East Atlantic, the Mediterranean, and connected Seas), historical approaches involve using Decision Matrices and precomputed databases due to the short time between tsunami generation and coastal impact. Overcoming real-time simulation challenges, the EDANYA group at the University of Málaga developed Tsunami-HySEA, a GPU code enabling Faster Than Real Time (FTRT) tsunami simulations [1].

A first approach using neural networks (NN) for maximum wave height and arrival time was done in [2]. In collaboration with the National Geographic Institute of Spain, we are extending that work for several faults and multiple coastal locations on the Spanish coast. The main importance of this work is that the models developed can be implemented in the Spanish TEWS producing estimations of the tsunami impact in seconds.

Tsunami-HySEA numerical model is used to generate the data to train the NN models. Around 300,000 simulations have been executed to account for various fault scenarios in the Atlantic Ocean, underlining the substantial demand for High-Performance Computing (HPC) resources.

References:

[1] Beatriz Gaite, Jorge Macías, Juan Vicente Cantavella, Carlos Sánchez-Linares, Carlos González, and Luis Carlos Puertas. Analysis of faster-than-real-time (ftrt) tsunami simulations for the spanish tsunami warning system for the atlantic. GeoHazards, 3(3):371–394, 2022.

[2] Juan F. Rodríguez, Jorge Macías, Manuel J. Castro, Marc de la Asunción, and Carlos Sánchez-Linares. Use of neural networks for tsunami maximum height and arrival time predictions. GeoHazards, 3(2):323–344, 2022