GC11-solidearth-10, updated on 19 May 2024
https://doi.org/10.5194/egusphere-gc11-solidearth-10
Galileo Conference: Solid Earth and Geohazards in the Exascale Era

ML Emulation of High Resolution Inundation Maps for Probabilistic Tsunami Hazard Analysis

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Local Probabilistic Tsunami Hazard Analysis (PTHA) aims to quantify the likelihood of a given metric of tsunami inundation at a given location over a given time interval. Seismic PTHA can require the simulation of thousands to tens of thousands of earthquake scenarios and can become computationally intractable when inundation over high-resolution grids is required. The numerical tsunami simulations write out time-series at offshore locations to simulate the wave height that would be recorded on tide gauges at selected locations. The offshore time-series can be calculated at a fraction of the cost of the full inundation calculations. For a stretch of the coast of Eastern Sicily, we explore the extent to which a machine learning procedure trained on a small fraction of the total number of scenarios can predict the inundation map associated with a given offshore time-series. We exploit a set of over 30000 numerical tsunami simulations to train and evaluate the ML-procedure. The ML-based inundation predictions for locations close to the water's edge, which are flooded in many of the scenarios, show excellent correspondence with the numerical simulation results. Predicting inundation at locations further inland, which are flooded in only a small number of the simulations, is more challenging. Mitigating this shortcoming is a priority in the ongoing study.