GC11-solidearth-50, updated on 25 Apr 2024
https://doi.org/10.5194/egusphere-gc11-solidearth-50
Galileo Conference: Solid Earth and Geohazards in the Exascale Era

Machine Learning based Estimator for ground Shaking maps

Marisol Monterrubio-Velasco[1], David Modesto[1], Scott Callaghan[2], and Josep de la Puente[1]
[1]Barcelona Supercomputing Center
[2]Southern California Earthquake Center, University of Southern California

Large earthquakes are among the most destructive natural phenomena. After a large-magnitude event occurs, a crucial task for hazard assessment is to rapidly and accurately estimate the ground shaking intensities in the affected region. To satisfy real-time constraints, ground shaking is traditionally evaluated with empirical relations called Ground Motion Prediction Equations (GMPE) which can be combined with local amplification factors and early data recordings, when available. Given their nature, GMPEs can be inaccurate to model rarely observed earthquakes, such as large earthquakes. Furthermore, even for very populated databases, GMPEs are characterized by large variances, as earthquakes of similar magnitude and location may have very different outcomes related to complex fault phenomena and wave physics.

The ML Estimator for Ground Shaking maps (MLESmap) workflow is proposed as a novel procedure that exploits the predictive power of ML algorithms to estimate ground acceleration values a few seconds after a large earthquake occurs. The inferred model can produce peak (spectral) ground motion maps for quasi-real-time applications. Due to its fast assessment, it can further be used to explore uncertainties quickly and reliably. MLESmap is based upon large databases of physics-based seismic scenarios to feed the algorithms.

Our approach (i.e. simulate, train, deploy) can help produce the next generation of ground shake maps, capturing physical information from wave propagation (directivity, topography, site effects) at the velocity of simple empirical GMPE. In this work, we will present the MLESmap workflow, its precision, and a use case.