Machine Learning based Estimator for Ground Shaking Map

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

M. Monterrubio-Velasco, R. Blanco-Prieto, S. Callaghan, D. Modesto, J. de la Puente

Rut Blanco Prieto (rut.blanco@bsc.es)

Poster No:
S31F-0407

Our pre-print

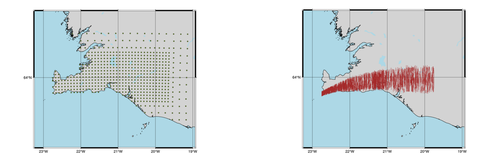
OBJECTIVE

The Machine Learning Estimator for Ground Shaking Maps (MLESmap) introduces an innovative approach that harnesses the predictive capabilities of Machine Learning (ML) algorithms, utilizing high-quality physics-based seismic hypothetical scenarios.

MLESmap aims to provide ground intensity measures within seconds following an earthquake. The inferred information can produce shaking maps of the ground, providing quasi-real-time affectation information to help us explore uncertainties quickly and reliably.

DATA SET

To set up the MLESmap technology, we used ground-motion simulations generated from the CyberShake platform in the Study15.4, which is a physics-based Probabilistic Seismic Hazard modeler developed for the Los Angeles basin region. In this case, the platform has been migrated for the first time to the South Iceland Seismic Zone (SISZ).

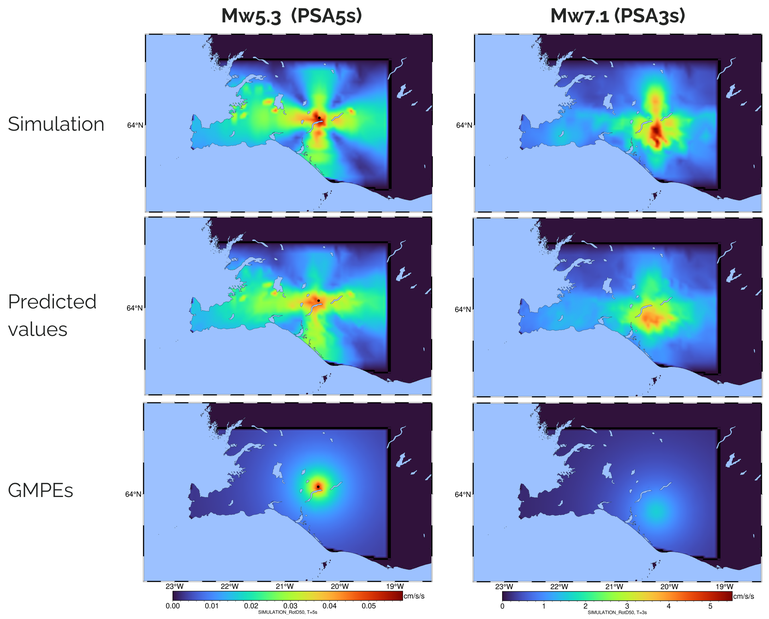


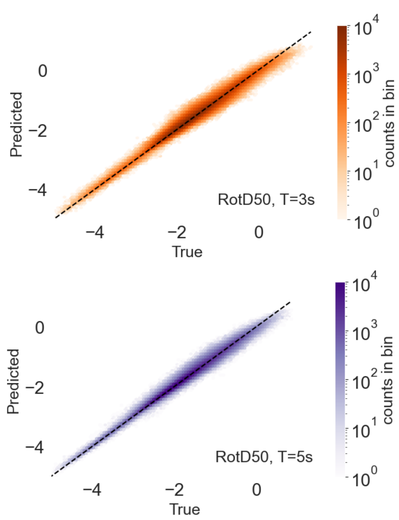
593 Synthetic Stations — 1792 faults

16,663 events

The input variables for training the ML models are magnitude, hypocenter location, and receiver location.

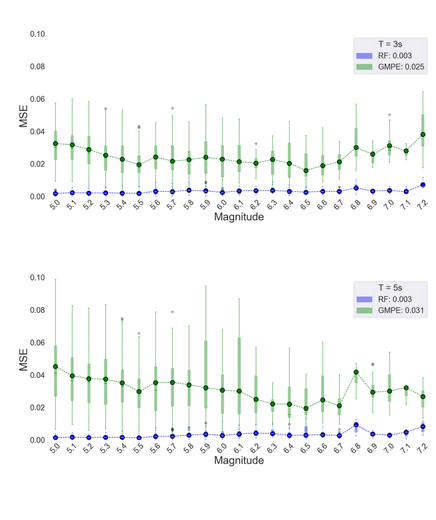
RESULTS





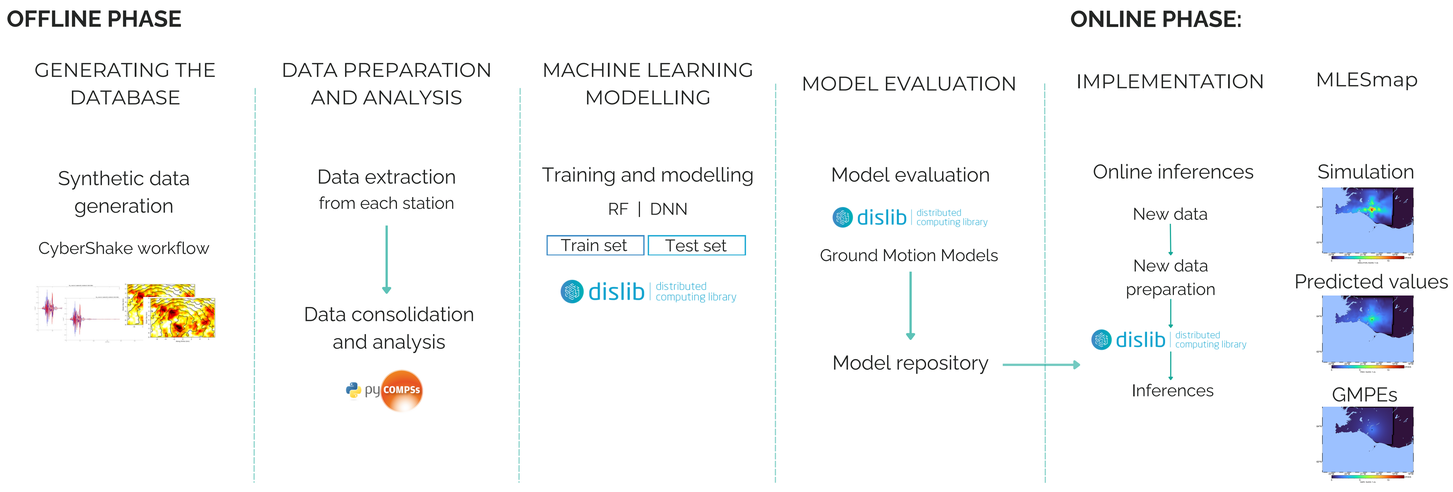
MSE: 0.0137
R2 Score: 0.9717
Explained Variance: 0.9718
MAE: 0.0861
Pearson Coef.: 0.9858

MSE: 0.0081
R2 Score: 0.9822
Explained Variance: 0.9823
MAE: 0.0637
Pearson Coef.: 0.9911



METHODOLOGY: MLESmap WORKFLOW

The methodology follows a four-step process: simulation, preparation, training, and deployment. It has two phases: first, an offline phase and then an online phase.



FUTURE WORK

- Testing MLESmap in a high-frequency dataset.
- Studying the optimal configuration of the stations to reduce the computational cost/hours.
- Generalizing the learning process over different regions (heterogeneous and homogeneous regions).
- Exploiting the transfer learning at low-frequencies over high-frequencies.
- Generating a suitable dataset, including extreme events (high-magnitude earthquakes).
- Exploring multi-target strategies.

ChEESE

cheese2 .eu

©2023 ChEESE-2P | Funded by the European Union. This work has received funding from the European High Performance Computing Joint Undertaking (JU) and Spain, Italy, Iceland, Germany, Norway, France, Finland and Croatia under grant agreement No 101093038.

eFlows4HPC

eflows4hpc.eu

2023 eFlows4HPC | This project has received funding from the European High-Performance Computing Joint Undertaking (JU) under grant agreement No 955558. The JU receives support from the European Union's Horizon 2020 research and innovation programme and Spain, Germany, France, Italy, Poland, Switzerland, Norway.