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## On-site Earthquake Early Warning: Predictive Models for Acceleration Response Spectra Considering Site-Effects

**Antonio Giovanni Iaccarino**<sup>1</sup>, Matteo Picozzi<sup>1</sup>, Dino Bindi<sup>2</sup>, and Daniele Spallarossa<sup>3</sup>

<sup>1</sup>University of Naples, Federico II, Department of Physics, Italy

<sup>2</sup>Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Germany

<sup>3</sup>University of Genova, Italy

Including site specific amplification factors in ground motion prediction models represented an advance for PSHA (Atkinson 2006; Rodríguez-Marek et al. 2013; Kotha et al. 2017) that has become nowadays a standard. However, this issue has only recently received attention by the seismological community of earthquake early warning (EEW) (Spallarossa et al., 2019; Zhao and Zhao, 2019), which applications require a real-time prediction of ground motion and the delivery of alert messages to users for mitigating their exposure to seismic risk. Indeed, all EEW systems are high-technological infrastructures devoted to the real-time and automatic detection of earthquakes, rapid assessment of the associated seismic hazard for targets and the prompt delivery of alerts through fast telecommunication networks. Among them, the on-site approaches are based on seismic networks placed near to the target, indifferently by the location of seismic threats and they issue the alert predicting the ground motion at the target from P-wave parameter. This configuration causes that On-Site EEWS are generally highly affected by site conditions.

In this work, we calibrated ground motion prediction models for on-site EEW considering acceleration response spectra (RSA) and the P-waves EEW parameters  $Iv2$  and  $Pd$ , and we investigated the role of site-effects. We considered a dataset of nearly 60 earthquakes belonging to the Central Italy 2016-17 sequence. The high density of stations near to the sequence has allowed us to use a non-ergodic random-effect regression approach to explore and to reduce the contribution of site-effects to the uncertainty of the On-site laws predictions. We grouped the records in two ways: by stations and by EC8 classification. Then, we validated the estimated models by the Leave One Out (L1Out) technique and applied a K-means analysis to assess the performance of the EC8 classification.

The residuals analysis proved that grouping by station provides a set of relations that improves the predictions at many stations. On the contrary, L1Out cross-validation proved that the regressions retrieved grouping by EC8 classification produce higher uncertainties on the predictions than the others. Furthermore, the cross-validation proved that  $Iv2$  is more correlated to RSA than  $Pd$ . Finally, the analysis of the random effect vs period curves confirmed that EC8 classification is unrelated to the site effect on RSA even looking only at the trend of these curves.

In conclusion, non-ergodic random-effect regression can be used also in the EEW applications to predict site-specific ground motion. EEWS that use this approach are less dependent by site-effect and able to provide more precise and reliable alerts.