An ANN-based Earthquake Ground Motion Model for Southwest Iberia

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A ground motion model (GMM) is essential for assessing seismic hazard and risk in any region. These models determine the distribution of earthquake intensity across various sites, factoring in earthquake magnitude, source-to-site distance, and soil conditions. In regions characterized as Active Shallow Crustal (ASCR) or subduction tectonic zones, the abundance of ground motion data has led to the development of numerous empirical models. However, for Stable Continental Regions (SCR) like Southwest Iberia, lower seismic activity and limited ground motion recordings pose challenges to developing empirical models. To address this data scarcity, stochastic simulations have been employed since the 1980s to generate synthetic ground motion records suitable for these regions.

This study presents the first GMM tailored for Southwest Iberia, encompassing mainland and offshore Portugal and the southwest of Spain. This area, located near the Azores-Gibraltar plate boundary, has a history of significant seismic events despite its relatively low seismicity. Notable events include the 1755 M~8.5 Lisbon earthquake and the 1969 M7.8 Algarve earthquake.

To address these needs, we divide Western Iberia into inland and offshore zones. We collect ground motion records from the Portuguese and Spanish seismic network databases and calibrate modelling parameters for stochastic simulations, resulting in two sets of parameters with associated aleatory variability. Ground motion simulations estimate spectral acceleration values on rock for various hypothetical earthquake scenarios. These synthetic records train, verify, and test an Artificial Neural Network (ANN) to predict ground shaking with high accuracy. The model's results are compared with existing GMMs for other SCRs and recordings from past regional earthquakes, demonstrating the effectiveness of our approach in enhancing seismic hazard and risk assessment for Southwest Iberia.

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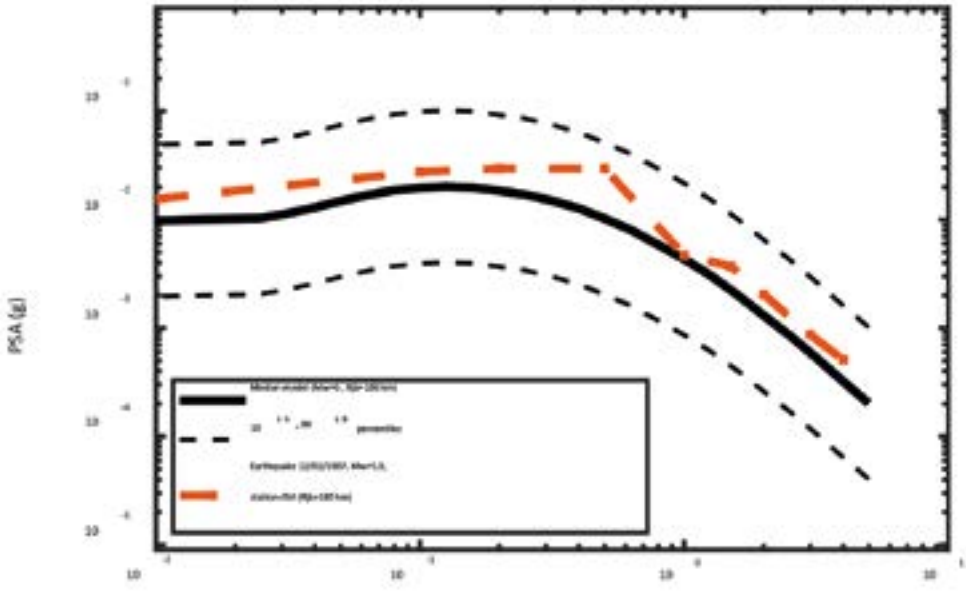

FIGURE 1
Comparison of median acceleration response spectra computed using the offshore model for Mw=6.0 with two empirical data from two events recorded at four different distances.