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New Ground motions relations for Portugal Mainland using a stochastic finite fault modeling

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In Portugal, being located at a moderate/low seismicity intraplate area, insufficient accelerograms have been recorded to satisfactory undertake any regional empirical study. Portugal has experienced several large earthquakes in the past, before the instrumental time so there are no strong ground motion data recorded by instruments. As prediction cannot be based on empirical analyses, well-founded physical models must be used as the basis for the predictions of strong motion in Portugal. These models should provide the means to make extrapolations to the range of magnitudes and distances of interest, and over the entire frequency range of engineering interest, with confidence.

The development of stochastic based ground motion synthesis associated to a seismological finite-fault modeling is a worldwide approach that can be used for representation of future large magnitude earthquakes occurring in Portugal, allowing the reproducing of specific source effects like directivity and asperities distribution, and path and crustal effects. This modeling technique is now being used to develop regional ground motions prediction equations in many regions of the world (eg. Atkinson & Boore, 2006; Motazedian & Atkinson, 2005; Sihua & Lung, 2004).

The model parameters calibration has been obtained with a dataset that includes horizontal components of ground acceleration records (at rock sites) obtained by the Portuguese digital accelerometer network. With regional parameters established, the calibrated model was used to create a data-base with a magnitudes and distance range of interest, allowing then to derive ground motions predictions equations for Portugal.

This work presents the first spectral ground motions prediction equations for Portugal mainland. Equations are presented for the two different tectonic environments that describe seismic input in Portugal (intraplate and interplate environment), using either the closest distance to the fault or the hypocentral distance.

Following Atkinson & Boore (2006), we consider the effects of aleatory uncertainty, expressing random variability in the parameter from one ground motion realization to another. Each key parameter (length, width and dip of the fault, stress, kappa and geometric-spreading coefficient) was treated as a probability distribution (truncated normal or uniform distributions, depending on the parameter which is being modeled).