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Developing of a VS30 map for addressing site effects for Portugal: evaluation of the effectiveness of using VS30-proxies for stable continental regions.

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The need to perform first-order estimates for site amplification in a regional sense has been strongly emphasized in recent years. The use site-amplification maps is of major importance for addressing both land-use planning (seismic-hazard maps) and emergency planning (instrumental intensity maps).

Project SCENE, funded by the Portuguese Foundation for Science and Technology (FCT), aimed at gathering and acquiring shear-wave velocity profiles in diverse lithological and geological formations in Portugal, in order to develop a regional site conditions map to be used for including first-order site-effects into seismic hazard assessment maps.

Within the scope of project SCENE thirty sites where strong motion stations are installed were characterized using shear-wave seismic refraction. The project SCENE shear-wave database also includes a significant amount of shear-wave refraction data available from FCT project NEFITAG and from previously performed CAPSA and ERSTA campaigns. Few sites characterised by using other methods (multichannel analysis of surface waves and invasive profiles) were also included in the database. The shear-wave database currently includes 85 shear-wave depth sections or profiles from a variety of lithological/geological formations.
In addition to the shear-wave profile database we compiled geotechnical and geological profiles in the vicinity of the sites analysed.

We performed a careful evaluation of the geological conditions for each site in the database using the largest scale available (usually 1:50 000). A smaller scale map (1:500000) was also used in order to evaluate the bias introduced by the scale-dependent map accuracy. We grouped the sites into six generalized geological units: S1 – igneous and metamorphic rocks; S2 – old sedimentary rocks (Limestones, marly limestones, dolomites, conglomerates and sandstones); S3 – Sand, sandstones, clays and conglomerates of Miocene age; S4 - Sandstones, gravels, sands and clays of Pliocene age; S5 – Sand deposits and clays, terrace deposits of Pleistocene age; and S6 - Alluvium, mud, sands, clay, silt and sand dune of Holocene age.

The time-average shear-wave velocity in the upper 30m (Vs30) from the database sites range from 123m/s to 1870m/s. The variance of the distribution of Vs30 values varies significantly with the generalized geological unit, being larger S1 and S2 units.

The use of proxies based either on the geological-geographical units developed for California by Wills and Clahan (2006) or on correlations with the topographic slope for stable continental regions (Wald and Allen, 2007) shows relatively unbiased total residual distributions of the logarithm of Vs30, although with a large variance. However, the performance of both methods varies significantly with the generalized geological unit analyzed. Both methods are highly biased towards lower values of Vs30 for unit S1 (hard rock). The topographic-slope method shows inconsistent bias for each generalized unit.

These results are not in agreement with those of Lemoine et al. (2012) who concluded that, for stable continental regions, the topographic-slope method performance was best for rock sites (A/B NERPH class). This discrepancy points to the limitations of the database on near-surface site-conditions used in project SHARE in what concerns stable continental regions.