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Incorporating Descriptive Metadata into Seismic Source Zone Models for Seismic-Hazard Assessment: A Case Study of the Azores–West Iberian Region

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Abstract In probabilistic seismic-hazard analysis (PSHA), seismic source zone (SSZ) models are widely used to account for the contribution to the hazard from earthquakes not directly correlated with geological structures. Notwithstanding the impact of SSZ models in PSHA, the theoretical framework underlying SSZ models and the criteria used to delineate the SSZs are seldom explicitly stated and suitably documented. In this paper, we propose a methodological framework to develop and document SSZ models, which includes (1) an assessment of the appropriate scale and degree of stationarity, (2) an assessment of seismicity catalog completeness-related issues, and (3) an evaluation and credibility ranking of physical criteria used to delineate the boundaries of the SSZs. We also emphasize the need for SSZ models to be supported by a comprehensive set of metadata documenting both the unique characteristics of each SSZ and the criteria used to delineate its boundaries. This procedure ensures that the uncertainties in the model can be properly addressed in the PSHA and that the model can be easily updated whenever new data are available. The proposed methodology is illustrated using the SSZ model developed for the Azores–West Iberian region in the context of the Seismic Hazard Harmonization in Europe project (project SHARE) and some of the most relevant SSZs are discussed in detail.

Online Material: Tables describing characteristics and boundaries of the seismic source zones.

Introduction

Since the development of the probabilistic seismic-hazard analysis (PSHA) formalism (Cornell, 1968), the concept of seismic source zones (SSZs) has been an important component of PSHA. Reiter (1991) distinguishes among three types of seismic sources: faults, localizing structures, and seismotectonic provinces or SSZs. Although faults and localizing structures are identified geological structures that produce earthquakes, SSZs are regions where the lack of correlation between earthquakes and known geological structures prevents the definition of faults or localizing structures. Therefore, SSZs are used in PSHA to address the hazard from earthquakes that are not associated with known geological structures.

SSZs are defined by Reiter (1991) as geographic regions that are delineated on the basis of geological, geophysical, and/or seismological similarities. In practice, SSZs are geographic polygons (or volumes, if depth is considered a parameter) that delineate areas with relatively uniform seismicity characteristics. Within an SSZ, the maximum magnitude, depth distribution, style of faulting, rupture orientations, and activity rates at different earthquake magnitudes are assumed to be uniform (although some variability in the activity rates can be allowed, depending on the methodology).

The widely implemented guidelines for PSHA published by the Senior Seismic Hazard Analysis Committee (SSHAC, 1997) include a detailed discussion of SSZs. The report distinguishes among three types of SSZs: (1) area sources that encompass spatial clusters of seismicity, (2) regional area sources, and (3) background area sources. The main difference between a regional and a background source zone is the

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