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Spatial sensitivity of seismic hazard results to different background seismic activity and temporal earthquake occurrence models

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ABSTRACT

Spatial sensitivity of seismic hazard results to different models with respect to background seismic activity and earthquake occurrence in time is investigated. For the contribution of background seismic activity to seismic hazard, background area source with uniform seismicity and spatially smoothed seismicity models are taken into consideration. For the contribution of faults, through characteristic earthquakes, both the memoryless Poisson and the time dependent renewal models are utilized. A case study, involving the assessment of seismic hazard for the Bursa province in Turkey, is conducted in order to examine quantitatively the influence of these models on seismic hazard results. The spatial variation of the difference in Peak Ground Acceleration (*PGA*) values obtained from these different models is presented in the form of difference maps for return periods of 475 and 2475 years. Best estimate seismic hazard maps for *PGA* and Spectral Accelerations (SA) at 0.2 and 1.0 s are obtained by using the logic tree method.

1. Introduction

The future earthquake threat at a site is generally quantified by carrying out a seismic hazard analysis. In the past, assessment of seismic hazard was carried out from a deterministic point of view, using the combination of macro-seismic and instrumental databases. In the deterministic models, uncertainties associated with the seismicity parameters are not treated explicitly, but to compensate for these uncertainties some conservative values are assigned to them and the most critical scenario is considered.

Considering the aleatory uncertainties related to earthquake occurrences with respect to time, space, magnitude and the additional epistemic uncertainties, probabilistic approach appears to be more appropriate. Probabilistic Seismic Hazard Analysis (PSHA) model was first proposed by Cornell [1]. After the pioneering work of Cornell [1], alternative models have been developed for describing the temporal, spatial and magnitude distribution of earthquakes as well as attenuation characteristics. Probabilistic procedures have become of increasing demand in the last four decades for evaluating the seismic hazard at a specific site as well as constructing seismic hazard maps where multi-sites are involved. Besides the popularity of the probabilistic approach, recently more attention is paid to the assessment of seismic hazard due to active faults and the use of stochastic models consistent with the available information on faults. Accumulation of more data and information on the main characteristics of faults has also contributed to this. In addition to active faults, the seismic hazard due to smaller magnitude earthquakes, which forms the background seismic activity, should also be taken into consideration.

Since assessment of the main parameters of faults requires time and is quite expensive if it is carried out for large regions like a country, the updating of current seismic hazard maps should be carried out on a region or province basis. To illustrate this view, the case study presented here involves the assessment of seismic hazard for the Bursa province.

Bursa is one of the most populated cities in Turkey. Additionally, it is an important city for the industry in Turkey. Bursa is located within a transitional zone of the extensional and contractional active tectonic regimes (Yucemen et al. [2]). Therefore, it is seismically quite an active region. According to the current earthquake zoning map of Turkey, the portions of this city are located in the 1st and 2nd degree earthquake zones. Recent investigations on the tectonics of the region and its near vicinity have resulted in the better assessment of the characteristics of active faults and estimation of their parameters. In view of this recent information, seismic hazard for the Bursa province will be evaluated by applying comprehensive source and earthquake occurrence models. Additionally, the spatial sensitivity of seismic hazard results to different models will be examined.

2. Seismicity and tectonic setting of the region

The city of Bursa is under seismic threat caused by several normal and strike-slip faults and fault segments located in and

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