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Ground Motion Characterization Logic Tree for the Vertical Component: a Case Study based on Updated Turkish Ground Motion Database

Zeynep Gülerce (1), Abdullah Sandıkkaya (2), and Nima Aghalipour (3)

(1) Middle East Technical University, Civil Engineering, Ankara, Turkey (zyilmaz@metu.edu.tr), (2) Hacettepe University, Civil Engineering, Ankara, Turkey , (3) Middle East Technical University, Civil Engineering, Ankara, Turkey

Several up-to-date ground motion models (GMMs) for the vertical ground motion component for different shallow crustal and active tectonic regions were proposed in the last three years (e.g. vertical GMMs published in the course of Next Generation Attenuation West 2 Project). These efforts increased the number of available vertical models significantly and lead to a possible change in the ground motion characterization logic trees utilized for the vertical ground motion component. When sets of vertical and V/H ratio GMMs are combined in the PSHA analysis, significant differences in the median predictions of these GMMs might have a substantial impact in the hazard estimates. This study intends to develop a new framework for building the vertical ground motion logic tree by evaluating the differences in the median predictions of the recently proposed vertical and V/H ratio GMMs. For this purpose, the Turkish Strong Motion Database (TSMD) (Akkar et al., 2010) is updated with the recordings from the earthquakes occurred between 2008 and 2015, including the Mw=6.1 Elazığ and Mw=7.2 Van earthquakes and utilized as a representative case. Updated strong motion database contains 2698 recordings with the earthquake metadata, source-to-site distance metrics for the recordings, measured VS30 values for the recording stations, and horizontal and vertical component spectral acceleration values. Four candidate V/H ratio GMMs (proposed by Gulerce and Abrahamson, 2011; Gulerce and Akyuz, 2013; Akkar et al., 2014; Bozorgnia and Campbell, 2016) and four global vertical GMMs (proposed by Bozorgnia and Campbell, 2016; Stewart et al., 2016; and Gulerce et al., 2017 using the NGA-West 2 database and Çagnan et al., 2017 model based on RESORCE database) are selected and the model predictions are compared with the actual data in the updated Turkish data set using the analysis of the residuals and data-driven techniques. Analysis results showed that the median predictions of the V/H ratio GMMs proposed by Gulerce and Akyuz (2013), Akkar et al., (2014) and Bozorgnia and Campbell (2016) are compatible with the V/H ratios in the Turkish strong motion data set. On the other hand, the magnitude scaling of Çagnan et al. (2017) model and the depth scaling of the Bozorgnia and Campbell (2016) model are inconsistent with the Turkish strong motion database. Additionally, small magnitude (SM) scaling of Stewart et al. (2016) and Gulerce et al. (2017) GMMs should be modified for a better fit with the Turkish dataset. Trellis plots of SM-modified Stewart et al. (2016) and Gulerce et al. (2017) vertical GMMs and selected V/H ratio models multiplied with TR-adjusted horizontal NGA-W1 models (Gülerce et al., 2016) are used to evaluate the differences in the median predictions and to determine the logic tree weights for the proposed vertical ground motion characterization logic tree.