

New Ground Motion Prediction Equations for Western Saudi Arabia

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We developed Ground Motion Prediction Equations (GMPEs) for western Saudi Arabia using 2770 selected records of PGA and PGV from 177 earthquakes of magnitude 3.0 –5.4, recorded at 58 stations in the distance range from 1 km to 400 km. Our GMPEs are developed based on one of the NGA-West2 Project GMPEs (Boore et al., 2014) by employing a mixed effects regression model.

Saudi Arabia is surrounded by several active tectonic regions, including an extension in the Red Sea and left-lateral strike-slip motion in the Gulf of Aqaba and along the Dead Sea Transform Fault (DSTF). In this area, multiple seismic swarms in and around volcanic fields, also known as harrats, have been detected over the past several decades (El-Isa and Shanti, 1989). The most recent large earthquake swarm in the region, which included more than 30,000 earthquakes, occurred from April to June 2009 beneath the volcanic field of Harrat Lunayyir in northwestern Saudi Arabia. The strongest seismic activity occurred May 13-19, 2009 and consisted of events $M > 4$ (Pallister et al., 2010). The largest earthquake occurred on May 19th, ML 5.4 as estimated by the SGS (Saudi Geological Survey) and Mw 5.7 by the USGS.

The NGA-West2 project used as a reference model mainly consists of shallow crustal earthquakes in active tectonic regions, rather than extensional earthquakes, such as those observed in Saudi Arabia. This deficiency is corrected by calculating a magnitude scaling of the new Saudi Arabia GMPEs compared to those of Boore et al. (2014). Furthermore, there is a clear difference in distance scaling for the Arabian GMPEs in comparison with the NGA-West2 GMPEs. This difference is especially significant at large distances and is mainly due to lower anelastic attenuation in the crystalline crust of western Saudi Arabia. Our empirical data demonstrate that the GMPEs presented here are in good agreement with observed earthquake ground motions in western Saudi Arabia.

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