Defining a 3D Seismic Source Characterization model for PSHA studies: A case study of Himalayan Thrust system, Pakistan

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Planar fault models have been developing in Middle East and Pakistan region under the scope of Earthquake Model for Middle East (EMME) project. These models require information on the geometric, kinematic and seismicity parameters of the major seismogenic faults. The active compressional nature, complex fault patterns, dipping geometeries, and insufficient data in NW Pakistan pose a serious problem in constraining various parameters that are essential for such models. This study aims at characterizing the seismic source parameters of Himalayan Thrust system of Pakistan for future utilization in fault based probabilistic seismic hazard assessment (PSHA) studies. The approach is primarily based on three datasets: geologic, geodetic and seismic data. Surface traces of active faults are compiled from the published literature and segmentation models are defined using first order geological complexities. Seismogenic depth and geometry i.e., dip angles are constrained from instrumental seismicity and focal mechanism solution catalogues. One of the major concern in this area is to analyze the methodological procedures for assigning and distributing the activity rates. Activity rates are assigned to the fault systems by two different approaches using geodetic and seismic data. Later on, contemporary Empirical relationships are utilized to assign the maximum magnitude (Mmax) values to active sources. Moreover, moment balancing technique is applied to select appropriate earthquake frequency models for the region. By integrating all the data, we define a 3D fault model for the major faults in the thrust system that can be directly adopted for regional scale PSHA studies.

Keywords: 3D fault models; fault-based PSHA; Himalayan thrust system; NW Pakistan