

Multi-hazards vulnerability and risk assessment in North-Pakistan, the challenges and way forward

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The physical, tectonic, environmental and climatological settings and anthropogenic activities coupled with the climate change in northern Pakistan, provide an ideal landscape for the frequent and damaging multi-hazards mainly landslides, debris flows, GLOF and earthquakes. However, given the complex terrains and data-poor region, comprehensive multi-hazard, vulnerability and risk assessment are rarely available for effective disaster management. Methodologies are developed to utilize the available data, techniques and models for regional- scale landslide, debris flow, GLOF, seismic hazards and risk assessments. Manual and semi-automatic techniques are applied to develop multi-hazard inventories that are related to the physical and environmental settings; and potential triggers to acquire the susceptibility and hazard assessments. The elements at-risk database comprising the settlement footprints, typological information, communication network, land use, critical infrastructure, and social vulnerability indicators are utilized for vulnerability assessment and eventually risk analysis. The element-at-risk features on the alluvial fan of the respective watersheds are analyzed for their exposure, vulnerability and risk analysis. Seismic site characterization maps are produced through field-based measurements of the shear wave velocities and relevant proxies such as the geology and terrain slope. The integrated multi-hazard is analyzed with the element at-risk databases for the multi-hazard vulnerability and risk assessment. Considering the unprecedented devastation caused by the intense monsoon in 2022, dynamic and quantitative risk assessment and adaption/mitigation planning are critical for disaster risk reduction and therefore offer opportunities for collaboration for joint research studies on climate change impacts on dynamic multi-hazard risk assessment in the region.