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Taking up the challenge of identifying active faults for seismic hazard assessment of the city of Ulaanbaatar (Mongolia)

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Ulaanbaatar, capital city of Mongolia (1.5 M inhabitants, i.e. half of the country's population), is located in Central Mongolia where seismic activity and deformation rates are low (< 1mm/yr.). In contrast, Western Mongolia has experienced four great earthquakes (M ≥ 8) between 1905 and 1957 as well as numerous moderate ones. Some (e.g. the 1957 Bogd earthquake) have been felt at the capital located more than 500 km away. During the last decades, several active faults, located 10 km to 45 km away from Ulaanbaatar, have been discovered and studied. Tectonic Geomorphology and Paleoseismology studies indicate that these faults are able to generate earthquakes of M ≥ 6 with average recurrence times ranging from 1 kyr to 10 kyr (e.g. 1195 ± 157 yr for the Sharkhai fault). Furthermore, since 2005 very dense microseismicity swarms located 10 km NW of the City have been monitored by the Seismic Observatory of Mongolia (IAG). Further studies showed the swarms are produced by the previously undetected Emeelt fault zone along three parallel branches. Due to their proximity to a key population and economic center, all these active structures contribute significantly to increasing Seismic Hazard. During the course of these studies, we documented Quaternary activity along several supplementary faults, which demonstrates that the knowledge of active faults in the region is still incomplete and suggests seismic hazard levels should be revised. Therefore, we undertook to map, as exhaustively as possible, all active tectonic structures in a radius of 300 km around Ulaanbaatar. Here we present preliminary results based on the combined analysis of multi-source and multi-sensor data from satellite images (e.g. Pleiades, Sentinel-2, Landsat8), UAV photographs, and digital elevation models (TanDEM-X and UAV photogrammetric DEMs) in order to extract the most relevant information at various scales. We performed a detailed Tectonic Geomorphology analysis of alluvial and slope landforms to identify recent deformation affecting stream channels and associated deposits (ponds, fans and terraces). On that basis, we document segmentation, deformation patterns and kinematics, as well as relationships between faults at regional scale. Finally, we identify potential sites for future paleoseismic investigations along the main structures. Though this project is in a preliminary stage, our long-term goal is to build a comprehensive database of sources of seismic hazard to the City of Ulaanbaatar and integrate these results into seismic hazard calculations.