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Site effect analysis to support the future seismic microzonation of Dushanbe, Tajikistan

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Similar to other big cities in Central Asia (such as Tashkent, the capital of Uzbekistan, or Bishkek, the capital of Kyrgyzstan), the capital of Tajikistan, Dushanbe, is highly exposed to earthquake and associated secondary hazards due to its close vicinity to two active fault systems, the Hissar–Kokshal Fault located in the north of the city, and the Iyak–Vaksh Fault in the south. The most recent damaging earthquake near Dushanbe was located in the Tajik Depression in western Tajikistan, the Hissar Earthquake in 1989 (M = 5.5), causing small direct damage on buildings, but triggered extensive liquefaction phenomena and related landslide in loess deposits. The villages of Sharora and Okuli-Bolo were affected by mudflows destroying more than 100 houses, and 247 persons died.

To ensure people's safety, especially for a rapidly growing city such as Dushanbe, adequate constructions and a detailed seismic microzonation map (and related data) are the keys for sustainable urban planning. Existing estimations of seismic hazards date back to 1978; they are based on engineering geological investigations and observed macroseismic data. These were used to create the Tajik Building Code which considers seismic intensities according to the Medvedev–Sponheuer–Karnik Scale, MSK-64. However, this code does not accurately account for soil types which vary considerably in Dushanbe – not only by their nature but also due to increasing anthropogenic alteration. In this study, we performed a series of analyses on Microtremor Array Measurements, Seismic Refraction Tomography, and instrumental data recording from permanent as well as from mobile seismic stations (H/V method) in order to provide the site effect analysis for a new comprehensive microzonation of Dushanbe (and neighboring areas) accounting for the different soil types. Our results identify several critical areas where major damage is likely to occur during strong earthquakes.