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Editorial: Seismic microzonation and risk reduction

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Editorial on the Research Topic Seismic microzonation and risk reduction

Although damaging earthquakes are not frequent natural events compared with other natural risks such as weather-related disasters, the impact of a damaging tremor is much higher in terms of damage to buildings, infrastructure, and population, as well as economic losses (direct and indirect). Additionally, earthquakes are the deadliest and most harmful events in developing countries, and the examples of the Haiti earthquake (2010) and the Sumatra earthquake (2004) are still in our memories. Understanding seismic risk is the only way to prevent as much damage as possible due to these earthquakes, and seismic microzonation is one of the cornerstones to accurately represent seismic hazard and related damage.

The propagation of seismic waves from hard and competent rocks to soft sedimentary layers implies amplification of the amplitude, frequency, and duration of the seismic waves. The so-called site effects represent the description and characterization of the interaction of the seismic wavefield with the near-surface structures. In addition, many studies have revealed that topographic features such as slopes, cliffs, hills, and canyons are able to alter seismic ground motion significantly. Depending on which part of the topographic feature is considered, seismic ground motion can be either deamplified (i.e., weakened or suppressed) or amplified. The latter has been often observed at hilltops or close to ridges and thereby has contributed to greater building damage (Molina et al., 2019). The ground motion, in combination with the topographic relief and the properties of each geologic unit, may also be responsible for triggering landslides.

Knowing the shear wave velocity (V_s) structure is important for geophysical data interpretation either to better constrain inversions for P-wave velocity (V_p) structures, such as in travel time tomography and full waveform inversions, or as the more relevant parameter in geo-engineering purposes (e.g., ground motion prediction). Passive and active geophysical methods are being widely used in order to characterize the shear-wave velocity structure in 1D, 2D, and 3D, and even the soil-structure interaction also taking into consideration the nonlinear behavior of the soils. Furthermore, determining the dominant periods of the ground is relevant in order to relate it to the fundamental period of

the buildings so the building resonance may be mapped as a vulnerability factor (Vidal et al., 2014).

In this Research Topic, we have collated a set of relevant articles that document some important studies related to the site effects in Bogotá (Colombia), Oslo (Norway), and Vancouver (Canada) and how the road network can be evaluated from the viewpoint of the susceptibility to seismically-induced landslides in Granada (Spain). These articles are being presented in the 13 International Workshop in Seismic Microzoning and Risk Reduction (<https://riesgosismico.es/13-iwsmrr/>) to be held in Alicante (Spain) from 30 November to 1 December 2023.

Zapata-Franco et al. aim to identify an intensity measure that combines the soil profile data under the structure with the ground motion at bedrock. This necessitates the consideration of the inelastic behavior of surface soil when describing ground motion at a structure's foundation. Given the unpredictability of these factors, a probabilistic approach with Monte Carlo simulation was used. Random soil profiles were created for a representative sample, while Colombian ground motion data was utilized for seismic hazard modeling. Through multi-regression analysis, functions were derived linking input variables to the dynamic response of various reinforced concrete structures. Some of these functions, derived from the displacement spectrum, can potentially enhance seismic risk predictions in urban areas.

Ghione et al. introduce an efficient, non-invasive method to determine the average shear wave velocity in the top 30 m of the ground (V_{s30}), which aids in defining soil classes and amplification in seismic assessments. Oslo currently lacks a map detailing the V_{s30} , missing vital information for seismic risk studies. The authors integrate existing databases of wells, topographical data from digital elevation models, and quaternary geological maps together with their own ground models obtained from constrained inversion of the horizontal to vertical spectral ratio (HVSr) of ambient noise interpreted as a diffuse wavefield (García-Jerez et al., 2016). A statistical geological mapping tool (COHIBA) combines different data sources. The study showcases this new approach using data from three areas in Oslo, suggesting a cost-effective seismic amplification mapping strategy for the entire municipality.

Adhikari et al. carry out a seismic microzonation mapping project for Greater Vancouver aimed at creating seismic hazard maps that account for local site effects, including hazards such as liquefaction, landslide, one-dimensional site response, and the three-dimensional Georgia sedimentary basin amplification. In this article, the authors evaluate the impact of various seismic site characterization criteria on the mapping of a large dataset for better communicating the seismic microzonation of the region (V_{s30} based on the Canadian National Building Code, V_{s30} based on the updated Eurocode 8, site period and a hybrid

classification obtained from site period, average V_{s30} and soil thickness). For clear communication, and guided by the geology of that area, the study suggests using the hybrid classification map or two separate maps for V_{s30} and site period.

Outside of the articles compiled here, the scientific community is focusing its efforts on developing integrated approaches to include these new findings, allowing faster results that can be used by decision-makers to minimize risks. The TURNkey project (<https://earthquake-turnkey.eu/>) and the RISE project (<http://www.rise-eu.org/home>) are recent examples of applied research financed by the European Union. Moreover, capacitation projects such as GEODRR (<https://geodrr.eu/>) focus efforts on working together with developing countries to prepare and deliver specialized high-quality academic programs that can suitably prepare young scientists and professionals to provide applicable solutions to disaster risk reduction.

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Conflict of interest

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