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EDITED BY
Iunio Iervolino,
University of Naples Federico II, Italy

REVIEWED BY
Pasquale Cito,
University of Naples Federico II, Italy

*CORRESPONDENCE
Brijesh K. Bansal,
bansal.moes@gmail.com

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Editorial: Seismic hazard assessment of metropolitan cities: scenario and challenges

Brijesh K. Bansal[1]*, Sumer Chopra[2] and Yih-Min Wu[3,4]

[1]Civil Engineering Department, Indian Institute of Technology Delhi, New Delhi, India, [2]Institute of Seismological Research, Gandhinagar, India, [3]Department of Geosciences, National Taiwan University, Taipei, Taiwan, [4]Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan

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Editorial on the Research Topic
Seismic hazard assessment of metropolitan cities: scenario and challenges

Large urban areas are marked by their dense population, developed infrastructure, and vital lifelines, including transportation networks, water, and power. The possibility of significant damage and loss in the event of an earthquake underscores the importance of assessing seismic hazards in metropolitan areas. The assessment process involves evaluating potential ground motions, geotechnical site conditions, and the susceptibility of the built environment to damage. However, in recent years, the assessment of seismic hazard in metropolitan areas worldwide has become more challenging due to the significant expansion of large-scale infrastructure development. With the continual growth and increasing population, it is not possible to carry out the contemporary surveys and investigations required for accurate hazard assessment, especially on a larger scale in old walled cities. This calls for the development and application of alternate approaches to undertake such studies. For this, satellite based techniques like interferometric synthetic aperture radar (InSAR) are an alternative for mapping deformations. Also, microtremor investigations are becoming a useful tool for mapping shear-wave velocities in old and congested settlements where finding open space is an Research Topic.

We collected eight papers under the Research Topic to address Research Topic related to site-specific seismic hazard assessment in and around metropolitan cities. The papers focus on various aspects, such as mapping of active faults, liquefaction potential, spatial and temporal variations of aseismic creeping, seismogenic potential of specific seismic zones, characterization of seismicity and ground motion, development of seismic hazard scenarios, the application of advanced technologies and evaluation methods, etc. The papers identify some of the major challenges associated with seismic hazard assessment in metropolitan cities, including the lack of detailed geological information, the complexity of the urban environment, and the need to develop appropriate methods for risk assessment. They also highlighted the importance of incorporating new technologies and data sets in seismic hazard assessment, such as satellite imaging and ground-based seismic networks. The papers provide useful guidance for the development of effective seismic hazard assessment strategies for metropolitan cities. They emphasize the importance of understanding the physical processes of earthquakes and their associated hazards like amplification, liquefaction, as well as the need to consider the local geology and urban environment.

Nath et al. proposed a comprehensive methodology for probabilistic seismic hazard, site characterization, liquefaction analysis, etc. for the Bengal basin with a detailed study of the seismic microzonation of Dhanbad and Mymensingh cities. They also carried out the structural impact assessment for these two cities and presented a socioeconomic seismic risk map, prepared by integrating peak ground acceleration (PGA) at the surface, vulnerability, demographic distribution, and building density, and assigning appropriate weightage to each of the themes.

Similarly, Kang et al. discuss the importance of soil liquefaction potential in the overall assessment of seismic hazard. They show that the spatial distribution of the ground vulnerability index, estimated from the analysis of ambient noise, correlates well with the distribution of sand boils, shear wave velocity, and the geological setting of the area. The well-established HVSR technique has been used to obtain the ground vulnerability index. The case study reports that the ground vulnerability index is an affordable supplement to traditional, expensive, and time-consuming geotechnical/geophysical techniques for the initial screening and regional evaluations.

The existence of littoral fault zone (LFZ) in the Northern Jiangsu Province in China is well documented; however, its geometric distribution and the late Quaternary activity are still controversial. With the help of two high-resolution shallow-reflection seismic profiles crossing the northern segment of the littoral fault zone (NLFZ) in the Yellow Sea, Ji et al. have tried to re-address the Research Topic of the littoral fault zone (LFZ). The study also infers that the kinematic properties of the LFZ transformed at the Middle Pleistocene, at least, from the normal dip–slip to the strike–slip.

Bansal et al. analysed the data of about two dozen small and moderate events, occurred in the Mizoram area of northeast India during June–August 2020. They studied the seismicity pattern and fault mechanisms, etc., of the recorded events and used the waveform data for simulating a potential future event in the region. They showed that in the event of the occurrence of a possible M8 earthquake in the region, a PGA ~480 gal could be expected.

In their discussion, Gupta and Rekapalli emphasized the significance of the duration of $M_w \geq 5$ aftershocks, given their potential to cause loss of human life and property damage, particularly when they occur near metropolitan areas. Their study presents findings from a case study of Mw ≥ 5 aftershocks that followed the devastating 2008 Sichuan earthquake in China, and also compares these results with the duration of M ≥ 5 aftershocks following major to great Himalayan earthquakes. They conclude that the dynamical/temporal estimates of the *p*-value may be useful in forecasting aftershock activity more effectively.

By analysing data on groundwater extraction, Rimando et al. established a correlation between groundwater withdrawal and accelerated creep in the Philippines. Their study demonstrated that higher rates of vertical displacement are associated with periods of faster extraction rates. Moreover, the study suggested that ongoing depressurization may result in static stress changes that could influence the timescale of earthquake occurrence due to the natural process of stress loading driven by regional tectonics.

Chen et al. by estimating the static stress increase, quantified the impact of slow slip events in the Ryukyu subduction zone on the possibility of a megathrust earthquake. The findings demonstrated that stress changes brought on by slow slip events are typically compatible with the thresholds that have caused significant interplate earthquakes in a number of subduction zones.

Dhali et al. have taken up a study for active fault mapping in the National Capital Region of Delhi using the high resolution Cartosat-1 Stereo pair data. They prepared anaglyph and DEM to map the active faults. Twelve sites were identified in the region based on satellite data interpretation, primarily along the Mahendragarh-Dehradun Fault, Sohna Fault, and their extensions. The presence of tectono-geomorphic markers such as warped surfaces indicative of fault scarps, stream offsets, gully erosion, and sag ponds, suggests active tectonic movement along major faults in the region. They identified a new right lateral Nuh-Jhirka fault (NJF). The results complement well the earlier findings around major lineaments.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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