Natural Hazards
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EDITORIAL

Special issue: Natural hazards, modelling, risk assessment and the role of scale

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Since about 1980, the number of disasters worldwide has been increasing, and during 2017 a total of more than 700 events was registered (Munich Re 2018). These include droughts, extreme temperatures, forest fires, floods, landslides, earthquakes, tsunamis and storms. In the high and middle-income countries, overall economic losses increased significantly in the same period. However, the number of fatalities was larger in low-income countries affected by extreme events. In recent years, meteorological and climatological events (storms, extreme temperatures, droughts and forest fires) occurred more often and are more extreme due to climate change.

This trend shows the importance of developing strategies for risk mitigation and safety measures, such as improving buildings' resistance and implementing flood-prevention schemes. In addition to adequate urban planning that takes into consideration that even more extreme events can occur, the population awareness will contribute to less vulnerable and more resilient communities.

Studies on natural hazards risk assessment and risk scenarios prediction are crucial to estimate real potential scenarios better and to undertake mitigation measures. Global modelling and simulation, along with GIS-based cartography, are essential tools for natural hazards risk assessment and for promoting capabilities and better resilient communities (OECD 2012; Pittore et al. 2017).

This special issue results from the scientific meeting "*International Conference on Urban Risks*" that was organised by the European Centre for Urban Risks (CERU) and took place in Lisbon, from 30 June to 2 July 2016. Issue guest editors selected the papers to give thematic coherence to the special issue. The main objective of the special issue is to advance the studies in disaster prevention and reduction related to natural hazards, namely

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earthquakes, tsunamis, heavy rainfall and floods. The innovative aspect of this special issue lies in the conjunction of three dimensions, mainly the impact of natural hazards on built environment and infrastructures, the contribution of modelling and simulation to natural hazards risk assessment and the discussion of the role of scale. Furthermore, some of the papers also focus on socio-economic impacts and vulnerability analysis.

The papers are diverse concerning the studied geographical areas, ranging from Latin America and Kuwait to European countries such as Spain, Portugal and Romania.

The first five papers deal with seismic probability assessment and the analysis and simulation of earthquakes impacts. The following two papers concentrate on the tsunami hazard evaluation and the constraints on pedestrian tsunami evacuation routes. The last three papers analyse the impact of heavy rainfall and flood risks.

Cardona et al. present a deep discussion of Latin America and Caribbean earthquakes included in the General Earthquake Model Consequences Database (GEMECD). The existence of detailed free access data on earthquake consequences, at different resolution levels, allows for more integrated and sustained disaster risk management, relevant for different experts and specialised fields. The value of the detailed analysis for selected earthquakes pertains to the adopted multidimensional approach, accounting not only for physical damages but also casualties, socio-economic impacts, damages to infrastructures and occurrence of secondary events. The paper sets benchmark procedures for further incorporating earthquake information of other regions in the GEMECD.

In post-earthquake scenarios, mainly in urban contexts, mobility capacity is essential for emergency interventions and short-term recovery. Toma-Danila proposes a new methodology, referring to a GIS framework, to study road network failure after an earthquake. It uses as case study the city of Bucharest, Romania, modelling for the entire urban space. The selection of Bucharest is justified for its high earthquake hazard, its vulnerable building stock and road congestion. The most innovative aspect of the paper is related to its standardised approach, proposing a model that can be replicated in other urban contexts.

Pavel et al. also present and discuss different seismic risk scenarios for the city of Bucharest, Romania. Although referring to Lagomarsino and Giovinazzi macroseismic method, the authors complement their risk analysis with damage data from a survey of 18,000 buildings after the 1977 Vrancea earthquake. The various tested scenarios indicate that further seismic resilience analysis and an evaluation of the equipment and personnel are needed for more efficient risk management related to earthquakes, as well as more elaborated datasets.

The paper by López Casado et al. uses the horizontal-to-vertical spectral ratio (HVSR) technique to estimate site effects in Melilla (Spain), comparing with the damage patterns of 01/25/2016 Alborán Sea earthquake. They conclude that there is high vulnerability of the ornamental facades of modern architecture and the building located on the lagoon and on the recent alluvial deposits. Their important conclusion is that seismic microzonation research using the HVSR technique can be used to assess site effects in cities threatened by damaging earthquakes, also contributing to urban development planning (master plans) that include site effects.

The paper authored by Salgado-Gálvez et al. evaluates earthquake risk and economic losses to water and sewage networks, using Manizales, Colombia, as a case study. This paper mobilises a sophisticated probabilistic seismic risk analysis, using the full potential of Probabilistic Risk Assessment Platform (CAPRA) risk assessment module. The applied methodology takes into account the different components of water and sewage, the expected losses and the estimation of occurrence frequency. This methodology can be extrapolated to analyse other lifelines and physical networks and could be used for insurance calculation purposes and for exploring alternative risk transfer instruments.

The paper by Latcharote et al. proposes a modelling analysis for the impact of tsunamis in Kuwait and Arabian Gulf from two possible origins: submarine earthquakes and sub-aerial landslides. Although the overall results show low tsunami risk for Kuwait and Arabian Gulf, the applied methodology has potential to be replicated in other contexts to analyse tsunami risk and infrastructural protection.

The paper presented by Trindade et al. has a direct application for disaster risk management related to tsunamis. The authors propose a GIS-based analysis of pedestrian evacuation routes based on the optimal path search problem. They use as case study the city of Cascais, Portugal. The detailed analysis allows for the determination of the time available for evacuation, the number of people to be evacuated at different scenarios, their arrival time to shelters and the identification of areas of congestion (flock maps). Beyond the applicability of the model for Cascais, the article sets some benchmark approaches that can be mobilised in other urban and highly dense contexts.

The paper from Barbosa et al. analyses the heavy rainfall event that occurred on 1 November 2015, in the Portuguese region of Algarve. They used a radar–rain gauge merging method that allowed for the correction of precipitation estimates. This modelling can result in better population warnings for specific urban areas. Although the 1 November 2015 episode led to exceeding of historical precipitation peaks in only two localities, the main impact of precipitation in Algarve region derived from historical changes in land morphology and land occupation due to real estate development projects. The results presented in the paper have direct relevance for urban planning and emergency planning related to rainfall in urban contexts changed by recent heavy construction.

Flood risk is also the subject of Cortès et al. paper, focusing in Barcelona. They did an analysis for the period 1981–2015, using land use, population and precipitation. They conclude there is no trend, attributing the obtained results to the lack of trend in extreme precipitation and also to the improvement of prevention measures, mainly in drainage systems and rainwater tanks. Nevertheless, the authors highlight the need for a sustained warning system to populations as well as empowerment and co-responsibility from all stakeholders.

In the last paper presented in this special issue, Santos et al. refer to a regional lower scale and to a local, higher scale, to assess flood risk in the city of Seixal, in the Tagus estuary, Portugal. Although both scales are complementary, the authors conclude that for urban planning, risk communication and early warning systems, the most relevant is the higher scale, at the building and sub-block level, of vulnerability assessment.

This special issue, focused on a diversity of natural hazards (earthquakes, tsunamis, unexpected heavy rain episodes and floods) and their impacts on urban contexts, draws lessons for the elaboration and implementation of mitigating measures through better and sustainable urban planning and population awareness.

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