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Editorial

Natural and Technological Hazards in Urban Areas: Assessment, Planning and Solutions

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Natural hazards are extreme natural phenomena whose associated consequences can lead to damage of both the natural and man-made environment. They occur worldwide, are rare at a particular place and time, and contribute to the progress of Earth's landscape [1–3]. Their cause, occurrence and evolution show important complexity and they differ in magnitude, frequency, speed and duration [4–6]. Moreover, their impact differs from place to place and when their consequences have a major impact on human life, they become natural disasters [7]. In this Special Issue, the term natural hazard refers to all atmospheric, hydrologic, geologic and geomorphologic hazardous natural phenomena that potentially affect human life and activities.

Generally, natural hazards and disasters take place more frequently in relation to our ability to restore the effects of past events [8]. On average over the past decade, about 60,000 people globally died from natural disasters each year. This number represents 0.1% of global deaths [9]. Additionally, global disasters produced $210 billion of losses in 2020 and were up 26.5% compared to 2019's cost of $166 billion [10].

On the other hand, a hazard of anthropogenic origin that can harm people, the environment or facilities is called a technological hazard. This type of hazard contains a wide range of modern issues and consequences of technology mismanagement and engineering mistakes [11]. Technological hazards such as desertification, water and soil pollution/degradation, land use changes, waste, hazardous materials incidents, pipelines and transportation are presented in this special issue.

Technological disasters account for about a third (36.4%) of all reported disasters worldwide since 1900 [12]. As technology becomes increasingly complex, technological hazards are likely to increase. The effects of technological disasters on humans may be long lasting. They are stressful, especially because they are random and unpredictable [13]. Technological hazards can bring on a crisis, menace the viability of a technological system, cause losses of life and property, and can put the social environment in which they occur at risk [14].

Natural hazards are physical phenomena active in geological time, while technological hazards result from actions or facilities created by human and occur in the recent past. Natural hazards are directly related to the natural environment and the use of technology may reduce their effects [15,16]. On the contrary, technological hazards can be mitigated by being aware of the natural environment [17,18].

Natural hazard events and technological accidents are separate causes of environmental impacts. In our time, combined natural and man-made hazards have been induced. Overpopulation and urban development in areas prone to natural hazards increase the impact of natural disasters worldwide [19,20]. Additionally, urban areas are frequently characterized by intense industrial activity and rapid but poorly planned growth that threaten environment and ecosystems, degrade quality of life and raise the likelihood of technological disasters.

To avoid the aforementioned effects, appropriate urban planning is crucial to minimize fatalities and reduce the environmental and economic impacts that accompany both natural

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and technological hazardous events. Thus, local authorities and countries should develop proper policies and strategies, aiming to effectively manage hazard risk, reducing the likelihood and consequences of disasters.

This Special Issue focuses on natural and technological hazards in urban areas. Additionally, hazard assessment, planning and solutions are included. Natural hazards such as floods, landslides, earthquakes, waterfall ice, fires, as well as technological hazards such as toxic elements, pipelines, waste and transportation, are presented.

Three works deal with the flood hazard assessment and one with the distribution of flash flood events. Joo et al. [21] assess a flood risk method in Korea. The leading indicators affecting flood damage were selected using factor analysis and principal component analysis. The analytic hierarchy process (AHP) [22], constant sum scale and entropy were used to assign the weights of the indicators. A relationship was examined between the elements and the indicators based on weights called the Integrated Index for flood risk assessment.

Liu et al. [23] estimate flood risk of urban areas in Kaohsiung city along the Dianbao River, in southern Taiwan. Floods and other extreme weather events occur continuously, threatening human lives and causing severe property losses [24]. A rainfall-runoff model (HEC-HMS) was adopted to simulate discharges in the watershed, and the simulated discharges were utilized as inputs for the inundation model (FLO-2D). A risk map was developed that compiled both flood hazards and social vulnerability levels.

Skilodimou et al. [25] propose a simple method to produce a flood hazard assessment map in burned and urban areas in a coastal part of the eastern Attica peninsula in central Greece. The Attica peninsula has suffered from wildfires and floods during the last decades [26]. Six factors were considered as the parameters most controlling runoff when it overdraws the drainage system's capacity. The analytical hierarchy process (AHP) method and geographical information system (GIS) were utilized to create a flood hazard assessment map of the study area.

Xiong et al. [27] measure the spatial and temporal distribution of flash floods and examine the relationship between flash floods and driving factors in Yunnan Province in China. Flash floods are one of the most serious natural disasters, and have a significant impact on economic development [28]. The results indicated that the number of flash floods occurring annually increased gradually from 1949 to 2015, and regions with a high quantity of flash floods were concentrated in Zhaotong, Qujing, Kunming, Yuxi, Chuxiong, Dali and Baoshan.

Another work focuses on landslide management in urbanized areas. Giordan et al. [29] show the importance of a dedicated monitoring solution and communication strategy for an effective management of complex active landslides in Italy. Large landslide emergencies are often managed by complex and multi-instrumental networks [30]. Since the management of these networks is often a complicated task, a new hybrid system focused on capturing and elaborating data-sets from monitored sites and on disseminating monitoring results to support decision makers was developed by the authors. It consists of an early warning application, which integrates a threshold-based approach, and a failure forecasting modeling.

Jia et al. [31] analyze and compare the importance of feature affecting earthquake fatalities in China mainland and establish a deep learning model to assess the potential fatalities based on the selected factors. Earthquakes cause significant damage to infrastructures and a large number of threats to the Chinese [32]. Thus, a proper rapid estimation of the number of casualties in an earthquake is important. In this paper, the random forest (RF) model, classification and regression tree (CART) model and AdaBoost model were used to assess the importance of nine features, and the analysis showed that the RF model was better than the other models.

Zhou et al. [33] examine the formation mechanism and influence factors of highway waterfall ice in northern China. Highways in the northern part of China have always been damaged by waterfall ice [34]. To explore the internal factors that lead to highway waterfall ice, gradation tests, penetration tests and freezing tests were conducted which revealed that coarse-grained particles can enhance the permeability of aquifers. Furthermore, to understand the formation mechanism of highway waterfall ice further, a mathematical model of saturated coarse-grained soil at the state of phase transition equilibrium was obtained.

Chen et al. [35] construct a natural hazard emergency relief alliance and analyze the mechanisms and dynamics of public participation. In China, the government plays an important role in emergency management and government supervision has a positive effect on environmental governance [36]. Using four different processes, namely participation proposals, negotiation interval, negotiation decision-making function and participation strategy, the authors comprehensively constructed an emergency relief alliance for natural hazards. In addition, the dynamic public interaction process was analyzed and a construction algorithm was given.

Additionally, two studies estimate the contamination of toxic elements in urban soils in Greece. Golia et al. [37] record the level of potentially toxic elements within the urban complex in the city of Volos, in central Greece. Urban and agricultural soils are often densely populated, and intensive human activities lead to large amounts of potentially toxic metals [38]. Soil pollution indices, such as the contamination factor (CF) and the geo-accumulation index (Igeo), were estimated regarding each of the metals of interest. The respective thematic maps were constructed, and the spatial variability of the contamination degree was displayed.

Alexakis et al. [39] investigate the soil quality of the Ioannina plain in western Greece concerning arsenic (As) and zinc (Zn), and delineate their origin as well as compare the As and Zn content in soil with criteria recorded in the literature. High concentration of toxic elements is reported in agricultural soil of Greece such as the Arta plain [40]. The geomorphologic settings, land use, and soil physicochemical properties were mapped and evaluated, including soil texture and concentrations of aqua-regia extractable As and Zn. The concentration of elements was spatially correlated with land use and the geology of the study area, while screening values were applied to assess land suitability.

Ali and Choi [41] review the existing methods for monitoring leakage in underground pipelines, the sinkholes caused by these leakages, and the viability of wireless sensor networking (WSN) for monitoring leakages and sinkholes. Leakage from underground pipe mains in urban areas may cause sudden ground subsidence or sinkholes [42]. The authors discussed the methods based on different objectives and their applicability via various approaches: (1) patent analysis; (2) web-of-science analysis; (3) WSN-based pipeline leakage and sinkhole monitoring.

Jia et al. [43] evaluate the vegetation restoration along an expressway in a cold, arid, and decertified area of China. Vegetation plays an important role in reducing soil erosion [44] and vegetation is significant in the restoration of expressways in the arid zone of China, although we still do not know which soil and vegetation types are most effective. The authors investigated soil particle size (SPZ), volume weight of the soil (VWS), soil water content (SWC), total porosity of soil (TP), soil organic matter (SOM), water erosion (WrE) and wind erosion (WdE) of eight sites, and evaluated them using the gray correlation method (GCM).

Kerpelis et al. [45] propose a theoretical approach for the estimation of seismic structural vulnerability of wastewater treatment plants. The assessment of seismic vulnerability is critical for lifelines such as wastewater treatment plants (WTPs) because failures may result in environmental degradation. For example, wildfires caused by earthquakes or urban fires can release toxic elements into the soil and water resources [46]. The authors tested and applied a rapid, simple methodology for assessing the seismic structural vulnerability (SSV) of WTPs (according to the qualitative method Rapid Visual Screening), using structural variables as indices of these infrastructures. An original new method involving the assessment of the SSV of 13 steps (four for a sample set of WTPs and nine for an individual one) was introduced following systematic literature retrieval.

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