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Editorial

Analysis of Extreme Hydrometeorological Events

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Extreme hydrometeorological events (e.g., storms, pluvial, fluvial, and coastal floods, droughts and landslides), with severe consequences in terms of injuries, casualties, and socioeconomic losses, are becoming increasingly frequent worldwide [1]. These events frequently have cascading effects [2], ranging from slope instability, causing infrastructure and service disruptions, to ecological disasters, from water scarcity to yield losses and rises in food prices. Climate variability and anthropogenic changes (e.g., population growth, urbanization, and environmental degradation) both play a role in amplifying the these events' effects on an increasing number of people [3,4]. Understanding the dynamics of these phenomena, improving early warning systems, and developing more coordinated disaster risk reduction strategies are, therefore, critical to properly managing the associated risk, reducing vulnerabilities, and increasing societal resilience to natural disasters. The purpose of this Special Issue was to highlight studies that address challenges in monitoring, modeling, forecasting, and assessing the effects of hydrometeorological hazards.

This Special Issue received six contributions. Three of the papers focus on floods, two on droughts, and one on glacier retreat (related to extreme temperature). Three contributions focus on areas in Poland, the other three studied areas in Italy, Brazil and Norway (Svalbard Islands).

A first contribution focuses on the prediction of the potential impacts of fluvial floods on urban population safety. The impact was estimated by combining the likelihood of a flood and the expected floodwater inundation level with a damage function, considering the purpose of the building, and the number of permanent inhabitants. After the application of the model to the Vistula River, the authors found that 500-year flooding could affect 2.35 percent of buildings and over 122,000 people in Warsaw. In contrast, the expected magnitude of flood impact on human health was estimated to be moderate, i.e., ten people per residential building in 80 percent of flood risk zones, mainly due to the shallow inundation depth of less than 1 m in many parts of the studied area. These models are of key importance for urban planning, and to raise public awareness of flood risks [5].

The issue of flood risk awareness in urban areas is also tackled in [6]. Specifically, they presented the findings of a 10-question survey on climate change and risk perception conducted in 11 municipalities of the Simeto River Valley. The survey, conducted within the activities of the LIFE project SimetoRES, collected 1143 responses from residents. The survey looked at: (a) citizens' level of concern about climate change in relation to extreme storms, (b) risk preparedness, and (c) citizens' willingness to implement sustainable drainage actions for climate change adaptation. According to the findings, more than 52 percent of citizens have insufficient knowledge of proper behavior during flooding events, and only 30 percent believe that they are responsible for reducing flooding risk. The population shows a modest willingness to support the construction of sustainable urban drainage infrastructure. Another interesting finding, derived from a statistical cross-analysis of the responses to the various questions, revealed that increased concern about climate change does not have a significant impact on either people's behavior in dangerous situations during flooding events or their willingness to support financially sustainable solutions.

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These findings suggest that increasing concern about climate change and related urban flooding risks is insufficient to improve preparedness.

The last contribution concerning floods analyzes whether the threat of flash floods is considered in municipal spatial planning. Using GIS, a preliminary assessment of 369 small catchments' susceptibility to flash floods was conducted through multicriteria analysis. Then, they examined the existing planning documents, flood hazard and risk maps, and flood risk maps for municipalities located in the most susceptible catchments. They found that, even when the risk is significant, flash floods are frequently overlooked at the local government level [7].

Looking at contributions on droughts, the first concerns the Brazilian savanna, one of the world's 25 biodiversity hotspots [8]. The authors examined meteorological and hydrological droughts and their effects on hydrological behavior in the savanna. They computed the Standardized Precipitation Index (SPI) and Standardized Streamflow Index (SSI) at different aggregation scales and analyzed the correlation between the two indices to investigate the propagation of meteorological to hydrological drought. They found no significant difference in the coefficients of correlation from 0- to 6-month lags in drought propagation, while a decrease in correlation was identified with lags at 9 and 12 months.

The second study on drought aimed to develop and test a model to simulate decreases in soil moisture during dry spells [9]. The analyses were based on diurnal data regarding the occurrence of atmospheric precipitation and diurnal values of soil moisture under a bare soil surface from May to October. During dry spells, the moisture rate decreased in six layers of the soil profile, described using a decreasing exponential trend. The least squares method was used to calculate the exponent value, which described the rate of soil moisture decrease, for each dry spell and soil depth. The exponential form of the trend of soil moisture changes over time used for the analysis also allowed for the calculation of the duration of a hypothetical dry spell, a result that can be related to land use.

Finally, the paper on glacier retreat is based on a comparative analysis of high-resolution differential digital elevation models (DEM of Difference (DoD)) based on terrestrial laser scanning (TLS) surveys conducted in the Svalbard Islands [10]. The comparison of DEMs at three-week intervals allowed for the identification of erosion and depositional areas, as well as the volume of the glacier's terminus melting. They found that the retreat of the glacier's snout ranged from 3 to 9 m (mean of 5 m) over a 3-week period, accompanied by an average lowering of the surface of up to 0.86 m (0.03 m) and a decrease in ice volume of 53,475 m^3 (1761 m^3). The deglaciated area increased by 4549 m^2 (5%), resulting in an extensive reshaping of the recently deglaciated area. The DEM of Difference (DoD) analyses offered important insights into the melting dynamics as related to air temperature, humidity, pressure and wind speed.

Overall, the contributions to this Special Issue provide some insights on the possible analyses that can be carried out to obtain a better understanding and management of natural hazards related to extreme hydrometeorological events, as well as highlighting how a greater dialogue between research, decision makers and laymen is desirable to increase community resilience to climate change.

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