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Editorial

Editorial to the Special Issue "Drought and Water Scarcity: Monitoring, Modelling and Mitigation"

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Drought is considered to be among the major natural hazards faced by human society, with significant impacts on environment, society, agriculture and economy stemming from its consequences. It is recognized that there is no universally accepted definition of drought due to the wide variety of sectors affected by drought as well as its diverse spatial and temporal distribution. Moreover, it is well known that water scarcity and droughts constitute a specific scientific field of hydrology and water resources. This area of study is currently receiving significant attention, which is primarily due to climate change, among other reasons. In addition, drought exhibits a number of key features, such as its non-structured effects, or its slow onset.

The direct and indirect effects of drought are difficult to measure in many sectors. For these reasons, it is necessary to improve the methods of assessment and response. Our objective should be to elaborate without delay the necessary preparation plans to face the consequences of drought, especially under actual climatic conditions, based on improved monitoring systems [1–3] and modelling methods [4], as well as methods of mitigation and adaptation.

We are launching this Special Issue of *Hydrology*, entitled "Drought and Water Scarcity: Monitoring, Modelling, and Mitigation", to elicit the contributions of the scientific community to bring its expertise to bear upon this topic.

An overview of the articles presented in this Special Issue is presented (Appendix A)).

Sidiropoulos et al. presents a methodology for the quantitative classification of desertification severity for degraded aquifers based on remotely sensed drought assessment. Desertification must be considered as a global problem that requires direct actions and measures. Natural and anthropogenic causes jointly lead to land degradation and eventually to desertification, a phenomenon which occurs in arid, semiarid and dry subhumid areas. Furthermore, extended drought periods may cause soil exposure and erosion, land degradation and finally desertification. Several climatic, geological, hydrological, physiographic, biological and human factors contribute to desertification. The methodological procedure presented is based on remote sensing tools for use in the quantitative classification of desertification severity over a watershed with degraded groundwater resources.

In Dimitriadis et al. 's paper, a global-scale investigation of stochastic similarities in marginal distribution and dependent structures of key hydrological processes is carried out. In order to seek stochastic analogies in key processes related to the hydrological cycle, an extended collection of several billions of data values from hundred thousand of worldwide stations is undertaken.

The article examines the processes of the new-surface hourly temperature, dew point, relative humidity, sea level pressure, atmospheric wind speed, hourly/daily streamflow, and precipitation.

Through the case of robust metrics, it is found that several stochastic similarities exist in the marginal structure. This is true both in terms of the first four moments, and in relation to the second-order dependent structure. Stochastic similarities are also detected among the examined processes, forming a specific hierarchy among their marginal and dependence structures, similar to the one in the hydrological cycle.

The scientific community must also face, especially under water penury conditions, the supply of greenhouse agriculture. Specifically, we must undertake a reliability analysis of rainwater harvesting tanks for use in irrigation water. This challenge is examined in paper of Londra et al., 2021.

Rainwater harvesting is an ancient water management practice that has been used to cover potable and non-potable water needs. In recent years, this practice has been considered as a promising alternative and a sustainable source of water to meet irrigation needs in agriculture in arid and semi-arid regions. Using the daily water balance model, the size of rainwater tanks for irrigation use was investigated in greenhouse settings for begonia and tomato cultivations in two regions of Greece.

The major droughts in the United States that have heavily impacted the hydrologic system and negatively affect energy and food production are analyzed in the paper of Kokikot and Omitaomu. An improved understanding of historical drought is critical for accurate forecasts. Data from global climate models cannot effectively evaluate local patterns because of their low special scale. This research leverages downscaled (~4 km grid spacing) temperature and precipitation estimates from global climate models' data to examine drought patterns. The high spatial scale at which the analysis was performed allowed us to uncover significant local differences in drought patterns. This is critical for highlighting possible weak systems that could inform adaptation strategies, as in the energy and agricultural sectors.

Another subject that is treated in the Special Issue is flash flood water management in arid areas. In the paper of Elsebaie et al, the examination and the derivation of intensity–duration–frequency (IDF) curves in an urban arid area under a variety of terrain patterns and climate changes is conducted. These IDF curves can be used to identify vulnerable hotspot areas in arid regions and flood mitigation steps can be suggested to minimize flood risk.

Dercas et al. uses the AquaCrop model to simulate the yield and water balance parameters in a wheat field under different nitrogen management practices. The model was applied in Thessaly plain (central Greece), where the risk of contamination of the groundwater aquifer due to increased use of agrochemicals was high. The analysis is particularly important to improve agricultural practices in an area with high pressure on natural resources (soil and water) and reverse the effects of the current management approach.

The agricultural sector is vulnerable to extreme phenomena such as droughts, particularly in arid and semi-arid environments and in areas where water infrastructure is limited. Devising preparedness plans, including means for efficient monitoring and timely identification of drought events, is essential for decision making on drought mitigation and water management. In the paper of Tigkas et al., two new indices, Agriculture Standardized Precipitation Index (aSPI) and the effective Reconnaissance Drought Index (eRDI), were incorporated in the Drought Indices calculator (DrinC) software. This enhances the applicability of the software, especially for the characterization of agricultural drought.

Sharma and Panu presents a procedure for the estimation of drought magnitude (M), which then forms the basis for estimating the drought duration or length (L). The drought magnitude (M) and the length of the critical period (Lcr) are estimated using the concept of behavior analysis prevalent in the hydrological design of reservoirs. The performance of the procedure to estimate drought length was found to be satisfactory up to the truncation level of Q75, whereas the estimation of drought magnitude was rated as good.

In the paper of Londra et al. 2022, the effect of rainfall regime on rainwater harvesting tank sizing for greenhouse irrigation use was investigated. A daily water balance model for greenhouse tomato cultivation was applied in three regions of Crete Island (Greece). Daily rainfall data from three representative rainfall stations of the study areas characterized by different rainfall regimes for a 12-year time series were used. The analysis was carried out for covered and uncovered tanks.

The subject of crop growing in arid, drought-prone environments and the necessary measures for adaptation and mitigation are analyzed in the paper of Sisto et al.. Drought poses significant risks in irrigated crop production, which accounts for a large share of global freshwater use. Given its key role in the production of food, feed and fiber crops, there exists a need for policy measures to prevent and mitigate the impact of drought on irrigated agriculture. The paper suggests that the design of drought policy should consider actual former behavior in response to water scarcity.

The impact of hydrometeorological hazards on agriculture and human well-being is analyzed in the paper from Minh et al. The study strives to evaluate both dry and wet conditions in the Vietnamese Mekong Delta (VMD). Different meteorological parameters from the last three decades were used to develop drought indices for Ca Mau province to investigate their impact on agriculture output. The standard precipitation index (SPI), the agricultural rainfall index (ARI) and the standardized precipitation evapotranspiration index (SPEI) were used. Ca Mau is a region with peculiar characteristics of the whole VMD, i.e., dry periods persist well into the wet season, extending the duration of drought events. The assessment contributes to the understanding of the pattern of unpredictable rainfall and meteorological anomaly conditions in Ca Mau. To face this situation, more robust plans for water management are needed in these areas.

Due to the change in climatic conditions, drought will be more persistent and will affect seriously vulnerable areas where the availability of water is already jeopardized.

Drought, as mentioned, has direct and indirect impacts on many sectors and affects biotic and abiotic environments. The analysis of those impacts must be thorough and continuous because the changes are significant, and they should be dealt with.

It is necessary to plan our reactions to extreme events that occur frequently. New tools should be used to mitigate drought effects, such as improved hydrological analysis, better evaluation of the droughts, adaptation of the agriculture to the new conditions (new varieties, improved water used, better agricultural practices), estimation of the water supply and adjustment of the infrastructure.

The articles included in this Special Issue work in this direction, but it is certain that the efforts should be pronounced in order to galvanize sustainable solutions to face the persistent drought conditions that lead to desertification, thus making areas increasingly unsuitable for agriculture.

Conflicts of Interest: The author declares no conflict of interest.

Appendix A

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