Editorial: Hydrologic extremes

Drought is a complex phenomenon that affects every sphere of human activities. A number of indices exist that quantify drought characteristics. Early detection of drought trends is expected to help/accelerate mitigation activities. From the other perspective, intensity duration frequency curves, design rainfall and floods are expected to help in formulating various water resources strategies and mitigation measures. Another dimension is climate change impact studies on hydrologic extremes which are expected to help policy makers, hydrologists and all the stakeholders significantly for better planning. This supplementary issue on hydrologic extremes consists of fourteen papers related to droughts and allied fields whereas nine papers are related to floods and allied research areas. A brief discussion on the papers which are part of the issue follows.

Khan *et al.* (2020) analysed Multivariate Standardized Drought Index (SDI), Standardized Precipitation Index (SPI) and Standardized Soil Moisture Index (SSI) in Heilongjiang Province, China during 1980 to 2015. Almost half of the exceptional and extreme drought events occurred during 1990–92 and 2004–05. Vishwakarma *et al.* (2020a) analysed SPI and Reconnaissance Drought Index (RDI) for Sagar division, Madhya Pradesh, India. They conducted trend analysis of considered meteorological variables. Substantial similarity between SPI and RDI was found based on analysis of variance (ANOVA) studies, and the authors concluded that RDI is the preferred index in terms of climate perspective. Katipoğlu *et al.* (2020) analysed SPI, Statistical Z-Score Index (ZSI), Rainfall Anomaly Index (RAI), Standardized Precipitation Evapotranspiration Index (SPEI), and RDI for the Euphrates basin, Turkey, between 1966 and 2017. SPEI and RDI have been found to be superior to other indices. Limones *et al.* (2020) proposed a structured approach to identify the highest levels of drought risk for south of Angola. It was also observed that most of the region faces severe multi-year meteorological drought. Mellak & Souag-Gamane (2020) analysed SPI to identify drought events in northern Algeria. Three Archimedean copula families were used to relate drought duration and severity and found that the Western part of Algeria is the most vulnerable to severe/extreme droughts. Al-Najjar *et al.* (2020) worked towards drought studies in the Gaza Strip (Palestine) using stochastic time series models and analysed drought situation. Rose & Chithra (2020) employed the SPEI and SPI for a tropical river basin, Kerala. Existence of drought condition in the past and future based on Representative Concentration Pathways (RCPs) 4.5 and 8.5 scenarios are observed. The authors opined that study will be helpful in risk management and decision making. Vishwakarma *et al.* (2020b) evaluated the reliability of five General Circulation Models (GCMs) in a Coupled Model Intercomparison Project 5 (CMIP5) category for the drought prone Bundelkhand region in central India. Bias-corrected GCMs played a better role than the CORDEX Regional Climate Models (RCMs). Ashrafi *et al.* (2020) investigated the impact of climate change on droughts using SDI for Gharasu basin, Iran. Uncertainty of drought projection in wet periods is found to be greater than that in the dry periods. Bouabdelli *et al.* (2020) estimated hydrological drought risk in three basins of northern Algeria. Projected risk of extreme drought recurrence in the future is found to be larger than the reference period. Sur & Lunagaria (2020) assessed the spatio-temporal status of meteorological drought for Gujarat state, India using remote sensing.

Tropical Rainfall Measuring Mission (TRMM) data was used to compute SPI, and Moderate Resolution Imaging Spectroradiometer (MODIS) data was used for Vegetation Condition Index (VCI) and concluded that drought indices derived from remote sensing are useful. Amin *et al.* (2020) computed SPI, Normalized Difference Vegetation Index (NDVI), VCI, stabilized vegetation index (STVI) and wheat crop yield anomalies to analyse drought across the Thal region of Punjab, Pakistan. They developed an agricultural risk map and concluded that this will be helpful for monitoring the effect of drought risk on agricultural productivity. Mukasa *et al.* (2020) assessed drought and households' adaptive capacity to scarcity of water during drought in Kasali, Uganda using RDI. It was concluded

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that the adaptive capacity of households to scarcity of water was low. Drought negatively impacted water availability. Fazel-Rastgar (2020) analysed three summer heat waves in the Canadian Arctic on the basis of high resolution datasets and made relevant observations.

Hajani (2020) assessed the effect of climate changes on design rainfall for New South Wales, Australia. Relative differences between the stationary and non-stationary intensity–frequency–duration curves increased with increase in the future period. Kirkpatrick & Olbert (2020) investigated changes in flood mechanisms, dynamics and extents due to climate change for a case study of the coastal city of Cork, Ireland. They concluded that present research can be used to determine climate-resilient flood management measures. Galstyan *et al.* (2020) analysed spatial-temporal trends and distribution of flood events in the context of climate change in Armenia. Geographic Information System (GIS)-based mapping shows the location of flood vulnerable areas and the study can be used for flood hazard assessment mapping and risk management. Saidi *et al.* (2020) assessed frequency and return period of extreme events in a High Atlas watershed (the Ghdat Wadi) using historical floods. They have considered flood peak flows and flood water volumes. Soo *et al.* (2020) analysed Climate Prediction Center morphing method (CMORPH), TRMM, Integrated Multi-satellitE Retrievals for GPM (IMERG), and Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) based on datasets during 2014/2015 extreme floods in Langat river basin, Malaysia and concluded that current estimations are still imperfect for any hydrological applications. Okkan & Kirdemir (2020) employed a hybrid use of the Particle Swarm Optimization with the Levenberg–Marquardt algorithm for calibration of a nonlinear Muskingum model for four different flood data sets and found it to be satisfactory when compared to other variants. Boudani *et al.* (2020) developed a conceptual numerical model for flood forecasting and management in a GIS environment for the north-east region of Algeria. The model is found to be promising and expected to be useful in flood management. Trinh *et al.* (2020) introduced a mechanism to construct long-term high resolution extreme 72-hour precipitation and hillslope flood maps over a tropical transboundary region. The methodology was applied to Da and Thao River watersheds within Vietnam and China. The WEHY-WRF model was used and it was concluded that heavy precipitation may not be the only basis to create an extreme flood event. Ajibade *et al.* (2020) employed the Revised Universal Soil Loss Equation model, GIS and remote sensing to assess the risk of soil erosion and hotspots in Anambra State in Nigeria. Soil loss is projected to increase with anthropogenic activities and climate change.

We hope this supplementary issue will create enthusiasm among researchers working in this thrust area and provide future research directions to young researchers.

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