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Editorial: Understanding Hydrological Extremes and Their Impact in a Changing Climate: Observations, Modeling and Attribution

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Editorial on the Research Article

Understanding Hydrological Extremes and their Impact in a Changing Climate: Observations, Modeling and Attribution

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The hydrological regimes have been significantly altered by climate change and human activities, which have resulted in increased hydrological extreme events such as floods and drought over the world (Samaniego et al., 2018) and it seems likely this trend will continue in the future (Liu et al., 2019a). Better understanding and forecast of hydroclimatic extremes are required for mitigating the impacts of the extreme events in the context of global warming. This calls for in-depth investigations on evolution and mechanism of hydroclimatic extremes. So far, the assessment and attribution of the hydrological extremes and their impacts on the regional/global scales remain a great challenge (Schewe et al., 2019). Hydrological models are powerful and physically-based tools for the assessment of hydrological extremes, while the statistical indices are efficient and data-driven approaches based on hydroclimatic observations for identifying and assessing flood and drought events. This special issue focuses on the development and application of various model- and index-based techniques for the detection and attribution of the changes in hydroclimatic extremes induced by climate change and human activities.

To understand the uncertainty in the widely used Standardized Precipitation Index (SPI), Zhang and Li (2020) investigated the effects of probability distributions and parameter errors on the estimates of SPI in the Heihe River basin, northwest China. Ten probability distributions were tested and the SPI using log-logistic-type distribution produced similar results as the benchmark SPI using the gamma distribution. As one of the most sensitive regions to climate change, the assessment and attribution of the changes in water resources in the Yarlung Zangbo river have attracted much attention of hydrologists during the 21st century (Yao et al., 2010; Tang et al., 2019). Niu et al. (2020) evaluated the drought characteristics in the Yarlung Zangbo River basin from a different perspective by using SPI, Soil Water Deficit Index (SWDI), and self-calibrating Palmer Drought Severity Index (PDSI) based on the output from Global Land Data Assimilation System and the Climate Research Unit dataset. The three indices indicated that drought conditions have aggregated to different degrees over the basin. The increased drought may be partly due to climate change in this basin (Lutz et al., 2014), however, the attribution of the changes in hydroclimatic extremes remains subject to large uncertainty because of human interventions and the lack of high-quality observations in such mountainous river basins.

The regional extremes are often not merely caused by the hydroclimatic variations on the local scale. Hamal et al. (2020) pointed out that dry and wet conditions over the Tibetan Plateau and surrounding areas might be significantly associated with large-scale circulations, e.g., the cyclonic and anticyclonic circulation in northern India. They showed that surface air temperature over these regions was colder in wet years than dry years. Further investigation on the relations linking dry/wet conditions, large-scale circulations, and heat extremes would definitely benefit the forecasts of regional extreme weather (Liu et al., 2019b).

Human activities would often aggregate hydroclimatic extremes under climate change, which can be better represented via hydrological models. By developing a water resources allocation model, Zeng et al. (2020) showed that water deficit would be largely mitigated along the east route of the South-to-North Water Transfer Project in Jiangsu Province, China. Based on remote sensing data, Song et al. (2020) pointed out that the coastal wetland has shrunk substantially during the past four decades mainly due to seaward shifting caused by human interventions such as intensive land reclamation. Intertidal wetland conservation should be a high priority over this region because the sea level was projected to rise more than 0.5 m around China seas in the future due to global warming (Qu et al., 2019). In the research report of Xiao and Li (2020), a simulation of the downward groundwater leakage rate based on the MODFLOW model was conducted to examine the risk of sinkhole hazards induced by human activities. Hydroclimatic extremes can have further impacts on water resources. Dang et al. (2020) reported that the intensification of extreme precipitation would significantly increase sediment yield in many branches of the Yellow River based on a scenario analysis, which may cause deterioration of the water environment in the Yellow River basin.

AUTHOR CONTRIBUTIONS

XL wrote the draft of the manuscript, ZL and PA editted and commented on the draft. All authors approved the manuscript for publication.

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