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Advances in Remote Sensing to Understand Extreme Hydrological Events

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Editorial

Advances in Remote Sensing to Understand Extreme Hydrological Events

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Hydrological extreme events [1, 2] often lead to catastrophes for humans [3] and the environment [4]. The identification, understanding, modeling, validation, and prediction of hydrological extreme events are crucial in preventing such catastrophes and eventually developing a system that is resilient to them, but such tasks are challenging. This is because it is difficult to obtain a comprehensive understanding of extreme events in which spatiotemporal characteristics vary significantly, and the corresponding damage that typically occurs over a spatial extent of several thousand kilometers.

The weather radar and the satellite-based remote sensing techniques are two major research branches to resolve these issues. Weather radar provides the near-real-time precise and accurate observation of precipitation over the spatial coverage encompassing several hundred kilometers. While traditional studies regarding weather radar have focused on the calibration [5, 6], bias correction [7], validation, and uncertainty estimation [8, 9] of radar measurements, recent studies investigated the topics of merging ground and radar precipitation data [10–12], storm movement tracking and forecast [13–15], application to urban flash flood and warning [16, 17], and design parameter estimation [18, 19]. The satellite remote sensing techniques allow us to observe a variety of components of hydrological cycle at a global scale. They have been developed for the estimation of water and energy fluxes between the land surface and atmosphere in terms of space and time. The major water and energy fluxes are land surface temperature, soil moisture, evapotranspiration, snow water equivalent, and vegetation/land cover [20].

In addition, technologies regarding radar and satellite sensors and satellite launchers have been advancing remarkably. The X-band radar instruments have been developed to figure out the Z-R relationships based on the shape of the rain drops and to capture rainfall intensity at the spatial resolutions of a few meters within a few kilometers of radius [21, 22]; the acquisition period for optical and SAR satellite images is already getting as shorter as less than one day [23].

This dramatic advance in the remote sensing techniques will eventually revolutionize the design and management framework to make current anthropogenic systems more agile and efficient against natural disasters. For example, the radar-gauge merging techniques and the accumulating length of the radar precipitation records enable a more thorough understanding of the characteristics of extreme precipitation including their whole spatial pattern, temporal progress, and interactions with other environmental variables, which subsequently yields more realistic and cost-effective design parameters [24] and agile real-time flood warning systems customized to the urban areas as small as several square kilometers [25].

In this era of abundant remote sensing data, the mission of hydrologists is evident: actively utilizing the data; extending the dimension of our understanding of nature; and returning the benefits to the human and environment.

Conflicts of Interest

The editors declare that there are no conflicts of interest regarding the publication of this issue.

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