frontiers | Frontiers in Earth Science

TYPE Editorial
PUBLISHED 21 October 2022
DOI 10.3389/feart.2022.1050027

OPEN ACCESS

EDITED AND REVIEWED BY
Wouter Buytaert,
Imperial College London,
United Kingdom

*CORRESPONDENCE
Sanjeev Kumar Jha,
sanjeevj@iiserb.ac.in

†Previous work by this author has been published under the name Hannes Müller

SPECIALTY SECTION
This article was submitted to Hydrosphere, a section of the journal Frontiers in Earth Science

RECEIVED 21 September 2022
ACCEPTED 06 October 2022
PUBLISHED 21 October 2022

CITATION
Jha SK, Müller-Thomy H and Cho J (2022), Editorial: Extreme precipitation events: Spatio-temporal connections, forecasting, generation, impact analysis, vulnerability and risk assessment. *Front. Earth Sci.* 10:1050027. doi: 10.3389/feart.2022.1050027

Editorial: Extreme precipitation events: Spatio-temporal connections, forecasting, generation, impact analysis, vulnerability and risk assessment

Sanjeev Kumar Jha[1]*, Hannes Müller-Thomy [2†] and Jaepil Cho[3]

[1]Indian Institute of Science Education and Research, Bhopal, India, [2]Department of Hydrology and River Basin Management, Leichtweiß-Institute for Hydraulic Engineering and Water Resources, TU Braunschweig, Braunschweig, Germany, [3]Integrated Watershed Management Institute Seoul, Seoul, South Korea

KEYWORDS

precipitation extremes, atmospheric circulation, numerical weather prediction, southwest vortex, urban flooding

Editorial on the Research Topic
Extreme precipitation events: Spatio-temporal connections, forecasting, generation, impact analysis, vulnerability and risk assessment

Extreme precipitation events (EPEs) have shown a significant increase in magnitude and frequency in various parts of the world. In the past decades, extreme precipitation has caused wide-ranging impacts on various sectors of society, leading to increased risk and vulnerability while decreasing resilience and adaptive capacity. Unfortunately, the frequency of EPEs is increasing and is estimated to even intensify in the future (Ali and Mishra, 2018). During the past decades, studies have used various approaches to understand the mechanism behind the formation of EPEs, their spatio-temporal characteristics, their impacts on various sectors of society, and ways to prevent adverse impacts (Singhal and Jha, 2021). On this vital research topic of Extreme Precipitation Events, 12 articles were accepted and published. Out of these, nine articles can be categorized under two broader themes: 1) understanding of mechanisms behind the generation of EPEs, and 2) challenges in urban and semi-urban areas due to increasing influences of anthropogenic activities on EPEs. The remaining three articles focus on various other aspects of extreme precipitation events.

Some parts of the world have been more prone to increased incidence of EPEs than others. One such region is Central Asia, where atmospheric processes and weather systems of different scales have significantly influenced the nature of extreme precipitation events. In this regard, Chen et al. assessed the mechanism behind the

unusually long duration of the rainy period in China during the 2020 Meiyu precipitation front. They found a meridional migration of the 2020 abnormal Meiyu rain belt from June to July, leading to extreme rainfall. Further, to better comprehend the characteristics of heavy precipitation occurring due to the Autumn Continuous Rain (ACR) in China, Yang et al. analysed daily precipitation data to assess the spatiotemporal variations in ACR and constructed a conceptual model including the factors such as sea surface temperature, arctic vortex and sub-tropical high. In another study, Wu et al. studied the dual-core southwest vortex and how the circulation process is affected by the release of latent heat and the local topography. They concluded that the release of latent heat significantly influenced the formation of the Dual-Core Southwest Vortex (DCSWV). At the same time, the topography of the Tibetan Plateau affected the location and duration of DCSWV in China. Similarly, Cao et al. explained the reasons behind increased EPEs over Central China by studying the moisture supply and water vapor transport throughout Europe and Asia. The authors used decomposed water vapor flux divergence with the Barnes filter and synoptic methods in different precipitation events. Further, Dong et al. investigated the characteristics and formation of two banded strong radar echoes over the Sichuan Basin of China in view of two vortices coupling.

Urban hydrology is an important research subject, especially in the context of climate change and extreme precipitation. Due to expanding anthropogenic influences, the world is witnessing abrupt changes in the hydrological and meteorological characteristics in various urban and semi-urban regions of the world. In this context, Singhal et al. developed a framework for generating impact-based forecasts by analysing extreme precipitation forecasts of 2017–2020 and estimated the impacts on various sectors of population, economy, and agriculture in a semi-urban region of northern India. Alongside this, the authors suggested corresponding preventive actions to mitigate the severity of the impacts. In another study, Davis et al. addressed the growing issue of urban flooding in India by setting up a Weather Research and Forecasting (WRF) model for the city of Bangalore, India. The authors used the hydrologic model PCSWMM to provide high-resolution flood forecasts using 6-h rainfall forecasts before the event. Further, Tian et al. used weather radars to obtain high-resolution and high-accuracy quantitative precipitation estimates. The authors used a deep neural network to improve the accuracy of rainfall estimates by including meteorological and geographical factors as covariates. Liu et al. analysed the rainfall trend taking into account the change in the categories of rain gauges from rural to urban. The authors applied an approach of dynamic sampling to find that the total annual and maximum daily precipitation has increased in the past 30 years in the Yangtze River basin of China.

Along with the aforementioned contributions, this Research Topic includes other significant articles focussing on various aspects of extreme precipitation, risk assessment and mitigation. For instance, Li et al. performed 32 experiments to find out the effect of porous fiber material (PFM) on the surface runoff and peak flow under the conditions of extreme precipitation in the Huaibei basin of China. Results show that PFM increases the water holding capacity and, as a result, reduces the risk of droughts and floods in the region. Tiwari et al. reviewed how the land surface plays a role in tropical cyclone intensification. The article reports about the advancement in the improved prediction of the north Indian Ocean Tropical Cyclone due to advancement in the atmospheric model and air-sea coupled models, and satellite-era. Wang et al. reproduced supercell precipitation by assimilating lightning data into the WRF model. The authors show that the assimilation of lightning data enhances the range and intensity of precipitation forecasts and compensates for the unavailability of observation data during supercell growth.

Author contributions

SKJ wrote the first draft of the Editorial. HM-T and JC proofread it.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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