frontiers | Frontiers in Earth Science

TYPE Editorial
PUBLISHED 17 October 2023
DOI 10.3389/feart.2023.1305527

OPEN ACCESS

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RECEIVED 01 October 2023
ACCEPTED 09 October 2023
PUBLISHED 17 October 2023

CITATION
Gomes HB, Herdies DL, Baltaci H and Juneng L (2023), Editorial: Extreme events and risk of hazards: perspectives from observations and modeling.
Front. Earth Sci. 11:1305527.
doi: 10.3389/feart.2023.1305527

Editorial: Extreme events and risk of hazards: perspectives from observations and modeling

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KEYWORDS

extreme events, climate change, landslides, droughts, floods

Editorial on the Research Topic
Extreme events and risk of hazards: perspectives from observations and modeling

Weather and climate extremes including floods, droughts, heatwaves, storms, and cold spells have severe socioeconomic implications and environmental impacts. Understanding the spatiotemporal and intensity changes of these extremes is crucial for modeling and predicting these events. For this purpose, accurate and high-density observation methodologies are needed to understand the present extreme weather events and to develop the current regional and global atmospheric and climate models. This information also helps us understand the dynamical formation of extreme atmospheric events and their frequency and intensity changes in the past, present, and future. As a result, we will have more opportunities to mitigate the potential risks caused by extremes, and adaptation and disaster risk management strategies will be developed.

In recent years, extreme events have become one of the most important topics in meteorology and climatology. This is related to their frequent disastrous effects, both environmentally and socioeconomically. The risks associated with these extreme climate and weather events have increased over the years. Projected changes in extremes are larger in frequency and intensity with every increment of global warming. Thus, we need to understand past and future changes in weather and climatic extreme events to support adaptation and risk management decisions.

The Research Topic aims to 1) reveal observational characteristics of extreme events and risk of natural hazards; 2) investigate the ability of regional and global climate models to represent extreme events in past, present, and future climates, including climatic impact drivers such as heatwaves, heavy rain, flood/droughts, and wildfire; and 3) contribute to policy decision-making for disaster prevention and mitigation under warming climate.

The aforementioned Research Topic includes four articles (organized) as follows:

Wen and Chen addressed the changes in drought characteristics in China during the past decades. Based on 613 meteorological station data, the standardized precipitation evapotranspiration index (SPEI) was calculated with a 3-month time scale due to their study mainly focusing on the meteorological drought. The authors reported an evident interdecadal variability in the drought changes across China, with more droughts and severe occurrences in the first (1961–1979) and third (2000–2019) decades, while in the second (1980–1999) decades, the events were weaker and fewer.

Ullah et al. addressed the drought events using global hydrological and climate model coupling. This study complemented through analysis of different shared socioeconomic pathways (SSPs) corresponding to the global representative concentration pathway (RCP) radiative forcing to investigate the recent and projected changes in water scarcity associated with droughts over southern Pakistan. This study revealed that one of the extreme droughts (2017–2020) of the last 100 years contributed to the recent extreme water deficit. It also highlighted that water scarcity is projected to be intensified in the areas already under stress in future scenarios.

Michael et al. used remote sensing information to monitor the occurrence of floods in two large sub-basins of rivers in Tanzania in rice-growing areas, using data from Sentinel-1 SAR (Synthetic Aperture Radar) in the Google Earth Engine platform. They demonstrated the valuable role of remote sensing in monitoring flooding within a region that lacks sufficient data on rice cultivation. This study highlighted the interannual variability in flood extent, both spatially and temporally. The flood maps generated through its results serve as guidance for the dissemination of new technologies on how flood-tolerant rice varieties can be identified, contributing to improving rice production in these regions of Tanzania.

Guan et al. focused on the response of fatal landslides to precipitation in the Chinese Loess Plateau region under global warming, using CMIP6 models, and analyzed the correlation between various extreme precipitation indices. The results showed that single continuous precipitation events with a cumulative precipitation of 185–235 mm and duration of 6 days or more have a higher correlation with fatal landslides, indicating that continuous precipitation plays a key role in fatal landslides compared to short-duration, high-intensity events. With the increase in the occurrence of extreme rainfall events due to global warming, the region may face more fatal landslides in the future, especially in the high greenhouse gas emission scenario (SSP5-8.5) using daily precipitation (2015–2100).

The papers presented here reveal the crucial importance of both observation and modeling techniques in understanding and managing hazard risks. This is particularly true in the context of warming of the planet and changing climate. Therefore, it is imperative that we continue to invest and integrate both the observation and modeling techniques to provide a robust foundation for informed decision-making and sustainable policies aimed at safeguarding our future.

Author contributions

HG: conceptualization, writing–original draft, and writing–review and editing. DH: conceptualization, writing–original draft, and writing–review and editing. HB: conceptualization, writing–original draft, and writing–review and editing. LJ: conceptualization, writing–original draft, and writing–review and editing.

Conflict of interest

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