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Editorial: Extreme precipitation in arid regions: observation, mechanisms, and simulations

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Editorial on the Research Topic
Extreme precipitation in arid regions: observation, mechanisms, and simulations

Arid regions, covering 41% of Earth's land area, experience insufficient vapor leading to deficient rainfall. These ecologically fragile regions are highly sensitive to climate change (Barriopedro et al., 2012; Wang et al., 2021; Yang et al., 2023). Despite their aridity, extreme precipitation events (EPEs) are observed in these regions. The increasing frequency of EPEs in arid regions due to global warming introduces challenges and uncertainties for ecosystems, environment, and sustainable development. This prompts essential researches about the characteristics and changing trends of EPEs, the sources of water vapor, the physical mechanisms of EPEs, and the relationship between the EPEs in arid regions and ocean/land signals (e.g., ENSO, soil moisture).

The performance of numerical models in simulating EPEs in arid regions remains a challenge. Previous study has revealed inconsistent simulations of EPE with different cumulus parameterizations (Zhaoye et al., 2022), indicating substantial uncertainties in performances of numerical models across diverse spatial and temporal scales in arid regions. Aggravated by sparse observations and unclear physics parameterizations in arid regions, necessitating an urgent need for improving simulations and better understanding of EPEs.

This Research Topic serves as a platform for researchers to share the latest findings on extreme precipitation in arid regions. The Research Topic includes eight original research papers of high quality, contributed by 42 authors. These contributions are broadly classified into three categories: changes in EPEs and associated processes, exploration of physical processes and mechanisms driving EPEs, evaluations and improvements of parameterizations in EPEs simulations.

Three papers focused on changes in extreme precipitation and related processes in arid regions. Yang et al. used long-term meteorological observations to scrutinize historical precipitation variations and explored future projections based on dynamic downscaled simulations, revealing intense precipitation occurrences over the southeastern and northern NWC, and projecting substantial reductions in future precipitation across the southern and eastern NWC. Silva et al. conducted a comprehensive analysis of extreme precipitation indices, indicating a decrease in the rainfall regime and an increase in dry days, especially during the annual time scale and the rainy season. Additionally, Jiang et al. employed two extreme wind

indices (i.e., EW90 and EW95) to examine the relationship between extreme-wind intensity and local-source sandstorm occurrences, showing a significant decreasing trend in extreme-wind speeds and annual frequencies, which contributes to the significant reduction of sandstorms over northern China.

There are two papers concerning the physical processes and mechanisms behind EPEs. Wu S. et al. assessed the coupled effects of soil temperature and moisture on extreme precipitation in NWC, highlighting the role of snow conversions in intensifying rainfall and influencing other cloud processes. Meanwhile, Zhang et al. investigated the impacts of roughness length (Z_{0h}) schemes on simulation of land-atmosphere interaction and proposed the optimal Z_{0h} schemes in accurately simulating water and heat exchanges.

Three papers focused on simulations and parameterizations of extreme precipitation. Wu D. et al. addressed the depicting cloud microphysical processes by assessing their impact on mesoscale convective systems, highlighting the substantial influence of graupel characteristics on convective initiation times, system morphology, and the intensity of related weather phenomena, such as wind gusts and cold pools. Meng et al. focused on refining soil moisture simulation in arid and semiarid regions. Their enhancements in an integrated urban land model notably improved soil moisture simulation, emphasizing the importance of accounting for soil water vapor transport in accurate modelling for these regions. Similarly, Xu et al. simulated extreme rainfall in northwest China's arid area, emphasizing the impact of snow conversions on rainfall production and other cloud processes.

While studies in this Research Topic present intriguing findings, several unresolved issues related to EPEs in arid regions persist. Key questions include understanding the mechanisms of water vapor transportation over long distances from ocean to arid regions, exploring the modulation of arid regions adjacent to the ocean by air-sea interactions, and investigating the influence of monsoons on precipitation patterns in arid areas. These questions underscore the need for further researches to deepen our understanding of the complex mechanism behind EPEs in arid regions.

Author contributions

CW: Conceptualization, Funding acquisition, Investigation, Supervision, Writing–review and editing. KY: Funding acquisition, Investigation, Writing–original draft. ZW: Investigation, Writing–review and editing. BH: Investigation, Writing–review and editing.

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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.

The authors declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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References

Barriopedro, D., Gouveia, C. M., Trigo, R. M., and Wang, L. (2012). The 2009/10 drought in China: possible causes and impacts on vegetation. *J. Hydrometeorol.* 13, 1251–1267. doi:10.1175/jhm-d-11-074.1

Wang, C., Zhang, S., Li, K., Zhang, F., and Yang, K. (2021). Change characteristics of precipitation in northwest China from 1961 to 2018. *Chin. J. Atmos. Sci.* 45, 713–724. doi:10.3878/j.issn.1006-9895.2101.20216

Yang, J., Yang, K., and Wang, C. (2023). How desertification in northern China will change under a rapidly warming climate in the near future (2021–2050). *Theor. Appl. Climatol.* 151, 935–948. doi:10.1007/s00704-022-04315-x

Zhaoye, P., Yang, K., and Wang, C. (2022). Impacts of cumulus parameterizations on extreme precipitation simulation in semi-arid region: a case study in northwest China. *Atmos* 13, 1464. doi:10.3390/atmos13091464