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Editorial: Extreme events and their spatiotemporal variability over polar regions

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Editorial on the Research Topic
Extreme events and their spatiotemporal variability over polar regions

Due to polar amplification the average Arctic temperatures rise at twice the rate of the global average which leads to a rapid decrease in Arctic sea ice extent. In contrast to decreased Arctic sea ice extent, Antarctic sea ice extent shows a somewhat increasing trend till 2014, followed by an abrupt decrease thereafter. There is also an increasing trend in seasonal Antarctic air temperature over the Antarctic Peninsula in the past four decades. Accompanying increasing seasonal mean temperature in polar regions, extreme warm (cold) events also show an increasing (decreasing) trend. Polar extreme precipitation and wind speed events also display an increasing trend. The above change in polar extreme events influences strongly the stability of ice sheet, ecosystem, and humidity activity. However, the physical processes of polar extreme events and their spatial and temporal variability remains not completely understood.

This Research Topic aims to improve our understanding of historical and future extreme events in polar regions, including the mechanisms behind the occurrence of extreme events, the variability and change of extreme events and the main influence factors. These extreme events include heat waves, cold waves, extreme precipitation events, extreme wind speed events, polar storms and extreme sea ice events. There are eight articles with contributions from 39 authors. Selected highlights from each paper are summarized below:

The paper Loeb et al. investigated the ability of ERA-5, MERRA-2, and CFSR reanalyses to represent extreme precipitation events in Eastern Canadian Arctic and Greenland. Overall, the reanalyses struggled to match the timing and location of specific observed events but matched the observed seasonality of precipitation extremes.

The paper Bae et al. attributed the extreme warming event on 9 February 2020 to the foehn and large-scale horizontal advection. Under the occurrence of the foehn winds, radiative heating and isentropic descent motion play important roles in the warming. The horizontal advection was associated with a strong blocking high in the upper and lower atmosphere.

The paper Araźny et al. presented the influence of Atmospheric circulation on meteorological conditions on Kaffiøyra using the calendar of circulation types. The variability of individual meteorological parameters depends primarily on airmass advection direction. The greatest positive anomalies and a significant frequency of extreme values of atmospheric variables occurred during air mass advection mainly from the southwest and south of the site.

The paper Cheng et al. compared the characteristics of precipitation for the Barents Sea, Kara Sea, Laptev Sea, and East Siberian Sea from May to December during the 2011–2020 period. Among four seas, the highest precipitation occurs over the Barents Sea. The variability of the precipitation over four seas is negatively correlated with that of the sea ice concentration there and the largest negative correlation occurs after 15 days of sea ice anomalies.

The paper Zong et al. compared sea ice concentration, sea ice area, and sea ice extent from dual-polarized ratio (DPR) algorithm with those from satellite passive microwave and ship-based visual observations. Over the whole Arctic Ocean, these sea ice data show great similarity. Among these sea ice satellite products, the differences in sea ice concentration, sea ice area, and sea ice extent were within ±5%. The difference of was consistently within ±0.5 million km^2, and within ±0.5 million km^2, respectively. The difference between DPR data and observations were less than 1% for sea ice concentration of 0. 85–1 and within 10% for sea ice concentration of <0.85.

The paper Sun et al. examined the influences of snow cover, topography, and air temperature on the sea ice growth rate. The sea ice thickness increased rapidly during the early stage of freeze-up. However, when the ice thickness reached 0.5 m, the sea ice growth rate became less sensitive to air temperature. The study highlights the inverse relationship between the sea ice growth rate and the snow thickness.

The paper Dai and Fan investigated the effect of anomalous atmospheric circulation related to Arctic sea ice anomalies on the temperature reversal over Northeast China. The sea-ice anomalies over the Davis Strait–Baffin Bayand the Barents–Kara Sea excited eastward propagations of tropospheric wave trains from the North Atlantic Ocean and the downward reflections of planetary wavenumber-1 from the stratosphere, which leads to the subseasonal reversal of winter temperature in 2014/2015.

The paper Dong et al. examined the trends of ECEs over eastern China in early and late winters. The number of days with ECEs had a faster and uniformly decreasing trend in late winter over eastern China, whereas the decreasing trend in early winter was not significant due to an increase of ECEs in northeast China and a decrease of ECEs in southeast China during the time period 1980–2021.

Overall, this Research Topic highlights the mechanism of extreme events occurrence in polar regions, their spatiotemporal variability and influence factors. All the selected contribute to the deep understanding of polar extreme events from different viewpoints. Finally, we would like to thank the reviewers and all authors for their contributions to this Research Topic.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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.

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