EGU21-3246
https://doi.org/10.5194/egusphere-egu21-3246
EGU General Assembly 2021

Reliability of global gridded precipitation products in assessing extremes

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Assessing extreme precipitation events is of high importance to hydrological risk assessment, decision making, and adaptation strategies. Global gridded precipitation products, constructed by combining various data sources such as precipitation gauge observations, atmospheric reanalyses and satellite estimates, can be used to estimate extreme precipitation events. Although these global precipitation products are widely used, there has been limited work to examine how well these products represent the magnitude and frequency of extreme precipitation. In this work, the five most widely used global precipitation datasets (MSWEP, CFSR, CPC, PERSIANN-CDR and WFDEI) are compared to each other and to GHCN-daily surface observations. The spatial variability of extreme precipitation events and the discrepancy amongst datasets in predicting precipitation return levels (such as 100- and 1000-year) were evaluated for the time period 1979-2017. The behaviour of extremes, that is the frequency and magnitude of extreme precipitation, was quantified using indices of the heaviness of the upper tail of the probability distribution. Two parameterizations of the upper tail, the power and stretched-exponential, were used to reveal the probabilistic behaviour of extremes. The analysis shows strong spatial variability in the frequency and magnitude of precipitation extremes as estimated from the upper tails of the probability distributions. This spatial variability is similar to the Köppen-Geiger climate classification. The predicted 100- and 1000-year return levels differ substantially amongst the gridded products, and the level of discrepancy varies regionally, with large differences in Africa and South America and small differences in North America and Europe. The results from this work reveal the shortcomings of global precipitation products in representing extremes. The work shows that there is no single global product that performs best for all regions and climates.