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Changes in the temperature and precipitation extremes in China during 1961–2015

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Based on daily maximum temperature (Tmax), daily minimum temperature (Tmin) and daily precipitation collected from 1867 meteorological stations in China from 1961 to 2015, the spatiotemporal variations in temperature and precipitation extremes and their associations with large-scale atmospheric and oceanic circulation patterns were analyzed. The Mann-Kendall method and linear trend analysis were used to examine the trends, and Pearson correlation analysis was used to identify the relationship between climatic extremes and circulations. Results indicate that both the maximum values of Tmax (TXx) and Tmin (TNx) and the minimum values of Tmax (TXn) and Tmin (TNn) had increased while the diurnal temperature range (DTR) decreased significantly in China as a whole. Spatially, TNx and TNn had increased significantly at rates of 0–0.5 ℃ and 0.2–1.0 ℃ per decade respectively, whereas the trends of TXx and TXn were not significant in most of China, resulting in a decrease of DTR at rates of 0–0.7 ℃ per decade in most areas of northeastern China, northern China and western China. Higher percentage change of TXx and TNx mainly occurred in the western China and northern China, whereas that of TXn and TNn was mainly appeared in the Yangtze River basin, south of the Yangtze River and southern China. The percentage change of TXn and TNn was much higher than that of TXx and TNx. For precipitation indices, simple daily intensity index (SDII) and extremely wet-day precipitation (R99p) had increased at rates of 0.10 mm/day and 2.6 mm per decade respectively, but the trends of maximum 1-day precipitation (Rx1day), maximum 5-day precipitation (Rx5day) and total wet-day precipitation (PRCPTOT) were not significant in China. The spatial trends of SDII, Rx1day, Rx5day, R99p and PRCPTOT were also not significant in almost the whole of China, though they were higher in the southeastern part of China. The percentage change of Rx1day and R99p was much higher than that of SDII, Rx5day and PRCPTOT, and higher percentage change for the indices of Rx1day, Rx5day, R99p and PRCPTOT mainly occurred in western China. Changes in some climatic extremes were associated with oceanic and atmospheric circulations. Atlantic multidecadal oscillation (AMO), Arctic oscillation (AO), East Atlantic/Western Russia (EA_WR) and East Pacific-North Pacific (EP-NP) had higher correlation with climatic indices than other circulation patterns, and most of climatic indices had positive correlation with AMO and negative correlation with EA_WR. The correlation between temperature indices and circulation patterns was more consistent and higher than that of precipitation indices. The variations of TXx and TNx were more related to the variability of AMO and EA_WR in China, and those of TXn and TNn were more associated with the AO in northeastern China, northern China and northern Xinjiang, thus the variations of DTR were connected with AMO and EA_WR in western China, northern China and northeastern China. The variations of precipitation indices were not significantly related to the circulation patterns in the vast majority of China.