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Trends and variability of daily temperature and precipitation extremes during 1960–2012 in the Yangtze River Basin, China

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The variability of surface air temperature and precipitation extremes has been the focus of attention during the past several decades, and may exert a great influence on the global hydrologic cycle and energy balance through thermal forcing. Using daily minimum (TN), maximum temperature (TX) and precipitation [U+3000] from 143 meteorological stations in the Yangtze River Basin (YRB), a suite of extreme climate indices recommended by the Expert Team on Climate Change Detection and Indices, which has rarely been applied in this region, were computed and analyzed during 1960–2012. The results show widespread significant changes in all temperature indices associated with warming in the YRB during 1960–2012. On the whole, cold-related indices, i.e. cold nights, cold days, frost days, icing days and cold spell duration index significantly decreased by -3.45, $^{-1}.03$, -3.04, -0.42 and $^{-1}.6$ days/decade, respectively. In contrast, warm-related indices such as warm nights, warm days, summer days, tropical nights and warm spell duration index significantly increased by 2.95, 1.71, 2.16, 1.05 and 0.73 days/decade. Minimum TN, maximum TN, minimum TX and maximum TX increased significantly by 0.42, 0.18, 0.19 and 0.14 ℃/decade. Because of a faster increase in minimum temperature than maximum temperature, the diurnal temperature range (DTR) exhibited a significant decreasing trend of -0.09 ℃/decade for the whole YRB during 1960–2012. Geographically, stations in the eastern Tibet Plateau and northeastern YRB showed stronger trends in almost all temperature indices. Time series analysis indicated that the YRB was dominated by a general cooling trend before the mid-1980s, but a warming trend afterwards. For precipitation, simple daily intensity index, very wet day precipitation, extremely wet day precipitation, extremely heavy precipitation days, maximum 1-day precipitation, maximum 5-day precipitation and maximum consecutive dry days all increased significantly during 1960–2012. In contrast, $\geq$ 10 mm precipitation days and maximum consecutive wet days decreased significantly, implying that the precipitation processes in YRB were dominated by precipitation events with shorter durations. Geographically, a wetting tendency was observed in the eastern Tibet Plateau and the middle and lower YRB, while the other regions experienced precipitation deficits. The increasing precipitation was mainly due to the intensification of extreme precipitation events and the decreasing precipitation may be attributed to the decrease of $\geq$ 10 mm precipitation days or moderate precipitation events. In addition, the regional trends were of greater magnitudes in the middle and lower YRB, indicating more frequent extreme precipitation events in these sub-regions.