Changes in “hotter and wetter” events across China

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As global warming intensifies, efforts to understand changes in extreme climate events have increased in recent years. However, some extreme events that are unprecedented remain a persistent challenge. Using daily temperature and precipitation dataset from 531 meteorological stations in China from 1961 to 2015, we define the hotter and wetter (HW) events (The HW event in this study is defined as an extreme event with high-temperature days and torrential rain days exceeding long-term averages (1961-2015a) simultaneously), and we further analyze the changes in HW events to evaluate the impacts in China during the period from 1961 to 2015. It is reasonable to define several different climatological regions. Following China’s national assessment report on climate change, 8 subregions in China are defined. More details on the 8 subregions can be found in Table 1.

A HW event is designed to be used when there is a JJA period in which high-temperature days and torrential rain days exceed the long-term average. We examined changes in the HW events in order to evaluate the impacts in China during 1961-2015. The results revealed that the distributions of the mean high-temperature and torrential rain days vary regionally. The CC, EC, and SC subregions experience the most frequent extreme heat and precipitation events, which occur concurrently. Increasing high-temperature days are found in NWC, SWC2, SWC1, and SC after the mid- to late 1990s. However, torrential rain days show an increasing trend in EC and decreasing trends in NWC and SC after the mid to late 1990s. This result not only indicates the important role of variability in both extreme events across NWC, SC, and EC but also considerably impacts societies and ecosystems.

The HW events in each subregions show different changes in both frequency and intensity. The frequency of the HW events is much higher in central and eastern China (SC, EC, and CC) than in other areas, especially SC. In SC and EC, there are significant increasing trends of 2.7 and 1.9 events per decade, respectively. In China, the HW events mostly occurred in the most recent 20 years of the study period, indicating that China has entered a period of high-frequency HW events. Therefore, it is implied that more simultaneous high-temperature and extreme precipitation events in JJA may lead to severe impacts that are unanticipated and have a major effect. Indeed, the torrential rain anomalies are greater than the high-temperature anomalies in NWC, CC, and EC after the mid- to late 1990s. However, the opposite trend is observed in NEC, SWC1, SWC2, and SC. Finally, the relationship between the HW events and warming is estimated. The results imply that the changes in HW events are associated with warming. Thus, an increase in the number of HW events with warming could be quite common in the future.

Understanding the changes in the HW events has an important role in climate adaptation and mitigation efforts. Further, although the historical changes in the HW events also have been recognized in this paper, we intend to use this definition to project future changes under different RCP scenarios.

Keywords: Extreme events, Hotter and wetter, Projection

Name	Latitude	Longitude
NWC: Northwest China	36°N—46°N	75°E—111°E
SWC2:Southwest China-region 2	22°N—27°N	98°E—106°E
SWC1: Southwest China-region 1	27°N—36°N	77°E—106°E
SC: South China	20°N—27°N	106°E—120°E
CC: Central China	27°N—36°N	106°E—116°E
EC: East China	27°N—36°N	116°E—122°E
NC: North China	36°N—46°N	111°E—119°E
NEC: Northeast China	39°N—54°N	119°N—134°N

