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Spatiotemporal patterns of rainy season characteristics and the influence of ENSO on rainy-season precipitation in mainland China

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Precipitation plays a significant role in many scientific researches such as agriculture, water resources and climate change. The variability of rainy season features (i.e. onset, retreat and rainy-season precipitation) are useful features to investigate the characteristics of precipitation under climate change. The influence of different ENSO types on precipitation during rainy season is also explored to further analyze the relationship between precipitation and climate change: central Pacific warming (CPW), eastern Pacific cooling (EPC), eastern Pacific warming (EPW), conventional ENSO and ENSO Modoki. The multi-scale moving t-test was applied to determine the onset and retreat of rainy season. Results show that: (1) rainy season began earlies in southeastern China in middle March and latest in northwestern China in early June. Retreat started from northwestern and southeastern China, with Central China having the latest retreat; (2) Onset (retreat) had delayed (advanced) trend for the period of 1960 to 2015, which is attributed to related to cold (warm) sea surface temperature (SST) in the conventional El Niño-Southern Oscillation (ENSO) regions. (3) Rainy-season precipitation has different performance under different ENSO types. Decaying CPW and EPW can cause increasing precipitation up to 30% above average precipitation. Precipitation anomaly showed decreasing trend in most areas in China during developing EPW phase. Developing El Niño had the largest effect on ENSO-related precipitation among developing ENSO and ENSO Modoki regimes. Decaying ENSO also had a larger influence on precipitation anomaly, compared to decaying ENSO Modoki. (4) The difference performance of rainy-season precipitation under various ENSO regimes may be attributed to the combined effect of anti-cyclone in the western North Pacific and the Indian monsoon. Stronger monsoon and anti-cyclone are related to enhanced rainy-season precipitation. These results suggest that predictability of rainy season can be improved through the atmospheric circulation and SST, and help agricultural planning and water resources management.