ENSO transition from La Niña to El Niño drives prolonged Spring-Summer drought over North China

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Persistent drought is a major meteorological disaster causing vast agricultural damages and long-term regional water crisis. Over North China, this type of drought tends to onset in spring and to persist until summer with severe societal impacts. This paper aims to identify the large-scale dynamic drivers of the prolonged spring-summer drought (PSSD) over North China. Our analysis has shown that the North China PSSD is associated with a persistent anomalous low-level cyclonic circulation spanning the mid-latitude North Pacific from spring to summer with reduced moisture transport to North China, in combination with a tropospheric cooling along the East Asian upper level westerly jet with dynamically forced anomalous descent above. Seven of the selected eight North China PSSD events occurred when La Niña transited to El Niño with a negative North Pacific Oscillation (NPO) phase in preceding winter. The two key circulation anomalies in spring are set directly by a negative NPO phase generated in the preceding winter. The NPO, in turn, forces an El Niño onset in summer through the so-called "seasonal footprinting mechanism". Consequently, sea surface temperature anomalies of El Niño in summer suppress Indian monsoon rainfall, triggering the tropospheric temperature cooling over East Asia through a circumglobal teleconnection along the East Asia upper-level westerly jet. Modeling analysis of the long pre-industrial control simulation confirms the above findings. This study demonstrates that ENSO phase transition from La Niña to El Niño is one of the important precursors of North China PSSD.

Key words: Prolonged North China drought, ENSO phase transition, seasonal footprinting mechanism

References

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