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Regional coupled and decoupled day-night compound hot extremes over the mid-lower reaches of the Yangtze River: characteristics and mechanisms

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Hot extremes impose severe effects on human health and the ecosystem, especially when high-temperature extremes sequentially occur in both daytime and nighttime within 1 day, known as Compound Hot Extremes (CHEs). Although a number of studies have focused on independent hot extremes, not enough work is devoted to compound ones, not to mention the coupling strength in covariations between the two variables (daytime and nighttime temperature: Tmax and Tmin) over a given region. The instantaneous coupling strength can be derived by Dynamical System (DS) approach from covariations between Tmax and Tmin over a given region, and used to classify CHEs into coupled and decoupled types. Results show that coupled CHEs tend to be more intense with prolonged duration and extensive spatial extent compared with decoupled CHEs. Also, the mechanisms behind these two types of CHEs are largely different. Coupled CHEs are accompanied by a significant intensification and westward extension of the western North Pacific subtropical high (WNPSH), and the extremely high-temperature is mainly caused by receiving more solar radiation under the corresponding anticyclone. It is found that barotropic structure, weak jet stream and developing La Niña are conducive to the enhancement and persistence of WNPSH, in favor of the occurrence of long-lasting CHEs. Decoupled CHEs are associated with strong sea-land breeze (SLB), whose diurnal cycle could weaken the persistent large-scale circulation and suppress covariations between Tmax and Tmin. This kind of decoupled hot extremes are attributed to the combined effect of receiving more solar radiation during the day and trapping more long-wave radiation at night, where moisture and cloud cover play an important role.