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Influence of the climate variability on extreme precipitation and floods in China

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Over recent decades, extreme events in the context of climate change have become a global concern. In China, floods are the one of the severest disasters, which cause 25.6% of all deaths from disasters and account for 54.4% economic losses of GDP. Hence, understanding the influence of climate variability on floods and flood-related variables is of vast theoretical and practical importance. In this study, daily precipitation data and EM-DAT data across China covering a period of 1961-2014 were analyzed to investigate the three indices of climate variability, El Niño Southern Oscillation (ENSO), the North Atlantic Oscillation (NAO), and the Indian Ocean Dipole (IOD) during their positive, negative and neutral phases, and to understand their relationships with frequency and intensity of extreme precipitation, flood frequency, and flood damage. The results indicated that:

(1) The positive and negative phases of NAO and IOD are associated with seasonal extreme precipitation frequency and intensity over large areas of China. During NAO^N and IOD⁺, extreme precipitation occurred more frequently and distributed more widely, especially in spring and summer.

(2) The influence of ENSO on the extreme precipitation frequency and intensity in China appeared to be much smaller than the influence of NAO or IOD, only strong during ENSO⁺ in spring.

(3) ENSO, NAO, IOD show significant relationships with flood frequency and flood damage in one or more phase and/or season.

The strongest link was observed between NAO and flood-related variables. During NAO⁺ and NAO⁻, summer flood occurred more frequently. Besides, during NAO⁻, anomalies in flood frequency, total death, total affected and total damage are respectively 12%, 3%, 97%, 93% higher in spring and 8%, 160%, 470%, 167% lower in autumn compared to NAO⁺ phase.

The impact of ENSO, IOD on flood-related variables is relatively weak. Compared to ENSO^N, autumn flood frequency is lower during ENSO⁺ and ENSO⁻, but total death and total damage are 48%, 146% higher during ENSO⁻.

IOD shows different characteristics per seasons. In spring and summer, floods occurred more frequently and flood damage showed low significant difference during IOD⁺. In autumn, flood

occurrence is low, but anomalies in total death and total damage were 51%, 102% higher than IOD+.

Overall, three indices of climate variability show different degrees of impact on flood-related variables over China, and the potential seasonal variation of climate variability indices plays an important role in forecasting flood disasters, mitigating flood risks and enhancing water resource management in China.