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Relationship between meteorological and hydrological drought in the mountain areas: a study in the upper reaches of Ying River, China

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ABSTRACT

This study attempts to probe into the relationship between meteorological droughts and hydrological droughts by analyzing the trends and the co-variability of precipitation and runoff data in an area with little human activity. In this study, the standardized precipitation index (SPI), modified Mann–Kendall (MMK) trend test and cross-wavelet analysis are used to study the relationship between meteorological droughts and hydrological droughts, including the various trends and correlations. It is found that: (1) the shorter the duration of hydrological drought, the higher its correlation with the meteorological droughts; (2) regardless of the time scale of standardized runoff index (SRI), SPI/SPEI on a longer time scale produces greater influence on SRI; (4) there are dry trends under both the hydrological and meteorological conditions in the upper reaches of Ying River, with the hydrological ones less obvious; (5) the periodicity of meteorological and hydrologic droughts follows different patterns with the increase of accumulation time. As the duration of meteorological droughts increases, the number of hydrological drought cycles decreases and the correlation between meteorological droughts and hydrologic droughts weakens. While the time scale of hydrologic droughts increases, the number of hydrological drought cycles remains unchanged. This demonstrates that the short time scale of hydrological droughts is attributed to the superposition of multiple periodic meteorological droughts; (6) this study also shows that SPEI is a better measure than SPI for short-time scale hydrological drought evaluation or forecast in the arid regions, and the 9 month time scale SPEI is more suitable for the characterization of hydrological droughts.

Keywords: Standardized precipitation index; Standardized rainfall index; Meteorological drought; Hydrological drought; Upper reaches of Ying River

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