EGU2020-2913
https://doi.org/10.5194/egusphere-egu2020-2913
EGU General Assembly 2020

Propagation from meteorological drought to hydrological drought on the Loess Plateau, China

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Drought is the most recurrent and destructive hazard in arid and semi-arid regions, and will only become more complex under climate change. It is vital to characterize the various types of drought, to investigate the potential factors affecting different types of drought, and to assess the relationship between drought types. In this study, the Standardized Precipitation Index (SPI) and the Standardized Runoff Index (SRI) were used to characterize meteorological and hydrological drought, respectively, and used to investigate drought characteristics and mechanisms in 17 catchments on the Loess Plateau from 1961–2013. Furthermore, the propagation time from meteorological to hydrological drought was explored and the potential factors influencing drought propagation time were investigated. The results indicate that the Loess Plateau has experienced an increased tendency towards both meteorological and hydrological droughts over the period 1961−2013, with hydrological drought more serious than meteorological drought at various drought assessment time scales. Moreover, average drought duration and severity were greater for hydrological drought than meteorological drought. Maximum 5-day precipitation (Rx5day) was the dominant extreme climate index for explaining variance in meteorological drought at the annual time scale. Owing to the greater complexity underlying hydrological drought, Rx5day, the number of warm days (Tx90p), and the number of warm nights (Tn90p) all contribute to the variance in hydrological drought. Furthermore, the percentage of forested land had a significant positive association ($p<0.001$) with propagation time, whereas the percentage of land given over to pasture had a significant negative association ($p<0.001$) with propagation time.