



Quantifying of the impact of climate change on drought trends over the Loess Plateau in China

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The increasing global drying trend with global warming motivated the efforts to assess drought and quantify the impact of climate change on drought trend. The Palmer Drought Severity Index (PDSI) has been widely used in drought researches. According to two different methods of estimating potential evapotranspiration, namely, the original Thornthwaite equation and the more physical Penman-Monteith equation, PDSI can have the corresponding two variants that are PDSI_{th} and PDSI_{pm} respectively. Here, we chose precipitation, average air temperature, wind speed, solar radiation, and relative humidity as the main changing meteorological factors, used both PDSI_{th} and PDSI_{pm} to study annual, summer and autumn drought trends over the Loess Plateau (LP) in China during 1960-2016 and quantified their responses to climate change. Main results for this study are as follows. 1) Both trends in PDSI_{th} and PDSI_{pm} represented that LP had been drying over the past 57 years, with similar fluctuations. Overall, PDSI_{th} indicated a larger trend in drought, nearly twofold compared to PDSI_{pm}. 2) For PDSI_{th}, the increase in temperature brought larger drying trend than that arising from the decrease in precipitation. For PDSI_{pm}, the reduction in precipitation contributed most to drying, followed by warming. The decline in wind speed and solar radiation brought some positive contribution to drought, that is, led to some wetness. Despite the fact that the reduction in relative humidity can accelerate evapotranspiration, its contribution to drought trend was the least compared to other factors. 3) Spatially, the contribution of precipitation trend determined the similar spatial pattern in the change of both PDSI_{th} and PDSI_{pm}, where the drying trend increased from north to south over LP. The contributions of temperature were similar among each stations, indicating the warming trend was uniform spatially. The contributions of wind speed and solar radiation were some of different at several stations, but the vast majority of them were uniform. For relative humidity, its contribution was little as a whole.