Spatiotemporal Variation of Drought and Associated Multi-Scale Response to Climate Change in Southeast Qinghai–Tibet Plateau, China

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Drought is one of the most widespread and threatening natural disasters in the world, which has terrible impacts on agricultural irrigation and production, ecological environment, and socioeconomic development. As a critical ecologically fragile area located in southwest China, the Yarlung Zangbo River (YZR) basin is sensitive and vulnerable to climate change and human activities. Hence, this study focused on the YZR basin and attempted to investigate the spatiotemporal variations of drought and associated multi-scale response to climate change based on the scPDSI (self-calibrating Palmer drought severity index) and CRU (climate research unit) data. Results showed that: (1) The YZR basin has experienced an overall wetting process from 1956 to 2015, while a distinct transition period in the mid 1990s (from wet to dry) was detected by multiple statistical methods. (2) Considering the spatial variation of the scPDSI, areas showing the significantly wetting process with increasing scPDSI values were mostly located in the arid upstream and midstream regions, which accounted for over 48% area of the YZR basin, while areas exhibiting the drying tendency with decreasing scPDSI values were mainly concentrated in the humid southern part of the YZR basin, dominating the transition period from wet to dry, to which more attention should be paid. (3) By using the EEMD (ensemble empirical mode decomposition) method, the scPDSI over the YZR basin showed quasi-3-year and quasi-9-year cycles at the inter-annual scale, while quasi-15-year and quasi-56-year cycles were detected at the inter-decadal scale. The reconstructed inter-annual scale showed a better capability to represent the abrupt change characteristic of drought, which was also more influential to the original time series with a variance contribution of 55.3%, while the inter-decadal scale could be used to portray the long-term drought variation process with a relative lower variance contribution of 29.1%. (4) The multi-scale response of drought to climate change indicated that changes of precipitation and diurnal temperature range (DTR) were the major driving factors in the drought variation at different time scales. Compared with potential evapotranspiration, DTR was a much more important climate factor associated with drought variations by altering the energy balance, which is more obvious over the YZR basin distributed with extensive snow cover and glaciers. These
findings could provide important implications for ecological environment protection and sustainable socioeconomic development in the YZR basin and other high mountain regions.