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## Evaluating the effects of human regulation on development and recovery characteristics of hydrological drought in a semi-arid area

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Understanding the impacts of human regulation on development and recovery characteristics of hydrological drought is crucial to detect the relationship between hydrological drought and the regional water cycle system. In this study the standardized streamflow index (SSI) which based on the observation and SWAT simulated runoff data were used to represent the hydrological drought under human disturbed and naturalized scenarios, respectively. Furthermore, the hydrological drought events under each scenario was divided into the development and recovery stages by the run theory. Comparing two scenarios under the stage I (1980-1989) and stage II (2007-2016), the human disturbed scenario presents a more severe hydrological drought than the naturalized scenario at stage II. Our study further found that the reservoir operation was the irreplaceable factor that affected hydrological drought development and recovery in the study area. The reservoir has the strong ability to alleviate the long-duration hydrological droughts, however, the recovery ability of drought has been weakened. To be noticed that though the water intake from the river by the reservoir has been reduced, the drought alleviates ability of the reservoir still become weaker than prototype after working for 30 years. Therefore, as time goes on the effects of reservoir will become progressively more important. The results of our study could be a hint for policymakers and stakeholders to enhance the drought early warning and forecasting system to optimal reservoirs' management at semi-arid areas.