



Influence of human activities on meteorological drought and its trends in Iran

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Abstract

Meteorological drought is one of the different types of drought that occurs all over the world with each climatic condition and has negative effects on various sectors such as available water resources, natural ecosystems, and rainfed agriculture. On the other hand, in recent decades, incompatible human activities with the principles of sustainable development have led to changes in drought regimes worldwide; therefore, in this research, it has been tried to assess the influence of human activities on meteorological drought and its trends in Iran. In this study, the meteorological data series of 24 Iranian stations from 1967 to 2017 were selected. First, the occurrence frequency of drought severity was calculated using the reconnaissance drought index (RDI) in constant and progressively increasing periods, i.e., 11 time periods including periods from 1967 to 1997, 1969 to 1999, ..., 1987 to 2017 during 31 years for all stations over seasonal time scales (i.e., winter, spring, summer, and autumn) and annual time scales. Then the Sen's slope estimator test was used to evaluate the trend of drought severity changes from 1967 to 2017 and the changes in the pattern of the trend of changes in drought. The results indicated that at 79.17% of stations (i.e., 19 out of 24 stations) in annual times scale and at 87.50%, 66.66%, and 29.16% of stations in the winter, autumn, and summer time scales (respectively), the intensity of decreasing trend in RDI in newer time periods such as T_{11} , T_{10} , and T_9 was more than the decreasing trend in RDI in older time periods such as T_1 , T_2 , and T_3 ; however, in spring time scale at 41.66% (i.e., 10 out of 24 stations), the intensity of decreasing trend in RDI in newer time periods was more than the decreasing trend in RDI in older time periods. It can be concluded that influenced by human activities and interventions, the intensity of decreasing trend in RDI at newer time periods was more than the older time periods.

Keywords Sen's slope estimator test · RDI · Trend test · Human activities · Drought

Introduction

Due to the importance of meteorological droughts and their direct and indirect effects on various sectors such as agriculture, livestock, rangelands, people's livelihoods, human income, employment, social and food security and so on, have

motivated numerous researchers from different parts of the world to work on the different aspects of drought such as severity, frequency, and trends (Hameed et al. 2020; Jie et al. 2020; Nyangena et al. 2020; Sam et al. 2020; Zarei and Mahmoudi 2020a; Zarei and Moghimi 2019). In recent decades, inappropriate human activities such as overproduction of carbon dioxide (CO_2), overexploitation of natural resources, resource management regardless of the principles of sustainable development, and some governments' lack of compliance with environmental rights and obligations have been causing the changes in climate parameters such as precipitation and temperature as well as drought regimes (Yu et al. 2020; Zarei and Mahmoudi 2020c; Javadinejad et al. 2019; Jiang et al. 2019; Marthews et al. 2019). For example, several studies have demonstrated that human-induced effects have deforested a vast region in Iran in recent decades (Abedi and Kazemi Rad 2020; Beygi Heidarlou et al. 2020; Yousefi et al. 2013). The results of Noor (2017) indicated that in recent

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