

Comparison of drought indices for appraisal of drought characteristics in the ken river basin

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Abstract

Drought indices are used to monitor drought conditions of a region. Various drought indices (DIs) have been proposed in past few decades, but some of those are region specific and have limitations of applicability in other climatic conditions. Also, multiple time steps of DIs make it hard to decide that which time step is the best to show the drought condition.

Present study aims to compare Standardized Precipitation Index (SPI), Effective Drought Index (EDI), statistical Z-Score, China Z-Index (CZI), Rainfall Departure (RD), Rainfall Decile based Drought Index (RDDI) for their suitability in drought prone districts of the Ken River Basin, located in central India, where the rainfall is concentrated in the monsoon season (June-September) and frequent occurrence of severe drought events are common. All selected DIs with multiple time steps are applied to compute the severity for five time steps of 1, 3, 6, 9, and 12-month, and compared with each other and EDI.

The study reveals that 1) 1-month time step in all DIs may produce erroneous estimates of drought duration. 2) The drought indices computed for 9-month time step are best correlated with each other. However, the drought duration and the drought frequencies estimated using RD and RDDI are in disagreement with other DIs, therefore, these are not suitable for this area where the summer concentration of precipitation is very high. 3) The DIs are highly correlated at same time steps and can alternatively be used. However, they are poorly correlated at dissimilar time steps, which makes it hard to assess whether the drought occurred or not. 4) Because there are no objective rules to select the appropriate time step, and the identified drought duration varies too much with different time steps, it is very hard again to assess when the drought occurred.

However, EDI, that has self-defined time step in itself, and free from time step problem, 1) is correlated better with other DIs for all time steps and effective on long and short drought together, with highest correlation at 9-month time steps, 2) identifies the drought condition earlier than any other indices, therefore, 3) is found to be more suitable drought index for the study basin. This is in agreement with the result of EDI application in Korea, Japan, Turkey, Australia and Iran though the methods of its testing are different.

Keywords

Drought; Effective drought index; Standardized precipitation index; Z-score; China z-index; Rainfall departure; Time step of drought

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