

EXTENDED ABSTRACT

Application of Effective Drought Index (EDI) in Characterizing Drought Periods (Case study: Tabriz, Bandar Anzali, and Zahedan)

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Introduction

Drought refers to a period of time when water shortage occurs and, therefore, the environment and human life are disrupted. Of course, depending on the regional considerations and the objectives of any research, drought can have different definitions since the lack of water in different regions is defined differently. Drought forecasting is almost impossible and is usually a phenomenon that progresses slowly. As a result, well-timed detection in the early stages makes it possible to reduce the adverse effects on different parts of the environment, agriculture, water resources, etc. Drought characteristics such as duration and severity can be determined by drought indices. Scientists have proposed various indexes to assess this phenomenon. Drought index is a useful tool to assess drought characteristics. Effective Drought Index (EDI) is a new method which is based on the cumulative daily precipitation and uses a weighting method.

Methodology

Effective Drought Index

In order to monitor the drought in a better way, selecting the time scale is of particular importance. The main advantage of effective drought index compared to other known indices is the daily time scale of this index.

Daily Effective Precipitation

The effective precipitation that is calculated for each day is a function of certain daily precipitation and the rainfall of previous days. Therefore, the recent days' precipitation gets a larger weight in the EP compared with that of distant days. Obviously, the calculations for the EP for the first year will be impossible, so the total number of the EPs is equal to {(number of years-1) * 365}.

The following equation was found to be the most proper relationship for calculating the EP.

$$EP_i = \sum_{n=1}^i \left[\left(\sum_{m=1}^n P_m \right) / n \right] \quad (1)$$

where i is the dummy period and P_m is the total precipitation received in the past m days.

Dry period and actual duration

Dry period refers to a time when values of DEP_i and SEP_i parameters are consecutively negative. The actual dry duration is calculated by adding the dummy duration and the dry period.

Precipitation required for a Return to Normal (PRN_j)

regarding the actual duration, the amount of precipitation needed for returning to normal conditions is calculated by iterating the calculation process in the previous steps. Thus, for each day of the time period with actual duration in hand, the values of EP_i , MEP_i and DEP_i are recalculated again. After calculating the DEP_i for every day with actual duration, the precipitation needed for returning to the daily normal (PRN_j) conditions can be obtained using the following equation:

$$PRN_j = \frac{DEP_j}{\sum_{N=1}^j \left(\frac{1}{N}\right)} \tag{2}$$

where j is the index for actual duration and PRN_j is the amount of precipitation needed for returning the normal condition (mm).

Effective Drought Index

EDI_j is the standardized value of the PRN_j and is introduced as the severity of the drought, which is calculated using the following equation:

$$EDI_j = \frac{PRN_j}{ST(PRN_j)} \tag{3}$$

where $ST(PRN_j)$ is the standard deviation of the PRN_j time series.

Findings

Figure 2 shows daily effective precipitation with dummy and actual durations. As can be seen in this figure, the highest amount of EP in Tabriz station is around 835 mm, which was experienced on April 19, 1969. Figure 3 shows the diagrams for the MEP and the PRN values for the selected stations. It can be concluded that the MEP of Tabriz station during the second decade of October to the second decade of December as well as the second decade of April to the middle of May was relatively too large. The greatest amount of mean of effective daily precipitation was about 472 mm, which corresponds to May 24th.

Conclusions

Average daily precipitation in Tabriz, Bandar-e Anzali and Zahedan stations are respectively 0-3.5, 0-45 and 0-2 mm per day and the maximum value of daily precipitation of the stations are respectively 60, 360 and 55 mm per day. Most of the precipitation received in the mentioned three stations is experienced in April, November and February, respectively.

Maximum daily effective precipitation (EP) obtained in Tabriz, Bandar Anzali and Zahedan were about 835, 4000 and 363 mm, respectively, which were experienced on 1969/4/8, 1962/9 /17 and 1960/1/16, respectively. In the other days of the year, the EP values were less than the mentioned values.

Effective precipitation (EP) is independent of daily precipitation and its fluctuation pattern is similar to the daily precipitation perturbation.

The maximum daily effective precipitation (EP) in Bandar-e Anzali is about 5 times greater than that of Tabriz station and the value of this parameter in Zahedan is half the corresponding value for Tabriz.

Mean values of effective precipitation (EP) calculated by actual duration were greater than

corresponding values calculated with dummy duration (365 days). The reason for this is the attribution of more weight to the rainfall occurring in the day under question and less as such to adjacent previous days.

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