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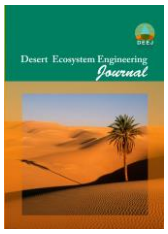

Determining the most appropriate probability distribution function for calculate and compare the SPEI and SPI drought index in Tehran

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Extended Abstract

Introduction: The study of drought as a natural phenomenon that affects the lives of most people is very important. According to researchers in the field of drought, rainfall, temperature, evaporation, wind and relative humidity have been shown to play an important role in drought. The low variety of data required and the simplicity of calculating the SPI index led to its widespread use. The effect of increasing temperature in drought intensification is far more than the decrease in rainfall, which can confirm the effective role of temperature in strengthening or weakening of drought. Based on this, the SPEI index can be used as the appropriate index for determining the drought. In our hydrological studies, we try to fit the empirically measured data into a proper fitting function. And the best function that matches the data is chosen as the probability distribution function to derive the value of the variable for each probability.
This research seeks to find the best distribution function for the SPEI index at the stations studied in Tehran province and also compares the SPI and SPEI indices at different time intervals.

Materials and methods: In this research, monthly precipitation and temperature data were used for Shemiran, Abali, Mehrabad and Tehran stations in Tehran province in 2017-1987. After qualitative control and correction and completion of statistics, statistical analysis of precipitation, based on the standardized precipitation index (SPI) and statistical analysis and dispersion analysis, are based on the standardized precipitation evapotranspiration index (SPEI). The values of the SPEI index are calculated using four Fatigue life, Weibull (three parameters), Loglogestic and kumaraswamy functions. Relationships (1) and (2) and (3) and (4) are used to calculate various cumulative distribution functions in the SPEI of the index.

$$F(x) = \varphi\left(\frac{1}{\alpha}\left(\sqrt{\frac{x-\gamma}{\beta}} - \sqrt{\frac{\beta}{x-\gamma}}\right)\right) \quad \text{Fatigue life} \quad (1)$$

$$F(x) = 1 - \exp\left(-\left(\frac{x-\gamma}{\beta}\right)^{\alpha}\right) \quad \text{Weibull} \quad (2)$$

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$$F(x) = \left(1 + \left(\frac{\beta}{X - \gamma}\right)^{\alpha}\right)^{-1}$$ Log logistic *(3)*

$$F(x) = 1 - (1 - Z^{\alpha_1})^{\alpha_2}$$ kumaraswamy *(4)*

In order to investigate the most suitable distribution function compatible with Di, P-value comparison was performed based on Kolmogorov –Smirnov test، Also to check the compatibility of the two indexes, graphs were plotted 24,12,6,3,1 and 48 months. To find out the degree of compatibility, we used the absolute value graphs of Difference of Two Indices.

Results: The results of computing and comparing the SPI and SPEI index indicate that in general, all stations in a drought condition are largely consistent and only in short periods of this adaptation are confused. Also, in comparison to the severity of drought between the two indices, the SPI index shows a lower intensity of drought and it can generally be concluded that the SPEI index shows the dry weather in terms of severity. Also, this index shows the beginning of drought in shorter time intervals, which can be attributed to the sensitivity of the SPEI index to rainfall variations and to include the temperature parameter in this index. In the short intervals, two indicators have a better match, and in the long term (24-48 months), the two indicators do not fit well. Abali station displays the best fit with the least error in all time intervals. The reason for the suitability of the Abali standardized evapotranspiration index station to show the overlap between the two SPI and SPEI indicators is the maximum rainfall and the minimum temperature and minimum evapotranspiration between stations however, it can be concluded that the drought index is well-matched in wet weather conditions with low temperatures. The difference between the two indicators in the hardest case in 1997 was 0.63, which means that each year, when the standardized rainfall index is reduced, the Standardized Precipitation Evapotranspiration Index is also declining. It can be concluded that these two indicators are in good agreement at this time interval and one can estimate one with a mean error of ± 0.209on the other consequently, reducing or increasing rainfall can directly affect the reduction and increase of evapotranspiration and temperature.

Discussion and Conclusion: In this research, it is assumed that, in addition to the spatial variation that causes changes in the statistical distribution, the annual variations of Di also confirm this hypothesis So, in calculating droughts or other climate studies, this should be considered, since rainfall, evapotranspiration, and temperature vary in different seasons, and therefore, in terms of statistical distribution, they act differently, for example The stations under study in Tehran province in the middle of June till the end of summer are followed by logistical distribution and in the middle of the warm year to late spring, more diverse statistical distributions are followed.
The results showed that the behavior of both SPI and SPEI indicators in the monthly time intervals, especially in wet areas (Abali station), and in the 12-month period are very similar. It was also found that the two indicators did not match the annual time interval and that the same behavior of the two indicators could not be expected in the study of drought with annual data.
The severity of all drought events, especially the most severe droughts, has been higher by the SPEI index for all periods of time. This is due to the sensitivity of this index to precipitation variations. Although rain has a special role in the diversity of drought time, the effect of temperature is significant and increases the phenomenon of drought. Based on the results, standardized evapotranspiration index has high accuracy in addition to having the main advantages of the SPI index, such as multi-variability and the use of minimum parameters of meteorology.

Keywords: SPI index, SPEI index, Probability distribution function, Tehran province, Evapotranspiration.