



Using the Fuzzy Clustering and Principle Component Analysis for Assessing the Impact of Potential Evapotranspiration Calculation Method On the Modified RDI Index

Abdol Rassoul Zarei¹ · Mohammad Reza Mahmoudi² · Ali Shabani³

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Abstract

The modified reconnaissance drought index (RDI_e) which is a modified version of RDI is presented for assessing drought conditions with an emphasis on agricultural drought. The potential evapotranspiration (PET) and effective rainfall are required climatic variables to calculate RDI_e. Although the FAO Penman–Monteith (FPM) equation is the reference method for determining the PET, due to the need for data of a large number of climatic variables it is difficult to use in areas with shortage climatic data. Therefore, in this research, using the fuzzy clustering (FC) and principle component analysis (PCA) methods, the influence of PET calculation methods including FPM (used as reference method), FAO Penman (FP), Hargreaves-Samani (HS), Blaney-Criddle (BC), Turc (Tu), Jensen-Haise (JH), Priestley–Taylor (PT) and FAO24 Radiation (Ra) methods on the RDI_e (in 1, 3 and 12-month time scales) was assessed. In this study the climatic data series of 5 stations in Fars province, Iran from 1989 to 2018 was used. Based on the results of PCA model, in short-term time scales (1 and 3-month), the calculated RDI_e values based on the HS method (at 100% of stations) and in long-term time scale (annual) based on the FP method (at 60% of stations) had the highest correlation with RDI_e based on the FPM method. According to the results of FC method, in 1-month time scale, the values of RDI_e using PT and HS methods (at 100% and 80% of selected stations, respectively), in 3-month time scale, the values of RDI_e using PT, HS and Ra methods (at 100% of stations) and in annual time scale, the values of RDI_e using FP method (at 60% of stations) had the highest similarities with the values of RDI_e using FPM. Therefore, it is recommended to replace the FPM method with HS (in 1 and 3-month time scales) and FP (in 12-month time scales) methods in areas with minimum available meteorological data.

Keywords PCA model · Fuzzy clustering · PET calculation method · Drought · Effective Rain

✉ Abdol Rassoul Zarei
Ar_Zareiee@Fasau.ac.ir; Ar_Zareiee@Yahoo.com

Extended author information available on the last page of the article