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ORIGINAL PAPER

Determining the most appropriate drought index using the random forest algorithm with an emphasis on agricultural drought

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Abstract
Since drought can mainly affect agriculture, especially rain-fed agriculture with high dependence on rainwater, and consequently jeopardize food security and social protection, it is absolutely essential to determine an appropriate drought index to assess the agricultural drought more accurately. In this paper, the random forest algorithm (RF) was employed to compare the capabilities of six more commonly used drought indices in agricultural drought assessment, namely standardized precipitation evapotranspiration index (SPEI), modified SPEI (M-SPEI), reconnaissance drought index (RDI), modified RDI (M-RDI), standardized precipitation index (SPI) and modified SPI (M-SPI) based on the correlation between the drought indices (i.e., independent variables) and yield of rain-fed barley (i.e., response variable). In this study, the data series of 10 stations with appropriate climate variety from 1968 to 2017 were used on 1-, 3-, 6-, and 12-month time scales (27 time periods in total). The results indicated that the linear regression between the simulated and predicted yield of rain-fed barley using the AquaCrop model and the RF algorithm (respectively) had no difference with a perfect reliable line (Y = X) in 0.05 or 0.01 significant levels. The R^2 between simulated and predicted barley yield (YB) was also significant at 0.01 levels in all stations, indicating the appropriate capability of the RF algorithm in YB prediction. The results also showed that some indices had better outcomes than others in stations; for example, the SPEI index in Arak, Mashhad, Shahre Kord, and Shiraz stations, the M-SPEI index in Babolsar, Gazvin, and Ramsar, the SPEI and M-SPEI indices in Esfahan and Gorgan stations, and the RDI and SPI indices in Rasht stations had the best outcome. Finally, it was recommended to use the SPEI and M-SPEI indices for agricultural drought assessment.

Keywords RF algorithm · Drought indices · Yield · Rain-fed barley · Agricultural drought

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