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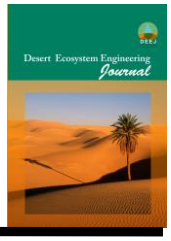

Assessing the Trend of Spatio-temporal Drought Changes Using Remote Sensing Time Series Data in Central Khuzestan Province

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Extended Abstract

Introduction: As a dreadful natural disaster caused by a severe reduction in precipitation rate, drought brings about, compared with other natural disasters, far-reaching spatial and temporal consequences, incurring severe damages. On the other hand, in late the 20th century, drought monitoring approaches underwent a paradigm shift, and advances in remote sensing and earth observation technologies allowed observations and monitoring of key drought-related variables over larger temporal and spatial scales than what the then conventional methods had already made possible. There are different remote sensing indices used to assess drought, including the PDI index which has been developed based on the spectral patterns of soil moisture changes in the NIR-Red space using the red and near-infrared bands of the ETM+ sensor. Therefore, as Khuzestan province is suffering from drought consequences, including but not limited to dust storms and economic difficulties, this study sought to identify the spatial and temporal trends of drought in the center of Khuzestan province.

Materials and Methods: The study area is located in southwestern Iran and the center of Khuzestan province at 31° 0′ 17″ to 31° 43′ 69″ N latitudes and 48° 35′ 51″ to 49° 32′ 2″ E longitudes covering an area of 7635/36 km2. To conduct the study, some twenty ETM+ remote sensing images of level-1 data taken from 1999 to 2018, (path/row 168/35) were collected from the United States Geological Survey website. After gathering the required data, some 411 random points were selected on the collected images, the pixel values of red and near-infrared bands were extracted and plotted against each other, and the slope of the best-fitted line, known as the soil line, was obtained. Then, the PDI drought index values were calculated using the slope and the values of the aforementioned bands. Finally, by applying a natural break classification method, different degrees were separated, and the drought's trend of spatial and temporal changes was identified using Mann-Kendall's seasonal trend test at different significance levels.

Results: The results of the spatial trend analysis of drought suggested that the trend was significant only in low drought and non-drought conditions. For the non-drought conditions, the probability of spatial changes was lower than the confidence level at 5% and 10% significant levels, indicating the significance of the conditions at these two levels, and thus, rejecting the null hypothesis at merely the 1% level. On the other hand, as the low drought conditions showed significant spatial changes only at the 10% significant level, the null hypothesis is rejected at the 1% and 5% levels. However, moderate and severe drought conditions revealed no trends in terms of spatial changes due to the higher probability values of 0.28 and 0.3, respectively, which were higher than the determined significance levels. Moreover, the results of temporal trend analysis indicated no trend for the non-

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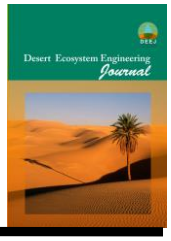

drought conditions, considering the fact that the null hypothesis was rejected at all significant levels. On the contrary, in the moderate drought conditions, a temporal trend was confirmed at all significant levels with the probability rate of 0.006 which was lower than all the assigned levels. Also, a temporal trend was found at low and severe drought conditions at 5% and 10% significance levels with a probability rate of 0.023 and 0.014.

Discussion and Conclusion: The spatial analysis of the drought trend suggested that only the area with non-drought conditions had a significant increasing trend, which could be justified by the increase in the area of irrigated land around water bodies in the area, especially around the Karun River in the west of the study area. The reduction in the area of land in the northeast of the study area with the low-drought conditions could be attributed to the rangeland degradation containing low and moderately dense vegetation. Moreover, the status of drought conditions in some sandy areas has changed from low in 1999 to moderate in 2018 due to vegetation destruction. The decreasing and increasing trends in areas of land with moderate and severe drought conditions, respectively, indicated the worsening of the drought conditions in the study area. Taking the changes in the drought index into account, it could be said that merely the areas with non-drought conditions remained unaffected by any significant increase or decrease in drought conditions, considering the fact that such areas are mainly wetlands, irrigated farms, and fish farms (that are naturally wet). However, the trend of the drought index value was found to be (highly) significant for other drought conditions, especially for moderate-drought conditions, indicating an increase in the severity of the drought conditions during the studied years. The frequent occurrence of dust storms in Khuzestan in recent years suggests that the results of this study correspond to the current reality of the region. In fact, it could be argued that during the last decade, the exacerbation of climate change and drought conditions on the one hand, and the development of construction projects and excessive extraction of water resources, on the other hand, have led to the dryness of many wetlands and wet areas, thus creating small deserts which are regarded as the main sources of dust storms in Khuzestan province within the past few years. Moreover, according to the findings of recent studies, desertification and drought trends have been increasing in recent years, indicating a great increase in the significance level of desertification in number 3 and 4 desertification centers in the east and southeast of Ahwaz, and a significant increase in the severity of drought conditions. This study proved the efficacy and applicability of the PDI drought index in drought monitoring.

Keywords: Drought, PDI Index, Time Series, Trend.