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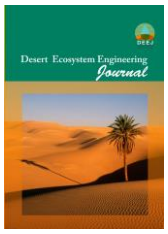

The Effect of Climate Fluctuation on Frequency of Dust Storms in Iran

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Extended Abstract

Introduction: Different regions have various dust production; and the increase of dust storms illustrates the arid ecosystem dominance in each region. Analyzing and identifying of dust storms and its association with climatic parameters is one of the crucial approaches to reduce the caused damage of this phenomenon. Since besides determining the portion of each climate variables in intensifying the circumstances, it also can play a fundamental role in priorities, macro management policies, and upstream rules in order to control and prevent dust particles.

Methods and Materials: In order to carry out this study hourly horizontal visibility data, World Meteorological Organization codes, hourly dust data, and also monthly meteorological and climatic data including maximum temperature, minimum temperature, average temperature, maximum wind speed, total rain, and soil temperature of different depth (5, 10, 20, 30, 50 cm) in 37 synoptic stations of the country were gathered through a longitudinal statistics of 25 years (1990-2014) and its trend was calculated by non-parametric statistics of Mann-Kendall and Sen's Estimator tests. After the qualitative analysis of the stations' statistics and elimination of defects, all the data were assessed via Run Test at the coefficient level of 95%. In order to analyze the effect of climate fluctuations on dust storms, beside the mentioned variables, draught variable of evaporation-rain index and standardized precipitation evapotranspiration index (SPEI) in seasonal period calculated and then Spearman test was applied for correlational analysis of climate elements and dust storms.

Results: The frequency outcomes of dusty days during a long-term study of 25 years indicates that Zabol, Abadan and Ahvaz orderly with 711, 401, and 321 days have the most dust storms. The results of Mann-Kendall show out of 37 under study weather stations, six stations of Ardebil, Birjand, Mashhad, Sabzevar, Yazd, and Semnan reported a descending trend. Five stations reported a meaningful growing trend with coefficient of 95% and 21 stations out of the 37 present stations have a growing coefficient of 99%. The result of Sen's Estimator test shows the six stations which based on Mann-Kendall test had a descending trend, they don't follow a trend in this method and orderly 11, 10, and 10 stations had a rising trend, significant rise at 95% coefficient level also at 99% coefficient level. Generally, in most cases the results of the two tests had the same coefficient level. The results of Spearman coefficient across the country shows that the frequency of

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dusty days with the maximum wind speed, SPEI scale, and maximum temperature among the mentioned climatic parameters in order 0.74, -0.57, and 0.48 had the highest coefficient and were all significantly coefficient at the 99% level. Among the rest temperature of different soil depths (5, 10, 30, 50 cm) in all 37 under study stations there is a direct relation with dust storms and were significant with 0.39 at the level of 95%. So, we can conclude the surface levels of soil (5 and 10 cm) have a crucial role in dust storms in different soil depths.

Discussion and Conclusion: The results of this study show, applying two methods of Mann-Kendall and Sen's Estimator tests are effective for analyzing the long-term changes of dust storms. Generally, the results of Mann-Kendall tests show a rising trend of dust storms in west and south west and some parts of north west and south east of the country. The result of the Sen's Estimator test says that Ardebil, Birjand, Mashhad, Sabzevar, Yazd, and Semnan don't follow a trend. As far as the mentioned stations do not have regular dusty days, thus we can consider Mann-Kendall is not a very strong test because of presenting integer results in the stations which contain data of many zeros. The results of correlation between climate elements and the frequency of the dust storm days showed that the highest correlation is related to the maximum wind speed variable with 0.74 as a strong lever for picking up the dust. There is a negative correlation between rain and evaporation-rain index and potential standardized precipitation evapotranspiration with dust phenomenon. This negative correlation is more tangible in SPEI and in most of the stations at the coefficient level of 95% and 99% significant. Thus, as there is more rain in the specified station, there are less dust days. All in all, after maximum wind speed, the SPEI index receives the highest correlation that justifies dust storms. The results also show as we go deeper to the soil layers, the correlation between soil temperature and dust storms declines. The highest and lowest correlation exists in depth of 5.50 cm of soil with the registered numbers of 0.39 and 0.017. The results of this study are useful for recognizing the effect of climate years on the frequency of dust storm and restraining deserts.

Keywords: Mann-Kendall test, Climate Parameters, Dust Storms, SPEI, Spearman Coefficient.