



Analysis of the Effect of Wind Speed and Soil Moisture on Horizontal Visibility Variations Caused by Dust Event in Arid Regions (Study Region: Southeast of Iran)

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Received: 23/05/2019

Accepted: 26/08/2019

Extended Abstract

Introduction: Increasing or reducing the production of suspended particles depends on the important climatic and terrestrial characteristics of a region. One of the most important climatic factors affecting soil erosion is wind speed, so if the surface winds speed in a region exceeds the threshold of erosion, soil susceptibility to erosion and dust production increases. In contrast, the most important factor controlling soil erosion is soil moisture content, which increase soil stickiness and decrease soil susceptibility to wind erosion. The various researches have been conducted on the relationship between climate parameters and Horizontal Visibility (HV), while the relationship between these variables has not been explored precisely at the occurrence time of dust events. For this reason, this study attempts to investigate this relationship on a daily scale. Given that the measurement of soil moisture in laboratory conditions or during land operations, especially in large scale is time and cost-consuming; to overcome this problem, we were used SMAP satellite images in the present study for a 2-year period (April 2015-April 2017).

Material and Methods: The aim of this study was to investigate the correlation between horizontal visibility with wind speed and soil moisture content retrieved from SMAP satellite imagery for southeastern regions of Iran. For this purpose, hourly data related to horizontal visibility and wind speed were obtained from the Iranian Meteorological Organization. Soil moisture content was retrieved from the SMAP satellite data. Since the SMAP satellite has 3-day spatial resolution and the main purpose of the present study is to examine the role of wind speed and soil moisture on the day of the occurrence of local-source dust; Therefore, in the next step, the dusty days that have the information related to Horizontal visibility, wind speed, and soil moisture content, were extracted. The pre-processing of SMAP satellite data was done based on the theoretical basis algorithm. Then, soil moisture content was retrieved at the site of the meteorological stations. Finally, the relationships between independent (soil moisture and wind speed) and dependent variables (HV) and as well as, the determination of the relative importance of each of the independent variables were analyzed based on ridge regression method.

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DOI: 10.22052/deej.2018.7.24.61

Results: The results showed that in recent years, the trend of daily changes in the horizontal visibility caused by sand and dust storms in south-eastern Iran has been decreasing. The results of Ridge regression analysis indicated that there was a significant and inverse relationship between the velocity of surface winds and the horizontal visibility, as well as a significant direct relationship between soil moisture content and horizontal visibility at Zahedan and Zabol stations. The correlation coefficient of Ridge regression model for these two stations was estimated to be 0.52 and 0.44, respectively. In Iranshahr, the relationship between the velocity of surface winds and the horizontal visibility was positive and significant, while the relationship between soil moisture fluctuations and visibility was non-significant. Horizontal visibility change due to the increase in wind speeds in this region was estimated at 35%.

Discussion and Conclusion: The findings of this study proved the effective role of increasing wind speed and decreasing moisture content of soil surface in decreasing horizontal visibility and intensifying air pollution in southeastern Iran, especially in Zahedan and Zabol cities. The results indicate an exacerbation of the phenomenon of desertification due to the occurrence of a destructive phenomenon of wind erosion in southeastern Iran. In other words, the ability of self-organizing the land of this area from the Iran has decreased and led to the expansion of the ecosystem of the desert, the increase of the occurrence of dust phenomena and reduction of HV in the study area. In fact, these results point to the drop in the threshold speed of wind erosion and the easier lifting of soil particles by surface winds. Therefore, if proper management and enforcement measures are not taken to control this destructive environmental phenomenon, the sustainability level of ecosystems in these areas is expected to decline sharply, and even these ecosystems may be irreversible. As a result, its economic and social damages will affect the ecosystems and people of these areas more than in the past.

Keywords: Desertification, Dust Storm, Ridge Regression, SMAP.