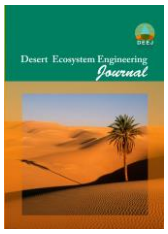
DEEJ (2019) 8 (23) 85-105

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir



Performance Evaluation of Detector Algorithms of Dust Storms in Arid Lands (Case Study: Yazd Province)

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Received: 14/01/2019 Accepted: 22/04/2019

Extended Abstract

Introduction: In recent years, frequency and intensity of dust storms have been increased because of human destructive activities and caused significant loss in different aspects of hygienic and health, environmental and socio-economic sections. Therefore, detection and trace of dust storms in shortest time is the first effective step in preparation and implementation of strategic and operational plans in regions where are affected by dust storms. Using of remote sensing techniques in running of detector algorithms of dust storm plumes via satellite images are efficient methods to detect dust storm events, especially in large areas presented by researchers who study in this field. In this research has been tried to compare the most important algorithms to detect dust plumes and introduce the most suitable algorithm for the Yazd province suffered dust storm events and their loss.

Materials and methods: To detect dust storms, the events with wind speed of more than 10 m/s and horizontal visibility of less than 1000 m were identified using meteorological synoptic stations data in the study area during 2010-2015. In the following, six common algorithms for detection of dust plume including Ackerman, Miller, Roskovensky and Liou, Thermal Infrared dust index (TDI), Thermal Infrared Integrated Dust Index (TIIDI) and Normalized Difference Dust Index (NDDI) were examined via satellite data of MODIS sensor in four dust storm events. In order to evaluate the accuracy assessment of dust maps, relation between the produced maps and horizontal visibility records of the meteorological stations located in the study area, as well as, Aerosol Optical Depth (AOD) of dust based on deep blue algorithms were analyzed.

Results: Results showed that Roskovensky and Liou, Thermal Infrared dust index (TDI) and Thermal Infrared Integrated Dust Index (TIIDI) had better accuracy and precision to detect dust storm events based on aerosol optical depth (AOD) maps and horizontal visibility records of the study area. According to the results, TDI and TIIDI algorithms had better performance to detect dust plume in 03/02/2011 event. Correlation of TDI and TIIDI maps with AOD were 0.65 and 0.49, respectively, which were significant at 1% level, while,

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DOI: 10.22052/deej.2018.7.23.59

Roskovenskey and Liou algorithm presented more suitable result to detect dust storm in 10/02/2015 event. Correlation of Roskovensky and Liou map with AOD and horizontal visibility records were 0.68 and 0.76, respectively, which were significantly at 1% and 5% levels, respectively. In 13/04/205 and 20/07/2015 events, TIIDI and TDI algorithms showed better performance to detect dust plumes. Correlation of TIIDI with AOD was 0.81 which was significant at 5% level. Also, the correlation between TDI and horizontal visibility records was 0.71 which was significant at 1% level.

Discussion and Conclusion: Some dust storm events are analyzed by remote sensing techniques via methods such as indices and algorithms related to dust detection, interpretation of false color composite and brightness temperature difference of features and phenomena in satellite images. These methods are very efficient to detect dust especially, the dust plumes which their visual detection are difficult because of low density. However, the results of indices of dust detection are different, because of various chemical composite of dust particles and resulted in different spectral and thermal properties in different regions. According to the results, none of the algorithms could detect dust plumes in all events. They were just able to detect dust plumes in one or two events. However, the algorithms that used thermal bands or combination of thermal and reflective bands in their equations had been more effective to detect dust storm. To have better dust storm detection, using threshold ranges according spectral and thermal properties are required in each region and even in each event. Using quantities data of aerosol optical depth of dust as well as horizontal visibility records of meteorological stations are suitable tools to adjust to the real situation and analyze accuracy assessment of dust maps made by different algorithms.

Keywords: Reflective, Thermal, Remote sensing, Aerosol Optical Depth, Horizontal visibility, Yazd.