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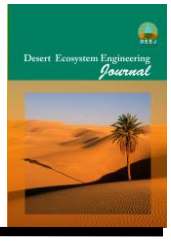

Desert Dust Mapping and Identification Using MODIS Level 1 and AOD-AI Indices in South West of Iran

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Extended Abstract

Introduction: Dust storm is a major weather event that plays an important role in the Earth's atmosphere and ocean surfaces. Dust storms affect marine phytoplankton, soil physical and chemical characteristics in entrainment and deposition areas, climate and radiative forcing, economic loss, and human health. They mostly originate from plains and playas across North Africa, the Middle East and Asia. One of the main sources of dust is relatively recent flood sediments deposited since the late tertiary. Asia, with approximately 60% of the population of the world, is an important source of dust that impacts the climate on a global scale. A dust storm is defined by the World Meteorological Organization (WMO) protocol as where 'strong winds lift large quantities of dust particles, reducing visibility to between 200 and 1000 m'. Therefore, the aim of present study was to investigate the potential of desert dust mapping algorithms using satellite images in the west and western parts of Iran.

Materials and methods: The study area has hot and arid climate; therefore, dust storms are usually occurred especially during dry seasons in this region including Iran, Iraq, Syria, Jordan, Kuwait, Saudi Arabia, Bahrain, Qatar, UAE, Oman, and Yemen. Although, some of dust in the study area comes from the Sahara in the Africa. In recent years, the most environmental problem in Iran is the dust crisis in the western half of the country in mountainous regions of Zagros. Zagros Mountains occupy a broad extent of western Iran, covering an area roughly 1300 km by 200 km. The mean annual rainfall is from 400 to 800 mm and mostly in the winter and spring. The average annual temperature ranges between 9°C and 25°C. The most common ecosystems in the region are the forest and semi-steppe areas. Forests with an area of 5 million hectares cover about 40% of Iran's forests and are the widest forest regions of the country. This region with its semi-arid climate is generally dominated by broad-leaved trees with the dominant species of *Quercus brantii* that covers more than 50% of Zagros' forest area. Dust storms from western neighbouring countries such as Iraq have significantly increased in recent years and much of Iran is affected. For example, 20 and 52 dusty days in 2008 with visibility less than 1000 m occurred in Somar and Abadan meteorological stations in Kermanshah and Khozestan provinces, which are the nearest stations to Iraq. Around 31% of Iraq's total land is desert, which is the main source of soil-derived mineral dust in the region. There are three important sources of dust storms in Iraq: one is centred over Baghdad; the second is centred west of Basrah; and the third is the Southern Desert. Thus, dust cases are common in central and southern Iraq. The major hotspots for dust generation are aeolian deposits south of

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Baghdad, Karbula, Najaf, Nasiriya, Basrah, as well as Kuwait, and also alluvial deposits of Tigris and Euphrates Rivers from sandy clayey silt (72%) to clayey sandy silt (28%). In addition to the high potential of Iraq's desert deposits for dust production, recent changes in the region such as war in Iraq, dam construction in Iraq and neighbouring countries, and intense drought conditions have increased the frequency of dust events. Saudi Arabia is rich in fine sediments from dry riverbeds and lakebeds and sand seas, and is another important dust source in the region. Therefore, for mapping this environmental crisis, MODIS level 1 B satellite images were acquired in winter and summer seasons and processed with MCT tool. Then, the BTD, Ackerman, Miller and TDI algorithms were applied to the images and dust regions were mapped with use of appropriate thresholds. The accuracy of the outputs maps were assessed against natural color composites and dust products including Aqua AOD and Aura AI.

Results: Results showed that a single method for identifying different dust plumes cannot be used due to differences in mineralogy and weather conditions of the events and each algorithm needs different threshold based on the event type and characteristics. The algorithms worked best on dense dust, but they performed differently in cloudy regions and over bright desert surfaces. Most of the algorithms examined here misidentified thick cloud cover as dust. Despite the published dust/no-dust thresholds for the methods tested here; results indicated that it was not possible to use a single dust/no-dust threshold for any of the algorithms applied to the studied events. Therefore, it seems that for each dust event an event-specific threshold is needed.

Discussion and conclusion: Comparison of the studied algorithms showed that all of them produced almost similar results and, among them, the TDI index had relatively better performance over dust sources and showed its usefulness as an effective approach for dust detection and mapping in the region. It appears that the combination of these simple algorithms is the best way to overcome the limitations of different dust detection methods. By combining several algorithms used in this study, the performance of dust detection and mapping may improve. The finding indicated that free and available dust products are sufficient for assessment and monitoring dust storms in Iran if the maps less than 10 km are not required.

Keywords: Desert, Dust Storm, Dust Indices, Remote Sensing.