

Analysis and tracking dust storms routes entering to east of Iran using the particle diffusion HYSPLIT model

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Extended abstract

1- Introduction

A dust storm is one of the biggest serious environmental problems in the arid and semi-arid regions of the world, causing irreparable damages to farms, facilities, roads, traffic and transportation every year and respiratory problems by contaminating the air. Due to the geographic location of Iran which is in the arid and semi-arid belt of the world, the country is frequently exposed to local and synoptic dust systems. Considering the increasing occurrence of dust in the coming years, drought and climate changes and the emergence of desert zones, the study of this phenomenon is considered important and should be studied by using scientific researches to identify the factors affecting the occurrence of this phenomenon and dust source areas. The main purpose of this research is to identify the sources and also track the dust route entering the east of Iran using the HYSPLIT model, satellite images and synoptic analysis.

2- Methodology

In this study, At first, warm season dust storms were studied by using weather data, phenomenal code and horizontal visibility. Then, the storm from August 12 to 14, 2018, was recorded using weather data for East stations and horizontal visibility. For more accuracy, MODIS images of the storm wave on this day were identified and the surface dust concentration was confirmed using the AOD Index. Then, using the European Center for Average Meteorological Data (ECMWF) with a spatial resolution of $0.25 * 0.25$, sea level pressure (SLP), temperature, direction and wind speed, and geopotential height At 850, 500 and 250 levels, jet streams were investigated and The synoptic factor of the dust storm was determined. In the next step, using the HYSPLIT model, the path of motion of particles and their source were determined at three levels of 500, 1000 and 1500 meters for 24 hours before the storm. The meteorological data of the model was obtained from a 0.5 degree GDAS.

3- Results

The intensity and extent of the dust storm from August 12 to 14, 2018 showed that its horizontal visibility had been decreased to less than 200 meters across stations in eastern half areas of Iran. On this day, the dry bed of Hamoun, Pozak, Saberi and Hirmand, Afghanistan's plains have been contributed to nourish the storm. The results of synoptic studies showed that when there is a high pressure independent cell in the north-east of Afghanistan and north-east of Iran as well as a low-pressure cell in the southwestern part of Afghanistan, a severe gradient is made between these regions that causes the wind speed at ground level to be more than 14 meters per second. The severe pressure and temperature differences in the region, the lack of humidity and the high radiation angle have

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drove the dust of deserts outside the northern and eastern borders toward the region, and this area has been under the Azores subtropical high pressure, which its blockage at high levels leads the persistence of dust for three days in eastern Iran. The results of the model also showed that more than 90% of the dust entry routes to the east enters the eastern part of Iran from the deserts of Turkmenistan, Khazakhstan and Afghanistan.

4- Discussion & Conclusions

Due to 120-day winds, low humidity, poor vegetation and dry regional substrates, the eastern part of Iran is prone to the frequent occurrence of dusty phenomena. Based on satellite images and AOD index, the storm has formed in the desert region of Turkmenistan and has been expanding to eastern Iran. According to the synoptic study of the warm period of the dust storm in the east, the upper levels of the Iranian plateau are under the control of the Azores high pressure and on the ground surface, the thermal low is also increasing in the eastern half. When two strong low-pressure nuclei with a 990 hp center in southeastern Afghanistan and southeastern Pakistan were deployed so that its tabs penetrated into the studied region and progressed to the Mediterranean, it created the appropriate conditions for climbing a huge amount of dust into the air that in the case of dryness of the area and north-northwestern and northeastern flow of the upper levels, this phenomenon intensified and moved to the eastern part of Iran. At high atmospheric levels, due to air stability and blocking events, as well as air stagnation, the dust is more durable temporally and the process of bringing it down to the ground surface will last longer days. The results of the HYSPLITE modeling output also showed that the source of dust of the eastern half of Iran in the storm studied enter the studied area from the deserts of Turkmenistan and northwest of Afghanistan and Khazakhstan with the north, northwest and northeastern directions up to 90 percent. In all cases, the results of the model are compared with and confirmed by satellite and synoptic studies.

Key Words: Tracking, Dust, HYSPLI, MODIS.