

## **Monitoring of Dust Storm in the Midwest of Iran Case Study: Dust Storm June 16-19, 2015**

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Dust storm is a destructive climatic phenomenon influenced by climatic elements, including pressure, cloudiness, rainfall, relative humidity, wind, temperature and evaporation. These storms every year inflict irreversible damages to human health, farms, industrial facilities, transportation lines and population centers. However, its damages can be countered to some extent by knowing its origin, mechanism of formation, developing and relation to atmospheric circulation patterns. This phenomenon occurs mainly in arid and semi-arid areas due to high speed of wind and its turbulence on unvegetated and erodible soil, which often results in a decrease in field of vision to less than one kilometer. In extreme cases, the concentration of suspended particles can reach even more than 6,000 milligrams per cubic meter of air. Given that about 91% of the country area is located in arid and semi-arid region, the effects of dust storms can cause many pervasive environmental damages. Therefore, studying the factors causing this phenomenon and identifying its origins is necessary to mitigate its damages.

The study area is located in the western half of Iran, including provinces of Lorestan, Ilam, Kohgiluyeh and Boyer Ahmad, Kermanshah, Khuzestan and Bushehr with an area more than 175280 square kilometers. This region is exposed to most of the dust storms entering the country. To determine the main sources of dust for a dust storm Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model was used. Also, 4-day range (16th-19th June 2015) was considered to investigate the causes of the occurrence and tracking of the storms in the western half of Iran. In this study, the particles were tracking at three levels of 500, 1000 and 1500 meters from the surface at a time interval of 6 to 48 hours prior to the dust storm event. National and Oceanic and Atmospheric Administration (NOAA) FNL database, with a resolution of 1 degree for 26 pressure levels between 1000 and 100 hPa and 6-hour time interval, was used in this study. In addition, European Center for Medium Range Weather (ECMWF) dataset including, geopotential heights of 500 hPa, omega of 500 and 1000 hPa, sea level pressure (slp), orbital and meridian components of wind, specific humidity of 700 hPa and satellite data of soil moisture up to depth of 10 cm were also used to synoptic analysis of the causes of this storm. At last, Aerosol Optical Depth (AOD) was used to determine the transparency of the atmosphere.

Iran location in the warm and dry region and its proximity to tropical desert region of Iraq, Syria and Saudi Arabia has led to a persistent hazard of dust storm in Iran, especially in the south-west of the country in the warm season. Based on the analysis of synoptic maps, the main cause of the phenomenon of dusts in the west of the country, in addition to the instability caused by the thermal low-pressure of the surface and Saudi Arabia high-pressure movements, which caused the convergence and intake the flows toward the west, the presence of a low-pressure at the middle levels of the atmosphere in the eastern Caspian Sea had also significant impact on the occurrence of this storm. Due to the instability in the middle level of the atmosphere, the lack of adequate moisture in the systems transferred to the west of the country, crossing the system from the deserts of Iraq and Syria and the lack of adequate moisture both in surface and depth of soil in study area and neighboring countries, the source of dust formed and transferred to the study area. Also, the study of Hysplit tracking maps shows that there are two general paths for the transfer of dust to the study area. 1. The Northwest-Southeast route, where most of the dust events occurred, passing through the dusty nuclei formed in northwestern Iraq and eastern Syria, transport dust to the western half of Iran. This route can be considered as the main route of dust entering the area at 1500 meters. 2. The western-eastern route, at 500 to 1,000 meters, which is the main source of dust on 18th and 19th June. The source of particles of this route is inside the country (around Huralazim), which by crossing the Zagros Mountains entered into the western part of the country and significantly reduced the horizontal visibility. The study of dust particles shows that these particles were initially transferred to upper levels by low-pressure systems in the region and then transported in three directions to the ground. The soil moisture map also indicates a severe lack of moisture to a depth of 10 centimeters of soil, which caused that passage of unstable systems and western currents from these areas, separate fine particles of soil from the ground and transfer it to the study area.

**Keywords:** Dust, Synoptic system, Hysplit model, Optical depth, Iran.