

An Analysis on Synoptic Patterns of Springtime Dust Occurrence in West of Iran

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Extended Abstract

Introduction

Dust storm is one of the most important natural phenomena and a kind of severe natural disaster that begins and diffuses under the influence of atmospheric systems. It occurs frequently in deserts and their surrounding areas in arid and semi arid regions. So, the major and most persistent sources for dust scattering in the Northern Hemisphere are located in the “dust belt” which extends from 20°N to 30°N and are developed under the subtropical high-pressure subsidence (Kalderon et al., 2009). In the recent years, there has been an increase in the trend of dust storms in the west and southwest of Iran, especially in spring and summer. Now it is going to change into a persistent environmental problem in Iran and the Middle East region. Dust storms have an impact on many aspects of society, such as the quality of the inhabitants' lives, transportation, air pollution, communication systems and consequent crisis such as, eco-social and biological problems. Additionally, dust can play multiple roles in mediating physical and biogeochemical exchanges among the atmosphere, land and water. So the dust storms affect many aspects of Iranian inhabitants especially who live in the western region. There are many reasons for dust scattering in the atmosphere, including the composition and moisture content of soils, wind velocity and distribution of pressure at the surface and atmospheric levels. The aim of this study is to analyze the different synoptic patterns of springtime dust occurrence in the west and southwest of Iran.

Methodology

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In this research, for determining the synoptic patterns of dust occurrence in west and southwest of Iran, three types of data were used including: 1) hourly data of dust phenomena and horizontal visibility for 2000-2011 years for 45 meteorological stations in west and southwest of Iran. 2) In order to detect dust, the data of Moderate Resolution Imaging Spectroradiometer (MODIS) sensor from NASA's Aqua and Terra satellites were used. Since in (MODIS) sensor, bands 31 and 32 (11 and 12 micrometer) are within the thermal infrared range, so the brightness temperature difference between 11 and 12 micron bands in the spectrum can be used for the detection of dust storms from other climatic phenomenon such as clouds. 3) Six-hourly global data analysis with $2.5^{\circ} \times 2.5^{\circ}$ resolution from the NCEP/NCAR reanalysis, including air temperature, sea level pressure, geo-potential height, U-wind and V-wind components, relative and specific humidity and omega from 1000hPa to 200hPa, were used for the preparation of maps and identify the synoptic patterns. The method of the research was based on the synoptic approach. After clarification of the most patterns of dust occurrences, we identified 15 widespread storms in 11-years period.

Results and Discussion

In this paper, by investigating the synoptic patterns of the dust storms, we identified three main synoptic patterns including:

Dynamic pattern: This pattern is the main pattern for creation of dust storm in the Middle East and division to westerly trough, coupling block and omega block. When, the emigrant systems of westerly waves are dominant atmospheric phenomena in Iran and its neighbors, the formation of a trough or blocking in the waves in east Mediterranean cause ascendant weather in Iraq or north of Arabian Peninsula which also cause the formation of a cyclone under the upper divergence part in the surface. Increased pressure gradient and formation of the cold or warm front which cause an increase in wind speed in Iraq and north eastern Arabian Peninsula, are basic sources for generating dust in west and southwest of Iran. Finally the lack of humidity in this region will cause dust storm in these regions.

Dynamic-Thermal pattern: In this pattern, westerly waves and the emigrant systems caused creation of dust in higher latitude (Iraq), similar to dynamic pattern, but at the same time in lower latitude, in Arabian Peninsula, Sub Tropical high-pressured are dominated and cause stable atmosphere in this region. So, the pattern of dust creation is different from upper latitudes. In this region, dust creation is under the influence of the increase of air temperature and reduction of relative humidity in the surface in east and northeast of Arabian Peninsula. Thus, it causes the development of Persian Gulf low pressure and an increase in wind's speed and creation of dust. The dusts generated with wind stream line in 700 or 850 HP scatter in southwest on Iran.

Thermal pattern: When sub tropical high-pressured are dominated in the Middle East, the increase of air temperature and reduction of relative humidity in the surface in Iraq and Arabian Peninsula cause the development of Persian Gulf low pressure and increase of wind's speed in

this region that is suitable for dust creation

Conclusion

In recent years dust occurrence is an important natural hazard in west and southwest of Iran. The annual dust cycle in the Middle east are associated with seasonal occupation changes in westerly winds, rainfall and soil moisture, downward flowing jet stream in cold period and thermal cyclone in warm period. This paper includes the following results:

- a) When westerly waves and their emigrant systems are dominant atmospheric phenomenon in low latitudes (Iraq and Arabian Peninsula), these ascendants cause the creation of dust in west and southwest of Iran.
- b) At the same time westerly waves and their ascendant in upper latitudes cause dust occurrence in Iraq. But in Arabian Peninsula, Sub Tropical high-pressure is dominant and creation of dust is affected by thermal surface low pressure.
- c) At the end of spring, the Middle East is dominated by subtropical high pressure and subtropical jets stream, but the circulation of the atmosphere during dust storm, shows that a low pressure extends over Persian Gulf and south of Turkey. So, the surface low pressure is the cause of dust occurrence in Iraq or Arabian Peninsula.

Basic sources for scattering of dust in west and southwest of Iran are Iraq, desert lands in north and northeast of Arabian Peninsula, East and southeast of Syria, also in some times is Sahara desert.

Keywords: *Synoptic Climatology, Dust, Atmospheric Systems, MODIS Sensor, West and Southwest of Iran.*