

A Synoptic Investigation of Dust Storms in Western Regions of Iran during 2005- 2010 (A Case Study of Widespread Wave in July 2009)

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Extended abstract

1- Introduction

Dust storm as an atmospheric phenomena and a well-known natural disaster has been of a great consideration to many scientist and researchers in different fields of study including atmospheric sciences. Origin, mechanisms of formation, transfer, and distribution as well as the consequences of the phenomenon have been investigated using different methods. Countries located in the arid and semi-arid belt of the world including Iran have been concerned with the dust storm phenomenon. Recent years repeated droughts and possible results of climate change as a result of desertification have

brought dust storms to the attention of many scientists.

Dust in the atmosphere as a pollutant has many different negative consequences among which reduction in growth and efficiency of crops, incidence of pests, plant diseases, and the increase in road accidents due to vision decrease, flight cancels and its cost and health costs can be mentioned. In spite of their Middle Eastern and African origin, the dust crossing the Middle East countries like Iran may reach India and China, cross the Pacific Ocean and reach North America.

2- Methodology

The study covers a statistical period of nearly five years from 2005 to 2010. Ten important dust waves based on their condensation and distribution were selected. Because of its unique distribution, the dust waves of 4th to 7 thof July 2009 were selected to be studied and discussed in detail.

Since the study is based on synoptic analyses, synoptic maps of different atmospheric levels and satellite images were provided. Weather maps were

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obtained from NOAA. To analyze the air stability indices and high level flows, thermodynamic diagrams (Skew T) of Kermanshah station were used. Kermanshah station was selected because of its position in the west of Iran and because it is a transfer and distribution path during dust storms and waves.

3- Discussion

The thermal low pressure cell has been stretched from Pakistan to the south of Iran and from there to the deserts in Saudi Arabia, Iraq and Syria. Iran –Pakistan low pressure system sometimes appears as low pressure belt from India, Iran, Iraq and even Turkey. Usually a cyclone with a sucking potential and changing dust ascending is active in the deserts of Iraq and Syria. The effects of this cyclone are obvious up to the level of 500 hpa cases like the wave occurred on 4th to 7th of July 2009. This cyclone as wind blowing and weather instability provides suitable conditions for the ascending of hot air and massive dust columns. Weakening and retreating of Azores subtropical high pressure wave in these conditions as well as air lift conditions are proved using omega maps.

In every case, the subtropical high pressure wave weakens and retreats. Weakening of the stable conditions along with the subtropical high pressure wave retreatment and the approaching of trough has led to the beginning of a dust storm in the region. With the retreat of the Azores high pressure or its tongues and approaching of a trough to the area, the conditions for dynamic ascent are enhanced and result in dust transfer to the higher levels of atmosphere. Trough displacement or high level trough consonant with surface cyclone during

dust storm, cause in the distribution of the dust or the limitation of its distribution in a special direction.

Concentrations of dust or aerosols are not equal in these waves and depend on the origin, expanding activity, conditions and intensity of the ascend, subtropical high pressure weakness and the intensity of the dynamic descend, the speed and the direction of the surface and high level winds, topographical characteristics and other factors. As an example on 5th of July in 2009 the minimum visibility in Qasr-e-Shirin has been reported to be 50 meters. In cities of Kermanshah, Abadan, Ahwaz, Shiraz, Khorram Abad and some other cities the minimum visibility was reported to be about 100 meters.

4- Conclusion

Low pressures on Iraq, Syria and the north of Saudi Arabia lead to the climbing of a huge amount of dust in the air which may result in the transfer of the dust to the intermediate levels of the atmosphere in case of the drought in the region and the existence of western or southwestern high level flows.

In an investigation of satellite images, synoptic maps and thermodynamic diagrams of 4th to 7th of July in 2009, it was determined that a surface low pressure system was active on the Middle East deserts on the days of the dust wave. The settlement of the system on the region and the enhancement of the instability conditions on the surface of the deserts resulted in the transfer of aerosols to the region atmosphere. The overlap of the surface low pressure system and westerlies trough, which was thoroughly obvious on 700 and 500 hpa in dust storm days, and the enhancement of the cyclonic wave on Iraq and Syria deserts

led to the strengthening of high level wind systems and an expanding distribution of dust on western and southwestern areas of Iran. Another deep and dense core which was formed in Iraq on 5th of July in the center of Iraq led to an increase in aerosols. The stoppage of high level winds on 5th to 7th of July resulted in relative inertia and slow activity of the system and led to delay in the distribution of aerosols.

Key words: Dust, Synoptic methods, Pressure systems, West of Iran

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