Statistic and Synoptic Analysis of Dust Phenomena in West of Iran

Azizi, Gh.[1], Shamsipour, A.A.[2], Miri, M.*[3], Safarrad, T.[4]
1-Assoc. Prof., Faculty of Geography, University of Tehran, Tehran-Iran, ghazizi @ut.ac.ir
2- Assist. Prof., Faculty of Geography, University of Tehran, Tehran-Iran, shamsipr@ut.ac.ir
3-M.Sc., Faculty of Geography, University of Tehran, Tehran-Iran,
4- Ph.D., Faculty of Geography, University of Tehran, Tehran-Iran, tsafarrad@ut.ac.ir
Received: June, 2011 Accepted: Jan., 2012

Introduction

A dust storm is a meteorological phenomenon common in arid and semi-arid regions. Dust comes from arid and dry regions where high velocity winds are able to remove detached particles mostly silt and clay sized material. Dust consists of particles in the atmosphere that arises from various sources such as soil and lifted up by wind. The Sahara and dry lands around the Arabian Peninsula are the main terrestrial source of airborne dust, with some contributions from Iran, Pakistan and India into the Arabian Sea. In addition, China's significant storms deposit dust in the Pacific. The term dust storm is more likely to be used when finer particles are blown long distances, especially when the dust storm affects urban areas. Dust has been known as one of the atmospheric features in West and South West region of Iran, which in recent years has increased its affecting severity, steadiness and area expanse. Iran and particularly west and south-west of Iran, periodically faces with the dust phenomenon and its problems. West of Iran considering its natural area and being near the sources of dust in the West Asian region is prone to frequent occurrence of the dust phenomenon. United Nations Development Program (UNDP) in a report about drought in the southwestern region of Iran and neighboring countries such as Iraq stated that having been associated with surface and subsurface moisture loss and also losing vegetation covers, are the main causes of increasing dust phenomena. Also outlined fine- grained texture sediment surfaces with human factors such as the construction of massive dams on the rivers leading to the basin of Mesopotamia (Iraq) by countries in the region. Therefore, the results of the dams' construction are low water entering the wetlands of Mesopotamia. Also a significant proportion of the sediment surfaces which had been under the water bodies in previous years, has been suffered by severe erosion through local and regional winds in recent years. Particles entering the atmosphere and flowing into the West of Iran are sometimes moved to the center of country. According to the importance of this phenomenon and the problems that have been established in different areas, in this study, we attempted to first, do statistical analysis of the dust phenomenon, and frequency of its occurrence in the past and present, and also to recognize regions of dust sources and the weather conditions, then diffusion patterns and dust storms routing have been analyzed through the combined methods.

Materials and methods

In this paper two dust samples have been selected and studied. They have sustained over three days with visibility less than 1000m in west of Iran. The first one occurred during 18 - 21 April 2008 and the second in 4 -11 Jun 2008. For this study combined statistics, synoptic and remote sensing analysis methods were used. Daily dust storm data was obtained 98 times per day in period of 2008-1979, from 61 selected stations in western half of Iran from the National Meteorological organization (Figure 1). Then data were analyzed using statistical methods. After primary investigation, due to the large data volumes, 20 stations were selected and compared. The presented results of statistical data were based on 5 five representative stations. In addition to dust and visibility hourly data, which were taken from National Meteorological Organization as special codes, temperature, moisture, precipitation and dew point data used to check the status of surface stations were processed and analyzed.

www.SID.ir

Corresponding author: Tel: 09125883987 mmiri@ut.ac.ir

Also to check the conditions of the upper atmospheric characteristics, needed data such as radio sound data was obtained from the University of Wyoming Atmospheric database for days with dust phenomena in Iran`s western half stations. Then having used software RAOB, created Skew-T diagrams were analyzed and plotted according to daily vertical atmospheric data. Next for identifying synoptic conditions of dusty days, daily data of sea level pressure, omega, geo-potential height, u and v wind components with net CDF format were received from NCEP-NCAR website. Required weather charts on the surface of 1000, 850 and 500hpa were prepared and analyzed using GrADS software. Then satellite images and their enhancements were obtained using MODIS and ENVI4.5 softwares. Brightness temperature was determined via NDDI equation which was extracted dust phenomena over study area. Note, in this study chosen samples have been studied based on code number 6, this means that the dust is entered out of the station.

Archive of SID

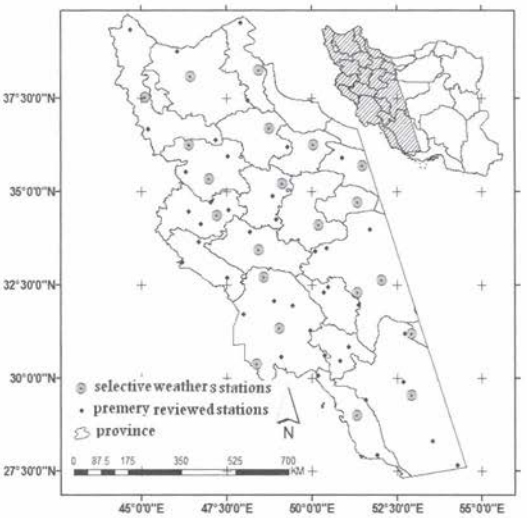

Fig. 1: Location of the study area

Results and discussion

The results show that the dusty days in the stations was more than today over a period of thirty years in the past, in the stations that have been located in the path of dust. So Dezful station with 3196 dusts days during the dust events has had the highest frequency. Annual Surveying of data shows the dust phenomenon in all the stations have two peak times; the first was during the period of 1982-1990 and another was from 2000- 2008. The difference between them is the intensity, persistence and the number of days with dust. The frequency of days with dust in the first period and the severity, duration and its spatially expanding in the second period, particularly in 2008 are considered. Also survey of the monthly frequency of occurrence of this phenomenon shows that most frequencies of dust events in west of Iran was in May, July and June (Figure 2). Hourly evaluation of dust event in the selected stations, in 8 hourly monitoring during 24hour, shows that the highest frequency of dust event has been seen in the afternoon in local time and the least rate of it is reported at 3:30 in local time.

Comparing satellite images over different periods showed that the number of dust sources has increased in recent decades. In 1989 the sources in origin countries were only 14 point, but in the recent years the number of them was increased to more than 100 points. In addition, new areas have been identified including: East of Syria, West and North-West of Iraq. Investigation of synoptic maps with appearance of dust on the MODIS sensing images in selected areas shows a low pressure center formed on the land surface over the Persian Gulf and West of Iran.Pressure gradient between these areas and high pressure formed on the Saudi Arabia caused movement of atmospheric patterns towards the study area.

www.SID.ir

Archive of SID

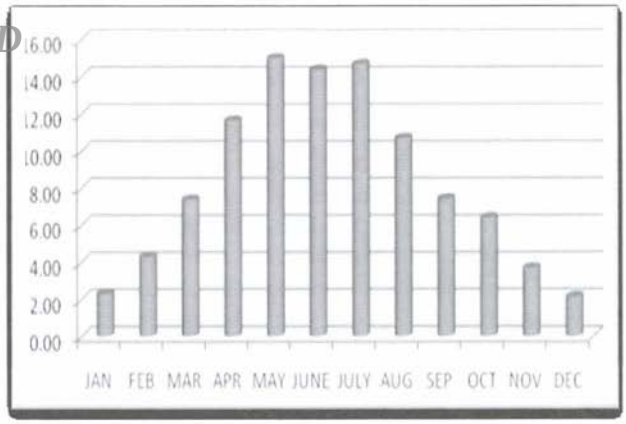

Fig. 2: monthly frequency percentage of dusty days in the case study region

Synchronic with the activity of these low pressure centers, forming of a trough in 500hpa level over Iraq and Syria and developing to north of Saudi, was the cue of formation of southwest and west atmospheric patterns in front of the trough and transferring of dust to Iran high latitudes (Figure 3). Synchronic with warming of surface, soil moisture, dry and poor cover of land in the deserts of Saudi and Iraq, Pressure gradient on surface and the roll of western patterns in the high level of atmosphere were reduced. So creation and transferring of dust phenomenon were easier. Also, because of the study area location which was in the East of trough and the path movement of streams formed over Iraq and Syria, dust particles were entranced to the West of Iran.

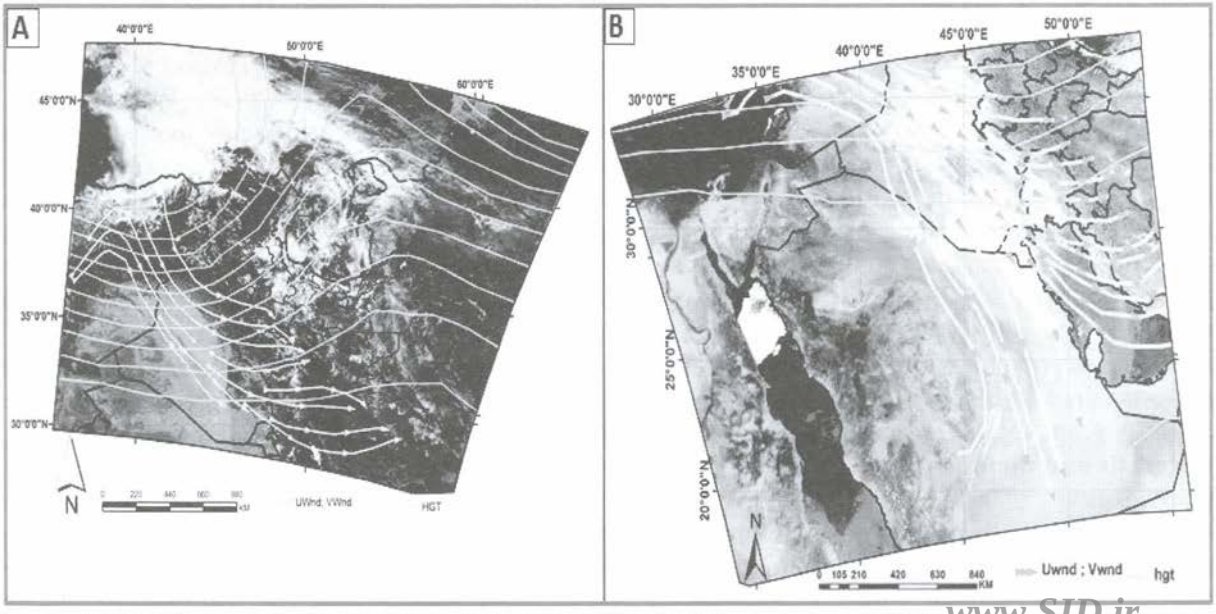

Fig. 3: extraction of dust via brightness temperature properties, A: 19April 2008 B: 08June 2008

www.SID.ir

Key word

Dust storms, Brightness temperature, Synoptic conditions, the West of Iran, natural hazards.