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The spatial distribution of dust sources in Iraq by using satellite images

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Abstract
Dust storms phenomenon occurs in the most regions of Iraq during the year, this paper is study this phenomenon by using the technique of satellite images, it has been used satellite images (Meteosat-9) with the sensor (SEVERI) and selected different dates of dust storms in 2012, geographic information system programs (ERDAS-GIS) has been used to discrimination the regions that cause this phenomena within the study area to prepare the images to read the real geographic coordinates and determines the regions that caused the occurrence of the dust storms represented by geographical location (Lon/Lat) and making Iraqi map describes these regions for year 2012 and compared with maps for previous years.

Keywords: Dust sources; Spatial distribution; ERDAS; Satellite images.

1. Introduction

A dust storm or sand storm is a meteorological phenomenon common in arid and semi-arid regions, dust storms arise when a gust front or other strong wind blows loose sand and dirt from a dry surface. Particles are transported by saltation and suspension, a process that moves soil from one place and deposits it in another , Dust storms, one type of dust event are in most cases the result of turbulent wind [1], which raise large quantities of dust from desert surfaces and reduce visibility to less than 1km. This dust reaches concentrations in excess of 6000 µg/m3 in severe events [2]. Dust storms cause a great variety of environmental impacts. Tropsopheric aerosols, including dust, are an important component of the earth's climate system and modify climate through their direct radiative effects of scattering and absorption [3], through indirect radiative effects via their influence on clouds microphysics [4], and by their role in processes of atmospheric chemistry [5].

According to the WMO (World Meteorological Organization) protocol, Dust events are classified according to visibility into the categories of:

(1) Dust-in-Suspension: widespread dust in suspension not raised at or near the station at the time of observation; visibility is usually not greater than 10km;

(2) Blowing Dust: raised dust or sand at the time of observation, reducing visibility to 1 to 10km;

(3) Dust Storm: strong winds lift large quantities of dust particles, reducing visibility to between 200 and 1000m; and

(4) Severe Dust Storm: very strong winds lift large quantities of dust particles, reducing visibility to less than 200m the frequency of all dust events is [6]:

In the year 2011, GERIVANI submitted a paper can be help to find the impact of geological units on the wind erosion for finding dust storm sources in regions of western parts of Iran [7]. The researchers in reference [8] have calculated the dust storm velocity by determining the front pattern for the storm which are found that the velocity value is (37.62) km/h. The researchers in reference [9] found that the most important reason of the occurrence of dust storms in Iraq is the passage of a low-pressure system over Iran , the carry cool air from that region towards warmer region or warmer air of regions like eastern Syria and Iraq.

2. Materials and methods

2.1 The study area

Iraq is located in south-west of Asia between (29-37 N), (39-48 E), thus it occupies the northeast corner of the Arab world, Iraq overlooking across the south coast of the Arabian Gulf for distance of 60km, bordered by Kuwait and Saudi Arabia to the south and west, Jordan and Syria to the northwest, Turkey to the north and Iran to the east. Iraq area is 435 052 km^2 (Figure 1).

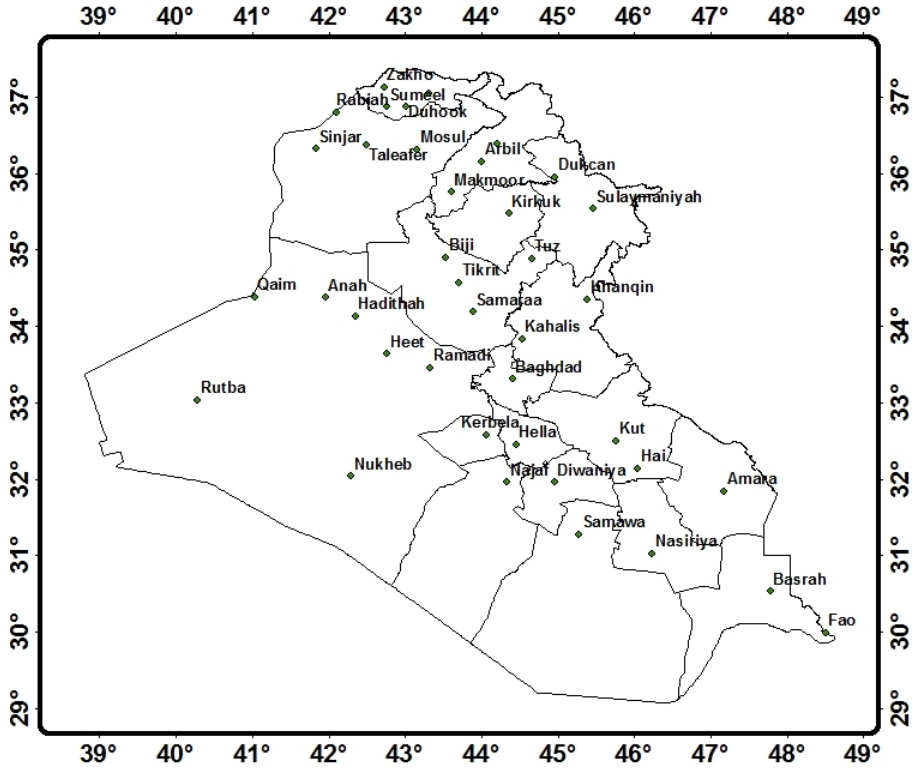


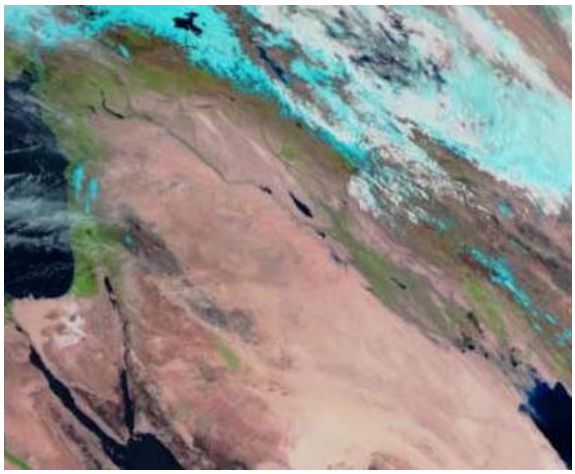
Figure 1. The area study

2.2 Data

In this study it has been used a remote sensing techniques and geographic information systems programs (GIS - ERDAS).Using sensor images (SEVERI) borne on the satellite Meteosat-9 with spatial resolution (3km) for different dates of year 2012 included (10/3) - (17.3) - (7-6) - (18.6) - (5/7) and time between (4 - 630 UTC). Add data meteorological of wind speed.

Satellite images have different dates and different months included seasons spring and summer, these images have a high and various wind speeds to discrimination the regions that cause the emission of dust particles and thus the occurrence of this phenomenon within the study area. These images represent the beginning of dust storms (start point reigns of dust) because it is in the early hours of the day. (Figure 2) shows the selected images [10].

It has been used meteorological data for different meteorological stations for the study area, these data represented by wind speed [11]. Figure 3 illustrated the average of wind speed (m/sec) during study period (January - late July).



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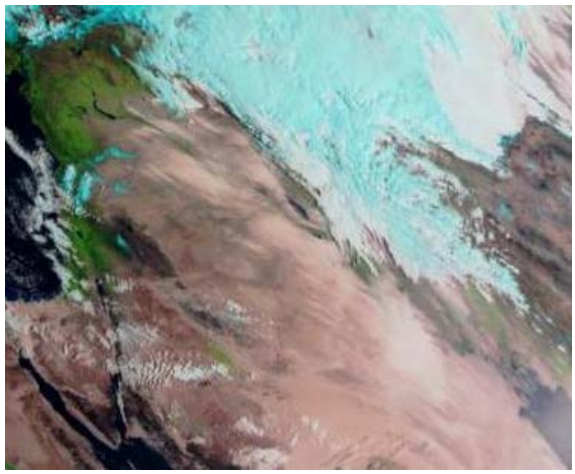

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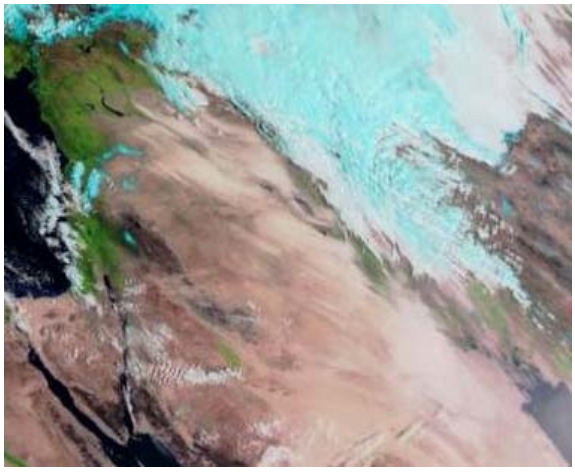

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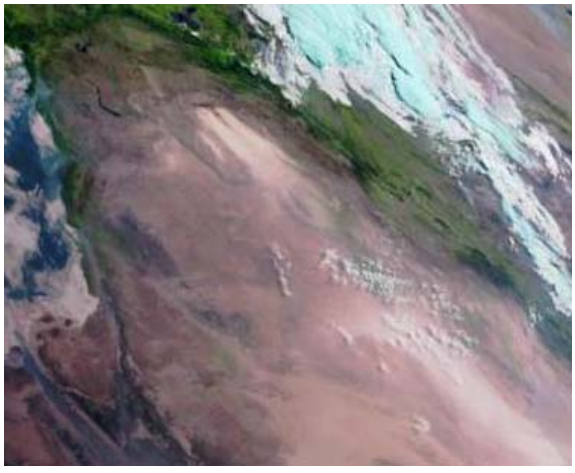

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Figure 2. The satellite images [10]

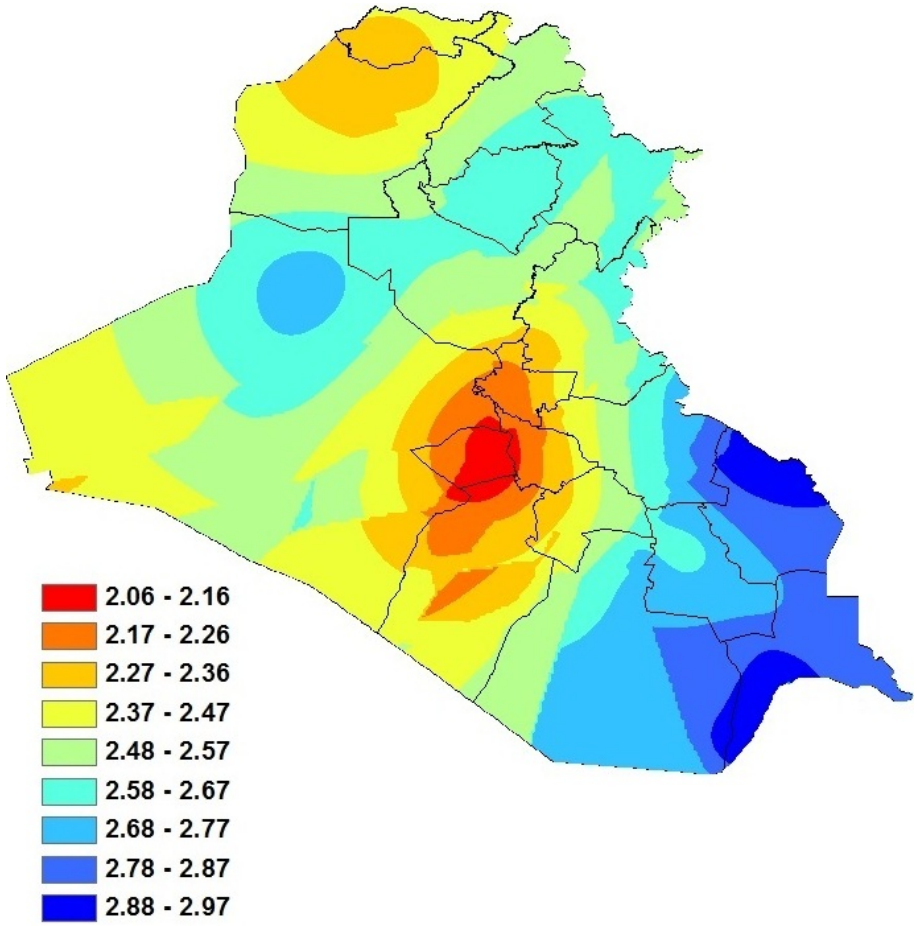


Figure 3. Average of wind speed [10]

3. Results and discussion

3.1 Geometric correction

Satellite images usually contain the distortions of engineering for several reasons such as: mile line scanning, speed of the satellite and the Earth's rotation and therefore cannot be relied upon to produce a correct dimensions map. The geometric correction process is necessary to convert satellite images from a grid of pixels to images read real coordinates and thus determines the accurate location; Figure 4 shows the satellite images after geometrically corrected.

3.2 Determining regions that cause the emission of dust

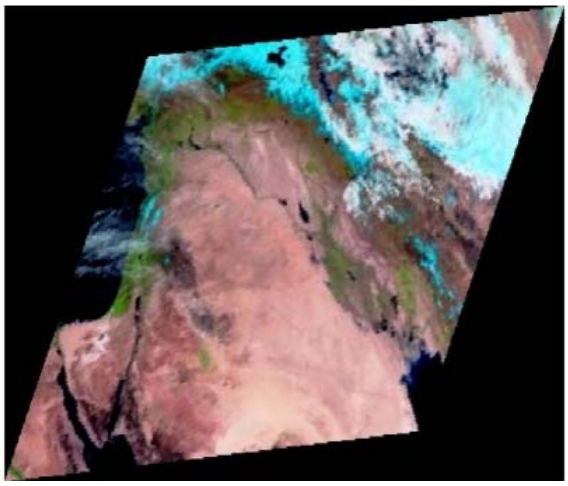
Geographic location of the regions that emit particles of dust and thus cause the phenomenon of dust storm in the study area (Iraq) has been determined, the determination of these points haves been identified depending on the usage the style of visual interpretation through very important known elements (Tone) and (Texture).

Figure 5 identifies regions inside and outside the study area, so it will suffice by regions that cause dust phenomenon within the study area only, as show in Figure 6.

It can determine the geographical location of these points or regions that cause the phenomenon of dust. See Table 1.

It can make map for the study area (Iraq) that represents the regions cause the dust storms, as shown in Figure 7.

The researchers (Walter M. and Wilkerson) [12] made a map of dust sources regions in Iraq and Syria that direct impact on Iran before 1991, in addition, in 2005 the researchers (Jalali and Davoudi) [13] sketched a map of the regions of dust sources in Iraq and Syria, and they sketched other map in 2008, as shown in Figure 8.



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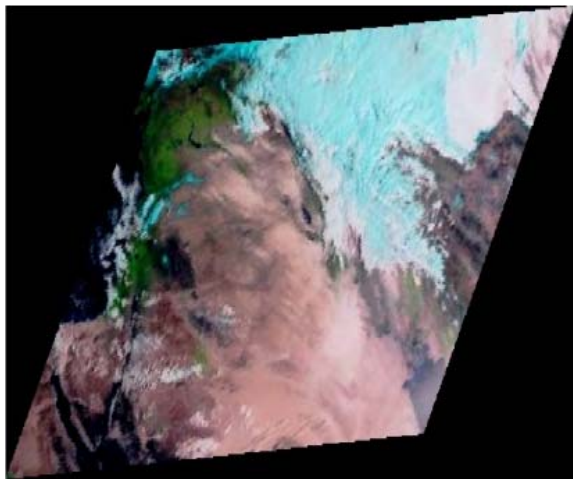

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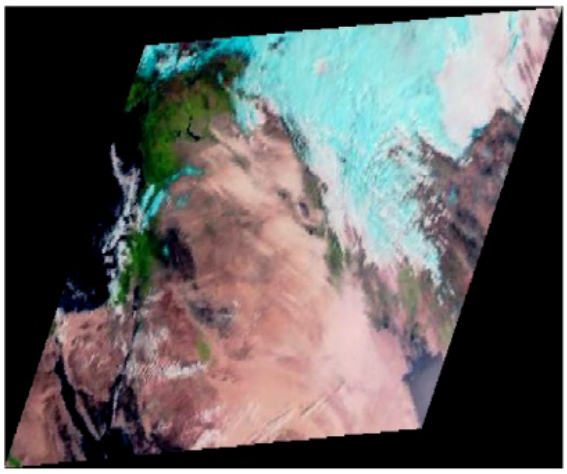

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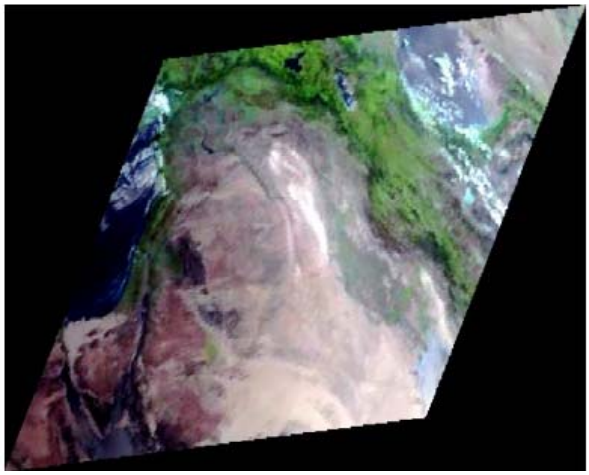

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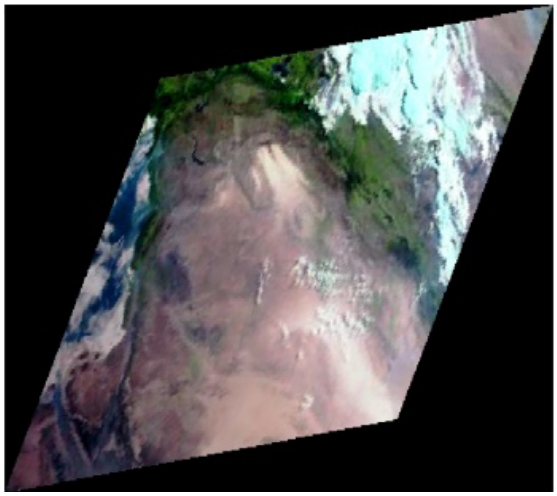

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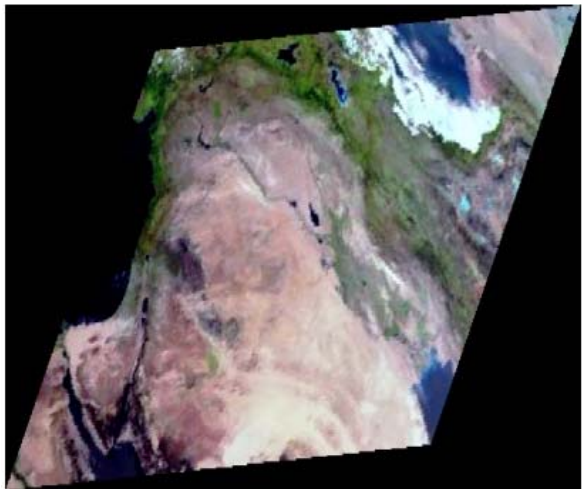

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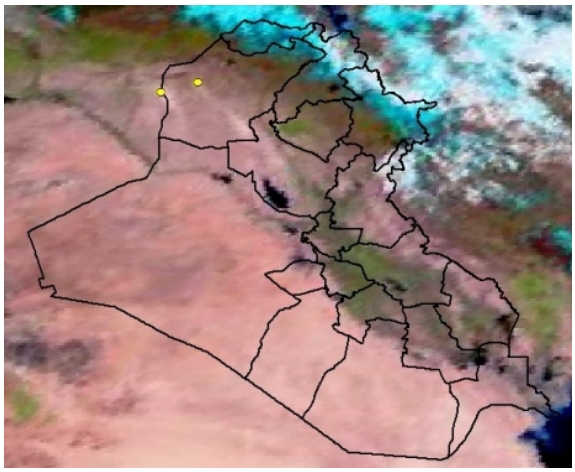
Figure 4. Corrected satellite images



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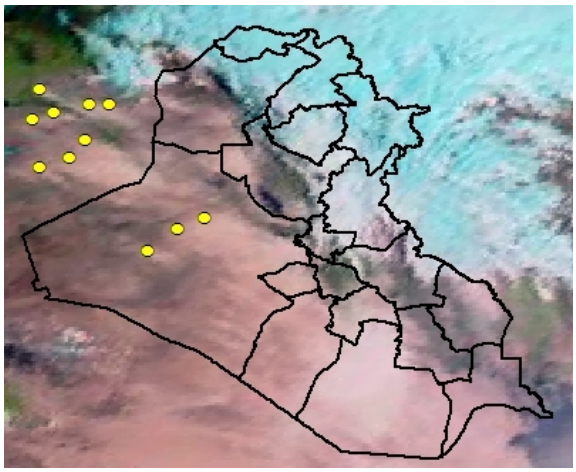

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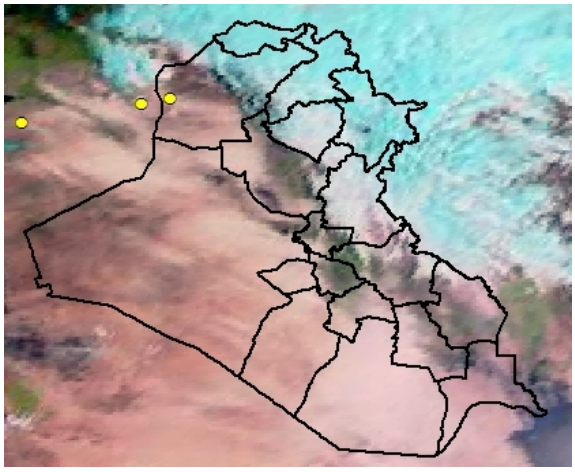

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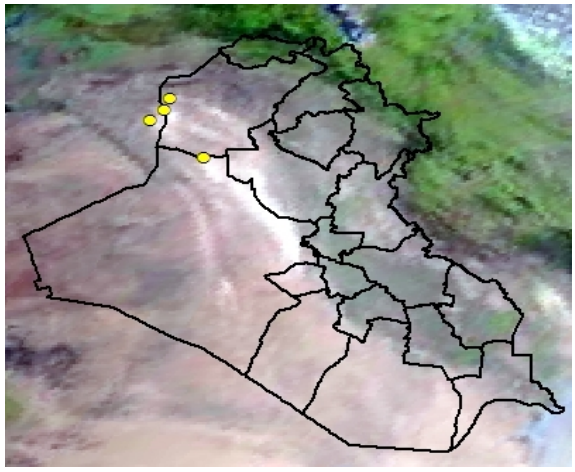

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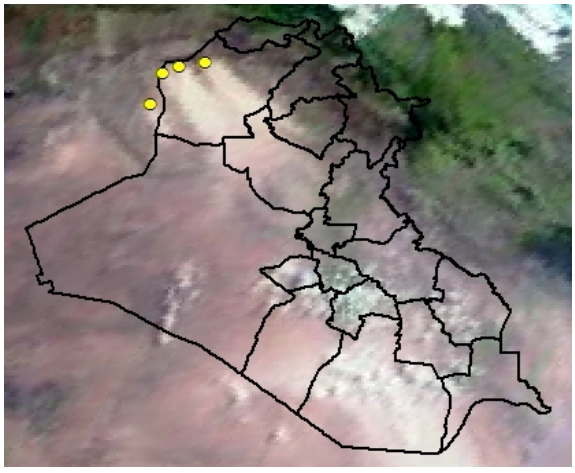

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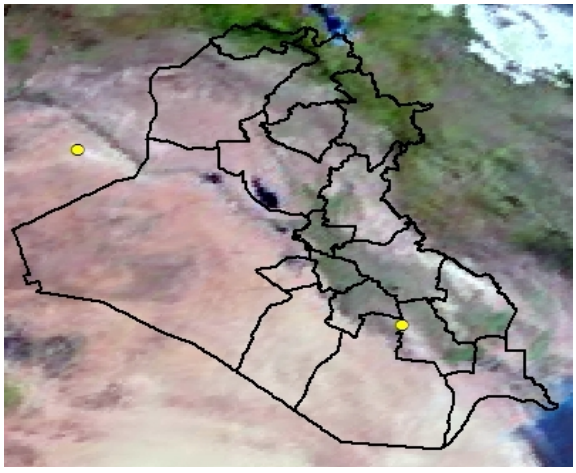

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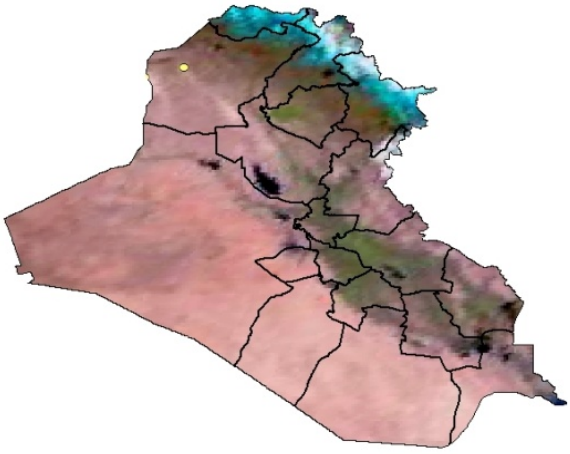
Figure 5. The regions that cause dust particles emission



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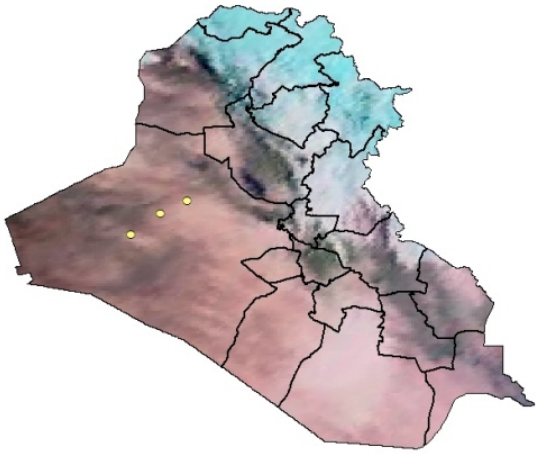

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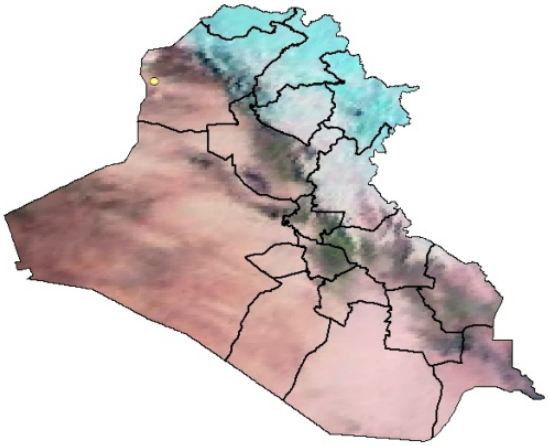

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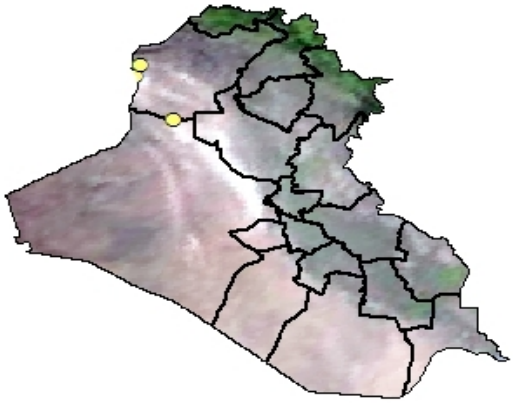

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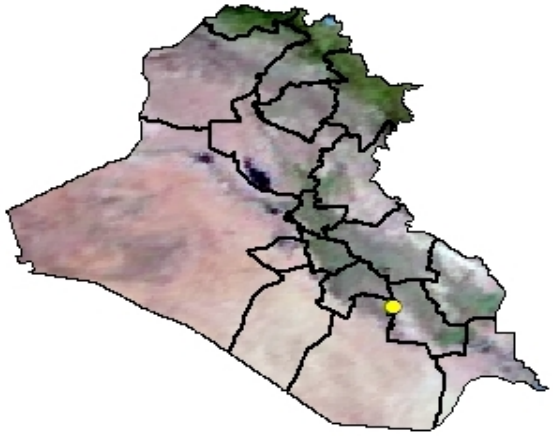

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Figure 6. The regions that cause dust particles emission in study area

Table 1. The geographical coordinates for the determined regions in satellite images

point	date	Time (UTC)	longitude	latitude
1	10/3/2012	630	41.934	36.201
2	17/3/2012	530	41.134	33.081
3	17/3/2012	530	41.683	33.484
4	17/3/2012	530	42.182	33.710
5	17/3/2012	6	41.521	35.919
6	7/6/2012	4	41.355	35.881
7	7/6//2012	4	41.459	36.123
8	7/6/2012	4	42.081	34.948
9	18/6/2012	4	42.150	36.535
10	18/6/2012	4	41.666	36.463
11	18/6/2012	4	41.344	36.320
12	5/7/2012	530	45.822	31.503

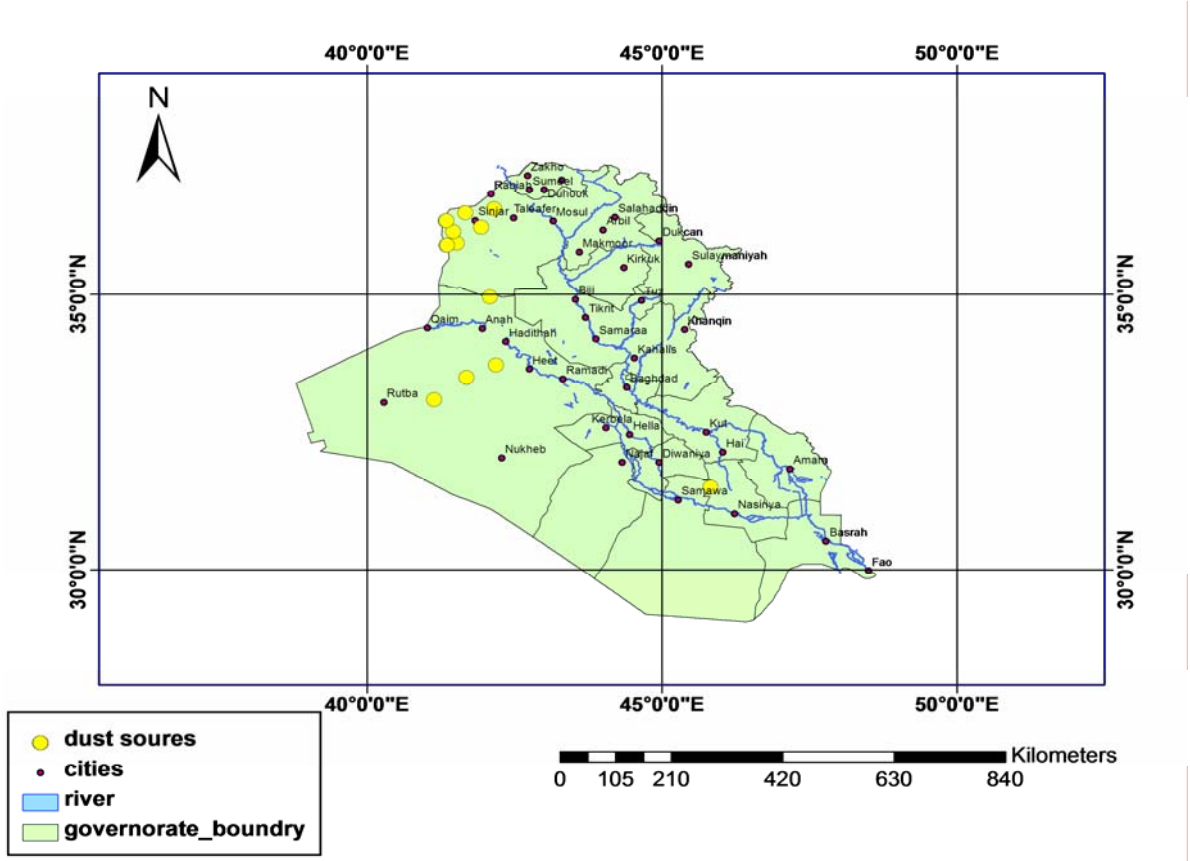
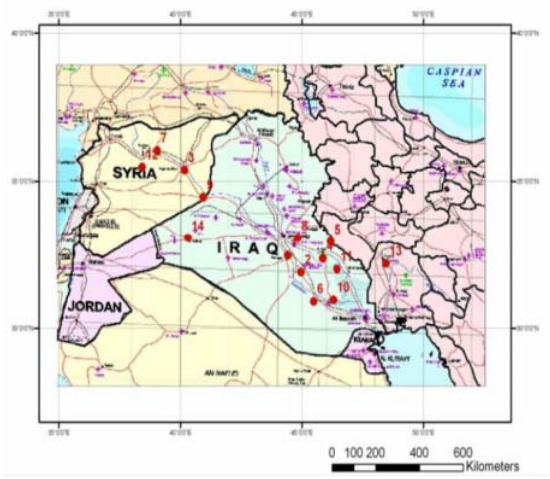


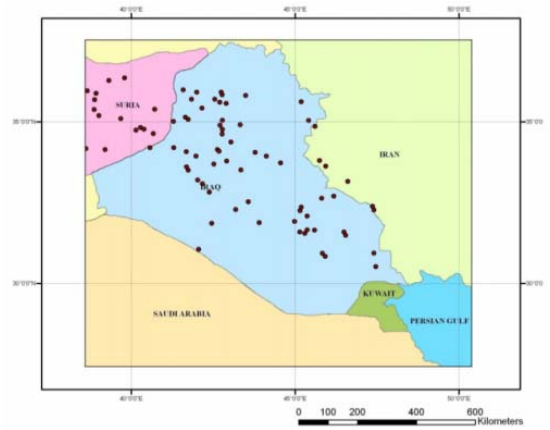
Figure 7. The spatial distribution for the regions that cause the occurrence of dust phenomenon in Iraq for year 2012

When comparing the map in 2012 with maps in years (1991-2005-2008) results showed that the northwestern region and the western region are the sources of the emission of dust particles, these reigns represented in the governorates of Al-Anbar and Ninwah.

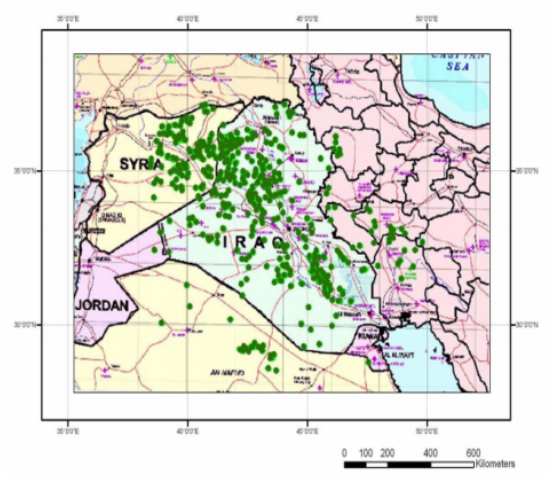
Through the study of climate data observed in Ninewah city, it shows that the general trend of temperatures increase, heat waves are increasing, the number of hot days increase in the summer, decreases the amount of rainfall, especially during the last two decades, bad distribution of rainfall during the rainy season, late rainy season and increases the frequency of drought cycles and severity in the region. 2008 was severe drought, severity reached (-2.48) according to the Standard Precipitation Index (SPI). Sandstorms significantly increase in repetition and intensity which is reached unfamiliar number (32) storms and 71 days of thick dust [14].



1991



2005



2008

Figure 8. The spatial distribution for the regions that cause the occurrence of dust phenomenon for different years [12, 13]

4. Conclusions

1. It has been made a map for the study area appears regions that cause the phenomenon of dust storms.
2. The north-western region and neighboring to the Syrian border (eastern Syria) represents of the most important regions that cause the emission of dust particles and the occurrence of the phenomenon of dust in various forms (dust rising – suspense dust - dust storms).
3. The satellite images of the satellite Meteosat-9 give us a good possibility to observe this phenomenon from the beginning (early hours of the day) and determine the emission regions of dust particles.

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