وزارة العلوم والتكنولوجيا
دائرة تكنولوجيا الفضاء والاتصالات
مركز علوم الجو والفضاء

Dust storms Monitoring, Prediction and Allocation of Sources

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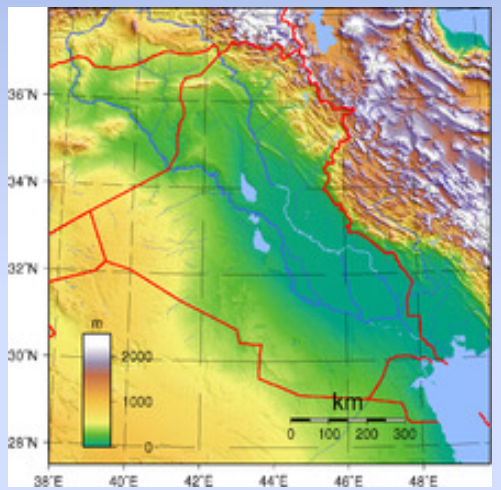
IRAQ Geography

- Iraq is situated in the north-east of the Arab world in western Asia and located within the North temperate zone in southwest Asia
- Iraq is characterized by surface variability and diversity is subject to the mountains and hills, valleys, plains and there are bodies of water within its borders are the lakes and marshes and rivers crossed by the Tigris and Euphrates.
- Geography of Iraq is diverse and is located in four major areas: the Western Sahara, which is located on the western side of Euphrates, Al-Jazera lies between the Tigris and the Euphrates rivers northwest the city of Baghdad which upper Mesopotamia, and the highlands in the north and north-east of Iraq which include the Zagros Mountains, and the alluvial plain country, which is called the Lower Mesopotamia,
- Around 38 per cent of the total land area is desert.



Iraq Climate

- Iraq's mainly continental climate is characterized by being hot and dry in general, and frequently exposed to solar radiation. The climate can be described as mostly desert like with mild to cold winters and dry, hot, and cloudless summers.
- The weather of Iraq is hot dry in summer and cold rainy in winter Iraq in the summer affected by area of low pressure centered in the Arabian sea and the Indian ocean so blowing it winds from regions of high pressure in the plateau of Anatolia a wind known as the north (Shamal) helps to mitigate the temperature because it is coming from regions of cold and dominant in the period from mid-June to mid-September and accompanied by intensive heating of the surface of earth from the sun and wind, accompany this sometimes dust storms could rise to more than a thousand meters.

Main challenges facing Iraq

- Shortages in water supplies
  - Deterioration of agriculture
  - Desertification
  - Dry Marshland

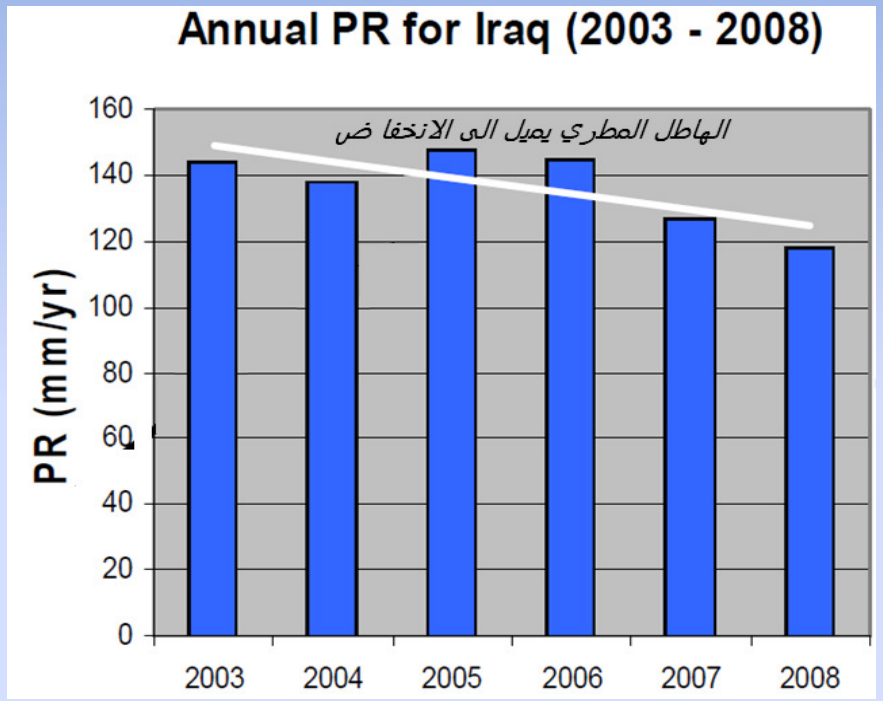
- Climate change
  - Little rain falls
  - Dust storms
  - Desertification

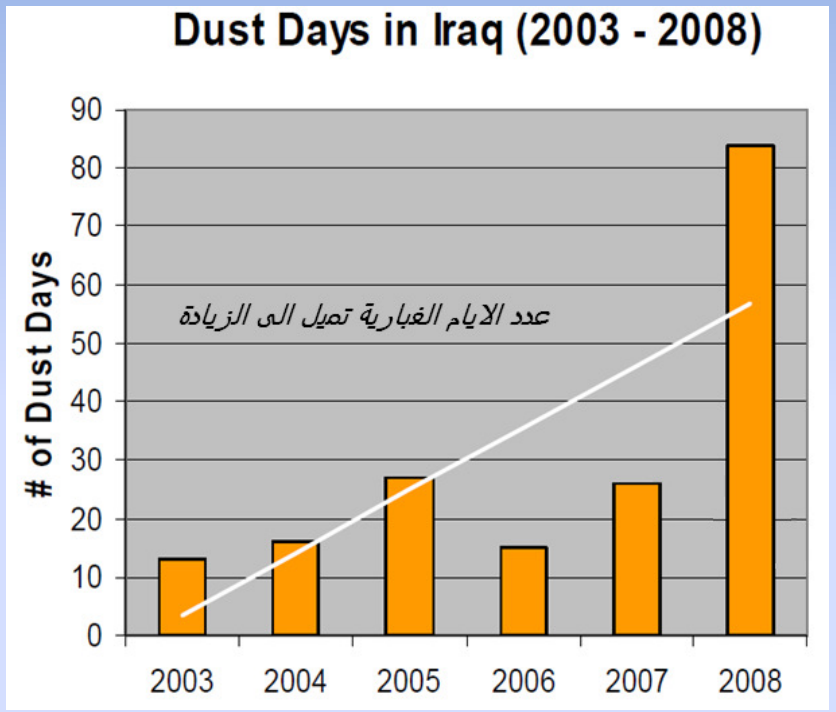
- Environmental pollution

The Required Space Applications

In Iraq the main applications of space technology now can be summarized in the followings;

- Monitoring of desertification, drought, land use, and land cover
- Monitoring of gasses and pollution in the atmosphere, land and rivers
- Monitoring of dust storms and locating their sources





In recent years high iteration of dust storms in Iraq and neighboring areas due to drought resulting from the low level of rainfall which led to reduced vegetation and the deterioration of soil quality [1].

Common Factors in Soil Erosion by Wind
ألعوامل التي تساهم في تعرية التربة بريح العواصف الترابية

- Wind velocity (ريح سرعة)
- Air temperature (الجوية الحرارة درجة)
- Humidity (الرطوبة)
- Surface roughness (خشونة السطح)
- Ground cover (الأرضي الغطاء)
- Surface obstruction (السطحيّة الإعاقة)
- Surface temperature (الحرارة درجة السطحيّة)
- Topography (الطوبوغرافيا)
- Soil structure (تركيبة التربة)
- Soil organic content (المحتوى العضوي للتربة)
- Soil texture (قوام التربة)
- Soil moisture content (المحتوى المائي للتربة)

DUST!!!!!!!! In Iraq


Effects on the life of the community


Effects on plants and crops


Effects on transport


Effects on people's health

Dust storms change visibility

Sandstorms lead to sand creep

Sand affects the railway

تأثير الرمال الزاحفة على السكك الحديدية في جنوب العراق

Accumulation of sand in the rivers

تراكم الرمال في مقطع المصب العام(سابقا) /جنوب العراق

تأثير العواصف الغبارية وزحف الرمال في العراق

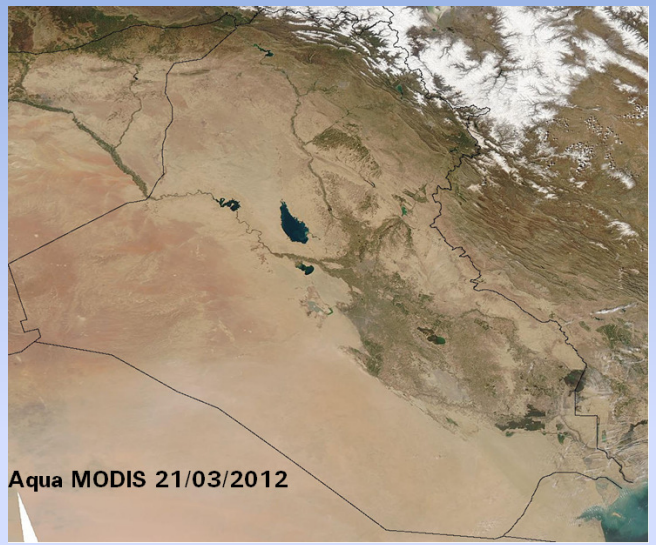
Sand affects the highway

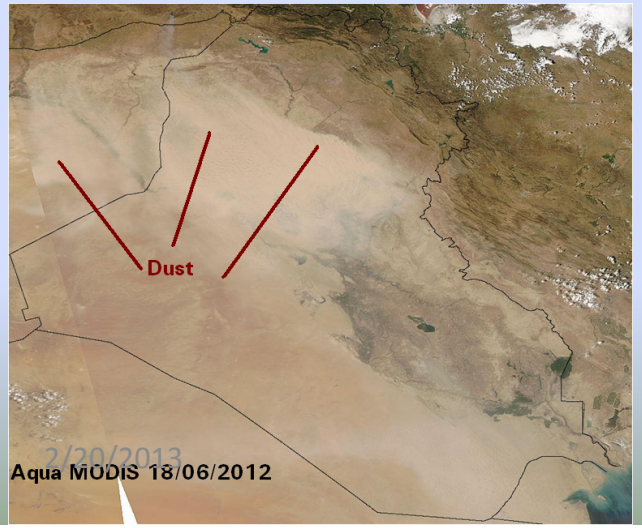
تأثير الرمال الزاحفة على طريق المرورالسريع في الانبار

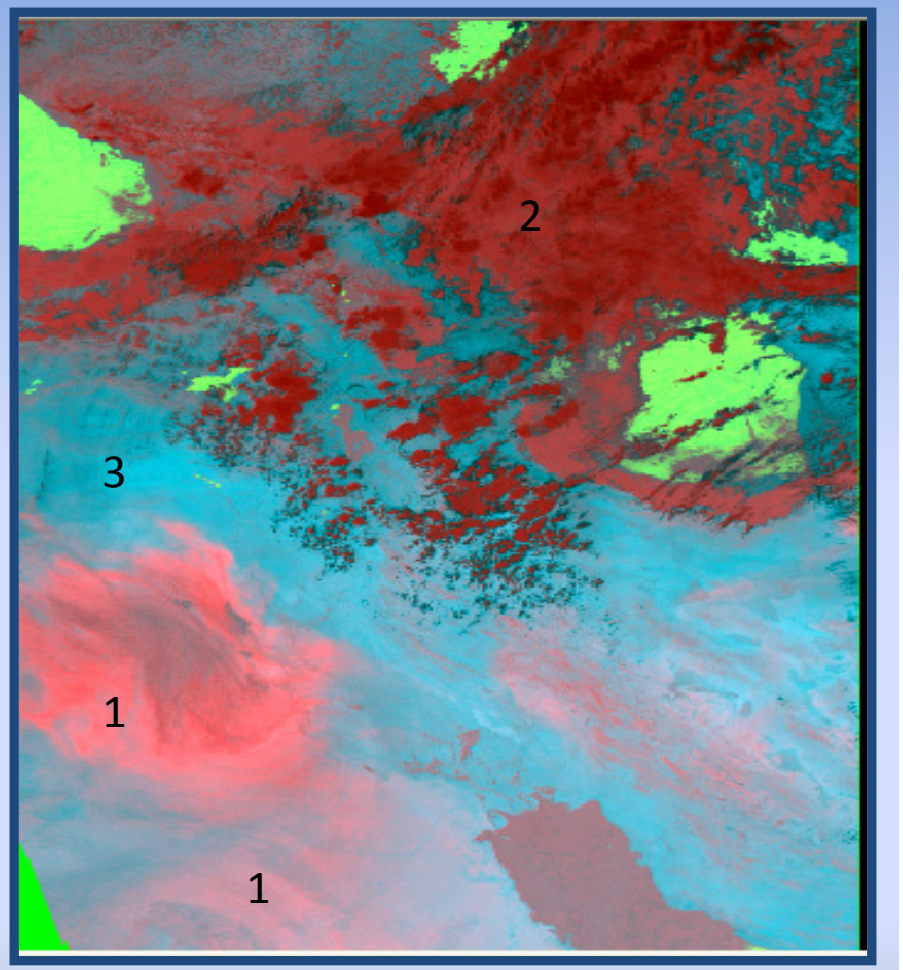
Accumulation of sand in irrigation sites

طمر احدى منشأت الري بالرمال الزاحفة

Dust storms as observed from space images (MODIS) and Dust Product to for Detecting Dust



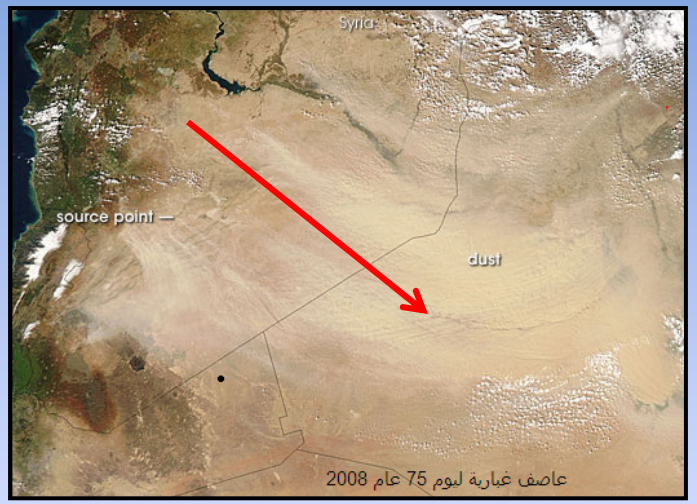


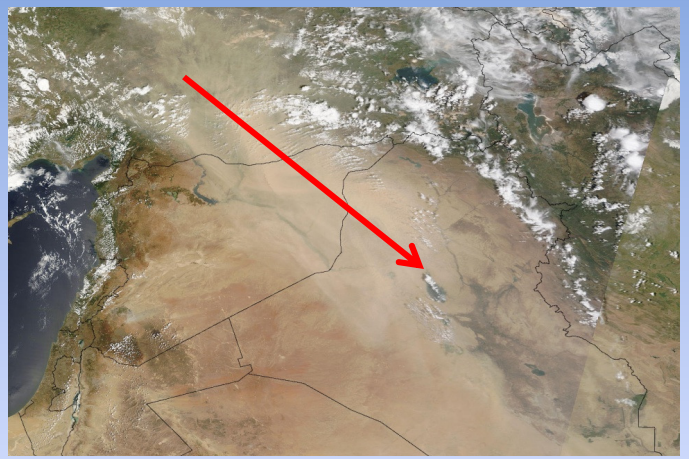


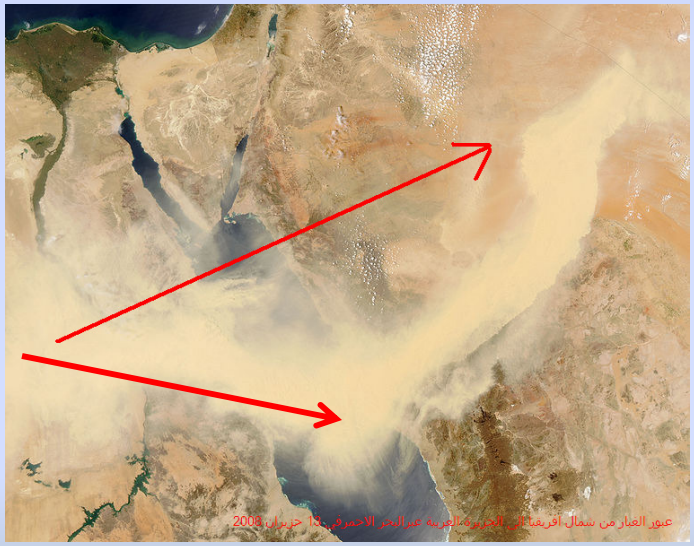
1	DUST STORM
2	Thick high-level CLOUDS
3	Desert sand

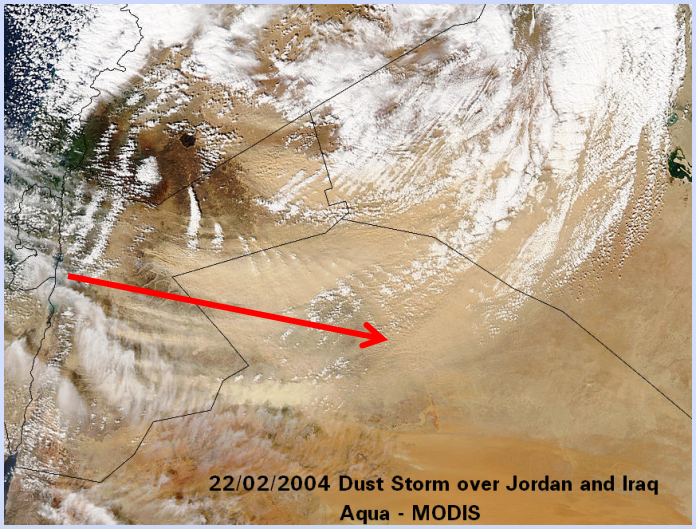
RED	B32-B31
GREEN	B31-B16
BLUE	B31

Sources of Dust Emission



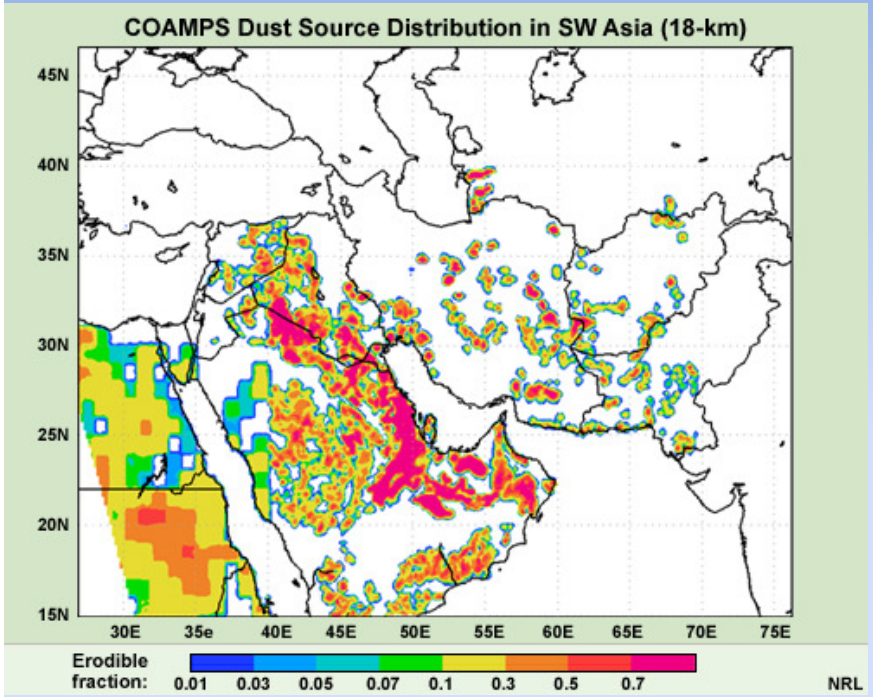




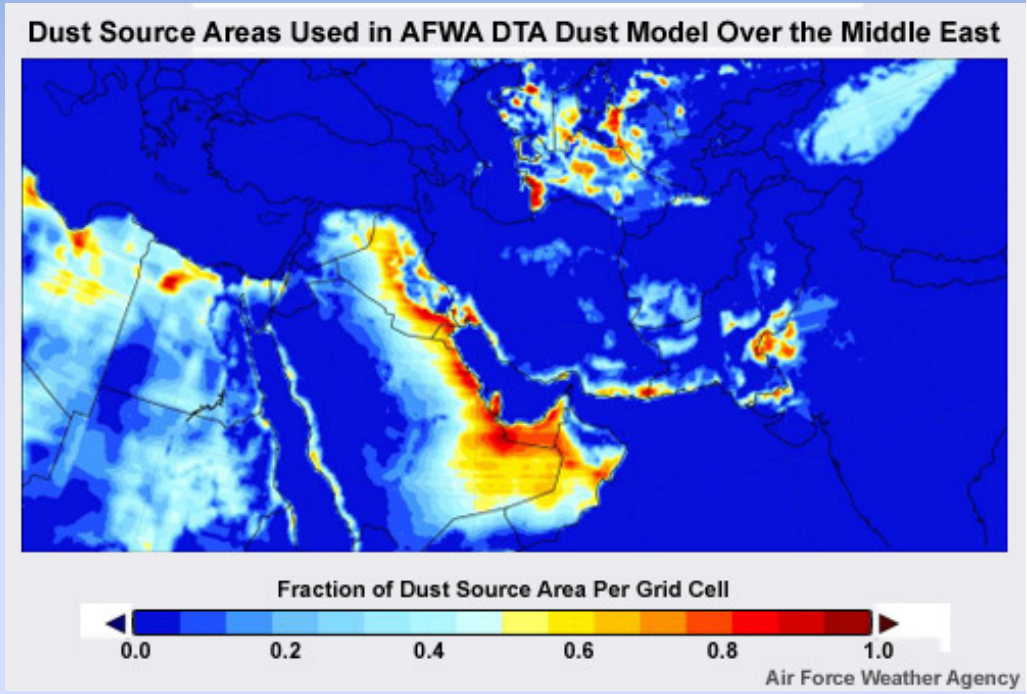


Large area in Iraq, Syria and Jordan and North Africa has become a source of the dust storms affecting Iraq and often extends to neighbouring countries

Dust Sources From Models



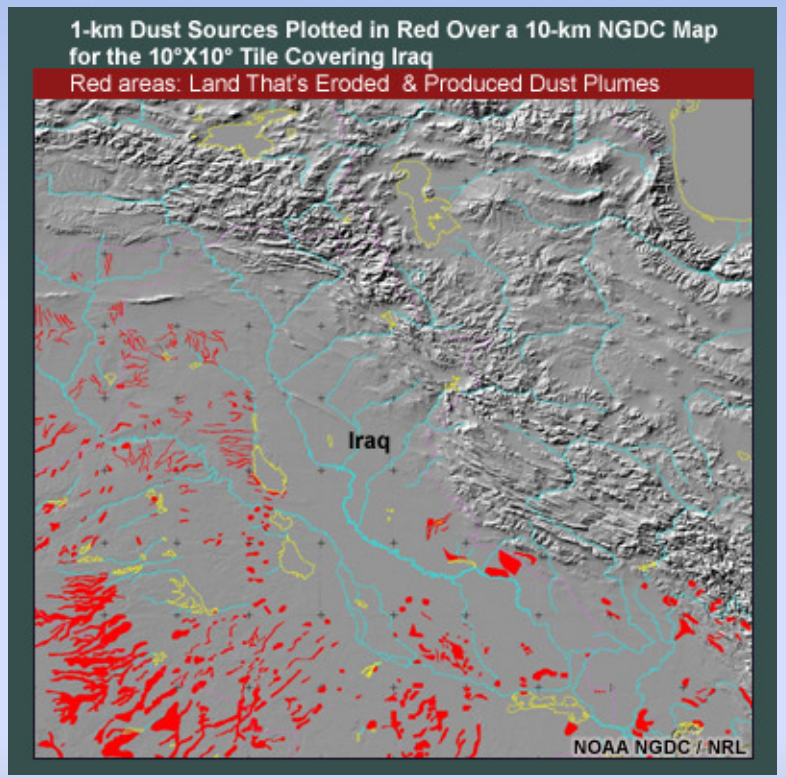
COMPAS NRL MODEL

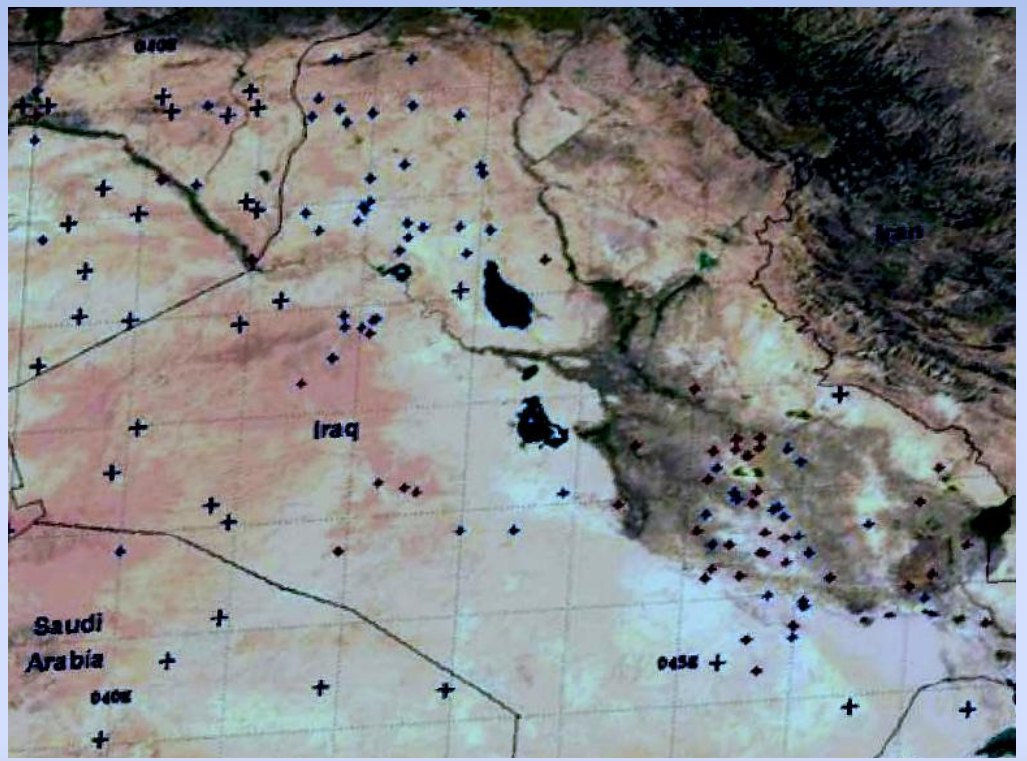


AIR FORCE WEATHER EGENCY MODEL

Models results give a clear difference in positions of dust sources

Dust Sources As Indicted in Literature

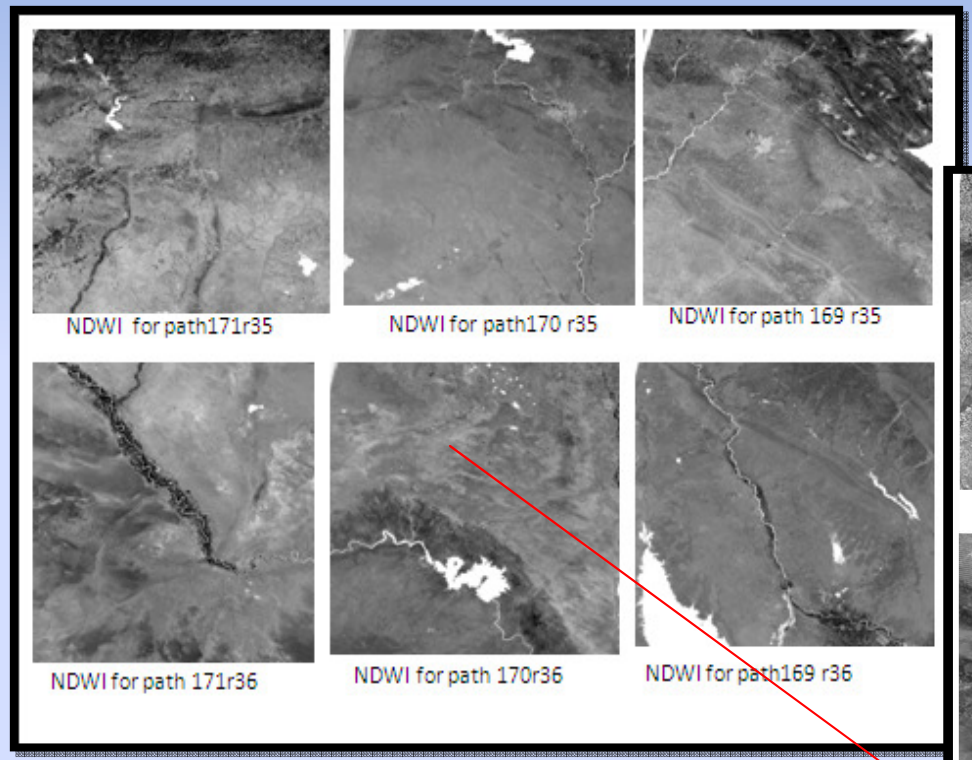




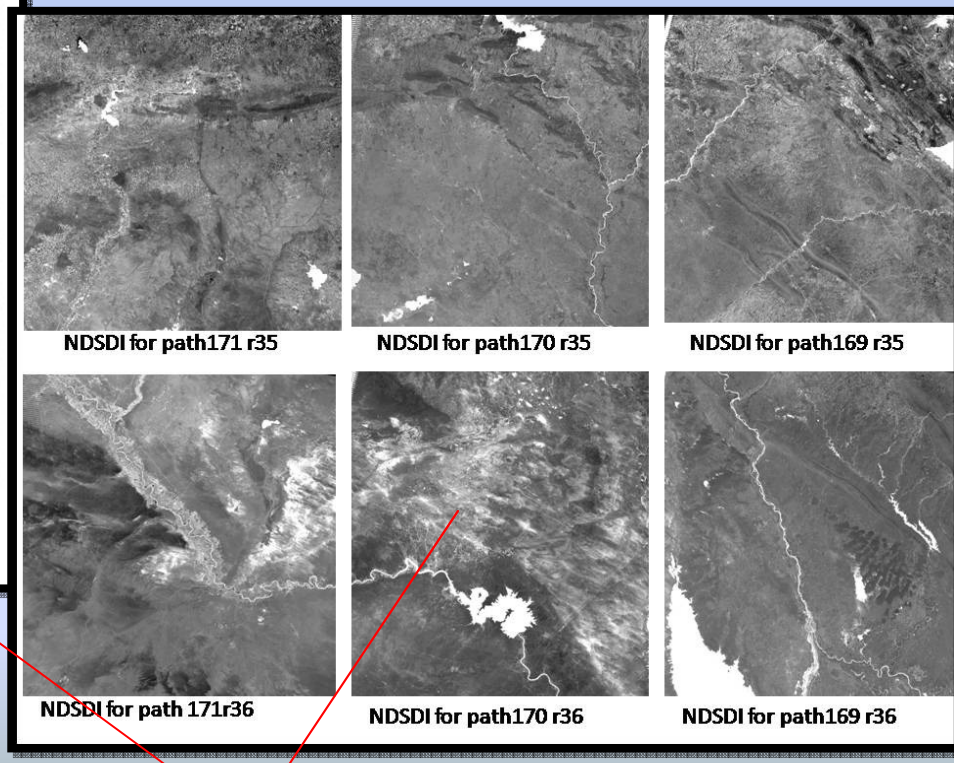
Used Tools For Dust Storms

- **LANDSAT 7 ETM+ Images**
- **MODIS Images**
- **Meteosat Data**
- **CALIPSO Data**

Applying the Indices NDWI and NDSDI LANDSAT 7 ETM+ Images



NDWI (Normalized Difference Water Index) for Landsat7 image= $\frac{band3 - band5}{band3 + band5}$

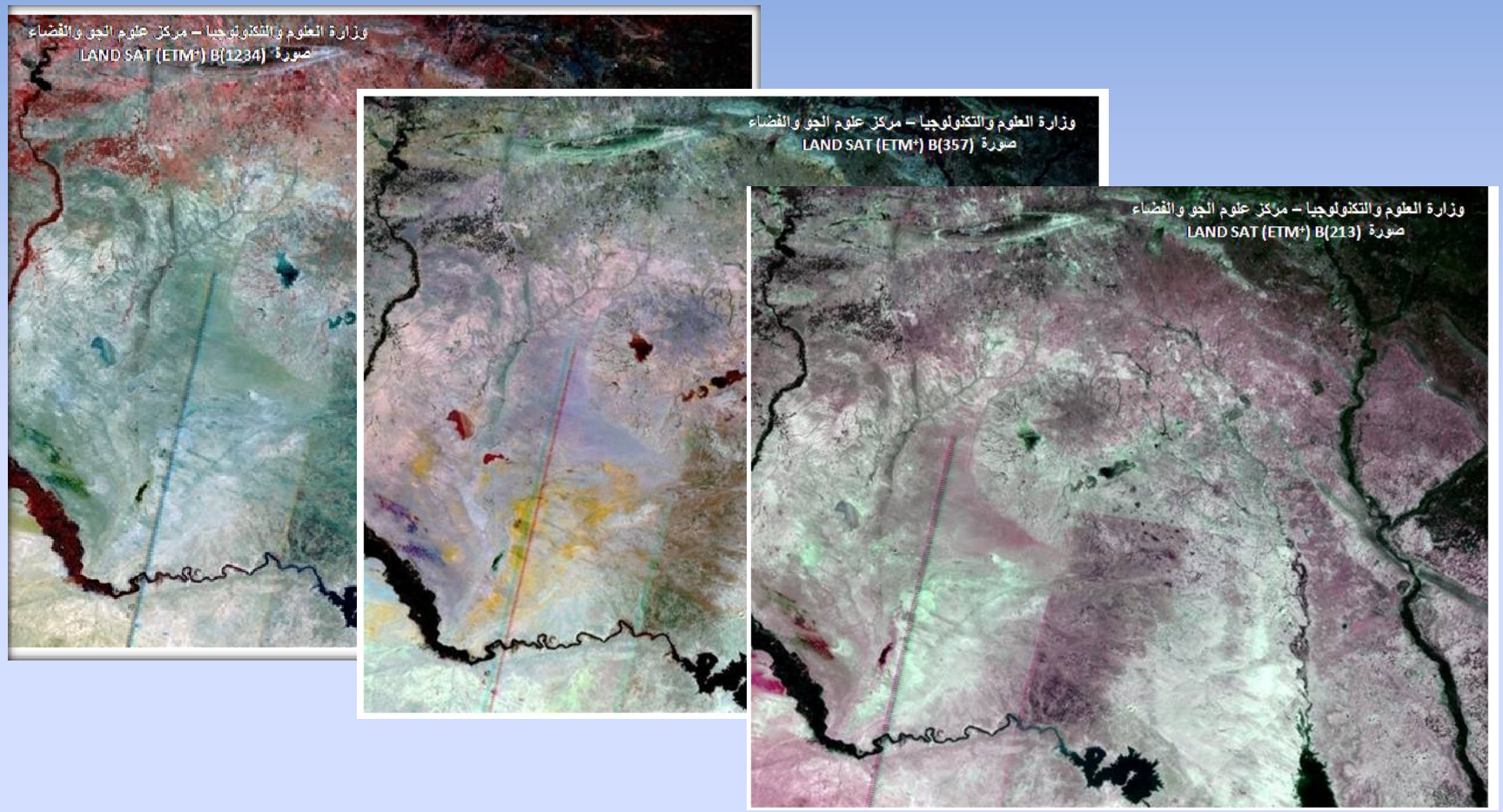


NDSDI (Normalized Differential Sand Dune Index) for Landsat-7 image=

$$\frac{band3 - band7}{band3 + band7}$$

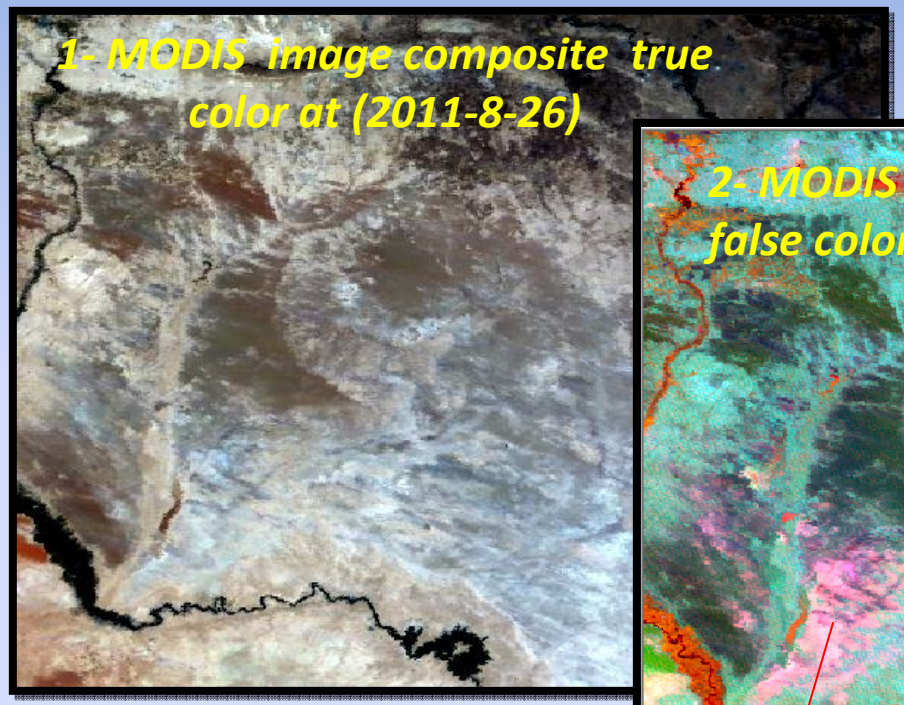
Possible Dust sources

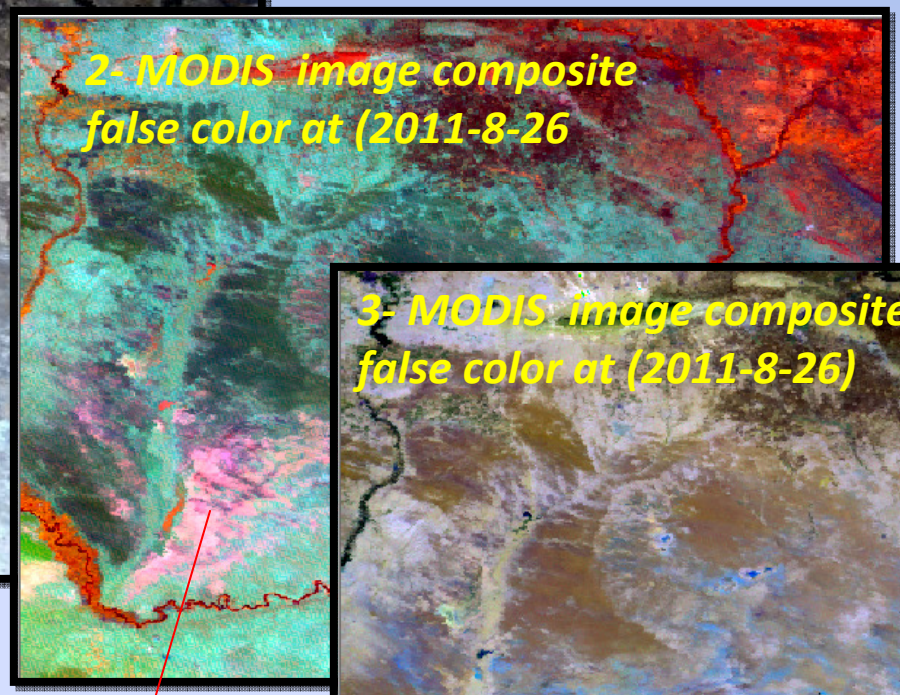
Landsat Composite Images

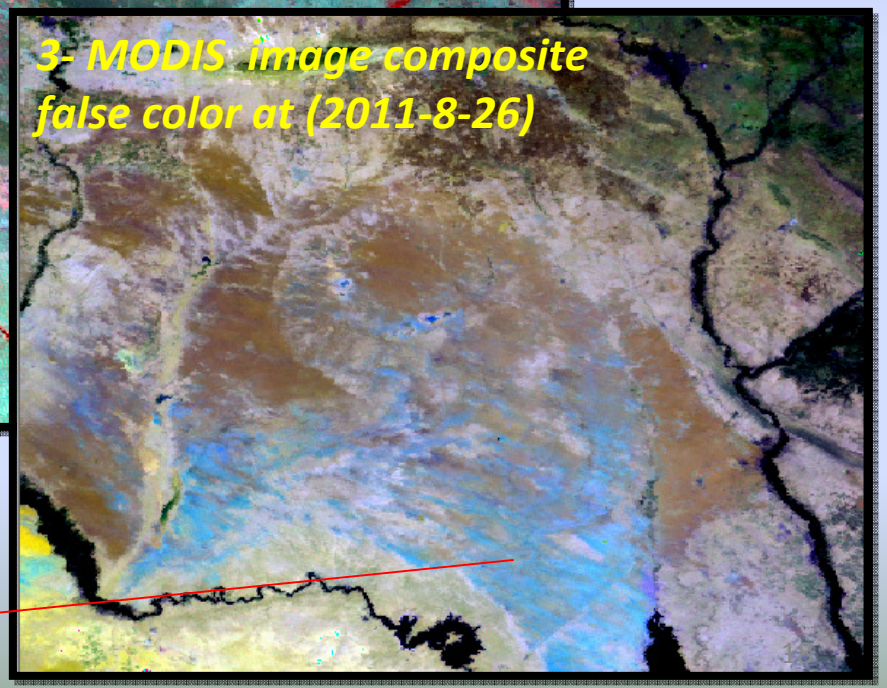


Deferent composite images are produced to identify the dust sources

MODIS Composite for hot day on (2011-Augst -26)







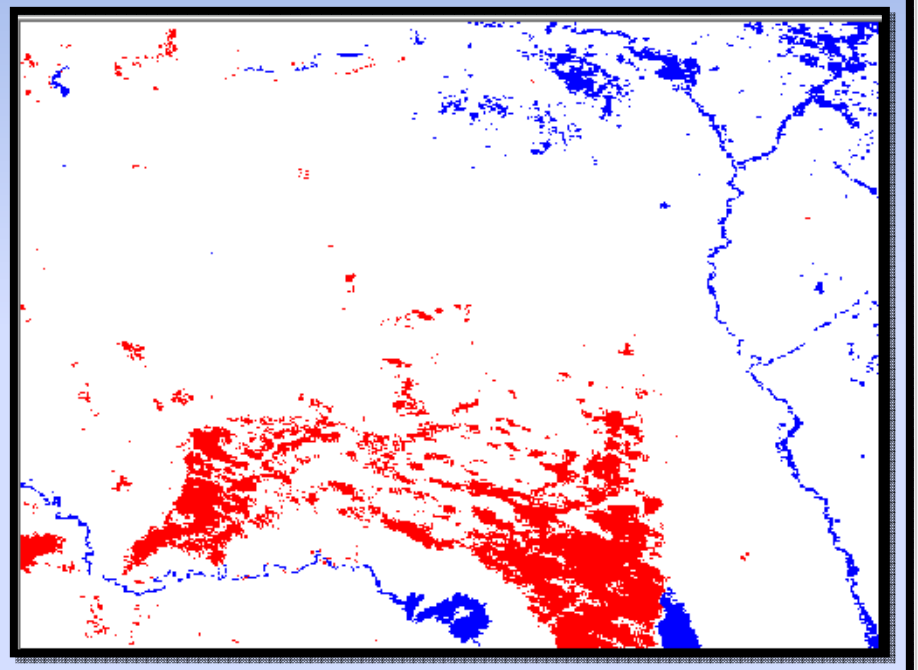
True color RGB= bands (1/4/3)

False color RGB=bands (6-7/2/3)

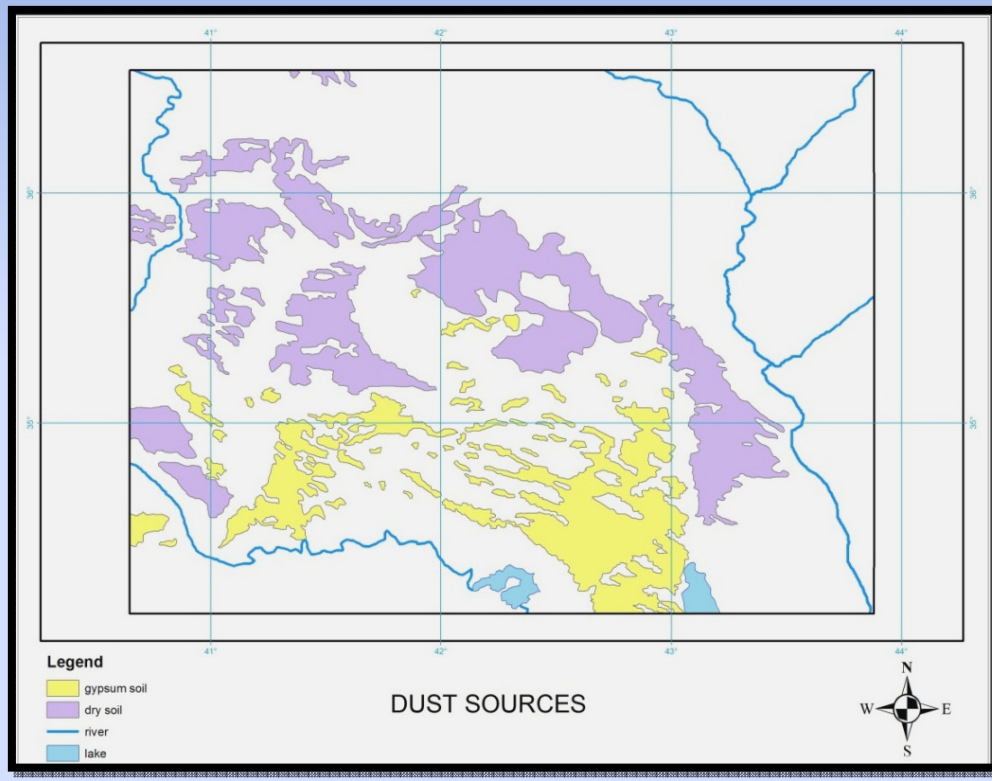
False color RGB= bands (7/6/3)

Good isolation for Dust region

Possible Dust Sources

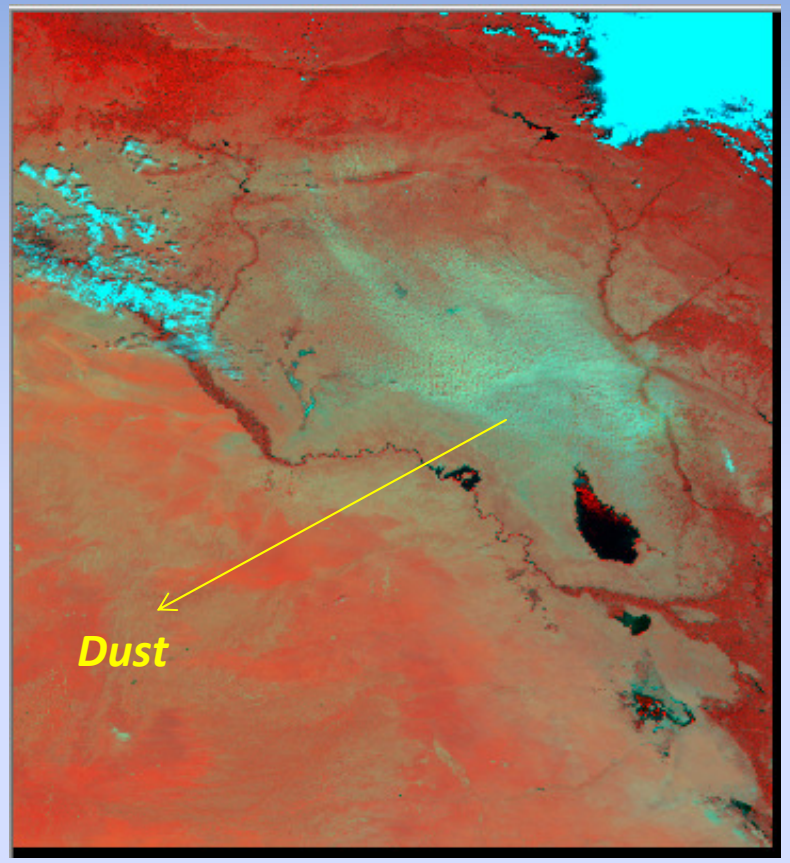


Dust region identified by using unsupervised classification Method From land surface temperature (LST) image

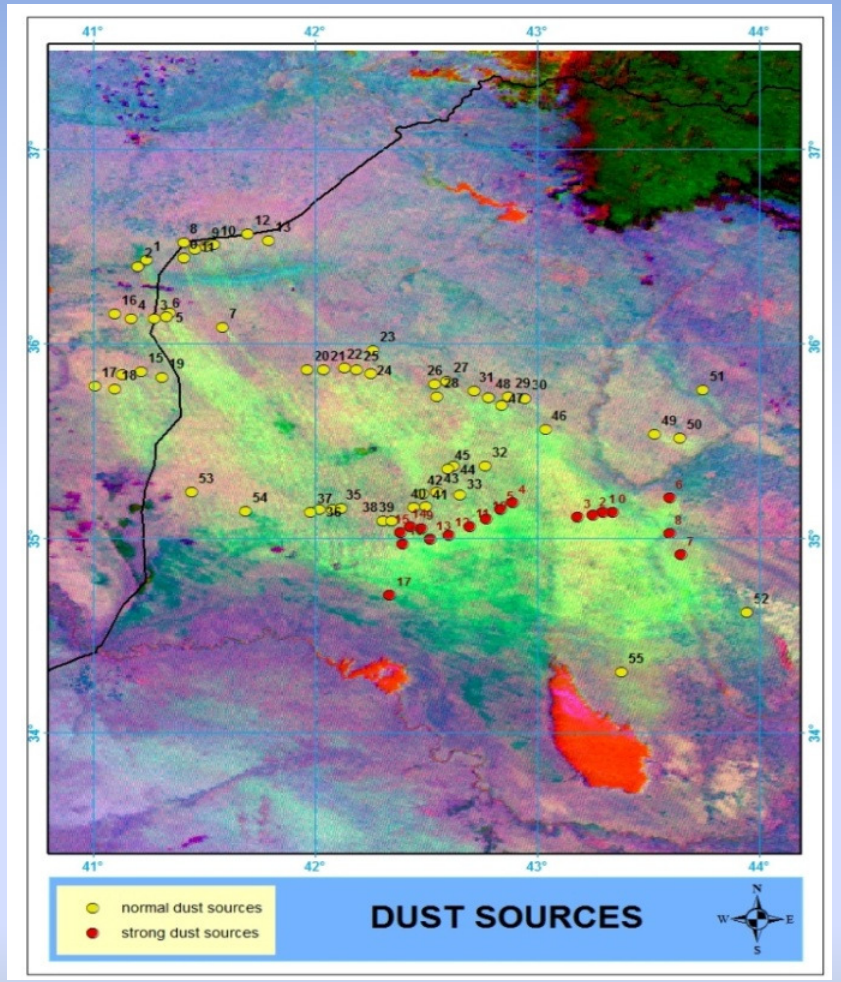


Dust Sources Map from remote sensing produced from composite RGB 763 image

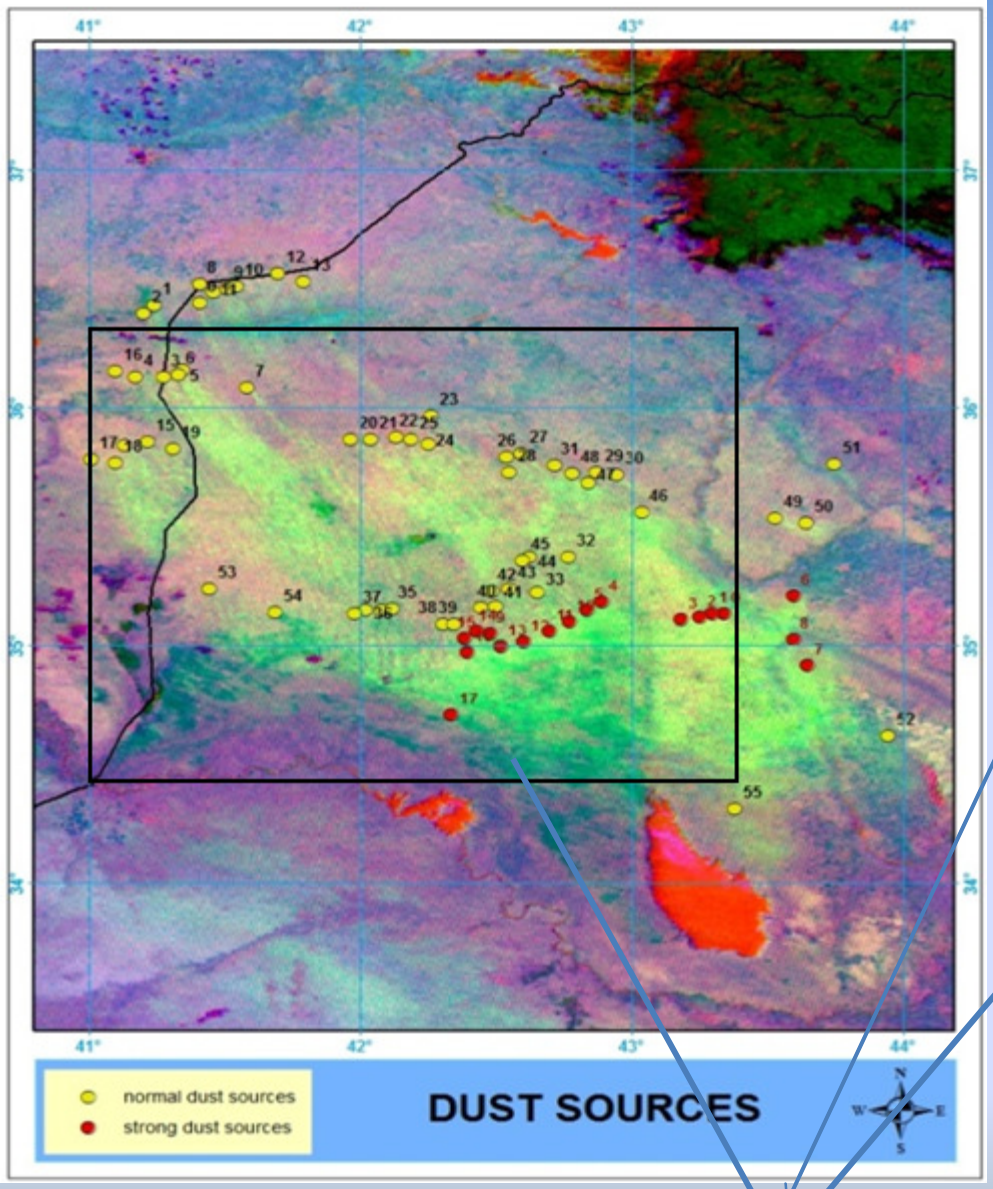
Dust Sources Allocation

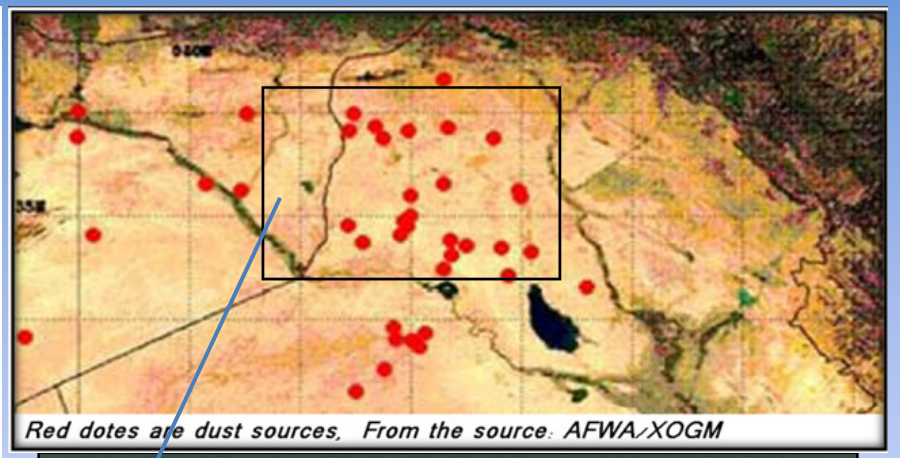


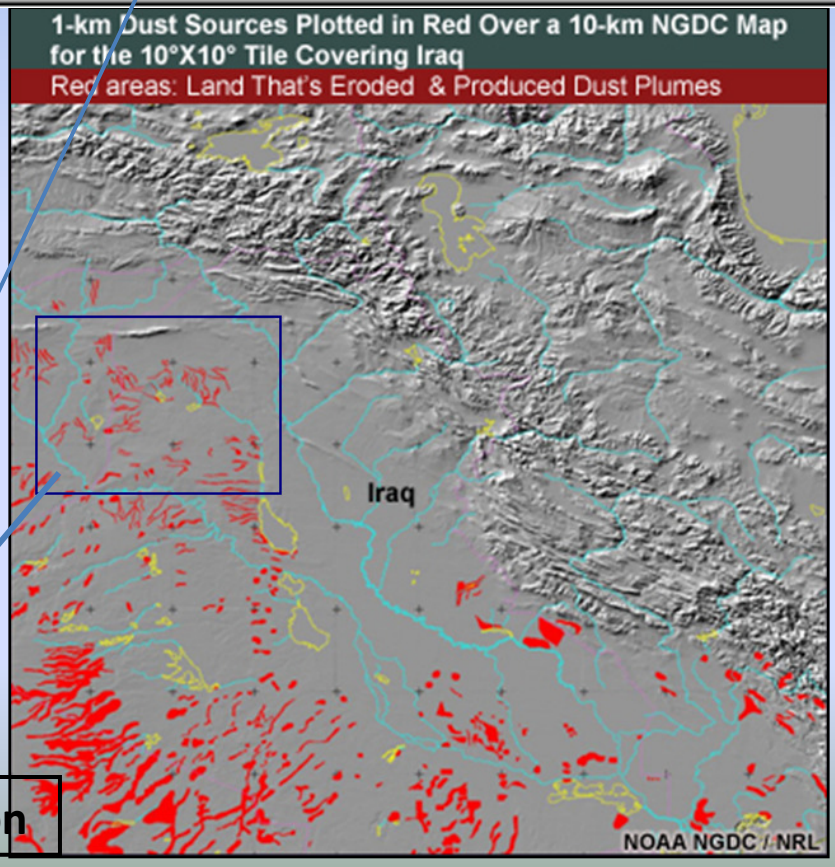
Dust product image gives good Detection and isolation from land surface Background



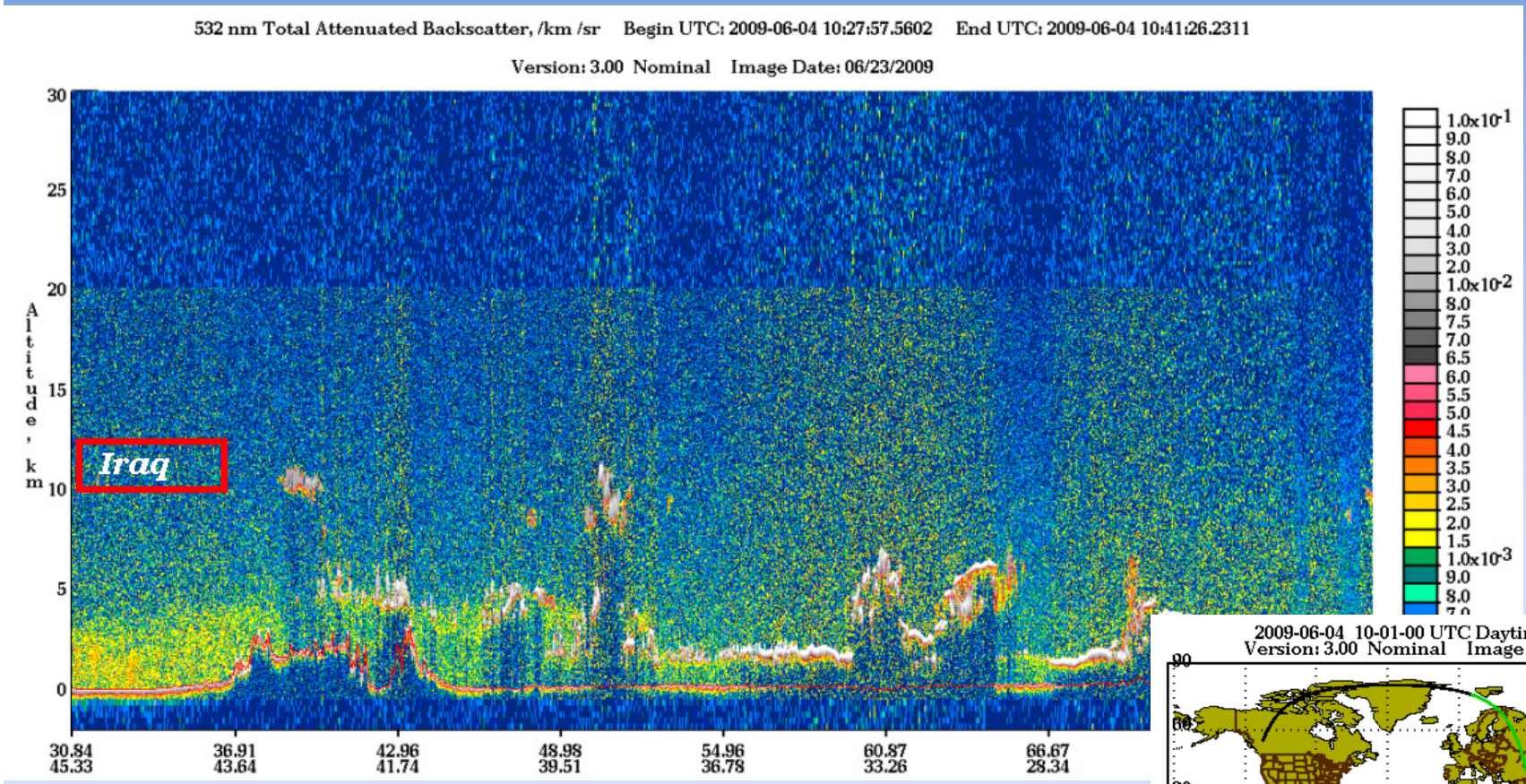
Identifying dust sources from MODIS Terra image

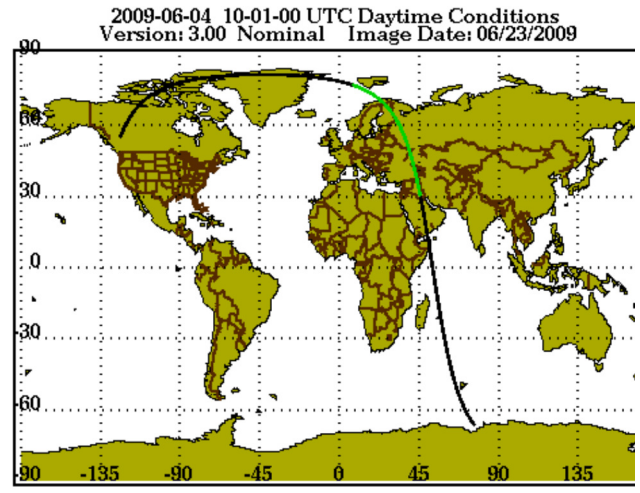




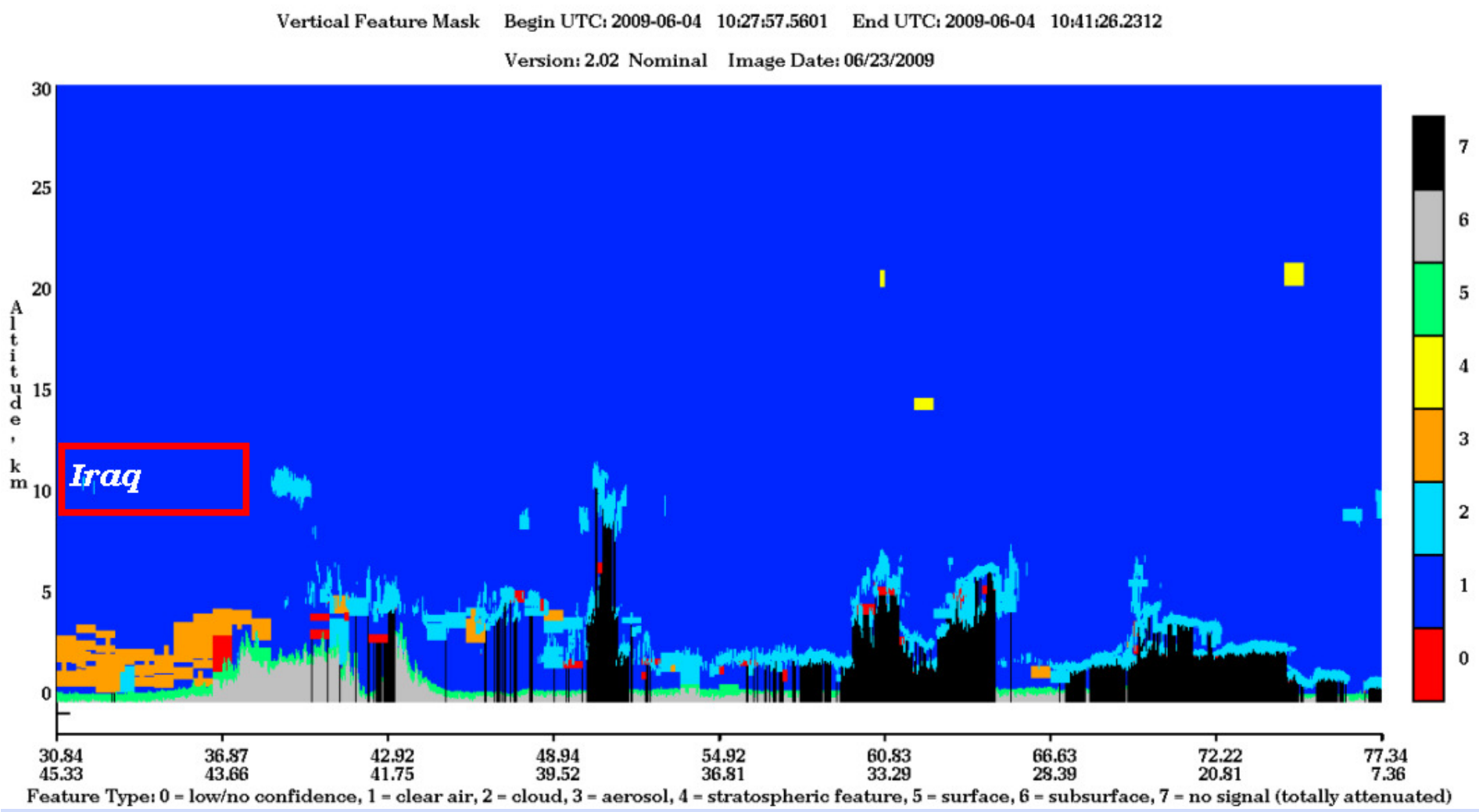


Dust sources of case study region



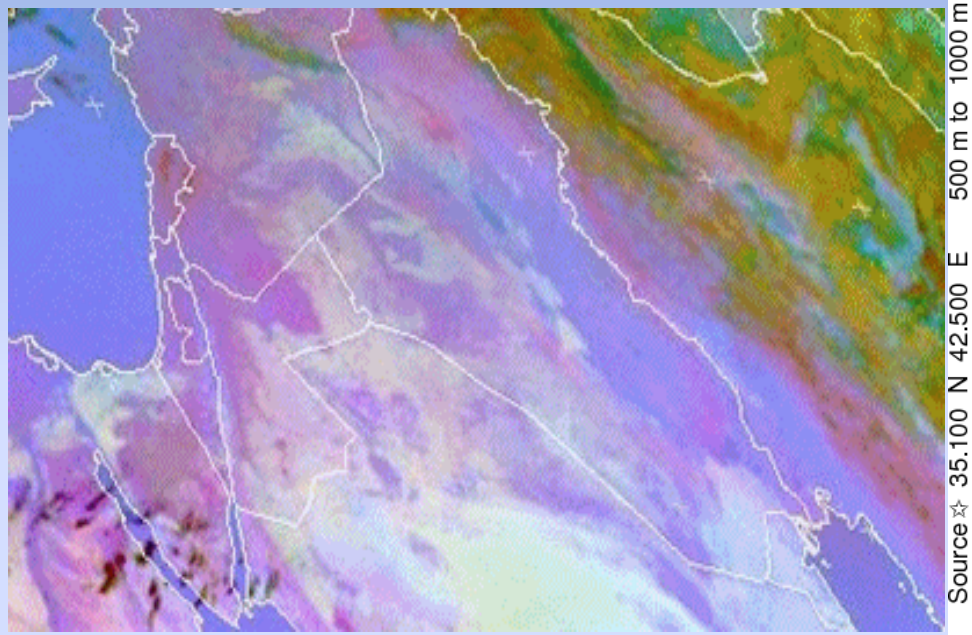


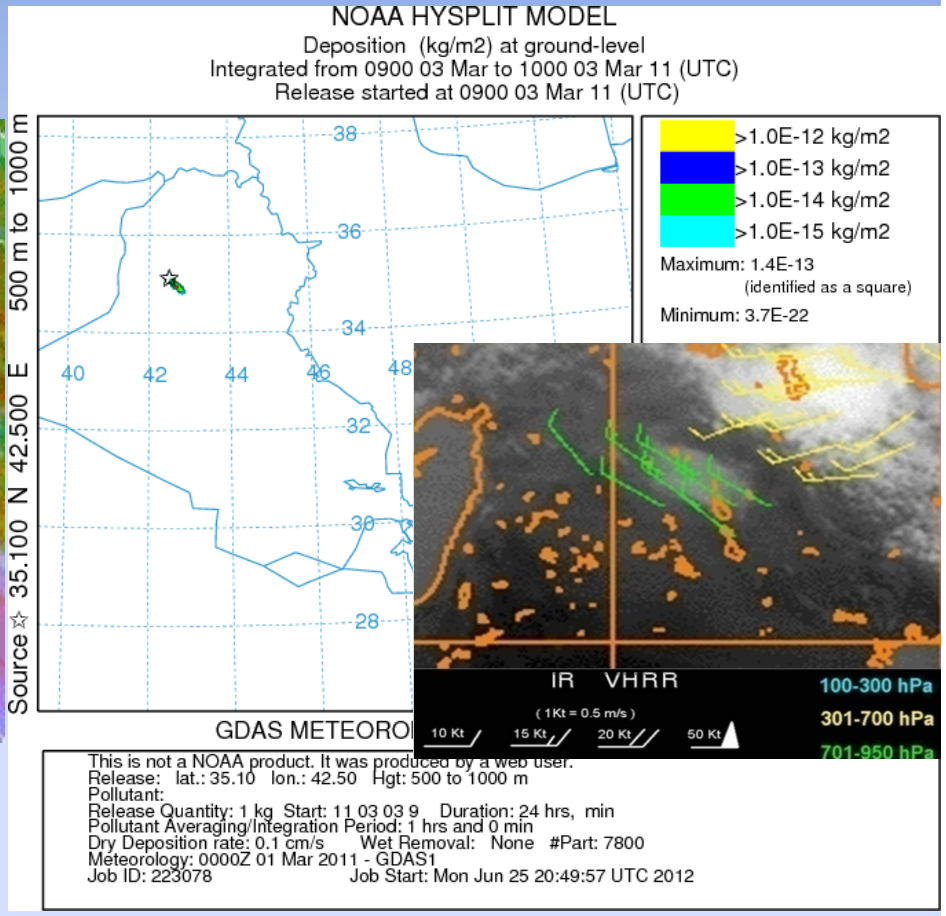
Suspended Dust as Observed from CALIPSO



Processed output from CALIPSO
illustrate the fine dusty aerosol over Iraq

Dust Storm Forecasting





Thank you for your Attentions

شِكرا جزيلا لاهتمامكم

References

1-Jacquelyn Crook "Climate Analysis And Long Range Forecasting of Dust Storms in Iraq", M.Sc thesis applied to Naval Postgraduate School in June 2009