Dust Classification and AOT Estimation Using Combined VIR and TIR Satellite Data in Urban Areas of Iran

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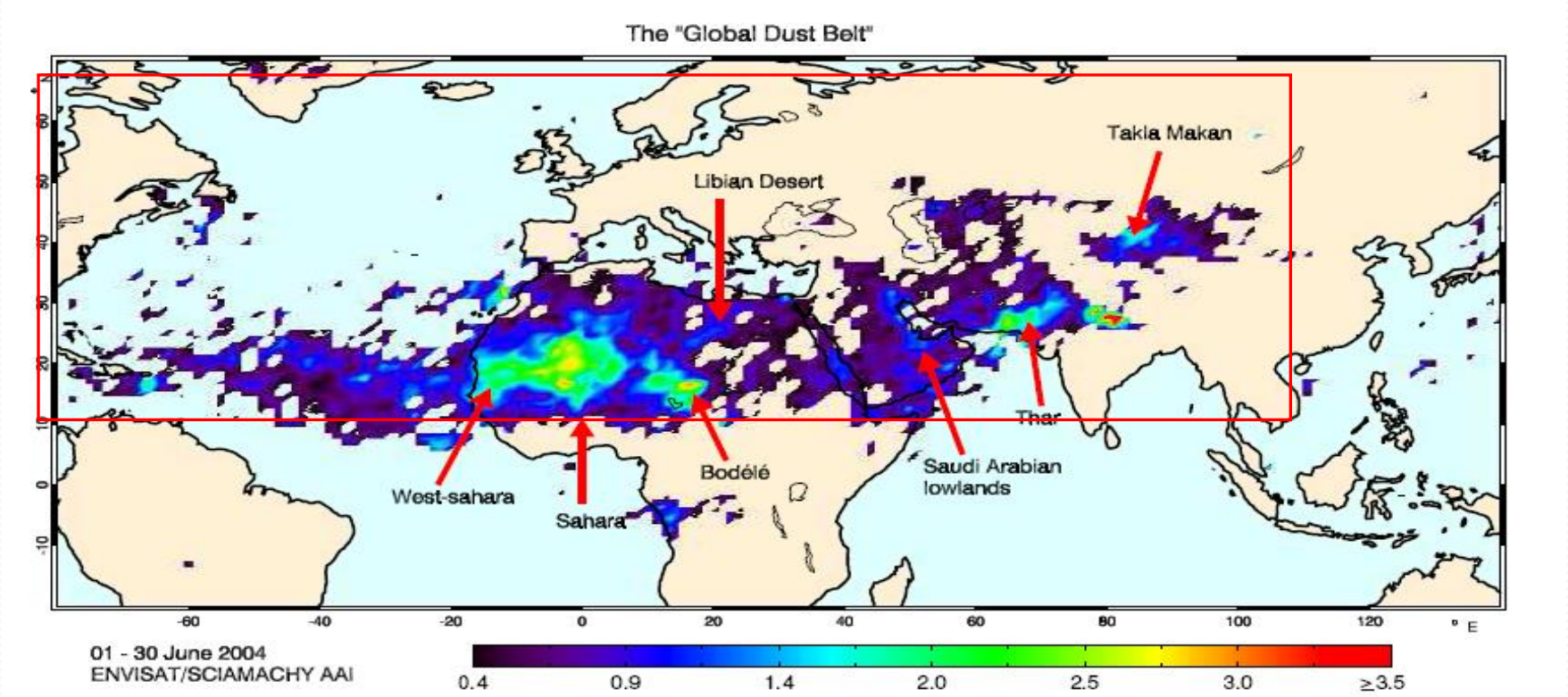
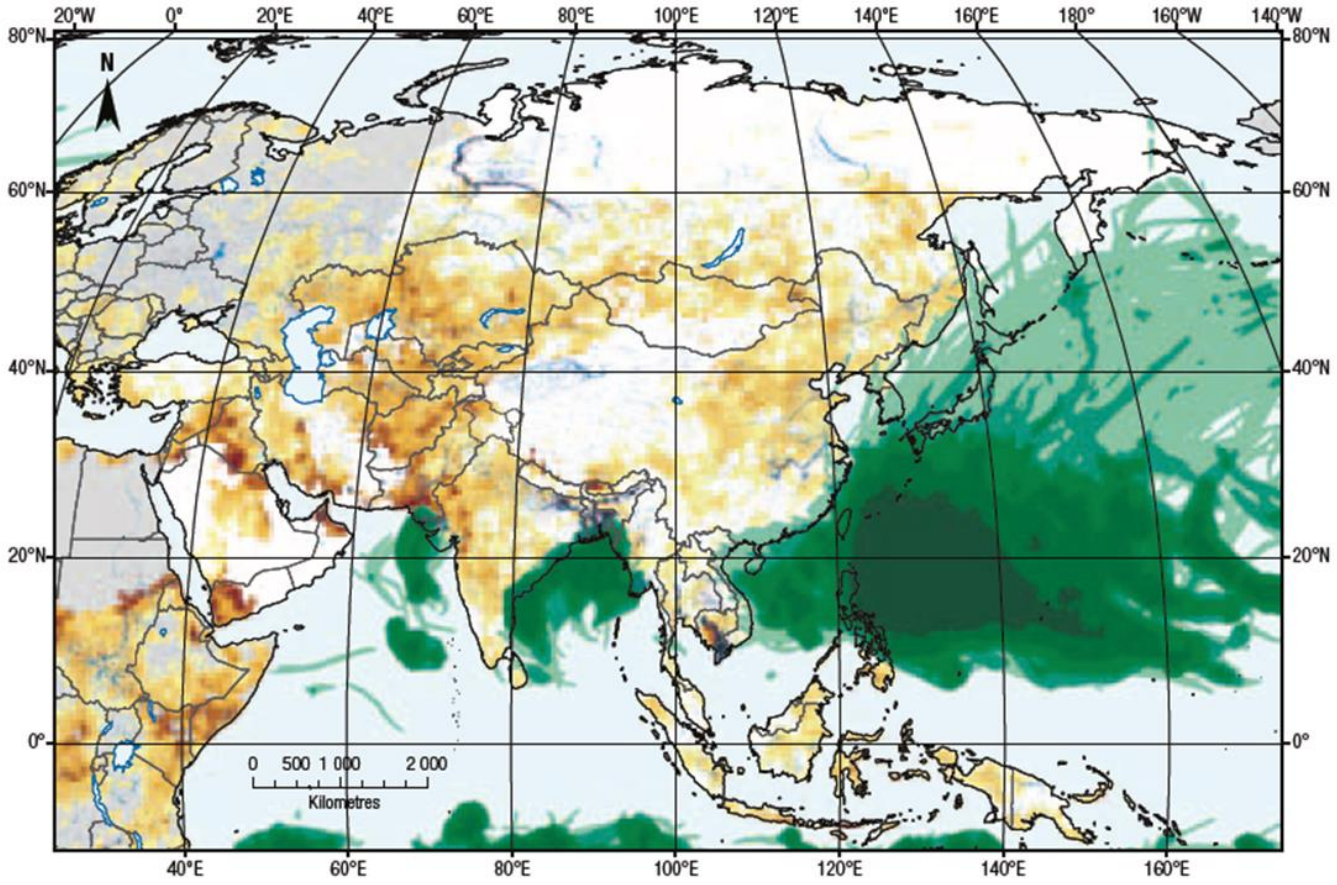
Background


The "Global Dust Belt"
Takla Makan
Libian Desert
Thar
Saudi Arabian lowlands
Bodélé
West-sahara
Sahara
-60
-40
-20
0
20
40
60
80
100
120
° E
01 - 30 June 2004
ENVISAT/SCIAMACHY AAI
0.4
0.9
1.4
2.0
2.5
3.0
≥3.5


ISNA
PHOTO: RECEIVED

Background

Dust Climatology over West Asia



Data sources:
Tropical cyclones: UNEP/GRID-Europe
Floods: UNEP/GRID-Europe + observed from Dartmouth Flood Observatory and frequency from Flood PREVIEW UNEP/GRID-Europe
Droughts: International Research Institute for Climate and Society of Columbia University.
Cartography: P.Peduzzi, UNEP, UNISDR, 2009

Weather-related hazards

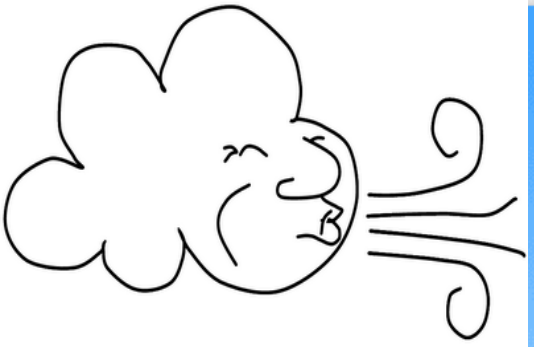
Droughts index
(frequency and intensity)
- Very high
- High
- Moderate high
- Moderate low
- Low

Tropical Cyclones
(sum of winds in km / year)
- 100 000 to 426 510
- 30 000 to 100 000
- 10 000 to 30 000
- 3 000 to 10 000
- Less than 3 000

Floods
(average annual frequency)
- 50 and more
- 20 to 50 years
- Less than 20 years

- Lakes and oceans
- Regional extent
- Other regions

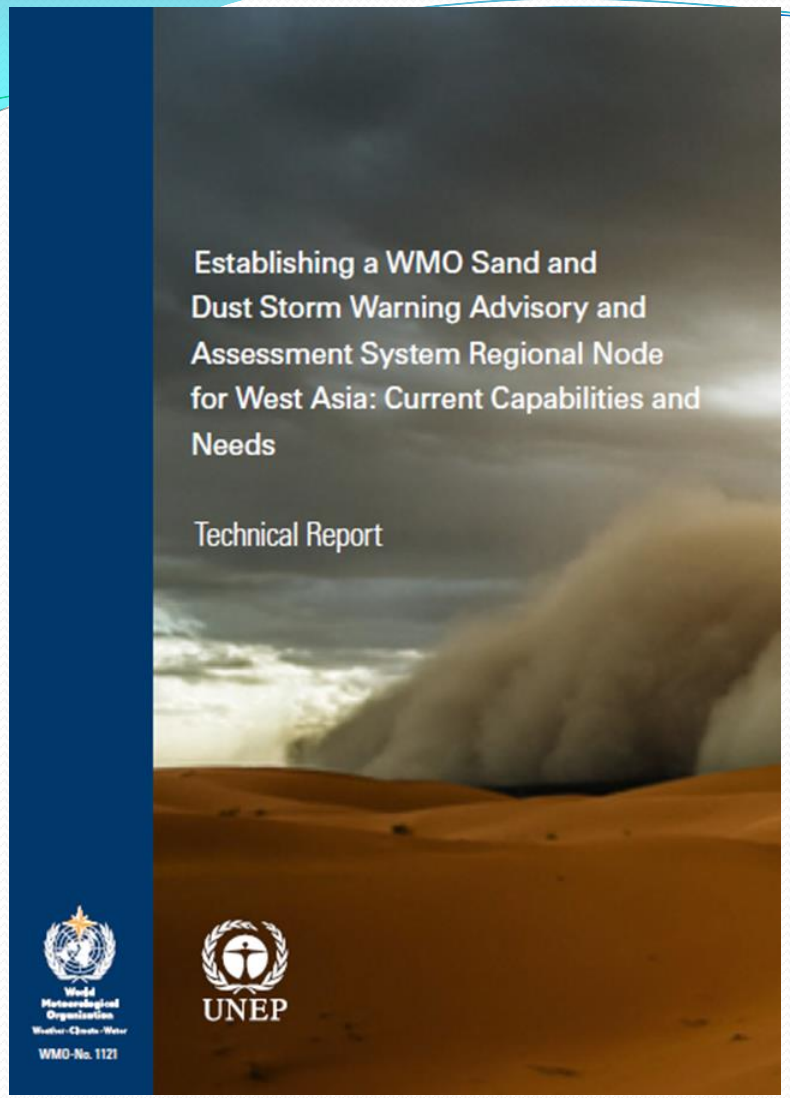
Mineral dust in the Earth climate system:



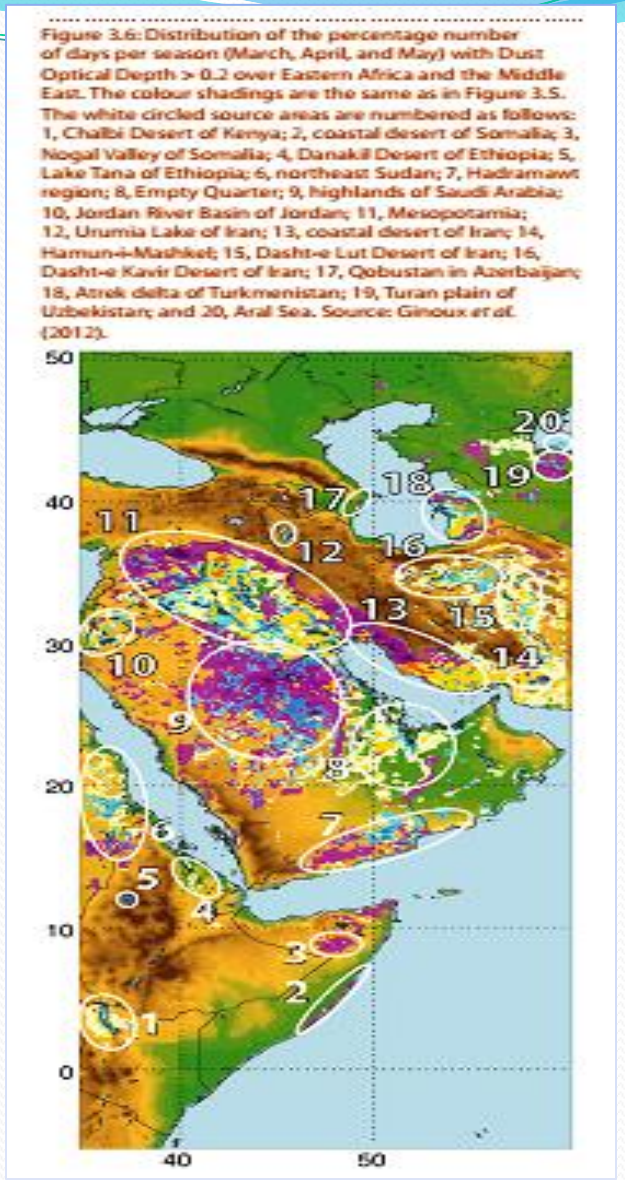
Direct and indirect radiative forcing, ocean and terrestrial biogeochemistry and atmospheric chemistry (Mahowald et al., 2002)

4

Background



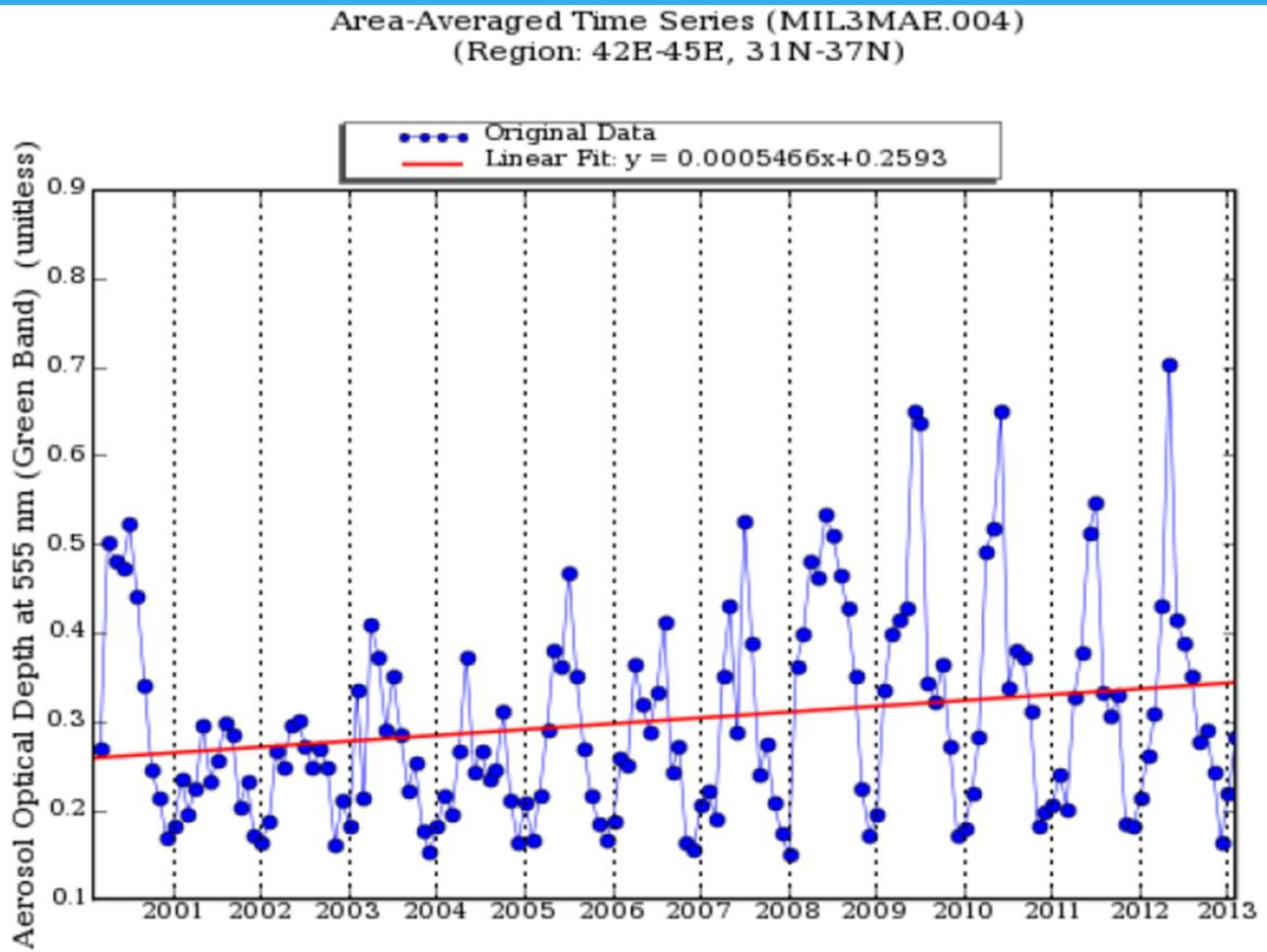
Available at:
http://www.wmo.int/pages/prog/arep/wwrp/new/documents/1121_SDS_Technical_Report_en.pdf



Ginoux et al.2012

Background

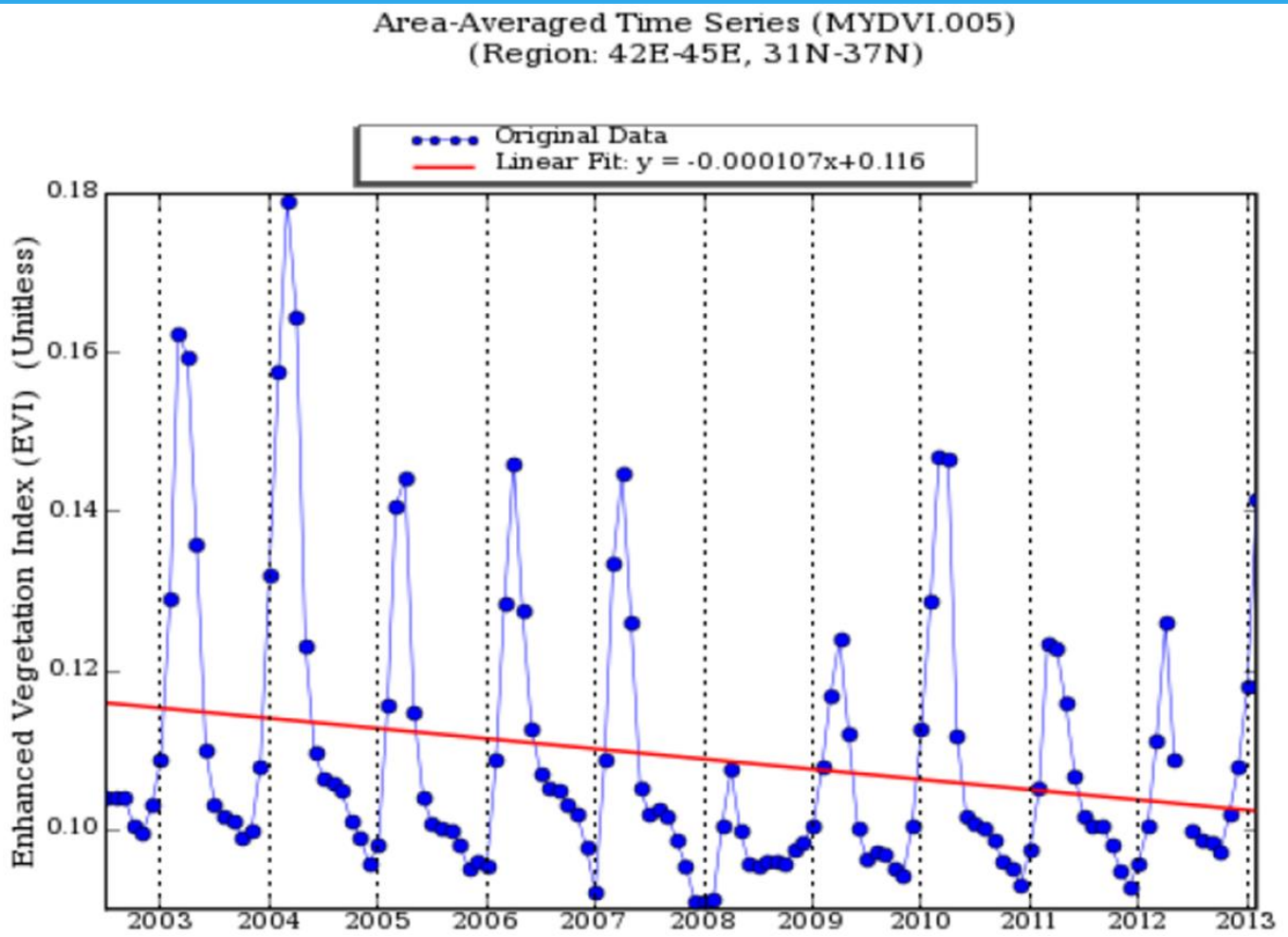
Dust Climatology over West Asia



Monthly mean AOD at 555 nm from MISR for **Mesopotamia (Iraq)** from February 2000 to February 2013

Background

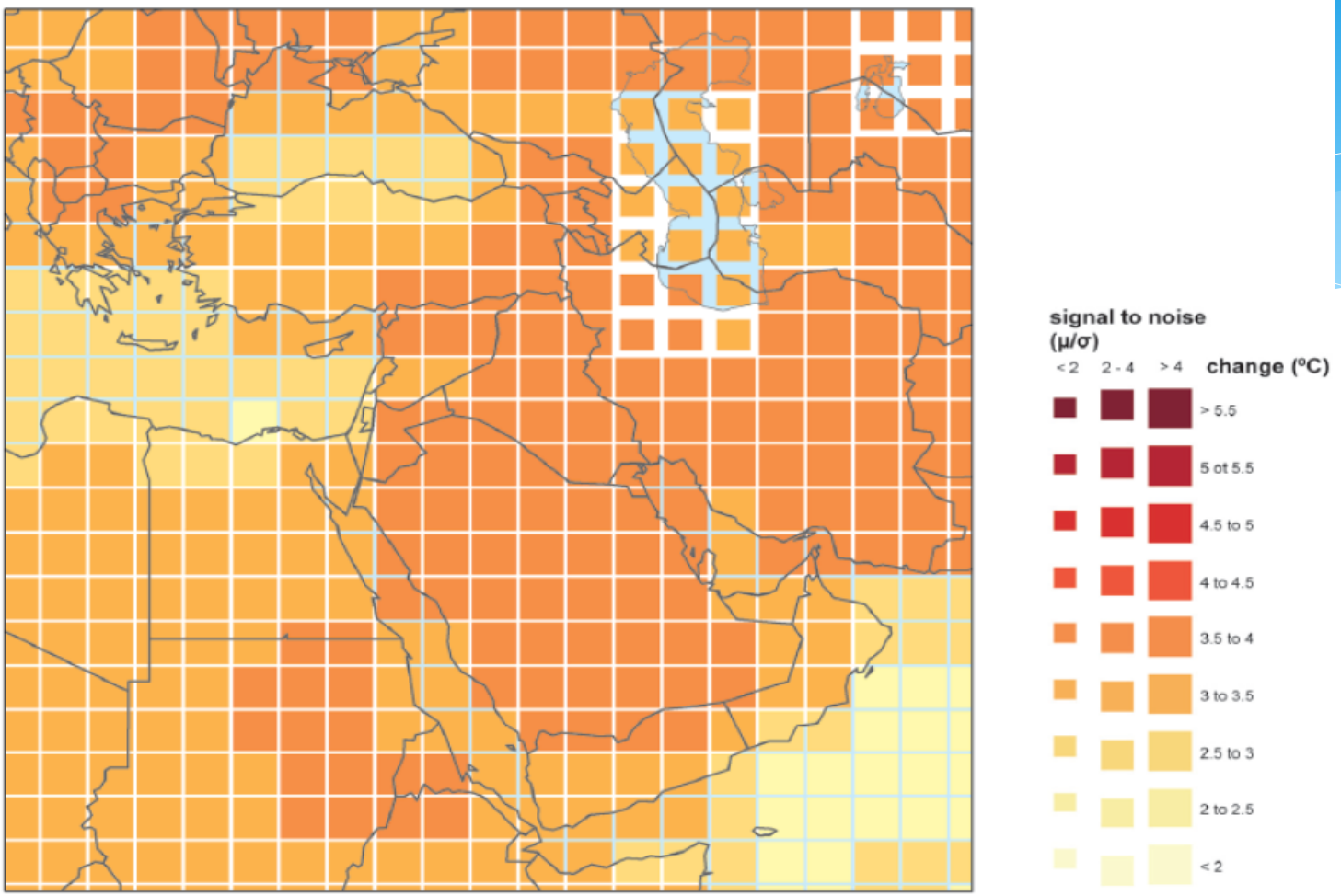
Dust Climatology over West Asia



Monthly mean Enhanced Vegetation Index (EVI) from MODIS for Mesopotamian region (Iraq) from February 2002 to February 2013

Background

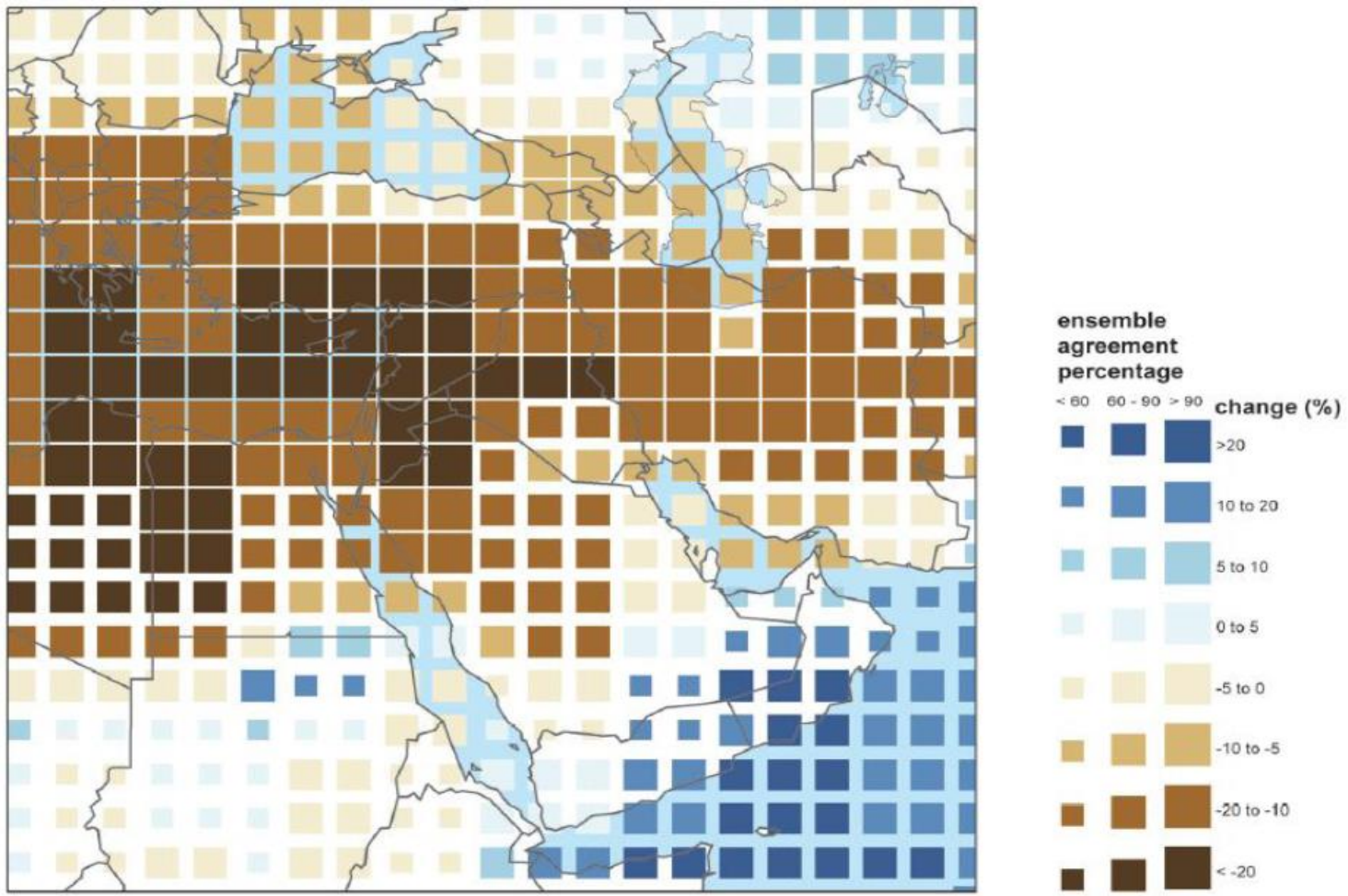
Dust Climatology over West Asia



Percentage change in average annual temperature by 2100 from 1960-1990 baseline climate, averaged over 21 CMIP3 models for West Asia. The size of each pixel represents the level of agreement between models **(Met Office, 2011).**

Background

Dust Climatology over West Asia



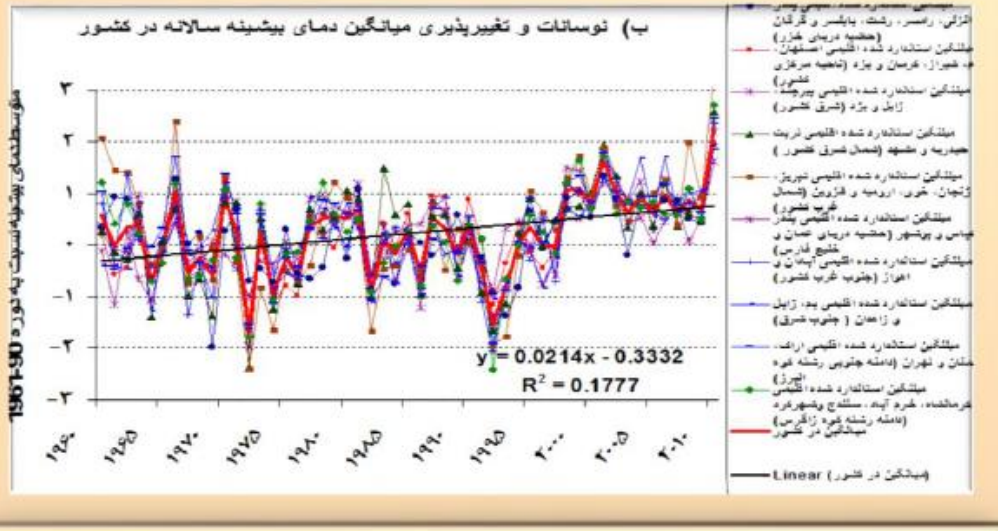
Percentage change in average annual precipitation by 2100 from 1960-1990 baseline climate, averaged over 21 CMIP3 models for West Asia. The size of each pixel represents the level of agreement between models **(Met Office, 2011).**

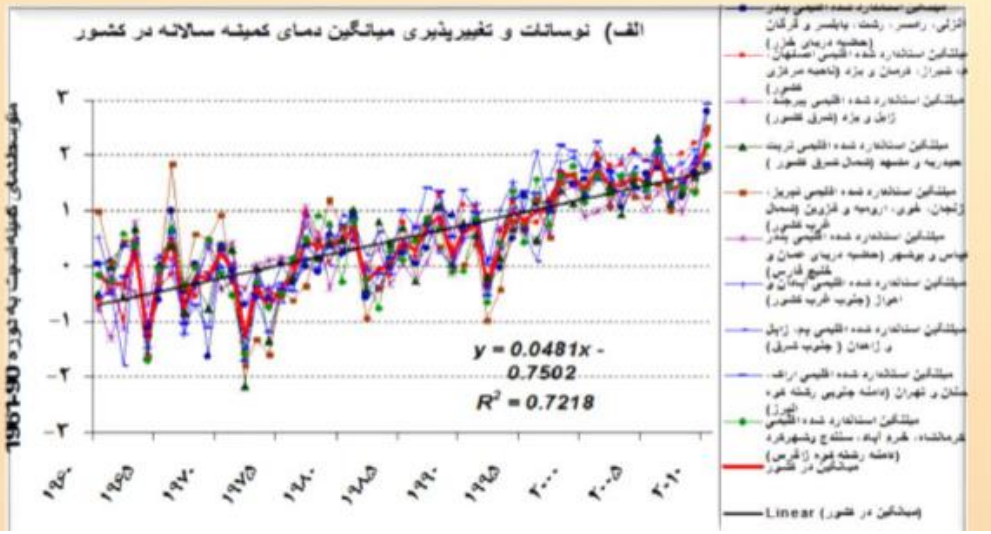
Background

Dust Climatology over Iran

Precipitation variation(1960-2010)

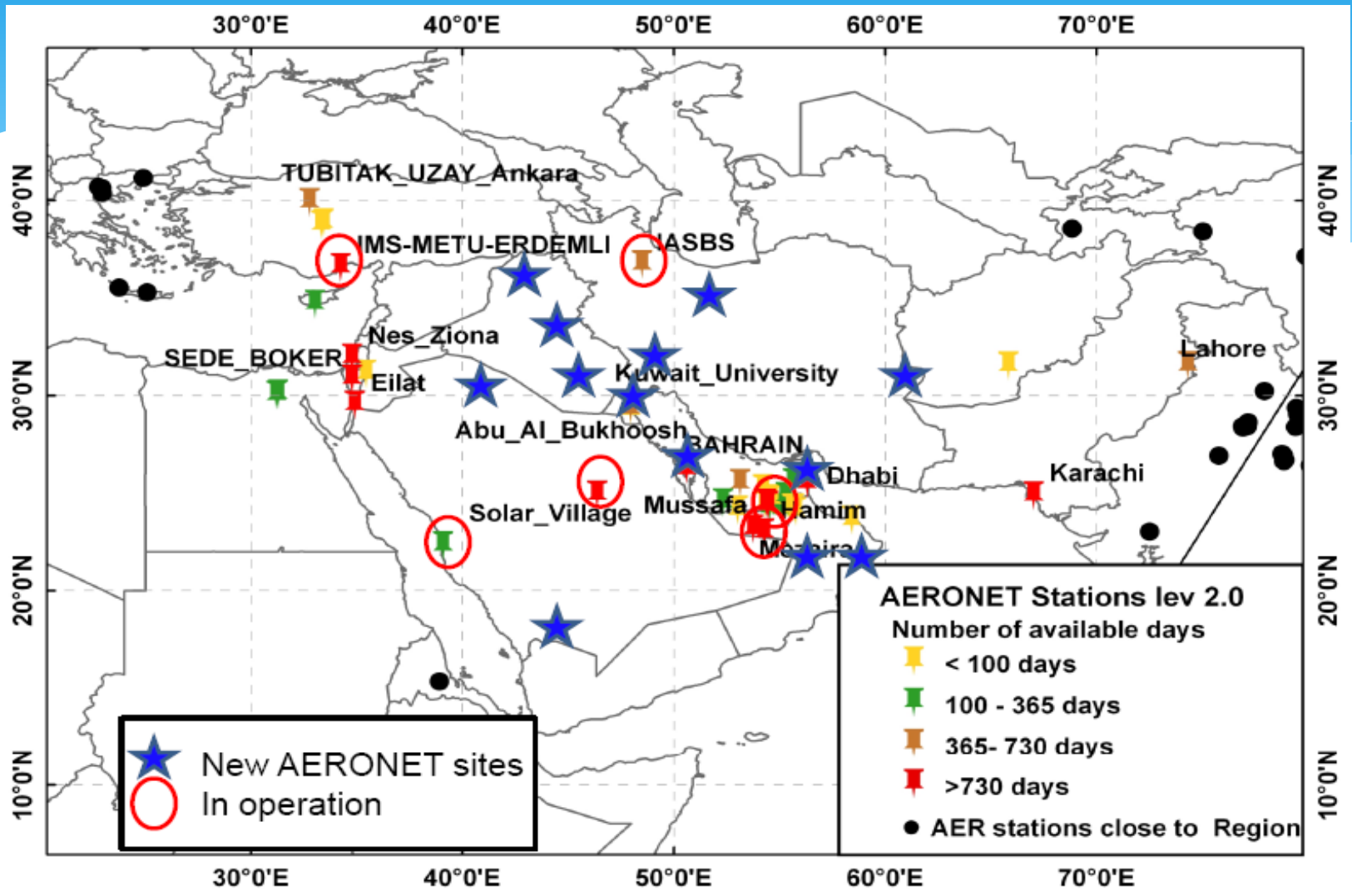
Tmax and Tmin Variation(1960-2010)



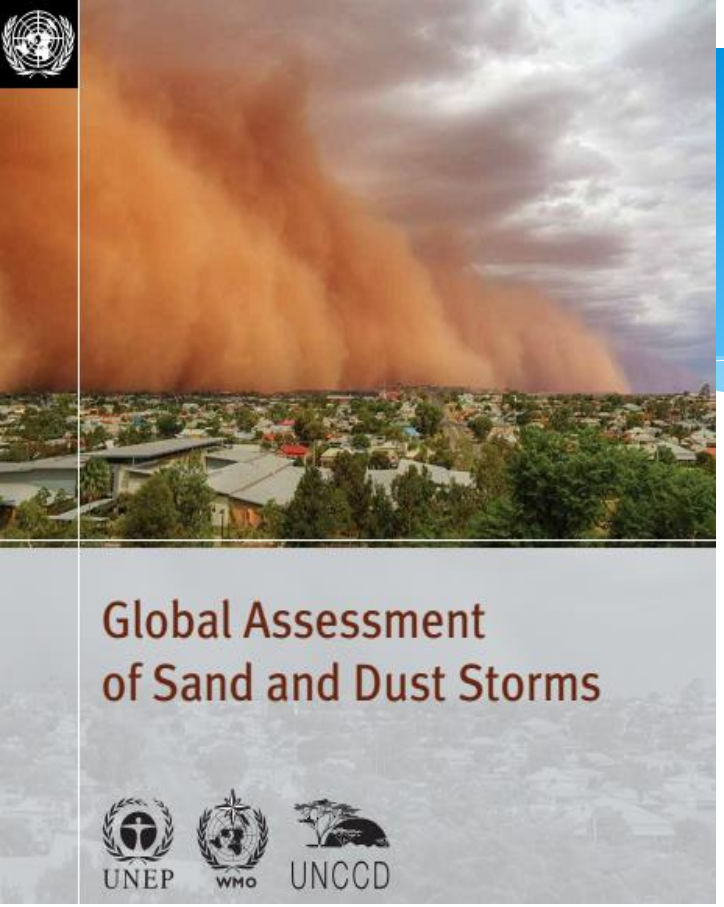


Background

An Example of Current Needs for West Asia

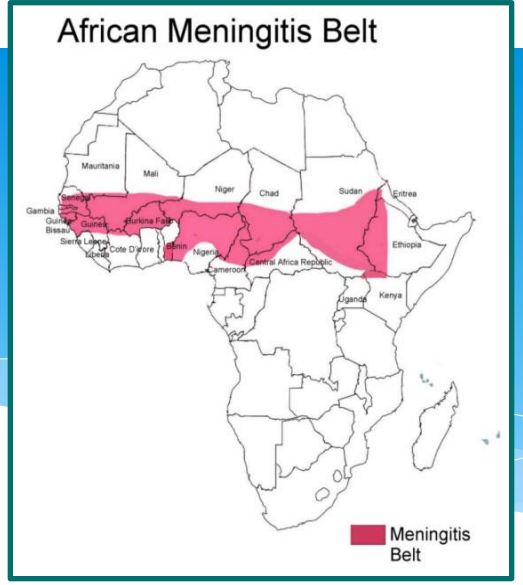


Ahvaz (Khuzestan), Zabol or Zahedan (Sistan basin) and Tehran + IASBS-Zanjan



Global Assessment of Sand and Dust Storms

UNEP WMO UNCCD



Human Health
(Asthma, infections, Meningitis in Africa, Valley Fever in the America's)

World Health Organization

World Meteorological Organization
Weather · Climate · Water

Box 8.6: Controlled experiments on the impact of dust on plant and animal health

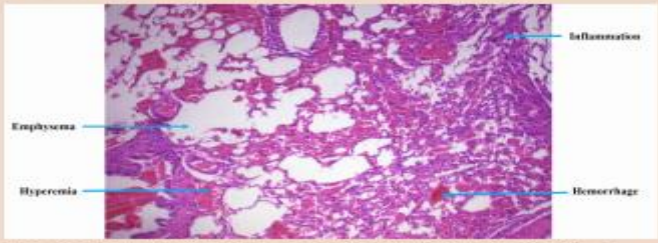
Laboratory experiments are being conducted under controlled conditions in the Islamic Republic of Iran to investigate the effects of dust particles on ornamental plants, crops, trees, and animals. Dust events are simulated using a wind tunnel and dust samples from current active sources in the country.

It was found that wheat (*Triticum aestivum*) has a high sensitivity to dust at the tillering stage (early phenological growth stage) compared with at heading stage. West Asia dust storms and especially in Iran tend to occur at the early stages of wheat phenology, having an adverse effect on wheat yield. Leaf chlorophyll, biomass, nitrogen, and moisture content were affected.

Similar results were found in rosemary flower (*Rosmarinus officinalis*), tomato (*Solanum lycopersicum*), marigold (*Calendula persica*), violets (*Viola odorata*), strawberry (*Fragaria ananassa*), and oak seedlings (*Quercus persica*).

Effects of exposure of Fragaria ananassa plants to exposure to simulated dust storms of different periods (1, 2, 4 and 6 days; right) compared with the control (left).

In another experiment two animal species including house mouse (*Mus musculus*) and rat (*Rattus norvegicus*) were exposed to simulated dust storms of different periods and concentration. In terms of lung disease, respiratory epithelium and hyperemia increased in both species. Bleeding (haemorrhage), inflammation and emphysema occurred in rats and pneumonia in house mouse. Edema (accumulation of water in tissue) and fibrosis were not affected by dust levels. Furthermore, dust led to a decrease in the number of white and red blood cells, and levels of alanine aminotransferase, aspartate aminotransferase, and other blood health indicators.



Lung emphysema, hyperemia, hemorrhage and inflammation in rat (*Rattus norvegicus*) exposed to simulated dust storms.

Source: Darvishi Boloorani et al. (2015)

Background

Iranian agreements on sand and dust stoms

Box 8.10: Iranian agreements on sand and dust storms

Title	Date	Place	Major Provisions	Signatory Authorities
Memorandum of Understanding (MOU)	26 Jan 2008	Tehran	8 Paragraphs, Environment and Sustainable Development, a joint committee, workshops.	Iran and Iraq (Ministers)
MOU	5 Jul 2009	Baghdad	6 Articles, sources of dust, new technologies on dust, dust monitoring, training, holding meetings in Baghdad, international cooperation.	Iran and Iraq (Ministers)
Summary Minutes of Negotiations	18 Nov 2009	Tehran	Harmful effects of dust, field visit in Iraq, create a dust monitoring network in Iraq, providing information, air monitoring in the area.	Iran and Iraq (Deputies)
Ministerial Statement Ankara	1 May 2010	Ankara	Establishment of a joint working group, prepared 2-year Plan, exchange of experiences in the field of environment, weather, dust, air quality management, desertification.	Iran, Iraq, Turkey, Syria (Ministers)
Track Record of Implementing Agreements on Combating Dust	6 Aug 2010	Tehran	13 Articles, an operating appendix, dispatch of experts, preparing of credit, training and assisting the Iraqi Meteorological promotion, health management, project shared views on global, regional and sub-regional meetings.	Iran and Iraq (Deputies)

Background

Iranian agreements on sand and dust stoms

Regional Action Plan	29 Sep 2010	Tehran	10 Articles and appendices, environment and weather and dust, air quality management, desertification and implementation of the action plan.	Iran, Iraq, Turkey, Syria (Ministers)
Bilateral Action Plan	8 Jun 2011	Tehran	10 Articles, an area of 1 million hectares set for desertification operations over 5 years, jointly invested by the private sector, 400-hectare pilot plant operations in Iraq, efforts to reduce the effects of dust, transfer of experiences in the field of desertification and afforestation in Iraq.	Iran and Iraq (Ministers)
Bilateral Action Plan	7 May 2011	Baghdad	10 articles and an appendix on operations, began operations in Iraq desertification.	Iran and Iraq (Deputies)
Executive Document Against Desertification	17 Jun 2011	Ahwaz	7,000 hectares of land desertification began operations in seven provinces in Iraq; rootstock studies on soil, water and vegetation, and meteorology, follow the provisions of the Memorandum of the Special Committee, public education on behalf of the Iraqi government to farmers in sustainable agricultural productivity, land management and watershed management.	Iran and Iraq (Deputies)

WMO Global Observing System in Support of Multi-Hazard Early Warning Systems

Components of an Effective Early Warning System

Governance and Organizational Issues

- **Risk Identification**
- **Communication & Dissemination**
- **Observing Systems & Forecasting of Hazards**
- **Emergency Planning, Preparedness and Response**

Meteosat History & Future

1977 — **2002** — **2020** — **and**

MFG

MSG

MTG-I and MTG-S

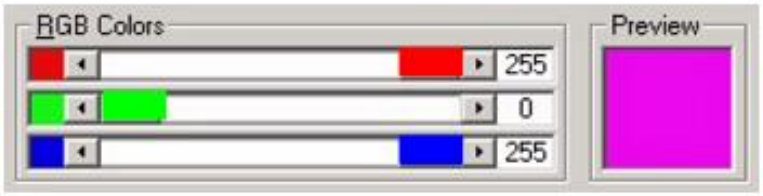
Observation mission:
MVIRI: 3 channels
Spinning satellite
Class 800 kg

Observation missions:
SEVIRI: 12 channels
GERB
Spinning satellite
Class 2 tons

Observation missions:
Flex.Comb. Imager: 16 channels
Infra-Red Sounder
Lightning Imager
UVN
3-axis stabilised satellites
Twin Sat configuration
Class 3.6 – 3.7 tons

RGB images – How and why ?

Exercise - Which of these colours do you need to make **magenta** ?



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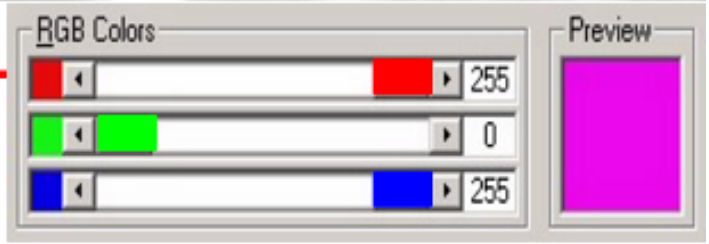
Dust RGB – How to get maximum of red ?

Red: IR 12.0 – IR 10.8

Range of values: - 4 ... + 2 K

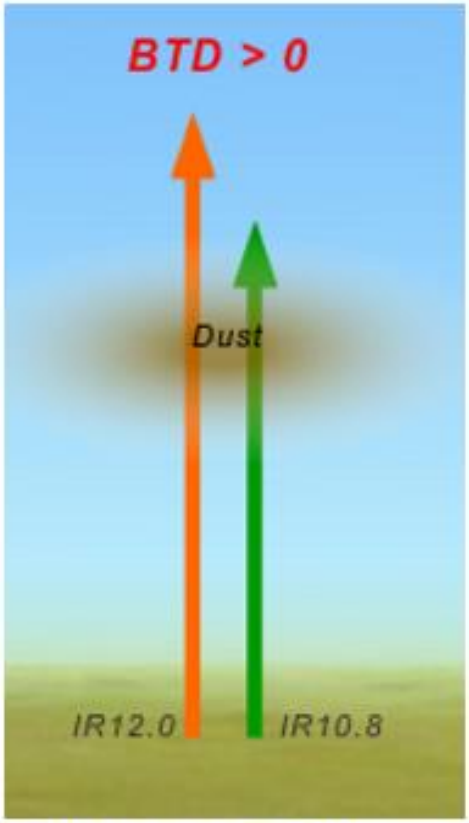
So full Red means

BT(IR12.0) – BT(IR10.8) = + 2 K



BT : Brightness Temperature

Dust RGB – How to get maximum of red ?



BTD IR 12.0 – IR 10.8

BTD : Brightness Temperature Difference

Another way of seeing it:

radiation at 10.8 micra
is **more absorved** by dust
than at 12.0 micra

EUMETRAIN Module on RGB images:
http://www.eumetrain.org/resources/operational_use_rgb.html

Dust RGB – How to get minimum of green ?

à frente do nosso tempo

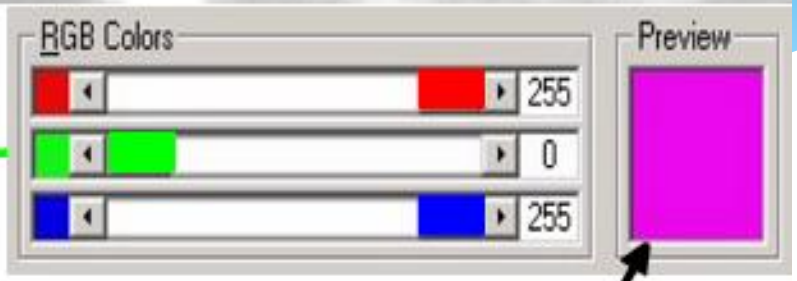
Green: IR 10.8 – IR 8.7

Range of values: 0 ... + 15 K

So No Green means

BT (IR10.8) – BT (IR8.7) = 0

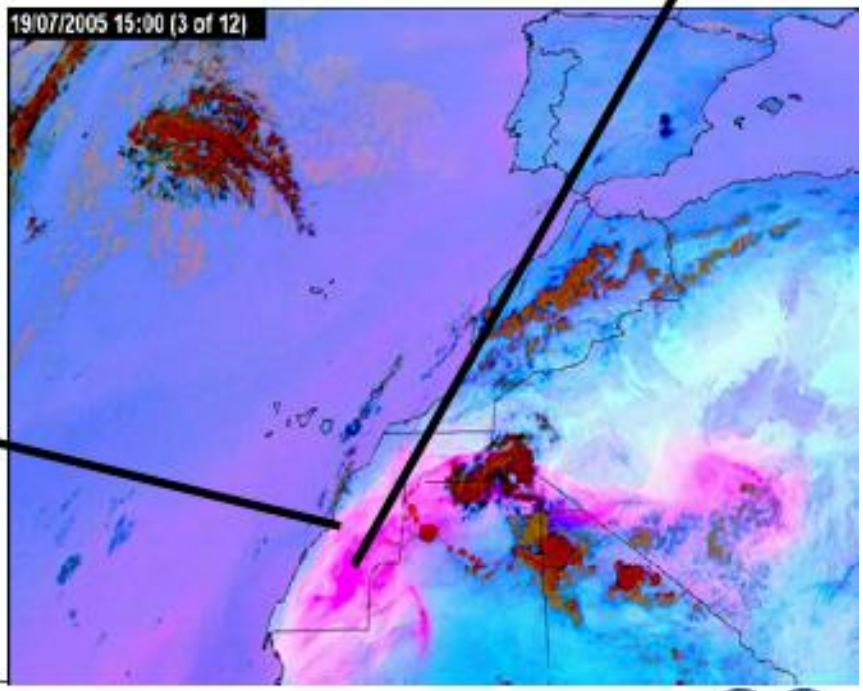
Or : BT (IR 10.8) = BT (IR 8.7)



But dust

is not always

a full magenta !



So BT (IR 10.8) > BT (IR 8.7)

This case: BT (IR 10.8) - BT (IR 8.7) ~ 5 K

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Dust RGB – The desert

In fact note the

for desert areas

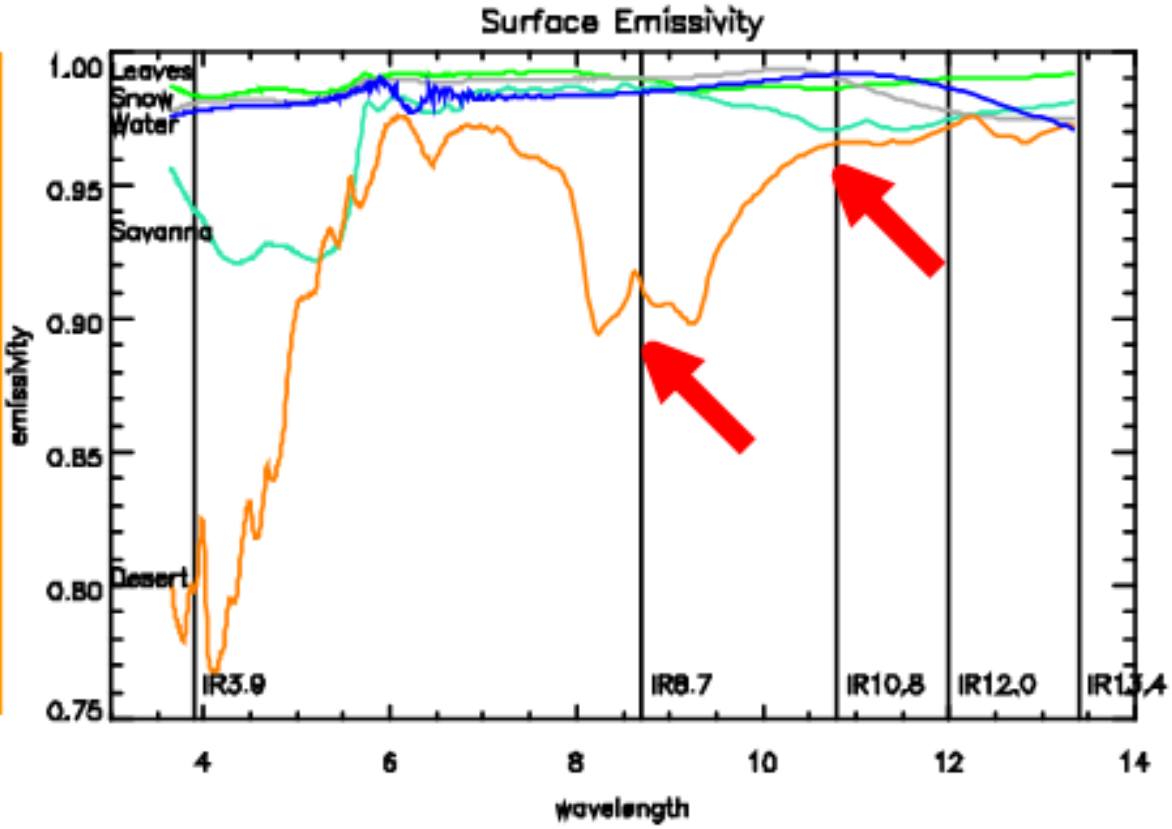
emissivity is higher

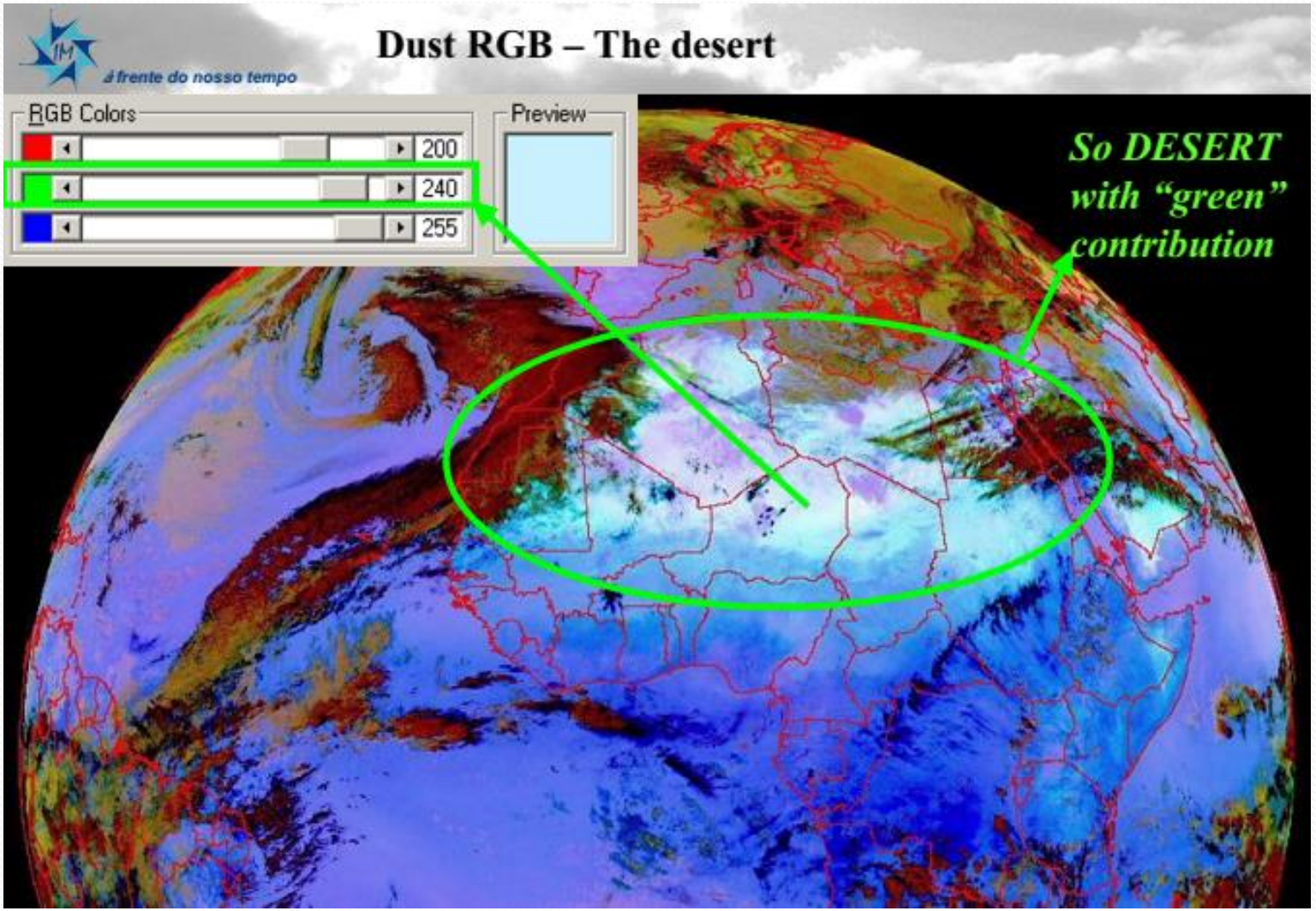
at 10.8 micra

than at 8.7 micra

So over the desert:

BT (IR10.8) > BT (IR 8.7)




Dust RGB – The desert
à frente do nosso tempo
RGB Colors
200
240
255
Preview
So DESERT
with "green"
contribution

Dust RGB – How to get maximum of blue ?

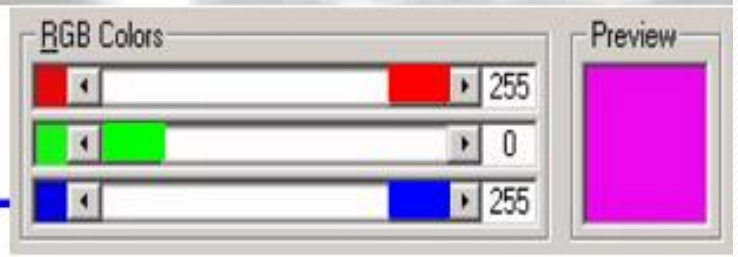
à frente do nosso tempo

Blue: IR 10.8

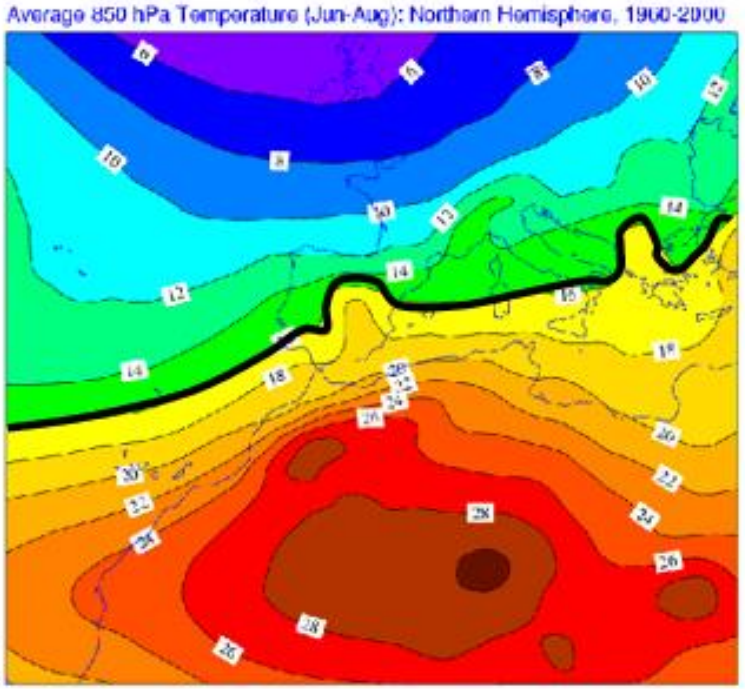
Range of values: -12ºC ...

So full Blue

BT (IR10.8) = + 16ºC



16ºC is a temperature "easy to reach" for desert & dust clouds



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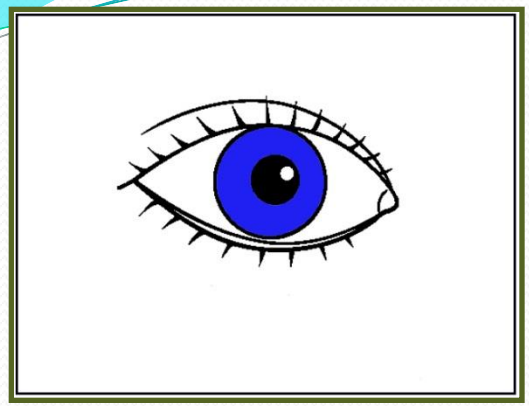
In-situ Estimations



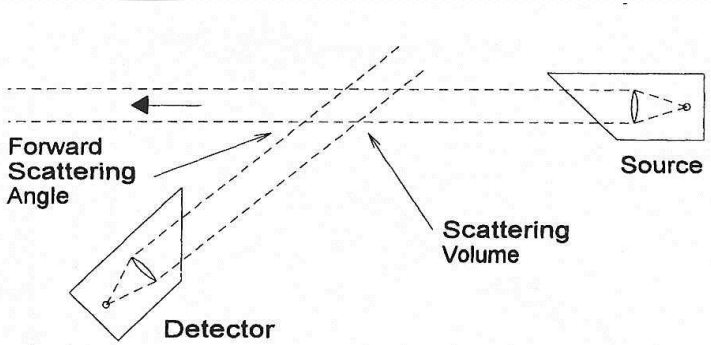
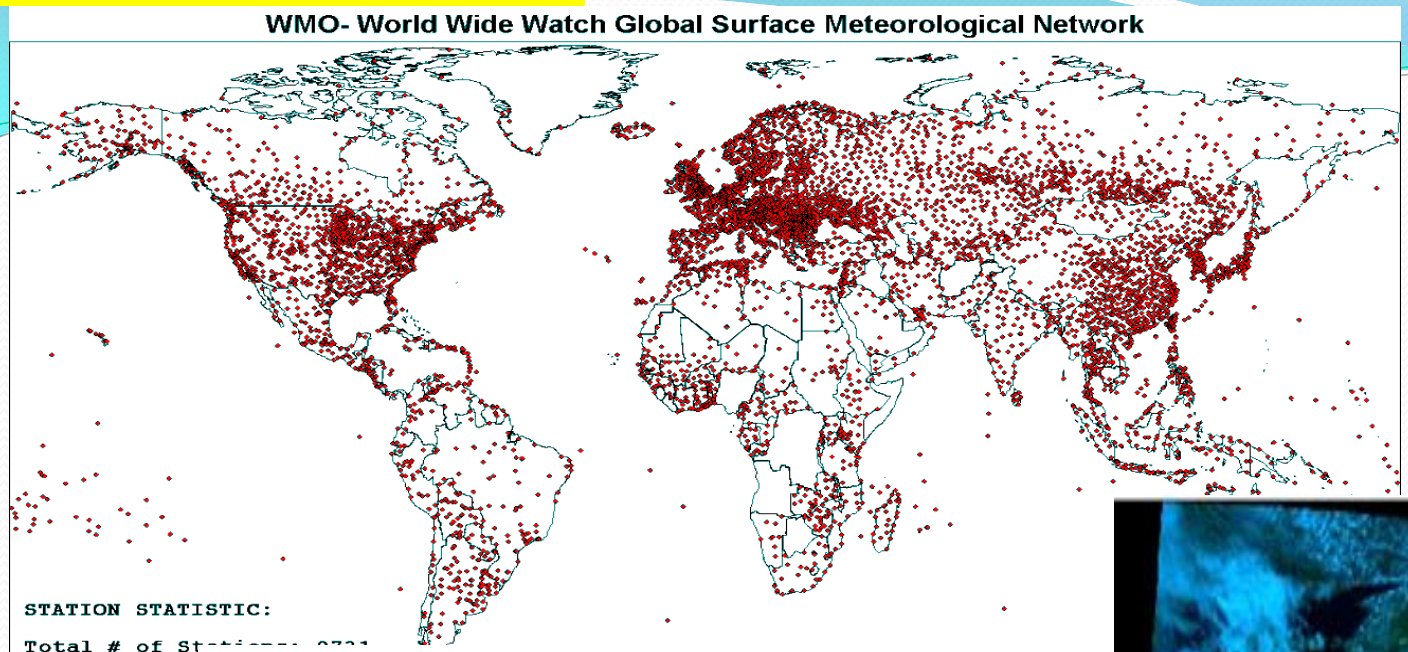


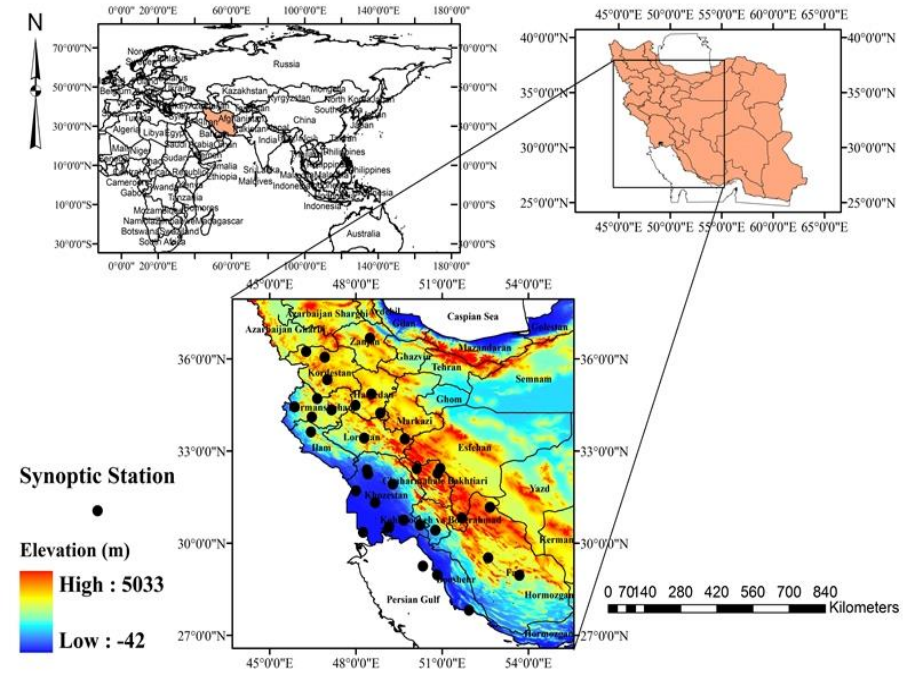
Fig. 11-4 A forward scatter visibility meter.

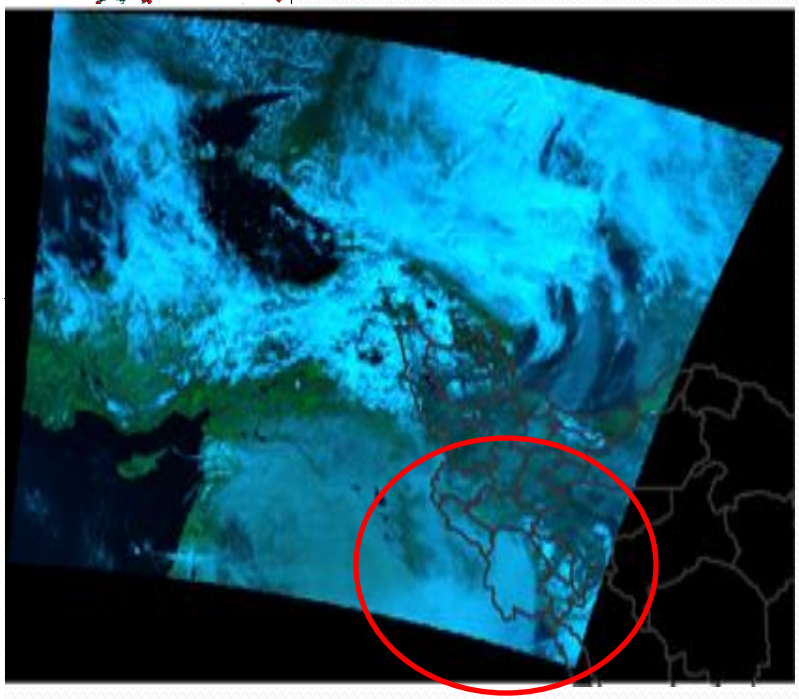
WMO – visibility

The greatest distance that a black object of "suitable dimensions," situated near the ground, can be seen and recognized when observed against a background of fog

In-situ Estimations

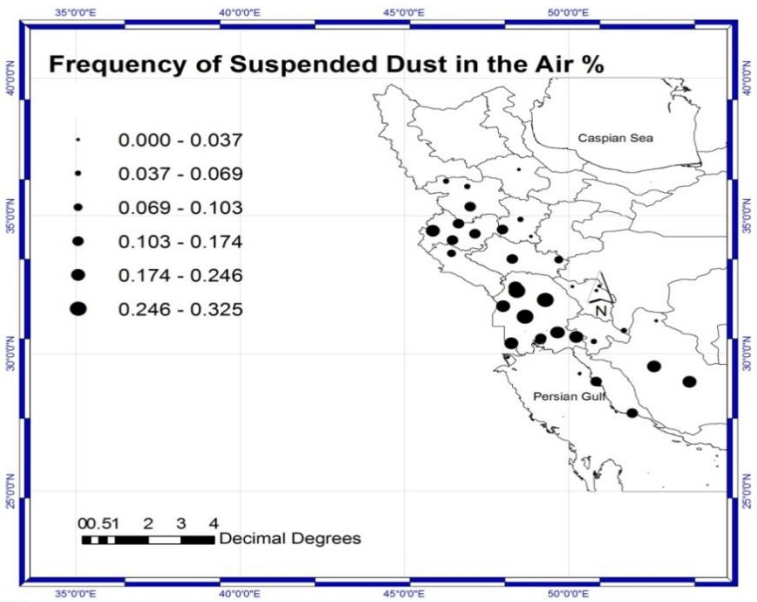


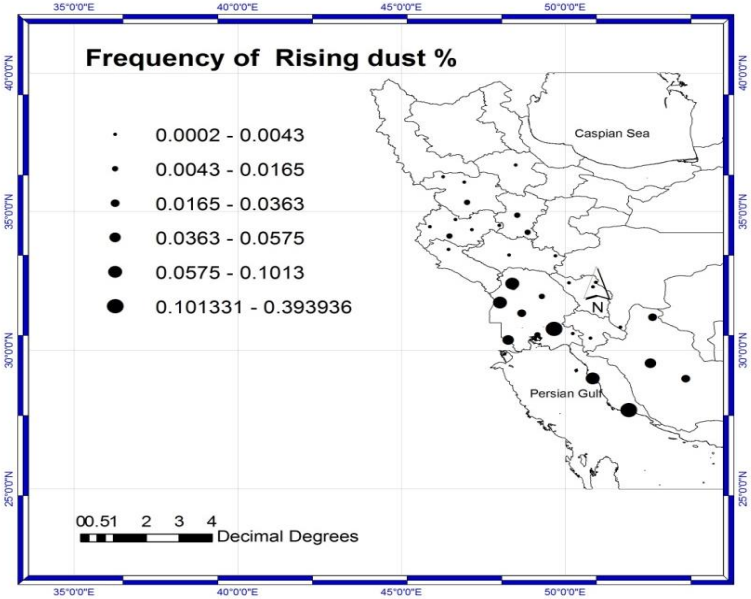


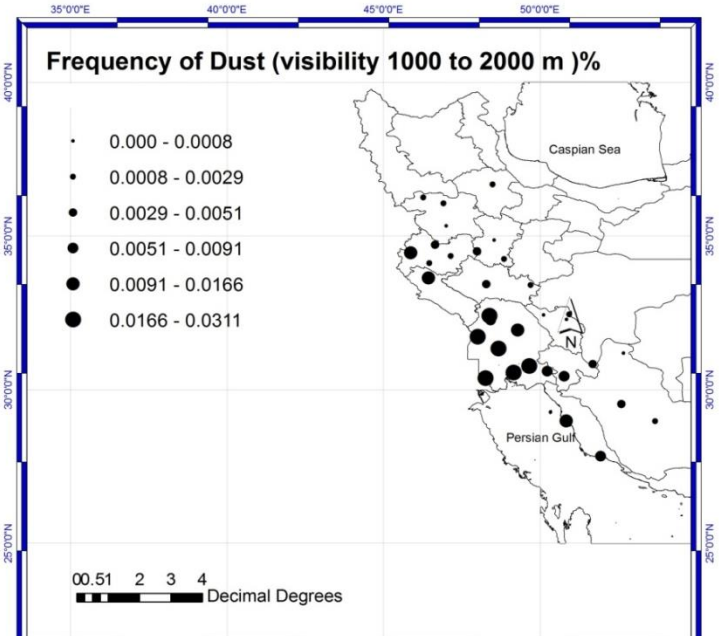


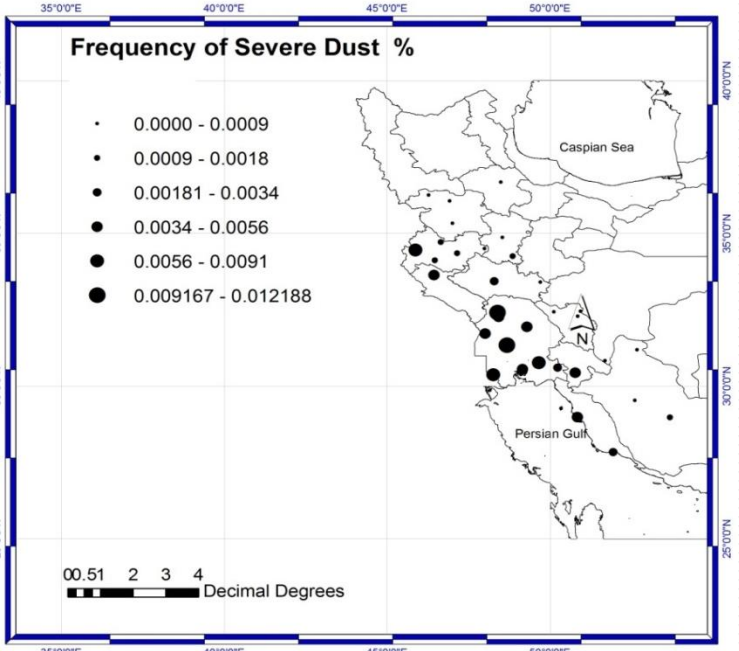
In-situ Estimations

Visibility Categorization









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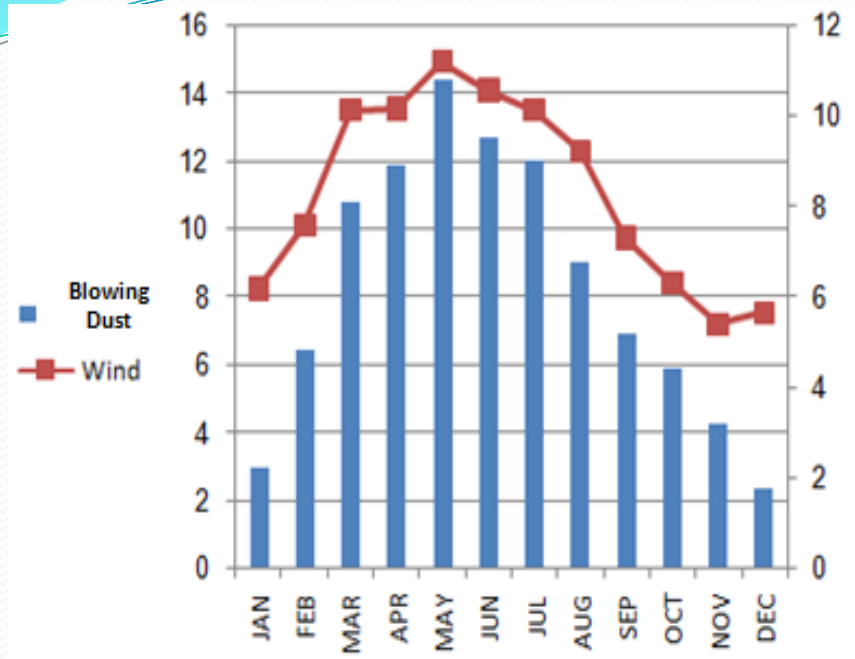
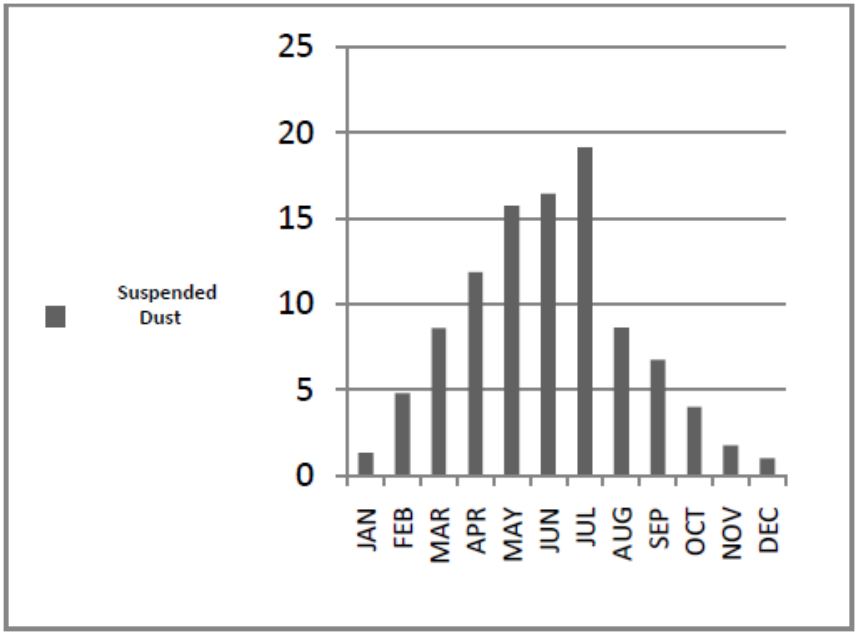
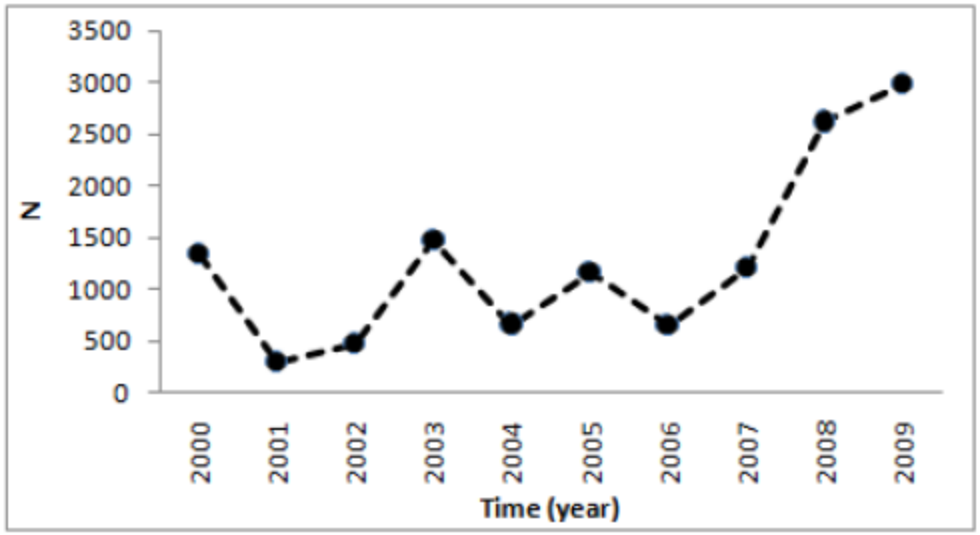
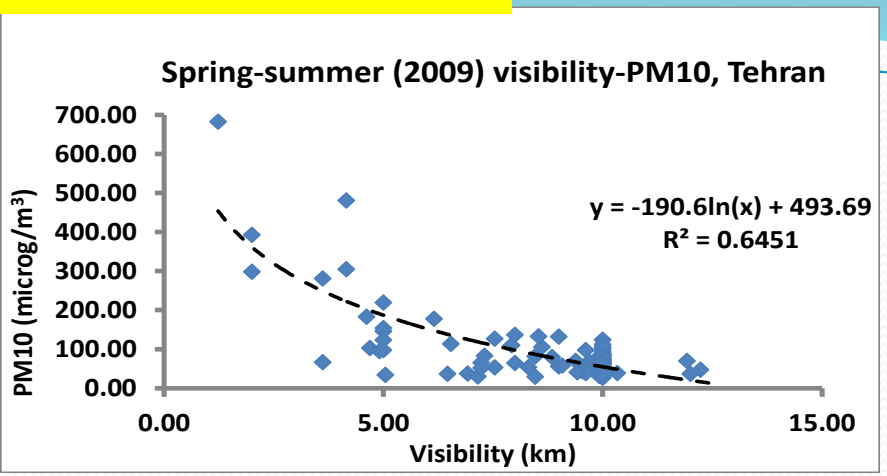
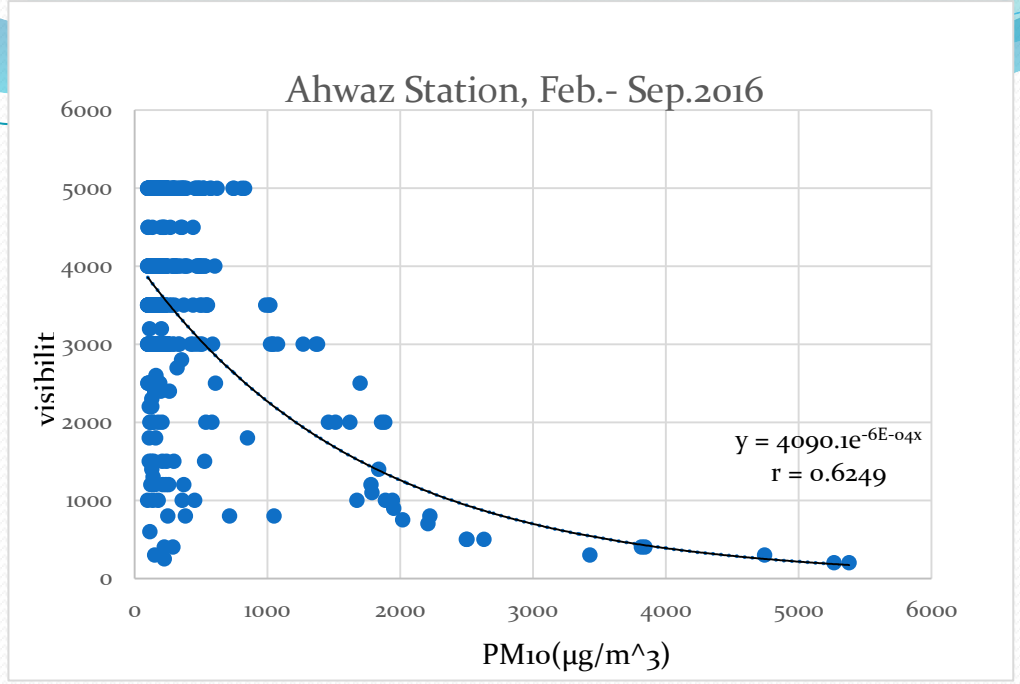


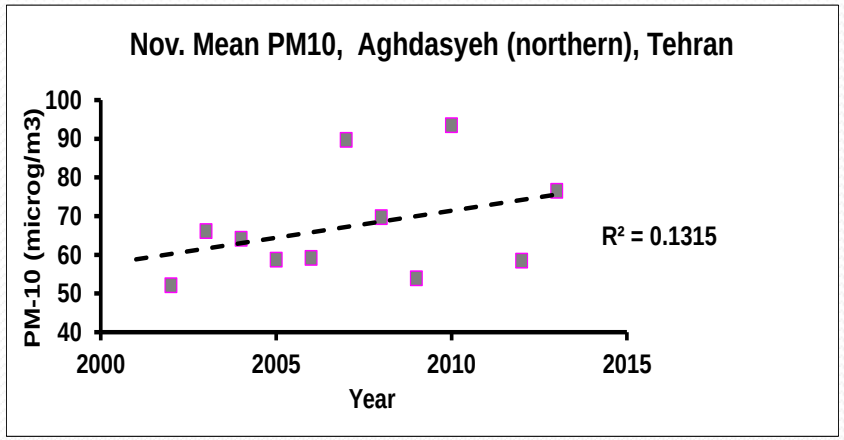


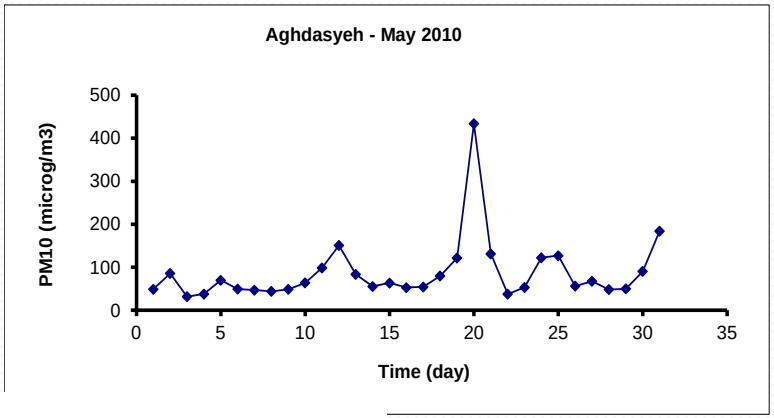


In-situ Estimations









Scientia Iranica A (2016) 23(5)

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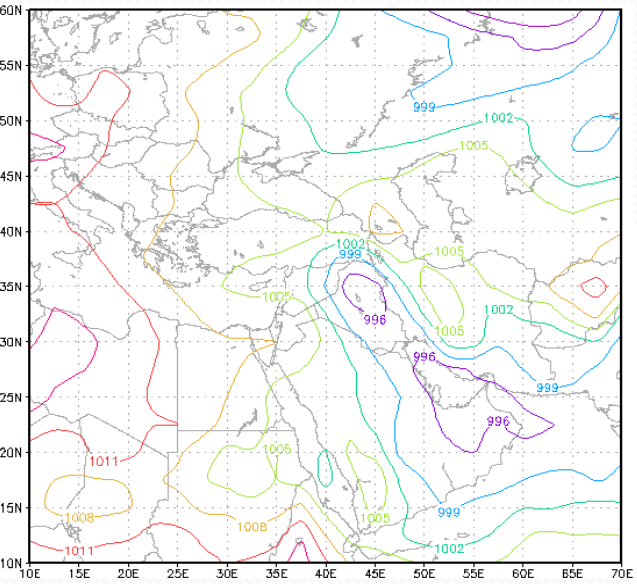
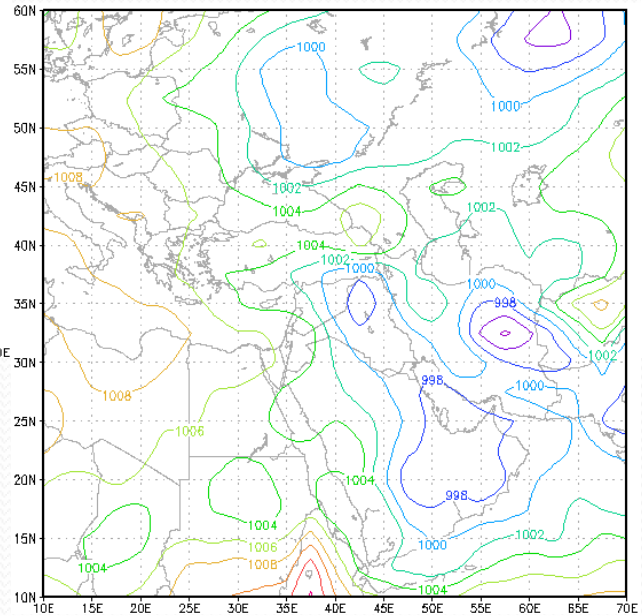
Some resilient aspects of urban areas to air pollution and climate change, case study: Tehran, Iran

A.A. Bidokhti[a,b], Z. Shariepour[b] and S. Sehatkashani[c,*]

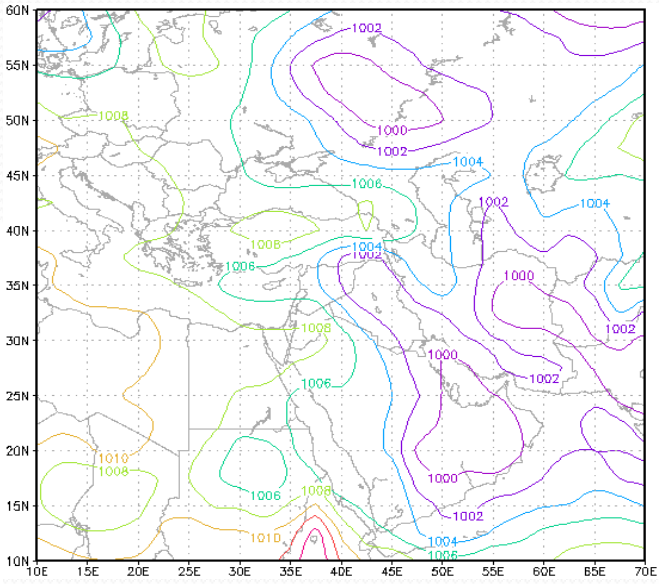
Synoptical analysis



July 4, 2009



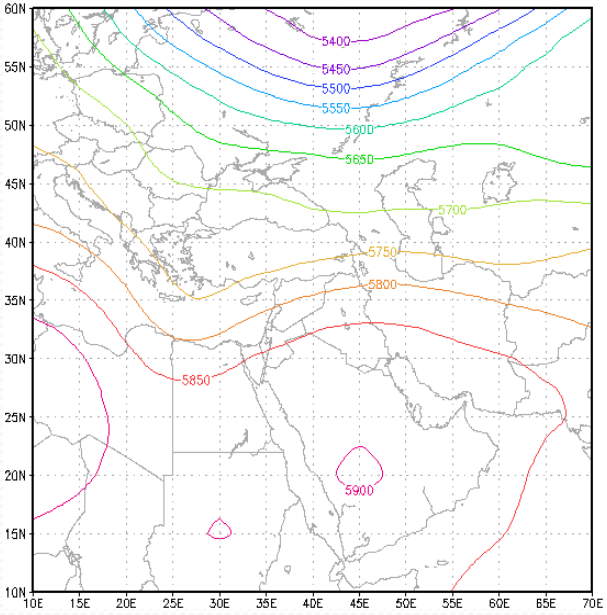
July 5, 2009



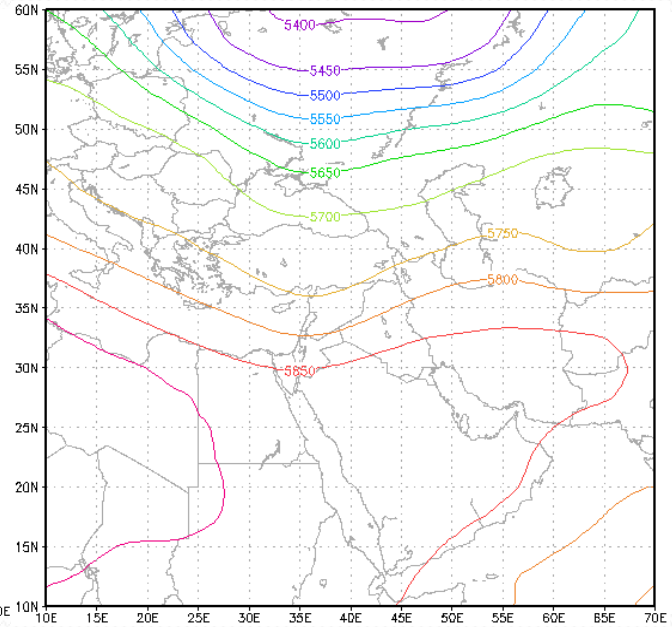
July 6, 2009

Mean Sea Level Pressure(mb)

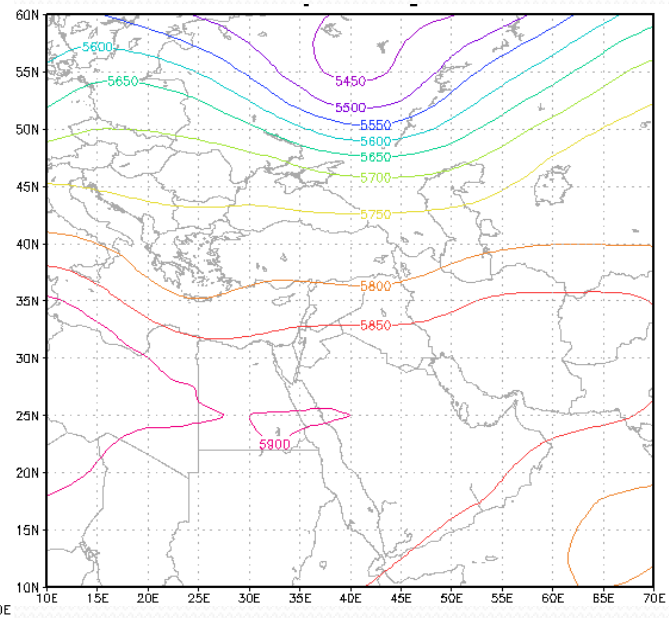
Synoptical analysis



July 4, 2009



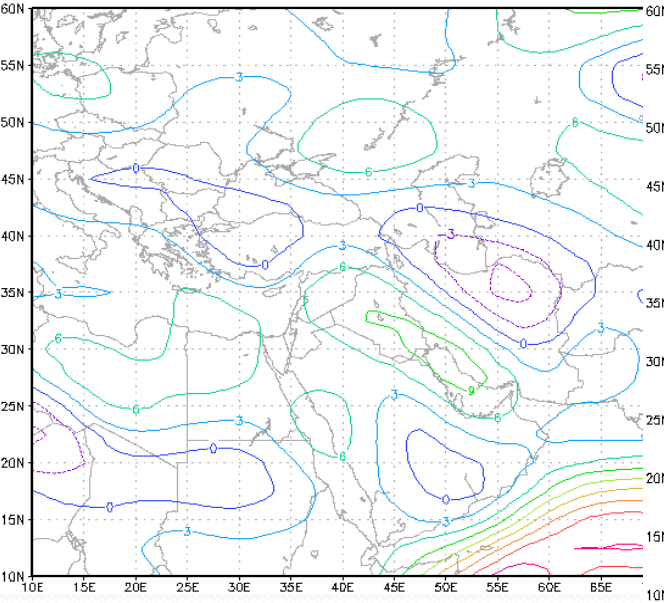
July 4, 2009



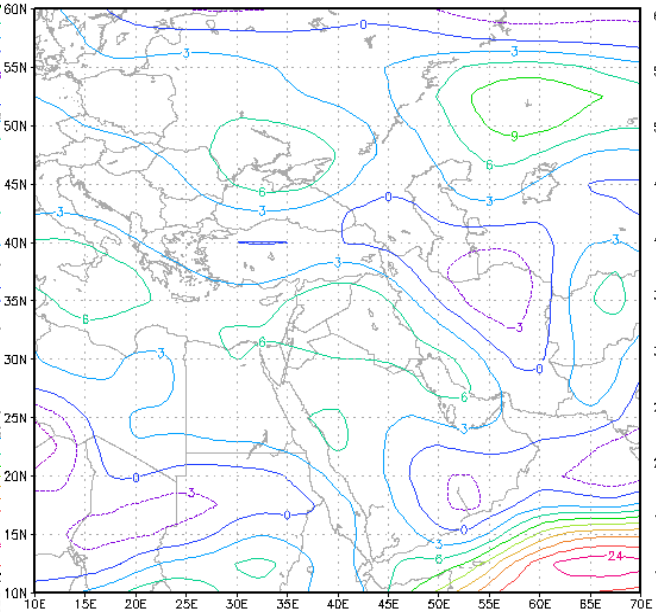
July 4, 2009

500 hPa Level

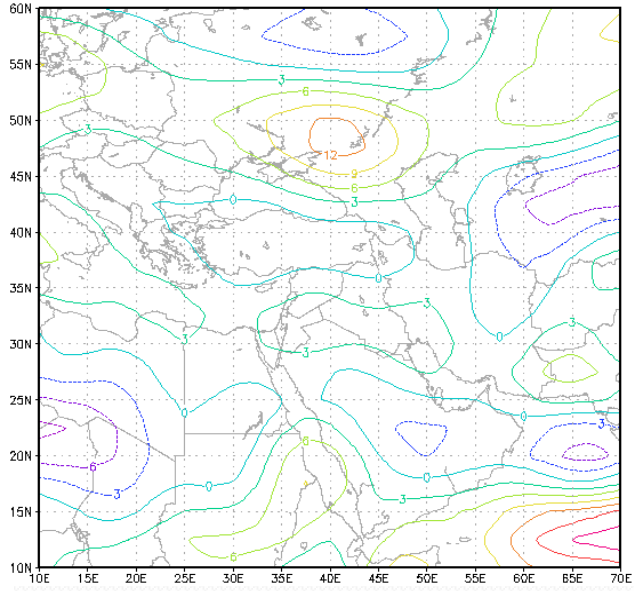
Synoptical analysis



July 4, 2009



July 5, 2009

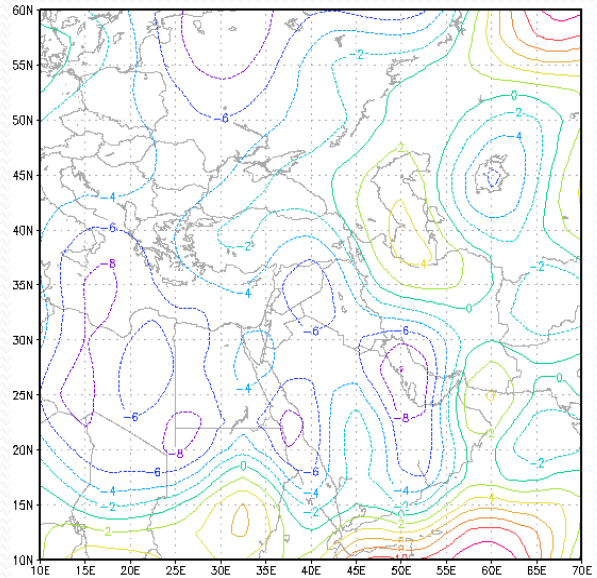


July 6, 2009

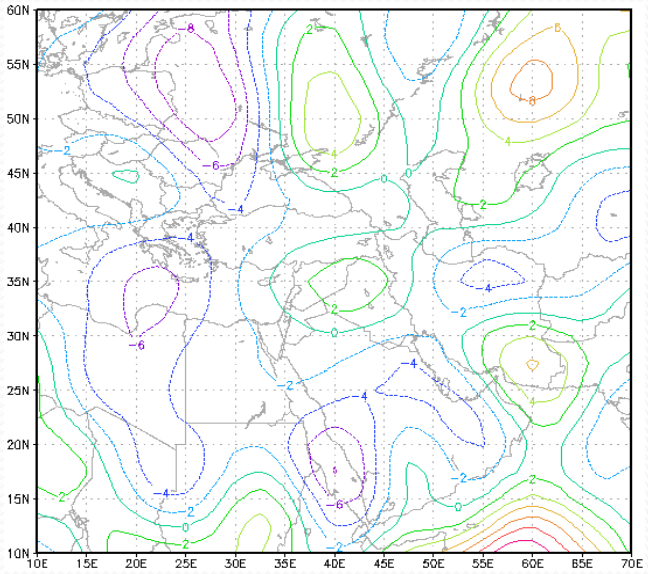
850 hPa zonal wind

Synoptical analysis

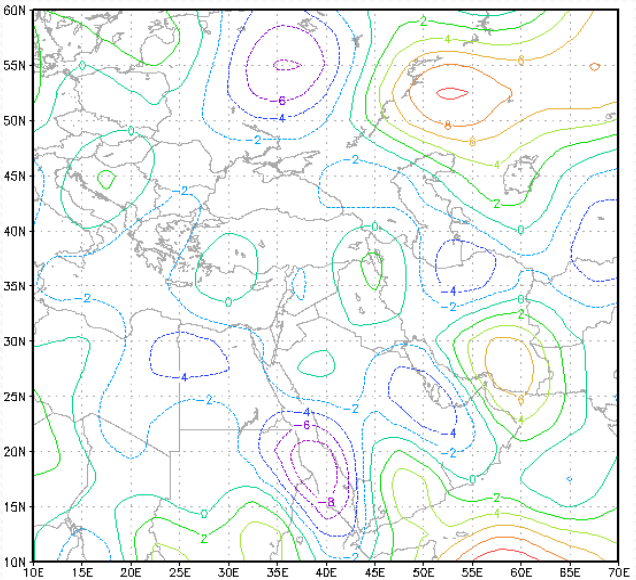
850 hPa merdional wind



July 4, 2009



July 5, 2009



July 6, 2009

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Advances in Environmental Biology

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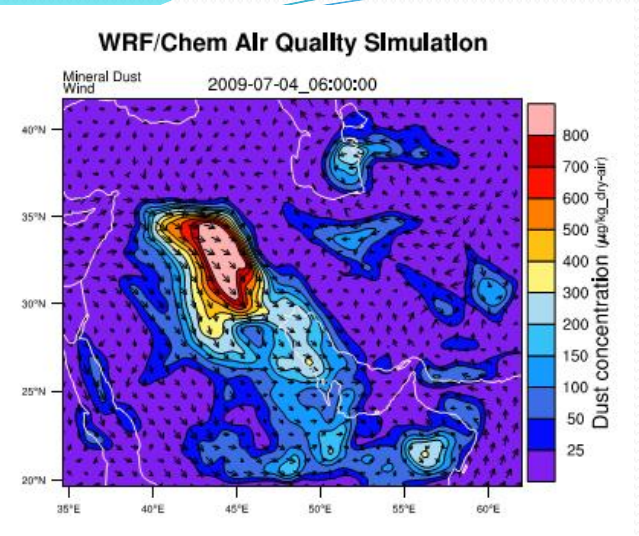
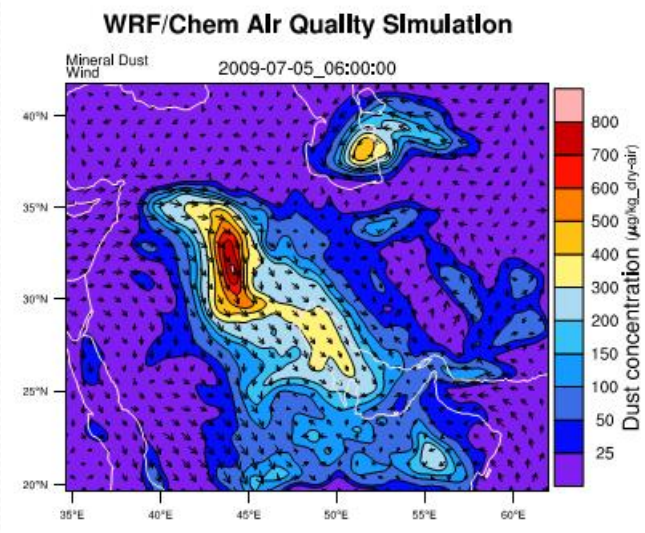
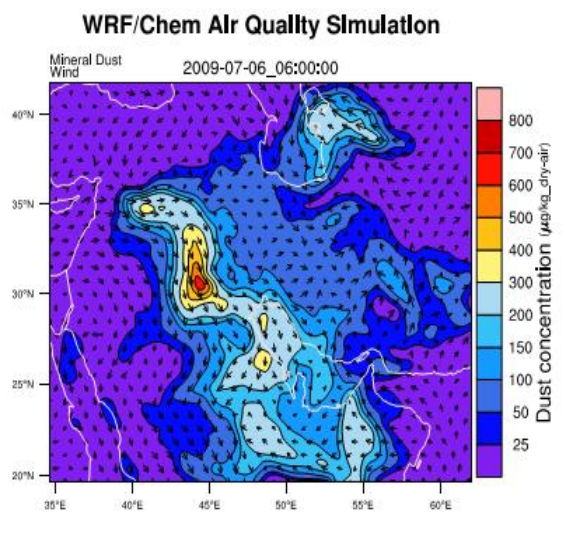
Synoptic and spectral analysis of some dust events in western and southwestern Iran

[1]Saviz Sehatkashani, [2]Gholamali Kamali, [3]Majid Vazifedoust, [4]Abbasali A. Bidokhti

Numerical analysis



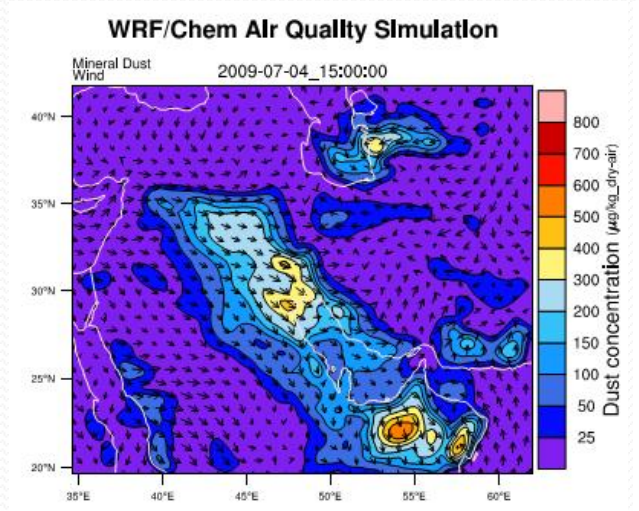


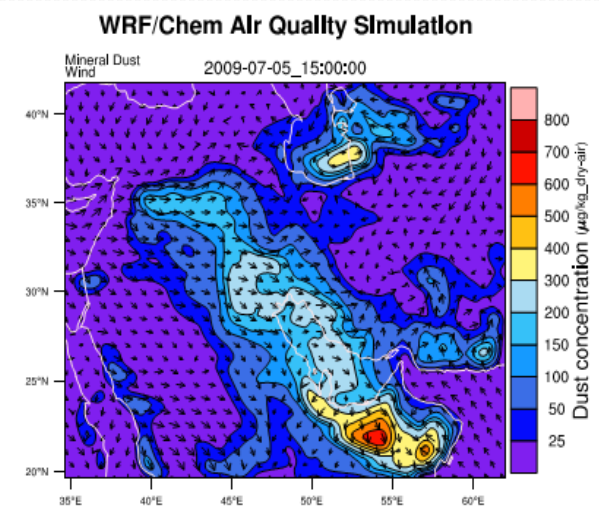


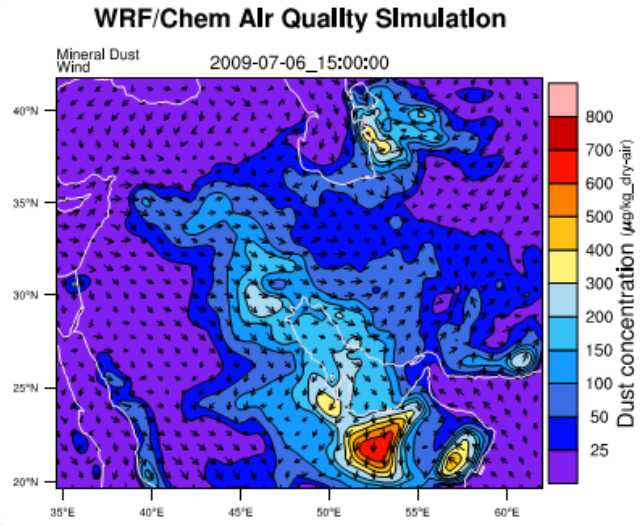
July 4, 2009

July 5, 2009

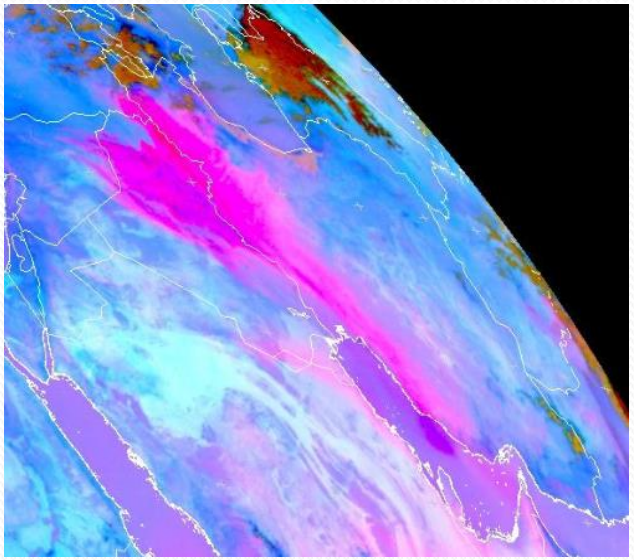
July 6, 2009



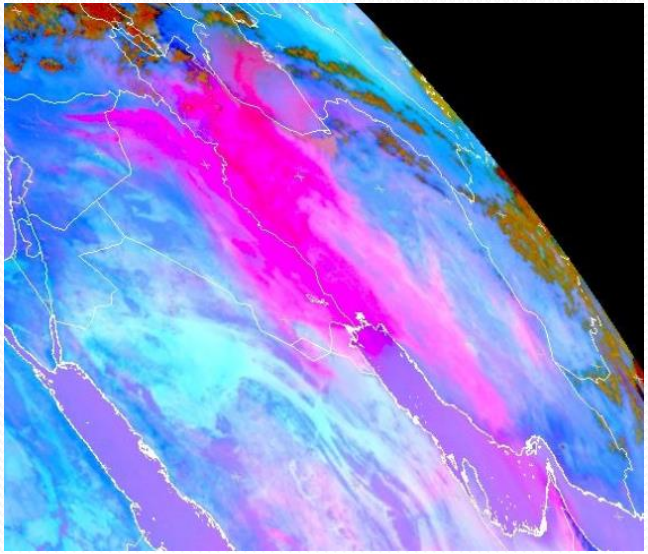




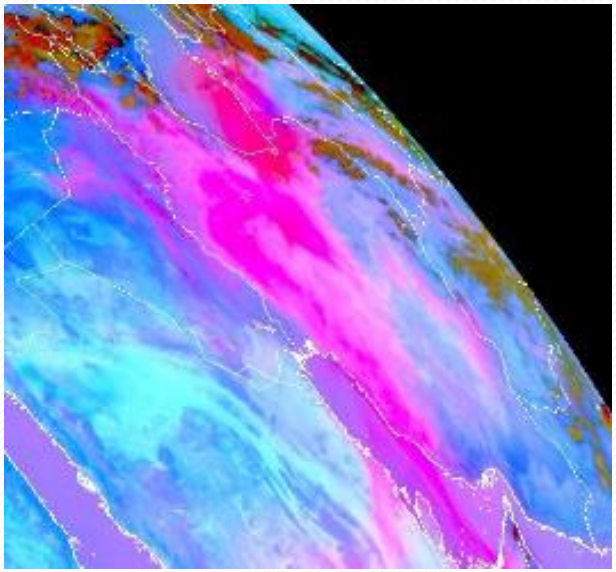
Spectral Analysis



July 4, 2009



July 5, 2009



July 6, 2009

EUMETSAT

Satellite Remote Sensing(Spectral Analysis)

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+ NASA Homepage

SEARCH GO

MODIS Web

+ ABOUT MODIS | + NEWS | + DATA | + IMAGES | + SCIENCE TEAM | + RELATED SITES | + SEARCH | + MODARCH

DATA

The MODIS Data section contains everything from ATBDs to Product Descriptions to tutorials on ordering MODIS data from the various DAACs. Peruse the Data section today.

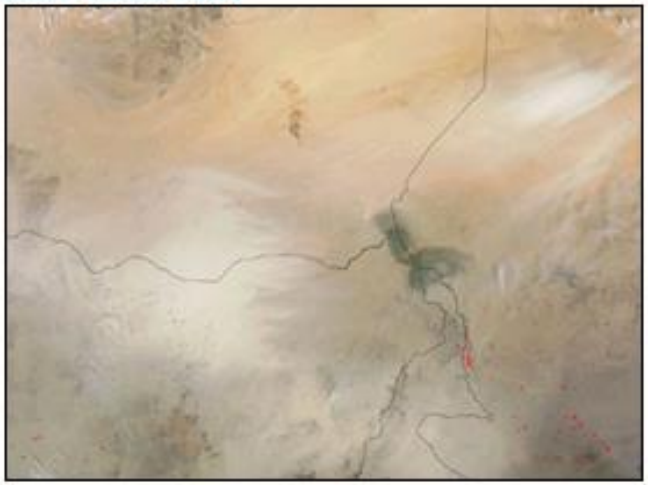
NEWS

The MODIS news section details all the developing news surrounding the MODIS project.

MODIS Atmosphere Team Releases New Data Products Calendar

IMAGES

Dust in Central Africa



This image of dust over central Africa was captured by the MODIS on the Terra satellite on February 11, 2009. Shown are Niger (upper left half of image), Chad (right side), Nigeria (lower left), Cameroon (bottom center), and the...

DISCIPLINES


Atmosphere

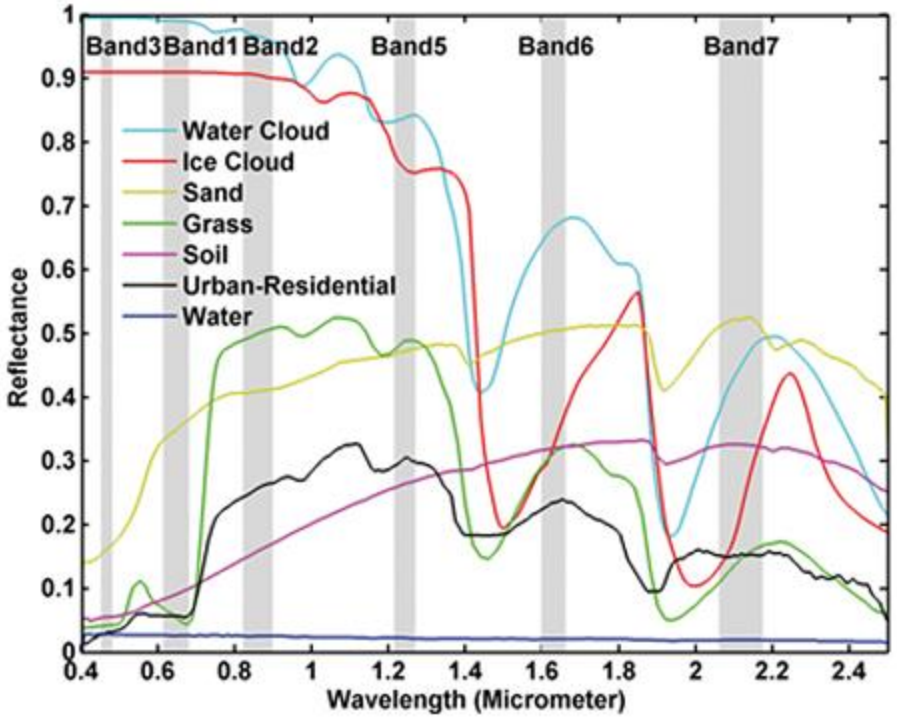

Land


Ocean


Calibration

Spectral Analysis

Dust Enhancement Algorithms:



1

$$NDDI = (\rho 2.13\mu m - \rho 0.469\mu m)/(\rho 2.13\mu m + \rho 0.469\mu m)$$

Qu(2006)

$\rho 0.469\mu m$: Reflectance at the top of atmosphere in 0.469 µm

$\rho 2.13\mu m$: Reflectance at the top of atmosphere in 2.13 µm

Dust Enhancement Algorithms:

2

$$T = \frac{hc}{\lambda_i k \ln\left(\frac{2hc^2}{1(\lambda_i)\lambda_i^5} + 1\right)}$$

BTD= (BT11µm - BT12µm)

BT11µm: Brightness Temperature at MODIS band 31

BT12µm: Brightness Temperature at MODIS band 32

Dust Enhancement Algorithms:

3

$$TDI = C_0 + C_1 \times BT_{20} + C_2 \times BT_{30} + C_3 \times BT_{31} + C_4 \times BT_{32}$$

BT: Brightness Temperature of MODIS bands20, 30,31and 32.

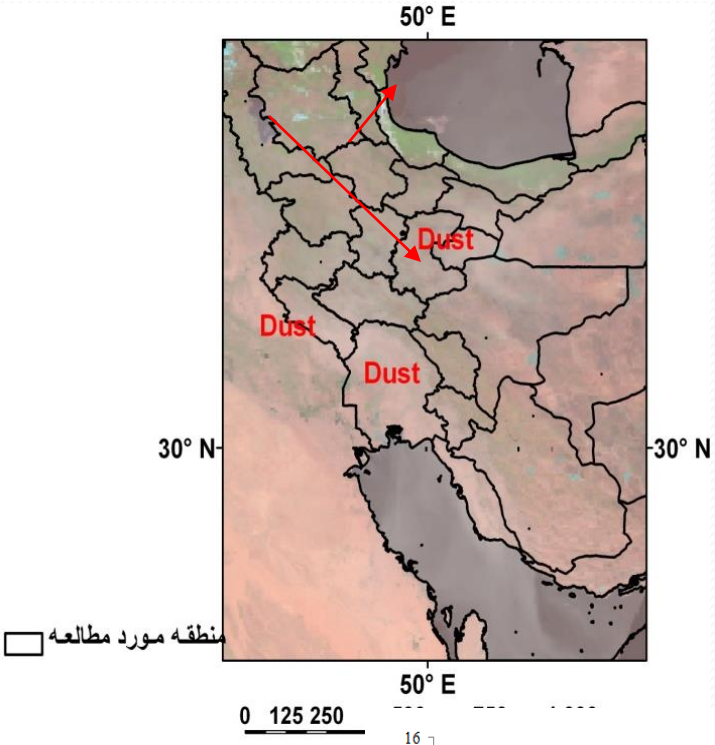
Coefficients of equation

(Hao& Qu,2007)

C_0	C_1	C_2	C_3	C_4
-7.937	0.1227	0.0260	-.7068	0.5883

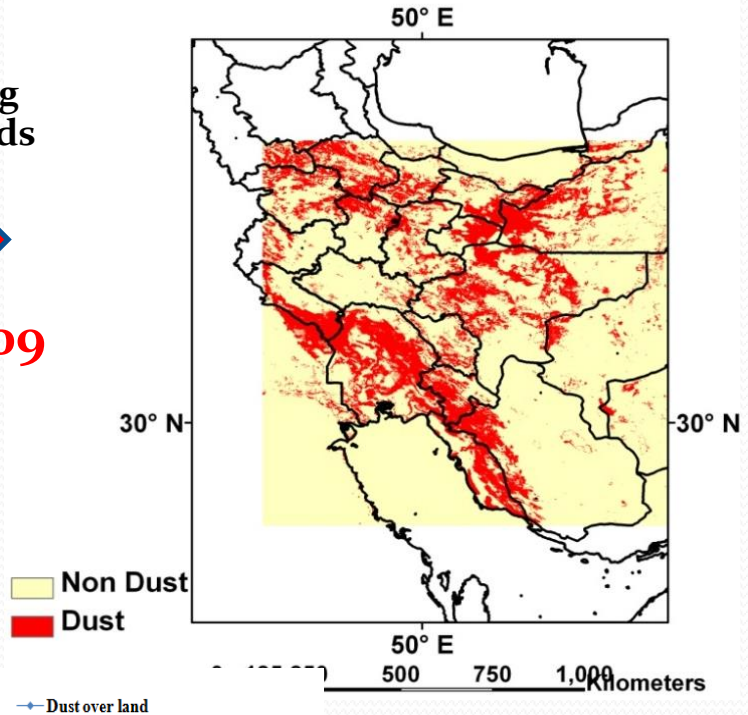
Spectral Analysis

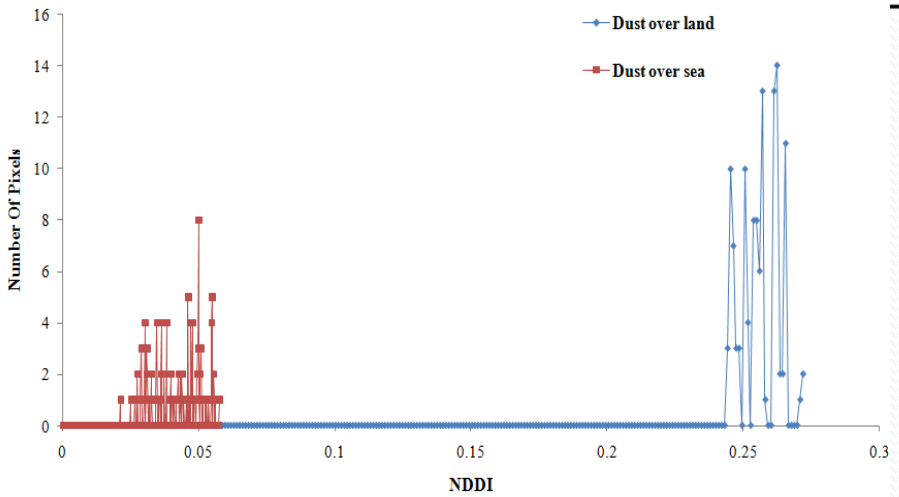
If 0.19<=NDDI<0.28 AND then DUST



Applying thresholds

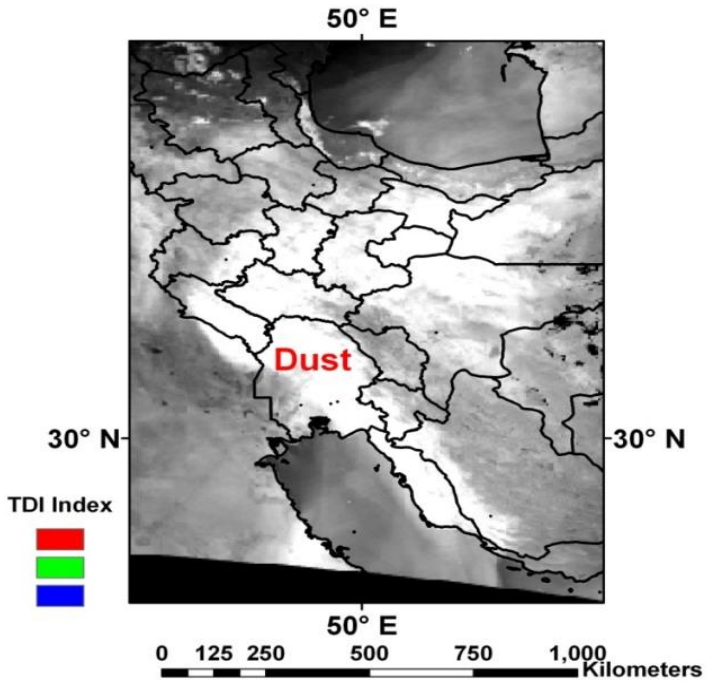
5 July 2009





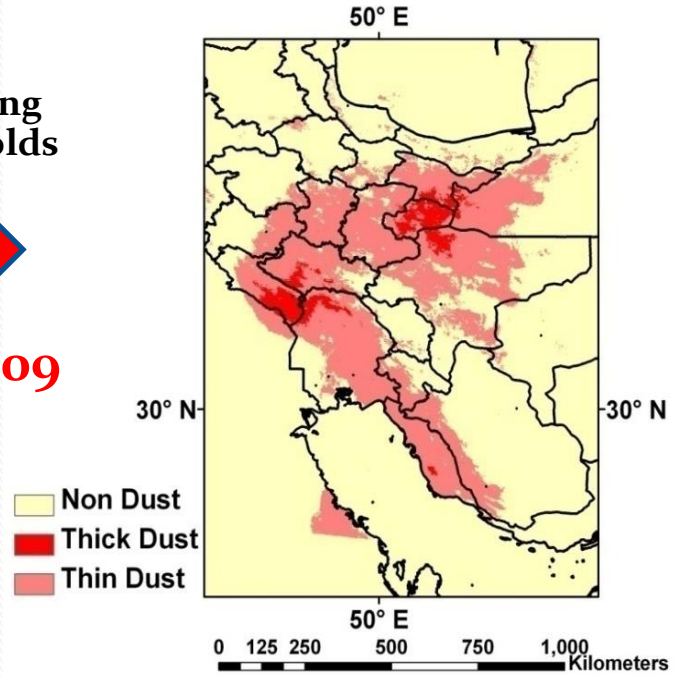
Spectral Analysis

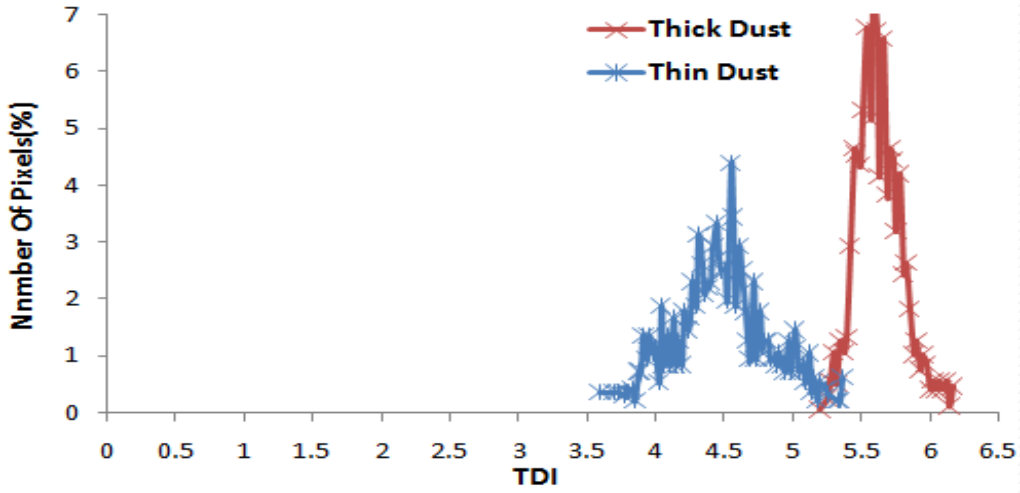
If TDI>=5.1K AND 278< BT31< 288 then THICK DUST
if 3.5K<=TDI < 5.1K AND 278< BT31< 288 then THIN DUST



Applying thresholds

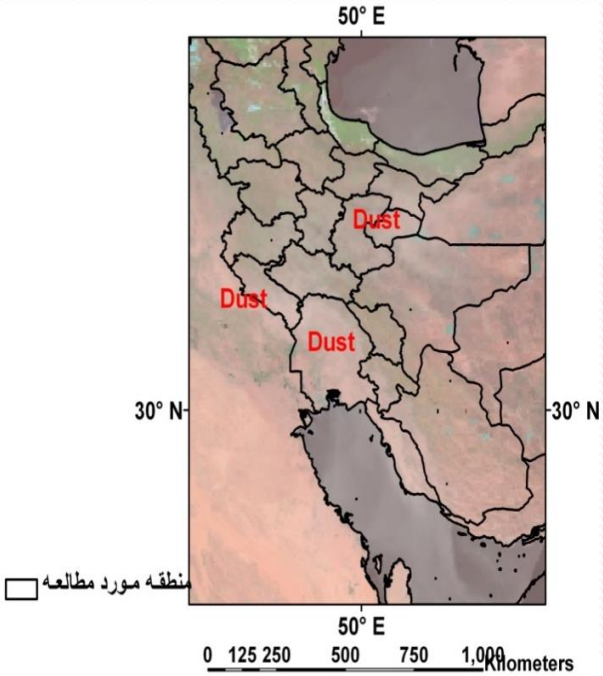
5 July 2009





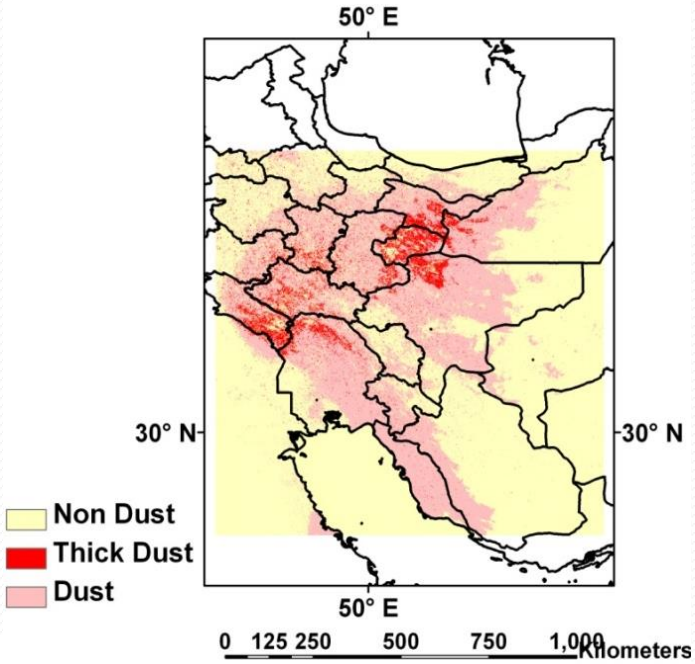
Spectral Analysis

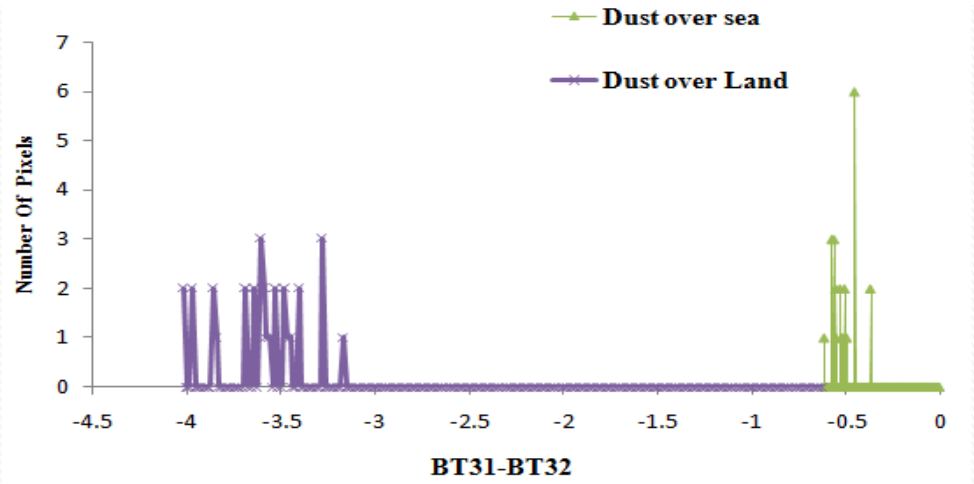
If BT31-BT32<-0.5 then DUST



Applying thresholds

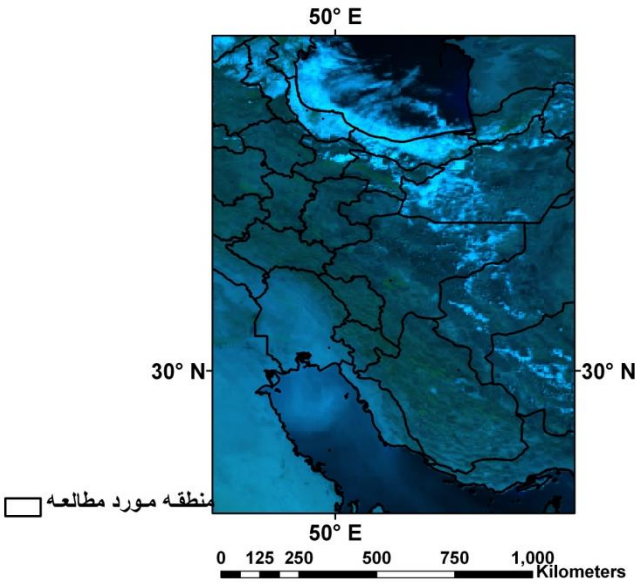
5 July 2009





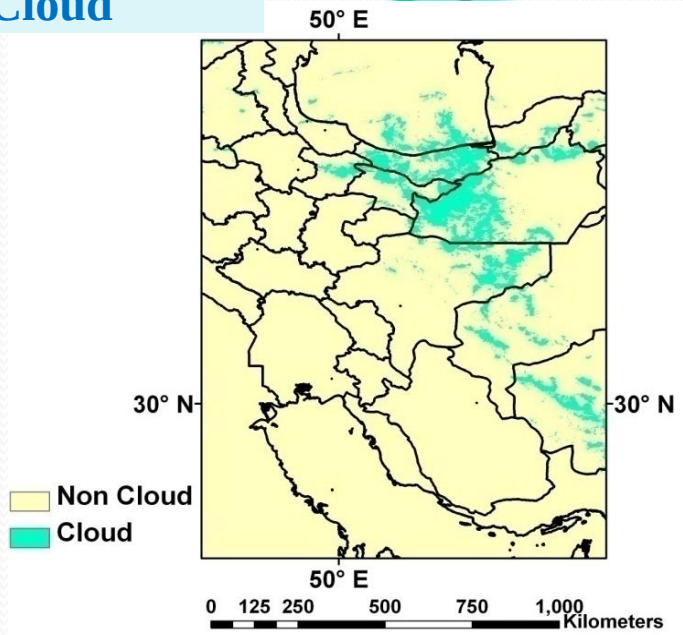
Spectral Analysis

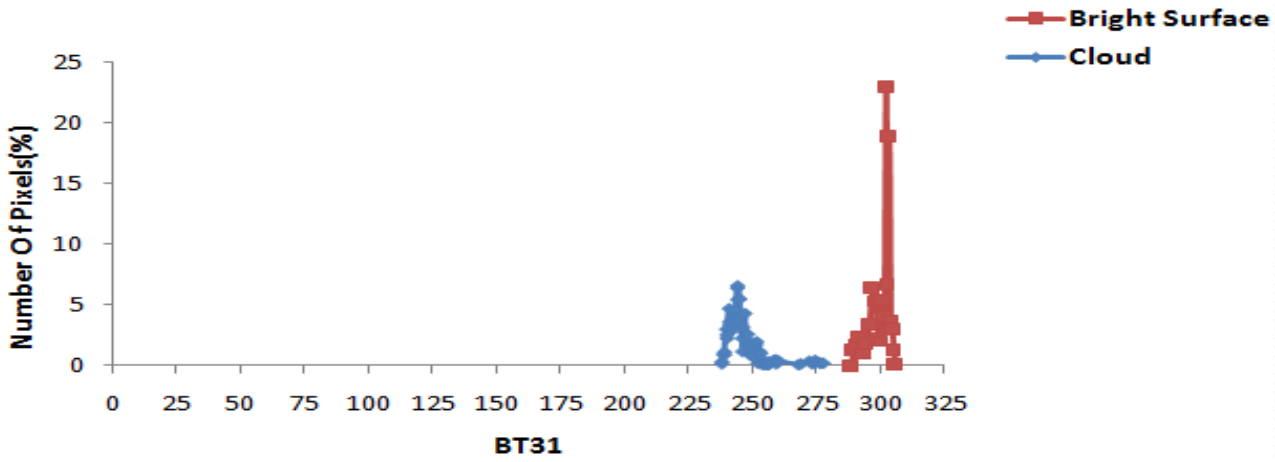
If BT31<278K then Cloud



Applying thresholds

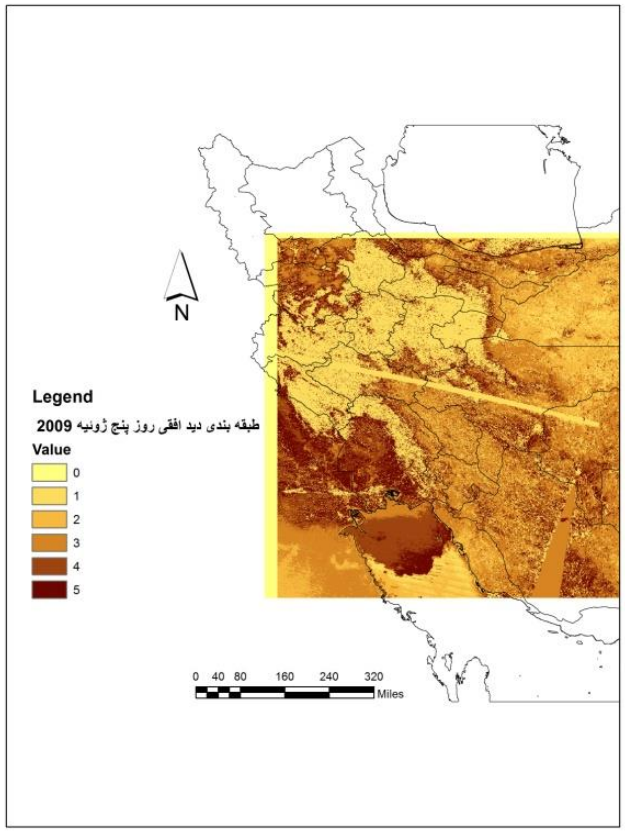
5 July 2009



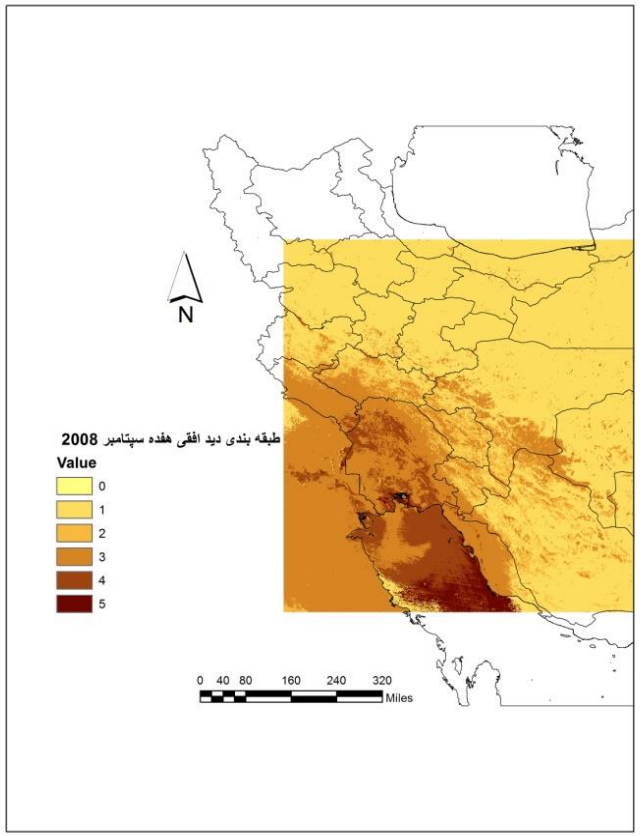


Visibility Categorization

Visibility = 2217.46 + 1479.4*BT31-BT32 + 6844.46*NDDI



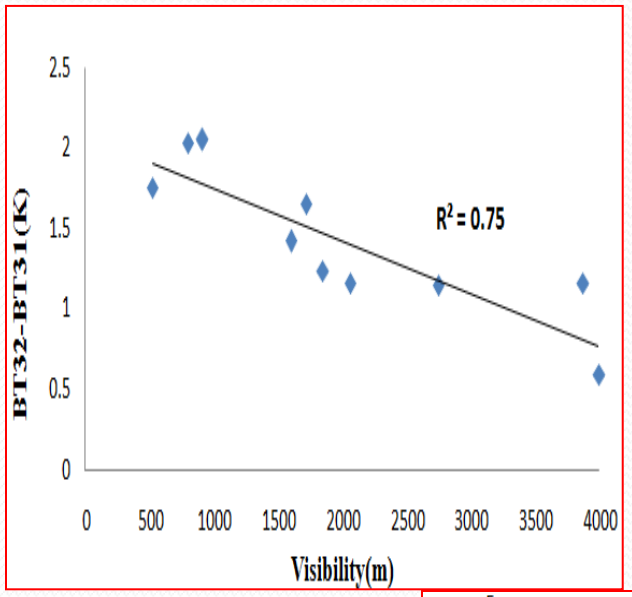
5 July 2009

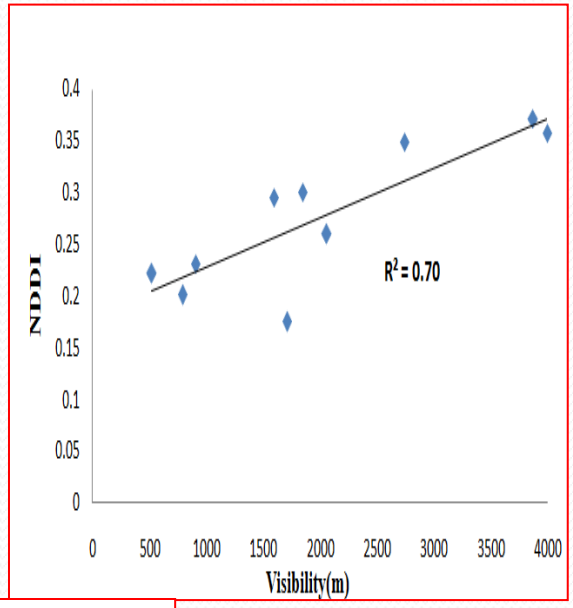


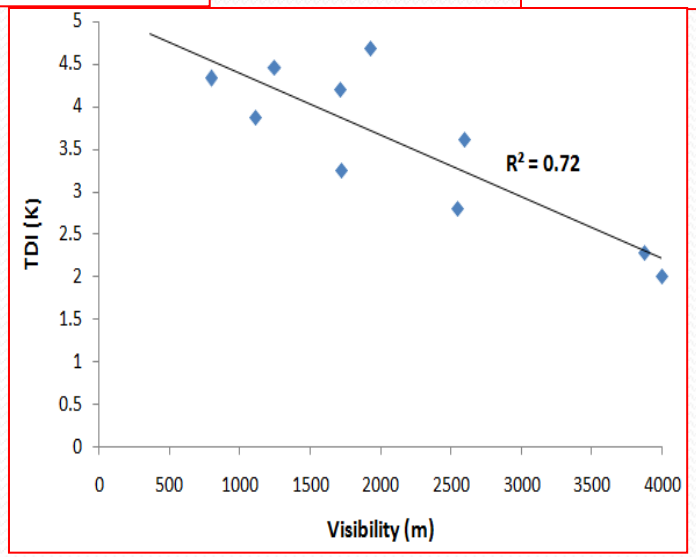
17 September 2008

Spectral Analysis

Dust Indices verification



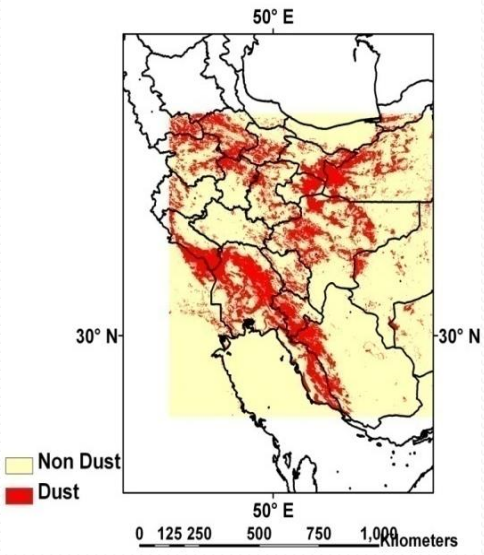




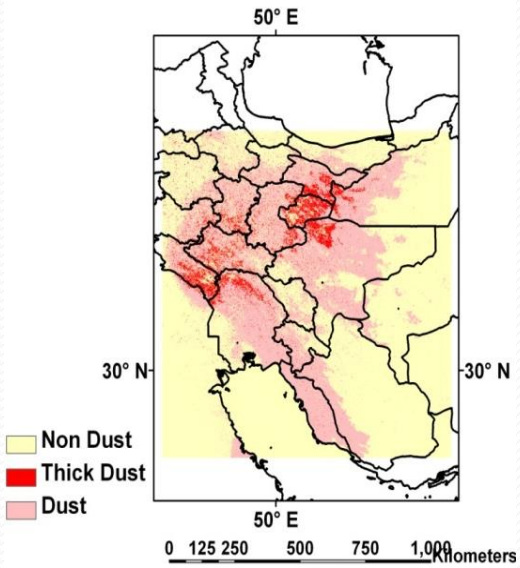
Spectral Analysis

Empirial AOT

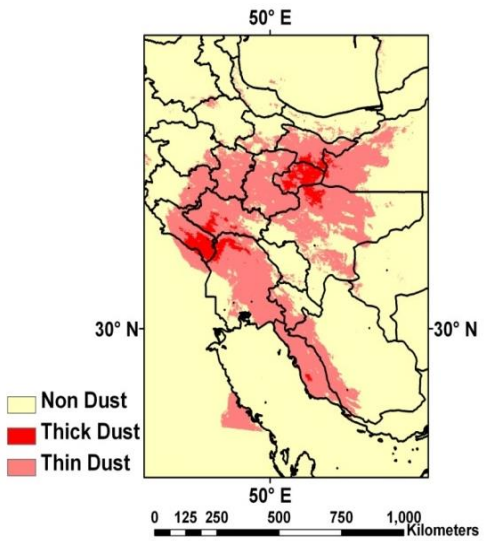
NDDI Index



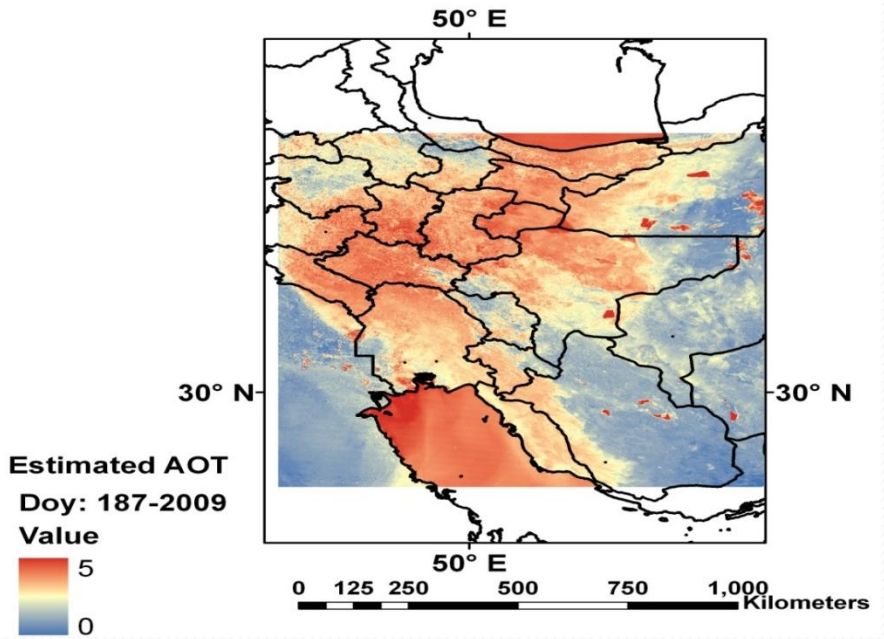
BTD Index



TDI Index

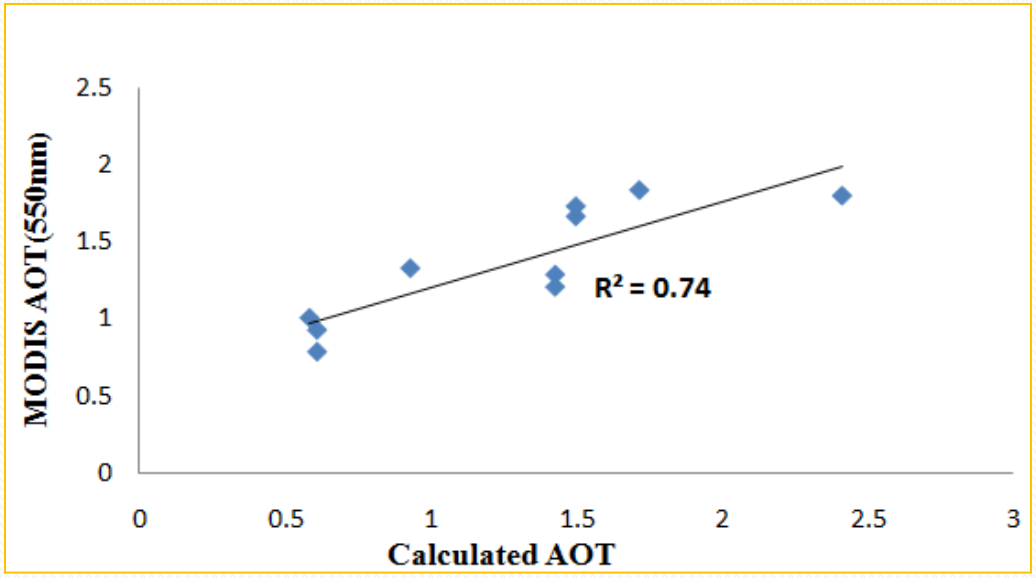


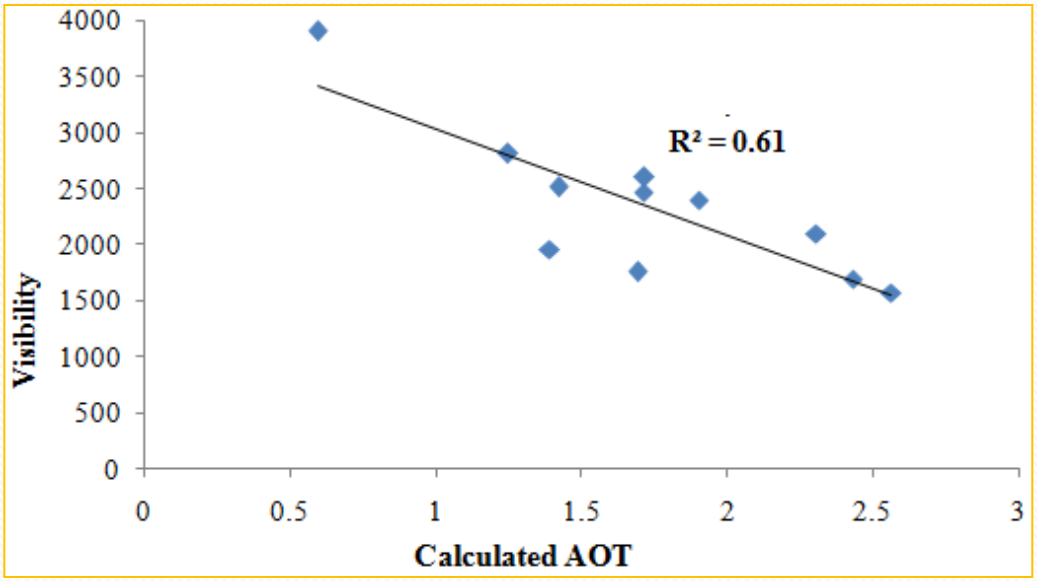
July 5, 2009



Spectral Analysis

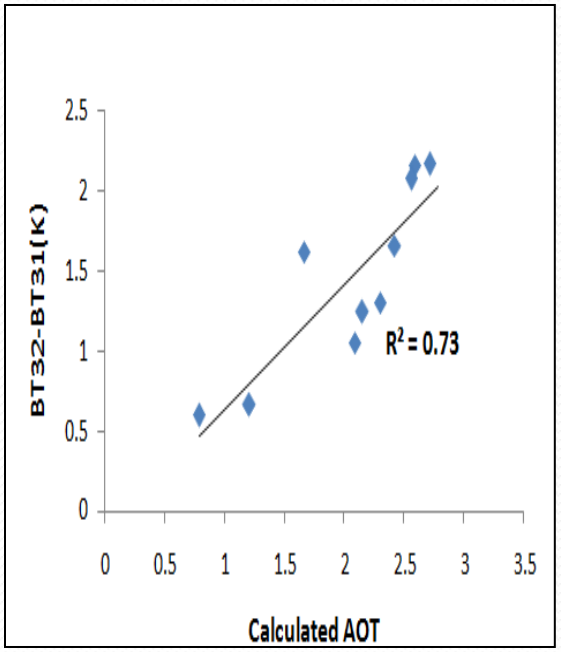
Dust Indices verification

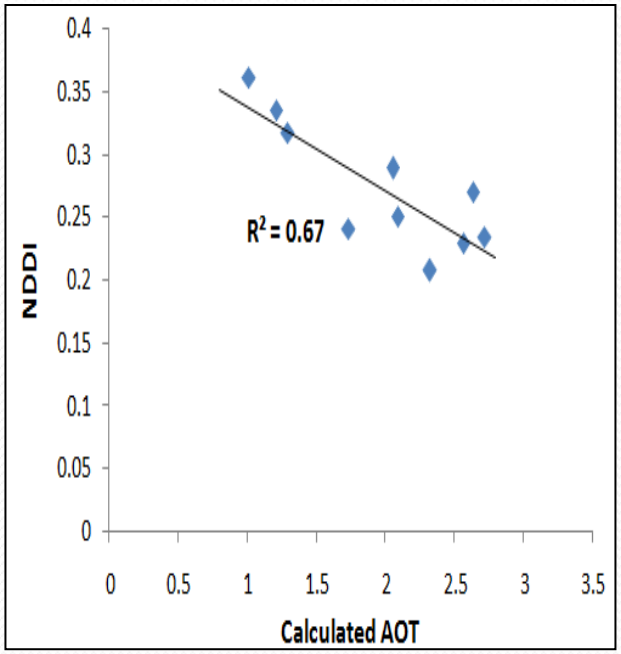


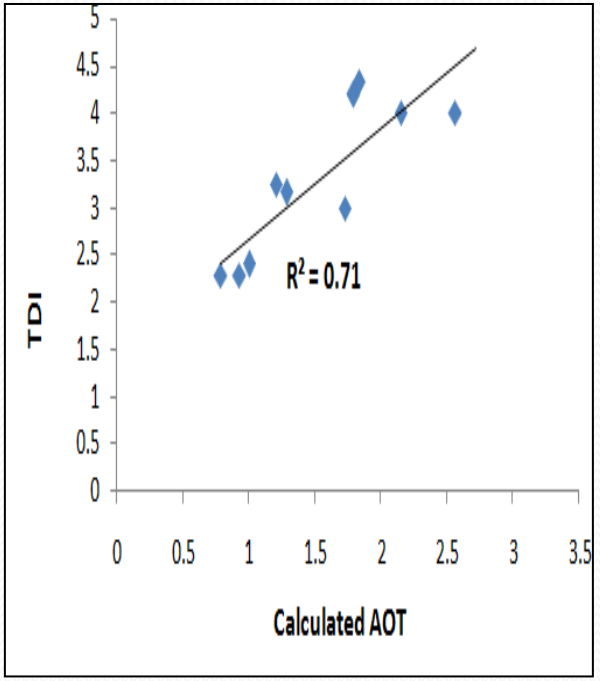


Spectral Analysis

Empirical AOT verification

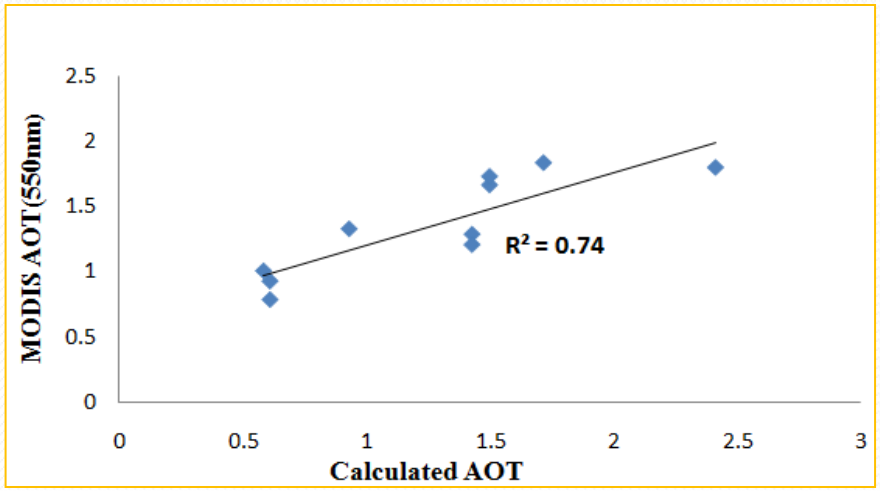


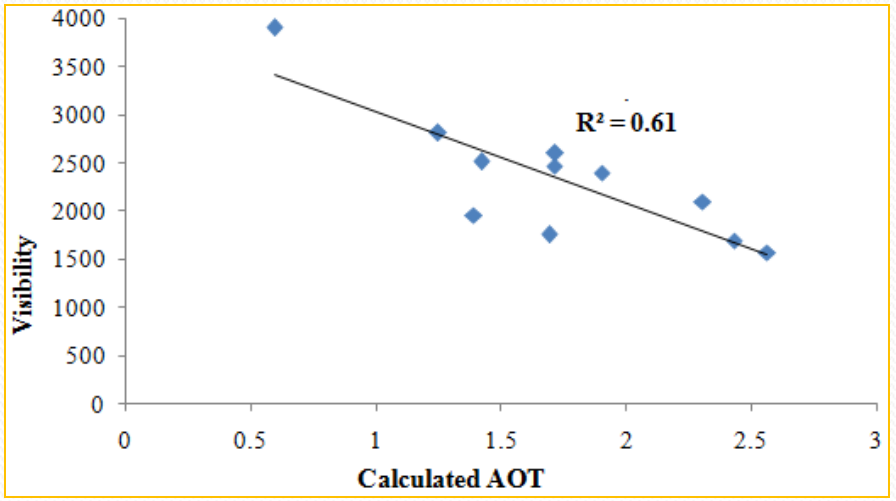




Spectral Analysis

Empirical AOT verification





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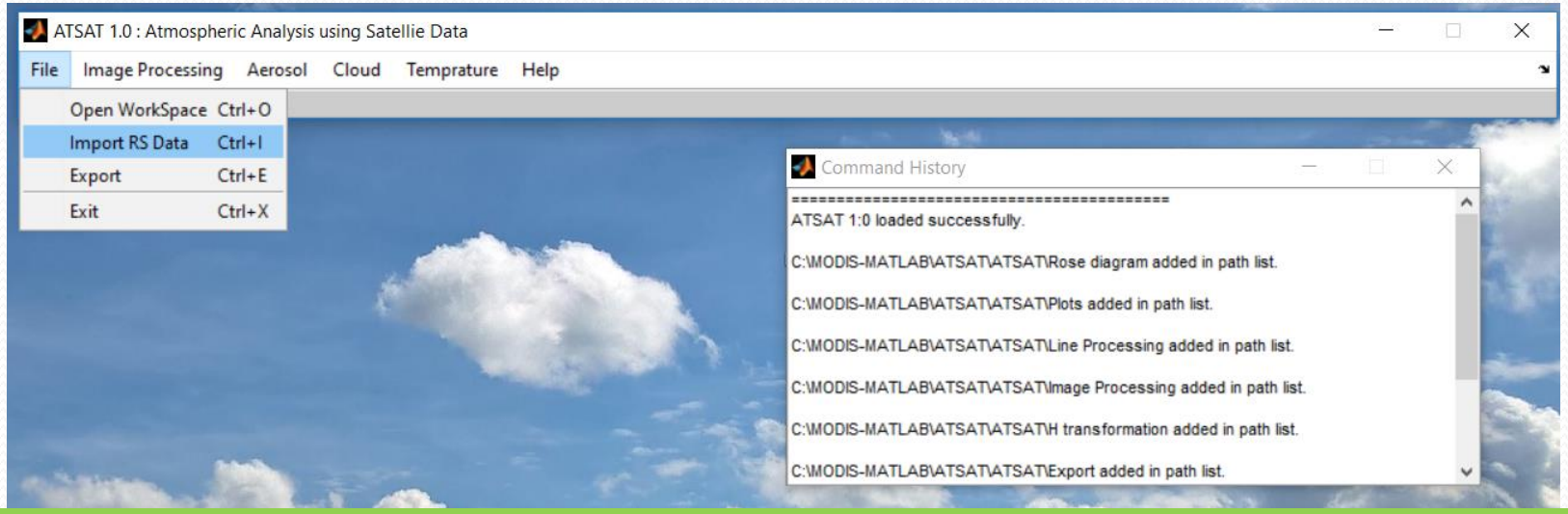
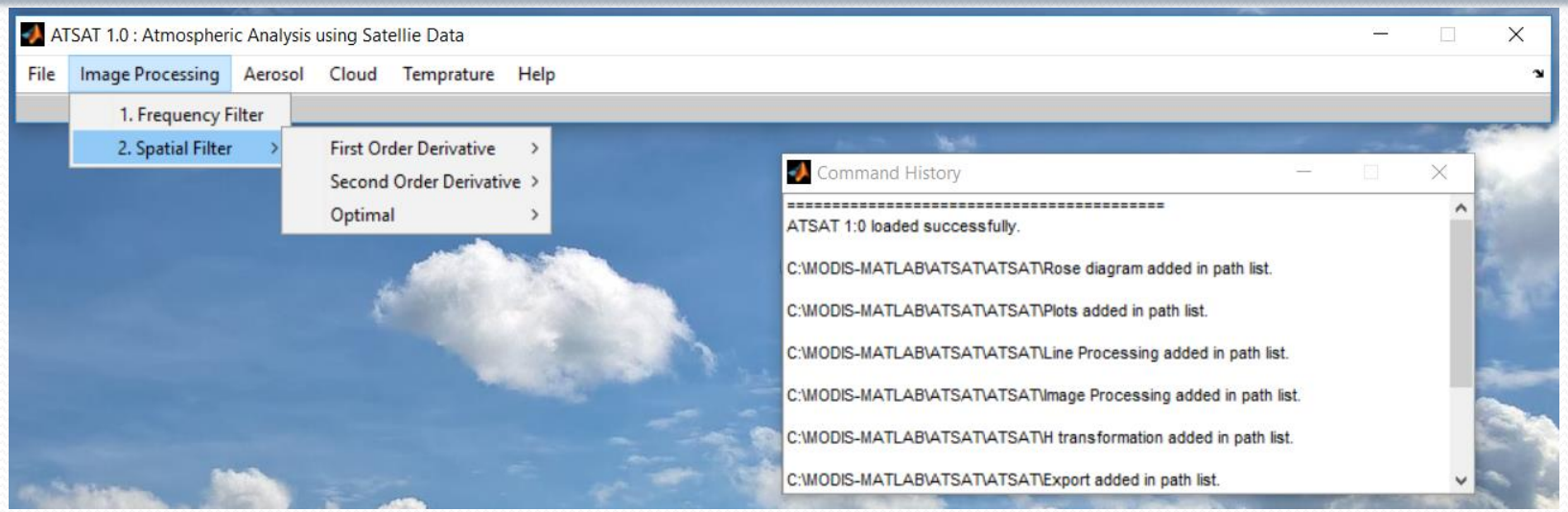
Dust detection and AOT estimation using combined VIR and TIR satellite images in urban areas of Iran

S. Sehatkashani[a], M. Vazifedoust[b,*], Gh. Kamali[a] and A.A. Bidokhti[c]

Spectral Analysis

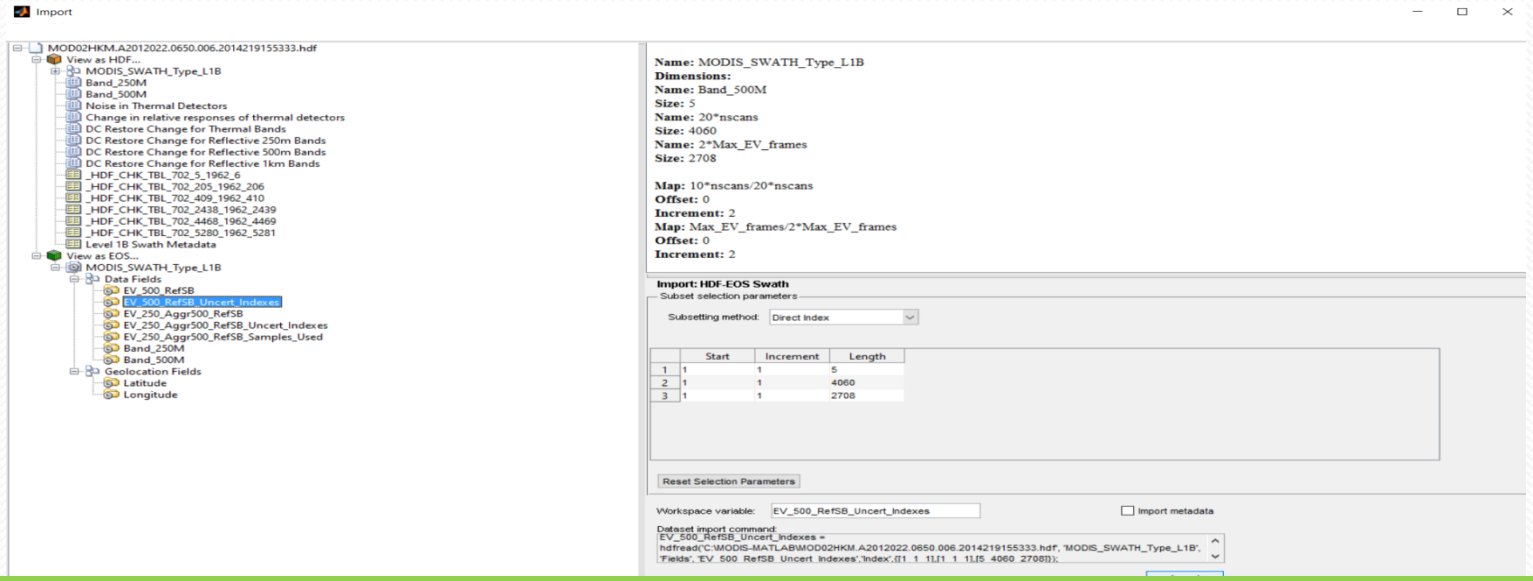
Dust Classification Approach

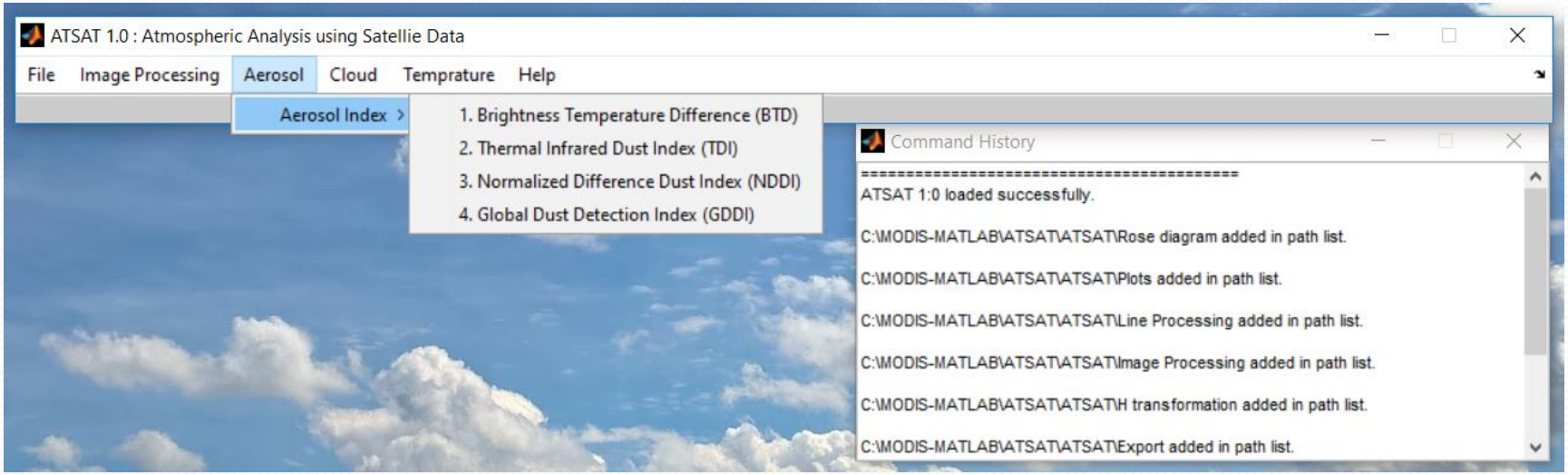




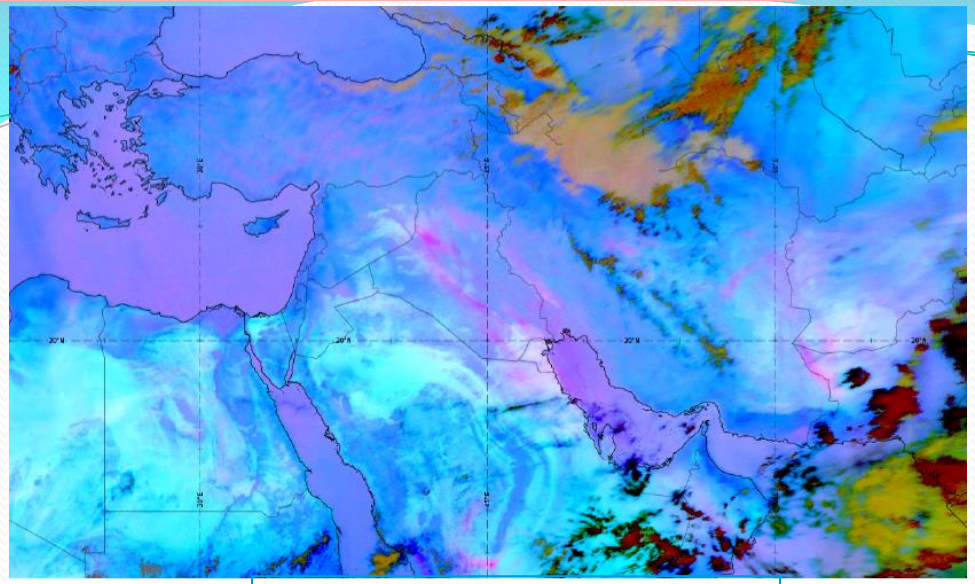
Spectral Analysis

Dust Classification Approach





Sistan July 2016 Dust Event



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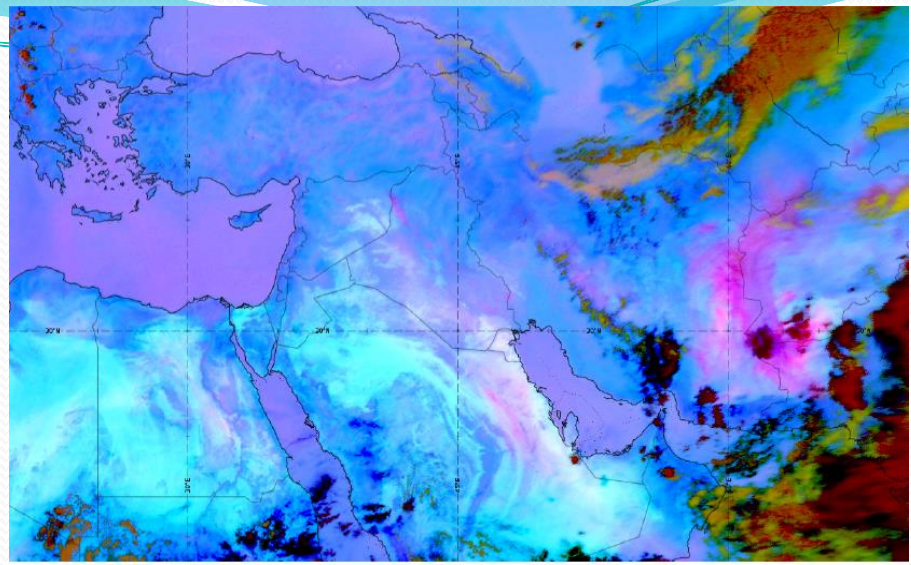

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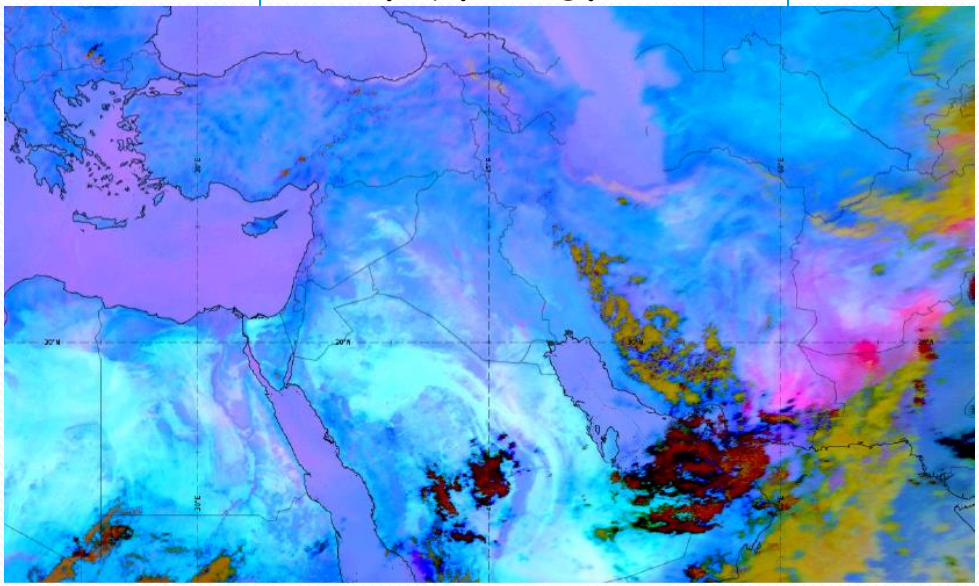

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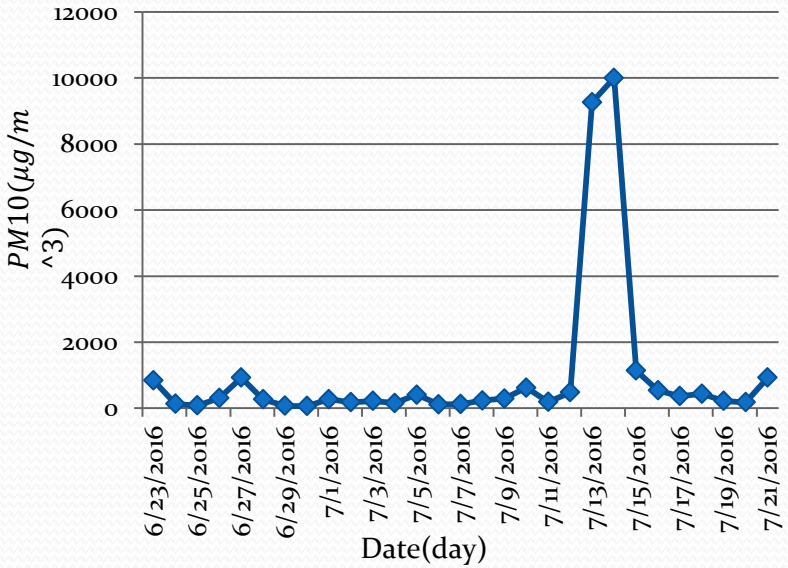
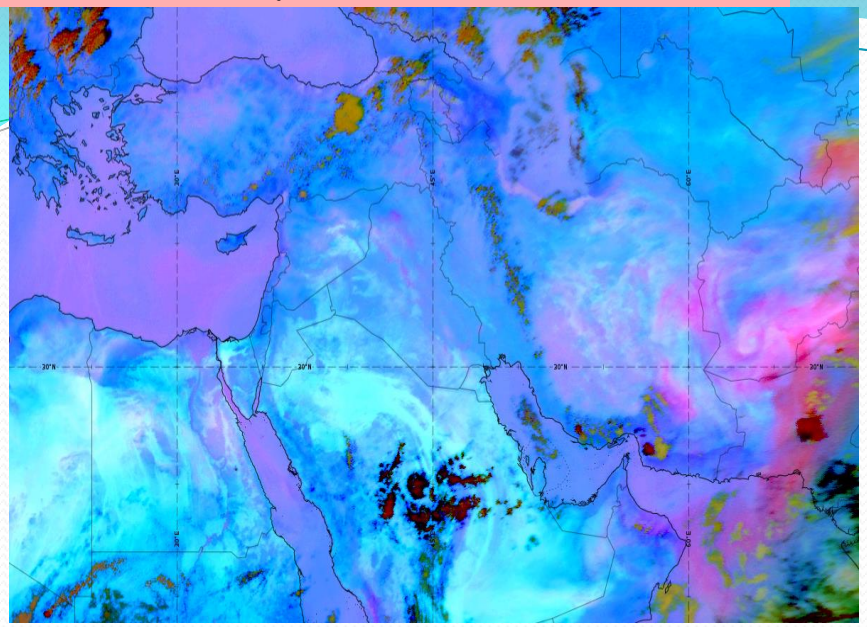


Sistan July 2016 Dust Event



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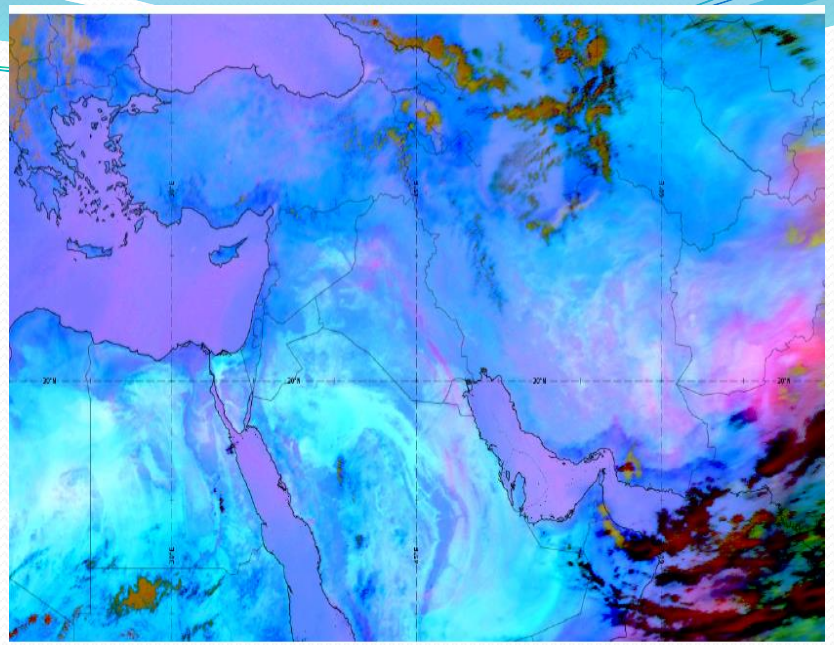

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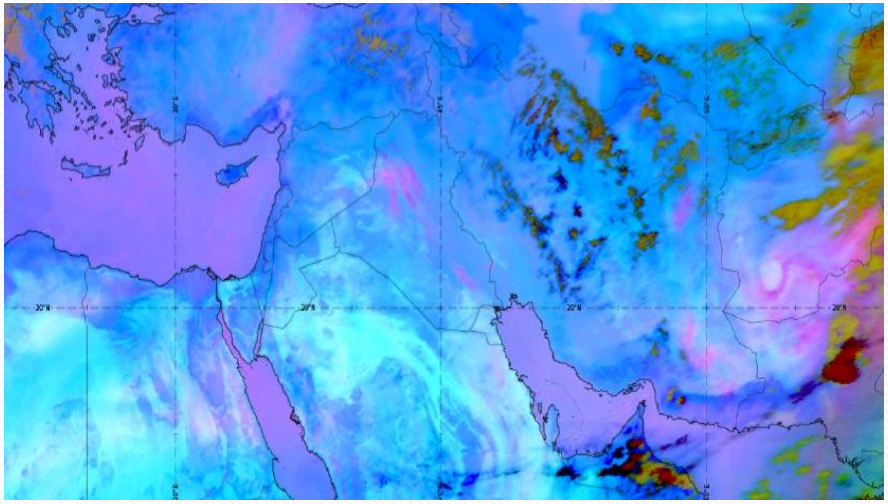

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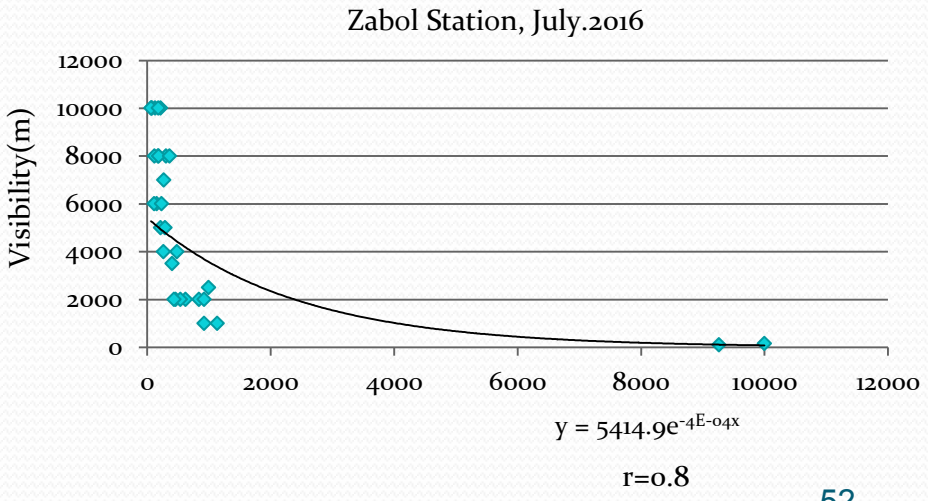

Only together

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Source: UNICEF

Thank you

Mount Damavand

Sehat.s@asmerc.ir