STUDY OF MINERAL DUST USING REMOTE SENSING TECHNIQUES

7TH. TRAINING COURSE ON WMO(SDS-WAS) PRODUCTS

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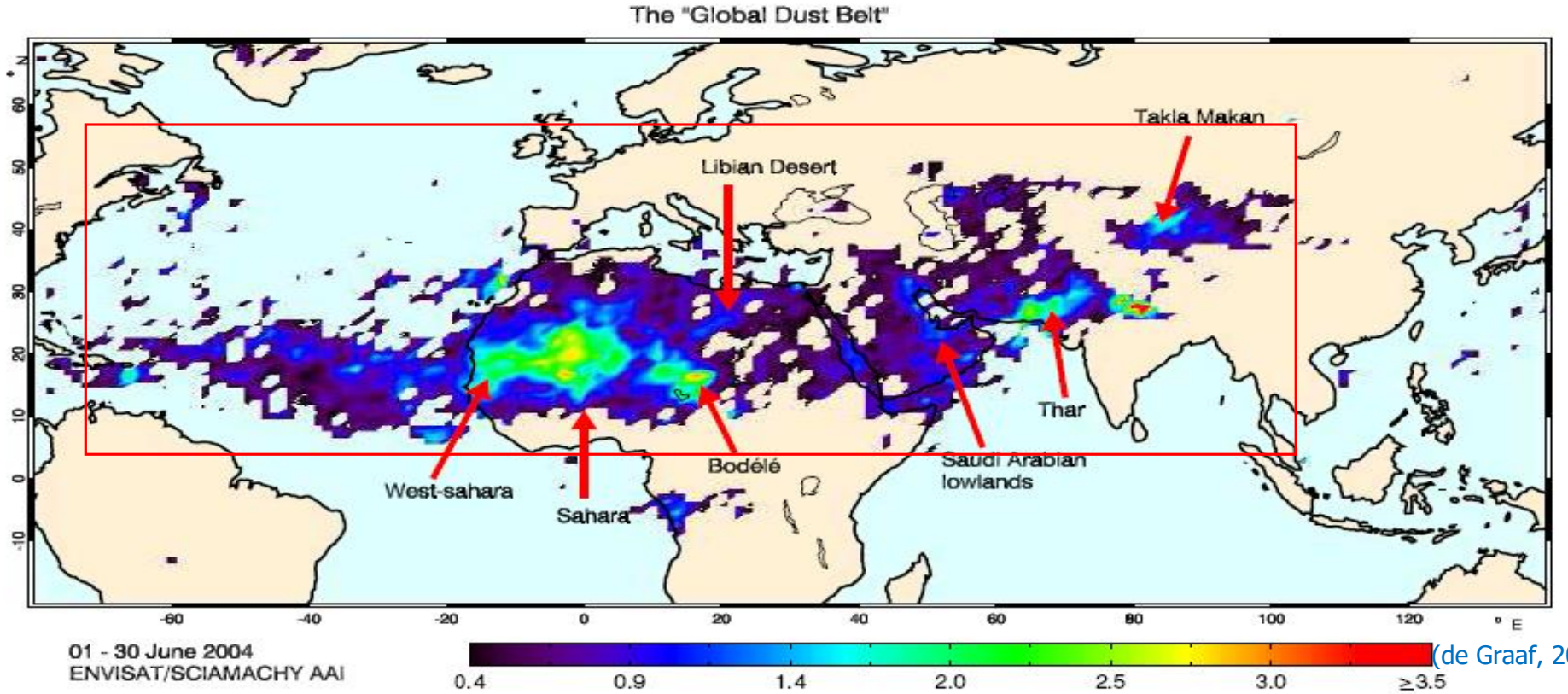
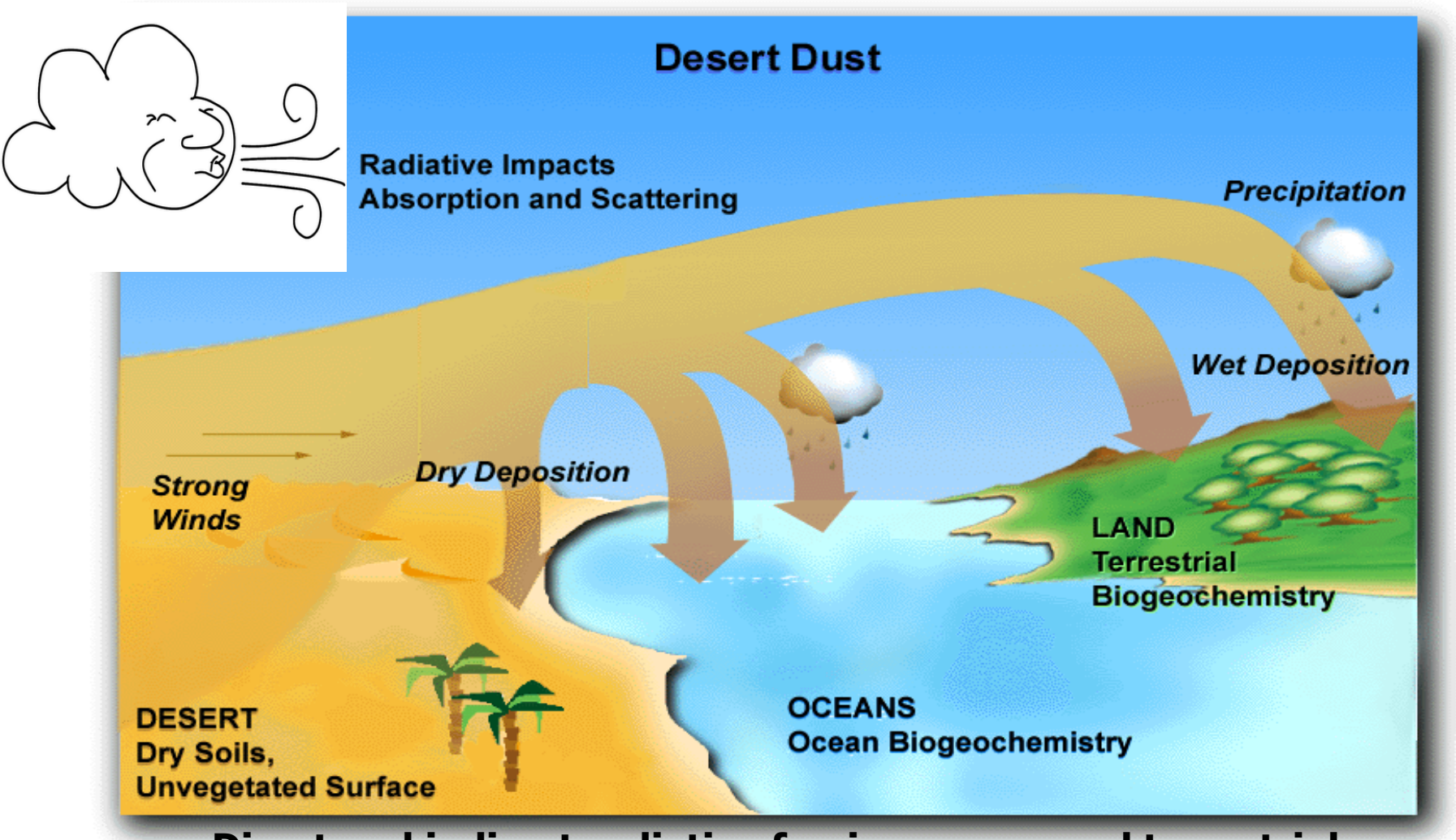
Atmospheric Science and Meteorological Research Centre(ASMERC),I.R.of Iran Meteorological Organization(IRIMO), Tehran, Iran

Dust Climatology over West Asia



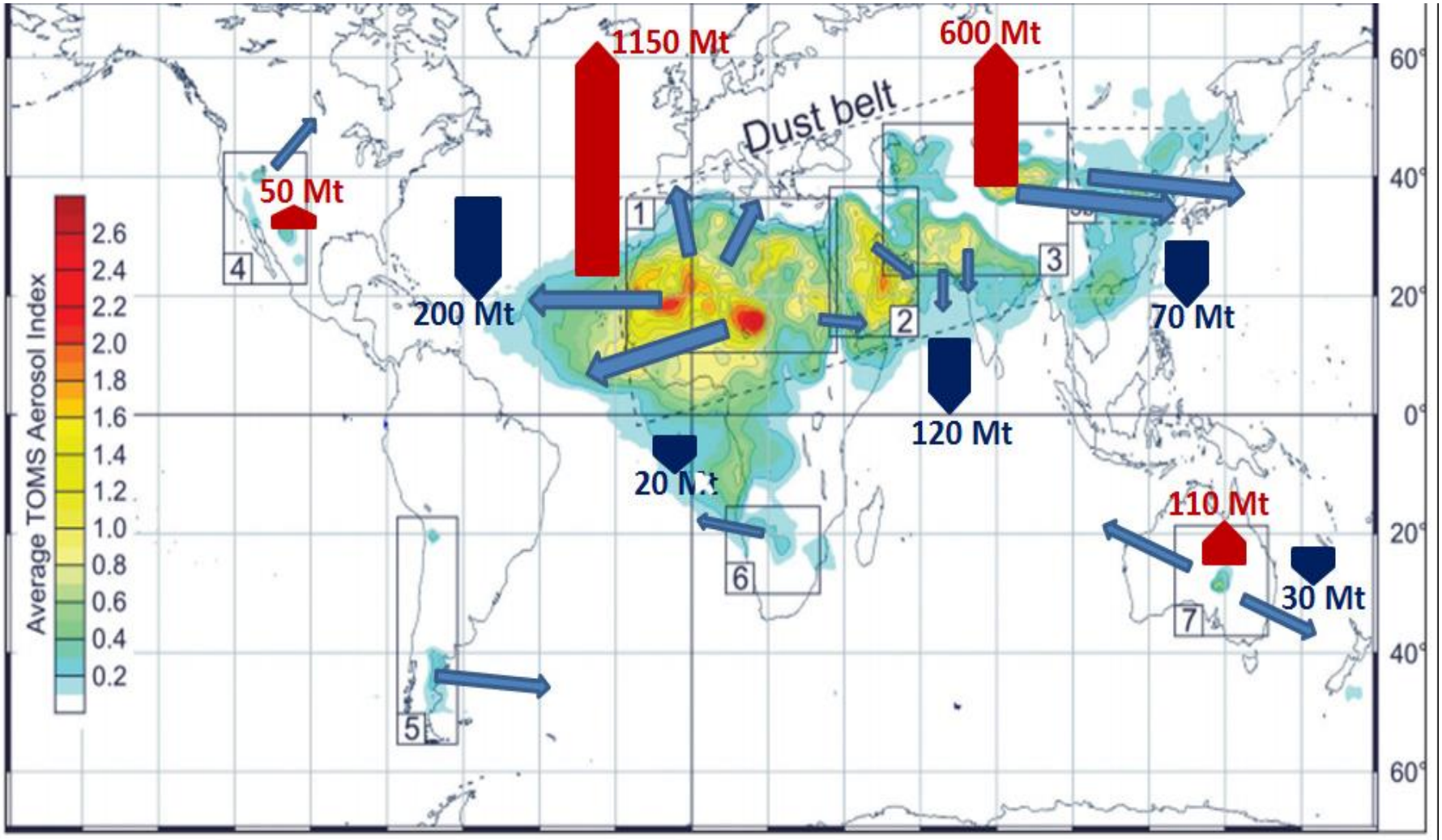
(de Graaf, 2006)

Mineral dust in the Earth climate system:



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

Major source areas and long-range transport trajectories for desert dust



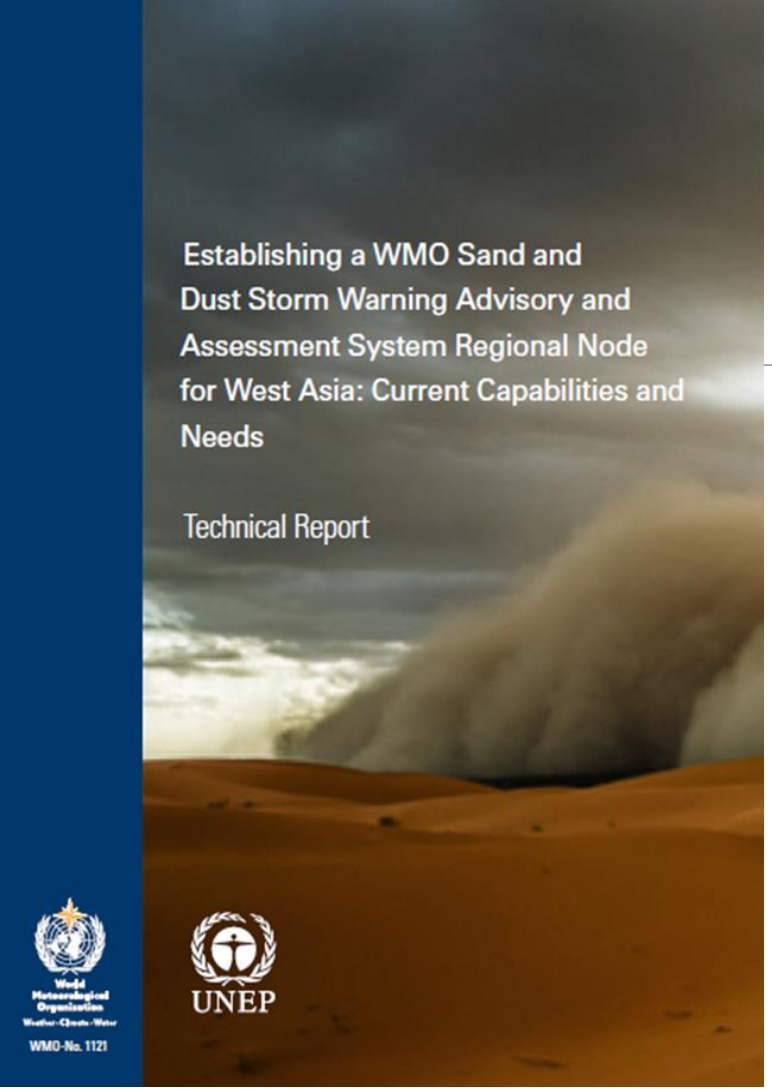
Background

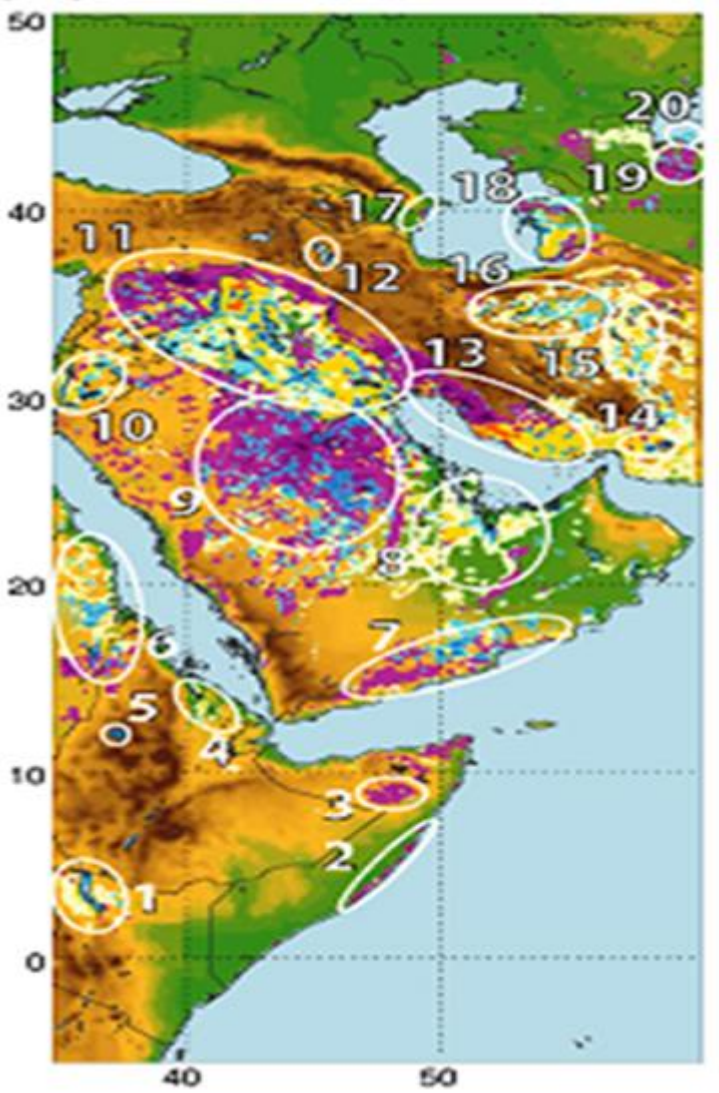
Maximum PM_{10} levels recorded in dust storms in Asia and the Middle East

Location	Date	PM_{10} (µg/m3)	Reference
WHO air quality guideline (24-hour mean)	–	50	
Doha, Qatar	1 April 20	000,000	Irfan et al. (2017)
Dalanzadgad, Mongolia		6626	Jugder et al. (2011)
Sanandaj, Iran		5619	Amanollahi et al. (2013)
Beer-Sheva, Israe		5197	Krasnov et al. (2014)
Jahra city, Kuwait		3171	Saeed and Al-Dashti (2011)
Zabol, Iran		3094	Rashki et al. (2012)
Bikaner, India		2907	Yadav and Rajamani (2006)
Urumqi, China		2635	Li et al. (2008)
Abu Dhabi, UAE	20 Mar 2012	1653	Basha et al. (2015)

Many epidemiological studies show possible associations of dust exposure with increase in mortality and hospital visits and admissions due to cardiovascular and respiratory diseases

from Nick Middleton Presentation, ESCAP meeting, Tehran, Nov.2018

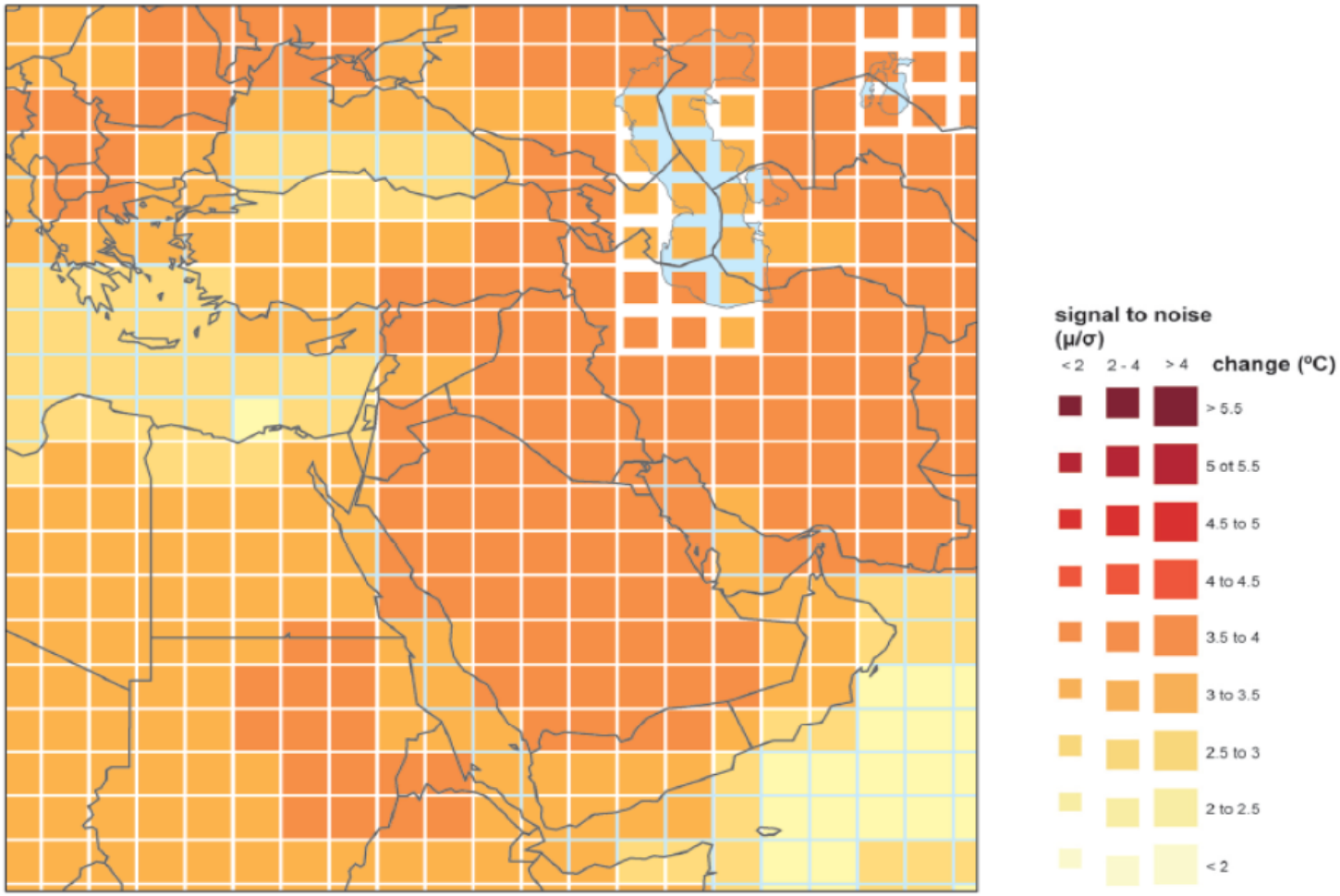




Available at:
http://www.wmo.int/pages/prog/arep/wwrp/new/documents/1121_SDS_Technical_Report_en.pdf

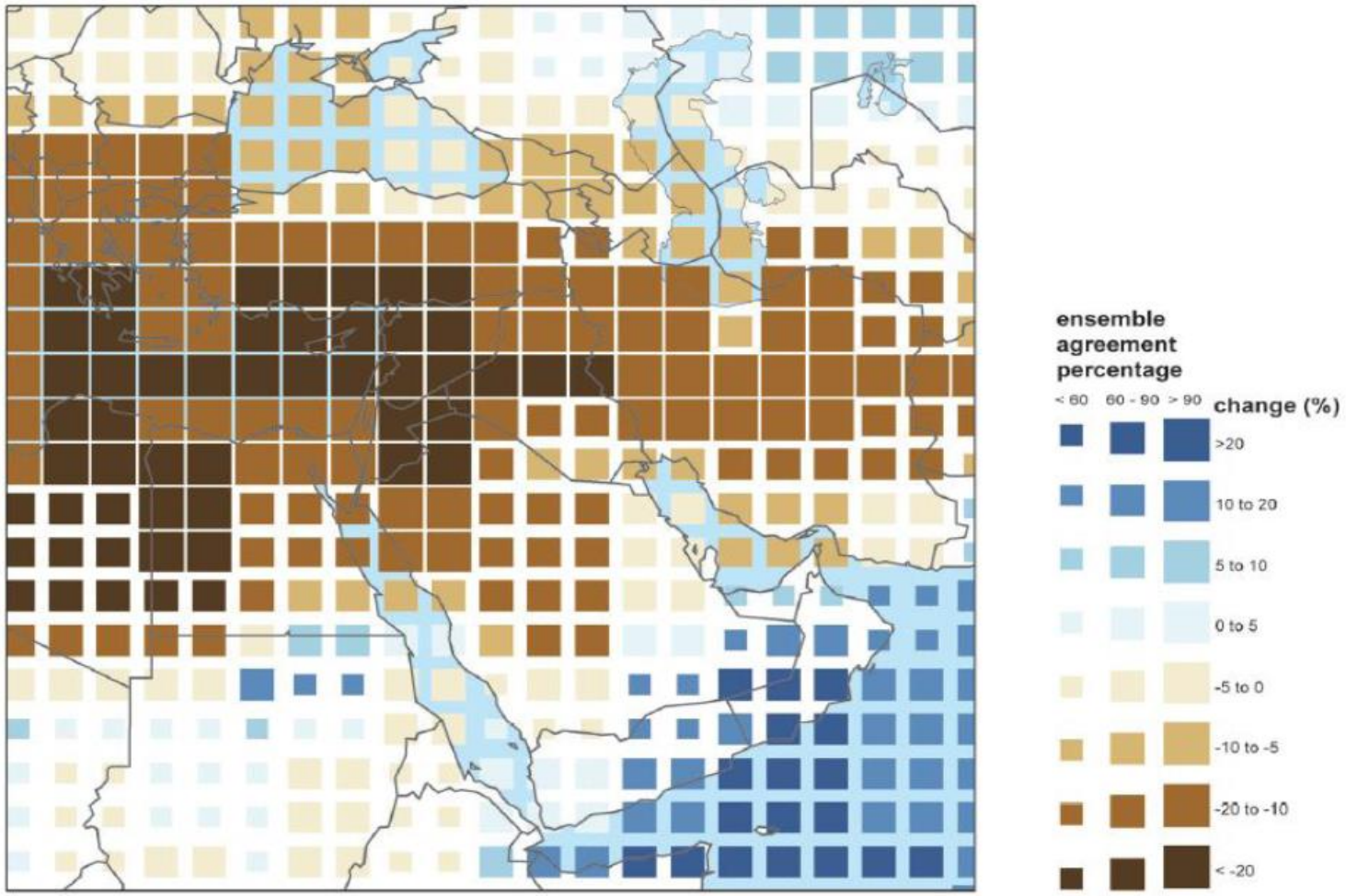
Ginoux et al.2012

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).**

Dust Climatology over West Asia

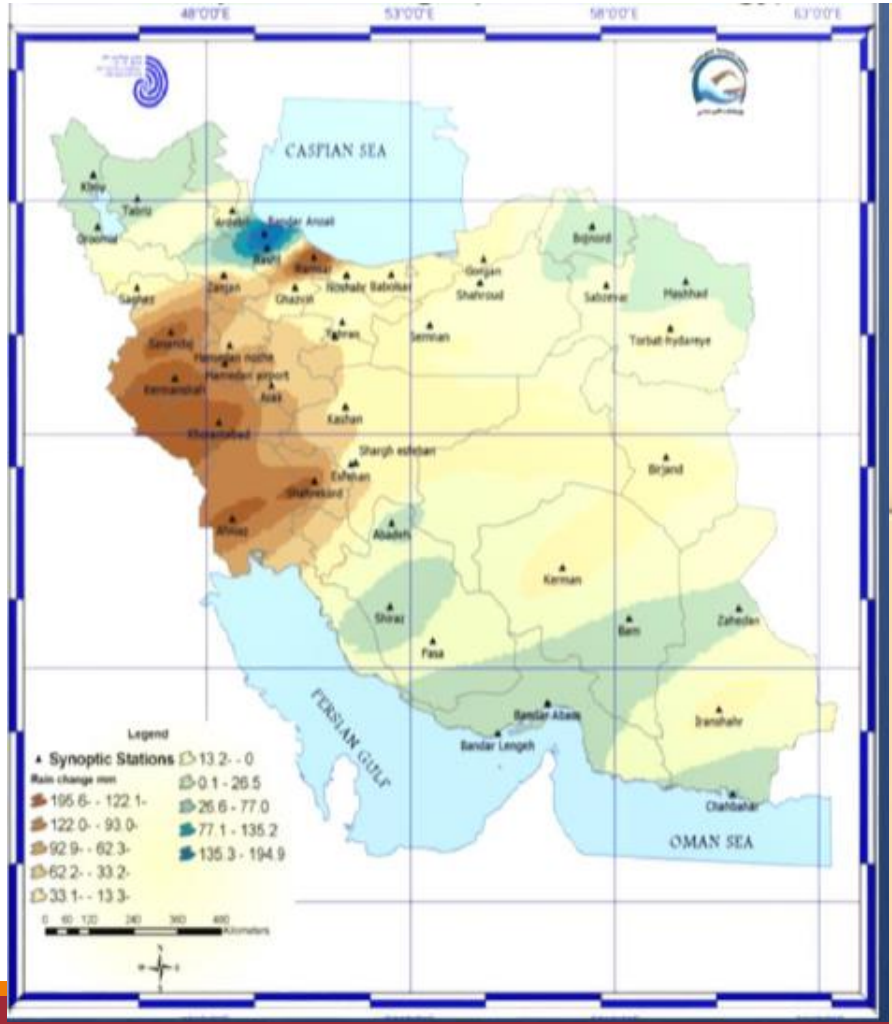


Percentage change in average annual precipitation by 2100 from 1960-1990 baseline climate, averaged over 21 CMIP3 models for West Asia. The size of each pixel represents the level of agreement between models **(Met Office, 2011).**

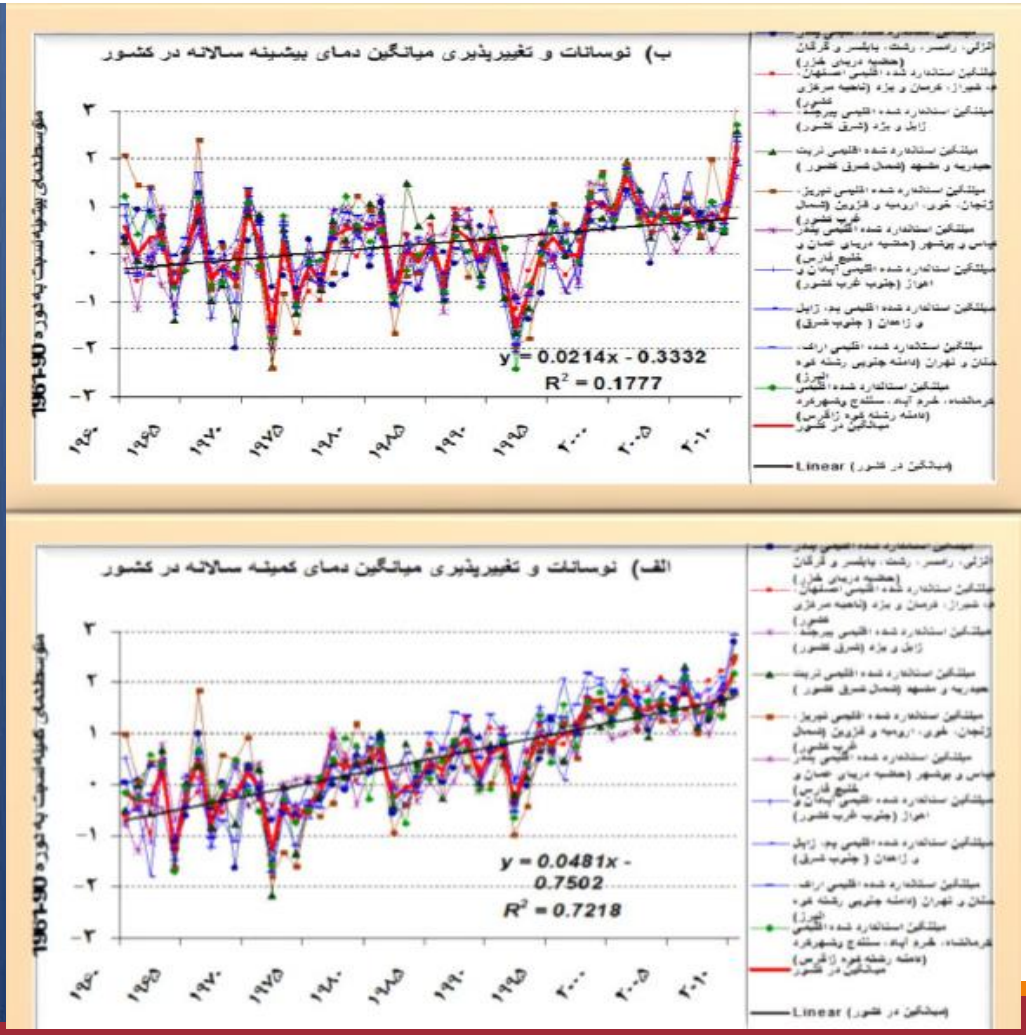
Background

Dust Climatology over Iran

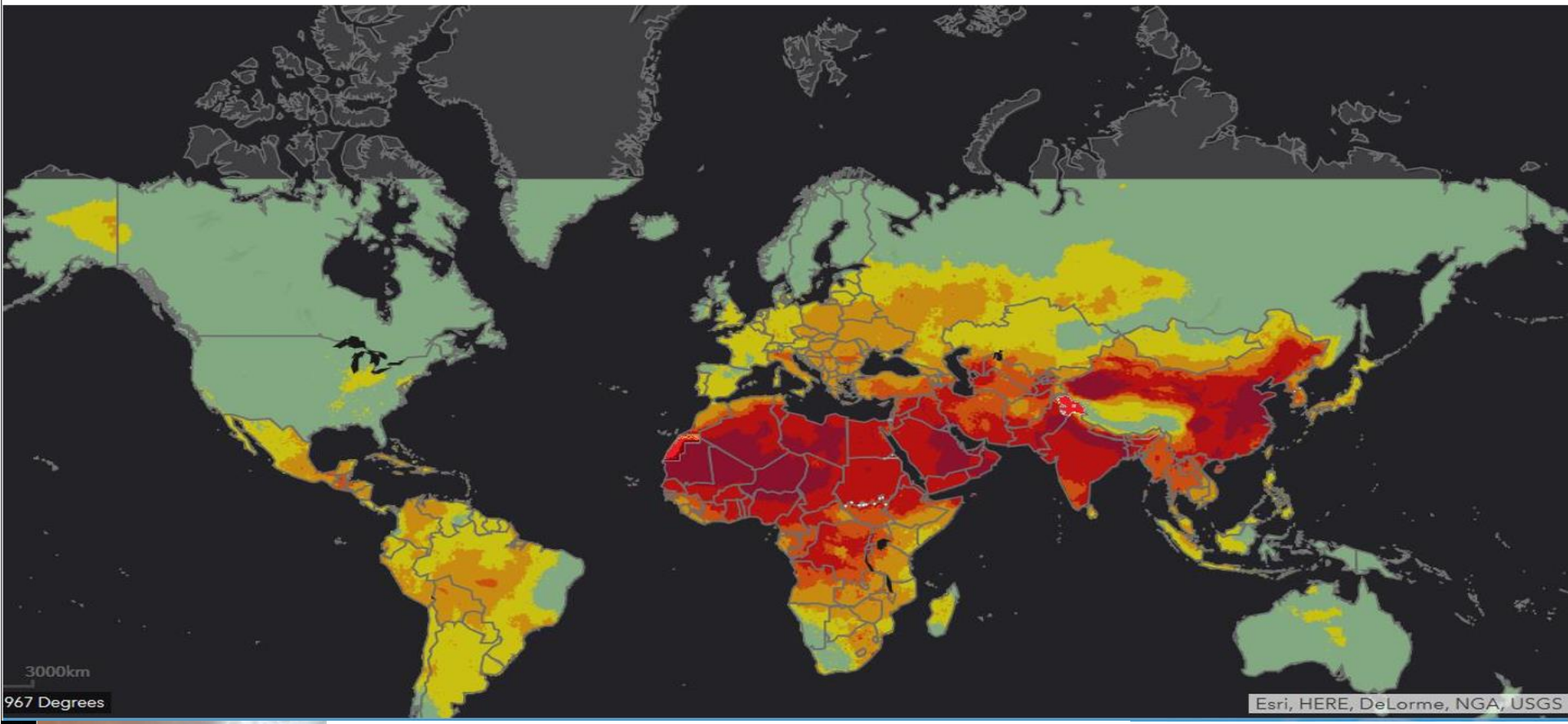
Precipitation variation(1960-2010)



Tmax and Tmin Variation(1960-2010)



Modeled PM2.5 *(WHO September 2016)*



Zabol: highest for PM2.5s

Zabol, an eastern Iranian city on the border with Afghanistan, was once at the heart of a bustling ancient civilisation, close to where the very first piece of animation came from in the form of an intricate pottery bowl dating back 5,000 years that displays a goat in motion.

But the city is now a largely neglected area plagued by poverty - and pollution.

Every summer, as temperatures rise to staggering levels of 40C or even higher, Zabol is struck by what is locally known as "120 days of wind", relentless dust storms from north to south.

From Mazen Malkawi presentation, 5th International Workshop on Sand and Dust Storms, Istanbul, TURKEY, 23-25 October 2017

Tehran Ministerial Declaration

Intl. event issues Tehran Declaration, vows to fight dust storms

July 5, 2017 Politics

TEHRAN – Ministers and high-level representatives participating in the UN-backed International Conference on Combating Sand and Dust Storms in Tehran (July 3-5) wrapped up the second day with the Tehran Ministerial Declaration, agreeing to "cooperate on combating SDS at sub-regional regional, and international levels."

Here is the full text of the declaration:

6- **Strengthen** research activities for effective monitoring, impact based assessment and forecasting and early warning mechanism for Sand and Dust Storms, to address disaster prevention and mitigation and for development of appropriate preparedness and effective response to Sand and dust storms,

7- **Encourage** enhanced regional and international cooperation to observe and forecast, mitigate and cope with the adverse effects of Sand and Dust Storms, and seek technical and financial support from the relevant United Nations organisations to that end.

8- **Consider** to further develop policy dialogue on responding to the issues of sand and dust storms among interested countries in partnership with relevant international bodies and organizations, including the establishment of a future platform, in synergy with relevant United Nations System.

9- **Recognize** the role of the Asian and Pacific Center for the Development of Disaster Information Management (APDIM), regional seas programs and SDS-WAS, to develop human and institutional capacity through strengthened regional cooperation in disaster information management.

News ID: 1467182 Service: Society/Culture

July, 17, 2017 - 17:04

TEHRAN (Tasnim) – More than 5,000 local residents in Iran's southeastern Sistan region have received medical treatment in hospitals as a persistent sandstorm, part of annual '120-day winds', is tearing through the area.

Sandstorm injures 145 in SE Iran

Society 08.10.2018 | 14:48

NEWS OF THE STORY
NEWS FROM OUR PARTNERS

- N. Korean leader invites pope to Pyongyang
- Hurricane Michael batters west Cuba with heavy rains, strong winds
- Preliminary results for Bosnia and Herzegovina PA - SDA and SNSD win most votes so far

OTHER STORIES

Zahedan, 8 Oct (BelTA - IRNA) – A total of 145 people have referred to the hospitals and healthcare centers in Iran's southeastern province since Saturday due to breathing, eye and heart problems, out of whom 27 were hospitalized, said Abdol Rahman Shahnavazi.

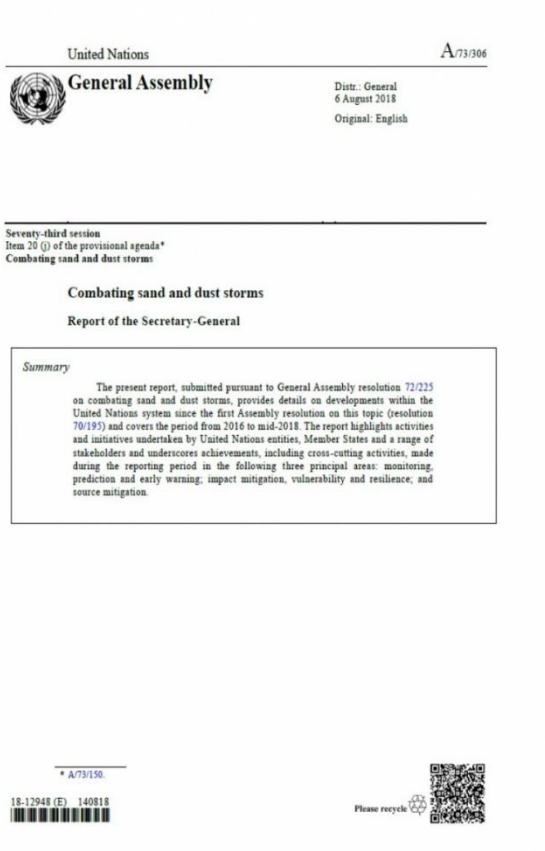
Referring to the rising pace of storm in recent days, he said that the storm speed reached 104 km an hour and the particulates were as high as 19 times the standard on Sunday.

Shahnavazi added that vision has been confined to 900 meters.

Sick people and senior citizens have been asked to stay home in some parts of the province.

Combating sand and dust storms Report of the UN Secretary-General A/73/306 August 2018

- Monitoring, prediction and early warning
- Impact mitigation, vulnerability and resilience
- Source mitigation
- Cross-cutting developments



United Nations A/73/306

General Assembly

Distr.: General
6 August 2018
Original: English

Seventy-third session
Item 20 (j) of the provisional agenda*
Combating sand and dust storms

Combating sand and dust storms

Report of the Secretary-General

Summary

The present report, submitted pursuant to General Assembly resolution 72/225 on combating sand and dust storms, provides details on developments within the United Nations system since the first Assembly resolution on this topic (resolution 70/195) and covers the period from 2016 to mid-2018. The report highlights activities and initiatives undertaken by United Nations entities, Member States and a range of stakeholders and underscores achievements, including cross-cutting activities, made during the reporting period in the following three principal areas: monitoring, prediction and early warning; impact mitigation, vulnerability and resilience; and source mitigation.

* A/73/150.

18-12948 (E) 140818

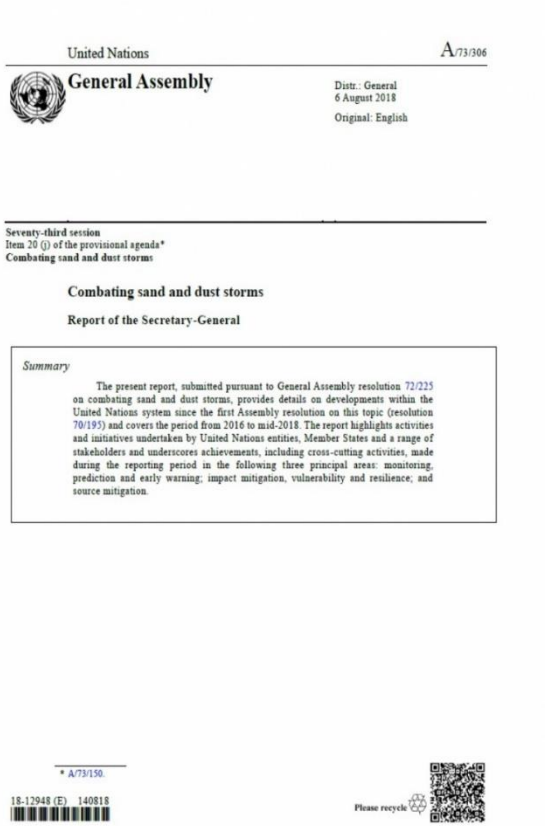
Please recycle

from Nick Middleton Presentation, ESCAP meeting, Tehran, Nov.2018

Combating sand and dust storms Report of the UN Secretary-General A/73/306 August 2018

Contributions from

- UN Environment (UNEP)
- World Meteorological Organization (WMO)
- UN Convention to Combat Desertification (UNCCD)
- Food and Agriculture Organization (FAO),
- Economic and Social Commission for Asia and the Pacific (ESCAP),
- UN Office for Disaster Risk Reduction (UNISDR)
- World Health Organization (WHO)



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* A/73/150.

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Coalition on Combating Sand and Dust Storms

- Cooperation at the global, regional and national levels in line with agencies' ongoing initiatives and in response to associated international calls
- UN bodies invited to highlight their agencies' ongoing or planned initiatives on sand and dust storms, opportunities for collaborative action in this area and their interest in joining the Coalition

from Nick Middleton Presentation, ESCAP meeting, Tehran, Nov.2018

Examples of cooperation between WMO SDS-WAS & IRIMO

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5th Training Course on WMO SDS-WAS products

Satellite and ground observation and modelling of atmospheric dust

I. R. of Iran Meteorological Organization (IRIMO),

Atmospheric Science and Meteorological Research Center (ASMERC),

European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and

Barcelona Dust Forecast Center (BDFC)

World Meteorological Organization (WMO)

When	Nov 05, 2016 to 2016
Where	Tehran, I. R
Add event to calendar	iCal

I.R.OF IRAN METEOROLOGICAT ORGANIZATION

ASMERC

EUMETSAT

WMO OMM

World Meteorological Organization

Organisation météorologique mondiale

Organización Meteorológica Mundial

Всемирная метеорологическая организация

المنظمة العالمية للأرصاد الجوية

世界气象组织

Our ref.:RES/WWR/AER/SDS-WAS/NAMEE SG

Ms. Saviz Sehat Kashani
The I.R. of Iran Meteorological (IRIMO)
P.O. Box 13185-461
Islamic Republic of Iran
E-mail: intl-affairs@irimet.net

GENEVA, 27 April 2017

Subject: Membership in the Steering Group of WMO SDS-WAS Regional Node for Northern Africa, Middle East and Europe

Dear Ms. Saviz Sehat Kashani,

On behalf of the World Weather Research Programme (WWRP) and Global Atmosphere Watch (GAW) Programme of the World Meteorological Organization (WMO), I am pleased to invite you to become a member of the Steering Group of WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) Regional Node for Northern Africa, Middle East and Europe (NAMEE), chaired by Dr. Slobodan Nickovic. This Steering Group coordinates implementation of the SDS-WAS objectives in the NAMEE region and reports to the global SDS-WAS Steering Committee, chaired by Dr. Enric Terradellas. The work is further guided by the World Weather Research Programme Scientific Steering Committee (WWRP-SSC) chaired by myself. The WWRP-SSC has been established under the WMO Commission for Atmospheric Sciences (CAS), whose President is Prof. Dr. Øystein H

Examples of cooperation between WMO SDS-WAS & IRIMO

case occurred in Sistan-Baluchestan, an Iranian province located in the SW of the country, along the border with Afghanistan and Pakistan. A progressive dessication of the wetlands caused by climate change, by a prolonged drought and by overuse of water resources on both sides of the border, has turned this province into one of the dustiest places on the planet (Alizadeh-Choobari et al., 2014). In particular, the disappearance in the early 2000s of the nearby Hamoun lake has exacerbated the situation in the city of Zabol to an unprecedented extent.

Figure 6: According to WHO, Iran's south-eastern Zabol city ranks first among the most polluted cities in the world

The Sistan endorheic basin is the most active dust source in the interior of Iran, with an average of 167 dusty days per year. Dust storms within the basin may occur at any time throughout the year, but they are more frequent from mid-May to mid-September when there is little or no precipitation and the strong northerly "wind of 120 days" (locally known as Levar) is the dominant flow. This wind is the result of a meridional pressure gradient between a persistent cold high-pressure system over the high mountains of the Hindu-Kush and a summertime thermal low over the desert lands of eastern Iran and western Afghanistan. When the synoptic situation reinforces the wind speed, entrainment of dust particles from bare soils, particularly from dried wetlands, where large amounts of erodible sediment are available, is also accelerated.

Between 13 and 14 July 2016, a strong anticyclone over the Caspian sea and a well-developed thermal low over western Afghanistan and southern Iran produced significant increase in the meridional pressure gradient, reinforced surface wind speed and strong intensification of dust release. The dust plume spread over the entire south-eastern part of Iran, as obser ved in the METEOSAT RBG-dust product of 13 July at 12 UTC, where dust is highlighted in pink colour (Figure 7). Daily-averaged PM10 reached 10,000 μg/m³ in Zabol, whereas visibility was reduced to less than 100 m (Figure 8).

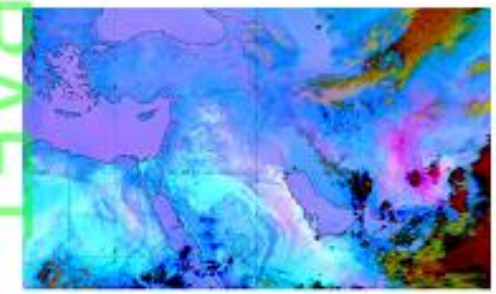

Figure 7: METEOSAT RGB-Dust product of 13 July 2016 at 12 UTC

News agencies reported that thousands of people were provided with emergency aid and dust masks by the Iranian Red Crescent as dust storms blew through the province of Sistan-Baluchistan, affecting major towns as Zabol, Zahak, Nimrouz, and Hirman along with small towns and villages.The high frequency of similar episodes makes the situation unsustainable. Decades of poor water management, depleting underground water, and policies of development that failed to consider the impact on the environment and ecosystems, have taken a toll on Iran's environmental future. Fortunately, steps have already been taken to reverse the situation, both nationally and internationally. UNEP has worked with Iran and Afghanistan to try to rehabilitate the Hamouns -seasonal or ephemeral lakes- and UNESCO has designated them as a biosphere reservoir. At a national level, authorities are revising irrigation methods and agricultural use of about 46,000 hectares of land in Sistan-Baluchistan to make farming more sustainable.

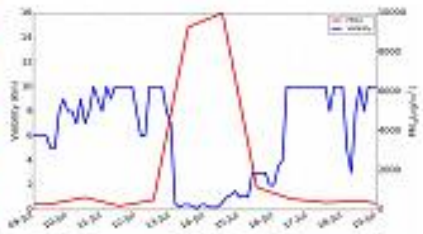

Figure 8: Daily-averaged PM10 and visibility records from Zabol

World Meteorological Organization
Weather • Climate • Water
GLOBAL ATMOSPHERE WATCH
WWRP

WMO AIRBORNE DUST BULLETIN

Sand and Dust Storm – Warning Advisory and Assessment System

No. 1 – March 2017

WMO SDS-WAS Regional Center for Asia

website: http://eng.nmc.cn/sds_was.asian_rc

Editorial board

Enric Terradellas (State Meteorological Agency of Spain), **Xiaoye Zhang** (Chinese Academy of Meteorological Sciences), **David Farrell** (Caribbean Institute for Meteorology and Hydrology) and **Alwxander Baklanov** (WMO)

Other contributors to this issue

Sara Basart, Gerardo García-Castrillo, Faezeh Noori, Abbas Ranjbar, Saviz Sehatkashani.

Examples of cooperation between WMO SDS-WAS & IRIMO

WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)

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Latest News

New members of the SDS-WAS Regional Steering Group for Northern Africa, Middle East and Europe
Jul 24, 2017

Cooperation between Spain and Iran in the framework of SDS-WAS
Jul 24, 2017

WMO supports the International Conference on sand and dust storms currently held in Tehran
Jul 04, 2017

Upcoming Events

Goldschmidt 2017. Session 9H: Variability of dust composition
Aug 13, 2017 - Aug 18, 2017 — Paris, France

16th AeroCom, 5th AeroSAT meeting
Oct 09, 2017 - Oct 13, 2017 — Helsinki, Finland

International Workshop on

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Cooperation between Spain and Iran in the framework of SDS-WAS

by Enric Terradellas — last modified Jul 24, 2017 10:13 AM

Dr. **Saviz Sehat Kashani**, Academic member of **Atmospheric Science and Meteorological Research Center** (ASMERC) of the Islamic Republic of Iran Meteorological Organization (IRIMO), participated in the training course on "**Atmospheric Aerosols and Mineral Dust**". The training course was organized by the **WMO Sand and Dust Storm Warning Advisory and Assessment System** (SDS-WAS) Regional Centre for Northern Africa, Middle East and Europe, hosted by tha State Meteorological Agency of Spain (AEMET) and the Barcelona Supercomputing Centre. It was held at the AEMET's Izaña Atmospheric Research Centre (IARC) from 20th June to 6th July 2017.

During the event, Dr. Sehat received information from Dr. **Emilio Cuevas** on the SDS-WAS program and specifically on mineral dust observation, complementarities and synergies between SDS-WAS and the WMO Global Atmospheric Watch (GAW) program

Dr. **Africa Barreto** introduced the main concepts of lidar technique and presented the lidar program conducted at the IARC to characterize the vertical structure of the Saharan Air Layer (SAL). Dr. **Carmen Guirado** was in charge of detailing operational and research aspects of solar photometry techniques and specifically the AERONET program and the European ACTRIS project. She provided practical information on sun photometry calibration by using the handheld Calitoo (Tenum) sunphotometer, and on activities carried out at the optical laboratory.

Examples of cooperation between WMO SDS-WAS & IRIMO

22-24 MAY 2018 – TENERIFE

- HOME
- WORKSHOP BACKGROUND
- SCOPE AND TOPICS
- WORKSHOP AND ADDITIONAL ACTIVITIES
- TENERIFE
- SCIENTIFIC PROGRAM
- GALLERY
- COMMITTEES
- SCHEDULE
- PROGRAM
- ABSTRACTS
- IMPORTANT DATES
- SPONSORS & COLLABORATIONS

DUSTWORKSHOP9

The 9th International Workshop on Sand / Dust storm and Associated Dustfall.

22-24 May 2018, Tenerife, Spain.

Teatro Leal, La Laguna city, Tenerife, Spain.

- 170 scientists from 37 countries.
- World Meteorological Organization, Sand and Dust Storm Warning Advisory and Assessment System
- United Nations, Convention to Combat Desertification
- European Union

Dear Dr. Sehat

this letter is an invitation to be member of the scientific committee of the dustworkshop9, which will be held in Tenerife, 22-24 May 2018.

This workshop is performed within the frame of the World Meteorological Organization – Sand and Dust Storm Warning Advisory and Assessment System (WMO SDS-WAS).

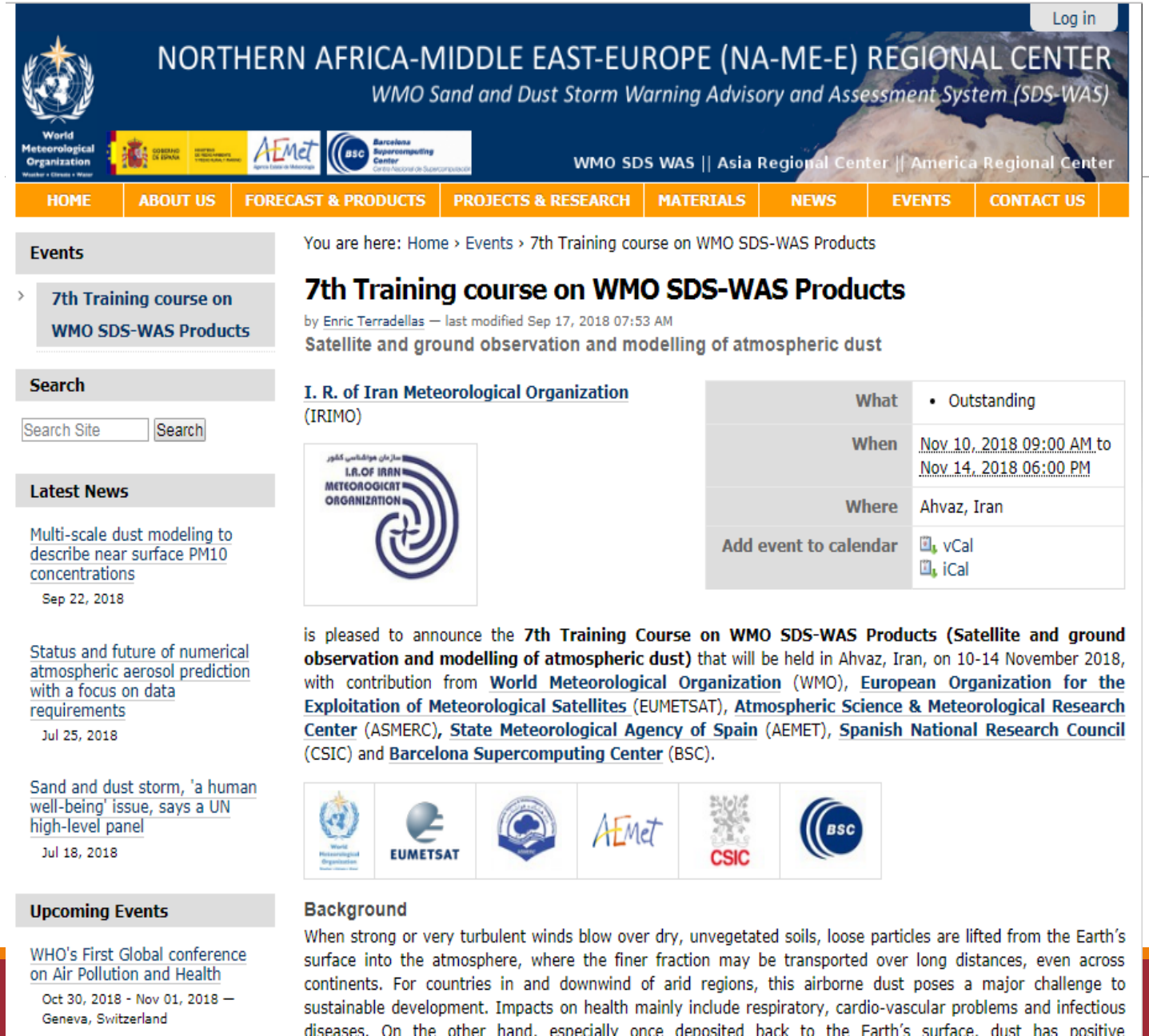
Because of your experience, your contributions would be very positive for the organization of this workshop.

Updated information on the event is available at the web site (abstracts, registration, etc...):

http://dustworkshop9.izana.aemet.es/

Santa Cruz de Tenerife, 29 Sep 2017

Examples of cooperation between WMO SDS-WAS & IRIMO



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NORTHERN AFRICA-MIDDLE EAST-EUROPE (NA-ME-E) REGIONAL CENTER

WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)

World Meteorological Organization

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› 7th Training course on WMO SDS-WAS Products

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Latest News

Multi-scale dust modeling to describe near surface PM10 concentrations
Sep 22, 2018

Status and future of numerical atmospheric aerosol prediction with a focus on data requirements
Jul 25, 2018

Sand and dust storm, 'a human well-being' issue, says a UN high-level panel
Jul 18, 2018

Upcoming Events

WHO's First Global conference on Air Pollution and Health
Oct 30, 2018 - Nov 01, 2018 — Geneva, Switzerland

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7th Training course on WMO SDS-WAS Products

by Enric Terradellas — last modified Sep 17, 2018 07:53 AM

Satellite and ground observation and modelling of atmospheric dust

I. R. of Iran Meteorological Organization (IRIMO)

What	• Outstanding
When	Nov 10, 2018 09:00 AM to Nov 14, 2018 06:00 PM
Where	Ahvaz, Iran
Add event to calendar	vCal iCal

is pleased to announce the **7th Training Course on WMO SDS-WAS Products (Satellite and ground observation and modelling of atmospheric dust)** that will be held in Ahvaz, Iran, on 10-14 November 2018, with contribution from **World Meteorological Organization** (WMO), **European Organization for the Exploitation of Meteorological Satellites** (EUMETSAT), **Atmospheric Science & Meteorological Research Center** (ASMERC), **State Meteorological Agency of Spain** (AEMET), **Spanish National Research Council** (CSIC) and **Barcelona Supercomputing Center** (BSC).

Background

When strong or very turbulent winds blow over dry, unvegetated soils, loose particles are lifted from the Earth's surface into the atmosphere, where the finer fraction may be transported over long distances, even across continents. For countries in and downwind of arid regions, this airborne dust poses a major challenge to sustainable development. Impacts on health mainly include respiratory, cardio-vascular problems and infectious diseases. On the other hand, especially once deposited back to the Earth's surface, dust has positive

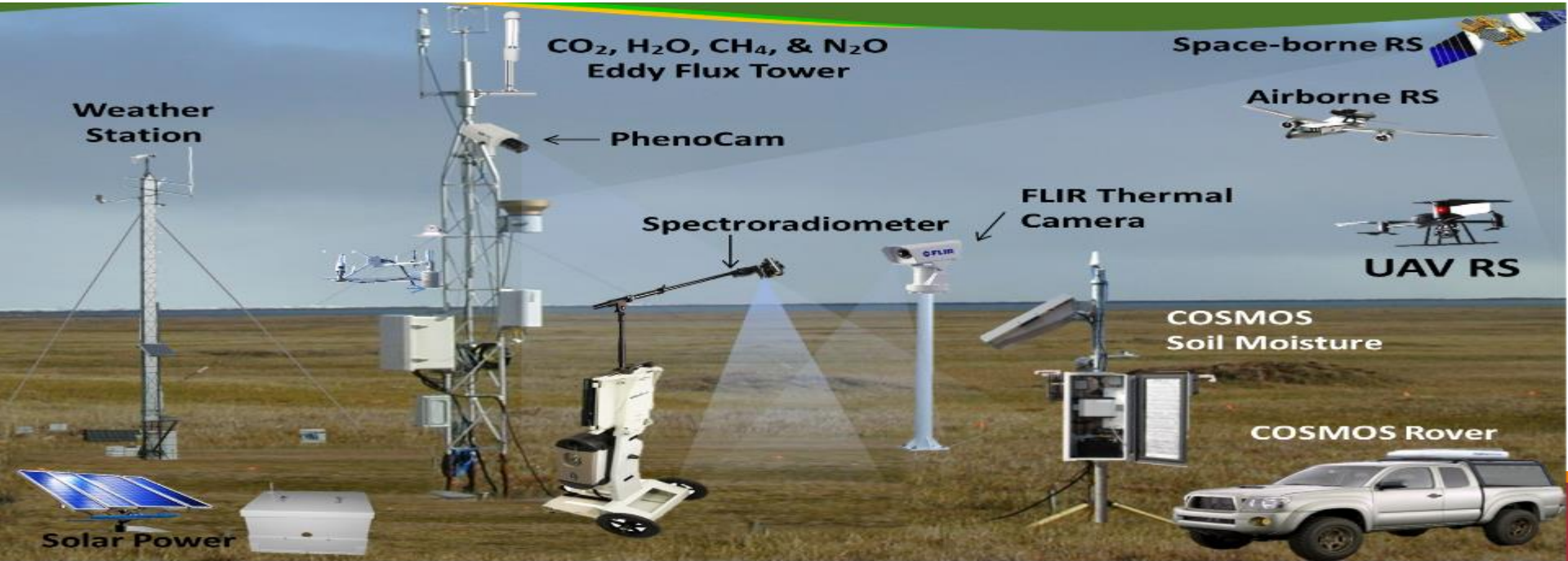
WMO Global Observing System in Support of Multi-Hazard Early Warning Systems

Components of an Effective Early Warning System

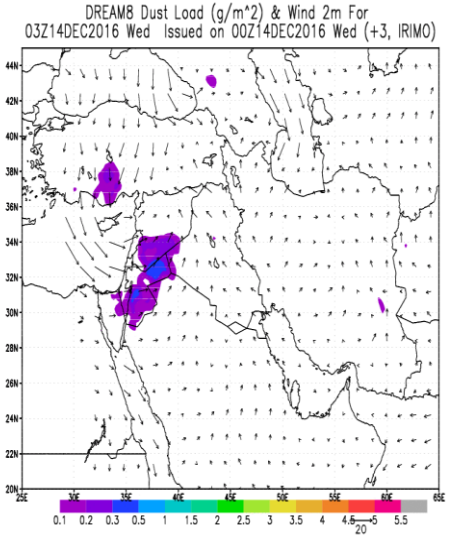
- Governance and Organizational Issues
- Risk Identification
- Communication & Dissemination
- Observing Systems & Forecasting of Hazards
- Emergency Planning, Preparedness and Response

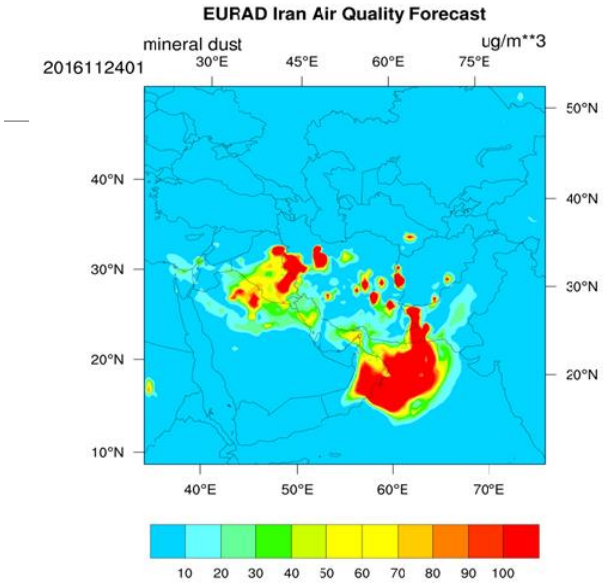
I.R. of Iran Meteorological Organization efforts on SDS

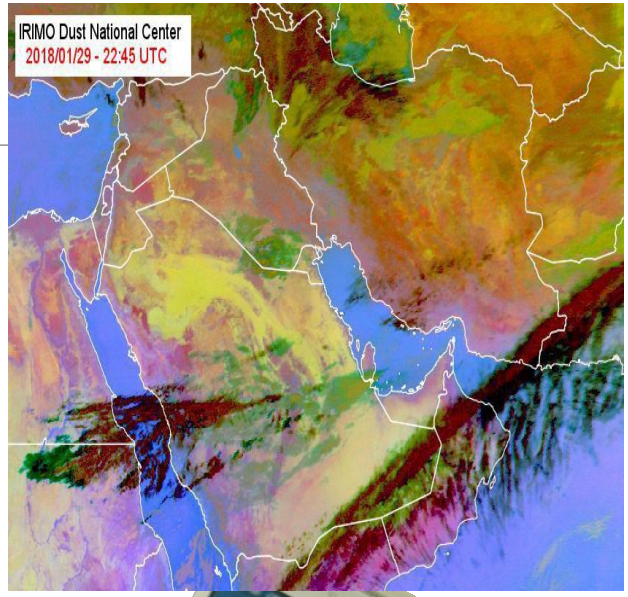
- ✓ Monitoring:
  - In-situ dust
    - Visibility (dust estimations)
    - PM10/PM2.5
  - Remote Sensing
    - Ground base Remote Sensing
      - Photometry & Radars
- ✓ Forecasting and Early warning
- ✓ Research, capacity building and training
- ✓ Collaboration with national and International bodies (WMO SDS-WAS)

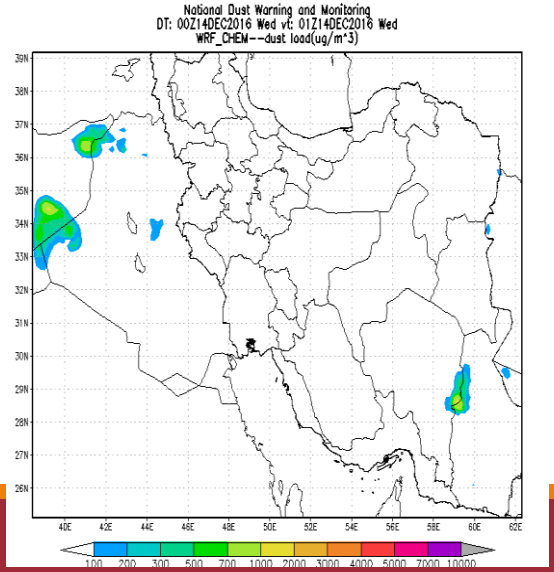


IRIMO DUST FORECASTING AND EARLY WARNING







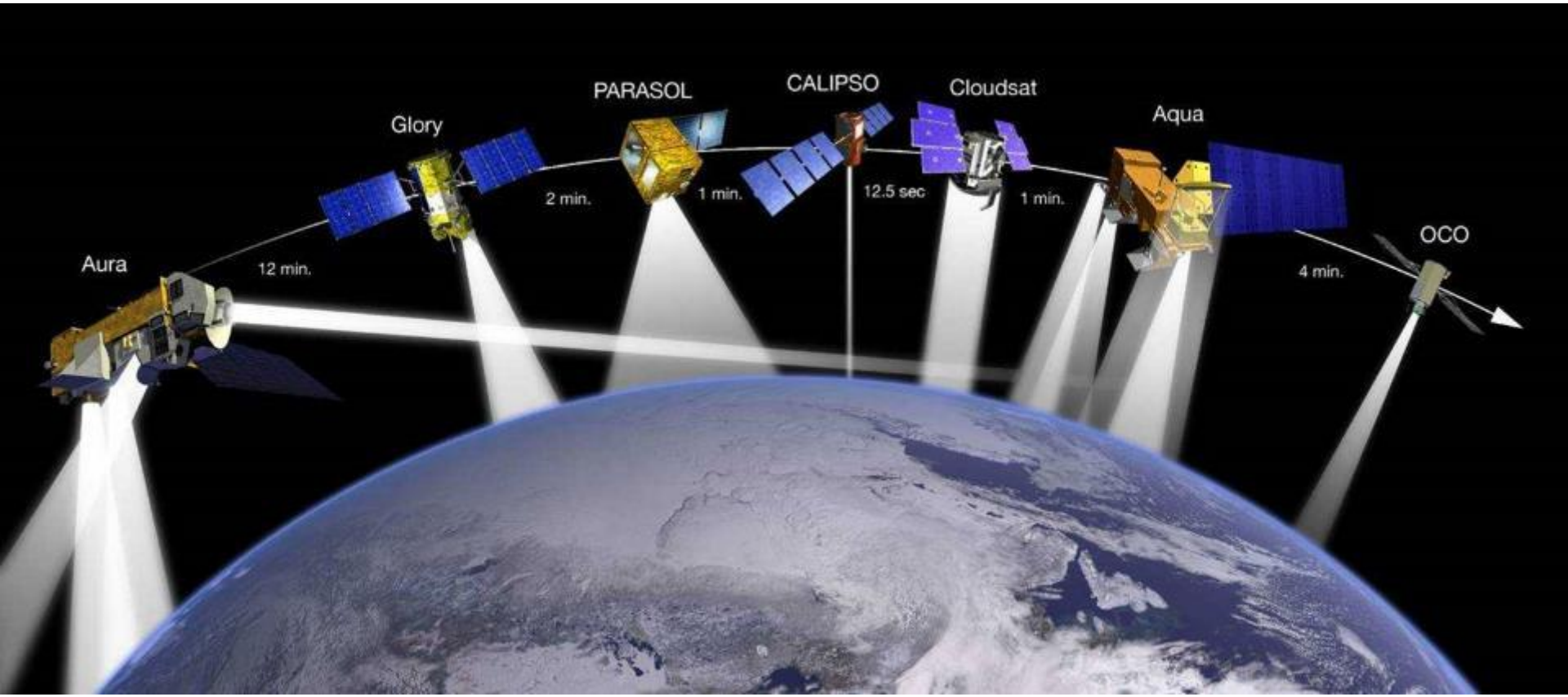


IRIMO operational Dust Forecasting models:

- **WRF_CHEM**
- **DREAM8b**
- **EURAD**

t.me/irimodustnc

The Afternoon Constellation (A-Train)



The A-Train satellites -- Aqua (2002), Aura (2004), PARASOL (2004), CALIPSO (2006), CloudSat (2006), Glory (2011) and OCO-2 (2014) bring together a rich array of instruments and observing strategies to better understand Earth's changing environment and climate.

Meteosat History & Future

1977 — MFG

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

2002 — MSG

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

2020 and

MTG-I and MTG-S

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

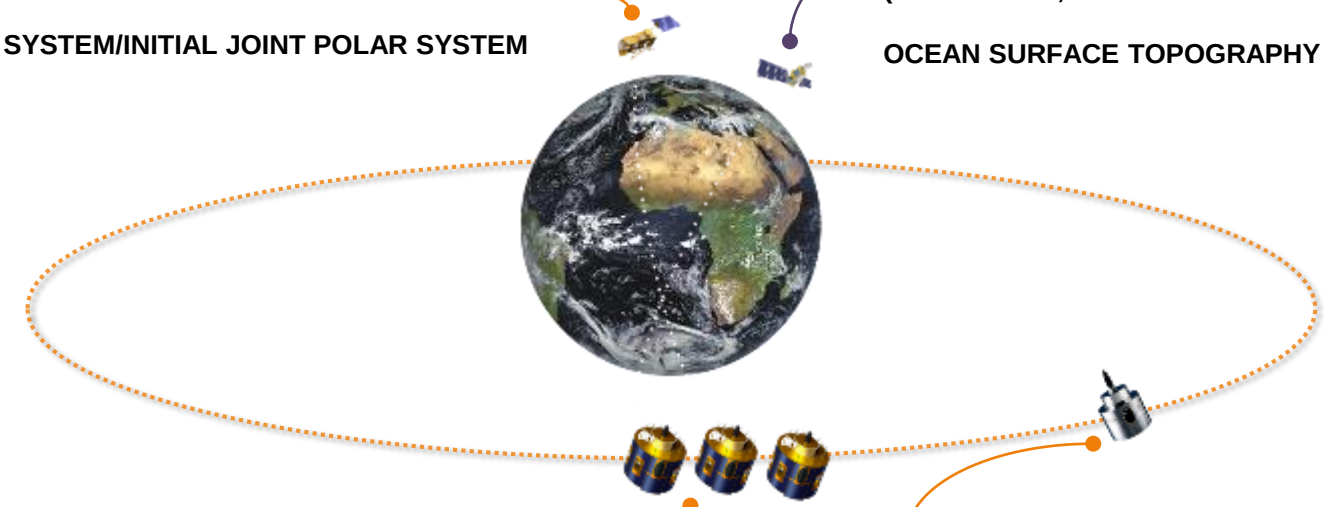
EUMETSAT Satellites

METOP A-B
(LOW-EARTH, SUN – SYNCHRONOUS ORBIT)

EUMETSAT POLAR SYSTEM/INITIAL JOINT POLAR SYSTEM

JASON-2 (shared with CNES, NOAA)
(LOW-EARTH, 63° INCL. NON SYNCHRONOUS ORBIT)

OCEAN SURFACE TOPOGRAPHY MISSION



METEOSAT 8-9-10-11 (2nd GENERATION)
(GEOSTATIONARY ORBIT)

TWO-SATELLITE SYSTEM:

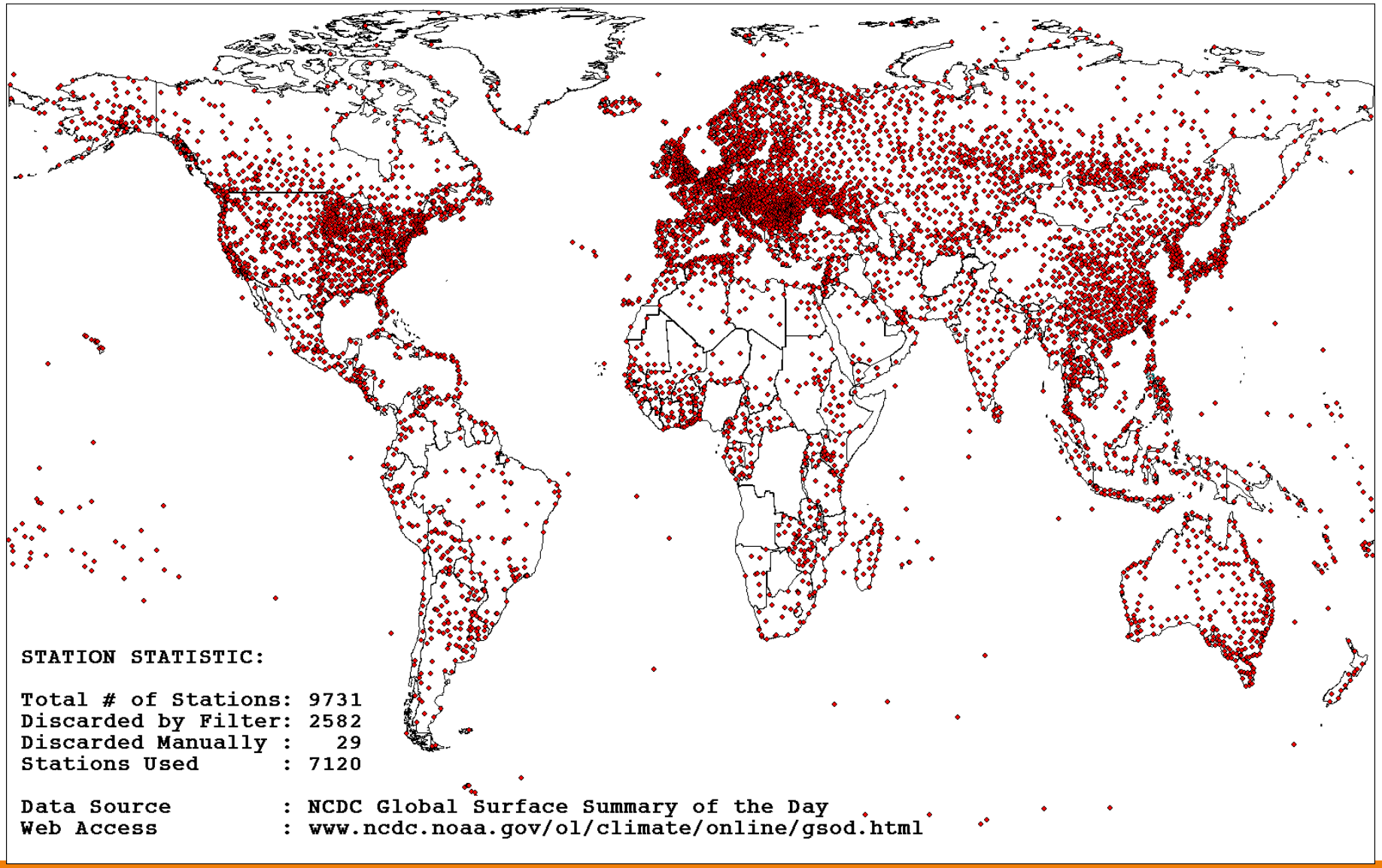
- **METEOSAT-10: FULL DISK IMAGERY MISSION AT 0° (15 MN)**
- **METEOSAT-9: RAPID SCAN SERVICE OVER EUROPE AT 9.5°E (5 MN)**

-METEOSAT- 8: BACK UP AT 3.5°E
-METEOSAT- 11: Commissioning AT 3.4°W

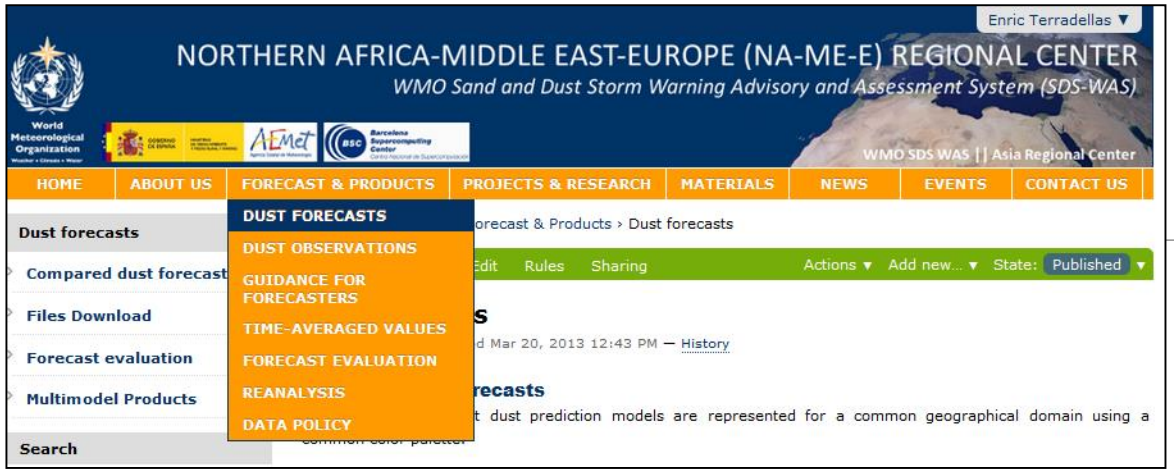
METEOSAT – 7 (1st GENERATION)
(GEOSTATIONARY ORBIT)

INDIAN OCEAN DATA COVERAGE MISSION AT 57°5 E (UNTIL END 2016)

WMO- World Wide Watch Global Surface Meteorological Network



Current need for Validation of NWP over west Asia



BSC-DREAM8b v2.0	DOWNLOAD FILES	Model website	Barcelona Supercomputing Center
MACC-ECMWF	DOWNLOAD FILES	Model website	macc
DREAM-NMME-MACC	DOWNLOAD FILES	Model website	SEEVCCC
NMMB/BSC-Dust	DOWNLOAD FILES	Model website	Barcelona Supercomputing Center
NASA-GEOS-5	DOWNLOAD FILES	Model website	NASA
NCEP-NGAC	DOWNLOAD FILES	Model website	NCEP
Multimodel MEDIAN	DOWNLOAD FILES	Model website	AEMet

WMO SDS-WAS IMPLEMENTATION PLAN 2015-2020

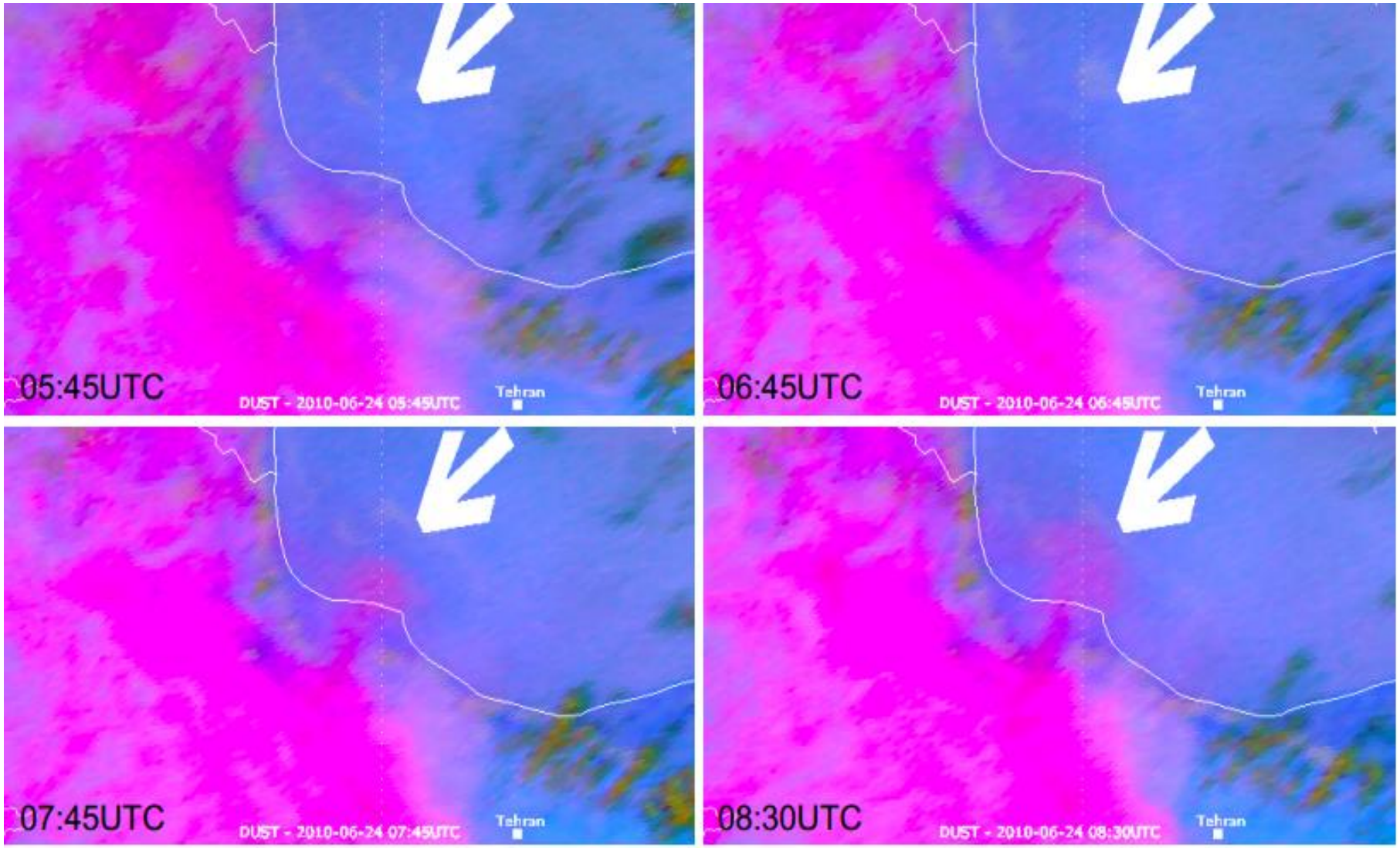
netCDF format

netCDF UCAR unidata

Iran:

The model DREAM8 Eta is run at IRIMO since 2012. This is a cooperation with South East European Virtual Climate Change Center (SEEVCCC) hosted by the Republic Hydrometeorological Service of Serbia.

An Example of major challenges for modeling over West Asia

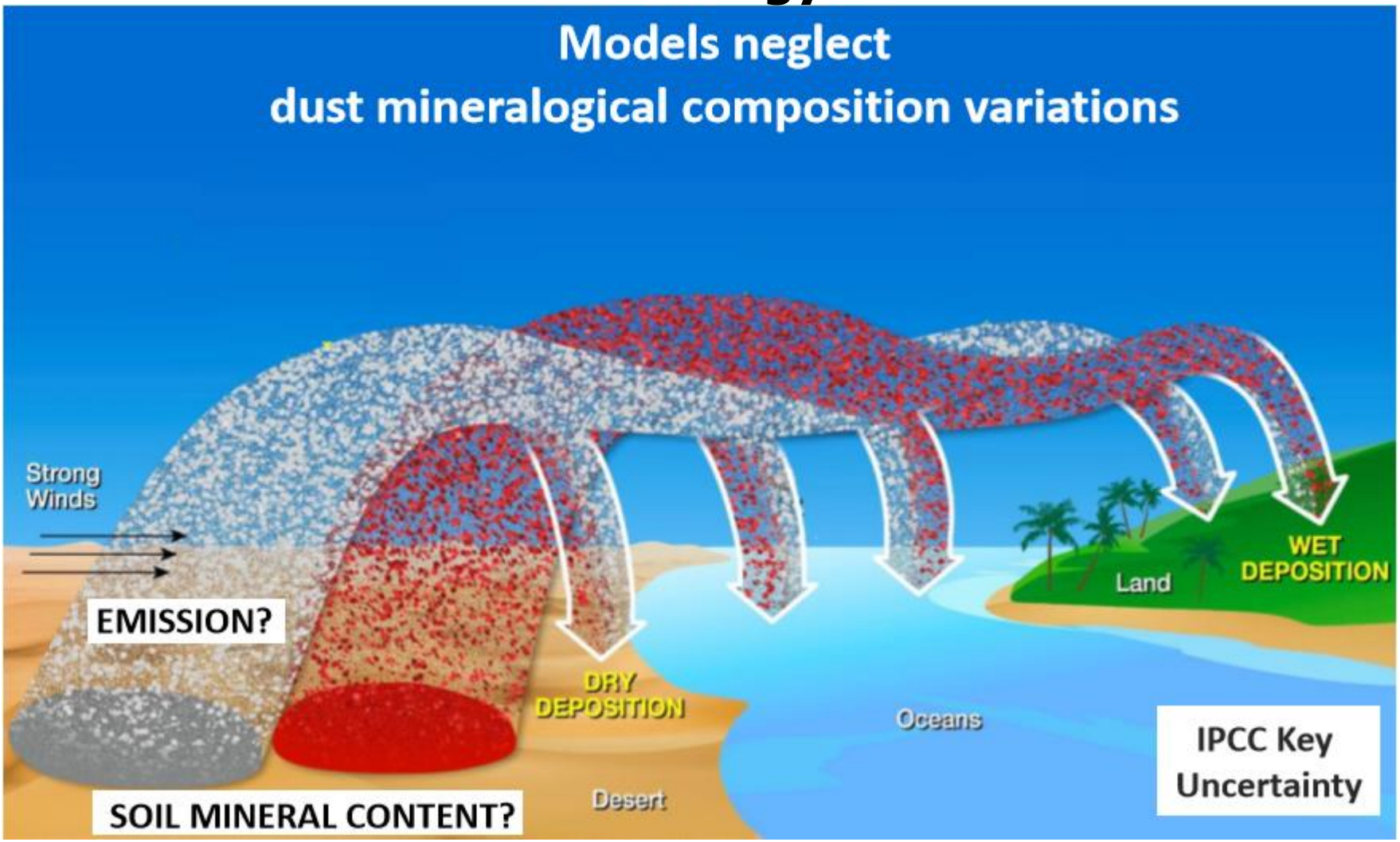


An Example of major challenges for modeling over West Asia

From the presentation Dr. Carlos Pérez
Dust Modeling: Challenges and Perspectives, 5th International Workshop on Sand and Dust Storms, Istanbul, TURKEY, 23-25 October 2017

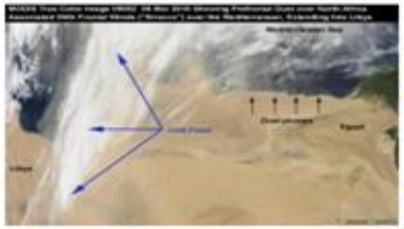
An Example of Current Needs and challenges for West Asia

Mineralogy

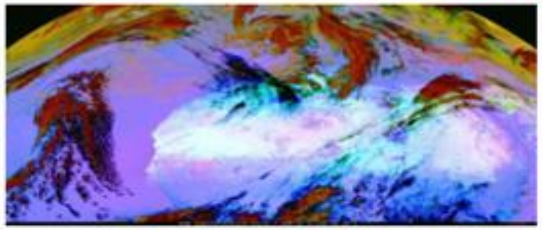


DUST CYCLE AND ASSOCIATED PROCESSES

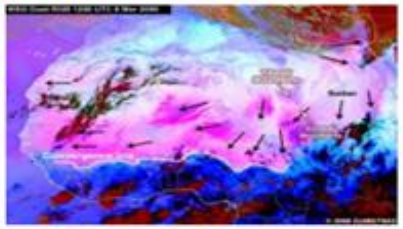
Synoptic dust storms (large scale weather systems) **Well captured by models.**



Pre-frontal winds

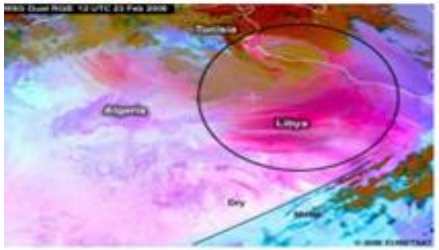


Post-frontal winds

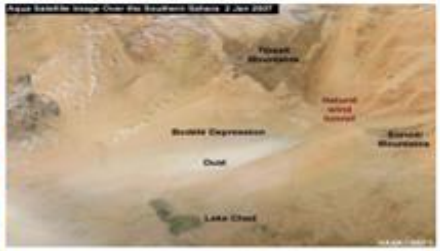


Large-scale trade winds

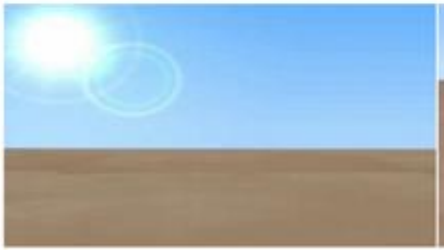
Mesoscale dust storms **Poorly captured by models.**
Some types improve in regional models.



Downslope winds



Gap flow



Dust devils

Haboobs

From the presentation Sara Basart, 6th training course SDS WAS, Turkey, 2017, 5th International Workshop on Sand and Dust Storms, Istanbul, TURKEY, 23-25 October 2017

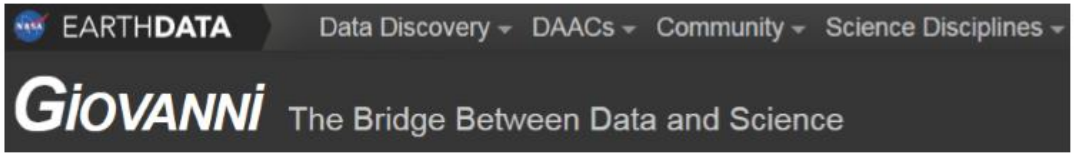
Some Applicable Tools for Analysis of SDS

EOSDIS Worldview – NASA

https://worldview.earthdata.nasa.gov/

NASA Giovanni

https://giovanni.gsfc.nasa.gov/giovanni/



HYSPLIT-WEB (Internet-based)

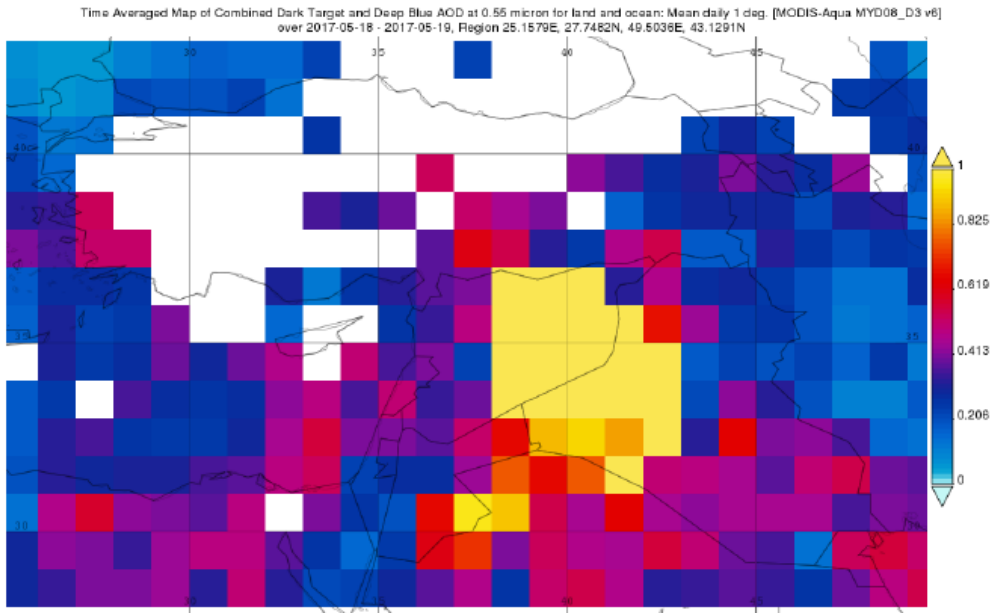
http://ready.arl.noaa.gov/HYSPLIT.php/

ESRL : PSD : Monthly/Seasonal Composites - NOAA Earth System

https://www.esrl.noaa.gov/psd/cgi-bin/data/composites/printpage.pl

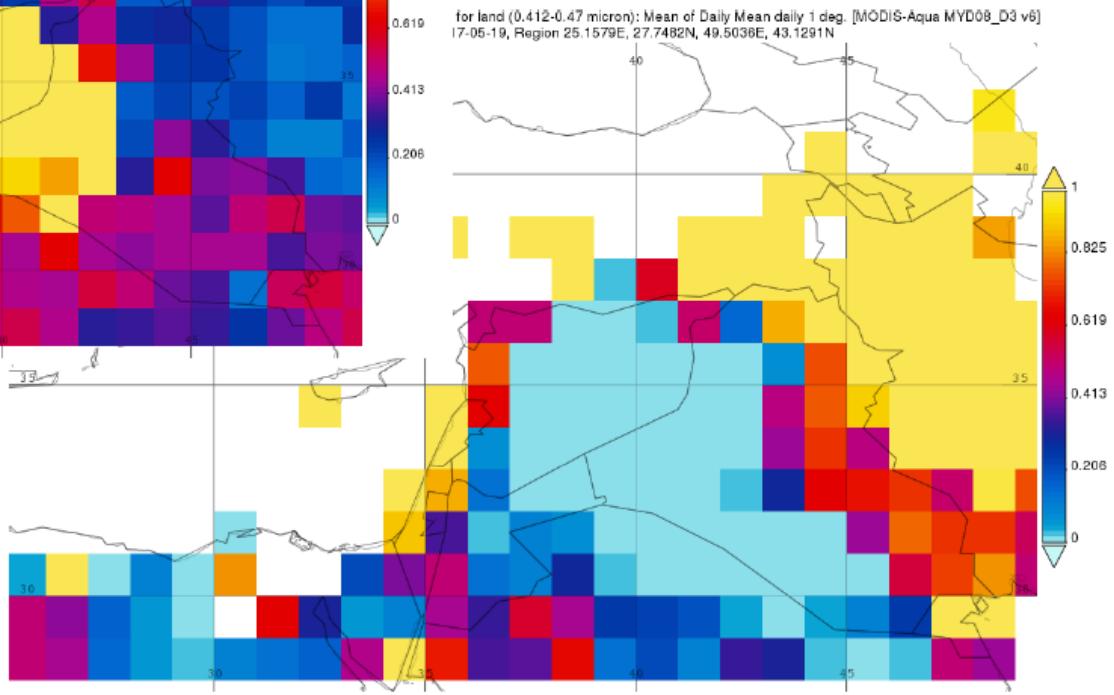
Some Applicable Tools for Analysis of SDS

https://giovanni.gsfc.nasa.gov/giovanni



AOD -Aqua

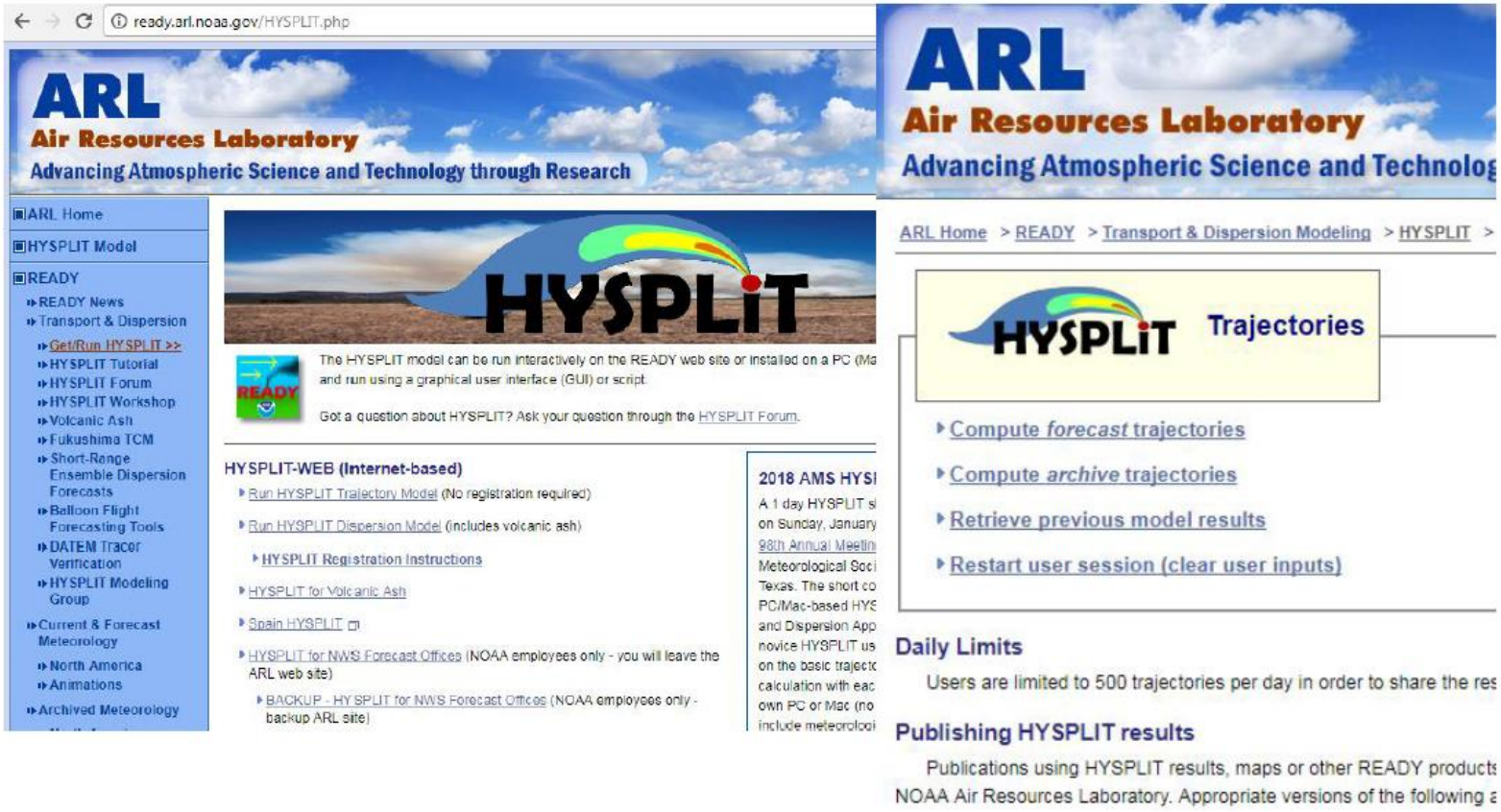
AE -Aqua



Some Applicable Tools for Analysis of SDS

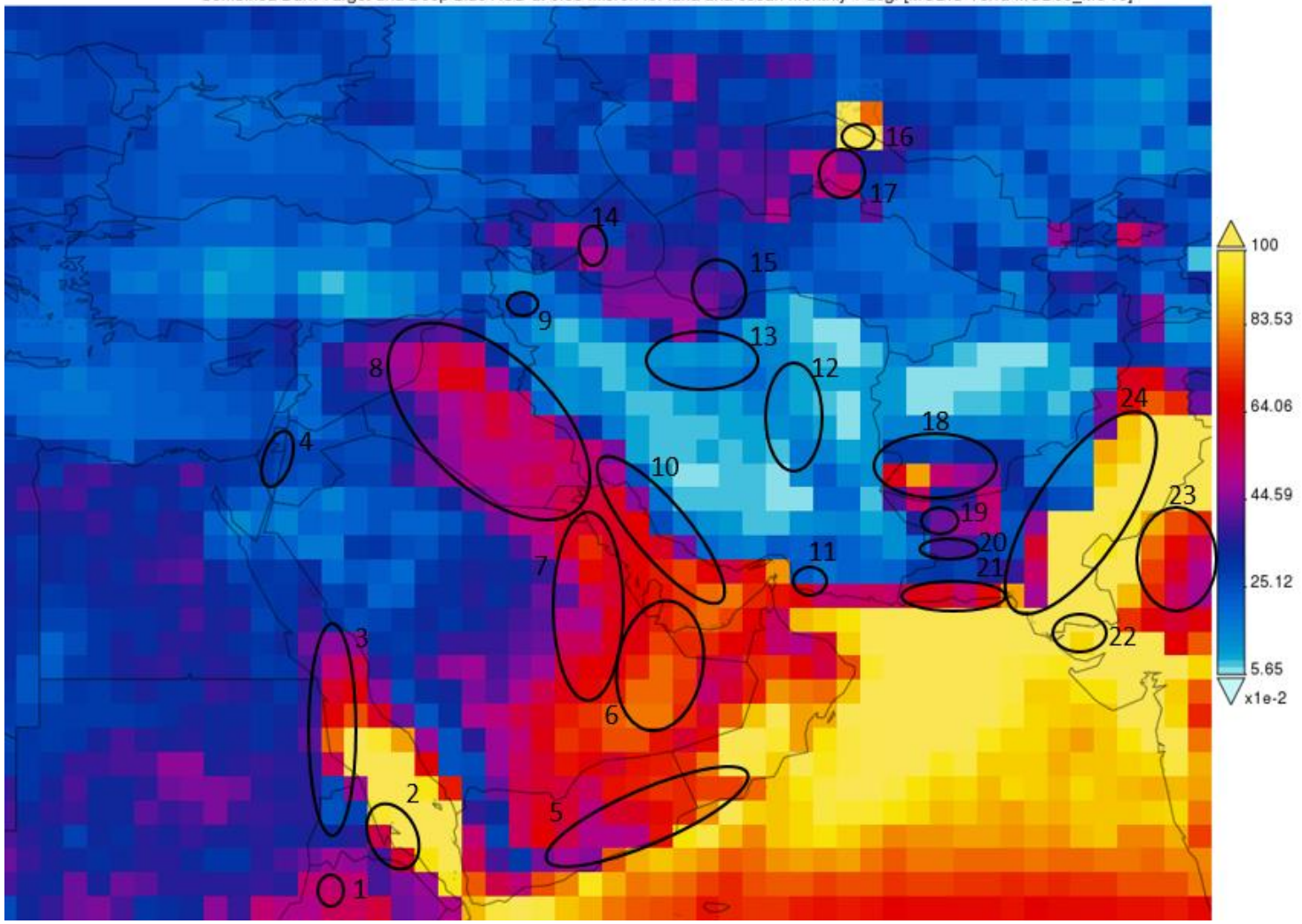
http://ready.arl.noaa.gov/HYSPLIT.php

You can use HYSPLIT model for the detection of SDS source area.



A 15 YEARS VIEW OF AEROSOL DUST OVER THE MIDDLE EAST,Saviz Sehatkashani, Sergio Rodríguez
5th INTERNATIONAL WORKSHOP ON SAND AND DUST STORMS, 2017

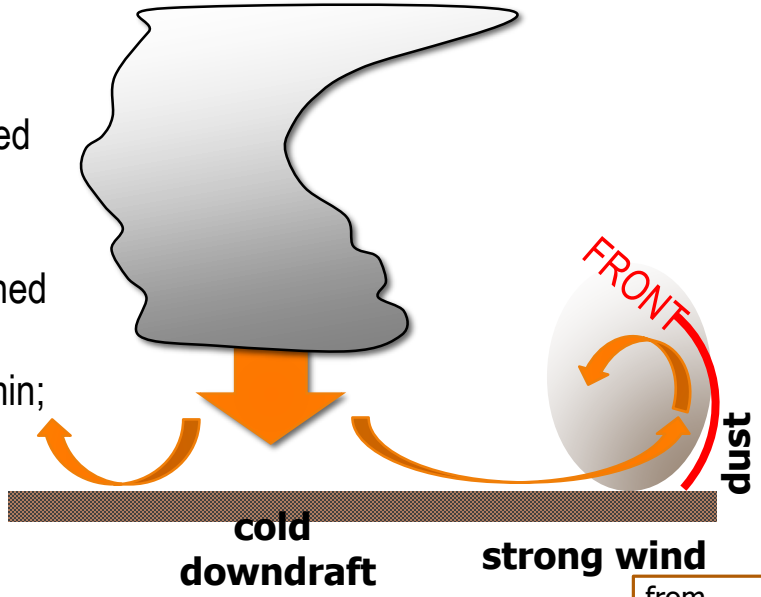
July (2001 - 2016)
Combined Dark Target and Deep Blue AOD at 0.55 micron for land and ocean monthly 1 deg. [MODIS-Terra MOD08_M3 v6]



Distribution of dust sources over the Middle East. The black circled sources are numbered as 1, Lake Tana of Ethiopia; 2,Danakil Desert of Ethiopia3, northeast Sudan; 4, Jordan River 5, Hadramawt region; 6, Empty Quarter; 7, highlands of Saudi Arabia; 8, Mesopotamia; 9, Urumia Lake of Iran; 10, coastal desert of Iran; 11, Hamun-i-Mashkel; 12, Dasht-e Lut Desert of Iran; 13, Dasht-e Kavir Desert of Iran; 14,Qobustan in Azerbaijan; 15, Atrek delta of Turkmenistan; 16, Turan plain of Uzbekistan; 17, Aral Sea. , desert of Rajasthan in India; 18, southern drainage basin of the Hindu Kush in Afghanistan; 19, ephemeral lakes around the city of Zabol; 20, Hamun-i-Mashkel of Pakistan; 21, Makran coast of Pakistan; and 22, Rann of Kutch in India ; 23, desert of Rajasthan in India

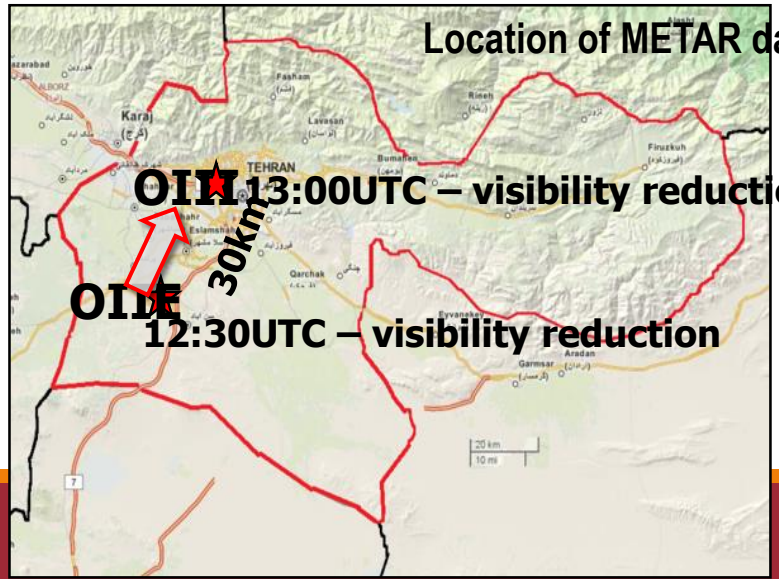
Information from reports

- reached city at 5.30 p.m. local time;
- passing of the sand storm over the fixed site lasted about 15min;
- storm duration less than 2h;
- reduction of visibility to ~10m; wind velocity reached 110 km/h;
- temperature dropped from 33 to 18C in several min;
- at least 5 deaths, 82 injured; multiple vehicle collision;
- 50 000 residential units lost power.



Theory

- Multicell storm: Intensive cold downbursts from convective cells produced high velocity surface wind, creating cold front which was lifting, mixing and pushing dust towards the city;
- Expected: high wind speed, drop in temperature, rise in humidity, rise in pressure, reduction of visibility.

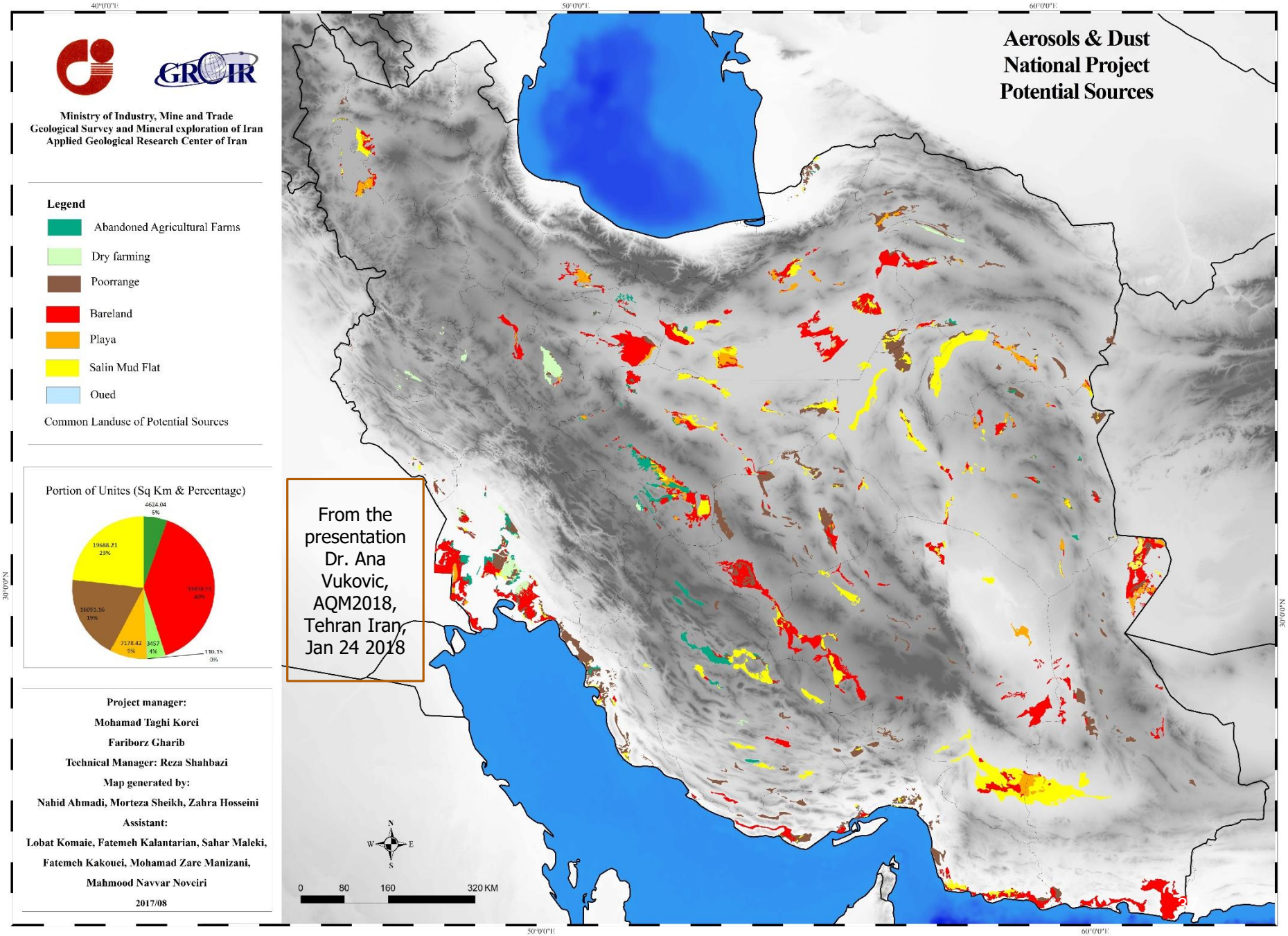


from Ana Vukovic Presentation, AQM2018, Tehran Iran, Jan 24 2018

Ana Vuković, Contributions from:

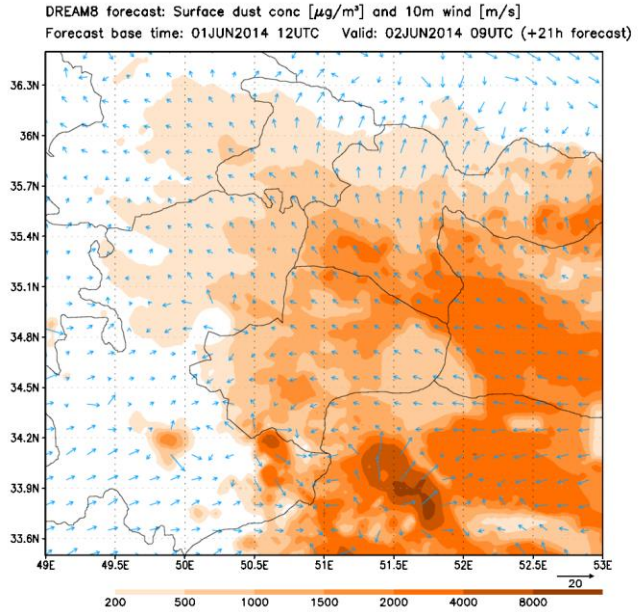
Bojan Cvetković, Mirjam Vujadinović, Slobodan Ničković, Faculty of Agriculture, University of Belgrade, Serbia ,SDS National Office, South East European Virtual Climate Change Center, RHMSS, Belgrade, Serbia, Theodore M. Giannaros, Vassiliki Kotroni, Konstantinos Lagouvardos – NOA, Greece Saviz Sehatkashani, ASMERC, Iran; Reza Shahbazi, GSI, Iran,Jose Prieto, EUMETSAT

DUST FORECAST WITH REAL DUST SOURCES: NMME-DREAM

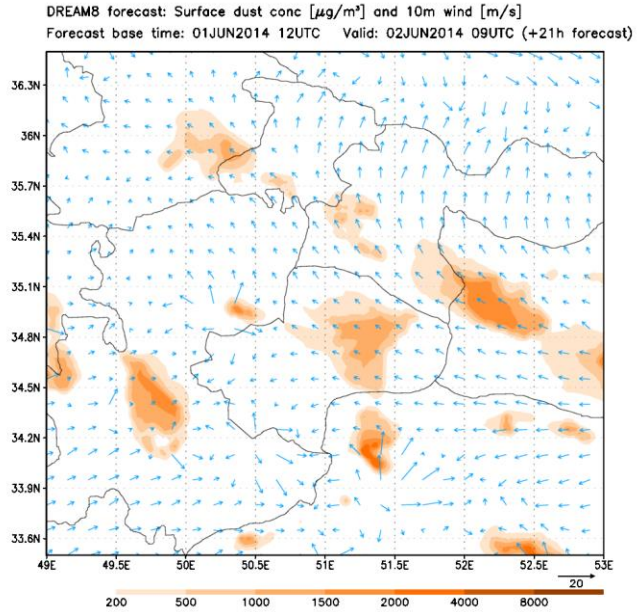


Dust forecast with the same model setup and all 3 versions of masks

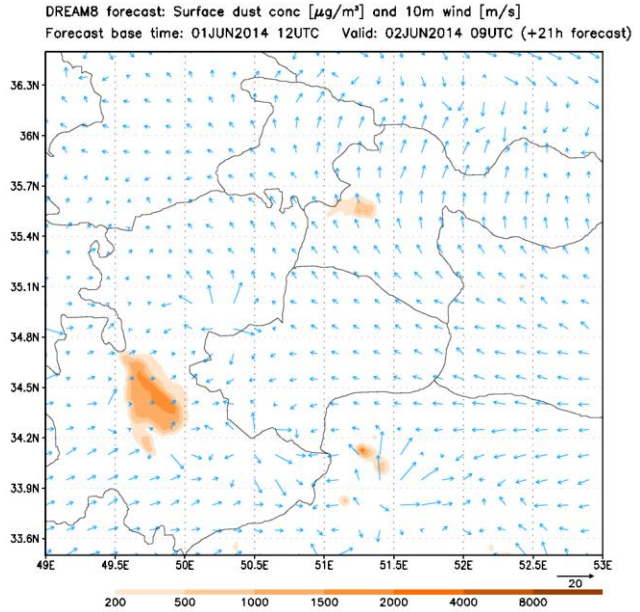
MCD



GSI



GSI-AGR



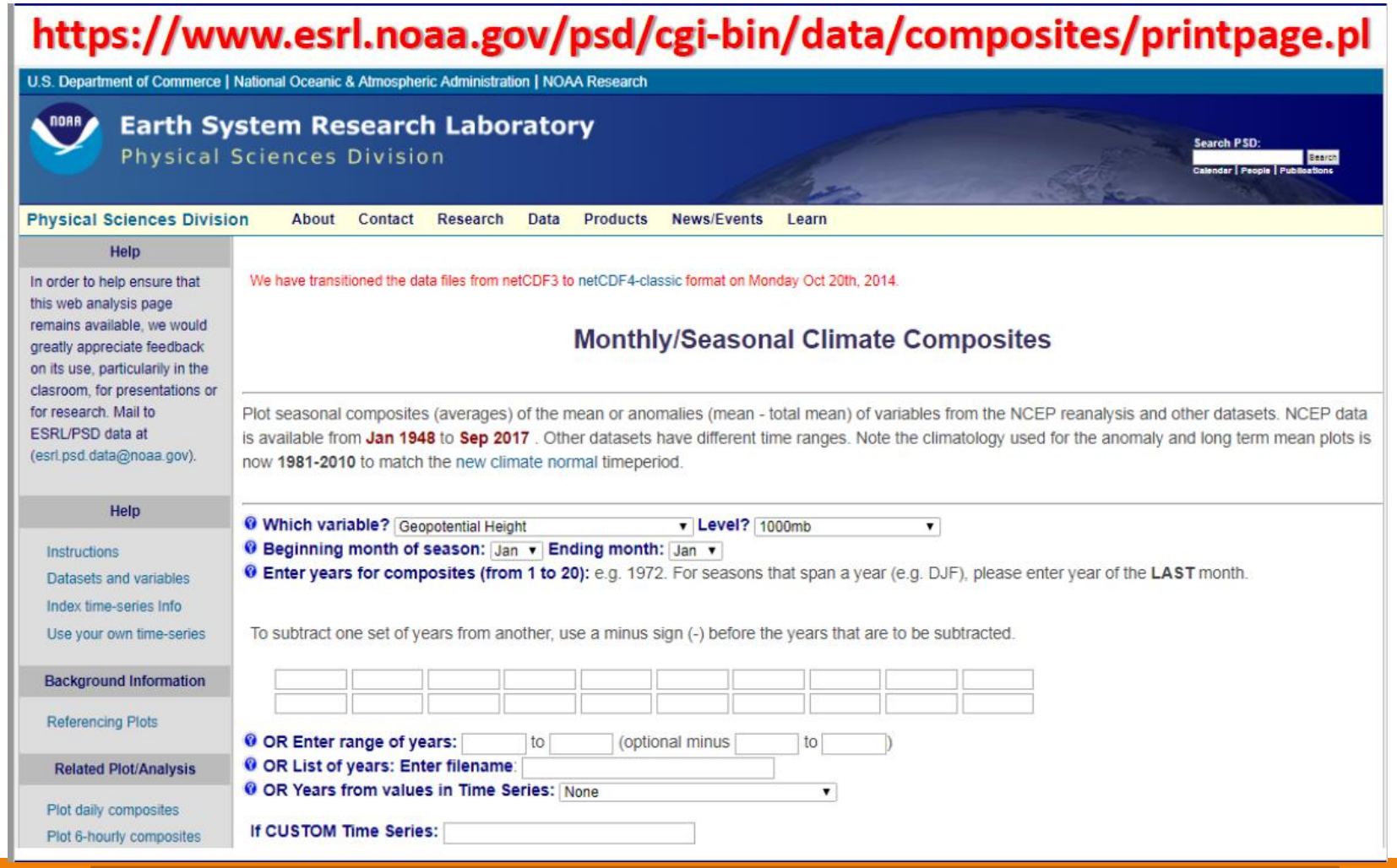
✓ **First time to use real dust source mask in dust forecast models - the main priority is fulfilled!**

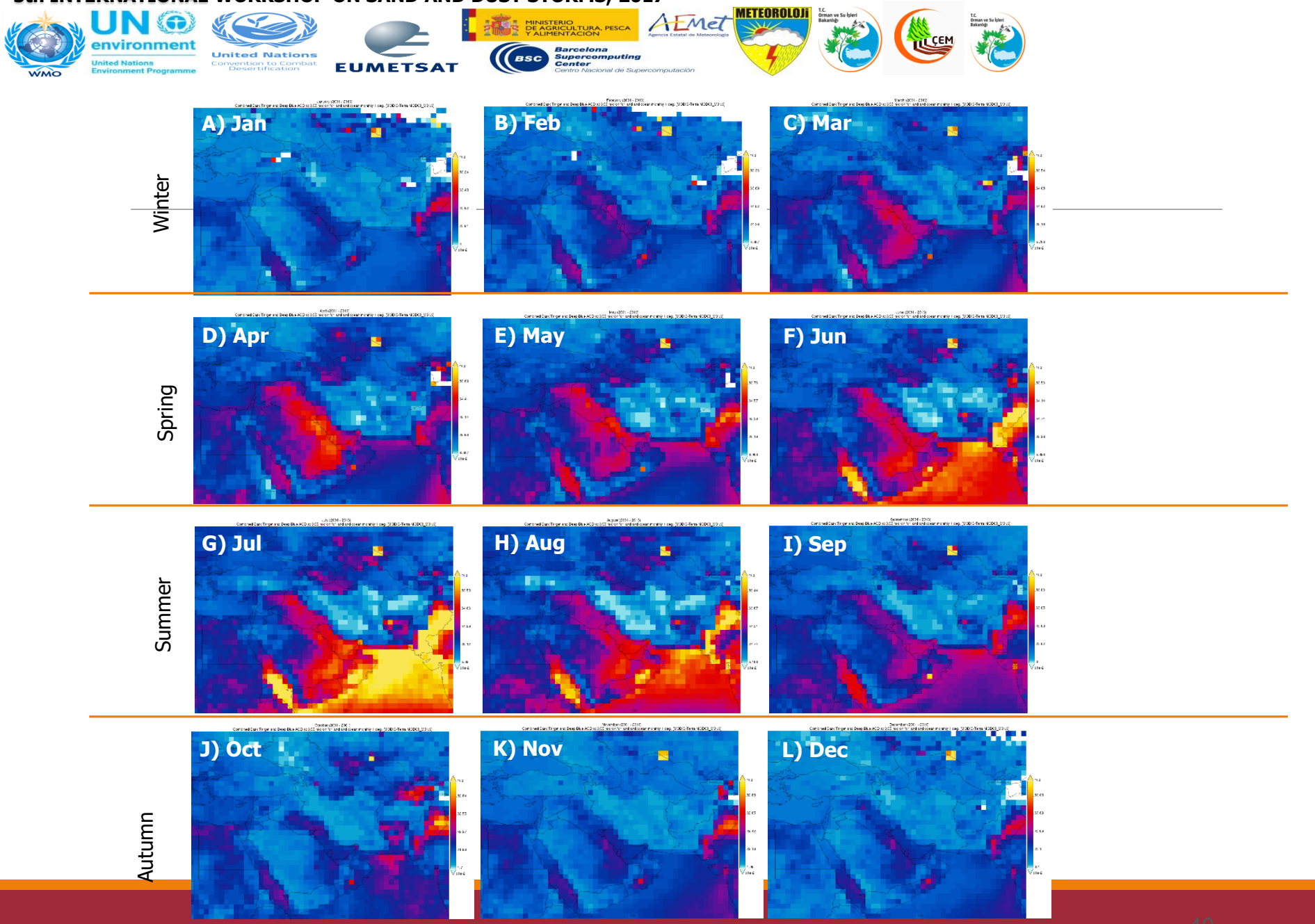
- Dust forecast much improved
- Reduced false alarms
- Next uncertainty is size distribution of dust particles in sources
- Serves to further dust models development!

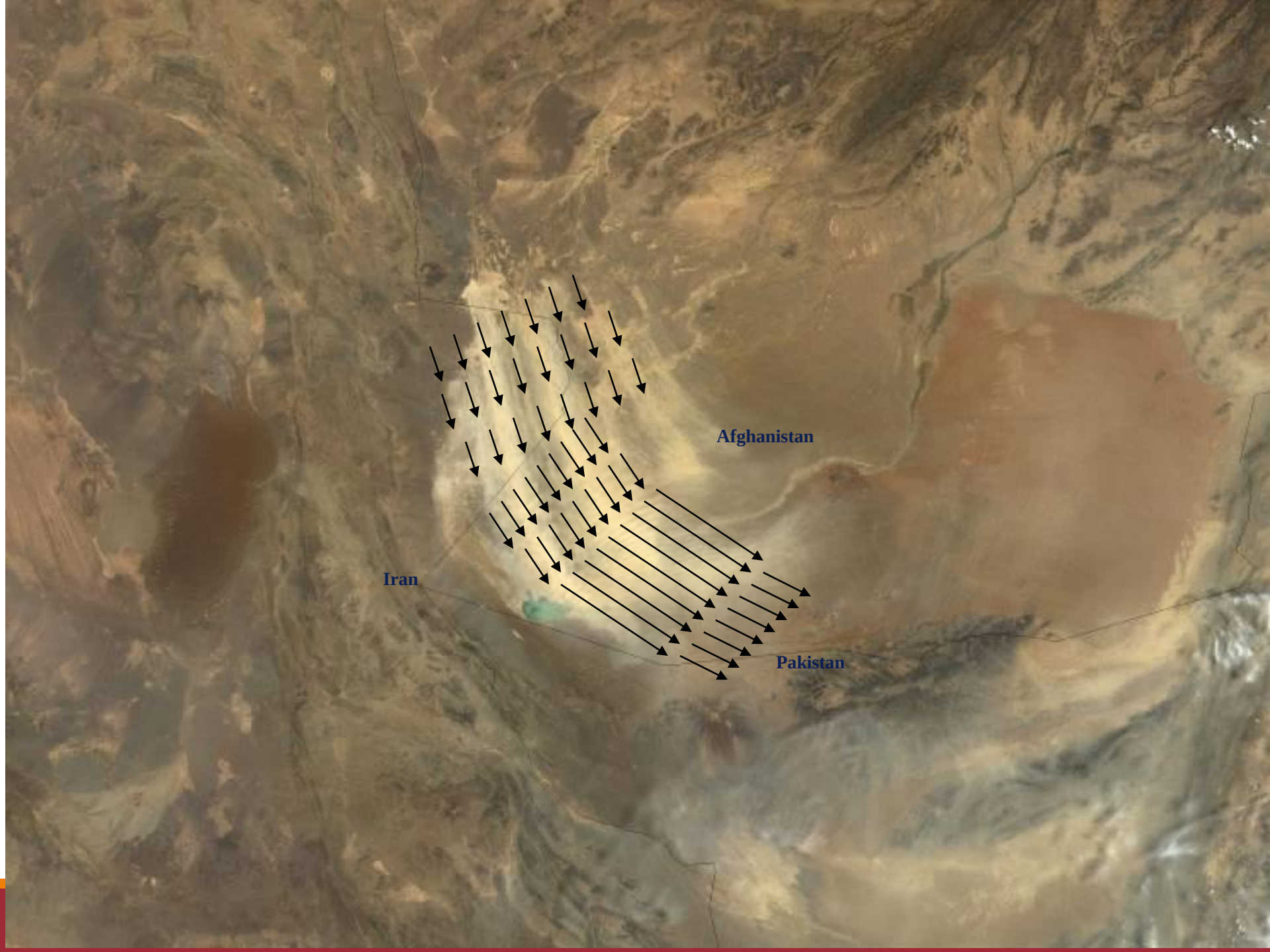
From the presentation Dr. Ana Vukovic, AQM2018, Tehran Iran, Jan 24 2018

Some Applicable Tools for Analysis of SDS

NOAA-ESRL: Monthly Seasonal Composites



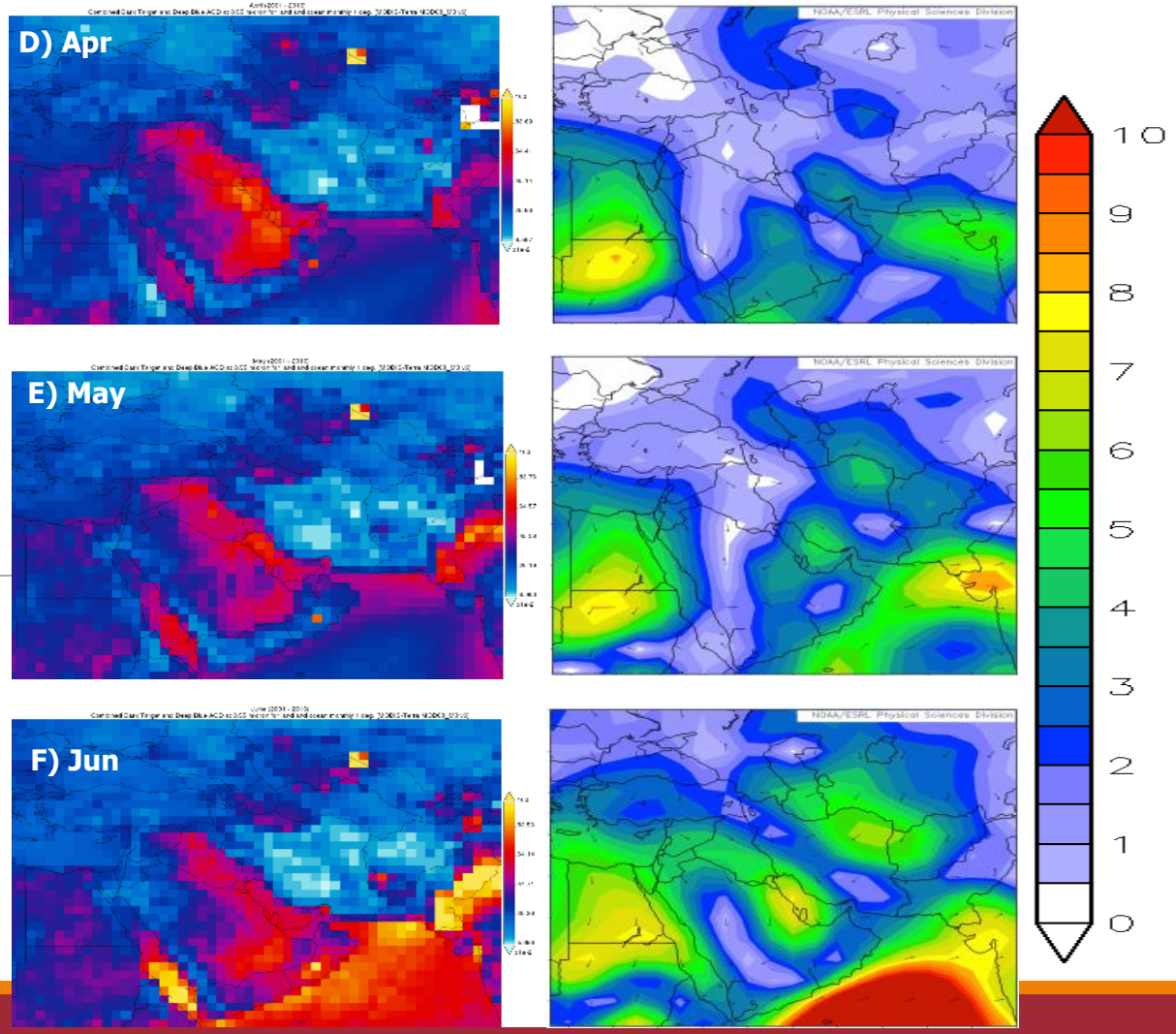

Winter
A) Jan
B) Feb
C) Mar
Spring
D) Apr
E) May
F) Jun
Summer
G) Jul
H) Aug
I) Sep
Autumn
J) Oct
K) Nov
L) Dec


Afghanistan
Iran
Pakistan

MODIS MOD08

NCEP/NCAR Reanalysis
925mb Vector Wind (m/s) Composite Mean

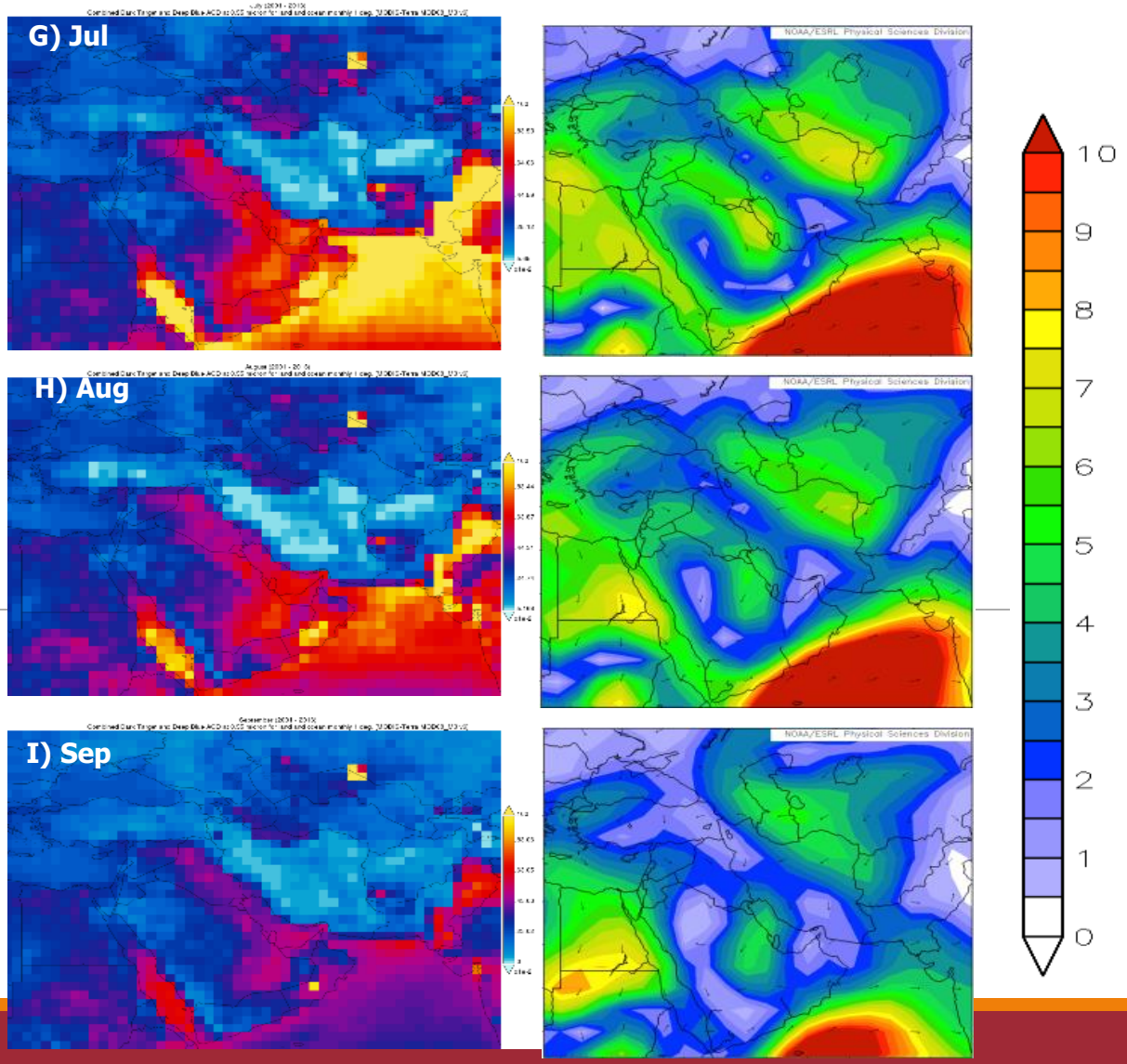
Spring



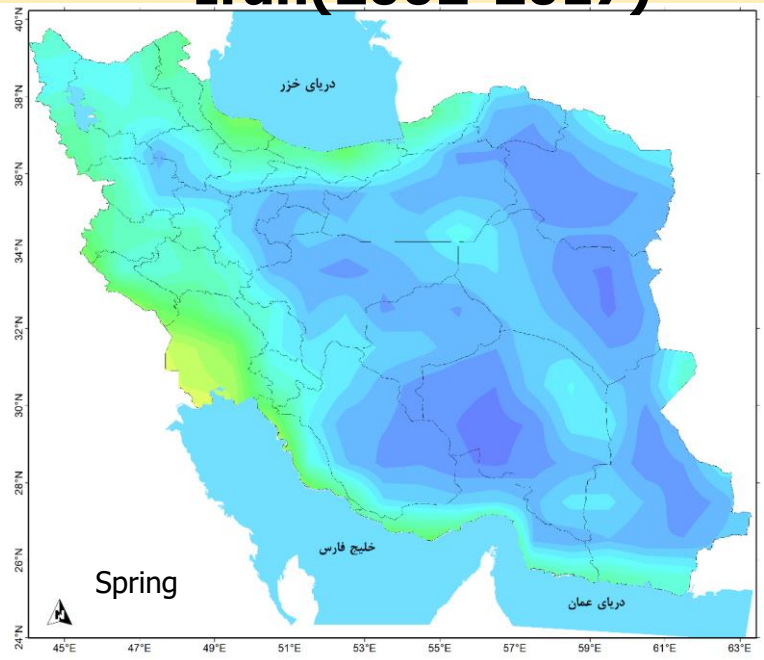
MODIS MOD08

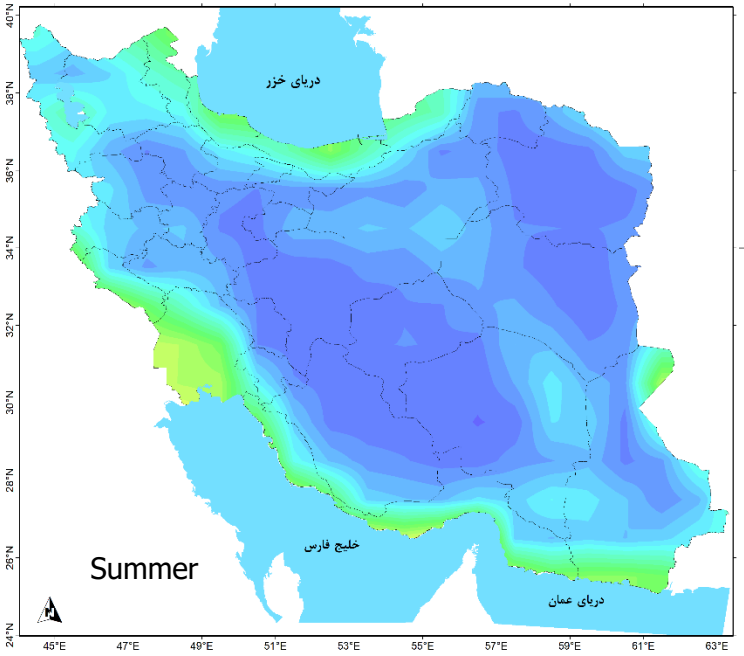
NCEP/NCAR Reanalysis
925mb Vector Wind (m/s) Composite Mean

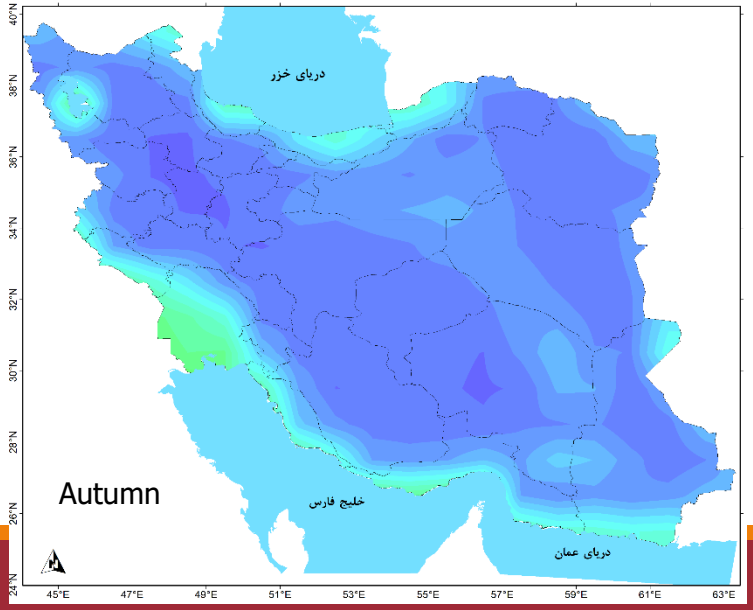
Summer

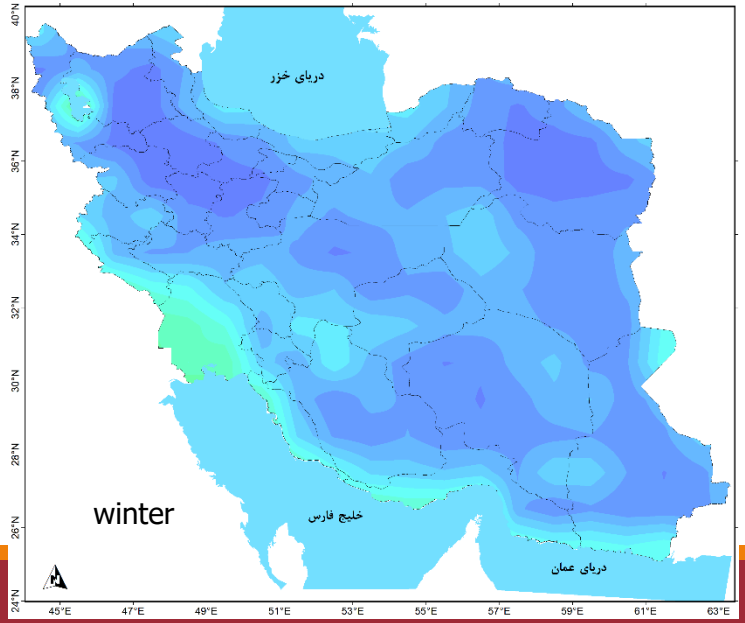


Seasonal AOD Variability over Iran(2002-2017)







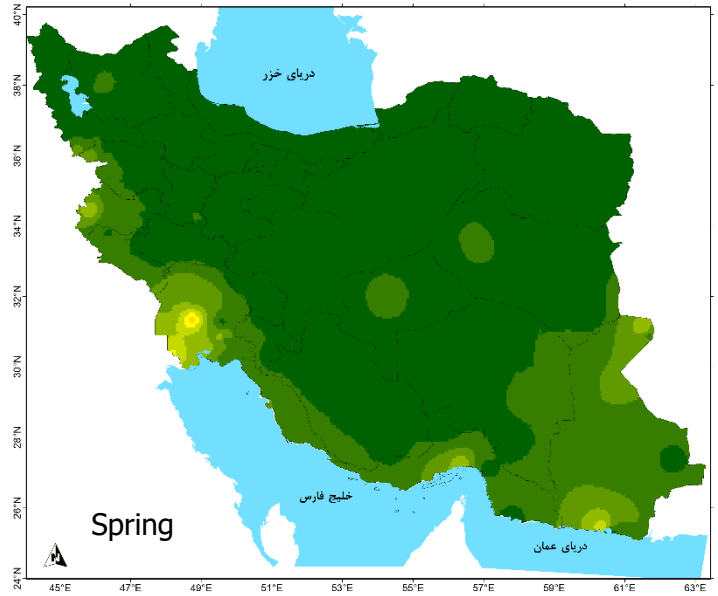


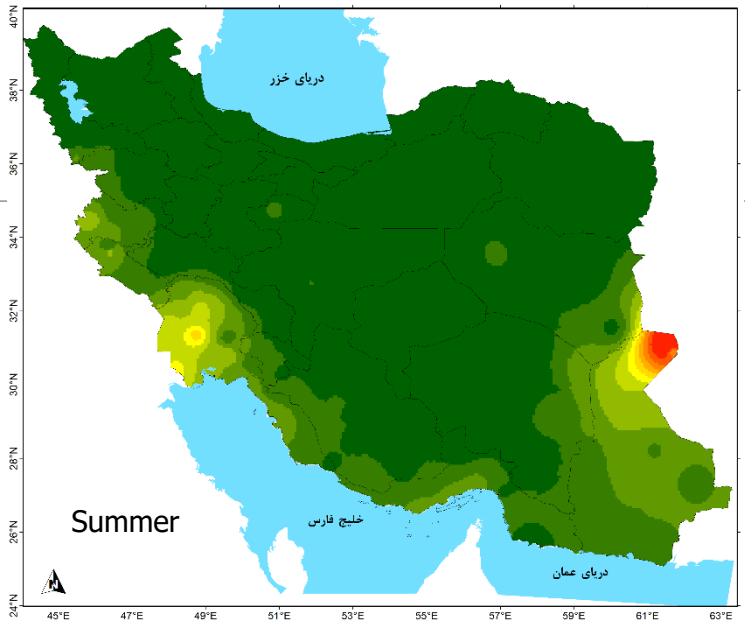
AOD
550nm

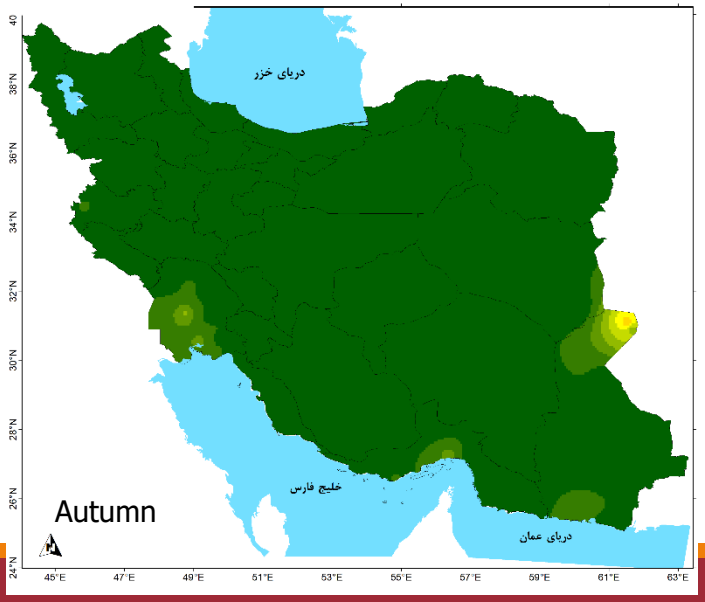
< 0.06	0.39 - 0.42
0.06 - 0.09	0.42 - 0.45
0.09 - 0.12	0.45 - 0.48
0.12 - 0.15	0.48 - 0.51
0.15 - 0.18	0.51 - 0.57
0.18 - 0.21	0.57 - 0.6
0.21 - 0.24	0.6 - 0.63
0.24 - 0.27	0.63 - 0.66
0.27 - 0.3	0.66 - 0.69
0.3 - 0.33	0.69 - 0.72
0.33 - 0.36	0.72 - 0.75
0.36 - 0.39	> 0.75

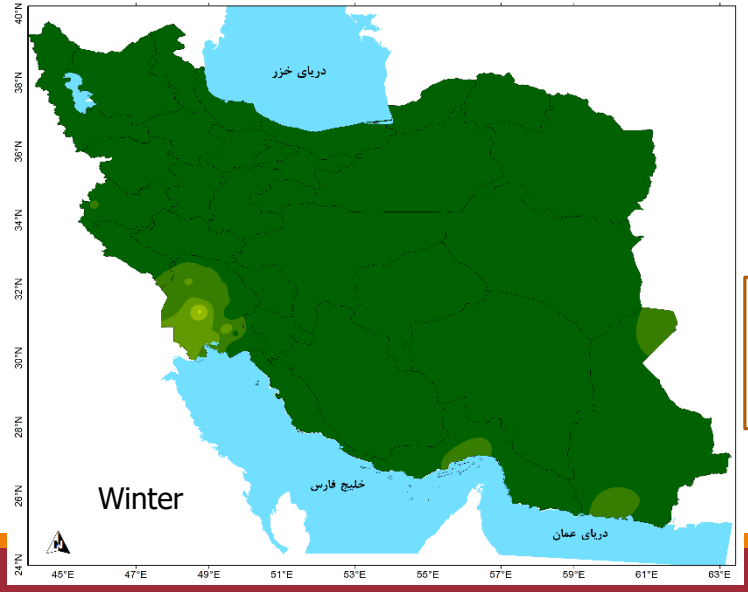
Saviz Sehatkashani et al., in Prep.

Seasonal variability of visibility(800-1500 m) reduction due to SDS over Iran(2002-2017)









Number of Days

Saviz Sehatkashani et al., in Prep.

summer shamal and winter frontal dust storms

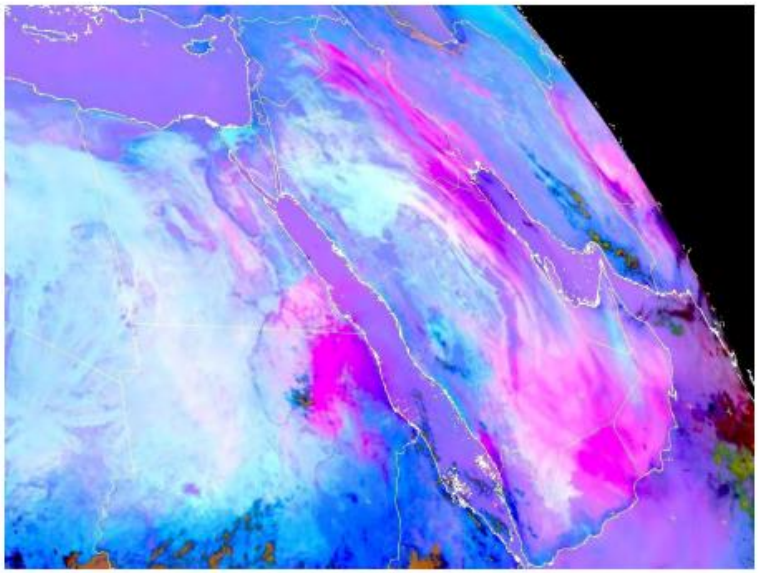
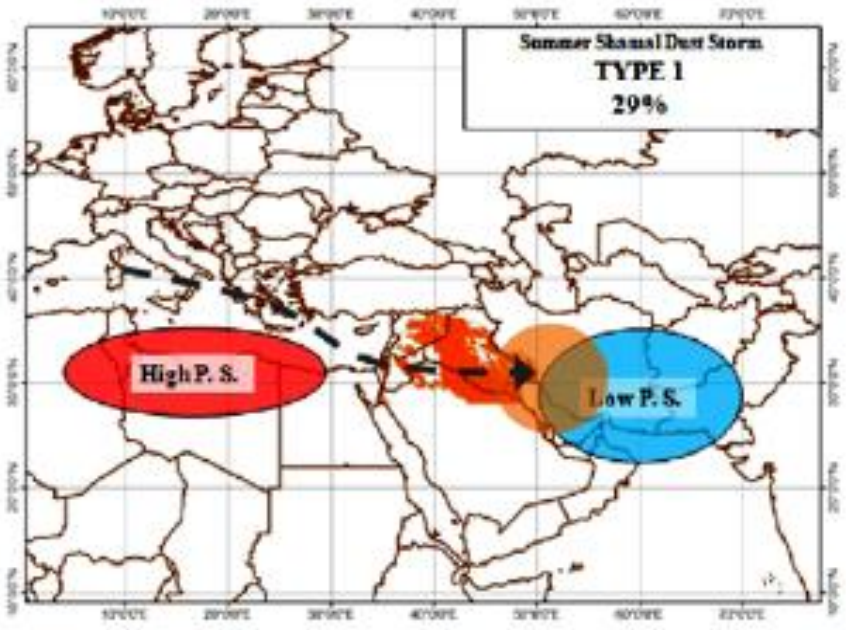


Figure 18 - A three-day summer shamal dust storm over Iraq and the Arabian Peninsula: dust is observed in pink with a tone more intensive the higher the dust content in the atmospheric column (17 June 2008, 08:00 UTC, Meteosat-9, EUMETSAT)



Hamidi, M., Kavianpour, M.R., Shao, Y., 2013. Synoptic analysis of dust storms in the Middle East. Asia Pacific J. Atmos. Sci.

Advances in Environmental Biology, 8(13) August 2014, Pages: 793-806

AENSI Journals

Advances in Environmental Biology

ISSN-1995-0756 EISSN-1998-1066

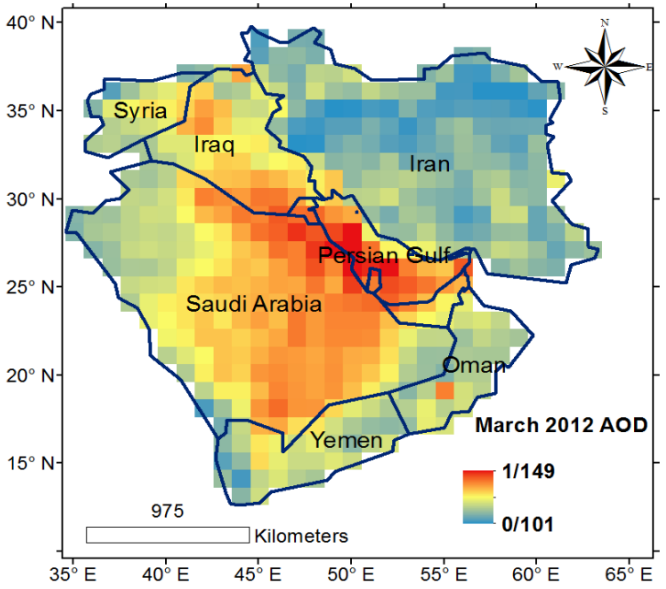
Journal home page: http://www.aensiweb.com/AEB/

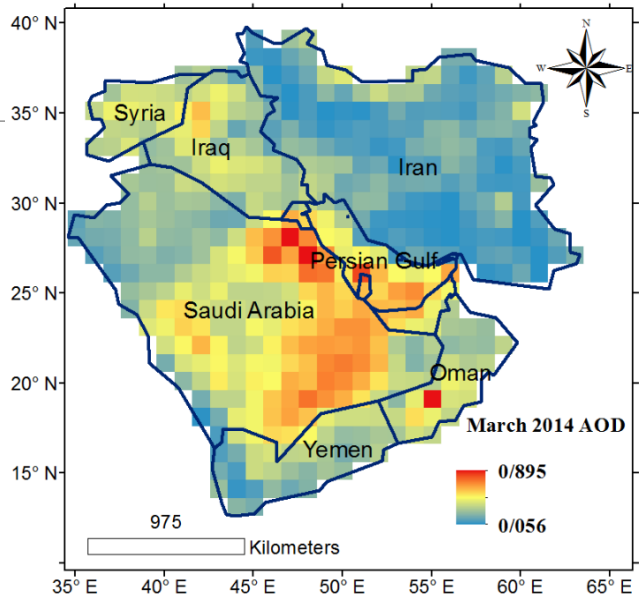
Synoptic and spectral analysis of some dust events in western and southwestern Iran

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

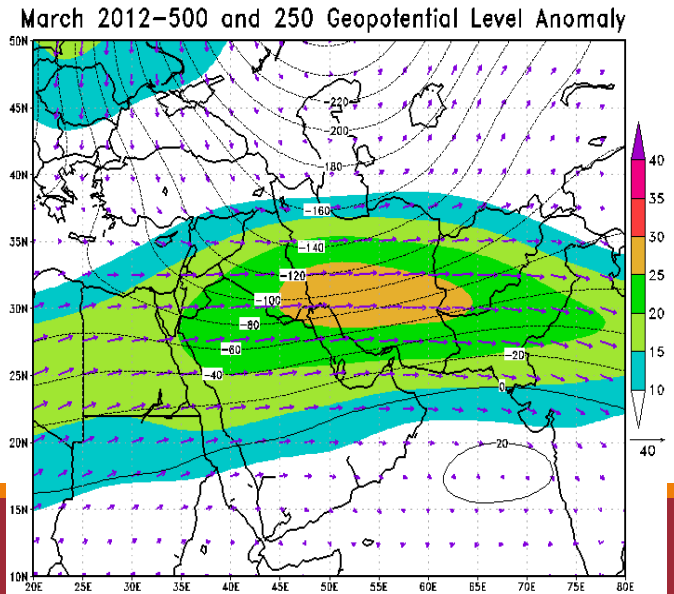
Impacts of climate and synoptic fluctuations on dust storm activity over the Middle East (Atm. Env., 2017)

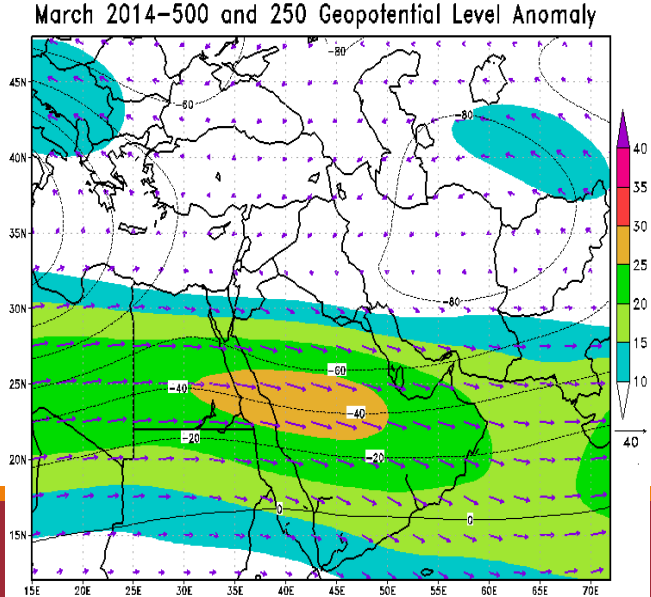
Soodabeh Namdari, Neamat Karimi, Armin Sorooshian, GholamHasan Mohammadi[5], Saviz Sehatkashani





Monthly mean AOD in study region for March 2012 (left) and March 2014 (right).

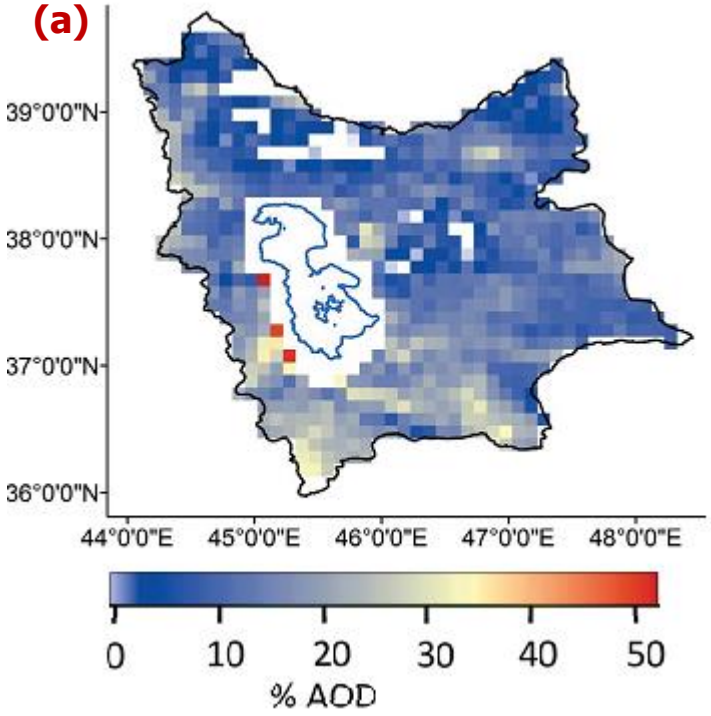


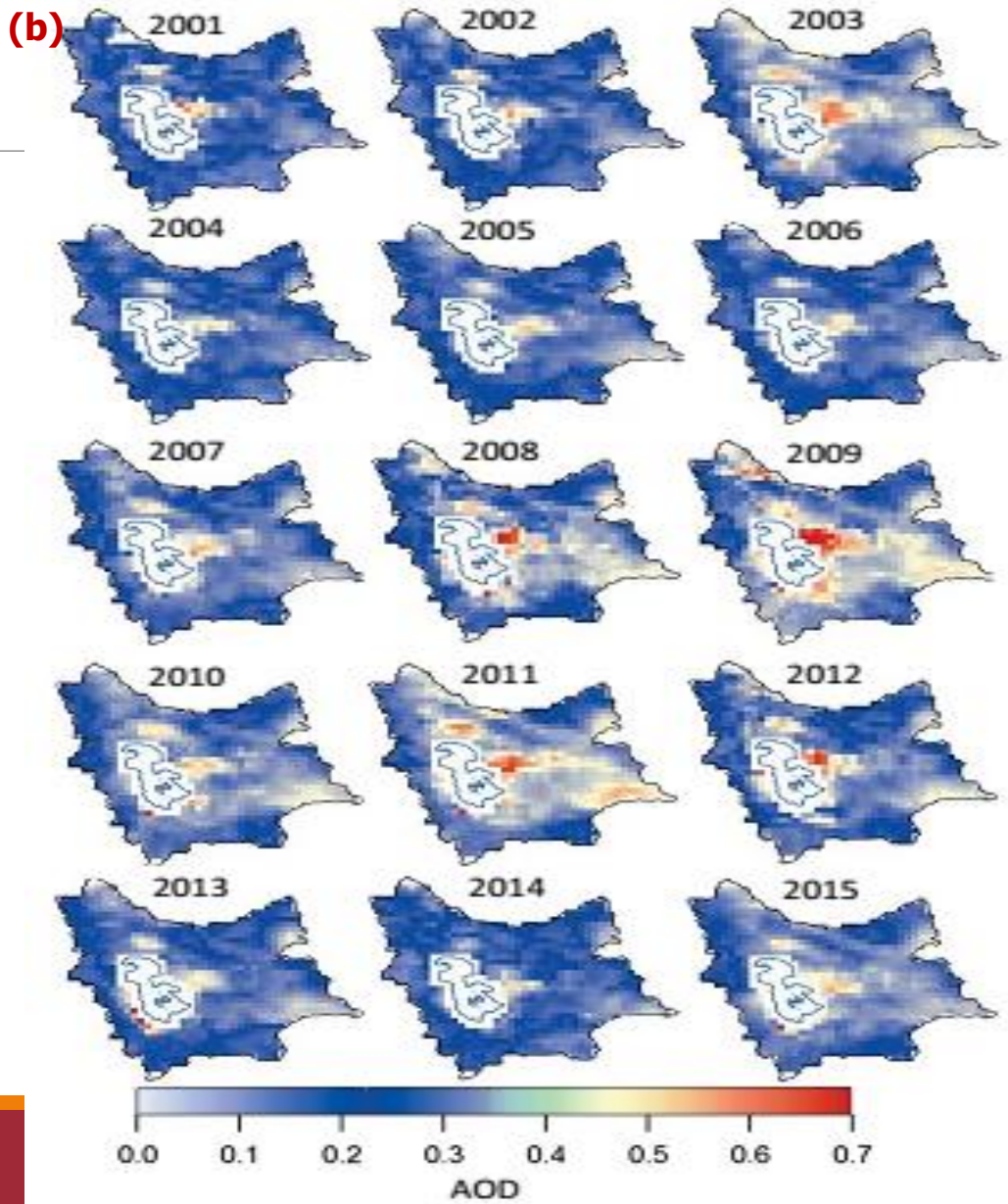


Composite anomaly chart at 250 and 500 hPa. Colors denote wind speed anomaly (m s-1) and violet solid lines represent geopotential contour anomalies at 500 hPa

The Lake Urmia Environmental Disaster in Iran: A Look at Aerosol Pollution (STOTEN,2017)

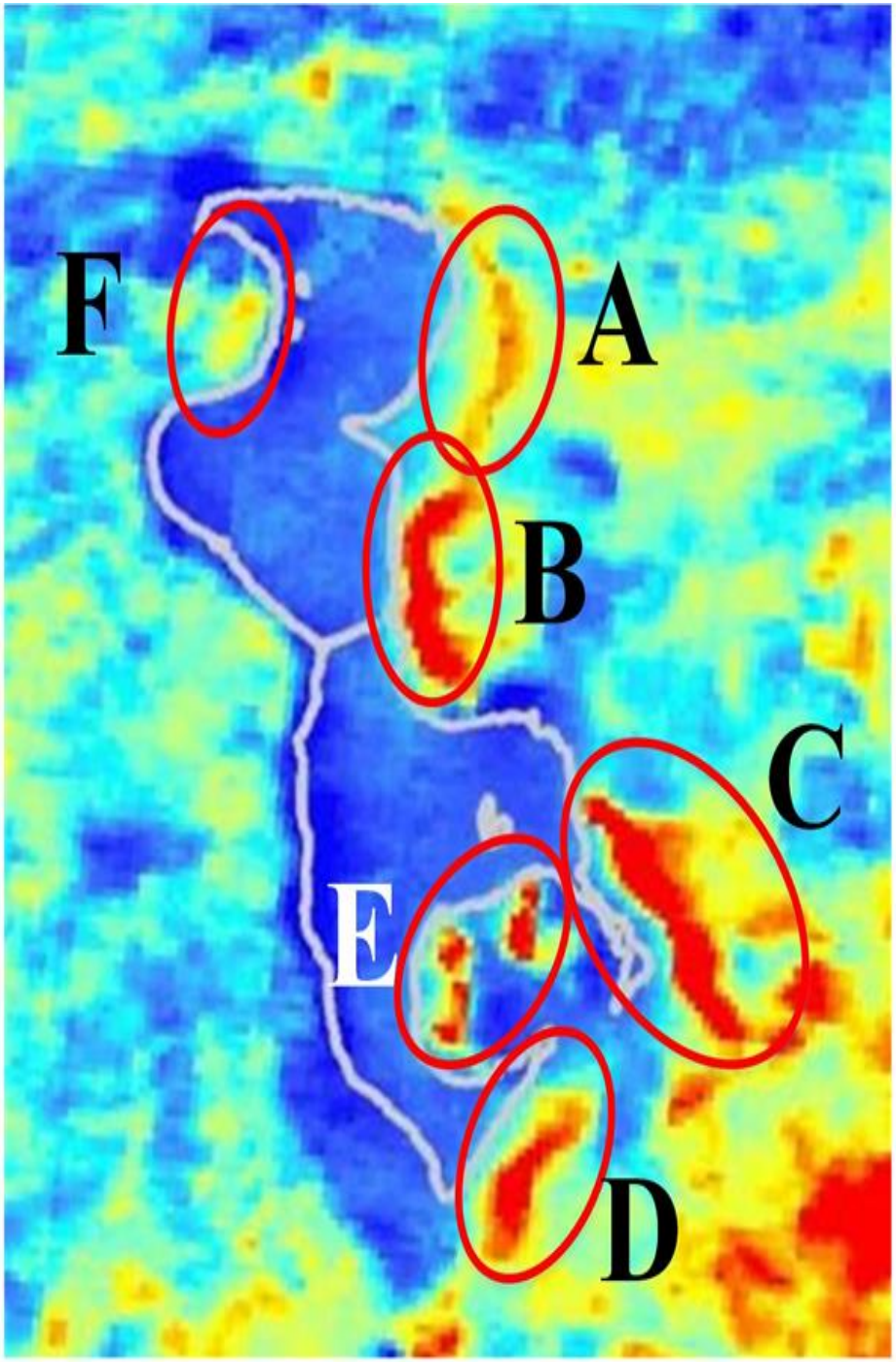
Ali Hossein Mardi, Ali Khaghani, Alexander B. MacDonald, Armin Sorooshian, Phu Nguyen, Neamat Karimi, Parisa Heidary, Nima Karimi, Peyman Saemian, Massoud Tajrishy, Saviz Sehatkashani





(a) Spatial distribution of AOD percent change between 2008-2015 as compared to 2001- 2007. Uncolored pixels represent an insufficient number of data points. (b) Spatial distribution of mean annual AOD for all years between 2001 and 2015. Uncolored pixels represent an insufficient number of data points.

Identify centers around the Lake Urmia by BTD



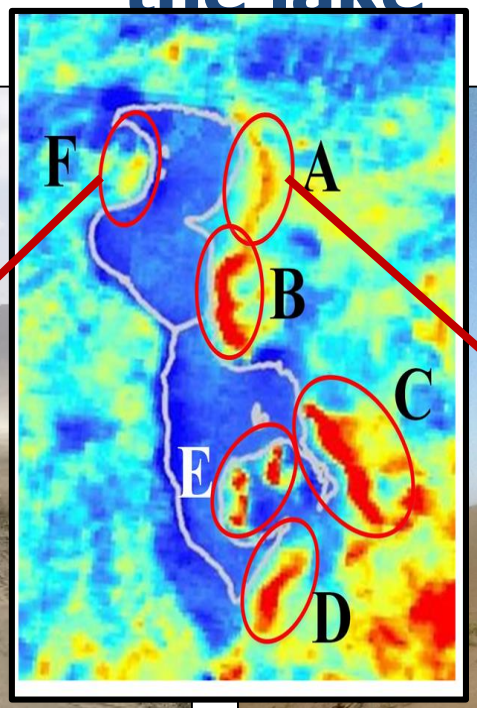
from Masoud Tajrishi Presentation, ESCAP meeting, Tehran, Nov.2018

Salt storm

Location: F of previous slide

from Masoud Tajrishi Presentation, ESCAP meeting, Tehran, Nov.2018

Sand dune movements in west and east of the lake



Urmia

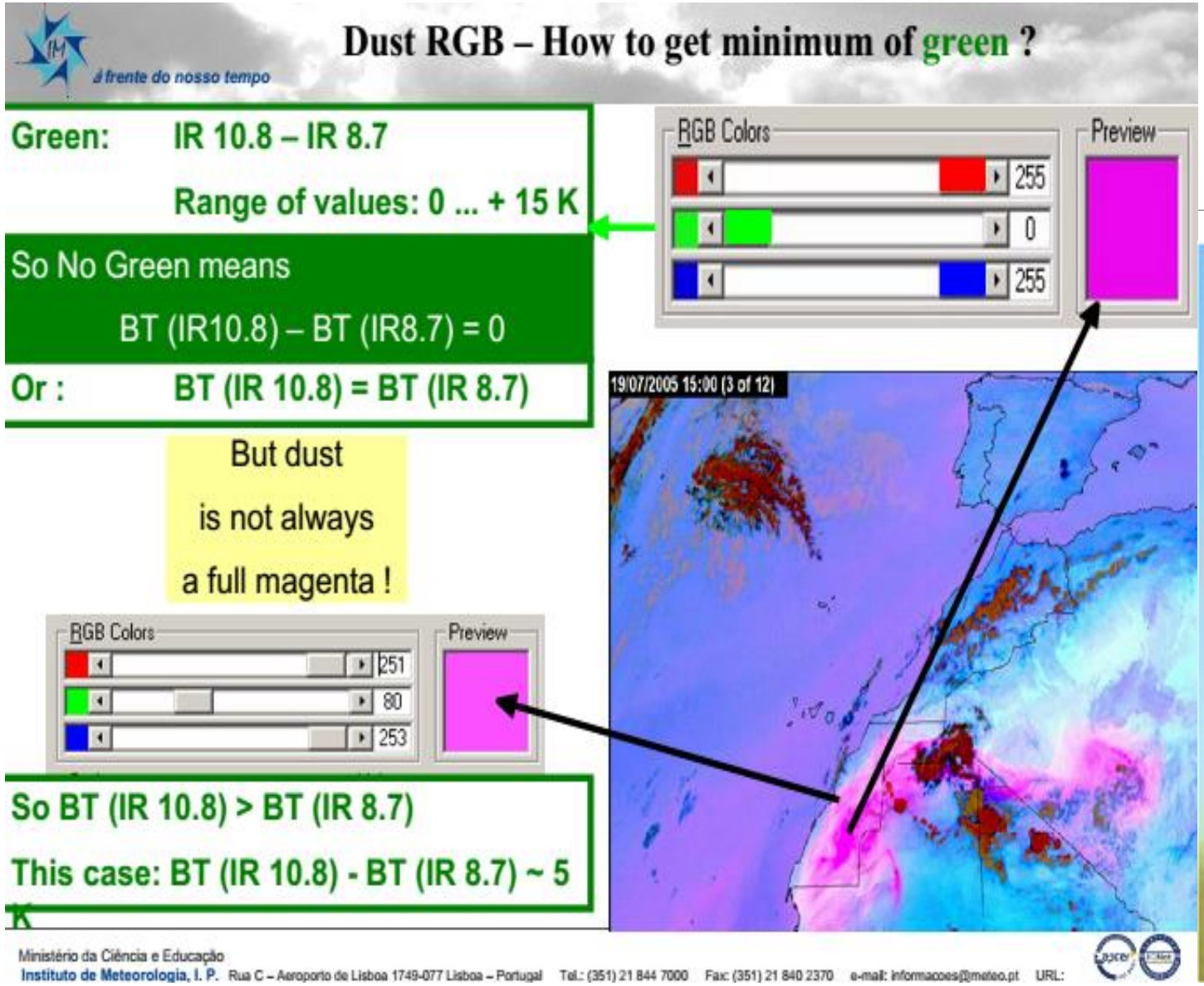
Shabastar

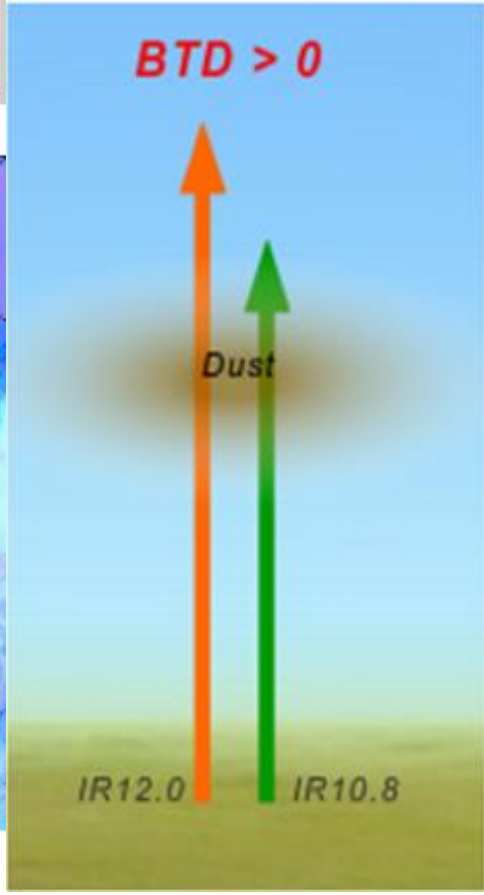
from Masoud Tajrishi Presentation, ESCAP meeting, Tehran, Nov.2018

from Masoud Tajrishi Presentation, ESCAP meeting, Tehran, Nov.2018

bed of Urmia Lake – Summer 2013

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

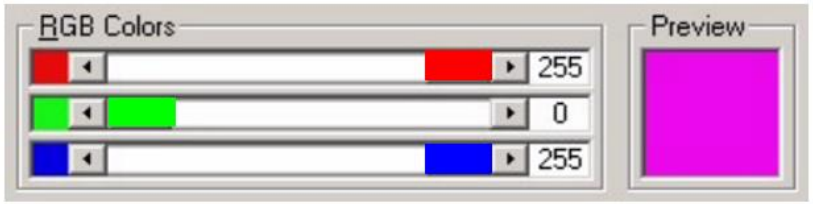


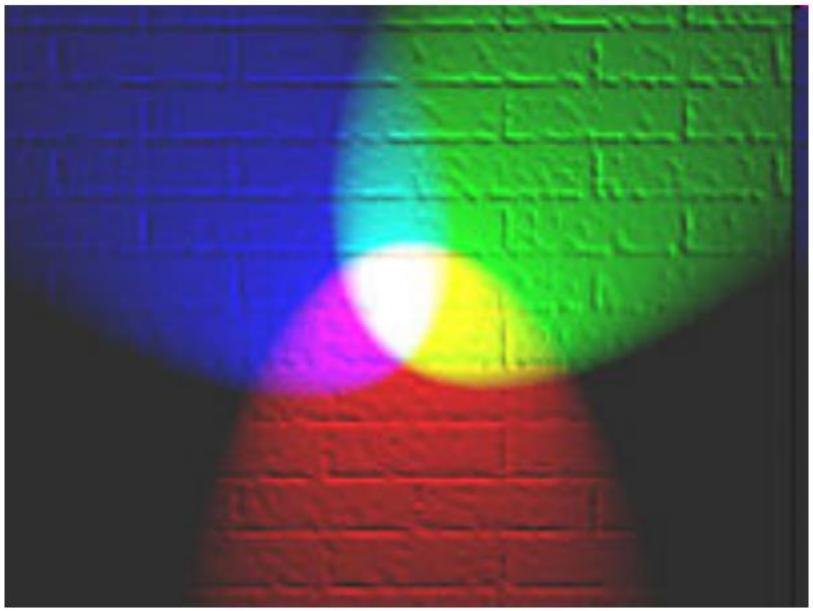


EUMETRAIN Module on RGB images:
http://www.eumetrain.org/resources/operational_use_rgb.html

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

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





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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

Dust RGB – How to get maximum of red ?

à frente do nosso tempo

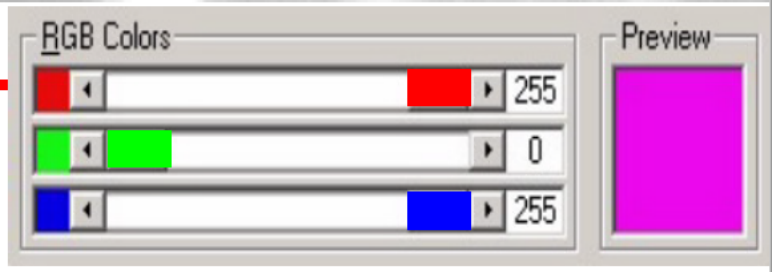
Red: IR 12.0 – IR 10.8

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

So full Red means

BT(IR12.0) – BT(IR10.8) = + 2 K

Or : BT (IR 10.8) – BT (IR 12.0) = - 2 K



BT : Brightness Temperature

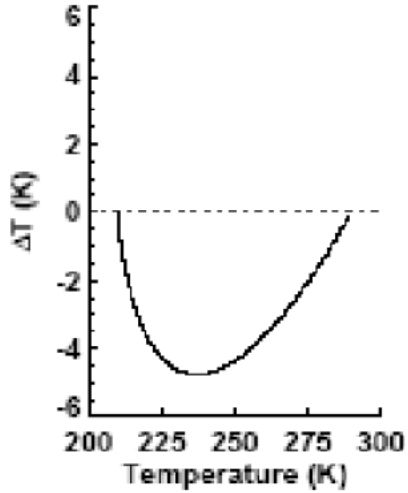
Prata and Grant (2000):

Spectral behaviour of

Silica rich particles

from ash (or dust) for

ΔT = BT(IR10.8) – BT(IR12.0)



So ... for DUST

in the interval [210K ; 290K]

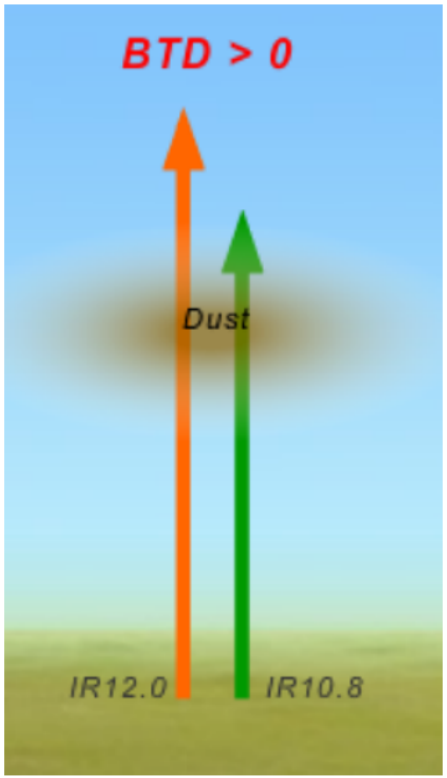
BT(IR10.8) – BT(IR12.0) < 0

BT(IR12.0) – BT(IR10.8) > 0

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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

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 Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

Selection tool for text and images

à frente do nosso tempo

Dust RGB – How to get minimum of green ?

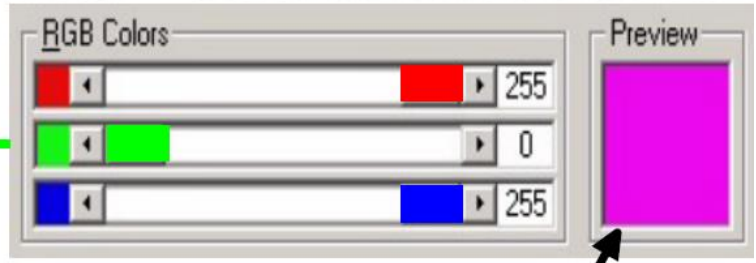
Green: IR 10.8 – IR 8.7

Range of values: 0 ... + 15 K

So No Green means

BT (IR10.8) – BT (IR8.7) = 0

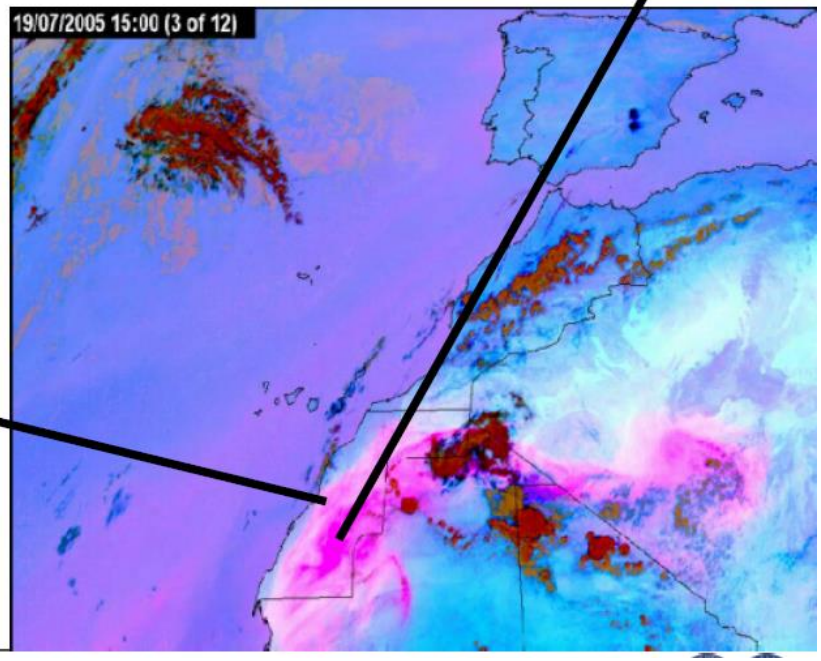
Or : BT (IR 10.8) = BT (IR 8.7)



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

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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

à frente do nosso tempo

Dust RGB – The desert

In fact note the

for desert areas

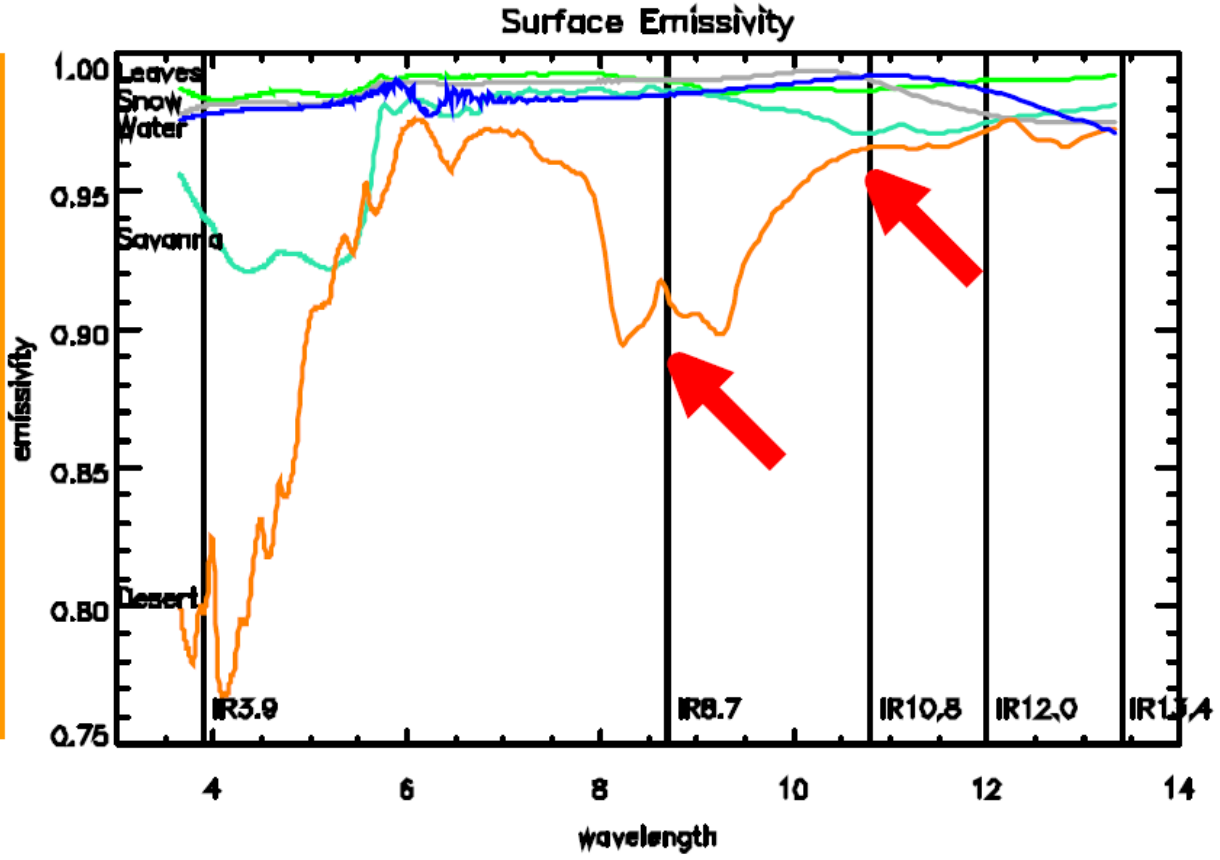
emissivity is higher

at 10.8 micra

than at 8.7 micra

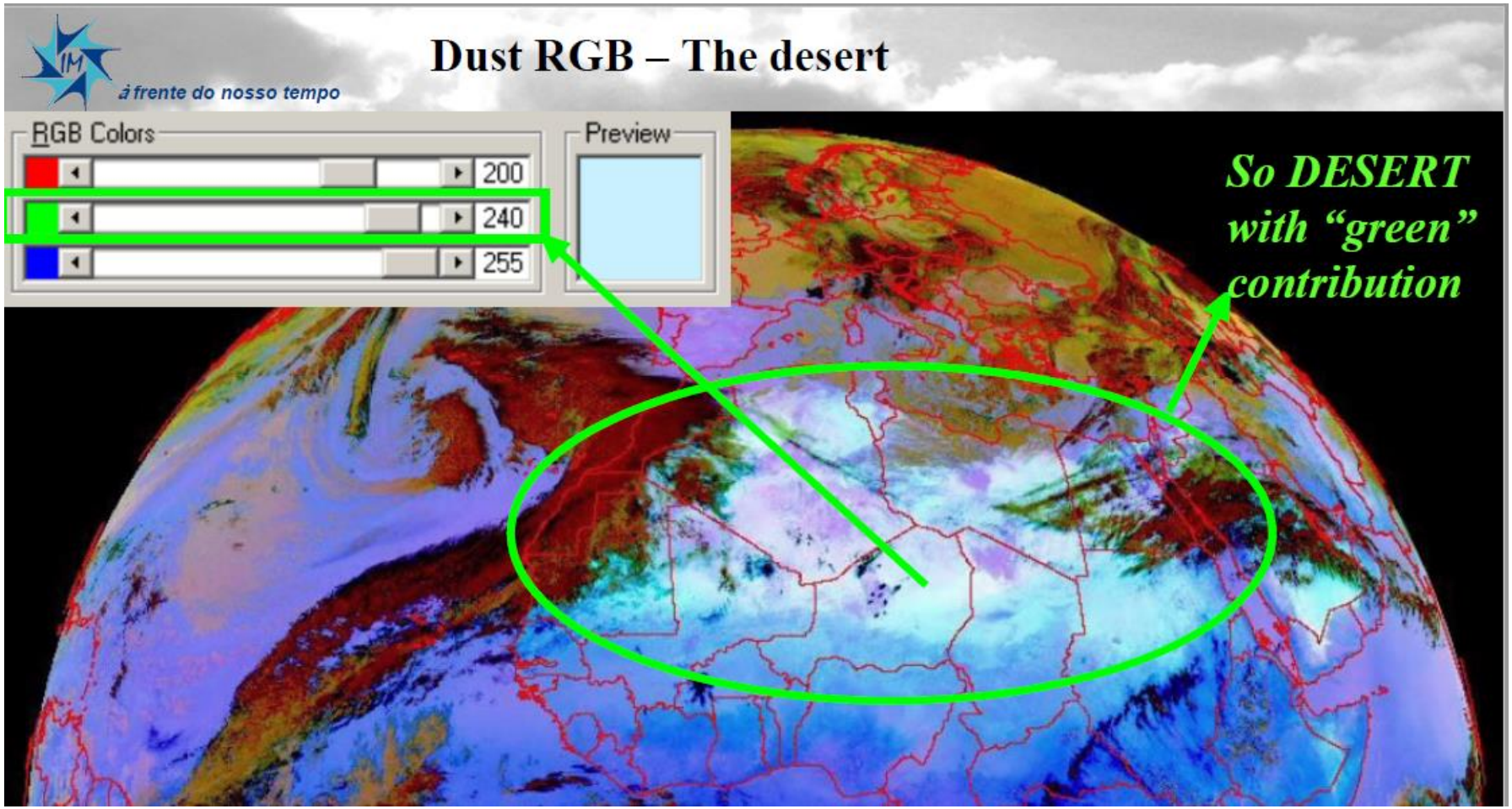
So over the desert:

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



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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE



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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

Dust RGB – How to get maximum of blue ?

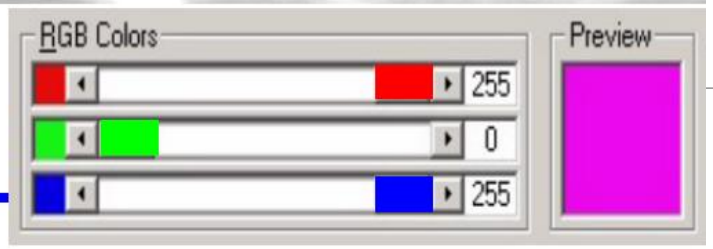
à frente do nosso tempo

Blue: IR 10.8

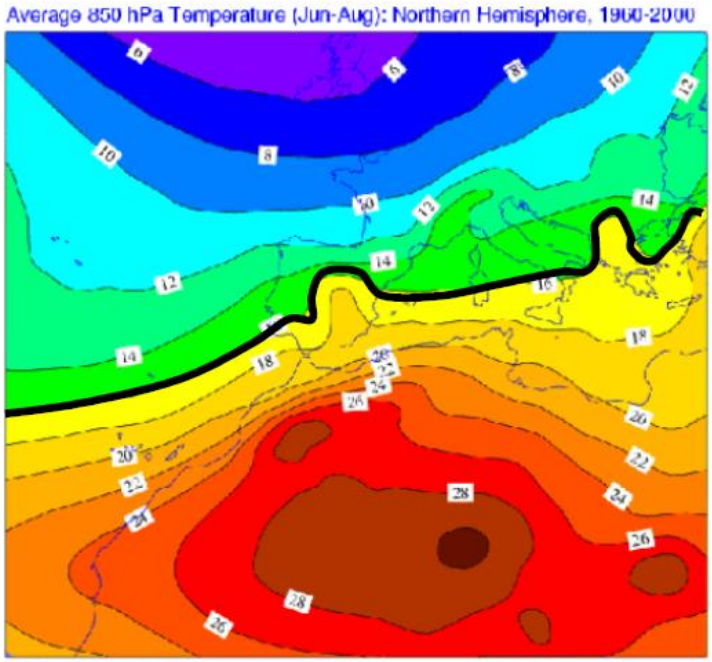
Range of values: -12ºC ...

So full Blue

BT (IR10.8) = + 16ºC



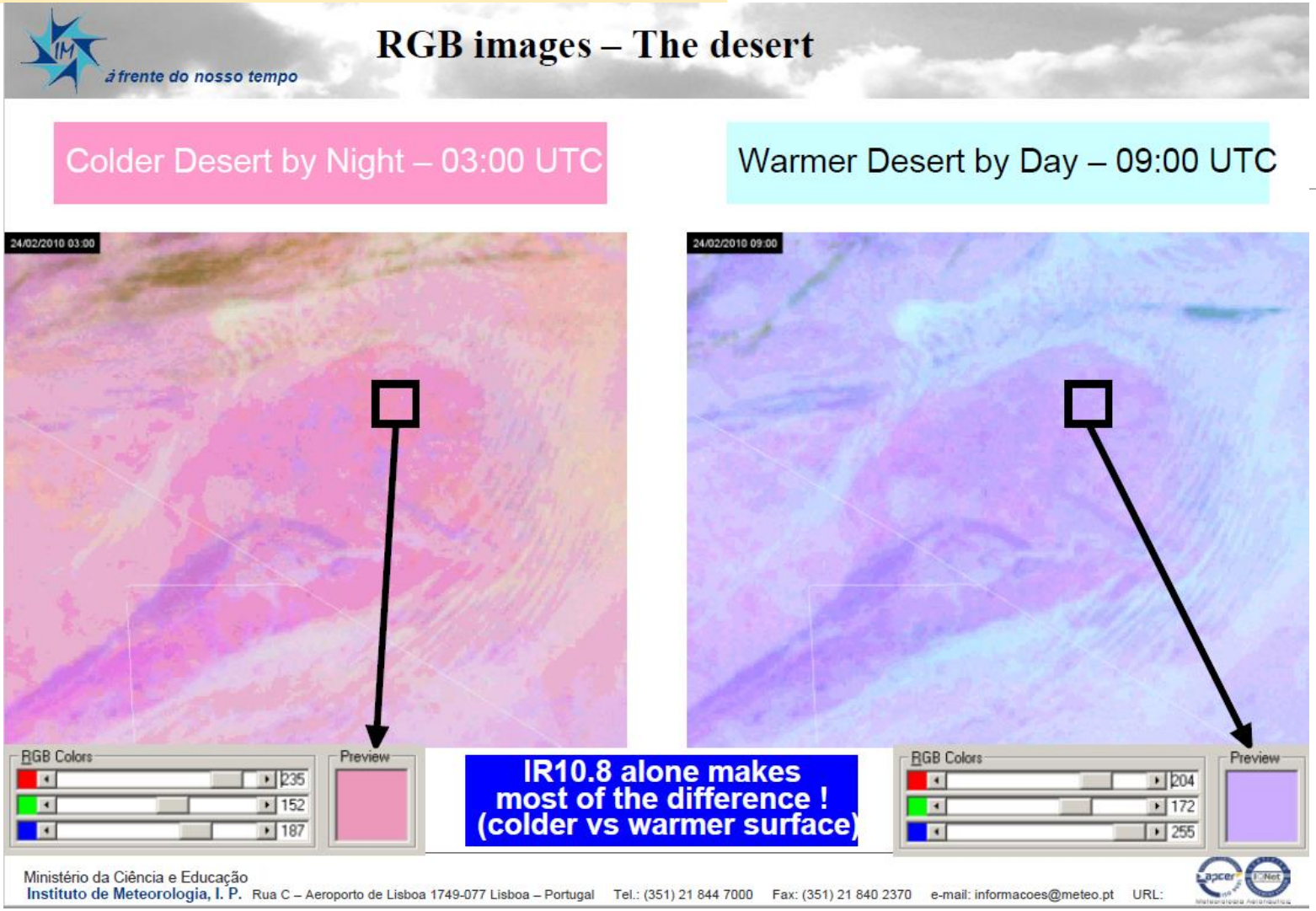
16ºC is a temperature "easy to reach" for desert & dust clouds



Instituto de Meteorologia, I. P. Rua C – Aeroporto de Lisboa 1749-077 Lisboa – Portugal Tel.: (351) 2

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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE



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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

Other colors in "Dust RGB"

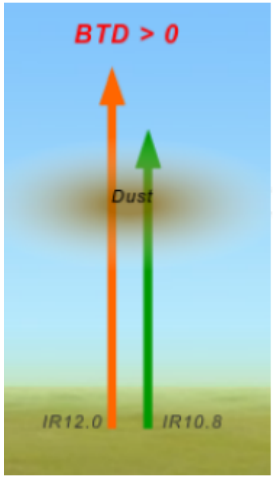
à frente do nosso tempo

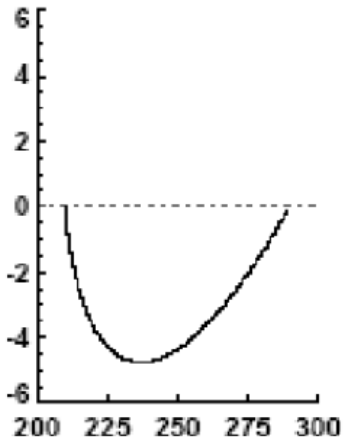
In fact the spectral property of silica-rich particles is called **reverse absorption**

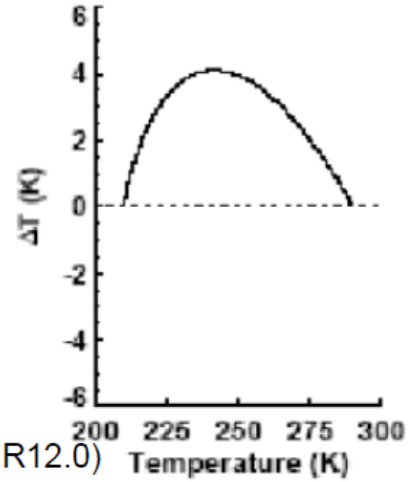
For water and Ice, the absorption is larger for 12.0 micra than for 10.8 micra

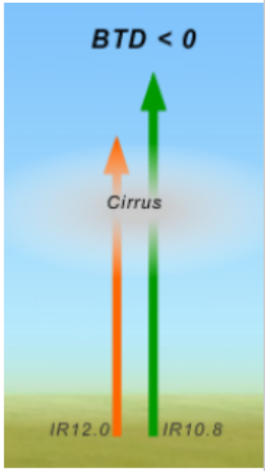
Dust / Ash : BT (10.8) < BT (12.0)

Water / Ice : BT (10.8) > BT (12.0)







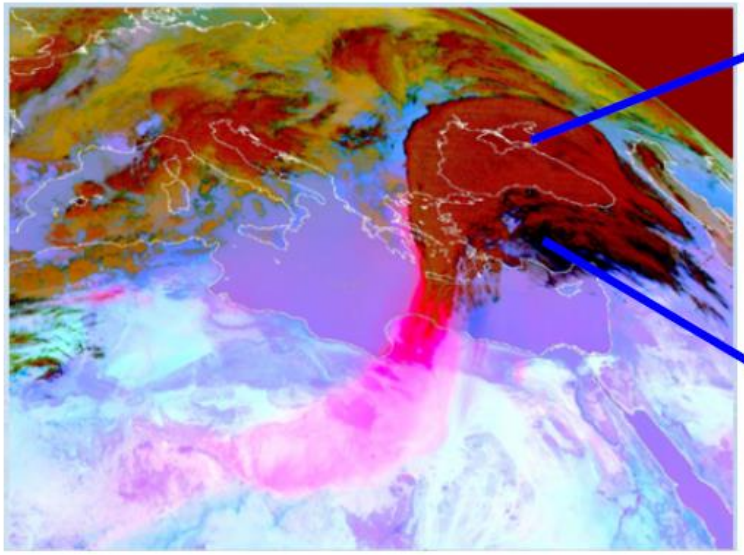


ΔT = BT(IR10.8) – BT(IR12.0)

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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

Other colors in "Dust RGB" - Black



cold thick high level clouds

BT (IR10.8) ~ BT (IR12.0)

BT (IR10.8) - BT (IR12.0) ~0

cold thin high level clouds

BT (IR10.8) > BT (IR12.0)

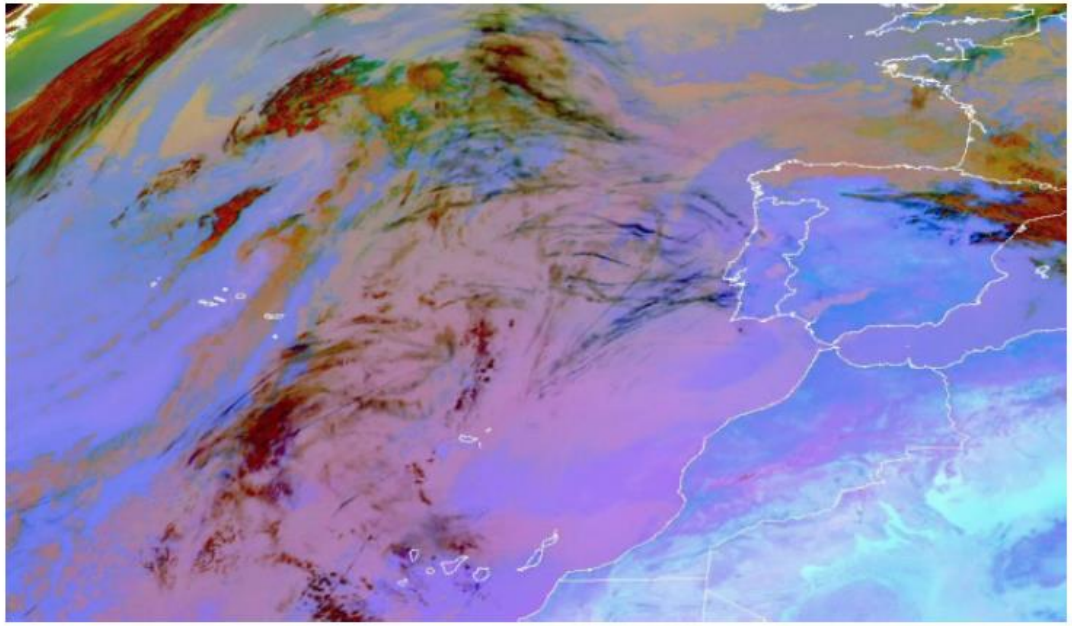
BT (IR10.8) - BT (IR12.0) ~ 4

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

Dust Enhancement Techniques- EUMETSAT DUST RGB COMPOSITE

Other colors in "Dust RGB" - Black

Contrails – a special case of cold thin high level clouds



CONTRAILS = ***CON****densation* ***TRAILS***

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

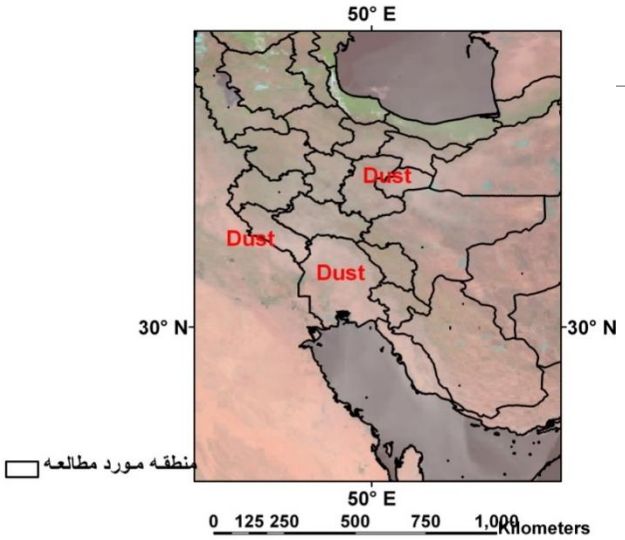
Verification of visibility estimation with RS empirical equation

Dust Indices

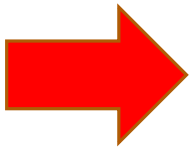
- Normalized Difference Dust Index (NDDI)
- Thermal-infrared Dust Index (TDI)
- Brightness Temperature Difference (BTD)

Verification of visibility estimation with RS empirical equation

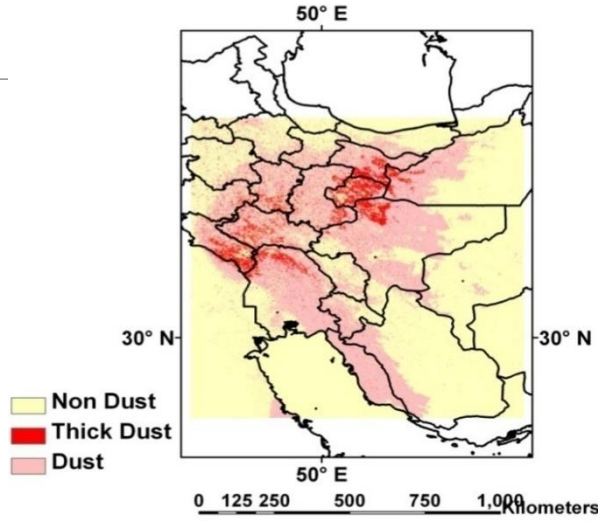
If $BT_{11\mu m} - BT_{12\mu m} < -0.5K$ then DUST.



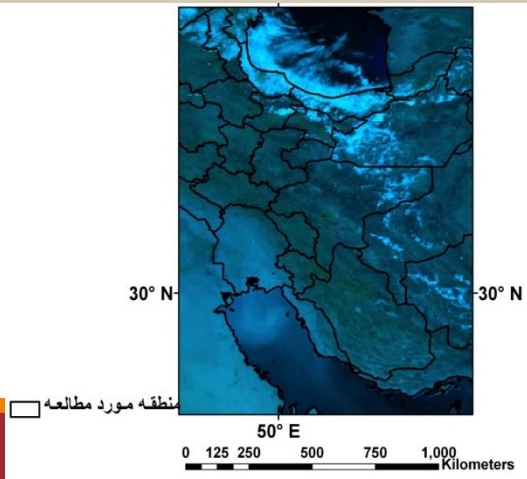
Threshold consideration

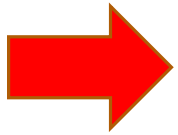


July 6,2009

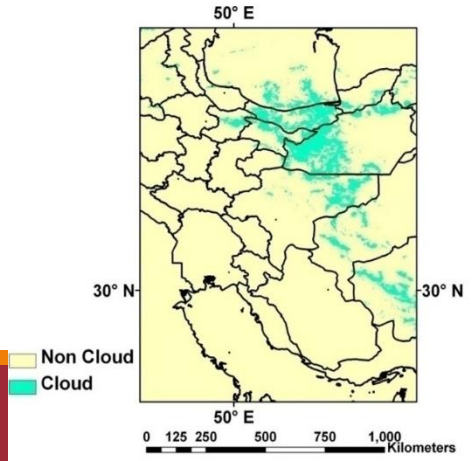


If BT31 < 278 K Then cloud , If BT31>288 then Bright Surface



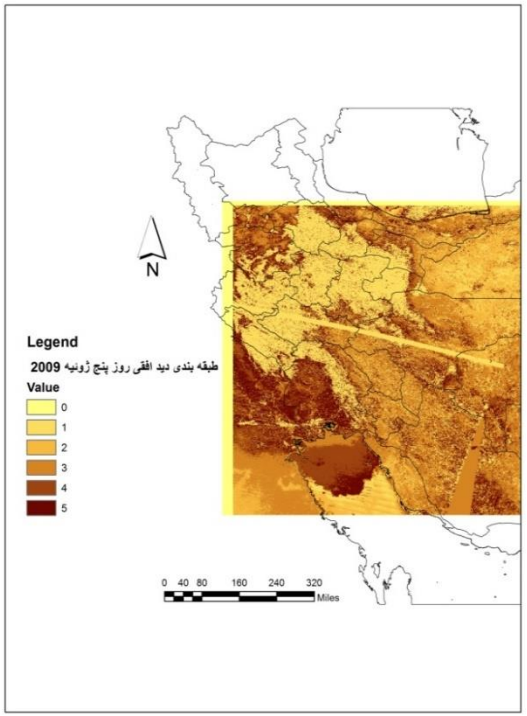


September 17 2008

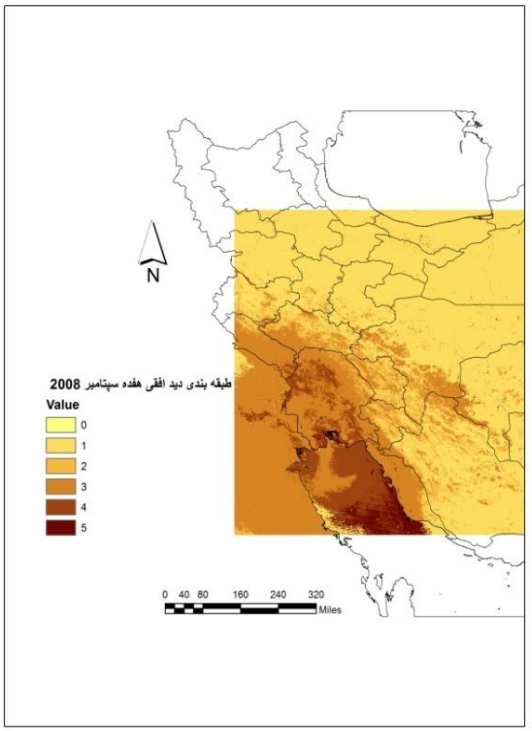


Verification of visibility estimation with RS empirical equation

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



July 5 2009



September 17 2008

Scientia Iranica A (2016) 23(5)

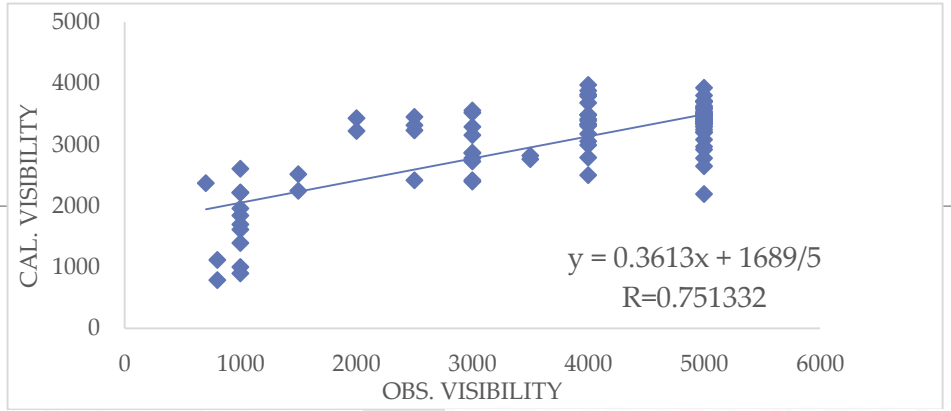
SCIENTIA IRANICA

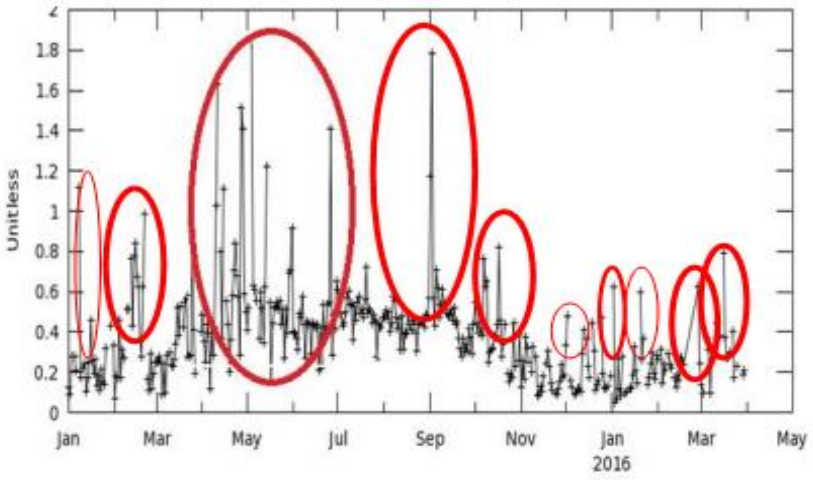
Sharif University of Technology
Scientia Iranica
Transactions A: Civil Engineering
www.scientiairanica.com

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

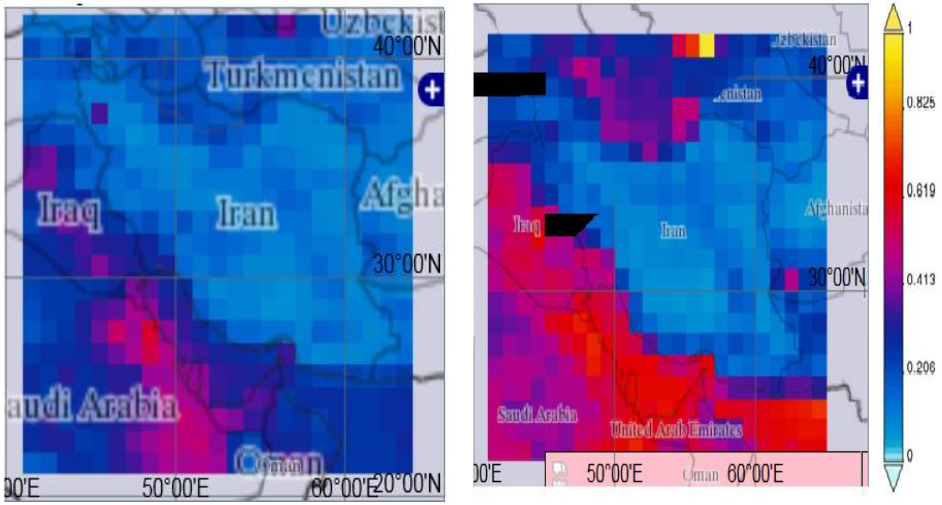
S. Sehatkashani[a], M. Vazifedoust[b,*], Gh. Kamali[a] and A.A. Bidokhti[c]

Dust Classification, visibility and AOT estimation interface according to their physical properties

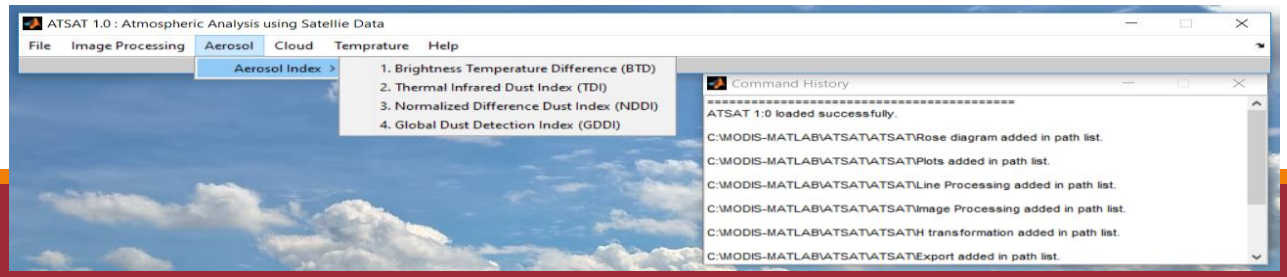




a combination of the AOD data retrieved using dark-target and deep blue (DB) algorithms. Daily level-3 products (collection 5.1), consisting of daily global gridded data of aerosol parameters at a resolution of (110 km)



AOD from MODIS, for October–April 2015–2016 (left column) and for May–September 2015–2016 (right column)



Saviz Sehatkashani et.al., 2016
Saviz Sehatkashani et al., in Prep.

people live in cities and breath a cocktail dust + pollutants

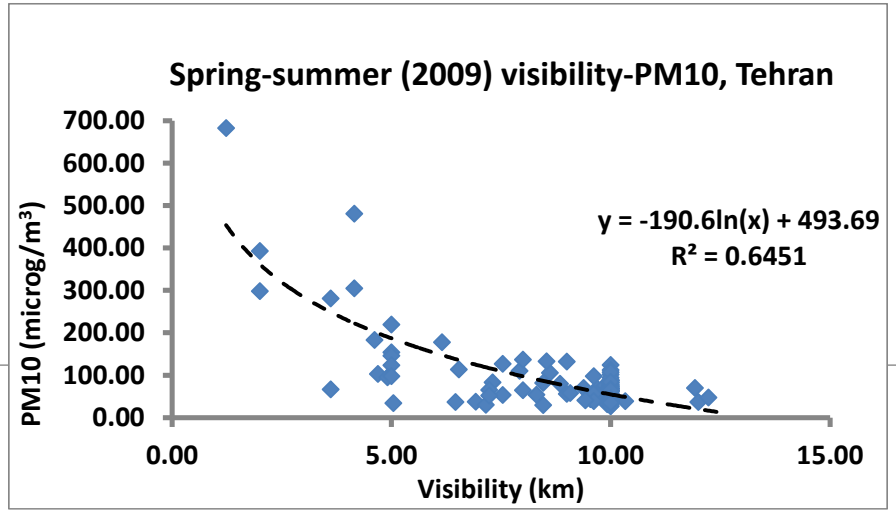
aerosols, a cocktail of chemicals:

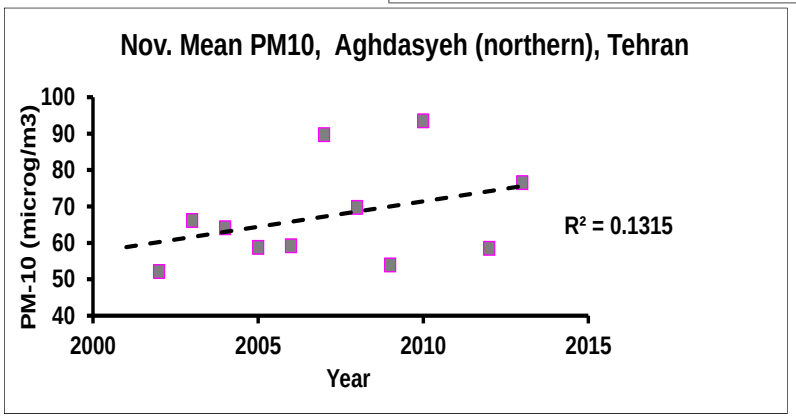
- **dust**
- sulphate
- nitrate
- organic mater
- black carbon (soot)
- metals (Ni, As, Cd, V, Co…)
- **sea salt**

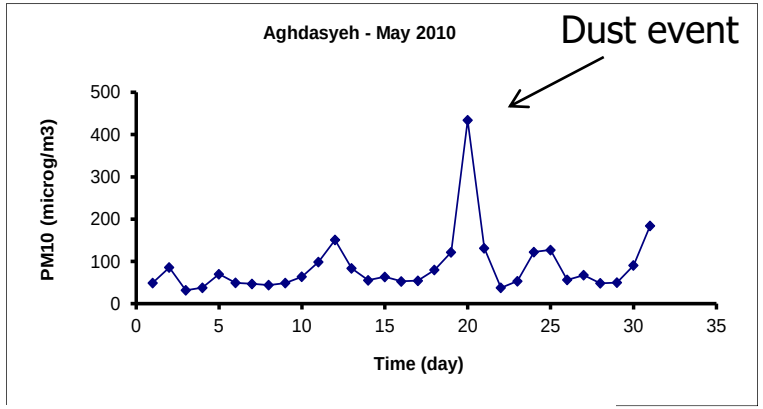
size: 1 nm (10^{-9} m) to 20 µm (10^{-6} m)

human hair: 70 µm

From the presentation Dr. Emilio Cuevas, Aerosols and mineral dust monitoring techniques Training course, Spain,2018







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

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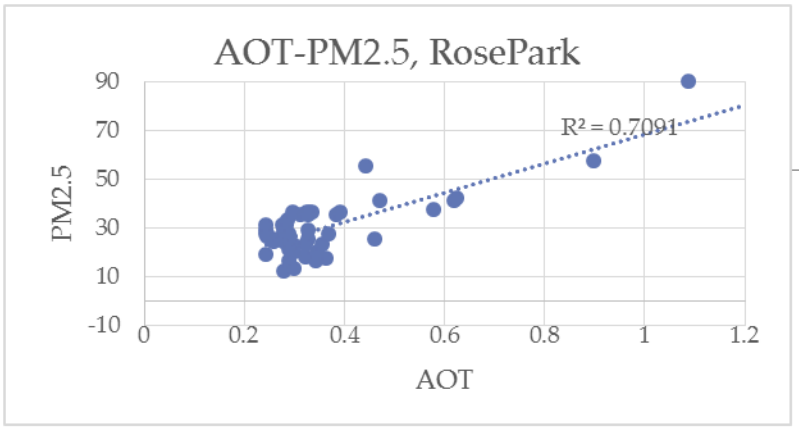
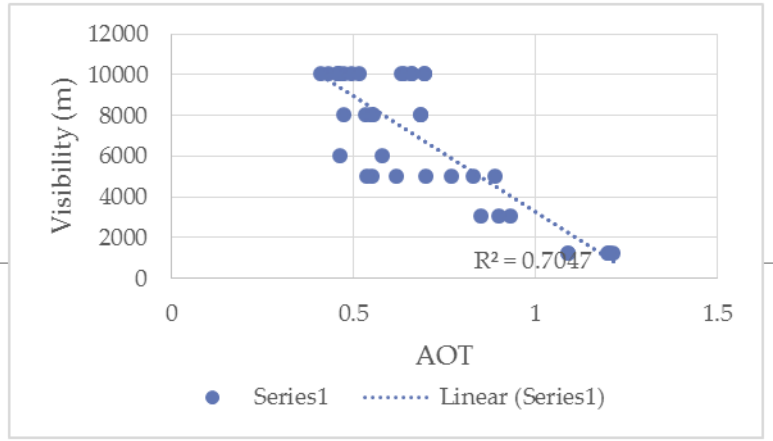
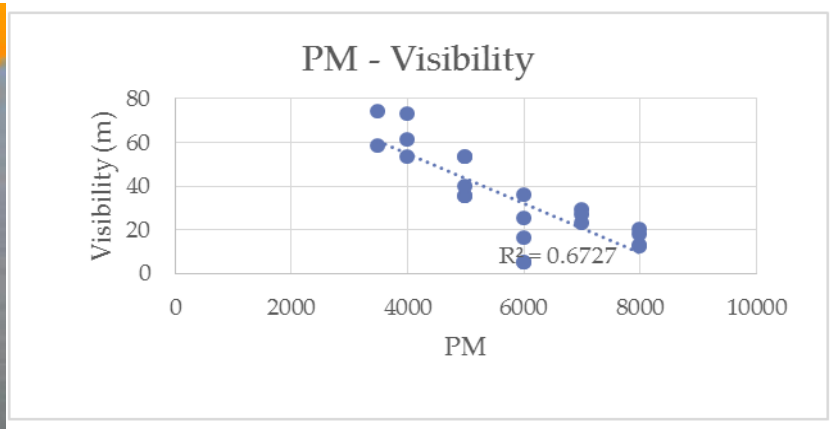
Examples of cooperation between WMO SDS-WAS & IRIMO







Calitoo hand-held sun-photometer)

Technical characteristics:

- Light channels: 465, 540 and 619 nm
- Possible 999 measures stored in memory
- AOD calculated in real-time
- USB data download
- Free software on web site.
- Supply : 4 batteries AA (1,5V)
- Dimensions : 210 x 100 x 35 mm
- Weight : 400 g (With batteries)
- Operating temperature : -20°C to 55°C

http://www.calitoo.com

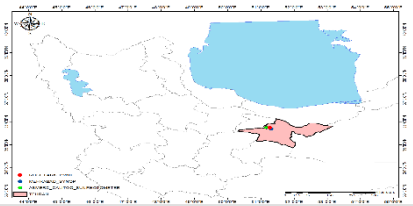
Calitoo hand-held sun-photometer)

The measurement principle is to point the Sun and search for the maximum flow. The photometer keeps only the maximum measured and then calculated the optical depth.

The Sun alignment is done manually. It is facilitated by the sighting device located above the display of the Calitoo.

The calculation of optical depth uses raw brightness measurements, calibration coefficients, date and GPS position as well as atmospheric pressure.

Aerosol characterization using Calitoo hand-held sunphotometer at the District 22 of Tehran



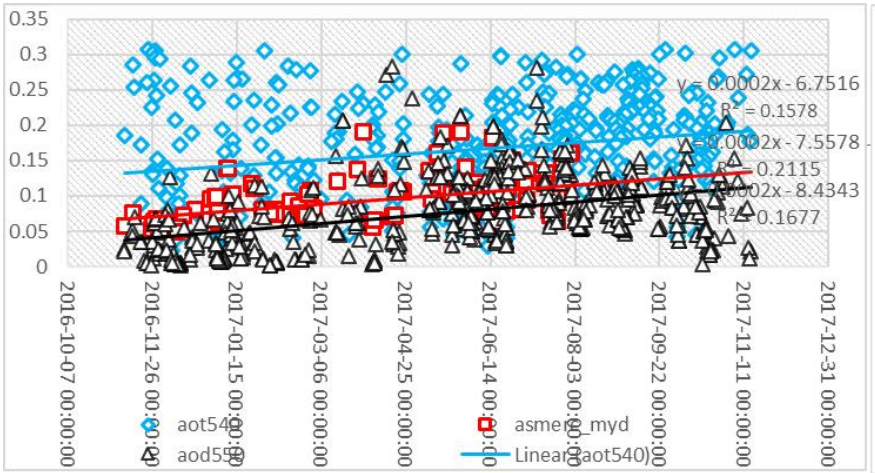


Fig. 7a. Scatter plot of WMO SDS-WAS median model AOT 550nm(black triangles), MODIS AOT(red squares) and hand held Calitoo sunphotometer(blue dots).

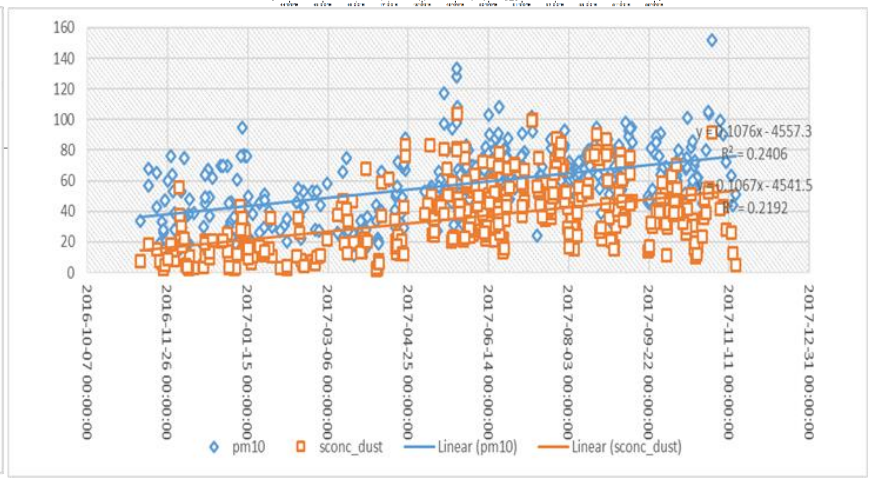


Fig. 7b. Scatter plot of WMO SDS-WAS median model surface concentration (red square) and PM10 observtion (blue squares).

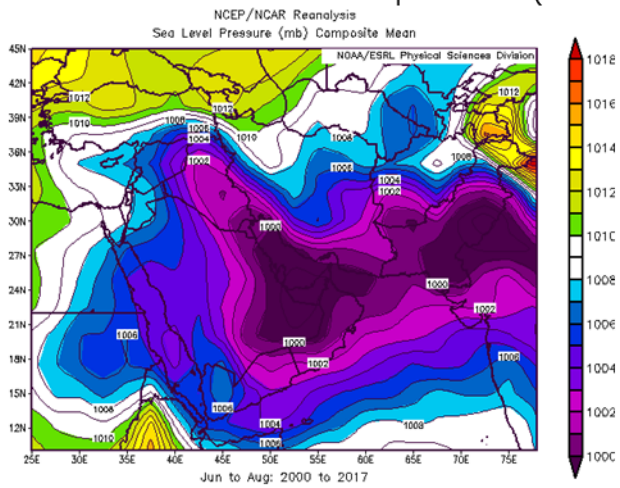


Fig. 3a-Same as 2a, but for summer(JJA)

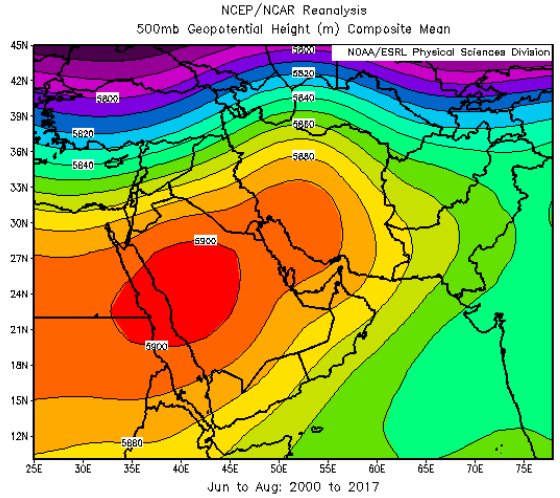


Fig.3b- Same as 2b, but for summer(JJA)

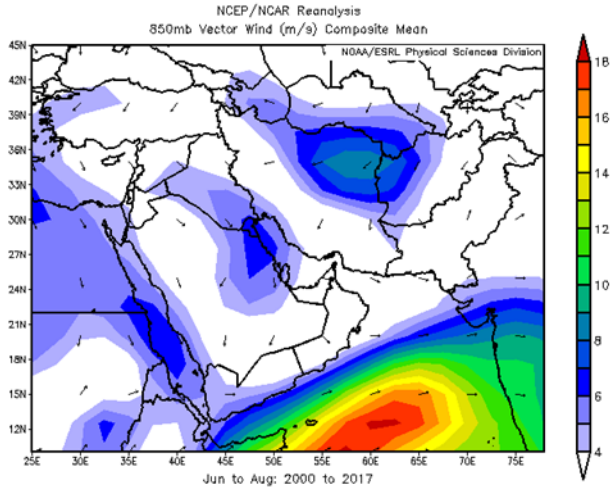


Fig.3c- Same as 2c, but for summer(JJA)

In-situ dust characterization

GAW

WORLD METEOROLOGICAL ORGANIZATION

WEATHER CLIMATE WATER

Global Global Atmospheric Watch Aerosol Programme

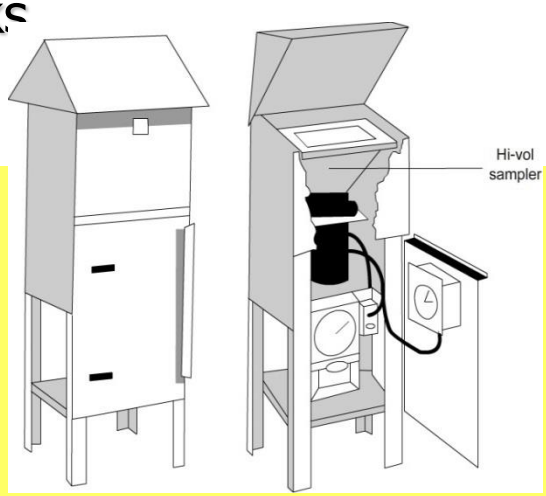
PM_{10} & $PM_{2.5}$ sampeling

EN 12341 & 14907 methods

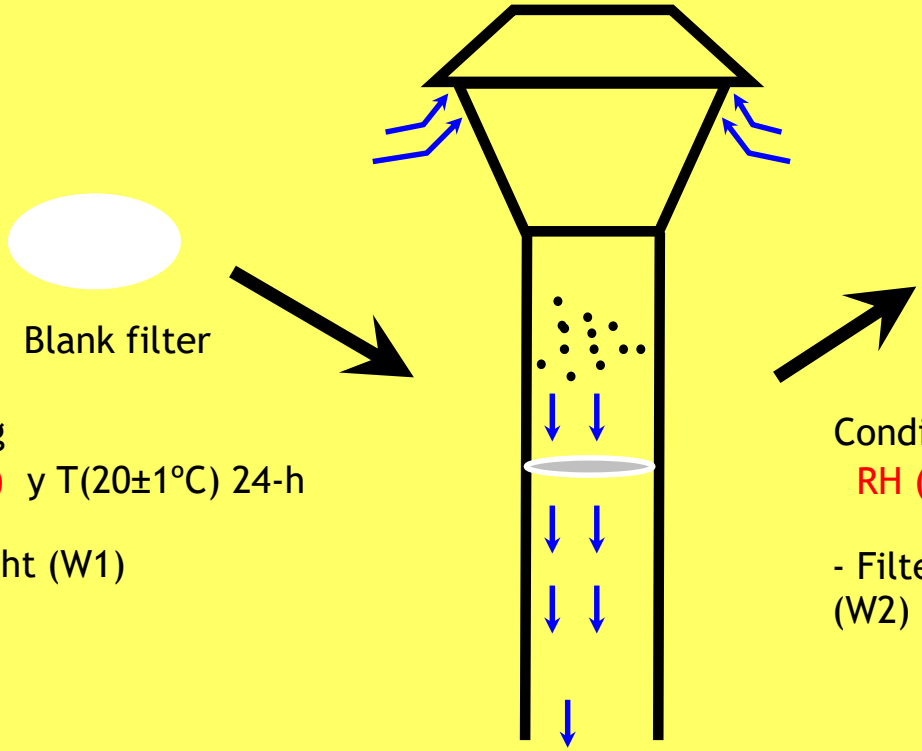
Weighting 20ºC
30-35% RH

PM_{10} and $PM_{2.5}$ measurements in air quality networks

1. Reference method: gravimetric method



$$PM = \frac{(W2-W1)}{Volume}\ \mu g/m^3$$



Blank filter

Conditioning
RH (50±5%) y T(20±1°C) 24-h

- Filter weight (W1)

Pump

Sampled filter

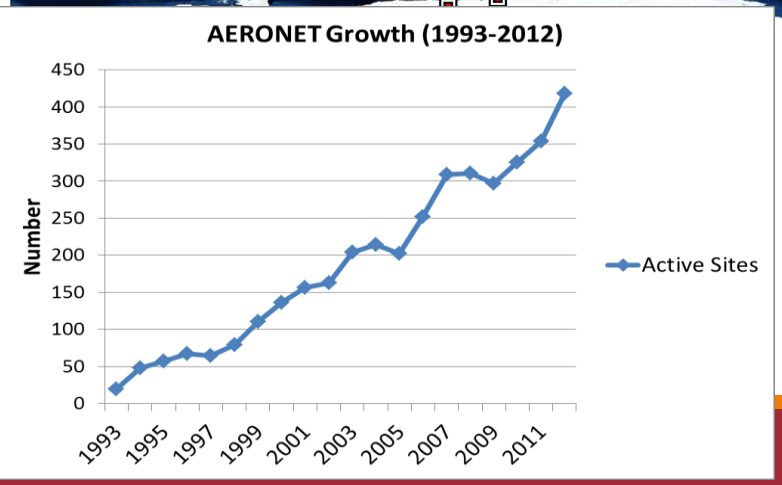
Conditioning
RH (50±5%) y T(20±1°C) 24-h

- Filter weight (W2)

AERONET Aerosol Robotic Network-Twenty Years of Observations and Research

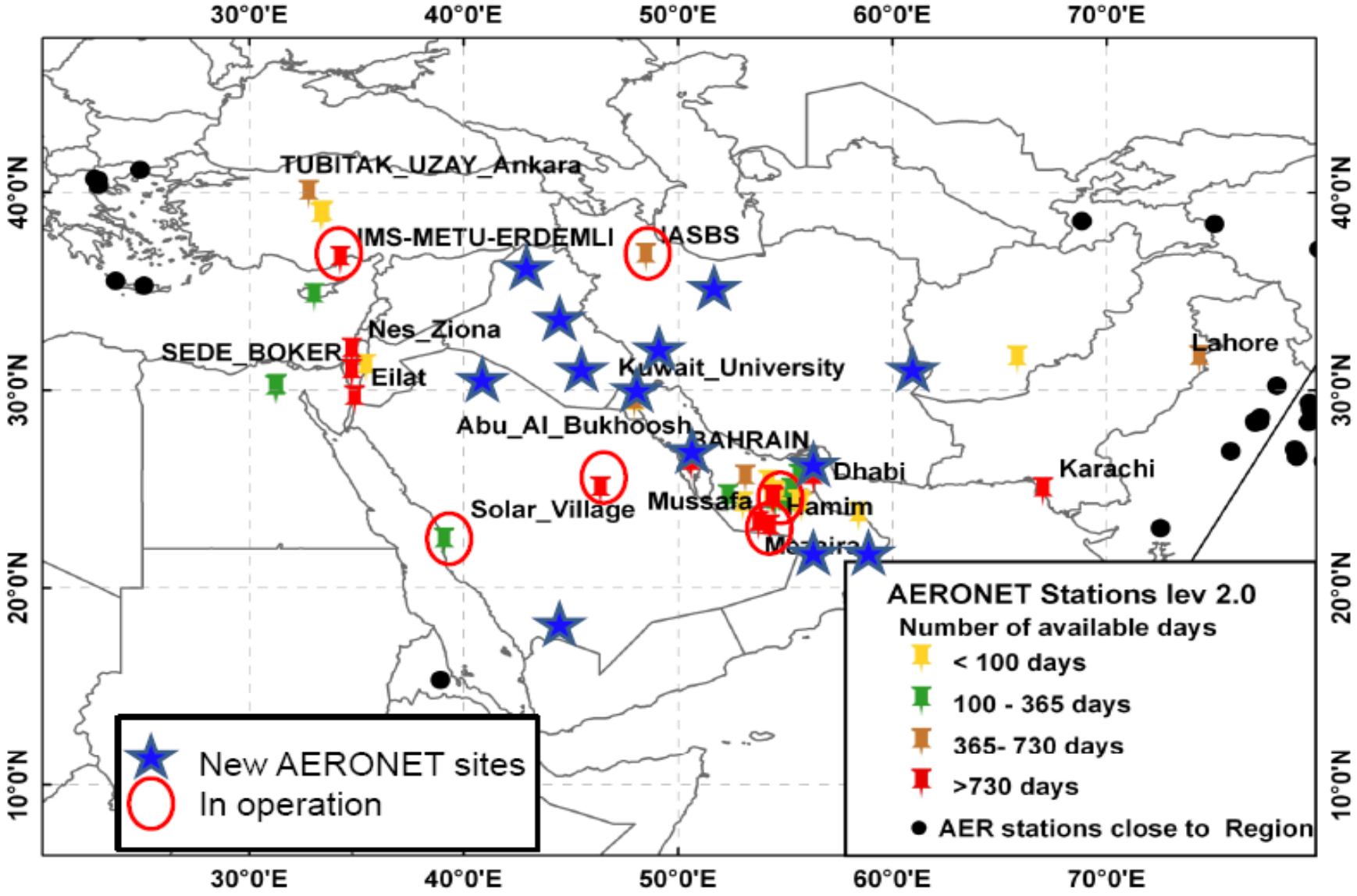
The AERONET program is a federation of ground-based remote sensing aerosol networks established by NASA and LOA-PHOTONS (CNRS) and has been expanded by collaborators from international agencies, institutes, universities, individual scientists and partners.

- >7000 citations
- >400 sites
- Over 80 countries
- http://aeronet.gsfc.nasa.gov



AERONET provides a long-term, continuous public database of aerosol optical, microphysical, and radiative properties for aerosol research and characterization, validation of satellite measurements, and synergism with other databases.

An Example of Current Needs for West Asia



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

Opportunities for future cooperation between WMO SDS-WAS & IRIMO

https://gawsis.meteoswiss.ch/GAWSIS//index.html#/

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Generate station report by:

Station name

GAW ID

Generate station lists by:

Country

Type

Find people by:

Contact name

GAW World Data Centres

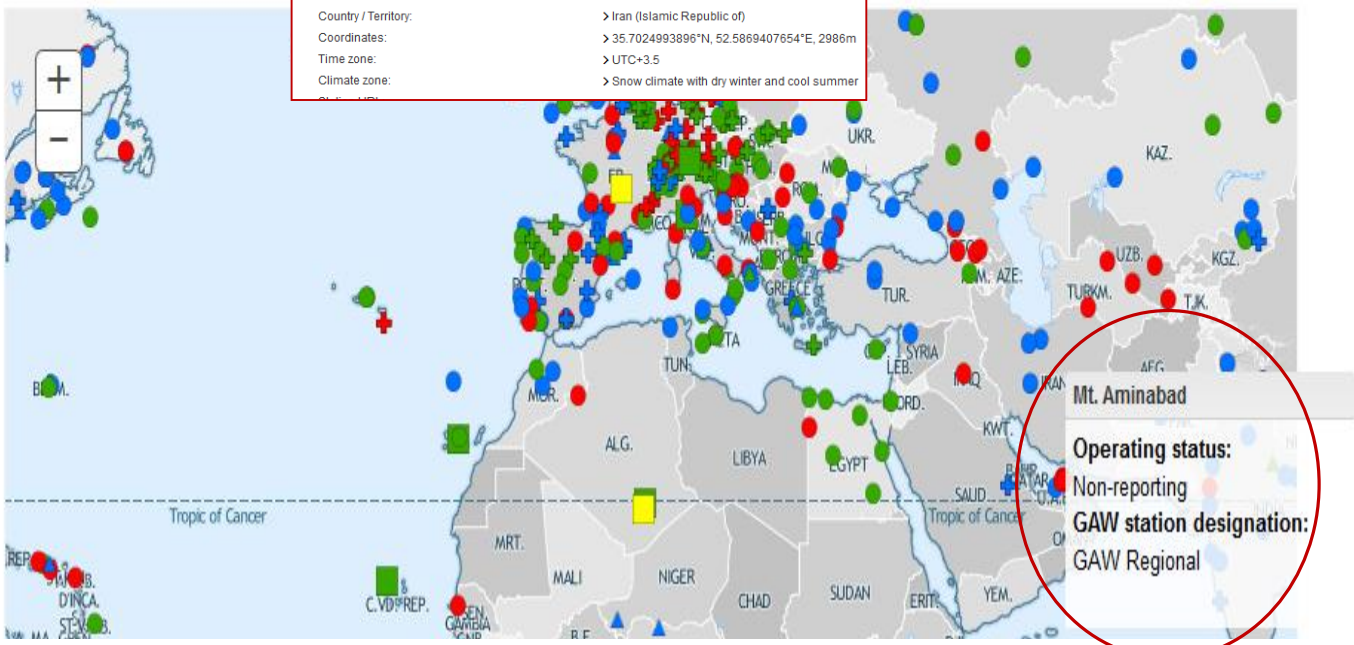
WDC-RSAT (World Data Center for Remote

Welcome to GAWSIS

Mt. Aminabad (Iran (Islamic Republic of))
GAW Regional station in WMO Region II - Asia

Station characteristics

Station name:	Mt. Aminabad
Station alias:	
Date established:	
Declared status:	Operational
Current recorded status:	Non-reporting
Station type:	Land (fixed)
Station class(es):	
GAW ID:	MAM
WMO index No:	0-20008-0-MAM
WMO region:	II - Asia
Country / Territory:	> Iran (Islamic Republic of)
Coordinates:	> 35.7024993896°N, 52.5869407654°E, 2986m
Time zone:	> UTC+3.5
Climate zone:	> Snow climate with dry winter and cool summer



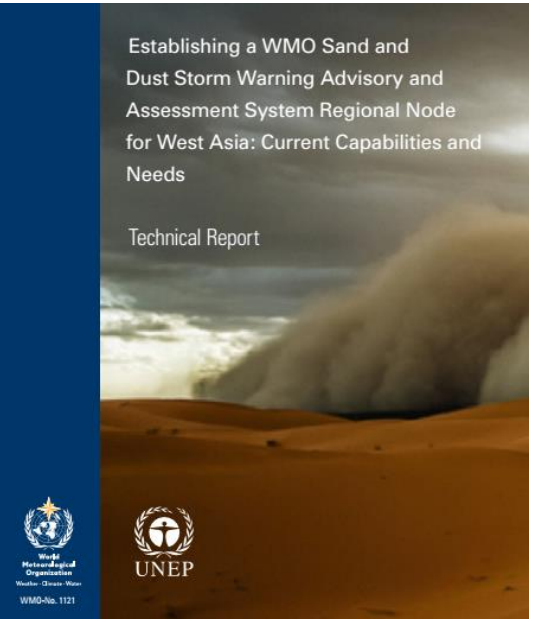
Programs / network affiliation:

Program / network affiliation	Program specific ID	Current recorded status	Declared status	From	To	Status
GAW Regional	MAM	Non-reporting	Operational	2016-04-28		Approved

Observations / measurements

There are no observations / measurements for this station

Opportunities for future cooperation among WMO SDS-WAS, IRIMO and other UN bodies



In-situ dust characterization

An insufficient number of stations to monitor mineral dust (mainly PM10) are located in rural background conditions, which would provide information about its impact on air quality in cities. PM10 and PM2.5 measurements in urban air-quality networks represent a mix of anthropogenic pollution (vehicles, gas flares, industries, ships) and natural contributions. It is difficult to separate the contribution of each source if there are no background stations unaffected by anthropogenic contributions.

There are no standards of air quality – especially for PM10 – common to all countries of the region.

A regional centre for common and homogenized quality assurance is lacking.

Ground-based remote sensing

Furthermore, and from a climatological point of view, we have to take into account the fact that, while MODIS-DB completes a global coverage every one or two days, MISR has a global coverage every nine days. This means that AOD climatologies correspond to a quite different number of days, during which dust episodes might vary significantly.

These differences must be analysed and understood, using ground-based measurements as carried out by AERONET. As suggested by *Shi et al. (2011),* additional AERONET sites are required for some of the regions with large MODIS/MISR ratio values, especially where it is suspected that aerosol optical property assumptions cause large uncertainties in satellite retrievals. This is the case in most of the Middle East. The NRT comparison of satellite- and ground-based measurements constitutes a good quality-assurance system, which will give a confidence level to the data provided by satellite and correct them, if necessary.

Only together…

Source: UNICEF

Mount Damavand, Iran
Captured by Saviz Sehat
Jan 2018

Thank You

Acknowlegde to Emilio Cuevas, Sergio Rodriguez, Carmen Guirado, Enric Terradellas, Sara Basart, Ana Vukovic, Carlos Perez, A. Ghazanfari, M. Sabzehzari as well as AERONET, MODIS, MSG Eumetsat and scientists for establishing and maintaining data used in the present contribution. Also special thank to all researchers, data providers and collaborators of the WMO SDS-WAS NA-ME-E Regional Node.

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