

# WMO Sand and Dust Storm – Warning Advisory and Assessment System

Enric Terradellas, AEMET, Barcelona, [eterradellasj@aemet.es](mailto:eterradellasj@aemet.es)  
SDS-WAS Regional Center for Northern Africa, Middle East and Europe

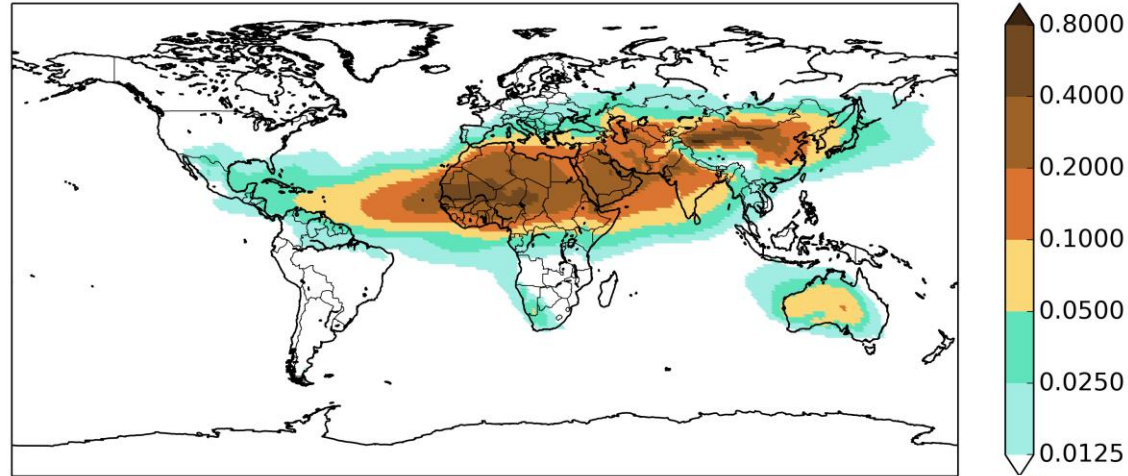
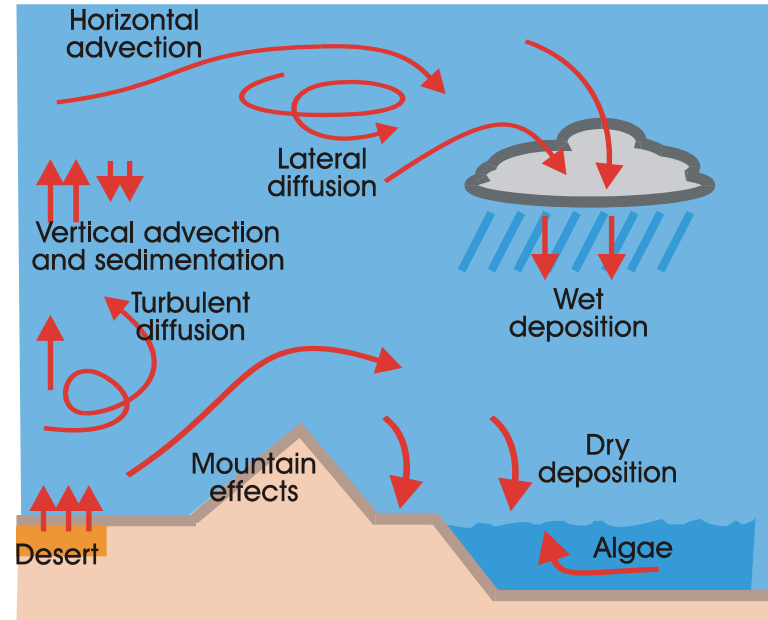


**International Workshop on Middle East (Regional) Dust Sources and Their Impacts, Istanbul, Turkey, 23-25 Oct 2017**

# Summary

- [Introduction](#)
- Dust monitoring
- Dust prediction
- Climate products
- Collaboration with other UN agencies / programmes

# The dust cycle



Copernicus

Average dust AOD at 550 nm 2003-2015.  
Based on a CAMS re-analysis. Image:  
WMO SDS-WAS



A significant part (30-40%) of the dust sources can be considered as anthropogenic: dessicated lakes or other water bodies, agricultural lands or direct human activity as mining, construction, ...

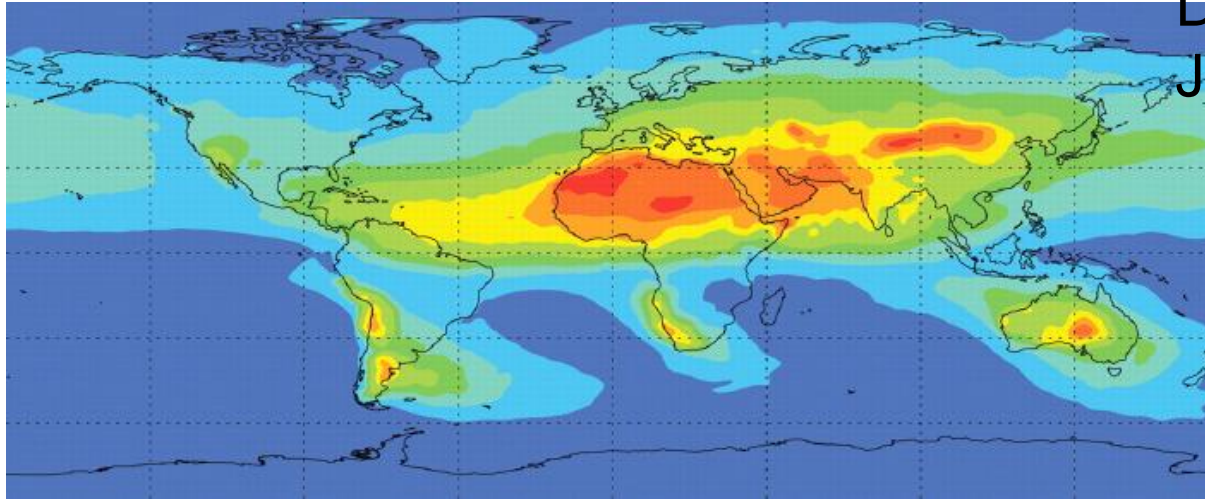
# Dust Impacts

- AQ & health
- Weather & climate
- Transportation (visibility reduction)
- Energy
- Agriculture, fishing
- ...



3:35P	On Time
3:45P	Cancelled
4:15P	On Time
4:24P	Delayed
4:30P	Cancelled
5:00P	On Time
5:12P	On Time
5:15P	On Time

# ... also positive impacts



Dust deposition  
Jickells et al. (2005)

Dust deposition is a source of micro-nutrients for both continental and maritime ecosystems.

Saharan dust is thought to fertilize the Amazon rainforest



Dust supply of Fe and P benefit marine biomass production in parts of the oceans suffering from the shortage of such elements

# WMO SDS-WAS

## Mission:

Enhance the capacity of countries to generate and distribute to end-users dust observations, forecasts, information and knowledge

## Structure:

Regional Center for Northern Africa, Middle East and Europe, Barcelona

Regional Center for Asia, Beijing

Regional Center for Pan-America, Bridgetown

Regional Center for West Asia (??)

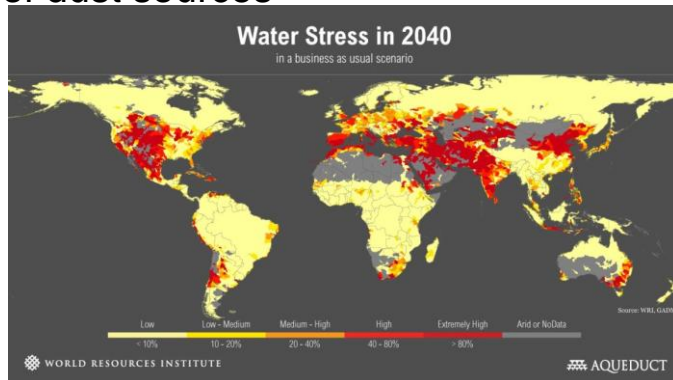
# SDS-WAS Reg. Center for W Asia?



W. Asia is the 2nd largest source after the Sahara. Unlike N. Africa, most population lives in the vicinity of dust sources

Mixture of natural and anthropogenic sources of pollution

Land degradation, water overuse



Climate change (higher temperature and evapotranspiration) may lead to drier soils and greater dust emissions



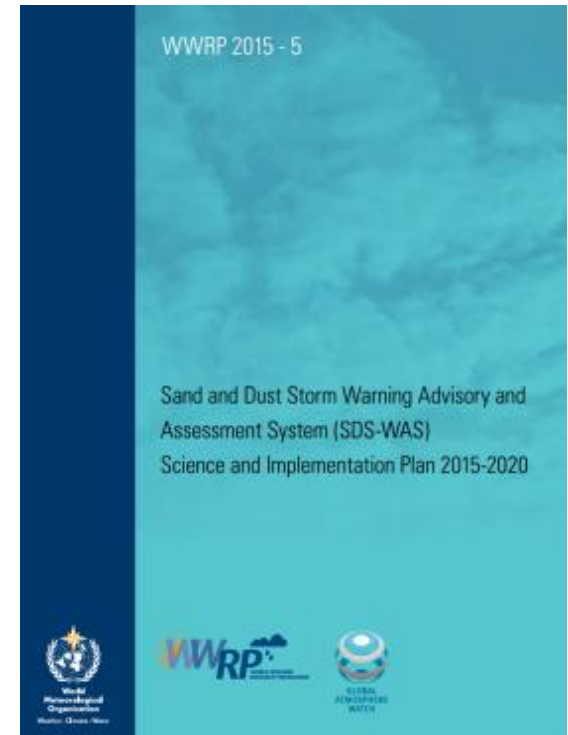
Cuevas et al. (2014)



Candidates: Turkey, Iran

# SDS-WAS objectives

- Identify and improve products for observation and prediction of atmospheric dust through collaboration with research and operational organizations as well as with users
- Facilitate user access to information
- Strengthen the capacity of countries to use the observations, analyses and predictions provided



SDS-WAS Science and Implementation Plan 2015-2020 (Nickovic et al., 2014)



# Summary

---

- Introduction
- **Dust monitoring**
- Dust prediction
- Climate products
- Collaboration with other UN agencies / programmes

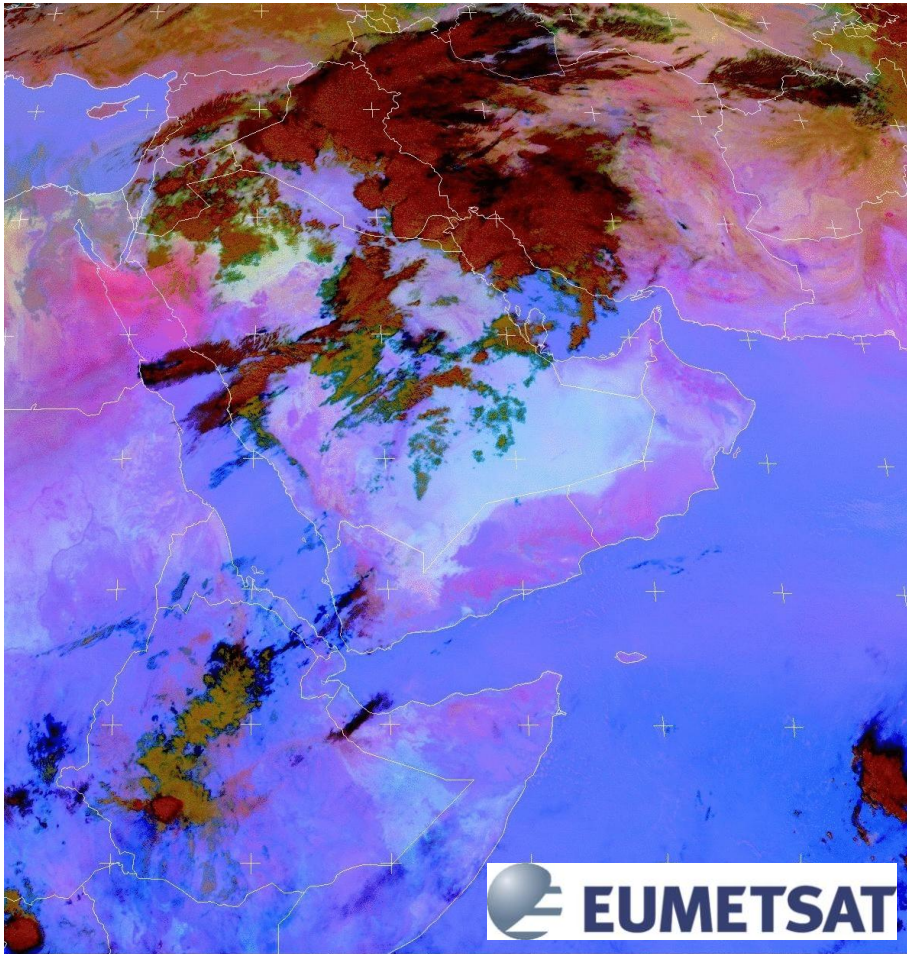
# Why do we need dust observation?

- Monitoring dust events
- Data assimilation into models
- Forecast verification
- Research, impact assessment
- Validation of other observations (i. e. ground observations to validate satellite products)

Mali, 2001

Foto: Remi Benali/Corbis

# Satellite products



The basic tools for dust monitoring are satellite images

EUMETSAT RGB-Dust is an RGB composite based upon three infrared channels of SEVIRI (Meteosat Second Generation).

## Drawbacks:

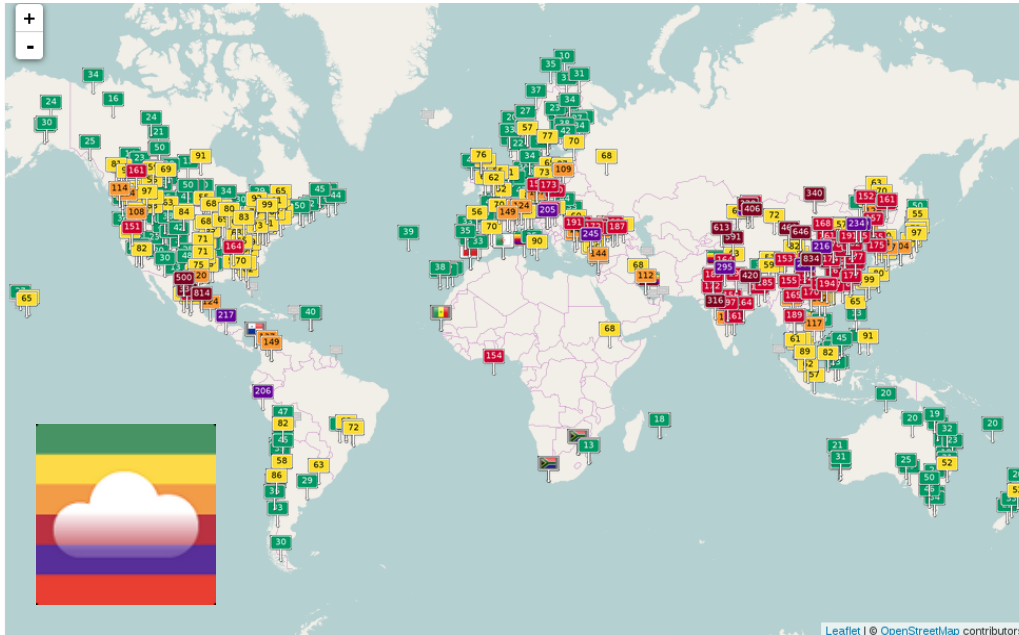
- Qualitative product
- No information below-cloud
- No information on near-surface conditions

EUMETSAT

Meteosat IODC Dust, 2017-03-19 00:00:00 UTC

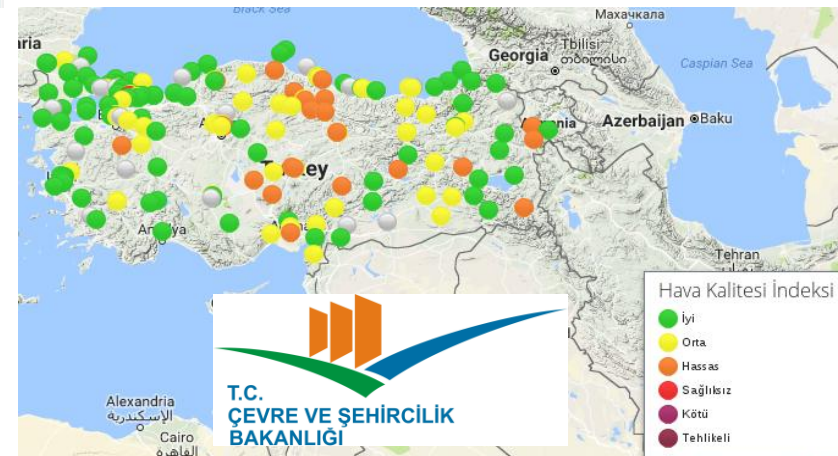
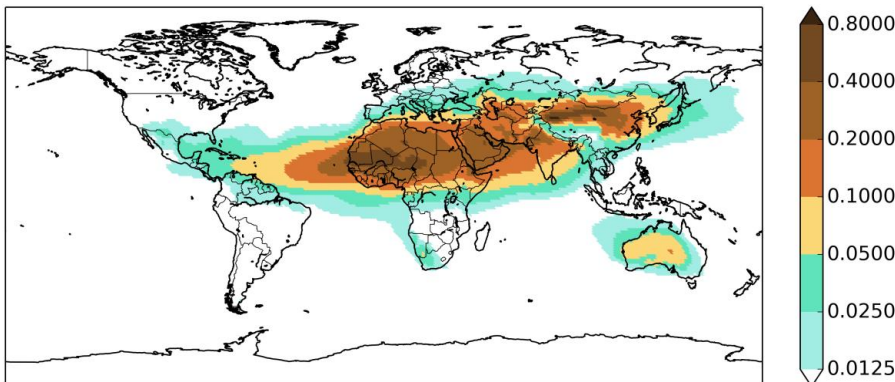
19 Mar 2017: Sandstorm named Madar, originated in Libya, swept through Egypt, KSA, Iraq, Kuwait and Iran

# Air quality monitoring stations

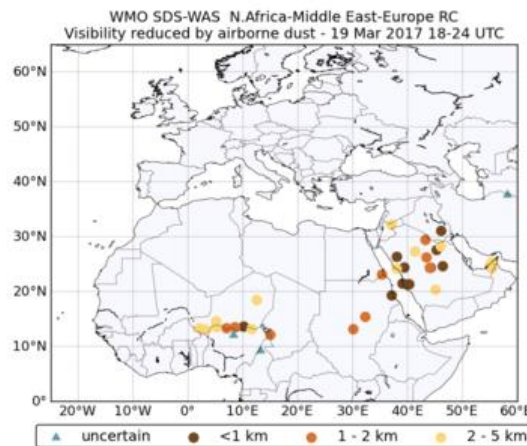
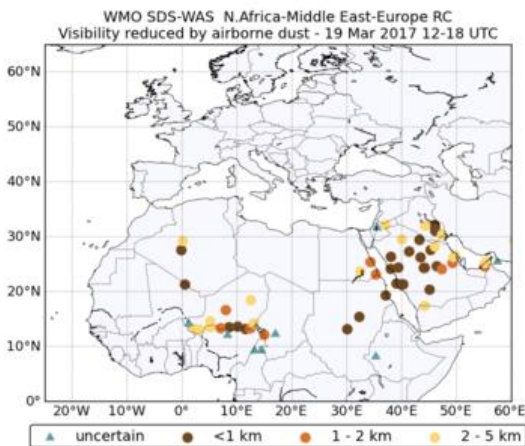
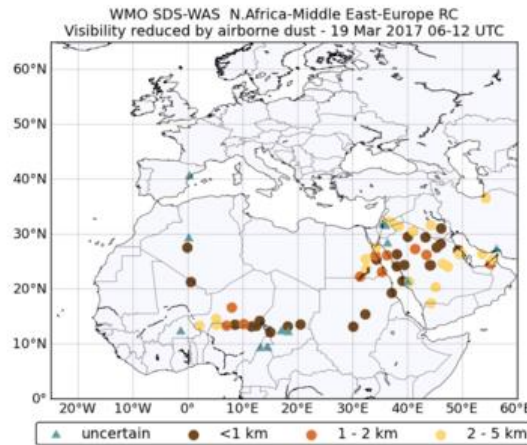
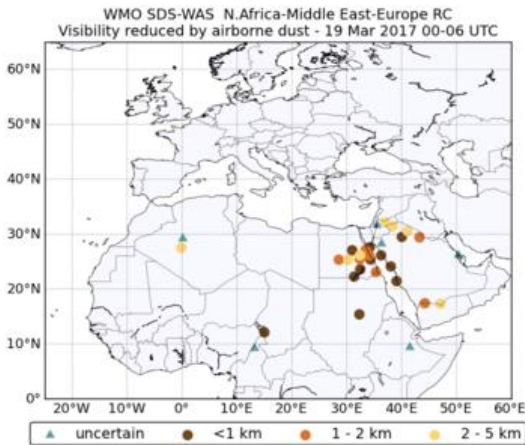


## Drawbacks:

- Few stations near dust sources
- No protocol for data exchange
- Lack of harmonisation in the measurements
- Species integration
- Most stations in urban environments



# Meteorological reports



## Drawbacks:

- Indirect estimation (no mass concentration)
- Subjective nature
- Limited to severe events

<http://sds-was.aemet.es>

19 Mar 2017

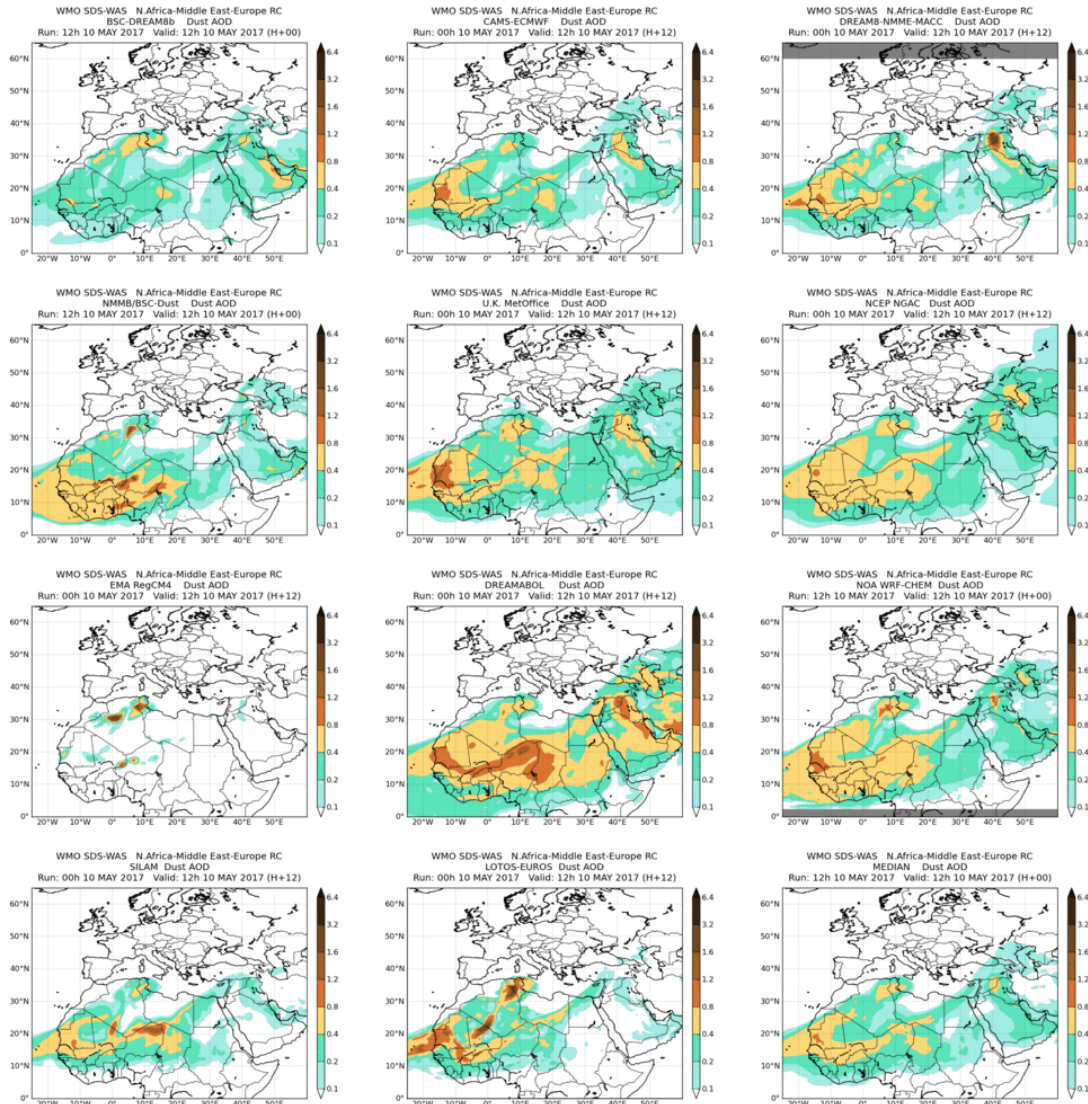


# Summary

---

- Introduction
- Dust monitoring
- **Dust prediction**
- Climate products
- Collaboration with other UN agencies / programmes

# SDS-WAS: Model inter-comparison



## Contributors

- BSC, Spain
- Copernicus, EU
- SEEVCCC, Serbia
- Met Office, UK
- NASA, USA
- NCEP, USA
- EMA, Egypt
- CNR, Italy
- NOA, Greece
- FMI, Finland
- TNO, The Netherlands

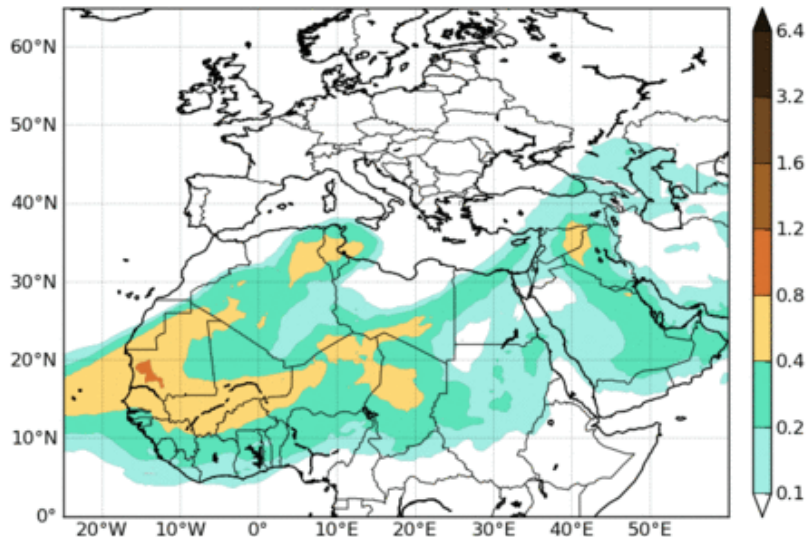
<http://sds-was.aemet.es>



10 May 2017

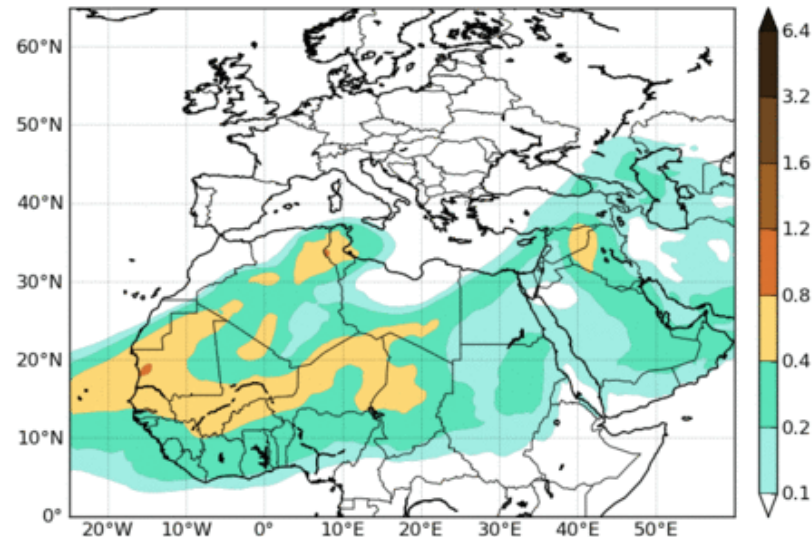
# SDS-WAS: Multi-model products

WMO SDS-WAS N.Africa-Middle East-Europe RC  
MEDIAN Dust AOD  
Run: 12h 10 MAY 2017 Valid: 12h 10 MAY 2017 (H+00)



10 May 2017

WMO SDS-WAS N.Africa-Middle East-Europe RC  
MEAN Dust AOD  
Run: 12h 10 MAY 2017 Valid: 12h 10 MAY 2017 (H+00)



<http://sds-was.aemet.es>





# SDS-WAS: From R&D to operations

The screenshot shows the website for the Barcelona Dust Forecast Center. At the top, there is a navigation menu with links for HOME, ABOUT US, FORECAST, FORECAST 10KM, EVALUATION, METHODS, NEWS, EVENTS, and CONTACT. Below the menu, there is a 'NEWSLETTER' section with a 'Subscribe' button. A featured article titled 'Training events in Muscat, Oman' is displayed, accompanied by an aerial photograph of a large building complex. Below the article, there is a 'SEARCH' section with a search box and a 'SEARCH' button. On the left side, there is a 'HOME' section with a list of links: About us, Forecast, Forecast 10km, Evaluation, Methods, News, Events, and Contact. At the bottom, there is a 'LATEST NEWS' section with a link to 'Establishing a WMO SDS-WAS Regional Node for West Asia'. The main content area features a 'Dust forecast' map of Northern Africa, the Middle East, and Europe, with a color scale indicating dust concentration in  $\mu\text{g}/\text{m}^3$ . The map is titled 'Dust forecast' and includes the text 'Latest dust forecast for Northern Africa, Middle East and Europe' and a link 'Check it here'.

<https://dust.aemet.es>



May 2013

WMO designates the consortium of **AEMET** and the **BSC** to host a Center that generates and distributes operational dust forecasts for Northern Africa, Middle East and Europe.

Feb 2014

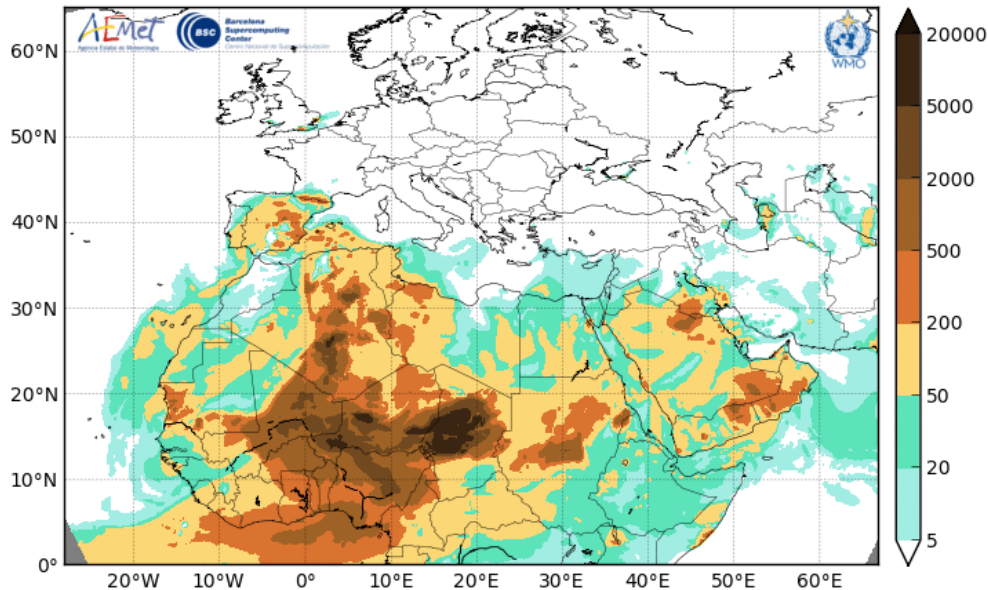
The Centre starts operations under the name of **Barcelona Dust Forecast Center (BDFC)**

June 2017

WMO designates **CMA** to host an operational Center for Asia

# Barcelona Dust Forecast Center

Barcelona Dust Forecast Center - <http://dust.aemet.es/>  
NMMB/BSC-Dust Res:0.1°x0.1° Dust Surface Conc. ( $\mu\text{g}/\text{m}^3$ )  
Run: 12h 23 FEB 2017 Valid: 12h 23 FEB 2017 (H+00)



Operational forecasts are distributed through:

- Website <http://dust.aemet.es>
- WMO Global Telecommunications System
- EUMETCast
- WMO, UNEP websites



Annual training events

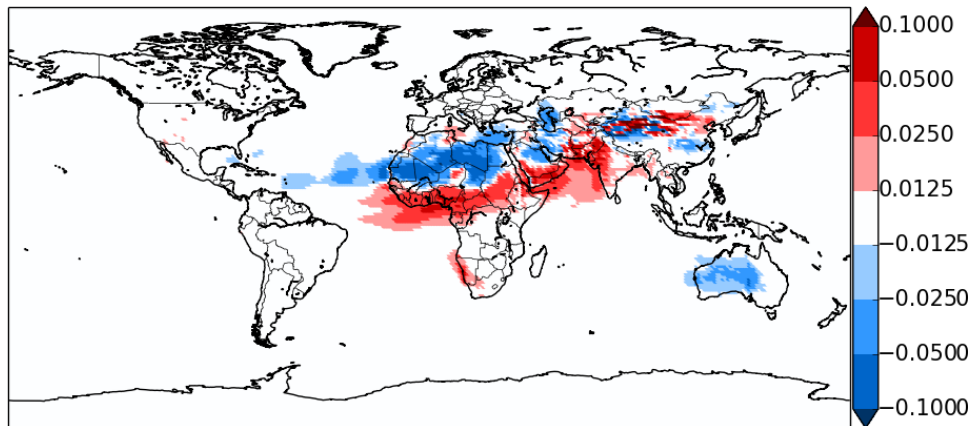
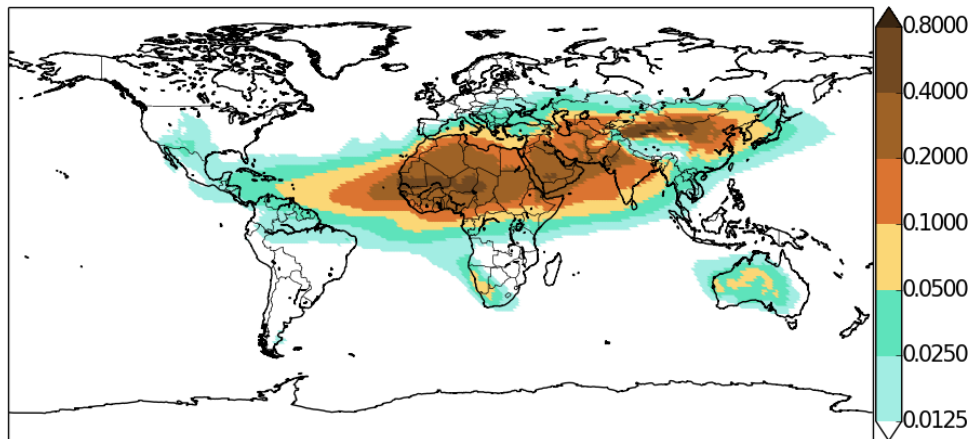
# Summary

---

- Introduction
- Dust monitoring
- Dust prediction
- **Climate products**
- Collaboration with other UN agencies / programmes

# Climate monitoring: 2016

Average dust AOD @ 550 nm in 2016 and anomaly based on Copernicus forecasts. Source: [WMO Airborne dust bulletin N. 1](#)



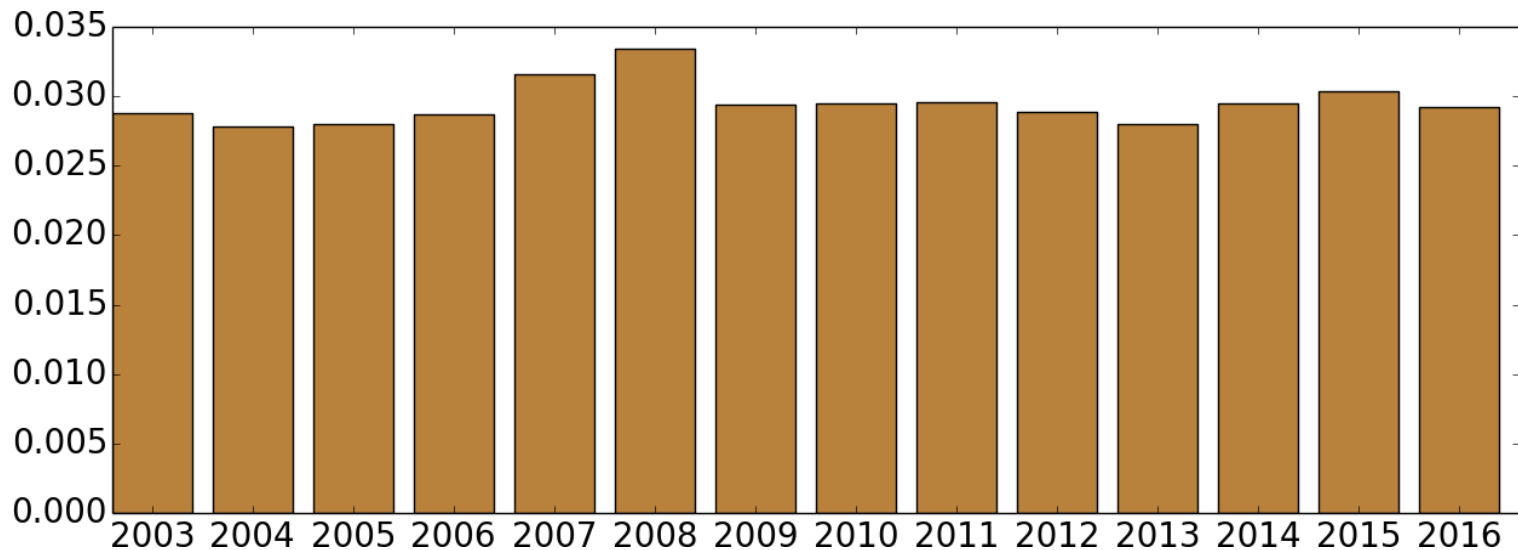
Negative anomalies over most of the Sahara. Conversely, more transport than usual to the Gulf of Guinea and the rest of equatorial Africa (due to strong activity in the Sahel during the first weeks of the year).

Uneven distribution of anomalies In the Middle East: small negative values in the N part and important positive anomalies in the South of the Arabian Peninsula (strong activity in spring). Positive anomalies in the Pakistan-India region and no clear sign in China-Mongolia.

Negative values in Australia.

# Long-term trends

Annual global average of dust AOD @ 550 nm based on Copernicus reanalysis and forecasts. Source: WMO Airborne dust bulletin N. 1



Although there is controversy over the long-term global trend, major changes over the last few years have been found on a regional scale.

# DustClim

**Dust Storms Assessment** for the development of user-oriented  
**Climate Services** in Northern Africa, Middle East and Europe



*European Research Area  
for Climate Services*



**Barcelona  
Supercomputing  
Center**

Centro Nacional de Supercomputación



GOBIERNO  
DE ESPAÑA

MINISTERIO  
DE AGRICULTURA, ALIMENTACION  
Y MEDIO AMBIENTE

**AEMet**

Agencia Estatal de Meteorología



**Consiglio  
Nazionale delle  
Ricerche**



**FINNISH METEOROLOGICAL  
INSTITUTE**

# Summary

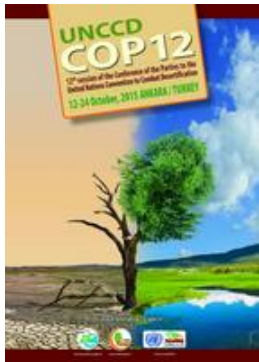
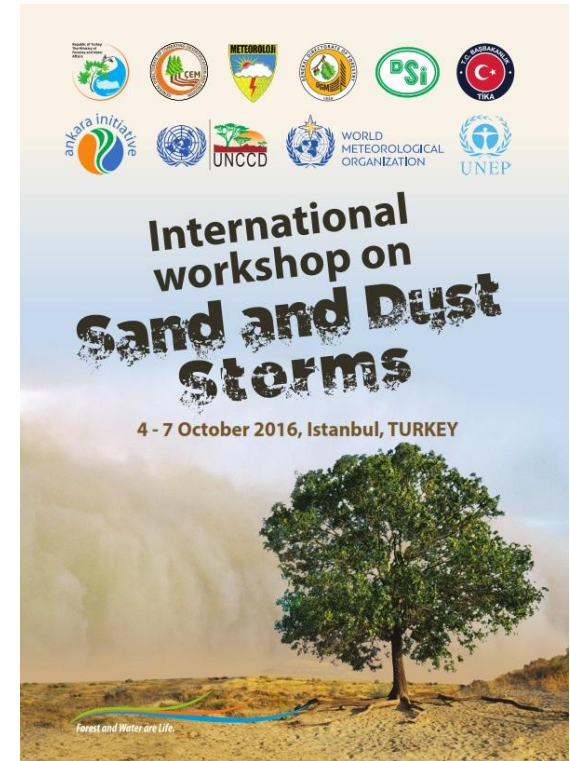
---

- Introduction
- Dust monitoring
- Dust prediction
- Climate products
- Collaboration with other UN agencies / programmes



# Cooperation with other UN agencies / programmes: workshops

## 1st Africa/Middle East Expert meeting and Workshop on the health impact of airborne dust



Side event  
The edge of crisis: Dust and sand storms



Achieving land degradation neutrality and combating sand and dust storms for healthy planet and healthy people

Date of event: 26 May Event Time: 1:00pm - 2:30pm





# Cooperation with other UN agencies / programmes: publications

