



**Barcelona
Supercomputing
Center**

Centro Nacional de Supercomputación

Dust prediction models

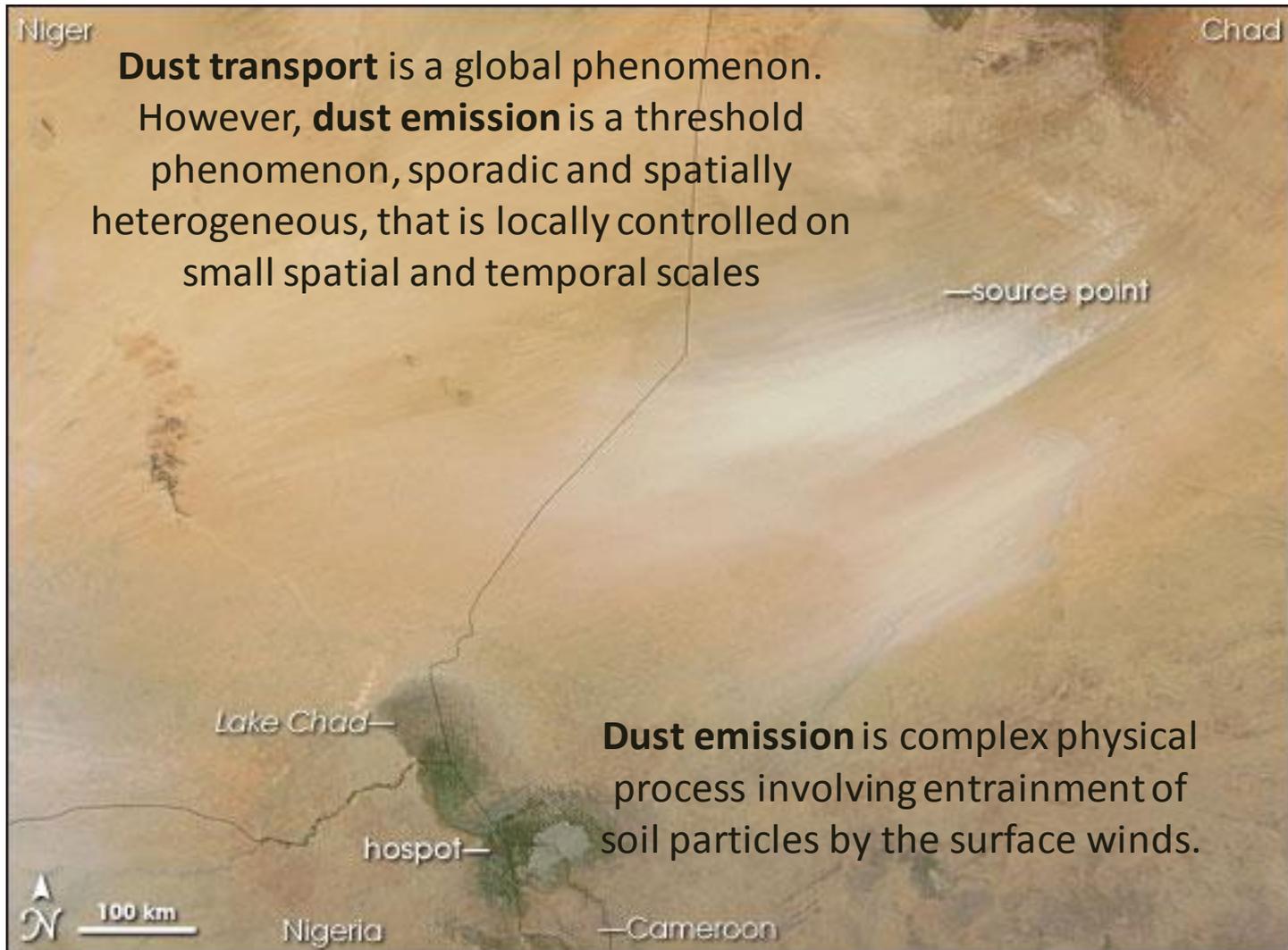
Sara Basart (sara.basart@bsc.es)

Earth Sciences Department, Barcelona Supercomputing Center

Questions will be welcome!

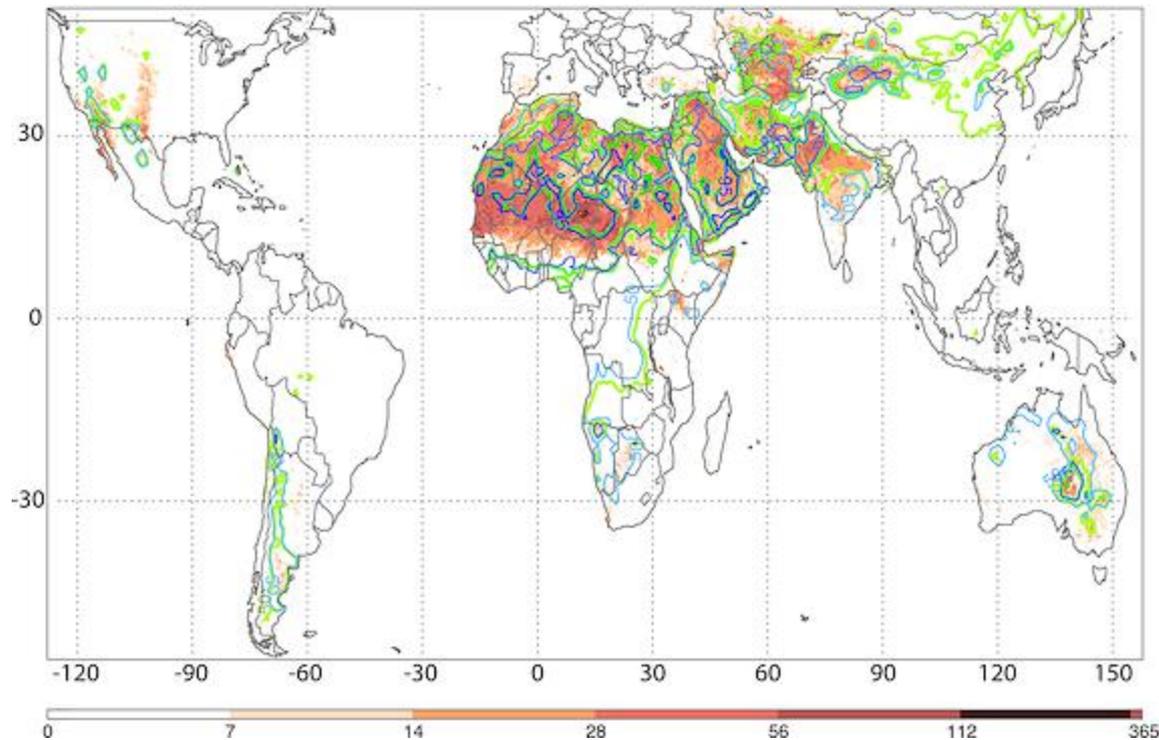


Dust cycle and associated processes



Dust cycle and associated processes

Global-scale attribution of anthropogenic and natural dust sources and their emission rates based on MODIS Deep Blue aerosol products (extracted from Ginoux et al., 2012)



Natural dust sources globally account for 75% of emissions; anthropogenic sources account for 25%.

Types of dust storms:

Synoptic dust storms (large scale weather systems)

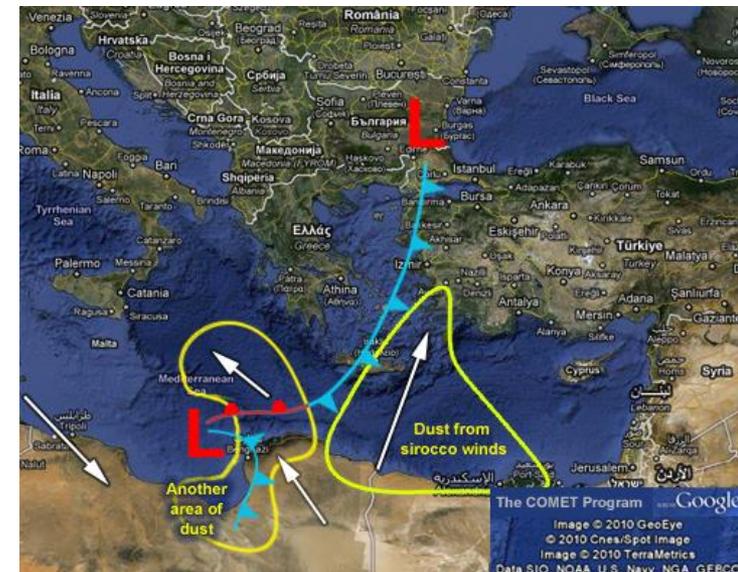
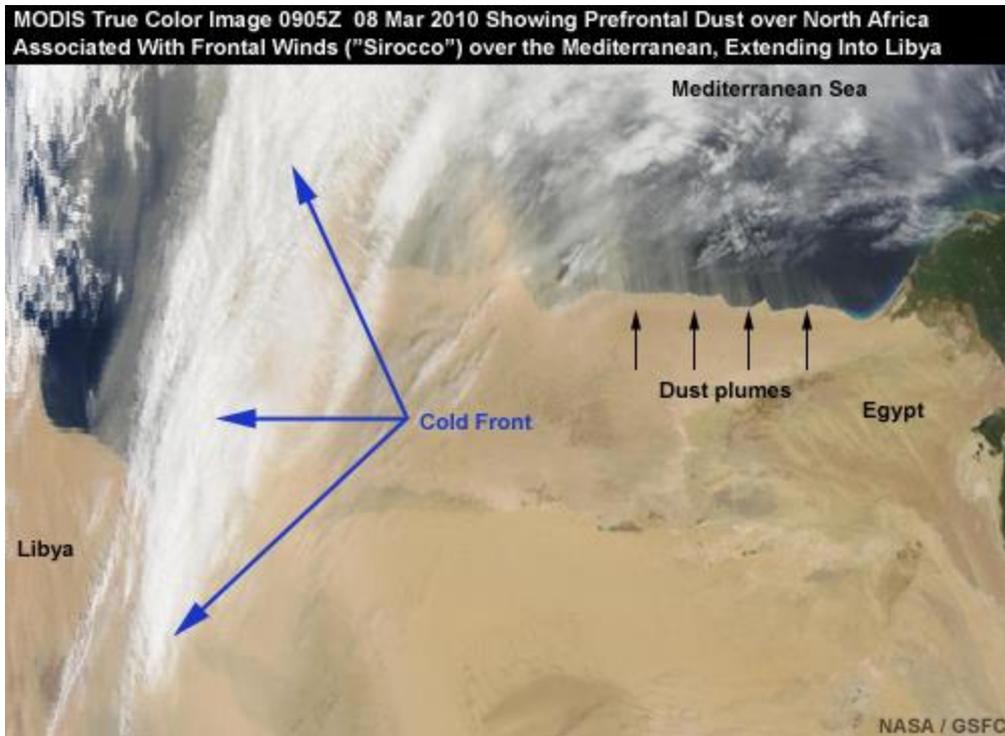
- Prefrontal winds
- Postfrontal winds
- Large-scale Trade winds
- ...

Mesoscale dust storms

- Downslope winds
- Gap flow
- Convection and Haboobs
- Inversion downburst storms
- ...

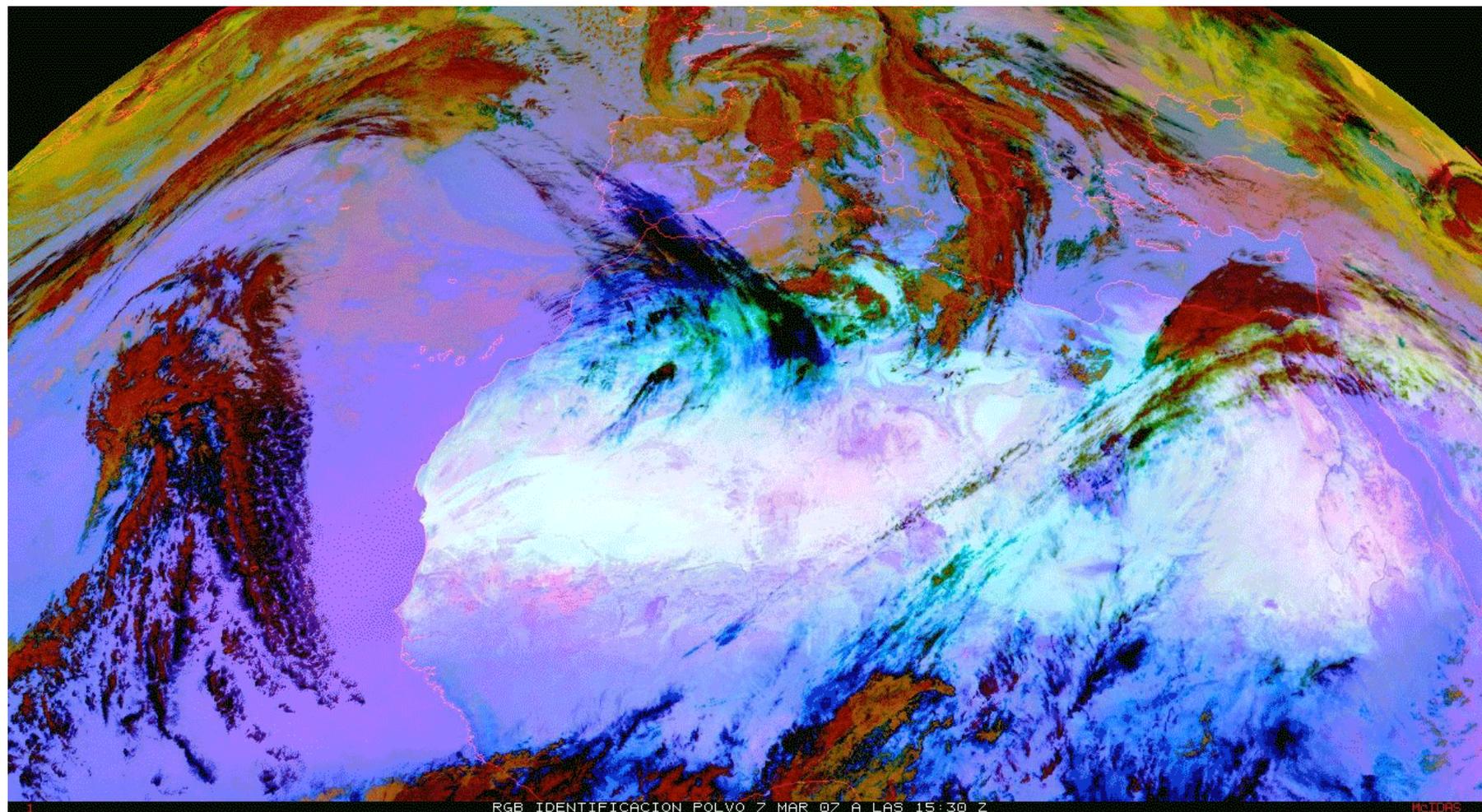
Dust cycle and associated processes

Synoptic dust storms: Pre-frontal



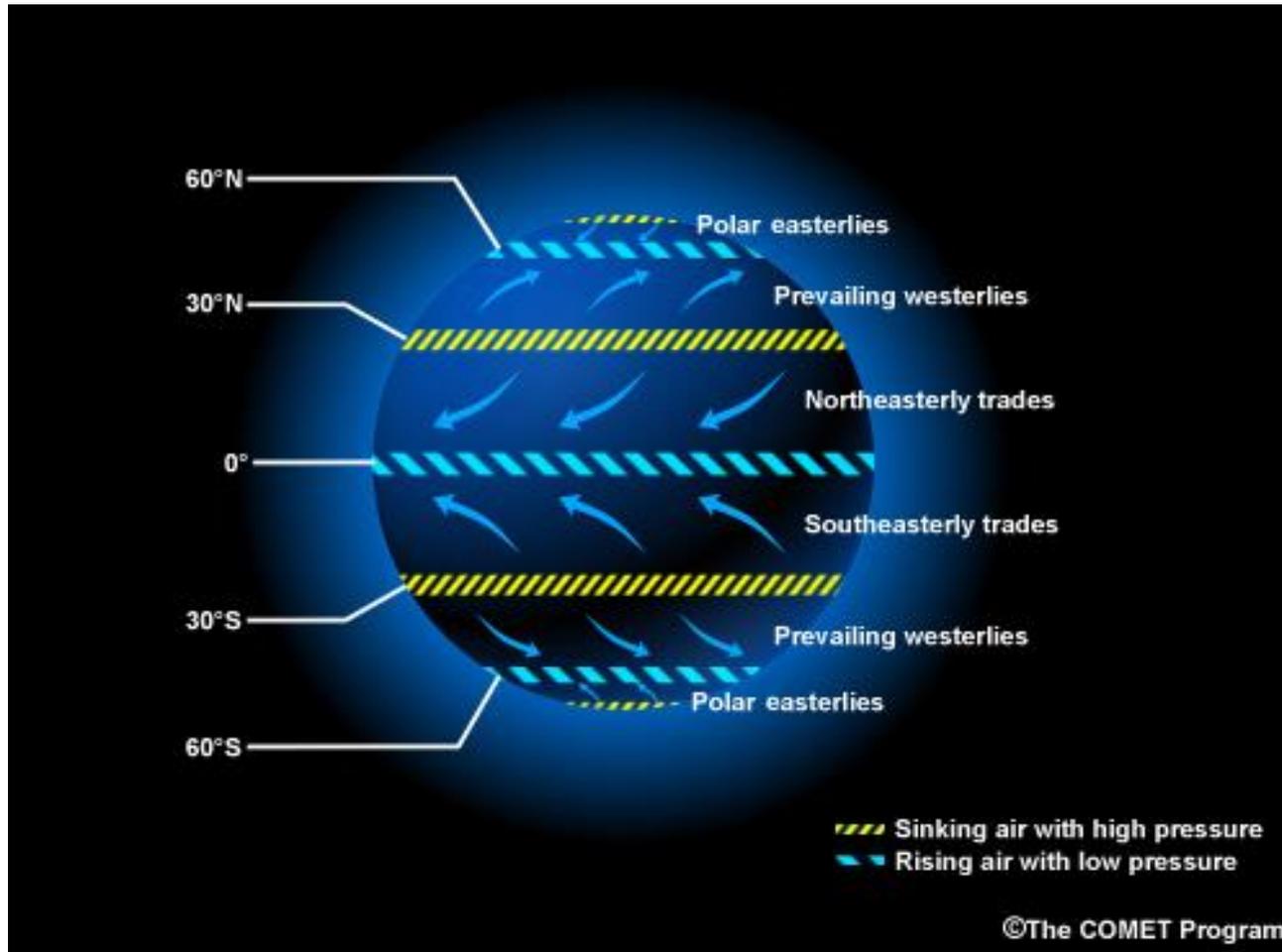
Dust cycle and associated processes

Synoptic dust storms: Post-frontal



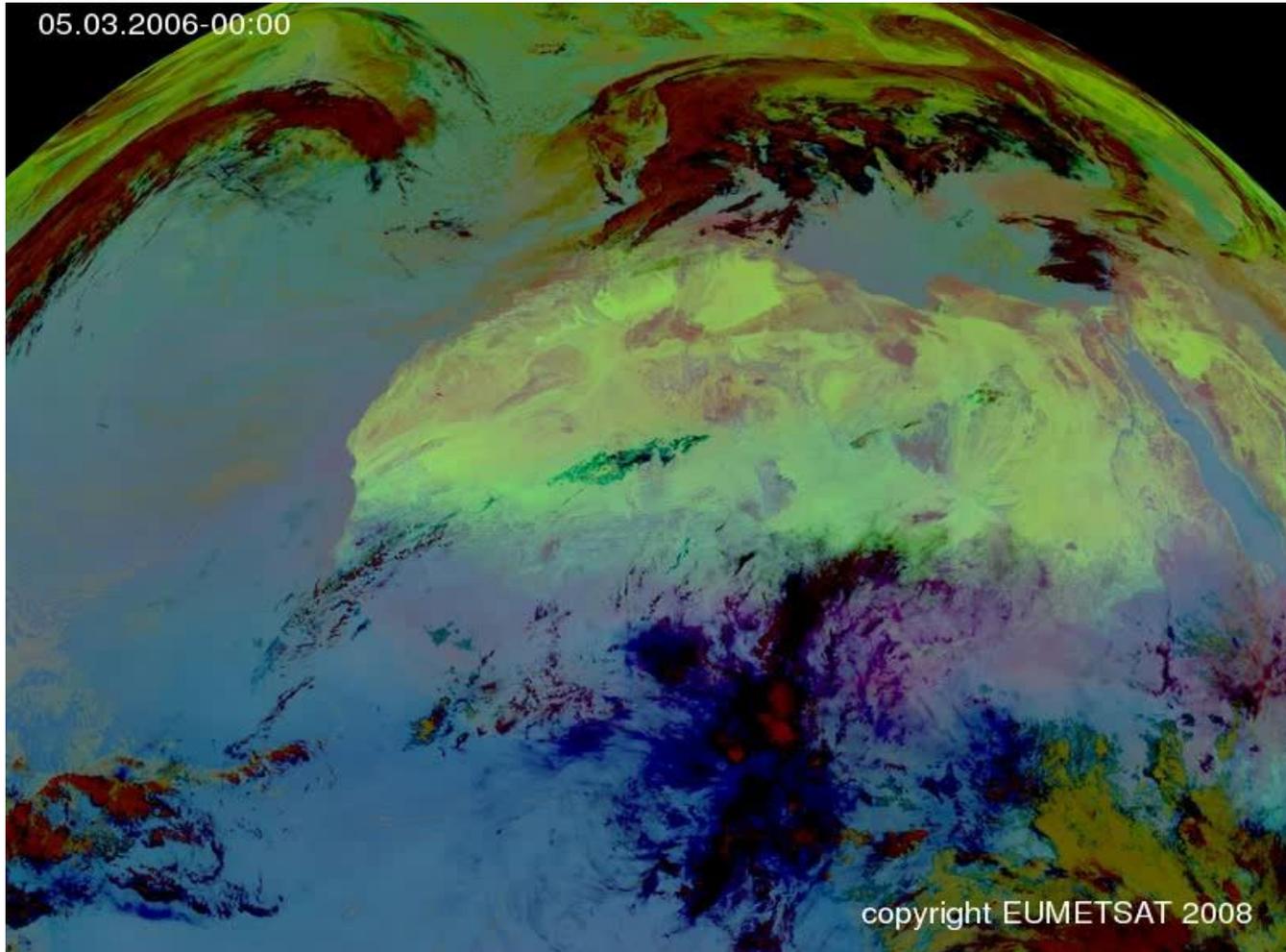
Dust cycle and associated processes

Synoptic dust storms: Large-scale trade winds



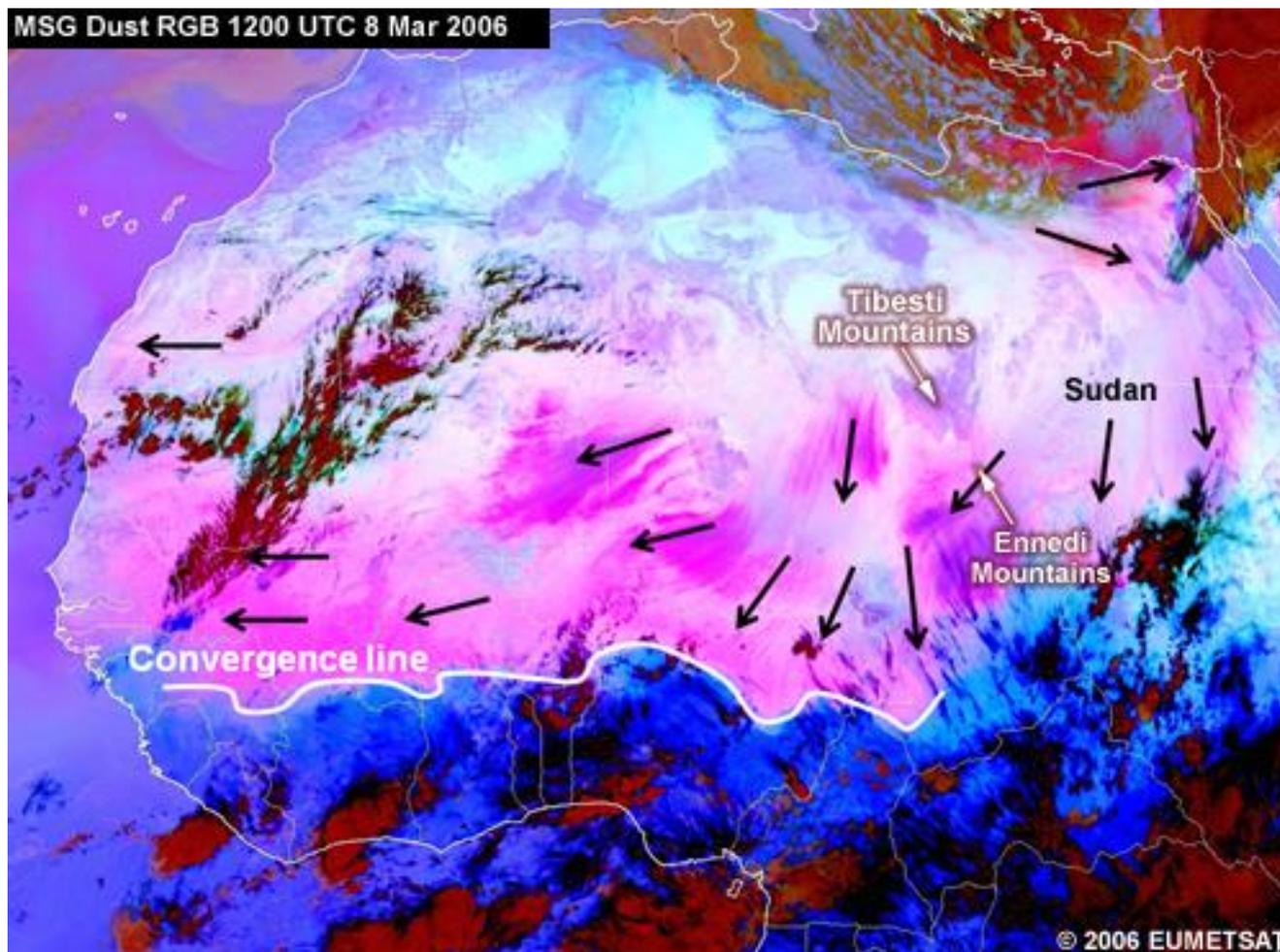
Dust cycle and associated processes

Synoptic dust storms: Large-scale trade winds

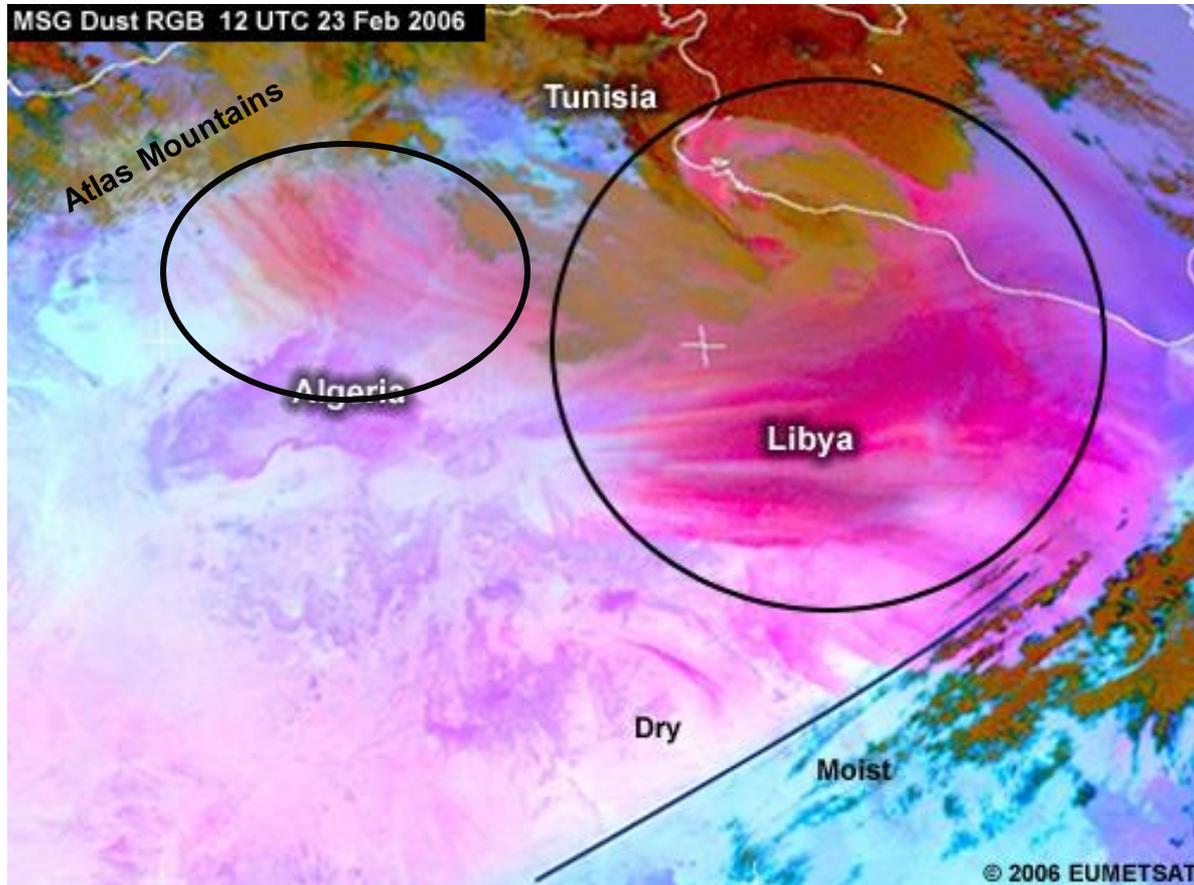


Dust cycle and associated processes

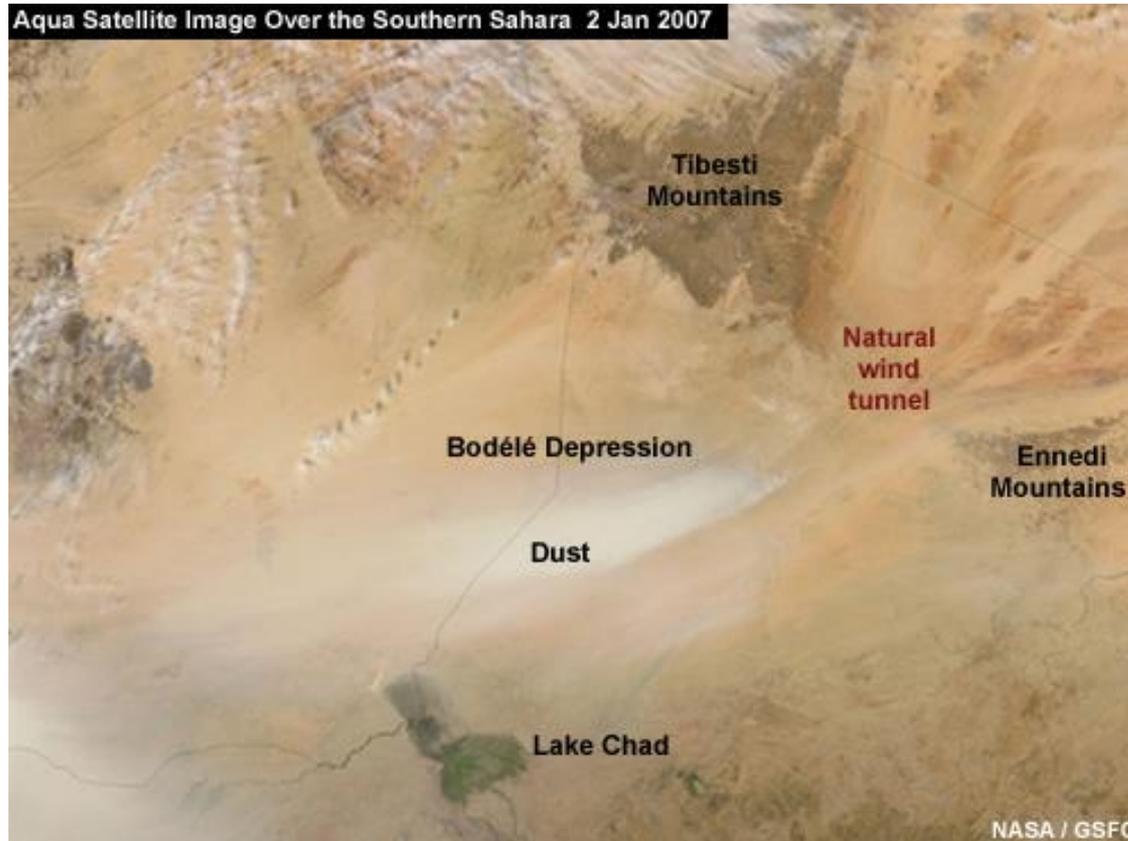
Synoptic dust storms: Large-scale trade winds



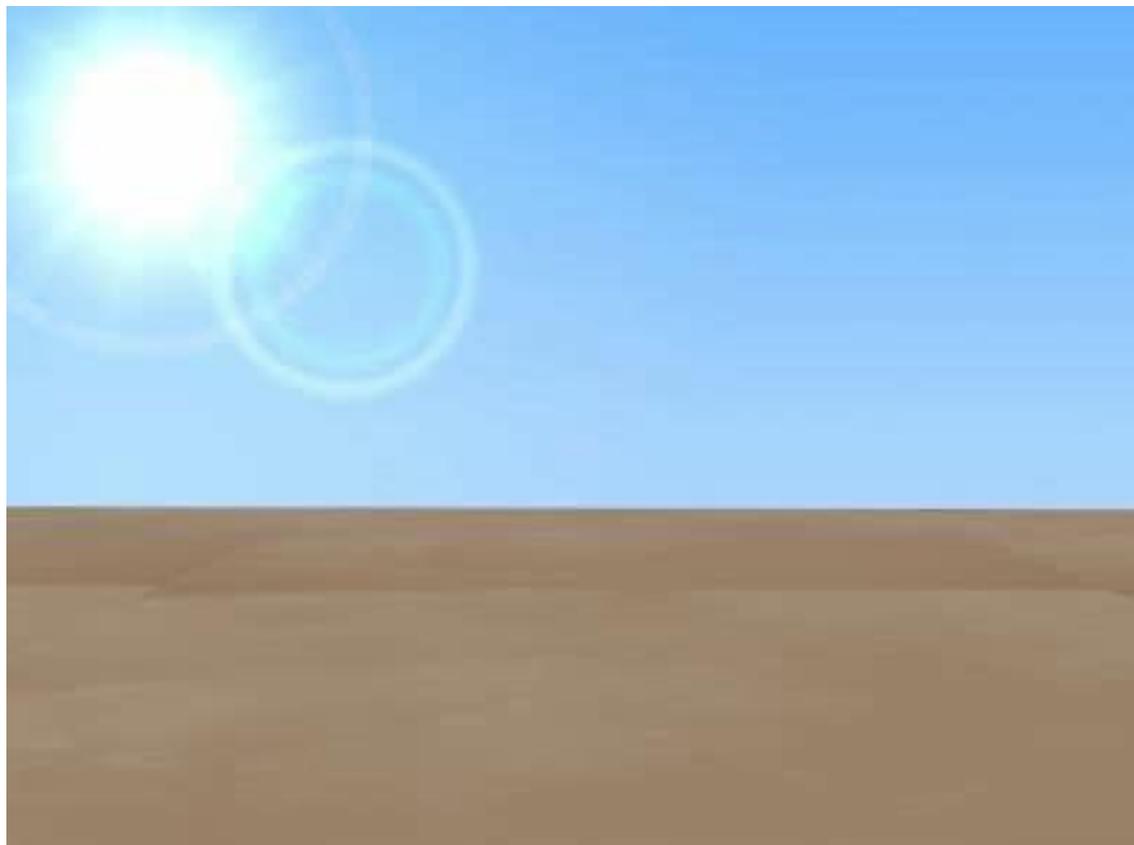
Mesoscale dust storms: Downslope winds



Mesoscale dust storms: Gap flow



Mesoscale dust storms: Dust devils (convection)



Movie from the COMET program at <http://meted.ucar.edu/> of the University Corporation for Atmospheric Research (UCAR)

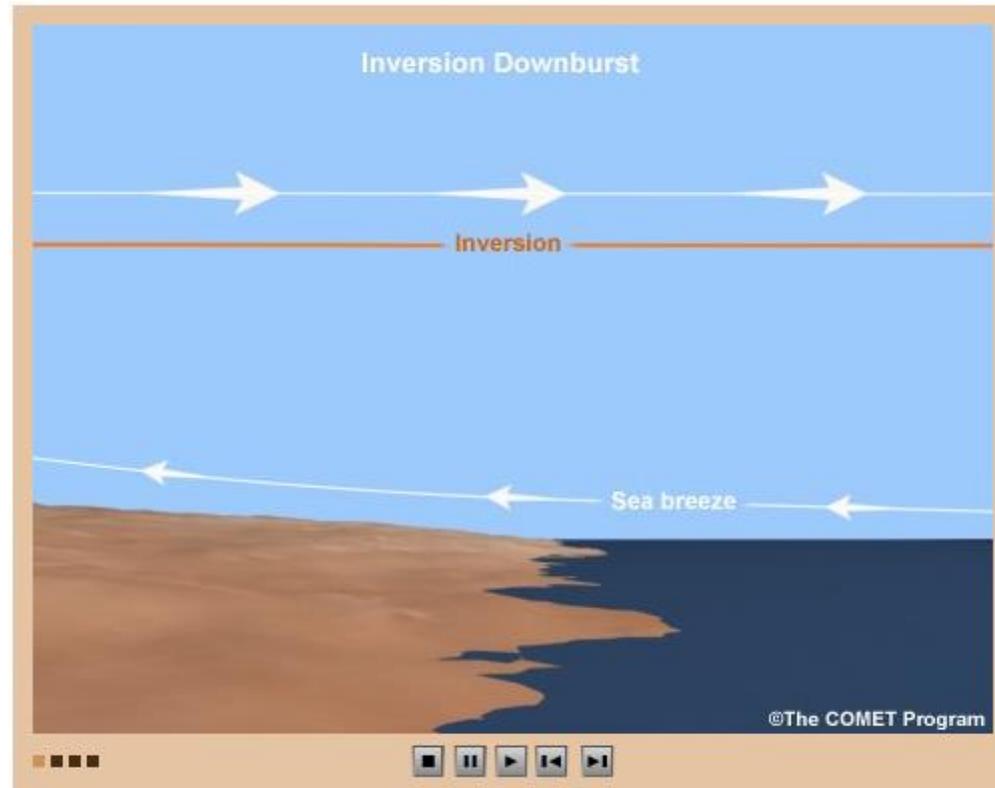
Mesoscale dust storms: Haboobs



Movie from the COMET program at <http://meted.ucar.edu/> of the University Corporation for Atmospheric Research (UCAR)

Dust cycle and associated processes

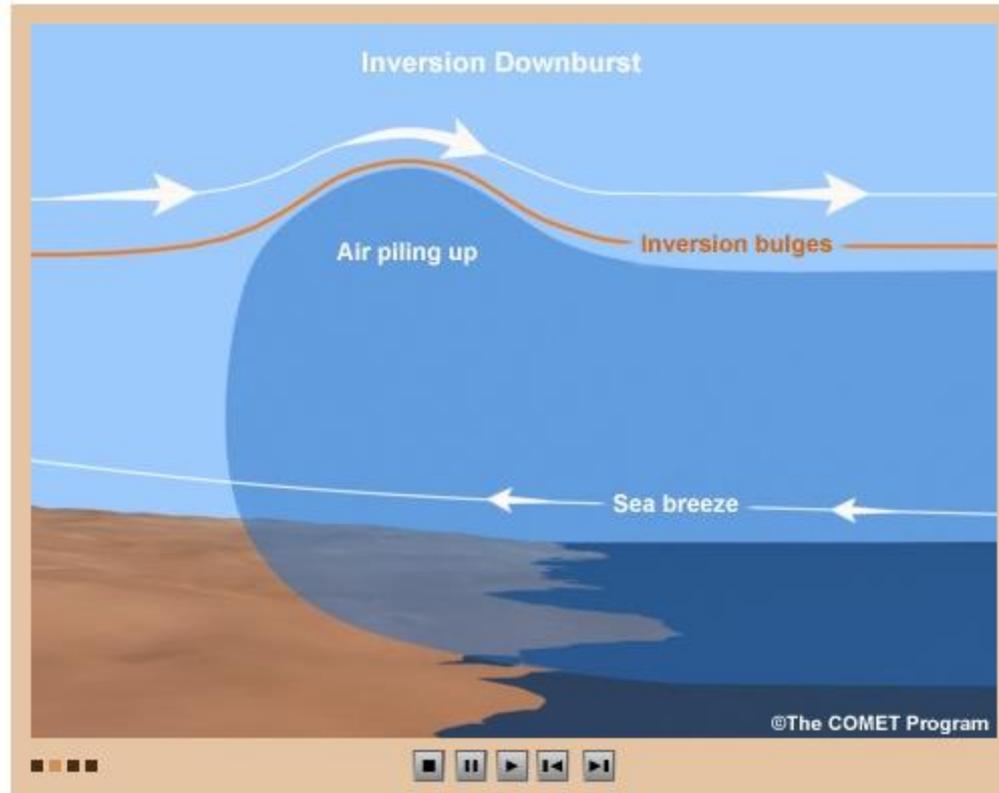
Mesoscale dust storms: Inversion downbursts



Movie from the COMET program at <http://meted.ucar.edu/> of the University Corporation for Atmospheric Research (UCAR)

Dust cycle and associated processes

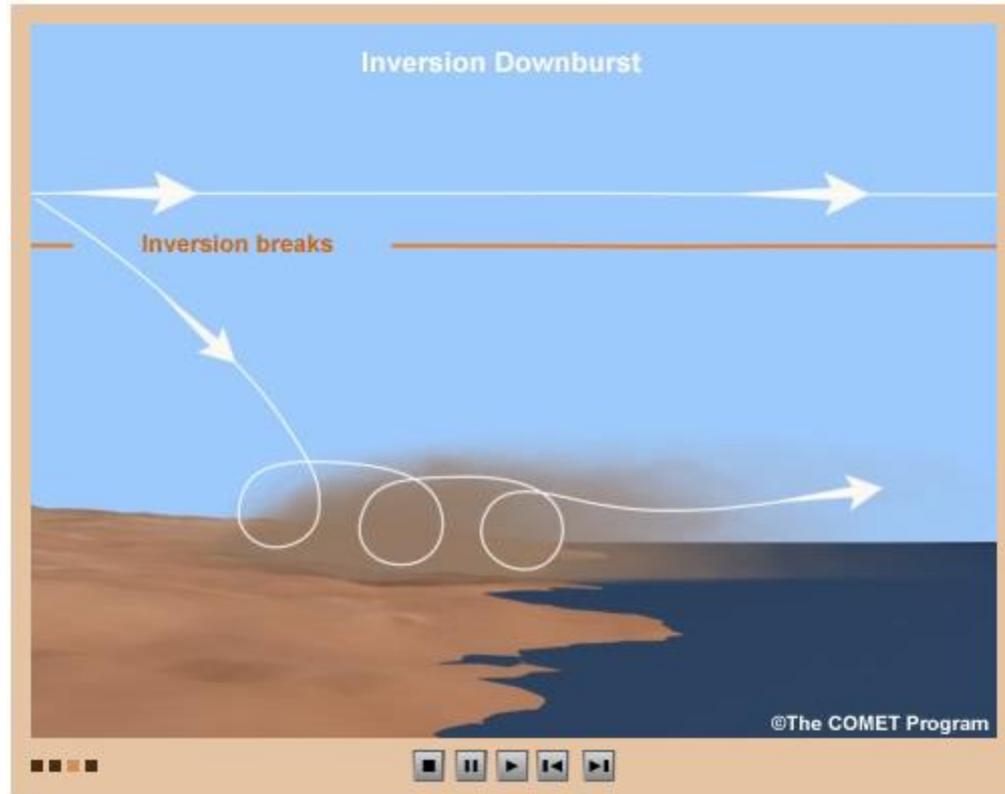
Mesoscale dust storms: Inversion downbursts



Movie from the COMET program at <http://meted.ucar.edu/> of the University Corporation for Atmospheric Research (UCAR)

Dust cycle and associated processes

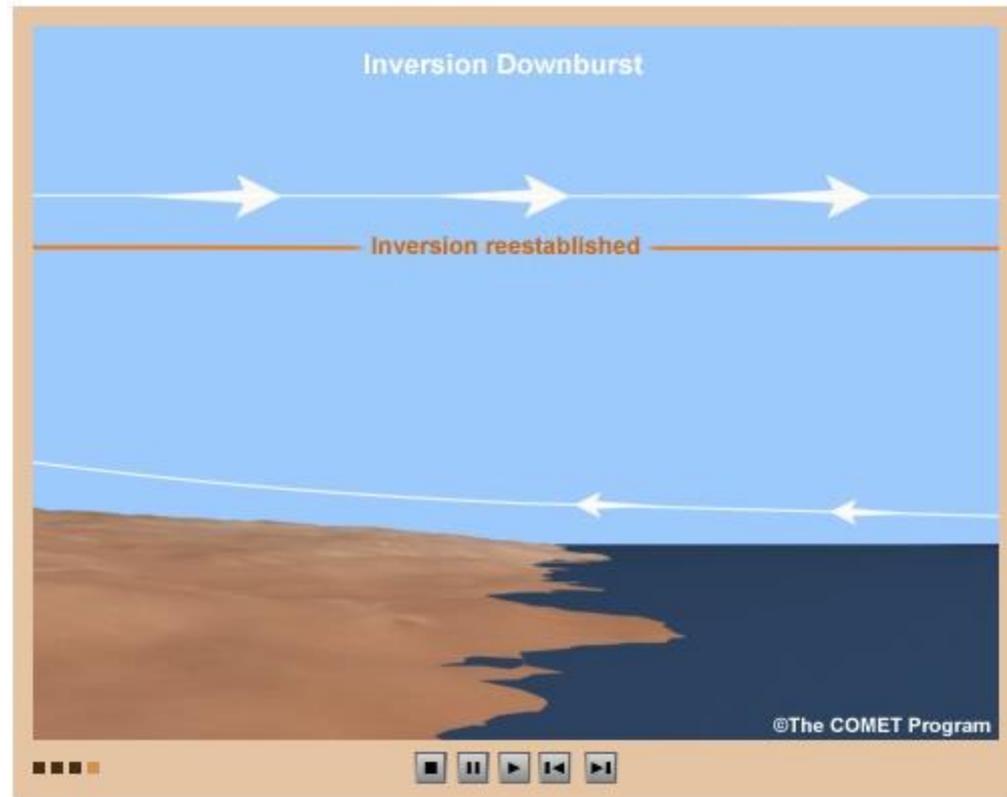
Mesoscale dust storms: Inversion downbursts



Movie from the COMET program at <http://meted.ucar.edu/> of the University Corporation for Atmospheric Research (UCAR)

Dust cycle and associated processes

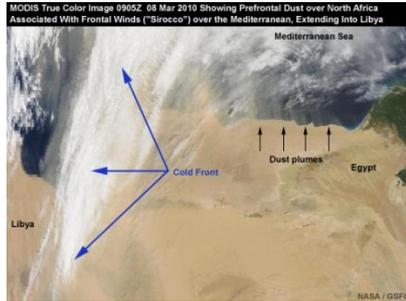
Mesoscale dust storms: Inversion downbursts



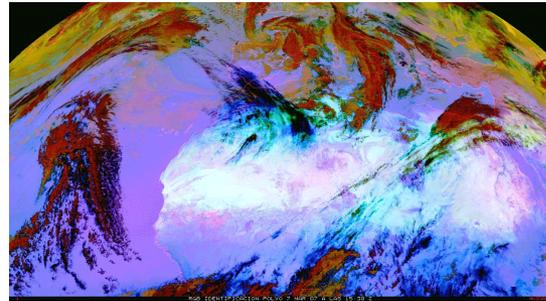
Movie from the COMET program at <http://meted.ucar.edu/> of the University Corporation for Atmospheric Research (UCAR)

Dust cycle and associated processes: Types of dust storms

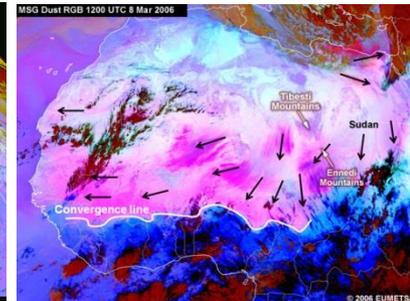
Synoptic dust storms (large scale weather systems)



Pre-frontal winds

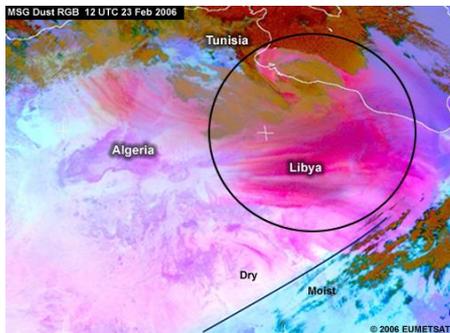


Post-frontal winds

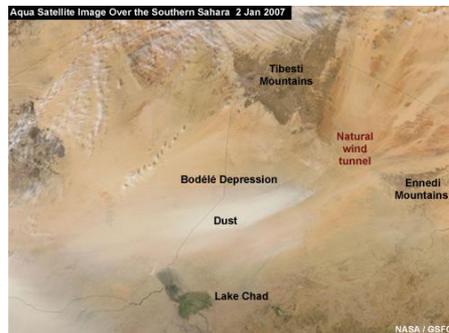


Large-scale trade winds

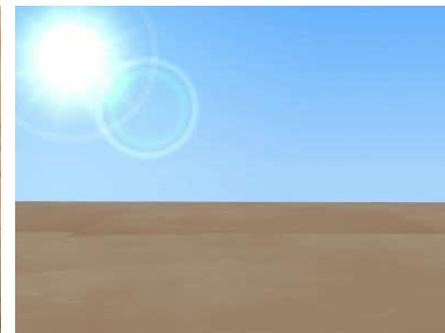
Mesoscale dust storms



Downslope winds



Gap flow



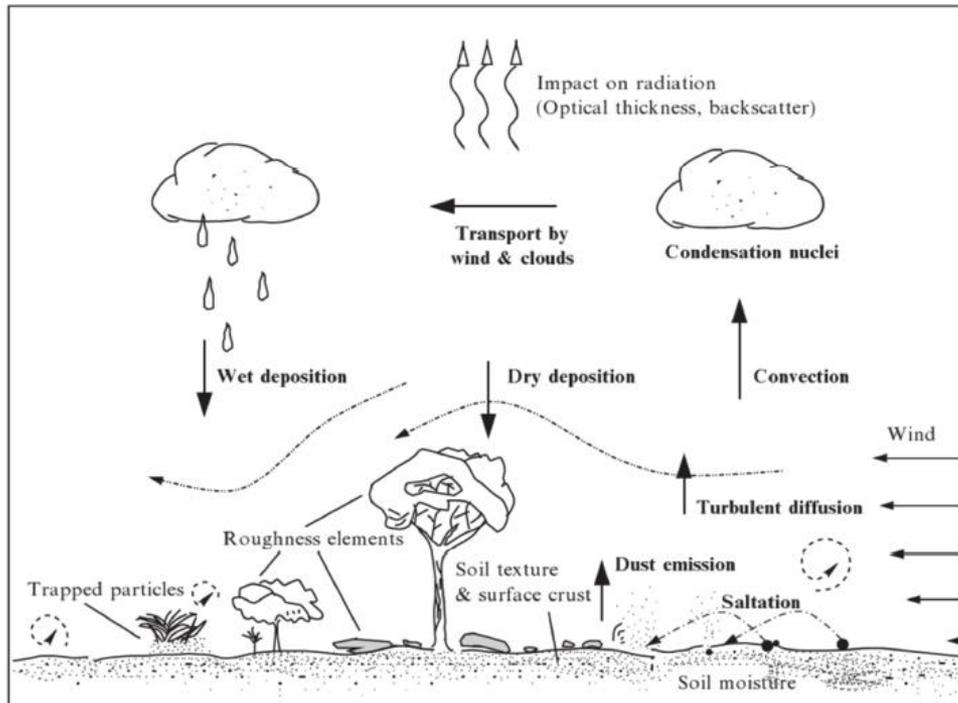
Convection & Inversion downbursts



Haboobs

Dust forecasting models

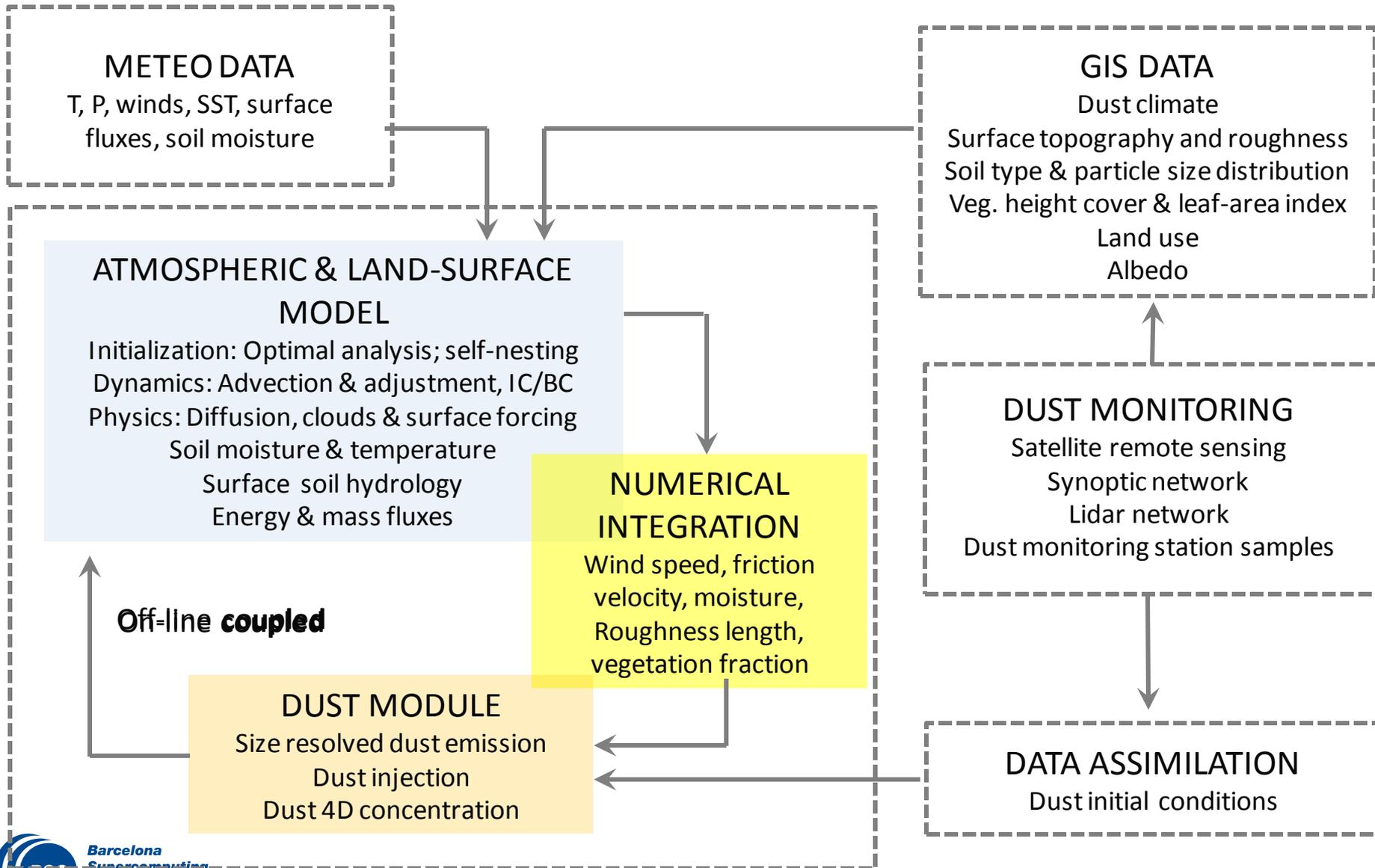
Dust models are a mathematical representation of atmospheric dust cycle.



Extracted from Shao (2008)

- ✓ To complement dust-related observations, filling the temporal and spatial gaps of the measurements.
- ✓ To help us to understand the dust processes and their interaction with climate and ecosystems.
- ✓ To predict the impact of dust on surface level concentrations used as **SHORT-TERM FORECASTING TOOLS** (3-5 days ahead)

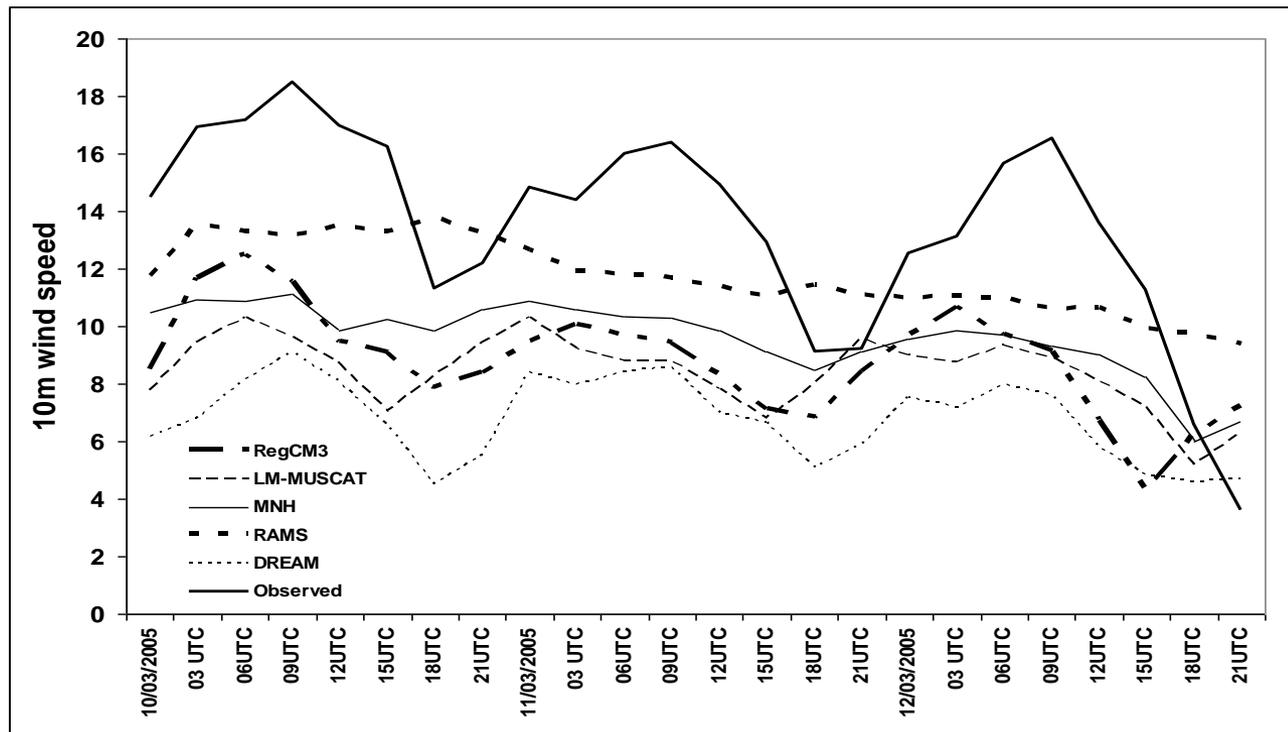
Dust forecasting models



Dust forecasting models

Experimental campaigns: BODEX 2005 (Todd et al. 2008, JGR)

First regional model intercomparison in the Bodélé hot spot



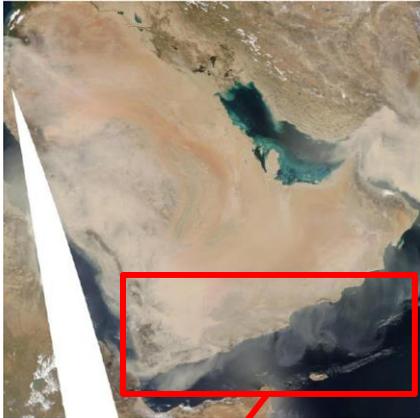
Strong differences between models!!!! → Meteorology and emission scheme

March 2012, West Asia

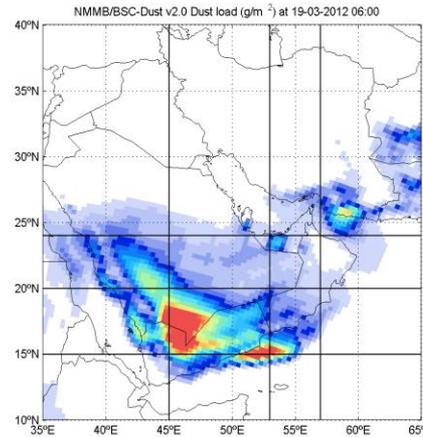
Dust forecasting models

Impact of the topography on dust transport

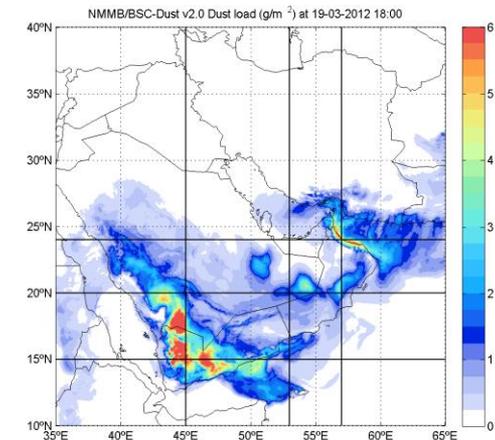
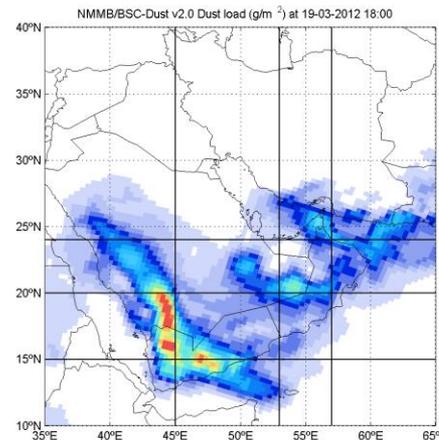
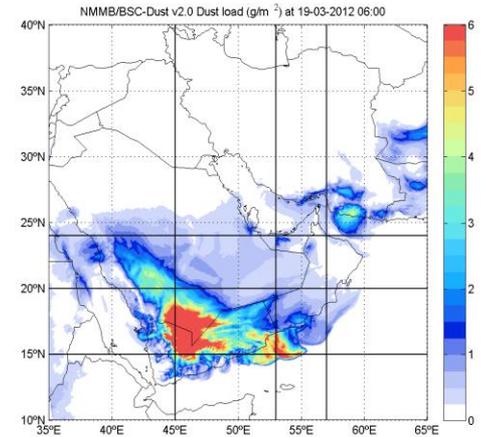
The impact of model resolution in dust propagation in a complex terrain region such as West Asia: 19th March 2012



Exp. 0.33° x 0.33°



Exp. 0.03° x 0.03°



ES-BSC: Mineral Dust Modelling



☞ Dust daily forecast:

- **BSC-DREAM8b**

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>

- **NMMB/BSC-Dust:**

<http://www.bsc.es/projects/earthscience/NMMB-BSC-DUST/>

ES-BSC: WMO Dust Centers



Barcelona Supercomputing Center
Centro Nacional de Supercomputación



MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO



NORTHERN AFRICA-MIDDLE EAST-EUROPE (NA-ME-E) REGIONAL CENTER
WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)

Log in

World Meteorological Organization
AEMet
BSC Barcelona Supercomputing Center

WMO SDS-WAS | Asia Regional Center

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Latest News

UfV Envoy Supports Greenbelts in Iraq to Combat Sandstorms
Feb 25, 2013

LINEP Global Environmental Alert Service releases 'Forecasting and early warning of dust storms'
Feb 18, 2013

Scholarship on desert dust at the Univ. of Reading, UK

Forecast & Products

DUST FORECASTS

DUST OBSERVATIONS

GUIDANCE FOR FORECASTERS

TIME-AVERAGED VALUES

FORECAST EVALUATION

REANALYSIS

DATA POLICY

Available for dust forecast

Multimodel Products

WMO SDS-WAS NA-ME-E Regional Center will be a Regional Specialized Meteorological Center

Forecast evaluation

Compared dust forecasts

Dust forecasts

WMO SDS-WAS | NA-ME-E Regional Center
Run: 12h 19 MAY 2014 Valid: 18h 20 MAY 2014 (H+30)

SEARCH

Search Site Search

RESEARCH

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

BARCELONA DUST FORECAST CENTER

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WMO SDS-WAS | NA-ME-E Regional Center

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LATEST NEWS

Barcelona Dust Forecast Center starts operations

The Center will release operational dust forecasts for Northern Africa, Middle East and Europe

Read More

Barcelona Dust Forecast Center
NMB/BSC-Dust Res: 0.1°x0.1° Dust Surface Conc. (µg/m³)
Run: 12h 19 MAY 2014 Valid: 18h 20 MAY 2014 (H+30)

Dust forecast

Latest dust forecast for Northern Africa, Middle East and Europe

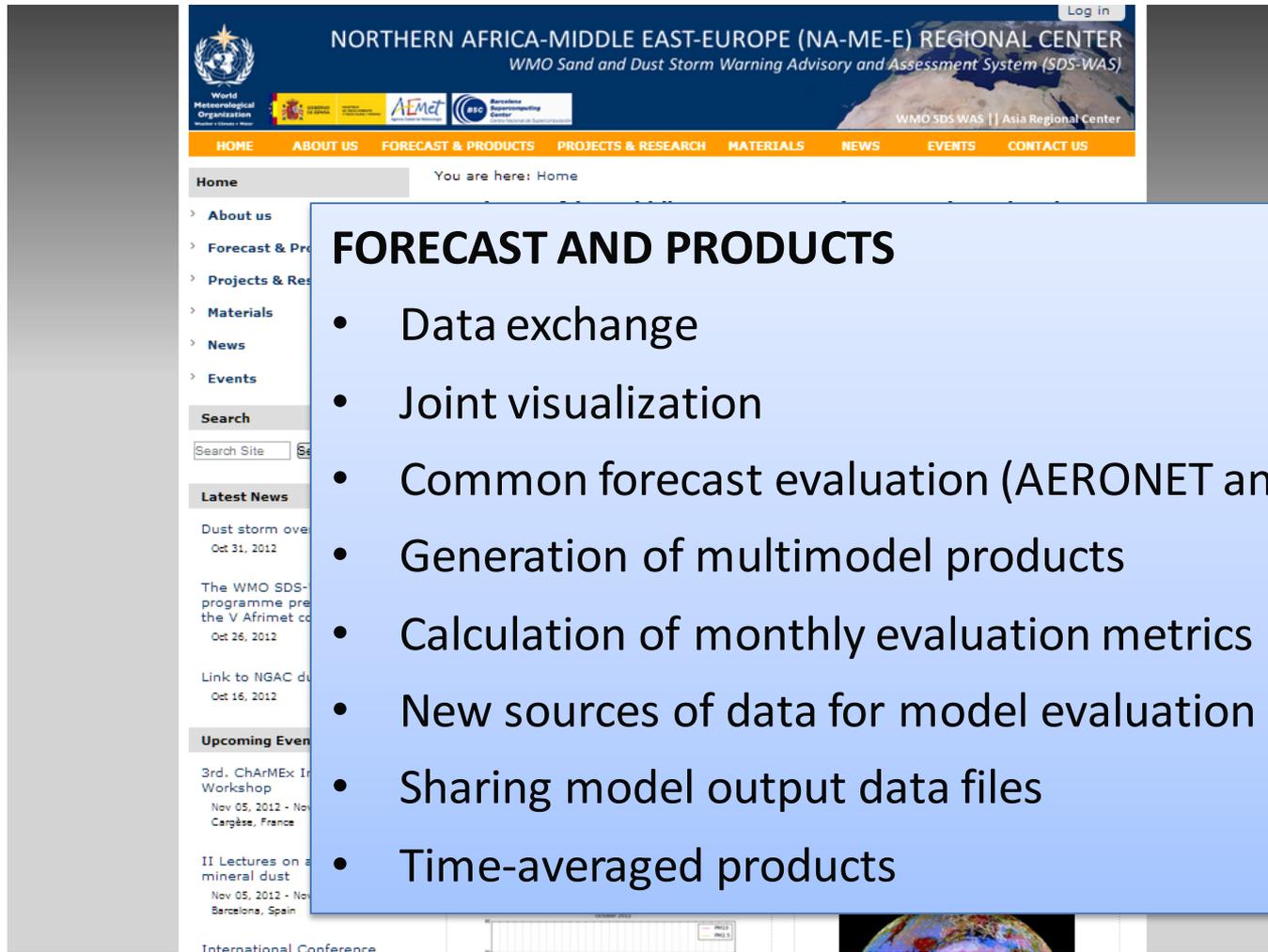
Check it here

OPERATIONAL

<http://dust.aemet.es/>



Barcelona Supercomputing Center
Centro Nacional de Supercomputación



The image shows a screenshot of the website for the Northern Africa-Middle East-Europe (NA-ME-E) Regional Center of the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS). The website header includes the WMO logo, the center's name, and logos for AEMET and BSC. A navigation menu is visible with options like HOME, ABOUT US, FORECAST & PRODUCTS, PROJECTS & RESEARCH, MATERIALS, NEWS, EVENTS, and CONTACT US. A blue overlay box is positioned over the 'FORECAST & PRODUCTS' section, listing several key services.

FORECAST AND PRODUCTS

- Data exchange
- Joint visualization
- Common forecast evaluation (AERONET and MODIS)
- Generation of multimodel products
- Calculation of monthly evaluation metrics
- New sources of data for model evaluation
- Sharing model output data files
- Time-averaged products

SDS-WAS: Dust models



LMD

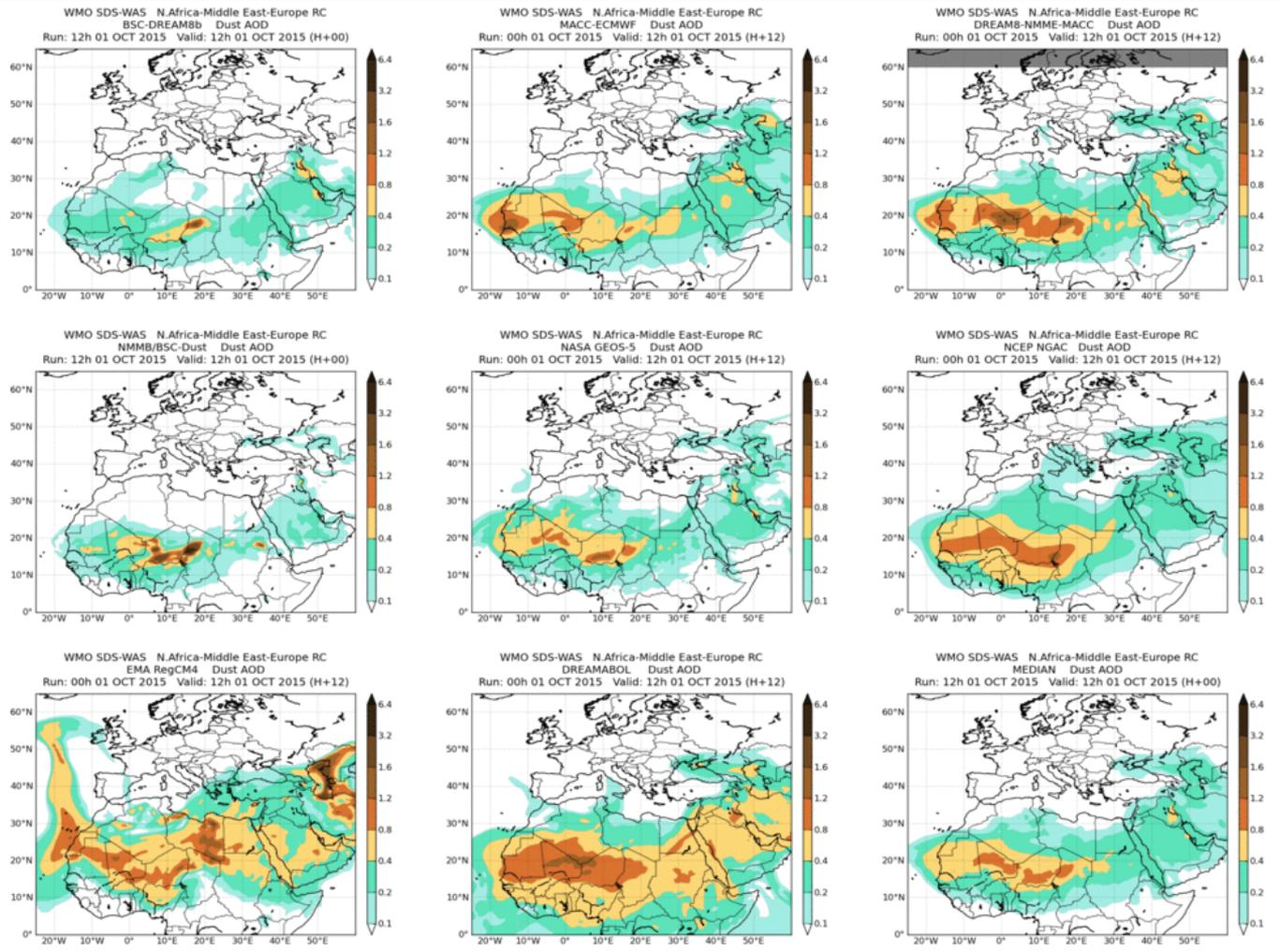


LSCE



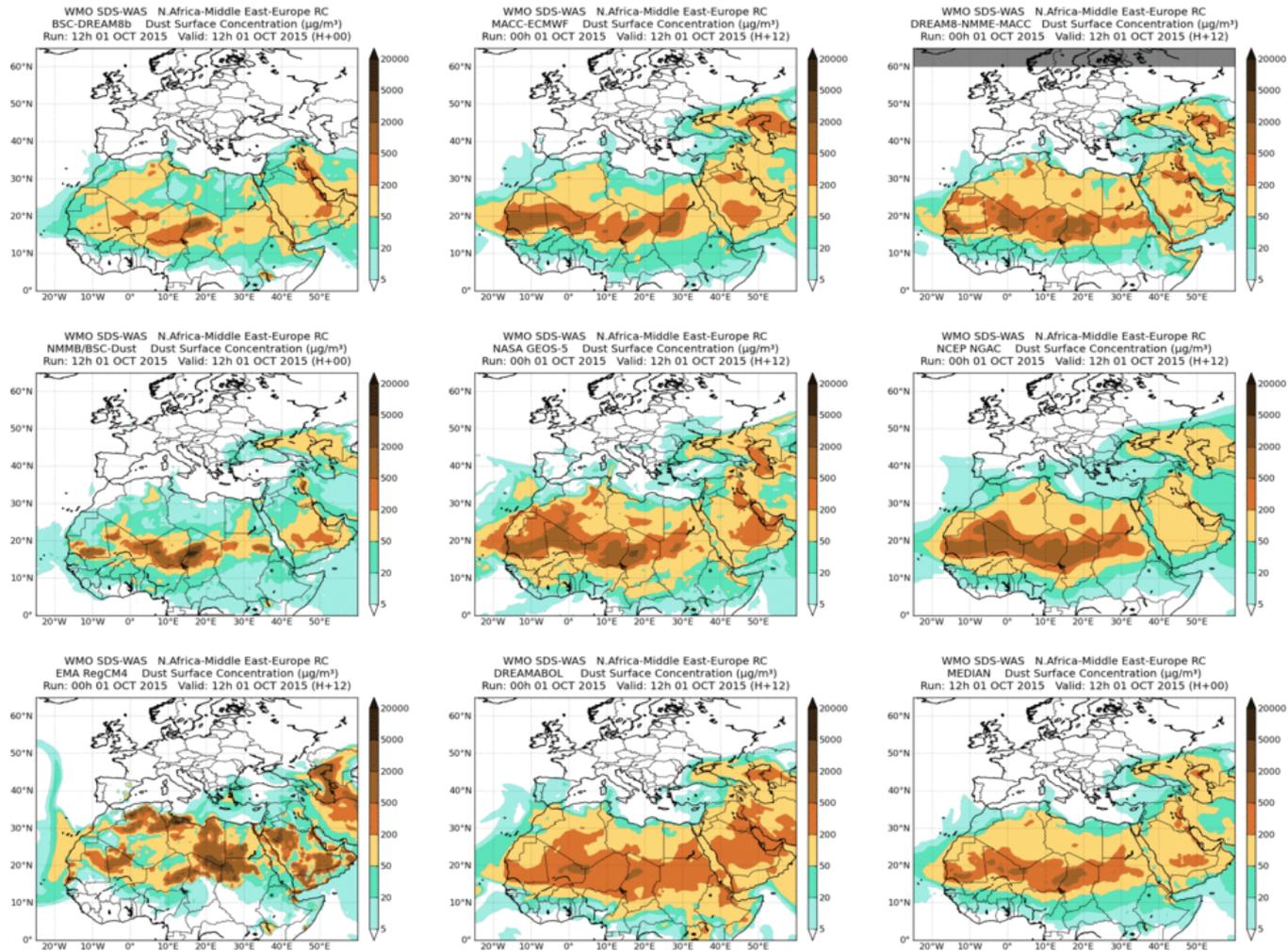
MODEL	RUN TIME	DOMAIN	DATA ASSIMILATION
BSC-DREAM8b	12	Regional	No
CHIMERE	00	Regional	No
LMDzT-INCA	00	Global	No
MACC	00	Global	MODIS AOD
DREAM-NMME-MACC	12	Regional	MACC analysis
NMMB/BSC-Dust	12	Regional	No
MetUM	00	Global	MODIS AOD
GEOS-5	00	Global	MODIS reflectances
NGAC	00	Global	No
EMA REG CM4	12	Regional	No
DREAMABOL	12	Regional	No

SDS-WAS: AOD joint visualization



AOD at 550nm
from 1-Oct-2015 12:00 to 3-Oct-2015 00:00

SDS-WAS: Surface concentration joint visualization

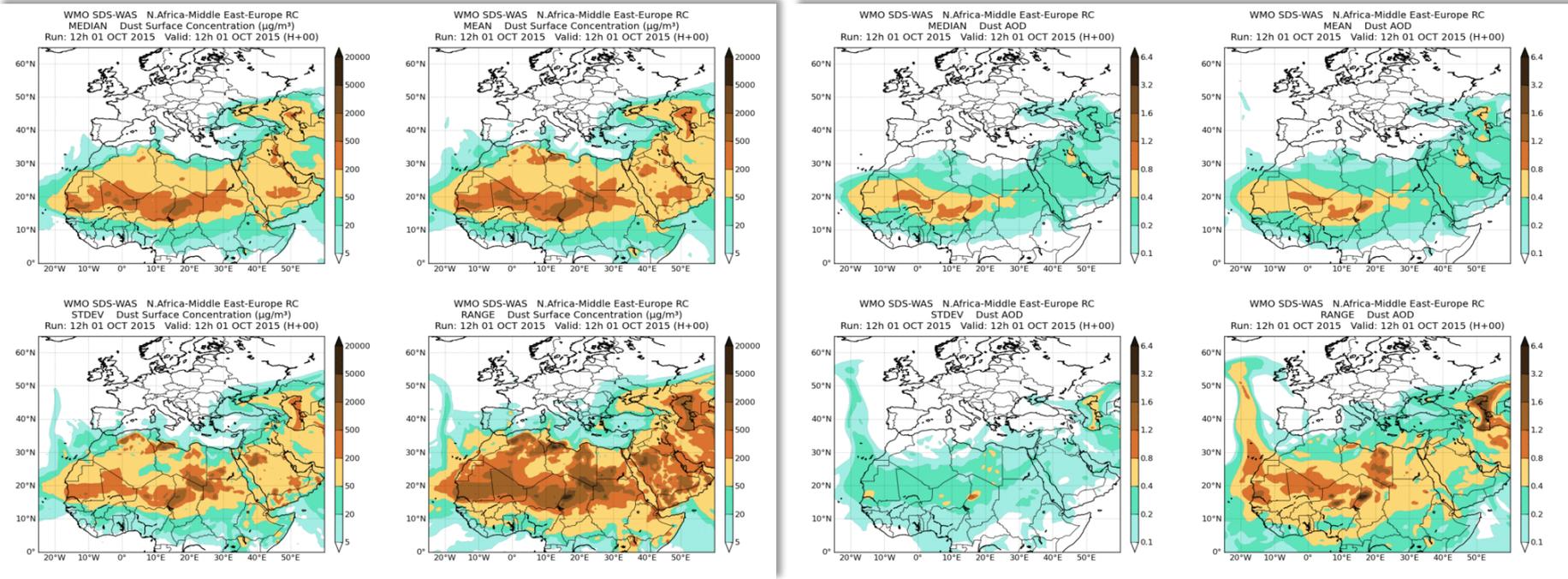


Surface concentration at 550nm
from 1-Oct-2015 12:00 to 3-Oct-2015 00:00

SDS-WAS: Generation of multi-model products

Surface concentration

AOD at 550nm



from 1-Oct-2015 12:00 to 3-Oct-2015 00:00

Model outputs are bi-linearly interpolated to a common $0.5^\circ \times 0.5^\circ$ grid mesh. Then, different multi-model products are generated:

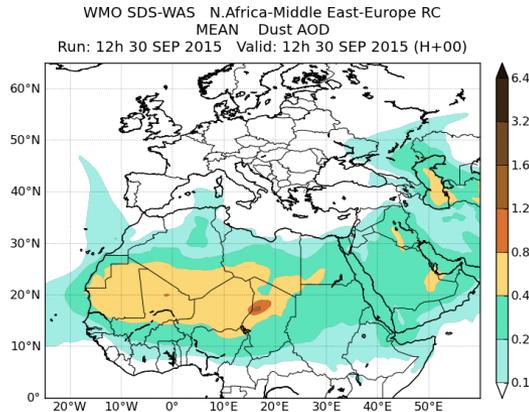
CENTRALITY: median - mean

SPREAD: standard deviation – range of variation

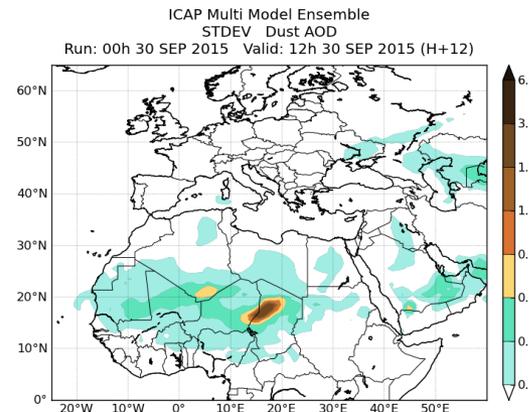
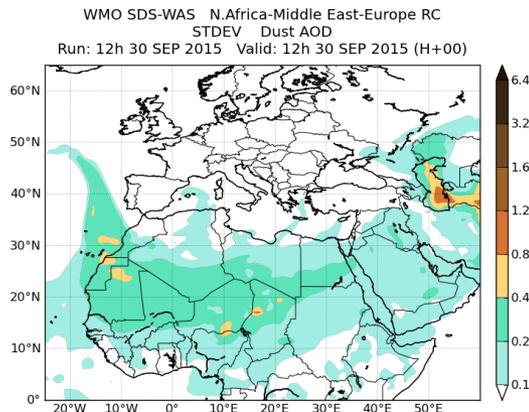
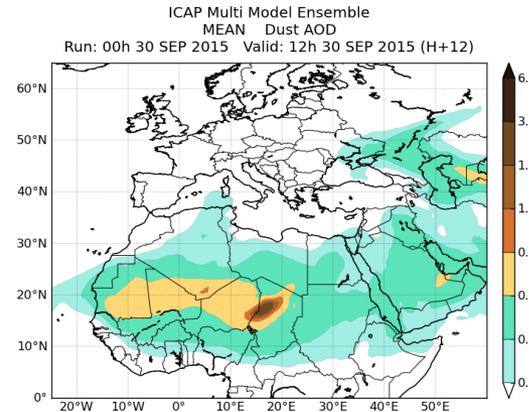
SDS-WAS: Generation of multi-model products

SDS-WAS and ICAP multi-model products

SDS-WAS

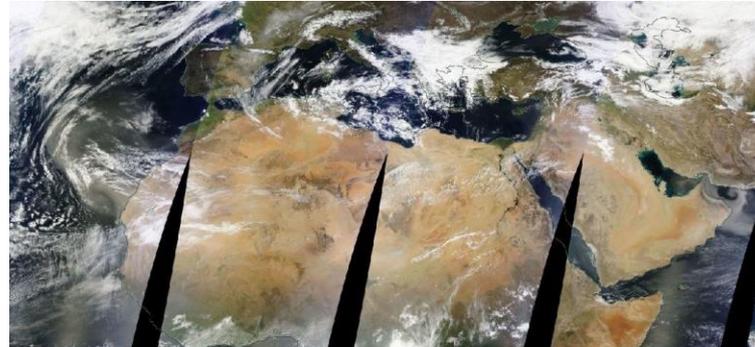


ICAP

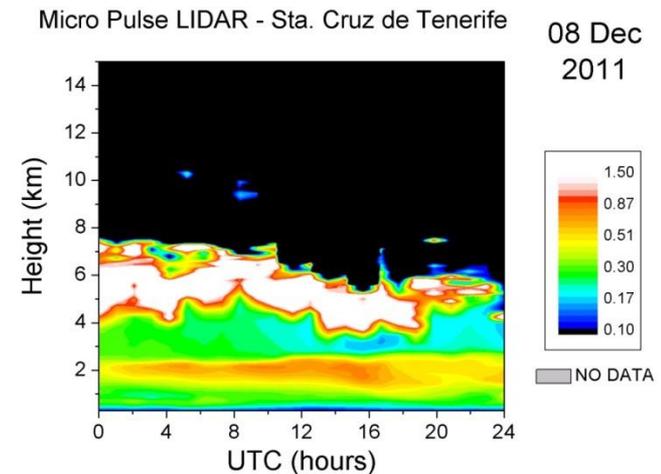
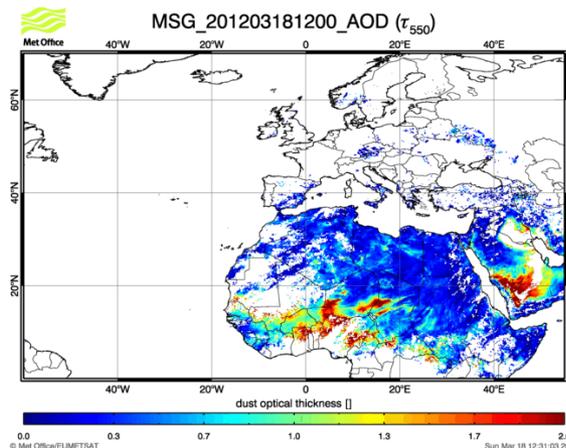


New sources of data for model evaluation

- Visibility
- MSG/SEVIRI
- MODIS
- OMI
- CALIPSO
- PARASOL
- MPLNET
- PM₁₀



MODIS composite 8th March 2015 from EOSDIS World Viewer

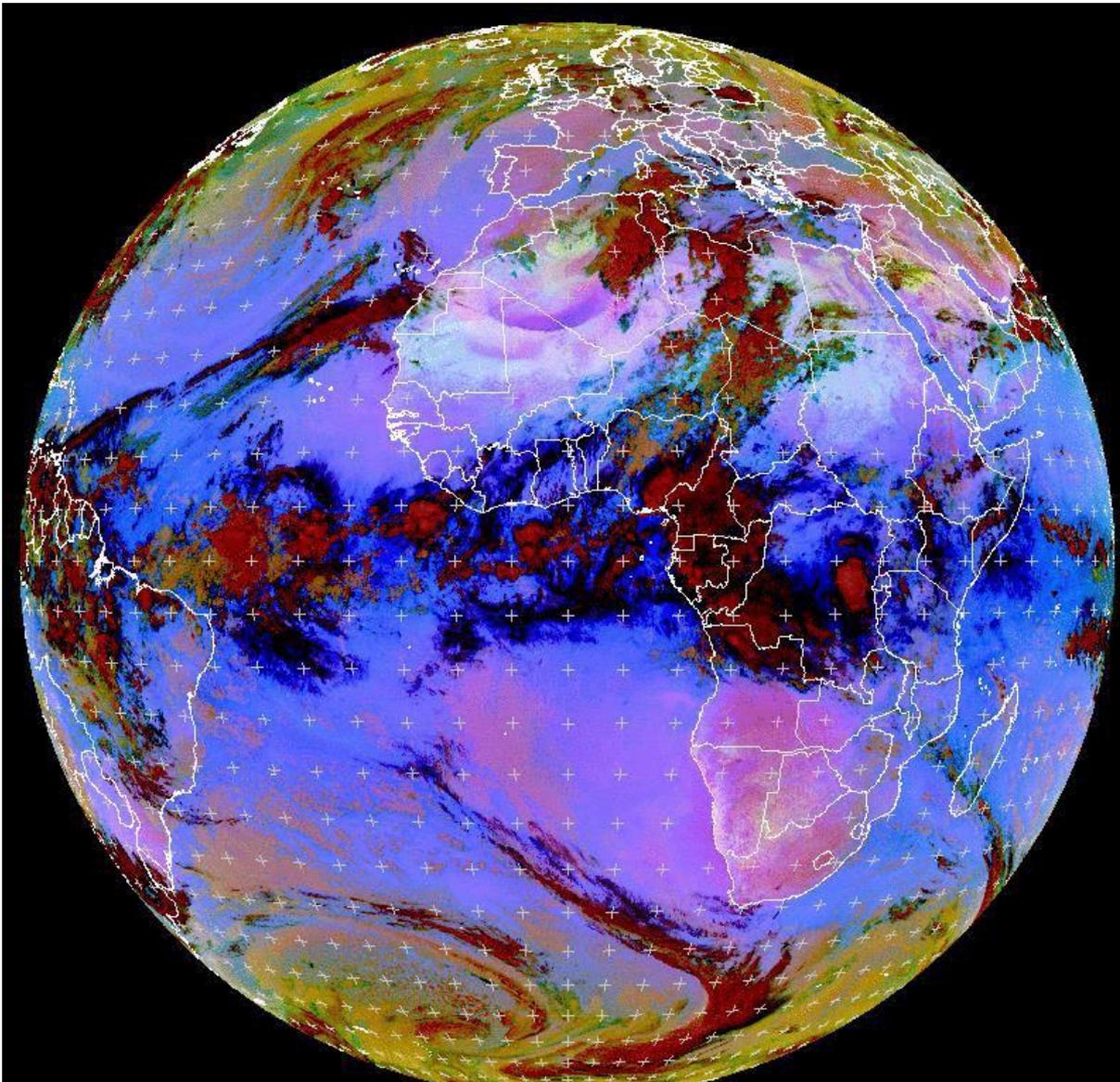
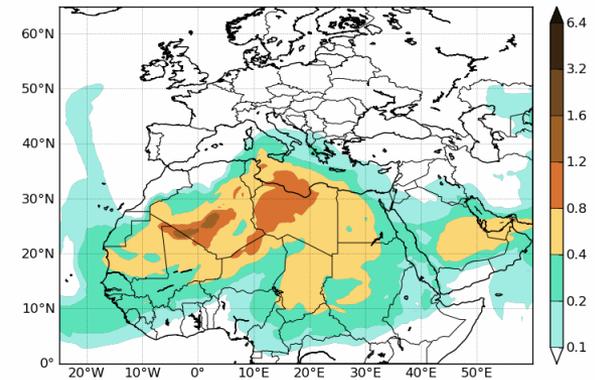


SDS-WAS: NRT Evaluation using satellite aerosol products



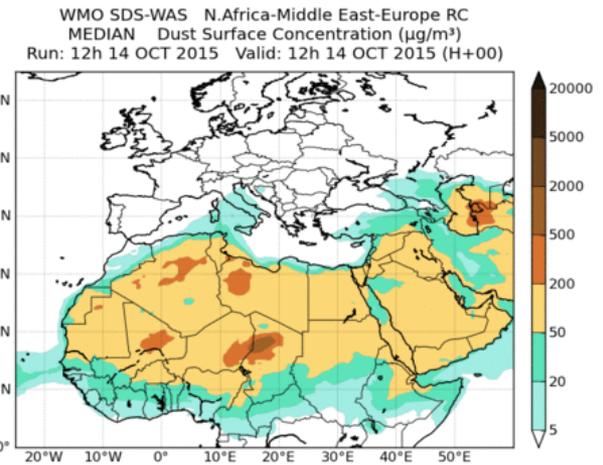
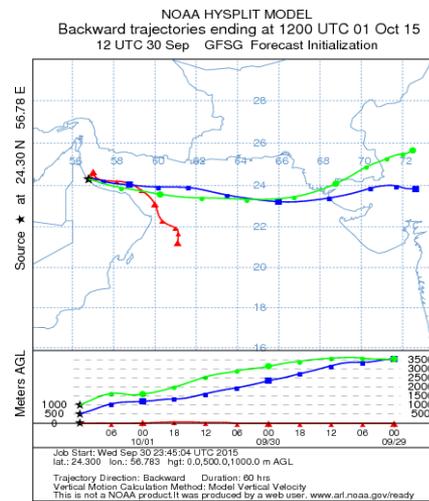
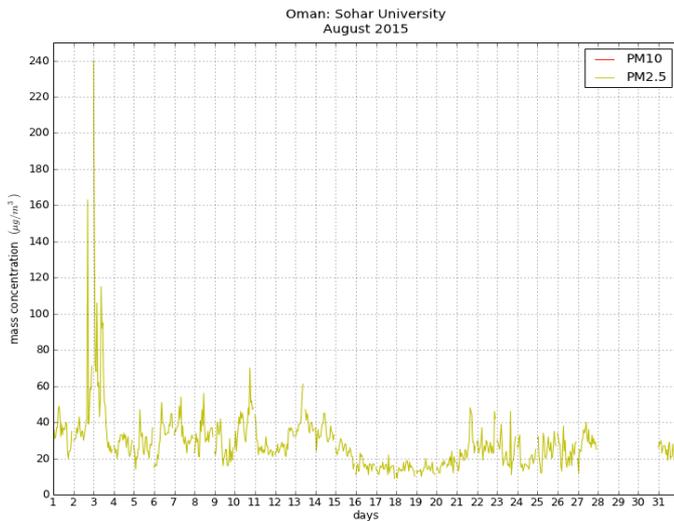
24 April 2013

WMO SDS-WAS N.Africa-Middle East-Europe RC
MEDIAN Dust AOD
Run: 12h 23 APR 2013 Valid: 00h 24 APR 2013 (H+12)



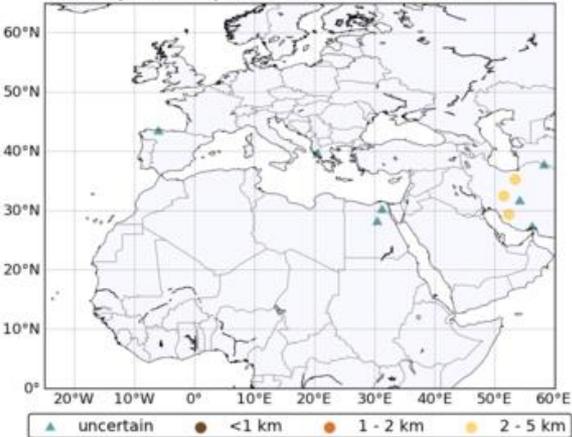
MET10 RGB-Dust 2013-04-24 00:00 UTC

SDS-WAS: NRT Evaluation using surface concentration

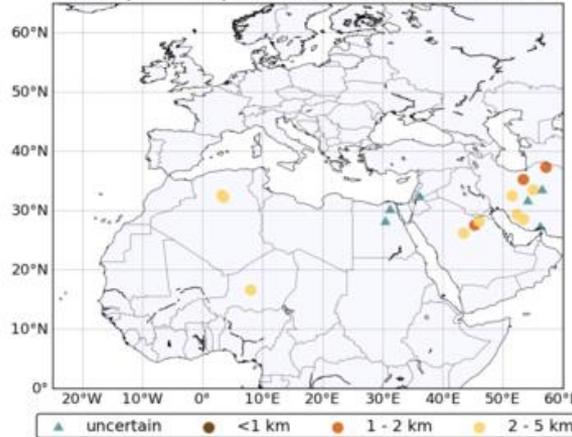


SDS-WAS: NRT Evaluation using VISIBILITY data

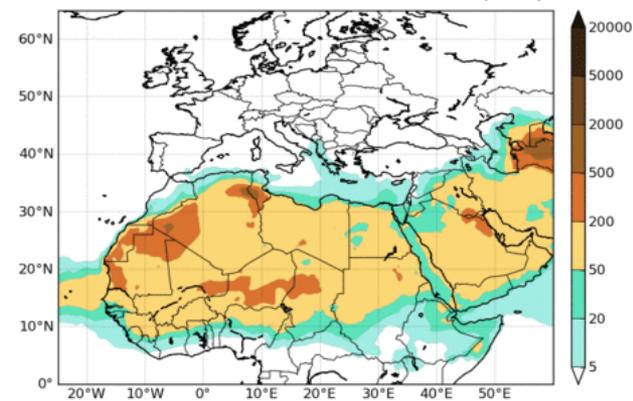
WMO SDS-WAS N.Africa-Middle East-Europe RC
Visibility reduced by airborne dust - 08 Oct 2015 00-06 UTC



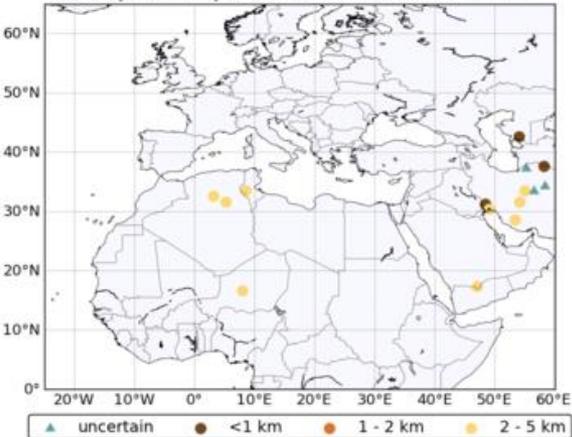
WMO SDS-WAS N.Africa-Middle East-Europe RC
Visibility reduced by airborne dust - 08 Oct 2015 06-12 UTC



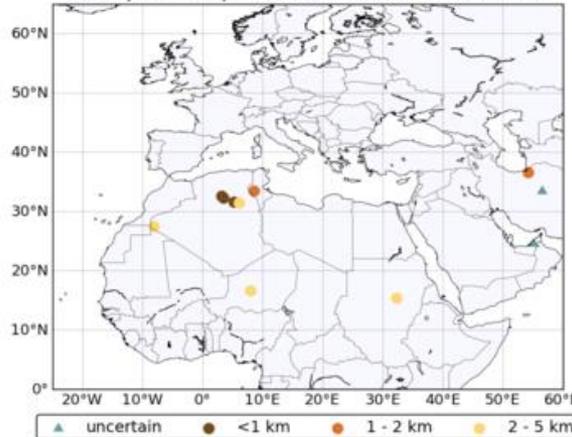
WMO SDS-WAS N.Africa-Middle East-Europe RC
MEDIAN Dust Surface Concentration ($\mu\text{g}/\text{m}^3$)
Run: 12h 08 OCT 2015 Valid: 00h 09 OCT 2015 (H+12)



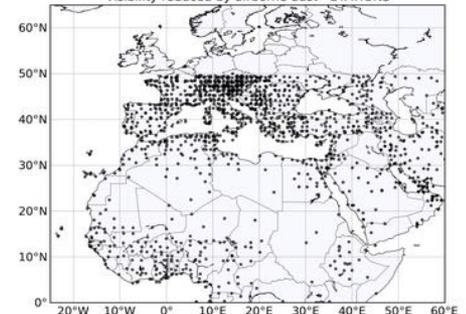
WMO SDS-WAS N.Africa-Middle East-Europe RC
Visibility reduced by airborne dust - 08 Oct 2015 12-18 UTC



WMO SDS-WAS N.Africa-Middle East-Europe RC
Visibility reduced by airborne dust - 08 Oct 2015 18-24 UTC



WMO SDS-WAS N.Africa-Middle East-Europe RC
Visibility reduced by airborne dust - STATIONS

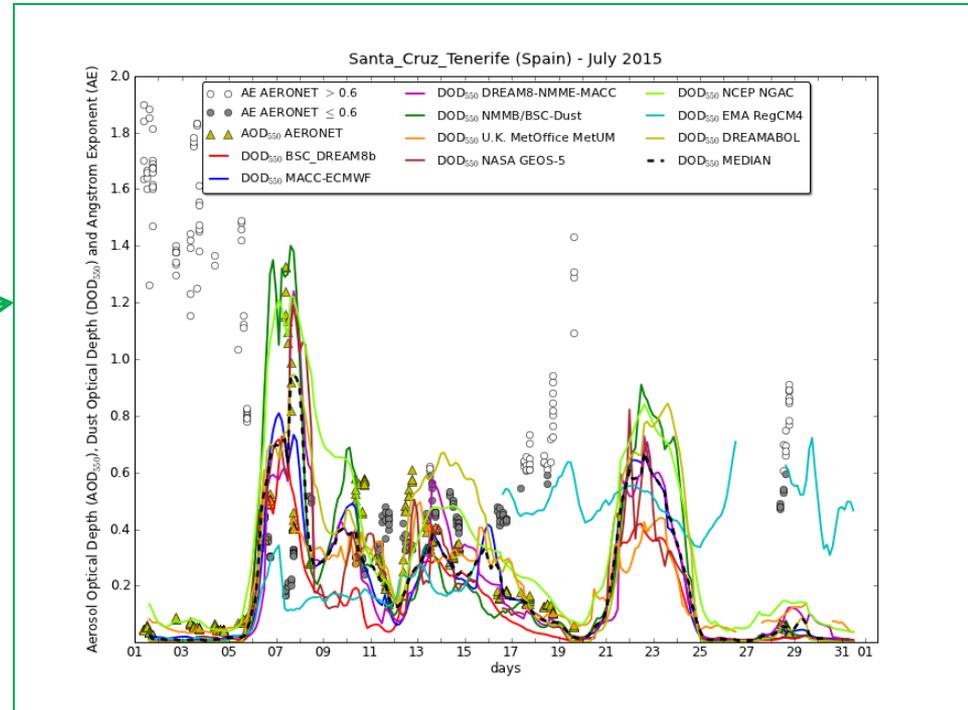


VISIBILITY on 8-Oct-2015

SDS-WAS: NRT Evaluation using AERONET

The screenshot shows the homepage of the Northern Africa-Middle East-Europe (NA-ME-E) Regional Center for the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS). The page features a navigation menu with categories like Home, About Us, Forecast & Products, Projects & Research, Materials, News, Events, and Contact Us. A breadcrumb trail indicates the current page is 'MODEL INTERCOMPARISON' under 'PROJECTS & RESEARCH'. The main article is titled 'Northern Africa-Middle East-Europe (NA-ME-E) Regional Center Model Intercomparison' by Francesco Benincasa, dated May 29, 2012. The article content includes sections for 'Outstanding' (II Lectures on Atmospheric Mineral Dust), 'Dust forecasts' (Compared dust forecasts), and 'Dust observations'. A red circle highlights the 'Forecast Evaluation' section, which contains a line graph comparing dust concentration forecasts from various models against AERONET observations. The graph shows dust concentration in $\mu\text{g}/\text{m}^3$ over time for September 2012. Other visible elements include a search bar, a newsletter subscription form, and a sidebar with 'Latest News' and 'Upcoming Events'.

SDS-WAS: NRT Evaluation using AERONET



Model evaluation metrics (bias, correlation, RMSE and FGE) are calculated:

- By regions: NA-ME-E, Sahel/Sahara, Middle East and Mediterranean
- By time periods: monthly, seasonal and annual

SDS-WAS: NRT Evaluation using AERONET

Annual scores

by Francesco Benincasa — last modified Nov 27, 2014 11:52 AM

Date:

Jan 2014 - Dec 2014. Dust Optical Depth.
Threshold Angstrom Exponent = 0.600

BIAS

	BSC_ DREAMb	MACC- ECMWF	DREAMB-NMME- MACC	NMMB/BSC- Dust	U.K. Met Office	NASA GEOS-5	NCEP NGAC	EMA RegCM4	DREAM ABOL	MEDIAN
Sahel/Sahara show stations	-0.23	-0.07	-0.08	-0.13	-0.07	-0.12	-0.01	0.32	-0.09	-0.10
Middle East show stations	-0.16	0.00	0.07	-0.14	-0.04	-0.12	-0.09	0.53	-0.02	-0.06
Mediterranean show stations	-0.18	-0.11	-0.10	-0.18	-0.10	-0.15	-0.08	0.11	-0.10	-0.13
TOTAL	-0.21	-0.08	-0.08	-0.15	-0.08	-0.13	-0.04	0.24	-0.09	-0.11

ROOT MEAN SQUARE ERROR

	BSC_ DREAMb	MACC- ECMWF	DREAMB-NMME- MACC	NMMB/BSC- Dust	U.K. Met Office	NASA GEOS-5	NCEP NGAC	EMA RegCM4	DREAM ABOL	MEDIAN
Sahel/Sahara show stations	0.40	0.32	0.35	0.36	0.31	0.33	0.30	0.69	0.38	0.31
Middle East show stations	0.26	0.23	0.24	0.25	0.21	0.24	0.25	0.67	0.20	0.22
Mediterranean show stations	0.30	0.27	0.29	0.29	0.25	0.27	0.26	0.49	0.26	0.26
TOTAL	0.36	0.30	0.33	0.33	0.29	0.31	0.28	0.62	0.33	0.29

CORRELATION COEFFICIENT

	BSC_ DREAMb	MACC- ECMWF	DREAMB-NMME- MACC	NMMB/BSC- Dust	U.K. Met Office	NASA GEOS-5	NCEP NGAC	EMA RegCM4	DREAM ABOL	MEDIAN
Sahel/Sahara show stations	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Middle East show stations	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Mediterranean show stations	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
TOTAL	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

A set of evaluation metrics are selected:

- Bias
- RMSE
- correlation coefficient
- FGE

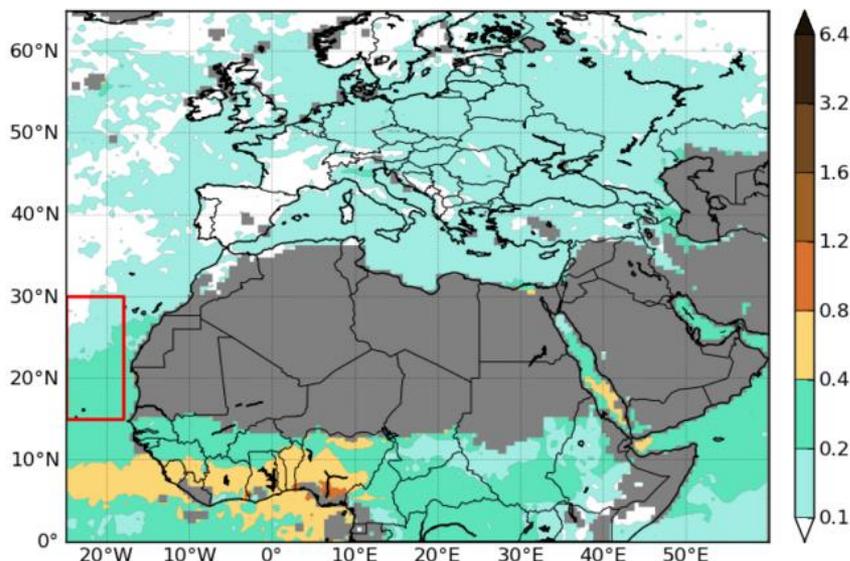
Calculations evaluation metrics are done for:

- monthly/seasonal/annual
- sites and regions



SDS-WAS: NRT Evaluation using MODIS

WMO SDS-WAS N.Africa-Middle East-Europe RC
MODIS AOD₅₅₀ - 2014



A set of evaluation metrics are selected:

- Bias
- RMSE
- correlation coefficient
- FGE

Calculations evaluation metrics are done for:

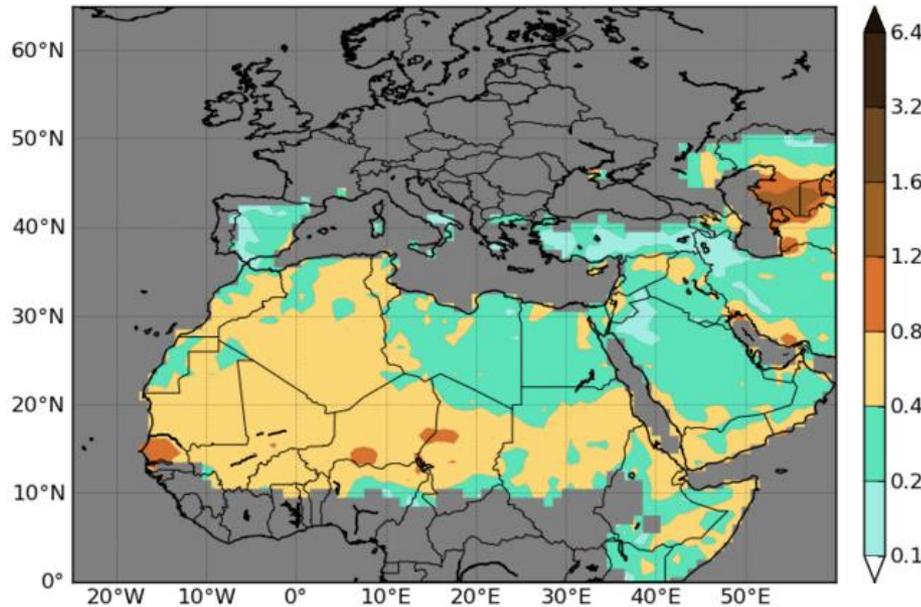
- monthly/seasonal/annual

[Download full image](#)

	BIAS	ROOT MEAN SQUARE ERROR	CORRELATION COEFFICIENT	FRACTIONAL GROSS ERROR	NUMBER OF CASES
BSC_DREAM8b	-0.14	0.20	0.72	1.07	22154
NMMB/BSC-Dust	-0.13	0.18	0.79	1.09	22154
NCEP NGAC	0.04	0.15	0.81	0.59	21608
EMA RegCM4	-0.04	0.37	0.26	1.09	13300
DREAMABOL	-0.04	0.17	0.69	0.92	13611

SDS-WAS: NRT Evaluation using MODIS Deep Blue

WMO SDS-WAS N.Africa-Middle East-Europe RC
MODIS DEEPLUE AOD₅₅₀ - JUN 2014 - AUG 2014



[Download full image](#)

	BIAS	ROOT MEAN SQUARE ERROR	CORRELATION COEFFICIENT	FRACTIONAL GROSS ERROR	NUMBER OF CASES
BSC_ DREAM8b	-0.17	0.35	0.26	0.84	100952
NMMB/BSC-Dust	-0.12	0.39	0.32	0.84	100952
NCEP NGAC	-0.01	0.31	0.39	0.59	99159
EMA RegCM4	0.48	0.95	0.19	0.97	88666
DREAMABOL	0.07	0.34	0.36	0.71	64441

A set of evaluation metrics are selected:

- Bias
- RMSE
- correlation coefficient
- FGE

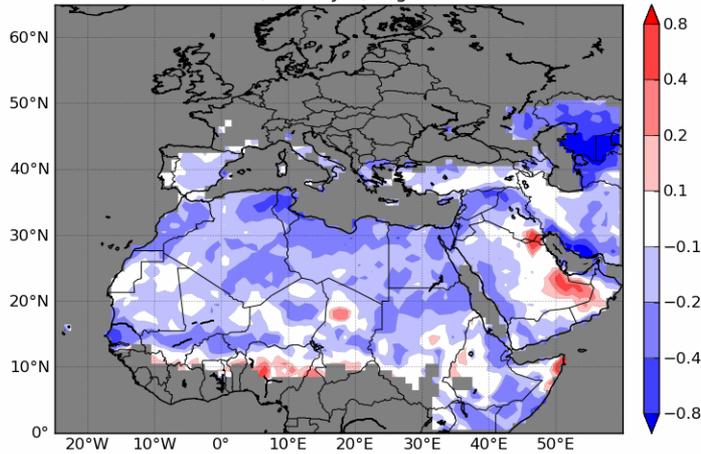
Calculations evaluation metrics are done for:

- monthly/seasonal/annual

SDS-WAS: NRT Evaluation using MODIS Deep Blue

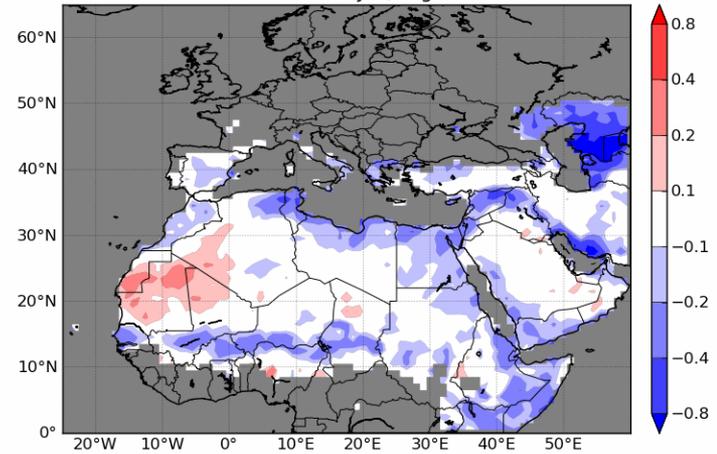
NMMB-BSC/Dust

WMO SDS-WAS N.Africa-Middle East-Europe RC
NMMB-BSC/Dust - Jun/Aug 2013 - bias



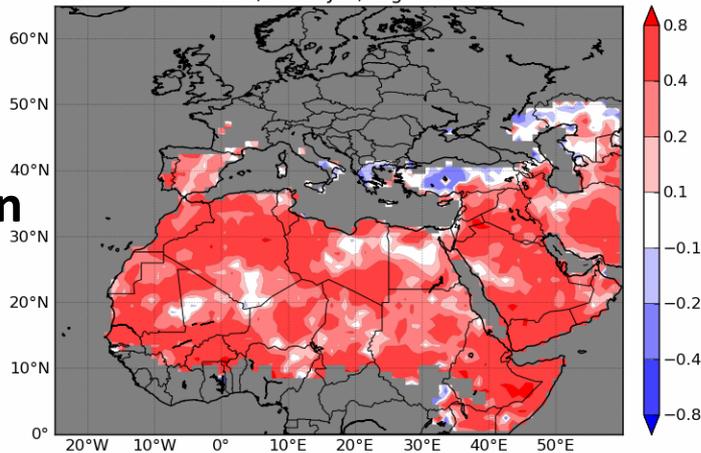
Multimodel MEDIAN

WMO SDS-WAS N.Africa-Middle East-Europe RC
multimodel MEDIAN - Jun/Aug 2013 - bias

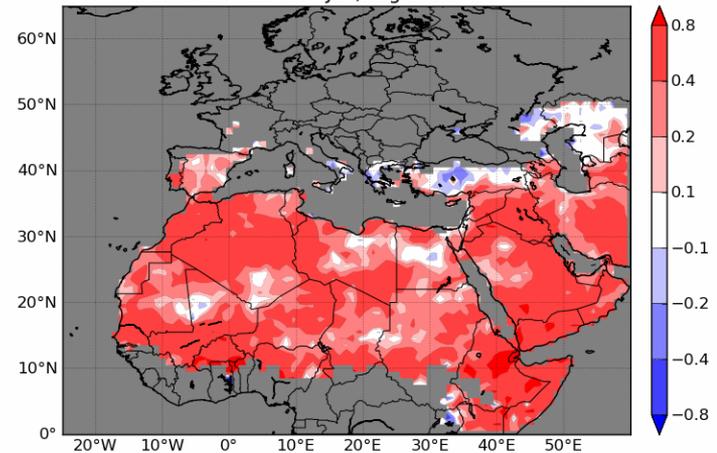


MB

WMO SDS-WAS N.Africa-Middle East-Europe RC
NMMB-BSC/Dust - Jun/Aug - correlation



WMO SDS-WAS N.Africa-Middle East-Europe RC
multimodel MEDIAN - Jun/Aug 2013 - correlation

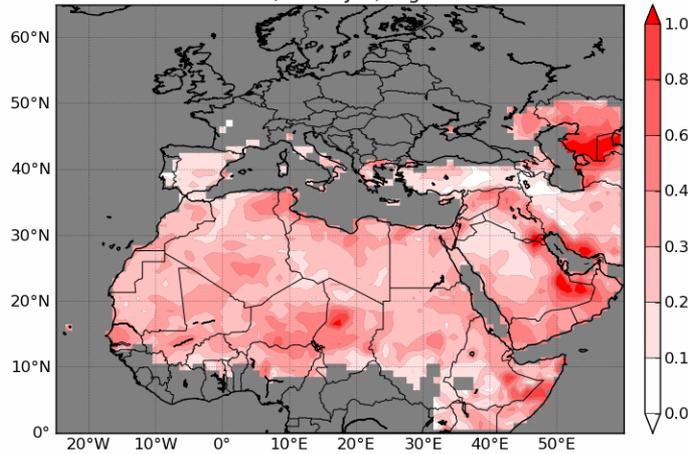


Correlation

SDS-WAS: NRT Evaluation using MODIS Deep Blue

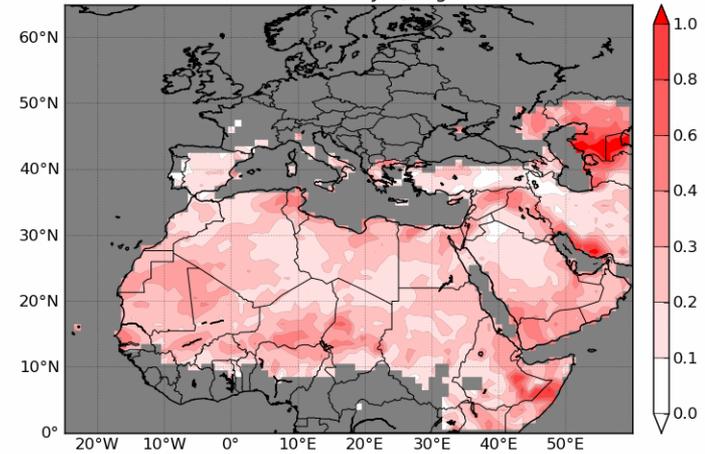
NMMB-BSC/Dust

WMO SDS-WAS N.Africa-Middle East-Europe RC
NMMB-BSC/Dust - Jun/Aug - r.m.s.e.



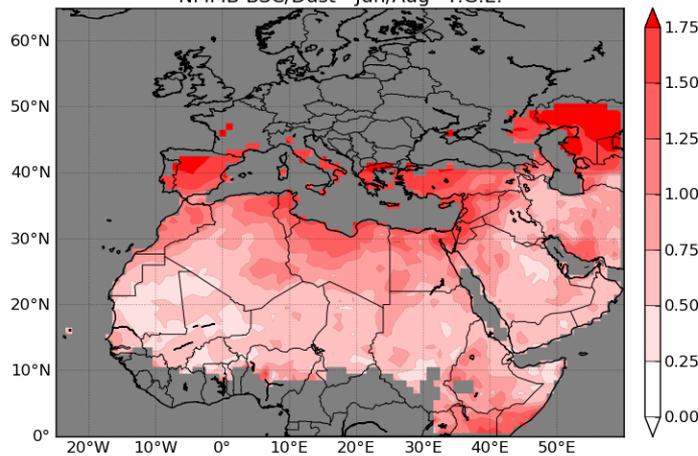
Multimodel MEDIAN

WMO SDS-WAS N.Africa-Middle East-Europe RC
multimodel MEDIAN - Jun/Aug - r.m.s.e.

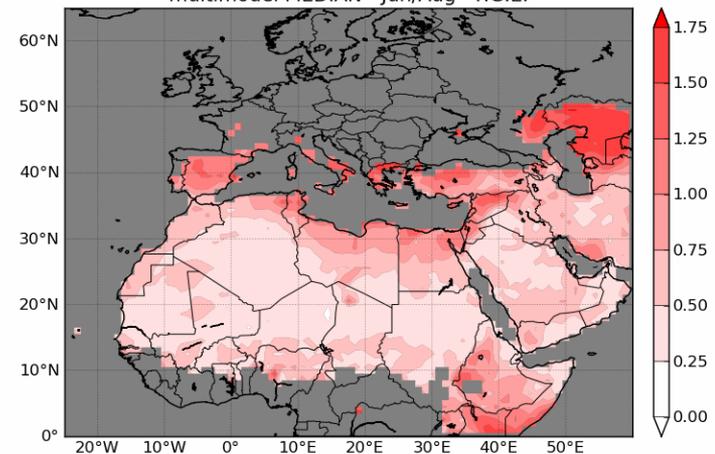


RMSE

WMO SDS-WAS N.Africa-Middle East-Europe RC
NMMB-BSC/Dust - Jun/Aug - F.G.E.

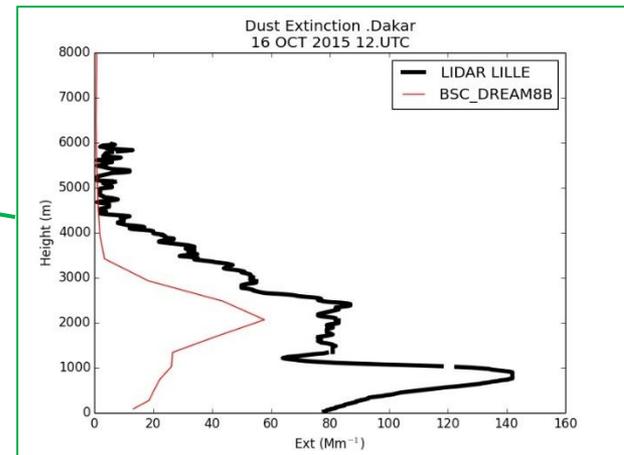
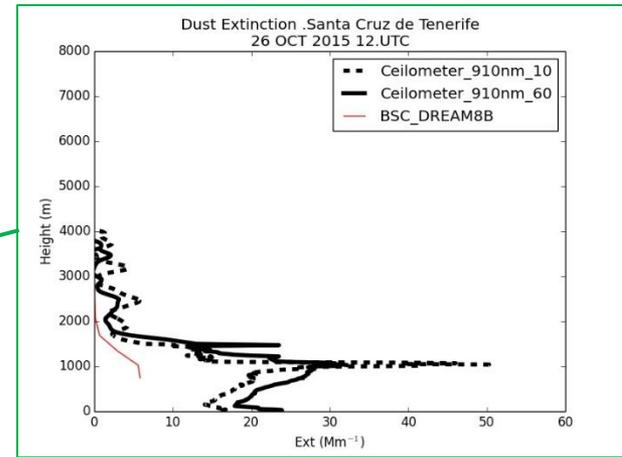
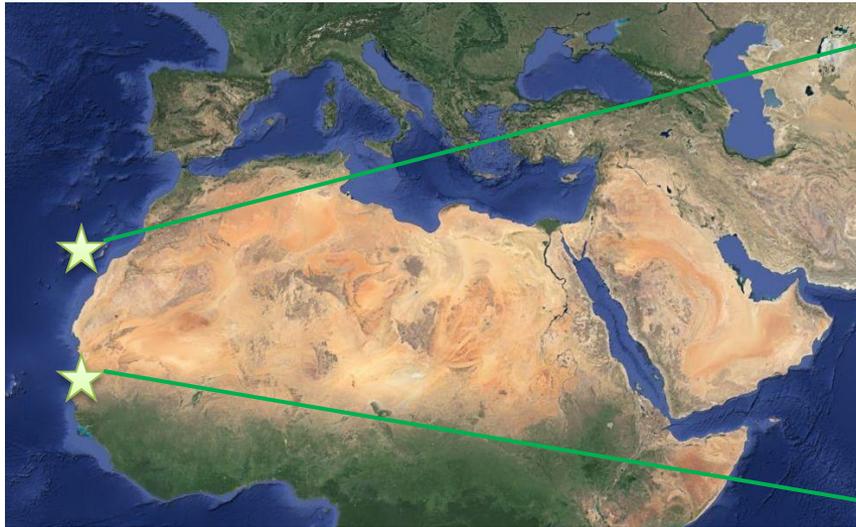


WMO SDS-WAS N.Africa-Middle East-Europe RC
multimodel MEDIAN - Jun/Aug - F.G.E.



FGE

SDS-WAS: Evaluation using LIDAR/Ceilometers data



SDS-WAS: Model intercomparison

The screenshot shows the website for the Northern Africa-Middle East-Europe (NA-ME-E) Regional Center of the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS). The page features a navigation menu with 'PROJECTS & RESEARCH' selected. A dropdown menu is visible, with 'SDS-WAS STUDIES' highlighted in red. The main content area includes a breadcrumb trail 'You are here: Home > Projects & Research > SDS-WAS STUDIES', a list of projects (MACC-II Project, Model Intercomparison, West Asia Regional Program to Combat Sand and Dust Storm, International Cooperative for Aerosol Prediction (ICAP), DIAPASON, SDS-WAS studies), a search bar, and a 'Latest News' section with two articles. A satellite image of the Saharan region is also present.

Log in Register

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

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

WMO SDS WAS | Asia Regional Center

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- PROJECTS & RESEARCH
- MATERIALS
- NEWS
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World Meteorological Organization
Member of United Nations

Comissió Interdepartamental de Recerca i Innovació Tecnològica

Aemet

BSC Barcelona Supercomputing Center
Centro Nacional de Supercomputación

You are here: Home > Projects & Research > SDS-WAS STUDIES

SDS-WAS STUDIES

by Enric Terradellas

Forecasting the North African dust outbreak towards Europe occurred in April 2011

Four state-of-the-art dust forecast models are examined to assess their performance to predict up to 72 hours ahead an intense Saharan dust outbreak over Western Europe up to Scandinavia between 5th and 11th April 2011. The capacity of the models to predict the evolution of the dust cloud is assessed by comparing their results with aerosol optical depth from AERONET and MODIS, as well as with dust surface concentration from air-quality monitoring stations. In addition, the CALIOP vertical profiles of extinction are used to examine the predicted vertical dust distribution of each model. To identify possible reasons for the different model performance, the wind fields yield by the simulations are evaluated with 10-m winds observed at meteorological stations and the vertical wind profiles from two radio sounding stations in the source region.

Huneus, N. et al. (2014): Forecasting the North African dust outbreak towards Europe in april 2011: A model intercomparison. MACC II Open Science Conference, Brussels

Basart, S. et al. (2012): Dust forecast model intercomparison: Case study of the dust cloud of April 2011. 24th ACCENT/GLOREAM Workshop, Barcelona

Search Site Search

Latest News

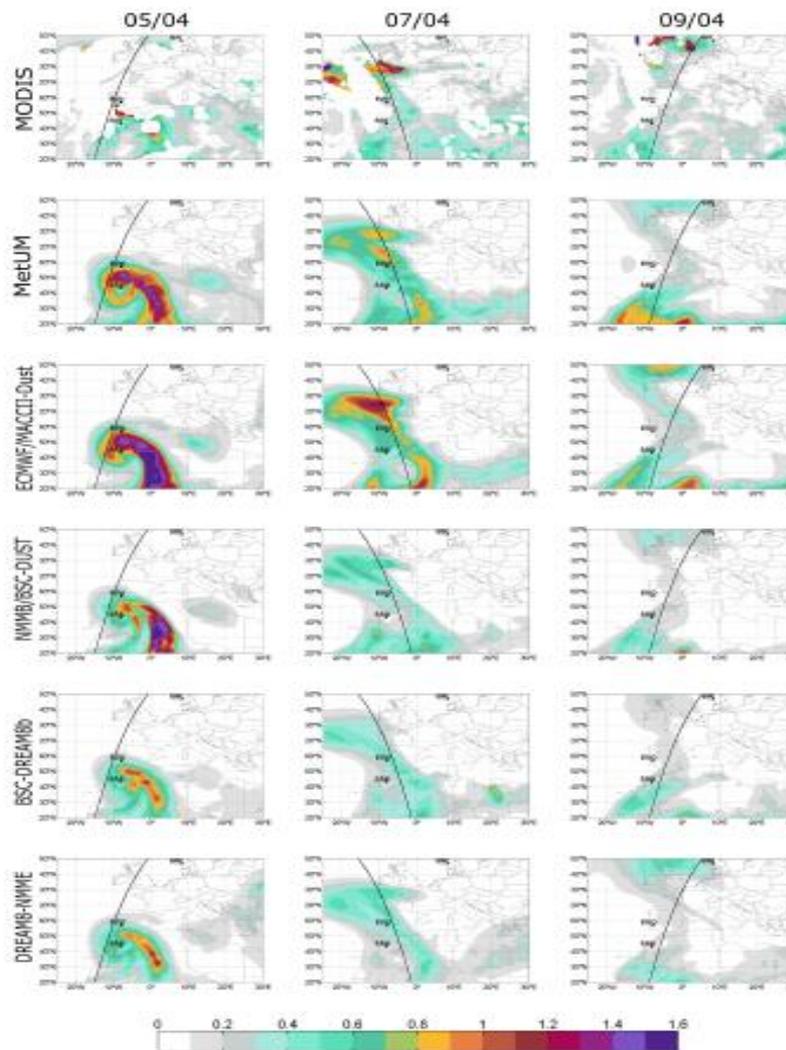
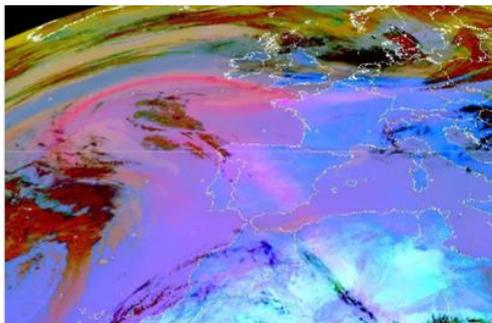
The book "Mineral Dust - A key player in the Earth system" has been released
Sep 08, 2014

sds-was.aemet.es/projects-research

Contact: Nicolás Huneus (nhuneus@daf.uchile.cl)

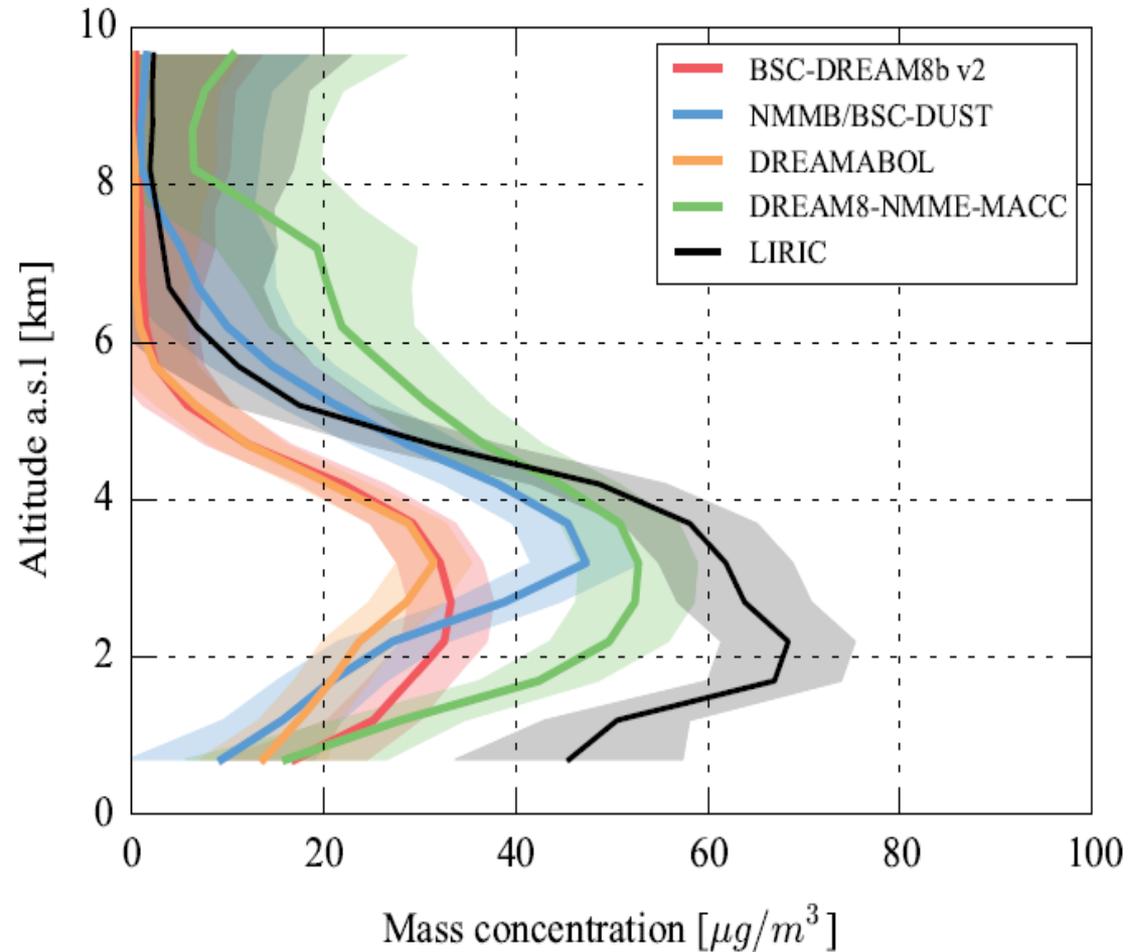
SDS-WAS: Model intercomparison

Study of a dust outbreak over Europe in April 2011



SDS-WAS: Model intercomparison

EARLINET vertical profiles 2011-2013



(Binitieglou et al., 2015, AMT)

SDS-WAS: Model intercomparison

Study of a haboob in Iran in 2014



Case study of the small-scale extreme dust storm occurred in **Tehran** on **2nd June 2014**, at 5:30 PM local time, lasting less than 2 hours according to public evidence.

Based on public news, the dust storm caused several deaths, reduction of visibility to several tenths meters in the city, and adverse disturbance of the public traffic. The blowing wind reached 110 km/h.

Contact: Slobodan Nickovic (nickovic@gmail.com)

Barcelona Dust Forecasting Center (<http://dust.aemet.es/>)

BARCELONA DUST FORECAST CENTER

Log in

GOVERNIO DE ESPAÑA
MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y PESCA
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Barcelona Dust Forecast Center starts operations

The Center will release operational dust forecasts for Northern Africa, Middle East and Europe

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Barcelona Dust Forecast Center
NMMB/BSC-Dust Res: 0.1°x0.1° Dust Surface Conc. (µg/m³)
Run: 12h 19 MAY 2014 Valid: 18h 20 MAY 2014 (H+30)

60°N
50°N
40°N

20000
5000
2000
500

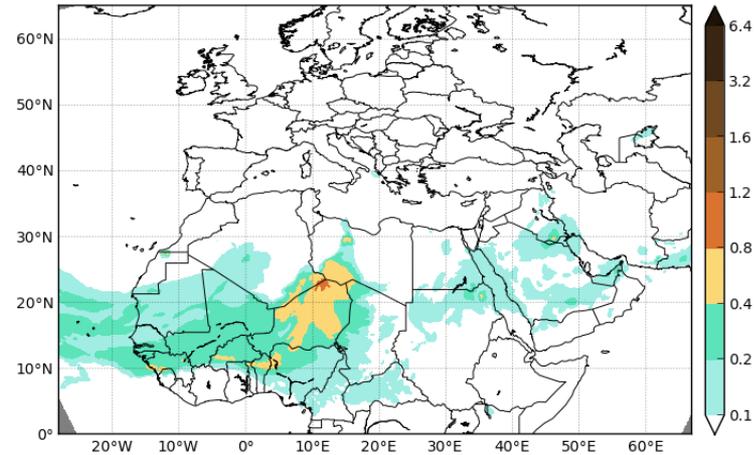
Dust forecast

Latest dust forecast for Northern Africa, Middle East and Europe

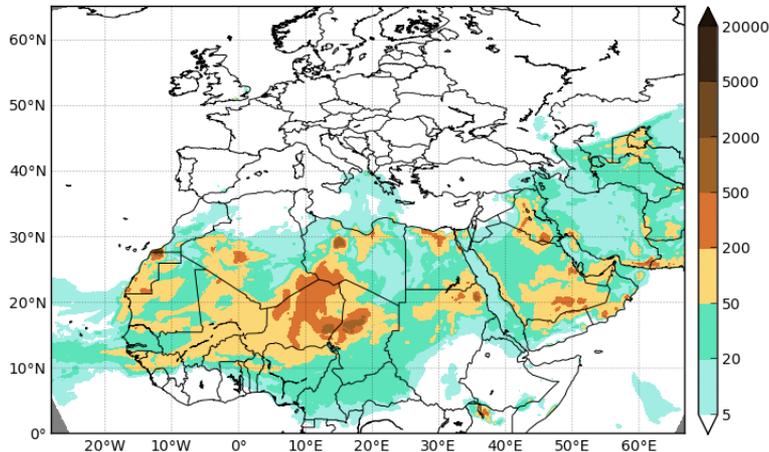
*First Specialized Center for Mineral Dust Prediction of WMO
NMMB/BSC-Dust selected to provide operational forecasts at high
resolution (10km) for NAMEE region*

Dust Optical Depth at 550nm
Dust Dry Deposition
Dust Load
Dust Surface Concentration
Dust Surface Extinction at 550nm
Dust Wet Deposition

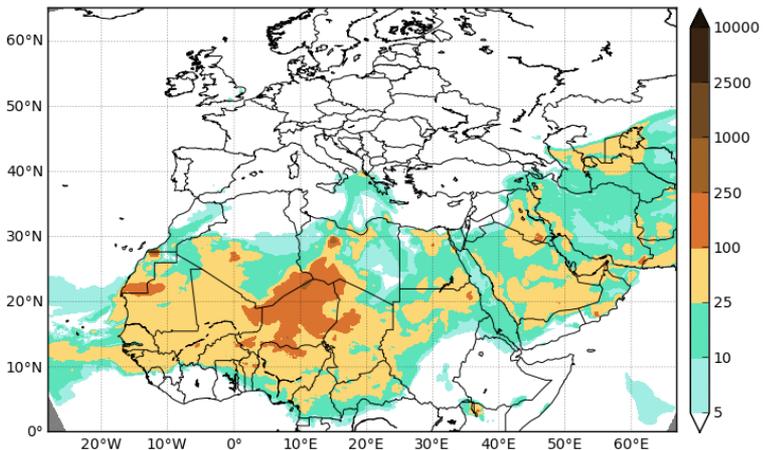
Barcelona Dust Forecast Center
NMMB/BSC-Dust Res:0.1°x0.1° Dust AOD
Run: 12h 06 OCT 2014 Valid: 12h 06 OCT 2014 (H+00)



Barcelona Dust Forecast Center
NMMB/BSC-Dust Res:0.1°x0.1° Dust Surface Conc. ($\mu\text{g}/\text{m}^3$)
Run: 12h 06 OCT 2014 Valid: 12h 06 OCT 2014 (H+00)



Barcelona Dust Forecast Center
NMMB/BSC-Dust Res:0.1°x0.1° Dust Surface Ext. (Mm^{-1})
Run: 12h 06 OCT 2014 Valid: 12h 06 OCT 2014 (H+00)



BDFC: NRT Evaluation using AERONET



Jan 2014 - Dec 2014. Dust Optical Depth.
Threshold Angstrom Exponent = 0.600

	BIAS	ROOT MEAN SQUARE ERROR	CORRELATION COEFFICIENT	FRACTIONAL GROSS ERROR	NUMBER OF CASES
Sahel/Sahara show stations	-0.12	0.38	0.51	0.75	7427
Middle East show stations	-0.10	0.27	0.39	0.64	112
Mediterranean show stations	-0.19	0.30	0.46	1.34	4623
TOTAL	-0.15	0.35	0.52	0.98	12162

A set of evaluation metrics are selected:

- Bias
- RMSE
- correlation coefficient
- FGE

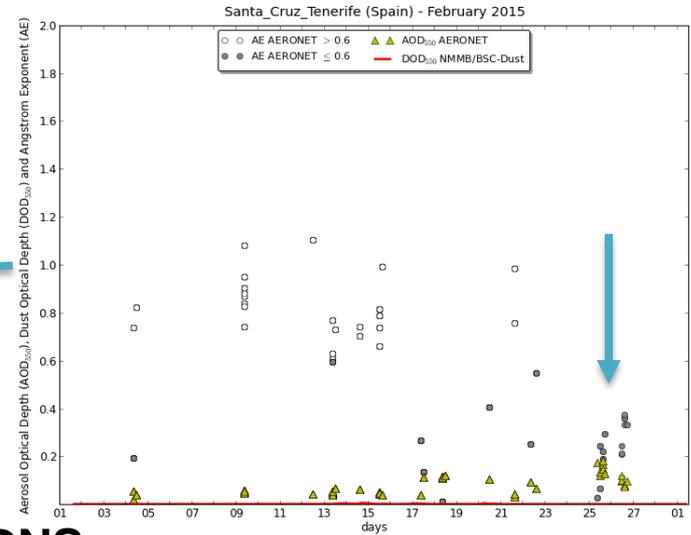
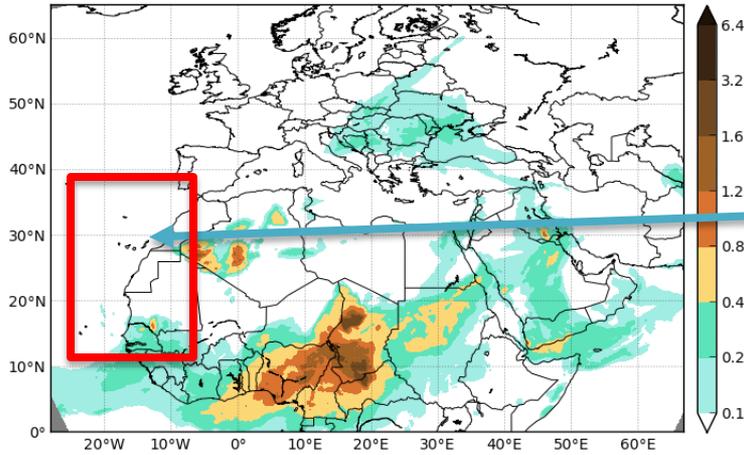
Calculations evaluation metrics are done for:

- monthly/seasonal/annual
- sites and regions

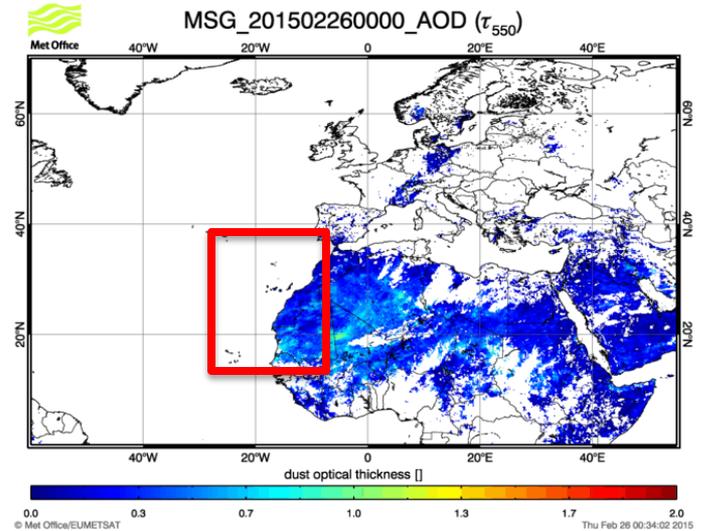
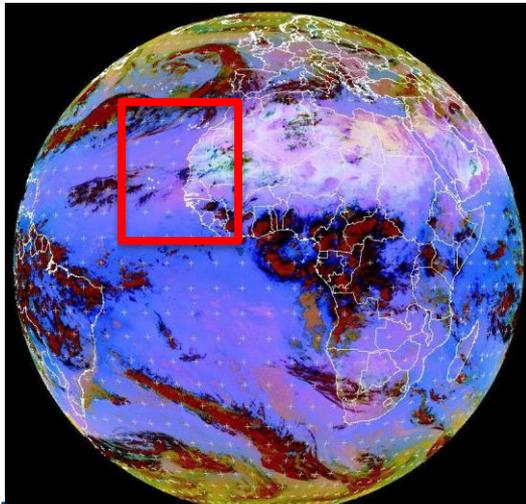
Canary Islands dust event February 2015

MODEL

Barcelona Dust Forecast Center
 NMMB/BSC-Dust Res:0.1°x0.1° Dust AOD
 Run: 12h 25 FEB 2015 Valid: 12h 25 FEB 2015 (H+00)



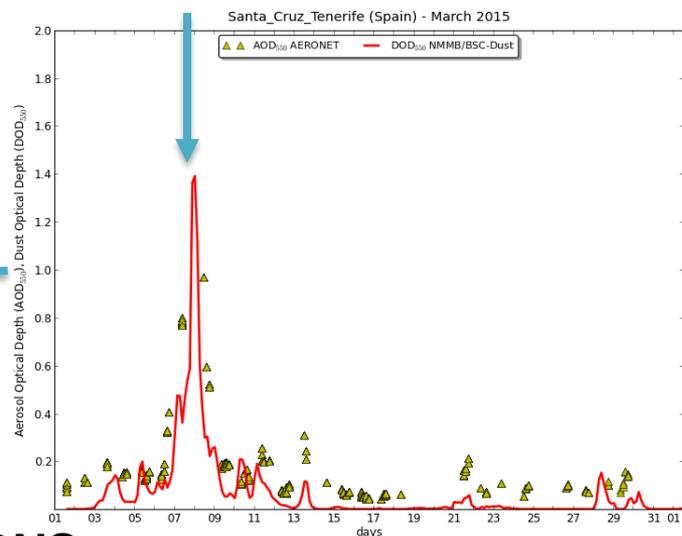
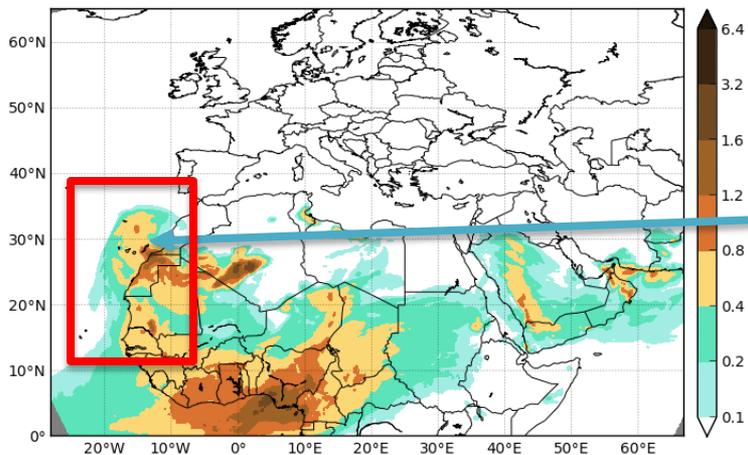
OBSERVATIONS



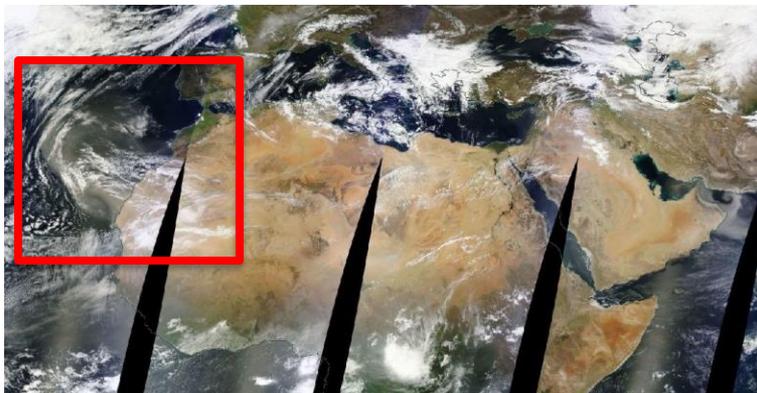
Canary Islands dust event March 2015

MODEL

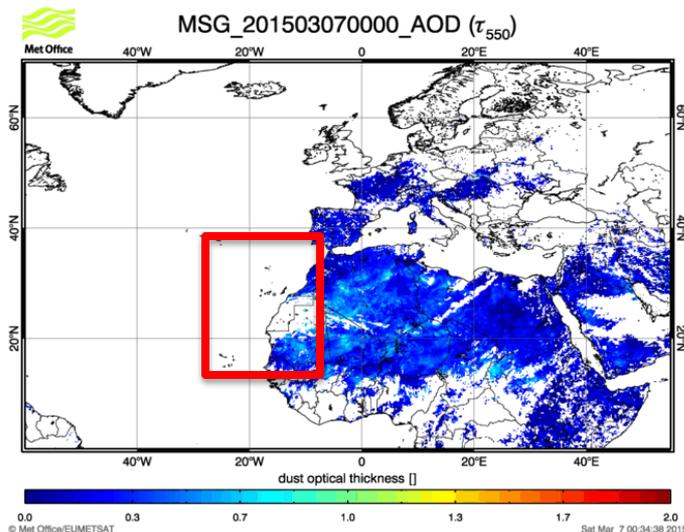
Barcelona Dust Forecast Center
 NMMB/BSC-Dust Res:0.1°x0.1° Dust AOD
 Run: 12h 07 MAR 2015 Valid: 12h 07 MAR 2015 (H+00)



OBSERVATIONS



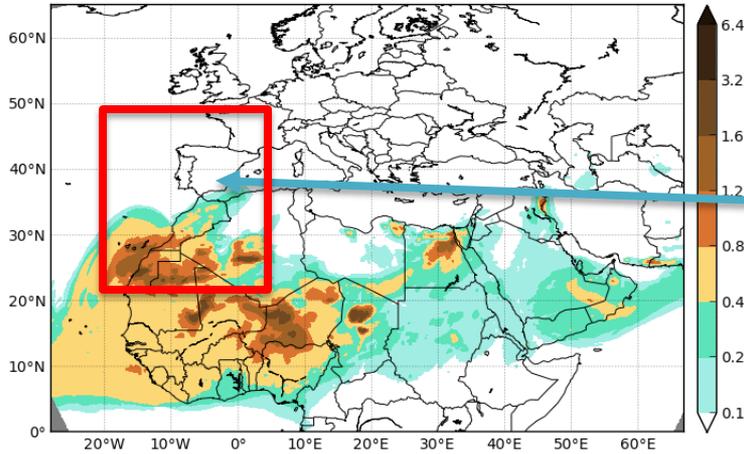
MODIS composite 8th March
 from EOSDIS World Viewer



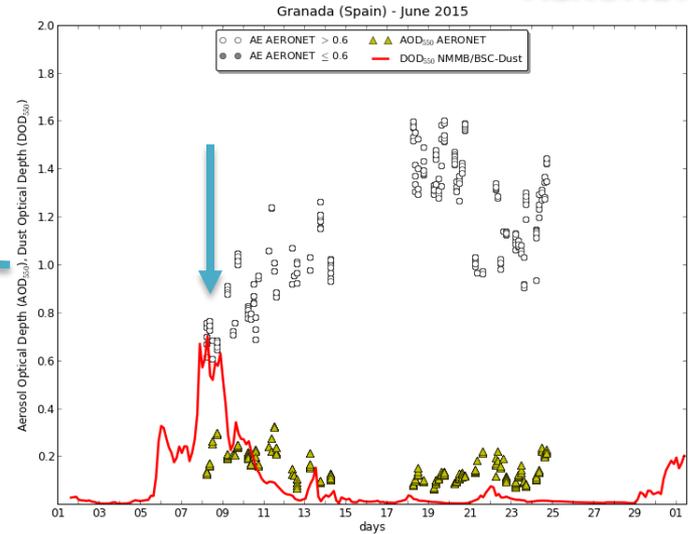
Europe dust event June 2015

MODEL

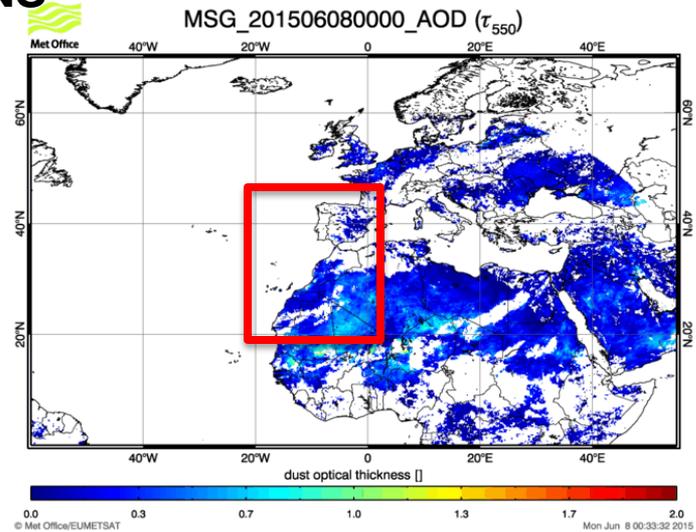
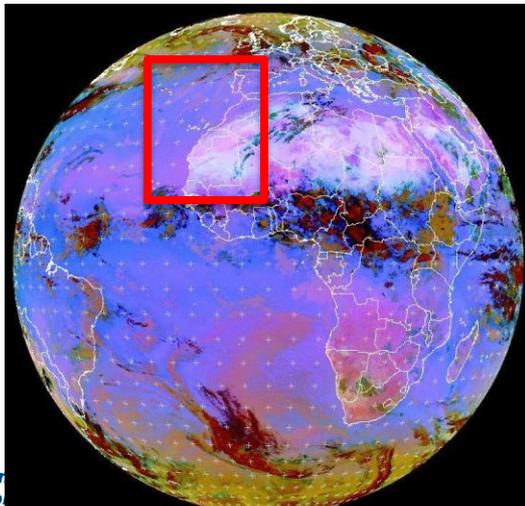
Barcelona Dust Forecast Center
 NMMB/BSC-Dust Res:0.1°x0.1° Dust AOD
 Run: 12h 11 MAY 2015 Valid: 12h 11 MAY 2015 (H+00)



— Model
 ▲ AERONET Obs.



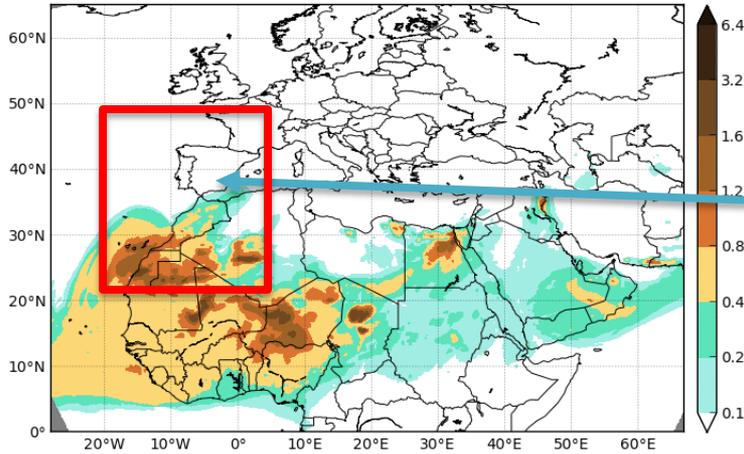
OBSERVATIONS



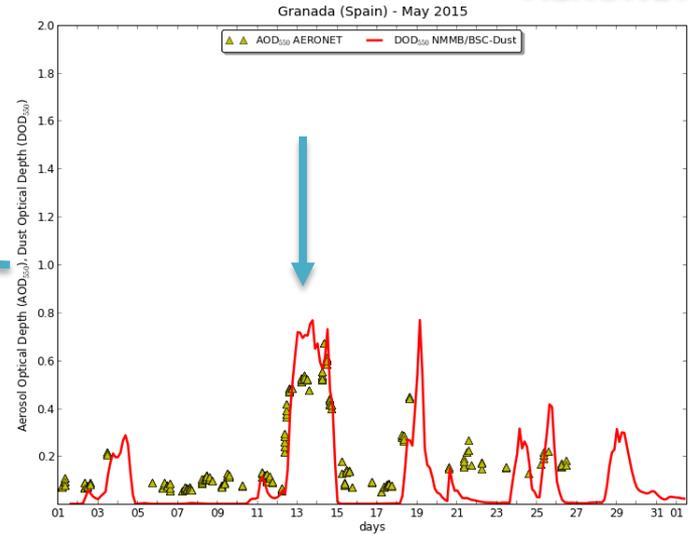
Europe dust event May 2015

MODEL

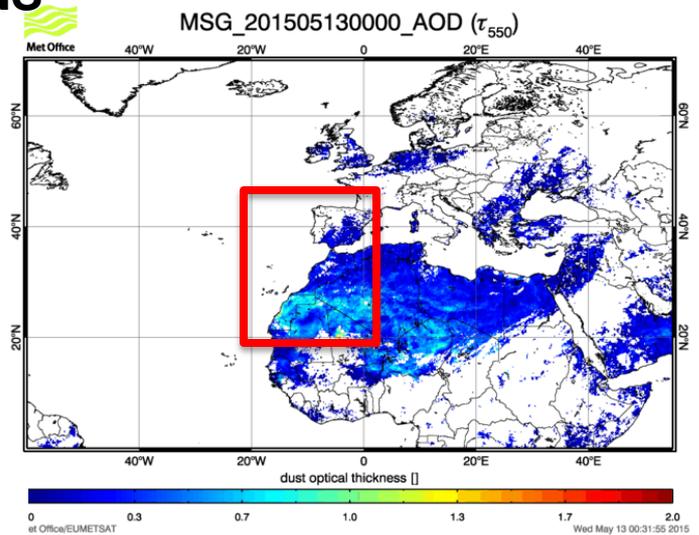
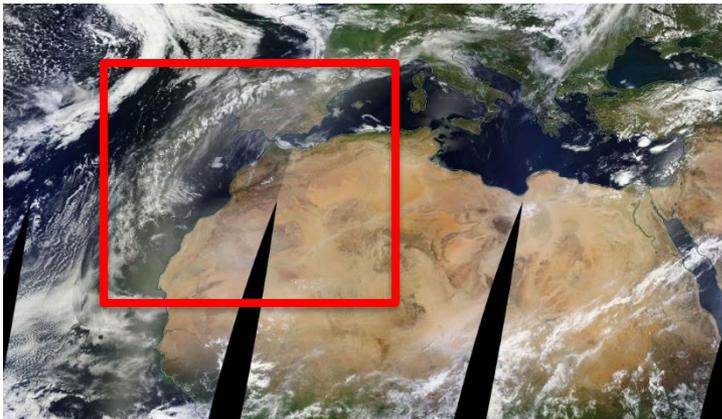
Barcelona Dust Forecast Center
 NMMB/BSC-Dust Res:0.1°x0.1° Dust AOD
 Run: 12h 11 MAY 2015 Valid: 12h 11 MAY 2015 (H+00)



— Model
 ▲ AERONET Obs.



OBSERVATIONS

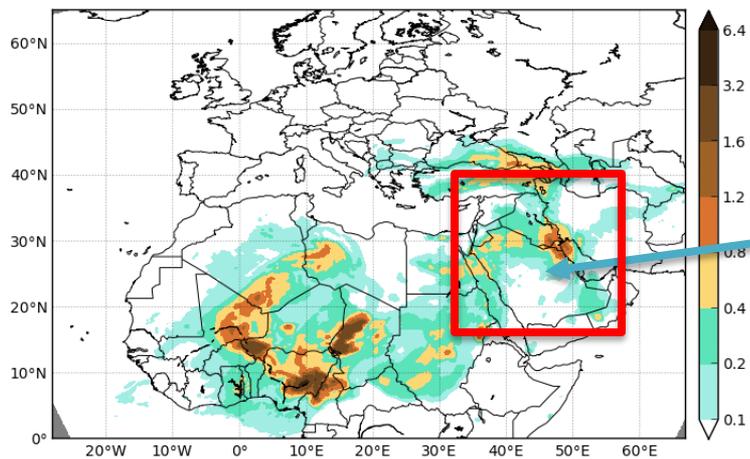


MODIS composite 13th May
 from EOSDIS World Viewer

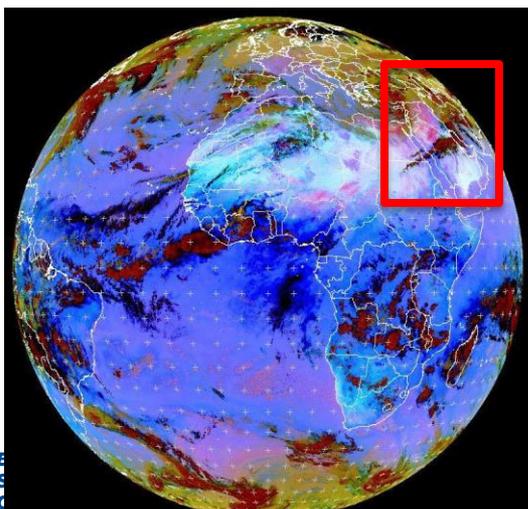
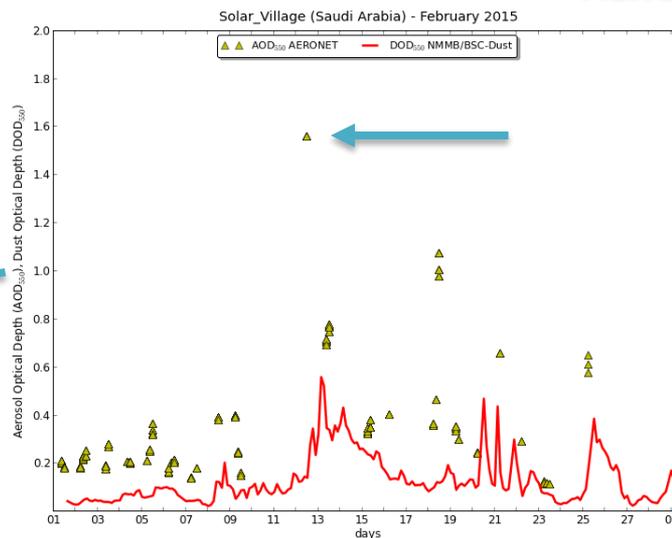
Arabian dust event February 2015

MODEL

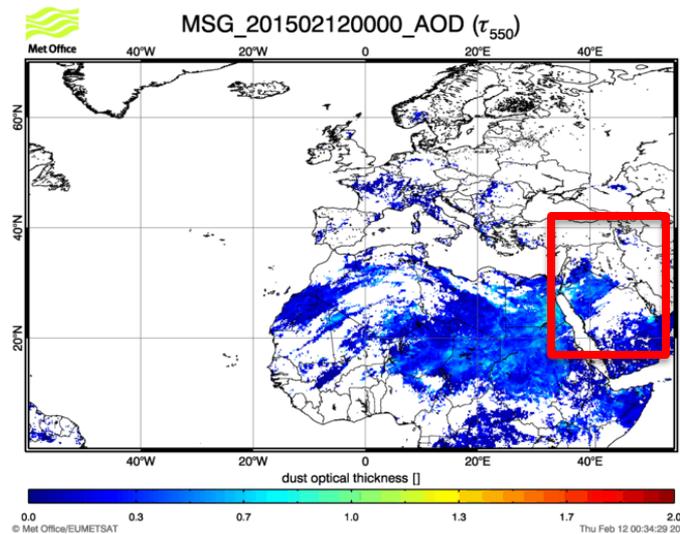
Barcelona Dust Forecast Center
 NMMB/BSC-Dust Res:0.1°x0.1° Dust AOD
 Run: 12h 12 FEB 2015 Valid: 12h 12 FEB 2015 (H+00)



— Model
 ▲ AERONET Obs.



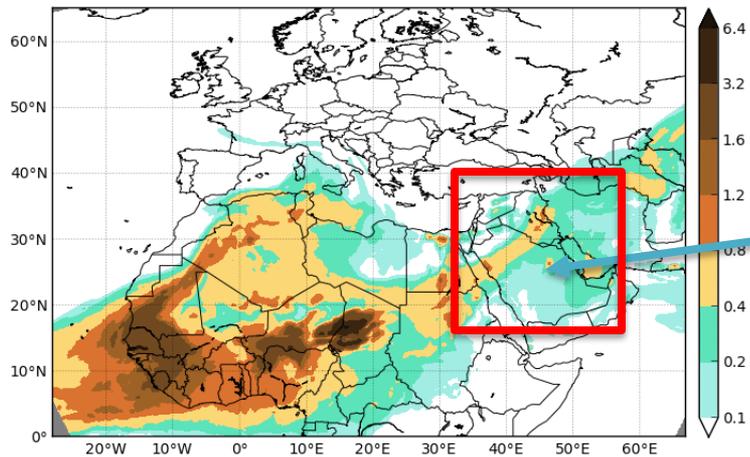
OBSERVATIONS



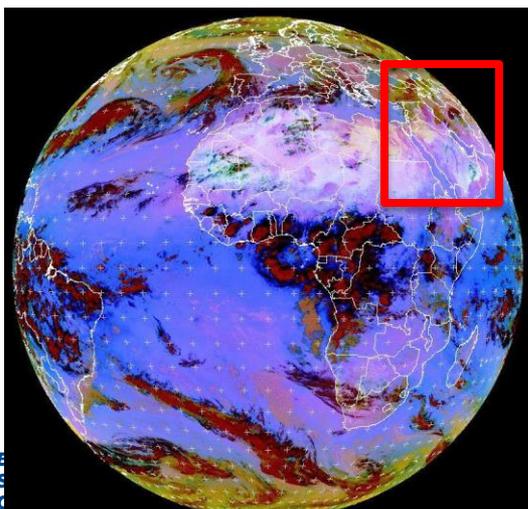
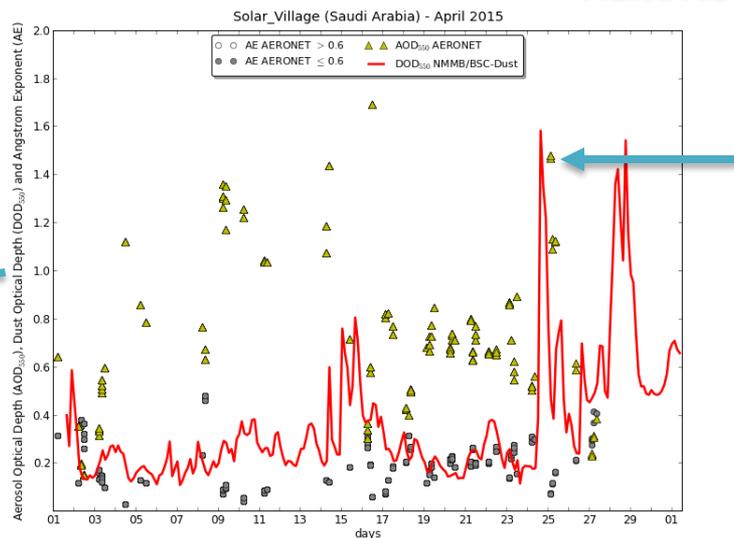
Arabian dust event Abril 2015

MODEL

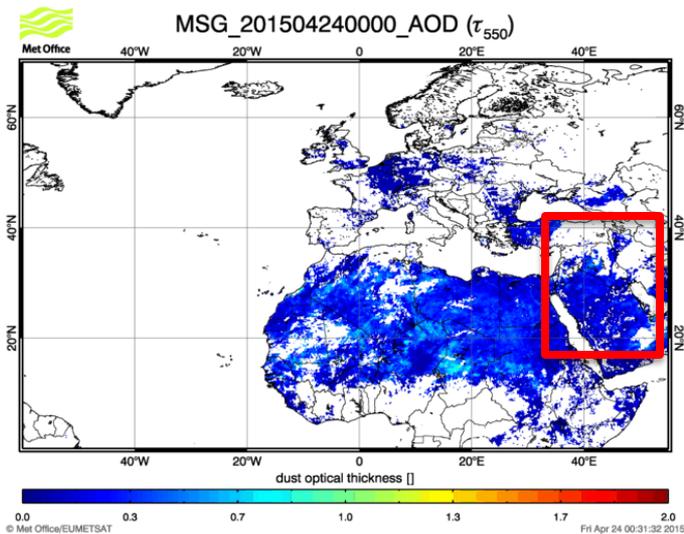
Barcelona Dust Forecast Center
 NMMB/BSC-Dust Res:0.1°x0.1° Dust AOD
 Run: 12h 23 APR 2015 Valid: 12h 23 APR 2015 (H+00)



— Model
 ▲ AERONET Obs.

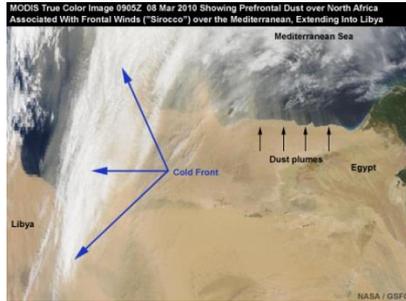


OBSERVATIONS

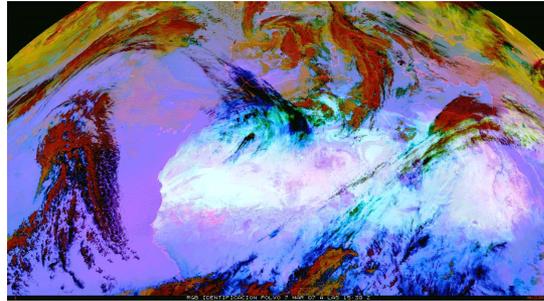


Dust cycle and associated processes: Types of dust storms

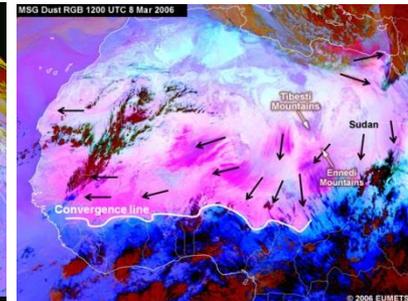
Synoptic dust storms (large scale weather systems) **Well captured by models.**



Pre-frontal winds

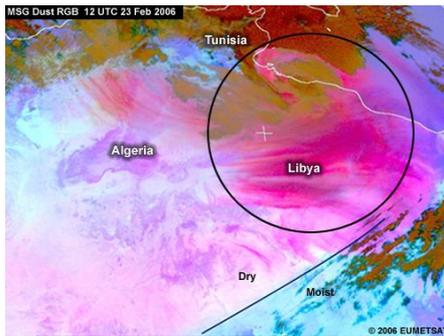


Post-frontal winds

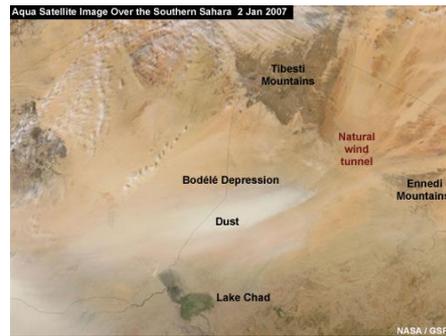


Large-scale trade winds

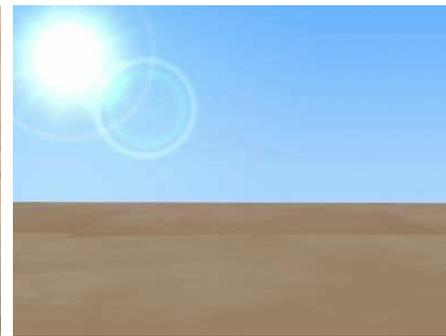
Mesoscale dust storms **Poorly captured by models. Some types improve in regional models.**



Downslope winds



Gap flow



Convection & Inversion downbursts



Haboobs



**Barcelona
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Centro Nacional de Supercomputación

**1st Africa/Middle-East Expert Meeting and Workshop on the health impact of airborne dust
Amman, Jordan, 2nd November 2015**

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