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The WMO SDS-WAS Regional Center Northern Africa, Middle East and Europe: Different approaches to dust forecast evaluation

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MILANO
EAC 2015
European Aerosol Conference

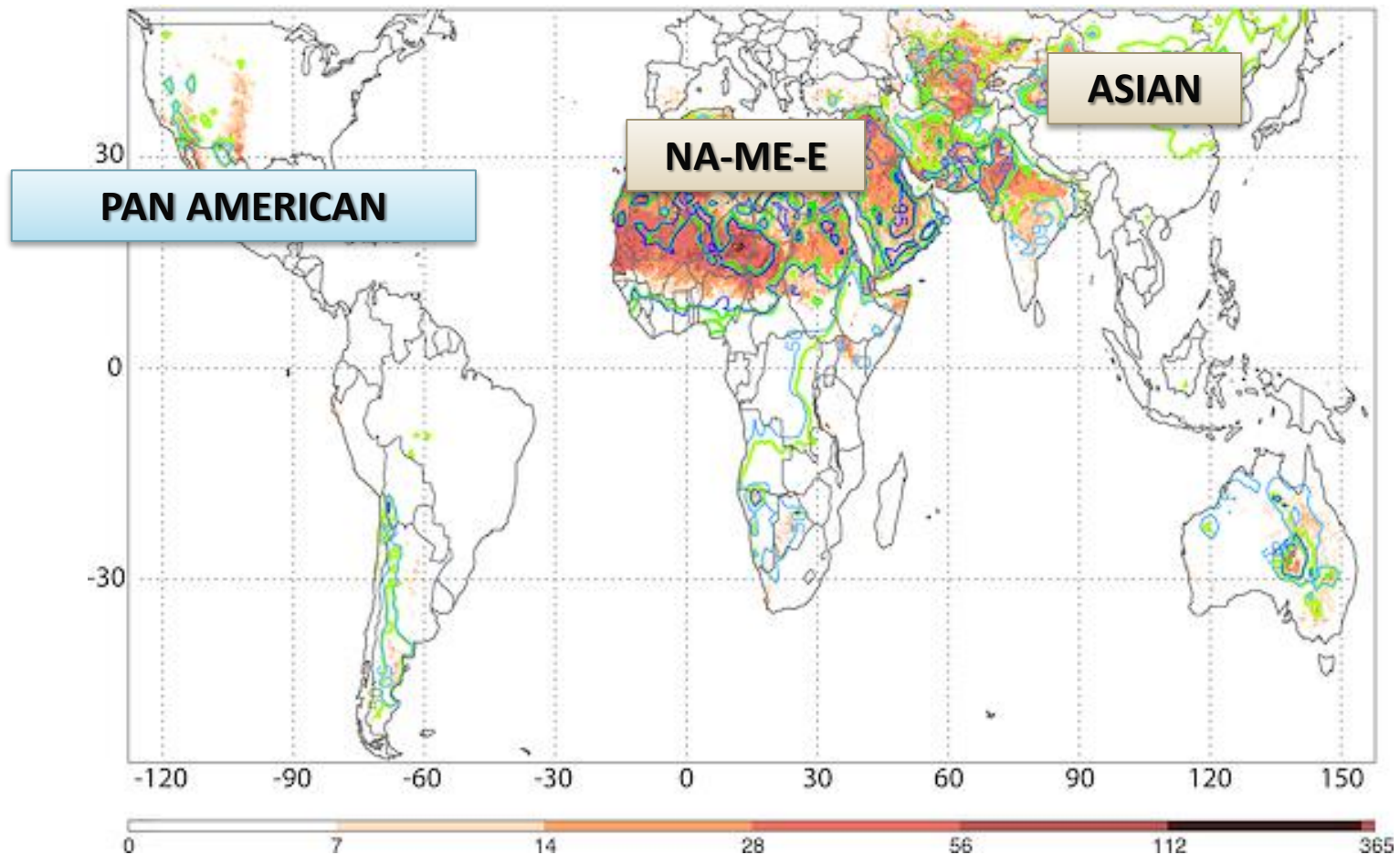
EAC 2015, Milano, Italy, 6-11 September, 2015

The screenshot shows the WMO website interface. At the top, there are navigation links: Print, Save as PDF, Text-only version, Send by e-mail, and Bookmark. Below these are language options: عربي, 中文, Français, Русский, Español, and Other languages. The main header features the WMO logo and the text "World Meteorological Organization Weather • Climate • Water". A secondary navigation bar includes "HOME" and "CONTACT US". A left sidebar menu lists various sections: About us, Governance, Members, Media centre, Programmes, GFCS, Meetings, Publications, Library, Learning, Meteoterm, Partnership, Themes, Vacancies, Visitors' info, and Youth corner. Below the menu is a search bar. The main content area is titled "World Weather" and "WWRP > SDS >". It features a large heading "WMO Sand and Dust and Assessment (SD)" and a sub-heading "The SDS-WAS programme at WMO". The text describes the program's establishment in 2007 to improve capabilities for more reliable sand products from atmospheric dust models in areas of societal benefit. It mentions that more than 15 organizations currently provide data from various regions and that the program integrates research and operational users. It also notes the establishment of regional nodes, specifically the Europe Node (hosted by Spain) and the Asia Node, with the goal of achieving comprehensive, coordinated capabilities of sand and dust storms in order to increase the understanding of the capabilities. At the bottom of the content area, there is a link for "Scientific background and modeling of sand" and a yellow box with the text "SDS-WAS Science and Information".

OBJECTIVES:

- Identify and improve products to monitor and predict atmospheric dust by working with research and operational organizations, as well as with users
- Facilitate user access to information
- Strengthen the capacity of countries to use the observations, analysis and predictions provided by the WMO SDS-WAS project

SDS-WAS Regional Centers



Annual mean frequency distribution of M-DB2 (2003–2009) DOD > 0.2 (red), TOMS (1980–1991) aerosol index ≥ 0.5 (blue), and OMI (2004–2006) aerosol index ≥ 0.5 (green). The isocontours of TOMS and OMI have been removed over oceans for clarity.

SDS-WAS: Asian RC (<http://www.sds.cma.gov.cn>)

WMO Sand and Dust Storm Warning Advisory and Assessment System(WMO SDS-WAS)
ASIA/CENTRAL PACIFIC REGIONAL CENTRE

Home | Forecast | Observation | Model InterComparison | News & Event | Publications | About us

FORECAST

Concentration
Movies of surface dust concentration distribution over Asia in 3 hours interval for 3 days forecast from the model CUACE/Dust.

CUACE/DUST OF CMA [see more>>](#) [MORE](#)

MASINGAR OF JMA [see more>>](#) [MORE](#)

ADAM OF KMA [see more>>](#) [MORE](#)

NEWS & EVENT

- >>Severe Solar Blast Affects China's Communication
- >>Science Steering Committee
- >>Workshop on the Implementation of the WMO SDS-WAS Asia Node (28-30 October 2009, Seoul, Korea)
- >>Workshop on the Implementation of the WMO SDS-WAS Asia Node

OBSERVATION

PM10

CMA | JMA | KMA | Other

AOD

CMA | JMA | KMA | Other

Satellite Observation

CMA | JMA | KMA | Other

MODEL COMPARISON

Model InterComparison
To promote the SDS forecast ability and to evaluate SDS forecast models representation in Asia Regional Center, one of the most important activities is model inter-comparison. At present there are three operational forecast models CUACE/Dust...

LOGIN

username
password
checking
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SDS COLOR INDEX

No SDS
Suspended dust
Blowing sand
Sand And Dust Storm
Severe SDS
Extreme Severe SDS

HOT LINKS

- >> cma
- >> wmo sds was
- >> ca was
- >> cans
- >> name regional center

FORECAST DATA SHARING

Download Forecast Data from

The Center is managed by a consortium of AEMET and the Barcelona Supercomputing Center (BSC-CNS)



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**Barcelona
Supercomputing
Center**

Centro Nacional de Supercomputación

Nexus II Building. Barcelona



MareNostrum supercomputer



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 header with the WMO logo and the center's name. Below the header is a navigation menu with tabs for HOME, ABOUT US, and FORECAST & PRODUCTS. The FORECAST & PRODUCTS tab is active, displaying a list of services: DUST FORECASTS, DUST OBSERVATIONS, GUIDANCE FOR FORECASTERS, TIME-AVERAGED VALUATION, FORECAST EVALUATION, REANALYSIS, and DATA POLICY. A sidebar on the left contains links to Home, About us, Forecast & Products, Projects & Research, Materials, News, Events, and Public Newsletter, along with a search bar and a 'Latest News' section. The main content area shows a 'Multimodel' section with a map of the region and a time-series plot of dust concentration.

FORECAST AND PRODUCTS

- Data exchange
- Joint visualization
- Common forecast evaluation
- Generation of multi-model products
- Calculation of monthly evaluation metrics
- New sources of data for model evaluation
- Sharing model output data files
- Time-averaged products

SDS-WAS: Dust Forecasts

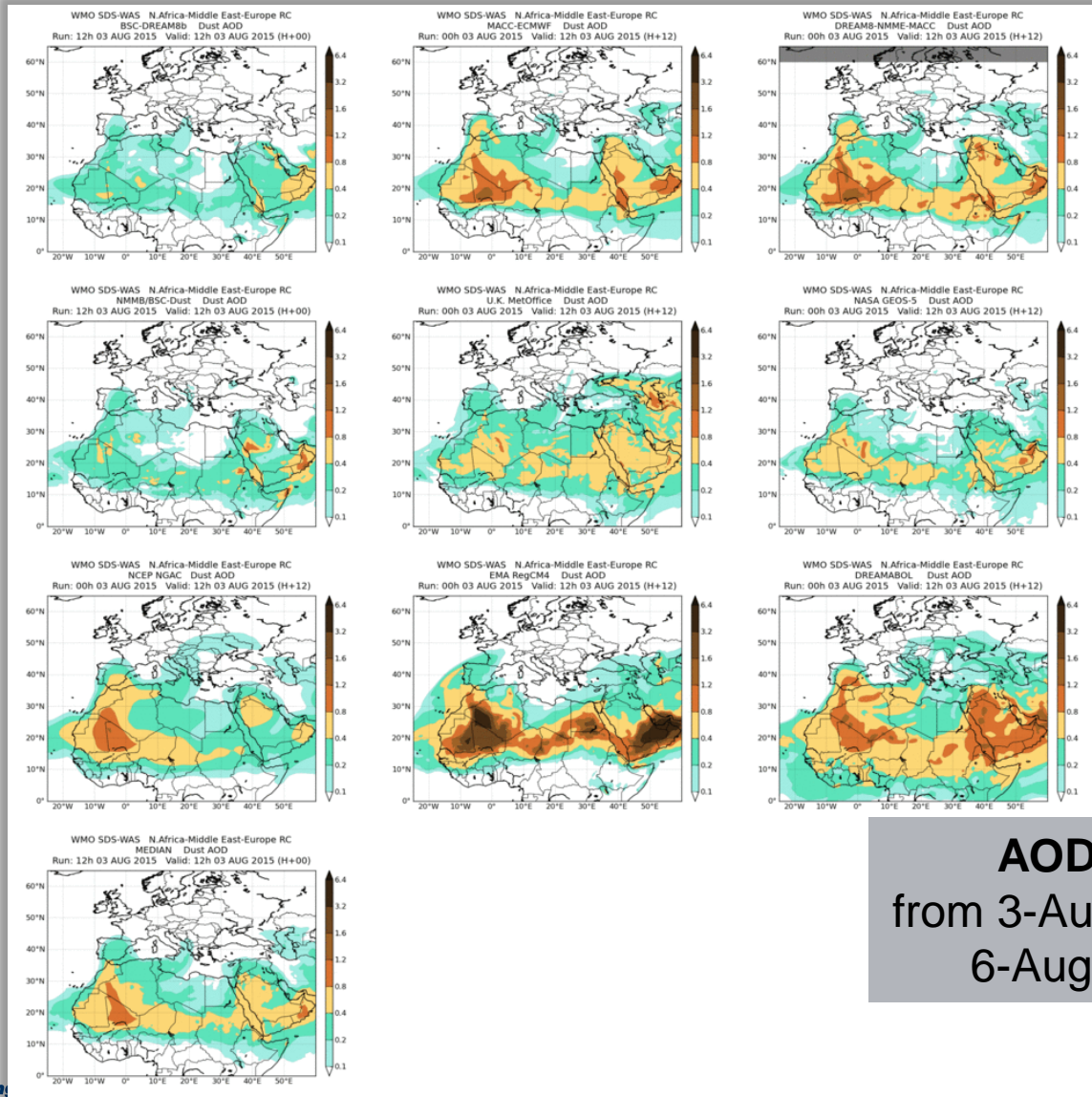
Dust prediction models provide 72 hours (at 3-hourly basis) of dust forecast (AOD at 550nm and surface concentration) covering the NAMEE region.



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

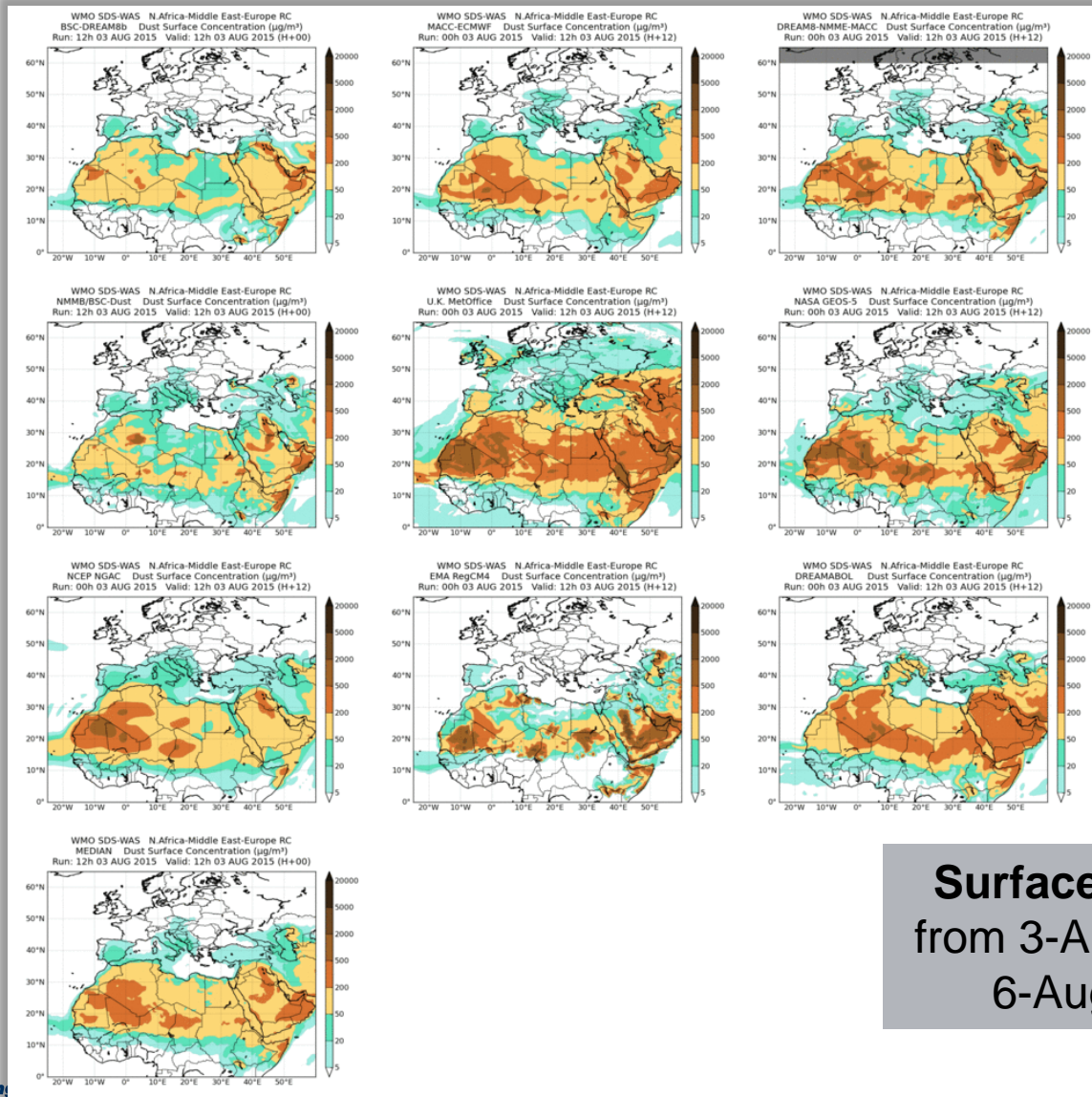
Numerical dust forecast are distributed in NetCDF format

SDS-WAS: AOD joint visualization



AOD at 550nm
from 3-Aug-2015 12:00 to
6-Aug-2015 00:00

SDS-WAS: Surface concentration joint visualization

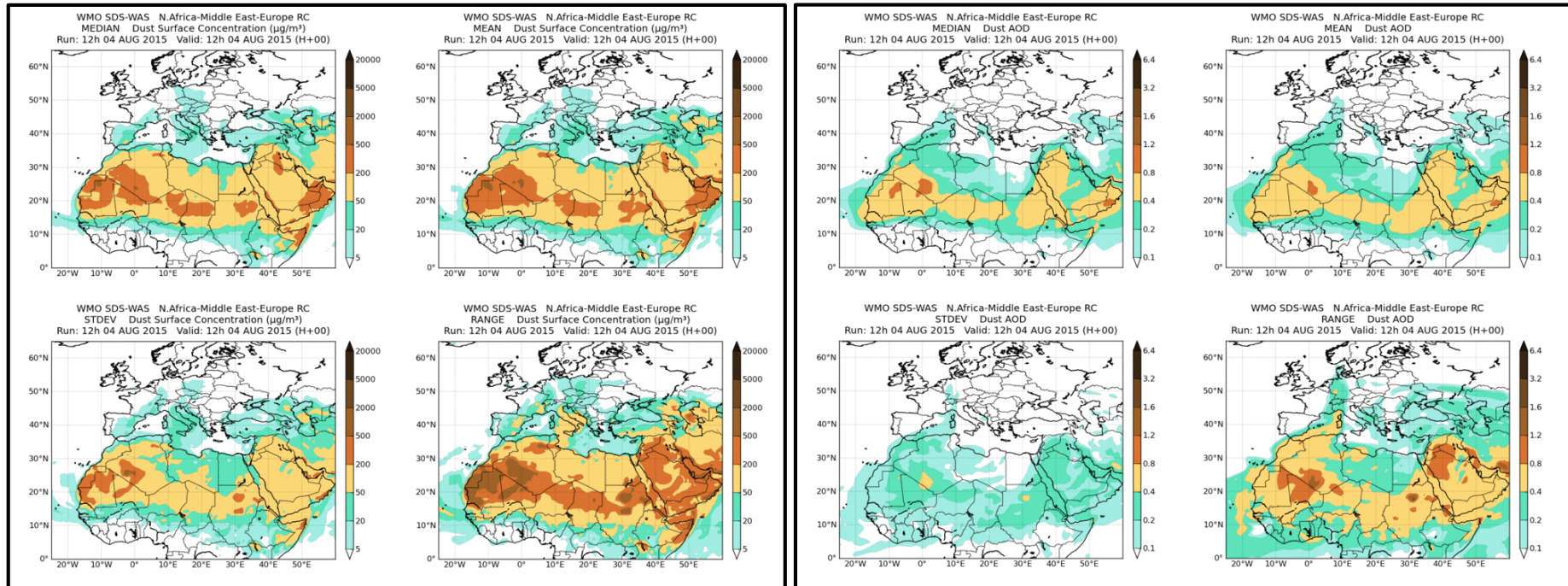


Surface concentration
from 3-Aug-2015 12:00 to
6-Aug-2015 00:00

SDS-WAS: Generation of multi-model products

Surface concentration

AOD at 550nm



from 3-Aug-2015 12:00 to 6-Aug-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

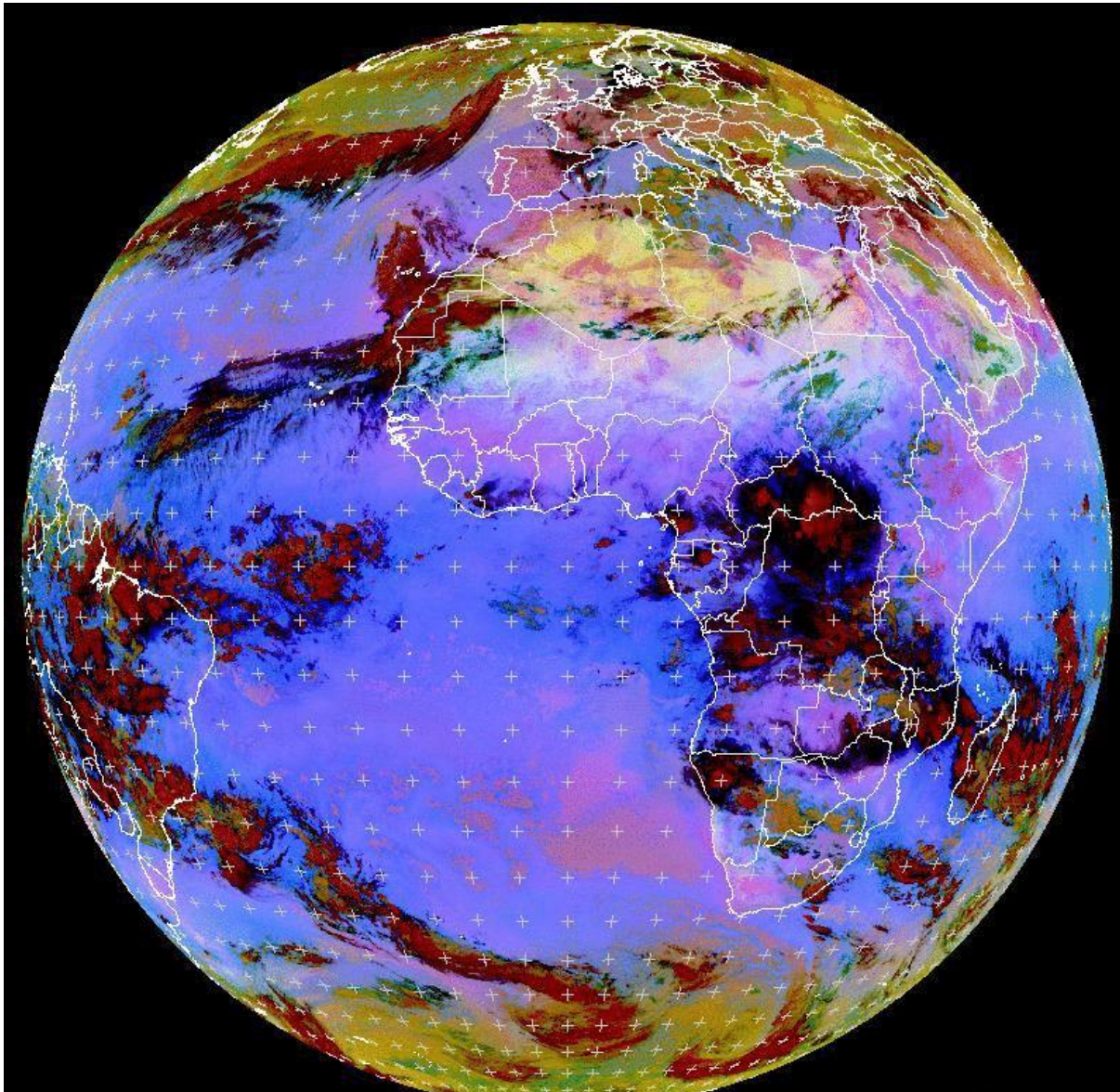
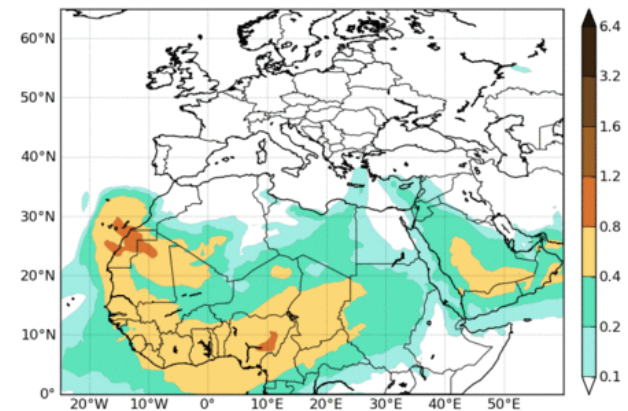
SPREAD: standard deviation – range of variation

SDS-WAS: NRT Evaluation using satellite aerosol products



7 March 2015


WMO SDS-WAS N.Africa-Middle East-Europe RC
MEDIAN Dust AOD
Run: 12h 07 MAR 2015 Valid: 12h 07 MAR 2015 (H+00)






MET10 RGB-Dust 2015-03-07 23:00 UTC



SDS-WAS: Forecast Evaluation

 **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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Home

You are here: Home

Northern Africa-Middle East-Europe (NA-ME-E) Regional Center
by Francesco Benincasa — last modified May 29, 2012 03:33 PM

Outstanding

- Automatic registration of new users temporarily suspended
- The book "Mineral Dust - A key player in the Earth system" has been released
- Dust forecasts available on the WMO Global Telecommunications System
- Updated information on SDS-WAS collaborative projects
- The Barcelona Dust Forecast Center has been presented

Subscribe to the Public Newsletter!

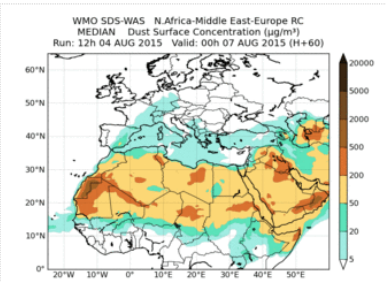
To be informed about our activities, news and events related to dust. Frequency is almost monthly.

Portal manual

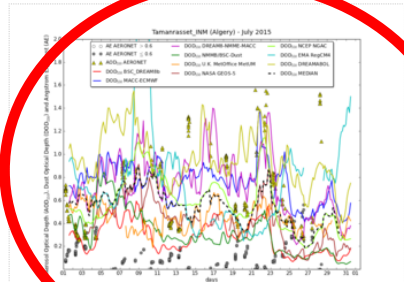
Please find a brief manual [here](#).

Dust forecasts

WMO SDS-WAS N.Africa-Middle East-Europe RC
MEDIAN Dust Surface Concentration ($\mu\text{g}/\text{m}^3$)
Run: 12h 04 AUG 2015 Valid: 00h 07 AUG 2015 (H+60)



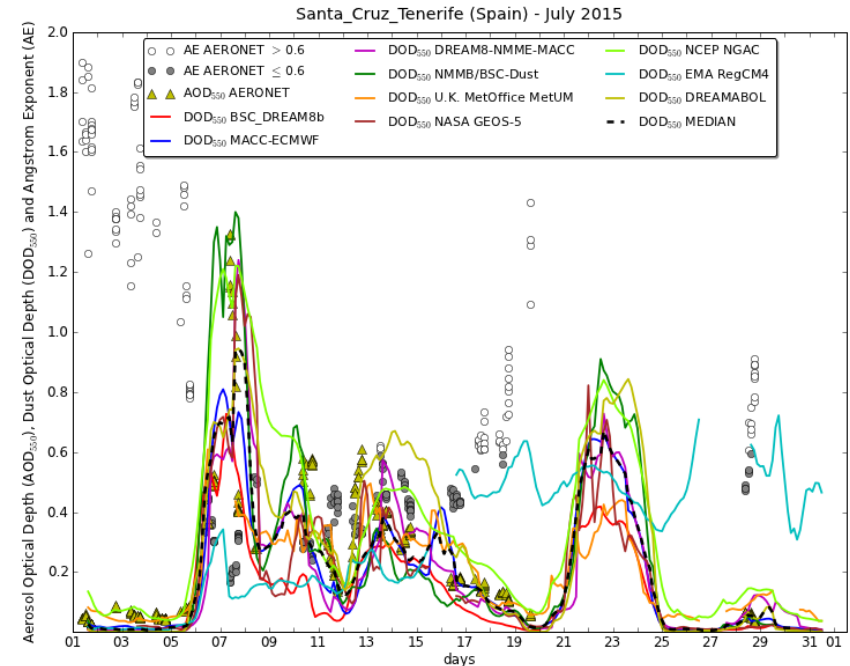
Tamanasset_NM (Algeria) - July 2015



Latest News

- Web portal down for maintenance
Jul 29, 2015
- Publication of SDS-WAS Technical Reports
Jul 21, 2015
- Presentations of the ICAP meeting on data assimilation
Jul 03, 2015

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	DREAM-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	DREAM-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

A set of evaluation metrics are selected:

- Bias
- RMSE
- correlation coefficient
- FGE

Calculations evaluation metrics are done for:

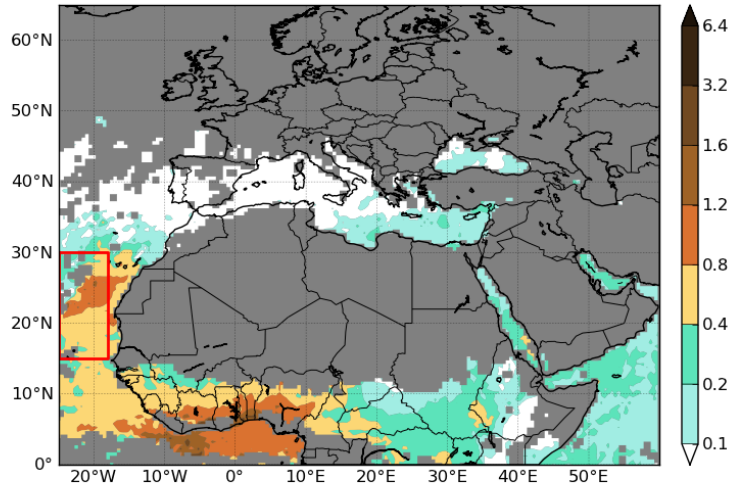
- monthly/seasonal/annual
- sites and regions



SDS-WAS: NRT Evaluation using MODIS



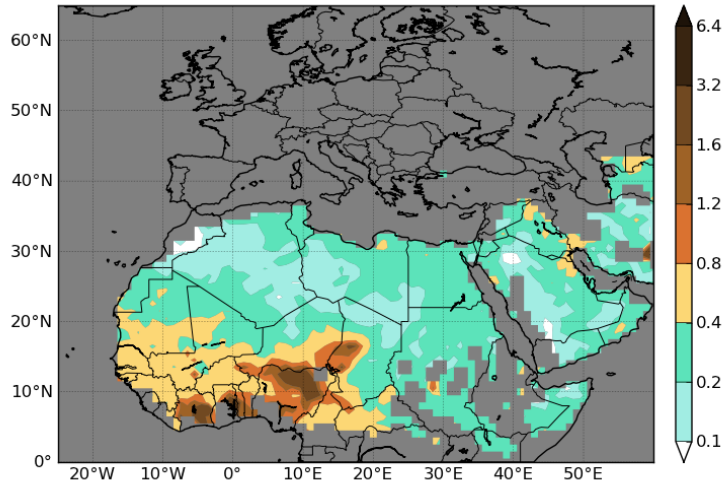
WMO SDS-WAS N.Africa-Middle East-Europe RC
MODIS AOD₅₅₀ - JAN 2015



	BIAS	ROOT MEAN SQUARE ERROR	CORRELATION COEFFICIENT	FRACTIONAL GROSS ERROR	NUMBER OF CASES
BSC_ DREAM8b	-0.47	0.62	0.66	1.19	2214
NMMB/BSC-Dust	-0.26	0.43	0.70	0.73	2214
NCEP NGAC	0.01	0.27	0.84	0.42	2214
EMA RegCM4	0.93	1.44	0.59	0.85	1733
DREAMABOL	-0.51	0.66	0.65	1.12	1926



WMO SDS-WAS N.Africa-Middle East-Europe RC
MODIS DEEPLUE AOD₅₅₀ - JAN 2015



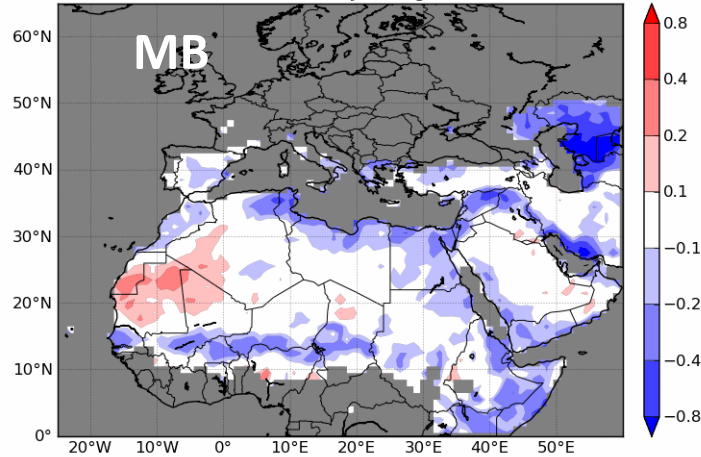
	BIAS	ROOT MEAN SQUARE ERROR	CORRELATION COEFFICIENT	FRACTIONAL GROSS ERROR	NUMBER OF CASES
BSC_ DREAM8b	-0.21	0.38	0.42	0.96	14567
NMMB/BSC-Dust	-0.12	0.33	0.70	1.07	14567
NCEP NGAC	-0.13	0.31	0.63	0.67	14567
EMA RegCM4	0.28	0.60	0.44	0.82	14567
DREAMABOL	-0.22	0.41	0.38	0.99	13401

SDS-WAS: NRT Evaluation using MODIS Deep Blue

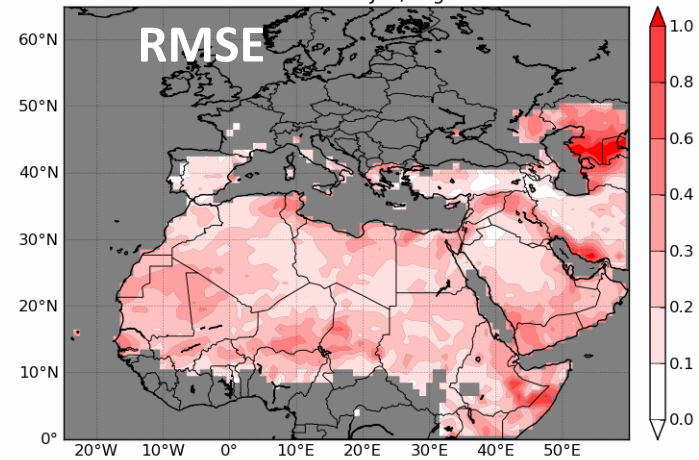


Multimodel MEDIAN

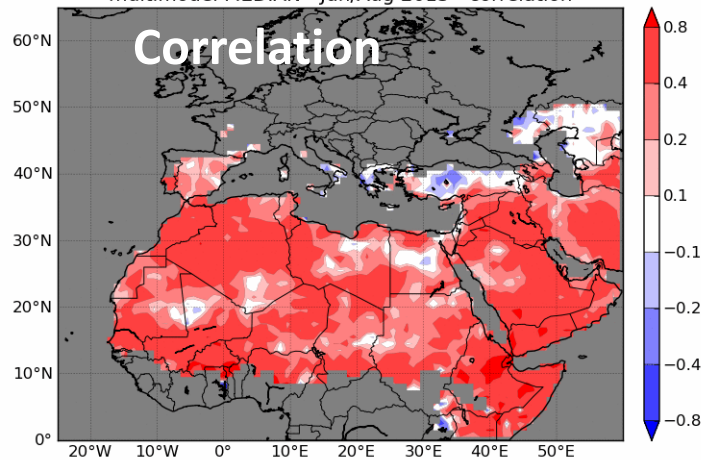
WMO SDS-WAS N.Africa-Middle East-Europe RC
multimodel MEDIAN - Jun/Aug 2013 - bias



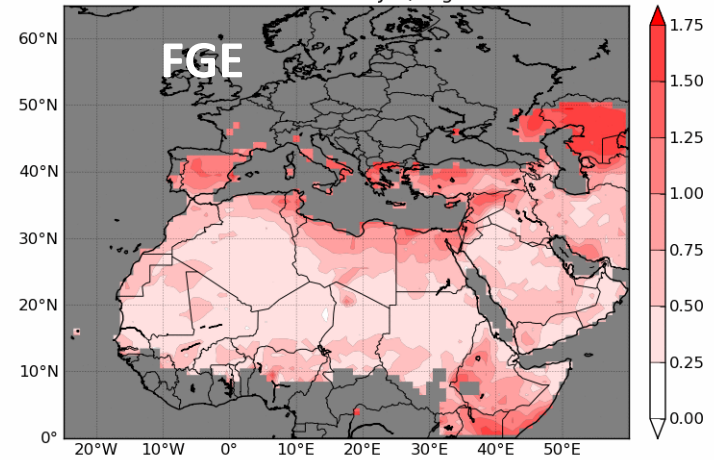
WMO SDS-WAS N.Africa-Middle East-Europe RC
multimodel MEDIAN - Jun/Aug - r.m.s.e.



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



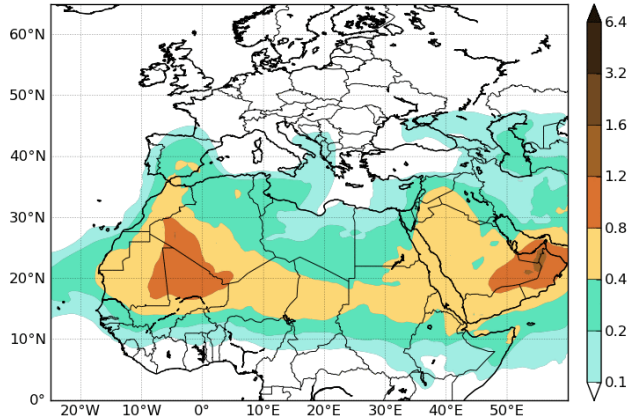
WMO SDS-WAS N.Africa-Middle East-Europe RC
multimodel MEDIAN - Jun/Aug - F.G.E.



SDS-WAS: Comparison with ICAP-MME model

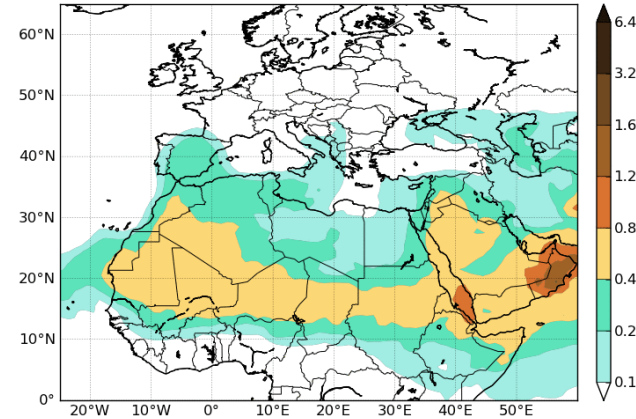
SDS-WAS

WMO SDS-WAS N.Africa-Middle East-Europe RC
MEAN Dust AOD
Run: 12h 03 AUG 2015 Valid: 12h 03 AUG 2015 (H+00)

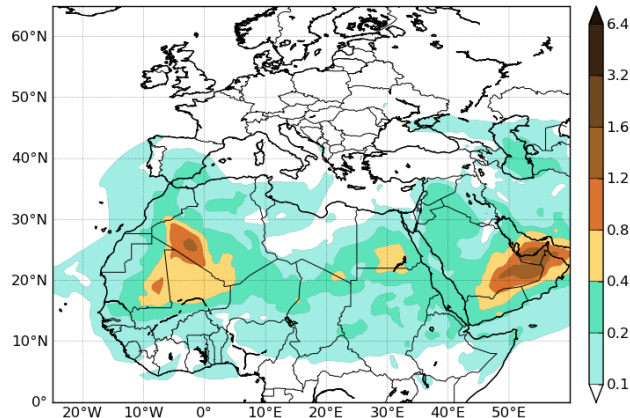


ICAP-MME

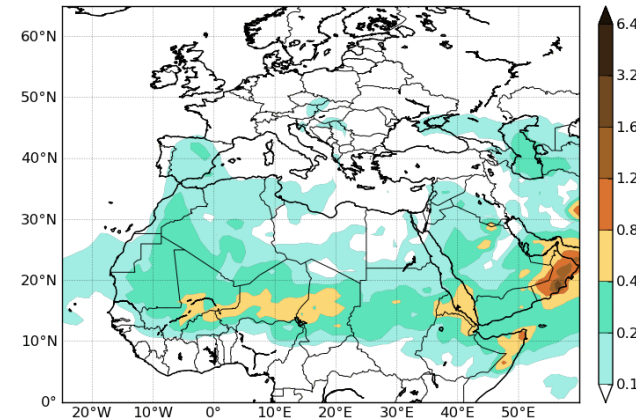
ICAP Multi Model Ensemble
MEAN Dust AOD
Run: 00h 03 AUG 2015 Valid: 12h 03 AUG 2015 (H+12)



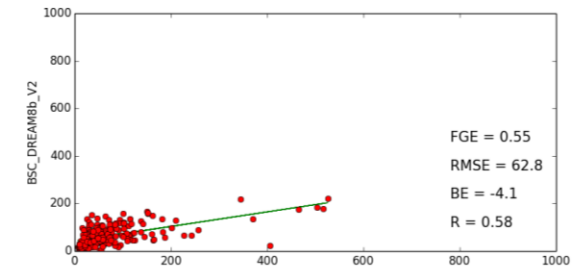
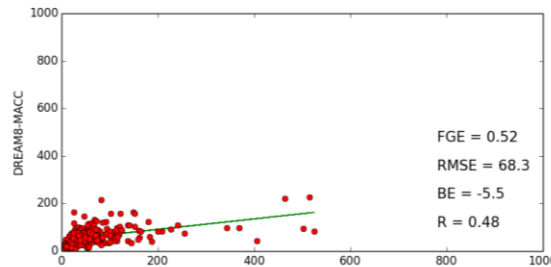
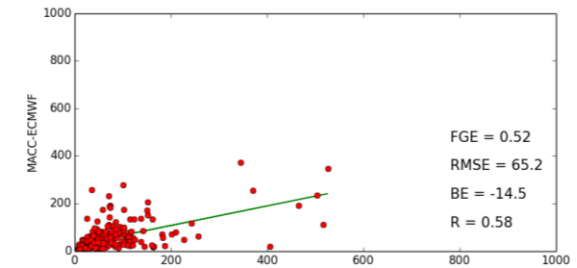
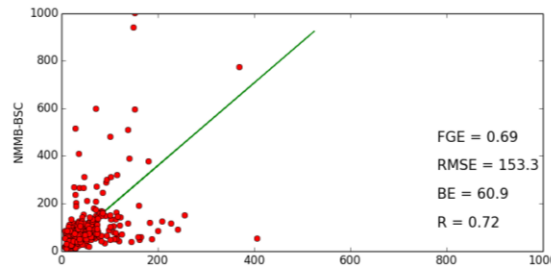
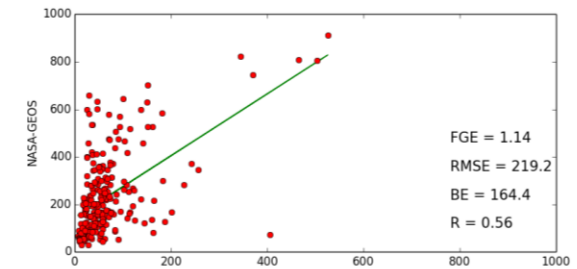
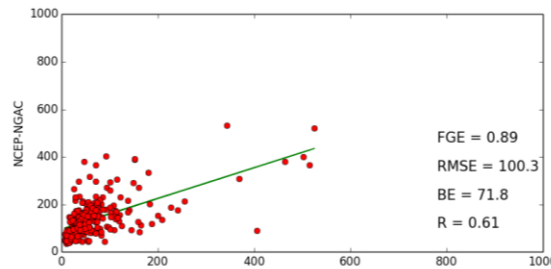
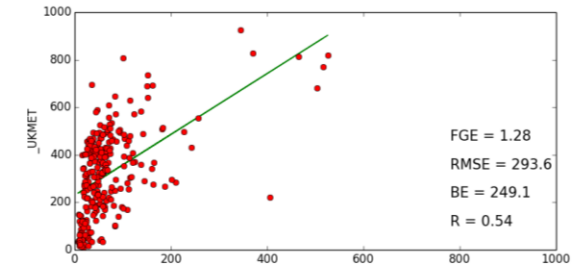
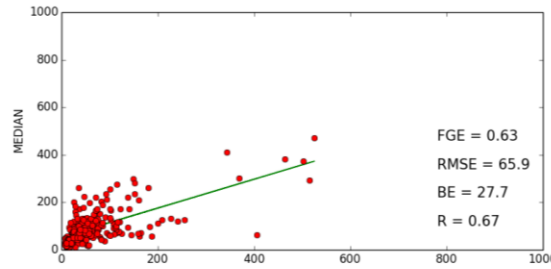
WMO SDS-WAS N.Africa-Middle East-Europe RC
STDEV Dust AOD
Run: 12h 03 AUG 2015 Valid: 12h 03 AUG 2015 (H+00)



ICAP Multi Model Ensemble
STDEV Dust AOD
Run: 00h 03 AUG 2015 Valid: 12h 03 AUG 2015 (H+12)



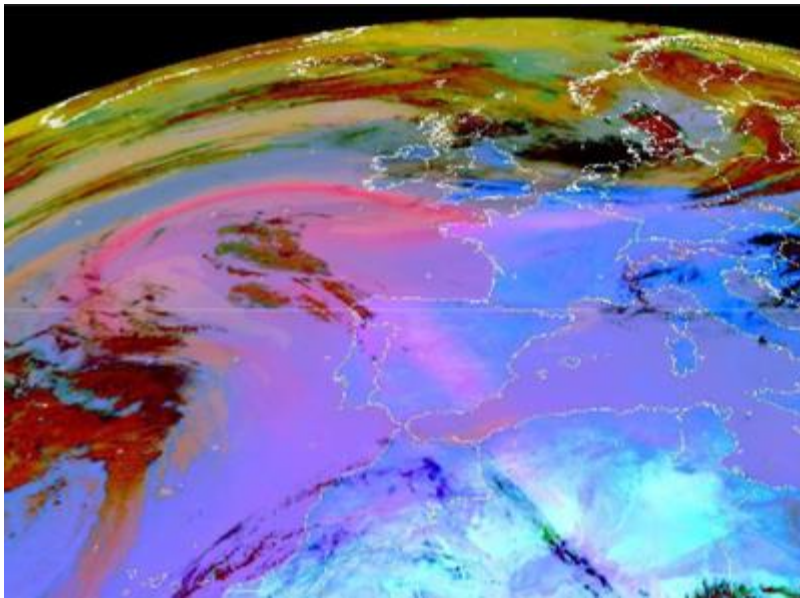
SDS-WAS: Sahelian evaluation using PM10 from AMMA



SDS-WAS: Model intercomparison

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 top navigation bar with links for Home, About Us, Forecast & Products, Projects & Research, Materials, News, Events, and Contact Us. A dropdown menu is open under 'Projects & Research', listing options such as MACC Project, Model Intercomparison, West Asia Regional Program, ICAP, Diapason, and SDS-WAS Studies. The main content area includes a 'Home' section with a breadcrumb trail, a 'Northern Africa-Middle East-Europe (NA-ME-E) Regional Center' header, and a list of news items. A 'Dust forecasts' section contains a map of the region and a line graph for 'Tinnarasert, NM (Algeria) - July 2015'. A 'Latest News' section lists recent updates, and a 'Public Newsletter' subscription form is also present.

SDS-WAS: Model intercomparison April 2011



*MSG/SEVIRI RGB product 7 April
Courtesy of EUMETSAT*

- The selected dust event corresponds to the one which occurred between the 5th and 11th of April of 2011.
- Participating models: BSC-DREAM8b, NMMB/BSC-Dust, ECMWF-MACC, UKMetOffice-UM and NMME-DREAM-MACC
- Comparison of each forecast (at 24, 48 and 72h) output to in-situ measurements of AOD (from AERONET), surface concentration (PM) and satellite retrieved AOD (MODIS, CALIPSO) and meteorology.

SDS-WAS: Lidar and models intercomparison



69 dust cases between Jan 2011 – Jun 2013



BSC-DREAM8b v2
NMMB-BSC/Dust



DREAM8-NMME-MACC



BOLCHEM

SDS-WAS: Study of a haboob in Iran



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.

In preparation. Contact: Slobodan Nickovic (nickovic@gmail.com)

Conclusions and ongoing activities

Conclusions

- Model validation activities (NRT and a posteriori) provide useful information for model developments → The comparison with multi-model products (as that from SDS-WAS NAMEE RC) provides additional information about the state-of-the-art of atmospheric models.
- At present, there is a lack of ground-based mineral dust observations over North Africa for an accurate model evaluation → Models are useful to understand dust observations as well as dust processes and their impacts.

Ongoing activities of the **SDS-WAS NAMEE RC** includes:

- Increased education and awareness to promote the information and forecasts that are publically and freely available.
- New sources of data for model evaluation (as **VISIBILITY** from METAR and SYNOP stations).

BARCELONA DUST FORECAST CENTER

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

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NEWSLETTER

In 2014, the First Specialized Center for Mineral Dust Prediction of WMO is created

NMMB/BSC-Dust selected to provide operational forecasts at high resolution (~10km) for NAMEE region

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HOME

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LATEST NEWS

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)

Dust forecast

Latest dust forecast for Northern Africa, Middle East and Europe

[Check it here](#)



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Centro Nacional de Supercomputación

Thank you!

Acknowledgements:

BSC is recognized as a Severo-Ochoa centre of excellence (SEV-2011-00067) of the Spanish Government. Simulations have been performed in the Marenostrum supercomputer. The authors thank AERONET, MODIS, U.K. Met Office MSG, MSG Eumetsat and EOSDIS World Viewer principal investigators and scientists for providing for establishing and maintaining data used in the present contribution.

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

MILANO

EAC 2015
European Aerosol Conference