World Meteorological Organization

GOBIERNO DE ESPAÑA
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO
AEMet Agencia Estatal de Meteorología

EXCELENCIA SEVERO OCHOA

BSC Barcelona Supercomputing Center
Centro Nacional de Supercomputación

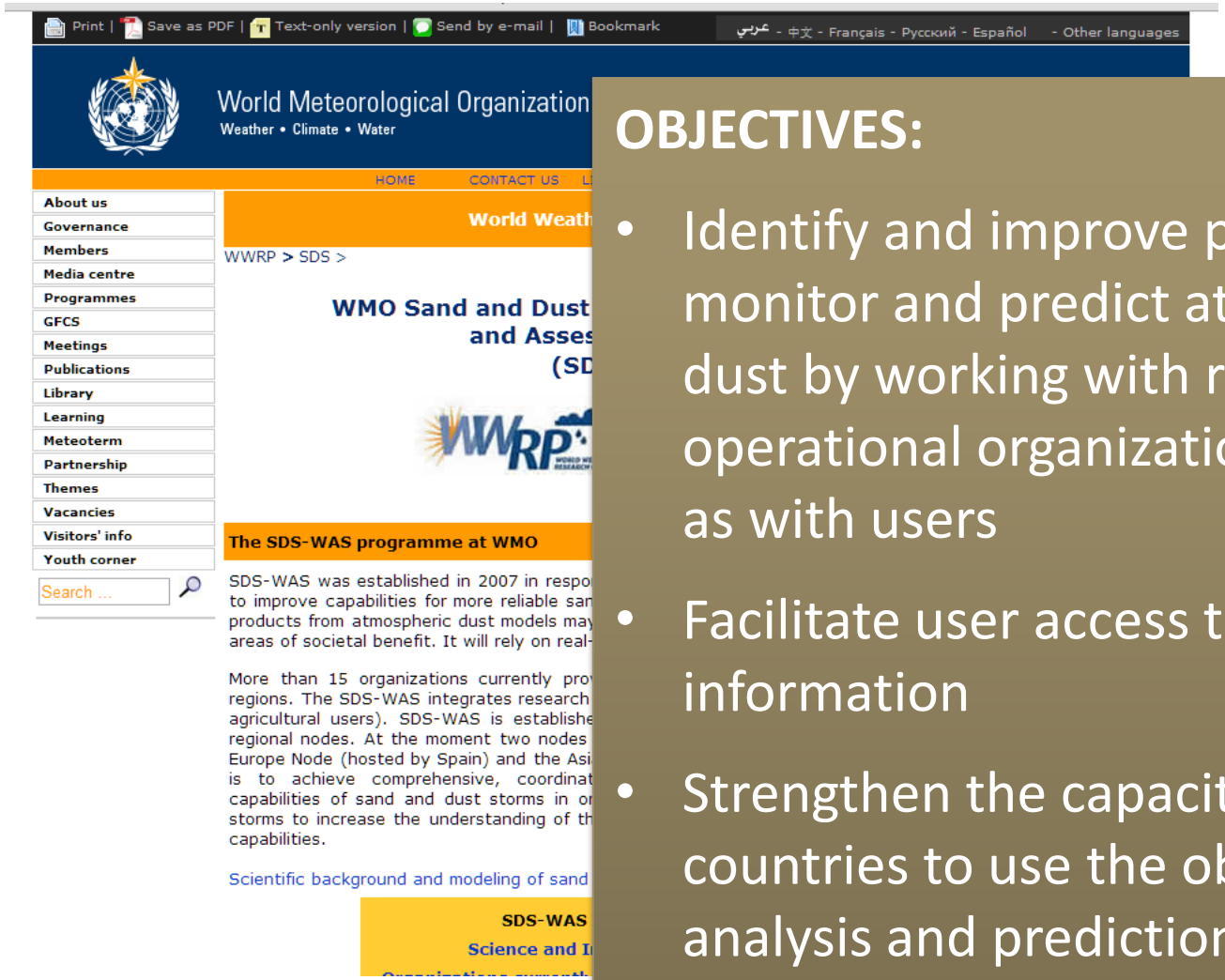
WMO SDS-WAS: TOWARDS CONTINUOUS EVALUATION OF DUST MODELS IN NORTHERN AFRICA

S. Basart[1], G. García-Castrillo[2], E. Terradellas[2] and E. Cuevas[3]

[1]Earth Sciences Department, BSC, Barcelona, Spain
[2]AEMET, Barcelona, Spain
[3]CIAI-AEMET, Tenerife, Spain

8th International Workshop on Sand/Duststorms and Associated Dustfall
Lisbon, Portugal, 2-4 May, 2016

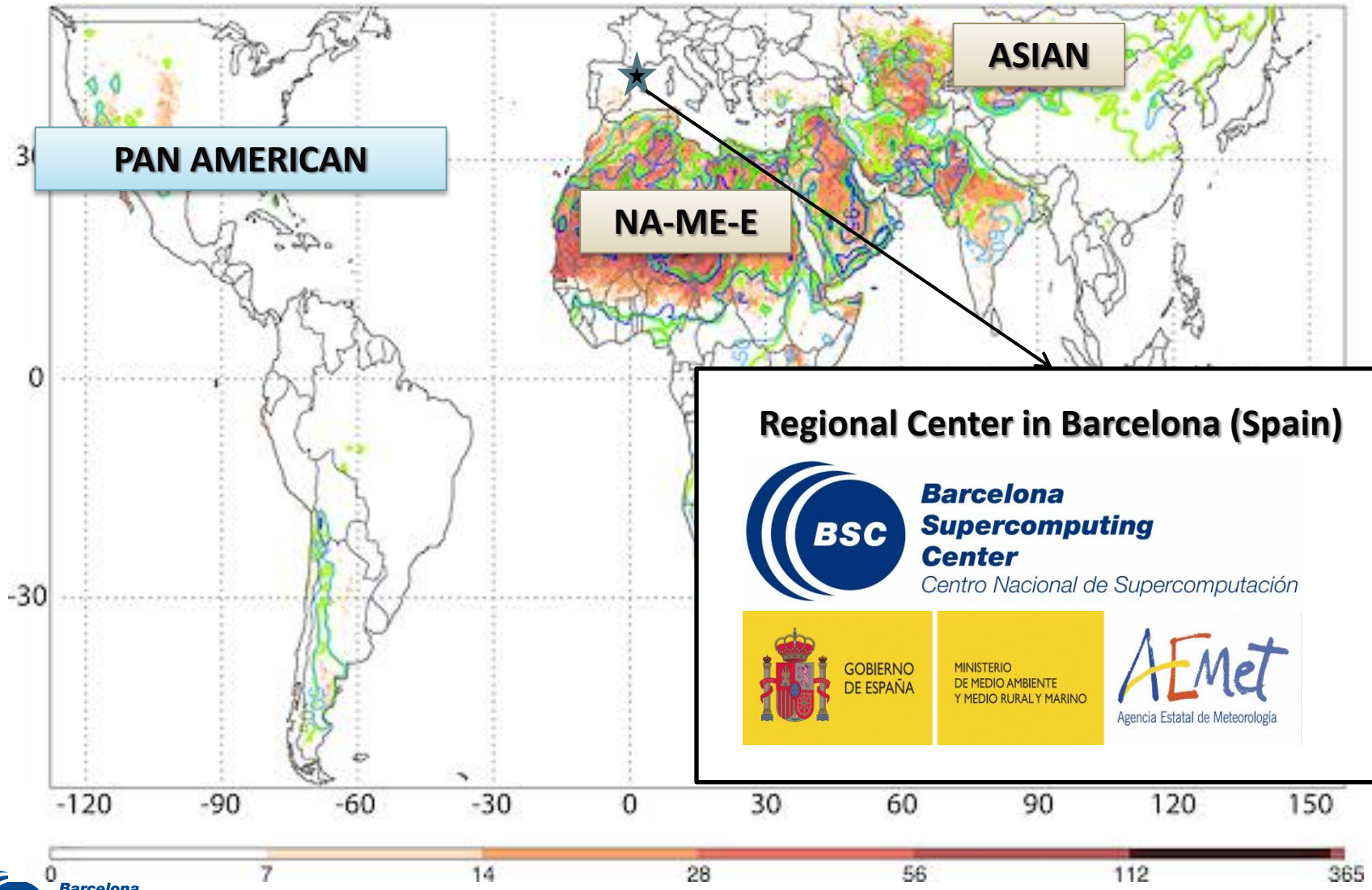
SDS-WAS (http://www.wmo.int/sdswas)



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



Regional Center in Barcelona (Spain)

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

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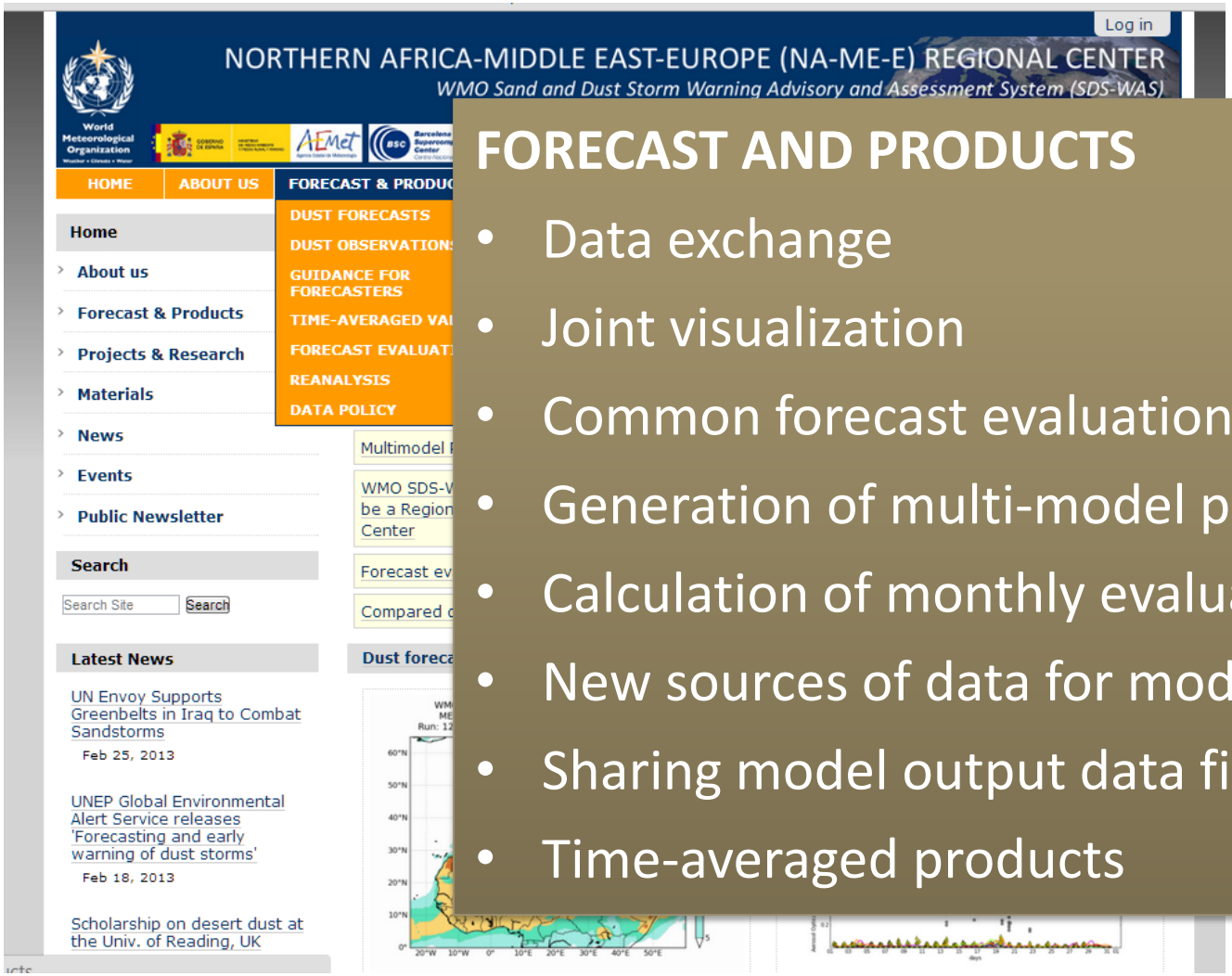
Extracted from Ginoux et al. (2012, Rev. Geophys.)

SDS-WAS NA-ME-E RC (http://sds-was.aemet.es)



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

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

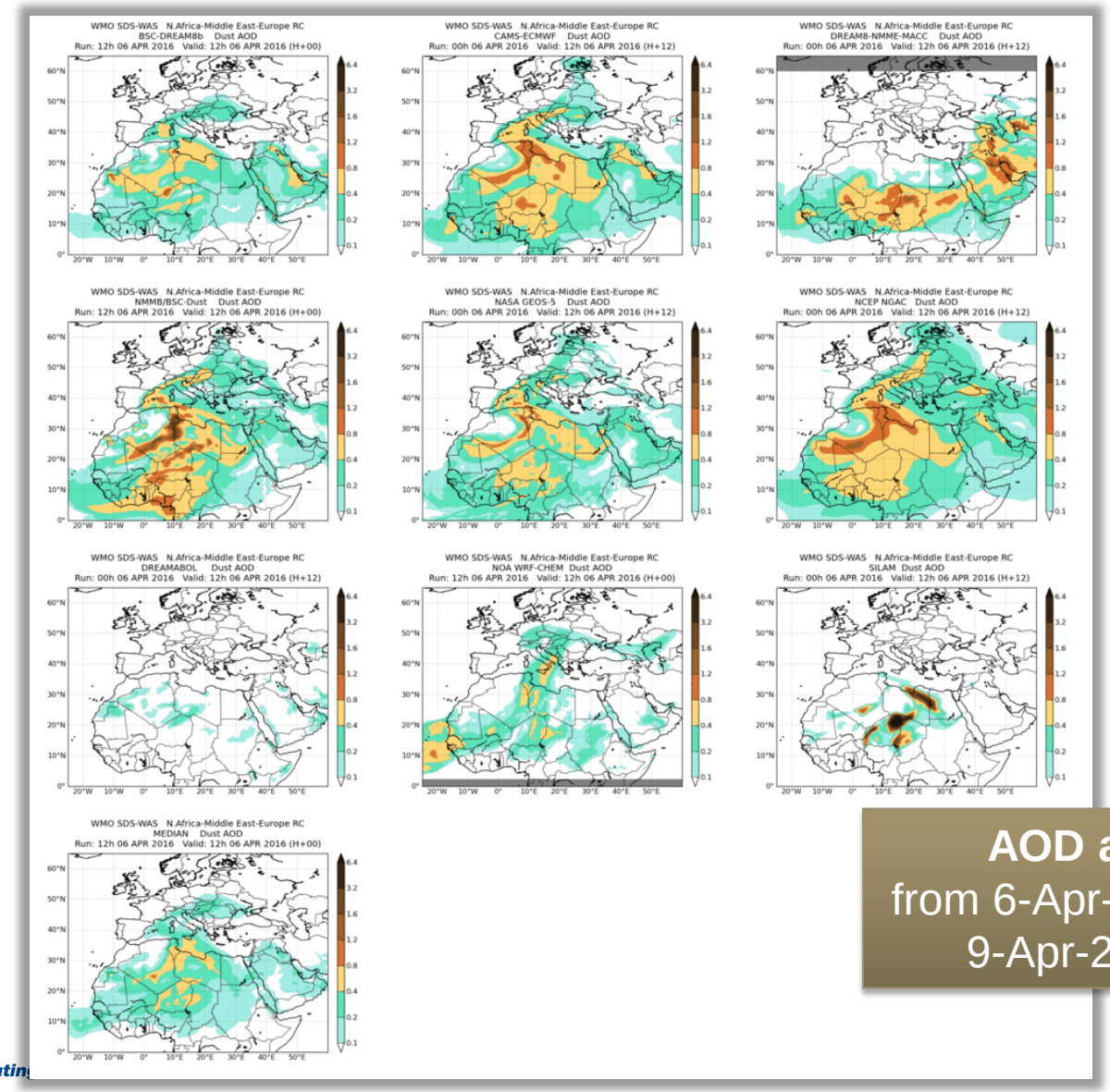
sdswas@aemet.es

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.

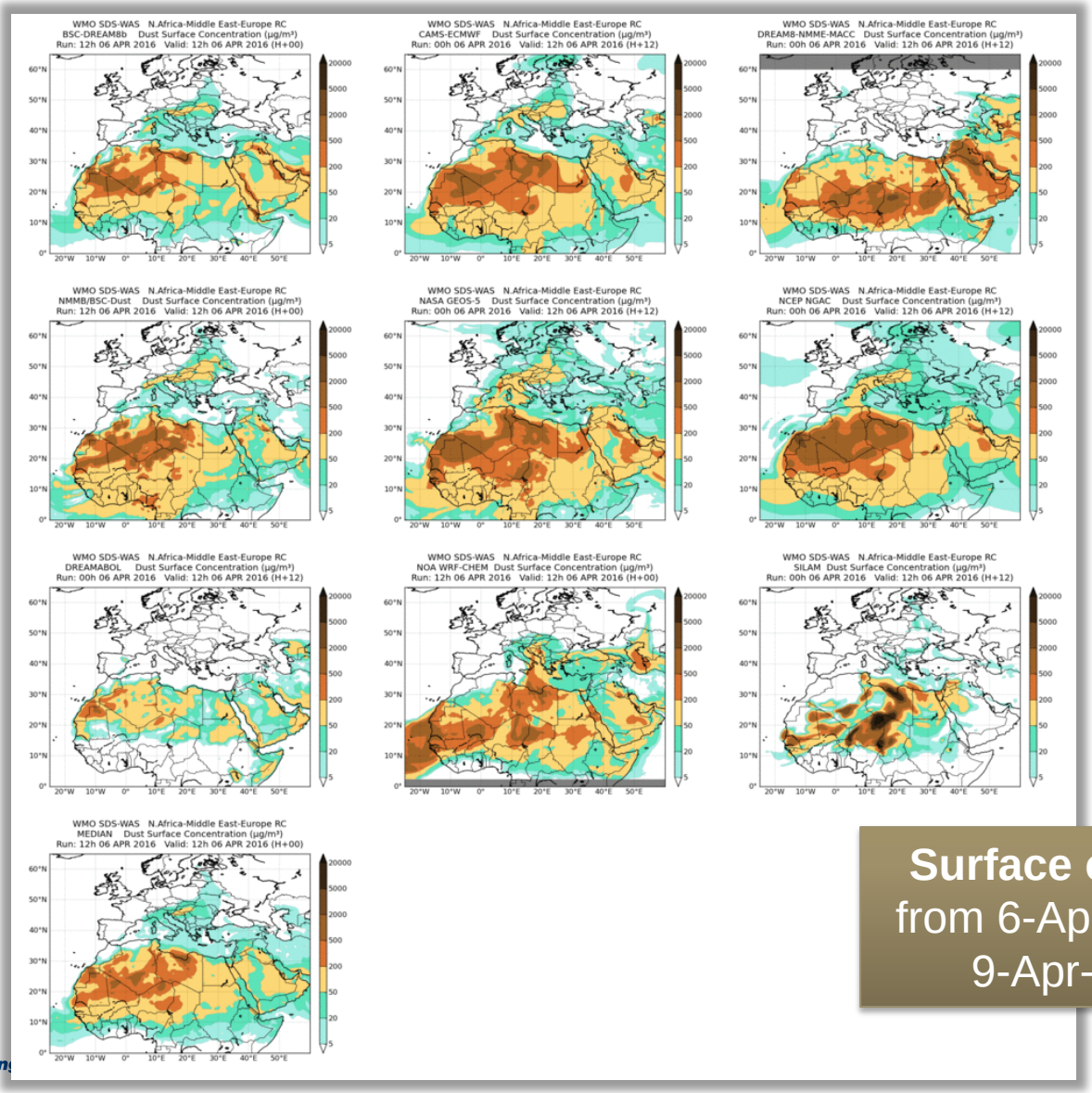
MODEL	RUN TIME	DOMAIN	DATA ASSIMILATION
BSC-DREAM8b v2.0	12	Regional	No
CHIMERE	00	Regional	No
LMDzT-INCA	00	Global	No
CAMS-ECMWF	00	Global	MODIS AOD
DREAM8-NMME	00	Regional	CAMS analysis
NMMB/BSC-Dust	12	Regional	No
MetUM	00	Global	MODIS AOD
GEOS-5	00	Global	MODIS reflectances
NGAC	00	Global	No
EMA REG CM4	12	Regional	No
DREAMABOL	12	Regional	No
NOA WRF-CHEM	12	Regional	No
FMI-SILAM	12	Global	No

DOD joint visualization



AOD at 550nm
from 6-Apr-2016 12:00 to
9-Apr-2016 00:00

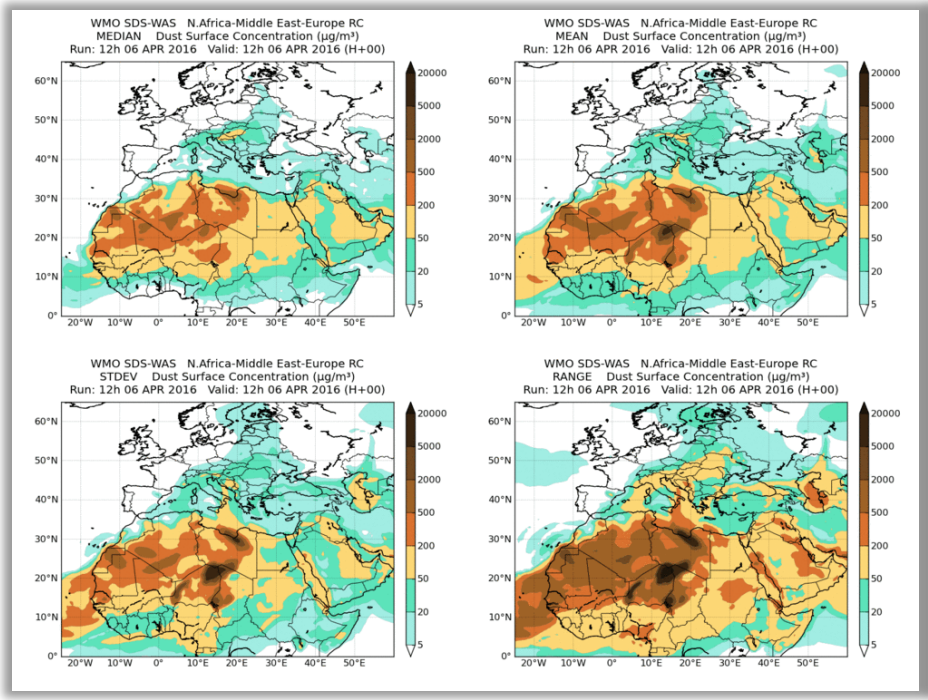
Surface concentration joint visualization



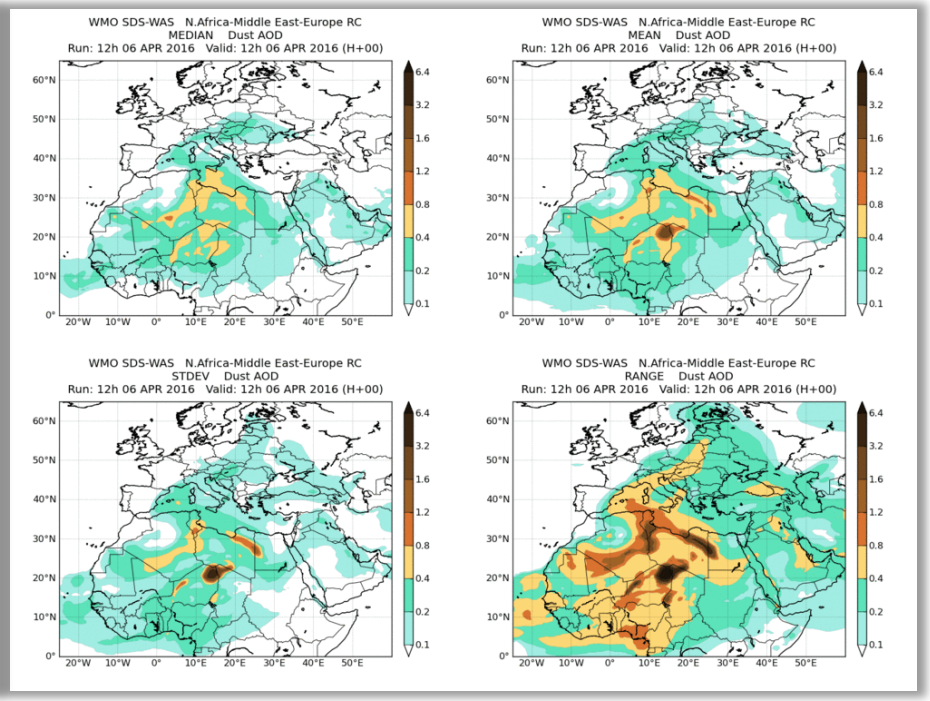
Surface concentration
from 6-Apr-2016 12:00 to
9-Apr-2016 00:00

Generation of multi-model products

Surface concentration



DOD at 550nm



from 6-Apr-2016 12:00 to 9-Apr-2016 00:00

Model outputs are bi-linearly interpolated to a common 0.5ºx0.5º grid mesh. Then, different multi-model products are generated:

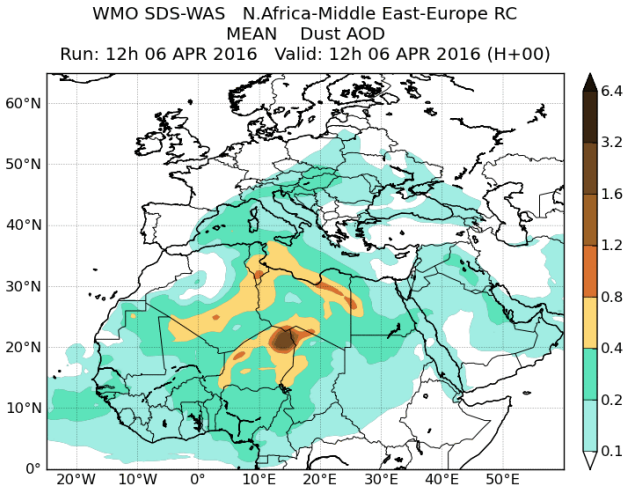
CENTRALITY: median - mean

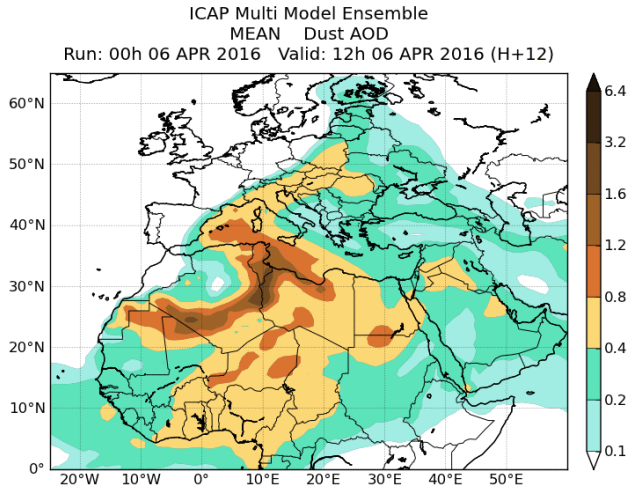
SPREAD: standard deviation – range of variation

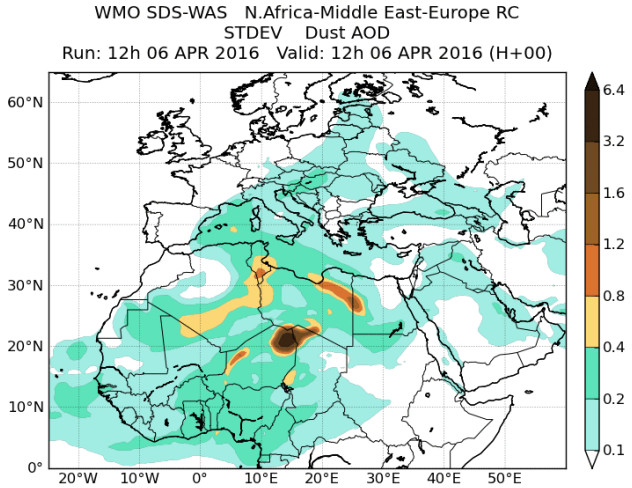
DOD comparison with ICAP-MME model

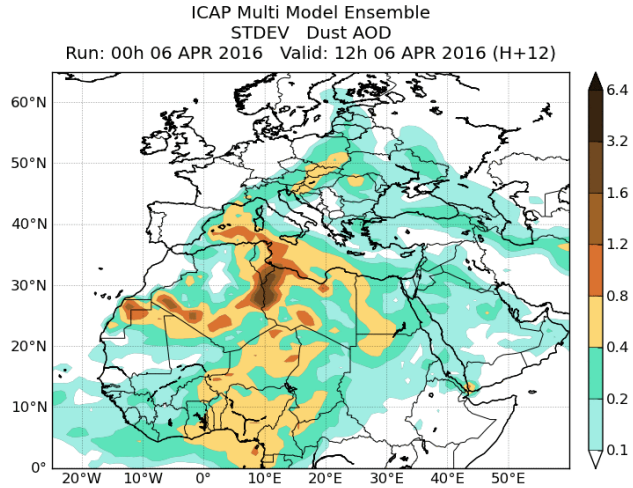
SDS-WAS **ICAP-MME (*Only global models*)**

from 6-Apr-2016 12:00 to 9-Apr-2016 00:00



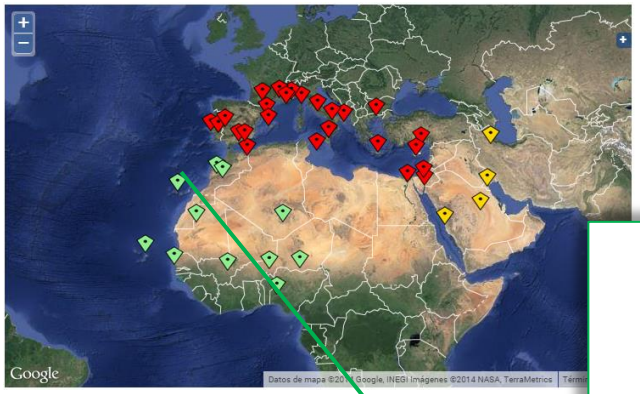


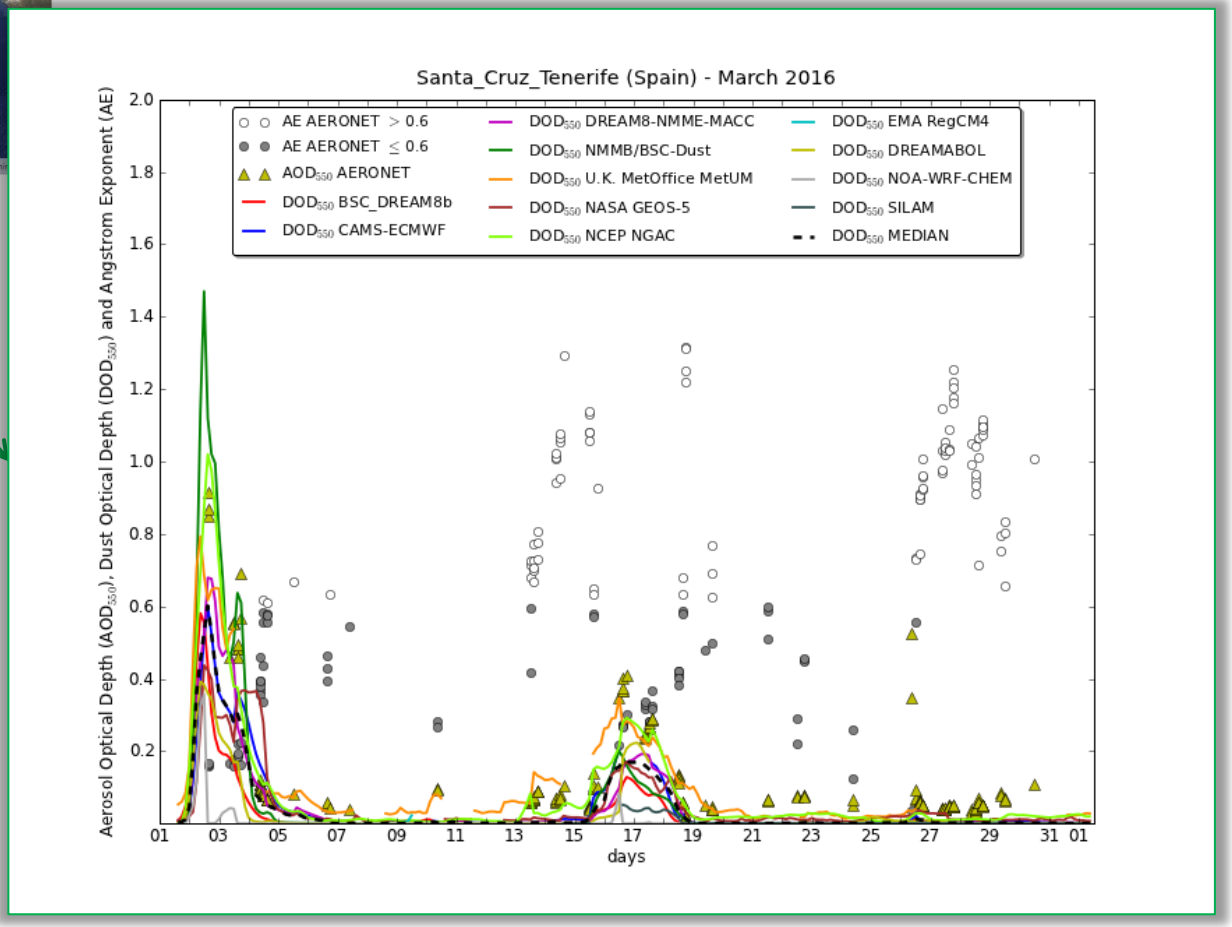




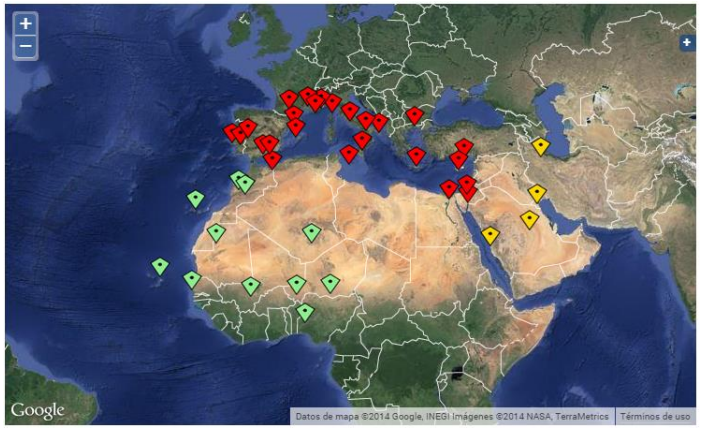
ICAP-MME (Sessions et al., 2014, ACP)

NRT Evaluation using AERONET





Evaluation using AERONET



A set of evaluation metrics are selected: ***Bias, RMSE, correlation coefficient and FGE***

Calculations evaluation metrics are done for:

- ***monthly/seasonal/annual***
- ***sites and regions***

Seasonal scores

by Francesco Benincasa — last modified Jan 14, 2016 04:52 PM

Date: - Select Year - ▼ - Select Season - ▼

Dec 2015 - Feb 2016. Dust Optical Depth.
Threshold Angstrom Exponent = 0.600

BIAS

	BSC_ DREAM8b	CAMS-ECMWF	DREAM8-NMME-MACC	NMMB/BSC-Dust	U.K. Met Office	NASA GEOS-5	NCEP NGAC	EMA RegCM4	DREAM ABOL	NOA-WRF-CHEM	MEDIAN
Sahel/Sahara show stations	-0.33	-0.17	-0.23	0.05	-0.06	-0.16	-0.10	0.10	-0.34	-0.25	-0.21
Middle East show stations	-0.12	-0.03	-0.07	-0.25	-0.03	-0.15	-0.17	0.13	-0.22	-0.17	-0.16
Mediterranean show stations	-0.17	-0.17	-0.15	-0.18	-0.09	-0.16	-0.13	-0.09	-0.16	-0.16	-0.16
TOTAL	-0.26	-0.17	-0.20	-0.04	-0.07	-0.16	-0.11	0.03	-0.27	-0.21	-0.19

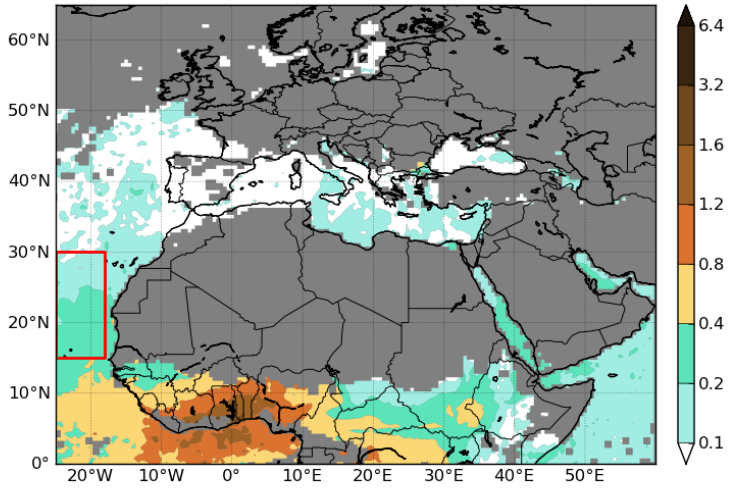
ROOT MEAN SQUARE ERROR

	BSC_ DREAM8b	CAMS-ECMWF	DREAM8-NMME-MACC	NMMB/BSC-Dust	U.K. Met Office	NASA GEOS-5	NCEP NGAC	EMA RegCM4	DREAM ABOL	NOA-WRF-CHEM	MEDIAN
Sahel/Sahara show stations	0.54	0.41	0.51	0.42	0.36	0.37	0.38	0.66	0.56	0.53	0.43
Middle East show stations	0.32	0.28	0.34	0.41	0.33	0.34	0.35	0.34	0.37	0.39	0.33
Mediterranean show stations	0.32	0.33	0.30	0.32	0.30	0.31	0.30	0.40	0.31	0.34	0.31
TOTAL	0.46	0.38	0.44	0.39	0.34	0.35	0.35	0.57	0.48	0.47	0.39

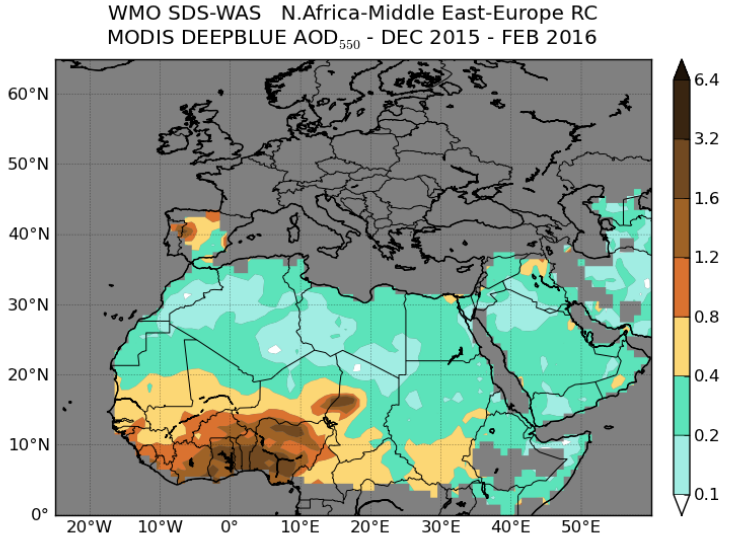
CORRELATION COEFFICIENT

	BSC_ DREAM8b	CAMS-ECMWF	DREAM8-NMME-MACC	NMMB/BSC-Dust	U.K. Met Office	NASA GEOS-5	NCEP NGAC	EMA RegCM4	DREAM ABOL	NOA-WRF-CHEM	MEDIAN

Evaluation using MODIS

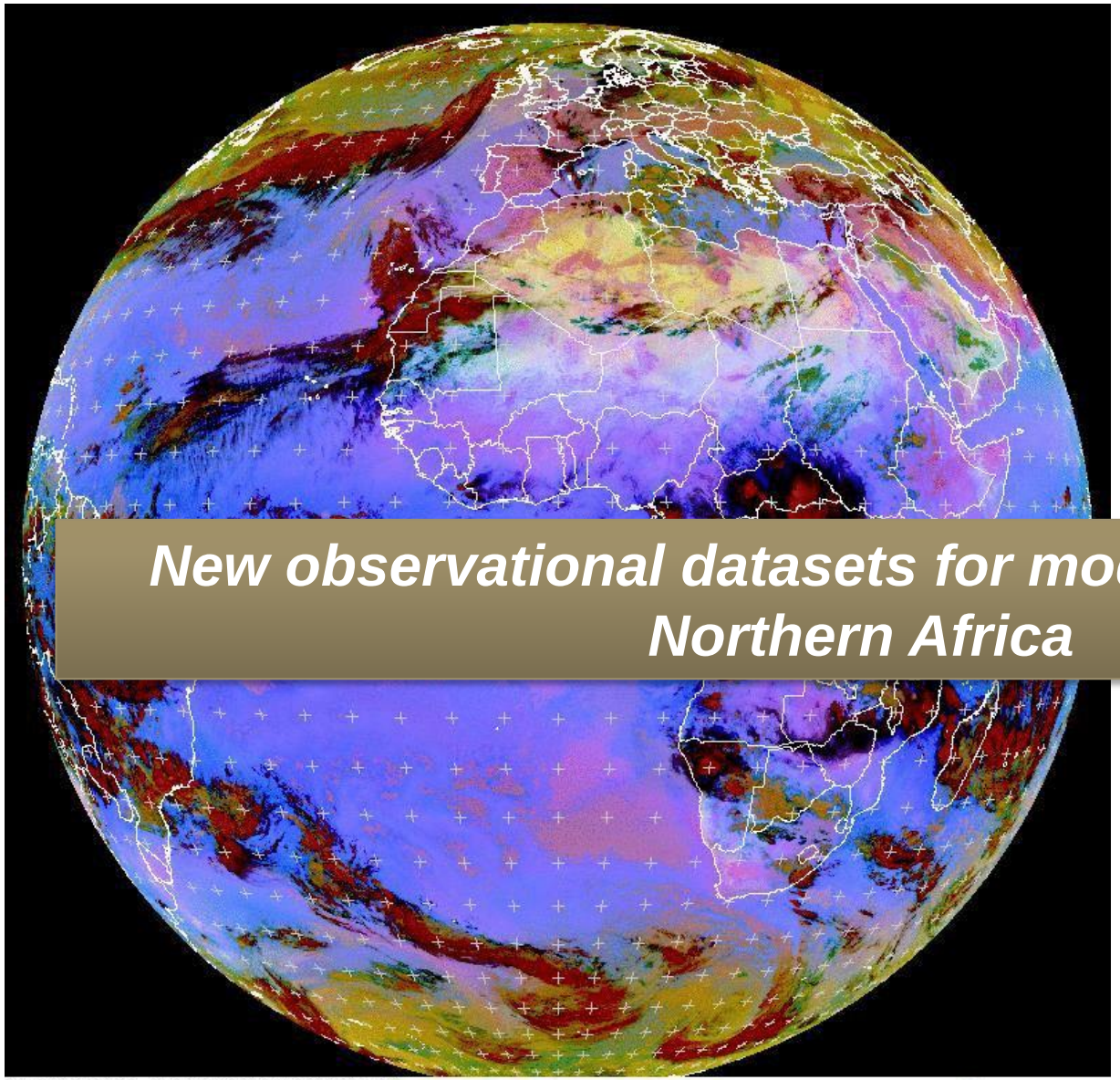


	BIAS	ROOT MEAN SQUARE ERROR	CORRELATION COEFFICIENT	FRACTIONAL GROSS ERROR	NUMBER OF CASES
BSC_DREAM8b	-0.24	0.43	0.63	1.07	207012
NMMB/BSC-Dust	-0.10	0.29	0.78	0.98	201353
NCEP NGAC	-0.12	0.32	0.68	0.71	207012
EMA RegCM4	0.11	0.54	0.29	0.94	39231
DREAMABOL	-0.21	0.44	0.36	0.96	198954
NOA-WRF-CHEM	-0.19	0.41	0.46	1.04	198463



	BIAS	ROOT MEAN SQUARE ERROR	CORRELATION COEFFICIENT	FRACTIONAL GROSS ERROR	NUMBER OF CASES
BSC_DREAM8b	-0.23	0.44	0.45	0.89	51308
NMMB/BSC-Dust	-0.11	0.34	0.78	1.03	47494
NCEP NGAC	-0.14	0.34	0.69	0.66	48659
EMA RegCM4	0.17	0.59	0.35	0.82	12050
DREAMABOL	-0.25	0.46	0.41	0.91	48036
NOA-WRF-CHEM	-0.22	0.43	0.48	1.03	51220

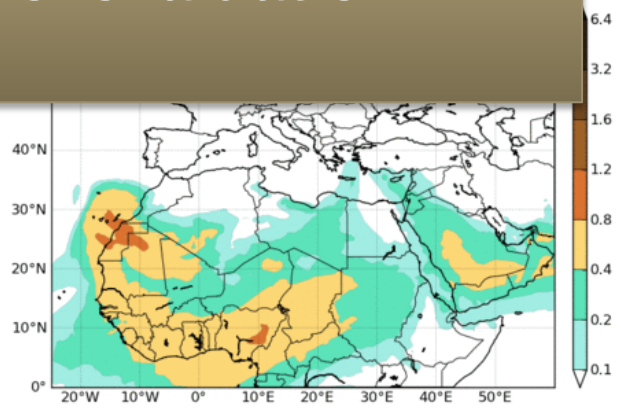
NRT Evaluation using satellite aerosol products



EUMETSAT

7 March 2015

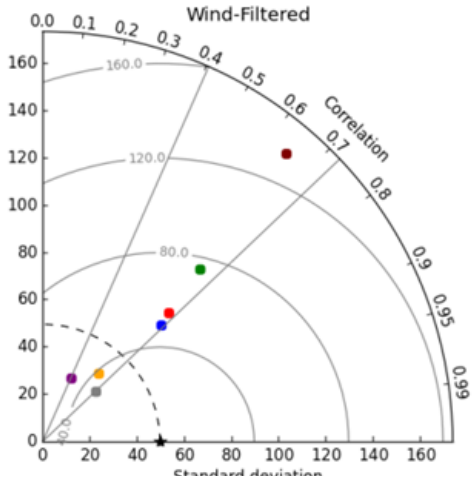
New observational datasets for model evaluation in Northern Africa



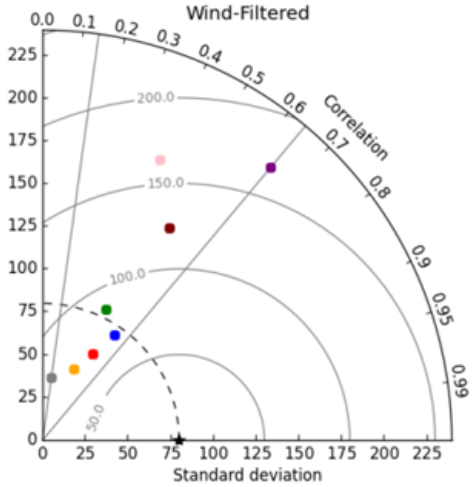
PM10 evaluation using AMMA sites: 2013

Not all PM10 is dust: *Local and biomass burning from Savannah fires.*
Dust filter: *Considering the localizations of the desert dust sources the filter is based on wind direction.*

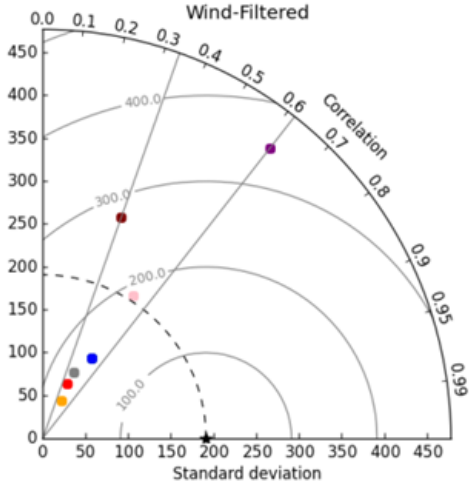
M'Bour-Senegal

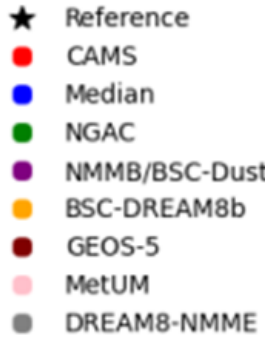


Cinzana-Mali



Banizoumbou-Niger

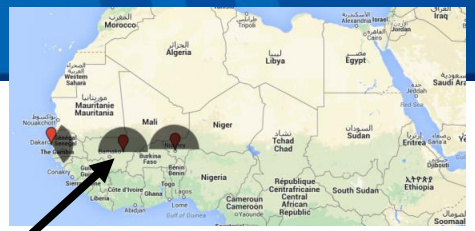


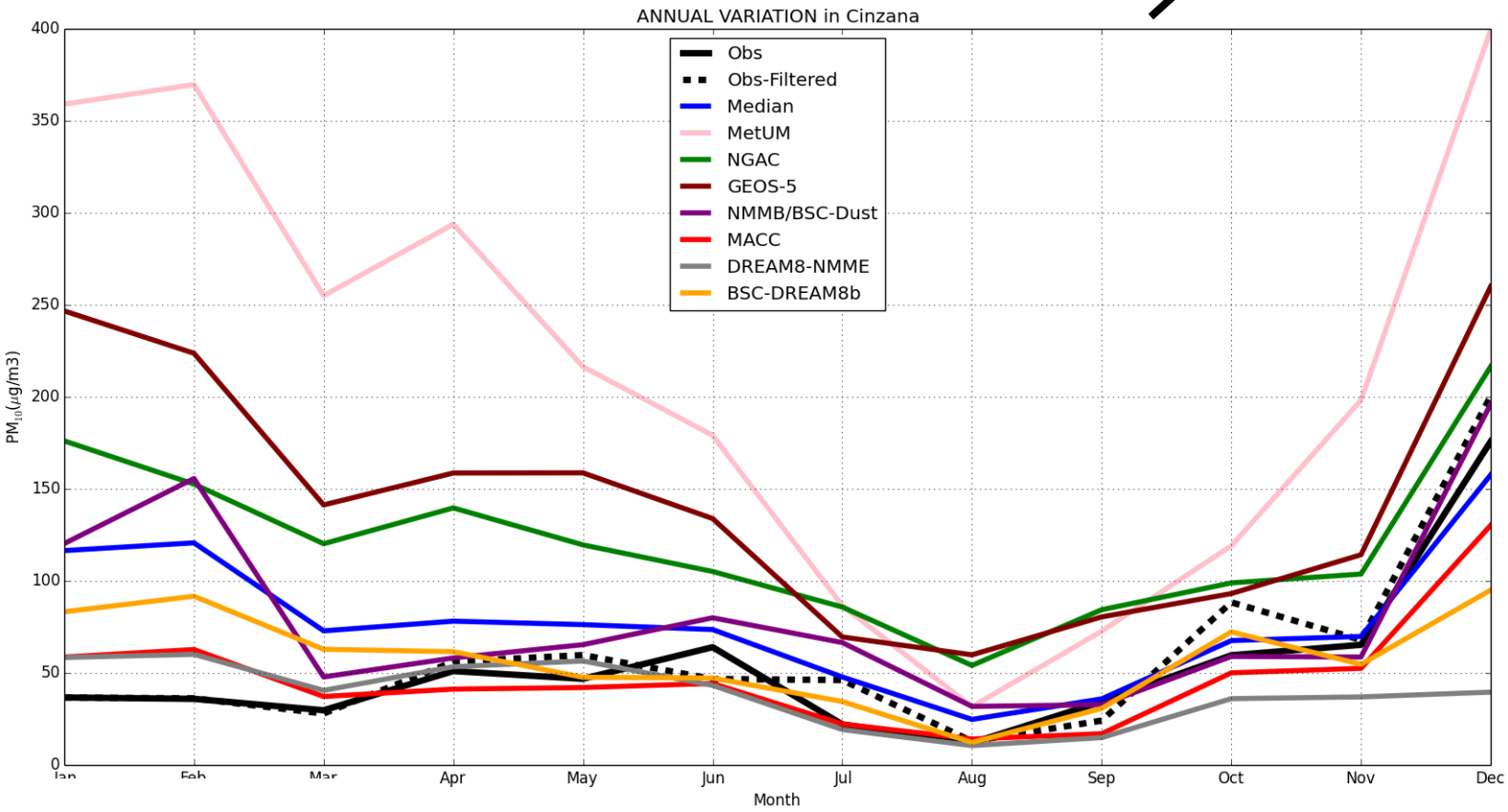


lisa

AMMA (Marticorena et al., 2010)

PM10 evaluation using AMMA sites: 2013



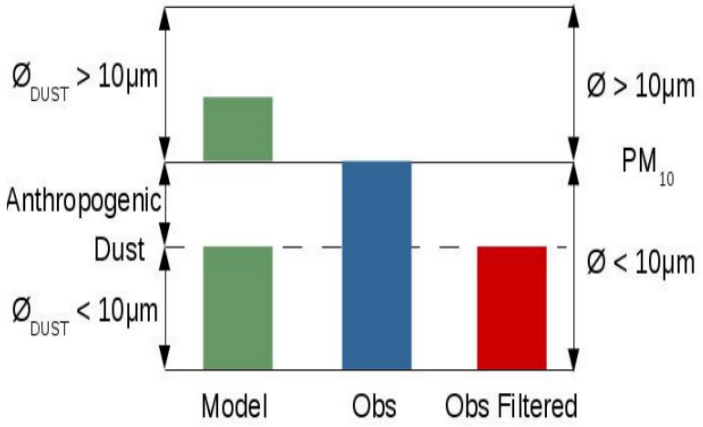


lisa

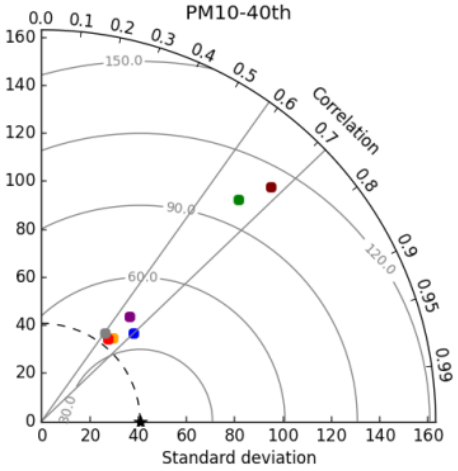
AMMA (Marticorena et al., 2010)

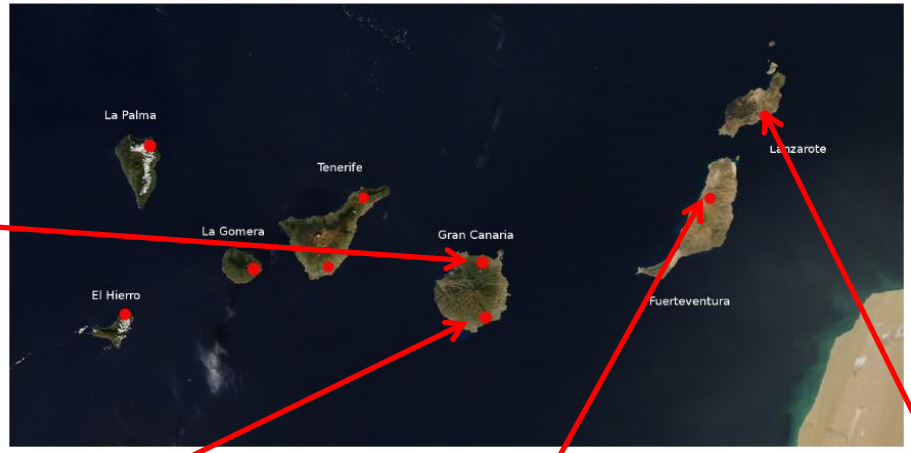
PM10 evaluation using AQ networks: Canary Islands

Not all PM10 is dust: *Local sources*
Dust filter: *Moving 40th percentile of 30 days, 15 days before and 15 days after (Escudero at al. 2007).*

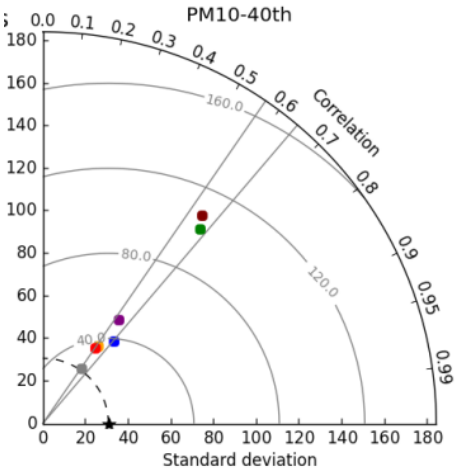


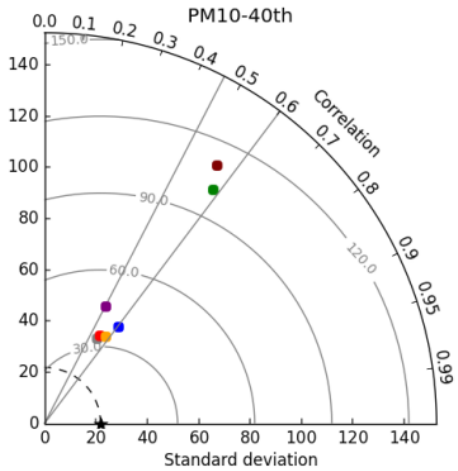
PM10 evaluation using AQ networks: 2013-2014

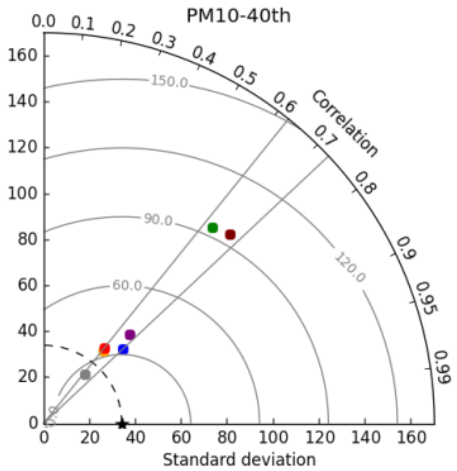




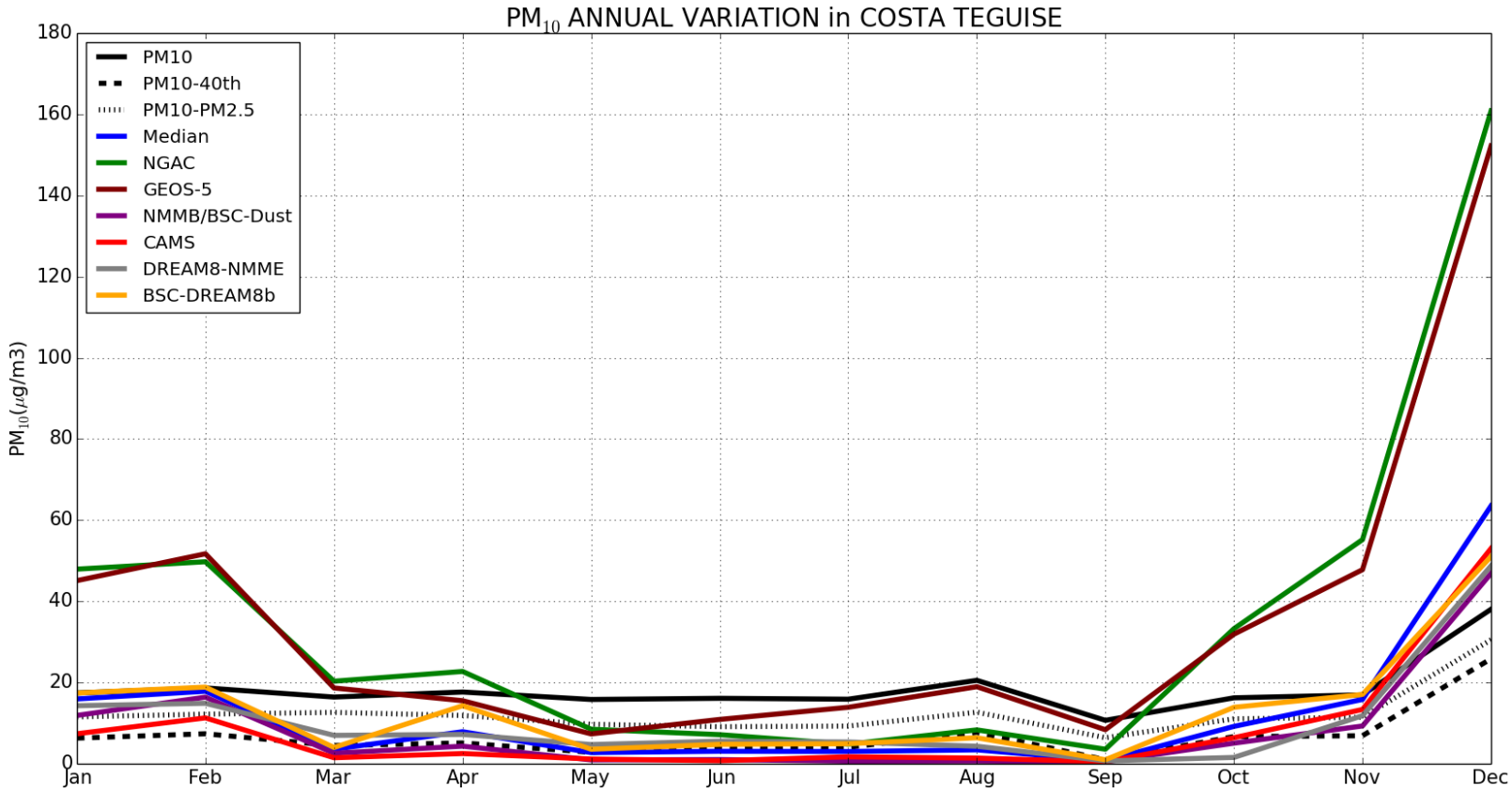
- Reference
- CAMS
- Median
- NGAC
- NMMB/BSC-Dust
- BSC-DREAM8b
- GEOS-5
- DREAM8-NMME



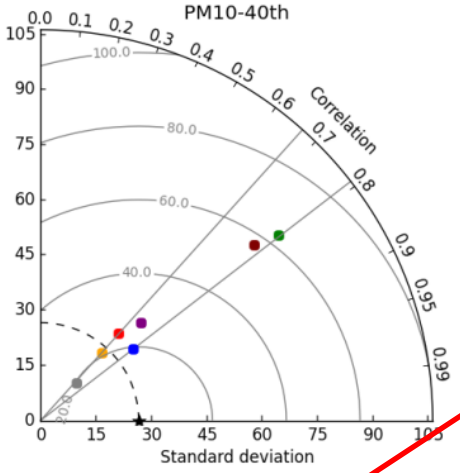




PM10 evaluation using AQ networks: 2013-2014



PM10 evaluation using AQ networks: 2013-2014



- Reference
- CAMS
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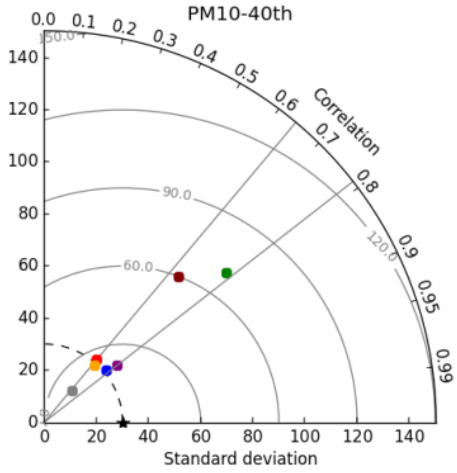
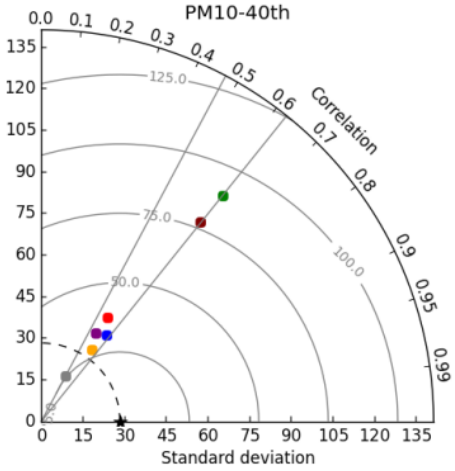
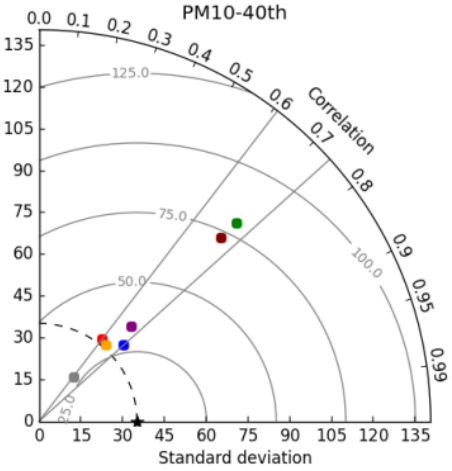
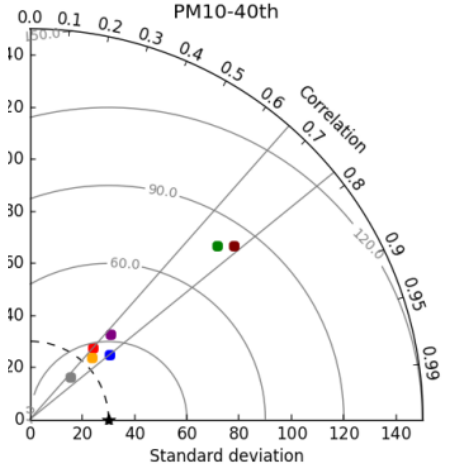
- NGAC
- NMMB/BSC-Dust
- BSC-DREAM8b
- GEOS-5
- DREAM8-NMME

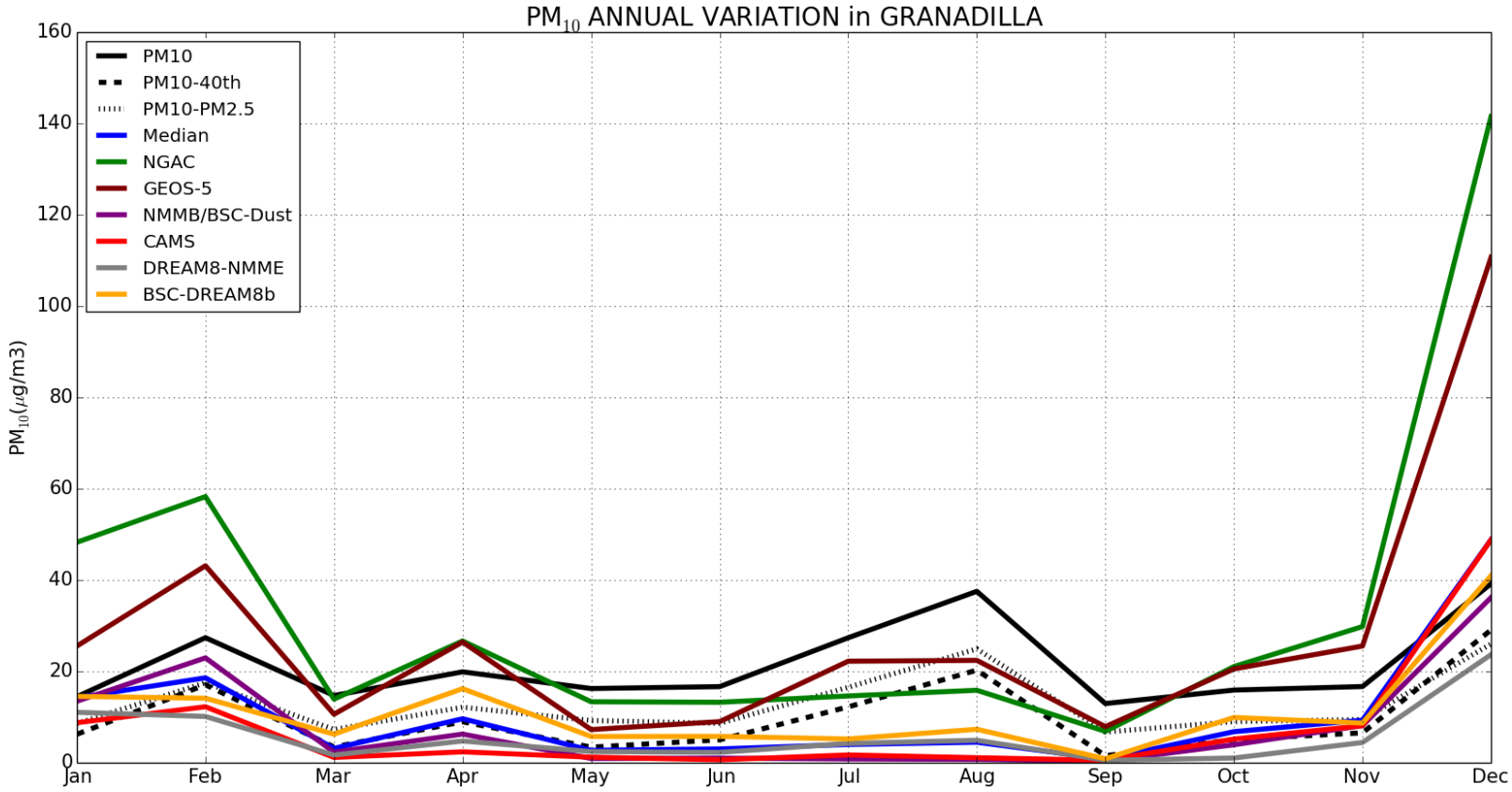




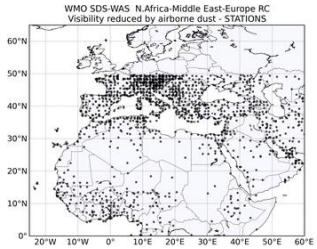


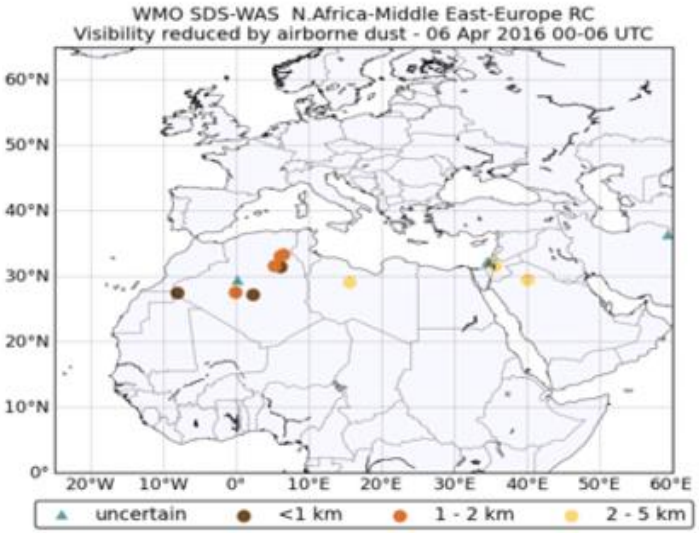


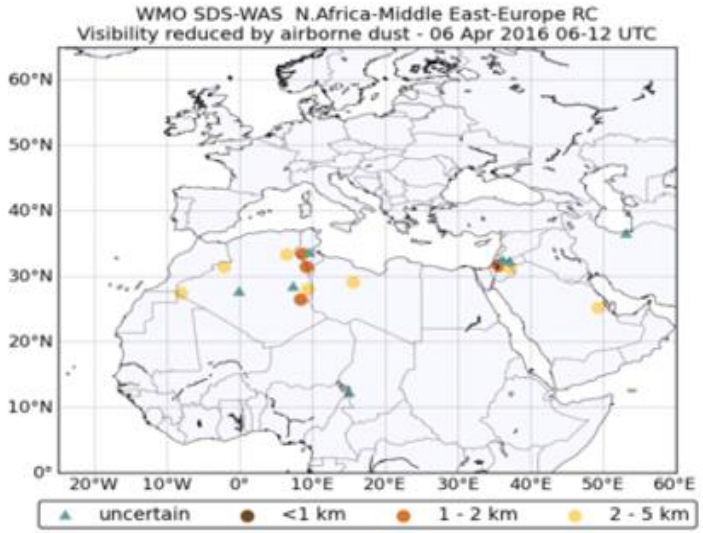
PM10 evaluation using AQ networks: 2013-2014

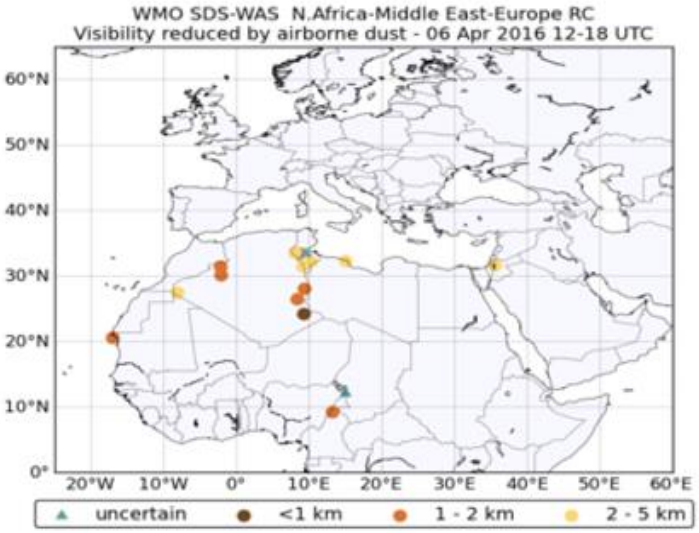


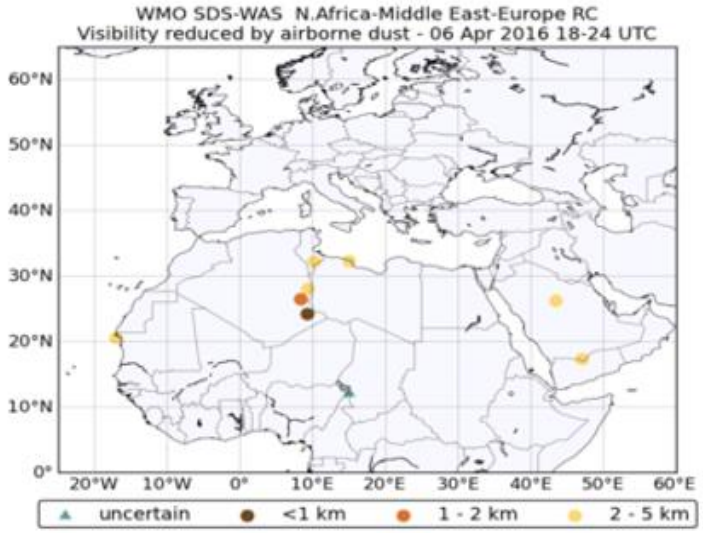
NRT visibility from METAR and SYNOP: 6-hourly reports





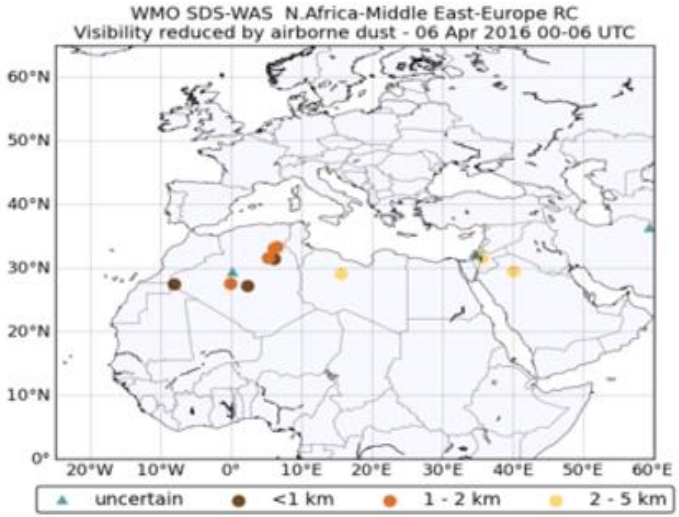


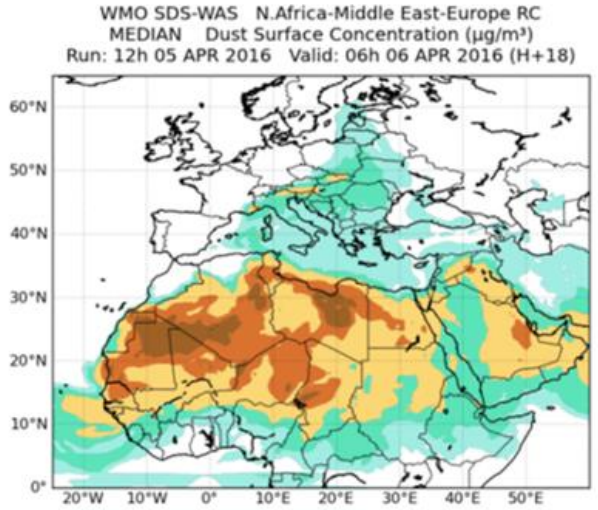


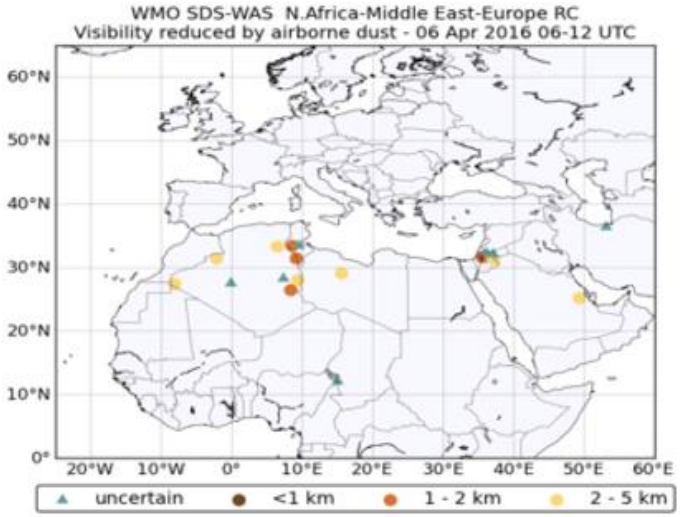


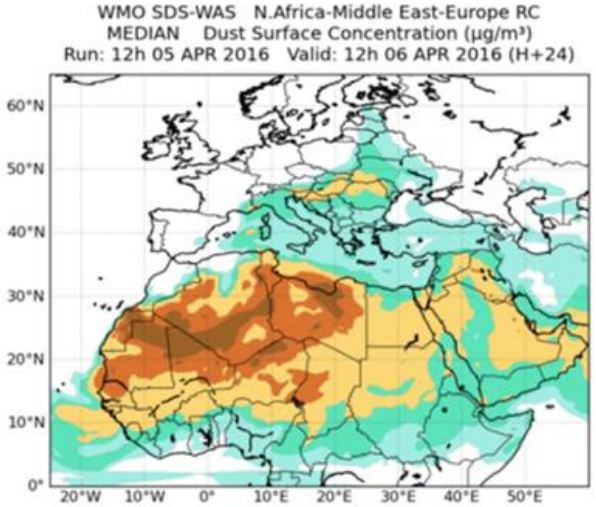
uncertain <1 km 1 - 2 km 2 - 5 km

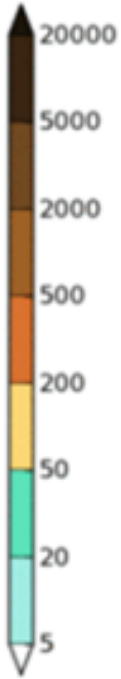
NRT visibility evaluation: 6th April 2016 0-12UTC



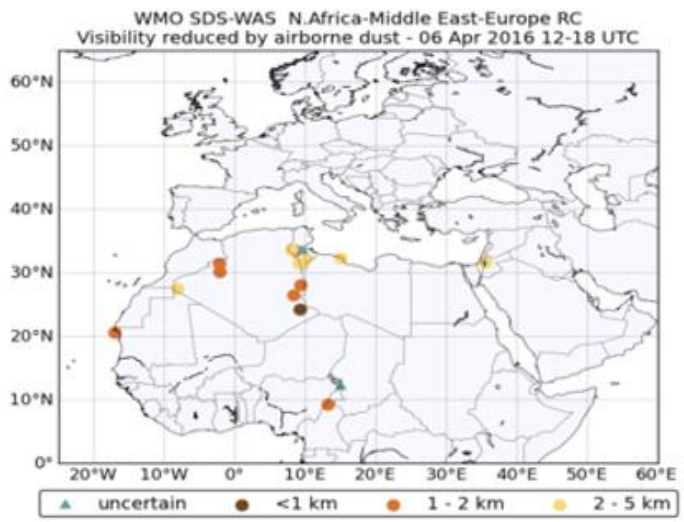


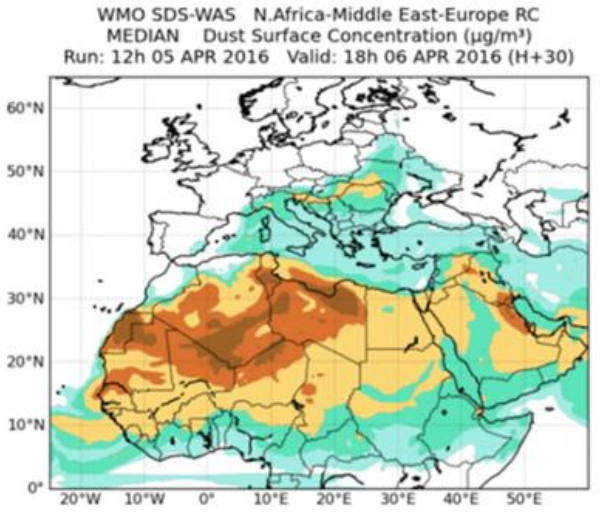


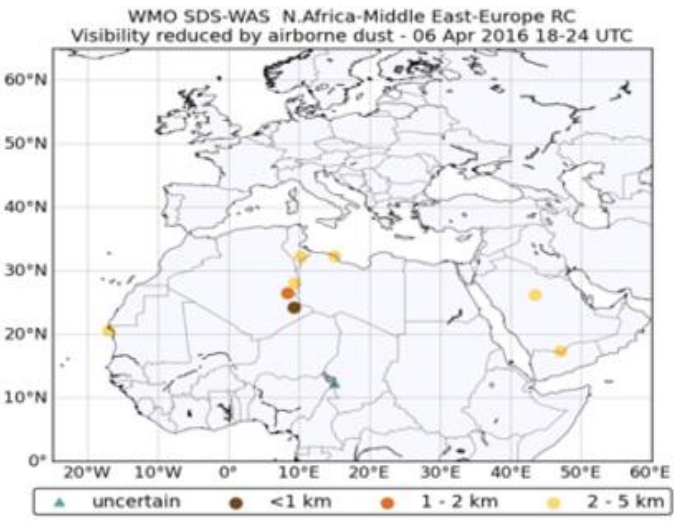


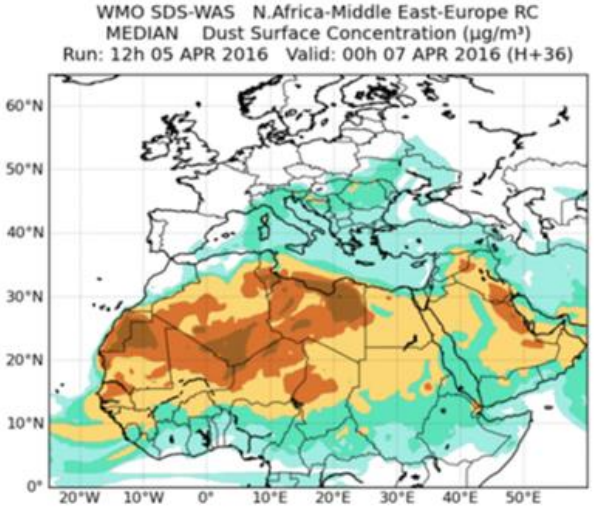


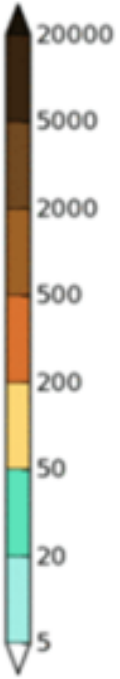
NRT Visibility evaluation: 6th April 2016 12-24UTC







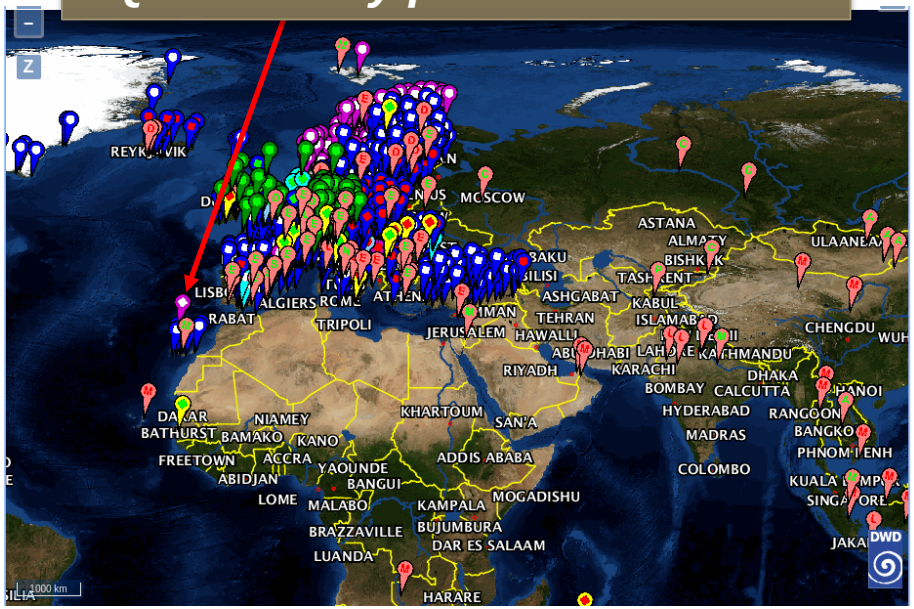




NRT Vertical profiles: Tenerife and Dakar

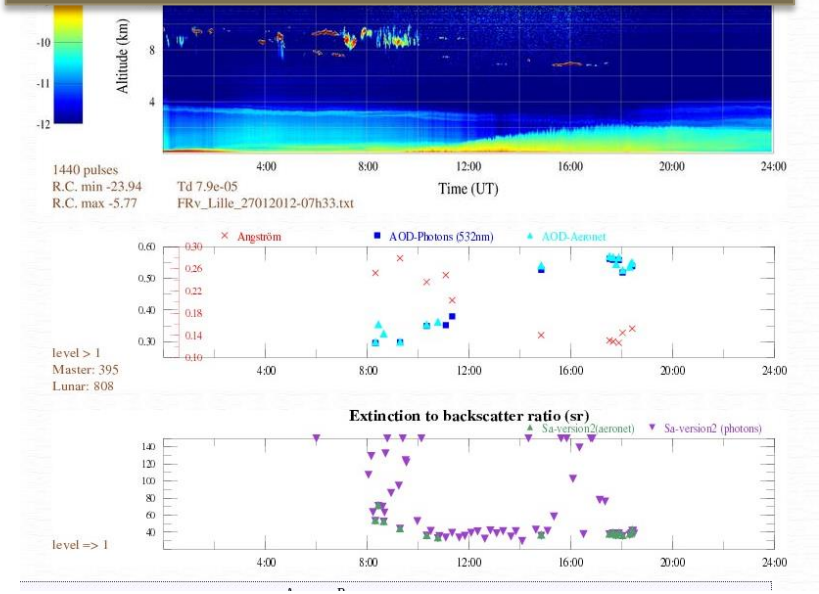
Ceilometer
Santa Cruz de Tenerife (Spain)

+ High density of stations
- Qualitatively products



Lidar
M'Bour (Senegal)

- Low number of stations
+ Quantitative products



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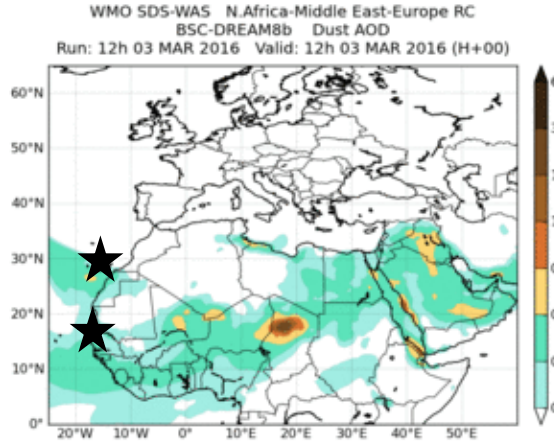
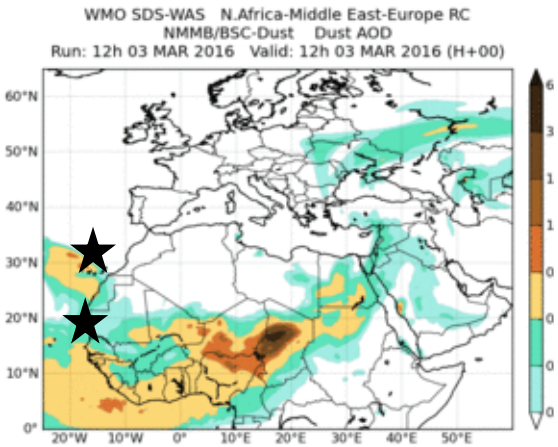
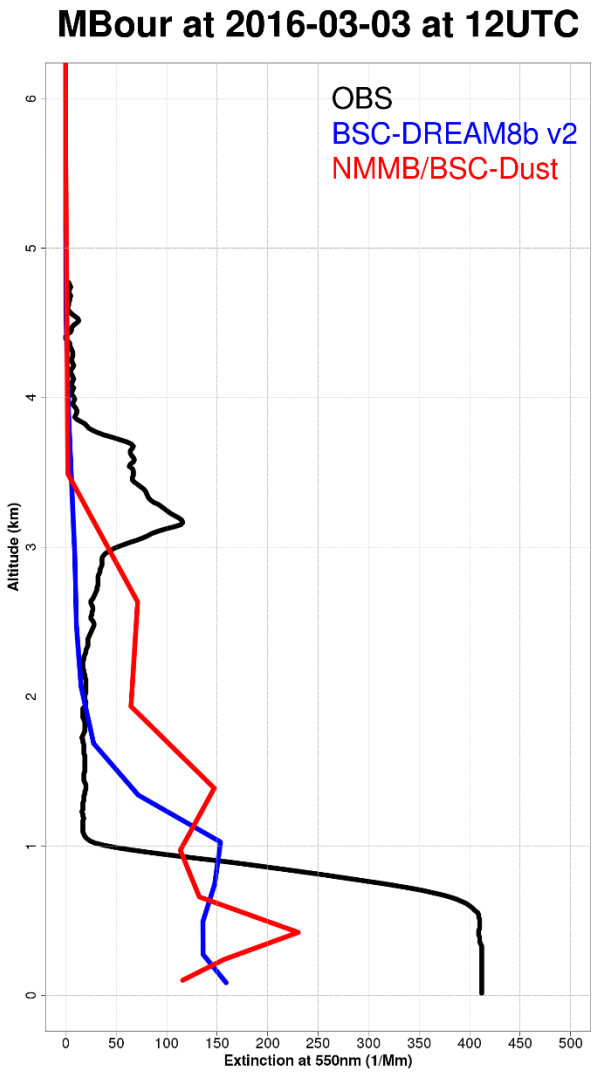
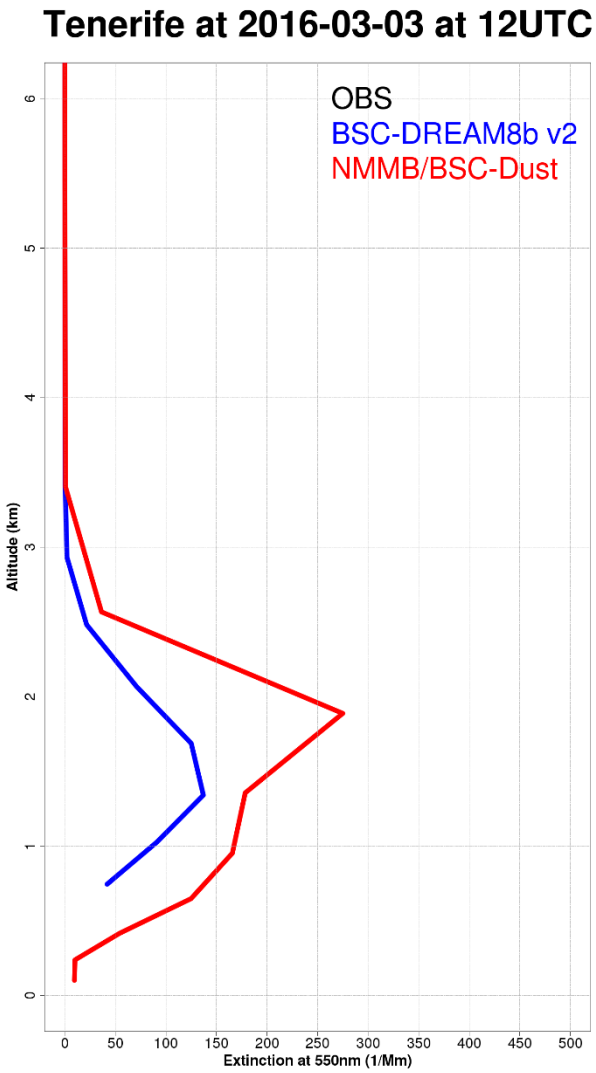
NRT Vertical profiles evaluation: at 12UTC

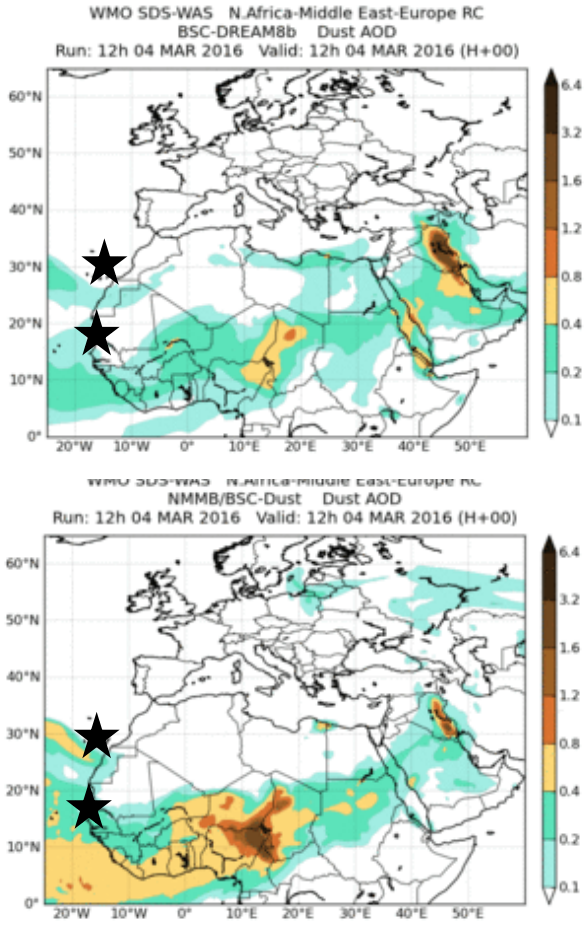


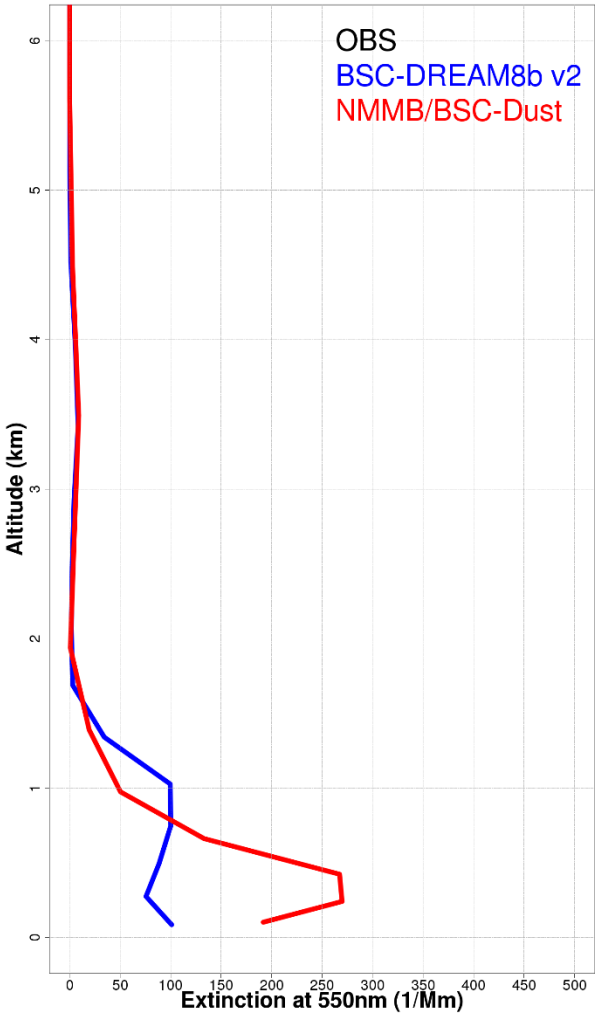


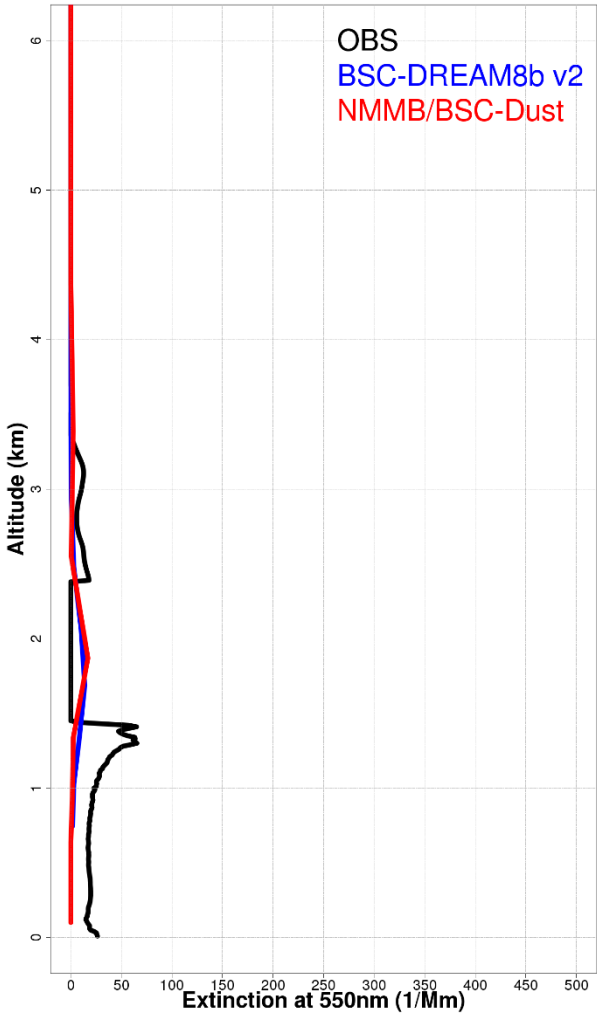




NRT Vertical profiles evaluation: at 12UTC



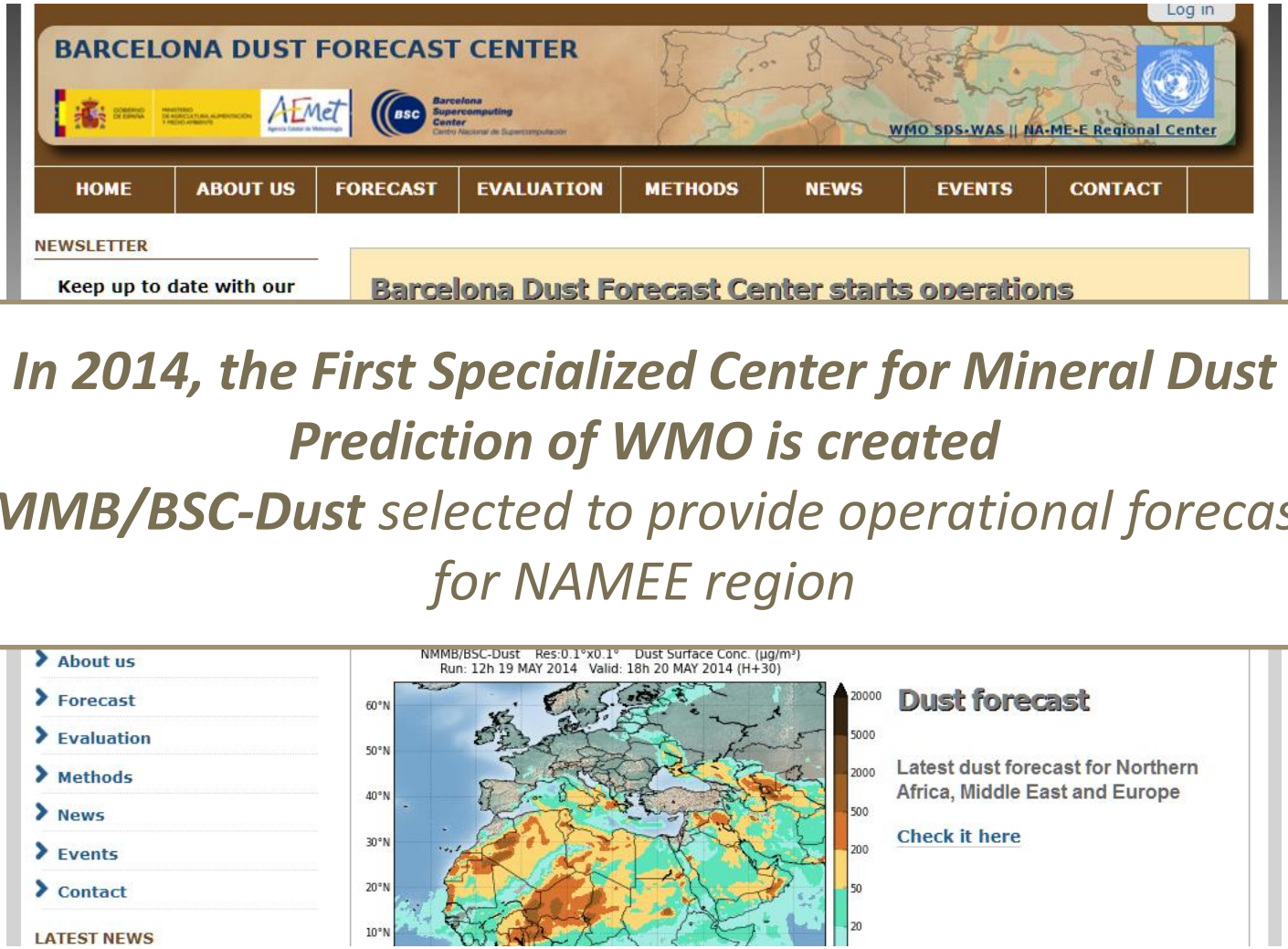




Conclusions

- **Model evaluation 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:**
  - PM10 from AQMS can be used for a preliminary evaluation of surface concentration in NRT
  - Visibility from METAR and SYNOP stations is a new operational product useful for operational prediction and model verification
  - Vertical aerosol products from lidar and ceilometers is starting to be deployed in the NRT evaluation

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



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

NMMB/BSC-Dust *selected to provide operational forecasts for NAMEE region*

http://dust.aemet.es/

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World Meteorological Organization

GOBIERNO DE ESPAÑA
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO
AEMet Agencia Estatal de Meteorología

EXCELENCIA SEVERO OCHOA

BSC **Barcelona Supercomputing Center**
Centro Nacional de Supercomputación

Thank you!

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