

Barcelona Supercomputing Center Centro Nacional de Supercomputación



Practical exercises for using SDS-WAS NAMEE Regional Center products

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PREFIA workshop, 7th October 2019, Nairobi, Kenya

Dust cycle and associated processes

Dust global distribution



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

Dust cycle and associated processes



MODIS true colour composite image for March 2005 depicting a dust storm initiated at the Bodélé Depression (Chad Basin)



MODIS True color Western Africa – Altantic Ocean

Dust transport is a global phenomenon. However, dust emission is a threshold phenomenon, sporadic and spatially heterogeneous, that is locally controlled on small spatial and temporal scales.

Observations



Dust forecasting models

Dust models are a **mathematical representation** of atmospheric dust cycle.



- ✓ 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 do **not** take account dust **resuspension**



Kathmandu, Nepal, March 2017

Dust impacts and its extension



Organic Carbon + Elemental carbon Dust Sulfate Sea salt

NASA | GEOS-5 Aerosols

Barcelona Supercomputing Center The MareNostrum 4 supercomputer

Total peak performance:

13,7 Pflops/s

Earth Sciences Department at BSC

Environmental modelling and forecasting, with a particular focus on weather, climate and air quality



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Mineral Dust Services

- BSC dust operational forecast (global and regional domains)
 - Contribution to the SDS-WAS (regional) and ICAP (global) multi-model ensembles

WMO Dust Regional Centers

- Barcelona Dust Forecast Center. First specialized WMO Center for mineral dust prediction. Started in 2014 - Operational
 - <u>http://dust.aemet.es</u>
 - @Dust_Barcelona
- SDS-WAS Regional Center. Sand and Dust Storm Warning Advisory and Assessment System. Started in 2010 – Research
 - http://sds-was.aemet.es









Barcelona Dust Forecasting Center

BARCELONA DUST FORECAST CENTER											
HOME ABOUT US	FORECAST	EVALUATION	METHODS	NEWS	EVENTS	CONTACT					
NEWSLETTER											
Keep up to date with our activities! Full Name Your email Subscribe SEARCH Search Site	Barce The Cent dust fore Middle Ea Read Mon	Iona Dust Fo er will release ope casts for Northern ast and Europe re	orecast Ce rational Africa,	nter start	s operatio	ns					
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> @Dust_Barcelona
http://dust.aemet.es/

Barcelona Dust Forecasting Center

72-hours forecasts of:

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









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



@Dust_Barcelona http://dust.aemet.es/

Barcelona Dust Forecasting Center

Website visits (http://dust.aemet.es/): 1 January 2015 – 20 October 2017







🍠 @Dust_Barcelona







SDS-WAS and the Regional Nodes/Centers



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

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



SDS-WAS and the NAMEE Regional Center

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

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НОМЕ	ABOUT US	FORECAST & PRODUCTS	PROJECTS & RESEARCH	MATERIALS	NEWS	EVENTS	CONTACT US			
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Forecast & I	Products	by Francesco Benincas	a — last modified May 29, 2012 (03:33 PM						
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Projects & Research		The InDust COST	The InDust COST Action website has been			To be informed about our activities, news and				
Materials		launched	launched			events related to dust. Frequency is almost				
News		RGB dust product	RGB dust product from Himawari-8 and GOES-16			monthly.				
> Events		Training Worksho	Training Workshop on Sand and Dust Storms in the Arab Region			Full Name				
		the Arab Region				Your email				
Search		The 9th Internatio	onal Workshop on Sand / Du	ist		Subscribe				
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May 08, 2018		Dust forecasts	Dust forecasts							
CAMS releases of new global	s first five yea reanalysis dat	rs a WMO SDS-W. MEDIAN D	WMO SDS-WAS N Africa-Middle East-Europe RC MEDIAN Dust Surface Concentration (µg/m [*])			Desar Geregali - April 2018				



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SDS-WAS NAMEE: Observations

- Better understanding and track of SDS → Dust-filtered observations
- Used for model evaluation and data assimilation
- Lack of observations, particularly in Africa









SDS-WAS NAMEE: Modelling

Products: surface concentration and DOD maps, the SDS-WAS multi-model product



12 Global – Regional models from \sim 100 to 10 km



SDS-WAS NAMEE: Joint Visualization







http://sds-was.aemet.es/ 18

SDS-WAS NAMEE: DOD Model Evaluation

Evaluation with AERONET data •

- Graphical NRT Evaluation by site
- Evaluation scores monthly/seasonal/annual • and sites
- **Evaluation with MODIS data onto the Atlantic** •
 - Evaluation scores monthly/seasonal/annual



- Evaluation of dust models with MODIS Deep Blue retrievals •
 - Evaluation scores monthly/seasonal/annual









WMO SDS-WAS N.Africa-Middle East-Europe RC

http://sds-was.aemet.es/forecast-products/forecast-evaluation





Study Case 23-25 June 2019: SDS-WAS Multi-model

DOD

40°N 30°N 20°N

> 50° 40°

20

10'

50° 40°









Study Case 23-25 June 2019: SDS-WAS Multi-model

SCONC









Study Case 23-25 June 2019: SDS-WAS Ensemble

SCONC DOD WMO SDS-WAS N.Africa-Middle East-Europe RC WMO SDS-WAS N.Africa-Middle East-Europe RC MEDIAN Dust AOD MEDIAN Dust Surface Concentration (µg/m³) Run: 12h 23 JUN 2019 Valid: 12h 23 JUN 2019 (H+00) Run: 12h 23 JUN 2019 Valid: 12h 23 JUN 2019 (H+00) 20000 6.4 60°N)°N 5000 3.2 50°N)°N 1.6 2000 40°N)°N 500 1.2 30°N)*N 0.8 200)°N 20°N 0.4 - 50 0.2 20 10°N)°N 0.1 5 0* 0° 20°W 30°F 40°E 50°E 20°W 50°E 10°W 0° 10°F 20°F 10°W 0° 10°F 20°F 30°F 40°F WMO SDS-WAS N.Africa-Middle East-Europe RC WMO SDS-WAS N.Africa-Middle East-Europe RC STDEV Dust AOD STDEV Dust Surface Concentration (µg/m³) Run: 12h 23 JUN 2019 Valid: 12h 23 JUN 2019 (H+00) Run: 12h 23 JUN 2019 Valid: 12h 23 JUN 2019 (H+00) 6.4 20000 60°N 60"N - 3.2 5000 50°N 50°N 1.6 2000 40°N 40"N 1.2 500 30°N 30°N 0.8 200 20°N 0.4 20"N - 50 0.2 - 20 10°N 10°N 0.1 0° 0° 20°W 10°W 0° 10°E 20°E 30°E 40°E 50°E 20°W 10°W 0° 10°E 20°E 30°E 40°E 50°E Barcelona

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Study Case 23-25 June 2019: SDS-WAS vs ICAP Ensemble

SDS-WAS

ICAP-Global







Study Case 22 June 2019: VISIBILITY OBSERVATIONS





Study Case 23 June 2019: VISIBILITY OBSERVATIONS

40°E

40°E

4

50°E 60°E

uncertain

Δ.

50°E 60°E

uncertain





Study Case 23 June 2019: AERONET OBSERVATIONS



SDS-WAS NRT evaluation

Near-real-time evaluation v3

by Francesco Benincasa — last modified Jan 22, 2018 06:17 PM





Barcelona



Study Case 23 June 2019: AERONET OBSERVATIONS

Near-real-time evaluation v3

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by Francesco Benincasa — last modified Jan 22, 2018 06:17 PM





Study Case 23 June 2019: AERONET OBSERVATIONS

Near-real-time evaluation v3

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by Francesco Benincasa — last modified Jan 22, 2018 06:17 PM







Study Case 23 June 2019: MSG/RGB Dust product



EUMETSAT



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Meteosat 0deg Dust, 2019-06-23 00:00:00 UTC

Study Case 23 June 2019: MSG UK MetOffice Dust product





Study Case 23 June 2019: MODIS images



https://worldview.earthdata.nasa.gov





Study Case 23 June 2019: MODIS aerosol product



https://worldview.earthdata.nasa.gov







SDS-WAS NAMEE: Early Warning System for Burkina Faso



https://sds-was.aemet.es/forecast-products/burkina-faso-warning-advisory-system



www.cost-indust.eu Contact: cost-indust@bsc.es



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THE ACTION ~ PEOPLE ~ GRANTS ~ EVENTS ~ MEDIA ROOM ~ GET IN TOUCH MEMBERS AREA ~







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EXCELENCIA SEVERO OCHOA









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