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Barcelona Supercomputing Center Centro Nacional de Supercomputación

Dust Forecast Services

WMO SDS-WAS and Barcelona Dust Forecast Center

Francesco Benincasa

Teheran, 8th of November 2016



Barcelona Supercomputing Center Centro Nacional de Supercomputación

OUTLINE

(Barcelona Dust Forecast Center

(Data visualization

(Data manipulation







System

(Bash: scheduled download of

- Forecast data (12 models for SDS, 1 for BDFC)
- Forecast images (UK MetOffice, ...)
- Observation data (txt, csv, xml, ...)
- Observation images (UK MetOffice, EUMETSAT, ...)

(Python:

- Normalize data to local standard (NetCDF regular lat lon)
- Export to other formats (GRIB1/2, ...)
- Communications between frontend and backend

[Fortran:

- Regrid to a common resolution
- Calculate evaluation scores (BIAS, RMSE, ...)





Barcelona Supercomputing Center Centro Nacional de Supercomputación

WMO SDS-WAS NA-ME-E Regional Center

					Log in Register
	IERN AFRICA-MIDDLE EAST-EU WMO Sand and Dust Storm V	IROPE (N Varning Adv	IA-ME-E isory and As) REGION	Stem (SDS-WAS
World Meteorological Organization Watter Cratter Water	Earcelonas Supercomputing Control Manual de Descorrestado			/MO SDS WAS	Asia Regional Cente
HOME ABOUT US FOI	RECAST & PRODUCTS PROJECTS & RESEARCH	MATERIALS	NEWS	EVENTS	CONTACT US
Home	You are here: Home				
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Forecast & Products	Outstanding		ubcoribo to ti	ha Dublia Naw	clattan
Projects & Research	outstanding	5	ubscribe to ti	ne Public New	sietter:
N	Barcelona will host the first WMO Regional	. 7	o be informed	about our act	ivities, news and
Materials	Meteorological Center specialized on Atmosph	ieric e	vents related	to dust. Freque	ency is almost
News	Sand and Dust Porecast		nonthiy.		
Events	Training events in Muscat, Oman			Full Name	
Events	Files Download			Your email	
Public Newsletter		_	6		
Users Newsletter	Compared dust forecasts			Subscribe	e
Search	Dust forecasts				
Search Site Search	WMO SDS WAS N Africa-Middle East-Europe RC MEDIAN Dust Surface Concentration (µg/m ³)		Ş 20	Rome_Tor_Vergata (Italy) - Novembe	er 2013
Latest News	Run: 12n 03 DEC 2013 Valid: 12n 03 DEC 2013 (M+00)	20000	0 0 AF AERONET > 0.6 • AF AERONET : 0.6 • A AFRONET : 0.6 • A ADO ₁₀ AERONET	DOD ₁₀ MACC 2CHIM DOD ₁₀ DREAMS NAME MACC DOD ₁₀ DREAMS NAME	DOD _{Lin} U.K. HetOffice HetSIH DOD _{Lin} NASA GEDS-5 DOD _{Lin} NCEP NGAC
Workshop on Meteorology, Sand and Dust Storm,	50"N	2000		0 0 0 0 0 0 8 8	- DOG _{IN} MEDIAN

Sand and Dust Storm, Combating Desertification and Erosion: Presentations and Pictures

Nov 12, 2013

Workshop on Meteorology, Sand and Dust Storm (SDS), Combating Desertification and Erosion held in Istanbul, Turkey Nov 08, 2013



a np Establishing a WMO SDS-WAS Regional Node for West Asia: nal Current Capabilities and Needs





Dust observations

Spain (Generalitat de Cat.): Beliver de Centanya November 2013



(Retrieving

- Data models from 12 contributions of 11 institutions of 9 countries (Spain, UK, Serbia, US, Egypt, Italy, Greece, Norway, Netherlands) with 2 variables (SCONC_DUST, OD550_DUST)
- Data observations (AERONET, MODIS, MODIS DB, ...)
- External observationals products (MSG RGB EUMETSAT, MSG UK MetOffice, Debra-Dust)



(Producing

- Dust forecasts of 2 variables (Surface concentration and Aerosol optical depth) of numerical models + 4 multimodel products
- Models evaluation against observations
- Guidance for forecasters
- Time averaged values
- Studies of dust episodes
- Workshops, training courses and seminars (with materials)



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



- Forecast

 Date:
 2015-10-29
 H+ anim •

 Doc on model inter-comparison
 Forecast evaluation
 Multimodel Products

 Please be sure to read the data policy.
 NOTE: Click on the images to enlarge.

 Dust optical depth:
 Dust optical depth:

You are here: Home > Forecast & Products > Dust forecasts > Compared dust forecasts



Compared dust forecasts

by Francesco Benincasa - last modified Mar 06, 2015 02:57 PM

















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

Browsable images

- Forecast
- Multimodel

You are here: Home > Forecast & Products > Dust forecasts > Multimodel Products

Multimodel Products

by Francesco Benincasa - last modified Oct 14, 2014 12:30

Compared dust forecasts Evaluation of the multi-model median

NOTE: Click on the images to enlarge.

Dust optical depth:



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

STDEV Dust AOD

Run: 12h 05 NOV 2016 Valid: 12h 05 NOV 2016 (H+00)









Download full image

40"1 30"1

20*

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

Browsable images

- Forecast
- Multimodel
- Evaluation
 - AERONET

You are here: Home > Forecast & Products > Forecast evaluation > Santa_Cruz_Tenerife - Spain



<< Back to Station Selection

NOTE: Click on the image to enlarge





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

Browsable images

- Forecast
- Multimodel
- Evaluation
 - AERONET
 - MODIS

You are here: Home > Forecast & Products > Forecast evaluation > Evaluation of Saharan Dust Transport onto the Atlantic

Monthly Evaluation

by Francesco Benincasa — last modified Dec 03, 2014 01:25 PM

Date:

Go to Seasonal evaluation

Average values of the MODIS retrievals used in the evaluation. The plot has been generated from products between the 2nd of the stamped month and the 1st of the following one.



BSC	Barcelona Supercomputing Center Centro Nacional de Supercomputación	
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	BIAS	ROOT MEAN SQUARE ERROR	CORRELATION COEFFICIENT	FRACTIONAL GROSS ERROR	NUMBER OF CASES
BSC_ DREAM8b	-0.15	0.19	0.80	1.14	1239

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

- Browsable images
 - Forecast
 - Multimodel
 - Evaluation
 - AERONET
 - MODIS
 - MODIS DB

You are here: Home > Forecast & Products > Forecast evaluation > Evaluation of dust models with MODIS Deep Blue retrievals

Monthly Evaluation

by Francesco Benincasa – last modified Jul 29, 2014 06:50

Date:

Average values of the MODIS retrievals used in the evaluation (data with an Angstrom exponent above 1.0 have not been considered). The plot has been generated from products between the 2nd of the stamped month and the 1st of the following one.



		BIAS	ROOT MEAN SQUARE ERROR	CORRELATION	FRACTIONAL GROSS ERROR	NUMBER OF CASES
B	SC_ REAM8b	-0.13	0.23	0.45	0.67	17766



(<u>http://sds-was.aemet.es</u>)

Browsable images

- Observacions
 - In situ

You are here: Home > Forecast & Products > Dust observations > In-situ measurements > Granadilla - Spain

Granadilla - Spain

by Enric Terradellas — last modified Aug 01, 2014 10:43 AM

Select another station -- select --

Display previous graphs 2015-10

<< Back to Station Selection

Check Backtrajectories >>

NOTE: Click on the image to enlarge





(<u>http://sds-was.aemet.es</u>)

Browsable images

- Observacions
 - In situ
 - MSG UK MO

You are here: Home > Forecast & Products > Dust observations > MSG - U.K. Met Office

MSG - U.K. Met Office

by Francesco Benincasa - last modified Feb 12, 2013 02:03

Date: 2016-11-05 anim ▼

The U.K. Met Office MSG dust product shows an estimation of the dust optical thickness retrieved from empirical relationship between SEVIRI infrared (10.8 μ m) radiance and aerosol optical depth at 550nm. It is generated by transforming original retrievals to regularly-spaced grids (0.18 degree) using simple average method.

WARNING: Some level of cloud contamination may exist in the MSGAOD product due to the lack of temporal differencing scheme in the cloud processing. These artefacts are predominant over the Sahel and southern latitudes.





(<u>http://sds-was.aemet.es</u>)

You are here: Home > Forecast & Products > Dust observations > MSG - EUMETSAT



- Observacions
 - In situ
 - MSG UK MO
 - MSG EUMETSAT





MET10 RGB-Dust 2015-10-30 09:00 UTC

MSG – EUMETSAT

Date: 2015-10-30

by Francesco Benincasa - last modified May 29, 2012 03:26 PM

anim •

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

Browsable images

- Observacions
 - In situ
 - MSG UK MO
 - MSG EUMETSAT
 - Debra-Dust

You are here: Home > Forecast & Products > Dust observations > DEBRA-Dust

DEBRA-Dust

by Enric Terradellas - last modified Jul 11, 2016 04:30







Visibility

Date 2015-10-26

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

- Browsable images
 - Observacions
 - In situ
 - MSG UK MO
 - MSG EUMETSA⁻
 - Debra-Dust
 - Visibility



by Francesco Benincasa - last modified Oct 28, 2015 09:32 AM

You are here: Home > Forecast & Products > Dust observations > Visibility





WMO SDS-WAS N_Africa-Middle East-Europe RC Visibility reduced by airborne dust - 26 Oct 2015 18-24 UTC 60*1 50*N 40°N 30°N 20°N 10°N 20°W 10°W 40°E 20°E 30°E 50°E 60°E uncertain <1 km 1 - 2 km 2 - 5 km .



[] <u>http://sds-was.aemet.es</u>

You are here: Home > Forecast & Products > Forecast evaluation > Model evaluation metrics

Monthly scores

by Francesco Benincasa - last modified Nov 27, 2014 11:51 AM

Date:

Numerical evaluation scores archive

Sep 2015. Dust Optical Depth. Threshold Angstrom Exponent = 0.600

BIAS

	BSC_ DREAM8b	MACC- ECMWF	DREAM8- NMME-MACC	NMMB/BSC- Dust	U.K. Met Office	NASA GEOS-5	NCEP	EMA RegCM4	DREAM ABOL	MEDIAN
Sahel/Sahara show stations	-0.28	-0.16	-0.12	-0.32	N/A	-0.20	-0.09	-0.05	0.02	-0.17
Middle East show stations	-0.28	-0.24	-0.22	-0.46	N/A	-0.27	-0.36	-0.23	0.02	-0.27
Mediterranean show stations	-0.31	-0.24	-0.23	-0.36	N/A	-0.25	-0.22	-0.20	-0.16	-0.26
TOTAL	-0.30	-0.20	-0.18	-0.35	N/A	-0.23	-0.17	-0.13	-0.06	-0.22

ROOT MEAN SQUARE ERROR

BSC_ DREAM8b	MACC- ECMWF	DREAM8- NMME-MACC	NMMB/BSC- Dust	U.K. Met Office	NASA GEOS-5	NCEP	EMA RegCM4	DREAM ABOL	MEDIAN
0.48	0.42	0.41	0.50	N/A	0.43	0.40	0.49	0.42	0.42
0.27	0.12	0.17	0.31	N/A	0.19	0.16	0.30	0.17	0.16
0.60	0.48	0.44	0.65	N/A	0.51	0.43	0.51	0.43	0.48
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.67	0.60	0.56	0.68	N/A	0.60	0.56	0.59	0.54	0.58
0.23	0.19	0.14	0.26	N/A	0.21	0.15	0.34	0.28	0.17
0.10	0.12	0.13	0.14	N/A	0.10	0.10	0.25	0.17	0.11
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.35	0.20	0.24	0.37	N/A	0.25	0.23	0.34	0.37	0.22
	ВSC_ DREAMSD 0.27 0.60 1.0.67 0.23 0.02 0.23 0.23 0.23 0.23 0.23	ВЗС_ DREAMBD МАСС- ECMWF 0.48 0.42 0.27 0.12 0.60 0.48 0.41 0.44 0.62 0.48 0.43 0.44 0.63 0.43 0.12 0.12 0.14 0.45 0.15 0.23 0.14 0.44 0.15 0.45	BRC_ DREAMB MACC- ECMUF DREAMB- NMME-MACC 0.48 0.42 0.41 0.027 0.12 0.017 0.060 0.48 0.44 1.040 0.44 0.44 1.040 0.48 0.44 1.040 0.48 0.44 1.041 0.44 0.44 1.042 0.44 0.44 1.043 0.44 0.44 1.043 0.49 0.44 1.043 0.41 0.44 1.044 0.44 0.44 1.045 0.41 0.44 1.045 0.41 0.44	BRC_ DREAMB MACC- ECMUF DREAMB- NMME-MACC NMMB/BSC- Dust 0.048 0.041 0.050 0.027 0.12 0.017 0.031 0.050 0.48 0.041 0.031 0.060 0.48 0.44 0.051 0.061 0.48 0.441 0.051 0.062 0.493 0.494 0.493 0.053 0.600 0.056 0.638 0.012 0.010 0.014 0.026 0.013 0.122 0.013 0.141 0.14 0.142 0.141 0.141 0.15 0.123 0.124 0.141 0.14 0.142 0.141 0.141 0.15 0.141 0.141 0.141	BRC_ DREAMBREAMB- NMME-MACCNMMB/BSCK.K.Met OfficeQ.48S.42Q.43Q.50N/AQ.027Q.12Q.017Q.31N/AQ.027Q.12Q.017Q.31N/AQ.050Q.48Q.44Q.65N/AQ.40Q.48Q.44Q.65N/AQ.40Q.44Q.404Q.44A/AQ.41Q.44Q.45Q.44A/AQ.42Q.41Q.44Q.44A/AQ.43Q.49Q.41Q.44A/AQ.43Q.41Q.44Q.44A/AQ.43Q.42Q.41Q.44A/AQ.43Q.42Q.42Q.44A/A	BSC_ DREAMBNAMCNRAME-MACCNMMB/BSCU.K. MET OfficeNASA GEOS-5Q.48Q.42Q.401Q.500N/AQ.43Q.027Q.12Q.017Q.031N/AQ.19Q.050Q.48Q.017Q.031N/AQ.19Q.050Q.48Q.444Q.055N/AQ.19Q.051Q.48Q.444Q.055N/AQ.14Q.051Q.48Q.444Q.655N/AQ.14Q.053Q.19Q.104Q.164N/AQ.10Q.101Q.121Q.101Q.144N/AQ.14Q.135Q.202Q.244Q.377N/AQ.25	BSC_ DREAMBNACC- ECMWFDREAMB- NMME-MACCNMMB/BSCUK. Met OfficeNASA ECMUSNCEP NGACQ.48Q.42Q.401Q.500N/AQ.431Q.4010.0270.120.0170.031N/A0.0190.1610.0500.480.0440.055N/A0.0510.4310.0400.480.0440.055N/A0.0510.4310.0510.0480.0400.0400.0400.0410.0410.0520.0590.0560.068N/A0.0100.1610.0230.0190.0140.0260.1410.1410.1010.0100.121Q.1013Q.141N/AN/AN/A0.0350.2000.201Q.131N/AN/AQ.251	BSC_ DREAMSNAGC- NMME-MACCREAMS- NMME-MACCNMMB/BSC DustNASA OfficeNCEP NGACRMA RegotableQ.48Q.42Q.441Q.500N/AQ.431Q.401Q.401Q.027Q.12Q.017Q.031N/AQ.19Q.161Q.301Q.030Q.48Q.017Q.031N/AQ.19Q.161Q.301Q.040Q.44Q.014Q.015Q.44Q.44Q.44Q.44Q.040Q.44Q.444Q.455N/AQ.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44Q.44Q.45Q.44Q.44Q.44Q.44Q.44 <td>BSC_ DREAMSNAME-MACCNMMB/DSC DustNASA OfficeNCEP RECOVERAA RegOMAREAM REGOMA0.480.42D.41D.50N/AD.43D.40D.42D.430.0270.120.0170.031N/A0.0190.160.0300.170.0500.480.0170.031N/A0.0190.160.0300.170.0600.480.0140.055N/A0.040.040.040.040.0740.0480.0140.056N/A0.040.040.040.040.0610.040.0560.040.0560.040.050.040.040.0510.040.0560.040.040.040.040.040.040.0530.0590.0560.0560.040.0560.0560.0560.0560.0540.0590.0510.0510.0510.0510.0510.0510.0560.0530.0190.0140.026N/AN/AN/A0.0160.0260.0170.0540.0200.0240.037N/AN/AN/AN/A0.0250.0310.0310.0550.230.240.2440.377N/AN/A0.0250.230.340.3710.0550.240.2440.377N/AN/A0.250.230.340.3710.0550.240.2440.377N/AN/A<td< td=""></td<></td>	BSC_ DREAMSNAME-MACCNMMB/DSC DustNASA OfficeNCEP RECOVERAA RegOMAREAM REGOMA 0.480.42D.41D.50N/AD.43D.40D.42D.43 0.0270.120.0170.031N/A0.0190.160.0300.170.0500.480.0170.031N/A0.0190.160.0300.170.0600.480.0140.055N/A0.040.040.040.040.0740.0480.0140.056N/A0.040.040.040.040.0610.040.0560.040.0560.040.050.040.040.0510.040.0560.040.040.040.040.040.040.0530.0590.0560.0560.040.0560.0560.0560.0560.0540.0590.0510.0510.0510.0510.0510.0510.0560.0530.0190.0140.026N/AN/AN/A0.0160.0260.0170.0540.0200.0240.037N/AN/AN/AN/A0.0250.0310.0310.0550.230.240.2440.377N/AN/A0.0250.230.340.3710.0550.240.2440.377N/AN/A0.250.230.340.3710.0550.240.2440.377N/AN/A <td< td=""></td<>



(<u>http://sds-was.aemet.es</u>)



Numerical data archive



Files Download

by Francesco Benincasa — last modified Jan 16, 2015 01:31 PM — History

This page allows downloading numerical dust forecasts issued by different dust prediction models. Dust models may have very different characteristics (global or regional, horizontal and vertical resolutions, dust emission and deposition parameterizations, presence or absence of data assimilation, feedback to the meteorological model, ...). Information on the characteristics and configurations of the models can be found on their respective websites.

Please be sure to read the data policy.

Models currently available are:

BSC-DREAM8b v2.0	DOWNLOAD FILES	Model website	Barcelona Supercomputing Center Center Nacional de Supercomputación
MACC-ECMWF	DOWNLOAD FILES	Model website	Constant of the second
DREAM-NMME-MACC	DOWNLOAD FILES	Model website	SEEVCCC
NMMB/BSC-Dust	DOWNLOAD FILES	Model website	Barcelona Supercomputing Center Center Nacional de Supercomputación
NASA-GEOS-5	DOWNLOAD FILES	Model website	NASA
NCEP-NGAC	DOWNLOAD FILES	Model website	NCEP
DREAMABOL	DOWNLOAD FILES	Model website	ISAC
EMA-RegCM4	DOWNLOAD FILES	Model website	EGYPTIAN METEOROLOGICAL AUTHORITY
Multimodel MEDIAN	DOWNLOAD FILES	Model website	

http://sds-was.aemet.es

Numerical evaluation scores archive

Numerical data archive

Data download

Title	Size	Modified				
latest - (download all)	4.0 kB	Nov 18, 20:	14 10:40 P	м		
2014 - (download all)	4.0 kB	Nov 01, 203	14 10:40 P	м		
2013 - (download all)	Title		Size	Modified		
2012 - (download all)	11 - (d	ownload all)	4.0 kB	Nov 18, 2014 10:40 PM		
	10 - <i>(d</i>	ownload all)				
ρ	09 - (d	ownload all)	Title		Size	Modified
C	08 - (d		20141	118_BSC_DREAM8b_V2.nc	47.7 MB	Nov 18, 2014 0
	07 - (d		20141	117_BSC_DREAM8b_V2.nc	47.7 MB	Nov 17, 2014 0
	07 (0		20141	116_BSC_DREAM8b_V2.nc	47.7 MB	Nov 16, 2014 0
	UD - (a	ownioad all)	20141	115_BSC_DREAM8b_V2.nc	47.7 MB	Nov 15, 2014 0
	05 - (d	ownload all)	20141	114 BSC DREAM8h V2 pc	47 7 MB	Nov 14 2014 0
	04 - (d	ownload all)	20111	111_000_0NEXM00_V2.md	17.7 100	1000 11, 2011 0
	03 - (d	ownload all)	20141	113_BSC_DREAM8b_V2.nc	47.7 MB	Nov 13, 2014 0
	02 - (d	ownload all)	20141	112_BSC_DREAM8b_V2.nc	47.7 MB	Nov 12, 2014 0
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			20141	109_BSC_DREAM8b_V2.nc	47.7 MB	Nov 09, 2014 0
			20141	108_BSC_DREAM8b_V2.nc	47.7 MB	Nov 08, 2014 0



I Data files download

First step: <u>REGISTER</u> to the portal (go to home page and click on the top-right link – temporally suspended, send and email to <u>sdswas@aemet.es</u>)

Go to <u>data download</u> page and download manually: follow model link and choose year, month and/or day ...



I Data files download

... or download automatically with a program (i.e. <u>WGET</u>):

a single file:

wget --http-user="YOUR_REGISTRATION_EMAIL" --http-password="YOUR_REGISTRATION_PASSWORD" --auth-no-challenge http://MODEL_REPOSITORY_URL/YYYY/MM/YYYYMMDDMODEL_NAME.nc

an entire month/year:

wget --http-user="YOUR_REGISTRATION_EMAIL" --http-password="YOUR_REGISTRATION_PASSWORD" --auth-no-challenge http://MODEL_REPOSITORY_URL/YYYY/MM/@@download -O FILENAME.zip

the latest file:

wget --http-user="YOUR_REGISTRATION_EMAIL" --http-password="YOUR_REGISTRATION_PASSWORD" --auth-no-challenge http://MODEL_REPOSITORY_URL/latest/@@download -O FILENAME.zip



(Materials

World Heteorological Organization Water Cana - New			-MIDDLE EAST-EU O Sand and Dust Storm	UROPE (N Warning Advis	A-ME-E sory and As	REGION sessment Sy MO SDS WAS []	Log in IAL CENTER stem (SDS-WAS) Asia Regional Center
HOME A	BOUT US	FORECAST & PRODUCTS	PROJECTS & RESEARCH	MATERIALS	NEWS	EVENTS	CONTACT US
Materials		You are here: Ho	me > Materials				
 Training Workshops 		Materials by Enric Terradellas	— last modified Oct 29, 2015 11:5	54 AM			
> Dust Events		This section inclu	des different materials relate	d to mineral dust			
 Scientific Doc Technical Rep 	umentatio oorts	training mate workshops information o	rials n several dust events			Г	\mathbf{m}
> Meningitis		scientific doct technical repo	orts				
> ACMAD bullet	ins	 information o information r WMO SDS-W 	n dust impacts (meningitis). elative to different events car AS (meetings, training course	rried out in the fr	amework of t	ne	
Search Search Site	Search	Print this					



Barcelona Supercomputing Center Centro Nacional de Supercomputación

Barcelona Dust Forecast Center





(Operational center

Operated by BSC and AEMET

Officially recognized by the WMO

72 hours forecast (3-hourly) model developed at BSC

6 variables (Optical depth, Dry and Wet deposition, Load, Surface concentration, Surface extinction)



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

(Products

Forecast images
 Google Earth integration (KML/KMZ files)
 Averaged values images
 Zoomed area forecast images (Spain, Burkina Faso, ...)



You are here: Home / Forecast

Dust Optical Depth





What are KML/KMZ files?



You are here: Home / Other products / Averaged values

Monthly averaged values

Monthly averaged values of dust surface concentration and dust load computed from the daily runs of the NMMB/BSC-Dust model.

Date 2015-10

Methods: Time-averaged values

NOTE: Click on the images to enlarge

Monthly Averaged Dust Surface Concentration (µm/m³)









(Services

Forecast images dissemination
 WMO GTS (Global Telecommunication System)
 EUMETCast (EUMETSAT's primary dissemination mechanism)







(WMO GTS

- Global network for transmission of meteorological data
- Data proceeding from weather stations, satellites and NWP centres
- Implemented and operated by
 - National meteorological services
 - Other international organizations (ECMWF, EUMETSAT, ...)



(WMO GTS





(EUMETCast

- Multi-service dissemination system based on standard Digital Video Broadcast (DVB) technology
- It uses commercial telecommunication geostationary satellites
- Multi-cast files (data and products) to a wide user community
- From 15th of October 2015 BDFC products are distributed over Europe and Africa



(EUMETCast







Barcelona Supercomputing Center Centro Nacional de Supercomputación

Data visualization

(Grid Analysis and Display System (GrADS)

- (<u>Ncview</u>
- (<u>McIDAS</u>
- **(ECMWF**<u>MetView</u>
- (Panoply data viewer

(MapGenerator (Python-based, home-made)



Data visualization – MapGenerator

(Problem

- Need to show results with high quality plots for an operational system
- Handling a huge quantity of data with tons of scripts can be very frustrating
- Hard to
 - Debug
 - Maintain
 - Add features, bug fixing, etc ...
- **(Solution**
 - Develop an easy to use general-purpose software system able to generate plots

(Software Stack: python/numpy/scipy/OpenGrADS



Data visualization – MapGenerator

(Various formats support (NetCDF, GRIB, HDF, ...)

Configuration through configuration file(s), no need to touch the code!

	[DREAM_asia_aod]
<pre>[General] aspect = False drawopts = 'coastlines', 'countries', area_thresh = 100 resolution = 'l' anim = True indir = '/home/dream/ETA_DREAM_v2/ASIA/OPER8N/eta.1.a/grads' outdir = '/home/sdswas/dream-images/data/images' lat = 5., 60., 10. lon = 58., 130., 10. total = 13 freq = 6 interval = 1 gap = 1, srcfile = 'CSFC.ctl', xsize = 1 ysize = 0.9 dpi = 56 joint_template = '%(date)s-JOINT-%(step)s'</pre>	<pre>title = """BSC-DREAM8b Dust Opt. Depth 550nm and 3000m Wind %(step)sh forecast for %(simhh)sUTC %(day)s %(MONTH)s %(year)s %http://www.bsc.es/projects/earthscience/BSC-DREAM/\$ """ bounds = 0.02, 0.15, 0.4, 0.8, 1.6, 3.2, 6.4 boundaries = 0, 10 lat = 5., 60., 10. lon = 45., 130., 10. total = 13 freq = 6 interval = 1 gap = 1, colors = '#A1EDE3', '#5DE3BB', '#53BD9D', '#FCCA26', '#E5724C', '#944038', over = '#AB025C' under = '#AB025C' under = '#ffffff' var = 'dod', srcfile = 'CSFC.ctl', wind = 'DUST.ctl' windopts = 'u.2', 'v.2', '6' xsize = 1 ysize = 0.9 dpi = 300</pre>
	<pre>img template = '%(date)s image %(step)s'</pre>



(WMO Dust Centers

(CALIOPE Air quality forecast system: <u>www.bsc.es/caliope</u>

(NMMB/BSC-Dust Forecast on BSC website

I BSC-DREAM8b v2.0 Atmospheric Dust Forecast System on BSC website

Used by some researchers in the department to plot maps for articles, posters or presentations



(Installation

- Java: <u>www.java.com</u>
- Panoply: www.giss.nasa.gov/tools/panoply/
- In case of memory problems, launch manually:

C:\> "C:\Program Files\Java\jre\bin\java" -Xmx1g -jar "C:\Program Files\PanoplyWin\jars\Panoply.jar"



Data visualization – Panoply





Data visualization – Panoply

OD550_DUST in 20131202_BSC_DREAM8b_V2

File Edit View History Bookmarks Plot Window Help

Plot / Array

Dataset: 20131202_BSC_DREAM8b_V2.nc Variable: OD550_DUST, OD550_DUST Units: -

						X-Axis: I	ongitude (°E)				
		67	-12,333	-12,000	-11,667	-11,333	-11,000	-10,667	-10,333	-10,000	-9,667
	63,000	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
	62,667	NaN	NaN	NaN	0,0E+00	0,0E+00	0,0E+00	1,7E-06	0,0E+00	0,0E+00	1,6E
	62,333	E+00	0,0E+00	6,9E-06	1,1E-05	6,5E-06	2,0E-05	4,3E-05	5,1E-05	6,0E-05	9,2E
	62,000	4E-05	2,7E-05	3,8E-05	5,6E-05	5,9E-05	6,6E-05	8,7E-05	1,1E-04	1,3E-04	1,4E
<u> </u>	61,667	5E-05	5,6E-05	5,7E-05	6,3E-05	6,7E-05	7,1E-05	7,9E-05	9,9E-05	1,2E-04	1,4E
0	61,333	2E-05	5,4E-05	5,6E-05	5,8E-05	6,0E-05	6,8E-05	8,4E-05	1,0E-04	1,2E-04	1,4E
- Pe	61,000	DE-05	5,2E-05	5,5E-05	5,8E-05	6,3E-05	7,8E-05	9,3E-05	1,1E-04	1,3E-04	1,5E
gti	60,667	9E-05	5,2E-05	5,5E-05	6,0E-05	7,5E-05	9,0E-05	1,1E-04	1,3E-04	1,5E-04	1,6E
is l	60,333	DE-05	5,3E-05	5,7E-05	7,3E-05	8,9E-05	1,1E-04	1,3E-04	1,4E-04	1,6E-04	1,7E
-Axi	60,000	2E-05	5,6E-05	7,1E-05	8,8E-05	1,0E-04	1,3E-04	1,5E-04	1,7E-04	1,7E-04	1,8E
× 🗌	59,667	5E-05	7,0E-05	8,7E-05	1,0E-04	1,3E-04	1,5E-04	1,7E-04	1,8E-04	1,9E-04	1,9E
	59,333	9E-05	8,6E-05	1,0E-04	1,2E-04	1,5E-04	1,7E-04	1,8E-04	1,9E-04	2,0E-04	1,9E
	59,000	5E-05	1,0E-04	1,2E-04	1,5E-04	1,7E-04	1,8E-04	1,9E-04	2,0E-04	1,9E-04	1,8E
	58,667	DE-04	1,2E-04	1,4E-04	N 1,6E-04	1,8E-04	1,9E-04	2,0E-04	1,9E-04	1,8E-04	1,7E
F	58.333	2E-04 ∢	1.3E-04	1.6E-04	1.7E-04	1.8E-04	1.9E-04	1.9E-04	1.8E-04	1.7E-04	1.5E
						Format	: %.1E 👻				
Ari	ray(s) Sc	ale C	ontours & Veo	ctors Map	Labels						
					Plot Map	✓ of	Array 1 Only 👻	Interpolat	e		
				Array 1: C	D550_DUST						
				Time: 1	of 25 = 2013-1	2-02 12:00:00	•				

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Slice: Time [1 of 25] = 2013-12-02 12:00:00





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Data manipulation

(Formats: NetCDF



- Developed and maintained at <u>Unidata</u> (UCAR)
- Well documented with complete <u>technical information</u>
- With a large list of <u>supporting software</u>



Data manipulation

(A NetCDF dataset contains

Dimensions

lon = 289 ; // longitude, number of points in the X axis
lat = 211 ; // latitude, number of points in the Y axis
time = 25 ; // number of timesteps

Variables

float sconc_dust(time, lat, lon) ;
 sconc_dust:long_name = "dust 10m concentration" ;
 sconc_dust:units = "kg m-3" ;
 sconc_dust:title = "dust 10m concentration" ;
 sconc_dust:_FillValue = -9.e+33f ;

And, of course, **numerical values**!



Data manipulation

(Metadata!

Data must be understandable: migrograms and kilograms are not the same!

Follow standards

Numerical metadata

Time units

int time(time) ;
 time:units = "hours since 2015-02-23 12:00:00.0" ;
 time:description = "time forecast" ;

Missing value

SCONC_DUST:missing_value = -999.f SCONC_DUST:_FillValue = -999.f



NetCDF3 "classic" diagram



A file has named variables, dimensions, and attributes. Variables also have attributes. Variables may share dimensions, indicating a common grid. One dimension may be of unlimited length.



From Unidata's NetCDF Data Model: http://www.unidata.ucar.edu/software/netcdf/docs/netcdf_data_model.html

NetCDF4 enhanced data model



A file has a top-level unnamed group. Each group may contain one or more named subgroups, user-defined types, variables, dimensions, and attributes. Variables also have attributes. Variables may share dimensions, indicating a common grid. One or more dimensions may be of unlimited length.



From Unidata's NetCDF Data Model: http://www.unidata.ucar.edu/software/netcdf/docs/netcdf_data_model.html

(NetCDF Operator (NCO)

(Climate Data Operators (CDO)

(Programming languages like <u>R</u> or <u>Python</u>



(Download the <u>installer</u> and execute it(Put the NCO directory in the PATH:

- 1. Right-click on "My computer" -> Properties -> Advanced -> Environment Variables
- 2. In "System variables" chose "Path" variable and click the "Edit" button.
- 3. Append the NCO path after a semicolon, e.g.: ORIGINAL_PATH;C:\nco

[Read the <u>documentation</u>!



Data manipulation – NCO/NCKS

(Append content

ncks -A FILEIN.nc FILEOUT.nc

(Isolate variable

ncks -v VAR FILEFROM.nc FILETO.nc

(Select an area

ncks -d longitude,260, 20150223_BSC_DREAM8b_V2.nc 20150223_BSC_DREAM8b_V2_cutted.nc



(Ncap2, the arithmetic processor

ncap2 -O -s 'SCONC_DUST=0.00347949*(exp(Insp)/t)*(aermr04+aermr05+aermr06)' IN.nc OUT.nc

(C Ncatted, the attribute editor

ncatted -a long_name,T,o,c,temperature IN.nc

(Ncrename

ncrename -h -O -v duaod550,OD550_DUST IN.nc OUT.nc



(Download and unzip the <u>compressed file</u>

If Put the CDO directory where you like in you filesystem and add the PATH to system one (like NCO)

(Read the <u>documentation</u>!



Data manipulation – CDO/Examples

(File info

cdo sinfov FILENAME.nc

(Select area

cdo sellonlatbox,25,60,10,30 FILEIN.nc FILEOUT.nc

(Time mean

cdo timmean FILEIN.nc FILEOUT.nc



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Thank you!

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