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Jornada técnica sobre observación de la Tierra

Centro Oceanográfico de Canarias (Tenerife)
12 de diciembre de 2006

El sistema de aviso de tormentas de polvo y arena para Europa, África del Norte y la Península Arábiga

WMO

Emilio Cuevas
INSTITUTO NACIONAL DE METEOROLOGÍA
Observatorio Atmosférico de Izaña

GEO Group on Earth Observations

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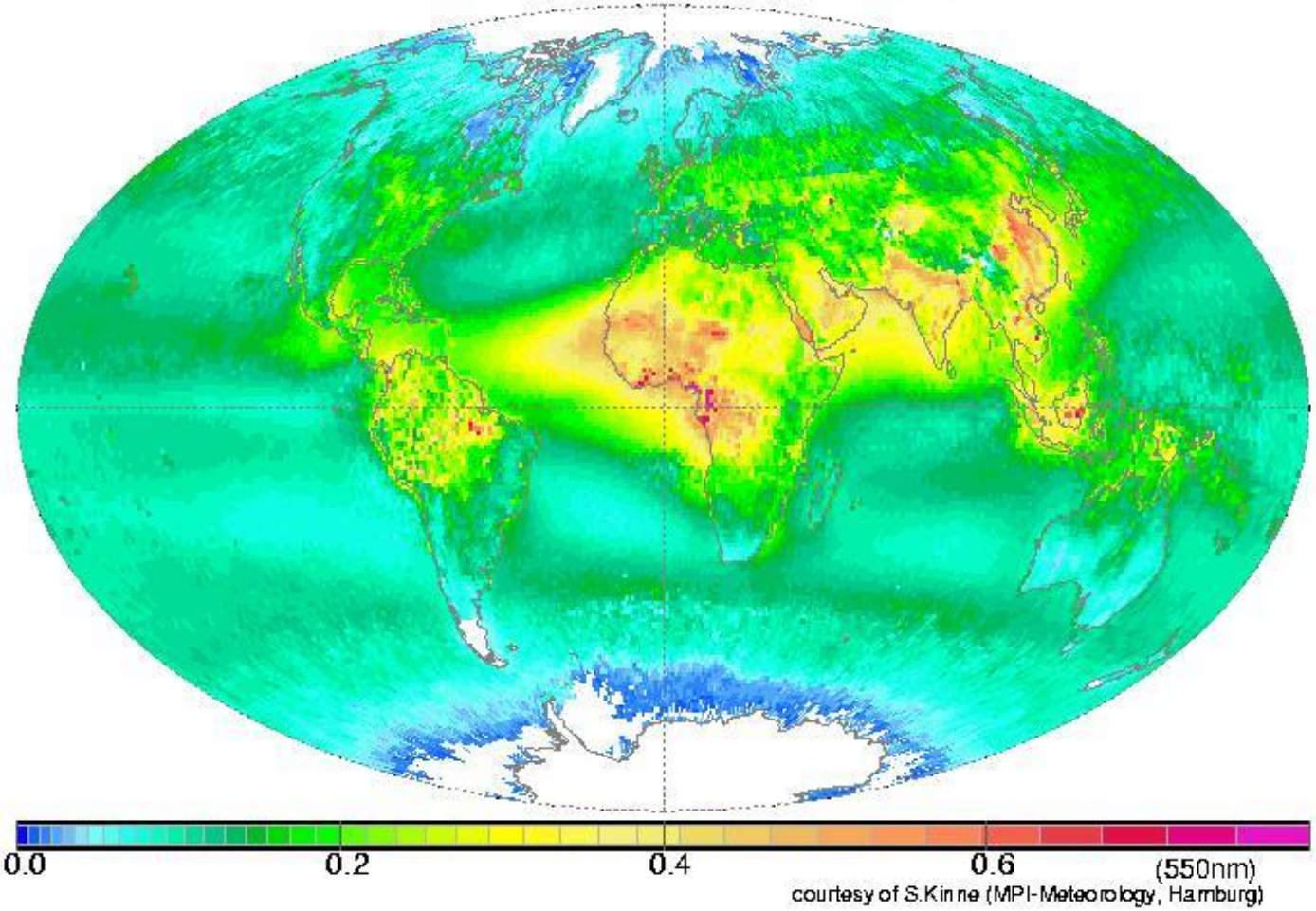
SATELLITE COMPOSITE of AOD



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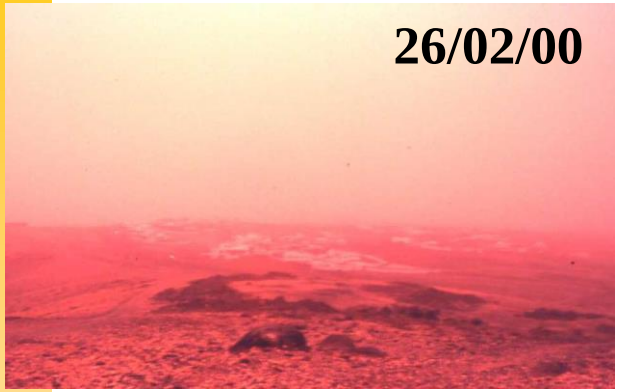
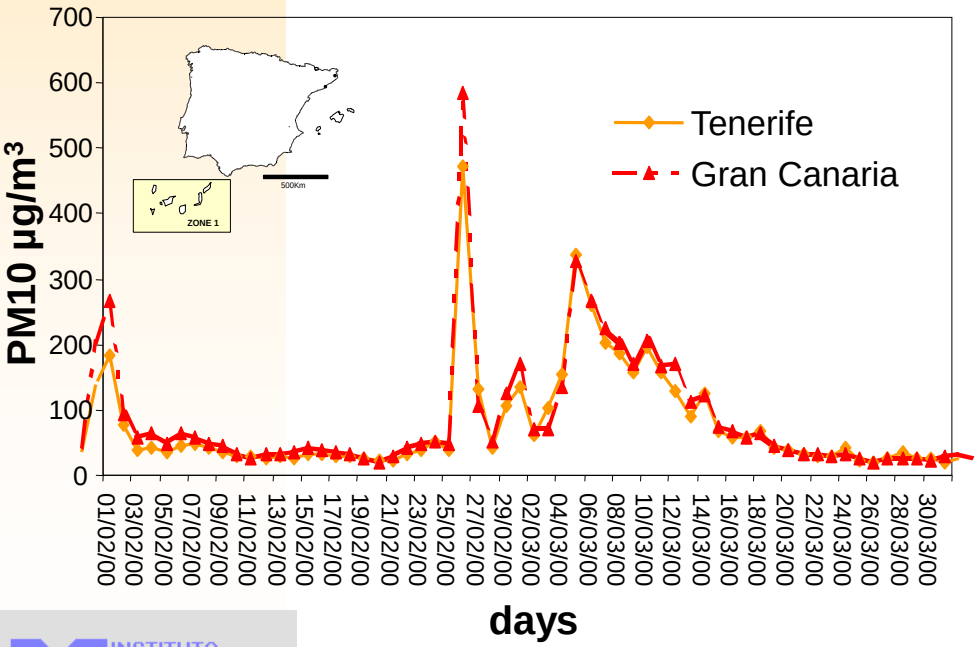
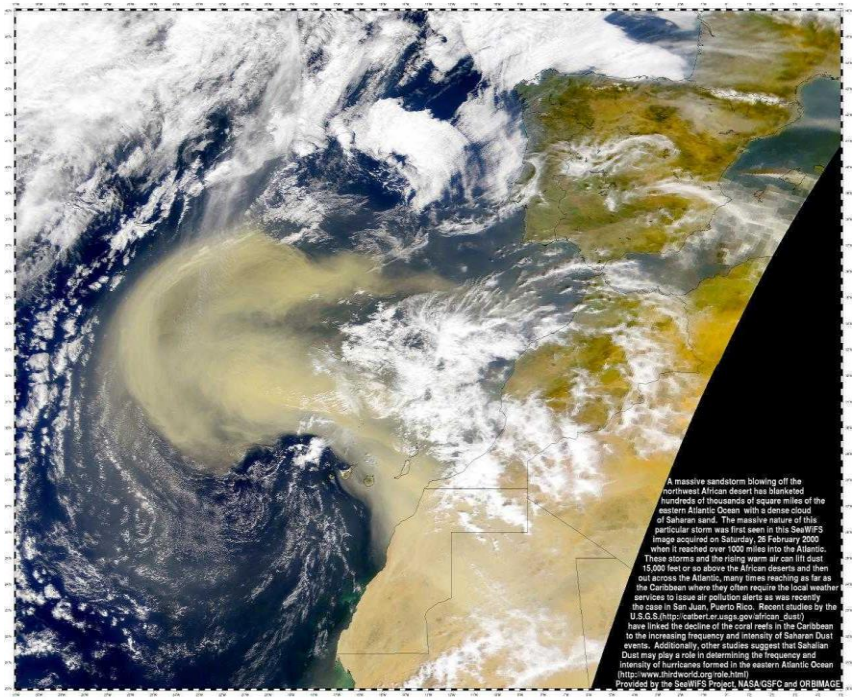
SDS impacts (1)







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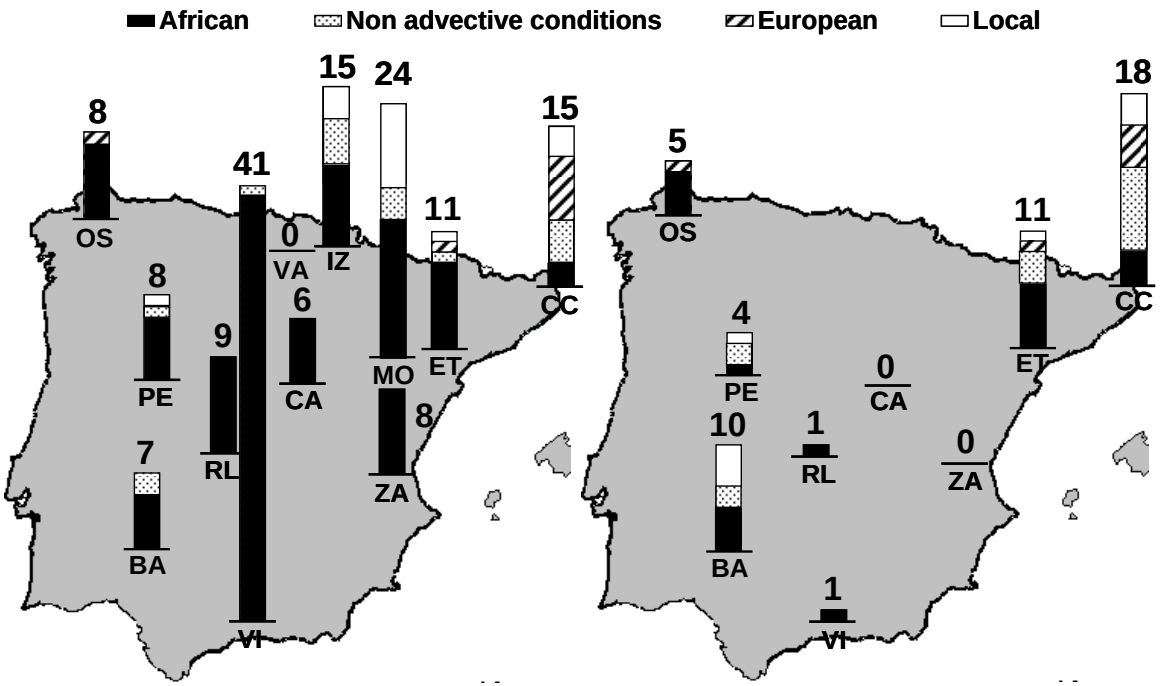
SDS impacts (2)

AIR QUALITY:

European directives

EMEP stations :Exceedances of the daily limit values (2001-2003)



EPISODES	PM10 > 50 µg m^{-3}	PM2.5 > 35 µg m^{-3}
ATLANTIC (LOCAL)	0-8	0-4
AFRICAN	2-40	0-6
EUROPEAN	0-6	0-4
WITHOUT ADVECTION		
TOTAL	0-4	0-8
	0-41	*0-18*

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SDS impacts (3)

INTERACTIVE RADIATION-DUST-CLOUD SYSTEMS

- A component of future chemical weather forecast models
- *Interactive dust-radiation* → to describe direct aerosol effects
- *Interactive dust-cloud* → to describe indirect aerosol effects

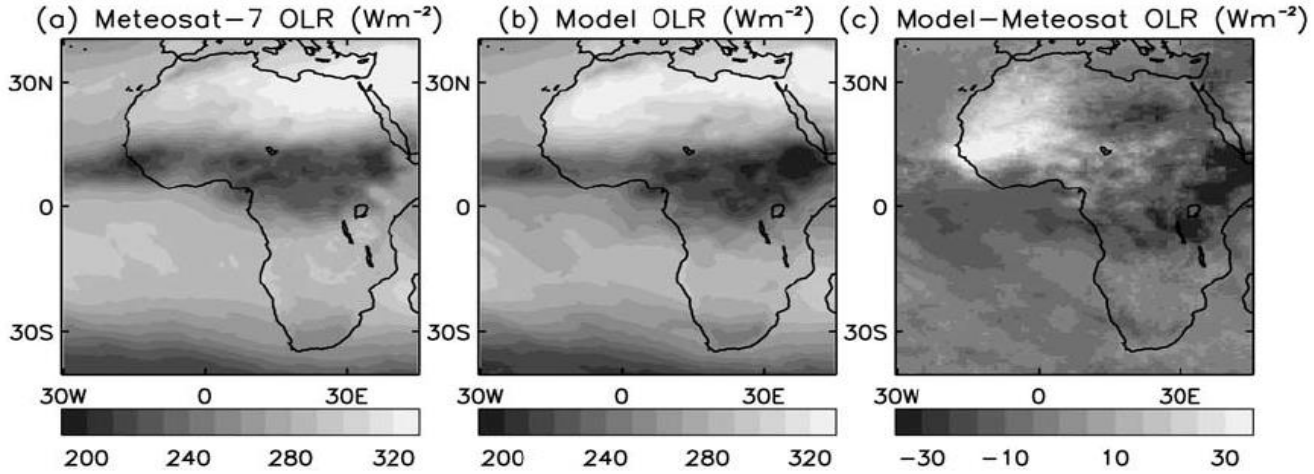

Figure 1. The July 2003 monthly mean for (a) OLR_{Met7}, (b) OLR_{model}, and (c) $OLR_{model} - OLR_{Met7}$. The monthly mean consists of the average of the monthly mean of the OLR diagnosed at 0000 UTC, 6000 UTC, 1200 UTC, and 1800 UTC. Units are Wm^{-2}. See color version of this figure in the HTML.

Can desert dust explain the outgoing longwave radiation anomaly in the UK operational model over the Sahara?
Haywood, et al., JGR 2003

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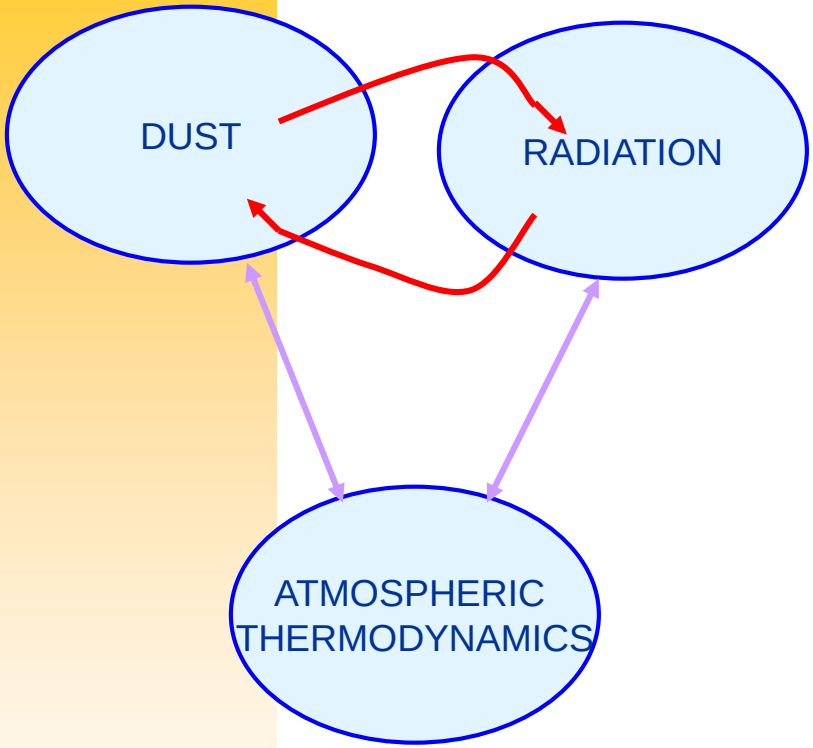
SDS impacts (4)

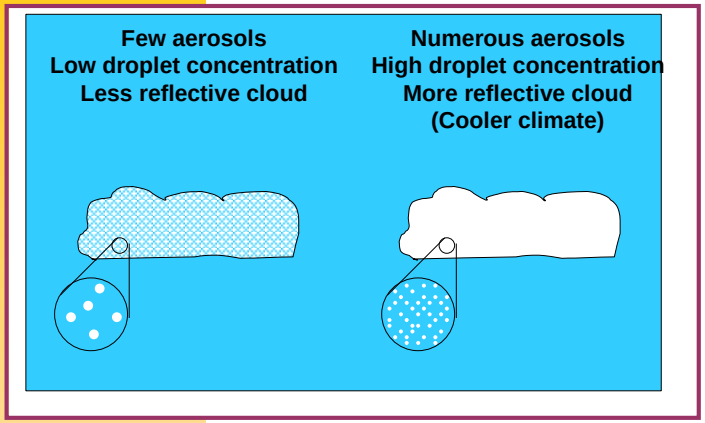


Direct effects

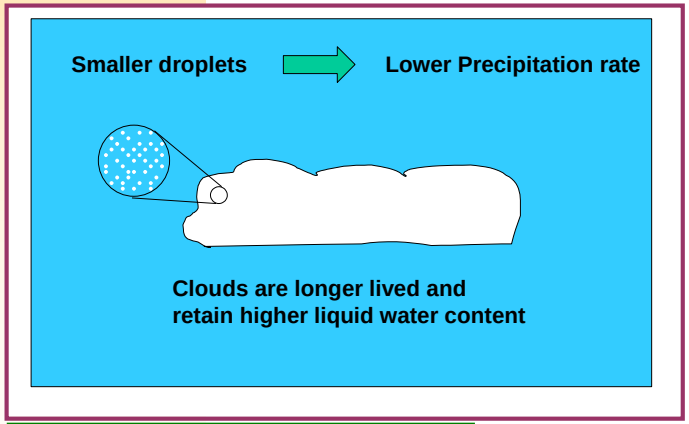
- Effects: ground cooling and slight upper-air heating
- I. Tegen's group – *first* interactive dust-radiation scheme in a global model (Perlwitz et al, 2001)
- Nickovic 2004: interactive scheme - a potential to *improve weather forecasts* in a regional model

Ground cools down to ~5^0 C during strong SDS

SDS impacts (5)



1st indirect aerosol effect



2nd indirect aerosol effect

Dust-clouds-radiation interactions – room for improvements of both dust and atmospheric models

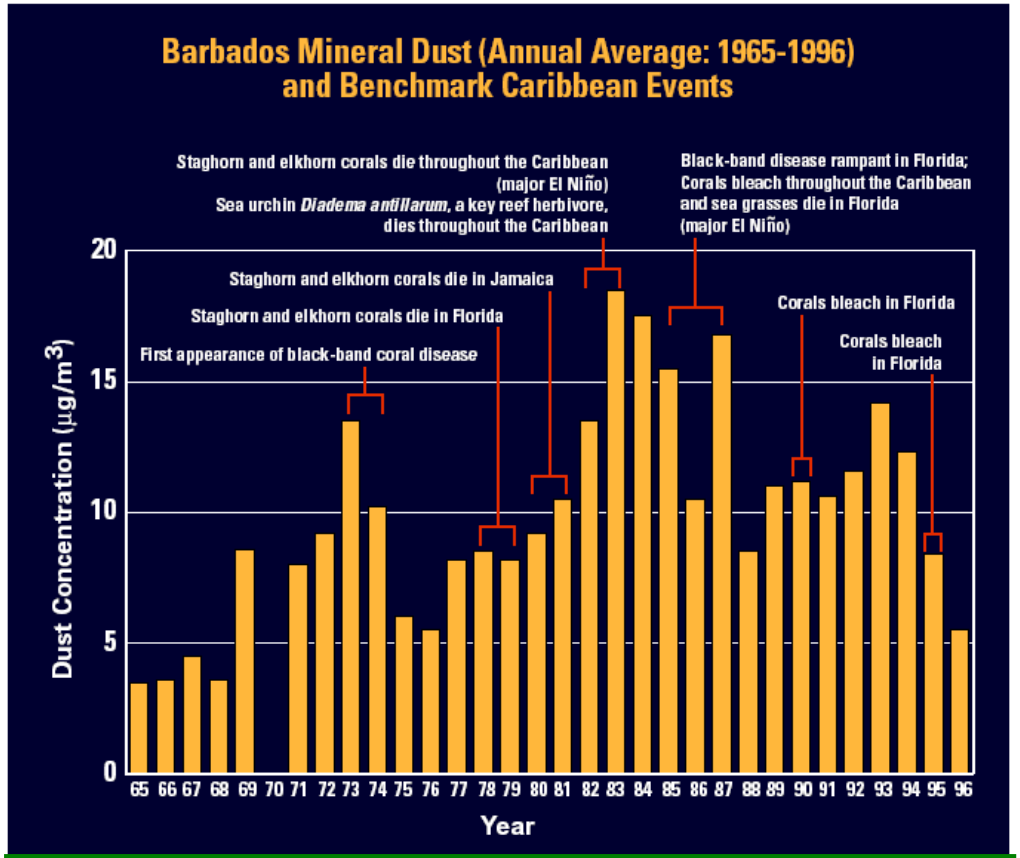
SDS impacts (6)

HEALTH:

Bronchial tubes,eye infections, asthma, heart stress

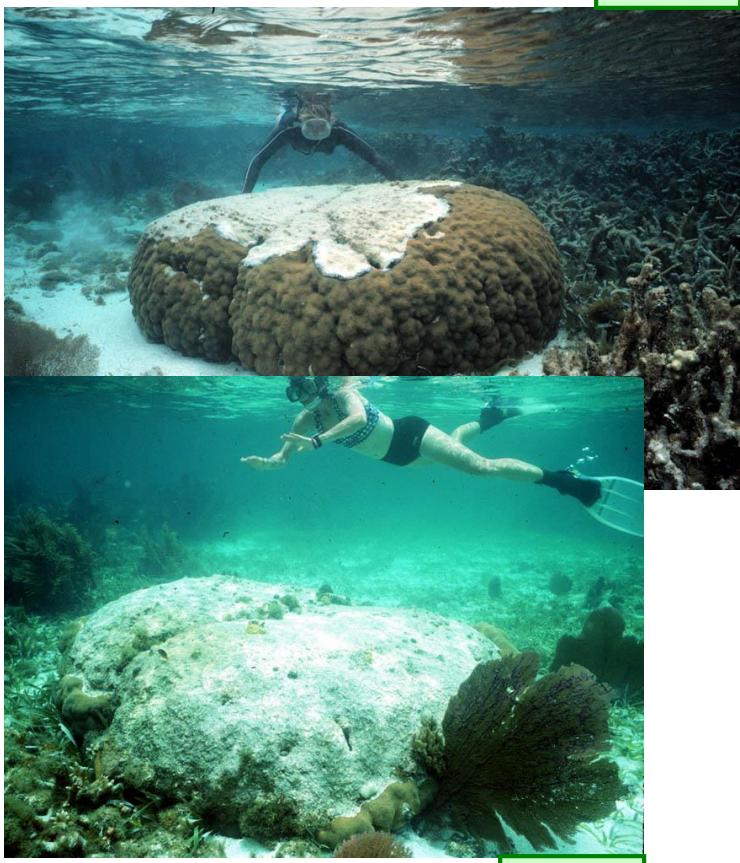
SDS impacts (7)

ENVIRONMENT:
Coral mortality and African dust



Courtesy of Dr. Joe Prospero, University of Miami

1988



1998

SDS impacts (8)

ENVIRONMENT:
Iron deposition to oceans

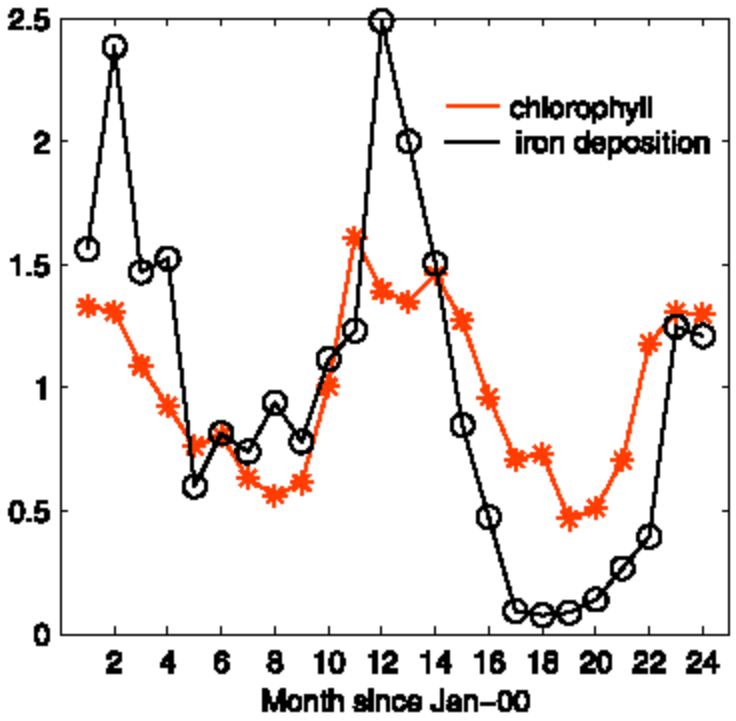
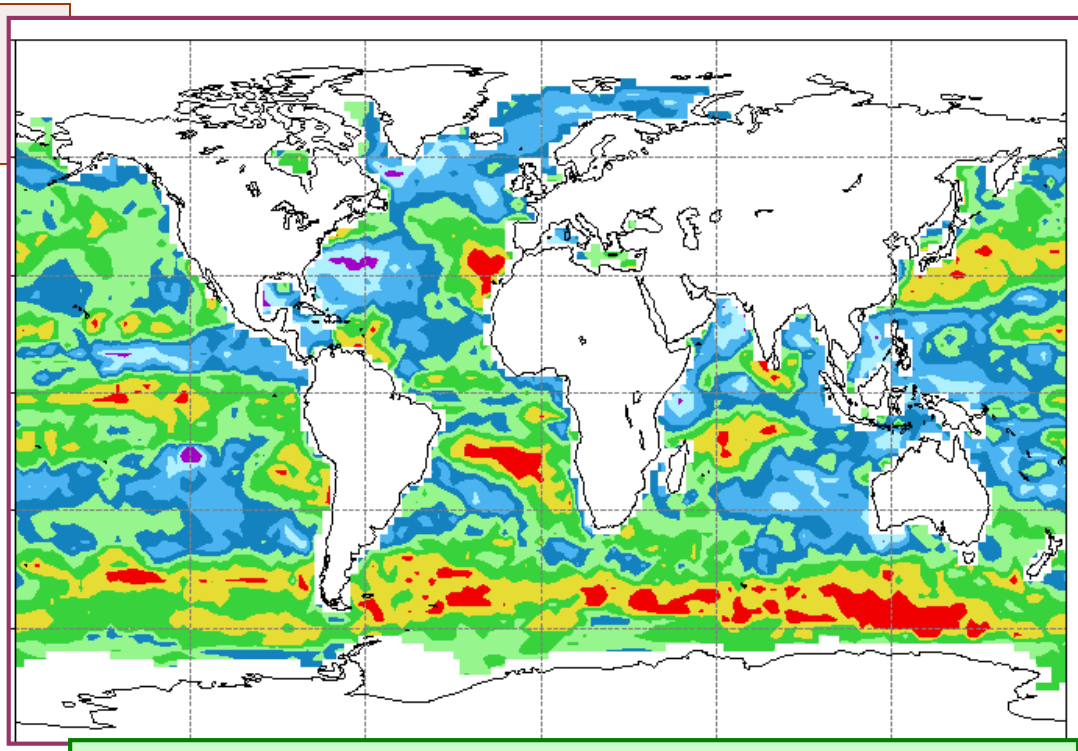


Figure 4. The standarized time series of the SeaWiFS chlorophyll and dust-Fe deposition for the 24 month period for the region 62.5W-42W, 40S-60S. This simple representation of the data averaged over the study region indicates correlation between Fe deposition and *Chl* that is more quantitatively represented in Figure 1.



Correlation coefficient between SeaWiFS chlorophyll vs. model deposition
Erickson, D., et al. 2002

Erickson et al., GRL, 2003

SDS impacts (9)

HEALTH, ENVIRONMNET:
Transcontinental transport of microorganisms

- Evidence: Saharan dust carries bacteria and fungi across the Atlantic
- 10,000 microbs/(gr of soil)
- 30 percent of the bacteria isolated from airborne soil dust are known pathogens, able to affect plants, animals, or humans (Griffin et al., 2003)

(Prospero et al, 2005)

Figure 4. Microbial growth on a sample filter collected during an African dust event in the US Virgin Islands, after 96 hours of incubation. Sample collected from Deck Point, St. Thomas, US Virgin Islands on 8 August, 2001 at 1145 am.

Sample filter collected during African dust event in the US Virgin Islands
Griffin et al., 2003

"…Endospores of *Bacillaceae* bacteria isolated from non-saline Japanese soil may be transported by Kosa event…"

Akinobu Echigo et al., 2003

SDS impacts (10)

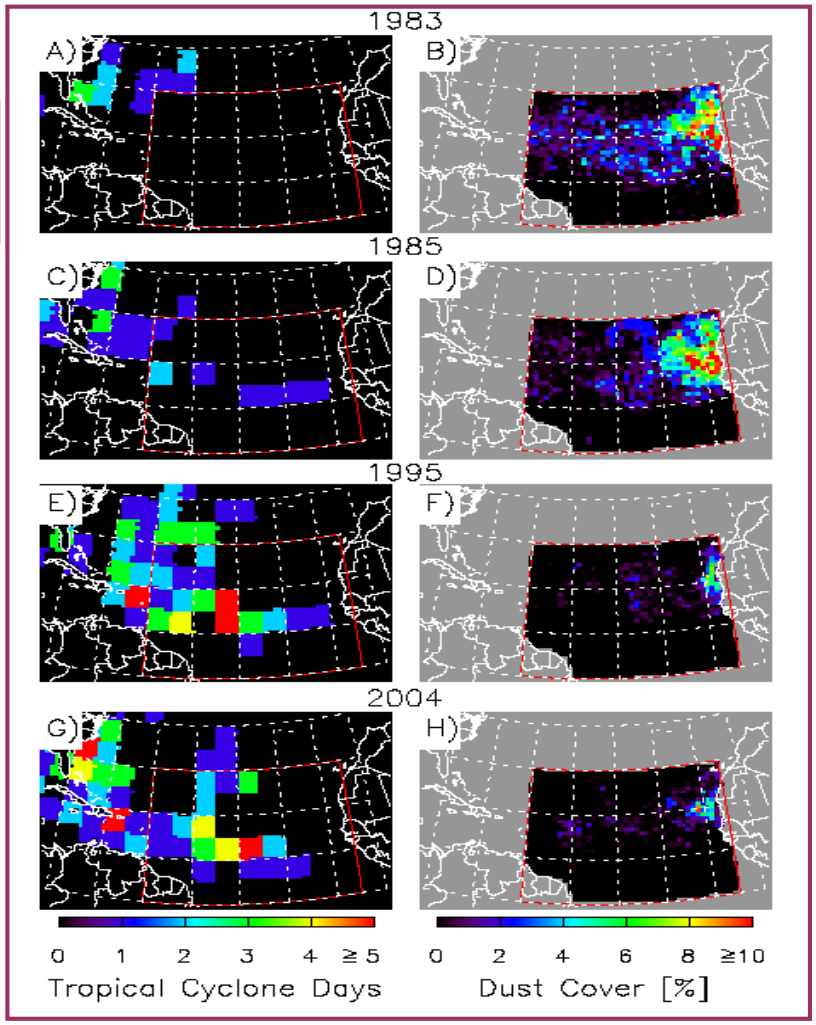
Dust and tropical storms

Recent evidence:

Amato T. Evan et al., 2006, JRL, New evidence for a relationship between Atlantic tropical cyclone activity and African dust outbreaks

Increased % of dust cover in the Eastern Atlantic → decreased number of tropical cyclones

A hypothesis: cyclogenesis and cyclone evaluation is reduced in the presence of sand and dust aerosol



Tropical cyclone days vs. dust cover
Evan et al., 2006

SDS impacts (11)

AGRICULTURE:
Transcontinental transport of microorganisms

Kellogg, Griffin, 2005:

Fungal diseases, affecting crops like sugarcane and bananas, have appeared in the Caribbean within a few days after an outbreak in Africa.

Identified bacterial pathogens of rice and beans in the Caribbean air samples, as well as those that cause disease in fruit and a variety of trees, from African air samples.

Speculation: African dust may carry the virus responsible for Foot and Mouth Disease (which is endemic to sub-Saharan Africa) because tentative links have been made between dust storms that passed over Great Britain and subsequent outbreaks of the disease at multiple points.

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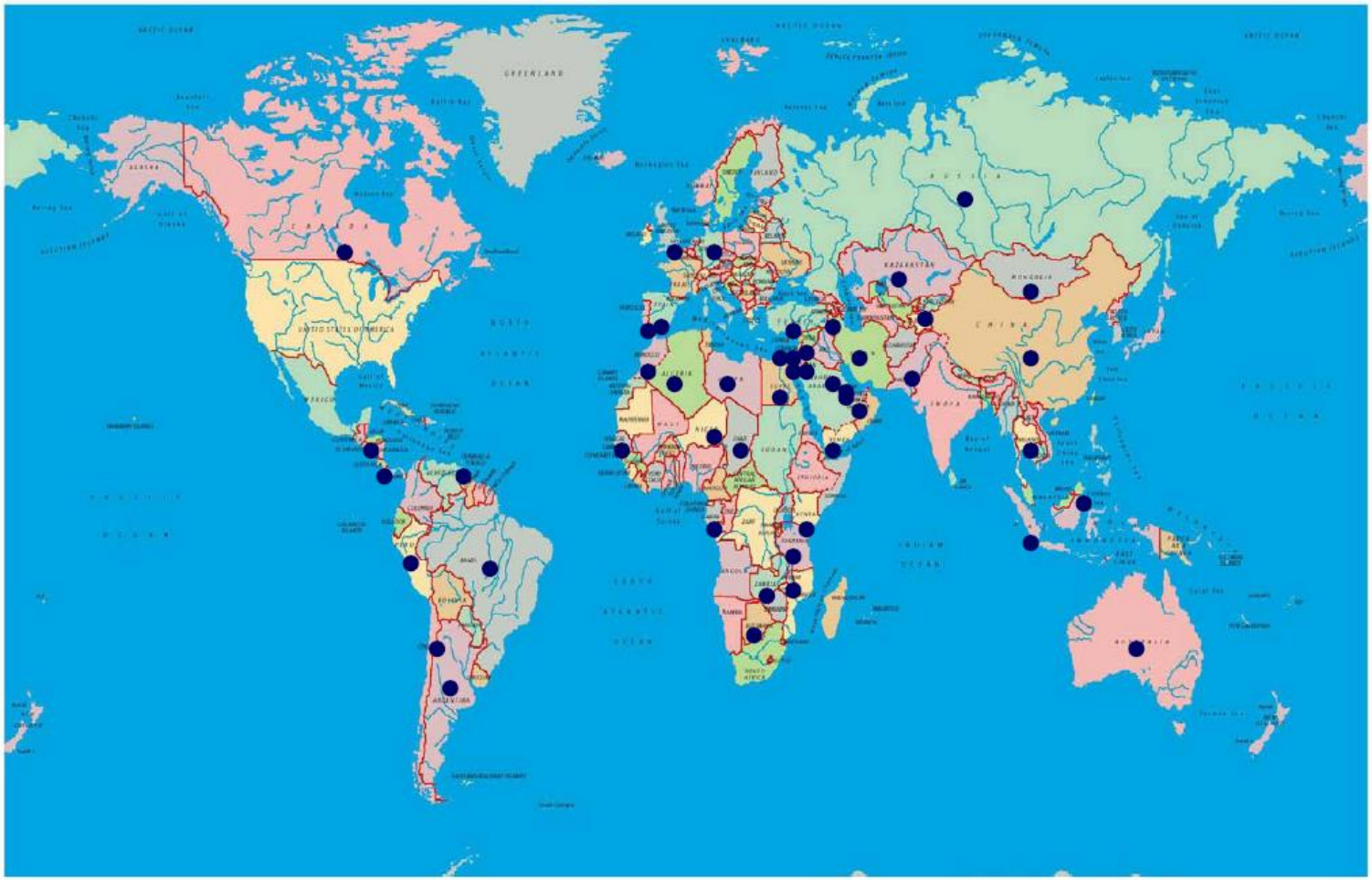
Interest for SDSWS

A questionnaire in 2005 showed that more than 40 WMO Members wished to participate in SDS project



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The Challenge:

WMO Sand And Dust Storm Warning System

Integrating Observations With Models & Delivering Products Useful To A Well Defined Community Of Practice

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WMO SDS WS: PROPOSED OBJECTIVE

To establish a WMO-coordinated global network of SDS forecasting centers delivering products useful to a wide range of users in understanding and reducing the impacts of SDS

Framework for SDSWS is the WMO SDS Project. One of its major goals is

"…to enhance the participating countries' ability to establish and improve systems for warning and forecasting services and to suppress the impact of SDS…"

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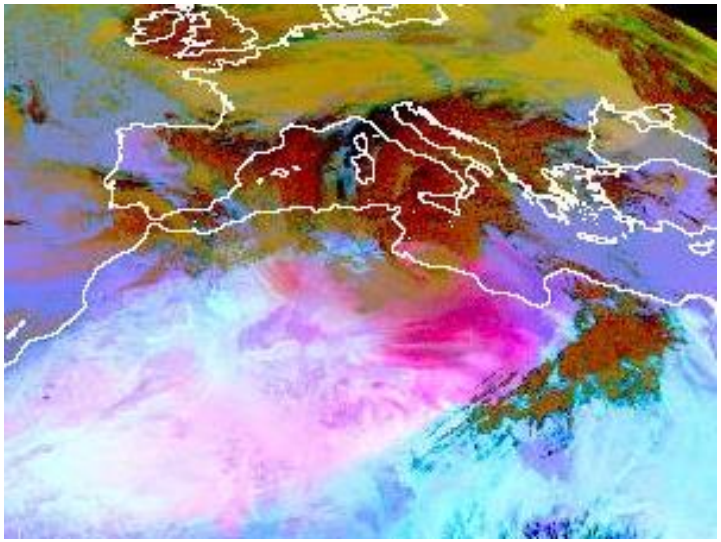
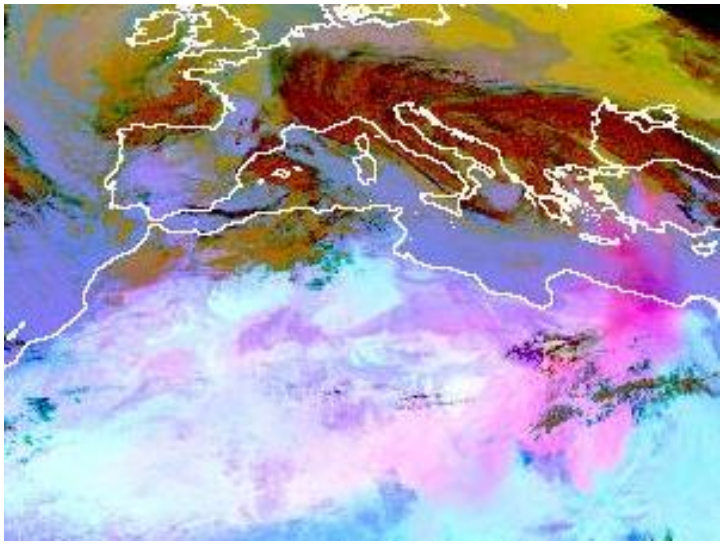
The present DSD Warning System in Spain (1)

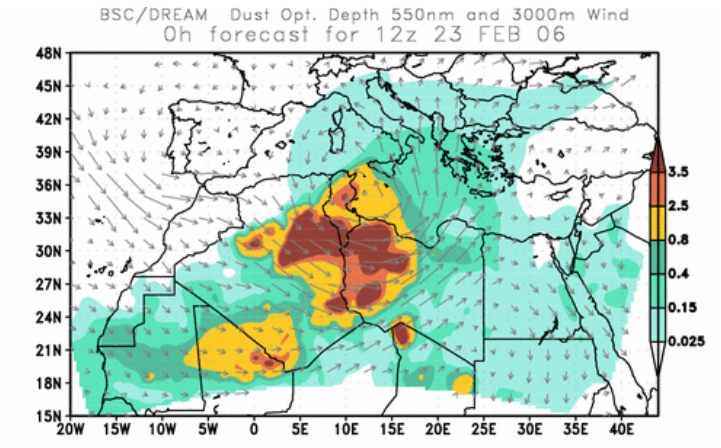
MSG

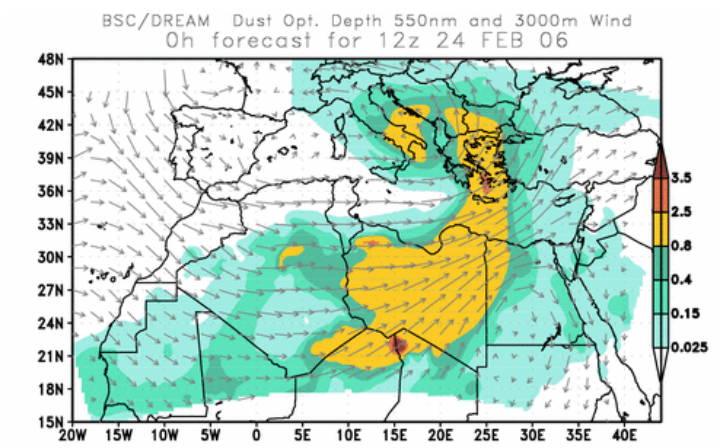
MSG-1
Feb 23-24, 2006
RGB Composite
R = IR12.0 - IR10.8
G = IR10.8 - IR8.7
B = IR10.8





DREAM





MSG - DREAM spatial verification

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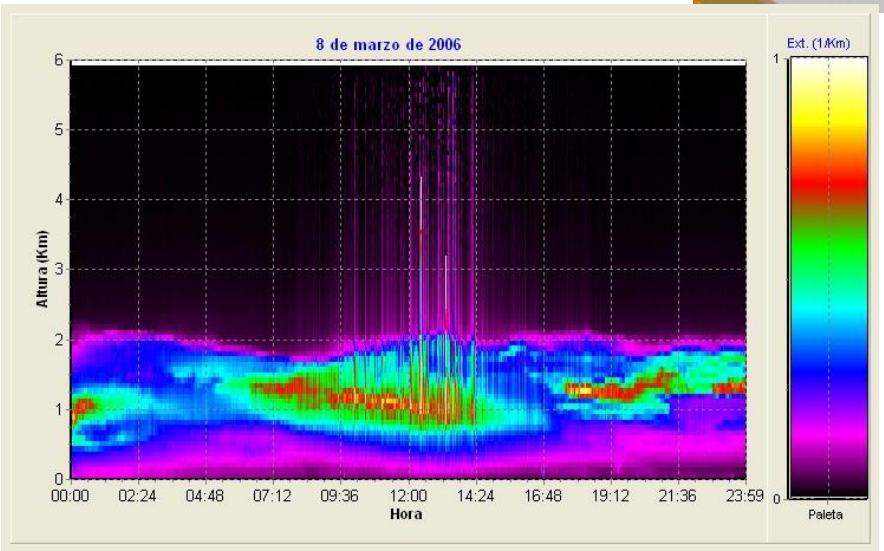
The present DSD Warning System in Spain (2)

Ground-based remote observations (aerosol lidar)

MPL at Santa Cruz

523 nm MPLNET
Fully authomatized since July 2005



Saharan Air Layer characterization

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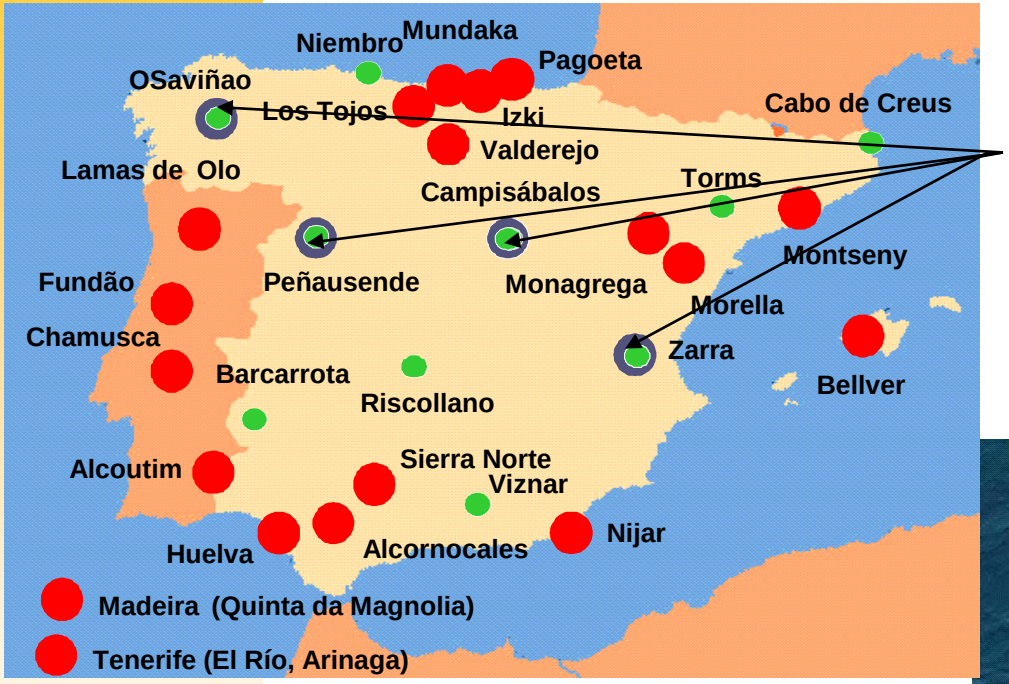
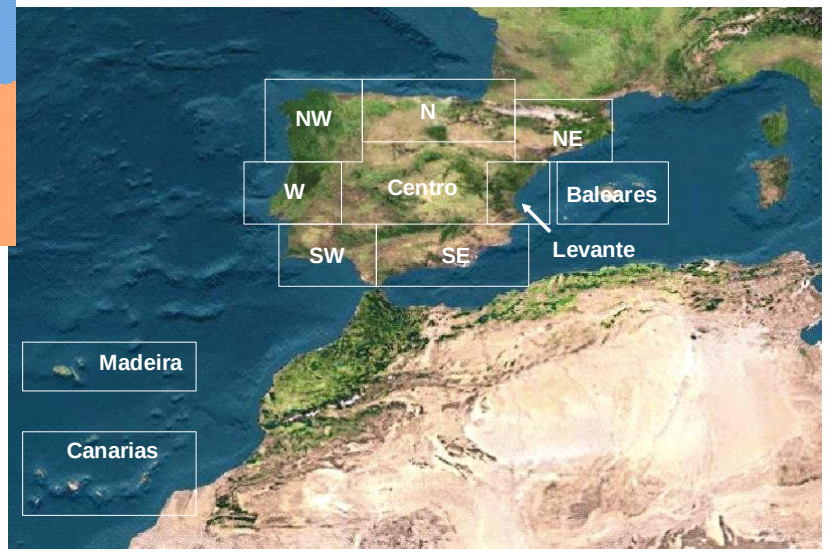
The present DSD Warning System in Spain (3)

Ground-based in-situ observations (PM10)



Beta and TEOM on-line instruments + GRIMM spectrometers at Izaña, Santa Cruz and Barcelona:

EMEP + Regional GAW stations



Off-line dust intrusion verification

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The present DSD Warning System in Spain (4)

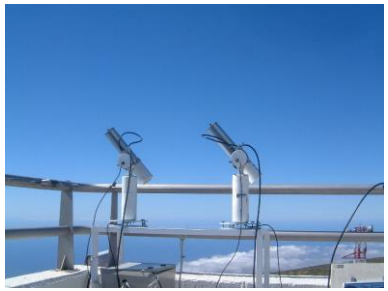
Ground-based remote observations (AOD)

AERONET (AErosol RObotic NETwork)

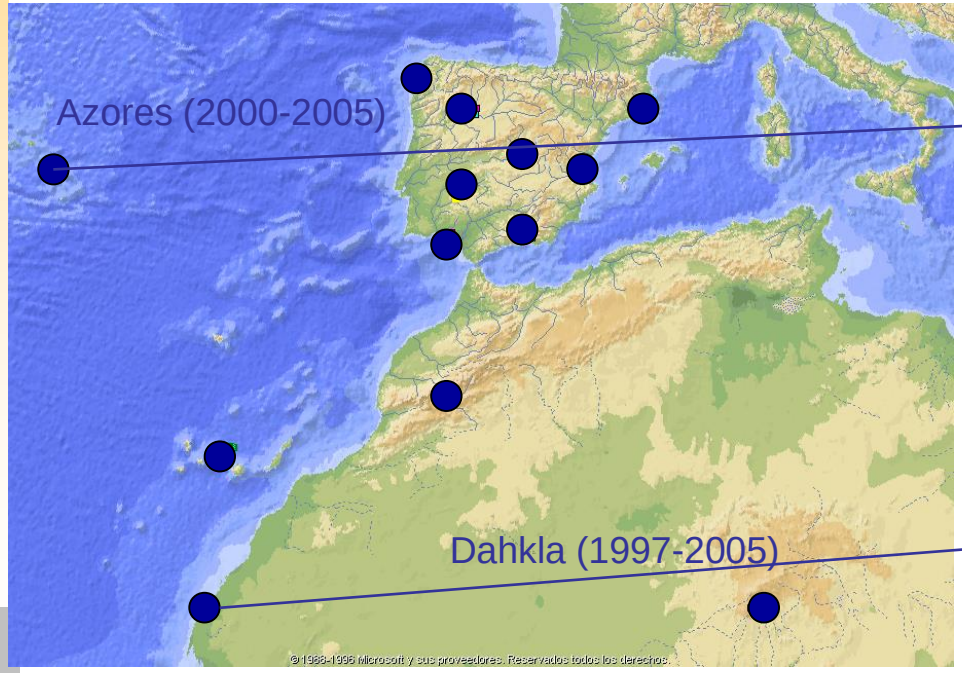
PHOTONS (PHOtométrie pour le Traitement Opérationnel de Normalisation Satellitaire)

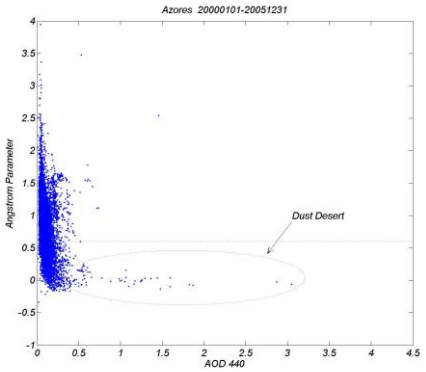
RIMA (Red fotométrica Ibérica de Medida de Aerosoles)

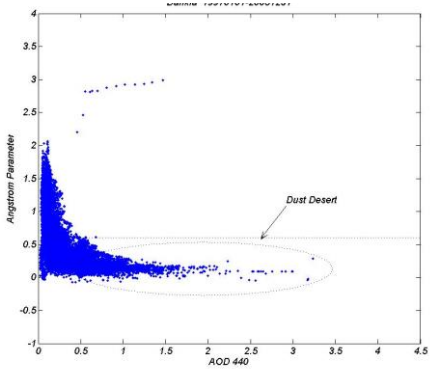
Izaña GAW station: Solar absolute calibration center for AERONET/PHOTONS



DREAM and MSG validation







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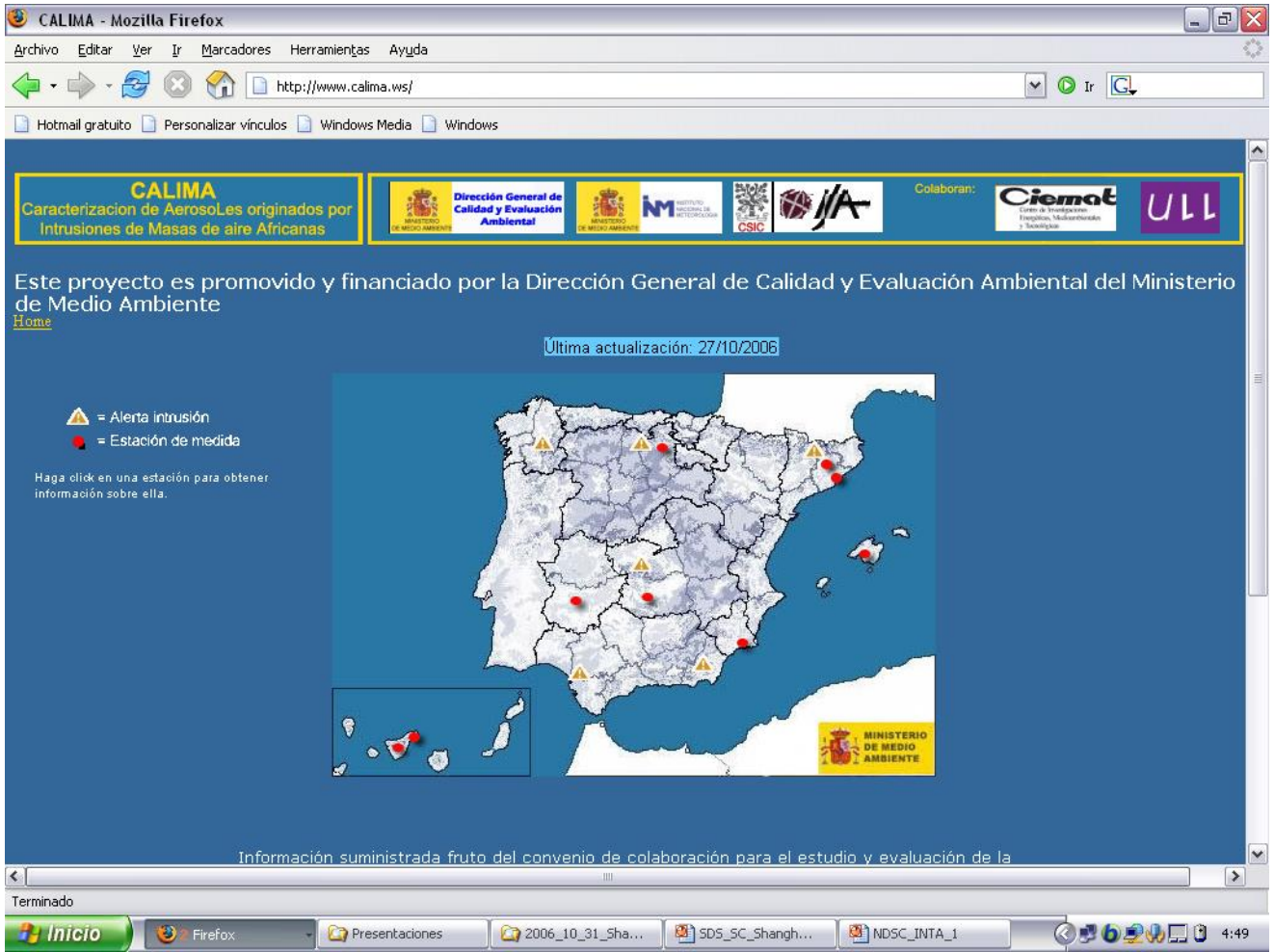
The present DSD Warning System in Spain (5)

Daily warning e-messages

www.calima.ws



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The WMO-GCOS Project

Improving GAW in the Mediterranean region: emphasis on aerosol program

Air quality

Climate

Enhancing capacity in the application of satellite remote sensing data

Satellite validation

GAW

Improving capacity in regional modeling

Model validation

Global Climate Observing System

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Proposal:
SDS Warning System for Europe and northern Africa (1)

The Consortium

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

WMO/AREP-GAW

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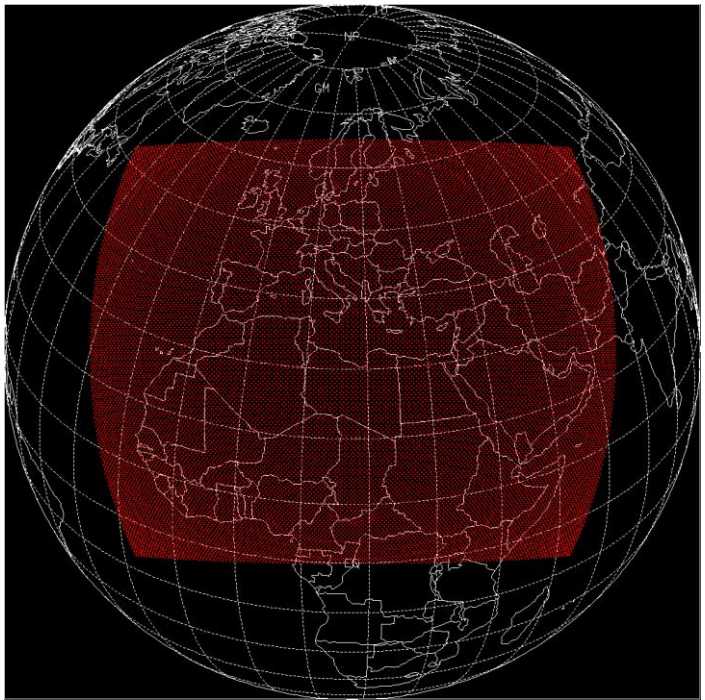
CSIC

gmv INNOVATING SOLUTIONS

GMES/ESA
PROMOTE project



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Proposal:
SDS Warning System for Europe and northern Africa (2)

The Consortium

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

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SDS Watch:

QRT (AOT @ 550 and 865 nm; Alpha) MSG (early 2007) + other satellites (done) **INMECast**

RT AOD from AERONET (done for the Mediterranean) www.aeronet.gsfc.nasa.gov and Brewer networks (done for Spain) www.iberonesia.com

RT PM10 from ground stations (EMEP and GAW) (done for Spain)

RT aerosol vertical distribution from MPL (done for Tenerife) + other lidars (Airlinet)

SDS Forecast:

BSC-DREAM dust forecast model + other models (operational)
http://www.bsc.es/projects/earthscience/DREAM/

SDS Public dissemination:

Calima, INM (done for Spain) www.calima.ws and BSC Webs (partially through BSC web)

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Proposal: SDS Warning System for Europe and northern Africa (3)

The Consortium

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

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Main goals

- Establish a system for routine SDS warning (implemented for Spain);
- Validate dust instrusion episodes (implemented for Spain);
- Accurately quantify the formation conditions and mechanism of SDS over northern Africa (ongoing);
- Validate AOD-MSG (to be done, starting in December 2006);
- RT validation of DREAM (ongoing);
- Characterize physical and chemical properties of SDS during its transport processes to Europe and the Canary Islands (ongoing);
- Conduct studies of SDS impact on temperature forecasting (ongoing);
- Determine possible long term changes (in the past) in dust transport patterns (ongoing for the Canary Islands);

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Proposal:
SDS Warning System for Europe and northern Africa (4)

The Consortium

Barcelona Supercomputing Center
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Current users of the system

- National Meteorological Services

- Scientific community

- Observational Networks: Earlinet (European Lidar Network), AERONET, EMEP, GAW and air quality networks

- Satellite community (Eumetsat, ESA, NASA…)

- National air quality managers: Alert system

- Experimental campaigns (TROMPETA, SAMUM,…)

Potential users

- Public Health Authorities: early warnings to population

- Air transport activities

- Oceanographers (dust deposition)

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Three countries has expressed interest to be regional SDS centres; they have been denoted as regional SDS warning system centres for

North Africa/Europe
Hosting Country of the Regional Center: **Spain**
Responsible institutes that will compose the Center:
Instituto Nacional de Meteorología
Supercomputer Center
Consejo Superior de Investigaciones Científicas
Domain to be covered: Euro-Mediterranean region, North Africa, Central Eastern Atlantic, Saudi Arabia)

East Asia/Western Pacific
Hosting Country of the Regional Center: **China**
Responsible institution: Center for Atmospheric Watch and Services, Chinese Academy of Atmospheric Science, China Meteorological Administration
Domain to be covered: East Asia, Western Pacific

North America
Hosting Country of the Regional Center: **Canada**
Responsable institution: Environment Canada
Domain to be covered: North America

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WMO

WMO Scientific Steering Committee of the SDS Project resolved
(Shanghai, November 1, 2006)

to focus within the next 2 years on implementation of the WMO SDS Warning System, with the overall goal of utilizing "WMO/GEO Expert Meeting on an International Sand and Dust Storm Warning System" to be hosted by Spain (BSC, INM and CSIC); the Meeting will be organized in Barcelona in early November 2007.

Announcing the Meeting to:

- **WMO Member countries through PRs**
- **Relevant organizations and communities (NASA, EUMETSAT, ESA, EARLINET, GAW, etc)**
- **Modelling groups that perform SDS forecasts and research**
- **Users**

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Links to users: developing the 'community of practice'

List of users – a first guess (to be completed before the Barcelona meeting)

Health
- Medical/Epidemiology research
- WHO

Health care service/industry; e.g. oxygen supply

Aviation
- ICAO
- Aircraft industry (MOSAIC)

Tourism and recreation
- World Tourism Organization (UNWTO)
- Ground transport - railway, roads (system managers)

Operational weather forecasters (WWW – to be a partner)

Industry (semi-conductor); representative(s) from electronic industry ?

Telecommunications

Agriculture (protection of livestock; FAO)

Disease transmission (valley fever)

Military

Air-quality managers

Fishing industry (potential)

Insurance industry (potential)

Research community

Authorities in countries affected by SDS e.g. Algeria, Morocco, Libya, Tunisia

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CSIC

Gracias !