



**WMO**

# World Meteorological Organization

Working together in weather, climate and water

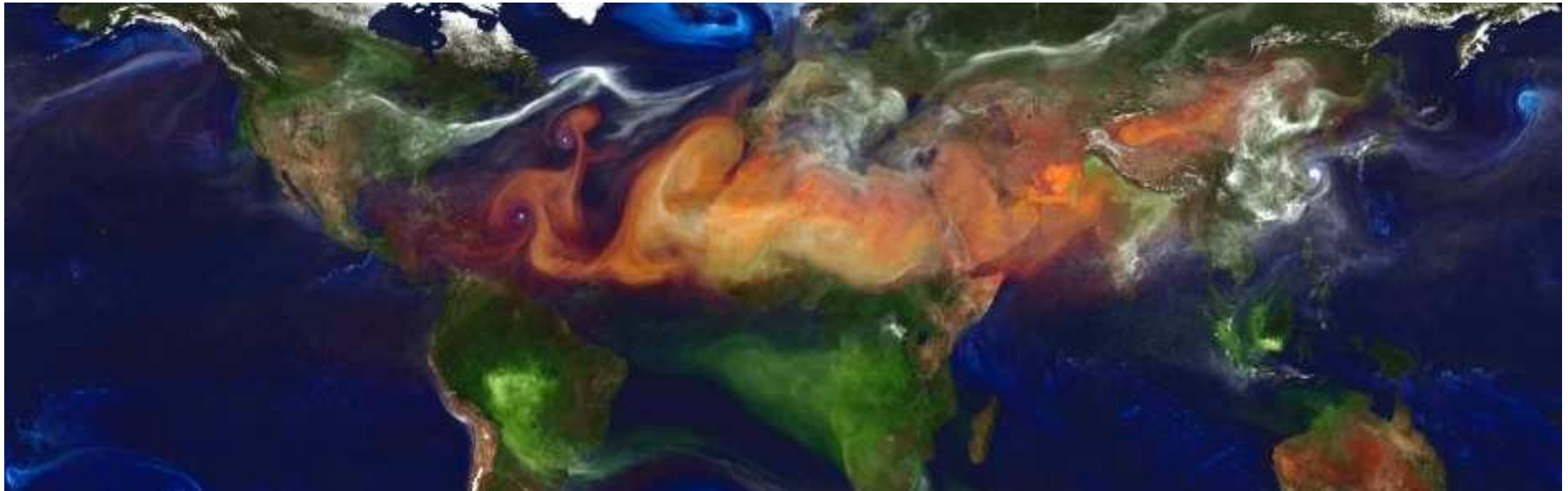
## Overview of WMO SDS-WAS program

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The Regional Training Workshop on Sand and Dust Storms in the Arab Region "SDS-ARAB"  
Cairo, Egypt, 10-12 February 2018



# Global Scale SDS Problem



Atmospheric Aerosol Eddies NASA Animated Map: 10km Geodetic Earth Orbiting Satellite (GEOS-5)  
AOD: Red colour – Dust Aerosols

<http://geo-pickmeup.com/atmospheric-aerosol-eddies-nasa-animated-map/>





# Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) supported by WMO WWRP/GAW



## Mission

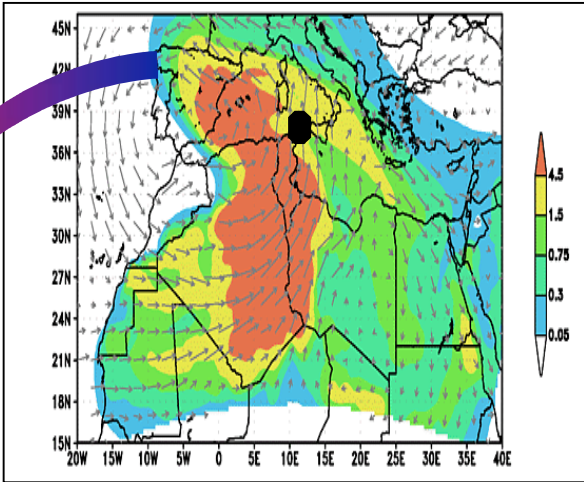
- *To establish a coordinated global network of SDS research & forecasting centres;*
- *To enhance the ability of countries to deliver timely and quality SDS forecasts, observations, information and knowledge to users through an international partnership of research and operational communities*



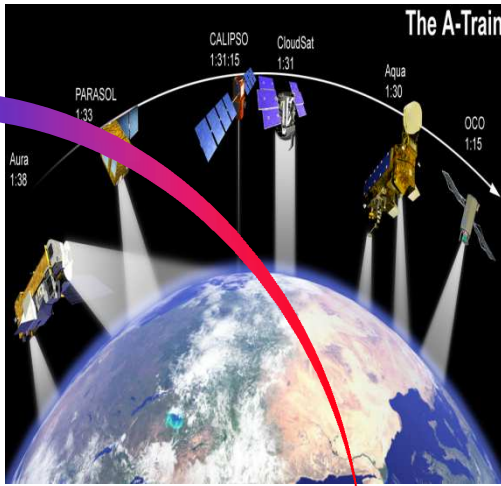




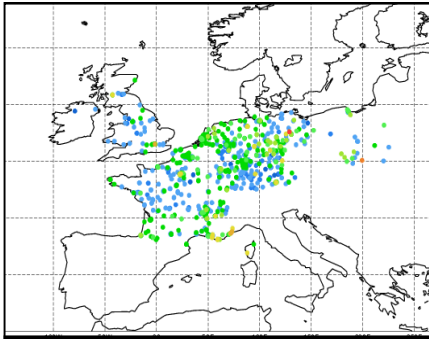
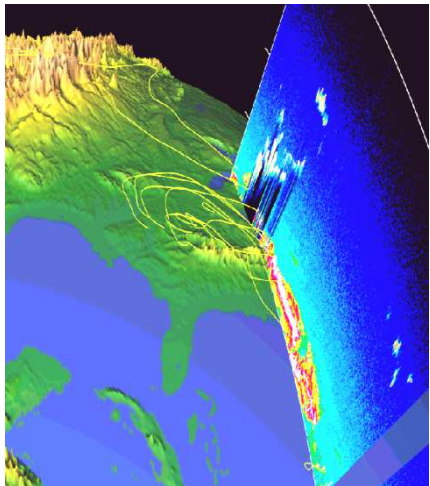
# WMO SDS-WAS System Components



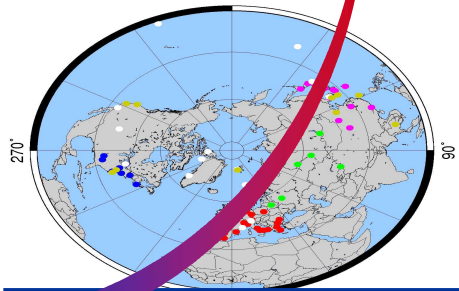
**Forecast Models**



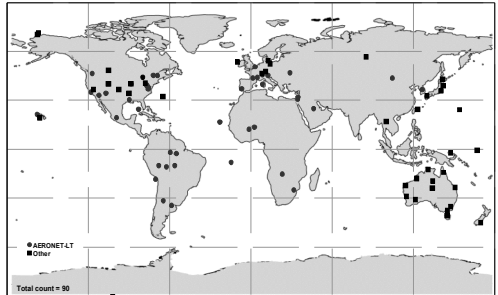
**NASA A-Train MODIS CALIPSO & Geostationary Satellite IR Obs**



**European PM10**



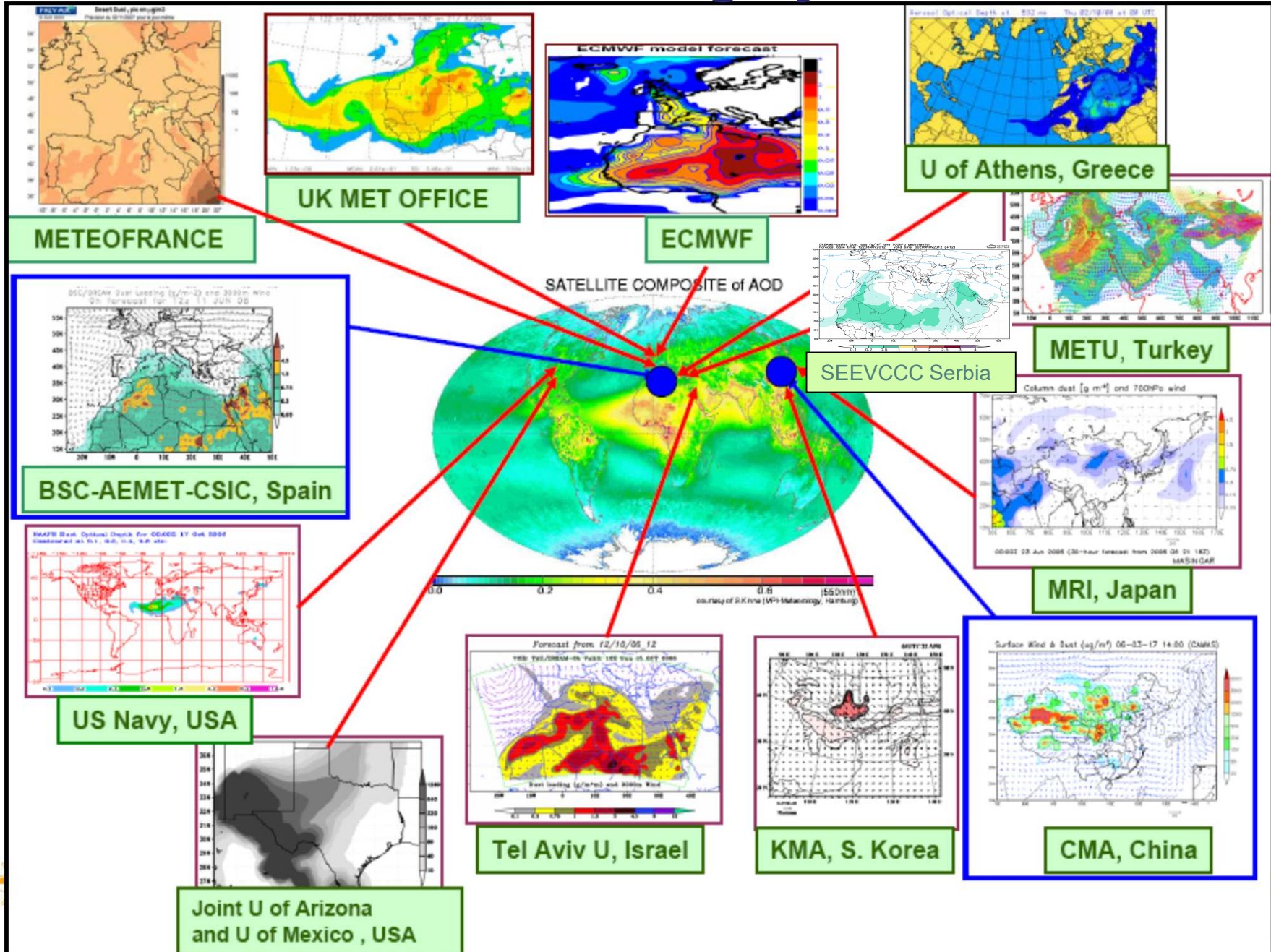
**GALION Surface-based LIDAR**



**GAW/AERONET/SKYNET Surface-based AOD**



# Dust forecasting systems







# Brief WMO SDS-WAS History

- **2004:** Beijing, China: International Symposium on SDS & WMO Experts **Workshop** on SDS.
- **2005:** **More than 40 Member countries indicated interest to cooperate in SDS-WAS.**
- **2007:** the 15th WMO Congress endorsed launching of the SDS-WAS.
- **2008:** the 60th EC of WMO welcomed the establishment of the three SDS-WAS Regional Nodes.
- **2009 - : A series of workshops:** Spain, Niger, Turkey, China, Japan, Korea, Iran, Serbia, Kuwait, Bahrain, Italy, Morocco, Jordan, ...
- **2014:** **Opening the Barcelona Dust Forecast Centre - 1<sup>st</sup> WMO Operational Dust Prediction Centre**
- **2017:** **Approved the Asian Dust Forecast Centre - hosted by CMA, Beijing 2<sup>nd</sup> WMO Operational Dust Forecast Centre**





# WMO SDS-WAS Coordination

## Global coordination

- The SDS-WAS activities at the global scale are coordinated by the Steering Committee (SDS-WAS SC).

## Regional coordination

- The SDS-WAS activities at the regional level are coordinated by the Steering Group (SDS-WAS SG) as a federation of regional partners.

*\* SDS-WAS is supported jointly by the WMO World Weather Research Programme (WWRP) and the Global Atmosphere Watch (GAW).*





# SDS-WAS Global Steering Committee

**SC Chair:**

**Enric Terradellas, AEMET/BSC**

**From NAMEE Node:**

**Slobodan Nickovic, NAMEE Chair**

**Angela Benedetti, ECMWF/CAMS**

**From Asia Node:**

**Zhang, Xiao-Ye, CMA, Asia Node Chair**

**Ryoo, Sang Boom, KMA**

**From Pan-America Node:**

**Sprigg, William A., Arizona Uni, Pan-American Node Chair**

**David Farrell, Barbados, CHMI, Pan-American Center Host**

**From WMO Secretariat:**

**Alexander Baklanov**

**From other UN Agencies:**

**Utchang Kang (UNCCD)**

**Valentin Foltescu (UNEP)**

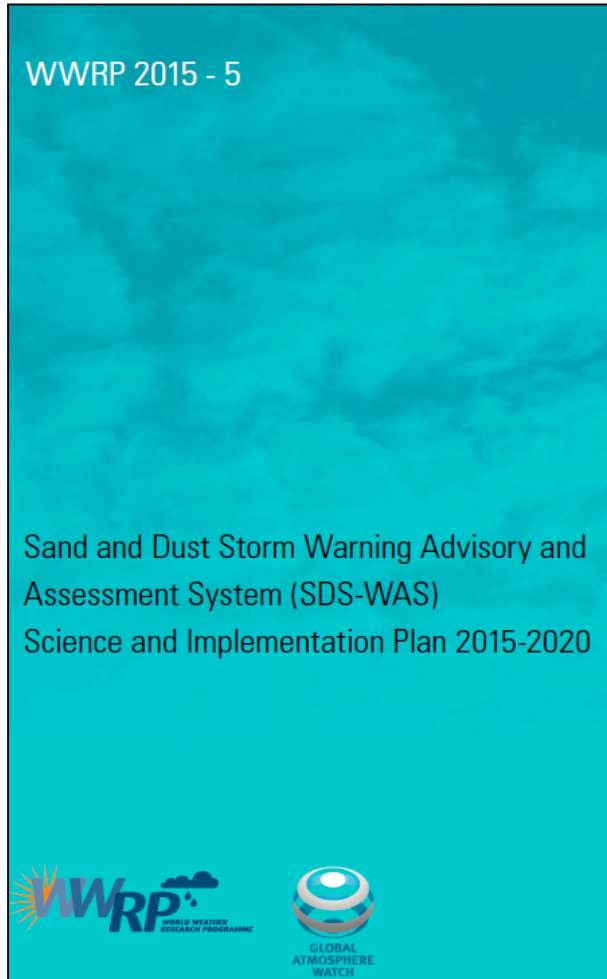
**Carlos Francisco Dora / Mazen Malkawi (WHO)**







# SDS-WAS Regional Nodes



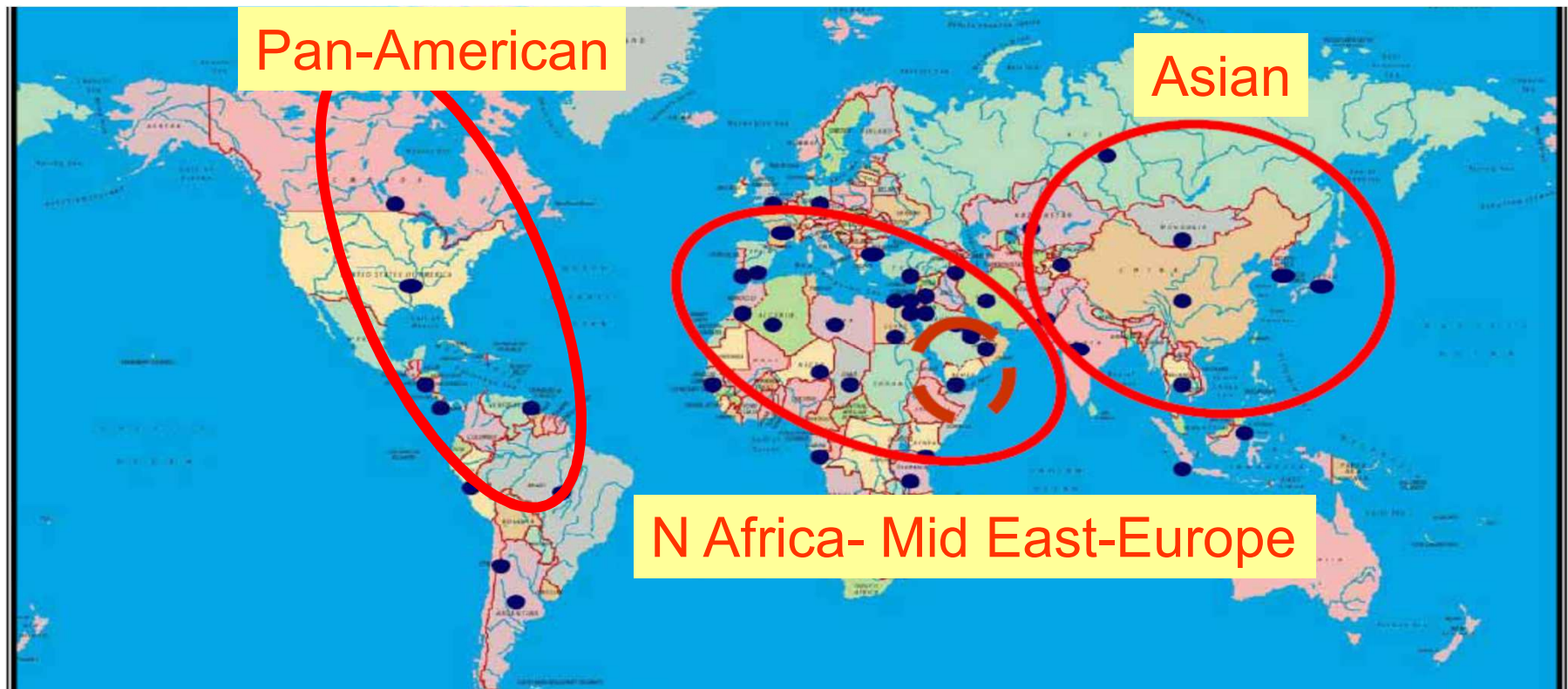
- **Regional Node for Asia**, coordinated by **Regional Centre** hosted by the CMA (Beijing, China)
- **Regional Node for Northern Africa, Middle East and Europe** (NA-ME-E), coordinated by **Regional Centre** as a consortium of the Spanish State Meteorological Agency (AEMET), and the Barcelona Supercomputing Center – National Supercomputing Center (BSC-CNS)
- **Regional Node for Pan-America** hosted by the Arizona University (USA) and the Caribbean Meteorological and Hydrological Institute, Barbados (in progress).





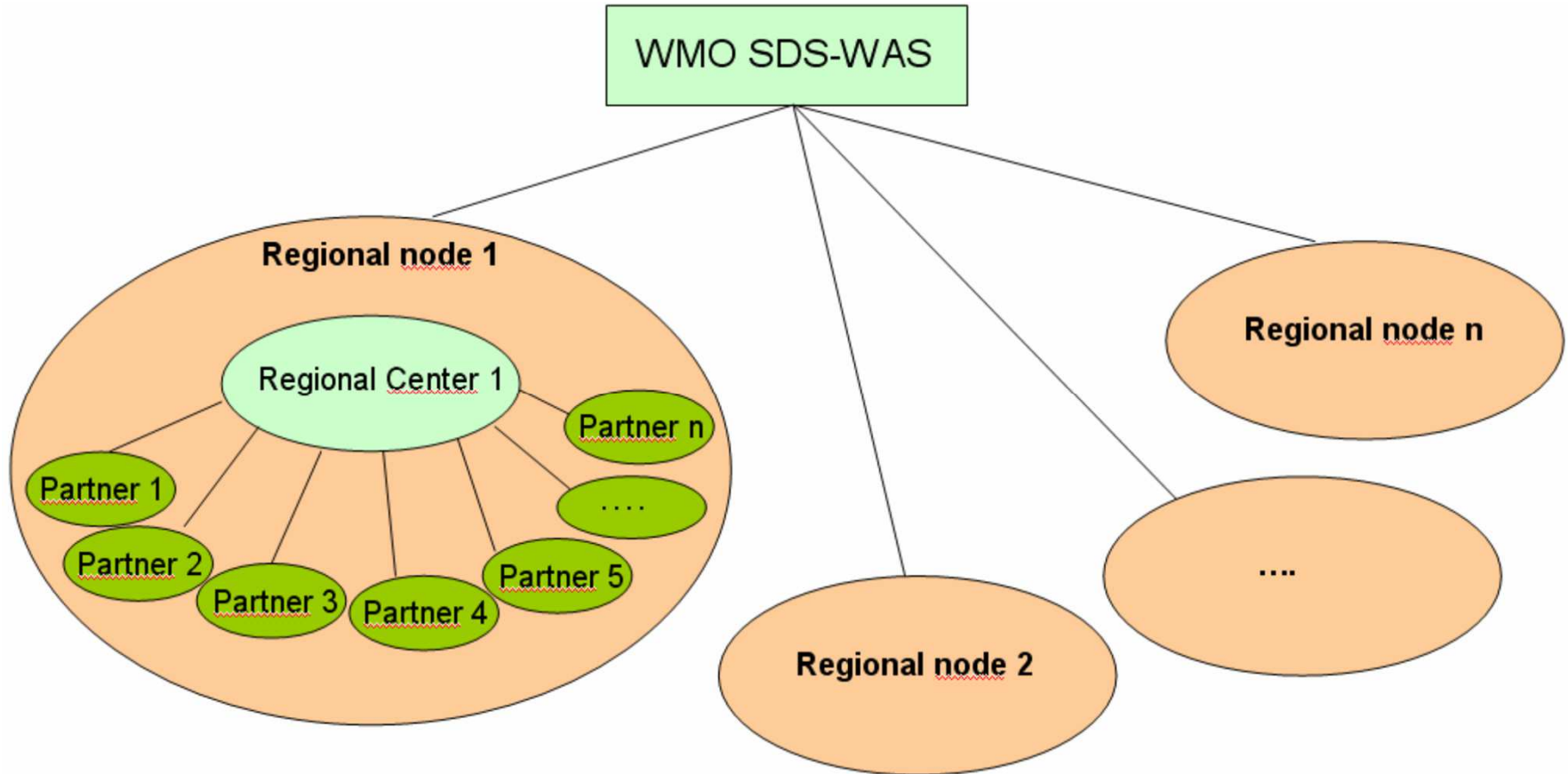
# SDS-WAS Regional Nodes

- 3 Regional Nodes, 15 organizations providing forecast
- Regional coordination: Regional Steering Group (for Regional Nodes)
- Global Coordination: Global Steering Committee
- Strategic Plan: SDS-WAS Science & Implementation Plan for 2015-2020
- Implementation: Trust Fund through WMO WWRP/GAW





# SDS-WAS: Federated System





# NAMEE Regional Steering Group Members

- **Slobodan NICKOVIC** (chair), Republic Hydrometeorological Service of Serbia, Serbia, [nickovic@gmail.com](mailto:nickovic@gmail.com)
- **Angela BENEDETTI**, European Centre for Medium-Range Weather Forecasts (ECMWF). [angela.benedetti@ecmwf.int](mailto:angela.benedetti@ecmwf.int)
- **Malcolm BROOKS**, Met Office, U. K. [malcolm.e.brooks@metoffice.gov.uk](mailto:malcolm.e.brooks@metoffice.gov.uk)
- **Mustafa COŞKUN**, Turkish State meteorological Service, Turkey, [mustafacoskun@mgm.gov.tr](mailto:mustafacoskun@mgm.gov.tr)
- **Emilio CUEVAS-AGULLO** (RC), State Meteorological Agency of Spain (AEMET), Spain. [ecuevasa@aemet.es](mailto:ecuevasa@aemet.es)
- **George KALLOS**, University of Athens, Greece. [kallos@mg.uoa.gr](mailto:kallos@mg.uoa.gr)
- **Benjamin LAMPTEY**, African Center of Meteorological Applications for Development, Niamey, Niger. [blamptey@gmail.com](mailto:blamptey@gmail.com)
- **Lucia MONA**, Institute of Methodologies for Environmental Analysis, Italy. [mona@imaa.cnr.it](mailto:mona@imaa.cnr.it)
- **Goran PEJANOVIC**, Republic Hydrometeorological Service of Serbia. [goran.pejanovic@hidmet.gov.rs](mailto:goran.pejanovic@hidmet.gov.rs)
- **Carlos PÉREZ GARCÍA-PANDO** (RC), Barcelona Supercomputing Center, Barcelona, Spain. [carlos.perez@bsc.es](mailto:carlos.perez@bsc.es)
- **Michael SCHULZ**, Norwegian Meteorological Institute, Norway. [michael.schulz@met.no](mailto:michael.schulz@met.no)
- **Saviz SEHAT**, Islamic Republic of Iran Meteorological Organization (IRIMO), Iran. [savizsehat@yahoo.com](mailto:savizsehat@yahoo.com)
- **Ina TEGEN**, Leibniz Institute for Tropospheric Research, Germany. [itegen@tropos.de](mailto:itegen@tropos.de)
- **Ashraf ZAKEY**, Egyptian Meteorological Authority, Egypt. [ashraf.zakey@yahoo.com](mailto:ashraf.zakey@yahoo.com)
- **Alexander BAKLANOV** (observer), World Meteorological Organization. [abaklanov@wmo.int](mailto:abaklanov@wmo.int)



# Numerical models contributing to WMO SDS-WAS (2016)

Model	Institution	Domain
BSC-DREAM8b_v2	Barcelona Supercomputing Center, Spain	Regional
CAMS	European center for Medium-Range Weather Forecast, U. K.	Global
DREAM-NMME-MACC	South east European Climate Change Center, Serbia	Regional
NMMB/BSC-Dust	Barcelona Supercomputing Center, Spain	Regional
MetUM	Met Office, U. K.	Global
GEOS-5	National Aeronautics and space Administration, U. S.	Global
NGAC	National Centers for Environmental Prediction, U. S.	Global
EMA REG CM4	Egyptian Meteorological Authority, Egypt	Regional
DREAMABOL	National Research Council, Italy	Regional
WRF-CHEM	National Observatory of Athens, Greece	Regional
SILAM	Finnish Meteorological Institute, Finland	Regional
CUACE/Dust	China Meteorological administration, China	Regional
MASINGAR	Japan Meteorological Agency, Japan	Global
ADAM	Korea Meteorological Administration, Korea	Regional

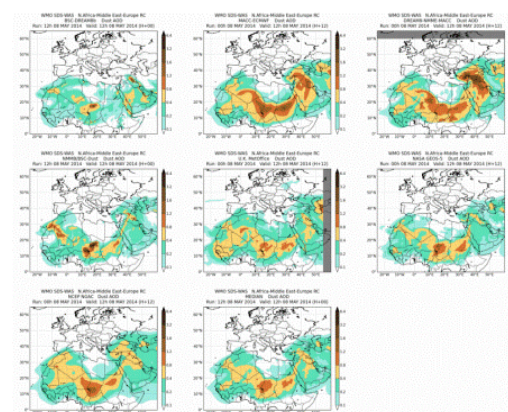
**5 global models**

**9 regional models**

**15 organizations**

**3 regional nodes**

**2 regional centers**





# SDS-WAS Implementation and Research Issues

- Global coordination of the regional SDS-WAS nodes
- Pan-America node development and establishing the West Asian sub-node
- Model validation and intercomparisons
- Better understanding and quantifying source regions and effectiveness of possible interventions
- Dust reanalysis, SDS trends and effects of climate change
- High-resolution dust modelling (1-3 km) – towards non-hydrostatic and cloud-resolving scales
- Observation network and NRT data access
- Data assimilation: GAW & other observations and satellite data
- Dust interaction with radiation and clouds and impacts to weather and climate => online coupled models
- Chemical and physical characterization of dust and impacts
- Health effects: Dust and meningitis & valley fever (WHO WG)
- Closer collaboration with UN programmes for DSS policies and adaptation/preventive measures



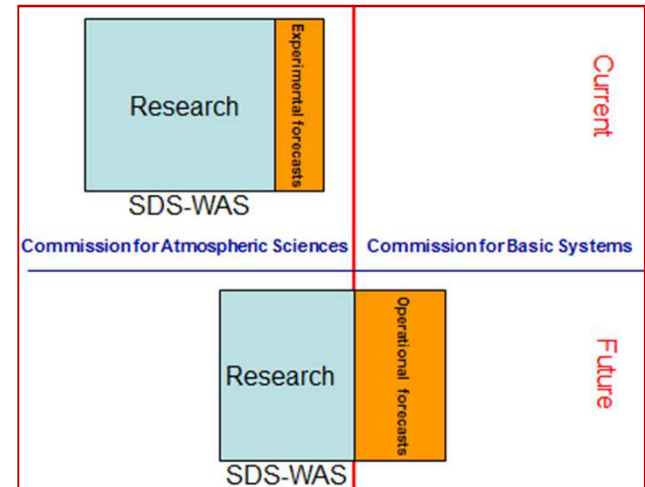




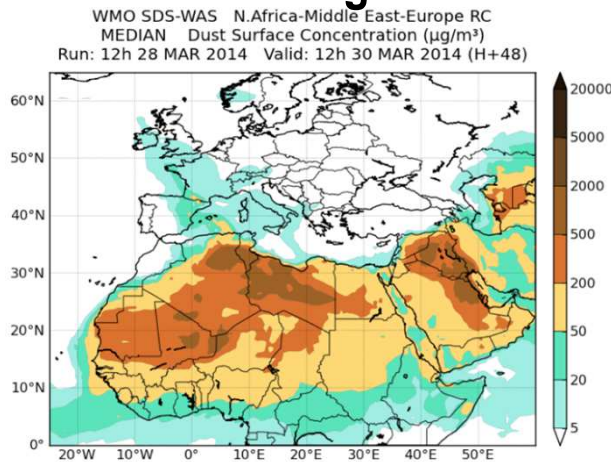
# WMO SDS-WAS: from Research to Operations

Regional Specialized Meteorological Center with activity specialization on Atmospheric Sand and Dust Forecast (RSMC-ASDF) (**Barcelona Dust Forecast Center**) enables daily dust forecasts; Operational from 2014

The Asian region is arranging such a center hosted by **China Meteorological Administration, Beijing**

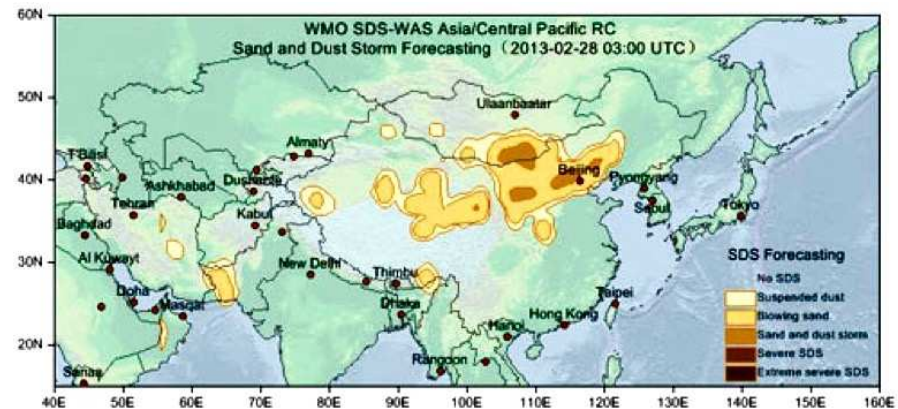


## Regional domains for operational SDS forecasts:



NAMEE/Barcelona Center

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



Asia Node/CMA Center

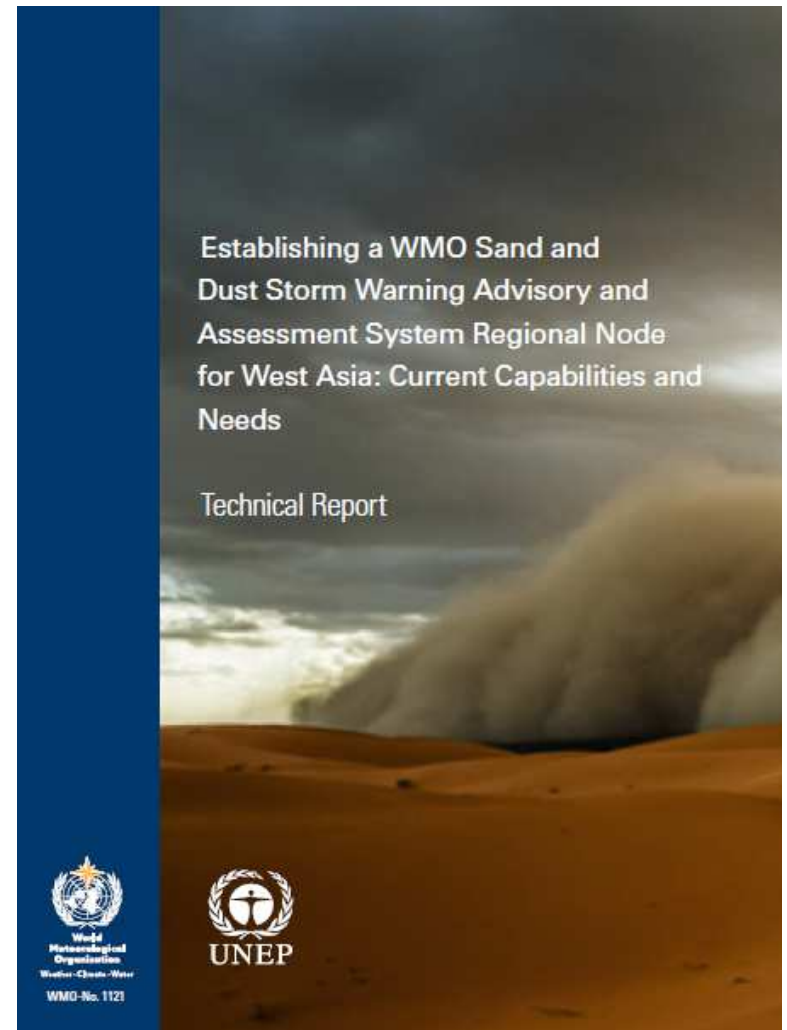
[http://eng.nmc.cn/sds\\_was.asian\\_rc/](http://eng.nmc.cn/sds_was.asian_rc/)





# SDS-WAS Regional Node for West Asia

- Joint WMO-UNEP: Report on the Establishment of WMO SDS-WAS Regional Node for West Asia (2013)
- ✓ *Needs: Higher resolution SDS forecast and observations*



[http://www.wmo.int/pages/prog/arep/wwrp/new/documents/1121\\_SDS\\_Technical\\_Report\\_en.pdf](http://www.wmo.int/pages/prog/arep/wwrp/new/documents/1121_SDS_Technical_Report_en.pdf)

[http://www.wmo.int/pages/prog/arep/wwrp/new/documents/FINAL\\_WMO\\_SDS\\_WAS\\_Exec\\_Summary.pdf](http://www.wmo.int/pages/prog/arep/wwrp/new/documents/FINAL_WMO_SDS_WAS_Exec_Summary.pdf)





## Draft Guidelines to establish Regional Node of Sand and Dust Storm - Warning Advisory and Assessment System (SDS-WAS)

1. Permanent Representative (PR) of the country sends a proposal to the WMO Secretary-General and the president of Regional Association(s).
  2. WMO Secretariat contacts SDS-WAS Steering Committee for consultation.
  3. SDS-WAS Steering Committee provides its recommendation.
  4. World Weather Research Programme (WWRP) Science Steering Committee makes decisions in consultation with Global Atmospheric Watch (GAW) Science Steering Committee and relevant Regional Association(s).
  5. Regional Nodes in the region can establish a Regional Steering Group and consider a possibility to build a Regional Coordination Centre for its coordination of activities including research and development.
- ❖ *Designation of the Regional Dust Forecast Centre (e.g., Spain and China) is regulated by the [SDS-WAS Science and Implementation Plan \(SIP\)](#), approved by the WMO Congress (Cg-17) (Annex 2).*

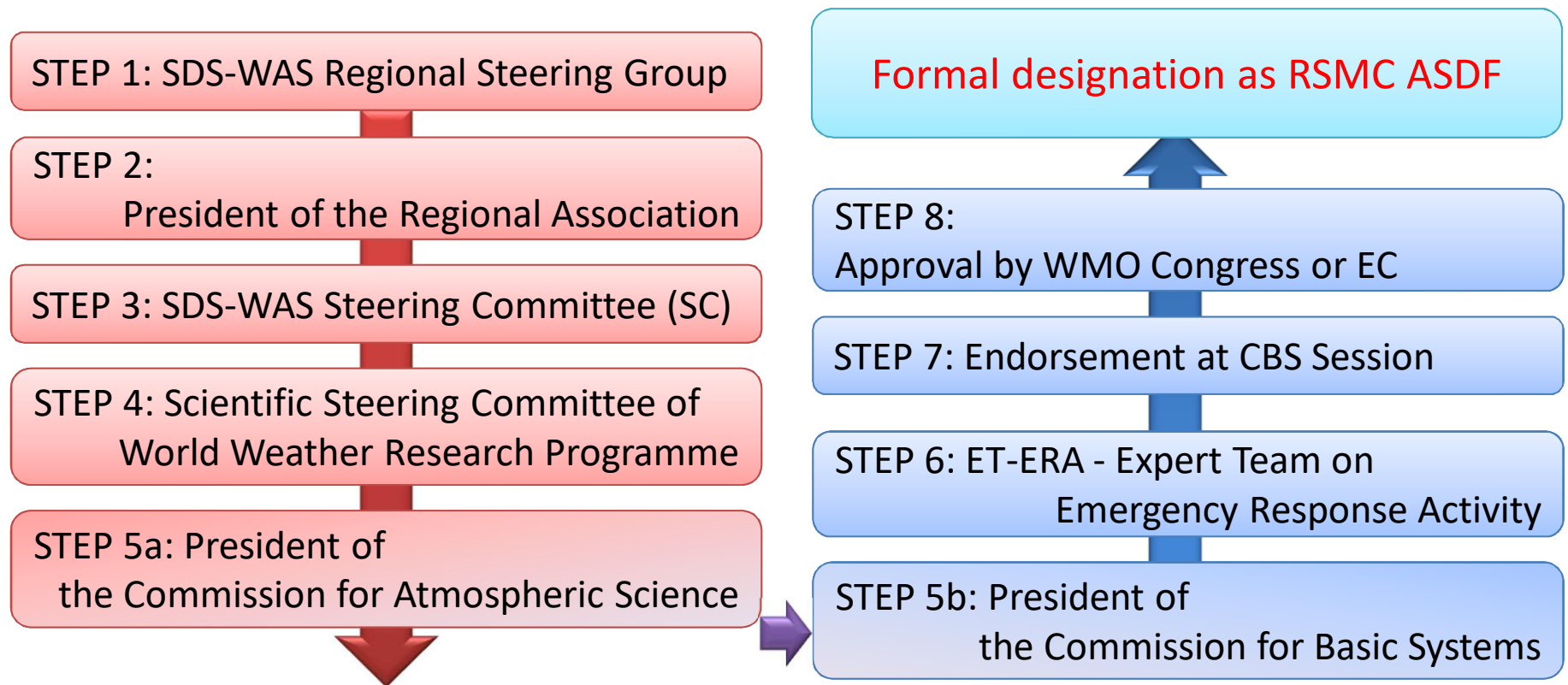






# Designation Process of Regional Specialized Meteorological Centre (RSMC) for Atmospheric Sand and Dust Forecast (ASDF)

- Annex 1 of SDS-WAS Science Implementation Plan -



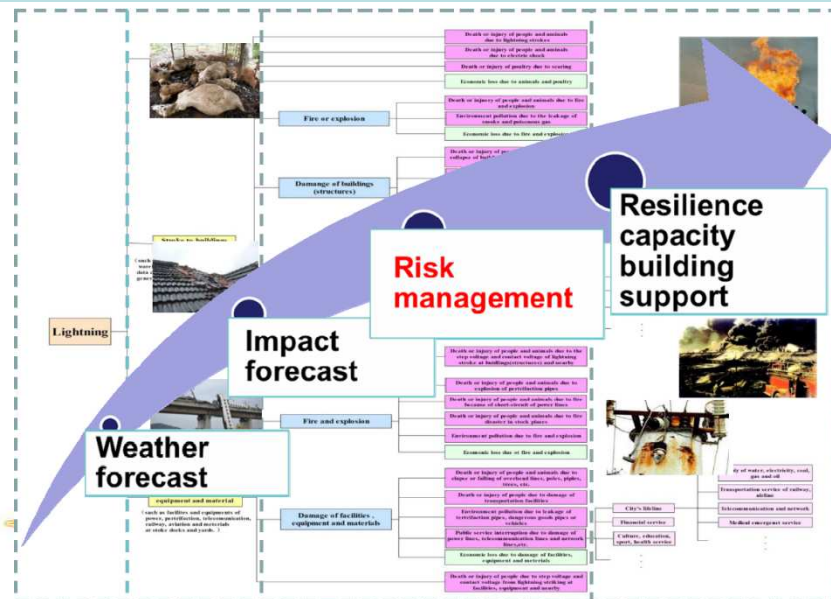


# SDS-WAS Current Mission

To establish a coordinated global network of SDS research & forecasting centres and to enhance the ability of countries to deliver timely and quality sand and dust storm forecasts, observations, information and knowledge to users through an international partnership of research and operational communities

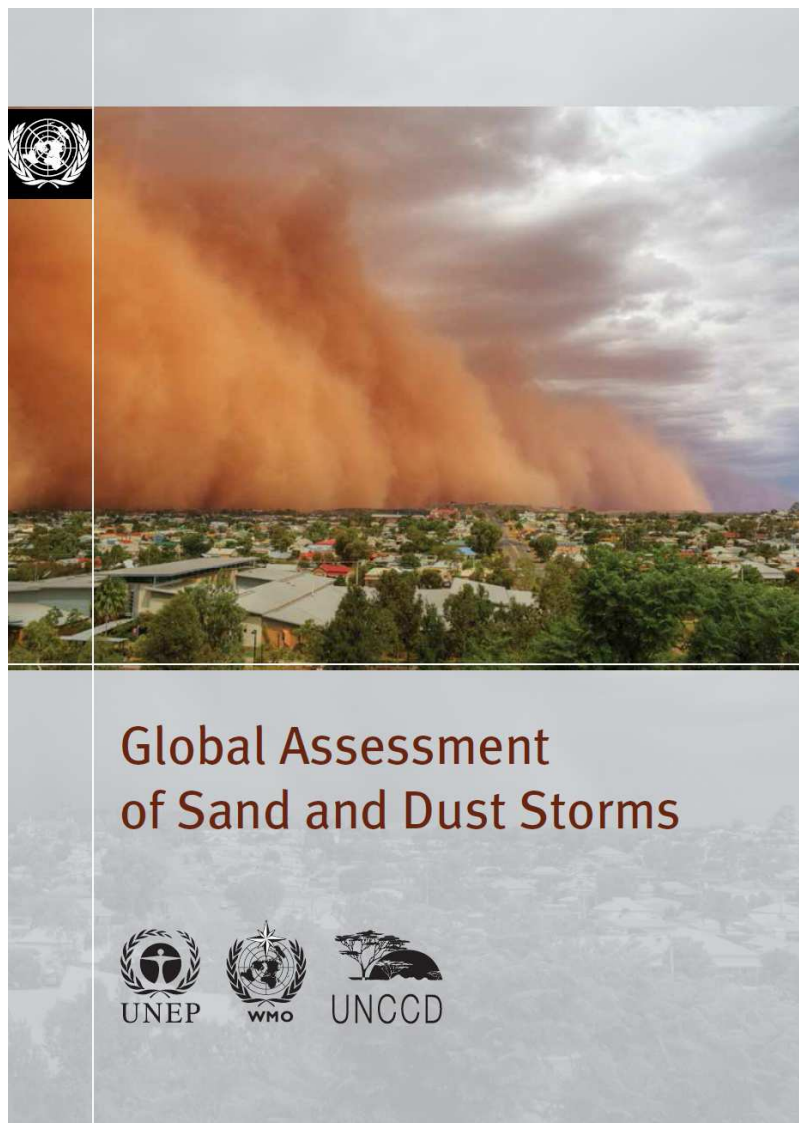
Extension is needed to Impact based assessment and combating SDS risk for =>

- **Human Health** (asthma, infections, meningitis in Africa, valley fever in the America's)
- **Agriculture** (negative & positive impacts)
- **Marine productivity**
- **Aviation** ( air disasters)
- **Ground Transportation**
- **Industry** (Semi-conductor, Tourism, etc)



=> Joint efforts of several UN Agencies (e.g., WMO, UNEP, WHO, UNCCD) and Authorities are needed

# Global Assessment of Sand and Dust Storms



## Foreword



Large sand and dust storms, which result from a combination of strong winds and loose dry soil surfaces in arid and semi-arid areas, are detrimental to human health, agricultural land, infrastructure, and transport. Every year, an estimated 2,000 million tons of dust is emitted into the atmosphere. While much of this is a natural part of the biogeochemical cycles of the Earth, a significant amount is generated by human-induced factors, especially unsustainable land and water management.

However, there is considerable uncertainty about whether sand and dust storms are increasing in intensity and frequency and how much is due to human causes. There is also need for greater clarity on the role that climate change is playing and how changes in dust emissions due to land use and climate change may impact the atmosphere, climate and oceans in the future. Policymakers and other stakeholders need more information on what can be done to reduce the frequency and intensity of sand and dust storms and to protect infrastructure and human health from their effects.

The Global Assessment is a significant contribution to our understanding, synthesizing the latest scientific information on the causes of sand and dust storms and their consequences for human and environmental well-being. It summarizes the latest knowledge on predicting them and reducing their impact.

Given the dominance of natural sources of dust and uncertainty regarding future dust emissions, the report stresses the importance of protective measures,

which include enhancing monitoring, prediction and early warning systems, and improving preparedness and emergency response. To reduce anthropogenic sources of sand and dust storms, the Assessment recommends integrated strategies that promote sustainable land and water management in cropland, rangelands, deserts and urban areas, and climate change mitigation.

The report proposes a consolidated and coordinated global policy for responding to sand and dust storms, integrated and synergistic actions across sectors, and strengthened cooperation among global institutions. These measures are integral to the success of the 2030 Agenda for Sustainable Development. They can contribute to improved public health, more liveable towns and cities and more sustainable rural areas. They can help combat climate change, conserve oceans, and protect terrestrial ecosystems, thereby helping to reduce poverty and protect economic growth.

I commend this report to all Governments and stakeholders engaged in reducing the occurrence and impact of sand and dust storms and working to achieve the Sustainable Development Goals.

A handwritten signature in black ink, reading 'Ban Ki-moon'.

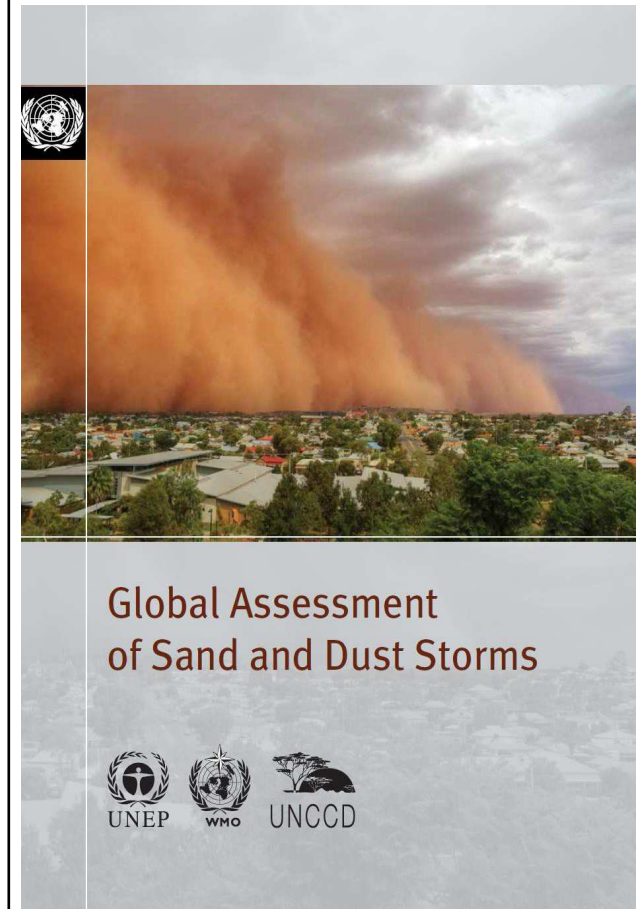
**BAN KI-MOON**  
United Nations Secretary-General



# Policy framework for mitigation of SDS

(UNEP, WMO, UNCCD 20161)

- 1. Measures to reduce anthropogenic emissions**
  - a. Sustainable land and landscape management
  - b. Climate change mitigation and adaptation
- 2. Physical protection of valuable assets, such as towns, infrastructure, and irrigation schemes**
  - a. Reducing wind speed through tree planting around urban areas and infrastructure to deposit sand and trap dust outside these areas
  - b. Aerodynamic methods to prevent sand and dust accumulation, such as alignment of roads, removal of obstacles to wind and land shaping
- 3. Monitoring, prediction and warning systems for sand and dust storms**
  - a. Monitoring of SDS through ground networks of meteorological and air quality monitoring stations, and combined use of satellite data
  - b. Sand and dust storm forecasting and early warning systems, including mapping of trends and future scenarios of anthropogenic dust sources
- 4. Preparedness and emergency response procedures**
  - a. Preparedness and emergency procedures for coping with sand and dust storm events (e.g., for airport, rail and road closures; hospital emergency services; advisory communications to public services)
  - b. Public awareness of sand and dust storm risks (via education, media and social networks and telecommunication) and emergency procedures
  - c. Mainstreaming sand and dust storms into disaster risk reduction and emergency response measures
- 5. Policies, legal frameworks and action plans to support the above actions**
  - a. International environmental law and initiatives (e.g., SDS-WAS)
  - b. Regional frameworks, agreements and action plans
  - c. National action plans
- 6. Research to reduce critical uncertainties**
  - a. Improved knowledge on the interaction of dust with biogeochemical global systems and climate systems
  - b. Improved methods for monitoring, prediction and early warning systems
  - c. Assessing the impacts and costs of SDS at local to global scales







## Recommendations for Global and Regional Coordination of Combating Sand and Dust Storms (SDS)

- **Immediate action** is needed to prevent and mitigate the impact of SDS both locally and globally;
- **A coordinated international cooperation** is essential for arrangements on monitoring, prediction and early warning to combat sand and dust storms under a well-designed Strategic framework for risk management;
- **Global SDS Virtual Centre** could be built upon the existing SDS-WAS Steering Committee for global coordination through the active engagement of WMO, UNEP, WHO, UNCCD and other related UN Organizations with coordinated functions and responsibilities in the SDS problem;



## Recommendations for Global and Regional Coordination of Combating Sand and Dust Storms (SDS)

- **A small Task Team** needs to be established to prepare a draft structure of the Global SDS Virtual Centre and compositions of coordination working groups on the key issues: (i) Characteristics of SDS, (ii) Early Warnings of SDS, (iii) Vulnerability, Resilience and Mitigation Policy;
- It is desirable to enhance the **collaboration between WMO and WHO** under the **Global Framework for Climate Services (GFCS)** through joint projects for further efforts towards creating a Global Dust-Health Early Warning System, building on the SDS-WAS initiative;



## Recommendations for Global and Regional Coordination of Combating Sand and Dust Storms (SDS)

- **A Global Conference on Combating SDS** could be organized for sharing information focusing on the themes of (i) Global scientific initiative; (ii) Platform for early warning and resilience, and (iii) Global platform for policy dialogue and coordination as a follow up on the UNGA Resolution (A/RES/70/195) on Combating SDS, inviting all relevant UN bodies, agencies, funds and programmes to address the problem and contribute to the enhancement of capacity-building.

# WMO Airborne Dust Bulletin

WEATHER CLIMATE WATER

 WORLD METEOROLOGICAL ORGANIZATION

 GLOBAL ATMOSPHERE WATCH

 WWRP  
WORLD WEATHER RESEARCH PROGRAM

## WMO AIRBORNE DUST BULLETIN

Sand and Dust Storm  
Warning Advisory and Assessment System

No. 1 | February 2017

 ORGANISATION MÉTÉOROLOGIQUE MONDIALE

 GLOBAL ATMOSPHERE WATCH

 WWRP  
WORLD WEATHER RESEARCH PROGRAM

## BULLETIN DE L'OMM SUR LES POUSSIÈRES ATMOSPHÉRIQUES

Système d'alerte, d'avis et d'évaluation concernant les tempêtes de sable et de poussière


 WWRP  
WORLD WEATHER RESEARCH PROGRAM


 GLOBAL ATMOSPHERE WATCH


 المنظمة العالمية للأرصاد الجوية

## نشرة التراب الجوي للمنظمة العالمية للأرصاد الجوية

نظام الإنذار بالعواصف الرملية والترابية وتقييمها التابع للمنظمة (WMO)

 世界气象组织

 GLOBAL ATMOSPHERE WATCH

 WWRP  
WORLD WEATHER RESEARCH PROGRAM

## WMO浮尘公报

沙尘暴预警咨询和评估系统

En: [https://library.wmo.int/opac/index.php?lvl=bulletin\\_display&id=3902](https://library.wmo.int/opac/index.php?lvl=bulletin_display&id=3902)

Fr: [https://library.wmo.int/opac/index.php?lvl=notice\\_display&id=19879](https://library.wmo.int/opac/index.php?lvl=notice_display&id=19879)

Ar: [https://library.wmo.int/opac/index.php?lvl=notice\\_display&id=19881](https://library.wmo.int/opac/index.php?lvl=notice_display&id=19881)

Ch: [https://library.wmo.int/opac/index.php?lvl=notice\\_display&id=19883](https://library.wmo.int/opac/index.php?lvl=notice_display&id=19883)



# SDS-WAS Dissemination

## WMO SDS-WAS websites and reports:

<http://www.wmo.int/sdswas>

<https://public.wmo.int/en/our-mandate/focus-areas/environment/sand-and-dust-storm>

## SDS-WAS Regional Nodes and Operational Forecasts:

for Northern Africa, Middle East and Europe: <http://sds-was.aemet.es>;

for Asia: [http://eng.nmc.cn/sds\\_was.asian\\_rc](http://eng.nmc.cn/sds_was.asian_rc);

for the Americas: <http://sds-was.cimh.edu.bb/>

Operational Barcelona Center: <http://dust.aemet.es/>



## WMO SDS-WAS Video

### [Protecting People from Sand and Dust Storms](https://www.youtube.com/watch?v=IYXcpYYIm8I)

<https://www.youtube.com/watch?v=IYXcpYYIm8I>

# SDS-WAS Capacity Building



UNIVERSITAT POLITÈCNICA DE CATALUNYA  
BARCELONATECH



Barcelona Supercomputing Center  
Centro Nacional de Supercomputación



## TRAINING COURSES

- Accra
- Addis-Ababa
- Ankara
- Antalya \*\*
- Barcelona \*\*
- Casablanca \*\*
- Istanbul
- Muscat \*\*
- Niamey
- Ouagadougou

## VISITORS FROM

- Iraq
- Romania
- Turkey



*Thank you!*

**WMO SDS-WAS web-site:**

[http://www.wmo.int/pages/prog/arep/wwrp/new/Sand and Dust Storm.html](http://www.wmo.int/pages/prog/arep/wwrp/new/Sand_and_Dust_Storm.html)

or [www.wmo.int/sdswas](http://www.wmo.int/sdswas)