

INTER-COMMISSION / INTER-PROGRAMME ACTIVITIES

**WMO Sand and Dust Storm Warning Advisory and Assessment System
(WMO SDS-WAS)**

(Submitted by the Secretariat)

PURPOSE:

- To update MG-3 on activities within SDS-WAS

DECISIONS/ACTIONS PROPOSED:

- To provide feedback on the Draft Implementation Plan of WMO SDS-WAS and on the direction of SDS-WAS in general.

REFERENCES:

- Cg-XV/3.3.3.5, 3.3.3.6; EC-LX/Doc. 4.1.10

CONTENT OF DOCUMENT:

1. Draft text for inclusion in the report of the CAS-MG3
2. Appendix: Draft Implementation Plan of WMO SDS-WAS

Summary of Activity

The WMO Sand and Dust Storm Warning and Assessment System (SDS-WAS) was initiated in 2006 in response to the request of more than 40 Members to improve capabilities for sand and dust storm forecasts and analysis products. During sand and desert storms, substantial amounts of soil particles are suspended by winds and transported over long distances and have impacts on weather, climate, health, disease transmission, agriculture, marine ecosystems, electronics industry and ground/air transport. Approximately fourteen research and/or operational centres around the world provide sand and dust research forecasts. It will rely on real-time delivery of products through WIS and will integrate research communities (modelling/prediction/analysis, observations, affects) and user communities (e.g. weather forecasters, medical researchers, aviation safety, agricultural, marine productivity).

In May 2007, the 15th WMO Congress endorsed this WWRP and GAW joint activity to create a WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS), aimed at coordinating observations and research forecast modelling of sand and dust storms, while forging strong links with users including operational forecasters. Congress welcomed the strong support of Spain to host the European/African/Middle East node of the SDS Warning System and to play a lead role in implementation.

In June 2008, the 60th Executive Council of WMO welcomed the initiatives towards the development of SDS-WAS, to assist Members to gain better access to services related to sand and dust storms prediction and warning advisories through capacity building and improved operational arrangements. It also welcomed the establishment of the two SDS-WAS regional nodes, in European/African/Middle East and in Asia/Central Pacific regions, and requested the Commission of Basic Systems (CBS) in charge of operations to collaborate with the Commission for Atmospheric Science (CAS) in charge of research to develop and establish operational procedures to determine the future role of the centres with the appropriate operational and research capabilities.

In July 2008, the Team for Writing the SDS-WAS Implementation Plan (IP) made a first draft that was circulated to the SDS-WAS Science Steering Committee members. The IP includes the steps and phases of actions that will be performed in the period 2009-2013 in order to implement the activities that lead to more accurate and coverage of warnings and assessments of sand and dust storms. It identifies the major challenges for SDS-WAS in the mid-term and proposes an architecture and information exchange for the SDS-WAS that will secure efficient and balanced cooperation between and participation of the major components of the SDS-WAS system: research, prediction, observations and service delivery. It is a cross-cutting activity within WMO programmes as well as involving a substantive partnership outside the National Hydrological and Meteorological Services, particularly in research. As indicated in the IP, the SDS-WAS mission is 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.

APPENDIX: SDS-WAS Implementation Plan



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WMO SECRETARIAT

**WMO SAND AND DUST STORM
WARNING ADVISORY AND ASSESSMENT SYSTEM (SDS-WAS):**

IMPLEMENTATION PLAN (2009-2013)

July 2008

**Research Department
Atmospheric Research and Environment Branch
World Weather Research Division**

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2 **Foreword**

3 When winds are strong, large amounts of sand and dust can be lifted from bare, dry soils into the
4 atmosphere and transported downwind affecting regions hundreds to thousands of kilometres away. A dust
5 storm or sandstorm is a meteorological phenomenon common in arid and semi-arid regions and arises when
6 a gust front passes or when the wind force exceeds the threshold value where loose sand and dust are
7 removed from the dry surface. In desert areas. Dust and sand storms are most commonly caused by either
8 thunderstorm outflows, or by strong pressure gradients which cause an increase in wind velocity over a wide
9 area. Drought and wind contribute to the emergence of dust storms, as do poor farming and grazing
10 practices by exposing the dust and sand to the wind

11 For countries in and downwind of arid regions, airborne sand and dust presents serious risks to the
12 environment, property and human health. Impacts on health include respiratory and cardio-vascular
13 problems, eye infections and in some regions, diseases such as meningitis and valley fever. Dust can carry
14 irritating spores, bacteria, viruses and persistent organic pollutants. It can also transport nutrients to parts of
15 the world oceans and affect marine biomass production. Other impacts include negative effects on the
16 ground transport, aviation, agriculture and visibility. The Inter-governmental Panel on Climate Change
17 (IPCC) recognizes dust as a major component of atmospheric aerosol that is an essential climate variable.
18 More and more dust particles are considered by atmospheric researchers to have important effects on
19 weather through feedback on atmospheric dynamics, clouds and precipitation formation. Thus, there is a
20 need for international coordination of a diverse community dealing with the societal impacts of sand and dust
21 storms. The World Meteorological Organization (WMO) has taken the lead with international partners to
22 develop and implement a Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS).
23 This document describes the motivation for such a system and offers an operational structure for dealing
24 with a very diverse community anchored by a well established WMO system of research, observations,
25 numerical weather and climate prediction and service delivery. The community of practice for sand and dust
26 storms observations, forecasts and analyses is very diverse requiring the development of interfaces with
27 users through careful assessments. WMO has a long history in jointly organizing research assessments like
28 those of the IPCC for climate which it co-sponsors with UNEP or the highly successful environmental
29 conventions, such as the Vienna Convention on the Protection of the Ozone Layer or the UN-ECE
30 Convention on Long Range Transboundary Transport. Moreover, as the authoritative international body for
31 weather, climate and water, WMO has coordinated the international provision of weather and climate
32 services and warnings for over a century.

33 The history of the WMO SDS-WAS development is as follows. On the 12 to 14 September 2004, an
34 International Symposium on Sand and Dust Storms was held in Beijing at the China Meteorological Agency
35 followed by a WMO Experts Workshop on Sand and Dust Storms. The recommendations of that workshop
36 led to a proposal to create a WMO Sand and Dust Storm Project coordinated jointly with the Global
37 Atmosphere Watch (GAW). This was approved by the steering body of the World Weather Research
38 Programme (WWRP) in 2005. Responding to a WMO survey conducted in 2005, more than forty WMO
39 Member countries expressed interest in participating in activities to improve capacities for more reliable sand
40 and dust storm monitoring, forecasting and assessment. In 2006, the steering committee of the Sand and
41 Dust Storm Project proposed the development and implementation of a Sand and Dust Storm Warning,
42 Advisory and Assessment System (SDS-WAS). The WMO Secretariat in Geneva formed an Ad-hoc Internal

1 Group on SDS-WAS consisting of scientific officers representing WMO research, observations, operational
2 prediction, service delivery and applications programmes such as aviation and agriculture.

3 In May 2007, the 14th WMO Congress endorsed the launching of the SDS-WAS. It also welcomed
4 the strong support of Spain to host a regional centre for the European/African/Middle East node of SDS-
5 WAS and to play a lead role in implementation. In August 2007, the Korean Meteorological Administration
6 hosted the 2nd International Workshop on Sand and Dust Storms highlighting Korean SDS-WAS activities as
7 well as this of Asian regional partners. From 7 to 9 November 2007, Spain hosted the WMO/GEO Expert
8 Meeting on SDS-WAS at the Barcelona Supercomputing Center. This consultation meeting brought one
9 hundred international experts together from research, observations, forecasting and user countries
10 especially in Africa and the Middle East to discuss the way forward in SDS-WAS implementation. In early
11 2008, WMO accepted the offer of the China Meteorological Agency to host a regional centre for the SDS-
12 WAS Asia/Central-Pacific node of SDS-WAS. In June 2008, the 60th Executive Council of WMO welcomed
13 the initiatives towards the development of SDS-WAS, to assist Members to gain better access to services
14 related to sand and dust storms prediction and warning advisories through capacity building and improved
15 operational arrangements. It also welcomed the establishment of the two SDS-WAS regional centres and
16 requested the Commission of Basic Systems (CBS) in charge of operations to collaborate with the
17 Commission for Atmospheric Science (CAS) in charge of research to develop and establish operational
18 procedures to determine the future role of the centres with the appropriate operational and research
19 capabilities.

20 This Implementation Plan (IP) defines the steps and phases of actions that will be performed in the
21 period 2009-2013 in order to implement the activities that lead to more accurate and coverage of warnings
22 and assessments of sand and dust storms. It identifies the major challenges for SDS-WAS in the mid-term
23 and proposes an architecture and information exchange for the SDS-WAS that will secure efficient and
24 balanced cooperation and participation of the major components of the SDS-WAS system: research,
25 prediction, observations and service delivery. It is a truly cross-cutting activity within WMO programmes as
26 well as involving a substantive partnership outside the National Hydrological and Meteorological Services,
27 particularly in research.

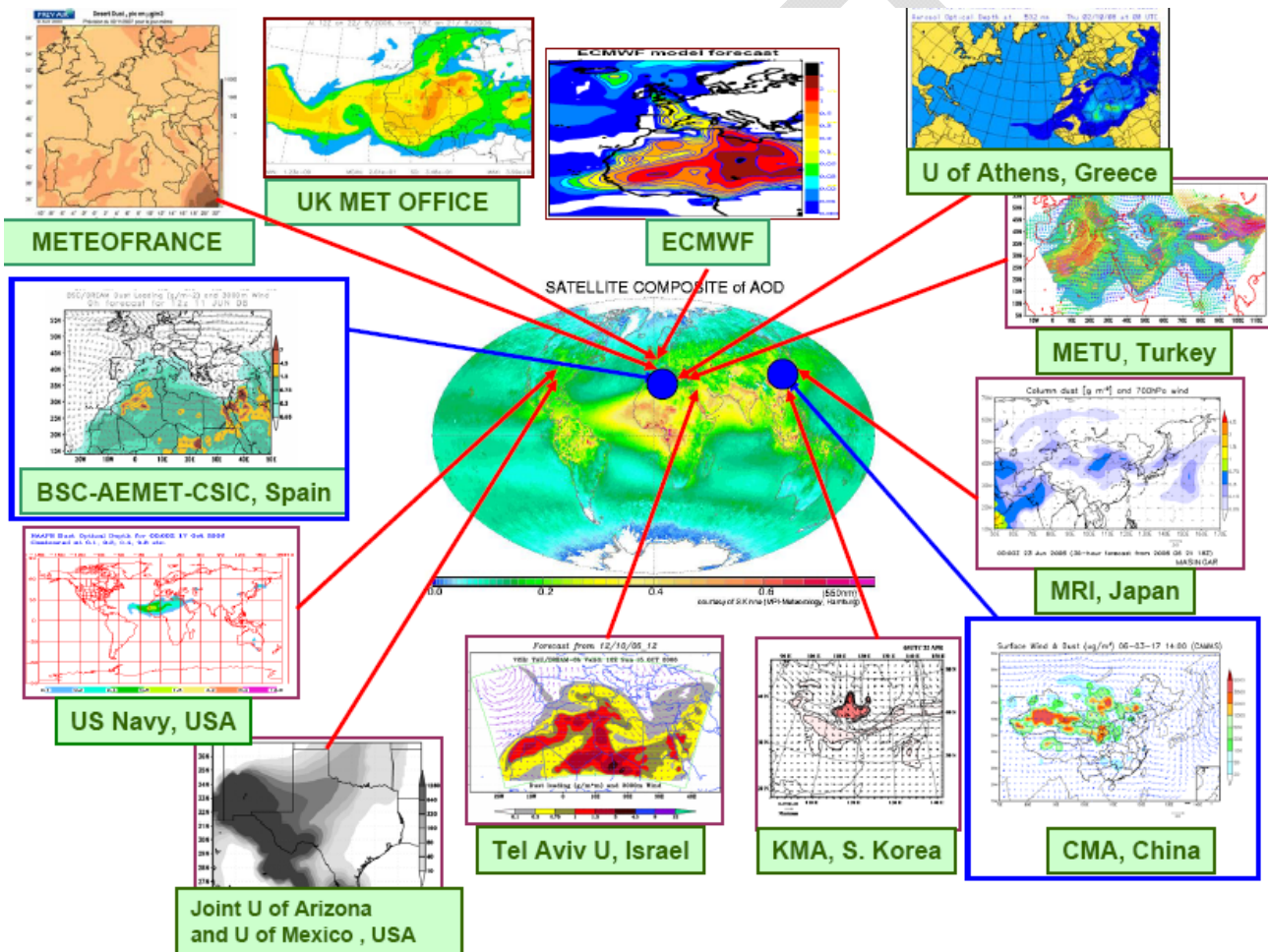
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29 Dr. Leonard A. Barrie,
30 Director of WMO Research Department

1 Rationale

2 In its mission as a world leader in weather, climate, water, and related environmental issues, the
3 World Meteorological Organization (WMO) contributes to the safety and well-being of people throughout the
4 world, and to the societal and economic benefit of all nations. Sand and dust storms are recognized by WMO
5 as serious events that can affect climate, weather, environment and health over much of the world. The
6 WMO therefore is taking a lead with international partners to establish the Sand and Dust Storm Warning
7 Advisory and Assessment System (SDS-WAS) to develop, refine and provide products to the global
8 community useful in reducing the adverse impacts of sand and dust storms and to assess impacts of the
9 SDS process on society and nature.

10 Mineral aerosols, mobilized during Sand and Dust Storms (SDS) in arid and semi-arid continental
11 regions, are the dominant component of the atmospheric aerosol over large areas of the Earth (Figure 1).



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14 Figure 1. In the center: a best estimate of the global distribution of annual average tropospheric aerosol optical depth (AOD) with
15 combined data from six satellites operating for limited periods between 1979 and 2004 (courtesy of S. Kinne MPI, Hamburg, Germany).
16 Mineral dust is mainly found in the Northern Hemisphere, in the broad “dust belt” that extends from the eastern subtropical Atlantic
17 eastwards through the Sahara Desert to Arabia and southwest Asia. On the outside of the Figure: sand and dust models performing
18 daily forecasts at different research and/or operational institutes as of July 2008 (see Annex I). Regional nodes in Asia/Central-Pacific
19 and in European/African/Middle East have been identified as of July 2008.

20
21 Although the main source regions include the Sahara desert and the Sahelian region in North Africa,
22 the Arabian Peninsula, Gobi and Taklamakan deserts in Asia, and the Australian and South American

1 deserts SDS events can also occur seasonally on a local sub-regional basis in many other parts of the world.
2 Dust plumes often cover large areas of the Atlantic, Pacific, and Indian oceans downwind of sources in arid
3 regions Estimates of the amount of dust exported annually range from 1000 to 3000 Tg year⁻¹ with the
4 largest contributions emitted from the North African (50-70%) and Asian deserts (10-25%). A major fraction
5 of this is of natural origin but indirectly through land surface modification and climate change a significant
6 fraction can be linked to human activities.

7
8 In 2008, approximately thirteen centres around the world (Fig. 1) provided sand and dust storm
9 research forecasts through freely available websites. Some are operated by research and/or operations
10 sections of the National Meteorological and Hydrometeorological Services (NMHSs) of the World
11 Meteorological Organization (WMO) and some are in separate research institutions. Sand and dust storm
12 models (Fig. 1) are useful tools in developing an understanding and providing services that can be used to
13 substantially reduce risk of various impacts. For instance, by providing dust concentration predictions for
14 several days in advance to NMHSs or by providing a retrospective analysis of past dust events, users can
15 find ways to avoid adverse effects of sand and dust. Numerical weather prediction systems or their analysis
16 products that drive these Earth System models use complex parameterizations and assimilation of satellite,
17 and surface-based observations to predict winds, clouds, precipitation and dust mobilization, transport, and
18 removal from the atmosphere. Observations of sand and dust are made by many agencies and are being
19 coordinated globally through the WMO Global Atmosphere Watch (GAW) programme as part of a WMO
20 Integrated Global Observing System.

21 Airborne sand and dust aerosol is a serious hazard with numerous adverse impacts. There are many
22 known social, economic and environmental consequences and most are negative. The SDS-WAS should
23 help reduce those that are not wanted, such as human exposure to unhealthy levels of dust, and take
24 greater advantage of those that are positive, such as nutrient deposition in ocean primary productivity zones.
25 Briefly below, are a few of the impacts and anticipated benefits from international collaboration in the SDS-
26 WAS. There are many applications to be documented in detail by SDS-WAS in future publications.

27 Human Health and Air Quality

28 When inhaled, airborne particulate matter of various sizes are known factors in cardiovascular,
29 respiratory and lung disease. The result of this is that many countries around the world have adopted air
30 quality standards for airborne particulate matter (PM) in various size ranges; for instance for PM less than 10
31 and 2.5 micrometre diameter (PM₁₀ and PM_{2.5}, respectively). Forecasts of the time and place where PM
32 will exceed air quality standards for human health allow information to be delivered that assists those
33 impacted to avoid exposure or to understand serious events that have happened.

34 An important application of dust forecasting to air quality management is found in southern Europe.
35 Elevated SDS PM in air masses transported from North Africa to countries of Southern Europe often causes
36 the PM₁₀ limits established for air pollution by the European Directive to be exceeded. This has important
37 implications for many constituencies in a country ranging from the public to industry. Thus in Spain, a
38 methodology has been implemented to quantitatively evaluate the African dust load contribution to
39 exceedances of the European PM₁₀ daily limit value using a combination of observations and dust
40 forecasting. This research will eventually replace an assessment methodology based on a low-resolution
41 PM₁₀ air monitoring network. SDS-WAS forecasts will help to routinely interpret PM records from ground
42 stations distinguishing between dust and other aerosols.

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Human Health and Disease

Bacteria, spores, chemical wastes and other potentially harmful materials mingle with mineral dust, riding along air currents to reach destinations from one to thousands of kilometres away. Predicting SDS can help to better understand and unravel the “hypothesized” role of mineral dust and dry hot air in outbreaks of meningitis across the Sahel’s “meningitis belt.” WHO, WMO and GEO are supporting an international research consortium including many African countries to further investigating this issue.

Valley Fever is caused by a soil-dwelling fungus endemic to the central valley of California and the desert southwest of the United States, Mexico, and locations in Central and South America. During dust storms, fungi are launched into the air and dispersed by air currents and upon inhalation, cause valley fever in humans and animals with sometimes fatal results. Forecasts of dust could assist public health services in improving operational disease surveillance and early detection.

Transportation

Air and highway safety are threatened by sudden and severe dust storms and may be improved using the appropriate SDS-WAS forecast and services. Visibility reducing dust storms are common in desert regions and a hazard to highway safety. With a fully-functioning SDS-WAS, traffic safety officers and accident emergency measures can help the public avoid costly accidents, reduce injuries and highway fatalities, and facilitate trucking and transport of goods. Air traffic control can alert pilots to conditions that should be avoided, such as dust storms that can interfere with visibility, radar and laser guidance systems and equipment function.

Marine Productivity

When deposited to oceans limited in nutrients, dust rich in iron, phosphate or nitrate can stimulate marine productivity with impacts on fisheries. Understanding when, where and how much mineral nutrient is being deposited may result in more efficient practices to sustain fisheries as well as to provide guidance to marine researchers in understanding complex processes of the marine environment.

Agriculture

Sand and dust storms erode soil, smother cropland by moving dunes, damage crops and injure livestock. They are a risk to food and water security. They are part of a feedback loop that begins with natural or human related land degradation leading to desertification, then to more dust and then back to land degradation closing the feedback. Sand and dust storm warning advisories and assessments will allow mitigating action to be taken, such as harvesting maturing crops and sheltering livestock, along with adaptive action, such as changing the time of planting, strengthening infrastructure, and construction of windbreaks and shelterbelts. With appropriate user consultation, tools and products of SDS-WAS could be developed to: (i) better assess crop yield; (ii) research plant and animal pathogen movement; (iii) understand the relationship between elevated dust levels and disease outbreaks and (iv) to develop soil erosion and land degradation models.

Weather Prediction

Airborne dust affects precipitation processes and the atmosphere’s energy and radiation budget. Advanced weather forecast models are increasingly taking into account the effects of dust and other aerosol types on direct radiative heating, on cloud radiative properties, cloud coverage and on the formation of rain and snow. There are many journal publications showing the improvement in atmospheric dynamics of

1 forecast models that result from adding aerosols as active “weather variables” in numerical weather
2 prediction models. This will no doubt play a role in reducing model uncertainty and accelerate progress
3 toward extending weather forecasts from one week to two weeks. There is evidence leading to a hypothesis
4 that Saharan dust over the Atlantic affects the development of hurricanes reaching the Americas. In
5 addition, there is modelling evidence that dust and pollution aerosol in India affects the Indian Monsoon.
6 SDS-WAS will promote this type of weather model research and development.

8 Climate Prediction

9 The Intergovernmental Panel on Climate Change in its 4th Assessment Report recommends
10 research to reduce important uncertainties in the effect of aerosols on the Earth’s radiation budget and
11 climate. Products of the research component of SDS-WAS will improve estimates of the contributions to
12 global airborne particulates from natural and anthropogenic sources and the land-atmosphere processes that
13 produce them. These will be essential for improving the accuracy in predicting seasonal to inter-annual
14 climate and providing users with estimates of SDS in future climate scenarios.

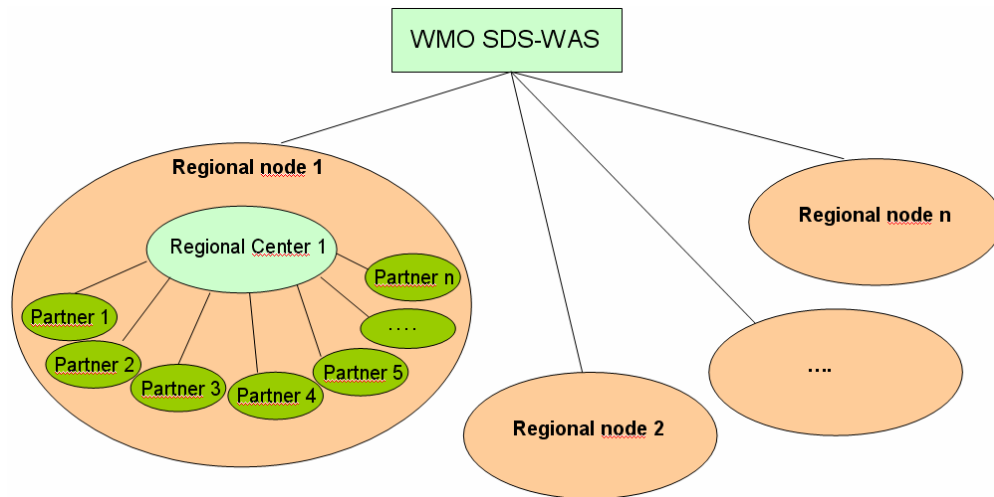
16 **Mission**

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18 The SDS-WAS mission is to enhance the ability of countries to deliver timely and quality sand and
19 dust storm forecasts, observations, information and knowledge to users through an international partnership
20 of research and operational communities.

22 **Objectives**

23 The SDS-WAS, as an international framework linking institutions involved in SDS research, operations
24 and delivery of services, will address the following objectives:

- 25 ▪ Provide user communities access to forecasts, observations and information of the SDS through
26 regional centres connected to the WMO Information System (WIS) and the World Wide Web.
- 27 ▪ Identify and improve SDS products through consultation with the operational and user communities
- 28 ▪ Enhance operational SDS forecasts through technology transfer from research
- 29 ▪ Improve forecasting and observation technology through coordinated international research and
30 assessment
- 31 ▪ Build capacity of relevant countries to utilize SDS observations, forecasts and analysis products for
32 meeting societal needs
- 33 ▪ Build bridges between SDS-WAS and other communities conducting aerosol related studies (air
34 quality, biomass burning, etc.)



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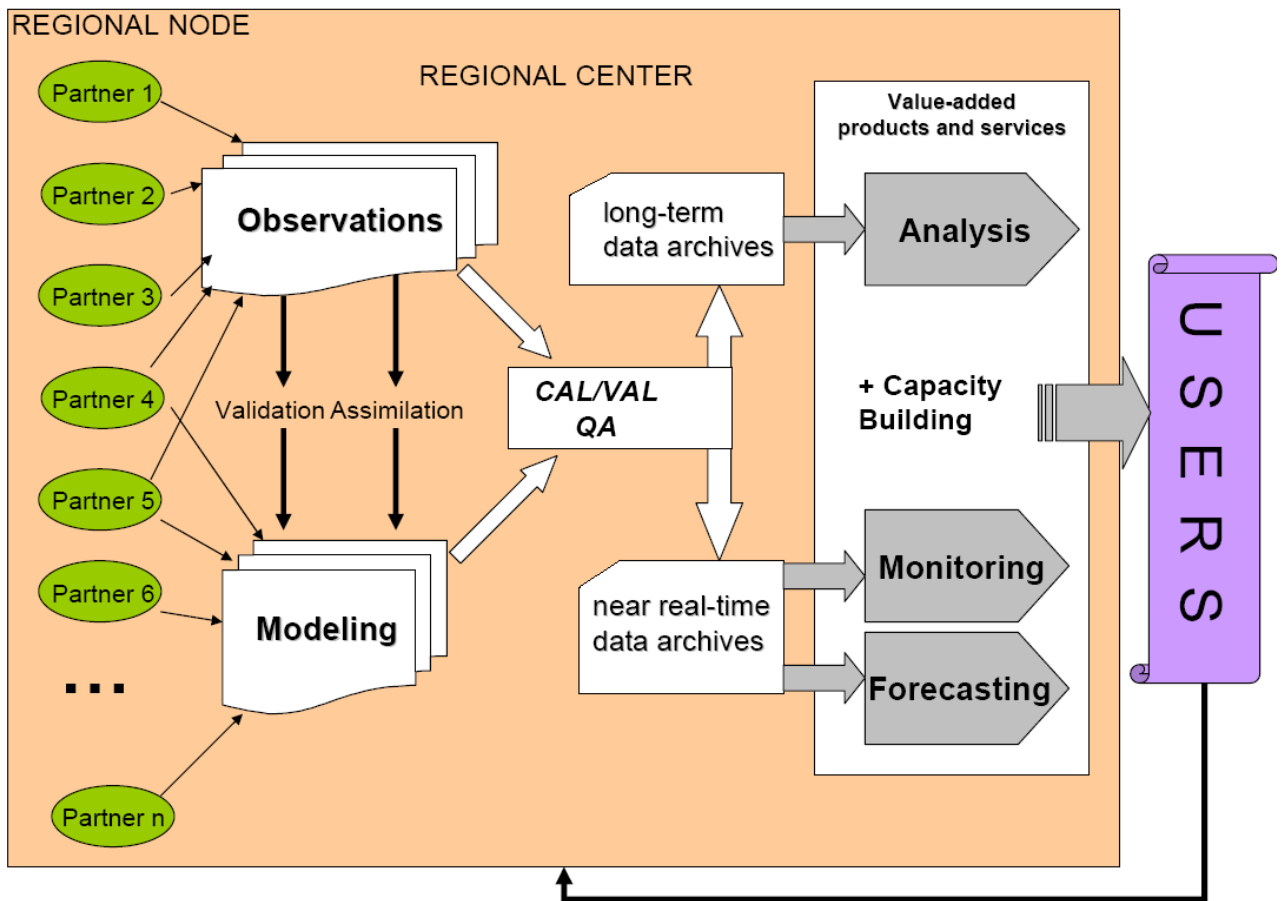
2 Figure 2. The international network of SDS-WAS comprised of federated nodes assisted by regional centres

3 **Structure and Federation**

4 SDS-WAS is an international network (Fig 2) of research, national operational centres and users
 5 organized through regional nodes assisted by SDS-WAS regional centres. It is centrally coordinated by the
 6 SDS-WAS Steering Committee supported by the WMO Secretariat and reporting to CAS through the WWRP
 7 and GAW programmes. This implementation plan calls for close collaboration with operational forecasting
 8 and service delivery programmes reporting to the WMO Commission for Basic Systems. At the regional
 9 level of nodes, SDS-WAS is structured as a federation of partners. The regional nodes as an aggregate
 10 structure comprise the SDS-WAS federation. What the term federation implies is an organized structure
 11 following minimum global standards and rules of practice. A federated approach allows flexibility, growth and
 12 evolution, while preserving the autonomy of individual institutions. It allows a variety of participants (such as
 13 regional centres-serving as hosts, university research centres - serving as partners, WMO designated
 14 operational forecasting centres, meteorological operational services, health organizations, etc.) to cooperate
 15 and benefit without requiring changes to their own internal structures and existing arrangements. The
 16 regional node (Figure 2) and its partners will adopt minimum regional standards to operate and is open to
 17 new members to join. The structure is scalable and allows for adaptability to changing research and
 18 operational environments.

19 The flow of information between various SDS-WAS regional components and the role of an SDS-
 20 WAS regional centre is shown in Figure 3. The Scientific Committee of SDS-WAS takes into account flow
 21 of information between system components (Fig 3) and the interaction of research and operations, as well as
 22 ensuring minimum global standards when appropriate.

23



1
2 Figure 3 Flow of information between SDS-WAS system components for a regional node consisting of a consortium of partners
3 supported by the Regional Steering Group and Regional Centre
4

5 SDS-WAS has several interface levels at which a regional node and its centre would function. *The*
6 *Introduction Level* interface would introduce the regional users to key concepts of the SDS phenomena. The
7 *Application Prototyping Level* interface would provide basic functionality such as weather information related
8 to formation of SDS events, basic visualization, etc. It is envisaged that such interfaces would be formed by
9 rapid application prototyping process, to achieve flexibility and evolution on a fast track. The *Knowledge*
10 *Level* interface would provide links for related terms for more in-depth analysis and understanding of the
11 complexities of SDS process. In terms of the data predictions and information products, they would be
12 provided by the nodes, aggregating and storing the products, filtering the information to produce value-added
13 products and distributing them to the users. In the following sections, the role and terms of reference of key
14 organizing groups of SDS-WAS are described.
15

16 SDS-WAS Steering Committee

17 The SDS-WAS Steering Committee (SDS-WAS SC) coordinates activities at the global scale. Its role is
18 to ensure the fulfillment of SDS-WAS objectives. It will manage the SDS-WAS according to this
19 implementation plan which in turn supports detailed plans developed by the regional nodes assisted by the
20 SDS-WAS Regional Centre (role defined below). The terms of reference of SDS-WAS SC are:

- 21 ▪ To periodically review the SDS-WAS objectives

- 1 ▪ To identify value-added global activities in research, assessment and operations and promote their
- 2 implementation
- 3 ▪ To identify gaps in SDS-WAS global coverage and to recommend solutions
- 4 ▪ To promote communication between regional nodes
- 5 ▪ To provide guidance on standardization between regional nodes
- 6 ▪ To represent at a global level SDS-WAS activities through a membership comprised of operational
- 7 and research representatives of the SDS-WAS RCs, chairs of RSGs, and selected experts to fill
- 8 programmatic and geographic gaps. It will meet every two years.
- 9 ▪ To promote extra-budgetary contributions to a WMO Trust fund for SDS-WAS
- 10 ▪ To report routinely to the appropriate bodies or expert groups of CAS and CBS as appropriate

12 **SDS-WAS Regional Centre**

13 An SDS-WAS Regional Centre (SDS-RC) supports a node in a global network of SDS-WAS research and
 14 operational partners (Figure 3) implementing SDS-WAS objectives in a region. The members of this node
 15 are the host institution of the SDS-WAS RC and regional partners engaged in research and operations of
 16 SDS-WAS. The node itself is organized as a federated system. Implicit in designation of the host institution is
 17 a commitment of long-term support and fulfillment of the following terms of references:

- 18 • To provide a web-based portal for user access to regional research and forecast activities and
- 19 services ¹
- 20 • To provide neutral ground for operations, research and capacity building in the region and to
- 21 build partnerships
- 22 • To support the identification and organization of activities through a regional steering group
- 23 (RSG) consisting of representatives of members of the regional node covering research,
- 24 operations and selected users. SDS-RC supports the activities of the node agreed upon by the
- 25 Regional Steering Group. The appointment and organization of the RSG activities are assisted
- 26 by the WMO Secretariat
- 27 • To cooperate with existing operational service delivery mechanisms, recognizing that warnings
- 28 related to SDS-WAS are generally the responsibility of the National Meteorological and
- 29 Hydrological Services (NMHSs) and that SDS-WAS products provide input to NMHSs.
- 30 • To report to the SDS-WAS Steering Committee annually

32 **Role of the WMO Secretariat**

33 The WMO Secretariat, through the lead of the Department of Research, working closely with
 34 Departments of Weather and Disaster Risk Reduction Sevices and other Departments, will provide support
 35 for SDS-WAS under the guidance of CAS and CBS. The Ad-hoc Internal SDS-WAS Group, chaired by the
 36 Research Department has the following ToR:

- 37 • To assist the appointment and organization of the SC and RSG activities

¹ SDS-WAS partners will communicate using regional web portals accessible through a general WMO SDS-WAS web site. They will contain value-added observational and forecast products as well as links to sources of basic information. They will also contain SDS-WAS description, tasks, upcoming events and background information.

- 1 • To support a biennial meeting of the SC and partial support of the RSG meetings
- 2 • To manage, in consultation with SC, a WMO Trust fund for SDS-WAS
- 3 • To promote national capacity building for SDS-WAS activities,
- 4 • To coordinate SDS activities with other international organizations, in particular with United Nations
- 5 Convention to Combat Desertification, World Health Organization, International Civil Aviation
- 6 Organization, Group on Earth Observations and United Nations Environmental Protection
- 7 • To assist in development, ongoing review and update of Implementation Plans in SDS-WAS
- 8 • To establish outreach and communication mechanisms, including the maintenance of a web site
- 9 portal to SDS-WAS

11 **Partners**

12 Participation of agencies and institutions in SDS-WAS is on a voluntary basis. They may link to one or more
 13 of the regional nodes, to the WMO Secretariat, or via an established portal or other Affiliate. Affiliate centres
 14 such as the U.S. National Centers for Environmental Prediction, the ECMWF, CMA, JMA and KMA
 15 forecasting centres, etc., may undertake collaborative research, provide data, test products, develop and
 16 provide added value products, improve monitoring, extend outreach, and expand the family of applications
 17 (e.g. demonstrate value for agriculture and fisheries).

20 **Research**

21 Research is an essential component of SDS-WAS. In 2008, the immaturity of atmospheric science
 22 related to aerosols and their inclusion in weather and climate models meant that a large fraction of activities
 23 and partners are research and development oriented. This plan recognizes that for success in the long term,
 24 it is important to establish a mix of research and operational activities with a strong dialog and link to
 25 capacity building. In the long term, SDS-WAS will be sustained through research assisting the delivery of
 26 effective operational services and assessments linked to user needs.

27 This implementation plan considers the following research foci as a priority for further development of
 28 the SDS-WAS:

- 29 ▪ Improved dust source specification and parameterization
- 30 ▪ Influence of local and mesoscale atmospheric processes on dust storm generation
- 31 ▪ Advanced methods in observing the SDS, including surface-based, aircraft and satellite methods
- 32 ▪ 4-D assimilation of dust-related observations
- 33 ▪ Inclusion of direct and indirect radiative forcing effects of dust in atmospheric weather and climate
- 34 models
- 35 ▪ The role of dust as ice nuclei affecting storm development and precipitation
- 36 ▪ Dust impact on high impact hydrometeorological and environmental phenomena (e.g. monsoons,
- 37 tropical cyclones, mesoscale convective complexes, flooding and droughts)
- 38 ▪ Developing ensemble systems for SDS prediction
- 39 ▪ Dust and health issues (e.g. meningitis, valley fever, asthma, etc)
- 40 ▪ Dust as a transmitter of disease and contaminants
- 41 ▪ Photochemical effects of dust and its impact on atmospheric ozone and other oxidants
- 42 ▪ Impact of dust on marine productivity

- 1 ▪ SDS reanalysis studies producing dust climatologies
- 2 ▪ SDS model validation and model intercomparisons

4 **Progress to Date**

5 For the historical background to development of SDS-WAS up to July 2008 see the Foreword.

6 Regional Centre for Asia/Central Pacific (SDS-WAS RC A-CP).

7 In order to promote more effectively the implementation plan, the Regional Center for Asia/Central Pacific
8 (SDS-WAS RC A-CP) hosted by the Centre for the Atmospheric Watch and Services of the National Satellite
9 Meteorological Centre and National Meteorological Centre of CMA in China supports a regional node in
10 SDS-WAS consisting of a consortium of partners from China, Korea, Japan, Mongolia and other interested
11 countries in the region.

12 Regional Centre for North Africa, Middle East and Europe (SDSWAS RC NA-ME-EU).

13 This Centre, hosted by Spain is composed of a consortium that includes: the Meteorological State Agency of
14 Spain (AEMET), the Barcelona Supercomputing Center (BSC-CNS) and the National Research Council
15 (CSIC). Some of the regional node partners will include Meteo-France, LISA, University of Athens, University
16 of Tel Aviv, Egyptian Meteorological Agency, METU and NMHSs in the region.

18 **Capacity Building**

19 Capacity building in SDS-WAS involves technology transfer with self-sustaining capability and long-term
20 partnership in mind. This capacity building will be coordinated through various mechanisms including those
21 very well established in WMO through the Development and Regional Activities Department. Elements of
22 capacity building include: consultation meetings with national users to develop effective and realistic
23 products and tools for their needs; training courses on use of services that are available; research
24 workshops and provision of guidance and outreach material. The SDS-WAS nodes will promote capacity
25 building through regional partnerships.

26 Depending on available resources, proposed activities include:

- 27 ▪ Regular scientific exchange: A scientific workshop or demonstration will accompany every group
28 meeting to discuss recent developments in SDS modelling and forecasting.
- 29 ▪ Dedicated training: It will include training on monitoring and modelling methods.

30 These activities will be carried out through In-house training courses and workshops conducted at an
31 institution within the regional node, at WMO headquarters, and at affiliated institutions. The capacity building
32 component of SDS-WAS will include expert visits to local institutions.

33 Capacity building, training and demonstrations may be assisted from relevant existing WMO programmes,
34 and from the regional SDS-WAS nodes. Subjects for training and demonstration include satellite data access
35 and analysis, dust storm forecast and simulation model output analysis, targeting user needs through new
36 information products, measuring and monitoring particulate air quality through remote sensing and in-situ air
37 sampling instruments, developing PM monitoring networks for verifying and validating SDS products, and
38 characterizing and mapping sand and dust source regions.

1 Programs such as the *Sistema Regional Visualización y Monitoreo* (SERVIR) routinely disseminate data
2 and value-added products derived from research and monitoring systems. Users and researchers from
3 throughout the Americas benefit from SERVIR, which is expanding to cover African nations as well. Training
4 and demonstrations in preparing and applying environmental information products provide access to tools
5 and technology generally not available except in the largest laboratories and institutions.

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1 **ANNEX 1**

2 **Organizations delivering or developing SDS systematic forecasts and other**
 3 **services as of July 2008**

Organization	Web site	Domain coverage	Contact person and e-mail
Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, Paris, France	http://www-lsceinca.cea.fr/cgi-bin/lsce/inca_work_annualrs.pl	Global	Dr Yves Balkanski yves.balkanski@lsce.ipsl.fr
Japan Meteorological Agency	http://www.jma.go.jp/en/kosafcst/kosafcst-c.html	East Asia, Central Pacific	Maki, Takashi maki@met.kishou.go.jp
Met Office, UK	Not publically available	Eastern Africa, Middle East and southern Asia	Dr Damian Wilson Damian.Wilson@metoffice.gov.uk
Spain: Barcelona Supercomputing Centre & the Meteorological State Agency of Spain (AEMET),	http://www.bsc.es/projects/earthscience/DR EAM/	North Africa, Middle East, Europe East Asia	Carlos Pérez carlos.perez@bsc.es José Baldasano Jose.baldasano@bsc.es Emilio Cuevas ecuevas@inm.es
Centre for Atmosphere Watch and Services (CAWAS), Chinese Meteorological Agency	http://www.sds.cma.gov.cn/index.php?mid=22	East Asia, Central Pacific	Xiaoye Zhang xiaoye@cams.cma.gov.cn
University of Athens, Greece	http://forecast.uoa.gr/dustindx.php	Middle East, Mediterranean, Europe, North Africa and Atlantic Ocean; Saudi Arabia for Arabian Peninsula, North Africa, Middle East and SW Asia – password protected	George Kallos kallos@mg.uoa.gr
Korean Meteorological Administration, Korea	http://web.kma.go.kr/eng/asi/asi_02_04.jsp	East Asia	Seungbum Kim skim@kma.go.kr
MeteoFrance	Pre-operational	Global	Vincent-Henri Peuch vincent-henri.peuch@meteo.fr
University of Tel Aviv, Israel	http://wind.tau.ac.il/dust8/dust.html	North Africa, Middle East, Europe	Pavel Kishcha pavel@cyclone.tau.ac.il
Naval Research Laboratory, Monterey, USA	http://www.nrlmry.navy.mil/aerosol/index_sh ortcuts.html	Global	Douglas Westphal douglas.westphal@nrlmry.navy.mil
Research Institute for Applied Mechanics, Kyushu Univ., Japan In cooperation with National Institute for Environmental Studies (NIES)	http://cfors.riam.kyushu-u.ac.jp/~cfors/index.html http://www-cfors.nies.go.jp/~cfors/index.html	East Asia, Central Pacific	Itsushi Uno, iuno@riam.kyushu-u.ac.jp
Laboratoire de Météorologie	http://www.lmd.polytechnique.fr/dust/dust-fcst-maps.php	Africa, Europe,	Laurent MENU menut@lmd.polytechnique.fr

Dynamique, Paris, France		Atlantic, Central Asia	
ECMWF	Pre-operational	Global	Jean-Jacques.Morcrette@ecmwf.int
University of Arizona; University of New Mexico	http://phairs.unm.edu/ Pre-operational	Regional	William Sprigg wsprigg@email.arizona.edu

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1 ANNEX 2

2 Phases of Implementation

3 The implementation of the SDS-WAS is planned in 2 phases.

4 Phase-1 (2009-2010)

5 The emphasis will be to formalize the SDS-WAS implementation plan through establishment of Regional
6 Groups (RGs) for the SDS-WAS Regional Centres in China and Spain and through consultation with CAS
7 and CBS. The next sessions of CAS and CBS are in Korea, November 2009 and Croatia, March 2009,
8 respectively. Effective cooperation between partners in regions will be established to exploit current routine
9 forecast and observation capabilities, to strengthen the SDS-WAS monitoring network and to develop a
10 routine verification system. During this phase, near real-time quantitative and qualitative verification system
11 will be implemented. Finally, platforms will be developed for users, for exchanging observational data for
12 model evaluation and data assimilation applications.

13

14 Phase-2 (2011-2013)

15 It is planned that cooperative research and development will be performed in the following areas.

- 16 ▪ Collection of data from field campaigns, to be used for a better understanding of the SDS process, to
17 evaluate of model performance. This will provide an assessment of the forecast capabilities of
18 current modelling technology and point to areas where improvement can be made.
- 19 ▪ The joint verification of the different forecasts with a common real-time verification system.
- 20 ▪ Data assimilation and ensemble forecasting experiments will also be undertaken and/or considered.
- 21 ▪ Establishing user-oriented studies (e.g. case studies of events affecting air/ground transport; studies
22 linking public health and dust, etc.)
- 23 ▪ Studies on saltation process and on active dust source areas to validate and complete dust
24 production modules.
- 25 ▪ Research in spatial distribution of dry size distribution of soil aggregates in all potential source areas.
- 26 ▪ Model inter-comparisons.

27

1 **ANNEX 3**

2 **Milestones**

3

4 July 2008:

- 5 ▪ SDS-WAS Implementation Plan Draft finalized by a core writing group and the WMO ad-hoc Internal
6 SDS-WAS Group and distributed to the SDS-WAS Steering Committee, the JSC for WWRP.

7 August 2008:

- 8 ▪ Revised Implementation Plan prepared
9 ▪ Prepare document for CAS Management Group meeting October 27-29, Geneva

10

11 September 2008:

- 12 ▪ Regional Steering Groups established
13 ▪ Prepare document for REGIONAL ASSOCIATION II(ASIA) FOURTEENTH SESSION Tashkent,
14 Uzbekistan 5 to 11 December 2008

15

16 November 2008

- 17 ▪ First meetings of the Regional Steering Groups in Tunis and Beijing to develop consensus on
18 operating principles and short term plan of action.
19 ▪ Prepare document for CBS-XIV (2009), Croatia, March 2009 and meeting of JSC-OPAG EPAC in
20 charge of GAW programme

21 January 2009:

- 22 ▪ Regional Centres in China and Spain establish data portals and information exchange between
23 partners in their regional nodes.
24 ▪ Prepare Input to WMO EC61

25 March 2009

- 26 ▪ CBS-XIV (2009), Croatia, March 2009
27 ▪ Meeting JSC-OPAG EPAC in charge of GAW programme

28 April 2009:

- 29 ▪ Implemented routine quantitative and qualitative verification systems in RCs

30 June 2009:

- 31 ▪ Report to EC61

32 July 2009:

- 33 ▪ Prepare IP for CAS XV

34 November 2009:

- 35 ▪ Report to CAS XV (20-27 November 2009)

36 January 2010:

- 37 ▪ Finalize IP

1 2010:

- 2 ▪ Data assimilation techniques will be reviewed and shared

3 2011:

- 4 ▪ Intercomparison studies.

5 2011:

- 6 ▪ Developing ensemble dust forecast systems will start.

7

8 **ANNEX 4**

9 **Members of the Provisional SDS-WAS Scientific Steering Committee**

10 Stephane Alfaro (France)

11 Jose Baldasano (Spain)

12 Leonard Barrie (WMO)

13 Seungbum Kim (Korea)

14 Emilio Cuevas (Spain)

15 M. Eissa (Egypt)

16 Sunling Gong (Canada)

17 Ata Hussain (Pakistan)

18 Dulam Jugder (Mongolia)

19 Menas Kaftos (USA)

20 Young Kim (Korea)

21 Mikami Masao (Japan)

22 Slobodan Nickovic (WMO)

23 Soon-Ung Park (Korea)

24 Carlos Pérez (Spain)

25 Nobuo Sugimoto (Japan)

26 Ina Tegen (Germany)

27 William Sprigg (USA)

28 Zhang Xiao Ye (China)

29

30 **Writing Team**

31 Jose Baldasano (Spain)

32 Leonard Barrie (WMO)

33 Peter Chen (WMO Ad Hoc group)

34 Emilio Cuevas (Spain)

35 Menas Kaftos (USA)

36 Slobodan Nickovic (WMO)

37 David Parsons (WMO)

38 Carlos Pérez (Spain)

39 Herbert Puempel (WMO Ad Hoc group)

40 Robert Stefanski (WMO Ad Hoc group)

41 William Sprigg (USA)

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