WMO SECRETARIAT

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

IMPLEMENTATION PLAN 2009-2013

(DRAFT)

July 2009

Research Department

Atmospheric Research and Environment Branch

World Weather Research Division

This Draft Implementation Plan is posted on the web
http://www.wmo.int/pages/prog/arep/wwrp/new/Sand_and_Dust_Storm.html
for comments and reviewed by the community.
Please send comments to the WMO Secretariat (S. Nickovic snickovic@wmo.int)

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Foreword

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

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

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

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

In May 2007, the 14th WMO Congress endorsed the launching of the SDS-WAS. It also welcomed the strong support of Spain to host a regional centre for the Northern Africa-Middle East-Europe (NA-ME-E) node of SDS-WAS and to play a lead role in implementation. In August 2007, the Korean Meteorological Administration hosted the 2nd International Workshop on Sand and Dust Storms highlighting Korean SDS-WAS activities as well as these of Asian regional partners. From 7 to 9 November 2007, Spain hosted the WMO/GEO Expert Meeting on SDS-WAS at the Barcelona Supercomputing Center. This consultation meeting brought one hundred international experts together from research, observations, forecasting and user countries especially in Africa and the Middle East to discuss the way forward in SDS-WAS implementation. In early 2008, WMO accepted the offer of the China Meteorological Agency to host a regional centre for the SDS-WAS Asia node of SDS-WAS. In June 2008, the 60th Executive Council of WMO (EC-LX, 2008) 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 centres in China and Spain 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 November 2008, first meetings of the Regional Steering Groups (RSG) for the two SDS nodes were held in Beijing (China) and Tunis-Carthage (Tunisia). At the fourteenth session of the Commission for Basic System (CBS), Dubrovnik, 25 March - 2 April, 2009, the Commission requested appropriate experts in CBS to review the draft SDS-WAS Implementation Plan "to clarify the future of the SDS-WAS centres (and nodes) in the context of the WMO Global Data-Processing and Forecasting System (GDPFS) and Regional Specialized Meteorological Centre (RSMC) structures" (from EC-LX, 2008), and recommended using its RSMC designation process for the establishment of the SDS-WAS centres, to ensure operational sustainability.

This Implementation Plan (IP) defines 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 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 and participation of the major components of the SDS-WAS system: research, prediction, observations and service delivery. It is a truly cross-cutting activity within WMO programmes as well as involving a substantive partnership outside the National Hydrological and Meteorological Services, particularly in research.

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

Rationale

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

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

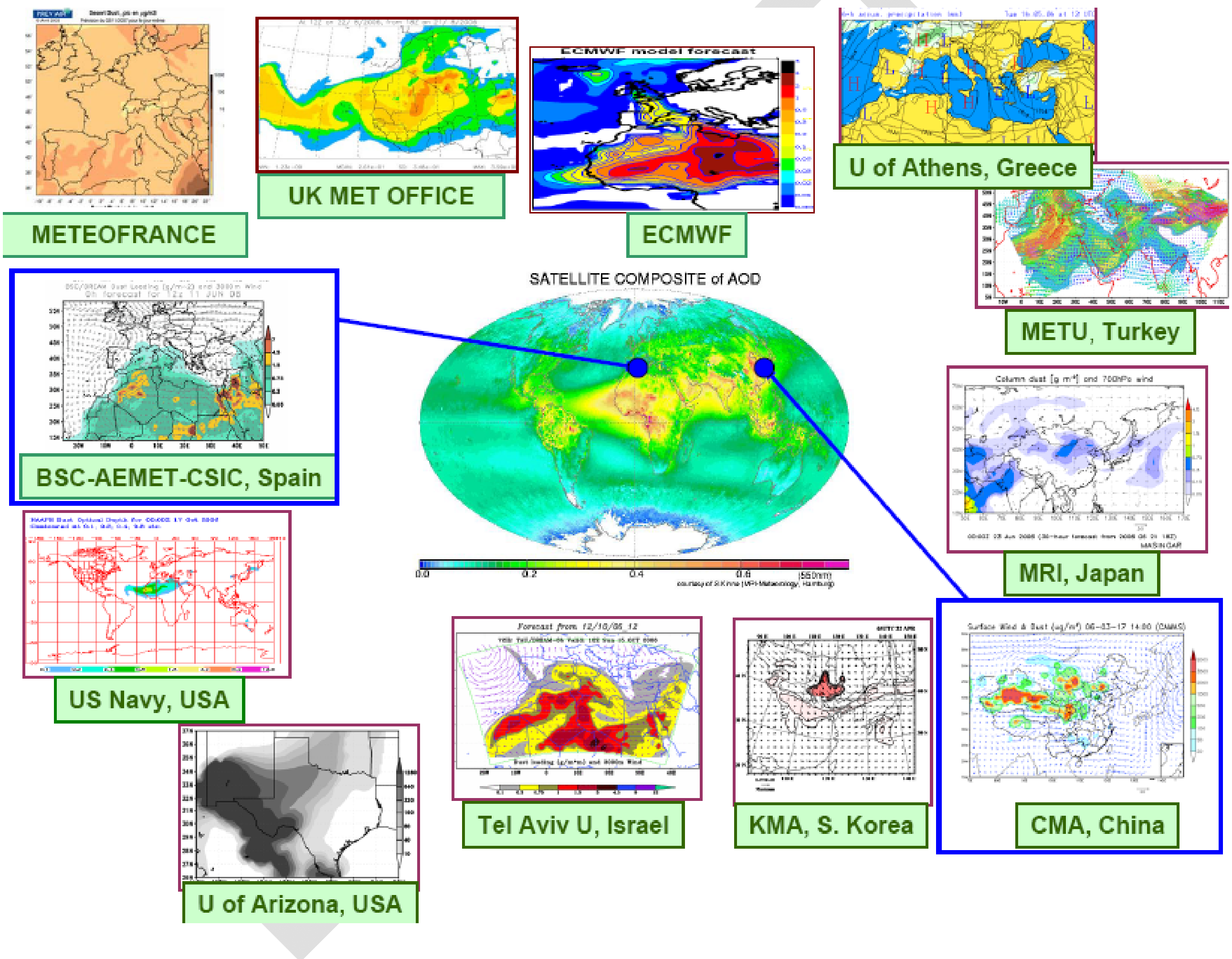

Figure 1. In the center: a best estimate of the global distribution of annual average tropospheric aerosol optical depth (AOD) with combined data from six satellites operating for limited periods between 1979 and 2004 (courtesy of S. Kinne MPI, Hamburg, Germany). Mineral dust is mainly found in the Northern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

Although the main source regions include the Sahara desert and the Sahelian region in North Africa, the Arabian Peninsula, Gobi and Taklamakan deserts in Asia, and the Australian and South American deserts SDS events can also occur seasonally on a local sub-regional basis in many other parts of the world. Dust plumes often cover large areas of the Atlantic, Pacific, and Indian oceans downwind of sources in arid regions Estimates of the amount of dust exported annually range from 1000 to 3000 Tg year^{-1} with the largest contributions emitted from the North African (50-70%) and Asian deserts (10-25%). A major fraction of this is of natural origin but indirectly through land surface modification and climate change a significant fraction can be linked to human activities.

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

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

<u>Human Health and Air Quality</u>

When inhaled, airborne particulate matter of various sizes are known factors in cardiovascular, respiratory and lung disease. The result of this is that many countries around the world have adopted air quality standards for airborne particulate matter (PM) in various size ranges; for instance for PM less than 10 and 2.5 micrometre diameter (PM10 and PM2.5, respectively). Forecasts of the time and place where PM will exceed air quality standards for human health allow information to be delivered that assists those impacted to avoid exposure or to understand serious events that have happened.

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

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

<u>Climate Prediction</u>

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

Mission

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.

Objectives

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

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

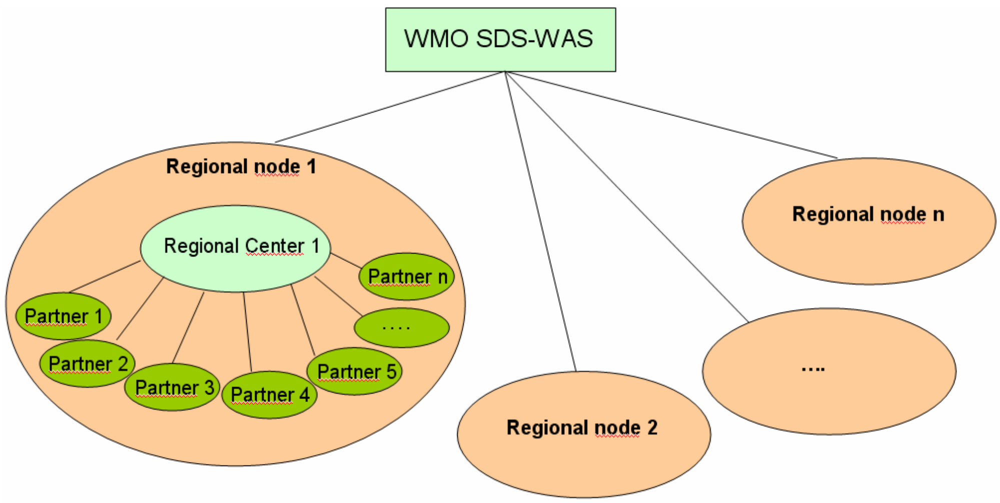

Figure 2. The international network of SDS-WAS comprised of federated nodes assisted by regional centres

Structure and Federation

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

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

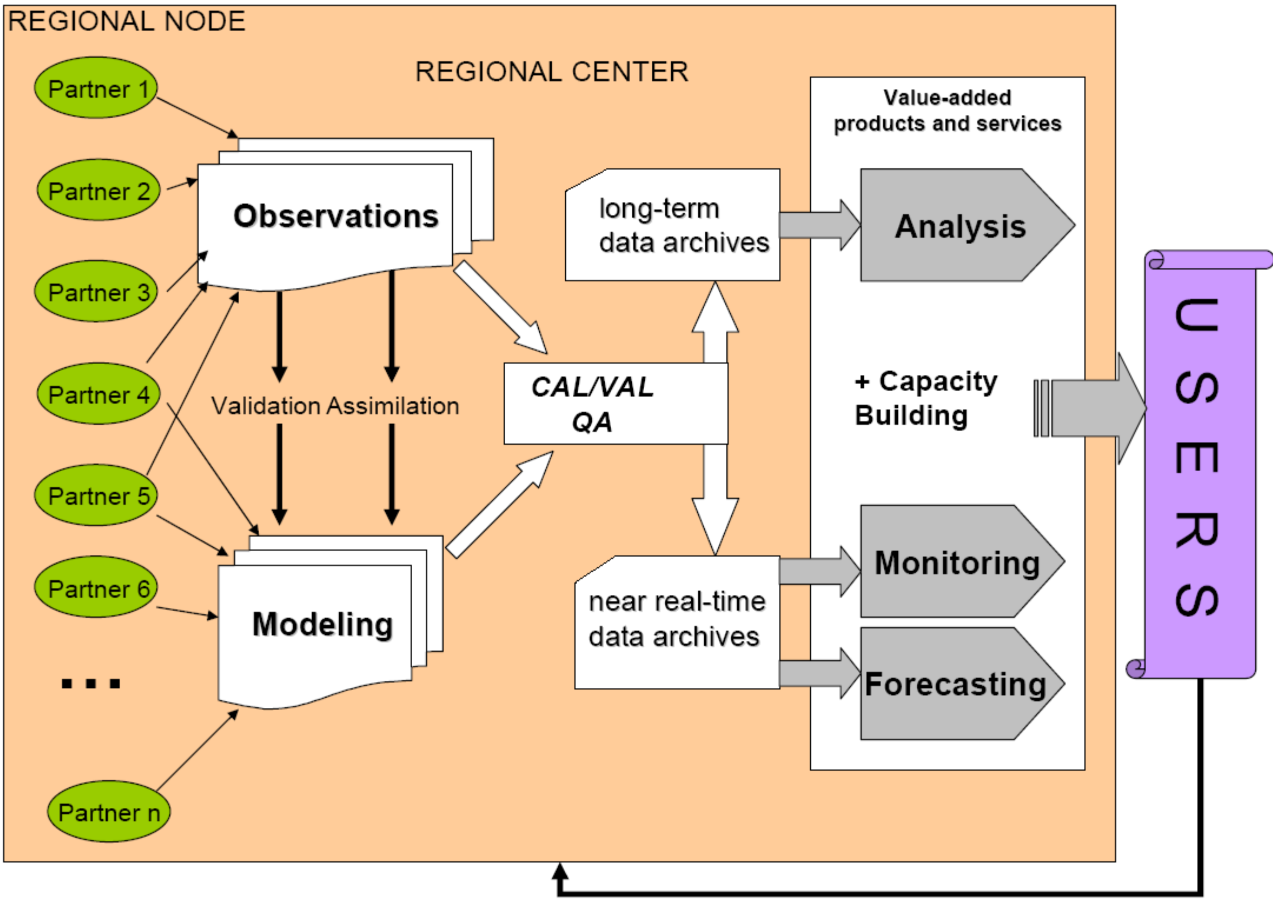

Figure 3 Flow of information between SDS-WAS system components for a regional node consisting of a consortium of partners supported by the Regional Steering Group and Regional Centre

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

SDS-WAS Steering Committee

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

- To periodically review the SDS-WAS objectives

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

SDS-WAS Regional Centre

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

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

Role of the WMO Secretariat

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

- 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.

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

Partners

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

Research

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

This implementation plan considers the following fociii as a priority for further development of the SDS-WAS:

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

- SDS reanalysis studies producing dust climatologies
- SDS model validation and model intercomparisons

Progress to Date

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

<u>Regional Node for Asia (SDS-WAS RC A).</u>

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

The Regional Steering Group made the following proposals for actions to be done in the period 2009-2010

- The RSG members are: S. Park, Seoul National University, Korea (Chair); M. MIKAMI, MRI, Japan (Co-Chair); X. ZHANG, CMA, China (Co-Chair); Takashi Maki, JMA, Japan; Nobuo Sugimoto, NIES, Japan; Seung-Bum KIM, KMA, Korea (research); Deuk-Gyun RHA, Korea (operations); DUAN Yihong CMA, China; HU Xiuqing, CMA, China; Farida Muratova, Met Office, Kazakhstan; Mongolia (TBD); India (TBD); A Representative for Aerosol Optical Dept Measurements (TBD)

- **Integrated Observations**
  - o Promote exchange of aerosol observations (PM10 and LIDAR) in near real time(1-3 hrs).
    - Action: Design a regional pilot project and host a technical workshop including major network representatives, models (research and operations) and WMO Information System (WIS) experts from each country {Lead and host Korea}

- **SDS Forecasting and Analysis**
  Multi-model qualitative comparison through display on the SDS-WAS Regional Node website hosted by RC (include research and operational products).
    - Action: propose a plan for consideration{ Lead Japan and Mikami }

  SDS model comparison using case studies of past SDS events
    - Action: Prepare and circulate for review an experiment design proposal (Lead RC)

  Links to home site of each model on the website
    - Action; implement {Lead RC}

  Standardize verification methodology (e.g. like Threat Score)
    - Action: Suggest a threat score methodology in a draft paper for PM10 and visibility to the RSG. Link this to observation technical workshop (lead: RC and Zhang, XY)

- **SDS User Interface (Products and Outreach)**
  Develop a common methodology for issuing a seasonal dust forecast for Asia.
    - Action: Link to WMO regional climate outlook forum(RCOF) and its regional representatives (WMO Secretariat and CMA, KMA , JMA)

  Prepare a list of SDS forecasts and analysis products and a guide for users and place on the website
    - Action; implement draft webpage for comment {Lead RC }

  Fill gaps in SDS product awareness and delivery in parts of Asia-central Pacific Region
    - Action: Hold WMO SDS-WAS User Workshop for Asia Central Pacific Region associated with technical observations workshop {Lead: Lead and host Korea }

<u>Regional Node Northern Africa - Middle East - Europe (SDSWAS RC NA-ME-E).</u>

This Centre supporting the <u>SDSWAS RC NA-ME-EU</u>, hosted by Spain is composed of a consortium that includes: the Meteorological State Agency of Spain (AEMET), the Barcelona Supercomputing Center (BSC-

CNS) and the National Research Council (CSIC). Some of the regional node partners will include Meteo-France, LISA, University of Athens, University of Tel Aviv, Egyptian Meteorological Agency, METU and NMHSs in the region.

In the first meeting of the Regional Steering Group (RSG) for the SDS-WAS Node for North Africa - Middle East - Europe, several proposals have been made:

- Regional implementation plans to be developed and annexed to the general Implementation Plan.
- The RSGs to be defined as open entities, where members of the RC and of participating institutions are represented. If necessary (it should be region dependent), a regional steering committee (RSC) will be established and composed of the RSG chair and leaders of specific regional tasks selected from the steering group.
- In the case of SDSWAS RC NA-ME-E, RSC members are: Michael SCHULZ (LSCE) (chair), Olivier BOUCHER (UK Met Office), *Ina TEGEN* (IFT), George KALLOS (Univ Athens), Emilio CUEVAS (AMET), Benjamin LAMPTEY (THORPEX/Africa Ghana), Moncef RAHJI (Tunisian Met Service), Slobodan NICKOVIC (WMO Secretariat), Jose BALDASANO (BSC), Carlos PEREZ (BSC) and Vincent-Henri PEUCH (MeteoFrance)
- On the regional node level, to achieve a formal agreement for all institutes concerning the data distribution. The agreement may include specific information on how different regional partners will contribute through the provision of observations and model data.
- To establish a coordination/collaboration between regional nodes. It is proposed that regional nodes exchange observers on their regional meetings.

Capacity Building

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

Depending on available resources, proposed activities include:

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

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

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

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

ANNEX 1

Organizations delivering or developing SDS systematic forecasts and other 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/DREAM/	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
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ANNEX 2

Phases of Implementation

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

Phase-1 (2009-2010)

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

Phase-2 (2011-2013)

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

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

ANNEX 3

Milestones

July 2008:

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

August 2008:

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

September 2008:

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

November 2008

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

January 2009:

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

March 2009

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

April 2009:

- Implemented routine quantitative and qualitative verification systems in RCs

June 2009:

- Report to EC61

July 2009:

- Prepare IP for CAS XV

November 2009:

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

January 2010:

- Finalize IP

2010:

- Data assimilation techniques will be reviewed and shared

2011:

- Intercomparison studies.

2011:

- Developing ensemble dust forecast systems will start.

ANNEX 4

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