Development of a Regional Sand and Dust Storm Early Warning System (SDS-EWS) in North East Asia

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Organization: World Meteorological Organization (WMO) via national entities
[Centre for Atmosphere Watch & Services (CAWAS),
China Meteorological Administration]
Background and Motivation

Three large SDS sources in the world
SDS occurs every Spring in the Northeast Asia

A huge dust storm broke out on 5 May 1993 in the northwestern desert area in China. In which More than 40 people died and many missing. Property damage was severe.

Jinchang, Gansu Province, China
(May 5, 1993)
Background and Motivation (cont.)

- Theoretically, tremendous dust storms damages could be prevented or mitigated if there were systematic early warning information.
Background and Motivation (cont.):

- Despite advances in soil dust aerosol researches on its climatic impact over the last decades, but the pace of improving SDS prediction are still restricted due to limitations in
  - observing coverage of both ground based and remote sensing networks,
  - model development,
  - and data assimilation methods.
Interested countries and organizations have collaborated to develop a SDS-EWS by conducting a comprehensive and sustained SDS research project under the umbrella of WWRP/GAW/WMO.

Potential Contributors: WMO-WWRP-GAW, China Meteorological Administration (CMA), KMA, National Agency for Meteorology Hydrology and Environment Monitoring (NAMHEM) of Mongolia, Ministry of Environmental Protection of Kazakhstan, JMA, Canadian groups, LISA of France, German groups, NOAA group, NASA group and Chinese Institute of Atmospheric Physics.
Objectives/ Expected Impact

- to provide scientific understanding that will serve as a basis for collecting, analyzing, forecasting, and disseminating information on SDS and to provide EW system to countries involved and for broader research communities.
Output:

- Obtain an accurate dust emission scheme and investigate various processes.
- Establish and strengthen the forecasting capacity at various space- and time-scales needs.
- Set up a comprehensive database which covers common forecast data, surface soil dust concentrations, visibility, LIDAR vertical profiles and satellite observations.
- Build a system to combine all the available information into an assimilate scheme to enhance the model forecasting ability.
- Assemble the forecasting information and provide the final SDS forecasting and EW result to the public or decision makers.
- Establish a data sharing mechanism and share the data and FC & EW results through this project.
Activities: 1) Monitoring Network

- Develop a regional network for forecasting and EW of SDS. It includes: design an organizational structure and a regional observation network;
Activities: 2) Parameterizations

Improvement of the Atmospheric Process Parameterizations of SDS

Meso-scale Meteorological Phenomenology and Dust Emission

Emission Scheme Closure Experiment

Comparison of Emission Modules

Comparison of Emission Fluxes with Observations

Graph: Threshold u* [cm s^{-1}] vs. Particle Diameter [μm]

Air density: 1.23 kg.m^{-3}
Dust particle density: 2650 kg.m^{-2}

MBA-Scheme
Shao-Scheme
Activities: 3) Forecasting System

- Develop and update a modeling system for SDS with data assimilation to enhance the models forecasting capability
Asian SDS Forecasting System (CUCSDust)

Wind Erosion Data Base. Desert distribution maps, soil texture map, land use/cover maps, surface roughness elements, grain size, and soil moisture.

The size distribution of vertical dust flux was derived from the observed surface dust size distribution in the desert regions.
Forecast without data assimilation

Forecast with data assimilation

Chinese FY-2C SDS Res.

SDS Report Data
Activities: 4) EW System

- Establish a dust forecasting and SDS-EWS (an expert diagnostic system to combine SDS forecasting outputs and observation data to provide the public or decision makers with SDS early warning information by TV, cables, Web sites and so on)

14 June 2004, 5 PM-Beijing, Visibility < 1 km

Short dust-storm in St. Petersburg, 1998

Burningman 2001 - Dust Storm couple

18 May 2004, 5 PM-Bayanhaote City, Inner Mongolia
Activities: 5) Data and Results Sharing

Collect all the data to be a database shared through the project.
Three Stages of the Project
Stage 1 (short term) in the first 5 years

- Establish a mechanism for coordinating the SDS monitoring network in northeast Asia.
- Set up modeling systems for SDS-EWS at the national focal agencies.
- A data base for observations and forecast outputs in this stage.
- Preparation for data assimilation method research with the data base.
- Build the expert diagnose system to do the SDS forecasting & EW.
Stage 2 (medium term)

- Upgrade monitoring capacity and expand the observation network.
- Improve SDS modeling parameterization.
- Enhance the modeling forecasting ability with the data assimilation module.
Stage 3 (long term)

- Do the operational SDS forecasting with all the modeling groups, observation networks.
- Make the systematic SDS-EWS run operationally to do the SDS EW services in the Northeast Asia.
Stake-holders

- International
  - UN organizations; international governmental agencies
- Scientific community
- National operational meteorological agencies; decision support systems
- General public
Roles and responsibilities

- International coordination mechanisms for monitoring and forecasting → EW.
  - WMO, GEF, ADB

- Scientific research
  - all interested countries and organizations etc ← WWRP & GAW.

- Note that SDS monitoring and observations are not well coordinated in many areas – need for scientific guidance, improved database management and information sharing mechanisms.

- Countries’ capacity building for FS & EWS-need enhanced.
Better forecasting and early warning

- helps industry and commerce, reduces the hazard
- allows the population to take preventative measures to safeguard property and human health
Resources

- The project will only happen if some partners are willing to put forward some realistic resources
- Allocation of time of employees
- Some support of any non-agency personnel
- Coordination support meeting costs

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