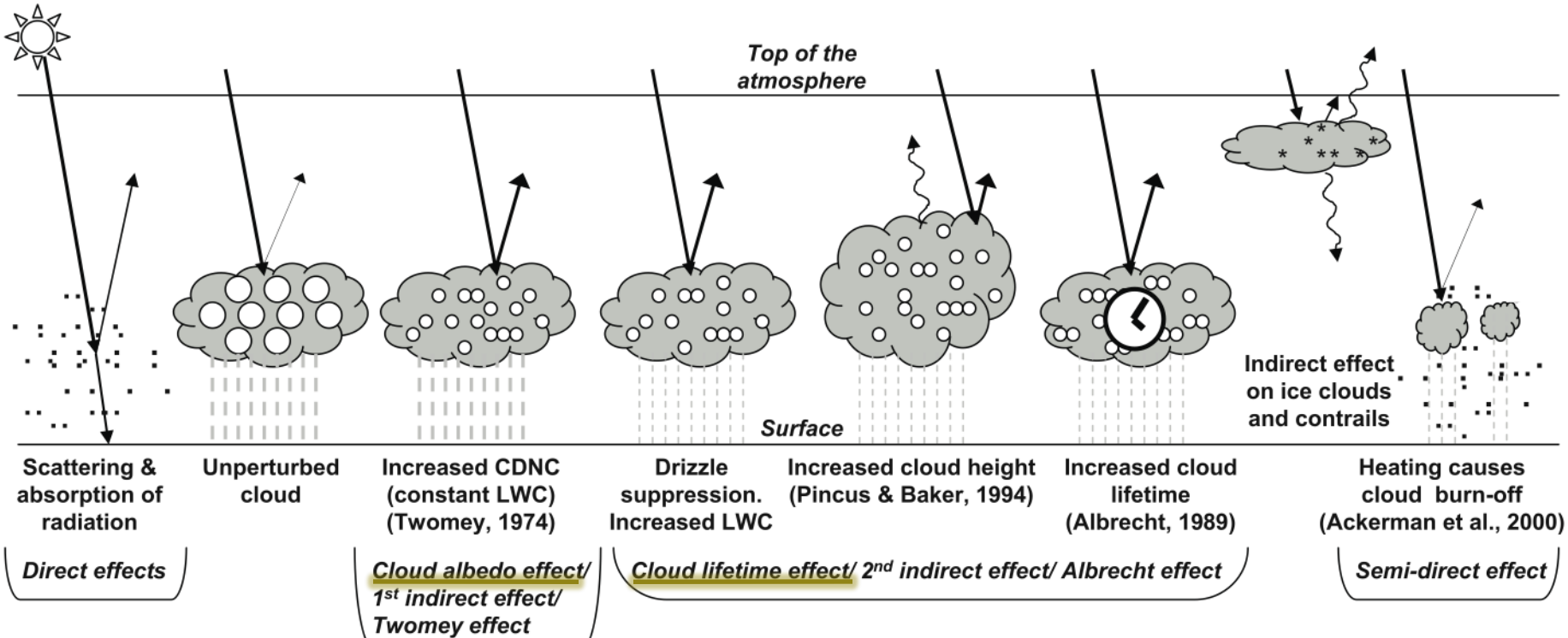
WMO SDS-WAS East Asia and TEMM WG1: Dust Forecasts in Asian countries

Masao MIKAMI (Meteorological Research Institute/ Japan Met. Agency)

SDS Impacts

- Human Health
  (Asthma, infections, Meningitis in Africa, Valley Fever in the America's)
- Agriculture (negative & positive impacts)
- Marine productivity
- Improved Weather and Seasonal Climate Prediction
- Aviation (air disasters)
- Ground Transportation

Direct Effect and Indirect Effect



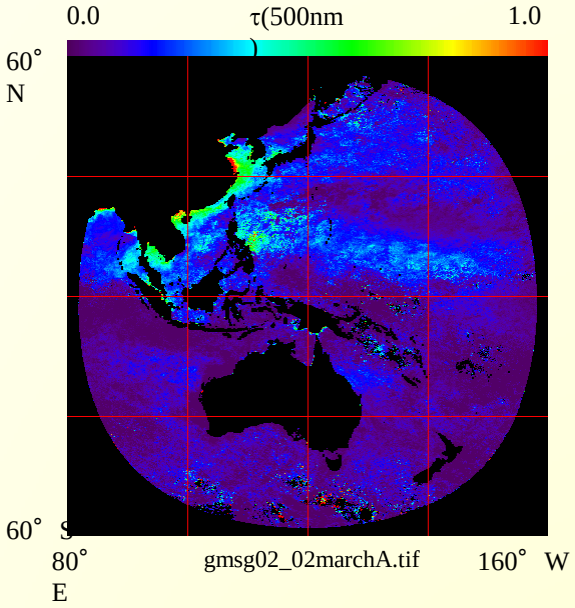
IPCC AR4 WG1

10-Days mean AOD by GMS

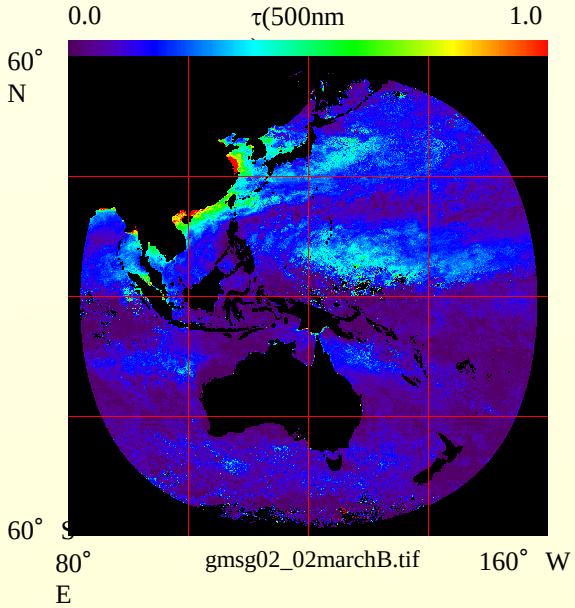
01 Mar. - 30 Apr. 2002

[14]

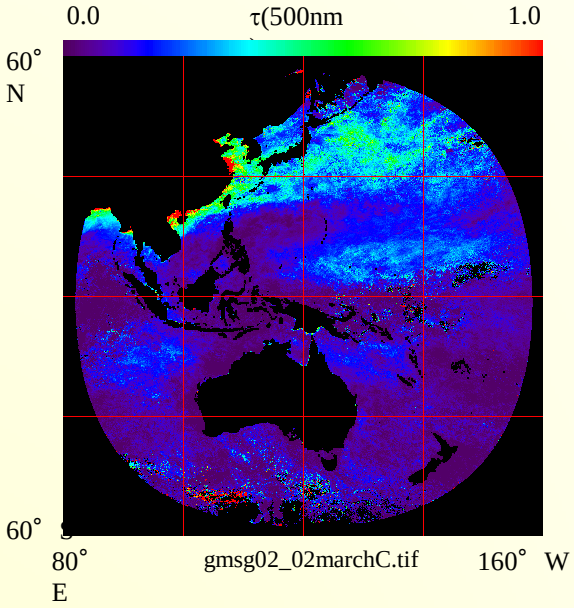
Mar. 01 - 10



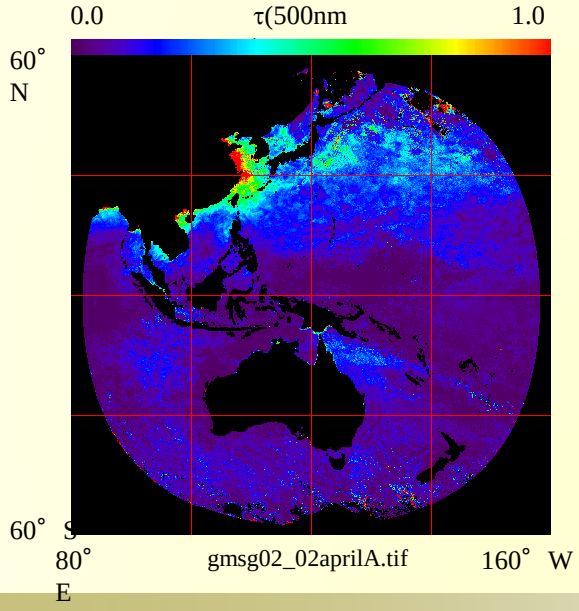
Mar. 11 - 20



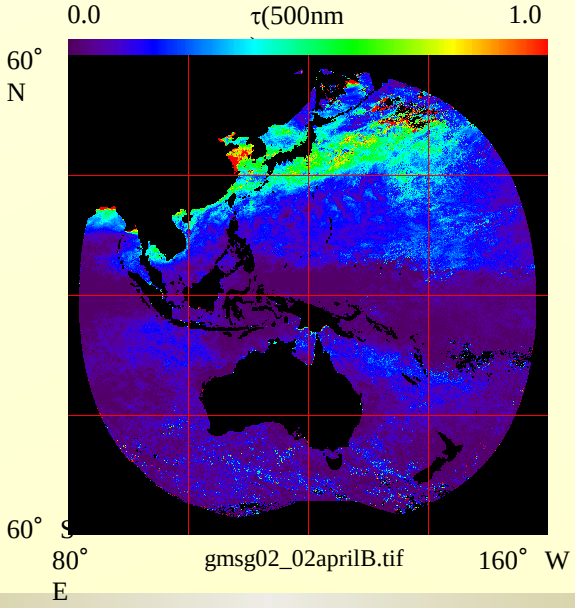
Mar. 21 - 31



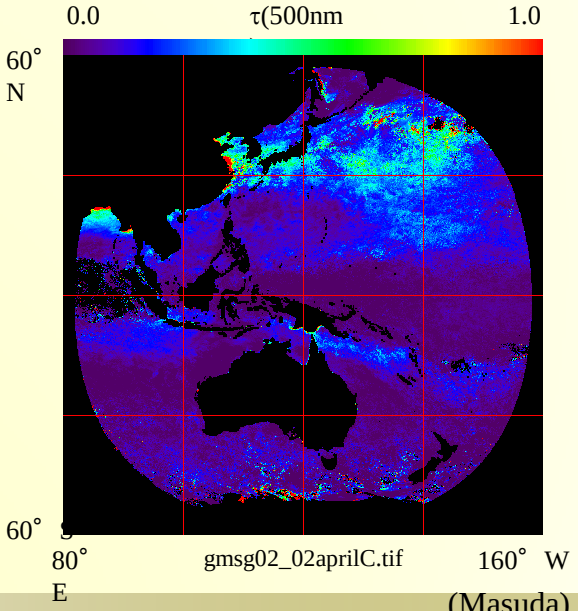
Apr. 01 - 10



Apr. 11 - 20



Apr. 21 - 30



(Masuda)

WMO-WWRP Sand and Dust Storm Warning Advisory and Assessment System SDS-WAS

Mission

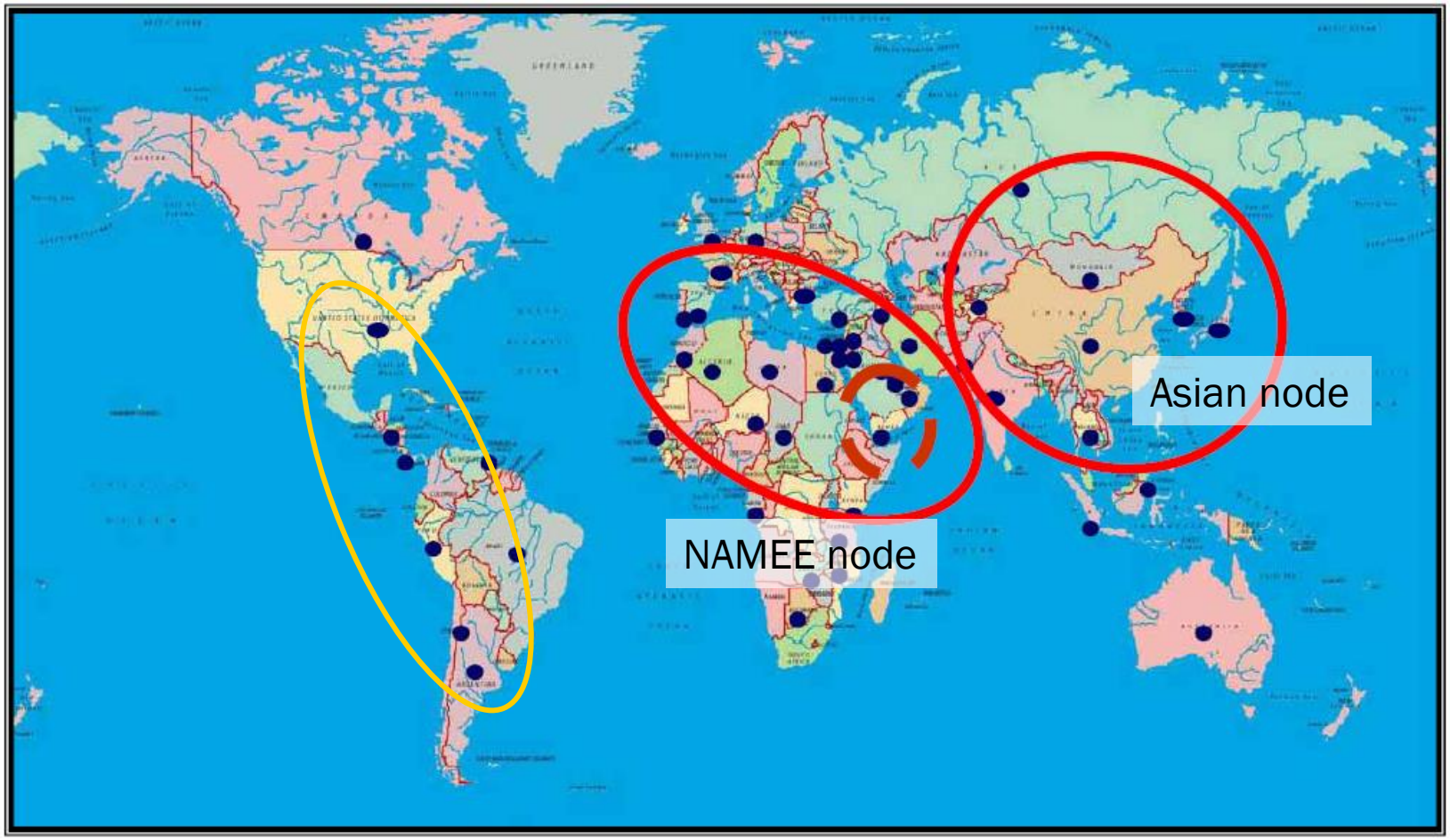
To enhance the ability of countries to deliver timely and quality sand and dust storm forecasts, observations, information and knowledge to users through an international partnership of research and operational communities

History

September 2004, the first meeting was held at CMA Beijing (WMO Experts workshop on SDS).

In 2012, Implementation plan was approved at CBS council.

SDS-WAS Node structure



The NAMEE Regional Center

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

GOBIERNO DE ESPAÑA
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO
AEMet
Agencia Estatal de Meteorología

The NAMEE Regional Center is jointly managed by AEMET and the BSC-CNS
It is located in Barcelona, at BSC-CNS premises

Asian-node RSG

- Chair: Masao MIKAMI (MRI, Japan)
- Co Chair: Xiao-Ye ZHANG (CMA, China)
- Co Chair: Young-Sin CHUN (KMA, Korea)

In March 2012, MEETING OF THE WMO SDS-WAS REGIONAL STEERING GROUP (RSG) FOR ASIA was held at Tsukuba, Japan.

Discussion on Mandatory Function and SDS-WAS Implementation Plan were made and above Asian-node Regional Steering Group was assigned.

And three action items, data share, common portal site, and model inter-comparison, were confirmed.

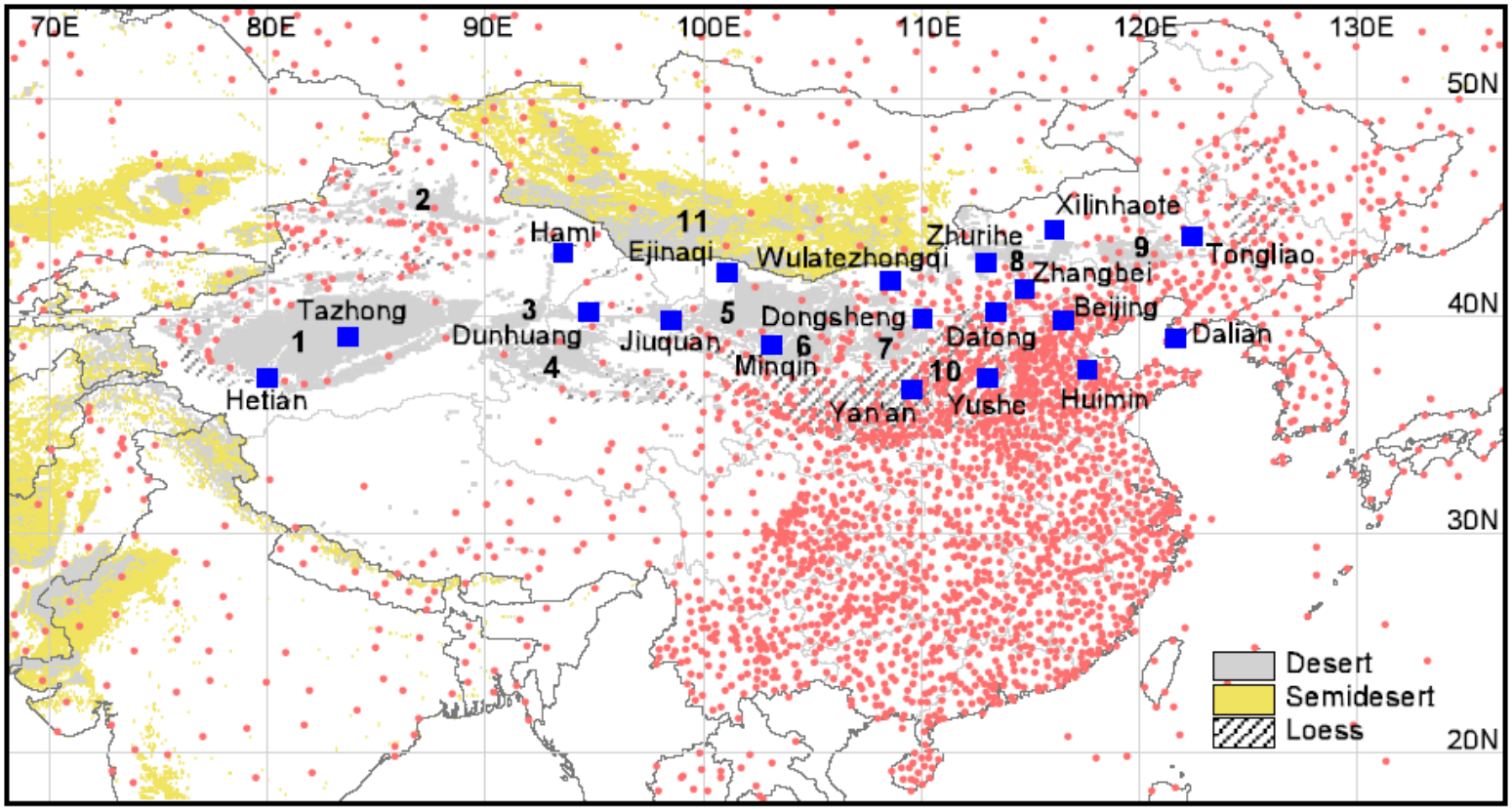
WG members

- Data Share (responsible to KMA: Y. CHUN)
  - KMA: KIM, Sumin
  - JMA: N. Sugimoto (NIES) & Candidate from JMA
  - CMA: Wang, Yaqiang
  - Mongolia: D. Jugder
- Common Portal Site (responsible to CMA: X. Y. ZHANG)
  - CMA: Wei, Li & Zhou, Chunhong
  - KMA: SHIN, Beomcheol
  - JMA: Candidate from JMA
- Model Inter-comparison (responsible to JMA: M. MIKAMI)
  - JMA: T. Maki
  - CMA: Zhou, Chunhong
  - KMA: HA, Jong-Chul

Long-term Monitoring for Asian SDS:

Thousands visibility stations

29 PM10 stations in CMA with 10 Sino-Korea co-operational stations



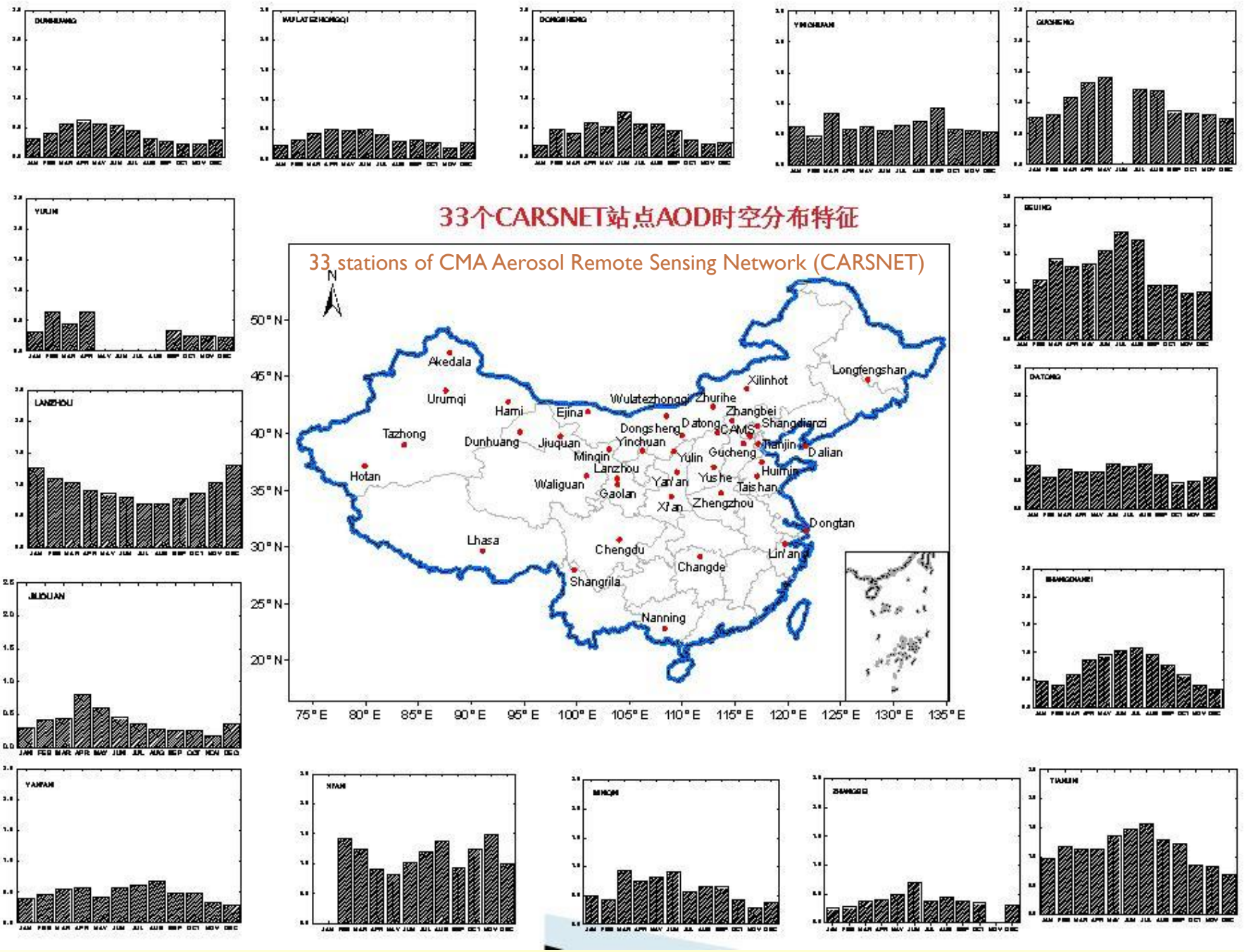
PM10

Visibility-SDS

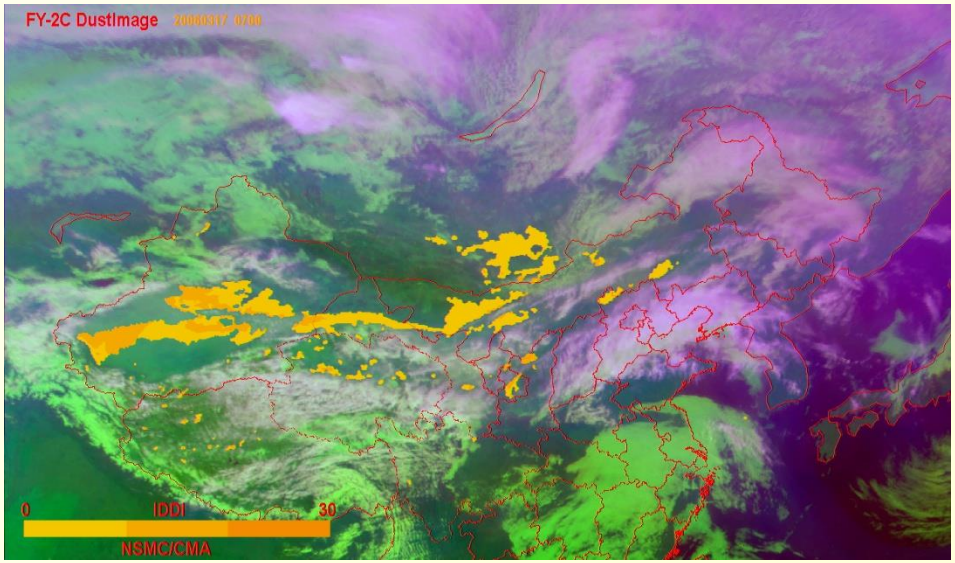
Main SDS source regions: 1, Taklimakan Desert; 2, Gurbantunggut Desert; 3, Kumtag Desert; 4, Qiadam Basin Desert; 5, Badain Juran Desert; 6, Tengger Desert; 7, Mu Us Desert; 8, Onqin Daga sandy land; 9, Horqin sandy land; 10, Loess Plateau; 11, Deserts and semideserts in Mongolia.

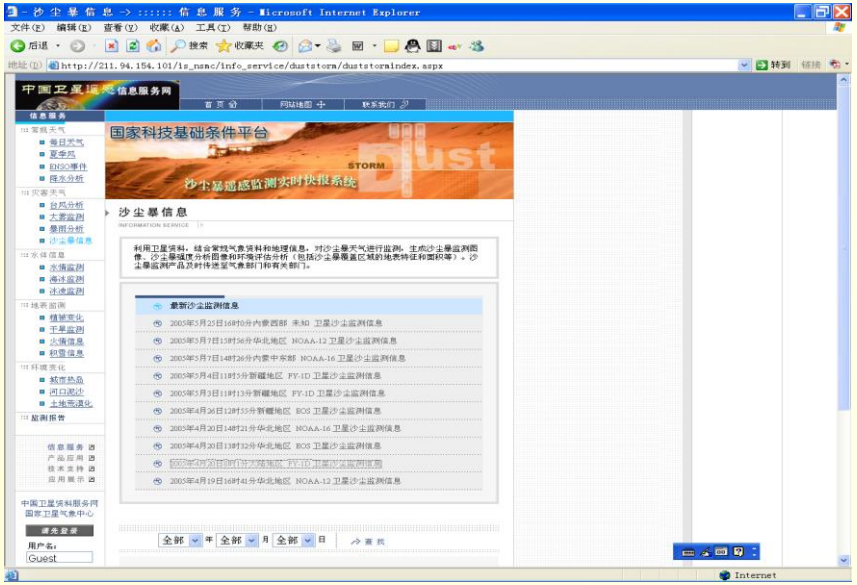
33个CARSNET站点AOD时空分布特征

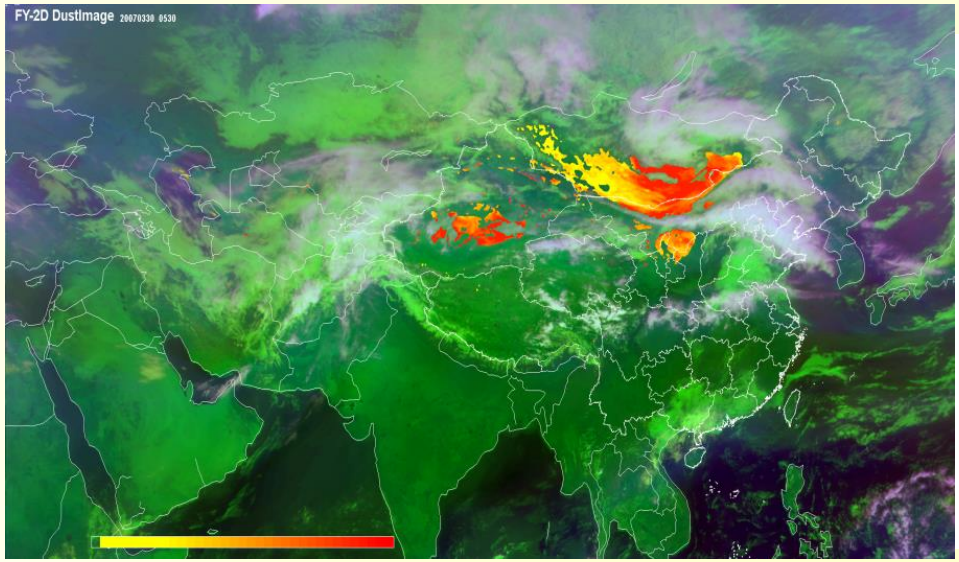
33 stations of CMA Aerosol Remote Sensing Network (CARSNET)

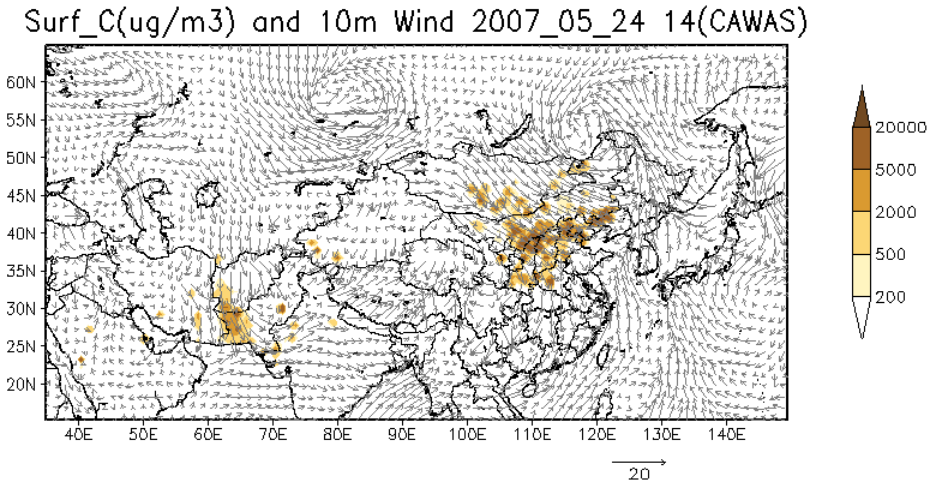


Near-Real Time SDS Retrieval for Asian SDS from FY-2C¥2D



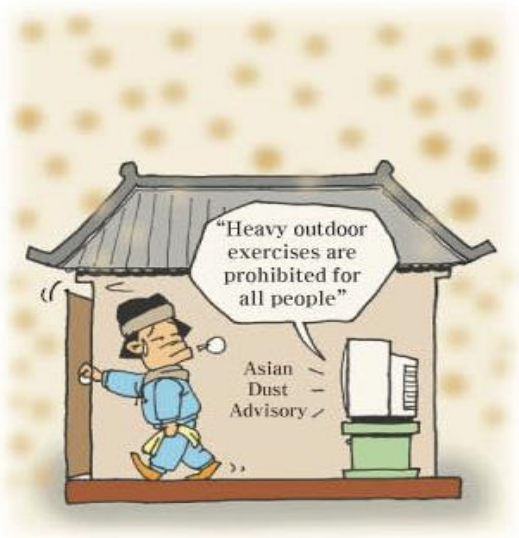






Early warning in KOREA

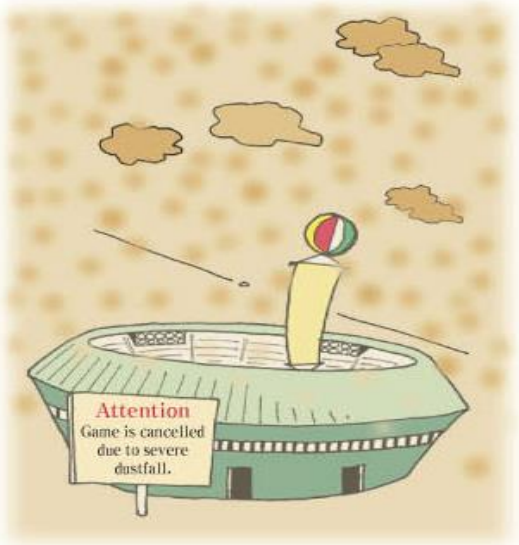
since April 2002



1. Advisory

An advisory is issued when the hourly average dust (PM_{10}) concentration is expected to exceed **400** $\mu g/m^3$ for over two hours.

- Outdoor activities for the old, the young, and those with respiratory diseases are prohibited.
- Kindergarden and elementary school students should stay at home and are prohibited from doing outdoor activities.
- Heavy outdoor exercises are prohibited.

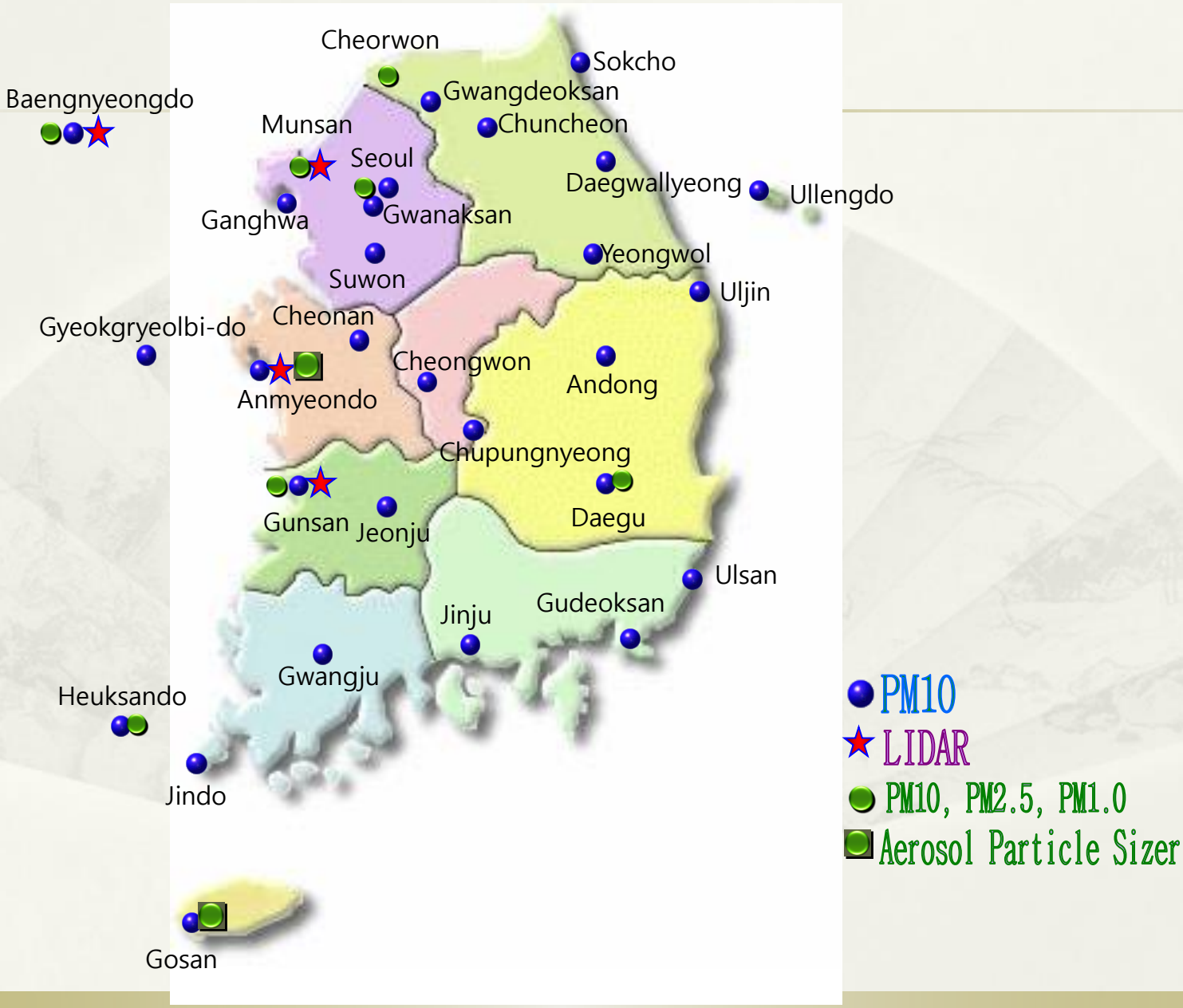


2. Warning

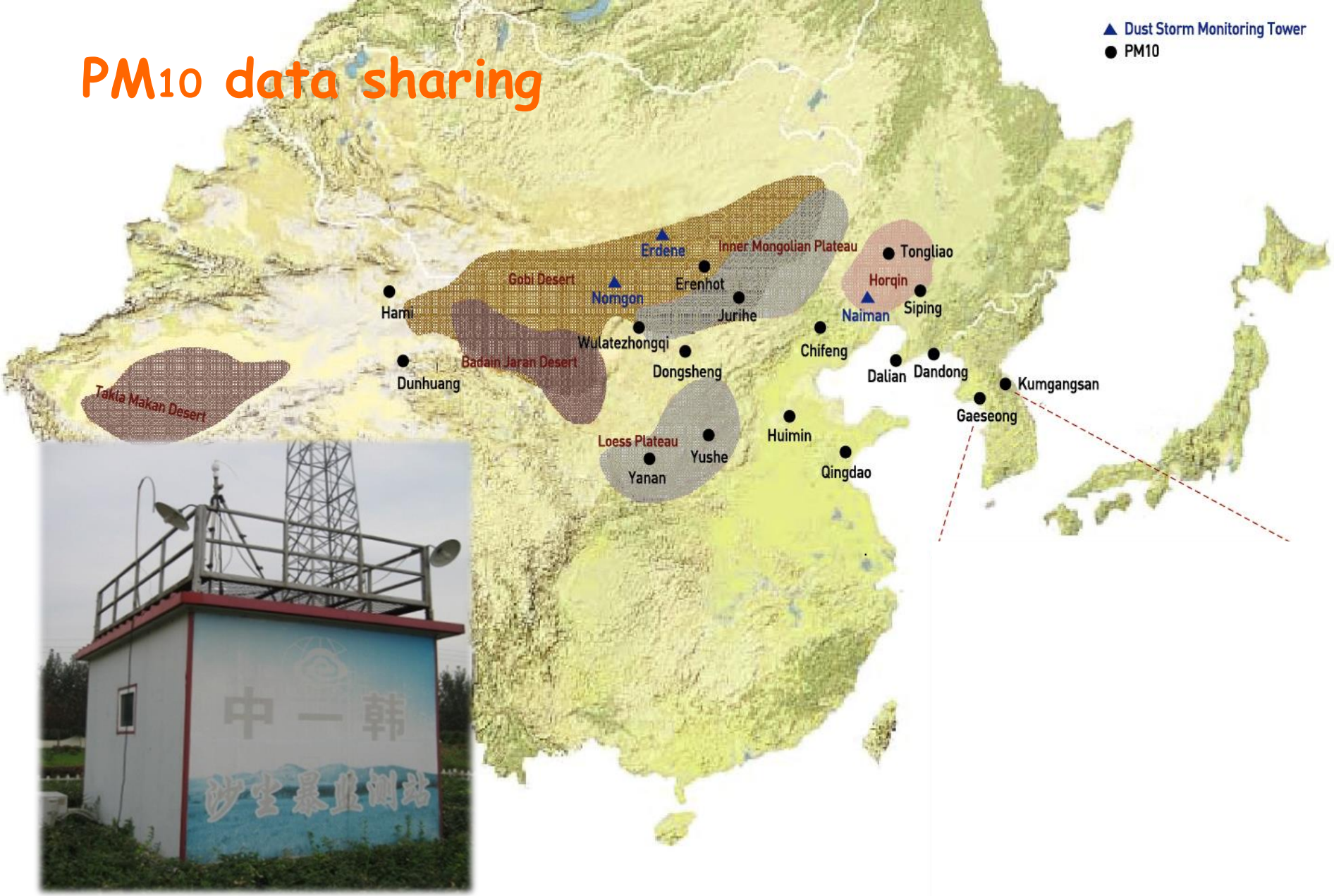
A warning is issued when the hourly average dust (PM_{10}) concentration is expected to exceed **800** $\mu g/m^3$ for over two hours.

- The old, the young, and those with respiratory diseases are prohibited from going outside.
- Kindergarden and elementary school students are prohibited from doing outdoor activities, and classes should be dismissed.
- Outdoor activities are prohibited.
- Outdoor sports events should be rescheduled.

KMA Monitoring in 2011

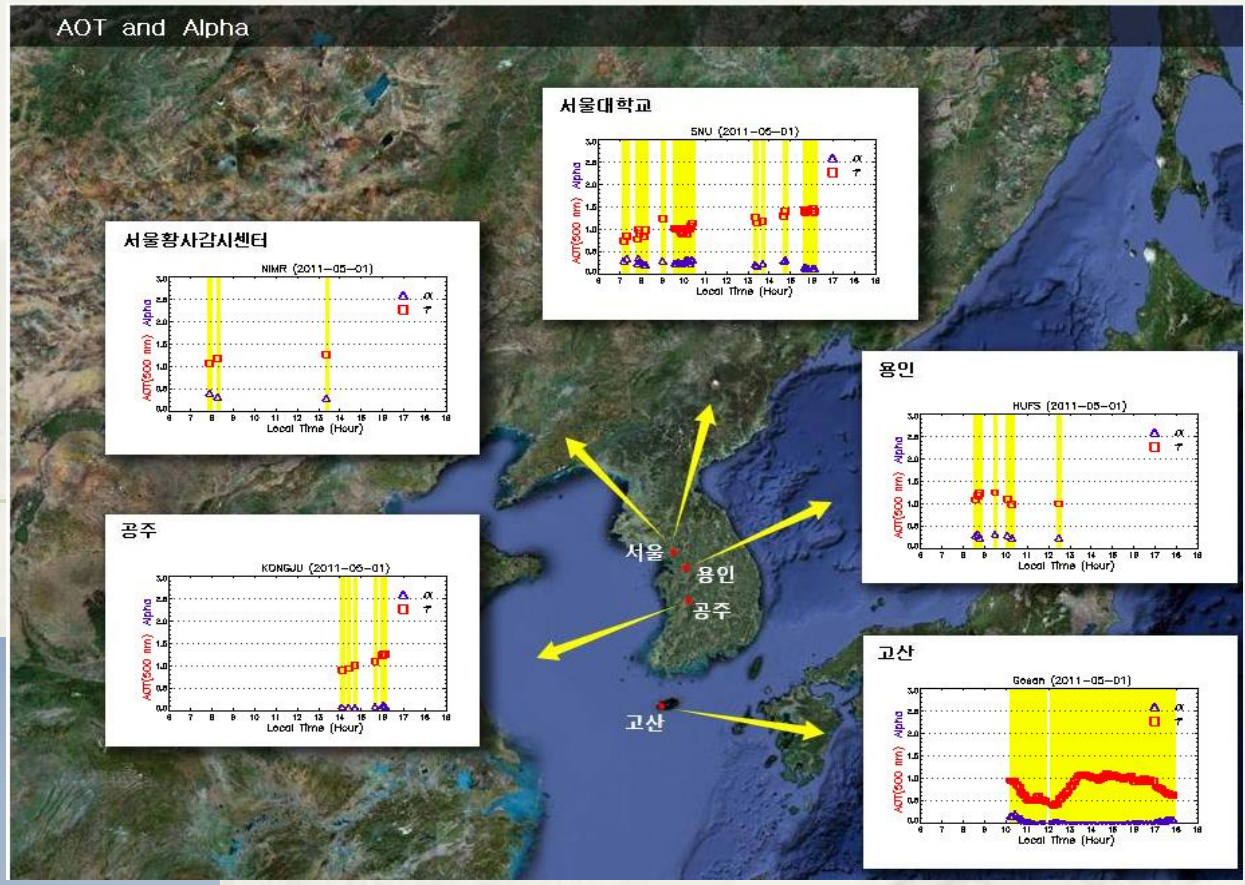


PM10 data sharing



CMA (15) + NAMEM (2) + N. Korea (2)

Optical properties by Skyradiometer

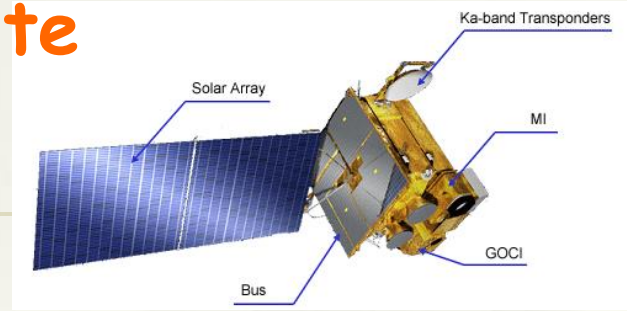


May 2011

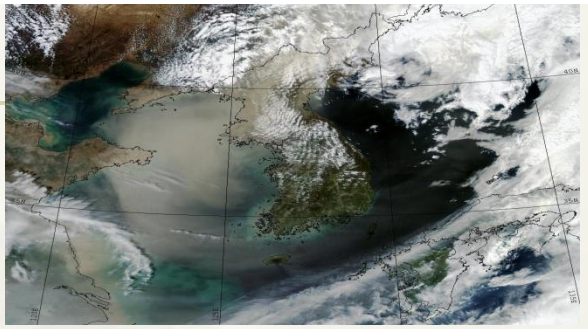
Seoul Hwangsa Monitoring Center

Korean Satellite

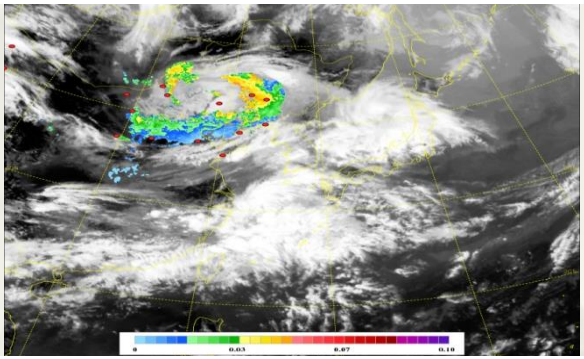
COMS



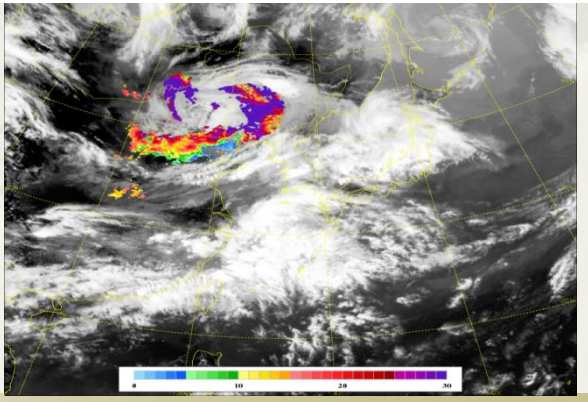
MODIS RGB Image

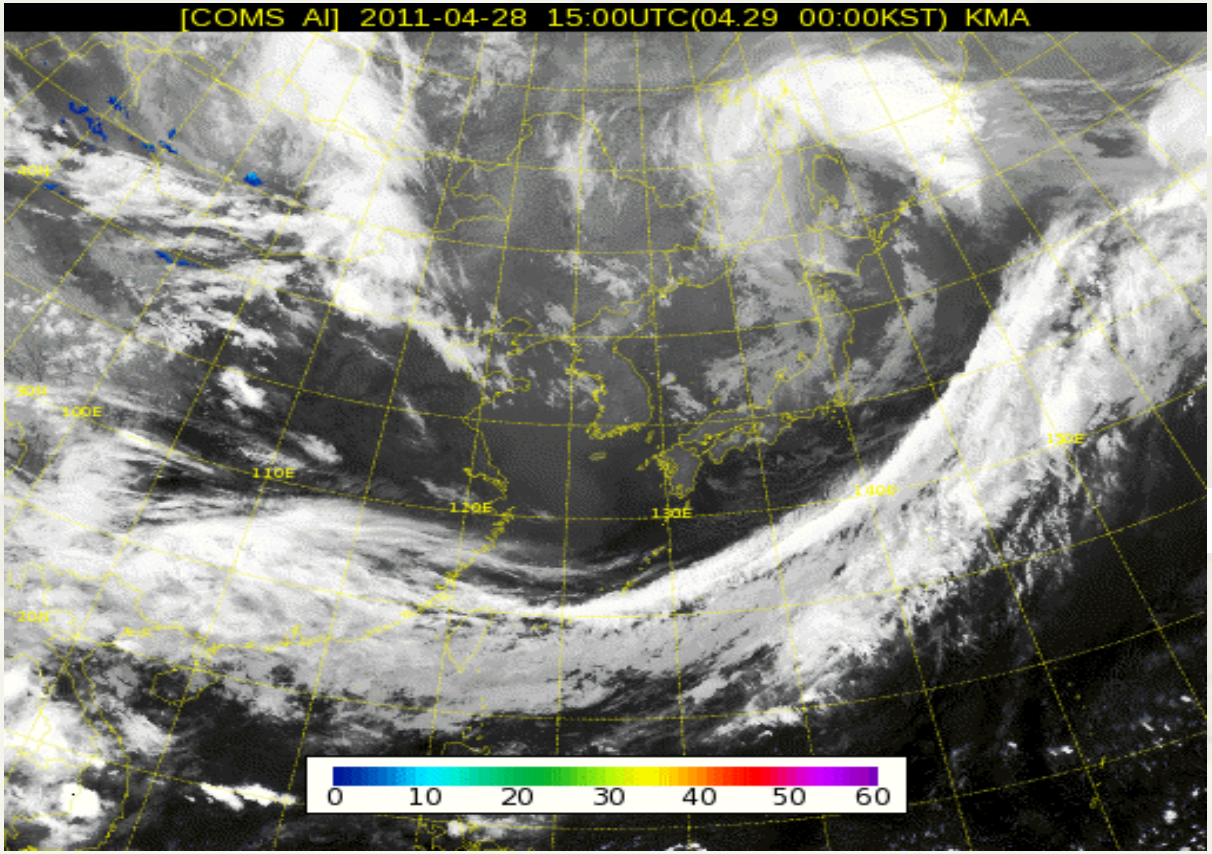


MTSAT (IODI)



MTSAT Dust Index(IDDI)





Asian dust Index

May 2011

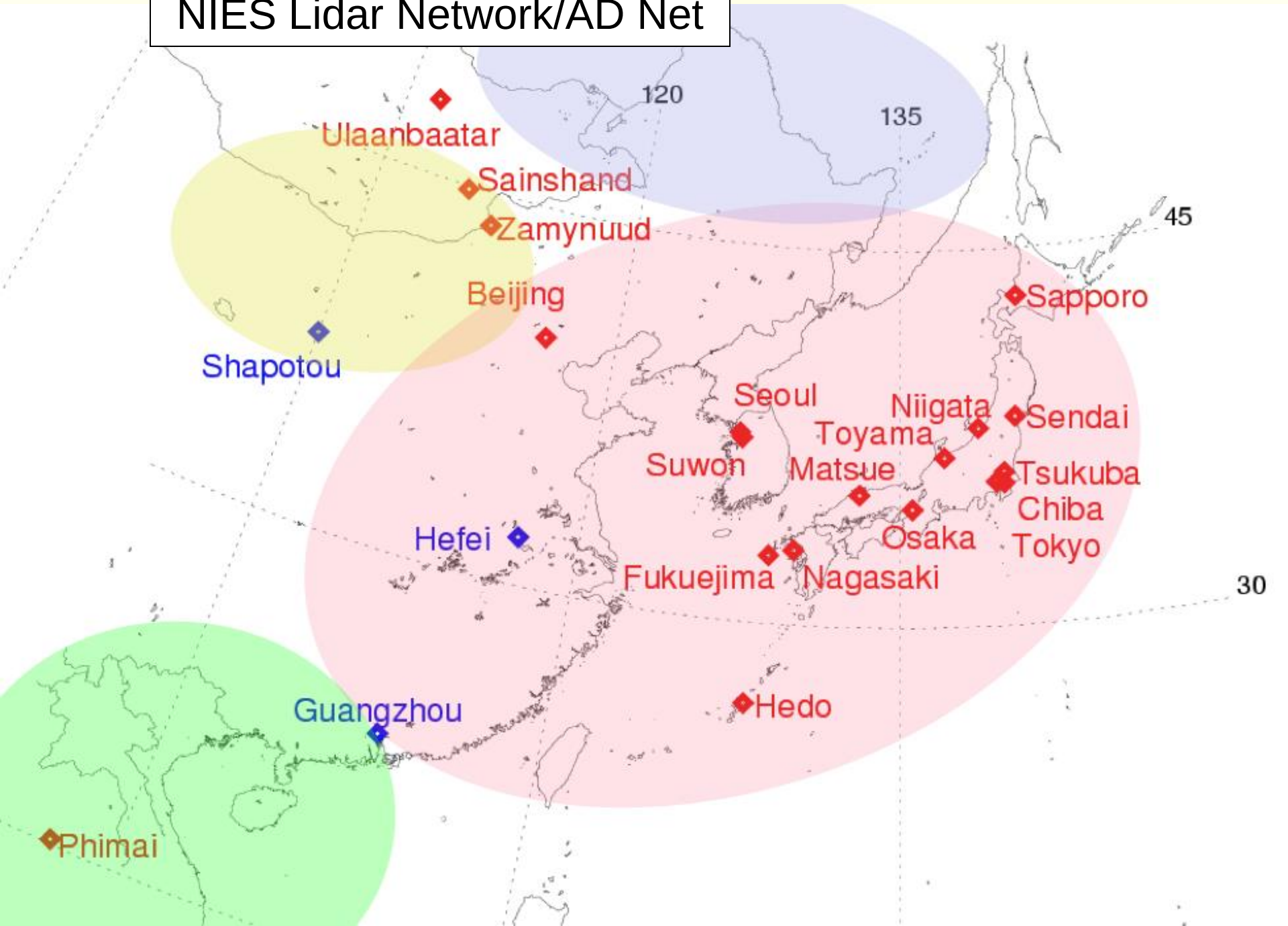
Observation of aeolian dust

a) Surface AOD

* JMA has been conducting AOD measurements using sunphotometers at 3 WMO/GAW stations as part of its environmental monitoring network.

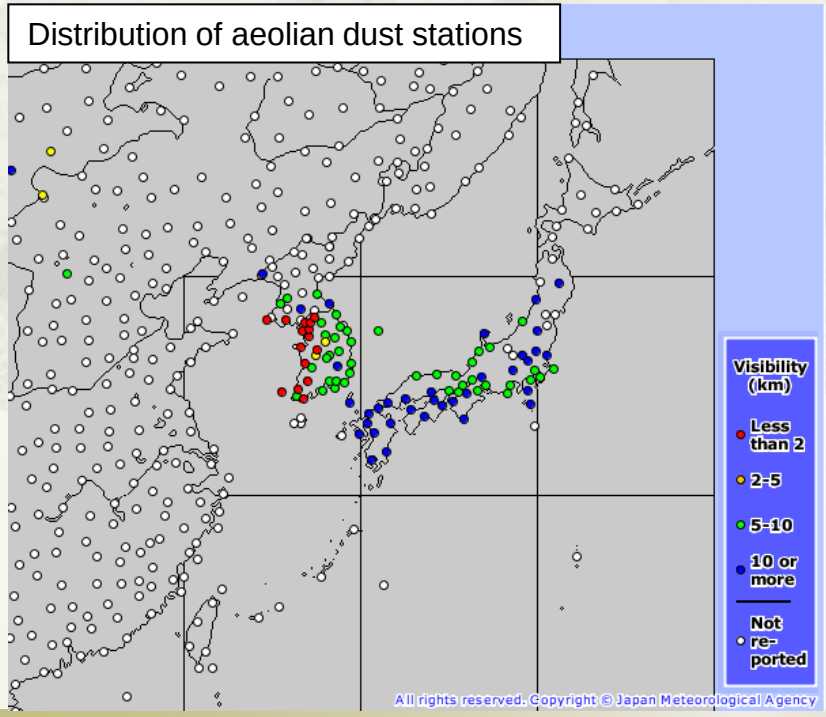
Precision Filter Radiometer (PFR)

NIES Lidar Network/AD Net



b) Visibility and meteorological conditions

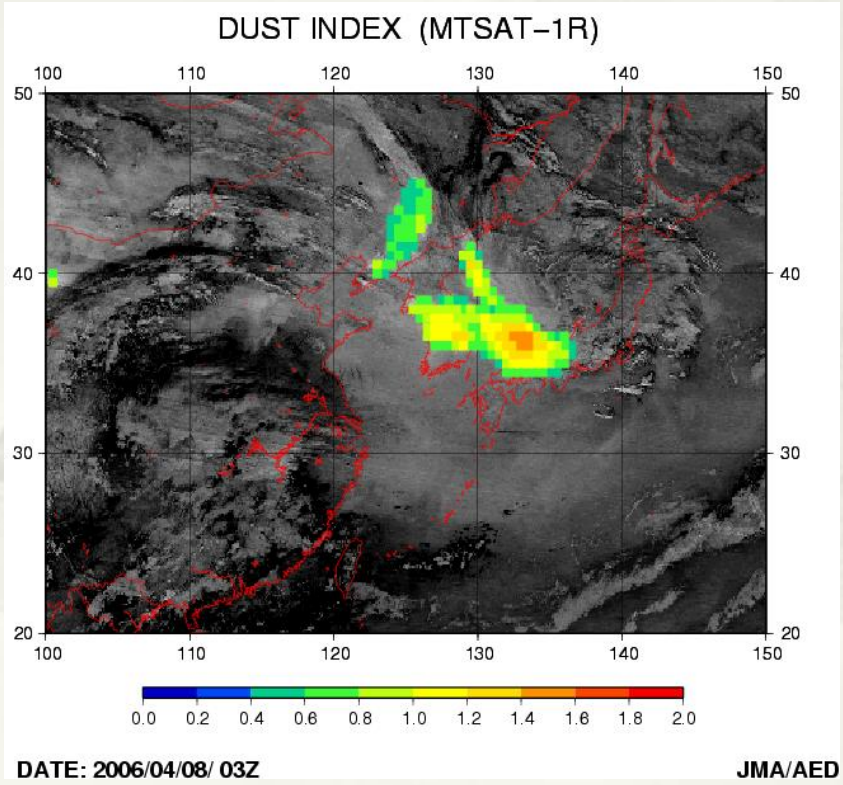
- JMA operates 61 manned observational stations, which observe aeolian dust in terms of the visibility and meteorological conditions.
- On JMA's webpage, the minimum visibility at each station is categorized in different colors.
- When the visibility becomes below 10 km, the station reports aeolian dust in SYNOP messages.



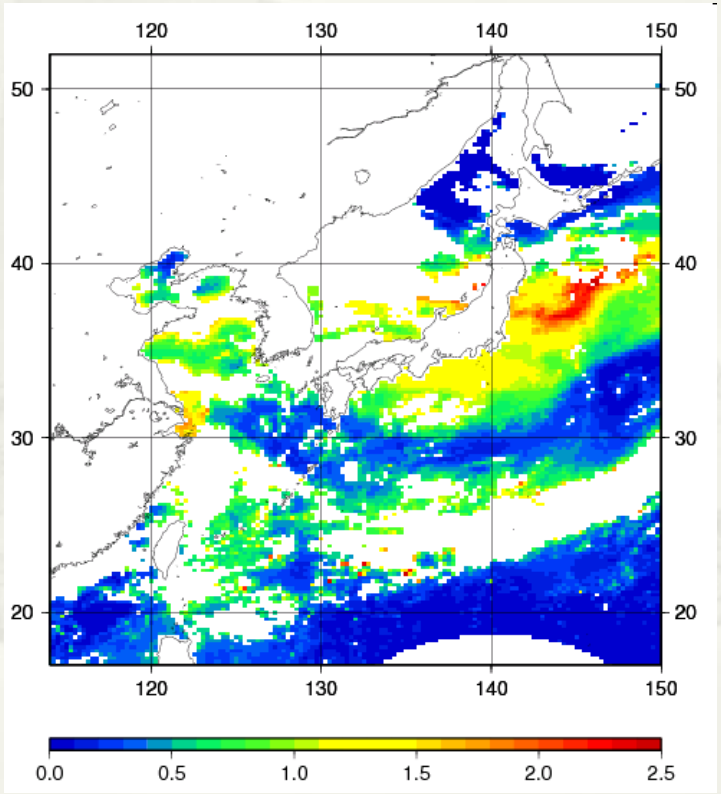
Map of stations observing aeolian dust Kosa or local sand/dust haze during the day

c) Satellite

- **JMA's monitors aeolian dust using satellite products (AOD and aeolian dust index) derived from satellite imagery of MTSAT at Meteorological Satellite Center of JMA.**



Aeolian dust index derived from infrared differential imagery of MTSAT (03UTC on 8 April 2006)



AOD derived from visible imagery of MTSAT (03 UTC on 18 April 2006)

Dust Monitoring Network in Mongolia

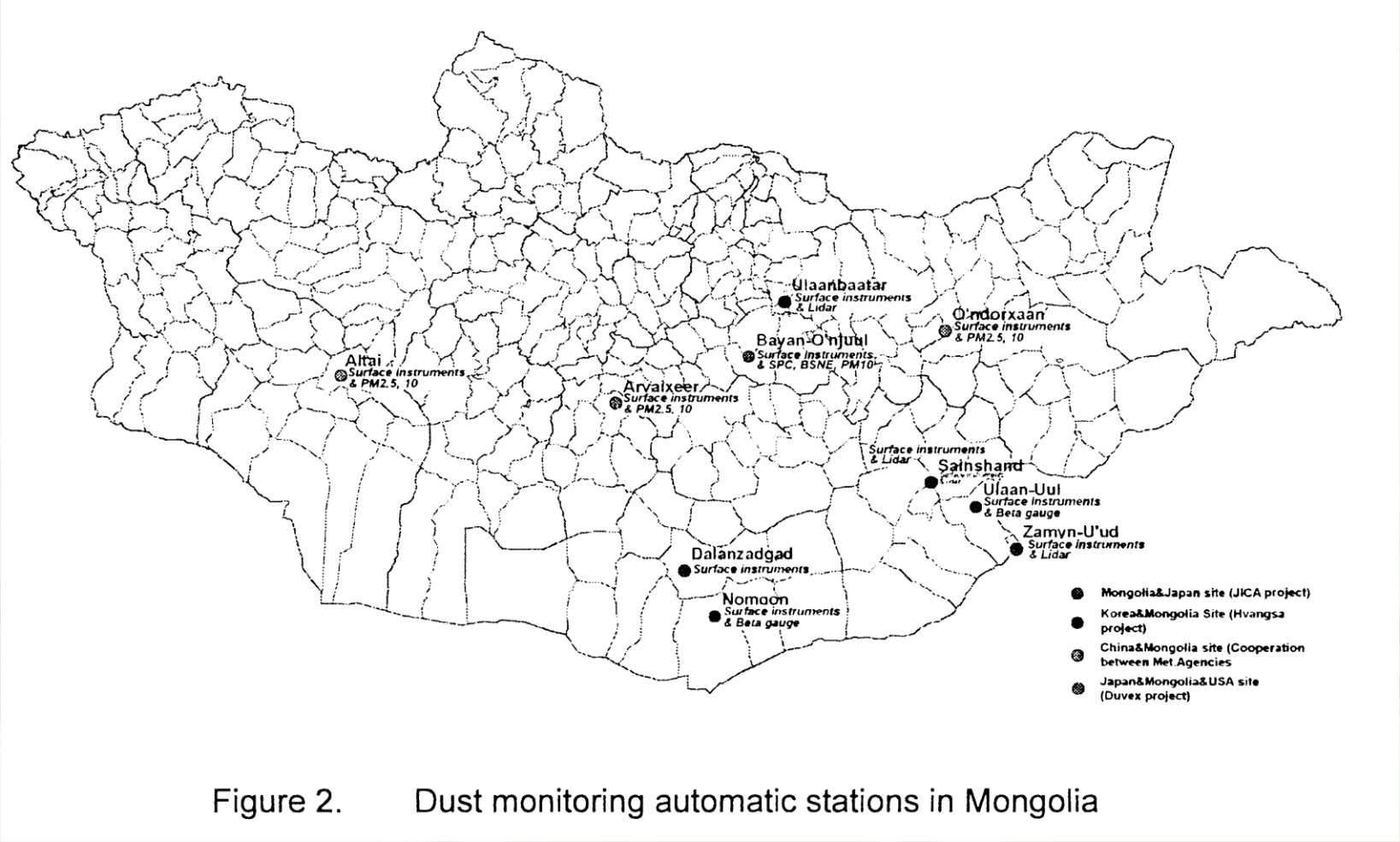
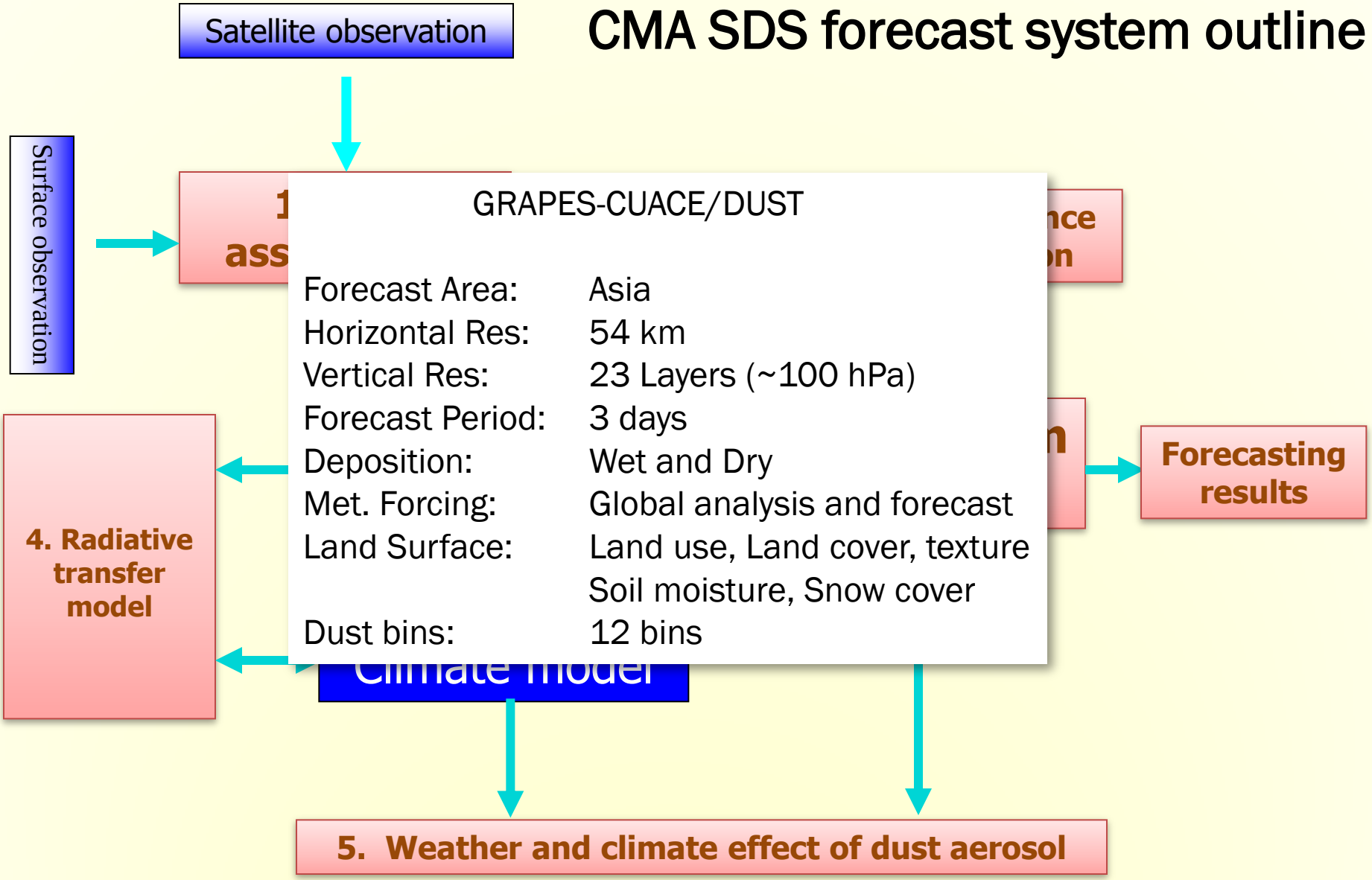


Figure 2. Dust monitoring automatic stations in Mongolia

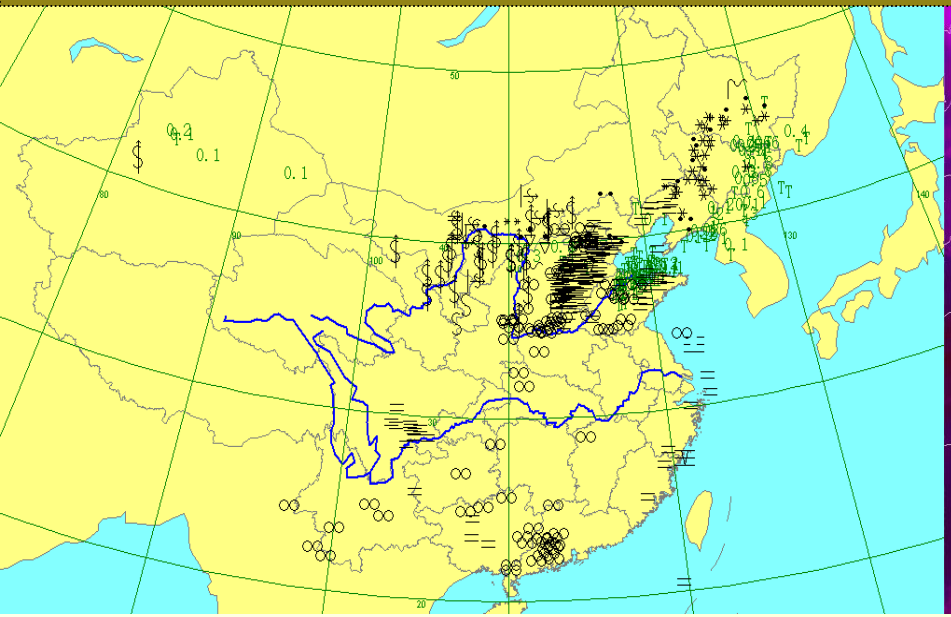
Data exchange and data policy

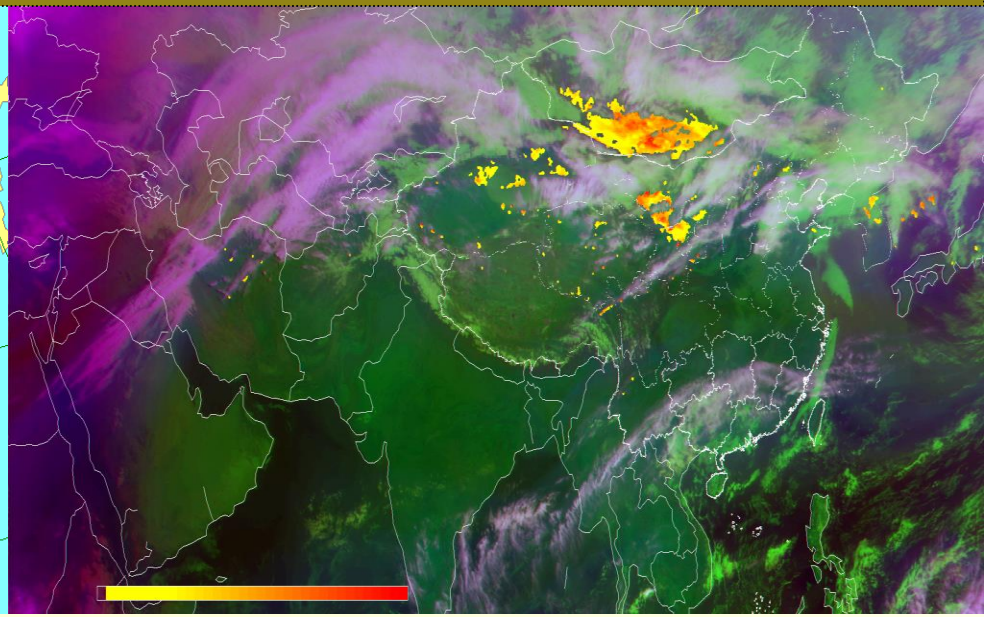
- In terms of NRT exchange of SDS observation data, it is required to confirm each country's data policy. Participants are requested to prepare the relevant information on the their data policies beforehand to bring the meeting venue.
- It is required to examine how Node members can reach agreement on the observation data exchange (conditions: prohibition on uses beyond the purposes in the Node and prohibition on provision to a third party, etc).
- It is required to identify problems to perform more instantaneous data exchange in each country.

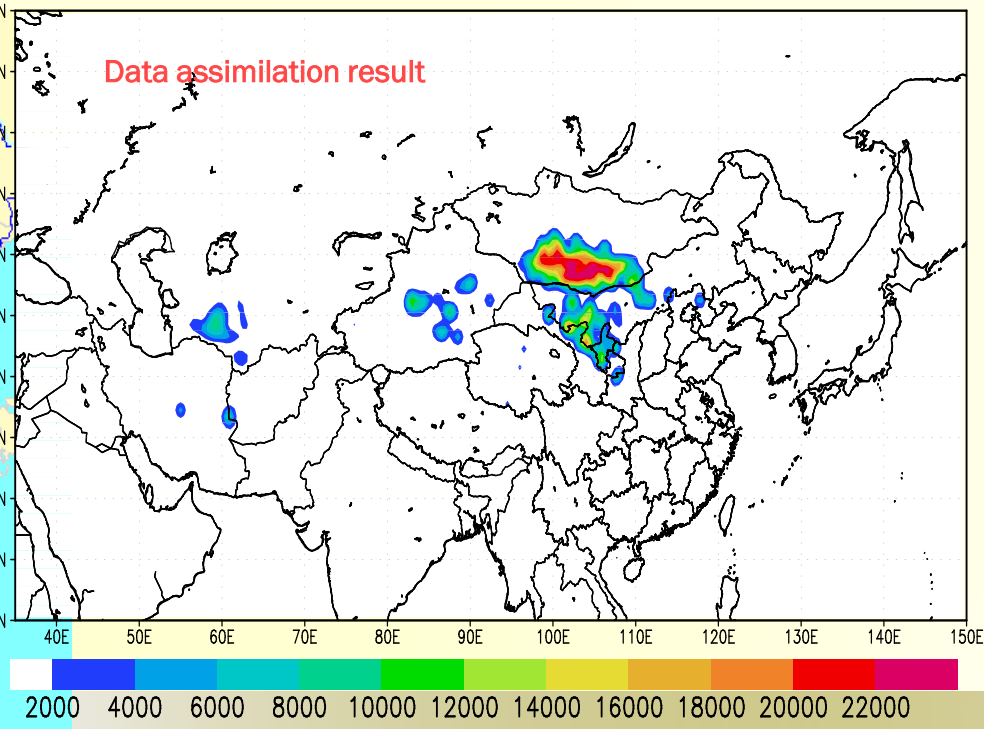
CMA SDS forecast system outline

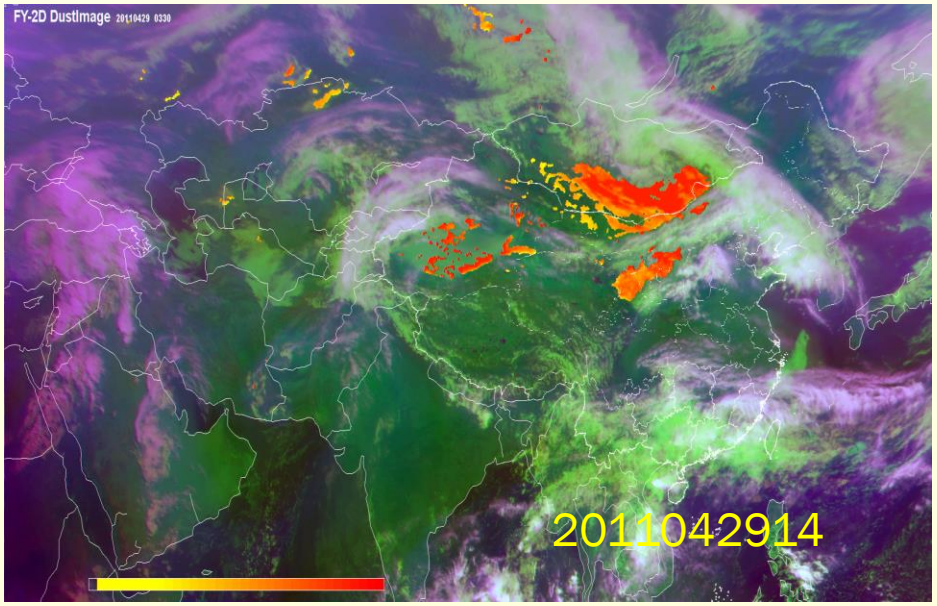


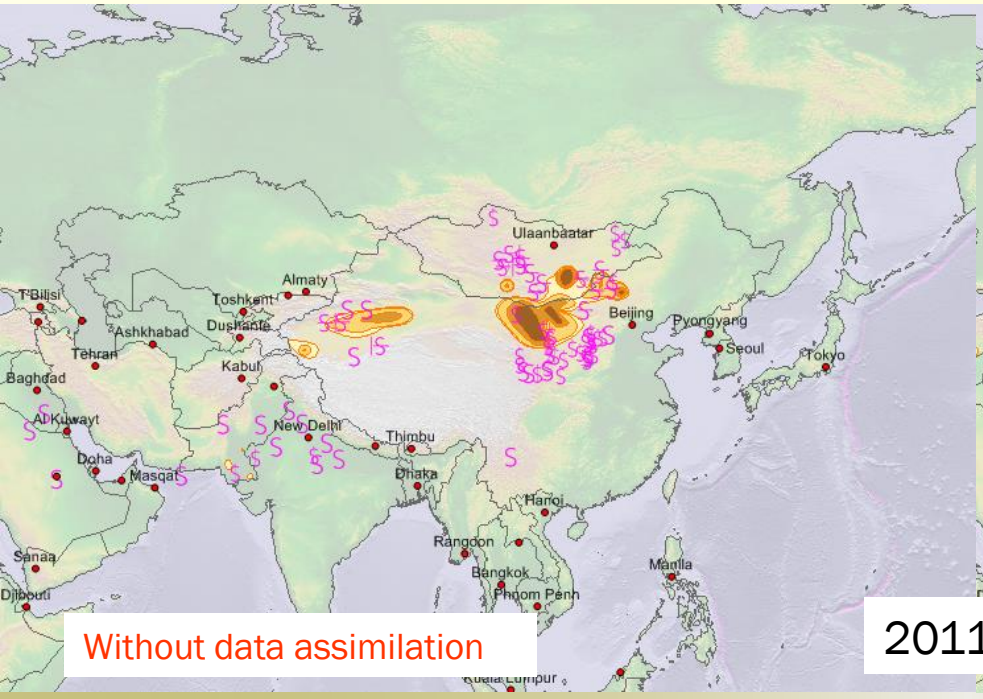
Data assimilation of three observation datasets on March 19, 2010





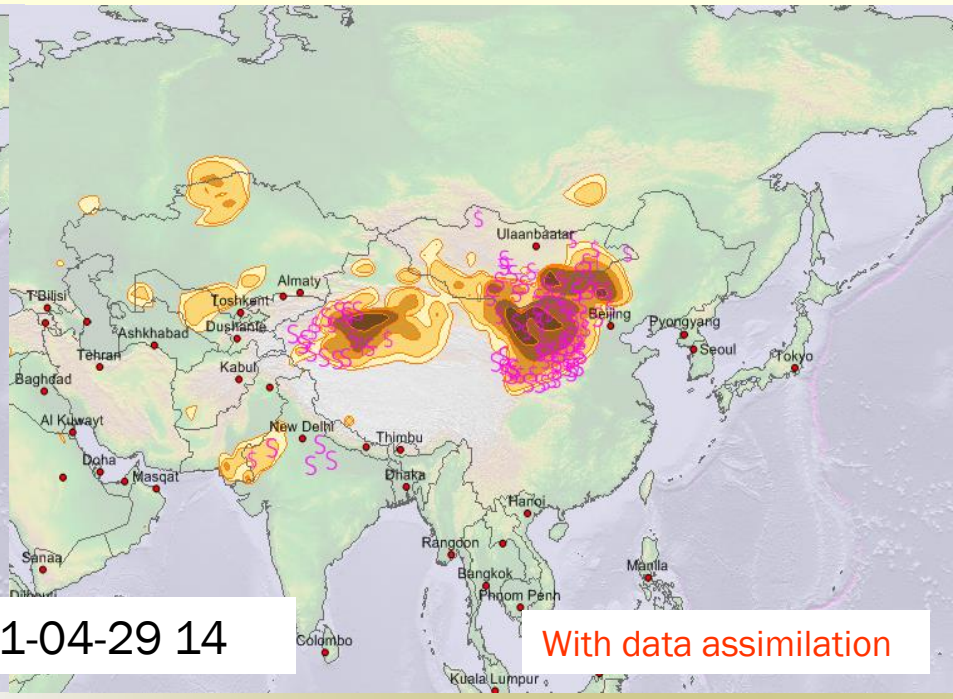






Without data assimilation

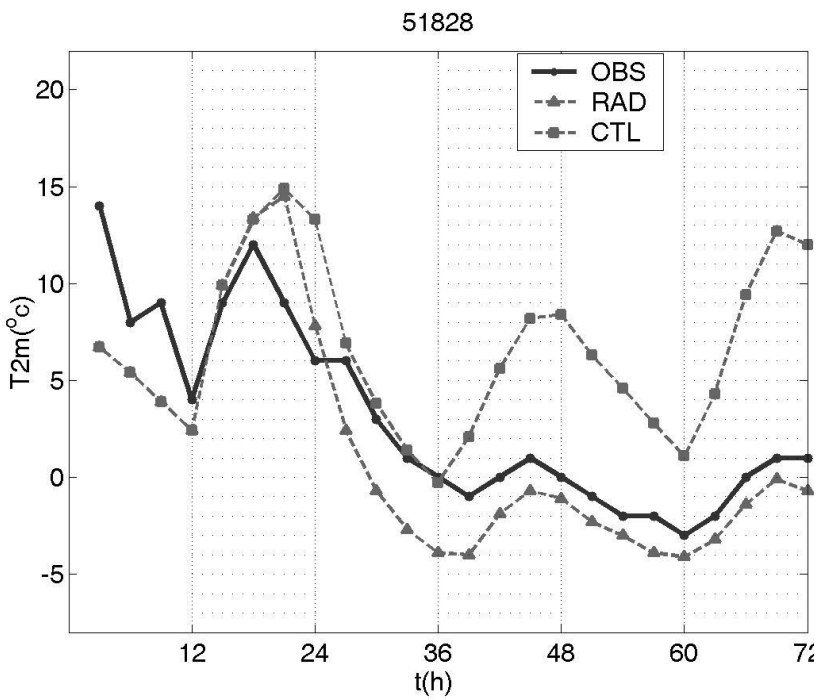
2011-04-29 14

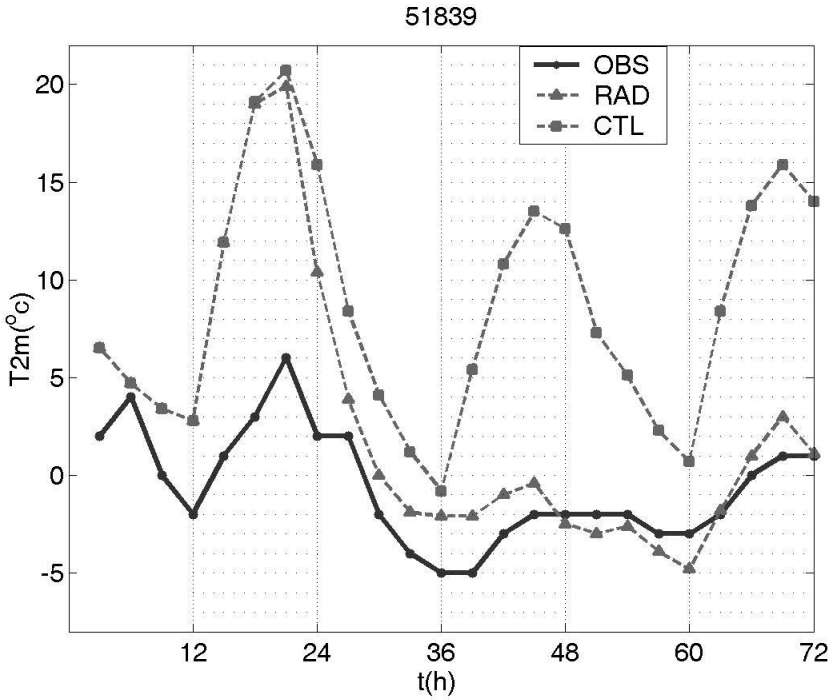


With data assimilation

(Dust aerosol feedbacks in the climate system→ Improving temperature simulation after including dust feedback (case study)

Surface 2m T°C

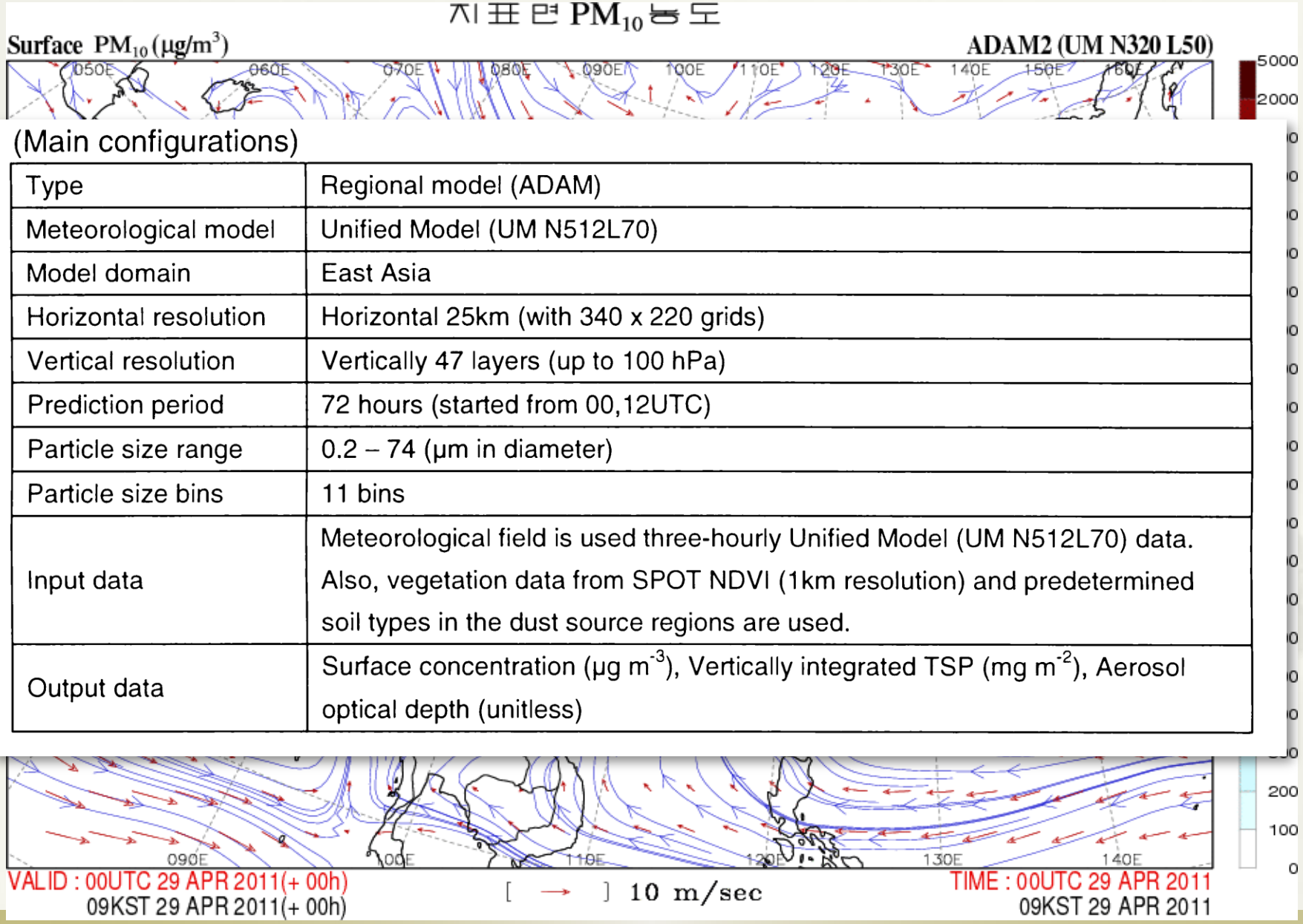




OBS: Observed surface T°C
RAD: Modeled T°C with dust feedback
CTL: Moeled T°C without dust feedback

(Wang et al., 2010)

KOREA: Asian Dust Aerosol Model (UM ADAM2)

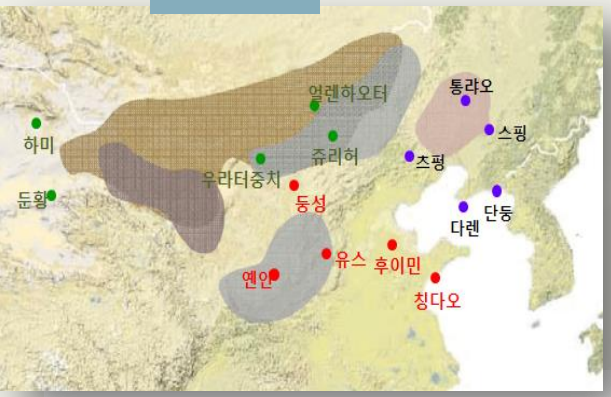


(Main configurations)

Type	Regional model (ADAM)
Meteorological model	Unified Model (UM N512L70)
Model domain	East Asia
Horizontal resolution	Horizontal 25km (with 340 x 220 grids)
Vertical resolution	Vertically 47 layers (up to 100 hPa)
Prediction period	72 hours (started from 00,12UTC)
Particle size range	0.2 – 74 (μm in diameter)
Particle size bins	11 bins
Input data	Meteorological field is used three-hourly Unified Model (UM N512L70) data. Also, vegetation data from SPOT NDVI (1km resolution) and predetermined soil types in the dust source regions are used.
Output data	Surface concentration (μg m^{-3}), Vertically integrated TSP (mg m^{-2}), Aerosol optical depth (unitless)

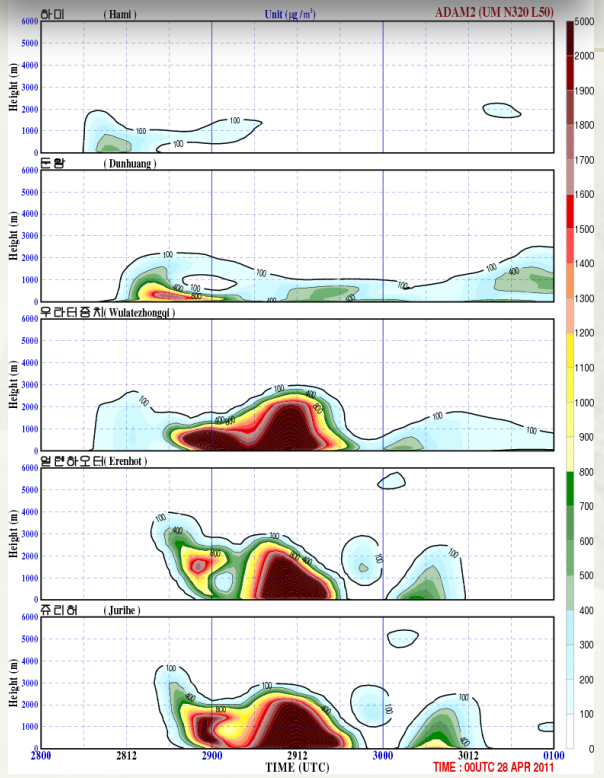
PM10 Vertical Profile

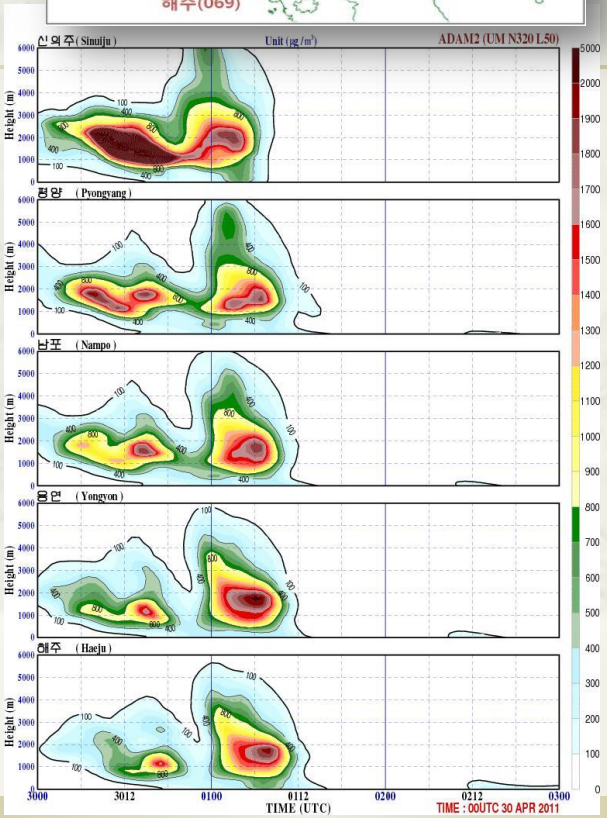
China

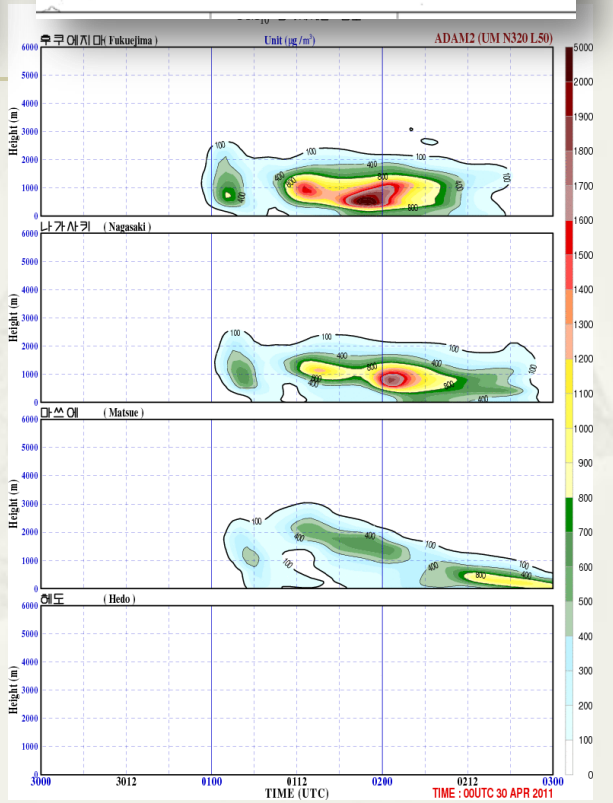


North Korea

Japan



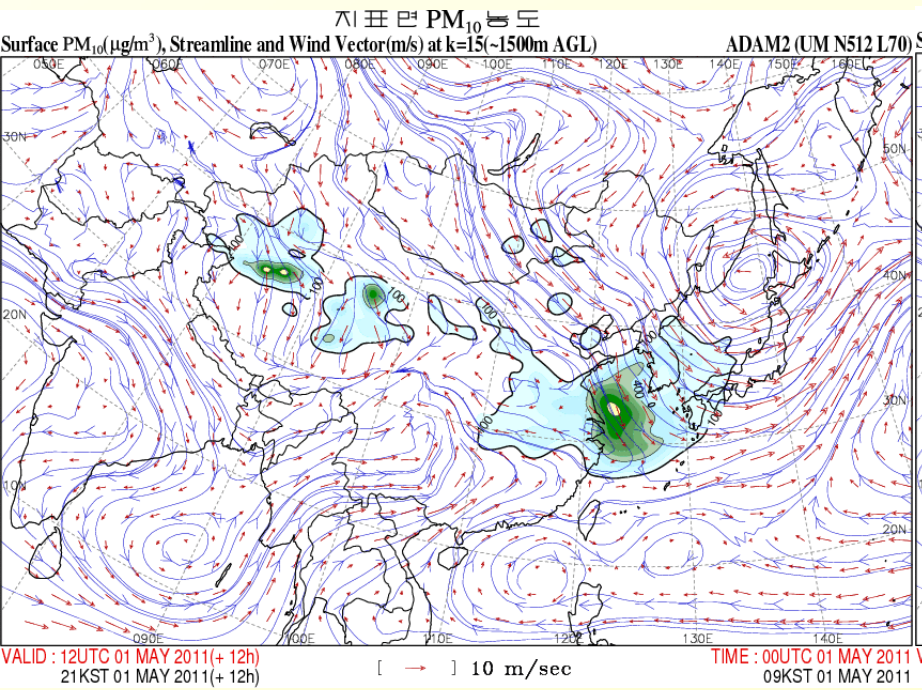


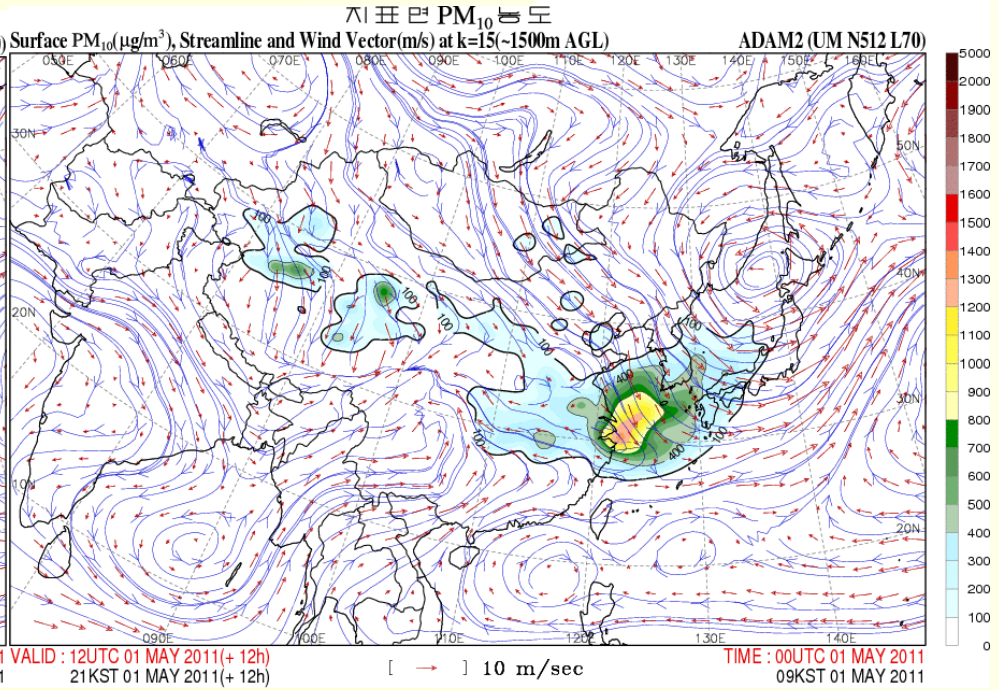


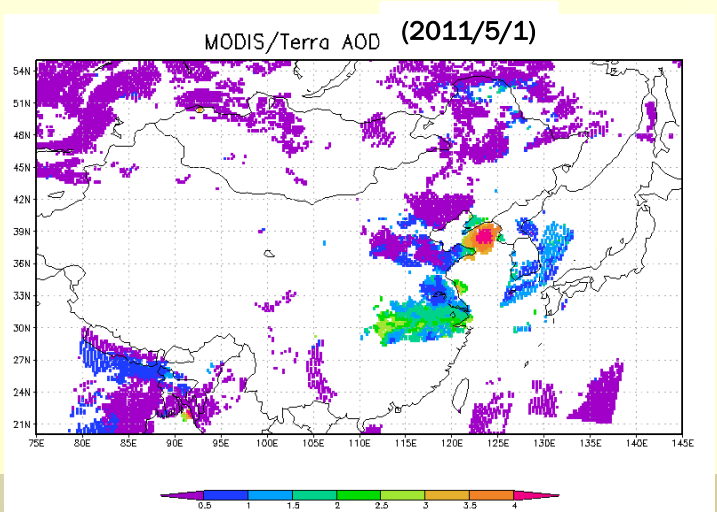
Data Assimilation

w/o assimilation

with assimilation







Daily AOD (MODIS)

May 2011

Improvement of Dust Model in MRI/JMA

	Present Forecast Model	MRI-AGCM3/MASINGAR mk-2
Aerosol Sub-model	MASINGAR (Tanaka et al. 2003)	MASINGAR mk-2
Dust emission	*Function* of *wind speed* (10m) $F = C\,u_{10}^2(u_{10} - u_t)$	*Function* of u_* (Shao et al., 1996; Tanaka and Chiba, 2005)
Aerosol type	Mineral Dust (MD) with 10 bins	MD (10 bins), Sulfate, BC, OC, Sea Salt
Resolution	Horizontal: T106 (~1.125°) Vertical: 20 Layer	Horizontal: TL159 →319 (0.56°) Vertical: 40 or 48Layer
Atmospheric model	MRI/JMA 98 AGCM	MRI-AGCM3
Advection	3-D semi-Lagrangian	←
Cumulus convection	Arakawa-Schubert	Tiedtke-like scheme
Land-surface model	SiB (3 Layer)	HAL
Connection with Atmospheric model	Subroutine connection for each time step	Coupler Library: SCUP (Yoshimura and Yukimoto, 2008)

Dust Forecast Model in Mongolia

(Main configurations)

Type	Regional model (MGLADAM)
Meteorological model	WRF
Model domain	East Asia
Horizontal resolution	Horizontal 27km with 190 X 170 grids
Vertical resolution	34 layers(σ-coordinate)
Prediction period	72 hours (3 days) starts from 00, 12 UTC
Particle size range	11 particle size bins in the range of 0.2μm -74μm in diameter
Input data	- 72 hour forecasts of meteorological field by Mongolian WRF - Soil type description and monthly reduction factor by vegetation which are externally given
Output data	- Surface PM10 (μm/ m^3) - Accumulated TSP (mg/ m^2) - Aerosol Optical Depth

Model inter-comparison

- Objective

  In order to facilitate the development of the prediction techniques and to improve the forecast accuracy within Node, exchange of the output of model predictions and their inter-comparisons will be implemented.

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

ASIA/CENTRAL PACIFIC REGIONAL CENTRE

ome | Forecast | Observation | Model InterComparsion | News & Event | Publications | About us

CMA
- Concentration
- Stations
- Flux
- Deposition
- Forecast Information

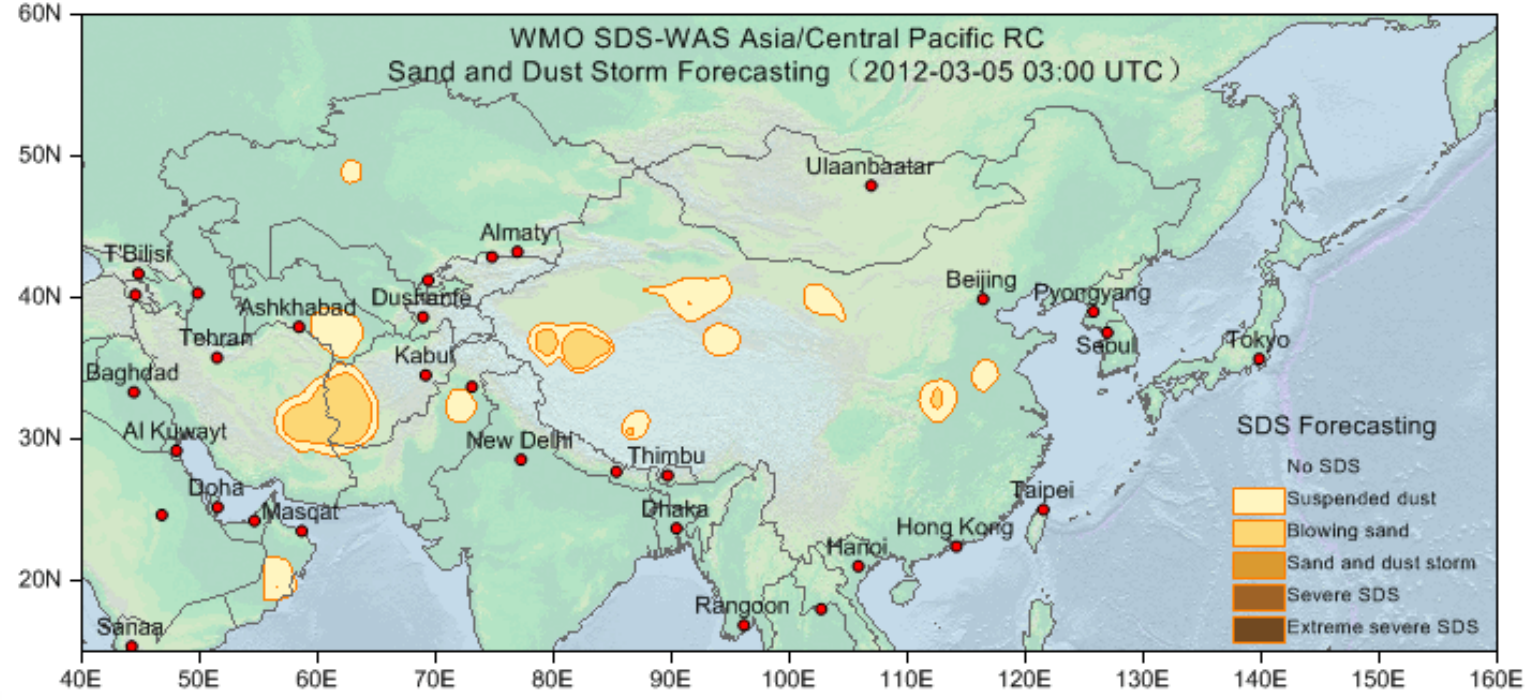
JMA
- To be decided

KMA
- To be decided

Data Sharing
- Output of CUACE/Dust

Concentration

dust110425 08 to submit Play prve next



dust110425 08:00 | dust110424 20:00 | dust110424 08:00 | dust110423 08:00 | dust110422 08:00 | dust110421 08:00 | dust11(

Web portal of Asian Node Centre
http://www.sds.cma.gov.cn

Operational dust forecast continuously throughout the year on a daily basis

Procedure of Hwangsa forecasting in KMA

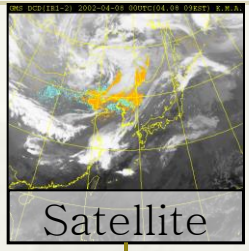
Monitoring
National and International

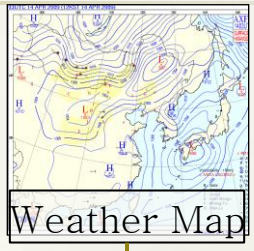
Analysis

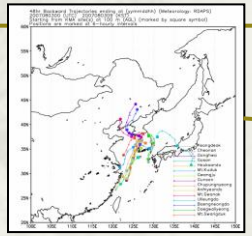

Naked Eye


PM10

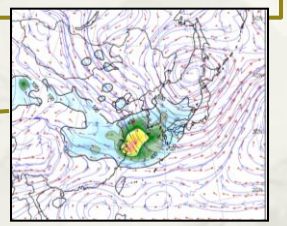

LIDAR

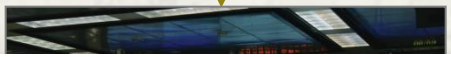

Satellite


Weather Map


Back trajectory

Special Forecaster of SDS


ADAM



http://www.kma.go.kr/weather/asiandust/graph.jsp (Korean)
http://web.kma.go.kr/chn/weather/asiandust/intro.jsp (Chinese)
http://web.kma.go.kr/jpn/weather/asiandust/timeseries.jsp (Japanese)
http://web.kma.go.kr/eng/weather/asiandust/timeseries.jsp (English)

TV & Mass Media

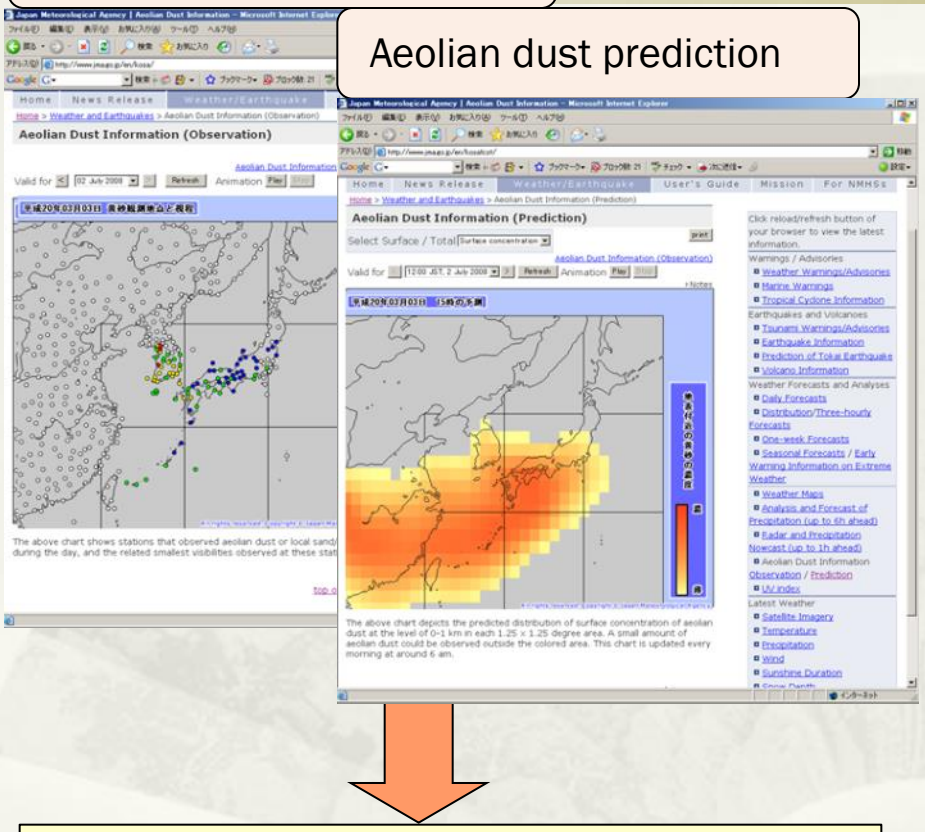
Discussion


Internet, Fax, Mobile Phone

Public information on aeolian dust

Aeolian dust observation

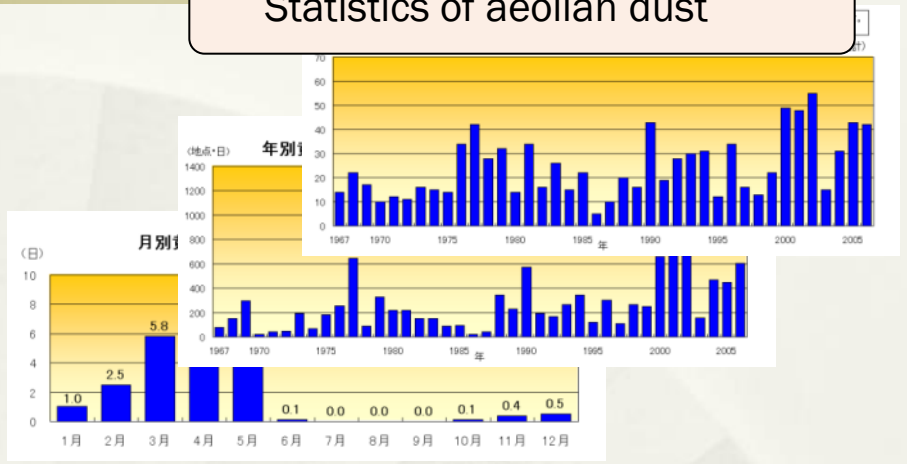
Aeolian dust prediction



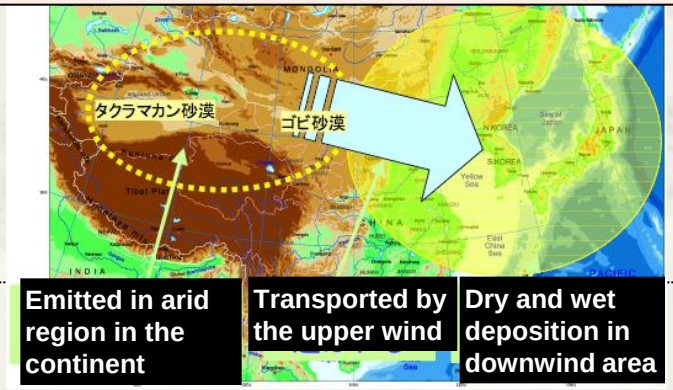
Aeolian dust warning information (when needed, Japanese only)

Japanese only

Statistics of aeolian dust



Basic knowledge about aeolian dust



JMA also provides aeolian dust prediction results (GPV) for private weather services via the Japan Meteorological Business Support Centre (JMBSC).

SDS-WAS Asia Node common portal development

- Objective

  In order to implement effective and efficient information exchange on the SDS events within Node, the enhancement of the RC web portal is necessary.

TEMM Dust and Sand Storm Program

TEMM DSS:

Based on the understanding of the resent increase of dust and sand storm (DSS) in East Asia, Ministers of the Environmental Ministry of China, Korea and Japan (TEMM) have agreed to promote cooperative measures for establishing dust monitoring network and early warning system. For this purpose, TEMM have established two expert working groups, one is for data sharing and improving dust forecast model (WG1) and the other is for countermeasure at dust source regions (WG2).

WG1:

It is planned to share the dust storm monitoring data for selected event and to validate and improving the dust forecast models, MASINGAR, ADAM, C-Force, using these data. Until now, WG1 special issue was published at SOLA. At the 5th meeting in Fukuoka, Japan, in Nov. 2012, it is agreed to share the monitoring data at 2011 dust events for the model development.

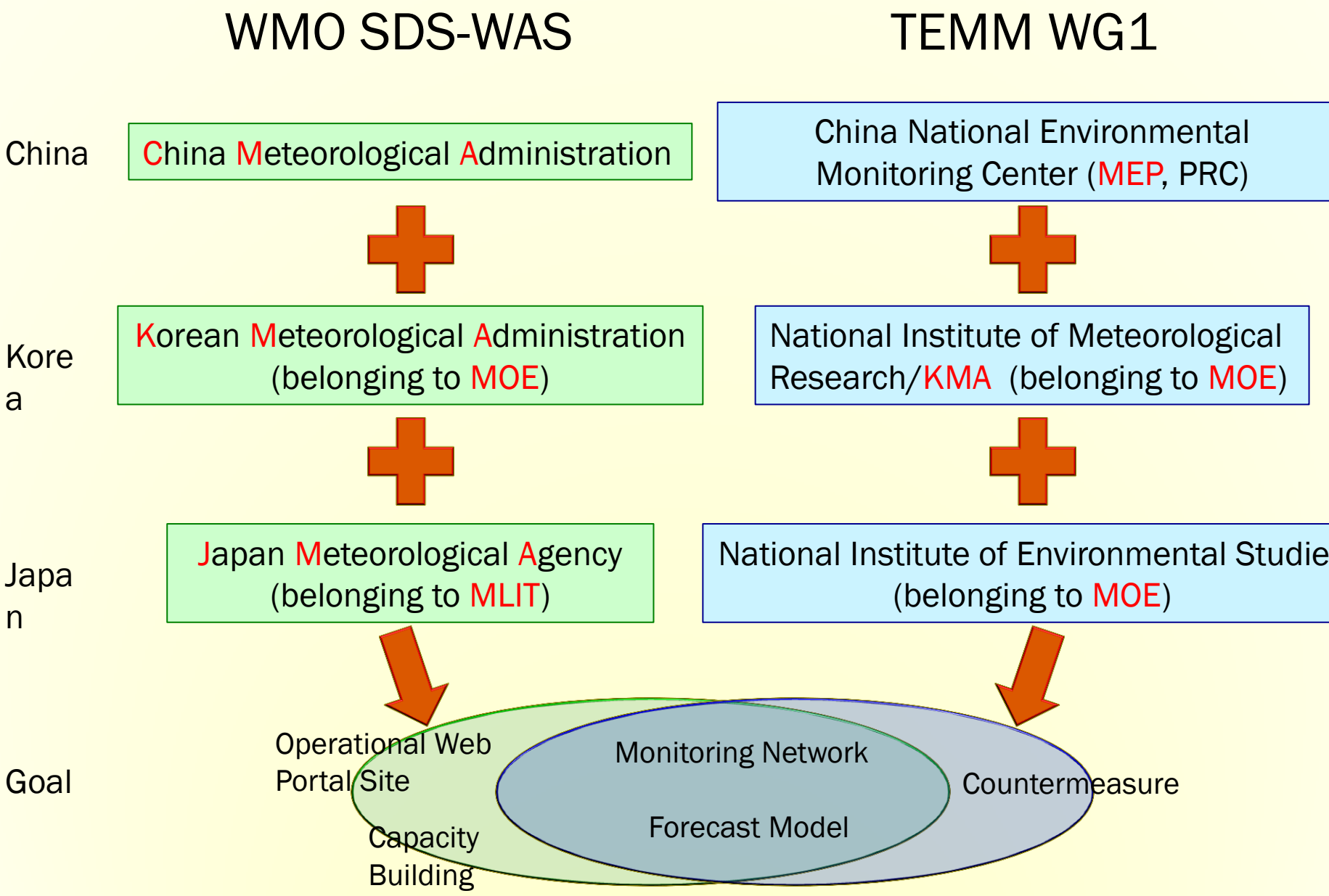
WG2:

It is planned to review countermeasure technologies for desertification and to make field inspections at desertification areas in China. In the 5th meeting of WG2 held at Jeju-Island, Korea, on Nov. 2012, it is discussed for the design of the field work at Inner-Mongolia.

Coming meetings:

On Nov. 2013, WG1 meeting will be held at Seoul, Korea and WG2 meeting will be held at China.

Structure of the two programs



SOLA TEMM-DSS WG1 Special Issue (free downloadable from Web site)

12 papers were published as a special issue of SOLA, an international letter journal published by Met. Soc. Japan, including;

Dust Emission Estimated with an Assimilated Dust Transport Model using Lidar Network Data and Vegetation Growth in the Gobi Desert in Mongolia, *by N. Sugimoto et al.,*

The Impact of Ground-Based Observations on the Inverse Technique of Aeolian Dust Aerosol, *by T. Maki et al.,*

The Effects of Snow Cover and Soil Moisture on Asian Dust: I. A Numerical Sensitivity Study, *by T. Y. Tanaka et al.,*

The Effects of Snow Cover and Soil Moisture on Asian Dust: II. Emission Estimation by Lidar Data Assimilation, *by T. T. Sekiyama et al.,*

Comparison of Surface Observations and a Regional Dust Transport Model Assimilated with Lidar Network Data in Asian Dust Event of March 29 to April 2, 2007, *by N. Sugimoto et al.,*

Relationship between Lidar-derived Dust Extinction Coefficients and Mass Concentrations in Japan, *by A. Shimizu et al.,*


Thank you for your attention.
Sunset in Mongolia