World Meteorological Organization
Working together in weather, climate and water

Prof. Alexander Baklanov, WMO focal point for SDS-WAS and UN SDS Coalition, abaklanov@wmo.int
Prof. Xiaoye Zhang, SDS-WAS SC chair, CMA, xiaoye@cma.gov.cn
Dr. Sang-Boom Ryoo, SDS-WAS Asia Node chair, KMA, sbryoo@korea.kr

WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) for SDS Risk Assessment in Asia and the Pacific

Mission:

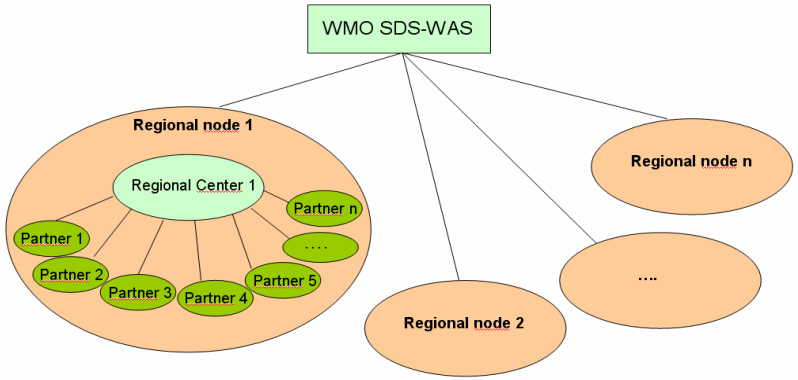
- To establish a coordinated global network of SDS research & forecasting centres;
- To enhance the ability of countries to deliver timely and quality SDS forecasts, observations, information and knowledge to users through an international partnership of research and operational communities

https://public.wmo.int/en/our-mandate/focus-areas/environment/SDS

The WMO SDS-WAS, which is **a global federation of partner system**, endorsed by the 15th WMO Congress (2007) and **organized around regional nodes**, **integrates research-operational and user communities** (e.g., health, climate, energy, transport, aeronautical, and agricultural users).

SDS-WAS Science Implementation Plan and Regional Nodes & Centers

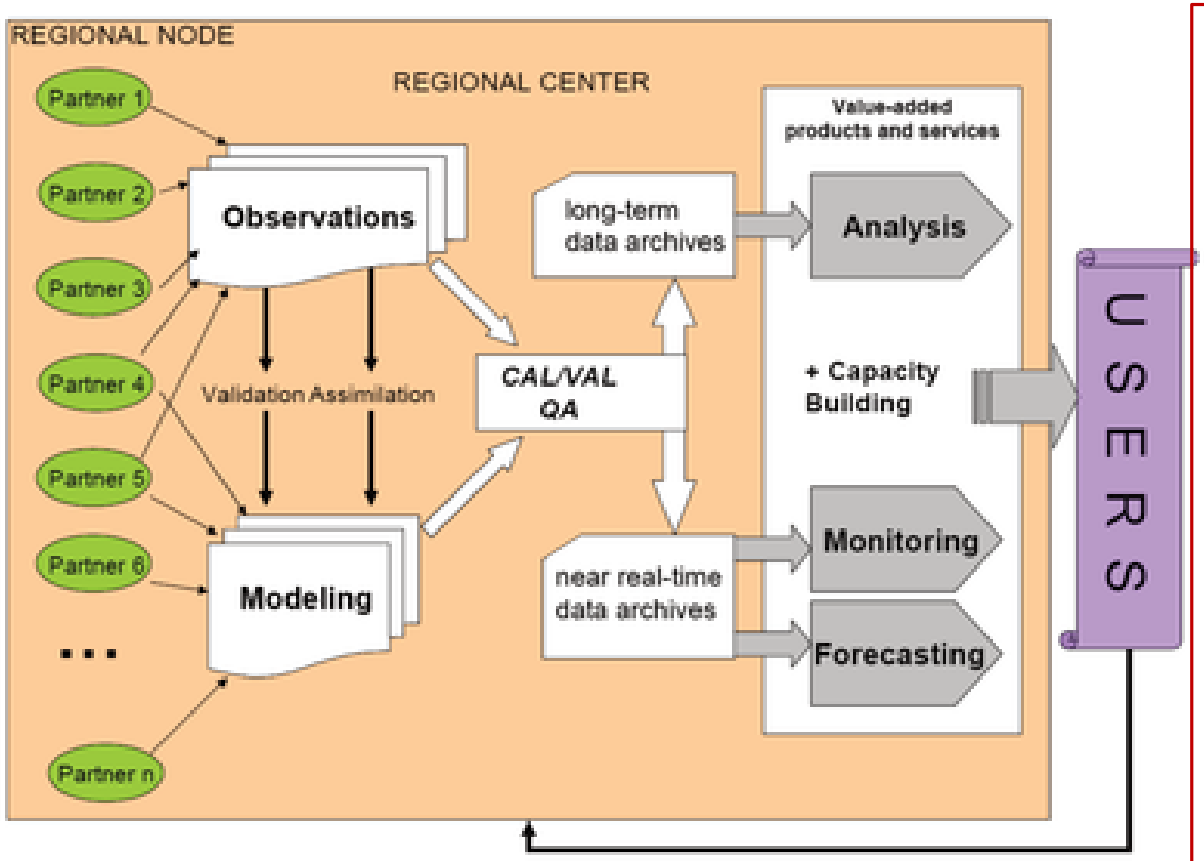
https://library.wmo.int/index.php?lvl=notice_display&id=19816#.YSadNogzY2w



- Global Steering Committee of SDS-WAS: https://public.wmo.int/en/our-mandate/focus-areas/environment/SDS
- **Regional Node for Asia, coordinated by a Regional Center hosted by the China Meteorological Administration (Beijing, China), http://www.asdf-bj.net/**
- Regional Node for Northern Africa, **Middle East** and Europe (NA-ME-E), coordinated by the Regional Centre as a consortium of the Spanish State Meteorological Agency (AEMET), and the Barcelona Supercomputing Center – National Supercomputing Center (BSC-CNS), https://sds-was.aemet.es/
- Pan-American Regional Node, coordinated by Regional Center hosted by the Caribbean Meteorological & Hydrological Institute, Barbados, http://sds-was.cimh.edu.bb/
- Two SDS-WAS Centers are approved as Operational Regional Specialized Meteorological Centers with Activity Specialization on Atmospheric Sand and Dust Forecast (RSMC-ASDF): Barcelona (2014) and Beijing (2017)

Current Mission of WMO Sand & Dust Storm Warning Advisory & Assessment System (SDS-WAS):

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

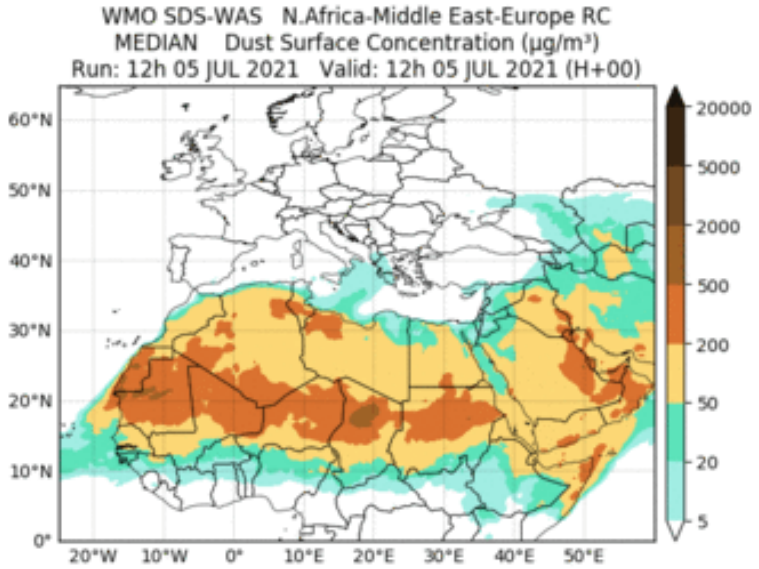


SDS-WAS components:

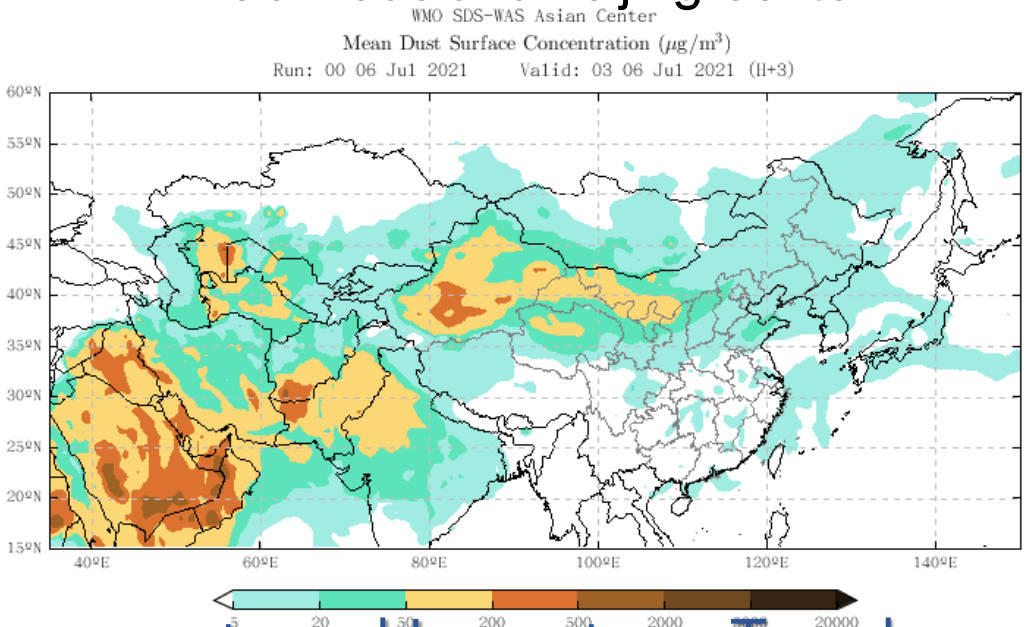
- Warning Advisory
  - monitoring/observing
  - forecasting
  - advising on warnings
- Assessment
  - reanalysis
  - sub-seasonal forecasts
  - cimate change projections;
  - multi-years trends

72 hours SDS Forecasting by WMO SDS-WAS Regional Centers

NAMEE Node and Barcelona Center

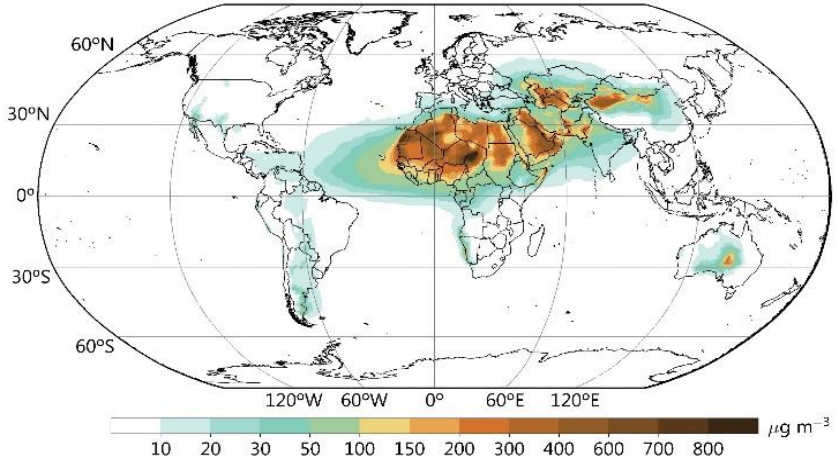


Asia Node and Beijing Center

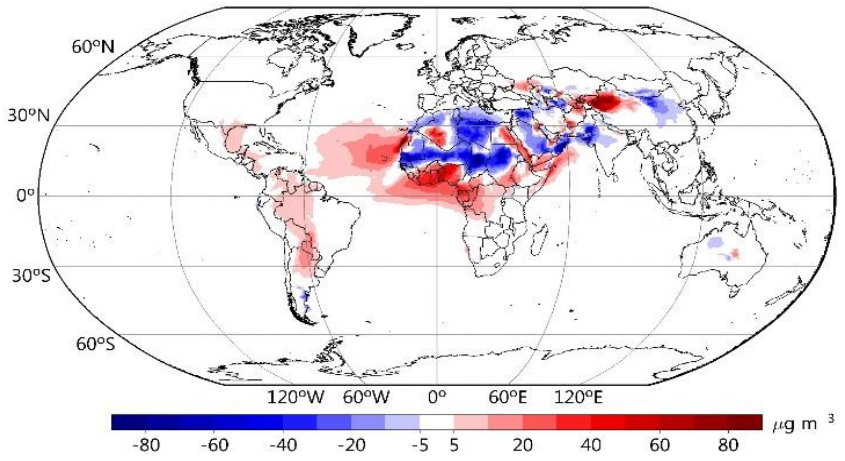


SDS-WAS Multi-year Dust Assessments and Long-term Trends

Such WMO SDS-WAS Asia Node (JMA) reanalysis was provided to ESCAP/APDIM for the SDS Risk Assessment



Annual mean surface concentration of mineral dust in 2020.



Anomaly of the annual mean surface concentration of dust in 2020 relative to mean of 1981-2010

WMO Dust Bulletin, #5, 2021

Emerging SDS-WAS research issues

Address Limitation

- Physical processes leading to specific types, very small scale of SDS, like haboob, etc.
- Interaction among dust aerosol and radiation and clouds
- Heterogeneous reaction on dust interface

Advance Method

- Data assimilation of SDS ground- & satellite-borne observations
- Retrieving dust mineralogy from space-borne measurements
- Sub-seasonal to seasonal (S2S) of SDS and climate prediction

Attribution

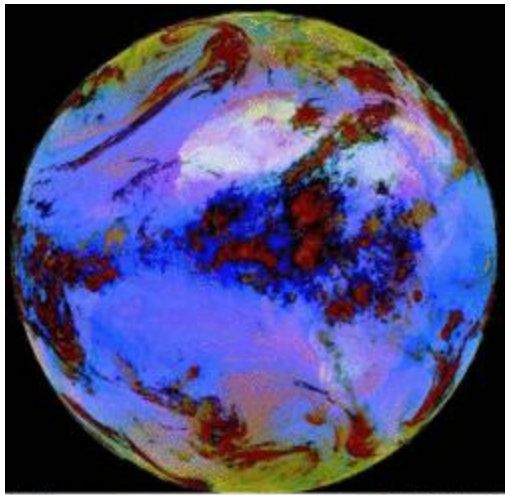
- Attributing changes in dust sources to land mismanagement, desertification and climate change

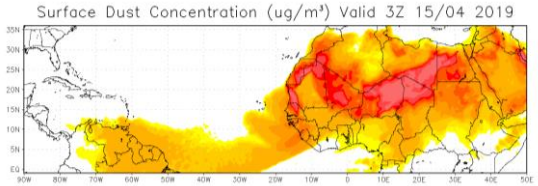
New Observation

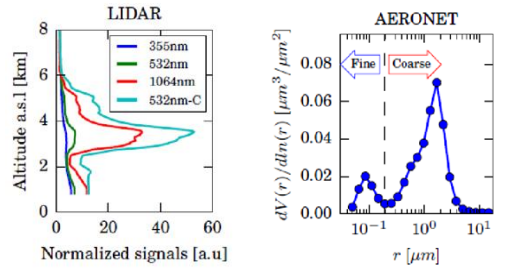
- New technique and methodology of observation of atmospheric aerosols optimized to mineral dust

Application

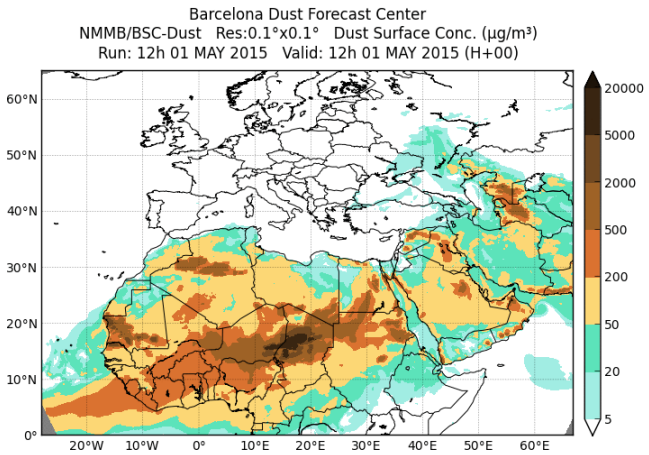
- Better coordinating and harmonising the process of transferring dust observations and predictions to users (in aviation, solar energy, health, air-quality, climate service communities).



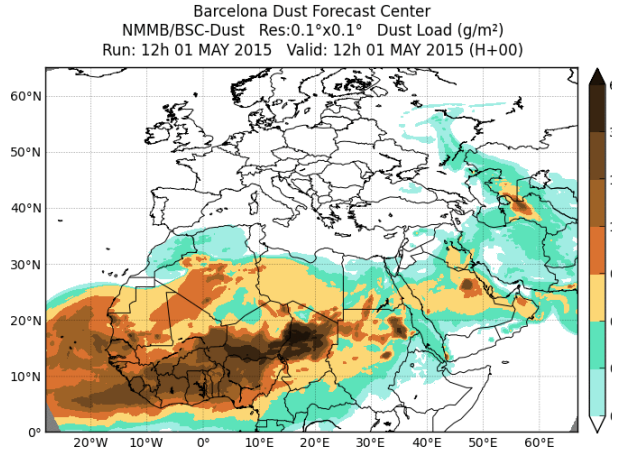




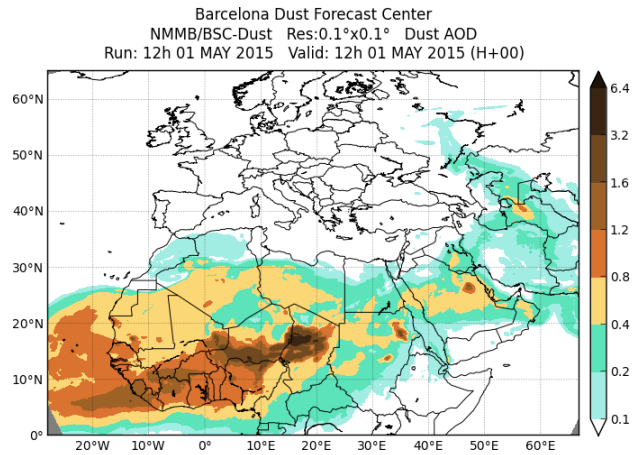
Dust Forecasts: variables



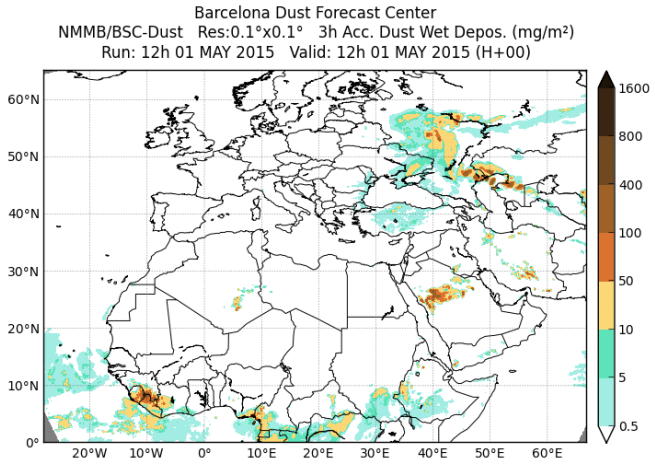
Surface concentration



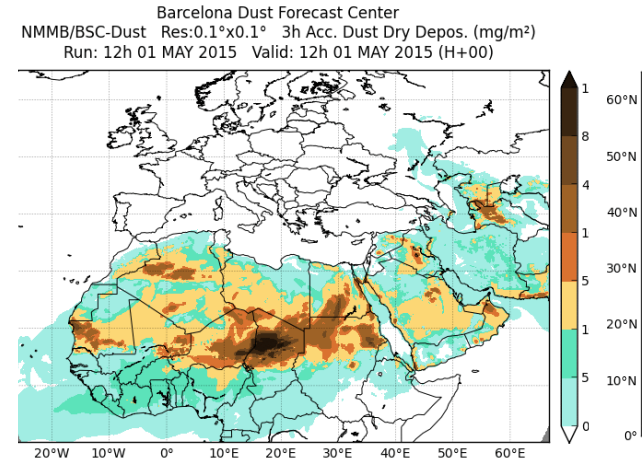
Dust load



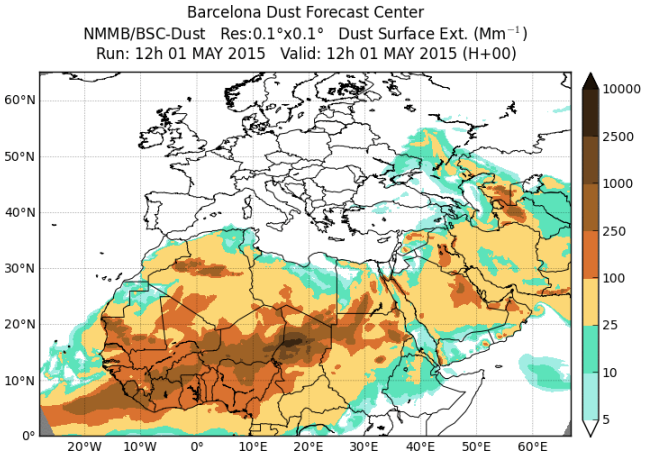
Dust AOD 550 nm



3-h acc. wet deposition



3-h acc. dry deposition

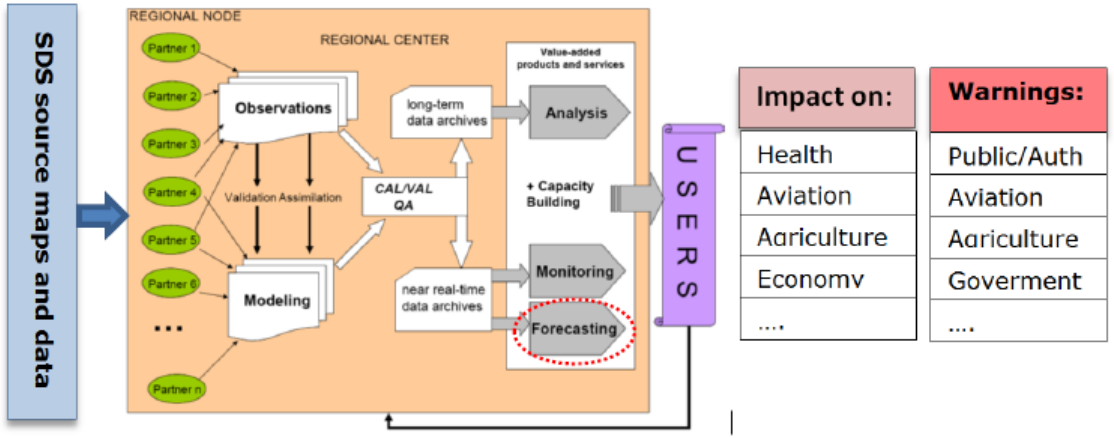


Sfc. extinction 550 nm

SDS-WAS NAMEE Node and Barcelona Center

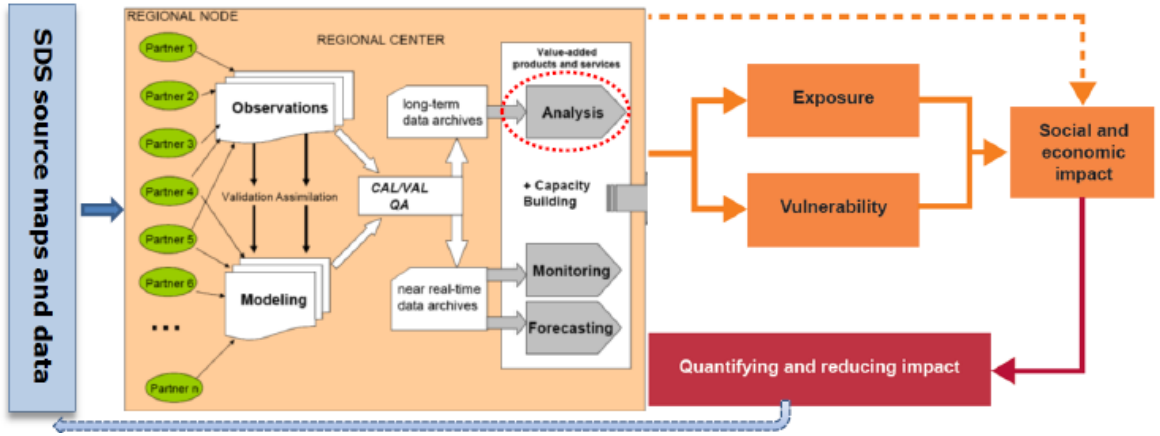
WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) for UN SDS Coalition

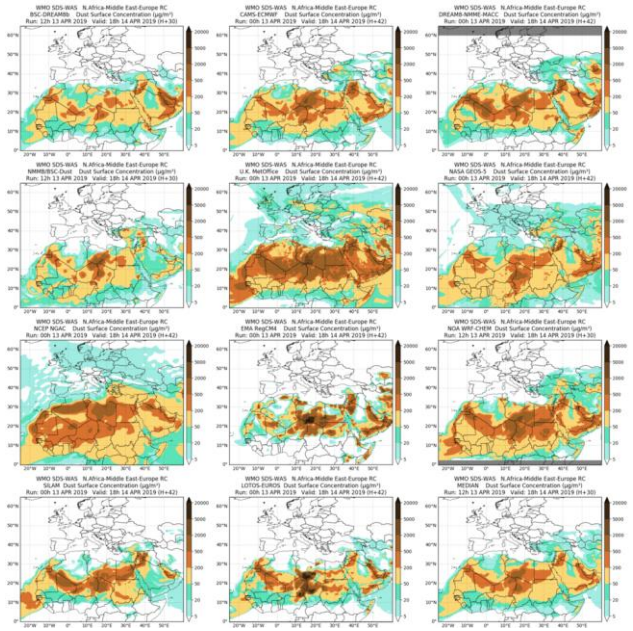
SDS-WAS for Early Warning:



- 9 global models
- 15 regional models
- 30 organizations
- 3 regional nodes & centers (*NAMEE, Asia, Americas*)
- 2 regional dust operational centers
- Several national centers

SDS-WAS for Impact Assessment:





Joint and coordinated efforts of several UN Agencies (e.g., WMO, UNEP, UNCCD, WHO, ESCAP, FAO, ICAO), National Authorities and Research community are needed

Our different Nodes are conducting or will conduct sand and dust reanalysis research, which will greatly support the SDS assessment or impact-based early warning of the UN SDS coalition

JMA in Asian Node

The **reanalysis SDS data** in **120-60 km resolution** for the 10-15yr long-term in the **Asian area** prepared and shared with ESCAP APDIM project in 2021.

Barcelona Dust Forecast Center (BDFC) in NAMEE Node

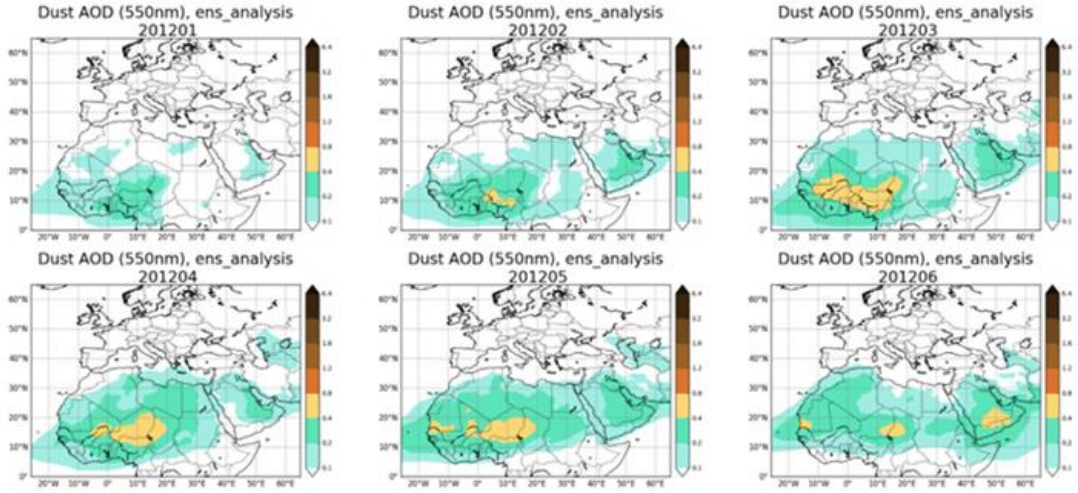
A reanalysis model **based on the operational model** and the **new DAS** will be ready at the **end of 2021** and will be run for our domain NAMEE

Beijing Dust Forecast Center (BJDFC) in Asian Node

A project related to chemical-weather coupling **reanalysis for aerosol (including dust)** has been approved by **NSF-China**, which will produce a **reanalysis-product of dust aerosol in Asia** in the next two years

WHO-WMO global assessment of SDS health impact

Joint model-measurement fusion assessment of the contribution that dust plays in global air pollution by **integrating ground monitoring with a global reanalysis** of atmospheric composition produced by CAMS *(Salter et al)*

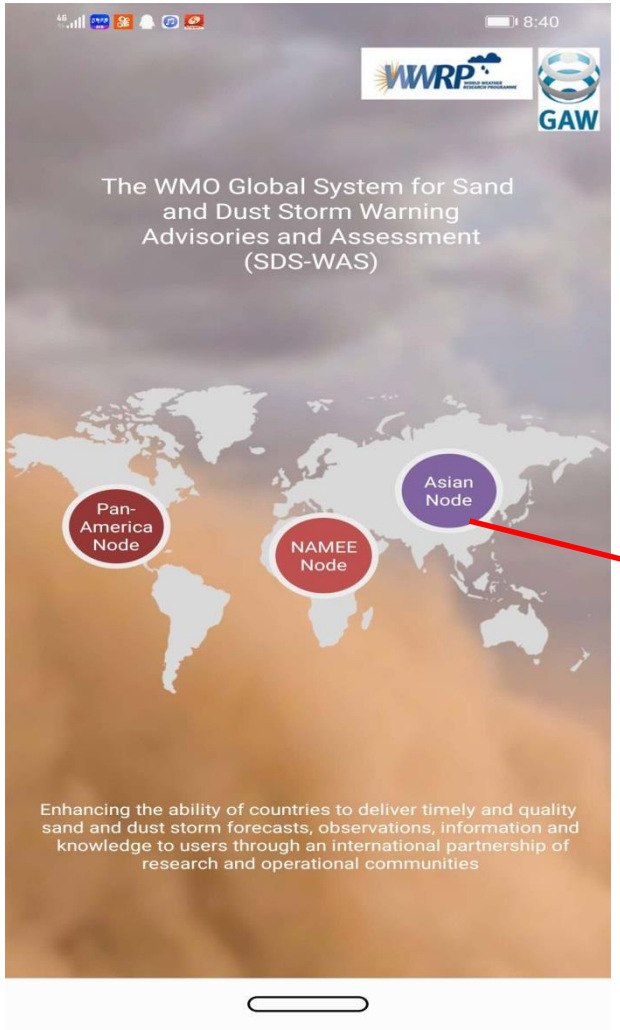


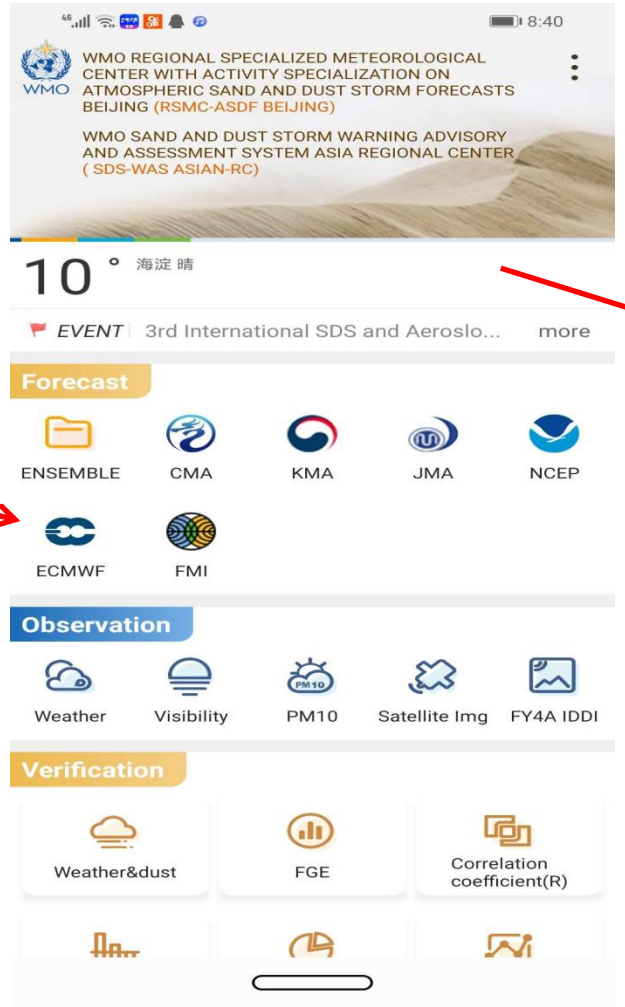
Reanalysis model example for January-June 2012

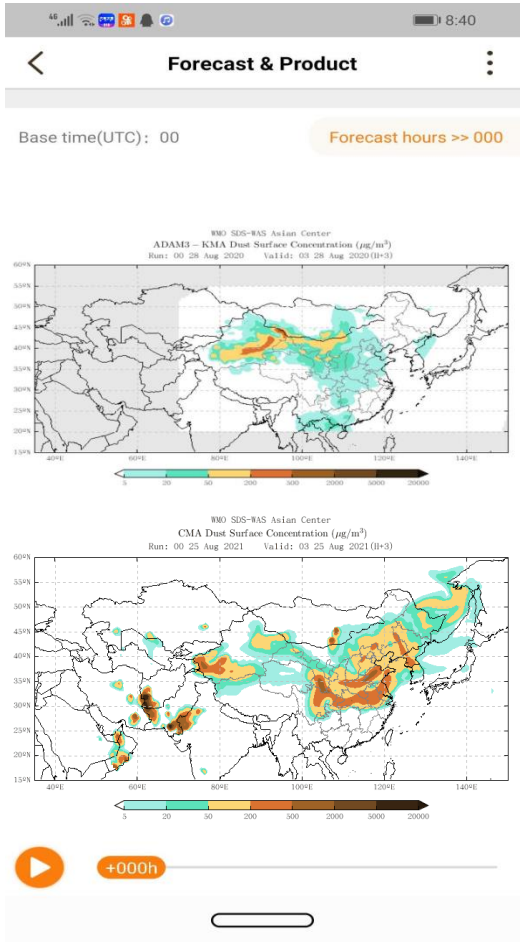
Using such reanalysis products will play an important role in understanding the anthropogenic and climate change impacts on SDS

Development of SDS APP

- Including Pan-America Node 、 NAMEE Node and Asian Node
- Providing SDS surface concentration, 550nm AOD 、 dry(wet) Deposition、 monitoring and verification etc.
- Providing the weather conditions of the region according to the User's area



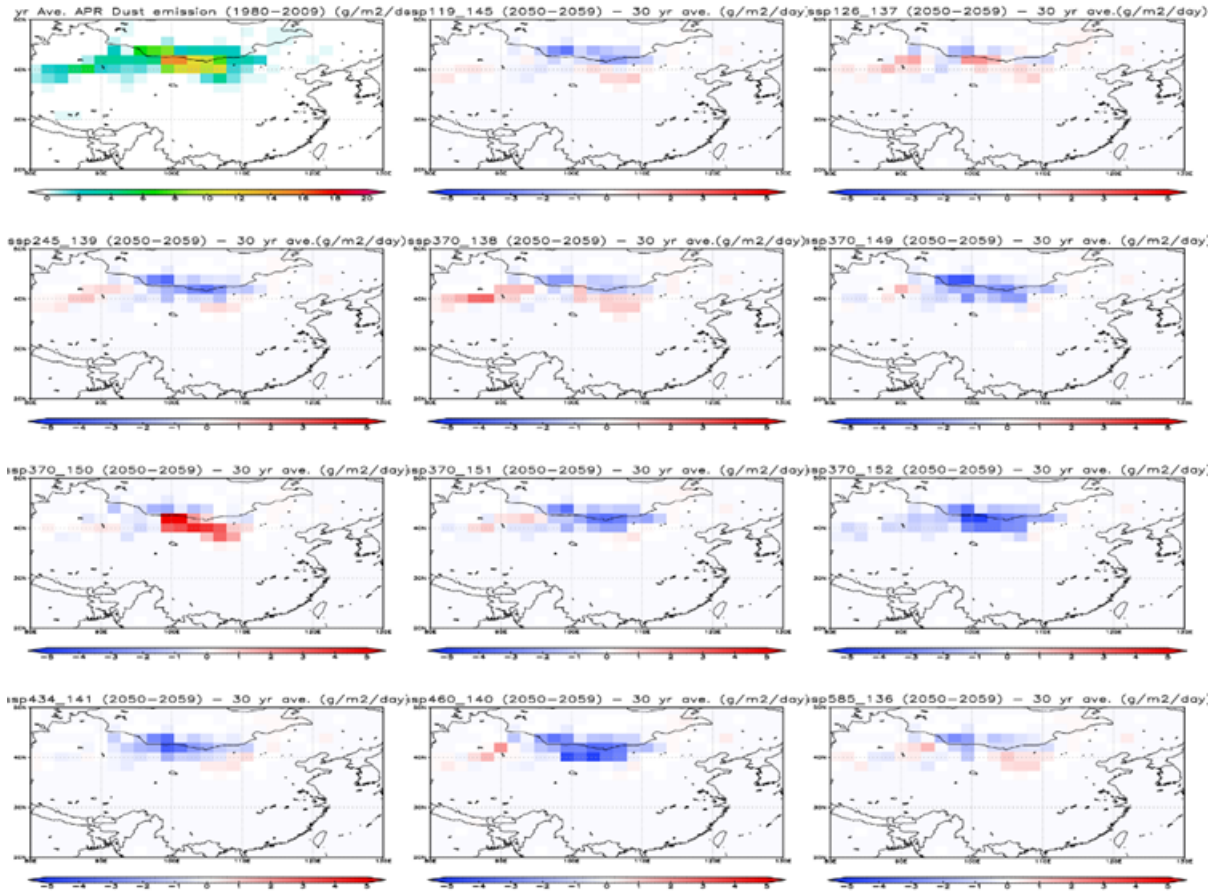




SDS-WAS will take the following **scientific and technological emphases** as our priorities up to 2023 (10)

- **SDS projection due to Climate Change**

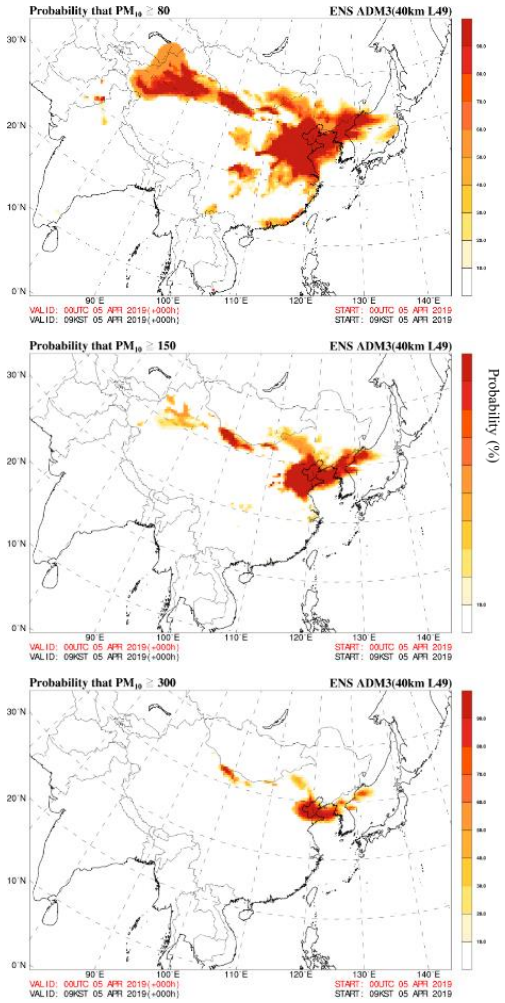
  → **externally funded research project by the NIES, MRI, Univ. Of Tokyo and Tottori Univ. (2020-2022)**



SDS emission amount (2050's)

SDS-WAS will take the following **scientific and technological emphases** as our priorities up to 2023 (11)

Step 1. Probabilistic forecast

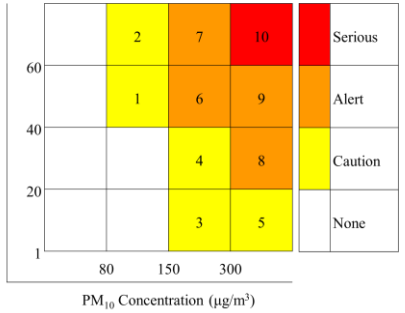


Probabilistic SDS forecast and Impact-based forecast

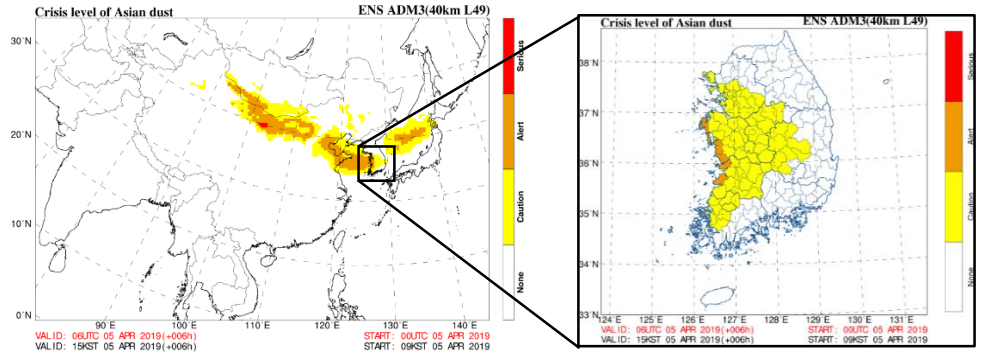
→ will construct ensemble SDS forecast system *using 52 ensemble number*

→ will operationally issue probabilistic SDS forecast and Impact-based forecast after 2023

Step 2. Risk matrix

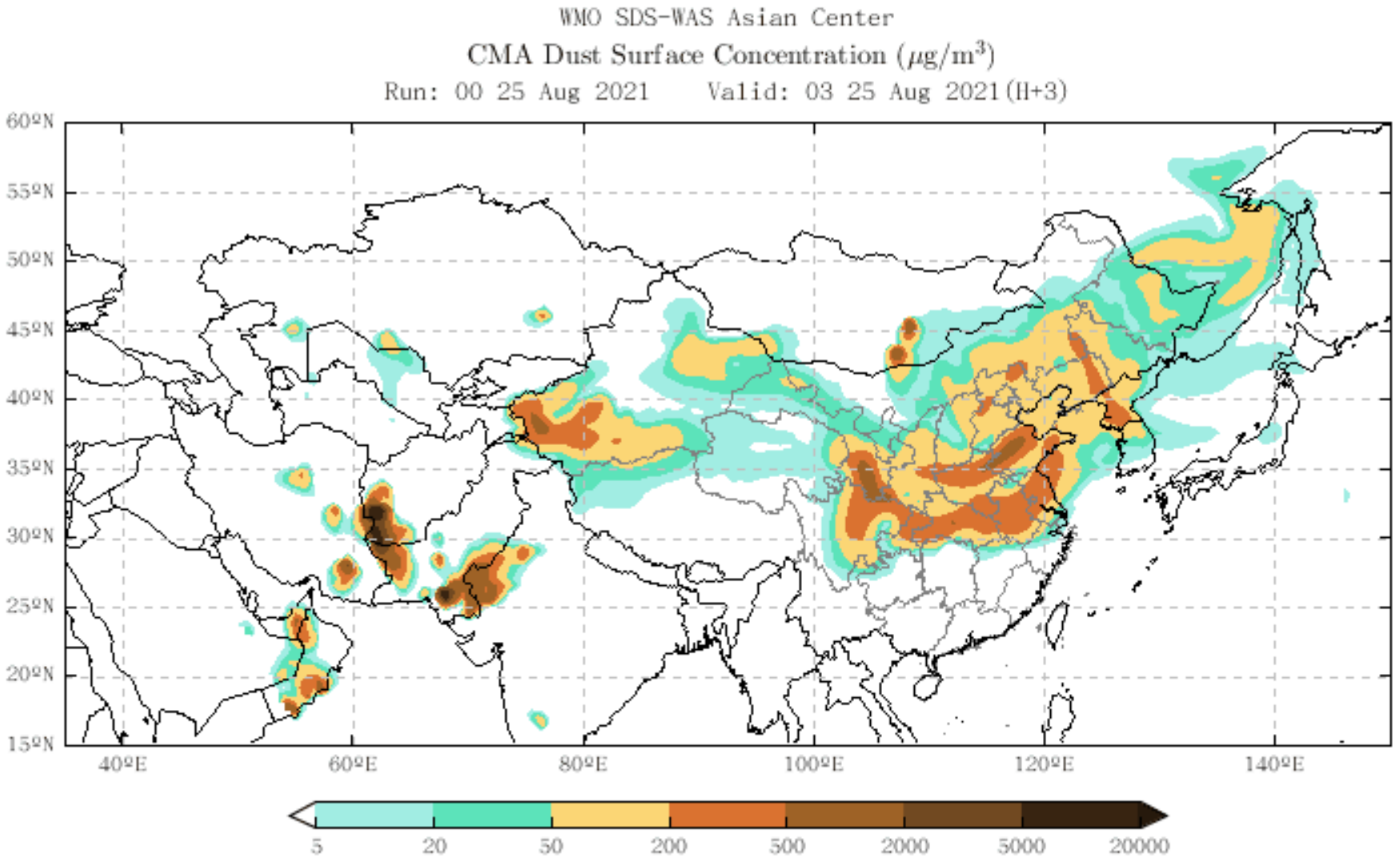


Step 3. Impact-based forecast



Current Activities in Asian Node. CMA

Asian RC provide operational forecast of SDS and Forecast range of CUACE\Dust was extended from 72 hours to 168 hours



Current Activities in KMA

Twin Geostationary satellite of Korea, GeoKOMPSAT-2A and 2B

	GK-2A	GK-2B	
Payload	AMI	GOCI-2	GEMS
Lifetime	10 years		
Location	36,000 km over equator at 128.2° E		
Channels	16	13	1000
Wavelength range	0.4 – 13.3 μm	380 – 865 nm	300-500 nm
Spatial resolution	0.5 & 1 km (Vis) 2 km (IR)	250 m @ eq 1 km (FD)	7 x 8 km^2 @ Seoul 3.5x8 km^2 (aerosol)
Temporal resolution	10 min (FD)	1 hour (daytime)	1 hour (daytime)
Data service	**L1 : 2019.6.~** **L2 : 2020.3.~**	L1 : early 2021~ L2 : TBD	L2: early 2021~ L2 : TBD
Aerosol products	Detection (aerosol, dust, ash) DAOD, AOD, AEP, Aerosol particle size	AOD Aerosol type Yellow dust	AOD Aerosol Index SSA AEH

AOD: Aerosol Optical Depth, DAOD: Dust AOD, AEP : Aerosol Angstrom Exponent
SSA: Single Scattering Albedo, AEH: Aerosol Effective Height

AMI: Advanced Meteorological Imager, **KSEM**: Korean Space wEather Monitor
GOCI-2: Geostationary Ocean Color Imager-2
GEMS: Geostationary Environmental Monitoring Sensor

SDS: Economic Impact & DRR

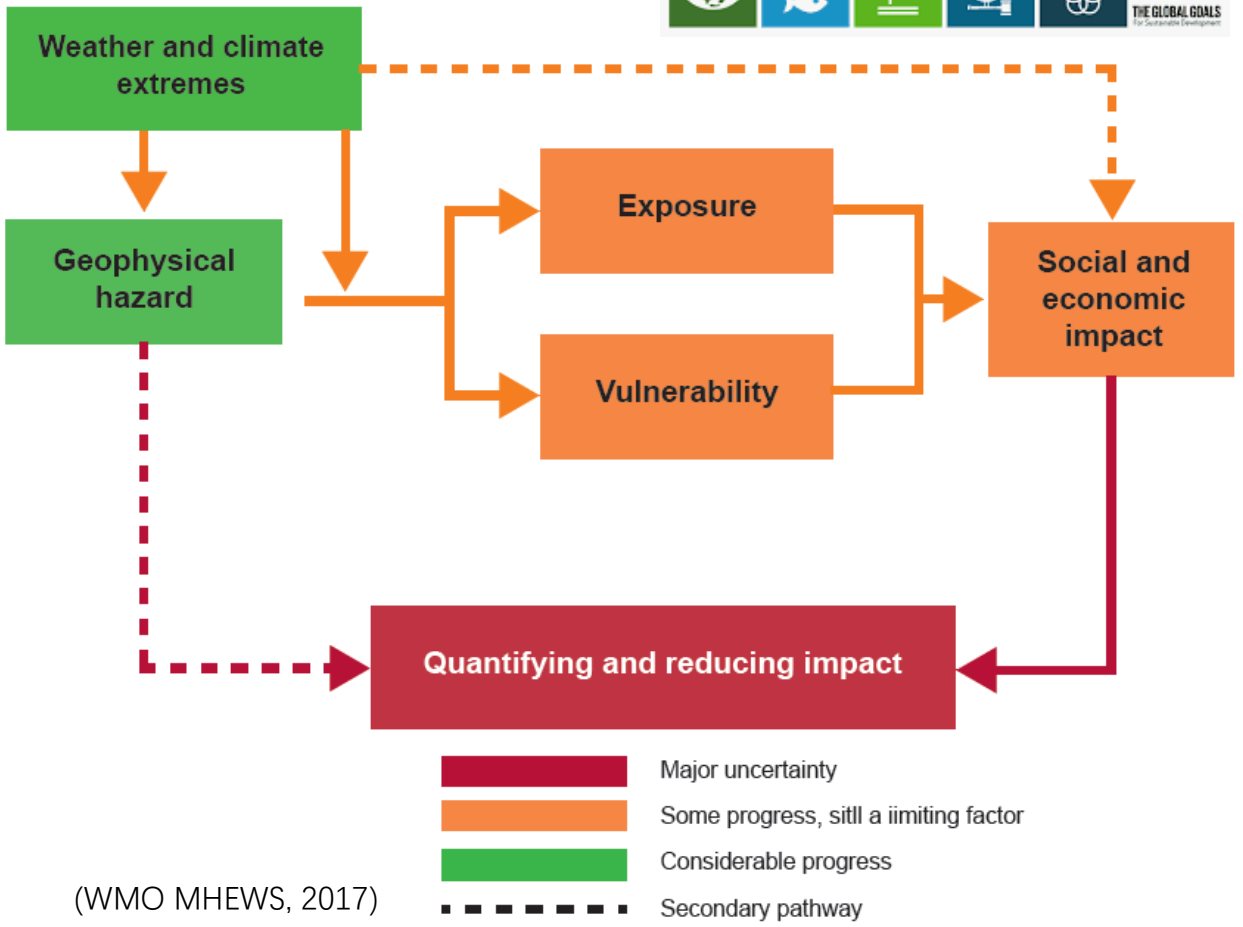
Short-term costs:

- Livestock mortality, crop damage, infrastructure damage, transport and communications disruption, effects on energy and clear industry, costs of clearing sand and dust.

Longer-term costs:

- Soil erosion and reduced soil quality, soil pollution through deposition of pollutants, and disruption of global climate regulation.
- Economic losses from a single event can be in the order of hundreds of million dollars, but benefits rarely quantified.

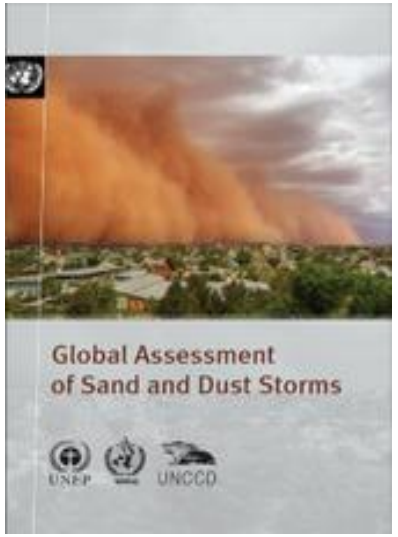
(UNEP, WMO, UNCCD 2016)



(WMO MHEWS, 2017)

Joint and coordinated efforts of several UN Agencies, National Authorities and Research community are needed !!
This ESCAP APDIM Report is a nice example of such starting collaboration! Hope we'll continue as a joint UN SDS Coalition team!

SDS-WAS Outreach Activities and Capacity Building



WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION | GLOBAL ATMOSPHERE WATCH | WWRP

WMO AIRBORNE DUST BULLETIN Sand and Dust Storm Warning Advisory and Assessment System

No. 1 | February 2017

ORGANISATION MÉTÉOROLOGIQUE MONDIALE | GLOBAL ATMOSPHERE WATCH | WWRP

BULLETIN DE L'OMM SUR LES POUSSIÈRES ATMOSPHÉRIQUES Système d'alerte, d'avis et d'évaluation concernant les tempêtes de sable et de poussière

No1 (2017):: https://library.wmo.int/opac/index.php?lvl=bulletin_display&id=3902

No3 (2019): https://library.wmo.int/index.php?lvl=bulletin_display&id=3972#.X4sMtkBuI2w

No5 (2021): https://library.wmo.int/index.php?lvl=notice_display&id=19826#.YSYYUYgzYuU

WWRP | GLOBAL ATMOSPHERE WATCH | المنظمة العالمية للأرصاد الجوية

نظام الإنذار بالعواصف الرملية والترابية وتقييمها التابع للمنظمة (WMO)

نشرة التراب الجوي للمنظمة العالمية للأرصاد الجوية

2020 STATE OF CLIMATE SERVICES

RISK INFORMATION AND EARLY WARNING SYSTEMS

No 2 (2018):: https://library.wmo.int/opac/doc_num.php?explnum_id=4572

No4 (2020): https://library.wmo.int/doc_num.php?explnum_id=10317

https://library.wmo.int/doc_num.php?explnum_id=10346

WMO SDS-WAS web-sites and reports:

https://public.wmo.int/en/our-mandate/focus-areas/environment/SDS
https://public.wmo.int/en/our-mandate/focus-areas/environment/SDS/warnings

SDS-WAS Regional Nodes and Operational Forecasts:

for Northern Africa, Middle East and Europe: http://sds-was.aemet.es;
for Asia: http://eng.nmc.cn/sds_was.asian_rc;
for the Americas: http://sds-was.cimh.edu.bb/
Operational Barcelona Center: http://dust.aemet.es/

SDS-WAS Training Courses, Conferences and Materials:

https://sds-was.aemet.es/materials/training