Updates of the aerosol prediction in Japan Meteorological Agency

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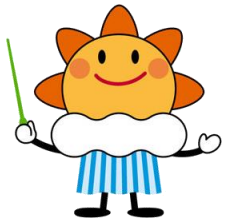
Takashi Maki, Tsuyoshi Thomas Sekiyama, Keiya Yumimoto



Japan Meteorological Agency/
Meteorological Research Institute, JMA

16 June 2015

7th ICAP working group meeting, BSC

気象庁
Japan Meteorological Agency

JMA

Outline

- Updates of JMA global aerosol model
- Status of JMA's new geostationary satellite Himawari-8
- Topics
  - News of SDS-WAS Asia node
  - WGNE aerosol exercise

- Data assimilation updates will be presented by Thomas Sekiyama on Thursday.

Updates of JMA/MRI aerosol model

- The Aeolian dust aerosol prediction model was upgraded in November, 2014 (MASINGAR-1 ➔ MASINGAR mk-2 rev.2β).
  - Horizontal resolution: ~110km (TL159): Vertical 20 ➔ 40 layers
- The operational dust prediction model will be upgraded again within this fiscal year (MASINGAR mk-2 rev.3)
  - Horizontal resolution upgrade : up to **~40km (TL479)**
  - Revised dust emission
  - Revised SOA from the ocean: Methanesulfonic acid is treated as SOA.
  - Revised hygroscopicity of sea salt
  - Many bug fixes, clean-up of codes, etc.

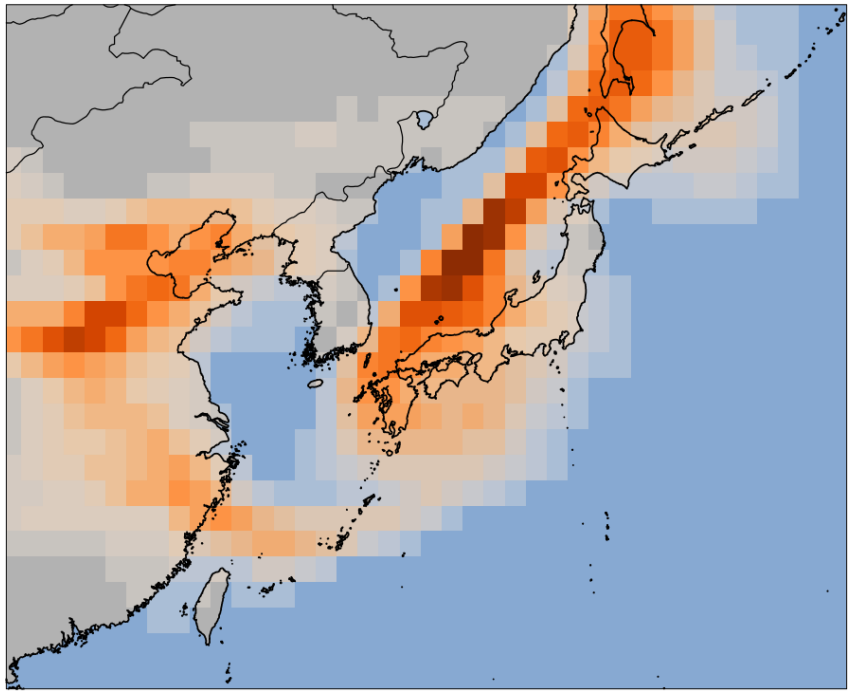
- Supercomputing system in MRI was replaced from Hitachi SR16000L2 to **Fujitsu FX100** in March.
- MRI joined “Post K computer” project.

FUJITSU PRIMEHPC FX100

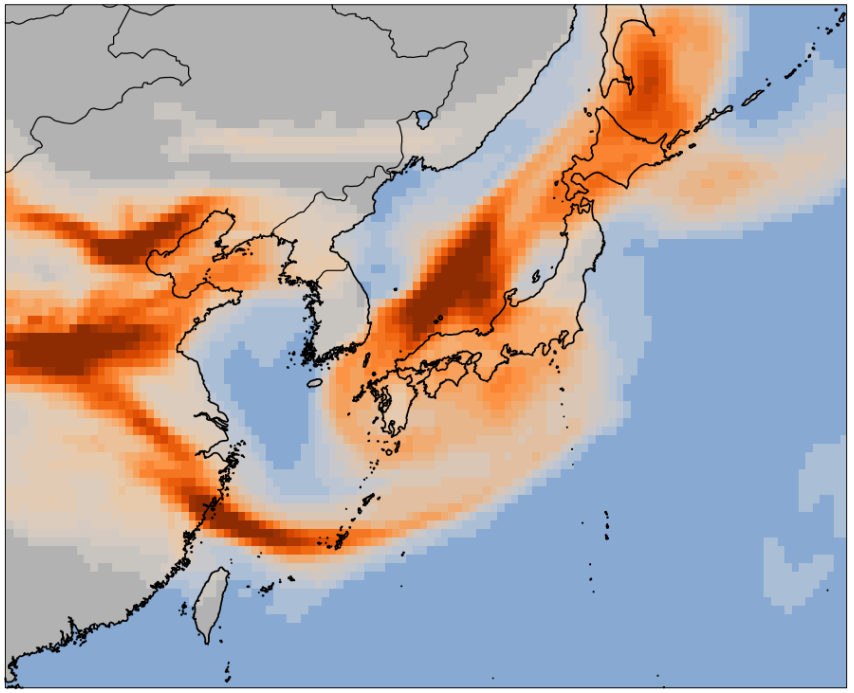
Total performance	1091 TFLOPS
Total nodes	1080 nodes
Total memory	33.75 TB

JMA's Next dust forecast model

Current operational version (TL159: ~110km)

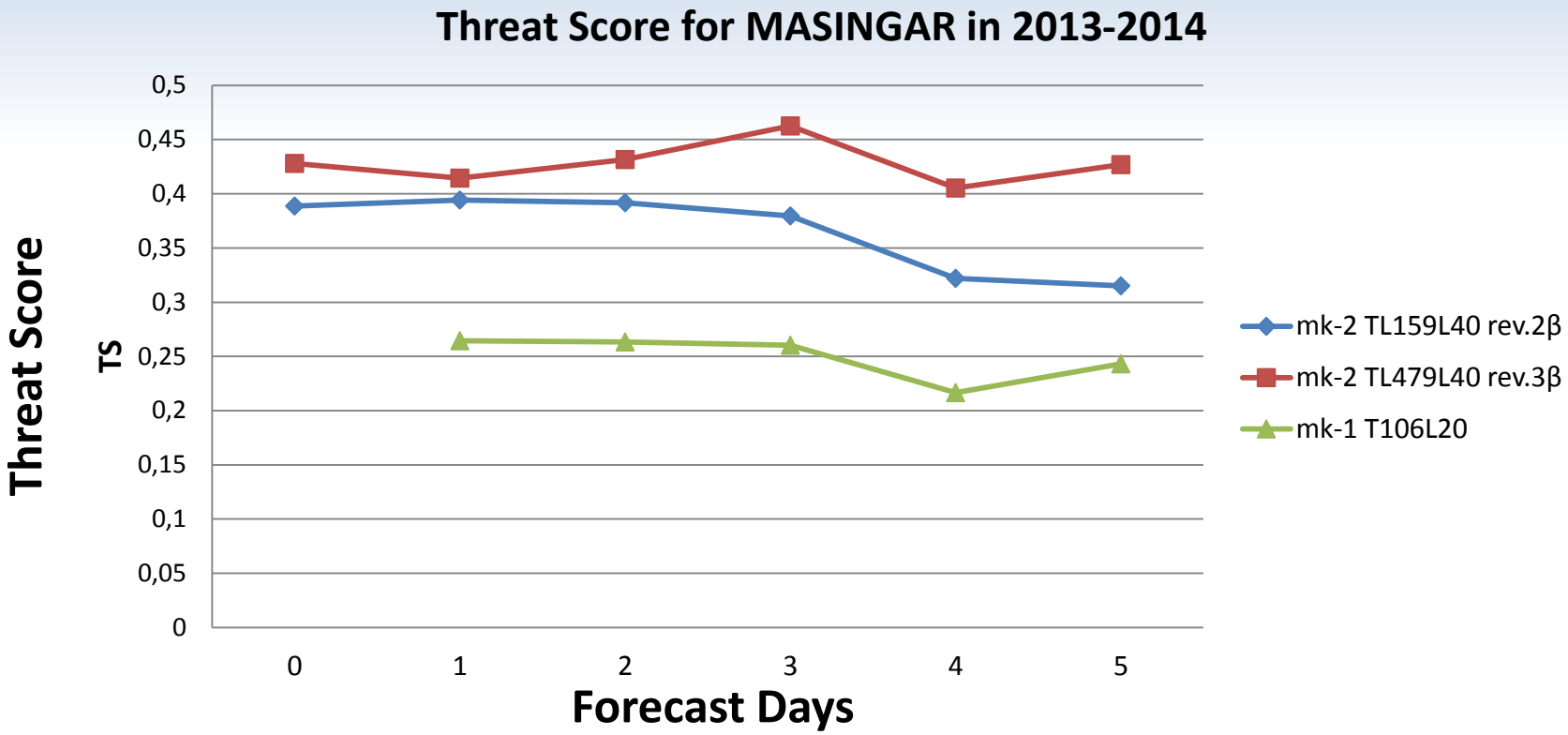


Next hi-res version (TL479: ~40km)



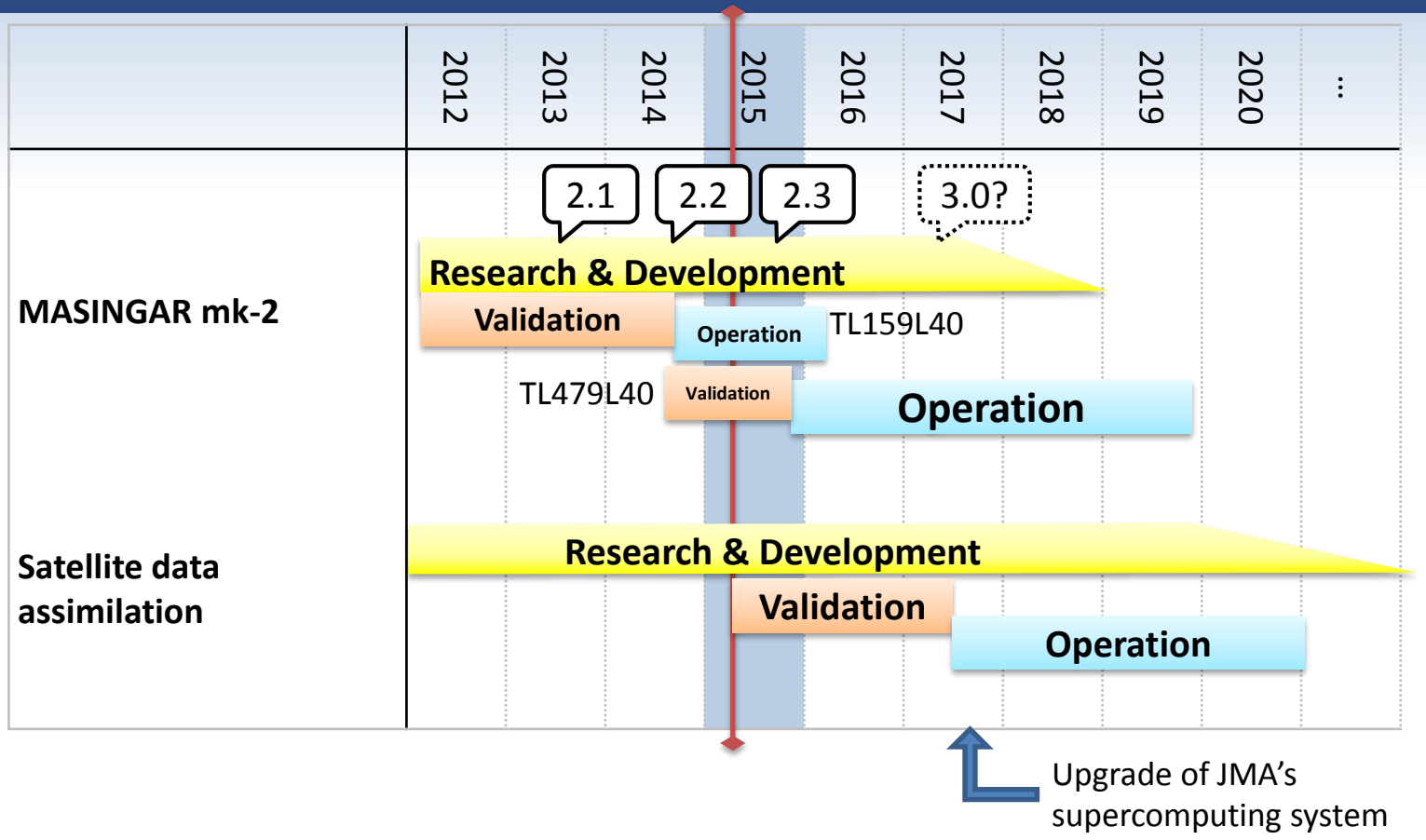
(Under development)

Validation of the new aerosol model



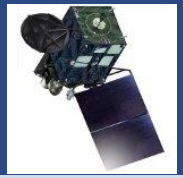
- Preliminary result of the threat score of Asian dust prediction over Japan.
  - Improvements of the TS in forecast over 3 days.

Plans of the global aerosol prediction

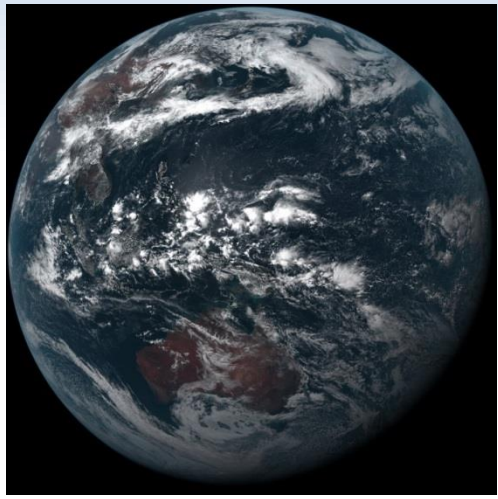


- 2014 Update to new version of aerosol model: (Horizontal TL159 (about 1.125°)
- 2015 Horizontal resolution will be increased to TL479 (about 0.375°).

Updates of Himawari-8



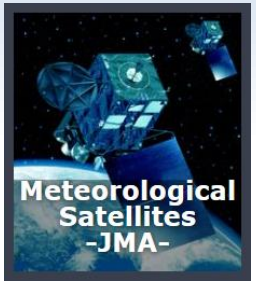
- JMA's new geostationary satellite Himawari-8 is scheduled to start operation on **7 July 2015**.
- JMA Meteorological Satellite Center (MSC) and JAXA/EORC is developing aerosol products.
  - Product of MSC is targeted for Asian dust only.



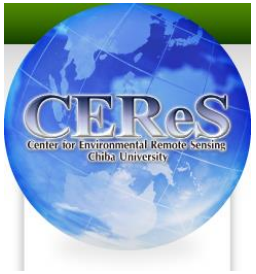
RGB composite image by Himawari-8, 10 Jun. 2015.

- Details of the status of Himawari-8 can be found at presentation at 2015 NOAA Satellite Conference
  - http://satelliteconferences.noaa.gov/2015/doc/presentation/1.6_NSC2015_Session_1.6_Kurino_final.pptx (327MB)

Information of Himawari-8 images



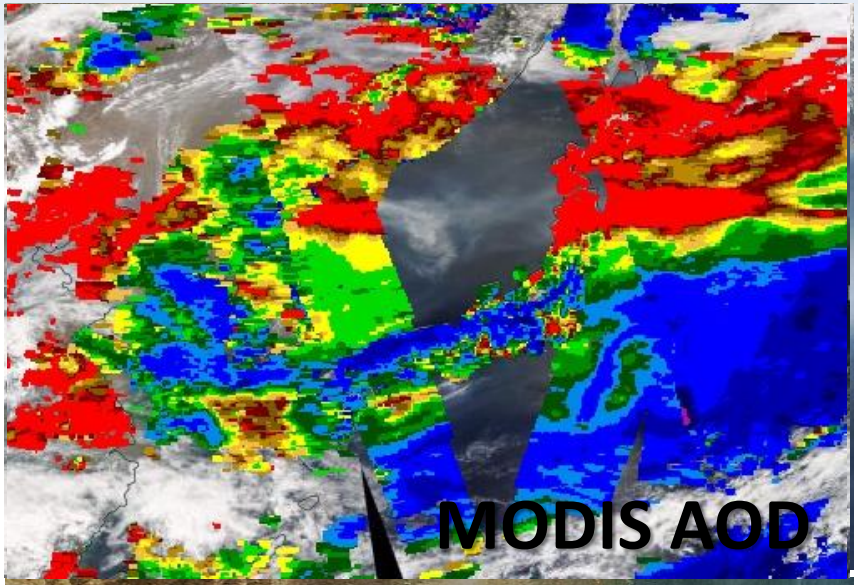
- A gallery webpage of Himawari-8 images is provided: http://www.jma.go.jp/jma/jma-eng/satellite/news/himawari89/20150501_himawari8_sample_data.html
  - [Sample of Asian dust movie]



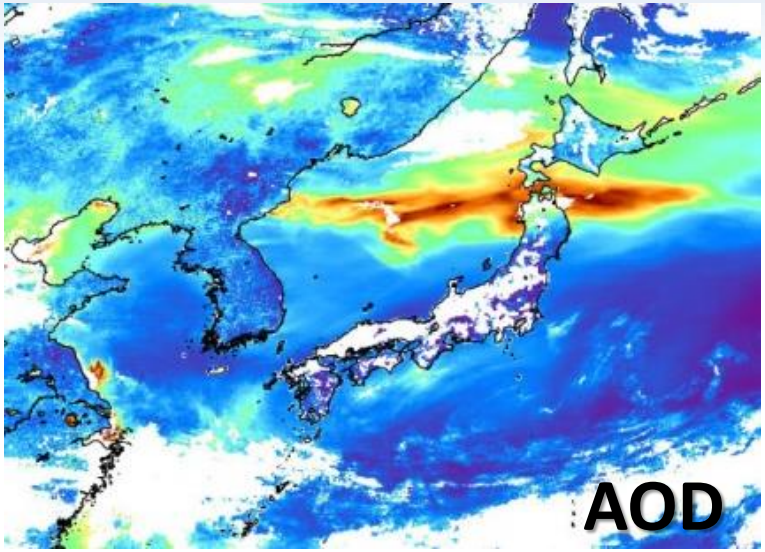
- Himawari-8 Rapid scan movie of aerosol over Sea of Japan in April, 2015 (by CEReS, Chiba university; NICT JMA HIMAWARI Visualization Team)
  - http://www.youtube.com/watch?v=dlWFohwcMU8 - [movie]

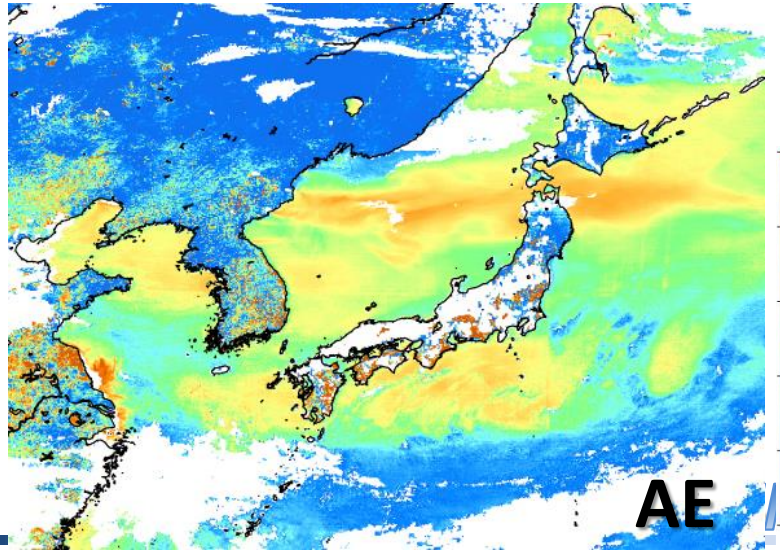
Smoke from fires in North Korea

MODIS image (by NASA, 27 Apr. 2015)



Experimental Himawari-8 retrieval product by JAXA/EORC





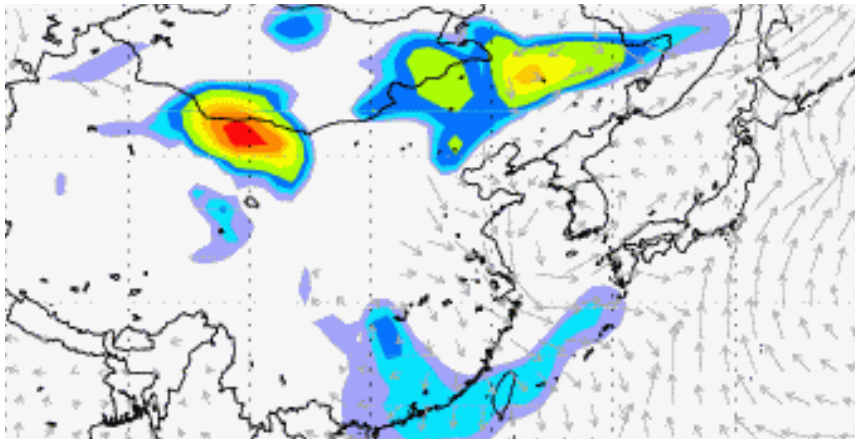
http://earthobservatory.nasa.gov/IOTD/view.php?id=8578

https://earthdata.nasa.gov/labs/worldview

Himawari-8 product for Asian dust detection (Color image using EUMETSAT algorithm)

JMA Asian dust Prediction

Currently, we are testing the RGB composite image based on the **EUMETSAT MSG dust product** for Asian dust monitoring.

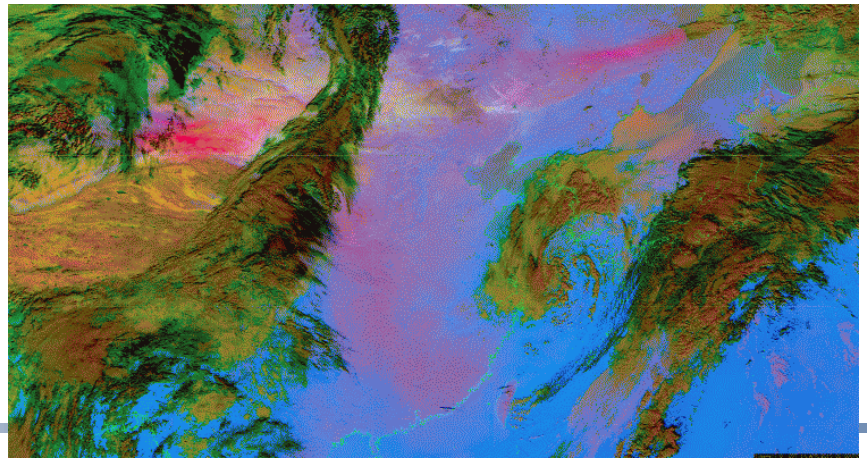


High concentration of dust indicated in pink.

Flow of dust can be seen all day and all night.

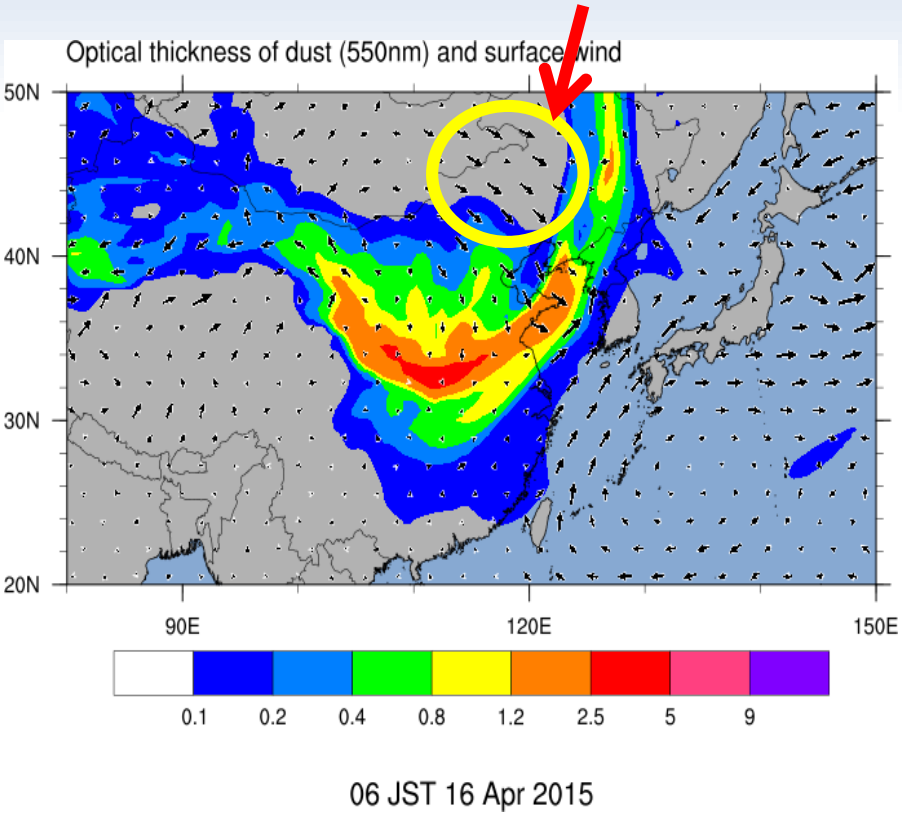
Color image for dust detection

R: 15-13 band
(12.3 - 10.4 mm)
G: 13-11 band
(10.4 - 8.6 mm)
B: 13 band
(10.4 mm)

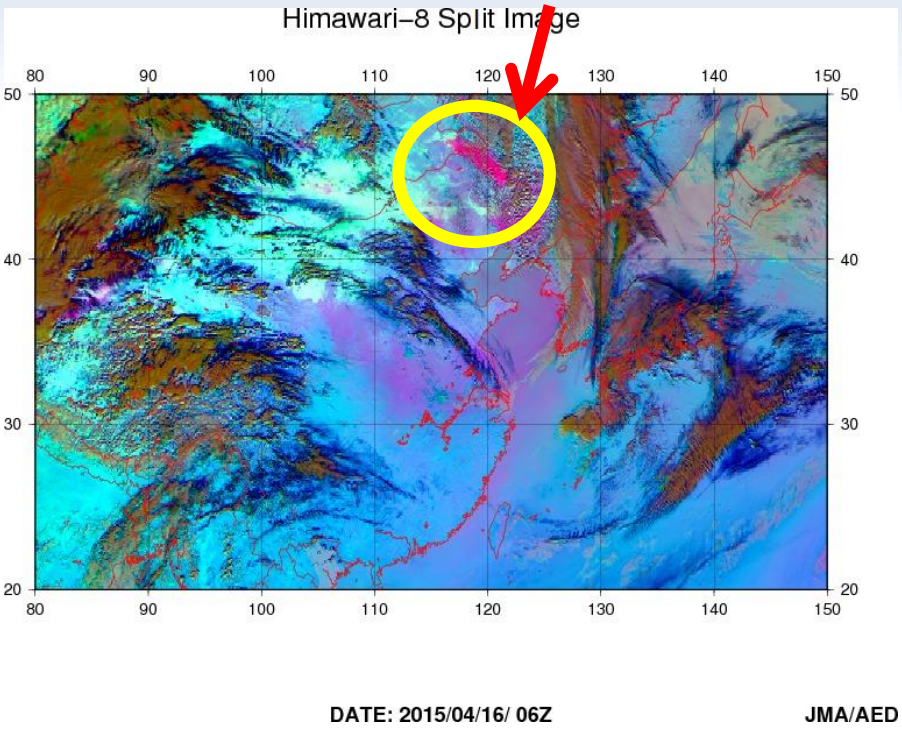


Detecting “Hot spots” of Asian dust emission

No Dust: improvements required.

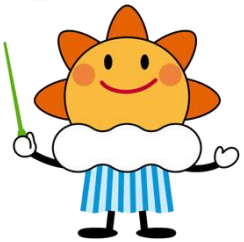


Dust from a hot spot?



Qualitatively, the dust over China is in good agreement. In this event, however, our model failed to capture the dust from the spot in the eastern Mongolia.

Other news: SDS-WAS Asia WGNE aerosol exercise



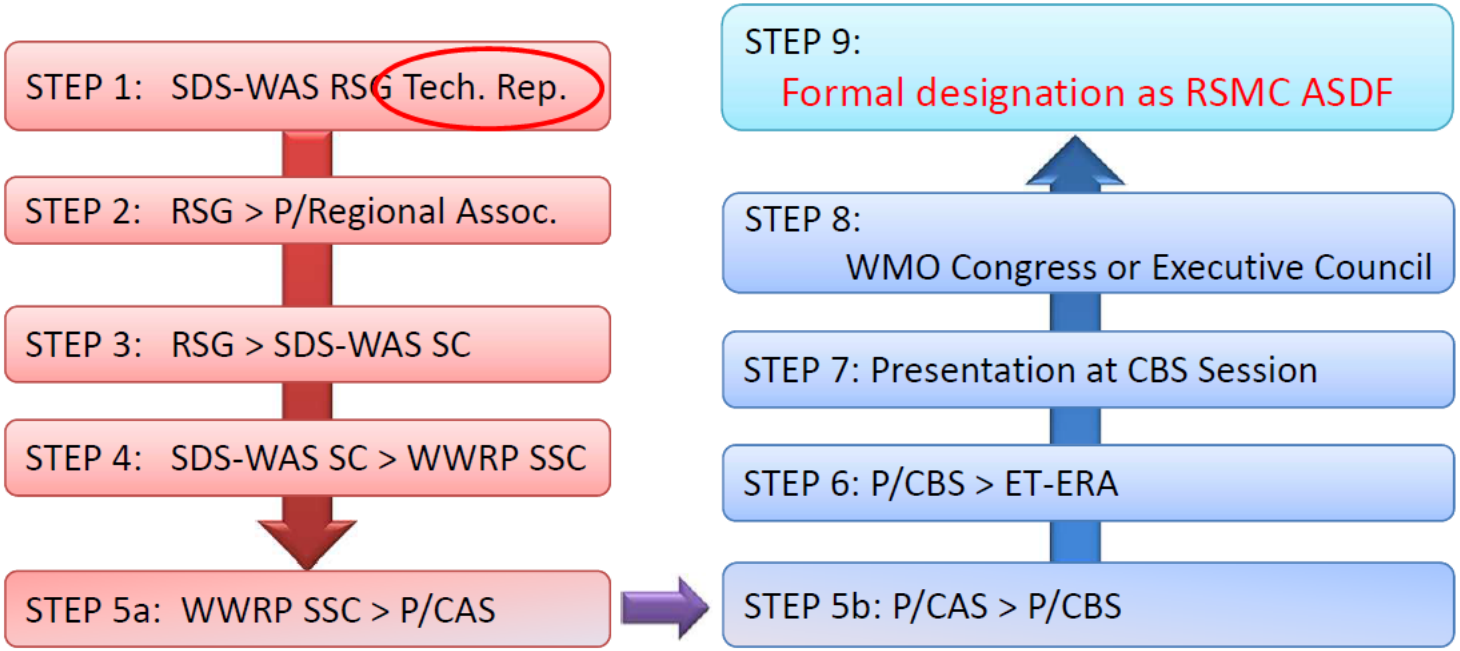
News on SDS-WAS Asia

- The 4th SDS-WAS Asia meeting was held in Beijing on 10-11 March, 2015.
  - Regional steering group approved that CMA's candidacy to be the WMO Regional Specialized Meteorological Centers with Activity Specialization on Atmospheric Sand and Dust Forecasts (**RSMC-ASDF**).
  - The draft of Technical report of SDS-WAS Asia was presented by CMA.
  - CMA opened the SDS-WAS Asia node portal website. http://eng.weather.gov.cn/dust/
- Dust model intercomparison among member agencies was planned (and is in preparation).

SDS-WAS Asia Beijing meeting (Mar 2015)

Designation Process of RSMC ASDF

- Section 7 of SDS-WAS Science Implementation Plan -



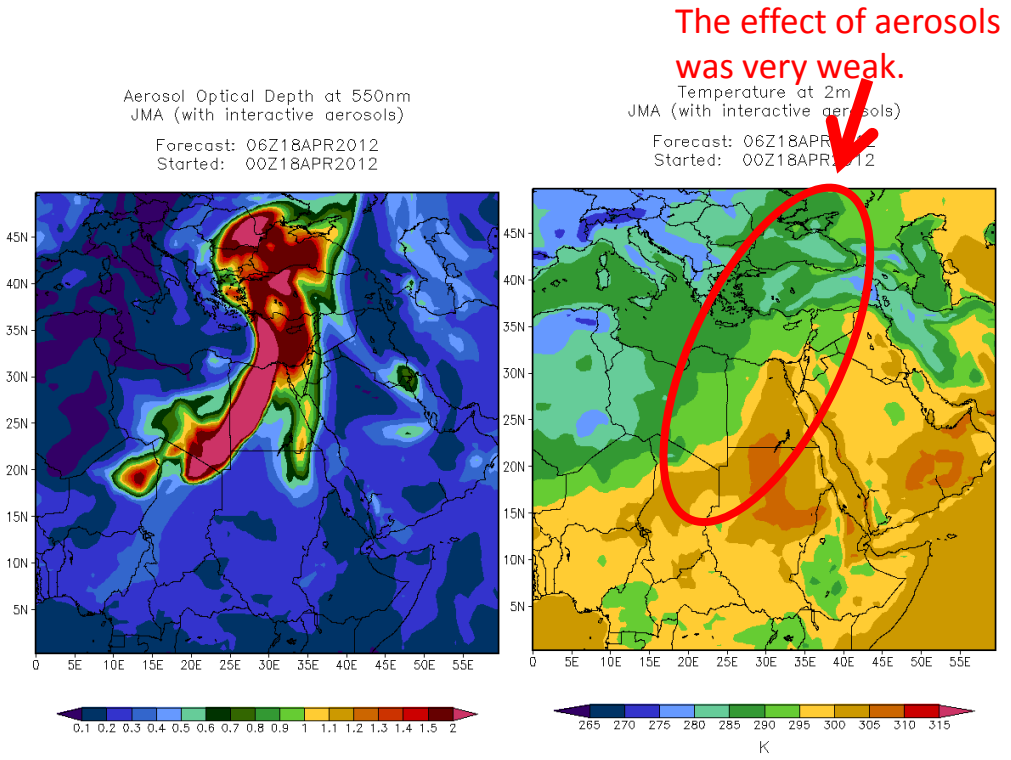
- **Technical Report**
  - to outline the institution's operational capabilities
  - to demonstrate the quality of dust forecasts for operations
    - Model evaluation and inter-comparison studies by the SDS-WAS regional node shall be described in detail.

2015. 3. 10 Beijing Meeting

(M. Mikami)

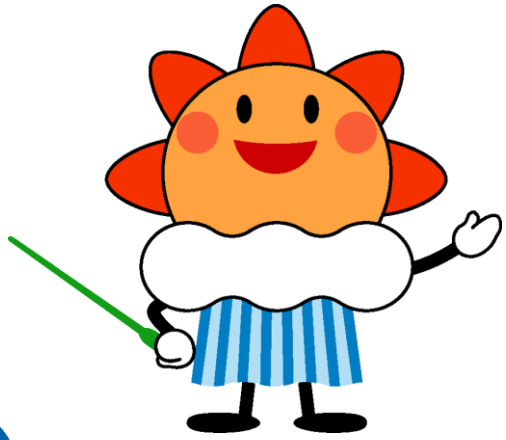
WGNE aerosol exercise

- **Bad news**: MRI-AGCM3's had serious bug in the treatment of aerosols and clouds, which caused underestimation of the radiative effect of aerosols.
  - We are now preparing to redo the forecast experiments, and hope to resubmit by the end of July.



Figures are taken from http://meioambiente.cptec.inpe.br/wgne-aerosols/

Thank you for your attention.



Thanks to:

- *JAXA Earth Observation Research Center*
- *Atmospheric Environment and Applied Meteorology Research Division, MRI, JMA*
- *Atmospheric Environment Division, Global Environment and Marine Department , JMA*
- *Meteorological Satellite Center, JMA*

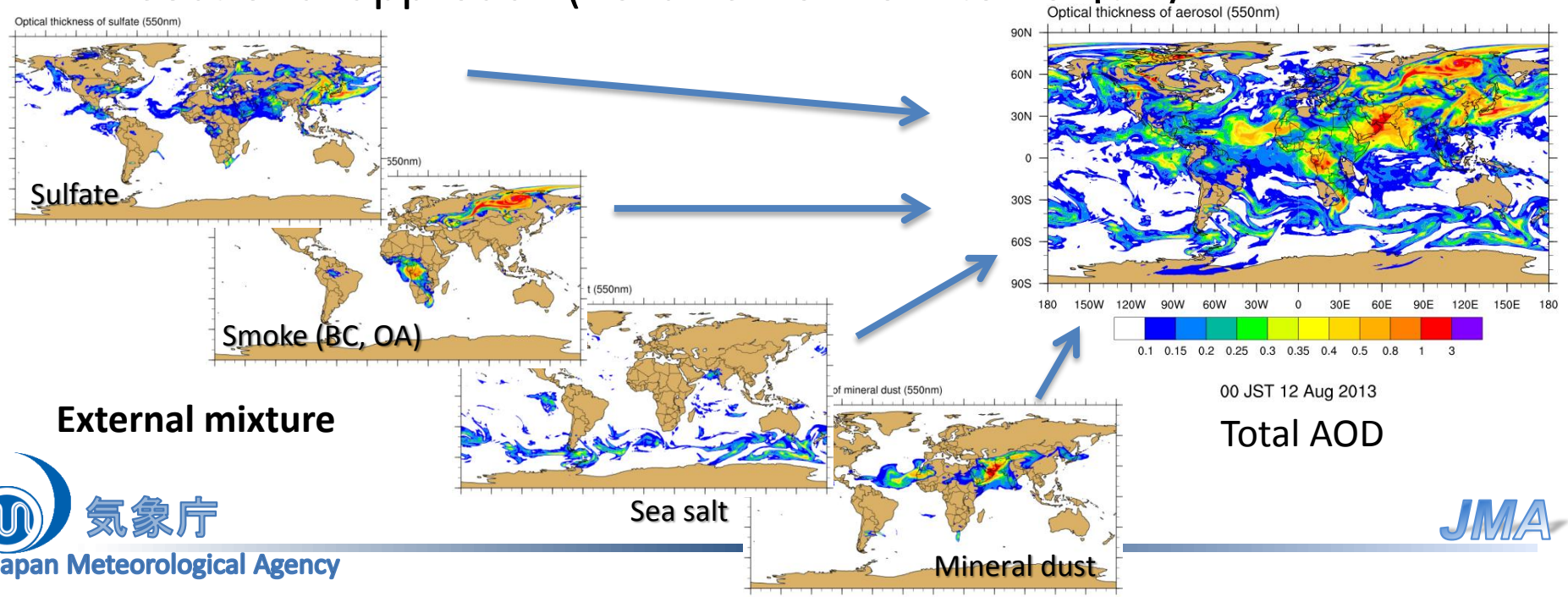
Supported by

- *Post K computer project*

Global aerosol model MASINGAR mk-2

(Model of Aerosol Species in the Global Atmosphere)

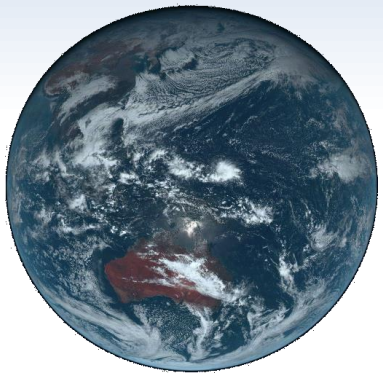
- Sulfate, black carbon, organics, sea salt, and mineral dust are included
  - The emission flux of sea-salt, mineral dust, and dimethylsulfide are predicted based on the surface properties calculated by the atmospheric model.
  - Particle size distributions of sea salt and dust are expressed by sectional approach (10-bins from 0.2 to 20 μm)



Advantages of Himawari-8/9 Imager (AHI) for dust detection

MTSAT-1R/2 → VIS: 1km, IR: 4km

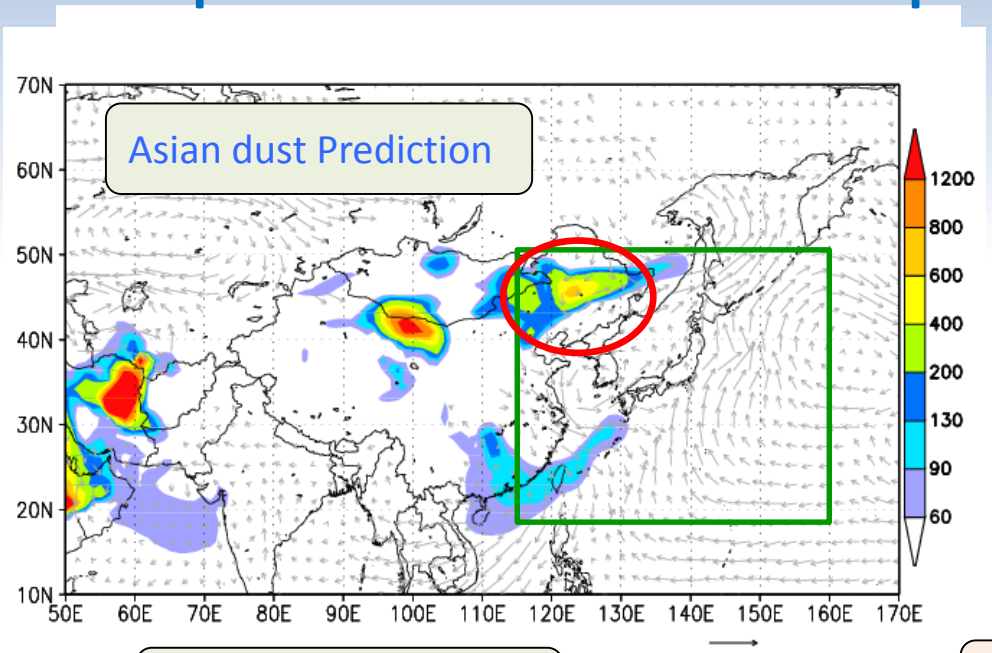
	Band	Center Wavelength [μm]	Spatial Resolution	
VIS	1	0.46	1Km	RGB band Composited
	2	0.51	1Km	
	3	0.64	0.5Km	
	4	0.86	1Km	NIR
	5	1.6	2Km	
	6	2.3	2Km	
IR4	7	3.9	2Km	
IR3	8	6.2	2Km	Water vapor
	9	7.0	2Km	
	10	7.3	2Km	
	11	8.6	2Km	SO_2
	12	9.6	2Km	O_3
IR1	13	10.4	2Km	Atmospheric Windows
	14	11.2	2Km	
IR2	15	12.3	2Km	
	16	13.3	2Km	CO_2



Many channels are useful for dust detection.

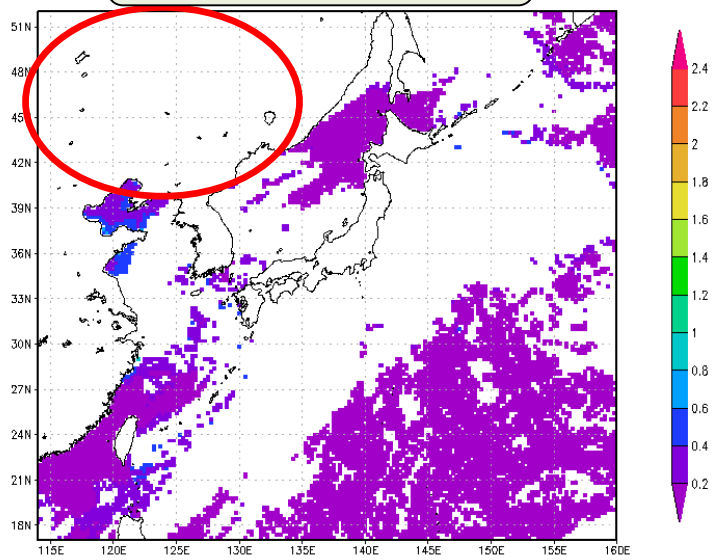
Improve dust detection

Example of Himawari-8 products (AOD)

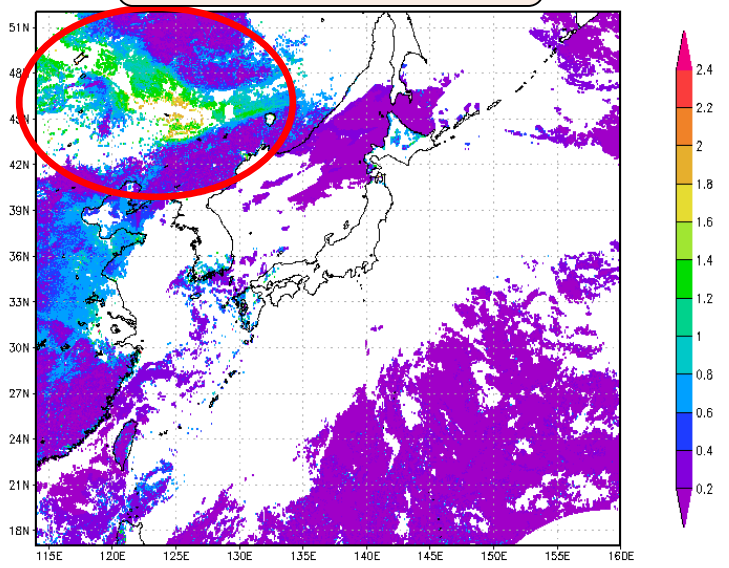


AOD is also calculated over the land at high spatial resolution

MTSAT-2 AOD

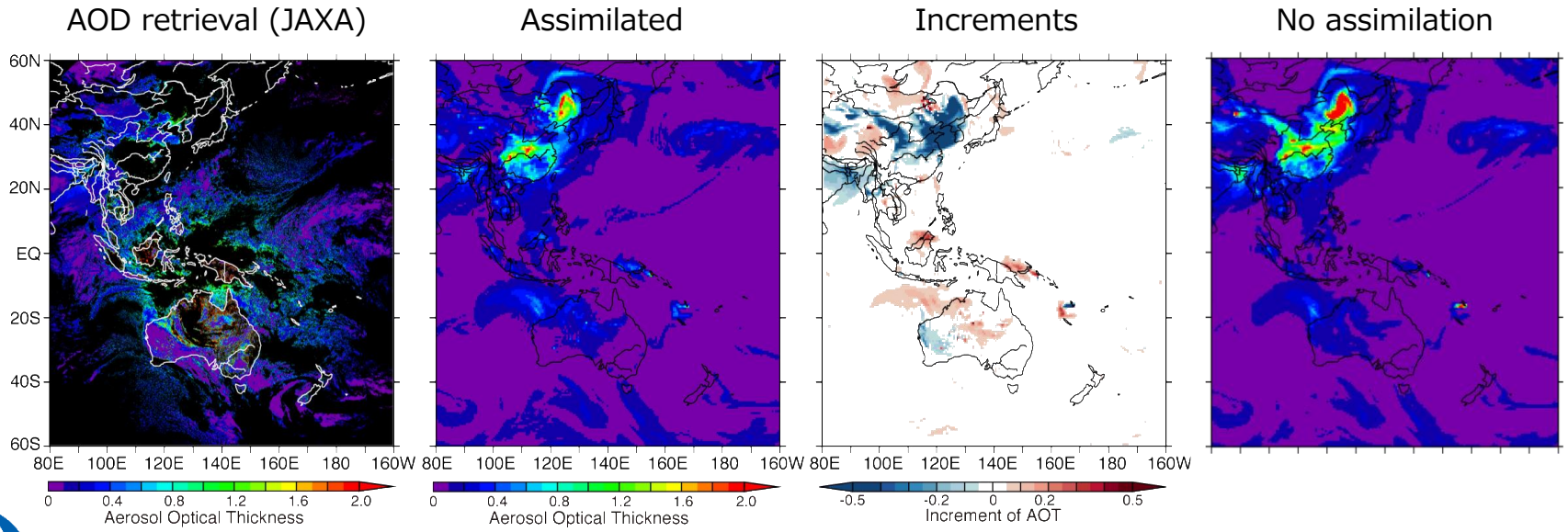


Himawari-8 AOD



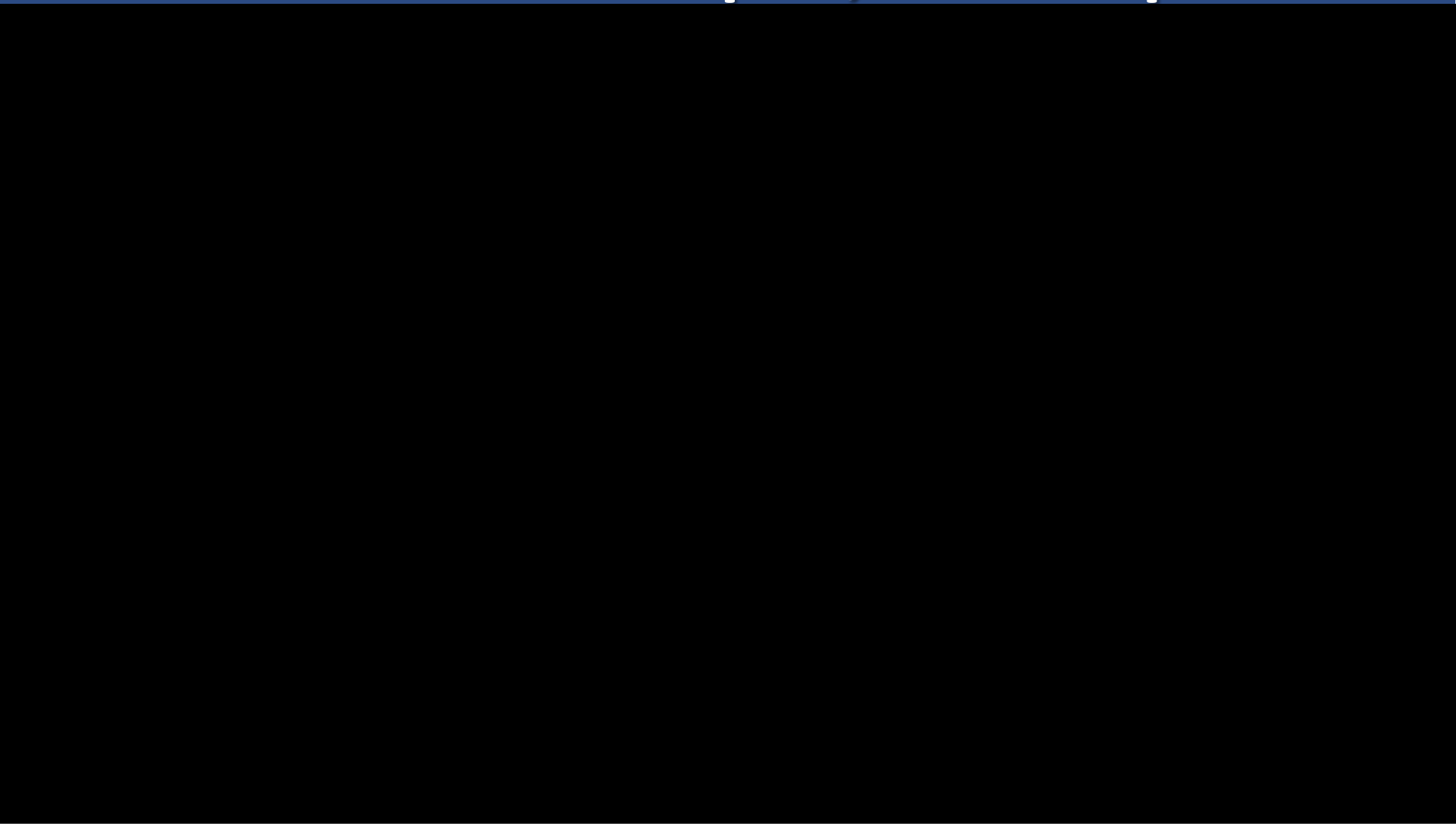
Aerosol data assimilation

- Development of data assimilation system with satellite imagers is under way
  - Currently, NRL MODIS L3 is used
  - Retrieved AOD of Himawari-8 is under experiment



Experiment of DA using Himawari-8 AOD (K. Yumimoto)

Smoke over Sea of Japan, 26-28 April 2015



Movie created by CEReS, Chiba University

https://www.youtube.com/watch?v=dlWFohwcMU8