



Update of the aerosol prediction of the Japan Meteorological Agency: Overview

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12 July 2016



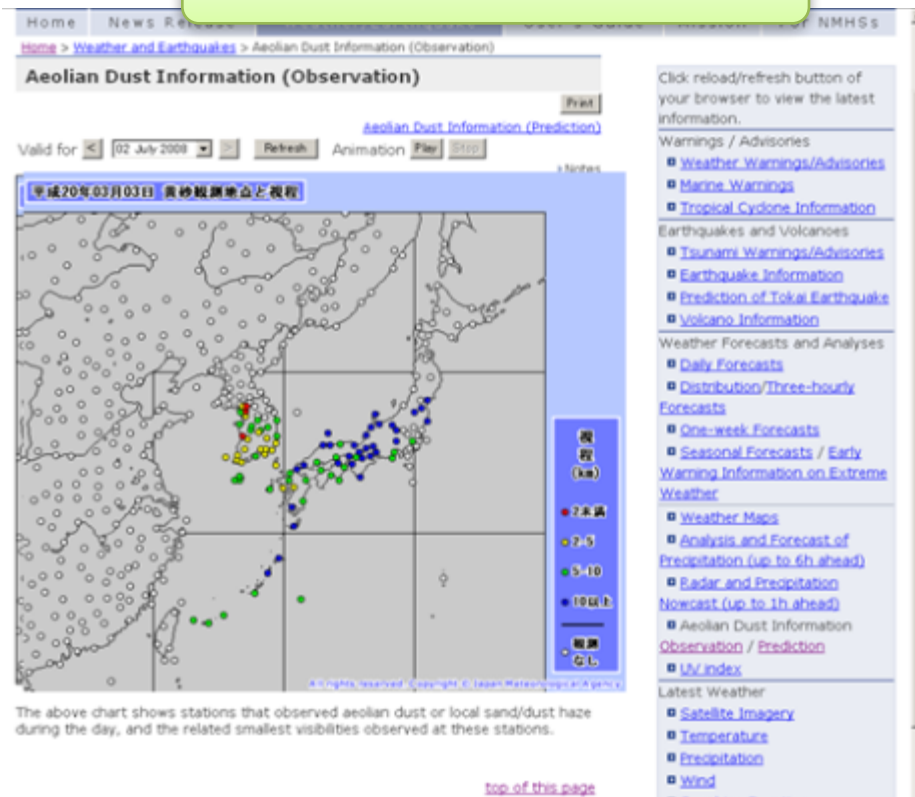
Outline

- Updates of JMA/MRI global aerosol prediction
- Updates of the geostationary satellite Himawari-8
- Topics
 - Recent aerosol episodes
- Updates of aerosol data assimilation
- Forecast verification will be presented by Akinori Ogi following this overview.
- Data assimilation updates will be presented by Keiya Yumimoto on Third day.

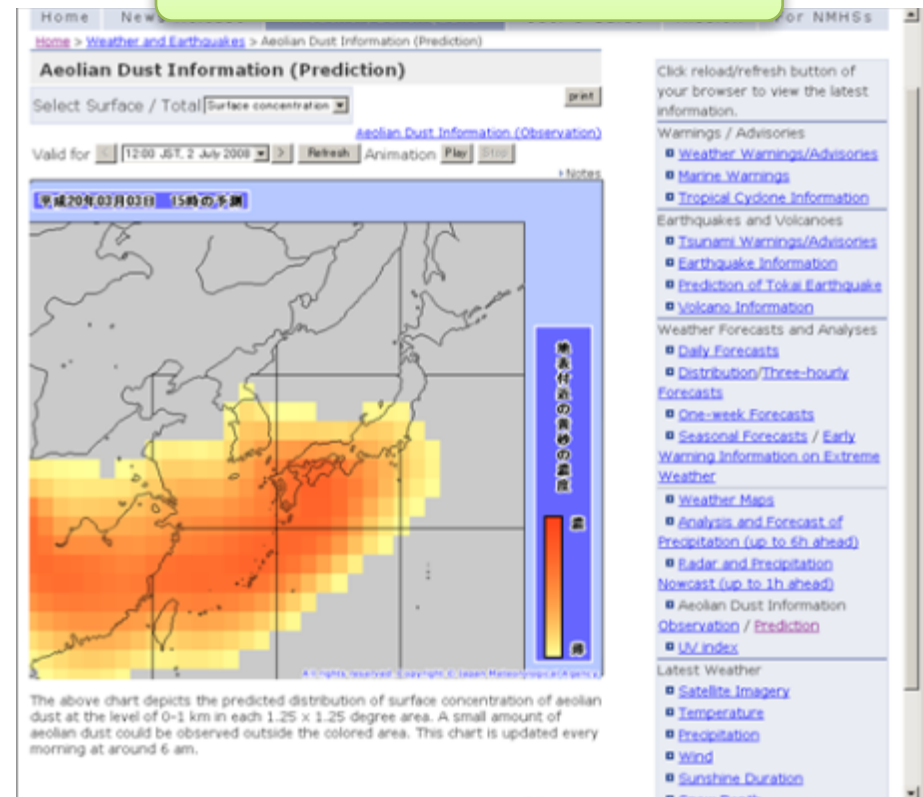
Aeolian dust Information

JMA has been providing Aeolian dust information based on numerical forecasts and observations since January 2004.

Aeolian dust observation



Aeolian dust prediction



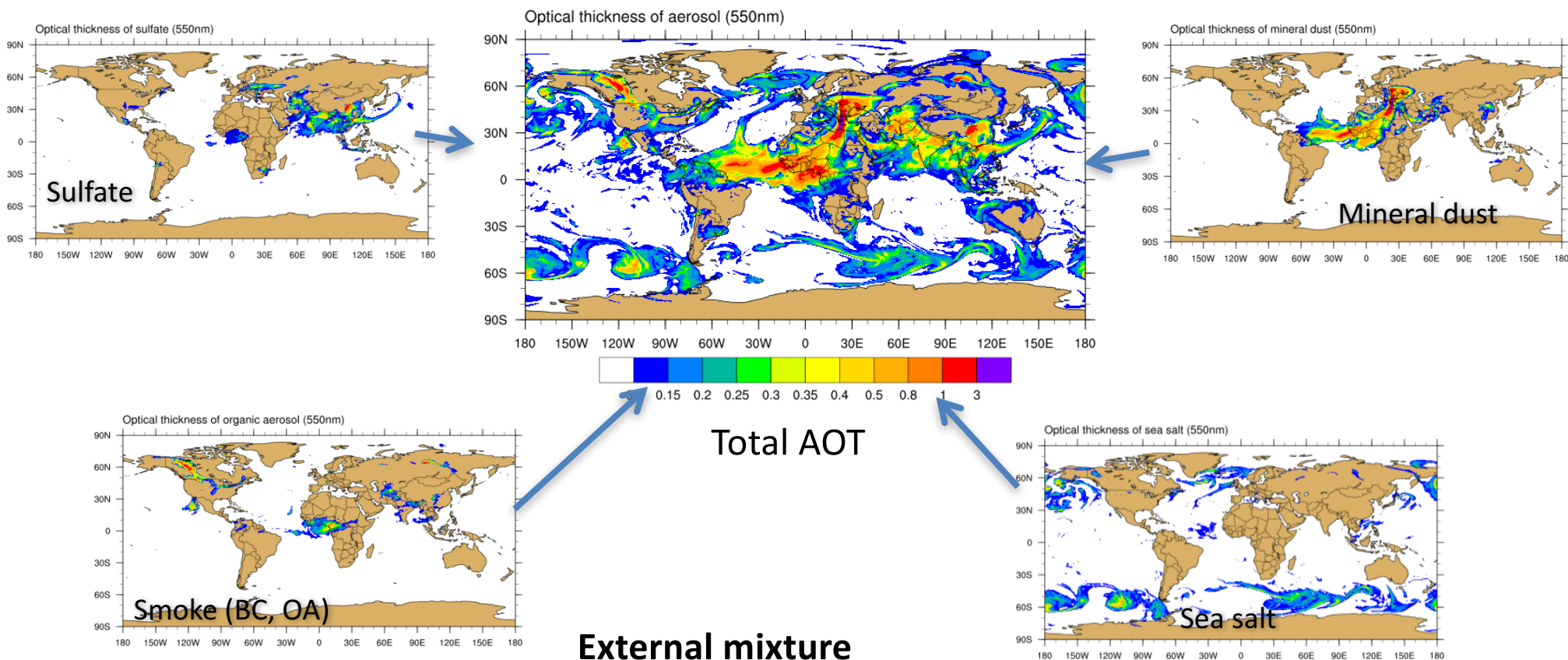
<http://www.jma.go.jp/en/kosa>

Aeolian dust advisory information

JMA also provides aeolian dust prediction results (GPV : GRIB2 format) for private weather services via the Japan Meteorological Business Support Center (JMBSC).

Aeolian dust prediction model (Model of Aerosol Species in the Global Atmosphere: MASINGAR)

- 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)



Updates of JMA/MRI aerosol NRT forecast

From Feb 1, 2016:

- Global aerosol model update: from MASINGAR mk-2 rev.2 to **MASINGAR mk-2 rev.3**.
 - Hygroscopicity of sea salt is revised.
 - Revised dust emission factor.
 - Revised SOA from the ocean: Methanesulfonic acid is treated as SOA.
 - Many bug fixes, clean-up of codes, etc.

From 19 Apr., 2016:

- Nudging dataset for AGCM is updated
 - use analyses of surface and upper atmosphere
 - use NWP global forecast.

Updates of the geostationary satellite Himawari-8

7 July 2015:

- Himawari-8 full operation started.

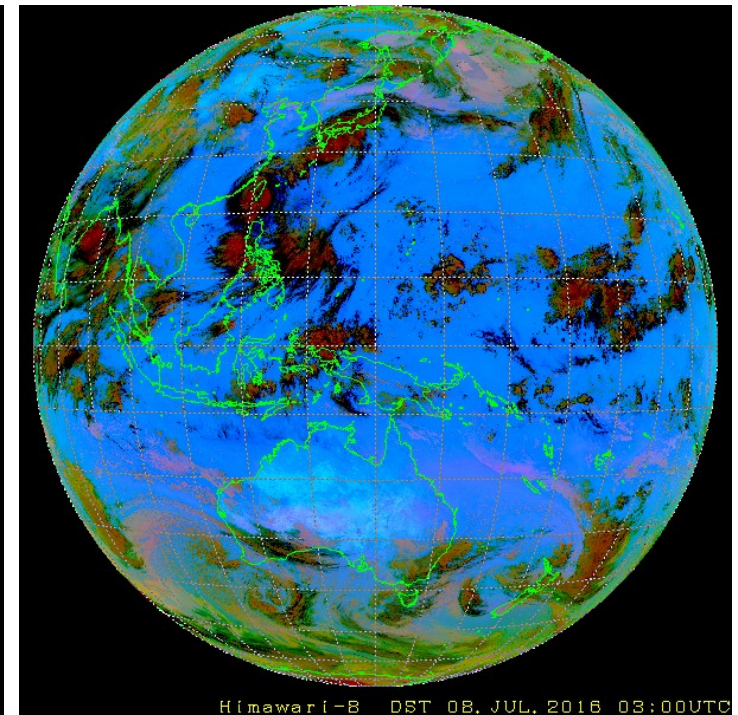
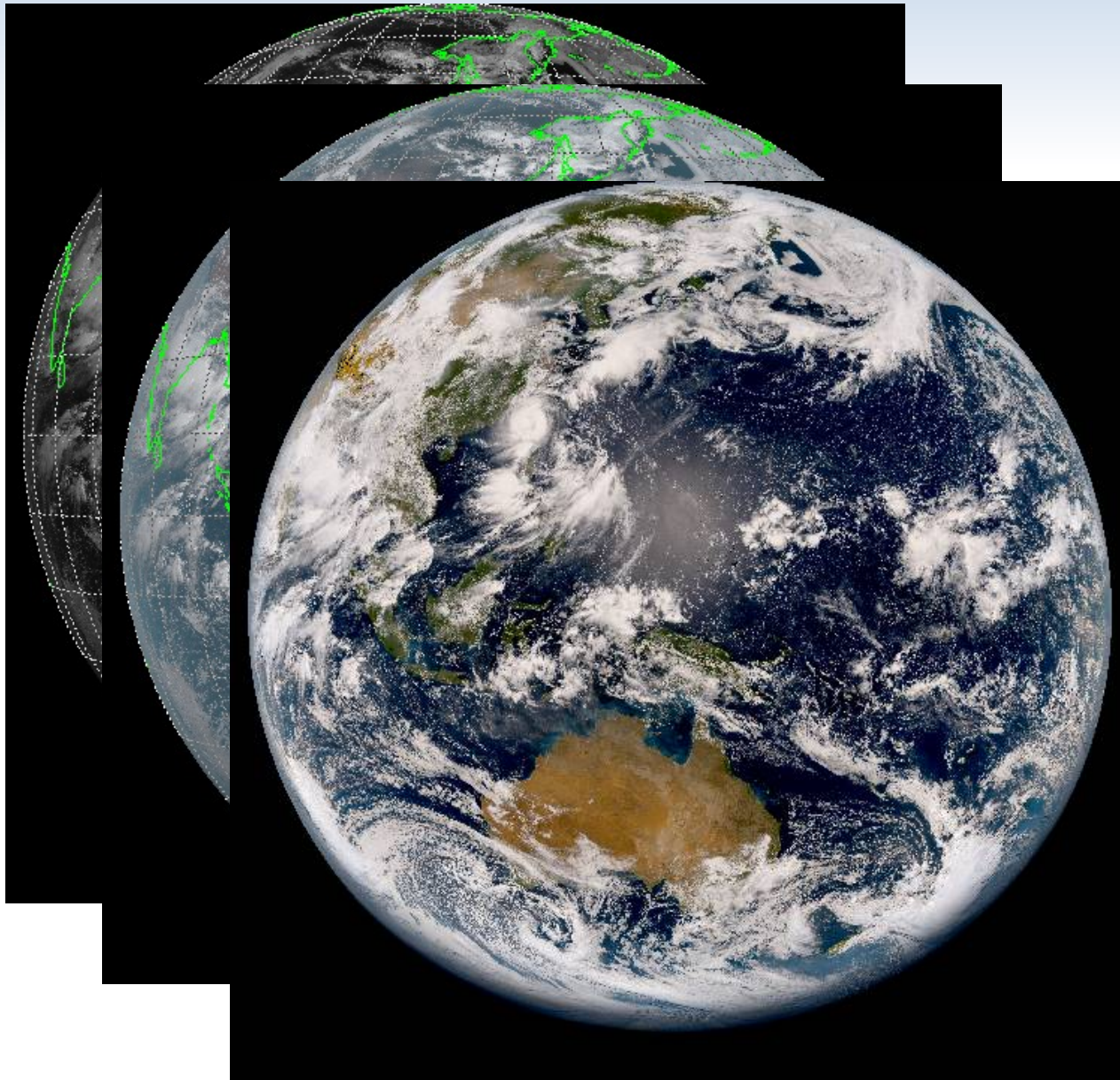
29 Aug 2015:

- JAXA EORC started providing **beta version of aerosol product** at <http://www.eorc.jaxa.jp/ptree/index.html>

10 May 2016:

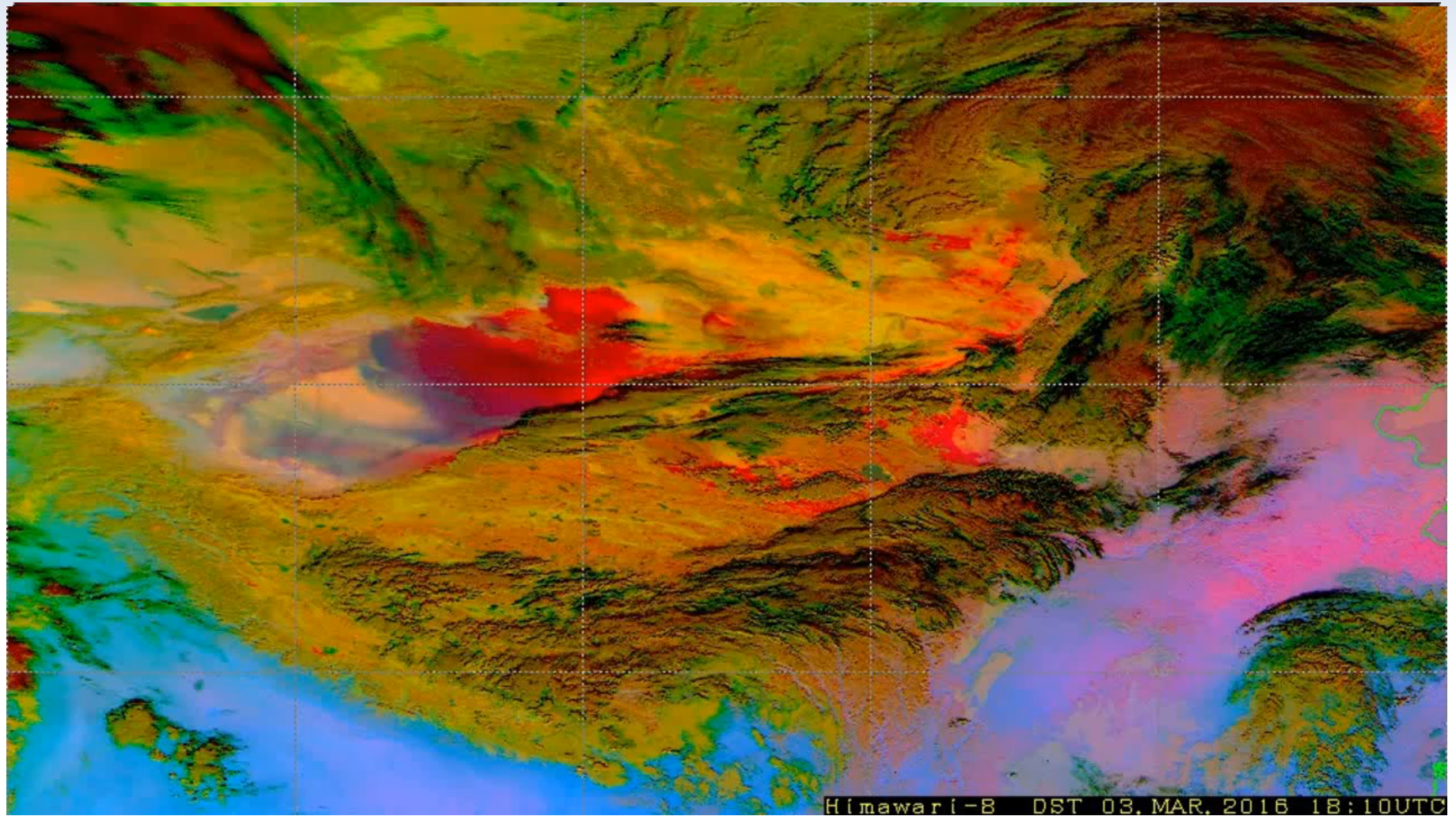
- Meteorological Satellite Center of JMA started providing “**True color reproduction image**”, thanks to Cooperative Institute for Research in the Atmosphere (CIRA) established by NOAA/NESDIS and Colorado State University.
http://www.data.jma.go.jp/mscweb/data/himawari/sat_img.php?area=fd

Himawari-8 Real-Time RGB composite imagery



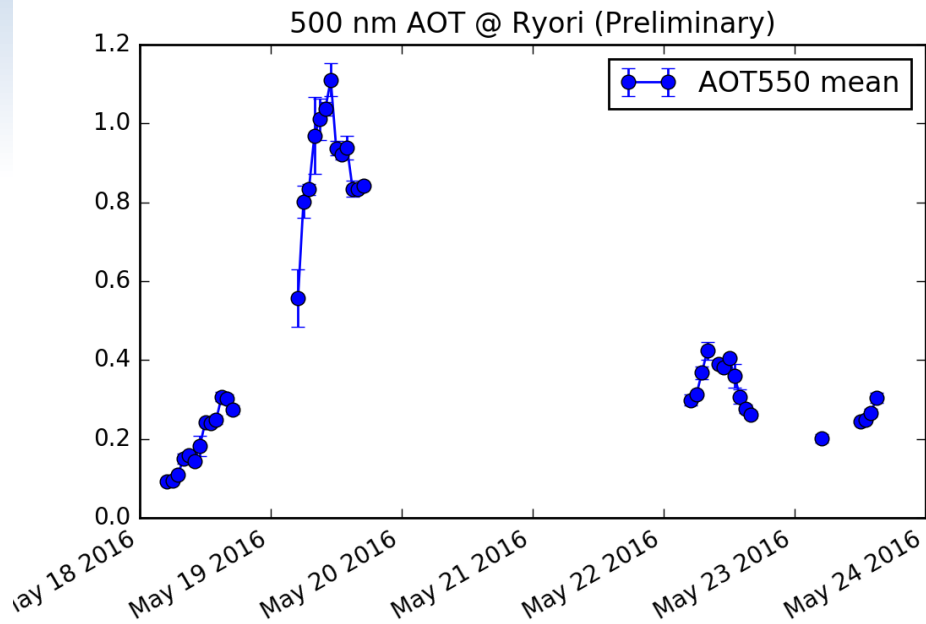
DustRGB

Recent aerosol episode (1): dust storm traveling over Mongolia and China, March 2016 by DustRGB.

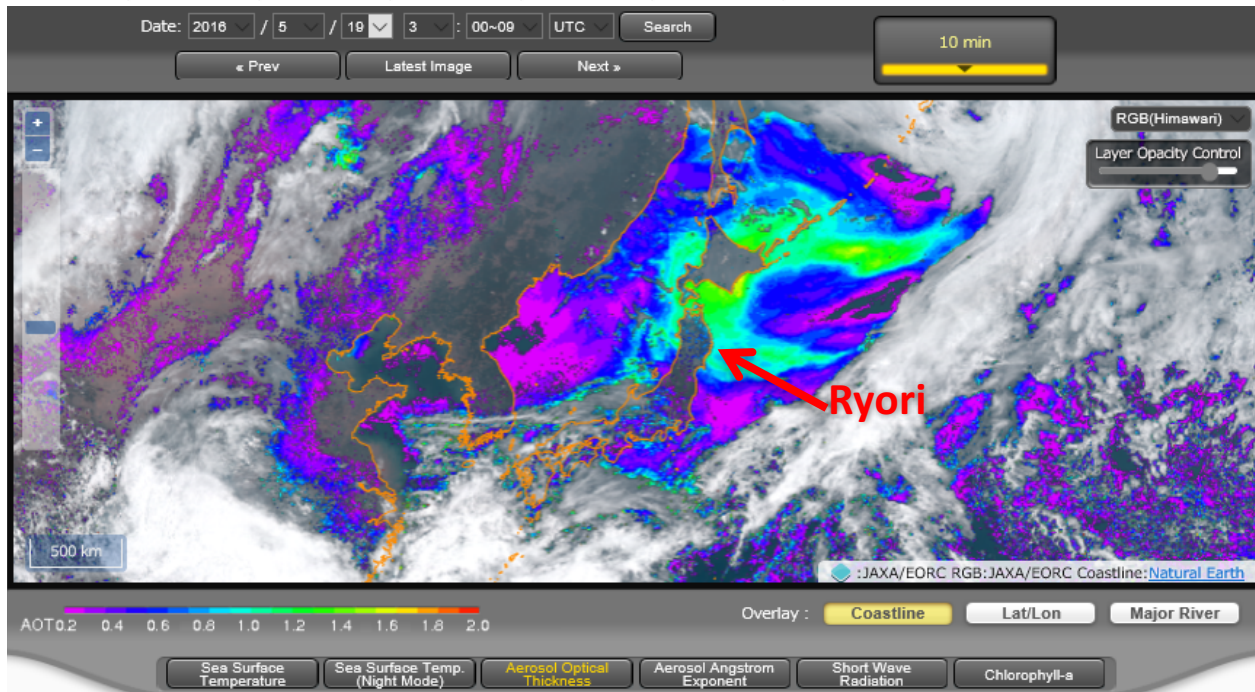


10-minute interval retrievals of DustRGB captured the occurrence of dust storm clearly.

Recent aerosol episode (2): Biomass burning smoke from eastern Russia, May 2016

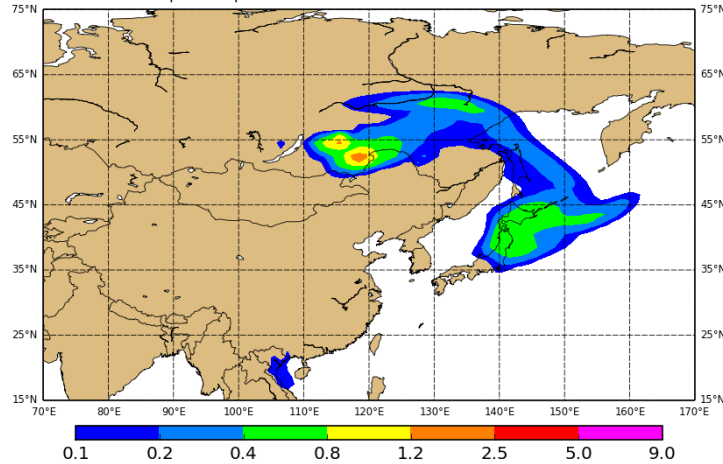


- Smoke from biomass burning in Russia reached northern part of Japan in May 2016.
 - Ground-based radiometers and Himawari-8 JAXA aerosol product clearly captured the AOT of the smoke from Russia.

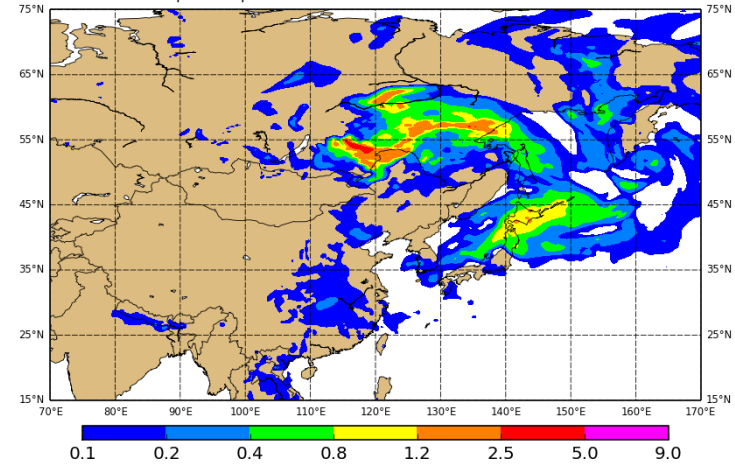


Recent aerosol episode (2): Biomass burning smoke from eastern Russia, May 2016

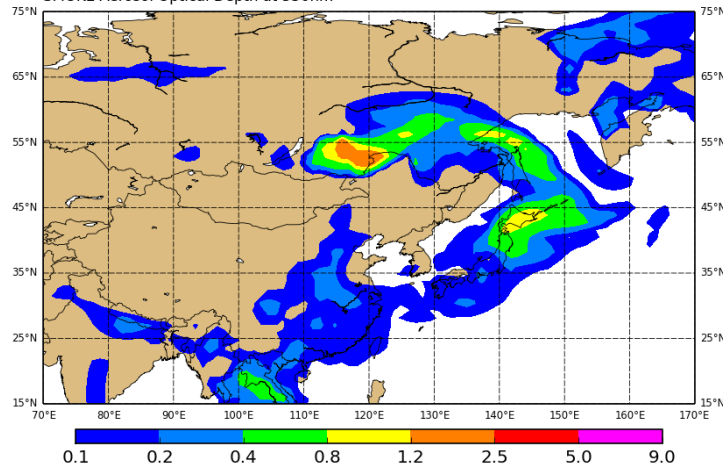
Thursday 19 May 2016 00UTC NAAPS Forecast t+006
Thursday 19 May 2016 06UTC Valid Time
SMOKE Aerosol Optical Depth at 550nm



Thursday 19 May 2016 00UTC GEOS-5 Forecast t+006
Thursday 19 May 2016 06UTC Valid Time
SMOKE Aerosol Optical Depth at 550nm

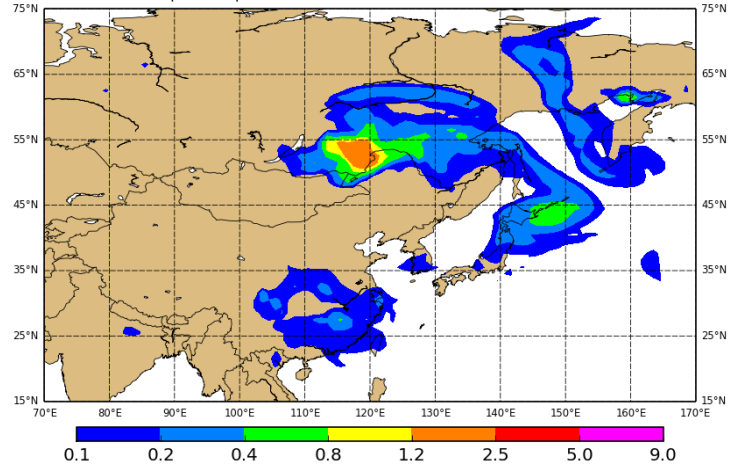


Thursday 19 May 2016 00UTC MACC Forecast t+006
Thursday 19 May 2016 06UTC Valid Time
SMOKE Aerosol Optical Depth at 550nm



Plots Generated Friday 20 May 2016 11UTC NRL/Monterey Aerosol Modeling

Thursday 19 May 2016 00UTC MASINGAR Forecast t+006
Thursday 19 May 2016 06UTC Valid Time
SMOKE Aerosol Optical Depth at 550nm



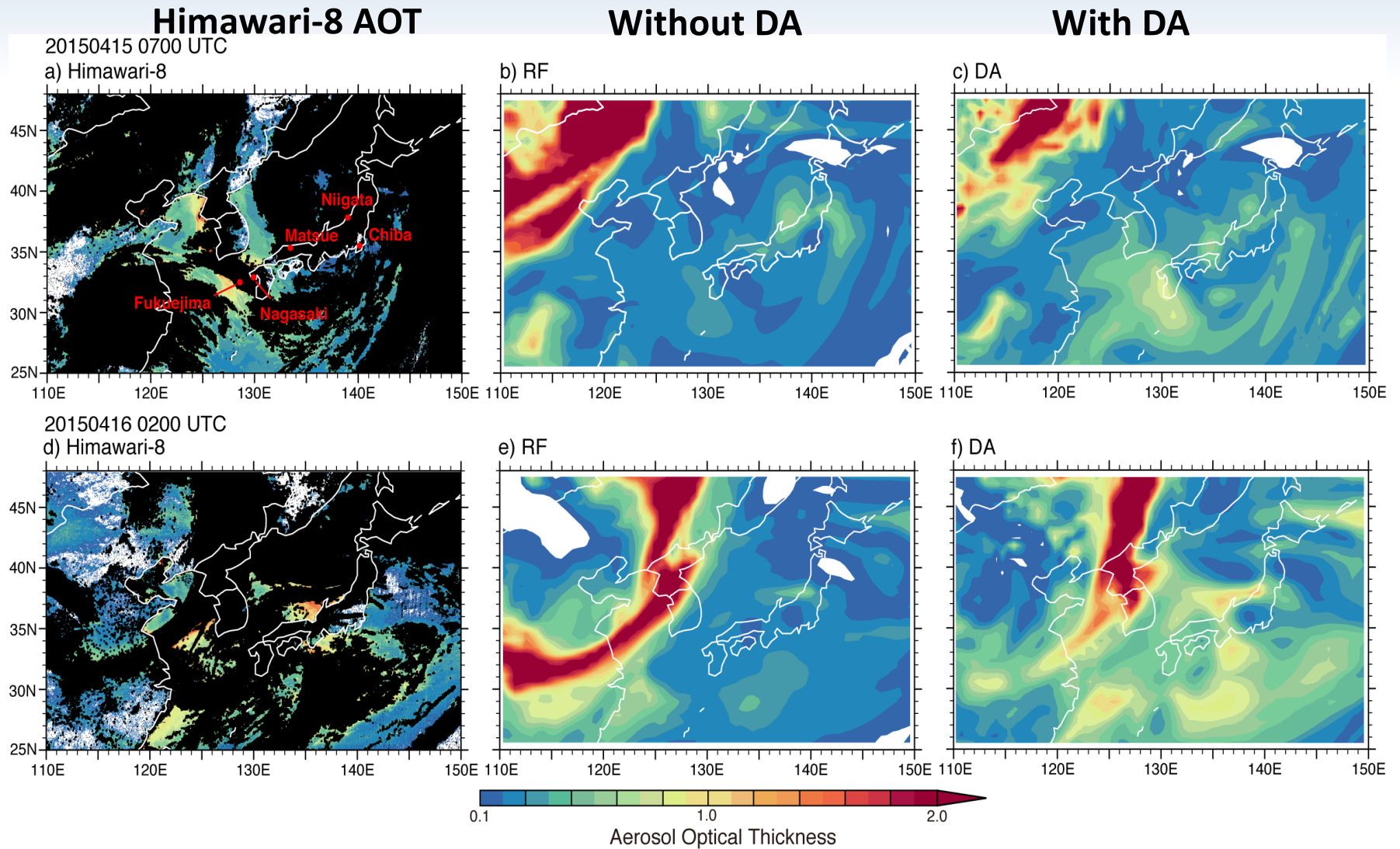
Plots Generated Friday 20 May 2016 11UTC NRL/Monterey Aerosol Modeling

Updates of aerosol data assimilation

Currently, our DA system has two approaches:

- **LETKF** (“Advanced course”)
 - Complex observations can be incorporated (e.g., lidars and imagers)
 - Two research papers of the DA using AOT by Himawari-8 were published ([Sekiyama et al. 2016, SOLA](#); [Yumimoto et al. 2016, GRL](#)).
 - Computationally expensive
 - (Lidar data assimilation experiment is continuing but struggling)
- **2D-VAR** AOT data assimilation (“Fast lane”): **New!**
 - Simplified and computationally reasonable
 - Suitable for high resolution NRT forecast
 - Currently, satellite AOT assimilation only

Data assimilation experiment of AOT with Himawari-8 by JAXA EORC using LETKF



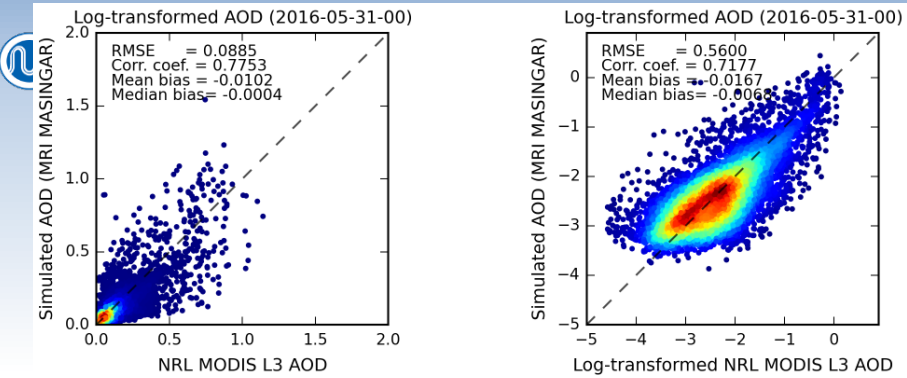
Current quasi-operational aerosol prediction in MRI

Currently, we are conducting 4 quasi-operational NRT prediction streams:

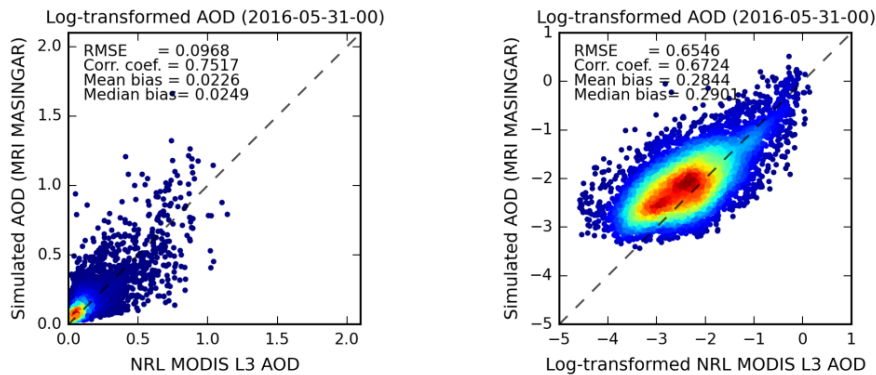
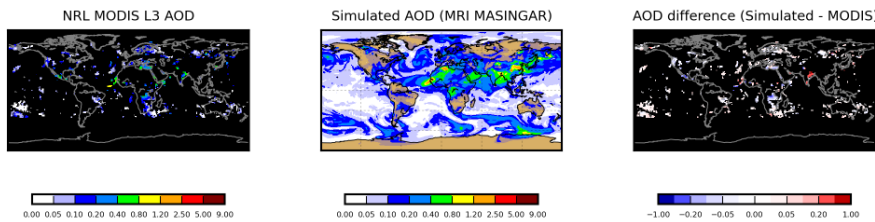
- **Main:** TL319L40 : provided to ICAP
- **High-res. experiment:** TL479L40 (~40 km)
- **DA (MODIS):** TL319L40 + 2D-VAR assimilation with MODIS L3 AOT
- **DA (Himawari-8):** TL319L40 + 2D-VAR assimilation with Himawari-8 AOT

Evaluation of the prediction

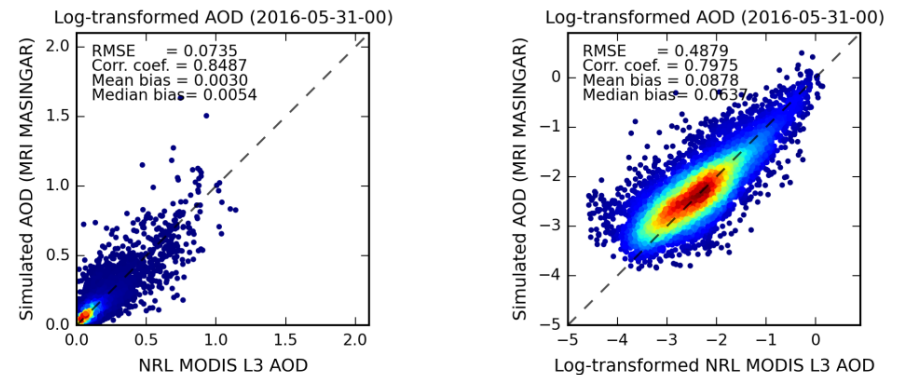
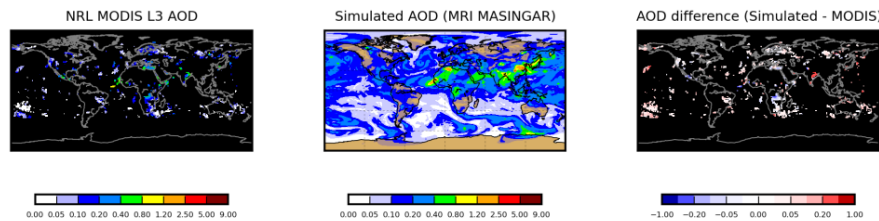
- Automatic generation of validation plots
- Evaluation of prediction against
 - MODIS AOT
 - Ground based radiometer (work in progress)
 - Surface concentrations (work in progress)



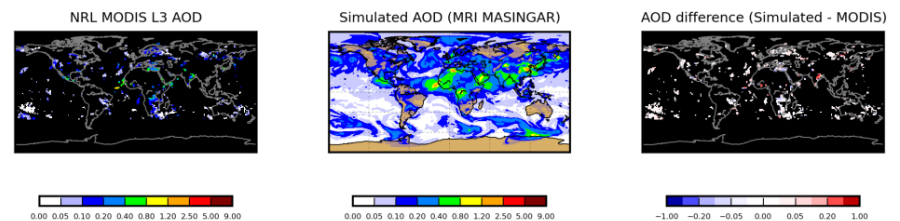
Main



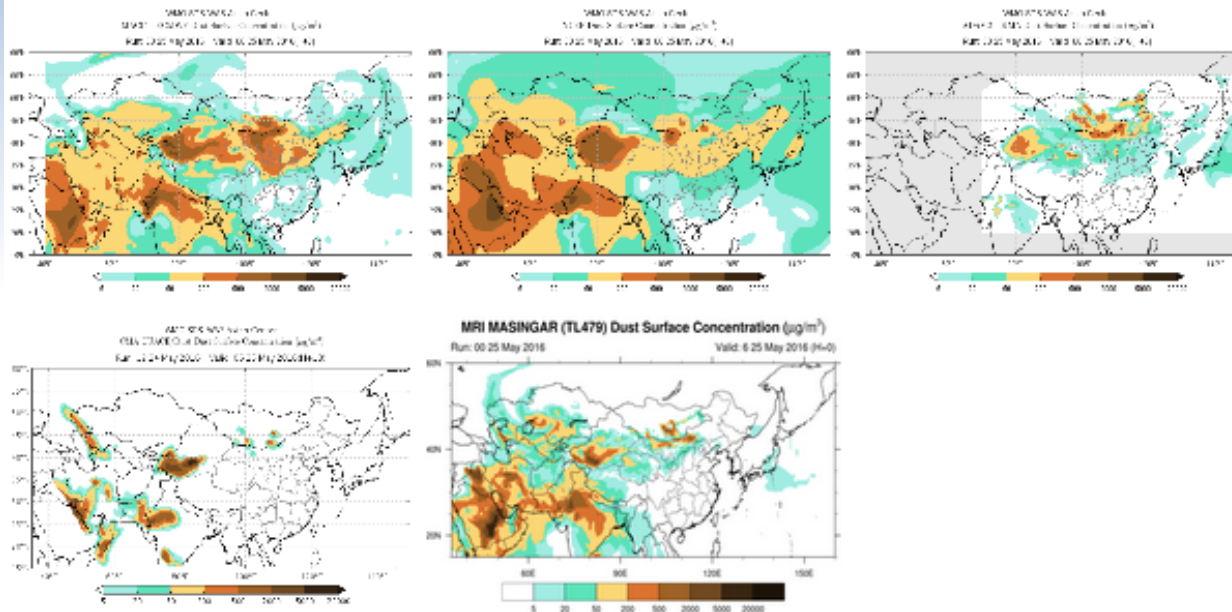
Himawari-8 DA



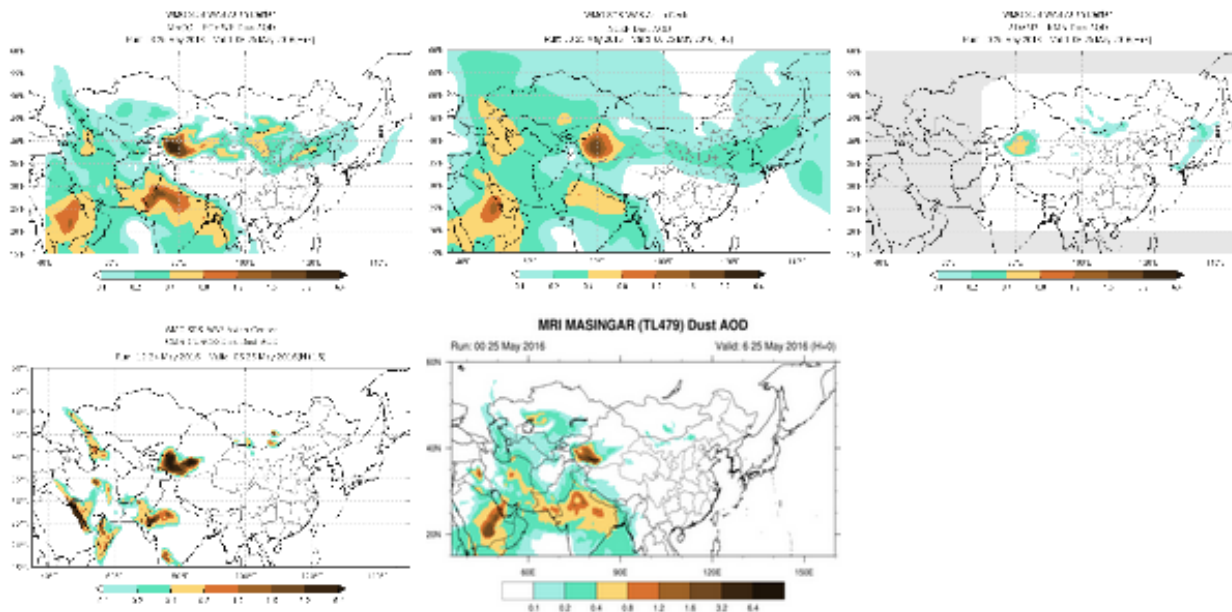
MODIS-DA



Surface dust concentration



Dust aerosol optical depth



Internal comparisons with SDS-WAS models

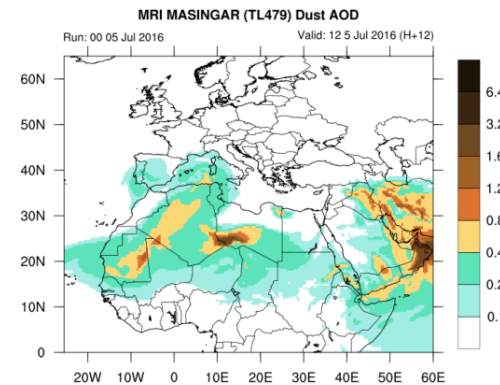
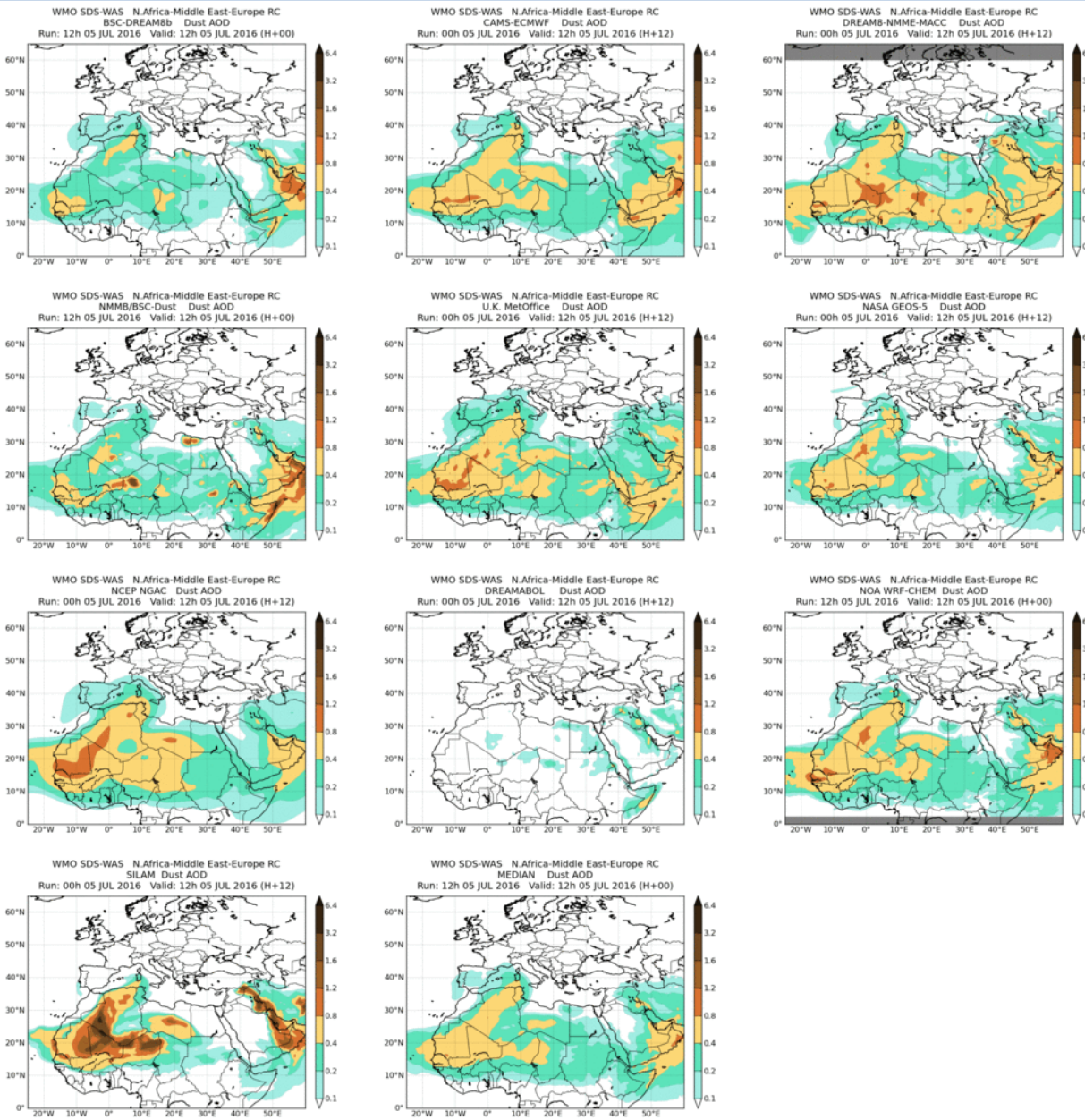
Daily comparison with SDS-WAS models is conducted internally.



Dust AOT @ 550nm

Internal comparisons with SDS-WAS models

Daily comparison with SDS-WAS models is conducted internally.

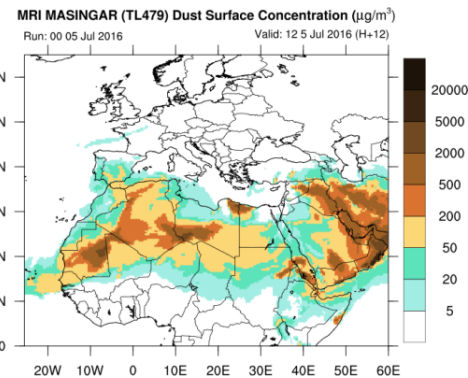
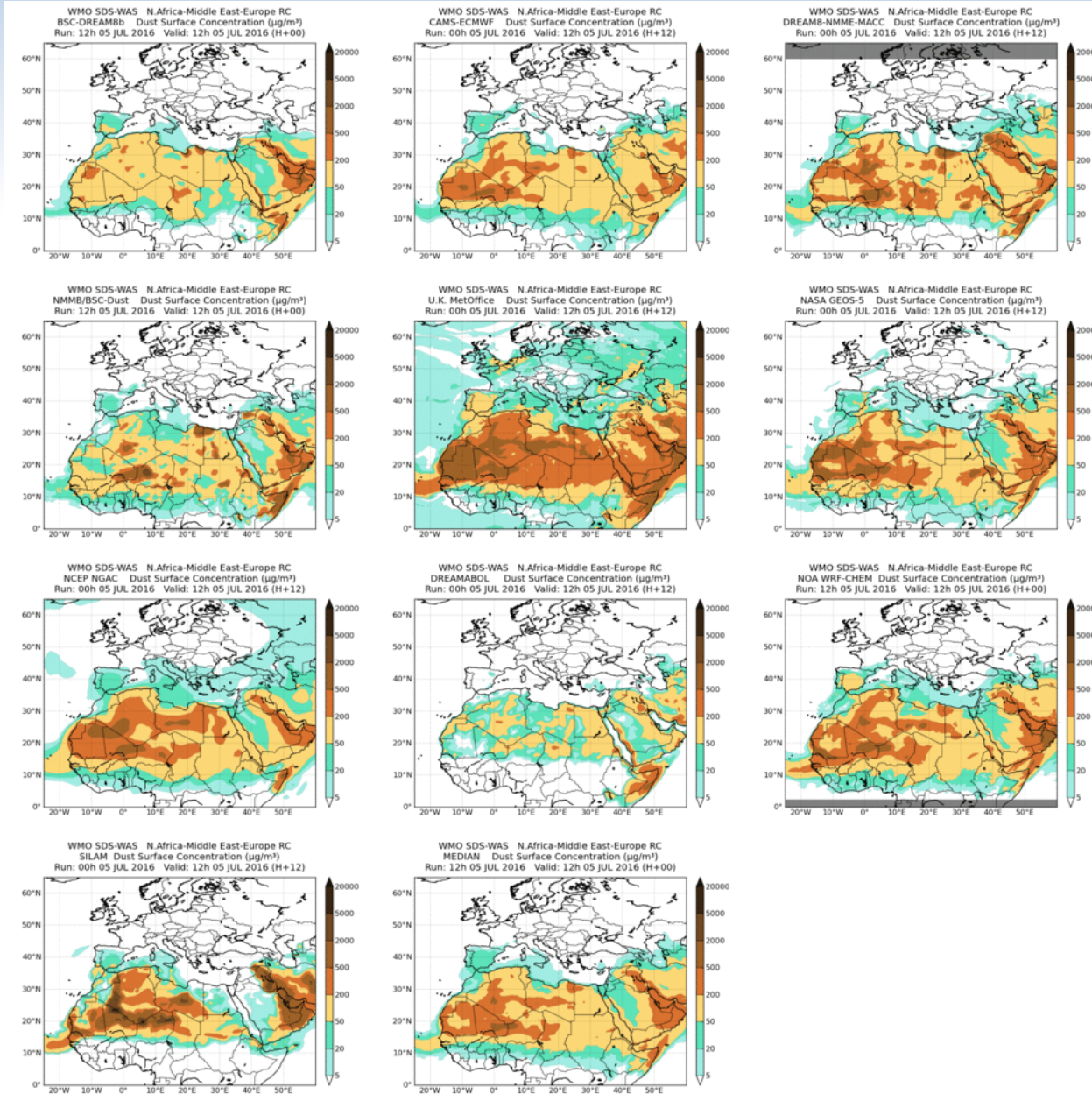




Surface dust concentration

Internal comparisons with SDS-WAS models

Daily comparison with SDS-WAS models is conducted internally.



Summary

- Quasi-operational NRT aerosol prediction at MRI is updated:
 - Model update: MASINGAR mk-2r2 → mk-2r3
 - Near-Real-Time high-resolution experiment is started.
 - Near-Real-Time data assimilation experiments are started.
- Beta version of Himawari-8 aerosol product is provided by JAXA EORC at their website from August 2016.
 - Maki Kikuchi will talk about it more in detail
- Development of 2D-VAR DA system started for operational use.
- Development of automatic evaluation tools are underway.

Future tasks

- Operational implementation of High resolution + 2D-VAR data assimilation
- Integrated approach with chemistry model
 - Adding nitrates
 - Modal approach for aerosol microphysics
- Nesting of regional chemical transport model (NHM-Chem) for detailed prediction over targeted area (East Asia)

Thank you for your attention.

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Thanks to:

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

