Aerosol Assimilation/Forecasting in Japan

I want to answer the guidance through talking about the current status and future plans of our system

Keiya YUMIMOTO
Research Institute for Applied Mechanics (RIAM), Kyushu University
Meteorological Research Institute (MRI), Japan Meteorological Agency
Aerosol Assimilation/Forecasting system

**[Pilot system]**

- **(Dust, sea salt, BC, OC, sulfate)**

  New version of model and DA method
  New observation data for DA

  **[JAXA Himawari monitor]**
  Monitoring and data archive

  **[ICAP*]**
  *International Cooperative for Aerosol Prediction*
  Monitoring and inter-comparison

  **[JRAero]**
  Japanese Reanalysis for Aerosol

**[Operational system]**

- **(Asian dust only)**

  Asian aeolian dust prediction by JMA

  The prediction results are also provided for private weather services and local government via the Japan Meteorological Business Support Center (JMBSC) in GRIB2 format.

  **[Aeolian dust advisory]**

  **[WMO SDS-WAS Asian Node]**

  (http://www.jma.go.jp/en/kosa)
Aerosol DA system: Current status

Himawari-8/MODIS AOD hybrid assimilation system

Model: **Global model (MASINGAR mk-2*)**
DA method: **2D-Var$**
DA data: **Himawari-8 AOD (JAXA), MODIS AOD (NASA)**

(Provided by LANCE-MODIS)

H08 AOD covers Asia/Oceania region **four times**.
MODIS AOD covers Europe/America regions where H08 cannot cover.

(*Tanaka et al., 2003, 5Yumimoto et al., 2017*)
Unified system for retrieval, DA and FC (1)

Retrieval

Radiation [L1]

AOT [L2, L3]

Assimilation/
Forecast

DA

Initial cond. [L4]

Model

“Retrieval” and “Assimilation” are completely separated in process.
Unified system for retrieval, DA and FC (2)

Retrieval

Radiation

AOT

Retrieval

a priori

Assimilation/
Forecast

DA

Initial cond.

Model

Radiation

AOT

Retrieval

a priori

Model

L1

L2, L3

L4

Forecast

(Yoshida et al., ACP, 2021)

- Retrieval can use realistic a priori AOT instead of climate (constant) AOT value.
- Observed information can be propagated to future retrieval through DA/FC.

→ Better accuracy in both retrieval and forecast.
Aerosol DA system: Future plans

**DA method**
- 2D-Var
- 3D-Var
- LETKF* (Local Ensemble Transform Kalman Filter)

**LEO/Imager**
- Terra, Aqua/MODIS
- GCOM-C/SGLI
- MetOp/PMAp
- EarthCARE/MSI
- GOSAT2/CAI2, GOSAT3/CAI3

**GEO/Imager**
- Himawari-8,9/AHI
- GOES-R
- Meteosat

**LEO/Lidar**
- CALIPSO/CALIOP
- EarthCARE/ATLID
Lidar can provide not only vertical profiles during nighttime that Himawari-8 ( imagers) cannot capture.
AOT500 by polarization (GCOM-C/SGLI)

GCOM-C/SGLI polarimetry shows good possibility to improve estimation of the **fine mode aerosols** and better coverage over the land.

(Hiroshi MURAKAMI @ JAXA/EORC)
Unified retrieval algorithm for GEO/LEO imagers

Our final goal
- produce synergistic global aerosol data set
  - using **JAXA Polar-orbiting** and **geostationary** satellites
  - Provided in near real time

This study
- A **common aerosol retrieval algorithm** is developed
  - for various satellite imaging sensors
  - over both land and ocean

Current and Upcoming Aerosol Monitoring Satellite

**Target sensors**

**Geostationary:**
- Himawari-8/AHI, GOES-R, Meteosat

**Polar-orbiting:**
- Aqua, Terra/MODIS, **GCOM-C/SGLI**, GOSAT2/CAI2, EarthCARE/MSI

(Mayumi YOSHIDA @ JAXA/EORC)