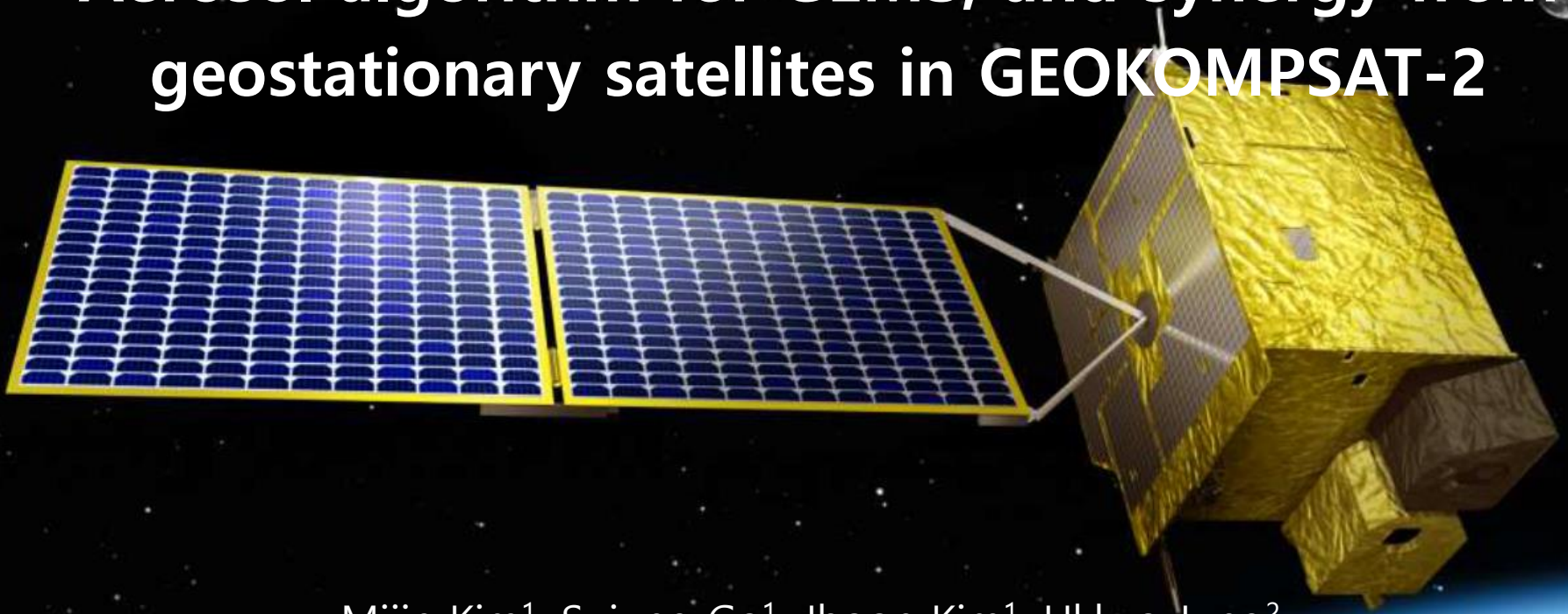


Aerosol algorithm for GEMS, and synergy from geostationary satellites in GEOKOMPSAT-2



Mijin Kim¹, Sujung Go¹, Jhoon Kim¹, Ukkyo Jung²,
Myungje Choi¹, Hyunkwang Lim¹

¹ Yonsei University, Seoul, Republic of Korea

² NASA GSFC

Outline

GEMS Stand Along Aerosol Algorithm

Algorithm, products, and validation

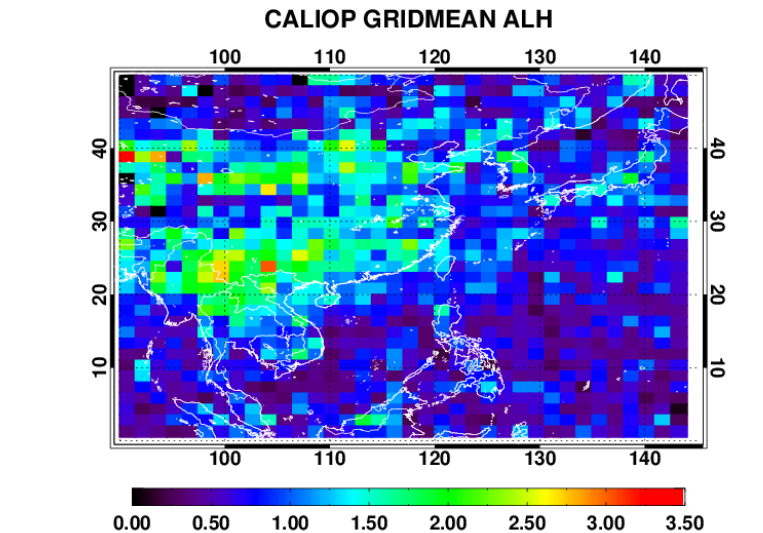
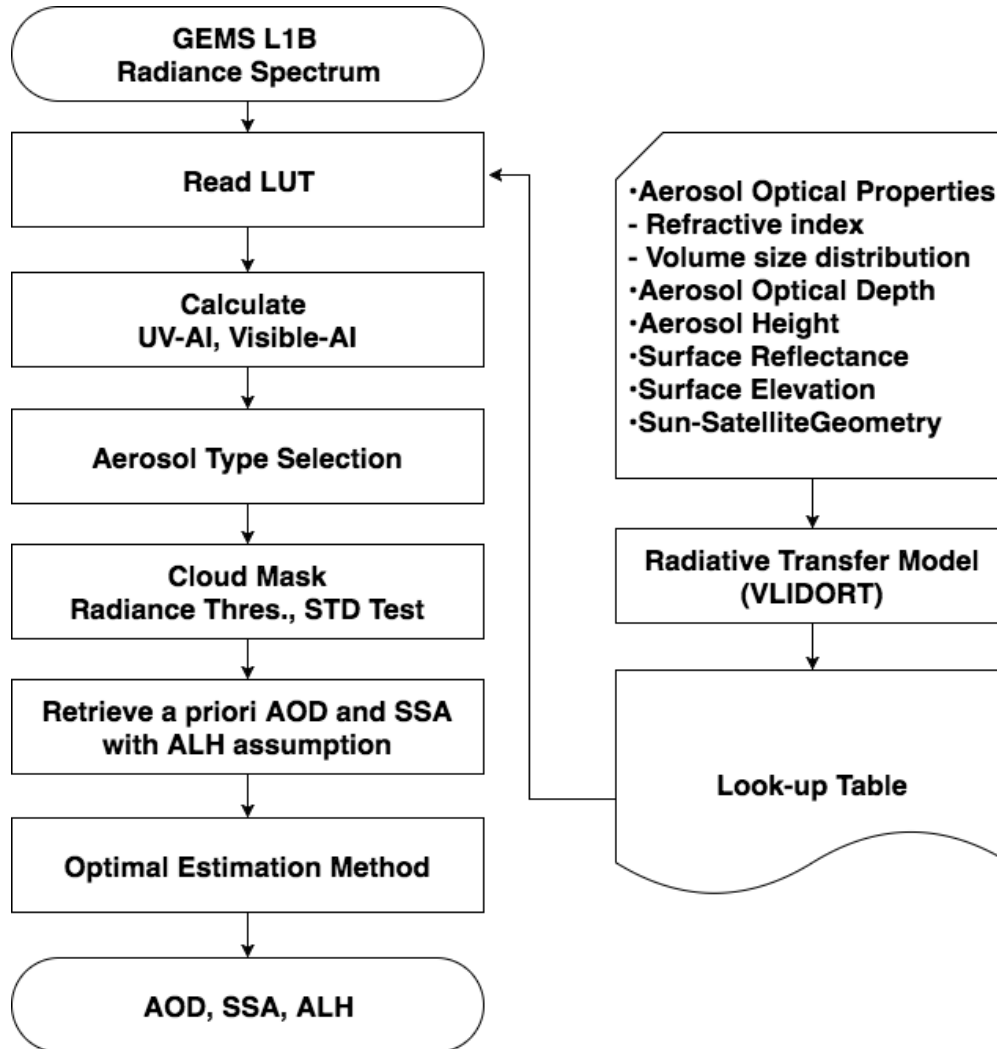
Algorithm Modification

Online Retrieval Algorithm

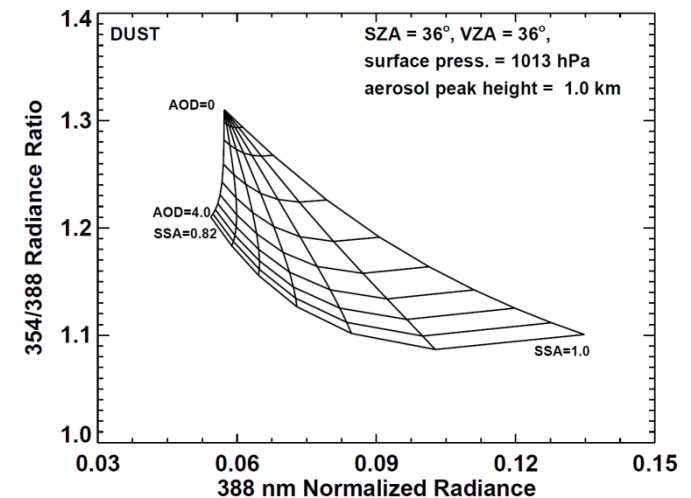
Non-spherical particles

Data Fusion technique for GEOKOMPSAT-2

GEMS Aerosol Algorithm



Attenuated-backscatter-weighted height
Torres et al., 2005 ; Torres et al., 2013



GEMS Aerosol Algorithm Products

MODIS (TERRA) RGB

UV-AI

Visible-AI

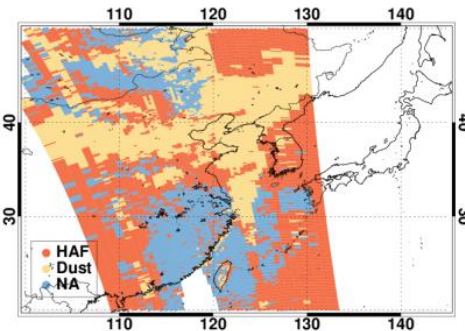
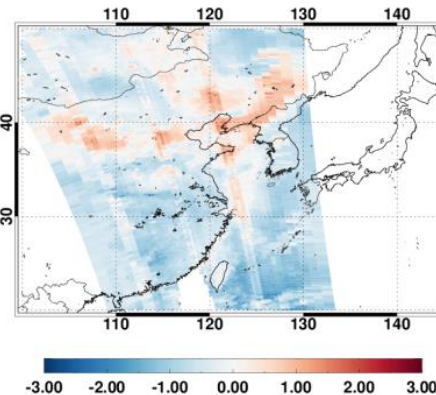
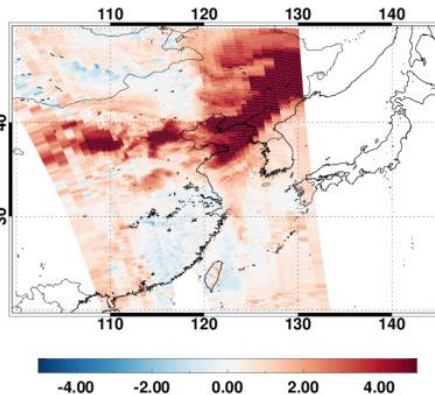
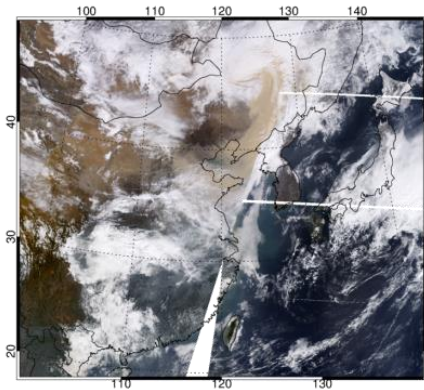
Aerosol Type

10 March 2006

UVAI from OMI2006m0310t0427

VISAI from OMI2006m0310t0427

Aerosol Type 2006m0310t0427

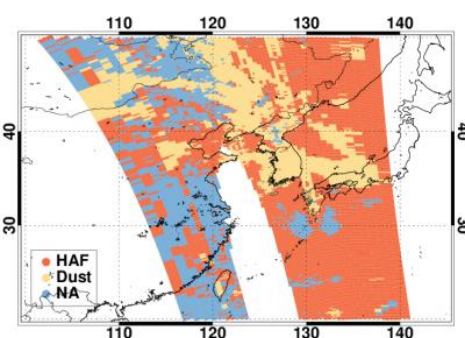
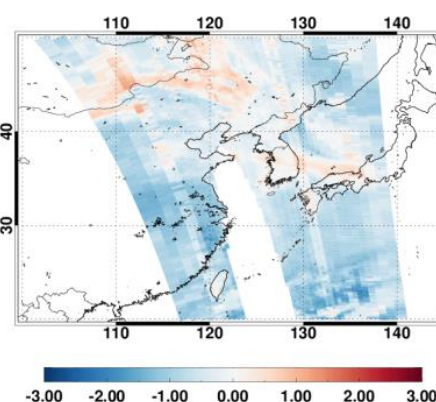
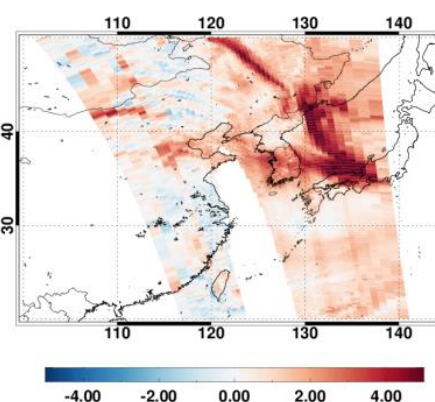
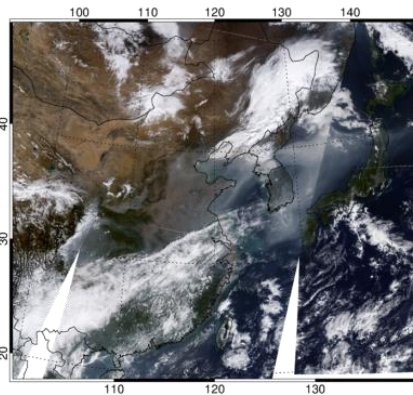


10 Oct. 2006

UVAI from OMI2006m0408t0400

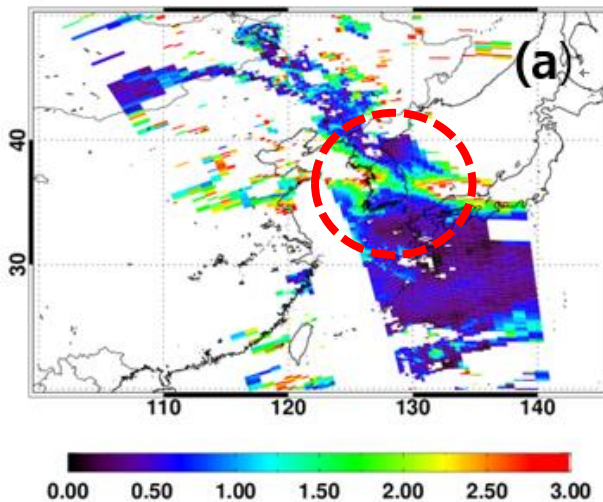
VISAI from OMI2006m0408t0400

Aerosol Type 2006m0408t0400

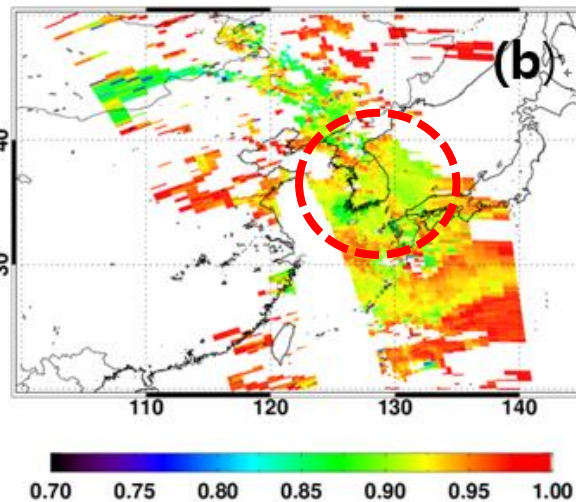


GEMS Aerosol Algorithm Products

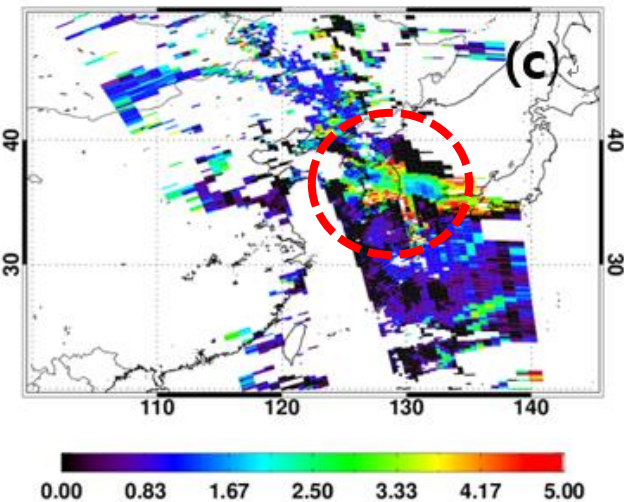
GEMS AOD 443nm



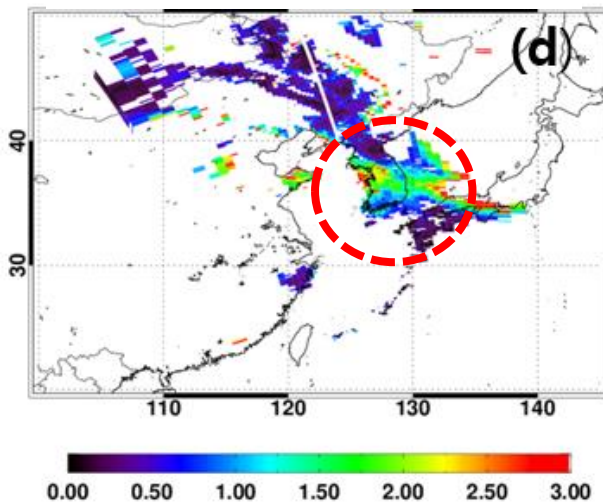
GEMS SSA 443nm



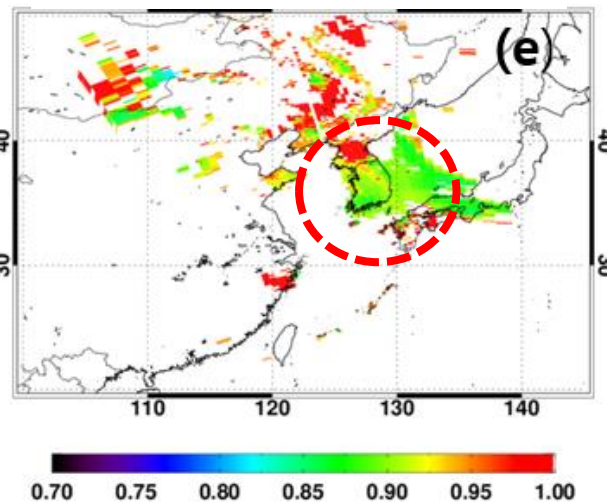
GEMS ALH



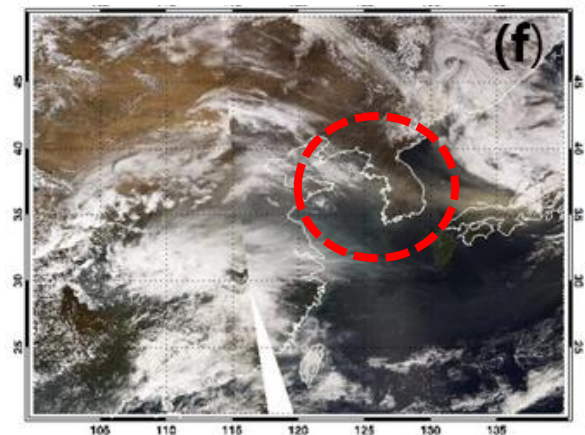
OMI AOD 388nm



OMI SSA 388nm

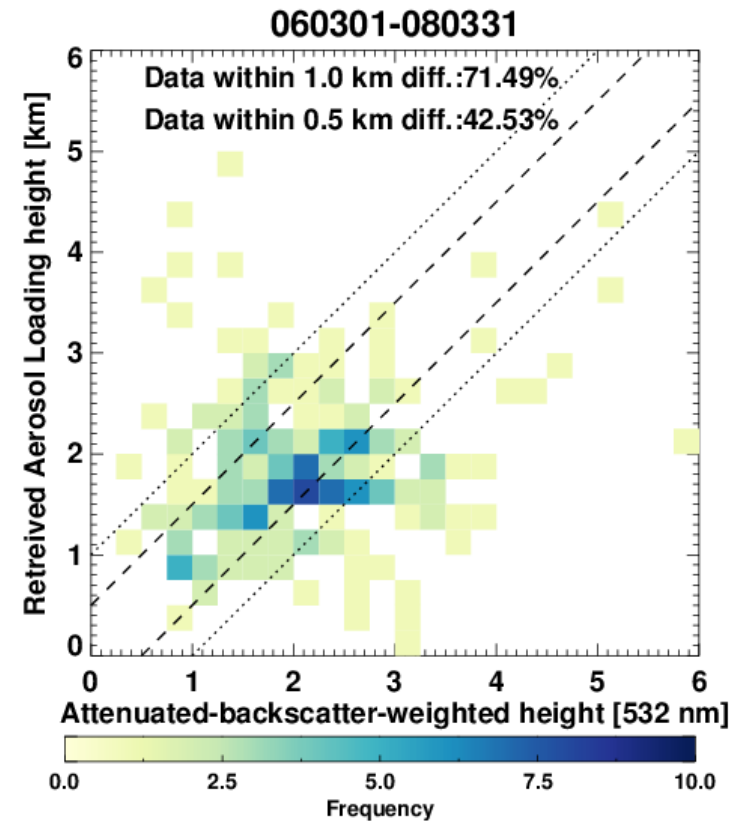
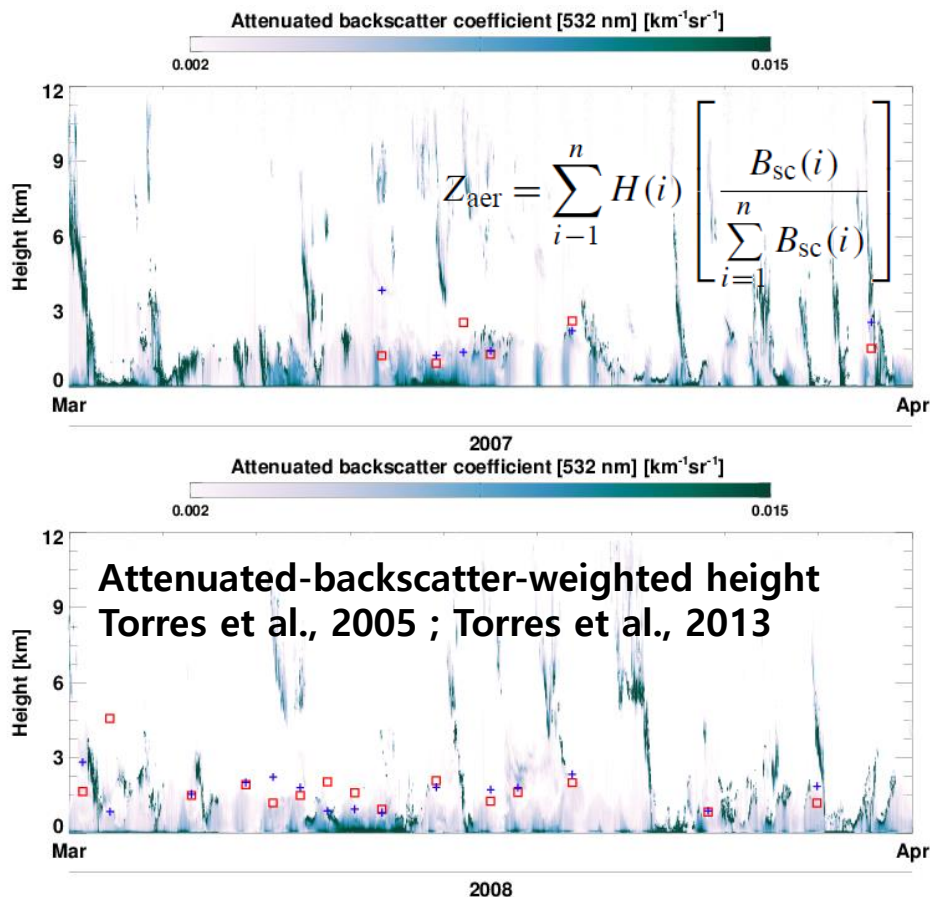


MODIS RGB



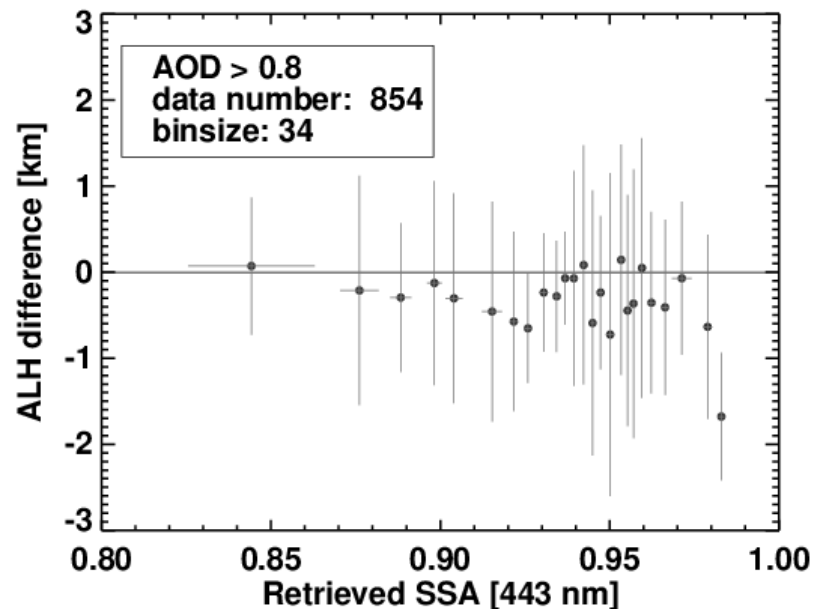
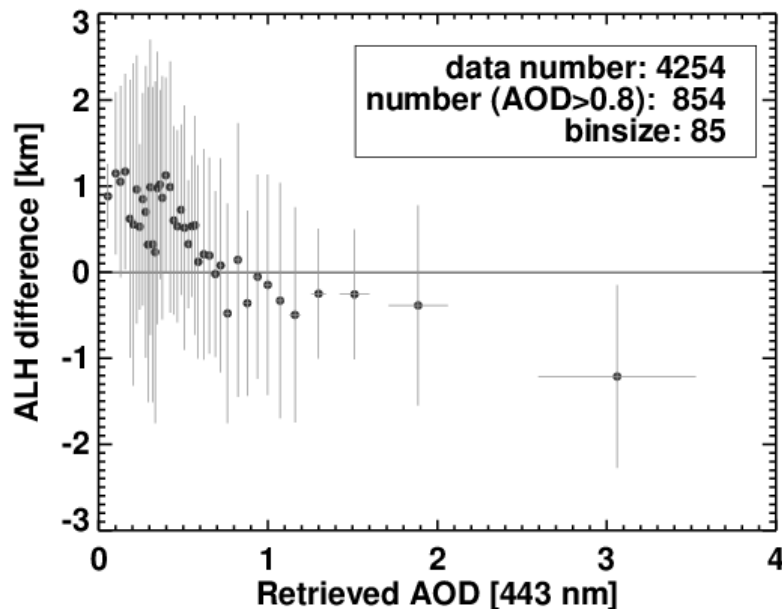
Validation of GEMS Aerosol Product : ALH

- Collocated with Lidar Observation in Seoul National University (<http://www-lidar.nies.go.jp/Seoul/>)
- Backscattering intensity (532 nm)
- Period : 2006.03~2008.03
- within +/- 30 min.



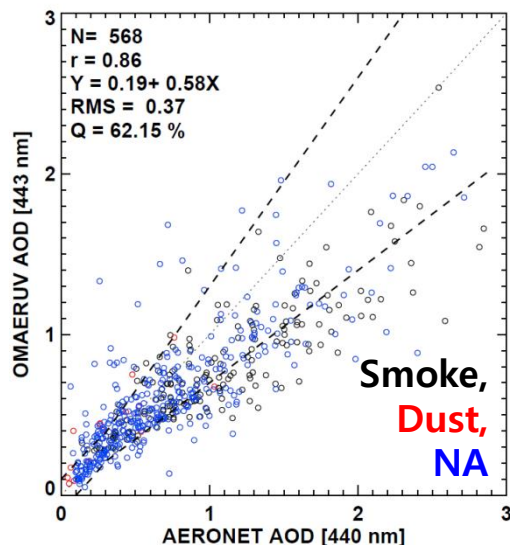
Validation of GEMS Aerosol Product : ALH

- CALIOP Backscatter Coefficient (532 nm)
- Period : 2007.03~2007.05
- Within +/-30 min.
- Within $0.25^\circ \times 0.25^\circ$
- Total Number of Data : 4254
- Number of Data (AOD > 0.8) : 854

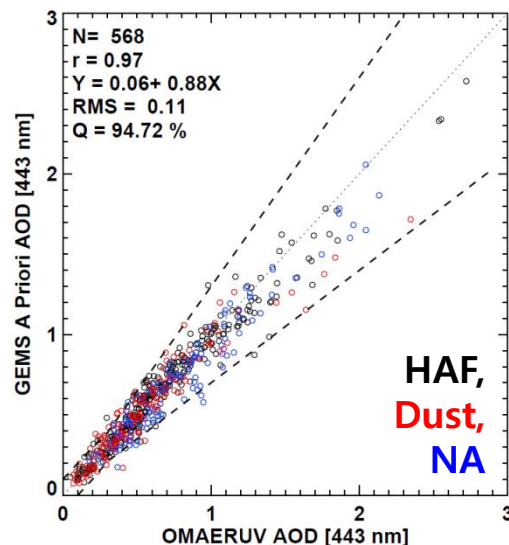


Validation of GEMS Aerosol Product : AOD

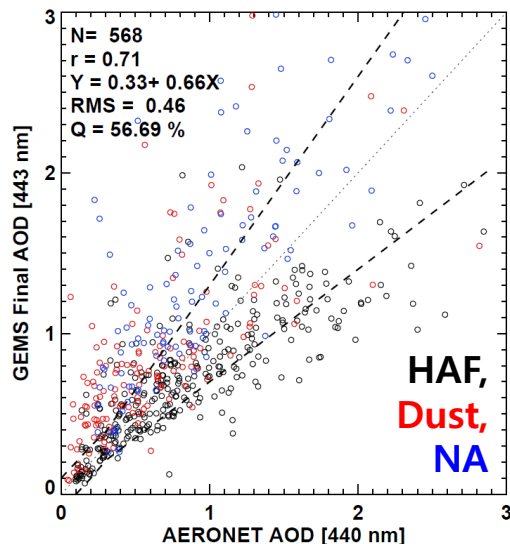
OMAERUV vs. AERONET



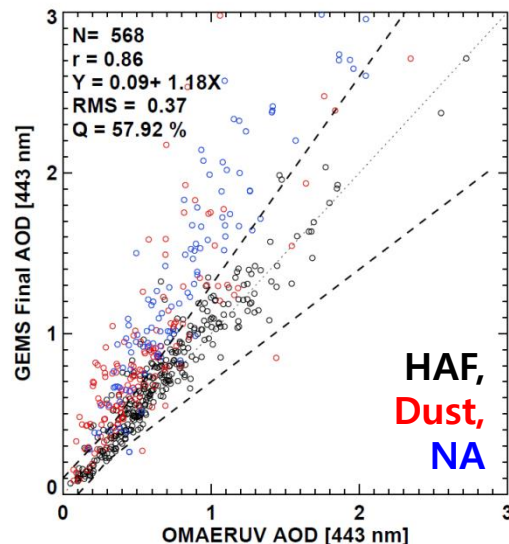
GEMS A-pr. vs. OMAERUV



GEMS Final vs. AERONET



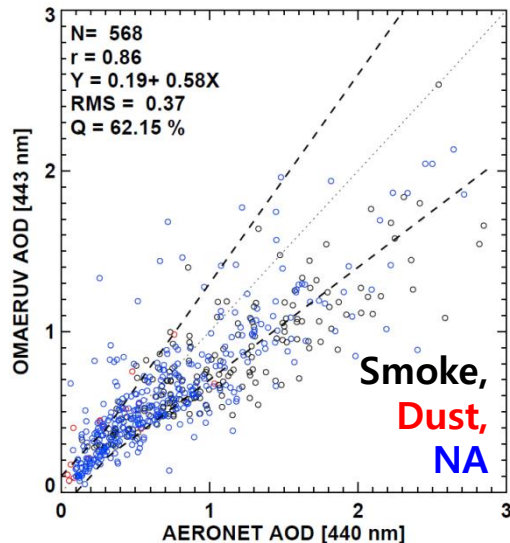
GEMS Final vs. OMAERUV



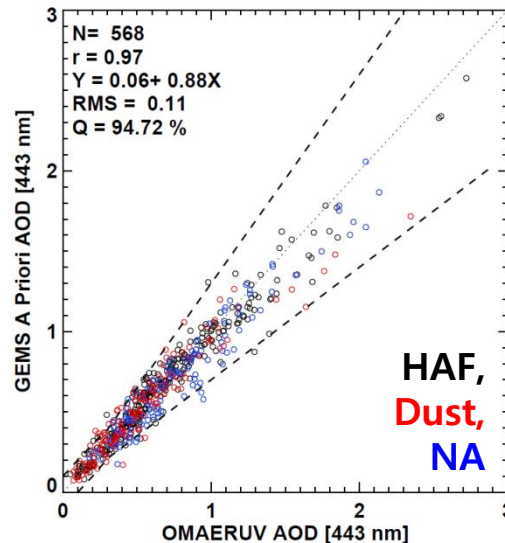
- Collocated with AERONET direct. (lv2.0)
 - within $0.4^\circ \times 0.4^\circ$
 - within 30 min
- 26 AERONET site in Asia
 - Anmyon, Bac_Giang, BackGarden_GZ, Beijing, Chen-Kung_Univ, Dalanzadgad, EPA-NCU, Gosan_SNU, Gwangju_GIST, Hangzhou-ZFU, Hefei, Hong_Kong_Hok_Tsui, Hong_Kong_PolyU, Liangning, Lulin, NCU_Taiwan, Noto, Osaka, PKU_PEK, SACOL, Shirahama, Taihu, Taipei_CWB, Ussuriysk, XiangHe, Xinglong
- Period
2005.01 – 2007.12
- Number of Data : 568

Validation of GEMS Aerosol Product : AOD

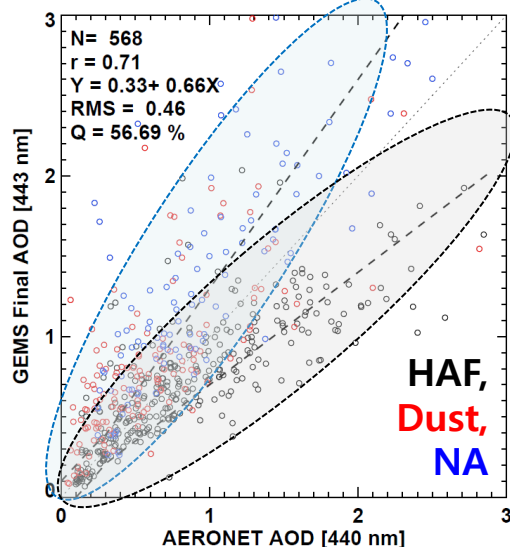
OMAERUV vs. AERONET



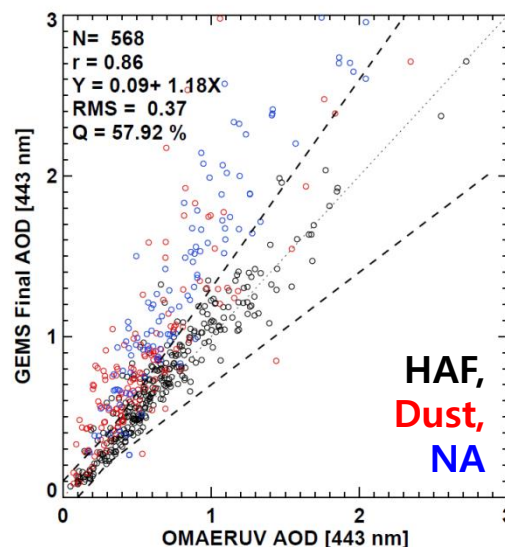
GEMS A-pr. vs. OMAERUV



GEMS Final vs. AERONET



GEMS Final vs. OMAERUV



- Collocated with AERONET direct. (lv2.0)
 - within $0.4^\circ \times 0.4^\circ$
 - within 30 min
- 26 AERONET site in Asia
 - Anmyon, Bac_Giang, BackGarden_GZ, Beijing, Chen-Kung_Univ, Dalanzadgad, EPA-NCU, Gosan_SNU, Gwangju_GIST, Hangzhou-ZFU, Hefei, Hong_Kong_Hok_Tsui, Hong_Kong_PolyU, Liangning, Lulin, NCU_Taiwan, Noto, Osaka, PKU_PEK, SACOL, Shirahama, Taihu, Taipei_CWB, Ussuriysk, XiangHe, Xinglong
- Period
2005.01 – 2007.12
- Number of Data : 568

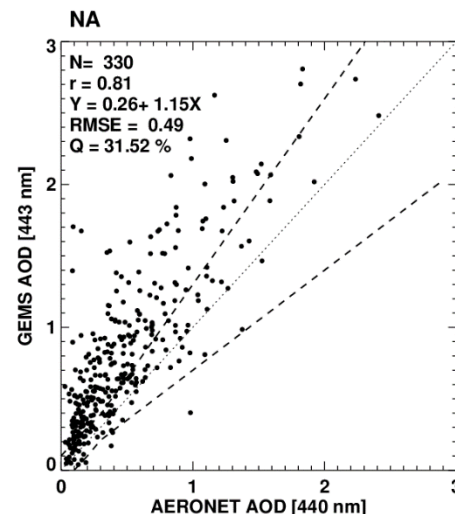
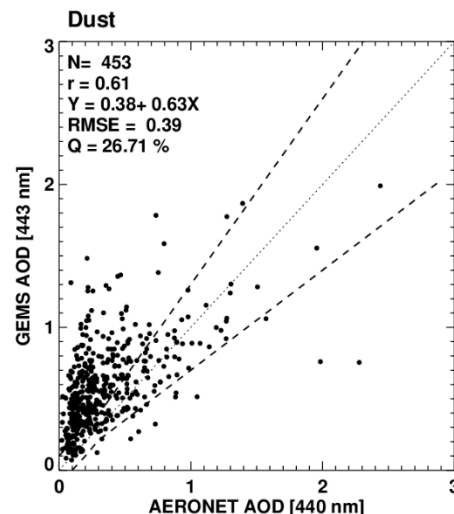
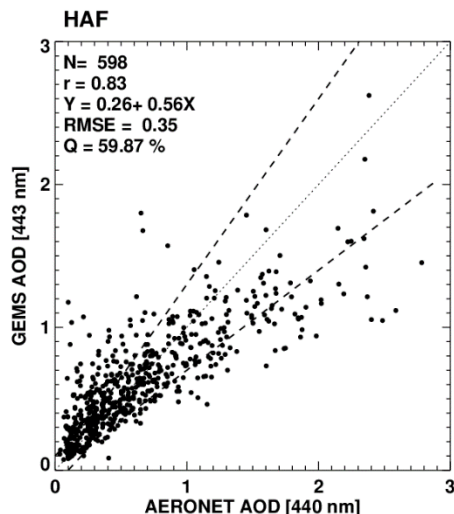
Algorithm Modification

HAF

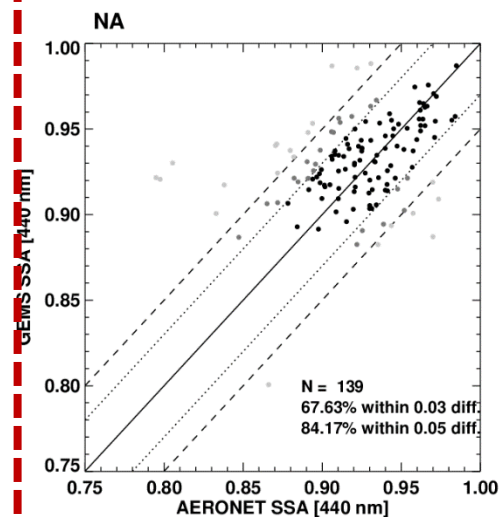
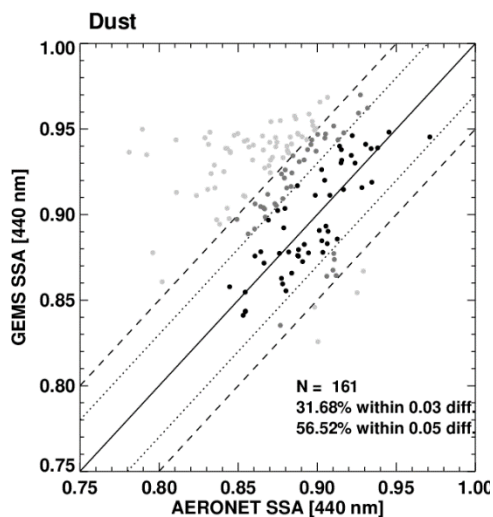
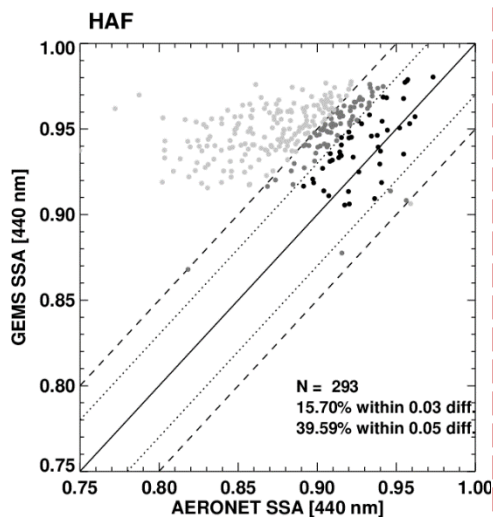
Dust

NA

AOD



SSA

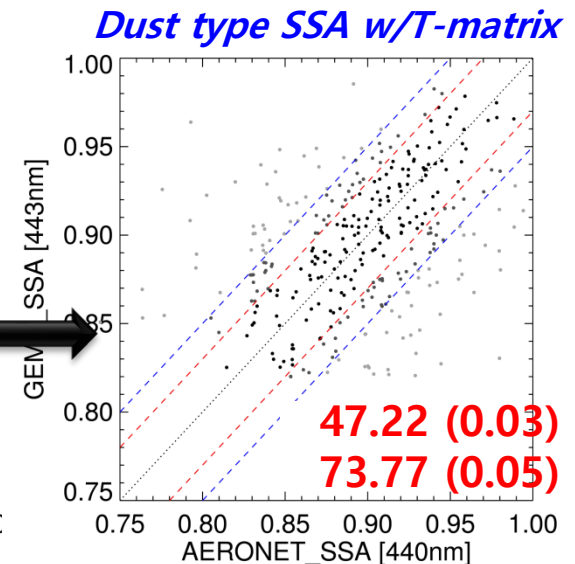
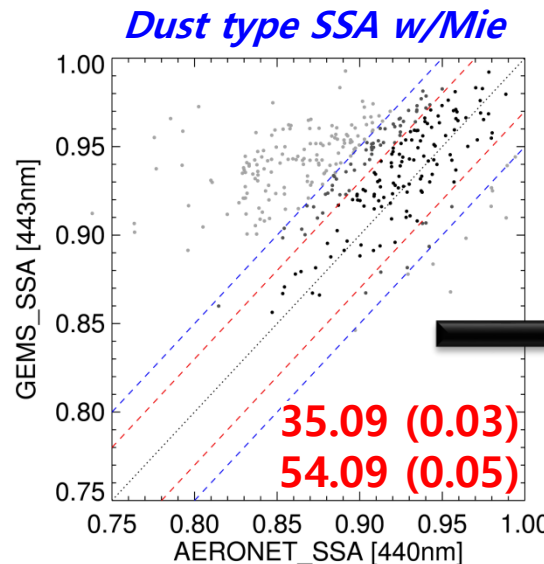
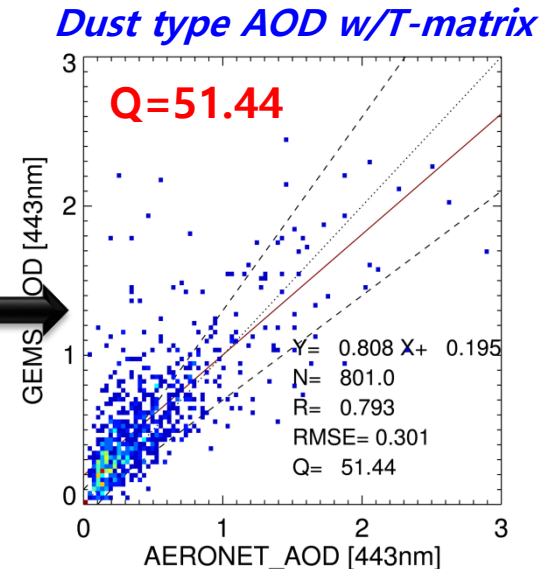
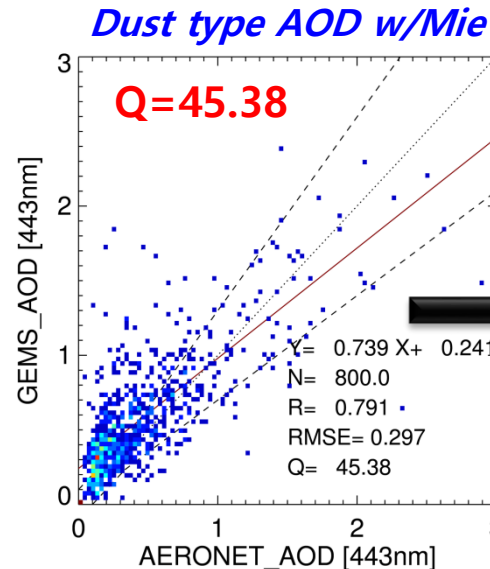
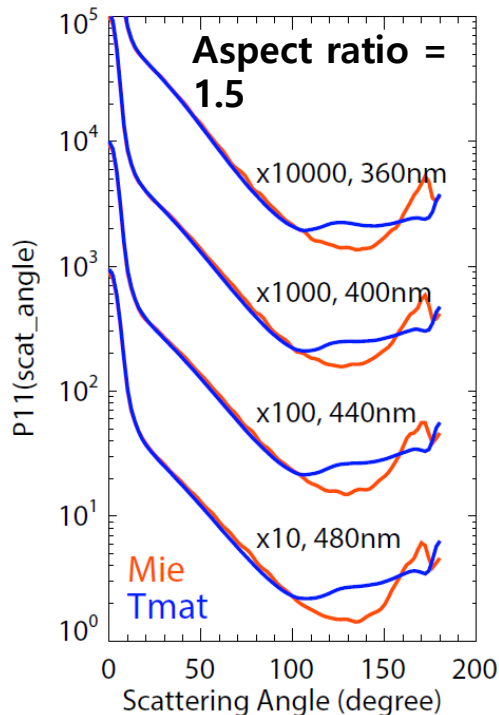


Dust detected pixels, retrieved with Mie LUT, cause error on AOD, SSA, and ALH

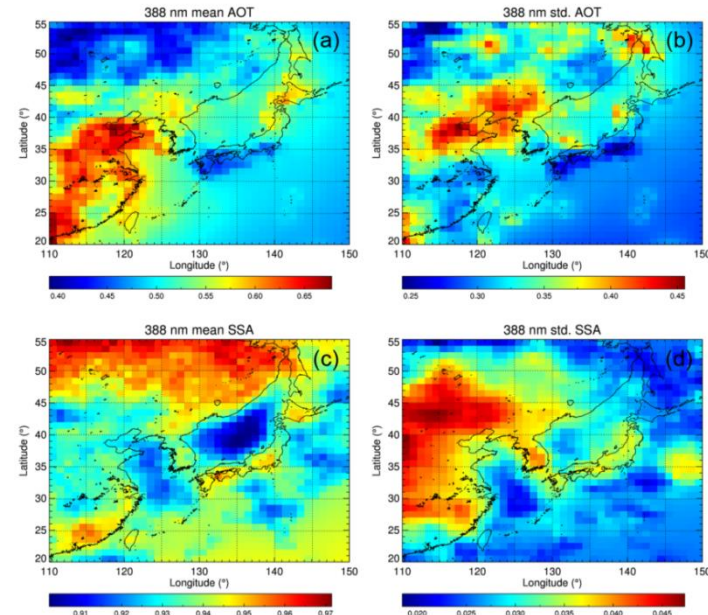
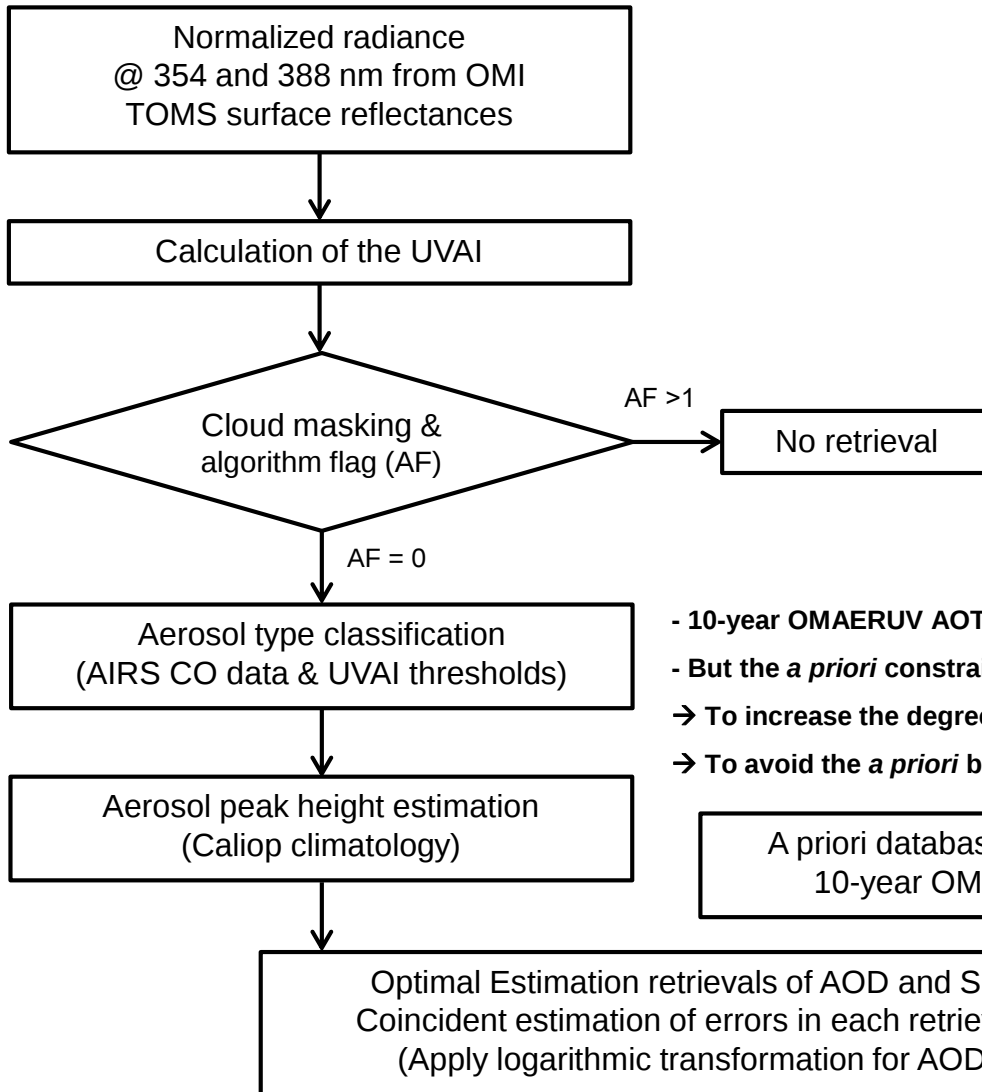
Algorithm Modification : Non-spherical particles

✓ *Validation Only for
Dust detected type*

*Phase Function
simulated with
VLIDORT*



Algorithm Modification : Online Calculation



- 10-year OMAERUV AOT and SSA in spring (May to March) from 2005 to 2014

- But the *a priori* constraints has been loosen

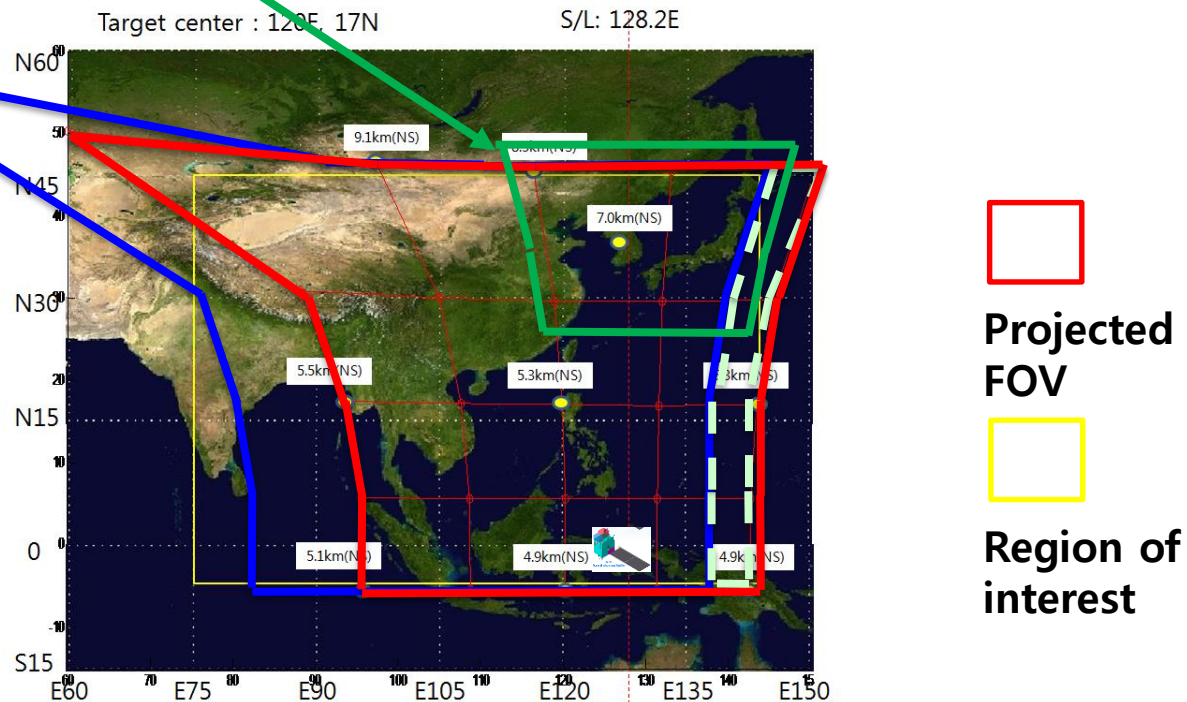
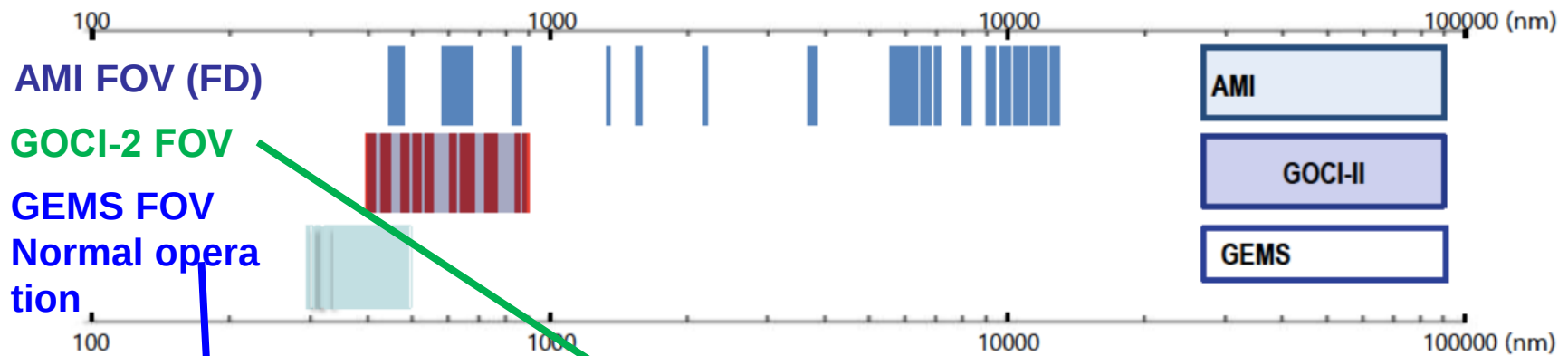
→ To increase the degrees of freedom

→ To avoid the *a priori* biases in OMAERUV algorithm

A priori database of AOD and SSA
10-year OMAERUV records

Online retrieval methods can reduce errors from the interpolation and are numerically efficient particularly for the smaller number of target retrievals

Algorithm Modification : Synergy from GK-2A/2B



GK-2A/2B Satellite instruments specification

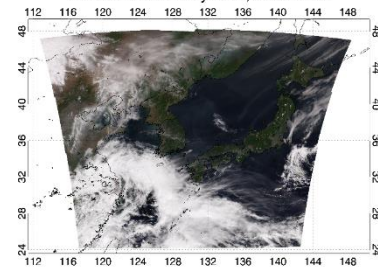
Satellite in Orbit	GEO-KOMPSAT-2A	GEO-KOMPSAT-2B	
Payload	AMI	GEMS	GOCI-2
Channels (μm)	16 channels (0.47~13.31)	1000 channels (0.3~0.5) Scanning UV-VIS Spectrometer	12 channels + 1 wideband (0.380~0.865) VIS, NIR
Temporal resolution	within 10 min (FD)	1 hour (8 times/day) (30min imaging + 30min rest)	1 hour (10 times/day (Local) + 1 times (FD))
Spatial resolution	1km (<0.856 μm , VIS) 0.5km (=0.64 μm , VIS) 2km (>1.38 μm , IR)	Gas : 7(NS)x8(EW) km Aerosol : 3.5(NS)x8(EW) km	250m (@130°E) 1km (FD)
Spectral resolution	-	<0.6nm (3 samples) (spectral sampling < 0.2nm)	12 narrow bands (10 ~ 40 nm)
Field of regard (FOR)	Full Disk	5,000km(N/S) × 5,000km(E/W) N/S: 45°N ~ 5°S, E/W: 75°E ~ 145°E (E/W, Selectable)	2,500km(N/S) × 2,500km(E/W)
Baseline products	- Scene & Surface Analysis - Cloud & Precipitation - <i>Aerosol</i> & Radiation : (AOD, Asian Dust detection, Particle Size) - Atmospheric condition & Aviation	O₃ (Column, Profile), NO₂, SO₂, HCHO, <i>Aerosols</i> (AOD, SSA, ALH), UVI, CHOCHO	- Water quality variable - Marine Environmental products - <i>Atmospheric Properties</i> : AOD, dust detection, aerosol type.. - Land variable



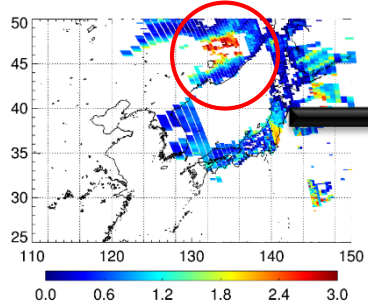
GEMS-AMI synergies : cloud masking

Cirrus case

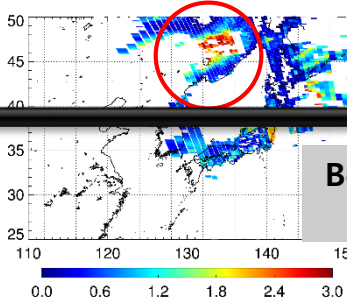
GOCI RGB - 22 May 2016, 03:30 UTC



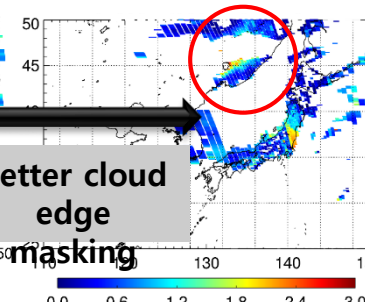
GEMS AOD



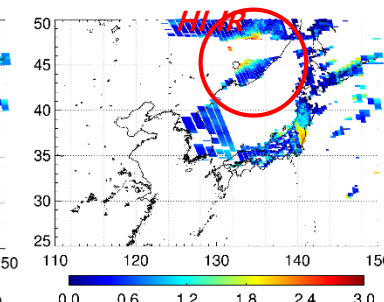
GEMS + GOCI



GEMS + MODIS



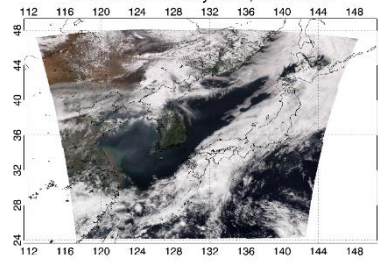
GEMS + GOCI + A



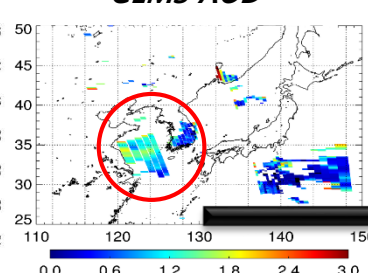
Better cloud
edge
masking

Aerosol case

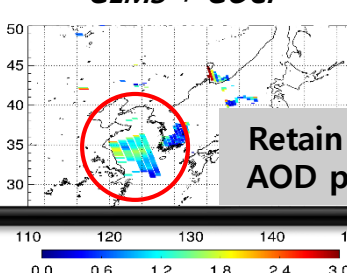
GOCI RGB - 25 May 2016, 03:30 UTC



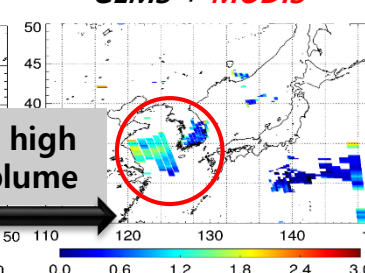
GEMS AOD



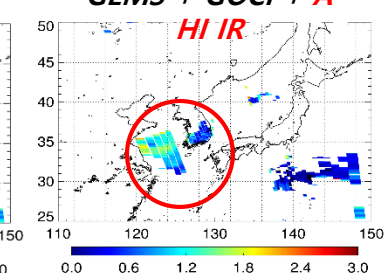
GEMS + GOCI



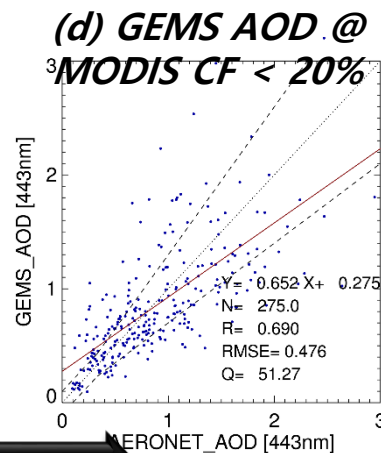
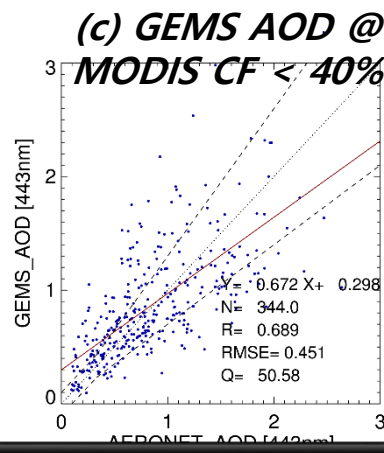
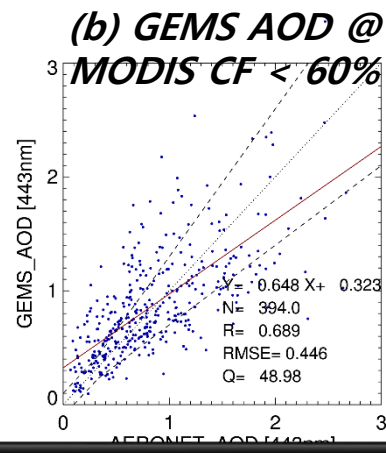
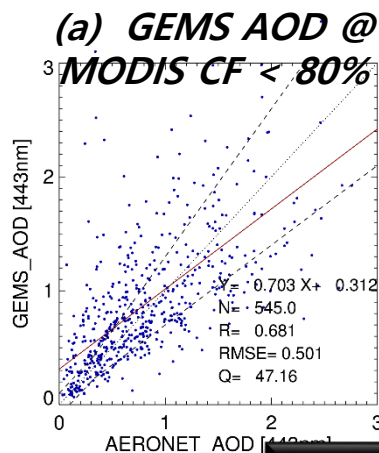
GEMS + MODIS



GEMS + GOCI + A



Retain high
AOD plume



Q=47.16

Q=48.98

Q=50.58

Q=51.27

Issues and Future Studies

■ **Modification of AI**

- Considering spectral dependency of surface reflectance
- Applying Mie Cloud Albedo to correct VZA dependency in UVAI

■ **Modification of surface reflectance**

- OMI Surface LER product (OMLER v003; Kleipool et al. (2008))
- Reduced spatial resolution: $0.5^\circ \times 0.5^\circ \gg 0.25^\circ \times 0.25^\circ$
- Spectral dependency

■ **Accuracy issue at Desert site**

- Both the GEMS and OMAERUV algorithms have poor accuracy at desert site such as SACOL, Dalanzadgad.

■ **Modification of spatial resolution**

- Reduced cloud contamination via finer spatial resolution (OMI $13 \times 24 \text{ Km}^2 \gg$ GEMS $3.5 \times 8 \text{ Km}^2$)



Thank you for your attention 😊

