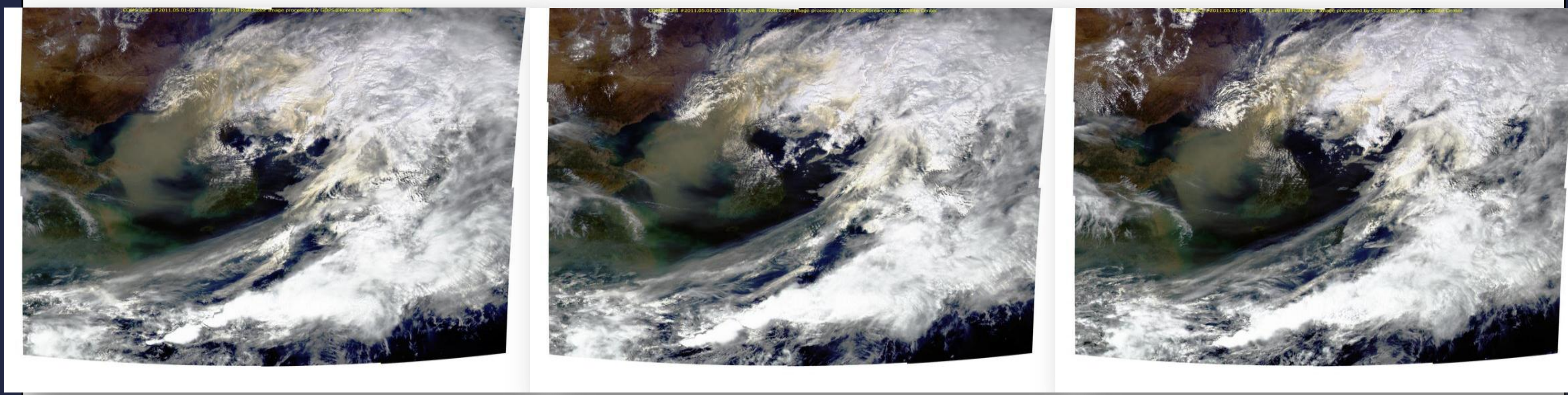
The Sixth Asia/Oceania Meteorological Satellite Users' Conference
09 – 13 November 2015, Tokyo/Japan

GOCI Yonsei aerosol retrievals during 2012 DRAGON-NE Asia and 2015 MAPS-Seoul campaigns



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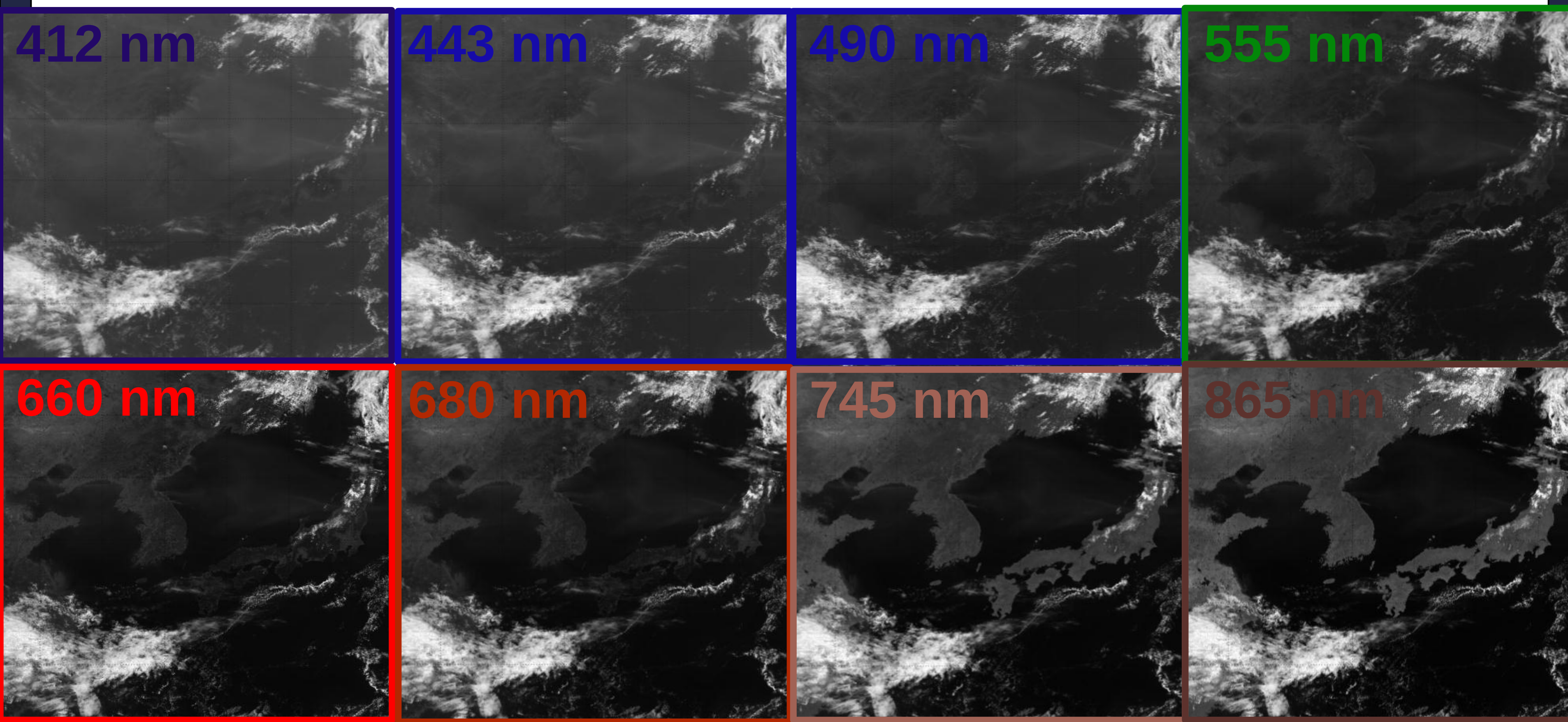
Geostationary Ocean Color Imager:

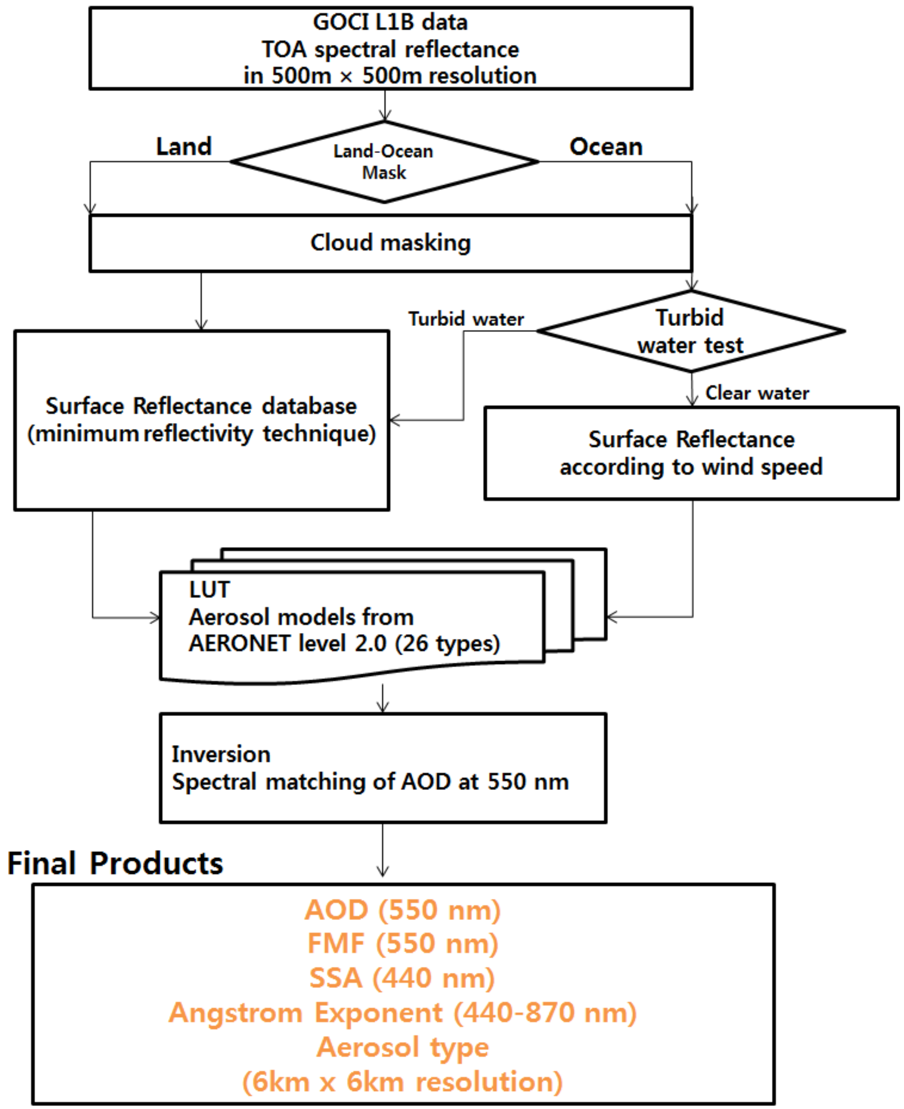
The first ocean color sensor in geostationary orbit

Successfully launched on June 27, 2010. Data is available from March 2011.

Wavelength: 412, 443, 490, 555, 660, 680, 745, 865 nm
Spatial resolution: 500 m x 500 m
Temporal resolution: 1 hour (09:30, 10:30, 11:30, 12:30, 13:30, 14:30, 15:30, 16:30; KST)
Target area: East Asia



Flowchart of GOCI Yonsei Aerosol retrieval (YAER) algorithm



[Lee et al., 2010, RSE]
[Lee et al., 2012, ACP]
[Choi et al., submitted to AMT]

Characteristics

1. Surface reflectance from minimum reflectivity technique
2. Detection of turbid water by using $\Delta\rho_{660\ nm}$ from interpolation
3. Consideration of nonsphericity

Aerosol Optical Depth (AOD)

: the effective depth of the aerosol column from the viewpoint of radiation propagation

Fine-mode Fraction (FMF)

: fine-mode AOD / total AOD
(aerosol size parameter)

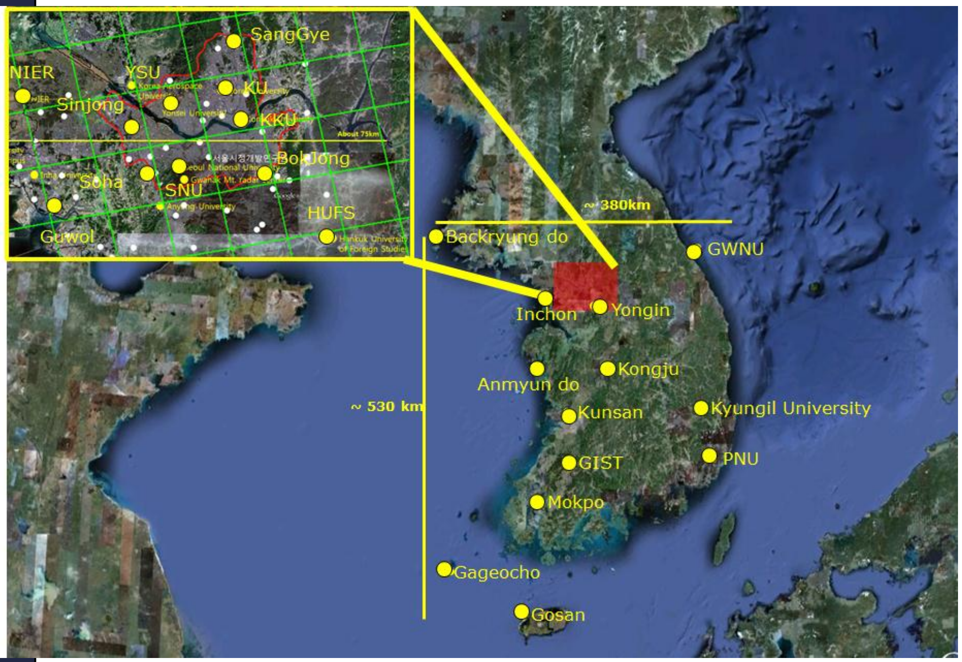
Angstrom Exponent (AE)

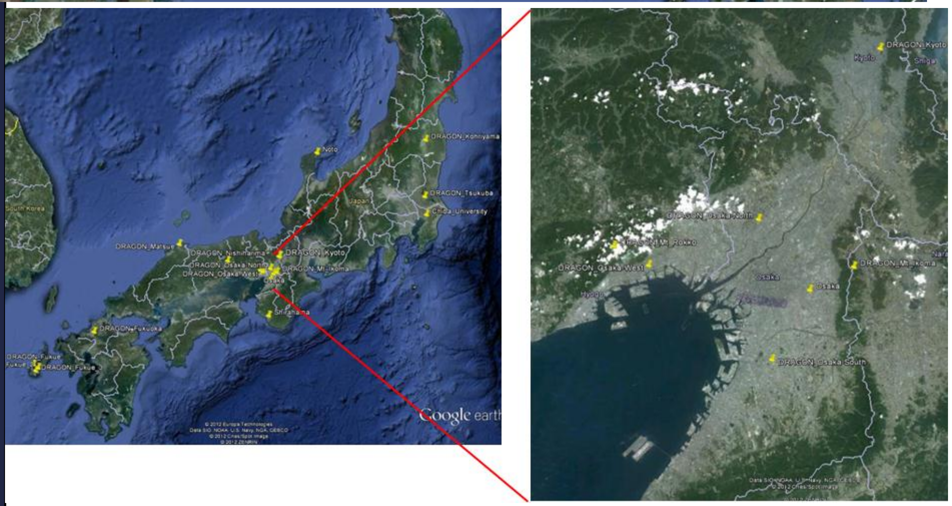
: relation of spectral AODs
(aerosol size parameter)

Single-scattering albedo (SSA)

: scattering efficiency
/ total extinction efficiency
(aerosol absorptivity parameter)

DRAGON-NE Asia 2012 (Korea and Japan, March – May)





[NASA AERONET homepage]

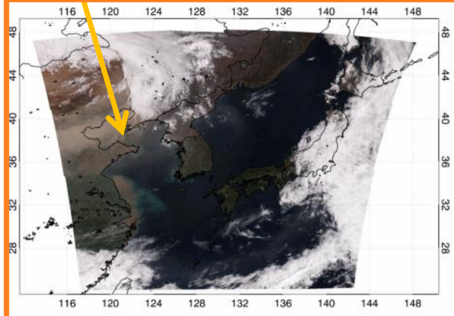
- **Distributed Regional Aerosol Gridded Observation Networks**
- Total 38 AERONET sunphotometer sites.
  (Seoul and Osaka metropolitan Regions)
- Develop a geo-referenced database that will accommodate supplementary/complimentary data sets
- Collaboration with NASA AERONET team and many site principal investigators.

Retrieval results : Dust case (2012.04.27)

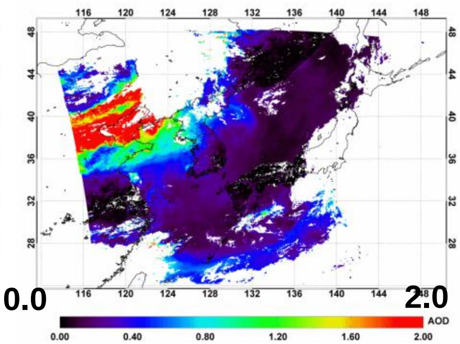
Yellow Dust

low FMF (~0.3): coarse particle

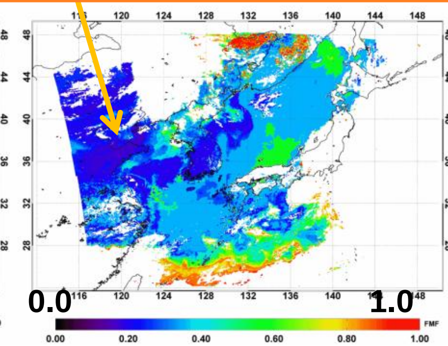
GOCI True color



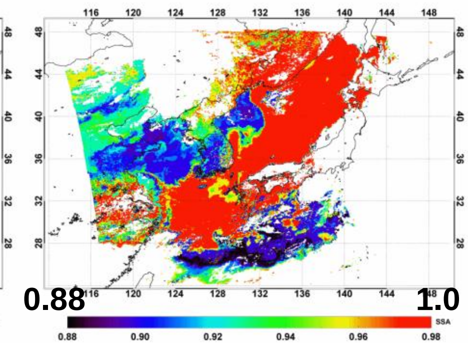
AOD (1hr interval)

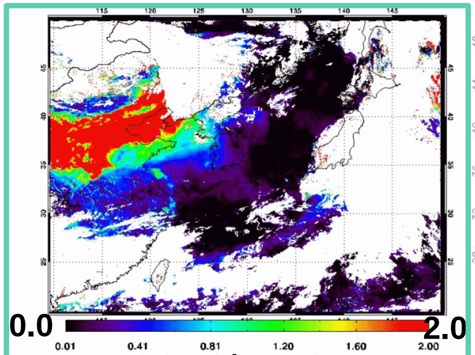


FMF

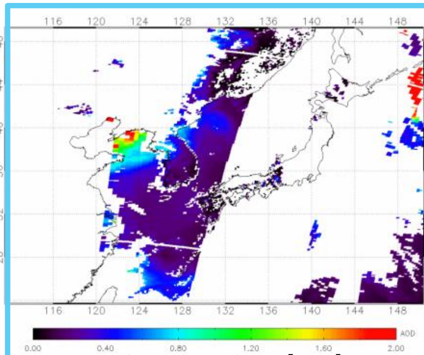


SSA

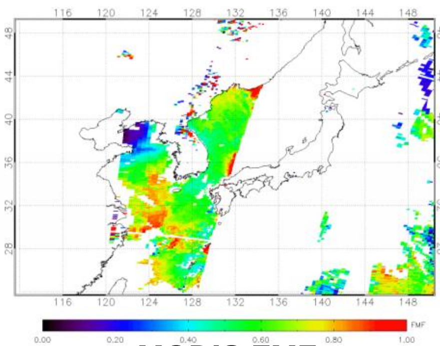




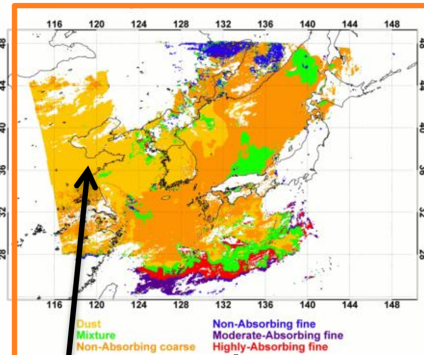
COMS/MI AOD (15min interval) (Kim et al., 2014)



MODIS AOD (DT) (2 times per day)



MODIS FMF

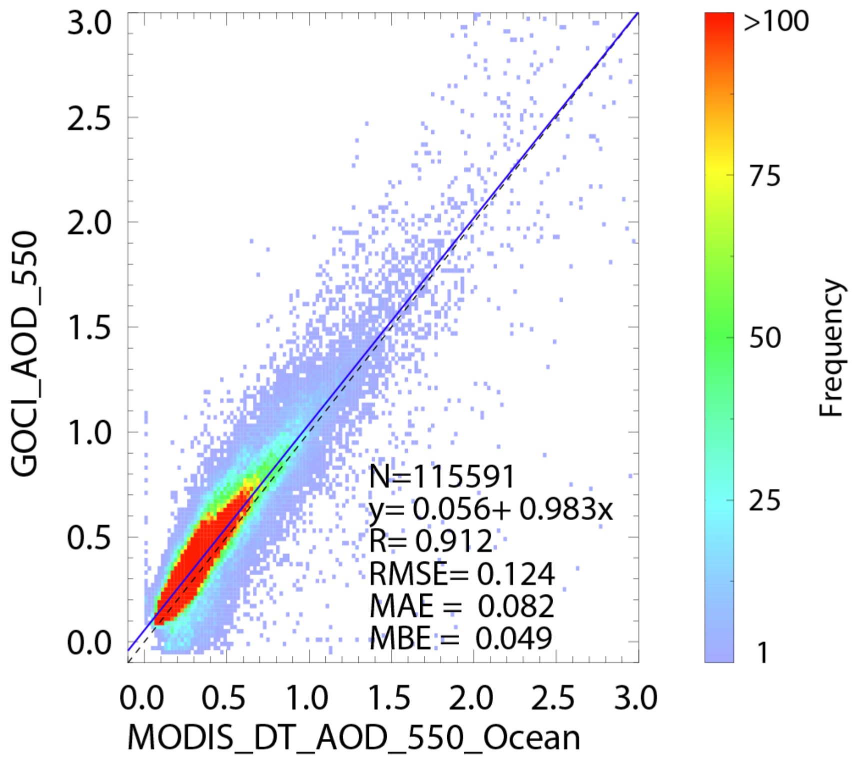


Aerosol Type

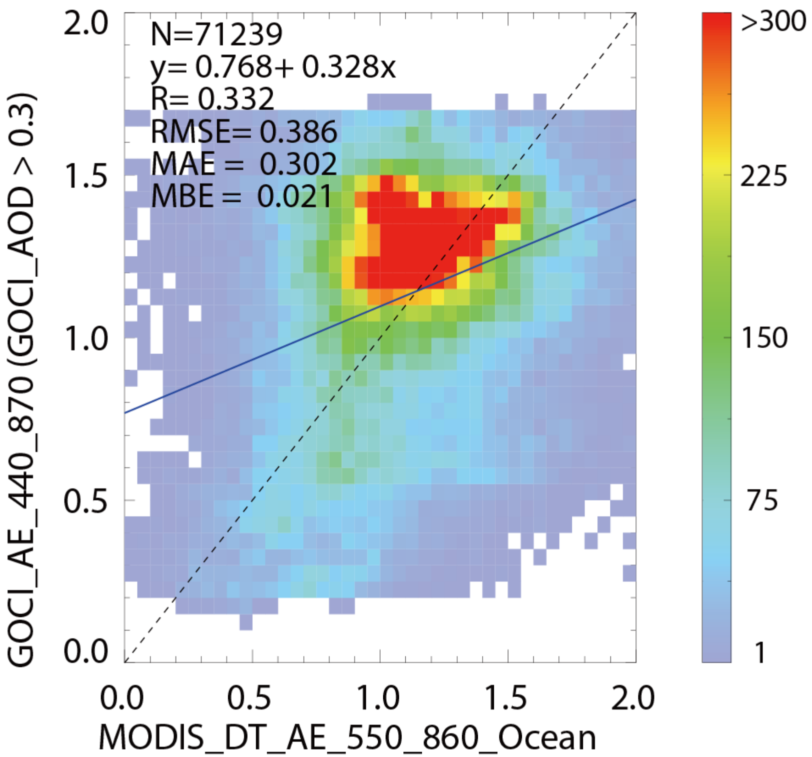
	HA, fine	MA, fine	NA, fine	Mixture	Dust	NA/coarse
FMF	0.6 ~ 1.0	0.6 ~ 1.0	0.6 ~ 1.0	0.4~0.6	0.1~0.4	0.1~0.4
SSA	0.85~0.90	0.90~0.95	0.95~0.99	0.85~0.99	0.85~0.95	0.95~0.99

Comparison b/w MODIS DT (C6) and GOCI (Ocean), 2012.03-05

AOD at 550 nm



AE b/w 440 and 870 nm

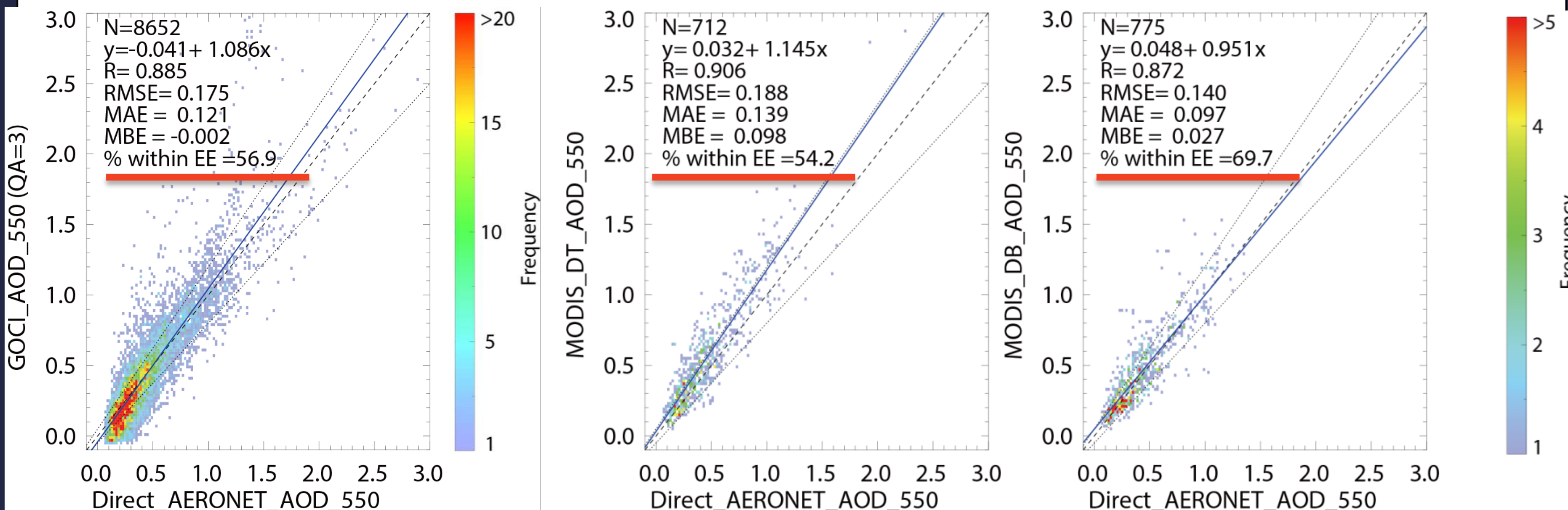


- Size of lon and lat grid for comparison: 0.2° (~20km)
- Area of comparison: East Asia (GOCI observation area)
- Observation time matching: mean of MODIS scan time vs GOCI in ± 30min

AOD Validation results of GOCI & MODIS using AERONET (Land)

2012.03-05 DRAGON Campaign period

GOCI **MODIS_DT (C6)** **MODIS_DB (C6)**

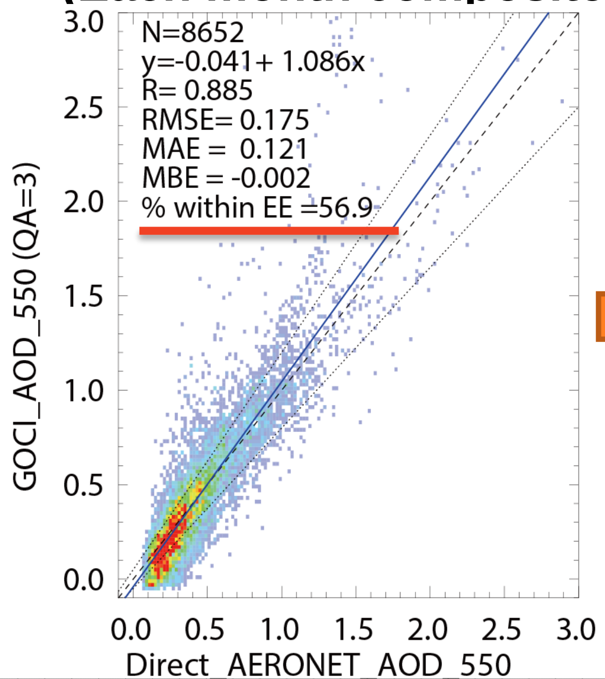


- DRAGON-NE Asia Campaign 38 sites
- Spatial colocation: average of GOCI pixels within 25km at AERONET site
- Temporal colocation: average of AERONET data within 30 min at satellite measurement time
- Expected Error (EE) = 0.05 + 0.15*AERONET AOD (Levy et al., 2007)

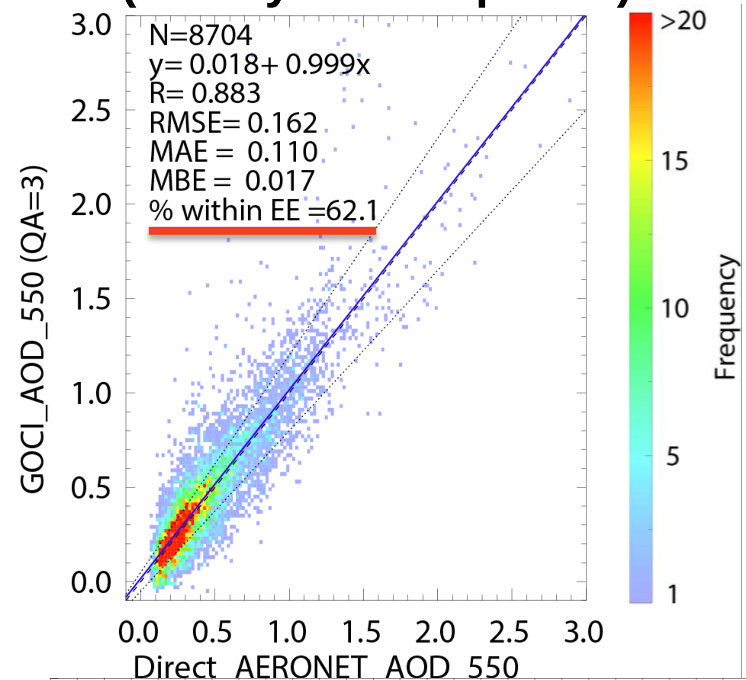
GOCI YAER AOD shows comparable results against MODIS even though geostationary observation.
Further necessary improvements**:** **surface reflectance and cloud masking**

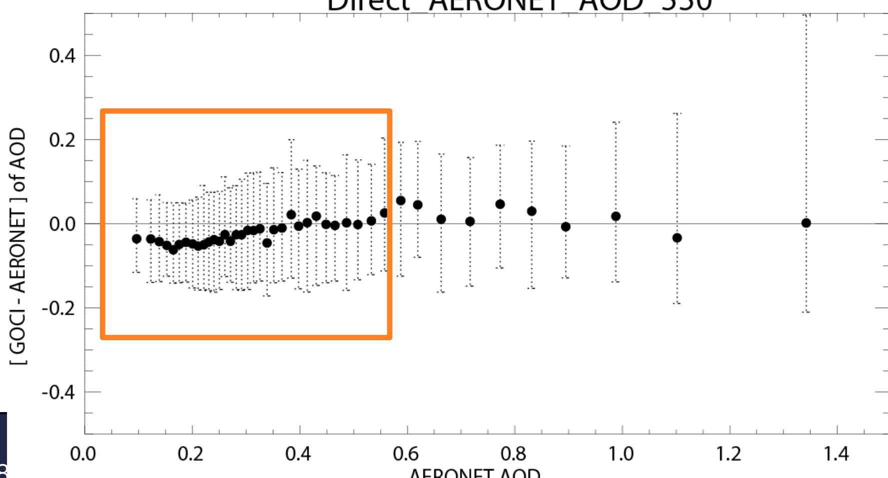
Improvement of AOD retrieval using multi-year surface reflectance database

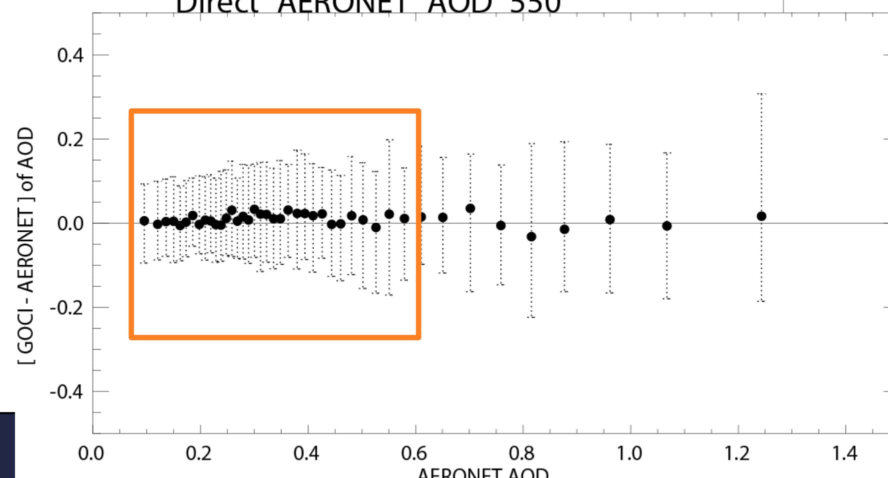
(Each month composite)



(Multi-year composite)

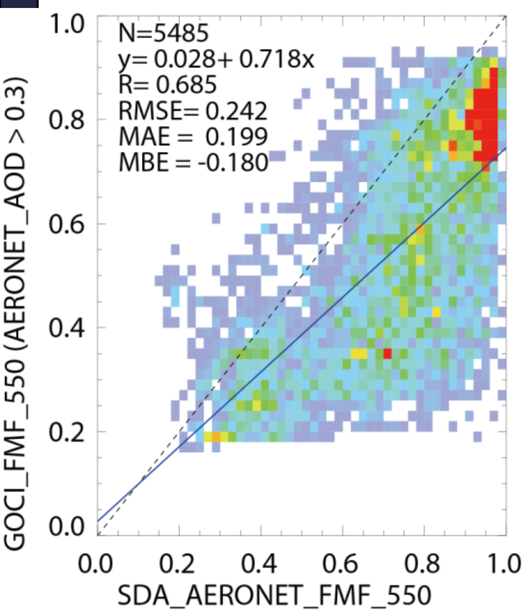




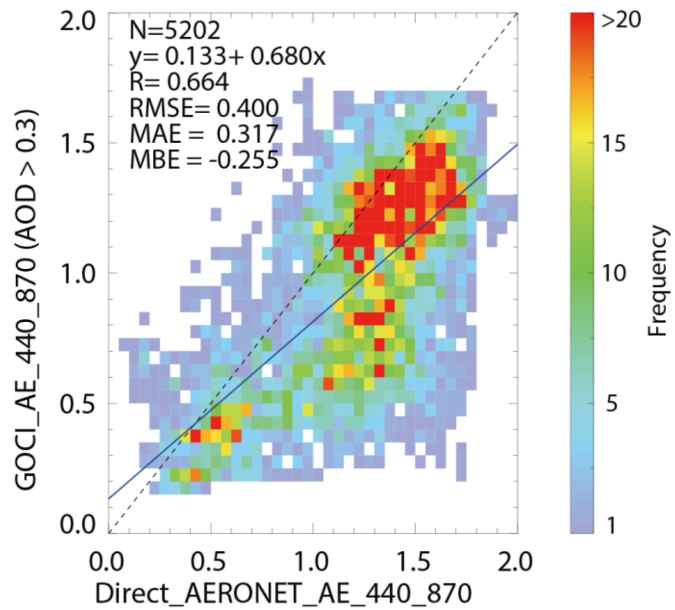


FMF, AE and SSA Validation results of GOCI using AERONET (Land) 2012.03-05 DRAGON Campaign period

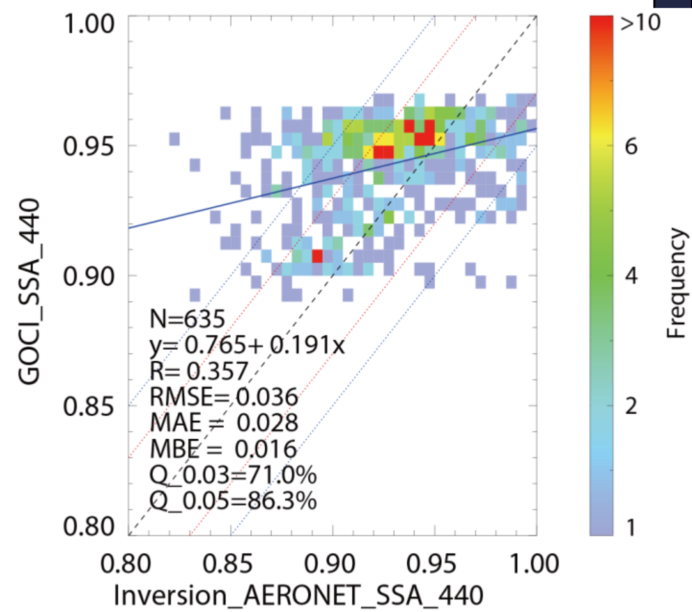
FMF at 550 nm



AE b/w 440 and 870 nm



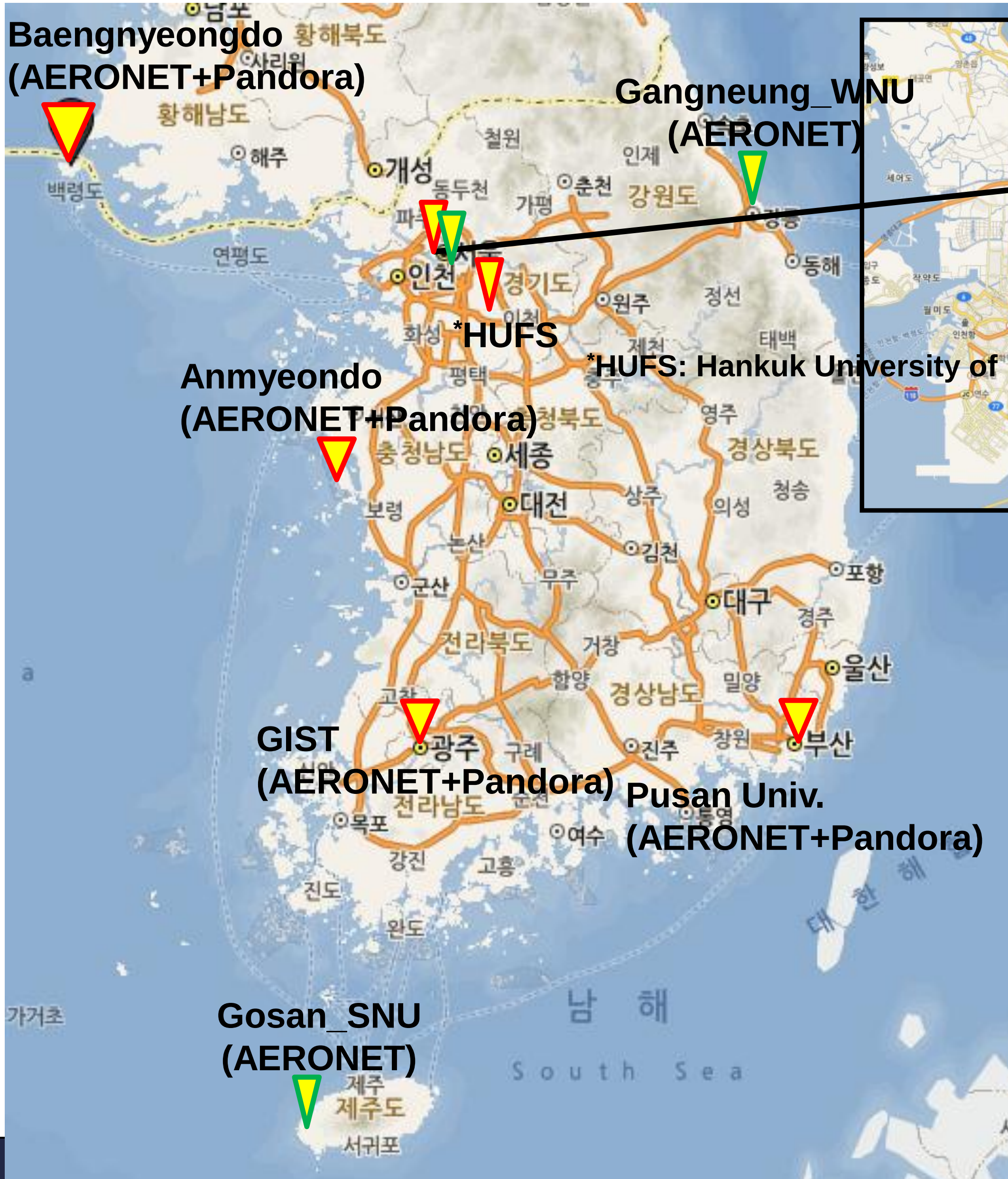
SSA at 440 nm



- DRAGON-NE Asia Campaign 38 sites
- Spatial colocation: average of GOCI pixels within 25km at AERONET site
- Temporal colocation: average of AERONET data within 30min at satellite measurement time

GOCI YAER FMF, AE, and SSA shows lower accuracy than AOD,
but still shows some skills for qualitative use.
(More improvements are necessary)

PANDORA & AERONET sites in Korea for KORUS-AQ



AERONET:
Aerosol optical properties (AOD, FMF, AE, SSA, refractive indicies, and etc.)

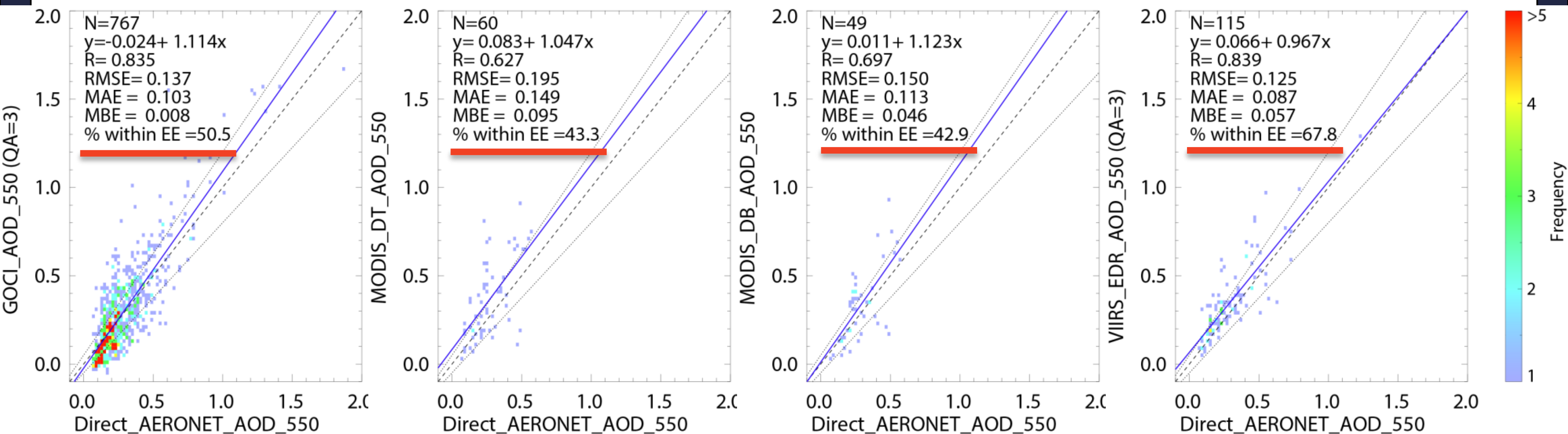
Pandora:
Trace gases concentration (O_3, NO_2, and etc.)

[collaboration with NASA]

AOD validation results of GOCI ,MODIS, VIIRS using AERONET (Land)

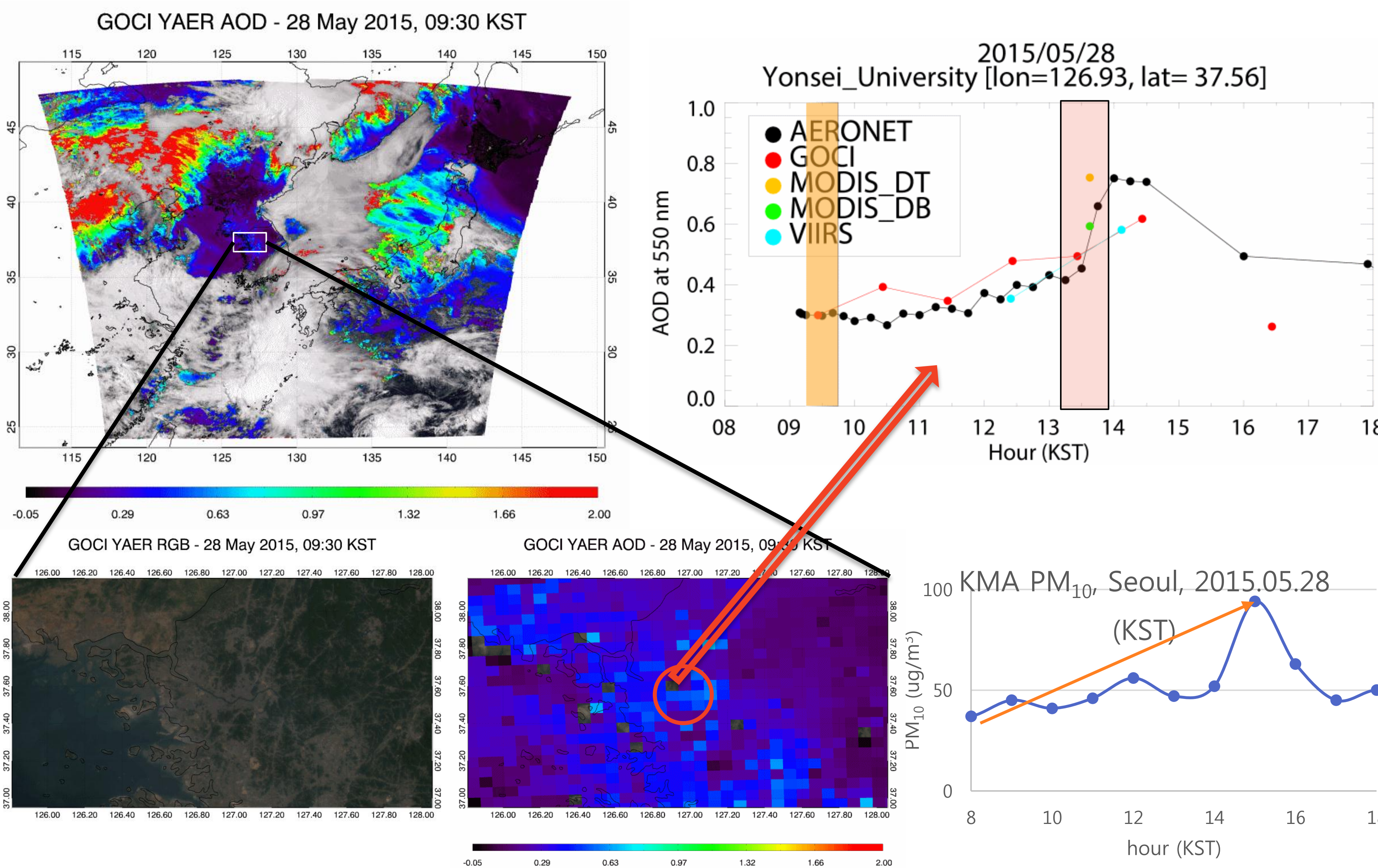
18 May 2015 - 14 June 2015 (Pre KORUS-AQ campaign)

GOCI | **MODIS_DT (C6)** | **MODIS_DB (C6)** | **VIIRS EDR**



- 2015 Pre KORUS-AQ Campaign 8 sites
- Spatial colocation: average of GOCI pixels within 25km at AERONET site
- Temporal colocation: average of AERONET data within 30 min at satellite measurement time
- Expected Error (EE) = 0.05 + 0.15*AERONET AOD (Levy et al., 2007)

High AOD case: 28 May 2015



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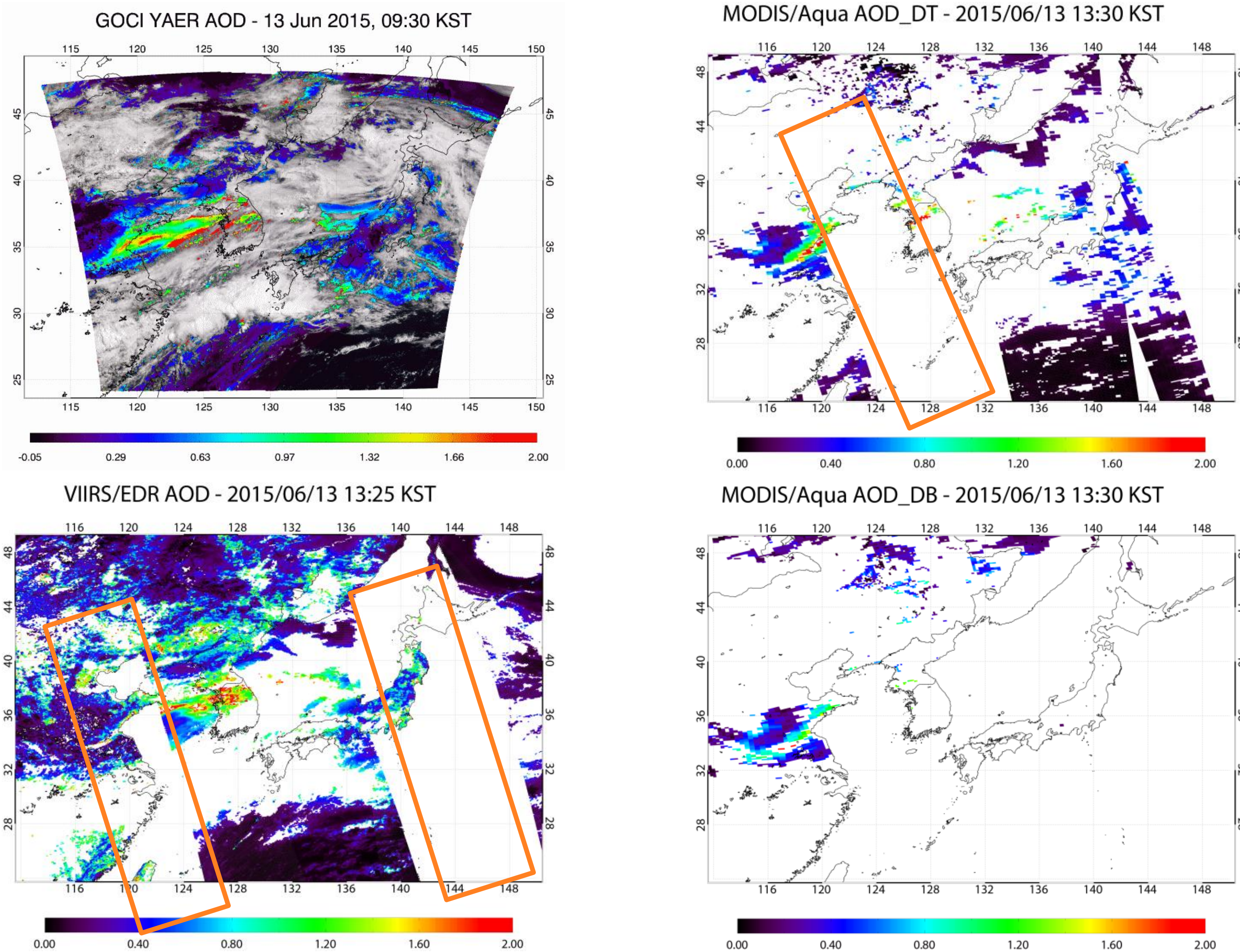
High AOD case: 13 June 2015



GOCI has wider retrieval area over ocean because of different sun-glint angle.

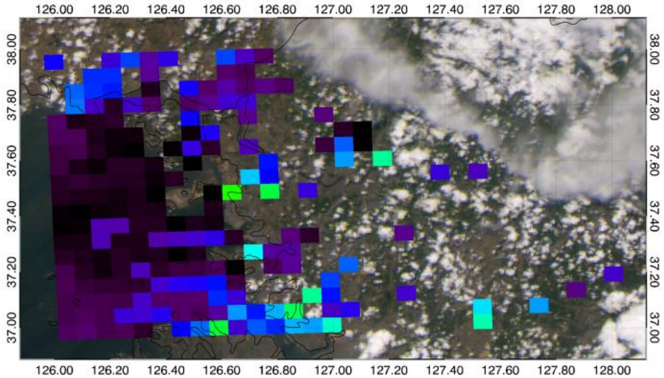
Higher spatial resolution aerosol retrieval

[Choi et al., 2015]

GOCI

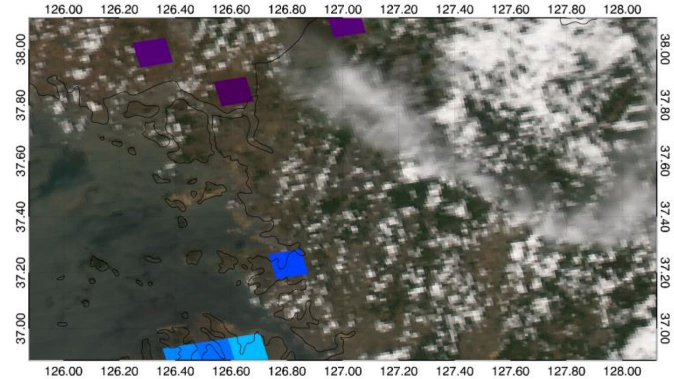
6 km

GOCI YAER AOD - 03 May 2012, 13:30 KST



MODIS_DT AOD (10km) - 03 May 2012

[Levy et al.,2013]



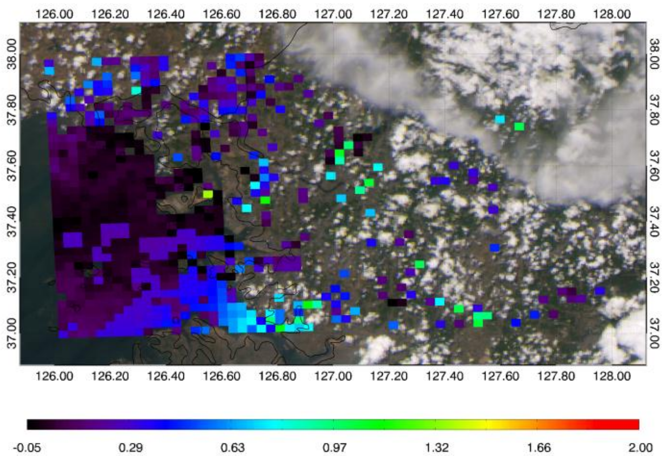
MODIS

10 km

[Test version]

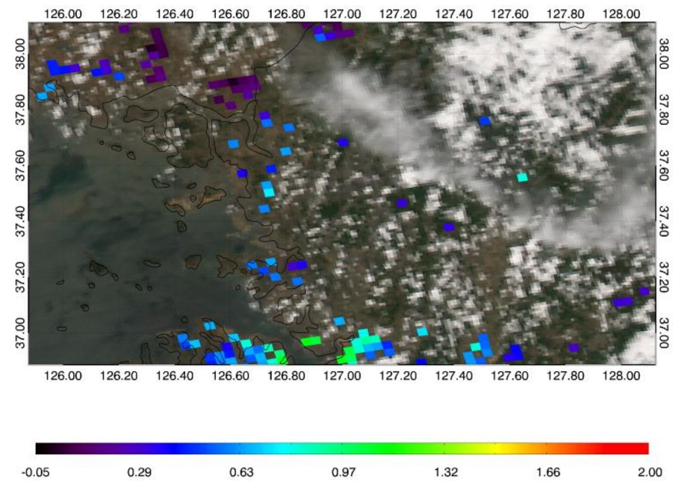
3 km

GOCI YAER AOD - 03 May 2012, 13:30 KST



MODIS_DT AOD (3km) - 03 May 2012

[Remer et al.,2013]

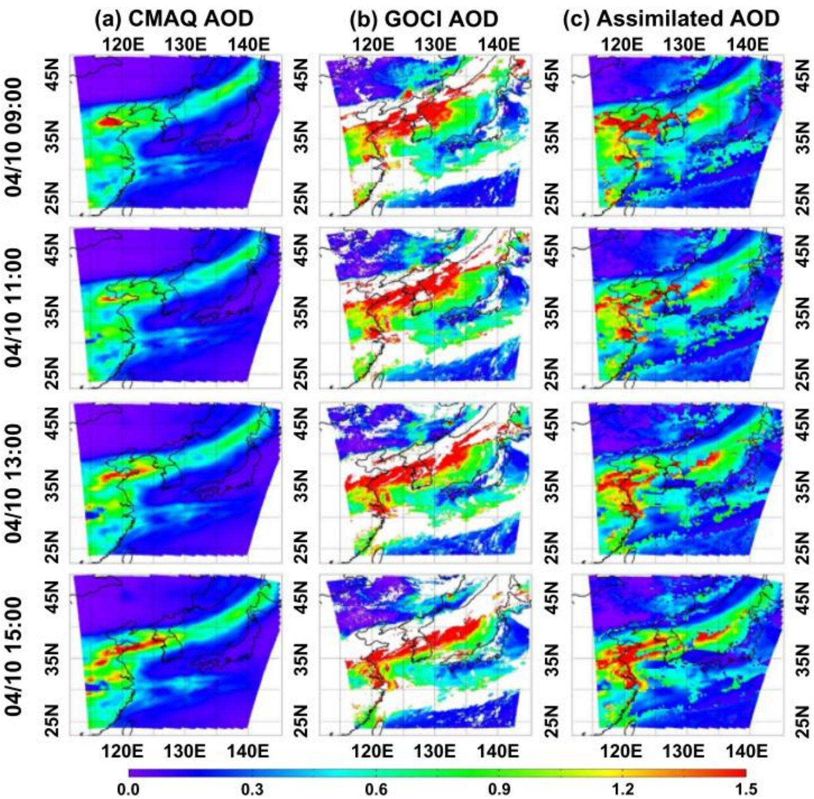


3 km

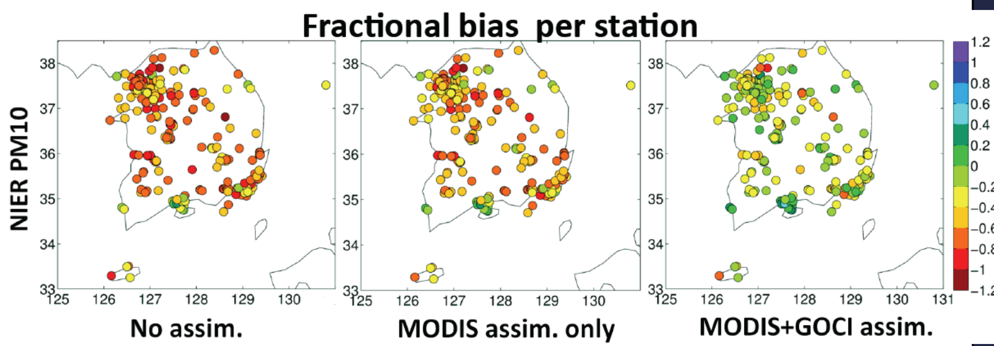
Sub-pixel size cloud and aerosol plume can be distinguished at 3 km retrieval.

Application of GOCI YAER AOD products

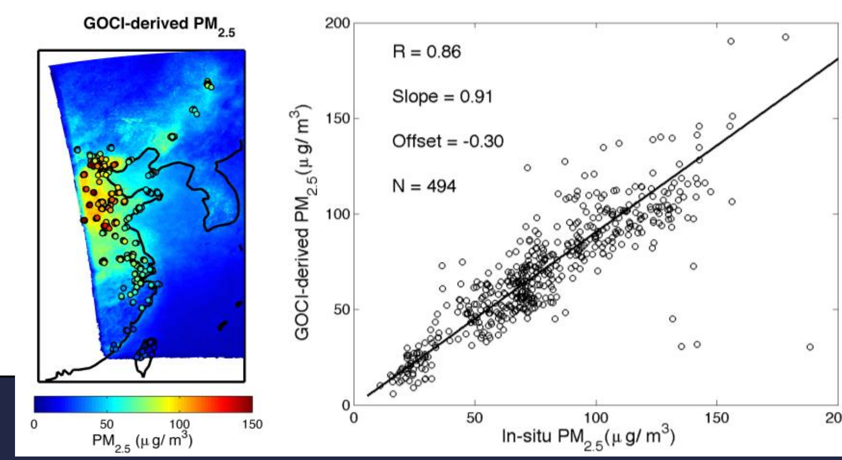
Data assimilation of GOCI AOD with chemical transport model (CMAQ)
Application to the PM_{10}
[Park et al., 2014, ACP]



Data assimilation of GOCI & MODIS AOD with chemical transport model (WRF-chem)
Application to the PM_{10}
[Saide et al., 2014, GRL]



Estimation ground-level $PM_{2.5}$ from GOCI AOD (using GEOS-chem)
[Junwei Xu et al., 2015, ACPD]



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Summary

- GOCI Yonsei aerosol retrieval algorithm was developed and has improved continuously. From GOCI, high spatial and temporal resolution aerosol products can be retrieved accurately (Choi et al., submitted to AMT).

- Retrieved aerosol products are validated with ground-based AERONET and other satellite sensors products. Through 2012 and 2015 ground-based campaigns, GOCI AOPs shows good accuracy against AERONET.
  GOCI = 0.999 × AERONET + 0.018, R = 0.885 (2012 DRAGON, 38 sites)
  GOCI = 1.114 × AERONET - 0.024, R = 0.835 (2015 Pre KORUS-AQ, 8 sites)

- For next year KORUS-AQ campaign, future work is the improvement of surface reflectance over land more accurately (Hsu et al., 2013). And, higher spatial resolution (~3 km) retrieval for air quality application (Remer et al., 2013).

- Inter-comparison study with Himawari-8 Aerosol products is also helpful for algorithm verification.

- Application of hourly GOCI AOD
  : Improvement of air quality simulations through data assimilation with CTM.

Thank you for your attention.