High-resolution MAIAC Aerosol Retrievals from AHI-8 HIMAWARI

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MAIAC: Main Features

1. *Sliding window algorithm – store up to 4 days of measurements in memory → BRDF;*

2. *Dynamic characterization of SR spectral ratios using MRM*

3. *Detailed surface characterization for each grid cell (spectral BRDF; spatial variation from 500m band; BT-contrasts etc.) → high quality cloud, snow, cloud shadow detection;*

4. *Smoke/Dust Absorbing aerosol Test*

5. *Product suite: CM, Snow Mask, AOD (0.47 and 0.55μ), Aerosol Type, Aerosol Plume Height, spectral surface reflectance (atmospheric correction); Over water – AOD and FMF (fine mode fraction), water-leaving reflectance*

MAIAC Aerosol Type (Smoke/Dust)

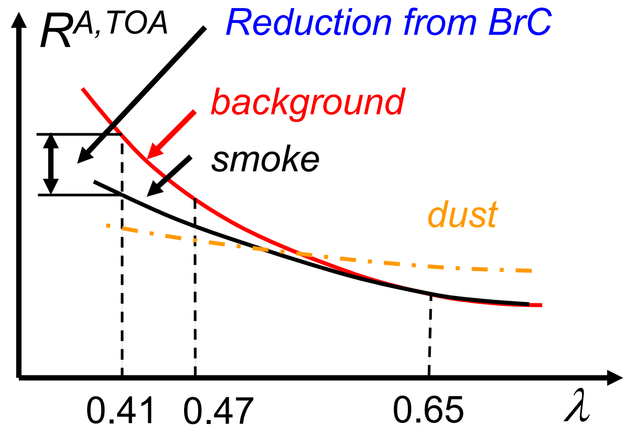
*Lyapustin, A. et al., 2012: Discrimination of biomass burning smoke and clouds in MAIAC algorithm, **ACP**, 12, 9679–9686.*

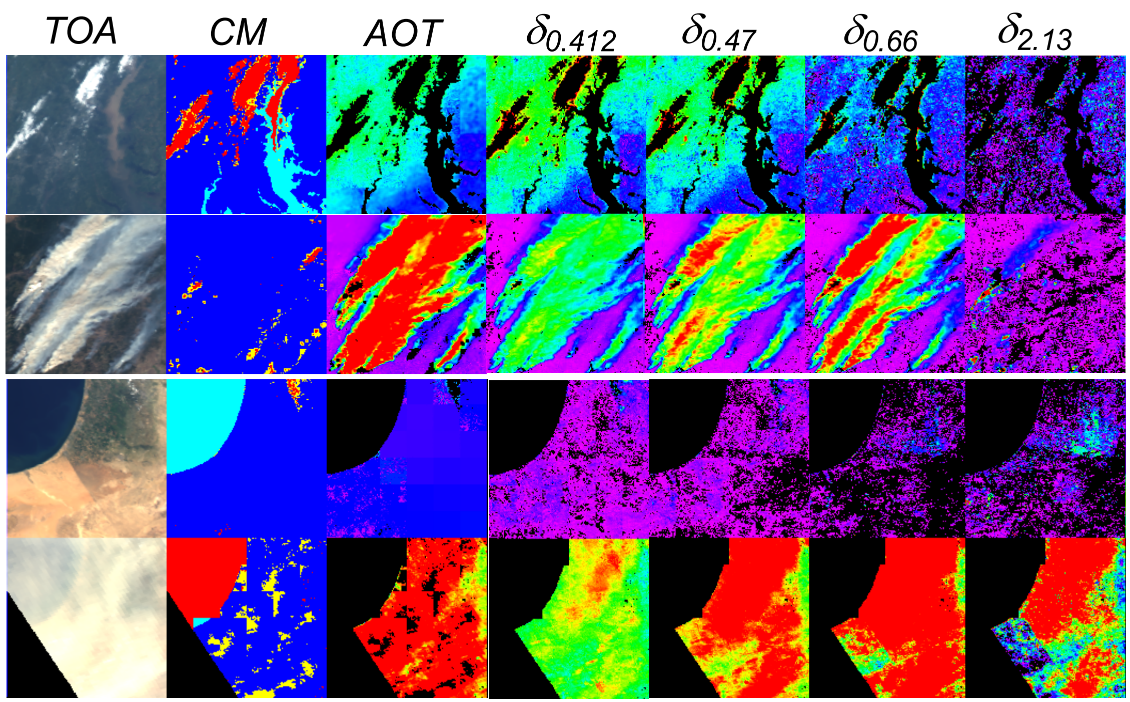
*Phys. principles (~OMI) – **enhanced shortwave absorption** (Red →Blue →DB)*

$$R_\lambda^{Aer} = R_\lambda^{Meas} - R_\lambda^{Molec} - R_\lambda^{Surf}(\tau^a)$$ *- proxy of aerosol reflectance*

1) *n_i increases R→DB for OC (smoke) and dust;*

2) *Multiple scattering, for absorbing aerosols.*





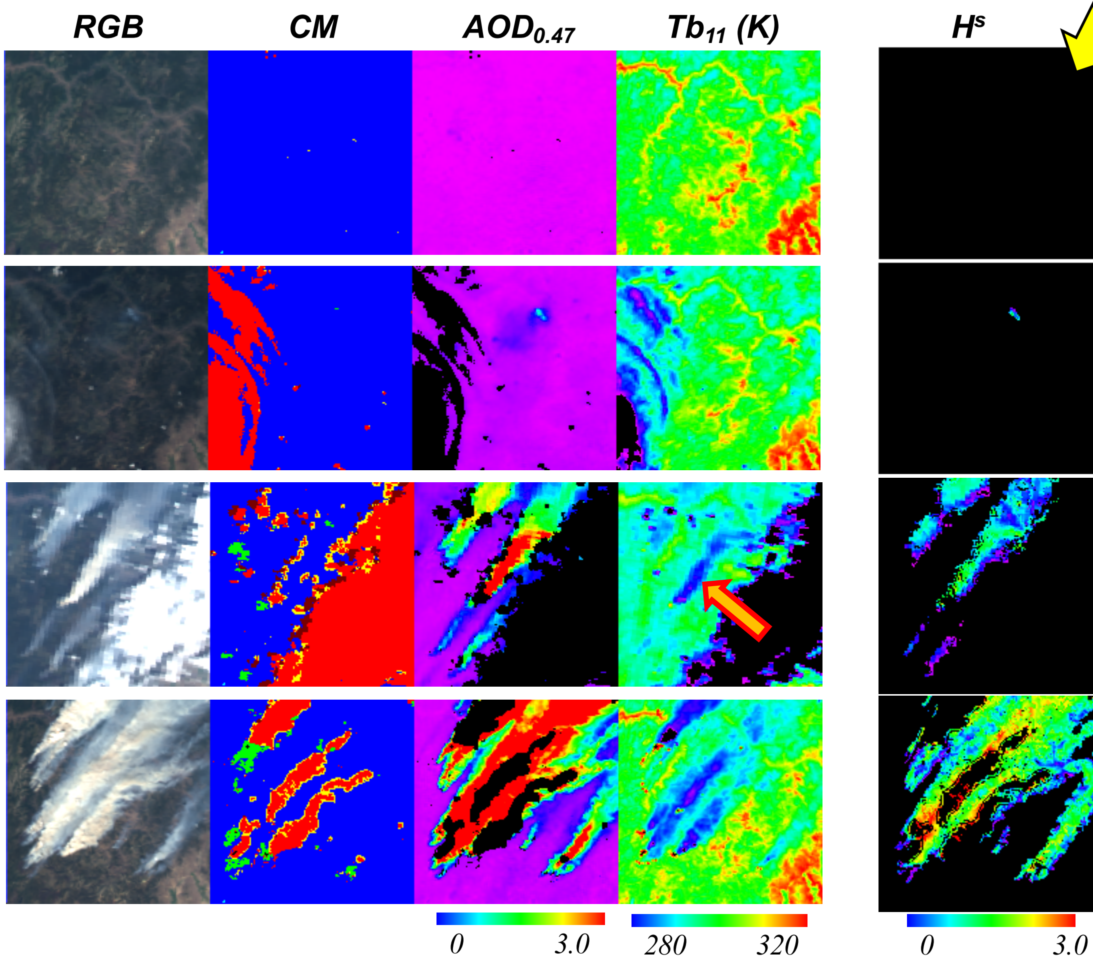
Backgr./Smoke/Dust

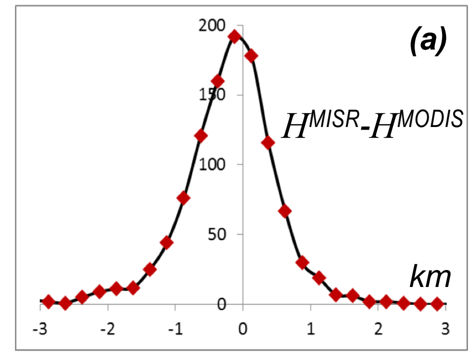
$$\delta_\lambda = R_\lambda^M - R_\lambda^T(\tau_{0.47}^a = 0.05)$$

Model	Abs.	Size
Backgr.	No	Small
Smoke	Yes	Small
Dust	Yes	Large

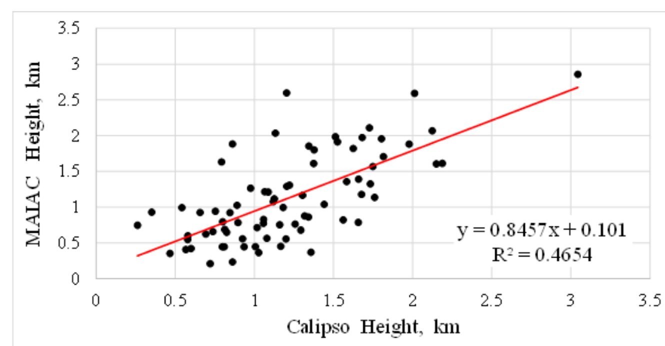
New: Aerosol Plume Height

Lyapustin, A., Y. Wang, S. Korkin, R. Kahn and D. Winker, MAIAC Thermal Technique for Smoke Injection Height from MODIS, TGRL, in review.





a) *Histogram of MODIS-MISR MINX plume height difference (2000-2008);*

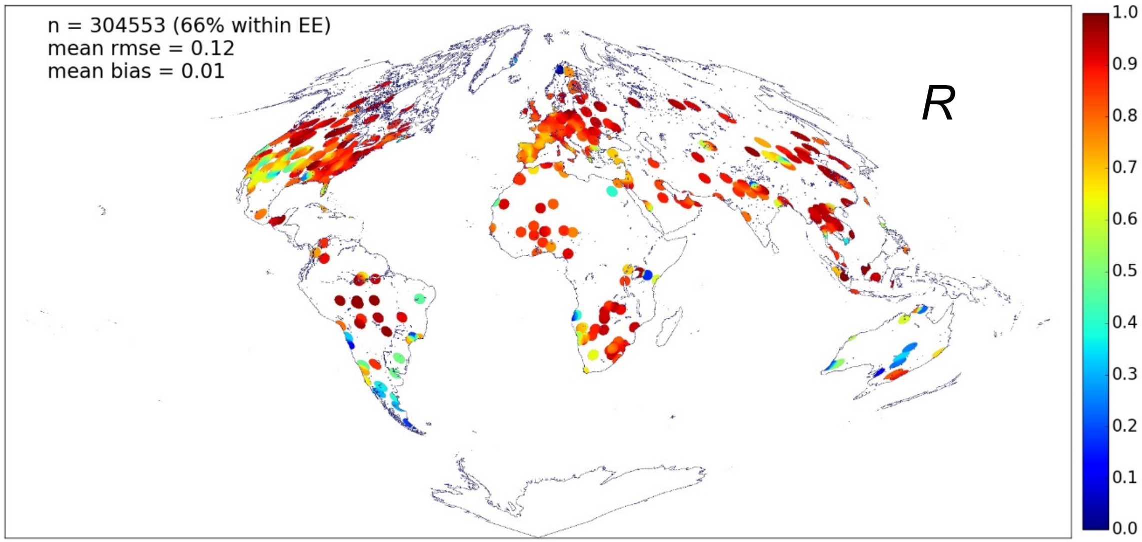


b) *Validation against CALIOP CALIPSO plume heights over N. America.*

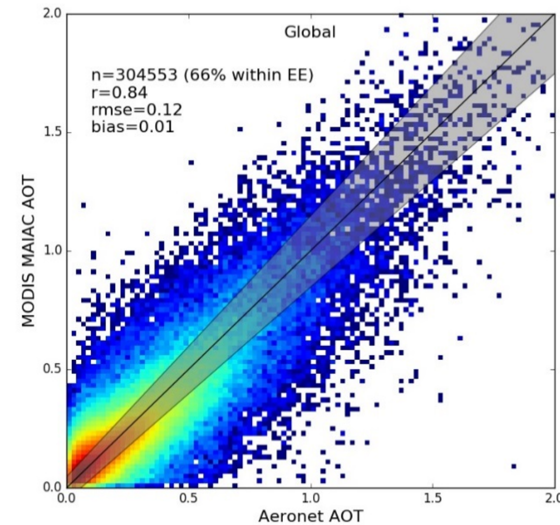
1. *MAIAC agrees to both MISR MINX and CALIOP CALIPSO to about ±500m.*
2. *On average, thermal height is 220-450m lower than lidar and stereoscopic data.*

Aerosol Validation (2000-2016)

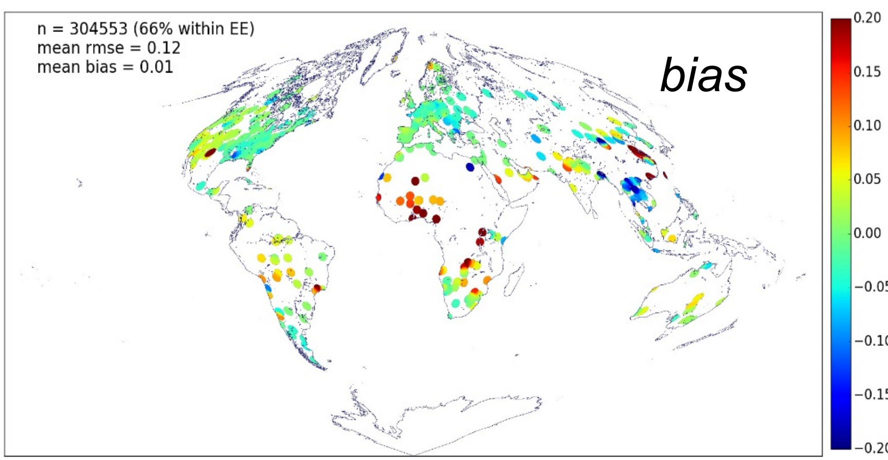
Lyapustin, A., et al..: MODIS Collection 6 MAIAC Algorithm, AMT, 2018

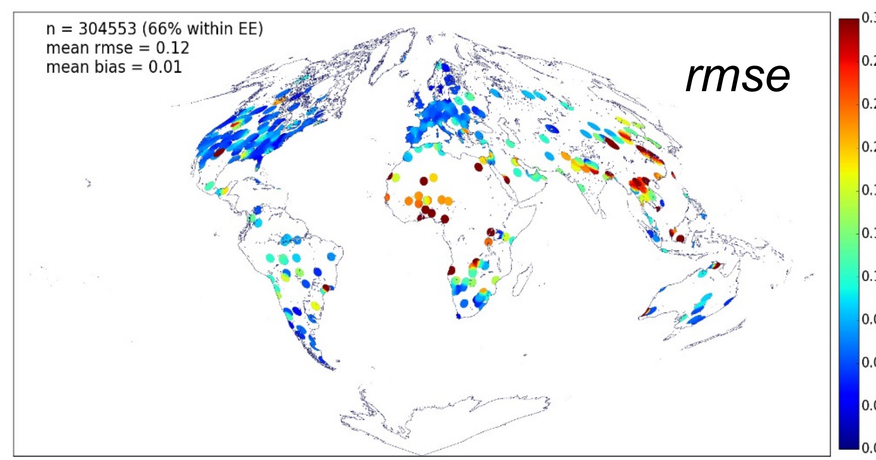


EE = ±0.05 ±0.1AOD



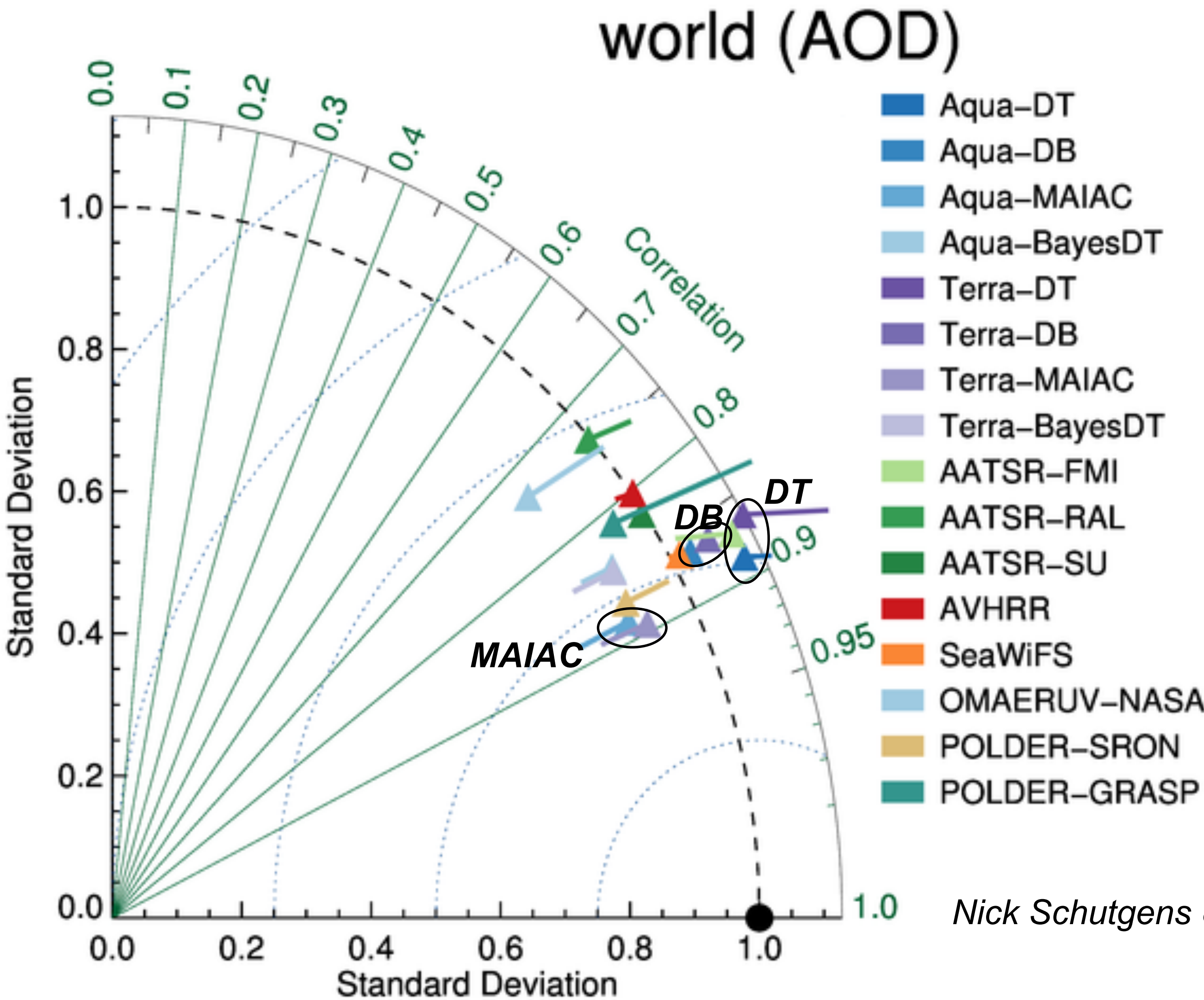
Bias is regionally clustered. Will be fixed in C6.1.





Global Over Land Inter-Comparison

1×1°, time-resolved



Nick Schutgens & AEROSAT team

Geostationary Observations

1. ***Geostationary Observations (10-15min):***

> *- Provide dynamics to study Aerosols, Clouds and their interactions;*
>
> *- Diurnal Cycle of Aerosol → Air Quality;*
>
> *- Dynamics of fires and dust storms;*

- Unprecedented angular resolution (in SZA, AZ) for land BRDF studies and vegetation structure;

- Improved vegetation phenology and productivity (e.g., timing of northern spring green-up);

- Improved GPP modeling from diurnally-resolved PAR;

- Rapid disturbance characterization at scales 500m-1km, etc.

2. ***Adapting MAIAC to AHI-8 HIMAWARI**:*

Bands: 0.47, 0.51, 0.64, 0.86, 1.61, 2.25, 3.9, …, 10.4, 11.2, 12.4μm

3. ***Adapting MAIAC to ABI GOES-16**:*

Bands: 0.47, 0.64, 0.86, 1.38, 1.61, 2.25, 3.9, …, 10.4, 11.2, 12.4μm

MAIAC for HIMAWARI AHI-8

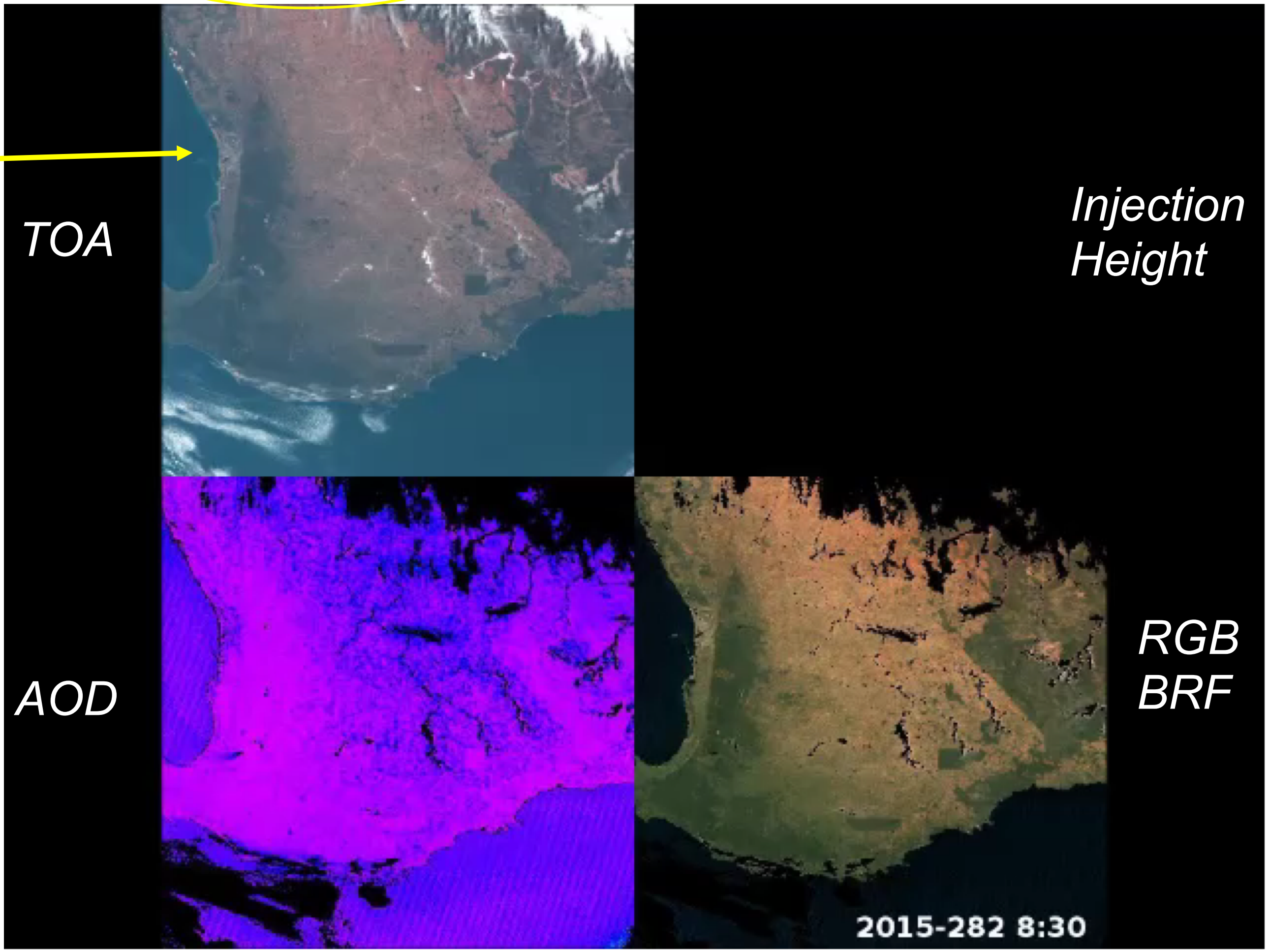
(Australian Bureau of Meteorology: controlled burns)

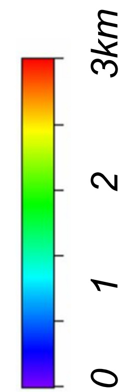
Parked at 142°E;

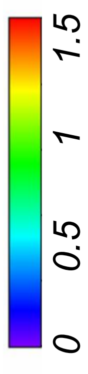
Smoke detection bands: sub-optimal

Bands: 0.47, 0.51, 0.64, 0.86, 1.6, 2.3, 3.9, …, 10.4, 11.2, 12.4μm

South-West Australia: Perth

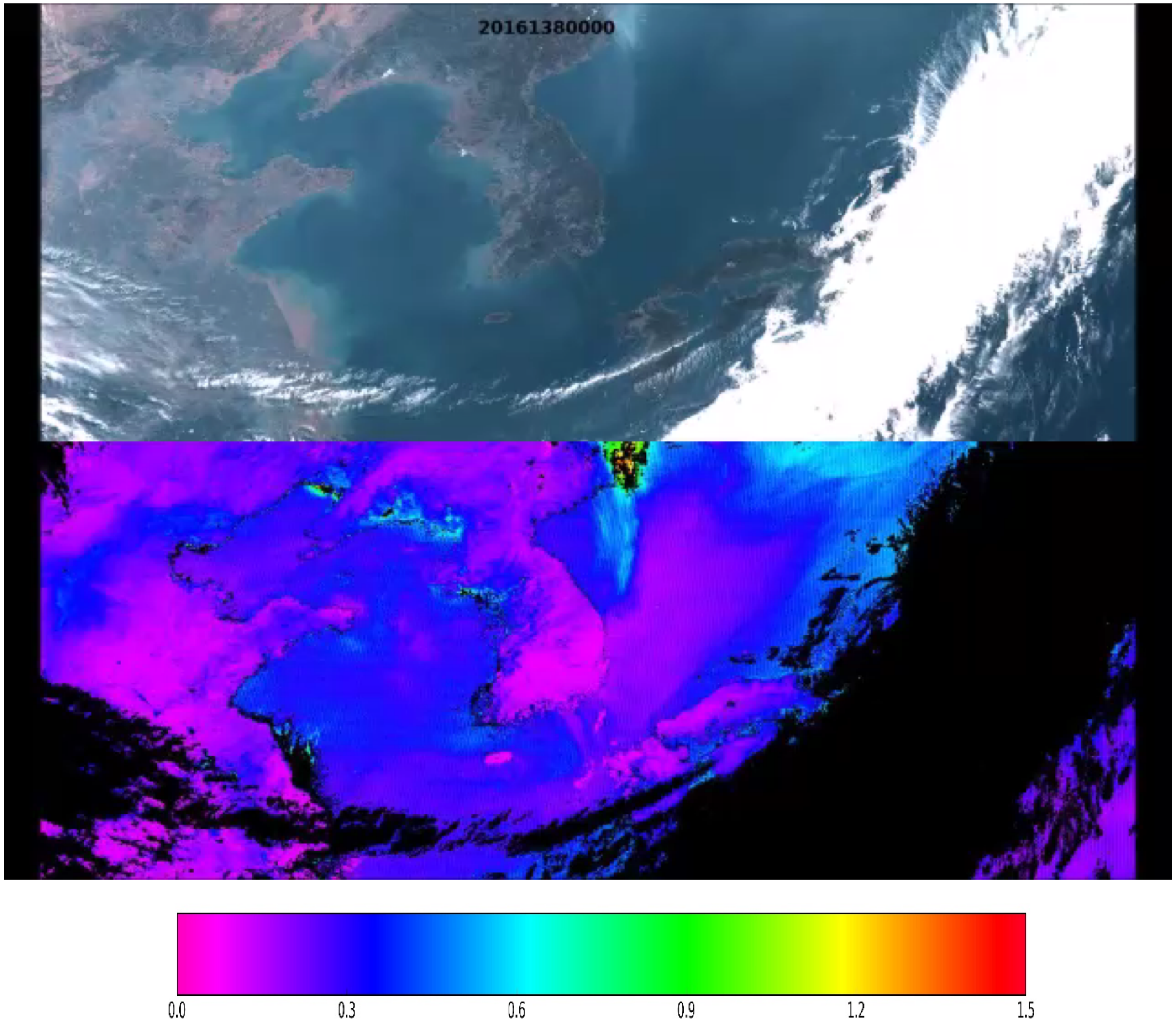






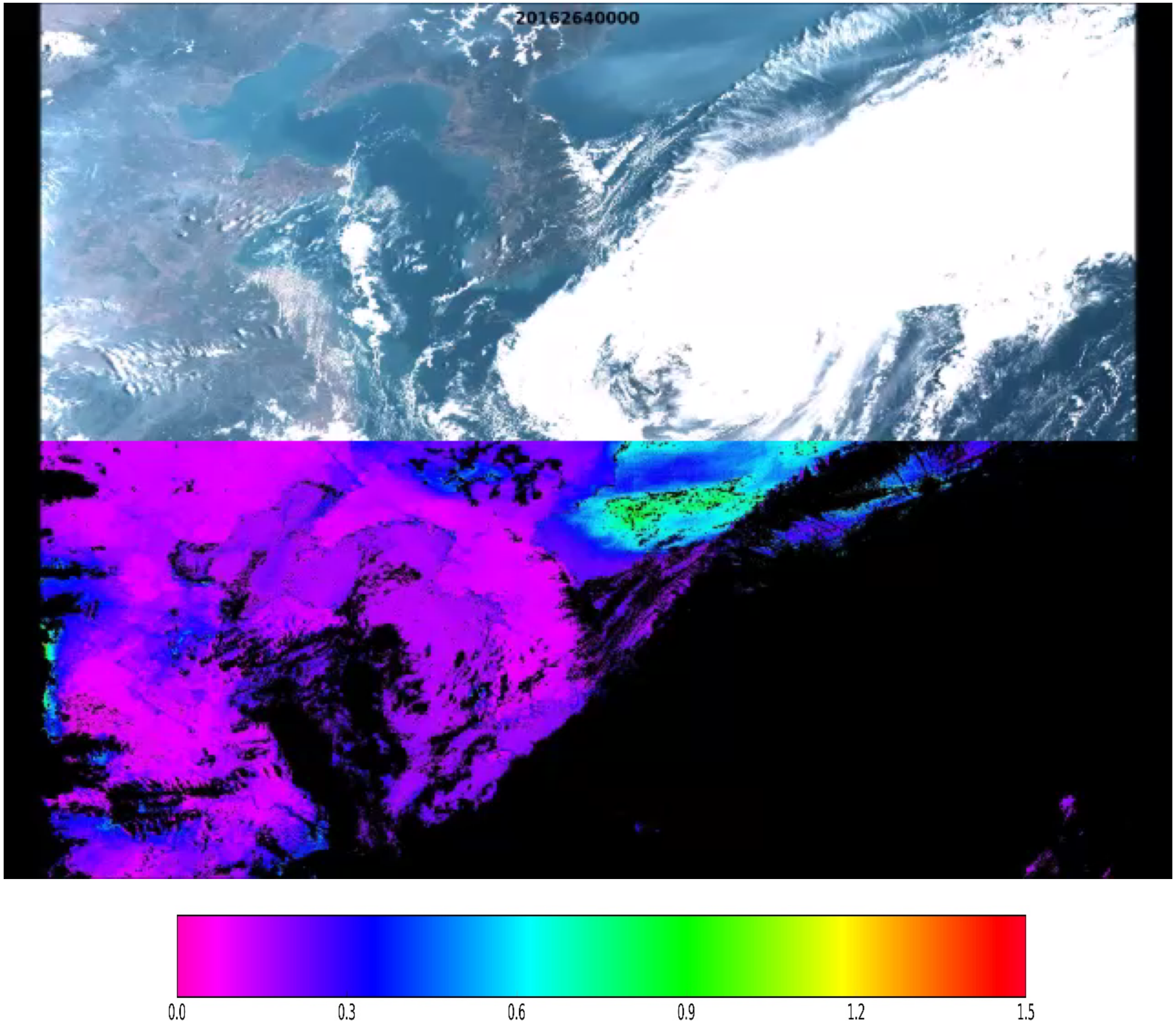
Siberian Fire Smoke Over Japan

May 17-23, 2016



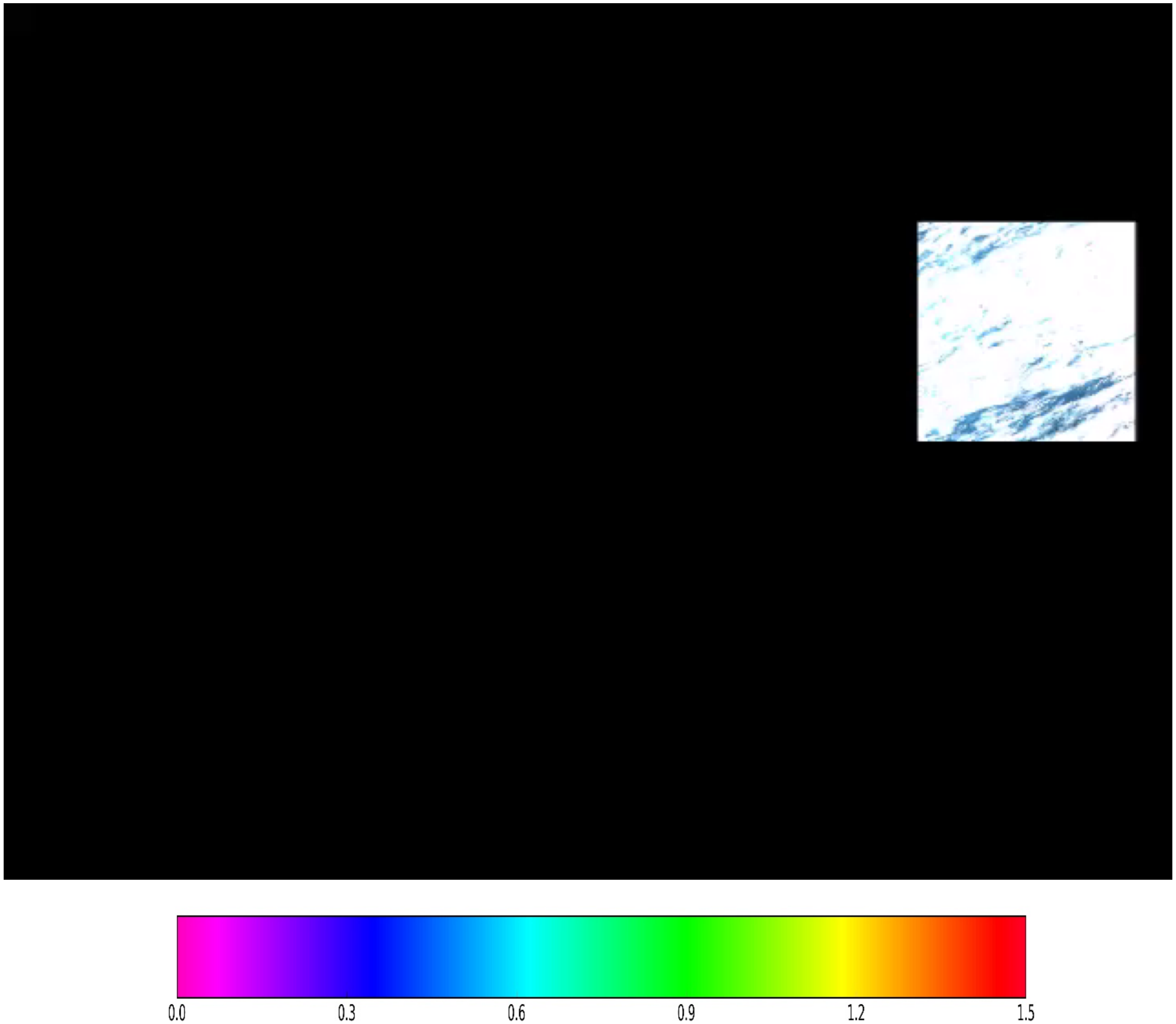
Pollution Passing Over Korea Overnight

September 20, 2016



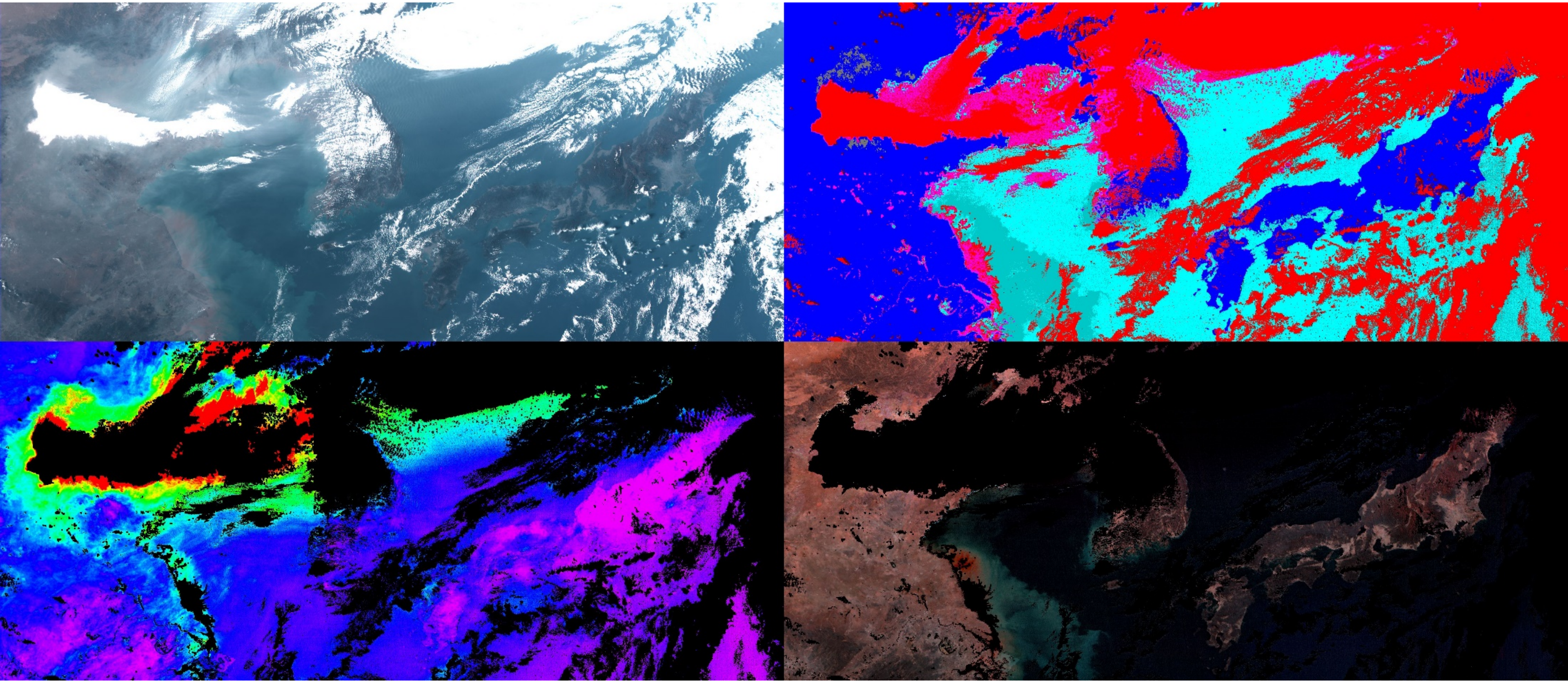
High AOD Over Korea

October 13, 2016

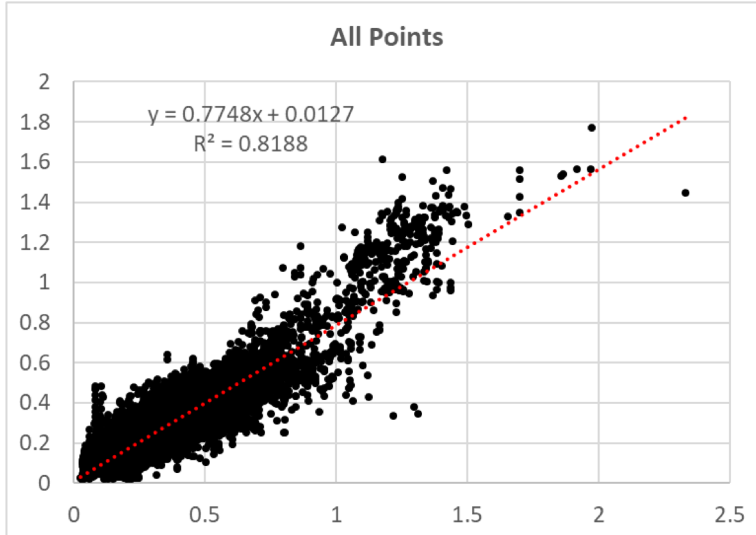


Atmospheric Correction and Ocean Color

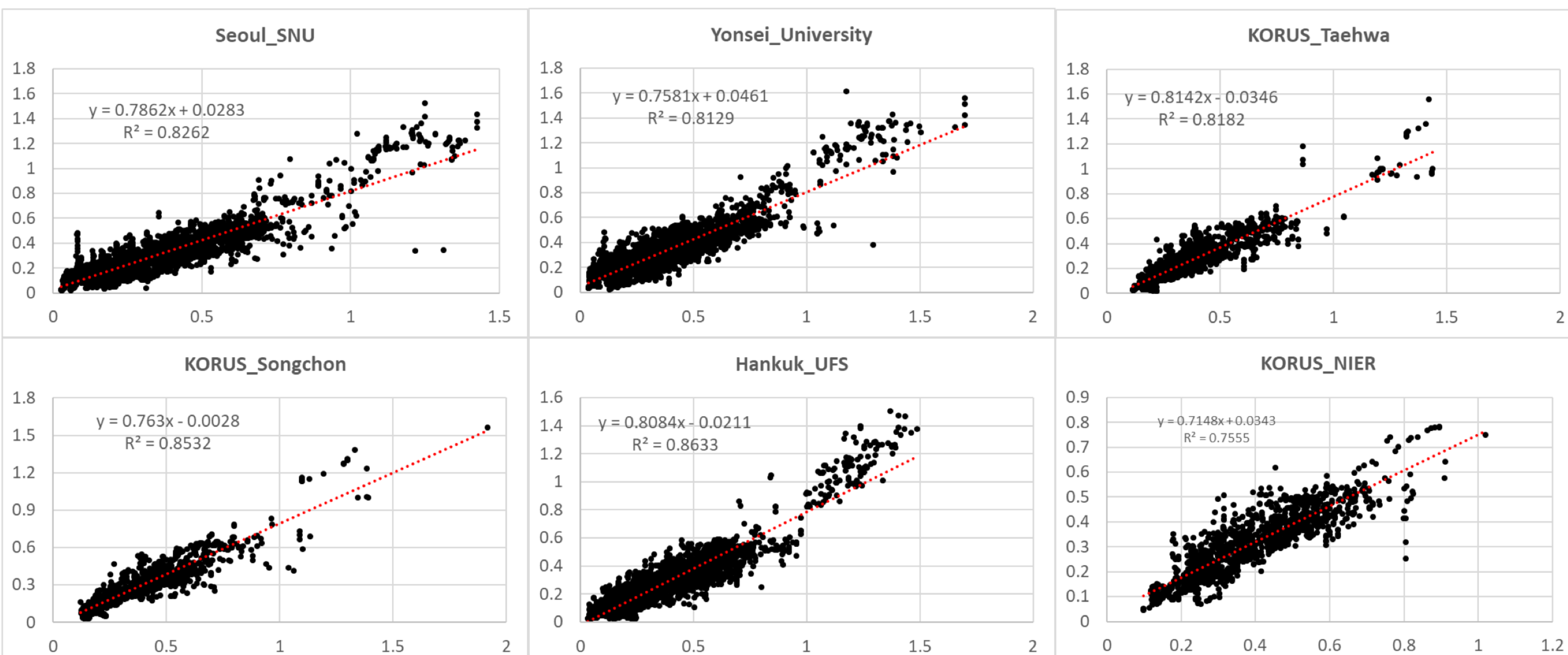
November 5, 2016



Validation for KORUS-AQ Campaign

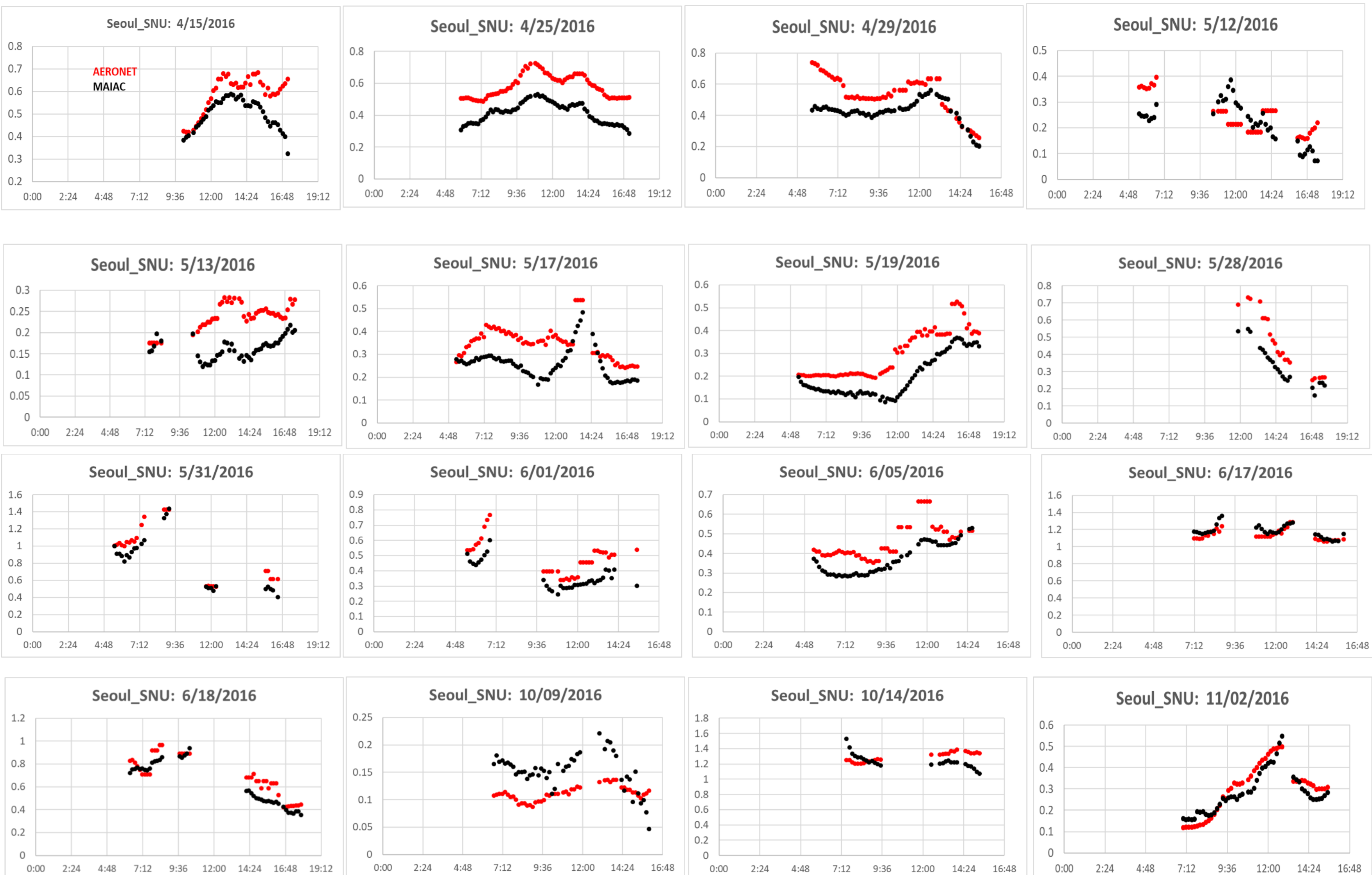


MAIAC data are averaged over 11km^2

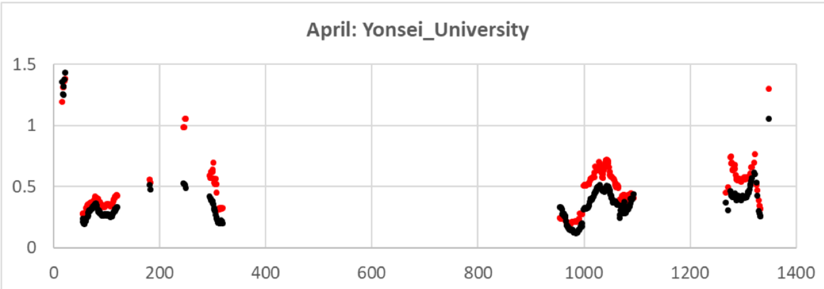


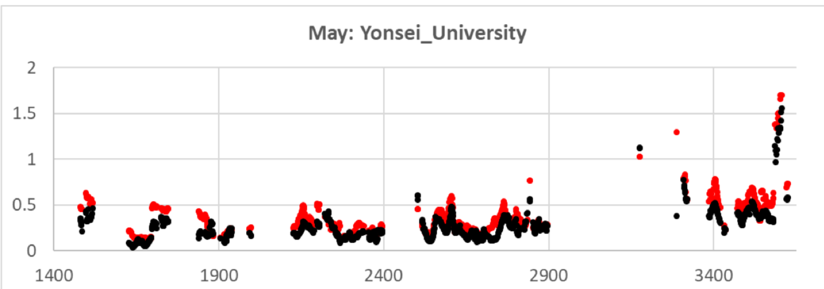
Diurnal Cycle

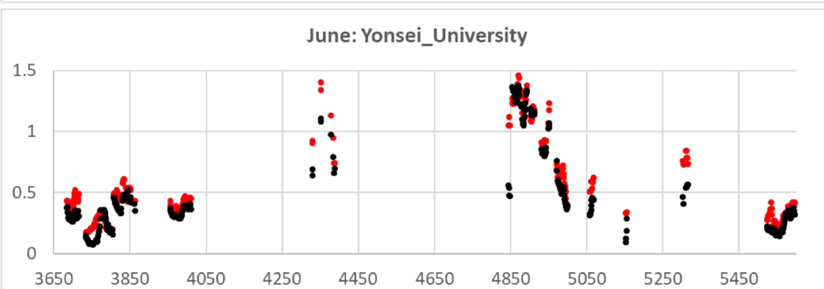
MAIAC data are averaged over 11km^2

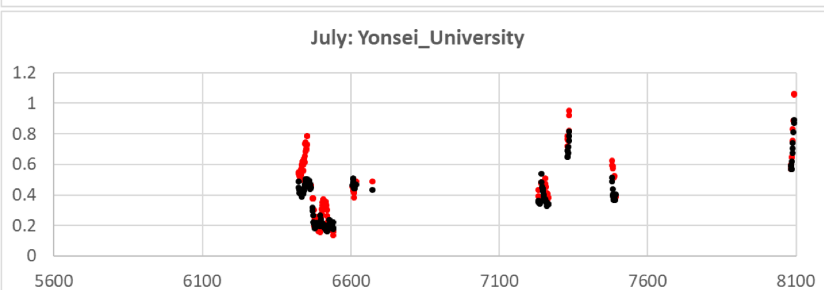


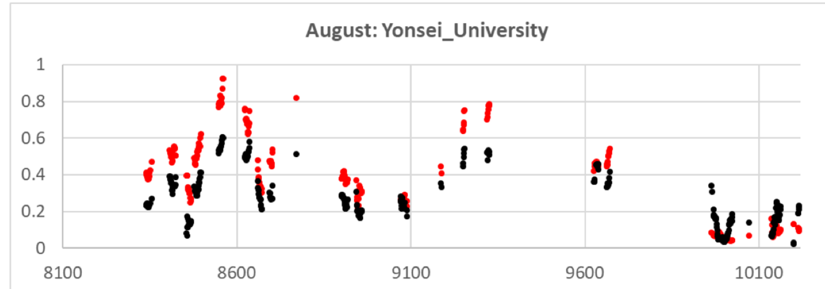
Diurnal Cycle

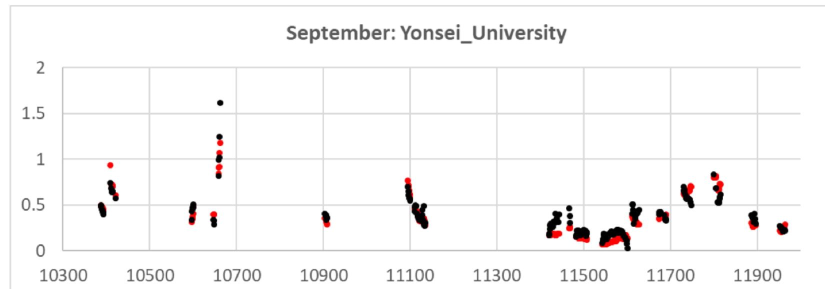


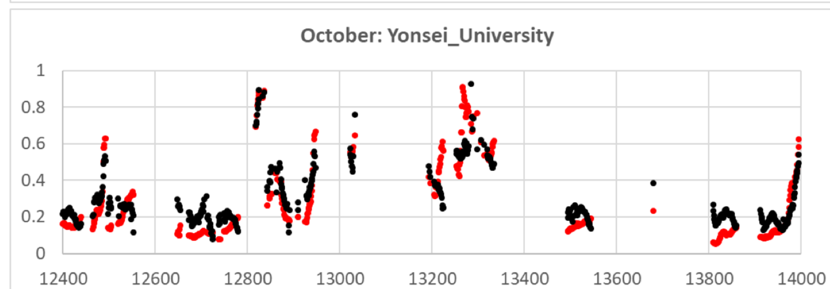


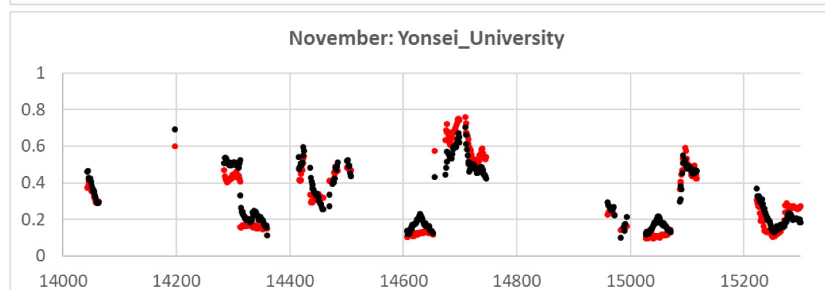




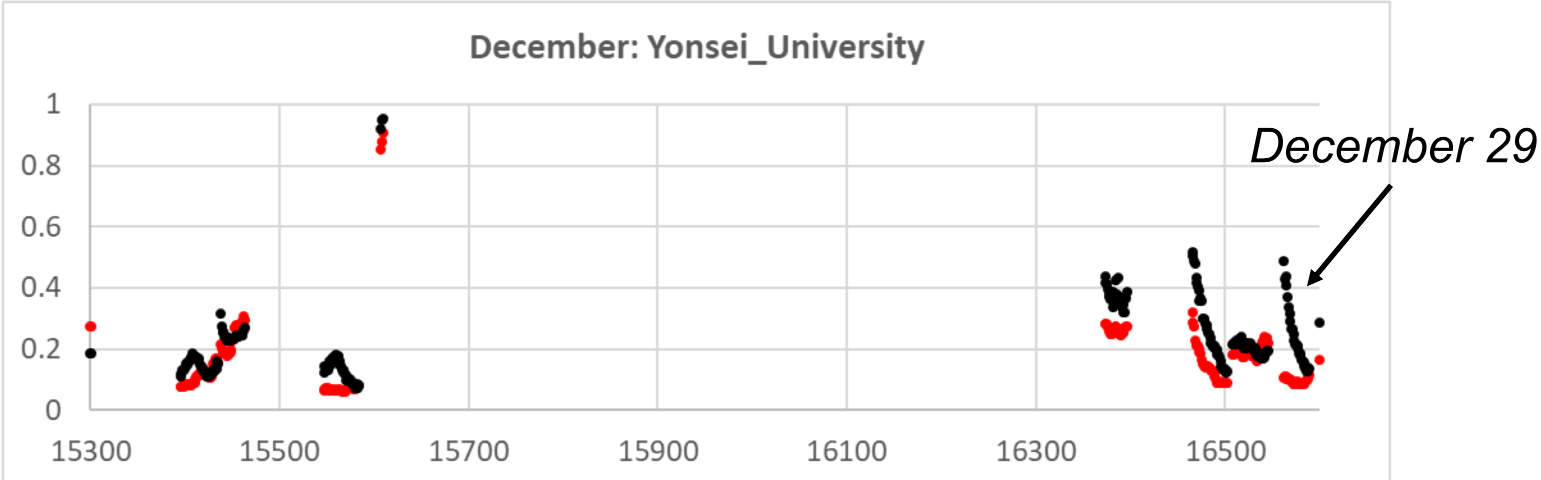




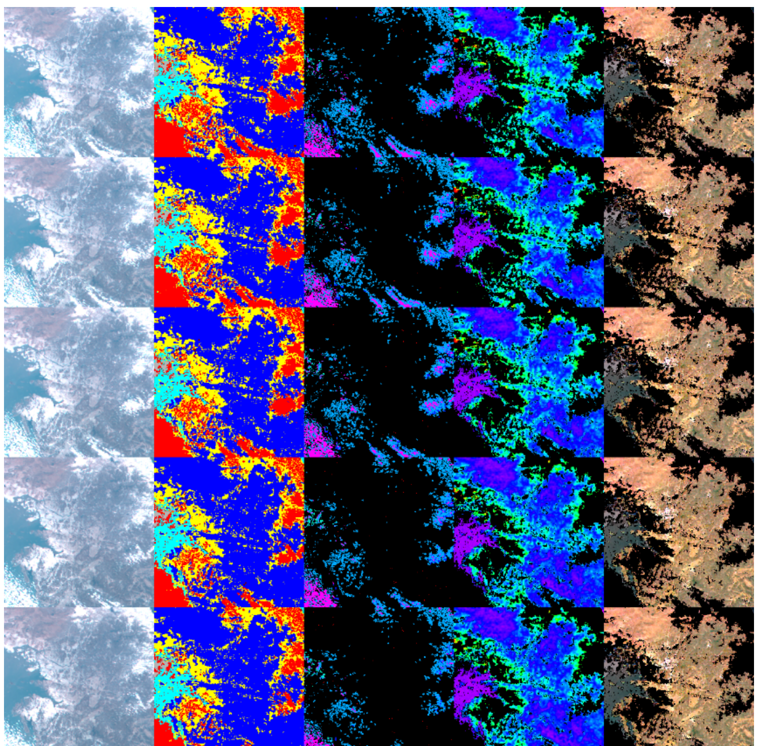




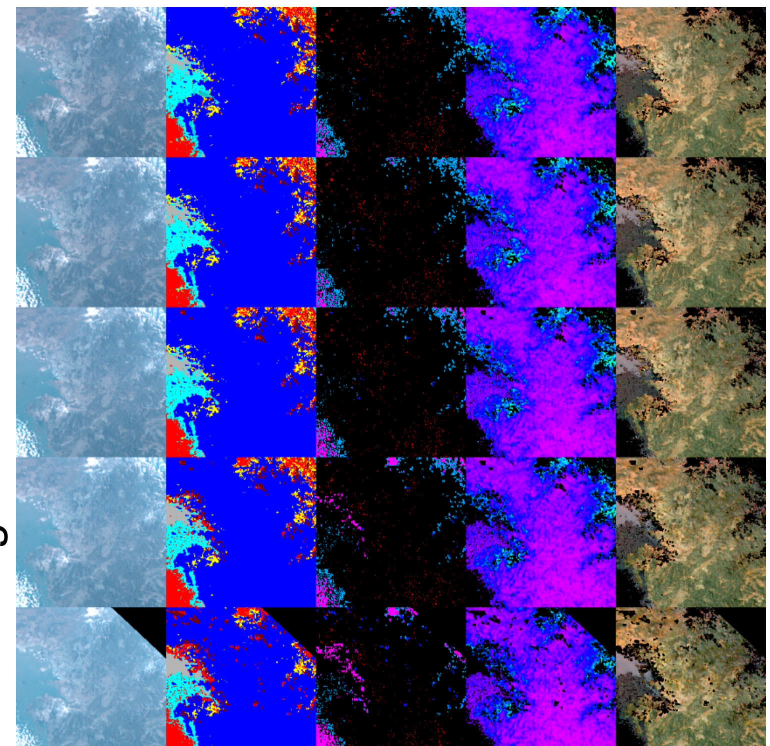
Diurnal Cycle



Morning: High AOD~0.5 due to undetected cloud edges



Evening: Clouds dissipated, AOD agrees with AERONET



Conclusions

1. *Currently, MAIAC is ~70% adapted for AHI-8 HIMAWARI;*
2. *Correlation with AERONET is good, R^2>0.8;*
3. *Reproduce the AERONET diurnal pattern with some exceptions;*
4. *Geostationary helps distinguish local sources vs long-range transport;*
5. *Issues to be addressed:*
   - *Dust Detection;*
   - *CM & snow detection optimization;*
   - *Systematic low biases in both AOD and SR at cSZA<0.4 – either PP RT model (spherical) or BRDF*