Aerosol observations using S-GLI sensor

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and CI team

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Contents

1. GCOM satellite series
   GCOM-C1 / SGLI

2. Aerosol retrieval for SGLI
   2ch polarization method
   by POLDER

   2ch polarization & 1ch total radiance method
   by POLDER + GOSAT / CAI

3. PM$_{2.5}$ retrieval

4. Summary
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4. Summary
Global Change Observation Mission (GCOM)

2 satellite series for 5 years, total 13 years observation.

- **GCOM-W** AMSR2 (AMSR-E follow on microwave radiometer) for **WATER CYCLE** (Satellite name: 雫)
- **GCOM-C** SGLI (GLI follow on) for **RADIATION BUDGET** and **CARBON CYCLE**

GCOM-W1 (WATER) Shizuku

Sensor

<table>
<thead>
<tr>
<th>Advanced Microwave Radiometer 2 (AMSR2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Microwave Observation</td>
</tr>
<tr>
<td>Water vapor, soil moisture etc</td>
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</tbody>
</table>

GCOM-C1 (CLIMATE)

Sensor

<table>
<thead>
<tr>
<th>Second Generation Global Imager (SGLI)</th>
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</thead>
<tbody>
<tr>
<td>Optical Observation 380nm – 12 micron</td>
</tr>
<tr>
<td>Cloud, Aerosol, Vegetation, Chlorophyll etc</td>
</tr>
</tbody>
</table>

Courtesy of Dr. Tanaka (JAXA/EORC)
## Implementation Plan: Milestone

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<td>BBM</td>
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<td>Phase-A</td>
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<td>Phase-C</td>
<td>Phase-D</td>
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<td>Project start</td>
<td>System PDR</td>
<td>System CDR</td>
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<td>Research Announcement</td>
<td>RA#1</td>
<td>RA#2</td>
<td>RA#3</td>
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<tr>
<td>Product version ups &amp; Software implementation</td>
<td>Analysis using existing satellite data</td>
<td>Implementation-1 Performance test</td>
<td>Intensive Cal/Val phase</td>
<td></td>
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<td>Operation test</td>
<td>Improvement with product version up</td>
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<td>Implement for C2</td>
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<td>Version-ups &amp; improvement</td>
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</table>

### Algorithm development & improvement

1. Initial development
   - Preparation study
   - Investigation of candidates

2. Performance development
   - Theoretical performance and applicability

3. Operational algorithm
   - Selection & development of operational algorithm

4. Post-launch development and improvement phase
   - Product validation and improvement
   - Achievement of GCOM-C science targets
   - New algorithm and usage
   - Succession to the GCOM-C2

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**Courtesy of Dr. Murakami (JAXA/EORC)**
SGLI on GCOM-Climate #1 satellite

SGLI ;
Second Generation Global Imager

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>SGLI IRS</strong></td>
<td><strong>SGLI VNR</strong></td>
</tr>
<tr>
<td>(Infrared Scanning Radiometer)</td>
<td>(Visible and Near IR Radiometer)</td>
</tr>
</tbody>
</table>

**Mission Life** | > 5 years
**Solar Paddle** | > 4000w (End of Life)
**Mass**          | about 2,000kg

Courtesy of Dr. Tanaka (JAXA/EORC)
SGLI Visible and Near infrared radiometer (SGLI-VNR)

VNR-SRU
- Diffuser stowed
- PL Nadir

VNR non Polarized Obs. (NP)
- 3 telescopes with 24deg FOV realize the total 70 deg FOV Observation (1,150km)
- Wide wavelength range Observation from 380 to 869 nm.

VNR Polarized Obs. (PL)
- 2 telescopes with 55 deg FOV each for 674 and 869 nm Observation.
- AT tilting mechanism for + / - 45deg
- 55 deg FOV with 45 deg tilting

October 2011 Post Acoustics Alignment

Courtesy of Dr. Tanaka (JAXA/EORC)
### GCOM-C SGLI characteristics

<table>
<thead>
<tr>
<th><strong>Orbit</strong></th>
<th>Sun-synchronous (descending local time: 10:30) Altitude 798km, Inclination 98.6deg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mission Life</strong></td>
<td>5 years (3 satellites; total 13 years)</td>
</tr>
<tr>
<td><strong>Scan</strong></td>
<td>Push-broom electric scan (VNR) Wisk-broom mechanical scan (IRS)</td>
</tr>
<tr>
<td><strong>Scan width</strong></td>
<td>1150km cross track (VNR: NP &amp; PL) 1400km cross track (IRS: SWI &amp; TIR)</td>
</tr>
<tr>
<td><strong>Digitalization</strong></td>
<td>12bit</td>
</tr>
<tr>
<td><strong>Polarization</strong></td>
<td>3 polarization angles for PL</td>
</tr>
<tr>
<td><strong>Along track direction</strong></td>
<td>Nadir for NP, SWI and TIR, +45 deg / -45 deg for PL</td>
</tr>
<tr>
<td><strong>On-board calibration</strong></td>
<td>VN: Solar diffuser, LED, Lunar cal maneuvers, and dark current by masked pixels and nighttime obs. SW: Solar diffuser, LED, Lamp, Lunar, and dark current by deep space window T: Black body and sensor back ground by deep space window</td>
</tr>
</tbody>
</table>

### SGLI channels

| CH | VNR, SW: VN, P, SW: nm T: μm | VNR, SWI: W/m²/sr/μm T: Kelvin | VN: Solar diffuser, LED, Lunar cal maneuvers, and dark current by masked pixels and nighttime obs. SW: Solar diffuser, LED, Lamp, Lunar, and dark current by deep space window | T: Black body and sensor back ground by deep space window |
|----|-----------------------------|---------------------------------|---------------------------------------------------------------------------------|
| VN1 | 380 10 60 210 250 250 |
| VN2 | 412 10 75 250 400 250 |
| VN3 | 443 10 64 400 300 250 |
| VN4 | 490 10 53 120 400 250 |
| VN5 | 530 20 41 350 250 250 |
| VN6 | 565 20 33 90 400 250 |
| VN7 | 673.5 20 23 62 400 250 |
| VN8 | 25 210 250 250 |
| VN9 | 763 12 40 350 1200 250/1000 |
| VN10 | 868.5 20 8 30 400 250 |
| VN11 | 30 300 200 250 |
| PL1 | 673.5 20 25 250 250 1000 |
| PL2 | 868.5 20 30 300 250 1000 |
| SW1 | 1050 20 57 248 500 1000 |
| SW2 | 1380 20 8 103 150 1000 |
| SW3 | 1630 200 3 50 57 250 |
| SW4 | 2210 50 1.9 20 211 1000 |
| TIR1 | 10.8 0.74 300 340 0.2 250/500 |
| TIR2 | 12.0 0.74 300 340 0.2 250/500 |

**Multi-angle obs. for 674nm and 869nm**

**250m over the Land or coastal area, and 1km over offshore**

**19 channels**

Courtesy of Dr. Tanaka (JAXA/EORC)
Polarized phase function: size information

\( (rg= 0.05, 0.1, 0.2, 0.4 \, \mu m, \ cg=2.0 \, \mu m \, \text{fix} ) \)

\( m=1.45-0.0i \, \text{fix} \)

0.67 \, \mu m

0.87 \, \mu m

Middle scattering region
Polarized phase function: refractive index (real part)

\( \text{rg} = 0.1 \, \mu\text{m}, \, \text{cg} = 2.0 \, \mu\text{m} \, \text{fixed} \)

\( \text{rf}r = 1.40, \, 1.45, \, 1.50, \, 1.55, \, \text{rf}i = 0.0 \, \text{fixed} \)

\( 0.67 \, \mu\text{m} \)

\( 0.87 \, \mu\text{m} \)

Middle scattering region
Two directional observations

Pol. Optics
670, 870 nm (2 ch)
1 km x 1 km

Non Pol optics
(Nadir)
380 nm ~ 12 µm (17 ch)
250 m x 250 m

Pol. optics
670, 870 nm (2 ch)
1 km x 1 km
Two directional observations

Pol. Optics

670, 870 nm (2 ch)
1 km x 1 km

Non Pol optics (Nadir)

380 nm ~ 12 µm (17 ch)
250 m x 250 m

Pol. optics

670, 870 nm (2 ch)
1 km x 1 km
SGLI polarization measurements (tilting operation)

- SGLI measures the atmospheric light at the scattering angle from ~60 to ~120.
Selection of observational wavelengths

BPDF Forest (NDVI=0.35)

\[ \Theta = 105 \ (\theta_0=41.8, \ 0=52.4, \ \Delta \phi=68.7) \]

\[ \alpha \]

\[ \tau \]
1. GCOM satellite series
   GCOM-C1 / SGLI

2. Aerosol retrieval for SGLI
   2ch polarization method
     by POLDER

   2ch polarization & 1ch total radiance method
     by POLDER + GOSAT / CAI

3. PM$_{2.5}$ retrieval

4. Summary
SGLI aerosol products

**ARV**: Aerosol products over ocean derived from VNIR measurements
AOT, Ang. Exp., Aerosol classification

**ARU**: Aerosol products over land by Near UV measurements
AOT, Absorbing information

**ARP**: Aerosol products over land by Polarization measurements
AOT, and Ang. Exp.

**POLDER**
2ch (red & NIR) polarization over land: AOT, and Ang. Exp.
Retrieval algorithms

**POLDER**
- 2ch (red & NIR) radiance over ocean: AOT, and frac. of bi-mode
- 2ch (red & NIR) polarization over land: AOT, and frac. of bi-mode

**CAI + PARASOL**
- 1ch (NUV) nadir radiance + 2ch (red & NIR) polarization over land: AOT, frac. of bi-mode, & SSA

**SGLI (future algorithm)**
- multi-channels radiance + 2ch (red & NIR) polarization over land: AOT, fraction of bi-mode, & complex ref idx.
Soil

Vegetation

Water

Land surface and Sea-surface model

Altitude

Molecules

Aerosols

Land surface and Sea-surface model

BPDF w/ IGBP & NDVI

BPDF w/ Wind speed
**Table 1. Atmosphere-Earth surface system.**

<table>
<thead>
<tr>
<th>Models</th>
<th>Descriptions</th>
</tr>
</thead>
</table>
| **Aerosol models**                  | **1. concentration:** Optical thickness of aerosols (ta),  
**2. size:** Angstrom exponent (a), which is calculated from Mie-scattering theory assuming log- normal size distribution  
**3. chemical composition:** Complex refractive index (m). |
| **Molecular information**           | AFGL US standard by Kneizys et al. (1988)                                                                                                    |
| **Ocean surface model**             | Cox and Munk (1954) model with 5 m/s wind speed, for the clear day.                                                                         |
| **Ocean model**                     | completely absorbent in the near infrared wavelength.                                                                                       |
| **Land surface model**              | Bi-directional polarization distribution functions by Nadal and Breon (1999) is adopted for soil, vegetated, and mixed of both, which is selected by land surface condition at target area. |
| **Land classification**             | IGBP land classification map (Loveland et al., 2000) and NDVI values from POLDER Vis.- NIR measurements.                                      |
| **Land altitude**                   | 5 cases; sea level, 1, 2, 3, 4 km height                                                                                                       |
Aerosols over Japan

Aerosol optical thickness        Angstrom exponent

March 18, 1997

April 25, 1997
Monthly AOT (550 nm) distribution derived from ADEOS / POLDER and ADEOS-2 / POLDER-2

(a) April, 1997
(b) May, 1997
(c) June, 1997

(a') April, 2003
(c') May, 2003
(c') June, 2003
2ch polarization algorithm for SGLI

1 directional POLDER measurement for SGLI simulation data

AOT @ 550 nm in Jan. 2009

Angstrom exponent in Jan. 2009

Courtesy of Dr. Hashiguchi (JAXA/EORC)
Validation Method

Validation data : AERONET  level 2 (cloud-screened and quality-assured)

Validation are made according to the following rules

1. The measurements are selected within the ±30 min over satellite.
2. The AOT of 443 and 870 nm as ground based measurements are selected for calculating Angstrom Exponent.
3. The AOT of 550 nm is estimated based on the Angstrom Exponent and the measurement of 670 nm.

AERONET sites in 2012

Selected AERONET sites

Courtesy of Dr. Hashiguchi (JAXA/EORC)
Validation of retrieved AOT (550 nm) with single mode size distribution

ADEOS-2 / POLDER-2
April and May in 2003
(RMSE=0.14, Corr. C=0.76)

PARASOL / POLDER
January and July in 2009
(RMSE=0.15, Corr. C=0.76)

Courtesy of Dr. Hashiguchi (JAXA/EORC)
1. GCOM satellite series
   GCOM-C1 / SGLI

2. Aerosol retrieval for SGLI
   2ch polarization method
     by POLDER

   2ch polarization & 1ch total radiance method
     by POLDER + GOSAT / CAI

3. PM$_{2.5}$ retrieval

4. Summary
Retrieval algorithms

POLDER
- 2ch (red & NIR) radiance over ocean: AOT, and frac. of bi-mode
- 2ch (red & NIR) polarization over land: AOT, and frac. of bi-mode

CAI + PARASOL
- 1ch (NUV) nadir radiance + 2ch (red & NIR) polarization
  over land: AOT, frac. of bi-mode, & SSA

SGLI (future algorithm)
- multi-channels radiance + 2ch (red & NIR) polarization
  over land: AOT, fraction of bi-mode, & complex ref idx.
CAI – Cloud Aerosol Imager
a complimentary sensor for Fourier Transform Spectrometer (FTS) launched on 23rd January, 2009.

Four observing wavelengths: 380, 670, 870, 1600 nm.
Level 1 data provide us with the TOA reflectance of the Earth.

<table>
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<tr>
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<th>Band 1</th>
<th>Band 2</th>
<th>Band 3</th>
<th>Band 4</th>
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</thead>
<tbody>
<tr>
<td>Spectral coverage</td>
<td>0.370-0.390</td>
<td>0.664-0.684</td>
<td>0.860-0.880</td>
<td>1.56-1.65</td>
</tr>
<tr>
<td>(μm)</td>
<td>(0.380)</td>
<td>(0.674)</td>
<td>(0.870)</td>
<td>(1.60)</td>
</tr>
<tr>
<td>Targeted substances</td>
<td>Cloud and aerosol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swath (km)</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>750</td>
</tr>
<tr>
<td>Spatial resolution</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>1.5</td>
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<tr>
<td>at nadir (km)</td>
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</table>
Dataset of A-Train's PARASOL and GOSAT
: time difference

Apr. 25, 2009

± 5 min

± 30 min
Forest fire event in Central Russia

August 8 in 2010
Composite image by GOSAT / CAI
Biomass burning aerosols from AERONET
Alaska (Bonanza), Amazon (JI_Parana_SE)

\[ \tau_{500} > 0.4 \]

<table>
<thead>
<tr>
<th>Wavelength (µm)</th>
<th>Imag. Component</th>
</tr>
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<tbody>
<tr>
<td>440 nm</td>
<td>1.491-0.0114i</td>
</tr>
<tr>
<td>670 nm</td>
<td>1.512-0.0085i</td>
</tr>
<tr>
<td>870 nm</td>
<td>1.515-0.0079i</td>
</tr>
<tr>
<td>1.02 um</td>
<td>1.505-0.0077i</td>
</tr>
</tbody>
</table>
Composite property of particles: internal mixing rule (biomass burning aerosols)

Maxwell-Garnett (MG) mixing rule: internal mixture of aerosols

Matrix

Inclusions

\[ f[\%]: \text{volume fraction of inclusions against matrix} \]

ex) Matrix: \( m=1.46 - 0.0002i \)
Inclusions: \( m=1.61 - 0.022i \)

\[
\varepsilon_{av} = \varepsilon_m \left[ 1 + \frac{3f(\varepsilon_{inc} - \varepsilon_m)(\varepsilon_{inc} + 2\varepsilon_m)^{-1}}{1 - f(\varepsilon_{inc} - \varepsilon_m)(\varepsilon_{inc} + 2\varepsilon_m)^{-1}} \right], \]

\[ \text{Re}\{\varepsilon_{av}\} = n^2 - k^2, \quad \text{Im}\{\varepsilon_{av}\} = 2nk. \]

Composite property of particles: internal mixing rule (biomass burning aerosols)

Refractive index (380 nm) from Maxwell-Garnett

<table>
<thead>
<tr>
<th>Volume fraction of inclusions [%]</th>
<th>Real part of refractive index</th>
<th>Imag part of refractive index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.460</td>
<td>0.002</td>
</tr>
<tr>
<td>10</td>
<td>1.475</td>
<td>0.0025</td>
</tr>
<tr>
<td>20</td>
<td>1.490</td>
<td>0.0050</td>
</tr>
<tr>
<td>30</td>
<td>1.505</td>
<td>0.0069</td>
</tr>
<tr>
<td>40</td>
<td>1.519</td>
<td>0.0089</td>
</tr>
<tr>
<td>100</td>
<td>1.610</td>
<td>0.022</td>
</tr>
<tr>
<td>Extreme case</td>
<td>1.710</td>
<td>0.042</td>
</tr>
</tbody>
</table>

"SSA is decreasing according to the volume fraction of carbonaceous inclusions."
Size distribution

Bi-modal log-normal volume distribution

\[
\frac{dV}{d \ln r} = (1 - F_{\text{coarse}}) \exp \left[ - \frac{(\ln r - \ln r_{\text{fine}})^2}{2 \sigma_{\text{fine}}^2} \right] + F_{\text{coarse}} \exp \left[ - \frac{(\ln r - \ln r_{\text{coarse}})^2}{2 \sigma_{\text{coarse}}^2} \right],
\]

Fine mode aerosols:
\[r_{\text{fine}} = 0.135 \, \mu m, \sigma_{\text{fine}} = 0.43 \, \mu m\]

Coarse mode
\[r_{\text{coarse}} = 2.365 \, \mu m, \sigma_{\text{coarse}} = 0.63 \, \mu m\]

(Dubovik et al., JAS, 2002)

Adjustment parameter \((F_{\text{coarse}})\)
CALIPSO / CALIOP results show that the Biomass burning plume was concentrated under 3-5 km height. Aerosol vertical structure is considered based on the US std profile with plume concentration under 5 km.

CALIOP 532nm Backscatter, on Aug. 8, 2010
Surface polarization model; BPDF

Nadal and Bréon, 1999
Maignan et al. 2009
Retrieval flow (3ch)

GOSAT CAI

\[ I (380, 670, 870) \]

USGS DEM

Atmospheric Correction
(Rayleigh corr.)

GOSAT / CAI

CAI time series dataset
2nd minimum reflectance
380, 670, 870 nm

Surface Reflectance
380 nm

NDVI
670, 870 nm

IGBP land class

BPĐF model

PARASOL POLDER

\[ Q, U (670, 870) \]

Model aerosols by MG-rule
AERONET climatology
US-AFGL US std model
CALIPSO Vertical info

Vector Radiative Transfer

Total Reflectance
\{I\}, 380, 670, 870 nm

Polarized Reflectance
\{Q and U\}, 380, 670, 870 nm

Retrieval of Aerosol Properties

AOT (\(\tau_a\)), Angstrom Exponent (\(\alpha\)), SSA (\(\omega\))
Aerosol properties over Central Russia on August 8 in 2010

Composite by CAI
(0.38, 0.67, 0.87 μm)

Composite by POLDER
(0.49, 0.67, 0.87 μm)

(a) AOT at 0.55 μm
(b) Angstrom exponent
(c) SSA at 0.38 μm

Figure Retrieved results of aerosol properties over Central Russia on August 8, 2010. (a) AOT at 0.55 μm, (b) Angstrom exponent and (c) single scattering albedo at 0.38 μm.
Validation of retrieved results

The AERONET AOT and Angstrom data are selected during the ± 30 min against the satellite overpass.

Error bars: Min and max values of the measurements.

Scattergram of retrieved values $\tau_a$, $\alpha$ against AERONET data.
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   2ch polarization & 1ch total radiance method
   by POLDER + GOSAT / CAI

3. PM$_{2.5}$ retrieval

4. Summary
Smog over China

MODIS rapid response image over East Asia
30th October 2011

China

Beijing

Korea

Japan
Recent PM$_{2.5}$ measurements at Osaka
PM$_{2.5}$ forecast by SPRINTARS

NHK TV distributes PM2.5 information.

( PM2.5 images by Prof. T. Takemura )
Target megacity (Osaka, Japan)

2nd large city in Japan
population: ~15 million

Mountains ~ 900 m
~600 m
~1000 m

Long range trans boundary aerosols
Local aerosols

Kinki Univ. (obs. site)
Sun photometer network in Spring of 2012
(DRAGON - Osaka, a part of DRAGON-Japan)

- Mt. West Harima (~400 m) (Incoming aerosols)
- West Harima astronomical observatory

AERONET: Osaka
- 6 city sites
- 3 mountains sites

Mt. Rokko (~800m)
Mt. Ikoma (~640m)
City north Kansai U
City (south Osaka-Pref U)
Nara Nara-W U
Kyoto basin
Kanto

Kyoto U
Aerosol retrieval procedure

1. Surface information

Assumption: Aerosol loading and types are constant in Osaka Plains, (AERONET-Osaka measurement is a representative of aerosol information over the area).

Atmospheric correction with AERONET AOT(550 nm) and AE.

Surface albedo

2. Retrieval of aerosol properties

Pre-estimated surface albedo
Pre-defined aerosol model (RT -> look-up table)
Satellite data (CAI / GOSAT :380, 670, 870 nm)

AOT, coarse mode fraction of bi-modal size dist, and SSA
Estimation of surface reflectance and aerosol retrieval

- **AERONET Climatology**
- **US-AFGL US std model**

Vector R.T. calc

- **GOSAT / CAI**
  - time series TOA reflectance data
  - 380, 670, 870 nm

Surface reflectance (380, 670, 870 nm)

- **USGS DEM**
- **Look up table**

- **GOSAT / CAI**
  - Level 1 (380, 670, 870 nm)

Aerosol Retrieval
- Col-AOT at 550, CMF, SSA

CMF: mixing ratio of coarse mode aerosol to fine and coarse mode

Ref idx is fixed to $m = 1.45 - 0.0001 i$
Aerosol properties over Osaka, Japan during DRAGON - Osaka

AOT (670 nm)


Aerosol properties over Osaka, Japan during DRAGON - Osaka

Angstrom exponent
Aerosol properties over Osaka, Japan during DRAGON - Osaka

Single scattering albedo


SSA

0.8
0.9
1.0
Cimel deployment during DRAGON - Osaka (March - May in 2012)
Validation of retrieved AOTs with DRAGON-Osaka

**In situ AOTs**: AERONET (DRAGON)
- Dots: averaged value (±1 hour)
- Error bars: (min, max)

**Retrieved AOTs**: CAI / GOSAT
- Dots: averaged value (±0.01 deg)
- Error bars: min, max of AOTs
Validation of retrieved AOTs with DRAGON-Osaka

Kobe, Osaka, Osaka-N, Osaka-S, Osaka-C sites during DRAGON - Osaka

380, 440, 670, 870 nm

$y = 0.962x + 0.006$

Corr. = 0.863

RMSE = 0.087 [N=159]

• 670 nm

$y = 0.366x + 0.120$

Corr. = 0.624

RMSE = 0.068 [N=42]
Validation of retrieved AE with DRAGON-Osaka

Kobe, Osaka, Osaka-N, Osaka-S, Osaka-C sites during DRAGON - Osaka

Angstrom exponent (440, 870 nm)

Retrieved Ang. Exp. (CAI/GOSAT)

Insitu Ang. Exp. (DRAGON-Osaka)

\[ y = 0.216x + 1.444 \]
Corr. = 0.576
RMSE = 0.60 [N=42]
Ground based columnar AOT, LIDAR and PM measurements

- Sun photometer and NIES 2ch Pol. LIDAR

- PM$_1$, PM$_{2.5}$/ PM$_{10}$/ TSP sampling
Relationship between PM$_{2.5}$ and columnar AOT (670 nm)
Satellite estimated PM$_{2.5}$ concentration during DRAGON - Osaka

AOT 670 nm
Validation with *in situ* PM$_{2.5}$ data

**PM$_{2.5}$ Instrument**

SPM-712 (Kimoto Elec. Co., Japan)
1 hour meas.
Beta ray gauge method
Teflon tape role
RH correction

![Graph showing validation with in situ PM$_{2.5}$ data](image)

AERONET Osaka site during DRAGON-Osaka

\[ y = 0.362x + 11.46 \]
Corr. = 0.321
RMSE = 5.5 µg / m$^3$  [N=10]
Summary

Status of aerosol algorithm development has been reported from the viewpoint of polarization measurements.

The operational algorithms as POLDER two channel type method which give us with
  aerosol optical thickness (550 nm) and Ångström exponent will be implemented first.

Our algorithms will be modified to achieve more accurate and more aerosol parameters with CI's collaboration.
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