Legacy GOES vs. GOES-R for Air Quality Applications

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https://www.goes-r.gov/spacesegment/abi.html
Five channel imager for meteorological applications

GOES visible (520 – 720 nm) band used to retrieve aerosol optical depth (AOD). Product name GASP. Coverage CONUS only

GASP for GOES-E from 2003-2017 and for GOES-W from 2003-present

Archived data available from NOAA CLASS (class.noaa.gov)

Resolution: Spatial 4 km nadir Temporal 30 min
Air quality forecasting
Numerical model verification
Flight coordination during field campaigns
Smoke exposure assessment
Estimates of smoke plume areal extent and smoke concentration
Diurnal variation etc.

Main tools for Air quality forecasters are yesterday’s MODIS AOD and today’s GOES AOD
GASP Applications

- Air quality forecasting
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- Diurnal variation etc.
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North Carolina Peate Fire Summer 2008

Susan Stone, USEPA
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Kondragunta et al., AGU, 2013
**GASP Data Quality and Usability**

**Bondville, IL**

**GOES vs. AEROENT AOD**

<table>
<thead>
<tr>
<th>Season</th>
<th>Bias</th>
<th>RMSE</th>
<th>r</th>
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<tbody>
<tr>
<td>Winter</td>
<td>0.059</td>
<td>0.112</td>
<td>0.522</td>
</tr>
<tr>
<td>Spring</td>
<td>0.109</td>
<td>0.178</td>
<td>0.616</td>
</tr>
<tr>
<td>Summer</td>
<td>0.022</td>
<td>0.136</td>
<td>0.728</td>
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<tr>
<td>Autumn</td>
<td>0.042</td>
<td>0.060</td>
<td>0.695</td>
</tr>
<tr>
<td>All</td>
<td>0.044</td>
<td>0.149</td>
<td>0.646</td>
</tr>
</tbody>
</table>

Correlation of AOD with PM2.5 high when:
- sulfates and organics dominate
- RH is between 60% and 80%
- Fine mode fraction is high

Green et al., *Comparison of GOES and MODIS Aerosol Optical Depth (AOD) to AERosol RObotic NETwork (AERONET) AOD and IMPROVE PM$_{2.5}$ mass at Bondville, Illinois*, JAWMA, 2009
GASP Data Quality and Usability

- Paciorek et al., Spatiotemporal associations between GOES aerosol optical depth and surface PM2.5, EST, 2011
- Prados et al., GOES Aerosol/Smoke Product (GASP) over North America: Comparisons to AERONET and MODIS observations, JGR, 2007
- Zhang et al., Aerosol optical depth (AOD) retrieval using simultaneous GOES-East and GOES-West reflected radiances over the western United States, AMT, 2013
- GASP algorithm adapted for GOCI (Korea)
- GASP algorithm adapted for INSAT-3D (India)
## GOES-R ABI Requirements

### Land

<table>
<thead>
<tr>
<th>AOD</th>
<th>Accuracy</th>
<th>Precision</th>
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<tbody>
<tr>
<td>&lt;0.04</td>
<td>0.06</td>
<td>0.13</td>
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<tr>
<td>0.04 – 0.80</td>
<td>0.04</td>
<td>0.25</td>
</tr>
<tr>
<td>&gt;0.8</td>
<td>0.12</td>
<td>0.35</td>
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### Water

<table>
<thead>
<tr>
<th>AOD</th>
<th>Accuracy</th>
<th>Precision</th>
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<tbody>
<tr>
<td>&lt;0.4</td>
<td>0.02</td>
<td>0.15</td>
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<tr>
<td>&gt;0.4</td>
<td>0.10</td>
<td>0.23</td>
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</tbody>
</table>
Faster coverage (5-minute full disk vs. 25-minute)

Improved spatial resolution (2 km IR vs. 4 km)

More spectral bands (16 on ABI vs. 5 on the current imager)

Onboard calibration * Better navigation * On demand mesoscale
GOES-R ABI

Default Operational Mode:

- Full Disk 15 min
- CONUS 5 min
- Mesoscale 1 min

Proposed mode to be consistent with AHI:

- Full Disk 10 min
Smoke from several small plumes blend together and become one large plume.
Dust storms in the southeast form in late evenings and last into the night;

Polar-orbiting satellites miss them due to mid-afternoon overpass time;

ABI imagery capture the events

Kondragunta et al., Tracking dust storms using latest satellite technology, EM, 2018
Alamo Fire

July 6 – July 19, 2017

~29,000 acres burned
CONUS vs. Full Disk
Measurements in geostationary era:
• Viewing geometries different from polar-orbiting satellites. Need to gain experience working in this space
• Requirements are to be met for a statistically large sample. Uncertain how performance metrics will be as a function of time of the day ---> important for AQ