New Nearly Continuous High Accuracy Satellite Aerosol Products for Fires, Dust, and Haze from GOES-16

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Satellites Identify Aerosols in the Atmosphere

- Satellites indicate areas of high particulate matter in the atmosphere associated with smoke plumes, blowing dust, and haze
- Aerosol satellite products have many air quality applications:
  - Modeling
  - Exceptional Events packages
  - Outreach/media
- But not very useful for forecasting – until now!!

VIIRS true color
Oct 9, 2017: Northern CA Wildfires
Geostationary Operational Environmental Satellites R-Series (GOES-R)

• Revolutionary new geostationary satellites
• “Like going from black and white TV to HD”
• GOES-16 launched Nov 19, 2016 (now GOES-East)
• GOES-S scheduled launch March 2018 (will be GOES-West)
ABI: New Generation GOES Imager

- **Advanced Baseline Imager (ABI)** is one of 6 instruments on GOES-R series satellites
- Huge leap forward in geostationary satellite technology
- ABI has **16 spectral bands** vs. 5 on previous GOES imager
  - New products!
  - Higher accuracy!
  - Higher spatial resolution!
- Faster scan rate compared to previous GOES imager
  - More frequent observations! (higher temporal resolution)
  - Routine CONUS and full disk views!
ABI Scan Mode 3 ("Flex Mode")

Previous generation GOES imager:
• 26 min for full disk scan (every 3 hrs)
• 7 min for CONUS scan (every 30 min)
• No Mesoscale in routine scans
ABI Products: GeoColor Imagery

- During daytime, closest approximation to **true color imagery** (combination of red, green, and blue spectral bands)
  - ABI doesn’t have a green band, so it’s simulated
- At night, multispectral IR shows low-level liquid water clouds and higher-level ice clouds
- New product from ABI! Not available from previous Imager!

GOES-16 ABI GeoColor imagery, full disk view:
- 4 km spatial resolution
- 15 min temporal resolution
ABI Products: Aerosol Optical Depth (AOD)

- AOD is a **quantitative** measure of aerosols in the atmosphere
- Measure of scattering/absorption of visible light by aerosols
  - High AOD (red, orange, yellow): smoke, blowing dust, haze
  - No AOD retrieval in regions with clouds or bright surfaces
- ABI has **high accuracy AOD** from multi-channel retrieval
  (similar to VIIRS and MODIS AOD)

Previous GOES Imager:
4 km, 30 min, lower accuracy

GOES-16 ABI:
2 km, 15 min, high accuracy

β-maturity data
Not for scientific use
ABI Products: Aerosol Detection

- Aerosol detection is a **qualitative** measure of aerosols
  - **Smoke mask**: indicates smoke plumes
  - **Dust mask**: indicates blowing dust
- Derived using satellite measurements in visible and IR
- New product from ABI! Not available from previous imager!

Smoke Mask: May 6, 2017

Dust Mask: March 31, 2017

β-maturity data
Not for scientific use
ABI Products: Dust RGB

- Made from a combination of three IR spectral bands on ABI (brightness temperature at 8.4 µm, 11.2 µm, 12.3 µm)
- Indicates areas of **blowing dust** in the atmosphere: appears as a **magenta** feature
- New product from ABI! Not available from previous imager!
At a Glance: Advantages of ABI Aerosol Products

ABI aerosol products are ideal for forecasting!

- Imagery begins streaming at sunrise; low latency
- Choice of routine CONUS and full disk views!
- High accuracy, high spatial resolution observations!

<table>
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<th>Data Characteristic</th>
<th>ABI</th>
<th>Previous Imager</th>
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<td>Observation Time</td>
<td>Continuous during daylight</td>
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<td>Routine Views</td>
<td>CONUS and full disk</td>
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<td>5 min (CONUS) 15 min (full disk)</td>
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<td>N/A</td>
</tr>
<tr>
<td>AOD</td>
<td>2 km (CONUS) 4 km (full disk)</td>
<td>4 km</td>
</tr>
</tbody>
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BC/Western US Wildfires: Aug/Sept, 2017

- Wildfires raged last summer in western US and British Columbia
  - Huge ridge of high pressure over western US; record-breaking heat wave in Pacific NW
- Seattle and Portland, OR hit particularly hard; days of Code Orange/Red PM$_{2.5}$ air quality
Lots of Media Coverage

All photos courtesy of the New York Times
Western US/BC Fires: ABI AOD and GeoColor Animation (Sept 4)

β-maturity AOD data
Not for scientific use
Access to ABI Aerosol Products Data Files

• Download data files in netCDF4 format from CLASS: https://www.class.ncdc.noaa.gov

• Variety of data readers available:
  – HDFView
  – Panopoly
  – NOAA’s Weather and Climate Toolkit
  – NOAA standalone IDL reader for ABI data

• Links to data readers, tutorials, and sample data files: https://www.star.nesdis.noaa.gov/smcd/spb/aq/aqpg/2017/ (Google “2017 NOAA Aerosol Workshop”)

NOAA
COMPREHENSIVE LARGE ARRAY-DATA STEWARDSHIP SYSTEM (CLASS)

Please select a product to search

SEARCH FOR DATA
- Environmental Data from Polar-orbiting Satellites
- Environmental Data from Geostationary Satellites
- Defense Meteorological Satellite Program (DMSP)
- Suomi National Polar-orbiting Partnership (NPP)
New NOAA AerosolWatch Website: Access to NRT ABI Aerosol Imagery

https://www.star.nesdis.noaa.gov/smcd/spb/ag/AerosolWatch/

AerosolWatch is being updated based on user feedback! Many changes coming soon!
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Exciting Plans for 2018

• ABI GeoColor and dust RGB currently provisional maturity
  – Can be used now, no changes expected unless issues develop with calibration or sensor artifacts

• ABI AOD and smoke/dust mask currently β-maturity
  – Do not use for scientific applications yet
  – Wait for provisional maturity products, anticipated May 2018
  – Fully validated products expected Fall 2018

• AerosolWatch website updates complete ~Spring 2018
  – Your destination for imagery to use for forecasting
  – Streamlining ABI imagery animation and product options
  – Adding additional products (AOD composites, 48-hr trajectories)
  – Incorporating polar-orbiting VIIRS satellite data

• GOES-S launches in March!
  – β-testing products begin flowing ~60 days after launch
  – Drift to GOES-West planned for ~ 200 days after launch
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