

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

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PennState



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



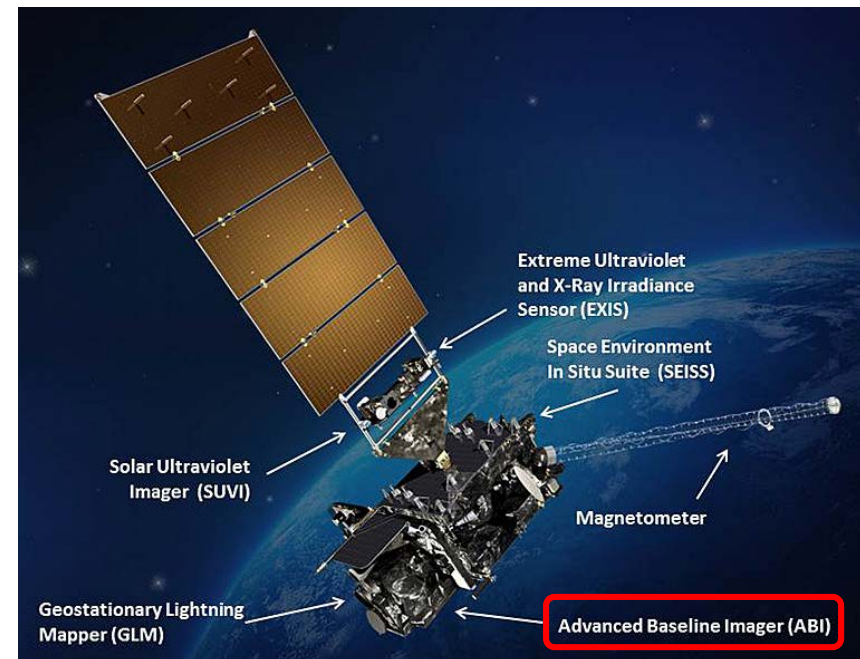
Geostationary Operational Environmental Satellites R-Series (GOES-R)

- 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)

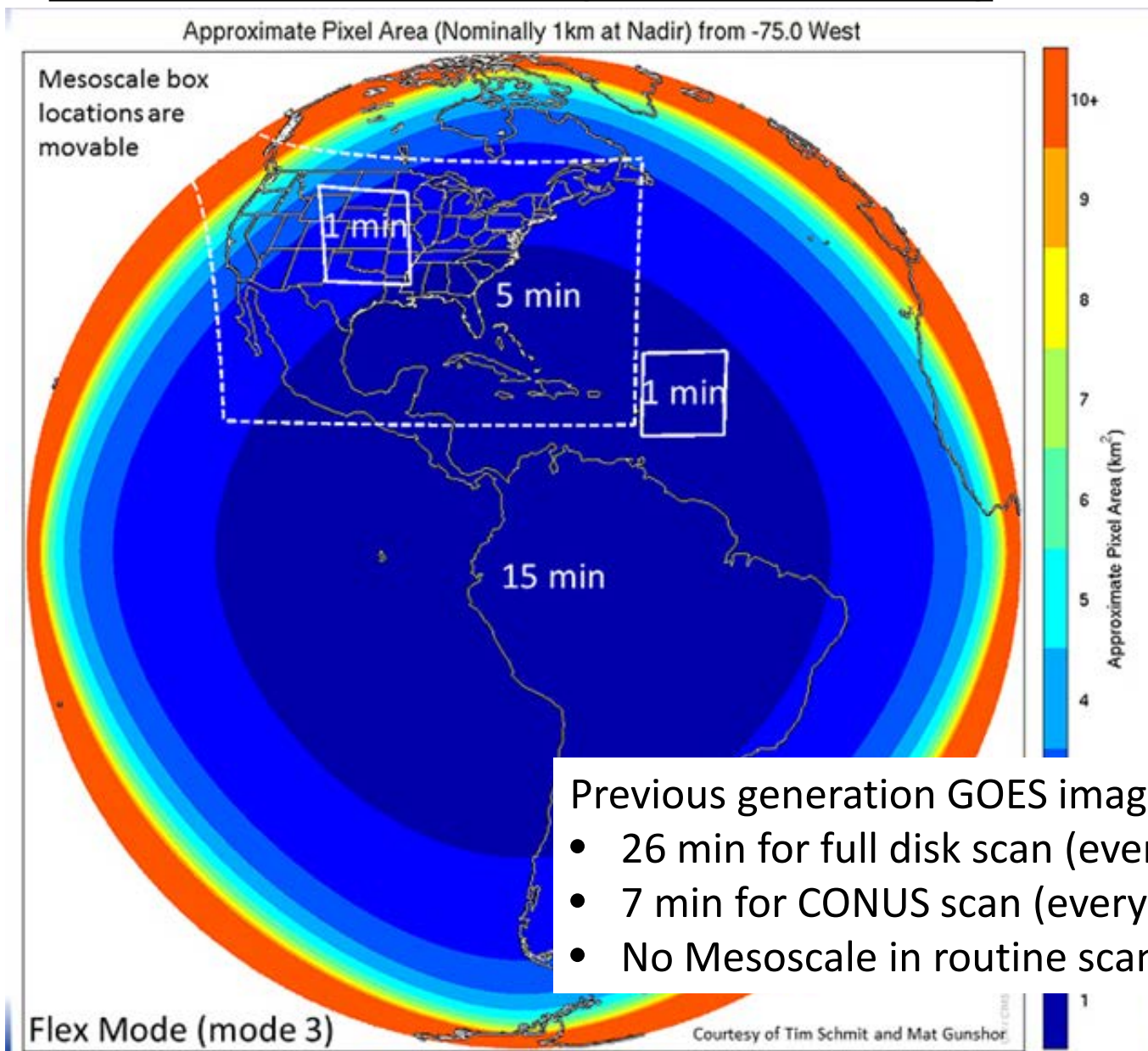


ABI: New Generation GOES Imager

- **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!

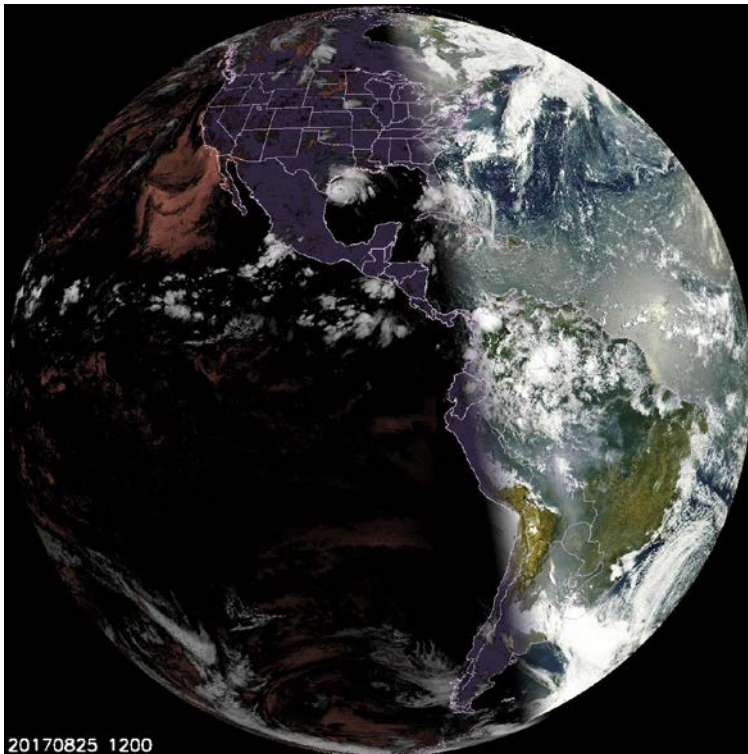


ABI Scan Mode 3 (“Flex Mode”)



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:

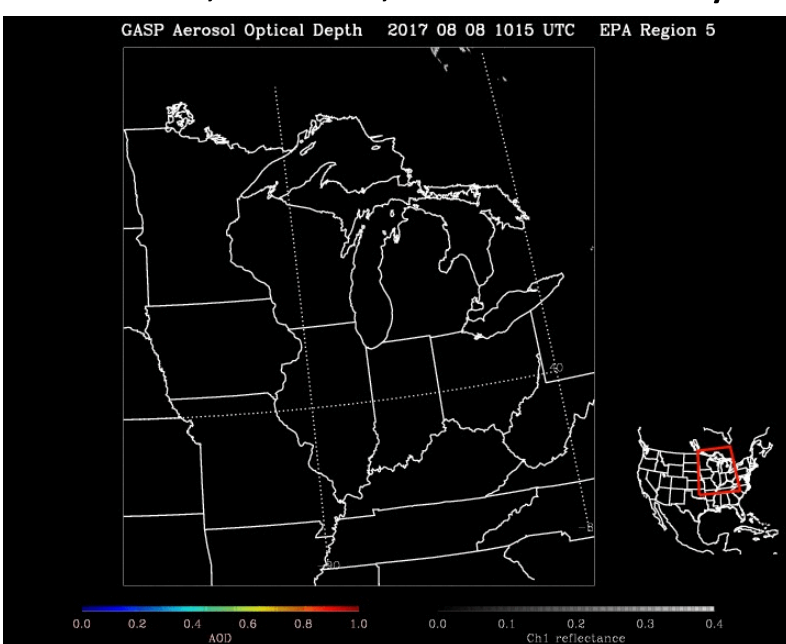
- 4 km spatial resolution
- 15 min temporal resolution

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)

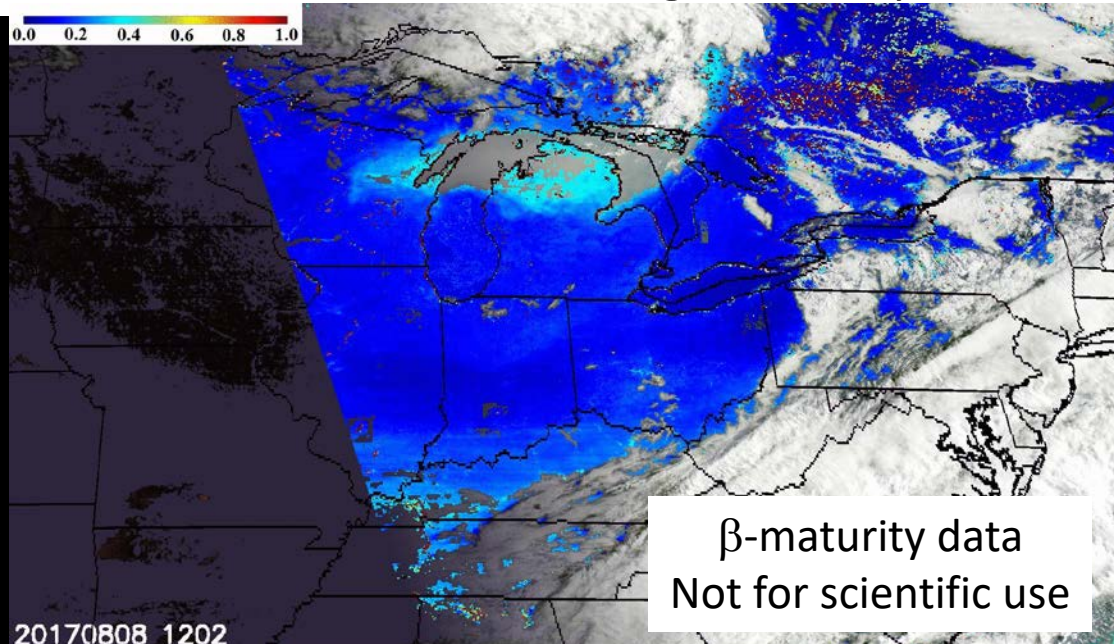
Previous GOES Imager:

4 km, 30 min, lower accuracy



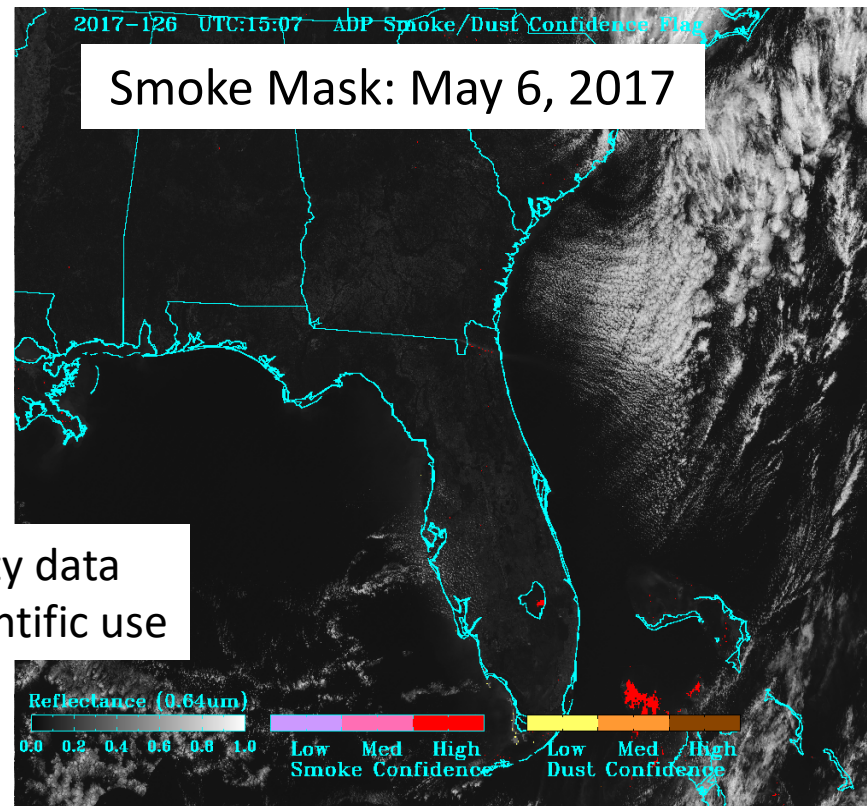
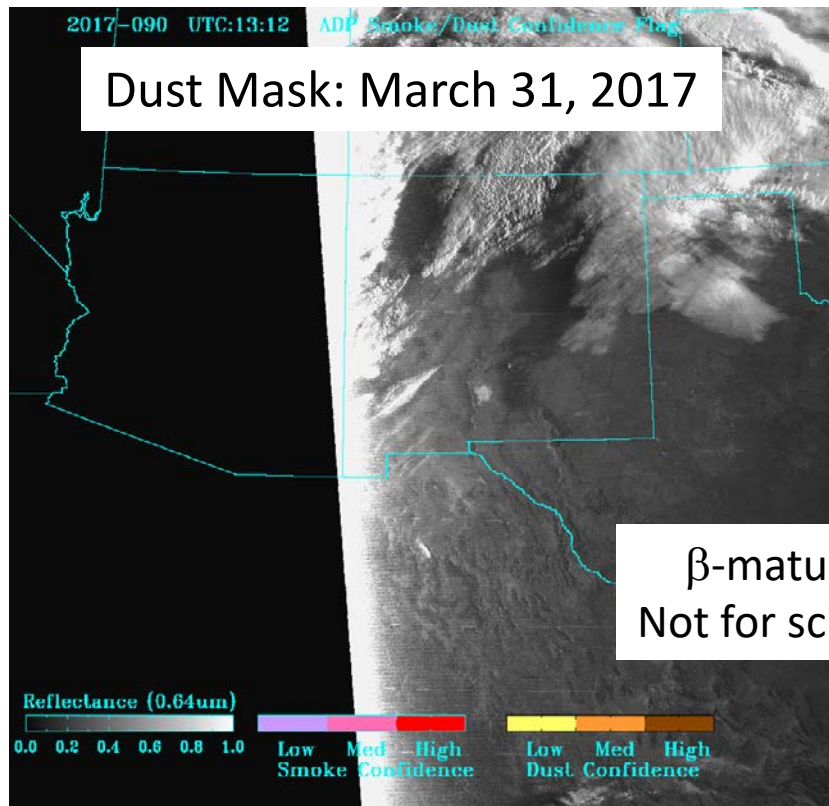
GOES-16 ABI:

2 km, 15 min, high accuracy



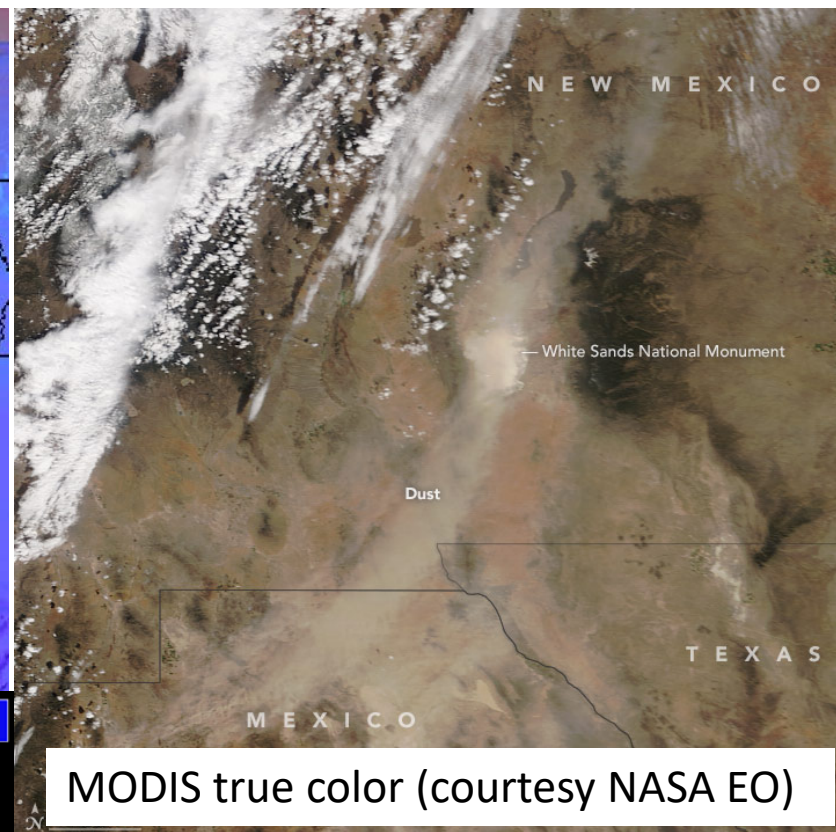
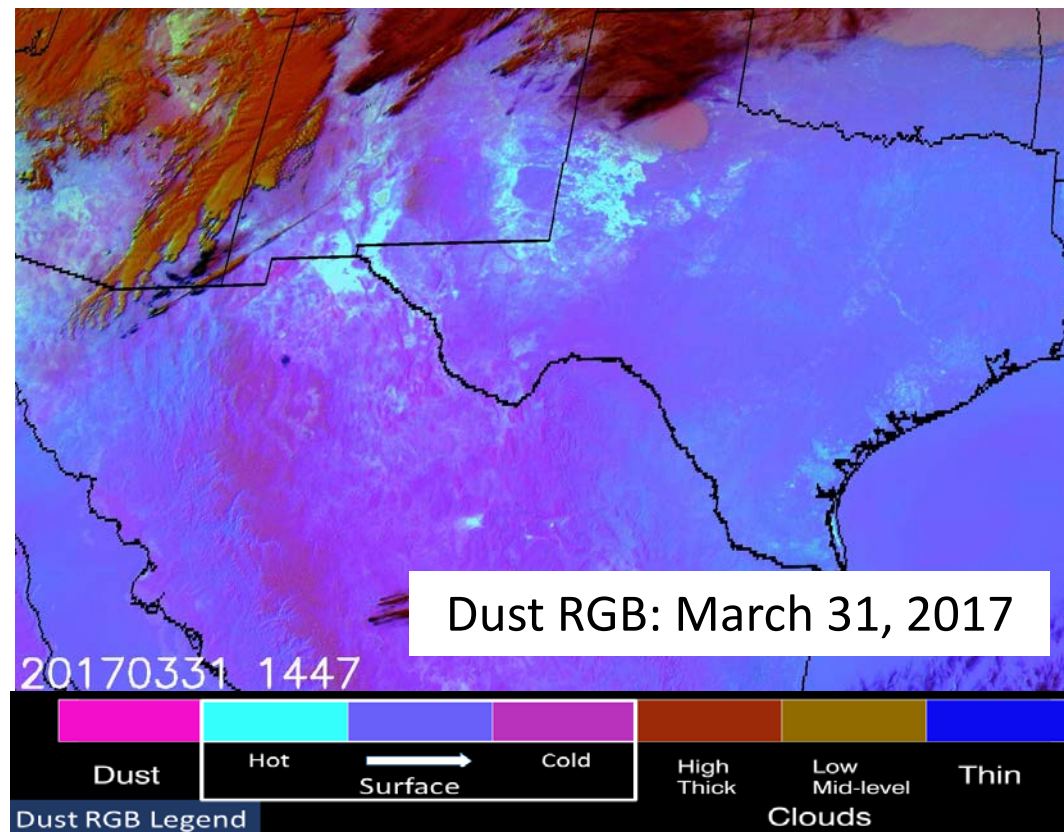
ABI Products: Aerosol Detection

- 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!



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

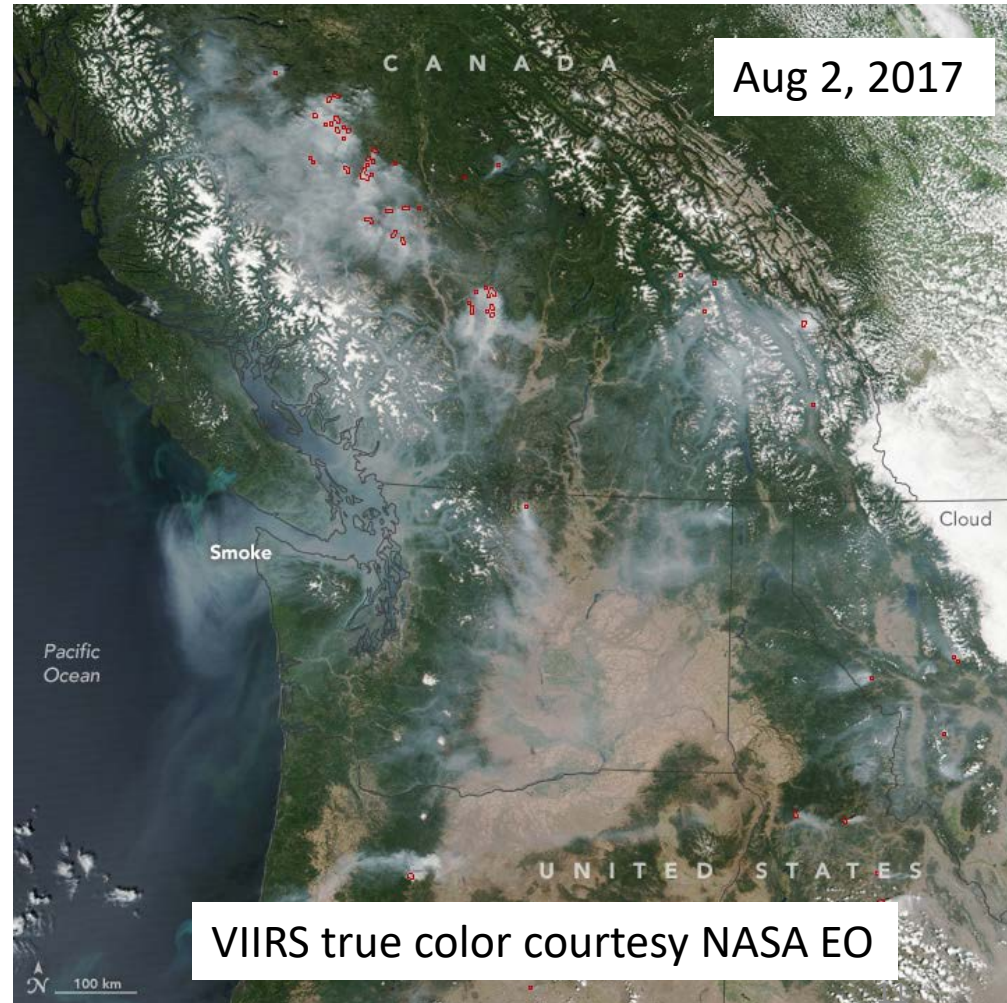
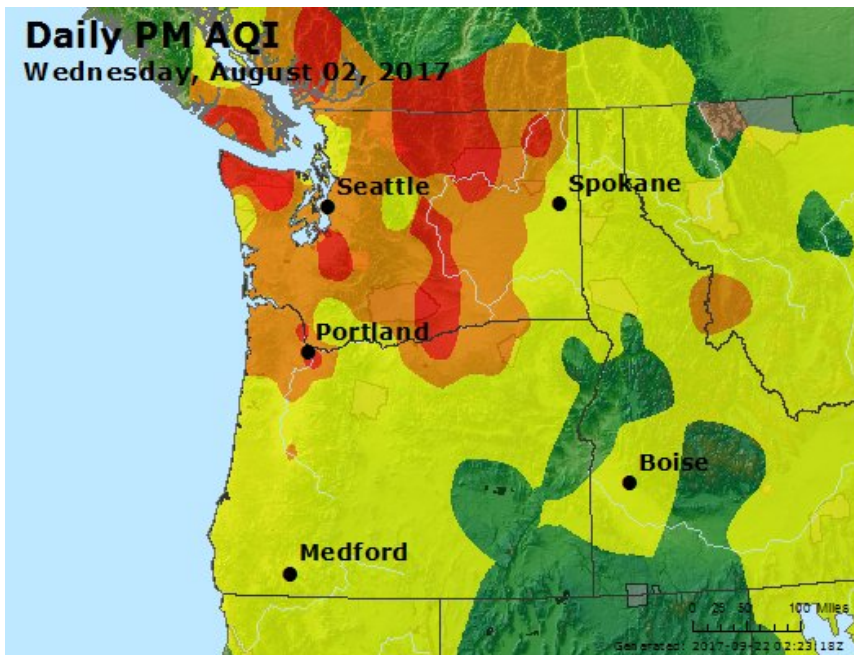
ABI aerosol products are ideal for forecasting!

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

Data Characteristic		ABI	Previous Imager
Observation Time		Continuous during daylight	
Routine Views		CONUS and full disk	CONUS only
Temporal Resolution		5 min (CONUS) 15 min (full disk)	30 min (CONUS)
NRT Imagery Latency		20 min	30 min
Spatial Resolution	GeoColor	1 km (CONUS) 4 km (full disk)	N/A
	AOD	2 km (CONUS) 4 km (full disk)	4 km

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



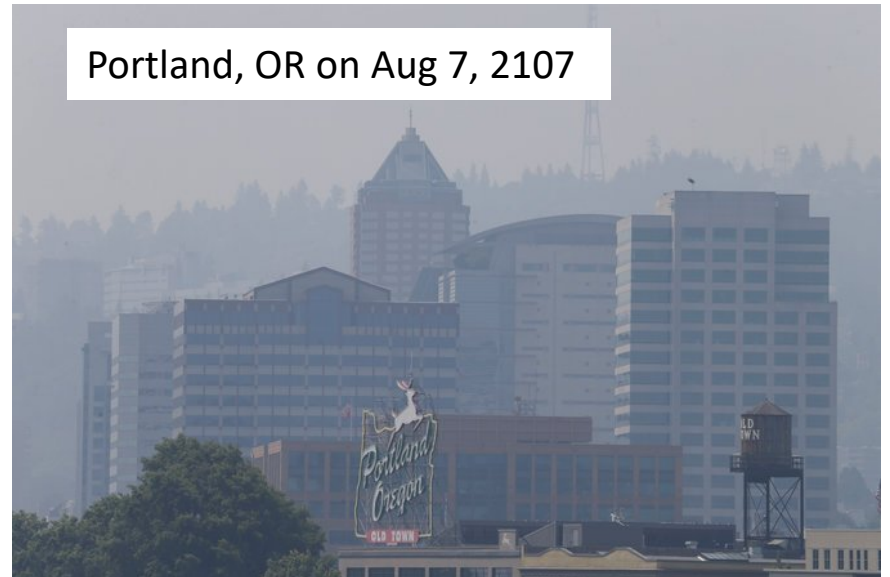
Mt Rainier on Aug 1, 2017



Mt Rainier on Aug 2, 2017



Lake Union, Seattle on Aug 5, 2017

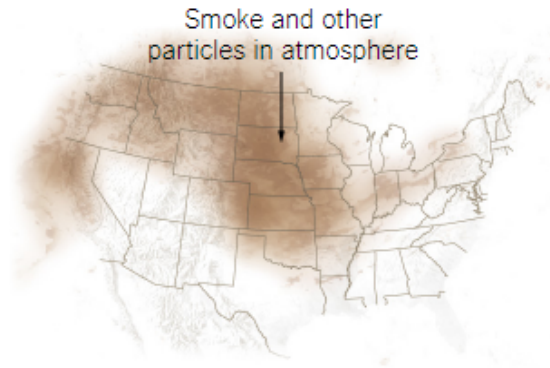


Portland, OR on Aug 7, 2107

Western US/BC Fires: ABI GeoColor Loop (Aug 29-Sept 5)

<https://www.nytimes.com/interactive/2017/09/16/us/wildfires-smoke-pacific-northwest.html>

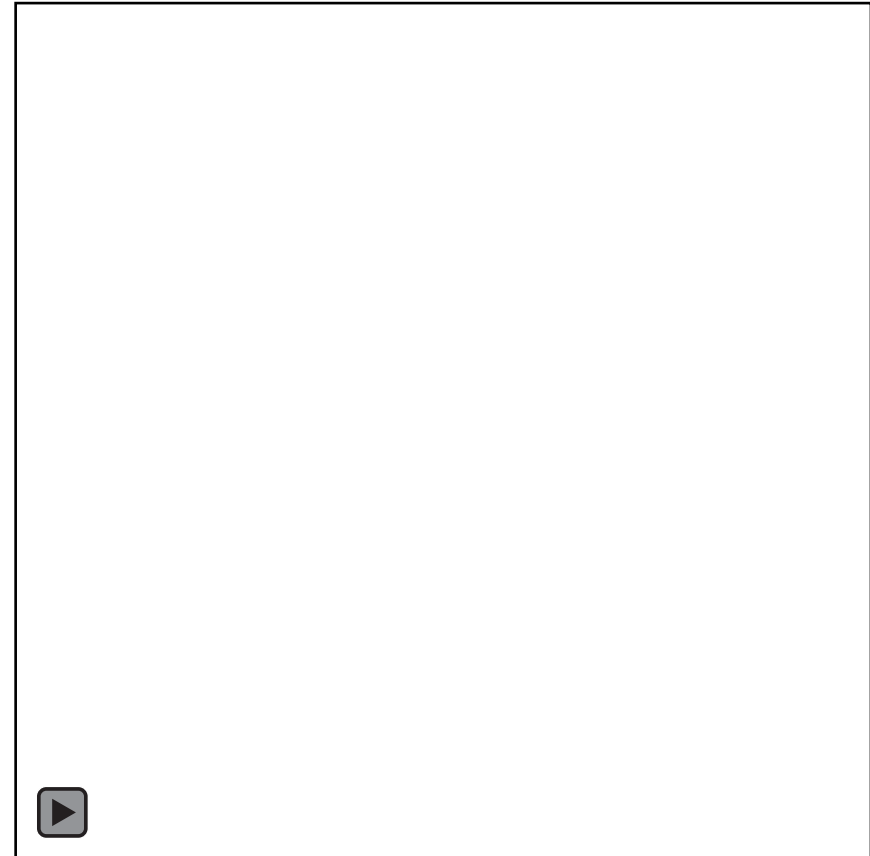
New York Times article, Sept 16, 2017 15-min loop of ABI GeoColor, fire hotspots
Aug 29 to Sept 5, 2017



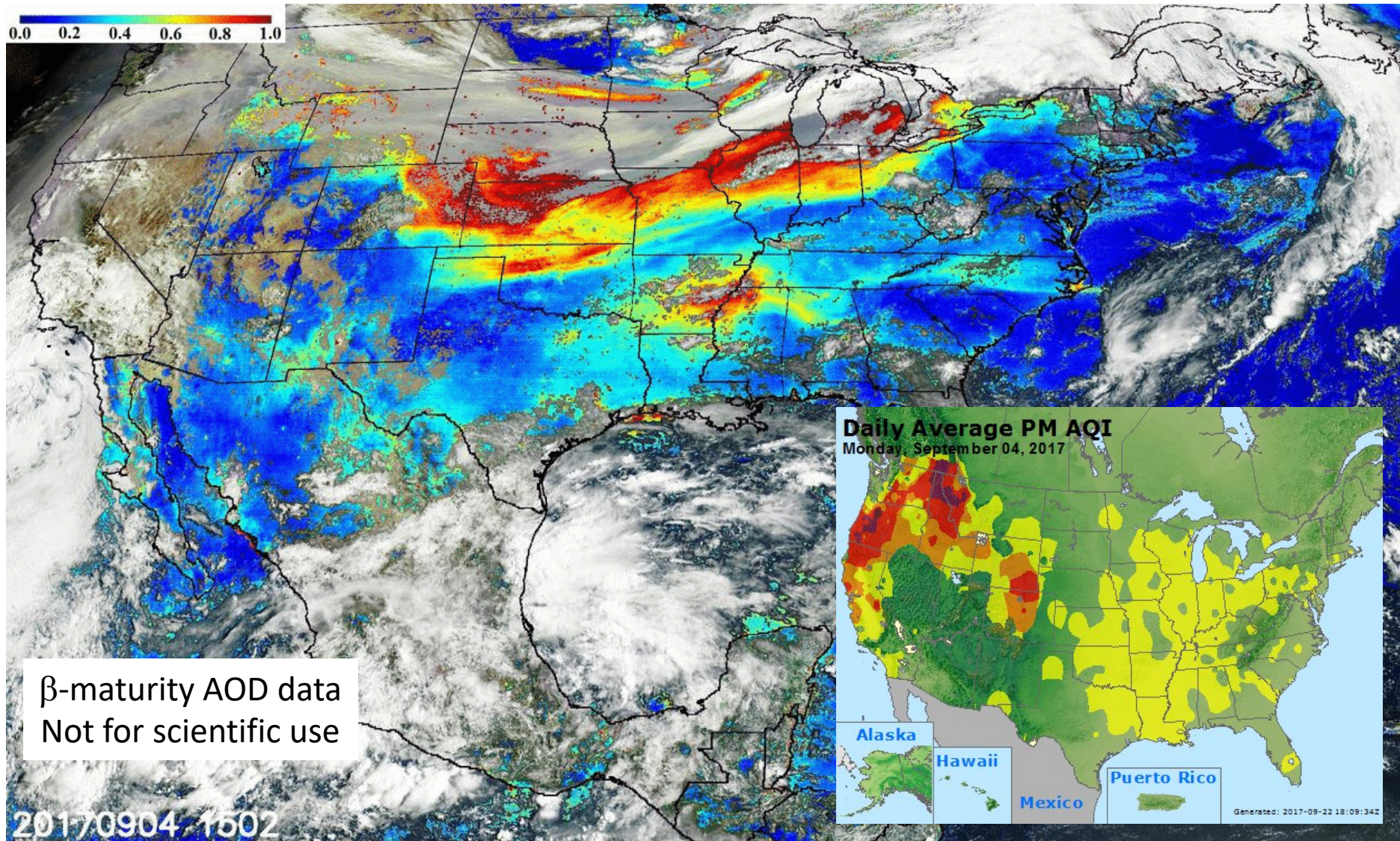
As Wildfires Burn in West, Ash Rides Wind High Across U.S.

By TROY GRIGGS, K.K. REBECCA LAI, JEREMY ASHKENAS and JUGAL K. PATEL SEPT. 16, 2017

Wildfires in the Pacific Northwest this summer gave rise to dangerous air quality throughout the region, and generated plumes of smoke that spread across vast swaths of North America.



Western US/BC Fires: ABI AOD and GeoColor Animation (Sept 4)



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
 - Panoply
 - 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”)



New NOAA AerosolWatch Website: Access to NRT ABI Aerosol Imagery

<https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch/>

CONUS or
Full Disk
view

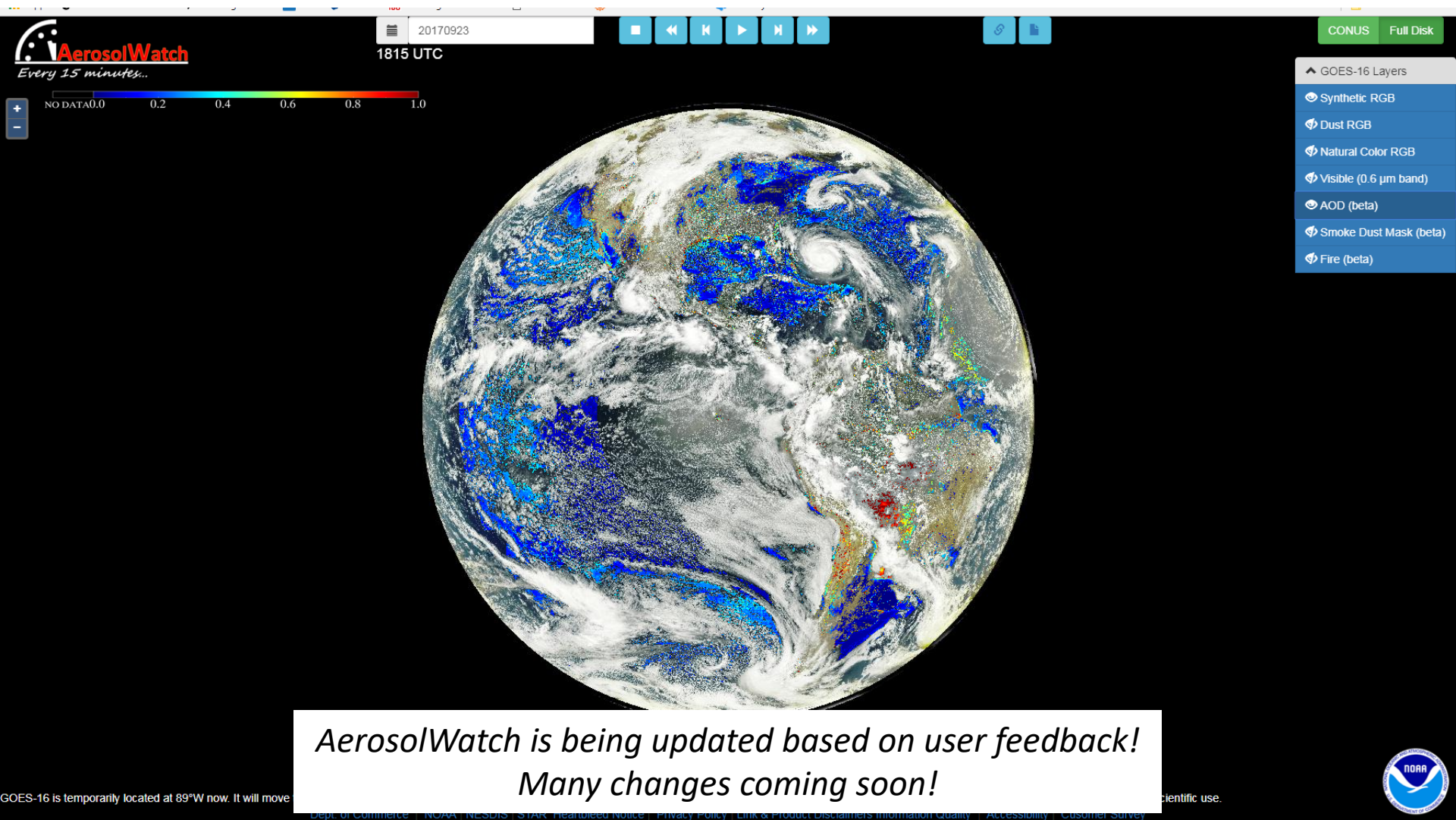
The screenshot displays the NOAA AerosolWatch web application. At the top left, the 'AerosolWatch' logo is accompanied by the text 'Every 15 minutes...'. The main map area shows a satellite view of North America with aerosol data overlays. Several interactive elements are highlighted with red boxes and labeled with purple callouts:

- Zoom in/out:** A vertical slider on the left side of the map.
- Open archive; Time Stamp:** A text input field containing '20170923' and '1817 UTC'.
- Animation controls:** A set of buttons for play, previous, next, and stop.
- Select ABI Products:** A dropdown menu on the right side of the map.
- Overlay state and national labels:** A checkbox labeled 'Labels Layer' at the bottom of the product menu.
- CONUS or Full Disk view:** Two buttons at the top right of the map area.

A white text box at the bottom of the map area contains the following message:

*AerosolWatch is being updated based on user feedback!
Many changes coming soon!*

AerosolWatch Full Disk View



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

Acknowledgements

- The entire NOAA aerosol Cal/Val team
- Funding support from the NOAA GOES-R and JPSS programs
 - Steve Goodman and Mitch Goldberg
- NOAA aerosol initiatives
 - Air Quality Proving Ground
 - Fire and Smoke Initiative

