Preparing for GOES-R Aerosol Optical Depth Using Proxy Data

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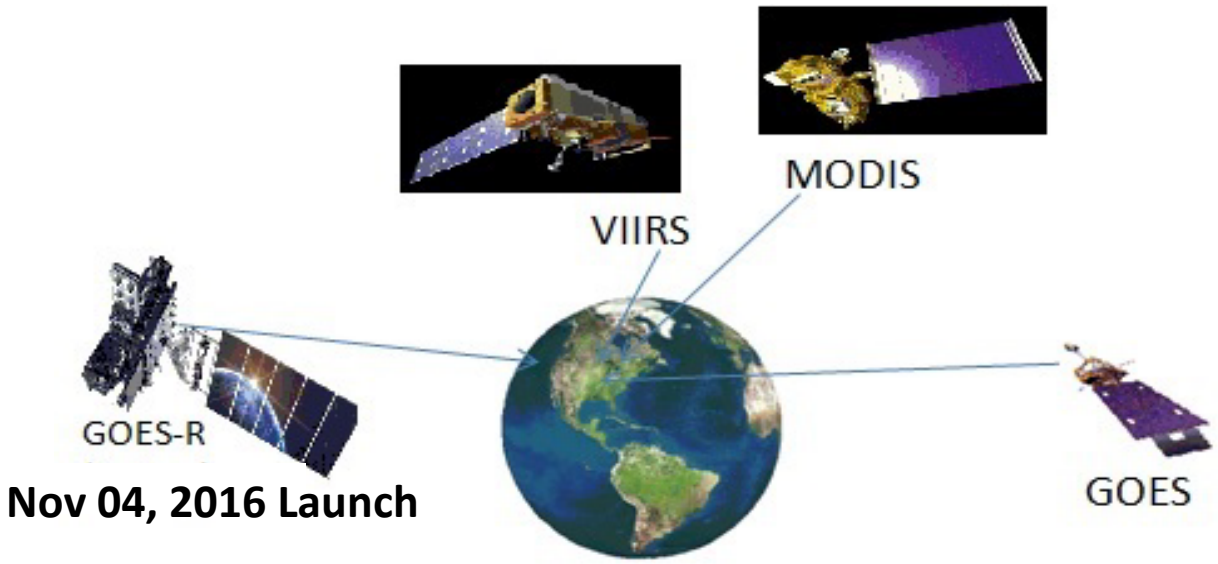
NOAA Satellite Aerosol Product Workshop for Science and Operational Users, September 13-14, 2016
National Center for Weather and Climate Prediction (NCWCP), College Park, MD 20740

The GOES-R Advanced Baseline Imager



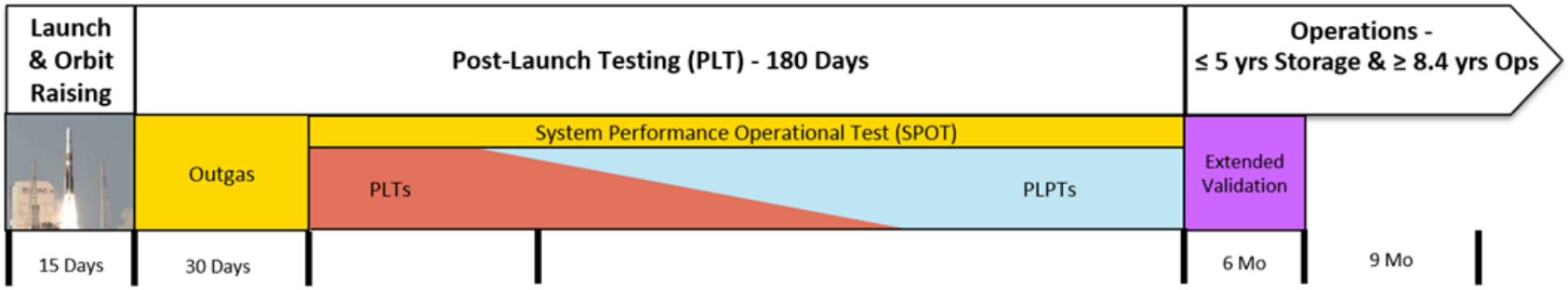
Nov 04, 2016 Launch

GOES-R ABI will have five channels between 0.47 and 2.25 μm with on-orbit calibration that can be used to retrieve aerosol properties over land and ocean.

- **The ABI aerosol algorithm is based on heritage MODIS and VIIRS algorithms.**
- **The ABI AOD retrieval is at *2-km spatial resolution and 5- and 15- minute temporal resolution* during daytime (VIIRS EDR AOD retrieval is once per day at 6km, MODIS C6 AOD retrieval is once per day at 3km)**

http://www.star.nesdis.noaa.gov/goesr/docs/ATBD/AOD.pdf

Post-Launch Plans for GOES-R



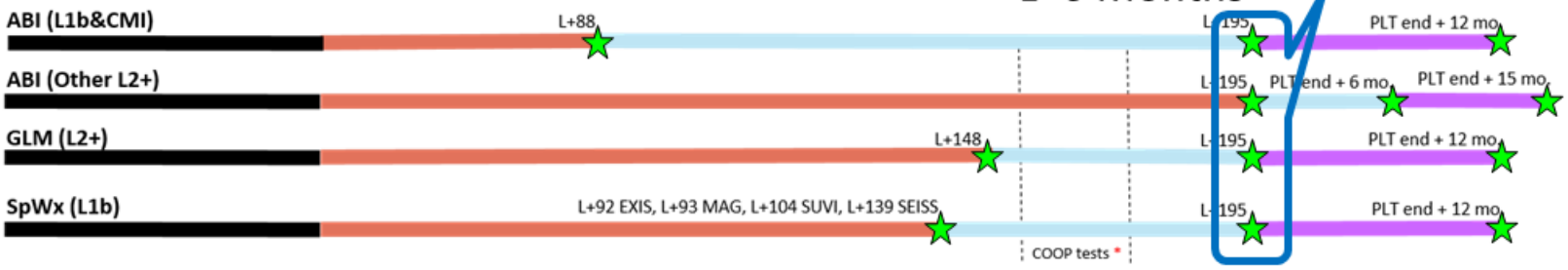
Internal Flow L+15 Days

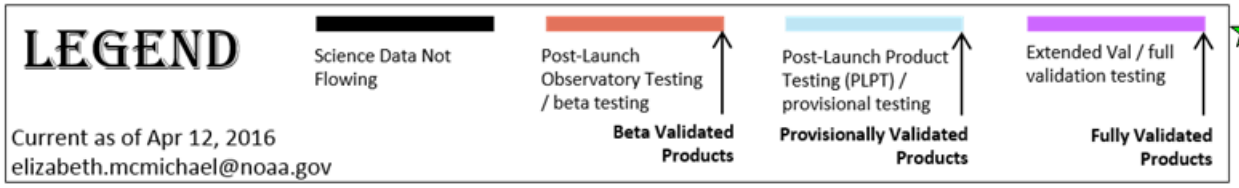
External Distribution L+88 Days

Handover Readiness Review (HRR) & Operations Handover L+6 Months

East/West Assignment L+12 Months

No later than L+6 Months





★ Declaration of Maturity Milestones occurs at Peer-Stakeholder Product Validation Reviews (PS-PVRs)

* Two one-day data blackout during this period due to COOP tests.

From Matt Seybold (GOES-R Data Operations Manager, OSPO/SPSD)

Product Maturity Levels

What do the Product Maturity Levels mean? There is a PS-PVR at each stage as a method of informing the user community of the following readiness for use:

Beta: Products are made available to users to gain familiarity with data formats and parameters. It has been minimally validated and may still contain significant errors and is not optimized for operational use.

Provisional: Product ready for operational use but has documented known issues. Product analyses are sufficient to communicate product performance to users relative to expectations.

Full: Product is operational. All known product anomalies are resolved and/or documented and shared with the user community.

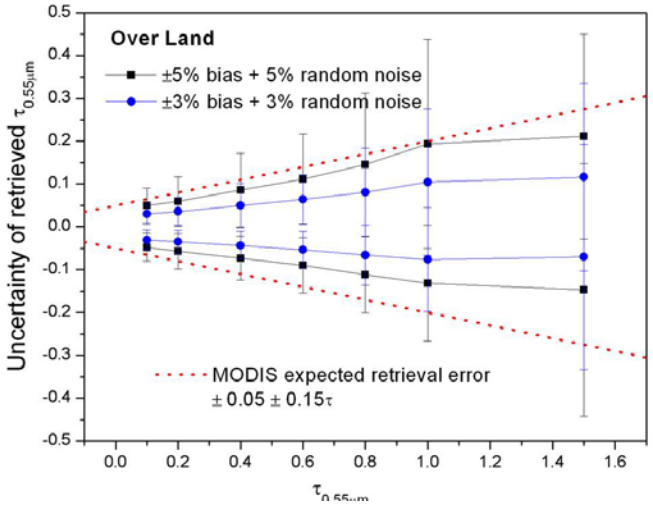
From Matt Seybold (GOES-R Data Operations Manager, OSPO/SPSD)

ABI Bands

Band No	Wavelength Microns	Bandpass microns	Primary Purpose
1	**0.47**	0.45-0.49	Daytime aerosol-on-land/coastal water mapping, vis.
2	**0.64**	0.59-0.69	Daytime clouds fog, insolation, winds
3	**0.86**	0.84-0.88	Daytime vegetation & aerosol-on-water, winds
4	**1.38**	1.365-1.395	Daytime cirrus cloud
5	**1.61**	1.58-1.64	Daytime cloud water, snow
6*	**2.26**	2.235 - 2.285	Daytime land/cloud properties, particle size, vegetation
7	**3.90**	3.80-4.00	sfc. & cloud/fog at night, fire
8	**6.15**	5.7-6.6	High-level water, flow
9	**7.0**	6.8-7.2	mid-level water, flow
10	**7.4**	7.3-7.5	Lower-level water & SO2
11	**8.5**	8.3-8.7	total water for stability, cloud phase, dust, SO2
12	**9.7**	9.6-9.8	total ozone, turbulence, winds
13	**10.35**	10.1-10.6	sfc. & cloud, ice part size
14	**11.2**	10.8-11.6	total water for SST, clouds, rainfall
15	**12.3**	11.8-12.8	total water & ash, SST
16	**13.3**	13.0-13.6	air temp & cloud heights and amounts

Current GOES Imagers | MSG or Sounder | MODIS or MTG, etc

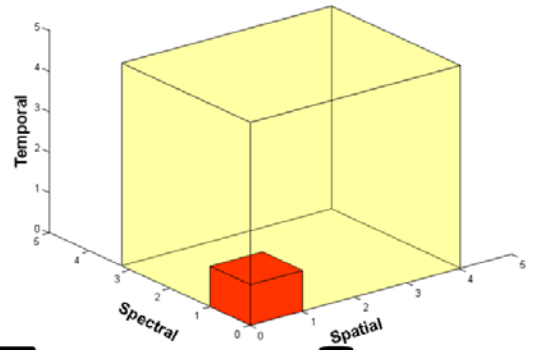
The ABI aerosol algorithm is based on heritage MODIS and VIIRS algorithms.



Comparison of 22-band NPOESS VIIRS with MODIS bands

NPOESS VIIRS		MODIS	
Band number	Central wavelength (μm)	Band number	Central wavelength (μm)
M1	0.412	**8**	0.412
M2	0.445	**9**	0.443
M3 (blue)	0.488	**3 (blue)**	0.469
M4 (green)	0.555	**4 (green)**	0.555
M5 (red)	0.672	**1 (red)**	0.645
M6	0.746	**15**	0.748
M7	0.865	**2**	0.858
M8	1.240	**5**	1.240
M9	1.378	**26**	1.375
M10	1.61	**6**	1.640
M11	2.25	**7**	2.13
M12	3.7	**22**	3.959
M13	4.05	**23**	4.05
M14	8.55	**29**	8.55
M15	10.763	**31**	11.03
M16	12.013	**32**	12.02

ABI verses Current GOES



5X Faster coverage (5-minute full disk vs. 25-minute)

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

3X More spectral bands (16 on ABI vs. 5 on the current imager)

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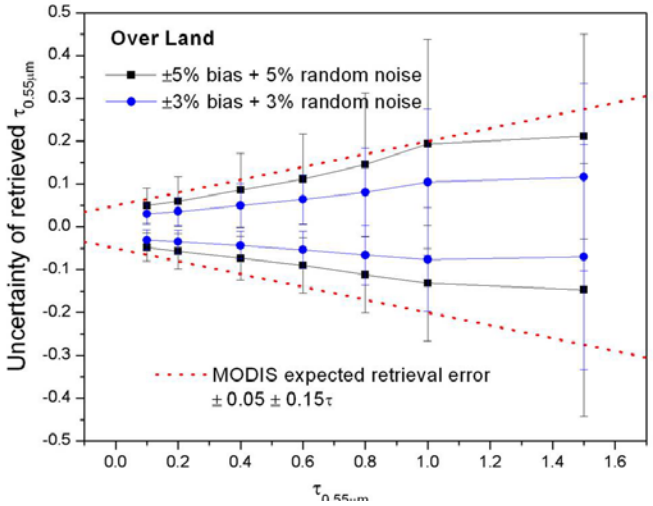

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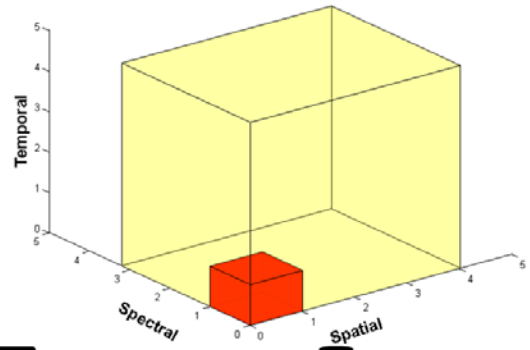

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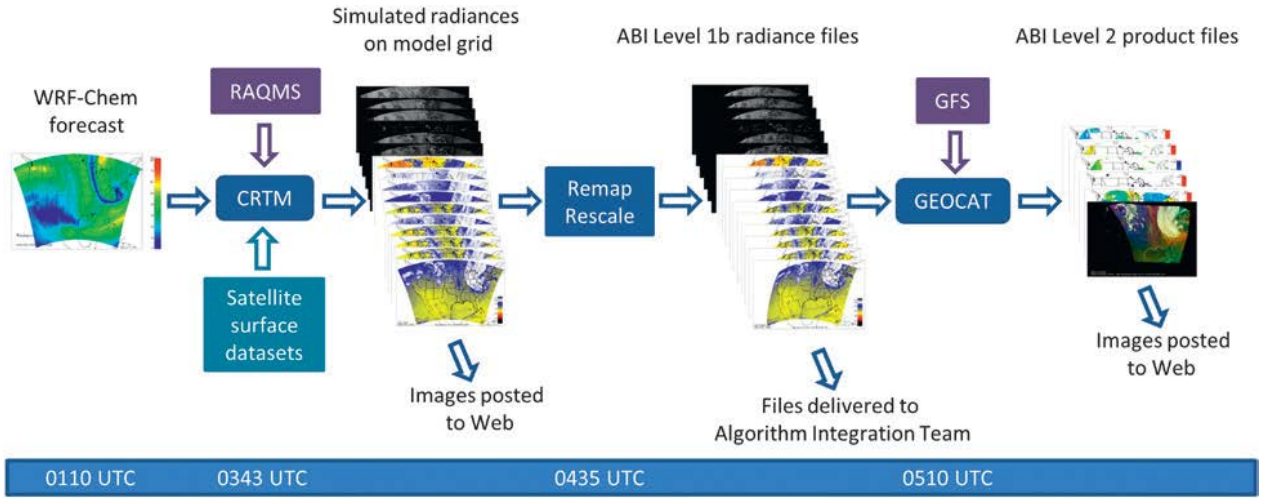
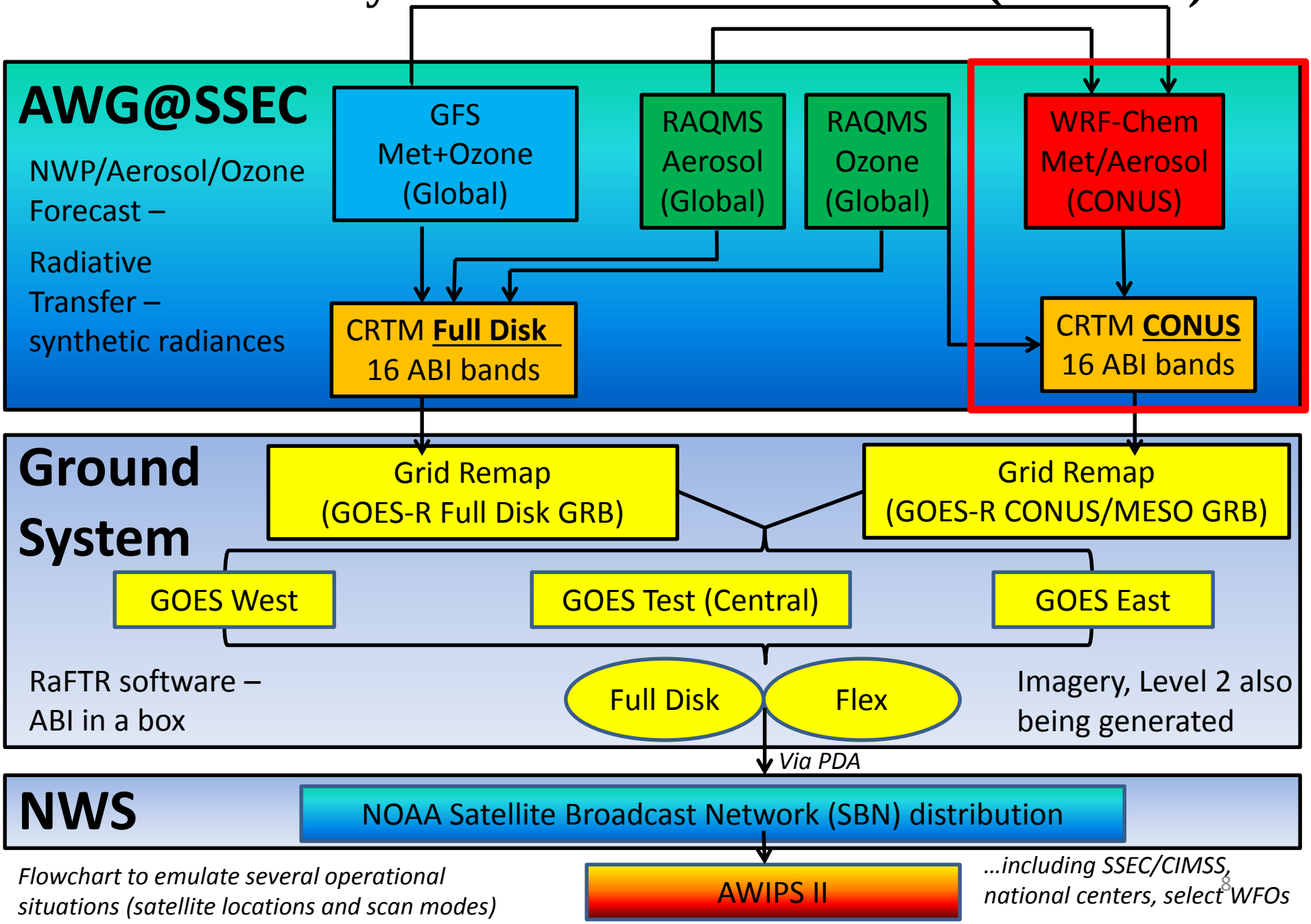
Real-time Simulation of the GOES-R ABI

- **High resolution (8km) Weather Research and Forecasting (WRF) model with chemistry (WRF-Chem) meteorological, cloud, and aerosol prediction**
- **Community Radiative Transfer Model (CRTM) forward modeling**
- **MODIS Bi-directional reflectance function (BRDF) surface reflectance**
- **Used for**
  - ✓ **GOES-R Ground System testing (Data Operations Exercise to test data flows)**
  - ✓ **User Readiness (test data formats, display software...)**
  - ✓ **Product Evaluation (running algorithms to catch deficiencies)**



Greenwald, T. J. et al. (2015), Real-Time Simulation of the GOES-R ABI for User Readiness and Product Evaluation. Bulletin of the American Meteorological Society 05/2015; DOI:10.1175/BAMS-D-14-00007.

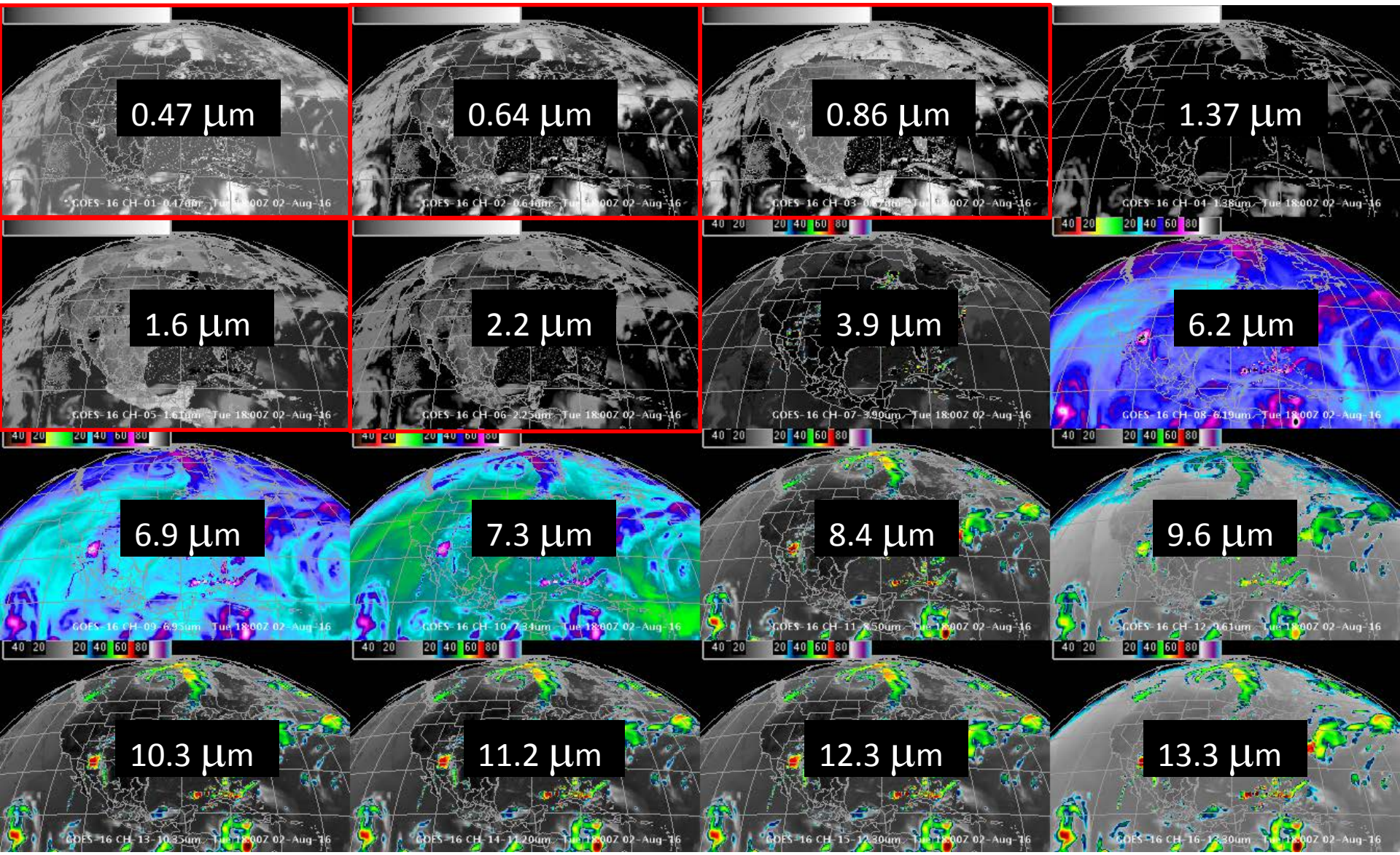
GOES-R Synthetic ABI AWG Datasets (AAWDS)



Flowchart to emulate several operational situations (satellite locations and scan modes)

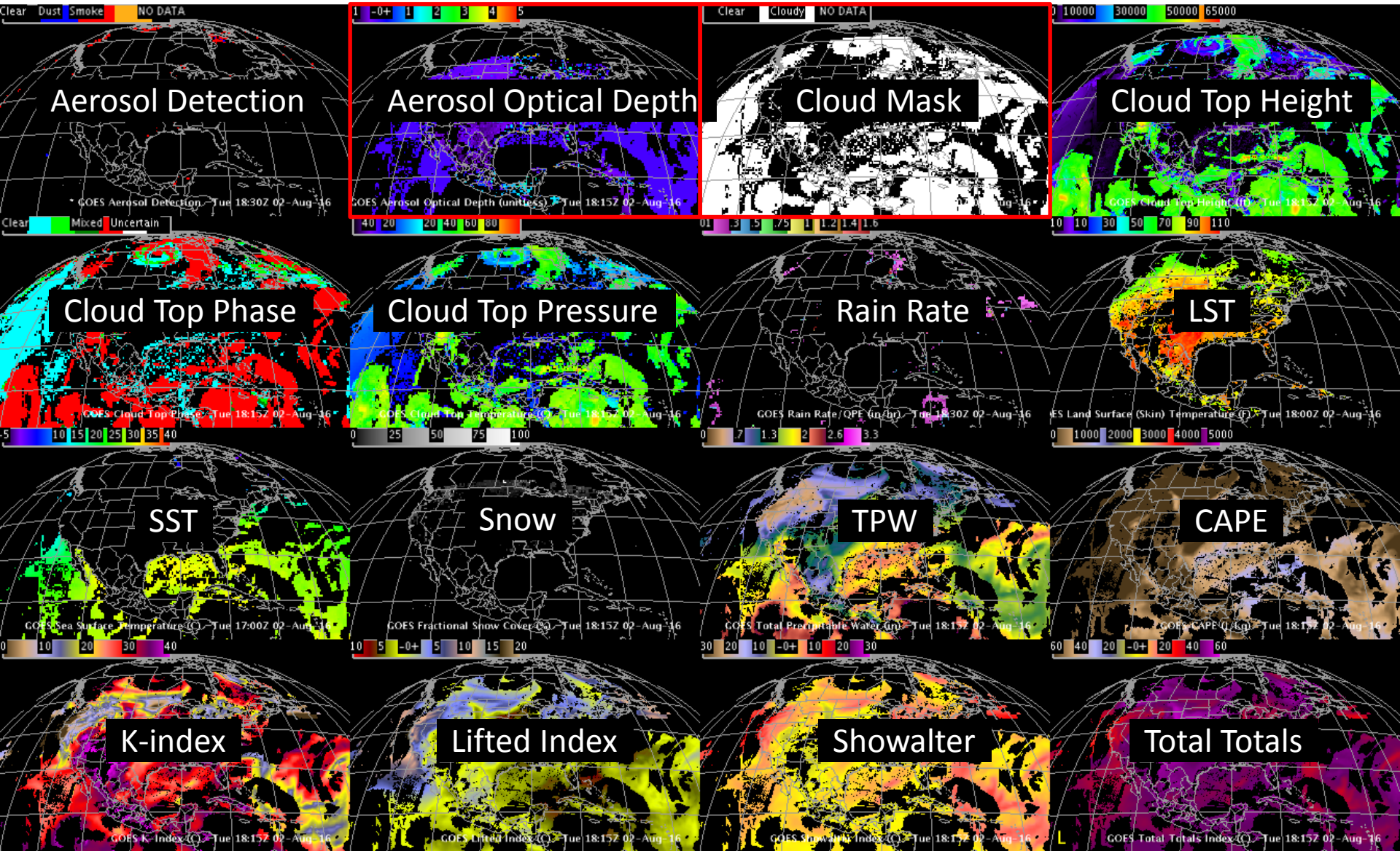
…including SSEC/CIMSS, national centers, select WFOs

Simulated ABI Spectral bands



GOES-R ABI Imagery simulated at UW via AWG Proxy, processed via the Ground System, acquired via NOAAPort, shown in AWIPS-II (default enhancements)

Simulated ABI (select) Derived Products



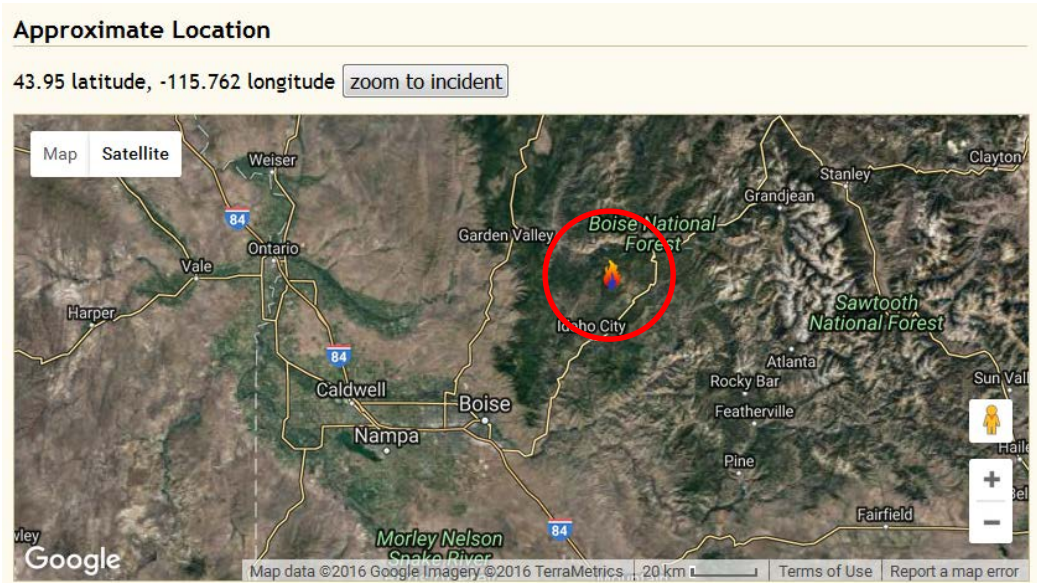
Using GOES-R ABI Imagery simulated at UW via AWG Proxy, processed via the Ground System, acquired via NOAAPort, in AWIPS-II (default enhancements)

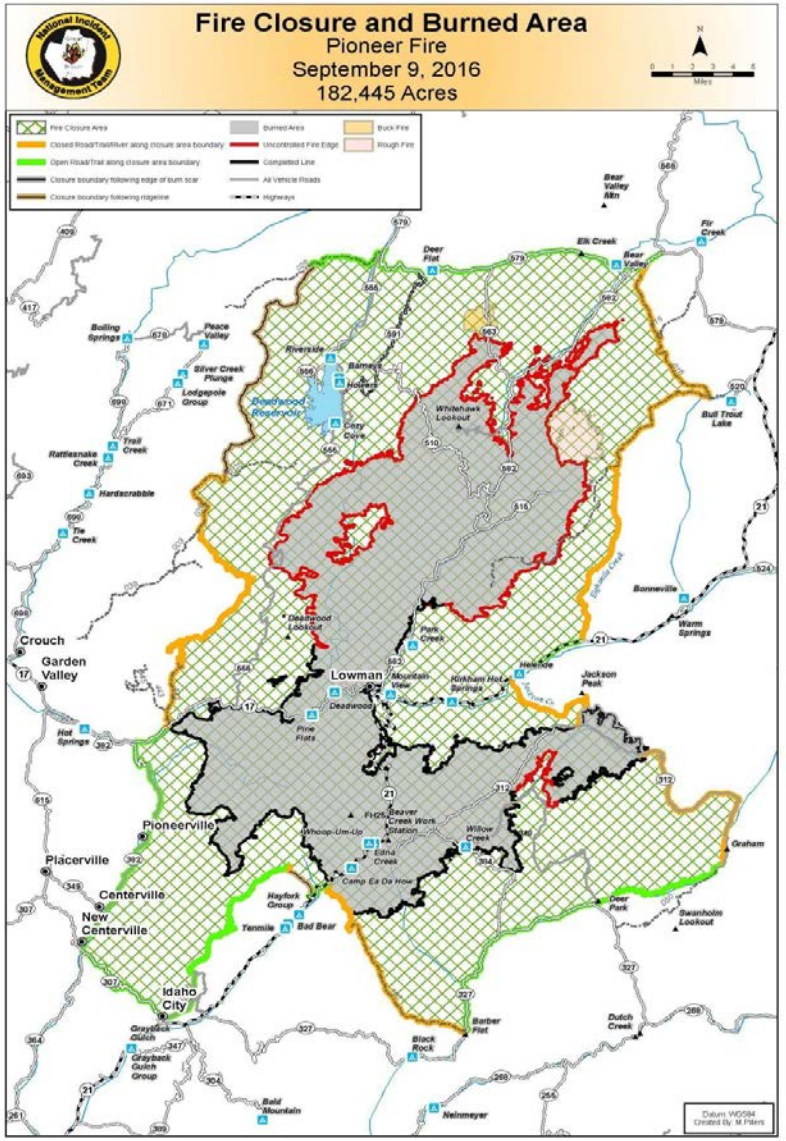
InciWeb
Incident Information System

Demonstration of GOES-R ABI aerosol retrievals using synthetic ABI proxy data

Pioneer Fire, Idaho

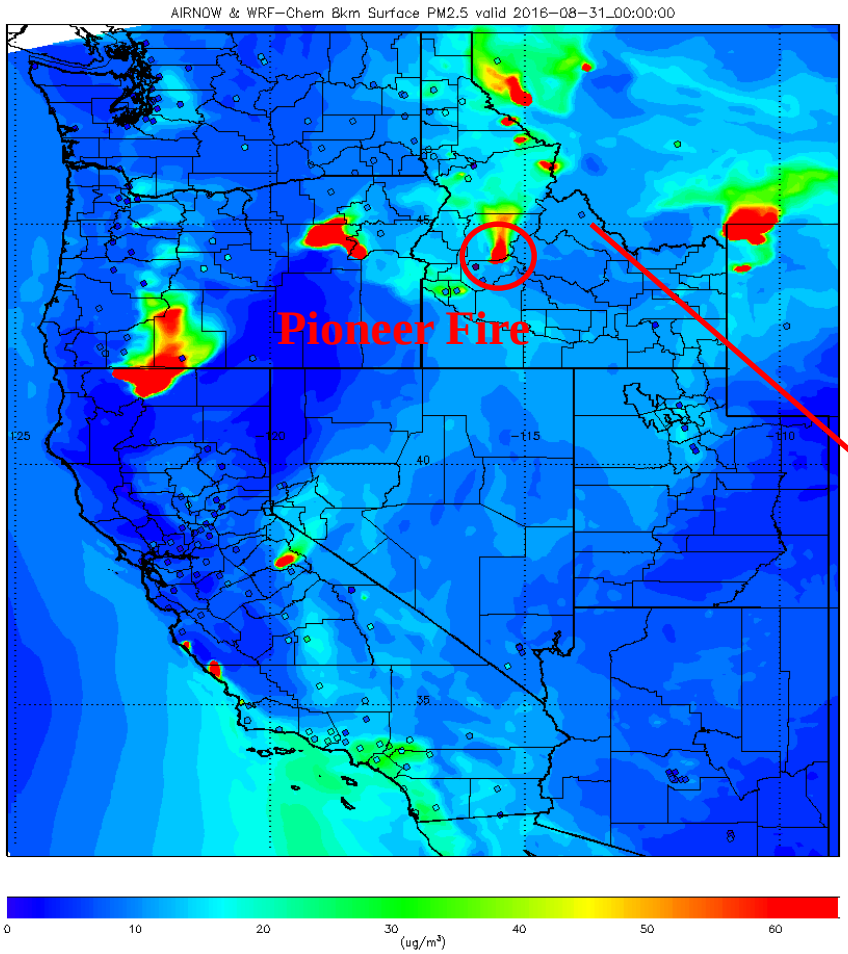
Current as of	9/9/2016, 11:52:28 AM
Incident Type	Wildfire
Cause	Unknown
Date of Origin	Monday July 18th, 2016 approx. 05:00 PM
Total Personnel	1,002
Size	182,445 Acres
Percent of Perimeter Contained	56%

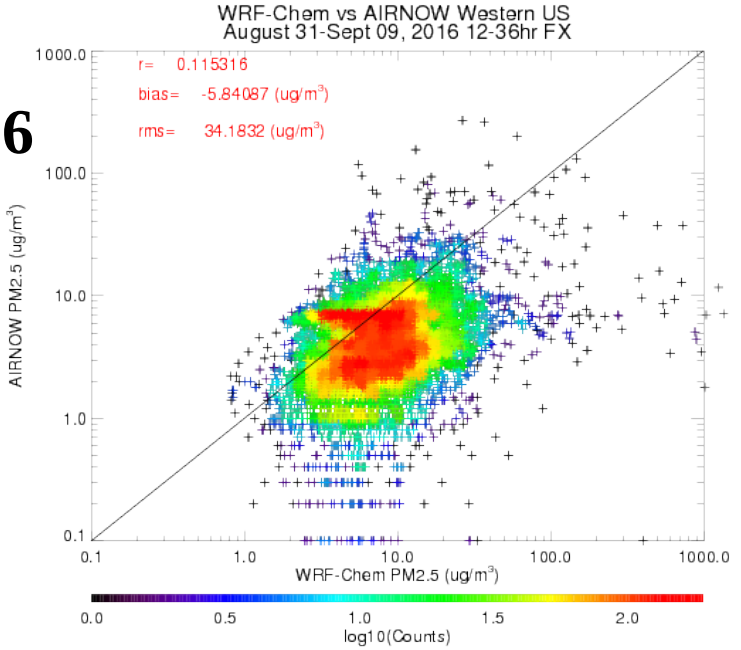


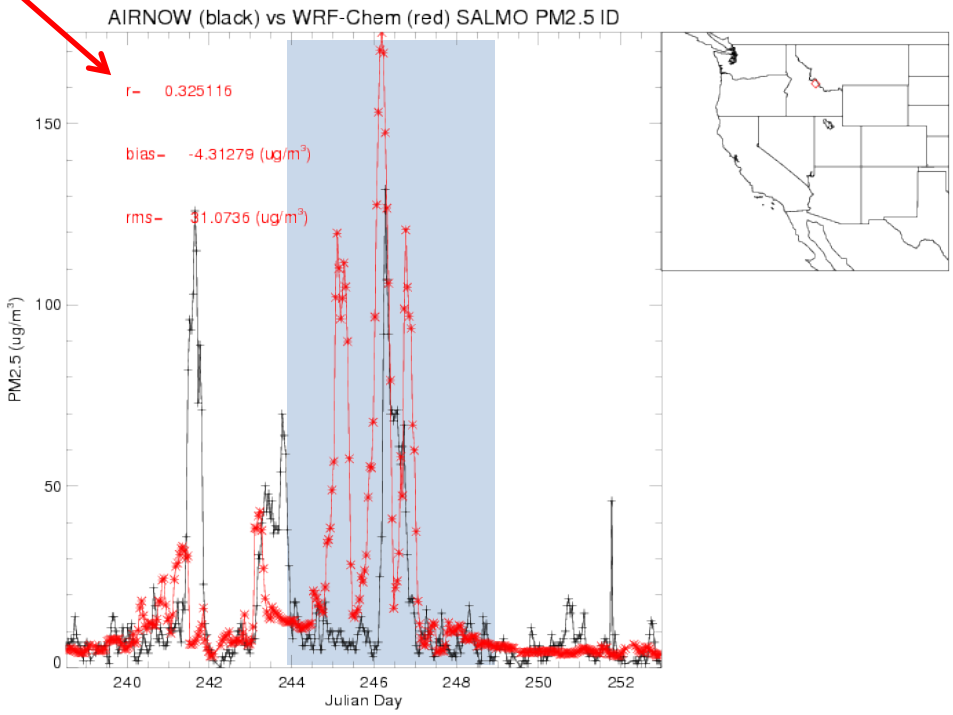


http://inciweb.nwcg.gov/incident/4866/

WRF-Chem surface PM2.5
Pioneer Fire August 31-September 05, 2016

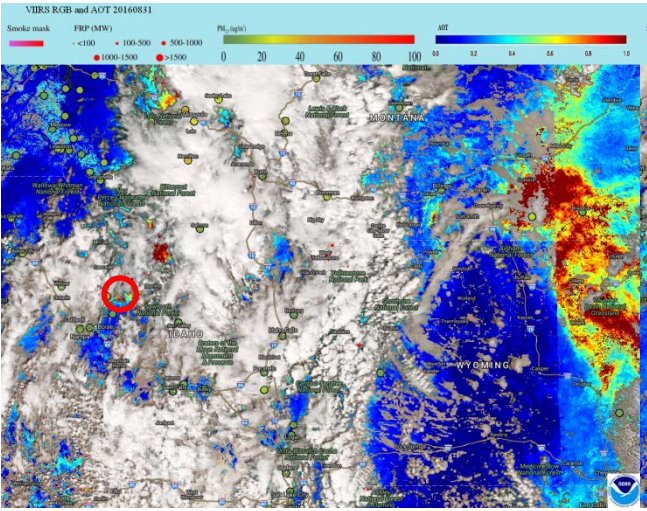




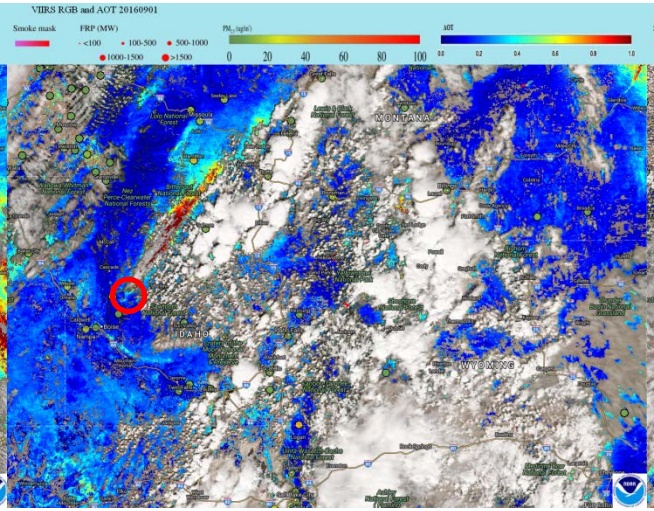


SNPP VIIRS Pioneer Fire
August 31-September 05, 2016

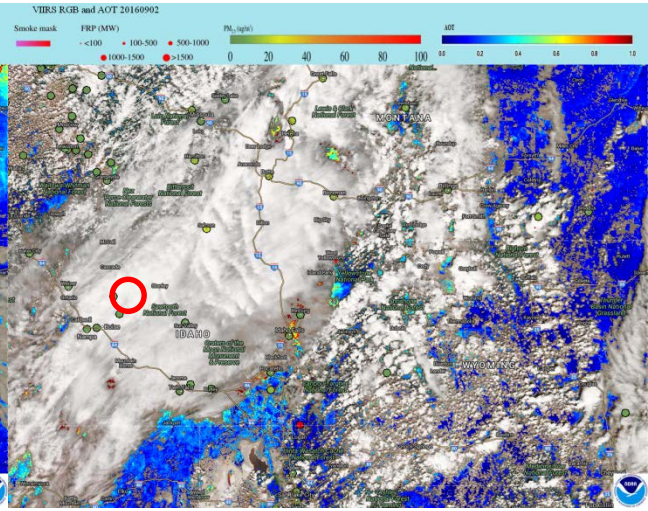
2016-08-31



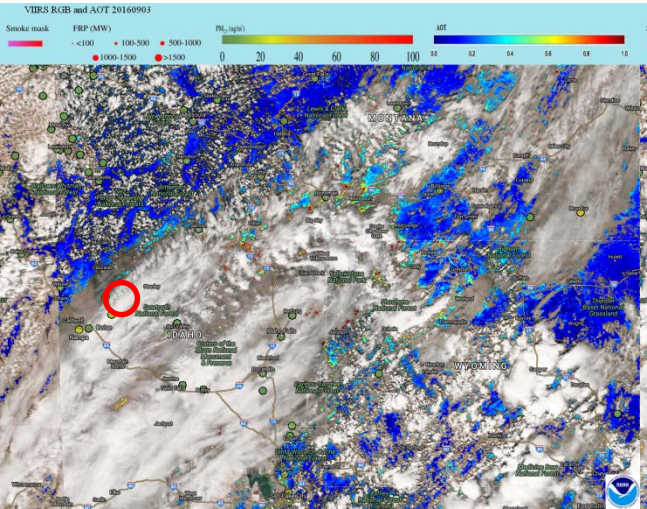
2016-09-01



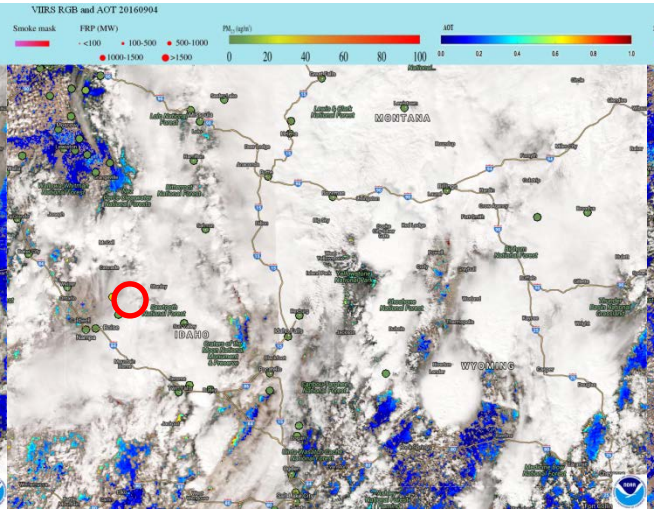
2016-09-02



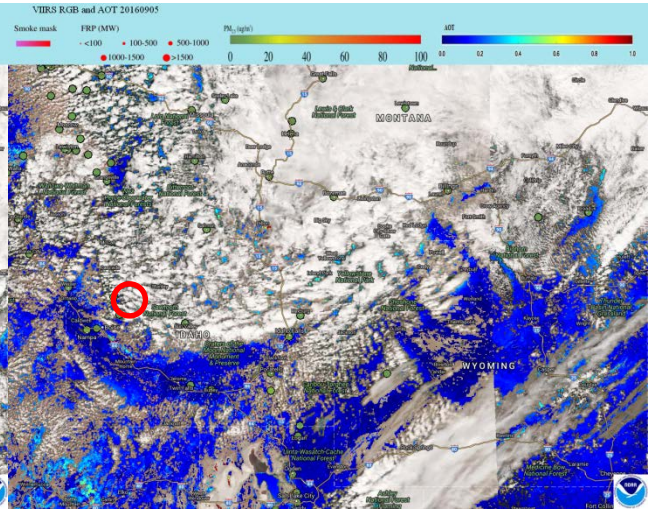
2016-09-03



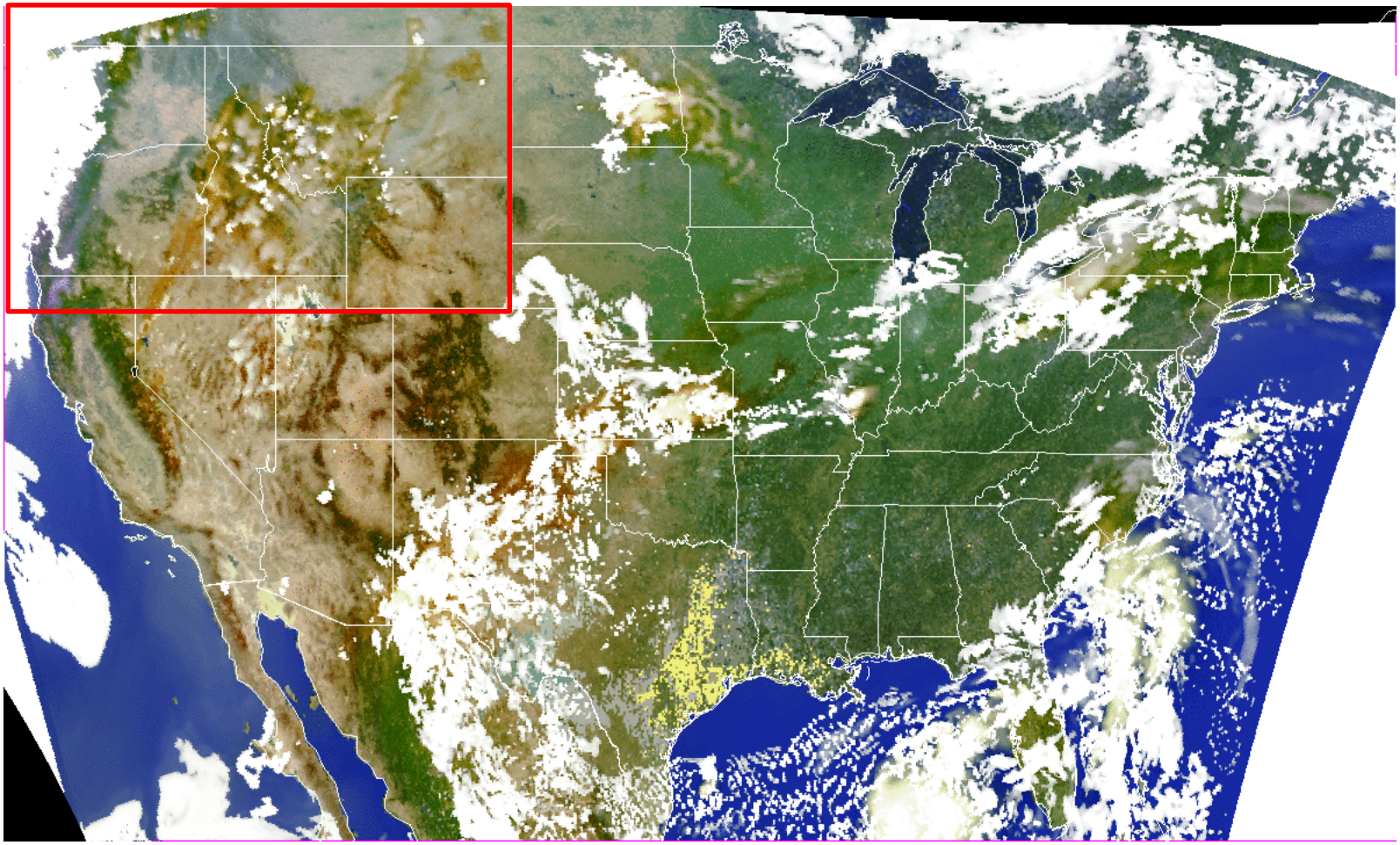
2016-09-04



2016-09-05

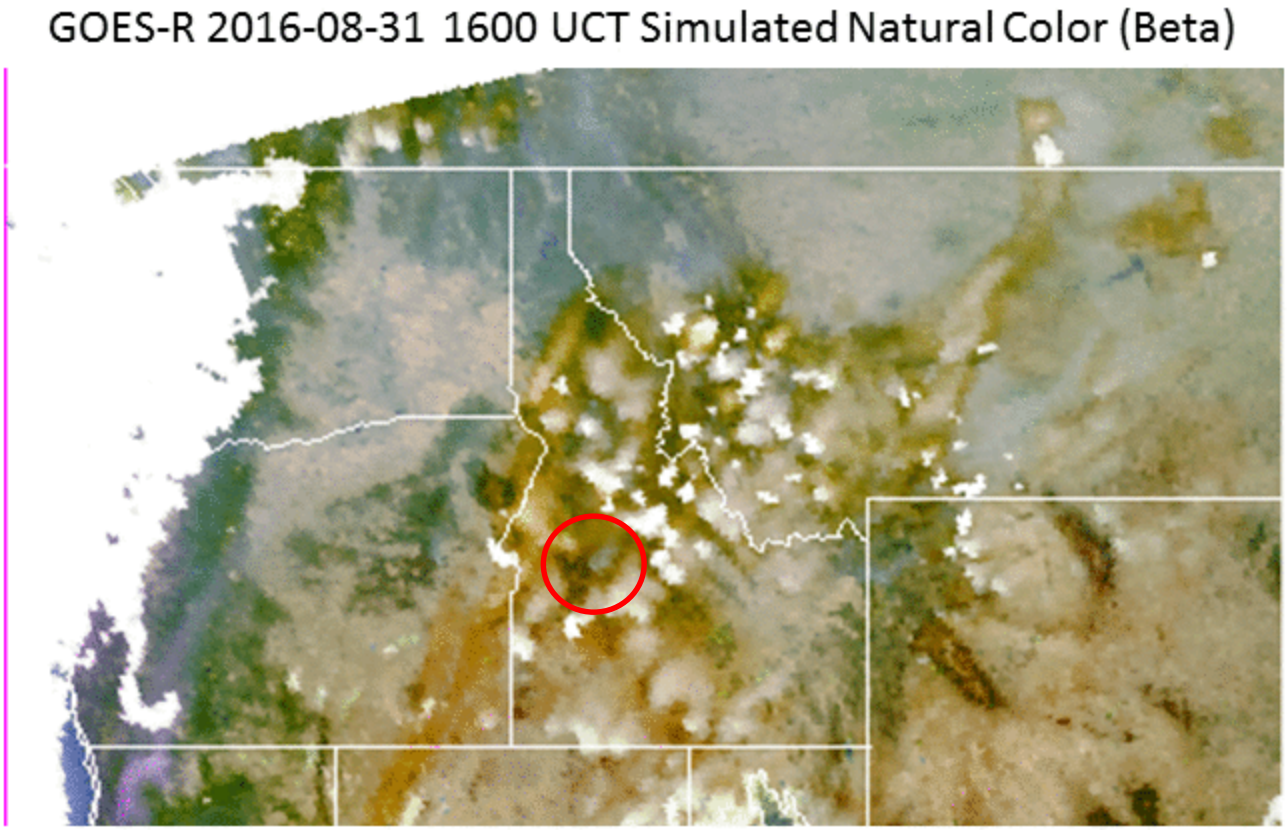


GOES-R ABI 2016-08-31 to 2016-09-05 (1600-2200 UCT)
Simulated Natural Color



Synthesized GOES-R ABI Green band:
The 0.86 µm near IR (NIR) band is utilized in a regression based LUT, along with the Red and Blue bands, to create the needed Green band.

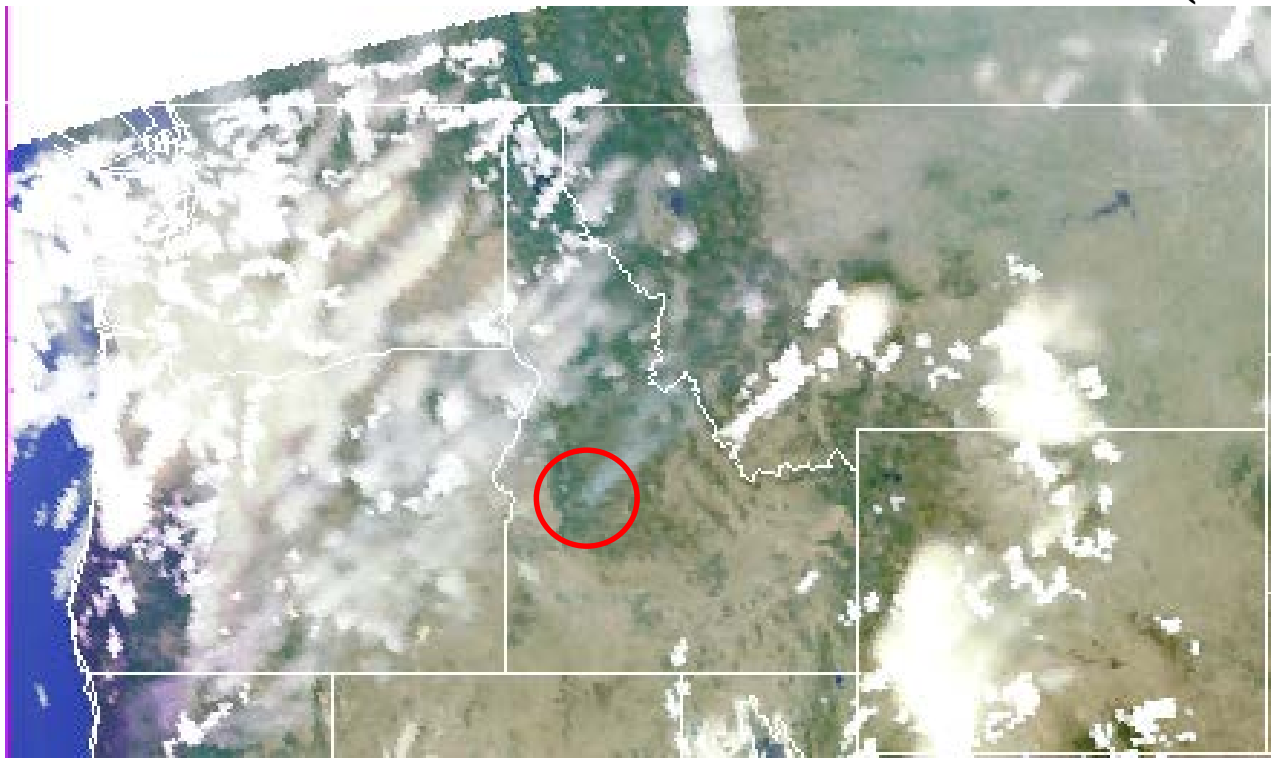
Pacific North West Zoom 2016-08-31 to 2016-09-01 (1600-2200 UCT)
Simulated Natural Color



Synthesized GOES-R ABI Green band:
The 0.86 µm near IR (NIR) band is utilized in a regression based LUT, along with the Red and Blue bands, to create the needed Green band.

Pacific North West Zoom 2016-09-01 2200 UCT
Simulated Natural Color

GOES-R 2016-09-01 2200 UCT Simulated Natural Color/AOD (Beta)



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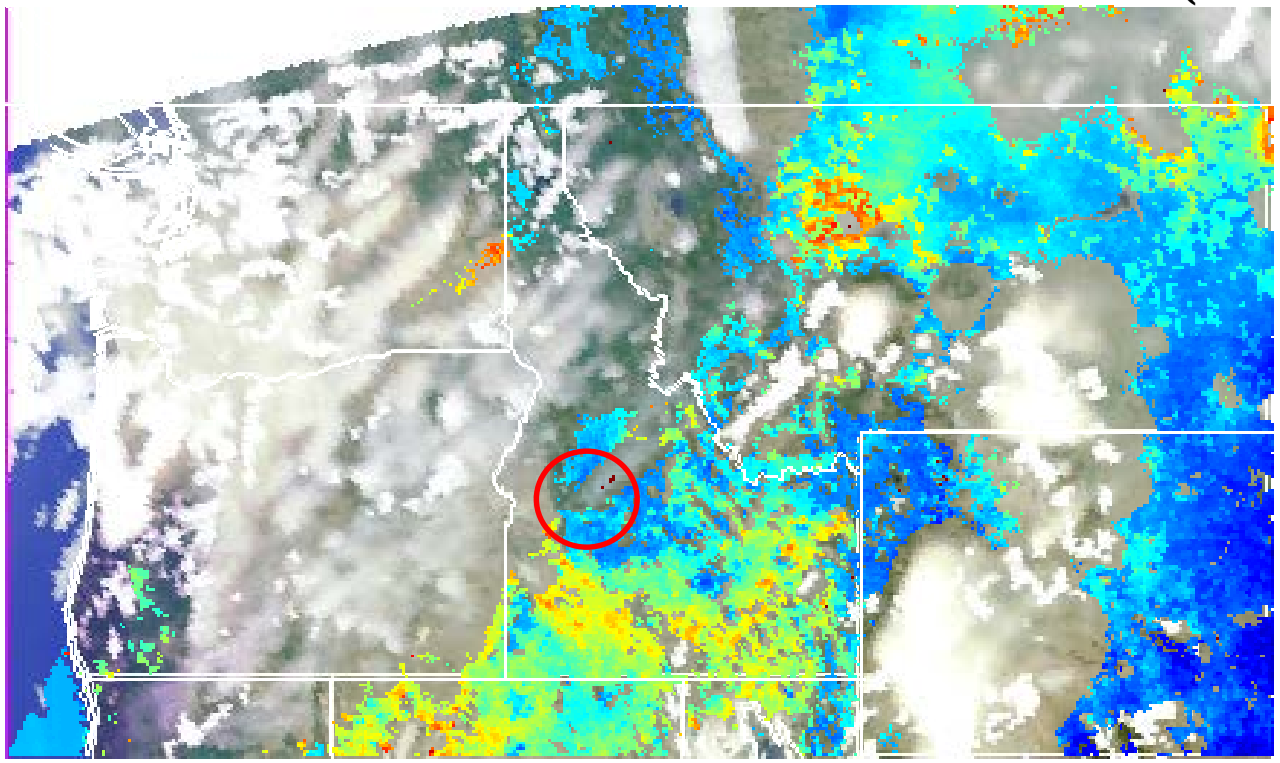
Pacific North West Zoom 2016-09-01 2200 UCT
Simulated Natural Color plus AOD

GOES-R 2016-09-01 2200 UCT Simulated Natural Color/AOD (Beta)



Synthetic GOES-R ABI AOD retrieval:
MODIS and VIIRS heritage multi-spectral AOD retrieval at high (2km) spatial and high (5 minute CONUS, 15 minute Full Disk) temporal resolution

Summary

- GOES-R launch scheduled for November 04, 2016
- Beta level maturity Aerosol Optical Depth (AOD) products available no later than Launch+6months
- GOES-R Advanced Baseline Imager (ABI) multi-spectral AOD retrievals based in MODIS and VIIRS heritage algorithms
- ABI will provide MODIS and VIIRS quality AOD retrievals at high spatial (2km) and temporal (5 minutes CONUS, 15 minutes Full Disk) resolution
- Increased spatial and temporal resolution will increase likelihood of cloud free scenes and improve characterization of aerosol loading over the continental US as well as long-range transport of aerosols from other sources.