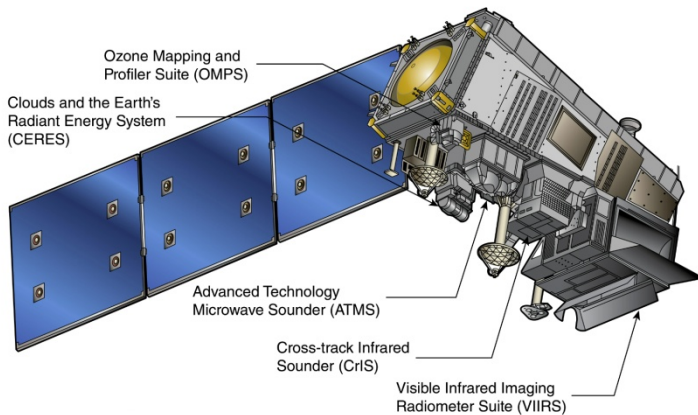


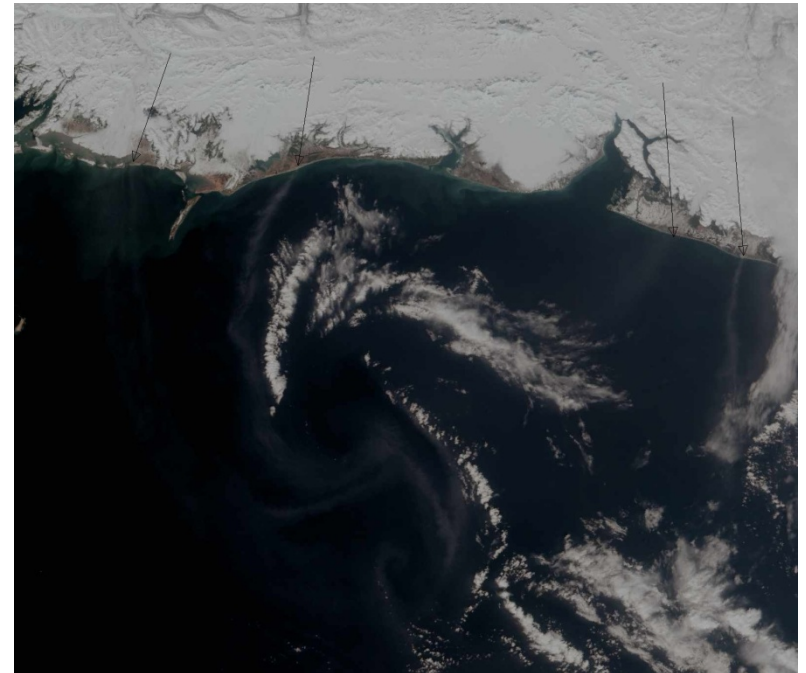
1

# Introducing VIIRS Aerosol Products for Exceptional Events Monitoring and Forecasting in Alaska



Shobha Kondragunta

NOAA/NESDIS Center for Satellite  
Applications and Research

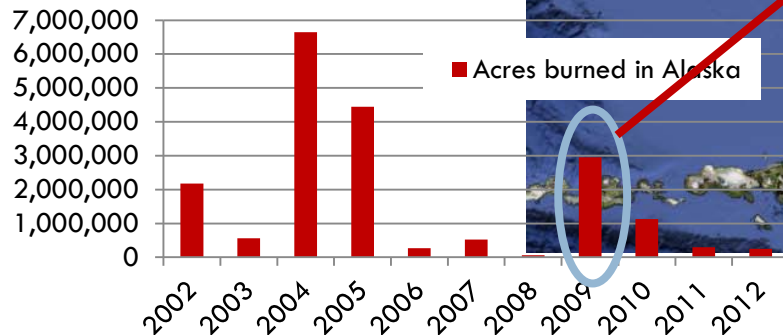


Contributions from: Hai Zhang, Chuanyu Xu,  
and Pubu Ciren, IMSG at NOAA

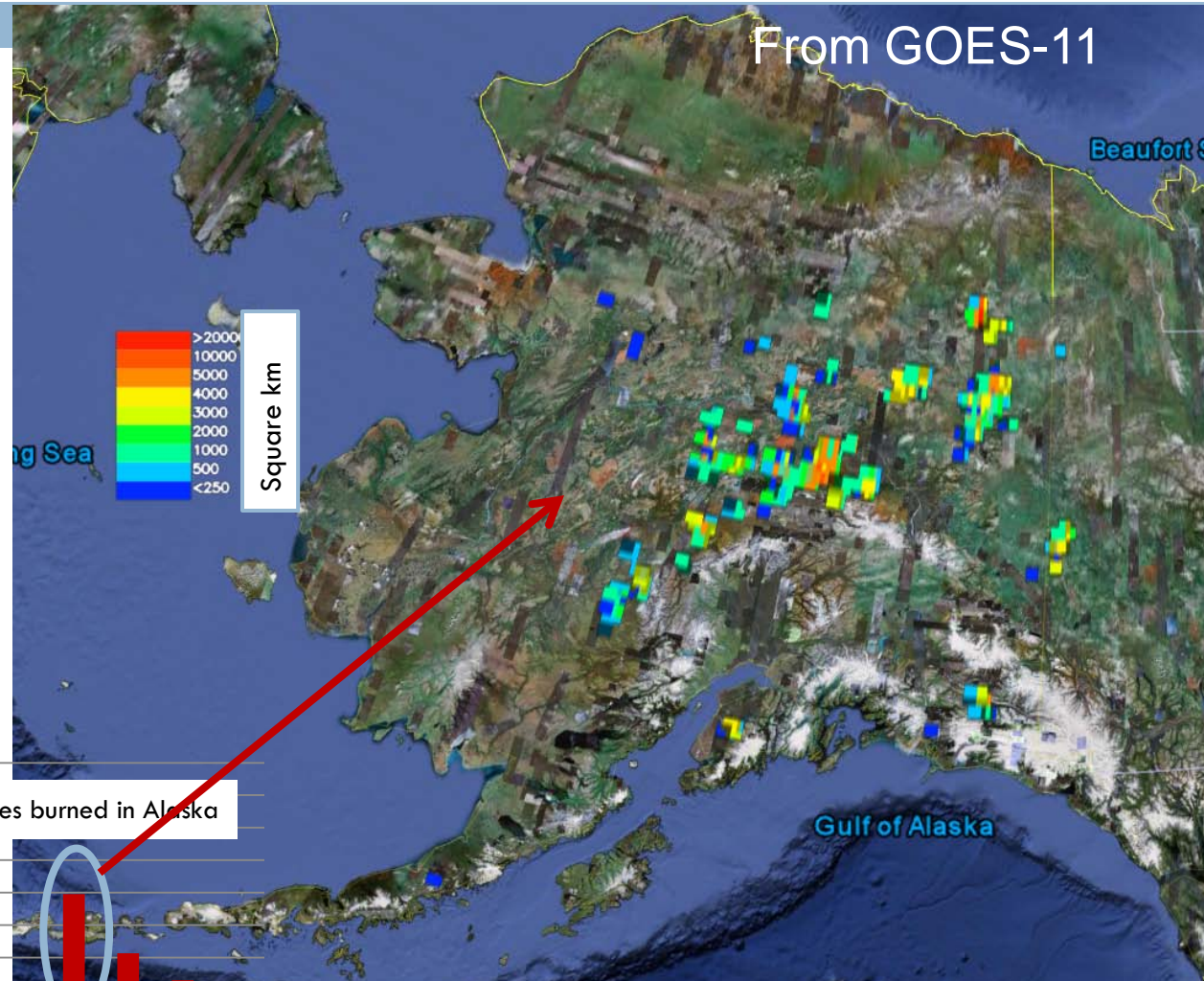
# Alaska Burned Area

2

Thousands of acres burn each year in Alaska and smoke from fires has an adverse impact on human health and economy



From National Interagency Fire Center



Eleven years of GOES burned area product available from NESDIS/STAR for applications

# JPSS Proving Ground Project

3

- Enable NWS Alaska to use near real time smoke plume imagery in monitoring, tracking, and forecasting of the Exceptional Events (EEs)
  - ▣ Adapt algorithms developed for GOES/GOES-R to VIIRS fire and aerosol products
    - Automated Smoke Detection and tracking Algorithm (ASDA) developed for GOES
    - Aerosol detection (smoke and dust) algorithm developed for GOES-R ABI
    - Aerosol detection (smoke and dust) algorithm developed for VIIRS
  - ▣ Run the smoke detection algorithms at NESDIS/STAR on VIIRS DB data and test/evaluate the product by comparing to event analysis and CALIPSO data
  - ▣ Transition the code to UF for implementation

# Automatic Smoke Detection and Tracking Algorithm

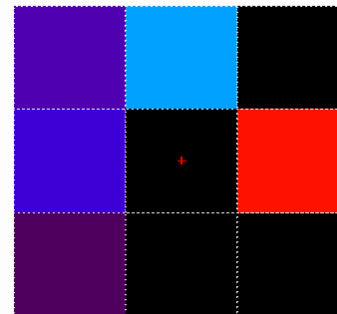
4

- Column average smoke concentration ( $\mu\text{g}/\text{m}^3$ ) using AOD and fire hot spots from GOES
  - Uses source apportionment and pattern recognition techniques to isolate smoke aerosols from other type of aerosols
  - Smoke mass concentration ( $m_c$ ) is obtained using AOD ( $\tau$ ), mass extinction efficiency ( $k$ ), and aerosol height ( $h$ )
- Product specifications
  - **Name:** ASDTA
  - **Satellites:** GOES-East and GOES-West (includes Alaska and Hawaii)
  - **Accuracy:** 60%
  - **Spatial resolution:**  $0.15^\circ$
  - **Temporal resolution:** hourly
  - **Latency:** one day
  - **Data format:** binary file, GRIB file, JPEG imagery
  - **Data availability:** 2007 - present

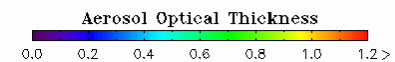
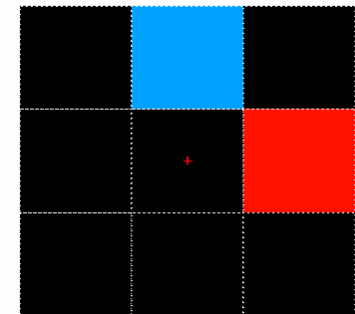
<http://airquality.weather.gov>

## Animation of Smoke Plume Detection

Original AOD Image

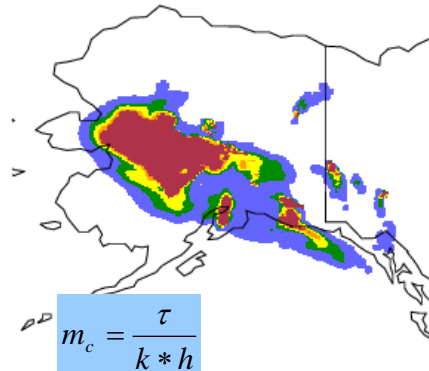


Smoke AOD Image

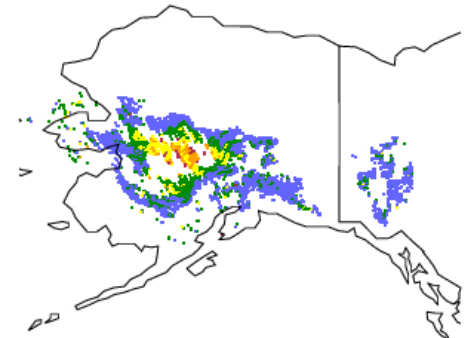


July 13, 2009 17Z – 18Z

Forecast

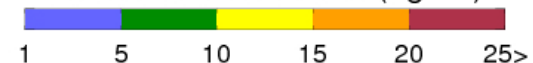


Observation



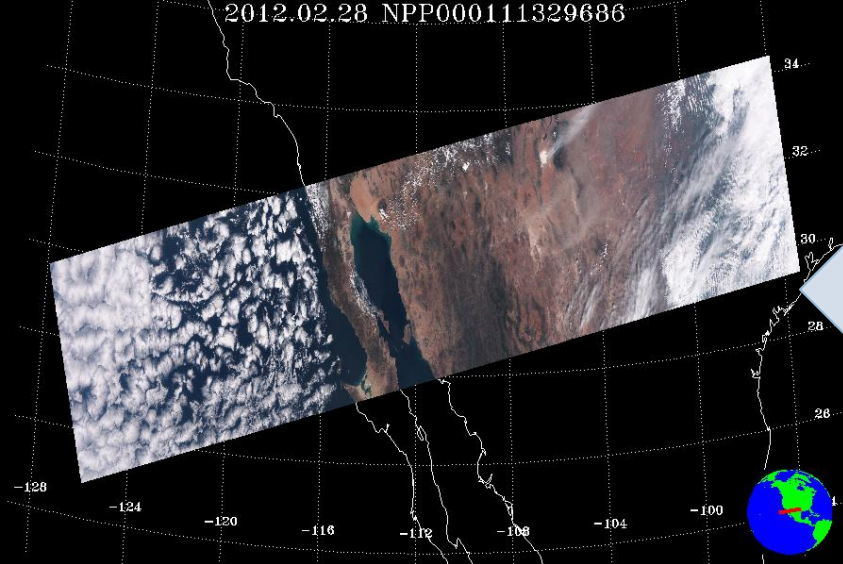
Levels:  $1\mu\text{g}/\text{m}^3$   $5\mu\text{g}/\text{m}^3$   
FMS (%): 29.74 22.65

Smoke Concentration ( $\mu\text{g}/\text{m}^3$ )





2012.02.28 NPP000111329686



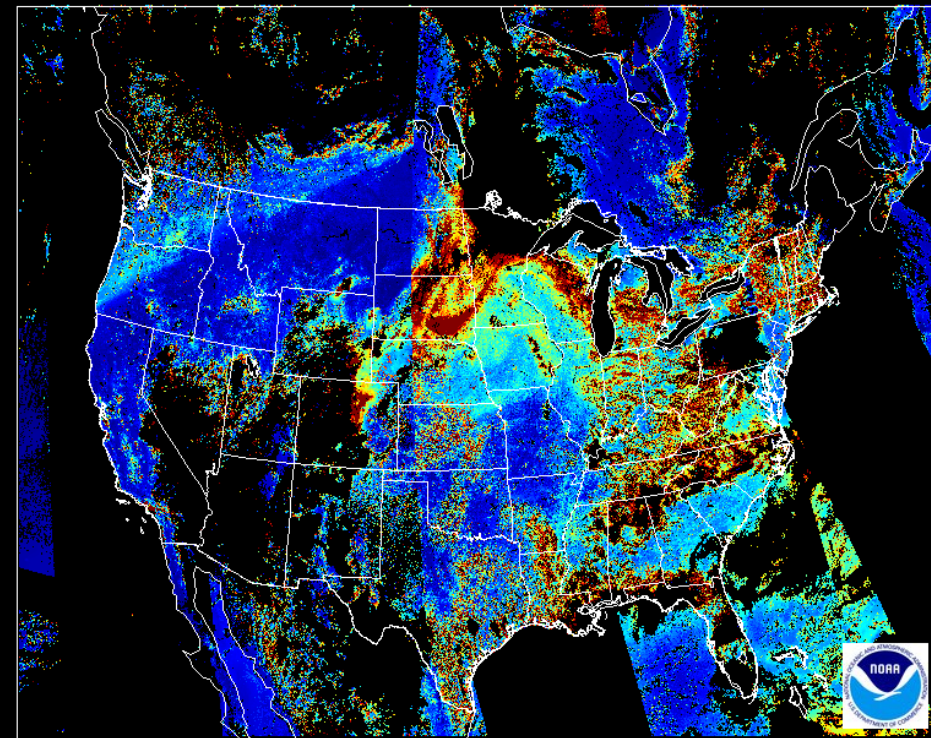
VIIRS Granule: 86 seconds; 48 scan lines; 3040 km swath width; 16 M-bands (412 nm to 12  $\mu\text{m}$ ); 768 X 3200 fixed array size per granule.

**Outputs (HDF5):** (1) AOT Intermediate Product, IP; (2) AOT Environmental Data Record, EDR; (3) Suspended Matter; (4) Aerosol Model Information; (5) Geolocation file for IP; (6) Geolocation file for EDR.

**Need to know:** IP is a pixel level AOT retrieval; EDR is an aggregate of about 8 X 8 IP pixels; IP product has Navy Aerosol Analysis and Prediction System AOT filled in for pixels with no retrievals but this is not included in EDR; **no AOT over inland water bodies**; **no negative retrievals allowed**; **no AOTs over 2.0 reported**; **VIIRS products come with several quality flags that are useful to screen the data.**

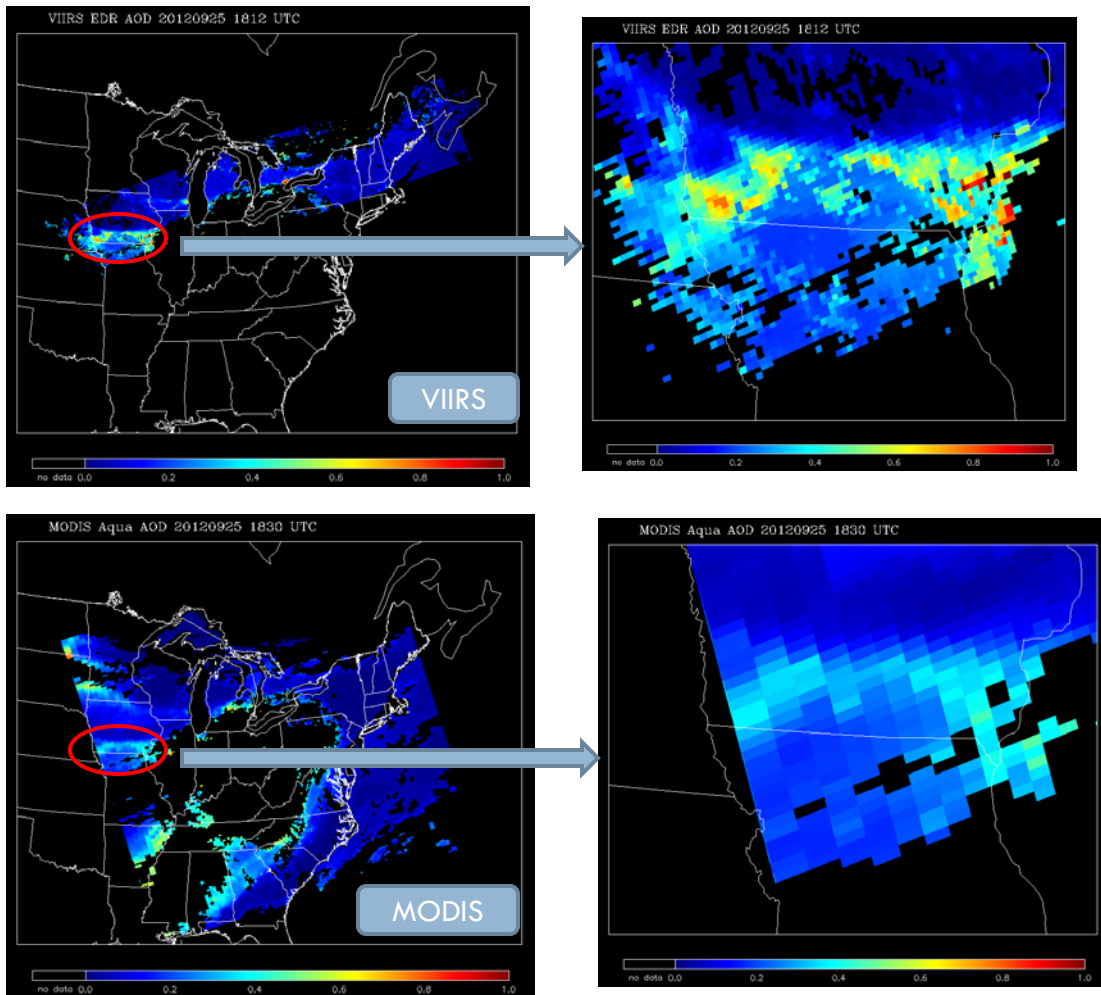


VIIRS 750m AOD 20120704 (Beta product for qualitative use only)



# VIIRS vs. MODIS EOS

6

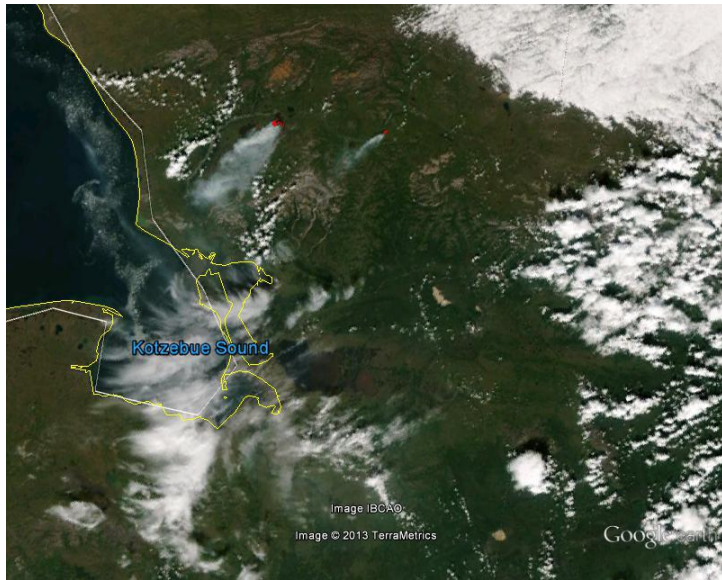


	MODIS	VIIRS
Orbit altitude	690 km	824 km
Equator crossing time	13:30 LT	13:30 LT
Granule size	5 min	86 sec
swath	2330 km	3040 km
Pixel nadir	0.5 km	0.75 km
Pixel edge	2 km	1.5 km
EDR AOT Product nadir	10 km	6 km
EDR AOT Product EOS	40 km	12 km

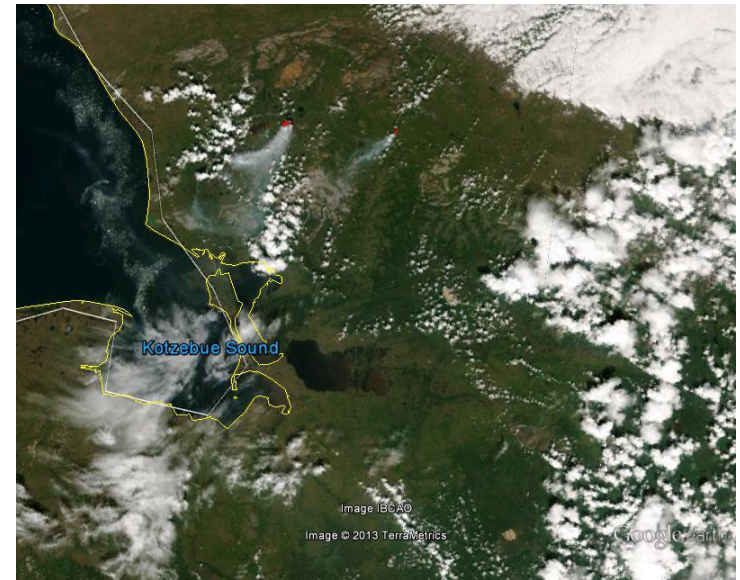


# Fire/Smoke Events in 2012

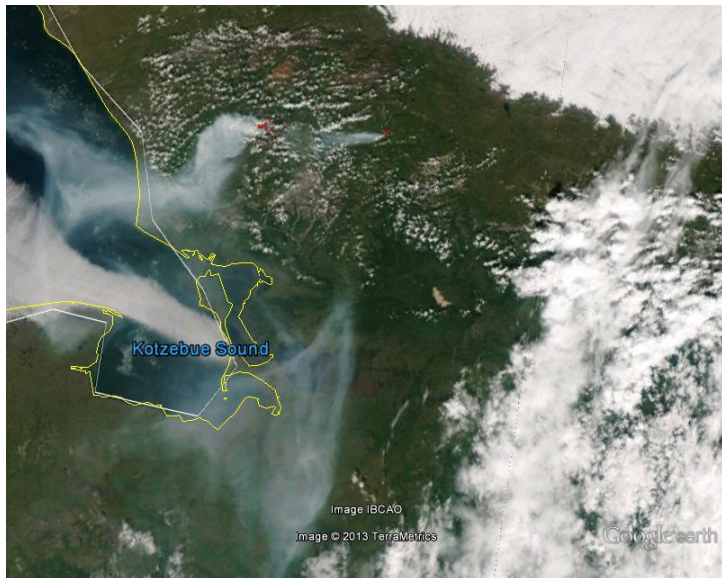
2012-07-07 2141 UTC RGB



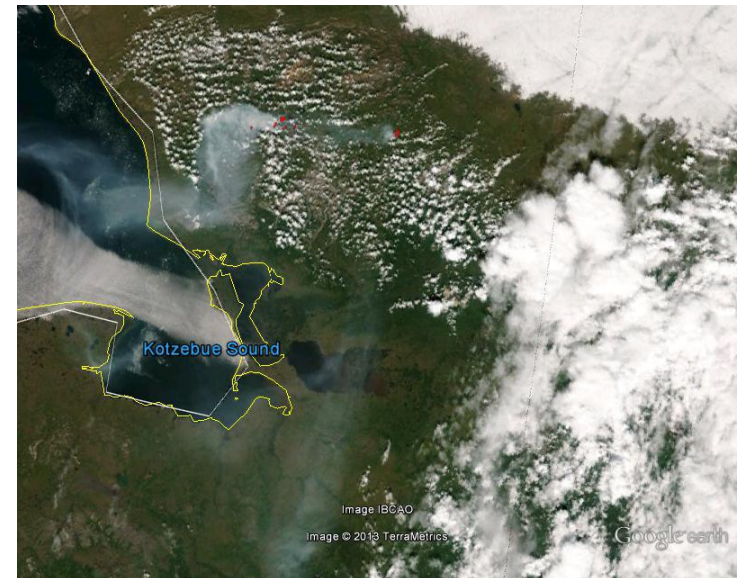
2012-07-07 2324 UTC RGB



2012-07-08 2122 UTC RGB

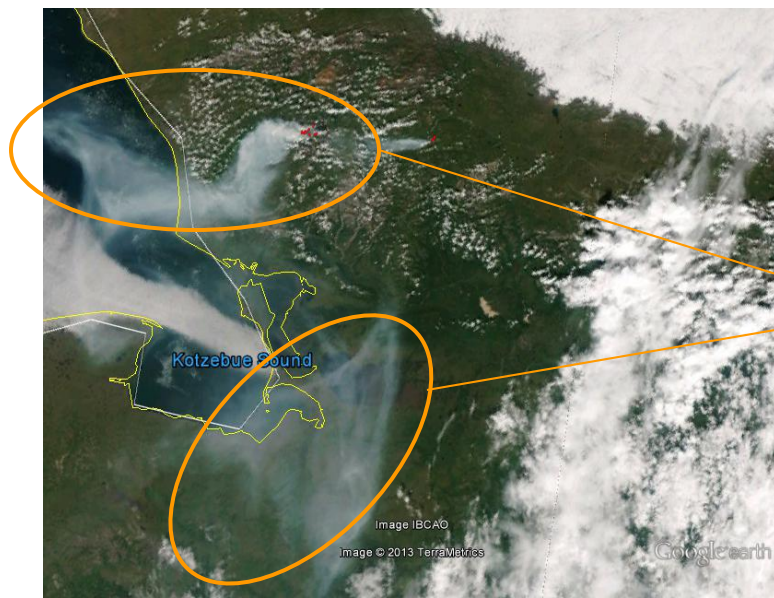


2012-07-08 2303 UTC RGB

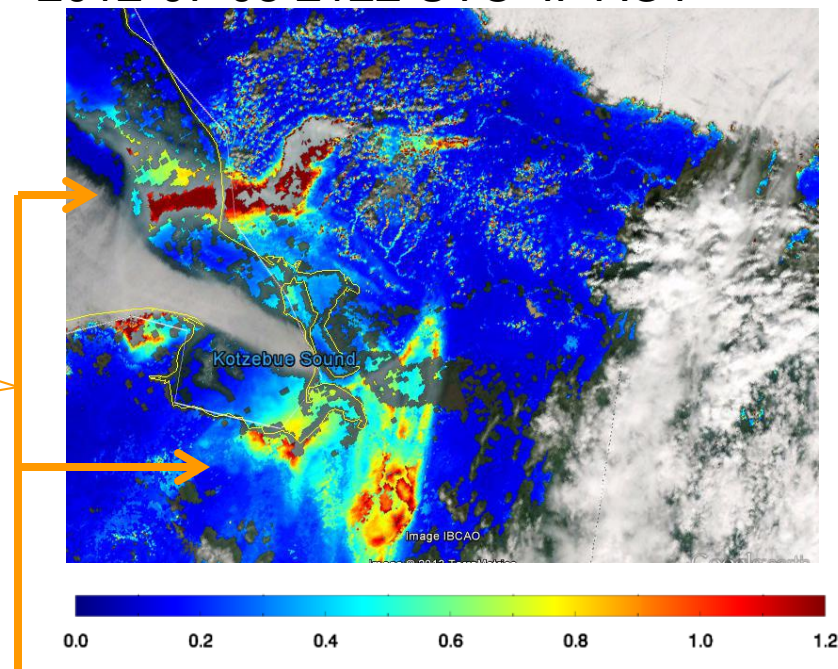




2012-07-08 2122 UTC RGB



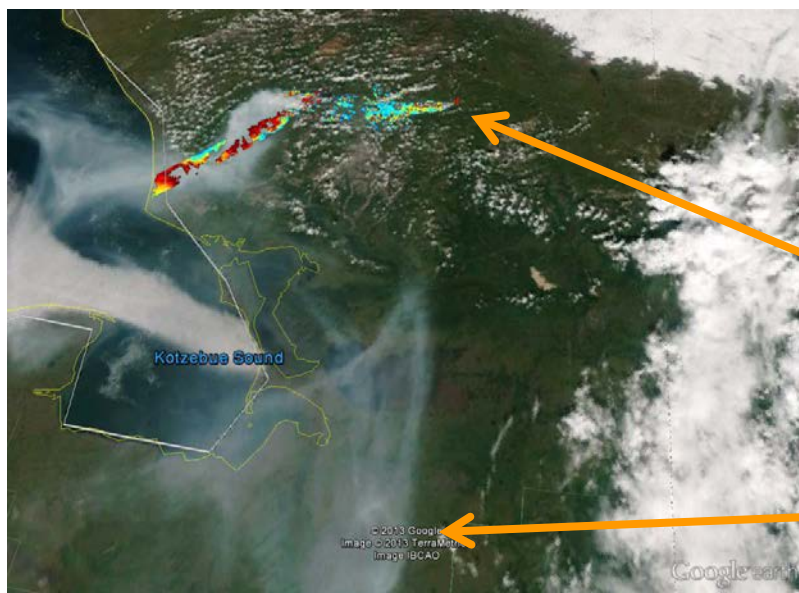
2012-07-08 2122 UTC IP AOT



Smoke visible in the RGB image is detected nicely in the VIIRS AOT product

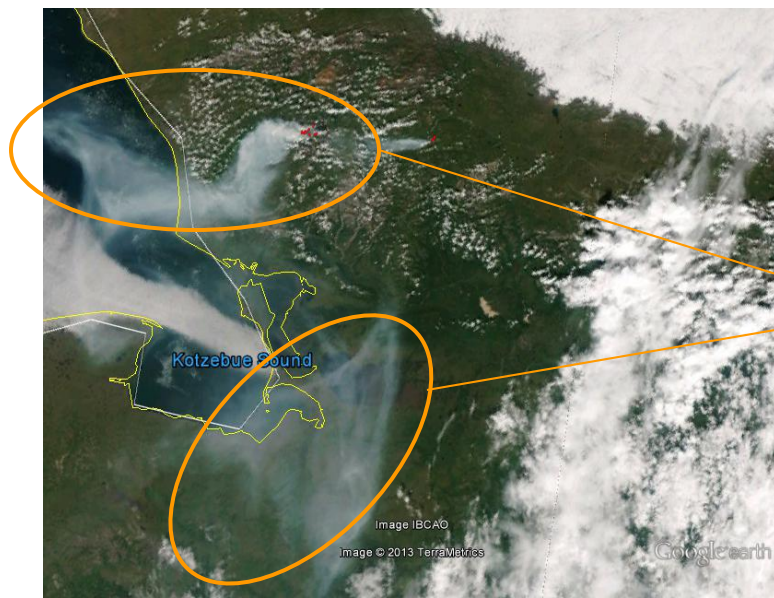
ASDA algorithm applied to VIIRS granules identifies a narrow smoke plume associated with fire

Smoke plume transported away from the fire source not detected because it is detached from the source.

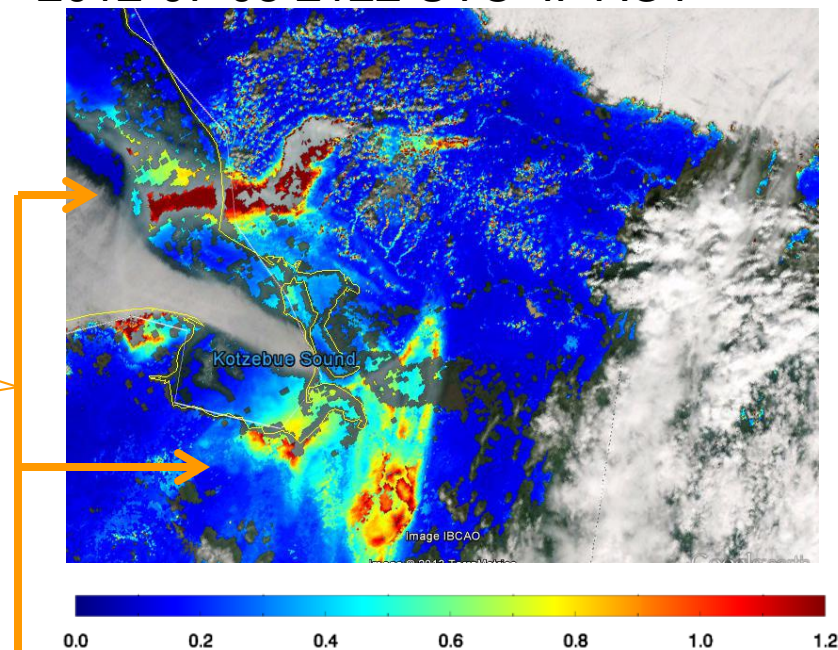




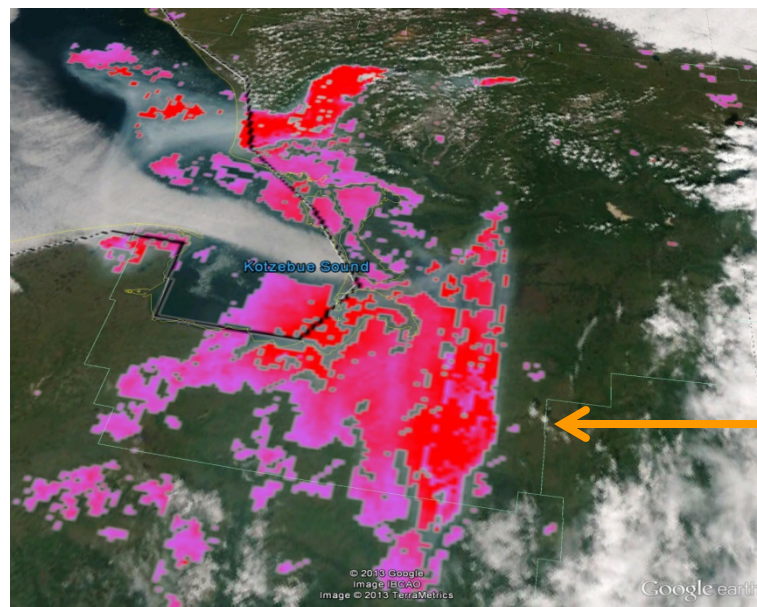
2012-07-08 2122 UTC RGB



2012-07-08 2122 UTC IP AOT

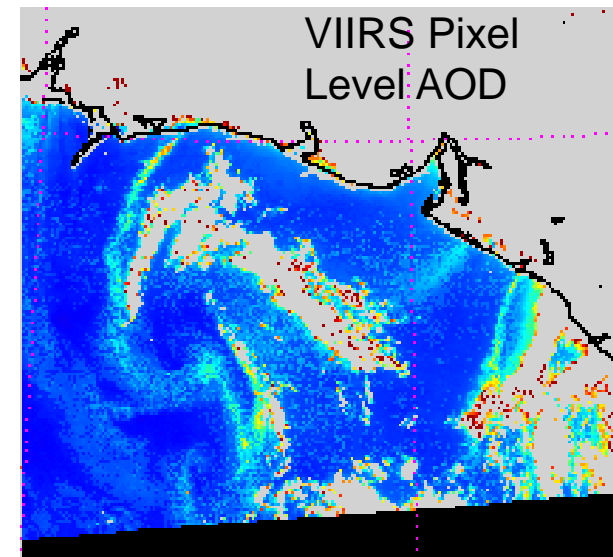
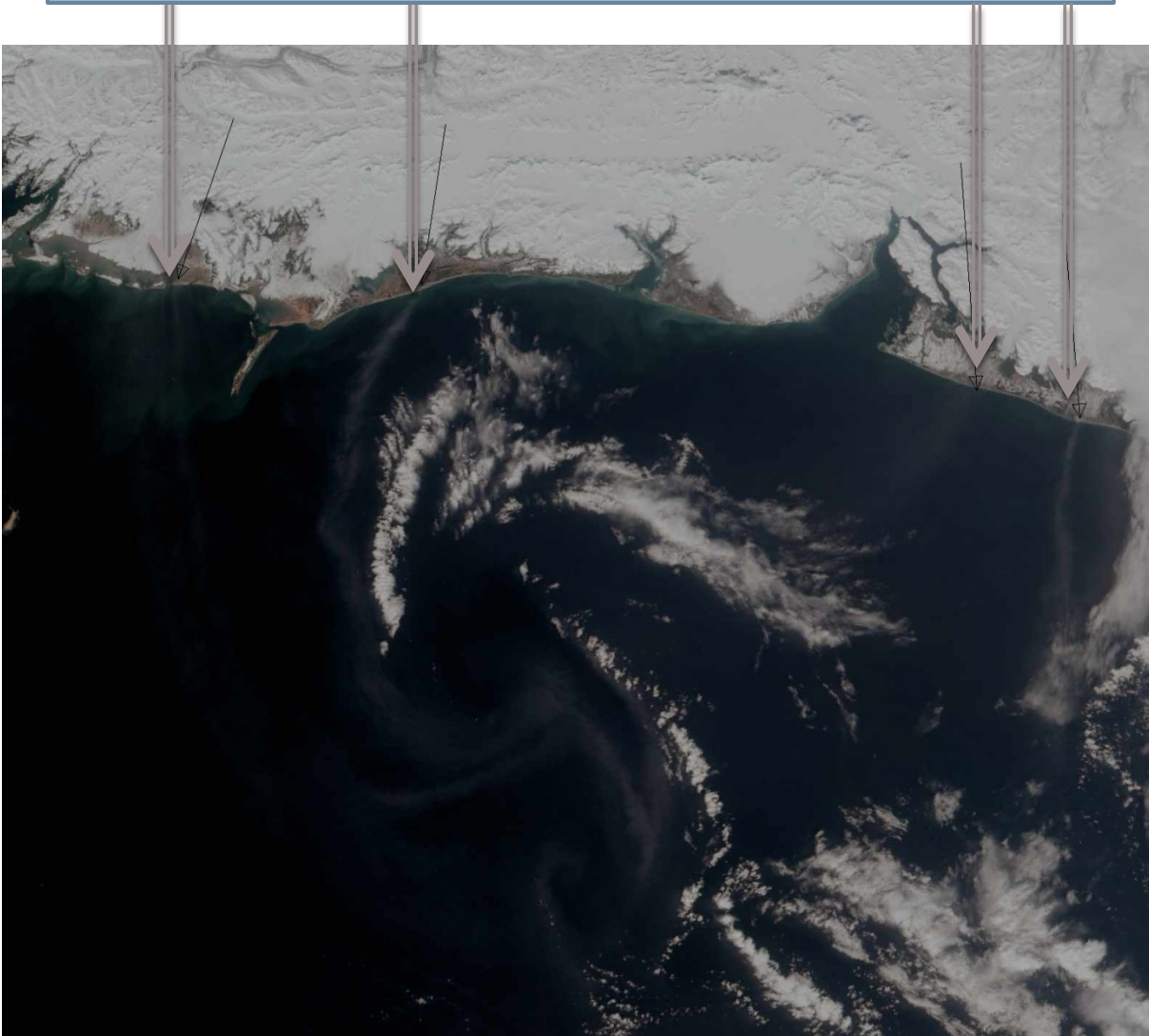


Smoke visible in the RGB image is detected nicely in the VIIRS AOT product



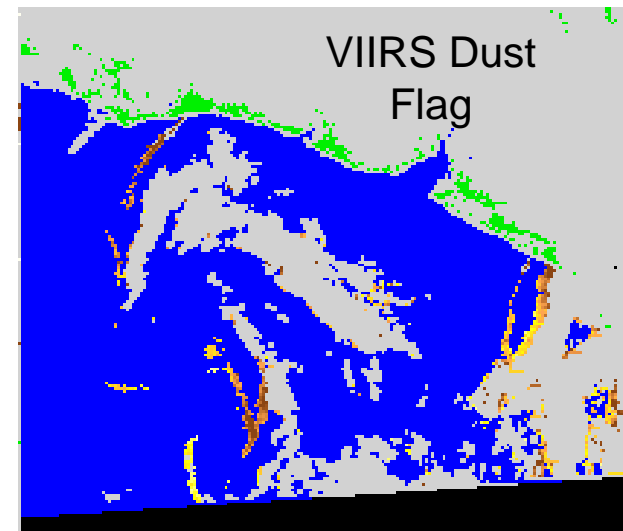
VIIRS smoke detection algorithm (research version ) applied to VIIRS granules identifies most of the smoke plumes associated with fires.

**VIIRS true color image of blowing dust from different  
sources in Alaska on  
April 28, 2013**

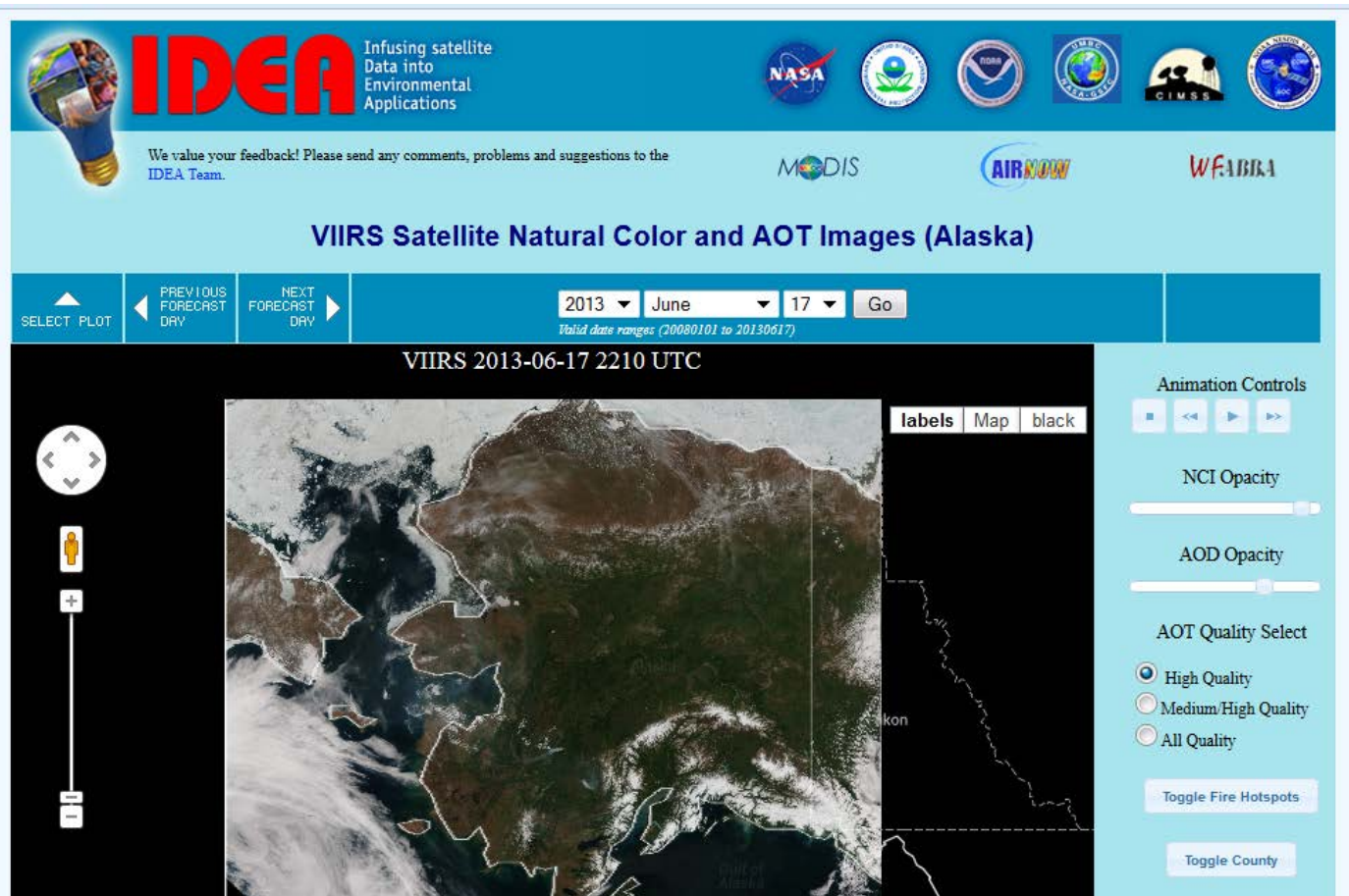


Aerosol Optical Depth

0.1 0.2 0.3 0.4 0.5

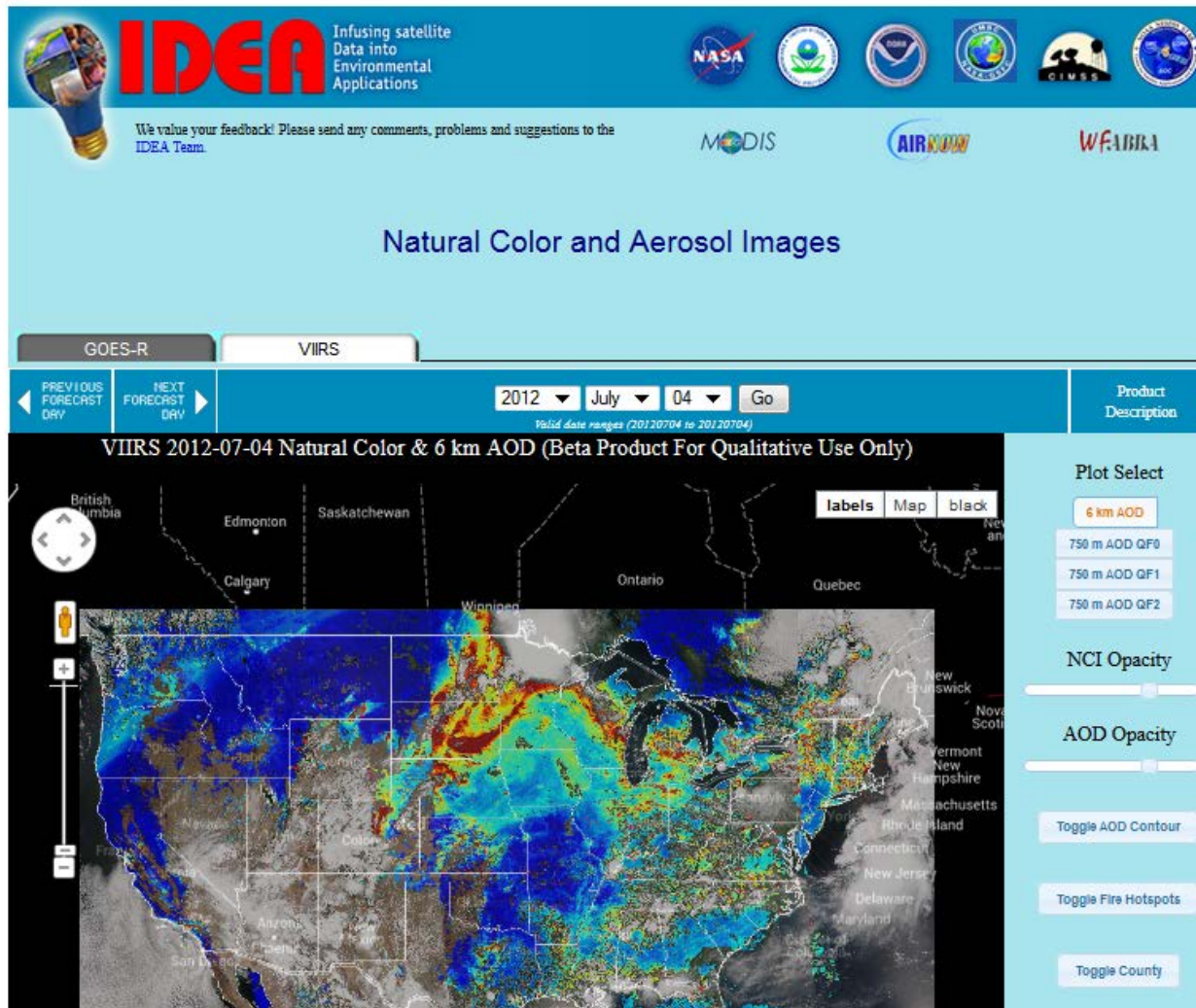






[http://www.star.nesdis.noaa.gov/smcd/spb/aq/index\\_viirs\\_AL.php?product\\_id=5](http://www.star.nesdis.noaa.gov/smcd/spb/aq/index_viirs_AL.php?product_id=5)





[http://www.star.nesdis.noaa.gov/smcd/spb/aq/aqpg\\_v3/index.php?plot\\_type=goesr\\_aod&product\\_date=20120704&product\\_gmt=1000&product\\_id=1](http://www.star.nesdis.noaa.gov/smcd/spb/aq/aqpg_v3/index.php?plot_type=goesr_aod&product_date=20120704&product_gmt=1000&product_id=1)

# Conclusions

13

- After CSPP VIIRS EDR package V1.1 is implemented at UF, AOT and ASDA images for Alaska region will be generated routinely on STAR computers;
- Algorithm performance will be evaluated by comparing the smoke AOT product with other satellite observations (e.g., CALIPSO);
- Will coordinate with UF and CIMSS on how to transition the algorithm