

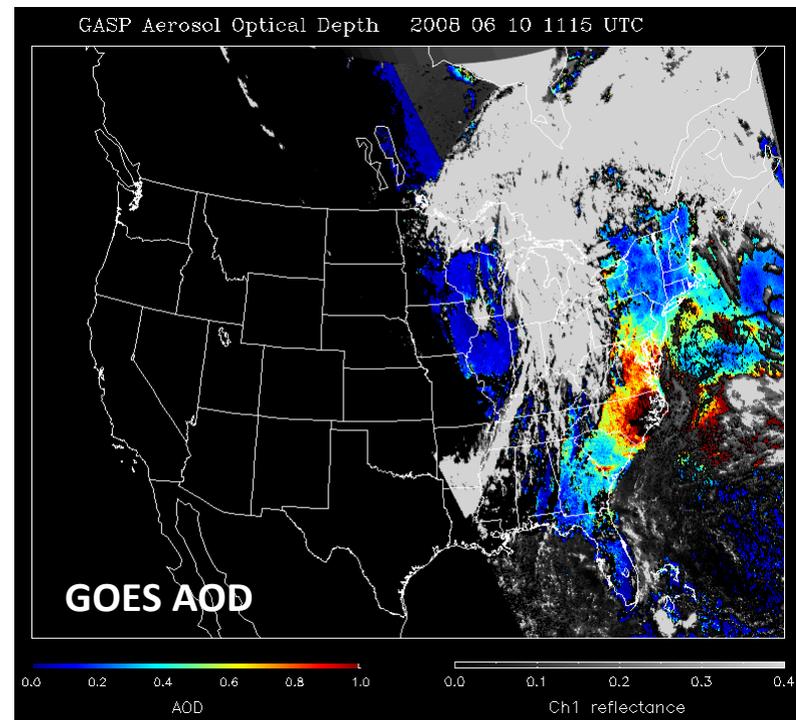
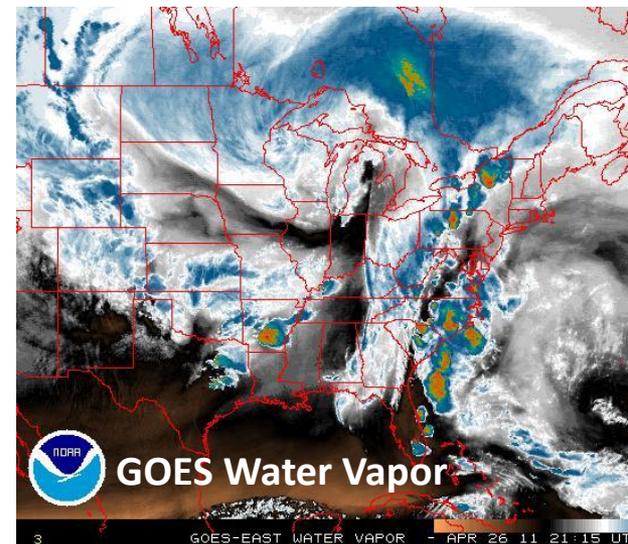
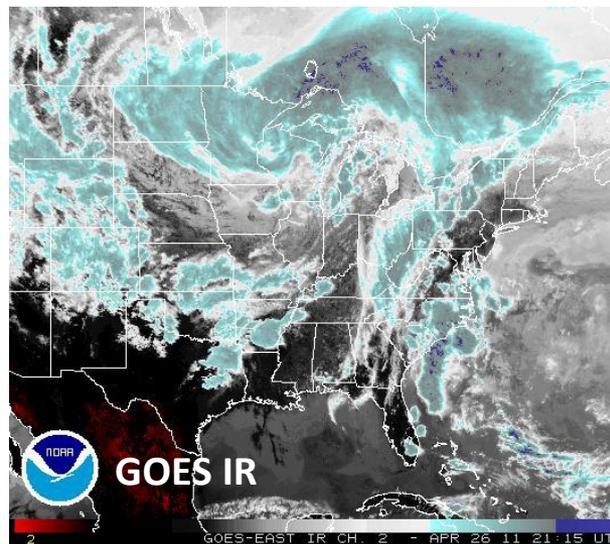
# The GOES-R Air Quality Proving Ground: Building An Air Quality User Community for the Next Generation of Products

S. Kondragunta, R. M. Hoff, A. Huff, C. Xu, P. Ciren, H. Zhang, S. A. Christopher, and E. S. Yang

Satellite Science Week, April 30 – May 4, 2012,  
Kansas City, MO



# Current NOAA Satellite Products for AQ Community



# Uses of Satellite Products by AQ Community

- Routine AQ forecasting and event analyses:
  - Identify meteorological features that affect air pollutant build-up and transport (e.g., cloud cover, convection, frontal boundaries)
  - Identify and evaluate significant air pollution events (e.g., wildfire smoke, windblown dust, haze)
  - Advanced warning of upwind significant events (especially wildfires)
- Retrospective and Exceptional Event analyses:
  - Document the overall meteorological setting of events
  - Document the location, severity, timing, transport, and extent of events
  - Utilize this evidence in regulatory exemptions under the Exceptional Event Rule

# NOAA's IDEA Site (dynamic flat webpages)

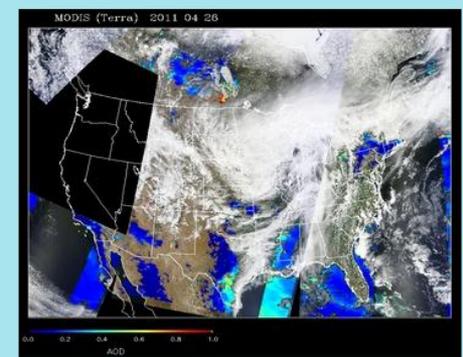
**IDEA** Infusing satellite Data into Environmental Applications

We value your feedback! Please send any comments, problems and suggestions to the IDEA Team.

AIRNOW MODIS WFLBA

MODIS (Terra) MODIS (Aqua) GASP GASP WEST

Regional plots of MODIS Terra aerosol optical depth (AOD)



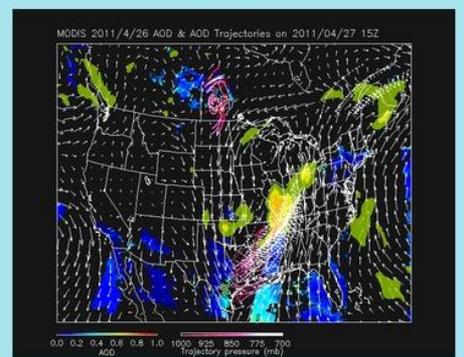
Select Region

Product description  
3-day composite history\*

View latest

Product description

48-hour aerosol trajectory forecast, with model winds and precipitation



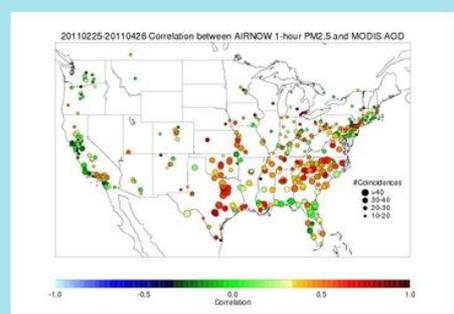
View latest

Product description  
PM2.5 Estimation from AOD

View latest

Product description

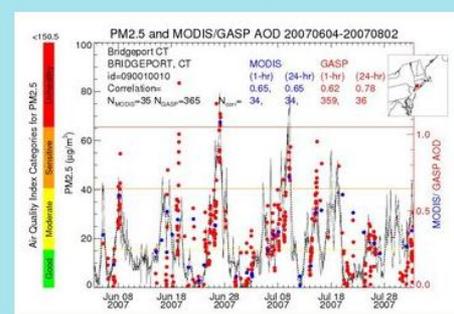
National correlation map between surface PM2.5 and MODIS aerosol optical depth



View latest

Product description

Time-series and correlations of MODIS/GASP aerosol optical depth and surface PM2.5



Select Site

Product description

## Tutorials for interpreting the IDEA products

Example: Forecasting fine particulate matter in the eastern U.S.

Trajectory Forecast

Regional plots

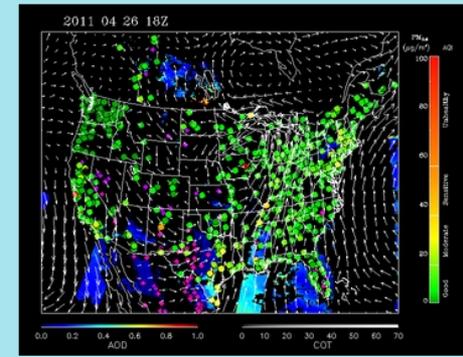
Correlation

Composite

The Regional plots are defined by US EPA Regions, with Regions 1-3 combined into one view. Regions 4-10 are separate plots.

This animation relates MODIS over 3 days to...

Tutorials



View latest

Product description

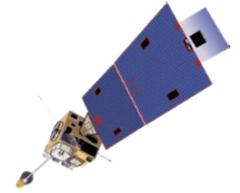


View latest

Product description

# Air Quality Proving Ground (AQPG)

<http://alg.umbc.edu/aqpg/>



- NOAA has created the **AQPG** – a subset of the GOES-R Proving Ground – focusing on the **aerosol products** that will be available from the ABI.
- Goal: build a user community that is ready to use GOES-R **air quality products** as soon as they become available.
- This distinction is important because the **air quality community has very different needs than the majority of NOAA users** (NWS meteorologists).
- AQPG is using *simulated GOES-R ABI data* for training and interaction with the user community.

# AQPG Activities

- Created an **Advisory Group of forecasters and analysts** who are providing feedback on products.
  - User community feedback is critical for **improving product quality, usage, and distribution**, and for the **development of new applications** (including specific data formats)
- Working with NOAA to prototype the **delivery system** for GOES-R **air quality** products.
- Creating **simulated GOES-R ABI products** for at least 10 case studies of past air quality events.
- Providing **training** on GOES-R and ABI products to Advisory Group and general AQ community at workshops and conferences.

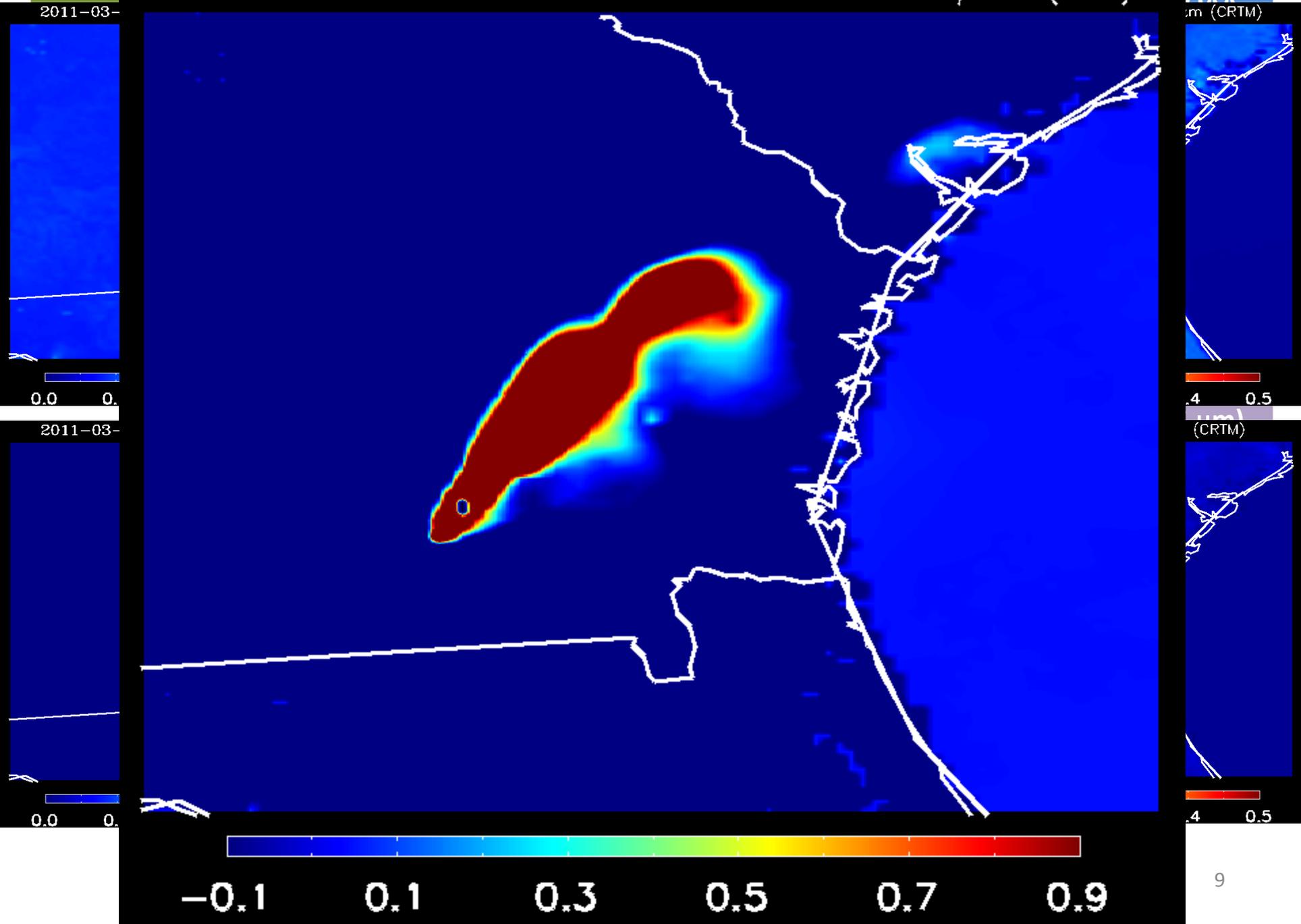
# User Group (eye chart ...)

Name	Affiliation	Name	Affiliation
Bill Adamski	Wisconsin Department of Natural Resources	Brian Lambeth	Texas Commission on Environmental Quality
George Allen	Northeast States for Coordinated Air Use Management (NESCAUM)	Laura Landry	Maryland Department of the Environment
Nelson Chafetz	Texas Commission on Environmental Quality	Sang-Mi Lee	South Coast Air Quality Management District
Weslee Copeland	Texas Commission on Environmental Quality	Scott Jackson	U.S. EPA Region 8
Ruben Delgado	UMBC	Anne McWilliams	U.S. EPA Region 1
Prakash Doraiswamy	New York State Department of Environmental Conservation	Bill Murphey	Georgia Department of Natural Resources
Nyasha Dunkley	Georgia Department of Natural Resources	Duc Nguyen	Maryland Department of the Environment
Kevin Durkee	South Coast Air Quality Management District	Sean Nolan	Pennsylvania Department of Environmental Protection
Michael Geigert	Connecticut Department of Environmental Protection	Curt Reutner	Texas Commission on Environmental Quality
Cary Gentry	Forsyth County (NC) Environmental Affairs Department	Mark Ruminski	NOAA NESDIS SAB/HMS
Lenny Giuliano	Rhode Island Department of Environmental Management	Bill Ryan	Pennsylvania State University
Mike Goldstein	Memphis and Shelby County Health Department	Howard Schmidt	U.S. EPA Region 3
Jennifer Hains	Maryland Department of the Environment	Dan Salkovitz	Virginia Department of Environmental Quality
Geoffrey Healan	Alabama Department of Environmental Management	Emmanuel Sanchez	APC Environmental Coordinator, Imperial County (CA)
Grant Hetherington	Wisconsin Department of Natural Resources	Matt Seybold	NOAA NESDIS
Joe Hoch	Wisconsin Department of Natural Resources	Jim Szykman	U.S. EPA National Exposure Research Laboratory
Jamie Kibler	NOAA NESDIS SAB/HMS	Rama Tangirala	District of Columbia Department of the Environment
Matthew Lacke	Jefferson County Department of Health (AL)	Greg Walters	Environment Canada
		Nick Witcraft	North Carolina Department of Environment and Natural Resources

## AQPG Trainings

- Held three full **workshops** with the User Group, the National Air Quality Conference attendees (60 people, March 2011).
- Workshops are tutorial in nature, presenting GOES-R 101 basics and then working with **Case Studies**.
- Users provide immediate and follow up feedback on the products and questions about utility of the AQ products in their daily forecasting.
- Since most of the AQ forecasters in the country work for **state and local agencies**, data and imagery access continues to be their primary concern.

# 2011-03-25 18 UTC AOD at 0.55 $\mu$ m (ABI)

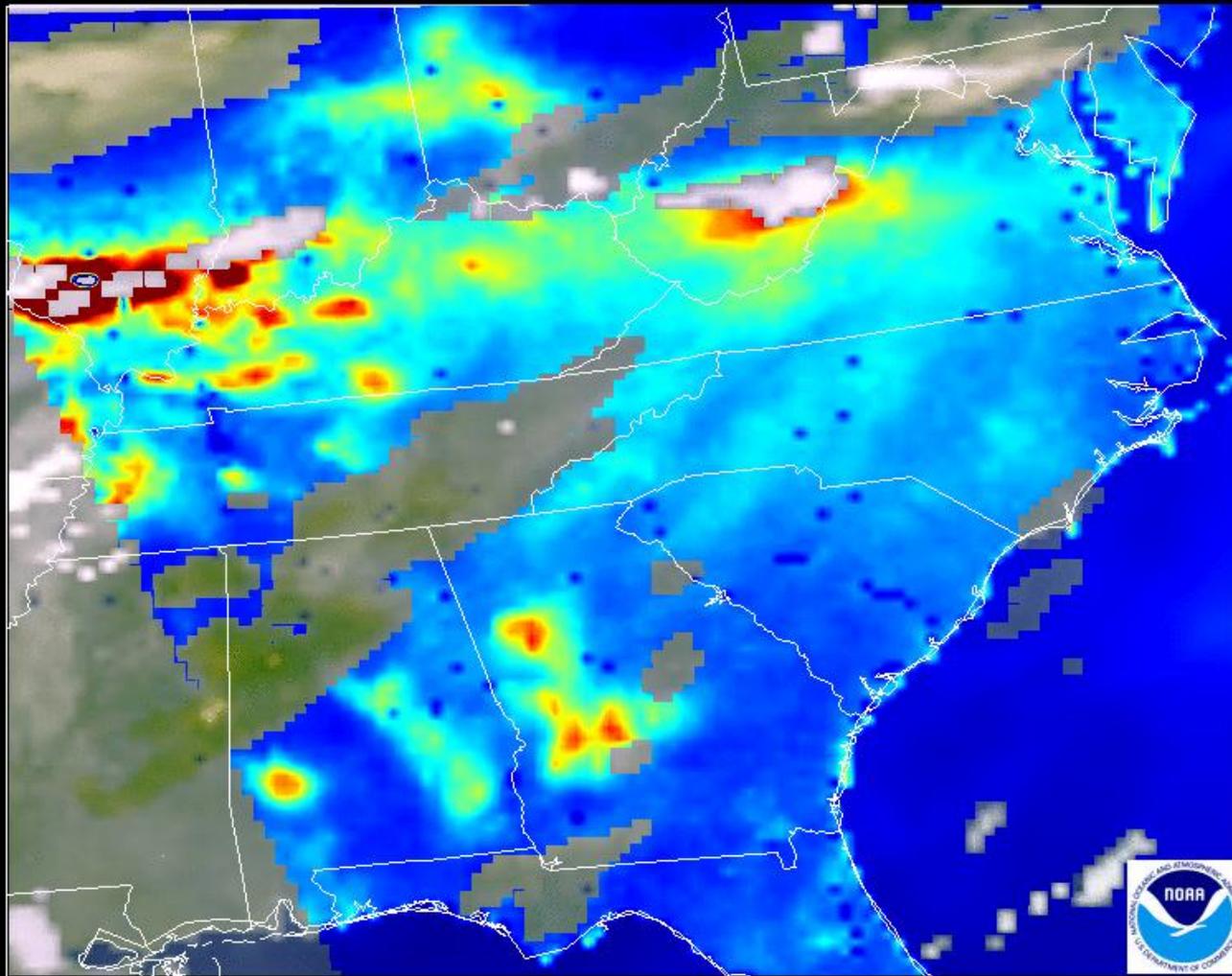


# Case Studies of Simulated ABI Aerosol Data

- Case studies are designed to help users envision what actual GOES-R ABI data will look like, particularly GOES-R's high temporal resolution, and anticipate how to use the data.
- Simulated ABI data are prepared for past air quality events and are used for training and to obtain feedback from the air quality community.
- Simulated ABI data are based on model data processed through the ABI algorithm, so they are not completely faithful representations of past conditions.

# Proxy ABI Aerosol Optical Depth (AOD)

2011-07-30 1200 UTC AOD (beta)



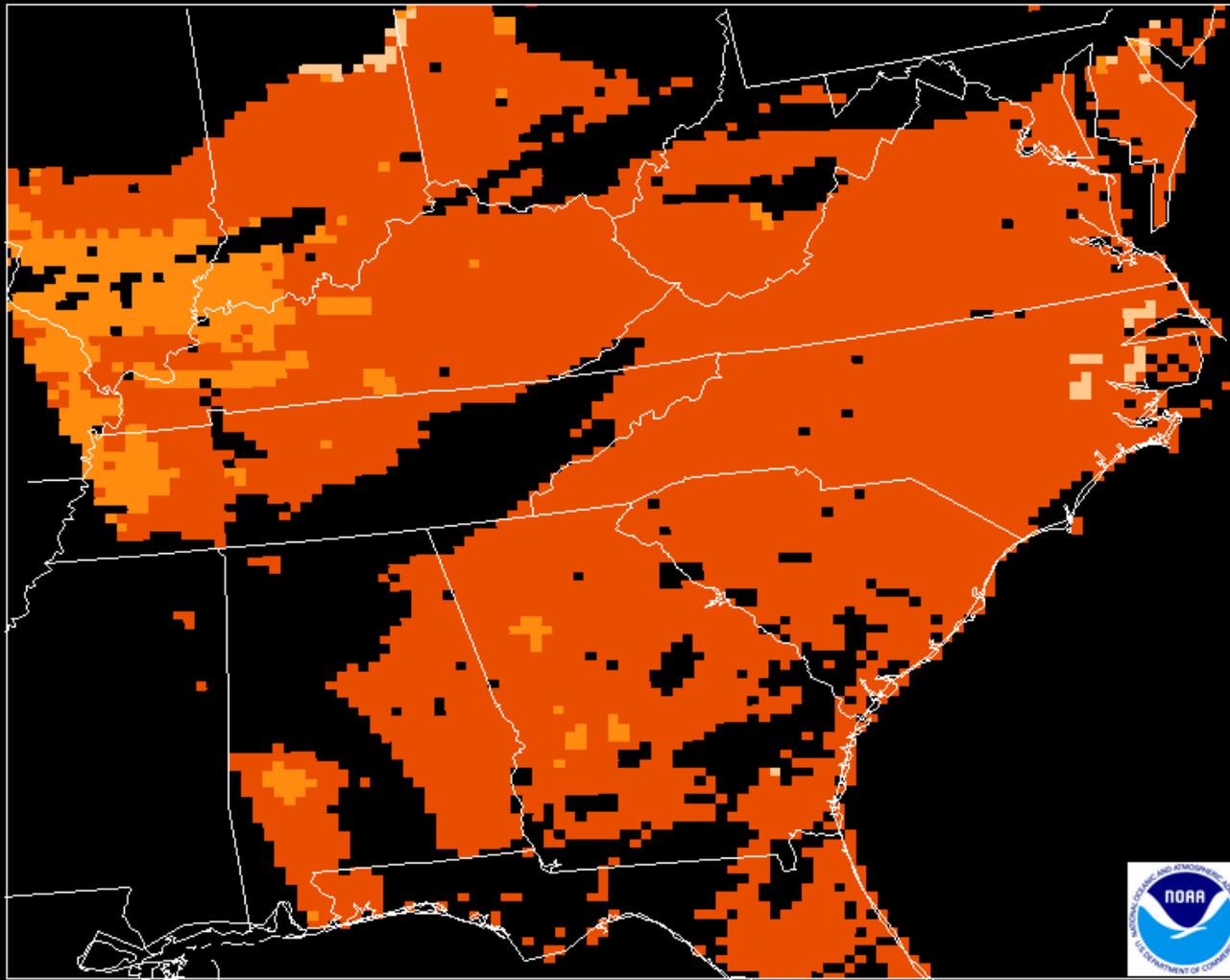
AOD indicates areas of high particulate concentrations in atmosphere

AOD is unitless; high AOD values (yellow, orange, red) indicate high particulate concentrations

Clouds block AOD retrievals

# Proxy ABI Aerosol Type

2011-07-30 1200 UTC Aerosol Type (beta)



DUST

GENERIC

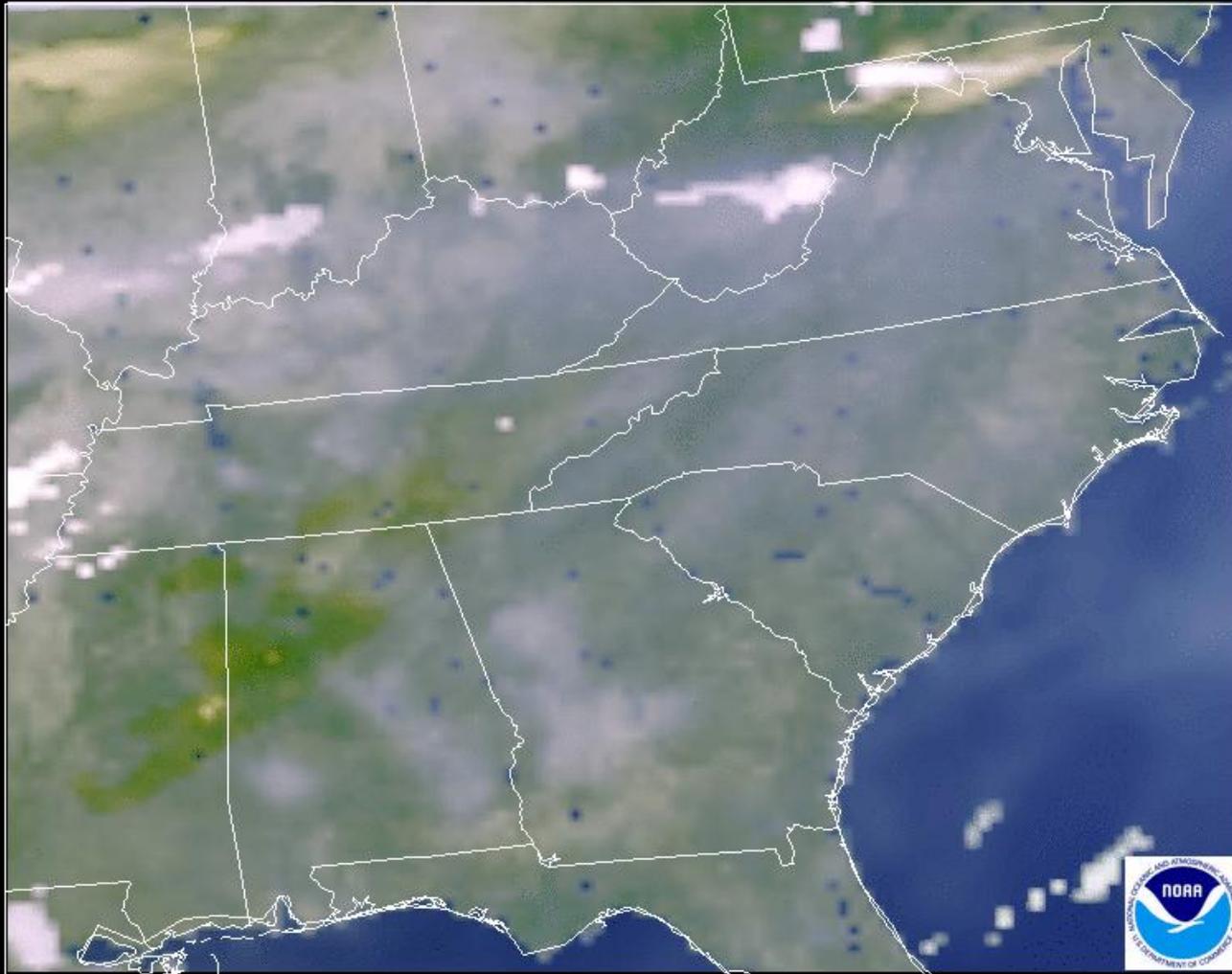
URBAN

SMOKE

- New product - not available with current GOES imager
- Qualitative and untested
- Useful for distinguishing between smoke and dust but can be noisy, especially at low AOD values

# Proxy ABI Synthetic Natural Color (RGB)

2011-07-30 1200 UTC (beta)



- No green band on ABI
- 2 methods to generate RGBs:
  - CIRA/SPoRT
  - UMBC/STAR
- UMBC/STAR method used for Summer 2011 experiment
- Algorithm development underway to improve RGB product

# Interactive Web Display for Proxy ABI Products

The screenshot shows the IDEA (Infusing satellite Data into Environmental Applications) web interface. At the top, there is a header with the IDEA logo and a lightbulb icon. Below the header, there are logos for NASA, NOAA, and other agencies. The main content area features a navigation bar with "PREVIOUS FORECAST DAY" and "NEXT FORECAST DAY" buttons. A date and time selection interface is present, with dropdown menus for "2011", "July", "30", and "2300", followed by a "Go" button. Below this, there are radio buttons for "Choose plot type": "RGB animated", "AOD animated" (selected), "Aerosol type animated", "RGB fixed frame", "AOD fixed frame", and "Aerosol type fixed frame". At the bottom, there is a "Start" button, a "Set Animation Speed" slider, and navigation arrows. The main display area shows a map with the text "2011-07-30 1400 UTC AOD (beta)".

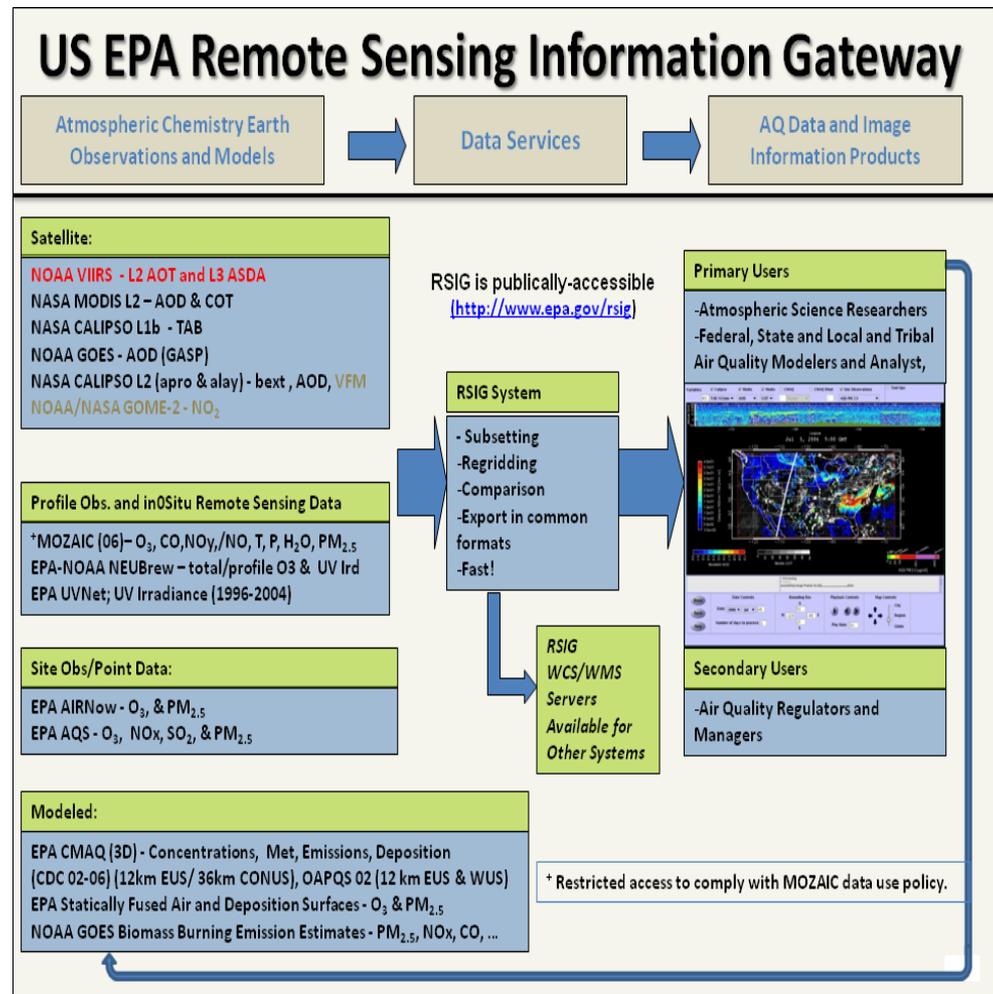
- Proxy ABI aerosol products were streamed to users through the NESDIS IDEA website (<http://www.star.nesdis.noaa.gov/smcd/spb/aq/aqpg/>)
- Users selected the day/time of interest using a pull-down menu and flipped between the three ABI proxy products using radial buttons

# Planning for the Next NRT Experiment

- AQPG team has incorporated user feedback from the Summer 2011 NRT experiment and is planning another NRT experiment for September, 2012.
- Volunteers are welcome.
- To generate additional proxy ABI products, the AQPG needs real-time model aerosol output with a CONUS domain
  - NOAA/OAR/ARL 48-hr aerosol forecasts for a 4-km CONUS domain will be used for 2012 experiment.

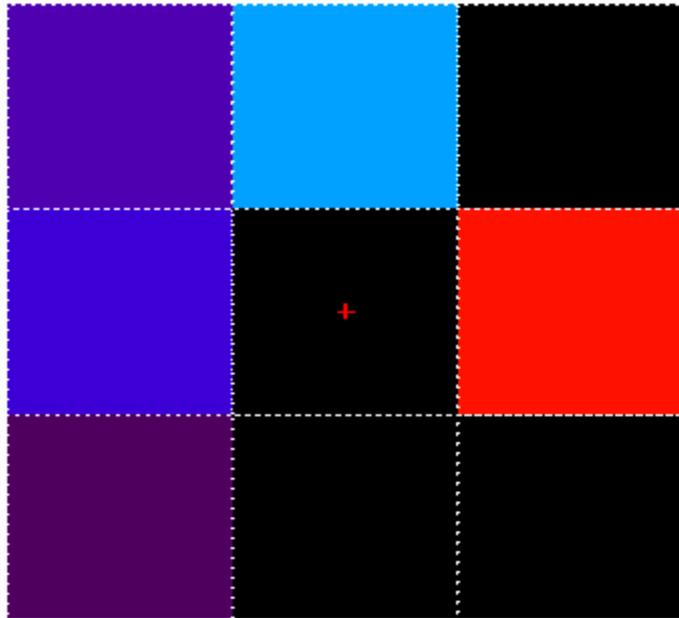
# Expanding the AQPG Activities to NPP/JPSS VIIRS Aerosol Products

- Maintain and enhance the IDEA website to include VIIRS products
- Work with EPA to incorporate VIIRS aerosol products and tools into its Remote Sensing Information Gateway
  - Products used primarily in states filing for exceptional events (fires and dust outbreaks) waivers

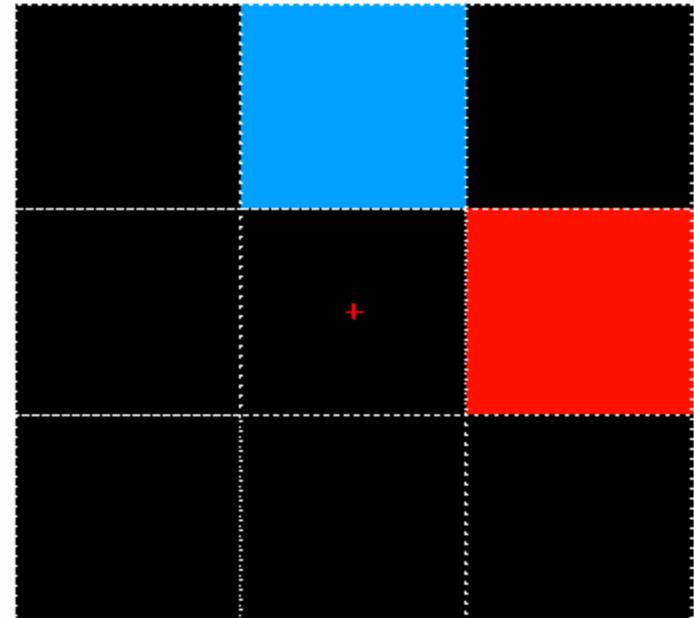


# Application of VIIRS Fire and Aerosol Products for EPA's Exceptional Events Rule Monitoring

AOD pixels



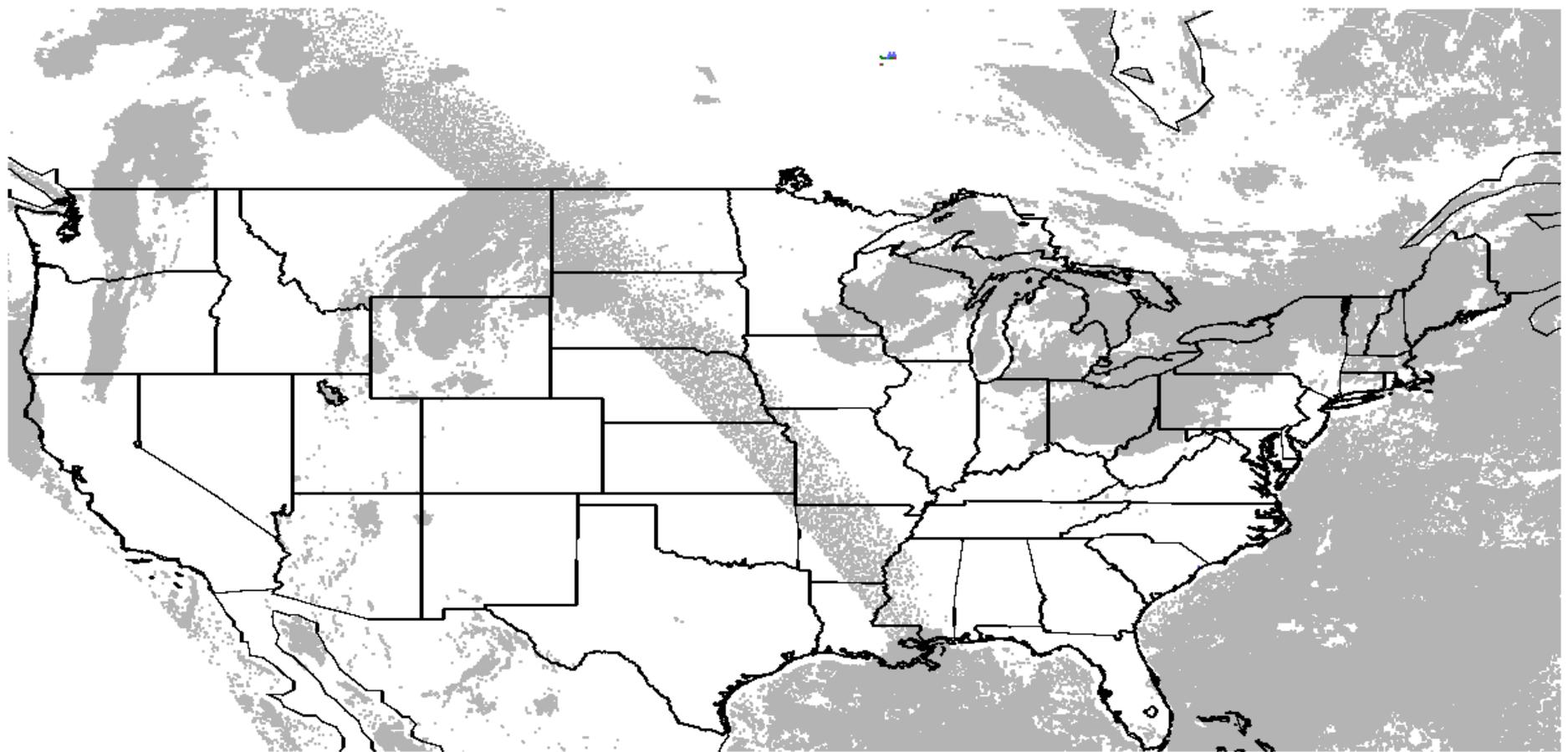
Smoke pixels



Aerosol Optical Thickness



**NOAA/NESDIS GOES-13 Smoke Observation 2011/07/18 1045UTC**



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



**0      10      20      30      40      50      cloud**

# Making the case for RGB Imagery

# West Texas Blowing Dust Episode

## 2012 February 28

- Blowing dust from White Sands region resulted in code orange air quality in western Texas.
- GOES and MODIS imagery are currently being used by the air quality community to understand the event.
- STAR aerosol team investigated VIIRS aerosol products to find out how VIIRS performed for this event.

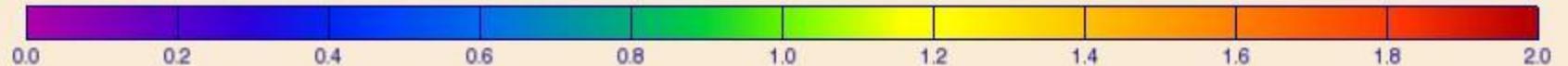
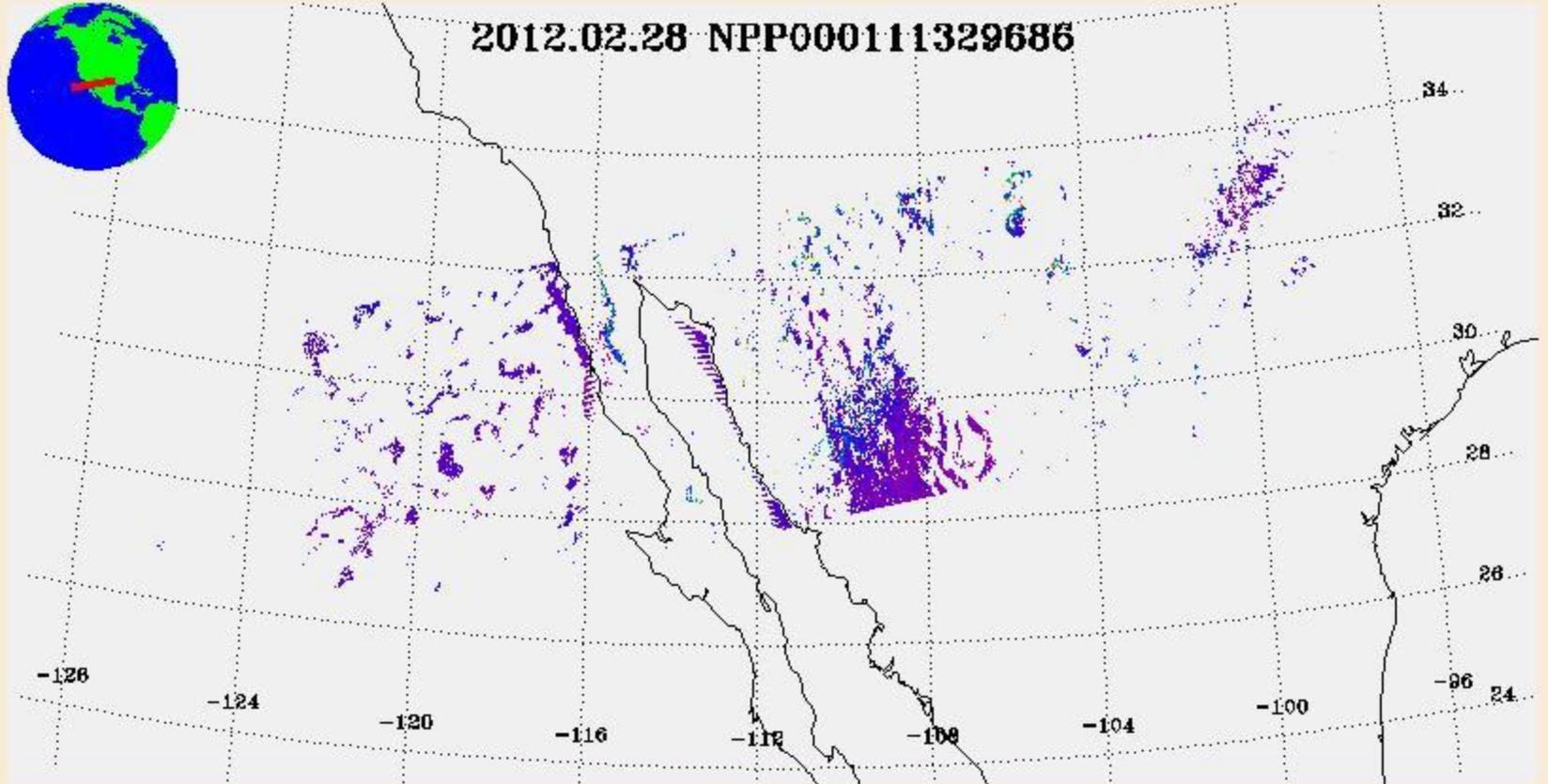


Lubbock International Airport on February 28, 2012 (picture courtesy of NWS)

PM10 at the Sunland Park City Yard station at 11 AM was 1746  $\mu\text{g}/\text{m}^3$  and PM2.5 was 104  $\mu\text{g}/\text{m}^3$  with 11 m/s winds from the WSW ([http://nmborderaq.blogspot.com/2012\\_02\\_01\\_archive.html](http://nmborderaq.blogspot.com/2012_02_01_archive.html)).

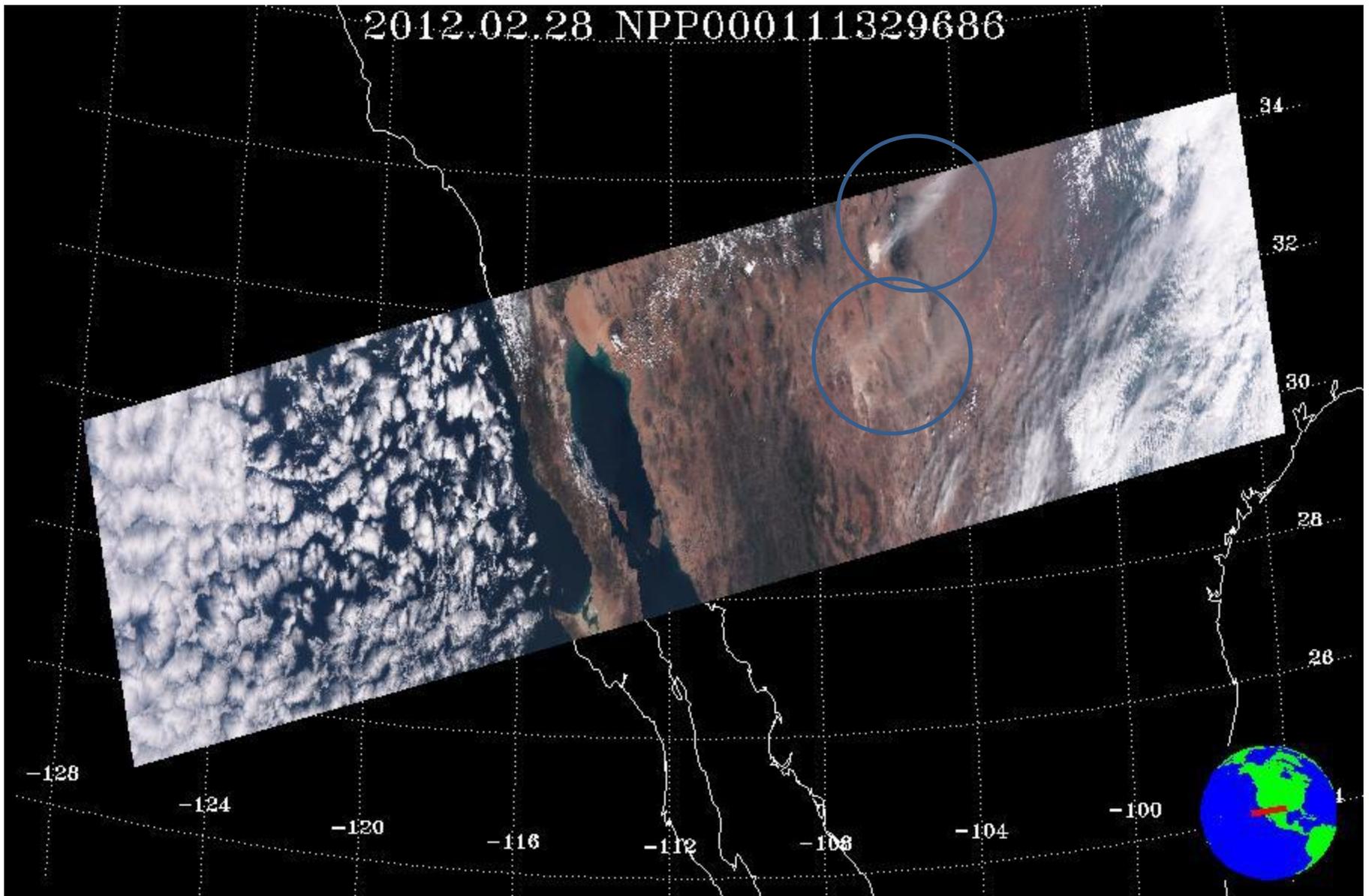
Aerosol Optical Thickness (IP) at 550nm  
IP AOT Quality=Good

2012.02.28 NPP000111329686



Algorithm limitations and various data quality filters do not allow the detection of the dust plume

2012.02.28 NPP000111329686



Qualitative visible RGB imagery clearly shows the dust plumes originating from White Sands and other dust sources

# Conclusions

- GOES-R Air Quality Proving Ground provided proxy aerosol retrievals generated using 48-hr numerical model aerosol forecast fields to air quality field forecasters
  - 2-week time periods in summer 2010 and 2011
  - First ever end-to-end product generation and dissemination to the forecasters with “data staging” as if GOES-R is in orbit (only exception – data flow was every hour instead of five minutes)
- Two manuscripts (EM and J. Tech) are in preparation to provide information to the community on how these experiments can be run successfully
- The team is prepared to expand its PG activities to VIIRS aerosol products. The next AQPG workshop will include VIIRS data along with GOES-R proxy data