

Three-Dimensional Air Quality System

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Ray Hoff, Ray Rogers, Allen Chu, Omar Torres
Joint Center for Earth Systems Technology **smoke**
University of Maryland, Baltimore County **dust**

Fred Dimmick, Jim Szykman, Brad Johns
U.S. Environmental Protection Agency

Shobha Kondragunta, NOAA
Jassim Al-Saadi, NASA
Chieko Kittaka, SAIC **smoke**
Vickie Boothe, CDC

Anthony Wimmers, University of Wisconsin

MODIS Aqua, 1 January 2006

Data from NASA GSFC Rapidfire

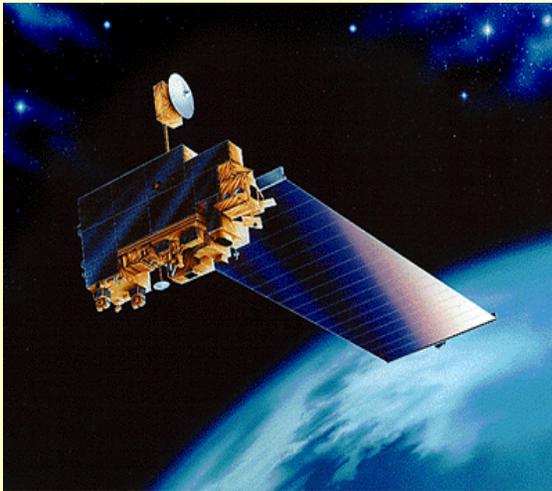
Overview

- Why EPA is interested in satellite and lidar data
- Quick overview of satellite data
- Quick overview of lidar
- Case study of integration of lidar, satellite, & ground-based data
- Upcoming 3D-AQS project
- How you can provide input

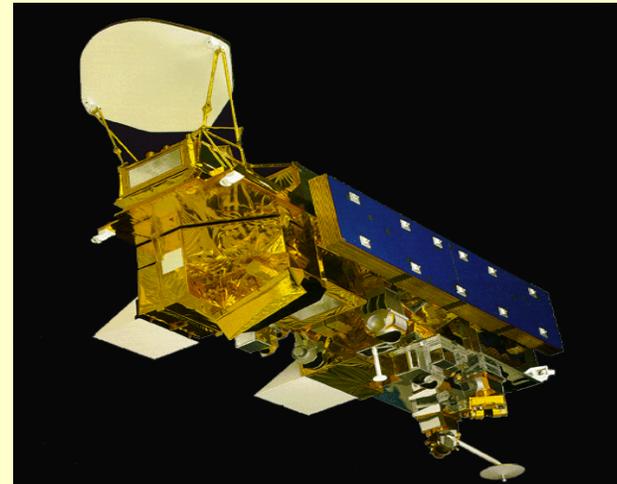
Why measure in 3-dimensions?

- Regional haze and regional scale events
- Long and medium distance transport
- Clean Air Interstate Rule
- Improved modeling
- Regulatory accountability

Many satellite sensors measure air quality...



Terra



Aqua

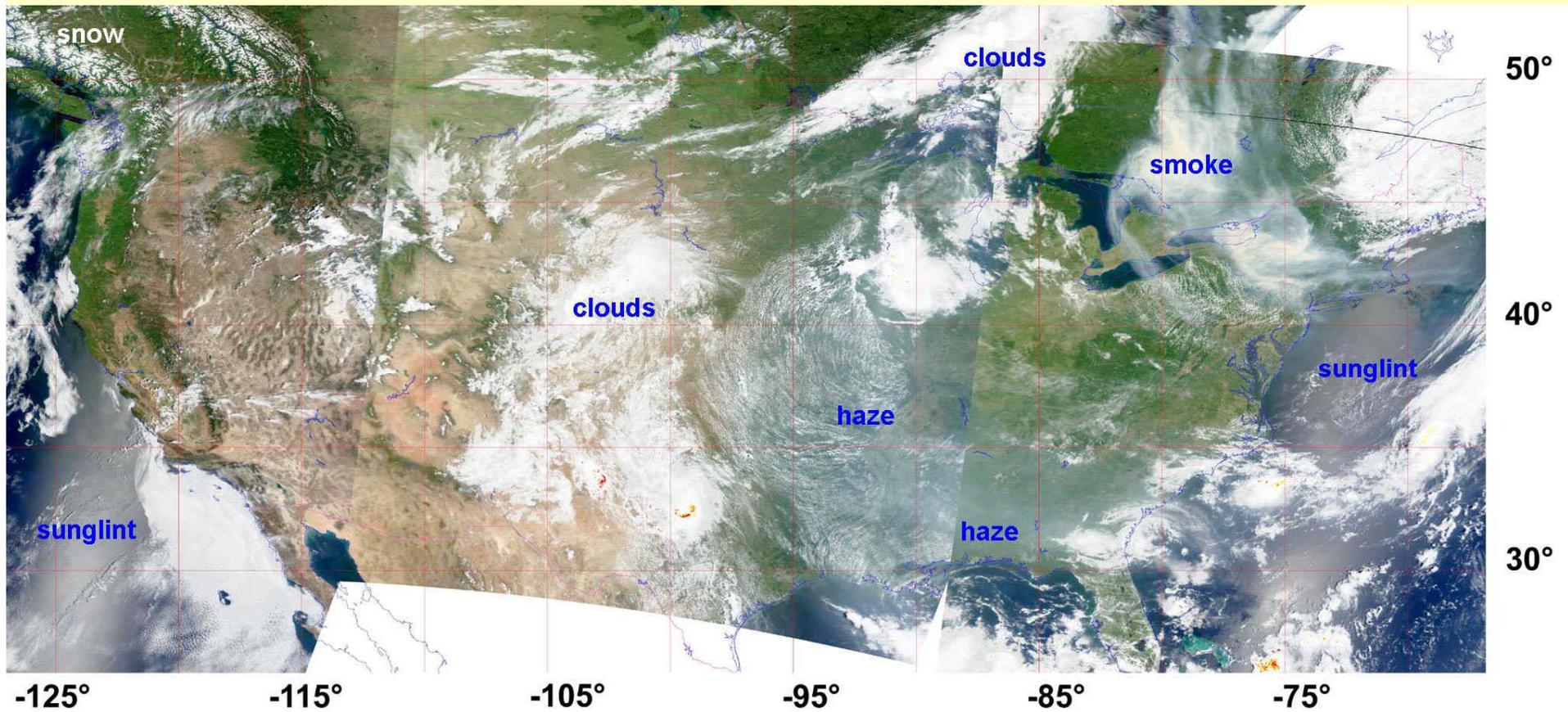


CALIPSO



Aura

MODIS True Color Image 6 July 2002



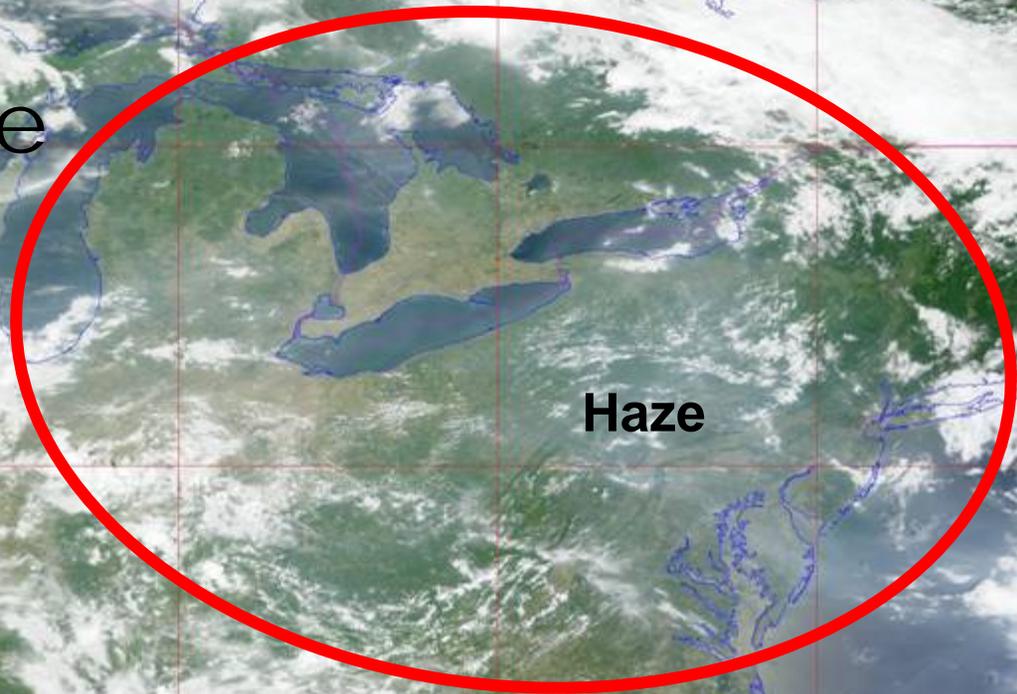
Engel-Cox, J. *et.al.* 2004. *Atmospheric Environment*.

Transport Case Study Illustration

MODIS

RGB L1B Image

25 June 2002



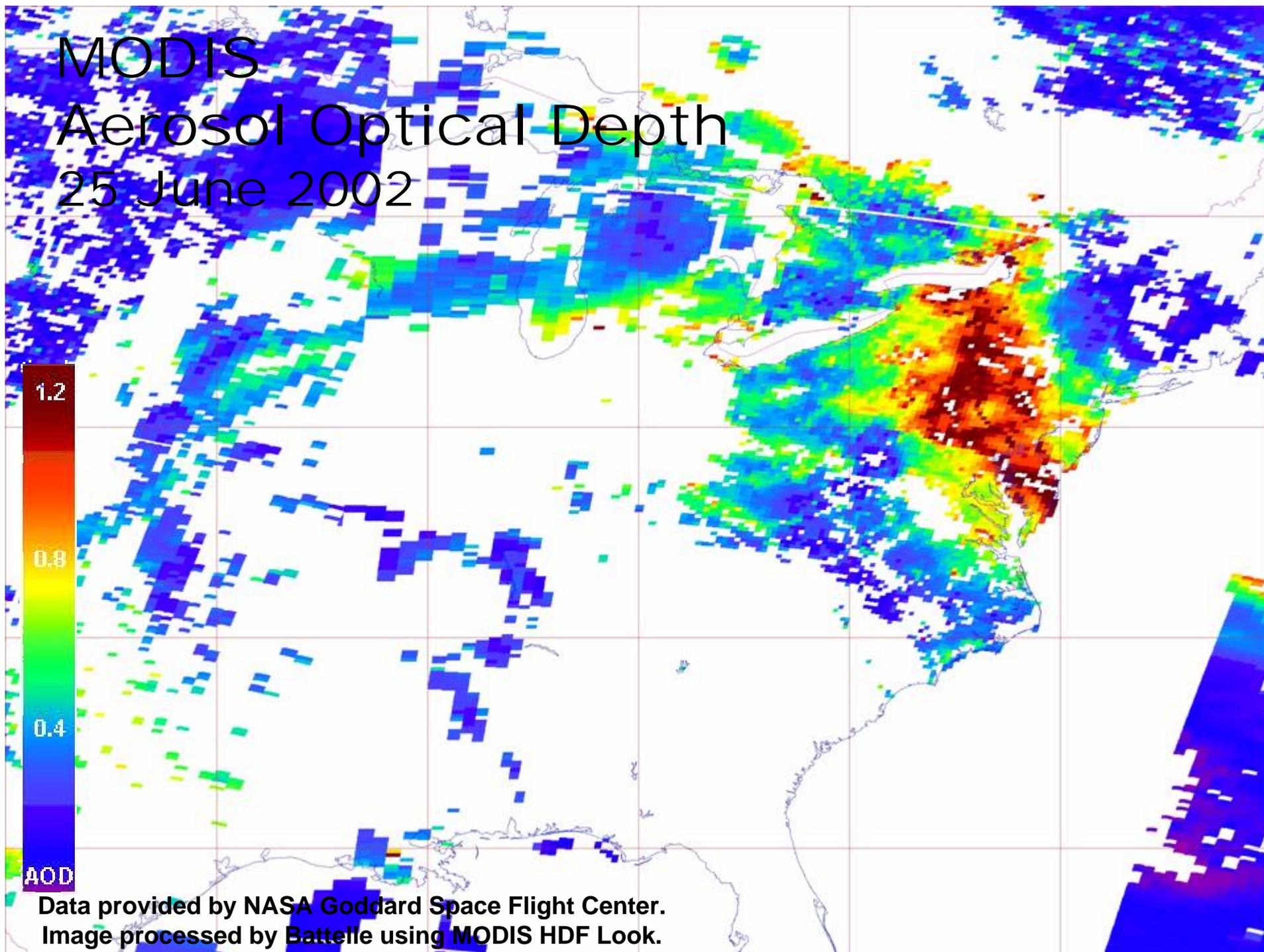
Haze

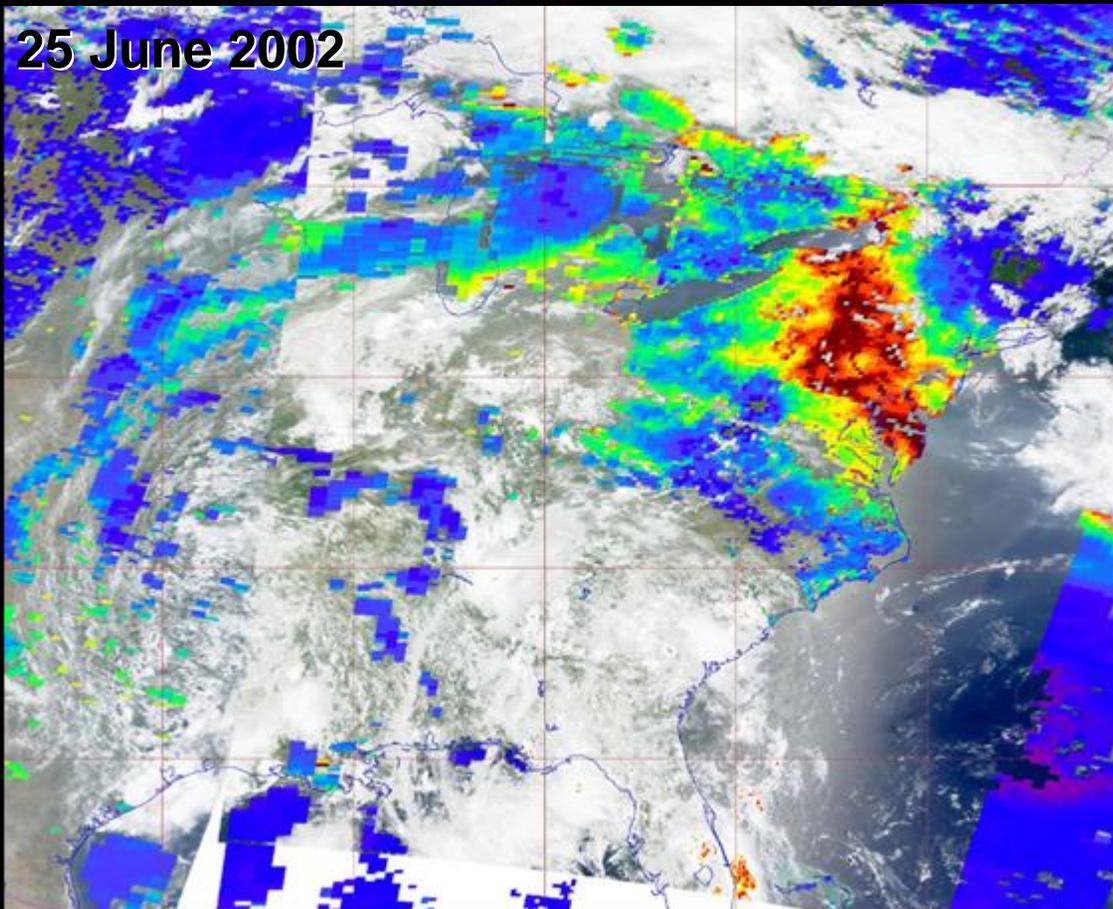
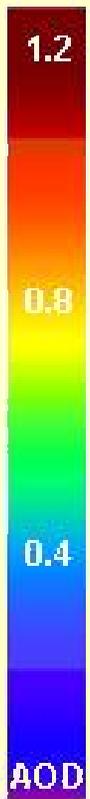
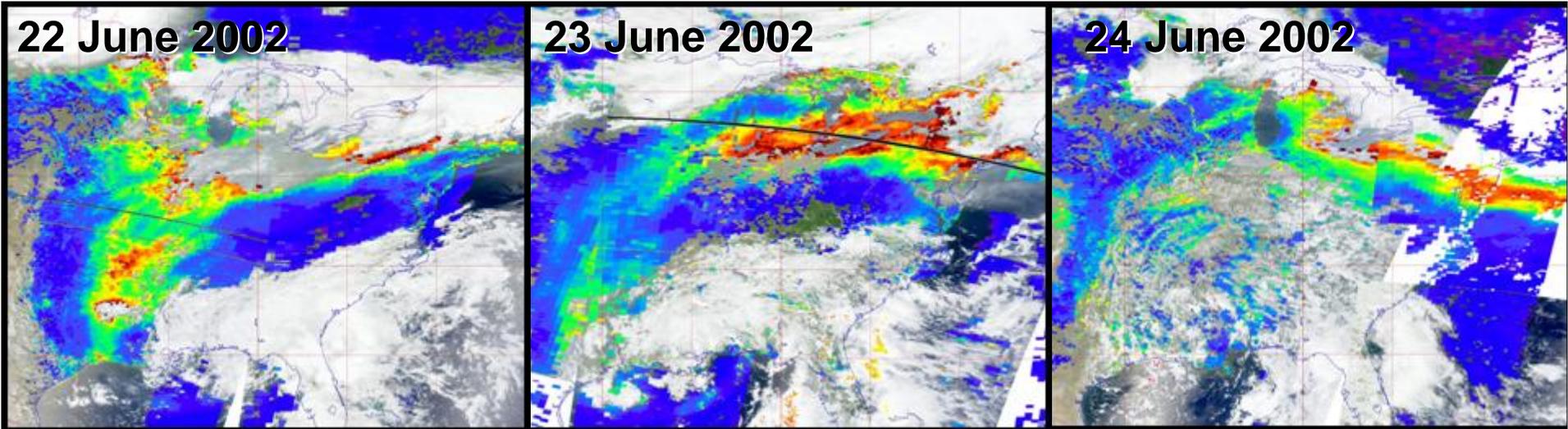
Cloud

Sun glint

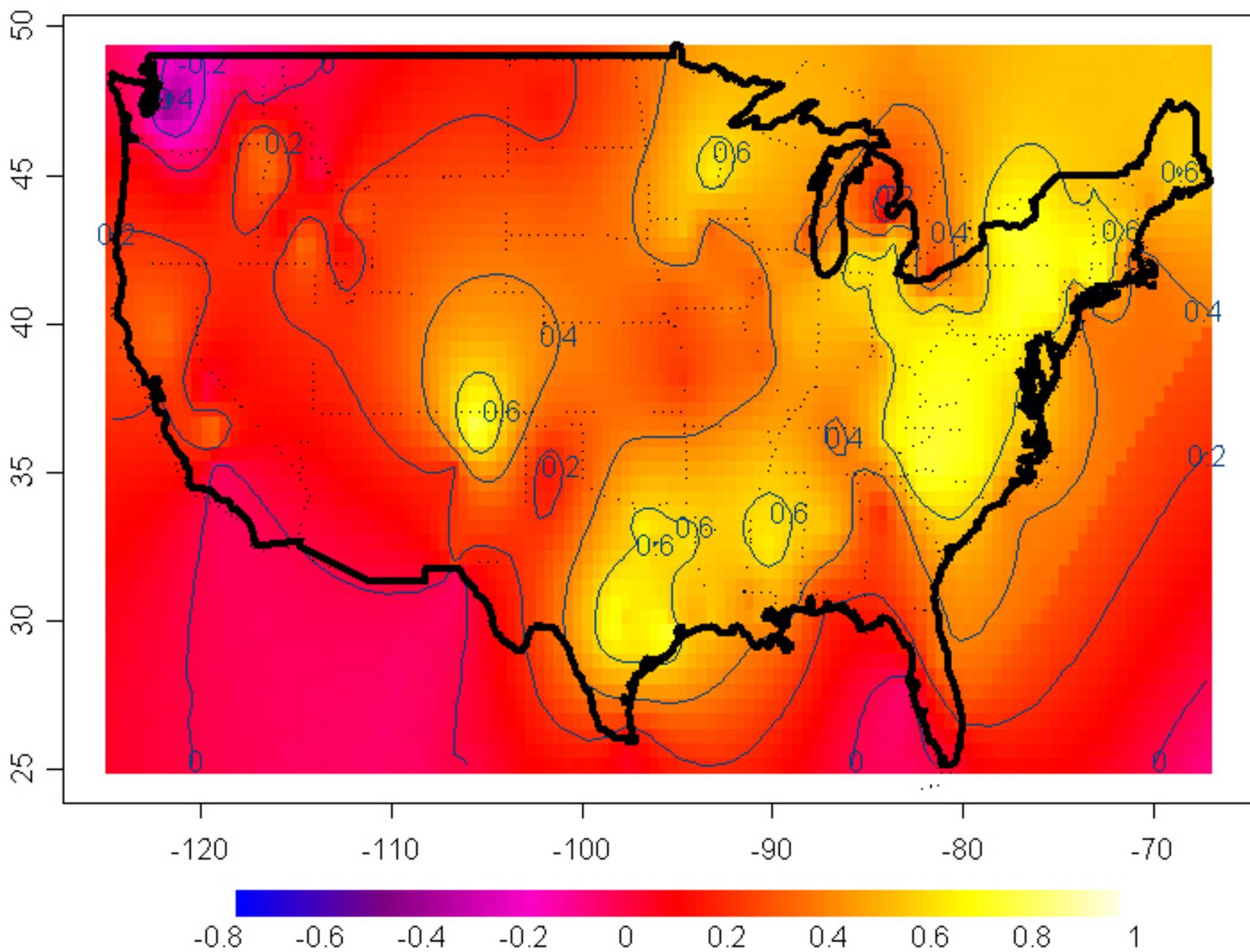
Data provided by NASA Goddard Space Flight Center.
Image processed by Battelle using MODIS HDF Look.

MODIS Aerosol Optical Depth 25 June 2002



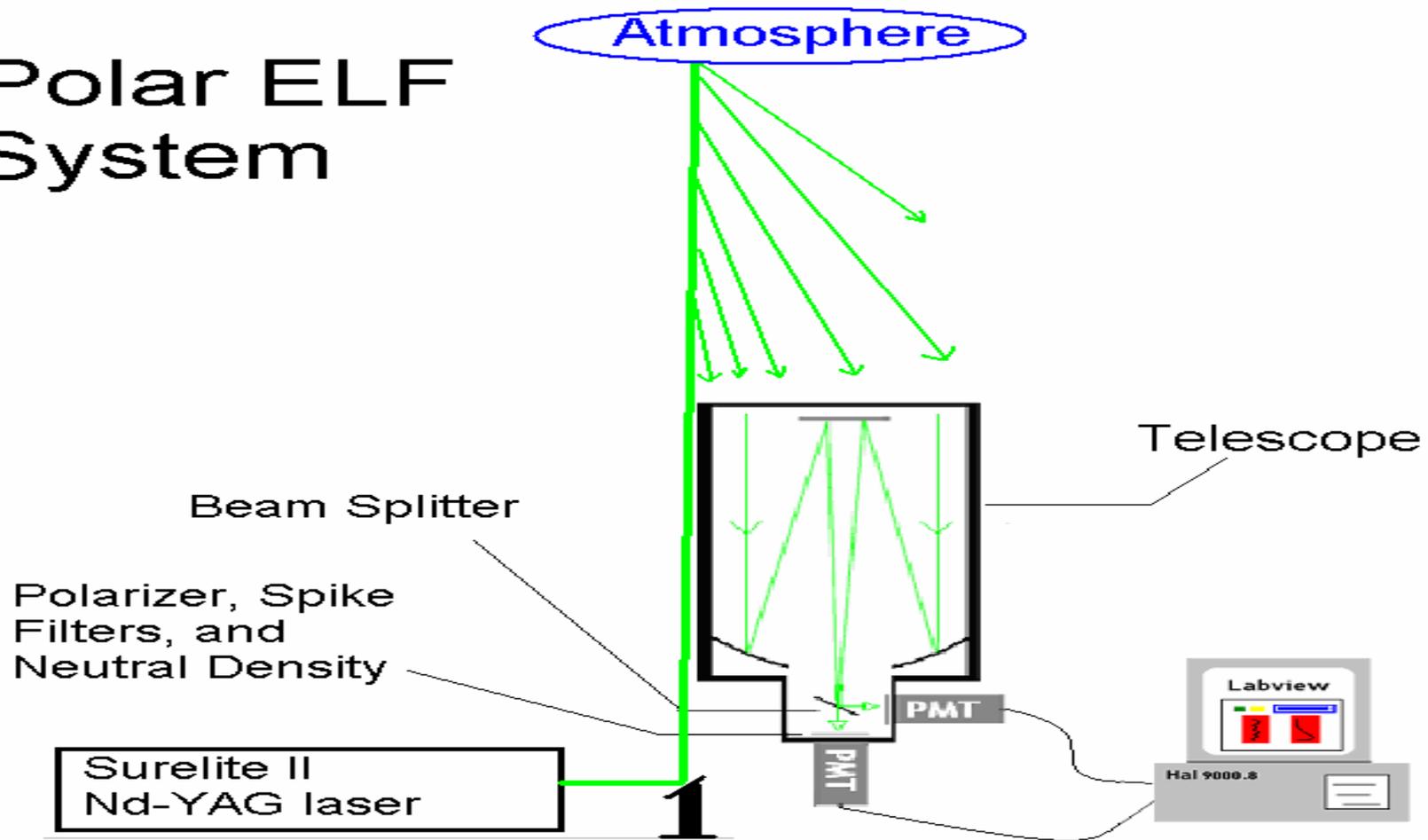


Correlations between AOD and PM2.5(hourly)



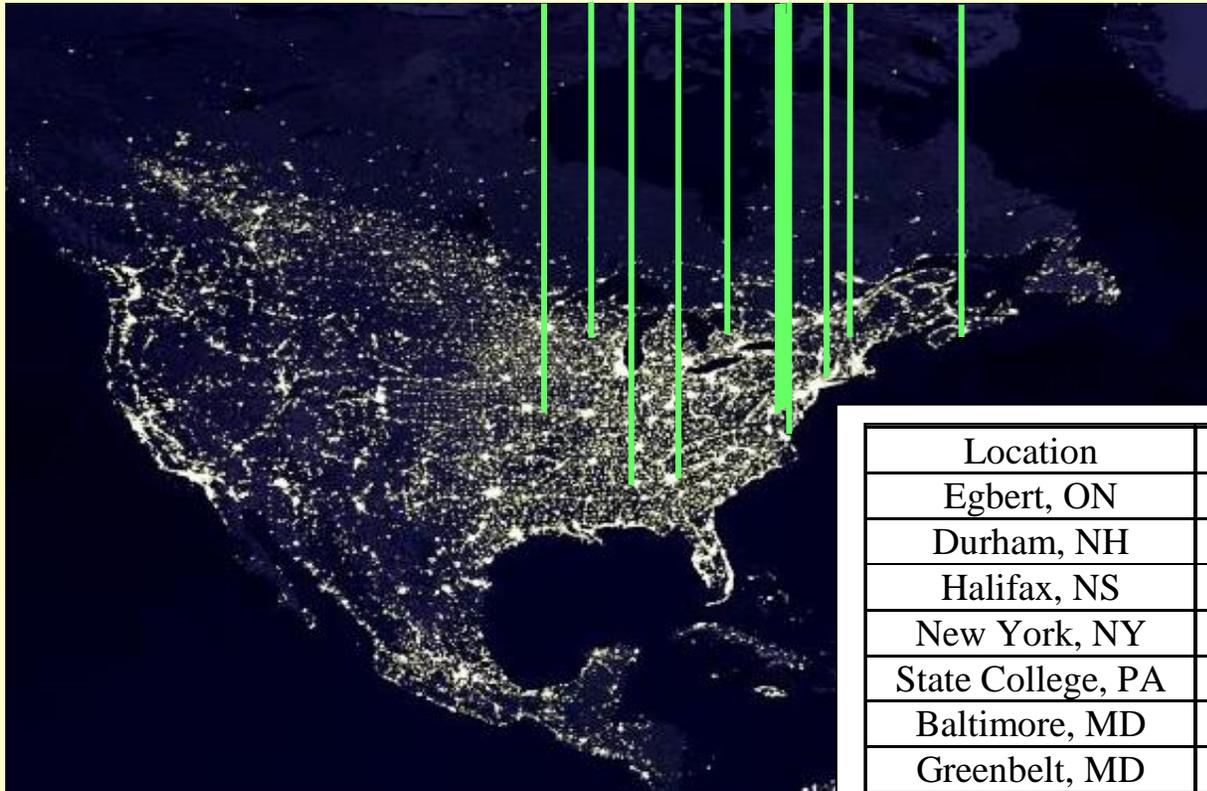
Elastic Lidar Facility (ELF)

Polar ELF System



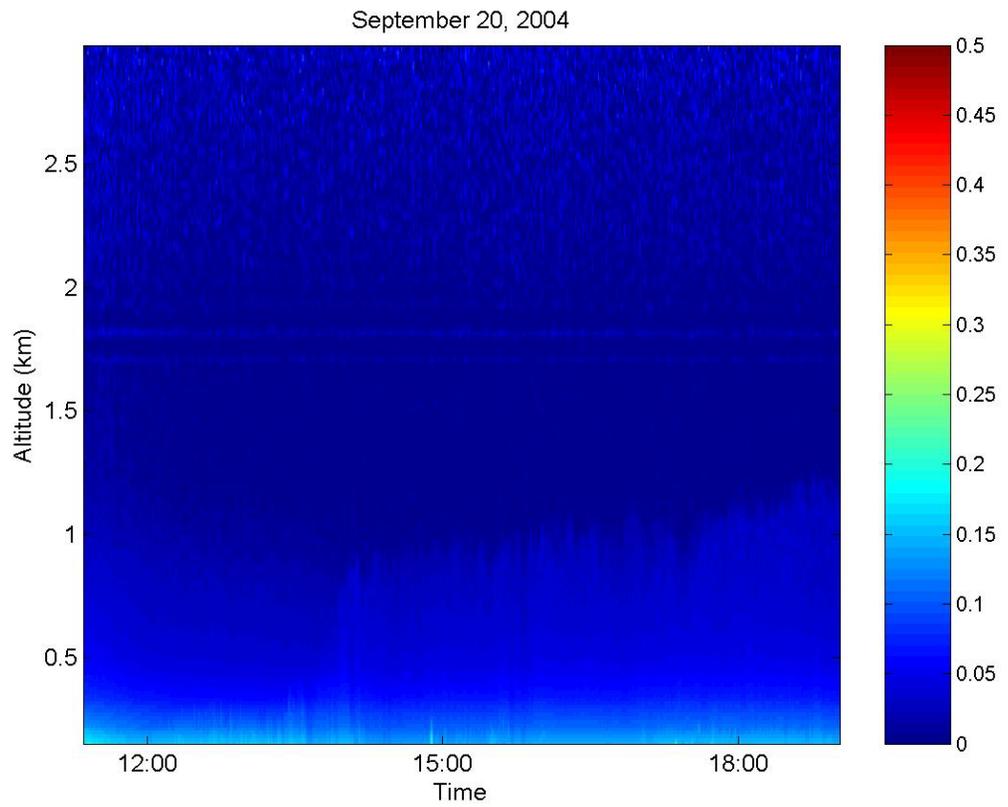
*Comer, J, "UMBC Elastic Backscatter Lidar Facility (ELF): Subvisible Cirrus Cloud and Aerosol Measurements during ABOVE 2002." UMBC 2002

Existing lidar systems

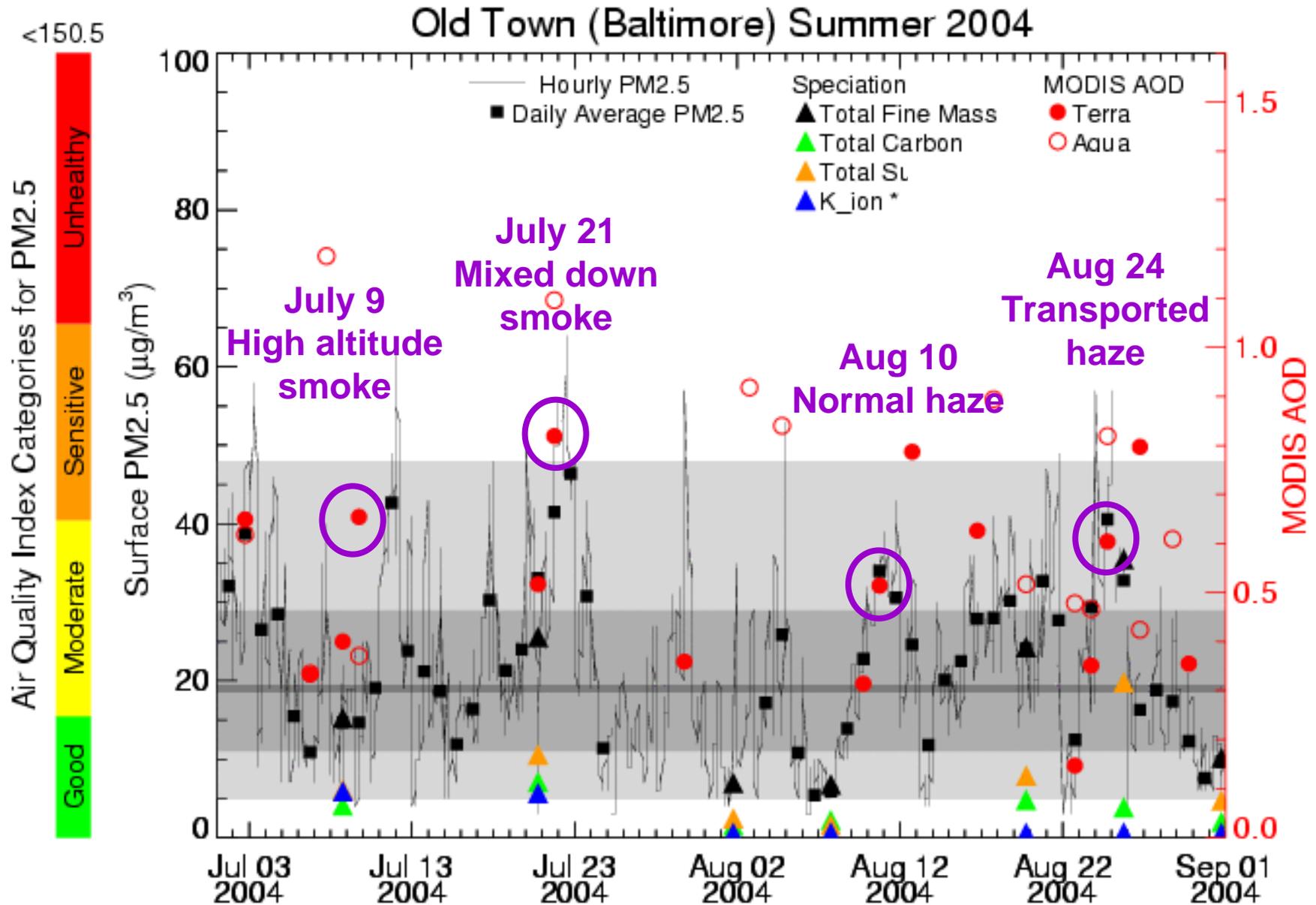


Location	PI	Type(s)
Egbert, ON	K.I. Strawbridge	Scanning elastic
Durham, NH	I. Dors	Winds
Halifax, NS	T. J. Duck	Elastic, Raman
New York, NY	F. Moshary	Elastic, DIAL
State College, PA	C.R. Philbrick	Raman, DIAL
Baltimore, MD	R.M. Hoff	Elastic, Raman
Greenbelt, MD	D.N. Whiteman	Raman
Greenbelt, MD	D. Venables	Raman
Hampton, VA	M.P. McCormick	Elastic
Huntsville, AL	M. Newchurch	DIAL
Atlanta, GA	G. Gimmetad	DIAL
Madison, WI	E.W. Eloranta	HSRL
Lamont, OK	T. Ackerman	Raman

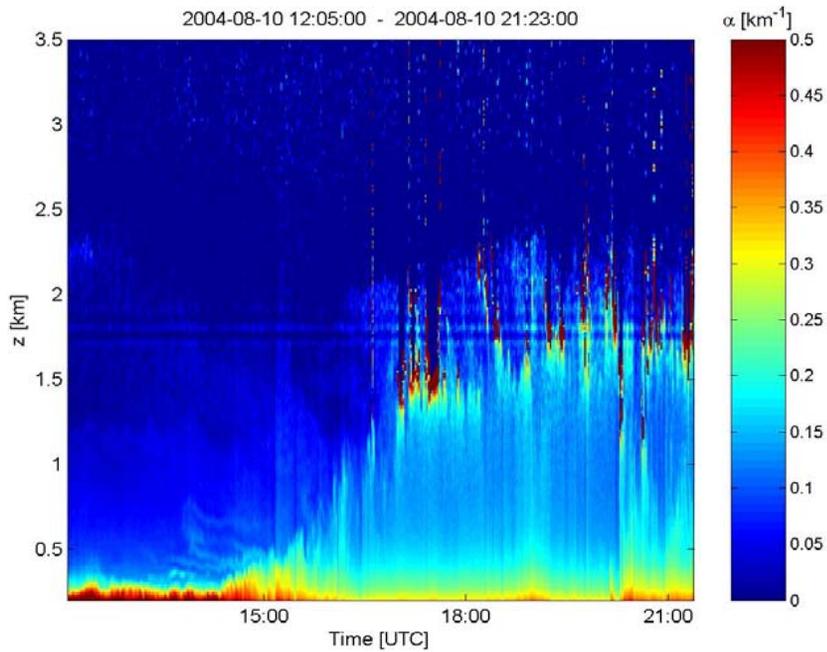
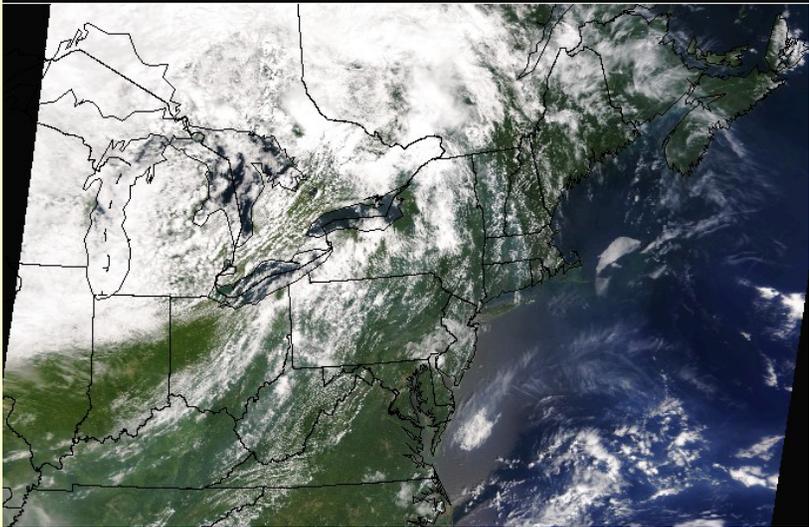
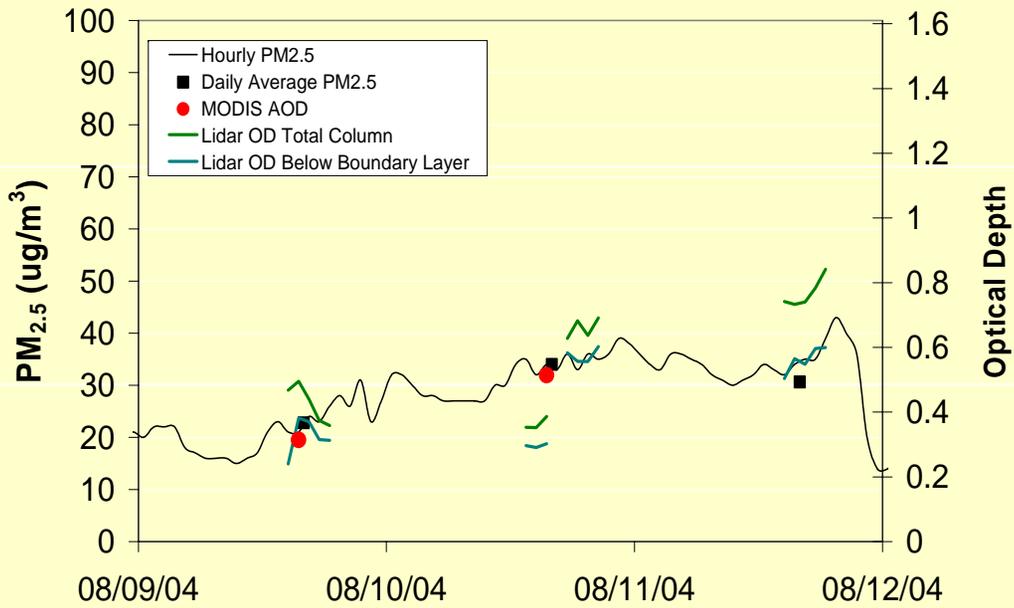
Lidar on a clear day...



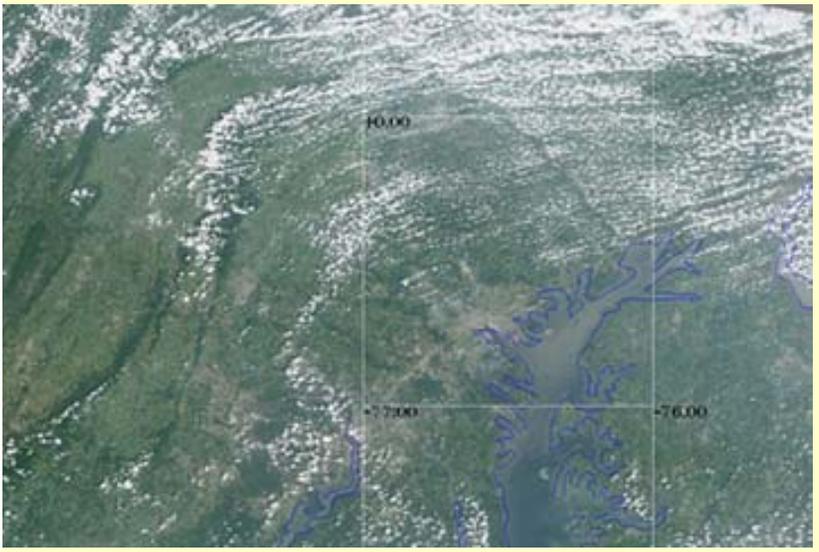
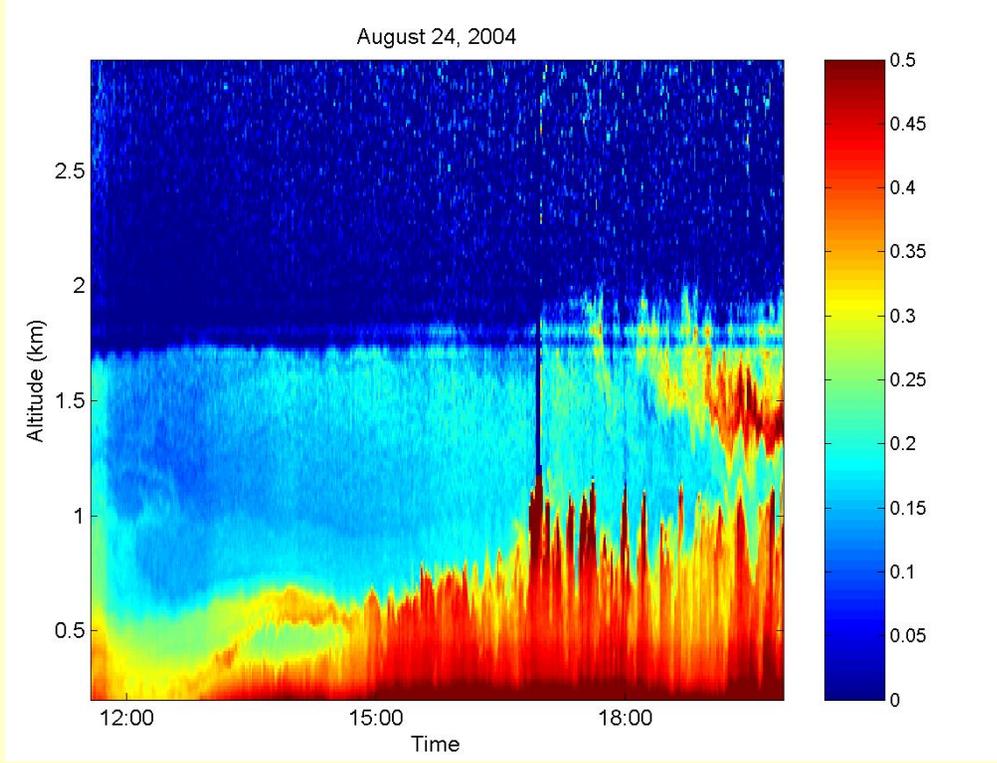
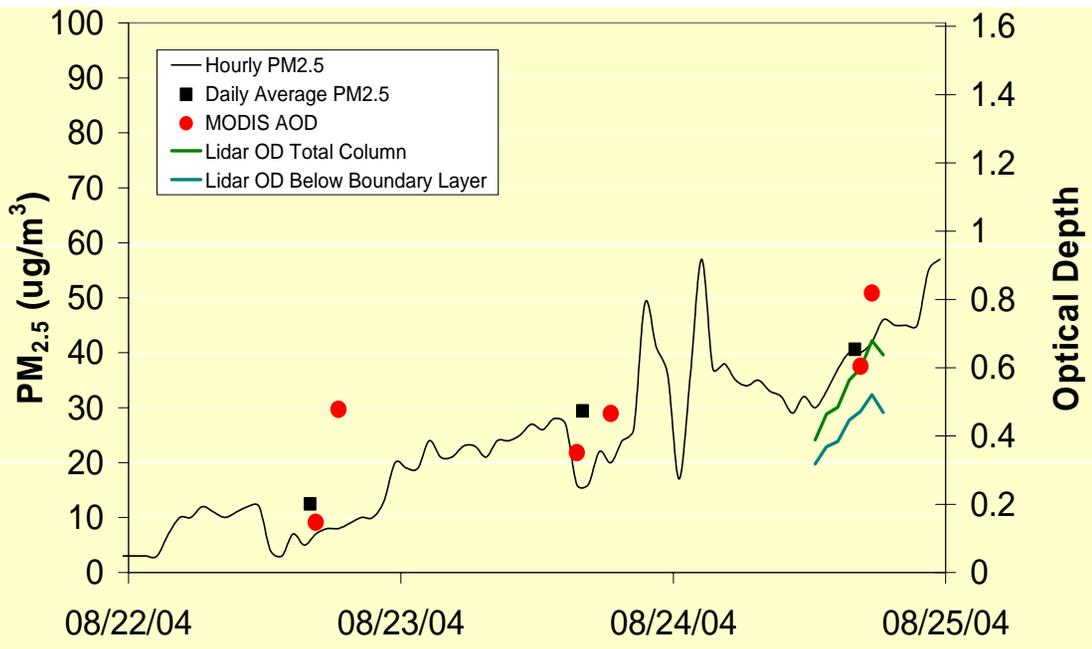
Baltimore, MD Summer 2004



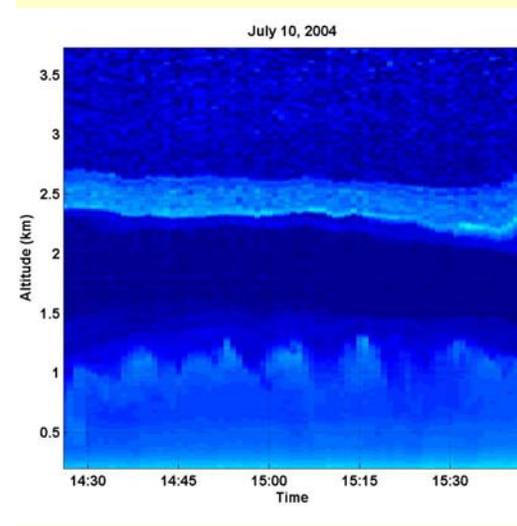
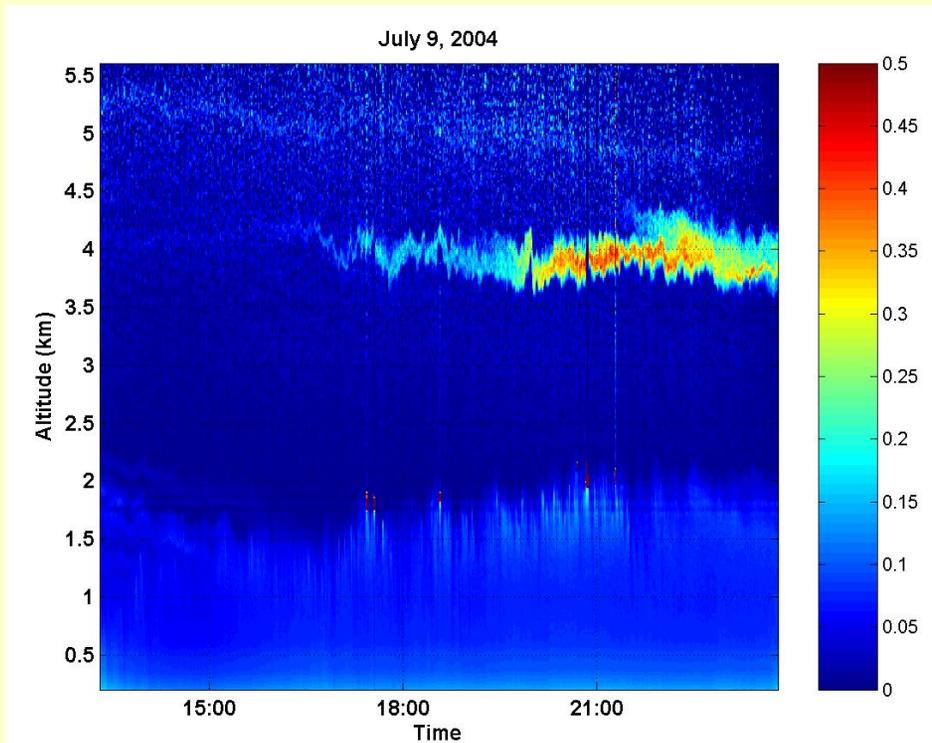
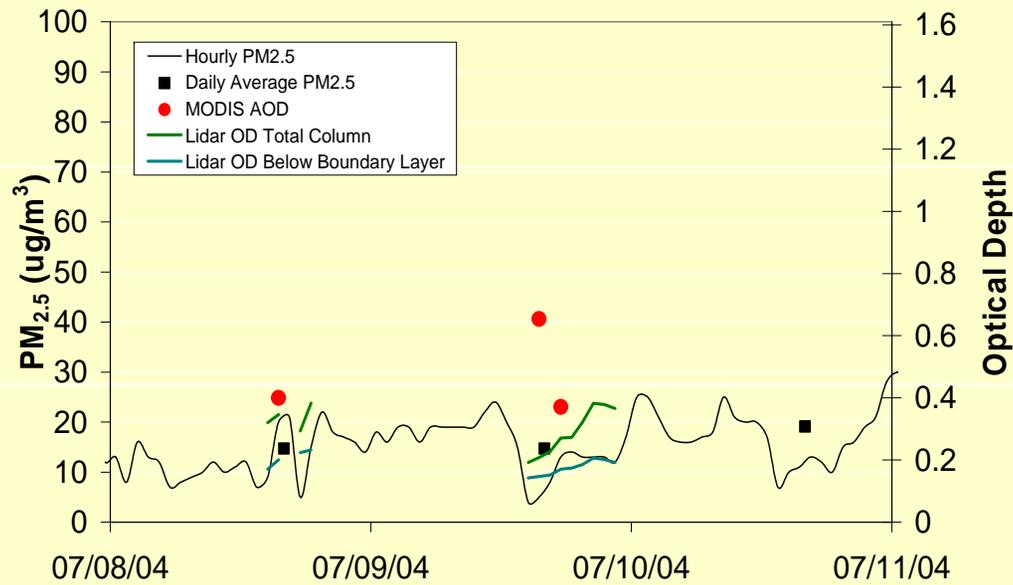
Common Summer Haze in Maryland 10 August 2004



Sulfate transport to Maryland 24 August 2004

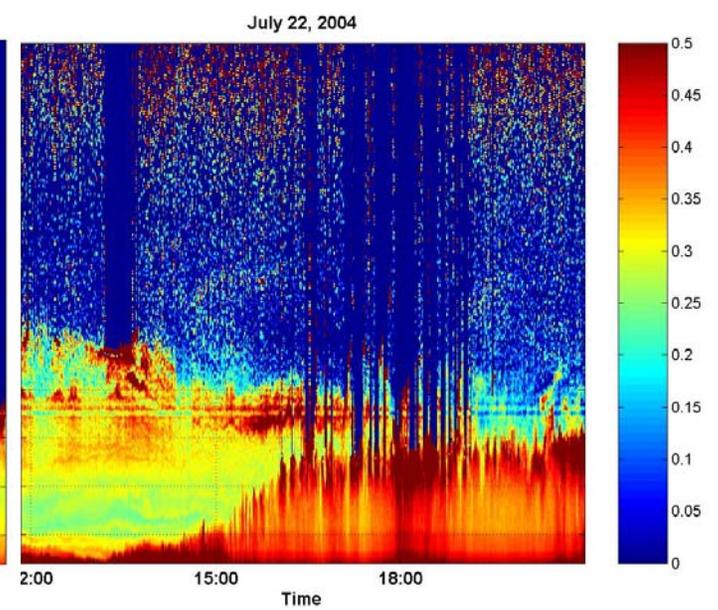
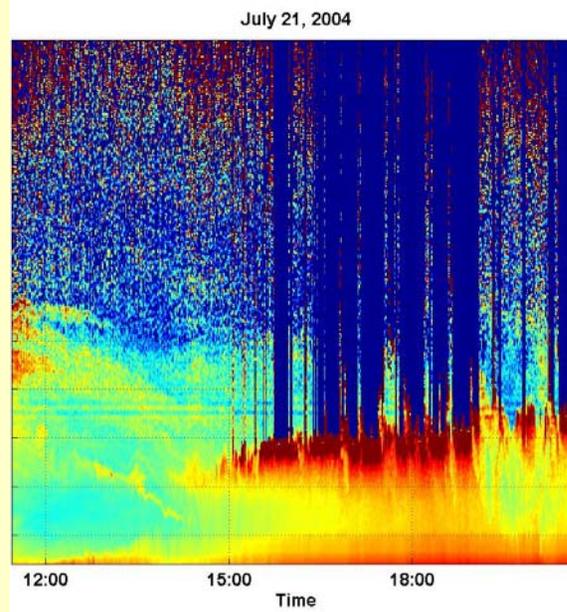
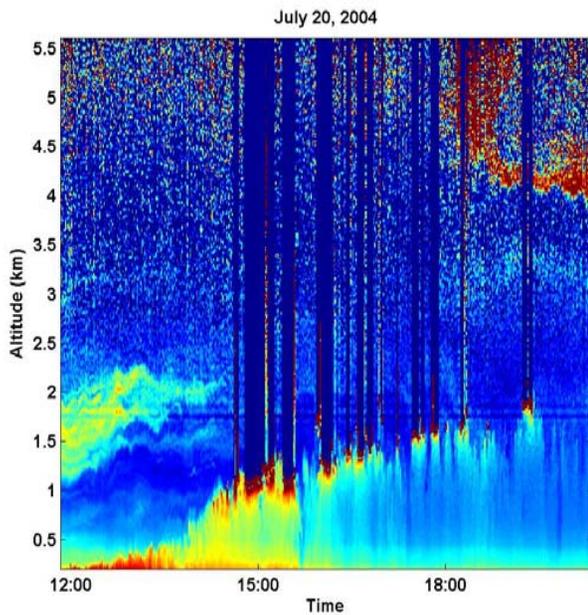
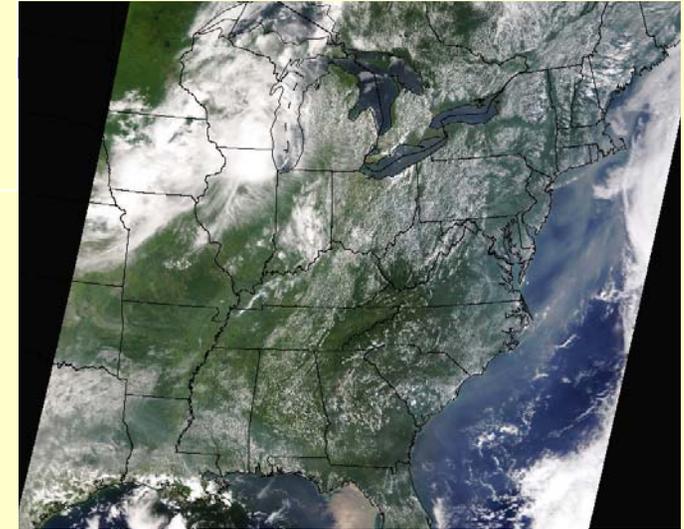
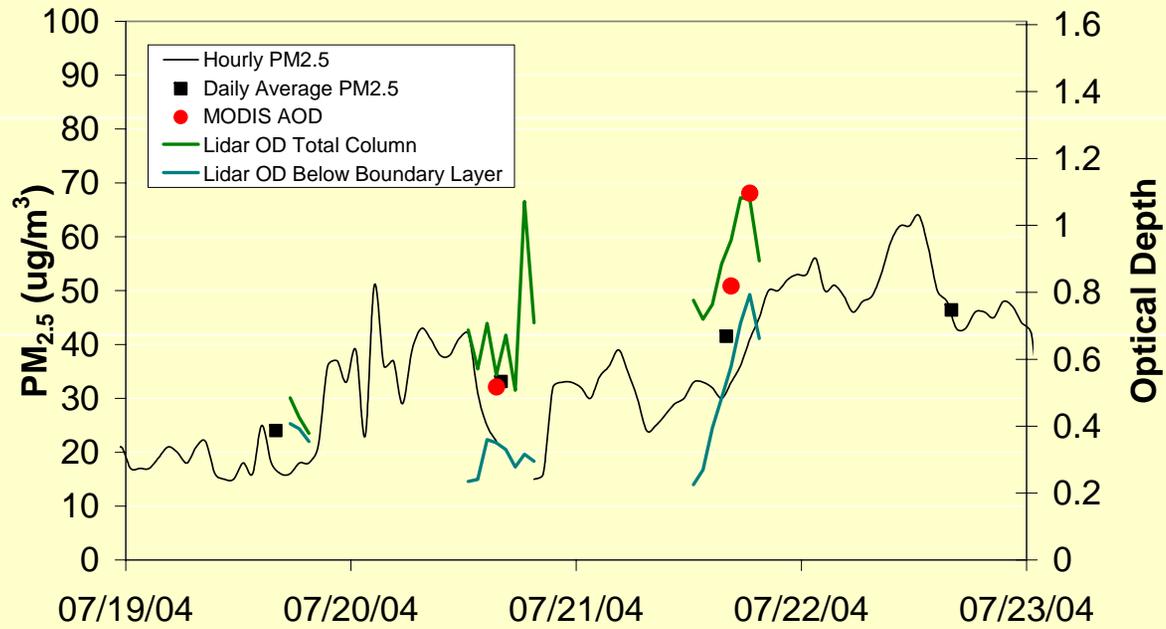


Alaskan Smoke over Maryland 9 July 2004

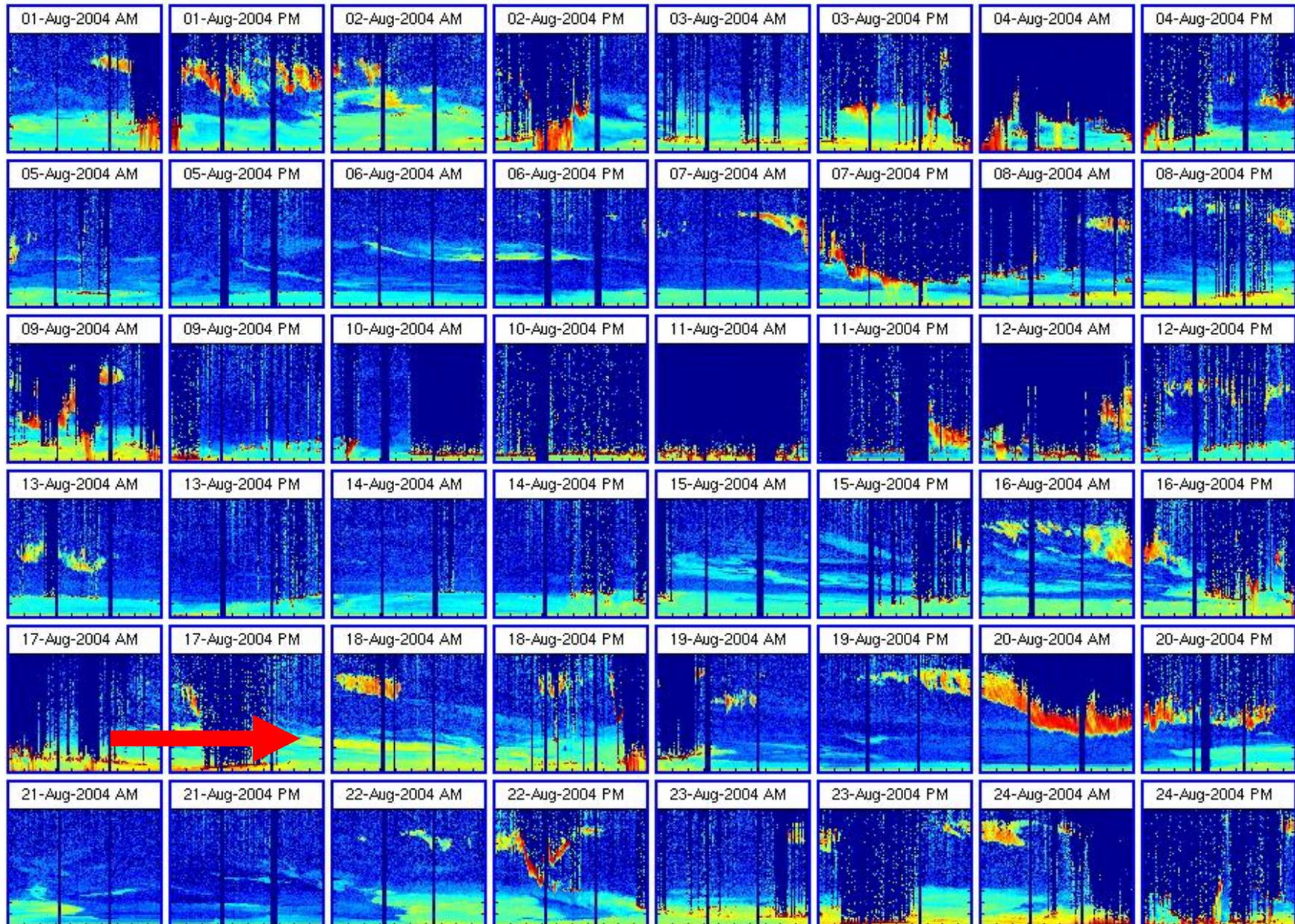


10 July 2004, am

Smoke mixing in Maryland 20-22 July 2004



University of Wisconsin Arctic HSRL



3D Air Quality System Project

Purpose

- Integrate NASA satellite sensor and lidar data into EPA's air quality data systems: AQS/AirQuest, AirNow, IDEA
- Provide greater accessibility and usability of satellite and lidar data to all users of these systems
- Enable monitoring in horizontal and vertical dimensions for forecasting and retrospective analysis

Timeline

- Funding from NASA expected in early 2006
- 2006: Algorithm research, product development and architecture design
- 2007: Prototyping with MODIS and evaluation of other sensors and lidar, development of visualization and data output
- 2008+: Complete data integration and transition to operations



Integrated System Solutions for 3-D AQS Impacting Air Quality & Public Health

Sun-Earth Observations and Models for Predictions/Assessments/ Forecasts

Observations

Terra/Aqua
 MODIS
 AIRS
 LIDAR
 REALM
 MPLNet
 GOES
 GASP
 Aura
 OMI
 CALIOP
 CALIPSO
 AERONET

Models

NOAA
 Hysplit
 LaRC
 modified
 IMPACT
 trajectory
 model

IDEA

3D-AQS

USAQ
Weblog

Partnership Area

Decision-Support Tools

- AIRNow/AQS-EPA/NOAA**
 - Increase synoptic data for PM_{2.5} forecasters
- AQS/AIRQuest (EPA)**
 - Multi-dimensional aerosol related data and analyses:
 - Assess general state of air quality and trends
 - Assess progress of SIPs and compliance
 - Waivers to air standards
 - Air quality rule development
- NEPHTN-PHASE (CDC)**
 - Produce better AQ maps through statistical models

Value & Benefits to Citizens & Society

Increase accuracy in AQ forecast: reduce poor air quality health impacts.

Increase knowledge in causes or poor air quality – leading to improvements in AQ and confidence in government.

Improved prevention initiative targeting.

INPUTS

OUTPUTS

OUTCOMES

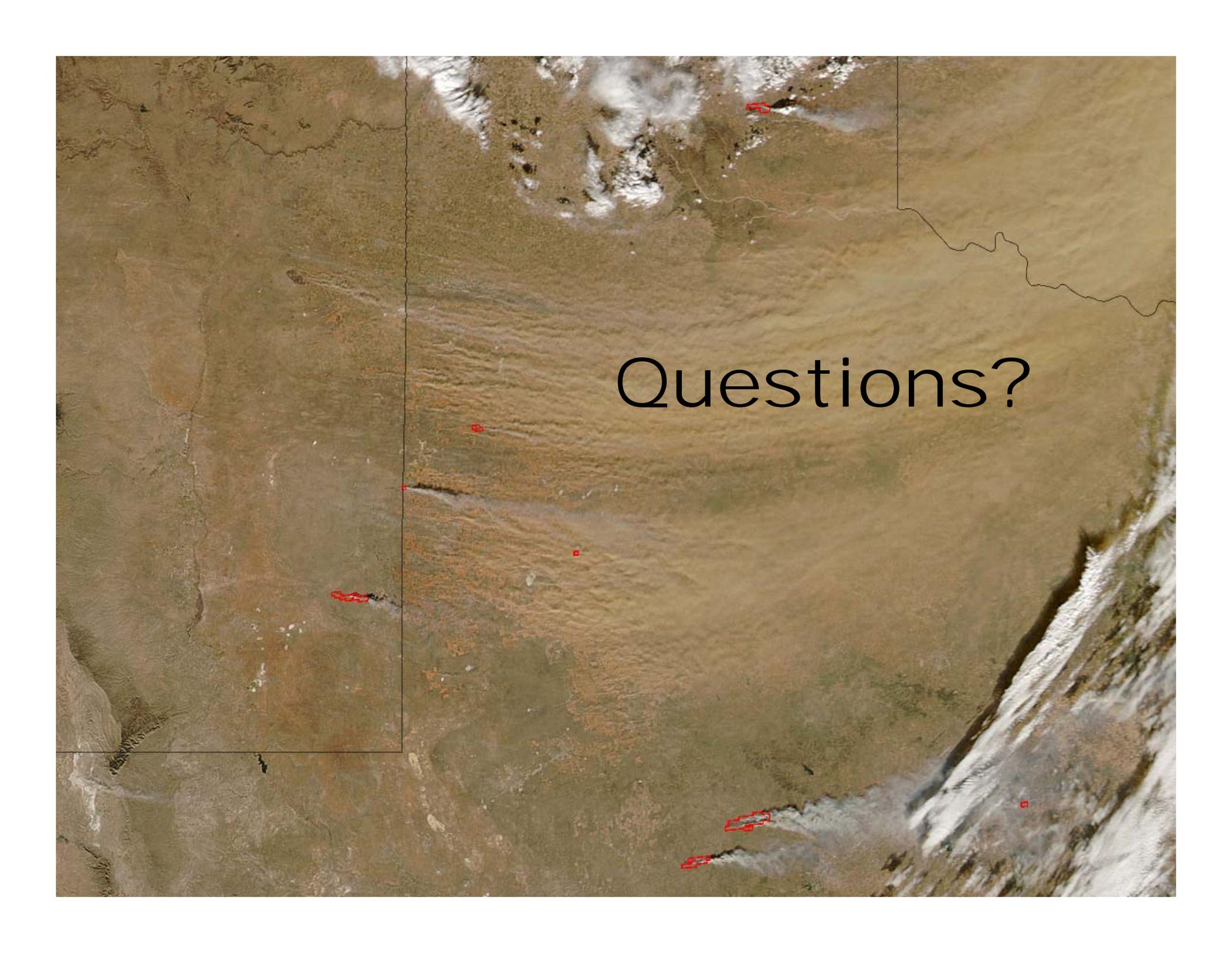
IMPACTS

NASA/NOAA/EPA/ UMBC/CIMSS/BMI

EPA/NOAA/CDC

3D-AQS Needs Input

- End user input needed
 - User committee will be formed consisting of EPA and state forecasters, data analysts, and data managers
 - General input solicited informally and through conference workshops
 - Routine input sought throughout process, via online demonstrations and formal sessions
- Type of input needed
 - Data types of interest
 - Level of processing and format required
 - Type and style of visualization
 - Temporal and spatial needs
- Contact: engelcoxj@battelle.org

An aerial photograph of a mountainous region, likely in the Himalayas, showing a large valley and surrounding peaks. The terrain is brownish-tan, indicating sparse vegetation or high altitude. Several red markers are placed on the map: a red rectangle in the upper right, a red square in the center, a red rectangle in the lower left, and a red square in the lower right. A black line runs vertically through the center of the image. The word "Questions?" is overlaid in the center of the image in a large, black, sans-serif font.

Questions?