Acronym soup
MPL-NET, REALM, GLAS, CALIPSO

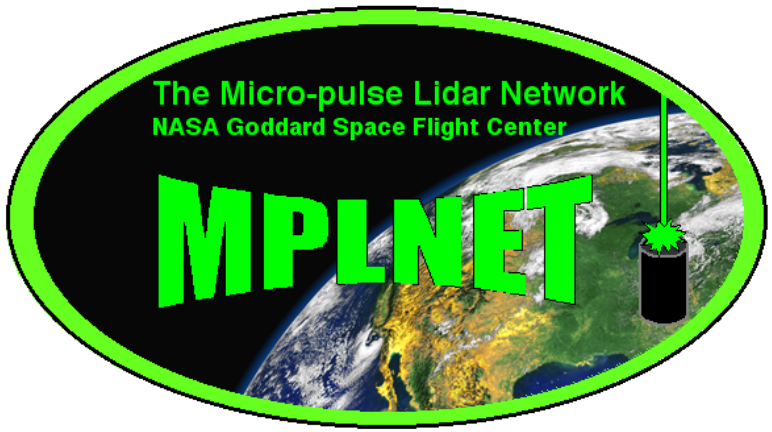
R. M. Hoff
University of Maryland,
Baltimore County

The Micro-pulse Lidar Network (MPLNET)

PI: Judd Welton
NASA Goddard Space Flight Center
Greenbelt, MD 20771 USA

Co-I's: James Spinhirne, Si-Chee Tsay, Brent Holben

Staff: James Campbell, Timothy Berkoff



MPLNET website: http://mplnet.gsfc.nasa.gov

The Micro-pulse Lidar Network : (MPLNET)

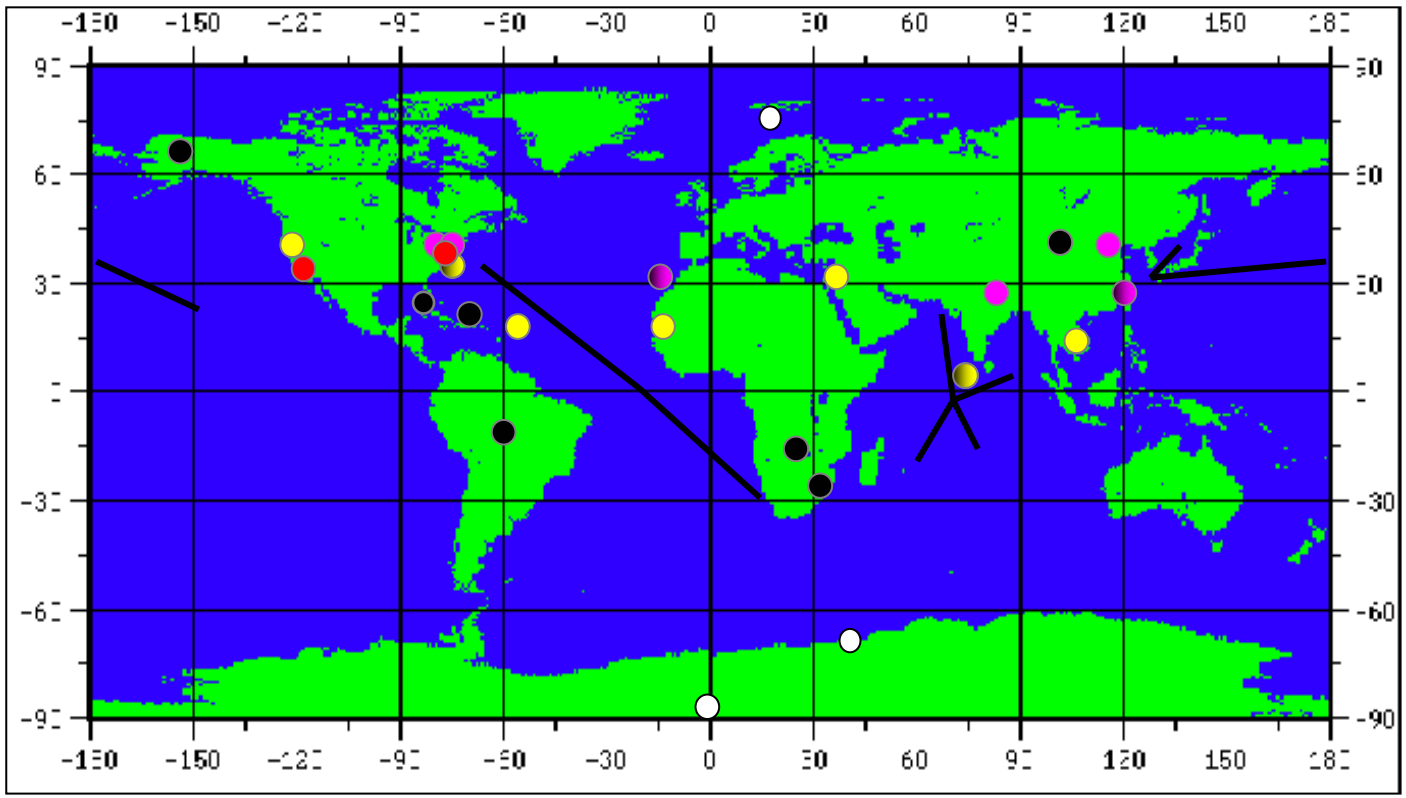
Mission: Long-term, world-wide observations of aerosol and cloud vertical structure using common instrument/data processing

Funding: NASA Earth Observing System & Radiation Sciences Program

Activities:

- co-locate sites with AERONET sunphotometers, and if possible BSRN radiometers
- partner with other independent research groups interested in MPL measurements (federated network)
- participate in field experiments and research cruises
- work with aerosol modelers to study aerosol transport processes

Satellite Lidar Calibration/Validation: GLAS - ICESat (2003), CALIPSO (2005)



Active Sites:

- MPLNET & AERONET
- MPLNET only
- Field Experiment
- Ship Cruise

Proposed Sites:

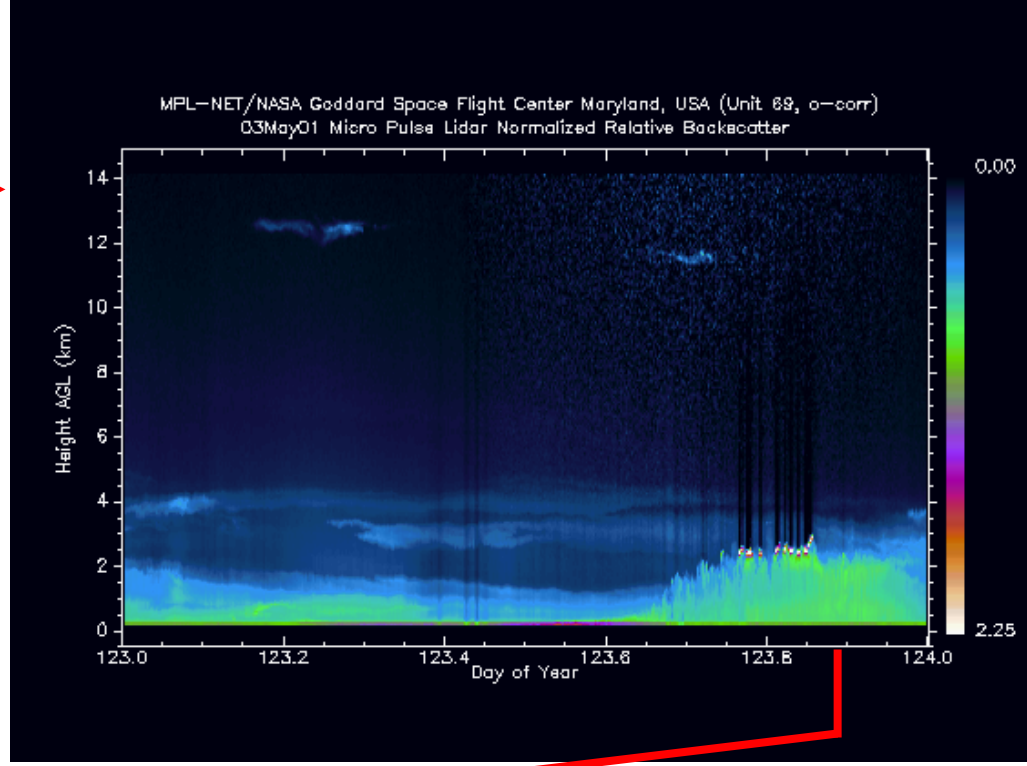
- 2004
- 2005
- Transition from experiment

* All proposed sites will be co-located with AERONET

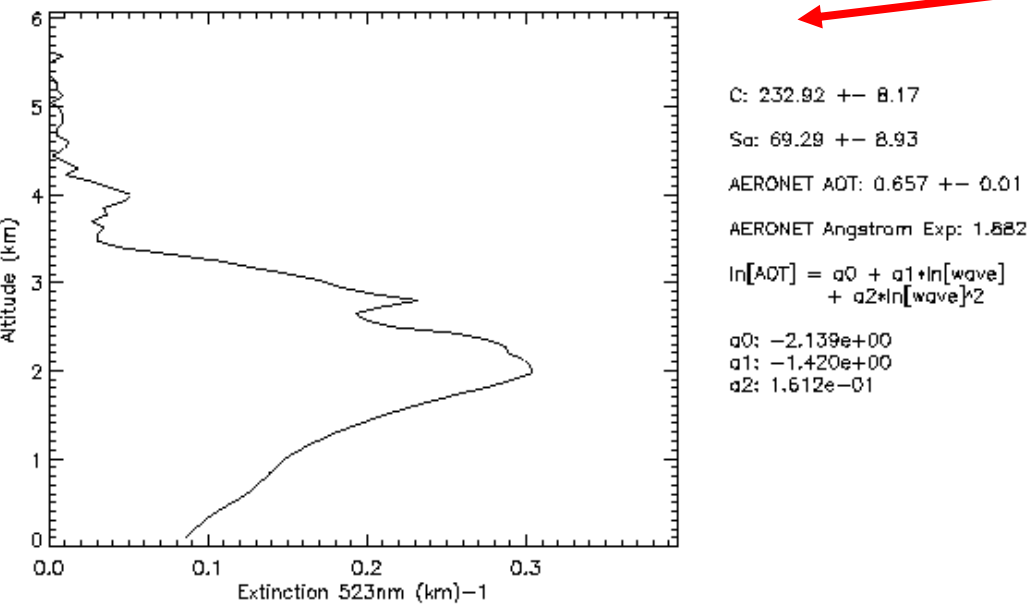
MPLNET website: http://mplnet.gsfc.nasa.gov

Real-time MPLNET Data Products:

Level 1.0 - lidar signal



Level 1.5a - extinction profiles correlated with AERONET data



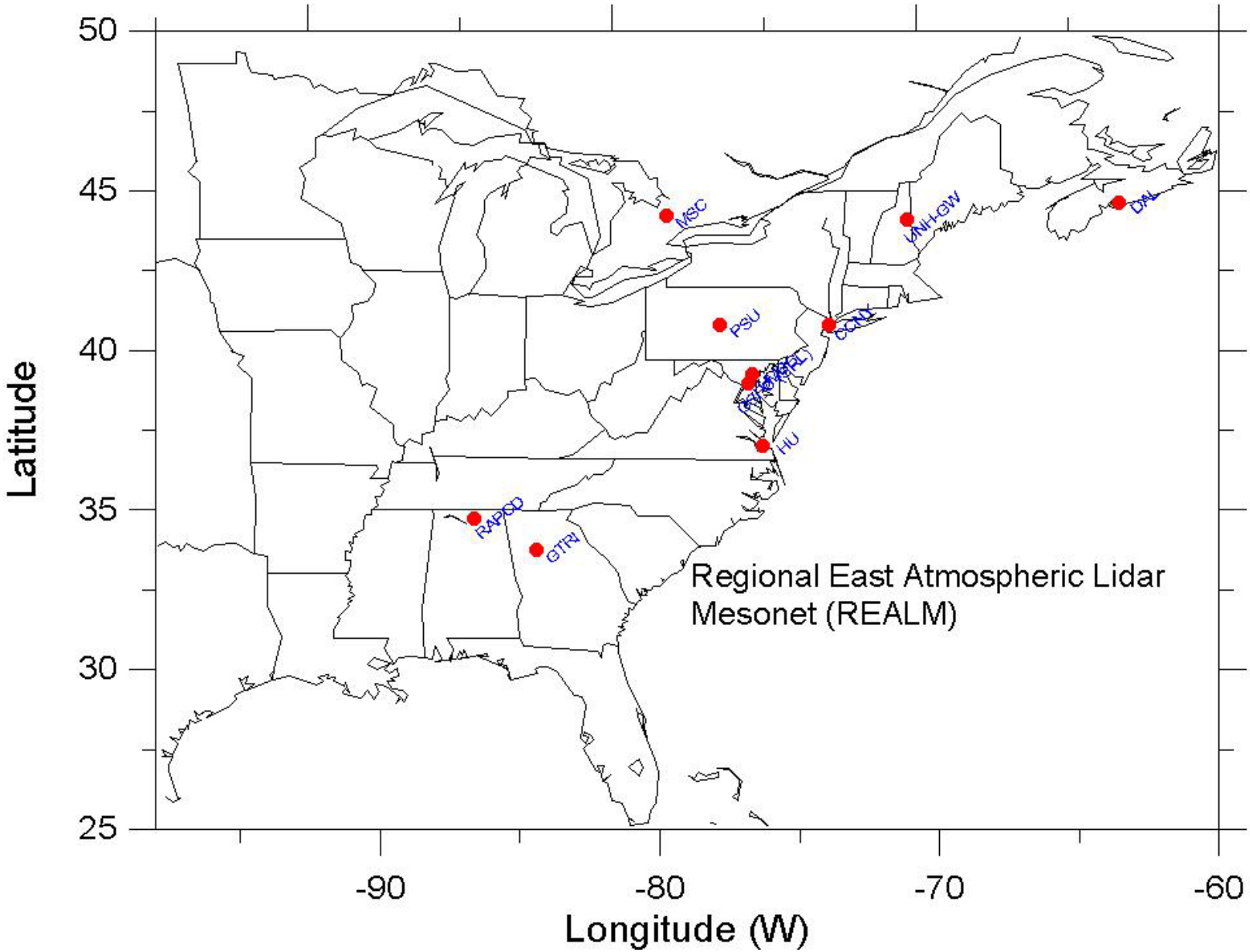
- **uncertainties are calculated for all data products**
- **MPLNET uses co-located AERONET data for processing**
- **MPLNET and AERONET results are correlated in 1 data file**

The Regional East Atmospheric Lidar Mesonet: REALM

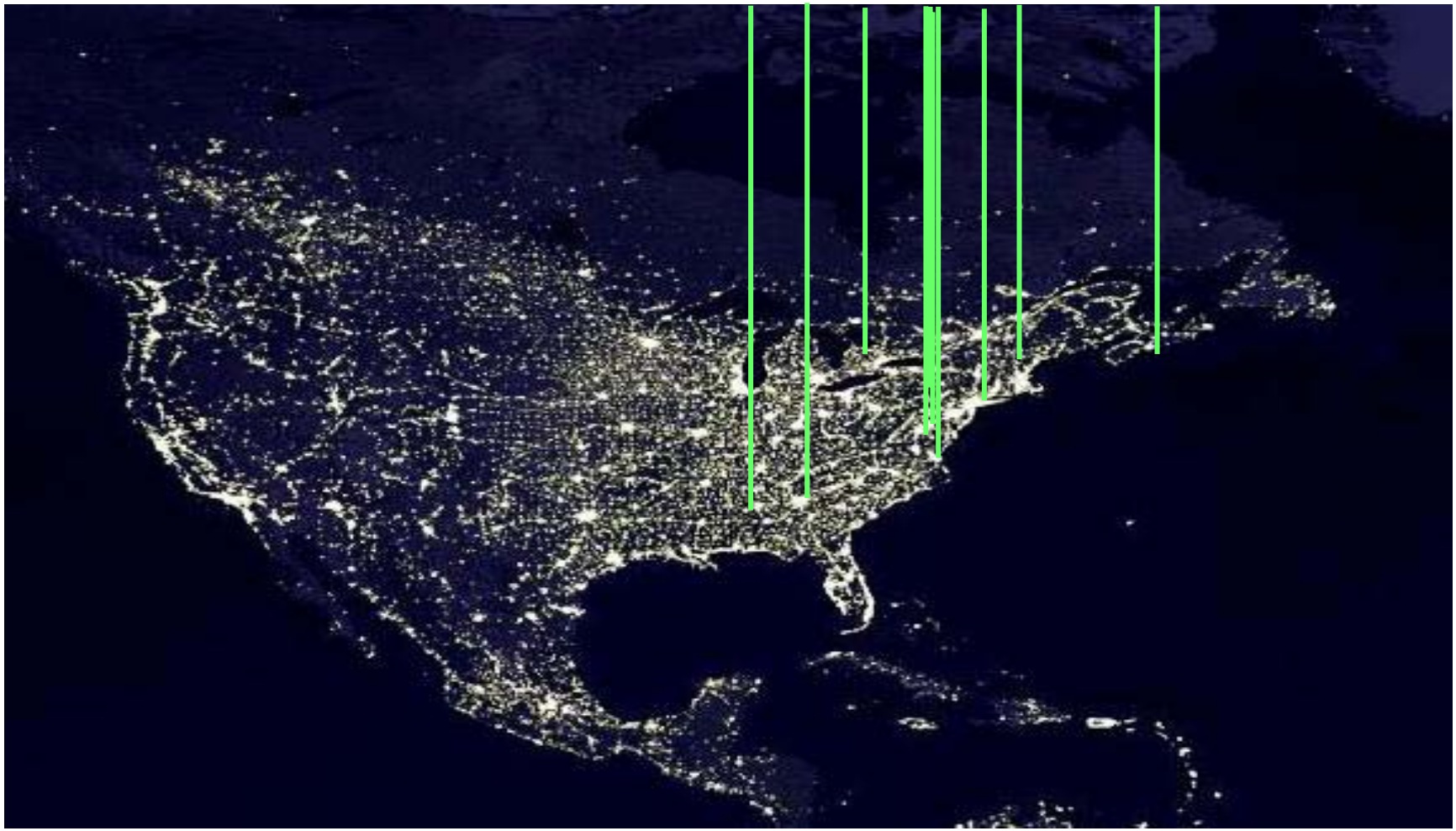
http://alg.umbc.edu/REALM

TABLE 1
REALM LIDAR SYSTEMS

Location	PI	Type(s)
Egbert, ON	K.I. Strawbridge	Scanning elastic
Durham, NH	I. Dors	Winds
Halifax, NS	T. Duck	Elastic, Raman
New York, NY	S. Ahmed	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. Gimmestad	DIAL

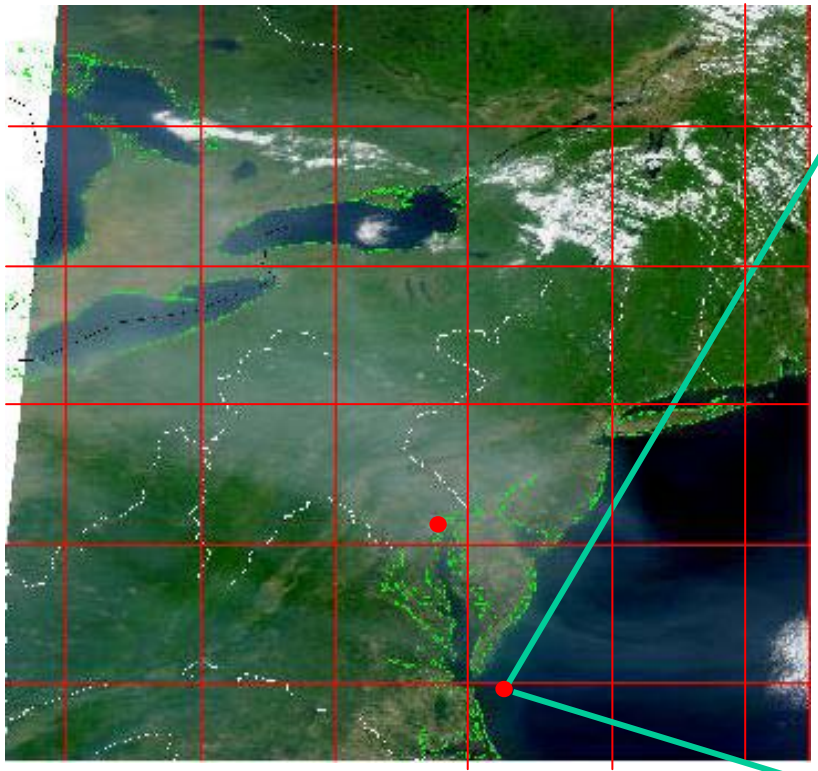

Latitude
50
45
40
35
30
25
-90
-80
-70
-60
Longitude (W)
MSC
PSU
HU
RAPOD
GTRI
UNH-GW
DAL
Regional East Atmospheric Lidar
Mesonet (REALM)

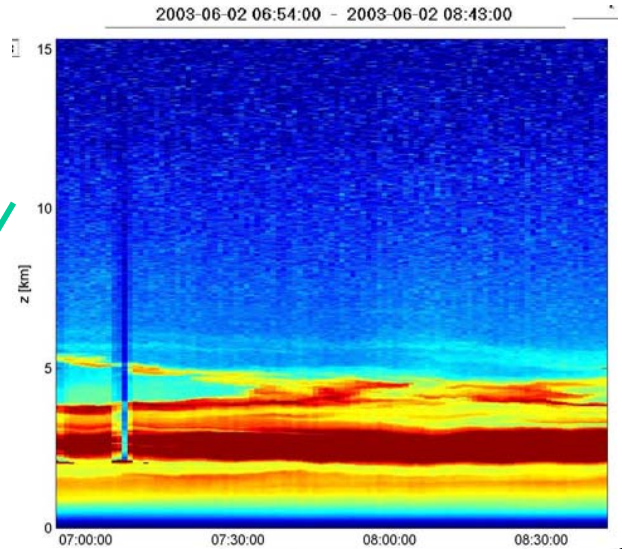
Monitoring the Megacity



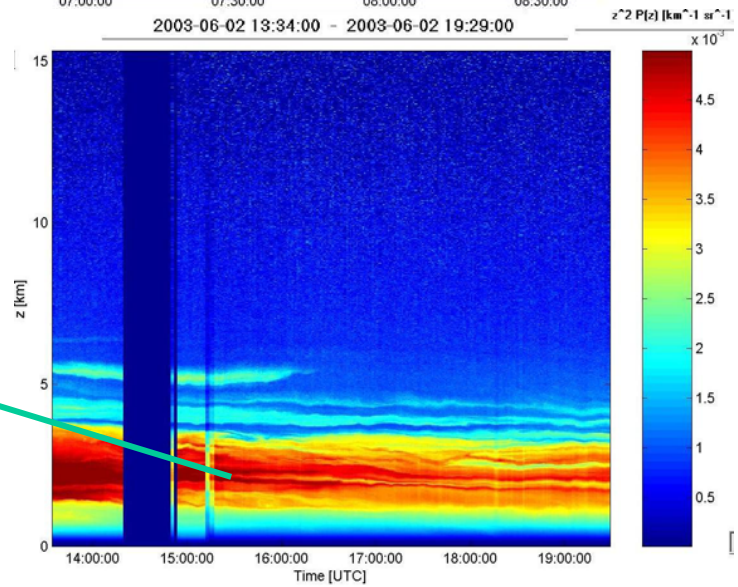
June 2, 2003 ELF Lidar

Terra MODIS 1530 UT





0654-0843 UTC



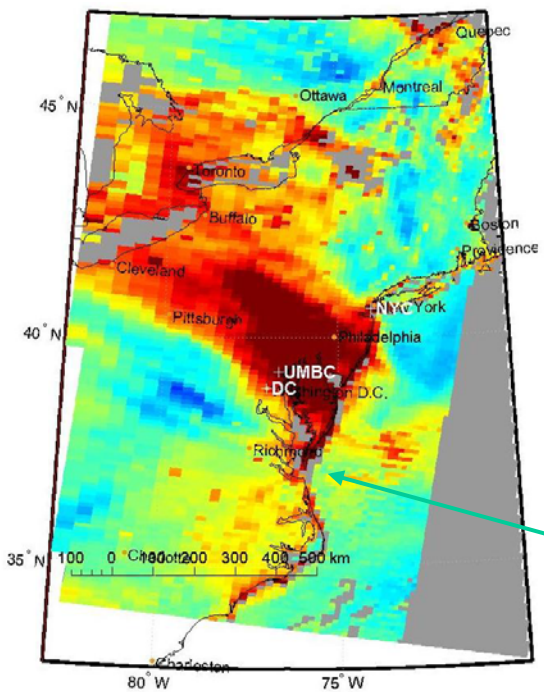
1334-1929 UTC

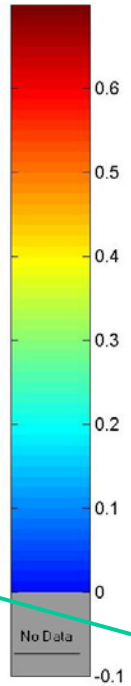
0.5º x 0.5º grid

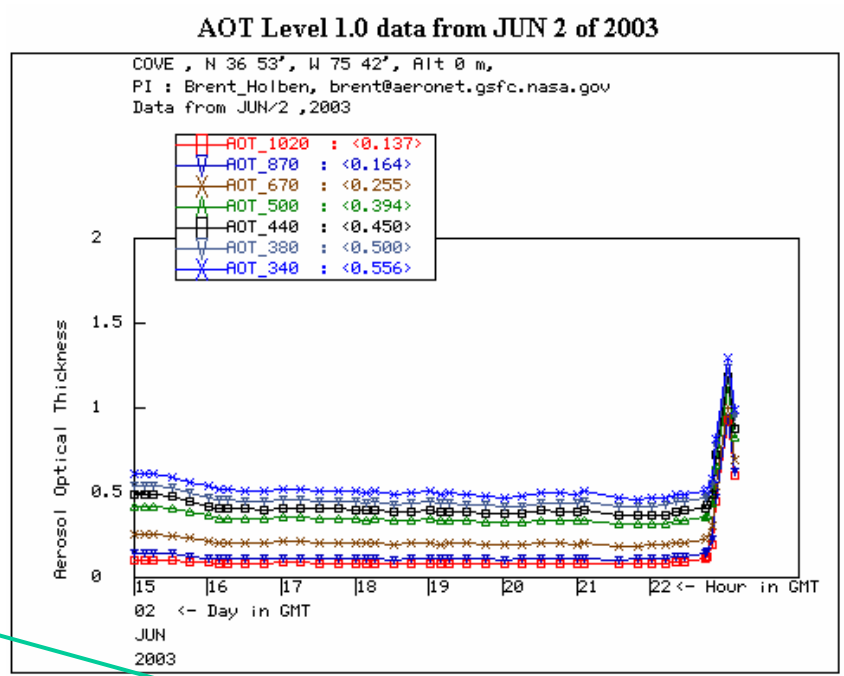
ABOVE
ELF, Chesapeake Lighthouse, VA

Hoff, UMBC

Optical Depth from MODIS/AERONET







MOD04 Aerosol OD
15:30 UT June 2

AOT, Cove Site = 0.394
@ 500 nm

Colorco trajectories, GSFC.

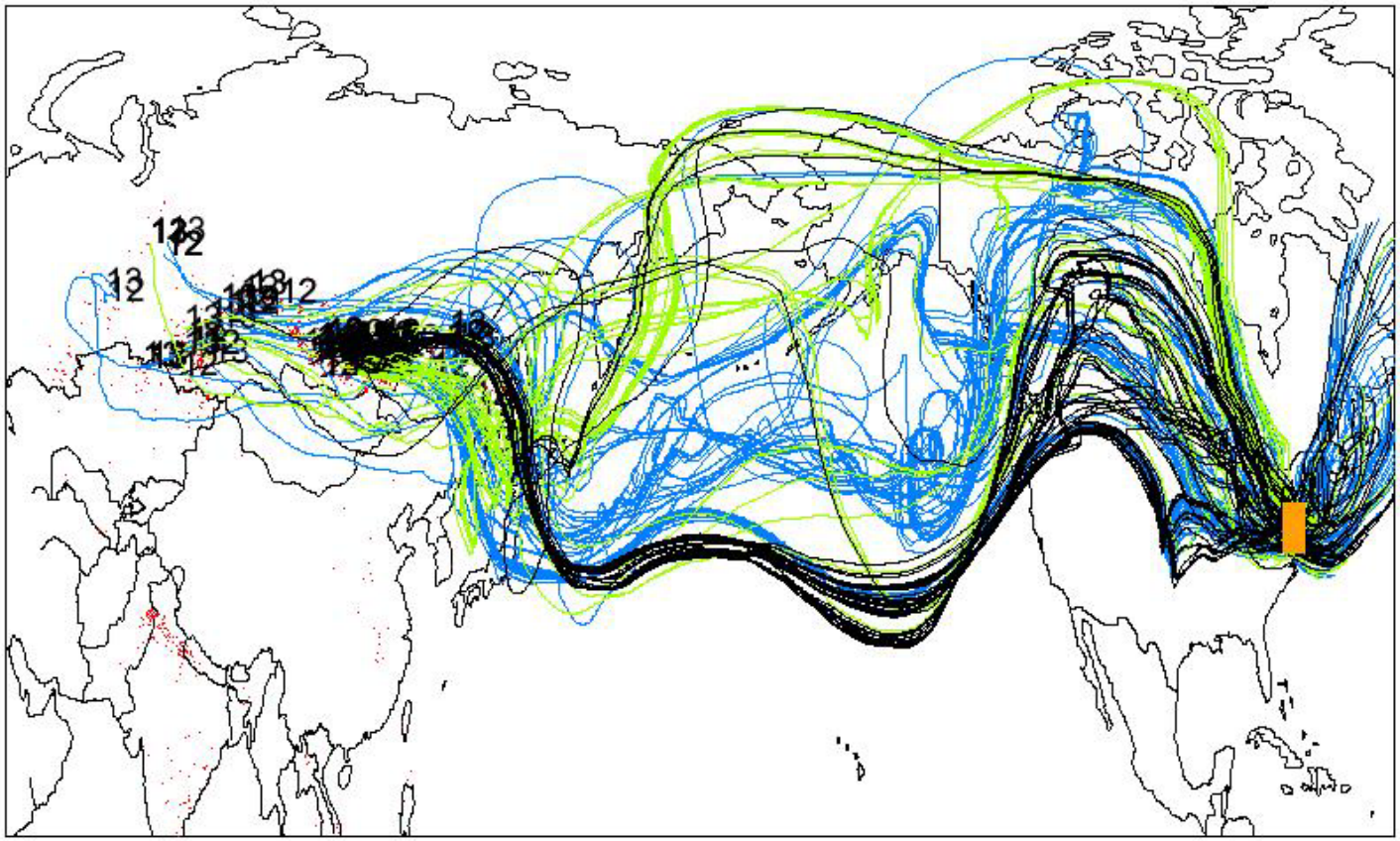
Initial time: May 19, 2003 1800 UTC
Forward trajectories +/- 2° of GSFC Site between June 1 - 3, 2003
between 700 - 400 hPa

Modis Firecounts

Target Site

Days (approx) to reach target

300 hPa n=(93)
500 hPa n=(52)
700 hPa n=(61)



Initial time: May 19, 2003 1800 UTC

GLAS

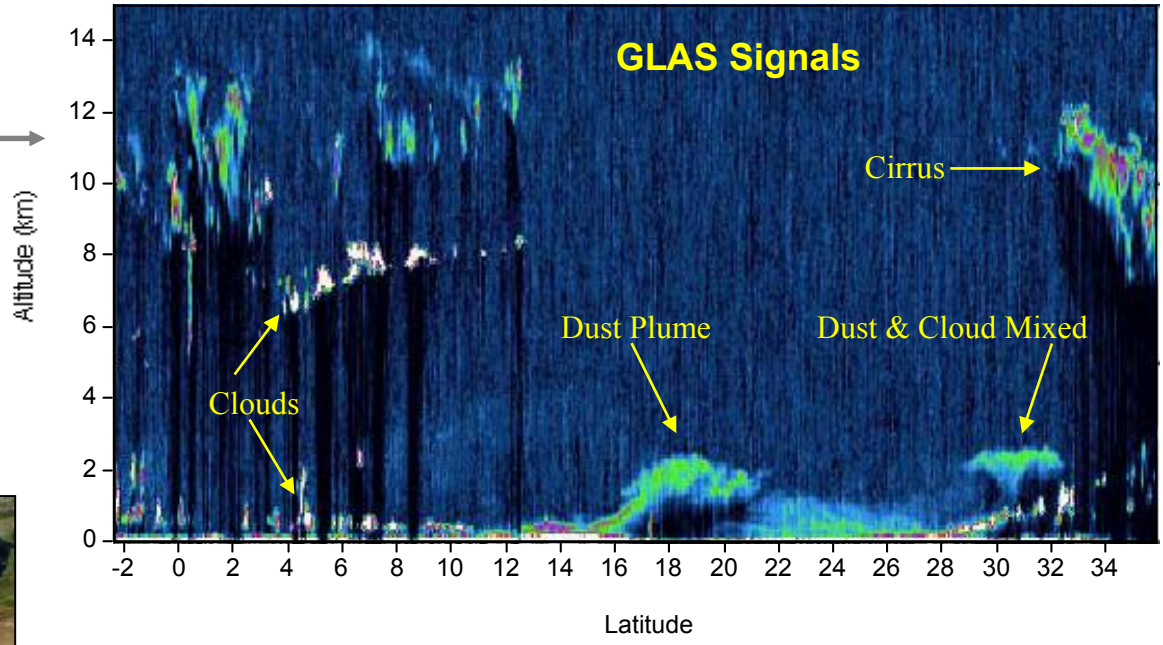
Judd Welton
NASA Goddard Space Flight Center
Laboratory for Atmospheres

GLAS Atmospheric Science Team:
James D. Spinhirne, Stephen P. Palm,
Dennis Hlavka, William Hart, Matthew McGill

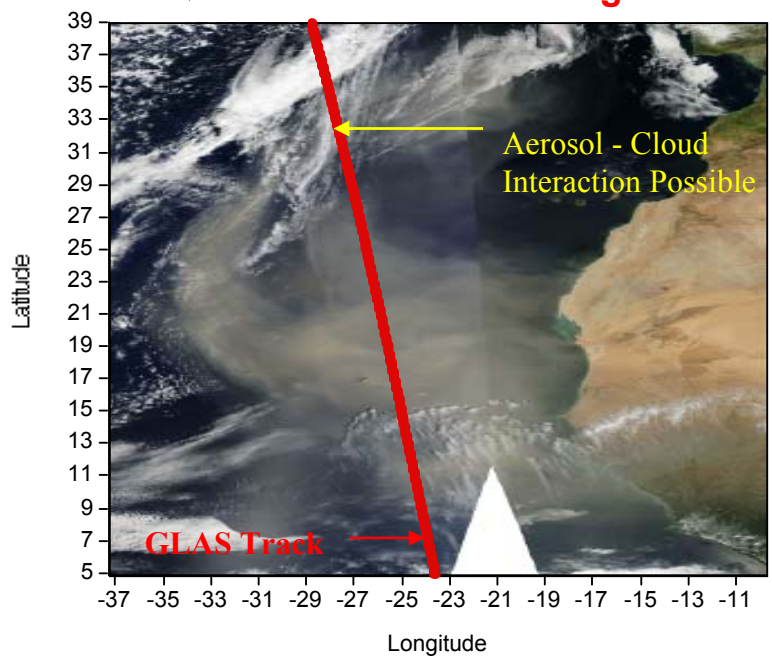
Results at 532 nm

E.J. Welton, NASA Goddard Space Flight Center, Judd.Welton@nasa.gov, 11/18/03

Example of Initial GLAS Data (1064 nm
March 3, 2003 Dust from West Africa
GLAS signals from ICESat:
04:40 UTC
MODIS images from Terra and Aqua:
12:40 and 14:00 UTC
(MODIS rapid response website - rapidfire.sci.gsfc.nasa.gov)



NASA MODIS Images

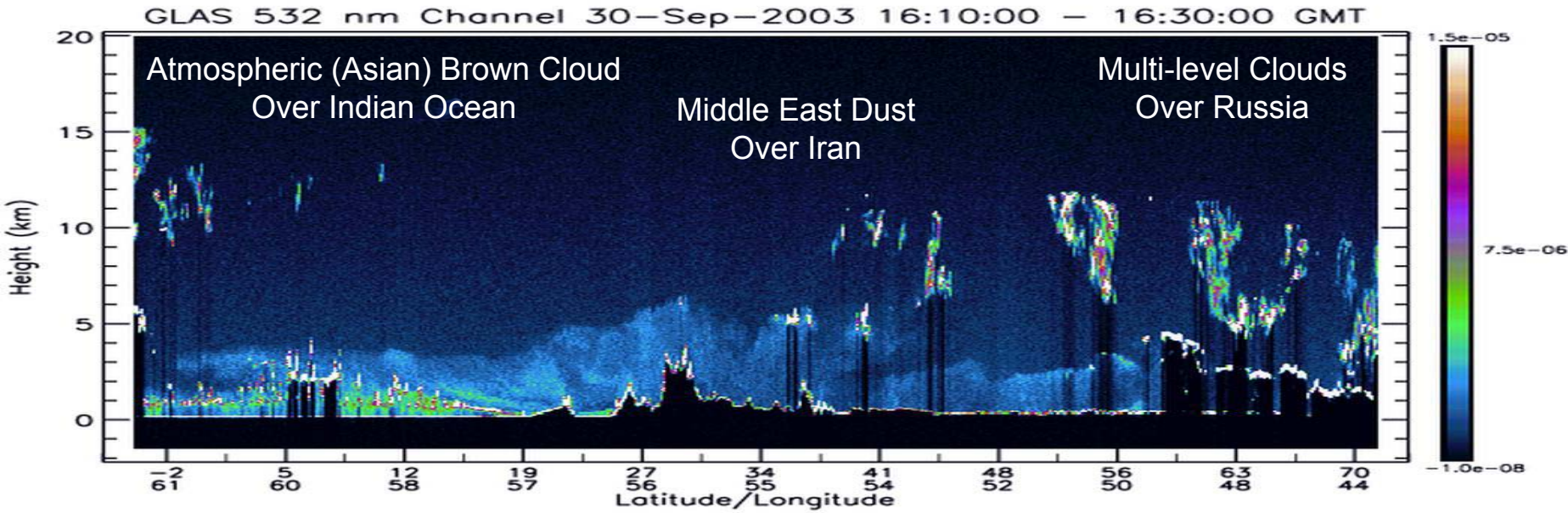


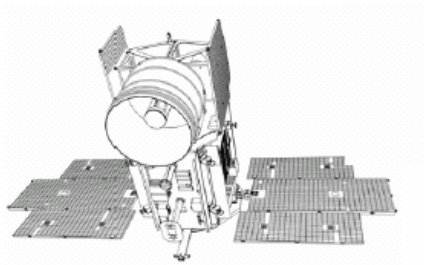
Preliminary outcome from initial dataset:
GLAS 1064 nm channel is detecting water & ice clouds, and moderate to high concentration aerosol plumes
GLAS was not within MODIS swath during Feb/Mar 03, but despite time difference of several hours, comparisons with dust plume images are not bad

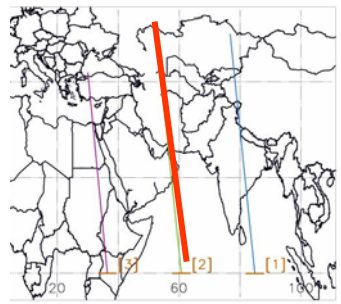
Geoscience Laser Altimeter System

Global Lidar Measurements of Clouds and Aerosol in the Atmosphere

GSFC

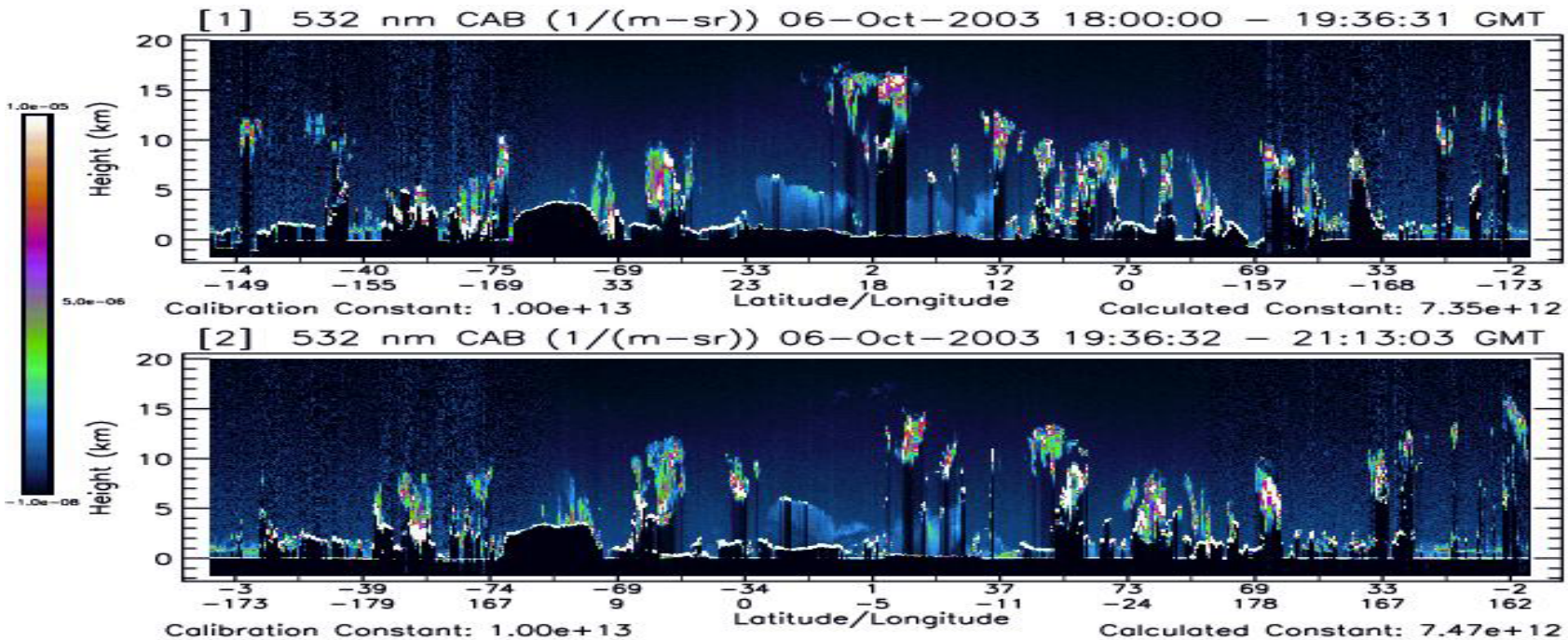


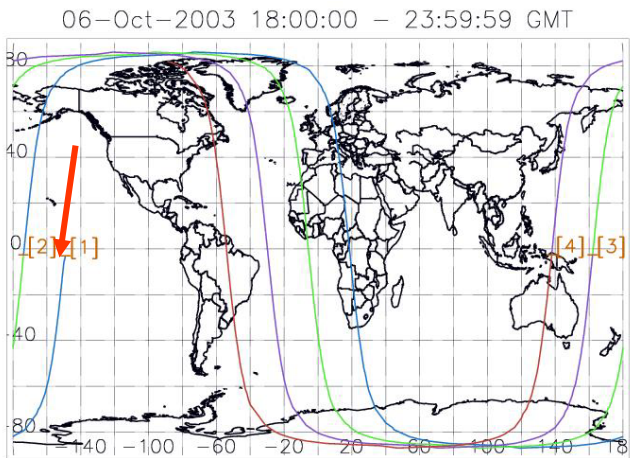




J. Spinhirne /GSFC January 2004

GLOBAL ORBITAL LIDAR OBSERVATIONS OF CLOUD AND AEROSOL VERTICAL DISTRIBUTION



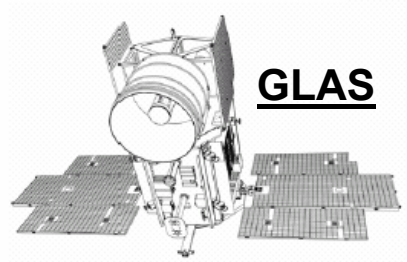


Geoscience Laser Altimeter System

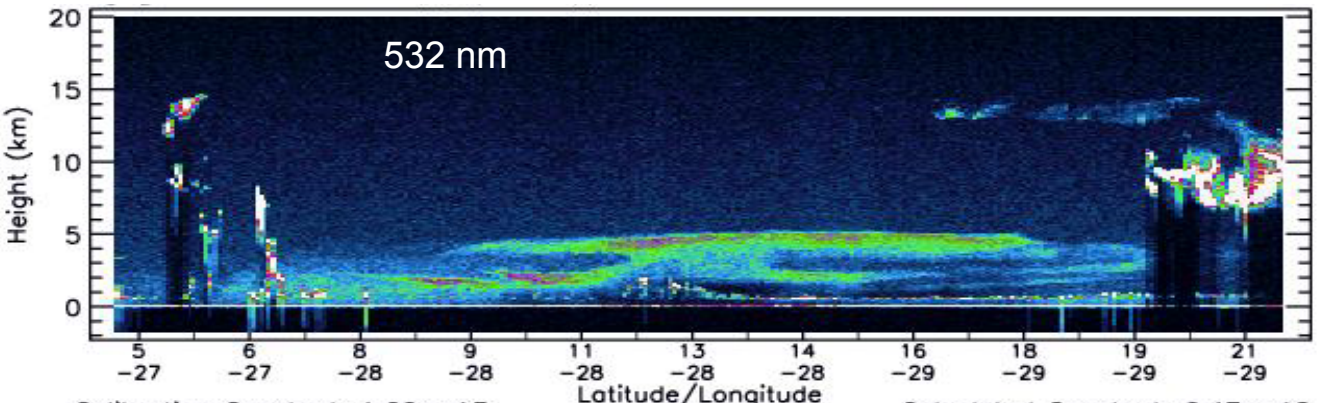
J. Spinhirne /GSFC January 2004

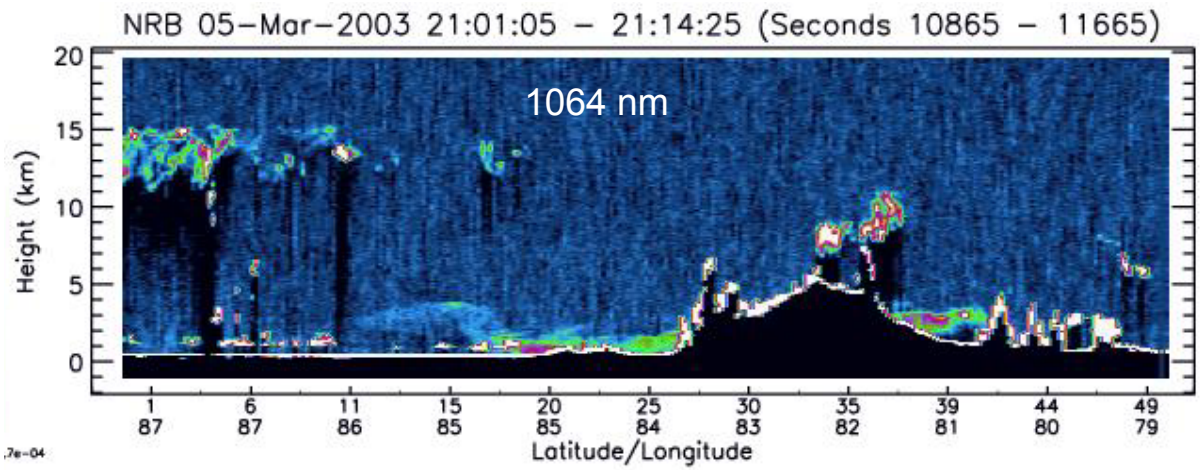
SPACE LIDAR OBSERVATION OF THE DISTRIBUTION OF AEROSOL

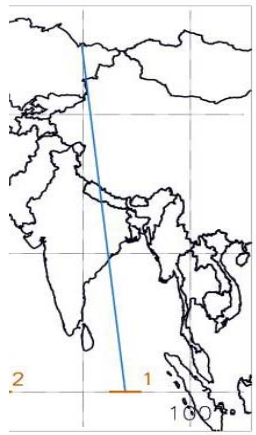
New Input for Models



GLAS View of Saharan Dust Layer







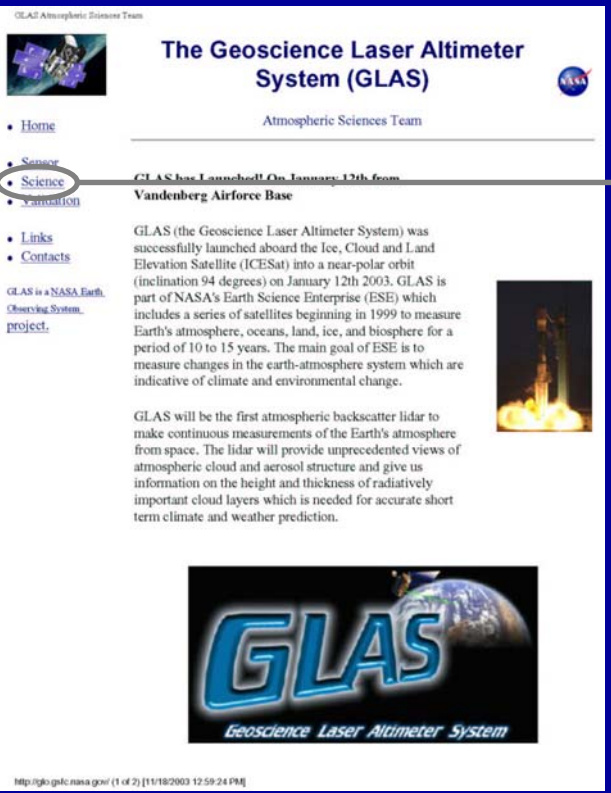
Asian Dust and Pollution

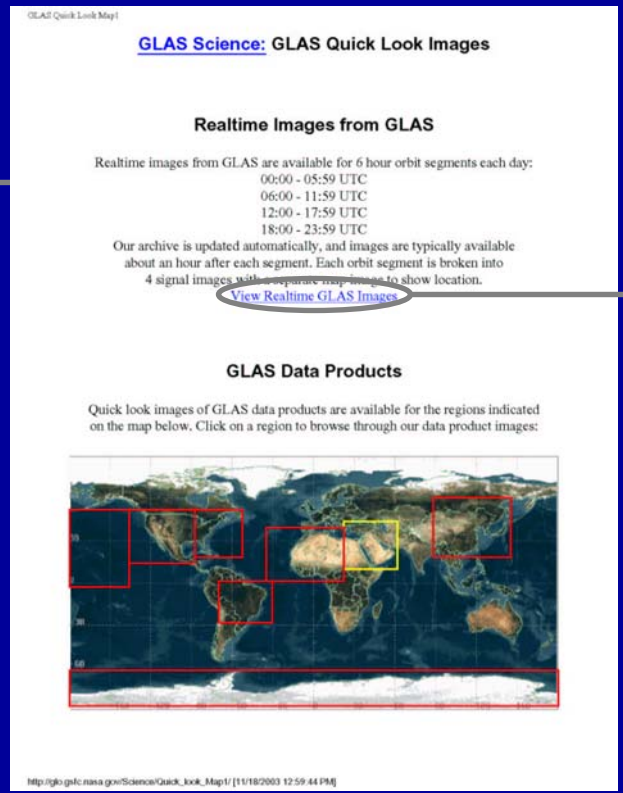
J. Spinhirne /GSFC January 2004

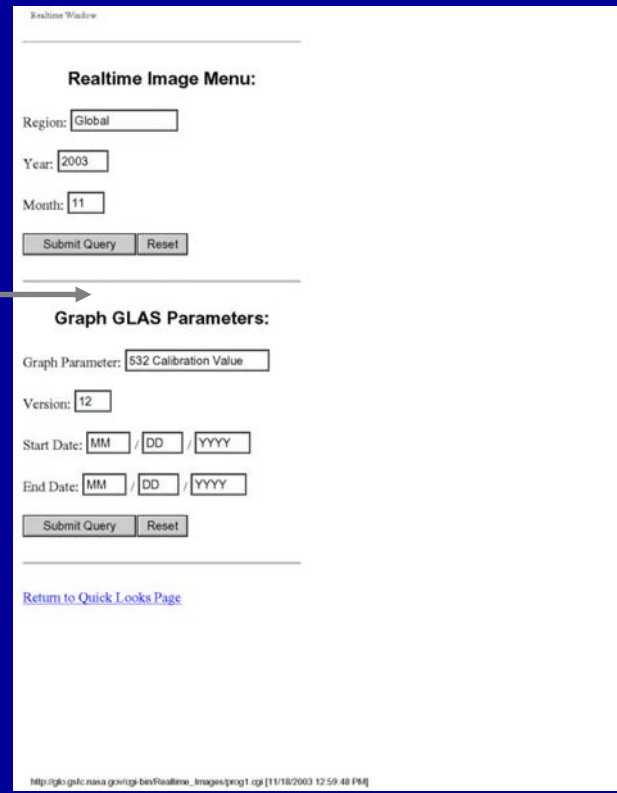
Data Access

E.J. Welton, NASA Goddard Space Flight Center, Judd.Welton@nasa.gov, 11/18/03

GLAS Atmospheric Science Team Website: glo.gsfc.nasa.gov







* Realtime images available within ~8 hours of observation

Update on Names

As of 11/01, PICASSO-CENA , ESSP3, ESSP3-CENA, P-C, … is:

The CALIPSO Mission

(Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations)

D. M. Winker, LaRC/NASA, PI

And,

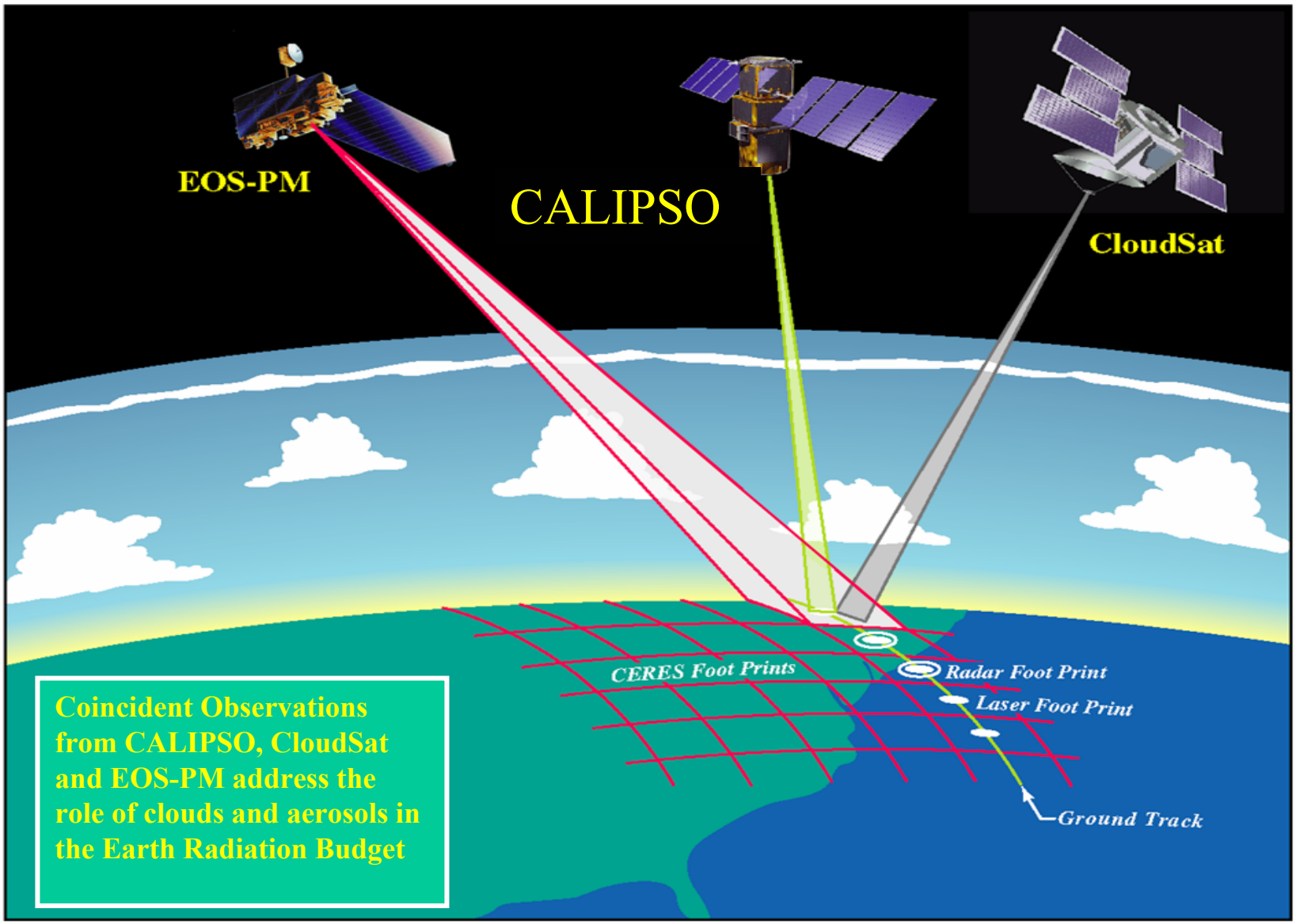
the CALIPSO lidar now has a name:

CALIOP

(Cloud-Aerosol LIdar with Orthogonal Polarization)

(rhymes with "I - O - P")

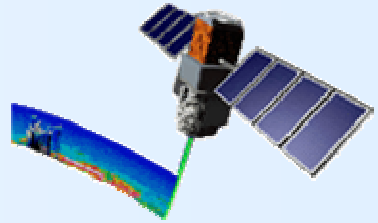
Mission Concept



Implementation

- **One spacecraft with 3 science instruments:**
  - **3 channel lidar**
  - **IR imager**
  - **wide-field camera**
- **Launch in March 29, 2005**
- **3-year mission**
- **Fly in formation with EOS-PM in polar orbit**

Measurement Capabilities



Data Product	Measurement Capabilities and Uncertainties	Representative Spatial Resolution	
		Night Horizontal x Vertical	Day Horizontal x Vertical
Aerosol layer top and base height	β_{min} = 2.5 x 10^{-4} km^{-1} sr^{-1} (τ = 0.005 for a 500 m thick layer)	20 km x 120 m	50 km x 120 m
Thin cloud top and base height	β_{min} = 1 x 10^{-3} km^{-1} sr^{-1} (τ = 0.005 for a 250 m thick layer)	1 km x 60 m	4 km x 60 m
Thick cloud base height	Layer τ < 5	4 km x 60 m	50 km x 60 m
PBL cloud structure	β_{min} = 1.6 x 10^{-2} km^{-1} sr^{-1}	333 m x 30 m	333 m x 30 m
Aerosol τ (Resolutions for case of τ = 0.1)	$\frac{\partial \tau}{\tau} \leq$ 40% (total error) (includes 30% error in S)	8 km horizontal	20 km horizontal
Aerosol $\sigma(z)$	$\frac{\partial \sigma}{\sigma} \leq 30\%$ (random error only)	3.5 km x 120 m	6 km x 120 m
Cirrus τ, σ (z)	Within a factor of 2 for τ < 5	15 km horizontal	NA
Ice/water phase	Layer by layer	16 km x 60 m or 4 km x 240 m	16 km x 60 m or 4 km x 240 m

Backups

MPLNET: Instruments

- **Micro-pulse Lidar Systems (MPL)**
  - compact & semi-autonomous
  - 523 nm wavelength
  - PRF 2500 Hz
  - eye-safe, output energy in μJ
  - small FOV, no multiple scattering

- **Sunphotometer**
  - Sites & Experiments: NASA Aerosol Robotic Network (AERONET) sunphotometers by Cimel
  - Handheld Microtops sunphotometer used on ocean cruises

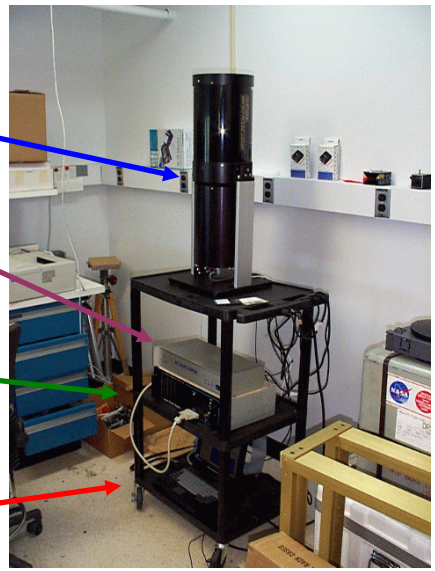
- **Original MPL Design (Type 1-3)**

Transceiver:
20cm Cassegrain Telescope on top
Laser Head, Detector, Optics below

Scalar Unit:
Data at 30, 75, 150, 300 m vert. res.

Laser Power Supply:
1 W Nd:YLF Laser Diode
(Doubled to 523nm on Head)

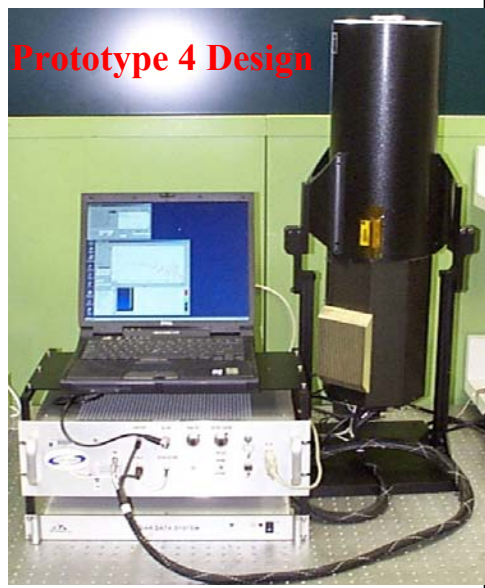
Laptop Computer:
Data Acquisition, Storage (1 min res)



- **New MPL Design (Type4)**

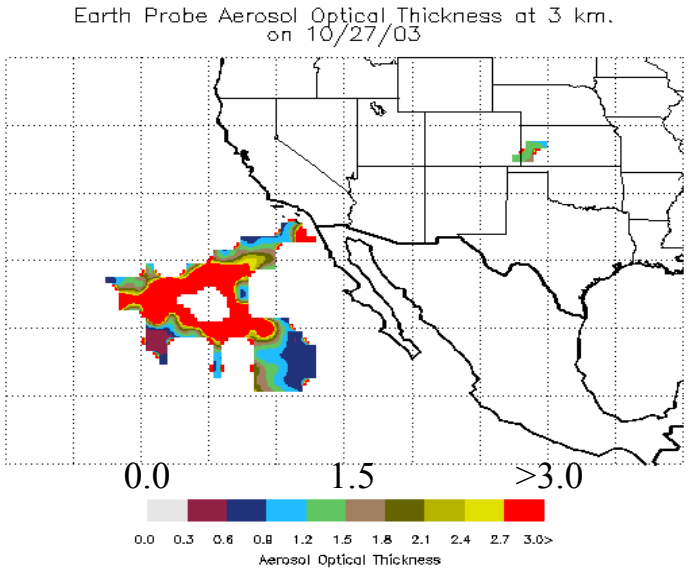
Basic System Specifications:
Same optical design, and wavelength with similar output energy. Temporal/Spatial resolutions the same. Still eye-safe & autonomous

Improvements:
- More rugged design
- Improved laser supply creates longer lifetime and control of laser via computer
- Multi-channel data system
- Fiber coupled detectors

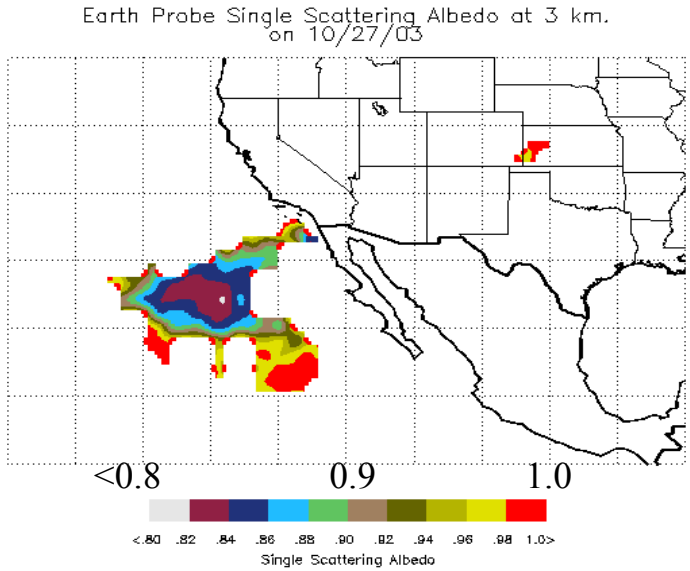


* **First three commercially produced Type 4 MPL systems are now under contract with Sigma Space Corporation.**

Aerosol Properties from TOMS observations

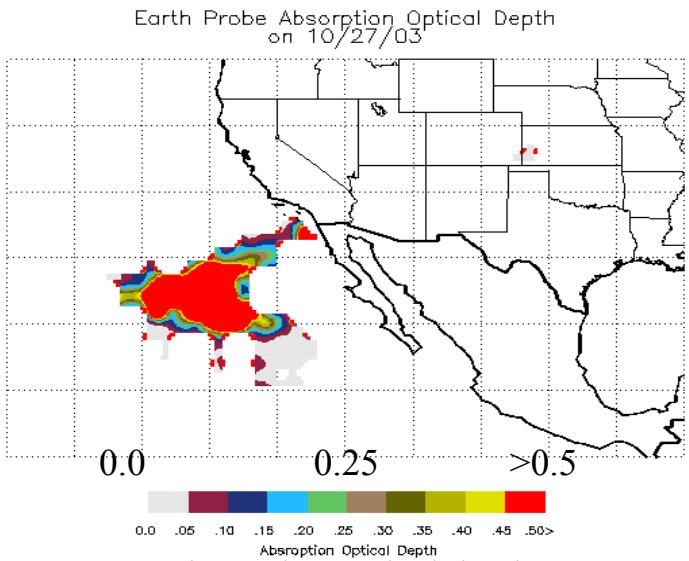


Extinction optical depth



Single scattering albedo

California Fires



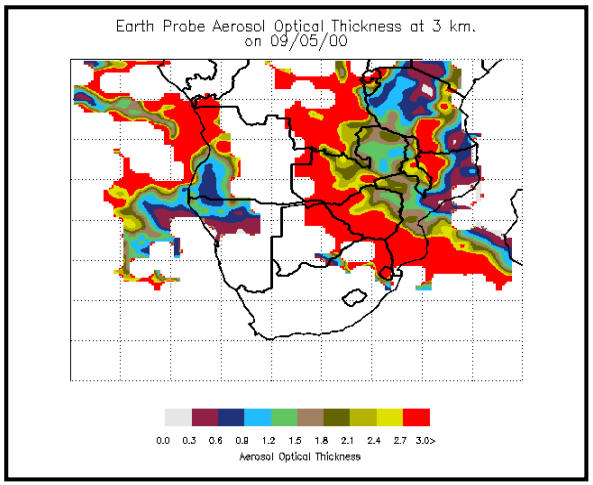
Absorption optical depth

October 27-2003

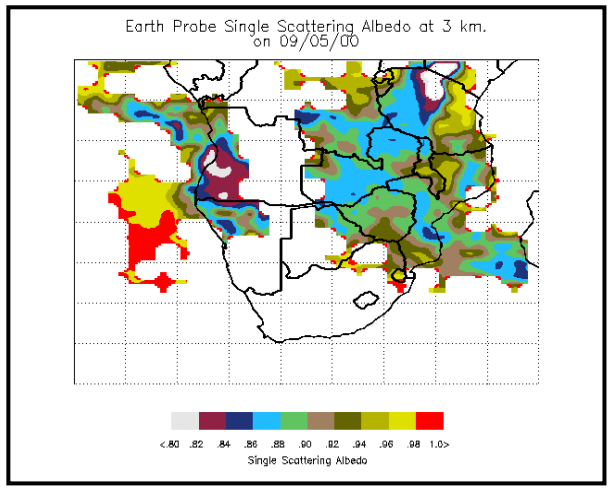
TOMS – Aeronet comparison during SAFARI2000

Sept.5 2000

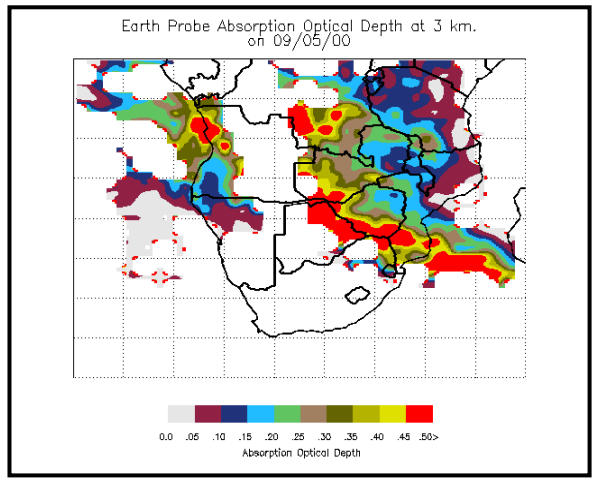
Optical depth (380 nm)

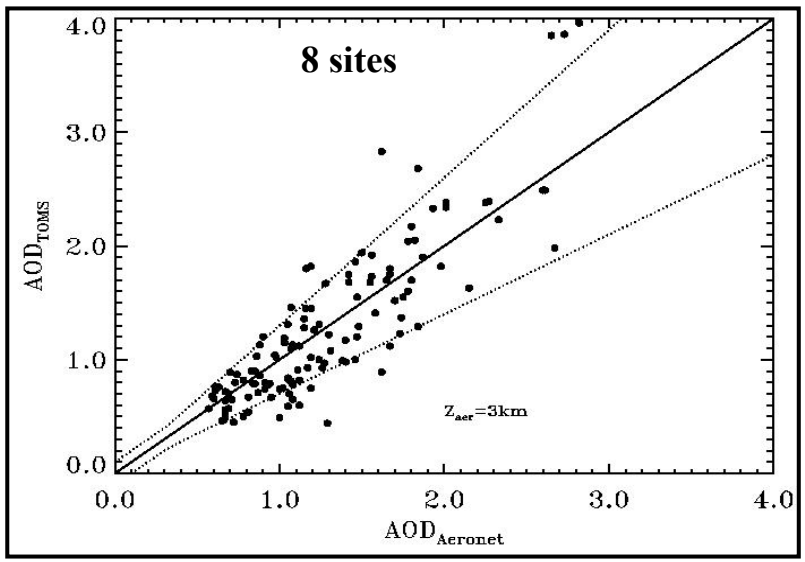


Single scattering albedo

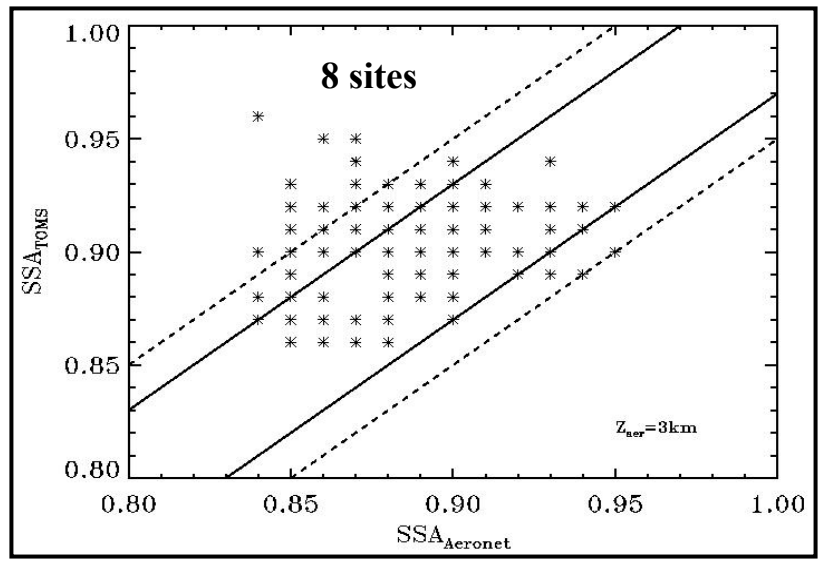


Absorption optical depth

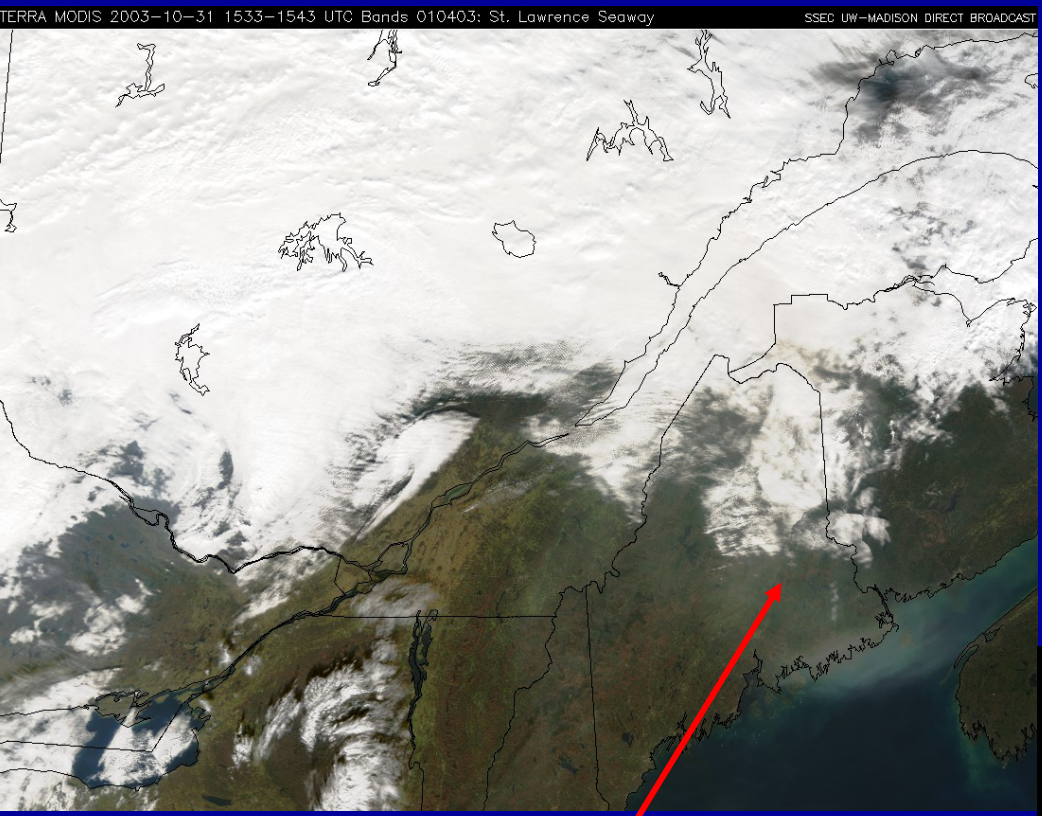




82% of points are within expected accuracy limits (0.1 or 30%)

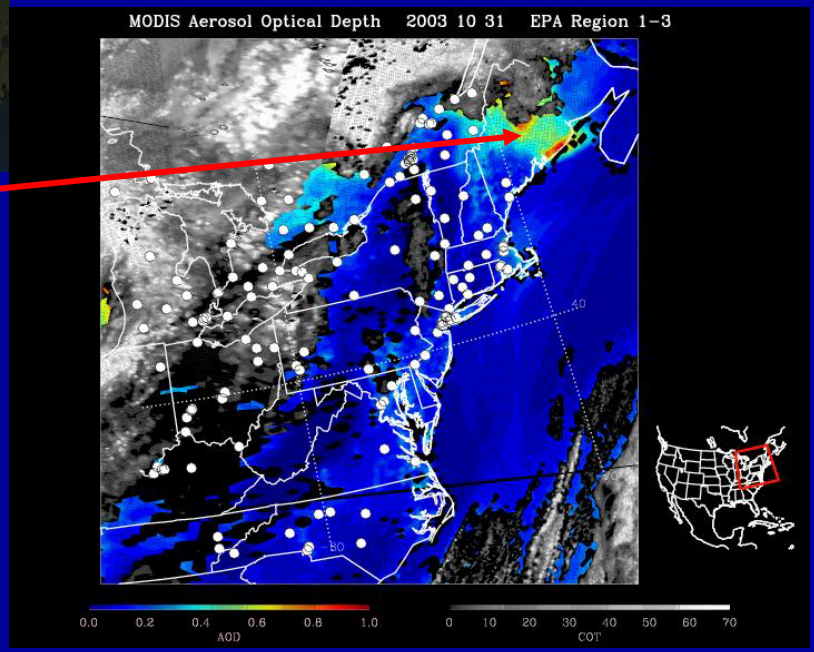


63% within +/- 0.03
87% within +/- 0.05

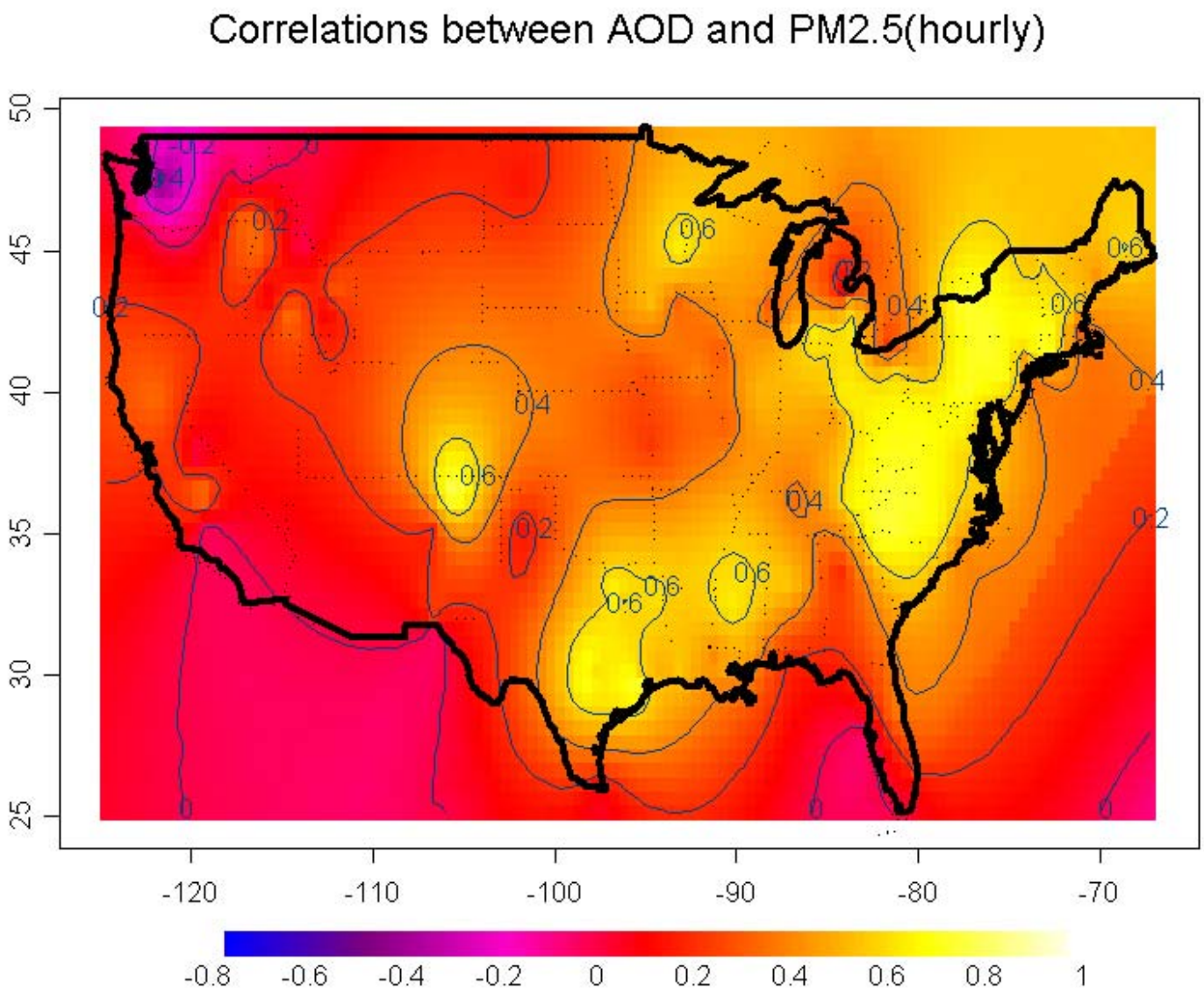


October 31, 2003
Bay of Fundy region
TERRA MODIS RGB

TERRA MODIS Optical Depth



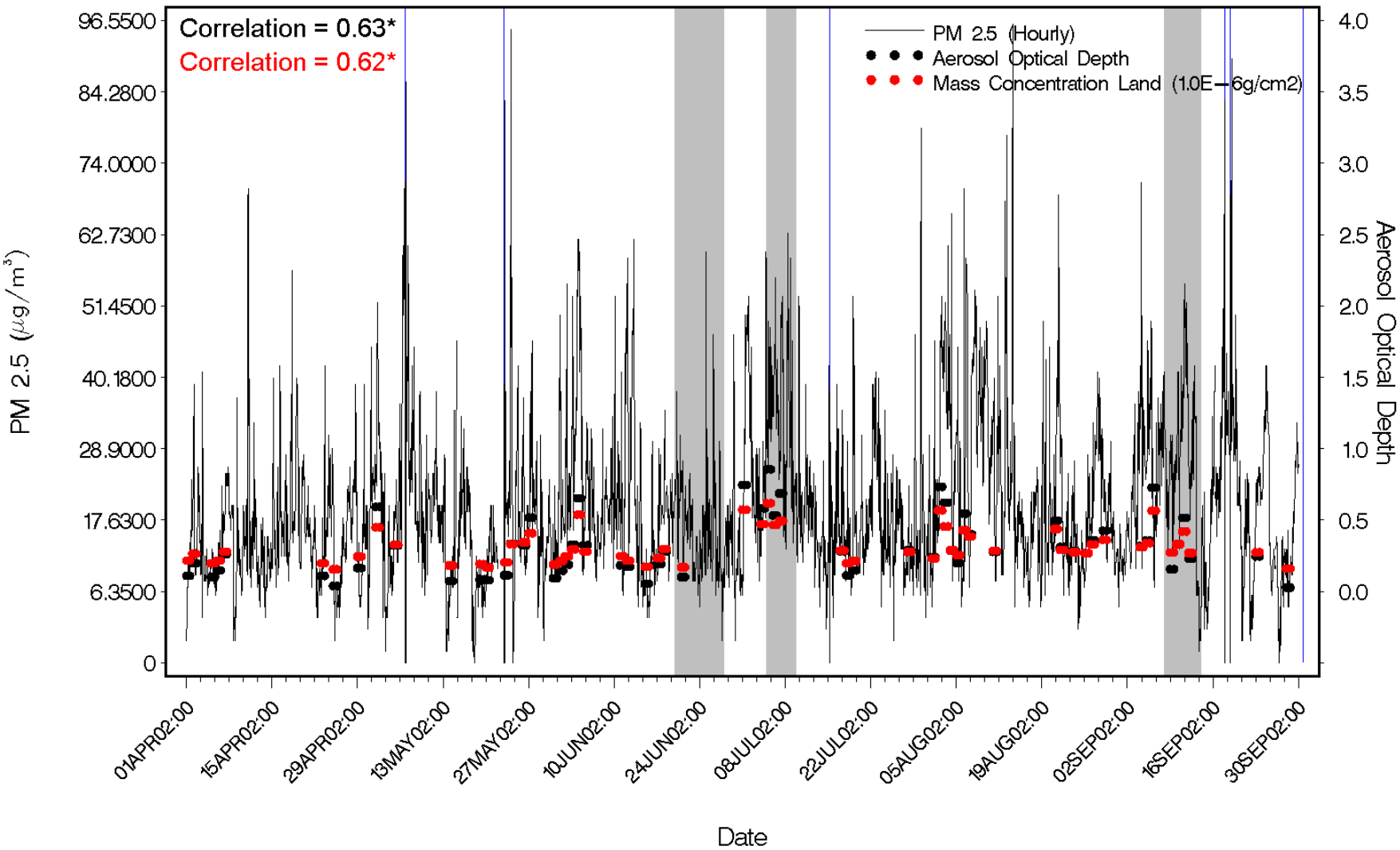
Aerosol over clouds
OD 0.6-0.8



Engel-Cox et al., 2004

BIRMINGHAM

Site 010732003



*Correlation estimates based on data for this site only.