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# Retrieval and Validation of Aerosol Optical Thickness and Total Precipitable Water Vapor

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## Validation -- the algorithms and the products

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- Ocean aerosol (TARFOX)
- Land aerosol (SCAR-B)
- Precipitable water vapor (SCAR-B)
- Rapid response (Mexico)
- Arm chair validation
- SMiR for water vapor

# TARFOX: Tropospheric Aerosol Radiative Forcing Observational Experiment



Imager, AVHRR, ATSR-2, TM  
on  
GOES-8, NOAA-14, ERS-2, Landsat



**NASA ER-2**  
- MAS, LASE, Cameras



**UK MRF C-130**  
- Flux & scanning radioms.  
- Aerosol size, scat, abs, filters, volatility  
- Met data



**UW C-131A**  
- Sunphotometer  
- Aerosol chem, size, scat, abs, hemi backscat, hygro growth, asphericity  
- Precursors, Tracers, Lidar  
- Flux & scanning radioms  
- Met data



**CIRPAS Pelican**  
- Sunphot. Flux radioms.  
- Spectroradiom.  
- Aerosol phys, chem.

**AEROCE**  
Radioms.  
Aerosol  
chem, phys.

Radioms.  
Lidar

Wallops Island

Bermuda

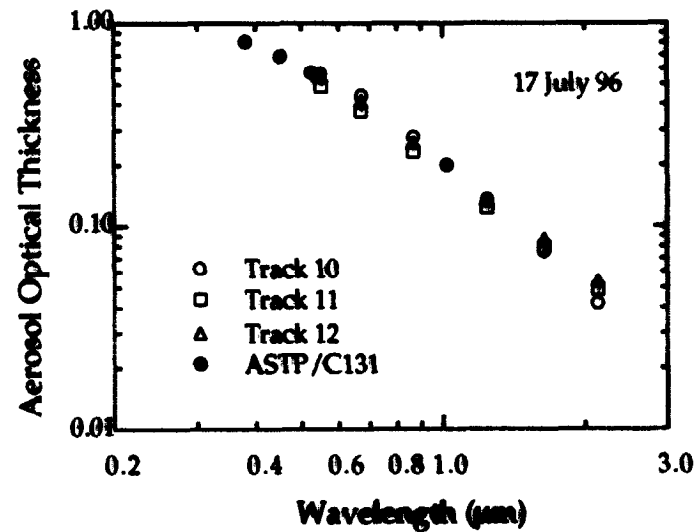
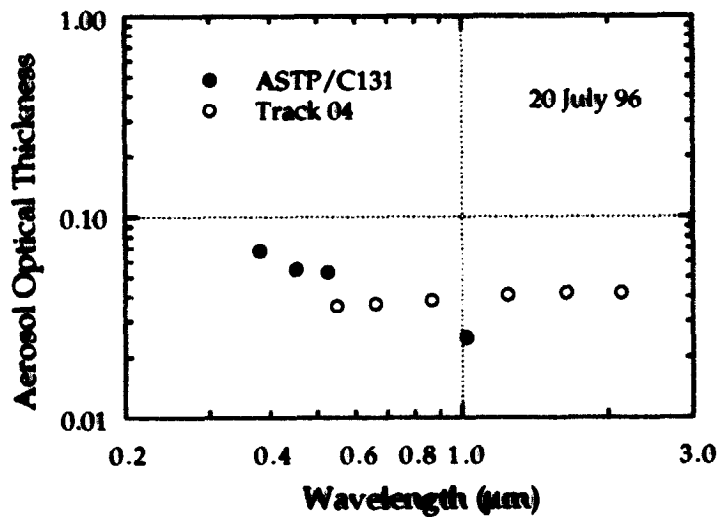


Ames Research Center

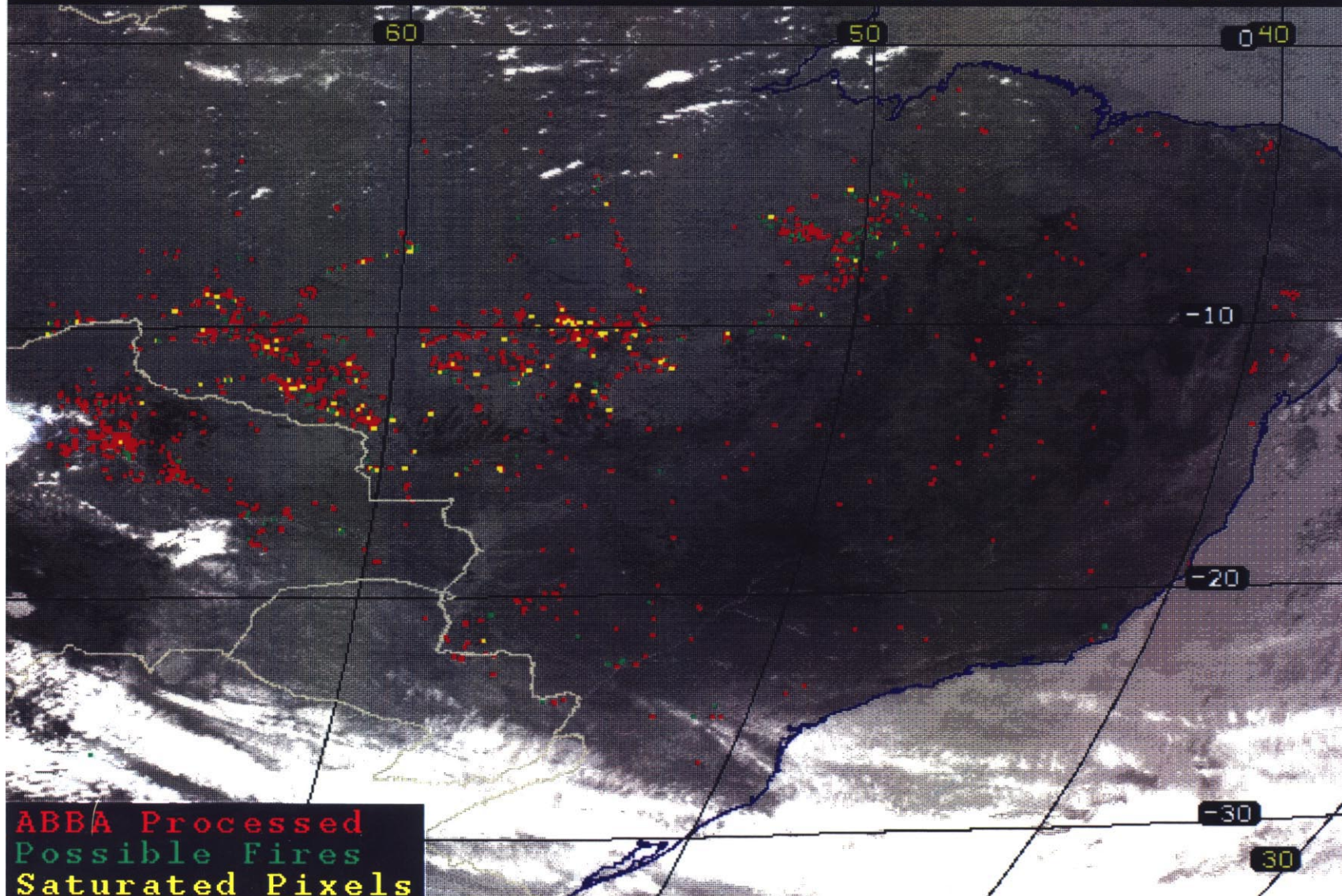
# AOT over ocean validation (TARFOX)

## Tanré et al. 1999

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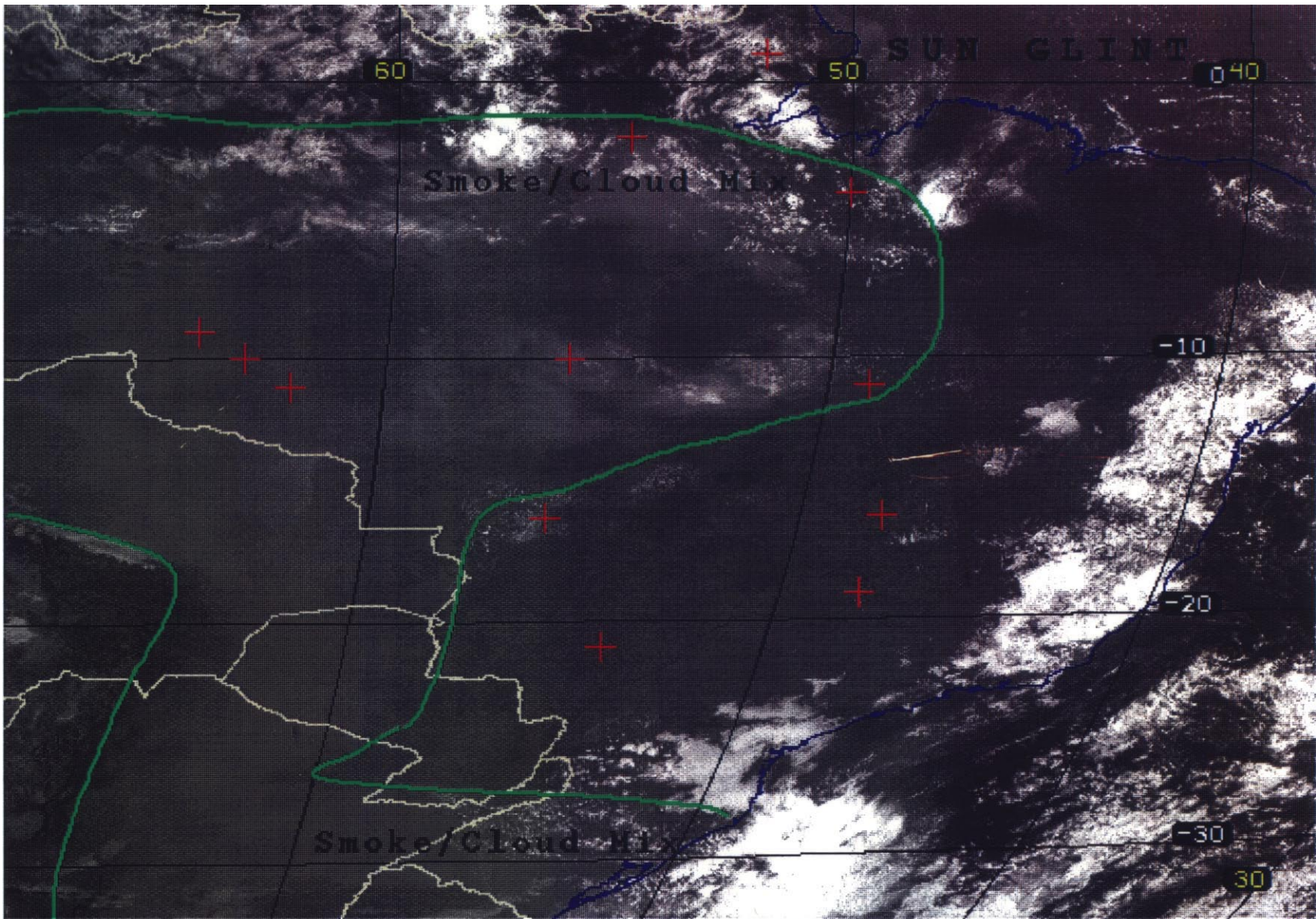
PRELIMINARY GOES-8 ABBA FIRE PRODUCT



ABBA Processed  
Possible Fires  
Saturated Pixels

UW-MADISON/SSEC/CIMSS

GOES-8 ABBA PRELIMINARY FIRE PRODUCT (4 UM IMAGE): 15 AUG 95 17:45 UTC

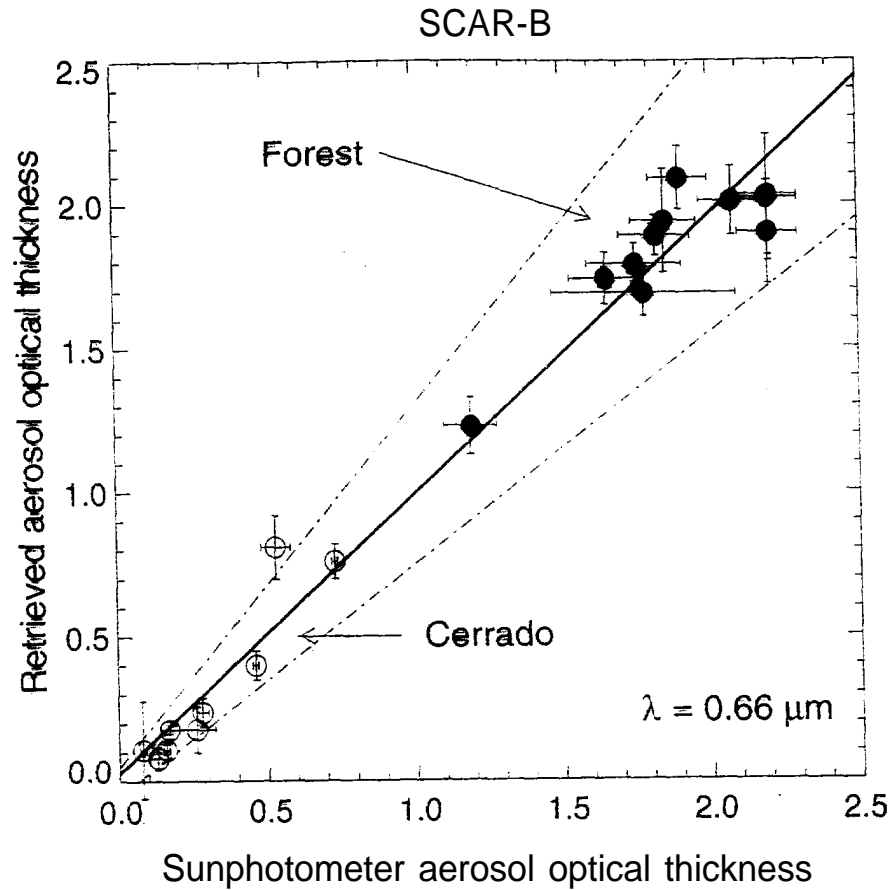


UW-MADISON/SSEC/CIMSS SMOKE: GREEN OUTLINE SUN PHOTO SITES: RED +  
GOES-8 SMOKE OBSERVATIONS (VIS IMAGERY): 22 AUG 95 11:45 UTC

# The Algorithm--Land

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- dark targets based on mid-IR
- estimate surface reflectance in visible
- choose dynamic aerosol model
- derive optical thickness at 0.47 and 0.66  $\mu\text{m}$



**Figure 1.** Comparison of the retrieved aerosol optical thickness from MODIS airborne simulator (MAS) measurements and ground-based Sun photometer observations at  $0.66 \mu\text{m}$  wavelength in SCAR-B. A total of 20 ER-2 flights over Sun photometer sites with closely temporal match are used. The solid line is the linear regression (slope of 0.97, intercept of 0.03 and correlation coefficient of 0.98). The dotted-dashed lines are the retrieval error ( $\Delta\tau = \pm 0.05 \pm 0.2\tau$ ) anticipated using MODIS aerosol retrieval algorithm [Kaufman et al., 1997a]. Two groups of optical thickness are indicated as measured from forest (solid circle) and cerrado (open circle) Sun photometer sites. The vertical and horizontal error bars represent, respectively, the standard deviation of spatial average of the MAS retrievals (typically within  $10 \times 10 - 20 \times 20 \text{ km}^2$  surrounding Sun photometer) and temporal average of the Sun photometer observations ( $\pm 30 \text{ min}$  of the ER-2 overpass time).

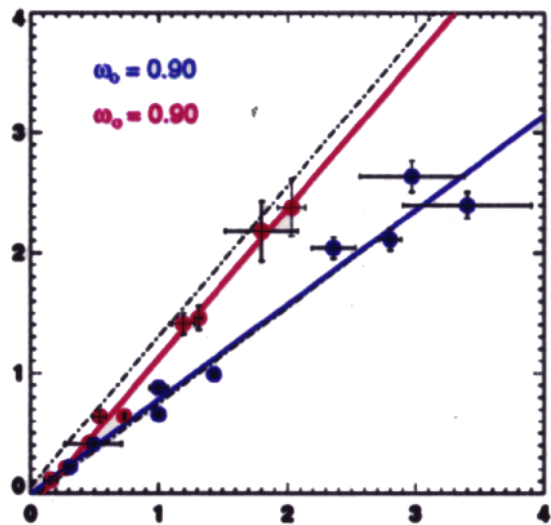
reference:

Chu D. A., Y. J. Kaufman, L. A. Remer, and B. N. Holben, Remote sensing of smoke from MODIS airborne simulator during the SCAR-B experiment, *J. Geophys. Res.*, in press. 1998.



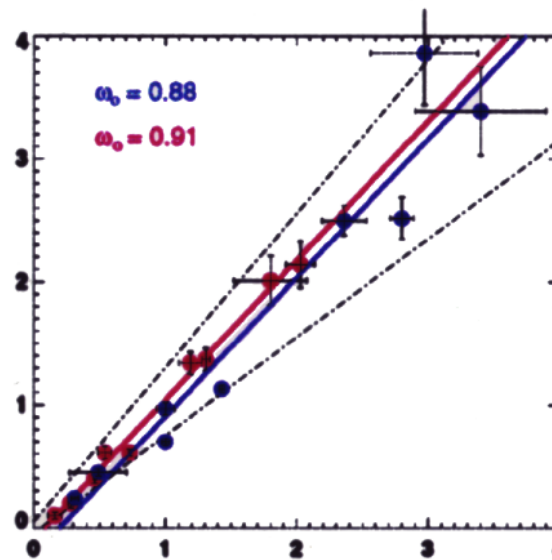
# Sensitivity of aerosol retrieval to single scatter albedo

Retrieved aerosol optical thickness from AVIRIS



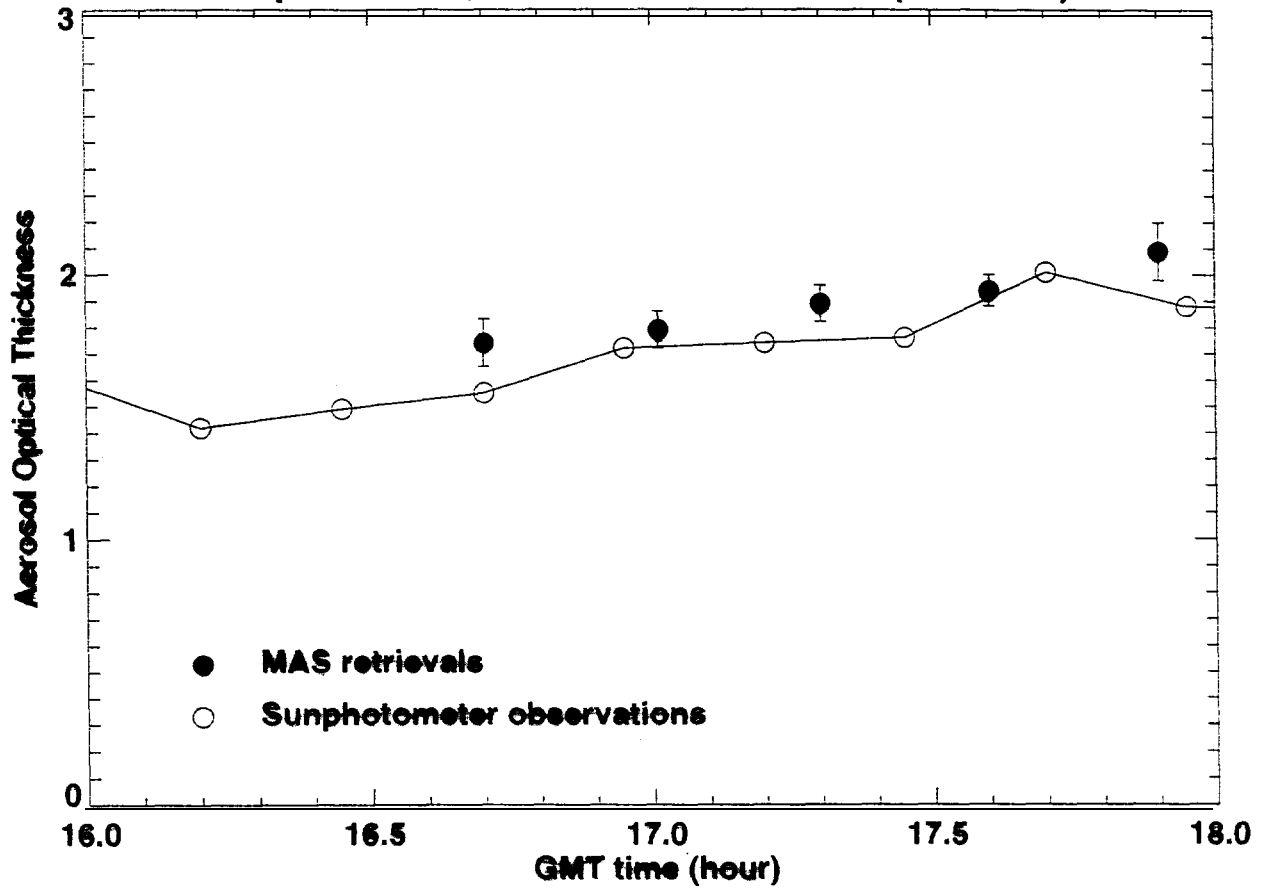
Sun photometer aerosol optical thickness

Retrieved aerosol optical thickness from AVIRIS

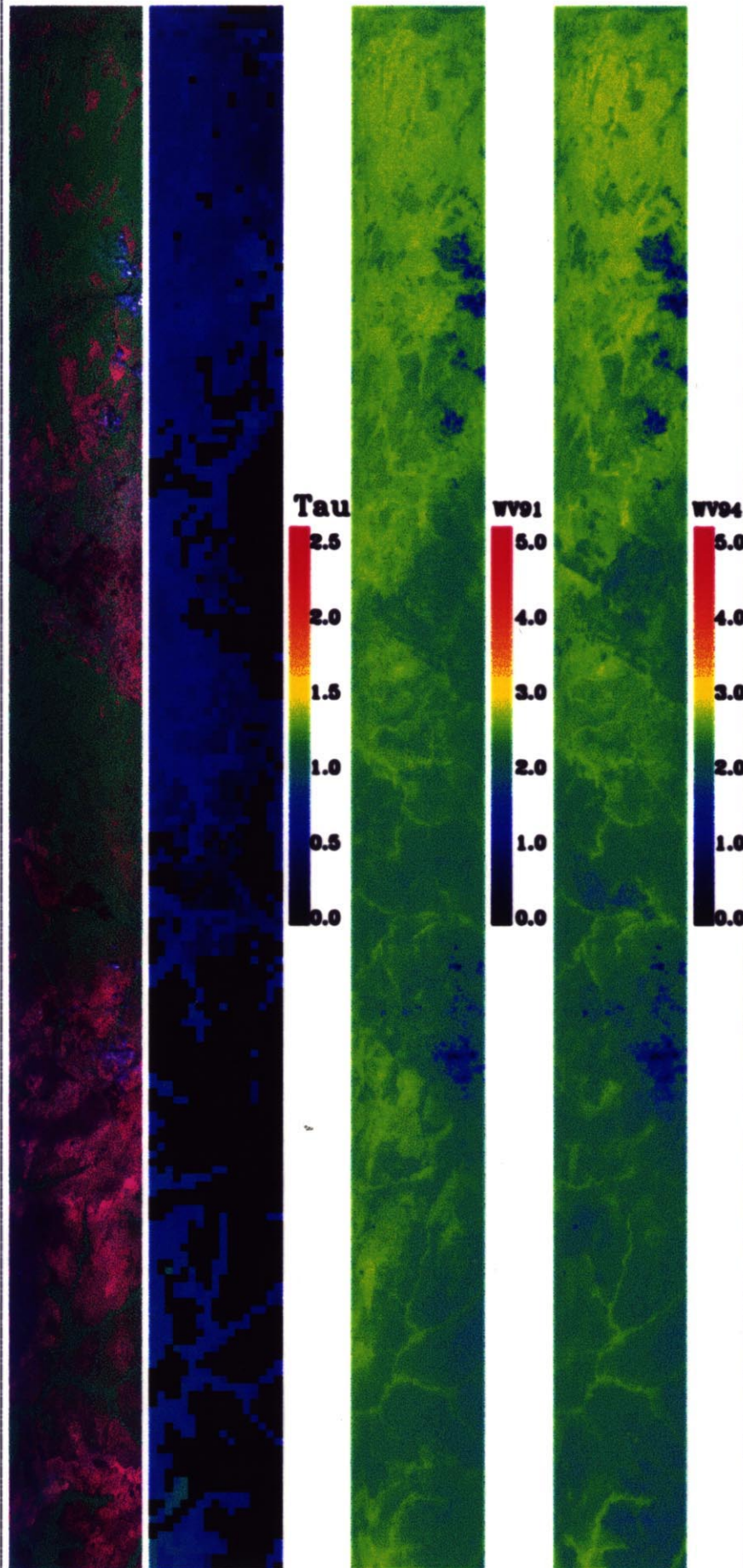


Sun photometer aerosol optical thickness

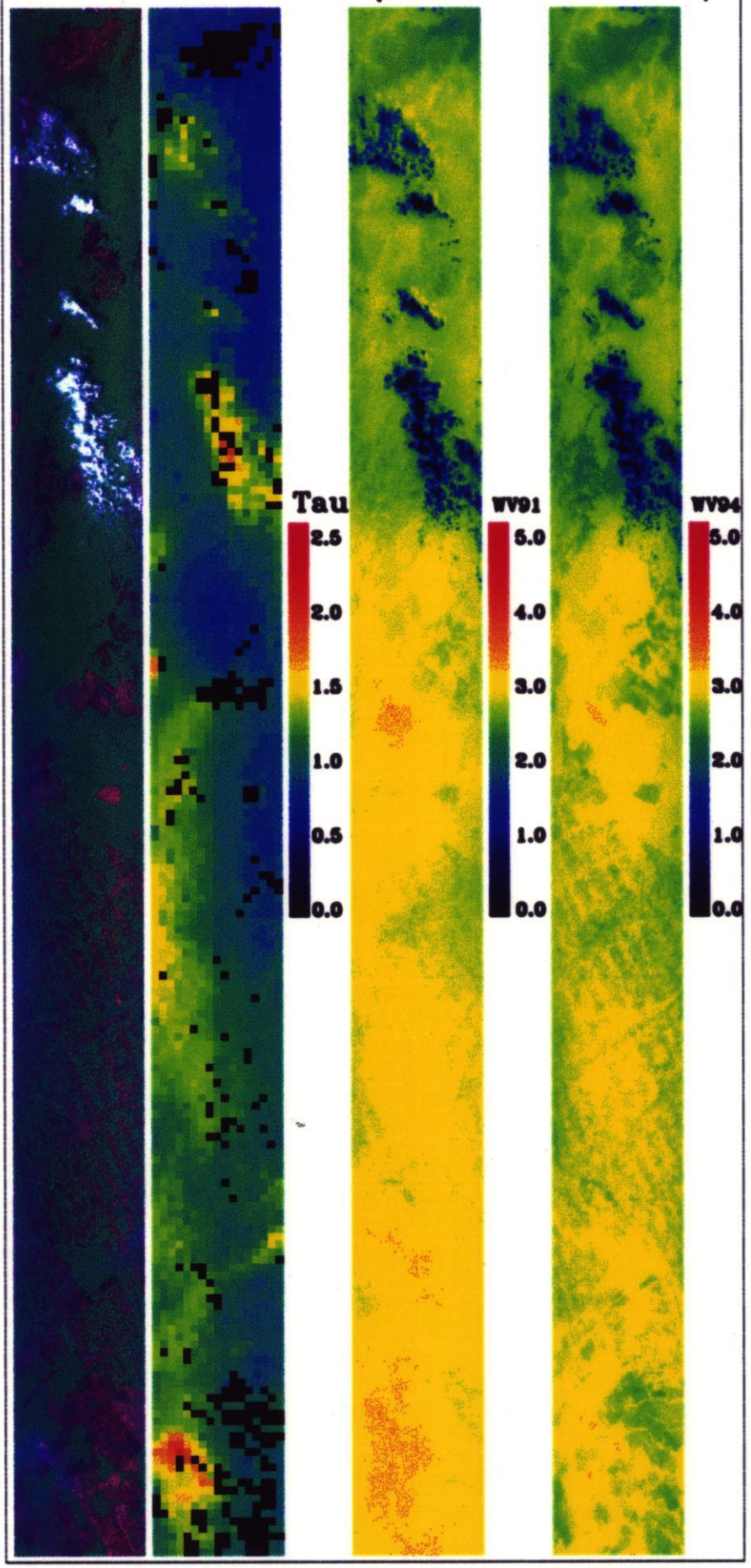
**September 4, 1995 at Jamari Town (SCAR-B)**



**SCAR-B MAS 1995 (MAS950904-f02)**



SCAR-B MAS1995 (MAS950904-f03)



# Total Precipitable Water Vapor

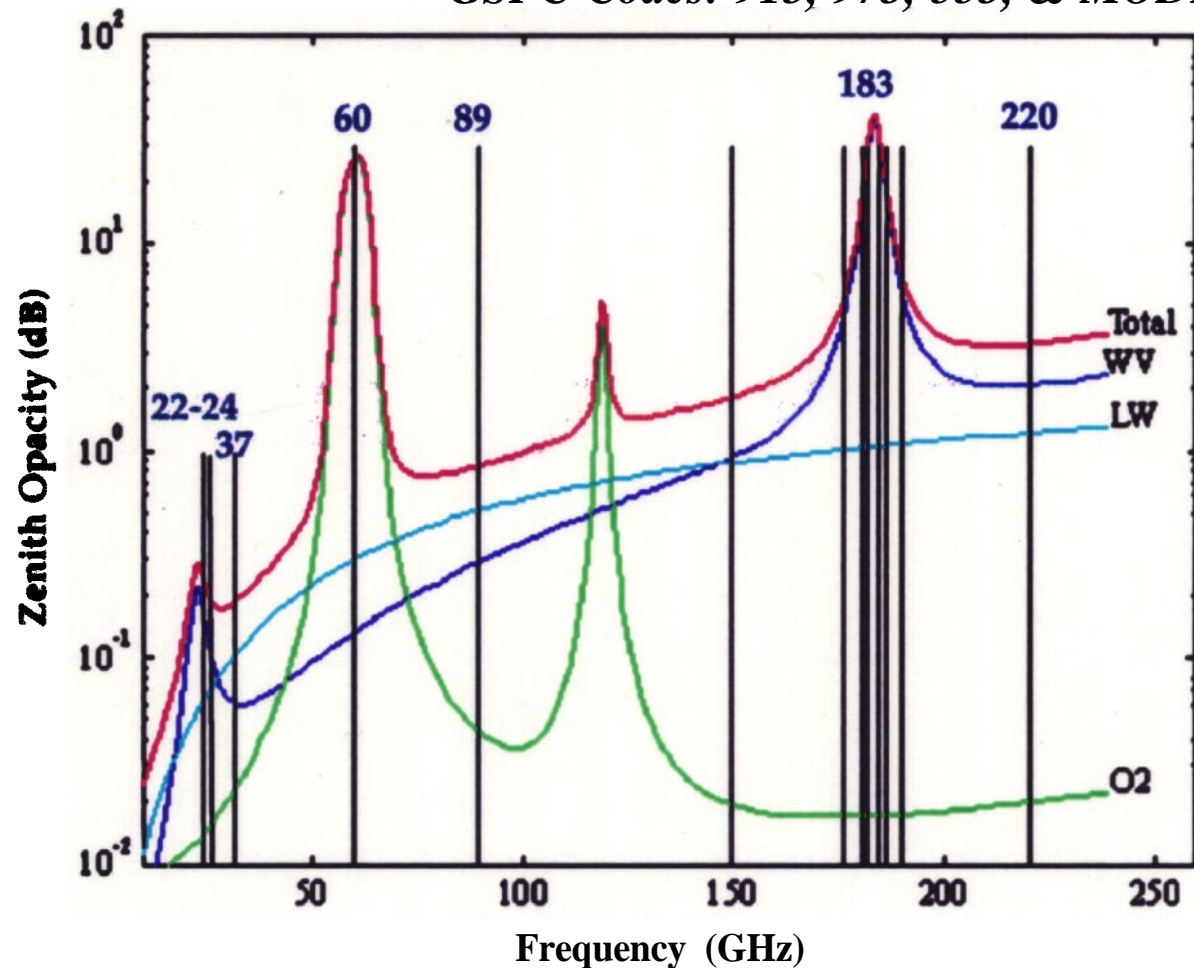
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- **AERONET (NIR)**
- **Radiosondes - Tenerife, Iceland (in situ)**
- **Microwave Radiometer (SMiR, Cart Site)**
- **GOES-8 (IR)**

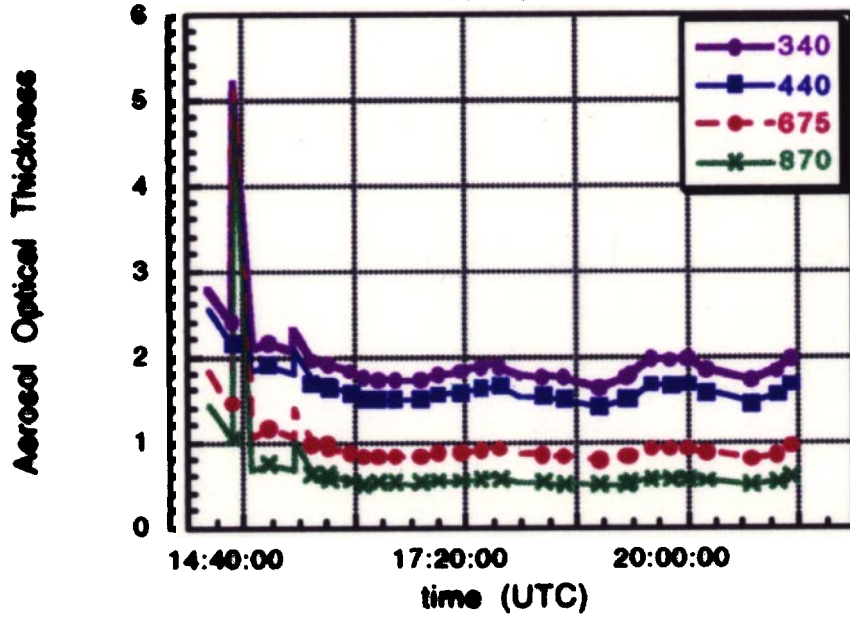
# *SMiR: Scanning Microwave Radiometer*

*GSFC Codes: 913, 973, 553, & MODIS*

- zenith scanning
- 22.8, 23.8, 37.0 GHz channels
- 60 GHz (O<sub>2</sub>): planned
- resolution: > BT(0.25 K)
- accuracy: > BT(0.5 K)
- cryogenic cal.: (Temp. ~10-77 K to ambient)
- column water vapor:  $\Delta > 1\% - 5\% f(q_{wv})$

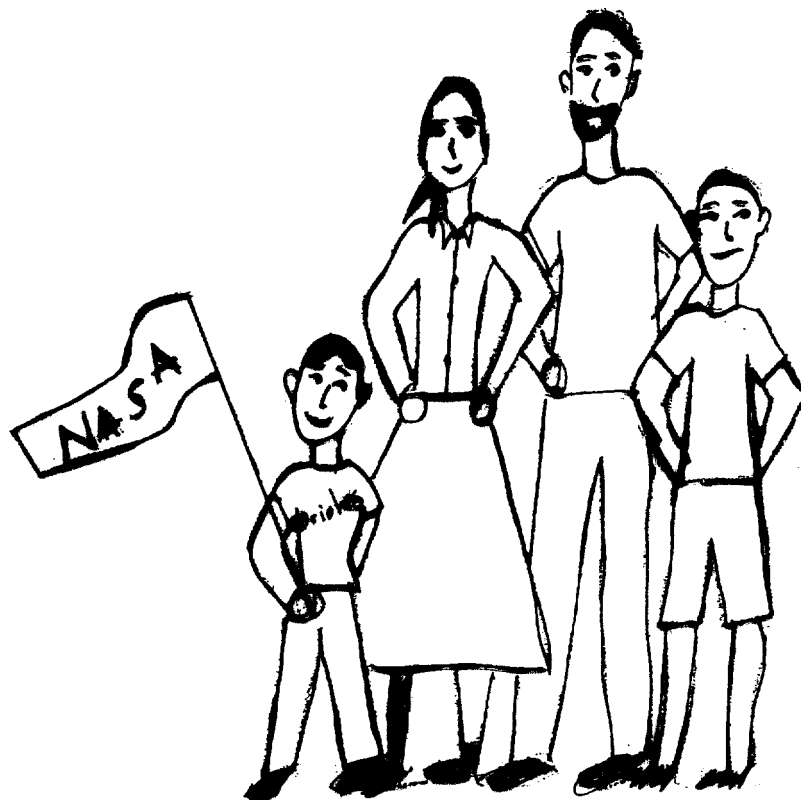


**May 15, 1998  
Louisiana**



An example of spectral optical thickness time series. These data were measured in Louisiana on May 15. Note the effects of clouds on the data at 14:40 UTC. The rest of the day shows gentle modulation of the optical thickness as inhomogeneities in the smoke concentration pass overhead.

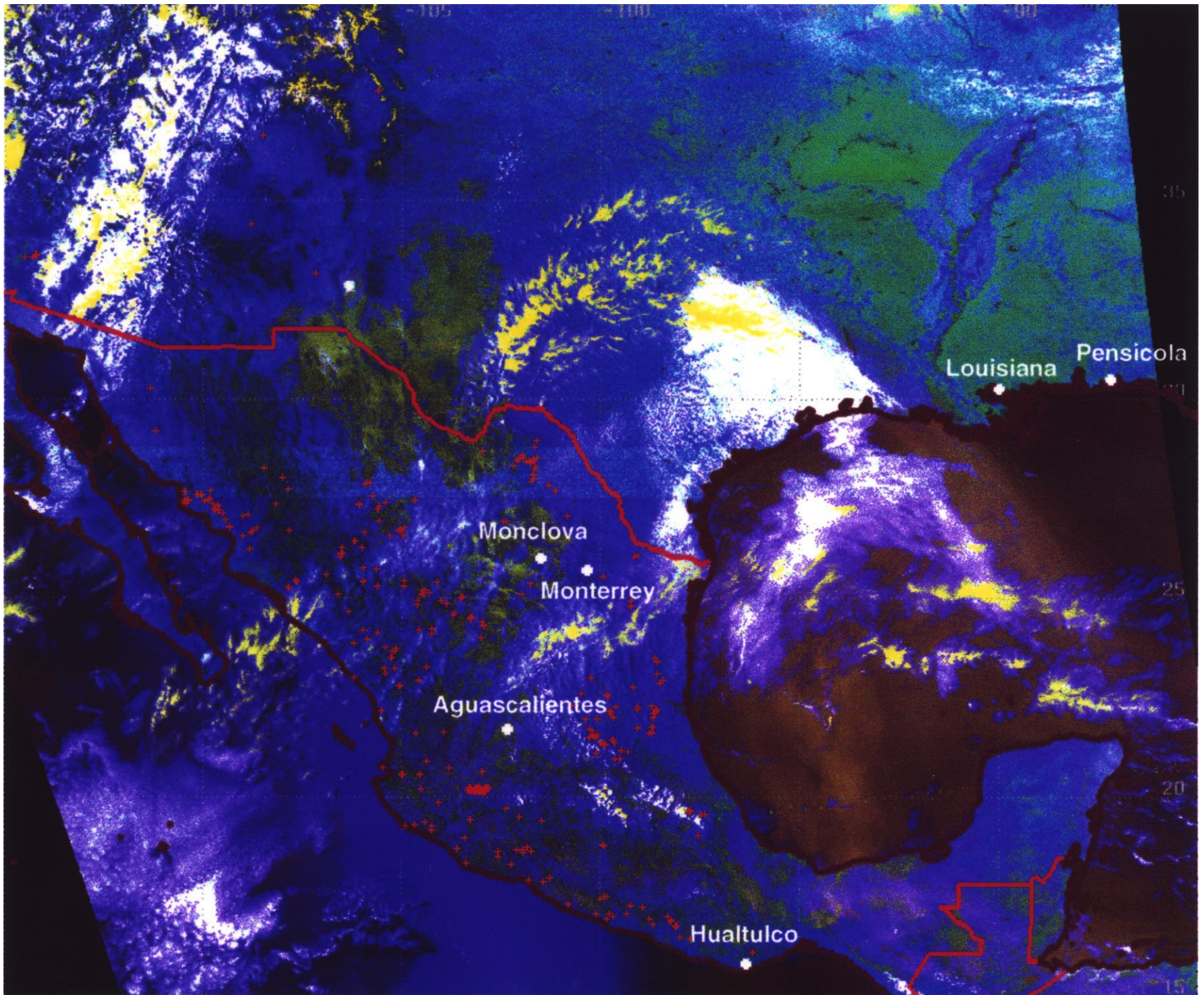
# NASA's Rapid Response

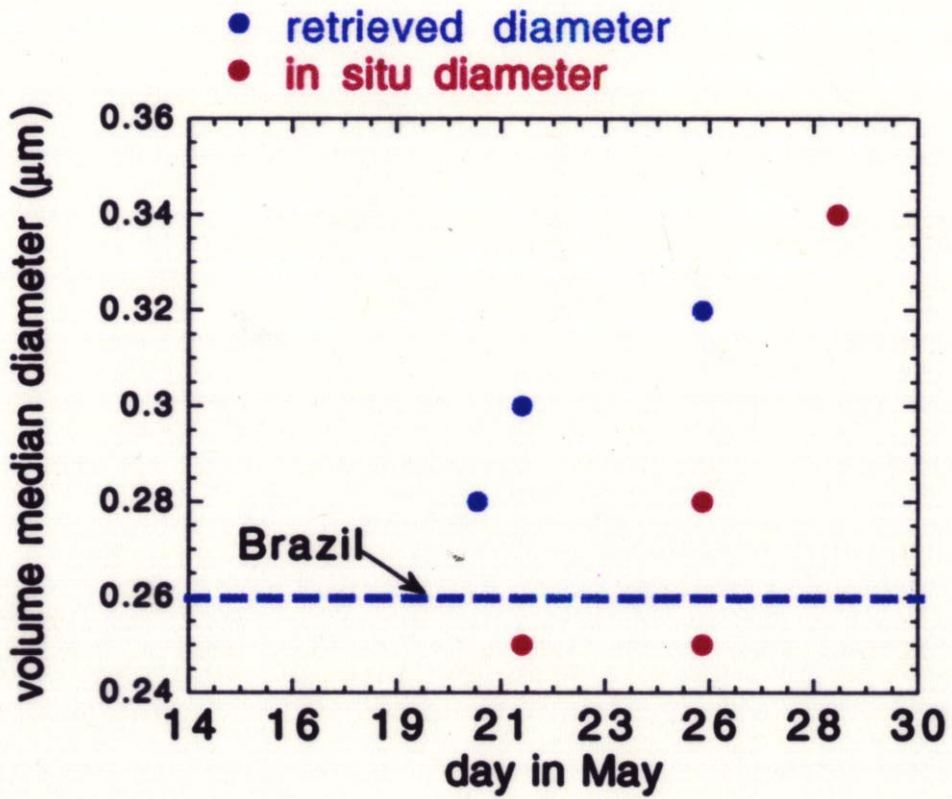
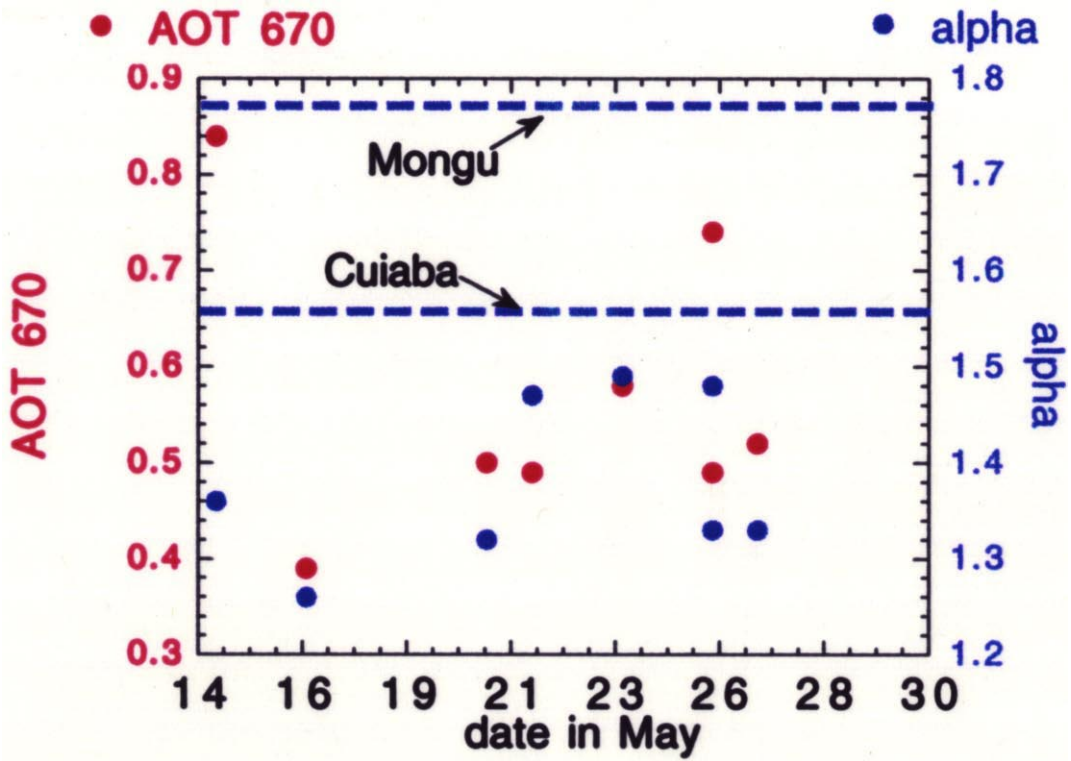


to the Mexican Smoke  
May 1998









# Conclusions

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- Validation of *algorithms* suggest success
- Plans for validation of *products*
- AERONET for both aerosols and water vapor
- Rapid response (like Mexico) to supplement AERONET aerosol
- Planned experiments (Safari 2000)
- Variety of methods for water vapor validation

