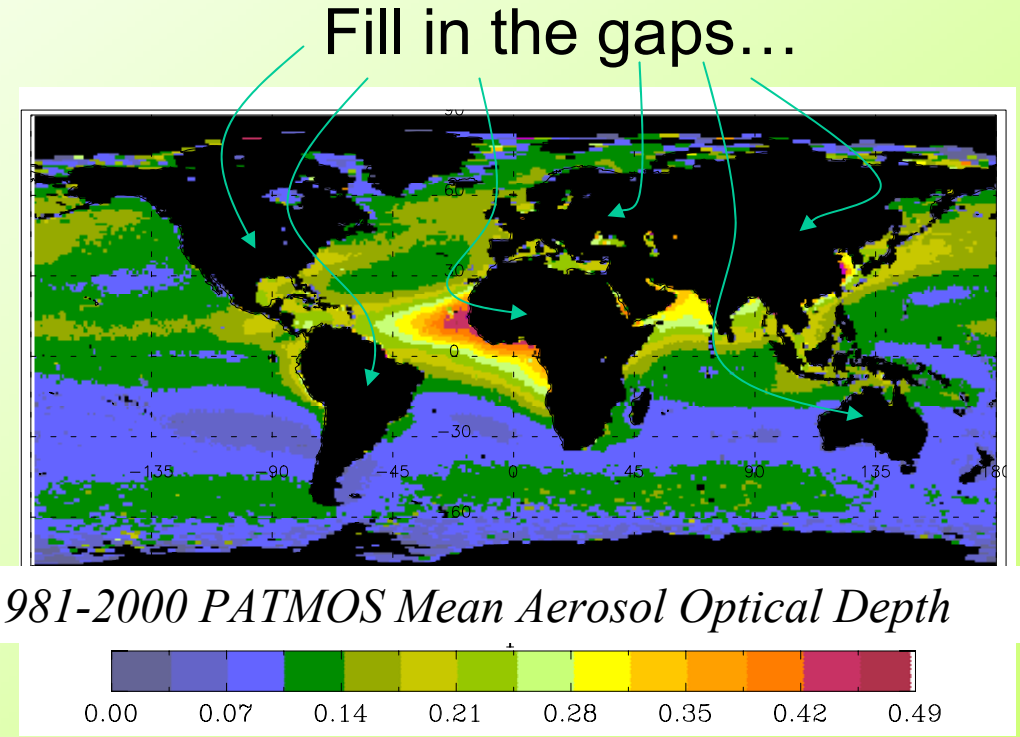
Aerosol Optical Depth over land from AVHRR Pathfinder Atmosphere Data

Kenneth Knapp
CIRA (NESDIS/ORA), Camp Springs, MD
Ken.Knapp@noaa.gov

Purpose

- To provide information on aerosols over land from 1981-2000

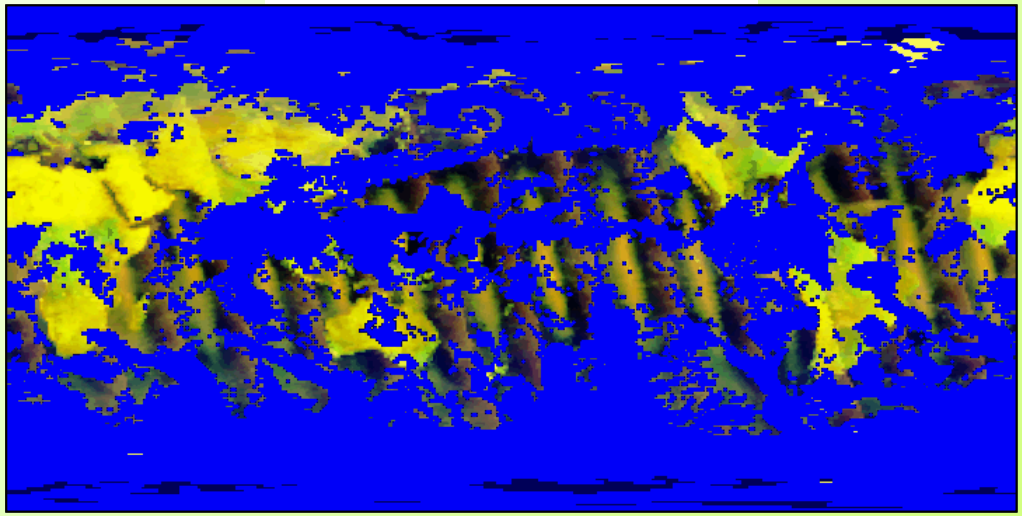


1981-2000 PATMOS Mean Aerosol Optical Depth

PATMOS Data

- 110x110 km equal area grid cells
- Cloud mask at pixel level provides cloudy and cloud-free info for each grid cell

Cloud Free



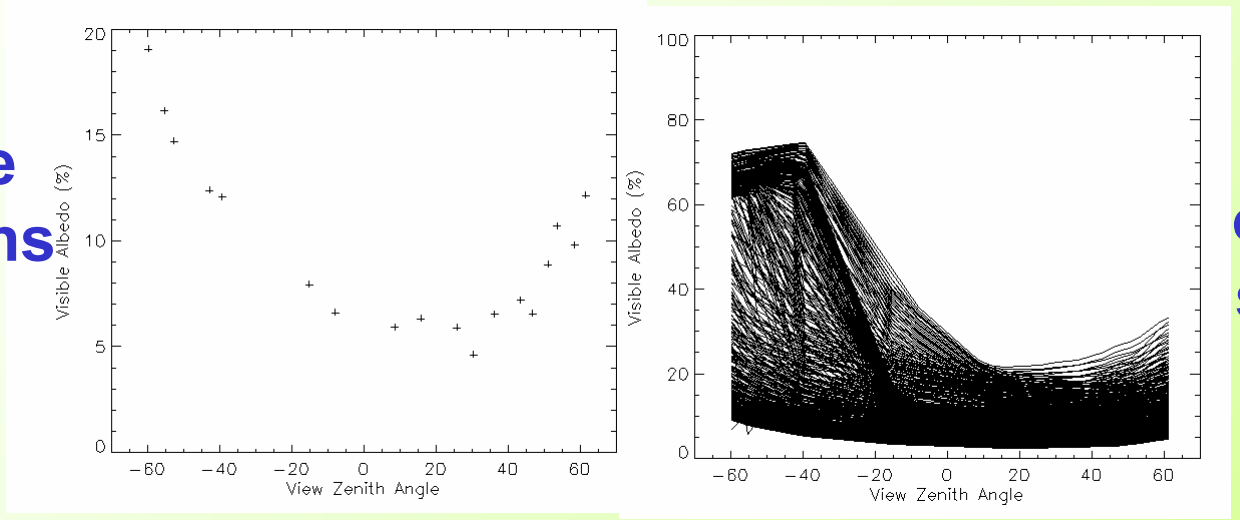
False color: RGB = (Ch. 1, Ch2, -Ch4)

Radiative Transfer Modeling

- RT Model – 6S
- BRDF Model – Rahman BRDF model
- Aerosol model - Continental aerosol
  - Retrieval is designed to work with all PATMOS land grid cells
- Build a Look Up Table with varying
  - Geometric variables
  - Surface BRDF parameters
  - Aerosol Optical Depths

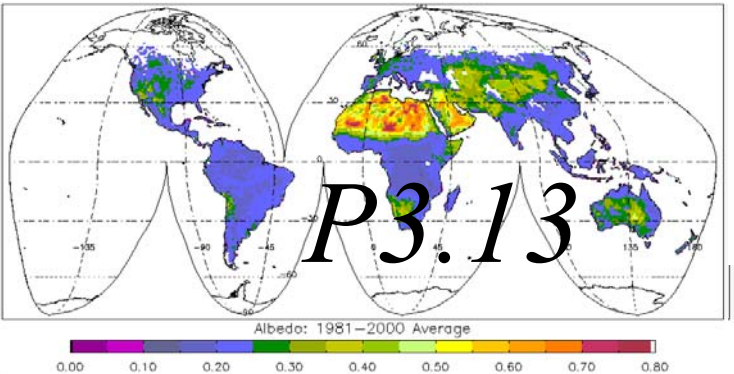
Surface Information Retrieval

Cloud-free observations

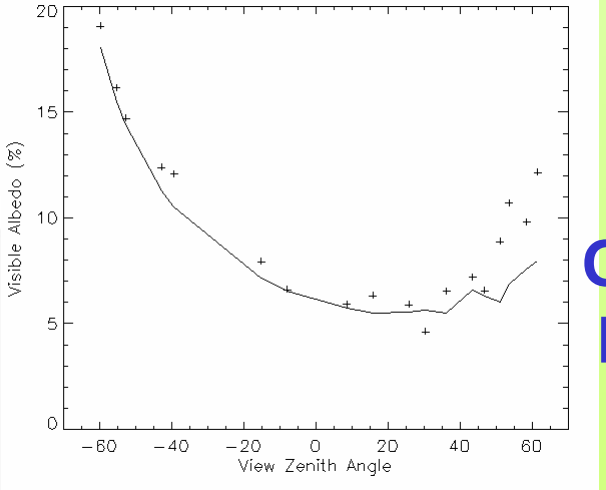


Possible satellite observations simulated by varying the BRDF parameters

Note: BRDF retrieval (for channel 1 and 2) allows calculation of NDVI and broadband albedo.



P3.13

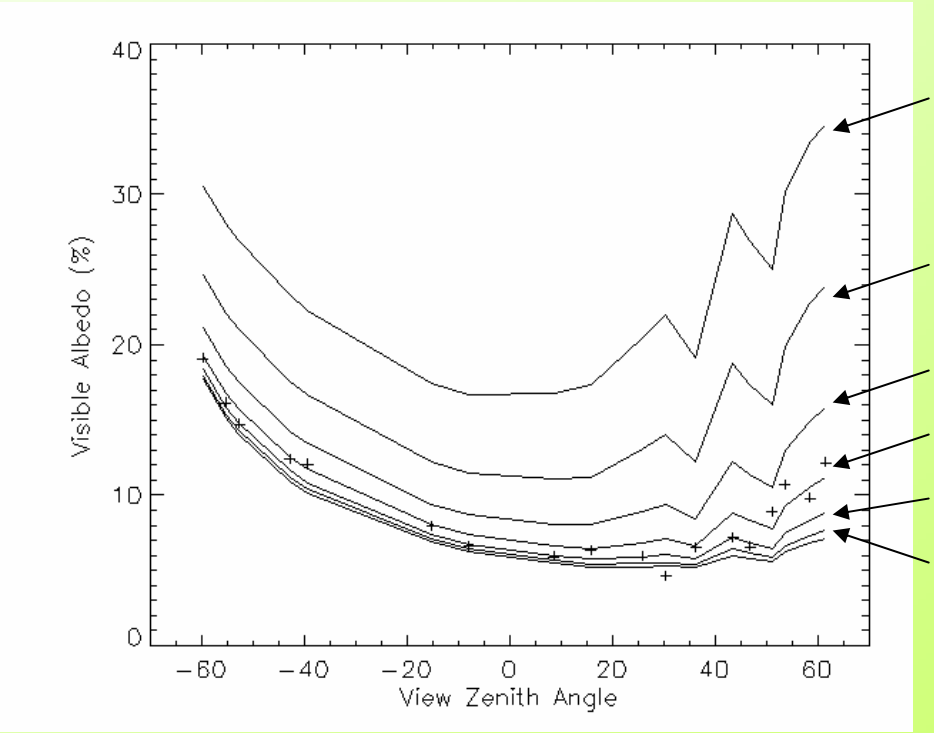


Cloud-free Observations with the best-fit surface BRDF

Ken.Knapp@noaa.gov

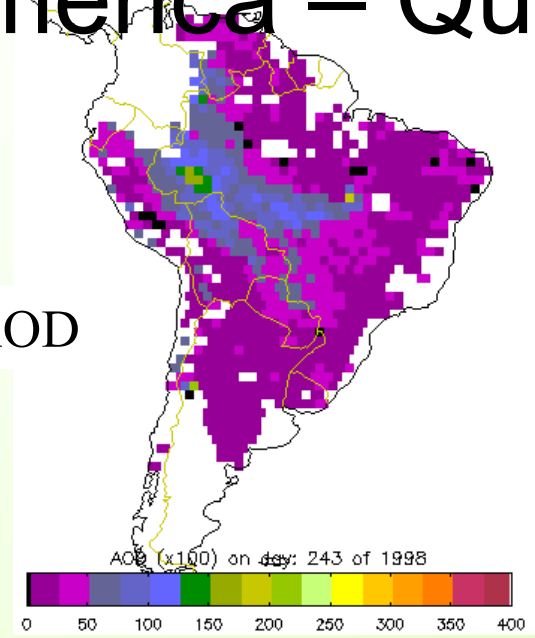
AOD Retrieval

- Use retrieved BRDF parameters to estimate aerosol optical depth
- Performed at:
  - All level 2 AERONET sites worldwide (~90)
  - 1993-1999
  - Available matchups: more than 5000

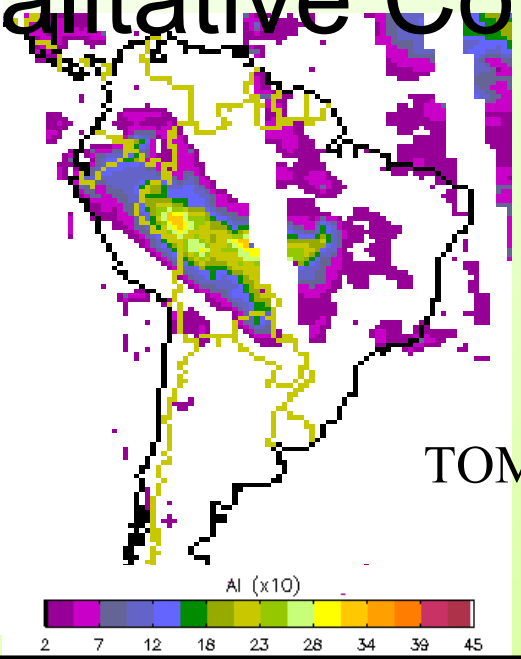


South America – Qualitative Comparison

PATMOS AOD



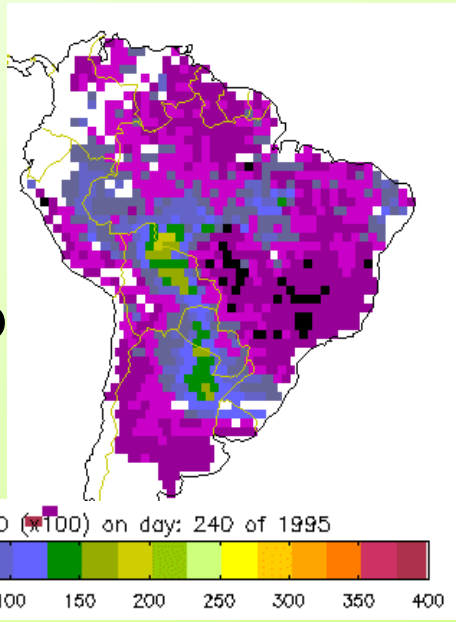
TOMS Aerosol Index



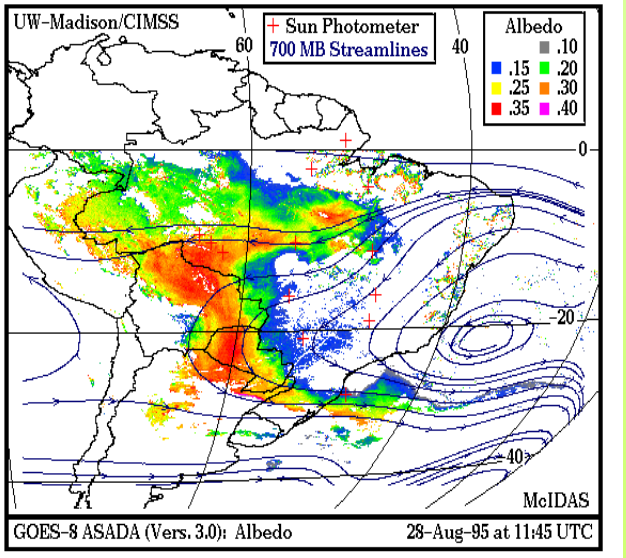
on 31 August 1998

on 28 August 1995

PATMOS AOD

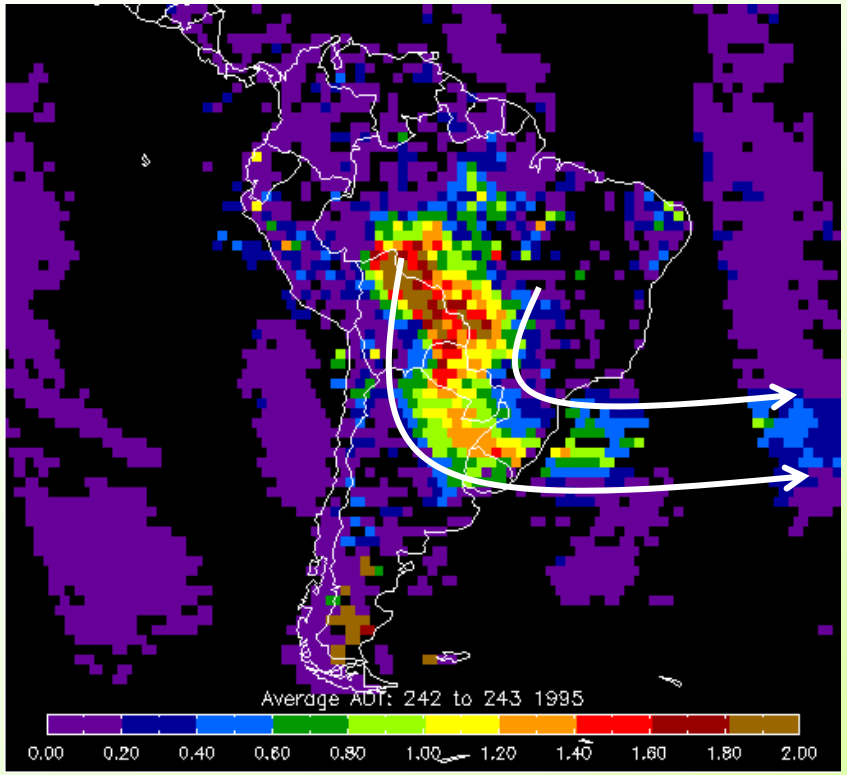


GOES ASADA

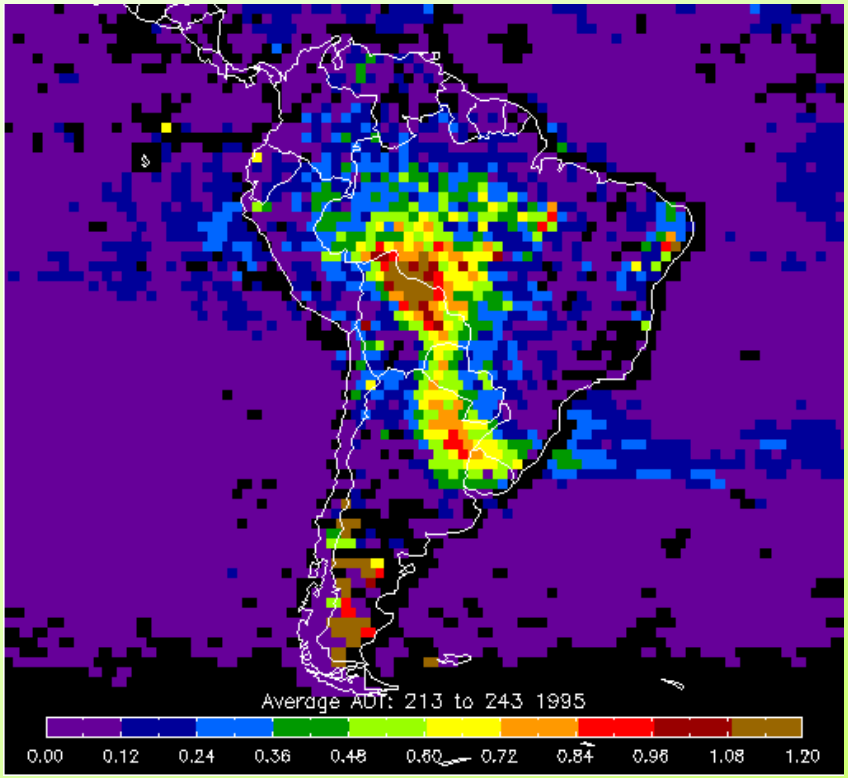


The Land-Ocean Merge

No retrieval in ocean sunglint



Aug. 30-31 1995 Mean AOD



Aug. 1995 Mean AOD

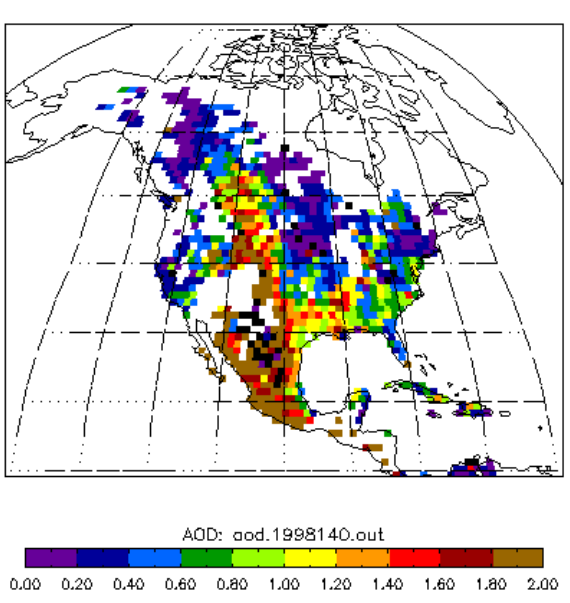
Limitations

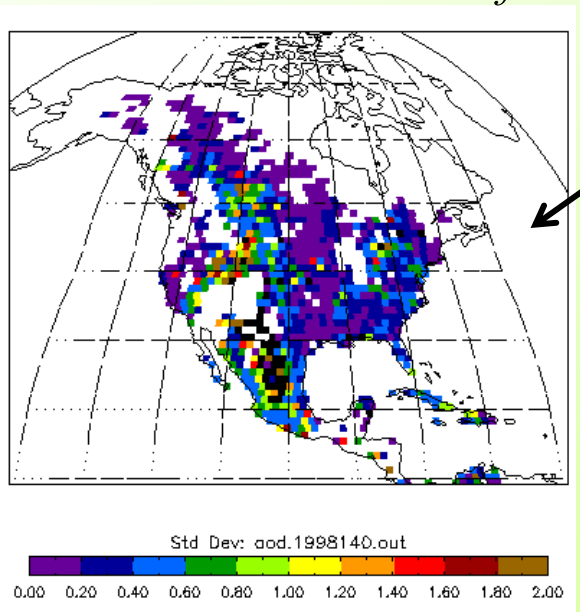
Limitations of this algorithm for global retrieval

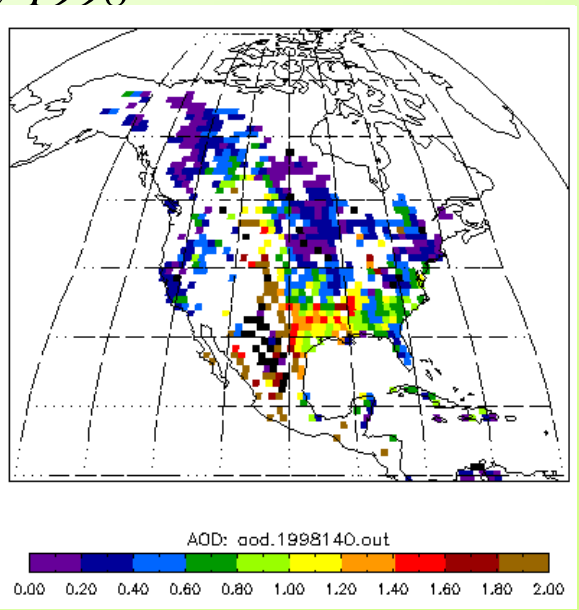
- Bright surfaces or “dark” aerosols
  - Algorithm is incapable of sensing:
    - Aerosols over bright surfaces
    - Absorbing aerosols over many surfaces
    - Need $\partial\rho_{sat}/\partial\tau > 0$
- Heterogeneous surfaces…
  - Different portions of the gridcell are cloud free on different days
- Temporally variable surfaces
  - Because a temporal composite is used to estimate the surface properties
- Stagnant aerosol masses
  - Because temporal composite may not have enough aerosol-free observations
- Other issues
  - Cloud mask, calibration, aerosol optical properties

Example of Bright Surface Problem

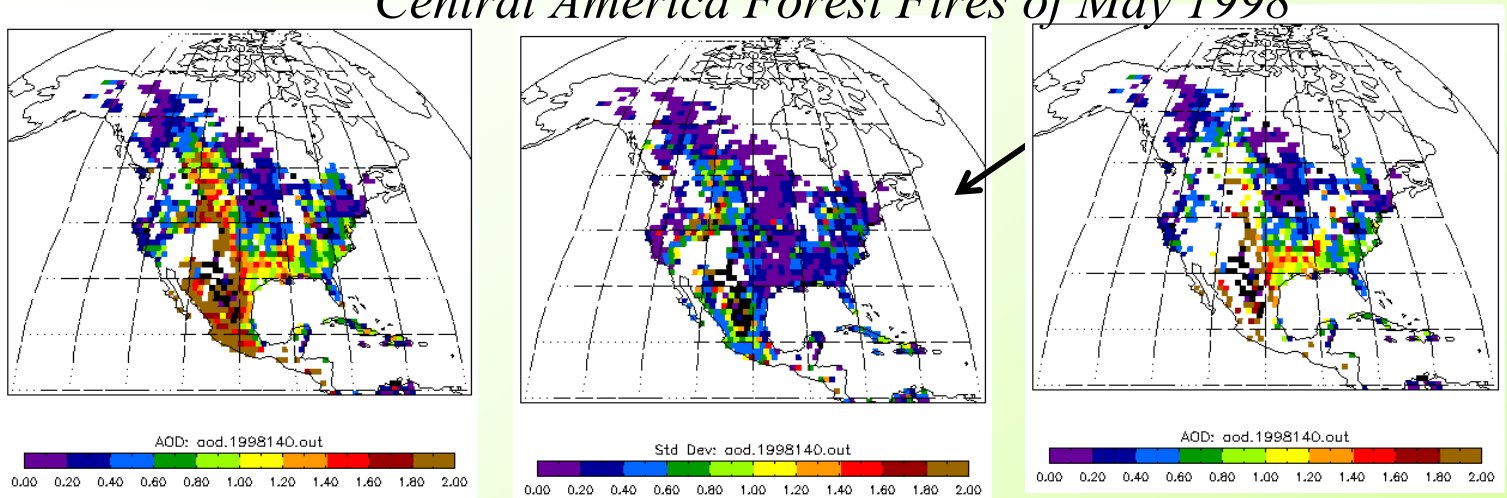
Central America Forest Fires of May 1998





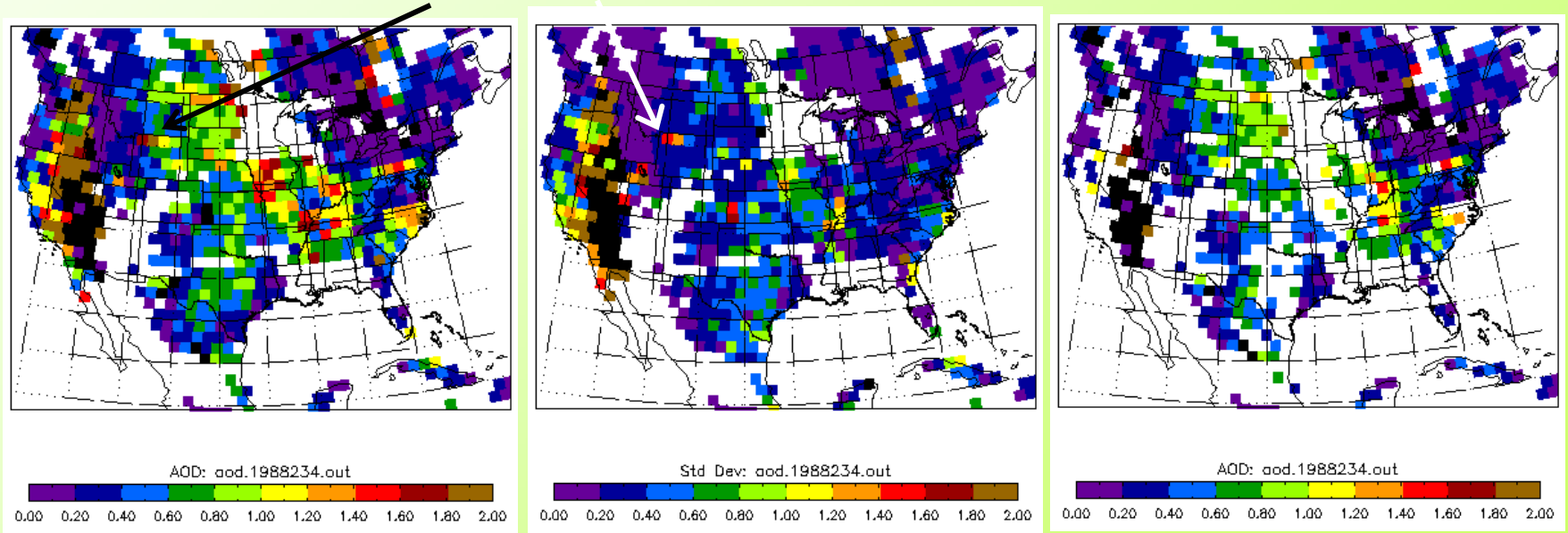


Central America Forest Fires of May 1998



Example of Heterogeneous Grid Cell

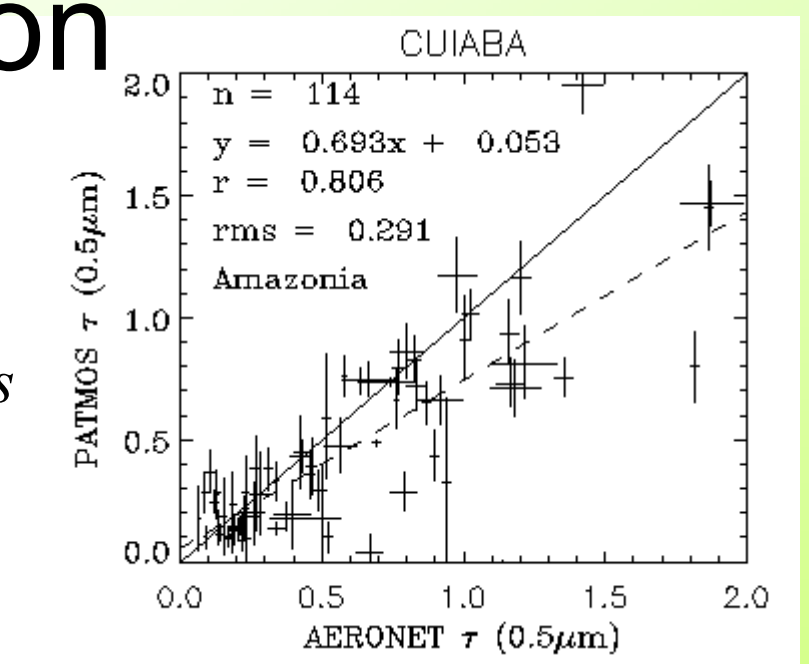
Yellowstone Fires of August 1988

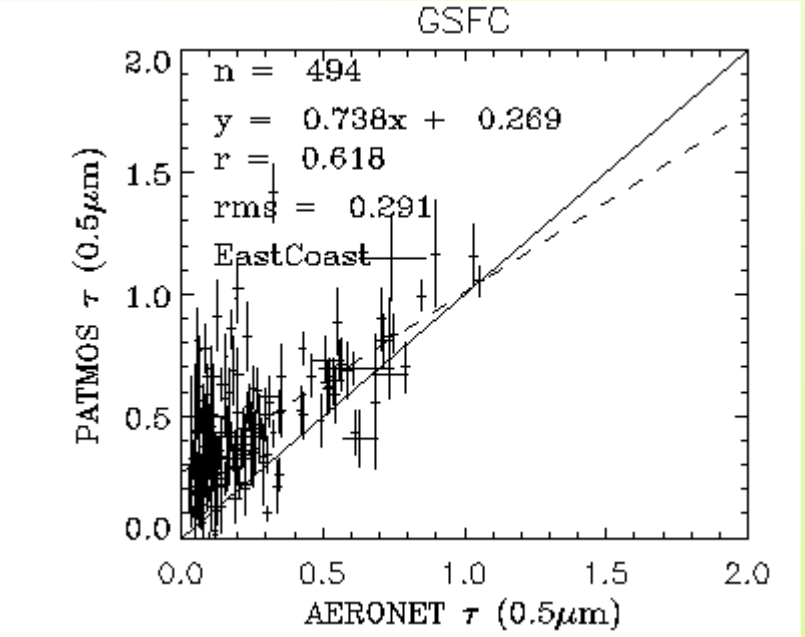


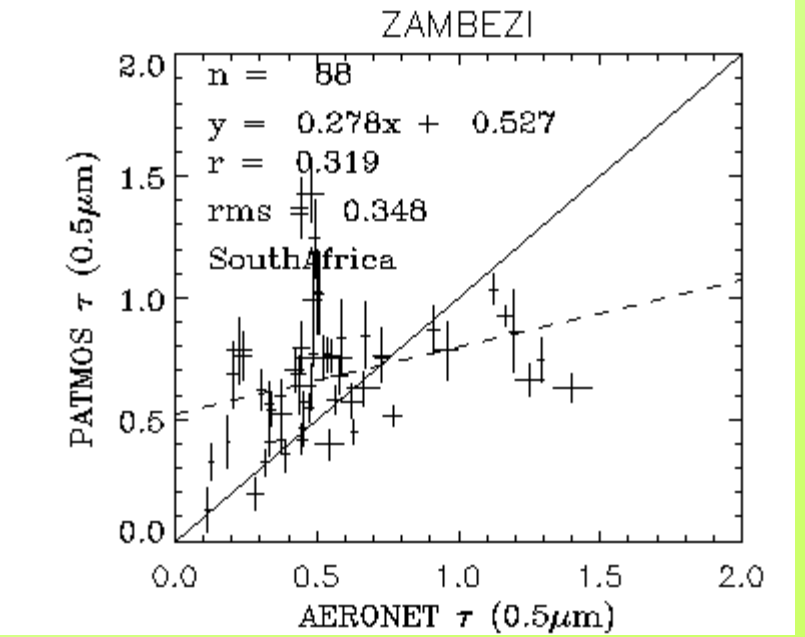
Validation

- Compare
  - PATMOS AOD
  - AERONET AOD
- 84 Sites
- 7493 total matchups

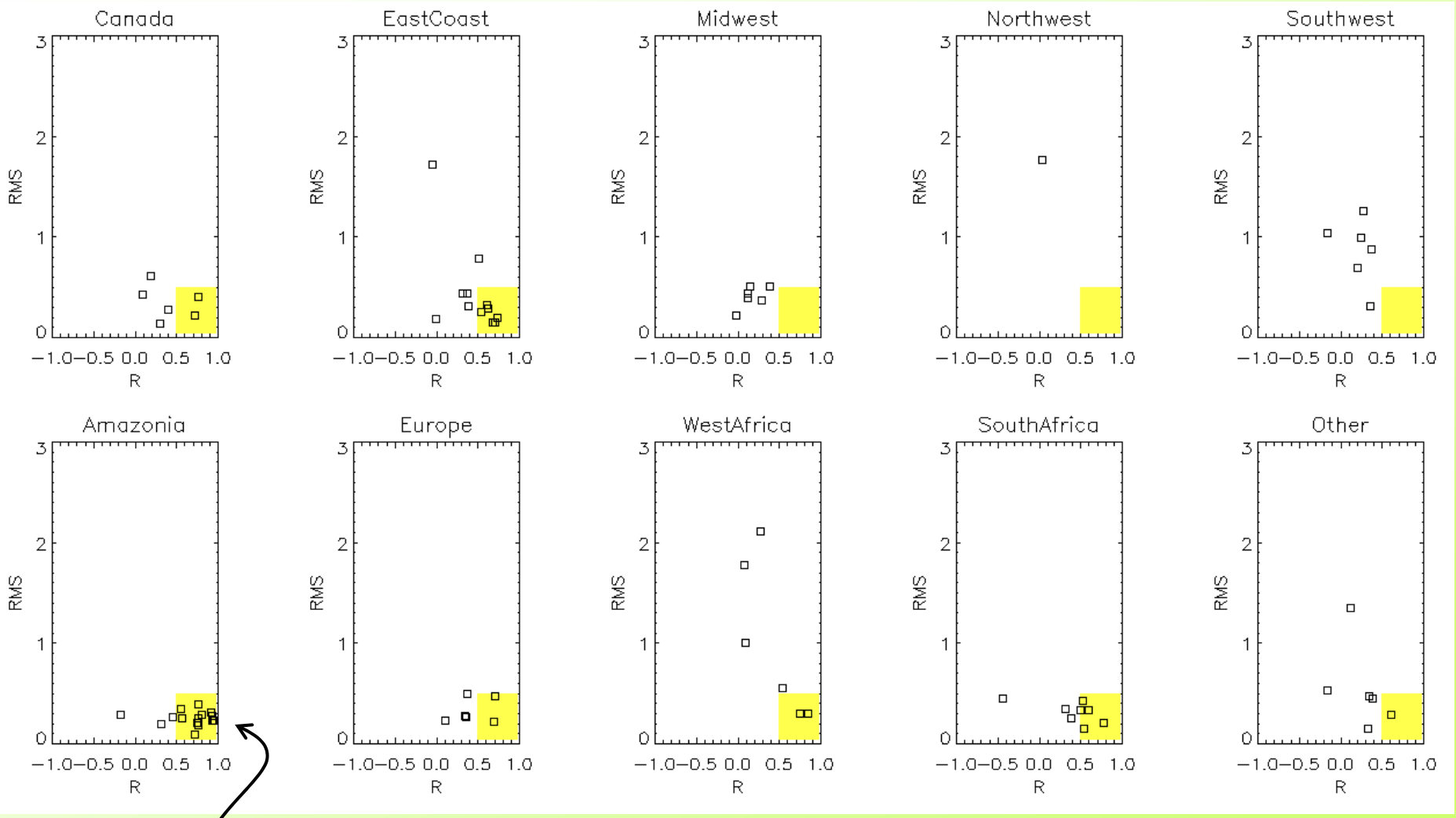
Examples







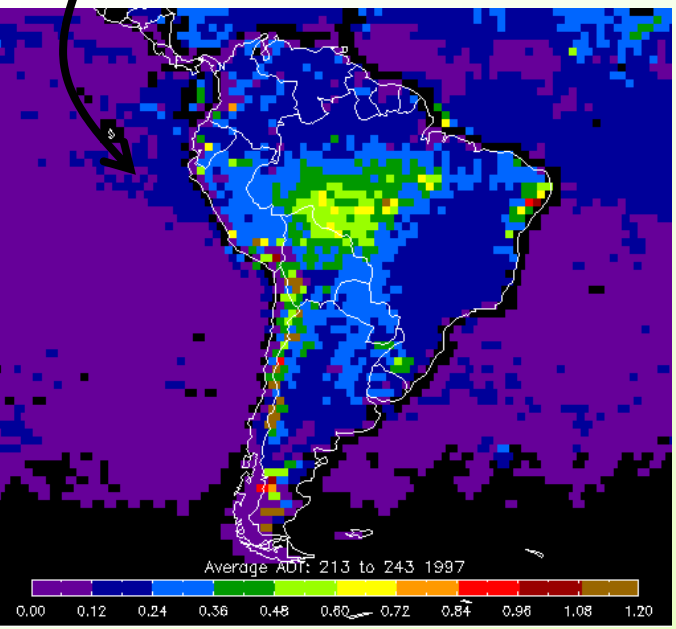
Regional Validation



Yellow: "Target area" – r > 0.5 and RMS < 0.5

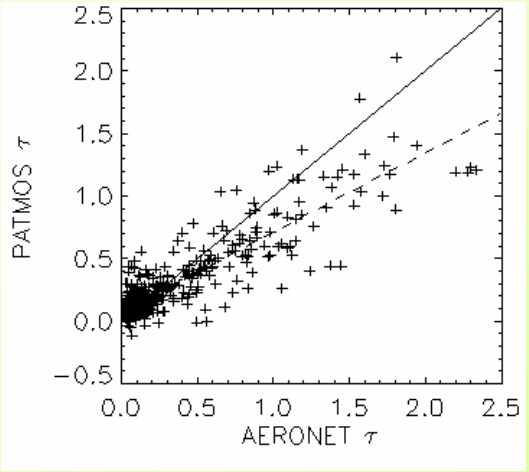
Regional Correction

PATMOS Ocean Retrieval

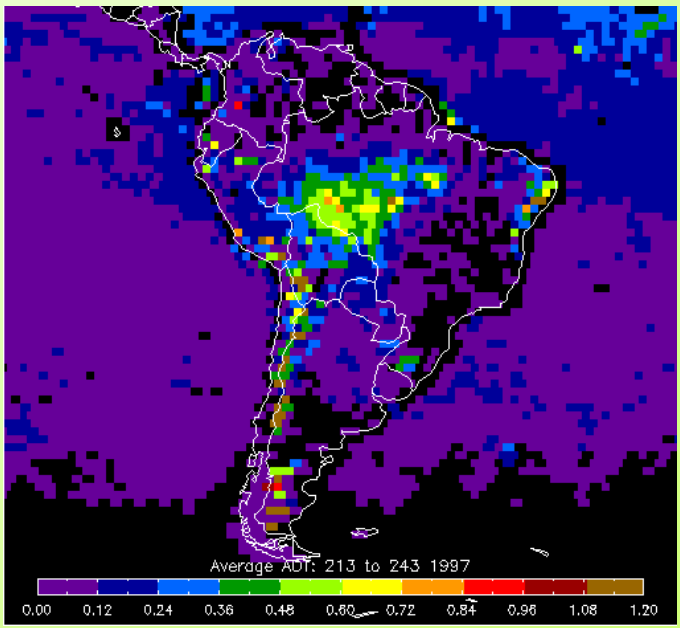


Aug. 1997 Mean AOD

South American AERONET Sites



$$\tau = (\tau_P - 0.18) / 0.66$$



Corrected
Aug. 1997 Mean AOD

Ken.Knapp@noaa.gov

Conclusions

- Method retrieves BRDF information …
  - Allows estimation of NDVI and Broadband Albedo
  - See poster P3.13
- Validation
  - Aerosol can be measured from AVHRR over land
  - More accurate in:
    - South America
    - East Coast
    - Southern Africa
- Qualitatively …
  - smoke observations compare with GOES and TOMS

Acknowledgements

- NASA/Global Aerosol Climatology Project
- AERONET – all PIs of each site used
- toms.gsfc.nasa.gov for TOMS data
- Satellite Active Archive Personnel