Aerosol Remote Sensing from GOES

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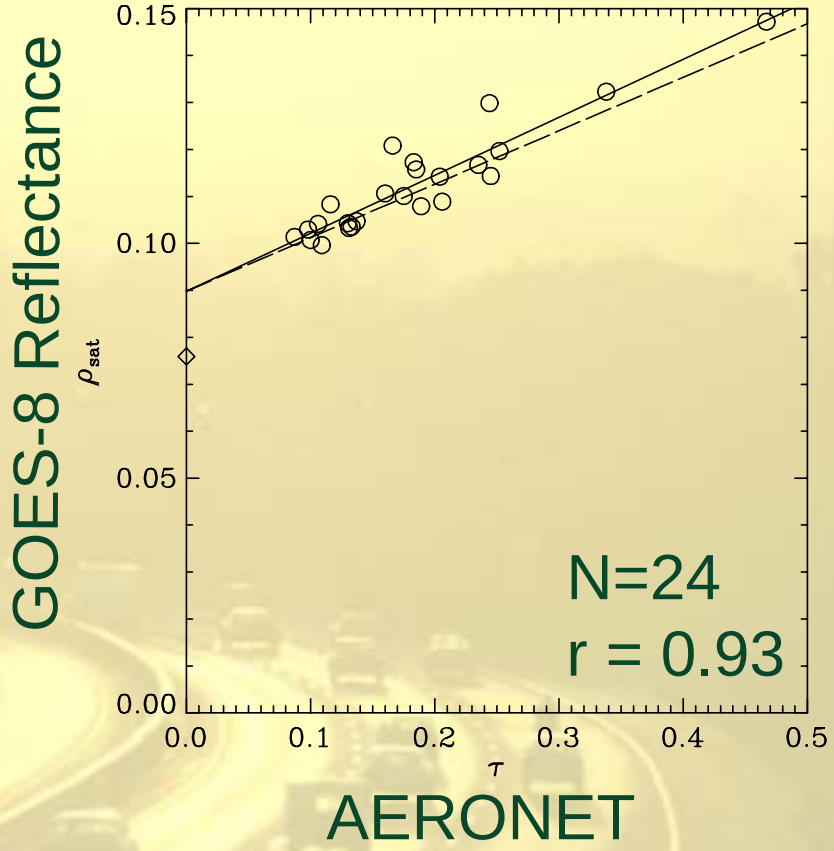
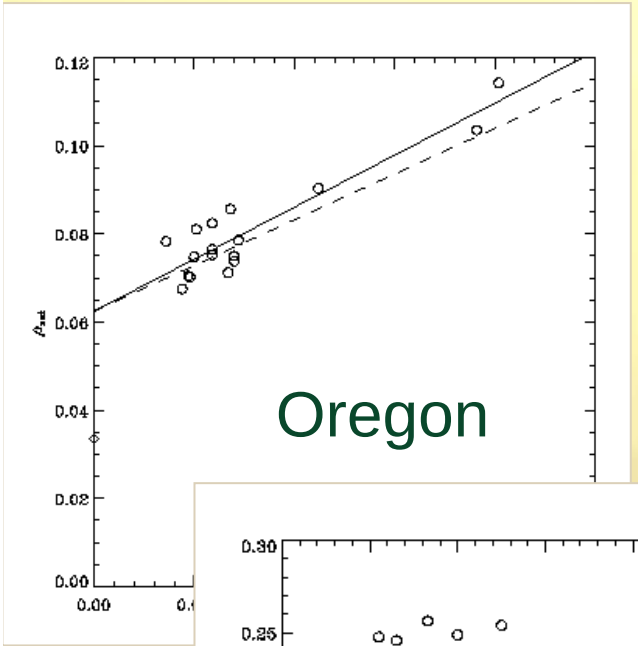
Detecting aerosol signal

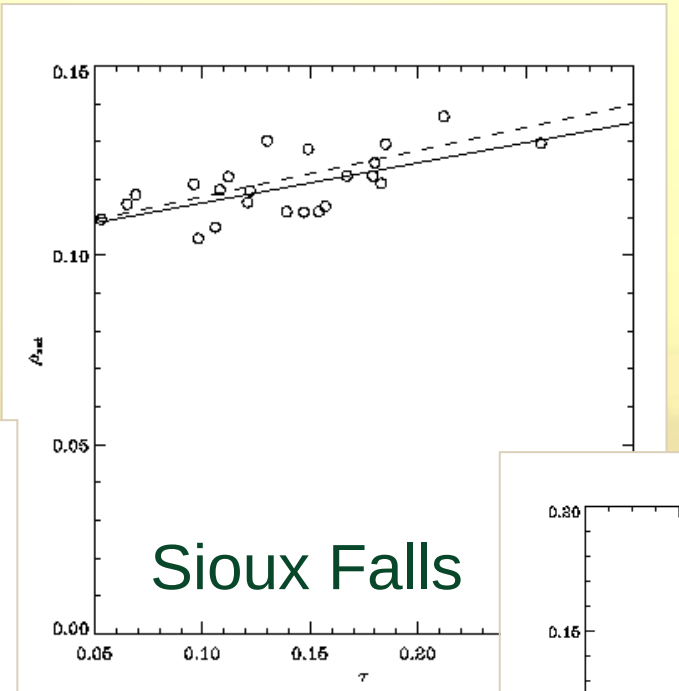
- Compare …
  - Cloud-free GOES reflectances
  - AERONET AOD
- Look for correlation & slope
- Low correlation from …
  - Cloud contamination
  - Varying aerosol optical properties
  - Varying surface reflectance
  - Lack of signal - small AODs
  - TOA reflect. insensitive to AOD

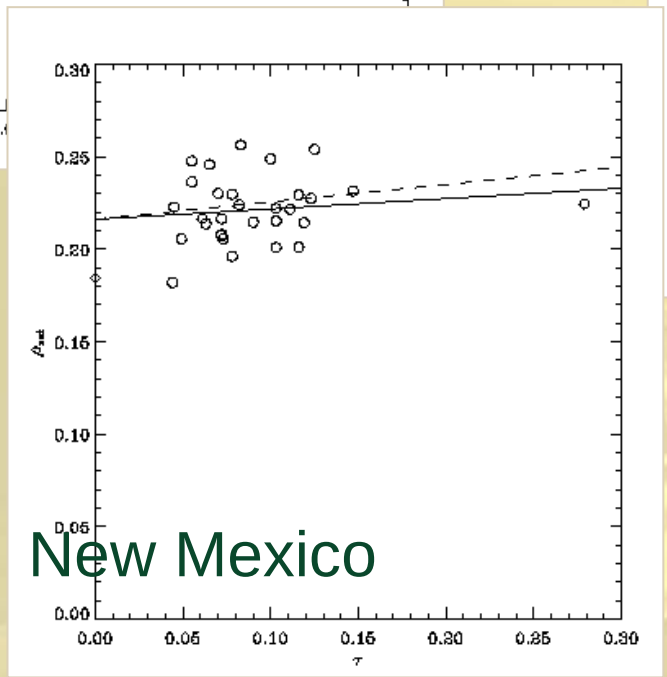
Comparisons from 90 days at Konza Prairie (Kansas) at 21:45 UTC

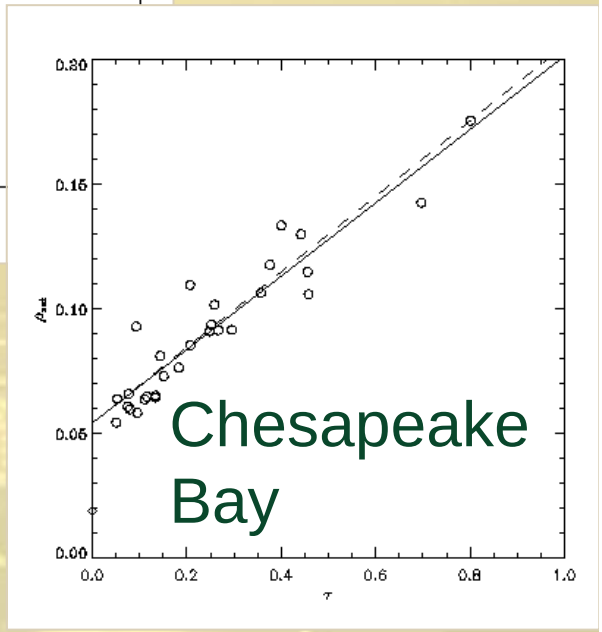


Aerosol signal varies around the US

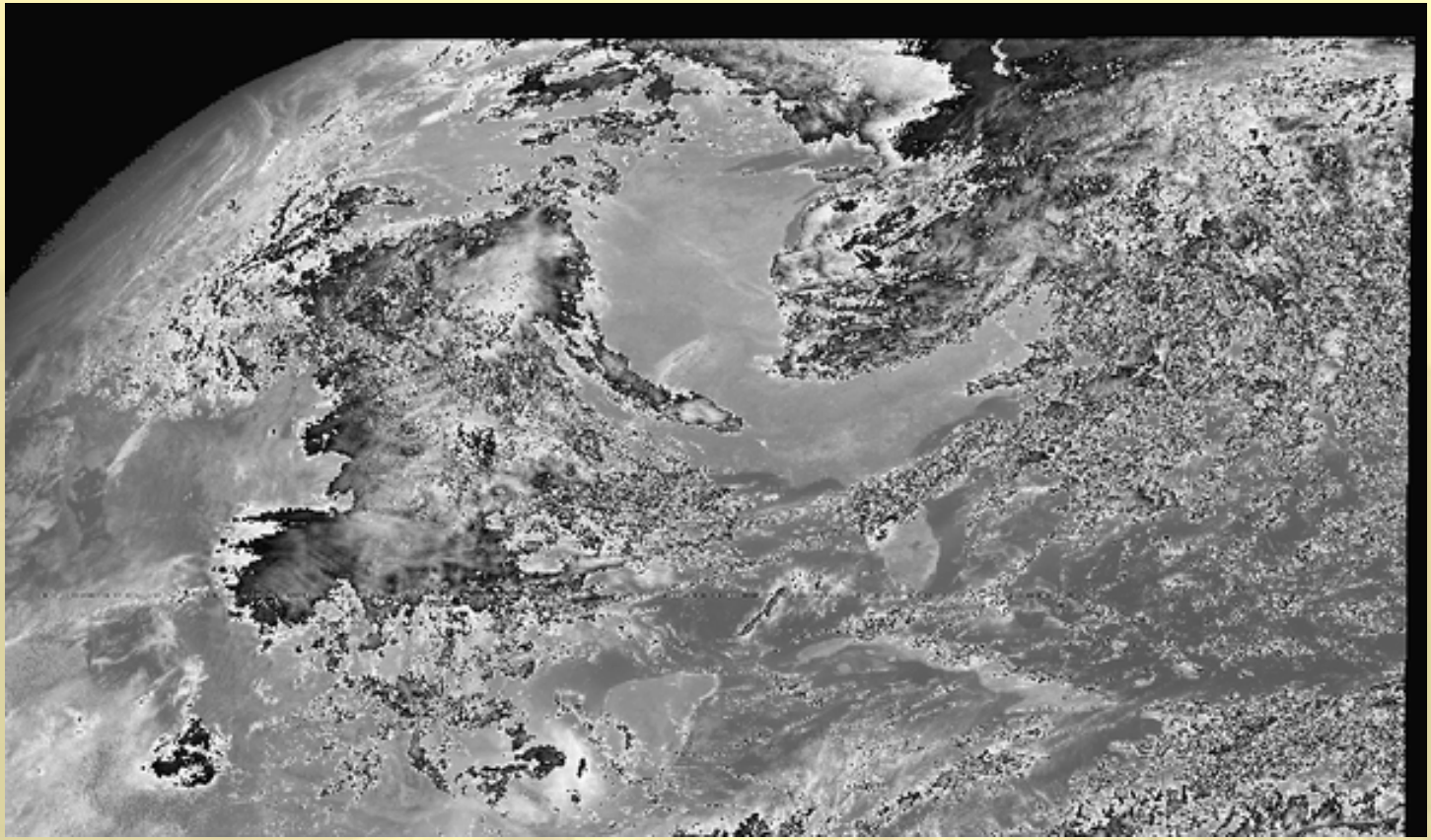




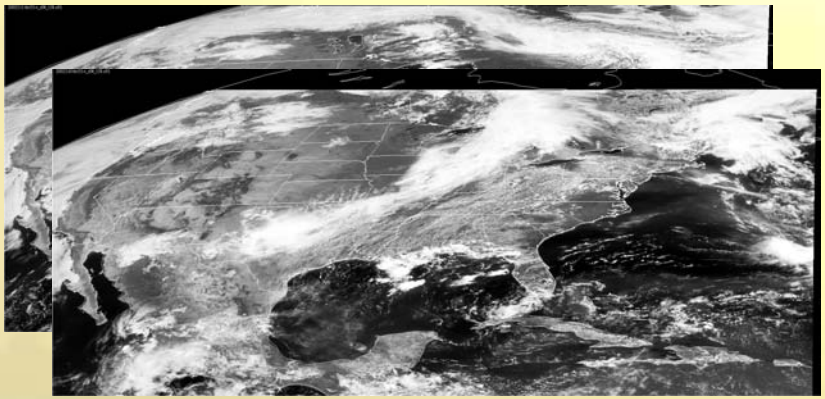




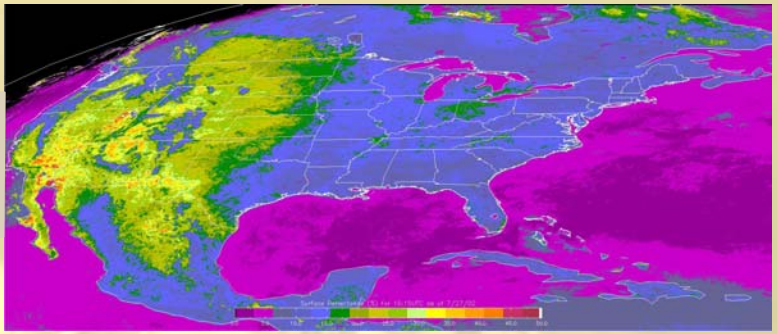
Surface Component from Composite Background



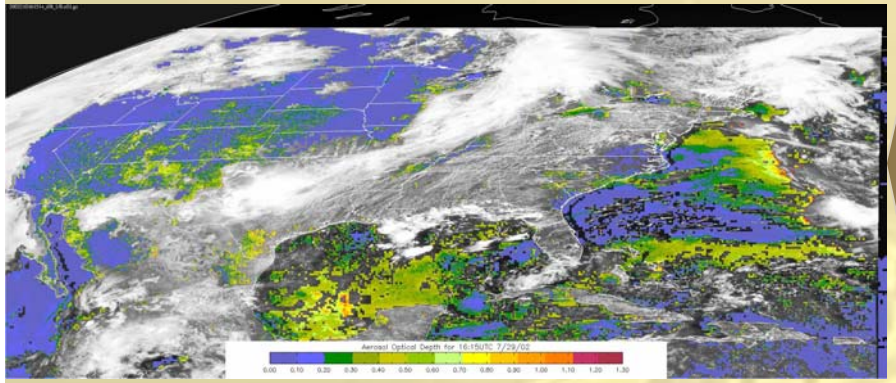
Retrievals from GOES … Method



Composite Clear reflectance



Surface reflectance



Aerosol Optical Depth

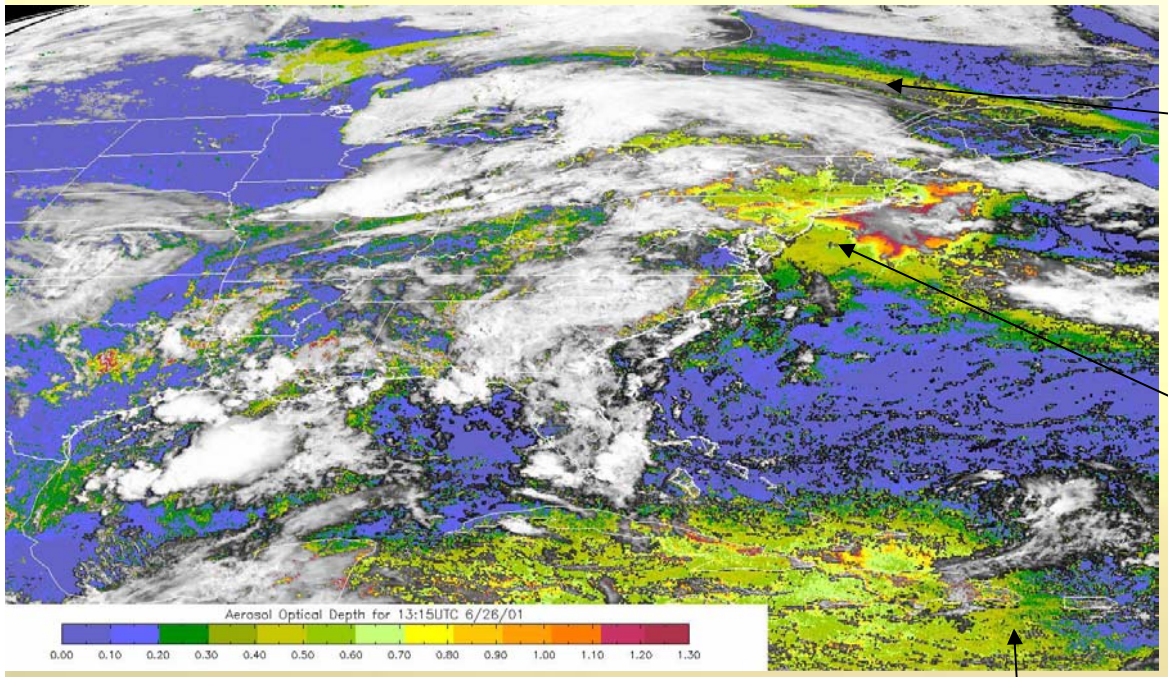
Radiative Transfer

- 6S – Second Simulation of satellite signal in the solar spectrum (Vermote et al.)
- Surface retrieval
  - Know: gaseous and Rayleigh optical depth
  - Assume Lambertian surface and aerosol optical depth
- Aerosol Optical Depth retrieval
  - Know: viewing and illumination geometry, surface reflectance
  - Assume: aerosol optical properties
- Retrievals performed using a look-up table

Retrieval limitations …

- Bright surfaces
  - No aerosol signal
    - Which is not particular to this method
- Cloud Mask
  - Distinguishing thick aerosol from thin cloud
- Geometry/orbit
  - Non-global coverage
  - Not all GEOs are identical
  - Not all GEOs are calibrated
- No cloud-free aerosol-free observation

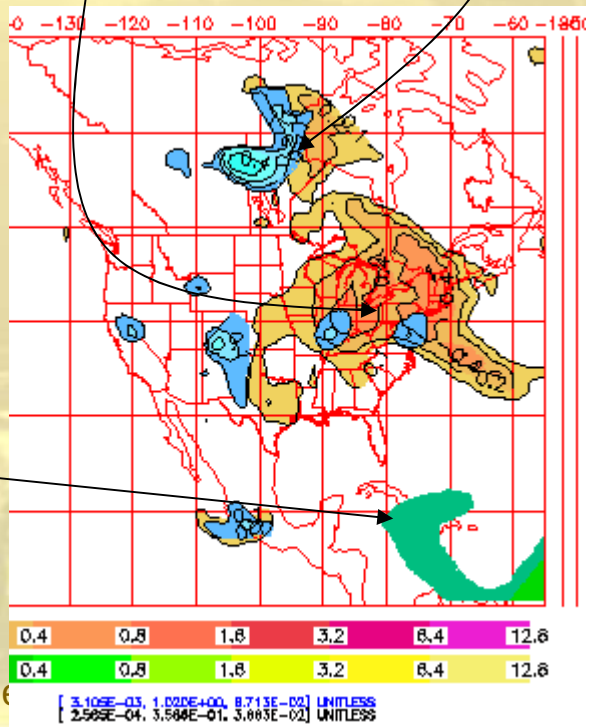
Retrieval example: 26 June 2002



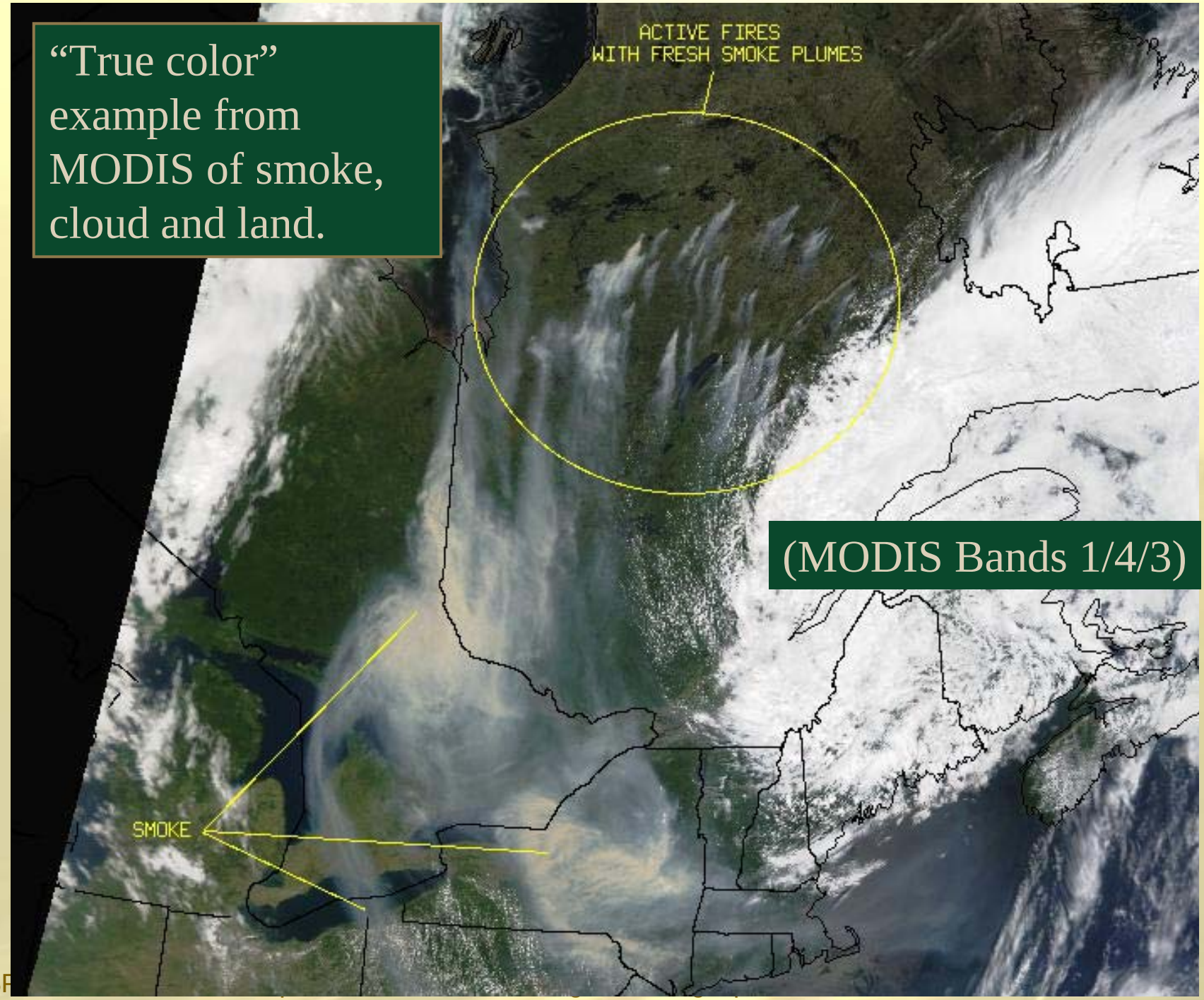
Forest Fire Smoke

Industrial Aerosol (sulfate)

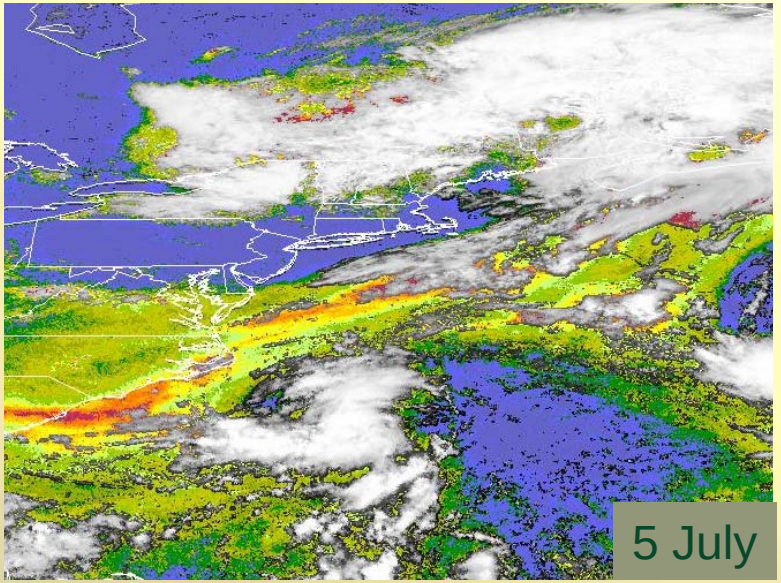
Saharan dust

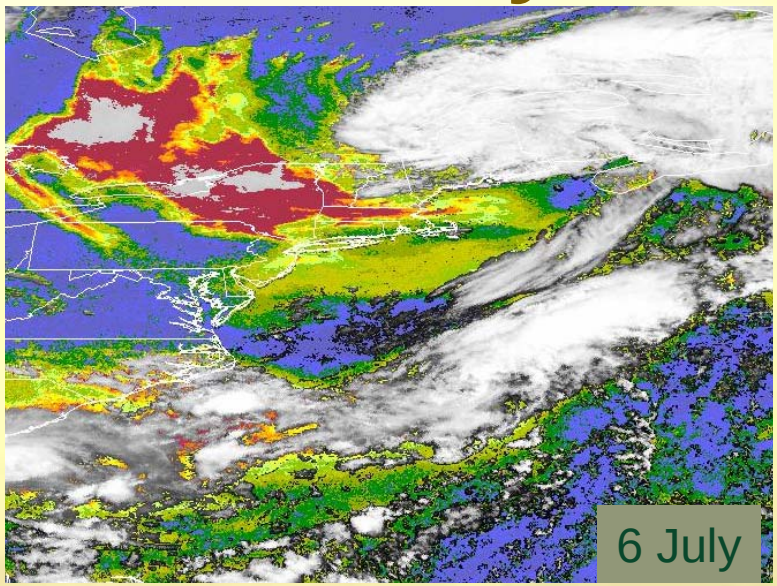


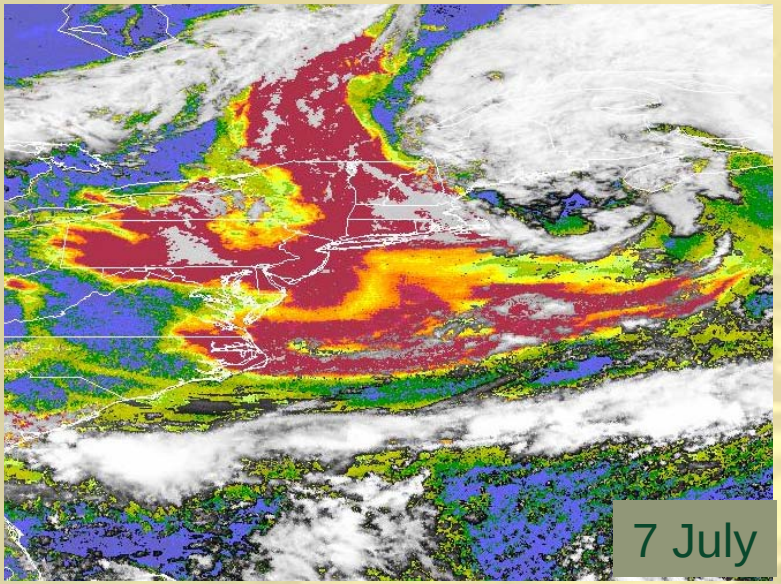
http://orbit-net.nesdis.noaa.gov/crad3/gasp/RealTime

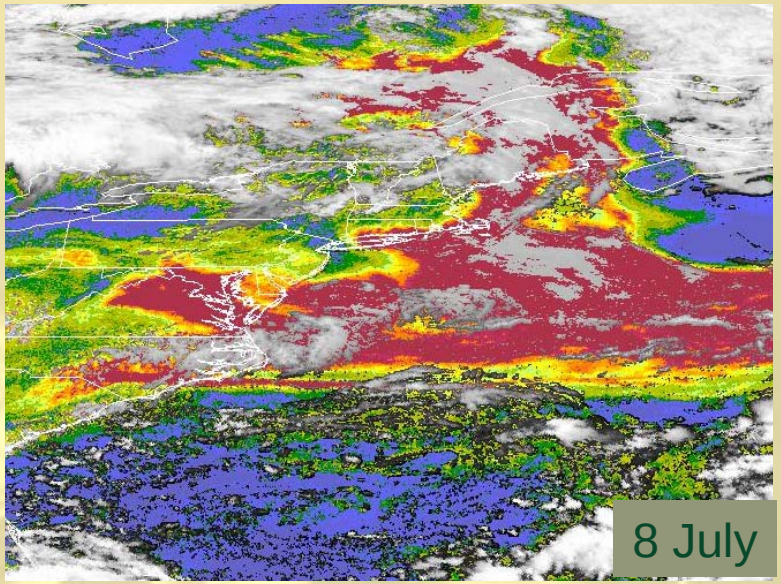

“True color” example from MODIS of smoke, cloud and land.
ACTIVE FIRES
WITH FRESH SMOKE PLUMES
(MODIS Bands 1/4/3)
SMOKE

Retrieval example: 5-8 July 2002









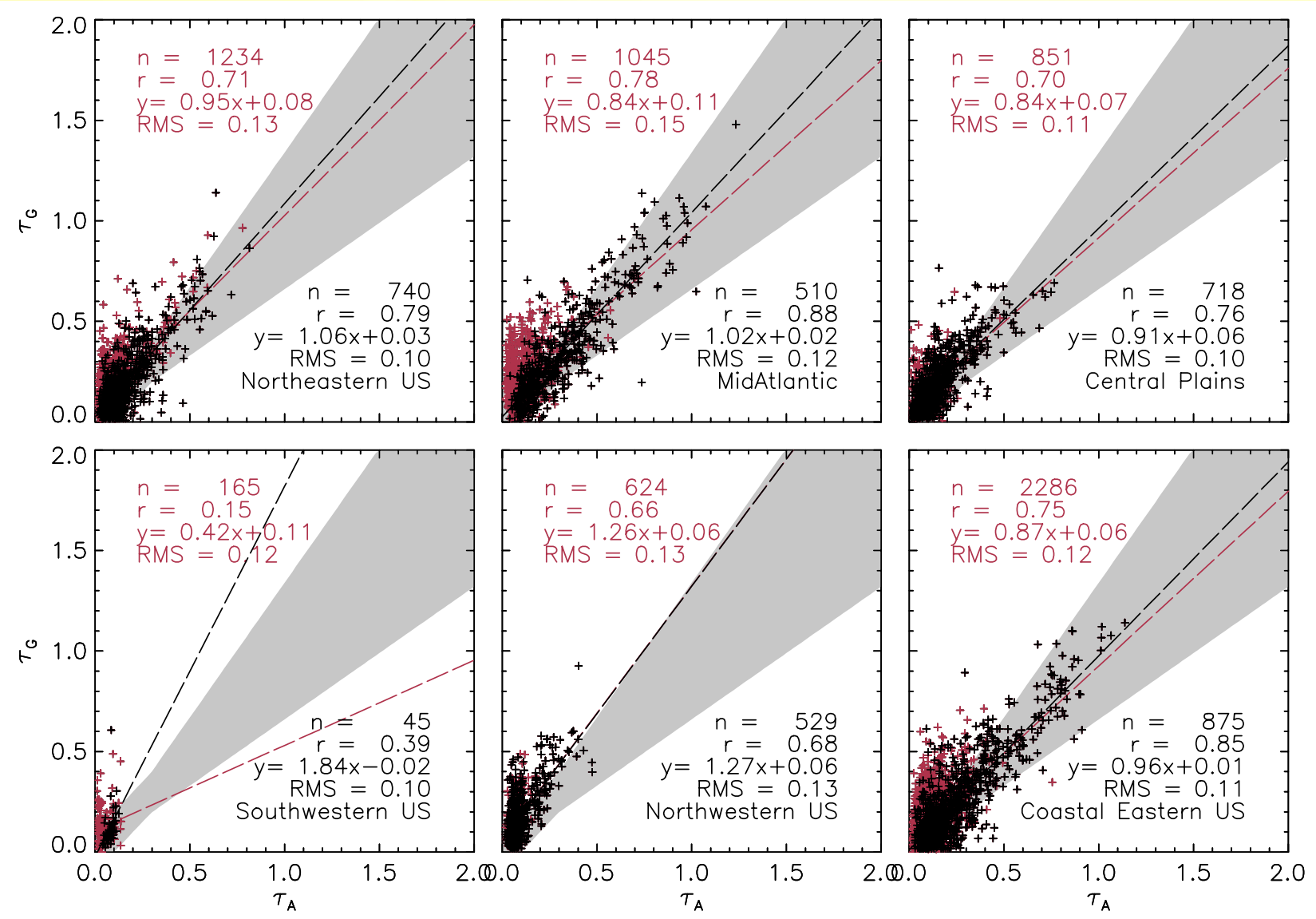
July 6 loop

Validation

- Using AERONET sites
  - Ground-based AOD observations
    - Accuracy ±0.02
  - Performed for Jan. – Dec. 2001
  - ~20 sites available around the US
- Using MODIS
  - Remotely sensed AOD
    - Accuracy ±20%
  - Performed for one pass from 2001

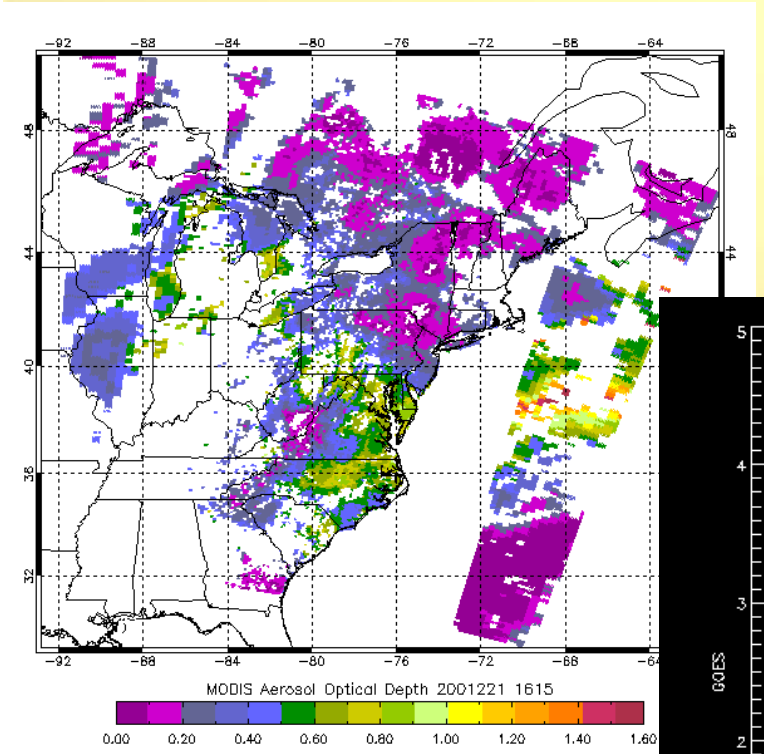
U.S. *(North American)* sites

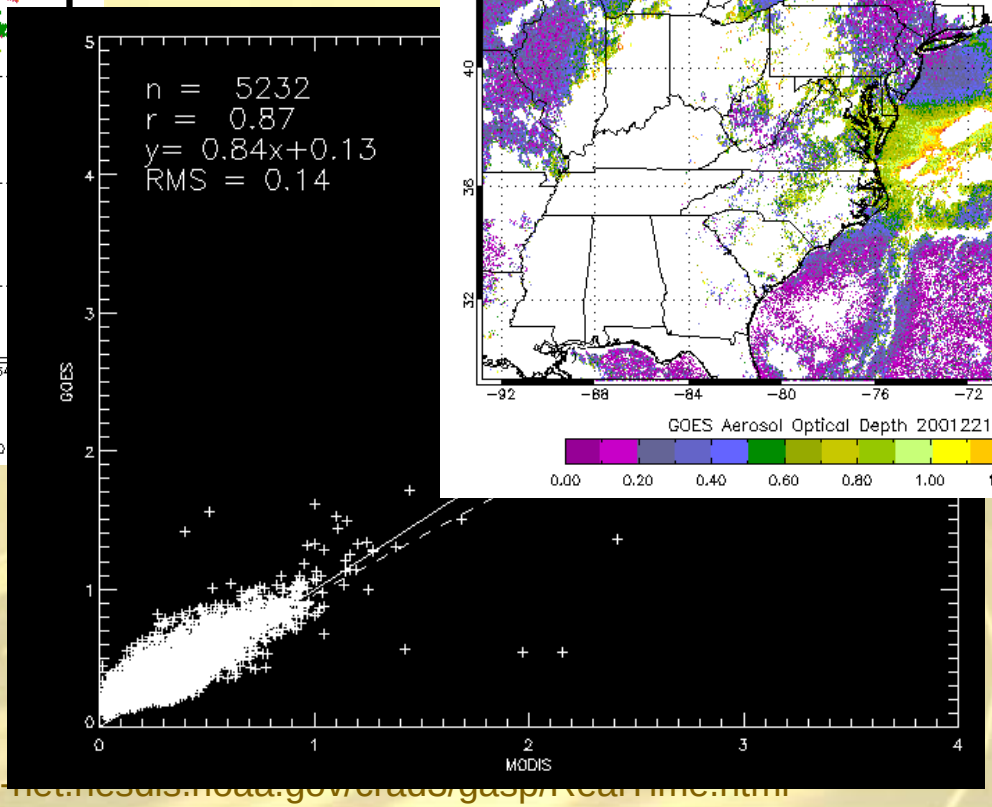
Validation with AERONET

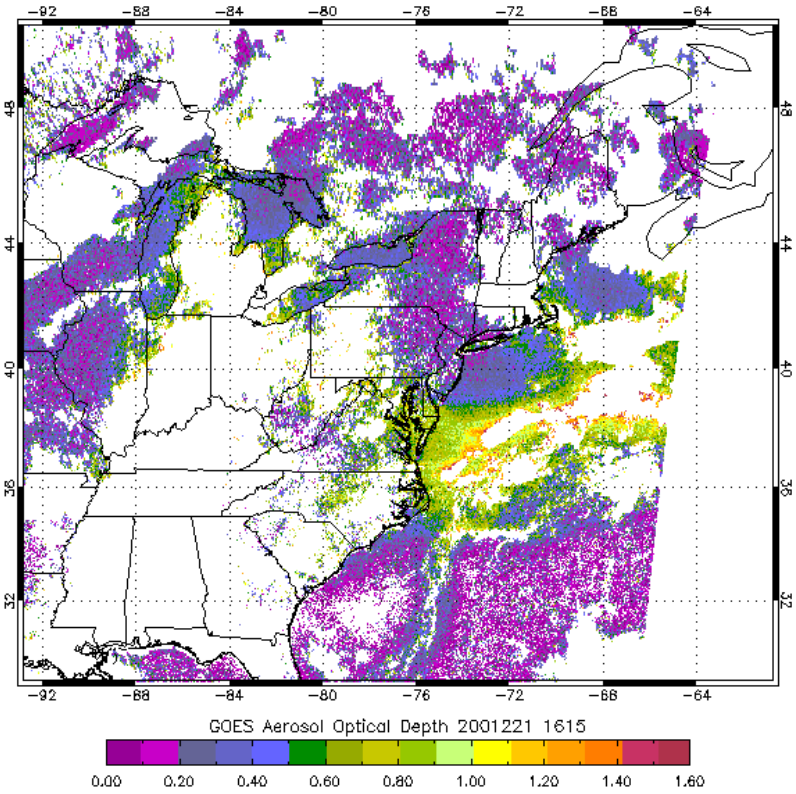


Comparisons with MODIS

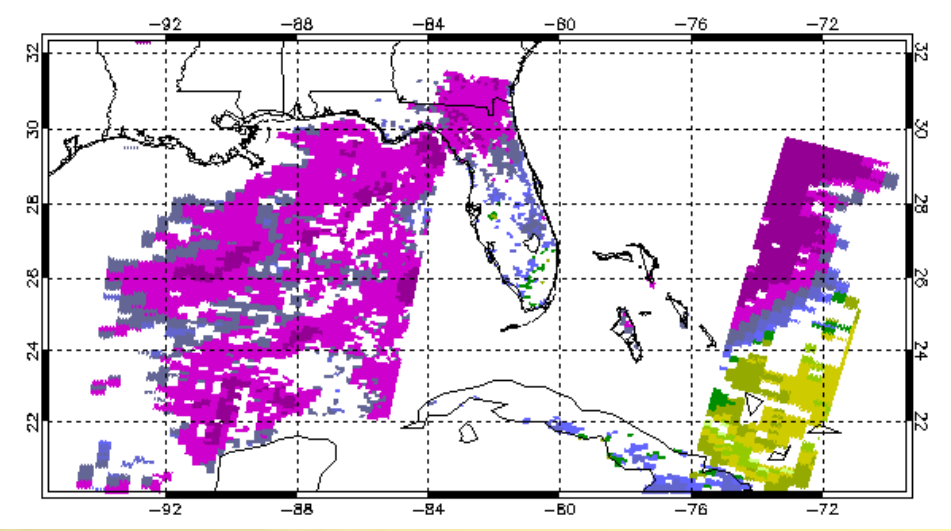
Many are available few are shown

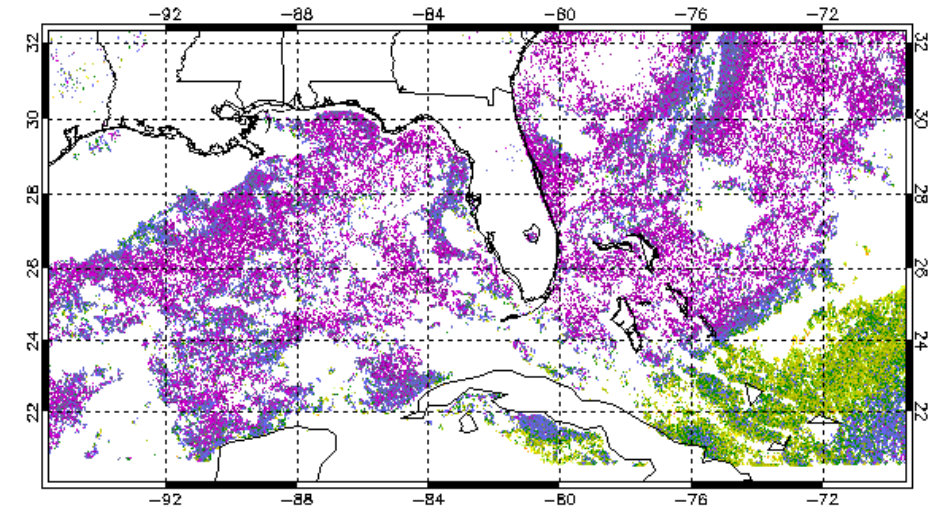


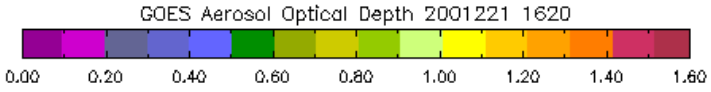


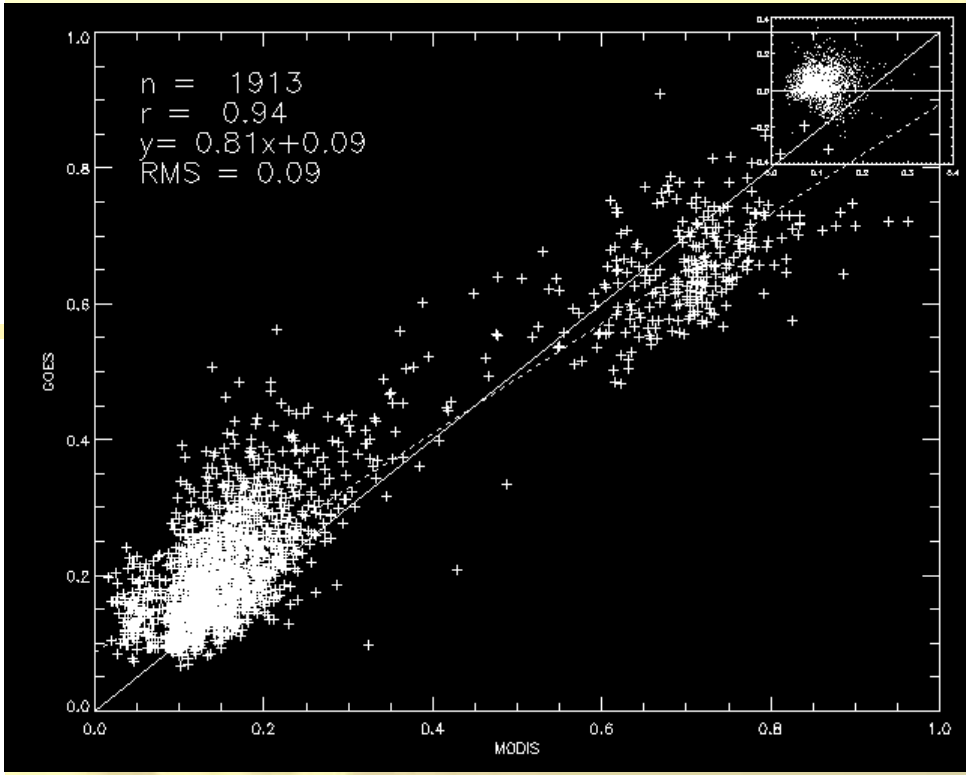


GOES-MODIS ... dust



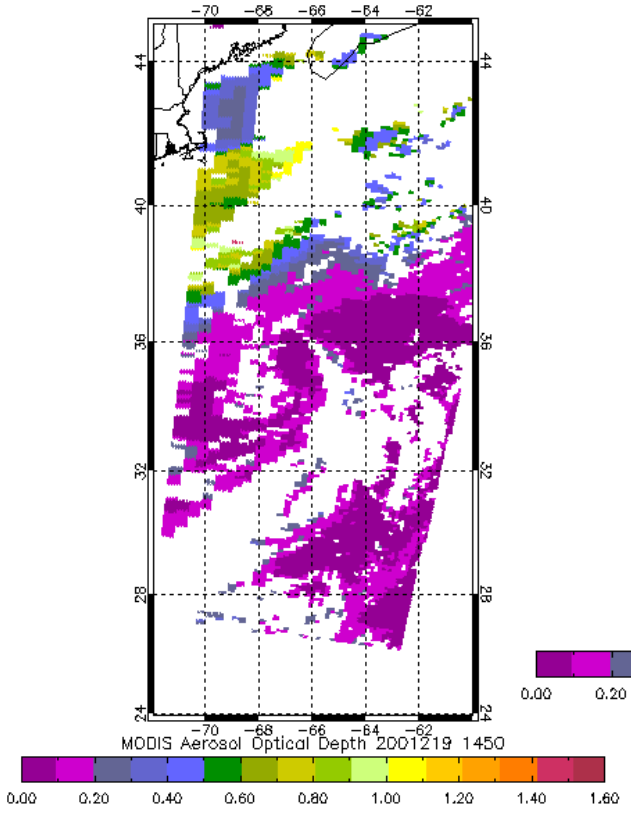


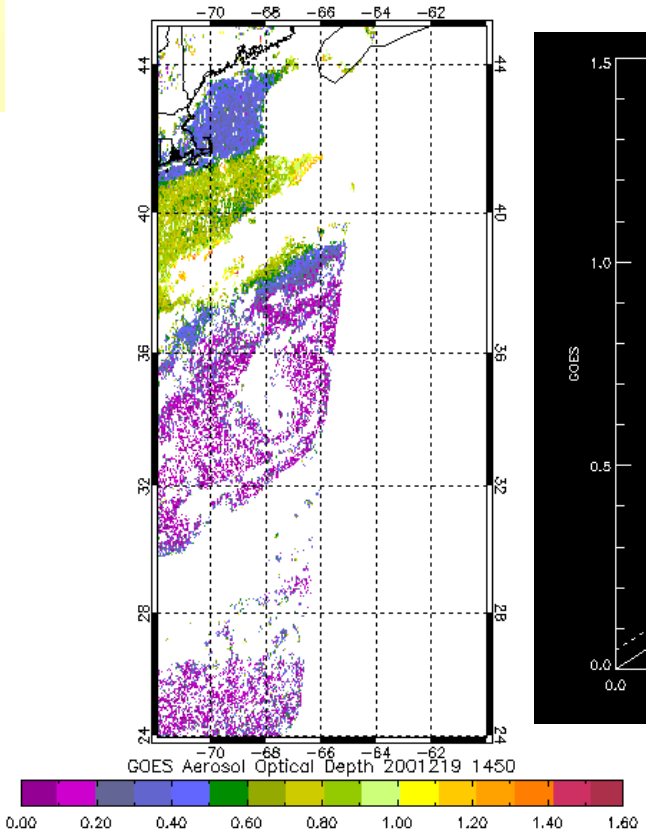


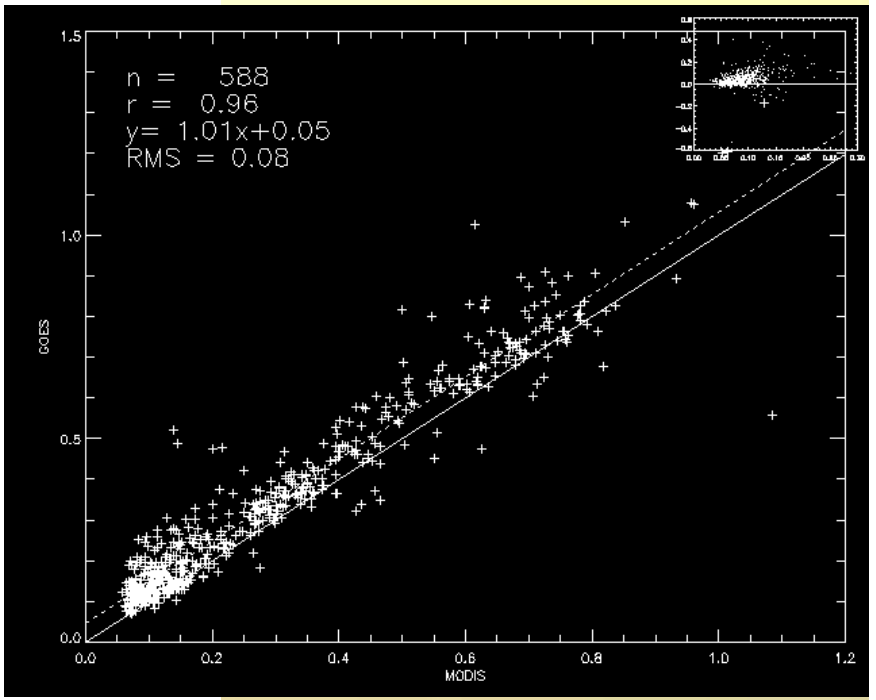


ov/crad3/gasp/RealTime.html

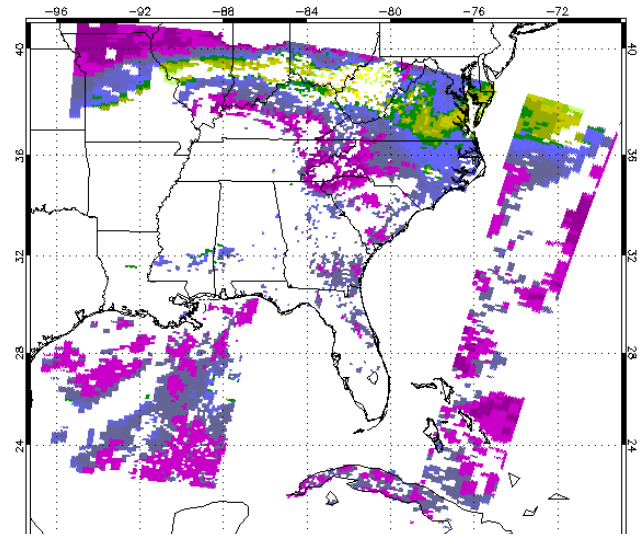
GOES-MODIS … ocean

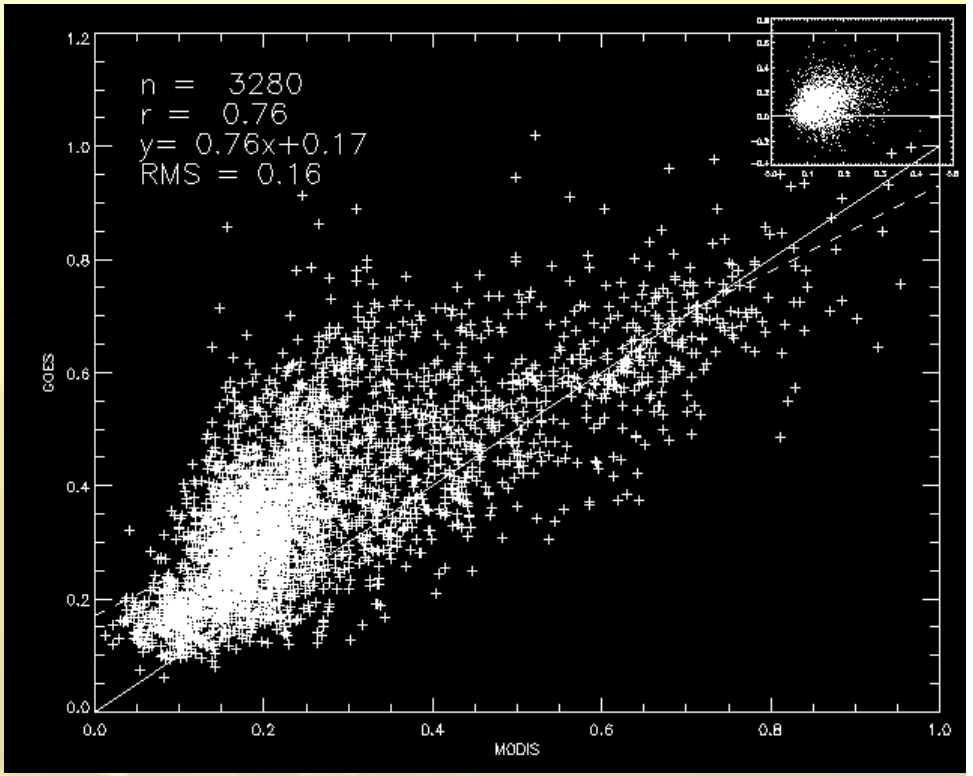


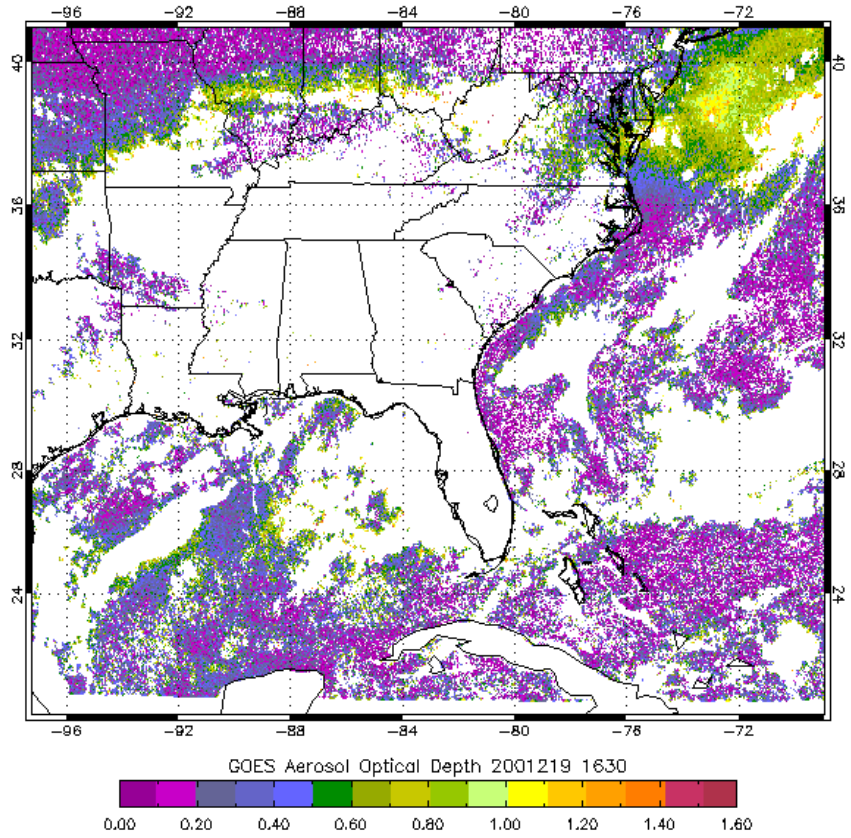




GOES-MODIS ... land







aa.gov/crad3/gasp/RealTime.html

Web page access to data

GASP online

- Automated system provides data in near real time
- 4km spatial resolution
- Clouds masked
- Continental US
  - ½ hour intervals
- Full Disk
  - 3 hour intervals

Conclusions

Current

- Aerosol retrieval works over the U.S.
  - Quantitatively … RMS ~ 0.1
  - Better retrievals over ocean and East Coast
  - Some improvement still possible
- Works very similarly to MODIS
  - Differences in aerosol model
  - Differences in estimating surface reflectance

Acknowledgements

- GOES data
  - Peter Romanov
  - Cindy Combs of CIRA
    - Provided 2001 GOES-8/10 data
- AERONET folks
  - Provide great data for all
- NASA DAAC
  - for MODIS data