

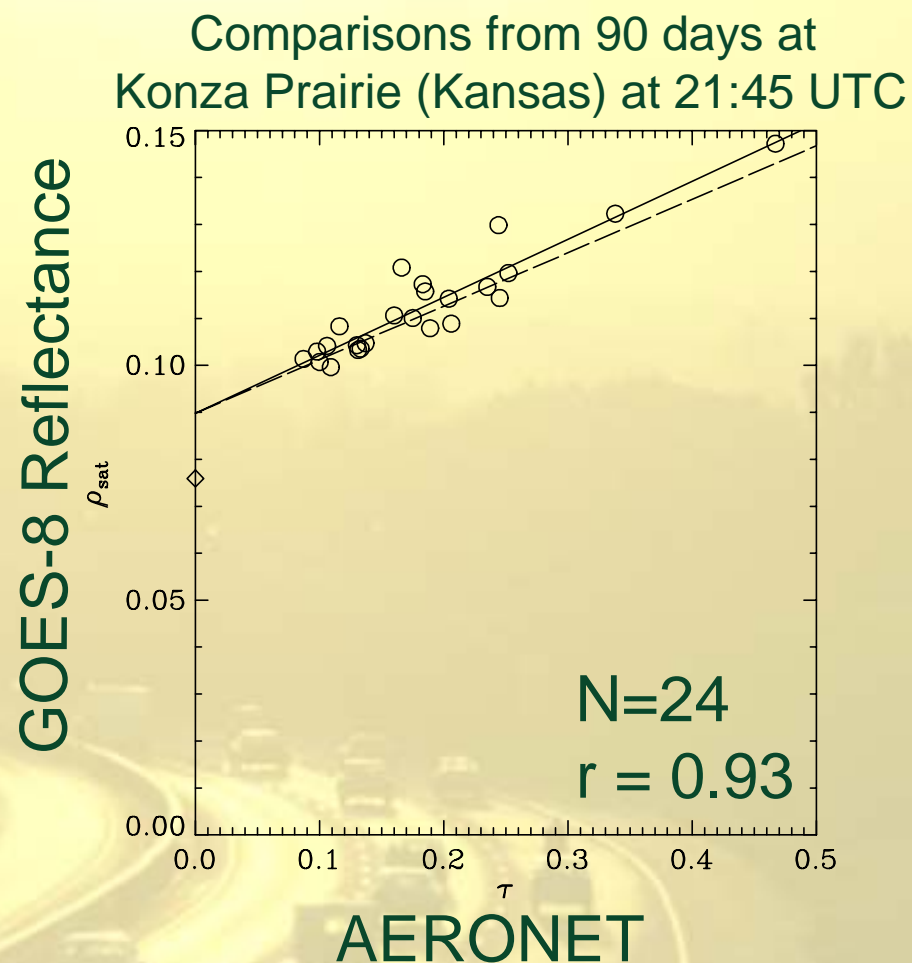


# Aerosol Remote Sensing from GOES

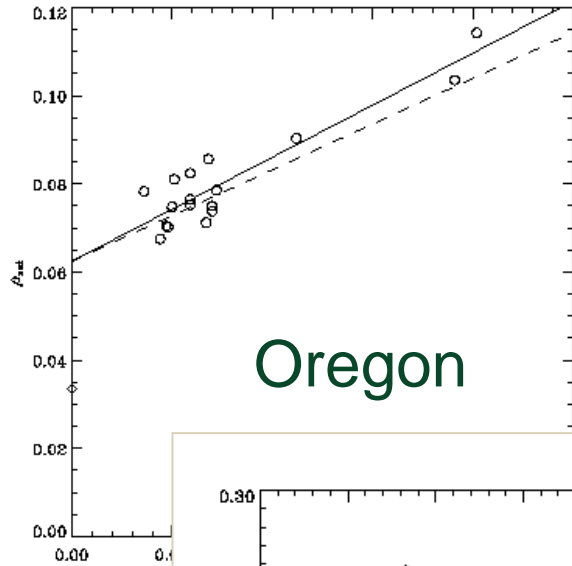
Ken Knapp

# Detecting aerosol signal

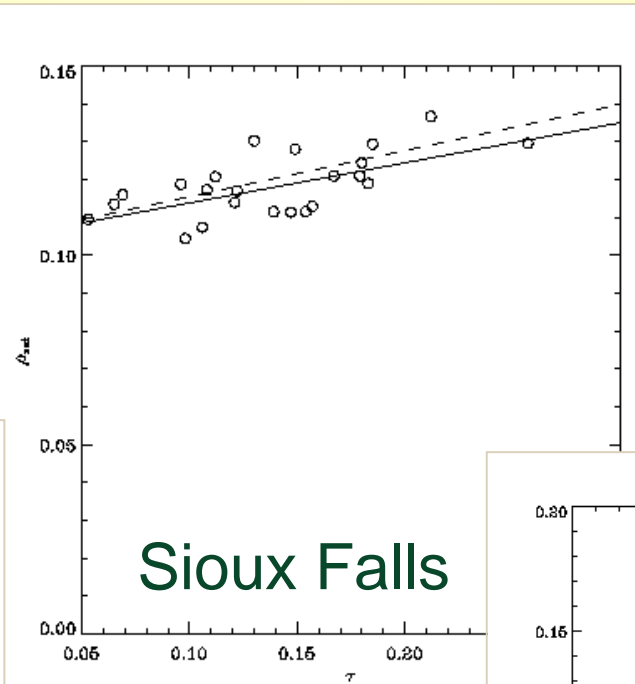
- Compare ...
  - Cloud-free GOES reflectances
  - AERONET AOD
- Look for correlation & slope
- Low correlation from ...
  - Cloud contamination
  - Varying aerosol optical properties
  - Varying surface reflectance
  - Lack of signal - small AODs
  - TOA reflect. insensitive to AOD



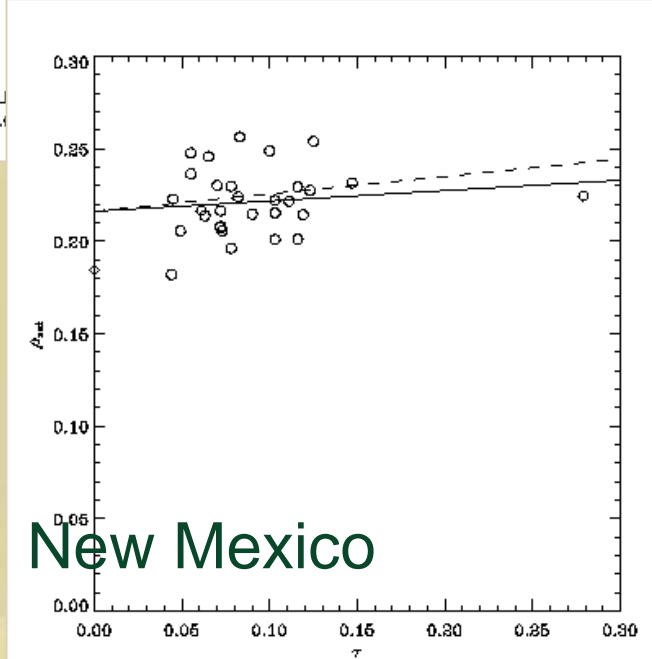
# Aerosol signal varies around the US



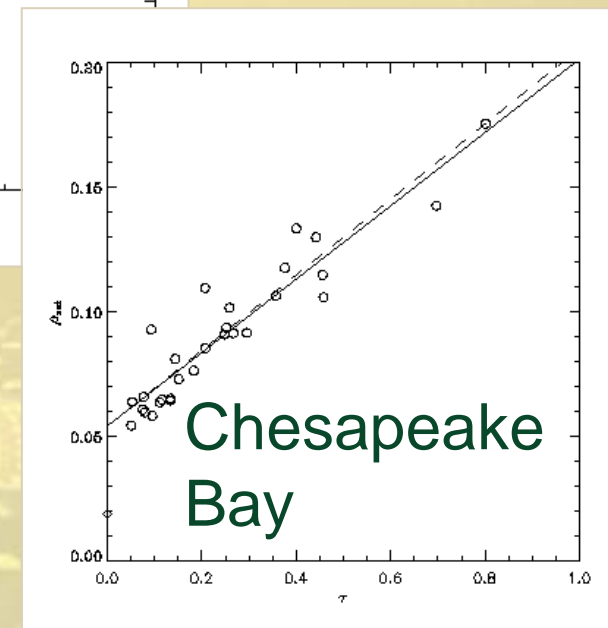
Oregon



Sioux Falls

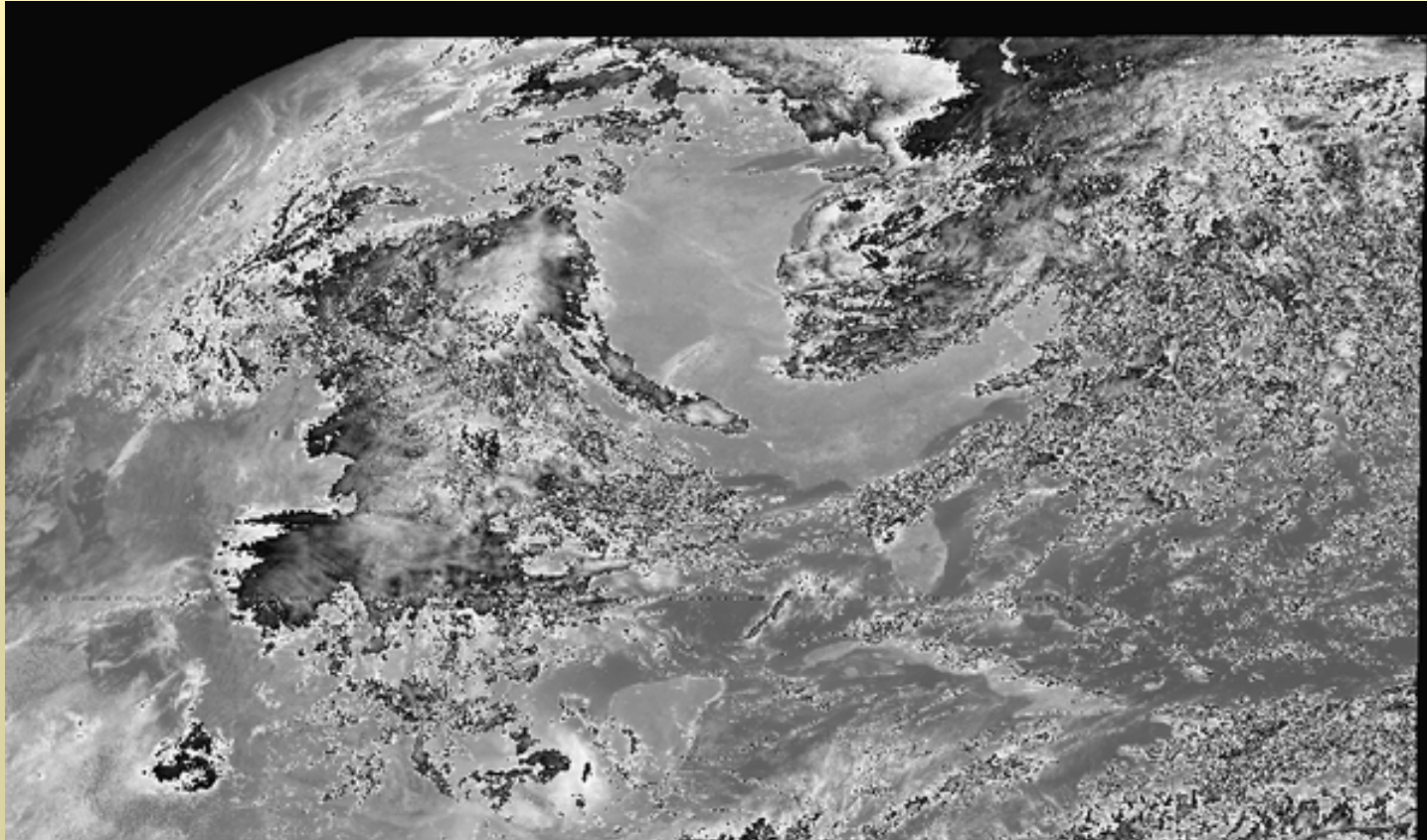


New Mexico

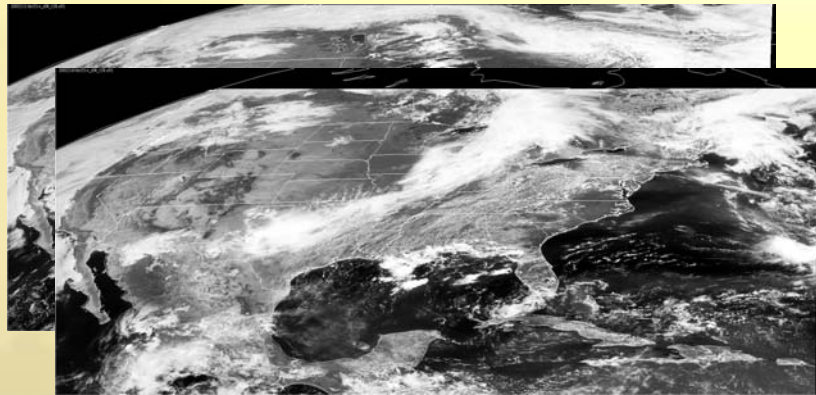


Chesapeake Bay

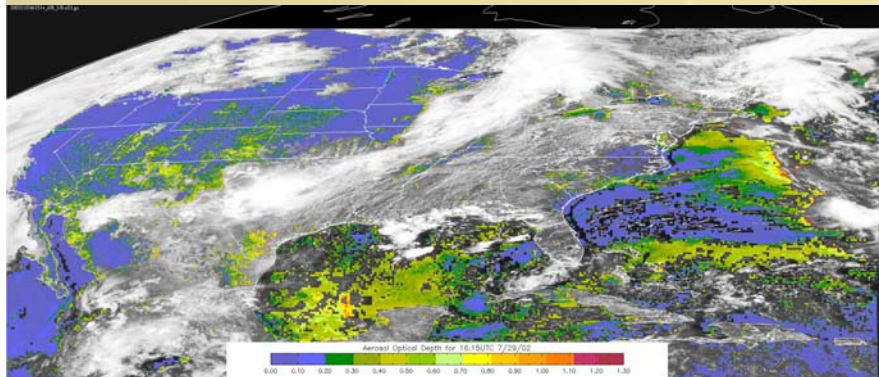
# Surface Component from Composite Background



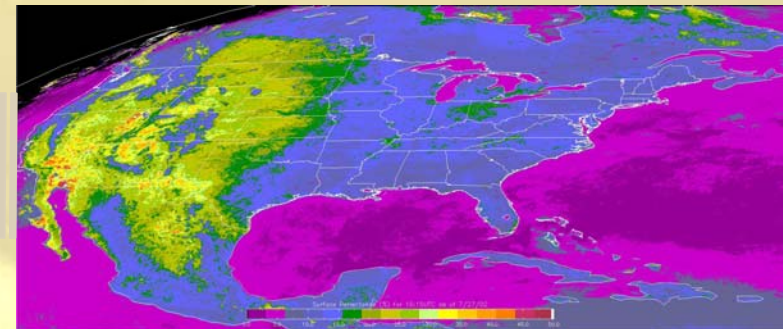
# Retrievals from GOES ... Method



Composite Clear reflectance



Aerosol Optical Depth



Surface reflectance

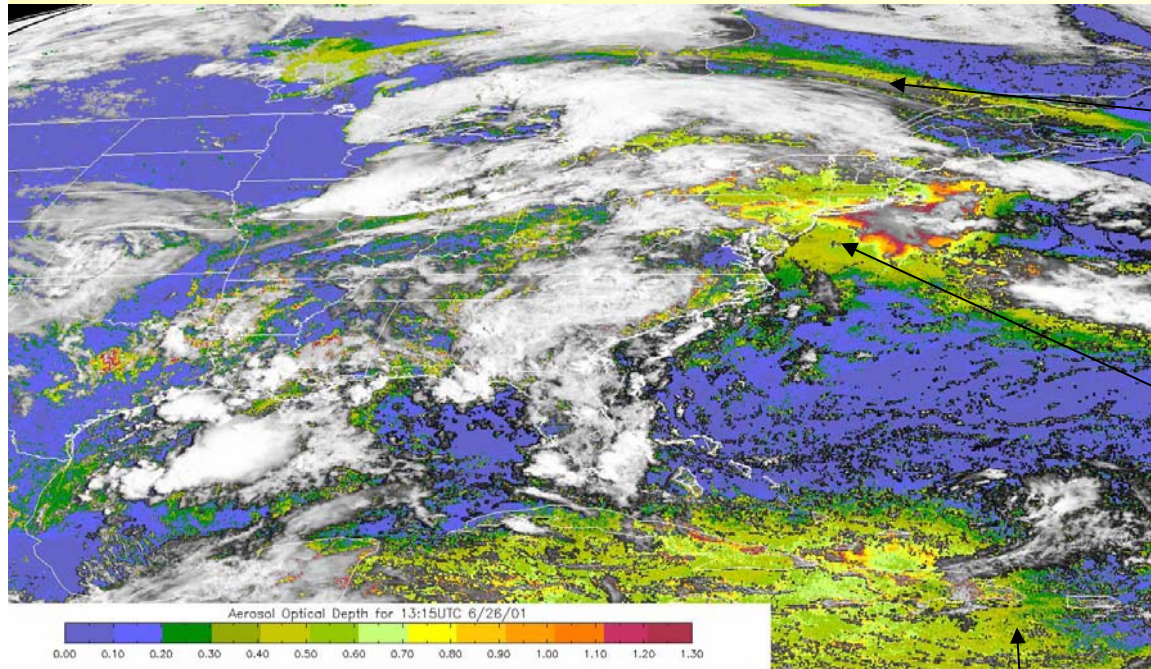
# Radiative Transfer

- 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

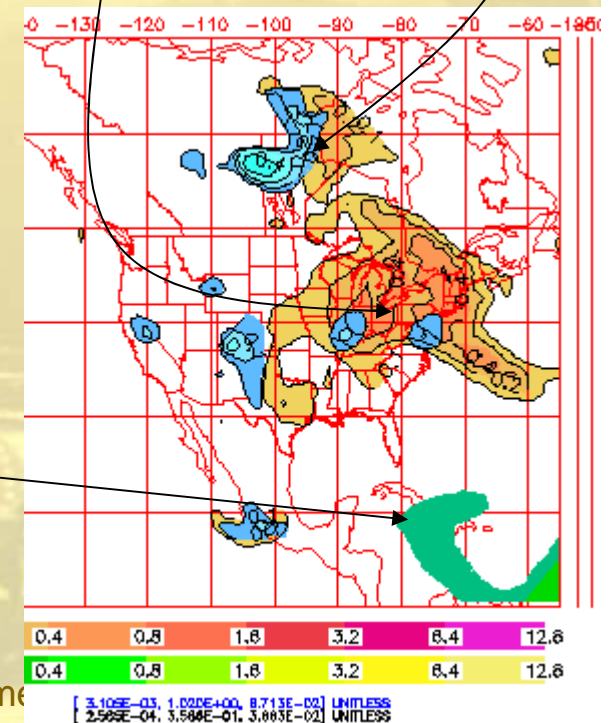
# Retrieval example: 26 June 2002



Forest Fire Smoke

Industrial Aerosol (sulfate)

Saharan dust



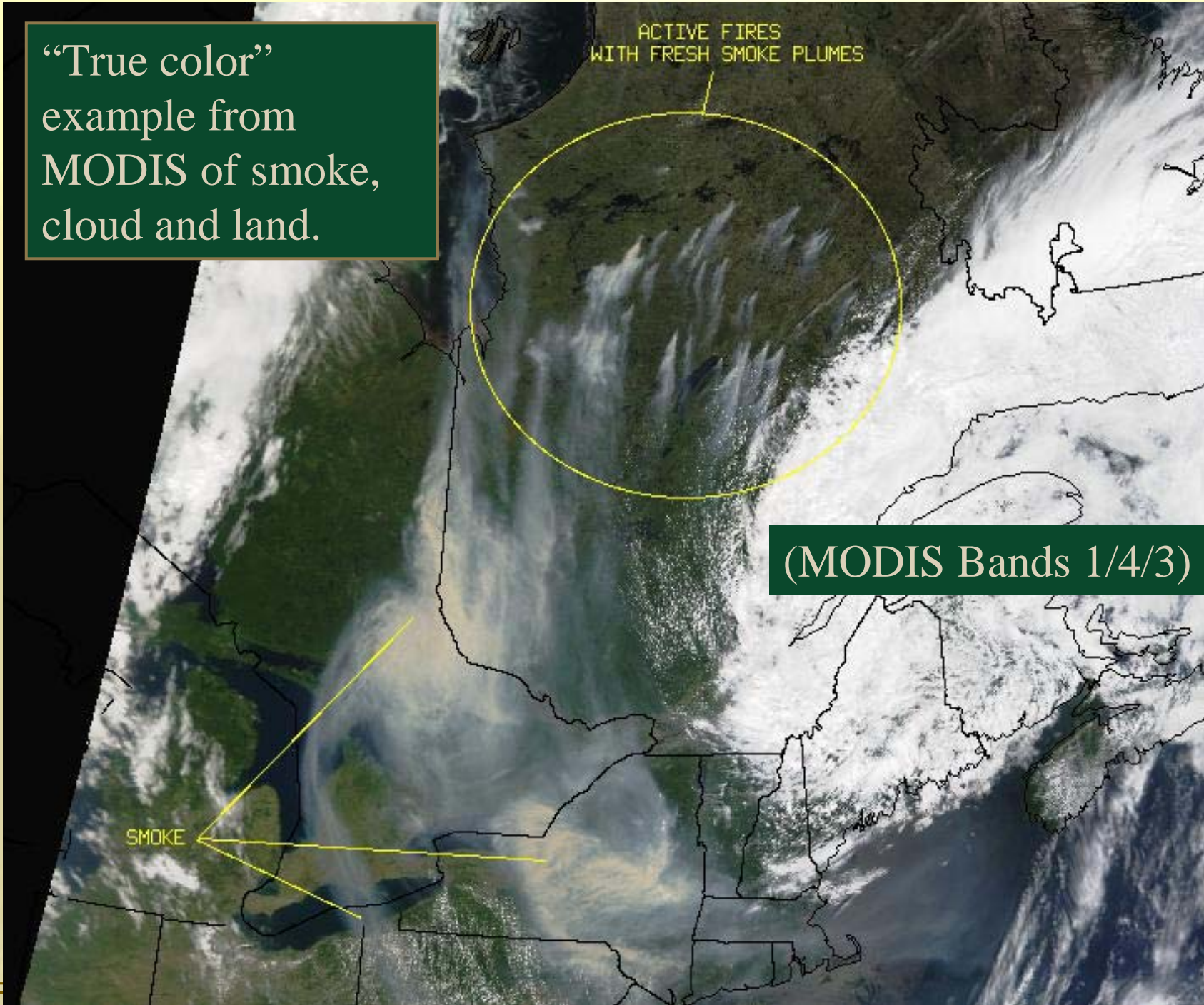


“True color”  
example from  
MODIS of smoke,  
cloud and land.

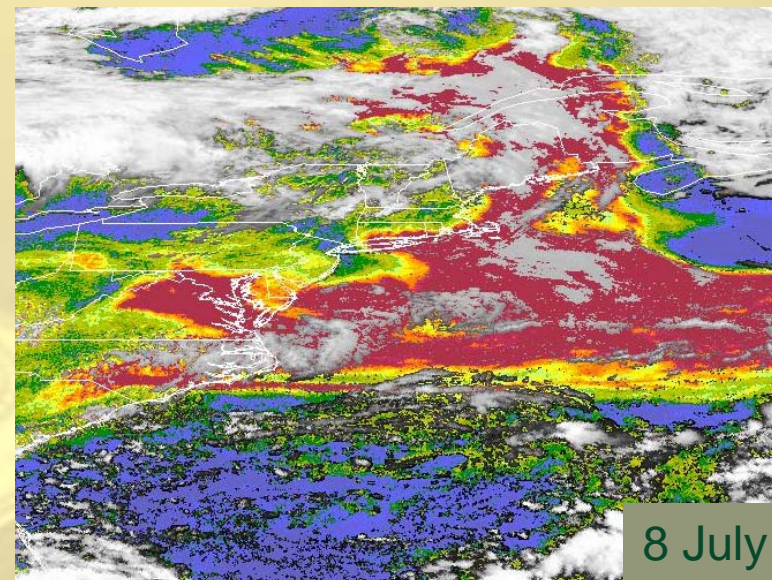
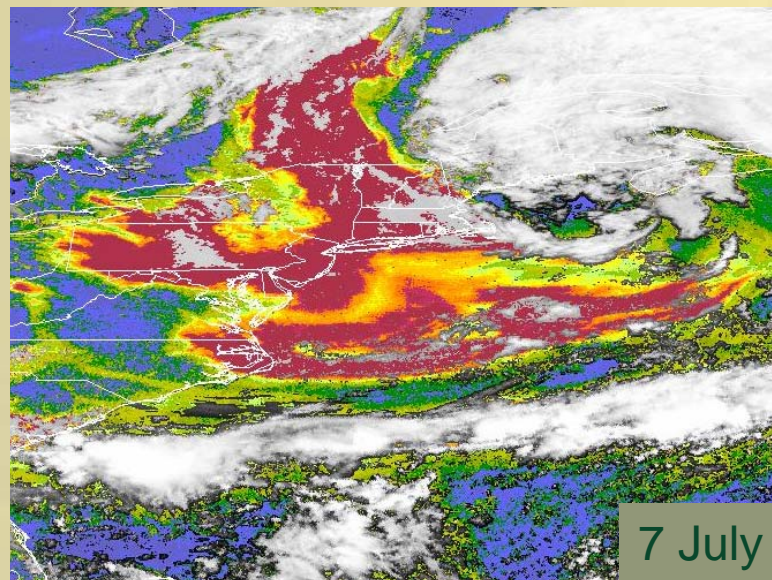
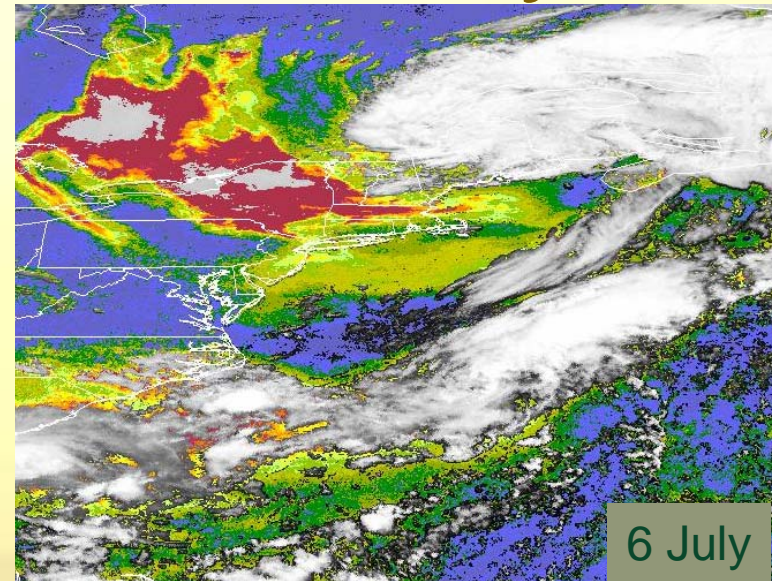
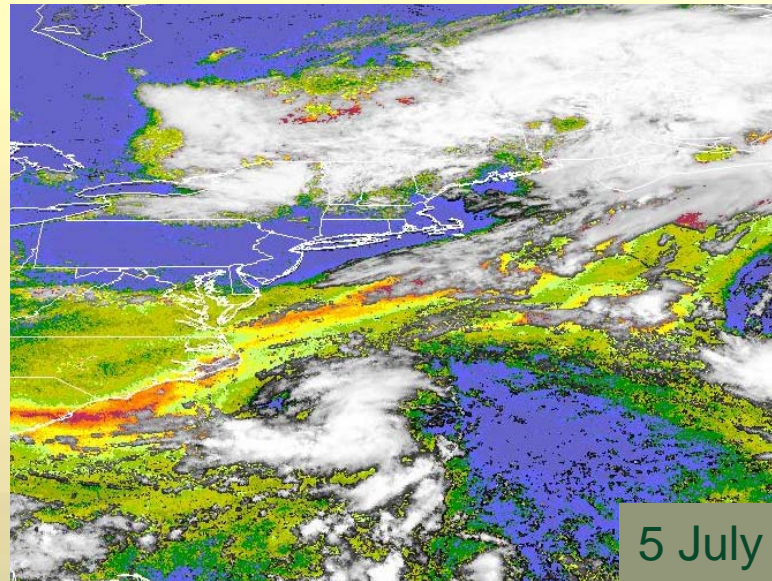
ACTIVE FIRES  
WITH FRESH SMOKE PLUMES

(MODIS Bands 1/4/3)

SMOKE



# Retrieval example: 5-8 July 2002



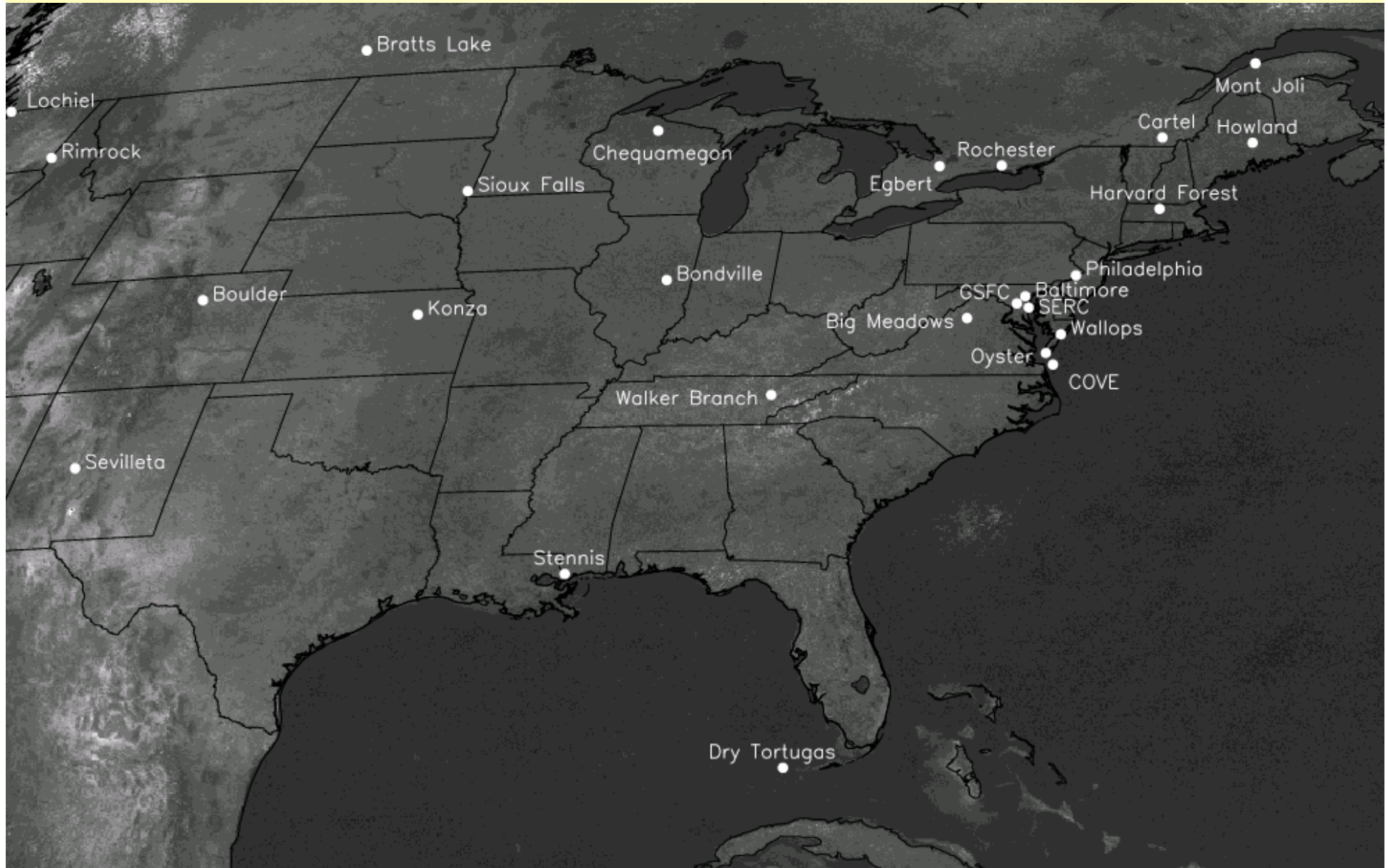
# July 6 loop



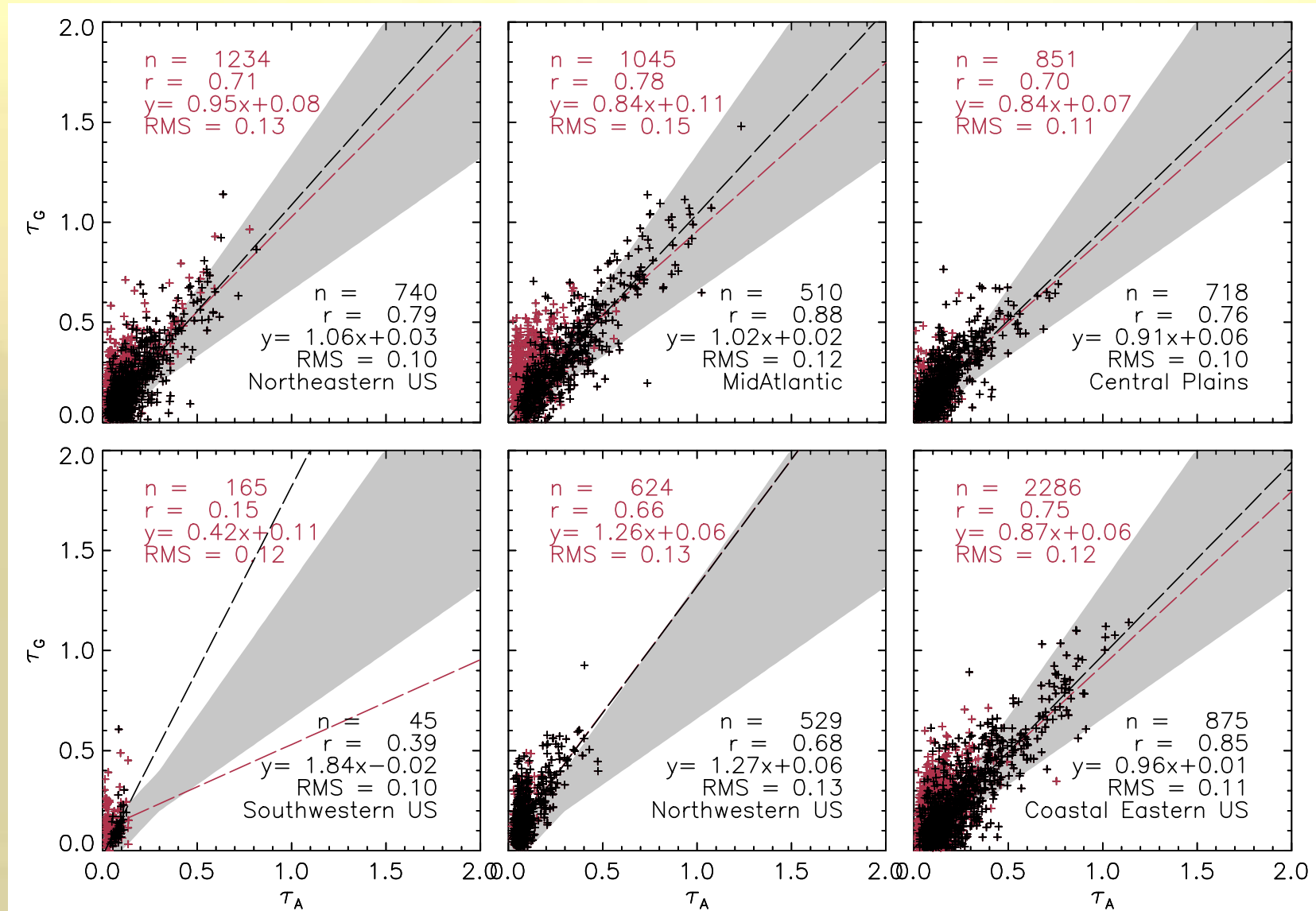
# Validation

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

# U.S. (*North American*) sites

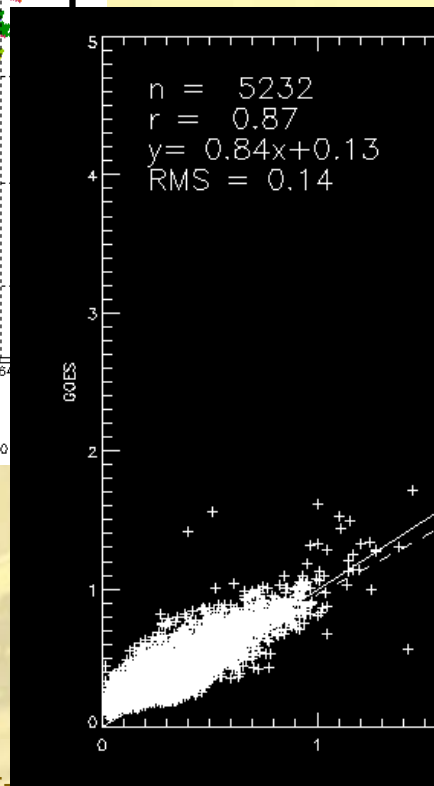
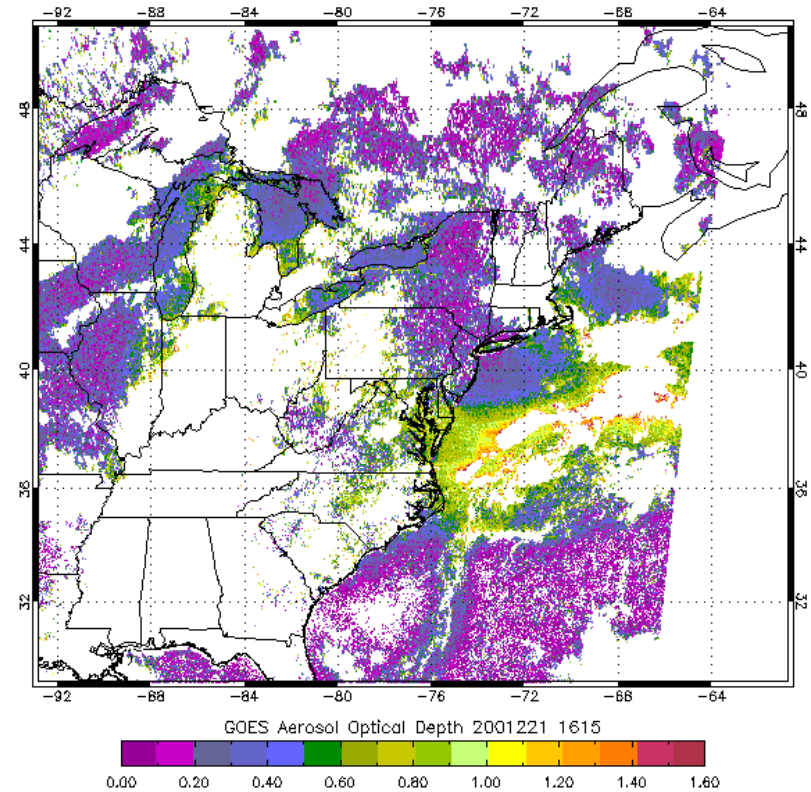
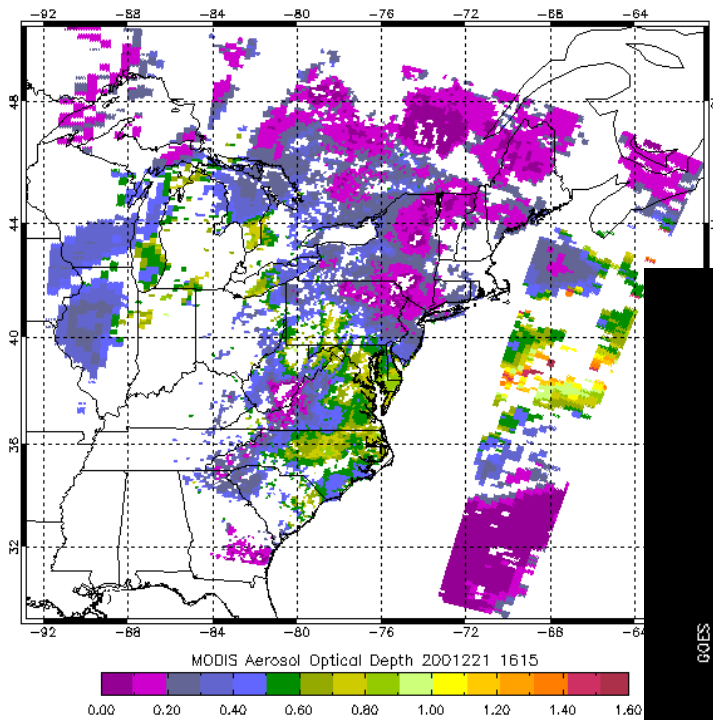


# Validation with AERONET



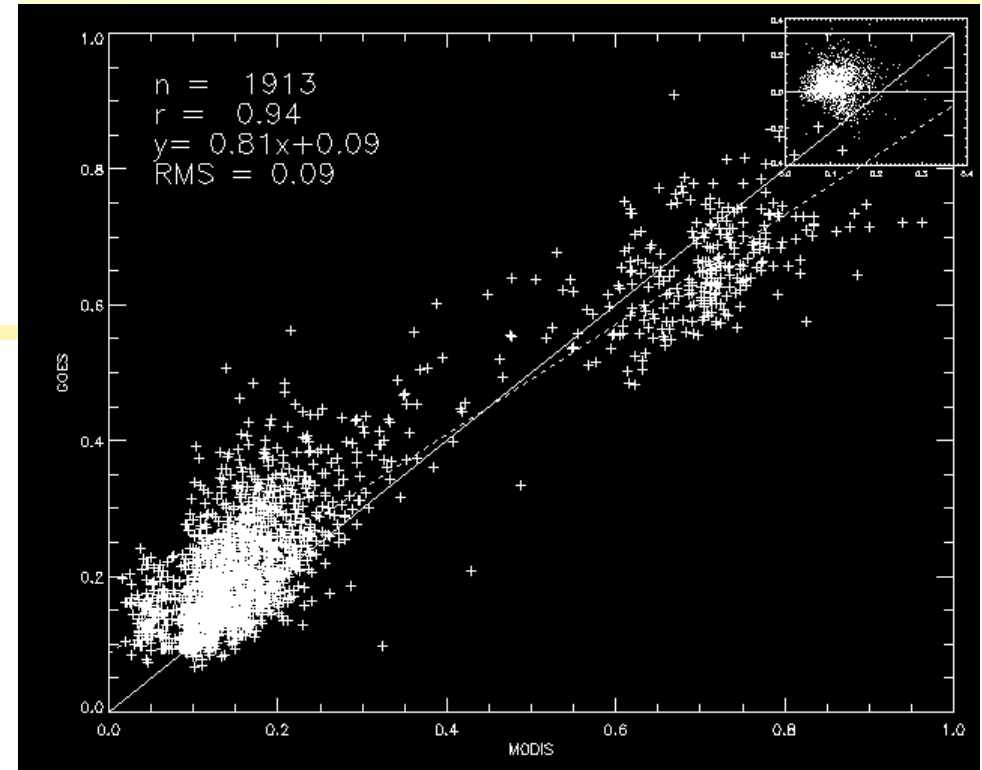
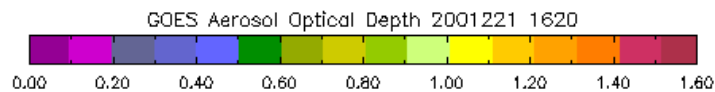
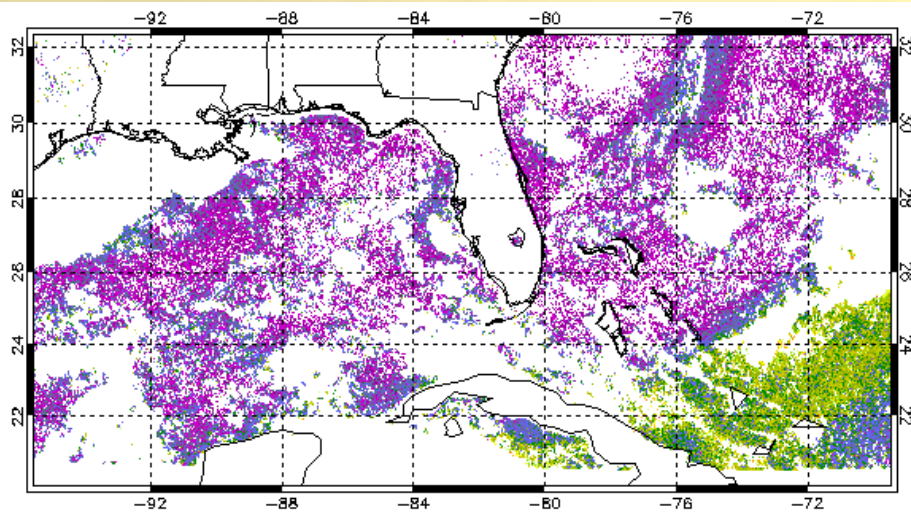
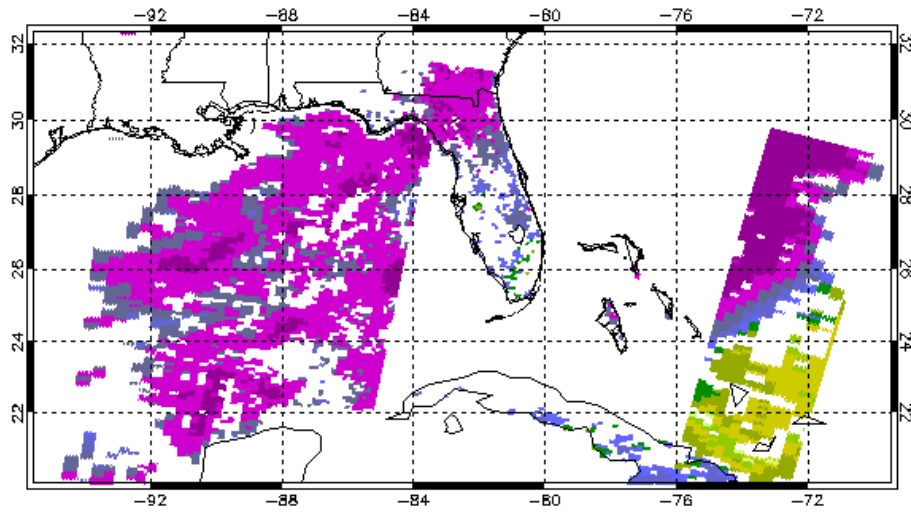
# Comparisons with MODIS

Many are available few are shown



# GOES-MODIS

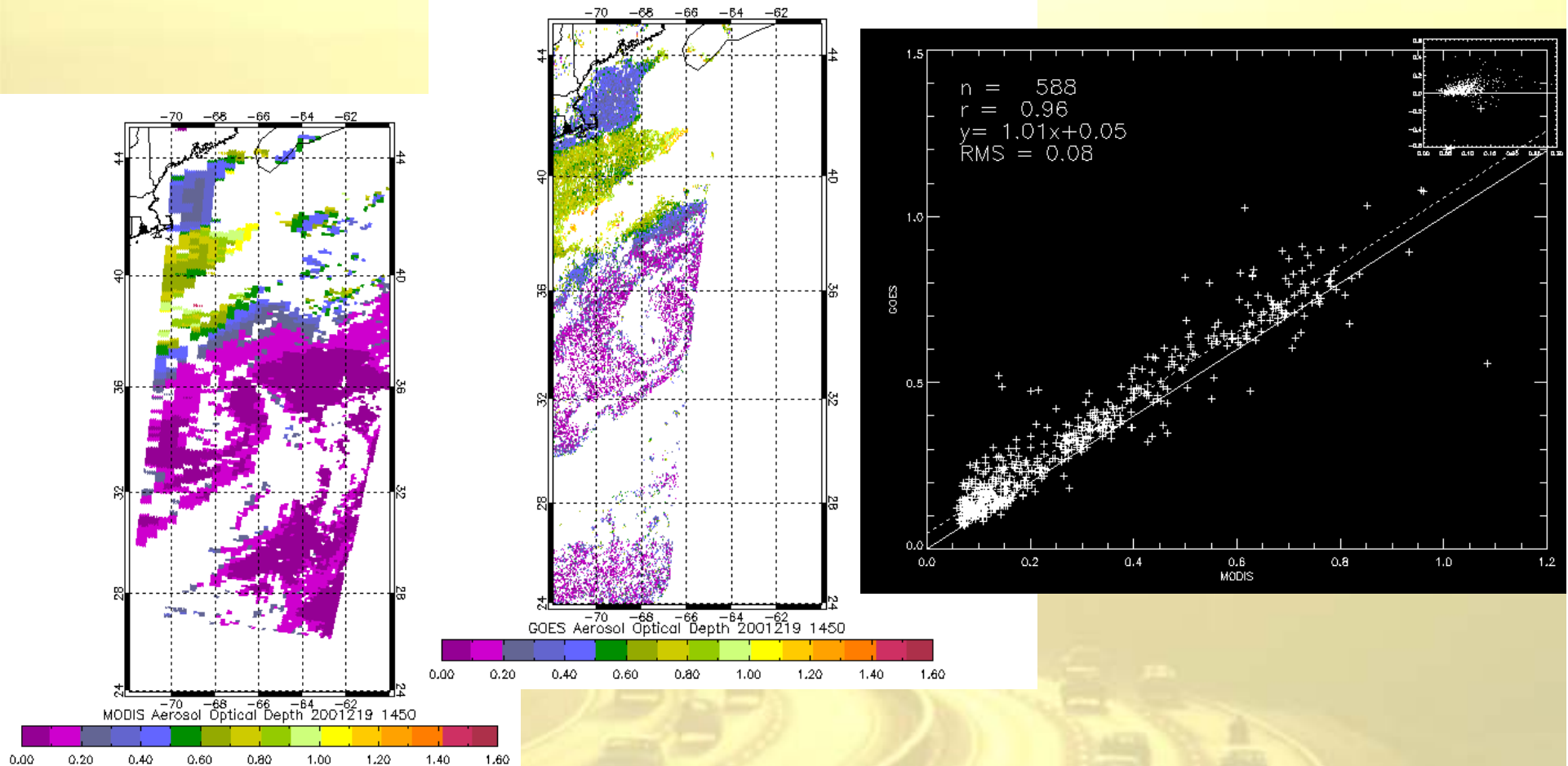
... dust



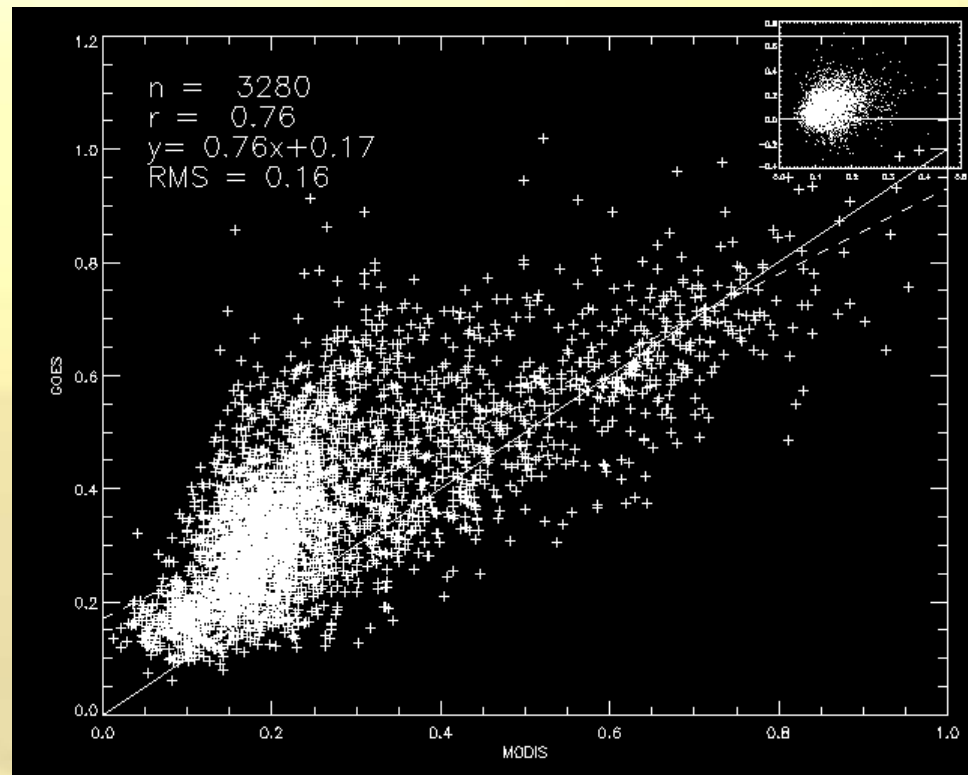
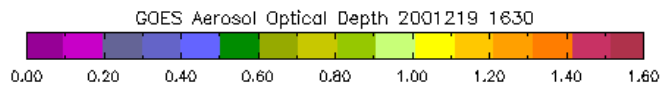
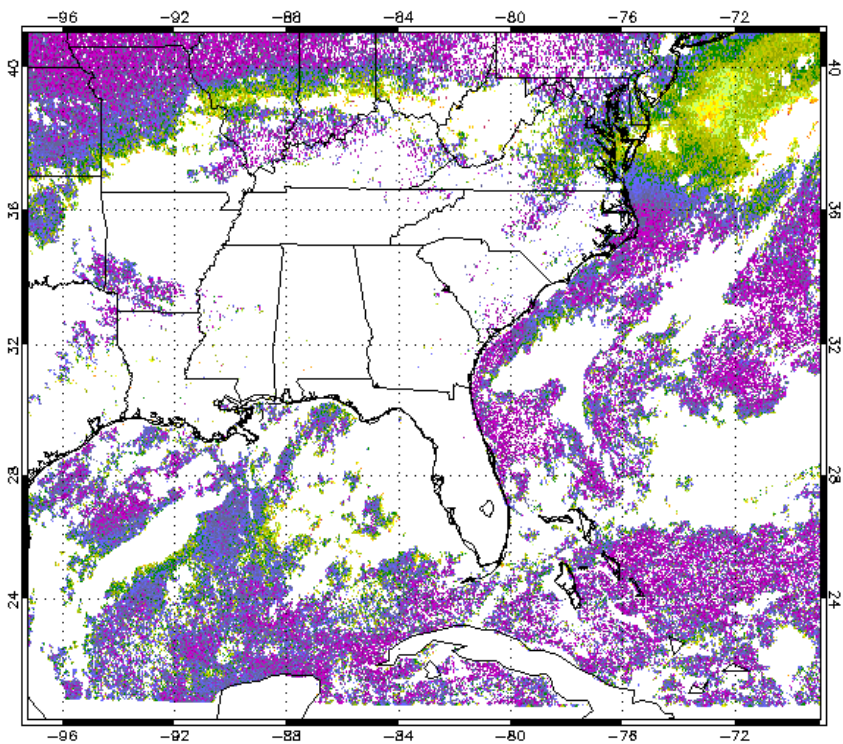
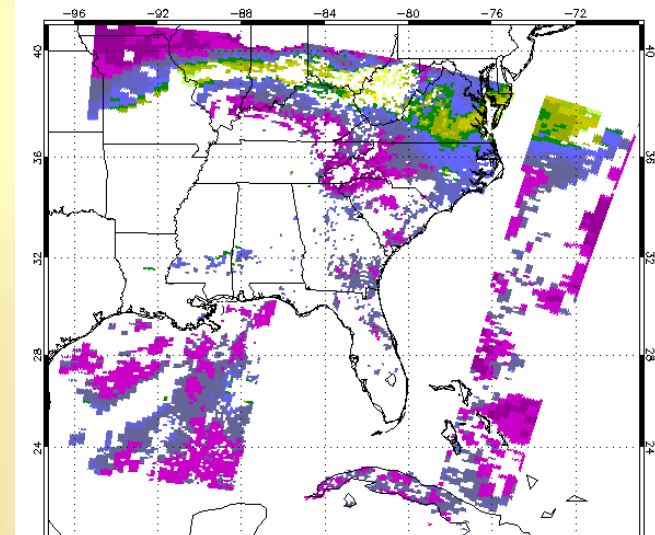
[sv/crad3/gasp/RealTime.html](http://sv/crad3/gasp/RealTime.html)



# GOES-MODIS ... ocean



# GOES-MODIS ... land



[aa.gov/crad3/gasp/RealTime.html](http://aa.gov/crad3/gasp/RealTime.html)

# Web page access to data



**GOES-8 Real Time Aerosol Optical Depth Retrievals - Netscape**

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Location: <http://orbit-net.nesdis.noaa.gov/crad3/gasp/RealTime.html>

wx search News Lookup DC John Fulton's V GOES-8 Real Tim Knapp Home Page Cooperative Ins USGS Real-Time Welcome To Juno Index of /crad3

## GASP

### GOES Aerosol/Smoke Product (GASP)

[Status/Updates](#)  
[Canadian Smoke 3-10 July 2002](#)

*Description*

- An experimental product produced by Ken Knapp ([email](#) - [web page](#)) - CIRA-NOAA/NESDIS/ORA/CRAD/SAT
- The data is provided without guarantees of accuracy or timeliness.
- If you have any interest in this data or possible use of this data, please contact me ([Ken Knapp](#)). I would be happy to answer any questions you have and would like to know how this is being used.
  - Further algorithm development is determined by needs from the users like you.
- A more thorough description of the data is found below.

### CONUS Processing

(4km resolution)

Time (UTC)	Latest Image	Cloud Mask	Mosaic	Surface Reflectance	GOES AOD
<b>Latest</b>	<a href="#">X</a>	<a href="#">Vis Therm</a>	<a href="#">X</a>	<a href="#">X</a>	<a href="#">X</a>
Loops	<a href="#">X</a>				<a href="#">X</a> <a href="#">Inspect</a>
12:45	<a href="#">X</a>	<a href="#">Vis Therm</a>	<a href="#">X</a>	<a href="#">X</a>	<a href="#">X</a>
12:15	<a href="#">X</a>	<a href="#">Vis</a>	<a href="#">X</a>	<a href="#">X</a>	<a href="#">X</a>

# 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