

# ***Remote Sensing Information Gateway (RSIG)***

Research & Development

*Building a science foundation for sound environmental decisions*



A composite image at the top of the slide. On the left, a satellite orbits Earth, with a beam of light directed towards the planet. On the right, a weather map shows a storm system over the Pacific Northwest, with colors ranging from green to red indicating intensity.

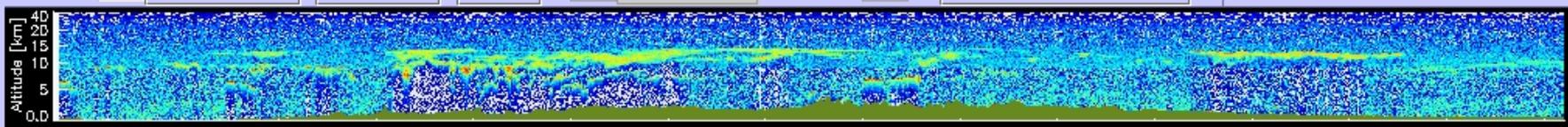
# Key Features

- Designed by EPA scientists
- Interoperable with other OGC-compliant systems
- Up and running today
- Subsets files at the source
- Single website virtually serving many kinds of data
- Aggregates data files
- Includes a **visualization capability**
- **Fast**: applet and servlets are streamlined
- Provides many useful **"Save As" formats** for the data and images, such as XDR binary, ASCII, HDF, MPEG, NetCDF, and KMZ



Variables:  Calipso  Modis  Modis  CMAQ  CMAQ Wind  Site Observations  Tool tips

40 TAB 532nm AOD COT 1 Ozone 1 AQS PM 2.5

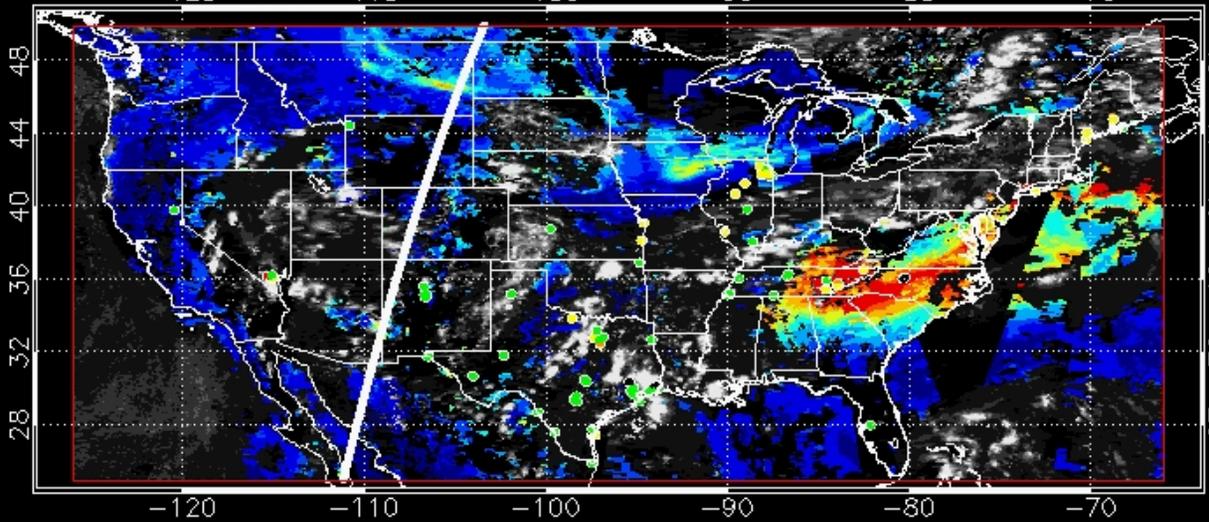


Longitude  
Jul 5, 2006 9:00 GMT

-120 -110 -100 -90 -80 -70



Calipso 532nm TAB [1/km/sr]



Modis04 AOD



Modis COT



AQS PM 2.5 [ug/m3]

\* Processing  
\* .....  
Assembling image frames locally.....done.

Show  
Save  
Help

Date Controls  
Date: 2006 Jul 05  
Number of days to process: 1

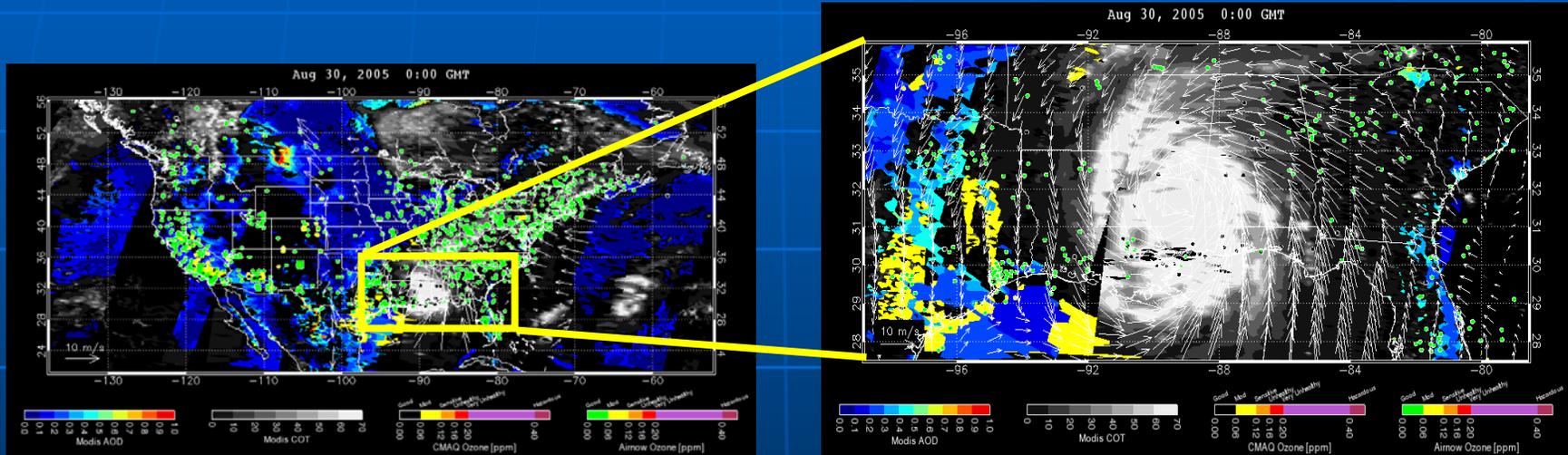
Bounding Box  
N 50  
W -126 -66 E  
25 S

Playback Controls  
Play Rate: 30

Map Controls  
City  
Region  
Globe

# Subsetting

- **Time:** extract & transfer only data within hourly range (over many days)
- **Variable:** extract & transfer only variables of interest
- **Domain:** extract & transfer only data within a chosen lon-lat box



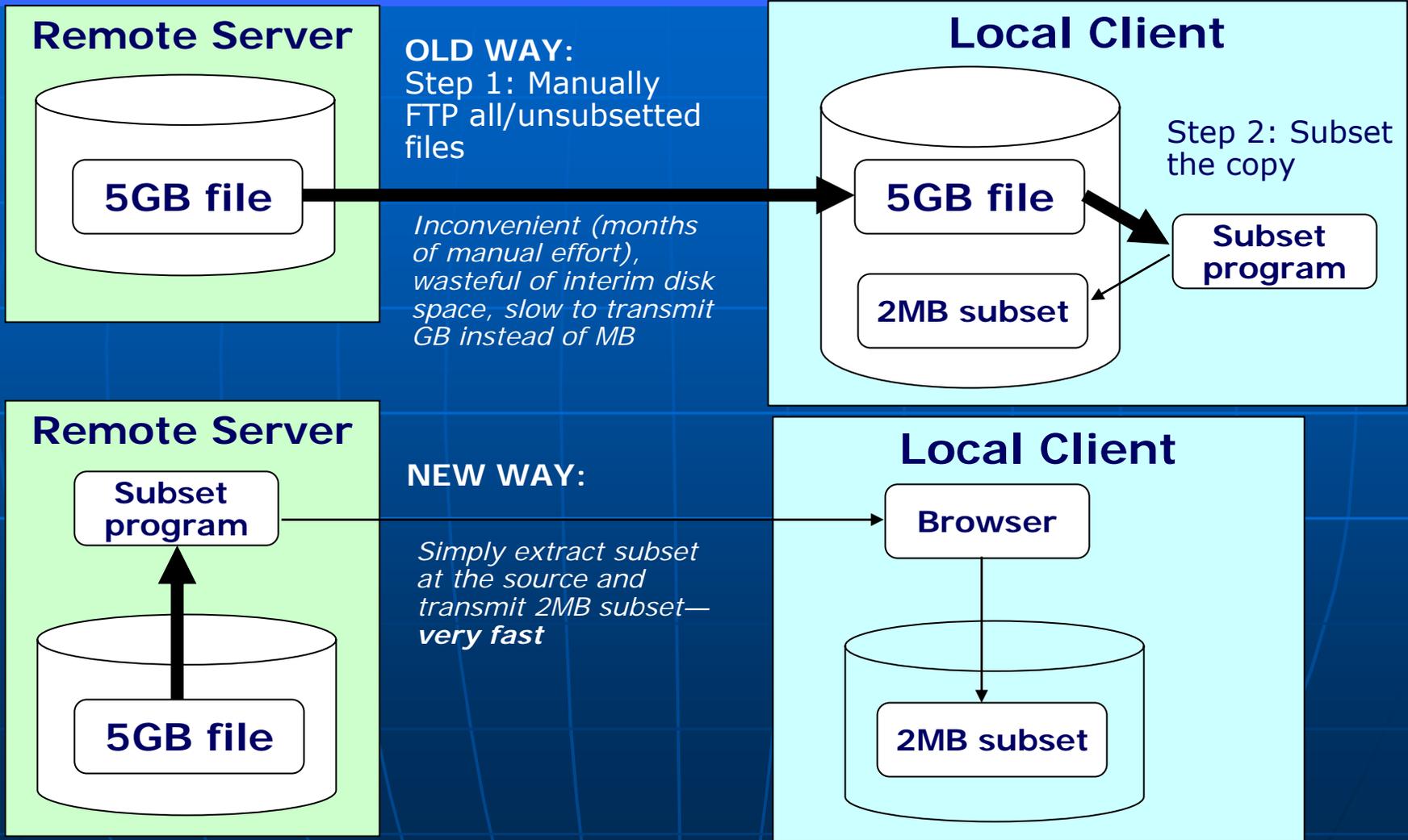
For example, each (daily met) CMAQ file is 442 rows x 265 columns x 22 layers x 10 variables = 5GB

The subsetted file is only 2.5MB—1/2000<sup>th</sup> the source data size. Convenient, fast, and efficient to transmit across the network.

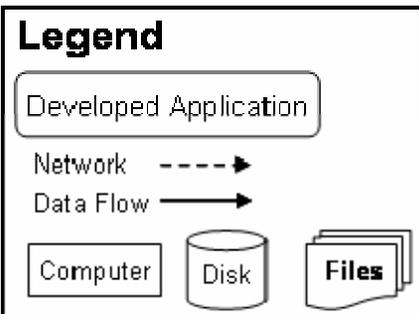
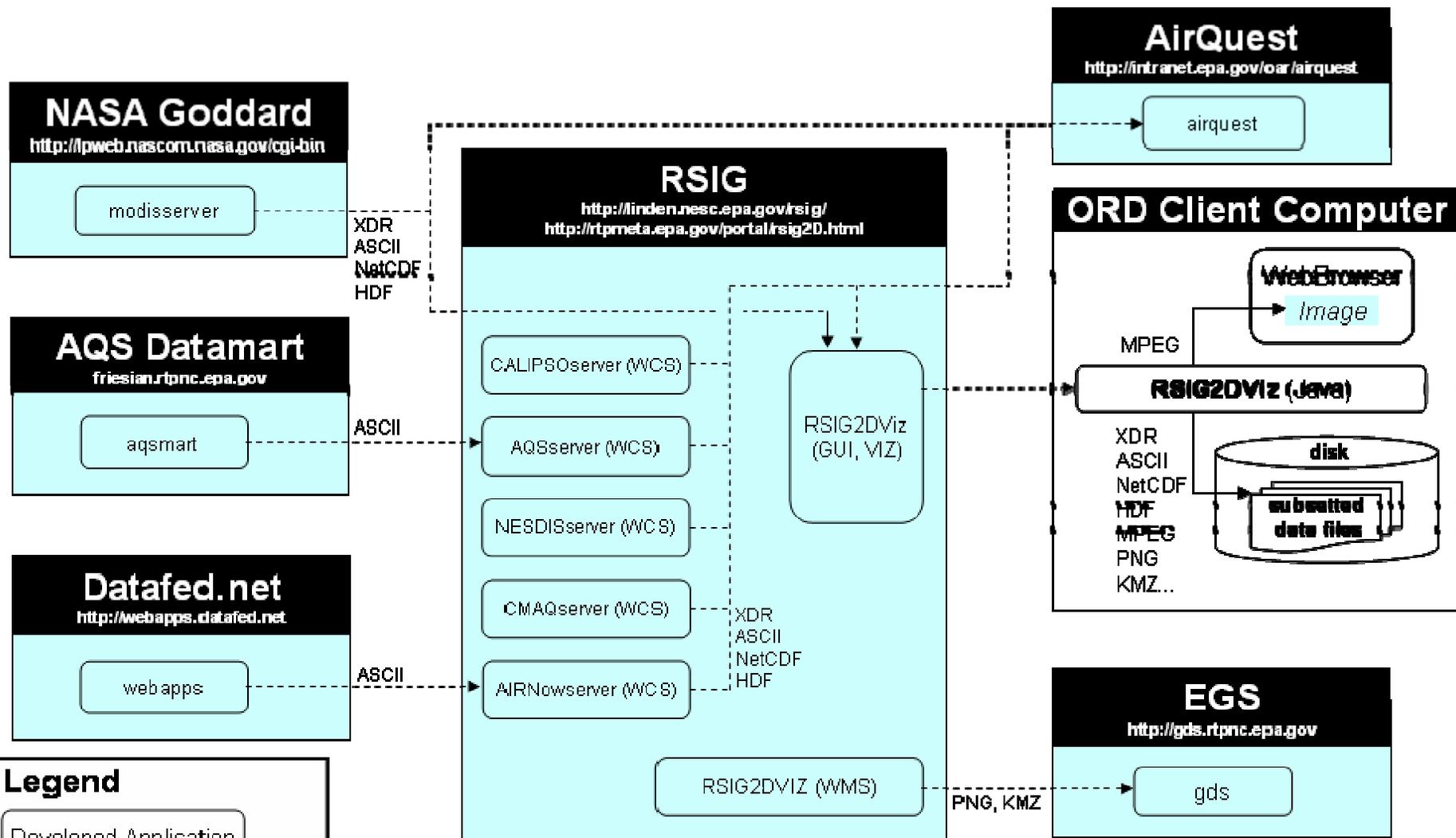


# Fast

What took *months* of manual effort to retrieve data can now be done in *seconds*



# Connections to and from RSIG

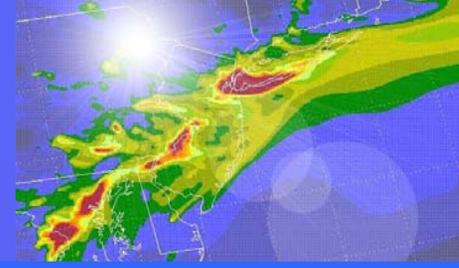


# Interoperability Standards Supported by RSIG

- OGC–WCS/XML
- OGC–WCS
- OGC–WMS
- ASCII
- IEEE–754
- XDR
- NetCDF
- NetCDF/COARDS
- NetCDF/IOAPI
- HDF
- HDF–EOS
- PNG
- MPEG
- KML/KMZ
- HTML
- PDF
- HTTP/80
- SI



# Why Standards Are Not Enough



- Missing data units
- WCS does not nail down the specifics of the format of the resulting data, for example, NetCDF–COARDS vs. NetCDF–IOAPI, CSV, etc.
- HDF/4/5/EOS: NASA satellite data files use inconsistent conventions for describing/encoding/structuring data, such as for the bounding box, variable names, dimensionality, data order, non–SI units, SDS, VData
- Performance issues, e.g., (1) too slow if data files are on tape or if the database has no appropriate index file, (2) need formats that are fast, efficient, simple and streamable (i.e., no disk I/O), such as RSIG’s custom ASCII/XDR format vs. NetCDF, etc.



A satellite in the top left corner and a weather map in the top right corner, both set against a blue background with a grid pattern.

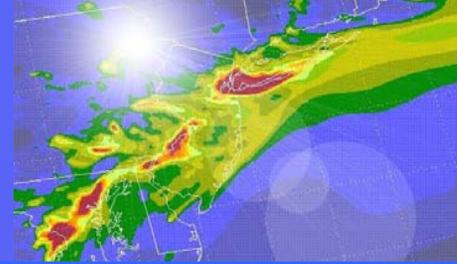
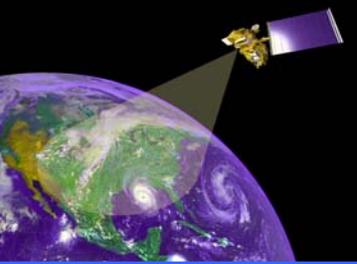
# Planned Enhancements

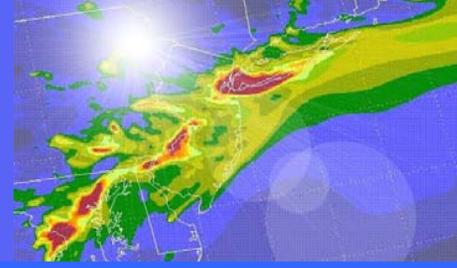
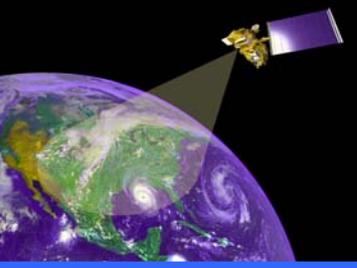
- Install WCS servers, web pages, and downloadable applet on the EPA Portal/Environmental Science Connector to allow access from computers outside the EPA network.
- WCS servers will be modified with an option to regrid (project and aggregate) all data onto CMAQ grid cells. This will be done at the source by custom-developed XDRConvert program for efficiency and performance.
- Add new data sources including: MOPITT CO, AURA-OMI NO<sub>2</sub>, GOME-2 NO<sub>2</sub>, GOES-AOD, etc.
- Add new output formats: GeoTiff, ESRI/ARC Grid, IOAPI (regrid), etc.
- Launch HB/MCMC and read and display resulting data from HB and LARCTM models, etc.
- Additional Thoughts? Looking for Your Input!



# Areas of Focus

- Access from non-EPA computers for research partners using the EPA Portal.
- Availability of EPA data outside EPA, such as CMAQ “base case” runs.
- Availability, performance, and convenient access to external data via WCS.
- Use RSIG WCS/WMS servers in other applications.

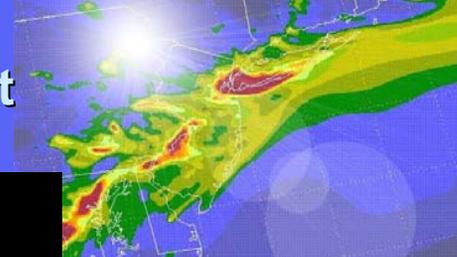




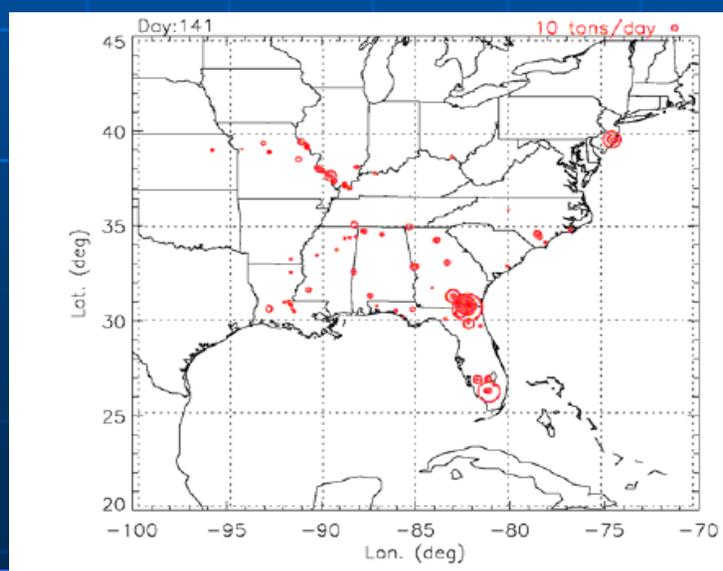
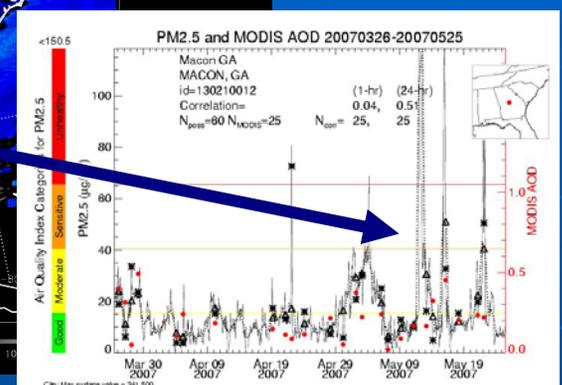
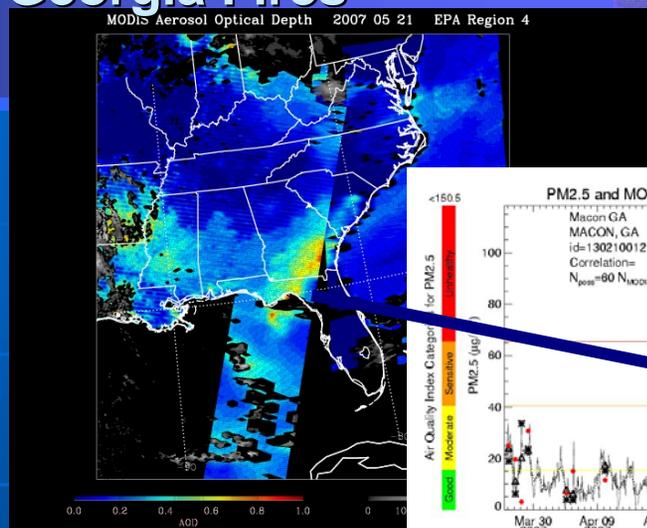
# Some Potential Applications of Data Sets Available via RSIG



# Use of RSIG as a tool to help Exceptional Event Flags - 2007 Georgia Fires



Macon, Georgia

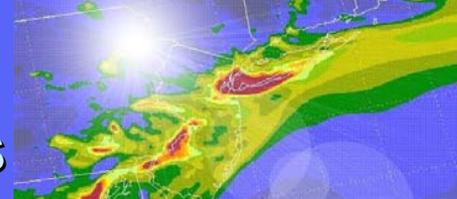


■ Adjacent plots show MODIS aerosol optical depth and time series of AOD & continuous PM<sub>2.5</sub> concentration (top panel) and NESDIS-GOES PM<sub>2.5</sub> emissions (bottom panel) from the May 2007 Georgia wildfires. Throughout May, smoke from these fires blankets part of Georgia and Florida and affected others states in the SE, leading to numerous air quality health alerts.

• Satellite data, such AOD, fire activity, and emissions can be used under 40 CFR Part 50 to demonstrate ground monitoring data was influenced by exceptional events, such as wildfires and dust storm.



# Comparison of CMAQ derived AOD and MODIS AOD - 2004 Alaskan Fires



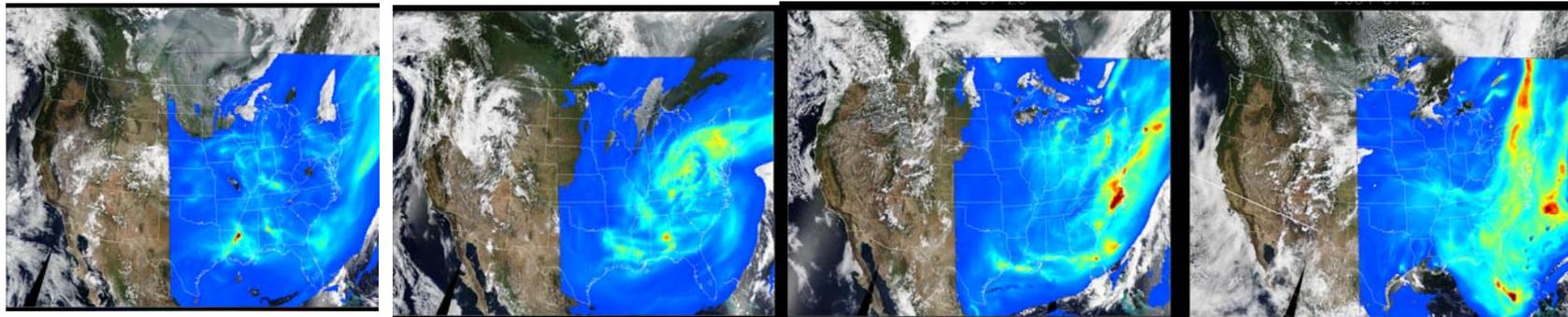
July 16

July 18

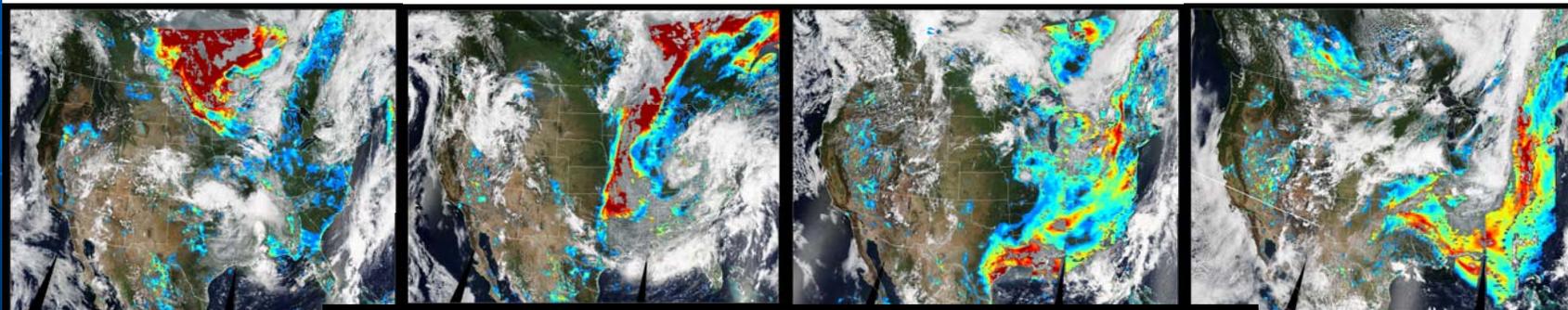
July 20

July 22

CMAQ AOD



MODIS AOD



0.2

0.4

0.6

0.8

1.0

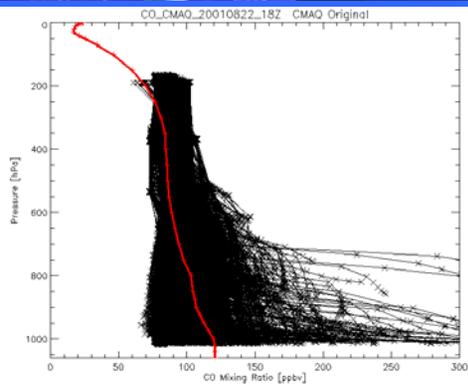
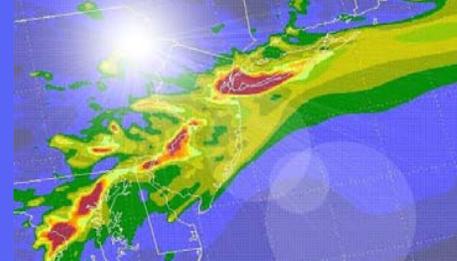
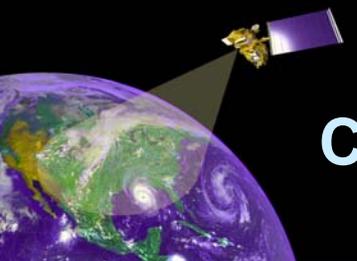
AOD

Transport from outside the domain influences observed PM concentrations causing under-prediction:

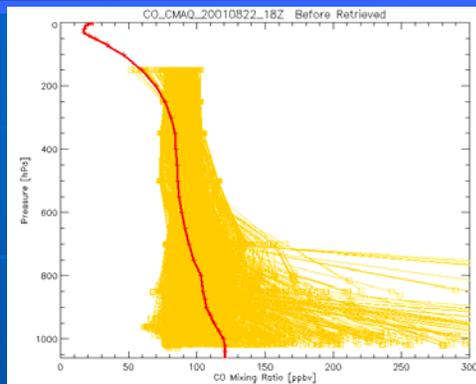
- Model picks up spatial signatures ahead of the front
- Under predictions behind the front (due to Lateral Boundary Conditions)



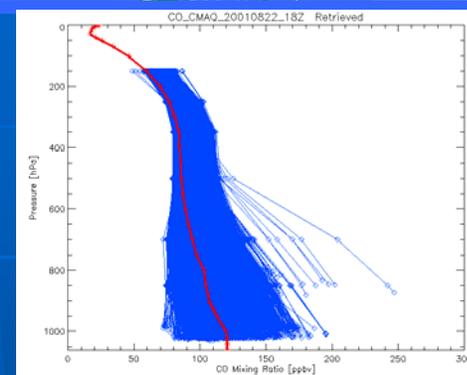
# CMAQ (retrieved) CO vs. MOPITT CO



CMAQ output

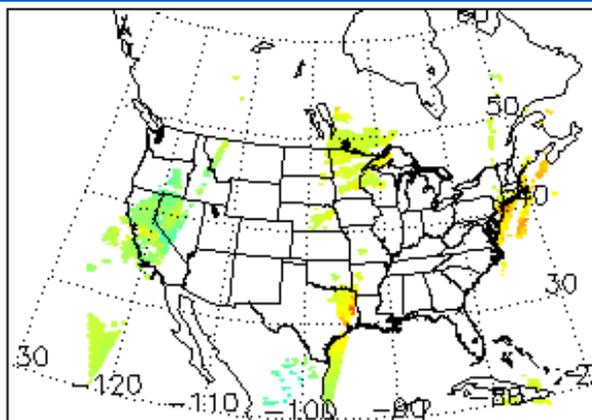


Interpolate CMAQ output to MOPITT pressure grid

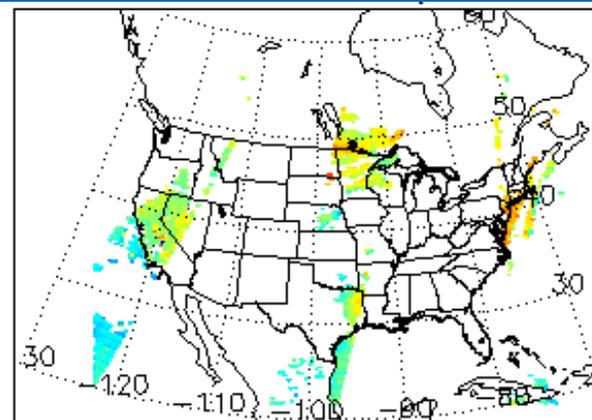


Interpolate CMAQ output resampled w/ MOPITT averaging kernel

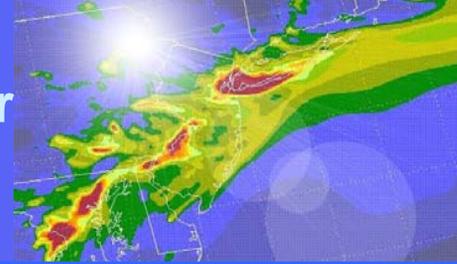
CMAQ Retrieved CO Column 2001  
0822 18Z



MOPITT CO Column (A Priori < 50%)  
2001 0822 18Z

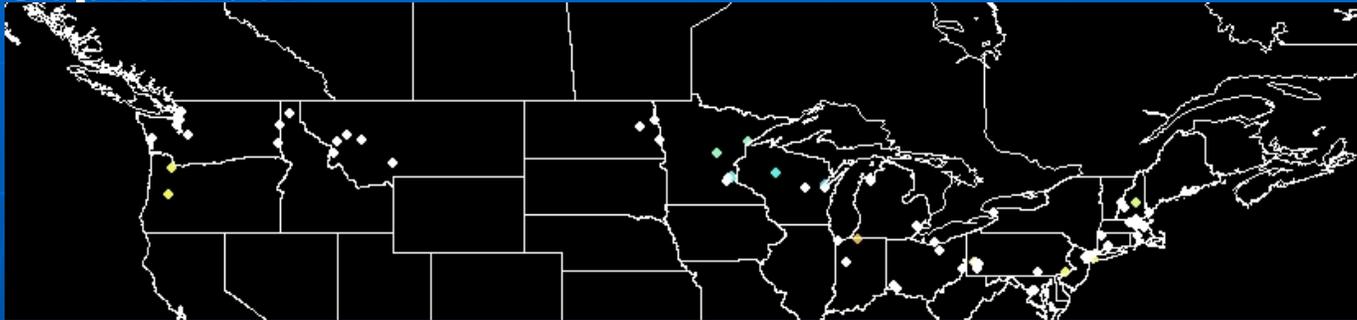


Can AOD be used to assess aerosol trends over large domains and relationship to  $PM_{2.5}$



September

EPA  $PM_{2.5}$  2000 - 2006



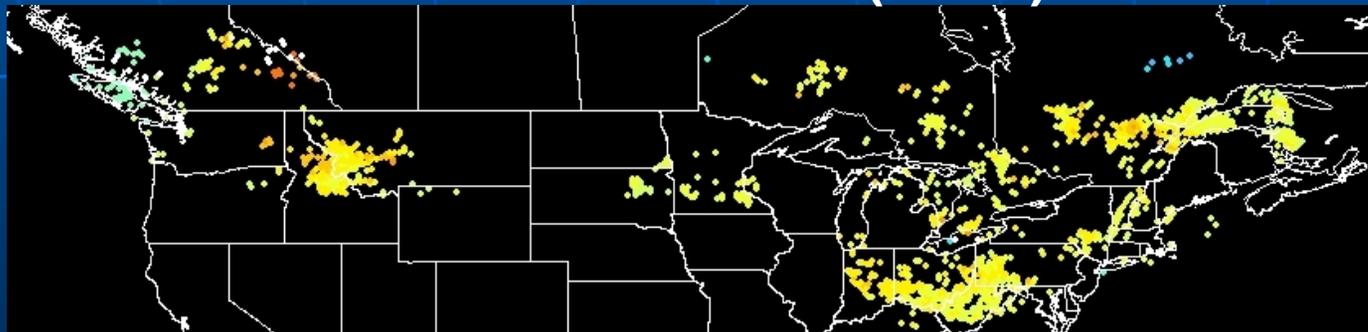
-7.0

0

7.0



MODIS AOD (Terra) 2000 - 2006



-0.4

-0.05

0

0.05

0.4

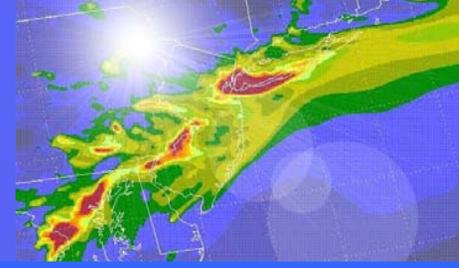
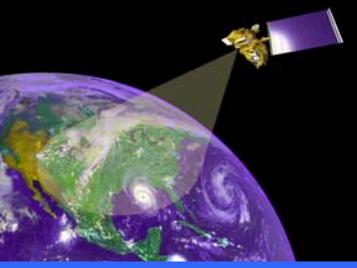


Research & Development

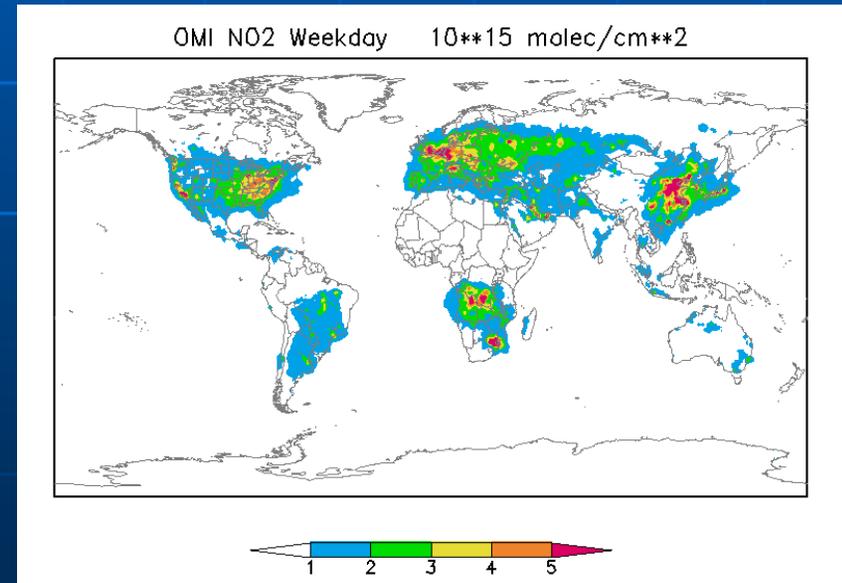
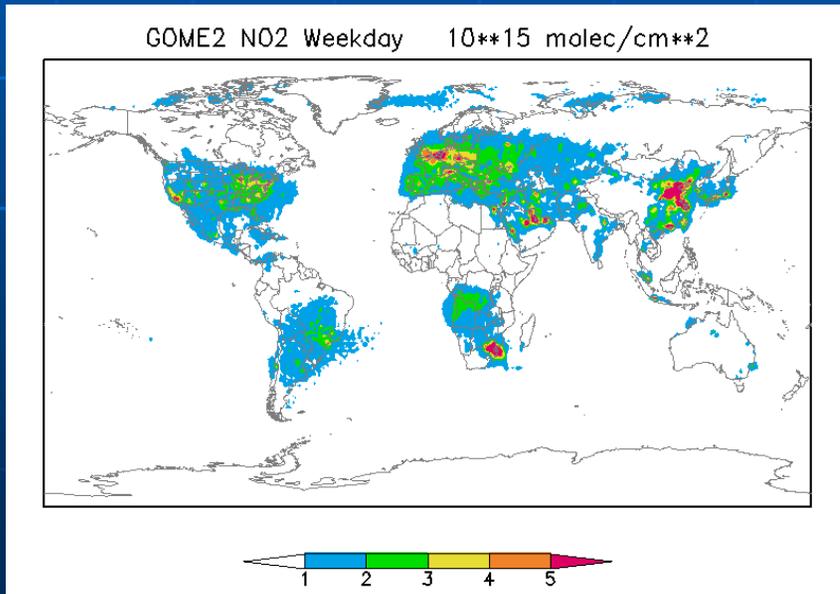
Building a science foundation for sound environmental decisions

DeWinter J., et. al, AGU Winter 2007

# Future Data accessed via RSIG



- Preliminary Satellite Column NO<sub>2</sub> data operationally processed by NOAA/NESDIS
- August 2007 monthly maps of GOME-2 and OMI NO<sub>2</sub>



# Q&A

- Questions?
- Comments?
- Concerns?

