USEPA GEO- Advance Monitoring Initiative

Modeling Fused Spatial Data for Improved Public Information on Air Quality

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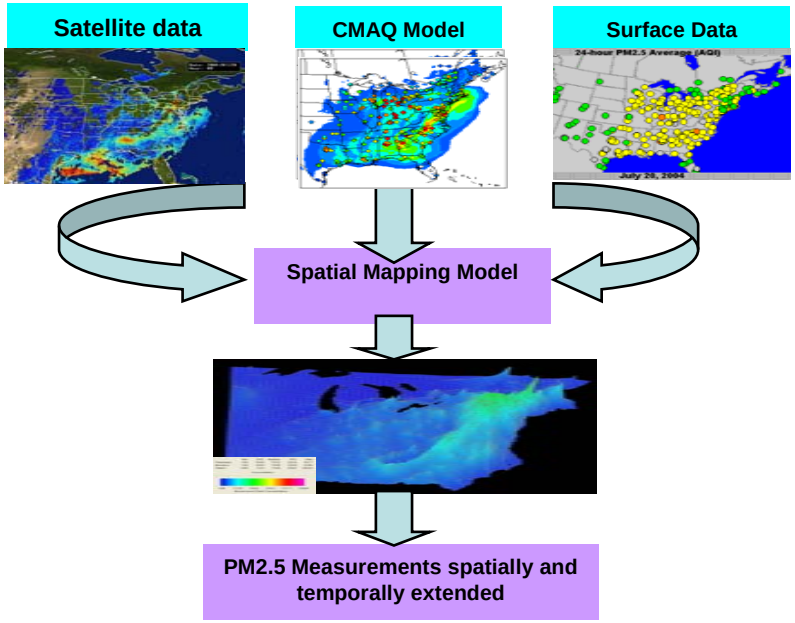
Air Quality Applications



AMI-Modeling Fused Spatial Data for Improved Public Information on Air Quality

Earth Science Results Used

•AOD products from MODIS-Terra and MODIS-Aqua at the standard horizontal resolution of 10km x 10km and high resolution 5km x 5 km.

•Current GOES AOD product at 4km x 4km horizontal resolution. This should be considered risk-reduction for future GEOS-R air quality application.

•Data remapping software developed at NASA LaRC for remapping MODIS and GOES AOD onto a standard grid used within EPA Community Multi-Scale Air Quality (CMAQ) model.

Partners, Approach, Milestones

•Partners: US EPA (ORD and OAQPS) , NASA-LaRC, NOAA (NESDIS and OAR), UMBC.

•EPA Advanced Monitoring Initiative (AMI) project, 2-year funding for demonstration of new measurement capabilities, part of EPA's effort under GEOSS**.**

•Use satellite data as a predictive parameter in a space-time-model to produce daily maximum surface concentrations of $PM_{2.5}$.

•Model development – early 2007

•.Run demonstration for near real-time predictive spatial maps – late 2007.

Expected benefits

•DSS – AIRNow: Current and next day spatial patterns of PM2.5 with associated prediction errors will be displayed and archived on EPA's AIRNow web site.

•Through the statistical fusion of air monitoring networks, MODIS and GOES aerosol optical depth, and results from CMAQ the goal of this project is to provide air managers more reliable evaluations of the effects of air quality across non-monitored regions**.**

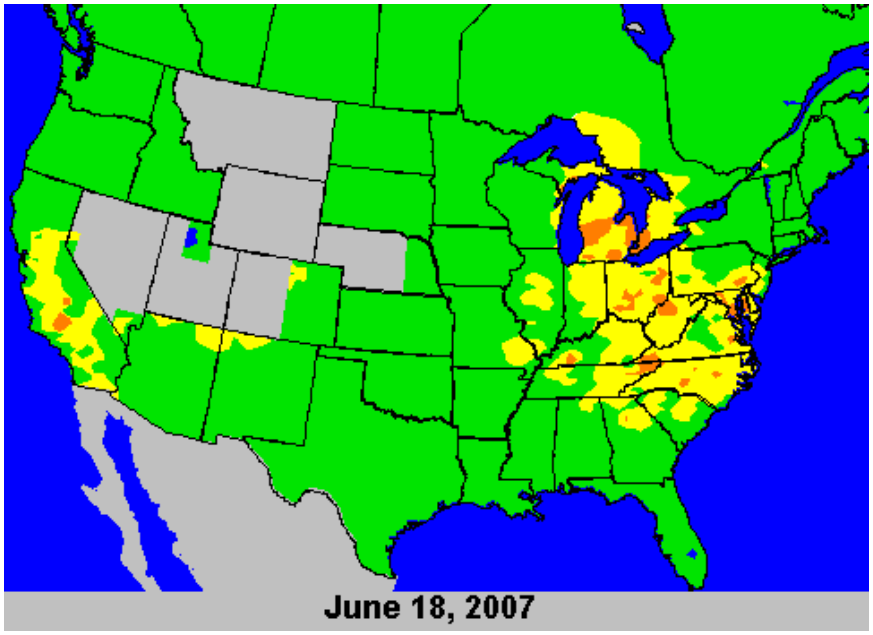
•Identified as USGEO Air Quality Assessment and Forecast System Near-Term Opportunity - *Integrated Observed-Modeled Air Quality Fields* to provide enhanced air quality characterizations through the fusion of air observation systems and predictive air quality models for air quality management, forecasting, science, and health effects research**.**

Modeling Objectives (FY06 AMI Proposal)

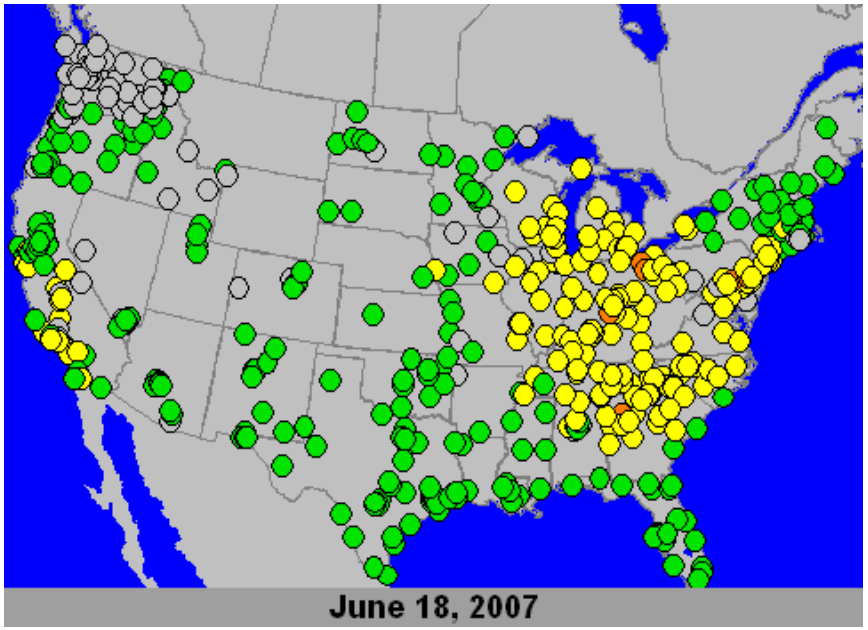
- **Objective**
  - For AIRNOW, provide a spatial maps of
    - maximum 8-hr ozone concentrations.
    - daily average $PM_{2.5}$ concentrations.
    - next day daily maximum 8-hr ozone concentrations.
  - O3 or PM2.5 Map is needed asap after last hourly measurement of previous day (ie. 11pm)

Current AIRNow Products

Ozone: 8-Hour Peak AQI

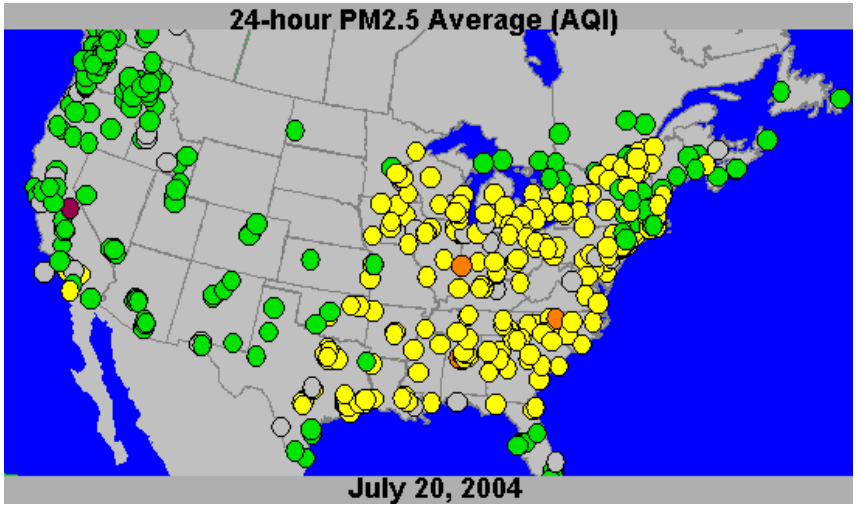


Particles (PM2.5): Daily 24-Hour AQI, (midnight to midnight)



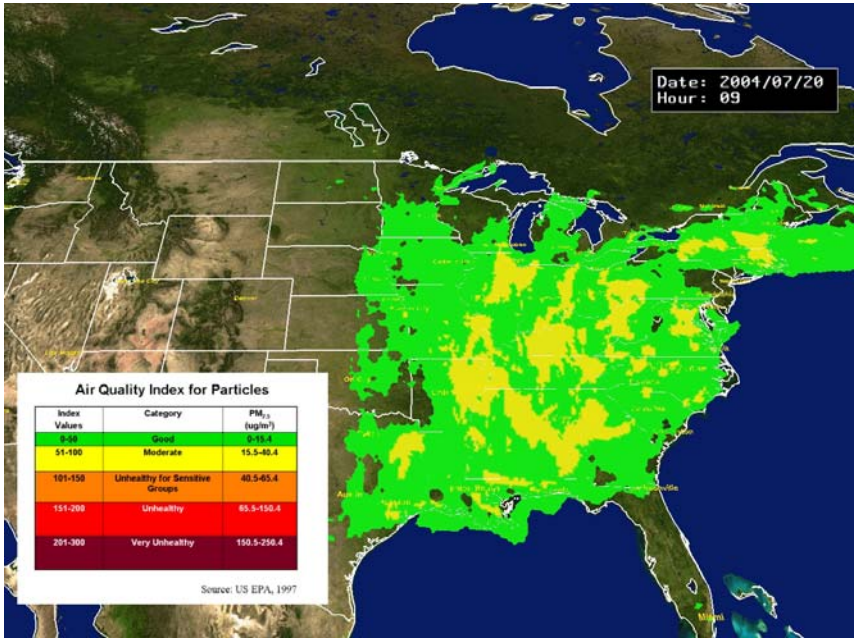
Ambient Air Monitoring

- "True" measure of air quality
  - Ozone and PM2.5– hourly
  - Sparse networks (number of monitors range from about 350 across U.S. for aerosols to 1000s for ozone)
- Monitors are usually sited in either urban
  - Many rural areas have no monitors for ozone of PM2.5
- Data quality and representativeness can vary for continuous PM2.5 networks



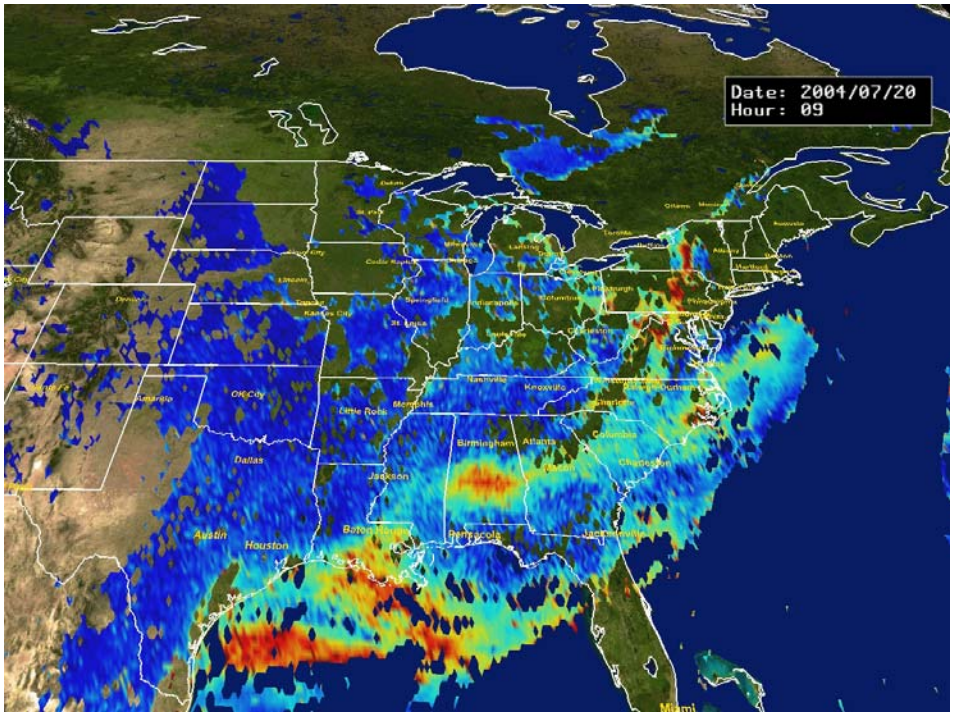
Air Quality Modeling

- Estimate of air quality
  - High spatial and temporal resolution
  - 12 km horizontal grid,1-hr time steps
  - *but* potential for high error in modeled concentrations relative to monitoring data
- Air Quality Forecasting
  - Emerging source of routine data



Satellite-Derived Air Quality Data

- Surrogate for air quality
  - High spatial and temporal resolution Provides integrated columnar information (vs. surface concentrations)
  - Algorithm uncertainties: Derived chemical species values from primarily radiative properties
  - Experimental uncertainties: Environmental Noise (e.g., clouds contamination, surface reflectance); Calibration issues
  - Emerging source of routine data



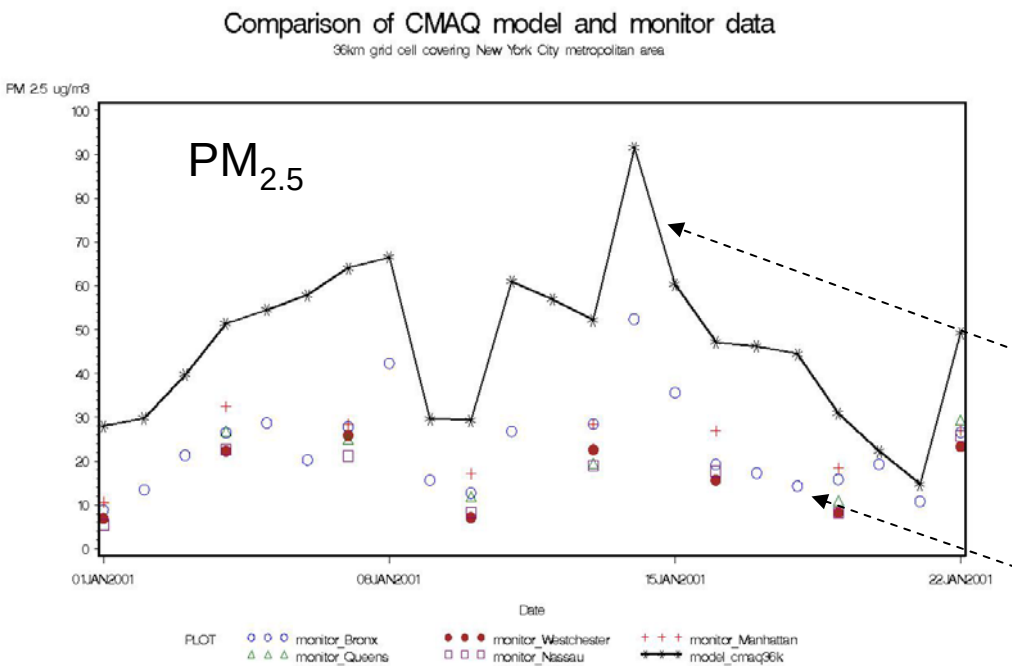
Sources of Spatial Data

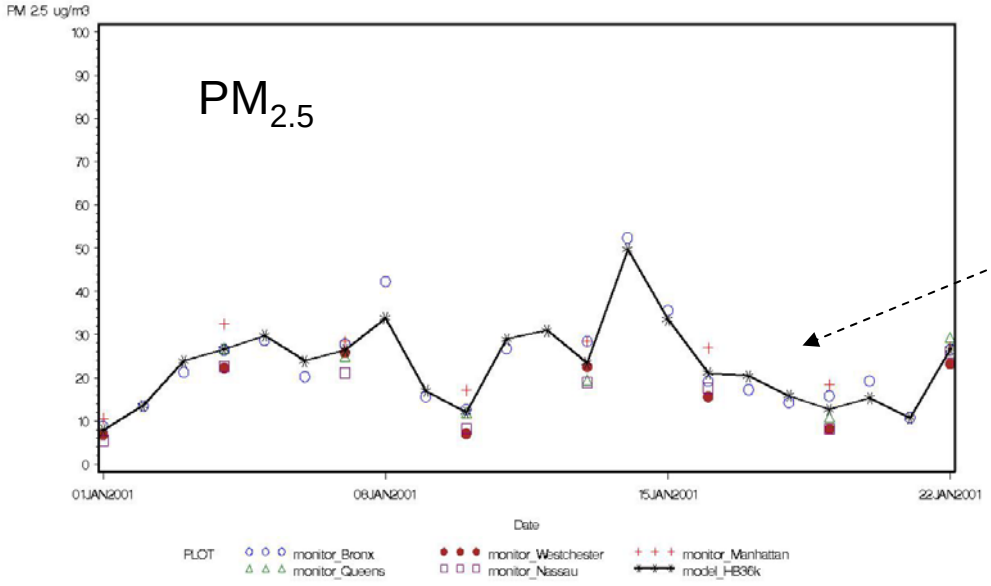
(Case Study Period August 2-14, 2005)

- **Surface Measurement Data (O_3 and $PM_{2.5}$)**
  - Hourly O_3 & $PM_{2.5}$ data from real-time monitoring sites in the eastern US (Use data from approximately 85% of sites for modeling (estimation and forecasting) and set aside data from 15% of sites for validation).

- **CMAQ Eta forecasts**
  - High resolution gridded data over a 12km grid in the eastern US ($PM_{2.5}$ not operational until 2012)

- **Satellite Derived Measurement Data ($PM_{2.5}$)**
  - MODIS AOD (Terra) and (Terra & Aqua) – Downlink limitations
  - GOES AOD (GOES East) 30 minute during daylight





Improving the quality of observations or modeled results in isolation through "fusion" techniques.

CMAQ Prediction
(line)

AQ Monitoring Data
(various points)

After application of statistical combination technique

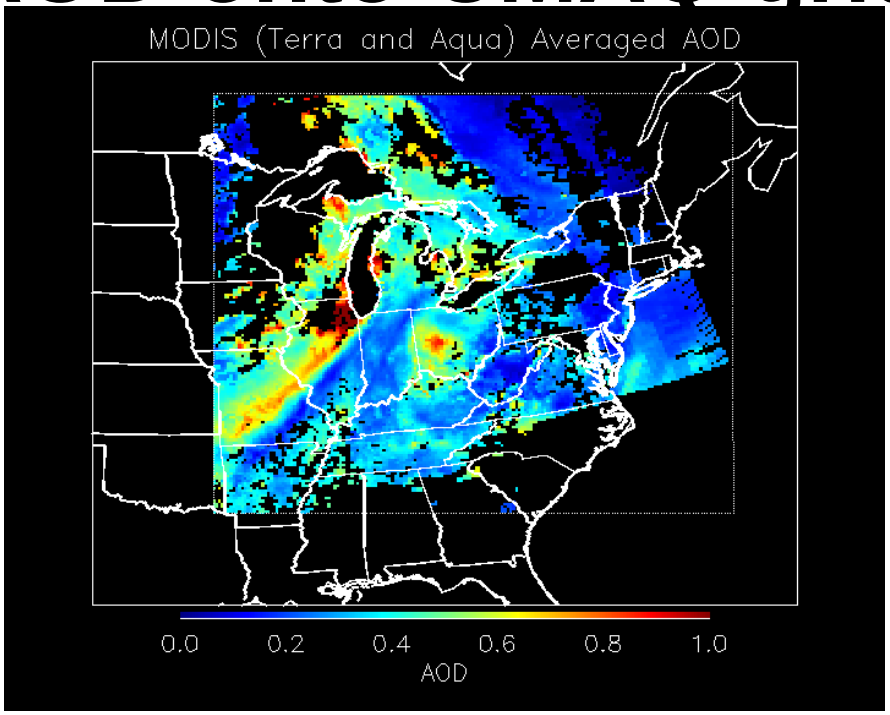
Use of AOD in PHASE Project

- Initial attempts use MODIS AOD as independent surface – spatial variable
- “Missing data” limit improvement in predictions
- Considering model changes and GASP AOD

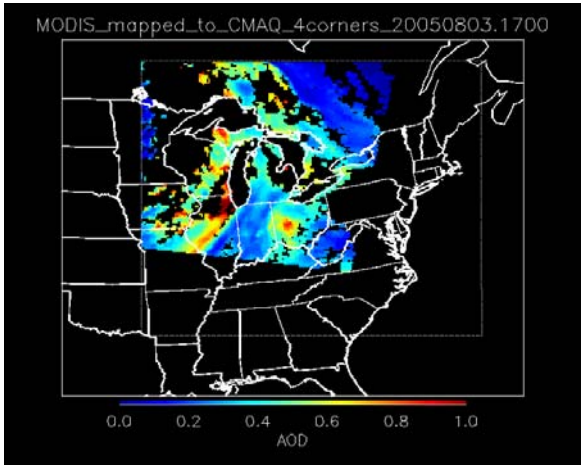
Regridding MODIS AOD onto CMAQ grid

2005 Aug 3 MODIS AOD

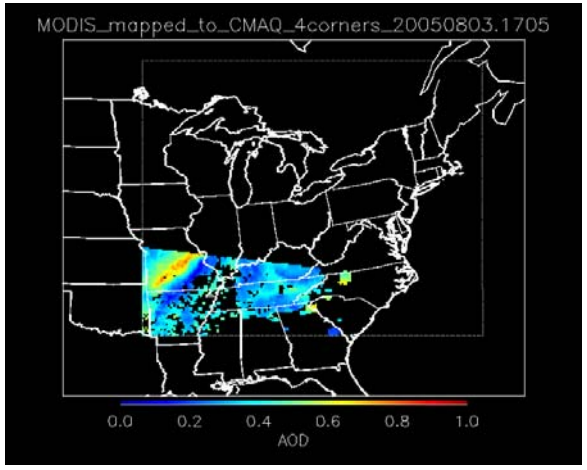
(Terra and Aqua)



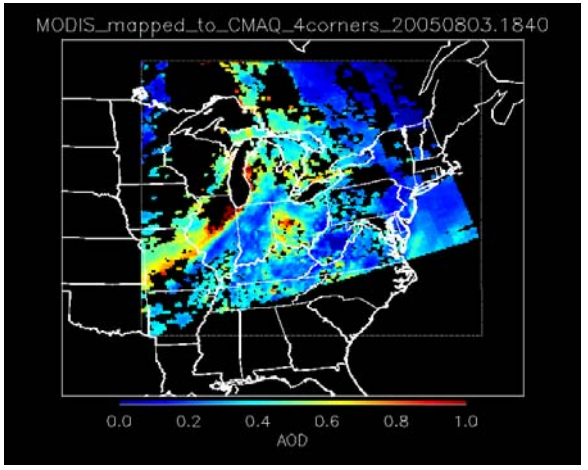
Terra



Terra



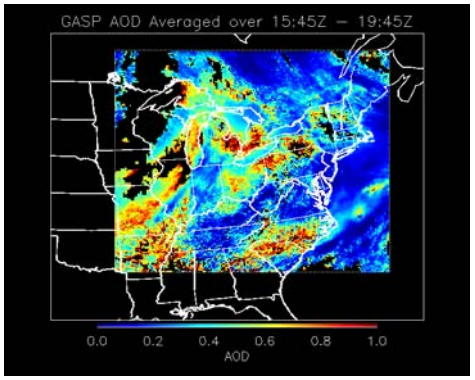
Aqua

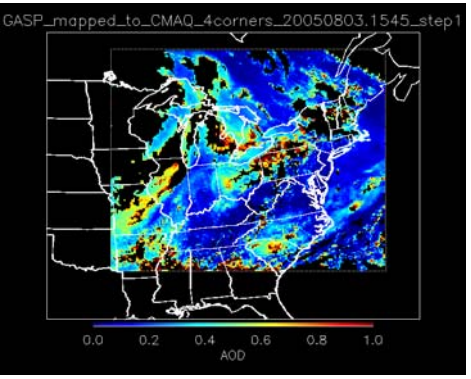


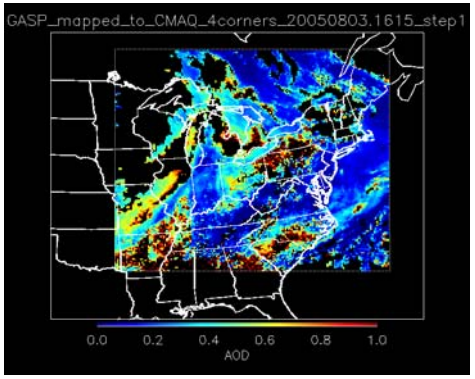
Regridding GOES AOD onto CMAQ grid

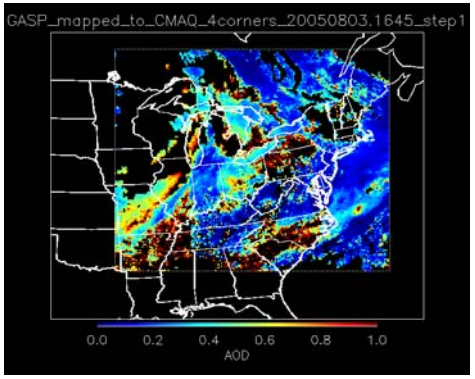
2005 Aug 3 GASP AOD

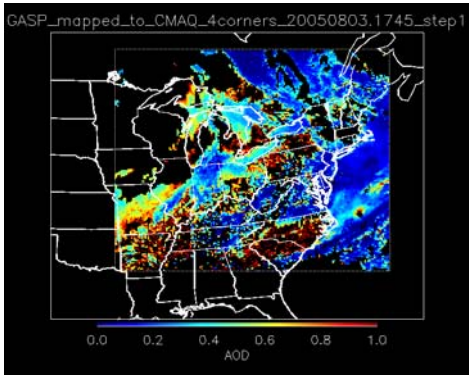
Note: 17:15Z not available

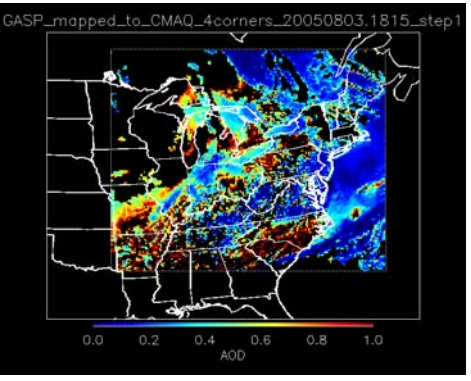


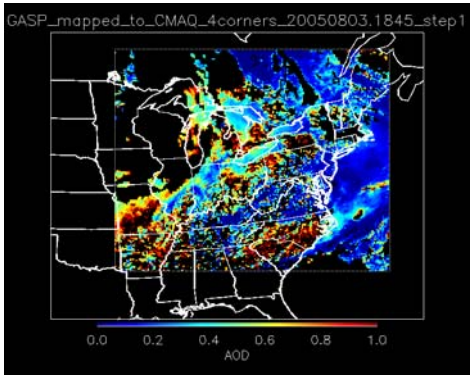


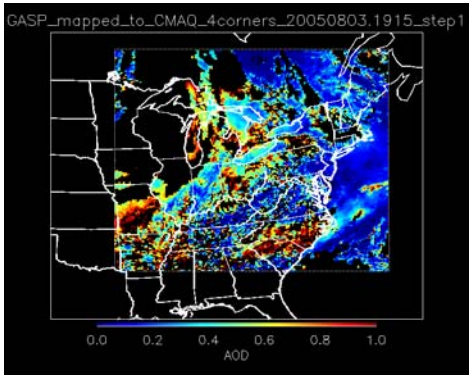


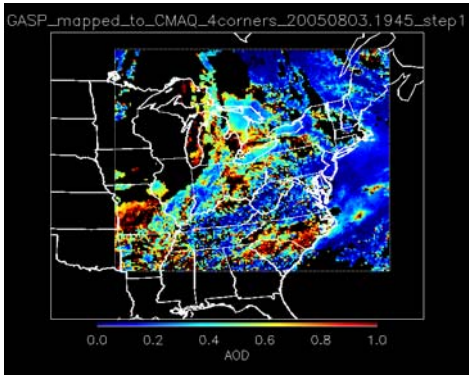






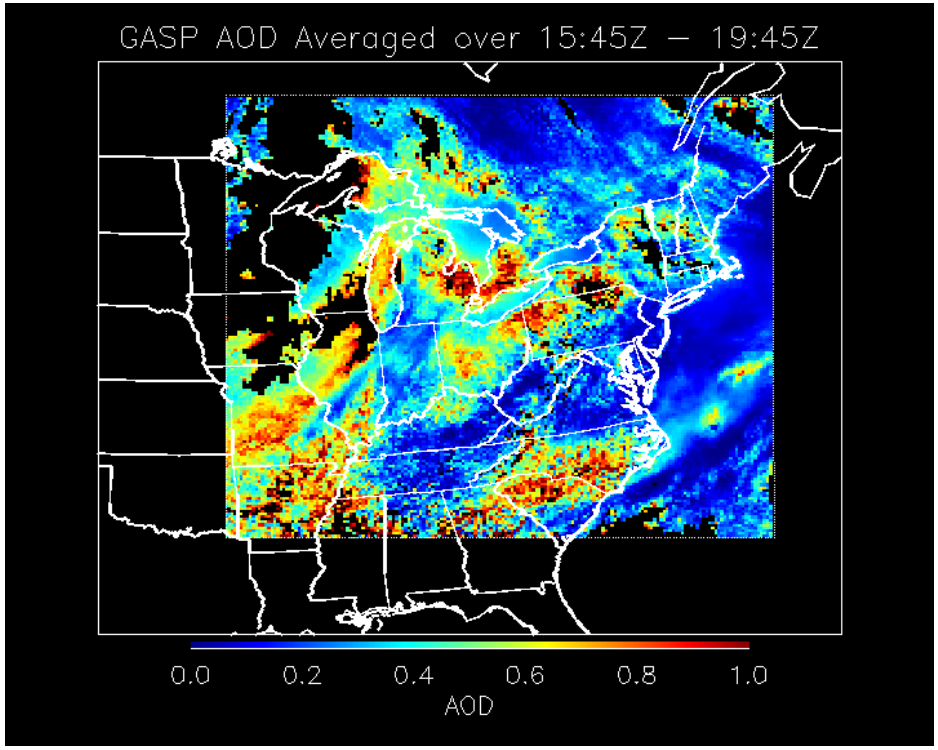




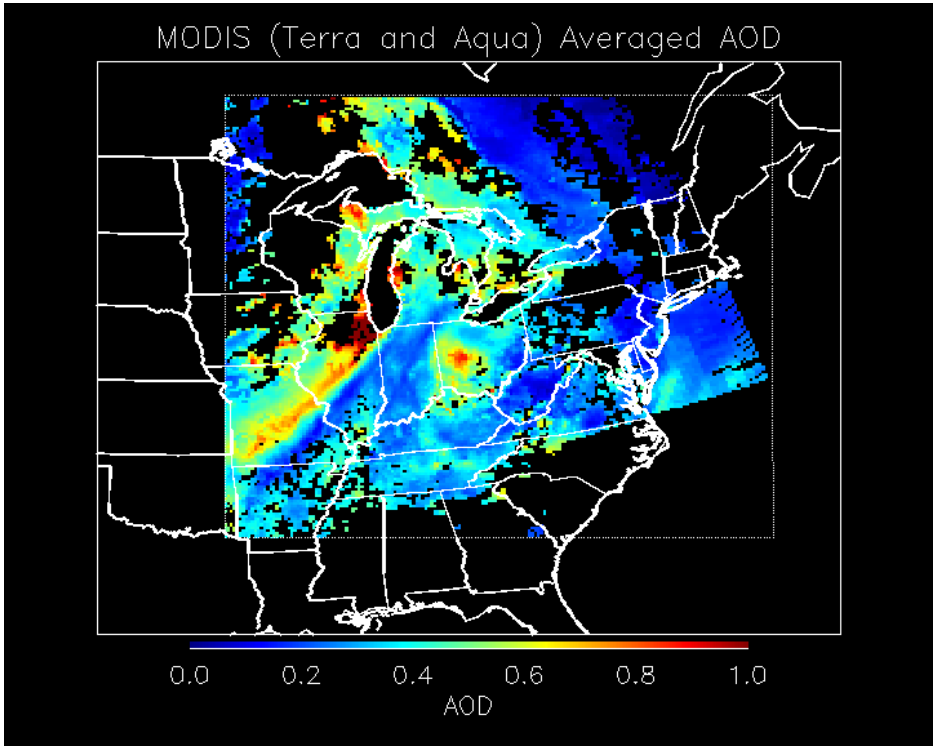


Regridding GASP and MODIS AOD August 3, 2005 on CMAQ grid

GASP



MODIS



Summary

- O3 predictive model under development
- Currently running developmental modeling for:
  - maximum 8-hr ozone concentrations.
  - next day daily maximum 8-hr ozone concentrations development in and forecast model
- Model for daily average (24) $PM_{2.5}$ concentrations will begin later in the fall.