

# *Aerosol Modeling during INTEX-NA*

Post-mission analysis on the aerosol events  
observed on July 18 – 23, 2004

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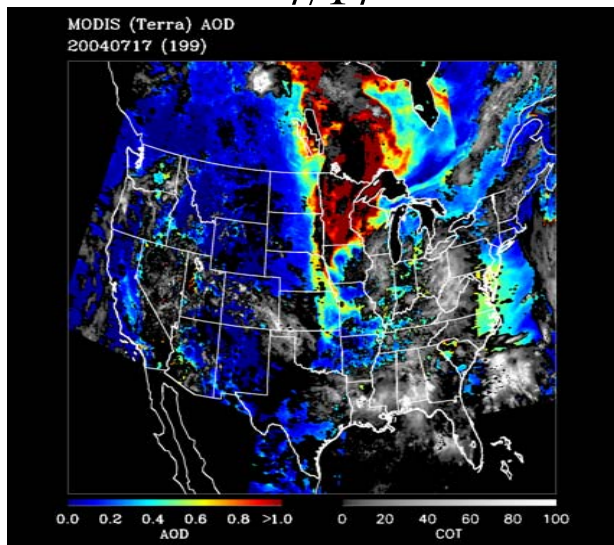
INTEX Science Team meeting  
March 29 – April 1, 2005

# *Overview*

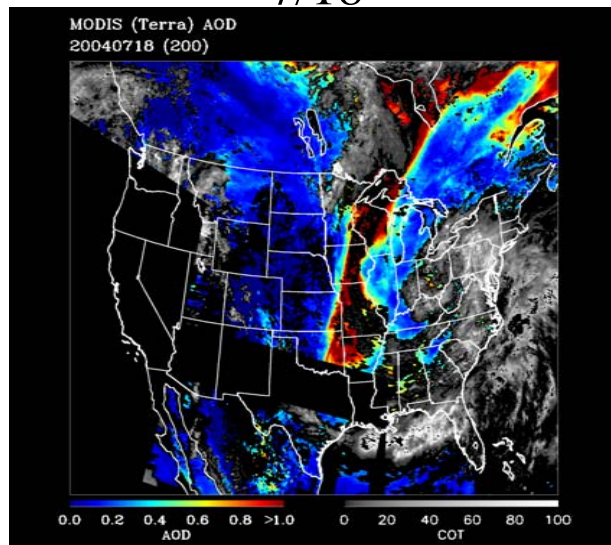
- In 2004 summer wildfires in Alaska burned more than 5 million acres and became one of the worst fire years for Alaska.
- Satellite observations depicted smoke plume being transported across Canada and then into the continental US from the Midwest to the South on July 18, 2004. EPA surface measurements indicated significantly deteriorated air quality over the Eastern US in the next couple of days.
- This poster presents a model study focusing on the aerosol event associated with this Alaskan smoke plume. The RAQMS regional aerosol model was initially constrained with assimilated MODIS aerosol optical depth (AOD) to account for the smoke plume inflow over the Midwest. The simulated results were compared with the DC8 aircraft measurements conducted during INTEX-NA, the EPA surface measurements and the MODIS AOD retrieval .
- This study shows the significant influence of the smoke plume on the boundary layer air quality, which was further deteriorated with regional sulfate pollution over the southeastern states. In contrast, the northeastern states are shown to have experienced elevated sulfate aerosol and a limited influence of the smoke plume .

# MODIS (Terra) Aerosol optical depth

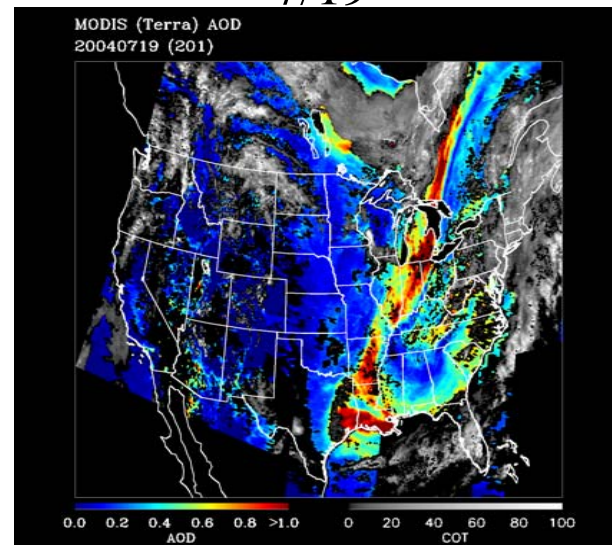
7/17



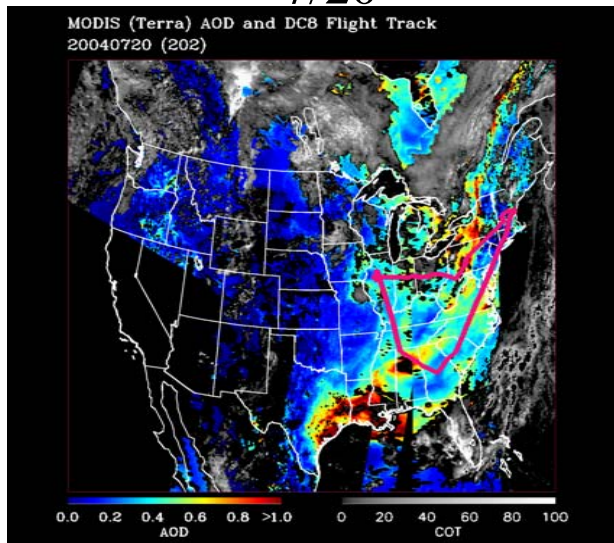
7/18



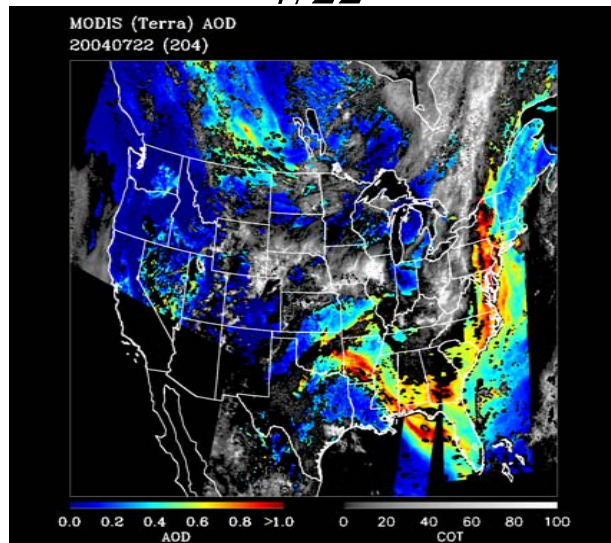
7/19



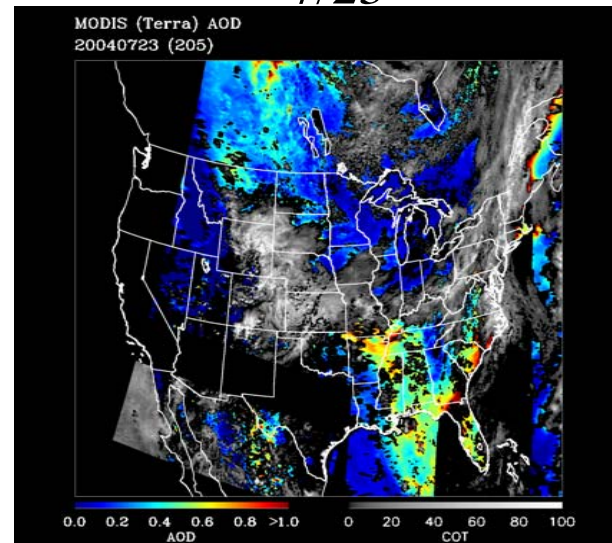
7/20



7/22



7/23



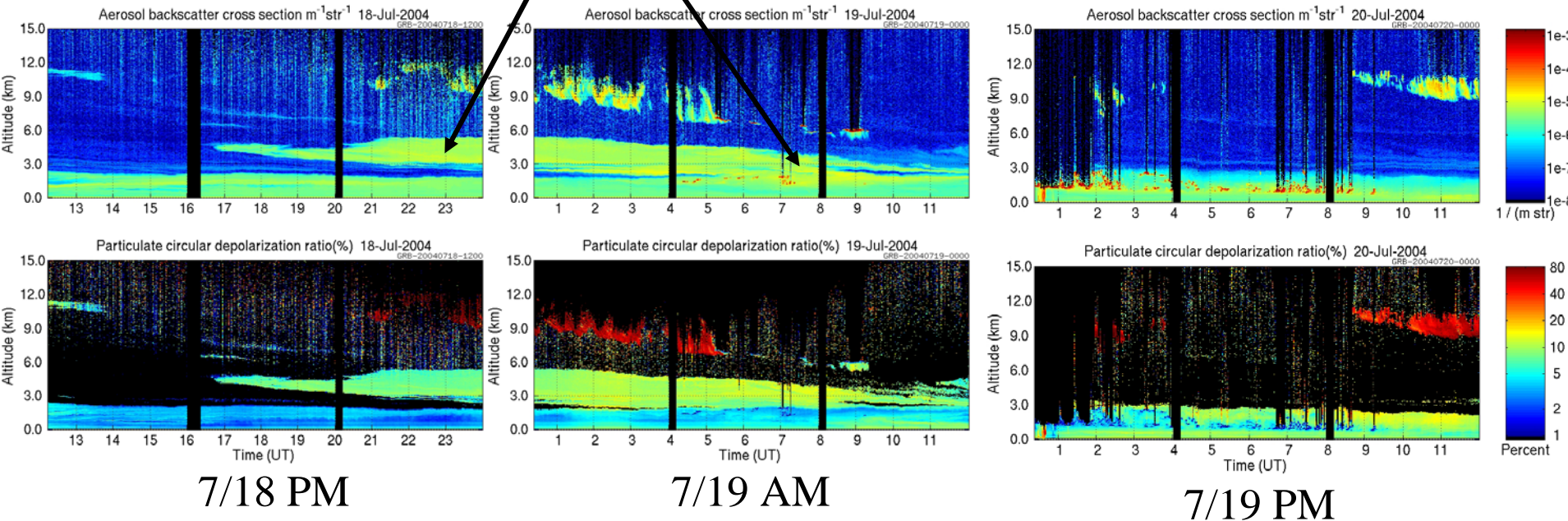


# Lidar observations at University of Wisconsin – Madison

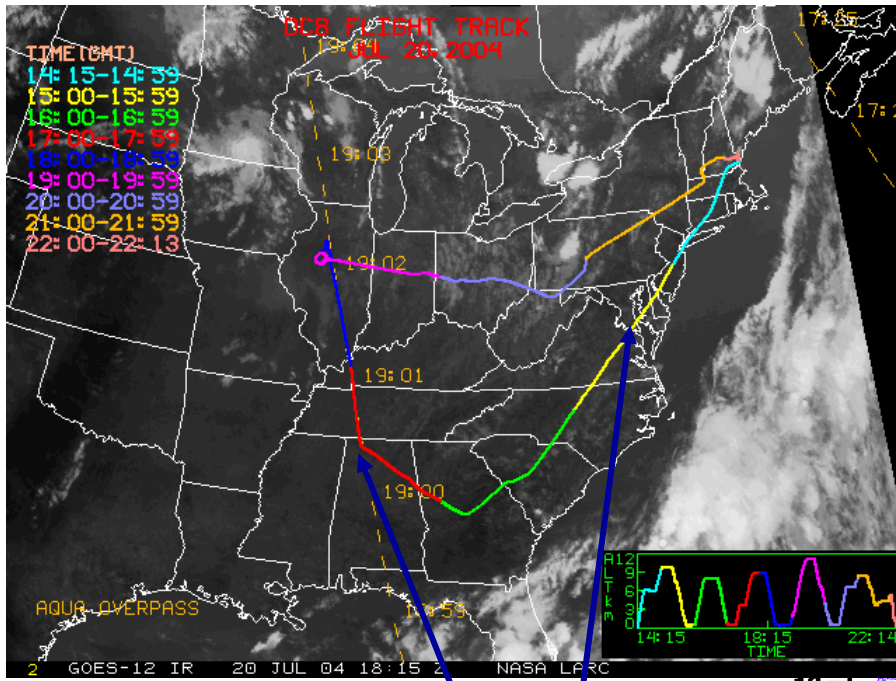
Top panel: Aerosol backscatter cross section

Bottom panel: Particulate circular depolarization ratio

Smoke plume being transported aloft (3-6km) and entrained into the boundary layer

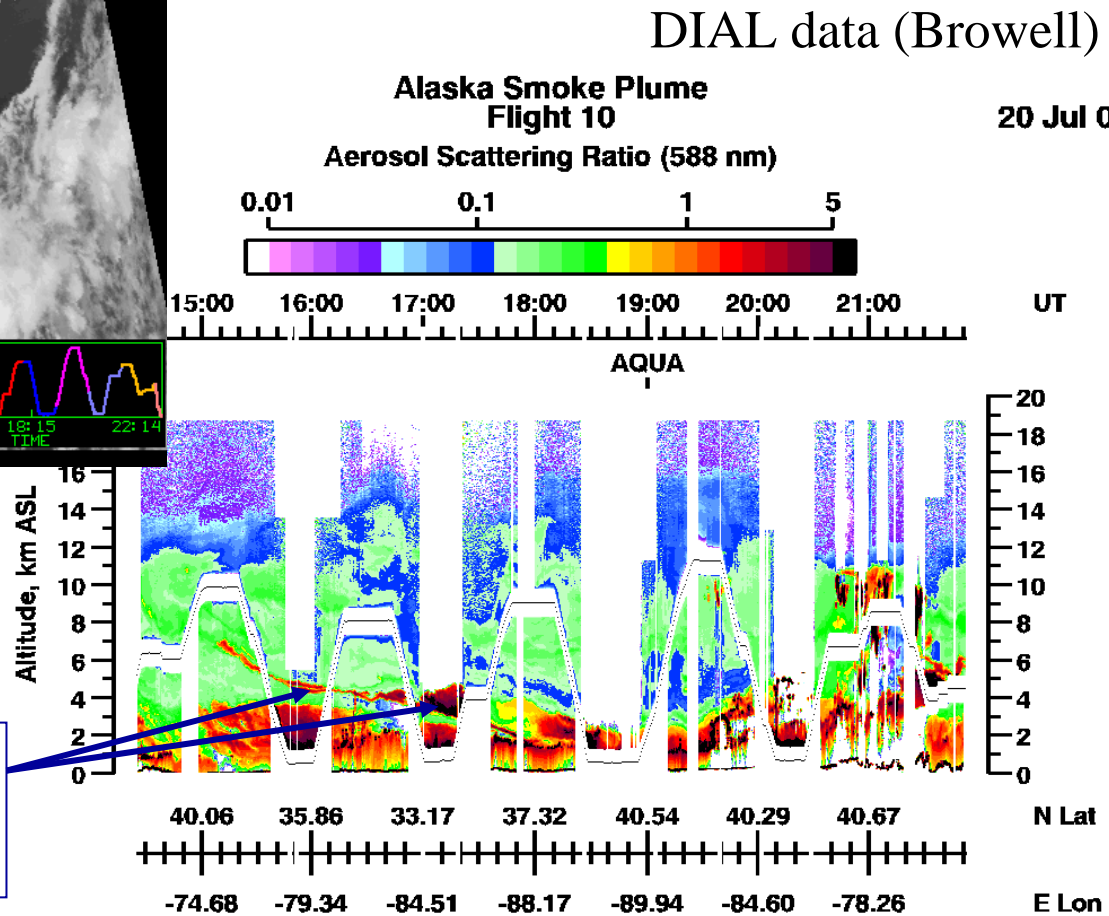


# DC8 Flight 10 encountered smoke plume on 7/20



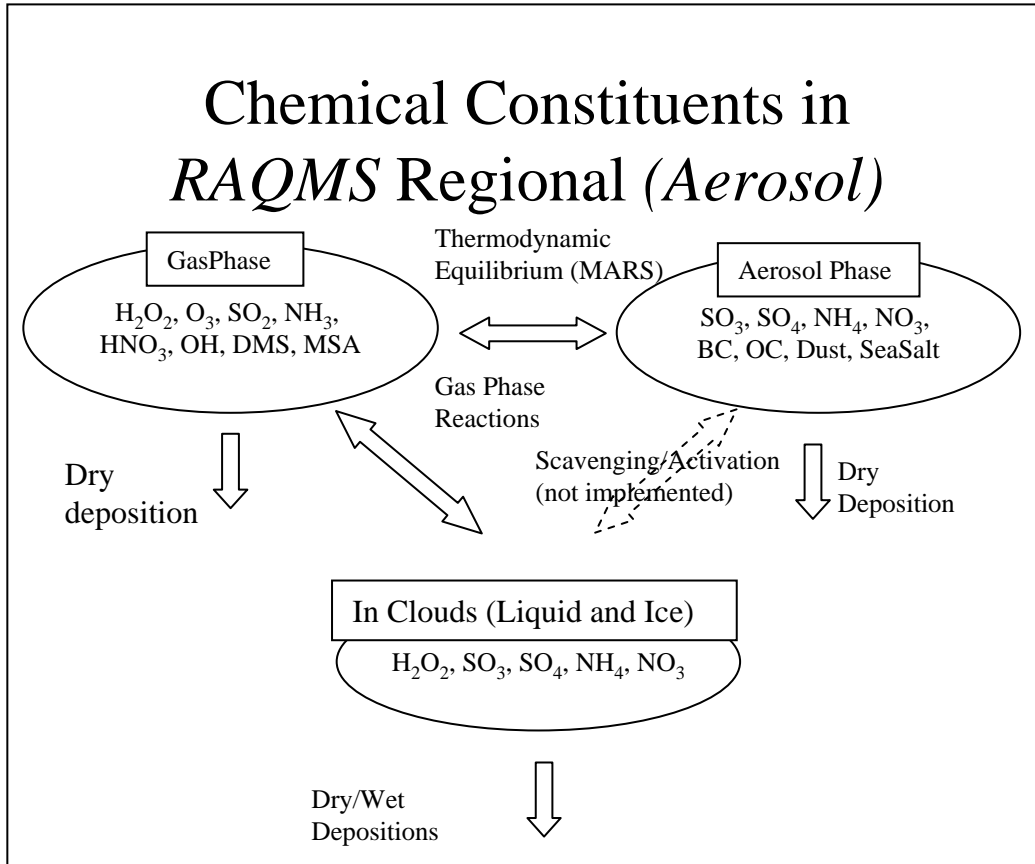
GOES-12 IR imagery  
with DC8 flight track  
(Westberg)

Smoke plume  
encounters



# RAQMS regional Aerosol Forecast

## MODIS AOD assimilation



- Initialized on July 15, 2004

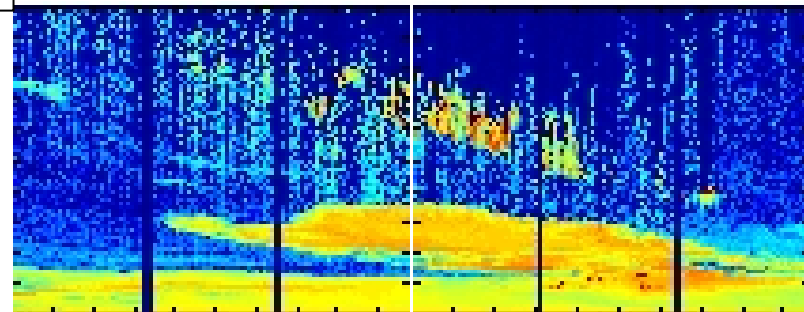
- UWNMS Dynamical Core
- 80Km Continental US/EDAS Met BC/IC
- RAQMS<sub>G</sub> Chemical BC/IC
- GOCART background climatological IC/BC
- Sulfate [Kittaka, 2004], Dust, Sea Salt, Carbonaceous Aerosol from GOCART [provided by Mian Chin, GSFC]
- Nitrate and Ammonium from GOES-CHEM [provided by Rokjin Park, Harvard]

- BC+OC perturbations added above BL on 18Z July 18, 2004, vertical extent constrained by SSEC Lidar
- One MODIS AOD assimilation cycle used for final constraint on total AOD

**UW-Madison SSEC Lidar (Eloranta)**

18-Jul-2004 PM

19-Jul-2004 AM



**Does Smoke from Alaskan Fires  
get entrained  
within CONUS boundary Layer?**

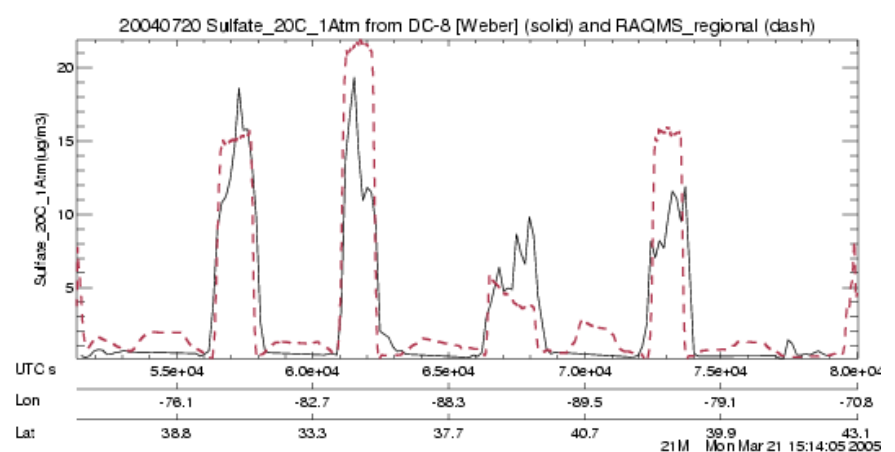
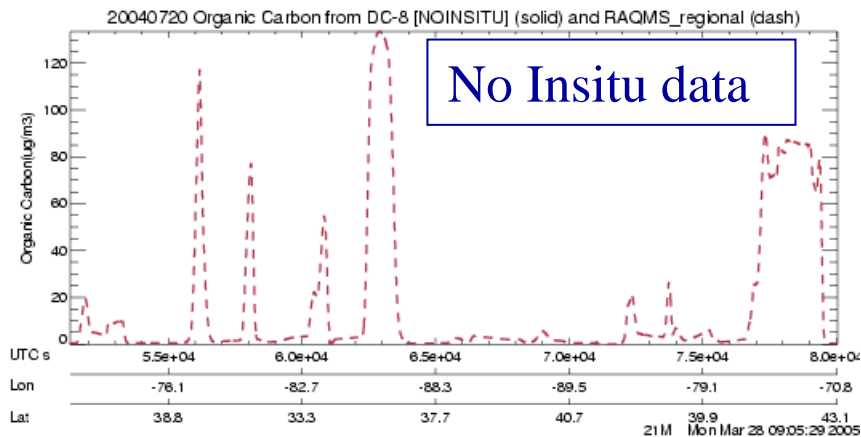
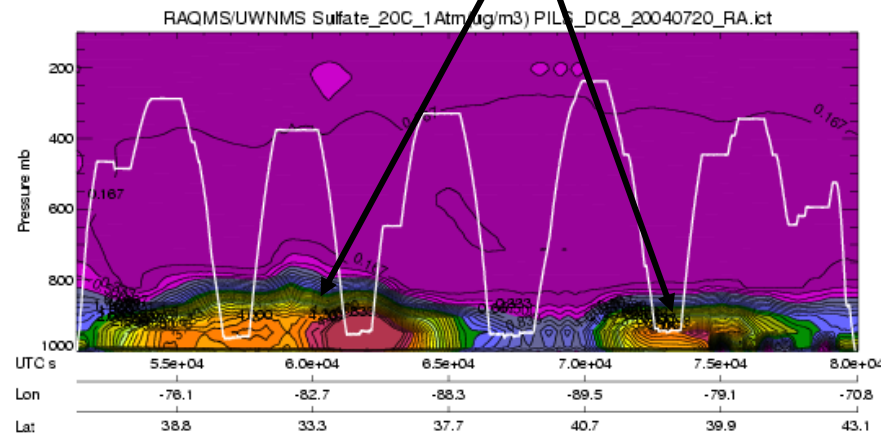
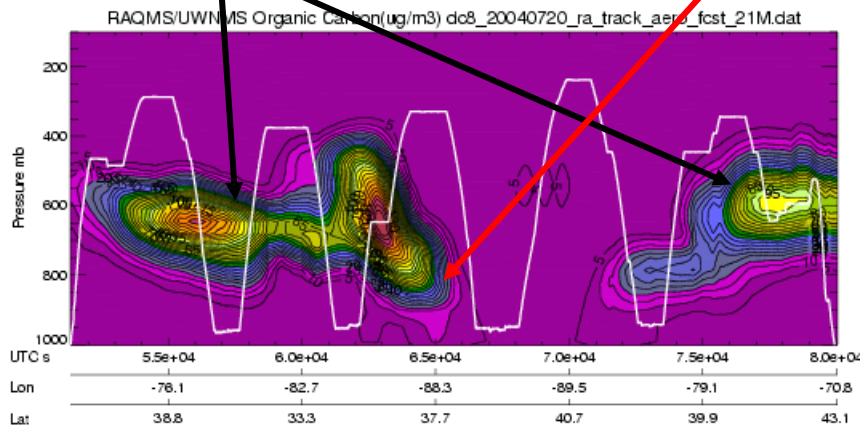
# Preliminary Results

Comparisons with DC8 aircraft measurements on July 20  
(Sulfate, NH<sub>4</sub><sup>+</sup> and NO<sub>3</sub><sup>-</sup> from R. Weber, Georgia Tech)

Significant amount of  
**Organic carbon**

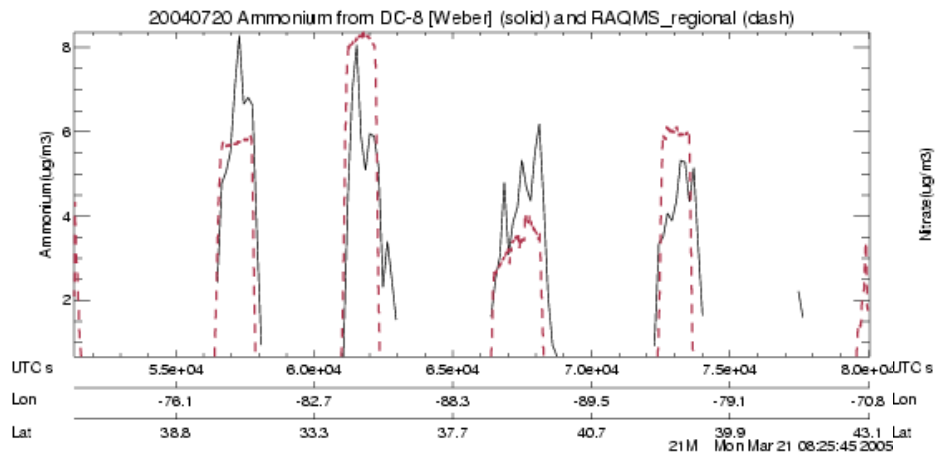
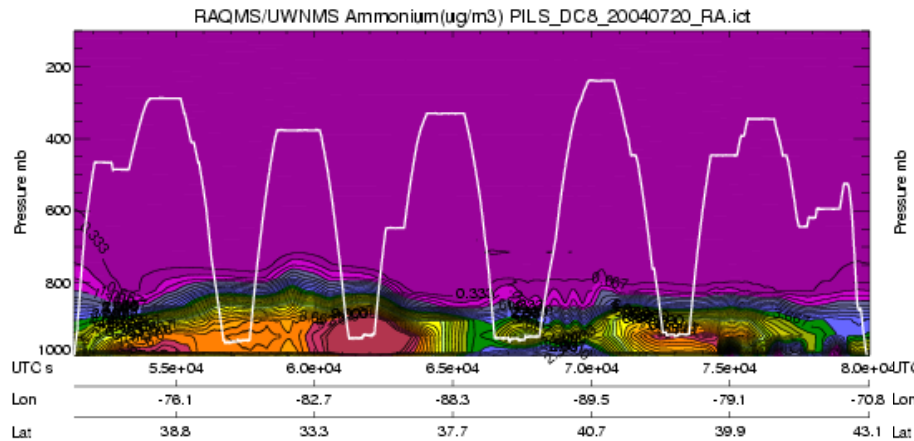
**Entrainment into BL**

**Sulfate** within BL

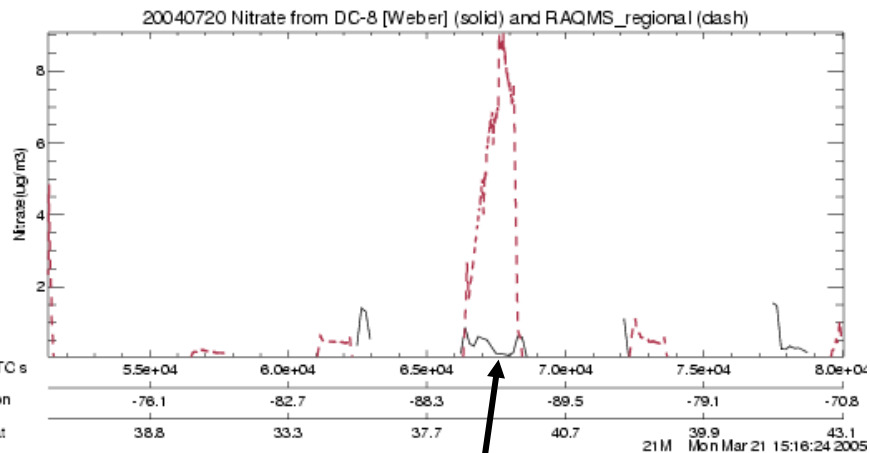
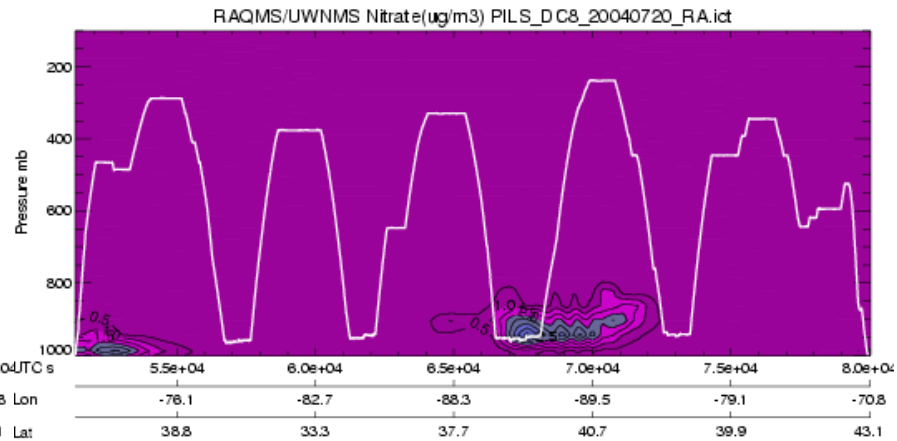




# Aerosol $\text{NH}_4^+$



# Aerosol $\text{NO}_3^-$



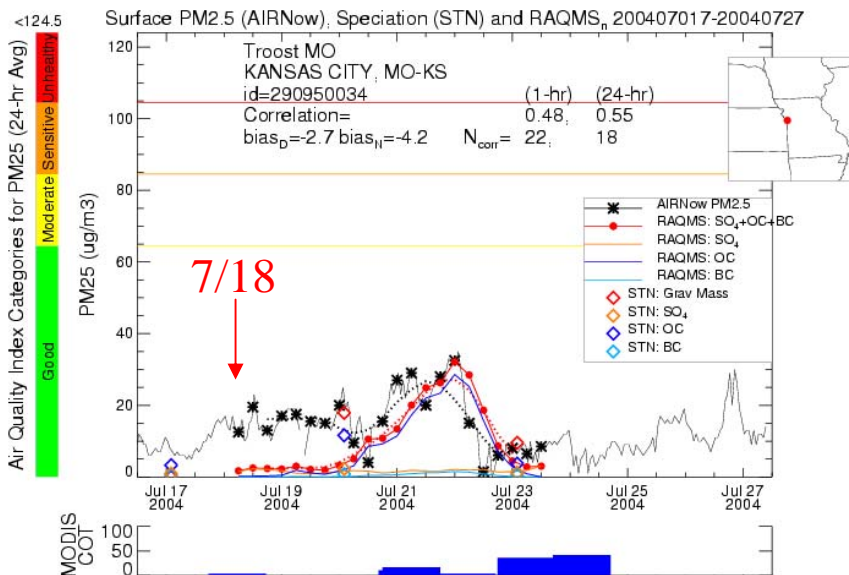
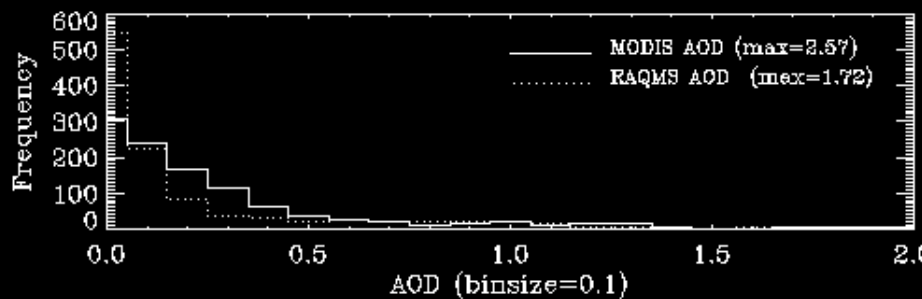
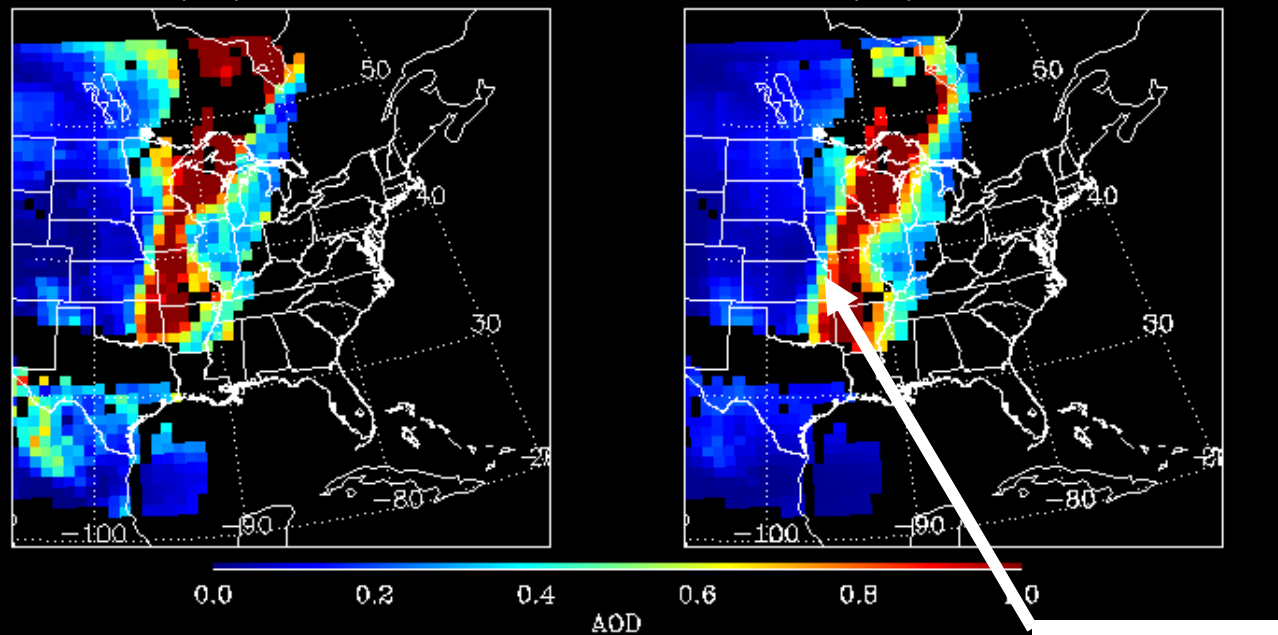
Overestimate  $\text{NO}_3^-$  due in part to an underestimate of  $\text{SO}_4^{2-}$



# MODIS vs RAQMS AOD at 17:28Z July 18, 2004

MODIS (Terra) AOD  
2004 07 18 (200) 17:28Z

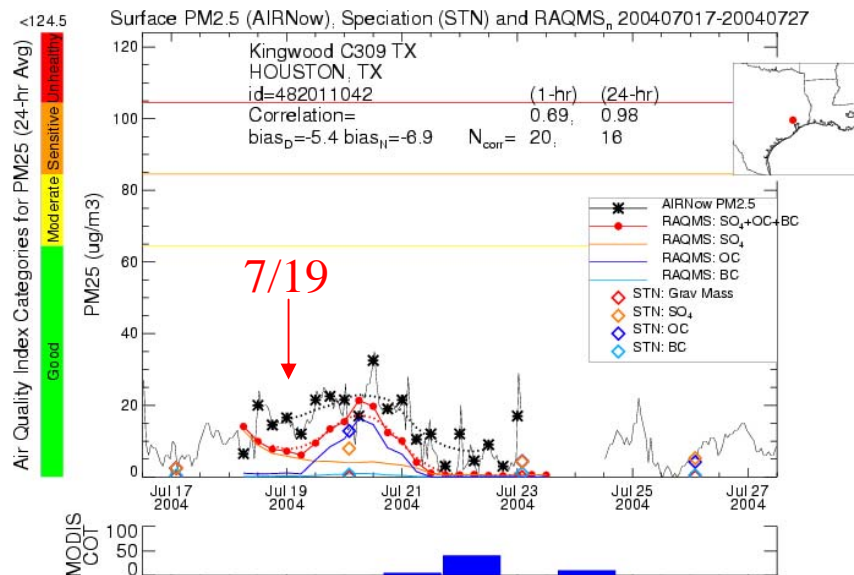
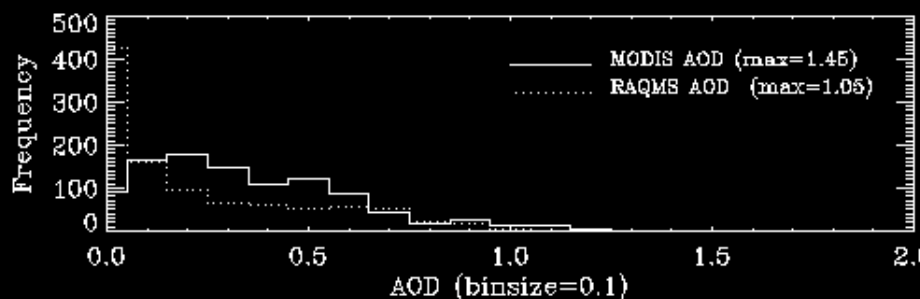
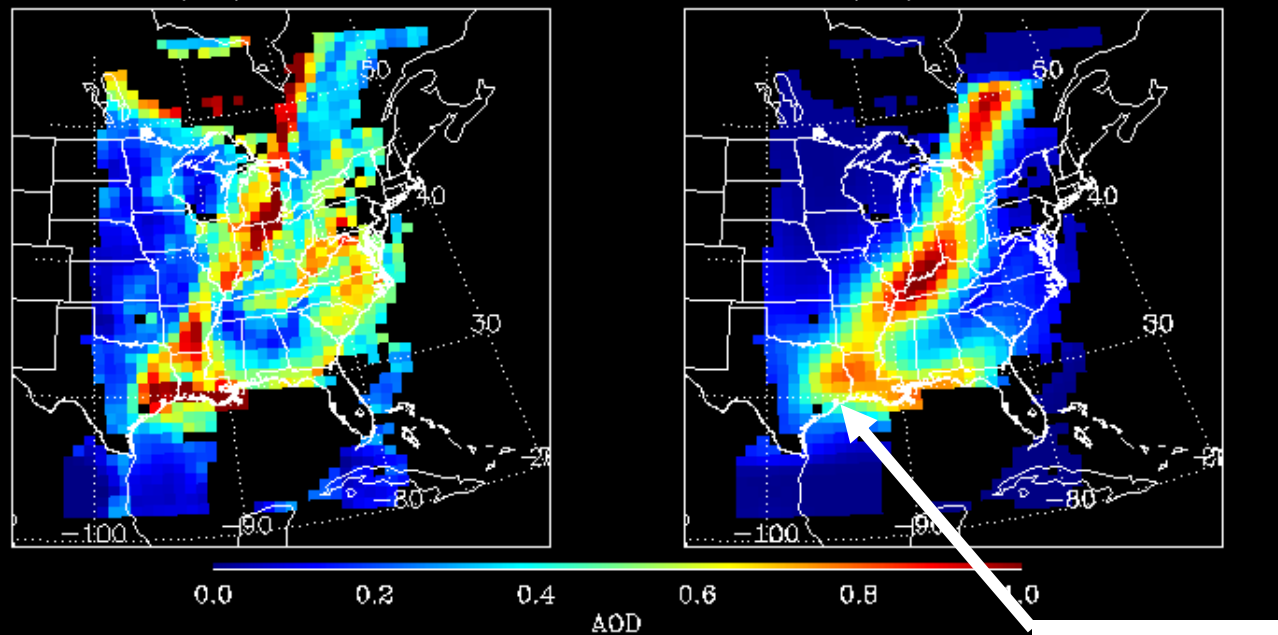
Time-interpolated RAQMS AOD  
2004 07 18 (200) 17:28Z



# MODIS vs RAQMS AOD at 16:33Z July 19, 2004

MODIS (Terra) AOD  
2004 07 19 (201) 16:33Z

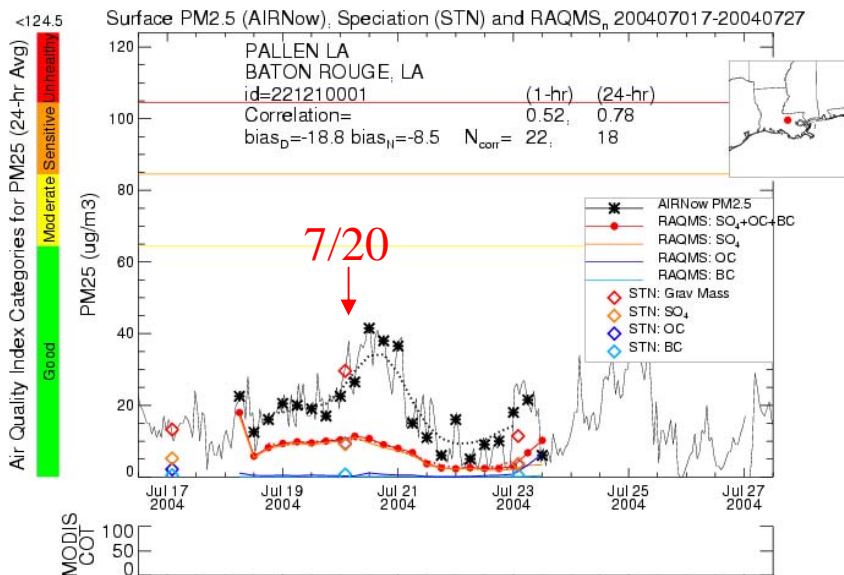
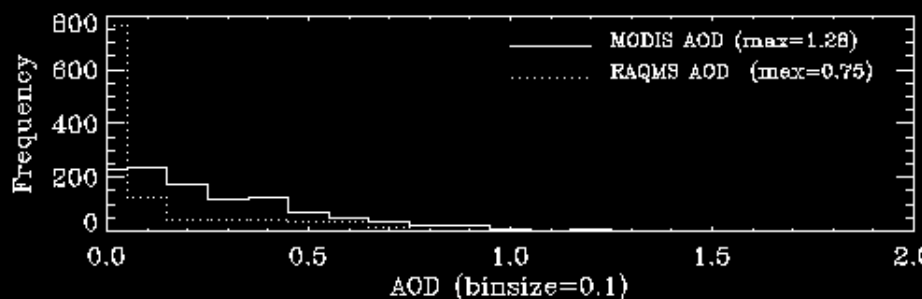
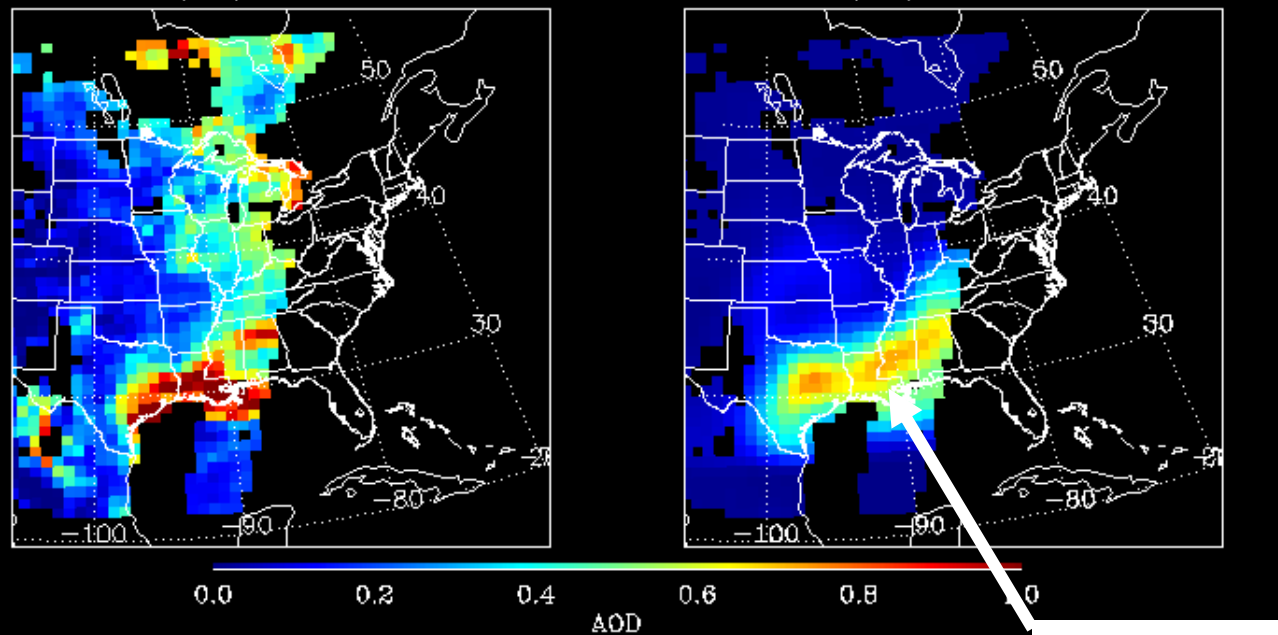
Time-interpolated RAQMS AOD  
2004 07 19 (201) 16:33Z



# MODIS vs RAQMS AOD at 17:16Z July 20, 2004

MODIS (Terra) AOD  
2004 07 20 (2002) 17:16Z

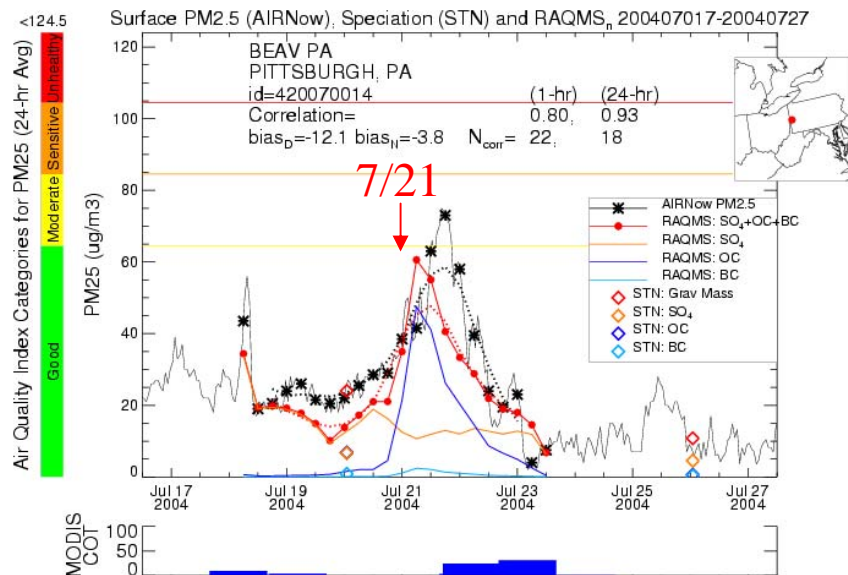
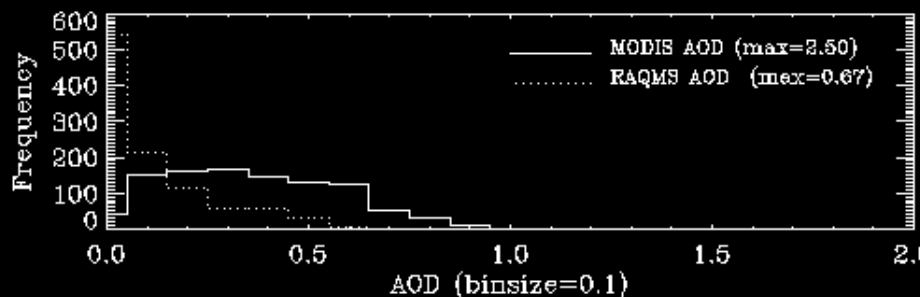
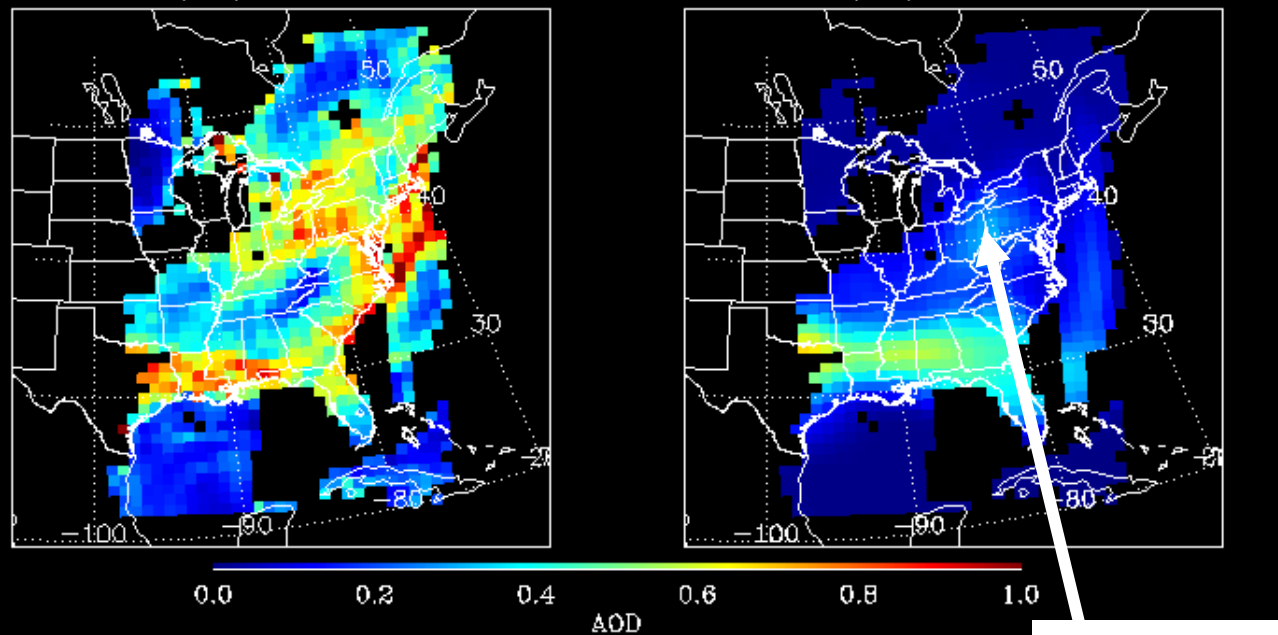
Time-interpolated RAQMS AOD  
2004 07 20 (2002) 17:16Z



# MODIS vs RAQMS AOD at 16:20Z July 21, 2004

MODIS (Terra) AOD  
2004 07 21 (2003) 16:20Z

Time-interpolated RAQMS AOD  
2004 07 21 (2003) 16:20Z

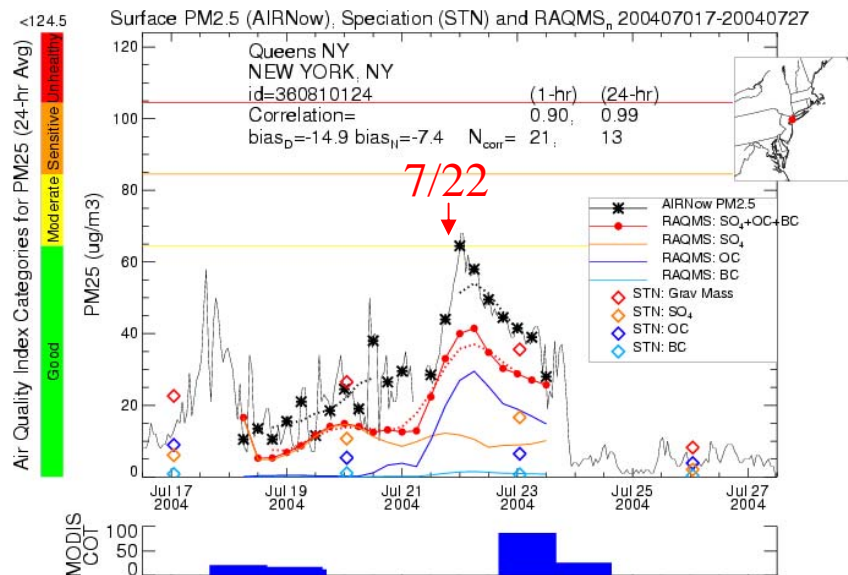
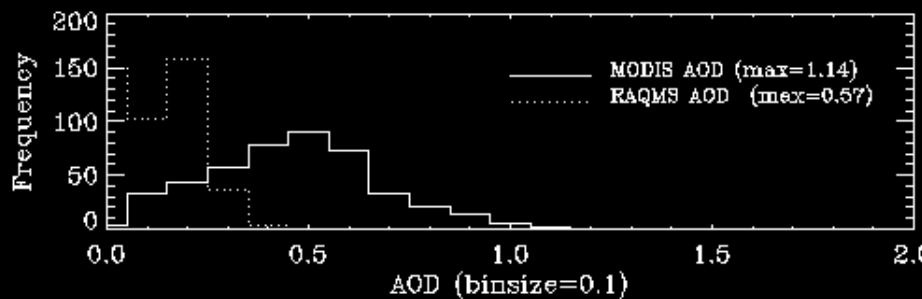
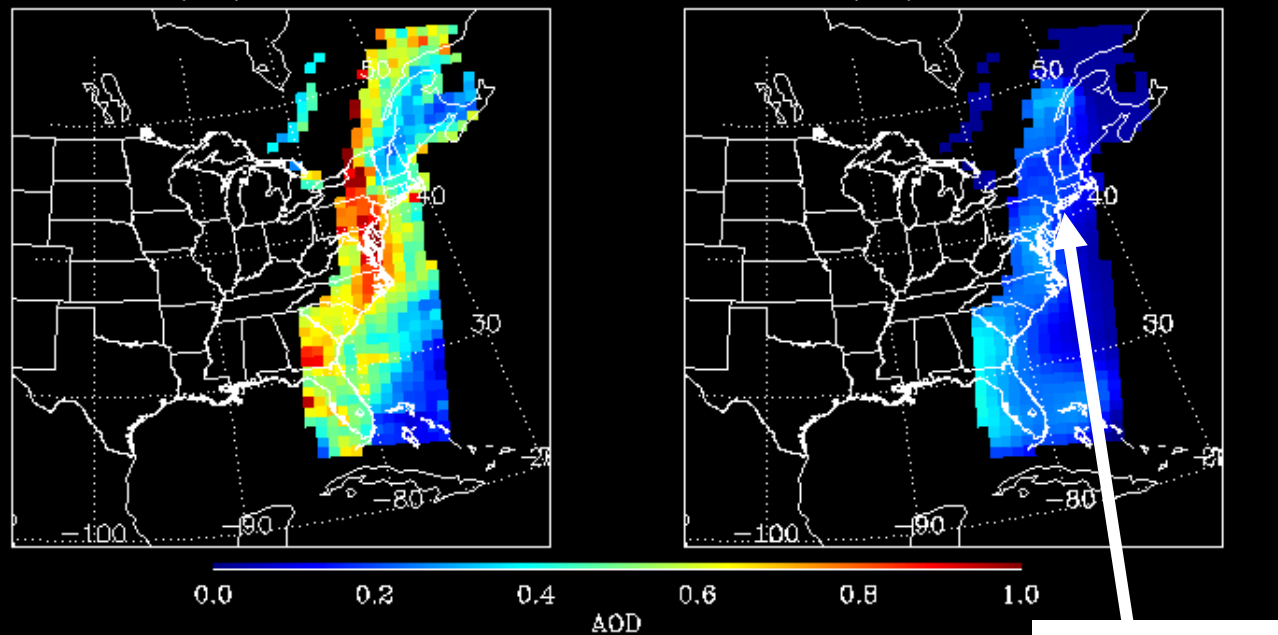




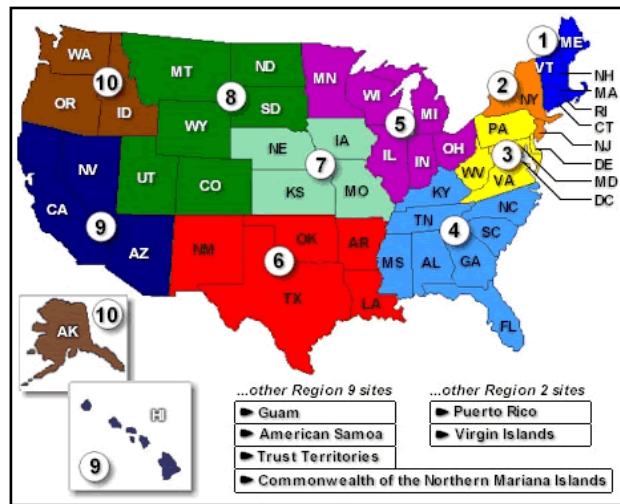
# MODIS vs RAQMS AOD at 15:27Z July 22, 2004

MODIS (Terra) AOD  
2004 07 22 (204) 15:27Z

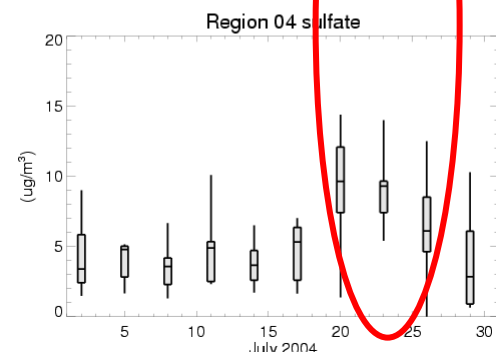
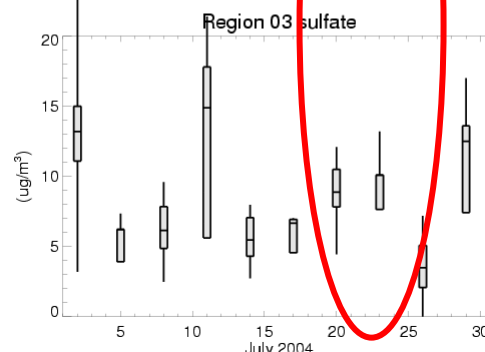
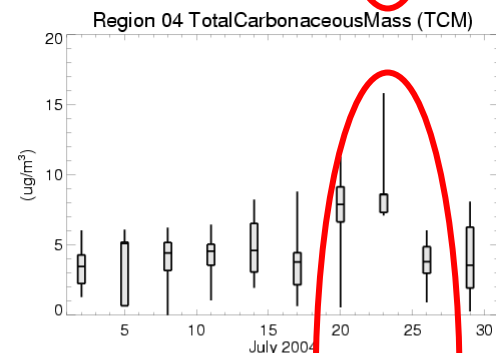
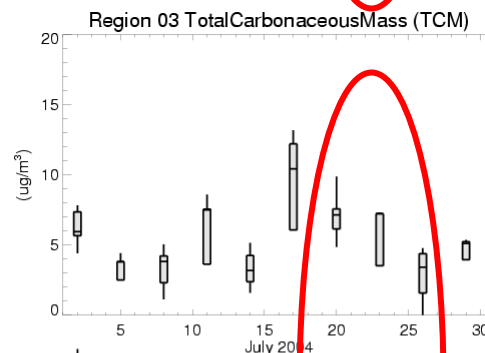
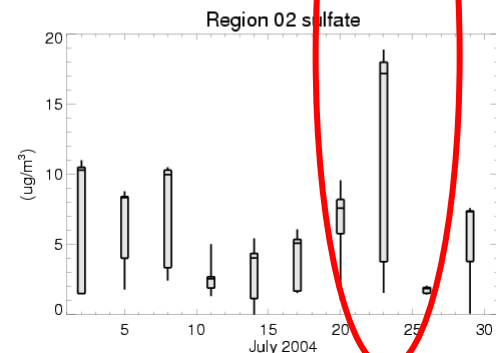
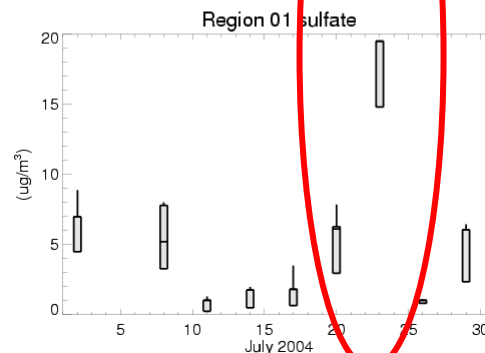
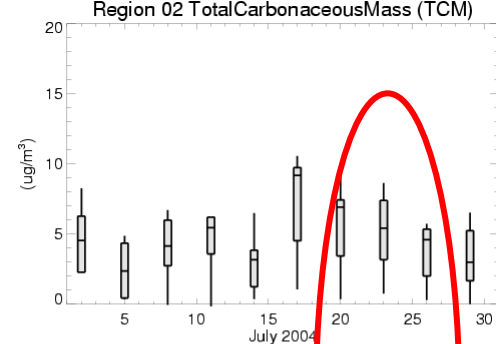
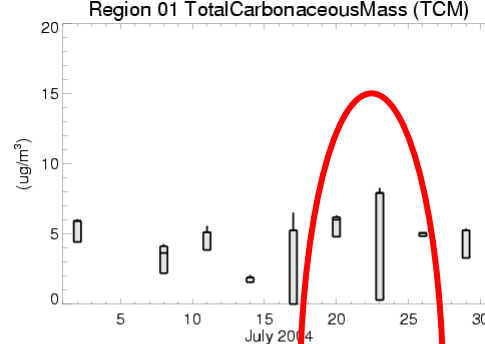
Time-interpolated RAQMS AOD  
2004 07 22 (204) 15:27Z



# EPA Surface PM2.5 Speciation Measurements July 2004

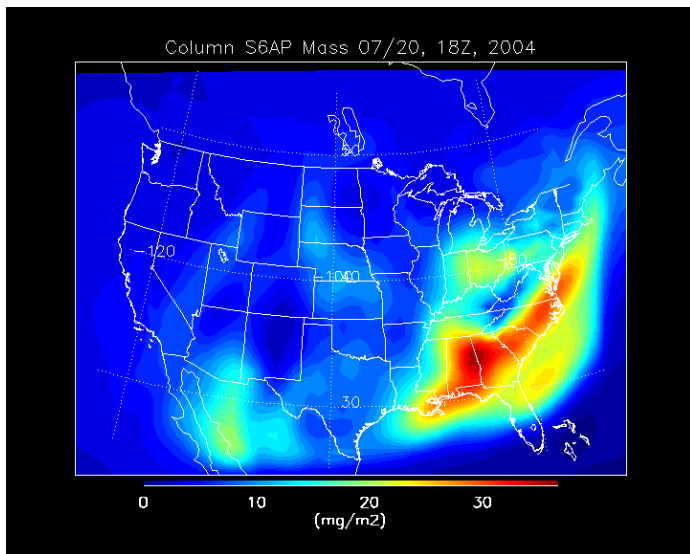


- The enhancement in NE (Regions 1 and 2) is dominated by sulfate.
- Both sulfate and carbonaceous aerosols are enhanced in SE (Region 4).

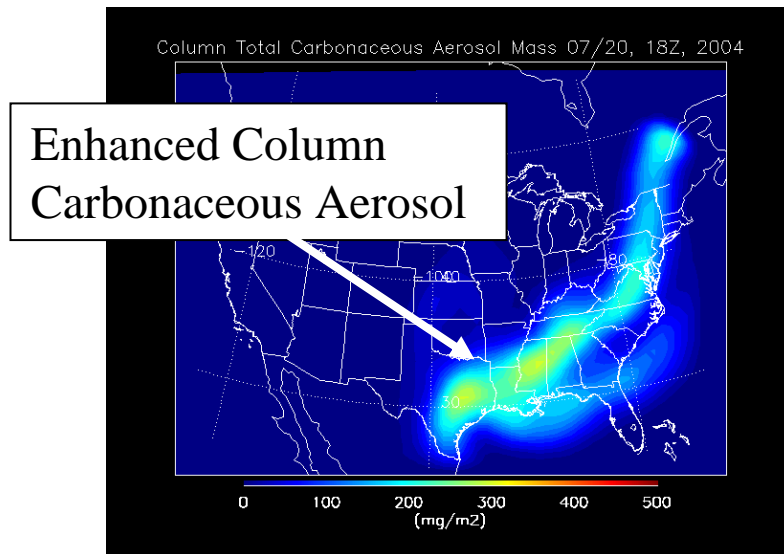


# RAQMS Regional Prediction for 7/20 18Z

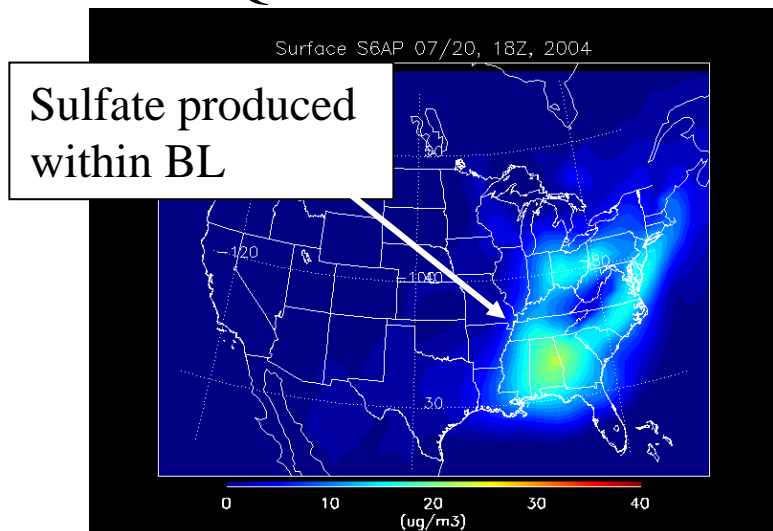
## RAQMS Column Sulfate



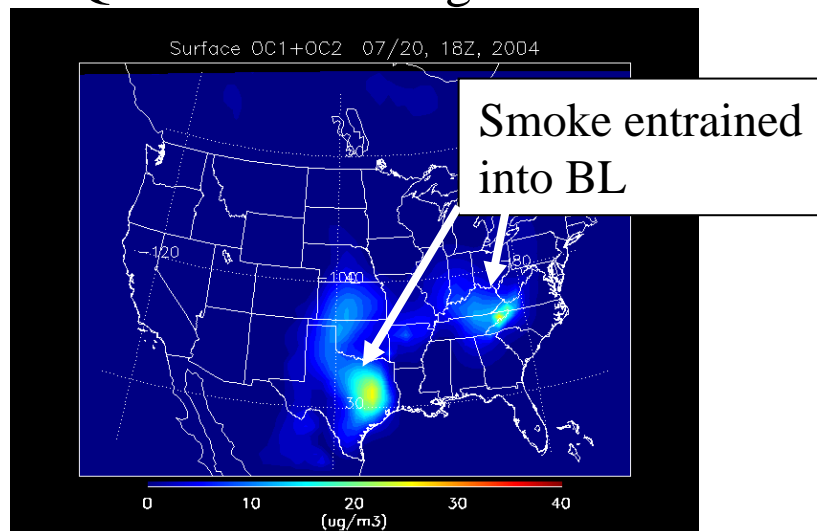
## RAQMS Column Carbonaceous



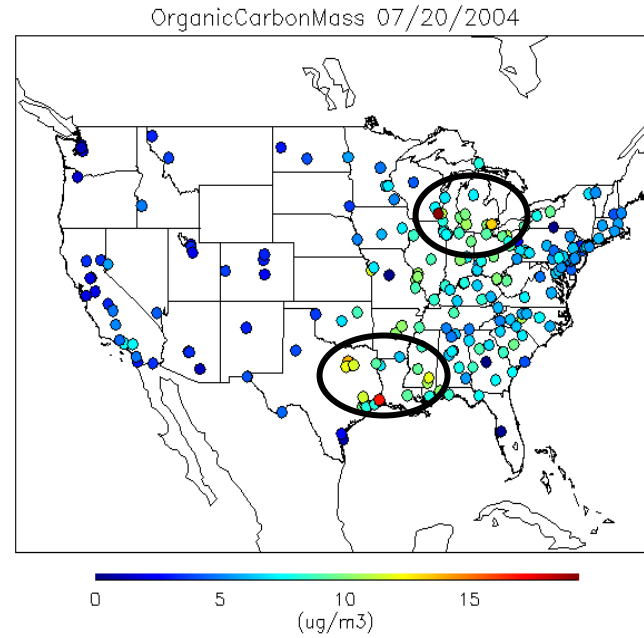
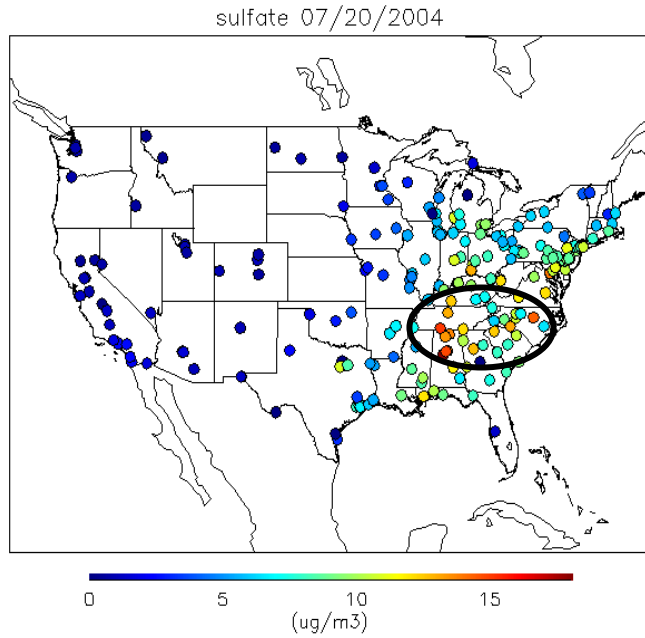
## RAQMS Surface Sulfate



## RAQMS Surface Organic Carbon



# EPA Surface PM2.5 Speciation Data for 7/20





# *Summary*

- In general, RAQMS\_aero initialized at 7/18 18Z with MODIS AOD assimilation successfully simulated the aerosol event observed in the Eastern US on 7/20/2004.
- Elevated aerosol loadings in the Eastern US during this time period are attributed to organic carbonaceous aerosol from the Alaskan fires and local sulfate production.
- Sulfate was underestimated in the Eastern US. This is due partly to a lack of initial observational constraints (MODIS AOD) over the Eastern US because of cloud cover.