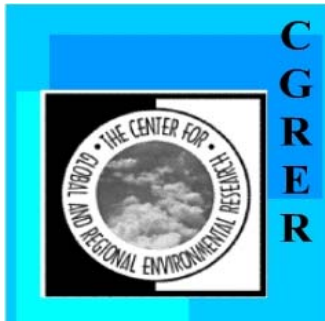


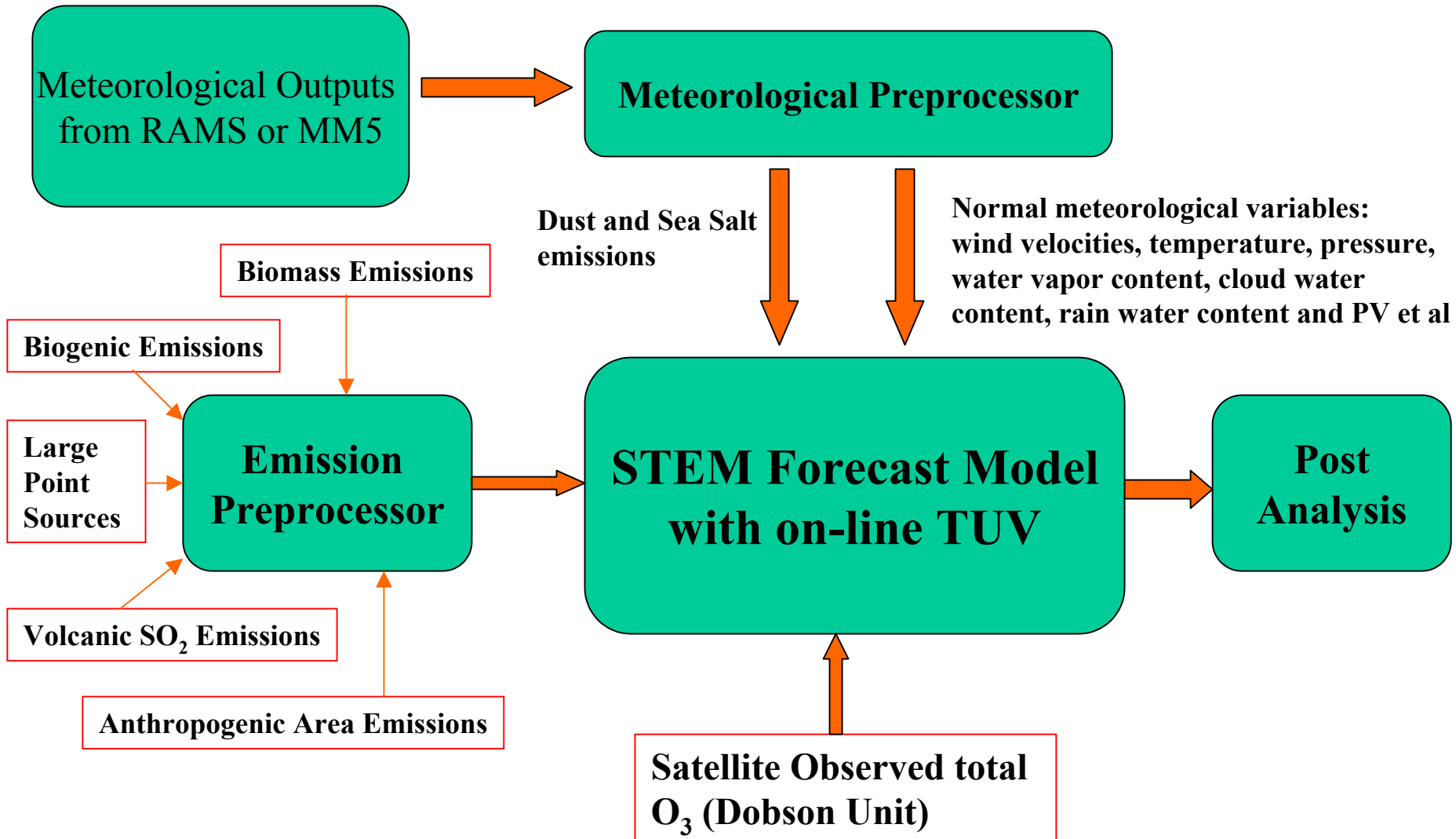
STEM with NCAR Tropospheric Ultraviolet-Visible Model (TUV) and their application on TRACE-P

Youhua Tang, Gregory R. Carmichael and
Sarath K. Guttikunda

Center for Global & Regional Environmental Research
University of Iowa



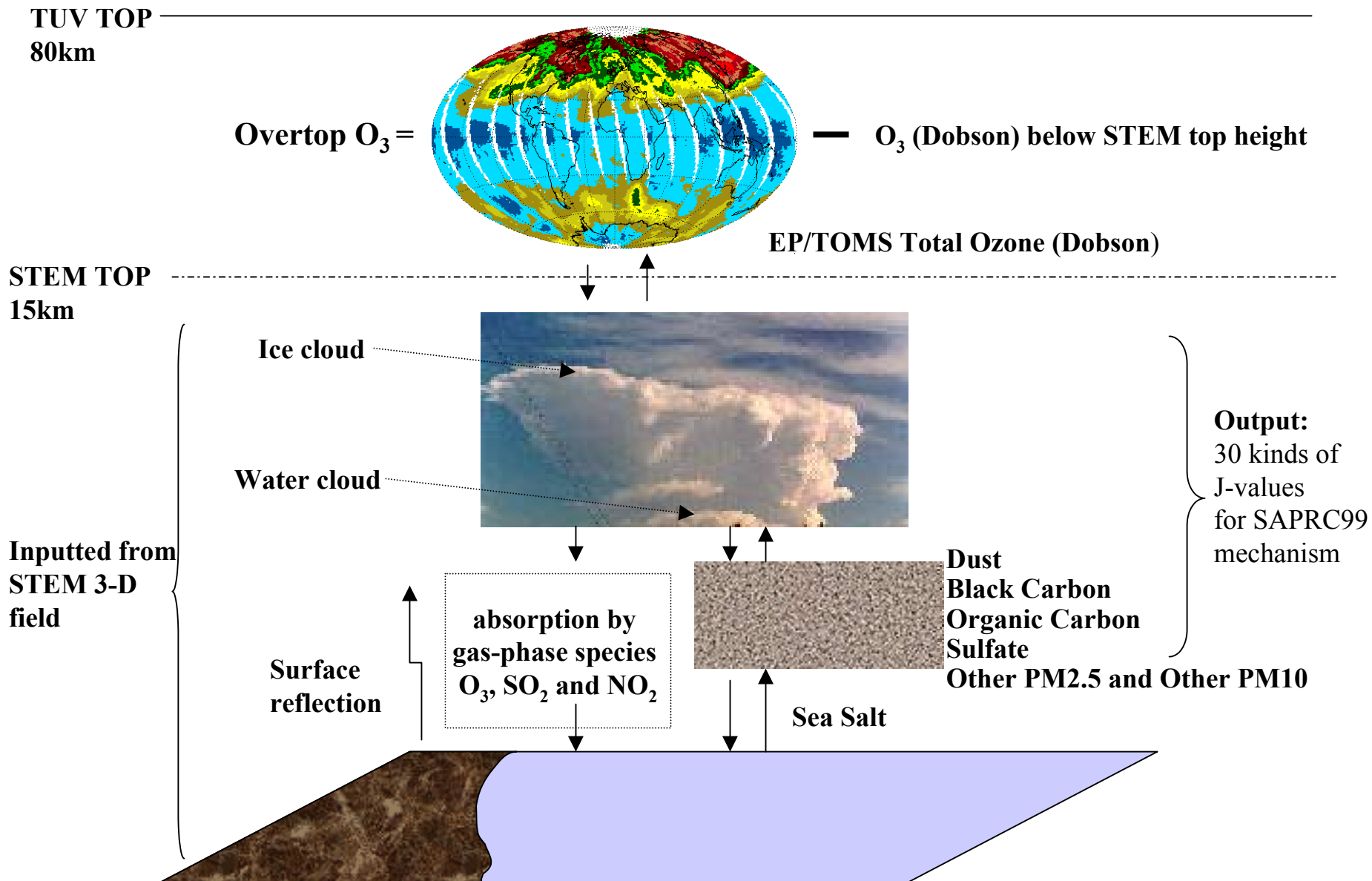
U. of Iowa STEM Model Data Flow Chart



Basic features of STEM used in TRACE-P Simulations

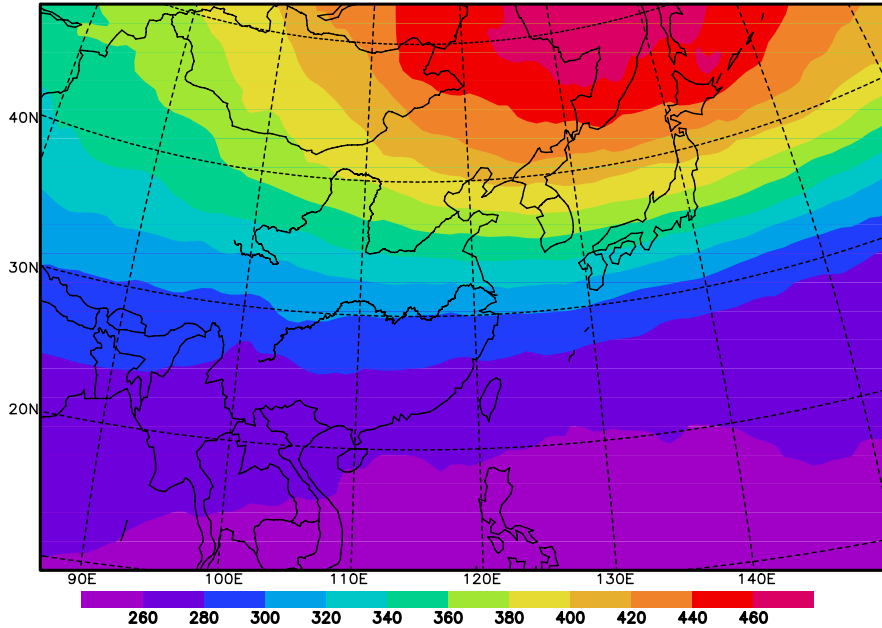
- ❑ Primary domain: 90x60 grids in 80 km horizontal resolution. Its top height is about 15km.
- ❑ SPARC99 (Carter, 2000) with KPP-Rodas solver is used for gas-phase chemical computation.
- ❑ Photolysis computation: NCAR TUV or look-up-table (fast method). Optical properties of aerosols and clouds calculation are based on OPAC (Hess et al, 1998)
- ❑ Daily varied biomass emissions are derived from satellite observed fire count data.

STEM on-line TUV overview

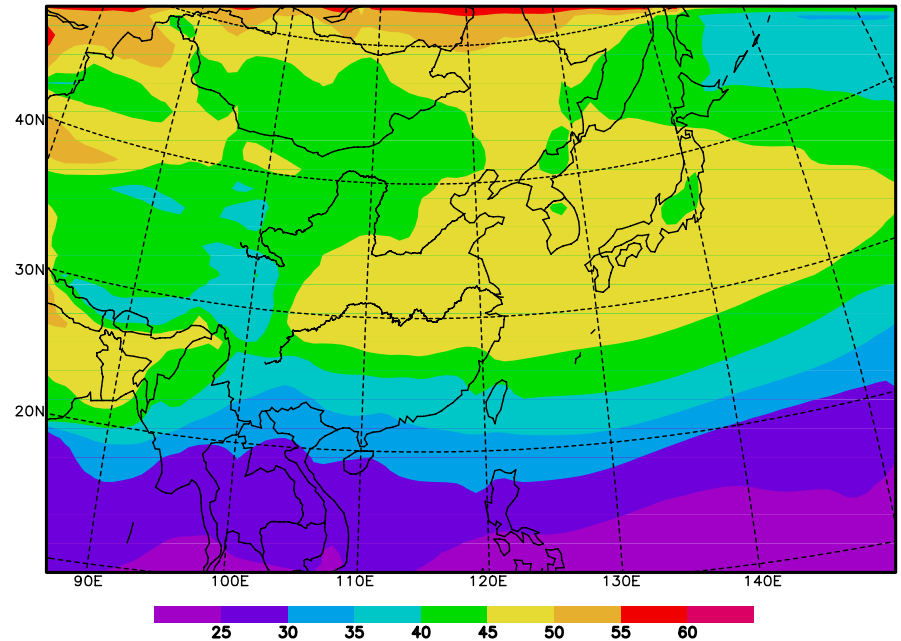


Observed total O₃ and simulated O₃ below STEM TOP

TOMS observed average O₃ column concentration (DU)
in March, 2001

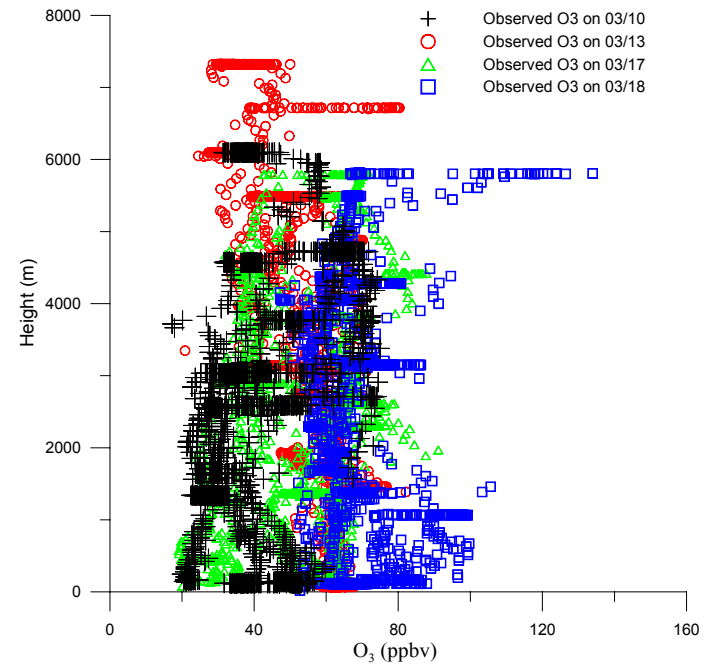
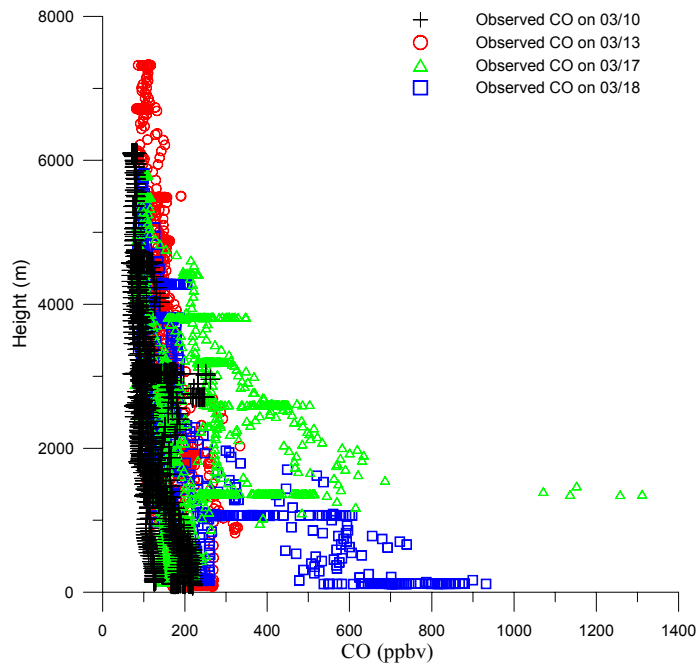


Simulated Averaged O₃ Column Concentration (Dobson Unit)



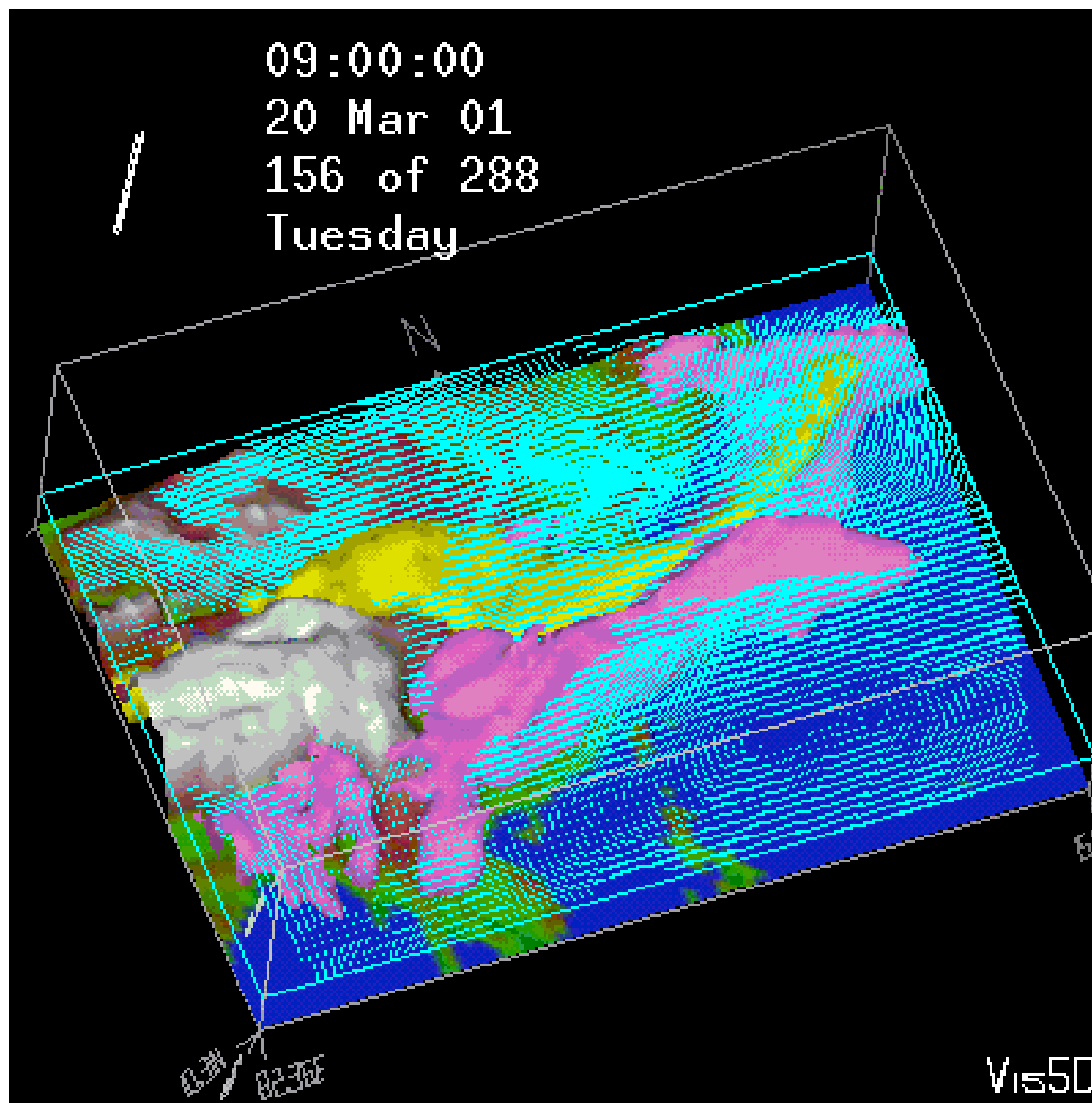
**Strong latitude variation of O₃
exists in both stratosphere and
troposphere**

Some long-lifetime species, such as CO, are sensitive to the model's lateral boundary conditions. So we adopted observed concentrations for the lateral boundary conditions.



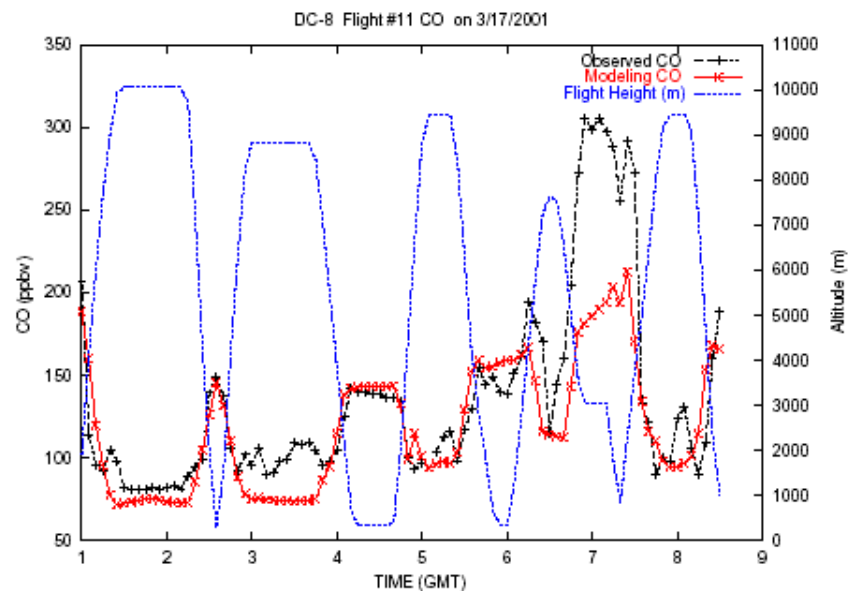
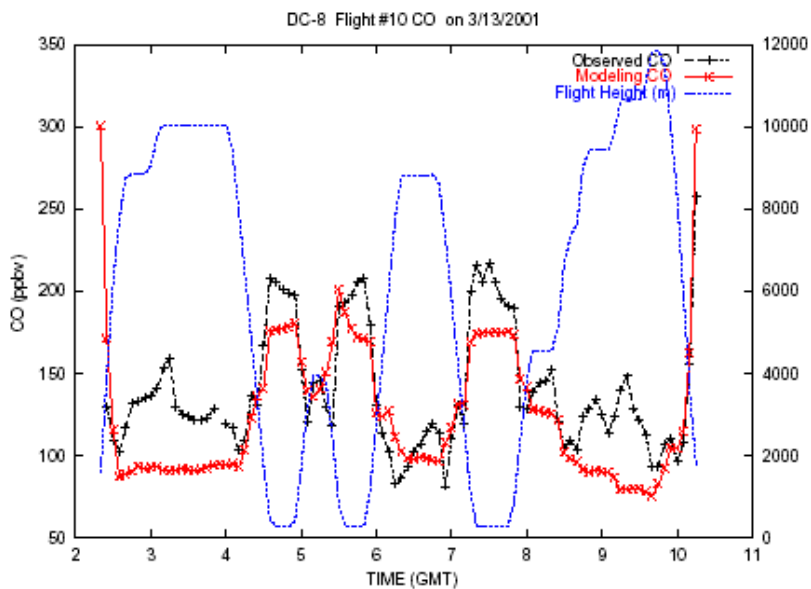
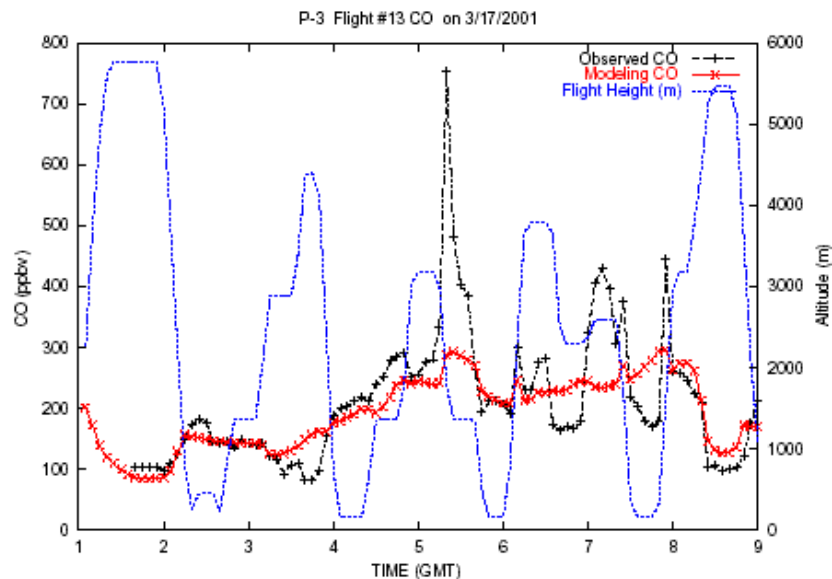
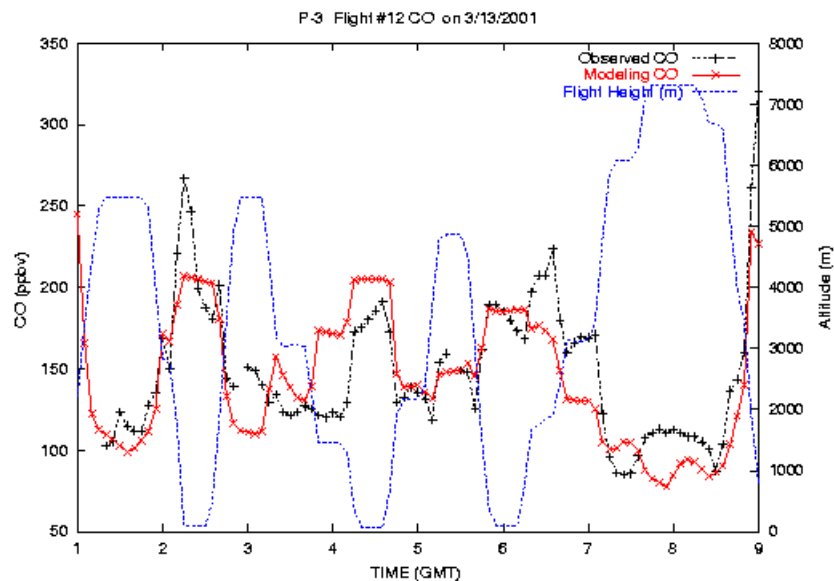
Observed CO and O₃ profiles during P3 flight 11-14

Besides anthropogenic emissions, biomass plumes and dust greatly contribute to aerosol concentrations

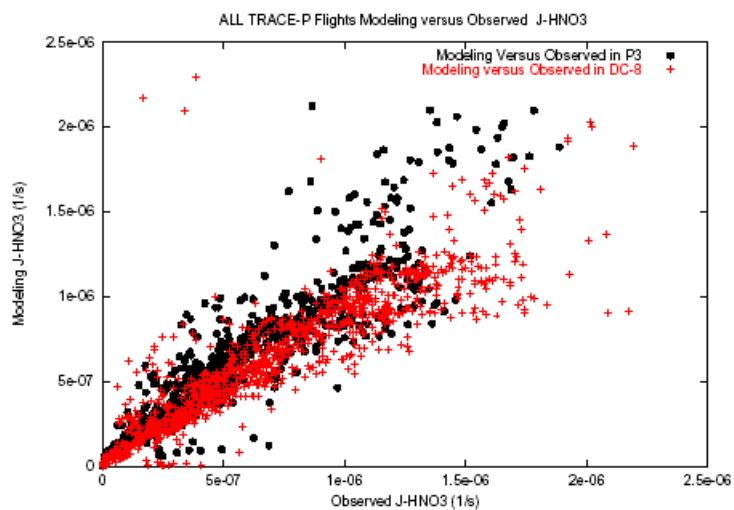
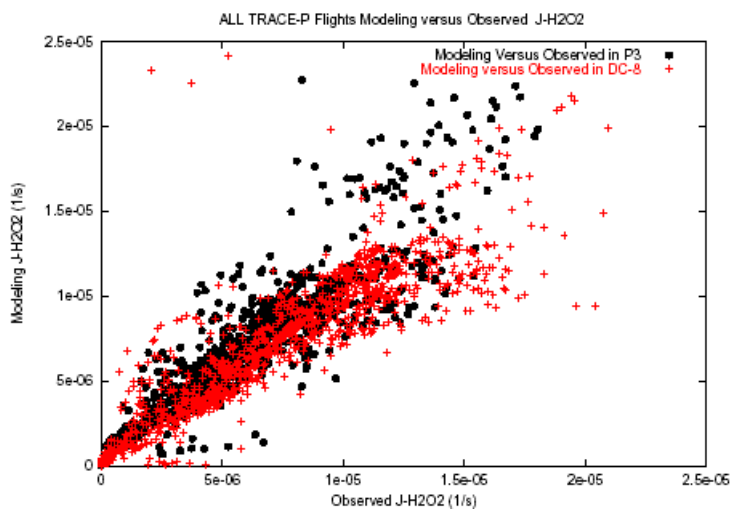
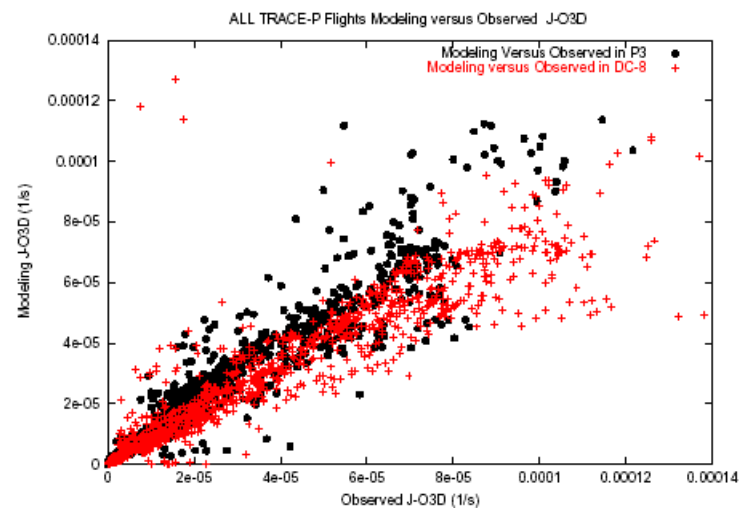
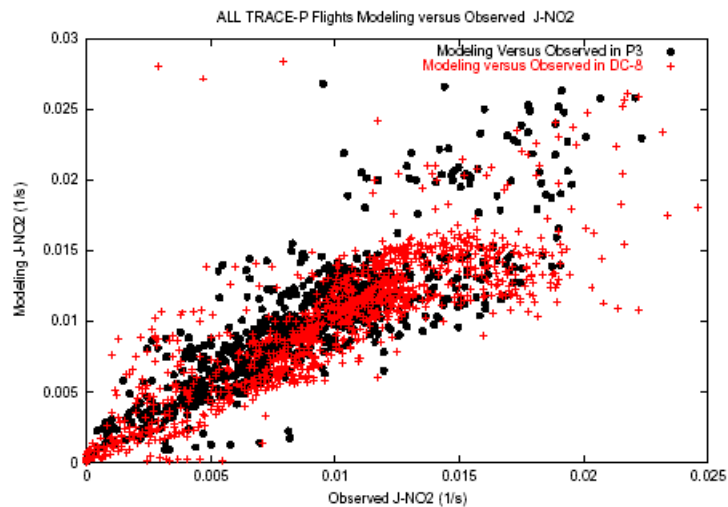


Our simulations are generally consistent with the observations for most species, such as CO, O₃, ethane, propane, formaldehyde et al

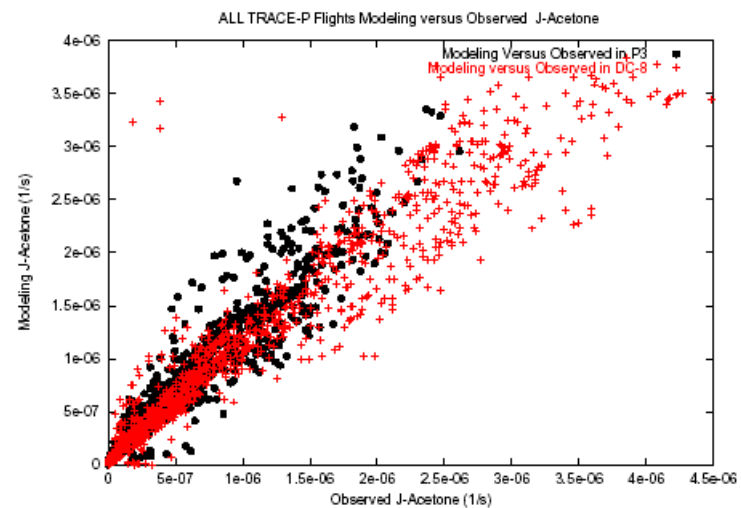
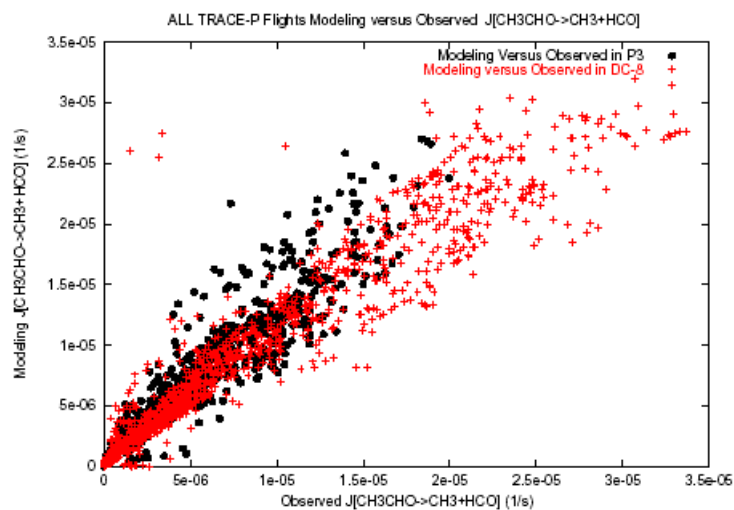
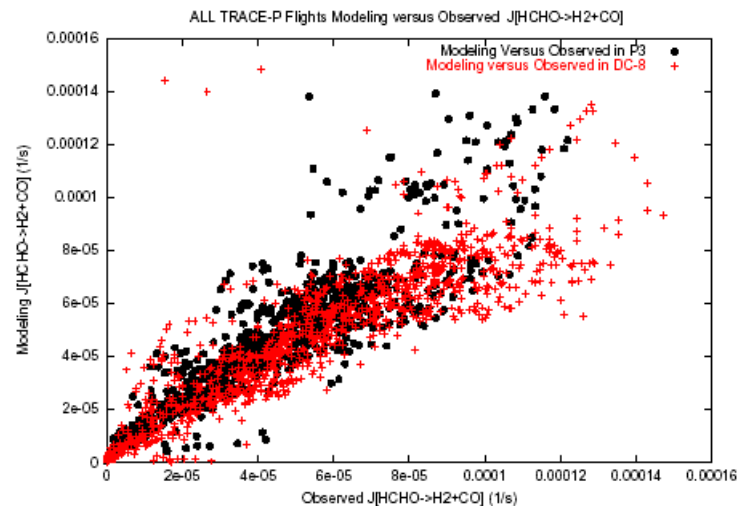
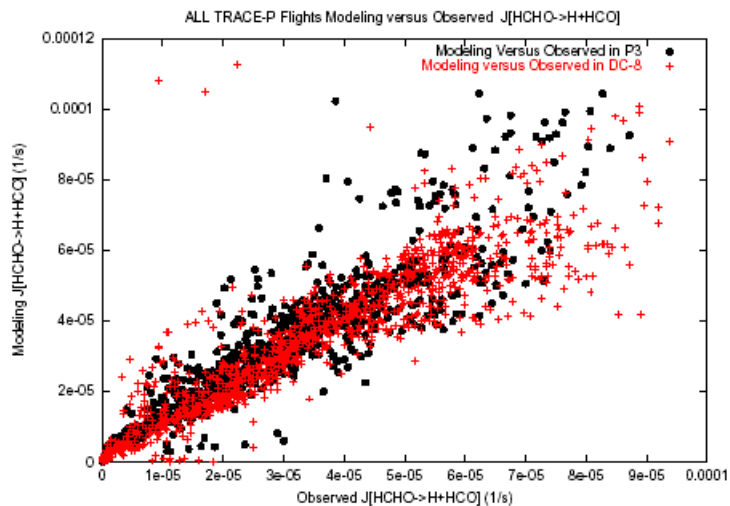
Simulated CO



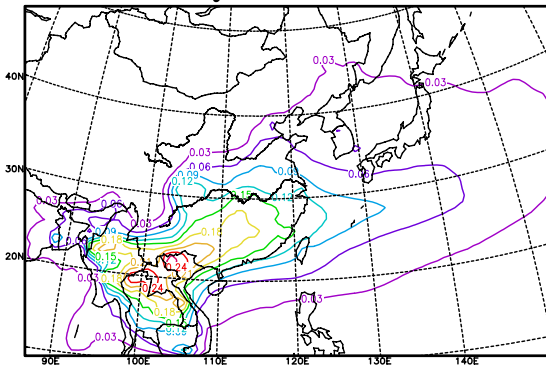
Modeling photolysis rate (J values) are generally consistent with observations



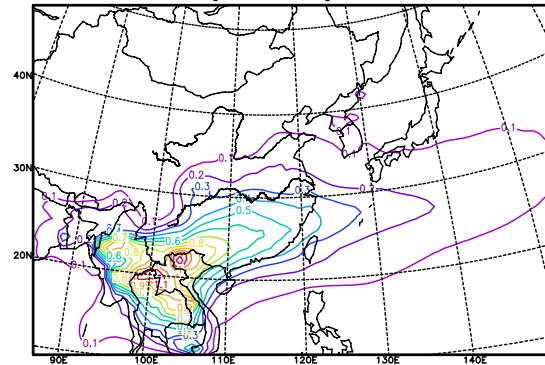
Continue from previous page



Simulated Average AOD of Black Carbon in March

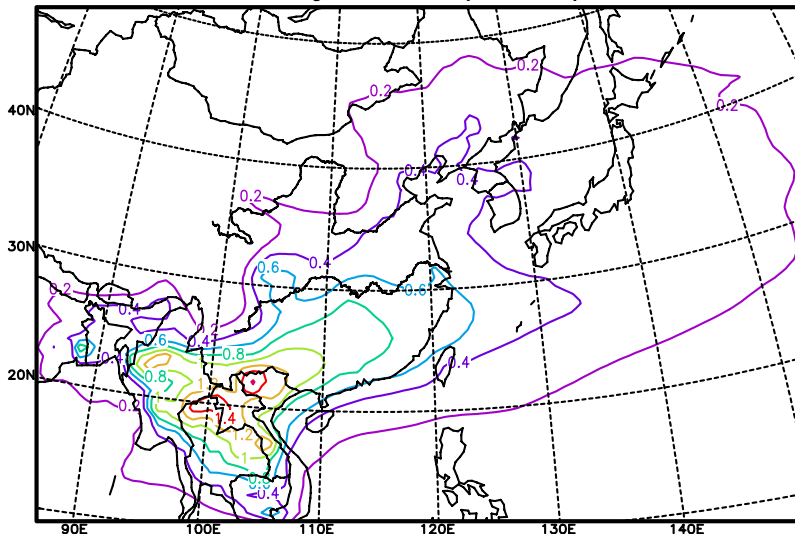


Simulated Average AOD of Organic Carbon in March

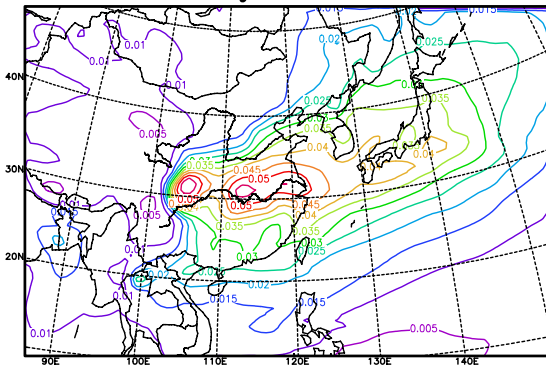


Biomass emitted BC and OC from Southeastern Asia are the important aerosols during TRACE-P period

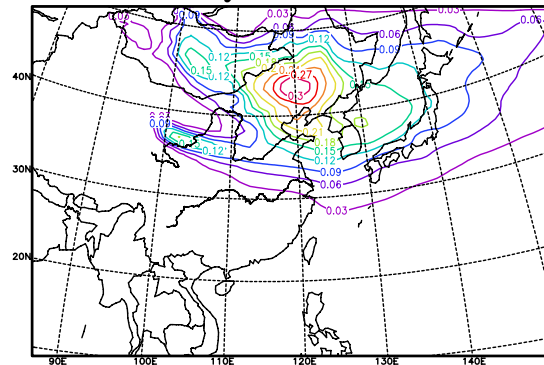
Simulated Average Aerosol Optical Depth in March



Simulated Average AOD of Sulfate in March



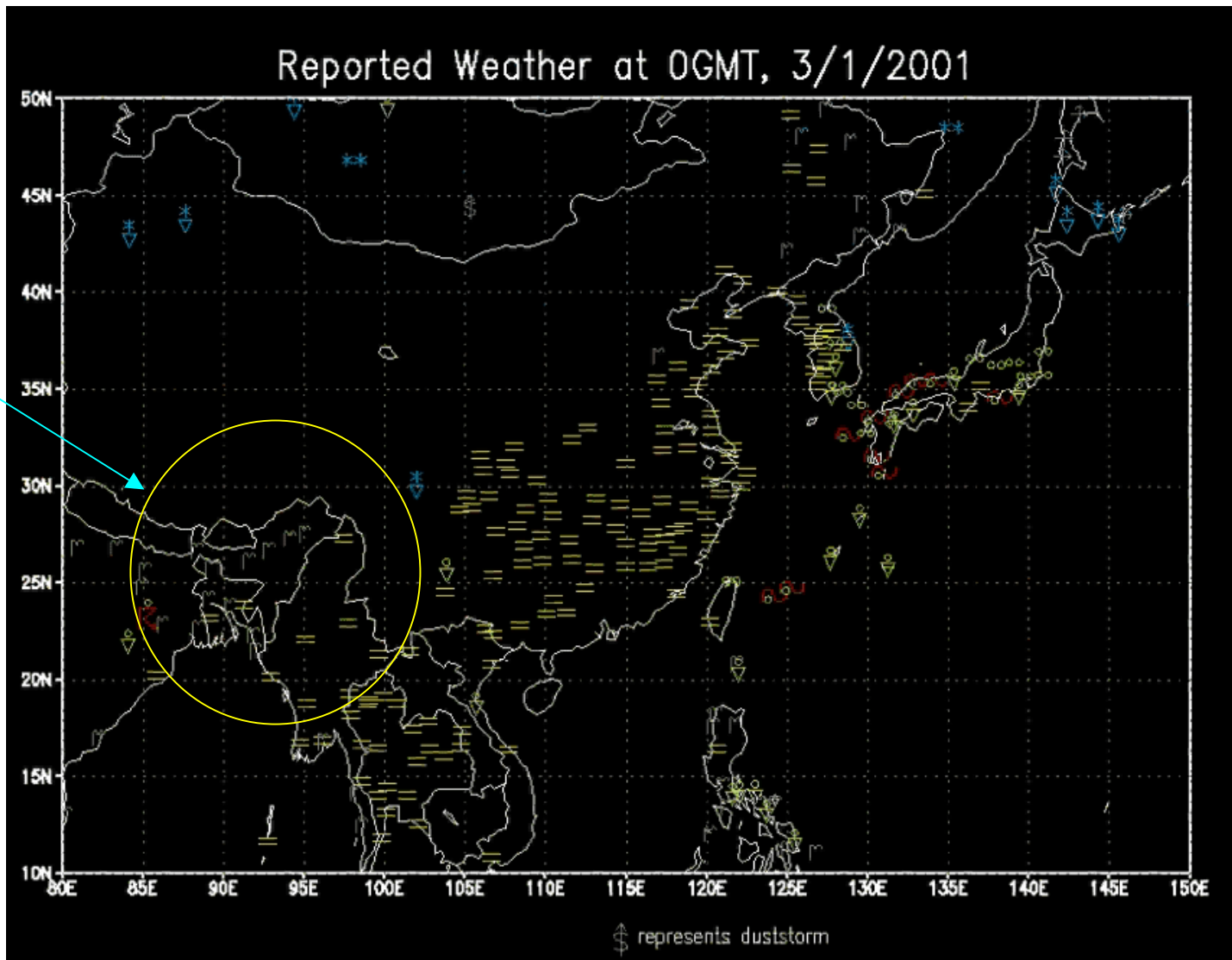
Simulated Average AOD of Mineral Dust in March



WMO weather reports also showed that the main biomass burning areas were dominated by the weather “**Visibility Reduced by Smoke Haze**”, implying that the biomass aerosols shielded off the sunlight.



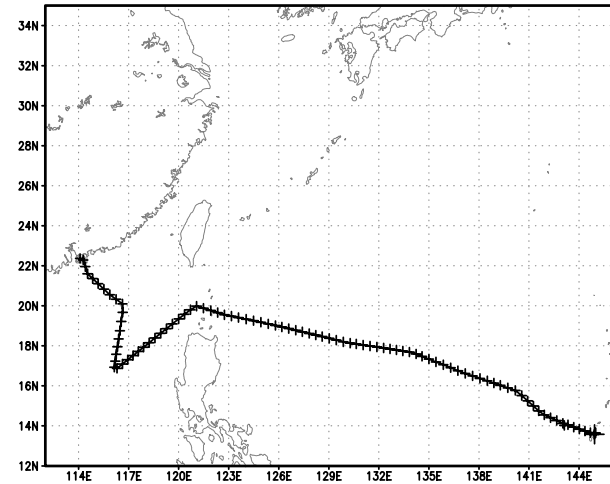
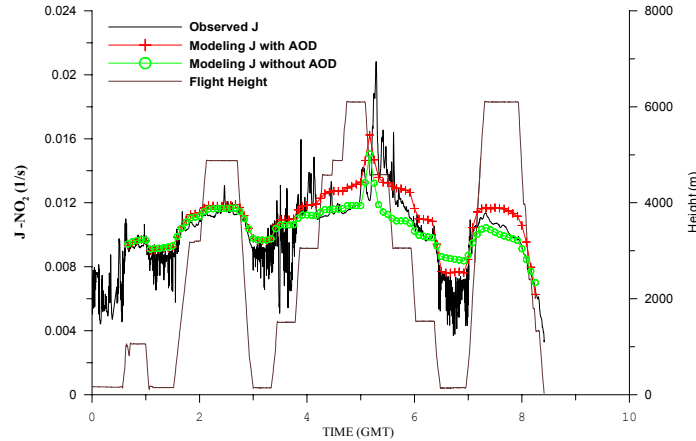
Main Biomass Burning areas



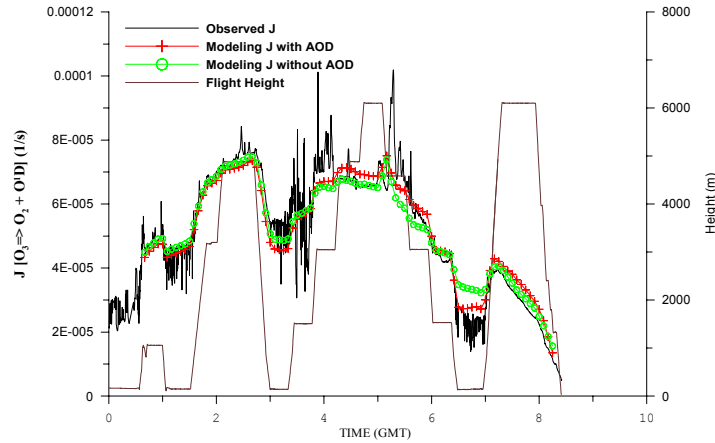
J-values Difference Between with and without considering AOD in P3 flight #08

P3 flew over clean areas, and the aerosol impacts on J values is not significant.

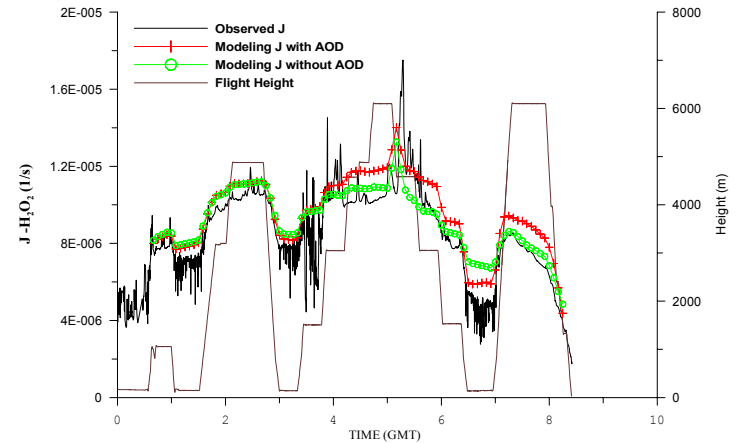
Modeling J-value Compared to Observation during P3 Flight 08 (03/04/2001)



Modeling J-value Compared to Observation during P3 Flight 08 (03/04/2001)

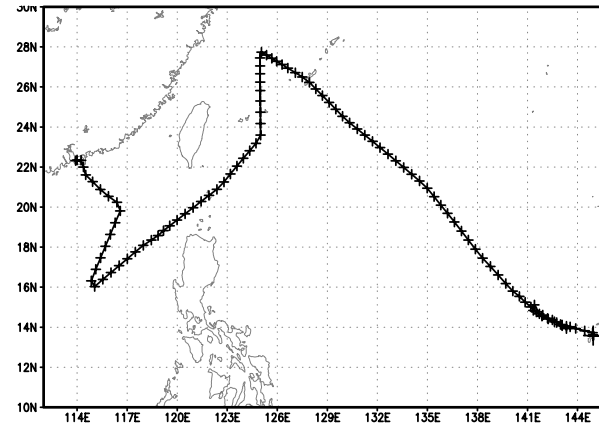
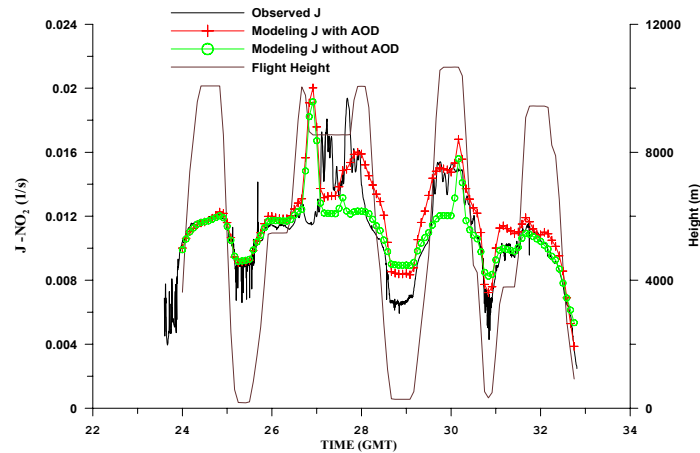


Modeling J-value Compared to Observation during P3 Flight 08 (03/04/2001)

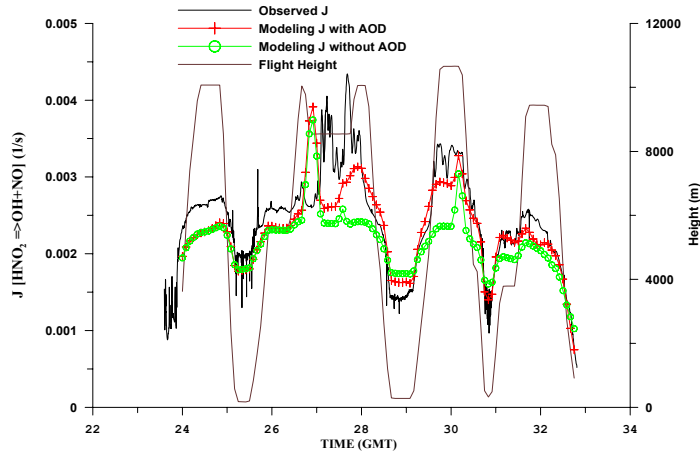


DC-8 flight #6 at the same day has the similar situation

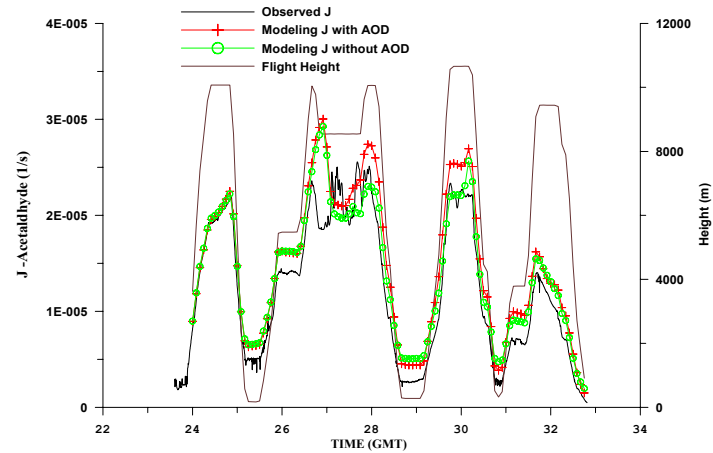
Modeling J-value Compared to Observation during DC-8 Flight #6 (03/03/2001)



Modeling J-value Compared to Observation during DC-8 Flight #6 (03/03/2001)

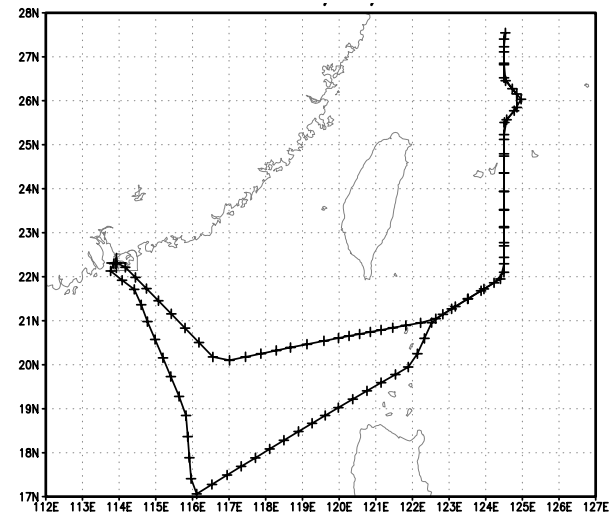
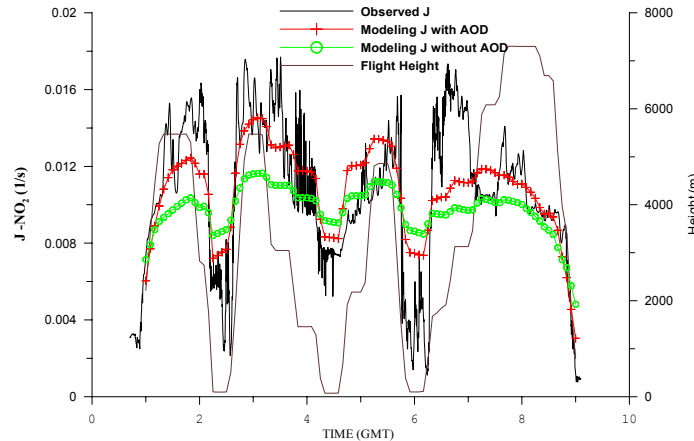


Modeling J-value Compared to Observation during DC-8 Flight #6 (03/03/2001)

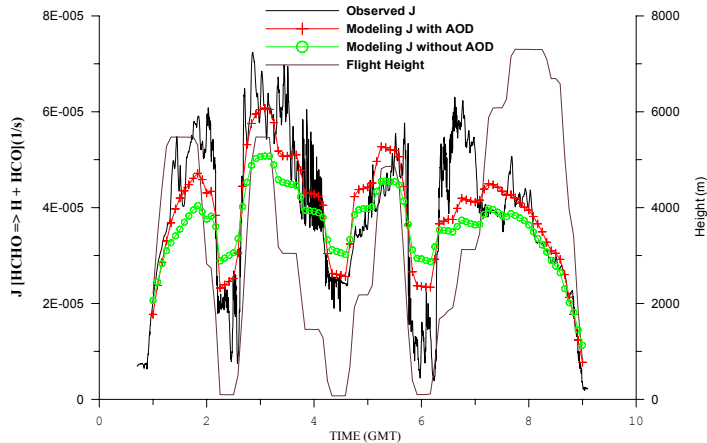


However, when the aircraft flew near polluted areas with relative high aerosol concentrations, aerosol optical depths made some differences on J-values.

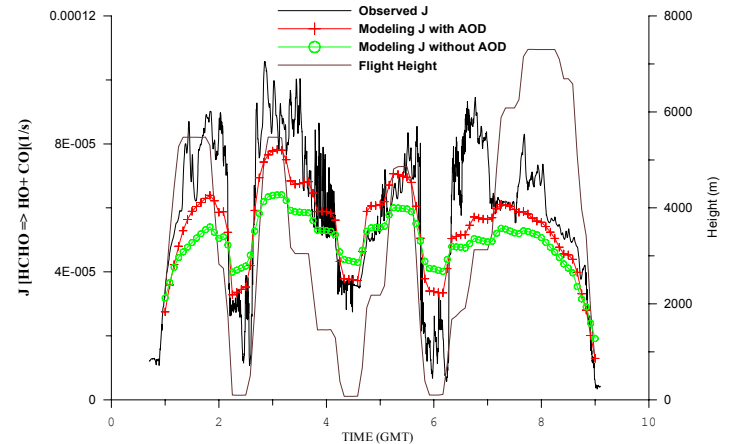
Modeling J-value Compared to Observation during P3 Flight 12 (03/13/2001)



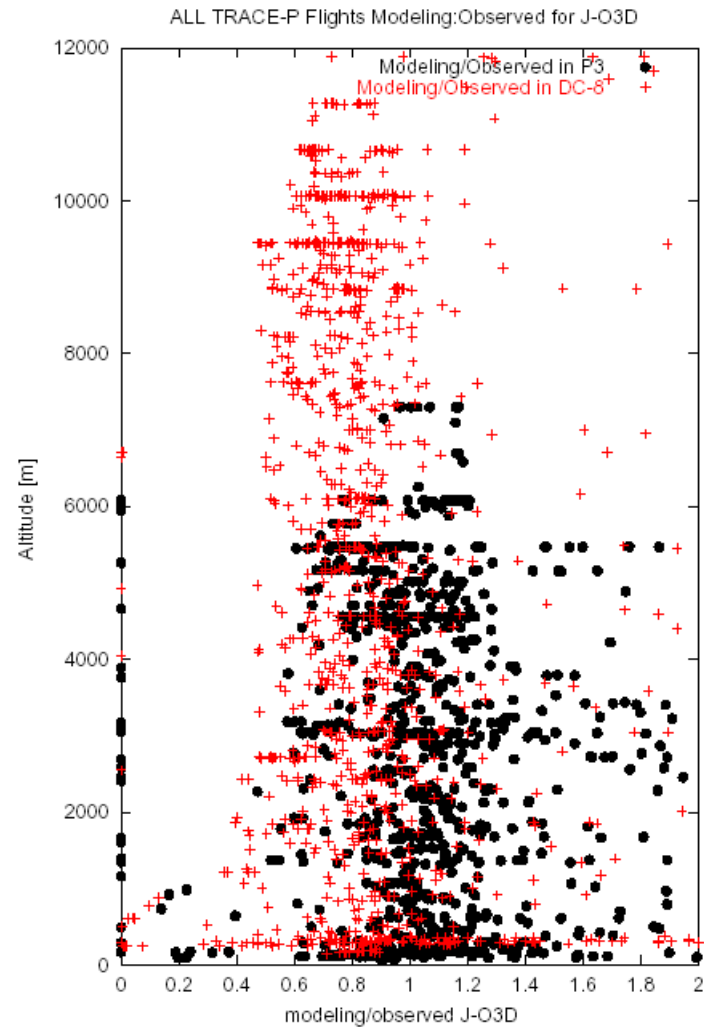
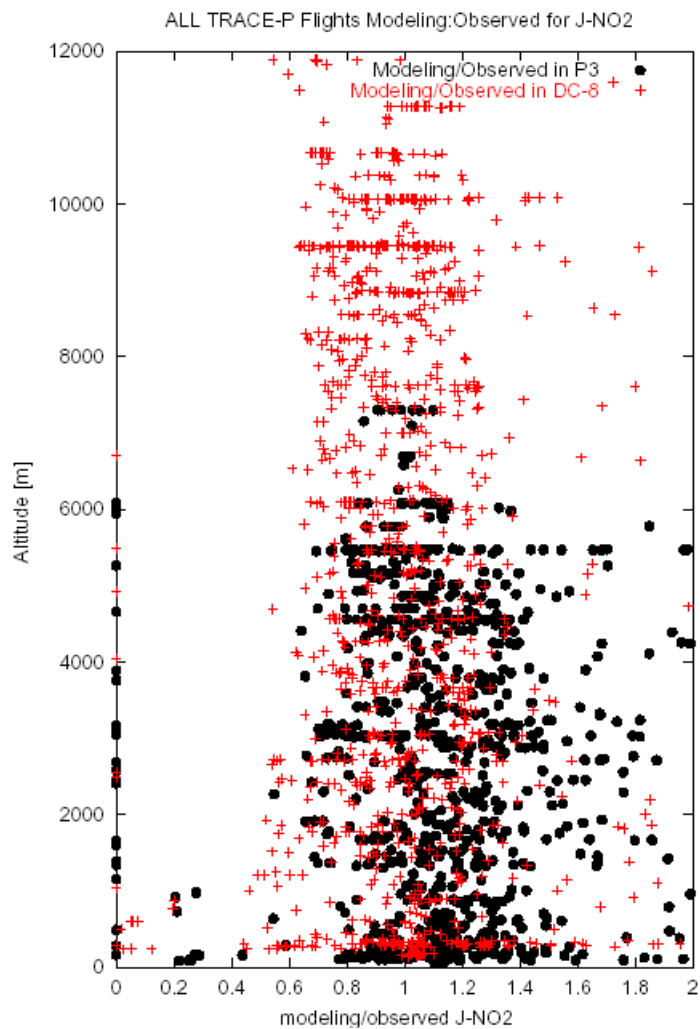
Modeling J-value Compared to Observation during P3 Flight 12 (03/13/2001)



Modeling J-value Compared to Observation during P3 Flight 12 (03/13/2001)

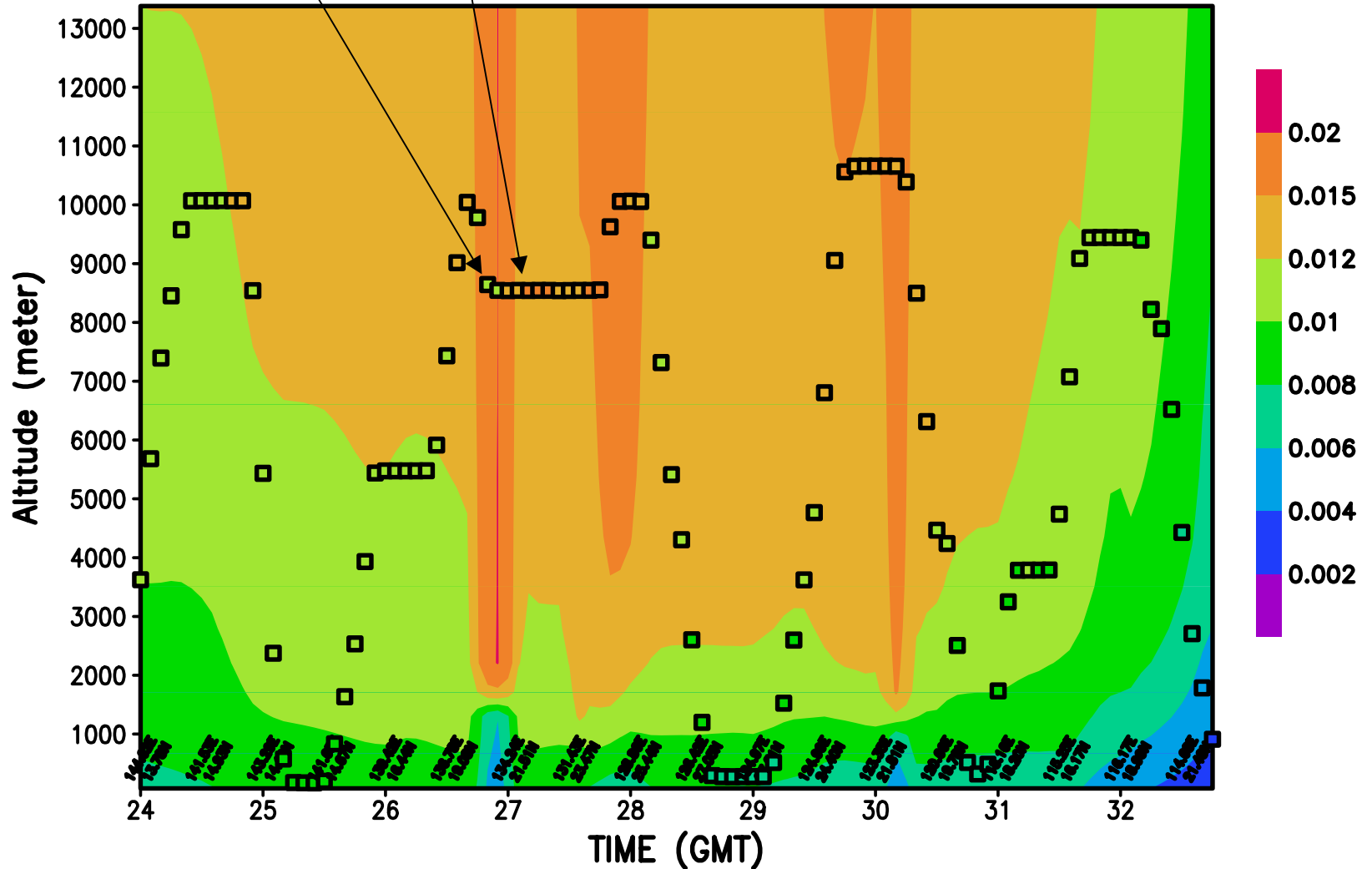


Generally our model yields the photolysis J-values consistent with TRACE-P flight observations.

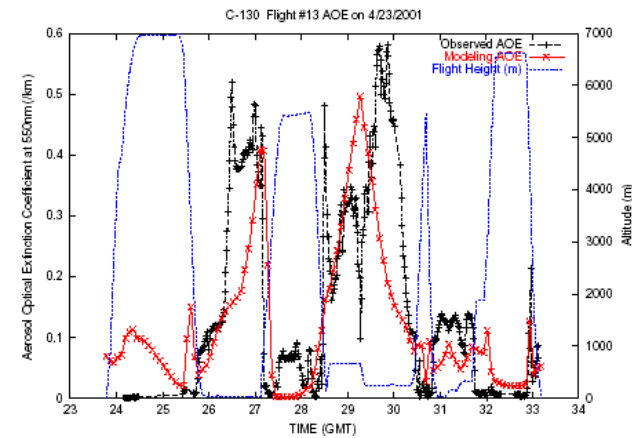
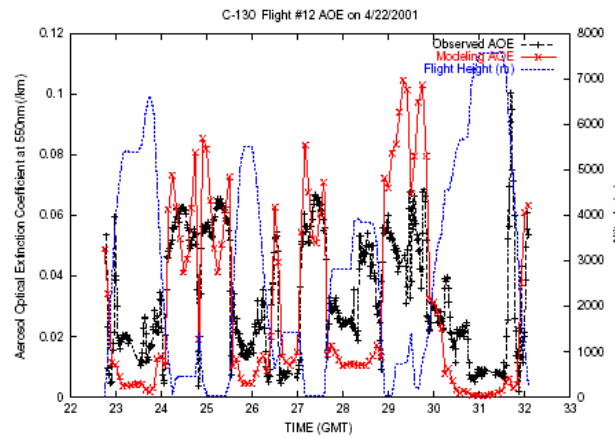
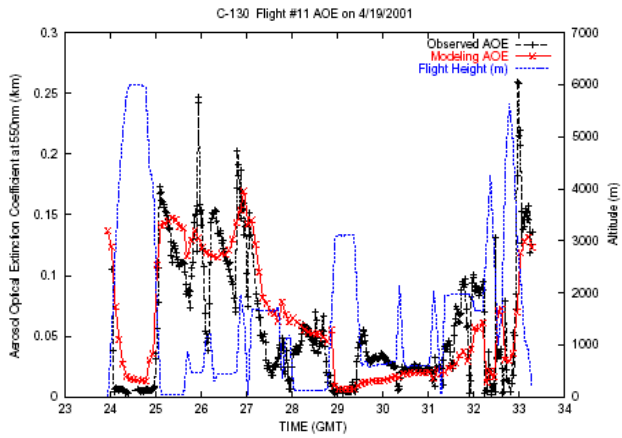


Some uncertain factors still exist, which may be due to clouds

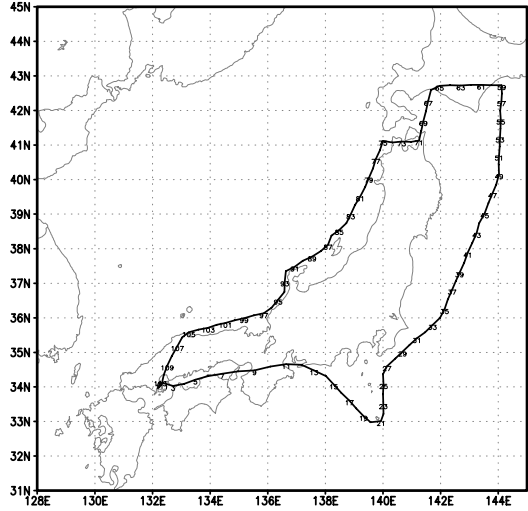
Simulated J-N₂ (1/s) compared to
DC-8 observation in Flight #06 (3/3/2001)



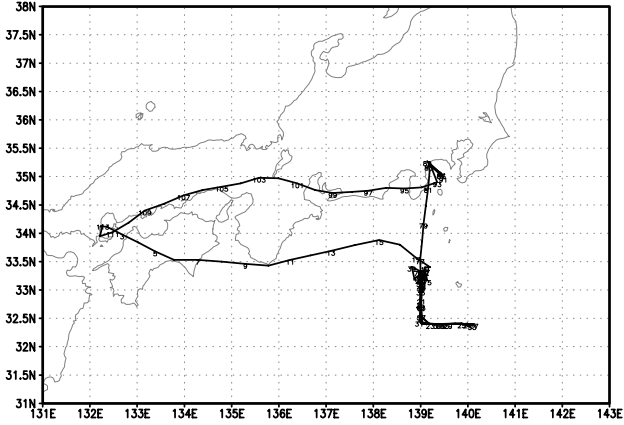
Modeling Aerosol Optical Extinction Coefficients compared to ACE-ASIA C-130 observations



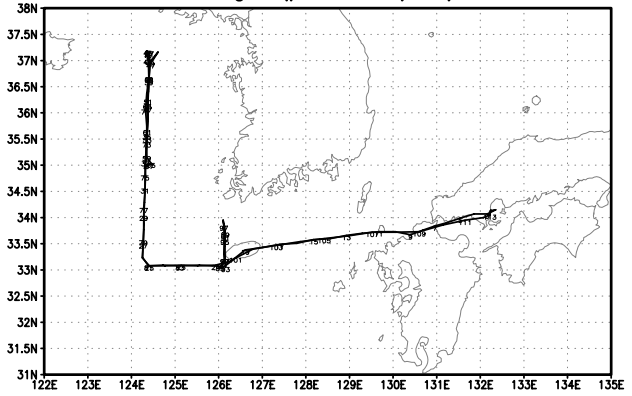
C130 Flight #11 04/19/2001



C130 Flight #12 04/22/2001



C130 Flight #13 04/23/2001



Summaries:

- **Our model performs a good simulation for J values in TRACE-P period with STEM and its on-line TUV**
- **In Asia-Pacific region, polluted air mass contains all kinds of high-concentration aerosols, from biomass aerosols to dust. Aerosol optical properties play an evident role on photolysis J values near polluted areas.**
- **Cloud is the most uncertain factor affecting J-values calculation during this period.**