

# Examining Photolysis Rates with a Prototype In-line Photolysis Module in CMAQ

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# Motivation

Extinction of UV radiation by aerosol particles reduces that amount of energy available for photolysis. Therefore, it is appropriate to calculate photolysis rates in-line to account for aerosol extinction.

# Design

Photon fluxes are calculated in seven intervals covering the range from 291 to 850 nm.

Updated absorption cross sections and quantum yields are taken from Fast-J<sup>1</sup>.

<sup>1</sup>Wild, O., X. Zhu, and M. Prather, Fast-J: Accurate simulation of in- and below-cloud photolysis in tropospheric chemical model, *J. Atmos. Chem.* Vol. 37, pp. 245-282, 2000.

# Design (continued)

A pseudo-spherical correction<sup>2</sup> has been incorporated to account for large zenith angles.

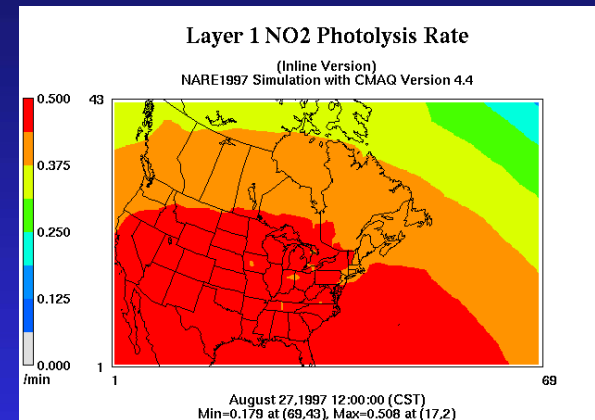
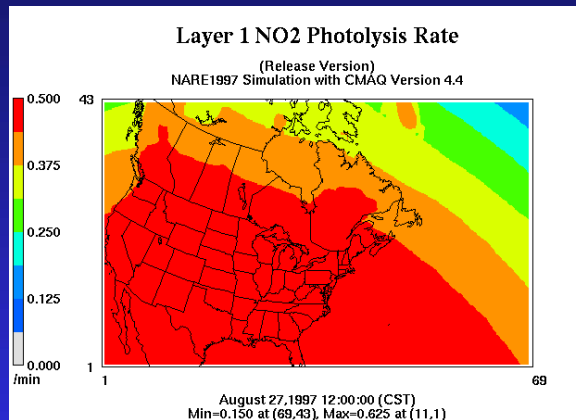
A new algorithm, optimized for a log-normal size distribution, is used for calculating aerosol extinction and scattering coefficients and the asymmetry factor.

<sup>2</sup>Dahlback, A. and K. Stamnes, A new spherical model for computing the radiation field available for photolysis and heating at twilight, Planetary and Space Sci., Vol. 39, pp 671-683, 1991

## Design (continued)

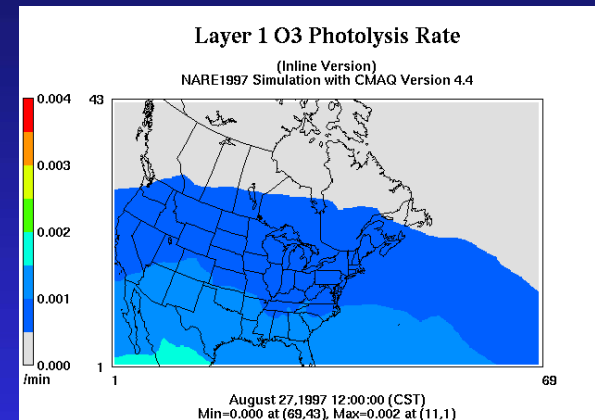
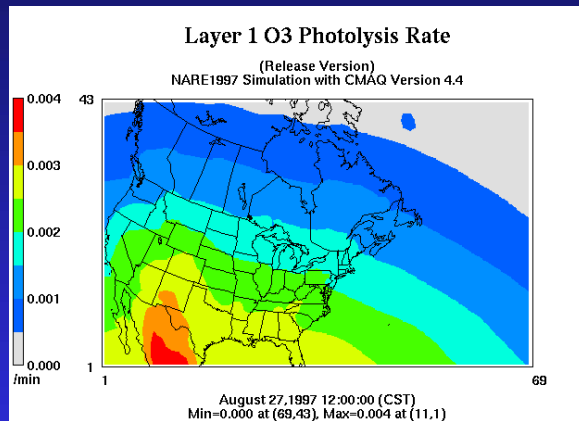
Photolysis rates are calculated for every grid cell at every synchronization time step.

# Comparison of Clear Sky $JNO_2$



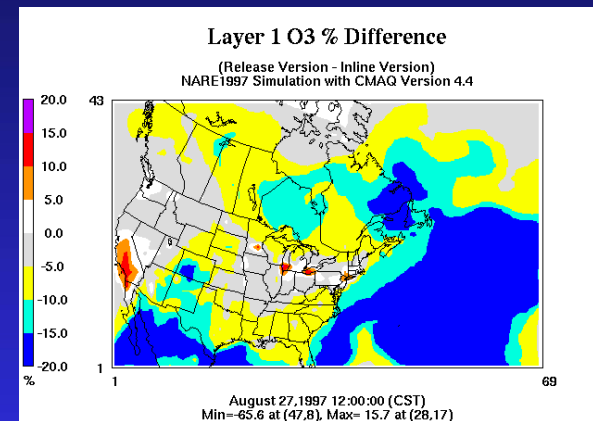
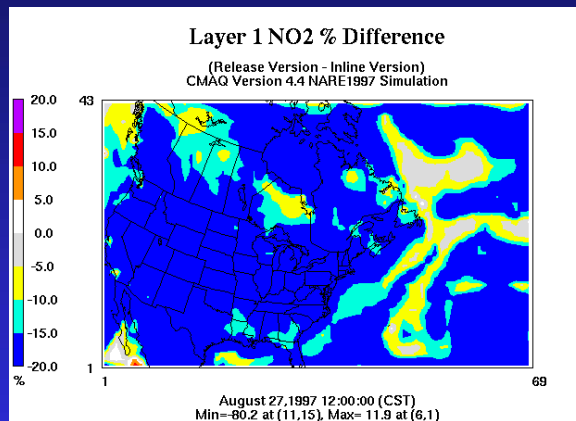
- Released Version on left In-line version on right

# Comparison of Clear Sky $\text{JO}_3$



- Released Version on left In-line version on right

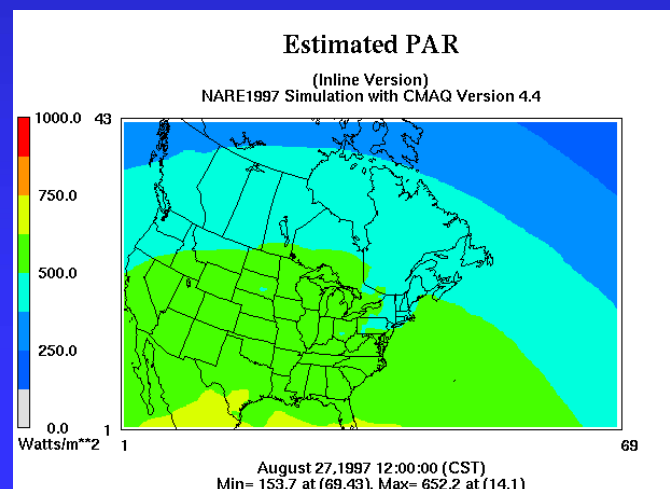
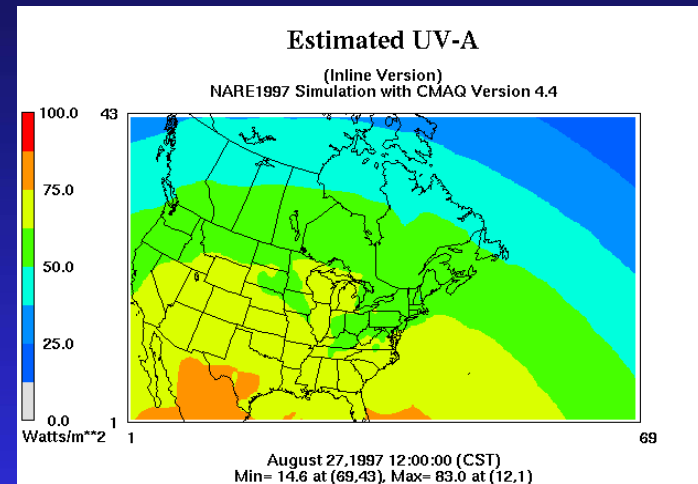
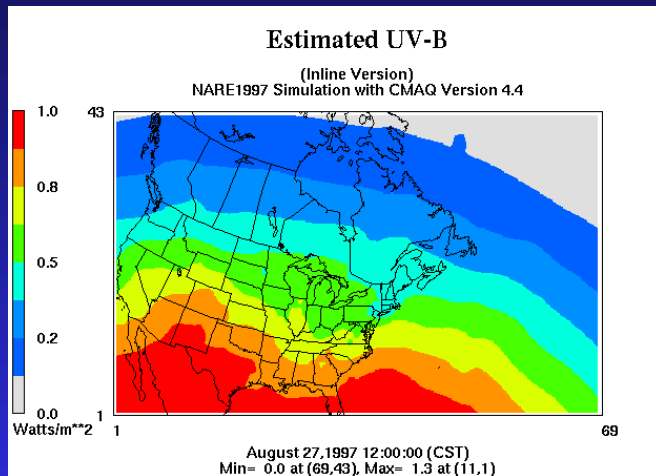
# Difference in Mixing Ratios [%] Released version - Inline version



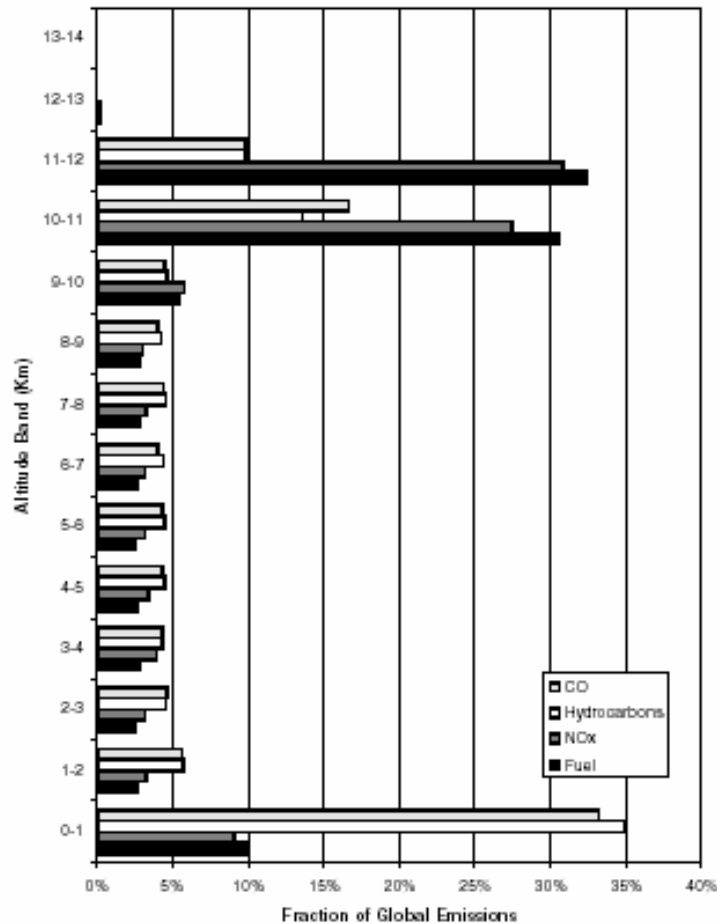
- NO<sub>2</sub> is on the left; O<sub>3</sub> is on the Right



# UV Surface Irradiance [ $\text{Wm}^{-2}$ ]

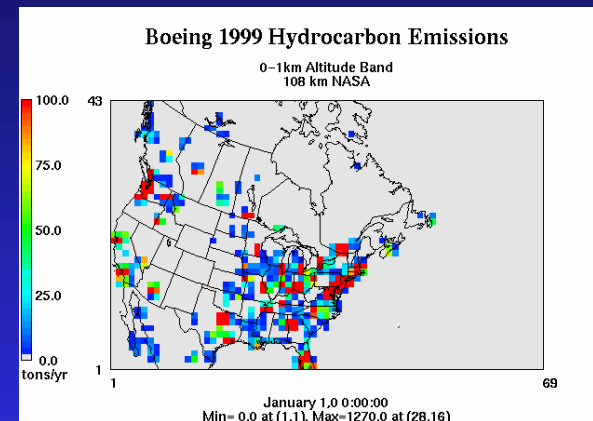
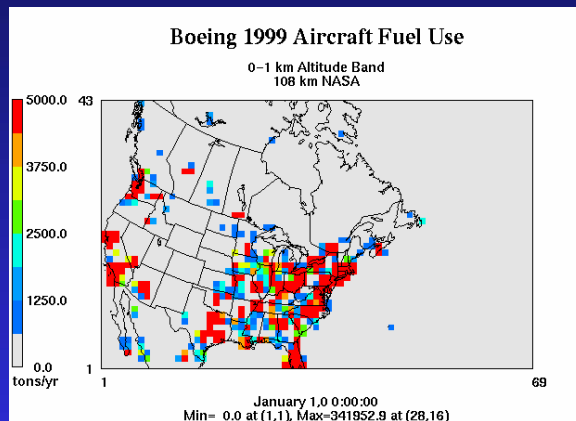


# Aircraft Emissions by Altitude



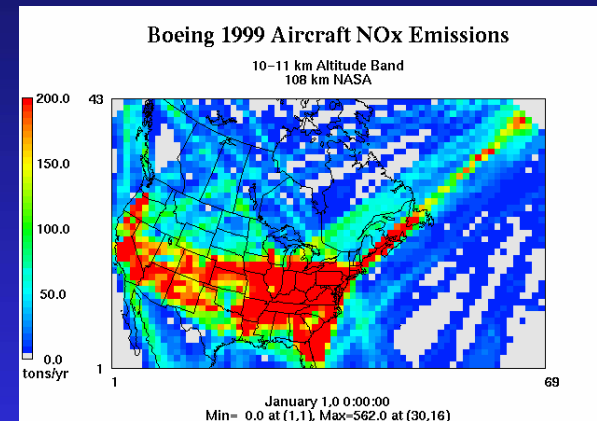
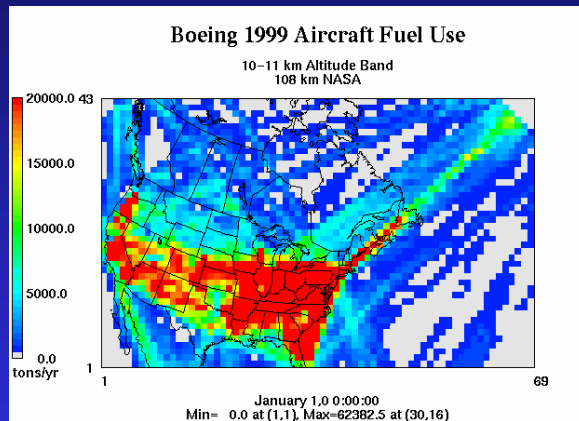
- CO and VOC emissions peak in 0-1 km band
- NOx and fuel use peak > 10 km

# Aircraft Information (0 - 1 km)



- Fuel use on left Hydrocarbon emissions on right

# Aircraft Information (10-11 km )



- Fuel use on left NOx emissions on right

# Future Work

We will be using CMAQ with the new in-line photolysis module along with the aircraft emissions to model episodes from the NASA INTEX NA experiment in 2004.