Regional Modeling and GMI

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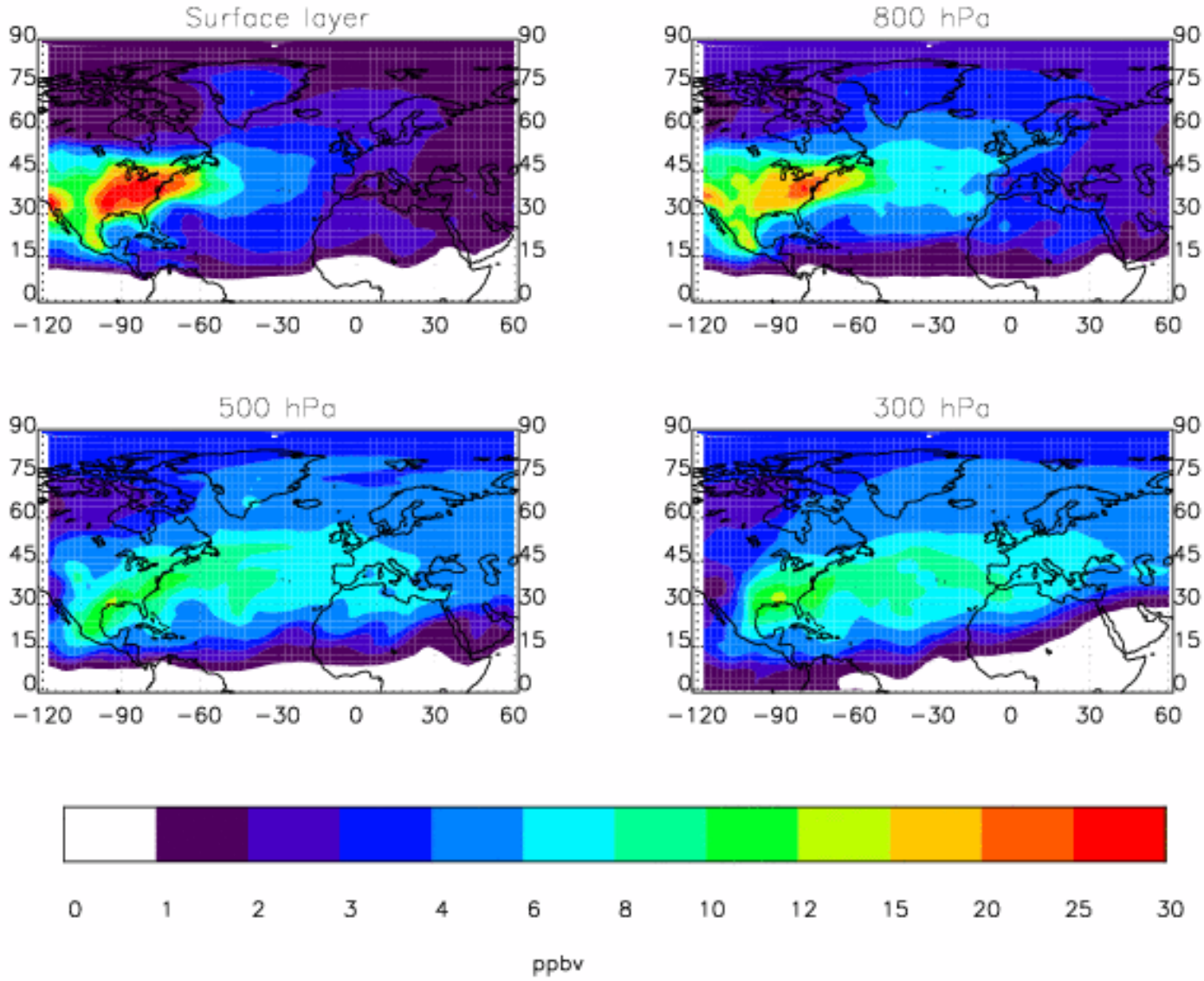
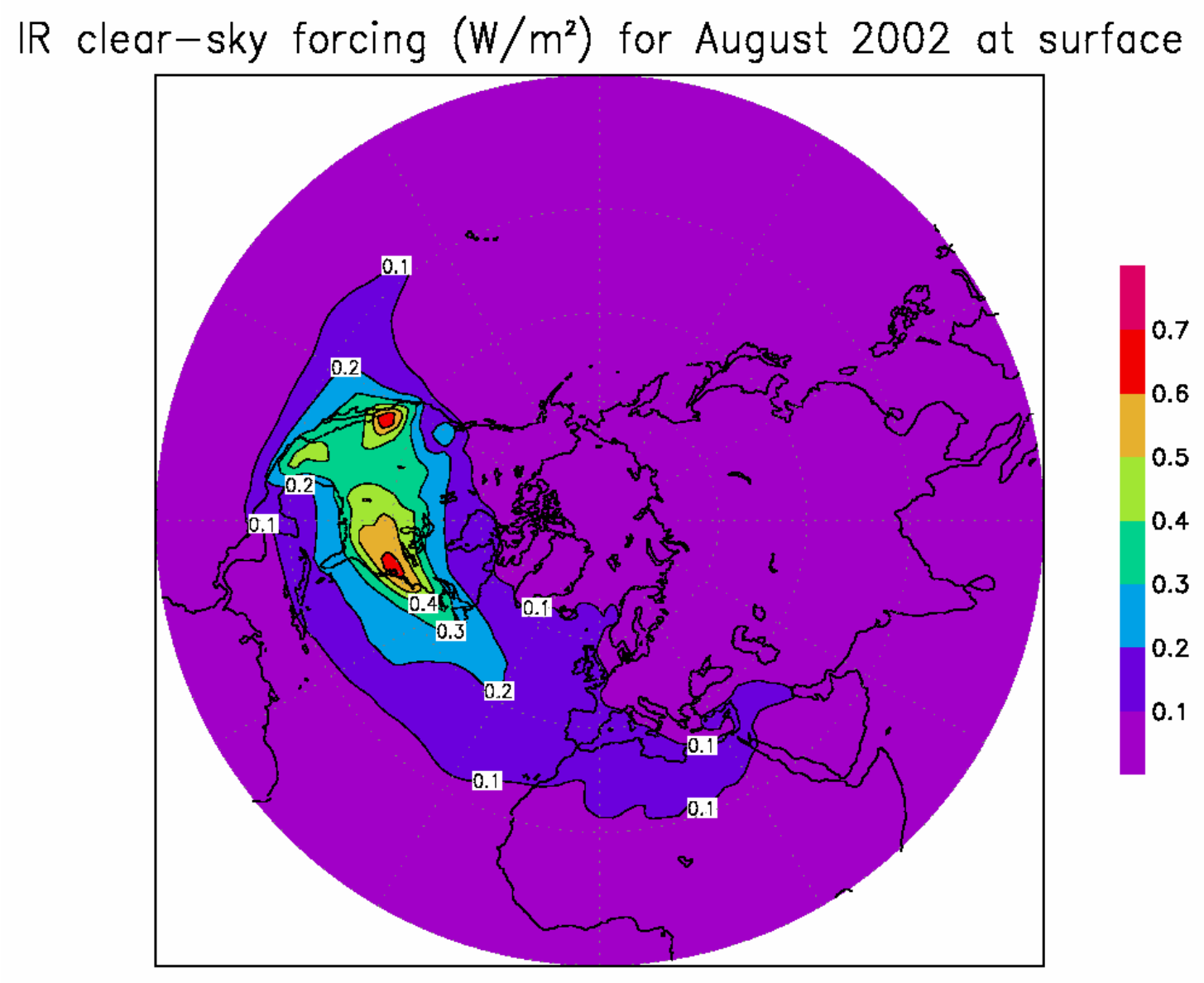
Additional O3 due to NA anthro emissions: June 2002



UMD-CTM simulation with N. American emissions minus one without



Chou et al. radiative code used to compute radiative fluxes based on UMD-CTM simulated ozone fields with and without N. American anthropogenic emissions

Downscaling Transport and Chemistry

- **Stretched-grid UMD-CTM (Allen et al., 2000; Park et al., 2004a,b; Allen et al., 2004)**

  Ozone production 15% smaller in PBL at 0.5 deg. than at 2 x 2.5 deg.; possibly larger difference in UT convective outflow plumes

  Mesoscale transport features (e.g., fronts) resolved; convection more localized

- **Nested grid approach – use GEOS-5 0.5^{o} x 0.67^{o} data in fine-grid region embedded within coarser-resolution global model**

- **WRF-Chem using initial and boundary conditions from N. Amer. Regional Reanalysis, GEOS-4, or GEOS-5, or MERRA and GMI**

  WRF-Chem – Grell et al. (2005); Fast et al. (2005); McKeen et al. (2005)

  Online photochemistry and aerosols in Weather Research and Forecasting regional model

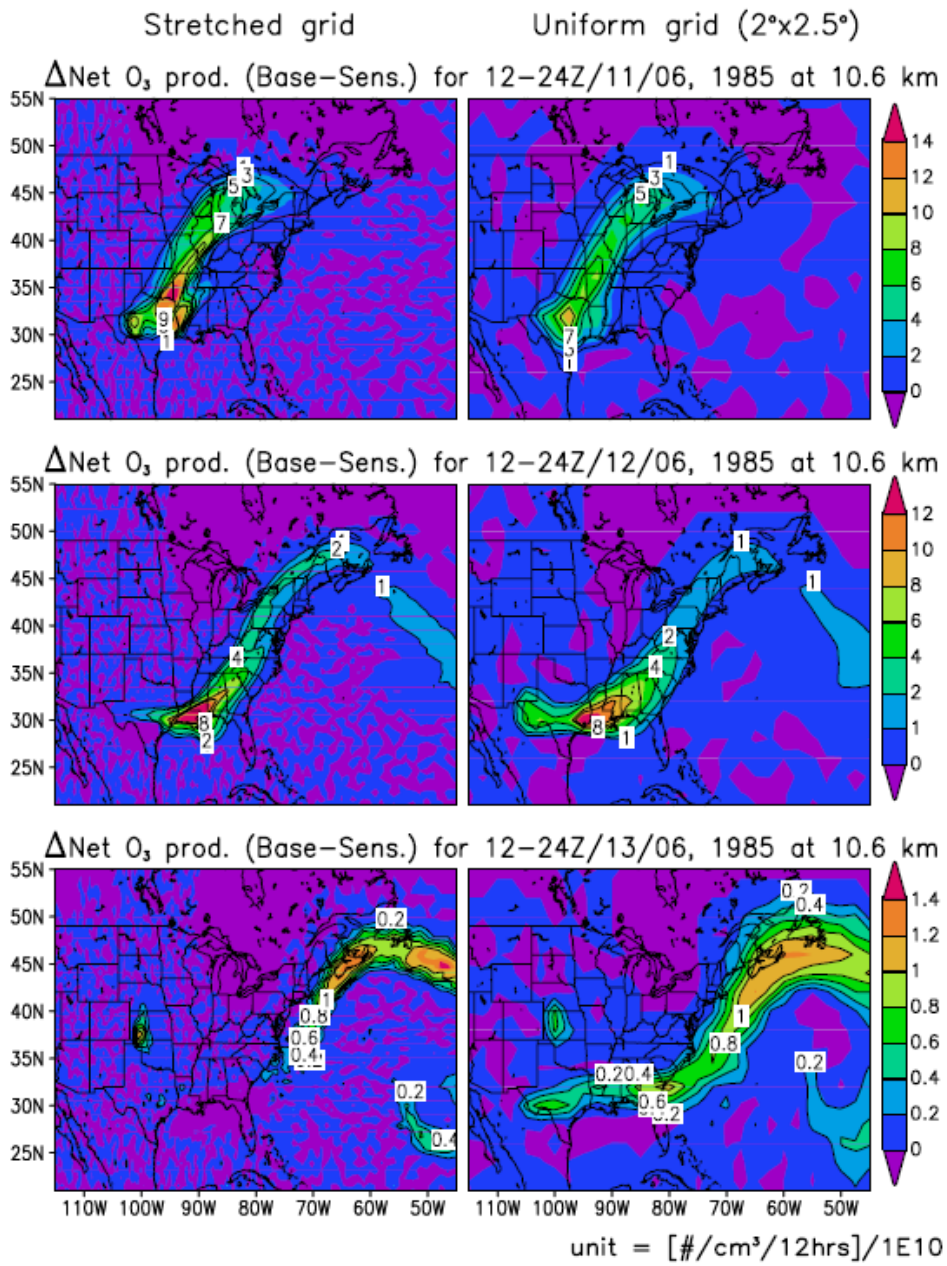
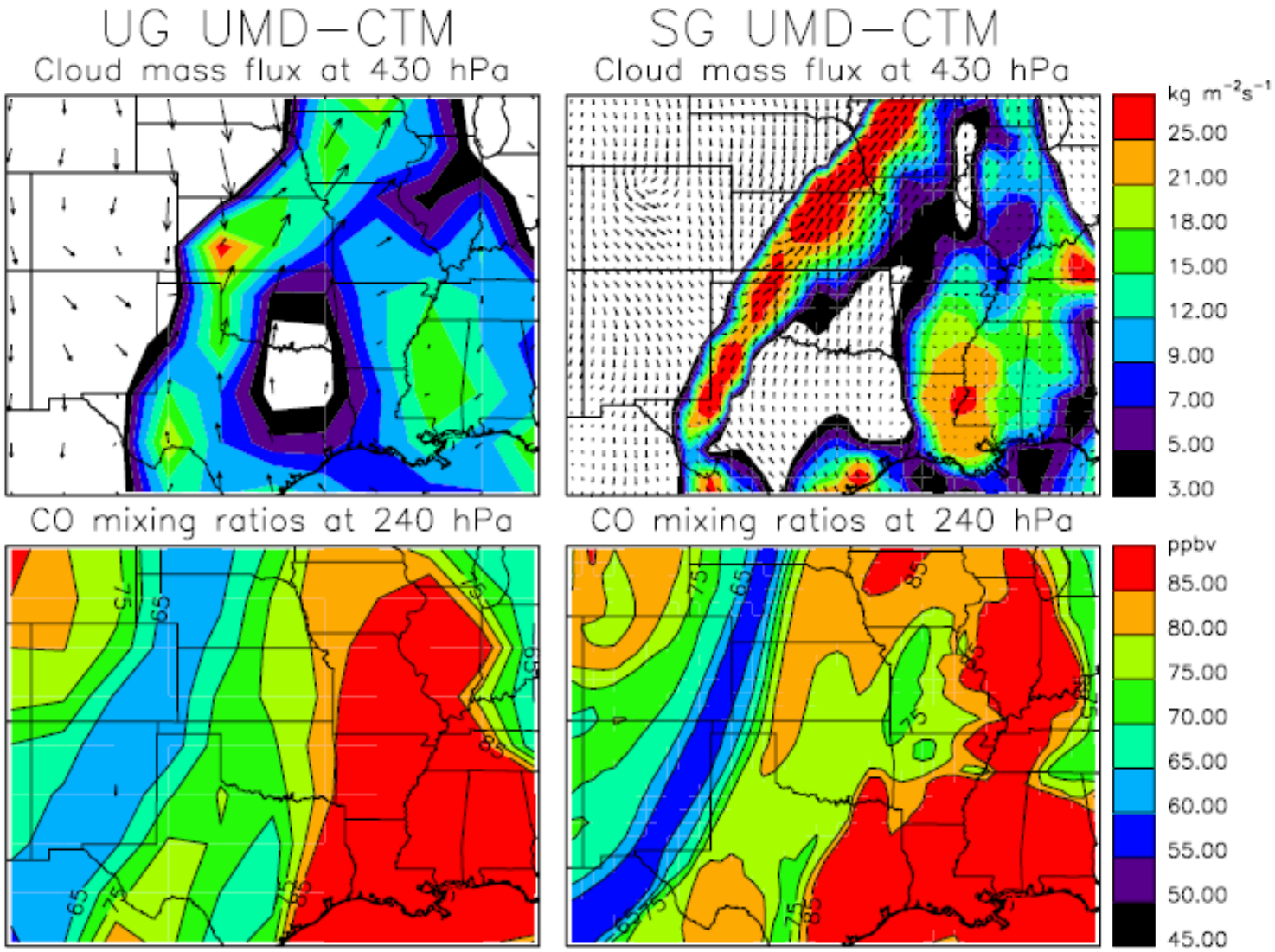


Table 3. Net Ozone Production Downstream of Convection at 10.6 km on 11–13 June 1985 (10^8 moles/12 hrs)[a]

Model	Time		
	12–24Z/11 June	12–24Z/12 June	12–24Z/13 June
Uniform grid (GEOS3, 2 × 2.5)	2.3	2.2	0.69
Stretched grid	2.3	1.5	0.24

[a]Net ozone production summed over the domain shown in Figure 11.



Horizontal gradient of CO at 240 hPa better captured at 0.5 degree (right) resolution than at 2 x 2.5 degrees (left) based on aircraft measurements

WRF-Chem Activities

- Dale Allen and grad students at UMD running WRF-Chem at 36- and 12-km resolution to generate trace gas and aerosol fields for use in indirect validation of Aura data over Mid-Atlantic region. IC and BC from NCEP/NAM and US background chemistry

- Mike Manyin at GSFC running WRF-Chem CO tracer (no chemistry) for TC4 period at 90-km resolution over large domain. IC and BC from GEOS-4 and GMI.

- Mian Chin/Thomas Diehl at GSFC putting GOCART aerosol algorithms into WRF-Chem in collaboration with Georg Grell at NOAA/ESRL.

New Project Funded Under ROSES-07
Aura Science Team

Tropospheric Transport Processes for Trace Gases and Aerosols: Regional-to-Global Chemistry and Climate Consequences

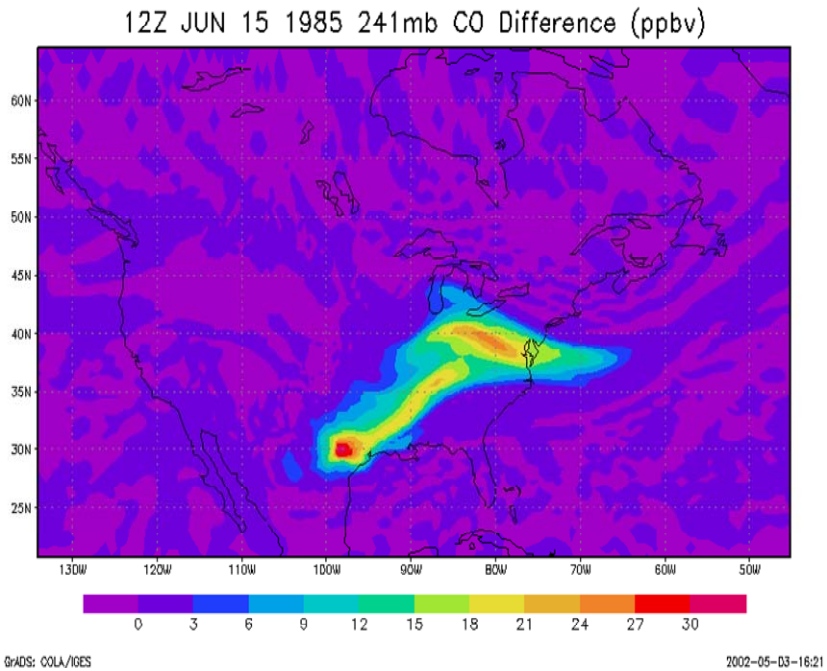
- Downscale transport and chemistry for computing continental export of pollution using regional model
- Evaluate regional model simulations using sonde, aircraft, and satellite (primarily Aura) data
- Compute regional radiative forcing due to tropospheric ozone, methane, and aerosols using fields from chemistry simulations with and without North American anthropogenic emissions
- Allow feedback of radiative perturbations to dynamics in regional model

WRF-Chem and GMI

- Obtain initial and boundary conditions for WRF-Chem from GMAO met fields and GMI CTM.
- Existing code distributed by NOAA/ESRL will be modified and used to convert GMI species to species appropriate for WRF-Chem (RADM2 or CBM-Z mechanisms) and interpolate to WRF-Chem grid for initial and boundary conditions.
- Emissions to be generated by SMOKE based on EPA NEI-02 with updates for power plants.
- Seasonal simulations to be conducted for North America – Western Atlantic for Summer 2004, 2005, Spring/Summer 2006;
  East Asia – Western Pacific for Spring/Summer 2001, 2005, 2006.
  Use 36-km resolution with nested 12-km resolution grid over primary pollution outflow regions.
- Compute continental export of ozone and aerosols

WRF-Chem and GMI

- Implement lightning NO parameterization for WRF-Chem currently under development at Florida State University
- Conduct WRF-Chem sensitivity simulations for convection/lightning using different convective parameterizations
- Compute fraction of continental outflow that results from convection
- Compute lightning NO_x contribution to ozone over North America, North Atlantic, East Asia, Western Pacific



CO with convection minus without convection in UMD-CTM

WRF-Chem and GMI

- Compute offline radiative forcing due to ozone, methane, and aerosols resulting from North American and Asian anthropogenic emissions.
- Calculate radiative perturbations due to gases and aerosols on line.
- Allow radiative perturbations to feed back to WRF-Chem meteorology
- Participate in HTAP modeling activities

- A question for the future: Could WRF-Chem output be fed back to the GMI model?