Temporal and spatial forecasting of chemical phenomena for data collection and sampling by airplane (& ozonesonde, & Ronald H. Brown, & satellite)

Chemical model designed entirely for purposes of flight planning during ICARTT
ICARTT – International Consortium for Atmospheric Research on Transport and Transformation

- NASA - Intercontinental Chemical Transport Experiment - North America (INTEX-NA)
- NOAA - New England Air Quality Study - Intercontinental Transport and Chemical Transformation (NEAQS-ITCT)
- Europeans (U.K., Germany, and France) - Intercontinental Transport of Pollution (ITOP).
- ICARTT was formed to take advantage of this synergy by planning and executing a series of coordinated experiments concerning:
  - regional air quality
  - intercontinental transport
  - radiation balance
Points of Emphasis

- Source data
- Meteorology
- Chemistry
- Model Validation
Source Data

- EPA gridded emission inventory
  - 24 hours vs. workday only
  - Weekday vs. weekend
  - Land use changes
- Daily NOAA satellite wildfire area coverage
- Topography for emission heights
Accurate depiction of CO, aerosols, NO, etc. introduced by ongoing wildfires is absolutely necessary.
Meteorology

• MM5
  – Initialized from 24 hour AVN forecast
  – Initialized at 0Z (6pm EDT)
  – 72 hour forecast
  – Nested 4km, 12km, 60km grids
• Also used for cloud forecasting during ICARTT
• MM5 also used for regional cloud modeling (NO ONE publishes a cloud model)
• Another example of MM5 data used for cloud forecasting (NO ONE publishes a vertical motion forecast either)
Chemistry

- Statewide Air Pollution Research Center (SAPRC) chemical mechanism (218 reactions)
- 30 photolysis rates are explicitly computed through UCAR’s Tropospheric Ultra-Violet and Visible radiation model (TUV)
- Aerosol Ions are calculated by the on-line four-bin SCAPE II module
- Lateral and top boundary conditions are provided by MOZART-2
STEM2k3
• 3 NESTED DOMAINS: 60KM, 12KM, 4KM
Species Forecasted

RH, SO2, O3, CO, NO2, HNO3, PAN, RNO3, NH3, OH, NOy, Ethane, Propane, HO2, H2O2, HCHO, Total AOE, BC AOE, OC AOE, Sulfate AOE, AOD, Single Scattering Albedo, Sulfate, Nitrate, NO3 Aerosol Ratio, Ammonium, NH4(3) Aerosol Ratio
Smoke Invades Midwest and Northeast on July 17
Model Validation

- Meteorology
- Chemistry
Objectives:
2. Aged convective/lightning outflow over southeast U.S.
3. Validation of CO2 column/Rhinelander, SCIAMACHY, AIRS
07-16. Smoke episode begins in Iowa
The MM5’s ability to model clouds well is imperative for correct photolysis rates to be modeled.
Temperatures continually show a 2°C discrepancy.

07/20

Temperature (C) by MM5

T contours @ 2m (C)

Temperature (C) by AVN

Time = 18Z 0720

Time = 18Z 0720
Temperature and wind from Appledore Island (July 21 & 22)
The Future

• Post-analysis
• Settle some arguments
• Informed policy decisions (we can only inform and encourage)
• Global transport in great evidence
Not just thank you

• Department of Energy, GCEP
• Center for Global and Regional Environmental Research, University of Iowa
• Gregory Carmichael, Narisara Nthongboonchoo, Bhupesh Adhikary, Marcelo Mena, Youhua Tang
• Renyi Zhang
• Jeff Gaffney, Milt Constantin