High Resolution CAM-Chem

Louisa Emmons - NCAR
Francis Vitt, Xiaoyan Jiang, Simone Tilmes, Jean-Francois Lamarque
Ozone – 0-2 km avg - June 13-22, 2008

CAM-chem - 0.47° x 0.63°

Animation by Tim Scheitlin, CISL
CAM-chem configuration

- CAM-4
- MOZART-4 chemistry, bulk aerosols
- 0.47° x 0.63°
- GEOS-5 specified dynamics (56 levels)
- Not with new MEGAN (waiting for land IC files)
- 2008 – ARCTAS-POLMIP emissions
Daily averages for June 14, 2008

Peak values are higher over source regions

Ozone CO

2°

CAM-chem/2deg - 14 June 2008 - CO

0.5°

CAM-chem/0.5deg - 14 June 2008 - CO

Ozone

CAM-chem/2deg - 14 June 2008 - O3

CAM-chem/0.5deg - 14 June 2008 - O3
Cities are much more pronounced in fine resolution.

- **NO**
  - CAM-chem/2deg - 14 June 2008 - NO
  - CAM-chem/0.5deg - 14 June 2008 - NO

- **NO2**
  - CAM-chem/2deg - 14 June 2008 - NO2
  - CAM-chem/0.5deg - 14 June 2008 - NO2

Color scale for ppbv:
- 0.0
- 0.2
- 0.4
- 0.6
- 0.8
- 1.0
- 1.2
- 1.4
- 1.6
- 1.8
- 2.0

ppbv scale:
- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
Spots of increased O3 production and loss in high resolution run over sources
Due to more concentrated NOx, affecting OH and HO2
Comparison for Shanghai, China

Shanghai is primarily in one 0.5° grid box, but straddles two 2° boxes.

Significant differences seen between 0.5° and either 2°

Eastern 2° box is mostly over ocean so has reduced O₃ deposition – doesn’t go to 0 at night.
Shanghai (cont.)

More emissions in eastern 2° box, but is mostly over ocean
Wide range of values from all of the 0.5° boxes in the 2° box
On average 2° resolution matches average of finer resolution
But averages are very different from Shanghai 0.5° box

Black line: 0.5° box at Shanghai
Blue dotted lines: All 0.5° points in 2° box
Blue thick dashed: mean of 0.5° points
Red: 2° box (east of Shanghai)
Similarly for Chicago

Again, city is at edge of 2° box
Mean of 0.5° boxes does not match 2°
CO is significantly diluted at coarse resolution
NO2 is slightly less and O3 is higher
CAM-chem – free-running - 2° vs 1°

Feb 2008: O3 (ppbv)

Feb 2008: NO2 (ppbv)
CAM-chem – free-running - 2° vs 1°

Climate changes with resolution – slight changes in Temperature
Differences in LAI, Temperature and cloud cover affect biogenic emissions
Future Work

Free-running CAM-chem at 0.5°
   Use 1° land model IC regrid to 0.5°

Specified dynamics at 0.5°
   With new online MEGAN for biogenic emissions

Compare free-running and specified dynamics to understand effects of changes in meteorology with resolution

Use for analysis of observations:
   DC3 – Thunderstorms and convective transport in US (May-Jun 2012)
   ARCTAS – fires in Canada & California; effect on long-range transport to Arctic (Apr-Jul 2008)
   Brazil – tower near Manaus (on-going)

Field campaign design of urban-biogenic interactions:
   Southeast US (SOAS)
   S. Korea