Development, evaluation, and application of GEOS-Chem driven by CCSM3 meteorological fields

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Objective and Background

Global CO B40
December

CO emissions inventory over Globe and Asia

Recent changes in Emissions by sector

SO2 vs. CO
Simulated seasonal surface $O_3$ for 2001: GEOS-Chem/CCSM3 vs. GEOS-Chem/GEOS-4

Both simulations produced consistent seasonal and spatial patterns of ozone concentrations in surface air.
Comparison between Simulated and Sonde O$_3$ at 800 hPa

Both simulations reproduced ozone sonde observation relatively well.
Comparison between Simulated and Sonde O$_3$ at 500 hPa

- TATENO (3/93–5/05):
  - LAT: 36.0
  - LON: 140.0

- HUNTSVILLE (4/99–11/07):
  - LAT: 35.0
  - LON: -87.0

- KAGOSHIMA (8/97–3/05):
  - LAT: 31.0
  - LON: 130.0

- NEW DELHI (8/94–11/06):
  - LAT: 28.0
  - LON: 77.0

- NAHA (8/97–5/07):
  - LAT: 26.0
  - LON: 127.0

- PARAMARIBO (9/99–11/07):
  - LAT: 5.0
  - LON: -56.0

- SEPANG AIRPORT (1/98–10/06):
  - LAT: 2.0
  - LON: 101.0

- MALINDI (4/99–1/06):
  - LAT: -2.0
  - LON: 40.0

- MAXARANGUAPE (1):
  - LAT: -5.0
  - LON: -36.0

- WATUKOSEK (8/99–11/07):
  - LAT: -7.0
  - LON: 112.0

- SUVA (2/97–11/05):
  - LAT: -18.0
  - LON: 178.0

- LAVERTON (4/92–2/99):
  - LAT: -37.0
  - LON: 144.0

Graphs showing ozone levels with red and green lines representing CCSM-3 and GEOS-4 respectively.
Comparison between Simulated and Sonde O$_3$ at 300 hPa

- TATENO (3/93–5/05)
  - LAT: 36.0, LON: 140.0

- HUNTSVILLE (4/99–11/07)
  - LAT: 35.0, LON: -87.0

- KAGOSHIMA (8/97–3/05)
  - LAT: 31.0, LON: 130.0

- NEW DELHI (8/94–11/06)
  - LAT: 28.0, LON: 77.0

- NAHA (8/97–5/07)
  - LAT: 26.0, LON: 127.0

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- CCSM-3
- GEOS-4
GEOS-Chem driven by CCSM3(CAM3-CLM3)+DGVM

An application of off-line coupling between GEOS-Chem and CCSM3 for 1997-2007 to look at the impact of BVOC emissions on air quality in East Asia
Decreases in LAI in northeast China correspond to the increases in surface air temperature in the same region.
Observations show opposite results from the model in LAI and air temp. The negative correlation between changes in LAI and surface holds both for obs. And model
Simulated Surface Isoprene and resulting Ozone Change

Ozone change is likely related to the distribution of isoprene at the near surface over East Asia, esp. east China, for the two different years.
Additional slides
Change in Surface Variables: GEOS-4

LAI in East Asia

PAR in East Asia

2-m air Temperature
Isoprene emissions from CCSM3-DGVM and GEOS-Chem are in general agreement in that lower isoprene emissions in mid- to high- latitudes over most of Northeast Asia for 2005 and higher emissions in tropics over Southeast Asia are shown. Vegetation maps are different!
CAM3-CLM3 with DGVM

Interactive Vegetation

Observed SST for 1997-2007

Bonan et al. (2003)

Sitch et al. (2003)

Meteorological Fields, Land Surface Variables, Tsf, LAI, and PAR
Comparison between Observed vs. Simulated Plant Type Functions (PFT)

Observation
Default CCSM3
CCSM3+DGVM

Comparison of Needleleaf Evergreen Trees (OBS), Broadleaf Evergreen Trees (OBS), Deciduous Trees (OBS), and Grasses (OBS) between Observed and Simulated data for CCSM3 and CCSM3+DGVM models.
MODELS

- CAM3-CLM3:
  1) with prescribed vegetation and 2) interactive vegetation (DGVM)
- GEOS-Chem driven by the CAM3-CLM3