GEOS-Chem Benchmarking Procedure

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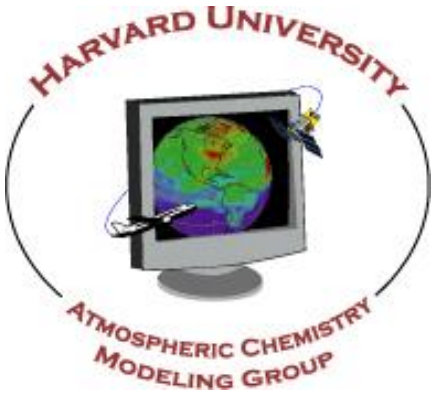


Overview

- New benchmark procedure instituted at IGC5.
- Model development priorities are determined by Working Groups at biannual GEOS-Chem meetings.
- The GEOS-Chem Steering Committee updates priorities and decides on a list of developments for each GEOS-Chem version during quarterly telecons.
- The GEOS-Chem Support Team is responsible for implementing new developments into the standard GEOS-Chem model.
- Each update is benchmarked following a standard protocol to ensure traceability and integrity of the model.
- Benchmark simulations help to identify major problems or issues.

Version nomenclature

- Following v9-01-03, we adhere to a new version naming convention.
  - We no longer have beta releases.
  - Every release is considered a “public release” in the sense that we run a 1-year benchmark before making the code available to the user community.
- Version numbering system: vX-YYa (e.g. v9-02h)

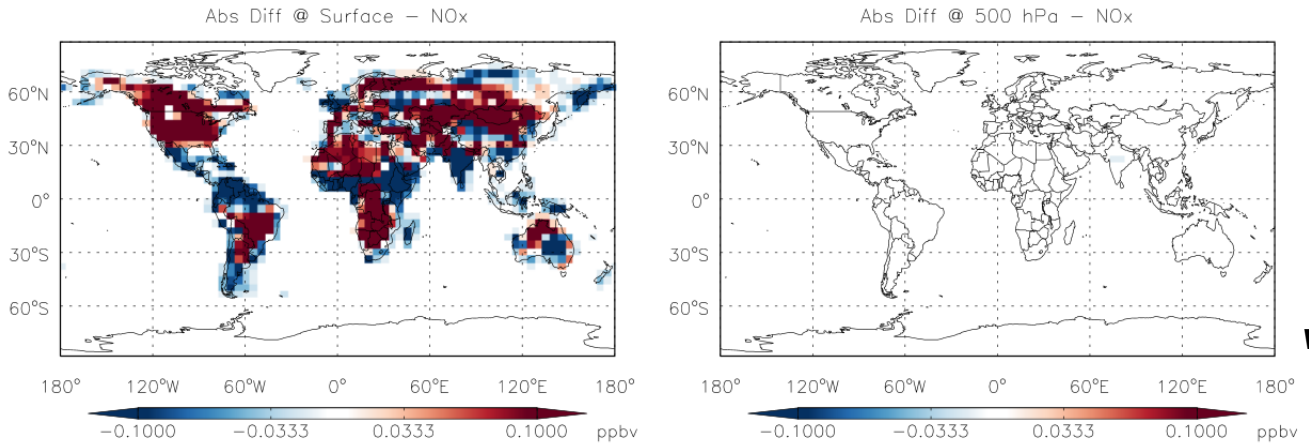
  X = Major version #. Denotes major changes (e.g. new met fields).

  YY = Public release #. Changes with each new public release.

  a = Intermediate state of the code where a 1-month benchmark simulation is done. The letters are for internal use and do not represent a version release.
- In the future, the GCSC will enforce a 9-month interval between public releases by prioritizing developments.

1-month full-chemistry benchmark

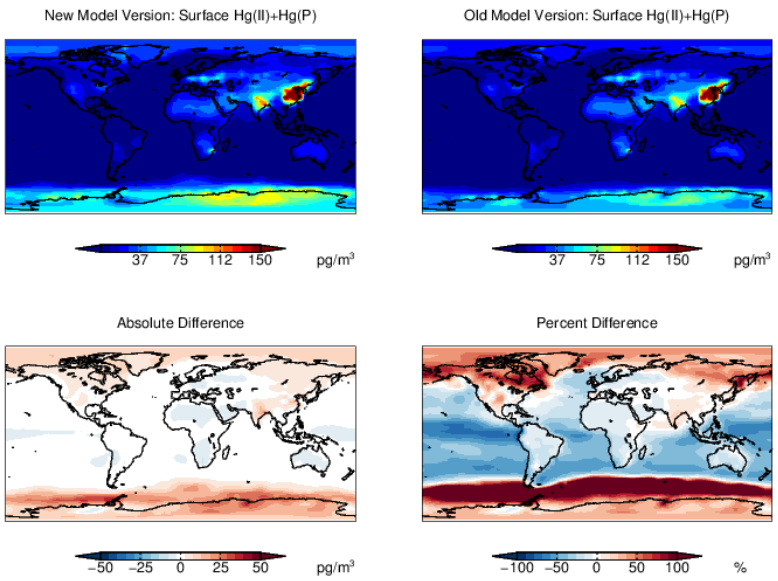
- Any change to the GEOS-Chem source code requires a 1-month full-chemistry benchmark on the global 4° x 5° grid.
  - Code updates may be bundled when appropriate.
- The developer assesses the benchmark results and fills out a form on the GEOS-Chem wiki.
- Once the developer and GCSC are satisfied, GEOS-Chem Model Scientist Daniel Jacob reviews the results and approves the new internal version.

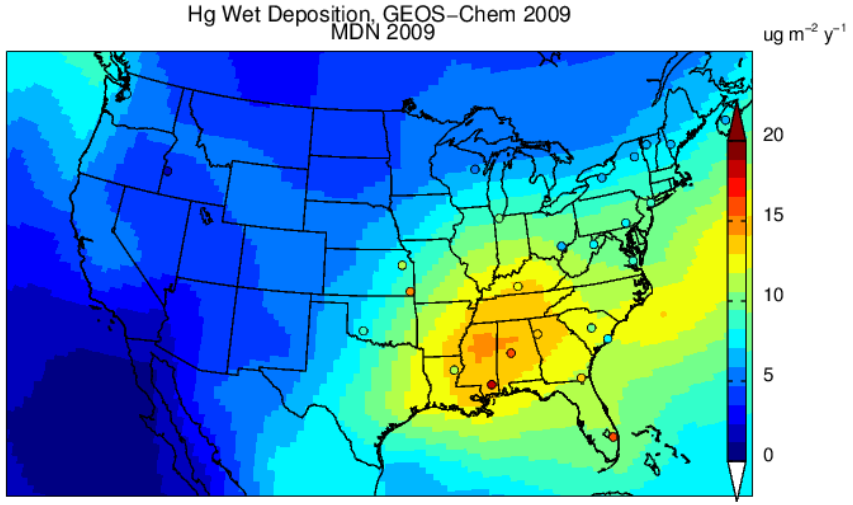


v9-02b – v9-02a

Special benchmarks

- If requested by the developer or GCSC, a 1-year benchmark simulation may also be conducted for internal versions.
- If the update is for an offline chemistry simulation (e.g. Hg, CO2, CH4), then a further benchmark may be conducted by the appropriate Working Group.





Hg benchmark v9-02c (courtesy Yanxu Wang)

1-year full-chemistry benchmark

- Each new model release is subject to a 1-year benchmark on the global 4° x 5° grid.
- We create a series of plots comparing 3 model versions simultaneously.
  - Difference maps at surface, 500 hPa, and along longitude slices.
  - Ratio maps at surface and 500 hPa.
  - Plots comparing model output against in-situ observations for several species such as O3, NOx, CO, hydrocarbons, and aerosols.
- The benchmark results are inspected by the GCSC before approval.
- The Nested Model Working Group performs a benchmark simulation for the North American nested grid, to ensure that software updates made to the global model do not affect the nested model.

GEOS-Chem v9-02

Already benchmarked:

v9-02a	GEOS-5 PBLH correction
v9-02b	New soil NOx emission module
v9-02c	Several updates to Hg simulation; POPs simulation
v9-02d	Updates for the grid-independent model
v9-02e	Bug fixes for MAP_A2A regridding algorithm
v9-02f	Inorganic chemistry updates; MPN chemistry
v9-02g	Standardize Paulot isoprene scheme; Fix RO2+HO2 rate constant
v9-02h	Remove NOx-Ox partitioning; Improved HO2 uptake by aerosol; Inhibition of N2O5 uptake by nitrate aerosol (***In progress***)

Up Next:

1) Updates for grid-independent model; Inline latest code modifications for TOMAS; Hg fixes
2) ***Emissions updates:*** Bug fixes; Updated scaling factors and emission inventories; RCP emission scenarios; EDGAR 4; MIT aviation emissions inventory, Interannual lightning
3) ***Aerosol updates:*** SOA simulation with semi-volatile POA; Acid uptake on dust aerosols; Cloudwater pH for sulfate formation; Update jv_spec.dat
4) ***Nested model updates:*** Nested grid model at 0.25° x 0.3125° using GEOS-5 “FP” data
5) ***CO2 updates:*** Improve temporal resolution of anthro CO2 sources; Year-specific CO2 fluxes
6) Online PBLH calculation