

GEOS–Chem: Code Management Overview and Future Directions

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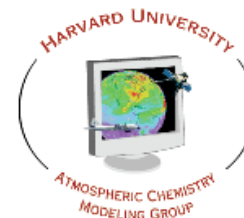
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GEOS–Chem Code Management

GEOS–Chem development is user-driven!

- Several user groups are continually providing GEOS–Chem with new functionality. (That's why we're here today...)

GEOS–Chem “standard code” is maintained at Harvard

- GEOS–Chem support team: Yantosca, Le Sager, Carouge
- Code stored in CVS repository to facilitate version control
- Documentation is provided & disseminated via web, wiki, email

Updates must be submitted to the G–C support team

- To prevent divergent versions from floating around

GEOS–Chem Versions

When are GEOS–Chem versions released?

- It is often expedient to add updates into G–C in stages.
 - This facilitates testing of the code in stepwise fashion.
- ***Beta releases*** are intermediate G–C releases.
 - Often several “beta” releases will follow in short succession.
 - G–C user manual is updated w/ “addenda”, but not totally rewritten
- ***Public releases*** are made after several beta releases
 - Typically at a point when having the cumulative additions in G–C will benefit the user community
 - G–C user manual is rewritten for each public release

GEOS–Chem Validation

GEOS–Chem benchmark simulations

- 1-month “full-chemistry” benchmark
 - Done for every GEOS–Chem release, “beta” or “public”
 - Results are compared to previous version w/ a large array of diagnostics
 - Comparison is posted on website for community inspection
 - Final approval needed from Model Scientist (D. Jacob) before release
- 1-year “full-chemistry” benchmark
 - Done for selected versions
 - For example, for updates that could have a major impact on the chemistry or emissions
 - Model output is compared to a large ensemble of observations
 - J. Logan provides climatology data and compares model to obs.
 - Most (if not all) public releases will have a 1-year benchmark done

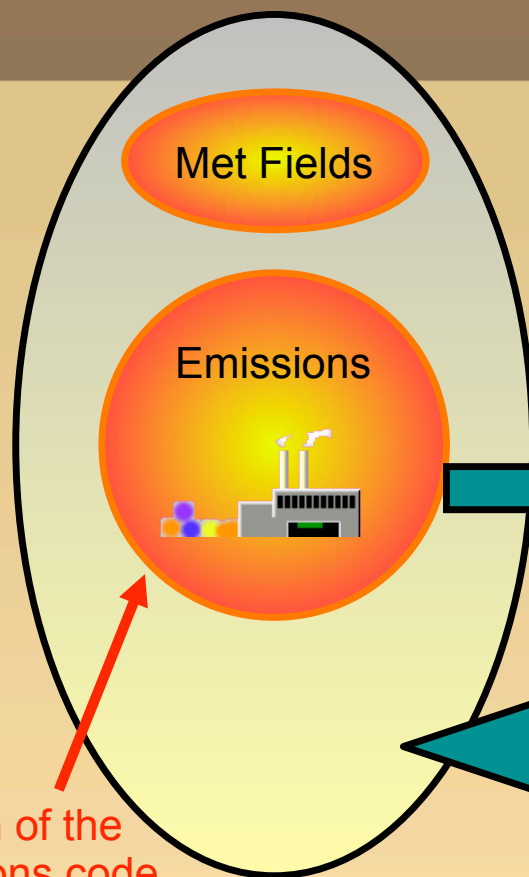
GEOS–Chem Status

Previous and near-future releases:

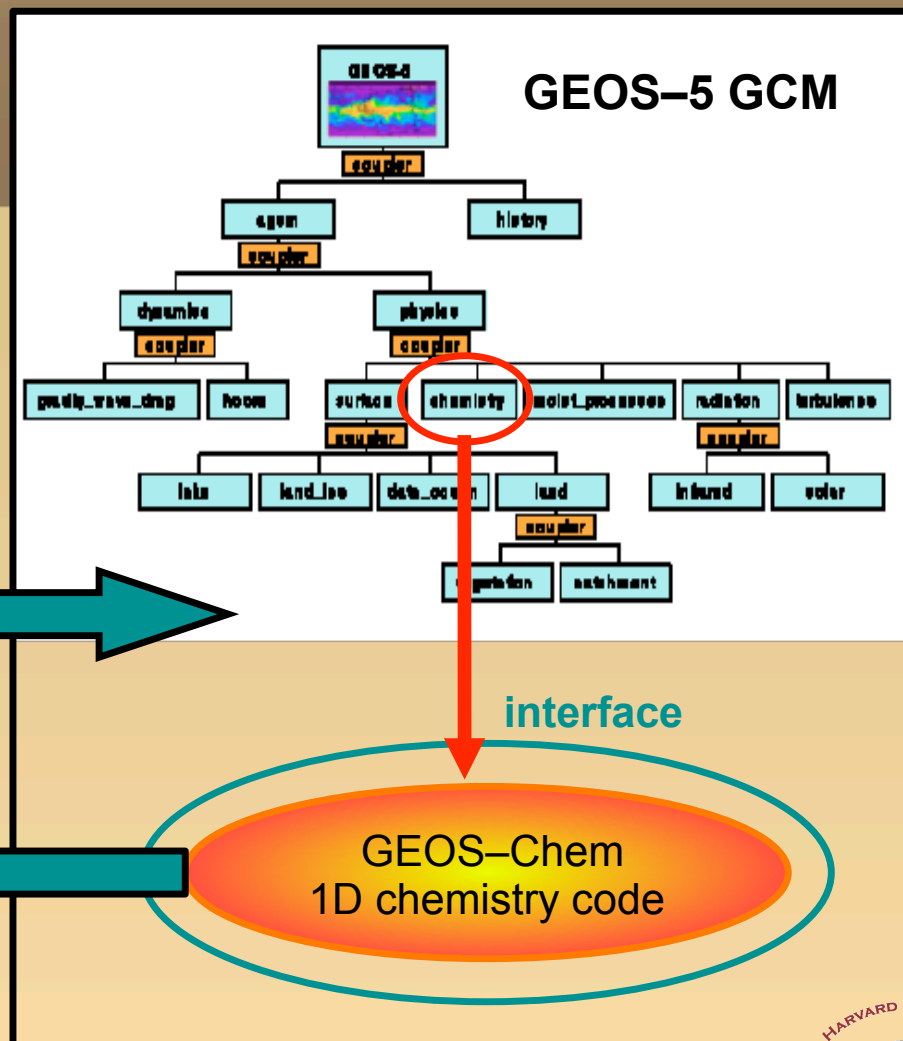
- Previous beta release (Feb 2009)
 - GEOS–Chem v8–01–04
 - Added many new options for emissions:
 - Anthropogenic, Biomass, Biofuel, Biogenic, Ship
- Next scheduled public release
 - GEOS–Chem v8–02–01
 - Will contain several new updates for the chemistry
 - Updates to chemical mechanism, etc.

The future: Interfacing GEOS-Chem code into NASA's GEOS-5 GCM, as well as creating a standalone ESMF code

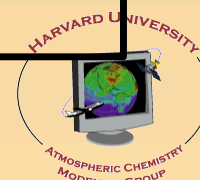
Standalone ESMF GEOS-Chem



Much of the emissions code is already complete!



Original slide courtesy of P. Le Sager



GEOS–Chem: Future directions

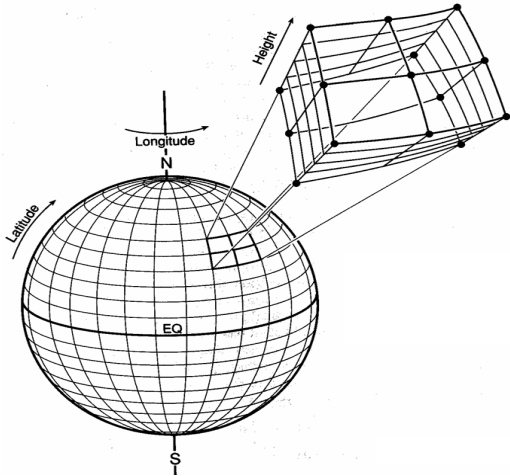
What is ESMF and what does it do?

- ESMF = “Earth System Model Framework”, a set of library routines for earth science models
- Facilitates “plug & play” code development
- Standardizes coding procedures

What is the main advantage of ESMF?

- ESMF greatly simplifies implementation of Message Passing Interface (MPI) parallelization
- With MPI, you can run on distributed systems w/ 1000's of processors

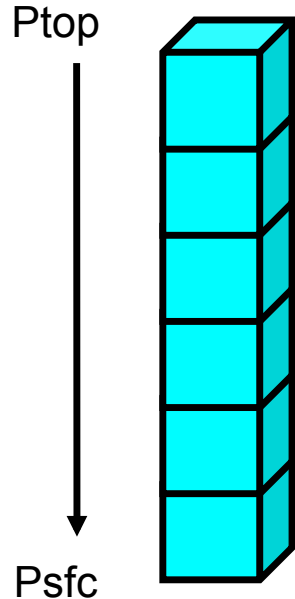
GEOS-Chem Column Chemistry Code



Existing GEOS-Chem chemistry code:

GEOS-Chem's chemistry solver package (i.e. SMVGEAR) requires arrays w/ 3 spatial dimensions (lon, lat, alt). This follows the structure of the legacy code from which GEOS-Chem was created.

Chemistry routines for aerosols (which were added later) also require arrays w/ lon, lat, alt dimensions.



Columnization: remove the (lon,lat) dependence from the grid

Chemistry routines work on a single atmospheric column (i.e. group of vertical boxes at a single lon/lat location) at a time. Looping over columns is handled by the calling routine.

Challenges:

- Legacy code has to be rewritten or replaced
- Init routines need to be separated from the rest of the code
- 3-D fields need to be saved for some quantities outside the column chemistry code – “internal state”