GEOS-Chem Support Team Activities

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# Meet the GEOS-Chem Support Team (aka GCST)

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<thead>
<tr>
<th>GCST Member</th>
<th>Affiliation</th>
<th>Projects</th>
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<tr>
<td>Bob Yantosca</td>
<td>Harvard</td>
<td>Software development and validation</td>
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<td>User support and documentation</td>
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<td>High-performance computing</td>
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<td>Project management</td>
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<td>Melissa Sulprizio</td>
<td>Harvard</td>
<td>Software development and validation</td>
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<td>Research project support</td>
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<td>Benchmarking new GC versions</td>
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<td>Matt Yannetti</td>
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<td>Electronic media management</td>
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<td>Lizzie Lundgren</td>
<td>Harvard</td>
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<td>Mike Long (off-site)</td>
<td>Harvard</td>
<td>High-performance computing</td>
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<td>Integrating GC into NASA GEOS-DAS system</td>
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<td>Junwei Xu</td>
<td>Dalhousie</td>
<td>Data processing and storage</td>
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<td>Processing GMAO met fields for input into GC</td>
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<td>Yanko Davila</td>
<td>Colorado Univ. @ Boulder</td>
<td>GC Adjoint development and validation</td>
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<td>GC Adjoint documentation and training</td>
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<td>GC Adjoint user support</td>
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GCST supports the GC user community

**User support**
- Welcoming new users to the GC community
- Providing technical assistance to GC users
- Distributing met fields & other data for input into GC
- Developing supporting software (eg GAMAP)

**Adding user-submitted code into GC**
- Enforcing version control (with Git)
- Maintaining public source code repositories
- Debugging & testing
- Validating & benchmarking (more in a couple slides)

**Documentation, communication, & education**
- GC Manual (manual.geos-chem.org)
- GC Adjoint Manual (wiki.geos-chem.org/GEOS-Chem_Adjoint)
- GC Wiki (wiki.geos-chem.org)
- Quarterly e-Newsletters
- Email blasts (geos-chem@seas.harvard.edu)
GCST helps to ensure the integrity of GC

Debugging and validation
- **Unit tests**: Short runs designed to reveal errors
- **Difference tests**: Ensures that purely structural changes do not adversely impact scientific results
- UT’s & DT’s are done before benchmark simulations

1-month benchmark simulations
- Full-chemistry + UCX, 4x5 GEOS-FP met, for July 2013
- Done after each new feature is added to GC
- Ratios, concentrations, differences are compared to the previous 1-month benchmark
- GCSC, developers, and interested users analyze and comment on benchmark results
- Final approval is by Model Scientist

1-year benchmark simulations
- Full-chemistry + UCX, 4x5, GEOS-FP met for year 2013
- Done before each public release of GC (or sooner)
- Compared to prior 1-year benchmarks plus obs.
- Approval process same as for 1-month benchmarks
GCST does fundamental software engineering

High-performance computing (HPC)
- Integrating GC into the NASA GEOS5-DAS (M. Long, GCST)
  - Using Earth System Model Framework / MPI
  - Running very high resolution simulations (7km)
- Creating GEOS-Chem HP
  - A standalone GC using ESMF/MPI for HPC clusters
- Cooperative development with GEOS-CTM (A. Molod)

HEMCO: Harvard-NASA Emissions Component
- by Christoph Keller, GCST, and NASA/GMAO
- Combines emissions inventories in a flexible manner
- Removes hardwired legacy emissions code
- Reads data from input files in netCDF format

Improving the efficiency of GC simulations
- KPPA fast chemistry solver (J. Linford, ParaTools)
- Reducing GC’s memory footprint (M. Yannetti, GCST)
- Consistent units throughout GC (L. Lundgren, GCST)
- NetCDF diagnostics (GCST)
For more info

• **Come to the IGC7 Model Clinics (5PM tonight)**
  – GEOS-Chem for Beginners
  – GEOS-Chem for Intermediate/Advanced users + HEMCO
  – GEOS-Chem in Massively Parallel and ESM Environments
  – GEOS-Chem Adjoint

• **Anytime**
  – GEOS-Chem wiki (wiki.geos-chem.org)
  – GEOS-Chem website (www.geos-chem.org)

• **Contact us**
  – geos-chem-support@as.harvard.edu
  – geos-chem-adjoint@seas.harvard.edu
Extra slides
Code validation – scanning for bugs!

GCST performs a set of **unit tests** each time a new feature is added.

Unit tests are **short simulations designed to catch common mistakes** in source code.

Unit tests are automatic and can run overnight.

Results are posted online.


GCST also performs **difference tests** to ensure that purely structural updates to GEOS-Chem do not change any scientific results.

A difference test compares the current state of the code against a prior state.