

GEOS-Chem Support Team Activities

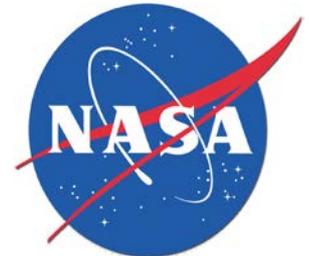
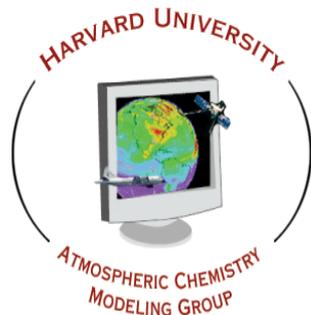
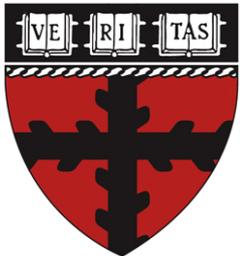
Bob Yantosca

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Cambridge, MA, USA

IGC7, 04 May 2015



Meet the GEOS-Chem Support Team (aka GCST)

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

GCST supports the GC user community



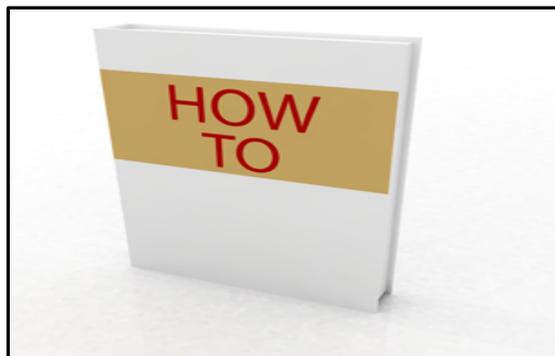
User support

- 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

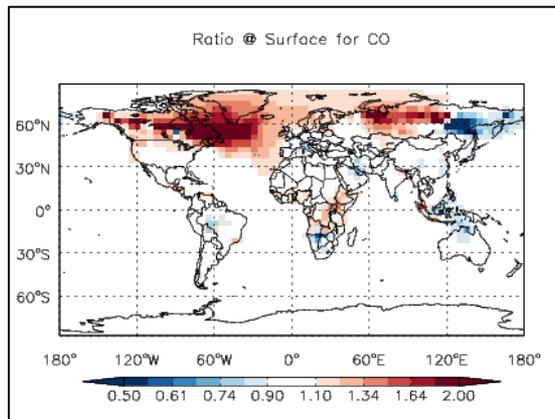
- GC Manual (manual.geos-chem.org)
- GC Adjoint Manual (wiki.geos-chem.org/GEOS-Chem_Adjoint)
- GC Wiki (wiki.geos-chem.org)
- Quarterly e-Newsletters
- Email blasts (geos-chem@seas.harvard.edu)

GCST helps to ensure the integrity of GC



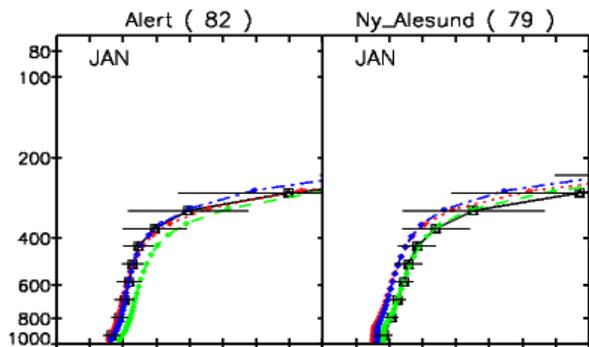
Debugging and validation

- 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

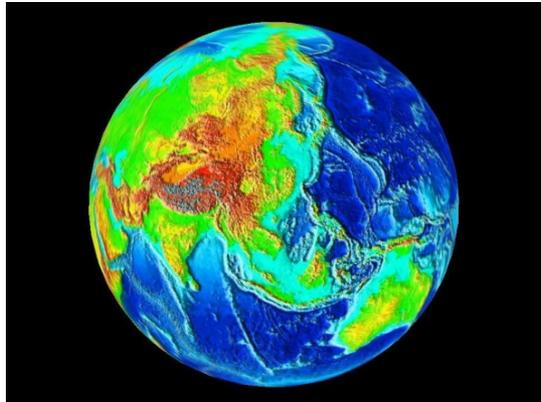
- Full-chemistry + UCX, 4x5 GEOS-FP met, for July 2013
- Done after each new feature is added to GC
- Ratios, concentrations, differences are compared to the previous 1-month benchmark
- GCSC, developers, and interested users analyze and comment on benchmark results
- Final approval is by Model Scientist



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!

GEOS-Chem Unit Test Results

Version: v10-01h

Date Submitted: 2015/03/27 10:18:33

Description: Tests v10-01h + fix for grid mod + speed up NEI2011

4° x 5° Unit Tests	UCX	Full-chem	SOA	SOA w/ SVPOA	Rn-Pb-Be	Hg	POPs	TagCO	TagO3	CH4	CO2	Aer-osols	TOMAS 40
GEOS-FP @ 4° x 5°													
MERRA @ 4° x 5°													
GEOS-5 @ 4° x 5°													
GEOS-4 @ 4° x 5°													
GCAP @ 4° x 5°													
2° x 2.5° Unit Tests	UCX	Full-chem	SOA	SOA w/ SVPOA	Rn-Pb-Be	Hg	POPs	TagCO	TagO3	CH4	CO2	Aer-osols	TOMAS 40
GEOS-FP @ 2° x 2.5°													
GEOS-5 @ 2° x 2.5°													

See: http://wiki.geos-chem.org/GEOS-Chem_Unit_Tester

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.

