GMI STATUS REPORT

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NASA/GODDARD SPACE FLIGHT CENTER

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PROPOSED GMI ACTIVITIES

- **“Core Activites” (SIVO: Damon, Hayes, Wojcik, Kouatchou; Steenrod, Strahan, Rodriguez, Duncan, Bian, Colarco; GMAO: Pawson, Nielsen, Strode)**
  - **Processing of fields**
  - **Production runs (workflow tool)**
  - **Model improvements – Synergy with CCM effort**
- **Hindcast – evaluation (Logan, Chin)**
- **Nitrate aerosols – (Bian)**
- **Subgrid chemistry – land processes (Duncan)**
- **GFDL fields / GMI – Global change impact on long-range transport**
- **Test convection – Pickering**
- **Other met. fields, uncertainty analysis, advection algorithm – Prather**
- **Model “process” evaluation – Strahan**
- **ODP, lifetime studies - Douglass**

SIVO Core Activities

- **Created workflow for G5Aura production run and completed G5Aura for the years 2005-2007.**
- **Integrated new lightning scheme into G5Aura version of the code.**
- **Added four new stations to the column station output for Benin, Costa Rica, Panama, and Namibia**
- **Made changes to code for 55 level GEOS-5 support.**
- **Created MERRA scout processing scripts.**
- **Produced 2 sets of runs for Hongyu: 2004 and 2005 Aura4 with idaily and adaily diagnostics**
- **Implemented production/loss statistics for Forced Boundary Condition calculations**
- **Wrote a new and simplified setup procedure Designed and implemented new interfaces for Surface Area Densities calculations, Chemistry solvers, Forcing Boundary Conditions, Surface Emission inside Chemistry, Gravitational Settling (32h; Jules)**
- **Ported the old and new versions of the GMI Code to Rafaella's platform in Greece**
- **Profiled the GMI code and report**
- **Miscellaneous support**

GEOS 5…

- Worked with GEOS 5.1, MERRA – Scout (not official version) – MERRA
- Harder than envisioned
  - Remap variable names
  - Some changes in gridding
  - Changes in units
  - Needed to derive precipitation
  - Profited from collaboration with GMAO.
- Worked with GMAO evaluating feasibility of using “replay” mode for GEOS met. fields
  - “Depressing” start..
  - Fixed replay bug, looks promising!
  - Would significantly reduce processing of met. fields
  - Facilitate incorporation of new developments in just one code
  - Other met. fields? (work in progress)

MODEL IMPROVEMENTS

- **Implementation of complete coupling between aerosols and gas-phase chemistry**
  - **Oxidant input into GOCART at each time step**
  - **GOCART input into gas-phase chemistry at each time step (heterogeneous chemistry, photolysis)**
- **Incorporation of nitrate aerosols (Significant progress)**
- **Restructuring of code to facilitate incorporation of changes in FastJx, others (in progress)**
- **Update chemical kinetics**
- **Update emissions, lightning, isoprene parameterization**
- **Incorporation of aerosol microphysics (CARMA, in GEOS-5).**
- **Incorporation of ECMWF fields (in progress)**

Requests for GMI fields during the past year

- Erwoon Choiu, SESDA
- Shuhui Wang, JPL
- Maggie Anguelova, NRL
- Baijun Tian, JPL
- Jay Kar, LaRC
- Mingzhao Luo, JPL
- Min Chen, Purdue Univ.
- Debra Kollonige, UMBC
- Daewon Byun, NOAA
- Doug Allen, NRL
- Ashley Jones, Univ. of Toronto (ACE Science Team)
- Qing Yang, GA Tech
- Steven Barrett, MIT

GMI Publications

- **Look at website**
- **2010:**
  - **5 submitted, 3 appeared**
- **2009**
  - **14 appeared**

ARRA (Stimulus funding) Work

- **Project to conduct assessment of subsonic aircraft**
  - **Originally an 18-month project, funding did not arrive until June 27, to be finished by Feb. 2011…**
  - **High priority (no choice) – All SIVO support towards this project**
  - **Some money for GEOS5 met. field processing, incorporation of other met. fields into GEOS-5 framework**
- **Simulations:**
  - **1992 conditions, with/without aircraft, for El Nino, La Nina met. fields**
  - **2006 conditions, with/without aircraft, with one of the above fields**
  - **"Future" conditions (emission scenarios from FAA?)**
- **Radiative forcings to be calculated by Langley (Natarajan, Faerlie).**
- **Abstract submitted to AGU on 1992 simulations**

ISSUES/NEEDS FOR NEXT YEAR (TO DISCUSS THIS PM)

- **Testing/understanding of new met. fields**
  - **Replay; ECMWF; GFDL**
- **Preliminary comparison/evaluation of replay (GEOS 5 Scout) vs GMI seems promising – Differences due partly due different lightning, transport?**
- **Need to perform standard, simple tracer tests before full chemistry simulations – for model-model comparison**
  - **CO2 (numerics, interhemispheric transport,)**
  - **fO3 (Synoz-like; strat-trop exchange)**
  - **Linoz?**
  - **e90 (synthetic tracer with 90-day e-folding time; tropopause)**
  - **Rn (or 5-day lifetime tracer) convection**
  - **Lead 210 (or "washout" tracer)**
  - **Others?**

“MIGRATION” to Replay

GEOS 5, 6…. 100

- **Understand differences**
- **Satisfied that every thing is working**
- **Need to learn to run Replay**
- **Idea will be to use this in hindcast simulations (no processing of met. fields)**
- **Will automatically update to latest advection algorithm (not updated yet in GMI/CTM)**
- **Single implementation of code changes**

Other Met. fields

- **Incorporation of archived met. fields into GEOS-5 framework, including column physics variables**
- **Testing?**
- **When do we completely switch?**

SUGGESTION FROM “ABOVE” (i.e., ME)

We determine asap that Replay is ok for GEOS 5, and use it for hindcast, etc.

Maintain GMI/CTM until “other fields” incorporation into GEOS-5 is satisfactory

CONTINUE MODEL IMPROVEMENTS/ISSUES

- **Continue testing of gas-phase/aerosol coupling, nitrate aerosols.**
- **Fast Jx**
- **Improve isoprene mechanism**
- **Finish incorporation/testing of ECMWF**
- **Incorporation of AM3 (2x2.5, 4x5) – multi-year**
- **Continued incorporation of time-dependent emissions (Strode?) – More "user friendly" coding**
- **Why is O(1D) production so different between GMI and GEOS-CHEM? (Is it FastJx parameters?)**
- **Incorporate diagnostic for P, L for odd oxygen (odd hydrogen? Others?)**
- **Quality Control**

Use of new met fields

- **This activity is somewhat labor intensive – One of the relasons why GMI "core" needs for scientific programming may be as large or larger than say, CCM.**
- **In GMI pre-history, we incorporated several met. fields, but nothing came out of this…**
- **WE NEED TO DEFINE SPECIFIC SCIENCE PROBLEMS TO BE ATTACKED WITH MULTIPLE MET. FIELDS – SIMPLE "INTERCOMPARISON" MAY NOT BE ENOUGH!**
  - **Rely on PIs for this**

Lightning

- Existing parameterization is “met. field” dependent, i.e., a new set of parameters needs to be developed for each met. field.
- This will not work in replay, nor in “future” scenarios.
- Not efficient for multi-year hindcast.
- Work is ongoing under CCM to develop “general” parameterization (not ready yet)
- WHAT DO WE DO?
  - Go back to “climatology”? (No).
  - Try to use some kind of direct relation to cloud mass fluxes, without “nudging” with climatological lightning data? (It will place lightning in the wrong locations for a particular year, but…).

CHALLENGES

- **“Core” personnel resources, given that**
  - **SIVO will be taken over by ARRA/aircraft until February**
  - **If we go to Replay, there needs to be learning of:**
    - **Running the model**
    - **Incorporating changes… (GEOS 5 may be less user friendly because of ESMF)**
  - **Need more “scientific programming” support? (a la Nielsen, Steenrod, Yantosca…)**
  - **Need to consider production runs envisioned for next year**
  - **Balance between “production” and “model integration”?**