GMI Status Report for the period November 15, 2003 to March 31, 2004

I. Tropospheric Studies

Radionuclide Simulations: The first GSFC radionuclide simulations with the model sent from LLNL had very large surface Pb-210 concentrations at high latitudes. This was partly resolved by a) modifying wet scavenging to include the parameters used by U. of Michigan and b) reducing the Rn source at high latitudes (reduced to .3 atoms/cm^2/s when Tsurf < 273 K).

After experimenting with a variety of fixed K_{zz}'s (see below), the best Rn/Pb agreement was found using the met fields' K_{zz}s and the new source function. The latest simulations using CCM3 and DAO winds yield reasonable agreement with surface Rn. Concentrations of ^{210}Pb at high latitudes agrees pretty well with observations on an annually averaged basis, but this appears to be because a summer surplus balances a winter deficit. At midlatitudes, surface ^{210}Pb is low compared to observations on an annually averaged basis.

This work was coordinated by David Considine and Bigyani Das, with contributions from Dan Bergmann, Daniel Jacob and Michael Prather.

Boundary Layer Mixing: At the November Irvine meeting, Jennifer Logan compared GMI/GISS CO profiles with MOZAIC CO profiles and found the model had too large gradients between 1000 and 800 hPa. On the basis of these comparisons, she and Daniel concluded that BL mixing needed to be increased. We tested K_{zz} values of 400 to 50 m^2/s in the DAO and CCM3 simulations but found that the Rn concentrations at the surface showed surprisingly little sensitivity. At present, we have adopted the K_{zz}'s found in the DAO and CCM3 winds, which are calculated in a manner consistent with other meteorological parameters in the model. No such values exist for GISS, and the values that were previously used (Kzz=100m^2/s when dry convection was present) did not seem justifiable. Thus, we have not repeated any calculations with the GISS winds, awaiting a resolution of this issue.

This work was carried out by Bigyani Das, Jae-Hoon Kim, Dan Bergmann, Daniel Jacob, Michael Prather, David Considine, and Jose Rodriguez.

Full Chemisry Simulations: Full chemistry tropospheric simulations have been completed for the DAO and CCM3 fields. GISS calculations await resolution of the boundary layer mixing. The latest set of calculations has incorporated a stratospheric loss with a lifetime of 100 days for CO, hydrocarbons, and other relevant species. The wet scavenging is the same used for the radionuclide calculations, with the U. of Michigan parameters. Some errors in the monoterpene- and methanol-mediated production of CO were corrected. In addition, an error was found in the coding of the reaction NO + NO3 → 2NO2 (the 2 was erroneously omitted, so we introduced a loss of NOy). Correction of this error has led to

some changes in the results. In particular, OH has increased, leading to smaller tropospheric lifetimes for methyl chloroform.

Analysis plots of these simulations have been produced by Bryan Duncan and Jennifer Logan. They are available for download from our new bulletin board (see Section IV).

This work was carried out by Jennifer Logan, Bryan Duncan, Bigyani Das, Yuhang Wang, Susan Strahan, Jose Rodriguez and David Considine.

Testing of GISS winds in the GMI and UCI CTMs: Both CTMs were used in simulations of CO_2, CO and CH_3I with the same set of GISS winds, but different treatments for convection, boundary layer mixing and numerical advection. These simulations and analyses identified a problem with convection in GMI-GISS simulations: lack of lower level entrainment in the convection algorithm. The analyses also found large differences between the two CTMs, including stratospheric age-of-air differences of more than 1 year. The GMI-GISS runs look more diffusive. Michael plans to increase the horizontal resolution of his runs and wants GMI to do the same in an attempt to see if convergence is achieved in each model and between models. Results of this model intercomparison were presented by Michael Prather at the Fall 2003 AGU Meeting. An updated version of this intercomparison (March 2004) can be downloaded from the new bulletin board.

This work was carried out primarily by Michael Prather and Jae-Hoon Kim.

Simple Tracer Studies – These simulations, recently completed, include fossil fuel CO, biomass burning CO, CO_2, and CH_3I. The purpose of these simulations is to provide diagnostic information to support the analysis of the full chemistry runs. Simulations were carried out by Jae-Hoon Kim.

II. Aerosol Studies

We have run a 2-yr simulation of the GMI aerosol model using DAO winds. This simulation used inputs from U. Mich. (monthly averaged OH, O_3, NO_3, HO_2, and JH_2O_2). A similar simulation is being carried out for CCM3 winds. Future aerosol runs will incorporate output from the GMI full chemistry simulations. At issue is the representation of the diurnal behavior of this input. The possibilities are: hourly output of the 5 input fields or monthly means of these fields for every hour of the day. Hourly outputs of these fields from a recent full chemistry simulation were produced for January and July, and we are investigating the best way to proceed.

Work in this area has been carried out by Bigyani Das, Joyce Penner, Susan Strahan and Xiaohong Liu.

III. Stratospheric Studies

We have just tested a 2x2.5 degree resolution version of the model and found significant improvement in vortex edge behavior. This settles the issue of resolution for the hindcast

simulation. This 1-year test run, carried out on 64 processors, took less than one day. The hindcast simulations, which will be compared with observed O_3 levels from 1975 to the present, will examine the sensitivity of ozone to dynamical differences resulting from very above normal and very below normal Arctic winters. Appropriate model years have been identified from a 50-yr FVGCM simulation with annually varying SSTs. We are presently preparing the input files, adding a solar cycle, galactic cosmic rays, and aerosol climatology. We hope to begin the hindcast simulation within a few weeks.

This work is being carried out by Susan Strahan, Steve Steenrod, Rich Stolarski, and Anne Douglass.

IV. Other Areas

Development of Combined Stratosphere-Troposphere Model: David Considine and Peter Connell are working development. The Langley combined stratospheric-tropospheric mechanism is being tested in an off-line box model. David has suggested implementation of Michael Prather's Fast J2 into the GMI code (extends the parameterization of wavelengths needed for the stratosphere).

Team Publications: We have 3 papers on the analysis of the stratospheric 'trend' runs in review or published.

1. Strahan and Douglass, "Evaluation of the credibility of transport processes in simulations of ozone recovery using the GMI 3-D CTM". JGR, Mar. 13, 2004.

2. Considine, Connell, Douglass, and Strahan, "Sensitivity of GMI CTM predictions of Antarctic ozone recovery to GCM and DAS generated meteorological fields". Submitted to JGR.

3. Douglass, Connell, Stolarski, and Strahan, "Radicals and reservoirs in the GMI CTM: comparison to measurements". Submitted to JGR.

Foreign national applications to get NCCS accounts: Tom Clune continues to press those responsible to tell us what we need to do to move the process along. Fortunately, access to model output will no longer be a problem with the move to an anonymous ftp archive (see below).

Data archive: The GMI archive is in the process of moving to an anonymous ftp site. Notification will be sent, including instructions for access, as soon as the move is complete. This will alleviate most of the problems of foreign nationals accessing NCCS machines. In addition, a password-protected bulletin board has been set up by Susan Strahan. We are beginning to post analysis plots here. A link to the bulletin board may be found on the GMI home page under "Information Exchange". The password has been sent to team members; contact Susan Strahan if you need assistance.

Viewing model output: Bryan Duncan has investigated a variety of tools that can be used to open netcdf files and plot the results. All are free software packages, but some require IDL. New core team member, Chris Readinger, has put together a GUI IDL program that can open and read in any of the fields in a GMI netcdf constituent file. See the GMI web page for details.

Web Site: The November meeting (Irvine) presentations are available on the GMI web site (gmi.gsfc.nasa.gov). With an NRA that includes GMI expected in the next month or two, it is increasingly important for us to have a web site that tells our story. We will be working on filling in the blank pages. ***We solicit from you written contributions on model evaluation, analysis, documentation, philosophy, etc to help complete the pages***.

Next Meeting: Our next meeting, which will emphasize science results, will be held near NASA/GSFC May 24 & 25, 2004. Details and logistical information was emailed April 1st (really, no fooling). This information will also appear on the web site soon.