Summary

GEOS-Chem emission routines for biogenic VOCs have been updated to MEGAN2.1 as described in Guenther et al., Geosci. Model Dev., 5, 1471–1492, 2012. The net result is a 11-12% decrease in the global flux for isoprene, and a 30% increase in the global flux for total monoterpenes. Biogenic alkene emissions are now computed using MEGAN instead of by scaling to isoprene, as was done previously. Biogenic emissions of acetaldehyde are now included. Annual emission totals at 2x2.5 resolution for the different compounds are within ~20% of the values in Table 6 of Guenther et al., within the expected uncertainty associated with differing meteorology, years, etc. Note that global emissions can also change by 10% or more when running at 2x2.5 versus 4x5 degree horizontal resolution (for both the updated and the standard emission routines).

One of the 'under-the-hood' changes is that there is now a single driver routine for calculating MEGAN emissions across all compounds (GET_MEGAN_EMISSIONS). Previously we had separate driver routines for each individual compound. GET_MEGAN_EMISSIONS is passed the compound name, looks up or computes the appropriate parameters, and returns the corresponding emissions. This should hopefully make it much easier to add new compounds in the future, since one just has to add the appropriate parameter values for that compound. There are parameters included for a number of compounds not presently in the standard chemistry scheme - for use in specialized simulations and/or future inclusion in standard fullchem. Another under-the-hood change is that the PCEEA/PECCA flag is no longer needed since we use this scheme exclusively now.

The new MEGAN implementation computes emissions for certain compounds based on pre-defined emission factor maps provided with the MEGAN source code. For other compounds emissions are computed in GEOS-Chem based on CLM4 plant functional type distributions combined with PFT-specific emission factors. This PFT approach can be used for all MEGAN compounds if desired (by adding in the corresponding emission factors for each PFT), which may be useful for applications using different vegetation maps or dynamically shifting vegetation.

As another update, all emission factors maps and the PFT maps are now read in directly at the appropriate model resolution (0.5x0.67, 2x2.5, 4x5), rather than regridded at runtime from 1x1.

The updated emissions lead to lower CO concentrations in the Northern Hemisphere during summer. A v9-1-3 4x5 run for 2006 gave CO mixing ratios (averaged for P>800 hPa) that were lower by a few ppb over much of the Northern Hemisphere during summer months. Maximum decreases of about 10ppb occur over certain source regions. O_x changes are small (< 2ppb for P > 800hPa) using the standard v9-1-3 (non-Caltech) chemistry scheme.

Accompanying files

Comparison between previous and updated BVOC emissions for standard tracers (year-2006):
EmissComp_2006_2x25.pdf
EmissComp_2006_4x5.pdf

Comparison between previous and updated BVOC emissions for standard tracers (nested NA, year-2011)
EmissComp_2011_05x067_NA.pdf

Updated emissions for all BVOCs, including non-standard tracers:
EmissAll_2x25.pdf

Monthly CO comparison for previous and updated MEGAN implementation (year-2006; 4x5 resolution):
COComp_2006_4x5.pdf

Please let me know if you find any bugs or other issues.
Dylan Millet
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