Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 8, 1329-1341, 2008
www.atmos-chem-phys.net/8/1329/2008/

Global isoprene emissions estimated using MEGAN, ECMWF analyses and a detailed canopy environment model

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Abstract. The global emissions of isoprene are calculated at 0.5° resolution for each year between 1995 and 2006, based on the MEGAN (Model of Emissions of Gases and Aerosols from Nature) version 2 model (Guenther et al., 2006) and a detailed multi-layer canopy environment model for the calculation of leaf temperature and visible radiation fluxes. The calculation is driven by meteorological fields – air temperature, cloud cover, downward solar irradiance, windspeed, volumetric soil moisture in 4 soil layers – provided by analyses of the European Centre for Medium-Range Weather Forecasts (ECMWF). The estimated annual global isoprene emission ranges between 374 Tg (in 1996) and 449 Tg (in 1998 and 2005), for an average of ca. 410 Tg/year over the whole period, i.e. about 30% less than the standard MEGAN estimate (Guenther et al., 2006). This difference is due, to a large extent, to the impact of the soil moisture stress factor, which is found here to decrease the global emissions by more than 20%. In qualitative agreement with past studies, high annual emissions are found to be generally associated with El Niño events. The emission inventory is evaluated against flux measurement campaigns at Harvard forest (Massachussets) and Tapajós in Amazonia, showing that the model can capture quite well the short-term variability of emissions, but that it fails to reproduce the observed seasonal variation at the tropical rainforest site, with largely overestimated wet season fluxes. The comparison of the HCHO vertical columns calculated by a chemistry and transport model (CTM) with HCHO distributions retrieved from space provides useful insights on tropical isoprene emissions. For example, the relatively low emissions calculated over Western Amazonia (compared to the corresponding estimates in the inventory of Guenther et al., 1995) are validated by the excellent agreement found between the CTM and HCHO data over this region. The parameterized impact of the soil moisture stress on isoprene emissions is found to reduce the model/data bias over Australia, but it leads to underestimated emissions near the end of the dry season over subtropical Africa.

Final Revised Paper (PDF, 1392 KB) Supplement (83 KB) Discussion

Paper (ACPD)

Citation: Müller, J.-F., Stavrakou, T., Wallens, S., De Smedt, I., Van Roozendael, M., Potosnak, M. J., Rinne, J., Munger, B., Goldstein, A., and Guenther, A. B.: Global isoprene emissions estimated using MEGAN, ECMWF analyses and a detailed canopy environment model, Atmos. Chem. Phys., 8, 1329-1341, 2008. Bibtex EndNote Reference Manager