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Integration of the Model of Emissions of Gases and Aerosols from Nature (MEGAN) into the DEHM Model

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Biogenic volatile organic compounds (BVOCs) play an important role in atmospheric chemistry and the carbon cycle. Plants emit large amounts of volatile organic compounds (VOC) with estimated annual emissions exceeding the combined anthropogenic sources (Lamb et al., 1993). Biogenic emissions play a central role in the chemistry of the polluted and pristine (natural) atmosphere and therefore need to be estimated accurately for use in chemical transport models.
The Model of Emissions of Gases and Aerosols from Nature (MEGAN) has recently been converted into FORTRAN computer code that is compatible with the Danish Eulerian Hemispheric Model (DEHM). The current release of DEHM includes the temporal allocation of emissions from the IGAC-GEIA biogenic emission model (Guenther et al., 1995) as an in-line module. The DEHM Model is a 3D long-range atmospheric chemistry-transport model with a horizontal domain covering the Northern Hemisphere. The model is defined on a polar stereographic projection with a resolution in the mother domain of 150 km x 150 km. We compare the algorithmic differences between these two biogenic emission models as a first step to using MEGAN in the DEHM model. The model estimates hourly isoprene, monoterpenes and other BVOC emissions with gridded emission capacities, monthly foliage density, and predicted hourly temperature and ground level shortwave radiations. Meteorological variables for MEGAN were generated from the coupled MM5v3 meteorological model. The model follows the same framework as earlier biogenic emissions models, but has several improvements, incorporating updated emission factors and land cover data, and includes more controlling variables over the emissions (Guenther et al., 2006).
Our examination of the two biogenic models reveals the estimates of isoprene emission from MEGAN are about 53% more than the estimates from IGAC-GEIA model outputs for 2006. Performance of the MEGAN model implemented in DEHM is validated by available measurements of ozone as indirectly effect of more isoprene. The observations used for this validation originates from the EMEP measuring network on Europe. The overall results from this study show that the performance of the DEHM model with respect to ozone improves significantly in the Mediterranean area using isoprene emissions of the MEGAN model compared to the older IGAC-GEIA biogenic emission model.

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