J5.12 INTEGRATION OF THE BIOGENIC EMISSIONS INVENTORY SYSTEM (BEIS3) INTO THE COMMUNITY MULTISCALE AIR QUALITY MODELING SYSTEM

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INTRODUCTION

The importance of biogenic emissions for regional air quality modeling is generally recognized [Guenther et al., 2000]. Since the 1980s, biogenic emission estimates have been derived from algorithms such as the Biogenic Emissions Inventory System (BEIS) [Pierce et al., 1998]. Version 3.10 of BEIS is being implemented as part of an upgrade to EPA's Community Multiscale Air Quality (CMAQ) modeling system. BEIS3.10 contains several improvements over BEIS2: (1) a 1-km vegetation database for the contiguous United States, which resolves forest canopy coverage by tree species; (2) normalized emission factors for 34 chemicals, including 14 monoterpenes and methanol; (3) a soil nitric oxide emissions algorithm that accounts for soil moisture, crop canopy coverage, and fertilizer application; and, (4) speciation factors for the CBIV, RADM2, and SAPRC99 chemical mechanisms. The purpose of this paper is to provide preliminary results from BEIS3.10 and to compare volatile organic compound (VOC) and nitric oxide (NO) emission estimates from BEIS2, BEIS3.09, and BEIS3.10.

INTEGRATION INTO CMAQ

The Community Multiscale Air Quality (CMAQ) model [EPA, 2001] obtains its emission estimates from the Sparse Matrix Operational Kernel Emissions (SMOKE) system [MCNC, 2001]. To create BEIS3.10, we extracted an interim version of BEIS3 (version 3.09) from SMOKE and modified it to include more-comprehensively speciated VOC compounds and to consider the relation of soil NO to rainfall and the day-of-year. Within the CMAQ modeling system, BEIS3.10 requires vegetation data from BELD3 and meteorological data from MM5v3. Although the BEIS3.10 algorithm estimates hourly, gridded emissions for 33 VOCs (including 14 monoterpenes), these estimates are aggregated into VOC groups contained either in the CBIV, RADM2, or SAPRC99 chemical mechanisms.

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PRELIMINARY RESULTS

Biogenic emissions from three versions of BEIS were estimated for a CMAQ modeling grid extending across the United States for 28 June – 9 July 1999 and speciated for the CBIV mechanism. As shown in Figure 1, domain totals of VOC emissions increased 13% in BEIS3.09 and 26% in BEIS3.10 compared to BEIS2. This increase is attributed mostly to changes in vegetation data and to expanded emission factors, particularly in BEIS3.10 the addition of oxygenated compounds like methanol (MEOH). Isoprene emissions decreased on average by 5% in BEIS3.09 and BEIS3.10 compared to BEIS2, although in some areas—notably the western U.S.—isoprene emissions increased because of new vegetation data. Over much of the eastern U.S., the revised treatment of solar radiation resulted in a slight decrease in isoprene emissions. As shown in Figure 2, domain totals of soil NO emissions decreased by 44% with BEIS3.09 and 57% with BEIS3.10 compared to BEIS2, *for this particular episode*. BEIS3.09 assumes dry conditions, and it does not simulate reductions due to fertilizer application dates and canopy interception, which are included in BEIS3.10. The soil NO results shown here should be viewed cautiously, because they are limited to a dry period several weeks into the growing season. Nevertheless, these results demonstrate the effect that BEIS3.09 and BEIS3.10 can have on soil NO compared to BEIS2.

FUTURE PLANS

The sensitivity of CMAQ to the changes in biogenic emissions is being examined for the June-July 1999 period, and these results should be made available on the BEIS web site. Research on biogenic emissions continues to advance, and this work will likely alter future biogenic emission estimates and improve their accuracy. Some of these advances include the use of satellite-derived visible radiation, the use of alternative vegetation data sets offering better temporal characterization, and the characterization of drought and leaf phenology effects. Finally, ongoing fieldwork should help in verifying and resolving flux estimates for oxygenated compounds like methanol.

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FOR FURTHER INFORMATION

http://www.epa.gov/asmdnerl/biogen.html

Figure 1. Biogenic VOC emissions estimated for the 32 km US domain for 28 June - 9 July 1999 [PRELIMINARY RESULTS]

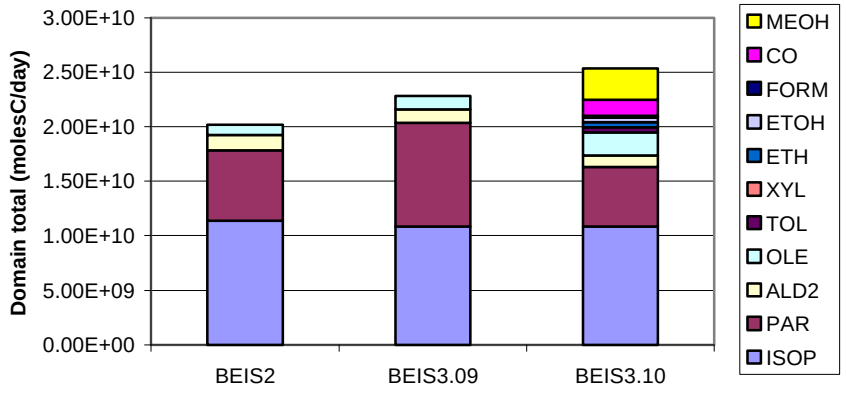

Figure 2. Soil NO emissions estimated for the 32 km US domain for 28 June - 9 July 1998 [PRELIMINARY RESULTS]