Impact of biogenic emissions on $PM_{2.5}$ concentration over Europe

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Natural and biogenic emissions are contributing to atmospheric pollution in addition to anthropogenic emissions. Over 90% of the total Volatile Organic Compounds (VOCs) entering the atmosphere are biogenic (Greenberg et al., 1999), having an important role in regulating the atmospheric composition. The impact of both anthropogenic and biogenic emissions on air quality is very important, as only the anthropogenic part can be influenced by abatement measures. Curci et al. (2009) estimated that biogenic VOC emissions increased on average summer daily ozone maxima over Europe by 5% (2.5 ppbv) using the CHIMERE chemistry-transport model. Sartelet et al. (2012) using the Polyphemus air quality modeling platform estimated that ozone decreased by 10-11% on average over Europe (locally up to 35%) while secondary organic aerosols decreased by 72-88% when removing biogenic emissions. The objective of this study is to estimate the effect of biogenic emissions on $PM_{2.5}$ concentration and chemical composition over Europe.

Meteorological fields are derived using the Penn State/NCAR Mesoscale Model (MM5) (Grell et al., 1994).

Emissions are processed by the Sparse Matrix Operator Kernel Emissions (SMOKE v2.6) Modeling System (http://www.smoke-model.org). The TNO gridded anthropogenic emissions inventory for the year 2006 over Europe in a 0.1 × 0.1 degrees resolution (ftp://neptunus.tno.nl) is used. The Biogenic Emission Inventory System, version 3 (BEIS3) is used for processing biogenic source emissions (http://www.epa.gov/asmdnerl/biogen.html) using the USGS gridded land use data in 1 Km resolution (http://edc2.usgs.gov/glcc/glcc.php).

The Community Multiscale Air Quality (CMAQ v 4.7) Modeling System with the Carbon Bond mechanism (CB05) (http://www.camx.com/publ/pdfs/CB05_Final_Report_120805.pdf) is used for the regional air quality modeling (177 × 217 grid cells of 35 km × 35 km, with 14 vertical layers) (Byun et al., 2006).

$PM_{2.5}$ concentrations are simulated with and without biogenic emissions for July, 2006. The effect of the addition of biogenic emissions to anthropogenic ones is computed to reduce the average monthly mean $PM_{2.5}$ concentration over European land by 2% with both positive and negative responses regionally (Fig. 1). The addition of biogenic emissions increases the average monthly mean organic carbon concentration by 14% (Fig. 2) and decreases the monthly mean inorganic component concentrations (SO_4: -6%, NO_3: -4%, and NH_4: -6% on average) due to the reduction in oxidant levels (OH: -30% on average). However, regional changes in inorganic concentrations with both positive and negative responses are simulated.

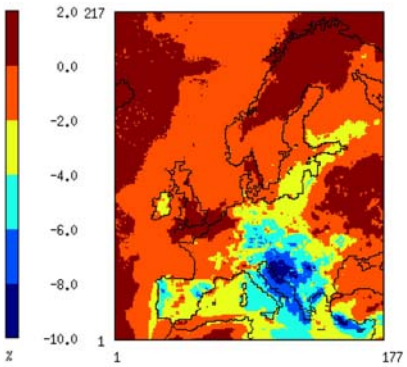

Fig. 1: Average change in $PM_{2.5}$ concentration (%) for July 2006 when biogenic emissions are added to anthropogenic emissions

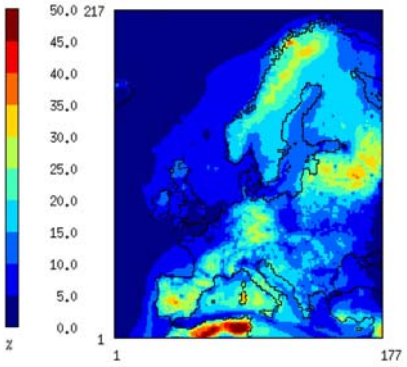

Fig. 2: Average change in OC concentration (%) for July 2006 when biogenic emissions are added to anthropogenic emissions

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