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# Formation of secondary organic aerosol from isoprene oxidation over Europe

M. Karl (1), K. Tsigaridis (2), E. Vignati (3), and F. Dentener (3)

(1) Norwegian Institute for Air Research, NILU, Urban Environment and Industry, Kjeller, Norway (mka@nilu.no), (2) NASA Goddard Institute for Space Studies, New York, USA, (3) European Commission, Joint Research Centre, Institute for Environment and Sustainability, Ispra

The role of isoprene as a precursor to secondary organic aerosol (SOA) in the atmosphere over Europe was studied using the two-way nested global chemistry transport model TM5 with a horizontal resolution of $1\times1$ degrees. We analysed results from three scenarios: 1) reference scenario: similar to the study by Tsigaridis and Kanakidou (Atmos. Chem. Phys., 3, 1849–1869, 2003) but including SOA formed from isoprene oxidation (SOA-I), 2) best guess scenario: considers several updates in parameterisations and uses the recent MEGAN isoprene emission inventory, and 3) zero SOA-I scenario: SOA formation from isoprene oxidation is ignored. The predicted tropospheric production of SOA-I over Europe using the best guess scenario is 0.10 Tg $yr^{-1}$. Total tropospheric SOA production in this scenario is 0.70 Tg $yr^{-1}$, roughly 40% higher than in the zero SOA-I scenario. Summertime measurements of particulate organic matter (POM) during the extensive EMEP OC/EC campaign 2002/2003 are better reproduced when SOA formation from isoprene is taken into account, reflecting also the strong seasonality of isoprene and other biogenic volatile organic compounds (BVOC) emissions from vegetation. However, during winter, our model strongly underestimates POM, likely caused by missing wood burning in the emission inventories. Uncertainties in the parameterisation of isoprene SOA formation have been investigated based on our reference scenario. The sensitivity of our model results to different European isoprene emissions inventories, different representations of the isoprene SOA formation route, and assumptions regarding the effectiveness of wet removal of isoprene oxidation products were investigated. Maximum SOA production is found for irreversible sticking (non-equilibrium partitioning) of condensable vapours on particles, with tropospheric SOA production over Europe increased by a factor of 4 in summer compared to the reference case. The amount and the nature of the absorbing matter are shown to be another key uncertainty when predicting SOA levels. Tropospheric isoprene SOA production over Europe in summer more than doubles when, in addition to pre-existing carbonaceous aerosols, condensation of semi volatile vapours on ammonium and sulphate aerosols is considered.