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Formation of secondary organic aerosol from isoprene oxidation over Europe

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Abstract. The role of isoprene as a precursor to secondary organic aerosol (SOA) over Europe is studied with the two-way nested global chemistry transport model TM5. The inclusion of the formation of SOA from isoprene oxidation in our model almost doubles the atmospheric burden of SOA over Europe compared to SOA formation from terpenes and aromatics. The reference simulation, which considers SOA formation from isoprene, terpenes and aromatics, predicts a yearly European production rate of 1.0 Tg SOA yr⁻¹ and an annual averaged atmospheric burden of about 50 Gg SOA over Europe. A fraction of 35% of the SOA produced in the boundary layer over Europe is transported to higher altitudes or to other world regions. Summertime measurements of organic matter (OM) 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 OM, likely caused by missing wood burning in the emission inventories. Uncertainties in the parameterisation of isoprene SOA formation have been 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. Completely neglecting SOA formation from isoprene results in the lowest estimate (0.51 Tg SOA yr⁻¹). The amount and the nature of the absorbing matter are shown to be another key uncertainty when predicting SOA levels. Consequently, smog chamber experiments on SOA formation should be performed with different types of seed aerosols and without seed aerosols in order to derive an improved treatment of the absorption of SOA in the models. Consideration of a number of recent insights in isoprene SOA formation mechanisms reduces the tropospheric production of isoprene derived SOA over Europe from 0.4 Tg yr⁻¹ in our reference simulation to 0.1 Tg yr⁻¹.

▣ [Final Revised Paper](#) (PDF, 1879 KB) ▣ [Supplement](#) (788 KB) ▣ [Discussion Paper](#) (ACPD)

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