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Global modelling of secondary organic aerosol in present and future climates using the ECHAM5/HAM model

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Organic aerosols are both emitted directly from the surface in particulate form and formed in the atmosphere by oxidation of gaseous precursors. The latter class, the secondary organic aerosols (SOA), form a significant fraction of the total tropospheric aerosol burden. Both biogenic and anthropogenic sources of SOA precursors are known, with the biogenic source strength being dependent on surface temperature and photosynthetically active radiation flux. The net climate effect of organic aerosols is a cooling effect: this has led to the hypothesis that a future, warmer climate will lead to enhanced production of SOA from biogenic precursors, giving rise to a biospheric negative feedback in the climate system. This paper describes the introduction of SOA into the global aerosol-climate model ECHAM5/HAM and the application of the updated model to the study of SOA production in present-day and future climates. The model treats SOA formed from the anthropogenic precursors toluene, xylene, trimethylbenzene and benzene and from the biogenic precursors isoprene and monoterpenes. SOA-specific modelled processes are precursor emissions, gas-phase formation of SOA and gas aerosol phase partitioning of SOA. Aerosol microphysical and sink processes (dry and wet removal) are treated with minor modifications of the existing model. The model study constrains the present-day climate by prescribing sea surface temperature (SST) from observations and the future climate by prescribing SST using model output from the coupled atmosphere ocean model ECHAM5/MPIOM for IPCC AR4 scenarios. Furthermore, the corresponding atmospheric CO2 concentrations are ap-

plied to the calculation of biogenic precursor emissions, unlike other model estimates of SOA production, which do not include this effect. Results do not support the sharp future increase in SOA production seen in other models that do not include the effect of CO2 concentration on biogenic emissions of SOA precursors, and accordingly this model does not lend support to the notion of a significant negative biospheric climate feedback via SOA production.