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Transient climate simulation of DMS in the ocean - atmosphere system

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Dimethylsulphide (DMS) is thought to be the major biogenic component of the global atmospheric sulphur burden. Phytoplankton produces dimethylsulphoniopropionate, which via enzymatic cleavage forms DMS in the seawater. Through sea-air exchange oceanic DMS enters the atmosphere. DMS in the atmosphere is oxidized to sulphate aerosols, which may impact climate directly through light scattering or indirectly through their role as cloud condensation nuclei (CCN), thereby affecting the cloud albedo. It has been postulated that the Earths climate is partly regulated by variation in DMS emissions through this DMS-CCN-albedo feedback.

A reduced version of the Hamburg Earth System Model is used to study the feedback of DMS on climate in a transient climate simulation running from 1860 to 2100. The model includes a scheme of the DMS cycle in the ocean linked to the explicit simulation of plankton dynamics in the marine biogeochemistry model (MPI-OM/HAMOCC5). The DMS emissions are passed interactively to the atmosphere model (ECHAM5). The atmosphere model is extended by the microphysical aerosol model (HAM), which predicts the size distribution, the composition and mixing state of the aerosol components sulfate, black carbon, organic carbon, sea salt and dust. These parameters are necessary for an inclusion of the radiative perturbations caused by aerosols in the radiation scheme of the atmospheric model. The transient evolution of black carbon, organic carbon and sulfur dioxide emissions are prescribed assuming for the future the IPCC SRES A1B scenario. DMS, dust and sea salt emissions are calculated interactively. Iron contained in dust deposited onto the ocean surface serves as a micronutrient for phytoplankton in the ocean and therefore influences the DMS production in the ocean. Phytoplankton growth is simulated to be light and temperature dependent. The simulated global warming between 1860 and 2100 affects

the marine ecosystem and alters the DMS sea surface concentration and the resulting DMS emissions. On the global scale the response is small. However, regionally the picture looks quite different with regions showing an increase in DMS emissions, most pronounced in regions with reduced sea ice cover, but also large regions where the DMS sea surface concentration and the DMS flux in the atmosphere is reduced under warmer climate conditions. Interestingly the simulated global DMS burden is rather unaffected by these changes in the DMS emission.