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Direct and indirect aerosol effect implications for atmospheric chemistry

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Aerosol particles influence the chemical composition in manifold ways. First of all, for multiple chemical compounds a partial partitioning into the aerosol phase reduces gas phase concentrations and hence gaseous reaction pathways. Furthermore, the scattering and absorbing properties of aerosol properties - which depend themselves on their chemical composition and water uptake efficiency - influence both the radiation budget and hence the atmospheric circulation and subsequently transport pathways. These overall affect the chemical composition of the atmosphere. Finally, aerosol particles modify the microphysical and hydrological properties of clouds, which implies feedbacks on dissolution of chemical compounds into the cloud and precipitation phase and subsequent wet deposition as well as modifications of the atmospheric circulation due to changes in radiative cloud properties.

This study presents model simulation results from the ESCiMo (Earth System Chemistry integrated Modelling) project, a consortial modelling initiative using the EMAC (ECHAM5/MESSy Atmospheric Chemistry) model. We analyse the effects of aerosols in general and the feedbacks of aerosol particles on the climate system with a focus on the chemical composition of the atmosphere. Separated simulations of the atmospheric aerosol with and without feedback via clouds and radiation will be presented to separate the effects of gas aerosol partitioning and heterogeneous chemistry from the feedbacks originating from the direct and indirect aerosol effects. The focus of the presentation will be set to inorganic species such as nitrogen and oxidised sulphur compounds in gas and aerosol phase and the impacts on tropospheric ozone.