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# Emission and transport-related uncertainties in global aerosol-climate simulations in the Arctic region

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Aerosol particles from long-range transport can contribute to the recent rapid warming of the Arctic (Arctic Amplification) by direct and indirect radiative effects. The actual composition and, therefore, the optical and radiative properties of the aerosol can vary considerably with variations in the local sources, transport, and atmospheric conditions. Global aerosol-climate models still struggle to reproduce the Arctic aerosol conditions. In particular, the vertical aerosol layering and the seasonal variability in aerosol microphysical properties are key challenges. The state of mixing, however, is important as aerosol particles interact with each other, changing their respective properties.
The global aerosol-climate model ECHAM6.3-HAM2.3 shows good capabilities in reproducing black carbon (BC) aerosol concentrations in comparison to ground-based and airborne in-situ measurements. It also shows, however, an overestimation of BC in atmospheric layers above 500 hPa especially in summer. This is likely related to a misrepresentation in wet removal of long-range transported BC, which may also be the reason for unusually high concentrations of mineral dust at high altitudes. In contrast, ECHAM6.3-HAM2.3 tends to underestimate the total aerosol optical depth in the Arctic in comparison to AERONET measurements and other models. This is probably due to an underestimation of the soluble aerosol fraction like sulfate, which again affects the growth and scavenging efficiency of BC and mineral dust particles.
In this study, the model uncertainties are explored in sensitivity studies on the emission setup as well as on the particle ageing in ECHAM6.3-HAM2.3. In-situ surface and aircraft measurements are used to thoroughly evaluate the modeled concentrations of the different aerosol types in the Arctic atmosphere.

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