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# Binary homogeneous nucleation of H2SO4/H2O particles in the Arctic free troposphere during the ASTAR 2004 campaign

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The classical mechanism for the formation of aerosol particles from condensable gases in the atmosphere is the binary homogeneous nucleation of H2SO4 and H2O which is strongly dependent on temperature and relative humidity. Here, we investigate the influence of subgrid-scale vertical motion on the binary homogeneous nucleation in the Arctic free troposphere. During the ASTAR (Arctic Study of Tropospheric Aerosol and Radiation) campaign nucleation mode particles (4 to 13 nm) were quite frequently observed at altitudes below 4000 m. However, in the upper free troposphere, nucleation mode particles were only observed once, namely during the flight on 24 May 2004 (7000 m). We perform microphysical box model studies along trajectories that were calculated 6-days backwards based on European Center for Medium-Range Weather Forcasts (ECMWF) meteorological analyses. The processes considered in the box model are the binary homogenous nucleation of H2SO4 and H2O, the Brownian coagulation and the diffusional growth due to the uptake of HNO3 and H2O. Due to the lack of measurements of H2SO4 the simulations were performed initialising the model with different H2SO4 mixing ratios (between 1 and 100 pptv). The simulation results can be devided into three cases: 1. nucleation occurs at the begin of the simulation due to very low temperatures, 2. nucleation occurs at a certain point in the simulation but for higher mixing ratios at the begin of the simulation, 3. nucleation occurs at three different time steps during the simulation. For case 1 the temperature was the only driving mechanism while for case 2 and 3 the sub-grid scale vertical motion could have influenced the formation of new particles.