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Technical Note: A numerical test-bed for detailed ice nucleation studies in the AIDA cloud simulation chamber

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Abstract. The AIDA (Aerosol Interactions and Dynamics in the Atmosphere) aerosol and cloud chamber of Forschungszentrum Karlsruhe can be used to test the ice forming ability of aerosols. The AIDA chamber is extensively instrumented including pressure, temperature and humidity sensors, and optical particle counters. Expansion cooling using mechanical pumps leads to ice supersaturation conditions and possible ice formation. In order to describe the evolving chamber conditions during an expansion, a parcel model was modified to account for diabatic heat and moisture interactions with the chamber walls. Model results are shown for a series of expansions where the initial chamber temperature ranged from -20°C to -60°C and which used desert dust as ice forming nuclei. During each expansion, the initial formation of ice particles was clearly observed. For the colder expansions there were two clear ice nucleation episodes.

In order to test the ability of the model to represent the changing chamber conditions and to give confidence in the observations of chamber temperature and humidity, and ice particle concentration and mean size, ice particles were simply added as a function of time so as to reproduce the observations of ice crystal concentration. The time interval and chamber conditions over which ice nucleation occurs is therefore accurately known, and enables the model to be used as a test bed for different representations of ice formation.

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