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# The structure of ice crystals at amospheric conditions

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There is laboratory evidence that the metastable ice phase Ic can form under atmospheric conditions[1)2)]. The presence of this so-called cubic ice in the upper troposphere and lower stratosphere would affect important processes occurring at these altitudes by changing crystal size distributions, dehydrating cold clouds and increasing the vapour pressure[3)].

Especially the latter effect makes the question for the crystal structure of atmospheric ice a crucial one since the discovery of supersaturations of water vapour inside and outside of cirrus clouds[4)].

Ice obtained from vapour deposition ("frost") was investigated by neutron powder diffraction. A structural model[5)], based on hexagonal and cubic stacking probabilities, allows us to fit the obtained diffraction patterns. By refining these probabilities and other parameters related to the crystal structure, we can analyze the stacking behaviour and determine the anisotropic particle size.

We observed that these properties change as a function of both temperature and time. While about 50% of the stacking sequences are cubic in the original frost, exposure to increasing temperatures leads to a monotonic decrease of their fraction, until near extinction at 220K. This correlates with measurements of supersaturations in this temperature range[6)].

The transformation from ice Ic to nearly hexagonal ice is accompanied by an increase of the particle size, indicating that mass transfer takes place during the annealing process.

Annealing experiments at constant temperatures showed that isothermal structural changes are still very slow at 175K, but occur on the timescale of several hours at 180 and 185K, which is in the same order of magnitude as the life time of cirrus clouds.

At present we make efforts to improve our control over deposition conditions. A specially developed condensation insert for the neutron diffractometer's cryostat allows us to prepare ice in-situ at atmospherically relevant and reproducible temperatures and pressures.

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