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Interactive Comment

Interactive comment on "The roles of dynamical variability and aerosols in cirrus cloud formation" *by* B. Kärcher and J. Ström

B. Kärcher and J. Ström

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The reviewer finds the agreement between measured and modeled ice crystal number concentrations unexpected and particularly remarkable and suggests to further discuss that issue.

We think that the agreement is brought about by two facts: (1) we are dealing with total number densities of ice crystals; (2) the subset of INCA measurements reported here was indeed mainly taken in cloud-forming regions. Below follows a brief description of a typical measurement, as it will be included in the revised version in a separate paragraph.

The aircraft climbed to high altitudes above the top of any cirrus present. Very often, being clearly above the main cloud layer, the aircraft flew in a veil of patchy cirrus. The aircraft descended down to and into the main cloud layer. Several flight legs at different

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levels of typically 10–15 minutes duration were flown within cloud. The flights ended by climbing to the stratosphere or cloud top altitude and then starting a stacked downward flight with levels of only 3–5 minutes duration. The fact that the aircraft approached the clouds from above resulted in the measurements being conducted mainly in the upper cloud part (the cloud formation region). When making aircraft measurements of cirrus the poor contrast between the cloud and the surrounding environment is at times such that one cannot maneuver to fly at cloud edges unless skimming the top.

We think that focus on ”young” cirrus as outlined above minimizes the influence of crystal sedimentation and sublimation on the distributions of n_i. We have indicated that already (p.1419, l.12ff). In addition, we provide the following arguments suggesting a weak, if any, impact of size sorting and sublimation on the distributions of n_i.

At least judging from our own observed size distributions the total crystal concentration is controlled by particles smaller than the lower detection limit of the 2D-probe. Thus the particle range mostly affected by sedimentation or size sorting has little effect on the total number density unless when flying in virga. As ice particles quickly vanish when sublimating below a few microns without changing their number density significantly, sublimation likely has a minor effect on the frequency distributions.

Effects on the frequency distributions due to dispersion (dilution effects) cannot be ruled out. It can be seen from Fig.4 that there is room for improvement between model and observations, in particular in the low concentration regions. Some of the observed low-n_i data may not come from nucleation (as assumed by our model), but may stem from dispersion of existing crystals (sedimentation and sublimation effects unlikely, see above). We will add this statement in Sect.3.4 and modify item 4 in our conclusions accordingly.

Finally, we also agree with the reviewer about the numerical follow-up study. In fact, we are currently performing such simulations using domain-filling trajectories covering the entire midlatitude northern hemisphere (manuscript in preparation). First results show

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that ice crystal concentration distributions do look similar to the ones presented here and that ice nucleation does frequently take place in waves with the largest cooling rates, but details remain to be examined.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 1415, 2003.

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