

Interactive comment on “Chemical composition of ambient aerosol, ice residues and cloud droplet residues in mixed-phase clouds: single particle analysis during the Cloud and Aerosol Characterization Experiment (CLACE 6)” by M. Kamphus et al.

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We thank referee #2 for providing a thorough review and thoughtful comments.

Anonymous Referee #2 Received and published: 10 August 2009

Overview This paper, by Kamphus et al., is appropriate for publication in Atmospheric Chemistry and Physics if for no other reason than the dataset from Jungfraujoch, which

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is a valuable addition to the literature. I would not object to publishing the manuscript as-is. That said, I have a couple of comments and some minor points.

Comments Comment: Implicitly, the freezing modes being considered in this paper are immersion and condensation, which brings up an interesting point, at least to me. The authors state that mineral dust with no associated soluble components (Class 1) are enriched in the ice residues. I find this a bit surprising for this type of cloud. For the relatively low maximum supersaturations I would expect in these clouds, I would have expected mineral dust with some soluble components to be favored since the soluble components would aid in the particles activation. By the time the droplet froze, it would be dilute enough for the freezing point depression to be negligible. On the other hand, mineral dust aerosol particles without soluble compounds associated would have higher critical supersaturations and might not activate. I am not disputing the finding presented here, it just seems curious to me. Do the authors know of any reason why pure mineral dust would be favored over mineral dust with (e.g.) sulfate as a freezing catalyst, especially if the cloud droplets from which the crystals froze were fairly large ($\sim 10 \mu\text{m}$) and therefore fairly dilute? Comment: It is odd that droplet residues were depleted in biomass burning components. I would not expect fresh biomass burning emissions to be good CCN necessarily, but it seems that they would be after aging in the atmosphere. (And there seems to be no indication that the clouds sampled here were influenced by fresh biomass burning emissions.)

Response: This is an interesting point. For the mixed-phase clouds encountered at the conditions of JFJ immersion and condensation freezing may be the dominant mechanisms but we are not aware that deposition and contact freezing can be excluded. The enrichment in comparison to the average BG aerosol is difficult to verify as we cannot compare the exact same air masses for BG and IR particles, (see also discussion of reviewers #1, point #6, and reviewer #5, major point). It is also interesting to note that apparently not all the mineral dust particles present have aged in the same way, some have very little soluble material associated while others have collected a lot. This is

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likely indicative of the amount of time a mineral particle has already spent in the atmosphere, whether it has undergone previous cloud cycles etc. As the CVI samples only young ice crystals $<20 \mu\text{m}$ which have formed very recently, in various situations we may not sample the best IN that activate first in a cloud (see comment to referee #5, minor comment p.15385, line 23). With respect to the droplet residues and biomass burning aerosols: a comprehensive discussion of the DR measurements is added in the revised ms.

Minor points I may be in the minority here, but please consider a global search and replace for the following: IR \rightarrow "ice residue" DR \rightarrow "droplet residue" BG \rightarrow "background aerosol" There's no excess page fee is there? I find non-standard acronyms distracting and using them doesn't cut the length that much. They don't, in my opinion, improve the flow of the paper.

Response: We would like to keep these acronyms as these three terms are used so often throughout the manuscript. We agree, these acronyms are non-standard so far but may become standard as more studies of this type are conducted in the future. We wanted to emphasize that there may be a difference between IN and IR and between CCN and DR, respectively. Besides, ACP publications are charged per page.

page 15390, line 25: reword "... ATOFMS was as well connected..." to "... ATOFMS was connected to the Ice-CVI inlet as well."

ok

page 15397, line 25: "Predominatly" ! "Predominantly" (note second "n")

ok

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 15375, 2009.

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