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Interactive comment on “Heterogeneous ice nucleation on atmospheric aerosols: a review of results from laboratory experiments” *by* C. Hoose and O. Möhler

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Congratulations to the authors! This is a well-written and timely review paper on ice nucleation summarizing and comparing the existing laboratory experiments on heterogeneous ice nucleation caused by different aerosol particles.

The authors correlate the higher nucleation temperatures of bioaerosols with the usually larger sizes of biological particles.

As we showed in our paper (Pummer et al., 2012), it is not the whole pollen grain being necessary for ice nucleation, but only some macromolecules, which are much smaller than the grain itself, and which can nucleate ice independently. Even the much larger

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bacterial IN clusters (Warren and Wolber, 1991) are relatively small in comparison with the mineral dust particles applied in most of the quoted studies. So in fact the biological ice nuclei are tendencially smaller than the dust particles.

A hypothesis, which is also given in the discussion paper, says that the IN activity of dust is also not caused by the whole grain, but by certain active sites of the surface. Through the eyes of a chemist, we are particularly missing the chemical perspectives: Up to now, no investigation of the chemical nature of mineral dust ice nuclei has been carried out. The open questions are: What is the chemical nature of these active sites? Do they have the same composition as the bulk, or are they something else? Could they be external contaminants (e.g. biological), which are too small to be seen in typical phase composition measurements (e.g. XRD)? By which processes are these active sites formed, and how common are these processes in real life? It would be imbalanced to assign the IN activity to a certain type of crystalline phase, if it originates in fact from active sites, which could be of completely different chemical origin, and might not be necessarily present on all mineral dust particles of a kind.

To gain more information about the mineral surface, one should initiate enhanced spectroscopic and microscopic surface characterizations of the nuclei, at least on some selected examples. Amble techniques might be scanning electron microscopy (SEM), Energy-dispersive X-ray spectroscopy (EDX), as well as vibration spectroscopy (IR, Raman, and neutrons), Low-energy electron diffraction (LEED) and X-ray photoelectron spectroscopy (XPS).

In Fig. 5a data points from our paper (Pummer et al., 2012) are shown and labeled as onset temperatures, but in fact these are median freezing temperatures. This is important for consideration, because consequently the numeric values are relatively lower than those of studies where the onset freezing temperature is quoted (e.g. those by Diehl et al., 2002).

REFERENCES

Diehl, K., Matthias-Maser, S., Jaenicke, R., and Mitra, S. K.: The ice nucleating ability of pollen. Part II: Laboratory studies in immersion and contact freezing modes., Atmos. Res., 61, 125–133, 2002.

Pummer, B. G., Bauer, H., Bernardi, J., Bleicher, S., and Grothe, H.: Suspendable macromolecules are responsible for ice nucleation activity of birch and conifer pollen, Atmos. Chem. Phys., 12, 2541–2550, doi:10.5194/acp-12-2541-2012, 2012.

Warren G., Wolber P.: Molecular aspects of microbial ice nucleation; Mol. Microbiol. 5, 239-243, 1991.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 12531, 2012.