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Biogeosciences Discussions

Interactive comment on "Potential relevance of Mortierella alpina as a source of ice nucleating particles in soil" *by* Franz Conen and Mikhail V. Yakutin

Anonymous Referee #1

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Review for "Potential relevance of Mortierella alpina as a source of ice nucleating particles in soil" by Franz Conen and Mikhail V. Yakutin, submitted to Biogeosciences Discuss.

This comparably short manuscript examines the ice nucleating ability of samples derived from six different soil samples collected in different parts of the world. The temperature range examined is restricted to comparably warm temperatures (down to -10°C), and different sample treatments are used to ascribe a fraction of the observed ice activity to "M-like" ice nucleators, i.e., to ice active entities which might be similar to those observed for the soil fungus Mortierella alpina. At the temperature of -10°C,

the fraction of these "M-like" ice active entities to the total number of ice active entities is then derived. It increases towards higher concentrations, much more than linearly, suggesting a possibly higher fraction of ice activity being contributed by "M-like" ice nucleators (possibly fungi) in colder areas.

The result that there are ice active entities in soils in different locations around the world is neither surprising nor totally new (the review paper by Szyrmer and Zawadzki (1997) already describes much older work on ice activity in soils). In recent times, this topic has been picked up again and refined, clearly identifying macromolecules related to soil fungi as ice active, and respective work is cited in the here presented manuscript. The new aspect of this new study is, that more locations are added where this ice activity in soils is found as well, together with the different treatments indicating that the observed ice nucleation may indeed be related to the abovementioned soil fungus. This is, however, only indirectly derived. The potentially higher ice activity of "M-like" ice nucleators in colder areas is also interesting but was described before (see my remarks below), albeit not to a great extent.

There are a few additions I would have wished for, and I give these below. However, I have to admit that I have difficulties in judging whether the content of the manuscript merits publication in Biogeosciences and would want to leave this final judgment for the editor, based on my remarks above.

Specific comments:

page 1, line 15: Literature on the statement that soils are a relevant source for ice nucleating particles (INP) would be good – while the presence of INP in soils is quite certain (see literature you cite in line 18), the transfer to the atmosphere is less well understood.

page 2, line 1: You call these INP "M. alpina like", and further down in the text it is justified some more why you assume that these are derived from fungi and not e.g., from bacteria, related to the treatments you do. It could help if you added here that the

assumption of a fungal origin is justified further down.

page 2, Methods: I would have liked to see a map which shows were the different samples were taken, at least roughly. Also: how much soil was originally sampled (e.g., in g of dried soil)? And in which depth (surface, further down, if it was the surface, was a plant cover removed, first)? This could be interesting information for people who would like to do similar experiments.

page 2, line 6: Why a NaCl solution and not pure water?

page 2, line 14: Put the units behind the numbers, i.e., "Final concentrations of particles < 5 μm ranged from 0.02 to 15.5 μg ml-1".

page 2, line 18: I wondered why you used guanidinium chloride, and this then only became clear at the end of this chapter. Please restructure the text so that the reader can know earlier what you are aiming at. The sentence on page 2, line 25-26 should be moved up.

page 2, line 29-31: Your findings here should be related to Schnell & Vali (1979), who report a dependency of the abundance of ice nuclei in leave litter on climatic zones, with higher abundancy in colder climates. A comparable relation has also been reported more recently for pollen in Augustin et al. (2013).

I would have liked to see some of the freezing curves. There are ample of them around in literature, but it is always good to look at them, as they tell stories, and as each study is different. This would be 15 curves (one each for each point shown in the present Fig. 1), and it would be nice to see if they are all similar, or different. Also, seeing the deactivation at least for selected samples and treatments presented as freezing curves would be good.

Literature:

Augustin, S., H. Wex, D. Niedermeier, B. Pummer, H. Grothe, S. Hartmann, L. Tomsche, T. Clauss, J. Voigtländer, K. Ignatius, and F. Stratmann (2013), Immersion

freezing of birch pollen washing water, Atmos. Chem. Phys., 13, 10989–11003, doi:10.5194/acp-13-10989-2013.

Schnell, R., and G. Vali (1976), Biogenic ice nuclei: Part I. Terrestrial and marine sources, J. Atmos. Sci., 33, 1554-1564.

Szyrmer, W., and I. Zawadzki (1997), Biogenic and anthropogenic sources of ice-forming nuclei: A review, BAMS, 78(2), 209-228.

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