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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ice nucleation and its effect on the atmospheric transport of fungal spores from the classes *Agaricomycetes*, *Ustilaginomycetes,* and *Eurotiomycetes*" *by* D. I. Haga et al.

Anonymous Referee #2

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Haga et al. present a survey study of the ice nucleation properties of different classes of fungal spores. Experiments were performed using the well-established drop freezing method with an apparatus that has been successfully employed in previous studies. ECHAM5 model simulations were used to test the implications of the fungal spore IN activity on the transport and distribution of spores on a global scale. The main findings of the manuscript are (1) that after normalizing per unit surface area the IN activity for different classes and species are relatively similar and (2) that the inclusion of IN scavenging in model simulations alters the concentration and distribution in the

atmosphere.

This a well-referenced manuscript that incrementally improves upon a previous manuscript of Haga et al. (2013, JGR). Aside from a few aspects of the manuscript that require clarification I recommend publication in ACP.

Comments: The authors have done a nice job in researching the different classes of fungal spores in the atmosphere. In the process several terms of the biological classification scheme ranging from phylum to species are being used without clear demarcation. Unlike IN active bacteria that can be characterized via 16s rRNA sequences and the presence of an IN active protein, the molecular mechanism responsible of fungal spore IN activity is unknown. It is difficult to argue a priori why different phyla, classes, genera, families, or species would differ in their IN activity. It would help if the authors better define what the expected similarities and differences are at the class and species level and how those might effect the IN activity. I don't know much about fungal spores but an example borrowed from algae would be different contact angles and materials of the surface as with cocolithophores and diatoms. Even if the root cause of the IN activity of the fungi is beyond the scope of this study that information is needed to begin exploring similarities and differences in IN activity between the different experiments. Also, some terms are never explained and/or used such as teliospore and conidiospore only appear in Table 1.

Throughout the manuscript the authors use "Number of nuclei per spore". I generally think of 1 nucleus = 1 particle. It may be better to say "fraction of spores that serve as IN at temperature T" or "average number of nucleation sites per spore"

Figure 2 shows that the experiment with P. brevicompactum has a signficant number of drops that freeze homogeneously, either because no spore was present in the drop or because the spore present did not contain an active site. Effectively those drops did not contain an active ice nucleus. Should those data then be presented as IN per spore in Figure 3?

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14, C1560–C1562, 2014

A related question is with respect to the average number of spores per drop. What is the variability of that average when considering individual drops? Using the Vali method assumes that the distribution of nuclei in the drop is fairly uniform. This is ensured when working with liquid suspensions. But I wonder if this is the case in the two-step procedure used here. First spores are deposited on the slide, then drops form on that slide by water nucleation. At minimum the authors should show (maybe they have in past work and then need to reference it) that the spores were distributed spatially uniformly over the slide and or that droplets formed on the slide are also formed spatially uniformly. Placing a virtual grid over the wet and dry images, computing the distribution of number of drops/spores per grid square and showing that it follows a Poisson distribution will do the trick. If the uniform condition is not satisfied it will be necessary to quantify how badly the maldistribution of spores per drop would interfere with the construction of Figure 4.

It is claimed that "all of the fungal spores investigated were found to cause freezing". It seems more appropriate claim that all of the species/classes studied contained some fraction of spores that serve as IN at temperatures warmer than homogeneous freezing.

The comparison to active site densities to dust are interesting but ultimately unhelpful. The much more relevant comparison would be the number of IN from dust and fungal spores, which requires scaling INAS with the surface area of dust and fungal spores in various environments.

pg. 5017 "cosmopolitan" is a strange word to use here

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 5013, 2014.