

Interactive comment on “Ice Nucleation Activity in the Widespread Soil Fungus *Mortierella alpina*” by J. Fröhlich-Nowoisky et al.

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This paper is a valuable addition to the ever-expanding range of known biological ice nucleators. The *Mortierella alpina* fungus has not been studied prior to this work. Finding this source of ice nucleators in a range of soil types is noteworthy because it implies a possible worldwide role. It also adds special interest to this work due to the potential for atmospheric impact. A third important contribution of this paper is the examination of the evolutionary and ecological role ice nucleating ability might impart to *Mortierella alpina*.

Specific comments here are restricted to the methodology and results of the ice nucleation measurements. Other reviews will no doubt address other aspects of the paper.

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Detection of ice nucleation in the samples followed well-established drop-freezing routine and was suitable for this study. The stepwise cooling of the drops and determination of the frozen fraction at each temperature step are not ideal. This manner of testing introduces a degree of ambiguity between the contributions of time and of temperature in leading to nucleation events. However, the impact of this ambiguity is minor compared to other limitations. The time factor is secondary, as has been shown by Vali and Stansbury (1966), Wright et al. (2013) and Budke and Koop (2014), so that evaluation of the results in terms of the singular approximation is justified. Greater limitation arises in this work from the small number of drops used in each test. That number sets both the range of concentrations of the INPs that is detected and the accuracy of the derived concentrations, as described in Vali (1995). In this work, the problem manifests itself in the pro quality of information that can be derived from Figs. 2, 3 and 4. Each of the lines shown in these figures have one point on left side that is lower but the rest of the points are practically indistinguishable in magnitude along the ordinate scale. With the large number of different samples to test, the measurement of ice nucleating ability had to be simple and modest. Nonetheless, perhaps the authors can find better representations of the data than what is seen in Figs. 2, 3 and 4.

It is mentioned in the paper that three replicate soil samples were taken from each location in the field. It is regrettable that no data are presented to show how much scatter was detected for the replicates.

The identification of this new source of potential atmospheric ice nucleating particles (INPs) adds further motivation to devise methods for identification of these INPs in the free atmosphere, at various locations, altitudes, etc. Establishing the link between such sources and their contribution to ice formation in clouds remains a major challenge. The intermediate step of studying the sizes of these INPs and their attachment to other parts of the soil are more readily pursued; such studies can help to better define the potential roles these INPs may play in the atmosphere.

The paper gives motivation for continued examination of the presence and of the ac-

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tivity of *Mortierella alpina* in a broader range of settings than what is included in the paper. At the same time the paper is also an indication of the magnitude of effort that is needed in pursuing that goal. The authors are to be congratulated on their effort. It is sad to note that Gary Franc didn't have the chance to see this work to completion.

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