

Interactive comment on “Immersion freezing of birch pollen washing water” by S. Augustin et al.

Anonymous Referee #1

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The authors used the Leipzig Aerosol Cloud Interaction Simulator (LACIS) to study the freezing of washings from two different types of pollen: Northern birch and Southern birch. Freezing of biological material, such as pollen, may be important for ice cloud formation, and hence the current topic is an important one and well suited for Atmospheric Chemistry and Physics. However, I have concerns about the interpretation of the data. Also, the atmospheric implications of the new results are not developed much beyond Pummer et al. 2012. Because of this I don't think the manuscript, in the current state, meets the high standards of Atmospheric Chemistry and Physics. I feel this manuscript is more appropriate for a lower impact journal. See additional comments below:

1) Abstract, Line 15. Heterogeneous nucleation rates do not explain the ice nucleation behavior. Please restate.

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- 2) Material and methods. Page 32915, Line 10. The authors indicate that the sample contained pollen. Does it contain anything else? Did the company do any processing of the sample? More history of the samples would be useful.
- 3) Page 32917, Line 6. “Especially for 500 nm and 800 nm particles, the ice fraction was analyzed as a function of temperature in a range from -18C to -35 C.” What do the authors mean by “especially”? Did they do a different analysis for 500 and 800 nm particles? Why only focus on these sizes? Please explain.
- 4) For Southern birch pollen the authors suggest that the ice fraction curves level off to constant values, indicating a saturation behavior of the immersion freezing process. However, I only see a leveling off for the 800 nm particles. The others sizes do not appear to reach a plateau.
- 5) Page 32918, Line 18-20. The authors should also point out that another possible explanation for their surface area dependence could be that their model (only a single IN) is incorrect.
- 6) Page 32920, Line 26. The data doesn't show that the material does not dissolve incompletely. This is only one possible explanation. Please restate.
- 7) Page 32922, Line 17-18. “In our case we observe that the particles of the Southern birch pollen washing water show one mode.” For the 800 nm particles I see two possible modes, one at -24 C and one at -26.5 C. Furthermore if I look at Figure 5 it looks like a model with two different types of IN would describe the data better.
- 8) Page 32923, Line 3. “This supports the assumption of two differently behaving INA macromolecules . . .” I think this should be changed to “this supports the assumption of at least two differently behaving IN macromolecules . . .” I would guess a model with three different types of INA macromolecules would also fit the data and probably better.
- 9) 32924, Line 0-10. The authors discuss how the slopes of the heterogeneous nucleation rates are connected to the distribution of the ice nucleation related properties

(e.g. contact angles) of the whole INA macromolecule population. I am confused by this discussion. For the Southern birch the authors assume only one type of INA. How can they have a distribution of ice nucleation related properties if the INA are all identical? Maybe I am missing something here?

10) 32924, Line 20. Please provide some justification for the statement “unlikely”.

11) Page 32925, Line 20-27. In your experiments did the pollen grains burst? If not, is this discussion relevant to your experiments? In the experimental section it sounds like it is only surface molecules that are dissolved in the washing waters. Please clarify what material is being incorporated into the washing water.

12) Page 32927, Line 5. “From that we conclude that the INA North is more homogeneous with respect to the ice nucleating related properties than the INA South.” I don’t understand this statement. I thought the model for INA south assumed only one type of INA?

13) Could the data be fit equally well with other models, such as a distribution of contact angles?

14) How would one use the heterogeneous nucleation rates determined in this paper to predict freezing in the atmosphere?

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 32911, 2012.

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