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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Birch leaves and branches as a source of ice-nucleating macromolecules" *by* Laura Felgitsch et al.

Anonymous Referee #1

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The paper presents analyses of ice nucleating particles (INPs) found in extracts of finely milled leaves, twigs, and branches from ten birch trees in Austria. It is a valuable contribution to the literature on potential sources of INPs found in the atmosphere. Its clear presentation provides for pleasant reading.

More discussion on the following issues would make the paper even stronger:

a.) Spectral analysis of extracts lead to the conclusion that birch leaves, twigs and branches contain chemical substances similar to those in birch pollen, which implies that INP in either material carry of the same sort of ice-nucleating macromolecules (INM). If so, leaf, twig, and branch INM should equally withstand denaturation at temperatures up to 445-460 K, which clearly distinguishes birch pollen INM from bacterial and fungal INM that are already denatured at much lower temperatures (Pummer et

al., 2015, https://doi.org/10.5194/acp-15-4077-2015). Did you test the heat tolerance of your samples? If so, what was the result?

b.) Another issue I would like to see addressed with regard to the nature of the INM is whether they could be a form of cellulose. This issue could be discussed with reference to the FTIR spectra in Figure 5 and also with regard to the slope of the cumulative nucleus spectra (Figure 3), as compared to similar spectra available for cellulose (e.g. Hiranuma et al., 2015, doi:10.1038/ngeo2374).

c.) In the Discussion you write that INM could be "...washed into the soil during rainfall..." (page 7, lines 29-30). Leaves and twigs are usually covered by a thin layer of wax to protect against desiccation. I wonder whether INM sitting in the tissues below the protective outer layer could be washed off. Wouldn't leaves and twigs first need to be shed and to disintegrate for INM to be washed off in larger numbers?

d.) In Section 2.1 you introduce the altitudinal gradient along which you sampled the trees. Later in the paper there seems no further reference to this gradient. Instead, you relate results to the proximity of the trees to road or river. Is altitude irrelevant for the production of INM? Could similarity in terms of INM in a particular kind of location result from a genetic proximity of the trees (i.e. seeds spreading along a road or a river)?

Minor comments

Page 2, line 9: Please be more precise. Concentrations reported by Christner et al. (2008) were quite low (at -10 °C: 4 to 490 INP/L) compared to other studies (up to 500'000 INP/L at -10 °C; Petters and Wright, 2015, dx.doi.org/10.1002/2015GL065733). What the paper by Christner et al. (2008) indeed has clearly shown was the large fraction (95%) of biological INP in the total number of INP.

Page 2, line 20: 'mechanism' seems more appropriate here than 'tool' (same in line 35).

The term “tissue” you use to denominate your samples does not seem correct to me. As I understand, you processed entire leaves and sections of twigs and branches, which you call primary and secondary wood. Branches, for example, are made up of several types of tissue (xylem, phloem, sclerenchyma, cortex, epidermis). I would find it more appropriate to not talk about “tissue” in your context but say that you analysed material from different parts of the trees (leave, twig, branch).

Trees differ in MFT and cumulative nucleus concentration in leaves. How reproducible are these values? Did you prepare and analyse, perhaps during the preparatory phase of your study, two or more samples from the same tree, i.e. did you process from one or several trees two sets of leaves or two sets of twig material?

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