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Biological particles capable of triggering ice nucleation in the atmosphere

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Ice-nucleating particles (INPs) have a huge impact on atmospheric processes, since they can trigger ice cloud formation. In general, ice clouds interfere with the radiation balance of planet Earth effectively at high altitudes. Since ambient matter of biological origin tends to have rather large aerodynamic diameters, it exhibits a fast sinking velocity and can only reach limited altitudes. Therefore, research focused on materials found in higher quantities in the upper atmosphere. However, recent findings indicate that the role of biological INPs has been underestimated in the past. In 2012 Pummer and colleagues found that the INPs from birch pollen can be washed off and constitute of macromolecules in the size-range of a few nanometres. With such a small diameter, they show a much longer life span in the upper atmosphere than expected. Further, Huffman and colleagues showed in 2013 a burst of biological INPs over woodlands triggered by rain events, which matches the finding of Pummer et al. well.

Plants originating from the northern timberline experience harsh conditions with night frost even during the warm seasons. To prevent frost damages, those plants developed coping mechanisms. Many plant species, which are domestic in cold weather zones, exhibit ice nucleation activity. Therefore, it is important to examine those plants to understand the scale at which biological INPs can be emitted.

For the presented results we focus on two types of samples: Berries and tree pollen. Both belong to plants domestic at the northern timberline. With our results we are able to show that INPs are spread vastly throughout different species. Furthermore, all those INPs show certain similarities to each other, most importantly, all of the found INPs seem to be associated to macromolecules in the nano-particulate size range. We examined the INPs from birch pollen more closely. Results indicate that proteins play a major role.

Pummer, B., Bauer, H., Bernardi, J., Bleicher, S., Grothe, H.; Suspendable macromolecules are responsible for ice nucleation activity of birch and conifer pollen; Atmos. Chem. Phys., 12, 2541 – 2550, 2012.

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