



Landscape-precipitation feedback mediated by ice nuclei: an example from the Arctic

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The Arctic is one of the regions on Earth which are particularly sensitive to the effects of climate change. One of the largest uncertainties in describing climate and climate change is constituted by the characterisation of the behaviour of clouds. Specifically in the Arctic region there is a low abundance of cloud condensation nuclei (CCN) resulting in low droplet concentrations in clouds. Ice nucleating particles (INPs) in the atmosphere promote the aggregation of water molecules into ice, increasing the chance for precipitation. Therefore, a change in the absolute abundance of INPs and their relative presence compared to CCN is expected to have strong impacts on climate in the Arctic in terms of the radiative budget and of precipitation.

In July 2015 we sampled particles from air at Halde Observatory, Norway (69°55'45" N, 22°48'30" E, 905 m a.s.l.) on PM₁₀ filters. We determined the number of INPs active at moderate supercooling temperatures (≥ -15 °C, INPs₋₁₅) by immersion freezing. To identify potential sources of airborne INPs we also collected samples of soil from a highland and decaying leaf litter. Air masses passing over the land were enriched in INPs₋₁₅, with concentrations twice to three times larger than those found in air masses directly coming from the Barents Sea. Ice nucleation spectra suggest that it is mainly litter which accounts for this enrichment in INPs₋₁₅.

This example helps elucidating the feedback linking landscapes and atmosphere mediated by INPs in the frame of climate change. While the snow coverage is progressively reducing in the Arctic, areas with decaying leaf litter and vegetation that are exposed to wind and grazing are expected to increase, resulting into a larger abundance of INPs in the local atmosphere. This increase in airborne INPs can promote a change in the freezing of clouds, with impact on the lifetime and on the radiative properties of clouds, and ultimately on the occurrence of precipitation in the Arctic region.