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The Importance of Mineral Dust and Proteinaceous Ice Nucleating Particles in the Canadian High Artic During the Fall of 2018

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Ice nucleating particles (INPs) can initiate ice formation in clouds, which has a large impact on the hydrological cycle and radiative budget of the Earth. Constraints on the concentration and composition of INPs are needed to predict ice formation in clouds and hence the climate. Despite previous INP measurements in the Arctic, our understanding of the concentrations, composition, and sources of Arctic INPs is insufficient. Here we report daily concentrations of INPs at Alert, a ground site in the Canadian High Arctic, during October and November of 2018. The contributions of mineral dust and proteinaceous particles to the total INP population were evaluated by testing the responses of the samples to heat and ammonium treatments. Possible source locations of the most effective INPs were investigated using back-trajectory simulations with a Lagrangian particle dispersion model. The results show that the INP concentrations in October were higher than that in November. Combining our results with previous INP measurements at Alert, a seasonal trend was observed for the INP concentrations at -18 °C and -22 °C, with a higher concentration in the late spring, summer and early fall, and a lower concentration in the early spring, late fall, and winter. For the October samples, proteinaceous INPs were detected at T > -21 °C with a fraction of 60% to 100% and mineral dust INPs were detected at T < -21 °C. For the November samples, proteinaceous INPs were only detected at T > -16 °C with a fraction of 88% to 100% and mineral dust INPs were detected at T < -20 °C. The most effective INPs were possibly from South China and California based on 20-day backward simulations using the FLEXible PARTicle dispersion model and the correlations between INP concentrations and Al, , Na^+, and Cl^- measured at the site.