The ice-nucleating efficacy of glacial dust from the Copper River, Alaska

Sarah Barr, Bethany Wyld, Natalie Ratcliffe, Jim McQuaid, and Benjamin Murray
Institute for Climate and Atmospheric Science, University of Leeds, United Kingdom (eeslb@leeds.ac.uk)

Ice nucleating particles (INPs) play an important role in the climate system by influencing cloud radiative properties, cloud lifetime and precipitation. An understanding of the interaction between INPs and clouds is needed in order to improve the accuracy of both climate projections and short term weather forecasts. In the high latitudes the influence of mid and low latitude sources of INPs (such as potassium feldspar from desert dust) is reduced and local sources could be important for ice nucleation. However, there is a scarcity of field observations and many dust sources which could be important sources of INPs have not been quantified. The south coast of Alaska, in particular the Copper River valley in the Valdez-Cordova region, is one such area where there are regular dust storms. These can clearly be seen from satellite imagery, which provides information on the frequency and extent of these outbreaks. In order to investigate the potential importance of the Copper River valley as a source of INPs we undertook a field campaign to collect samples in October 2019. During this campaign size segregated aerosol samples from the near surface (1.5 metre) were collected on to polycarbonate filter substrates using a multistage cascade impactor with 5 size categories in the range <0.25 μm to >2.5 μm. We collected samples during 7 dust emission events over a 10 day period. In addition, samples of dry sediment were collected from the surface. We used the University of Leeds Microlitre Nucleation by Immersed Particle Instrument (μL-NIPI) to quantify the ice nucleating ability of these samples. We also used laser diffraction particle size analysis to determine the surface area of particles to allow the subsequent calculation of ice active surface site density ($n_s$). In addition, surface samples were separated in order to isolate the atmospherically relevant fraction (<10 μm) and used to determine the chemical composition of the dust using x-ray diffraction. This, combined with further work such as heat testing, will be used to identify what controls the ice nucleating efficacy in this dust and if there is an active biological contribution. We will present the results from the field campaign and subsequent analysis. These results show high ice nucleating activity of the samples, comparable to glacial dust from other regions, and highlight the importance of glacial dust as a source of INPs in the high latitudes.