Aerosols and albedo: Links between airborne particulate matter and melting of the Greenland Ice Sheet

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Surface melting in the southwest sector of the Greenland Ice Sheet (GrIS) is amplified by albedo reduction caused by blooms of pigmented glacier algae on the ice surface[1,2,3,4]. In order to better understand algal bloom development and ice sheet darkening, we characterised airborne particulate matter (PM) deposited at a site in southwest GrIS. Particle dispersion modelling informed possible PM transport pathways.

During field campaigns in 2016 and 2017, mean concentrations of airborne black carbon (BC) were 8 and 11 ng/m^3, respectively. BC nanoparticles were structurally diverse, and therefore possibly derived from multiple combustion sources. Time resolved aerosol size distribution measurements revealed that 83% of the aerosols were <1 μm in size. Silicate mineral dust dominated the measured airborne PM, and was primarily delivered via snowfall. Mineralogical and elemental analyses indicated that snow delivers P and Fe-bearing mineral phases to the ice, indicating that airborne PM may supply glacier agal blooms with inorganic micronutrients. Local meteorology combined with dispersion modelling using Flexible Particle (FLEXPART) indicates that airborne PM is delivered to southwest GrIS via complex transport pathways.

These findings indicate that while concentrations of airborne PM over the GrIS are low, the deposited PM accumulate on the ice surface and may influence supraglacial biogeochemical cycles, particularly by providing nutrients to glacier algae darkening the ice sheet.

[1]Lutz et al. *Microbial Genomics* 2018(4). [2]Cook et al. *The Cryosphere* 2020 (14). [3]Tedstone et al. *The Cryosphere* 2020(14). [4]Williamson et al. *PNAS* 2020(accepted).