The Great Melting: the unstoppable contest between snow physics, soot, mineral dust and microbes

LIANE G.BENNING[1,2,3] JENINE MCCUTCHEON[3], STEFANIE LUTZ[1], JAMES B MCQUAID[3], MARTYN TRANTER[4] AND THE BLACK AND BLOOM FIELD TEAM[1,2,3,4].

[1] GFZ, German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany (benning@gfz-potsdam.de)
[2] Department of Earth Sciences, Free University of Berlin, 12249 Berlin, Germany
[3] School of Earth and Environment, University of Leeds, LS2 9JT, Leeds, United Kingdom
[4] School of Geographical Sciences, University of Bristol, BS8 1SS, Clifton, Bristol, United Kingdom

The speed and extent of melting of the Greenland Ice Sheet (GrIS) and the linked surface energy- and mass balance variations are driven by changes in surface albedo. These changes are the response of the ice sheet surface to an as yet not well quantified interplay between physical, chemical and biological parameters that all increase the darkening of the GrIS surface. The drivers behind the change in albedo is derived from a combination of changes in snow and ice properties and an increased amount of light absorbing impurities (LAI). Although, traditionally LAI were assumed to be solely Aeolian delivered black carbon and mineral dust, recently bio-albedo factors have been recognized as important[1,2]. Through the Black & Bloom project we combine surface, airborne and satellite based measurements of the role of inorganic and biological particulates in the GrIS darkening. We quantify the interactions between microbes and minerals in the highly dynamic snow-ice transition zones, where snow and ice algal blooms will, in contrast to black carbon and mineral dust, more rapidly respond to the ever-increasing changes in the timing and duration of the annual melt seasons. As climate warms and melt seasons become longer, these biological-inorganic interactions will increasingly contribute to the darkening of the GrIS, yet these effects are currently not included in predictive numerical models.

[1] Lutz, S. et al. (2016) *Nature Commun*. 7, doi:10.1038/ncomms11968.
[2] Cook *et al*. (2017) *J Geophys Res*. 122:434.