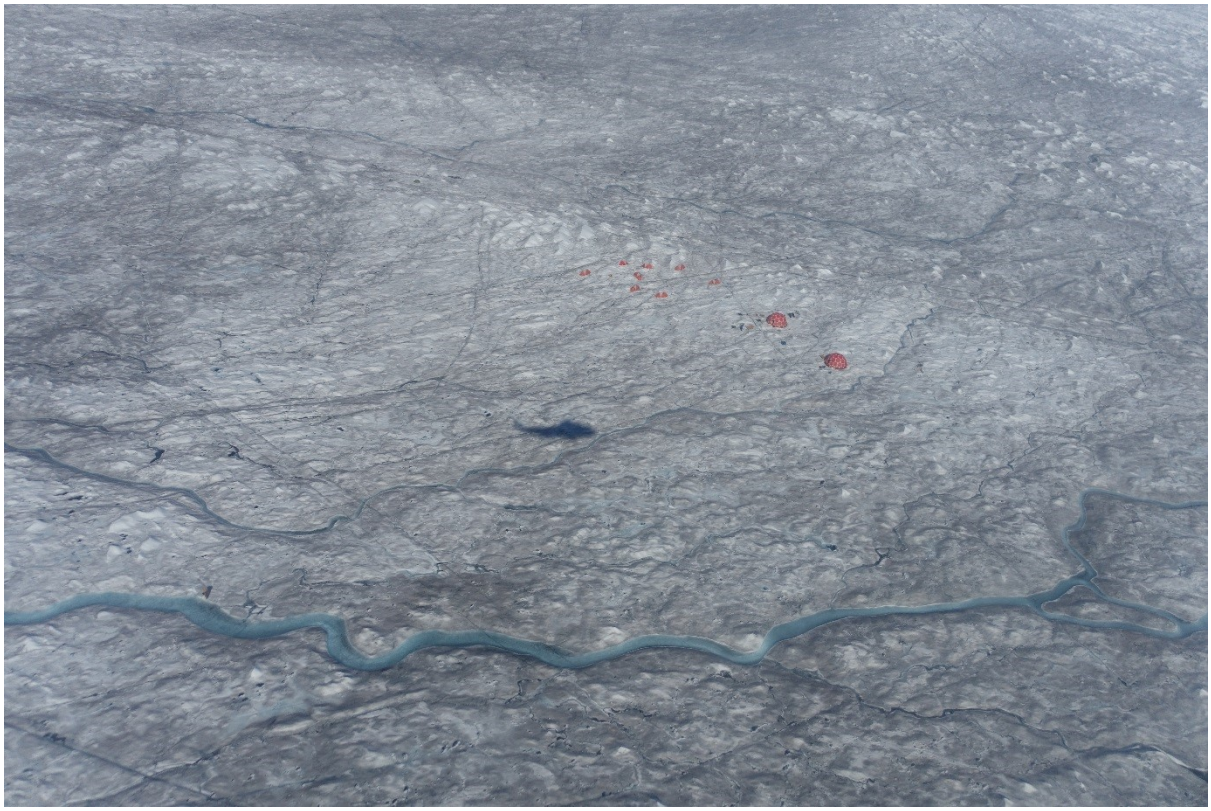
Black and Bloom 2016 Greenland Field Work Report

'Black and Bloom' is a large UK National Environment Research Council project that aims to deepen our understanding of the processes darkening the Greenland Ice Sheet. This is important because the colour of the ice sheet is one of the main drivers of its melt rate because it controls how much sunlight the ice sheet reflects or absorbs. The more sunlight absorbed, the more energy is available for melting ice.

In 2016 a team of researchers from Bristol, Sheffield, Leeds, Potsdam, Aberystwyth and NASA JPL camped on the ice sheet throughout the summer melt season in order to measure and monitor the changing colour of the ice and determine the causes of the darkening. The camp was inhabited in two month-long shifts. The first team comprised Joseph Cook (AC committee member, University of Sheffield), Chris Williamson (University of Bristol), Johan Nilsson (NASA JPL), Ewa Sypianska (Cardiff University), Tom Gribbin (Bristol University), Tris Irvine Fynn (Aberystwyth University) and Jim McQuaid (University of Leeds). Three weeks in, we were joined by Liane Benning, Steffi Lutz and Jenine McCutcheon (all University of Leeds). The team and all the camping and scientific kit was delivered in two flights on an Air Greenland Sikorsky S-61 helicopter.

The camp was built around two large Mountain Hardware “Space Station” tents, one of which was used as a mess tent (with a dining table and chairs, gas hob and food storage) and the other was a laboratory (kitted out with microscopes, spectrometers, filtration units, gas analysers, and all the usual lab consumables). The lab tent was also our power station, with the batteries, inverters and tracking system for our solar array. The long daylight hours and low temperatures helped the solar arrays to perform extremely well and we were able to charge all our scientific equipment, as well as laptops and satellite phones any time without issue. We were even able to run extension cables from the solar array to the mess tent to provide power across the camp! Around these two large tents were our own sleeping tents. Each person had a 3-man tent to provide room for bags and belongings.



A big problem is that the tents can melt the underlying ice, so we pitched on top of layers of white ‘polfelt’ and plyboard that both insulated the floor and provided a flat(ish) surface to walk on. However, this insulation also meant that after a few days the tents rested upon large ice pinnacles so needed to be repitched regularly!

For most of the season the weather was very friendly, with clear skies and very little precipitation – typical of summer on the SW Greenland ice Sheet. However, there was a significant rainfall event early on that washed away the crunchy, weathered ice layer and left a slick, slippery surface that was impossible to walk on without sharp crampons. It is also hard to dry out wet clothes and equipment in cold, overcast conditions. The rain also caused lots of glacier surface sediment (called 'cryoconite') to be washed onto the ice surface, instead of being held at the bottom of 'cryoconite holes'. The combination of washed cryoconite and the loss of the crunchy, white ice made the surface noticeably darker.

We were particularly interested in the role of algae on the colour of the ice, and therefore our microbiology team was hard at work characterising the biology of the ice surface, including identifying the species present, their productivity, abundance and colouration. It seems that algae can bloom very densely and have a severe darkening effect on the ice surface. Coupled with this were detailed measurements of the reflectivity of the surface and the deposition of dark particulates from the atmosphere.

After the first month, the 'in' team decamped and was replaced by the project's head-honcho Martyn Tranter, Alex Anesio, Alex Holland and Andrew Tedstone. Jenine also stayed out there with the second team. By the end of the season, the temperature had dropped significantly – large streams were freezing up completely every evening and remaining frozen until the middle of the day. What were almost 24 hour days at the start of the season became shorter and shorter and the team was treated to spectacular sunrises and sunsets over the ice sheet. In the far distance was a plume of water that, upon close inspection in the helicopter, turned out to be spray from a huge meltwater river crashing round a tight bend. Cryoconite holes grew, coalesced, divided and migrated around the camp.

The field season was successful in terms of the science and the team also reported feeling both awestruck at the scale of the ice sheet and simultaneously surprised by its sensitivity. The growth of microscopic algae and deposition of nanoscale particles of dust and soot influence the rate at which the vast ice sheet melts, and may therefore amplify climate changes and accelerate sea level rise. The Black and Bloom Team's challenge now is to quantify these processes and integrate them into future melt predictions.

In summer 2017 the team will be out in Greenland again – this time likely earlier in the year to monitor the transition from snow to slush and finally bare ice, as this is a very weakly understood part of the ice sheets annual biological and glaciological cycle. Please visit blackandbloom.org to find out more about the project and keep up to date with developments.