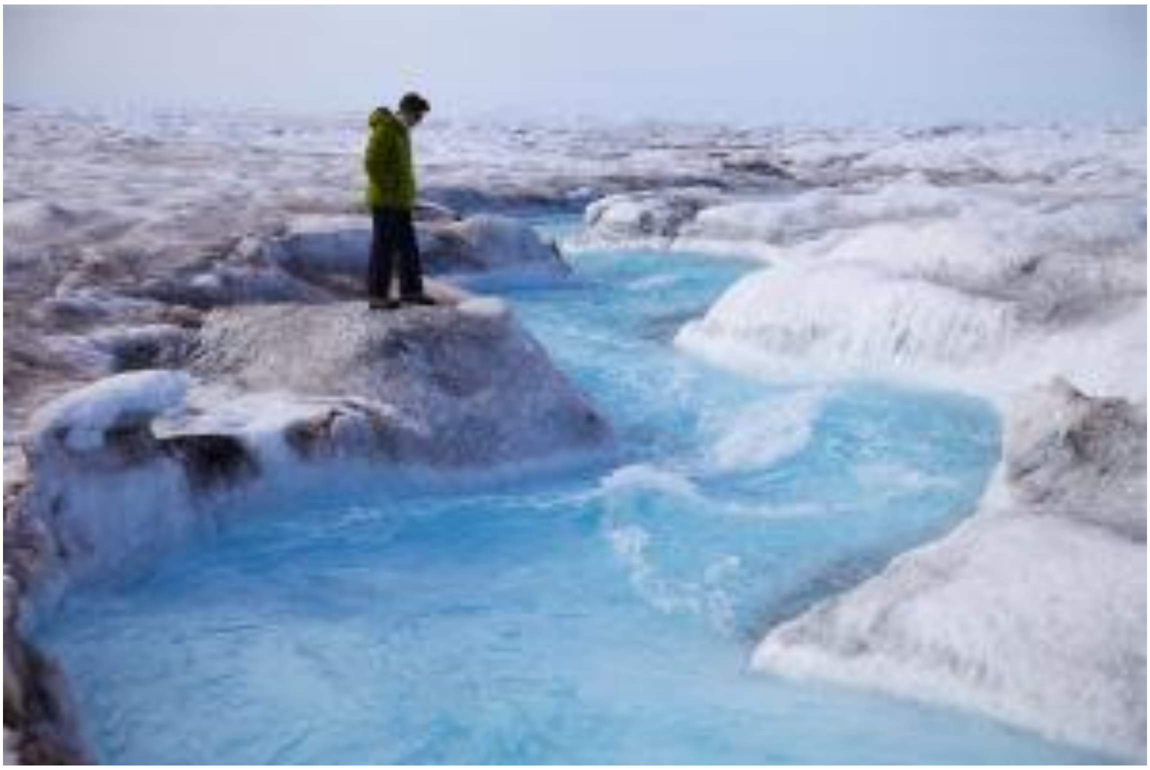
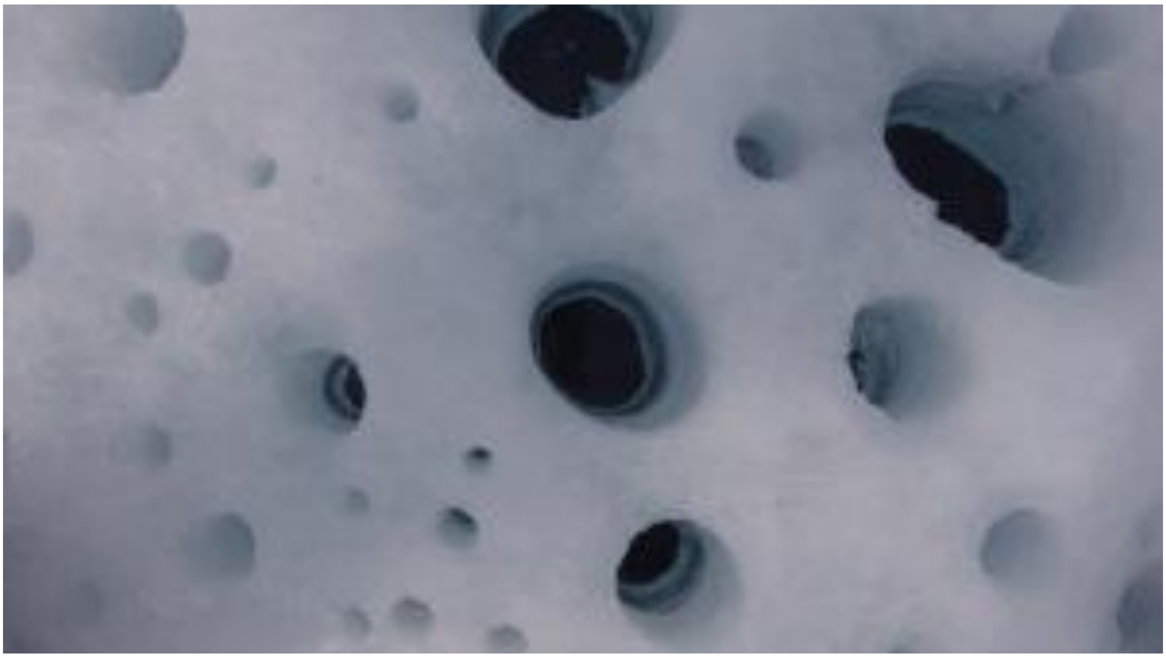
Brief Report: Greenland 2014

The Greenland ice sheet is the largest continuous body of ice in the northern hemisphere, covering an area of ~22million km^2. Melt water from the ice sheet contributes to global sea levels and oceanic circulation, while ice sheet shrinkage could initiate a feedback that threatens to exacerbate climate warming. Understanding the processes that control ice sheet melt is therefore of great importance. Despite appearing to be devoid of life, the ice sheet is a huge reservoir of microbial biodiversity, offering many habitats for microscopic lifeforms. These microbes might play an important role in the way the ice sheet behaves, including how quickly it melts.



Greenland ice sheet melt in action: observing surface runoff in a stunning supraglacial stream (ph. Sara Penrhyn-Jones)

One particularly important habitat is cryoconite. The term "cryoconite" refers to granular aggregations of minerals and biological material that provide microhabitats for a range of microbes including those that use sunlight to harvest energy (autotrophs) and those that feed upon particulate organic carbon (heterotrophs). Biological material makes cryoconite very dark, meaning it often drills down into the ice surface forming pits called cryoconite holes. We currently have a weak understanding of the bio-glaciological implications of these processes, which is why Dr's Arwyn Edwards, Tris Irvine-Fynn and I spent the last month on the Greenland ice sheet immersing ourselves in the dark and dirty world of cryoconite.

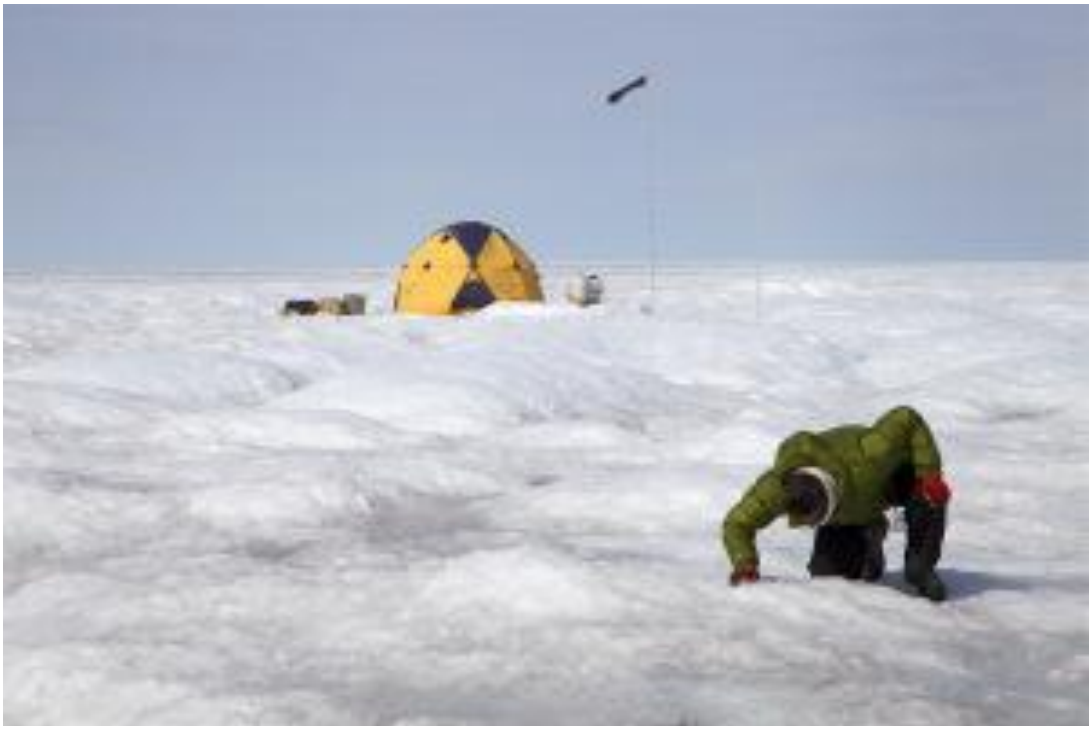


The beautiful cryoconite at S6, Greenland ice sheet

We spent two exciting weeks in a field camp kilometres into the ice sheet, at a site known as S6, with scientists from the Dark Snow Project. These scientists were examining the links between algal growth and the darkening of the ice surface (http://darksnowproject.org/).

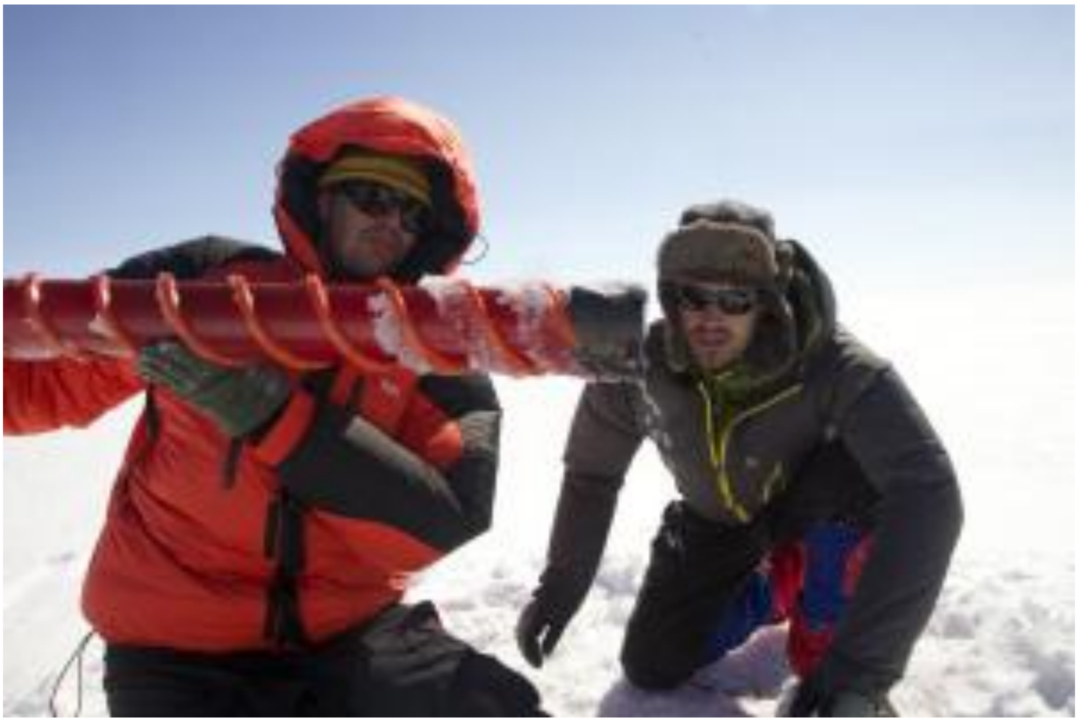
Dr Irvine-Fynn: out of the helicopter and onto the ice…

My primary focus was on cryoconite. I previously found that cryoconite holes widen when supplied with sediment, causing cryoconite to spread out and maintain maximal exposure to solar radiation (required for photosynthesis), whilst still being protected from the local weather and melt runoff by hiding on hole floors. It is possible, therefore, that these features maintain a biogeochemical homeostasis, whereby they change their dimensions to make sure conditions are favourable for microbial activity. Where rates of photosynthesis are higher there is more biomass available to sustain other microbes and more robust granules can form, meaning a more diverse array of microbes can survive. My focus during my time in camp was to examine the implications of this self-regulation for carbon cycling in cryoconite.



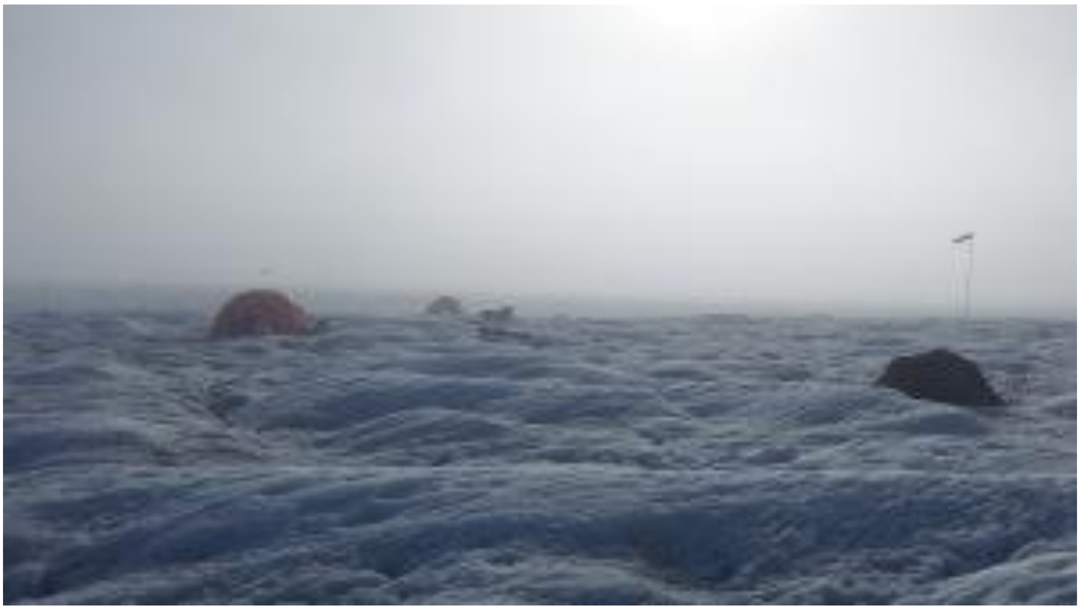
Peering into one of thousands of cryoconite holes at camp!

Furthermore, Arwyn and I jumped at the chance to visit a site further inland, in the accumulation zone of the Greenland ice sheet, with a shallow ice corer. A whirlwind visit saw us extract three ice cores from beneath the accumulating snow. A potentially major finding was that there was liquid water present ~1m beneath the surface – possibly an aquifer feeding the microbially active ablation zone with cells and nutrients and greatly expanding the known habitable area of the ice sheet. Such an aquifer has been identified before in Eastern Greenland, but this might be the first time it has ever been observed on the western coast.



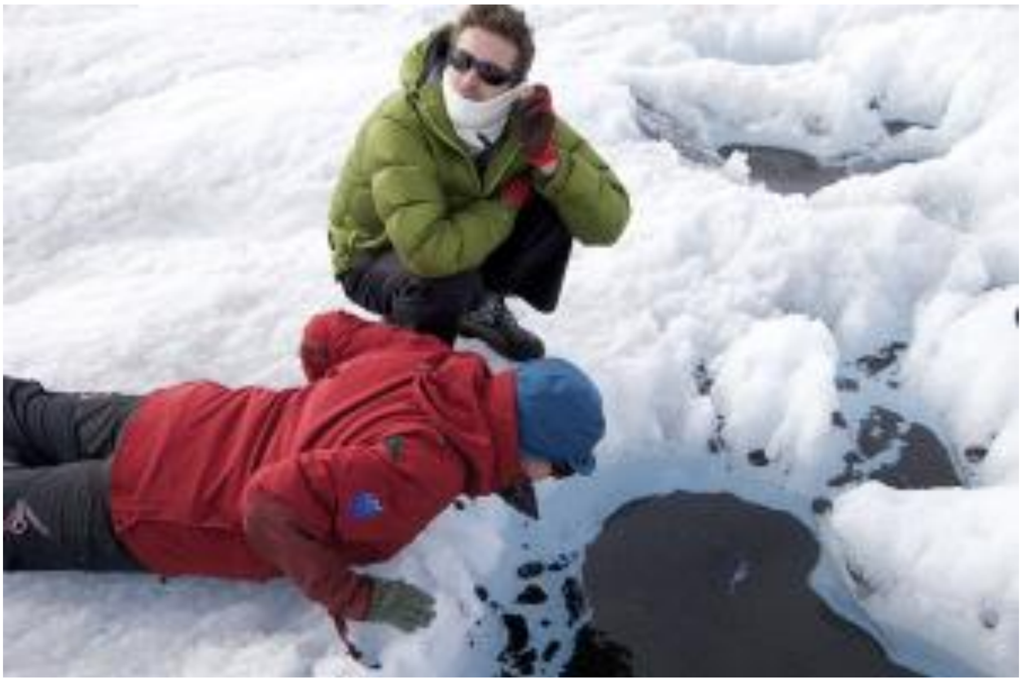
Dr Arwyn Edwards (left) and I removing the first of three ice cores that struck subsurface liquid water (ph. Sara Penrhyn-Jones)

Although we were blessed with stable, sunny conditions for most of the field season, one dramatic change in the weather reminded us how remote the site was and how uncomfortable field work can be. Drying clothes and equipment and staying warm can be challenging on a cold, continuously melting ice sheet…



The camp looking bleak as the weather suddenly changed for the worse…

Finally, Dr.s Edwards and Irvine-Fynn and I extracted from Camp Dark Snow and spent the remainder of our season working on the marginal zone, examining similarities and contrasts in cryoconite characteristics and hydrological processes between the edge and the interior of the ice sheet.



Dr Arwyn Edwards (front) and I examining large cryoconite pools near the margin on the Greenland ice sheet (ph. Sara Penrhyn-Jones)

Now it is time to begin collating and processing the stack of data gathered in the field, and planning for the next visit – like any great field season, we have returned with many more questions and unexplained observations than we left with!