



THE BRITISH STAUNING ALPS EXPEDITION GREENLAND 2017

EXPEDITION DATES 4TH APRIL – 5TH MAY

The expedition ventured into unexplored areas of the remote Stauning Alps region in Central-Eastern Greenland. The team were self-sufficient throughout, carrying all kit, food, shelter, scientific instrumentation and travelling on skis, pulling pulks. A huge physical challenge. Objectives were threefold: explore, research and inspire.



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THE MELT STREAMS ON THE BJORNBO GLACIER

INTRODUCTION

INTRODUCTION

This report gives an account of our expedition and details various other aspects including the planning, logistics, finance, equipment and food. It is hoped the report will be of use as a source of information for people planning similar expeditions or visits to the same area, as well as a document where those interested can discover more about our expedition.

BACKGROUND

The idea of a big expedition first came about while on a climbing trip in Croatia over the New Year of 2015/16. Having been on lots of climbing and mountaineering trips over the years in many different continents, they all had one thing in common – a guidebook! It was about time we left the books behind and made a legacy of our own. There are still places on our planet where humans have yet to set foot and new exciting adventures are at our fingertips, if we're willing to seek them out. More than willing to accept the challenge, our brains were set to work.

Looking through previous expedition reports and back at the famous explorers of years past, provided great inspiration. We noted that the well-known polar expeditions led by famous explorers such as Shackleton, Franklin, Nansen and Scott all had strong scientific elements. Some of their measurements provide a historic baseline to current datasets, and instruments which they developed, such as Nansen bottles, were still in use until very recently. Horace-Bénédict de Saussure, often credited as the founder of alpine climbing, was both a famous physicist and geologist, often spending days camping on the cols and summits which he reached to collect scientific data. Mountaineering and science have a long history together. Most of the historic datasets from the polar regions were collected on exploratory expeditions whose missions were to explore, map, and collect data from remote and unexplored regions of the planet.

We wanted to carry out our expedition in the same spirit, driven by the desire to explore, research and inspire. There are numerous mountaineering expeditions to the polar regions each year which visit areas that are lacking basic and simple glaciological measurements. Meanwhile scientific research requires major grants and therefore focuses on expensive and complex datasets, leaving a gap for simple but vital measurements. Our expedition was planned in the spirit of those carried out in the past and presents an interesting narrative on the links between science and mountaineering – one which we hope to rekindle.

ORIGINAL OBJECTIVES

At the outset, the aim of the British Stauning Alps 2017 Expedition was to complete a self-supported expedition to an extremely remote part of Arctic Greenland with the following 3 objectives:

- Explore - to venture into unexplored areas and claim several first ascents on new peaks
- Research - to repeat measurements taken during the 1970s and to install a network of ablation stakes in the Roslin Glacier to observe the impacts of climate change
- Inspire – to show that the difficulties of disability can be overcome, and that in spite of the additional challenges, adventures are still possible

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TEAM MEMBERS

We were a team of 5 passionate mountaineers with many years of experience and friendship behind us. All competent climbers and skiers, but this was our first big Arctic expedition. Most of us had met while studying at Bath University and have since gone on to do various jobs ranging from science and engineering to research and the outdoors. Here's a bit more about us...

Molly Thompson – Expedition Leader



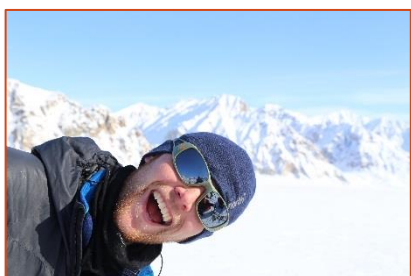
Molly is an experienced mountaineer, with 15+ years experience of climbing throughout Europe. She has worked as an instructor at Outward Bound Hong Kong and has lead trekking, climbing and sea kayaking activities in China, with first ascents at Waterfall Rock, HK. Molly has explored South East Asia extensively and also spent time trekking in Western China and Tibet. She's experienced leading climbs throughout the UK at grades around E1, sport routes up to 7a and in winter climbing Scottish grade III and WI4. In addition, she is a competent skier and Alpinist with several trips to the Alps, Norway and New Zealand under her belt.

Jesse Dufton



Jesse is an experienced mountaineer and skier. He has almost 20 years of climbing experience leading up to E1, sport 6b, WI4 and Scottish grade III. He has been skiing for 15 years with numerous trips to the Alps, across all disciplines: downhill, touring and cross country. He has spent a couple of summer trips in Chamonix Alpine climbing and several winter trips ice climbing. He has accomplished all this despite being registered as blind/severely sight impaired due to a genetic eye condition which has affected him since birth.

Alistair Everett



Alistair is currently completing a PhD in Glaciology. Having spent his university days climbing and exploring mountains. He continued his studies by bringing his passion for the mountains into his work with hopes to protect them for the future. He has climbed Scottish winter grade III, lead rock climbs of VS and spent time climbing Alpine routes around Chamonix. His research has taken him to Svalbard and the Arctic as well as to conferences meeting the leading minds in his field. He was overseeing the scientific part of the trip.

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Jennifer Roberts



Jen is a qualified Mountain Leader based in Scotland with a passion for travel and conservation. She has explored several continents, trekking and expeditioning in India, Egypt, Vietnam, Chile, Borneo and, of course, Scotland. Her climbing experience, both on rock and ice, ranges from the UK, Norway, France, Italy, Croatia and Chile. Jen is a competent skier with many trips to the French Alps, Italian Dolomites and Spanish Pyrenees under her belt. Jen loves to go off the beaten track and was keen to visit the vanishing glaciers of Greenland, to explore new routes, and have real adventures in this fragile landscape with inspirational team mates.

Oliver Mentz



Oliver is a qualified mountain instructor with over a decade's experience climbing in summer and winter throughout the world. He has put up new routes in Morocco and Chile as well as regularly climbing throughout the UK. As a passionate climber, he has lead British Traditional E4, Scottish grade V, and sport climbs at 7a. He holds the Mountain Instructor Award and Winter Mountain Leader qualifications. He is also a keen skier having spent several weeks ski touring in the Alps. Oliver sees this trip as a great opportunity to use his skills with other able individuals to explore and study an amazing part of the globe.

Another very important member of the team was Simon Hall. Everyone needs a mate like Simon! He was our UK based contact while out in Greenland.

Simon Hall



Simon currently holds the award for being the most reliable and committed person we know. While we were in Greenland he acted as our UK emergency contact. Throughout his time on the team his Twitter skills improved greatly, his weather reporting was second to none and he holds a 100% record of answering our calls. No matter where he was (Scotland, the Lakes, at home, at work, at the checkout in Aldi, on the toilet...) he had his phone, pen and paper to hand to scribble down our coordinates. We can't recommend him enough. Great work Simon!

"Choose your companions carefully - you may have to eat them."

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ACKNOWLEDGEMENTS

We sincerely thank all our supporters, everyone involved with this expedition, along with all those who helped us in the planning stages and while out in the field. Without you all, our expedition would not have been possible. In particular, our thanks go to the following:

OUR SUPPORTERS

Scientific Exploration Society <i>Molly is The SES Sir Charles Blois Explorer Award 2017 winner</i>	 THE SCIENTIFIC EXPLORATION SOCIETY		The Arctic Club <i>Arctic Club Award Winners 2017</i>
Scott Polar Research Institute <i>Gino Watkins Memorial Fund</i>	 Scott Polar Research Institute <small>University of Cambridge</small>		The Douglas Bader Foundation <i>Supporting Jesse to achieve his goals in the "can do" spirit</i>
Mount Everest Foundation	 MOUNT EVEREST FOUNDATION		IMechE <i>Molly won a Special Purpose Award towards her expedition leadership.</i>
Transglobe Expedition Trust (TET)	 TRANSGLOBE EXPEDITION TRUST	The Jeremy Willson Charitable Trust 	The Jeremy Willson Charitable Trust
Horizon Lectures		 Scottish Arctic Club	The Scottish Arctic Club



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The DigitalGlobe Foundation			Wicked World Tours
Scottish Mountaineering Trust			British Mountaineering Council and The Julie Tullis Memorial Award
The Alpine Ski Club			The Richard Overall Trust
Austrian Alpine Club (UK)			The John Muir Trust – Bill Wallace Grant
Satmap Systems Ltd			Be-Well Expedition Foods
Baker Hostetler			DMM

Also, a special mention and thanks to all the following individuals:

M Morgan	Helen, Tim, Bryn	Mike Hawkins	Elizabeth Knight	Michael Everett
K Pownall	George Thompson	Simon Danby	Simon Hall	Heather Driscoll
Miao He	Max Armstrong-Brown	Jon Rogerson	Tangent Expeditions	Mark Krietzman
Shahad Al-Janabi	Jamie O'Hare	Philippa Russell	Adam Drummond	Andrew Blake

...and all our Parents!



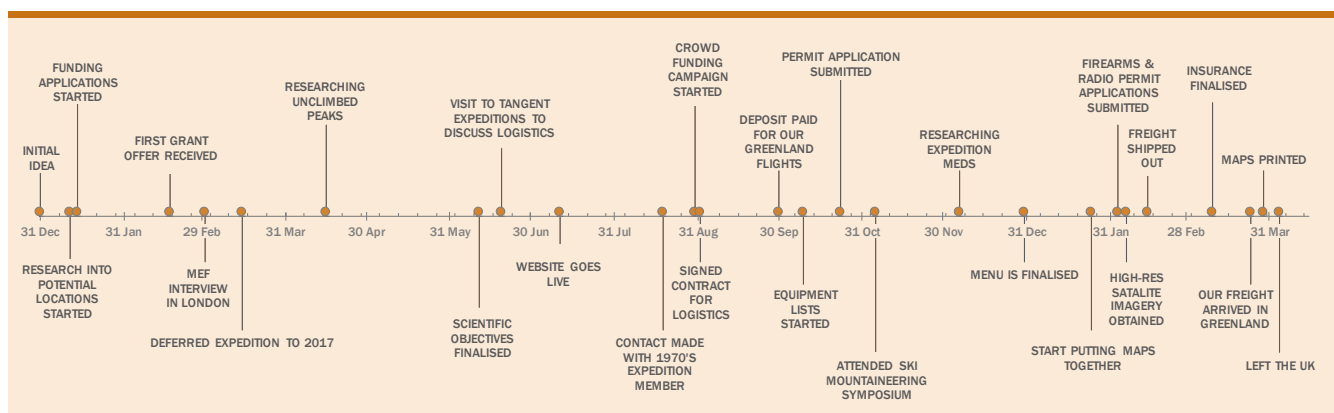
PLANNING & LOGISTICS

PLANNING & LOGISTICS

A trip to one of the most remote areas on the planet requires a lot of planning! All in all, from devising the idea to jumping on the plane was about 15 months.

We'd settled on a ski touring exploratory and scientific trip to Greenland pretty early on, but devising the details took time. Many evenings were spent reading scientific papers and discussing ideas with glacial research groups. Weekends were spent trawling maps and previous expedition reports to determine potential new routes and virgin peaks. We somehow managed to marry all our objectives into one location – the central-eastern Stauning Alps.

With our location set, it was then time to turn our attention to when would be the best time to go and how we were going to get there. The timeline below shows the key milestones in our expedition planning. We had initially hoped to get out there in April 2016, but it soon became apparent that 3 months was not long enough to plan an expedition of this nature!



Expedition Planning Timeline

The next few subsections provide more detail of what was involved in putting together an expedition like this and will hopefully provide some useful information for those wishing to do something similar.

AREA AND LOCATION DETAILS

Greenland is one of the world's great remaining wildernesses, permanently covered by ice up to 3000m deep in the interior, the coastline is punctuated by jagged peaks rising from complex systems of valley glaciers and ice caps. The Arctic environment is unforgiving, even around the coastline average winter temperatures are below -20°C. Permanent settlements, particularly on the east coast, are few and far between. Much of this remote wilderness is home only to polar bears, musk oxen, arctic foxes, hares and few other creatures which can survive the harsh climate. Greenland has attracted the attention of explorers, mountaineers and scientists for centuries. The remote peaks and harsh environment present a challenge to even the most experienced mountaineer. Meanwhile, scientists are working hard to understand the behaviour of the relentlessly flowing ice and how it may respond to changes in global climate.

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The Stauning Alps are located on the eastern coast of Greenland at a latitude of around 71.5°N. The region is bounded by Scoresby Sund to the south and Kong Oscar Fjord to the north. The area is characterised by a mixture of rocky and snowy summits emerging from the valley glaciers and ice fields which cover the area. The glaciers covering the Stauning Alps are independent of the main Greenland ice sheet and mainly consist of a complex system of valley glaciers with some small ice fields in the upper reaches. The peaks in the Stauning Alps are generally between 1000 and 2500 metres, with the highest peaks found in the central areas of the range. Peaks towards the outside of the region rise from a little above sea level, while those in the central parts of the range can be accessed from glaciers and cols at elevations of around 1500 metres. The region is bounded to the east by Schuchert Dal, a wide and relatively flat glacial valley, providing access to the glaciers draining to the east side of the range.

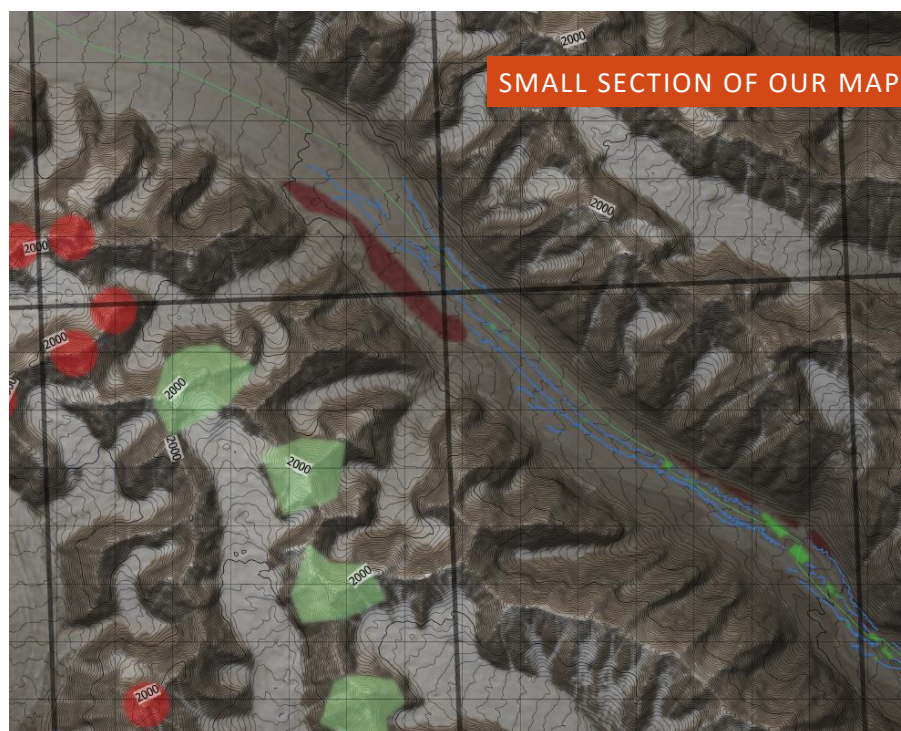


The area is very remote; the closest permanent settlement is Ittoqqoormiit, around 200km to the south east. Access to the region is either from Constable Point airport, close to Ittoqqoormiit village, or via an airstrip at an old mining settlement at Mestersvig to the north. The remaining part of the journey must then be made by snow mobile over one or two days depending upon snow conditions (or by private chartered helicopter if you've got money to burn!). The first maps of the area were produced in the 1920s and 30s and the majority of expeditions to the region have taken place since then. A number of scientific expeditions visited the area in the 1970s, but aside from this, expeditions to the region have primarily focussed on exploration and mountaineering.

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MAPS

As the Stauning Alps is visited infrequently, there are few maps of the area. The only printed map available is produced by Saga maps (22. Kangertertivarmit - Kangerivat / Nordvestr Fjord - Stauning Alper) at a scale of 1:250,000. Other maps, including a pdf and interactive version, can be found on the Geological Survey of Denmark (GEUS) website (<http://data.geus.dk/stednavnedb/>). This also includes a list of recognised peak names and first ascents. As we found out, other maps and basemaps which cover the area are often hopelessly inaccurate. The basemap provided on our GPS devices had no contours and colour coded the region in either green or white, but even with this we often found that when we were stood on glaciers the basemap was green and vice versa! Because of this we decided to produce some of our own maps, this allowed us to identify features important to us and create a bespoke map without any inaccurate or distracting features which would just be covered in snow. The maps were produced in Quantum GIS, an open source GIS package. Elevation data came from a 30m resolution digital elevation model of the region. Map shading was generated by overlaying a summer satellite image which highlighted glaciers and land. Features such as surface streams and crevasses are critical to finding a route across the glaciers, and it can be very hard to identify the best and safest routes on the ground. The ends of some of the glaciers are also surrounded by complex and intricate moraines which can be difficult and tiresome to navigate with pulks.



We were lucky enough to secure a grant from the Digital Globe Foundation which gave us access to 0.5m resolution imagery of the area (964 GB in total!). From these images, we digitised the position of large surface streams, areas of crevasses, moraines and complex terrain to avoid and also marked routes which appeared safe on the more complex areas. Having our own elevation data also allowed us to produce slope angle and avalanche runout maps. These are incredibly useful for identifying the easiest routes to summits and avoiding avalanche

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prone terrain as far as possible, as well as stopping you pitching your tent in an avalanche run out zone. [Satmap Systems Ltd](#) were very helpful in uploading these maps onto the GPS devices they provided to us so that we could take digital as well as printed versions.

Please get in touch if you would like to use these maps.

TIMINGS

We had decided upon the location for our expedition which was determined by our scientific and mountaineering objectives. The timing of our trip was thus constrained; there are two windows of opportunity for accessing the Stauning Alps. It is possible either in early spring when the sea ice is still firm and the travel from Constable Point could be made by snow mobile. Alternatively, once the sea ice has melted it is possible to approach by boat in the summer months. We had decided to undertake our expedition on skis and this limited our choice to early spring. In summer when the sea ice has melted, there is insufficient snow on the lower reaches of the glacier to warrant skis and to enable the use of pulks.

Our requirements included; snow covered ground, long daylight hours, good alpine climbing conditions and for the sea ice still to be frozen.

To date, the sea ice begins to break up in mid-May, although this timing may well alter in the future due to the effects of climate change. This set the end date for our expedition as the first week in May. The start date is simply calculated from this based upon the time we could devote to the trip. It would have been possible to shift the trip earlier into the year but this would come at the obvious cost of having a larger proportion of very cold and inhospitable conditions during the trip. Due to several team members having full time jobs and a limited amount of leave, we decided on a month-long expedition, using all the 25 days of leave in one hit! This would hopefully allow us time to achieve all our objectives.

We settled on the first week in April to the first week in May and a few days either side for travelling to and from.

TRAVEL ARRANGEMENTS

Having decided where and when to go, it was then the small matter of working out how we were going to get there. All our web-based research pointed us in the direction of Paul Walker from Tangent Expeditions, he seems to be the Guru for everything Greenland. We went to meet him up in Northumberland to discuss our plans and this proved invaluable. Reaching the Stauning Alps is no mean feat, but Paul seemed confident that he'd be able to get us and our kit out to the Roslin Glacier in April on snowmobiles – fantastic! He had a fleet of snowmobiles based at Constable Point, which were used mainly for expedition logistics to the less remote Liverpool Land. So, the last leg of the journey was reasonably simple, we only had two options – snowmobile or helicopter. This was a relatively straight forward choice as the helicopter proved prohibitively expensive.

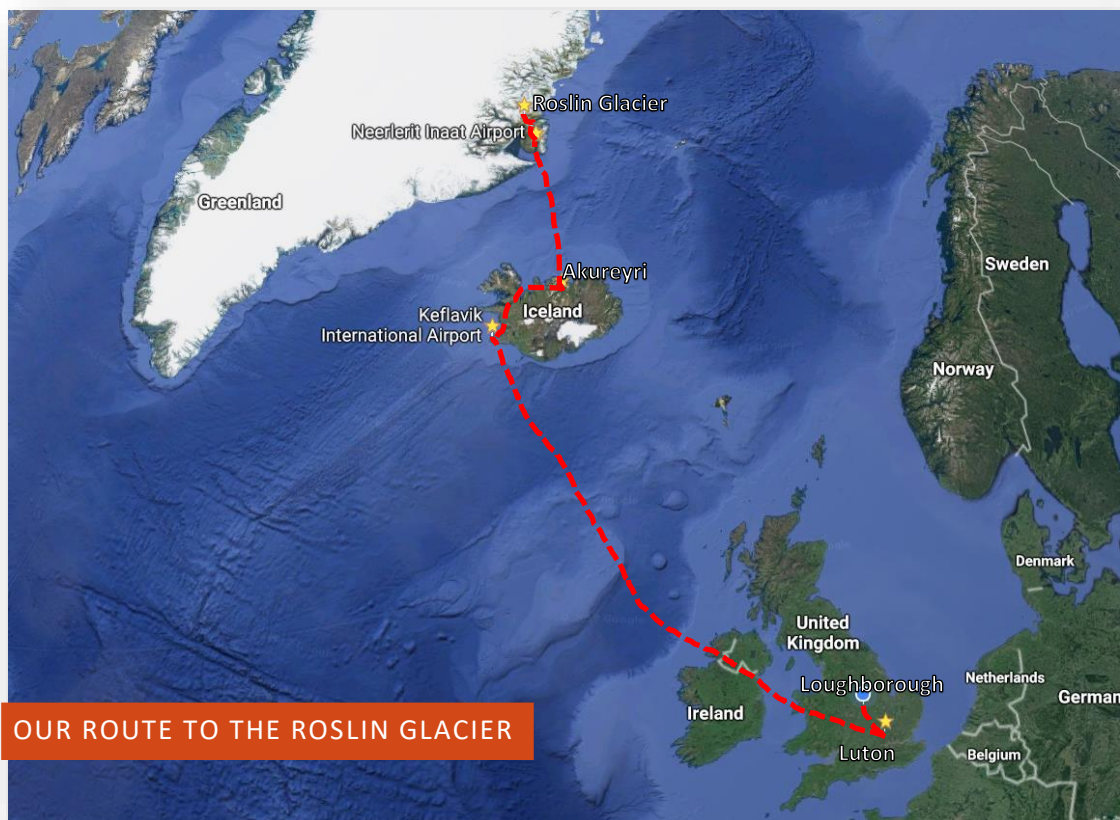
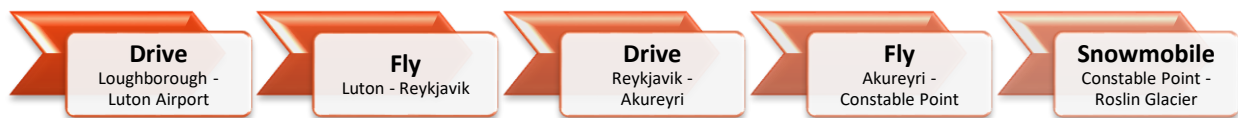
Constable Point was the home of Neerlerit Inaat Airport and this was serviced by chartered flights from Akureyri in Iceland. Paul assisted with booking this leg of the journey too – there were weekly flights on Thursdays. It was then down to us to get ourselves to Akureyri on the north coast of Iceland. Different options were available with connecting flights, but we went with the cheapest option of an Easyjet flight from Luton to Keflavik (Reykjavik)

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and then a hire car. The drive from Reykjavik to Akureyri was pretty straight forward – they were connected via the coast road which circumnavigates Iceland, a nice scenic route!

We gave ourselves additional days either side of our flights to/from Greenland to allow for weather delays etc. We were delayed 1 day on the way out, but other than that everything ran smoothly and no additional costs were incurred on rearranging flights.

Our travel arrangements consisted of the following:



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FUNDRAISING

The remoteness of our chosen location meant very bespoke travel requirements, which in turn meant it would be very expensive to get to. It soon became apparent that the costs involved would be prohibitively expensive based upon our team's financial resources. After much discussion, we felt we were able to save up and personally put in £3,000 each towards the trip which was somewhat short of our estimated total costs of £35,000.

Until we started searching on the internet for fundraising ideas for arctic expeditions, we had no idea that there were so many grant giving bodies, trusts and clubs out there for this kind of thing! There are grants available for a wide variety of adventurous travel, climbing firsts, leadership, remote research, and inspirational feats etc. The fact that our proposed expedition ticked many of these boxes meant a large pool of potential supporters. A lot of time and effort was put in by all members of the team, filling in application forms, going to interviews, making videos and phone calls. Being so passionate about our proposed expedition and so determined to get out there, this didn't feel like a chore.

Early on in our fundraising, we met Kenton Cool at an interview for the Mount Everest Foundation and discussing our proposals with him was quite surreal. Kenton is one of the world's leading high-altitude climbers and an avid adventurer; he has successfully climbed Mount Everest twelve times! His goal is to inspire the next generation – he certainly did that! He gave us some great advice – 'speak to everyone and don't give up.'

In the region of 50 applications were submitted to a wide range of potential supporters, kit sponsors and expedition food suppliers and we were amazed by the response we got.

One of the first awards we received was from the Arctic Club, whose members had a special interest in our expedition as they were part of the Stauning Alps expeditions in the 1970's. We are hugely grateful for the specific information and photographs from their trips and for their support throughout.

It was fantastic the amount of backing Jesse received for participating in such an adventurous and physically challenging expedition. Being registered as blind/severely sight impaired, many with his disability or in fact any other disability may think such a feat would not be possible. His story, his 'can do' attitude, bravery and determination to participate on an equal footing will surely inspire other people with disabilities to go on and achieve amazing things.

We also set up a crowd funding campaign. However, this was not as successful as we hoped it might be. Critically the interest generated by social media seemed to occur after our initial crowd funding campaign had closed. We did search for crowd funding sites that had an open-ended campaign but none were available at the time. In part our hand was forced by the need to pay an initial deposit to secure the expedition's logistics quite early on.

In the early stages of our fundraising we managed to raise approximately £8,000. This was enough to pay the initial deposit for our logistics. At this point we had to commit and hope that we would be able to raise the remaining funds needed to cover the total cost of the expedition. We were reasonably confident that we would be able to reach our fundraising target, so proceeded at our own risk.

As you can see by our financial statements, we ended up paying £3,217.32 each.

We'd like to reiterate that we are hugely grateful to all our supporters for making the expedition possible.

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PERMITS

We required several permits for our expedition which are all listed below. Tangent Expeditions helped with obtaining these.

- **Travel in remote areas of Greenland Permit**

The Government of Greenland, more specifically the Ministry of Nature, Environment and Justice looks after the administration of the Executive Order on Access to and Conditions for Travelling in Certain Parts of Greenland. A permit is required for all expeditions to the area covered by the Executive Order, of which the Central Eastern Stauning Alps is a part. There is an online application process which includes information relating to the area, objectives, dates, means of access to/from base camp, expedition leader, local emergency in country contact, emergency equipment carried, communications equipment, experience of the group, individual names and contact details. It's pretty straight forward – we had no problems obtaining this permit.



- **Radio license Permit**

TELE Greenland Inc. operates the public telecommunication services in Greenland on behalf of the Greenland Home Rule. Telecommunication to, from and within Greenland is based on fixed-satellite links, microwave links and a few single-channel radio-telephone connections. The Radio License permit allows the use of certain specific items of electronic and communications equipment during the expedition, including satellite telephone, personal locator beacon (PLB) and VHF air band radio. The VHF radio is for ground to air communication with Twin Otter aircraft, helicopter transportation, and emergency search and rescue operations. The PLB is a specialist locator device that transmits our position anywhere in the world. This is done via a network of satellites using the 406mhz frequency and is activated only in a serious emergency and/or life threatening situation. The PLB also transmits an accurate GPS position simultaneously. We had no problems obtaining this permit and carried these three communication devices on our expedition.

- **Firearm Permit**

All expeditions are required to carry a rifle in Greenland, as a last line of defence against Polar Bears. We hired a high-quality Tikka large calibre 30.06 rifle from Tangent, who also assisted with arranging the permit for us. Basic training was provided.

- **Insurance Statement**

It is a requirement from the Greenland authorities to get an Insurance Statement form signed by your insurance company before they issue you a Permit. Your name will not be included on the permit until this form has been signed and received by them. The statement refers to the requirement for a minimum level of cover of 1,000,000 Danish crowns (approximately £120,000) as well as imposing special terms on your underwriters. We spent a lot of time enquiring into many different insurance companies but found only one company that would sign the Insurance Statement - the British Mountaineering Council (BMC) and P J Hayman Ltd no longer insure expeditions to Greenland. Only IF Skadesforsikring would sign and therefore they provided our insurance.

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INSURANCE

As alluded to above, this was the biggest headache we encountered during our planning stage. We initially contacted the BMC. We filled out the form for the High Altitude and Remote cover option which included very detailed information on the team, the location and our intended activities and we were told that 'cover for mountaineering below 6,500 metres (including trips in Greenland) is included in the BMC 'Alpine & Ski' policy'. We queried this as there was no wording within the Alpine & Ski policy that suggested expeditions to Greenland were covered. The response we received was – 'No, the Greenland wording is not included within the policy document. You are welcome to keep this email thread if you need to show it to a trip organiser'. We thought we were onto a winner with this as it was much cheaper than the amount we had budgeted. The Insurance Statement was then sent through for signature, which is a requirement from the Greenland Authorities for all expeditions to Greenland. The response to this was where it all started to unfold: 'Many thanks for your interest in our insurance policies but on this occasion the BMC cannot insure this expedition to Greenland. The reason for this is the underwriters cannot agree to signing the document you sent to us. We realise this means you are unable to use BMC insurance for this trip but we wish you a safe and enjoyable trip.'

We were back and forth with the BMC for several weeks. They had been in contact with 3 different underwriters, none of which would sign the Insurance Statement. The crux of the matter seemed to be that the underwriters were uncomfortable with the level of maximum pay-out specified in the insurance statement. At current exchange rates, the search and rescue fee was approx. £120k and this was above the level they were happy to insure. Their limit was £100k and they regard this as extremely high already, and that asking them to increase this to £120k was a non-starter.

Tangent Expeditions have their own bespoke cover which covers all their Companies Professional Liability Insurance etc. but they are very expensive. This was an option for us, but we wanted to exhaust all other possibilities first. We spent a lot of time enquiring with many different insurance companies to see whether they would sign the Insurance Statement, but with no luck. This was hugely frustrating! It was the insurance statement that was the real sticking point. So we had no other choice than to go with Tangents bespoke cover (it was that or a Danish company that was more than double the cost!). The premium was £4,250 (£850 per person). The policy was arranged by McGregor Insurance Services Ltd and underwritten by Lloyd's by Vibe Syndicate Management Limited. Tangent advised that the current policy was valid until 20/3/17 when it was to be renewed again by them (on an annual basis) and any changes in documentation would then be sent to us in early April, just prior to your departure.

During this renewal process and only 3 weeks before we were due to fly out, the underwriters decided that they were no longer going to insure expeditions that require the signing of the Insurance Statement. This was the same situation as happened previously with the BMC. Not the news we wanted! This meant we needed to arrange our insurance with the only other company in the world offering this policy; a company called IF, based in Greenland. The new policy was more expensive at £1,065 per person as opposed to the cheaper £850 policy we'd previously been offered from McGregor. Thankfully this didn't affect our expedition permit and all was in place in time for our arrival.

WHITE OUT



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RISKS

A risk assessment compiled to fully evaluate the risks involved in our expedition was completed. This assisted us in preparing fully for the expedition not only by minimising the risks but also by making sure we could cope as and when certain hazards arose. We put control measures in place where possible to avoid such instances. The key risks included:

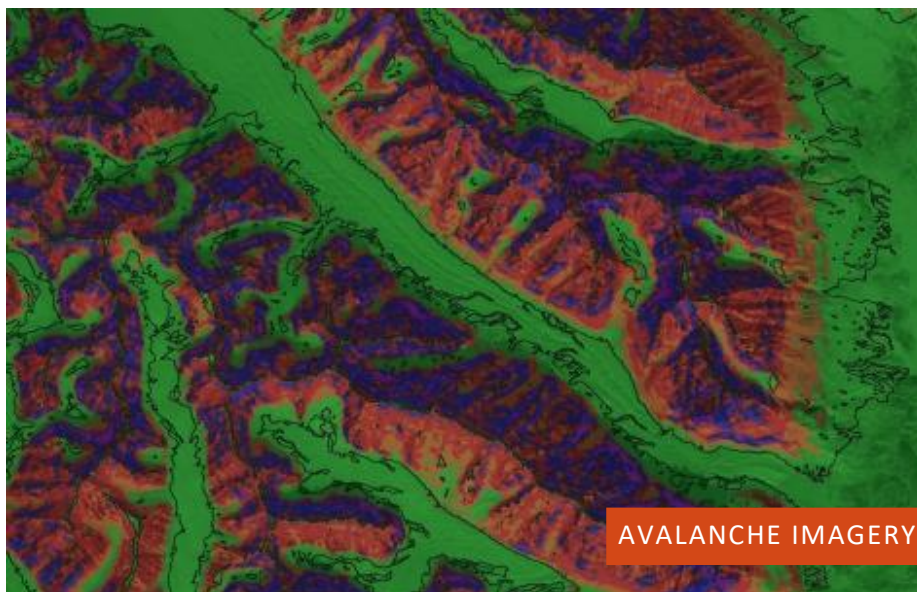
- **Avalanches**

Temperature variations, snowfall, wind speed and direction all affect the stability and strength of the snowpack. Critical to staying safe was good decision making – being aware of the dangers, heeding the warnings and recognising the indications that the mountains provide.

The statistics show that 90% of avalanche victims had triggered the avalanche in which they themselves were caught! We all carried avalanche safety equipment (transceiver, probe and shovel) and were well drilled with efficient transceiver searching, effective probing and strategic shovelling. Loose snow avalanches, slab avalanches, powder snow avalanches and wet snow avalanches were all potential dangers to us in the Stauning Alps region.

Together with the Danish mapping agency, [Satmap Systems Ltd](#) and our own expertise we collated satellite imagery, gpx files, digital elevation models and armed ourselves with as much data and knowledge as possible to plan a safe expedition. Satmap kindly offered to loan us some of their GPS units loaded with all this information!

Factors we took into account included slope aspect, altitude, slope angles and our avalanche maps looked like the image below. The different colours show the different slope angles and the black lines are an estimate of avalanche runout zones. This was massively helpful for us locating safe base camps, identifying safe routes and also areas to avoid.



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- **Crevasses**

We used high-resolution WorldView summer satellite imagery to identify areas of crevasses on the surface of the glacier. This allowed us to mark areas which might be dangerous to cross, and areas where crevasses might be hidden by the snow covering the glacier in spring. While skiing on the glaciers we were able to take routes which avoided these areas and we saw little if any evidence of crevasses on our chosen route. In some areas, particularly on the small tributary glacier which we used to access the first col, the steeper slope and undulating topography meant that there were some large crevasses visible, but these were easy to avoid. Ultimately crevasses turned out to be only a small concern and we rarely felt it necessary to rope up.

- **Climbing incidents**

Climbing new peaks was one of our objectives of the expedition which incurred the risk of injury through rockfall or climbing falls. The risk couldn't completely be eliminated; however, it was mitigated by the fact that all of our party were experienced mountaineers. Experience and skill makes climbing falls less likely as well as giving the situational awareness to minimise the team's exposure to rock fall and other climbing related incidents.

- **Polar Bears**

The very aptly timed April fool a week before we flew out didn't fool us or our parents (!)...polar bears were still a risk to us and full precautions were needed in case we came across one.

The Government of Greenland prioritises the safety of both humans and bears, and the Department of Fishing, Hunting, and Agriculture has released Guidelines for Polar Bear Encounters which give its' official recommendations for how to act and what to do.

Our polar bear defences consisted of the following:

- 1 x pepper spray – (for those close encounters!)
- 1 x rifle & 20 rounds ammunition – (for last resort)
- 1 x bear warning camp perimeter fence – (made up of broom handles, cord and a rape alarm)
- Selection of flares – including flare guns and hand flares



- **Fire in the tent**

We were starting off with 35 litres of fuel (Heptane) in 5 litre containers. This was a large amount of flammable liquid which presented a huge risk if not managed carefully. The fuel was needed only for our cooking stoves – to melt snow and to cook food. We decided to have a separate cooking tent from our sleeping tents to avoid the risk of losing our sleeping stuff, excessive condensation and carbon monoxide poisoning. Decanting fuel would be done outside, away from the tents and from any sources of fire. A designated stove area at the end of the tunnel tent was used to limit the chances of the stoves being knocked over accidentally and meant we also had a clear exit route. We made wooden stove boards which provided a level surface for the stoves to sit on and caught any spills. All users of the stoves were fully conversant with the intricacies of getting the stoves lit etc.

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- **Evacuation**

Being somewhere so remote in a harsh environment, with difficult access and no phone signal required some thought upfront. If something were to go wrong, how would we initiate a rescue and evacuation etc. In terms of communication while we were out in the field, the following devices were taken:

1 x 406mhz emergency Personal Locator Beacon
1 x VHF marine band radio

1 x VHF air band radio
1 x Satellite phone

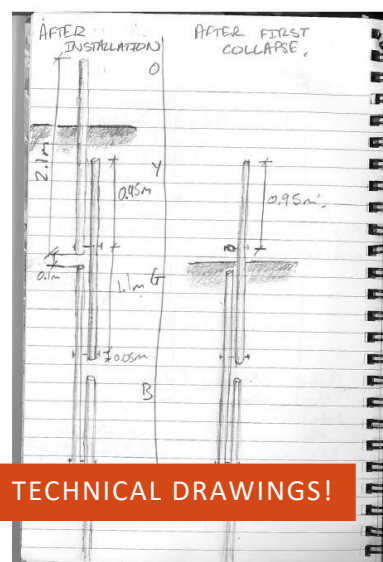
Our emergency procedures and evacuation plan was written, read and understood by all team members and a laminated copy was packed for reference. We had a designated UK Contact (not a family member of anyone) who was our last resort to coordinate an evacuation if all other avenues failed. Our evacuation Plan is appended at the end of this document for reference.

SCIENTIFIC RESEARCH

The scientific motivation turned out to be fairly influential in planning our route. We had settled on East Greenland, specifically flying in to Constable Point, pretty early on, but there were still plenty of locations which could be accessed from there, at varying levels of time/cost/scientific merit. Once we'd started looking into the scientific research in the area, several things became apparent pretty quickly, one of the primary ones being that up until now there hadn't been much! The main ice sheet attracts a lot of scientific attention for obvious reasons; however, access to the ice sheet from Constable Point immediately requires an additional privately chartered flight either by plane or helicopter to get there. Add to this the amount of work already done there with major grants and that there aren't many peaks on the ice sheet, we decided this wasn't a good target for us.

There were a number of recent studies which looked at the peripheral glaciers and ice caps around the Greenland ice sheet which stood out to us. These studies showed that these glaciers were making a significant contribution to sea level rise, but also that the amount of ground based data was really quite limited. We also discovered that during the 1970s a number of expeditions had visited Roslin Glacier in the Stauning Alps, but since then, very little work had been done in the region other than around 100km to the north in 2008.

Following this research, we made contact with Tobias Bolch and Horst Machguth at the World Glacier Monitoring Service in Zurich, two authors of the most recent studies in the area. They had a lot of useful advice for data which we could collect in the area; however, we had to come to a compromise between the value of the data we could collect and the size and weight of equipment which would be required. One of the first suggestions was to drill a firn core which would have required us taking around 60kg of drilling equipment! Ablation stakes were our second option; since similar measurements had been collected in the 1970s the value of these measurements was significantly increased. Ablation measurements really become useful if a record has been collected over a long time period, so having a baseline from the 1970s with which we could compare made this look like an appealing option.



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There were some downsides to this method – particularly that ablation stakes are normally drilled into the glacier during summer when the surface of the ice is exposed. This meant that we would have to dig through the snow to access the glacier surface. However, we decided to use this to our advantage and collect temperature and density profiles of the snow in the pits we were digging, which would add extra value to the dataset. Ablation stakes also require repeat visits in future years to collect measurements, but we hope that the simplicity of measuring the stakes means that future mountaineering teams can easily do this. The choice to install ablation stakes and compare them to past measurements meant that our route had to go up or down the Roslin Glacier at some point, and so a major part of our route was chosen! As we would be losing weight each time we installed a stake, it also made sense to do this at the start of our journey.

Once we had settled on drilling ablation stakes, a number of specifics had to be arranged. After briefly considering a Heucke Steam drill to install the stakes, we decided that a Kovacs hand drill would be our best option. This had the advantage of not requiring any external power or fuel (Heucke drills require a heavy gas cylinder for the burner). Kovacs drills are relatively light, and Horst kindly offered to lend us their drill. As the drill was in Zurich we had to get it posted to the UK, and this turned out to be one of the trickiest parts of the scientific logistics! In future, we recommend leaving plenty of time to allow for this and making sure the correct customs forms are filled in when the drill is posted! The drill weight came to 12kg, with enough sections to drill 6m into the ice.

We also needed some ablation stakes, we didn't have a big budget for these, and we had some quite specific requirements including that they needed to be lightweight, collapsible, visible in shallow snow cover and, of course, cheap! We came up with a stake design which would allow them to be visible with up to 1m of snow on the surface of the glacier, this significantly extends the window of opportunity to remeasure the stakes in future. Initially we planned to use jointed bamboo stakes as they met most of our requirements, but we found that the dowel sections available from Homebase and B&Q were a similar weight to the bamboo and we decided they would be much easier to drill for joints than bamboo. After emptying all of the local DIY shops of 10mm dowel sections, a few evenings were spent drilling stakes. We also decided to paint the sections different colours, partly to protect the wood, but also so that when they were remeasured the colour could be noted. That way, the stake length would be known even if the upper sections had broken off after they had collapsed onto the snow. We took 44 x 2.1 m sections, enough for 11 x 8m stakes when they were put together. In total the stakes and cable ties to join them weighed 5.7kg.



THE FINISHED PRODUCT

The remaining equipment required for the snow temperature and density profiles was kindly lent by a colleague from the Norwegian Polar Institute. This included a digital thermometer, snow density cutter, compact digital scales, folding ruler, scraper, brush, tape measure, notebooks and pencils. In total, this weighed just under 1kg.

PLANNING & LOGISTICS

FOOD, EQUIPMENT & MEDICAL SUPPLIES

For an expedition of this length and to an area so remote, a lot of thought was required into what equipment, food and medical supplies were needed. Tasks were assigned to each member of the team and together we came up with extensive lists and spreadsheets of what was required for our self-supported expedition. The itemised lists are included in the appendix.

- **FOOD**

The principal consideration when planning what food to take, is the calculation of calorific value per unit weight. As we would be carrying all our food we needed to maximise the amount of energy for the minimum amount of weight. There was a trade-off to be made between calorie density and the monotony of any potential menu. On expeditions where weight is truly at a premium, the variety of food which can be taken is compromised and the participants could find themselves eating large lumps of butter and drinking nothing but hot chocolate. In our menu planning, we sought to avoid this extreme scenario at the cost of our food being slightly heavier.

We targeted eating 4500 calories per person per day, while trying to keep the weight of what we took to 1kg of food per person per day. The body is unable to metabolise more than about 5000 calories per day for most people and so this set an effective ceiling for the amount of food to take.

We spent a large amount of time before the expedition planning our menu and packing as much of the food into individual portions as possible. This was an excellent investment of time. Making things as easy as possible when you are on expedition makes a big difference. Many trips to many supermarkets were made and many funny looks were received for our trolley loads of cup-a-soups, oat cakes and tubes of Primula cheese!



For breakfast, we ate mostly porridge. We had individual bags of oats pre-mixed with a few different combinations of additives e.g. dried fruit, nuts and desiccated coconut. For one third of our days we had taken cereal to have as a cold breakfast. We planned to have these cold breakfasts on summit days or when we needed to make a quick get away from camp in the morning. Unfortunately, the dried milk powder we had intended to have with our cereal was one of the only things on our expedition which we forgot and was left behind in the UK. Dried cereal and cereal bars sufficed.

Lunches had been prepacked into 2 portion ration bags (individual ration bags were ruled out due to the excessive amount of packing weight that this would have entailed). There were 3 different ration packs to provide variety. Each pack contained a selection of snacks to keep in our pockets and to have throughout the

PLANNING & LOGISTICS

day. It was too cold to have prolonged breaks and because people's blood sugars run low at different times we felt it was important to graze throughout the day. We included a good mix of sweet and savoury snacks. (See the appendix for a full list of what we took.) Oatcakes, tubes of Primula cheese and meat sticks were our equivalents for sandwiches and they provided the protein we required.

To keep hydrated we had a supply of cup-a-soups, hot chocolate, coffee and tea (normal and peppermint) which just required boiling water.

For dinner, the constrained weight meant that we had no option but to take dehydrated meals. These were rehydrated using boiling water produced by melting snow. We had 9 different evening meals all of which contained 1000 calories. In addition, we had dehydrated desserts which added another 500 calories. Having 9 different main meal options was excellent as eating them in a rotation meant that we didn't get bored with the food. We had only taken 2 different kinds of dessert and this became repetitive. In hindsight, it would have been better to take a wider variety of desserts even if this came at the cost of some calorie density.

As the trip went on we found that having salted peanuts in every pack became repetitive. We had included these due to their excellent calorie density and because they were cheap. In hindsight, we should have taken a variety of different types of nuts even though this would have made it more expensive. We also craved more protein such as meat. Sachets of tuna would have been an excellent addition but we couldn't find a source when purchasing our food.

Despite eating the 4500 calories a day most of us still lost weight during the trip, up to 6.5kg. There is no substitute for stocking up on cake and roast dinner before an expedition, you will need the energy.

- **EQUIPMENT**

A great deal of planning went into what equipment we would take, both on a personal and group level. We needed to balance the capability offered by taking a given piece of equipment with the extra weight we would need to carry. We planned out exactly what we would take along with every piece's weight in a spreadsheet (which is added as an appendix). The list includes camping stuff, cooking, skiing, climbing, clothing, science equipment, rescue, First Aid and repair kits.

We decided against taking spares of things and instead opted to take an extensive repairs kit. Needle and thread for repairing gloves. Jubilee clips were essential for pulk repairs!



In general, we were very happy with our gear selection. There were a few items which simply didn't stand up to the harsh environment, some of which were excusable such as the cheap inflatable pillows which became brittle in the cold and exploded on the first night. Other pieces such as the ratcheted adjustments on Jen's ski boots sheared off as they became too brittle. Given that this was their intended use we felt this was a poor design.

We would recommend devoting serious thought to what second footwear to take for when you are not skiing. To save your feet, we would recommend taking a second and comfy set of footwear for when you are setting up camp and in the evenings. A modular system with an insulated sock and a separable protective outer-boot is probably the best option. The outer-boot needs to come up to knee level and be sealable around the top to

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prevent snow from getting in. A thick, insulative sole which spreads your weight and is not slippery on snow is also desirable.

We took a total of 190m of rope (2x60m, 1x70m single ropes 11mm diameter). This was a limiting factor when crossing the cols with pulks as the slopes we needed to descend were considerably longer than 190m. Future expeditions which will need to cross cols with pulks could consider taking a dedicated long static rope for this purpose. Taking a drum of 500m of 6mm static cord would be very useful if its weight could be justified.

Taking the outer shell of a tunnel tent to use as a mess tent is an excellent idea. It gives your team somewhere out of the wind to cook which isn't your sleeping tent. This reduces the amount of moisture in your sleeping tent as there is no moisture from cooking. Having a communal area where the whole team can sit is a huge boost for morale. Dig a trench in the centre of the tent which creates two bench seats on either side, put a dedicated foam mat onto these to keep your bums warm.

We took a 60W Solar panel and a 30Wh external battery pack so we could charge camera and GPS batteries etc. This setup worked very well, the panel unfolded and was lashed on top of a pulk which charged the battery throughout the day. We never ran out of power.

- **FIRST AID AND MEDICAL SUPPLIES**

Being so remote also meant we had to consider what would happen if we had any medical issues. We were all first aid trained, so could deal with any basic issues which may arise, but our primary concern was something more serious than a burn from the stove, a simple break or a blister. Jen was tasked with arranging medical supplies for the trip. She used our logistics company's standard medical kit as the inspiration for our three kits: a large base camp kit and two smaller mountain kits.

Base Camp Medical Kit - The base camp medical kit remained at the camp and was more substantial than the mountain kits. As mentioned, this was based on the medical kit our logistics company took out into the field with their clients. We therefore knew it was relevant for the environment into which we were travelling. A small amount of prescription-only medication was provided by Nomad Travel for £118.75. This was stored safely in the base camp medical kit.

Mountain First Aid Kits - The mountain first aid kits were carried by separate team members when travelling away from our base camp, including completing the first ascents. Two kits were taken on the mountain in case the team needed to separate, so both had access to basic first aid items.

We were lucky no real medical issues arose, but we agreed it was good to have these items with us in case something did happen.

- **FREIGHT**

Due to the amount of food and equipment required for a month in Greenland and the lack of any shops there, we needed to send most of our kit ahead of time as freight. This meant that we had to be very organized with our packing and remember exactly what had been sent! It also meant that we would be without our gear for 6 weeks prior to the expedition, so additional thought was required into who could do without what for that period. Another added complication was that we had a training week in Tromsø planned for the beginning of March, this meant most of our skiing stuff needed to be retained in the UK. Calculations were done and we

PLANNING & LOGISTICS

ticked off the list what was for 'freight' and what was for 'plane'. Anything that needed to be packed for freight was sent to our expedition base in Loughborough where all the sorting and packing took place. Parcels were coming in thick and fast! We decided on using cardboard & plastic boxes rather than barrels for packing our things in. This saved weight and also cost and it meant the volume packed in our pulks would gradually decrease as boxes were emptied and flattened. The cardboard boxes were obtained from supermarkets and parcels we'd received in the post and the plastic boxes were borrowed from parents. The 3 plastic boxes we packed were really useful while on expedition; one had all our electricals in it, and the other 2 were used in the mess tent for all our cooking and eating implements, daily rations etc.

The total weight of all our outward freight was limited to 60kg per person (300kg total for 5 people). This included the weight of all food packaging materials and boxes etc. The total weight of our returning freight was limited to 30kg per person (150kg total) for 5 people, after all the food had been consumed.

Packing was done over several weeks – many rolls of parcel tape were used! In total, we had 21 boxes and after we'd finished packing we sent all the details (weight, dimensions etc.) for our shipment off, so I guess they knew at the port how many pallets were required.

Box Number	Box Type	Contents	Weight (kg)	Height (cm)	Width (cm)	Depth (cm)
Box 1	Plastic Box	Cooking equip, group spares/repairs	12.3	32	54	39
Box 2	Plastic Box	Clothing and bottles	7	32	54	39
Box 3	Plastic Box	Climbing equip & rope	17	32	54	39
Box 4	Cardboard Box	Camping Equip	15.2	49	61	38
Box 5	Cardboard Box	Sleeping Bags & clothes	16.3	48	78	51
Box 6	Cardboard Box	Rucksacks & clothes	13.6	33	62	48
Box 7	Cardboard Box	Camping Equip & First Aid	9.6	33	66	52
Box 8	Cardboard Box	Tent & Rope	9.7	20	67	33
Box 9	Cardboard Box	Food – dehydrated meals	27	35	49	51
Box 10	Cardboard Box	Food – dehydrated meals	26	35	49	51
Box 11	Cardboard Box	Food – ration B	14.7	28	48	35
Box 12	Cardboard Box	Food – ration B	18	28	46	35
Box 13	Cardboard Box	Food – ration C	18	28	52	34
Box 14	Cardboard Box	Food – ration A	12.4	34	34	34
Box 15	Cardboard Box	Food – ration A	19.5	45	39	32
Box 16	Cardboard Box	Food – breakfasts	10.5	27	42	29
Box 17	Cardboard Box	Food – breakfasts	15.4	23	60	41
Box 18	Cardboard Box	Food – ration C	12.6	20	57	44
Box 19	Cardboard Box	Food – goodies	5.9	38	32	22
Stakes	Cardboard tube	Wooden poles/stakes	6.6	217	15	15
Drill	Hold bag	Ice drill	12.7	123	22	22
		TOTAL WEIGHT	300			

PLANNING & LOGISTICS

Molly hired a van for the day and took all our freight to Eimskip UK in Immingham, Lincolnshire on 14th Feb. The boxes were loaded onto pallets, wrapped in plastic and left at the port to wend their way to Greenland.

The freight service included the following relating services and fees:

- Sea Freight of our food and equipment from Immingham, UK to Reykjavik cargo warehouse, Iceland
- Air freight & haulage charges for transfer of our food & equipment within Iceland
- Air freight charges for transfer of our food and equipment from Akureyri to Constable Point, Greenland
- Freight storage charges at Constable Point
- Air freight charges for transfer of our returning equipment from Constable Point, Greenland to Reykjavik
- Haulage charges for transfer of our returning equipment within Iceland
- Sea Freight of our returning equipment from cargo warehouse, Iceland to Immingham, UK
- Freight terminal handling, storage and transfer charges in UK, Iceland and Greenland
- All freight customs and export/import documentation charges
- Customs duty on food imported into Greenland
- Costs of Tangent staff checking and sorting our freight at Constable Point

The freight arrived at Constable Point a few weeks before we did and all the boxes had survived the journey well. All were present and correct.

On the way home, it was much more of a rushed job with packing. We only had an evening and a morning at Constable Point between arriving back from The Stauning Alps and flying out, but we had a lot less to pack! We only had 6 boxes and all our skis for freight on the way back. We weighed in on the airport scales and had our fingers crossed we were within our 150kg limit. Amazingly we were nearly bang on, 149kg! Our kit arrived back on UK shores on 11th June (5 weeks after we'd returned). Molly made the trip up to Immingham again to pick it all up, no van required this time (it all fitted into her Fiesta!). We were pleased with how the freight logistics worked – we had no hiccups, everything ran smoothly and none of the kit was broken in transit. We'd definitely recommend this service! Thanks to Tangent Expeditions for their help and their checking and sorting at Constable Point.



KING AIR, OUTBOUND TO GREENLAND

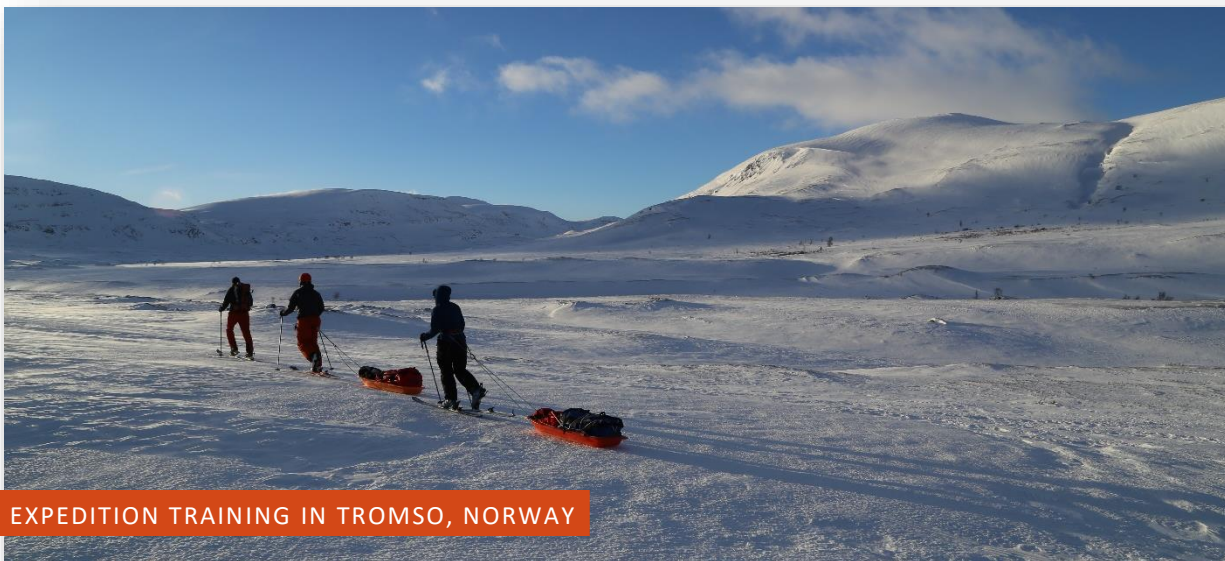
PLANNING & LOGISTICS

TRAINING

Training for our trip can be split between physical training and skills training.

All our expedition members were already experienced winter climbers/mountaineers having multiple Scottish winter, Norwegian ice climbing and summer alpine trips under our belts. Our ski touring experience was more modest. In recognition of this, Molly and Jesse attended the ski mountaineering symposium organised by the Eagle and Alpine Ski Clubs at Plas Y Brenin. This was an excellent way of picking up some pointers on how to make an expedition run more smoothly. For example, this is where we got the tips about having a separate mess tent and having neoprene pouches to keep the evening meals warm while they were rehydrating and allowing us to hold them without burning our hands. For any expedition members who are similarly inexperienced, when it comes to long term trips in harsh environments, we would encourage members to talk to previous expedition participants and collect tips about what made their expeditions run smoothly, or not as the case may be.

We also organised a week long training camp in northern Norway in order to check our ski set-ups and to gain some experience pulling pulks. This trip proved invaluable. It highlighted that 2 of the team's pairs of boots needed to be custom fitted by blowing out the shells. It also informed our choice of clothing by demonstrating that even if the ambient temperature is below -15°C , when there is no wind and you are pulling a heavy pulk, you generate enough heat to need only a base layer. Wearing too many clothes is ill advised as if you sweat it is very difficult to dry your clothes without becoming cold. We also gained an appreciation of how long it takes to melt snow!



EXPEDITION TRAINING IN TROMSO, NORWAY

In terms of physical training, the best thing is to be out in the mountains for long days consecutively. However, for those with office jobs this is not always practicable. Anyone considering an expedition should have a good level of base fitness. We did not do specific training such as dragging tractor tyres along beaches. We

FINANCIAL STATEMENTS

recommend doing as much aerobic training as is possible, focusing almost exclusively on your legs. Going to the climbing wall and getting really strong arms probably won't help pull that 100kg pulk.

We did all suffer with our feet being confined to ski boots for a month. Where possible, do what you can to toughen up your feet beforehand. Identify the points on your feet where your boots rub and try to toughen up the skin in these areas. If you intend to use tape to protect your feet, practise placing it beforehand. Once a sore spot has developed it will not heal until you return home, so make sure your taping efforts don't lead to any sore spots.

We'd advise planning a training camp pre-expedition to test out any new kit and learn group dynamics – knowing your team members well and how they work is important when you'll be living inside each other's pockets for a month!



FINANCIAL STATEMENTS

With all the monies coming in and going out for our expedition, we thought it would be a good idea to set up a specific expedition bank account so we could properly manage our finance. We found this to be extremely useful and would recommend anyone planning a similar large trip to do similar. A detailed breakdown of costs and income follows:

FINANCIAL STATEMENTS

COST BREAKDOWN

DESCRIPTION	COMMENTS	AMOUNT
Logistics – Skidoo	Tangent Expeditions	£10,500.00
Fees	Tangent Expeditions	£1,400.00
Freight shipments	UK – Greenland 300kg freight	£2,500.00
Insurance	IF	£5,325.00
Field Equipment		£5,000.00
Medical Supplies	Nomad Travel	£230.47
Stove Fuel	35l White Gas	£400.00
Permits	National Park, Radio, Firearms	£1,250.00
Customs & Taxes		£800.00
Flights to Iceland	Easyjet	£812.75
Flights to Greenland	Akureyri - Constable Point	£7,500.00
Other Travel Expenses	Travel in Iceland	£362.47
Accommodation	Iceland B&Bs (3 nights)	£531.72
Food	Supplies for a month	£1,723.70
Misc - Ice Drill Postage	From Zurich	£134.10
TOTAL COSTS		£38,470.21

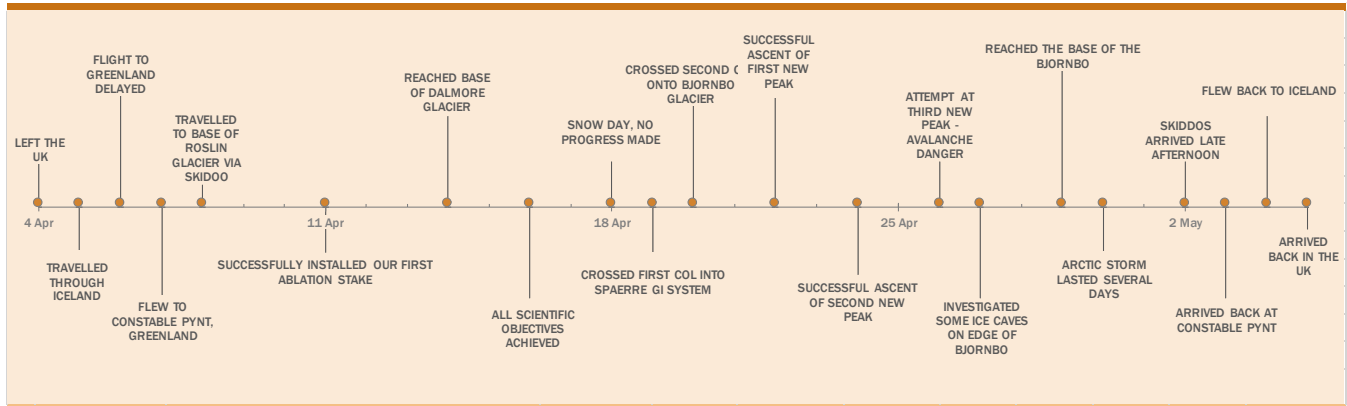
INCOME BREAKDOWN

DESCRIPTION	AMOUNT
Jeremy Willson Charitable Trust	£500.00
The Julie Tullis Memorial Award	£150.00
BMC	£400.00
The Richard Overall Trust	£500.00
Wicked World Tours	£500.00
Douglas Bader Foundation	£2,000.00
Trans-globe Expedition	£1,000.00
Scottish Mountaineering Trust	£500.00
Austrian Alpine Club UK	£250.00
Scottish Arctic Club	£500.00
Horizon Lectures	£450.00
SES Sir Charles Blois Explorer Award '17	£5,000.00
Bill Wallace Grant	£400.00
Gino Watkins Memorial Fund (& Arctic Club)	£5,000.00
Memorial Adventure Fund (Alpine Ski Club)	£375.00
The Mount Everest Foundation (MEF)	£1,200.00
IMechE - Personal Development Award	£2,000.00
Crowd Funding & Donations	£1,658.60
Expedition Team Personal Savings	£16,086.61
TOTAL INCOME	£38,470.21

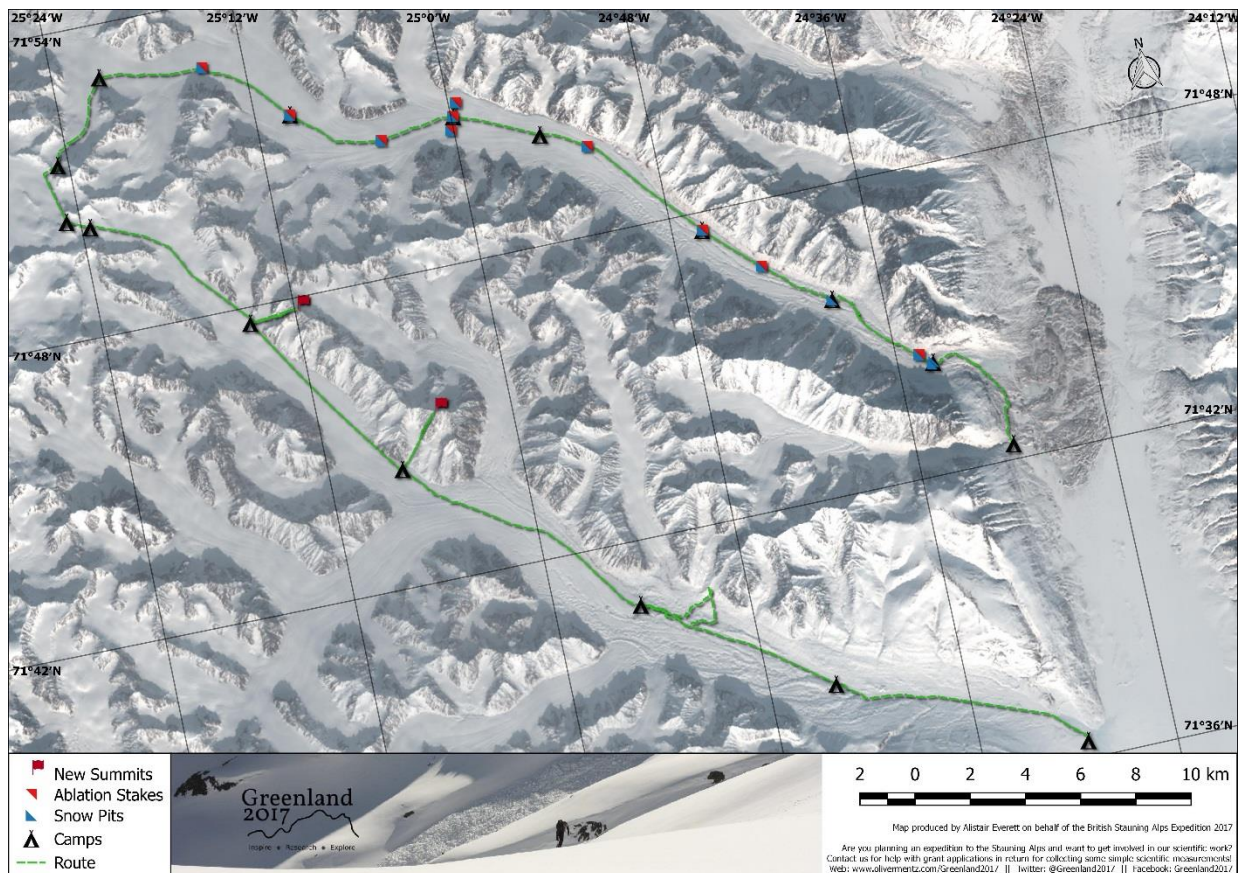
THE EXPEDITION

THE EXPEDITION

The timeline and map below show our key milestones throughout the expedition and the route we took.



Expedition Timeline



THE EXPEDITION

EXPEDITION DIARY

The team gathered in Loughborough to sort gear and get ready a few days before we were due to fly. Early on the morning of the 4th April we travelled to Luton and flew to Reykjavik, the journey had begun. We picked up our hire car from the airport in Reykjavik and drove to Akureyri on the North coast of Iceland. There was a lot of snow on the high passes, the drive took about 5 hours. We spent 2.5 days in Akureyri, longer than expected due to our flight out to Greenland being delayed for technical reasons (we didn't enquire further). We were itching to get to Greenland having exhausted all the things to see in Akureyri, it's only a small town! We hit most of the cafes and even ventured to the botanical gardens which didn't have much to offer at that time of year! We got the call with our new flight time and excitement began to mount...it was finally time to go.

Day: 1	Date:	7th April 2017	
Start Location:	65.652572, -18.075225	Finish Location:	70.745053, -22.645253

We caught a taxi to the airport. Check-in was very relaxed compared to Luton. The names on our flight tickets were almost correct and the fact that they didn't match our passports didn't seem to matter. The plane was tiny. It only had 5 seats (our very own private jet!), which were on one side of the aisle. The seats on the other side had been removed to make room for our equipment. It was cloudy on the flight out, we caught a glimpse of the sea ice as we were approaching Greenland. We spotted the airport at Constable Point from the plane, like no other we'd seen...a couple of sheds and a snowy runway! It was a smooth landing at Constable Point and were met by Paul Walker from Tangent. It started to sink in, what we were about to go and do. We spent the rest of the day collecting the kit which had been shipped out in advance and packing up the pulks ready for the skidoo trip the next day. We set up camp for the first time. The temperature was about -22°C, this seemed quite chilly. There were a few nerves in the group but we were all keen to get started.

Day: 2	Date:	8th April 2017	
Start Location:	70.745053, -22.645253	Finish Location:	71.70497, -24.49978

We got up early, loaded the skidoo trailers with our pulks and had a quick briefing from the Tangent guys. We set off at about 0830. The first 2 hours were along the sea ice, the mountains on either side funnelled the wind down the valley into our faces. We were each wearing all the clothes we had brought but were still only just warm enough. We stopped approximately every 2 hours firstly at the Red House (an old scientific research station now used by expeditions and hunters) and then at an Inuit navigation marker which was a stone monument in the shape of a man. The route then saw us dropping down into Schuchert Dal, the views of the icebergs were absolutely stunning. We passed a hut on the coast that had been attacked by a polar bear and was now full of snow as the windows had been broken. We arrived about 9 hours later at the base of the moraines of the Roslin glacier. Unpacked the pulks and we waved the Tangent guys off, now all alone. When we unpacked the pulks we realized that because they had been on their side for the whole trip out, one of the jerry cans of fuel had leaked. The spill had soaked Ollie's sleeping bag and coated one of the ropes. Ollie manned-up – rubbed most of it off with snow and put up with the smell of fuel. We set up camp and erected the bear fence...a nervous night's sleep.

THE EXPEDITION

Day: 3	Date:	9th April 2017	
Start Location:	71.70497, -24.49978	Finish Location:	71.70497, -24.49978

We decided to go without pulks to the base of the glacier as the moraine we had to cross to get there was going to be tricky. We took a high line over a prominent shoulder so that we could see the moraine below. There was roughly 50:50 snow and rock patches and it was quite difficult to find a route through the snow patches to the base of the glacier. Once we had found the best route we returned to our drop-off point and our tents. We packed 2 pulks full of kit we wouldn't need that night and Jesse and Alistair took this kit and cached it at the base of the glacier in order to make the pulks lighter for the whole team the next day. Meanwhile Ollie went through how to use the stoves we had brought with Molly and Jen. A good reccie day.

Day: 4	Date:	10th April 2017	
Start Location:	71.70497, -24.49978	Finish Location:	71.73640, -24.56463

The whole team took the pulks through the moraine. It was hard going through the rocky sections. We collected the kit from our cache and got up onto the base of the Roslin glacier. The first steep section proved incredibly difficult with pulks. We had no way of measuring how much each pulk weighed and Molly and Ollie's pulks were too heavy for them to move up the steep slope. We swapped pulks around and tried to redistribute the weight so that we could all ski up the steep sections. We set up camp efficiently taking about 30 minutes to get all the tents up and stoves on. After dinner, we went to dig snow pits to place the stakes in. Unfortunately, when we dug down we hit rocks sitting on top of the glacier rather than ice we could drill the stakes into. We dug 2 pits that night each 1.5m deep but hit rock both times. We had attempted to use the satellite imagery from the summer to see rocks on the surface and avoid them but on this occasion, it hadn't worked. We decided to place the stake after an hour of travel the next day.

Day: 5	Date:	11th April 2017	
Start Location:	71.73640, -24.56463	Finish Location:	71.76333, -24.65209

We woke to bright sunshine, broke camp, breakfasted and set off. After about an hour we stopped to try and place our first stake. We dug 1.8m down and this time hit ice rather than rock. We took turns to drill the hole for the stake while the others took the snow temperature and density measurements. Once the stake was installed we continued up the glacier. We crossed 3 melt streams, the second of these we roped up for as the snow-bridge was quite narrow. Using the satellite imagery to plan a route through these melt streams was working really well as it stopped us taking any dead-end routes. We set camp and attempted to place another stake after dinner. Unfortunately, when drilling, we hit a rock that was buried about 30cm below the surface of the ice. This blunted the drill bit and we gave up for the night...it was getting late. Should sleep well tonight.

Day: 6	Date:	12th April 2017	
Start Location:	71.76333, -24.65209	Finish Location:	71.79430, -24.76939

It was very windy and our camp was in the shade. This made it feel significantly colder and everything took much longer to do. We dug another snow pit approximately 100m away from the first in the hope of placing another stake, but hit rock again. We carried on up the Roslin, steady going past the last of the melt streams. At lunch, we dug another pit and placed a stake. Now that the drill bit was blunt it was significantly harder to drill the holes. We found that the only way to make noticeable progress was for Jesse to climb up the sides of the pit and press down on the top of the drill with all his weight. Someone else would then stand in the hole, occasionally between Jesse's legs and spin the drill. We did try to rotate who was pressing on the drill and who

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was spinning it but as Jesse was the heaviest it was most effective when he was pressing on the drill. We set camp and successfully placed a second stake in the evening. Kit is starting to wear already, gloves sewn up.

Day: 7	Date:	13th April 2017	
Start Location:	71.79430, -24.76939	Finish Location:	71.83551, -24.91325

A windy morning delayed our start. We made great progress up the Roslin this morning smashing out 5km. We stopped for lunch and dug another snow pit. 4 stakes now installed – great job! All feeling pretty tired now, but we carried on slogging up hill. A good steady pace saw us bag several more km before stopping to make camp. It's good to be able to stop when you're tired and stick a tent up, the whole glacier is ours. Not seen any animal tracks for a few days now, it's just us up here. All alone. It's quite eerie when the wind stops blowing, silence. Tired legs, bums and backs. Defrosting sun cream still seems wrong! No drilling tonight – a night off. Snow forecast for tomorrow let's see if it appears.

Day: 8	Date:	14th April 2017	
Start Location:	71.83551, -24.91325	Finish Location:	71.84711, -24.99774

Woke up to low cloud and the mountains had disappeared, we all sat in the mess tent needing a poo, waiting for the winds to die down before venturing out. Wind and light snow all morning. We dragged our lightening pulks a further 5km. We'd now reached the mouth of the Dalmore glacier. The views are absolutely stunning. The line of stakes that the teams in the 70's placed was at this point along the glacier. We spent the afternoon drilling 3 more holes across the width of the glacier. It was nice to ski without pulks. We beasted them all in good time, working together well, we shared the digging screwing and measuring. We then set camp up and retired to the mess tent at about 7pm, a welcome round of cup-a-soups followed by hot chocolate warmed us up. We were surprised that our feet were still in relatively good nick at this point. We had discussions on route planning for the following couple of days. We decided to skip attempting a peak on the Roslin glacier in favour of pushing on to the Bjørnbo. The two cols we would have to cross to get there were an unknown quantity and we wanted to pass these before thinking about summit attempts.

Day: 9	Date:	15th April 2017	
Start Location:	71.84711, -24.99774	Finish Location:	71.85845, -25.16362

Didn't want to get up this morning, pee bottles filled twice through the night. It was sunny and windy when we got up, so a chance to dry out our snowy and icy sleeping bags. They lay nicely across our pulks in the sun. We made good progress, moving faster than previous days. Every corner we turned the mountains and views became even more impressive. So much climbing to be had here, endless snow gullies and virgin peaks, it's a shame we don't have more time. After about 3.5km we stopped to place our eighth stake, and had a spot of lunch. We continued on a further 3km, our pace slowing with tired legs. We arrived at our planned camp spot for the evening and installed our ninth stake. All feeling quite exhausted and wind beaten. The snow pit here was 1.8m deep which took quite some digging. It was 2 rounds of cup-a-soup and hot chocolate before our meals tonight. It all seems quite civilised in our mess tent. Getting used to the Arctic way of life.

Day: 10	Date:	16th April 2017	
Start Location:	71.85845, -25.16362	Finish Location:	71.88290, -25.35066

We were slower getting off this morning and left camp at about 1100. The wind was stopping and starting and we couldn't work out our layers. It was obvious that the mountains often funnelled the wind through this spot

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as there were windblown crests in the snow pack. These ridges kept on stopping the pulks dead, jerking the hips and shoulders. This made the going tough. The wind was picking up but we had to stop to dig the final pit. While digging the pit the wind was seriously strong. We built a snow wall behind the pulks to shelter from the wind while we grabbed a quick bite to eat. Despite this a few of us got really cold and very grumpy. This took the sheen off placing the last stake. We didn't want to stop and celebrate completing all our science objectives, we just wanted to get moving and try and get warm again. Molly was pulling her pulk wearing her huge down jacket and still wasn't warm. We ploughed on with the pulks and managed another 3/4km to a point where we could see our next glacier, our turning off the Roslin. Alistair spent the second evening in a row trying to untangle the string from the bear fence which had tangled into a huge knot when he had tried to put it up on his own. He was not thrilled about this! An earlyish night after a brutal day, the forecast for tomorrow looks better.

Day: 11	Date:	17th April 2017	
Start Location:	71.88290, -25.35066	Finish Location:	71.85754, -25.41122

False alarm this morning, Molly heard Alistair getting up for a pee and thought it was time to get up. The rest of us got up an hour or so later. It was blue skies and less windy. We dried our sleeping bags and time-lapsed our de-camping. Ollie spent some time fixing tent poles. We headed off and turned left off the Roslin glacier onto a much smaller glacier (unnamed). Our first col was almost in sight, and it was a long steep hill to the top. We stopped for lunch part way up and didn't have to dig or drill, so was a nice relaxing lunch break. We kept plodding away until we couldn't plod any longer. The col was just there. We checked the Satmap and we were up at about 2250m altitude, which meant a massive 800 meters of ascent had been done today. We were all hugely amazed we'd managed to achieve such a feat pulling our heavy gear. We celebrated with a bag of Haribo! This was our most spectacular camp spot so far. We were feeling awesome (and broken). We sent a contingent without pulks to check out the col for tomorrow, and worked out a plan of attack of how we would descend. While setting up camp, the wind caught the tent underlay, but thankfully Alistair had positioned the toilet right in line and managed to catch the flying underlay mid-poo! Feeling hungry, food was woofed down tonight.

Day: 12	Date:	18th April 2017	
Start Location:	71.85754, -25.41122	Finish Location:	71.85754, -25.41122

It had been snowing most of the night, and the tents were part buried with snow. We could hear the snow still hitting the outside of the tent and in damp sleeping bags we were reluctant to move. The forecast we had was snow until 1500. We sat tight in our camp not wanting to risk the col under fresh snow. We had breakfast about 1000 and played a round of cards, and read for most of the afternoon. The snow eased about 1600 and we had received good news on the weather, there was no heavy snow forecast for tomorrow only cloud. We were looking forward to hitting the col tomorrow. We went skiing in the afternoon in the bowl on the Roslin side of the col below our camp. A slow day today, got some rest. Keen to get moving again tomorrow.

Day: 13	Date:	19th April 2017	
Start Location:	71.85754, -25.41122	Finish Location:	71.83898, -25.41422

Awoke at 0700, clear blue skies and no wind. We packed our stuff up. It was a short steep slope up to the col. In fact, it was very steep! The steepness made the going with pulks extremely difficult. The heavier pulks were impossible to move without 2 people, so we had to shuttle them up to the top, it was incredibly hard to move them even such a short distance. The views from the top of the col were amazing. A huge white plateau with

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peaks in the far distance. We set up an anchor with a snow bollard and a deadman. Our initial estimates of how far down it was proved hugely inaccurate. We had thought 100m of rope would be sufficient. In the end, we used all our ropes tied together to lower Molly 190m down and this was about 2/3 of the total descent. Molly made a substantial snow ledge, untied and waited to help the others who were coming down with the pulks. From the ledge, the angle had lessened so that it was possible to man-handle the pulks down the remainder of the slope without a rope. The last section of the slope could be descended sat on top of the pulk... Ollie had remained at the top and once the others were down safely, removed the anchors and down climbed. Looking up at the col we estimated the route would have been Scottish grade 1 to climb. We had a relaxed lunch at the bottom of the col and enjoyed the sun and the view. We then continued on the 3km to the base of the second col. The journey across the plateau was amazing, with epic views in every direction. Upon reaching camp Ollie and Alistair were dispatched to reccie the second col which seemed to be a harder prospect – overhanging cornice, longer, steeper, avalanche prone. An early night.

Day: 14	Date:	20th April 2017	
Start Location:	71.83898, -25.41422	Finish Location:	71.83635, -25.39042

It was pretty windy when we got up today and the sun hadn't quite reached our camp yet. We set off up the last 500m to the top of the col, it was not as steep as the last one, no help with pulks was required. We had a group photo on top with a view out over the Bjørnbo, stunning. We also got a view over the section we needed to descend and it looked pretty terrifying, but it was the best-looking option. The wind had picked up and on top of the col it was freezing. Jesse lowered Ollie down to set up the anchors above the cornice, a snow bollard and deadman. Ollie then abseiled 60m down over the cornice and set up a second lower anchor and made a large snow ledge for us to sit on. He then prussiked back up to meet the rest of the team at the top. We then each abseiled down with our pulk and attached it to the lower anchor that had been set up and we sat on the ledge. There was a section of the abseil which was free hanging. When 3 of us were down the lower anchor started to bite in on the left side of the snow bollard. We added a buried ski as a further back-up before the remaining 2 came down. Abseiling with a pulk is extremely difficult as controlling where the pulk goes isn't always possible. We found the best technique was to use a Y-hang system so that the pulk hung alongside you. It helped slightly to attach the bottom end of the pulk to the rope using a 60cm quick draw. This reduced the tendency for the pulk to slide off in a different direction but it is still extremely awkward.

Once we were all on the ledge by the lower anchor, we pulled the ropes through, had a quick snack and got ready for the next stage. We planned to lower each person and their pulk a full 3 rope lengths (190m) and then build another anchor and ledge if necessary or continue to the bottom if the angle was shallow enough. We began to lower Jen and her pulk. She was about 10m down from the rest of us when everything started to move. She shouted up to slow down, but there was nothing Ollie could do. The entire anchor was moving. Ollie did his best to slow the system down, but there was 5 pulks and Jen pulling down and the weight was too much. The anchors had all failed and the entire system started to slide. Alistair was tied into the anchor system and was yanked off the ledge when his leash became tight. Molly and Jesse were left sitting on the ledge as they had not been tied into the system. Ollie, Jen, Alistair and the 5 pulks were shooting down the ~280m of remaining slope which was 40-45°, there was no way they could stop the system and they simply had to ride it out. Molly and Jesse were left on the ledge, helplessly watching the horror unfold. The 4 pulks attached to the remains of the anchor were tumbling over one another uncontrollably. There were clouds of snow being kicked up and pieces of debris were being flung clear of the destruction. Once they had all stopped sliding they shouted down, asking if the others were alright. Jen got to her feet and started waving madly. The shock had robbed her of her ability to speak. Alistair and Ollie found their voices and shouted back, and Molly could see that they were all moving. Molly and Jesse had been left on the ledge with no crampons, axes etc. so

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Jesse kicked steps down the slope and they descended as fast as they could, collecting the pieces of wreckage on the way. The metal bars from the pulks had snapped off. The snow was loose and powdery which made the descent insecure and tricky.

All reunited at the bottom we checked for injuries. Amazingly nothing was broken just a few bruises. We emptied out all the pulks and did a gear check. All our kit, including the skis which had been strapped to the top of the pulks, were unscathed. The only thing which hadn't survived (other than pulks, was a tub of couscous, which had lost its lid and spilt, tragedy. The pulks came off the worst. The handles had sheared off 3 out of the 5 pulks. We decided to push the pulks out of the avalanche run out zone and set up camp, had a badly needed hot chocolate and left the full gear audit and pulk repair to the next day. An early night was had by all, we were all glad to be unbroken.

Day: 15	Date:	21st April 2017	
Start Location:	71.83635, -25.39042	Finish Location:	71.79481, -25.24794

Another clear blue sky morning and no wind. After breakfast, we set about fixing the pulks. We were thankful that we had packed an extensive repair kit. Cable ties proved to be insufficient. The metal poles on the pulk handles had sheared off so we made the handles shorter by using jubilee clips to attach the snapped sections alongside one another. We had a slow morning. Molly sat in a cardboard box and fell asleep in the sun for an hour. Packed up camp, had lunch and left at about 1330. We set off down the Bjørnbo. Downhill was amazing we were all loving how easy it was after the mammoth efforts we had been putting in up the Roslin. We covered 7.3km in the afternoon, we were flying. We scouted out potential target peaks on our way down and stopped in a snow bowl at the base of a mega-looking mountain. We set up camp and gathered our climbing stuff ready for the next day. Our pulks had held up amazingly well, no additional fixes were required.

Day: 16	Date:	22nd April 2017	
Start Location:	71.79481, -25.24794	Finish Location:	71.79481, -25.24794

Woke up, had cold breakfast rations to aid a quick getaway. Left our tents and headed up towards the target peak. We skinned up as far as we could. When it got too steep we swapped to crampons, leaving our skis to come back to later. We continued up the steep snow for what felt like ages. We traversed below a few rocky sections and hugged close to the left side of a buttress. The snow was good and a stairway was kicked into the snow. We got to about 50m from the top and had to stop because of a tricky rock section. We roped up, the rock was very friable and so gear was pretty sketchy. A few pitches of climbing to the top. The summit was rocky and very pointy. There was only room for one person at a time on top. All were elated to have summited a previously unclimbed peak. We abseiled the first 60m and then continued the down climb without ropes. Jesse and Alistair skied down the couloir and we all skied down from its base back down to camp, Making our own fresh tracks in the snow. A great day was had by all. Celebrated our success with a pack of After Eights.

Day: 17	Date:	23rd April 2017	
Start Location:	71.79481, -25.24794	Finish Location:	71.73839, -25.12406

Up as usual, Jesse's little toe had blistered and gone raw. Molly tended to it before breakfast, by cleaning up and resting the wound it looked pretty sore. Chilled out breakfast and a quick repair session (gloves, down jacket, tent outer) We carried on down the Bjørnbo having a leisurely lunch as we attempted to rest. It was warm and we were wearing only our base layers, the temperature must have been >-10°C. This felt tropical compared the -25°C we had the night before. We travelled about 8km and pulled up just below our next

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target peak. We had identified this from satellite imagery and it was our primary target. It looked harder than the summit we had climbed the day before. From our camp, we could see down into Schuchert Dal and polar bear territory so we had a go with the rifle. A cardboard box was set up as a target about 50m away Alistair went first and clipped the top left of the box. Ollie hit the bottom right and Molly the top right. So, we would have got both the polar bear's ears and its right paw.

Day: 18	Date:	24th April 2017	
Start Location:	71.73839, -25.12406	Finish Location:	71.73839, -25.12406

Up at 0700 sharp this morning, a quick breakfast, harnessed up and off we went. A gentle ski down to the melt stream at the edge of the Bjørnbo, across a snow bridge and the ascent started. It was a nice steady ascent to a huge snow bowl, surrounded by peaks. We were surrounded on 3 sides by towering buttresses and snow gullies. We had chosen the highest peak and eyed up a line which was almost continuous to the top. The snow was much harder here and it was pretty good going until we hit a rocky section. Ollie roped up and did a great lead. Once the coating of powder was gone it was a tricky rock gully. We all managed it, but there was some trepidation. Back on snow we continued up, we veered off to the left and negotiated soft and unstable snow covering an arête. This section was tricky as the snow was very powdery and didn't consolidate properly when stamped on. We found ourselves in another snow gully which we could see went all the way down to the snow bowl, meaning we could take this gully on our descent. It was still a long way to the top. We gradually made our way, kicking steps in the snow. And finally, up and over the summit cornice. There was a full 360° view of mountains and glaciers, absolutely stunning. This felt like an even greater achievement than the previous peak, 1100m of ascent and a technically challenging rocky section. Jesse took this opportunity to get down on one knee and proposed to Molly, totally unexpected. Fortunately, Molly just about managed to get out an affirmative. We all had to snap our attention back to the down climb that was still going to be tricky and potentially dangerous. We each down climbed the second gully all the way back to the snow bowl. It was hard work and we got hot and sweaty. We never thought that we would get this hot in Greenland. A quick ski back to camp rounded off an outstanding day, we'd been out for over 11hours and all felt tired. Lindt balls to celebrate, funnily enough they don't taste as good as normal when they're frozen.

Day: 19	Date:	25th April 2017	
Start Location:	71.73839, -25.12406	Finish Location:	71.67939, -24.91191

The warmest night yet, we woke up to no snow in the tent for the first time. Leisurely breakfast, we spent a long time chatting about what to name the peak and routes. We tried to make a name out of the initials of our names, no such luck. We packed up and headed off. Jesse had very sore feet today. The terrain became more undulating as we neared the glacial melt streams. We completed about 10km, not bad for an afternoon. We set up camp in the shape of a smiley face so that we could look down on it from above, we were in view of several potential unclimbed peaks. All starting to feel tired and feet are getting sore. 3 weeks in ski boots are starting to take their toll.

Day: 20	Date:	26th April 2017	
Start Location:	71.67939, -24.91191	Finish Location:	71.67939, -24.91191

Up as normal, packed bags for a light and fast ascent. Energy levels are much lower now, cumulative exertions have had an effect. We started by tracing a route through the undulating terrain and streams in preparation for needing to pass this way with pulks tomorrow. It took a while to find a suitable route that would be manageable with the pulks. We then headed down to cross the major melt stream between us and our

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targeted peak. There were some amazing glacial features, ice cliffs, frozen rivers which were bright blue in colour. We skied down along the edge of the river to find a place to cross. There were no snow bridges and it took a while to find a suitable crossing point. A little further down the glacier than hoped, we now looked back up at the peak. On the uphill we warmed up quickly and were soon down to only our base layers. We were in strong sunshine and it was hard going zig zagging up the mountain side. We made it up to a plateau on a die arête below a large snow gully we had targeted. We sat and had lunch in the warm sun. It was considerably warmer than at any other time so far. There were avalanches going off on all the surrounding mountains. The rocks were warming up dramatically and releasing the snow to trigger the avalanches. We decided not to go any further. We made the most of the photo opportunity and skied back through difficult undulating terrain back to the frozen river before we needed skins for the journey back to camp. We received news of an incoming arctic storm and decided to get clear of the mountains and back to a pick-up point before the snow came, as pulling the pulks through meters of fresh powder would have been extremely difficult and could have resulted in us missing our pick up. Our plan for the next few days was to make it back to Schuchert Dal.

Day: 21	Date:	27th April 2017	
Start Location:	71.67939, -24.91191	Finish Location:	71.64101, -24.73163

We followed the previous day's tracks through the undulating section of the glacier. We passed some very interesting glacial features such as ice caves. We investigated some of the caves, you could see small rocks frozen into the ice and suspended above our heads. There were amazing ice crystals. The difficult terrains and pulks were proving challenging and everyone face planted the snow when coming to a stop before their pulk had finished moving. We found a nice lunch spot. Everyone was feeling much hungrier than earlier in the trip we had all burned though our reserves and all the rations were consumed in short order. We made our way down alongside huge ice cliffs to the end of the Bjørnbo glacier. We found a great place to camp, a nice flat area in an ice amphitheatre. Everything echoes and makes it very atmospheric. The snow is getting softer and more powdery the lower we get, this makes setting up camp harder work and more time consuming. The mess tent construction isn't as solid either. We had about 12km to our finish point and we were all keen to get there before the storm came.

Day: 22	Date:	28th April 2017	
Start Location:	71.64101, -24.73163	Finish Location:	71.60555, -24.49056

It had snowed most of the night and our tents had a good coating. There was really low cloud and we couldn't tell where snow stopped and sky began, it was very eerie. The visibility got even worse over breakfast. We followed landmarks like ice cliffs and didn't get lost. After an hour of skiing the cloud began to lift and we could look back to the mountains we were leaving behind. The terrain was changing dramatically to more rounded hills. We saw what must have been an arctic lemming (we had assumed that it was a mouse) as well as some snow buntings. There was a large group of Musk Oxen high on the hillside to our left. The snow was soft and our pulks were ploughing a deep furrow, our pace was good. Jesse's foot was hurting badly and he had the bit between his teeth. After a couple of hours, we emerged into Schuchert Dal. We aimed for a small cluster of rocks in the distance. As we approached, the rocks moved and we realized that they were in fact Musk Oxen. We slowed down and moved stealthily towards them, they were huge, hairy, horny and quite guinea pig like. We got within about 100m of them before they turned and ran. We were all very happy to be able to see them so close. We set up camp with views as far as we could see and in a good location to be picked up by the snow mobiles. All very happy to have made it and completed our objectives, celebratory seashells for all. We waited with some trepidation for the coming storm.

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Day: 23	Date:	29th April 2017	
Start Location:	71.60555, -24.49056	Finish Location:	71.60555, -24.49056

We woke to strong winds and heavy snow. These strengthened and we only left the tents to go to the toilet and to seal a snow gap between the inner and outer tent sections with snow. The mess tent was being battered by the winds so we built a wall of snow to offer it a degree of protection. It was a pretty heavy blizzard, with horizontal snow and extremely strong winds. Jesse's foot seemed to be getting better but it was badly swollen and mangled with infected skin around the wound. We kept having to clear the outside of the tent. We were very grateful for the advanced warning of this storm as moving in it would have been impossible. We only left the tent to eat dinner. The snow and wind picked up again, it was going to be a long night.

Day: 24	Date:	30th April 2017	
Start Location:	71.60555, -24.49056	Finish Location:	71.60555, -24.49056

It was dark inside the tents and snow was still falling, but thankfully the wind had stopped. There had been a lot of snow - the tents and pulks were buried, all that could be seen was the tops of our skis poking out from the top of the snow. We dug out our camp and had breakfast. We spent a lot of time digging! In the afternoon, we built Greenland's biggest snow woman and named her Primula. She was at least 10 ft. tall, she had a Wispa nose, a peanut mouth, oatcake buttons and ski pole arms. Through the afternoon, she gradually listed and eventually fell over. The sun came out and we managed to dry our kit. 9pm bedtime tonight. It doesn't really get dark here, but no problems getting to sleep in the light.

Day: 25	Date:	1st May 2017	
Start Location:	71.60555, -24.49056	Finish Location:	71.60555, -24.49056

Very low cloud this morning, we'd planned to go skiing but the visibility was extremely poor so we stayed in camp. Jesse's foot had incapacitated him. The wound was oozing pus and require cleaning and drying. The swelling seemed to go down when it was rested and elevated. Jen and Molly cannibalised Primula's corpse in an attempt to make an igloo. Unfortunately, the blocks they cut were too thin to be strong enough to close the roof, it wound up looking more like an ancient ruin. Jesse remained in camp resting his foot while the others went for a quick ski outing. Molly, Jen and Alistair came across a post screwed into the ground that was some sort of reference point of a known location. Although the local arctic foxes simply used it to pee against.

All returned to camp and decided to have some target practice with the rifle. We made a target from our masses of left over peanuts on the remains for Primula's bum. Then each took it in turns shooting out of a window cut in the ancient ruin. Alistair managed to score a bull's eye, straight through the target and out the other side. Definitely our designated polar bear blaster. We packed the majority of our kit into the pulks ready for pickup and called Tangent to arrange a rendezvous.

Day: 26	Date:	2nd May 2017	
Start Location:	71.60555, -24.49056	Finish Location:	71.233011, -24.584900

Woke up to blue sky and no wind, it was a glorious morning and ideal for drying our things and packing them away. We expected the skidoos just after lunch, they turned up at about 1600. When they arrived, there were only 4 skidoos. This caused some consternation in the team as we watched the dots slowly get bigger as they

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drove towards us. It turned out that one of the 5 skidoos that had brought us out had broken and been cannibalised for parts, there was no backup skidoo so we were left with 4. Scott Webster was in charge of the team collecting us. They had had a mission getting from Constable Point to us, very soft snow and flat light combined with the fact that all the other drivers were novices. Scott gave it a 50:50 chance of making it back to base. We set off back to Gurreholm (polar bear attack hut). Made reasonable progress but the skidoo drivers inexperience was showing. Set up camp as the snow was falling. We were advised to set up a bear watch, as the visibility was <10m we decided to rely on the bear fence and all went to bed ready for a 0300 start the next day to make the most of the colder conditions and firmer snow for the skidoos.

Day: 27	Date:	3rd May 2017	
Start Location:	71.233011, -24.584900	Finish Location:	70.745053, -22.645253

Alarm went off at 0300, it is light outside. It had snowed more through the night and was low cloud again. The light was flat making it hard to see the tracks and the terrain. If we could make the first 20km we should be able to make it back to Constable Point. We decamped in record speed, grabbed some cereal bars and packed away our kit. We had to wait for the Tangent guides, we won our little getting ready race. We set off at 0415. We hadn't realized quite how ideal the conditions had been on the way out, things were very different today.

Every hill seemed to be a trauma for the skidoos with at least one of them getting stuck. Molly and Jen had to share a skidoo with Scott and he had to keep abandoning them on top of each hill while he went back to help release the stuck skidoos. The first 15km seemed to take forever with Scott going back and forth using much more fuel than he'd hoped. On one hill one of the skidoo drivers reached the top of the hill, Alistair looked down and said "Owen, your foot is on fire". There was a flame coming from the toe of his boot. He quickly stepped off the skidoo into the snow which thankfully extinguished the fire quickly and without incident. It turned out that he'd accidentally driven up the last hill with the handbrake on. This had become superheated and set fire to his foot. Now we had another skidoo with no functioning brakes, good job we weren't going to need them. The conditions were proving challenging for the novice skidoo drivers. As we approached the 20km mark things started to look up. It was still very stop-start, but the worst was over.

The clouds cleared and it was blue sky for the rest of the afternoon. We saw 2 large gatherings of arctic hares, many herds of musk Oxen and some fresh polar bear tracks. We made it back to the Red House and had lunch inside. It was the first time inside a building for 4 weeks and felt quite strange. Once down onto Scoresbysund it was the last stretch, only a couple of hours more. We had to pause to allow the skidoos to cool down as they were overheating having taken a battering.

We arrived at Constable Point at 1600, a long day. Jesse's toe was seen to by a proper doctor. He was amazed that Jesse was feeling alright, with no nausea or dizziness. The toe was badly infected and he should have started taking some of the antibiotics we had been carrying about a week ago. This was our last night in tents next to the wreckage of a Mountain Hardware space station tent that had been destroyed by a storm while we had been out in the mountains.

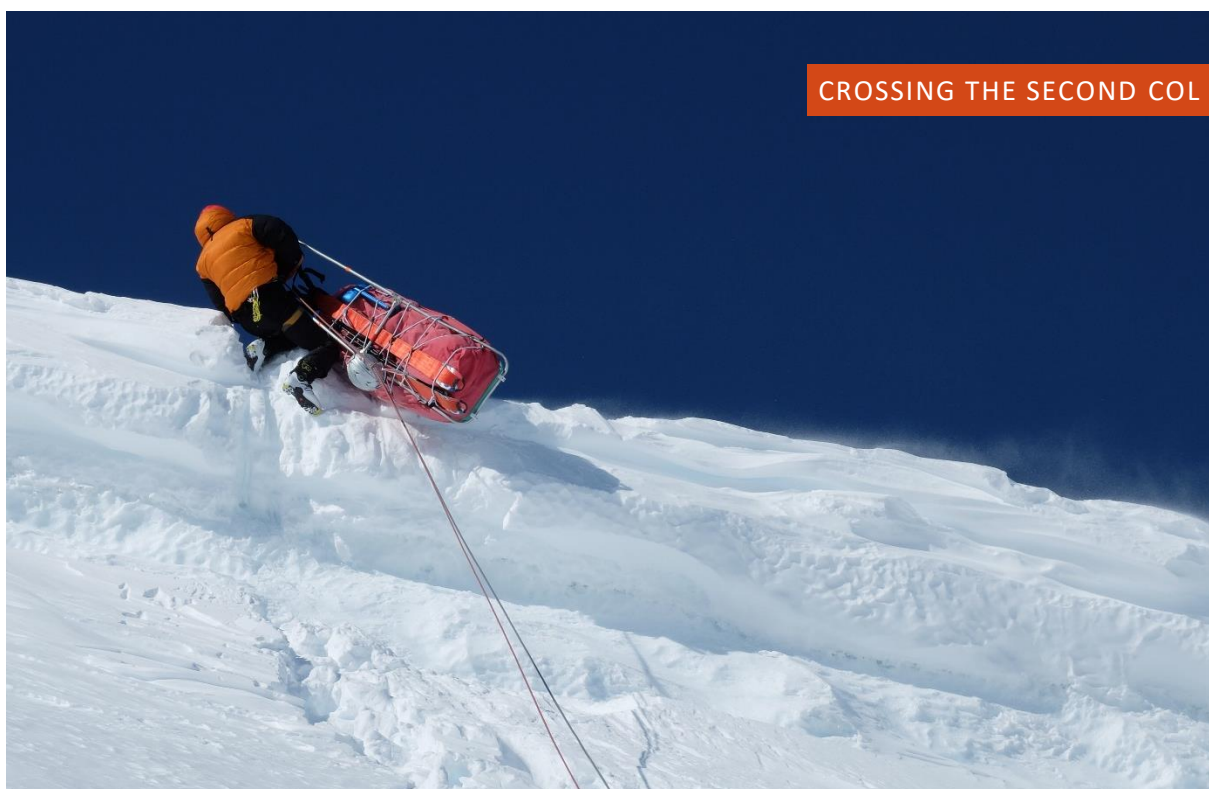
Day: 28	Date:	4th May 2017	
Start Location:	70.745053, -22.645253	Finish Location:	Reykjavik Guest House

We awoke and seemed to ache more after the bone shaking 17hour skidoo ride than we had during the expedition. We raided our spare rations for the best bits, eating all the meat we'd brought. We packed away our kit and organised it to be shipped back to the UK. After a brew with the Tangent guys we went over to the

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airport. The airport check-in was a table and some scales. We checked in our hold bags, just about within the weight limit. Our freight was only 1kg below our allowance of 150kg.

We waited in the airport “lounge” not really knowing when we would be leaving, the stated departure times seemed to be a pleasant fiction. A member of another group asked one of the airport staff when they would be leaving and getting the response “when we’re ready”. She then proceeded to direct passengers to the two planes waiting on the tarmac by going down a list of passengers, pointing at a passenger and saying either “red one” or White one” We found ourselves on “the Red One” aka the Twin otter. The skies were clear on the way out and we got a good look at the sea ice below. Landing in Iceland the temperature was +20°C and there was very little snow left. We drove down to Reykjavik all looking forward to a much-needed shower.....



CROSSING THE SECOND COL

WEATHER

The Stauning Alps is so remote that getting average climatic data for that area proved difficult, however, there was some useful information for Constable Point (Nerlerit Inaat Airport), which gave us a good idea of what we were to expect. Below is a summary of what we were expecting and what we’d used to plan our kit and equipment requirements. (We also anticipated the temperatures to be a little cooler in the mountains.) ‘April is usually characterized by rapidly rising daily high temperatures, with daily averages increasing from -14°C to -7°C and rarely falling below -24°C or exceeding -5°C. The percentage of time that the sky is overcast or mostly cloudy decreases from 64% to 56% through April and there is little snowfall throughout the month. From the start to the end of the month, the length of the day increases by about 5 hours (an average daily increase of over

THE EXPEDITION

10 minutes). The shortest day of the month is April 1, with 14 hours, 11 minutes of daylight and the longest day is April 30, with 19 hours, 12 minutes of daylight. The wind experienced at any given location is highly dependent on local topography and other factors, and instantaneous wind speed and direction vary more widely than hourly averages. The average hourly wind speed at Nerlerit Inaat Airport is increasing during April, from 10.9 km/h to 8.8 km/h over the course of the month. The average daily incident shortwave solar energy is also very rapidly increasing during April, rising by 2.3 kWh, from 2.4 kWh to 4.7 kWh, over the course of the month.'

We also used this website to check the current state of the sea ice cover:

<http://ocean.dmi.dk/arctic/Ittoqqortoormiit.uk.php>. On cloudless days, we could see reasonably clearly the extent of the sea ice. This was relevant for our skidoo trip out and back to the Stauning Alps region.

The website we used for weather forecasts was this one:

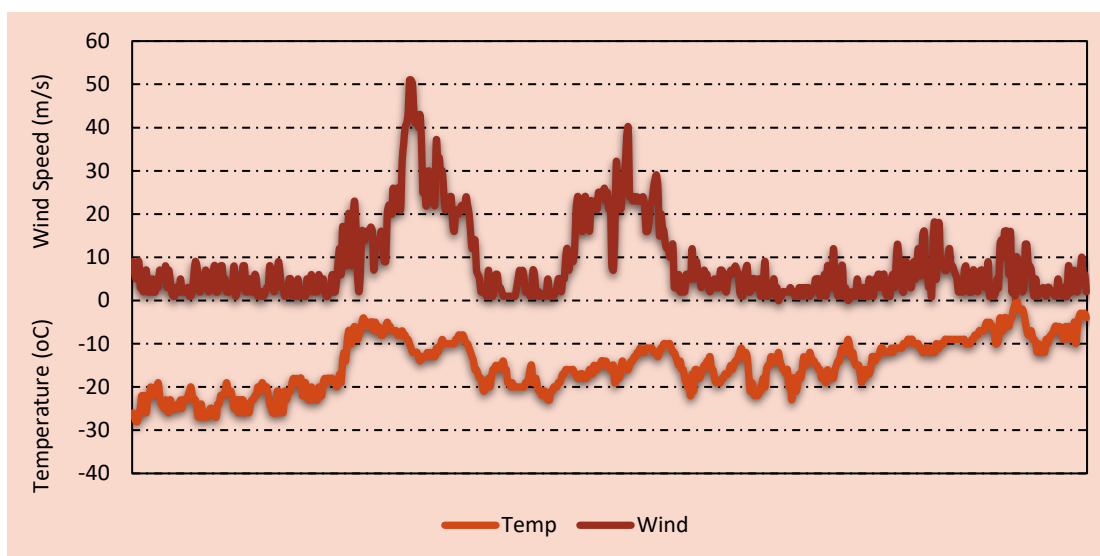
https://www.yr.no/place/Greenland/Other/Stauning_Alper/. Overall, we were quite impressed with the accuracy! It was surprisingly good – the wind speeds were possibly a bit off but overall it was good. We got daily text messages with an updated forecast to our satellite phone from Simon in the UK. This helped us plan ahead - when we knew snow was coming, we were able to time our Col crossings to avoid fresh powder etc. At the end of our expedition we were also able to get off the Bjørnbo glacier before being hit by an Arctic storm. This saved us from potentially getting stuck and not being able to reach our pick-up point on time.

We took a small temperature and wind gauge with us, mainly for interest but we were also able to download the data from it. I think we were blessed with the weather we experienced for the duration of our expedition. We were more than aware that we could be stuck in tents for weeks on end, like many expeditions before us, but we predominately had settled weather and blue skies. The table and graph below show the average temperatures ranging from -24 to -3°C, and maximum wind speeds we experienced while out there.

	Average Temp (°C)	Max Wind Speeds (m/s)		Average Temp (°C)	Max Wind Speeds (m/s)
Thu, 6 Apr	-24	9	Fri, 21 Apr	-12	29
Fri, 7 Apr	-24	9	Sat, 22 Apr	-17	12
Sat, 8 Apr	-24	8	Sun, 23 Apr	-15	8
Sun, 9 Apr	-23	8	Mon, 24 Apr	-17	9
Mon, 10 Apr	-22	9	Tue, 25 Apr	-16	5
Tue, 11 Apr	-20	12	Wed, 26 Apr	-15	12
Wed, 12 Apr	-7	23	Thu, 27 Apr	-14	6
Thu, 13 Apr	-7	43	Fri, 28 Apr	-10	16
Fri, 14 Apr	-12	51	Sat, 29 Apr	-10	18
Sat, 15 Apr	-10	30	Sun, 30 Apr	-8	9
Sun, 16 Apr	-17	7	Mon, 1 May	-5	16
Mon, 17 Apr	-19	7	Tue, 2 May	-9	7
Tue, 18 Apr	-19	12	Wed, 3 May	-7	8
Wed, 19 Apr	-16	26	4 - 5 th May	No data	No data
Thu, 20 Apr	-15	40	Sat, 6 May	-3	10

THE EXPEDITION

We could definitely feel the daily temperatures rising throughout our expedition. The first 2 weeks felt brutally cold compared with the last week. The wind chill also had a massive impact on how cold we felt. We were well prepared and took the right clothing and sleeping systems to keep warm. We were all thankful we took additional insulated (either down or synthetic) trousers!



This graph shows the variations in wind speed and temperature for the duration of our expedition.

WILDLIFE AND ENVIRONMENT

WILDLIFE

We weren't expecting to see much wildlife and were quite surprised at the amount we saw. We ticked most things off our list, it was only the Polar Bears that didn't come out to play. Although we saw Polar bear tracks twice, no *actual* bears.



Musk Oxen live in the frozen Arctic and roam the tundra in search of sustenance by the way of roots, mosses and lichens. They hang around in herds and we spotted quite a few on our way out and back on the skidoos. Our most impressive sighting was at the end of our trip in Schuchert Dal. We got within 100m of a pack of 3 adults and one of their young, before they bolted. They are huge mammals – very hairy to keep them warm and looked pretty intimidating with their horns. How they managed to get enough food to survive, we'll never know.

THE EXPEDITION



Snow Buntings

Down in the lower reaches of the glacial system we saw quite a few snow buntings. They were not shy, happy to land on our tents, hop around our camp and pose for photographs. These birds migrate to the Arctic to reproduce, with the males arriving first in early April followed by the females in May when the snow starts to melt. They must be hardy to be able to survive in temperatures down to -30°C . Their early migration may be due to them being a highly territorial species.



Arctic Foxes

We only had one sighting of an Arctic fox, on our last day while waiting for the snowmobile pick up. There was a plethora of foot prints in the snow, but they were obviously well camouflaged or in stealth mode! Thick fur on their bodies allows them to maintain a constant temperature and the thick fur on their paws means they can walk around on snow and ice. Arctic foxes are known for their incredible hearing which allows them to locate the exact position of their prey beneath the snow - Lemmings are their staple diet.



Arctic Hares

We didn't see any hares on our journey out to the Stauning Alps, but saw many groups of 8 or more hares on the way back through Jameson Land. Tufts of vegetation were showing through the snow, so they would have been feeding on the woody plants and mosses. They live in holes dug under the snow to keep warm and sleep and eat snow to get water. The Arctic hare is said to be able to run up to 40mph!



Arctic Lemmings

We saw a couple of what we first thought were mice. But once back in the UK and after a bit of googling we discovered they were actually Arctic lemmings. They were tiny little creatures hovering over the snow, probably after our crumbs. They live in burrows in the snow during the winter and live on a diet of various plants. The Arctic lemming is vital in the food chain being an important source of food for most other larger animals. An interesting fact being that they can and do swim in search of a new habitat!

THE EXPEDITION

ENVIRONMENT

From the beginning to the end of our expedition all we saw was snow, ice and rocks. We saw no flora what so ever to speak of. It wasn't until we returned home and were going through our photos with family that questions got raised about the lack of trees etc. "Did you get bored of just snow and mountains? Was it weird there being no trees?" No. The scenery was so spectacular it didn't even cross our minds.



ICEBERGS, MOUNTAINS AND SNOW

COMMUNICATIONS

We decided we wanted to have a system that would allow us to update friends, family and others on our position and how things were going. This would serve a couple of purposes including letting people know we were safe, but also allowing people to engage in the expedition and follow our progress. There are a number of devices and services designed specifically for this, including SPOT GPS devices. However, we decided against one of these systems for a couple of reasons: partly, these devices are expensive and some require a subscription to work, but additionally, we were already carrying devices which essentially serve the same function. So, in the interests of keeping weight and costs down and using our equipment efficiently, we decided to embark on designing our own bespoke system. Luckily, Ollie and Alistair are both coding geeks, so they set about researching how we could do this ourselves. We quickly found out that satellite phones can be set up to tweet updates to twitter via text message, so then we just needed a system which could scrape these messages from twitter and plot them on a map. We won't bore you with too many of the details here, but in the end, we settled on running a node.js application on Amazon Elastic Beanstalk, which is free to use and handles the deployment and running of an application on Amazon's Cloud computing service. The process is roughly summarised in this flow chart:



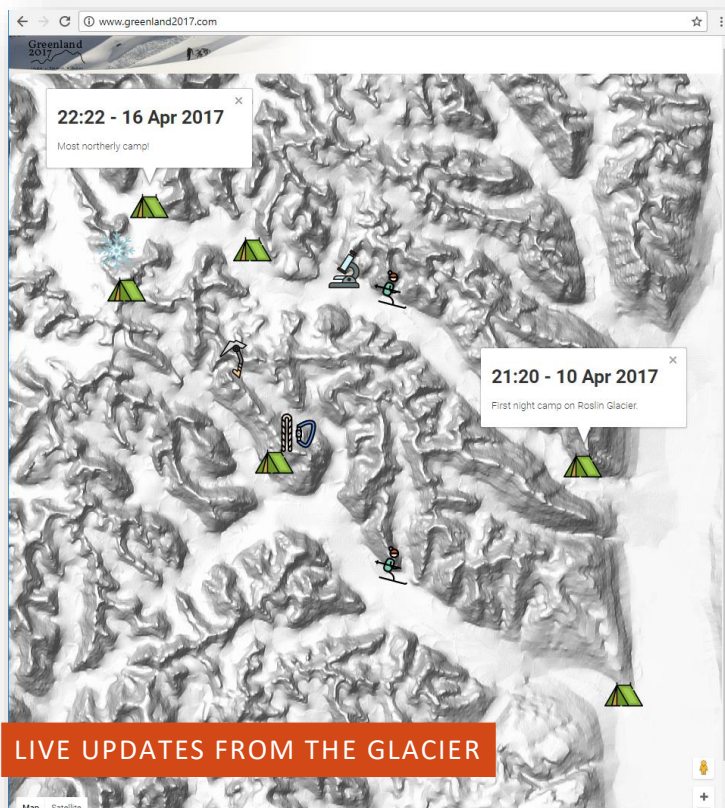
THE EXPEDITION

The node.js application uses the twitter API to scrape the tweets from our twitter account. Our tweets followed a predefined format so the information was easy to extract. Here's an example of one of our tweets:

T*65.654198*-18.073476*In the airport ready to go. Greenland here we come.

Apr 7

The format of the tweet is `[Marker image]*[Latitude]*[Longitude]*[Message Text]` and we used the stars to separate the four different parts of the message. Once the tweets have been read, the node.js application uses the google maps API to create a map and place a marker image and text at that latitude and longitude on the map. We had a list of 20 or so different marker images and we just used a single letter to select which image we wanted to use. This process means that anything posted on twitter was immediately read and translated into a marker location which was plotted onto our online map. At the time of writing, you can still view and interact with this map here: <http://sample-env.c2tjpt2cq7.us-west-2.elasticbeanstalk.com/>. We are happy to share the code if anyone is interested.



Unfortunately, after all this hard work, we found out the day before we were due to fly out to Iceland (which was after Ollie and Al had written all the code) that the Satellite phone we were hiring could only receive text messages and not send them. Our plan to send live updates from the glacier was flawed, as it relied on us sending text messages. This was a bit of a blow and it was too late to get another satellite phone. We had to revert to the more clunky plan B, which was to ring Simon (in the UK), give him a verbal update with our coordinates etc. from which he could then log in and update online for us. We had limited minutes so the updates weren't as frequent as we'd previously planned but it worked well and our progress could be followed from people back home. ***Lesson learnt – check that your Satellite phone can send text messages!***

SCIENCE & RESEARCH

SCIENCE & RESEARCH

AIMS

Our two scientific aims were to install a network of ten ablation stakes on Roslin Glacier and to collect snow pit data from pits dug during the stake installation. This data is valuable for calculating the melt rate (ablation) of the surface of the glacier. The stakes were to be placed at 150-200m elevation intervals, with additional stakes placed to replicate cross-glacier lines monitored during the 1970s.

WHAT WE DID

The first location selected for our lowest stake was unfortunately unsuccessful. We made two attempts to install a stake here; however, we found the glacier surface was covered with rocks in both snow pits, making them unsuitable for drilling. Instead, the following day, we moved up-glacier for around 500 metres before digging a new snow pit and installing the first stake, this time there were no problems with rocks. The first stake was very easy to drill, and installation, including digging the snow pit, took less than 45 minutes. Over the next few days we broke up the days of pulling the pulks by installing one or two stakes during the day or in the evening close to camp. Unfortunately, in some areas, there were a lot of small pieces of gravel close to the surface of the ice, and drilling in these locations seemed to blunt the drill blades relatively quickly. We had a spare set of blades for the drill bit; however, these blades rapidly suffered from the same problem and it gradually got more and more difficult to drill the holes. The only way we could continue to drill with the blunted bits was by having one person putting as much weight as possible onto the drill handle while another turned it. This meant that drilling the later stakes took much longer than the first stake and was much more physically tiring. A solution to this in future might be to take more spare drill bits, some tools to sharpen the drill blades, or to use ice axes to cut down through the surface layers containing gravel before drilling.



DEEP SNOW PITS

Despite this, we achieved all of our scientific objectives; we installed all ten stakes, and collected snow temperature and density profiles from 12 successful snow pits.

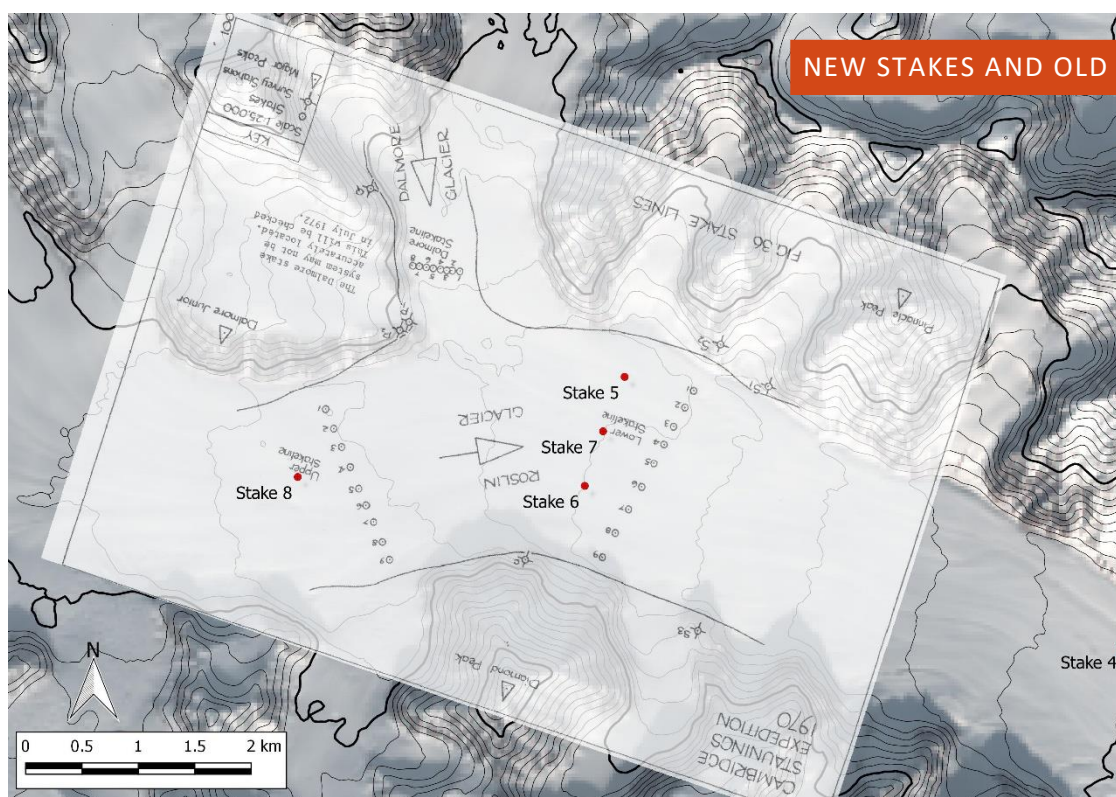
SCIENCE & RESEARCH

STAKE LOCATIONS

Aside from the drill bits blunting, the stakes were all installed successfully. We were able to drill all stakes to a depth of 4-5 metres. The locations and spread of the stakes are fairly close to what we had intended (these are all plotted on the route map a few pages back). Ideally, the stakes could have been located more centrally on the glacier; however, due to the pattern of surface streams which we had to navigate this would have been impossible without either attempting to cross some of the streams or retracing our steps. Given these considerations and the practicalities of installing the stakes as part of an expedition like this we are very happy with the final locations of the stakes.

The image below shows four of the stakes we installed close to the positions of the 1970s stakes. The map locations are overlaid with a scaled and georeferenced map from the 1970s expeditions (note that the Dalmore stakes are not accurately located on the 1970s sketch map). Our stakes are approximately 500 metres up glacier from the 1970s, and close to the same elevation given the thinning of the glacier since 1970. The close positioning of these stakes means that future measurements collected from them will provide an interesting comparison to the data collected by the 1970s expeditions.

The full list of stake locations is listed in the appendices, if you are reading this and planning an expedition to the area, please get in touch and we can provide details of how to locate the stakes and what measurements need to be collected.



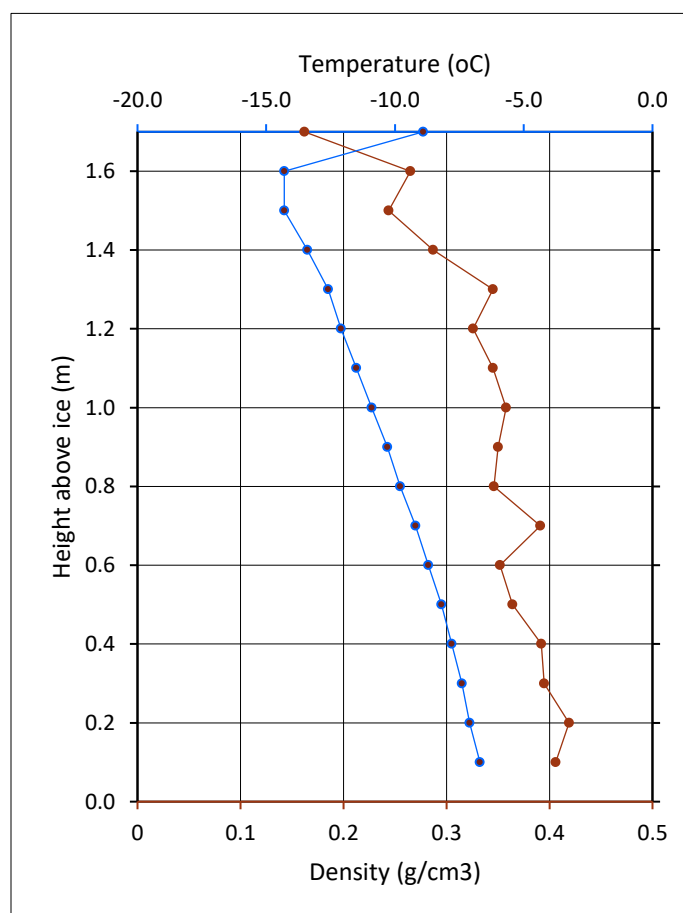
SCIENCE & RESEARCH

TEMPERATURE AND DENSITY PROFILES

Snow cover on the glacier varied between 1.4 and 2 metres, working together we could dig a pit large enough to drill the stakes and take snow measurements in about 30 minutes. Initially, we had planned to collect stratigraphic data as well as temperature and density profiles from the snow pits; however, our limited experience of collecting snow pit stratigraphy and time constraints meant that we decided to stick to the objective measurements of temperature and density. In the first snow pits, drilling was completed before we had finished collecting the snow data, but as we got more efficient at collecting the snow data and the drill bits became progressively more blunt, the snow data collection soon became quicker than drilling.

The raw temperature and density data collected from the snow pits are listed in full in the Appendices. The figure below shows an example of the data collected in snow pit number 6.

As can be seen in the figure, temperatures close to the surface in the snow pack are typically influenced by the air temperature, hence the inflection close to the surface. The top 20 cm responds quickly to changes in the air temperature, therefore the time of day and weather conditions have an important influence on these parts of the profiles. Because of this, the surface temperatures we collected range between -9.6°C (Pit 12) up to -17.1°C (Pit 4).



SCIENCE & RESEARCH

The temperatures in the surface layers are generally higher in the later pits as the daily temperatures gradually increased during this part of the expedition (see the temperature plot earlier in the report). Deeper in the snow pack the temperature is more stable and less influenced by fluctuations in the air temperature. The temperature at the base of the snow pack ranges between -6.3°C (Pit 6) and -9.4°C (Pit 12). In contrast to the surface layer, the deeper layers show a clear decrease in the temperature at higher elevations, reflecting the conditions averaged over a longer time period.

DRILLING HOLES FOR STAKES



FUTURE WORK

In order to gather useful data from the ablation stakes, they must be remeasured in future years. This data will be collected as frequently as possible over the next few years. The depth to which the stakes were drilled means that they should remain in place for at least two years at lower elevations, and for many more years at higher elevations. The measurements are simple to gather, and simply require the length of the stake and the colour to be recorded in order to determine the depth of ice which has melted since the stakes were installed. Once the stakes melt out of the glacier they will need to be re-drilled in order to continue the record. Once these measurements have been gathered they will allow comparison to measurements carried out in the 1970s. If these measurements are collected during spring or autumn when there is snow on the glacier it will also be possible to collect repeat measurements of snow density and temperature to see how the snow pack can vary from year to year.

MOUNTAINEERING & EXPLORATION

MOUNTAINEERING & EXPLORATION

One of our objectives for the expedition was to successfully summit unclimbed peaks. We'd done a lot of research before going out and had an exhaustive list of peaks that had already been climbed, leaving us with a plethora of unclimbed peaks to choose from. We'd highlighted several target peaks before we set off from the UK, mainly based on satellite images. As we approached the Stauning Alps region on snow mobiles, our initial impression was "wow, these mountains look pretty formidable!" – a lot steeper, unforgiving and more spectacular than what we'd imagined. The new climbing potential was considerable!



The mountains were largely snow covered in the lower reaches with steep rocky buttresses and topped with impressive rock spires composed of rough well weathered red granite. As should be expected there was a lot of loose rock and great care was taken in navigating the rocky sections.

The snow conditions we experienced were quite varied depending on the aspect of the slope. There were significant cornices at the top of south and south easterly facing slopes, indicating northerly and westerly winds had predominated. The sections of snow that were exposed to the wind (e.g. top of cols) were generally bullet hard. However, due to the lack of freeze / thaw cycles (due to the temperatures being consistently below freezing) the snow was soft, loose and unconsolidated on the more sheltered slopes, making the going slow. Several areas of avalanche debris were seen, notably on the second Col crossing at the head of the Bjørnbo Glacier on the south facing slopes. Towards the end of the expedition the temperatures rose significantly which triggered numerous avalanches on the south facing slopes. It was rare to be able to walk on the surface of the snow without breaking through, at least to mid-shin depth. There were several sections, notably on the second peak, that felt sketchy due to the deep soft snow. Conditions for skiing however, were good. We successfully achieved this objective.

MOUNTAINEERING & EXPLORATION

FIRST ASCENT DETAILS & ROUTE DESCRIPTIONS

Peak 1 – Sue’s Spire

On 22nd April, all members of the team successfully made the first ascent of **Sue’s Spire**, via the **Sequoia Spire Route** (PD, 2237m).

We chose to try this first peak, because it looked cool! An awesome ice buttress in its centre, a triple spire summit and a feature we called ‘The Middle Finger’, an impressive column of rock jutting out from the southern ridge. Through the binoculars, a route to the summit looked possible, only the top section looked like it may slow our progress. Early the next morning, we skinned up on our skis as far as we could and when it got too steep we swapped to crampons. We continued up the steep snow for what felt like ages. We traversed below a few rocky sections and hugged close to the left side of a buttress. The snow was good and a decent stairway was kicked for what must have been about 700m of ascent. We got to about 100m from the summit and were stopped by of a tricky loose rock section. We roped up here, the rock was very friable and so gear was distinctly average. A few pitches of climbing lead to the top. There was only room for one person on the summit pinnacle, so we each had our own individual summit photo! Once we were down safe and sound the celebrations began! It was such a huge achievement and the feeling was amazing. You couldn’t wipe the smiles off our faces. We cracked open a box of After Eight mints that had been stashed away as a surprise treat for a special occasion. This was definitely it!



SEQUOIA SPIRE ROUTE, SUE’S SPIRE (PD, 2237M)

MOUNTAINEERING & EXPLORATION

Name of mountain: **Sue's Spire**

Altitude: 2237±5m (GPS elevation)

Estimated route length: 792m ascent (Elevation change from barometric pressure)

Dates: 22nd April 2017

Route name: Sequoia Spire Route

Grade: PD (ascent and descent)

Style: Alpine (no fixed ropes)

First ascent: Yes

Successful or not: Successful

High point reached: The summit

Reason for retreat (if applicable): n/a

Weather conditions: Sunny, clear sky, -21 ° C to -15 ° C, light winds

Names of climbers: Oliver Mentz, Jennifer Roberts, Molly Thompson, Jesse Dufton, Alistair Everett

The route is described as follows:

1. Ascend the shallow couloir to the right of the large bulge of ice to a plateau beneath the steepening buttresses.
2. Traverse left across the plateau to the bottom of a wide 'Y' snow gully directly beneath the summit.
3. Take the left-hand fork and follow the steepening gully, first trending right and then left to the base of a rock step (approx. 80m from the summit).
4. Tackle the rock step and the short rocky gully above to a small snow platform on the summit ridgeline (a belay can be built here).
5. Follow the line of snow and the final rocky corner to the summit (30m).

Peak 2 - Boughfell

On 24th April, all members of the team successfully made the first ascent of **Boughfell**, via the **Katalice Route** (AD, 2191m).

Unlike the first peak, we'd selected this mountain from the comfort of our sofas back in the UK. This was our main target – it stood out on the satellite imagery and looked truly immense, a much harder looking prospect than the first peak. Up at 0700 sharp, a quick cold breakfast, harnessed up and off we went. It was a nice steady ascent to a huge snow bowl, we've named Wid-Combe. We were surrounded on 3 sides by towering buttresses and snow gullies. We had chosen the highest peak and eyed up a line which was almost continuous to the top. The snow was much harder here and it was pretty good going until we hit a large slab of rock under shallow powder snow. In the shade and struggling to get beyond the rock, we started to get cold. The rope came out and Ollie took the lead. He found a way through requiring much bravery; a fantastic lead. He then belayed the rest of the team across this section and we were then back on snow. We veered off to the left and negotiated soft and unstable snow around an arête into another snow gully that lead all the way to the summit. Looking down, this snow gully continued all the way down to the snow bowl, a much easier descent. It was still a long way to the top. We gradually made our way, kicking steps in the snow. And finally, up and over the summit cornice. There was a full 360° view of mountains and glaciers, it was absolutely stunning. Ollie made the final push to the summit pinnacle. This felt like an even greater achievement than the previous peak, 1100m of ascent and more technically challenging. We felt on top of the world! We all had to snap our attention back to the down climb that was still going to be potentially dangerous. We each down climbed the second snow gully all the way back to the snow bowl. It was hard work and we got hot and sweaty, a strange feeling having been frozen for the past 3

MOUNTAINEERING & EXPLORATION

weeks. We never thought that we would get this hot in Greenland! A quick ski back to camp rounded off an outstanding day, we'd been out for over 11 hours and all felt exhausted.

Name of mountain: **Boughfell**

Altitude: 2191±10m (Height from digital elevation model/GPS)

Estimated route length: 1111m ascent (Elevation change from GPS camp elevation and summit height)

Dates: 24th April 2017

Route name (ascent): Katalice Route

Route name (descent): Boughfell Butt-race

Grade: AD (ascent), PD (descent)

Style: Alpine (no fixed ropes)

First ascent: Yes

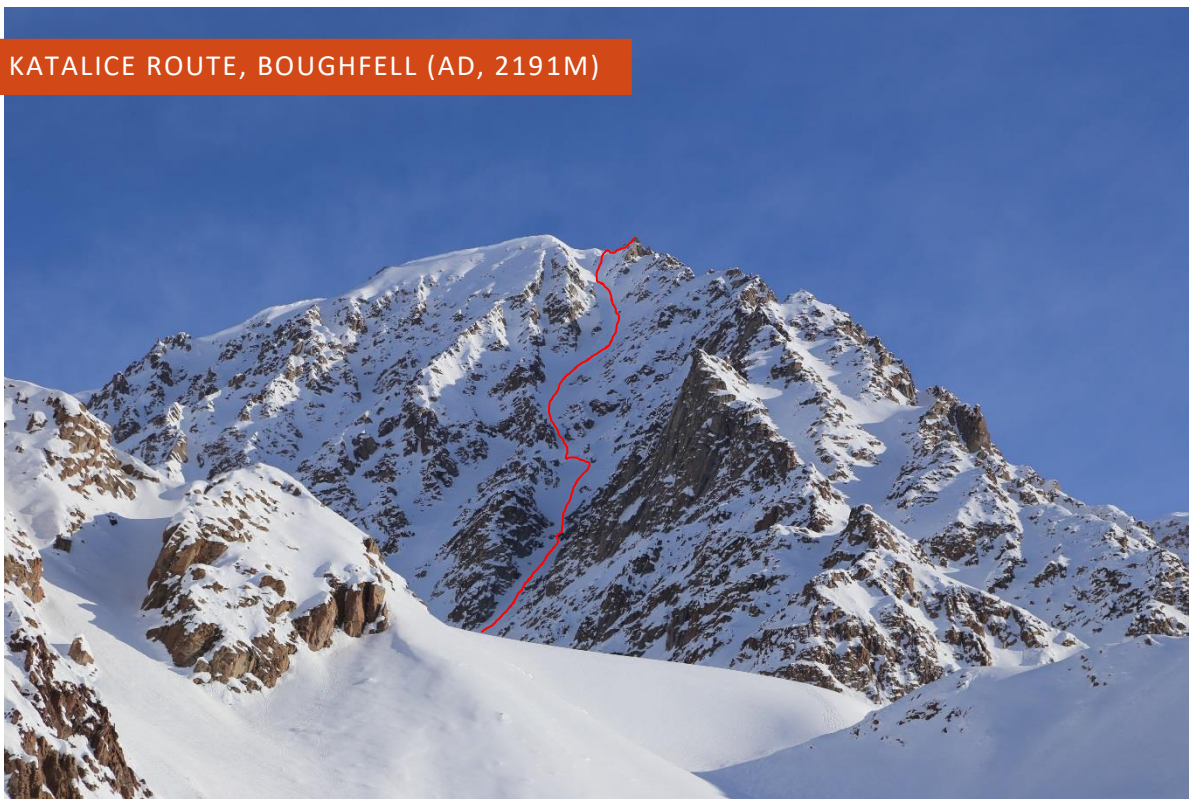
Successful or not: Successful

High point reached: The summit

Weather conditions: Sunny, clear sky, -19 ° C to -13 ° C, light winds

Names of climbers: Oliver Mentz, Jennifer Roberts, Molly Thompson, Jesse Dufton, Alistair Everett

KATALICE ROUTE, BOUGHFELL (AD, 2191M)



The route is described as follows:

1. Cross the melt stream on the north-eastern edge of the Bjørnbo Glacier and skin up to the base of a shallow couloir.
2. Ascend the steepening couloir to a large basin, Wid-Combe.

MOUNTAINEERING & EXPLORATION

3. Trending rightwards, walk beneath a towering triangular rock buttress to the base of the first obvious narrow snow gully on the right-hand side of the amphitheatre.
4. Ascend the gully to a large slab of rock at its narrowest point (a belay can be built on the right-hand side beneath a small roof).
5. At the base of the slab of rock trend right and bridge up a short rocky gully to its top and a good belay.
6. Trend upwards and left to a snow-covered section of the ridgeline.
7. Cross the ridgeline into the next snow gully and take the narrow left fork.
8. When the gully widens, trend right and soon the summit cornice will come in to view.
9. Break through the cornice on the right-hand side to the summit snow plateau (enjoy the 360° panorama).
10. Ascend the final rock pinnacle to the summit peak.

FIRST ASCENT, BOUGHFELL (AD, 2191M)



The significance of the name - **Boughfell** is a tribute to one of our close friends Sarah Bough. Molly wrote a diary everyday throughout the expedition and here's an extract of what was written the evening of the successful summit: *"Will never forget this day - still hasn't really sunk in. We've had our hearts set on a tribute for ages - Sarah would have loved it here. We hope to name this peak after Bough - she'd definitely approve. Maybe Boughfell or Mount Bough...the most beautiful mountain with the most stunning views over the Staunings. A great fit for a great friend. Never forgotten."* We think it's very fitting with links back to Bowfell, one of the lakeland fells that we loved to climb back in our Uni days. This one's for you.

MOUNTAINEERING & EXPLORATION

Peak 3 – Peanut Peak

On 26th April, all members of the team made an attempt for the first ascent of Peanut Peak, via the Nutty Gully route (PD, 1777m).

This peak was the stand out summit on a ridgeline further down the Bjørnbo Glacier, it looked a more straightforward snow gully to the top. We packed bags for a light and fast ascent our energy levels were much lower now, the cumulative exertions over the previous 3 weeks were starting to take effect. We started by tracing a route through the undulating terrain and streams and headed down to cross the major melt stream on the edge of the glacier that stood between us and our target peak. We skied down along the edge of the frozen river to find a place to cross, there were no snow bridges and it took a while to find a suitable crossing point. A little further down the glacier than we had hoped, we were now looking quite a long way back up at the peak. Skinning up the lower reaches of the mountain was hot work, we were soon down to only our base layers. We were in strong sunshine and it was hard going zig zagging up the mountainside. The temperatures had really warmed up, it was approx. -5°C, which considering the temperatures we had been used to (-20's) it felt tropical! We made it up to a snow plateau on a wide arête below the large gully (Nutty Gully) we had planned to go up. We sat and had lunch here and felt quite lethargic. The warmth of the sun was heating the rocks up and causing the snow to slip, there were avalanches going off on all the surrounding mountains. We didn't want to take any unnecessary risks or push our luck, so took the decision to go no further. It was a tough decision to make as it was our last chance of another summit.



PEANUT PEAK (1777M)

MOUNTAINEERING & EXPLORATION

Name of mountain: Peanut Peak

Altitude: 1777m (Height from digital elevation model)

Estimated route length: ~1100m (from digital elevation model)

Dates: 26th April 2017

Route name: Nutty Gully

Grade: estimated at PD

Style: Alpine (no fixed ropes)

First ascent: Yes

Successful or not: No

High point reached: shoulder at approx. 834m

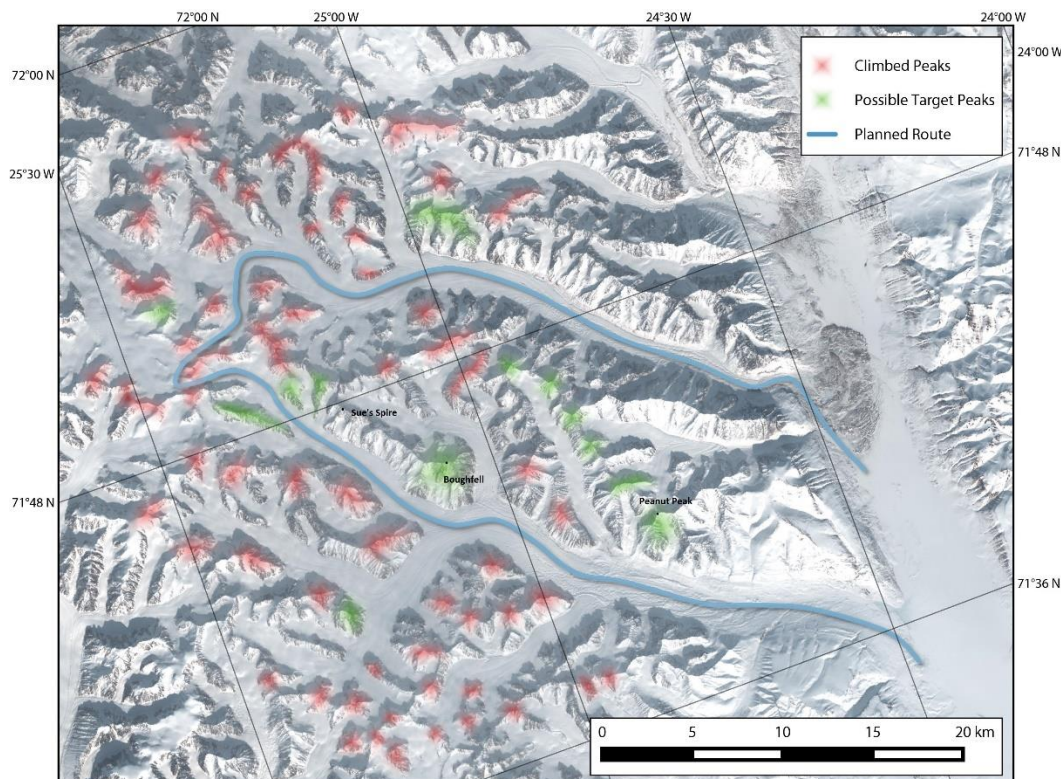
Reason for retreat (if applicable): High avalanche danger

Weather conditions: Sunny, clear sky, -9oC to -5oC, no wind

Names of climbers: Oliver Mentz, Jennifer Roberts, Molly Thompson, Jesse Dufton, Alistair Everett

SUGGESTIONS FOR NEW ROUTES / PEAKS

The mountains highlighted in green below (excluding **Boughfell**) are still unclimbed peaks and pose a great target for future expeditions. The peaks that aren't highlighted are also unclimbed, they just weren't targeted by our expedition either because they were more minor peaks, part of a continuous ridge line or simply overlooked for being too challenging for our party and the time we had available. There is so much still to go at in this area, the opportunities are endless! We can provide more information and photos for anyone who is interested, just ask.



MOUNTAINEERING & EXPLORATION

INJURIES

Fortunately, the most major incident of our trip, which occurred crossing the second col on day 14, resulted in only minor bruises. Other minor injuries included Ollie losing the tip of his finger while we were disassembling the drill for the snow stakes. The sections of the drill connected and were held in place with a press stud. Ollie was pressing the stud, and without thinking Jesse was gently pulling the two sections apart. Once the stud was depressed the sections slid over each other taking the end 3mm of Ollie's finger off. We realized later that we had a specific finger dressing in one of the first aid kits. However, only Jen knew this and so it wasn't used! Obviously in hindsight, every member of the party should have known exactly what was in each of the first aid kits to avoid making do with a standard dressing. The finger had healed nicely by the end of the trip.

Although it started relatively benignly, the most serious injury of the trip was to Jesse's little toe. On day 15 we started to ski down the Bjørnbo glacier: 'As we skied down the glacier my ski boots were probably not as tight as they needed to be. The little toe on my left foot started to rub. I didn't think much of it at the time. It didn't hurt that much, but in hindsight this was because my feet were numb and I couldn't feel them properly. When we reached camp, I found that my toe had blistered and popped inside my boot and it had fluff from my sock etc. inside the wound. We cleaned and dressed it and carried on. In the subsequent days, it became quite sore and my foot swelled up. The pain was not centered on the wound, instead it was in the ball of my foot under the joint of my second toe. For the second peak (on day 18) it was too painful to put my foot in my boot normally due to the swelling. To make extra space, I removed the foot-bed from the boot which allowed me to climb the peak without too much complaint from my foot. The condition of my foot started to deteriorate after this day. With hindsight, I should have started taking antibiotics as soon as the foot started to swell but I was unsure if the foot was swollen simply because it was being battered by ill-fitting plastic ski boots. The wound produced large amounts of puss and smelt horrible when Molly kindly cleaned and dressed it for me. I had to suck up the pain of putting my foot back into the ski boot until we had skied out of the mountains. When we were sheltering from the storm I considered taking the antibiotics as my foot was swollen but what threw me was that when I rested my foot the swelling disappeared. However, the swelling would return whenever I walked on my foot. Instead of wearing my ski boot on my left foot I took to wearing my Rab expedition bootie (covered in a plastic bag to keep it dry as they are poorly designed).

When we returned to Constable Point, Owen, one of the Tangent guys, kindly looked at my foot. He works as a paramedic. He was quite shocked at the mess it was in and that I hadn't taken the antibiotics we had brought with us. However, he thought that if the swelling continued to go down in the UK there would be no need for antibiotics. We returned to the UK and walking, hobbling really, through the airports was extremely painful. My foot swelled to half way up my shin, but this almost totally receded when I rested for 2 days over the weekend at home. However, it would swell up again as soon as I weighted it. On the Monday, I went to the GP who gave me a 7-day course of antibiotics. My foot was still swollen 2 days after I finished this course. I was about to go back to the doctor but then the swelling abated and my foot started to improve. I write this 3 weeks after returning and my foot is swelling free and the wound is healing over.

Obviously, lessons learnt are to catch the blisters early and if anything starts to swell up then start taking the antibiotics you should have with you.



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

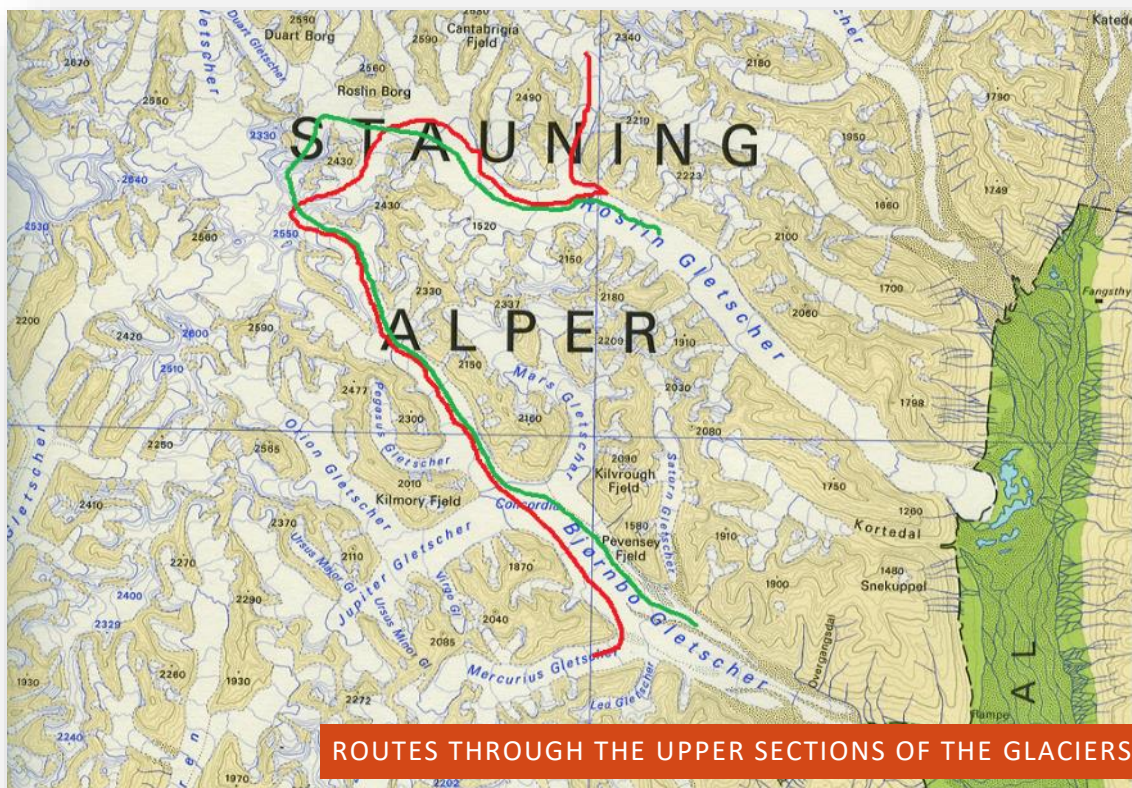
PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

The Arctic Club have been a huge supporter of ours and it was through their network that we got in touch with John Thorogood. John was part of the 70's expedition teams and was out there on the Roslin Glacier in 1973, 1975 and 1978 and then flew himself up and down the Roslin Glacier in the summer of 2014.

"What struck me, as I compiled these photographs is just how much the glacier has receded in its lower sections but the level on the upper reaches is still very much the same as 45 years ago. The Roslin is subject to periodic surges and what we might be seeing is how the mass balance instability develops. I recall we did a barometric traverse down the glacier to get surface elevations, but I cannot find mention of the results. It would be worth repeating it, this time with GPS, the difference would be very interesting." John

We've been through a selection of Johns' photographs from the Roslin and Bjørnbo taken in 1972, 1975, 1978 and overflight in 2014. An interesting comparison can be seen in the selection of photographs that follow.

The map below shows the 1975 route in RED (going from North to South) and an extract of our route in 2017 in GREEN.



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

From Schuchert Dal, looking up the Bjørnbo Glacier

SUMMER 2014



SPRING 2017



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

The snout of the Roslin Glacier from the moraines.



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

The Roslin Glacier has considerably shrunk in 45 years



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

The melt streams required care to cross.

SUMMER 1972

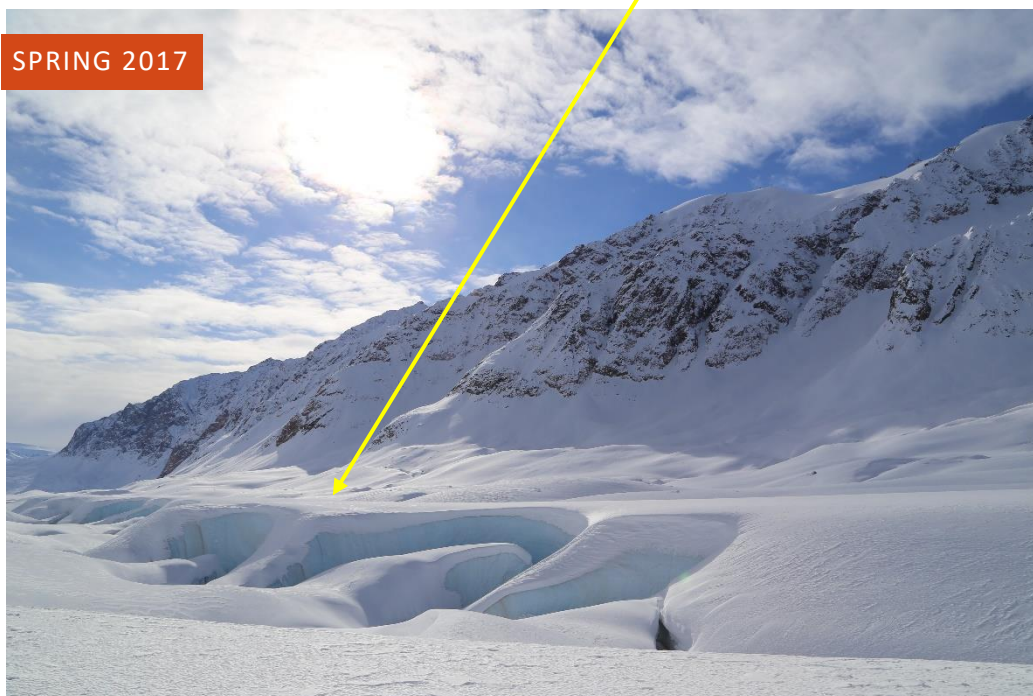


SPRING 2017



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

Melt streams on the Roslin Glacier



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

Roslin Borg beyond Dalmore Junior



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

Crossing melt streams.



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

In the upper reaches, the glacier was like a motorway, 1978

SUMMER 1978



SPRING 2017



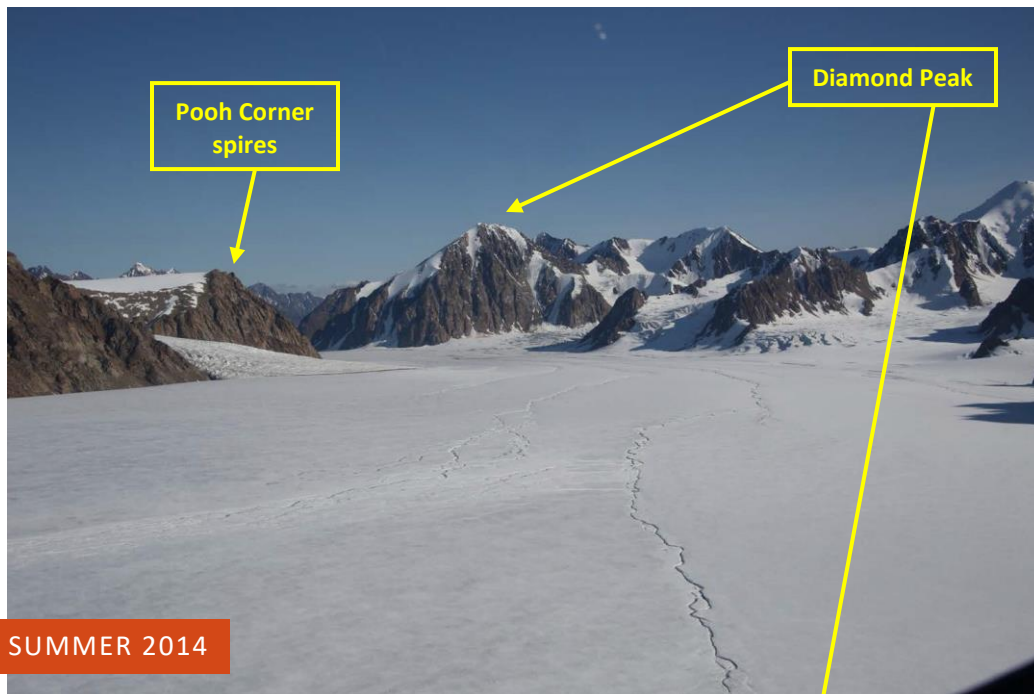
PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

Keith Miller working the plane table at “Sunny Nook” in 1972.



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

Looking back down the Roslin glacier



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

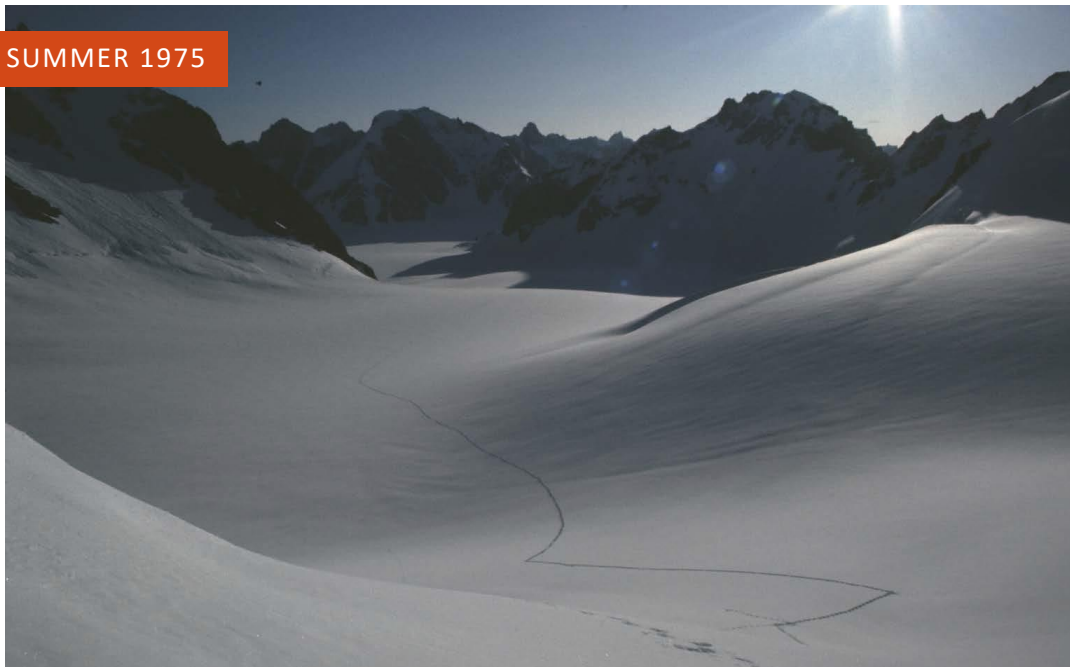
View downstream from a camp just above Pooh Corner, 1975



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

Footprints in the snow, looking back towards Roslin Borg from the col, 1975

SUMMER 1975



SPRING 2017



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

Crossing knife edge cols proved the biggest challenge with pulks.

SUMMER 1975



SPRING 2017



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

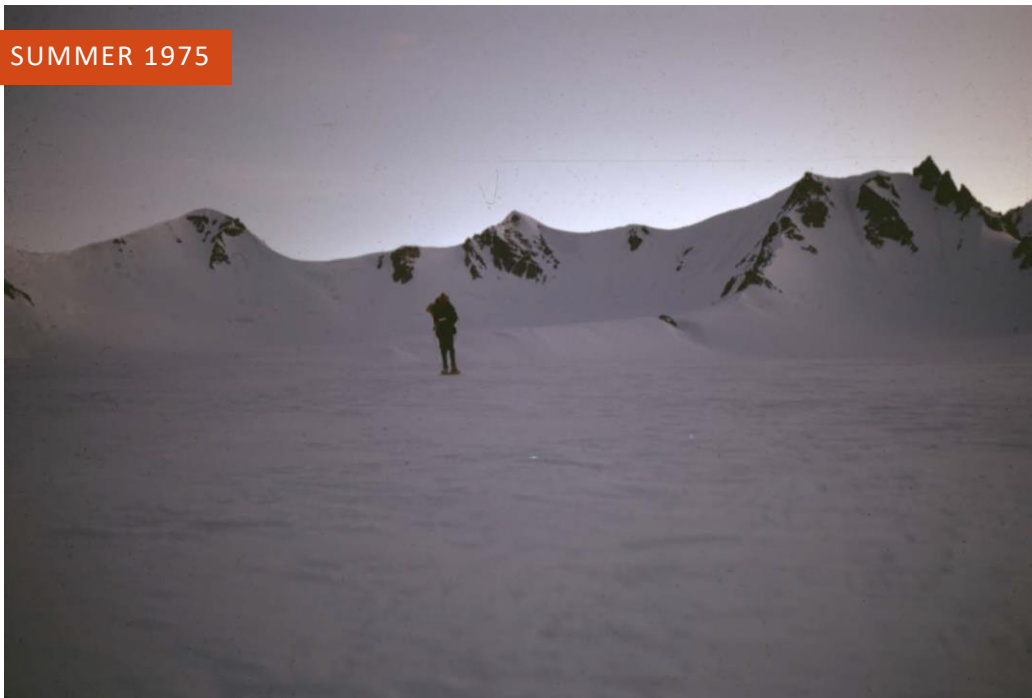
Col Camp, looking down into the Bjørnbo system, 1975



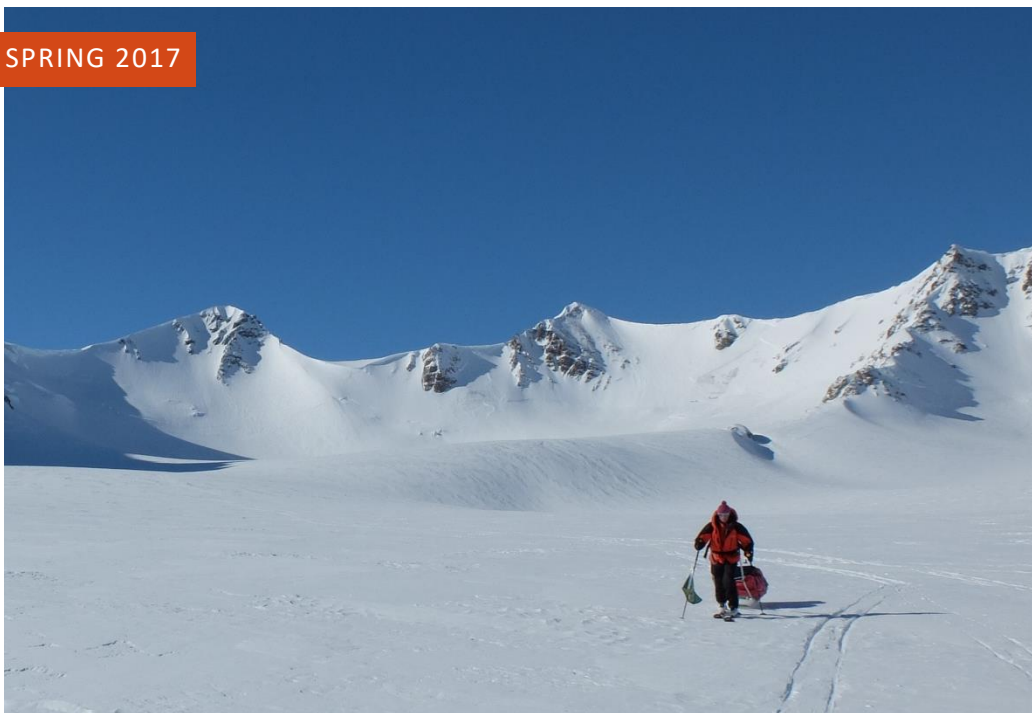
PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

Retrospect towards the Col Camp, from the Bjørnbo system, 1975

SUMMER 1975



SPRING 2017



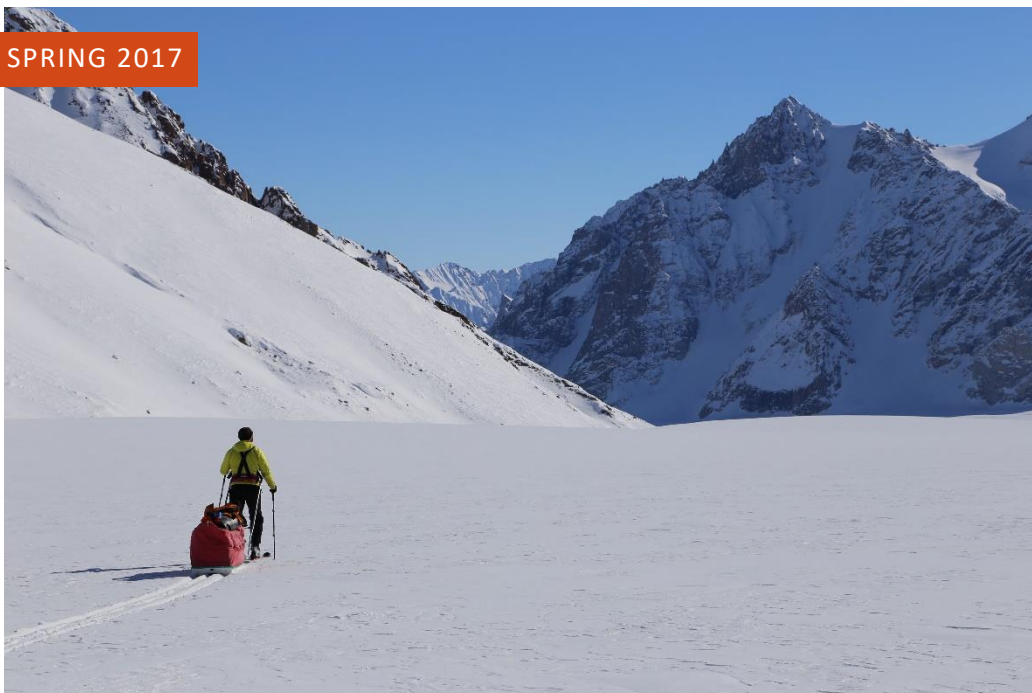
PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

A nice morning in Concordia.

SUMMER 1975



SPRING 2017



PHOTOGRAPH COMPARISON WITH PAST AND PRESENT

ACCURACY OF GOOGLE EARTH IMAGES

Overall, satellite imagery of the Stauning Alps available via Google Earth appears to be reasonably accurately located, and also includes some high-resolution summer images of the area which have been added recently. The 3D terrain model, however, appears to be much less accurate.

The images below compare our GPS track (red) at the summit of **Sue's Spire** with the imagery (left) and 3D elevation model (right) from Google Earth. The contours overlaid on the images are from the terrain model which we used to produce maps of the area.

The Google Earth imagery shows good agreement with our GPS and contour elevation, with a horizontal accuracy of a few metres. However, the Google Earth elevation data is much less accurate. The horizontal offset between the summit in the Google Earth elevation model and our GPS position on the summit is around 200m.

The heights of the peaks are also underestimated in Google Earth, the summit height for **Sue's Spire** in Google Earth is 2197m, while our GPS devices recorded a height of 2237 ± 5 m, showing a vertical offset of around 40m. **Boughfell** is slightly more accurate in Google Earth, with a horizontal offset of around 50m and a vertical offset of 48m.



INSPIRATION

INSPIRATION

As well as our scientific and mountaineering objectives, our team hoped to demonstrate that disability is not necessarily a barrier to taking part in extreme challenges. One of our team members, Jesse, suffers from Rod-Cone Dystrophy. This is a genetic disorder which affects his eyes in a degenerative manner. While it is very difficult to quantify his current level of sight, it is extremely poor (he is registered as blind/severely sight impaired). It was fantastic the amount of financial backing Jesse received for participating in such an adventurous and physically challenging expedition. His story, 'can do' attitude, bravery and determination to participate on an equal footing will hopefully inspire people to go on and achieve amazing things. Below is a short passage on his experiences of expedition and how he managed his lack of sight throughout.

"I suppose that a logical place to start is with the question of how much can I see. The trite answer is "not very much" though I'd probably use more colourful language than that. It is difficult to give a fuller answer, because my condition is genetic, it has affected me since birth and consequently I have never been able to see what a normal person would. This makes it difficult to establish a baseline of what others can see which I can compare to. One of the doctors who has advised me about my eyes estimated that when I was in my early teens I had about 20% of normal central vision and negligible peripheral vision. Unfortunately, the condition gets progressively worse with time. I am now 31 and I guess that I am down to about 10% of normal central vision. Though it is a gross over-simplification, I tell people "imagine you are looking down a drinking straw and that straw has 3 or 4 layers of cling film stretched over the end". I can barely read one letter at a time and the text must be extremely large for me to do even that. The rod-cone dystrophy affects my retina, and so this problem can't be addressed with glasses.

So, the next thing that people ask is "Given that you can't see anything, how do you still go climbing and skiing in Greenland?" The honest answer to this is that I don't really think about it. It helps that I have been climbing and skiing for a long time and that I learnt to ski and climb when my sight was considerably better than it is now. I can tie all the knots that I need blindfold and I am very adept at picking up non-visual feedback from my surroundings. When I'm skiing downhill I'm extremely reactive to lumps/bumps in the snow and my reactions are often good enough to absorb the impact when I ski into a lump. I can be knocked off balance temporarily but I have had plenty of practice at regaining my balance quickly.



There are plenty of things which it isn't possible to have a practical workaround for, I can't usefully read maps anymore, enlarging them simply isn't practical. For things like this the easiest solution is to be part of a team. Let your mates help you out with the things there is no work around for, such as navigation. I just make sure I take a greater share of the other tasks the team needs to do. I'm quite a big guy and people say that I'm very strong. This meant that I could assuage some of my guilt at letting the others sort out some tasks my eyes would have

INSPIRATION

made very hard by being the team's pack mule. Pulling heavy pulks uphill is incredibly hard work but it's slightly easier if you are heavier as the weight is smaller in relative terms. I made sure that my pulk was the heaviest so that the others had more energy when they got into camp for things like cooking which I stayed clear of. The stoves are quite fiddly and if you get it wrong the result is a big fireball, we had a couple of these!

Having an expedition on skis made things much easier for me with my sight. Walking over broken ground like boulder fields is extremely hard work for me as I can't see where to put my feet. Consequently, every step I take, I put my foot down in a bad place, on the edge of a sloping rock for example. It means I'm always off balance and compared to everyone else I'm working much harder just to go at walking pace. However, on skis the difference in required effort is much less. I can ski behind someone and as long as I keep their coloured blur in front of me I'm going the right way. I sometimes come out of the tracks that they've made and into the soft snow at the side, making it harder work, but this is much less of an issue than crossing boulder fields. Snow is largely flat and so it doesn't matter so much if I put my foot in the wrong place. I do still have to work harder than everyone else. When we were climbing the two peaks we would be kicking steps into the snow. When you're following someone, you can stand in the steps they've made and this makes it much easier. Unless you can't see their steps that is. The combination of not being able to see the steps and being significantly heavier than the others meant that I was often kicking my own steps and if I did manage to follow someone else's they would often collapse under the extra weight. There's nothing I can do about this; you just have to suck it up and accept that you're going to have to work harder than those following in footsteps.

It was a fantastic experience and a challenge I wouldn't hesitate to undertake again in the future. It's amazing what you can achieve if you put your mind to it. I don't know of any other blind people to make first ascents in Greenland so I may be the first! I hope my story can inspire people to go on and achieve amazing feats no matter what challenges are put in front of them."

Jesse Dufton



PULLING HEAVY PULKS UP THE ROSLIN

INSPIRATION

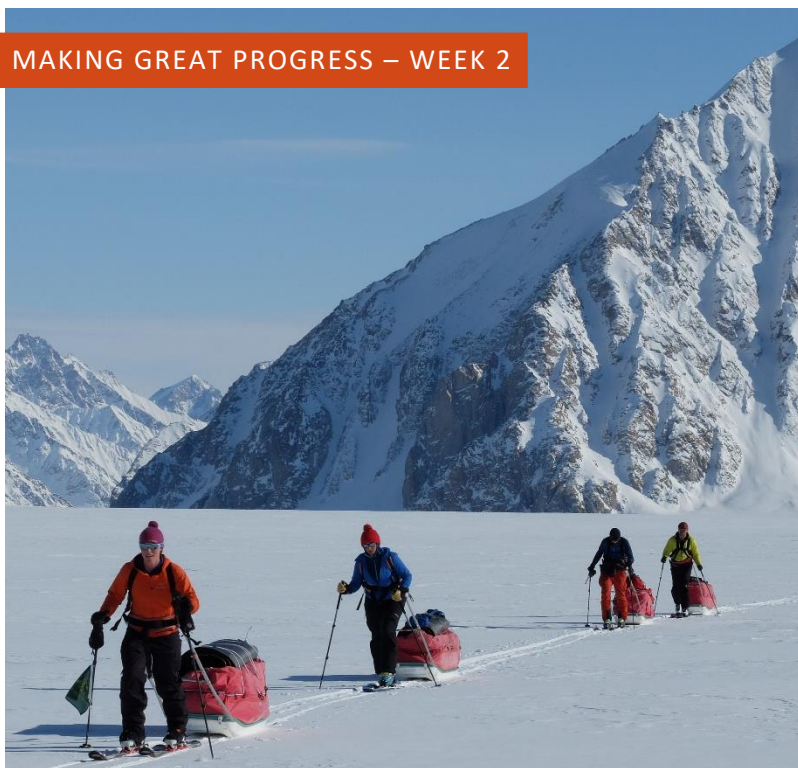
LEADERSHIP & REFLECTION

Lady explorers are few and far between, lady expedition leaders also, but Molly has shown here that it is possible for everyday folk to follow their dreams. Not many people can call themselves award winning Arctic Explorers. This team have achieved exactly that, through hard work and determination.

"There's nothing extraordinary about me, I lead what I think to be a very normal life. I'm an engineer with a 9-5 job during the day and a climbing bum hanging around the wall in Loughborough by night (well, evening). I'm known for my bright-coloured outdoor clothing and love of chocolate.

The backing I received early on in the planning stages was fantastic and spurred me on make this expedition a reality. My request for assistance from the IMechE was favourably received by the Committee and as a result I was offered the Special Purpose Award. My role as expedition leader was a new role for me and a huge challenge to take on. I hoped that this experience in a challenging environment would develop my leadership skills and also enhance my project management skills in the researching, financing and logistical planning stages of the expedition. I also hoped that leading a team in an extremely challenging environment will demonstrate the wide applicability of skills developed as an engineer and inspire others to continually develop through different initiatives.

MAKING GREAT PROGRESS – WEEK 2



We had a hugely successful journey, completing all our intended goals and I feel proud to have led this expedition. There were many challenges through the planning stages and while out in the field, but I was able to make decisions and inspire the team to meet our goals. At the beginning of the expedition I felt nervous and I was aware that there was a very high expectation of me and that significant pressure was on my shoulders. I'm an experienced climber and mountaineer, but this was my first arctic expedition and venturing out into the unknown was both hugely exciting and terrifying! I am proud that I have vindicated the trust which others put in me, and feel that given a similar situation in the future, I would be much more comfortable in my own abilities and in shouldering the burden of responsibility.

My leadership skills were greatly enhanced throughout this expedition and I believe I have grown as a person by taking on this project. I was able to delegate wisely, set goals, communicate effectively, make decisions and

INSPIRATION

inspire and motivate. I would not hesitate to take on future challenges of this magnitude again and would actively engage with others to share my experience. The team was fantastic too. We were faced with very challenging conditions and terrain and we all pulled together extremely well. We knew each other's strengths and weaknesses and assisted each other when needed. We also experienced some difficult situations, which we came through unscathed thanks to quick thinking, problem solving and team work. I hope this is the start of many more adventures.

We have initiated a long term observational record and will publish our findings into the scientific literature when we have enough data to report the findings. This will be hugely valuable to gain a more accurate insight into the effects of climate change on our vulnerable planet. I never expected to become an award winning arctic explorer in my spare time. I was fortunate to win the coveted Scientific Exploration Society's Sir Charles Blois Explorer Award 2017 and also the Arctic Club Award 2017. I have captured the imagination of many and hope to inspire more pioneers with purpose. Continued professional development can take many forms, I have benefitted hugely from this experience and hope to take what I have learnt back to the world of engineering and project management. I hope I can go on to inspire others to challenge themselves and further develop through different initiatives."

Molly Thompson

TIPS FOR FUTURE EXPEDITIONS

Here is a list of things we learnt while out on expedition that we thought would be useful for future expeditions:

- Using the shell of a tunnel tent as a mess tent works really well. You can dig downwards to form bench seats on either side and there is a platform to cook on. It gives a central area where you can all sit and eat together. It also reduces the amount of condensation in the sleeping tents.



INSPIRATION

- Take spare insulated mats to put on the bench seats.
- Digging pits in the porches of tents makes it much easier to sit in the entrance and put your ski boots on.
- Take pans with a heat exchanger on the bottom as it makes cooking much more efficient.
- Dehydrated food is definitely worthwhile. Make a neoprene pouch to fit the packages of the food you are taking. This keeps the food warm while it rehydrates and ensures it is still warm when it is ready to eat. Without these, the food would have been cold by the time it was ready to eat.
- Inflatable pillows can become brittle in the extreme cold. We had 2 that exploded on the first night. Therm-a-rest foam pillows work well and are quite snow and ice resistant.
- The elastic in tent poles becomes slack if they are stored in the cold for extended periods. Stretching the elastic repeatedly restores its elasticity.
- Make sure you have somewhere to store snacks, even when you need to strip off to your base layer. Pulling pulks was hard work and you need easy access to your food but you might not have pockets in your base layer. Consider taking a bum bag to put your goodies in.
- Water bottles freeze extremely quickly, make sure you take enough thermos flasks for your water to drink in the day. Recommend at least one thermos and one Nalgene per person. The Nalgene bottles are used as hot water bottles at night
- Once you have finished cooking dinner, fill all the thermos flasks you have with boiling water so that you can use the water to start cooking breakfast in the morning saving time.
- Take some comfy footwear for the evenings and around camp. These need to have a waterproof outer layer and come up to knee height. In Scandinavia, you can buy Gore-Tex over shoes with a sole ideal for this purpose. Inside these you can put an insulated bootie either down or synthetic. The modular Rab expedition booties are not suitable. The sandal does not keep the down from getting wet and losing its insulative value.
- Make sure you check your feet every night and take pre-emptive action to stop blisters forming. Some people recommend using zinc oxide tape to cover your entire foot before you start, akin to making tape gloves for jamming.
- When the sun shines, it is incredibly bright, category 4 sunglasses are essential.

OLLIE CHECKING OUT THE MELT STREAMS ON THE BJORNBO



CONCLUSIONS & LEGACY

- From mid-April onwards it never gets dark, you will need something to cover your eyes at night but a black buff doubles as an eye mask adequately.
- Take liner gloves, they are useful for doing tasks that are too fiddly for thicker gloves. Make sure that they are well fitted to your hands so you can do fiddly things without taking them off.
- Before you leave home pack your food into daily ration packs to minimize the amount of faff you need to do on expedition. Things taste very different when they're frozen, check that nothing becomes inedible when frozen before you go. We craved more protein e.g. tuna or meat.
- Consider taking a Gore-Tex bivi-bag to put over your sleeping bag. Even if you are not cooking in the tent the condensation from your breath forms a significant amount of snow which can wet your bag when it falls on you in the morning.
- Use a tent underlay (3mm thick foam mat), place it inside your tent to avoid it freezing to the ground in the morning. Ideally cut it to fit the base of your tent with a bathtub type overlap around the edges of your tent rising up ~15*20cm all around the edge. We used 3 layers of 3mm foam in addition to a thicker foam sleeping mat and an inflatable sleeping mat. Take an extremely extensive repair kit. Jubilee clips were essential for us. Silicon seam sealant didn't work as it was too cold for it to set.
- Take at least one brush for cleaning snow off bindings and out of tents - it needs to be fairly stiff.
- Solar panels work well and can be strapped to the top of your pulk in the day. Take a large capacity (30Whrs) battery pack which you can charge during the day and then charge your devices overnight inside the warm of your sleeping bag. Think carefully about the cables you will connect the battery and panel with. We had problems with the cable working loose during the day. When charging the battery in the day put it inside an insulated pouch or thick insulated mitt, it won't charge properly if it is frozen solid.
- Using satellite imagery to plan your route through tricky sections of the glacier works extremely well. Make sure to consult both the summer and winter photos, you can see features such as melt streams on the summer images and plot your route to avoid these features which may be hidden by the snow in winter.
- Discuss your drop-off point in detail with the skidoo drivers. We were dropped off in a non-ideal location on the other side of the moraine from our intended drop off site. This may have been due to snow conditions. Crossing moraines with pulks is hard work!

CONCLUSIONS & LEGACY

It was truly epic.



JEN TAKING IT ALL IN

CONCLUSIONS & LEGACY

- **Research**

We have achieved our objective of installing a network of ablation stakes, we have publicised their presence and it is now up to us to ensure future expeditions take further measurements of these stakes. When future expeditions return to the area, we will collaborate with them to detail what is required and receive their measurements on their return. We have initiated this hopefully long term observational record and will publish our findings into the scientific literature when we have enough data to report the findings. It will be appreciated that we cannot specify in which journal these results will appear, as the acceptance of a paper is at the journal's discretion in light of the peer review process. Our intention is to make any papers freely available through open access. Data will also be made available through online repositories and added to online data catalogues (such as the WGMS database http://wgms.ch/data_exploration/), in order to encourage future scientific use. The timing of any potential journal articles is dependent upon future expeditions and so it is not possible to give accurate timescale for this currently.

Alistair is in contact with other international researchers (including Horst Machguth of the Geological Survey of Denmark and Greenland and Tavi Murray of the Swansea University Glaciology Group) to ensure that the data collected will be useful in validating and improving remote sensing data, and significantly improving our understanding of the behaviour of glaciers in the area. Our work and results may be used in their future work too.

We are also reaching out to potential expeditions to make them aware of the need for repeat visits. Tangent Expeditions who run expeditions from their base at Constable Point in Greenland are aware of our work and will inform us of any expeditions heading out to the Stauning Alps. Our plan also includes making the Bath University Mountaineering Club, from which 4 of our expedition hailed, aware of our project and encouraging younger mountaineers to challenge themselves and undertake their own expedition. We wish to create a legacy of pioneering with purpose and keep the links with where we started off our adventures. We believe this would be a fantastic project for future students and we're all keen and willing to provide mentorship.

- **Explore**

We successfully completed a new route up the Roslin glacier and down the Bjørnbo glacier. It was a huge physical and mental challenge, being so remote and fully self-supported for the duration of the expedition. We explored new places and achieved our goal of summiting unclimbed peaks. We have written up our routes and new peaks and will disseminate to all relevant parties to update records of the area.

- **Inspire**

Through reports, presentations and articles we will tell our story and share our experiences with a wide audience with the hope that we can move people to raise their own objectives.

We would love to hear from anyone interested in visiting the Stauning Alps region. If you want to find out more or are planning, or even remotely considering an expedition to the same area in the next few years and would like to get involved in the science, please do get in touch!

APPENDICES

APPENDICES

EQUIPMENT LIST

Camping Equipment

Tent 1 (2 man)
Tent 2 (3 man)
Group Shelter (4/5man)
Snow saw x1
Snow pegs
Sleeping bag x5
Sleeping bag liner x5
Inflatable sleeping mat x5
Foam roll mat x5
Pillow x5
Biodegradable toilet roll
Pee bottles x5
Pepper spray x1
Rifle & 20 rounds ammunition
Bear fence x1
Flare gun x1
Hand flares x2

Cooking Equipment

Tent 3 (mess)
Foam roll mat x2
Stove 1 + windshield
Stove 2 + windshield
Matches & lighting stick etc.
Stove boards x2
Pans & lids x2
Knife x 2
Sporks x5
Mugs x 5
Bowls x 3
Fuel Bottle x2
Funnel (fuel)
Group Thermos x5
Pan scrubber
Water Bottles x5

Climbing & Skiing Equipment

Rigid covered pulks x5
Ropes x3 (2x 60m, 1x70m)
Dead man x2

Lead rack x2
Ab tat (20m 5mm cord)
Touring skis & bindings
Skins x5 pairs
Ski crampons x5
Ski boots x5
Neoprene ski boot protectors
Climbing Harness x5
Belay Device & screw gate x5
Pulley/revolvers x5
Screw gates x3 each
Prussiks x3 each
sling & snap gate x1 each
avalanche Shovel x5
avalanche transceiver x5
avalanche probe x5
Helmet x5
Goggles x5
Sunglasses x5
Poles x5 pairs
Axes (+leashes) x5 pairs
Crampons x5
rucksack (50ish ltr) x5

First Aid

First Aid (see separate appendix)
Laminated emergency contracts info

Electrical Equipment

60W Solar Panel
GPS (x2)
Rechargeable battery
DSLR Camera + accessories
Compact Camera + accessories
Spare AAA batteries
Small speaker x1
Personal Locator Beacon
VHF air band radio
VHF marine band radio
Satellite phone

APPENDICES

EQUIPMENT LIST (CONTINUED)

Science

Group log book & pencil
Science Stakes & cable ties
Ice Drill
Temperature probe
Snow density cutter
Electronic scales

Personal Clothing

ski socks x2
liner socks x1
ski mountaineering trousers x1
insulated trousers x1
long johns x1
underwear x2
base layer top x2
mid layer x2
shell jacket x1
down jacket x1
Mitts x1
Gloves x2
Down boots / socks x1
Balaclava x1
Neoprene face mask x1
Hat x1
Buff x1

Food

Food (separate appendix)

Misc.

Large dry bags x8
sun cream (600ml)
lip salve (x5)
Moisturiser (500ml)
Toothpaste x5
Plastic Boxes x3
Pegs x10

Hold Bags x6
Laminated maps
Union Jack flag
Compass & Whistle x5
Binoculars x2
Toothbrush x1
Head torch x1
Hand warmers
luxury item x1 each

Spares and repairs Kit

Spares and Repair kit bag
Needle & Thread
Seam Grip
Spinnaker Tape
Tent Pole sections x3
Pole sleeve x3
Duct tape
Leatherman
Pipe clamps (various sizes)
Therm-a-rest patch repair kit
Omni-fuel repair kit
Pipe cleaner
Cable ties
Spare middle bar (crampon)
Skin Glue
Ant-balling spray
Scraper
Glop stopper wax
Lighter
Screwdriver & bits
Screws (range of)
Wire wool
Epoxy
Allen Keys
Hand Drill and bits
Spare skin and skin trimmer
Parcel tape (packaging return freight)

APPENDICES

MEDICAL SUPPLIES LIST

Base Camp Medical Kit

Anusol cream (1 tube)
Burn gel/aloe vera (1 tube)
Adhesive plasters (Assorted)
Antibacterial Wash - Hibiscrub (1 bottle)
Antiseptic wipes (10)
Blister plasters (2 boxes assorted)
Crepe bandages 10cm (2)
Crepe bandages 7.5cm (1)
Dressing large (1)
Dressing medium (2)
Elastic Adhesive Bandage- Coflex (1 roll)
Eye Dressing (1)
Finger Dressing (1)
Gauze swabs 5 x 5cm.sq (2 packets)
Adhesive dressing 10 cm. sq. (3)
Micropore tape 2.5cms (1 roll)
Safety pins (10)
Saline capsules (3)
Steri strips (3 pack) (1)
Triangular bandages (1)
Vaseline gauze burn dressing 10cm.sq (2)
Zinc oxide roll plaster 2.5cms (1)
Plastic gloves (non sterile) (5 pairs)
Cling Film (1)
Cotton buds (10)
Dental first Aid Kit (1)
Duct Tape (1 roll)
Sam splint (1)
Sharpie (1)
Thermometer (1)
Scissors (1)
Chlorphenamine 4mg (Piriton) (40 tablets)
Clotrimatazole (Canesten) (2 tubes)
Dioralyte sachets (10)
Ibuprofen (32 tablets)
Loperamide (Imodium, Arret) (18 capsules)
Rennie (40 tablets)
Senna tabs (20 tablets)
Steri strips (1)
Aspirin 300mg (16 tablets)
Paracetamol 500mg (20 tablets)
Cicerone First Aid and Wilderness Medicine (1)

Prescription Medication

Analgesics:
Co-codamol 30/500mg tabs 30's
Naproxen 500mg tabs 28's
Tramadol 50mg Capsules 10's (CD)
Antibiotics:
Co-amoxiclav 375mg tabs 21's
General Medical Items:
Prednisolone 5mg Tabs 28's
Salbutamol 100mcg inhaler
Eye, Ear and Nose:
Chloramphenicol 1% Eye Ointment 4g
Tetracaine Minim 1% singles
Powders & Creams for the skin:
Bactroban Cream/Ointment 15g

Mountain First Aid Kits

Adhesive plasters (1 box assorted)
Antiseptic wipes (5)
Aspirin 300mg (16)
Blister Plasters (1 pack)
Blizzard Bag/Survival Bag (1)
Crepe bandages 10cm (1)
Dressing large (1)
Dressing medium (1)
Duct Tape (1 roll)
Gauze swabs 5 x 5cm.sq (1 pack)
Gloves (2)
Guidance Sheet (1)
Ibuprofen (16)
Melolin adhesive dressing 10 cm. sq. (1)
Micropore tape 2.5cms (1)
Paper (1)
Resusciade (mouth-to-mouth barrier) (1)
Safety pins (10)
Sam Splint (1)
Scissors (1)
Sharpie (1)
Stretch bandage (1)
Steri Strip (5)
Thermometer (1)
Triangular bandages (1)
Tweezers (1)
Zinc oxide roll plaster 2.5cms (1)

APPENDICES

FOOD LIST

	Breakfast	Snack AM	Lunch	Snack PM	Tea	Desserts	Drinks	Total kcal	Total W (g)
day 1	porridge oats	Twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4540.1	1028.7
	fruit and nut mix	Indian cornflake mix	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 2	porridge oats	Snickers	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4406	1109.4
	fruit and nut mix	pork scratchings	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	white chocolate	snickers	cous cous	hot chocolate	coffee/tea		
			Jerky						
day 3	fruit and nut granola	twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4578	1051.7
	raison munch bar	Indian rice sticks	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 4	porridge oats	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4418.1	1023.1
	fruit and nut mix	Indian cornflake mix	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	white chocolate	mars bar		hot chocolate	coffee/tea		
			Jerky						
day 5	porridge oats	Twix	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4492	1112.7
	fruit and nut mix	pork scratchings	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	milk chocolate	Snickers	cous cous	hot chocolate	coffee/tea		
			primula cheese						
day 6	fruit and nut granola	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4455.9	1046.1
	raison munch bar	Indian rice sticks	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	white chocolate	mars bar		hot chocolate	coffee/tea		
			Jerky						
day 7	porridge oats	twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4540.1	1028.7
	fruit and nut mix	Indian cornflake mix	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 8	porridge oats	Snickers	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4441.4	1117.7
	fruit and nut mix	pork scratchings	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	white chocolate	twix	cous cous	hot chocolate	coffee/tea		
			Jerky						
day 9	fruit and nut granola	Twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4578	1051.7
	raison munch bar	Indian rice sticks	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 10	porridge oats	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4418.1	1023.1
	fruit and nut mix	Indian cornflake mix	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	white chocolate	mars bar		hot chocolate	coffee/tea		
			Jerky						
day 11	porridge oats	twix	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4492	1112.7
	fruit and nut mix	pork scratchings	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	milk chocolate	Snickers	cous cous	hot chocolate	coffee/tea		
			primula cheese						
day 12	fruit and nut granola	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4455.9	1046.1
	raison munch bar	Indian rice sticks	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	white chocolate	mars bar		hot chocolate	coffee/tea		
			Jerky						
day 13	porridge oats	Twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4540.1	1028.7
	fruit and nut mix	Indian cornflake mix	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 14	porridge oats	Snickers	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4441.4	1117.7
	fruit and nut mix	pork scratchings	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	white chocolate	twix	cous cous	hot chocolate	coffee/tea		
			Jerky						
day 15	fruit and nut granola	twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4578	1051.7
	raison munch bar	Indian rice sticks	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 16	porridge oats	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4418.1	1023.1
	fruit and nut mix	Indian cornflake mix	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	white chocolate	mars bar		hot chocolate	coffee/tea		
			Jerky						

APPENDICES

FOOD LIST (CONTINUED)

day 17	porridge oats	Twix	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4492	1112.7
	fruit and nut mix	pork scratchings	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	milk chocolate	Snickers	cous cous	hot chocolate	coffee/tea		
			primula cheese						
day 18	fruit and nut granola	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4492	1048.4
	raison munch bar	Indian rice sticks	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	white chocolate	Snickers		hot chocolate	coffee/tea		
			Jerky						
day 19	porridge oats	twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4540.1	1028.7
	fruit and nut mix	Indian cornflake mix	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 20	porridge oats	Snickers	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4406	1109.4
	fruit and nut mix	pork scratchings	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	white chocolate	snickers	cous cous	hot chocolate	coffee/tea		
			Jerky						
day 21	fruit and nut granola	Twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4578	1051.7
	raison munch bar	Indian rice sticks	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 22	porridge oats	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4418.1	1023.1
	fruit and nut mix	Indian cornflake mix	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	white chocolate	mars bar		hot chocolate	coffee/tea		
			Jerky						
day 23	porridge oats	twix	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4492	1112.7
	fruit and nut mix	pork scratchings	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	milk chocolate	Snickers	cous cous	hot chocolate	coffee/tea		
			primula cheese						
day 24	fruit and nut granola	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4455.9	1046.1
	raison munch bar	Indian rice sticks	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	white chocolate	mars bar		hot chocolate	coffee/tea		
			Jerky						
day 25	porridge oats	Twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4540.1	1028.7
	fruit and nut mix	Indian cornflake mix	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 26	porridge oats	Snickers	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4406	1109.4
	fruit and nut mix	pork scratchings	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	white chocolate	Snickers	cous cous	hot chocolate	coffee/tea		
			Jerky						
day 27	fruit and nut granola	twix	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4578	1051.7
	raison munch bar	Indian rice sticks	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	milk chocolate	Snickers		hot chocolate	coffee/tea		
			primula cheese						
day 28	porridge oats	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4454.2	1025.4
	fruit and nut mix	Indian cornflake mix	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	fruit and nut mix	peanut butter pretzels	white chocolate	Snickers		hot chocolate	coffee/tea		
			Jerky						
day 29	porridge oats	twix	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4492	1112.7
	fruit and nut mix	pork scratchings	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	milk chocolate	Snickers	cous cous	hot chocolate	coffee/tea		
			primula cheese						
day 30	fruit and nut granola	Snickers	oat cakes	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4492	1048.4
	raison munch bar	Indian rice sticks	primula cheese	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	crunchy peanut bars	banana chips	white chocolate	Snickers		hot chocolate	coffee/tea		
			Jerky						
day 31	porridge oats	twix	sweet potato crackers	roasted/salted peanuts	exped. food packs	exped. dessert packs	Cuppa soup	4492	1112.7
	fruit and nut mix	pork scratchings	Meat stick	chocolate chip bars	Cuppa soup	mixed fruit	hot chocolate		
	dedicated coconut	jelly babies/Win Gums	milk chocolate	Snickers	cous cous	hot chocolate	coffee/tea		
TOTALS								139121.3	32994.7 per person
TEAM TOTALS								695606.37	164973.5 team

APPENDICES

EMERGENCY EVACUATION PLAN

Greenland Stauning Alps Expedition Safety Plan

Contacts

Ann Thompson	Molly's Mum	
Ken Dufton	Jesse's Dad	
Shirley Everett	Alistair's Mum	
Barbara Hill	Jen's Mum	
David Mentz	Ollie's Dad	
Paul Walker	Tangent Expeditions (logistics)	
Sat Phone contact	In field contact	

Team Member Details

Name	Molly Thompson	Jesse Dufton	Alistair Everett	Jennifer Roberts	Oliver Mentz
Passport No					
Expiry Date					
Nationality					
Date of Birth					
Mobile No					
Blood Group					
Any medical conditions					

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Insurance

Insurance details:

Name of insurance company: If Skadesforsikring, C/O Kalaallit Forsikring Agentur

Name of contact person: Allan B. Lynge

Address of insurance company: Sipisaq Avannarleq 1 • PO. Box 1071 • 3900 Nuuk

Phone number: +299 701243

Fax number: +299 324240

E-mail: kfa.privat@if.dk

Insurance Policy Number:

How to make a claim:

To initiate the processing of a rescue operation If Skadesforsikring need the following information and documentation:

- Documentation of the sequence of events
- Report from the Greenlandic authorities

It is the policy holder's responsibility to gather and send forward these information's and documentation to:

If Skadesforsikring
Stamholmen 159
2650 Hvidovre
Denmark
Phone +45 70 12 24 24
Fax +45 70 12 24 25

For evacuation, sudden illness or injury:

Politiet	Politiet
Blok G - B53	Mikip Aqq. B1150
DK-3910 Kangerlussuaq	DK-3913 Tasiilaq
Phone: +299 841222	Phone: +299 981448

Details of what is covered:

The insurance shall cover expenses for search and rescue operations carried out by aircraft, helicopter, ship, dog sledge etc. with the aim of finding the expedition or the participants of the expedition.

*In an **emergency** please contact:*

SOS International a/s

Telephone: +45 70 10 50 50

e-mail: if@sos.dk

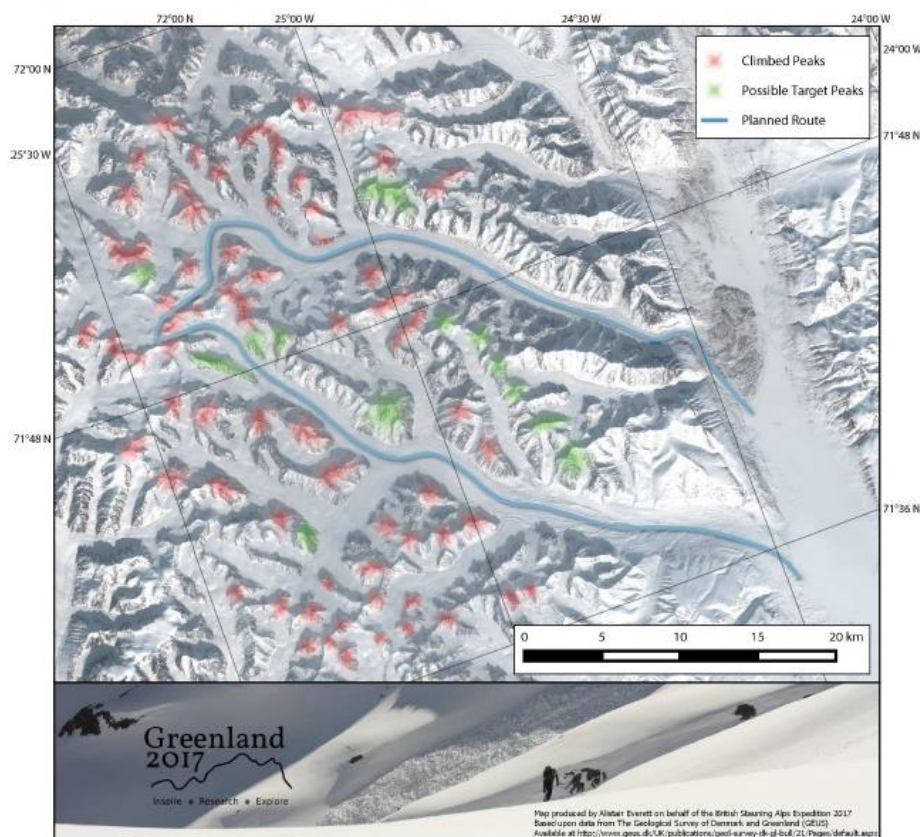
APPENDICES

General Information about the Expedition

Title of expedition	BRITISH STAUNING ALPS GREENLAND EXPEDITION 2017		
Date of arrival in Greenland	06-APRIL-2017	Date of departure from Greenland	04-MAY-2017
Place of arrival to Greenland	CONSTABLE PYNT	Place of departure from Greenland	CONSTABLE PYNT
Expedition Start Location	STAUNING ALPS ROSLIN GLACIER N71°43' W24°30'	Expedition End Location	STAUNING ALPS BJORNBO GLACIER N71°38' W24°40'
General area of activities	STAUNING ALPS, NORTHEAST GREENLAND		
Purpose of the expedition	TO SKI UP THE ROSLIN GLACIER AND RETURN DOWN THE BJORNBO GLACIER AND CLIMB MOUNTAINS IN THE CENTRAL STAUNING ALPS.		

Map or Area and Route

The outline of our intended route is shown on the map below:



APPENDICES

Itinerary

	Date	Location	Details	Notes
Tue	4th April	Reykjavik, Iceland	Fly from UK to Iceland	Flight tbc
Wed	5th April	Akureyri, Iceland	Overland travel by car across Iceland to Akureyri	Last night in a B&B
Thu	6th April	Constable Point, Greenland	Fly from Iceland to Greenland	Time of flight tbc
Fri	7th April		Snowmobile trip with guides	
Sat	8th April	Mouth of Roslin Glacier	Snowmobile trip with guides	Dropped off by Tangent Guides
Sun	9th April – 1st May	As per route plan above	On skis	Under own steam
Tue	2nd May	Mouth of Bjornbo Glacier	Snowmobile trip with guides	Pick up by Tangent guides
Wed	3rd May		Snowmobile trip with guides	
Thu	4th May	Constable Point, Greenland	Fly from Greenland to Iceland	Time of flight tbc
Fri	5th May	Fly to UK		

Emergency Procedure

Primary Personal Locator Beacon (provided by Tangent)

The team is carrying 1 primary **emergency personal locator beacon (PLB)**. When triggered these send an alert via satellite containing the team's location as specified by an integrated GPS. They operate continuously for at least 24 hours once triggered. The alert is relayed to the emergency services where the PLB is registered (Falmouth Coastguard) as well as the country where the PLB is located. A number of contacts are registered against each PLB who the emergency service will call to check that it is not an accidental activation and to find out more details about the party carrying the PLB.

Should the beacon be inadvertently activated, immediately telephone **Paul Walker** on [REDACTED] and advise your position. DO NOT turn off your beacon until advised.

Character unique ID: 1D160429BF81FE0 "Tangent 4"
Registered in Greenland and with Falmouth Coastguard.

Registered Safety Contact Details (these are the people who will be called in the event of the PLB being triggered):

	Contact Number
First Contact: Paul Walker	[REDACTED]
Second Contact: Tangent Expeditions Base	[REDACTED]

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Additional Communication Equipment (provided by Tangent Expeditions)

The team is also carrying 2 VHF radios:

- 1 x VHF air band radio
- 1 x VHF marine band radio
- 1 x Satellite phone

Evacuation Plan

1. In the event of an emergency, we will first attempt to evacuate on foot and or overland using locally available resources. Our Satellite phone shall be used to communicate our location and situation. **Priority – prevent further harm to casualty or other team members.**
2. If a rapid response is required and/or we are unable to arrange an evacuation on the ground we will set off the primary emergency PLB. **If team separated and away from base camp medical kit, assess casualty ability to move to camp. If yes, do so safely. If no, assistance must be summonsed from camp/other team.**
3. Paul Walker is likely to be the first point of contact for any emergency situation, who will be on-call throughout our expedition. Should an emergency situation arise he will co-ordinate (all his time & expenses for his involvement will be recoverable under insurance).
4. Should Paul be un-contactable/unavailable, the situation shall be co-ordinated directly by the expedition team. In this circumstance the priority will be to contact the Greenlandic Authorities, Constable Point Airport, Scoresbysund Hospital, and our UK contact and report with the 'Medical Details - Situation Report'.

In Country Contacts:

	Contact Number
Constable Point (Nerlerit Inaat) Airport	+299 99 38 50
Constable Point AFIS Airport Tower	+299 99 38 54
Scoresbysund Police	+299 99 10 22
Scoresbysund Hospital	+299 99 10 11
Greenland Police (Nuuk)	+299 32 14 48
Greenlandic Authorities	+299 84 12 22 +299 98 14 48

UK Contact:

	1 st Number
First Contact: Simon Hall	

The following 'Medical Details - Situation Report' is to be communicated:

In event of medical incident details to be communicated as follows:

1. State name and Sat phone number
2. Position – Lat and Long
3. Number of Casualties
4. If greater than one casualty deal with most serious first
5. Accident/Illness Description
6. Clinical Description

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- a. Conscious Level – AVPU
- b. Airway – clear
- c. Breathing – respiratory rate, depth
- d. Circulation – bleeding, skin colour, pulse
7. Treatment given
8. Next course of action
9. Assistance needed – evacuation (*casualty priority as below*)
10. Additional info – e.g. weather, other relevant info

Casualty Priorities:

- Priority1A Immediate evacuation, if possible from accident area
- Priority1B Immediate evacuation, can transfer from accident area to base camp
- Priority2 Urgent evacuation
- Priority3 Evacuation needed soon
- Priority4 Evacuation needed, but not life threatening

5. **The UK contact is to act as a central point of contact (until Paul Walker can be reached) and communicate our status and updates to all the contacts in the front page of this document.**
6. The expedition team are to await further instruction regarding evacuation plans.
7. The expedition team are to determine Latitude/Longitude position of nearest safe landing zone if casualty cannot move to camp.
8. The expedition team are to ensure communications remain available – both sat phone and VHF to be on, and on correct channel throughout evacuation phase. If not possible agree pre-arranged communication times and methods.

BAD WEATHER DELAYS

All team members and their next of kin and family should be made fully aware that in exceptional circumstances delays can occur with groups being picked up from the mountains. These delays are usually as a result of prolonged bad weather or storm conditions in the mountains. In the event of such an occurrence, related planned flight connections for return to the UK can also sometimes be disrupted or missed. Normally it should be possible for clients to contact family members by satellite telephone to advise them of the situation, however on occasion this may not be possible due to expired battery power, failure of the phone terminal, or disruption to the service network. In such circumstances friends and relatives should be advised prior to the expedition that a “no news is good news” attitude should be adopted unless informed otherwise.

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SCIENTIFIC DATA

STAKE LOCATIONS

Stake No.	Latitude	Longitude	Height* (m)	Length* (m)
1	71.73976	-24.5763	0.415	6
2	71.77870	-24.7166	0.685	6
3	71.79414	-24.7685	0.651	6
4	71.82855	-24.8677	0.413	6
5	71.85135	-24.9921	0.802	5
6	71.84279	-25.0032	0.474	5
7	71.84708	-24.9981	0.471	5
8	71.84423	-25.0763	0.614	5
9	71.85841	-25.1641	0.318	5
10	71.87928	-25.2438	0.275	4

Notes:

Height – the height of the stake visible above the ice surface when the stake was installed.

Length – the total length of installed stake.

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SNOW PITS

SNOW PIT NO:	3
DATE:	11.04.2017
TIME:	10:00
LAT:	1°44'23.14" N
LON:	24°34'34.54" W
SNOW DEPTH:	1.535 m
AIR TEMP:	-10.2 °C
NOTES:	

EMPTY MASS:	142.6 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-6.4	180.4	0.378
0.1	-6.5	179.5	0.369
0.2	-6.8	179.1	0.365
0.3	-7.3	179.1	0.365
0.4	-7.8	176.7	0.341
0.5	-8.6	176.3	0.337
0.6	-9.3	--	--
0.7	-10.0	176.7	0.341
0.8	-10.7	176.8	0.342
0.9	-11.5	175.2	0.326
1.0	-12.4	174.2	0.316
1.1	-13.0	174.6	0.320
1.2	-13.8	172.0	0.294
1.3	-14.9	171.6	0.290
1.4	-15.9	172.2	0.296
1.5	-15.5	162.1	0.195
Surface	-8.3	157.6	0.150

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SNOW PIT NO:	4
DATE:	11.04.2017
TIME:	19:00
LAT:	71°45'47.93" N
LON:	24°39'5.92" W
SNOW DEPTH:	1.65 m
AIR TEMP:	-16.3 °C
NOTES:	Readings taken after sunset. Down glacier breeze. Clear Skies.

EMPTY MASS:	142.6 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-6.9	174.2	0.316
0.1	-6.9	182.1	0.395
0.2	-7.1	184.4	0.418
0.3	-7.4	182.1	0.395
0.4	-7.9	179.9	0.373
0.5	-8.3	177.1	0.345
0.6	-8.8	174.9	0.323
0.7	-9.6	178.4	0.358
0.8	-10.2	175.1	0.325
0.9	-10.9	176.8	0.342
1.0	-11.9	175.9	0.333
1.1	-12.1	177.5	0.349
1.2	-12.7	173.4	0.308
1.3	-13.5	173.3	0.307
1.4	-14.1	169.9	0.273
1.5	-15.1	173.3	0.307
1.6	-16.2	162.5	0.199
Surface	-17.1	163.2	0.206

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SNOW PIT NO:	5
DATE:	12.04.2017
TIME:	10:00
LAT:	71°45'47.68" N
LON:	24°39'8.85" W
SNOW DEPTH:	1.75 m
AIR TEMP:	-8.3 °C
NOTES:	Overcast, rather pleasant. V. uneven ice at bottom of snow pit

EMPTY MASS:	142.8 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM3)
0.0	-6.4	--	--
0.1	-6.5	184.5	0.417
0.2	-6.8	183.5	0.407
0.3	-7.1	182.5	0.397
0.4	-7.4	183.2	0.404
0.5	-7.8	179.5	0.367
0.6	-8.3	180.7	0.379
0.7	-8.8	183.3	0.405
0.8	-9.4	177.0	0.342
0.9	-10.0	175.8	0.330
1.0	-10.6	179.0	0.362
1.1	-11.4	175.0	0.322
1.2	-11.9	175.5	0.327
1.3	-12.6	178.1	0.353
1.4	-13.1	173.0	0.302
1.5	-14.1	161.3	0.185
1.6	-15.0	168.7	0.259
1.7	-15.0	166.1	0.233
Surface	-13.5	158.5	0.157

APPENDICES

SNOW PIT NO:	6
DATE:	12.04.2017
TIME:	14:00
LAT:	71°46'43.32" N
LON:	24°42'59.58" W
SNOW DEPTH	1.75 m
AIR TEMP:	-3.6 °C
NOTES:	Clear and sunny. Large snow crystals at base.

EMPTY MASS:	143.3 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-6.3	179.2	0.359
0.1	-6.7	183.9	0.406
0.2	-7.1	185.2	0.419
0.3	-7.4	182.8	0.395
0.4	-7.8	182.5	0.392
0.5	-8.2	179.7	0.364
0.6	-8.7	178.5	0.352
0.7	-9.2	182.4	0.391
0.8	-9.8	177.9	0.346
0.9	-10.3	178.3	0.350
1.0	-10.9	179.1	0.358
1.1	-11.5	177.8	0.345
1.2	-12.1	175.9	0.326
1.3	-12.6	177.8	0.345
1.4	-13.4	172.0	0.287
1.5	-14.3	167.7	0.244
1.6	-14.3	169.8	0.265
1.7	-8.9	159.5	0.162
Surface	-4.7		

APPENDICES

SNOW PIT NO:	7
DATE:	12.04.2017
TIME:	20:30
LAT:	71°47'38.91" N
LON:	24°46'6.69" W
SNOW DEPTH	1.85 m
AIR TEMP:	-15.4 °C
NOTES:	In the shade. Too icy near bottom to get density

EMPTY MASS:	143.1 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-7.2		
0.1	-7.1		
0.2	-7.4	182.1	0.39
0.3	-7.7	181.9	0.388
0.4	-8.1	182.5	0.394
0.5	-8.6	180.8	0.377
0.6	-9.0	178.6	0.355
0.7	-9.5	177.4	0.343
0.8	-10.2	181.4	0.383
0.9	-10.7	179.4	0.363
1.0	-11.3	178.1	0.35
1.1	-11.8	178.0	0.349
1.2	-12.7	174.9	0.318
1.3	-13.1	173.8	0.307
1.4	-13.7	175.1	0.32
1.5	-14.3	174.0	0.309
1.6	-14.6	169.4	0.263
1.7	-14.4	170.6	0.275
1.8	-15.1	165.0	0.219
Surface	-15.9		

APPENDICES

SNOW PIT NO:	8
DATE:	13.04.2017
TIME:	14:00
LAT:	71°49'42.79" N
LON:	24°52'3.80" W
SNOW DEPTH:	1.65 m
AIR TEMP:	-8.4 °C
NOTES:	Clear and sunny. Large snow crystals at base.

EMPTY MASS:	143.2 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-7.5	169.5	0.263
0.1	-8.0	180.6	0.374
0.2	-8.5	179.1	0.359
0.3	-8.9	179.6	0.364
0.4	-9.3	179.5	0.363
0.5	-9.8	177.0	0.338
0.6	-10.3	175.8	0.326
0.7	-10.8	174.4	0.312
0.8	-11.5	182.5	0.393
0.9	-12.0	176.5	0.333
1.0	-12.6	180.6	0.374
1.1	-13.1	176.0	0.328
1.2	-13.6	173.6	0.304
1.3	-14.3	172.2	0.290
1.4	-14.6	168.2	0.250
1.5	-14.0	166.8	0.236
1.6	-11.3	169.5	0.263
Surface	-8.8		

APPENDICES

SNOW PIT NO:	9
DATE:	14.04.2017
TIME:	14:00
LAT:	71°51'4.84" N
LON:	24°59'31.66" W
SNOW DEPTH:	1.65 m
AIR TEMP:	-6.1 °C
NOTES:	Down glacier wind, cloudy, sun breaking through

EMPTY MASS:	143.2 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-8.0		
0.1	-8.6	176.2	0.330
0.2	-9.2	183.0	0.398
0.3	-9.6	176.8	0.336
0.4	-10.2	177.9	0.347
0.5	-10.8	174.6	0.314
0.6	-11.3	172.9	0.297
0.7	-11.9	178.5	0.353
0.8	-12.8	177.4	0.342
0.9	-13.5	176.4	0.332
1.0	-14.1	175.9	0.327
1.1	-14.7	175.0	0.318
1.2	-15.2	171.2	0.280
1.3	-15.6	172.6	0.294
1.4	-15.7	168.9	0.257
1.5	-14.8	166.3	0.231
1.6	-11.3	163.4	0.202
Surface	-7.9		

APPENDICES

SNOW PIT NO:	10
DATE:	14.04.2017
TIME:	16:00
LAT:	71°50'34.04" N
LON:	25° 0'11.60" W
SNOW DEPTH:	1.4 m
AIR TEMP:	-8.7 °C
NOTES:	Overcast/Clearing from cloudy, down glacier wind

EMPTY MASS:	143.2 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-8.2		
0.1	-9.6	178.8	0.356
0.2	-10.2	181.7	0.385
0.3	-10.8	177.2	0.340
0.4	-11.4	173.7	0.305
0.5	11.9	172.6	0.294
0.6	-12.7	179.6	0.364
0.7	-13.4	178.3	0.351
0.8	-13.9	172.9	0.297
0.9	-14.4	176.4	0.332
1.0	-14.7	168.6	0.254
1.1	-14.9	173.6	0.304
1.2	-14.5	168.7	0.255
1.3	-12.9	171.1	0.279
Surface	-10.4	165.5	0.223

APPENDICES

SNOW PIT NO:	11
DATE:	14.04.2017
TIME:	17:00
LAT:	71°50'49.48" N
LON:	24°59'53.12" W
SNOW DEPTH:	1.55 m
AIR TEMP:	-8.6 °C
NOTES:	Low cloud to glacier level, no wind

EMPTY MASS:	143.1 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-8.5		
0.1	-9.5	182.6	0.395
0.2	-10.0	179.0	0.359
0.3	-10.6	182.6	0.395
0.4	-11.1	175.8	0.327
0.5	-11.5	175.5	0.324
0.6	-12.2	182.2	0.391
0.7	-12.8	180.6	0.375
0.8	-13.3	176.6	0.335
0.9	-13.9	178.9	0.358
1.0	-14.4	173.6	0.305
1.1	-14.8	173.3	0.302
1.2	-15.1	173.3	0.302
1.3	-14.9	168.4	0.253
1.4	-13.8	174.4	0.313
1.5	-11.8	168.6	0.255
Surface	-10.6		

APPENDICES

SNOW PIT NO:	12
DATE:	15.04.2017
TIME:	11:50
LAT:	71°50'39.24" N
LON:	25° 4'34.53" W
SNOW DEPTH:	1.6 m
AIR TEMP:	-9.5 °C
NOTES:	Sunny, down glacier wind

EMPTY MASS:	142.8 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-9.4		
0.1	-9.9	177.2	0.344
0.2	-10.3	180.4	0.376
0.3	-10.7	178.0	0.352
0.4	-11.4	179.6	0.368
0.5	-11.9	179.1	0.363
0.6	-12.3	173.6	0.308
0.7	-13.1	183.2	0.404
0.8	-13.6	177.0	0.342
0.9	-14.0	183.3	0.405
1.0	-14.4	181.3	0.385
1.1	-14.7	173.0	0.302
1.2	-14.8	173.6	0.308
1.3	-15.0	172.8	0.300
1.4	-14.9	173.2	0.304
1.5	-14.5	169.5	0.267
Surface	-9.6	163.8	0.210

APPENDICES

SNOW PIT NO:	13
DATE:	15.04.2017
TIME:	16:00
LAT:	71°51'30.26" N
LON:	25° 9'50.62" W
SNOW DEPTH:	1.75 m
AIR TEMP:	-11.1 °C
NOTES:	Sunny, light down-glacier breeze

EMPTY MASS:	142.5 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-9.3		
0.1	-9.9	178.4	0.359
0.2	-10.4	181.5	0.390
0.3	-10.9	178.4	0.359
0.4	-11.3	178.2	0.357
0.5	-11.8	177.2	0.347
0.6	-12.3	174.8	0.323
0.7	-13.0	171.9	0.294
0.8	-13.8	178.3	0.358
0.9	-14.3	179.6	0.371
1.0	-14.9	181.0	0.385
1.1	-15.4	177.5	0.350
1.2	-15.9	173.6	0.311
1.3	-16.2	172.8	0.303
1.4	-16.6	170.8	0.283
1.5	-16.8	171.4	0.289
1.6	-16.5	168.0	0.255
1.7	-15.7	163.0	0.205
Surface	-14.3		

APPENDICES

SNOW PIT NO:	14
DATE:	16.04.2017
TIME:	13:30
LAT:	71°52'45.39" N
LON:	25°14'37.76" W
SNOW DEPTH:	1.7 m
AIR TEMP:	-14.3 °C
NOTES:	Strong, wind. Cold. Tough conditions

EMPTY MASS:	142.6 g
VOL:	100 cm ³

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM ³)
0.0	-8.7		
0.1	-8.8	172.2	0.296
0.2	-9.7	176.2	0.336
0.3	-9.8	180.6	0.380
0.4	-10.2	180.8	0.382
0.5	-10.7	178.5	0.359
0.6	-11.3	178.4	0.358
0.7	-11.6	173.8	0.312
0.8	-12.4	174.5	0.319
0.9	-13.0	181.4	0.388
1.0	-13.7	179.8	0.372
1.1	-14.3	182.6	0.400
1.2	-14.7	178.9	0.363
1.3	-15.2	172.5	0.299
1.4	-16.3	172.6	0.300
1.5	-17.3	170.5	0.279
1.6	-18.0	171.6	0.290
1.7	-15.5	168.6	0.260

APPENDICES

SNOW PIT NO:	14
DATE:	16.04.2017
TIME:	13:30
LAT:	71°52'45.39" N
LON:	25°14'37.76" W
SNOW DEPTH:	1.7 m
AIR TEMP:	-14.3 oC
NOTES:	Strong, wind. Cold. Tough conditions

EMPTY MASS:	142.6 g
VOL:	100 cm3

METRES ABOVE ICE	TEMPERATURE	MASS (G)	DENSITY (G/CM3)
0.0	-8.7		
0.1	-8.8	172.2	0.296
0.2	-9.7	176.2	0.336
0.3	-9.8	180.6	0.380
0.4	-10.2	180.8	0.382
0.5	-10.7	178.5	0.359
0.6	-11.3	178.4	0.358
0.7	-11.6	173.8	0.312
0.8	-12.4	174.5	0.319
0.9	-13.0	181.4	0.388
1.0	-13.7	179.8	0.372
1.1	-14.3	182.6	0.400
1.2	-14.7	178.9	0.363
1.3	-15.2	172.5	0.299
1.4	-16.3	172.6	0.300
1.5	-17.3	170.5	0.279
1.6	-18.0	171.6	0.290