Poster Abstracts

Abstracts submitted with applications are listed as in the participant list, alphabetical by first name.
UKPN Cryospheric Sciences Workshop, University of Sheffield, 4-6 November, 2009

Aisling Dolan
Modelling late Pliocene Greenland glaciation: a test of ice sheet model dependency

Prior to 3 million years ago it is thought that only ephemeral glaciation existed in the Northern Hemisphere. During the late Pliocene, however, Northern Hemisphere glaciation intensified. Several hypotheses have been proposed to explain this increase in glaciation: the termination of a permanent El Nino, the opening of the Panama seaway, the tectonic uplift of mountain regions and a decrease in atmospheric carbon dioxide. Lunt et al (2008) presented ice sheet modelling results (using the GLIMMER ice sheet model) which suggested that even with the application of a favourable cold orbit, the largest control on the growth of the Greenland ice sheet was the decline in atmospheric carbon dioxide during the late Pliocene. Here we present an investigation as to how dependent these results are on the ice sheet model used. Following Lunt et al (2008) we use the same driving climatology and glaciological parameters, but a different thermomechanically coupled ice sheet model (BASISM). We present an ensemble of ice sheet simulations testing the four main hypotheses and provide a comparison with the work by Lunt et al (2008).

Alice Joana de Almeida Pena Ribeiro Ferreira
Analysis of air and soil freezing indexes to determine the influence of snow cover on the ground thermal regime

The n-factor is the ratio between the seasonal degree-day sum of air and ground surface temperatures and it is used to assess the relation between atmosphere and soil, with regard to heat exchange. By analysing the freezing indexes and n-factors during the cold season we can evaluate the influence of microclimatic variables on soil thermal regime, particularly snow cover, which is of decisive significance in permafrost regions. The snow pack season, thickness and physical properties are crucial in determining the thermal characteristics and spatial distribution of permafrost.

In the Antarctic Peninsula the knowledge about permafrost and its climatic sensitivity is still very scarce and with average annual air temperatures ranging between -4 and -2ÂºC, therefore close to the climatic threshold of permafrost, the study of freezing indexes in key locations will help understanding the influence of snow cover on soil thermal regime.

In this presentation, we analyze air and soil surface temperatures for three sites in different geographical situations in Hurd Peninsula (Livingston Island, Antarctic). The preliminary results show that where the n-factor is smaller, there is more snow cover, so the buffer effect of snow cover between air and ground is largest. The effects on ground temperature regimes are analyses through these differences in snow cover.

Allen Pope
Recent Changes to Langökull, Iceland: Integrating airborne LiDAR and satellite imagery

Langjökull, Iceland's second largest icecap (~950 km2), was the subject of an incomplete airborne LiDAR survey in August 2007. This study investigates and evaluates the application of photoclinometry, which employs visible light imagery (here, Landsat ETM+ band 4) to interpolate unmeasured sections of this fragmented data set. Using the completed DEM of Langjökull for summer 2007 and a previously prepared corresponding 1997 data set, Langjökull was found to have a specific annual mass balance of -0.99 + 0.1 m yr-1 w.e. Comparison of remotely-sensed mass balance values and traditional in situ measurements revealed a possible systematic disparity; it is hypothesized that field measurements may not be sufficiently constraining behaviour of interior areas and that the signal from strongly receding outlet glaciers may be skewing the in situ mass balance value calculated for the entire icecap. The new 2007 DEM allowed for clear visualization of strong recession on several Langjökull outlets as well as interior mass loss and terminus advance witnessing to the 1998 surge event of outlet Hagafellsjökull Eystri. In

addition, slight interior elevation increase and anti-correlated mass loss and terminal retreat potentially indicate a future surge of outlet Hagafellsjökull Vestari. The technological and glaciological information put forward in this study provides a method for innovative cryospheric research, presents a much needed benchmark and update on the state of Langjökull, and ultimately facilitates and encourages continued monitoring of highly important smaller glaciers and icecaps.

Amanda Ferguson
The sedimentological and glaciological relationships between tills, flutes and crevasse-fill ridges during a surge, Eyjabakkajökull, Iceland

Compared to other landforms and landform assemblages in glacier forelands, limited research has been carried out into crevasse-fill ridges and their relationship to flutes and the sediments below them. This is partly due to the ephemeral nature of the features and the effect of dead ice decay, but also the restrictions caused by the inaccessibility of potential sites. Eyjabakkajökull is a surging glacier situated on the North Eastern margin of Vatnajökull, Iceland, where as a consequence of recent surges, a variety of landforms, including crevasse-fill ridges and flutes, have been superimposed on the pre-existing landscape.

At Eyjabakkajökull the crevasse-fill ridges appear to be draped across the flutes; this observation contradicts with previously published models which suggest that flutes indicate coupling to the bed whilst the crevasse-fill ridges are taken to reflect de-coupling from the bed. Sedimentological and micromorphological analysis of these landforms, individually and at points of intersection, have identified characteristic structures associated with them. The crevasse-fill ridges suggest de-coupling from the bed has occurred and the till has been squeezed up. Where it intersects with a flute the till is forced up through the flute, but the cross-section through the crevasse-fill ridges shows little evidence of the flute's existence. Although these landforms developed in the same surge it does suggest that they did not form concurrently; instead the flute appears to have formed first, squeezed up and pushed through the crevasse-fill ridge.

Andrew Gray

Having just started an MSc in Polar and Alpine Change at the University of Sheffield, the topic of my poster will pertain to the subject area of my thesis.

Chad Ellis
Sensitivity of Radiation to Snow in Rocky Mountain Coniferous Forests

Coniferous forests cover much of the Rocky Mountain landscape from where snowmelt runoff is a critical water resource to Western North America. Energy for snowmelt in forests is dominated by radiation, which is strongly affected by forest cover through the extinction of shortwave radiation while simultaneously increasing longwave irradiance to snow via forest thermal emissions. Consequently, radiation to forest snow varies greatly with forest cover density and atmospheric condition, and is further complicated in mountain environments by the large ranges in slope, aspect and elevation. This study investigates the sensitivity of radiation to snow to changes in forest cover density, atmospheric condition, slope, aspect and elevation using a physically based model estimating shortwave and longwave fluxes to forest snow. Particular attention is paid to the effect of longwave emissions from forests heated by shortwave radiation absorption. This feature is simulated by calculating the vertical distribution of shortwave absorption in the canopy and the probability of longwave emissions from heated foliage being transferred to sub-canopy snow. The model provides a useful representation of the widely varying shortwave and longwave radiation regimes observed on hillslopes of various grade and aspect and at differing elevations. Seasonal model simulations show that maximum cumulative radiation to snow occurs for very different forest cover densities on slopes of varying aspect, suggesting that the impact of changes in mountain forest cover on the timing and rate of snowmelt are strongly controlled by topography.

Christine Wesche
Detection of small icebergs in the Weddell Sea, Antarctica, using SAR images

Iceberg calving is the most important loss term in Antarctica's mass balance and has an effect on its physical and biological environment. Current mass balance studies can only rely on systematic observations of larger icebergs with edges of > 10 km, whereas data about numbers and sizes of smaller icebergs (edges of 100m to 10 km) are sparse so that their contribution can only be estimated.

We present a method for detecting small icebergs in SAR images from the Weddell Sea, Antarctica. According to the season, icebergs appear as bright or dark targets in SAR images. Statistical analyses of the iceberg signatures show that the threshold of bright and dark appearing icebergs can be fixed at -7.5 dB for ERS-2 SAR images.

For a first classification, SAR images were divided into two groups with mainly bright and mainly dark appearing icebergs, independent from the radar signature of the environment (open water, sea ice). With the aid of a Weibull distribution, the statistical significance of backscattering of icebergs and background is investigated and shows overlapping backscattering ranges, where the icebergs cannot certainly be separated from the background. In-between these ranges a constant false alarm rate (CFAR) is used to detect icebergs. Beyond the overlapping ranges a threshold decides, whether the image pixel belongs to an iceberg or to the background. This combination of detection methods provides a detection performance of 70 %. It is assumed, that the integration of seasonal variations in the backscattering coefficients will improve the detection algorithm a lot. This work is in progress.

Claire McKay

My poster will consist of my potential M.Sc. thesis; my research topic which will not have stabilised until the latter half of my first semester. Areas I am particularly interested in are palaeoclimate, ice core studies, glacial geology and sedimentology.

Clare Boston
Geomorphological mapping in the Monadhliath Mountains, central Scotland: assessing the use of remotely sensed data and field surveys"

The analysis of geomorphological evidence has been used as an approach for reconstructing former ice masses for over 150 years. Traditional field surveys have been greatly aided by the availability of aerial photographs since the 1950s and more recently by satellite and airborne imagery from the 1970s onwards. Remotely sensed data has facilitated rapid reconnaissance mapping over large areas and enabled the identification of large-scale landform patterns, which are often indistinguishable at a smaller scale (Clark, 1997). In particular, NEXTMap Great Britain (NEXTMap) has significantly contributed to our understanding of the palaeogeography of the British-Irish Ice Sheet (BIIS) over the last 3-5 years due to its high spatial resolution of 5m and its relatively widespread availability.

Glacial landforms were mapped in the Monadhliath Mountains, central Scotland, using a combination of NEXTMap, aerial photographs and field surveys. Whilst the same landforms were recognised using all three techniques, significant differences occurred in the way these features were depicted on the maps produced, particularly in terms of the size and scope of these landforms, raising a number of questions: How compatible are these techniques and can they be used interchangeably? How does remotely sensed mapping compare to traditional field surveys in terms of both time and accuracy? How can we make the most of all of this data in order to produce an accurate and detailed representation of the landforms present?

Danielle Pearce
Reconstruction of Younger Dryas plateau icefields: a glaciological perspective and palaeoclimatic implications

The thesis investigates Younger Dryas ca. (12.7-11.5 cal. ka BP) plateau icefields in the English Lake District. Reconstructing the palaeo-climate and glacial processes that operated during this time is crucial to further the understanding of past atmosphere-cryosphere interactions and for calibrating numerical climate models. Environmental changes during the stadial have been documented by both proxy-based records and model simulations but there is currently a disparity between Younger Dryas palaeo-temperature derived from sub-fossil assemblages and the values from ice mass reconstruction, thus effecting the validity of the models. In short, the sub-fossil proxy record in the British Isles denotes an Arctic style stadial that experienced a broadly cold and dry climate but palaeo-climatic reconstructions based on ice masses consistently produce a warm and wet maritime climate at the glacier Equilibrium Line Altitude (ELA).

To address this issue empirical data from a modern analogue and a multi-proxy approach were combined. Field mapping using standard techniques in glacial geology and a morphostratigraphical approach are integrated using high-resolution DTMs and GIS producing a geomorphological map from which the 3-D form of the plateau icefield was reconstructed. Palaeoclimatic variables derived using established techniques and additionally re-calculated using contemporary meteorological data collected on and off-ice in Iceland.

Preliminary results indicate a 3°C difference in temperature purely due to the effect of a glacierised surface. When applied to the reconstructed Lake District icefield this lowers palaeo-climatic variables at the ELA by ca. 31% to a scenario that is more in-line with sub-fossil records and an Arctic style stadial.

Delia Gheorghiu
Testing climate synchronicity between Scotland and Romania since the Last Glacial Maximum

This project will attempt to test climate synchronicity between the Rodna Mountains, Romania (high altitude, mid latitude) and Monadhliath Mountains, Scotland (low elevation, high latitude).

The morphostratigraphy of the Monadhliath Mountains suggests two episodes of glaciation: an older one during the Late Devensian, as part of an overall ice sheet deglaciation, and a subsequent separate valley/ice cap glaciation (Younger Dryas). The relative chronology was supplemented with surface exposure dating using the in situ produced cosmogenic nuclide ^{10}Be. Two ^{10}Be exposure ages from an esker indicate deglaciation ca. 13.9 ± 1.4 ka at 300 m, the lowest elevation in the study area. Another Late Glacial advance occurred during the Younger Dryas stadial as boulders from moraines in 3 corries yielded exposure ages between 12.4 - 11.0 ka (400 - 650 m).

Field evidence suggests that during the Devensian glaciation, ice reached lower elevations (~ 750 m) in Rodna Mountains than previously suggested. The cosmogenic nuclide exposure ages provide a preliminary chronology for ice retreat. Two boulders were abandoned about 36.8 ± 1.0 ka at an elevation of ~ 850 m. Glacial erratics and bedrock samples (n = 27) provide a good chronology for deglaciation during the Late Glacial, suggesting that ice retreated into the corries between 18.1 - 13.2 ka (1100 - 1800 m altitude). Final deglaciation took place in the corries at about 12.5 - 11.2 ka (n = 8).

Continuing field and laboratory analysis will further constrain spatial and temporal limits of glaciation allowing ice masses and palaeoenvironmental conditions to be reconstructed within the Rodna and Monadhliath Mountains.

Eleanor Rainsley
Holocene Stability of the Greenland Ice Sheet

This poster communicates a new research project being undertaken in Sermilik Fjord, East Greenland, previously a major ice stream of the Greenland Ice Sheet (GRIS). The extent of the GRIS throughout the Holocene is currently not fully understood. Conventionally it is argued the ice sheet reached a minimum during and following the Last Glacial Maximum (LGM); however, some more recent research has argued for a "maximum" model of LGM ice extent in Greenland, with ice filling all coastal troughs. As such, major fjord systems such as Sermilik - which incorporates Helheim fjord, one of the largest outlet glaciers of the current GRIS - present ideal opportunities to resolve this issue.

Through the development of the glacial chronology of Sermilik Fjord throughout the Holocene, this study will allow the links between climate and the long-term dynamics of the GRIS to be better understood. From this, it is expected that a greater insight will be gained into the current accelerated thinning rate of the southern GRIS margin; such an improved knowledge of outlet glacier dynamics offers the opportunity to improve the precision of ice sheet models used to predict sea level rise.

A combination of absolute and relative dating techniques is being used to achieve this, with a focus upon terrestrial cosmogenic nuclide (TCN) dating. This will be supported by palaeoclimatic data inferred from pollens and chironomids. Extracted from terrestrial sediment cores from three sites in Sermilik, initial results of these are presented in conjunction with the field data of seven TCN vertical "dip stick" transects taken along the fjord.

Emily Fraser
Using airborne laser altimetry to improve the treatment of vegetation in global estimates of snow water equivalent from passive microwave instruments

The determination of vegetation structure from airborne laser altimetry measurements will be used to advance retrievals of snow water equivalent (SWE) from passive microwave instruments. Defining the physical characteristics of vegetation in the satellite pixel area will allow the development of retrieval algorithms which can remove the effect of the biomass canopy and allow variables such as SWE or soil moisture to be more accurately derived from remotely sensed observations. Laser altimetry data has been acquired as part of the University of Melbourne's National Field Experiment in 2006 which ran three 17km flights over a study area in the Yanco area of the Murrumbidgee catchment in Australia. The idea of using laser altimetry to determine vegetation structure is not new (e.g. Houldcroft et al. 2005), but our intent is to advance the technique and apply it to advance skill in retrieving environmental variables from passive microwave observations.

The effect of vegetation in the area of a satellite pixel is a major source of error in snow SWE retrievals, causing underestimations of SWE of up to 50% (Foster et al. 2005). To retrieve SWE in forested areas, the value as retrieved using Chang's algorithm (Chang et al. 1987) is often adjusted by a simple forest factor, for instance the fraction of forest cover in the scene, as derived from satellite vegetation measurements or databases (Clifford, in press). 'Correction' of retrieved SWE to account for vegetation in this way is common although results from transects in Canada (Derksen at al. 2005) have suggested that there is little or no correlation between fractional forest cover and SWE underestimation: forest inventory variables such as stem volume and canopy closure are suggested as more physically relevant to the retrieval. Such characteristics of the structure of vegetation have been shown to be retrievable from airborne laser altimetry, which is an important step towards the development of a more physically based retrieval algorithm for SWE from SMMR measurements.

My presentation may also include data from the Reynolds Creek Experimental Watershed in Idaho*, where high densities of vegetation, notably sagebrush, cause significant underestimates of snow mass and SWE retrieved from passive microwave instruments, when validated against data collected in situ.

* In association with Dr Adam Winstral (ARS, USDA)

Hannah Mathers
Constraining ice sheet dynamics in North West Scotland using cosmogenic nuclide analysis

The extent and volume of the last British Ice Sheet in Scotland remains undefined. Predictions vary considerably on the thickness, lateral extent and flow regime of the ice mass. Recent work has highlighted the importance of ice stream activity in governing mass balance, and position of ice margins. This project focuses on north west Scotland, where the suggestion of a dynamic margin is supported by evidence for a palaeo-icestream in The Minch. Using cosmogenic isotope analysis, this project will provide quantitative data to constrain icestream dynamics and lateglacial ice sheet geometries. High resolution offshore data will provide a seamless extension to NEXTMap surface models, allowing the cosmogenic data to be contextualised within a regional ice margin setting. Specifically this project will address: evidence for ice-sheet limits (both vertical and horizontal); reconstruction of former ice-flow dynamics; and chronological constraints on ice-sheet retreat.

Heather Channon
The subglacial characteristics of the Tweed Palaeo Ice Stream, British Ice Sheet.

The landforms and sediments of palaeo ice stream beds can provide important data on the basal characteristics and flow mechanisms pertaining to rapid flow. The Tweed Ice Stream drained a substantial sector of the last (LGM) British Ice Sheet, flowing eastwards from the Southern Uplands to the present day coastline where it was deflected and became confluent with the southerly-flowing North Sea ice. This study applies a range of techniques to present a comprehensive depiction of the Tweed Ice Stream subglacial environment at multiple scales. Subglacial bedforms were mapped from a high resolution (5 m) digital elevation model and variations in their morphometry were analysed both along and across the ice stream bed. Sedimentological studies were conducted at sites within the ice stream bed and directly outside the ice stream bed and include lithofacies analysis, clast fabric, particle size distribution, clast morphology analysis, geotechnical measurements and micromorphological sampling and analysis.

This analysis shows that the ice stream bed is characterised by an isochronous swarm of elongated drumlins and subglacial meltwater channels. The abundance and character of these landforms are different for the northern and southern lateral margins of the ice stream allowing inferences to be made about the dynamics and hydrological characteristics of these margins. Evidence from the ice stream subglacial sediments indicates that the bed was deforming up to a depth of 6 metres. Clast fabric measurements are highly variable over short distances and display both transverse and parallel orientations to former ice flow.

Holly Reay
Poster Abstract

As part of the OASIS Barrow 09 campaign (US-French-Canadian-British field work) the UV-visible optical properties of snow and sea-ice were measured. The snowpacks studied can be characterised into 4 representative types based on optical criteria: hard windpack, soft windpack, inland snow and snow on sea-ice. Using a radiative transfer model we have a) predicted fluxes of NOx from snowpack owing to NO3- photolysis, and b) measured absorption spectra of snowpack impurity. The predicted fluxes are important from the oxidizing capacity above snow and the absorption spectra is climatically important for ice-albedo feedback.

Iain Leighton
Palaeo-Ice streams: the sedimentary signature

What goes on in the subglacial environment is crucial for an understanding of glacier dynamics. Processes at the ice-substrate interface are still poorly understood, and, as a consequence, the ‘basal boundary’ still constitutes a major uncertainty in ice sheet modeling.

The uncertainties are particularly evident where fast flowing bodies of ice, such as ice streams are concerned. While recent glaciological research highlights the importance of understanding fast glacier

flow, notably in the context of ice sheet stability and future sea level rise the knowledge of what controls ice streaming is mostly theoretical and mainly conceptual in character.

There seems to be a general consensus that variations in glacier velocity are related to changes in subglacial hydrology and substrate rheology but convincing empirical evidence has yet to be presented. This study will examine sedimentary microstructures found in sediments taken from different locations around suspected palaeo-ice stream pathways South Central Alberta, Canada. If indeed glacier velocity is controlled by hydrology and rheology then it can be expected that some form of signature will be left behind in the sediments.

A macroscopic description will be complemented by a microscopic analysis which will include texture, structure, and deformation signature. This study will then be correlated with land form analysis from the same area in order to help create a set of sedimentological criteria for the identification of sediments that have once been overridden by ice stream events.

Using this it is hoped that more accurate mapping of palaeo-ice streams can increase our knowledge of the past and aid in the modeling and understanding of future events.

Inka Koch

Annual ice content and oxygen isotope ($\delta^{18}O$) maxima in two short ice cores dated 1975- 2000 and 1966-1999 from the Prince of Wales Icefield, Ellesmere Island, Canada, accurately reflect major changes in summer climate and glacier mass balance. Mean annual ice content increases with annual positive degree-day totals (sum of mean daily temperatures > 0°C), and records a region wide decrease in glacier mass balance around 1987. The annual $\delta^{18}O$ maxima provide a record of the summer air temperatures during precipitation events and capture an increase in regional summer temperatures around 1980. Vapor diffusion is highly dependent on firn/ice density and introduces significant systematic noise into the seasonal oxygen isotope record. This was removed though back-diffusion of the seasonal $\delta^{18}O$ signal using a model that was modified to account for sporadic ice layers within the firn. These findings will aid in the interpretation of summer climate proxies from long ice cores extracted from the same icefield and provide new methods to assist in the interpretation of ice cores taken from areas of periodic melt.

James McIntosh

My MSc course commences in October - the poster is likely to be related to my dissertation proposal.

Jonny Kingslake

Having started my PhD this Autumn, I am not sure on the content of my poster. It will most likely be a summary of previous work done in the field of theoretical prediction of jokulhlaup hydrographs and peak discharge. It will also include a brief plan of where my project will be heading. The broad aims of the project include; modeling of floods, using both well established physics and newly developed ideas, analysis of data from previous work and fieldwork in the Tien Shan Mountains. As with most physical models, the earliest works on outburst floods made several simplifications. The ice at the bed and the water flowing through any tunnels at the bed were assumed to be at the pressure melting point. These assumptions have been taken out in later works along with some generalisation of the shape of the tunnel cross-section. This project will aim to contribute to one of the many remaining areas of this field which require attention and to correlate any corrections to the models with real-world data. Fieldwork will be conducted at a marginal lake which drains sub-glacially on a near annual basis. This time will be used in gathering data on all aspects of the event including; flood hydrographs, lake topography, glacial displacement during a flood, environmental factors (air temp and melt-water supply) and water temperature both in the lake and at the snout.

Joseph Cook
Cryoconite Holes: New Theories from Modelling and Fieldwork

Despite many studies concerning the microbiology, biogeochemistry and hydrology of cryoconite holes, very little has been written to explain how and why these features come to be, and why they attain the characteristic dimensions which are observed in the field. To rectify this, cryoconite holes have been examined under a combined field and modelling framework. Data collected on Austre Broggerbreen (Svalbard) during the summer of 2009 is presented to support new theories concerning the spatio-temporal physical evolution of cryoconite holes derived from modelling experiments.

Katherine Bazeley

The poster examines the geomorphological and sedimentological processes of jökulhlaups (outburst floods) in an area of glacial retreat, on the Súla River, south-east Iceland, with the aim of assessing the impacts of these floods on the river system. The Súla is an outflow of Skeiðarárjökull, located on the western margin of Skeiðarársandur, the world's largest glacial outwash plain. Jökulhlaups have been recorded to have drained through the Súla system and have significant geomorphological and sedimentological impacts upon it. These impacts are due to the erosional and depositional action of the floods, which cause major re-working of sediment. The magnitude of these floods could be great enough to cause considerable damage, not only to the ice-marginal environment, but also to the infrastructure in the surrounding area; in particular Route 1 - the major route way across the south of Iceland.

This investigation looks to assess the past impacts of jökulhlaups on the Súla system, and thus attempt to predict the magnitude and frequency of subsequent floods. The most significant jökulhlaup on the Súla River occurred in 1996, when a volcanic eruption beneath Vatnajökull ice-cap caused 3.8 km^3 of water to be released from beneath the glacier. By looking at the impacts of this flood on the Súla system, with particular focus on the terraces that it formed, and the debris and sediment that were deposited in both the ice-proximal and distal parts of the river, future floods could be modelled. Furthermore, by assessing the changes in the morphology of the river channels, landforms and deposits over time (through looking at aerial photos and mapping of the current environment), future landscape changes could also be predicted.

Kristian Marr

I am a taught masters (Polar and Alpine Change MSc) student at the University of Sheffield and I will only begin my course this week. My poster will most likely consist of my thesis topic, however, I have only begun my course this week, therefore I have not decided upon a topic.

Laura Comeau
Modelling snow distribution and melt across Arctic landscapes and the implications for human activities

The quantity and distribution of snow across the landscape and timing of the spring snowmelt is key to understanding a diverse range of Arctic processes, from the hydrological cycle and glaciation through to ecological and human-environment interactions. The viability of Norse settlement in Greenland and Thule Inuit migration are likely to have been influenced by 13^{th}-17^{th} Century climate variations, but what was the role of changing snow and to what extent did human practices affect the snowcover? Understanding how past climate variations and human influence on the landscape have affected snowcover enables current populations to prepare for the potential impacts of future climate change. Arctic landscapes are typically remote, inaccessible and lack observation data, especially at high resolutions and spanning multi-decadal time periods. Models are therefore valuable tools for understanding the impacts of variations in snow distribution and snow water equivalent as a result of climate and landscape change. A physically based, high resolution snow model is tested through fieldwork in Arctic Sweden at a research site with detailed landscape and climate data. The idea is to explore methods of model transfer, using both temperature index and energy balance melt models, from data rich sites to data poor areas of different spatial scales and over varying time periods, and assess the impacts on model uncertainty. This will involve model transfer to other data rich Arctic research basins, such as in the Canadian Arctic, with future fieldwork in Arctic Norway and further model development. The aim is to determine the most robust method of

capturing snow distribution across regional landscapes with limited data availability, but at a resolution relevant to understanding human-environment interactions. Using this method, the model will be applied to investigate the role of snow in the 14th Century extinction of the Norse Greenlanders, and to project how future climate variations and potential human influences on the landscape may affect snowcover and subsequently Arctic processes.

Laura Llana
Supra-glacial lake depth derivation from ICESat data used to validate models based on optical properties of water

Supra-glacial lakes on the Greenland Ice Sheet store large amounts of water which if it drains to the ice base can be an important factor in controlling the seasonal and inter-annual variations of the ice sheet's flow. Lake depth can be derived from models based on the optical properties of the water; bed albedo, water attenuation coefficient and the reflectance of optically deep water are the key parameters needed to apply these models. We have used ICESat (Ice, Cloud, and land Elevation Satellite) satellite data from 2006 to 2008 together with a mask of lake coverage derived from MODIS (Moderate Resolution Imaging Spectroradiometer) imagery to map the depth of lakes on the Greenland Ice Sheet: we moreover identified lake drainage events in these data. Lake area data were combined with the ICESat results to derive lake volume. The lake depths derived from ICESat tracks were used to validate depths derived from ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) and MODIS data using the optical model method. The results show the potencial of ICESat imagery to estimate surface elvevation changes, which should improve the accuracy and coverage of current studies.

Mai Winstrup
Dating of Ice Cores Using the Visual Stratigraphy

Ice cores provide a wealth of information on past changes in climate. And compared to most other paleoclimatic records, ice core data stand out as having the potential of being exceptionally well dated. A precise and high-resolution dating of the Greenland ice cores is important for interpreting the climatic record found in the ice cores, and hence for understanding the complex mechanisms involved in climate changes.

Many chemical components in a Greenland ice core exhibit a seasonal variation, which can be used for distinguishing annual layers, and hence for estimating past accumulation rates. In this study, a semi-automatic method of annual layer counting have been developed and used on the visual stratigraphy of the NGRIP ice core. To a first order, the visual stratigraphy is a high resolution record of the dust content in the ice, which displays an annual cycle. Compared to other seasonally varying data series, the visual stratigraphy has the advantage of being maintained down to great depths in an ice core.

In this study, we use this method to look into the change in accumulation rates between the cold and warm phases of the Dansgaard-Oeschger events. In the future, these methods are to be used for extending the Greenland Ice Core Chronology 2005 (GICC05) beyond 60 ka BP.

Marianne Haseloff
The Role of Ice Shelves for Grounding-Line Hysteresis

In context of the ongoing discussion about marine ice sheet (in)stability, a grounding- line hysteresis under variations of external forcing has been proposed for overdeepened beds in the flow-line case (Schoof, C. (2007), J. Geophys. Res.), but the major limitation of analytical studies of grounding-line migration is the exclusion of buttressing ice shelves. Here, this very issue is addressed numerically by means of simplified geometries showing the characteristic features leading to a hysteresis behaviour as well as buttressing. Using the large-scale ice-sheet simulation code PISM-PIK, the hysteresis mechanism is analysed in detail and the interactions between grounding- line motion and ice-shelf properties are investigated. The collapse of the buttressing ice shelf is found to be a necessary precondition for the disintegration of a marine ice sheet, and three stages of this process can be identified.

Marie Porter
Variability in South West Norway

The sensitivity of glaciers to the atmosphere, and the link between changes in oceanic circulation and atmospheric conditions (such as wind, precipitation and temperature patterns), suggests that an indirect link may exist between the oceans and glaciers. The North Atlantic Ocean is thought to be changing and large amounts of variability over the past 60 years have been observed. However, it is unknown whether these changes have influenced the observed fluctuations in surrounding glaciers.

Between the 1960s and mid 1990s North Atlantic Water became increasingly fresh and cool, with a reversal in the trend seen since that time. Simultaneous cryospheric measurements show glacial mass balance throughout maritime Scandinavia has increased, in contrast to the negative global trends indicated by the 2007 IPCC report.

The dominant influence on the mass balance of maritime glaciers is winter precipitation. As coastal precipitation is closely linked to sea surface temperature it follows that sea temperature could be a major influence on mass balance. Investigations using time series data in Norway show links between mass balance and winter sea surface temperature. This relation appears to be heavily dependent on seasonal wind direction, supporting the suggestion a connection in the atmosphere between the two systems.

The title of my PhD is: Linking recent variability in Atlantic Ocean circulation and glacier mass balance in Greenland and Norway. I am working across the two disciplines of oceanography and glaciology with supervisors in both.

Martin O'Leary

While there has been considerable work in recent years on the modeling of ice shelf behaviour, this has largely focused on issues such as grounding line migration, which can be handled by conventional glaciological flow models. These models largely ignore frontal processes, partly for historical reasons, and partly due to the difficulty of reconciling continuum-based flow models with the discrete nature of the calving process.

One of the main difficulties in such a reconciliation is the complexity of most physically based models of calving. This complexity makes them ill-suited for inclusion in an ice shelf model, as computational costs quickly soar. The lack of simple criteria for ice fracture is thus holding back the development of a combined model of flow and calving, something which is essential to our increased understanding of ice shelf processes.

We present here the results of analytic calculations, based on a physical model of ice fracture. In particular limit cases, we give simple analytic expressions for the stress required for ice fracture. We also explore the behaviour of this critical stress as conditions are varied, and give approximations which will be of use in future modeling work. So far results indicate that this is a viable new method in analytical as well as numerical simulations of ice shelf calving fronts.

Matt Strzelecki
Post Little Ice Age retreat rates of glaciers in the surrounding of Petunia Bay, central Spitsbergen.'

This poster presents data on retreat of several glaciers surrounding Petunia Bay collected during last 25 years by AMU Poznan polar expeditions. Field measurements (geomorphological mapping, DGPS) together with aerial and satellite photogrammetry, and analysis of archival data were used to calculate rates of deglaciation following the LIA maximum of various types of glaciers (land terminating, tidewater, cold and polythermal type) located in one of the warmest and driest parts of Svalbard Archipelago.

Nanna Karlsson
Remote Sensing of the Internal Layering of the North Polar Layered Deposits on Mars

The polar layered deposits on Mars are the largest reservoir of surface water on the planet. According to crater counts the surface of the North Polar Layered Deposit (NPLD) is geologically young (< 100Ma) though some resurfacing processes could be present. The physical properties of the NPLD are not well-known, but it is clear that the ice is exchanging water with the atmosphere and thus plays an important role in the Martian climate. An increased understanding of the processes that are or have been influencing the NPLD is important in order to gain insight into the past and present Martian climate.

Here we present results from an analysis of radar data from the SHARAD (SHAllow RADar) instrument on board NASA's Mars Reconnaissance Orbiter (MRO). The data shows extensive layering throughout the ice. We focus on the southernmost part of the NPLD, named Gemina Lingula, since this region has been identified as the one most likely to have undergone processes similar to those observed in terrestrial ice. Several internal horizons within the Gemina Lingula were traced in multiple data lines in order to build a three-dimensional image of the internal geometry of the layers. Further processing of the data will reveal to what extent the internal layers have been influenced by processes such as ice flow or internal stresses and strain.

Nicola Lang
The strength and characteristics of interglacials in the late Quaternary

Analysis of the EPICA Dome C ice core has provided high resolution records of climate variability over the last 800ka and reveal variations in the duration, 'shape' and strength of interglacial and glacial periods during this time. This variability is also seen in other palaeoclimate records such as foraminiferal $\delta^{18}O$ records; however no synthesis of available 800ka ice, marine and terrestrial records has yet been made to compare and contrast interglacial and glacial characteristics.

Records of δD, CO_2, CH_4 and temperature from EDC, globally distributed high resolution benthic & planktonic $\delta^{18}O$ records, and sea surface temperature, loess records from the Chinese Loess Plateau, Lake Baikal biosilica and the Tenaghi Philippon pollen record have been selected for their length, resolution, continuity and spatial distribution. Marine records have been aligned with the LR04 stack using the graphic alignment program Match to enable comparison with ice core records on the EDC3 timescale.

A suite of characteristics from these records, including average and peak values of interglacial and glacial intensity & termination magnitude, have been compared to investigate what the regional/global similarities and differences can suggest about the character and mechanisms of long term climate change over the last 800ka.

Rebecca Rixon

Presently the Antarctic Peninsula Ice Sheet (APIS) is poorly understood in terms of its behavior since the last glacial maximum. Although models show that the Larson Ice Shelf is a potential source of melt water during deglaciation and a possible source for the MWP-1A, previous work on the last glacial maximum has concentrated on the western side of the Peninsula. Here we report the results of field investigations during 2008-09, from a transect from the central Eternity Range down to Engel Peaks on the Eastern side of the Peninsula. Through detailed geomorpholigal mapping and cosmogenic isotope sampling this work aims to constrain past thickening inland and resulting grounding of the APIS in the Weddell Sea.

MWP-1A created an annual increase in sea level of 40 mm over a 500-year period. The event is responsible for 20-25% of eustatic sea-level rise observed from the last glacial maximum to present. Such rapid large-magnitude event would have a significant effect on global climate depending on the distribution of melt water sources for this event. Research suggests that the MWP-1A originating from a source in the southern hemisphere could explain the onset of the Bølling-Allerød warm interval. However this result remains controversial given the current debate on whether the MWP-1A event was sourced primarily from the northern or southern hemispheres.

Richard Gravelle
Water routing and sediment transport in a polythermal glacier: modelling and high-resolution measurement

It has long been established that subglacial hydrology acts as an important influence on sediment transport by controlling transport pathways. Several studies have suggested a seasonal evolution of the subglacial drainage system as both water and sediment sources change throughout the glacial melt season. This results in changes to the hydraulic efficiency of drainage pathways, and hence, the efficacy of sediment transport through these systems. However, most studies of subglacial hydrology have focused on temperate glaciers: few studies have focused on cold-based or thermally-complex, polythermal glaciers which provide a more reliable analogue for high latitude glaciers and palaeo-ice masses. These glaciers are therefore of great importance to studies of past and future glacial response to climatic variations.

This study aims to assess water routing and sediment transport at a representative polythermal glacier in Arctic Sweden through a combination of proglacial hydrological measurements, and modelled data from linear reservoir model of glacial meltwater production and discharge. As well as using traditional hydrological techniques, this study will utilise Acoustic Doppler Current Profiling (ADCP) technology to allow data to be collected at spatial- and temporal-resolutions unachievable by other methods. The research will also allow the potential applications of ADCP to further studies of glacial hydrology and sediment transport to be assessed in comparison with established techniques, which are often limited in glacial environments.

It is anticipated that the results of the study will allow the interpretation of patterns of sediment delivery, which are understood to be dominated by the availability of stored sediment and the transport pathways of meltwater, both of which are subject to significant seasonal change. This will further allow comparisons to be made between sediment transport in glaciers of different temperature regimes, which are currently scarce.

Richard Morris
Refreezing and Runoff at the Surface of the Greenland Ice Sheet

Rising air temperatures are associated with increasing melt extent over high-latitude large ice bodies such as the Greenland Ice Sheet, a trend that is predicted to continue. Not all of this melting becomes, or will become, runoff: across the accumulation zone, a proportion of the generated meltwater will instead percolate into the snowpack and refreeze as near-surface ice layers and lenses. It is important that the distribution of, and controls on, this refreezing are elucidated. This is for two reasons. Firstly, changes in the amount and distribution of refreezing are an important factor in the response of large ice bodies to future climatic change. Secondly, the presence of near-surface ice layers, and the rapid snowpack densification associated with them, affects radar altimetry returns from large ice bodies. Therefore, a model is currently in development that can simulate the densification of, and formation of ice layers within, a high-latitude snowpack and the underlying firn. Currently, some disparities exist between modelled output and observed changes within the snowpack of a high arctic ice cap over a melt season, in particular seasonal changes in snowpack height and the depths of elements of snow/firn density within the stratigraphy by the end of the melt period. An overview of the model, and modifications made to improve its accuracy, will be presented.

Rupert Bainbridge

The Djúpá is one of many river systems which drains Síðujökull, an outlet glacier of the Vatnjökull ice cap, south east Iceland. Large glacial outburst floods known as jökulhlaups frequently occur in this region of Vatnjökull and they have been extensively researched. However the Djúpá system remains a relatively unstudied region of Iceland in terms of its jökulhlaup history. Evidence of historic jökulhlaups has been recorded in the system, but no in depth analysis has been carried out. Thorarinsson (1974) lists two known jökulhlaups events in 1753 and 1873 caused by eruptions of the Síðujökull and Grimsvötn volcanic systems respectively. The Djúpá is also thought to have carried small amounts of flood water in 1994, the main flow was directed down the adjacent Hverfisfljót river system which also drains Síðujökull. The investigation aims to look at erosional and depositional evidence within a valley sandur to infer the magnitude and frequency of jökulhlaups in the Djúpá system. Aerial photographs of the fieldsite and

some of the data collected, implies valley wide inundation by water, palaeo stage indicators will help to infer the magnitude of the floods. Lichenometric dating using a size-frequency approach is being used to attempt to date different terrace levels within the sandur. Stratigraphical evidence from sediment exposures is also being used to infer a sequence of landscape evolution.

Sari Nevala

I am a Masters student starting in October and I will most likely present a poster containing ideas for what my Masters thesis will be.

Thomas Cropper

I am a PGT student at Sheffield University, my Poster will likely cover my potential Master's Dissertation topic which will be decided upon quite soon. My undergraduate dissertation was focused on analysis of the daily hydrological cycle of a temperate glacier, and my postgraduate topic will most likely follow a similar area of interest.

Thomas Watts

I have recently started an MSc in Polar and Alpine Change at the University of Sheffield. I anticipate my poster being based on my proposed dissertation topic, although I am yet to decide exactly what this will be.

Tom Matthews

The interactions between the climate and glaciers must be better understood to accurately predict changes in mass balances. Traditionally research in this area has emphasized the boundary layer and glacier surface conditions, specifically through energy balance studies. This approach however does not readily lend itself to quantitative prediction of glaciers in response to regional – scale climate change. Modelling at an appropriate scale often requires the downscaling of General Climate Models (GCMs) and/or the upscaling of point measurements, both of which are major challenges. This project therefore attempts to link surface meteorology with regional climatology for the Langjökull ice cap (925 km^2), Iceland. This is pursued using gridded re – analysis data and boundary layer data from automatic weather stations. Synoptic types are extracted from downscaled data through robust statistical procedures (principal components and cluster analysis). These synoptic conditions that characterise dominant weather patterns are therefore quantitatively linked with glacier boundary layer conditions, as such the output from GCMs, concerning changes in the timing and duration of synoptic types, can be directly related to boundary layer conditions and the subsequent impact on melt can be directly assessed.

Wil Poole

University of Sheffield masters student, poster will related to chosen dissertation topic.

Yoann Drocourt

In this poster, we present a comparison of two orthorectification methods, implemented in two different software: Cosi-Corr within ENVI and PCI Geomatics. The purpose of our work is to evaluate these two tools and use the best one to orthorectify a series of Formosat2 satellites images and extract information about the behavior of a glacier (the Kronebreen) in Svalbard, Spitsbergen. More precisely our interest is focused on the Kronebreen's surface velocity variability. Kronebreen is one of the fastest moving glaciers in Spitsbergen, making it a very relevant target for satellite monitoring and flow dynamics comprehension. The task of orthorectification is essential because the more accurate it is, the more precise the velocities are.

A set of GCPs, a Spot5 DEM and a Spot5 HRS orthorectified image are used to generate the formosat2 orthorectified images using Cosi-Corr and PCI Geomatics. In order to track the displacement of surface features we ran a pair by pair image correlation for ortho-images acquired in different periods of the year of the same area. We then calculate and compare the mean velocity in two different zones: first at the glacier’s surface and second on non-glacial areas, where no displacements are expected. The comparisons of the statistics obtained allow us to identify the more accurate ortho-rectification method.