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**UK Polar Network Day**  
**National Oceanography Centre, Southampton**

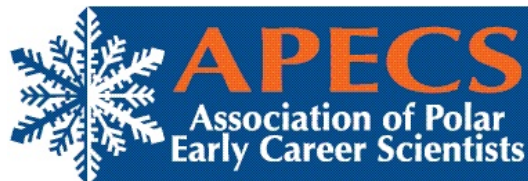
**27<sup>th</sup> November 2009**

**Book of Abstracts**



**National Oceanography  
Centre, Southampton**

UNIVERSITY OF SOUTHAMPTON AND  
NATURAL ENVIRONMENT RESEARCH COUNCIL



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## Acknowledgments

The UK Polar Network is very grateful to the National Oceanography Centre, Southampton (NOCS) for hosting this event. We wish to thank Professor Mike Coffin, Head of Research at NOCS, who through the Seed Funding Programme provided funds to support our event. We extremely grateful to Prof. Jane Hart, Dr. Debora Iglesias-Rodriguez, Dr. Sheldon Bacon, Dr. Alberto Naveira-Garabato and Dr. Mark Brandon for accepting our invitation to talk about their research.

Table 1: PROGRAMME

9:30 - 10:00	Registration	
10:00 - 10:30	<b>Sheldon Bacon &amp; Alberto Naveira-Garabato</b>	Introductory Talk: Polar Science at NOCS (Invited Talk)
10:30 - 11:00	<b>Jane Hart</b>	TBC (Invited Talk)
11:00 - 11:15	Audrey Wayolle	Studying Soil Carbon Stocks in Two Arctic Landscapes
11:15 - 11:30	Margot Saher	Changes in Distribution of Benthic Foraminifera in the Central Barents Sea Between the Periods 1965-1992 and 2005-2006
11:30 - 11:45	<b>COFFEE</b>	
11:45 - 12:00	Catherine Preece	The Effects of Winter Icing Events on the Growth and Phenology of sub-Arctic Dwarf Shrubs
12:00 - 12:15	Nihls Ohlanders	Hydrological Control on Carbon Fluxes in Three Subarctic Micro-catchments
12:15 - 12:45	<b>Mark Brandon</b>	Autosub Under Icebergs in the Weddell Sea (Invited Talk)
12:45 - 13:30	<b>LUNCH</b>	
13:30 - 14:00	<b>Debora Iglesias-Rodriguez</b>	TBC (Invited Talk)
14:00 - 14:15	Claire McDonald	Herbivory in Antarctic Fossil Forests: A Comparison with Modern Analogues in Chile
14:15 - 14:30	Jo Browse	How well do we Model Arctic Aerosol?
14:30 - 14:45	Thomas Brown	IP25: A Highly Specific Sea-ice Indicator
14:45 - 15:00	Alex Tate	The Polar Data Centre
15:00 - 16:30	<b>POSTERS</b>	
16:30 - 16:45	Cedric Chavanne	Synoptic Antarctic Shelf-Slope Interactions Study
16:45 - 17:00	Michelle Taylor	Deep-sea Corals from Fisheries by-catch in South Georgia: Assessing Species Diversity in the Deep
17:00 - 17:15	Alex Brearley	The East Greenland Current System South of Denmark Strait
17:15 - 17:30	Sudipta Sarkar	Analysis of Shallow Gas and Fluid Migration Within the Gas Hydrate Bearing Sedimentary Succession Offshore Svalbard Using 2D Multichannel Seismic Reflection Data
17:30 - 17:40	<b>CONCLUSION</b>	

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## Abstracts of Invited Talks

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# Autosub Under Icebergs in the Weddell Sea (Invited Talk)

**Mark Brandon.**

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**Abstract:** Icebergs are a key feature of the Antarctic oceanic environment. They represent a major term in the mass balance of the Antarctic continent as well as a potentially potent force for oceanic mixing. On the first Antarctic campaign of the AUV Autosub it flew under 27 icebergs with drafts ranging from 12 m to 146 m. Boundary layers within 80 m of icebergs were encountered showing melt signals. Five short duration missions (typically 5-10 km) were designed to map specifically targeted icebergs and the associated regional environment. One of these missions under three drifting icebergs shows their effect on the underlying water column. A clear lee wave in the wake of one iceberg is generating downwelling of up to 10 cm/s and further downstream there is upwelling over an area of between 3-400 m. Mixing generated by such icebergs could have a significant impact on the regional water properties.

*Research Area: Physical Oceanography/Ocean Technology.*

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## Abstracts of Talks

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# The East Greenland Current System South of Denmark Strait

Alexander Brearley<sup>1</sup> and Robert S. Pickart<sup>2</sup>.

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**Abstract:** In the period 2001 to 2007, four high-resolution hydrographic/velocity sections were occupied across the East Greenland Shelf and slope near 66°N, south of Denmark Strait. The boundary current system at this location has three different components: the surface-intensified East-Greenland/Irminger Current centered at the shelfbreak; the bottom-intensified East Greenland Spill Jet located on the mid to upper slope and the Deep Western Boundary Current at the base of the slope. The Spill Jet, first noted in the 2001 occupation, had previously gone undetected on account of its narrow width (less than 20 km). However, it is present in all four hydrographic sections and has a surprisingly large equatorward transport (between 1.9 and 8.9 Sv). Furthermore, the vorticity structure of the Jet suggests that it is highly non-linear, with the relative cyclonic and anticyclonic vorticity associated with the feature forming a large fraction of the total Ertel potential vorticity. It is suggested that the Jet is formed by dense water cascading over the shelf and forming a thin gravity current. During this process, intense mixing occurs, which alters the hydrographic structure of the shelfbreak flow prior to it continuing southward into the North Atlantic. Possible reasons for spilling process are discussed, including the role of atmospheric forcing due to storms.

*Research Area: Physical Oceanography.*

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## IP25: A highly specific sea-ice indicator

**Thomas Brown and Simon Belt.**

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**Abstract:** IP25 is a novel chemical proxy for Arctic sea ice extent (Belt et al., 2007). Derived from sea-ice diatoms, IP25 is found in many Arctic sediments, yet the specific nature of its production and preservation require further examination. To make sense of sedimentary observations we need to better understand when and where IP25 is produced. Understanding these two key principles will greatly enhance the reliability of future applications of this palaeo sea ice indicator. In this presentation evidence will be offered to clarify the specific nature of IP25 as a sea-ice extent indicator. It shall address questions relating to where production occurs within sea ice, from biosynthesis within select species of diatom, to identifying the region of maximum production within sea ice itself. In addition to this, further investigations reveal when IP25 is produced. Combined, the data provided will lead the way for increasingly accurate interpretations of palaeo sea ice extent. References Belt, S.T., Mass, G., Rowland, S.J., Poulin, M., Michel, C., LeBlanc, B., (2007) A novel chemical fossil of palaeo sea ice: IP25. *Organic geochemistry*, 38, 16-27.

*Research Area:* Palaeo sea ice reconstruction.

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# How well do we model Arctic aerosol?

**Jo Browse<sup>1</sup>, Ken Carslaw<sup>1</sup>, Steve Arnold<sup>1</sup> and Olivier Boucher<sup>2</sup>.**

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<sup>2</sup>Met Office Hadley Centre. Met Office, FitzRoy Road, Exeter, EX1 3PB, UK.

**Abstract:** The Arctic is warming at an accelerated rate to the rest of the planet and aerosol forcing has been suggested as a possible cause. Quantification of the temperature increase attributable to aerosol is highly uncertain due in part to the lack of observations in the Arctic with which to validate aerosol models. Recent interest in the Arctic (including the international polar year) has caused new data to become available for model validation studies. Comparison of long term ground station data from 1994 to 2004 with output from the Leeds university global model of aerosol processes (GLOMAP) shows that the model fails to capture the seasonality (high in summer compared with the observed winter/spring maximum), the size distribution (underestimates springtime average particle radius by a factor of 10 whilst overestimating the summertime by the same amount) or the mass concentrations (springtime black carbon and sulphate mass underestimated by a factor of 4 and 8 respectively) of sulphate and black carbon aerosol loadings in the Arctic. This talk discusses the failings of GLOMAP in the Arctic and presents a series of emission and wet deposition sensitivity studies examining which processes and emission sectors are most significant in controlling modelled aerosol loadings over the Arctic.

*Research Area: Modelling Arctic aerosol.*

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# Synoptic Antarctic Shelf-Slope Interactions Study

**Cedric, Chavanne<sup>1</sup>, Karen Heywood<sup>1</sup>, Keith Nicholls<sup>2</sup>, Colin Griffiths<sup>3</sup>  
and Mark Inall<sup>3</sup>.**

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<sup>1</sup>University of East Anglia, School of Environmental Sciences, Norwich, NR4 7TJ, UK.

<sup>2</sup>British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, UK.

<sup>3</sup>Scottish Association for Marine Science, Dunstaffnage Marine Laboratory, Oban, PA37 1QA, UK.

**Abstract:** An array of five moorings was deployed in January and March 2009 across the Antarctic shelf and slope in front of the Riiser-Larsen Ice Shelf, in the southeastern Weddell Sea ( $\sim 18^{\circ}\text{W}$ ), as part of the UK contribution to the multinational Synoptic Antarctic Shelf-Slope Interactions (SASSI) study. The moorings have been instrumented to quantify the components of the freshwater transport by the flows on the continental shelf and slope, in an area located upstream of the regions of deep water formation in the southwestern Weddell Sea. They will provide the first year-round observations of the upstream processes influencing the formation of Antarctic Bottom Water and the melting of ice shelves in the Weddell Sea. Two hydrographic sections were undertaken during the mooring deployments, along with measurements of currents from lowered ADCPs. They confirm the existence of surface-intensified southwestward currents, with significant barotropic transports consistent with previous observations. They also reveal the existence of northeastward undercurrents trapped against the steepest part of the slope, and associated with an onshore upward sloping of isopycnals through thermal-wind balance. This brings the Warm Deep Waters closer to the shelf break, past which they could be transported and mixed with the colder Shelf Waters, through advection by tides, shelf waves and eddies, thus providing heat to melt the ice shelves. The moorings will enable us to quantify these processes and their impacts on ice shelves melting and consequent freshening of the waters flowing into the regions of deep water formation.

*Research Area: Physical Oceanography.*

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# Herbivory in Antarctic Fossil Forests: a comparison with modern analogues in Chile.

**Claire McDonald, Jane Francis and Steve Compton.**

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University of Leeds. Earth Sciences, School for Earth & Environment, LS2 9JT, Leeds, UK.

**Abstract:** Insect body fossils from Antarctica are very rare, yet collections of Palaeogene fossil leaves from Antarctica provide insect trace fossils, indicating that insects were an important component of the unique forests that once grew in south polar regions. These insect traces provide an excellent opportunity to examine the palaeoecology of Antarctica. The fossils studied include Palaeogene leaves from both Seymour Island and King George Island on the Antarctic Peninsula. A database of all insect traces on the Antarctic fossil leaves was compiled and analysed in terms of the diversity of palaeoherbivory. The fossil leaves are diverse with several different plant families present such as Nothofagaceae and Cunoniaceae. The range of traces that were found includes leaf mines, leaf galls, general leaf chewing and skeleton feeding, of which both marginal and non-marginal examples were present. To provide a greater understanding of ancient herbivore intensity and diversity in Antarctica, modern insect traces on Nothofagus leaves, and their associated insects, were examined from the temperate forests in Chile, the modern day analogue of the Antarctic forests during the Palaeogene. Modern traces show a similar diversity of damage types to that seen in the Palaeogene, but the intensity of damage appears to be greater now.

*Research Area: Palaeoecology.*

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# Hydrological Control on Carbon Fluxes in Three Subarctic Micro-catchments

Nils Ohlanders<sup>1</sup>, Andy Hodson<sup>1</sup> and Gareth Phoenix<sup>2</sup>.

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**Abstract:** Fluxes of dissolved organic carbon from soil to stream can be expected to increase during periods of high flow. At the same time, flow rates often control weathering rates and thereby amounts of sequestered atmospheric CO<sub>2</sub>. Characterisation of hydrological processes and coupled carbon dynamics was investigated in three micro-catchments within the subarctic Kårsa valley in Sweden. This valley stretches from a small glacier with surrounding forefield of bare rock, moraine and thin soils (top site) to alpine meadows (mid site) further downhill and arctic birch forest in the lower valley (low site). Discharge water leaving the three micro catchments and soil water at several depths were sampled regularly during two snowmelt seasons. Correlations between flow rate and various solute concentrations as well as comparisons of Principal Component Analysis runs on stream and soil water samples suggest that spatial flowpaths are an important factor driving discharge chemistry only at the mid site. Dilution of water travelling through very thin soils by large quantities of snowmelt was completely dominating at the top site whereas discharge chemistry at the low site were relatively small and controlled by groundwater residence time. Resulting annual fluxes of organic and inorganic carbon show that export of organic carbon via discharge was much smaller than the amount of carbon taken up from the atmosphere in weathering reactions, when calculated per unit of catchment area, at all sites except the top site where oxidation of pyrite, where atmospheric CO<sub>2</sub> is not being sequestered, was the dominant weathering reaction.

*Research Area: Geochemistry.*

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# The Effects of Winter Icing Events on the Growth and Phenology of sub-Arctic Dwarf Shrubs

**Catherine Preece<sup>1</sup>, Terry V. Callaghan<sup>2</sup> and Gareth K. Phoenix<sup>1</sup>.**

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<sup>2</sup>Abisko Naturvetenskapliga Station, ANS (Abisko Scientific Research Station), SE-981 07, Abisko, Sweden.

**Abstract:** Ice encasement of Arctic vegetation can occur following a rain-on-snow event or during freeze-thaw cycles. The frequency of such icing events is predicted to increase and consequences for plants include freezing damage (as ice is less insulating than snow) and the development of an anoxic environment caused by encasement within the ice layer. A new field experiment was established in sub-Arctic heathland, northern Sweden, in which winter icing was simulated in early March in 2008 and 2009. Growth and phenology responses of three dominant dwarf shrubs (*Vaccinium myrtillus*, *V. vitis-idaea* and *E. hermaphroditum*) were measured in the following growing season. Shoot mortality of *V. myrtillus* and *V. vitis-idaea* was increased (by 70% and 165% respectively) after the first ice treatment. In contrast, *V. myrtillus* also showed significantly earlier leaf emergence after two years of icing. A significant decrease in flower production was seen in *V. vitis-idaea*, but only in the second year of the study and there were no effects of the ice treatment on *E. hermaphroditum*. These results show considerable interspecific differences in tolerance of ice encasement by sub-Arctic plants and icing cannot be assumed to always have a negative impact. Interspecific differences in tolerance may lead to species change, hence understanding the impacts of icing is important if we are to fully predict long-term changes to Arctic ecosystems.

*Research Area: Plant Ecology.*

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# Changes in Distribution of Benthic Foraminifera in the Central Barents Sea Between the Periods 1965-1992 and 2005-2006

**Margot Saher.**

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School of Geography, Earth and Environmental Sciences, University of Plymouth.  
Drake Circus, PL4 8AA, Plymouth, UK.

**Abstract:** Live benthic foraminifera assemblages from 30 surface sediment samples taken in 2005 and 2006 from the central Barents Sea have been compared with total benthic foraminifera assemblages from a database containing samples taken in 1965-1992. We evaluate the hypothesis that observed environmental change in the region has led to observable change in benthic foraminiferal fauna. The 12 infaunal species studied show a marked decrease in cold water species *Buccella* spp., *E. excavatum*, *I. norcrossi* and *N. labradorica*. A decline combined with a marked change in spatial distribution is seen in *C. laevigata*, *T. fluens*, *S. loeblichii*, *C. reniforme*, *C. neoteretis*, *M. barleeanum*, and *P. bulloides*. Warm water species *E. nipponica* is the only studied species that increased in abundance. The general shift toward dominance of warm water species agrees well with the observed temperature increase in the basin. At the level of individual data points, a relationship between assemblage change and environmental change is not straightforward. The comparison of the new data with the database also displays a shift toward higher abundances of more fragile species, which can be attributed to method differences. The magnitude of benthic foraminifera change in the study area is largest in a conspicuous belt that appears to roughly follow the polar front. This area has a lower temperature and salinity gradient through the last decades than the rest of the study area, and its high faunal change may be due to a shift in the Polar Front, and associated changes in the sea ice edge.

*Research Area: Recent climate change/ benthic foraminifera.*

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# Analysis of Shallow Gas and Fluid Migration Within the Gas Hydrate Bearing Sedimentary Succession Offshore Svalbard Using 2D Multichannel Seismic Reflection Data

**Sudipta Sarkar<sup>1</sup>, Timothy Minshull<sup>1</sup>, Douglas Masson<sup>1</sup>, Anne Chabert<sup>1</sup>, Christian Berndt<sup>2</sup> and Graham Westbrook<sup>3</sup>.**

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<sup>3</sup>Geography, Earth and Environmental Sciences, University of Birmingham. Edgbaston, Birmingham, B15 2TT, UK.

**Abstract:** A likely result of global climate change is the warming of the ocean bottom sediments. This may destabilize marine gas hydrate and release methane into the water column. In order to document the impact of bottom water warming on the marine gas hydrate we conducted a multi-disciplinary cruise on RRS James Clark Ross offshore Svalbard (Northern Europe) in August-September 2008. We collected multichannel high-resolution 2D seismic reflection data (1 ms sample interval and 3.125 m CMP spacing), multi-beam bathymetry data, side-scan sonar data, and a range of other data. The data show different fluid escape features and a bottom simulating reflector (BSR) which is a proxy for the presence of gas hydrate. Seismic evidences for fluid migration include (a) gas chimneys, (b) chaotic high-amplitude reflectivity beneath gas escape, (c) velocity pull downs, and d) areas of reduced seismic amplitudes possibly representing dewatering structures. Within the gas hydrate stability zone (GHSZ) we found few fluid escape pathways which either reach the sea floor or are buried under the shallow unconformities, suggesting frequent venting in the past. Where the base of the gas hydrate thins out, a zone of diffuse fluid escape is seen, originating from the deeper gas pockets. Our observations suggest that as warming erodes the hydrate stability field, it is not only the release of methane from the dissociating gas hydrate which may be a potential concern, but also the deeper methane, which finds easier routes to migrate from depth to the sea-floor as the GHSZ wedges out.

*Research Area: Dynamics of Gas Hydrates in Polar Environments.*

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# The Polar Data Centre

**Alex Tate.**

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**Abstract:** The Polar Data Centre is the NERC Data Centre with a mission to manage, disseminate and curate the UKs polar data and information. This enables the scientific community, stakeholders and the wider world to use them effectively and to their full potential, both now and in the future. The Polar Data Centre replaced the Antarctic Environmental Data Centre in April 2009 and is based at the British Antarctic Survey. One of the roles of the Polar Data Centre is to provide an effective bridge between NERC's discipline specific communities, and the international polar community. This is carried out by closely working with other NERC Data Centres and acting as a gateway to discover UK polar data wherever it may be held. This presentation gives an overview of the data centre, details recent data science projects, outlines the connections between data centres and looks to the future of a more co-ordinated approach to Polar data management.

*Research Area: Data Science.*

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# Deep-sea Corals from Fisheries by-catch in South Georgia: Assessing Species Diversity in the Deep

**Michelle Taylor<sup>1</sup>, Alex Rogers<sup>2</sup> and Dabid Agnew<sup>3</sup>.**

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**Abstract:** The deep sea is the largest environment on Earth but the least well known, sampled, and studied. Within this vast area are rare zones of hard substrata and where they occur (e.g. seamounts, canyons) distinct and sometimes spectacular communities of sessile megafaunal organisms (corals, sponges etc) are present. These provide habitat to hundreds of other species (urchins, seastars, brittlestars etc) and could be associated with rich populations of fish targeted in fisheries. Fishing gear contacting the seabed can potentially destroy these benthic organisms and with some deep sea corals living for over 4500 years the recovery times are well beyond our generation. Benthic by-catch from the bottom longline fishery for Patagonian toothfish in South Georgia was investigated (500m–2000m in depth). Significant by-catch of octocorals was observed and species were identified morphologically and using DNA barcoding. Octocorals have very low levels of variation in mitochondria thus two of the most variable mt genes were used for this purpose. Hotspots of diversity were highlighted resulting in the initiation of three special management areas where fishing was removed to protect these vulnerable deep sea habitats. There have been few studies into bottom long line fishing gear by-catch and as bottom longlining is increasingly being used in deep-sea fisheries these investigations prove very useful and timely. There are also relatively few studies of deep sea octocorals, especially around Antarctica, and this research has already led to several new species and genus discoveries.

*Research Area: Benthic marine habitats, octocoral taxonomy.*

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# Studying soil carbon stocks in two arctic landscapes

**Audrey Wayolle<sup>1</sup>, Philip Wookey<sup>2</sup>, Mathew Williams<sup>3</sup> and Clare Wilson<sup>2</sup>.**

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**Abstract:** Arctic soils are sensitive to temperature changes, and have to be integrated to any climate change model. But they are difficult to study and estimates of the carbon stocks they contain are diverse. The quantification of carbon stocks in arctic soils has to be made at several scales to be accurate. The sites of Abisko (Swedish Lapland) and Kevo (Finnish Lapland) are studied to map carbon distribution from the microscopic to the landscape scale. The possibility to upscale data gained from field observation will be evaluated. The 2008 and 2009 field seasons have been centred on getting samples for bulk density, carbon content and nitrogen content. This required a determination of the plots by the use of Geographic Information Systems and Global Positioning System. Other data have been obtained through plot description as the vegetation communities present and the organic matter depth. The sampling schemes used have been cyclical patterns, allowing for the choice of plots to be as objective as possible. This should give a balanced representation of the vegetation types present on the site. Combining these data should help in mapping carbon at the landscape scale and in three dimensions. Micromorphology should help in clarifying the repartition of carbon at the microscale in different landscape units. The objective is to integrate these data into climate models and to precise the validity of upscaling these observations at larger scales.

*Research Area: Soil Science.*

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## Abstracts of Posters

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# The Micromechanics of Permafrost Thaw

**Áine Ní Bhreasail, Catherine O’Sullivan, Clark Fenton and Peter Lee.**

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**Abstract:** Global climate change has resulted in an increase in permafrost temperatures in almost all areas of the Northern Hemisphere in the last 20-30 years (Romanovsky et al., 2007; Nishimura et al., 2009). An obvious consequence of permafrost thaw is the potential for buildings and infrastructure damage and landslide activation as the frozen soil loses strength and stiffness (Andersland & Landanyi, 2004). In addition to the loss of mechanical strength of soil, from the perspective of climate change a second, and more serious consequence is the potential release of greenhouse gases (methane and carbon dioxide) currently locked within these frozen soils. Additionally organic material currently preserved in the frozen soil, will decompose, further emitting large amounts of greenhouse gases. The aim of the research is to bring together expertise from geology, soil mechanics and materials science in a fundamental study of the changes to soil microstructure during thawing.

*Research Area: Soil Mechanics.*

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# Linking ecological responses to hydrological change in the High Arctic (Svalbard)

**Phillip Blaen, David M. Hannah and Alexander M. Milne.**

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**Abstract:** High-latitude and -altitude systems are particularly sensitive to the impacts of climate change due to strong linkages between atmospheric forcing and the mass-balance of glaciers and snowpacks. Flow regimes in headwater areas are expected to peak earlier with annual snowmelt and become increasingly variable as the buffering effect of glaciers is diminished. However, the response of ecological communities to hydrological change is unclear. The aim of this project was to link quantitative water source contributions from glacier melt, snowmelt and groundwater to habitat conditions and invertebrate communities in a High Arctic environment. Stream water, physicochemical and ecological samples were acquired from nine sampling sites near Ny lesund, Svalbard, during July 2009. End-member mixing analysis to quantify water source contributions to stream flow was met with limited success and suggested that differences between polar and temperate glaciers may render end-member mixing analysis unsuitable for use in high-latitude region. Significant correlations ( $p < 0.01-0.05$ ) were identified between physicochemical habitat variables and ecological metrics. Longitudinal changes in habitat condition and macroinvertebrate community structure conformed to the conceptual model proposed by Milner et al. (2001) that warmer temperature and greater channel stability are associated with higher macroinvertebrate abundance and diversity. Strong relationships between ecological, hydrological and atmospheric conditions suggest that high-latitude freshwater ecosystems are likely to experience substantial changes in the near future given the anticipated effects of climate change in Arctic regions.

*Research Area: Hydroecology.*

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# Accumulation of Transient Tracers in the Weddell Gyre Over the Last 20 Years

**Peter Brown<sup>1,2</sup>, Marie-Jose Messias<sup>1</sup>, Andrew Watson<sup>1</sup>, Stephen Woodward<sup>1</sup> and Mike Meredith<sup>2</sup>.**

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<sup>2</sup>British Antarctic Survey. High Cross, Madingley Road, CB3 0ET, Cambridge, UK.

**Abstract:** The Weddell Gyre is regarded as the primary location of deep and bottom water formation and sequestration of carbon, nutrients and atmospheric gases in the Southern Ocean. Major quantities of dense, cold waters generated near and on the Antarctic continental shelf spill down the slopes, entraining surrounding water masses as they descend. The waters travel northwards hugging the western boundary before being exported into the mid latitude Southern Ocean and spreading globally at depth. It is thought that these water masses carry substantial loadings of anthropogenic gases; high levels of CFCs have previously been observed in the Weddell Sea. However, disagreements still exist as regards the exact quantities of anthropogenic carbon present in these waters - models and some data-based methods suggest only very small inventories in the region. The ANDREX project (Antarctic Deep Water Rates of Export) seeks partly! to investigate these issues. Initial data from the primary leg of cruise fieldwork in January 2009 are presented here for a suite of transient tracers and compared to similar measurements from the same transect on an approximate 20 year time lag. Ventilation age estimates are compared to assess circulation and mixing variability, and primary estimates of anthropogenic carbon are shown, calculated using the transit time distribution technique. These first data present a beguiling snapshot of the variability of the Weddell Gyre using ocean tracer measurements.

*Research Area: Chemical Oceanography.*

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# The Thermodynamic Formation and Growth of Sea Ice

**Nuala Carson, Harry Leach and Clare Postlethwaite.**

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**Abstract:** Sea ice is a discontinuous solid which covers approximately 7% of the Earth's oceans at any time, forming and melting seasonally with the polar winter and summer seasons. The exchange of energy, mass, and momentum across this boundary directly influences the formation, distribution and thickness of sea ice. The importance of large scale numerical models studying the Earth's climate has increased significantly in recent decades, spurred on by the dramatic climate change experienced and the demand for future predictions. To produce an accurate coupled model the fluxes of heat, moisture, momentum and mass between the air-sea interface must be properly represented. A series of 1D numerical models have been created in which the formation and growth of sea ice over a 2metre water column and a range of time scales can be predicted. Each model version increases in complexity, with the final model simulating realistic surface boundary fluxes but not realistically representing the cycles of incoming solar radiation. The model results are graphed and compared with published models, Stefans 1890 simple empirical model and Billellos 1961 more sophisticated freezing degree day model. The ice thickness results showed similar characteristics with the published models which validates the foundation of the formulated models. The models are not run for an annual cycle and so are not verified by their ability to accurately represent seasonal formation, growth and decay.

*Research Area: Sea ice dynamics.*

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# Seismic Modelling of Gas Hydrate and Free Gas in Sediments, from Ocean-bottom Seismometer Data Along the Continental Margin of Western Svalbard

**Anne Chabert<sup>1</sup>, Tim A. Minshull<sup>1</sup>, Graham K. Westbrook<sup>2</sup> and Christian Berndt<sup>3</sup>.**

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**Abstract:** Over the next decades, the shallow parts of continental margins in the Arctic are likely to experience warming of bottom-water. It is, therefore, important to evaluate how methane hydrate beneath the seabed in these margins will react to future increases in bottom-water temperature and whether release of methane from hydrate will have an impact on climate. As part of the International Polar Year initiative, a multidisciplinary marine expedition was carried out in August-September 2008 along the continental margin west of Svalbard. One of its objectives was to determine the extent of the gas hydrate stability zone (GHSZ) along the continental slope and to quantify the amount of methane present as hydrate or gas beneath the seabed, using seismic techniques. Thirteen ocean-bottom seismometers (OBS) were deployed at 5 representative sites along and across the continental margin. The sub-seabed variation of P-wave velocity was modelled for 5 sites located above and below the upper limit of GHSZ, using a ray-traced forward modelling. Our preliminary results indicate the presence of gas hydrates at the deepest site (~1250 m) of the experiment, but have so far failed to produce unequivocal evidence for gas hydrate at the shallower site where hydrate would be most sensitive to bottom water changes. However, the fact that free gas can be inferred for two different sites nearly 100 km apart, suggests that free gas is widespread along the Svalbard continental margin and that hydrate may exist close to the upper limit of the GHSZ.

*Research Area: Marine Geophysics*

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# Fossil Plants From Svalbard and Their Climatic Significance

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**Abstract:** Palaeogene fossil floras from Svalbard and their climatic significance  
During the Palaeogene forests grew up to 80N. These forests thrived at a time when the climate was significantly warmer than today and atmospheric CO<sub>2</sub> is estimated to be four times the present day value (Pagani et al., 2005). Fossil leaves are found in the Eocene/Oligocene Aspelintoppen Formation on Svalbard. The flora is dominated by angiosperms, some of which are represented by modern genera such as *Corylus*, *Aesculus*, *Ulmus*, *Cercidiphyllum* and *Fagus*. The deciduous conifer *metasequoia* is common along with juniper and ferns. Fossil leaves are associated with sediments that indicate a tidal flat environment, and are preserved in mudstones that represent flood plain deposits, and sandstones that represent channel/tidal sand bodies. *Equisetum* species are abundant and appear to be the primary colonizers of sand bodies. A particular feature of the fossil leaves found is that many of them are complete, indicating little transportation with quiet water conditions. They occur as leaf mats suggestive of an autumnal leaf fall. In addition to this many leaves have petioles (stems) attached, which is further evidence for autumnal leaf fall. The leaves are notably large, some exceeding 30 cm in length. This may be indicative of a climate with high rain fall and/or an adaptation to the low angle of light at high latitudes. New fossil floras collected from the Aspelintoppen Formation in 2009 will be analysed using physiognomic and nearest living relative approaches to yield quantitative climate data. Further quantitative climate data will be gained from analysis of fossil soils and clay minerals from the associated sediments.

*Research Area: Palaeoclimatology.*

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# Stable Isotopes for Freshwater Additions to the EGC and EGCC

**Katharine Cox<sup>1</sup>, Eelco Rohling<sup>1</sup>, Sheldon Bacon<sup>1</sup>, Jennifer Stanford<sup>1</sup>, Alistair McVicar<sup>2</sup> and Mike Bolshaw<sup>1</sup>.**

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**Abstract:** Observations over the last decade suggest both a thinning of the Arctic sea-ice cover (Rothrock et al., 1999; Laxon et al., 2003) and a dramatic reduction in its spatial extent (Comiso, 2002; Stroeve et al., 2005). We detect a positive change of  $10 \text{ ‰}$ , between 2004 and 2005, in the stable oxygen isotope composition of the net freshwater component in the East Greenland Current (EGC) and East Greenland Coastal Current (EGCC), key carriers of freshened surface waters out of the Arctic. This isotopic signal is unique since at least the early 1960s and we show that it reflects a remarkable increase in the sea-ice melt water transport within these currents. Our findings suggest that a large proportion of the sea-ice meltwater resulting from the rapid reduction of Arctic sea-ice between is exported from the Arctic via the EGC/EGCC into the northern North Atlantic. Additionally it appears that this sea-ice meltwater export is not in phase with atmospheric circulation regimes such as the North Atlantic Oscillation and the Arctic Oscillation. These findings might have important ramifications for the global thermohaline circulation (e.g. Rahmstorf, 2005).

*Research Area: Physical Oceanography/Sea Ice.*

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# Temporal Variability in Diapycnal Mixing in the Southern Ocean

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**Abstract:** Diapycnal mixing rates in the oceans have been shown to have a great deal of spatial variability, but remain unmeasured in many areas of the worlds oceans. Model studies strongly suggest that these rates have an impact of the circulation of the oceans, and subsequently our ability to model future climate. Here we present results from a method developed to calculate diffusivity (a controlling factor for mixing) from data obtained by moored Acoustic Doppler Current Profilers. An 18-month time series of diffusivity was obtained from data taken by a LongRanger ADCP moored at 2400m depth, 600m above the sea floor, in Shag Rocks Passage, a deep cut in the North Scotia Ridge (Southern Ocean), where strong currents and complex topography are expected to result in enhanced mixing. The time series has a mean diffusivity of  $5.1 \times 10^{-4} \text{ m}^2 \text{ s}^{-1}$  and varies over more than an order of magnitude. There is no significant peak at annual or semiannual frequencies, but there is evidence of a significant signal at a period of approximately four days. Mechanisms that might cause this include atmospheric forcing, as evidenced by an  $\sim 4$ -day peak in local reanalysis winds. Other possible mechanisms include topographically-trapped waves. The spatial distribution of diffusivity, (found from CTD and LADCP profiles taken in Shag Rocks Passage), is consistent with published values for similar regions, with diffusivity  $\sim 100 \times 10^{-4} \text{ m}^2 \text{ s}^{-1}$  near the sea floor, dropping to the expected background level of  $\sim 0.1 \times 10^{-4} \text{ m}^2 \text{ s}^{-1}$  in areas away from topography. *Research Area: Physical Oceanography.*

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# Impact of freshwater ice melt on surface circulation in the Barents and Kara Seas

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**Abstract:** The surface circulation currents in the Barents and Kara Seas are presently not well known due to the area previously being covered in ice. However, during this century there will be no September sea ice in the Arctic; it is melting at a faster rate than expected as indicated by recent observations, causing rapid implications on circulation. The aim of this study is to investigate the surface circulation in the Barents and Kara Seas and to determine the changes of the water column structure by using a limited number of Argo floats, archived CTD measurements and remotely sensed data. The implications of increased freshwater input upon circulation are to be identified; it is hypothesized that the surface circulation velocity will increase with increased freshwater input.

*Research Area: Physical Oceanography.*

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# Spatial and Temporal Variability in the Antarctic Circumpolar Current

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**Abstract:** The Antarctic Circumpolar Current (ACC) is a unique feature upon Earth: it is the only uninterrupted longitudinal ocean current and it is a key aspect of Earth's climate. As a result of previous dissertation study upon the southern hemisphere sub-polar gyres and the subsequent emergence of the concept of a sub-polar Super-Gyre, assessing the variability of the ACC appears crucial to understanding the forcing of the sub-polar regime. This emerges from the fact that the ACC forms the northern limit of the three conventional gyres (Weddell, Ross Sea and newly identified Deep Australian-Antarctic) as well as the Super-Gyre concept. Assessing temperature and salinity fluctuations both spatially, around Antarctica and temporally along repeat cruise tracks, provides insights into the variability of this key component. Temperature-salinity plots provide the means for a qualitative assessment, whilst the identification of temperature and salinity maximum provide the means for quantitative assessment of variability. The end result is to attempt to calculate a rudimentary estimation of diffusive mixing over long distances.

*Research Area: Antarctic Physical Oceanography.*

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## Water and Sanitation in Cold Climates

**Nicola Greene, Mike Smith and Lee Boshier.**

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**Abstract:** Despite the extensive research and development activities that have taken place in the last 30 years to try to improve water and sanitation (WATSAN) delivery and use, most work has been focused on the needs of people living in hot and temperate climates. However, of the 1.1 billion people in the world that do not have access to an adequate water supply and the 2.4 billion that do not have adequate sanitation, many millions live in areas that experience extremely cold climates for all or part of the year. As a result, there is an urgent need to collate and develop appropriate strategies for improving WATSAN and hygiene practices in both development and emergency situations in cold climates. Due to the lack of documented evidence on the subject, this task is heavily reliant on assembling information from people with experience of life in a colder climate; people which are not in abundance in the UK. Many of the UKPN members will have been/plan to go on temporary expeditions to polar areas and will therefore have used/plan to use adaptive measures suitable in cold climates for their WATSAN/shelter provision (e.g. snow melt as a water source). I am interested to hear the experiences of the members as some techniques encountered used may be applicable to the refugee and/or emergency situations I am investigating. Furthermore there is valuable information to be gained from the members knowledge of the effects a low temperature may have on workers attitudes, energy levels and general health in these areas. The talk I would present would explain my work, whilst simultaneously making an appeal to the UKPN members to share the more unusual practices they have come across in past expeditions and to be extra vigilant to note the techniques they encounter in future trips.

*Research Area: Water and Sanitation Provision in Cold Climates.*

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## Copepod Siblings in Arctic Fjords

**Claudia Halsband-Lenk<sup>1</sup>, Ragnhildur Gudmundsdottir<sup>2</sup>, Ann Bucklin<sup>3</sup>  
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**Abstract:** In high-latitude marine environments, where pelagic species diversity is generally reduced, assessments of ecological and functional diversity are complicated due to the occurrence of morphologically very similar species. Examples are the copepod siblings *Pseudocalanus minutus* and *P. acuspes*, common in arctic coastal waters. To determine their potentially different distribution patterns around Svalbard, an archipelago between Greenland and the Barents Sea, a species-specific polymerase chain reaction (PCR) was developed using species-specific primers. The data show a seasonal succession: *P.acuspes* requires warmer waters and/or more food for development than *P. minutus*. Morphological IDs were generally consistent with PCR, except in Rjipfjorden, where the population might have uncharacteristic morphotypes or possibly hybrids of both congeners. Climatic warming could favour *P. acuspes* over *P. minutus* in the future and thus reliable identification techniques are needed.

*Research Area: Biological Oceanography.*

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# Multi-year Predictability of Greenland Sea Late Winter Sea-ice Volume in a Coupled Climate Model

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**Abstract:** Prediction of sea-ice is not only important for shipping but also for weather as it can have a significant climatic impact. Therefore sea-ice predictions are important for accurate inter-annual to decadal prediction of climate in coupled climate models. However, to our knowledge there has been little work on how predictable sea-ice is in a coupled atmosphere-ocean-ice model. We have studied the predictability of sea-ice in HadCM3 using case study ensemble experiments with external forcing from the late 20th century designed to emphasize the predictability in the climate system due to initial conditions. Here, we will concentrate on late winter (maximum) ice-volume in a box in the Greenland Sea (30W to 10E, 68N to 80N). Model climatology from a control-run shows that this region has high inter-annual variability in sea-ice volume. We find that although ice may almost completely disappear from this area in late autumn, the same anomalies re-appear in the following spring for at least the first four years in three out of four case studies. The mechanism for this appears to be related to persistence of ocean heat content in the initial conditions and the state of the meridional overturning circulation and its associated heat transport. In these experiments, the atmosphere appears to be less important than the ocean in determining the predictability of sea-ice volume in the Greenland Sea.

*Research Area: Sea-ice predictability.*

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# Long term sea surface height variability in the Nordic Seas

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**Abstract:** The Nordic Seas are the regions of exchanges between the Arctic and the Atlantic oceans. Furthermore, they are the regions of deep-water formation. By providing a substantial part of the source waters for North Atlantic Deep Water the Nordic Seas influence the global thermohaline circulation. Therefore, an understanding of the Nordic Seas circulation and its variability is needed to determine how changes in the high latitude climate affect the global thermohaline circulation and the regional climate. Although, the summer circulation in the region is known from in-situ and other measurements, knowledge about the winter circulation is limited because of the unavailability of data from the ice-covered seas. However, Peacock and Laxon (2004, J Geophys Res, 109, C07001) showed that it is possible to derive sea surface height anomaly from satellite altimeter data in the ice-covered seas. The study presents novel satellite-altimeter data derived from ice-covered seas combined with altimeter records from the open ocean. Envisat altimeter data for a six-year long period, beginning in October 2002, have been used and corrected by applying a set of relevant geophysical corrections. Empirical orthogonal functions of sea surface height and harmonic functions fitted to the data are analyzed. Seasonal and interannual variability of the sea surface height anomaly is discussed.

*Research Area: Physical Oceanography.*

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# Does earlier leaf development in spring result in more growth in summer in subarctic dwarf shrubs?

**Eva Koller<sup>1</sup>, Malcolm C. Press<sup>2</sup> and Gareth K. Phoenix<sup>1</sup>.**

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**Abstract:** Arctic ecosystems, of which dwarf shrub heathlands are an important part, are particularly vulnerable to climate change, and have experienced the greatest rate of total global warming so far. Increases in winter and spring temperatures are greater than summer temperature increases in these systems, influencing season length and snow cover duration which experimental studies have shown to determine the onset of leaf development in spring. This makes the influence of spring temperature - which mediates snow melt timing - on plant spring phenology, and the potentially different response of different arctic species to this factor, particularly interesting to our understanding of climate change impacts in these ecosystems. Two questions asked here are: Will earlier snow melt in spring delay leaf bud burst as expected, and will earlier leaf bud burst result in more growth in summer? The species studied are three important circumpolar dwarf shrubs, the deciduous *V. uliginosum* and *V. myrtillus* and the evergreen *E. hermaphroditum*. Observations of spring leaf development and subsequent growth rates were made at three sites with contrasting environmental conditions along a catchment sequence near Abisko, Swedish Lapland. Snow cover duration in spring, nutrient status and average summer temperatures were all taken into account as important influences on plant development and productivity. The relationship between earlier onset of leaf development in spring and higher shoot biomass production in summer will be explored in this presentation. The importance of functional type (evergreen shrub and deciduous shrub) in this relationship will also be discussed.

*Research Area: Plant Ecology.*

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# Sensitivity of Oceanic Carbon Uptake to Southern Ocean Physics.

**Jonathan Lauderdale, Alberto Naveira-Garabato and David Smeed.**

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**Abstract:** This study presents the results of perturbation experiments to physical forcings and components of the Southern Ocean circulation using the Massachusetts Institute of Technology general circulation model (MITgcm) and a coupled biogeochemistry model. The sensitivity of the oceanic carbon cycle and atmospheric CO<sub>2</sub> concentration to changes in the zonal wind stress and its dependence on isopycnal diffusivity and surface boundary conditions is assessed, and implications for the past and future evolution of oceanic carbon uptake discussed.

*Research Area: Southern Ocean Physical Oceanography and Global Climate Modelling.*

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**Abstract:** TBC.

*Research Area: Supra-glacial lakes on the Greenland Ice Sheet*

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## The Ice2sea Project

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**Abstract:** Ice2sea (<http://www.ice2sea.eu>) is a project funded by European Union Framework-7 for four years from March 2009. The project will study processes affecting the evolution of mountain glaciers, ice caps, and polar ice sheets. One Work Package involves high-resolution modelling both of the ocean and - using regional climate models - of the atmosphere. In another Work Package, dynamical ice models will be developed and run. The ultimate aim of the project is to assess the impact of ice on global sea level during the 21st and 22nd centuries. At the Met Office Hadley Centre, we will use the Met Office's regional climate model to study changes in the surface mass balance of the Greenland Ice Sheet over the 21st and 22nd centuries both under SRES scenario A1B and under another scenario, E1 (used in the ENSEMBLES project), in which emissions evolve such that global CO<sub>2</sub> concentrations stabilise at 450 ppm. Preliminary work currently underway involves testing the regional model output for sensitivity to choice of domain, to allow the selection of the optimum domain for the 200-year integrations to be performed later. Here, I will give a brief overview of the ice2sea project and the Met Office's contribution to it, and also present some initial results.

*Research Area: Ice sheet modelling.*

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# The Application of the Legal Regime of Marine Scientific Research in Arctic Waters

**Rogers Roland.**

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**Abstract:** The undertaking of MSR in the Arctic basin falls within Part XIII of UNCLOS . Article 76 of the same Convention allows the States that border the Arctic basin to claim extensions to their Continental shelves. This mix of sovereignty along with an ice shelf that has a winter and summer limit means that access to undertake MSR by third party researching States will require good forward planning by the Polar scientific community.

*Research Area: Law of the Sea.*

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# Biogeography and Systematics of Deep Weddell Sea Gromiids.

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**Abstract:** Gromiids are large amoeboid protozoans with an organic test and filose pseudopodia, which protrude through a shell aperture that is surrounded by an oral capsule. It was only in 1994 that gromiids were found for the first time at bathyal depths when the first deep-sea gromiid, *G. sphaerica*, was recovered from below the oxygen minimum zone in the Arabian Sea. The present study is based on the largest sample set of undescribed deep-sea gromiids thus far including the description of twelve new morphospecies from bathyal and abyssal depths (1180 m–4800 m) in the Weddell Sea, Antarctica, using a combination of morphological and molecular criteria. Their identification as gromiids is confirmed by analyses of SSU rDNA gene sequences for three of the twelve new species: *Gromia marmorea* sp. nov., *Gromia melinus* sp. nov., and *Gromia winnetoui* sp. nov. Phylogenetic analysis revealed that *G. marmorea* and *G. melinus* form two distinct clades reflecting the morphological differences amongst the Weddell Sea species, and between deep-water Southern Ocean *Gromia* and previously described shallow-water gromiid *G. oviformis*, as well as gromiids from the deep Arabian Sea. *Gromia winnetoui* forms a third clade which branches with one of the Arabian Sea species. It is hypothesized that further sampling will increase the number of species and novel morphotypes. Gromiids appear to be found in highest abundances in areas with elevated fluxes of organic matter and are likely to play an important role in carbon and nitrogen cycling, as well as increasing local biodiversity.

*Research Area: Deep Sea Biology.*

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# Physical Oceanography of the Bellingshausen Sea, Antarctica, Summer 2007

**Deb Shoosmith**<sup>1</sup>, **Adrian Jenkins**<sup>1</sup> and **Mark Brandon**<sup>2</sup>.

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**Abstract:** The Bellingshausen Sea, West Antarctica, experiences a variable and warming climate, and as a result, the sea ice and land ice cover in the region are declining. This poster provides an overview of cruise JR165 on RRS James Clark Ross in early 2007. The cruise set out to investigate the oceanographic regime of the Bellingshausen continental shelf, in particular the processes that introduce warm Circumpolar Deep Water (CDW) to the shelf, drive its circulation on the shelf and regulate the amount of heat it gives up to the overlying ice cover and atmosphere. To this end, we occupied a number of CTD sections that cross two major troughs on the Bellingshausen continental shelf, as well as further sections across the shelf break at the mouths of the troughs. These will allow us to track the progress of CDW along the shelf edge, onto the shelf and up to the floating ice shelves. A CTD section spanning the Bellingshausen Sea from Fletcher Peninsula to Charcot Island shows the predominance of CDW across the shelf and enables us to determine circulation and transports for the entire region. In addition, sections across the fronts of the Wilkins and George VI Ice Shelves will allow us to quantify heat and meltwater transports, giving an estimate of the rate of basal melting, and thus determine the oceanographic impact on these ice shelves.

*Research Area: Physical Oceanography West of the Antarctic Peninsula and the Ocean's Impact on Ice Shelves.*

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# Contrasting Phenology of Roots and Shoots in Arctic Tundra Plant Communities

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**Abstract:** Plant roots are one of the least well understood components of terrestrial arctic ecosystems, despite their large biomass relative to stems and leaves and their importance in providing inputs to the soil organic matter pool. We used the mini-rhizotron technique to make weekly measurements of root growth in five contrasting arctic tundra plant communities in northern Finland during summer 2008. Shoot phenology (bud-burst) and growth were also recorded for the same period, in order to elucidate relationships between below-ground plant processes, which cannot be easily observed even at the plot scale, and above-ground plant processes, which can be monitored at wider scales using remote sensing techniques. The results showed that in plant communities dominated by graminoids (sedges), root and shoot phenology were closely coupled, with both root and shoot growth beginning in early June and reaching a maximum in early July. In contrast, in shrub and forest communities, root growth commenced almost a month after shoot growth and reached a maximum in mid-August. The differences in timing of root growth between communities could not be explained by soil temperature, which was similar in all five communities throughout the growing season. These results suggest that shoot growth does not adequately represent overall vegetation growth in arctic ecosystems, and may also have implications for the prediction of the response of arctic ecosystems to climate change, especially in view of the expansion of shrub-dominated communities in this region and the potential impacts this will have on below-ground processes.

*Research Area: Plant Ecology.*

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# The Influence of Bottom Slope on the Dynamics of Jets and Eddies in an Idealised Model of the Southern Ocean

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**Abstract:** The Antarctic Circumpolar Current (ACC), the strongest ocean current in the world, is dominated by mesoscale processes involving coherent eddies and narrow jets. Dynamics involving these poorly understood features play an important role in determining the Earth's climate. Observations show a clear influence of bottom topography on these processes, but the details are not well characterised. Here we use an idealised framework to provide further insight in this area. The properties of the Southern Ocean lend themselves well to a quasi-geostrophic approximation (small Rossby number, length scale larger than deformation radius) as a simplified system to use to gain initial insights. Numerical simulations of two-dimensional quasi-geostrophic flow in one and two-layer models are presented. The well-known formation of multiple jets resulting from the 'beta effect' (the latitudinal variation of the Coriolis parameter) is demonstrated and effects of introducing a linear gradient in bottom slope, in both meridional and zonal directions, investigated. Preliminary results on the variations in energy produced by eddies and the angle of the resultant jets with these gradients are presented.

*Research Area: Physical Oceanography.*

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An inverse diagnostic of the circulation and heat and freshwater fluxes across the rim of the Arctic Ocean in summer 2005.

**Takamasa Tsubouchi, Sheldon Bacon and Alberto Naveira-Garabato.**

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**Abstract:** As the integrated Arctic Ocean Observing System (iAOOS) is getting established, we have much better observations across the main gateways of the Arctic Ocean (Davis, Fram and Bering straits, and Barents Sea Opening). We are able to enclose the Arctic ocean using the! se hydrographic sections for a certain period. We are trying to estimate oceanic fluxes through these gateways by using inverse techniques applied to hydrographic, moored current meter and other available data in summer 2005. We will show the on going model diagnostics of ocean circulation and associated heat and freshwater fluxes. Considering thermal wind velocities (relative to the bottom) and bottom reference velocities, preliminary initial mass (3.25Sv output), salt (5.76 Sv\*psu input) and heat (21.77 Sv\*deg input) were calculated as a preliminary result.

*Research Area: Arctic Ocean Physical Oceanography.*

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# Glacier-influenced topography on the zonation of deep-sea megabenthos west of the Antarctic Peninsula

**Paul Tyler<sup>1</sup>, Sven Thatje<sup>1</sup>, Chris Hauton<sup>1</sup>, Abigail Pattenden<sup>1</sup>, Emily Dolan<sup>1</sup> and Andrew Clarke<sup>2</sup>.**

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**Abstract:** The ROV Isis was used to determine the biodiversity of megabenthos from 500 to 3500m depth from the fjordic regions west of the Antarctic Peninsula, across Marguerite Bay and into deep water of the Bellingshausen Sea. Biodiversity decreased with depth but appeared to be greatly influenced by the seabed topography including submarine drumlins, outwash channels, cliffs and current-induced ripples in deep water. Besides topography and depth the main influencing factor was phytodetritus availability. The dominant megabenthic taxa were echinoderms and cnidarians.

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# The Southern Ocean Fine Structure (SOFine) Project

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**Abstract:** SOFine seeks to investigate the momentum balance, overturning circulation and water mass transformation in a major standing meander of the Antarctic Circumpolar Current (ACC) north of the Kerguelen Plateau. Present theoretical and numerical models suggest that such large-scale meanders provide the focus for the transfer of momentum from the ACC to the solid Earth through topographic form stress, and that they host intense cross-stream motion and mixing of water masses as a result of eddy stress divergences and stirring. SOFINE will challenge this paradigm through mainly two lines of research. *Continues next page.*

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# The Southern Ocean Fine Structure (SOFine) Project

**S. Waterman** *et al.*

**Abstract:** *Continued from previous page.* First, it will test the hypothesis that internal wave generation resulting from the interaction of the ACC jets with small-scale topographic roughness is a leading-order momentum and energy sink, and that the subsequent internal wave radiation, breaking and stress divergence contributes significantly to forcing the cross-stream overturning. Second, it will assess the extent to and conditions in which ACC jets in the region behave as eddy-induced mixing barriers or blenders, and how these different mixing behaviours affect water mass transformations in the meander. This research will be pursued through the analysis of observations collected from the RRS James Cook in November - December 2008. These observations include a CTD/ADCP/ microstructure double-box survey of the meander, a 2.5-week deployment of three moorings surveying the internal wave field, and  $\sim 1500$  profiles of thermohaline and shear finestructure gathered by a swarm of 14 EM-APEX and Iridium Argo floats. Initial results of this analysis will be presented.

*Research Area: Physical Oceanography.*

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# Modelling Seabird Habitat Suitability: Assessing at-sea observation data quality for conservation

**Chun Wong.**

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**Abstract:** Vast amount of sub-Antarctic seabird at-sea observation data are publicly available online, which has many potential applications for seabird conservation such as for designing MPAs and for bycatch mitigation. Recent studies have called for an urgent assessment on the quality of these data. This study therefore aims to test seabird observation data quality and provide a framework methodology to assess their suitability for conservation purposes. Ensemble habitat suitability maps were derived from MAXENT and ENFA models and compared with baseline knowledge derived from satellite telemetry studies to assess data quality. The results showed that seabird observation data quality is sufficient to create habitat suitability maps that matched baseline seabird distribution knowledge but is also highly susceptible to survey biases. Therefore at-sea observation data must always be analysed in conjunction with survey intensity data. They are particularly useful when used to supplement conservation studies based on satellite telemetry to mitigate seabird bycatch, identify gaps of survey and MPA coverage, as well as to analyse seasonal distribution patterns of seabirds.

*Research Area: Sub-Antarctic Seabird Conservation.*

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# Simulating the Arctic Ocean using Data Assimilation in the NEMO Model

**Hao Zuo, Ruth Mugford, Keith Haines and Greg Smith.**

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**Abstract:** The Arctic Ocean circulation is simulated by using a 1/4 degree global ice-ocean model (NEMO) with a data assimilation scheme. Some results will be presented including the control run and data assimilation run, as well as the inter-comparison with the 1 degree NEMO run for the Arctic region.

*Research Area: Arctic Freshwater Budget.*