Antarctic Science Conference 2016

The Enterprise Centre, University of East Anglia

Tuesday 5th & Wed 6th July

List of abstracts for talks and posters in alphabetical order of presenter

Claire Allen (British Antarctic Survey)
A new proxy for reconstructing past wind strength in the Amundsen-Bellingshausen Sea

Winds in the Southern Ocean drive exchanges of heat and carbon dioxide between the ocean and atmosphere. Winds also explain the dominant patterns of both basal and surface melting and the collapse of ice shelves in the Amundsen and Bellingshausen Seas. However- long records of past wind strength and atmospheric circulation are needed to assess the significance of these recent changes. Here we present a novel proxy for past wind strength in the Amundsen-Bellingshausen Sea- based on diatoms entrained in ice cores. The diatom abundance- species assemblages and total particulate content vary from year to year and relate to the regional wind strength and circulation patterns that influence the onshore northerly winds. We present data from the Ferrigno ice core in the southern Antarctic Peninsula to investigate wind strength and circulation over the past 300 years.

Dorothee Bakker (UEA)
Quantifying the Southern Ocean carbon sink

The Southern Ocean is an important sink for carbon dioxide (CO2) emissions by human activity. Recent studies have suggested long-term variation in Southern Ocean CO2 uptake- ranging from a saturation of the Southern Ocean carbon sink to a re-invigoration of the Southern Ocean carbon sink. Synthesis of surface ocean CO2 observations in the Surface Ocean CO2 Atlas (www.socat.info) has become an important tool for quantification of the ocean carbon sink. Version 3 of SOCAT has 14.5 million surface ocean CO2 values for the global oceans and coastal seas from 1957 to 2014. Mapping methods- including statistical interpolation- regression- and model-based regression or tuning- are used for quantification of the global ocean carbon sink based on surface ocean CO2 observations. The Surface Ocean pCO2 Mapping Intercomparison (SOCOM) compares 14 such mapping methods. The mapping methods reproduce the seasonal cycle of surface ocean CO2 in Southern Ocean regions. Most methods also highlight year-to-year and longer term variation in the Southern Ocean carbon sink- but with sizeable differences between the estimates. This presentation will explore key uncertainties in our knowledge of the Southern Ocean carbon sink and how we can reduce these uncertainties.

Thomas Barningham (UEA)
Continuous atmospheric O2 and CO2 measurements at the Halley Research Station- Antarctica: Insights into Southern Ocean carbon sink variability and ne

We present the first 4 months of data from a very recent installation of a fully automated- continuous atmospheric O2 and CO2 measurement system at the Clean Air Sector Laboratory (CASLab) at the Halley Research Station- Antarctica- in collaboration with the British Antarctic Survey. The main aim of this new installation is to assess both the short and long term variability of the Southern Ocean carbon cycle. In particular- by incorporating the short term (days to weeks) atmospheric O2 data in the NAME (Numerical Atmospheric dispersion Modelling Environment) atmospheric transport model- one can discern regions of the Southern Ocean where marine biological productivity dominates air-sea gas exchange of O2- or- conversely- where deep ocean ventilation dominates. In addition- from our preliminary data we believe we have found evidence for the depletion of O2 due to the production of CO2 and O3 in the presence of sunlight. Oxygen- due to its large atmospheric reservoir- is typically assumed to be a constant unchanging source in the CO-CO2-O3 system. However- by achieving an O2 measurement precision of < 1 ppm and by measuring in a pristine- unpolluted environment- we believe we have found evidence for O2 depletion caused by O3 production.

Jesamine Bartlett (University of Birmingham)
How to be a successful invader: Lessons from the life cycle of an Antarctic midge

Given the inexorable increase in human activity and ongoing climatic changes- understanding the impact of non-native species on the nutrient-limited and low biodiversity Antarctic ecosystems has never been more pressing. Establishing the life histories of influential invading organisms is a key element of this understanding. The flightless midge Eretmoptera murphyi is recently introduced to maritime Antarctic Signy Island from its endemic sub-Antarctic South Georgia. After its introduction in the 1960s- this fly was initially 'persistent'- with very little expansion in range. Since the late 1980s it has undergone considerable increases in population density and local distribution and is suspected of substantially altering the nutrient turnover rates in its typical habitat- and thus potentially the immediate ecosystem. However even now only fragments of its life cycle and ability to survive in this more extreme environment are understood. This project will fully detail the life history of E. murphyi and- in particular- establish the existence of any environmental controls on development and phenology. Here we provide initial data on previously undocumented life stages- including the first recorded development and subsequent hatching of eggs- and suggested environmental triggers for pupation and emergence.

Anna Belcher (British Antarctic Survey)
Antarctic krill faecal pellets as an agent of POC flux transfer in the Southern Ocean

Antarctic krill (Euphausia superba) play a central role in the food web of the Southern Ocean- forming the link between primary production and large predators. Krill also produce large- rapidly sinking faecal pellets (FP) which can make up a large component of deep ocean carbon fluxes. However- the patchy distribution of krill swarms means that limited sediment trap coverage in the Southern Ocean may not fully capture these episodic- but potentially large- carbon fluxes. - - We measure particle flux and composition using Marine Snow Catchers in the marginal ice zone near the South Orkneys- Antarctica. Krill FP were the dominant component of the flux- accounting for 60-85% of the particulate organic carbon (POC) flux. We compare these direct FP flux measurements to estimates of FP production based on krill densities (KRILLBASE) and FP egestion rates from the literature- and calculate attenuation rates in the upper mesopelagic. We find that krill FP are transferred much more efficiently than estimated by global biogeochemical models that use average attenuation rates of total POC. Scaling up our estimates to the whole Southern Ocean based on krill densities suggests that krill FP may explain disparities between Southern Ocean models and observed deep ocean POC fluxes.

Mike Bentley (Durham University)
Deglacial history of Pensacola Mountains, Antarctica from glacial geomorphology and cosmogenic surface exposure dating

A new dataset of geomorphological and cosmogenic surface exposure dating from the Pensacola Mountains allows us to make inferences on the glacial history of this region, and in particular the deglacial history of the Foundation Ice Stream. There is evidence of at least two glaciations with an earlier glaciation that was warm-based, and which weathering suggests was relatively old, and a second, more recent glaciation that was cold-based. Maximum thickening in the most recent glaciation was >380m. The precise timing of the onset of deglacial thinning is not well-constrained by these data but was well underway by the Early Holocene and there is evidence of progressive thinning of the Foundation Ice Stream and tributary Academy Glacier through the Holocene. The thinning trajectory is similar at multiple sites, reaching present ice levels by 2.5ka. The thinning history reported here is broadly similar to that reported from the Ellsworth Mountains, and is consistent with, but does not mandate, a recently hypothesised retreat within present margins followed by a Late Holocene readvance in the Weddell Sea. These data provide additional constraints on attempts to infer former ice sheet extent in the Weddell Sea embayment using numerical flowband modelling of the Foundation Ice Stream.

Louise Biddle (UEA)
Identifying Glacial Meltwater in the Amundsen Sea

Pine Island Ice Shelf (PIIS) - located in the Amundsen Sea- is losing mass rapidly due to relatively warm ocean waters melting from below. Tracing the glacial meltwater (GMW) pathways from the ice sheets is important in order to identify the regions most affected by the increased input of this water type. - - Water mass characteristics (temperature- salinity- O2 concentration) are used to calculate GMW fractions. The observations from the Amundsen Sea appear to show a plume of GMW travelling away from PIIS along s = 27.7 kg m-3- out to the shelf edge. We investigate the reliability of these results to ascertain the GMW pathways in the Amundsen Sea. - - We analyse the effects of both physical and biological processes on the reliability of the calculated GMW fractions using a modified one-dimensional ocean model based on Price-Weller-Pinkel (1986). The model simulates changes in the water mass endpoints- as well as biological activity. These processes are found to result in a false GMW signature- similar to the plume observed at the shelf edge. - - Recommendations are made to improve the reliability of GMW calculations. The resulting GMW fractions reveal a meltwater pathway leading to the west of PIIS- along the coastline.

Elisabeth Biersma (University of Cambridge/British Antarctic Survey)
Mixed Patterns of Recent Arrivals and Long-Term Survivors: the Evolutionary History of Plants in Antarctica

How long have modern plants been present in Antarctica? Glaciological reconstructions of the Last Glacial Maximum (LGM; ~22–18kya) and earlier glaciations suggest that thick ice sheets covered most terrestrial areas of the Antarctic- implying that virtually no terrestrial life could have survived in Antarctica. Low endemism levels and low species richness appear to further support recent colonization (post-LGM) of the major group of Antarctic plants- the mosses. However- recent molecular studies of Antarctic terrestrial faunal groups strongly support long-term survival through multiple glaciations in situ and- alternatively- mosses may have had a long and previously underestimated persistence in Antarctica. - Here- using population genetics combined with molecular dating methods on several species of mosses (including members of the Polytrichaceae- and the genera Bryum- Ceratodon and Chorisodontium)- we reveal a mixed pattern of persistence in Antarctica. While some Antarctic populations are of seemingly recent (post-LGM) arrival- others reveal the first clear evidence of long-term survival- with genetic dating methods revealing multi-million year persistence- and even examples of migration out of Antarctica from source populations. This study suggests that- despite the harsh climate and ice extent during glacial periods- mosses have had a much longer presence in Antarctica than previously thought. -

Alexander Brearley (British Antarctic Survey)
Controls on turbulent mixing on the west Antarctic Peninsula shelf

Turbulent mixing on the west Antarctic Peninsula shelf is a highly important process- being responsible both for delivering ocean heat to the melting glaciers of the region- and for supplying nutrients to the biologically productive surface layers. Despite this- literature estimates of the turbulent diffusivity and the associated heat fluxes vary by up to an order of magnitude- and direct estimates of mixing are extremely sparse. - - In this talk- we document and discuss two separate pieces of fieldwork aimed at understanding both the magnitude of mixing at the Rothera Time Series (RaTS) site- and its controlling processes. Whilst overall heat fluxes through the pycnocline at the site are relatively modest (~1 W m-2)- shear instabilities in the water column arise by different mechanisms during periods when fast ice is absent or present. Whilst the diurnal tides are important in generating velocity shear year-round- a significant input of wind-driven near-inertial energy into the ocean during the fast-ice-free months is responsible for generating significant turbulent motions. We will also discuss the most recent microstructure estimates of turbulent diffusivity obtained in February 2016 from Ryder Bay- and discuss how the results compare to finestructure-based estimates of turbulent dissipation.

Helen Burns (University of Southampton)
The response of diabatic eddies and southern ocean residual overturning to altered northern boundary conditions in an idealised channel model.

The overturning circulation in the Southern Ocean consists of a residual overturning circulation (ROC) formed by opposing mean and eddy circulations. Previous studies of the Southern Ocean ROC have focused local surface wind and buoyancy forcing (surface boundary conditions). However in order to close the ROC an open northern boundary condition must be applied and if closed will not allow for a ROC to be maintained. Buoyancy budget arguments imply that this must be achieved through a response in the diabatic eddies. Using a series of idealised channel model set ups we focus on the diabatic eddy response to altering northern boundary stratification to gain a better understanding of diabatic eddy processes. This could have implications for the ROC response to far field forcing and that process representation in climate model feedbacks.

Benjamin Butler (Bangor University)
The effect of mineral precipitation on measurements of sea ice brine salinity

Sea ice contains concentrated brines which are the site of in-situ chemical and biological reactions. The brines become supersaturated with respect to mirabilite (Na2SO4·10H2O) below –6.4 °C- and the associated removal of Na+ and SO42- from the brine results in considerable non-conservative changes to its composition. The changes are reflected in the brine salinity- which is a fundamental physico-chemical parameter in the sea ice brine system. Here- measurements of electrical conductivity and brine composition in synthetic sea ice brines between –1.8 and –20.6 °C are combined with modelled estimates to assess the behaviour of the absolute (SA) and practical (SP) salinities of sea ice brines. Results display substantial divergence of SP from SA below –6.4 °C- which approaches a 7.2% difference with decreasing temperature. This is shown to create inaccuracies when SP is assumed to be equivalent to SA- firstly by misrepresenting the conditions inhabited by sea ice biota- whilst also creating errors in the calculation of physical sea ice parameters. To combat the discrepancies between the two salinity concepts- we propose a conversion factor for the estimation of SA from SP measurement in sea ice brines- ultimately highlighting careful consideration of salinity concepts in the sea ice system.

Stephen Chuter (University of Bristol)
Antarctic Ice Shelf Thickness from CryoSat-2 Radar Altimetry

Ice shelf thickness has previously been inferred from satellite radar altimetry using the assumption of hydrostatic equilibrium- although sensor limitations have led to poor data coverage and accuracy- particularly within the grounding zone. We present a new ice shelf thickness dataset using four years (2011-2014) of CryoSat-2 elevation measurements- with its SARIn mode of operation alleviating the issues affecting previous sensors. - - Validation with Radio Echo Sounding data over the Amery ice shelf shows mean differences of 3.3% and 4.7% across the whole shelf and within 10 km of the grounding line respectively- presenting a two to threefold improvement in accuracy when compared to the previous data product. - - The impact on Input-Output mass balance estimates is shown for the Abbot Ice Shelf. Our new product shows a mean 29% reduction in ice thickness at the grounding line- equating to a change in mass balance from -14±9 GTyr-1 to -4±9 GTyr-1. This is more consistent with the positive surface elevation rate in this region obtained from satellite altimetry and shows the datasets potential for reducing uncertainties in input-output mass budget estimates for the ~30% of the grounding line where direct measurements of ice thickness to do not exist.

Peter Convey (British Antarctic Survey)
Atmospheric linkages and bryophyte dispersal in the Antarctic Peninsula and South Atlantic

Antarctic terrestrial habitats are typically small and 'island like'. Along the Antarctic Peninsula and Scotia Arc- some terrestrial biota are widely distributed. As the majority of these 'islands' probably became exposed during post-Pleistocene glacial retreat- clearly successful dispersal events must be reasonably frequent- but few biological studies have addressed this. In contrast- other biota have very restricted distributions- a striking example of this being the bryophytes specifically associated with geothermal ecosystems of the South Sandwich Islands and Deception Island- where some species are restricted to single fumarole systems. Bryophytes produce different dispersing propagules- and spores in particular are adapted for passive dispersal in the air column. However- very few studies have addressed even the basic aerobiological question of how frequently such aerial transfer events might have opportunity to occur in the Antarctic and across the Southern Ocean- while ecophysiological data relating to spore survival during transfer or viability on arrival are currently unavailable. Here- we provide an overview of the importance of spore production in Antarctic and Southern Ocean Island bryophytes- and an initial assessment of the level of potential aerobiological connectedness between different locations within the Antarctic Peninsula- the remote South Atlantic islands- and lower latitudes.

Arnaud Czaja (Imperial College)
An illustrative model of Southern Ocean heat uptake

The mechanisms controlling surface heating and the associated "heat pathways" in the ocean and atmosphere will be discussed in light of an idealized model including air-sea interactions and ocean dynamics.

Peter Davis (British Antarctic Survey)
Recent Ocean Conditions in the Amundsen Sea and their Influence on Pine Island Glacier

Thinning ice in the Amundsen Sea sector of West Antarctica contributes about 10% of the current rise in global sea level. The cause is an acceleration in the flow of outlet glaciers in the region that appears to be driven by changes in the volume and temperature of the warm deep waters that flow onto the Amundsen Sea continental shelf. In particular, observations in front of and beneath Pine Island Glacier have shown that warm water flows onto the shelf through two troughs at the continental shelf break and can readily access the sub-ice shelf cavity, rapidly melting the ice above, and promoting swift retreat of the glacier. Since 2009, ocean moorings have been deployed within the vicinity of Pine Island Glacier and throughout the Amundsen Sea as part of an international effort that included the NERC iStar – Ice Sheet Stability Program. Recently, the recovery of a further four moorings has extended the available timeseries up to 2016, allowing us to investigate the longer term interactions between Pine Island Glacier and the ocean over which it floats. Here we will present the key findings from these new timeseries, including, for the first time, concurrent measurements of ocean properties in the two troughs that feed warm water towards Pine Island Glacier

Rowan Dejardin (University of Nottingham)
A deglacial and Holocene multiproxy palaeoceanographic record from the Subantarctic island of South Georgia.

To assess the Southern Ocean's sensitivity to climate change and place recent environmental changes within a historical context- it is important to develop our understanding of how water mass properties and circulation patterns have varied- particularly in the little-studied Subantarctic Zone. South Georgia is of particular interest because it sits in the path of the Antarctic Circumpolar Current (ACC). Past changes to

primary productivity may provide insights into natural oceanographic variability. Here we present micropalaeontological and geochemical data from a sediment core on the continental shelf east of South Georgia- spanning the last 15 kyrs. Benthic foraminiferal assemblages and organic carbon accumulation indicate a highly productive late deglacial and early Holocene- with Fursenkoina fusiformis dominating benthic foraminifera assemblages- similar to some Antarctic Peninsula records (e.g. Palmer Deep and Marguerite Bay). Subsequent changes in the mid and late Holocene lead to assemblages dominated by Miliammina arenacea. There is potential for these changes to be linked to the interaction of the Southern Antarctic Circumpolar Current Front with the South Georgia shelf- deglacial out-washing- and/or wind-driven dust- or more regional scale variability such as variation in the ACC- possibly driven by changes in the position and strength of the Southern Hemisphere Westerly Winds.

Fausto Ferraccioli (British Antarctic Survey/NERC)
Unveiling the last frontier on Earth: East Antarctica

East Antarctica is the least understood piece of continental crust due to vast ice sheet cover. Here I review results of international aerogeophysical research efforts that provide tantalising glimpses into subglacial landscapes- geology and deeper crustal architecture over several East Antarctic frontiers. - - Discoveries include the uniquely well-preserved fluvial landscapes in the Gamburtsev Sublgacial Mountains and a mosaic of previously unknown lithospheric provinces underlying the mountains- that were assembled together to form East Antarctica. The discovery of one of the longest rift valley systems on Earth that surrounds the mountain range itself provides clues on how these enigmatic mountains formed and then provided a nucleation site for ice sheet development. We now know that huge subglacial basins including the Aurora- Wilkes and Recovery basins are controlled by lithospheric-scale tectonic structures and include major subglacial sedimentary basins that are likely to contain important paleoclimate archives- as well as affect ice sheet dynamics and stability. The new knowledge on the structure and evolution of the crust makes it possible to address broader linkages between East Antarctica and the global supercontinental cycle- and also investigate how the Solid Earth can affect the largest ice sheet left on Earth.

Rebecca Frew (University of Reading)
The Impact of Snow Ice on Sea Ice in the Southern Ocean

Sea ice is frozen seawater that expands to cover the ocean at both poles during their respective winters. Arctic sea ice is melting rapidly under the effects of climate change- but at the same time Antarctic sea ice is actually expanding overall. The changes in Antarctic sea ice over the last thirty years have a strong seasonal dependence- and the way - that these changes grow in spring and decay in autumn suggests that feedbacks are strongly involved (Holland- 2014). The changes might ultimately be caused by winds- atmospheric warming- snowfall changes- etc.- but to understand these forcings we need to untangle the feedbacks. Precipitation over the southern Ocean is projected to increase- and this is likely to increase the amount of snow ice formation. This could produce two competing effects on the sea ice thickness- a direct increase in the thickness of ice- but a decrease in the thickness of snow cover insulating the sea ice. In order to investigate the impacts of these competing effects on the seasonal sea ice cycle an idealised modelling study representing the Amundsen and Weddell Sea regions in the Southern Ocean has been carried out. -

Jessie Gardner (UEA/British Antarctic Survey)
Pteropod larvae exhibit shell dissolution and malformation in a high CO2 Ocean.

Early developmental stages of marine calcifiers are thought to be particularly vulnerable to climate change. Thecosome pteropods (planktonic gastropods) are often referred to as sentinels to ocean acidification due

to their aragonite shells. However- the impact of ocean acidification on pteropods early life stages remains poorly understood and their response to multiple environmental stressors- such as ocean acidification and global warming- undetermined. - We investigated the response of pteropod larvae (Limacina helicina antarctica) to the rapid acidification and warming projected within the Southern Ocean. Adults were incubated under ambient conditions- where some spawned eggs. Larvae that subsequently hatched were incubated within ambient (1°C and pH 8.1)- warm (3.5°C and pH 8.1)- acidified (1°C and pH 7.6) and warm-acidified (3.5°C and pH 7.6) conditions. To evaluate the implications of exposure to these conditions over time- shell morphology and dissolution were inspected daily for 5 days. - Across all days larvae exposed to acidified and warm-acidified conditions displayed shell dissolution but after 3 days within warm and warm-acidified conditions larvae developed shell malformation. We demonstrate that ocean acidification and warming- along with exposure duration- could have severe implications on pteropod larvae development and in turn impact the population dynamics of this keystone species.

Alejandro Roman Gonzalez (Cardiff University)
Advances in developing Antarctic sclerochronogical archives from the marine bivalve Yoldia eightsi

A strong warming trend in west Antarctic has been measured over at least the last 50 years- this is associated with a shortening of the winter season- increased deglaciation and meltwater runoff and warming and freshening of surface waters. These environmental responses are very likely to affect Antarctic ecosystems from shallow habitats to deeper communities. However- investigation of these changes is limited because of a lack of long-term environmental records. Annually-resolved sclerochronological archives have now the potential to fill some of the gaps and even extend beyond the instrumental record. Yoldia eightsi is an infaunal marine bivalve found in shallow waters (down to 100 m)- believed to have a circum-Antarctic distribution. We present five chronologies from two Antarctic locations: South Orkney Islands (Signy station) and West Antarctic Peninsula (Rothera station). Yoldia eightsi shell growth showed a negative relationship with winter duration (r=-0.52- N=24- P=0.01) and fast-ice duration (r=-0.41- N=24- P=0.05) and a positive relationship with mean annual sea surface temperature (SST; r=0.48- N=24- P=0.05) winter SST (r=0.57- N=24- P=0.01) and summer SST (r=0.46- N=24- P=0.05) between 1965 and 1988 at Signy. Chronologies developed from adjacent sampling locations at Rothera may offer insights into the local hydrography.

Kathryn Gunn (University of Cambridge)
Mesoscale eddies as shelf exchange mechanisms of Circumpolar Deep Water in the west Antarctic Peninsula

Exchange of Circumpolar Deep Water across the west Antarctic Peninsula shelf plays a significant role in ice-shelf processes- consequently affecting ice-sheet mass balance and global sea-level. However- the physical mechanisms for this warm water circulation remain elusive. Here- we investigate shelf-exchange using two-dimensional seismic imaging of the water column- attaining vertical and horizontal resolutions of ~ 10 m. 7 seismic profiles- acquired in February 2015 using the RRS James Clark Ross- are analysed. Observed reflections are caused by changes of temperature (~ 80%) and salinity (~ 20%) hence delineating water masses of different physical properties. 10 XCTDs and XBTs plus a 38 kHz echo-sounder profile were simultaneously acquired and used for calibration. Curved- discontinuous reflections forming lens shapes- between 70-300 m depth- are attributed to eddy-like parcels of Upper Circumpolar Deep Water. Two warm core eddies- temperatures = 1.5°C and length > 10 km- are imaged in Marguerite Trough. A cold core eddy- length 60 km- is calibrated with temperature data and is believed to be recirculated intrusions. Between 10-15 eddies- 2-15 km in length- are imaged in Belgica Trough. The seismic profiles indicate mesoscale eddies are a significant mechanism for water exchange in the west Antarctic Peninsula.

Richard Hindmarsh (British Antarctic Survey)
Using glaciology to date the post-LGM retreat of the Antarctic ice-sheet.

The Antarctic ice-sheet (AIS) is surrounded by over one hundred grounded ice islands- between 1km and 100 km in size. These ice islands are known as "ice-rises". The internal stratigraphy of these can be sampled using ice-penetrating radar. Ice flow effects cause stable and thus predictable folding to occur within them. This folding is initiated by changes in the large-scale geometry of the ice-sheet. - - The above-water part of the AIS is nearly all covered by ice- causing difficulty for well-established geological dating techniques. The ice-rises are largely situated in areas where post-LGM retreat has occurred- and dating of the retreat can be made from radar surveys of the ice-rises. - We have visited six ice-rises in the Ross Ice-Shelf and Ronne Ice-Shelf- surveyed them with radar and dated the commencement of formation of the folding. These give surprisingly recent late Holocene dates. We will present results from radar surveys- indicate how the dating was done and review the history of post-LGM AIS retreat.

Jennifer Horrocks (Durham University and British Antarctic Survey)
First high-resolution record of Late Quaternary environmental changes in the Amundsen Sea revealed by multi-proxy analysis of drift sediments

The Amundsen Sea sector of the West Antarctic Ice Sheet (WAIS) is experiencing rapid mass loss- and there is a pressing need to place the contemporary ice-sheet changes into a longer term context. The continental rise in this region is characterised by large sediment mounds that are shaped by westward flowing bottom currents and that resemble contouritic drifts existing offshore from the Antarctic Peninsula. - Here we use multi-proxy data from four sediment cores (PC494- PC496- PS58/253-1- PS58/255-2) recovered from two of the Amundsen Sea mounds to present the first high-resolution study of environmental changes on this part of the West Antarctic continental margin over the Late Quaternary glacial-interglacial cycles. Age constraints for the records are derived from biostratigraphy- AMS 14C dates and lithostratigraphy. - We report sedimentary records extending from Marine Isotope Stages 1 to 10. Geochemical and mineralogical sediment composition are used to infer changes in terrigenous sediment supply in response to the advance and retreat of the WAIS across the shelf and changes in biological productivity that are mainly controlled by the duration of annual sea-ice coverage. Grain-size records suggest that condensed sedimentation caused by increased bottom current speed occurred during interglacial periods below =3720 m water depth. -

Pat Hyder (Met Office)
Understanding and reducing Southern Ocean biases in the HadGEM3 coupled climate model and IPCC CMIP5 models

We employ a new method to estimate globally balanced net fluxes based on Top of Atmosphere observations and ERA Interim re-analysis energy divergence- assuming atmospheric column energy conservation. These estimates are used with CERES radiative fluxes to estimate turbulent fluxes as a residual (split into latent and sensible heat using OAFLUX Bowen Ratios). Our estimates are inter-compared with a range of existing heat flux products. Sensitivity to the re-analyses used in the new method indicates spreads of ~<10W/m2 in multi-annual zonal means- which is considerably less than the spread between other net heat flux estimates. - - The new fluxes are employed for the Southern Ocean (and other regions) to assess:
• Atmospheric biases in the IPCC CMIP atmosphere only models and relate these biases to corresponding coupled biases- suggesting that atmospheric errors largely drive coupled Southern Ocean biases and that there is considerable error cancellation between different flux terms across the models.
• Heat fluxes for ocean forcing sets above observed sea surface temperature (SST) - suggesting that there are large errors which inhibit adequate assessment of ocean models.
• & Improve process-representation the HadGEM3 atmospheric component of the coupled climate model- resulting in a 50% reduction in coupled SST biases.

Stewart Jamieson (Durham University)
An extensive subglacial lake and valley system in Princess Elizabeth Land- East Antarctica

The subglacial landscape of Princess Elizabeth Land in East Antarctica is poorly constrained due to a paucity of ice-thickness measurements. We analyse a series of satellite imagery datasets to reveal ice surface expressions of macro-scale landforms beneath the ice sheet. We find evidence that a a series of large-linear features lie hidden beneath the East Antarctic Ice Sheet in Princess Elizabeth Land: a feature that is 140 x 20 km in dimension- and multiple narrow (ca. 10 km) sinuous features that appear connected and may extend for over 1-100 km from central PEL to the coast. We hypothesise these surface features relate to a large subglacial lake in the interior of PEL linked to a large- deep- valley or canyon system. The presence of deep valleys is confirmed at a few localities by radar data from the ICECAP project but no data exist over the proposed subglacial lake. We suggest the features represent a tectonically-controlled valley system incised by rivers prior to continental-scale Antarctic glaciation at 14Ma since which time it may have been modified by subglacial water flow. An aerogeophysical survey programme (ICECAP2) is focussed on confirming the presence of these features and mapping their detail.

Jessica Johnson (UEA)
Geophysical Hazard of the South Sandwich Islands

The South Sandwich Islands (SSI) is an arc consisting of eleven small volcanic islands. The SSI are uninhabited and distant from shipping and air routes. The high latitude of the islands mean that satellite imagery and photographs are rare. For these reasons- the geophysical hazard associated with the SSI is not well classified. In this study- we analyse existing literature and published satellite imagery to draw conclusions about the earthquake- tsunami and volcanic hazard and risk from the South Sandwich Islands. -- Preliminary results indicate that there have been 12 earthquakes >M7 in the SSI in the last 50 years- the greatest being the 1964 M7.8 event. In general- large thrust earthquakes are usually intermediate depth- while shallow large earthquakes are strike-slip in nature- posing low risk of tsunami. Satellite imagery and geological investigations indicate that several of the islands have hosted recent eruptive activity- including a lava lake on Saunders Island and an explosive and effusive eruption on Montagu Island. The islands are mostly made up of basaltic material with small calderas- most of which formed without significant pyroclastic material. The greatest risk is tsunami from sector collapse- of which there is evidence from large debris lobes in the bathymetry.

Nadine Johnston (British Antarctic Survey)
Developing integrated analyses of Southern Ocean ecosystems: status, change and future projections

Southern Ocean ecosystems provide globally important ecosystem services: maintaining biodiversity, influencing biogeochemical cycles and in supporting fisheries they affect global food security. They are also being affected by rapid climate driven changes, with impacts being observed at every trophic level in the ecosystem. Understanding the impacts of change in these ecosystems requires integrated (end-to-end) ecosystem analyses at regional and circumpolar scales. Developing those analyses has been the focus of the Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme. This 10 year programme has three major scientific objectives: 1) understand how climate processes affect ecosystem structure and dynamics, 2) understand how ecosystem structure and dynamics interact with biogeochemical cycles, and 3) determine how ecosystem structure and dynamics should be incorporated into management approaches for sustainable exploitation. These are being achieved through three key activities; circumpolar data synthesis and mining, field coordination and modelling. Here we highlight our recent progress, particularly in the development of end-to-end analyses and models. An ICED-led assessment of the status of Southern Ocean ecosystems has highlighted the urgent need for better

observational data to allow the evidence of change to be rigorously tested. We highlight major current ICED activities focused on the the rescue of historical data, development of scenarios and models for the projection of the impacts of future change.

Julie Jones (University of Sheffield)
Are recent trends in high-latitude Southern Hemisphere climate unusual?

Understanding the causes of recent climatic trends and variability in the high latitudes of the Southern Hemisphere is hampered by a sparse and short instrumental record. Here- we use a synthesis of instrumental and satellite data with palaeoclimate proxy records and climate model simulations to assess recent changes in the atmosphere- ocean and sea ice in this region. Over the 36-year satellite observation era- significant linear trends in annual mean sea ice extent- surface temperature and sea level pressure are superimposed on large interannual to decadal variability. However most of the recent instrumental record trends are not unprecedented over the past two centuries- as documented in palaeoclimate proxy records- and are compatible with natural regional variability depicted by unforced model simulations. When driven by both natural and anthropogenic forcings- models do not capture many characteristics of the recent observed trends- in particular the increase in sea ice extent. This suggests either that recent trends are largely due to a singular event associated with natural multidecadal variability- and/or that climate models misrepresent key physical processes. The recovery of historical data- extraction of new palaeoclimatic records- and improvements of model representations for this key region are imperative.

Julie Jones (University of Sheffield) – 2nd submission
Antarctic Station Based Seasonal Pressure Reconstructions Since 1905

Seasonal mean Antarctic pressures at 17 stations are reconstructed using principal component regression, employing midlatitude pressure data as predictors. Seasonally, reconstruction skill was high in austral summer across the entire Antarctic continent. Spatially, the reconstruction skill was highest near the Antarctic Peninsula in all seasons, and weakest in coastal East Antarctica and the Antarctic Interior during austral spring and autumn; the spatial variability of the skill in part reflects the distance to the nearest mid-latitude predictor.
Nonetheless, for nearly all seasons and locations the observed trends since 1957 were well captured by the reconstructions, as was the low-frequency decadal scale variability. These results suggest Antarctic pressure observations can be extended throughout the 20th century with high confidence, especially in summer, allowing for a more precise understanding of the role and magnitude of natural atmospheric circulation variability across Antarctica.
In summer, there is considerable interannual variability that was spatially uniform across all of Antarctica. Negative summer pressure trends during the last ~40 years across all of Antarctic are unique in the context of 30-year trends throughout the entire 20th century, suggesting a strong component of anthropogenic forcing on the recent summer trends. Results for winter will also be presented.

Richard Jones (UEA)

Evaluation of four global reanalyses using in-situ observations in the Amundsen Sea- Antarctica

The glaciers within the Amundsen Sea Embayment (ASE)- West Antarctica- are amongst the most rapidly retreating in Antarctica. Meteorological reanalysis products are widely used to help understand and simulate the processes causing this retreat. Here we provide an evaluation of four of the latest global reanalysis products within the ASE region – ERA-Interim- JRA-55- CFSR and MERRA. The observations comprise data from four automatic weather stations (AWS)- three research-vessels and a new set of 38

radiosondes. - All four reanalyses produce 2 m temperatures that are colder than AWS observations- with the biases varying from approximately -1.8°C (ERA-I) to -6.8°C (MERRA). Over the Amundsen Sea- spatially averaged summertime biases compared to research vessel observations are between -0.4°C (JRA-55) and -2.1°C (MERRA) with larger cold biases close to the continent (up to -6°C). All four reanalyses underestimate near surface winds at high wind speeds (>15 m s-1) and exhibit dry biases in specific humidity. - A comparison with radiosonde soundings shows that the cold- dry bias extends into the lower troposphere. The reanalyses generally contain larger temperature and humidity biases- when a temperature inversion is observed; and contain larger wind speed biases (~2 to 3 m s-1) when a low-level jet is observed.

Richard Jones (UEA) – 2nd submission

High resolution numerical weather prediction in the Amundsen Sea Embayment, Antarctica

The glaciers of the Amundsen Sea Embayment are amongst the most rapidly retreating in Antarctica. Relatively warm circumpolar deep water is transported on to the continental shelf and leads to basal melting of floating ice shelves. Recent research has shown the importance of local processes such as sea ice formation in determining the ocean heat content (and subsequent glacial melt) in the vicinity of Pine Island and Thwaites glaciers. Cold air outbreaks and their associated large heat fluxes from the ocean to the atmosphere are important for the formation of sea ice. Here we examine the meteorological conditions associated with large ocean heat fluxes through a 10 year climatology from ERA-Interim reanalysis data. We also examine recent, large heat flux case studies using high resolution (2.2km) numerical weather prediction simulations with the Met Office Unified Model. For these case studies we compare the magnitude of the heat fluxes given by the high resolution model to those from ERA-Interim which has a much coarser horizontal resolution (~70km). The magnitude of any differences in heat fluxes between the NWP model and reanalysis will be an important consideration for future ocean modelling studies.

Tom Jordan (British Antarctic Survey)

New aerogeophysical survey targets the South Pole Frontier

Despite major advancements in Antarctic airborne geophysical research over the last decade- the South Pole region has remained one of the largest “poles of ignorance” of the entire continent- as very little data have been acquired here since pioneering surveys performed in the 1970’s. - - During the most recent 2015-2016 Antarctic campaign we flew a major aerogeophysical survey that led to the successful collection of ca 30-000 line km of new radio echo sounding- laser altimetry- airborne gravity and aeromagnetic data over the South Pole as part of the PolarGAP project- supported by the European Space Agency (ESA). The main aim of the survey was to provide key missing airborne gravity data required to fill in the major void in GOCE (Gravity Field and Steady-State Ocean Circulation Explorer) satellite gravity data coverage south of 83.3°S. - - Here we present the first products derived from this survey- including ice thickness- bedrock topography- and gravity and magnetic anomaly images. The data provide a new geophysical tool to study the Pensacola-Pole subglacial basin in the hinterland of the Transantarctic and Ellsworth-Whitmore Mountains- and its’ boundaries with the Recovery Subglacial Highlands and Gamburtsev Subglacial Mountains in East Antarctica. -

Amelie Kirchgaessner (British Antarctic Survey)

Measurements of IN with the Spectral Ice Nuclei Counter SPIN at Halley during Antarctic season 2015/16

Climate and weather forecasting models perform significantly poorer in southern hemisphere high latitudes than at mid-latitudes- not least due to a lack of in situ measurements of parameters relevant to the radiation and thus surface mass balance in Antarctica. As part of the project MAC (Microphysics of Antarctic Clouds) in November and December 2015 a Spectral ice Nuclei Counter (SPIN- DMT Inc) was deployed at Halley in the Clean Air Sector Laboratory (CASLab). The instrument has a particle detection range from 0.5 – 15 µm. The detector design allows for sizing of individual particles- and discrimination between ice and water particles. - Two types of measurements were performed. Firstly- a sequence of predefined temperature and super saturation settings was run daily to sample ambient air. - Secondly- air- collected during flight missions with MASIN aircraft in bags- was led through the instrument- also at predefined temperature and super saturation settings. Samples were usually taken over open water and over sea ice. - These are the first measurements of this kind in Antarctica. We will present an initial analysis of the obtained measurements.

Hannes Konrad (University of Leeds)

Surface lowering on Pine Island and Thwaites Glacier from more than 20 years of satellite altimetry

We combine satellite radar altimetric observations by ESA's satellite missions ERS-1, ERS-2, Envisat, and CryoSat-2, as well as satellite laser altimetric observations by NASA's ICESat mission over the glaciers in Amundsen Sea Embayment, West Antarctica, and derive a more than 20 yr long record of surface elevation rates in this area, which we analyse for spatio-temporal trends.

The competing ice-dynamical, meteorological and hydrological processes lead to a relatively incoherent pattern on Thwaites glacier. Steady migration of surface lowering from the grounding line towards the interior can only be detected in the last 10 to 15 years and is of little significance. On Pine Island Glacier, however, we find that the surface lowering exhibits migration of surface lowering towards the interior, which is temporally steady but spatially non-uniform.

Hannes Konrad (University of Leeds) – 2nd submission

Surface mass balance of Pine Island Glacier from GPR- firn cores- and neutron probing

Its geometrical configuration makes Pine Island Glacier- West Antarctica- sensitive to changes in its oceanic and atmospheric environment- manifesting in its current state of ice-dynamical imbalance. Our ability to observe this imbalance is limited by fluctuations in the glacier's surface mass balance. We present our progress in deriving surface mass balance variations over the last decades based on ground-penetrating radar data- firn cores and snow-density measurements from neutron-scattering collected on Pine Island Glacier as part of the NERC iSTAR-D project. We are going to compare our results to model results and existing observations of surface mass balance and apply it to radar altimetric measurements of the ice-dynamical imbalance.

Ray Leakey (NERC)

The New UK Polar Research Vessel

The Natural Environment Research Council (NERC) has commissioned a new state-of-the-art polar research vessel to enable UK polar scientists to remain at the forefront of environmental research in both the Antarctic and the Arctic. The new polar ship will provide a cutting-edge research facility with greater ice-strengthened capability and longer endurance than NERC's existing polar research ships which are coming to the end of their operational life. It will operated by the British Antarctic Survey on behalf of NERC and the UK scientific community. The ship- which is now under construction at Cammell Laird shipyard in Liverpool- will accommodate up to 60 researchers and act as a central hub for a range of data-gathering remote instruments and on-board environmental monitoring systems- including both marine and airborne robotic systems. It will incorporate flexible laboratory space to meet the evolving needs of science over the lifetime of the ship and include a helideck and hangar- and a moon pool. The ship will be ready for operation by 2019. This presentation will outline the new polar research vessel's design- scientific capability and capacity.

Geoffrey Lee (UEA)

A 'strange event': unexplained isotopic signals recorded in an Antarctic ice core

Previous work1 identified an interesting and unexplained phenomenon at Berkner Island- Antarctica- following two significant Antarctic Isotope Maxima (AIM) events (8 and 12). Between ~48 and 35 ka nitrogen gas isotope measurements (d15N) from entrapped air bubbles in an ice core covaried with hydrogen water isotopes (dD) from the ice- suggesting locally temperature-controlled d15N. Supposition that the d15N reflects only temperature is undermined by a large positive excursion (the 'Strange Event'1) beginning at approximately 35 ka and not returning to ambient for almost 10 ka; a similar excursion is not observed in the coeval dD record. d15N is controlled by temperature-dependent and gravitational fractionations- although the gravitational component can be quantified using the isotopic fractionation of argon isotopes (d40Ar)- which responds primarily to gravitational fractionation. However- Mani's1 d40Ar measurements were inconclusive. One possible cause of the Strange Event is a large increase in the local ice accumulation rate which would have increased the diffusive column height- and thus gravitational fractionation. The observed d15N-dD divergence certainly suggests some additional fractionation mechanism besides temperature. We present high-resolution water isotopic and ice impurity measurements to establish seasonality- constrain ice accumulation rates- and thus explore the origins of the Strange Event.

Celilia Liszka (British Antarctic Survey/UEA)

Contribution of prominent vertical migrators to active carbon flux in the Southern Ocean

The Southern Ocean is an important moderator of climate- particularly through the absorption and phototrophic sequestration of atmospheric CO2- via the passive sinking of biogenic particles and other physical processes of mixing- advection and diffusion. The biological pump is a vital component of this system- with the synthesis of organic carbon and its subsequent cycling by microbial and zooplankton communities fundamentally controlling the extent of CO2 draw down and export. What is still not fully understood- however- is the contribution that diel vertically migrating (DVM) zooplankton make to the

active export of carbon from this system- and the impact this may have on the Southern Ocean's ability to respond to climate change. I am addressing this question through analysis of the zooplankton community over the diel cycle- and experimental analysis of respiration rates and faecal pellet attenuation- to estimate the active flux from these sources of DIC and POC. I will describe spatial and temporal abundances and biomass estimates from a series of net samples across an established transect of stations in the Scotia Sea- highlighting key vertical migrators. I will present respiratory flux estimates of i) a key migratory euphausiid- Euphausia triacantha- derived from on-board incubation experiments- and ii) algorithm-based estimations for other prominent migrators. I will discuss this in the context of overall carbon export and whether it may be considered a significant component of the flux.

Helen Mallett (UEA)

Seasonal change in Circumpolar Deep Water in the Amundsen Sea- Antarctica- using seal-borne tags

Global attention is focused on the melting of the West Antarctic Ice Sheet and the impacts of associated sea level rise- yet the mechanisms by which the ocean melts the ice are not well understood. In the Amundsen Sea Embayment there have been suggestions that warm Circumpolar Deep Water (CDW) is increasingly crossing the continental shelf- contributing to increased ice mass loss- but detailed understanding of this process is limited by the difficulty of collecting data in this area- especially during the winter. Analysis of > 11-000 new seal-borne hydrographic profiles from the summer- autumn and winter seasons of 2014 reveals that the warmest CDW enters the shelf sea via the eastern trough. CDW through much of the eastern Amundsen Sea is ~ 0.06 more saline in winter than in autumn. This seasonal variation is less prominent in Pine Island Bay. The potential temperature of the CDW is ~0.01 to 0.1 ºC colder in winter than in autumn. It is suggested that these seasonal changes are due to CDW mixing with surface layers during winter. These observational measurements of the seasonal cycle of the CDW are essential for verifying model simulations of associated ice melt.

Yasmina M Martos (British Antarctic Survey/NERC)

ANOMALOUSLY THICK CRUST BENEATH THE GAMBURSTEV SUBGLACIAL MOUNTAINS LINKED TO ACCRETION AND COLLISION

East Antarctica is underlain by thick Precambrian cratonic lithosphere. Located in the middle of East Antarctica- the Gamburtsev Subglacial Mountains are underlain by over 200 km thick lithosphere and remarkably thick crust for a Precambrian craton- up to 60 km thick. The origin and preservation of such remarkably thick crust is disputed- with some models predicting thickening linked to the assembly of East Antarctica during Rodinia supercontinent amalgamation- and others linking it with subduction and collision during East-West Gondwana assembly. Here we analyse airborne geophysical and satellite images and present preliminary models- and larger-scale plate reconstructions to re-investigate both the structure and origin of the thick crust. We conclude that a model invoking the combination of subduction-related accretionary tectonics at ca 1Ga- followed by collision and much later reactivation of the former suture zone during Gondwana assembly can explain the geophysical observations and models. However- it also questions whether previously proposed linkages between interior East Antarctica and other orogenic belts within Rodinia remain tenable.

Ashleigh Massam (British Antarctic Survey)

Comparison of palaeoaccumulation estimates from observations and modelling at Fletcher Promontory- Antarctica

The construction of accurate age-depth profiles is paramount to the interpretation of the palaeoclimate records preserved in ice cores. The simplest way to calculate the age of ice at a particular depth is to determine the number of annual layers above that depth; in areas of high annual accumulation this can be done by counting annual layers but most often- due to the low mean accumulation over regions of Antarctica- reliable reconstructions of palaeoaccumulation and the vertical thinning history of the ice are required. - - A newly-developed model- which reconstructs palaeoaccumulation and the age-depth relationship of an ice core- uses in situ englacial velocities measured by phase-sensitive radar- pRES- to determine the ratio of thinning from the surface of the ice sheet to the bedrock. The vertical velocity of an ice particle- as it travels deeper into an ice sheet- offers a view of the present-day thinning profile of annual layers. Applying the thinning profile derived from pRES measurements to a palaeoaccumulation history produces an estimate of annual layer thickness at all depths along the ice core. An initial palaeoaccumulation history at Fletcher Promontory has been reconstructed from the stable water isotope profile and optimised by a Monte Carlo Markov Chain algorithm. The output is a new age-depth profile that is constrained to known-age horizons preserved along the ice core- for which the thinning profile is independent of existing techniques. - - The new palaeoaccumulation reconstruction is compared to output from a global circulation model (GCM). The HadCM3 GCM simulations that we use cover the period from 0 to 21-000 years ago- and provide accumulation and d18O output at approximately 250 km2 spatial resolution across Antarctica. Monthly accumulation and d18O output from these GCM simulations is interpolated to the Fletcher Promontory drill site prior to the data-model comparison. - - In order to assess the palaeoaccumulation reconstructions from both modelling techniques- model outputs have been compared with high-resolution measurements of annual layer thickness made at six depths along the Fletcher Promontory ice core. Discrete samples were made at a sub-annual resolution to obtain a seasonal view of the ice analysed. In order to compare with the model outputs- the measured annual layer thickness has been converted to palaeoaccumulation by inverting the ApRES-derived thinning profile. Results from both modelling techniques and the high-resolution analysis are presented with a view to assessing the reliability of the reconstruction methods used to estimate palaeoaccumulation. -

Anna Mikis (Cardiff University)

The use of individual planktonic foraminifera from sediment traps to assess seasonal variability along the West Antarctic Peninsula

The Antarctic Peninsula region has experienced some of the most rapid warming in recent decades resulting in an increase in melting of marine and tidewater glaciers into coastal regions; the scale of which has been unprecedented over the past 200 years (Hendry and Rickaby- 2008). The main aim of the project is to develop a novel method for assessing variations in climate and meltwater flux in the past- by studying variations in the input of glacial meltwater along the WAP and their effect on the stable isotope composition of foraminiferal calcite. To achieve this- stable isotope analysis of single specimens of planktonic foraminifera (unicellular protists that secrete a calcite shell)- derived from a six-year long time series situated along the West Antarctic Peninsula- is performed along with the assessment of flux study of morphological variability. Foraminifera time-series from polar sediment traps are exceptionally rare which makes the Palmer Long Term Ecological Research time series a unique opportunity to study seasonal variations of seawater. Foraminifera flux together with the stable isotope record will allow us to compare foraminiferal stable isotope measurements with observed meltwater flux variations between 2006 and

2013- hence- our research will help constrain future studies of past meltwater flux in this climatically-sensitive region. A number of single specimens of foraminifera are analysed from monthly samples to provide statistically robust results. Prior to analysis- specimens were assessed through image capturing to investigate year-on-year morphological changes related to variations in environmental conditions. In addition- summer trap samples with high sediment flux and foraminifera numbers are targeted to determine the extent of biological effects on the stable isotope composition of the foraminiferal calcite at this location. Results were then compared to organic flux- carbon- and nitrogen flux data from the time-series site as well as with temperature- sea ice and chlorophyll concentration data to complete a unique investigation of seasonal ocean variability in this region.

Martin Miller (Open University)

Controls on oxygen triple-isotope distributions in Antarctic precipitation and ice cores

On a 103ln(1+d17O) versus 103ln(1+d18O) plot- most meteoric waters fit a line of slope (?) close to 0·528- and with ordinate axis offset ~40 ppm when the respective isotope d values are reported relative to Vienna Standard Mean Ocean Water (VSMOW). Theoretical considerations suggest that the magnitude of the offset of individual data points from a reference line of slope 0·528 and which passes through VSMOW on this plot is indicative of the normalised relative humidity at the oceanic source region. Such offsets- defined by ?17O = ln(1+d17O) - 0·528ln(1+d18O)- are commonly referred to as '17O-excess' values. - Recent application of such measurements to Antarctic precipitation and ice cores have shown- however- that 17O-excess records from many localities – especially those distal from the coast – cannot be used for reliable reconstruction of past oceanic normalized relative humidity. It has been suggested that kinetic fractionation during ice formation at high values of vapour supersaturation (and very low temperatures) can account for part – or indeed all – of the empirical findings. - This presentation considers whether published empirical data from several recent studies enable a common- principal control on oxygen triple-isotope distributions in Antarctic precipitation to be identified. The resulting implications will also be discussed- briefly.

Freya Mitchison (Cardiff University)

Southern Ocean diatoms at the Middle Miocene Climatic Transition; tiny fossils, big questions

Southern Ocean diatoms play an important role in the marine carbon cycle, are highly sensitive to environmental change, and support a wide variety of marine fauna. However, relatively little is known of their role in, and response to, Cenozoic climate evolution. This study offers the first quantitative diatom dataset across the Middle Miocene Climatic Transition (MMCT), ca.13.9 Ma; a major episode of cryospheric expansion. Three ODP Sites, located on and just south of the Kerguelen Plateau, document fluctuations in surface water conditions across the MMCT. Diatom assemblages at all three Sites show a shift from warm water centric species to cooler pennates, slightly preceding major ice growth. Diatom concentration (v/g) increases with cooling, suggesting an increase in diatom productivity. However, ongoing research will more fully determine the role of diatoms at the MMCT.

Robert Mulvaney (British Antarctic Survey)

Seventy years of accumulation in the Pine Island glacial basin

Prior to satellite observation- little was known about the rates at which ice sheets would respond to climate change. During the past two decades measurements from successive Earth-orbiting satellites have provided valuable insight about the behaviour of Antarctica's large ice sheets. The surface topography of the glaciers draining the West Antarctic Ice Sheet towards the Amundsen Sea have suggested substantial thinning and mass loss over recent decades- with the implication that this might be a response to a warming climate- and warming oceans. - - Whilst satellite observations allow us to estimate how much ice is being lost to the ocean- they cannot distinguish changes in surface elevation due to trends in snow accumulation rate. - - The UK Natural Environment Research Council has carried out linked ocean and ice sheet research into the dynamics of the Pine Island glacial basin under its iSTAR (Ice Sheet Stability) programme. - - During the iSTAR over-snow traverse in 2014/15 we recovered ten 50m ice cores in addition to radar- strain and near-surface density data. From the ice cores- corrected for density changes and strain thinning- we are able to derive the snow accumulation history of the past 70 years across the Pine Island glacial basin.

Jan-Marcus Nasse (Institute of Environmental Physics- Heidelberg University/Germany)

Autonomous remote sensing of reactive halogens and other trace gases in Antarctica using Long Path DOAS

Reactive Halogen Species (like IO- BrO- ClO- etc.) have an important impact on atmospheric chemistry in Polar Regions. Among the most prominent effects of RHS on the Polar atmosphere are the change of the oxidative capacity of the troposphere entailing a number of effects such as the widespread and frequent virtually complete destruction of tropospheric ozone- in particular during springtime- or the oxidation and subsequent deposition of gaseous elemental mercury. - The understanding of the underlying processes varies greatly between bromine- iodine and chlorine compounds. This is mainly due to the technically challenging observation of these highly reactive trace gases with typical concentrations of a few ppt. - Here we present the design and first results of a novel Long Path DOAS (Differential Optical Absorption Spectroscopy) instrument. In contrast to passive DOAS instruments that use scattered sunlight- it has an own light source and is capable to detect a wide range of trace gases absorbing in the UV/Vis including IO- BrO- ClO- OClO- I2- OIO- ozone- NO2- H2O- O4- and SO2. It has been set up at the German Research Station Neumayer III in coastal Antarctica during the summer season 2015/16 and is planned to operate autonomously for at least one year.

Guy Paxman (Durham University)

Investigating the tectonic and erosional evolution of the Shackleton Range region in East Antarctica

The evolution of Antarctic bedrock topography is a key control on ice sheet behaviour. Evolution of the subglacial landscape over geological timescales is controlled by tectonics- erosion- and deposition- as well as the solid Earth response to these processes. Here we aim to quantify these processes to better constrain the palaeotopographic evolution of the Shackleton Range in the previously largely unexplored Recovery Province of East Antarctica. - - The flexural response to glacial incision since 34 Ma is quantified using 2D and 3D elastic and viscoelastic plate models. We also examine the effect of fluvial incision over longer timescales. Geological constraints on the amount of erosion and uplift in the Shackleton Range include the observed tilt of the sub-Beacon Peneplain and apatite fission track and (U–Th)/He thermochronology

datasets. The effect of tectonics is examined by modelling the uplift of the Shackleton Range on the flank of the Filchner Rift. Our models will help to quantify the relative contributions of tectonics and erosion (and climate) in shaping the topography of the Shackleton Range region- and better comprehend the linkages between the evolution of palaeotopography and the behaviour of the Antarctic ice sheet since the Early Oligocene.

Nial Peters (University of Cambridge/UCL)

Radar observations of Erebus volcano's active lava lake

Active lava lakes provide a rare opportunity to observe directly volcanic processes that are normally hidden from view. An exceptional example of an active lava lake is that at Erebus volcano- Antarctica. Previous studies have shown that many of the properties of the lake (surface level- surface motion- gas output) demostrate a pulsatory behaviour that is thought to be a surface manifestation of deeper magmatic processes. However- detailed analysis of this behaviour has been limited by the difficulty in collecting long timeseries of data at the volcano. Here I will present a new ground based radar system (currently at the prototype stage) for continuous monitoring of the lava lake at Erebus. Preliminary data collected during January 2016 will be discussed and directions for the continuation of the project explored.

Jennifer Pike (Cardiff University)

Holocene record of giant iceberg calving from the Amery Ice Shelf- Prydz Bay

Understanding the role- and historical context- of environmental change in the Antarctic cryosphere is an imperative in global change research. Recently we have shown that- along the western Antarctic Peninsula- the combination of marine diatom silica oxygen isotope ratios with diatom species assemblages can be used as a palaeo-indicator of the past balance between atmospheric and oceanic forcing of glacial discharge from the Antarctic ice sheets. Now we have applied our approach to a Holocene sediment core from Mac.Robertson Land- East Antarctic margin (NBP0101 JPC43B)- that is downstream (along the Antarctic Coastal Current) from Prydz Bay. At this site our diatom silica oxygen isotope data show intervals of short-lived (decades) very low oxygen isotope ratios- not found along the western Antarctic Peninsula and that we attribute to the input of freshwater from grounded- melting giant icebergs (>18 km dimensions). Further- the low oxygen isotope samples are characterised by diatom species assemblages that are associated with giant icebergs and are also different to neighbouring samples with higher oxygen isotope ratios. In this presentation we will explore the potential of our proxy giant iceberg record to be used as an indicator of the Holocene dynamic behaviour of the large Amery Ice Shelf.

Heather Regan (Cardiff University/British Antarctic Survey)

Sources and fate of freshwater in the ocean west of the Antarctic Peninsula

The Antarctic Peninsula is warming more rapidly than any other location in the Southern Hemisphere- with air temperatures increasing by nearly 3 degrees Celsius since 1950. The consequences of this- such as ocean warming and ice loss- are still not fully understood. Freshwater plays a key role in the dynamics of the Bellingshausen Sea- west of the Antarctic Peninsula- but the various components of the freshwater balance - glacial ice- sea ice- and precipitation - are affected by warming in different ways. This problem is compounded by a sparsity of data. To this end- a high-resolution model of the region has been developed- using the MITgcm to represent ocean- sea ice- and ice shelves. Passive tracers track the advection- mixing

and ultimate fate of freshwater from different sources- and demonstrate the differing spatial and temporal scales of their impacts on ocean structure. They highlight the dominance of sea ice melt on seasonal timescales- and identify an important site in the south of the region which sees a relative freshening by some sources but a net loss of freshwater overall. Results will be used to investigate the causes and consequences of warming and freshwater change west of the Antarctic Peninsula.

Ian Renfrew (UEA)

Foehn warming distributions in non-linear and linear flow regimes: A focus on the Antarctic Peninsula

The structure of lee-side warming during foehn events is investigated as a function of crossbarrier - flow regime linearity. Two contrasting cases of westerly flow over the Antarctic - Peninsula (AP) are considered – one highly nonlinear- the other relatively linear.Westerly - flow impinging on the AP provides one of the best natural laboratories in the world for the - study of foehn- owing to itsmaritime setting and the Larsen C Ice Shelf (LCIS) providing an - expansive- homogeneous and smooth surface on its east side. Numerical simulations with - the Met Office Unified Model (at 1.5 km grid size) and aircraft observations are utilized. - In case A- relatively weak southwesterly cross-Peninsula flow and an elevated upwind - inversion dictate a highly nonlinear foehn event- with mountain wave breaking observed. - The consequent strongly accelerated downslope flow leads to high-amplitude warming and - ice-shelf melt in the immediate lee of the AP. However this foehn warming diminishes - rapidly downwind due to upward ascent of the foehn flow via a hydraulic jump. In case - C- strong northwesterly winds dictate a relatively linear flow regime. There is no hydraulic - jump and strong foehn winds are able to flow at low levels across the entire ice shelf- - mechanically mixing the near-surface flow- preventing the development of a strong surface - inversion and delivering large fluxes of sensible heat to the ice shelf. Consequently- in case C - ice-melt rates are considerably greater over the LCIS as a whole than in case A. Our results - imply that although nonlinear foehn events cause intense warming in the immediate lee - of mountains- linear foehn events will commonly cause more extensive lee-side warming - and- over an ice surface- higher melt rates. This has major implications for the AP- where - recent east-coast warming has led to the collapse of two ice shelves immediately north of - the LCIS.

Jeff Ridley (Met Office)

The representation of Weddell high salinity shelf water in HadGEM3-GC3

The combination of the ocean model (NEMO) and sea ice model (CICE) in HadGEM3-GC3 produce Weddell high salinity shelf water (HSSW) that is too fresh. This has implications for the model representation of intermediate and bottom water. Much of the real world HSSW is thought to be produced in the sea ice factory of the coastal polynya at the front of the Ronne iceshelf. HadGEM3-GC3 includes new processes such as explicit icebergs and implicit ice shelf basal melt which may be interfering with sea ice production. Here we examine the impact of the horizontal resolution- in both atmosphere and ocean/ice- on the coastal production of sea ice and associated salt fluxes from the coastal polynya.

Thomas Slater (University of Leeds)

Investigating the impact of firn properties on CryoSat-2 elevation measurements using a numerical backscatter model

Satellite radar altimetry over the Antarctic ice-sheet provides elevation change measurements used as primary inputs in determining mass balance. The reliability of these elevation measurements is affected by spatio-temporal variability in the backscattering properties of the incident firn. Of particular note is the observation of temporally correlated fluctuations in elevation and power- which introduce spurious signals in elevation change. As a result two significantly different elevation estimates can be retrieved from the same geographical location over time- despite there being no real change in surface elevation. We present results from a backscattering model which parametrises the scattering behaviour of the snow through application of a numerical deconvolution technique. This model is applied to CryoSat-2 Low Resolution Mode waveforms- allowing the variability of ice-sheet scattering characteristics to be observed. The effects of this variability upon elevation estimates are considered through a comparison of different retracking algorithms- with the aim of better constraining ice-sheet elevation change estimates.

Victoria A. Sleight (British Antarctic Survey)

Antarctic shell formation: a molecular approach using damage-repair experiments

Our climate is changing and- as a result- so is the marine environment. The Western Antarctic Peninsula is one of the fastest warming regions on the planet and in addition- the Southern Ocean is becoming more acidic and is predicted to be undersaturated in calcium carbonate within the current century. - How will life in the Southern Ocean cope with three major climate changes: increased temperature- increased ice-berg scouring and decreased pH? - In order to predict how life will respond to climate change- we need to improve our understanding of the basic biological mechanisms which are likely to be the most vulnerable. Calcified organisms- such as molluscs- are under threat; yet how molluscs control and co-ordinate the shell-building process- at a molecular level- remains unclear. This talk will discuss candidate genes involved in shell production and damage-repair experiments used to study biomineralisation in the Antarctic clam Laternula elliptica.

John Smellie (University of Leicester)

Early Miocene glacial and non-glacial Antarctic palaeoenvironments at 87°S deduced from the two southernmost volcanoes in the world

Geological information on Early Miocene palaeoenvironments from terrestrial locations in Antarctica is practically non-existent. However- two small Early Miocene volcanoes are present at the head of Scott Glacier- at 2.5 km elevation and just 300 km from South Pole- thus potentially providing a unique window into East Antarctic environmental conditions at a high-elevation inland location. This talk will present the initial results of a palaeoenvironmental study of those outcrops. One outcrop- at Mt Early (16 Ma)- is a small monogenetic glaciovolcanic centre erupted under an East Antarctic Ice Sheet (EAIS) substantially thicker than present that was capable of overriding the Transantarctic Mountains. By contrast- the other outcrop- at Sheridan Bluff (19 Ma)- is a relict of a small subaerial shield volcano. It shows no obvious signs of ice coeval with eruption and the characteristics are much more consistent with an ice-free environment dominated by a large lake. The results imply that the Early Miocene palaeoenvironment was highly variable and associated with a highly dynamic EAIS that fluctuated between much larger than present and much

smaller (or even absent). Our results illustrate how powerful investigations of volcanic rocks can be in determining palaeoenvironmental conditions in Antarctica (and elsewhere).

Andy Smith (British Antarctic Survey)

The iSTAR Pine Island Glacier traverses 2013-2015. A summary of science achievements and operational legacy

The iSTAR programme's goal is an improved understanding of ice sheet and ocean processes in the Amundsen Sea and on Pine Island Glacier to enable better predictions of ice sheet behaviour. - - The science needs and remote location of iSTAR's ice sheet component prompted development of a tractor traverse capability- and two traverses were successfully completed. Each was a "moving platform" from which science was achieved- including radar- seismic- snow density- ice core and GPS work. Operationally- this was a step-change in the UK's ability to support research on the Antarctic continent. - - BAS have since supported other projects and logistics in a similar way. For the right projects- it is more efficient- and can achieve much more than other methods- especially in remote ice sheet locations. - - Operationally- the traverse capability functions at two levels- which complement each other. Regionally- it brings greater scope for large research efforts in remote places. Locally- it acts as a hub for multiple projects and for different scales of operational method (aircraft- skidoos or static camps- for example). - - The iSTAR traverse thus has a dual legacy- in the science that was achieved and in establishing a logistical capability previously was unavailable to UK Antarctic research. -

Charlotte Spencer-Jones (Durham University)

Assessing the Role of Oceanic Forcing in West Antarctic Ice Sheet Retreat since the Last Glacial Maximum: An Organic Proxy Approach

The West Antarctic Ice Sheet (WAIS) is one of the largest potential sources of future sea-level rise. For the last 40 years glaciers flowing into the Amundsen Sea sector of the WAIS have thinned at an accelerating rate. These changes may be driven by warming in the Amundsen Sea- however- data extending beyond the last few decades is lacking largely due to difficulties in recovering and calibrating temperature proxies in polar waters. This project uses organic biomarker records to reconstruct palaeo ocean temperature change. The TEX86L index relates to specific sedimentary archaeal lipid signatures (glycerol dialkyl glycerol tetraethers; GDGT) which correspond to ambient water temperature of the upper 0-200m of the water column (sub-sea surface temperature; sSST). Our new low-resolution data strongly suggests that ocean temperatures have varied significantly during the past c.13kyrs. In this study- we will extend our TEX86L records to reconstruct sSST of the Amundsen Sea over the past 25kyrs. This work will identify if past ice sheet retreat coincided with the presence of warm Circumpolar Deep Water and to determine if recent oceanographic conditions in the Amundsen Sea Embayment are unprecedented compared with palaeo reconstructions.

George Swann (University of Nottingham)

Holocene controls on silicic acid utilisation along the West Antarctic Peninsula

Over the past half century- the impact of climate change along the West Antarctic Peninsula has been exemplified by atmospheric and oceanic warming associated with increases in glacial melting. Here- for the first time- we present a diatom silicon isotope record from Palmer Deep (ODP Site 1098) which we use to

reconstruct Holocene controls on photic zone silicic acid cycling along the West Antarctica Peninsula margin- a region in which the modern phytoplankton environment is constrained by seasonal sea ice. We demonstrate that biogeochemical cycling of silicon during the Holocene alternates between regimes regulated by solar insolation- sea ice and glacial discharge from the surrounding grounded ice sheet. With further warming and climatically-driven changes forecast for the 21st Century- our findings document the long-term controls on nutrient dynamics along the West Antarctic Peninsula and demonstrate the potential for future silicon cycling along the margin to be regulated by processes other than sea ice dynamics.

Liz Thomas (British Antarctic Survey)

Climate variability on the Antarctic Peninsula and Ellsworth Land since 1600 AD

The Antarctic Peninsula and West Antarctica have experienced considerable climate change in recent decades. Instrumental records reveal a warming trend during the late 20th century and the Amundsen Sea sector of the West Antarctic ice sheet has been losing mass. However- long records of snowfall and surface temperatures are needed to place the recent changes in context. Here we present multi-proxy records from an array of ice cores drilled in the southern Antarctic Peninsula and Ellsworth Land- to investigate climate variability in this region over centennial scales. We reconstruct past snow accumulation and surface temperatures (stable isotopes) back to 1600 AD and demonstrate how the climate is influenced by local sea ice conditions- changing atmospheric circulation and tropical teleconnections.

Max Thomas (UEA)

Novel in situ pressure measurements in young sea ice

Preliminary results are presented from a new- state of the art sea-ice simulator at the University of East Anglia. A 20cm pressure sensor chain- with 10 piezo-electric pressure sensors- has measured pressure profiles in situ in (artificial) sea-ice for the first time. Deviations from atmospheric pressure are only observed near the surface of the ice (top ~2cm)- where two modes of pressure build up and release are observed. 1) A slow build up at constant atmospheric temperature- followed by a slow release- and 2) a rapid spike in pressure upon warming- followed by a slower release. - - Work is ongoing to explain both modes. We tentatively propose that 2) is caused by thermal expansion and subsequent efflux of gas within bubbles and/or brine pockets within the ice. 1) is observed in conjunction with a ~1mm brine skim forming at the ice surface. Possible explanations for 1) are growth or nucleation of gas bubbles within sea ice brine pockets as increases in brine salinity drive decreases in gas solubility- or compression of immobile brine as ice (with a lower density) forms in brine pockets. These results are relevant for the formation of brine skims- and gas dynamics at the ice-atmosphere interface. -

Sally Thorpe (British Antarctic Survey)

Biology at the ice-ocean interface: understanding a vital habitat

The interactions that occur at the sea ice-ocean interface are critical for marine ecosystems. Antarctic krill- a key component of the Southern Ocean marine food-web- is one species that depends on sea ice at crucial stages of its life cycle. Used as an important over-wintering habitat- sea ice provides both refuge from predators and food. Interactions with the sea ice environment- and the ocean beneath- change as krill mature. Coupled physical-biological models allow us to investigate how these interactions with sea ice determine the successful overwintering of krill and the distribution of krill around the circumpolar Southern

Ocean. It is evident that an accurate understanding of the movement of both the sea ice and the near-surface ocean beneath the ice is essential. We will highlight key areas where sea ice interactions are particularly important in affecting the subsequent success and distribution of krill- information that is essential for appropriate management of the ecosystem.

Michel Tsamados (UCL)

Sensitivity of Antarctic sea ice to form drag parameterization

A new drag parametrization accounting explicitly for form drag has been recently formulated and applied to the Arctic sea ice (Lupkes et al, 2012 and Tsamados et al, submitted). We summarize here the fundamental elements of this formulation and we then adapt it to the Antarctic sea ice. Considering the general expression of the momentum balance of sea ice, we analyze the total (neutral) drag coefficients by studying separately air-ice and ocean-ice momentum fluxes, and by introducing the parameterization for both the atmospheric neutral drag coeffcient (ANDC) and the oceanic neutral drag coeffcient (ONDC). The two coefficients are calculated as a sum of their skin frictional contribution and form drag contribution, which comes from ridges and floe edges for the ANDC and keels and floe edges for the ONDC. Due to the contrasting geography of the two polar regions, there are important differences, both dynamic and thermodynamic, between Arctic and Antarctic sea ice. In the Antarctic, sea ice is younger, less ridged (hence thinner and smoother). Due to the intense snowfalls, the snow cover is generally thicker than in the Arctic, with values that vary significantly both seasonally and regionally and can affect the roughness of the surface and can lead to flooding of the ice. At the outer boundary of the Southern Ocean, the ice is unconstrained by land, divergent and subject to meridional advection, which leads to a much faster ice drift than in the Arctic. We show here how the new parameterization accounting for form drag influences the Antarctic sea ice characteristics.

Rebecca Tuckwell (British Antarctic Survey)

Spatial variability of major chemical species at Pine Island Glacier- Antarctica.

Satellite observations in the Pine Island Glacier (PIG) region suggest the ice sheet elevation in this region is changing. Different physical measurements were collected at Pine Island Glacier- Antarctica as part of the iSTAR D (ice loss) programme to help better understand these changes. In addition- ten shallow ice cores were drilled at various sites along the iSTAR traverse to be able to acquire a chemical archive spanning approximately 60 years. Cores were drilled down to depths of 50 meters and sent back to the UK for analysis. Analysis of the ice cores were performed using our on – line melting continuous flow analysis system. The system enables high resolution measurements of trace chemical substances in ice cores. Here we present sub-annually resolved dust and seal salt proxy data sets from the multiple iSTAR ice cores providing a unique spatial chemistry record of this region.

Ben Webber (UEA)

Mechanisms Modulating the Ocean Forcing of Pine Island Glacier

Pine Island Glacier terminates in a rapidly melting ice shelf- where ocean forcing of the melt rate has been implicated in the acceleration and retreat of the glacier. A set of mooring records close to the Pine Island ice shelf were recovered in 2014- two of which are combined to provide an unprecedented five-year time series of temperature- salinity and current velocity. These data reveal considerable seasonal and

interannual variability in intermediate to deep ocean temperatures- of sufficient magnitude to make a substantial impact on the melt rate of Pine Island ice shelf. The seasonal cycle in ocean temperature is correlated with surface wind speed over the continental shelf- suggesting a role for local surface heat fluxes and convection in influencing the observed temperatures down to 600 m depth. Meanwhile- the interannual variability is associated with Ekman upwelling near the easternmost shelf-edge depression that feeds into Pine Island Bay. Observations of ocean currents suggest this cold period was accompanied by a reversal in the circulation pattern around the bay- and the concurrent increase in salinity implies increased sea ice formation. - - Numerical modelling simulations conducted in a high-resolution regional configuration of the MITgcm are used to further investigate the dynamical links between surface forcing and ocean forcing of the glacial melt rates. Heat fluxes into the cavity beneath the Pine Island Ice shelf exhibit large variability on interannual and decadal time scales. At the decadal time scale- these variations are closely linked to heat fluxes onto the continental shelf driven by surface winds at the shelf break and surface-driven upwelling across the continental shelf. The barotropic circulation around the Pine Island Trough region spins up and down in response to this forcing. In addition- there is an overturning cell within Pine Island Trough that strengthens (weakens) during periods of large (small) heat fluxes towards Pine Island Bay.

Pippa Whitehouse (Durham University)

Glacial history of the Weddell Sea sector of Antarctica since the Last Glacial Maximum

The Weddell Sea sector of the Antarctic Ice Sheet is hypothesized to have made a significant contribution to sea-level rise since the Last Glacial Maximum. Using a numerical flowband model we investigate the controls on grounding line motion across the eastern Weddell Sea and compare our results with field data relating to past ice extent. We find that ice shelf basal melt plays an important role in controlling grounding line advance- while a reduction in ice shelf buttressing is found to be necessary for grounding line retreat. We find two stable positions for the grounding line under glacial conditions; at the northern margin of Berkner Island and at the continental shelf break. Global mean sea-level contributions for these scenarios are ~50 mm and ~130 mm- respectively. Comparing model results with field evidence from the Pensacola Mountains and the Shackleton Range- we find it unlikely that ice was grounded at the continental shelf break for a prolonged period during the last glacial cycle. However- we cannot rule out a brief advance to this position- or a scenario in which the grounding line retreated behind present during deglaciation and has since re-advanced; a scenario recently proposed for the south-west Weddell Sea sector.

Aihong Xie (Linienzugbeeinflussung (LZB)

Extreme Temperature Assessment of ERA Interim reanalysis in East Antarctica

Based on daily minimum, maximum and mean surface air temperature (T_{min}, T_{max}, T_{mean}) from European Centre for Medium-Range Weather Forecasts reanalysis from 1979 onwards (ERA Interim), the accuracy of daily T_{min} and T_{max} reanalysis is assessed against in-situ observations from four Automatic Weather Stations (Zhongshan, EAGLE, LGB69 and Dome A) in East Antarctica from 2005 to 2008. ERA Interim generally shows a warm bias for T_{min} and a cool bias for T_{max}, with an underestimation of the diurnal temperature range. The reanalysis explains more than 84% of the daily and annual variance, and the replicating ability decreases gradually from the coast to the interior, with annual root mean square errors of 2.4°C, 2.6°C, 3.0°C and 4.3°C for daily T_{min}, and 2.2°C, 3.1°C, 3.4°C and 4.9°C for daily T_{max} at Zhongshan, LGB69, Eagle and Dome A, respectively. ERA Interim shows little seasonal variability, although it performs a little better in the austral spring and worse in winter and autumn at Dome A. An analysis on spatial distribution of temperature and

wind field indicates that ERA Interim has successfully replicated the progress of temperature extremes developing, occurring and disappearing. In addition, weather events extracted from ERA Interim mainly occur on the same day as observations, with high cross-correlation coefficients ($R \geqq 0.287$, $N \geqq 1131$, $P<0.001$). ERA Interim is, despite its regional limitations and deficiencies, proved to be a powerful tool for weather and climate studies in the Antarctic region.