Annual Report

2007-2008

British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Above and cover: *BAS RIB (Rigid Inflatable Boat) STELLA cruises among the icebergs to a dive site near Rothera Research Station, Adelaide Island, Antarctica.*

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Our vision

British Antarctic Survey aspires to become, by 2012, the leading international centre for global science in the Antarctic context.

Our mission

To undertake a world-class programme of scientific research and to sustain for the UK an active and influential regional presence and a leadership role in Antarctic affairs.

Director's introduction

It is a great pleasure and honour to be introducing a British Antarctic Survey (BAS) Annual Report for the first time. Since becoming Director in September 2007, I have spent time learning about the organisation, its origins and culture, operational capabilities and above all, the fantastic science we do.

BAS is a wholly owned component of the UK Natural Environment Research Council (NERC). NERC supports research and training across all the scientific disciplines and in all environments; BAS is the focus for UK research in the Antarctic. We fulfil this role primarily by carrying out research directly through our science programmes, often collaborating with UK and international researchers, and by providing expertise and support for other researchers, such as UK university scientists.

BAS also has a second role – to provide a UK presence in the Antarctic and leadership in Antarctic affairs. We do this through our world-leading science and advice, which we provide to the UK Government and the Overseas Territories to help determine policy. We have been doing this since the earliest days of BAS and it continues to be an essential requirement.

In the following pages you will find examples of our wide-reaching activities, from award-winning science to our strategy for reducing our carbon footprint. It is difficult to select particular achievements from such a rich mix, however, there are four that I would like to highlight.

Together with our international collaborators, we achieved a notable success in winning the prestigious Descartes Prize for the EU-funded EPICA programme (European Project for Ice Coring in Antarctica). The major part of the work took place over 10 years, in the challenging environment of Dome C. This region is located on a high-altitude ice plateau in Antarctica, where the accumulation of snow traps small quantities of air, which provide an archive of the properties of the atmosphere extending back 800,000 years, preserved in a 3,300m ice core. EPICA has shown, among many things, the unequivocal link between the concentrations of carbon dioxide in the atmosphere and global temperature. The Descartes Prize is an exciting honour, reflecting the significance of this science.

Many of our scientists contributed to the work of the Intergovernmental Panel for Climate Change (IPCC), which received the great honour of the Nobel Peace Prize – shared with former US Vice President Al Gore – "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change". The Antarctic is a clear bellwether of the changes already under way, almost certainly due to human-induced climate change, and also a key component of the Earth System with a myriad of interactions and influences on global climate. Many examples of these connections and their complexity appear in this report.

An exciting development for BAS, and UK Antarctic science in general, was the start of the construction of Halley VI Research Station. A research station was first established 50 years ago, at the current location on the Brunt Ice Shelf, as part of the International Geophysical Year (IGY) of 1957. Work has been carried out continuously at Halley since then – the best-known discovery being the ozone hole in 1985. Because of its location on the ice shelf, which streams inexorably towards the sea, and the large accumulation of snow, which steadily buries structures on the ice, Halley Station has been rebuilt four times since 1957. The successful start of this latest ambitious project, in one of the world's most inhospitable environments, is testament to the planning and ingenuity of all involved.

This year was particularly significant for the international polar science community because of International Polar Year 2007-2008 (IPY) – a celebration of the 50th anniversary of the IGY. IPY was initiated in recognition of the importance of the polar regions in the functioning of the Earth System and also, especially in the Arctic, of their role in human society. This highly complex programme,

Images: Above: *BAS Director, Professor Nicholas Owens.* **Top Right:** *BAS Principal Investigator Dr Eric Wolff (front centre) and other EPICA ice-core scientists receive the prestigious Descartes Prize.*
Middle Right: *Logo of International Polar Year 2007-2008.* **Bottom Right:** *Project Manager Karl Tuplin stands beneath the first completed module of the new Halley VI Research Station.*

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involving 231 projects (of which BAS is involved in 56) and 62 countries, is co-ordinated by the International Programme Office hosted by BAS and funded by NERC.

Reflecting on the year and BAS's achievements, I am struck by how much is associated in some way with change: in either recent or longer-term conditions in the Antarctic. For example, we have been investigating current changes in ice thickness, snowfall, and the marine ecosystem, as well as evidence of change over much longer timescales as revealed in ice cores or preserved in the geological record. The year has also seen the development of NERC's new strategy – Next Generation Science for Planet Earth. NERC's new way of working – Next Generation NERC – will see us winding down our current research programme, Global Science in the Antarctic Context, and adapting to different ways of funding. We view these changes as a great opportunity to develop our science further through our new science programme, Polar Science for Planet Earth. I look forward to introducing the outputs of this work in future Annual Reports.

In closing, I would like to pay tribute to my predecessor Professor Chris Rapley. Chris was an outstanding and dedicated Director, and that I took over an organisation in such excellent shape is due in no small part to his skills and commitment. We all wish him well for the future.

Global Science in the Antarctic Context

Global Science in the Antarctic Context (GSAC) comprises eight interconnected research programmes totalling 18 projects, plus long-term monitoring and survey. It sees Antarctica as a pivotal component of the Earth System and a unique source of environmental knowledge. It covers the period from 30 million years in the past to 100 years in the future and focuses on issues of climate, sea level, and biological evolution and adaptation. GSAC aims to increase our skill in predicting the future behaviour of the planet and the effects of environmental change for the benefit of society, policy-makers and business. GSAC involves over 120 national and international collaborations. BAS undertakes commissioned research on behalf of the Government of South Georgia and the South Sandwich Islands, as well as receiving grants for complementary UK and European research projects.

Image: *Releasing a meteorological balloon from the launching platform at Halley Research Station, Brunt Ice Shelf, Antarctica.*

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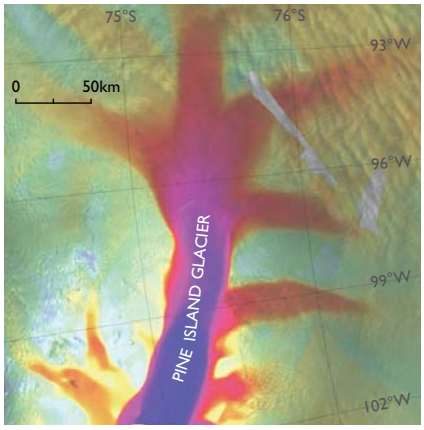
GRADES Glacial Retreat in Antarctica and Deglaciation of the Earth System

Principal Investigator: **Prof David Vaughan dgv@bas.ac.uk**



Subglacial conditions on Pine Island Glacier

Pine Island Glacier is the largest and most rapidly changing glacier in West Antarctica. During the last two austral (southern-hemisphere) summers we have conducted surveys of the area using seismic, radar and satellite-positioning systems. Measurements show that the rate of glacier flow increased continuously over the two years by up to 6%. Our observations suggest that this acceleration is likely to continue in the near future for several reasons. Firstly, the bed beneath Pine Island Glacier is currently a mix of deforming and non-deforming sediments. This implies that resistance underneath the glacier from the bed may reduce if increasing amounts of water, generated by increasing frictional melting, caused a greater proportion of the sediments to deform. Secondly, the pattern of glacier acceleration means that the surface slope, which provides the driving force for glacier flow, is increasing. Finally, our measurements show that local changes in the glacier's speed are transmitted through the glacier very rapidly, which implies that the entire system may be sensitive to projected changes in the nearby Amundsen Sea.

Contact: **Dr Andy Smith amsm@bas.ac.uk**

Introduction

The West Antarctic Ice Sheet (WAIS) has long been identified as being potentially vulnerable to rapid retreat, which would add substantially to future sea-level rise.

Recent satellite observations have shown that within the WAIS, one area, the Amundsen Sea embayment, is thinning rapidly. Even by Antarctic standards this area is remote and its weather hostile – it has only been visited a handful of times. In the last two seasons, the GRADES programme has undertaken successful field campaigns in this area and is now delivering new insights into the causes of ice-sheet retreat, and its potential contribution to sea-level rise.

First exposure ages from the Amundsen Sea embayment

Although a dramatic loss of ice from the Amundsen Sea sector of the WAIS has been observed via satellites since 1992, no-one knows how these changes compare with the expected long-term retreat of the ice sheet. We have used chemical analyses of rock samples to derive the first surface exposure ages from rock outcrops close to the major glaciers that drain into the Amundsen Sea. These measurements reveal slow and progressive thinning of these glaciers over the last few thousand years, but at rates that are very much slower than those recorded during the past two decades. The data provide much-needed constraints for ice-sheet models, which are the primary tool for predicting the future changes in the WAIS and its contribution to sea-level rise.

Contact: **Dr Jo Johnson jsj@bas.ac.uk**

Technical Terms: Deforming sediments: *Material (in this case beneath the ice sheet) that is shaped by movement of the surrounding ice or water.* **Non-deforming sediments:** *Material whose shape is not being altered by the movement of surrounding ice or water.* **Seismic surveys:** *A method of determining the geological structure beneath the ice using sound waves.* **Frictional melting:** *Melting due to heat generated from the movement of the ice over the material beneath it.* **Surface exposure age:** *How long ago the rock was first exposed to the air by the retreating ice.*

Images: Above: *Satellite data reveals the drainage system of Pine Island Glacier beneath the West Antarctic Ice Sheet (Image: NASA).* **Below:** *Helicopter support (in this case from German Antarctic logistics) was needed to access the remote rocky outcrops of the Amundsen Sea embayment.*

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CACHE Climate and Chemistry: Forcings, Feedbacks and Phasings in the Earth System

Principal Investigator: **Dr Eric Wolff ewwo@bas.ac.uk**

Introduction

The CACHE programme uses ice cores, along with marine and lake sediment records collected in Antarctica, to examine past climates. These reveal complex interactions between different parts of the Earth System, and very large natural swings in global climate.

Present-day atmospheric chemistry and complex models help us to interpret past data, so that we can understand how climate and atmospheric composition were linked in the past, and to suggest how they may interact in the future.

Ozone loss in the lower atmosphere: the role of salty ice surfaces

In spring, ozone is often almost totally removed from the lowest few hundred metres of the Antarctic atmosphere. This is believed to be caused by high concentrations of reactive bromine compounds close to the ground, which destroy the ozone. Ozone-depleted air masses are associated with passage over newly formed sea ice, on which frost flowers and salty snow cover often exist – both of which have been suggested as the source of the bromine compounds. Collaborating with the Paul Scherrer Institute in Switzerland and Johannes Gutenberg University in Germany, we used 3-D x-ray computer images, generated at the Swiss Light Source synchrotron facility, to visualise the evolution of the brine in sea ice and frost flowers or snow. The results suggest that a brine film, highly concentrated in bromine compounds, can form on the ice surfaces. This can then lead to many important atmospheric consequences, including the ozone loss.

Contact: **Dr Manuel Hutterli mahut@bas.ac.uk**

Ice core records reveal details of past climate transitions

In glacial periods, such as the last ice age, large ice sheets covered much of North America and northern Europe. Interglacial periods were relatively mild, much like the present. The EPICA ice core from Dome C, Antarctica, covers nine transitions from cold to warm during the last 800,000 years. Even though the total amount of warming in Antarctica was different in each transition, the rate of warming was similar, and the atmospheric CO_2 concentration was very closely tied to Antarctic temperature. We have found that the amount of surrounding sea-ice (recorded through the quantity of sea salt reaching the Antarctic continent) continued to reduce as long as temperature rose. However, above a certain temperature the amount of South American dust reaching Antarctica stabilised, suggesting a threshold was passed. Understanding the patterns of change in these transitional periods tells us how different components of climate interact. This is highly relevant to help us understand how further warming is likely to affect the climate system in the future.

Contact: **Dr Regine Röthlisberger rro@bas.ac.uk**

Technical Terms: Brine: *Water that is highly concentrated in salt, e.g. sea water.* **Bromine compounds:** *Any chemical compound containing bromine, a highly reactive element that depletes ozone when released into the atmosphere.* **EPICA:** *European Project for Ice Coring in Antarctica.* **Frost flowers:** *Delicate salty crystals that form on newly grown sea ice.* **Interglacial period:** *A warm period between glacials, particularly those times when northern hemisphere ice sheets were much reduced.*

Images: Above: *A single, laboratory-grown, salty frost flower.* **Below:** *A slice of ice core from Dome C (depth 550m). Trapped air bubbles, an archive of the past atmosphere, are visible in the ice.*

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COMPLEXITY Natural Complexity Programme

Principal Investigator: **Dr Mervyn Freeman** **mpf@bas.ac.uk**

Introduction

Scientific evidence suggests that the world is approaching a state never before experienced by humankind.

But how much can science help us to live with this uncertain future, especially when faced with the incredible complexity of the Earth System? Can we only deal with uncertainty by understanding this system in ever-greater detail? Will we ever know enough to answer the needs of society and government? Complexity science offers an alternative approach by seeking to understand the generic behaviours of systems with many interacting components, of which the Earth System is a prime example.

Complexity – a common language for environmental science?

In August 2007, BAS sponsored a meeting in Cambridge which brought together an unusual mix of over 80 environmental scientists from the UK and abroad. The common goal was to discuss how complexity science is helping us to deal with environmental challenges, such as the spread of disease, and sudden tipping points in nature's response to climate change, and to understand what we can really infer from scientific models and observations. A one-day symposium introduced some of the challenges and their links with complexity science, and subsequent days began with a tutorial introducing essential concepts and tools of complexity, followed by presentations on their application to real-world problems. Two of these challenges, Earth's tipping points and the over-interpretation of scientific models, were reported in the magazine *New Scientist* and the national press. Inspired by the meeting, the journal *Science* also invited the organisers to write an article discussing the concept, issues and challenges of natural complexity.

Contact: **Dr Nick Watkins** **nww@bas.ac.uk**

Are the polar ice sheets approaching a tipping point?

The Greenland and West Antarctic Ice Sheets have been identified as two potential tipping points in the Earth System. Recent measurements of ice-mass loss have been interpreted as approaching a tipping point driven by human-induced climate change. But how sure can we be that these changes are not just part of normal natural variability? To investigate this, scientists from BAS and the Universities of Alaska and Montana performed experiments using two state-of-the-art ice-sheet models. The aim was to see how predicted ice-mass loss varies by altering some currently uncertain variables, e.g. snowfall. Under the same conditions, results were relatively similar for the two models, but the rate of ice-mass loss was hugely sensitive to assumptions about snowfall variability. If snowfall was assumed to be random, temporally and spatially, current annual Antarctic ice-mass loss can be viewed as a 1-in-37 year natural event. If the snowfall is assumed to be uniform in time and space, current ice-mass loss becomes a 1-in-7,700 year event. This highlights the sensitivity of ice-sheet models to uncertainties in atmospheric variables, and the need to couple together environmental models to improve their accuracy to help answer the key questions of climate change.

Contact: **Dr Mervyn Freeman** **mpf@bas.ac.uk**

Technical Terms: **Tipping point:** *The critical threshold that when crossed, potentially by a relatively small change, causes a complete change of state from which it would take a relatively long time to recover, if at all.*

Images: **Above:** *Complexity science seeks to understand the generic behaviours of systems with many interacting components, of which the Earth is a prime example.*
Below: *The West Antarctic Ice Sheet has been identified as a potential tipping point in the Earth System.*

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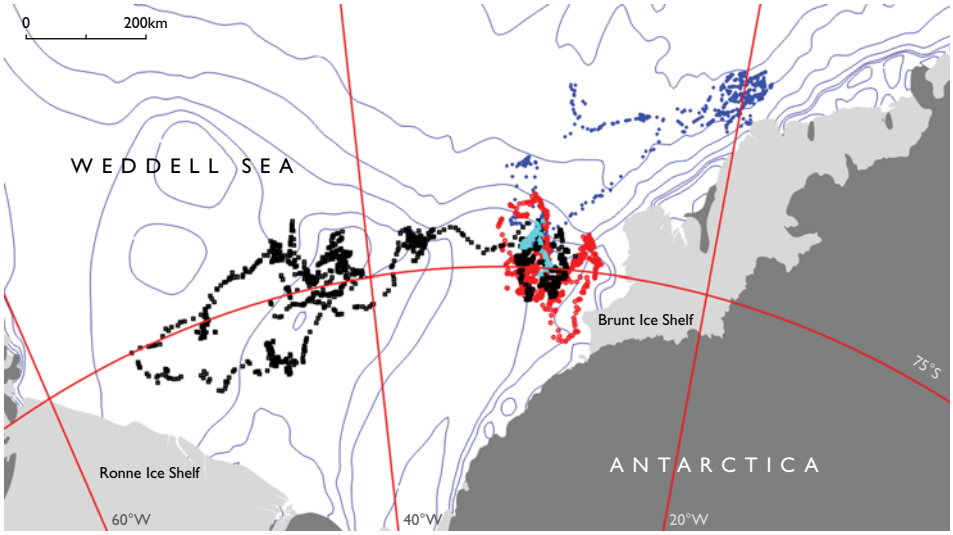
ACES Antarctic Climate and the Earth System

Principal Investigator: **Dr John King jcki@bas.ac.uk**

Introduction

Predicting how the Earth's climate may vary in response to natural or man-made changes is one of today's greatest scientific challenges. It requires an understanding of how the climate system works, both in its components and in the ways that these interact.

ACES integrates studies of the Antarctic atmosphere, ocean and sea ice to provide a new perspective on the Antarctic climate system and how it affects, and is affected by, the global atmosphere and ocean. By determining the role of polar processes in controlling global climate, ACES will help make predictions of climate change more certain.



Seals help to map the structure of the Weddell Sea

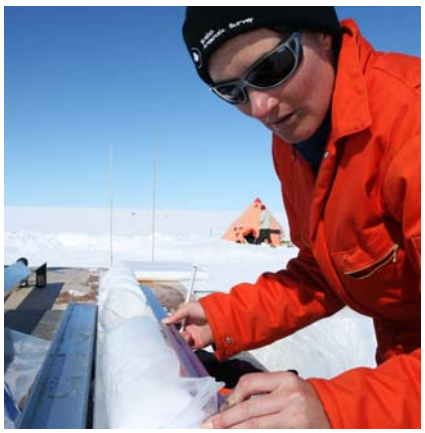
Antarctic Bottom Water helps cool and ventilate the world's deep ocean. One of its main sources is the continental shelf of the south-western Weddell Sea. However, until now we have not known exactly how this happens, as sea-ice conditions make access to this region difficult. In February 2007, we worked with seal biologists from the Sea Mammal Research Unit, based at the University of St. Andrews, to fit instruments to four Weddell seals in this region. Tiny conductivity-temperature-depth (CTD) tags were glued to the animals' fur. When the seal returns to the surface after a dive to forage for food, the tag transmits the CTD data to the UK via satellite. The tag falls off when the seal moults. During the austral winter of 2007 the seals transmitted over 2,900 CTD profiles, which revealed a flow of water onto the shelf estimated at between one and two million m^3 per second, a large fraction of the total needed to ventilate the shelf regime. This is the first view of winter oceanographic conditions over the continental shelf.

Contact: **Dr Keith Nicholls kwni@bas.ac.uk**

A doubling in snow accumulation in the western Antarctic Peninsula since 1850

Climate records from Antarctica rarely exceed 50 years in length. However, we can use information obtained from ice cores to set the recent rapid warming trend at Antarctic Peninsula stations in a longer time frame. In January 2007, a new ice core was drilled at a site of high snow accumulation on the south-western Antarctic Peninsula, named Gomez (73.59°S, 70.36°W), to investigate changes in atmospheric circulation over the past 150 years. Analysis of the ice core reveals that annual snow accumulation at Gomez has doubled between the 1850s and the present day. Comparison with published accumulation records indicates that this rapid increase is the largest observed across the region. By evaluating the relationships between Gomez accumulation and the variability of the primary modes of atmospheric circulation, we see that the Southern Annular Mode (an index of the strength of the westerly winds that circumnavigate the Antarctic continent) is the main factor in governing decadal variability of accumulation at the core site.

Contact: **Dr Gareth Marshall gjma@bas.ac.uk**



Technical Terms: Antarctic Bottom Water: *A cold, dense water mass formed at locations around Antarctica, occupying a depth range below 4,000m.* **Primary modes of atmospheric circulation:** *The large-scale patterns of circulation variability within the global atmosphere.*

Images: Above: *Positions of oceanographic profiles obtained by four Weddell seals.* **Below:** *Processing an ice core at the Gomez drilling site on the Antarctic Peninsula.*

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DISCOVERY 2010 Integrating Southern Ocean Ecosystems into the Earth System

Principal Investigator: **Prof Eugene Murphy ejmu@bas.ac.uk**

Introduction

Over the last two centuries the large-scale removal of seals, whales and fish greatly affected the Southern Ocean ecosystem. Now Antarctica is also experiencing significant climate change.

Our challenge is to predict how climate change and modern fisheries will affect Antarctica's unique ocean ecosystems. DISCOVERY 2010 carries out research to build computer models to simulate the biological and physical processes that shape the ecosystem.

Sea ice and ocean currents can take krill to different places

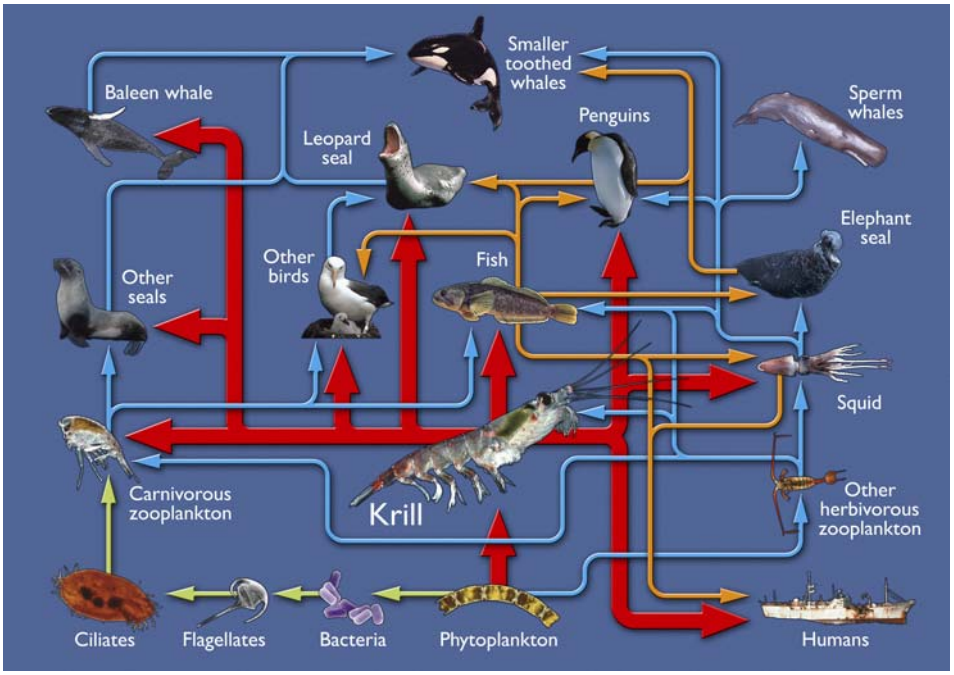
Young Antarctic krill are at the mercy of the strong ocean currents that dominate their surroundings. During winter, young krill feed and shelter from predators on the bottom of the sea ice. Sea ice, however, drifts differently from the underlying ocean. We combined computer model predictions of ocean currents and satellite measurements of sea-ice motion to simulate the transport pathways of young krill. This showed that the krill associated with sea ice could reach different destinations from those that are only transported by ocean currents. This has important implications for understanding the life-cycle and distribution of krill throughout the Southern Ocean, particularly in regions such as around South Georgia, that appear to have insufficient local krill breeding to support the vast numbers of seabirds and marine mammals found during the spring and summer months.

Contact: **Dr Sally Thorpe seth@bas.ac.uk**

Climate signals cascade through Southern Ocean marine ecosystems

The consequences of a warming climate for long-lived species depend on their ability to survive changes in their environment. Among seabirds and marine mammals examined in a recent study, BAS scientists found that for many species, rates of adult survival and fertility do not vary much from year to year, so climate-driven changes appear to have little effect on their life-cycles. However, Antarctic fur seals seem to have lost this tolerance to change in the south-west Atlantic. A rapidly changing ecosystem, associated with climate variability, has made the quantity of their main food supply, Antarctic krill, less predictable. This has increased variability in adult fur seal mortality and fertility, affecting their population dynamics. If extreme climatic and ecosystem fluctuations occur more often, the effects on many seabirds and marine mammals, and on their vital habitats, are likely to increase, particularly at regional scales. This may cause demographic changes affecting population dynamics and distribution for less adaptable species.

Contact: **Dr Phil Trathan pnt@bas.ac.uk**



Technical Terms: Ecosystem: *An interacting community of organisms (e.g. plants and animals) and their physical and chemical environment.* **Food web:** *The network of interconnected food chains within a community.* **Krill:** *Shrimp-like crustaceans that form a key part of the Antarctic food web.*

Images: Above: *Antarctic krill form a vital part of the Antarctic marine ecosystem.* **Below:** *Antarctic food web.*

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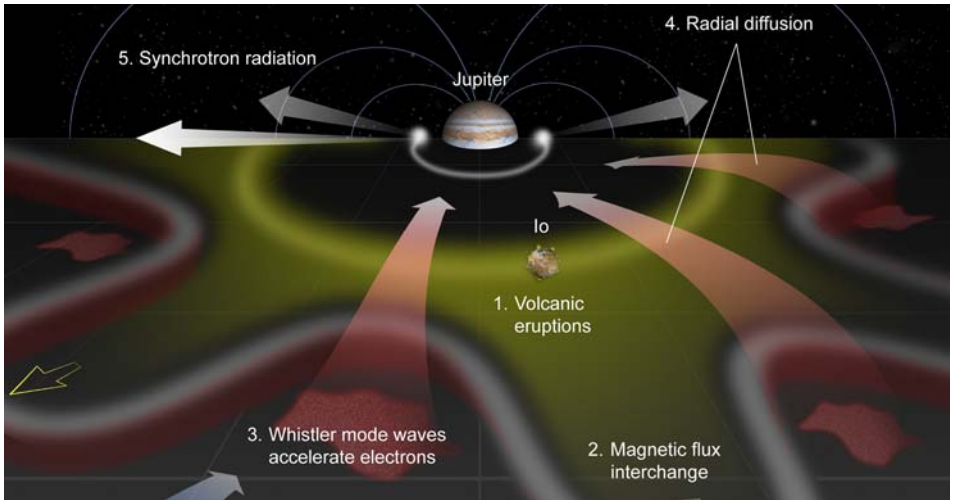
SEC Sun-Earth Connections

Principal Investigator: **Dr Richard Horne rh@bas.ac.uk**

Introduction

The Sun emits heat, light, and bursts of high-energy particles that vary with an 11-year cycle. These outputs affect the atmosphere in different ways to influence climate, and also disrupt satellites, power supplies, and navigation signals, causing financial loss.

In the SEC programme we combine ground and satellite measurements with modelling studies so that we can determine how solar energy affects the chemistry, dynamics and electrical properties of the atmosphere from space to the ground. By doing so, we can distinguish better between natural and human effects on climate change, and find ways to protect space technology.



Earth and Jupiter

For several years, BAS scientists have suggested that high-energy charged particles are accelerated inside the Earth's magnetic field by a special type of radio wave. These waves have been detected in space and in the atmosphere above Antarctica. If the idea is correct, the theory should also work at other planets with magnetic fields. Using data from the Galileo spacecraft, we found the same type of radio waves at Jupiter and, using computer modelling, showed that they are strong enough to accelerate electrons within Jupiter's magnetic field. At Jupiter, the waves are powered by ionised gases originating from volcanoes on the moon Io, combined with the planet's rapid rotation – once every 10 hours. Jupiter's magnetic field is 20,000 times stronger than the Earth's and provides the ultimate test of the theory, which overturns the conventional wisdom of more than 30 years. High-energy particles damage satellites, and this confirmation of the theory will help us to forecast periods when satellites are at risk.

Contact: **Dr Richard Horne rh@bas.ac.uk**

Pole to pole

The atmosphere heats up more quickly over land than over sea. This results in large-scale waves in the atmosphere, known as planetary waves, which extend upwards from the surface and play a major role in transporting energy, chemicals and aerosols around the planet. Using data from a SuperDARN radar at Halley Research Station, planetary waves from the northern hemisphere have now been identified over the Antarctic, both directly and through their influence on atmospheric tides, the strength of which depend on the direction of the wind at the equator. Studies show that the wind at the equator, which changes direction roughly every two years, is alternately blocking and unblocking the spread of planetary-scale waves from one hemisphere to the other. These planetary waves interact with the upper-atmospheric tides seen above Halley Research Station, causing year-on-year variability. These results demonstrate long-range horizontal and vertical links in the Earth's atmospheric processes, and explain a significant component of the natural variability of the polar atmosphere.

Contact: **Dr Rob Hibbins rehi@bas.ac.uk**

Technical Terms: Atmospheric tides: *Global-scale, periodic oscillations of the atmosphere.* **Ionised gases:** *Gases that have had their atoms or molecules converted into electrically charged particles (ions).* **SuperDARN:** *The Super Dual Auroral Radar Network (SuperDARN) is an international radar network for studying the upper atmosphere and ionosphere, comprising 11 radars in the northern hemisphere and seven in the southern hemisphere.*

Images: Above: *High-energy particles above Antarctica behave in the same way as those within Jupiter's magnetic field.* **Below:** *The SuperDARN radar at Halley V Research Station, Brunt Ice Shelf, Antarctica.*

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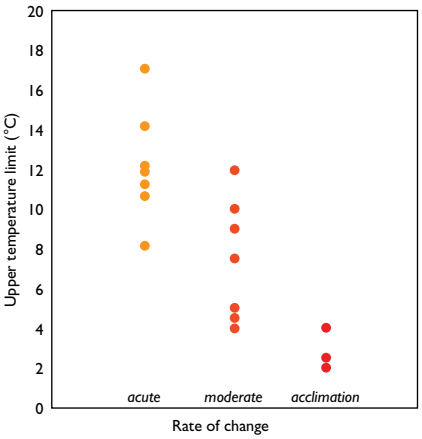
BIOFLAME Biodiversity, Function, Limits and Adaptation from Molecules to Ecosystems

Acting Principal Investigator: **Dr Pete Convey pcon@bas.ac.uk**



Can marine species in Antarctica survive long-term temperature rises?

By taking a systematic approach using different rates of heating and progressively longer temperature acclimation times (varying from days to months), we have demonstrated that, although Antarctic marine animals may survive increased temperatures over short timescales (days or weeks), they cannot acclimate to more long-term increases (months or years). Our data show that the maximum sustained sea temperature in which an average species could survive for one year is 2.4°C. The data predict that over longer timescales (up to 10 years) this value might be only 1.3°C. Current average sea temperature at Rothera Research Station is ~0°C, however, recent increases along the Antarctic Peninsula mean that summer temperatures reach 1.5-1.8°C for short periods. This is approaching a value where the most temperature-sensitive species may start to be affected. We were also able to show that smaller individuals (juveniles) and more active species (usually predators) survive longest. The effects of temperature change are complex, affecting not only survival rates, but also reproductive capacity and food webs.

Contact: **Prof Lloyd Peck lspe@bas.ac.uk**

Introduction

BIOFLAME takes a holistic approach to studying Antarctic biology, from individual genes to regional biodiversity and biogeographical distributions.

It aims to answer major global questions about Antarctic animals' physiology, distribution and response to natural and human-induced change. BIOFLAME blends traditional biodiversity, ecology and physiology with molecular biology methods to answer these questions on microbial and animal groups in Antarctica, both on land and in the sea.

Does understanding terrestrial life in Antarctica alter the continent's established glacial history?

A BAS study of life on Antarctica's frozen wastes has questioned current understanding of Antarctic glacial history and millions of years of biological development. There is clear evidence that, as recently as the Last Glacial Maximum (LGM) (~20,000 years ago), Antarctic ice sheets were thicker and more extensive than they are now. Ice-sheet modelling of the LGM and previous ice maxima shows that most, if not all, ground that is currently ice-free would have previously been covered. This has led to a widely held perception that all Mesozoic (pre-glacial) terrestrial life on Antarctica was wiped out by successive and more extensive glacial events. Such widespread destruction implies that most, possibly all, terrestrial life found on the continent today has colonised Antarctica during later periods of glacial retreat. However, several recent and complementary areas of biological and geological research fundamentally challenge the currently accepted reconstruction of Antarctic glacial history. Emerging insights suggest that Antarctic terrestrial organisms have been continuously isolated *in situ* on a multi-million year timescale, even before the final phases of the break-up of the Gondwana supercontinent (more than 40 million years ago). The findings mean we must adopt a new biological paradigm for Antarctica and directly challenge current understanding of Antarctic glacial history. This has major implications for our understanding of Antarctica's key role in the Earth System.

Contact: **Dr Pete Convey pcon@bas.ac.uk**

Technical Terms: Biodiversity: *The variety and abundance of species.* **Biogeographical distribution:** *The varying distribution of animals, plants and microbes across a geographical area.* **Food web:** *The network of interconnected food chains within a community.* **Gondwana:** *Ancient southern hemisphere supercontinent that drifted apart to form present-day Antarctica, India, Africa, Australia, South America and New Zealand.* **Paradigm:** *A model used to explain a concept or theory.*

Images: Above: *The effects of increasing temperatures on rates of change for Antarctic marine species.* **Below:** *Has life survived on Antarctica's remote outcrops for millions of years?*

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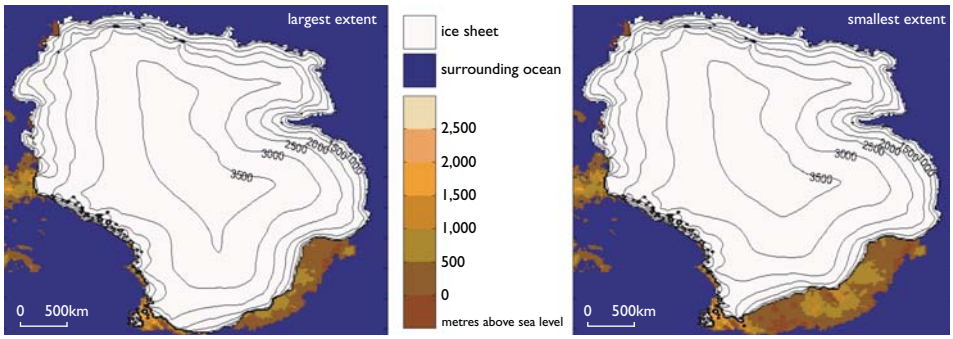
GEACEP Greenhouse to Ice-House Evolution of the Antarctic Cryosphere and Palaeoenvironment

Acting Principal Investigator: **Dr Alan Vaughan apmva@bas.ac.uk**

Introduction

Through the collection and combination of geological data with advanced computer models of Earth as an integrated system, GEACEP is investigating the evolution of the Antarctic ice sheet and the changing global environment over the last ~30 million years.

The programme is exploring the nature of warm climates in Earth history, investigating the forcing and feedback mechanisms associated with how glaciation began on Antarctica, as well as examining the stability of the Antarctic ice sheet in the recent geological past.



Climate models reveal a smaller but persistent Antarctic ice sheet during Earth's last major warm period

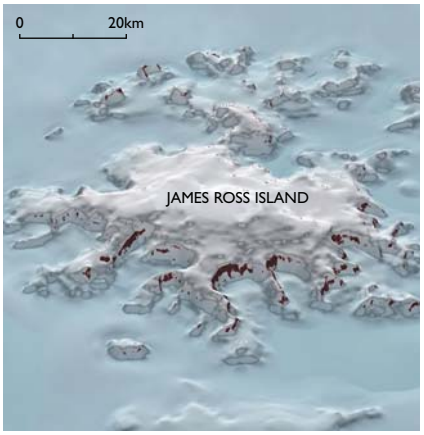
The last time global temperatures were higher than they are today, the East Antarctic Ice Sheet was significantly smaller than it is now, but did not disappear completely. The Pliocene epoch (5.3 to 1.8 million years ago) is the last period of geological time when global temperatures were generally warmer than they are presently. New models suggest that climate variations (2.1°C higher than today) were not sufficient to trigger a major deglaciation of East Antarctica during this period. There was a smaller, persistent ice sheet, with the main reduction in ice over the Wilkes and Aurora subglacial basins (Wilkes Land). The models show that even the largest reconstructed extents of the East Antarctic Ice Sheet during the Pliocene are smaller than today, with at least an 8% reduction in ice cover. This suggests that previous theories of a stable, unchanging ice sheet cannot be extended to the entire continent. Studying the East Antarctic Ice Sheet during the warmer conditions of the past is essential to help us understand the future behaviour of Earth's ice sheets in a warmer world. The climate of the mid-Pliocene is similar to that predicted for the year 2100 by the Intergovernmental Panel on Climate Change (IPCC). This research reinforces Antarctica's key role in predicting the global effects of future climate change.

Contact: **Daniel Hill dahi@bas.ac.uk**

Volcanic rocks provide a window on six million years of Antarctic Peninsula ice sheet configuration

Persistent basaltic volcanic activity in the James Ross Island region of the Antarctic Peninsula has produced at least 50 separate eruptions over the last six million years, most of which show evidence for interactions with an ice sheet. Studies have revealed changes between a regionally-extensive Antarctic Peninsula ice sheet and a local James Ross Island ice cap. The ice was sometimes surprisingly thin, typically only a few hundred metres, but occasionally reached exceptional thicknesses of about 750m – still much thinner than the 'giant' ice sheets predicted previously. These results are the first detailed evidence for the morphology, thickness and thermal regime of any part of the Antarctic ice sheet before the Last Glacial Maximum (~20,000 years ago). The results imply that the ice sheet may have been remarkably robust to global change, contradicting current concerns about its climate sensitivity.

Contact: **Prof John Smellie jlsm@bas.ac.uk**



Technical Terms: Basaltic volcanic activity: *A type of eruption expelling basaltic lava – fast-flowing molten rock that cools to form basalt, a fine-grained, grey-to-black igneous rock.* **Feedback mechanism:** *A change within a system as a result of a forcing mechanism (e.g. environmental change) that affects it.* **Forcing mechanism:** *A process that drives a system or causes it to change.* **Morphology:** *Form and structure.* **Thermal regime:** *Temperature distribution; in this case linked to the amount and distribution of water within an ice sheet.*

Images: Above: *Largest and smallest ice-sheet reconstructions of the mid-Pliocene East Antarctic Ice Sheet (3.29-2.97m years ago).* **Below:** *An illustration of James Ross Island showing the thin ice cover that may have characterised the region during most of the past six million years.*

For more information, please visit our website: **www.antarctica.ac.uk**

LTMS Long-term Monitoring and Survey

Geological sciences contact: **Dr Alistair Crame jacr@bas.ac.uk**
Biological sciences contact: **Prof Paul Rodhouse pgkr@bas.ac.uk**

Krill discovered living in the Antarctic abyss

BAS scientists have discovered Antarctic krill living and feeding down to depths of 3,000 metres in the waters around the Antarctic Peninsula. Until now, this shrimp-like crustacean was thought to live only in the upper ocean. Scientists from BAS and the National Oceanography Centre, Southampton, used a deep-diving, remotely-operated vehicle known as 'ISIS' to film previously unknown behaviour of krill. It was a surprise to observe actively feeding adult krill, including females that were apparently ready to spawn, close to the sea-bed in deep water. Other observations had shown that the bulk of the population of adult krill is typically confined to the top few hundred metres of the water column. The discovery completely changes scientists' understanding of the major food source for fish, squid, penguins, seals and whales. There is clearly still a great deal to learn about the deep sea.

Contact: **Prof Andrew Clarke accl@bas.ac.uk**

Introduction

BAS undertakes a wide range of long-term monitoring and survey activities that underpin national and international research, and government and international policies.

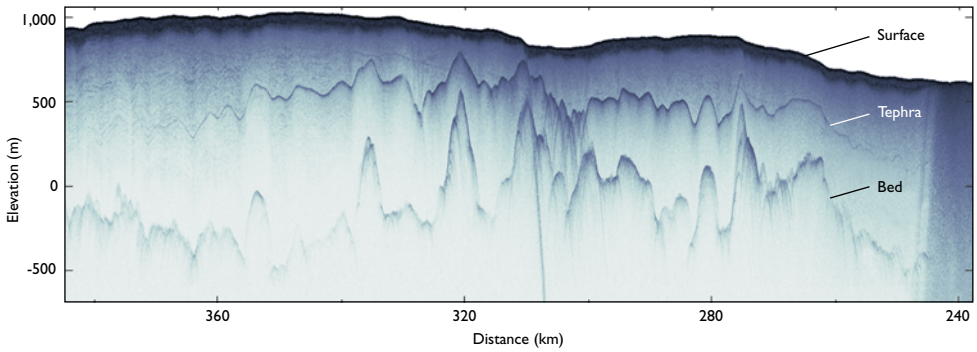
We are building on a legacy of more than 50 years of observations and measurements, and continue to survey some areas for the first time.

Aerogeophysical surveying reveals secrets under the ice

Ice-depth radar, gravity and magnetic measurement equipment installed in a BAS Twin Otter aircraft allow novel insights into Antarctica's inner secrets. For example, the evidence of a volcanic eruption from beneath Antarctica's most rapidly changing ice sheet has recently been identified. The volcano on the West Antarctic Ice Sheet (WAIS) erupted 2,000 years ago (325BC) and was discovered by radar reflections from a layer of tephra (erupted material), covering an area greater than Wales, inside the ice sheet. This layer was produced by a subglacial volcano and confirms that the volcanoes in the West Antarctic rift structure are active. This suggests that geothermal activity significantly affects WAIS behaviour, as subglacial melt-water accelerates ice flow. The volcanic source of the tephra layer is close to Pine Island Glacier. If geothermally active, it may be influencing the glacier's currently accelerating flow rate. The discovery is another vital piece of evidence that will help determine the future of the WAIS and refine predictions of future sea-level rise.

Sub-glacial lakes can also be identified from airborne geophysical data. From the recent joint British/Italian survey across the Wilkes Subglacial Basin, a cluster of nine new lakes has been identified. The quantity and extent of the acquired data allows us to construct a reliable subglacial topography map, which is then used to describe the lakes' physiography. Field images provide insights into the geological setting of the newly identified subglacial lake district along the margin of the basin. The findings bring the total number of lakes discovered beneath the Antarctic ice sheet to almost 170. The lakes have been isolated from the surface for long periods and may have unique biological environments, as the habitats must be in total darkness, have low nutrient levels, high water pressures and be isolated from the atmosphere.

Contact: **Hugh Corr hjfc@bas.ac.uk**



Technical Terms: Aerogeophysical surveying: *Ground/ice survey using sophisticated instruments mounted on the wings of, and inside, an aircraft.* **Geothermal:** *Relating to the Earth's internal heat.* **Krill:** *Shrimp-like crustaceans that form a key part of the Antarctic food web.* **Physiography:** *The physical features of a natural landform.* **Topography:** *The shape of the surface of the Earth.*

Images: Above: *Antarctic krill have been found living and feeding down to depths of 3,000m for the first time.* **Below:** *A terrain-corrected radar echogram from a section across the West Antarctic Ice Sheet.*

For more information, please visit our website: **www.antarctica.ac.uk**

Delivering the Science

Image: *RRS* Ernest Shackleton *powers through a freezing Weddell Sea after completing the relief of Halley Research Station at the start of the summer season.*

For more information, please visit our website: **www.antarctica.ac.uk**

UK influence in global affairs

Contact: **Dr John Shears** **jrs@bas.ac.uk**

International Polar Year 2007-08

International Polar Year 2007-08 (IPY) is an intense scientific programme focused on both the Arctic and Antarctic. It is the largest co-ordinated international scientific effort for 50 years. The IPY International Programme Office is hosted at BAS and funded by NERC. IPY supports 231 projects, of which BAS is involved in 56. For example, in February 2008, BAS ship RRS *James Clark Ross* supported the Census for Antarctic Marine Life (CAML) project. This studies the evolution of life in Antarctic waters and its links to current biodiversity, and aims to predict responses to future change. BAS also takes a leading role in the Association of Polar Early Career Scientists (APECS) project, formed during IPY to help develop the next generation of polar scientists.

Through encouragement, integration and co-ordination, the International Programme Office has played an important role in co-ordinating exciting new polar research and establishing international science and education networks. These will, with time and with continued co-ordination, achieve a step change in the profile and importance of polar research.

Contact: **Dr David Carlson**
ipy.djc@gmail.com

Introduction

Sustaining a scientific leadership role for the UK in global affairs, as well as in the Antarctic, is a key part of the BAS mission.

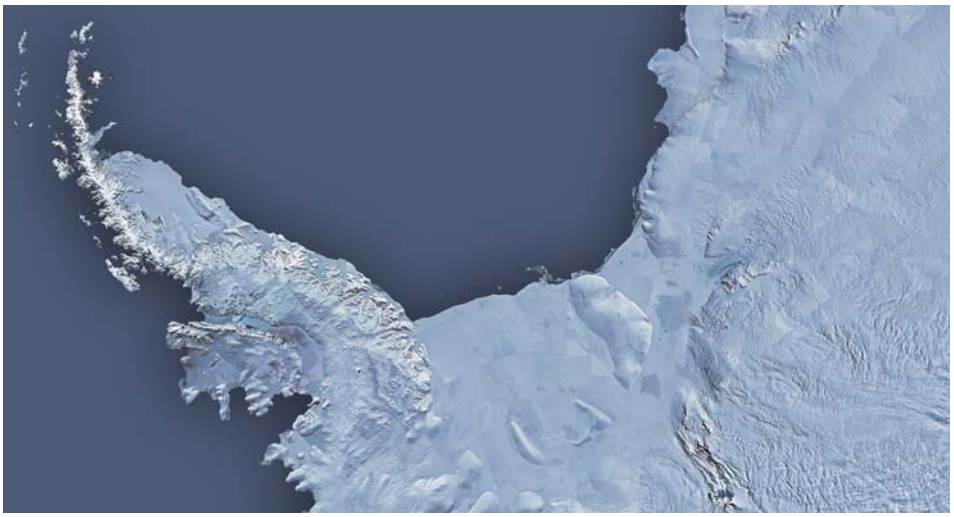
We ensure that the UK Government, the Intergovernmental Panel on Climate Change and key decision-makers are scientifically well advised and address key areas of concern, such as global climate change, sea-level rise, sustainable fisheries management, and protecting the Antarctic environment.

A new high-definition view of Antarctica

BAS has collaborated with the US Geological Survey and NASA to create the Landsat Image Mosaic of Antarctica (LIMA) – a new high-resolution satellite image mosaic of Antarctica, launched in November 2007 as part of International Polar Year 2007-2008. The visually stunning mosaic contains more than a thousand Landsat scenes selected and processed to give a seamless, virtually cloudless satellite view of Antarctica's frozen landscape. With 15m resolution, it provides much greater detail for the entire continent than has been available before, allowing features about the size of half a tennis court to be seen. The entire mosaic, as well as the original source images and versions of the mosaic enhanced for glaciological and geological applications, are freely available for download from the USGS at *http://lima.usgs.gov*. LIMA is set to give new insights into the glaciology and geology of Antarctica, lead to a step-change in the quality of topographic mapping and has already proved invaluable for scientific fieldwork operations and logistics. The images were mainly collected over a three-year period and so the mosaic offers a time-stamped baseline for measuring future changes in Antarctica's ice cover.

A separate website 'Faces of Antarctica', hosted by NASA, offers additional educational and public engagement resources, such as features on Antarctic science, maps and fact-sheets produced by BAS and NASA. See *http://lima.nasa*.

Contact: **Adrian Fox** **ajfo@bas.ac.uk**



Images: Above: *The logo of International Polar Year 2007-2008 adornes the side of BAS Royal Research Ship* James Clark Ross. **Below:** *A section of the new high-resolution Landsat Image Mosaic of Antarctica showing the Antarctic Peninsula region.*

For more information, please visit our website: **www.antarctica.ac.uk**

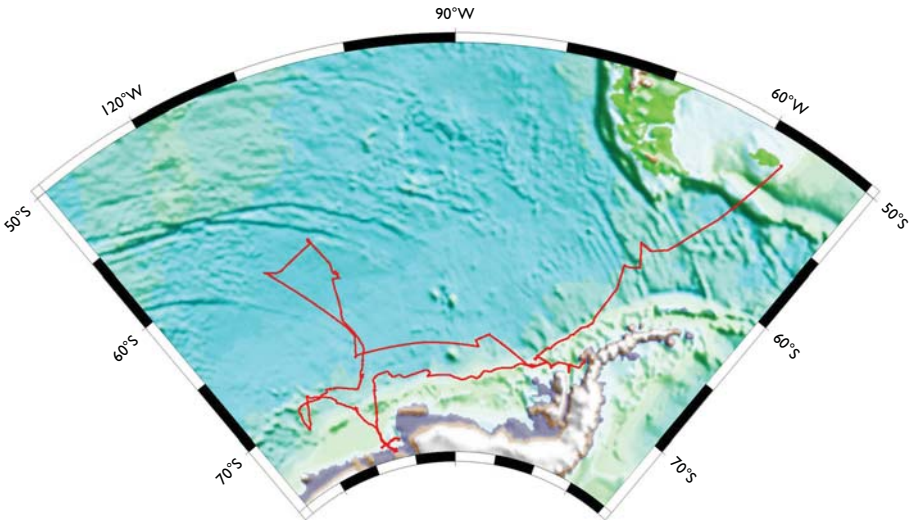
Infrastructure and operations

Contact: **John Pye ajpye@bas.ac.uk**

Introduction

To deliver world-class science 16,000km away, BAS needs modern technology for science and infrastructure, up-to-date facilities and effective operational management.

We have long-term planning horizons, a flexible and innovative approach, and an ongoing programme to introduce new facilities and technology. Success depends on excellent teamwork across many disciplines, a continuous search for better ways of working, and collaboration with other NERC programmes and national Antarctic operators.



RRS *James Clark Ross* travels further west and south than ever before

On her last major cruise of the season, BAS's Royal Research Ship *James Clark Ross* took biological and geological teams from BAS and collaborating institutes into Pine Island Bay, Amundsen Sea, to conduct the first benthic biological and further geological sampling in this area. By using the new BAS epibenthic sledge and BAS's purpose-built Agassiz trawls, scientists collected an unexpectedly large variety of animals from a range of depths down to 1,500m. Geologists used piston and gravity corers to collect mud samples from on and off the shelf to help determine the age and rapidity of the last glacial recession and to provide records of past ocean and ice-sheet dynamics. They also collected swath bathymetry data and filled in gaps on existing swath coverage, revealing features formed at the base of the former ice sheet and during deglaciation. The work will contribute to several International Polar Year 2007-2008 programmes. Favourable ice conditions meant we managed to penetrate deep into Pine Island Bay, getting all the biological and many of the geological samples we wanted, and in the process took the ship further west than she had ever been before and to the furthest south she has ever been on the western side of the Antarctic Peninsula.

Contact: **Dr Peter Enderlein pend@bas.ac.uk**

Milestone reached in the development of Rothera Research Station

The long-term redevelopment plan for Rothera Research Station optimises the design and positioning of buildings to reduce maintenance, energy usage and the build-up of snowdrifts. In January 2008, Ed Wallis, Chairman of the Natural Environment Research Council, marked the completion of the first phase of redevelopment by officially naming the newly completed Bransfield House. The attractive new building provides Rothera with modern domestic, office and social facilities for up to 120 people. The steel-frame construction improves snow management – the building is raised two metres above the ground – and provides the flexibility to change the internal layout when needed. The modern design greatly improves the amount of usable space, and energy-efficiency measures include solar collectors to help reduce fuel consumption for heat and power.

Contact: **Neil Farnell nifa@bas.ac.uk**

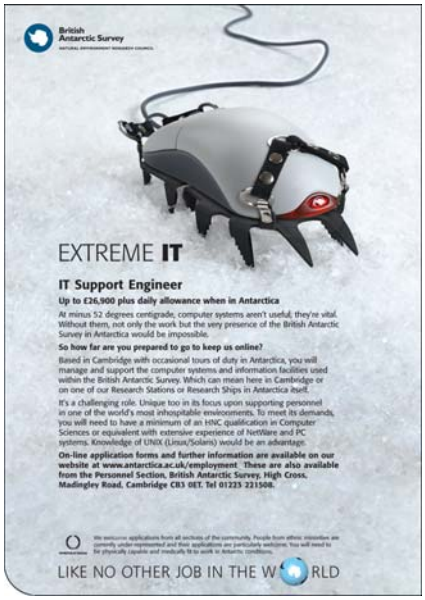
Technical Terms: **Agassiz trawls:** *A dredge consisting of a net attached to a metal frame that is used to collect organisms, particularly invertebrates, living on the ocean bottom.* **Benthic biological sampling:** *The collection of organisms from the bottom of a body of water, e.g. the seabed.* **Epibenthic sledge:** *A rectangular metal frame with a fine mesh net (often more than one) attached to it, which is towed along the ocean floor to collect small organisms on the seabed, in the first few centimetres of sediment, and in the water column just above the seabed.* **Gravity corer:** *A device used to sample the sediment layers at the bottom of lakes or oceans by penetrating the bed via gravitational force (i.e. freefall).* **Piston corer:** *A long, heavy tube, containing a piston, that is driven into the seafloor to capture mud and sediment samples, usually up to 90 feet in length.* **Swath bathymetry:** *An accoustic technique for mapping the ocean floor (from a ship) in a continuous strip that can be up to several kilometres wide.*

Images: **Above:** *The cruise track for RRS* James Clark Ross *– further west and south than ever before.* **Below:** *NERC Chairman Ed Wallis opens the new Bransfield House building at Rothera Research Station.*

For more information, please visit our website: **www.antarctica.ac.uk**

Halley VI Research Station

Contact: **Robert Culshaw rocu@bas.ac.uk**



Extreme team

The labour market for trades staff in 2007 was difficult, and we started to feel the competition from building projects like the Olympics. Fortunately, the Halley VI project provided a new and exciting focus for our regular recruitment campaigns to service the research stations in Antarctica. Using the idea of an 'Extreme Team', we ran high-profile adverts that concentrated on personal challenge and achievement. We also used our 'Antarctic Employment Pool' of experienced staff to help us meet the extra demand. As a result, an outstanding team was recruited.

Contact: **Laura Formoy lafo@bas.ac.uk**

Introduction

Halley VI Research Station will set a new standard for science facilities in Antarctica.

The delivery date is 2012. Its design, as a relocatable and modular research station, will give Halley VI a very long working life.

From concept to construction – Halley VI build begins

Work began on the Brunt Ice Shelf this year to build the new Halley VI Research Station. RRS *Ernest Shackleton* and a chartered vessel delivered more than 10 times the normal cargo. Excellent sea-ice and ramp conditions meant that the materials were moved 15km to the main construction site in just seven days. This set the season off to a great start, with the two-month intensive building phase finishing at the end of February 2008.

With over 100 people on station, instead of the usual 60, the season was very demanding. All the main construction activity went to plan. Seven modules were assembled; one was clad in its distinctive blue panelling and the others protected by tents. The Halley VI foundation and cabling works were finished ahead of schedule. Good planning and the enthusiasm of the BAS and contractor's staff were crucial to the successful achievement of this key project milestone.

Contact: **Karl Tuplin ketu@bas.ac.uk**

Images: Above: *One of BAS's award-winning recruitment advertisements as part of the 'Extreme Team' initiative.* **Below:** *The first completed module of Halley VI Research Station sits below a green aurora on the Brunt Ice Shelf.*

For more information, please visit our website: **www.antarctica.ac.uk**

UK and international collaborations

Contact: **Prof Alan Rodger asro@bas.ac.uk**

Introduction

Many of the problems posed by Antarctica cannot be answered by BAS alone. Therefore, we collaborate extensively with the environmental community in the UK and overseas to share best practice and to maximise the scientific impact.

Independent environmental audit of ANDRILL

ANDRILL is a collaborative programme of geological drilling and core analysis conducted by Germany, Italy, New Zealand and the USA. Drilling from platforms on sea ice or on the ice shelf in McMurdo Sound, Ross Sea region, the project aims to recover rock and sediment cores from 1,000m below the sea floor. The cores are analysed to determine ice-sheet history and environmental change over 14 million years, and to calibrate climate-change models.

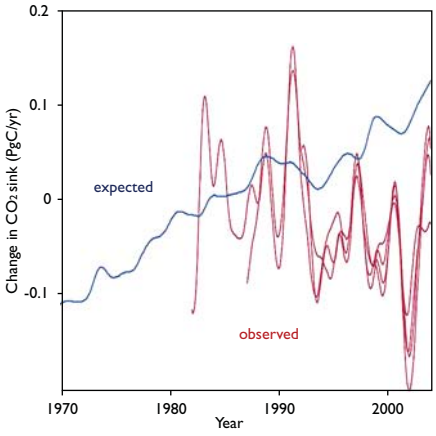
An independent environmental audit, undertaken jointly between BAS and the Australian Antarctic Division, aimed to verify the scientific intent of ANDRILL, and to ensure compliance with the environmental impact assessment. Key environmental issues included contingency planning in case of break out of the sea ice, the potential loss of the drill rig, camp and bulk fuel storage, high-pressure gas or fluid 'blow-outs', drill fluid recovery, the use of explosives for seismic profiling, bulk fuel storage and handling, waste management and site remediation.

Contact: **Rod Downie rhd@bas.ac.uk**

One of the Earth's natural carbon 'sinks' is weakening

A four-year study by scientists from BAS, the University of East Anglia and the Max-Planck Institute for Biogeochemistry in Germany reveals that an increase in winds over the Southern Ocean, caused by increasing greenhouse gases and ozone depletion, has led to a release of stored CO_2 into the atmosphere and is preventing further absorption of the greenhouse gas. This is the first time we've been able to say that climate change itself is responsible for the saturation of the Southern Ocean sink. This is a serious issue. All climate models predict that this kind of 'feedback' will continue and intensify during this century. The Earth's carbon sinks – of which the Southern Ocean accounts for 15% – absorb about half of all human carbon emissions. With the Southern Ocean reaching its saturation point, more CO_2 will remain in the atmosphere.

Contact: **Prof Corinne Le Quéré cleq@bas.ac.uk**



Technical Term: Carbon sink: *A reservoir within the Earth System that absorbs or takes up released carbon dioxide from another part of the carbon cycle.*

Images: Above: *The ANDRILL site with Mt. Erebus in the background, Ross Sea, Antarctica.* **Below:** *Changes in the Southern Ocean carbon sink from 1970 to present.*

For more information, please visit our website: **www.antarctica.ac.uk**

Protecting the environment

Contact: **Rachel Clarke racl@bas.ac.uk**

Introduction

BAS is committed to delivering its science programme and associated logistics with the minimum environmental impact.

We strive for continuous improvement and achieve this through the use of an environmental management system (certified to the internationally recognised ISO 14001 standard), environmental impact assessment and monitoring. We also maintain a leadership role in Antarctic environmental affairs, for example by supporting the UK Government in Antarctic Treaty Consultative Meetings.

BAS launches its Carbon Reduction Strategy

BAS recognises that the consumption of fossil fuel and subsequent emission of carbon dioxide is one of its greatest environmental impacts. In October 2007, BAS introduced the Carbon Reduction Strategy as part of its continuing commitment to minimise its impact on the environment. The Carbon Reduction Strategy aims to exceed UK Government targets for long-term reductions in carbon emissions and sets the following targets for the five-year period 2007-2012: 20% reduction from 2006 levels in emissions from BAS Cambridge and Antarctic stations, and a 5% reduction from 2006 levels in emissions from BAS ships. Progress towards meeting these targets will be reported on the BAS website.

The practical steps include better monitoring and reporting of energy consumption, energy audits to establish where further efficiencies can be gained, staff education programmes and new energy efficient technologies.

Contact: **William Ray wray@bas.ac.uk**

Driving down computer power needs

Sustainability and energy saving are key issues for BAS, and computers and IT equipment have a significant power demand. To reduce the number of computers and servers deployed at BAS, and hence the power consumed, we are introducing a technology called virtualisation. The virtualisation project includes the Cambridge site and stations in the Antarctic. At Bird Island Research Station on South Georgia, the power used by the IT equipment was halved during the 2007/08 season. This was achieved by replacing five existing servers with one unit and deploying energy-efficient hardware. Following the success of the Bird Island installation, this method will now be applied to the other Antarctic stations and BAS ships.

In Cambridge, virtualisation has enabled the number of physical servers to be reduced from 20 to three during the past year. This has been achieved with no reduction in the level of service provided. Work will now start to reduce the power consumption of users' PCs.

Contact: **Doug Willis ddw@bas.ac.uk**

Images: Above: *The new solar panel array installed on Bransfield House at Rothera Research Station.* **Below:** *The server room at BAS Cambridge has recently been upgraded.*

For more information, please visit our website: **www.antarctica.ac.uk**

Science in society

Contact: **Linda Capper lmca@bas.ac.uk**

Introduction

Explaining our science in accessible language is vital to enable informed public dialogue about global environmental issues.

Media relations, publications, events, exhibitions, educational resources, the internet and a public information service are the main means of achieving public engagement and dialogue about BAS science. Our strategic goals for science communication and public engagement are driven by the BAS vision and Government aspirations outlined in its vision for science and society.

BAS band stars in global music concerts

BAS's Rothera Research Station band Nunatak participated in Al Gore's Live Earth concerts in July 2007, reaching an astonishing two billion global viewers. Live Earth's aim was to raise global awareness of climate change across all seven continents. Representing Antarctica, Nunatak recorded two original songs that were broadcast on more than 120 television networks around the world and streamed on the Internet. Nunatak's music videos were played to a packed Wembley Stadium in London and shown on televisions and computers around the world. BAS's involvement provided an innovative approach to reaching an audience (15-24 year olds) that is often difficult to engage in science.

Contact: **Athena Dinar amdi@bas.ac.uk**

Ice Station Antarctica

BAS collaborated with the Natural History Museum in London to launch Ice Station Antarctica, a major new interactive exhibition that challenged kids to survive the extreme conditions faced by scientists researching the frozen continent, and to find out how Antarctica affects the rest of the planet. Created over five years, the exhibition opened in May 2007 and was aimed at families, especially with children aged seven and over. Almost 200,000 people visited during its year-long London run, most of whom were families and school parties. An online interactive learning resource extended the experience for young visitors. The launch attracted influential stakeholders from the worlds of science, the arts, business and politics. The exhibition has now moved to Spain's Parque de las Ciencias in Granada for the next stage of its international tour.

Contact: **Linda Capper lmca@bas.ac.uk**

Images: Above: *Ice Station Antarctica's emblem.* **Below:** *Rothera Research Station's band Nunatak played a part in the global Live Earth concerts.*

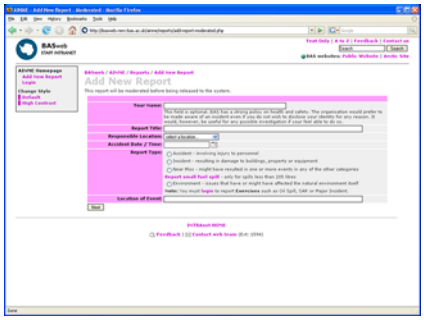
For more information, please visit our website: **www.antarctica.ac.uk**

Health and Safety

Contact: **Robert Culshaw rocu@bas.ac.uk**

Introduction

BAS attaches the utmost importance to managing the health and safety aspects of all its operations. We remain committed to eliminating or reducing health and safety risks, to meet our legal obligations and to protect the interests of all our staff. We have continued to seek improvements in our health and safety management system, with excellent results in the past year.



BAS has developed its own web-based system of reporting AINME (Accidents, Incidents, Near-misses and Environmental impacts). As well as providing statistical information, this enables lessons to be learned quickly. When necessary, management action can then be taken to improve health and safety performance. This AINME system is now being adopted right across NERC and by the managers of the Antarctic programmes of other nations.

We have retained certification to BS OHSAS 18001, the occupational health and safety management standard. We met or exceeded all the targets we set last year, including a significant reduction in accidents resulting in sprains or strains, which had been the largest accident type in the previous year. Despite the dangers of Antarctic operations, we recorded no accident serious enough to be reportable to the Health and Safety Executive. The BAS Board monitored our health and safety policy and performance in detail, through a standing item on the agenda of the monthly Board meetings. We have continued to consult our staff on changes to the management of health and safety through committees on all our stations and ships. We encourage staff to become involved in their health and safety at BAS and welcome constructive comments. We operate an open system of management so that the minutes of all health and safety meetings are published on our internal website with our policy, procedures, guidance and summaries of accident reports and investigations.

Images: Above: *BAS's online AINME (Accidents, Incidents, Near-misses and Environmental impacts) database and reporting system.* **Below:** *Constructing one of the new buildings for Halley VI Research Station on the Brunt Ice Shelf.*

For more information, please visit our website: **www.antarctica.ac.uk**

Recruitment and career development

Contact: **Laura Formoy lafo@bas.ac.uk**

Introduction

Our success depends on the skills, quality, commitment and attitude of everyone who works for us. Our aim is to create a working environment that encourages team approaches and allows people to achieve their potential and contribute fully. This means we strive to develop our staff continuously and promote adaptability, flexibility and inter-disciplinary teamwork.

INVESTOR IN PEOPLE

Recruiting top-quality scientists continues to be a challenge, as we compete with the UK university sector and international opportunities. There were longer delays in filling specialist posts, but an easing on restrictions for work permits is helping. Indeed, over 20 nationalities are now represented at BAS, which has additional benefits for science through additional networking.

In May 2007, BAS went through a second re-accreditation process to assess whether it still met the criteria for 'Investors in People (IiP)', first awarded in 2002. The independent assessor said that BAS had performed exceptionally well against a new enhanced standard, with key strengths including professional staff at all levels, clear strategic objectives, excellent planning skills, a proactive approach and a culture of continuous improvement.

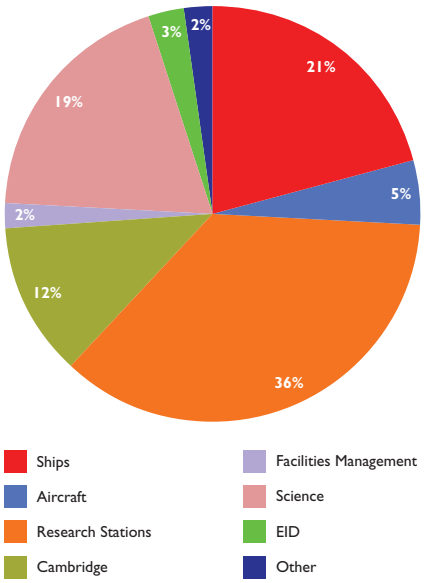
BAS invests significantly in career development for staff, providing a wide range of opportunities for training, coaching and mentoring and short attachments or secondments. Advice and feedback is also important. In 2007, we established a new 'Career Development Panel' for Engineering, Technical, Data Management and Communication staff to provide guidance and advice. We also introduced a new Management Programme for Marine Officers in collaboration with colleagues at the National Marine Facilities unit at the National Oceanography Centre.

Images: Above: *BAS recruits top-quality scientists to work in one of the most challenging environments on Earth.* **Below:** *Logo for Investors in People.*

For more information, please visit our website: **www.antarctica.ac.uk**

Facts and figures 2007-2008

Analysis of Expenditure 2007-2008



Total budget 2007-2008: £61.4 million (£43.7m running costs, £17.7m capital spend, including Halley VI)

Full figures can be found in the BAS Business Plan, which can be viewed at: *www.antarctica.ac.uk/about_bas/publications/corporate.php*

Total staff employed
547 staff worked for BAS

UK staff, based at BAS Cambridge
155 scientists contributed to the BAS science programme
77 scientific support staff, including Directorate
118 staff in the Administration and Logistics Division, technical, aircrew and ships

Overwintering Antarctic staff
23 at Rothera Research Station
18 at Halley Research Station
9 at King Edward Point Research Station
4 at Bird Island Research Station

Summer participants in Antarctic operations
213 at Rothera, including 10 scientific collaborators from the UK and overseas
89 at Halley, including 37 contractors
39 at Signy, Bird Island and King Edward Point, including 4 scientific collaborators from the UK and overseas
55 in the field and on various projects off HMS *Endurance* and on South Georgia, including 8 scientific collaborators from the UK and overseas

Summer participants in Arctic operations
7 at Ny Ålesund, Svalbard

Research students
52 registered for higher degrees (co-supervised by BAS staff)

Ships
Two complements of 28 crew on RRS *James Clark Ross*
Two complements of 21 crew on RRS *Ernest Shackleton*
65 scientific cruise staff working on RRS *James Clark Ross*, including 12 scientific collaborators from the UK and overseas
134 staff transported to Antarctic destinations on RRS *James Clark Ross*, RRS *Ernest Shackleton* and HMS *Endurance*

Publications
255 peer-reviewed research papers listed in the ISI database of high-quality journals, including 11 published in leading science journals *Science* and *Nature*
Details of all BAS papers can be found at: *www.antarctica.ac.uk/about_bas/publications/science_publications.php*

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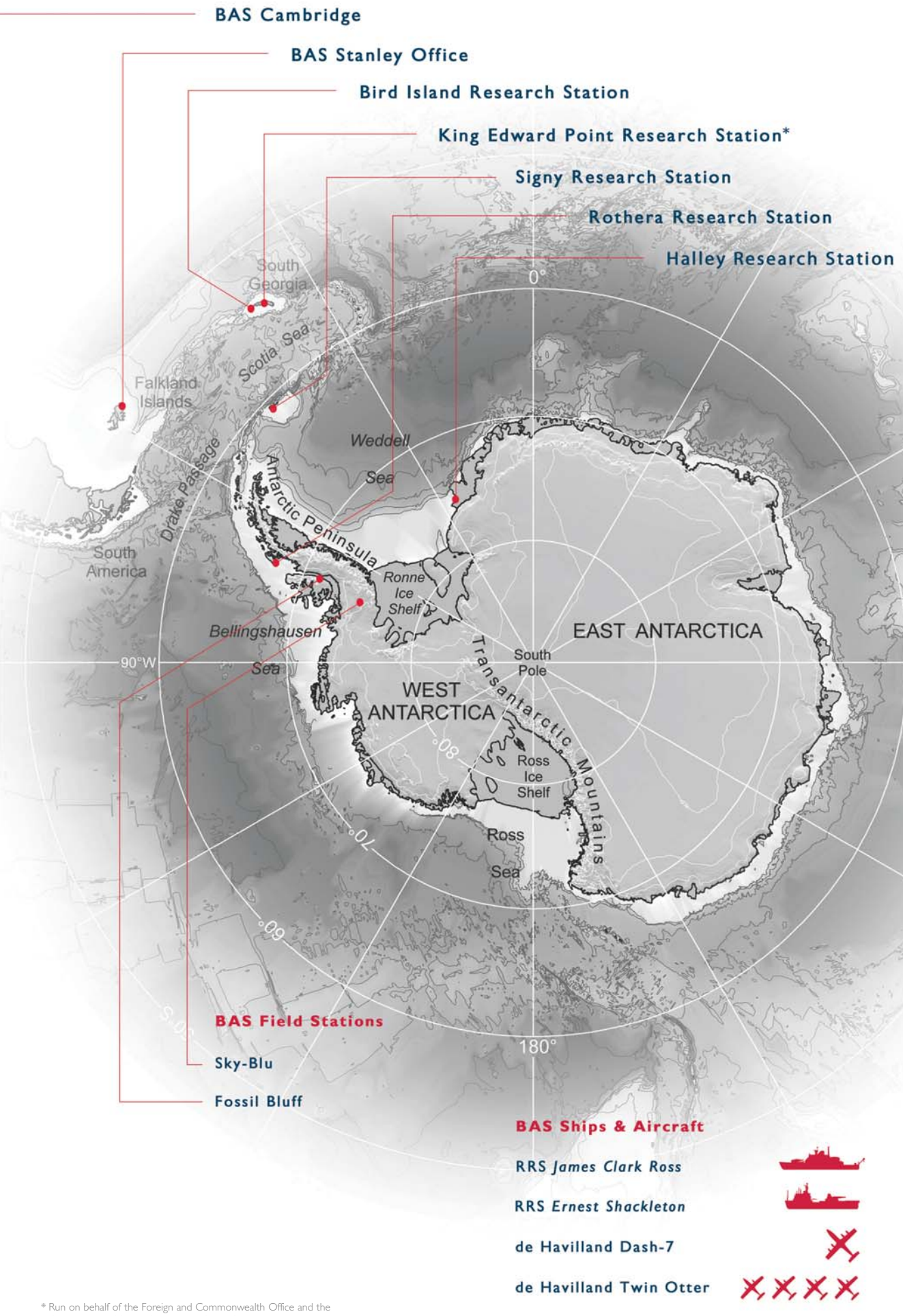

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Feedback and further information
We welcome your feedback and comments on this document. These should be addressed to:

Linda Capper
Head of Press, PR & Education
British Antarctic Survey
High Cross, Madingley Road
Cambridge, CB3 0ET, UK
Email: lmca@bas.ac.uk

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