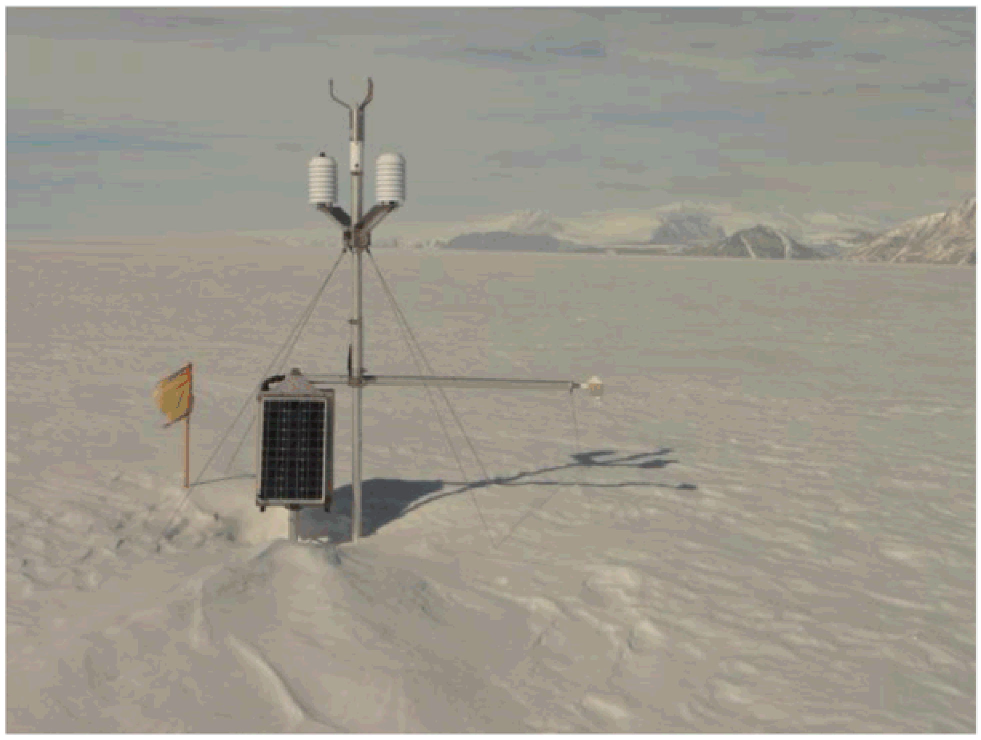
K049
2009/10

LOGISTICS REPORT



K049: NZ ITASE

ANTARCTICA NEW ZEALAND 2009/10

Event Personnel (Name and Organisation)

Nancy Bertler	Joint Antarctic Research Institute, Victoria University of Wellington and GNS Science
Darcy Mandeno	Science Drilling Office, Antarctic Research Centre, Victoria University of Wellington
Victoria (Holly) Winton	Joint Antarctic Research Institute, Victoria University of Wellington and GNS Science

Compiled by: Nancy Bertler

Signed:

EVENT PURPOSE & SUMMARY:

Unprecedented changes are occurring in the Earth's climate. The current decade was the warmest on record since 1880 AD. The global average surface temperature has increased, especially since about 1950 with 100-year trend (1906–2005) of 0.74°C ± 0.18°C (IPCC, 2007). Although the scientific evidence of global warming is now widely regarded as unequivocal (IPCC, 2007), predicting regional impacts still poses challenges. Especially, conclusions of the Southern Hemisphere record are limited by the sparseness of available proxy data at present (Mann & Jones, 2003).

While meteorological records from instrumental and remote sensing data display the large intercontinental climate variability, the series are insufficient to infer trends or to understand the forcing, which renders prediction difficult (Jones et al., 1999; Mann & Jones, 2003). The long ice core records from the Antarctic interior and Greenland revolutionised our understanding of global climate and showed for the first time the occurrence of RCE (Rapid Climate Change Events, for review e.g. Mayweski and White (2002)). To understand the drivers and consequences of climate change on timescales important to humans, a new focus of ice core work is now moving towards the acquisition of 'local' ice cores that overlap with and extend the instrumental records of the last 40 years back over the last several thousand years (Mayewski et al., 2005).

This has been a key motivation behind the US-led International Transantarctic Scientific Expedition (ITASE) of which New Zealand is a member (Mayewski et al. 2005). The NZ ITASE objective is to recover a series of ice cores from glaciers along a 14 degree latitudinal transect of the climatically sensitive Victoria Land coastline to establish the drivers and feedback mechanism of the Ross Sea climate variability (Bertler et al., 2004a; Bertler et al., 2004b; Bertler & 54 others, 2005; Bertler et al., 2005a; Bertler et al., 2005b; Bertler et al. 2006, Patterson et al., 2005, Rhodes et al. 2009).

Due to logistical constraints by Antarctica New Zealand, the field deployment planned for 2009/10 was cancelled and a substantially reduced programme was carried out. The objectives below refer to the revised programme.

OBJECTIVES

Priority	Objective	Outcome achieved	% completed
	Maintenance of AWS - EPG	Ye	100
	Pullout of AWS – Skinner Saddle	Yes	100
	Retrieval of AWS data	Yes	100
	Measurement of Mass Balance	Yes	100
	Collection of aolian samples	Yes	100

SUPPORT DAYS

We are interested in working out how productive your time was in Antarctica. How much time was spent preparing for your research versus doing your research. This is just as applicable if your work was based out of Scott Base, rather than in the field.

Planned # of person days on ice	360
Actual person days on ice	38
Person days spent at SB preparing to go to field (if applicable)	NA
Person days spent in the field	NA
Person days packing up at Scott Base	NA
Person days of delay	2

DELAYS

Please indicate the cause of any delays to your event. (for any reason)

We were delayed twice due to weather conditions and once due to communication delays with staff in Christchurch

EVENT MANAGEMENT PHASES

For each event management phase please provide feedback on any aspect that would allow us to add more value to your support, increase efficiency and sustainability, and provide additional safety.

PHASE 1: INITIATION

Includes:

- Proposal process
- Science Selection and logistics review / Non- science selection and logistics review
- Environmental Impact Assessment (PEE, IEE, CEE)

What worked well?

N.A. – I was not required to participate this year's proposal submission

What needs to be improved?

PHASE 2: PLANNING

Includes:

- Event Planning process
- Development of your logistical support package (i.e. MA, RA, field, engineering, etc.)
- Ministry of Foreign Affairs and Trade Permitting
- Environmental advice
- Safety & Risk Assessment

What worked well?

Information and execution of environmental and MFAT permitting, as well as risk assessment process

What needs to be improved?

Long term planning capability, early indication of constraints and changes, communication

PHASE 3: PRE-DEPLOYMENT

Includes:

- Medical
- Cargo
- Deployment information

What worked well?

Pre-deployment information was received in a timely matter, shipment of cargo to and from Antarctica was conducted excellently

What needs to be improved?

Status quo is excellent

PHASE 4: OPERATIONS

Includes:

- Intercontinental flights
- Scott Base operations & support
- Engineering support (staff support, vehicles, equipment, etc.)
- Services (Staff support, communications, food, etc.)
- Facilities (Scott Base & Huts)
- Field operations & support (staff support, food, equipment, etc.)
- Training at Scott Base (Arrival briefing, Antarctic Field Training, Vehicle, engineering, etc.)
- Intra-continental flights (Helicopter, Fixed Wing)

What worked well?

Service at Scott Base was very good

What needs to be improved?

The support could be improved by increased authority of decision making by staff based at Scott Base.

How well did the planning match your final operations in Antarctica?

Poorly

PHASE 5: REDEPLOYMENT

Includes:

- Return to NZ
- Support for returning
- Intercontinental

What worked well?

Redeployment was organized excellently

What needs to be improved?

Status quo is excellent

PHASE 6: REVIEW

How can this report and Scott Base debrief be improved?

The current format works well

How can we make our planning and operations more sustainable and efficient (Thinking from an environmental, financial, and social perspective?

Please refer to substantial documentation provided by Mr. Alex Pyne to AntNZ staff.

Health and Safety Reporting

Incidents, accidents, hazards and near misses from your event and how you addressed these issues (Please report any incidents, accidents, hazards, and near misses that you have not filed an HSE form during your visit. It is very important to Ant NZ and your team's safety for us to have all incidents, accidents, and especially near misses/hazards reported so we can learn and improve the safety of all personnel in Antarctica

None

How can we make working in Antarctica safer and help ensure *Zero Harm* to all?

There is value in experience.

Environmental Impact Reporting

Information from this section helps us to assess the environmental (including cumulative) impacts and overall environmental performance of New Zealand's activities each year. This reporting is a requirement of the Antarctica (Environmental Protection) Act, which implements the internationally agreed Protocol on Environmental Protection to the Antarctic Treaty in New Zealand. The report also forms the basis for annual input into Antarctica New Zealand's environmental database, an electronic record of all New Zealand activities in the Ross Sea region since 1957.

Please be as specific as possible. For locations occupied, provide the site or protected area name, and GPS coordinates or map references where appropriate. GPS coordinates should be given in degrees, minutes and decimal minutes (e.g. 78° 20.835'S 166° 33.541'E). Note that the geodetic reference used should be WGS84.

Three sub-sections are compulsory (*) as they are relevant to **all** events. Sub-sections without asterisks need only be completed if relevant. Unnecessary sections should be deleted. Comments on any area of environmental management are welcome and can be added beneath the relevant table.

Note that all event leaders who hold permits for entry to an ASPA, and have done so, need to complete a **Visit Report** for each ASPA entered. This is a requirement under the Antarctic Treaty system as well as domestic law. Please download this form from our 'Returning to New Zealand' web page or contact Renee Burns, the Environmental Officer.

***Sites Visited** (please complete a table for each site visited)

Site name	Evans Piedmont Glacier
Site coordinates	76°43.534'S, 162°35.294'E
Is this site in an ASMA or ASPA? If so, which one?	McMurdo Dry Valleys
Dates occupied (from – to)	05 December 2009
Total time (days /hours) at site	8 hr
Maximum number of people at site (your event)	3
Total person-days (or person-hours) at site	24
Main activity undertaken	Maintenance and data retrieval
Cumulative impacts observed	None
Helo landing site coordinates if not established AND marked	
General Weather	Fair
If this is a refuge hut provide general observations and areas of required improvement	

Site name	Victoria Lower Glacier
Site coordinates	77°19'48.31"S, 162°31'55.29"E
Is this site in an ASMA or ASPA? If so, which one?	McMurdo Dry Valleys
Dates occupied (from – to)	05 December 2009
Total time (days /hours) at site	1 hr
Maximum number of people at site (your event)	3
Total person-days (or person-hours) at site	3
Main activity undertaken	Mass balance measurement
Cumulative impacts observed	None
Helo landing site coordinates if not established AND marked	
General Weather	Fair
If this is a refuge hut provide general observations and areas of required improvement	

Site name	Skinner Saddle
Site coordinates	80°55.886' S, 159°30.135' E
Is this site in an ASMA or ASPA? If so, which one?	no
Dates occupied (from – to)	08 December 2009
Total time (days /hours) at site	8 hr
Maximum number of people at site (your event)	5
Total person-days (or person-hours) at site	40
Main activity undertaken	Retrieval of data and AWS
Cumulative impacts observed	None
Helo landing site coordinates if not established AND marked	
General Weather	Fair
If this is a refuge hut provide general observations and areas of required improvement	

Geological Material

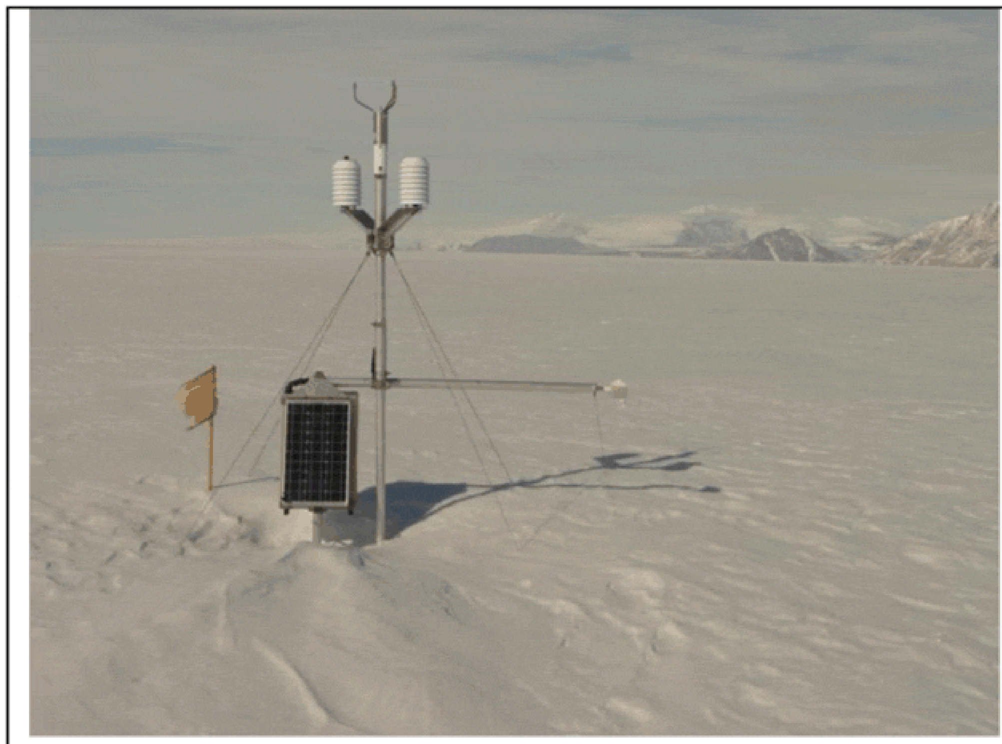
Detail any collection of geological material (including meteorites, ventifacts, fossils or sub-fossils) or soil. For **each sample** (or group of samples) taken provide:

Location		*Specimen type*	*Quantity (kg)*
Site name	Coordinates		
Haskell Straight * (taken as part of K131 field activities)	Various - see Map 1	Snow samples	200 lb
Skinner Saddle	80°55.886' S, 159°30.135' E Map 2	3 m firn core	20 lb

Equipment installed/left in field

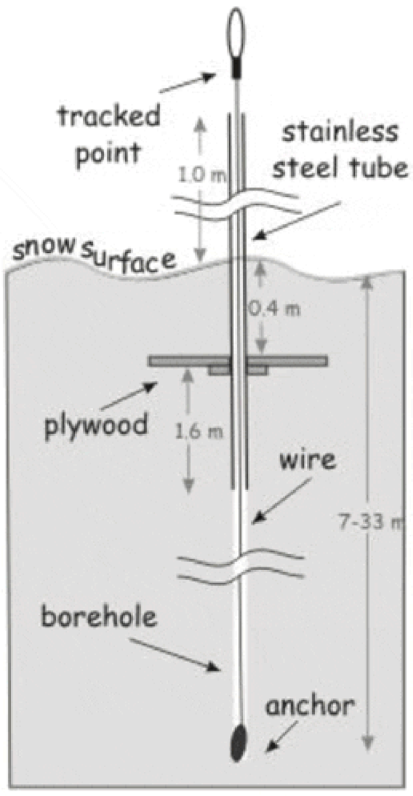
List any equipment, markers, stakes or cairns installed in the field during your visit. Upon completion of your event there should be no trace of any equipment or markers, etc., unless permitted to do so. This should include the removal of any constructed stone cairns. If any equipment installed and/or remaining in the field, provide:

Type of equipment/marker installed	*Season of installation*	*Location (name and coordinates)*	*Number of items left in field*	*Dimension (in metres: H, W, L)*	*Removal status**
AWS	2004/05	Evans Piedmont Glacier 76°43.534'S, 162°35.294'E	1	3m, 4m, 4m	Ongoing use
AWS	2007/08	Skinner Saddle 80°55.886' S, 159°30.135' E	1		removed
Mass balance device	2004	Evans Piedmont Glacier 76°43.534' S, 162°35.294'E	2	20cm (~12m below surface) x 3cm x 3cm	Ongoing Use
Mass balance device	1999	Victoria Lower Glacier 77°19'48.31"S, 162°31'55.29" E	2	0.5m (~12m below surface) x 3cm x 3cm	Ongoing Use
If equipment has been **left in the field** please provide a justification and insert or append a photograph of the installation(s):					



Automatic Weather Station:

The meteorological data will be used to establish transfer functions between ice core proxies and atmospheric parameters. The AWS records temperature, wind direction and speed, humidity, snow accumulation, snow temperature, pressure, and solar radiation. Both sites have identical weather stations. The figure shows the set-up at Skinner Saddle



Mass Balance Device:

The mass balance data are used to establish the longer term mass balance of coastal ice masses in Antarctica. We measure the net loss or gain via submergence velocity measurements. We will remove as much of the device as possible once the base is buried too far below the surface to continue the measurements. Both sites have similar mass balance set-ups. The figure shows the set-up at Victoria Lower Glacier

*Removal status categories are: 'Ongoing Use' (provide date of removal); 'Remaining' (provide date of removal); 'Removal Intended' (provide date of removal); 'Removed'; 'Unknown'; 'Unlikely'; 'Unrecoverable'.

***Bioprospecting activities**

New Zealand is collecting data for discussions on bioprospecting in Antarctica at the Antarctic Treaty Consultative Meetings. Here, we define bioprospecting as '*The search for chemical compounds and genetic materials from plants, animals and micro-organisms; the extraction and testing of those compounds and materials; and the research and commercial development of those that show activity.*'

To your knowledge, does your science involve any bioprospecting activity?

No

***Differences from original Preliminary Environmental Evaluation (PEE)**

If the activities described above differ from the environmental impact assessment (usually a Preliminary Environmental Evaluation (PEE)) completed for this event (and any approved changes), or from the Environmental Authorisation issued to it, explain how and why they differed. If there were no differences, please specify 'None'.

None

ANTARCTIC SPECIALLY PROTECTED AND MANAGED AREAS

ASPAs may be designated under the Protocol on Environmental Protection to the Antarctic Treaty where management is required to protect areas of outstanding scientific, environmental, aesthetic or wilderness values, or any combination of these values. In addition, Antarctic Specially Managed Areas (ASMAs) can be designated where increased coordination and/or cooperation is required to minimise environmental impacts. Please identify in this section any sites you believe should be considered for ASPA or ASMA designation and explain why.

- *New ASPA or ASMA designation to be considered:*
- *New Special Features within the McMurdo Dry Valleys ASMA to be considered:*

DESCRIPTION OF REMOTE, RARELY USED FIELD SITES

For the planning of future events, we are particularly interested in gaining as much useful information as possible on remote field sites that are rarely visited, or have never been visited before your event. If your event worked at such a site, we ask for any useful information you have to offer that you haven't already provided in this report on:

- Weather
- Campsite suitability
- Helicopter and/or fixed wing landing site suitability
- Travel (e.g. crevasse problems, ruggedness of terrain, used/potential routes)
- Sea ice activity and suitability for travel
- Overall description of the area
- Availability of freshwater
- Suggestions for any of the above for future use of the site/area
- Any other comments you wish to provide.

Antarctic Place Names

If you are interested in naming a geographic feature please contact Antarctica NZ for details.

Other Comments and Observations

Provide any information or supporting documents that may be helpful in future planning and operations.

The lack of a handbook this year was sadly observed. In my opinion the handbook is a valuable resource to connect research groups and provides an overview of the science supported by New Zealand.

ATTACHMENTS (TO BE INCLUDED IN THIS REPORT)

- Maps
- Photos of camp site situations, and equipment installed in the field
- Other information of historical value for future planning use
- Photos of Sites of past activity (e.g. food cache, equipment, camp)

ATTACHMENTS (TO BE ATTACHED BY ANT NZ IN PDF)

- Final Movements Annex
- Final Resource Allocation
- Final Risk Assessment
- Associated event SOP's (if developed) or other documentation
- Scott Base Event Debrief form

Appendix one

FIELD EVENT HEALTH, SAFETY, AND ENVIRONMENTAL SELF AUDIT (FOR FIELD EVENTS ONLY)

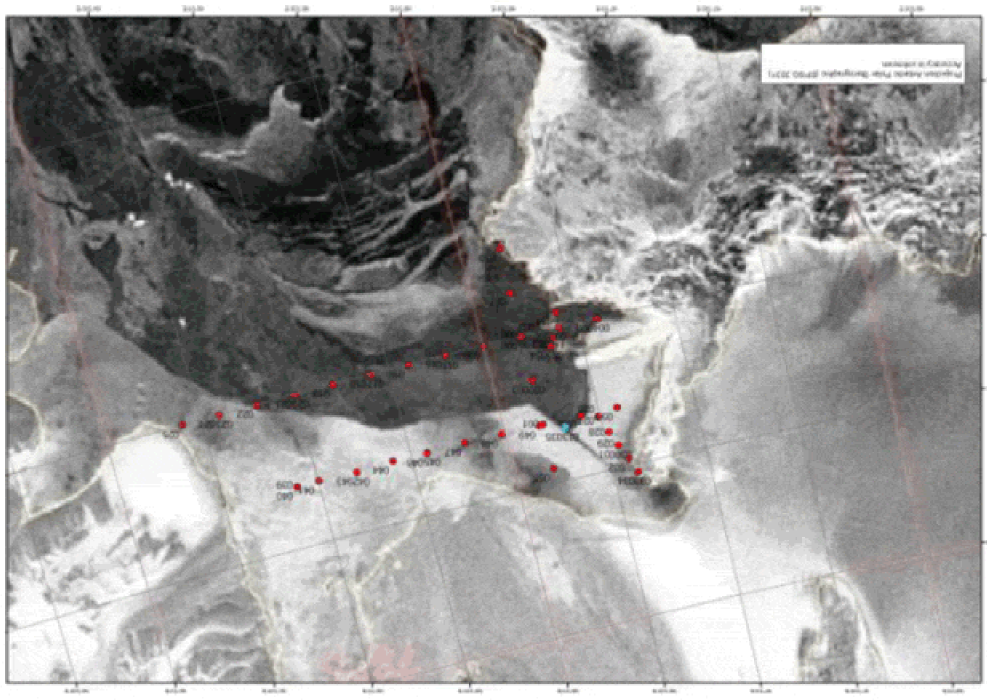
Please complete the self audit form before returning to NZ, preferably during your work in Antarctica. Your leadership as a PI in ensuring the highest level of Health, Safety, and Environmental care in the field is core to us all achieving our goal of 'Zero Harm' and being a leader in environmental stewardship in Antarctica. The self audit is key to promoting your leadership and accountability as a PI working in Antarctica. Ant NZ will conduct audits of up to 10% of events with the core objective of working with PIs to help develop their capability and provide learning for both Ant NZ and the event.

Compliance with approved PEE/IEE (EIA) and code of conduct (where there any) **Yes**
Explain the waste management processes: officer assigned, waste correctly handled and streamed, use of prohibited items, amount of food scraps, cooking efficiency to reduce waste? **No field camp deployment – all waste was returned to Scott Base**
Biosecurity – what measures are taken to prevent the spread of exotic organisms, are deliberate introductions controlled as authorised? **All equipment and personal clothing was cleaned and inspected before shipment to Antarctica**
Awareness of protected areas/ managed areas/ historic sites and use of management plans? Were permits issued to work in protected areas? **Yes – McMurdo Dry Valleys**
Use of chemicals (incl. Explosives) as authorised in approval/permit? Quantities and Procedures taken to prevent release to the environment. Procedures for waste chemicals? Not applicable
Interference with animals, sampling as authorised in approval/permit? Not applicable
Other impacts (trampling, camping, dust, noise etc) as authorised, efforts made to minimise? Not applicable
Field Fuel use, procedures and fuel prevention and response equipment? Not applicable
Avoiding disturbance to wildlife? Not applicable
Explain the event's Safe camp set up? Not applicable

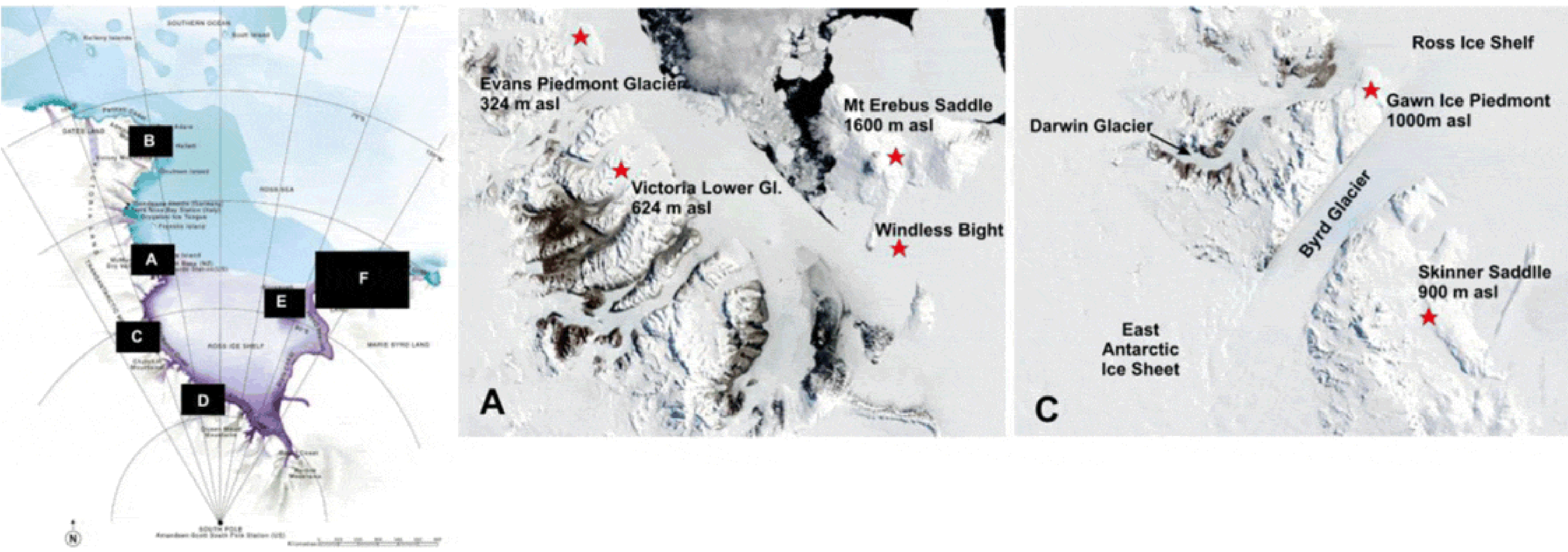
Procedures to prevent carbon monoxide poisoning? Not applicable
Health and Safety of the field party *All health and safety regulations were observed*
Procedures for safe travel away from camp? Not applicable
Other comments, ideas or concerns:

Attachment:

Maps:



Map 1: Satellite image of McMurdo Sound showing snow sampling for aeolian material in November 2009. Red dotes: Sampling sites. Blue dote: Base camp. North of the yellow line dark areas denote first year sea ice, while lighter areas denote multi-year ice. Yellow outline marks the continental and sea ice edge.



Map 2: Overview map of the locations of satellite images A and C in the Ross Sea. A) Satellite image of Victoria Lower and Evans Piedmont Glaciers in the Dry Valleys Antarctic Specially Managed Area. C) Satellite image of Skinner Saddle

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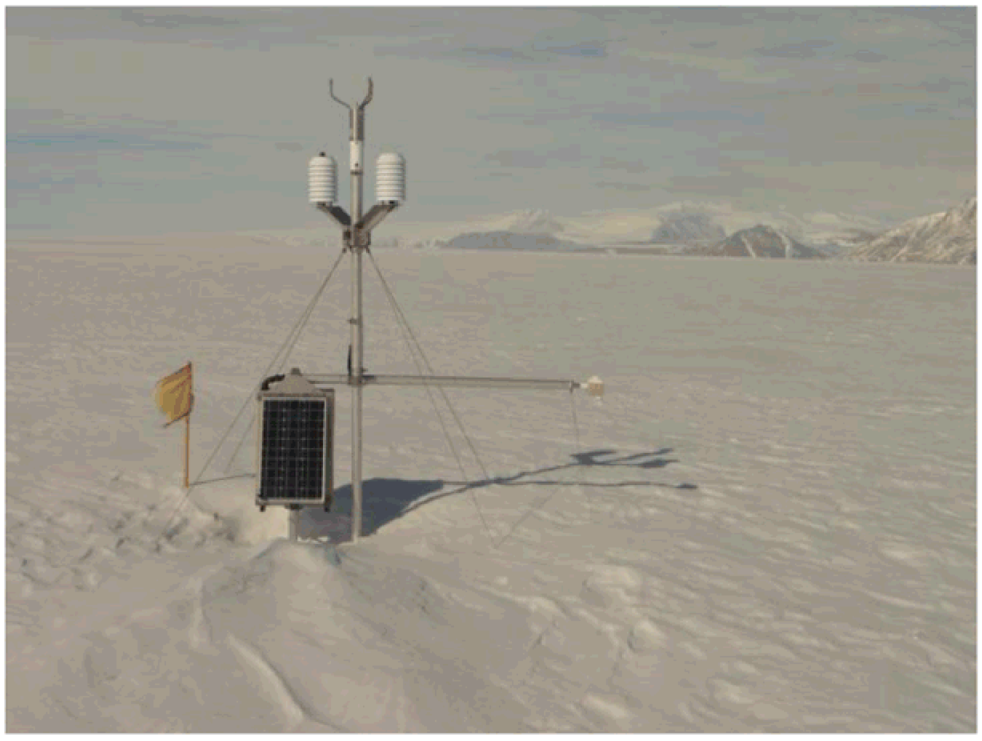
2009/10

IMMEDIATE SCIENCE REPORT



K049: NZ ITASE

ANTARCTICA NEW ZEALAND 2009/10

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Nancy Bertler	Joint Antarctic Research Institute, Victoria University of Wellington and GNS Science
Darcy Mandeno	Science Drilling Office, Antarctic Research Centre, Victoria University of Wellington
Victoria (Holly) Winton	Joint Antarctic Research Institute, Victoria University of Wellington and GNS Science

1. Scientific Programme

a. Research Objectives

Unprecedented changes are occurring in the Earth's climate. The current decade was the warmest on record since 1880 AD. The global average surface temperature has increased, especially since about 1950 with 100-year trend (1906–2005) of 0.74°C ± 0.18°C (IPCC, 2007). Although the scientific evidence of global warming is now widely regarded as unequivocal (IPCC, 2007), predicting regional impacts still poses challenges. Especially, conclusions of the Southern Hemisphere record are limited by the sparseness of available proxy data at present (Mann & Jones, 2003).

While meteorological records from instrumental and remote sensing data display the large intercontinental climate variability, the series are insufficient to infer trends or to understand the forcing, which renders prediction difficult (Jones et al., 1999; Mann & Jones, 2003). The long ice core records from the Antarctic interior and Greenland revolutionised our understanding of global climate and showed for the first time the occurrence of RCE (Rapid Climate Change Events, for review e.g. Mayweski and White (2002)). To understand the drivers and consequences of climate change on timescales important to humans, a new focus of ice core work is now moving towards the acquisition of 'local' ice cores that overlap with and extend the instrumental records of the last 40 years back over the last several thousand years (Mayewski et al., 2005).

This has been a key motivation behind the US-led International Transantarctic Scientific Expedition (ITASE) of which New Zealand is a member (Mayewski et al. 2005). The NZ ITASE objective is to recover a series of ice cores from glaciers along a 14 degree latitudinal transect of the climatically sensitive Victoria Land coastline to establish the drivers and feedback mechanism of the Ross Sea climate variability (Bertler et al., 2004a; Bertler et al., 2004b; Bertler & 54 others, 2005; Bertler et al., 2005a; Bertler et al., 2005b; Bertler et al. 2006, Patterson et al., 2005, Rhodes et al. 2009).

Due to logistical constraints by Antarctica New Zealand, the field deployment planned for 2009/10 was cancelled and a substantially reduced programme was carried out.

b. Brief Methodology

Automatic weather station set-up, maintenance, and data retrieval
Since 2004/05 we deployed an automatic weather station on Evans Piedmont Glacier and since 2007/08 also at Skinner Saddle. The data permit the calculation of transfer functions between ice core proxies and meteorological parameters, such as temperature, precipitation, meso-scale atmospheric circulation pattern, katabatic winds, and seasonality of snow accumulation. In addition, a new snow accumulation sensor and high precision snow temperature probes allow us to monitor snow accumulation rates, the potential influence of snow loss through sublimation, wind erosion or melt, and the quality of preservation of the meteorological signal in the snow. Furthermore, the data allow us to estimate the uncertainty of re-analysis data (NCEP/NCAR and ERA-40 data) in the region. At the request of Antarctica New Zealand, the automatic weather station was retrieved from Skinner Saddle this year.

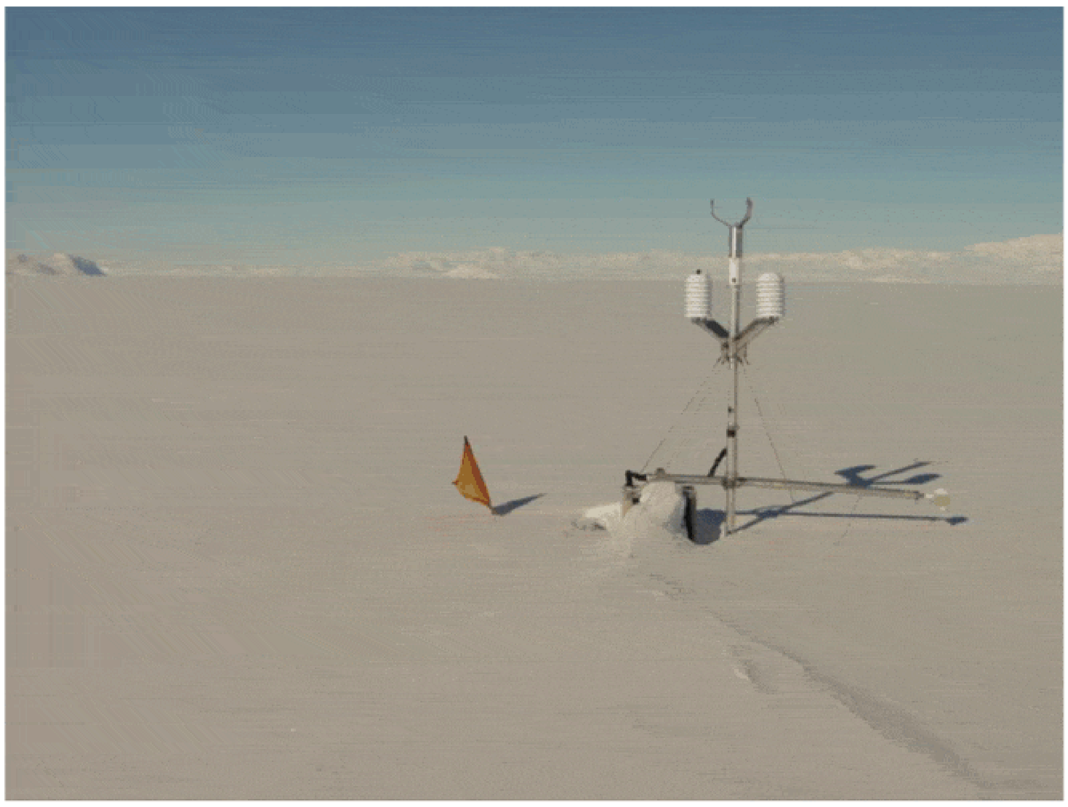

Fig.1: Automatic weather station at Skinner Saddle

Submergence Velocity Measurements at Victoria Lower and Evans Piedmont Glacier

The response time of a glacier to changes in accumulation or ablation is dependent on the size and thickness of the ice mass. In general, the response time of cold-based glaciers is positively correlated with the size of its ice mass, leading to long response times in Antarctica. For glaciers in the McMurdo Dry Valleys, with lengths on average of 5-10km and flow rates of 1 to 3 m/a, the response times are thought to range from 1,500a to 15,000a (Chinn, 1987; Chinn, 1998). Consequently, annual variations in surface elevation may only reflect changes in loss rates. As a result surface measurements of mass balance are difficult to interpret in terms of long-term mass balance (Hamilton & Whillans, 2000). This is especially the case in places like the McMurdo Dry Valleys where mass loss is thought to be predominately due to sublimation at ice cliffs and glacier surface caused by wind and solar radiation (Chinn, 1987; Chinn, 1998). For Victoria Lower Glacier (VLG), two mass balance measurements are available in the literature for 1983 and 1991 based on ice cliff characteristics and the motion of the glacier snout (Chinn, 1998). The measurements indicate that VLG was advancing 1.24m/a into Victoria Valley during this time period. However, the small number of observations (2) and the cliff's sensitivity to sublimation (contemporary surface ablation) result in a high uncertainty of longer term mass balance. To determine the longer-term mass balance of the glaciers, unaffected by annual surface variations, three 'coffee-can' or 'submergence velocity' devices (Hamilton et al., 1998; Hamilton & Whillans, 2000) were deployed at Victoria Lower Glacier in 1999/2000 and two at Evans Piedmont Glacier in 2004/05. These are annually re-measured to monitor mass balance changes.

Fig.2: Submergence Velocity Measurements at VLG

Snow Sampling for Aeolian Material

As our drilling programme had been postponed for a year, Dr. Tim Haskell (PI of K131) kindly allowed Holly Winton to join his group to conduct her research project. Her project focuses on iron fertilisation of the Ross Sea region. Fine-grained aeolian dust (<10 μm) is believed to be a significant source of iron (Fe), which is the bio-limiting nutrient required for phytoplankton growth in the McMurdo Sound, Antarctica. The dust accumulates on sea ice and is added to the ocean each year when the ice breaks up. This 'fertilisation' of the ocean results in vast phytoplankton blooms that alter the food web and generate large volumes of biogenic sediment. In spite of the apparent importance of aeolian dust in 'biogeochemical cycling' in the McMurdo Sound, the details of the interdependence of the geological processes that supply the Fe and the

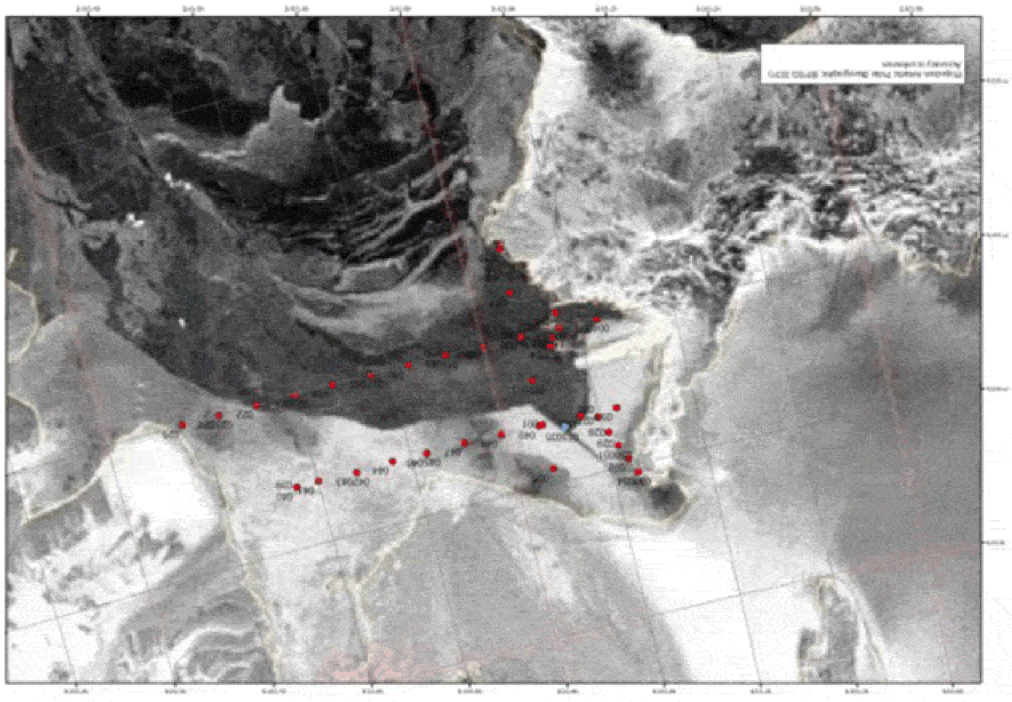

Figure 3: Satellite image of McMurdo Sound showing snow sampling sites in November 2009. Red dotes: Sampling sites. Blue dote: Base camp. North of the yellow line dark areas denote first year sea ice, while lighter areas denote multi-year ice. Yellow outline marks the continental and sea ice edge.

resulting plankton growth are poorly understood. This project aims to quantify aspects of this biogeochemical cycle for the first time by analysing the physical (size distribution, abundance and variability) and chemical (total and "bio-available" Fe content) properties of the aeolian dust blown off the Antarctic continent, deposited and trapped in coastal snow and ice in the McMurdo Sound region. Snow samples from McMurdo sea ice were collected this season for these measurements with the intention of publishing the results in an internationally peer-reviewed journal and presenting them at the Antarctica New Zealand conference.

c. What were the key achievements of your visit? Include any key preliminary findings that are of particular interest.

- **Automatic weather station set-up, maintenance, and data retrieval:**
  Weather station data were downloaded and the instruments were serviced
- **Submergence Velocity Measurements at Victoria Lower and Evans Piedmont Glacier**
  High resolution GPS measurements were conducted and the devices were serviced
- **Snow sampling for aeolian material**
  An excellent spatial coverage of 55 snow samples were collected along three transects on the McMurdo sea ice (Figure 3). Sampling was carried out using ultra clean methodology to prevent contamination from personnel, sampling equipment and sample bottles. Two samples at each site were collected and duplicates of these taken at every second site to evaluate local and regional scale variability. First, snow samples from the snow surface to a depth of 2 cm above the sea ice (to prevent sampling saline snow), for elemental concentration and bio-availability measurements of dust were collected in pre-acid washed Nalgene polypropylene 500 ml or 1000 ml bottles. Second, larger volume samples of the full snow depth were collected for dust concentration and grain size measurements.

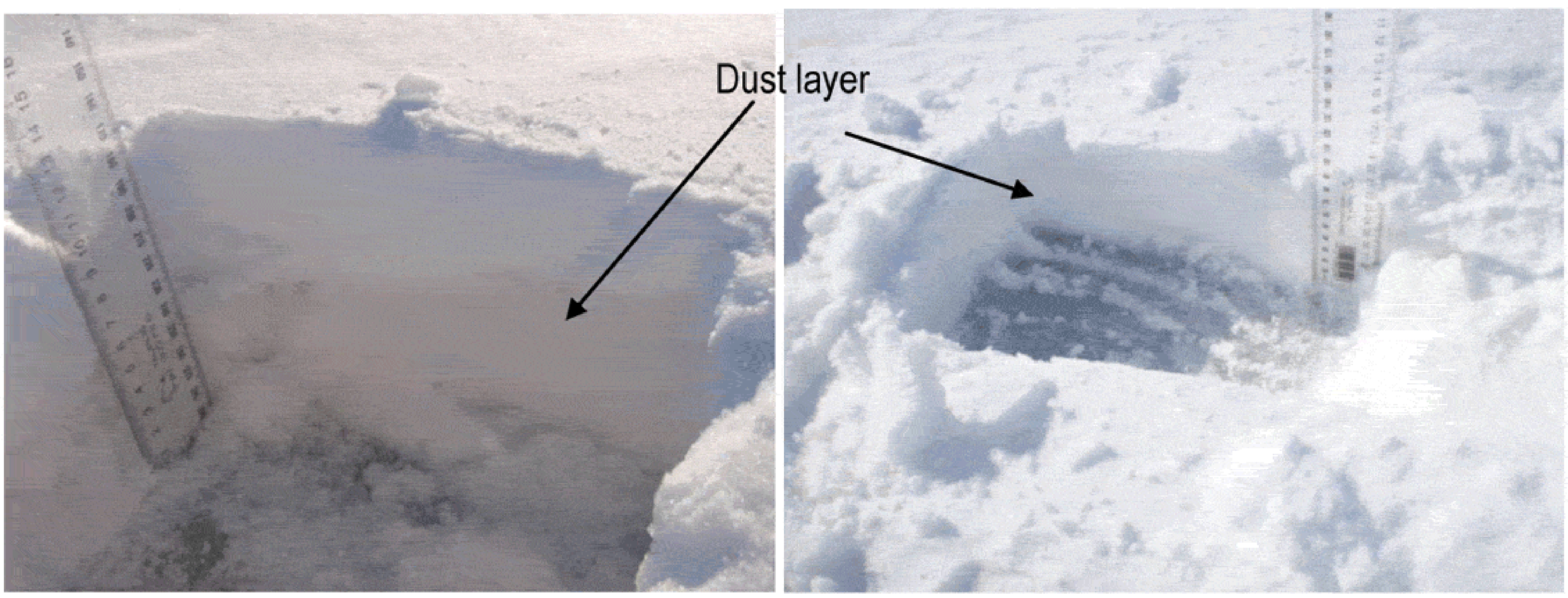

Figure 4: Dust layers in snow. A) First year ice downwind of Black Island, B) First year ice downwind of Black Island.

2. Collaboration

Indicate any international collaborators who were part of your event. Include information about the organisation where the collaborator works and their position. If the collaborator is supported by an international grant or their host organisation please outline the details of this.

N.A. – Postponed to 2010/11

3. Publications

As part of the measurement of research outputs that we are now undertaking, it is important that all your publications for the past year are included as these will be used for searching the Web of Science for citation data. Note that reprints of any publications resulting from work supported by Antarctica New Zealand are to be forwarded to the Science Advisor at Antarctica New Zealand. These are kept in a reprint collection for reference, recorded in our bibliography (available on the web), and titles are submitted to the Cold Regions Bibliography Project **(www.coldregions.org/)**.

a. Publications since your last Antarctic season

Dunbar, G.B.; Bertler, N.A.N.; McKay, R.M. 2009 Sediment flux through the McMurdo Ice Shelf in Windless Bight, Antarctica. Global and planetary change, 69(3): 87-93; doi:10.1016/j.gloplacha.2009.05.007

Mayewski, P.A.; Meredith, M.P.; Summerhayes, C.P.; Turner, J.; Worby, A.; Barrett, P.J.; Casassa, G.; Bertler, N.A.N.; Bracegirdle, T.; Naveira Garabato, A.C.; Bromwich, D.; Campbell, H.; Hamilton, G.S.; Lyons, W.B.; Maasch, K.A.; Aoki, S.; Xiao, C.; van Ommen, T. 2009 State of the Antarctic and Southern Ocean climate system. Reviews of geophysics, 47(1): RG1003, doi:10.1029/2007RG000231

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b. Conference presentations since your last Antarctic season (oral or poster)

Bertler, N.A.N. 2009. The Roosevelt Island Project. WAIS Ice Core Meeting, 1st to 3rd October, La Jolla, San Diego USA

Bertler, N.A.N. 2009. Chemistry Past and Future Climate Variability in the Ross Sea Region. Annual Antarctic Conference: Sustaining the gains of the international polar year. Auckland University, Auckland New Zealand, 1-3rd July, 2009.

Bertler, N.A.N. 2009. Past Climates Symposium Lecture: Climate drivers & Ice cores. Past Climate Symposium and Australasian INTIMATE workshop. Te-Papa, Wellington, New Zealand, 15-17th May, 2009.

Bertler, N.A.N. 2009. Antarctic Climate Change. Climate of the Past – Transfer of Science to Policy, 30th January 2009, Victoria University

Bertler, N.A.N. 2009. Past and Future Climate Variability in the Ross Sea Region. Ice Core Symposium, 8th October, GNS Science, National Isotope Centre, Lower Hutt

Bull, J.R., Bertler, N.A.N., Baker, J.A., 2009. Chemistry of modern Antarctic snow: A potential ENSO indicator. Antarctica New Zealand. Annual conference: Sustaining the gains of the international polar year. Auckland University, Auckland New Zealand, 1-3rd July, 2009.

Bull, J.R., Bertler, N.A.N., Baker, J.A., 2009. Chemistry of modern Antarctic snow: A potential ENSO indicator. GNS Science, New Zealand. Past Climate Symposium and Australasian INTIMATE workshop. Te-Papa, Wellington, New Zealand, 15-17th May, 2009.

Bull, J.R., Bertler, N.A.N., Baker, J.A., 2008. Climatic controls of trace element chemistry at a coastal Antarctic site; Evans Piedmont Glacier. Joint Antarctic Research Institute (JARI). Ice core research workshop. GNS Science, Wellington, New Zealand, 15th December, 2009.

Bull, J.R., Bertler, N.A.N., Baker, J.A., 2008. Chemistry of modern Antarctic snow: A paleoenvironmental calibration for ice cores. Geological Society of New Zealand, New Zealand Geophysical Society and New Zealand Geochemical & Mineralogical Society Joint Annual Conference. Te-Papa, Wellington, New Zealand, 23-26 November, 2008. Geological Society of New Zealand Miscellaneous Publication 124A.

Rhodes, R.H., Bertler, N.A.N., Baker, J.A., Sneed, S.B., 2008. An ice core indicator of Ross Ice Shelf stability? Joint Antarctic Research Instiute Ice Core Symposium. National Isotope Centre, GNS Science, Lower Hutt, New Zealand, 5th December, 2008.

Rhodes, R.H., Bertler, N.A.N., Baker, J.A., Sneed, S.B., 2008. An ice core indicator of Ross Ice Shelf stability? Geological Society of New Zealand, New Zealand Geophysical Society and New Zealand Geochemical & Mineralogical Society Joint Annual Conference. Te-Papa, Wellington, New Zealand, 23-26 November, 2008. Geological Society of New Zealand Miscellaneous Publication 124A.

Rhodes, R.H., Bertler, N.A.N., Baker, J.A., Sneed, S.B., 2008. An ice core indicator of Ross Ice Shelf Stability? Royal Society Beanland-Thornley Student Talks Competition. Wellington, New Zealand, 4th September 2008.

Rhodes, R.H., Bertler, N.A.N., Baker, J.A., Sneed, S.B., 2008. High resolution climate reconstruction utilizing trace element geochemistry and stable isotopes from Mt. Erebus Saddle. SCAR/IASC IPY Open Science Conference, Polar Research – Arctic and Antarctic Perspectives in the International Polar Year. St. Petersburg, Russia, 8-11th July 2008.

Rhodes, R., Bertler, N.A.N., Baker, J., and Sneed, S. B., 2008. Effects of Large Icebergs on Sea Ice and Primary Productivity in the Ross. Annual Antarctic Conference - International Polar Year and the Next Generation. Dunedin, New Zealand.

c. Planned publications

Bull, J., Bertler, N., Baker, J. (in prep.): A paleo-wind indicator from the Southern Victoria Land coast, Antarctica using major and trace element chemistry of snow pack.

Sinclair, K., Bertler, N. (in prep.): The importance of air-mass trajectory for moisture delivery to two ice core sites in the Ross Sea region, Antarctica.

d. Other outputs (MSc or PhD theses)

Bull, J.R. 2009: Stable isotope, major and trace element chemistry of modern snow from Evans Piedmont Glacier, Antarctica: insights into potential source regions and relationship of glaciochemistry to atmospheric circulation and vigour. M.Sc., Victoria University of Wellington.

Schuck, I. 2009: Mineralogical characterisation and geographic province of atmospheric particles in coastal Antarctic ice cores – indicator of past climate variability. M.Sc., University of Karlsruhe, Germany, University of Wellington, New Zealand, and GNS Science, New Zealand

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