



Antarctic Climate & Ecosystems Cooperative Research Centre

Annual Report 2003 — 2004



Established under the Australian Government's
Cooperative Research Centres Programme.

2004



Vision

The ACE CRC will serve as the keystone of the national effort to deliver environmental, economic and social value from Australian engagement in the Southern Ocean and Antarctic region. The ACE CRC will:

- Advance Australia's aspirations for its Antarctic territory and Southern Ocean exclusive economic zones
- Increase international engagement in Southern Ocean and Antarctic research relevant to Australia's interests
- Deliver strategic science for climate adaptation, ecosystem management, carbon budgeting, and marine and ice operations
- Deliver the knowledge and information needed by our diverse research users and ensure that policy and commercial opportunities are realised
- Produce expertly-trained scientists with international experience, skills in research, its broad application, and its role in enterprise

Mission

ACE CRC research will:

- Provide a factual base for the sustainable management of Antarctic and Southern Ocean fisheries and ecosystems in line with Australia's obligations under the Convention on the Conservation of Antarctic Marine Living Resources
- Provide estimates of the ability of the Southern Ocean to act as a carbon sink, including the efficacy and risks of iron fertilization to enhance CO₂ uptake, thereby increasing Australia's influence in international climate negotiations
- Deliver systems for operational prediction of Southern Ocean currents and sea-ice conditions for use in Antarctic operations, ranging from shipping to fisheries management to tourism
- Contribute key observations and insights on the role of the Southern Ocean and Antarctica in climate in order to produce more reliable projections of variability and change, allowing Australia to benefit from opportunities and minimise risks
- Increase the reliability of projections of sea level rise for Australia and neighbouring nations for use in coastal zone management and other risk assessments

Antarctic Climate & Ecosystems

Cooperative Research Centre

Annual Report 2003-2004

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Highlights

- The ACE CRC was launched by Minister for Science, the Hon Peter McGauran, on July 31, 2004.
- The ACE CRC worked with the Tasmanian Department of Primary Industry, Water and Environment to assist with the preparation of an Information Paper on sea level rise that has been distributed by the Minister to all coastal local councils. This paper is available from www.dpiwe.tas.gov.au.
- Researchers in the Sea Level Rise program completed a revised estimate of global averaged sea level rise over the period 1950 to 2000. They found the sea level rise to be 1.8 millimetres per year. They also produced the first observational estimate of the regional distribution of sea level rise.
- ACE CRC researchers estimated sea level rise around Australia for the period 1920 to 2000 and showed that the extreme events of a given level occurred two to three times more frequently at Fremantle and Sydney in the latter half of the 20th century compared with the first half of the 20th century.
- Scientists at ACE CRC found that at the Totten Glacier in East Antarctica, the ice surface has lowered by around 10 m over 16 years (equivalent to a sea level rise of 0.02 mm/yr).
- Field surveys of a glacier on Heard Island conducted by the ACE CRC show that glacier retreat on the island has greatly increased over the last three years.
- Chemical analysis of the Law Dome ice core has shown that the sea ice edge has retreated by 20 per cent since 1950, after having remained steady for the previous century.
- Ship-based and moored observations provided the first direct measurements of the production of Antarctic Bottom Water in the Mertz polynya, confirming the region as a significant source of dense, oxygen-rich water to the deep sea.
- Researchers have identified the impediments and opportunities related to marine bio-prospecting in Southern Oceans south of 60 ° South.
- A new project in the ACE CRC Policy program has begun to identify stresses and gaps in current arrangements for the management of Antarctic adventure tourism.
- Researchers have analysed the legal regime of 'hot pursuit' and identification of challenges in high seas and deep seas fisheries enforcement.
- The ACE CRC Postgraduate Program has 61 students enrolled during 2003-04, with nine completing all requirements for graduation and a further five students having submitted their theses.
- In the first year of the ACE CRC, researchers produced 65 referred papers, 44 conference papers and 31 other publications.
- ACE CRC staff and students conducted 61 media interviews, participated in 75 meetings, were involved in 15 national and 46 international collaborative projects, sat on eight national and 19 international committees and were awarded 37 external grants worth a total of \$5.9m.

Chairman's Report

Welcome to the first Annual Report for the Cooperative Research Centre for Antarctic Climate and Ecosystems, the ACE CRC.

The ACE CRC was funded to build upon the acclaimed work of the former Cooperative Research Centre for Antarctica and the Southern Ocean. The various incarnations of Antarctic Cooperative Research Centres have always been heralded as shining examples of the value of so-called "public good" CRCs, in terms of delivering value to the taxpayer for the research investment. Given the changed paradigm of the CRC program into an industry support mechanism, it was fortunate that our funding renewal was successful before the shutters came down on public-good CRCs.

What do CRCs such as ACE deliver to the taxpayer that makes them so valuable? ACE carries out research into the climate and ecosystems of the Southern Ocean and Antarctica, specifically accounting for their important roles in global climate and the impacts of changes in climate on the special ecosystems of Antarctica and the Southern Ocean. The recognition of the broader value of this research is demonstrated by the support and participation of non-Antarctic organisations such as the Australian Greenhouse Office, the Australian Bureau of Meteorology, and the Department of Agriculture Fisheries and Forestry.

The research carried out by the ACE CRC will lead to an increased capacity to predict changes in climate and sea level in our region and to incorporate this knowledge into the national effort to develop sustainable management of our environmental economic and social resources. For example, improved weather and sea-ice forecasting will assist Southern Ocean shipping, including fishing vessels. Better predictions of the changes in sea level that are now considered inevitable will allow Commonwealth, State and Local governments to better plan for coastal urban developments that will have to cope with increased

sea levels. Industries will have the information necessary to plan their activities strategically in full knowledge of the likely consequences of elevated sea levels and more severe storm events. Improved understanding of climate change will allow Australia to better manage our agriculture resources, as well as having significant global value. The ACE CRC Antarctic Marine Ecosystem program will lead to a better understanding of the management of the Southern Ocean ecosystems and significantly aid Australia's role in the international arrangements for managing Antarctica. The Policy program will ensure that the outputs from our research are delivered in a form that is accessible and useful to Australia's government departments and policy makers.

The impact that ACE research will have on Australia's ability to manage its resources and cope with the ongoing reality of climate change underscores the value that such cooperative research in the public arena can deliver to the Australian taxpayer. It is appropriate that the Australian Government, on behalf of all Australians, should be the major client of such CRCs.

The Board of ACE was delighted to appoint Professor Bruce Mapstone to be CEO of the new Centre. Bruce has made the transition from the warm waters of the Reef CRC to the cooler southern climes and he is leading an extremely able team.

I am looking forward to an exciting year, building on this solid start.



Dr Katherine Woodthorpe
Chair, ACE CRC

CEO's Report

The ACE CRC is a 'new from existing' 3rd stage CRC which builds on the outstanding work of two previous CRCs with an Antarctic focus, dating back to 1991. The ACE CRC focuses on the roles of the Antarctic and Southern Ocean processes in global climate and on the likely responses of Antarctica, the Southern Ocean and Antarctic marine ecosystems to the seemingly inevitable changes in climate. Our programs, which clearly signal the directions of our research, are:

- Climate Variability and Change
- Ocean Control of Carbon Dioxide
- Sea Level Rise
- Antarctic Marine Ecosystems
- Southern Ocean and Antarctic related Policy

The objectives, work and highlights for each of these programs are spelled out elsewhere in this report and I won't repeat them here.

Despite our name, however, the issues we are addressing in the ACE CRC are not simply issues for Antarctica. Australia has a high profile in Antarctica and Southern Ocean affairs, promulgated largely (though not exclusively) through our engagement with international research. Over the last 10 years or so, however, we have learned that the importance of Antarctica and the Southern Ocean to Australia is not only iconic, strategic and diplomatic, but that the region has enormous influence over Australia's future.

We now understand that events in the Southern Ocean and in the atmosphere over Antarctica and the Southern Ocean have profound influence over global climate and, in particular, climate over Southern Australia. Variations in the circum-polar weather patterns to Australia's south are likely to be among the primary drivers of rainfall, storm events and temperature over the southern third of the Australian mainland.

The ACE CRC will play a major role in understanding exactly how these influences will respond to and, in turn influence, climate change over coming decades. Through close collaborations with our partners, we will bring together understanding of these Southern Ocean processes and work being done on the influences of warm temperate and tropical processes on Australia's climate to provide, collectively, improved predictions of Australia's climate and weather futures.

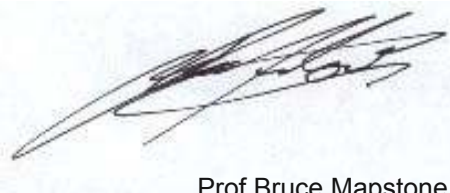
The first year of any CRC, whether 'new' or 'new from existing', is a busy and sometimes challenging period. In the case of the ACE CRC, 2003-04 has been a mixture of continuing to build on previous work, coming to grips with the inevitable changes involved in moving into a 3rd stage CRC and responding to the heightened expectations for commercialisation and use of research outputs of what is essentially a

'public good' or 'national benefit' partnership. More than ever, we all now recognise that doing great science is a necessary but not sufficient justification for a CRC and we are developing the tools and approaches necessary to ensure the application of our science.

Much of the research we do is of necessity in the public domain, both because of our mandate and because of the provisions of the Antarctic Treaty, and so unlikely to be commercialisable in a market or industry sense. On the other hand, the fact that we work in extremely harsh, remote places requires that our scientists and technicians are innovative in developing technologies that work in those difficult conditions. Some of these technological innovations do have commercial potential in international market places and we now have on board a commercial development manager to develop processes and partnerships with relevant industry sectors to make the most of that potential.

Under the terms of our grant, we also recognise that our key clients are government departments, on behalf of the Australian people and the plethora of large and small industries and family businesses that are faced with responding to fundamental changes in our climate. One of the initiatives we have taken to engage with our government clients is to convene annually a policy research users' forum where we discuss with those clients what we are doing and, more importantly, what issues they face for which we can provide information and the most effective mechanisms for doing so.

There is now no doubt that the Antarctic and Southern Ocean is important to Australia and internationally for diverse reasons beyond the iconic nature of the environment. Much work remains, however, to resolve the details of just how the mammoth processes of the Southern Ocean and icy Antarctic margins interact with the oceanic and atmospheric processes closer to home to determine our climate and changes in climate globally. Over the next five years, the ACE CRC will play a key role in providing those details.



Prof Bruce Mapstone
CEO, ACE CRC

Structure & Management



Structure and Management

The ACE CRC was successful in its bid as a new from existing CRC in the 2002 round of CRC funding, its predecessor being the Antarctic and Southern Ocean CRC. The ACE CRC began its seven-year life on 1 July 2003 and is an unincorporated joint venture.

Core Partners

Australian Antarctic Division (AAD)
Australian Bureau of Meteorology (BoM)
CSIRO Division of Atmospheric Research (CAR)
CSIRO Division of Marine Research (CMR)
University of Tasmania (UTas)

Supporting Partners

Alfred Wegener Institut (AWI, Germany)
Australian Greenhouse Office (AGO)
The Australian National University (ANU)
National Institute of Water Research (NIWA, New Zealand)
Silicon Graphics Inc (SGI)
Tasmanian Department of Economic Development (TDED)

The University of Tasmania has been appointed as the ACE CRC agent, and contributes services for finance, human resources and asset management.

Governing Board

The ACE CRC Governing Board has an independent Chair and members from the partners and key research users. The Australian Antarctic Division holds an additional *ex-officio* seat in recognition

of the magnitude of its contributions. The Board meets quarterly and we would like to acknowledge the efforts of the members in attending the meetings held prior to the official start-up of the ACE CRC.

Preliminary Meetings prior to 1 July 2003

23 December 2002
21 January 2003
24 March 2003
20 May 2003

Meetings 2003 / 2004

31 July 2003
8 October 2003
18 December 2003
10 March 2004

Management Committees

The Governing Board has approved the following management committees.

Executive Committee

The ACE CRC Executive Committee has been created to support implementation of the ACE CRC through the provision of leadership and advice on a wide range of matters relating to the management of resources, including human resources, and coordination of research across the ACE CRC portfolio. The ACE CRC Executive Committee will advise the CEO and Board of the ACE CRC. It comprises all Program Leaders and ACE administration, together with representatives

The Governing Board

Member	Organisation	Position
Dr Katherine Woodthorpe Chair	People & Innovation Corporate Advisers Pty Ltd	Director
Dr Tony Press	AAD	Director
Prof Andrew Glenn	UTas	Pro Vice-Chancellor (Research)
Dr Bill Downey	BoM	Deputy Director Corporate Activities
Dr Tony Haymet	CMR	Chief
Mr Greg Johannes	TDED	Deputy Secretary
Mr Bill Trestrail	SGI	Managing Director Australia and New Zealand
Mr Howard Bamsey	AGO	Chief Executive Officer
Prof Michael Stoddart <i>ex-officio</i>	AAD	Chief Scientist
Prof Bruce Mapstone <i>ex-officio</i>	ACE CRC	Chief Executive Officer

Structure and Management

from TPAC and the research student body. An Australian Bureau of Meteorology participant will be joining the Executive Committee in 2004-2005.

Meetings 2003/2004

19 November 2003
5 December 2003
6 February 2004
6 May 2004

Executive Committee

Member	ACE CRC Position
Prof Bruce Mapstone, Chair, ACE CRC	Chief Executive Officer
Dr Ian Allison, AAD	SLR Program Deputy Leader
Dr John Church, CMR	SLR Program Leader
Dr Marcus Haward, UTas	Policy Program Leader
Ms Christie le Goy, TDED	Manager - Commercial Development
A/Prof Andrew McMinn, UTAS	Education Program Leader
Dr Kelvin Michael, UTAS	Education Program Deputy Leader
Ms Katrina Nitschke, ACE CRC	Communications Manager
Dr Stephen Nicol, AAD	AME Program Leader
Mr David Pointing, UTAS	PhD student
Ms Vicki Randell, ACE CRC	Business Manager
Dr Stephen Rintoul, CMR	CVC Program Leader
Dr Jason Roberts, TPAC	Chair Computing Committee
A/Prof Thomas Trull, UTAS/CSIRO	CO2 Program Leader/ Deputy CEO
Ms Kerrie Bidwell, Secretary, ACE CRC	Administration Manager

Computing Committee

The ACE CRC Computing Committee has been created to support the science, education and policy programs of the ACE CRC through advice on Information Technology infrastructure and management. This support is focussed primarily on those components of the ACE CRC based on the University of Tasmania's Hobart Campus. The ACE CRC Computing Committee will advise the ACE Executive Committee and CEO.

Meetings 2003/2004

26 March 2004

Computing Committee

Member	ACE CRC Position
Dr Jason Roberts, Chair, TPAC	Chair Computing Committee
Professor Bruce Mapstone, ACE CRC	Chief Executive Officer
Dr Kelvin Michael, UTas	Deputy Leader Education Program
Ms Vicki Randell, ACE CRC	Business Manager
Mr Glenn Hyland, AAD	Researcher
Mr Rick Smith, ACE CRC	Researcher
Dr Richard Matear, CMR	Researcher
Dr Roland Warner, AAD	Researcher
Mr Steven Phipps, Utas	PhD student
Mr Ben Joseph, ACE CRC	Computer Support Officer
Mr Michael Sumner, UTas	PhD student
Ms Kerrie Bidwell, Secretary, ACE CRC	Administration Manager

Commercialisation Steering Committee

The ACE CRC Commercialisation Steering Committee has been created to support implementation of the ACE CRC through the provision of advice on commercialisation opportunities arising from ACE CRC activities. The ACE CRC Commercialisation Steering Committee will advise the CEO, Executive Committee and Board of the ACE CRC.

The committee will first meet formally in 2004-05.

Structure and Management

Communications Advisory Committee

The ACE CRC Communication Advisory Committee has been created to support implementation of the ACE CRC through the coordination of public communication and reporting strategies by the ACE CRC and its partner organisations to maximise awareness of the ACE CRC and its contributions to Australian and international science and policy. The ACE

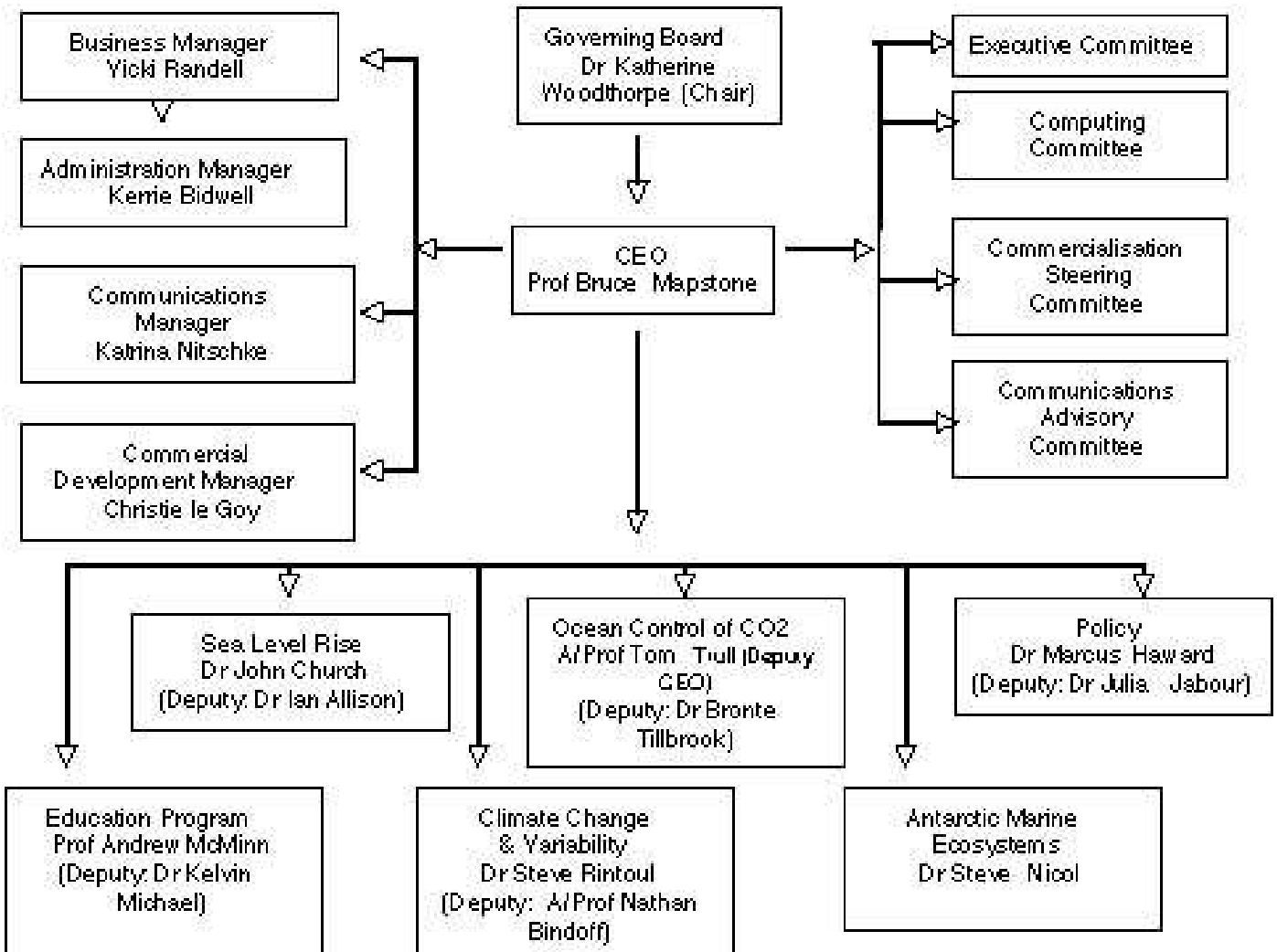
CRC Communication Advisory Committee will advise the CEO, Executive Committee and Board of the ACE CRC.

An informal gathering of Partner communication practitioners was held in June 2004 to discuss amongst other things, membership, terms of reference and the meeting schedule of this committee.

Commercialisation Committee

Person	Position
Professor Bruce Mapstone, ACE CRC	Chief Executive Officer
Mr Rod Allen, AAD	General Manager, Corporate
Mr Don Gunasekera, BoM Dr Steve Pendlebury (alternate)	National Manager, Special Services Unit Regional Director, Tasmania
Ms Jackie Zanetti, CMR	Business Development Manager
Ms Christie Le Goy, TDED	ACE CRC Commercial Development Manager
Ms Wendy Spencer, TDED	Director-Innovation, Science and Technology Unit
To be announced	UTas

Organisational Structure



Commercialisation



Commercialisation

The research programs in the Antarctic Climate & Ecosystems CRC have been strongly associated with those CRC objectives focussed upon high quality research and teaching, cooperative endeavour, and the transfer of research outcomes into predominantly non-commercial outcomes of economic, environmental and social benefit to Australia.

The intended research users of the ACE CRC are:

- Government agencies utilising the ACE CRC research to support wise stewardship of its Antarctic territory, thereby supporting Australia's aspirations in this region
- Operational agencies utilising new approaches to forecasting ice and ocean conditions
- Management agencies utilising research to support assessment of sustainable ecosystem management, development of carbon management plans, assessment of climate variability and change
- The international scientific community
- Economic users referencing information to support planning.

Activities focussing on strategies for utilisation and transfer to these users will increase in importance as the research program progresses.

The program commenced in the third quarter with the three-year appointment of the Commercial Development Manager, Ms Christie le Goy, part of the in-kind contribution from the Tasmanian Government.

It is worth noting that the previous Antarctic CRC did not have an equivalent position and a large effort has been made to increase the awareness of the commercialisation aspects and obligations of being part of the CRC Programme amongst all ACE CRC staff and students.

One of these CRC Programme obligations is the development of a Commercialisation Plan for the ACE CRC, to be submitted by the end of Year Two to the CRC Programme. Drafting of this plan has begun and it is on track for delivery as required.

Efforts have also been directed towards formalising various 'housekeeping arrangements' such as documentation and policies with respect to Intellectual Property matters, confidentiality agreements, visitor arrangements and student agreements.

In the current foundation phase of the Commercialisation program, the ACE CRC is facing the challenge in seeking *commercial* outcomes for its research, while continuing to deliver on our traditional strengths of scientific excellence and influence.

Potential commercial outcomes for the research may be found within those industry sectors that utilise technology developed for cold climate research, or that could face physical, regulatory or competitive risks if under-prepared to anticipate and adapt to the impacts of climate change using the best available information tuned to Australian conditions.

The ACE CRC aims to build its capability to make and deliver on commitments to potential industry partners through:

- Systematic management of its potential commercially valuable intellectual property
- Building awareness of and specific relationships with targeted industry sectors and
- Building linkages to local SMEs with the potential to partner in fields relevant to cold climate or marine technologies.

Commercialisation

Strategy	Achievements 2003-2004	Plans 2004-2005
<ul style="list-style-type: none"> Systematic management of potential commercially valuable intellectual property 	<ul style="list-style-type: none"> Delivered first commercialisation workshop to senior research staff in May Created IP Register framework Developed Visitor and Participant confidentiality deeds Developed Student Assignment of IP deed Established Commercialisation Steering Committee, invited partner nominations Planned series of seminars on commercially related topics for students 	<ul style="list-style-type: none"> Implement student assignment deeds for incoming PhD students Commission IP opportunity audit Deliver further commercialisation workshops to staff and students Implement IP register for each project Implement project level management of utilisation and technology transfer objectives Develop local Tasmanian interest group of managers involved with commercialisation
<ul style="list-style-type: none"> Building awareness of and specific relationships with targeted industry sectors 	<ul style="list-style-type: none"> Identified target industries Formed initial contacts within commercial, government and professional organisations Contributed to the economic study of Australian Antarctic programme commissioned by the Australian Antarctic Division 	<ul style="list-style-type: none"> Preliminary gap analysis between industry requirements and ACE research programs
<ul style="list-style-type: none"> Build links to local SMEs with interests in fields relevant to cold climate, remote or marine technologies 	<ul style="list-style-type: none"> Supported local relevant SME clusters: the Tasmanian Polar Network and the Marine ICT Cooperative 	<ul style="list-style-type: none"> Plans are contingent upon outcome of IP opportunity audit

Commercialisation

Research Users	Basis for Interaction	Description	Principal Researchers
Clarence City Council Land and Coast Care	Grant collaboration	Shoreline Movement Study	John Hunter
Sorrell City Council	Grant collaboration	Shoreline Movement Study	John Hunter
Tasmanian Department of Primary Industry Water and Environment	Grant collaboration	Participation in Sea Level Rise Reference Group	John Hunter, John Church, Richard Coleman
University of Maine – Climate Change Institute	Collaboration	Ice core sampling	Vin Morgan
Belgian Federal Office for Scientific, Technical and Cultural Affairs	Collaboration	Maintain sediment trap mooring programme	Tom Trull
US National Science Foundation/WHOI	Collaboration	Vertigo	Tom Trull
Australian Bureau of Meteorology	Core Participant	Climate change predictions and analysis; climate models	Most project staff
Australian Greenhouse Office	Supporting Participant	Climate models, climate change predictions and analysis	Most project staff
Silicon Graphics, Inc	Supporting Participant	Advanced computing services, climate models	Nathan Bindoff, Jason Roberts, Petra Heil, Roland Warner
Tasmanian Department of Economic Development	Supporting Participant	Access to potential commercial innovations, contact with advanced technology development	Christie le Goy, Bruce Mapstone
Intergovernmental Panel on Climate Change	Research user	Climate models, climate predictions, climate change impact analysis	John Church, Ian Allison, Steve Rintoul, Nathan Bindoff

Research



Research: Sea Level Rise

Program Leader

Dr John Church, CSIRO Marine Research

Program Aims

- **To narrow estimates of the range of 20th century global-averaged and regional sea level rise.** The current wide range of estimates of 20th century sea level rise limit our ability to critically test models and to develop adaptive strategies.
- **To improve estimates of the different contributions to 20th century sea level rise.** Correctly simulating 20th century contributions to sea level rise and its regional distribution will reduce uncertainties of future projections.
- **To significantly reduce the range of 21st century projections of sea level rise.** Global average and regional sea level rise projections are essential in addressing anthropogenic climate change and its societal impact.
- **To forecast change in extreme events during the 21st century for strategic locations.** Sea level rise will impact most importantly through an increase in frequency and intensity of extreme events such as storm surges.
- **To address key uncertainties in the longer-term projections of sea level rise.** Sea level will continue to rise after 2100 but the rate and amount of rise are highly uncertain (but may be several metres).

Program Background

The Intergovernmental Panel on Climate Change (IPCC) projections for the period 1990 to 2100 are of a sea level rise of between 9 and 88 cm and an increase in the frequency of extreme events. Sea-level rise at the mid to upper end of these projections, particularly when combined with continued coastal development, is likely to have severe impacts on hundreds of millions of people. Increases in the frequency and severity of extreme flooding events will put billions of dollars of coastal development at risk. The impacts of sea level rise are local and may vary over the globe by as much, or more, than the range of mean global estimates of sea level rise because of the complex ways in which the additional water is distributed in the ocean. In order for Australia to prepare effectively for sea level rise, the range of global sea level predictions needs to be narrowed, extended to predict regional

variations, and accompanied by estimates of associated probabilities, particularly changes in the frequency and intensity of extreme events.

Sea level rise depends on many factors, including ocean thermal expansion, changes in polar ice sheets, glacial and terrestrial run-off, ocean circulation and land elevation. The ACE CRC, including the collaborative arrangements with the ANU and the AWI, will be one of the few institutes in the world with the breadth of capability, and the commitment, to address most aspects of sea level change and significantly reduce uncertainties surrounding future projections and their impacts in Australia and the South Pacific.

A combination of higher sea level and windier conditions will cause more frequent extreme storm surges. Estimates developed for some cities show that the extreme surges that occur only every 50 years or so at present are expected to occur every few years by 2100. The overall goal of the ACE CRC Sea Level Rise Program will be to narrow uncertainty in projections of global and regional sea level change, including changing frequency of extreme events for selected cities and populated regions of the Australian coastline and Australia's neighbours in the South Pacific.

Program Achievements

- Nathan Bindoff and Ian Allison have been selected as convening lead author and lead author on chapters in the IPCC 4th Assessment report (due for release in 2007).
- John Church has been elected to the Vice Chair of the Joint Scientific Committee of the World Climate Research Programme.
- Ian Allison is Co-vice Chair of the Climate and Cryosphere Project.
- Engaged with Tasmanian DPIWE and assisted with the preparation of an Information Paper on sea level rise that has been distributed by the Minister to all coastal local councils.

Project Reports

Observations of Sea Level Rise

Project Leader

John Church

Project Staff

Neil White, John Hunter, Richard Coleman, Kurt

Research: Sea Level Rise

Lambeck

Students

Chris Watson, Gisela Estermann, Richard Stanaway

Project Aim

The project will produce new estimates of historical sea level change.

Project Achievements

- Measured a significant bias in the Jason satellite altimeter and confirmed the importance of geographically correlated orbit error.
- Completed a revised estimated of global averaged sea level rise (1.8 mm/yr) over the period 1950 to 2000 and the first observational estimate of the regional distribution of sea level rise.
- Estimated sea level rise around Australia for the period 1920 to 2000. Showed that extreme events of a given level at Fremantle and Sydney occurred two to three times more frequently in the latter half of the 20th century compared with the first half of the 20th century.

Estimates of Ocean Thermal Expansion

Project Leader

John Church

Project Staff

Neil White, Siobhan O'Farrell, Nathan Bindoff, Jens Schroeter

Project Aim

This project will provide increased confidence in our understanding of 20th century sea level rise by providing more accurate estimates of observed 20th century thermal expansion and the confirmation that climate models are realistically simulating the observations.

Project Achievements

- Completed estimates of ocean thermal expansion using the CSIRO Mark 3 model for representative greenhouse gas scenarios and submitted the results to the IPCC Data Distribution Centre.

Ice Sheet and Glacier Contributions

Project Leader

Ian Allison

Project Staff

Neal Young, Roland Warner, John Hunter, Neil Adams, Siobhan O'Farrell, Mike Craven, Doug Thost

Students

John Court, Shavawn O'Donoghue, Adam

Treverrow, Heidi Leffanue

Project Aim

The project will deliver more robust estimates of 20th and 21st century accumulation of snow and ice on the Antarctic and Greenland continents. It will also deliver estimates of longer-term contributions to sea level changes from the Greenland and Antarctic Ice Sheets and from glacier melting.

Project Achievements

- The first direct observation of negative mass balance (net loss of ice) in East Antarctica has been found for the Totten Glacier (67 S, 115 E) where the ice surface has lowered by around 10 m over 16 years (equivalent to a sea level rise of 0.02 mm/yr).
- New ice thickness measurements along the coastal ice sheet between Dumont d'Urville and Davis stations, made in conjunction with the Italian Antarctic program, will allow estimation of the ice discharge to the sea across this sector.
- Measurements in a new borehole through the Amery Ice Shelf (70 S, 70 E) have provided data on the structure and properties of the 200 m layer at marine ice on the bottom of the Amery Ice Shelf.
- A palaeo accumulation record, that allows past mass input to the coastal ice sheet to be estimated, has been derived from ice core data from Law Dome.
- Field surveys of a glacier on Heard Island show that glacier retreat on the island has greatly increased over the last three years.
- Early results from modelling the circulation and melt/freeze rate under the Amery Ice Shelf were published in the Forum for Research into Ice Shelf Processes (FRISP) Report 15: 2004.
- The first results of the Ice Shelf-Ocean Model Intercomparison Project (including the ACE CRC model) were presented at the AGU meeting in San Francisco in December, 2003.

Modelling Extreme Events

Project Leader

Kathleen McInnes

Project Aim

This project will enable the simulation of extreme events for key locations around Australia.

Project Achievements

- Analysis of extreme winds and their changes via CSIRO Climate Models have enabled projections of how the drivers of storm surge in the mid-latitudes will be affected.
- Refined analysis techniques of storm tide simulations to present return periods as spatial maps.

Research: Sea Level Rise

Program Achievements Against Milestones

Outcome: Estimates of sea level change resulting from anthropogenic climate change used as one of the bases for intergovernmental climate change negotiations.

Milestone	Date	Achievements
Revised estimates of historical (20 th century and early 21 st century) sea level change.	2004, 2009	Revised estimates of sea level rise for the period 1950 to 2000 have been published.
Revised estimates of ocean thermal expansion from observations and models (both the CSIRO and AWI models).	2005, 2009	Revised estimates of ocean thermal expansion using the CSIRO Mark 3 model for representative greenhouse gas scenarios and submitted the results to the IPCC Data Distribution Centre.
Revised estimate of the 20 th century Antarctic ice sheet contribution to sea level change derived from a comparison of measured ice discharge (field observations and remote sensing) with results from a balance flux model forced with improved estimates of accumulation distribution and temporal variability (from field observations, meteorological models and ice cores).	2005, 2009	
Revised estimates of future ocean thermal expansion.	2005, 2009	Revised estimates of ocean thermal expansion using the CSIRO Mark 3 model for representative greenhouse gas scenarios and submitted the results to the IPCC Data Distribution Centre.
Estimate of the future contribution of the Antarctic and Greenland ice sheets to sea level change using an improved high-resolution ice sheet-system model (including ice stream-ice shelf interaction, full thermodynamics and flow anisotropy) and changes in meteorological forcing.	2010	to be completed
Estimates of the response of ice shelves to global warming from improved models of ice shelf-ocean interaction (validated against field observations and remote sensing data from the Amery Ice Shelf); prediction, from improved models of ice stream-ice shelf boundaries, of the consequence of ice shelf collapse on the discharge of grounded ice.	2006, 2009	to be completed

Outcome: Estimates of sea level change as an essential input to coastal zone management and other planning considerations in Australia and in neighbouring nations in the South Pacific.

Milestone	Date	Achievements
Estimates of the historical frequency of extreme events from observational (and proxy) records.	December, 2004	Showed the frequency of extreme events of a given level at Fremantle and Sydney increased by two to three times in the latter half of the 20 th century compared with the first half of the 20 th century.
Selection of key locations for more detailed studies.	2004	The South Coast of Australia was selected as the first location for more detailed study.
Estimates of the changes in frequency of extreme events from numerical modelling studies.	2009	

Research: Climate Variability and Change

Program Leader

Dr Steve Rintoul, CSIRO Marine Research

Program Aims

- To characterise the variability of Southern Ocean currents and sea ice and understand their causes.
- To determine the likelihood and impact of significant changes in the Southern Ocean physical environment.
- To combine state-of-the-art ocean observations and numerical models to provide simulations and forecasts of ocean currents and sea ice for Southern Ocean applications.

Program Background

Variability of the physical environment of the Southern Ocean influences regional and global climate, the distribution and productivity of marine organisms, ocean uptake and storage of CO₂, and the rate and pattern of sea level rise. Knowledge of the variability of the coupled ocean-atmosphere-ice system and understanding of the physical processes driving the variability are therefore prerequisites for the other ACE CRC programs. The CVC program is using a variety of observations and output from dynamical models to characterise and understand the variability of the coupled ice – ocean – atmosphere system.

Changes in the Southern Ocean are likely to have profound impacts on climate and marine ecosystems. For example, the overturning circulation controls how much heat and carbon are stored by the ocean, provides the nutrients that fuel biological productivity, and supplies oxygen to the deep sea. Climate models suggest the overturning circulation will slow-down or collapse due to climate change. Climate models also suggest that sea ice extent will decrease by up to 50% by the end of the century. Such changes would have a dramatic impact on global climate and Antarctic marine living resources. The research of the CVC program will determine the likelihood and consequences of such changes in the Southern Ocean as a result of climate change.

The revolution in ocean observing and modelling systems means that it is now possible to deliver useful ocean forecasts for research and applications. The applications include ecosystem prediction, marine resource management, marine impact

studies, initial state estimates for climate models, public good services such as search and rescue, guidance for safe Antarctic shipping operations, and research into ocean dynamics. The CVC program is combining observations and dynamical models to provide hindcasts and forecasts to meet these needs.

Key activities in 2004-5:

- During the coming year, we will carry out a 10-week expedition with six major goals: to measure changes in ocean storage of heat, carbon and other properties along a transect from Perth to Antarctica; to measure the transport of the Antarctic Circumpolar Current and currents along the Antarctic margin; to recover a mooring array deployed across the deep boundary current adjacent to the Kerguelen Plateau; to measure the transport through the Princess Elizabeth Trough; to deploy 25 Argo profiling floats; and to obtain the first direct measurements of mixing rates in the Southern Ocean. The voyage is a collaboration with Japan and the USA.
- A new medium-depth core will be drilled near the Law Dome summit to obtain a 500 year record of past atmospheric conditions with a continuous high quality chemical signature.
- Climate change simulations will be prepared and delivered to the IPCC, the coupling of the sea ice and ocean models will be completed, and an inverse model of the Southern Ocean overturning circulation will be developed.

Program Achievements

- Chemical analysis of the Law Dome ice core has shown that the sea ice edge has retreated by 20% since 1950, after having remained steady for the previous century. Previous estimates based on the short satellite record had shown no change in Antarctic sea ice. The high accumulation rate of the Law Dome core allows past ice extent to be inferred with better than annual resolution for centuries before the satellite era.
- A major international experiment involving scientists from 15 institutions was carried out on the RSV *Aurora Australis* in September – October 2003. The purpose of the Antarctic Remote Ice Sensing Experiment (ARISE) was to validate new satellite instruments that will provide measurements of sea ice concentration, snow cover depth and ice temperature with unprecedented accuracy. These data sets will be crucial for development of the ACE CRC sea ice analysis and forecast system.

Research: Climate Variability and Change

- A synthesis of ship-based and moored observations provided the first direct measurements of the production of Antarctic Bottom Water in the Mertz polynya, confirming the region is a significant source of dense, oxygen-rich water to the deep sea. High resolution simulations of the polynya with a coupled sea ice – ocean model successfully reproduced the circulation and water mass transformation processes observed in field measurements. The model was then used to estimate how bottom water production varies from year-to-year.

Project Reports

Variability of Southern Ocean Circulation and Air-Sea Interaction

Project Leader

Steve Rintoul, CSIRO Marine Research

Project Staff

Serguei Sokolov, John Church, Rick Smith, Nathan Bindoff, Clodagh Moy, Mark Rosenberg, Diana Greenslade, Jeff Kepert, Eberhard Fahrbach, Mike Williams, Helen Neil, Richard Coleman

Students

Guy Williams (PhD completed June 2004)

Project Aim

To characterise and understand the variability of Southern Ocean currents and air-sea interaction. Key phenomena include the transport and variability of major ocean currents (Antarctic Circumpolar Current, Antarctic Slope Front, deep boundary currents and cross-shelf exchange), water mass formation, changes in stratification and mixed-layer depth, and the oceanic signal of climate change. The understanding of Southern Ocean variability developed in this project underpins many ACE CRC projects across each of the programs. The outcome of the research will be more reliable projections of Southern Ocean variability and change and its impacts on climate, marine ecosystems, ocean carbon uptake and sea level rise.

Project Achievements

- Mertz polynya research (see Program Achievements).
- A new method of inferring front locations from satellite altimetry was combined with position and temperature data from satellite-tracked penguins to show that King penguins at Macquarie Island feed almost exclusively in the Polar Frontal Zone. The understanding of how penguin behaviour is related to oceanographic variability developed in this project is a first

step towards linking the response of marine ecosystems to changes in the physical environment, a key goal of the ACE CRC. (Joint with AAD).

- Satellite ocean colour data was used to demonstrate the importance of eddies in driving exchange between coastal and offshore waters and therefore controlling the spatial distribution of phytoplankton production near the Antarctic continental margin. (Joint with the National Institute of Polar Research, Japan).
- Wind observations from satellite scatterometers were used to demonstrate that the Bureau of Meteorology atmospheric model LAPS does a good job of simulating Southern Ocean winds (error less than 0.4 m/s).
- ACE CRC scientists participated in a Japanese expedition that carried out the first circum-global oceanographic transect, near 30S. The data will help constrain estimates of the exchange of heat, water masses, and carbon between the Southern Ocean and lower latitudes. (Jointly with Japan Marine Science and Technology Centre, JAMSTEC, Japan).
- Repeat oceanographic transects were used to quantify the variability of the major Southern Ocean fronts south of New Zealand. The research resolved a long-standing disagreement over the nature of the oceanographic frontal structure in this sector. (Joint with CLIMA, Italy).

Ice–Ocean–Atmosphere Interaction and Variability

Project Leader

Tony Worby

Project Staff

Ian Allison, Vicky Lytle, Rob Massom, Petra Heil, Barry Giles, Tim Shaw, Mike Craven, Russell Brand

Students

Andrew Roberts (submitted PhD Thesis)
Matthew Paget (PhD)

Project Aim

To characterise and understand the interactions between sea ice, ice shelves, ocean and atmosphere, their variability, and their sensitivity to climate change.

Project Achievements

- ARISE experiment for validation of satellite measurements (see Program Achievements).

Research: Climate Variability and Change

- Further demonstration of the viability of remote sensing of sea ice thickness using EM measurements from ship-based and air-borne instruments (jointly with AWI, Germany). This represents an important step forward for determining sea ice thickness.
- Derived a method for simulating sea ice ridging in a high resolution oriented fracture model capable of short term forecasting of sea ice state, and established a basic assimilation scheme for incorporating passive microwave data into a model for estimating thickness distribution of sea ice.
- Several studies have emphasised the importance of synoptic weather events, and the distribution of fast ice and icebergs, in determining interannual variability in the distribution of sea ice. The resulting sea ice changes are correlated with significant variability in penguin populations. "Blocking" events in the mid-latitude atmosphere were shown to drive significant anomalies in Antarctic climate.
- A comparison of ship-board and satellite observations of the sea ice edge has shown that satellite sensors do a relatively poor job of estimating the sea ice edge during the melt season. The result has important implications for the interpretation of interannual and decadal changes in sea ice extent from satellite observations.
- The Amery Ice Shelf Ocean Research (AMISOR) project successfully completed a new 480 m-deep borehole through the Amery Ice Shelf, about 100 km from the front. Measurements in the borehole obtained data on the structure and properties of the 200m-thick layer of marine ice that underlies the ice shelf. Data from previously moored oceanographic instruments at this and other sites was recovered. A sediment core and video evidence of marine life beneath the shelf were collected.
- Further development of the ASPeCt sea ice data base through contributions from Australian and other national programs.

History of Southern Ocean and Antarctic Climate from Ice and Sediment Records

Project Leader

Tas van Ommen

Project Staff

Vin Morgan, Mark Curran, Will Howard, Barbara Smith, Mark Richardson, Doug Thost

Students

Andrew Moy (PhD), Alison McMorrow (PhD), Annette Foster (Hons 2003, PhD 2004-), Meredith Long (Hons 2003)

Project Aim

To characterise historical variability and change in Antarctic and southern hemisphere climate on time-scales beyond instrumental reach. The project complements the research on present day and future climate by providing improved reconstructions of past southern hemisphere climate and insights into the processes driving climate on time-scales from glacial cycles to synoptic events.

Project Achievements

- Sea ice extent changes over the last 150 years were derived from changes in methanesulfonic acid (MSA) in the Law Dome ice core (see Program achievements).
- Refined dating of the DSS core has provided a palaeo-accumulation series that has shown that accumulation captures short term temperature variability better than the isotope ratio.
- Analysis of the iceberg cores B9B and C4 show accumulation signals from the sea-ice zone correlate with Law Dome - suggesting that Law Dome is useful as a recorder of accumulation in the sea ice region.
- Mount Brown (MBS) cores show an MSA signal that tracks sea-ice extent in much the same manner as the Law Dome data - strengthening the conclusion of Curran and others 2003 (in Program achievements) (IASOS Hons project).
- The record of sub-seasonally resolved isotope ratios from the Law Dome ice core has been extended back from 900AD to 650AD (the plan is to continue to about 0 AD in order produce a very high resolution Antarctic coastal record of the last 2000 years of the Holocene). The high resolution trace ion record was extended from 1300AD to 847AD.
- Measurements of sea salt aerosol in the Law Dome core were shown to correlate with atmospheric circulation anomalies. The observations were used to derive a 700 year proxy record for variations in the Southern Annular Mode, the dominant mode of southern hemisphere atmospheric variability.
- A new global synthesis of carbon isotopes in benthic foraminifera from deep and intermediate waters suggests that the

Research: Climate Variability and Change

“Conveyor Belt” circulation operated throughout the last glacial maximum, but that its influence on Southern Ocean deep water masses was lessened. Southern Ocean deep water masses took on similar values to the deep Pacific as a result of this slowdown of the overturning circulation. (joint with CO2 program).

Simulation of Ice-Ocean-Atmosphere Interaction and Climate

Project Leader

Nathan Bindoff

Project Staff

Jason Roberts, Petra Heil, Neil Adams, Steve Pendlebury, Simon Marsland, Tony Hirst, Siobhan O’Farrell, Roland Warner, Oscar Alves, Neville Smith, Faina Tseitkin

Project Aims

- To develop insights into ice–ocean–atmosphere interactions in the Southern Ocean by development and analysis of high resolution simulations with ocean-only, sea ice–ocean, ocean–ice shelf models.
- To develop and use coupled climate change models to deliver projections of changes in Southern Ocean currents, stratification, and sea ice.
- To combine state-of-the-art ocean observations and numerical models to provide simulations and forecasts of ocean currents and sea ice for Southern Ocean applications.

Project Achievements

- Simulations of Mertz polynya (see Program achievements).
- High resolution simulations have been used to test an improved parameterisation of the effect of eddies in the Southern Ocean, based on the Transformed Residual Mean (TRM) theory. The eddies play a critical role in the dynamics of the Southern Ocean, and improved representation of their effects will result in more skilful climate forecasts.
- Numerical simulations have shown how decadal variations in surface forcing in the Southern Ocean drive variability in the upper waters at mid-latitudes of the Indian Ocean. The results are important for distinguishing the effects of climate change from those of natural variability.
- A workshop was held in March to discuss the development of a national ocean model for climate (AusCOM - Australian Climate Ocean Model). Several organisations (BMRC, CSIRO, ACE CRC, TPAC, Universities) agreed to develop a common model. An initial configuration for AusCOM was also agreed, including the sea ice model and grid developed at the TPAC, the ACE CRC and the AAD. A unique design of AusCOM is increased resolution in the Southern Ocean, making it ideal of southern hemisphere high latitude climate studies. A preliminary version of the model has been set up ready for testing.

Program Achievements Against Milestones

Milestone	Date	Achievement
Establishment of initial data assimilation experiments in ocean-only model	2005	to be completed
Creation of historical and real-time ocean database system	2005	to be completed
Estimation of overturning strength from WOCE data using inverse models	2008	to be completed
Production of ocean analyses for the Australian sector by data assimilation model	2008	to be completed
Estimation of sensitivity of overturning strength to changes driven from different forcing scenarios	2008	to be completed
Census of water mass changes from recent and historical data	2008	to be completed
Identification and quantification of physical mechanisms driving variability in the ocean-ice system in the Australian Antarctic sector	2009	to be completed
Production of scenarios of changes in Southern Ocean circulation and sea ice and their impact on ecosystems, carbon uptake and sea level rise	2009	to be completed
Operational, fully-coupled ocean-sea ice analysis and forecast system	2010	to be completed

Research: Ocean Control of Carbon Dioxide

Program Leader

A/Prof Tom Trull, University of Tasmania and CSIRO Marine Research

Program Aims

- **To determine the current magnitude of uptake of anthropogenic atmospheric CO₂ by the Southern Ocean south of Australia.** This will contribute to assessment of global ocean uptake and thus to evaluation and verification of CO₂ management strategies. It will also quantify relationships between ocean circulation and CO₂ transfers and thereby improve projection of future atmospheric CO₂ levels.
- **To determine the role of rapid mixed-layer dynamics in Southern Ocean plankton production and associated carbon transports, including air-sea exchange of CO₂.** This is required to assess the role of climate variability and change in the control of phytoplankton production and biological carbon export to the deep ocean, and in the assessment of ocean uptake of CO₂.
- **To determine the influence of iron availability on Southern Ocean plankton community structure and the associated ecosystem control of carbon transfer to the deep ocean.** This is necessary to quantify the role of Southern Ocean biology in past and future regulation of atmospheric CO₂, including the efficacy and risks of proposals to increase carbon sequestration by controlled iron fertilization.
- **To determine the impact of increasing CO₂ concentrations on phytoplankton and on the relative growth rates of different classes of Southern Ocean phytoplankton.** This will contribute to an integrated assessment of the impact on global change on marine ecosystems.

Program Background

The Ocean Control of CO₂ Program builds on the recognition that the ocean is the largest reservoir of carbon that is active on timescales of days to thousands of years. Changes in its temperature, circulation and biological processes control atmospheric carbon dioxide levels, including absorbing approximately one third of annual anthropogenic emissions. Research in the program seeks to quantify the processes that control ocean

carbon transports and examine their sensitivity to global change. It also examines the impacts of increased carbon dioxide levels on marine ecosystems.

In 2003-4, the CO₂ program focused on technique and equipment development, while still undertaking several field observational programs. We experienced some frustrations including loss of mooring equipment and late withdrawal of our planned new scientist appointment in biogeochemical modelling. Successes included receiving US National Science Foundation funding for a collaborative program to examine particle transformations at mid-depths in the ocean, and expansion of the repeat Tasmania to Antarctica transect program onboard the French ship Astrolabe to include carbon dioxide, phytoplankton, and other biogeochemical measurements.

In 2004-2005 we will participate in several major field campaigns including the Clivar I9 hydrographic section, the French KEOPS program examining iron influence on marine ecosystems, the Sub-Antarctic Zone (SAZ) sediment trap and PULSE mooring mixed layer dynamics projects, the SAFE international iron analytical intercalibration exercise, and the US program Vertical flux in the Global Ocean (VERTIGO) designed to document the vertical movements of carbon and other nutrients in the world's oceans.

Program Achievements

- Using sediment trap based calibrations of ¹⁵N and ¹³C proxies for surface carbon and nitrate abundances, the role of Southern Ocean biological productivity in lowering atmospheric CO₂ was assessed, and the magnitude of anthropogenic carbon uptake over the industrial era estimated.
- A global compilation of ocean inventories of anthropogenic CO₂ confirmed the importance of the Southern Ocean in its uptake.
- A highly sensitive analytical method was developed to discern the influence of the essential micronutrient selenium on Southern ocean phytoplankton production.
- Astrolabe transects showed a tight correlation between phytoplankton abundance (as measured by pigment concentrations) and the draw down of carbon dioxide. A workshop is planned to link this processes with oceanographic

Research: Ocean Control of Carbon Dioxide

conditions as a first step in assessing connections across climate, carbon, and ecosystem processes.

Project Reports

Large-scale Measurements of Ocean Carbon Contents

Project Leader
Bronte Tilbrook

Project Staff
Bronte Tilbrook, Mark Pretty

Students
Andrew Lenton, Emilie Breviere (Paris)

Project Aim
This project will estimate the total and anthropogenic CO₂ inventories in the Southern Ocean on repeat sections, and contribute to understanding the Southern Ocean influence on the global carbon budget.

Project Achievements

- Underway measurement of pCO₂ and other carbon system parameters completed using the French Antarctic resupply ship *Astrolabe*. Some results were presented at a symposium on The Ocean in a High CO₂ World, held in Paris, May 2004.
- Bronte Tilbrook co-authored a publication in *Science* that shows since preindustrial times the major ocean basins have stored 118 ± 19 PgC. Approximately 60% of the storage occurs in the Southern Hemisphere. The work confirms the importance of Southern Ocean Mode and Intermediate waters in regulating the storage.

High-frequency measurements of ocean mixed-layer dynamics

Project Leader
Tom Trull

Project Staff
Brian Griffiths, Bronte Tilbrook, Richard Matear, Ed Butler, Clodagh Moy, Stephen Bray, Lindsay Pender, Alex Papij, Dan Mclaughlin

Project Aim
This project will design and deploy innovative automated instrument moorings to determine daily and seasonal physical-chemical-biological variations in the ocean and their role in carbon transports.

Project Achievements

- Design of an innovative deep ocean mooring completed and the PULSE-

Test mooring deployed in August 2004. Development of gel-traps and an in-situ settling column achieved during the *Vertigo-1* cruise in June 2004.

Quantification of Ecosystem Responses and Carbon Export in Iron-Fertilized Systems

Project Leader
Andrew Bowie

Project Staff
Tom Trull, Lisette Robertson, Stephen Bray, Ed Butler

Students
Bronwyn Wake (PhD), Juliette Tria 9PhD)

Project Aim
This study will improve efficacy and risk assessments for the regulation of iron fertilization to increase biological uptake of CO₂ by the ocean and help quantify the role of iron in controlling low atmospheric CO₂ levels at the last glacial maximum. A key component of this work will be studies of the relationships between persistent iron availability, high algal biomass, and carbon export in the Kerguelen-Heard Island region.

Project Achievements

- Andy Bowie participated in a multi-disciplinary investigation of the delivery of iron in terrestrial dust to the Atlantic Ocean and examined its effect on upper water column biogeochemistry. Preliminary results were presented at the ASLO-TOS Ocean Research Conference meeting in February 2004.

Effect of elevated CO₂ on phytoplankton

Project Leader
Simon Wright

Project Staff
Andrew Davidson, Tom Trull

Project Aim
Experimental incubations in large tanks will be used to study the affect of increased CO₂ on phytoplankton. This project will examine changes in growth rates, shell calcification in coccolithophores, and species dominance in phytoplankton communities, with emphasis on changes in chemical and stable isotopic compositions for comparison with natural systems.

Project Achievements

- Funding has been secured to allow modification of the minicosm systems to allow headspace gases to be monitored and controlled.

Research: Ocean Control of Carbon Dioxide

Program Achievements Against Milestones

Milestone	Date	Achievement
An estimate of the current inventory of anthropogenic CO ₂ in the Southern Ocean south of Australia	First estimate in 2005 and second estimate in 2009	Publication of a summary article in Science
Measurement of anthropogenic CO ₂ contents along the WOCE/CLIVAR I9 section from Western Australia to Antarctica	2005	to be completed
Measurement of anthropogenic CO ₂ contents along a transect along the Antarctic shelf	2006	to be completed
Determination of the role of stratification in biological carbon export to the deep sea, to inform estimates of future carbon export in an increasingly stratified ocean	2005-2007	to be completed
Development of a model with explicit ecosystem structure linking stratification and export over seasonal timescales	2006	to be completed
Comparison of the model to observations of stratification and surface export in the Southern Ocean south of Australia	2008	to be completed
Comparison of the model to observations of export to deep sediment traps in the Southern Ocean south of Australia	2010	to be completed
Examination of the links between iron supply and export in an area of natural iron inputs	2003-2005	Presentation of preliminary results at the ASLO-TOS Ocean Research Conference (Honolulu, Feb 2004)
Quantification of the response of Southern Ocean ecosystems to persistent natural iron fertilization	2006-2007 and 2009, with assessments of efficacy and risk issued in 2006 and 2010	to be completed
Determination of the role of elevated CO ₂ levels on phytoplankton communities	2007	to be completed

Research: Antarctic Marine Ecosystems

Program Leader

Dr Stephen Nicol, Australian Antarctic Division

Program Aims

- **To identify how biological productivity is affected by sea-ice extent and properties, and by ocean circulation.** Productivity in the Southern Ocean has been linked to the winter sea-ice cover and to large-scale ocean circulation patterns, both of which are sensitive to climate change. The hypothesis that reduced sea-ice extent (for example with climate warming) will lead to a smaller sea-ice algal community and reduced secondary productivity will be tested.
- **To quantify and describe processes that link sea-ice, and primary and secondary productivity.** Better experimental understanding of these processes is needed to develop coupled physical-biological models that link changes in the physical environment to changes in the marine ecosystem.
- **To project the effects of long-term change on Antarctic ecosystems.** Remote sensing of ocean colour and water movements, combined with *in situ* oceanographic and biological measurements, will facilitate biological-physical modelling of the effects of ocean circulation and sea-ice on productivity. Improved models and better data availability are necessary to assess the response of marine ecosystems to Southern Ocean variability and change.
- **To translate predictions of the effects of climate change on Southern Ocean ecosystems into sustainable management models.** The physical-biological models will enable prediction of the effects of physical changes on harvested and dependent species, and thus lead to more effective management of marine living resources.

Program Background

Many of the vertebrate species (eg whales, seals and penguins) of the Antarctic region are of high conservation value. The current inability to predict the effects of environmental changes on their populations makes it difficult to establish sound long-term management strategies in bodies such as the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and the International Whaling Commission (IWC). CCAMLR manages the krill harvest, which is the Antarctic's largest fishery and the one with the greatest potential for widespread ecosystem impacts. The krill fishery is projected to expand into one of the world's largest fisheries,

yet the effects of climate change on krill stocks, and on the species dependent on krill (seabirds, penguins, seals and whales), are unknown. The ACE CRC will examine the predicted environmental changes and their implications for sustainable management of Southern Ocean fisheries and the marine life protected through CCAMLR, to which Australia is a signatory. Australian research has already highlighted the structure and dynamics of the krill-based Southern Ocean ecosystem, and this has led to the adoption by CCAMLR of many precautionary proposals put forward by Australia. The proposed ACE CRC research on the interactions of ocean circulation, sea-ice extent, and ecosystem structures will enable Australia to continue to lead in this area. The need for Australian research to underpin sustainable management in these regions is emphasised by increased fishing by other nations and by Australia's plans to make a submission in relation to an extended continental shelf in accordance with terms of the United Nations Convention on the Law of the Sea (UNCLOS).

Program Achievements

- Significant recruitment activity: three new staff appointed (biological oceanographer sea ice ecologist and sea ice ecosystem modeller).
- Commencement of the ecosystem modelling effort with one short workshop and a number of discussion groups, followed by participation in a major CCAMLR workshop on ecosystem modelling.
- Planning beginning for the major survey voyage in 2005/06 with a document outlining the aims and objectives of the voyage being submitted to CCAMLR.
- Organisation of a workshop to be held in August in St Andrews, Scotland, to prepare a proposal for the use of Southampton University's Automated Underwater Vehicle (AUV) in winter 2007/08. Recently appointed oceanographer (Guy Williams) to participate in a voyage off Iceland to gain experience in the use of the AUV.

Project Reports

Large-Scale Relationships

Project Leader

To be announced

Project Aim

This project will explore, using data from ice cores, sediment cores, penguin rookeries and operational data, whether major changes in the sea-ice environment in Antarctica may have occurred prior to the recent satellite record.

Research: Antarctic Marine Ecosystems

Project Achievements

- Appointment of Will Howard to examine palaeo records.
- Preliminary discussions with AAD's sea ice group on possible approaches.
- Submission of a paper looking at Antarctic-wide relationships

Processes Linking Physical and Biological Elements of the Ecosystem

Project Leader

Klaus Meiners (Currently Yale University, joining ACE CRC in January 2005)

Project Staff

Guy Williams (commenced July 2004)

Project Aim

This project will study the links between physical and biological elements of the ecosystem using *in situ* experimental approaches, and through modelling.

Prediction of ecosystem variability and change for sustainable management

Project Leader

To be announced

Project Aim

This project will develop a modelling framework that links the large-scale climate models with focused ecosystem models for ecosystem prediction and management. Climate models and harvesting models will be used together to examine potential change and to thus establish precautionary measures related to projected changes.

Project Achievements

- Commencement of the modelling process with workshop on approaches and submissions to CCAMLR's Working Group on Ecosystem Monitoring and Management in July 2004.

Program Achievements Against Milestones

Outcome: Incorporation of physical and biological information into Antarctic ecosystems model

Milestone	Date	Achievement
Development of under-ice remote sensing instrumentation for AUV	2004	Visited University of Southampton to discuss use of AUV with its development team (Nicol). Ascertained mechanisms for developing a joint proposal with UK scientists with NERC (UK). Planning workshop arranged for August 2004 with UK collaborators (Dr. Dave Thomas, University of Wales, Bangor and Dr Andy Brierley, University of St Andrews, Scotland). Participation in AUV cruise off Iceland to gain experience in its operation (Williams)
Testing of the hypothesis that there has been a major change in sea-ice extent in the 1950s and 1960s using data from ice cores, sediment cores, penguin rookeries and operational data	2005	to be completed
Submission to CCAMLR of an estimate of the biomass of krill in Division 58.4.2	2006	Submission to CCAMLR of a proposal to survey Division 58.4.2 for krill.
Autumn/winter/spring process study voyages	2007-2009	to be completed
Development of an observation-based model that links physical variables (sea-ice, oceanography, meteorology) with biological productivity at the primary and secondary levels	2008	to be completed
Development of a region-based predictive model that integrates existing climate models with higher trophic level ecosystem models	2010	to be completed

Research: Policy

Program Leader

Dr Marcus Haward, University of Tasmania

Program Aims

- **To translate research outputs into forms useful to research users in the spheres of law, policy, and regulation.**
- **To identify emergent issues influencing the developments in legal and political regimes in the Southern Ocean and Antarctica.** Improved understanding of the Southern Ocean ecosystem produces a number of emergent issues. Understanding of impacts of climate variability, and changes in primary productivity, have direct impact on decisions over resource use in the Southern Ocean and related ecosystems. Iron fertilisation of the Southern Ocean involves a number of issues including its legal status and impact. Improved projections of sea level rise have direct impacts on coastal management in Australia, yet need to be incorporated into appropriate legislative and policy instruments. For example, as climate knowledge improves, the definition of extremes in natural events and the degree to which they represent “acts of God” will evolve, with ramifications for public and private relief and insurance industries.
- **To contribute to improved effectiveness of management arrangements and regimes governing the Southern Ocean and Antarctica.** Australia has significant national interests in the Southern Ocean and Antarctica. It is party to key international instruments that cover the region, including the Law of the Sea Convention (LOSC), the Antarctic Treaty, and CCAMLR. Linking improved understanding of the Southern Ocean and Antarctic region to appropriate international regimes and Australian policy is fundamental to improving effectiveness of the instruments governing the Southern Ocean and Antarctica.

Program Background

The policy program has an important role in the ACE CRC. Before outlining the rationale, and objectives of the program it is important to be clear that neither this program, nor the ACE CRC in general, ‘makes policy’. What the Policy Program can, and will, do is to contribute to policy advice and work closely with partner agencies and research users, as well as the other ACE CRC programs

to research and analyse emerging policy issues and options for dealing with them. We aim to contribute to discussion and evaluation of options and provide useful ‘distance’ from government to provide opportunities to discuss issues and topics important for policy formulation.

The policy program seeks to ensure that scientific outputs from the ACE CRC are able to contribute to policy development and outcomes for partner agencies and research users. It seeks to help integrate Australian government goals, objectives and interests into the work of the science programs. The policy program aims to inform ACE CRC programs of the salience of their work and provide links between research users and the science programs.

The program also aims to provide ‘in house’ expertise in the social sciences, public policy and law and to undertake interdisciplinary research that contributes to achieving the broad goals of the ACE CRC. The program seeks to provide advice on probable impacts arising from the outputs of the science programs in terms useful to research users; and ensure that ACE CRC scientists become aware of the policy issues that arise as a result of their research.

Program Achievements

- Identification of impediments and opportunities related to marine bio-prospecting in Southern Oceans south of 60 ° South.
- Identification of stresses and gaps in current arrangements for the ‘management’ of Antarctic ‘adventure’ tourism.
- Analysis of the legal regime of ‘hot pursuit’ and identification of challenges in high seas and deep seas fisheries enforcement.
- Members of the policy program have provided media commentary on bio-prospecting in the Southern Ocean, illegal, unreported and unregulated fishing and Antarctic Tourism.
- Engagement with research users – Organised, coordinated and made presentations at Workshop on Bioprospecting in the High Seas (Dunedin New Zealand, November 2003).
- Engagement with research users: Presentation on policy options for IUU

Fishing at Australian Bureau of Agricultural Economics (ABARE) *Outlook 2004* conference, Canberra March 2004.

Project Reports

Assessing and improving the effectiveness of Southern Ocean regimes

Project Leader

Marcus Haward

Project Staff

Julia Jabour, Rob Hall, Aynsley Kellow, Lorne Kriwoken, Gail Lugten,

Students

Carl Murray (PhD), Helena Widolf (PhD)

Project Aim

Australia is a party to a number of instruments that address the management of Southern Ocean maritime space and marine resources. This project aims to assess the effectiveness of relevant international and regional instruments and regimes given domestic effect in Australia through national legislation and policy. This assessment will be undertaken by establishing criteria to assess the effectiveness of existing management regimes, developed from an analysis of the definition of 'effectiveness'. This also focuses on the concepts of implementation and compliance and the tools and approaches used to operationalise them.

This framework will be applied to relevant instruments including the Antarctic Treaty, the Madrid Protocol, CCAMLR, ICRW and LOSC that govern marine areas and resource use, management and conservation in the Southern Ocean. This project will examine emergent and cross-cutting issue such as the issue of liability for environmental damage in the Antarctic and management of Antarctic tourism.

Project Achievements

- Identification of key regimes
- Key elements underpinning the concept of effectiveness
- Identification of approaches to improve compliance

Whaling and the Management of cetaceans in the Southern Ocean

Project Leader

Julia Jabour

Project Staff

Eric Molenaar

Students

Kristy Welch (PhD)

Project Aim

This research addresses the pro-whaling/conservation deadlock in the International Whaling Commission over whaling in the global oceans, and

the Southern Ocean in particular. The Southern Ocean is a whale sanctuary under the International Convention for the Regulation of Whaling, with limited prescribed scientific whaling. Australia is fundamentally opposed to the use of lethal techniques in scientific research on cetaceans.

Project Achievements

A comprehensive literature search and data gathering exercise has been undertaken and all secondary information has been collected. This includes the latest information and positions resulting from the 56th annual International Whaling Commission meeting in Sorrento, Italy.

The Challenges for Demersal and Pelagic Fisheries Management in the Southern Ocean

Project Leader

Marcus Haward

Project Staff

Julia Jabour, Gail Lugten, Erik Molenaar, Tavis Potts

Students

John Sumby (PhD)

Project Aim

This research focuses on the problem of illegal, unreported and unregulated (IUU) fishing in the Southern Ocean. This project will centre on the problems of IUU fishing in the high seas in the Southern Ocean and within exclusive economic zones (EEZs) of states, including the Australian EEZ off Heard and Macdonald Island and Macquarie Island. It will contribute to the analysis of the efficacy of existing instruments, institutions and practice, including the science-policy interface, and the potential of emergent instruments such as trade and market instruments to combat this problem.

Project Achievements

- Critical evaluation of policy instruments directed at IUU fishing
- Examination of issues surrounding 'hot pursuit'
- Establishment of a research project on science policy-gap, identification of key variables

The Management of 'Dependent and Associated Species'

Project Leader

Marcus Haward

Project Staff

Rob Hall, Julia Jabour, Gail Lugten, Lorne Kriwoken

Students

Cheryle Hislop (PhD), Jane Harris (PhD), Jon Neville (PhD), Jacque Turner (PhD)

Research: Policy

Project Aim

This project will focus on the development of legal and political responses to the problem of managing impacts on associated and dependent species.

The project will address (i) the development and implementation of marine protected areas and (ii) tools and approaches that can be used to facilitate the implementation of the Agreement for the Conservation of Albatross and Petrel species (ACAP). The project will also investigate the influence of The Convention on Biological Diversity and the World Heritage Convention and associated world heritage site listings of sub-Antarctic Islands on management arrangements.

Project Achievements

- Establishment of evaluative framework for examination of ACAP.
- Establishment of inventory of instruments related to marine biodiversity.

The Nexus Between the Law of the Sea Convention (LOSC) and the Antarctic Treaty System (ATS) in Marine Areas South of 60° S

Project Leader

Marcus Haward

Project Staff

Julia Jabour, Gail Lugten, Erik Molenaar,

Students

Cheryle Hislop (PhD), Jane Harris (PhD), Jon Neville, (PhD) Jacque Turner (PhD), Jason Kendall Moore (PhD)

Project Aim

The Law of the Sea Convention (LOSC) is the centre of the regimes governing management of the world's oceans, including those within the jurisdiction of the Antarctic Treaty. The LOSC provides the basis for a comprehensive 'constitution for the oceans', being described as a 'framework convention in relation to the exploitation of marine living resources.' LOSC elaborates rights for coastal states (with concomitant obligations and responsibilities) that in relation to maritime zones and boundaries, fisheries etc, directly impacts on provisions and practices within the Antarctic Treaty. The Antarctic Treaty and its associated instruments and arrangements have been developed to provide a management regime south of Latitude 60° South, based on consensus and collaboration.

This project focuses on the nexus between the two regimes and will analyse the extent to which they are converging or diverging, and the implications for management of the Southern Ocean.

Project Achievements

Establishment of collaborative project with University of Sydney Law School.

Impacts of Potential Sea Level Rise for current and Future coastal Zone Management Including Policy Implications of Climate Variability and Change

Project Leader

Marcus Haward

Project Staff

Aynsley Kellow

Students

Jenni Rigby (Honours)

Project Aim

The Australian coastline borders a number of biogeographic regions, each containing a diversity of marine habitats. Management of the Australian coast reflects a similar diversity. While the majority of this area is under State jurisdiction, both the Commonwealth and local government have a major influence on Australian coastal zone policy and management. Policy towards the Australian coast is shaped by the political, legislative and administrative overlap in interests and responsibilities between the Commonwealth, State and local governments.

This project focuses on the extent to which current legal, administrative and institutional arrangements can manage the impacts of climate variability and change, including sea level rise, in the coastal zone.

Project Achievements

Analysis of opportunities for development of 'adaptive decision-making' approaches for coastal planning.

The Oceans Role in the Carbon Cycle: Legal and Political Implication of Large Scale (Including commercial) Iron Fertilisation in the Southern Ocean

Project Leader

Marcus Haward

Project Staff

Aynsley Kellow, Julia Jabour

Project Aim

This project focuses on the political and legal issues that have arisen as research has increased on the ocean's role in the carbon cycle. The theoretical potential of oceanic sequestration of CO₂ is yet to be proven but experiments in 'iron fertilisation' are already raising concern over potential impact on ecosystems and whether it is a long-term option for enhancement of CO₂ uptake by the Southern Ocean. This project will provide an analysis of the legal regimes and policy development governing iron fertilisation – focusing on the differences in regulation of marine scientific research and commercial activities, both inside EEZs and in the high seas.

Project Achievements

Review of current legal status of 'iron fertilisation'.

Program Achievements Against Milestones

Milestone	Date	Achievements
Delivery of science outputs to research users	2003-2010	Establishment of links with ACE CRC Science programs
Improving responses to emergent issues	2003-2010	Identification of key issues related to bioprospecting, IUU fishing and adventure tourism
Identify and, with science programs, provide policy users with details on emergent issues and likely impacts on Southern Ocean management regimes	Ongoing	Underway – work internally. To be presented at Research Users' forum
Annual reporting on progress at research users' forum; reporting on achievements of milestones; recommendations to government	Annual	Development of focus and content of Research Users' Forum for 2004
Identify emergent issues eg. bio-prospecting, iron fertilization	Ongoing	Workshop Report; Media release
Complete an inventory of Southern Ocean management regimes	2004	Inventory underway – to be completed December 2004
Critical review and assessment of regimes	2006	to be completed
Identification of gaps in regimes	2008	to be completed
Completion of project; recommendations to government	2010	to be completed
Improved Australian influence in and effectiveness of Southern Ocean management regimes	2003-2010	Project established and milestones determined
Establish criteria for assessment of Australian influence in, and the effectiveness of, Southern Ocean management regimes	2004	Criteria to be completed 12/04
Annual reporting on progress at research users' forum; reporting on achievements of milestones; recommendations to government	annual	Development material for Research Users' Forum in 2004
Assessment of Southern Ocean management regimes against criteria	2008	to be completed
Completion of project; recommendations to government	2010	to be completed

Education



Background

The ACE CRC Education Program has been established with the following objectives:

- To develop higher education programs that meet the needs of ACE CRC stakeholders
- To address the long-term un-met national demand for highly-trained personnel with quantitative skills in oceanography and marine ecology
- To facilitate the communication of our research outcomes to the community through interactions with the media, museums, schools and other community associations.

The overall performance of the Education Program will be measured relative to the following Milestones/Outputs:

- Attracting an increasing number of top-quality students and delivering on-time completion of research theses
- Through staff development, to produce productivity gains for ACE CRC
- Communicating exciting science to the public through ACE CRC contributions to Antarctic Adventure, museums and educational facilities.

Progress

Objective 1

The higher degree education programs that have operated within the ACE CRC during the reporting year mainly represent a continuation of the IASOS postgraduate training that had evolved through the lifetime of the Antarctic CRC (predecessor of ACE CRC). Through the recruitment of a small number of students enrolled through other schools of the University of Tasmania, and also one student enrolled at another university, the ACE CRC Education Program it is certainly envisaged that the research higher degree training provided to students associated with the ACE CRC will continue to evolve in a progressive manner, and at the same time better meet the needs of the various ACE CRC stakeholders. There are two principal mechanisms via which this development will occur:

- through appropriate deployment of the budget and resources of the ACE CRC Education Program to devise and deliver training to supplement formal instruction in research methods
- by providing opportunities for high-level consultation within ACE CRC between the Education Program and the stakeholders.

In the 2003-2004 year, tangible progress has been made on the first mechanism through the planning of media and commercialisation training workshops and delivery of the former (the latter is scheduled for October 2004). The second mechanism has been very well served by the establishment of the ACE CRC Executive Committee, which includes a number of representatives of the ACE CRC Education Program, as well as representatives of all other ACE CRC programs and other relevant stakeholders.

Objective 2

Significant progress towards this objective has been achieved during the last year, both solely under the ACE CRC banner and in collaboration with other Research Higher Degree initiatives at the University of Tasmania. Two of the main ACE CRC partners (CSIRO and the University of Tasmania) have combined to create a specific postgraduate training program in Quantitative Marine Science. This QMS program involves the creation and delivery of formal courses in oceanography, fisheries science and mathematics. Funds have been set aside to fund research higher degree scholarships for students wishing to enter the QMS program. A number of the ACE CRC staff are heavily involved in the program as a whole, and in the delivery of the course work.

The ACE CRC Education Program aims to work closely with the QMS program, via direct interaction with Prof Richard Coleman, appointed to lead the program, with a view to joint marketing and recruitment of students, and co-sponsoring of projects. Many of the projects promoted during 2003/2004 as being available to QMS students were supported by ACE CRC scientists, and this trend toward greater collaboration is likely to increase.

Objective 3

At this early developmental stage of the ACE CRC, the emphasis on research output has been relatively minor and there has been relatively little material progress towards this objective. These important activities will be addressed with more vigour in subsequent years however, involving collaboration between the ACE CRC Education Program and the ACE CRC Communications Manager, as well as other components/staff of the ACE CRC as required. The Antarctic Adventure, which was specifically mentioned in the ACE CRC Business Plan, closed in November 2003.

Education: Postgraduate Students

	Candidate	Course	Scholarship	Start Date	Topic	Supervisors (Affiliation)
1	Mr Daniel Bombardieri	PhD	APA + AAD	11-Feb-02	Study of Ground-Level Enhancements in Cosmic Ray Flux	Dr Kelvin Michael (UTAS), Dr Marc Duidig (AAD), Dr John Humble (UTAS)
2	Ms Ann-Maree Catchpole	PhD	Strategic + ACE CRC	25-Mar-99	Detecting Climate Change in the Presence of Decadal Variability in Coupled Ocean-Atmosphere Models and Ocean Observations	A/Prof Nathan Bindoff (UTAS), Dr John Church (CSIRO)
3	Mr David Clement	PhD part-time		1-Oct-99	Annual Productivity in Antarctic Fast Ice: Use of Unattended Monitoring Platforms	A/Prof Andrew McMinn (UTAS)
4	Mr John Court	PhD	APA + AAD	1-Feb-03	Numerical Modelling of the Dynamics of the Continental Ice Sheet	Prof Bill Budd (UTAS), Dr Roland Warner (AAD)
5	Ms Shavawn Donoghue	PhD	TPRS	14-Oct-02	Heard Island Climate and Glacial Retreat	Dr Rob Massom (ACE CRC), Dr Ian Allison (AAD), Dr Doug Thost (AAD)
6	Ms Elizabeth Foster	PhD	ARC SPIRT	30-Apr-01	Regional Marine Plans: Fisheries Management Challenges under the Australian Oceans Policy	Dr Marcus Howard (UTAS), Dr Nathan Evans (AFA), Mr Glenn Hurry
7	Mr Brett Goldsworthy	PhD part-time	APA	9-Oct-95	Antarctic and Southern Ocean Processes in Global Climate Modelling	Prof Bill Budd (UTAS), Dr Xingren Wu (AAD)
8	Mr Michael Grose	PhD	CGBAPS	31-Mar-04	Biogenic Gas Production and Phytoplankton Ecology at Cape Grim	A/Prof Andrew McMinn (UTAS)
9	Ms Jane Harris	PhD	TPRS	31-Mar-03	Alternative Strategies for Protected Areas in the Antarctic	Dr Marcus Howard (UTAS), Dr Julia Jabour (UTAS), Dr Eric Woehler (UTAS)
10	Mrs Jane Higgins	PhD	APA + AAD	18-Feb-03	Mapping of UV Radiation in Antarctic Sea Ice	Dr Kelvin Michael (UTAS), Dr Rob Massom (CRC)
11	Ms Katrina Hill	PhD	Faculty	11-Nov-96	Digital Image Analysis Techniques for Antarctic Remote Sensing Applications (SAR Interferometry)	Dr Kelvin Michael (UTAS), Dr Ray Williams (Computing), Dr Rob Massom (ACE CRC)
12	Ms Kate Hodgson	MSc	TPRS + TAFI	1-Aug-02	Biology of Southern Ocean Squid: An Ecosystem Approach	Dr George Jackson (UTAS), Dr Jeremy Lyle (TAFI)
13	Ms Sarah Howe	PhD	Strategic + ACE CRC	15-Feb-99	Detecting Climate Change in the Southern Ocean Using Historical and WOCE Temperature, Salinity and Nutrient Data	A/Prof Nathan Bindoff (UTAS), Dr Steve Rintoul (CSIRO)
14	Mr Brian Hunt	PhD	IPRS/UTAS	4-May-01	Distribution of Zooplankton in the Southern Ocean	A/Prof Andrew McMinn (UTAS), Dr Steve Nicol (AAD)
15	Mr Tim Ingleton	PhD part-time		1-Aug-02	Changes in Diatom Abundance and Diversity in Sediment Cores	A/Prof Andrew McMinn (UTAS), Dr Gustaaf Hallegraef (UTAS), Dr Henk Heijnis (ANSTO)
16	Mrs Christine Jackson	MSc		1-Mar-04	Biology and Ecology of Southern Ocean Ommastrephid Squid	Dr Tom Trull (UTAS), Dr Leanne Armand (UTAS)
17	Ms Sam Lake	PhD	TPRS	15-Oct-01	Population Ecology of Weddel Seals in the Vestfold Hills, Antarctica	Dr George Jackson (UTAS), A/Prof Mark Hindell (UTAS), Mr Harry Burton (AAD)
18	Mr Andrew Lenton	PhD	ACE CRC	7-Oct-02	Oceanic Controls on Carbon Dioxide Concentrations	Dr George Jackson (UTAS), A/Prof Mark Hindell (UTAS), Mr Harry Burton (AAD)
19	Mr Patrick Lewis	PhD	APA	25-Mar-02	An Investigation into Introduced Marine Species in the Sub-Antarctic	A/Prof Andrew McMinn (UTAS), Dr Chad Hewitt (CSIRO), Dr Martin Riddle (AAD)
20	Ms Angela McGaffin	PhD	UTas/AntDiv	1-Mar-00	Growth and Ageing in Southern Ocean Pelagic Invertebrates	Dr George Jackson (UTAS)

Education: Postgraduate Students

21	Ms Alison McMorrow	PhD	APA+ ACE CRC	1-Jun-99	Intercomparison of Snow Pit Parameters and Meteorological Observations	Prof Bill Budd (UTAS), Dr Mark Curran (AAD), Dr Tas van Ommen (AAD), Mr Vin Morgan (AAD)
22	Mr David Matthews	MSc		1-Feb-04	Southern Ocean Circulation from Iceberg Drift Patterns	A/Prof Nathan Bindoff (UTAS), Neal Young (AAD)
23	Mr Jason Kendall Moore	PhD	Crawford + IPRS	7-Feb-03	The Western Hemisphere and US-British Commonwealth Relations toward the Antarctic, 1939-1959	Dr Marcus Howard (UTAS)
24	Mr Thomas Moore	PhD	NASA+APA	3-Dec-01	Mesoscale Variability and Ecosystem Processes	Dr Tom Trull (UTAS), Dr Richard Matear (CSIRO), Dr David Griffin (CSIRO)
25	Mr Andrew Moy	PhD	Strategic	17-Apr-00	Late Pleistocene Paleogeographic and Geochemical Evolution	Dr Will Howard (UTAS), Dr Peter Harris (GA)
26	Mr Carl Murray	PhD	APA	31-Aug-03	Antarctic Conservation: An Enquiry into Values	Dr Tom Trull (UTAS), Dr John Volkman (CSIRO)
27	Mr Jon Nevill	PhD	APA	31-Mar-04	Australian Marine Biodiversity Conservation: Rhetoric and Reality	Dr Marcus Howard (UTAS), Dr Karen Edyvane (Geography&Env Studies)
28	Ms Frederique Olivier	PhD	OPRS + UTAS	31-Aug-01	Landscape Ecology of Snow Petrels (Pagodroma nivea) and Wilson's Storm Petrels (Oceanites oceanicus)	Dr George Jackson (UTAS), Dr Eric Woehler (UTAS)
29	Mr Matthew Paget	PhD	ACE CRC	1-Jun-99	The Role of Polynyas in Antarctic Sea Ice Processes	Dr Rob Massom (ACE CRC), Dr Ian Allison (AAD), Dr Vicky Lytle (AAD)
30	Mr Andrew Pankowski	PhD	TPRS	5-Mar-01	Stress Responses of Sea Ice Algae	A/Prof Andrew McMinn (UTAS), Dr John Bowman (UTAS)
31	Ms Rachael Parkinson	PhD	APA	11-Mar-03	Determination of Palaeoprecipitation using High-Resolution Lake Sediment Cores from the Vestfold Hills	A/Prof Andrew McMinn (UTAS), Dr Donna Roberts (UTAS)
32	Mr Abraham Passmore	PhD	APA	25-Feb-02	A DNA-based Study of the Diet of Antarctic Krill	A/Prof Andrew McMinn (UTAS)
33	Mr Steven Phipps	PhD	IPRS+Faculty+ ACE CRC	12-Apr-00	Simulation of Paleoclimate Epochs through the Glacial Cycle	Prof Bill Budd (UTAS), Dr Xingren Wu (AAD), Dr Tas van Ommen (AAD)
34	Ms Rhonda Pike	MSc		6-Mar-00	Diet and Distribution of Weddell Seals along the Mawson Coast, East Antarctica	Dr George Jackson (UTAS), A/Prof Mark Hindell (UTAS), Mr Harry Burton (AAD)
35	Mr David Pointing	PhD	TPRS+OAA	30-Mar-02	Development of Hydrogen-based Renewable Energy Power Sources in Antarctica	Dr Kelvin Michael (UTAS), Dr Oystein Ullenerg (IFE, Norway), Prof Joe Zhu (UTS, Sydney)
36	Ms Tilla Roy	PhD	APA+ ACE CRC	2-May-99	Atmospheric Carbon Modelling	Prof Bill Budd (UTAS), Dr Richard Matear (CSIRO), Dr Roger Francey (CSIRO)
37	Ms Krystyna Saunders	PhD	APA	29-Mar-04	Development of a Comprehensive Diatom-based Data Set of Tasmanian Coastal Lagoons	A/Prof Andrew McMinn (UTAS), Dr Donna Roberts (UTAS)
38	Ms Frances Scherrer (UTAS)	PhD			International Environmental Law	Prof Don Chalmers (UTAS), Dr Marcus Howard (UTAS)
39	Mr Rick Smith	PhD part-time		1-Jan-00	Distribution of Energy Regimes that Mobilise Sediment around the Australian Continental Shelf	A/Prof Richard Coleman (UTAS), Dr Peter Harris (GA)
40	Mr Richard Stanaway (ANU)	PhD	ACE CRC (50%)		Investigations of Sea Level Rise	Prof Kurt Lambeck (RSES, ANU), Dr John Church (CSIRO)
41	Mr Michael Sumner	PhD	TPRS	12-Aug-02	Modelling the Relationships between the Biota and Physical Properties of the Southern Ocean	Dr Kelvin Michael (UTAS), A/Prof Mark Hindell (UTAS)

Education: Postgraduate Students

42	Mr Adam Treverrow	PhD	APA	31-Mar-02	Laboratory Investigation of Ice Rheological Properties	Prof Bill Budd (UTAS), Dr Roland Warner (AAD), Dr Jo Jacka (AAD)
43	Ms Jacquelyn Turner	MSc part-time		1-Apr-04	Use of Consensus Decision-Making in CCAMLR	Dr Marcus Howard (UTAS), Dr Julia Jabour (UTAS)
44	Ms Bronwyn Wake (Chemistry)	PhD	TPRS + CSIRO	28-Apr-03	Trace Metal Species and their Role in the Southern Ocean	Prof Paul Haddad (UTAS), Dr Andrew Bowie (ACE CRC), Dr Ed Butler (CSIRO)
45	Ms Elli Widolf	PhD	TPRS	30-Jun-02	Understanding our Natural Resources - the Polar Regions	Dr Marcus Howard (UTAS), Dr Julia Jabour (UTAS)
46	Mr Guy Williams	PhD	Strategic + ACE CRC	30-Jun-99	On the Formation and Circulation of Adelie Land Bottom Water in East Antarctica	A/Prof Nathan Bindoff (UTAS), Dr Steve Rintoul (CSIRO)
47	Mr Toshihiro Yoshida	PhD	ACE CRC	24-May-04	Effect of Environmental Factors on the Early Development of Antarctic Krill	Dr Steve Nicol (AAD), Dr So Kawaguchi (AAD)
Thesis Submitted						
48	Ms Allison Lane	PhD	Strategic	31-Aug-00	Ecotoxicological Effects of Selected Pollutants in Waters near Casey Station	A/Prof Andrew McMinn (UTAS), Dr Martin Riddle (AAD)
49	Mr Chris Lane	PhD	Strategic	31-Aug-00	Changes in Diatom Community Composition in Response to Climate Variability	A/Prof Andrew McMinn (UTAS)
50	Ms Teresa O'Leary	PhD	Tas + ACE CRC	30-Apr-96	Particulate Organic Carbon in Marine Waters	A/Prof Tom Trull (UTAS), Dr John Volkman (CSIRO)
51	Mr Andrew Roberts	PhD	School + ACE CRC	24-Feb-97	Antarctic Sea Ice and Ocean Heat Flux in Coupled Climate Models	Prof Bill Budd (UTAS), Dr Xingren Wu (AAD)
52	Mr Gareth Wilson	PhD	School + ACE CRC	20-Jul-98	Southern Ocean Food Chains: Use of Lipids in the Examination of Food Chains in the Southern Ocean / Antarctic Ecosystem	A/Prof Andrew McMinn (UTAS), Dr Peter Nichols (CSIRO)
Thesis Requirements Completed						
53	Dr Neil Adams	PhD		1-Feb-96	Numerical Weather Prediction Over Antarctica	Prof Bill Budd (UTAS), Dr Kamal Puri (BOM), Dr Graham Mills (BOM)
54	Mr Michael Grose	MSc		13-Apr-99	Study of Productivity in the Antarctic Sea Ice/Ridge Edge	A/Prof Andrew McMinn (UTAS)
55	Dr Mark Hemer	PhD		22-Mar-99	Sediment Studies under the Amery Ice Shelf	
56	Ms Kristen Karsh	MSc		15-Sep-00	Investigation of Nitrogen Isotope Fractionation in the Southern Ocean	A/Prof Tom Trull (UTAS), Dr Leanne Armand (Geology)
57	Dr Belinda McGrath	PhD		11-Oct-99	Reproductive Biology and Population Genetics of the Arrow Squid, <i>Nototodarus gouldi</i> , from Australian Waters	Dr George Jackson (UTAS)
58	Dr Katrina Phillips	PhD		30-Jun-99	Lipid Biochemistry of Southern Ocean Squid	A/Prof Tom Trull (UTAS), Dr Peter Sedwick (Bermuda Biological Station for Research)
59	Dr Alix King	PhD		31-Mar-99	Climate Variability in the Southern Hemisphere	Dr Will Howard (ACE)
60	Dr Tavis Potts	PhD		27-Sep-99	Southern Ocean Fisheries: Future Exploitation or Sustainable Regimes for Marine Resources	Dr Marcus Howard (UTAS), Dr Julia Jabour (UTAS), Dr Steve Nicol (AAD)
61	Ms Louise Trenery	MSc		1-Jul-99	Pack Ice Algal Productivity	A/Prof Andrew McMinn (UTAS)

Education: Honours Students

	Candidate	Topic	Supervisors	Honours Result
1	Ms Benita Ainsworth	Antarctic Maritime Claims under the Law of the Sea Convention (LOSC) and the Antarctic Treaty: Conflicting or Coincident Regimes?	Dr Julia Jabour (UTAS), Dr Marcus Haward (UTAS)	First Class
2	Ms Stephanie Ellis	Putting a Price on Antarctica: Cultural Perceptions of Environmental Damage and the Unresolved Liability Debate in the Antarctic Treaty System	Dr Julia Jabour (UTAS), Dr Marcus Haward (UTAS)	First Class
3	Ms Diane Erceg	Detering Illegal, Unreported and Unregulated (IUU) Fishing through State Control over Nationals	Dr Julia Jabour (UTAS), Dr Marcus Haward (UTAS)	First Class
4	Ms Annette Foster	Glaciochemical Studies of the Mt. Brown Region, East Antarctica: Climate Connections with the Southern Ocean	Dr Mark Curran (AAD), Dr Barbara Smith (AAD), Dr Kelvin Michael (UTAS)	First Class
5	Ms Fay Helidoniotis	Marine Invertebrates in Space: Human Impacts and Spatial Distribution of Benthic Marine Assemblages around Casey Station	Dr Andrew McMinn (UTAS), Dr Martin Riddle (UTAS), Dr Jonathan Stark (UTAS)	Second Class, Upper Division
6	Mr Justin Hulls	Spatial Variability of Sea Ice Algae in East Antarctica	Dr Andrew McMinn (UTAS), Dr Kelvin Michael (UTAS)	Second Class, Upper Division
7	Ms Denna Kingdom	Variation in Plant Diversity and Performance along an Altitudinal Gradient on Subantarctic Marion Island	Dr Dana Bergstrom (UTAS), Dr Andrew McMinn (UTAS)	First Class
8	Mr Andrew Lee	Establishing a Monitoring Protocol for Antarctic Burrowing Birds: A Comparison of Methodologies for Estimates of Abundance of Snow Petrels in the Windmill Islands	Dr Eric Woehler (UTAS), Dr George Jackson (UTAS)	Second Class, Upper Division
9	Ms Meredith Long	Ice Bergs: Useful Archives for Climate Information?	Dr Mark Curran (AAD) Dr Tas van Ommen (AAD), Mr Vin Morgan (AAD), Dr Kelvin Michael (UTAS)	Second Class, Upper Division
10	Ms Jo Naylor	Ecological Sustainability Issues in the Southern Ocean: A co-evolutionary analysis of Australian policy-making and scientific research	Dr Julia Jabour (UTAS), Dr Will Howard (UTAS)	First Class
11	Mr John Stoukalo	Operation of a Hydrogen-Powered Vehicle in Antarctica	Mr Peter Magill (UTAS), Dr Kelvin Michael (UTAS)	Second Class, Upper Division
12	Mr Rohan Tepper	Malaysia's Path from Challenger to Consultative Party, Challenges for the Antarctic Treaty System and Australia's role in the use of Second Track Diplomacy	Dr Marcus Haward (UTAS), Dr Julia Jabour (UTAS), Mr Andrew Jackson (UTAS)	Second Class, Upper Division
13	Ms Claire Webb	Relative Impacts of Ozone Depletion and Global Warming on Antarctic Tropospheric Circulation	Prof Bill Budd (UTAS), Dr Kelvin Michael (UTAS)	First Class

Collaboration



The research of the ACE CRC relies strongly on national and international cooperation. The work is often lengthy, large-scale and expensive and collaboration is a critical factor in the success of the work. Drawing on its predecessor, the Antarctic CRC, the ACE CRC has well-established cooperative links with other researchers. A major focus for the CRC in its first year, and in coming years, is to further develop its links with research users nationally and internationally.

Internal

The ACE CRC has established a number of strategies to encourage communication and collaboration between researchers in the first year of the CRC including:

- A range of e-mail groups
- A participants-only area on the web site
- An Annual Symposium
- A weekly seminar series
- Quarterly Executive Committee meetings, at which each Partner and each program is represented
- Program Workshops that occur at least annually.

External

The CRC is expanding its international and national networks to facilitate cooperation in its research and research uptake activities. Significant work is being devoted to building links with research users, with much of the Commercialisation Manager's time being spent on connecting with potential industry users of the research.

Strategies for engagement include:

- Building relationships with opinion-leaders in relevant industry sectors
- An Annual Research Users' Forum to take place in Canberra to engage with the users of the CRC's research. The first of these forums will be held November 2004 and will focus on potential users in government.
- Joint application for grants
- International visits and exchanges
- Regular attendance at international meetings
- Participation in national and international panels, advisory committees and interest groups.

National Collaborative Projects

ACE CRC Researcher(s)	Collaborator	Organisation	Project
Allison I, Young N	Lorenzin G, Puniard D	Geosciences Australia	Defining and mapping the East Antarctic coastline
Bowie A	Townsend A	Central Science Laboratory, University of Tasmania	Iron content of Southern Ocean phytoplankton: implications for carbon transfer to the deep sea
Bowie A	Trull T	UTAS/CSIRO	Targeting organically-complexed iron species in seawater using selective solid-phase adsorbent resins Selenium as a key micronutrient in primary productivity in the Southern Ocean
	Haddad P	School of Chemistry, University of Tasmania	
	Butler E	CSIRO Marine Research	
Bowie A	Mancuso-Nichols C	School of Agricultural Science, University of Tasmania	Exopolysaccharides from Antarctic bacteria
Bowie A	Anthony K	James Cook University	Targeting organically-complexed iron species in seawater using selective solid-phase adsorbent resins
Curran M, Morgan V, van Ommen T, Smith B	Smith A	ANSTO	1. ¹⁰ Be in Antarctic ice 2. Radio-Methane in Antarctic ice

Collaboration

ACE CRC Researcher(s)	Collaborator	Organisation	Project
Haward M	Rothwell D	University of Sydney	Australia's Antarctic Agenda
Haward M Matear R	Bergin A	University of New South Wales	Australia and International and Regional Fisheries Management Southern Ocean Carbon cycling
	McNeil B	University of New South Wales	
Haward M	Vrbancich J	DSTO	Australia and International and Regional Fisheries Management
Michael K	Nunez M	University of Tasmania	Studies of Coral Bleaching at Heron Island, Great Barrier Reef
	Hoegh-Guldberg O and Fine M	University of Queensland	
Rintoul S, Church J, Tilbrook B, Matear R and Hirst T		Australian Greenhouse Office	Australian Greenhouse Office Climate Change Science Program
Rintoul S, Church J, Tilbrook B, Matear R and Hirst T		CSIRO Wealth from Oceans Flagship Program	Biogeochemical modelling; Marine climate change modelling; Marine climate scenarios and impacts
Roberts D and McMinn A	D Gore, Adamson D and Kirkup H	Macquarie University	Palaeoenvironments of the Antarctic coast, from 50E to 120E.
Trull T	Waite A	University of West Australia	Role of large diatoms in Southern Ocean ecosystems
Worby A	Reid J	University of Tasmania	Measurement of sea ice thickness using electromagnetic techniques

International Collaborative Projects

ACE CRC Researcher(s)	Collaborator	Organisation	Country	Project
Allison I, Thost D	Truffer M	Geophysical Institute, University of Alaska, Fairbanks	United States	Dynamics and mass budget of the Brown Glacier, Heard Island
Allison I	Lingen B, Dahe O	Chinese Meteorological Administration	China	Surface meteorological measurements in East Antarctic using automatic weather stations
Allison I	JianCheng K	Polar Research Institute of China	China	Sea ice process, physical/chemical characteristics and climate in the Antarctic
Allison I, Craven M	Zhaoqian D and Yuansheng L	Polar Research Institute of China	China	Amery Ice Shelf - ocean interaction
Allison I	Jiawen R, Cunde, Lanzhou	Institute for Glaciology and Geocryology, Academia Sinica, Lanzhou	China	Surface mass balance of the Lambert Glacier Basin, Antarctica.

Collaboration

ACE CRC Researcher(s)	Collaborator	Organisation	Country	Project
Bowie A	Sedwick P	Bermuda Biological Station for Research	United States	Iron atmospheric inputs to the Sargasso Sea: temporal variability and impact on iron distribution in the upper ocean
	Church T	University of Delaware	United States	
Bowie A	Worsfold P	University of Plymouth	United Kingdom	Targeting organically-complexed iron species in seawater using selective solid-phase adsorbent resins
Bowie A	Boyle E, Bruland K, Coale K, Johnson K, Measures C, Moffett J, Sedwick P, Wu J	Bermuda Biological Station for Research	United States	The certification of iron in seawater (SAFe project)
Bowie A	Blain S and others	Centre d'Océanologie de Marseille	France	KEOPS: Kerguelen: compared study of the ocean and the plateau in surface water
Bowie A	Measures C	University of Hawaii	United States	Trace element (Al and Fe) distributions in upper ocean waters during the CLIVAR repeat hydrography program
	Landing W	Florida State University	United States	
Bowie A	Sedwick P	Bermuda Biological Station for Research	United States	Analytical intercomparison between flow injection–chemiluminescence and flow injection–spectrophotometry for the determination of picomolar concentrations of iron in seawater
	Worsfold P	University of Plymouth	United Kingdom	
Bowie A	Worsfold P, Achterberg E, Gledhill M	University of Plymouth	United Kingdom	Redox and colloidal iron biogeochemistry in surface Atlantic waters and its role in ocean productivity
Church J and White N	Members Jason-1 Science Working Team	NASA and CNES	United States, France	Jason-1
Craven M and Allison I	Carsey F	California Institute of Technology (NASA/JPL)	United States	Deployment of ice borehole probe video camera system
Craven M and Allison I	Yuansheng L	Polar Research Institute of China	China	Dynamics of the Amery Ice Shelf

Collaboration

ACE CRC Researcher(s)	Collaborator	Organisation	Country	Project
Haward M	VanderZwaag D		Canada	Australia – Canada Ocean Research Network
Heil P	Hibler, Hutchings	University of Alaska, Fairbanks	United States	Modelling of fine-scale sea-ice deformation
Matear R	Keller K	Penn State University	United States	Investigating oxygen changes in the Southern Ocean
Matear R	Gruber N	University of California, Los Angeles	United States	Ocean inversion to determine anthropogenic CO2 uptake
Morgan V, van Ommen T, Curran M, Smith B	Mayewski P	Institute for Quaternary and Climate Studies, University of Maine	United States	Trace chemicals in ice cores as indicators of environmental processes
Rintoul S		CLIMA	Italy	Variability of Southern Ocean circulation and air-sea interaction
Rintoul S	Speer K	Florida State University	United States	Direct observations of mixing in the Southern Ocean
Rintoul S	Morrow R	CNES	France	SURVOSTRAL: Surveillance de l’Ocean Austral
Rintoul S	Watanab S	JAMSTEC	Japan	CFC measurements along the CLIVAR I9S and Kerguelen boundary current sections
Rintoul S	Wakatsuchi M and Fukamachi Y	Hokaido University	Japan	Kerguelen Deep Western Boundary Current mooring array
Rintoul S, Church J and Bindoff N	Fukasawa M	JAMSTEC	Japan	The BEAGLE expedition (Blue Earth Global Expedition)
Roberts D and McMinn A	Hodgson D	British Antarctic Survey	United Kingdom	Limnological and near shore diatom communities of Heard Island: proxies of subantarctic change?
Roberts D, McMinn A and van Ommen T	Hodgson D	British Antarctic Survey	United Kingdom	An integrated analysis of climate variability and change in the Antarctic during the last millennium
Roberts D and McMinn A	Zwartz D	University of Utrecht	Netherlands	Palaeoenvironments of the Antarctic coast, from 50E to 120E
	Melles M	University of Leipzig	Germany	
	Rhodes E	Oxford University	United Kingdom	
Trull T	Francois R, Honjo S	Woods Hole Oceanographic Institution	United States	Southern Ocean particle fluxes

Collaboration

ACE CRC Researcher(s)	Collaborator	Organisation	Country	Project
Trull T	Buesseler K	Woods Hole Oceanographic Institution	United States	Upper Ocean Export Processes
Trull T	Dehairs F, Cardinal D, Savoy N, Elskens M	Belgian Antarctic Program	Belgium	Southern Ocean particle characteristics
Trull T	Boyd P, Nodder S	NIWA	New Zealand	Controls on Southern Ocean carbon export
Trull T	Pilskaln C	Bigelow Marine Labs	United States	Southern Ocean particle export in Prydz Bay
Trull T	Sigman D	Princeton University	United States	USA15N of nitrate in the Southern Ocean
Trull T	Bender M	Princeton University	United States	Oxygen isotope approaches to productivity estimation
Warner R	Williams MJM	NIWA	New Zealand	Antarctica's subglacial waters – is frazil ice a vital factor?
Warner R, Young N and Coleman R	Fricker HA and Bassis J	Scripps Institution for Oceanography, San Diego	United States	Monitoring an active rift system at the front of Amery Ice Shelf, East Antarctica
Worby A	Comiso J	NASA/Goddard Space Flight Centre	United States	Analysis of sea ice edge location using satellite and in situ measurements
Worby A	Markus T	NASA/Goddard Space Flight Centre	United States	AMSR validation
Worby A	Warren S, Grenfell T and Brandt R	University of Washington	United States	Regional and seasonal analysis of sea ice albedo
Worby A	Timmerman R	AWI	Germany	Model validation using the ASPeCt sea ice thickness data base
	Goosse H and Fichefet T	Universite de Louvain le Neuve	France	
Worby A	Geiger C	US CRREL	United States	Antarctic sea ice thickness distribution and GIS web site for ASPeCt data base
	van Woert M	US NIC	United States	

Collaboration

Committee Membership: National

ACE Researcher	Committee
Allison I	National Committee for Antarctic Research (AAS)
Allison I	National Committee for Earth System Science (AAS)
Allison I	Antarctic Science Advisory Committee (ASAC), ex-officio
Allison I	Antarctic Research Assessment Committee, Physical Sciences
Butler E	Committee member (Tas representative), Environmental Chemistry Division, Royal Australian Chemical Institute
Butler E	Committee member, Tasmanian State Branch, Royal Australian Chemical Institute
Church J	Member, Permanent Committee for Tides and Mean Sea Level Member, Tasmanian Sea Level Reference Group
Haward M	CCAMLR Consultative Forum
Heil P	Member (co-opted), Australian National Committee for International Polar Year 2007-08
Heil P	Member, Australian Partnership for Advanced Computing EOT committee
Hunter J	Sea Level Reference Group, convened by The Department of Primary Industries, Water and Environment, Tasmania
Trull T	Member, SOLAS-ANZ Science Planning and Implementation Committee

Committee Membership: International

ACE Researcher	Committee
Bowie A	Scientific Committee on Oceanic Research-International Union of Pure and Applied Chemists (SCOR-IUPAC) Working Group 109, "The Certification of Iron in Seawater"
Church J	Member Joint Scientific Committee for the World Climate Research Programme (Officer of JSC from April 2000)
Church J	Vice-Chair, Joint Scientific Committee for the World Climate Research Programme
Church J	Member, Organising Committee for the CLIVAR Science Conference, Washington DC.
Haward M	Deep Sea 2003 Program Committee
Haward M	Australia-Canada Oceans Research (ACORN)
Hunter J	Marine Modelling Centre Advisory Group, Martin Ryan Marine Science Institute, National University of Ireland, Galway
Matear R	Member, Ocean Carbon Cycle Intercomparison Project
Rintoul S	Co-Chair, CLIVAR/CliC/SCAR Southern Ocean Implementation Panel
Rintoul S	SCAR Antarctic Sea Ice Processes and Climate Committee
Trull T	(ASPeCt), Project Scientist WCRP Climate and Cryosphere (CliC) Data Management and Information Panel (DMIP)
Trull T	Member, 116 on Upper Ocean Export Joint Global Ocean Flux Study
Trull T	Member, Belcanto (Belgian Antarctic Carbon Cycle science program) research review committee
Trull T	Member, Global Ocean Observing System (GOOS) Steering Committee
Trull T	Member, Scientific Committee on Oceanographic Research Experts Group
Trull T	Member, Southern Ocean Synthesis Group
van Ommen T	SCAR-ITASE convenor for ITASE climate variability synthesis group. Editorial committee, Annals of Glaciology Volume 39.
van Ommen T	SCAR – ITASE (International Trans Antarctic Scientific Expedition): Convenor, Climate Variability Working Group
van Ommen T	SCAR – ITASE: Australian representative (ad hoc)

Collaboration

International Exchange

Dr Michael Williams from NIWA visited the ACE CRC for four weeks (17th May - 11th June 2004) to collaborate with Dr Roland Warner on their Marsden Fund project “Antarctica’s subglacial waters – is frazil ice a vital factor?”

Dr Helen Fricker from the Scripps Institution for Oceanography (USA) visited the ACE CRC to collaborate with Dr Neal Young, Prof Richard Coleman and Dr Roland Warner on studies of the rifting in the Amery ice shelf.

Dr Julia Jabour co-organised and conducted a workshop on Antarctic science grant application processes for University of Science Malaysia students, held at the Muka Head Marine Research Station, Penang, Malaysia in May 2004.

In May and June 2004, Dr Andrew Bowie visited Dr Grady Hanrahan, California State University, Los Angeles (USA), Dr Peter Sedwick, Bermuda Biological Station for Research and Prof Paul Worsfold, University of Plymouth (UK).

Mr Steve Phipps, a PhD student, visited the Climate Modelling Group at the University of Victoria, British Columbia, Canada, from 22 March to 20 April 2004, as the guest of Dr Andrew Weaver.

Dr Volkmar Damm, of the Federal Institute for Geosciences and Natural Resources, Germany visited Neal Young and Ian Allison in December 2003.

Prof Stephen Warren, of Atmospheric Science, University of Washington, visited Dr Ian Allison and Dr Tony Worby in February 2004.

Dr Vin Morgan and Dr Tas van Ommen were visited by Prof Dorthe Dahl Jenssen, Neils Bohr Institute, University of Copenhagen, Denmark in February - March 2004.

Dr Petra Heil was visited by Prof W Hibler, of the International Arctic Research Center, University of Alaska during March 2004.

Management



Management and Operating

The ACE CRC is staffed by a mixture of cash funded and in-kind staff contributed from a number of its Partners. For 2003/2004 this amounted to an effective 48.96 full time staff, with actual contributions from 111 staff. A high proportion of staff are located at the ACE CRC headquarters at the University of Tasmania's campus in Sandy Bay, Tasmania. Others are located at their Partner locations in Hobart, Melbourne, Canberra and overseas in New Zealand and Germany.

Staff fora are held in Hobart to encourage staff from different locations to meet, and the first annual science symposium was held over two days in late August 2004. The ACE CRC website (www.acecrc.org.au) is an important communication tool for staff, with access to a participants-only section for all ACE CRC policies, templates etc.

The ACE CRC began life with a number of cash funded research, technical and administrative staff that had previously been with the Antarctic and Southern Ocean CRC. These staff are employed under new contracts that began on 1 July 2003. The ACE CRC was fortunate to retain these staff with their excellent blend of research and technical skills and knowledge of Antarctica and the Southern Ocean. We also appreciate that these staff were committed to staying with the previous Antarctic CRC through to its end date, before it was known whether or not the ACE CRC would receive funding.

The cash funded position of Chief Executive Officer was advertised in early 2003 and Professor Bruce Mapstone was appointed in mid 2003, taking up his position in September 2003. Prior to his appointment, Bruce was with the Tropical Reef CRC involved with marine research and senior management.

Associate Professor Tom Trull has been appointed as Deputy Chief Executive Officer. Tom is an ACE CRC Program Leader and is an in-kind contribution from both CMR and UTas. Tom was also the ACE CRC bid team leader and is to be congratulated on all his co-ordinating efforts that resulted in the successful bid.

Program Leaders were in place prior to the ACE CRC start-up and Deputy Program Leaders have also been nominated (see Organisational Structure chart page 10).

Six new research scientist positions were advertised in mid 2003, with two positions filled from these initial advertisements. Re-advertising and worldwide promotion of the opportunities available for scientists with the ACE CRC has resulted in further appointments, though these all have start dates post 30 June 2004. The difficulty in obtaining high quality staff with the required mix of modelling and research skills is a major obstacle for our research programs to overcome and highlights the scarcity of this resource. We are in competition with research institutes worldwide to attract these researchers and many of these institutions are in the position to offer high value remuneration packages and indefinite appointments that Australian institutions, such as ourselves, are hard put to match.

Time spent on maritime voyages and in Antarctica is a vital component of the ACE CRC research. A number of research and technical staff spend considerable amounts of time each year on extended field trips, deploying equipment and collecting data for analysis and computer modelling. We appreciate the enthusiasm and efforts of all these staff and of their families' patience in coping with their time away from home.

The Administration team is under the leadership of the CEO, Professor Bruce Mapstone. The team has been structured to streamline administrative and financial duties and to give due recognition to the commercialisation and communication responsibilities of a CRC.

Ms Vicki Randell is Business Manager, a position she also held with the previous Antarctic CRC. Vicki is responsible for financial reporting and liaison with the CRC Programme. Ms Kerrie Bidwell was appointed Administration Manager in July 2003 and is responsible for much of the day to day running of the CRC and liaison with the various administrative areas of the University of Tasmania. In particular she has been heavily involved with the scientist recruitment efforts.

Ms Christie le Goy took up the position of Manager Commercial Development in early 2004. This position is a three year in-kind contribution from the Tasmanian Department of Economic Development and is based at

Management and Operating

the ACE CRC. Christie is undertaking an assessment of the status of our Intellectual Property rights and ensuring that all staff and students are aware of the commercialisation and utilisation responsibilities inherent in being part of the CRC Programme.

The full time position of Communications Manager was initially held by Dr Donna Roberts and Donna successfully undertook the task of organising the launch of the ACE CRC onboard the icebreaking vessel the *RSV Aurora Australis*, tied up at the Hobart

Port, with Minister McGauran and Tasmanian Lieutenant-Governor Mr Justice Cox present. Ms Katrina Nitschke took over the position in November 2003, joining us from the CRC for Water Quality and Treatment. Katrina is instituting a communications plan for the ACE CRC and has managed the development of the ACE CRC website.

Specified Personnel

Specified personnel as at 30 June 2004

Title and Name	Role in CRC	Contributing Organisation	Time CRC (0.0 - 1.0)
Prof Bruce Mapstone	Chief Executive Officer	ACE CRC	1.0
Dr Stephen Rintoul	CVC Program Leader	CMR	0.25
Dr Stephen Nicol	AME Program Leader	AAD	0.5
Dr Thomas Trull	CO2 Program Leader/ Deputy CEO	CMR/UTas	1.0
Dr John Church	SLR Program Leader	CMR	0.28
Dr Marcus Haward	Policy Program Leader	UTas	0.5
A/Prof Andrew McMinn	Education Program Leader	UTas	0.5
Ms Christie Le Goy	Manager - Commercial Development	TDED	1.0
Ms Vicki Randell	Business Manager	ACE CRC	1.0
Ms Katrina Nitschke	Communications Manager	ACE CRC	1.0

Changes during 2003/2004

Appointments

Prof Bruce Mapstone, Chief Executive Officer
Ms Christie le Goy, Manager – Commercial Development
Ms Katrina Nitschke, Communications Manager

Resignation

Dr Donna Roberts, Communications Manager

Publications



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Communication



Public Presentations, Public Relations & Communications

Communication is essential to the success of the ACE CRC and is strongly supported by the Board and Executive team. For Australia to fully realise the benefits of the ACE CRC's work, and to ensure a continued commitment to its research, the ACE CRC must understand the needs of research users and ensure an on-going engagement with them. The ACE CRC's research needs will be delivered to a range of research users, in a variety of ways that suits their particular needs.

Dr Donna Roberts was Communications Manager from July until September 2003. In November 2003, Katrina Nitschke assumed the role.

The ACE CRC Communication Strategy, developed early in 2004, provides a framework for communication activities within the ACE CRC. The first year of communications activity in the ACE CRC focused on establishing the foundation – the necessary processes and frameworks – for effective communication. The following years will build on these foundations to achieve further goals, especially those focussed on external stakeholders in the ACE CRC and relevant industry sectors.

The major communication goals of the ACE CRC over the next six years, as outlined in the Communications Strategy, are:

1. Researchers involved in the ACE CRC have sense of community and common purpose. A strong corporate culture exists, strengthening staff and student commitment to the organisation and fostering collaborative work among participants.
2. There is effective two-way communication between all staff and students within the ACE CRC and knowledge about research and other activities flows between and across programs and the administration team.
3. The ACE CRC Executive is supported in encouraging consideration of the life of the CRC post 2010.
4. Partner representatives are aware of the work of ACE CRC
5. Partners gain value from their involvement with ACE CRC
6. Partners gain the benefit of ACE CRC research
7. The ACE CRC Board is supported in considering the life of the CRC post 2010.
8. Key stakeholders have an awareness of the ACE CRC and its role, achievements and value to Australia
9. High quality students join the ACE CRC postgraduate education program
10. There is ongoing engagement in CRC research by private sector organizations
11. Links between the ACE CRC and other relevant research and development activities are strong, within Australia and internationally
12. ACE CRC research contributes to evidence-based decision-making by local, state and federal government in the realms of Antarctica, the Southern Ocean, global and regional climate changes and their impacts
13. Private industry in Australia uses ACE CRC research to plan for the impacts of climate change
14. The CRC Programme and its objectives are promoted
15. The Australian community has an increased understanding of Antarctica, the Southern Ocean and climate change

Communications Advisory Committee

The ACE CRC has established a Communications Advisory Committee to advise the CEO, Executive Committee and Board of the ACE CRC. This Committee consists of representatives of each of the Partners of ACE and exists to maximise collaboration and minimise conflict between the communication activities of ACE CRC and the activities of partner organisations. The Communications Coordinating Committee met once in this reporting period.

Communication Activities

In its first year, the ACE CRC has started building the framework for its communication activities over the next seven years. This year, the ACE CRC has:

- Held a major event to launch the ACE CRC, with guests including the Lieutenant-Governor of Tasmania, Justice Cox; the Minister for Science, the Hon Peter McGauran; and representatives from major stakeholders
- Published a book highlighting the achievements of the CRC for Antarctica and the Southern Ocean
- Developed an information-rich web site. The site is now gaining around 350 unique visitors a month
- Produced information brochures for the ACE CRC and each of the Programs

Public Presentations, Public Relations & Communications

- Developed a collection of graphics resources for staff and students
 - Produced a display for use at public events
 - Held a media training course for staff and students
 - Distributed seven media releases
 - New Era in Antarctic Research
 - \$23.5 Million Antarctic Research Centre
 - Marine Science Boost in New Study Agreement
 - CRC Research Benefits the Nation: Coastal, climate change, salinity and water quality research saves \$
 - Volunteers to Monitor Shoreline Erosion
 - More Storms and Surges with Warmer Conditions
 - Warning on Biotreasure Hunt in Deep Waters
 - Begun building effective relationships with key media, briefing journalists and editors on emerging issues and participating in public debate as appropriate. ACE CRC researchers have participated in numerous media interviews (Appendix A1), leading to at least 1.4 million potential print impressions
 - Participated in many public meetings (Appendix A2) and other events to communicate with ACE CRC stakeholders. Researchers from the ACE CRC have presented at 75 events over the 2003-04 period.
- A full list of ACE CRC researchers meeting participation and public presentations is available in Appendix A on p68.
- A full list of media interviews conducted by ACE CRC researchers is available in Appendix B on p 71.

Grants and Awards



Grants and Awards

Researchers (ACE CRC researchers in bold)	Project	Granting Body	Duration	Amount (A\$'000)
Allison I (AAD)	Lead Author, Intergovernmental Panel on Climate Change, Fourth Assessment Report	Australian Greenhouse Office	2004-2006	48.4
Allison I (AAD)	Sea ice thickness distribution in the Indian Ocean sector of the Southern Ocean	Australian Antarctic Research Program	2003/04-2007/08	244
Allison I (AAD), Bindoff N (TPAC), Lytle V , Craven M (AAD)	Ice shelf - ocean interaction in the cavity beneath the Amery Ice Shelf	Australian Antarctic Research Program	2003/04-2006/07	1,898
Allison I (AAD)	The drift of Antarctic sea ice	Australian Antarctic Research Program	2003/04-2007/08	N/A
Allison I and Morrissy (AAD)	Ice sheet-atmosphere interaction and surface climatology of interior Antarctica	Australian Antarctic Research Program	2003/04-2007/08	N/A
Bindoff N (TPAC), Heil P (AAD), Roberts JL , Phipps SJ and Petrelli P (TPAC)	Water mass formation in a coupled Earth systems model	APAC Merit Allocation Scheme	2004	400
Bindoff N (TPAC), Heil P (AAD), Roberts JL , Phipps SJ and Petrelli P (TPAC)	Stimulating the Southern Ocean with an active sea ice model	APAC Merit Allocation Scheme	2003	400
Bindoff N (TPAC), Roberts JL , Church JL (CSIRO)	High resolution scenarios and validation of global change on the Southern Ocean since the 1950s	APAC Merit Allocation Scheme	2003	520
Bowie A (UTAS)	Targeting organically-complexed iron species in seawater using selective solid-phase adsorbent resins	Australian Research Council: Discovery - Projects	April 2003 - March 2006	275
Bowie A (UTAS), Townsend A (Central Science Laboratory)	Iron content of Southern Ocean phytoplankton: implications for carbon transfer to the deep sea	Department of Environment and Heritage: Australian Antarctic Science grant	July 2002 - June 2004	8.3
Butler E (CSIRO)	Selenium as a key micronutrient in primary productivity in the Southern Ocean	Australian Antarctic Science (AAS) Grant	2004/05-2006/07	122

Grants and Awards

Researchers (ACE CRC researchers in bold)	Project	Granting Body	Duration	Amount (A\$'000)
Curran M (AAD), Budd WF, (UTAS), Morgan V (AAD), Pook M (CSIRO), van Ommen TD (AAD)	Antarctic climate History from ITASE ice coring in Eastern Wilkes Land	Australian Antarctic Science (AAS) Grant	1999-2004	N/A
Gale F and Haward M (UTAS)	'Supporting or Sabotaging Sustainable Development: State Responses to Environmental Certification Schemes'	ARC Discovery	2004 -2006	150
Goodwin I (Uni Newcastle), Curran M , van Ommen TD (AAD)	Holocene sea-ice history: the association between deep-sea and continental ice core records	Australian Antarctic Science (AAS) Grant	2003	26.5
Gore D (Macquarie University), McMinn A , Roberts D (UTAS), Zwartz D (University of Utrecht), Adamson D (Macquarie University), Melles M (University of Leipzig), Rhodes E (Oxford University) and K Hirkup (Macquarie University)	Palaeoenvironments of the Antarctic coast, from 50E to 120E	Antarctic Science Advisory Committee	1998/99-2003/04	11.3
Haward M , Hurry G and Evans N (UTAS)	'Regional Marine Plans: Fisheries Management Challenges under the Australian Oceans Policy'	ARC Spirt	2001-2003	158.6
Heil P (AAD)	Investigation of Southern Ocean sea ice with a high-resolution coupled ice-ocean model	APAC Merit Allocation Scheme	2004	20
Heil P (AAD), Bindoff N (TPAC)	Implementation of a novel sea-ice model	Australian Antarctic Science (AAS) Grant	2004-2006	N/A
Heil P and Allison I (AAD)	Variability of the coastal Antarctic climate derived from fast-ice observations	Australian Antarctic Research Program	2004-05	N/A
Heil P , Allison I (AAD)	Variability of the coastal Antarctic climate derived from fast-ice observations	Australian Antarctic Science (AAS) Grant	2004-2008	N/A

Grants and Awards

Researchers (ACE CRC researchers in bold)	Project	Granting Body	Duration	Amount (A\$'000)
Hindell M, Michael K, Coleman R (UTas), Bindoff N (UTas/CSIRO), Rintoul S (CSIRO)	Winter Temperature and Salinity Profile Measurements in the Southern Ocean Using Elephant Seals as Ocean Sampling Platforms	ARC Discovery	2003-2006	230
Howard WR (ACE CRC)	Oceanographic and climatic evolution of Kerguelen Plateau region: Collaborative research aboard the Japanese research vessel Mirai	Japan Marine Science and Technology Center	2003-2004	13
Hunter J (ACE CRC)	Contribution for equipment purchase	Sorell Council, Tasmania	Indefinite	1.2
Hunter J (ACE CRC)	Land and Coast Care Grant	Clarence City Council, Tasmania	indefinite	2.4
Jabour J (UTAS)	Australia's strategic policy position in the International Whaling Commission	Institutional Research Grants Scheme	2003-2004	5
Johnson K (MBARI, USA), Bowie A (UTAS)	Sampling and Analysis of Iron (SAFe), an International Collaboration	National Science Foundation: Chemical Oceanography (USA)	Oct 2003 – Sept 2005	9.6
Kellow A (UTAS) and Haward M (UTAS)	'Federalism and International Risk Management'	ARC Discovery	2002-2004	90
Massom R, Allison I (AAD), Bindoff N (TPAC), Lytle V, Michael and Worby A	Sea ice remote sensing validation experiment	Australian Antarctic Research Program	2003/04-205/6	3510
Michael K (UTas)	Ocean Colour Measurements in the East Antarctic Sea Ice Zone	Australian Antarctic Science Grant	2003-04	1.2

Grants and Awards

Researchers (ACE CRC researchers in bold)	Project	Granting Body	Duration	Amount (A\$'000)
Michael K (UTas)	Funds for a scholarship and production material to encourage research into relevant Tasmania Antarctic Industry	Tasmanian State Government	2003/04	20
Michael K , Nunez M (UTas)	Measurement and Modelling of Water Transmission in and around Heron Reef at Visible and Ultraviolet Wavelengths	IRGS	2003-04	18.3
Michael K , Nunez M (UTas), A Davidson (AAD)	UV Climate over the Southern Ocean South of Australia and its Biological Impact	Australian Antarctic Science Grant	2003-04	13.9
Morgan V, van Ommen T, Curran M and Smith B (AAD)	Ice core paleoclimatology	Australian Antarctic Science (AAS) Grant	1994-2006	
Phipps SJ (UTAS) and van Ommen TD (AAD)	Simulating the climate of the last glacial cycle	Australian Partnership for Advanced Computing	1 July 2003 – 30 June 2004	135.7
Phipps SJ , Budd WF (UTAS) and van Ommen TD (AAD)	Modelling the climate of the Last Glacial Maximum	Australian Partnership for Advanced Computing	1 July 2003 – 30 June 2004	80
Roberts D, McMinn A (UTAS) and Hodgson D (British Antarctic Survey, UK)	Limnological and nearshore diatom communities of Heard Island: proxies of subantarctic climate change?	Antarctic Science Advisory Committee	2003-04	2.7
Sedwick P (Bermuda Biological Station for Research), Church T (University of Delaware, USA), Bowie A (UTASCRC)	Iron Atmospheric Inputs to the Sargasso Sea	National Science Foundation: Chemical Oceanography (USA)	Jan 2003 - Dec 2005	524.5
Swadling K (UTas) and Trull T (UTas/CSIRO), Buesseler K (Woods Hole Oceanographic)	VERTIGO – Vertical Particle Flux in the Global Ocean	UTas Internal Research Grant Scheme	Jan 2003 - June 2004	21

Grants and Awards

Researchers (ACE CRC researchers in bold)	Project	Granting Body	Duration	Amount (A\$'000)
Thost D, Allison I (AAD), Truffer (Geophysical Institute, University of Alaska)	Heard Island glacier fluctuations and climatic change	Australian Antarctic Research Program	2003/4	630
Trull T (Utas/CSIRO), Bray S (ACE CRC)	Tissue Turnover Time in Antarctic Krill Euphausia SuperbaK	Australian Antarctic Science (AAS) Grant	2003-2004	1200
Trull T (UTas/CSIRO), Griffiths FB (CSIRO)	PULSE Mooring Service Visit	CSIRO Major Item of Equipment fund	Sept 2003- Sept 2006	137
Trull T (Utas/CSIRO), Honjo S and Francois R (Woods Hole Oceanographic)	Particle export and reminerlization in the Southern Ocean south of Australia:A WHOI contribution to the Australian "SAZ project Subantarctic zone mooring study of interannual variability in particulate carbon export	US National Science Foundation, Office of Polar Programs July	2001-2004	850
Trull T (UTas/CSIRO), Matear R (CSIRO) and others	Equipment for autonomous moored observations of upper ocean biogeochemical properties	US National Science Foundation Chemical and Biological Oceanography	Jun 2003 - Jun 2006	220
Williams M (NIWA) and Warner R (AAD)	Antarctica's subglacial waters – is frazil ice a vital factor?	Royal Society of New Zealand Marsden Fund	2004-2006	90
Young N, Allison I, Michael, Worby A, Lytle V (AAD)	Validation of CryoSat Sea Ice Thickness Measurements in Antarctica	European Space Agency	2004/05	N/A
			TOTAL	11 167.6

Awards and Other Recognition

Petra Heil and colleagues won the Best Technical Paper award at APAC 2003 for their paper: Heil P, Roberts JL, Phipps SJ, Fiedler RAS and Bindoff NL (2003) Toward a high-resolution coupled ocean-sea ice model, *Proceedings of the APAC Conference on Advanced Computing, Grid Applications and eResearch*, ISBN 0-9579303-1-3, 10pp.

PhD student **John Court** won the award for the Best Commencing Student presentation at APAC 2003.

Heil P, Roberts JL, Phipps SJ, Fiedler RAS and Bindoff NL (2003) Toward a high-resolution coupled ocean-sea ice model, *Proceedings of the APAC Conference on Advanced Computing, Grid Applications and eResearch*, ISBN 0-9579303-1-3, 10pp.

PhD student **Elli Widolf** secured an IASOS travel grant to the sum of \$400 to assist in travels to the 10th International Symposium on Society and Resource Management (ISSRM).

PhD student **Frederique Olivier** received an Australian Geographic Society Award of \$1100 for her work on Southern Ocean seabirds.

Barbara Smith is Convenor of the Tasmanian Link Group of the Women in Science Enquiry Network (WISNET) and is also a volunteer mentor in the Women Tasmania mentoring program (Cosgrove High School).

Julia Jabour was awarded a University of Tasmania Teaching Merit Certificate in 2003.

Performance Measures



Performance Measures

CRC Programme Objective 1: To enhance the contribution of long-term scientific and technological research and innovation to Australia's sustainable economic and social development

Centre Objectives	Performance Measures	Achievement 2003-04
1.1 Advance Australia's aspirations for its Antarctic territory and Southern Ocean exclusive economic zones.	<p>International commitment to Australia's claims is augmented by wise stewardship. ACE will provide scientific leadership necessary to this stewardship.</p> <p>Performance measures include:</p> <ol style="list-style-type: none"> 1. Use of ACE research by EA, AGO, and other Australian agencies in their international discussions, regulatory activities and management decisions. 2. Broad recognition by the international community that Australian Antarctic climate and ecosystem science is of the highest quality, and is targeting essential issues. 	<p>ACE CRC researchers sit on 11 national and 28 international committees relating to Antarctic and Southern Ocean research/management and climate change prediction and analysis</p> <p>ACE CRC researchers published 67 refereed papers, 50 conference papers, seven book chapters and 26 other papers</p>
1.2 Increase international engagement in Southern Ocean and Antarctic research relevant to Australia's interests.	Commitment by other nations to undertake scientific research in the Australian Antarctic territory and in the Southern Ocean south of Australia in collaboration with ACE.	ACE CRC has 38 international collaborations, involving 10 countries, relating to Antarctica, the Southern Ocean and/or climate change

CRC Programme Objective 2: To enhance the transfer of research outputs into commercial or other outcomes of economic, environmental or social benefit to Australia

Centre Objectives	Performance Measures	Achievement 2003-04
2.1 To develop new approaches to the forecasting of ocean and ice conditions, which can be implemented for operational use by partner and other agencies.	1. Uptake of these approaches by operational agencies.	Research projects initiated
2.2. To provide science for the assessment of sustainable ecosystem management.	1. Use of these outputs by management agencies.	Successful scientist recruitment program
2.3 To ensure recognition of oceanic carbon sinks and their impacts, to contribute to the effective management of carbon dioxide emissions.	1. Consideration of ocean carbon sinks in carbon management plans and agreements.	Research projects initiated
2.4 To provide observations essential to the consideration of climate change and variability in economic and environmental planning.	<ol style="list-style-type: none"> 1. Improved assessments of climate variability and change, and 2. Increased reference to this information by economic and environmental research users. 	Research projects initiated

Performance Measures

CRC Programme Objective 3: To enhance the value to Australia of graduate researchers

Centre Objectives	Performance Measures	Achievement 2003-04
3.1 To become a major training centre for climate, marine, and ecosystem science.	1. Increased recognition of Hobart as a top educational centre in these areas.	First intake of ACE CRC postgraduate students and awarding of ACE CRC scholarships
3.2 To deliver students with interdisciplinary skills useful to the climate, marine, and ecosystem research and research-user communities.	1. Successful placement of students within these communities.	Seven of 11 (63%) completing postgraduate students took up employment with industry/research using groups

CRC Programme Objective 4: To enhance collaboration among researchers, between researchers and industry or other users, and to improve efficiency in the use of intellectual and other research resources

Centre Objectives	Performance Measures	Achievement 2003-04
4.1 To undertake interdisciplinary research which is larger in scope than the interests of individual participants.	1. Number of projects involving multiple participants 2. Degree to which participants view the research as larger than the sum of its parts.	15 of 22 (68%) research projects involved multiple participants
4.2 To undertake research of direct value to research-users.	1. Number and success of projects involving research users in their design and completion.	Development of Research Users' Forum proposal

Appendices



Appendix A: Public Meetings and Presentations

ACE Researcher	Meeting/Presentation
Allison I	Joint Standing (Parliamentary) Committee on the National Capital and External Territories "Enquiry into the adequacy of funding for the National Antarctic program", Hobart
Allison I	XXIII General Assembly of the International Union of Geodesy and Geophysics (IUGG), 5-12 July 2003, Sapporo, Japan
Allison I	National Committee for Antarctic Research, 22 July 2003, Melbourne
Allison I	Final Science Conference of WCRP Arctic Climate System Study, 11-14 November 2003, St Petersburg, Russia
Allison I	Meeting of the Scientific Steering Group of WCRP Climate and Cryosphere project, 16-18 November 2003, St Petersburg, Russia
Allison I	Second meeting of the ICSU International Polar Year Planning Group, 17-19 December 2003, Paris, France
Allison I	Third meeting of the ICSU International Polar Year Planning Group, 31 March – 3 April 2004, Paris, France
Allison I	Antarctic Glaciology summer school of the Polar Research Institute of China, 11- 21 May 2004, Shanghai, China
Allison I	The Antarctic ice sheet and sea ice, QANTAS Antarctic sight-seeing flights, February 1, 5 and 8 2004
Allison I	Antarctic sea ice, Hobart Midwinter Festival, June 26, 2004
Allison I	The International Polar Year 2007-2008 , Antarctic Division Seminar, May 5 2004
Adams N	AMPS-AMRC workshop, Hobart
Bowie A	ACE CRC 'Ocean Control of CO ₂ ' program workshop, Hobart
Bowie A	KEOPS cruise planning workshop (12 Feb 2004) Hobart
Bowie A	American Society of Limnology & Oceanography – The Oceanography Society (ASLO-TOS) Ocean Research Conference, Honolulu, USA
Bowie A	Project FeATMISS: Iron ATMospheric Inputs to the Sargasso Sea, Australian Centre for Research on Separation Science, Hobart
Church J	CSIRO Climate Forum, Melbourne
Church J	27 th Meeting Permanent Committee of Tides and Mean Sea Level, Sydney
Church J	Australian Greenhouse Office, Future Climate Change Science Workshop, Melbourne
Church J	CSIRO Complex System Symposium, Sydney
Church J	Australian Greenhouse Office, Climate Change Workshop, Canberra
Church J	21 st Session of the Intergovernmental panel on Climate Change, Vienna, Austria
Church J	9 th Session of the Intergovernmental panel on Climate Change, Working Group 1, Vienna, Austria
Church J	JSC Officers Meeting, Geneva, Switzerland
Church J	GLOSS Sea Level Training Course, Kuala Lumpur, Malaysia
Church J	JSC Meeting, Moscow, Russia
Church J	Coast to Coast Conference Hobart
Church J	CLIVAR/WCRP Ocean Modelling Workshop, Princeton, USA
Church J	CLIVAR Conference, Baltimore, USA

Appendix A: Public Meetings and Presentations

ACE Researcher	Meeting/Presentation
Church J	CLIVAR SSG Meeting, Baltimore, USE
Court J	Modelling the dynamics of the Antarctic Ice Sheet APAC '03 The APAC Conference and Exhibition on Advanced Computing, Grid Applications and eResearch, Student Forum Gold Coast
Craven M	AMISOR 2003-04, Hot Water Drilling, Aurora Australis (at sea)
Craven M	AMISOR 2003-04, Hot Water Drilling, Davis Station, Antarctica
Craven M	Antarctic Glaciology University of the 3 rd Age, Hobart
Craven M	AMISOR 2003-04, The Abyss, Hobart
Haward M	Deep Sea 2003, Queenstown, New Zealand
Haward M	Outlook 2004, Canberra
Haward M	Australasian Political Studies Association Conference, Hobart Australia
Heil P	AGU's START Conference on Global Climate Change, UNESCO, Trieste, Italy
Heil P	APAC Education workshop, Gold Coast
Heil P	APAC03 Conference on Advanced Computing, Grid Applications and eResearch, Gold Coast
Heil P	APAC2 Planning Projects Workshop ANU, Canberra
Heil P	AusComm workshop, BMRC, Melbourne
Heil P	MPI Applications and Optimization workshop. University of Tasmania, Hobart
Jabour J	Invited presenter, "Imaging Nature: Environment, Media and Tourism" Conference, Cradle Mountain, Tasmania
Jabour J	Invited debater, Antarctic Midwinter Festival Great Debate on Antarctic Tourism, Hobart
Jabour J	Convenor and facilitator, public screening of documentary "What to do about whales", and discussion, Hobart
Jabour J	Participant, 2 nd International Seminar on Antarctic Science, Penang, Malaysia
Jabour J	Invited participant, International Association of Antarctica Tour Operators (IAATO) annual meeting, Christchurch, New Zealand
Jabour J	Invited participant in workshops by Tasmanian Government and Tasmanian Polar Network to develop Antarctic and sub-Antarctic Policy, Hobart
Jabour J	Invited presenter, Deep Sea 2003. "Report from Bioprospecting in the High Seas" Workshop. Queenstown, New Zealand
Jabour J	Convenor, "Bioprospecting in the High Seas" – a workshop sponsored by UN FAO, Dunedin, New Zealand
Hunter J	Tasmanian Climate Change Briefing (to Tasmanian State and Local Government) CSIRO, Hobart
Hunter J	Sea level in Tasmania from 1841 to the present: the results of the Port Arthur Sea Level Study. Martin Ryan Marine Institute, National University of Ireland, Galway, Ireland
Hunter J	Sea level in Tasmania from 1841 to the present: the results of the Port Arthur Sea Level Study Scottish Association for Marine Science, Dunstaffnage Marine Laboratory, Oban, Scotland
Hunter J	Sea level rise: Is it happening? Is it important? Our Climate in Crisis, Impacts and Solutions. Tasmanian Environment Centre, Hobart
Hunter J	The proposed Ralphs Bay development: environmental issues. Public meeting, Lauderdale, Tasmania

Appendix A: Public Meetings and Presentations

ACE Researcher	Meeting/Presentation
Massom RA	Joint AMSR/AMSR-E Science Team Meeting, Monterey, USA
Matear R	ANU future directions, Canberra
Matera R	Pacific Carbon Cycle Meeting, Seattle, USA
Michael K	Second Malaysian International Seminar on Antarctica, Penang, Malaysia
Olivier F	Impacts of marine debris in the southern ocean: how much are seabirds affected? Hobart
Olivier F	Variation of snow petrel breeding success in relation to sea ice extent: local response to large scale processes? Hobart
Olivier F	Variation of snow petrel breeding success in relation to sea ice extent: local response to large scale processes? Hobart
Phipps SJ	1 st General Assembly of the European Geosciences Union, Nice, France
Rintoul S	1 st International CLIVAR Science Conference: Understanding and Predicting Our Climate System, Baltimore, USA
Rintoul S	CLIVAR Working Group on Ocean Model Development GFDL, Princeton, USA
Rintoul S	CLIVAR/CLiC/SCAR Southern Ocean Implementation Panel and Southern Ocean Science Week, Bremerhaven, Germany
Roberts A	European Geophysical Union 1 st General Assembly April 2004 Nice, France
Roberts D	Antarctic Geoscience Forum, University of Tasmania, Hobart
Roberts J	AusCOM workshop, Bureau of Metereology, Melbourne
Roberts J	SC2003, Phoenix, USA
Smith B	Working in Antarctica Matthew Pearce Primary School Sydney
Smith B	Ice Coring in Antarctica Last Summer, Hobart
Smith B	Ice Coring in Antarctica Last Summer Probus New Town, Hobart
Smith B	Ice Coring in Antarctica Last Summer Mid-Winter Festival/WISENET/Women Tasmania, Hobart
Smith B	InterIce Meeting (Ice core laboratory management) University of Milano, Bicocca, Italy
Smith B	7 th International Symposium on Antarctic Glaciology University of Milano Bicocca, Italy
Trull T	ASLO-TOS Ocean Sciences Conference, Honolulu, USA
Trull T	Experts Group Meeting on Upper Ocean Export, Wrigley Marine Institute, USA
Trull T	IFREMER Australia-France Collaborations – presentation of ACE CRC programs, Hobart
Trull T	Teaching Matters 2003, University of Tasmania, Hobart
Trull T	ACE CRC Launch, Hobart
Trull T	Belgium Antarctic Carbon program (BELCANTO) Research Users Review, Brussels, Belgium
Trull T	Governor's Forum on Antarctica, Hobart
Trull T	Japan-Australia 2001-2002 marine annual cycle synthesis along 140E. Hobart
van Ommen T	Seventh International Symposium on Antarctic Glaciology, Milan, Italy
van Ommen T	Australian Antarctic Science Advisory Committee – Australian Antarctic Science Strategic Plan 2004/5-2008/9 Workshop, Hobart.

Appendix B: Media Interviews

Researcher	Media Outlet	Topic	Date
Butler E	ABC Local Radio (Hobart)	Mercury in fish	March 2004
Craven M	ABC Radio News	Amery Ice Shelf drilling	November 2003
	The Mercury	Amery Ice Shelf drilling	November 2003
	ABC Radio & Online "News in Science"	Amery Ice Shelf glaciological research	November 2003
	The Sydney Morning Herald	Ice shelves and climate change	November 2003
Hunter J	The Mercury	Shoreline Monitors Needed	April 2004
	ABC TV News (TAS)	Sea level rise in Tasmania	June 2004
	ABC Television, Stateline	Sea level rise	August 2004
	Smithsonian Magazine	Sea level rise at Tuvalu	December 2003
	ABC Radio, Country Hour	Sea level rise and shoreline movement	April 2004
	Graeme Mitchell Radio 2SM	Sea level rise	April 2004
	ABC Radio, Earthbeat	Sea level rise: effect on proposed canal development	June 2004
Jabour J	ABC NW Queensland radio	Antarctic Tourism	April 2004
	Australasian Science	Bioprospecting in Antarctica	February 2004
	ABC Radio Cairns	Bioprospecting in Antarctica	February 2004
	Radio NZ	Bioprospecting in the High Seas	February 2004
Mapstone B	The Australian Financial Review	Research money tied to returns	February 2004
	The Australian Financial Review	Out of the dish, into dollars	February 2004
	ABC Local Radio (Hobart)	The research of the ACE CRC	March 2004
	ABC TV News (Hobart)	launch of the ACE CRC	September 2003
Matear R	The Sydney Morning Herald	Abrupt Climate Change	February 2004
	The Sydney Morning Herald	Chilling global forecast	March 2004
	The Age		March 2004
	ABC Local Radio (Hobart)		March 2004
	ABC Science OnLine		March 2004
McInnes K	The Canberra Times	Grim outlooks as sea levels rise	April 2004
	The Courier Mail	Coastline to weather rising tides	April 2004
	ABC Radio National Countrywide	extreme events	April 2004
	Herald Sun	Rising Oceans Warning	April 2004
	ABC National Radio	Extreme events	April 2004
	ABC TV News (QLD)	Extreme events	April 2004
	ABC TV News (TAS)	Extreme events	April 2004

Appendix B: Media Interviews

Researcher	Media Outlet	Topic	Date
	ABC Local Radio (WA)	Extreme events	April 2004
	ABC Local Radio (QLD)	Extreme events	April 2004
	ABC Local Radio (QLD)	Extreme events	April 2004
	ABC Local Radio (QLD)	Extreme events	April 2004
	ABC Local Radio (TAS)	Extreme events	April 2004
	ABC Local Radio (TAS)	Extreme events	April 2004
	ABC Local Radio (TAS)	Extreme events	April 2004
Rintoul S	ABC Radio National: The World Today	Antarctic Circumpolar Current transport	July 2003
	ABC Local Radio (WA)	Antarctic Circumpolar Current transport	July 2003
	ABC Local Radio (QLD)	Antarctic Circumpolar Current transport	July 2003
	ABC TV (Hobart)	Antarctic Circumpolar Current transport	July 2003
	The Mercury	Antarctic Circumpolar Current transport	July 2003
	The Age	Antarctic Circumpolar Current transport	July 2003
	Science News	Oceans Aswirl	July 2003
	German national public radio	Argo floats	March 2004
	ABC TV Lateline (National)	Abrupt climate change	May 2004
	ABC Radio National: Earthbeat	Abrupt climate change	May 2004
	QLD - State Television News	Southern Ocean monitoring	April 2004
	TAS - Regional Radio	Southern Ocean monitoring	April 2004
Trull T	ABC Radio National: Country Hour	The value of ACE CRC research to primary producers	July 2003
	WIN TV (Hobart)	The new ACE CRC	July 2003
	ABC TV Stateline (National)	The new ACE CRC	September 2003
van Ommen T	ABC Hobart Radio	The Day After Tomorrow (film commentary)	June 2004
	ABC Sydney Radio	EPICA Antarctic Nature Paper (comment) and The Day After Tomorrow (film)	June 2004
	ABC Hobart Radio	EPICA Antarctic Nature Paper (comment)	June 2004
	ABC Radio National–The World Today	Sea-ice MSA paper in Science magazine	November 2003
	The Age	Sea-ice MSA paper in Science magazine	November 2003
	Southern Cross TV News Hobart	Sea-ice MSA paper in Science magazine	November 2003

Appendix C: Research Staff Resources

Name	Total % Time	AME	CO2	CVC	POL	SLR	Rsch Total	Edu	Comm Istn	Admin
Australian Antarctic Division – In-Kind										
Dr I Allison	100%	10%		40%		50%	100%			
Dr J Anderson	100%					100%	100%			
Dr I Ball	10%	10%					10%			
Mr H Brolsma	20%					20%	20%			
Dr A Constable	17%	17%					17%			
Dr M Craven	100%			100%			100%			
Dr M Curran	95%			95%			95%			
Dr A Davidson	25%		25%				25%			
Mr A Elcheikh	100%			50%		50%	100%			
Mr Handsworth	80%					80%	80%			
Dr P Heil	37%			37%			37%			
Mr G Hyland	100%			100%			100%			
Dr J Jacka	8%					8%	8%			
Dr S Jarman	10%	10%					10%			
Mr S Kawaguchi	10%	10%					10%			
Dr V Lytle	95%	20%		75%			95%			
Dr H Marchant	20%	10%	10%				20%			
Dr MD McDonnell	50%					50%	50%			
Dr A McMorrow	14%					14%	14%			
Dr V Morgan	92%			70%		22%	92%			
Dr S Nicol	50%			40%			40%		10%	
Mr M Richardson	80%			40%		40%	80%			
Mr A Roberts	54%			54%			54%			
Dr B Smith	100%			50%		50%	100%			
Dr D Thost	100%					100%	100%			
Dr T van Ommen	100%			75%		25%	100%			
Dr R Warner	100%			25%		75%	100%			
Dr A Worby	92%	9%	83%				92%			
Dr S Wright	60%	10%	50%				60%			
Mr N Young	100%					100%	100%			
Dr PR Zwart	12%			12%			12%			
	1931%	106%	168%	863%	0%	784%	1921%	0%	10%	0%
Commonwealth Bureau of Meteorology – In-Kind										
Dr N Adams	20%			10%		10%	20%			
Dr O Alves	25%			25%			25%			
Dr D Greenslade	25%			25%			25%			
Mr J Kepert	25%			25%			25%			

Appendix C: Research Staff Resources

Name	Total % Time	AME	CO2	CVC	POL	SLR	Rsch Total	Edu	Comm Istn	Admin
Dr N Smith	25%			25%			25%			
Ms F Tseitkin	50%			30%		20%	50%			
Total	190%	0%	0%	160%	0%	30%	190%	0%	0%	0%
CSIRO Division of Atmospheric Research – In-Kind										
Dr T Hirst	8%			8%			8%			
Dr K McInnes	37%					37%	37%			
Dr S O'Farrell	16%			6%		10%	16%			
Total	61%	0%	0%	14%	0%	47%	61%	0%	0%	0%
CSIRO Division of Marine Research – In-Kind										
A/Prof N Bindoff	30%			30%			30%			
Dr E Butler	29%		29%				29%			
Dr J Church	28%			4%		24%	28%			
Dr B Griffiths	30%		30%				30%			
Dr S Marsland	100%			100%			100%			
Dr R Matear	42%		42%				42%			
Dr S Rintoul	25%			25%			25%			
Dr B Tilbrook	51%		51%				51%			
A/Prof T Trull	50%		50%				50%			
Dr N White	59%					59%	59%			
Total	444%	0%	202%	159%	0%	83%	444%	0%	0%	0%
University of Tasmania – In-Kind										
A/Prof N Bindoff	50%			35%		10%	45%		5%	
Prof R Coleman	10%			10%			10%			
Prof L Forbes	15%		5%				5%	10%		
Dr R Hall	10%				10%		10%			
Dr M Haward	50%				25%		25%	15%	10%	
Ms M Hazlewood	25%									25%
Dr J Jabour	50%				30%		30%	20%		
Dr G Jackson	35%	10%					10%	25%		
Prof A Kellow	10%				10%		10%			
Dr L Kriwoken	13%				13%		13%			
Dr G Lugten	25%				25%		25%			
A/Prof A McMinn	50%	25%					25%	15%	10%	
Dr K Michael	25%							25%		
Dr M Nunez	15%		15%				15%			
A/Prof T Trull (UTas)	50%	10%	20%				30%	5%	10%	5%
Total	433%	45%	40%	45%	113%	10%	253%	115%	35%	30%

Appendix C: Research Staff Resources

Name	Total % Time	AME	CO2	CVC	POL	SLR	Rsch Total	E	Comm Istn	Admin
Alfred Wegener Institute (Germany) – In-Kind										
Dr E Fahrbach	41%			41%			41%			
Dr C Haas	46%			46%			46%			
Hydrographer	40%			40%			40%			
Dr J Schroter	11%					11%	11%			
Prof U Bathmann	13%	13%					13%			
A Pfaffling	85%			85%			85%			
D Otto	17%			17%			17%			
I Richter	19%			19%			19%			
M Wenzel	55%					55%	55%			
Total	330%	13%	0%	251%	0%	67%	330%	0%	0%	0%
Australian National University – In-Kind										
Prof K Lambeck	15%					15%	15%			
T Purcell	15%					15%	15%			
Dr P Tregoning	5%					5%	5%			
Total	35%	0%	0%	0%	0%	35%	35%	0%	0	0
National Institute for Water and Atmospheric Research (New Zealand) – In-Kind										
Dr P Boyd	22%		22%				22%			
Dr H Neil	60%		25%	35%			60%			
Dr S Nodder	10%		10%				10%			
Dr M Williams	70%			35%		35%	70%			
Total	162%	0%	57%	70%	0%	35%	162%	0%	0%	0%
Tasmanian Department of Economic Development – In-Kind										
Ms C le Goy	50%								50%	
Total	50%	0%	0%	0%	0%	0%	0%	0%	50%	0%
TOTAL IN-KIND	3636%	164%	467%	1562%	113%	1091%	3396%	115%	95%	30%

Appendix C: Research Staff Resources

Name	Total % Time	AME	CO2	CVC	POL	SLR	Rsch Total	Edu cation	Comm lstn	Admin
Cash Funded Staff – University of Tasmania										
Ms K Bidwell	85%									85%
Dr A Bowie	100%		95%				95%		5%	
Mr R Brand	100%			95%			95%		5%	
Mr S Bray	100%		95%				95%		5%	
Dr W Howard	100%	10%	35%	50%			95%		5%	
Dr J Hunter	80%					75%	75%		5%	
Prof B Mapstone	100%	10%	10%	10%	10%	10%	50%	10%	20%	20%
Dr R Massom	100%	10%		85%			95%		5%	
Ms C Moy (nee Curran)	100%		35%	60%			95%		5%	
Mr R Murray	100%			95%			95%		5%	
Ms K Nitschke	75%								10%	65%
Ms V Randell	100%								10%	90%
Dr D Roberts	5%									5%
Ms L Robertson	100%		95%				95%		5%	
Ms C Robinson	5%									5%
Mr M Rosenberg	100%		25%	70%			95%		5%	
Mr T Shaw	100%		35%	60%			95%		5%	
Mr R Smith	100%			45%		50%	95%		5%	
Total	1550%	30%	425%	570%	10%	135%	1170%	10%	100%	270%
Cash Funded Staff – CSIRO Division of Atmospheric Research										
Dr T Hirst	8%			8%			8%			
Dr K McInnes	37%					37%	37%			
Dr S O'Farrell	16%			6%		10%	16%			
Total	61%	0%	0%	14%	0%	47%	61%	0%	0%	0%
Cash Funded Staff – CSIRO Division of Marine Research										
Mr M Pretty	50%		50%				50%			
Dr C Rathbone	5%		5%				5%			
Dr S Sokolov	80%			80%			80%			
Total	135%	0%	55%	80%	0%	0%	135%	0%	0%	0%
Cash Funded Staff – Australian National University										
T Purcell	35%					35%	35%			
G Estermann	100%					100%	100%			
Total	135%	0%	0%	0%	0%	135%	135%	0%	0%	0%
TOTAL CASH	1881%	30%	480%	664%	10%	317%	1501%	10%	100%	270%
TOTAL INKIND & CASH	5517%	194%	947%	2226%	123%	1408%	4897%	125%	195%	300%

Glossary of Abbreviations

AAD	Australian Antarctic Division	CVC	Climate Variability and Change Program (ACE CRC)
AAS	Australian Antarctic Science (grant)	DSTO	Defence Science and Technology Organisation
ACAP	Agreement for the Conservation of Albatross and Petrel species	EEZ	Exclusive Economic Zones
ACE CRC	Antarctic Climate & Ecosystems Cooperative Research Centre	FRISP	Forum for Research into Ice Shelf Processes
AGO	Australian Greenhouse Office	GA	Geosciences Australia
AME	Antarctic Marine Ecosystems Program (ACE CRC)	IASOS	Institute for Antarctic and Southern Ocean Studies (UTAS)
AMISOR	Amery Ice Shelf Ocean Research	IPCC	Intergovernmental Panel on Climate Change
ANSTO	Australian Nuclear Science and Technology Organisation	IUU	Illegal, Unreported and Unregulated (fishing)
Antarctic CRC	CRC for Antarctica and the Southern Ocean	IWC	International Whaling Commission
ANU	The Australian National University	JAMSTEC	Japan Marine Science and Technology Centre
APAC	Australian Partnership for Advanced Computing	KEOPS	Kerguelen compared study of Ocean and Plateau in surface
ATS	Antarctic Treaty System	LOSC	Law of the Sea Convention
AusCOM	Australian Climate Ocean Model	NASA	National Aeronautics and Space Administration (USA)
AUV	Automated Underwater Vehicle	NIPR	National Institute of Polar Research (Japan)
AWI	Alfred Wegener Institute	NIWA	National Institute for Water and Atmospheric Research (NZ)
BMRC	Australian Bureau of Meteorology Research Centre	QMS	Quantitative Marine Science (UTAS)
BoM	Australian Bureau of Metereology	SAZ	Sub-Antarctic Zone
CAR	CSIRO Atmospheric Research	SGI	Silicon Graphics International
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources	SLR	Sea Level Rise Program (ACE CRC)
CERES	Clouds and the Earth's Radiant Energy System	SO	Southern Ocean
CLIMA	Ross Sea variability, processes and interactions related to the climatic fluctuations project	TDED	Tasmanian Department of Economic Development
CLIVAR	Climate Variability and Predictability: World Climate Research Programme	TPAC	Tasmanian Partnership for Advanced Computing
CMR	CSIRO Marine Research	UNCLOS	United Nations Convention on the Law Of the Sea
CNES	Centre National d'Etudes Spatiales	UTAS	University of Tasmania
CO ₂	Carbon dioxide	VERTIGO	Vertical flux in the Global Ocean
CO2	Ocean Control of Carbon Dioxide Program (ACE CRC)	WOCE	World Ocean Circulation Experiment
CRC	Cooperative Research Centre		



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