

## RESEARCH UTILISATION

The ACE CRC is focused not only on producing great research, but also on ensuring uptake of our research outcomes in the wider community. In 2010, we built on our previous research utilisation plan focusing on the publication of timely, plain-English assessments of recent developments in climate science and related policy issues; proactive and regular liaison with industry and government; regular workshops and seminars for industry and government across all research programs; and a strategic communications plan.

### Informing policy through government and international agencies

Our research is an important source of information for government departments responsible for assessing and developing policy on climate change, and for international agencies that help to inform governments, other organisations and the public about climate change science.

For example, in an area such as sea-level rise, projections by ACE scientists will enable policy makers to more accurately judge the scale and timing of the response needed. Knowledge of changes in the cryosphere will enable the creation of more accurate global climate models to be used in planning. Ice core research is increasing our knowledge of climate history and therefore our ability to determine whether climate events in Australia, such as drought, are outside the range of normal climate variability. Our research will increase the accuracy of carbon cycle models and will be used to guide carbon management and regulation. It will provide a scientific basis for the evaluation and regulation of experimental activities such as ocean fertilisation. Our ecosystems research will help to inform government agencies charged with managing marine biodiversity, biological conservation and sustainable fishing.

The government departments and international agencies using our research include:

- The Department of Climate Change and Energy Efficiency
- The Department of Sustainability, Environment, Water, Population and Communities, including the Australian Antarctic Division
- The Department of Industry, Innovation, Science and Research, including the CSIRO and the developers of its Australian Community Climate and Earth System Simulator (ACCESS),
- The Department of Agriculture, Fisheries and Forestry
- State and local governments
- The Intergovernmental Panel on Climate Change
- International Ocean Carbon Coordination Project
- CO<sub>2</sub>/CLIVAR (the CO<sub>2</sub> component of the Climate Variability and Predictability project)
- GEOTRACES (an international program which aims to improve the understanding of biogeochemical cycles and large-scale distribution of trace elements and their isotopes in the marine environment)
- The International Whaling Commission
- The Convention on the Conservation of Antarctic Marine Living Resources
- Non-government organisations such as WWF-Australia

## Publications

Continuing with our successful format of producing plain-English synopses of the latest science for policymakers, ACE produced "Report Card: Southern Ocean Acidification" in late 2010. Three more continued in development: 'Southern Ocean Circulation and Climate Change', 'Southern Ocean Marine Ecosystems and Climate Change' and 'Southern Ocean Sentinel and Monitoring for Climate Change'.

ACE researchers Professor Ian Allison and Professor Nathan Bindoff were also significant contributors to "The Copenhagen Diagnosis: Updating the World on the Latest Climate Science" (2009). This report synthesises the most policy-relevant climate science published since the close-off of material for the last IPCC report. It serves as an interim evaluation of the evolving science mid-way through an IPCC cycle - IPCC AR5 is not due for completion until 2013. The report also served as a handbook of science updates that supplemented the IPCC AR4 for the Copenhagen Climate Conference in December 2009.

**REPORT CARD**  
Southern Ocean Acidification

ANTARCTIC CLIMATE & ECOSYSTEMS CRC

<p><b>PHOTO 4</b></p> <p>PHOTO 5</p> <p>PHOTO 6</p> <p>PHOTO 7</p>	<p>...change in ocean chemistry (lowering ocean pH) and the concentration of carbonate ions available for organisms that build calcium carbonate shells or skeletons (known as calcifiers).</p> <ul style="list-style-type: none"> <li>Some calcifiers are more at risk than others; shells can be made from aragonite or calcite (and aragonite is more easily dissolved than calcite).</li> </ul> <p>Continued acidification will push the ocean towards chemical compositions not seen for a long time!</p> <ul style="list-style-type: none"> <li>pre-industrial pH was 8.2</li> <li>current average pH is 8.1</li> <li>we expect a drop to 7.8 by 2100 under 'business as usual' CO<sub>2</sub> emissions</li> <li>Polar pH is changing at twice the rate of tropical waters!</li> </ul>	<p>...changes in CO<sub>2</sub>, pH and carbonate ion availability.</p> <ul style="list-style-type: none"> <li>How acidification will interact with other ocean variables likely to change in the future (e.g. temperature and oxygen).</li> <li>How calcifiers made from aragonite and calcite will respond to changes in pH and carbonate ion availability.</li> </ul> <p>What areas of the Southern Ocean are most at risk of continued ocean acidification?</p> <p>What the role of acidification will be in Southern Ocean waters.</p>	<p>...acidification on Southern Ocean organisms including:</p> <ul style="list-style-type: none"> <li>shrimps and deep-sea corals (aragonite calcifiers) and</li> <li>foraminifera and coccolithophores (calcite calcifiers)</li> </ul> <p>Developing comprehensive Southern Ocean ecosystem models to simulate:</p> <ul style="list-style-type: none"> <li>probabilities of risk,</li> <li>consequences of risk, and</li> <li>regions of risk.</li> </ul> <p>Polar ecosystems are forecast to be among the first to be affected by acidification!</p>	<p>...acidification from the atmosphere, measured on a logarithmic scale</p> <p>...increasing concentrations</p> <p>...the influence of ocean circulation, egg and larval survival, and reduced sound</p> <p><b>Online Links</b></p> <ul style="list-style-type: none"> <li>Global Carbon Project 2008: <a href="http://www.globalcarbonproject.org">www.globalcarbonproject.org</a></li> <li>World Society Report 2009: <a href="http://www.wsr.org.au/2009">www.wsr.org.au/2009</a></li> <li>Ocean Acidification: <a href="http://www.oceanacidification.org">www.oceanacidification.org</a></li> <li>Green Acidification 2009: <a href="http://www.greenacidification.org">www.greenacidification.org</a></li> <li>CO<sub>2</sub> emissions and trends 2008: <a href="http://www.globalcarbonproject.org/carbonbudget/index.htm">www.globalcarbonproject.org/carbonbudget/index.htm</a></li> <li>High Latitude Acidification 2009: <a href="http://www.oceanacidification.org/issue/issue_active/issue_2009_A224_tarry.pdf">www.oceanacidification.org/issue/issue_active/issue_2009_A224_tarry.pdf</a></li> </ul>
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The ACE CRC's "Report Card: Southern Ocean Acidification" is a synopsis of the latest research in this growing field.

## Communications

The ACE website, [www.acecrc.org.au](http://www.acecrc.org.au), and our quarterly e-newsletter, ACE News, are the main vehicles for providing timely updates on our science to our stakeholders. The ACE website is currently being completely revamped and will be launched in 2011.

## Vocational Training

A short course for policymakers and public servants was held in Canberra in March 2010. The objective was to provide an overview of the latest Antarctic and climate change science relevant to the audience. This built on the success of the short course held in 2009.

ACE is in the process of developing a range of vocational short courses on climate change and Antarctic-related science topics. We aim to gauge end-user interest in 2011.

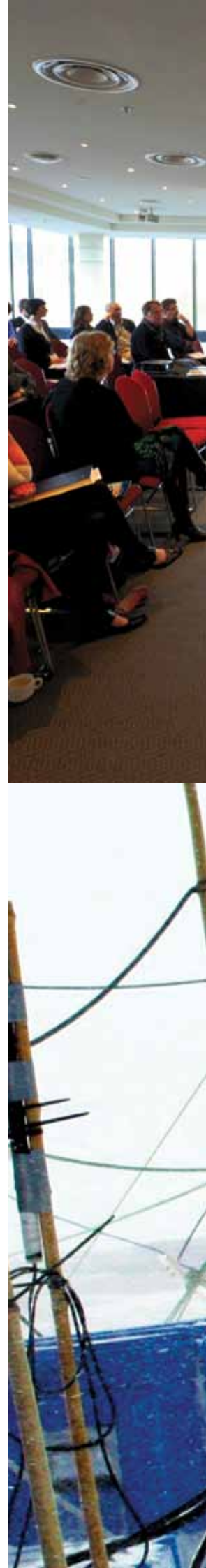
We completed our sea-level rise and sea-level extremes workshops and seminars during early 2010. In total ACE presented the latest sea-level science and our technique to estimate the likelihood of flooding under future sea-level rise to close to 1000 participants in key capital cities and major coastal communities around Australia. The training course is currently being developed into an online training format which will be accessible via [www.sealevelrise.info](http://www.sealevelrise.info).

## End User Forums

A highlight during the year was an end-user roundtable held in Canberra in June, with attendance from across a range of key government departments including DAFF, DCCEE, SEWPAC, DFAT, DIISR, NRM, Office of Chief Scientist and ONA. This forum was a two-way dialogue allowing ACE CRC to explain its proposed science program and policymakers to provide input on their needs. It is proposed to conduct further end-user roundtables throughout the life of the CRC.

ACE scientist Dr Tessa Vance and her colleagues, Dr Tas van Ommen, Joel Pedro and Rob King have initiated "Climate Conversations", a series of community forums designed to encourage a conversation between scientists and the public about climate change. During the presentation the scientists use a 2000-year-old ice core from Antarctica to help explain the history of climate change.

**Photos** - Top: Communicating research at the Climate Futures for Tasmania Summit. © Chris Crerar (Blink Photography). Bottom: Ice core scientist and Climate Conversations organiser Tessa Vance during field work to drill an ice core at Law Dome, Antarctica. © Mark Curran (ACE CRC)





## THE CLIMATE CONVERSATIONS

*"Rather than preaching to the converted we wanted to develop a talk that would encourage the members of the public who aren't completely convinced about climate change to come along."*

*"It is about providing them with the information that we have, and then letting them do what they want with that information."*

*"I think this really demonstrates the community's thirst for factual information direct from the scientists."*

**Ice core scientist Dr Tessa Vance**





## Industry Collaborations

**Climate Futures for Tasmania** is an externally funded, collaborative research project that is generating improved climate change information for Tasmania over the 21st century. Key stakeholders include sectors in government, water and power generation, agriculture and viticulture, and emergency services. During 2010 there was an intense focus on the analysis of data sets and the presentation of preliminary results to end users. Results are being distilled into a series of end-user orientated documents. There are now 30 complementary research projects in progress using the Climate Futures data sets.

**ClimateAsyst®** has been developed by SME consulting firm pitt&sherry with scientific support from ACE and funding support from the Tasmanian Government. ClimateAsyst® is a software tool that assists asset owners to understand the potential impacts of climate change on their infrastructure at a local scale. It does this by linking high resolution climate projections with infrastructure asset classes, their relevant engineering design standards, design codes and documentation. ClimateAsyst® outputs help end users determine the risk to existing infrastructure from a changing climate and assess whether current design codes for planned infrastructure will be adequate. ClimateAsyst® is currently being promoted within Tasmania with a view to marketing it nationally and internationally.

**sealevelrise.info** is a web-based decision support tool that is being used by SMEs throughout Australia. Coastal infrastructure owners and developers can determine the appropriate allowance for sea-level rise dependent on the location, greenhouse gas emission scenario and the level of acceptable flooding risks. Further development and enhancement is under way with input and support from ACE's commercial participants and with funding support from the DCCEE.

## Providing Advice

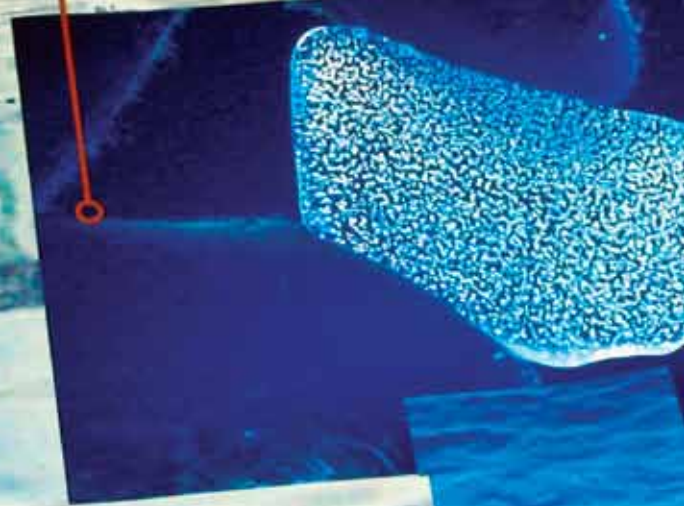
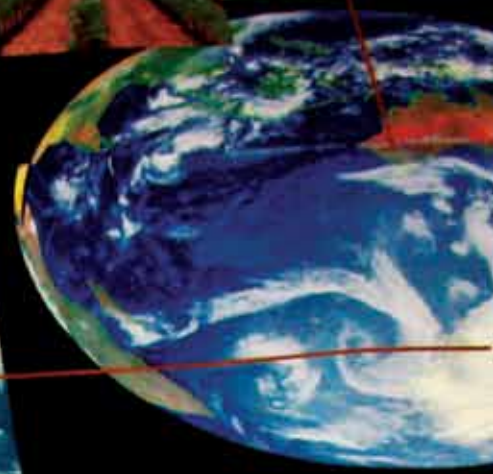
**Sutherland Shire Council NSW:** In conjunction with commercial participant GHD, the ACE CRC delivered an assessment of likely future sea-level rise impacts to council coastal infrastructure.

**Tasmanian Planning Commission SLR Project:** A collaborative project with UTAS, it combines GIS mapping, storm-tide modelling and sea-level rise probability of flooding data. It provides maps of the probability of flooding due to sea-level rise for all parts of the Tasmanian coastline where there is LIDAR data.

**WA Government Department of Transport:** ACE was commissioned to provide scientific review of the WA Government Department of Transport report 'Sea Level Change in Western Australia; Application to Coastal Planning'.

**Photo -** Display stand at the Australian Meteorological and Ocean Society conference in Canberra. © Suzie Gaynor (ACE CRC)

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## EDUCATION

Helping to build the next generation of highly trained scientists is extremely important to ACE. Education for all our programs is coordinated by the University of Tasmania, mainly through its new Institute for Marine and Antarctic Studies (IMAS).

IMAS staff teach into undergraduate science degrees, and graduate diploma, honours, coursework masters, research masters and PhD programs. Students study a range of topics relevant to Antarctica and the Southern Ocean.

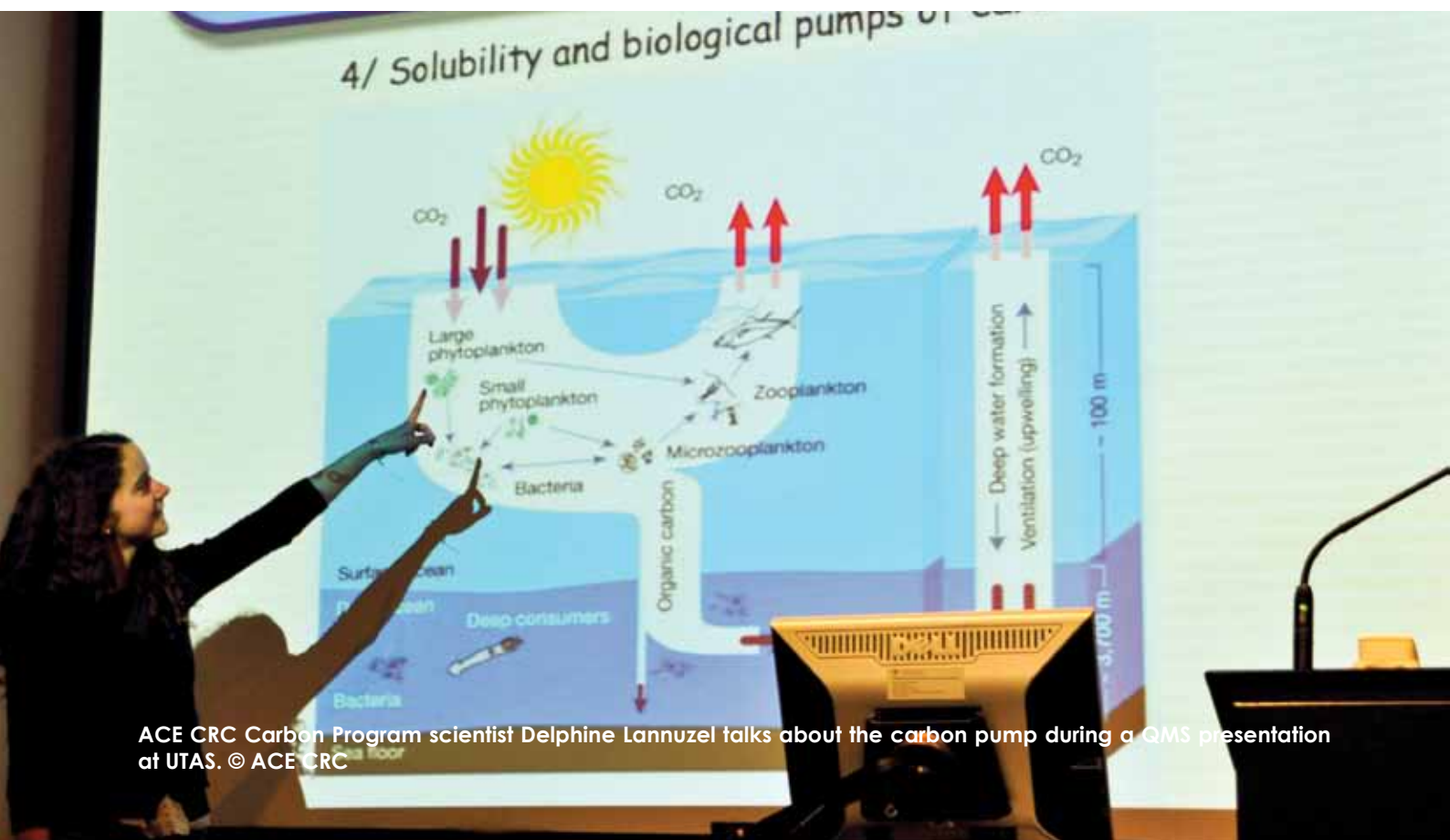
ACE Carbon Program leader Professor Tom Trull directs the UTAS-CSIRO Joint PhD Program in Quantitative Marine Science (QMS), which addresses a particular skills shortage in the marine sector. ACE researchers continue their involvement in coursework teaching and research supervision.

Five PhD students began their candidature between the beginning of the new CRC in January 2010 and June 2010. A total of 19 research higher degree students at IMAS are being supervised by staff funded directly by ACE. In addition, there are 17 students supervised by Australian Antarctic Division staff and 17 by CSIRO staff. ACE has listed 13 projects for the new UTAS Elite Research Scholarship program and is working closely with IMAS and the CSIRO-UTAS QMS program to boost the recruitment of candidates.

Three students who submitted their theses for examination in the period were successful in securing postdoctoral positions, one interstate and two overseas.

In addition ACE provided travel support for conferences to four PhD candidates during the period.

Ten students are enrolled in the Masters of Antarctic Science by coursework at IMAS. This course is designed to produce expertly trained scientists with international experience and research skills in the area of Antarctic marine science. Five honours students are enrolled in ACE CRC related projects.



ACE CRC Carbon Program scientist Delphine Lannuzel talks about the carbon pump during a QMS presentation at UTAS. © ACE CRC

*"I recently submitted my PhD thesis, entitled East Antarctic Landfast Sea-Ice Distribution and Variability. Originally from Devonport, in the north-west of Tasmania, I moved to Hobart at the beginning of my undergraduate degree nine years ago. Hobart is a fantastic place for Antarctic research, with several institutes combining to form a critical mass of Antarctic researchers.*

*Completing my PhD at the ACE CRC has been an incredibly rewarding experience. It is great to be able to interact with world-class scientists on a daily basis. In particular, there are so many opportunities for multi-disciplinary collaboration at ACE, especially with IMAS also being located on the UTAS Sandy Bay campus.*

*Being an ACE CRC-affiliated PhD candidate certainly has its advantages in terms of supporting travel and field work. For example, during my candidature I attended two high-profile international conferences (in Troms, Norway, and Cape Town, South Africa), a sea-ice field training course in Hokkaido, Japan, and participated in the six-week Sea Ice Physics and Ecosystems eXperiment (SIPEX) voyage off the East Antarctic coast (see [www.sipex.aq](http://www.sipex.aq)).*"

**Alex Fraser, PhD Student**



## KEY PAPERS 2010

- ALLISON, I., BIRD, M., CHURCH, J., ENGLAND, M., ENTING, I., KAROLY, D., RAUPACH, M., PALUTIKOF, J., SHERWOOD, S. (2010) The Science of Climate Change: Questions and Answers. [www.science.org.au/policy/climatechange2010.html](http://www.science.org.au/policy/climatechange2010.html), Published by Australian Academy of Science, Canberra. ISBN 085847 286 4
- DELIBERTY, T. G. C., ACKLEY, S., WORBY, A & VAN WOERT, M. (2010) The annual cycle of sea ice thickness and volume in the Ross Sea. *Deep Sea Research Part II*.
- FUKAMACHI, Y., RINTOUL, S. R., CHURCH, J. A., AOKI, S., SOKOLOV, S., ROSENBERG, M. A. & WAKATSUCHI, M. (2010) Strong export of Antarctic Bottom Water east of the Kerguelen plateau. *Nature Geoscience*, 3, 327-331.
- GROSE M. R., BARNES-KEOGHAN, I., CORNEY, S. P., WHITE, C. J., HOLZ, G. K., BENNETT, J. B., GAYNOR, S. M., & BINDOFF, N. L. (2010) Climate Futures for Tasmania: general climate impacts technical report, Antarctic Climate & Ecosystems Cooperative Research Centre, Hobart, Tasmania.
- HELM, K. P., BINDOFF, N. L. & CHURCH, J. A. (2010) Changes in the global hydrological cycle inferred from ocean salinity. *Geophysical Research Letters*, 37, L18701, doi:10.1029/2010GL044222
- HERRAIZ-BORREGUERO, L. & RINTOUL, S. R. (2010) Subantarctic mode water: distribution and circulation. *Ocean Dynamics*, 1-24.
- HUNTER, J. (2010) Estimating sea-level extremes under conditions of uncertain sea-level rise. *Climatic Change*, 99, 331-350.
- KAWAGUCHI, S., KURIHARA, H., KING, R., HALE, L., BERLI, T., ROBINSON, J. P., ISHIDA, A., WAKITA, M., VIRTUE, P., NICOL, S. & ISHIMATSU, A. (2010) Will krill fare well under Southern Ocean acidification? *Biology Letters*.
- LANCELOT, C., DE MONTETY, A., GOOSSE, H., BECQUEVORT, S., SCHOEMANN, V., PASQUER, B. & VANCOPPENOLLE, M. (2009) Spatial distribution of the iron supply to phytoplankton in the Southern Ocean: A model study. *Biogeosciences*, 6, 2861-2878.
- MASSOM, R. A., GILES, A. B., FRICKER, H. A., WARNER, R. C., LEGRÉSY, B., HYLAND, G., YOUNG, N. & FRASER, A. D. (2010) Examining the interaction between multi-year landfast sea ice and the Mertz Glacier Tongue, East Antarctica: Another factor in ice sheet stability? *Journal of Geophysical Research C: Oceans*, 115, C12027, doi:10.1029/2009JC006083.
- MASSOM, R. A. & STAMMERJOHN, S. E. (2010) Antarctic sea ice change and variability - Physical and ecological implications. *Polar Science*, 4, 149-186
- MEIJERS, A. J. S., BINDOFF, N. L., RINTOUL, S. R. (2010) Estimating the 4-dimensional structure of the Southern Ocean using satellite altimetry. *Journal Ocean and Atmospheric Technology* (accepted)
- NICOL, S., MEINERS, K. & RAYMOND, B. (2010) BROKE-West, a large ecosystem survey of the South West Indian Ocean sector of the Southern Ocean, 30°E-80°E (CCAMLR Division 58.4.2). *Deep-Sea Research Part II: Topical Studies in Oceanography*, 57, 693-700.
- NICOL, S., BOWIE, A., JARMAN, S., LANNUZEL, D., MEINERS, K. M. & VAN DER MERWE, P. (2010) Southern Ocean iron fertilisation by krill and baleen whales. *Fish and Fisheries*, 11 (2).
- SALLÉE, J. B., SPEER, K., & RINTOUL, S. R. (2010) Response of the Southern Ocean mixed-layer depth of climate variability. *Nature Geoscience*, 3, 273-279, doi:10.1038/ngeo812.
- SALLÉE, J. B., SPEER, K., RINTOUL, S. R. & WIJFFELS, S. (2010) Southern Ocean thermocline ventilation. *Journal of Physical Oceanography*, 40, 509-529, doi:10.1175/2009JP04291.1
- STEVENS, R. P. & HEIL, P. (2010) The interplay of dynamic and thermodynamic processes in driving the ice-edge location in the Southern Ocean. *Annals of Glaciology*.
- VAN OMMEN, T. D. & MORGAN, V. (2010) Snowfall increase in coastal East Antarctica linked with southwest Western Australian drought. *Nature Geoscience*, 3, 267-272.

For full list of publications please refer to [www.acecrc.org.au/Publications](http://www.acecrc.org.au/Publications).





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