

IMOS News

> For more news from all the IMOS Facilities check the IMOS website imos.org.au/news.html

Exciting new tool for exploring images from the Autonomous Underwater Vehicle

The IMOS Autonomous Underwater Vehicle (AUV) Facility operates an ocean going AUV called Sirius. It is based at the Australian Centre for Field Robotics, at the University of Sydney, but with the support of IMOS funding it is used to conduct benthic imaging based surveys around Australia for the benefit of the whole Australian marine science community.

The data collected by the AUV consists of stereo imagery, multibeam sonar, vehicle navigation and water chemistry data. All data products are precisely geo-referenced using state-of-the-art terrain-aided navigation algorithms. Optical imagery is delivered as individual high-resolution, color-corrected images (geotiffs) and also in processed form, as mosaics and 3D sea floor reconstructions.

The AUV data presented a unique challenge for the eMarine Information Infrastructure (eMII) Facility, which is based at the University of Tasmania in Hobart. eMII are responsible for creating and developing the information infrastructure to make all IMOS data discoverable and accessible via the IMOS Ocean Portal: <http://imos.aodn.org.au/webportal/>. However, the sheer quantity of data (greater than 1 TB) from each of the AUV campaigns includes over 900,000 High-Resolution and Geo-referenced stereo images of the sea-floor and the map-based

Ocean Portal was not going to be the most user friendly method of discovery for this highly visual data stream.

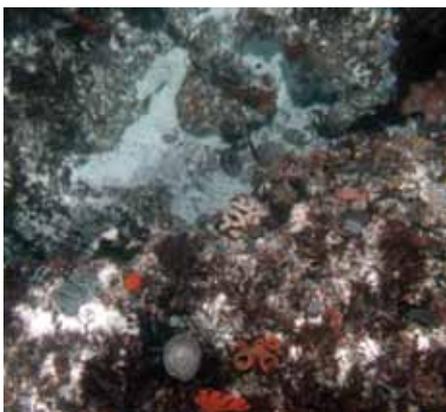
Laurent Besnard and Philip Bohm from eMII have created a new viewing tool that allows users to examine the imagery from AUV campaigns and the associated bio physical parameters. Working with the AUV Facility leader Dr Stefan Williams they have created a web-browser tool which is accessed through the Ocean Portal that allows the user to view the many images from each campaign.

Once inside the AUV Images Viewer the user can navigate around the map of the campaign, pick an area of interest and then view the images on the screen. The user can quickly travel along the track as if they are the robot viewing all the images, or visually discover



data according to the bathymetry/ temperature range of their choice. The full size images can be downloaded, as well as all the other data-products not used in the AUV viewer (3D texture mapped seafloor). Other useful information available includes: a dive report with time series plots, a link to a THREDDS catalog to download the NetCDF files, a MEST metadata record per dive and the location of each picture with their corresponding scientific data. In the future the viewer will allow the marine community to tag species in the images, discover data according to colour (for example the colour of sand or kelp), and also provide visualisation of 3D mesh mosaics.

eMII have created a fantastic and exciting tool for the marine research user community, that enables the user to simply explore the wealth of data that is created by each of the AUV campaigns. For more information about the IMOS AUV Images Viewer please contact info@emii.org.au.



director's corner

Tim Moltmann



Welcome to the first Marine Matters for 2011. It promises to be a very exciting year for the IMOS community. Data streams are building up from established deployments, and increasing emphasis will be placed on uptake and use of IMOS data to do great science with high impact. It is pleasing to see the Nodes taking responsibility for driving this, and the WAIMOS and NSW-IMOS Science and Data User Workshop featured here is the first of a number being planned.

Significant new deployments will also be made using second stage funding provided through the Marine and Climate Super Science Initiative, and the story on the Polynya Mooring deployment is but one example.

Of course marine observing is a challenging business, and stories in this edition about Cyclone Yasi and dramas with the Southern Ocean Flux Mooring highlight the risks that need to be managed.

However it is the professionalism of the Operators that shines through here, getting the job done and most importantly, getting it done safely.

With the initial NCRIS phase ending in June 2011, this year marks full transition to the second stage of IMOS. Work has commenced on building the case for ongoing funding beyond mid-2013, and a Draft Decadal Strategy has been developed, supported by a National Science and

Implementation Plan. These documents are available in the 'Plans and Reports' section of the IMOS website.

It is encouraging to see the Australian Government planning for the next stage of investment in national research infrastructure, with a new Strategic Roadmap to be developed by August 2011. The Exposure Draft was issued in late June, with comments to be submitted by 22nd July. The IMOS submission will be available on our website.

It's very early days, but the signals in the Discussion Paper are positive and the value of what we are doing is clearly recognised. Our strongest arguments for the future will lie in staying focused, continuing to deliver, and working together to grow the impact of marine and ocean climate science in Australia.

Tim Moltmann

New IMOS satellite sea surface temperature (SST) products released

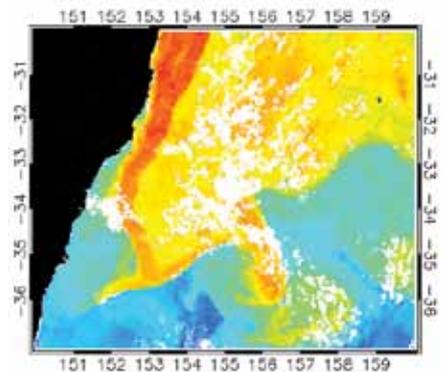
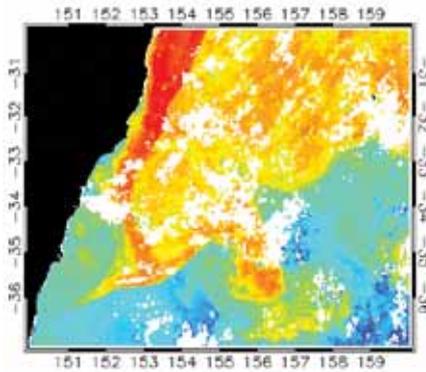
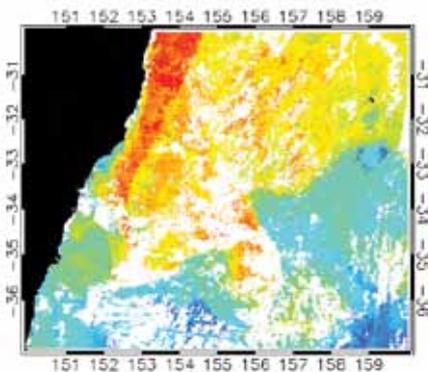
The IMOS Satellite Remote Sensing Facility has adopted a new format for its SST products from the Advanced Very High Resolution Radiometers (AVHRR) aboard National Oceanic and Atmospheric Administration (NOAA) polar-orbiting meteorological satellites. The new format, called GDS v2.0, was defined in October 2010 by the International Group for High Resolution Sea Surface Temperature (GHRSSST) to assist with international data exchange

and collaboration. IMOS was the first to release the SST products internationally.

Through the IMOS Satellite Remote Sensing Facility, the Bureau of Meteorology in collaboration with CSIRO Marine and Atmospheric Research is combining the raw data from the various ground stations around the country to produce real-time high resolution skin SST data products in a range of GDS v2.0 formats.

The new products are a major advancement on the legacy products were available, as they are more accurate by improving cloud clearing and calibration, and will have a larger amount of associated metadata. The new products are now available through the IMOS Ocean Portal.

For more detailed information please visit the IMOS website: <http://imos.org.au/sstproducts.html>



This figure provides a comparison between the legacy SST products and the new SST product, showing the East Australian Current off the NSW coast for the period 9 to 11 April 2010. Left: The Bureau of Meteorology legacy product. Centre: The CSIRO legacy product. Right: The new IMOS SST product.

The Hon Kevin Rudd visits the IMOS ocean glider Facility



The Hon Kevin Rudd, Australian Minister for Foreign Affairs, took the opportunity to visit the IMOS ocean glider Facility at the University of Western Australia, while he was in Perth. Winthrop Professor Charitha Pattiaratchi, the Ocean glider Facility leader, took Mr Rudd on a quick tour of the ocean glider laboratory. Mr Rudd and Professor Pattiaratchi discussed gliders, the Indian Ocean Rim Association for Regional Cooperation and the tsunami warning system. Mr Rudd also gave a lecture to students at University of Western Australia.

> Mr Rudd examines a Slocum sea glider with Ocean glider Facility leader, Chari Pattiaratchi (left) and Dennis Stanley (right).

IMOS featured in FISH magazine

FISH is the official newsletter of the Fisheries Research & Development Corporation and they have recently interviewed the IMOS Director, Tim Moltmann, the Argo Facility and Bluewater and Climate Node co-leader, Susan Wijffels, and IMOS Scientific Officer, Katy Hill about IMOS.

The article provides a description of IMOS, the need for an ocean observing system in Australia, and the potential users of IMOS data. It also outlines the five research themes: multi-decadal ocean change, climate variability, major boundary currents, continental shelf processes and biological response. Giving an example of how the different data streams from the various IMOS facilities are used to answer science questions in a research theme. To read the FISH article you can download it at www.frdc.com.au/index.htm (IMOS would like to acknowledge the FISH magazine for allowing us to post it on the website for download).



2011 Strategic Roadmap for Australian Research Infrastructure

During 2011, a Strategic Roadmap for Australian Research Infrastructure will be developed to inform future decisions on where Australia should make strategic infrastructure investments to further develop its research capacity and improve research outcomes over the next five to ten years.

The 2011 Roadmap aims to consider new and emerging areas of research which may require different types of infrastructure in the future, and determine whether the current mix of capability areas continues to meet researchers' needs.

The 2011 Strategic Roadmap for Australian Research Infrastructure Discussion Paper was released for comment in March. The purpose of the Discussion Paper was to seek feedback from stakeholders and the wider research community on the views

expressed by the Expert Working Groups and to canvass additional feedback on the research infrastructure requirements to support excellent research and innovation outcomes into the future.

IMOS provided a response to the Strategic Roadmap Discussion Paper. In addition to the IMOS response, the IMOS Director, Tim Moltmann, worked with the Directors of TERN, ALA and AuSCOPE to develop a joint response on coastal zone issues raised in the Discussion Paper.

The Department of Innovation, Industry, Science and Research, supported by the Expert Working Groups, are currently considering the comments received and will turn the Discussion Paper into an Exposure Draft which is currently available for feedback until July 22.

Both IMOS responses are available on the following web page: <http://imos.org.au/plans.html>

The global Argo array was featured on the Open University TV series

Dr Susan Wijffels, the leader of the IMOS Argo Facility, was featured in an episode of the Open University TV series called 'Sea Change'. The episode profiles the extraordinary developments in oceanography and follows Susan from her home in Tasmania to Argentina where she leads a mission of international scientists who are working with Argo floats to provide a deeper understanding of what climate change really means.

The episode not only features the IMOS Argo Facility but also the deepwater moorings that will be deployed as part of the Indonesian Through Flow array.

The episode which IOC-GOOS co-produced with the Television Trust for the Environment (TVE) and was co-sponsored by the Open University. To watch the Sea change episode www.open.ac.uk/openlearn/whats-on/earth-reporters-sea-change

Western Australia IMOS science and data user workshop

The Western Australia IMOS (WAIMOS) Science and Data Uptake workshop was held at the University of Western Australia in late February 2011, and attracted approximately 80 participants from a wide range of sectors – university, federal and state government, consultancies, and industry.

The workshop goals were to:

- 1) Raise awareness of WAIMOS, and other complementary, data streams;
- 2) Familiarise users with access options for IMOS and other datasets (e.g. Australian Ocean Data Network – AODN); and
- 3) Increase utility, uptake and impact of IMOS data.

The morning session began with an overview of IMOS and WAIMOS (Chari Pattiaratchi), followed by a session by Luke Edwards (IVEC) on how to access data via IMOS and the AODN. The subsequent sessions focused on each of the IMOS data streams of particular relevance to WAIMOS users, including Ocean Radar, the National Mooring Network, Ships of Opportunity, Ocean Gliders, Satellite Remote Sensing, Animal Tagging and Monitoring, and the Autonomous

Underwater Vehicle. The speakers provided specific information about the data/variables being measured, what datasets were now available, and how these were being used.

The afternoon session was focused on increasing utility, uptake and impact of IMOS data, with discussions led by Jamie Oliver (AIMS), our recently appointed WAIMOS Deputy Node Leader. With the goal of broadening WAIMOS engagement with the local community, we had speakers that provided a state agency perspective (Kim Friedman, Department of Environment and Conservation; Nic Caputi, Fisheries WA), a private sector perspective (Ian LeProvost, president of the Environmental Consultants Association, WA; Geoff Wake, Woodside), and a research perspective (Gary Kendrick, UWA). We appreciated the support of the IMOS national office in making this workshop a success, in particular participation by Katy Hill in providing a national perspective on how to make best use of IMOS data and increase opportunities for linkages and collaboration, and the eMII team for joining us for the workshop and running a Data User Workshop the following day.

2011/12 EIF Annual Business Plan submitted to DIISR

Following on from the IMOS Annual Planning Meeting in February, the IMOS office with the Facility and Sub-facility leaders, prepared their plans for the 2011/12 financial year.

The Annual Business Plan was approved by the IMOS Advisory Board and submitted to the Department of Innovation, Industry, Science and Research (DIISR) on 29th March 2011. We are currently awaiting advice from DIISR that the plan has been accepted.

To download the plan:

http://imos.org.au/fileadmin/user_upload/shared/IMOS%20General/documents/IMOS/Plans__Reports/IMOS{EIF}_ABP_2011-12.pdf

IMOS represented at Australia-EU workshop in Brussels

IMOS was one of three Australian participating groups in the first European Union-Australia Workshop on Research Infrastructure held in Brussels 4-5 April 2011. The meeting enabled high-level DIISR officials and representatives from IMOS, the Australian Microscopy and Microanalysis Research Facility and the Australian Synchrotron to meet with European counterparts and explore opportunities for collaboration around research infrastructure. Dr Roger Proctor, Leader of the eMarine Information Infrastructure (eMII) Facility, led a team from eMII who represented IMOS as the workshop. The workshop:

- explored the status of marine information infrastructure in Australia and Europe, including the relationship between observations and models,
- considered newly emerging standards, developments and technologies for data management,
- examined how the approaches in Australia and Europe can be more closely aligned, and
- discussed how a common approach between Australia and Europe can contribute to interoperability.

Nv new funds for follow-up activities over the next 12 months have been provided by DIISR.

NSW-IMOS Node meeting and data user workshop

The NSW Node meeting and data workshop was held at the University of Technology, Sydney on Thursday 12 May following a seminar by Katy Hill on 11 May. About 35 people attended and heard an update from Dr David Griffin on the unusual oceanographic conditions during summer 2010-2011. Interestingly, NSW experienced both the highest and lowest sea surface height anomalies recorded during the past 14 years. A summary of David's talk will be posted on the IMOS website. Following morning tea, there was a 90 minute open discussion about integrating data streams and building modelling capacity. The node is now developing several projects linking physics and biology, and is also involved in two recently funded Australian National Network in Marine Science (ANNiMS) projects.



Dr Martina Doblin, NSW-IMOS Deputy Node leader and Dr Moninya Roughan, NSW-IMOS Node leader at their recent Node meeting.



Dr Katy Hill, IMOS Scientific Officer presents at the NSW-IMOS data user workshop.

Cyclone Yasi damages IMOS infrastructure

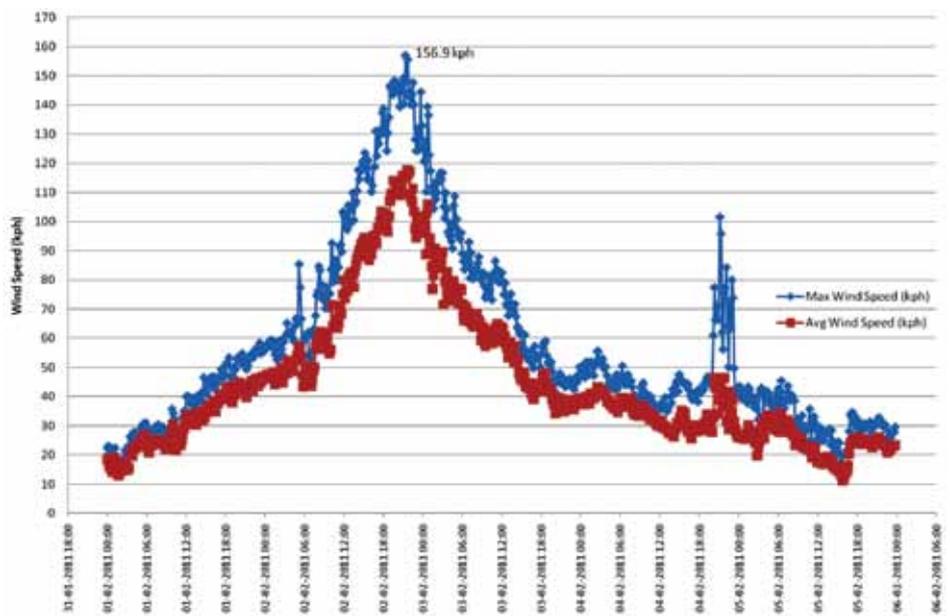
On its path to the Queensland coast on 3 February earlier this year, Cyclone Yasi passed through a region that has a range of IMOS infrastructure. While the majority of the IMOS infrastructure in the region was unharmed, unfortunately the Cyclone has caused damage to:

- The ocean colour observatory at Lucinda Jetty was destroyed, however the loss was minimised by the retrieval of the computer equipment and instrumentation from the site in late January,
- The wireless sensor networks at Davies and Rib reefs and Orpheus Island have sustained damage to the moorings, with damage to the instruments to be determined,
- The Yongala National Reference Station and the acidification mooring adjacent to the site have sustained damage to the moorings and instruments,
- The animal tagging and monitoring system at Orpheus Island has also sustained some damage.

The IMOS office has informed Department of Innovation, Industry, Science and Research and will work with the Operators of this infrastructure to ensure data interruptions are kept to a minimum and any damage rectified as soon as possible.



A wireless sensor float being deployed at Rib reef in 2010 (left). The damage caused by Cyclone Yasi as it went through, the top section of this float has been completely ripped off (right).



Maximum and average wind speeds (kph) from Davies Reef Weather Station for Tropical Cyclone Yasi, it is interesting to note that Davies Reef is some 160km from the eye of the cyclone, and wind speeds of up to 156.9kph were still recorded.

First continuous plankton survey around Southern Australia

The Spanish vessel, *Hespérides*, is one of two advanced oceanographic vessels involved in the Malaspina Expedition, named after a Spanish nobleman-turned-explorer and contemporary of Captain Cook. The Malaspina Expedition, a \$A23M Spanish Government project, aims to assess the impact of climate change and pollution on the oceans and explore their biodiversity. Together the two research vessels will sail 42,000 nautical miles during their nine-month circumnavigation of the world.

As part of the expedition, IMOS conducted the first continuous plankton survey around southern Australia, from the Leeuwin Current off the Western Australia coast to the East Australia Current off NSW. The device being towed by the *Hespérides* is a Continuous Plankton Recorder, the most cost-effective way to monitor phytoplankton and zooplankton over vast areas of the ocean. It is a modified version of a device first used in a British expedition to the Antarctic in the mid-1920s.

The Australian Continuous Plankton Recorder (AusCPR) Survey is part of

the IMOS Ships of Opportunity Facility and is jointly operated by CSIRO and the Australian Antarctic Division.

“This work will help us map the biogeography of Australia’s plankton, highlighting the boundaries of the temperate and sub-tropical flora and fauna,” explains the AusCPR Survey Leader Anthony Richardson. “This will provide an invaluable baseline for assessing how these boundaries will shift in the future with climate change. It will also contribute to the Atlas of Australian Zooplankton, which describes the biodiversity of the microscopic inhabitants of our oceans.”

Oceans of data from world-first buoy deployment

IMOS has successfully recovered the South Ocean Flux Station (SOFS) after it survived 13 months of hostile conditions in the Southern Ocean. In a remarkable technical and engineering achievement for IMOS and the Bureau of Meteorology the flux station was moored on March 17 last year in water 4.6 km deep, 580 km southwest of Tasmania in the Sub-Antarctic Zone, home of the Roaring Forties. Built by the Woods Hole Oceanographic Institution (WHOI) in Massachusetts at a cost of \$1M, the flux station is 2.7m in diameter, 4.3m high and weighs 1300 kg.

After 11.5 months of successful real-time data delivery SOFS started to drift beyond its watch circle on the 3rd March 2011, indicating that the mooring had broken loose. Data delivery continued while SOFS drifted slowly northwest before being picked up on 20th April 2011 by the scheduled recovery voyage 50 nautical miles from its station. The failure mode has been identified and WHOI is providing a solution prior to the next deployment.

The mooring break did not affect the data-stream or instruments: real-time

data delivery for the core contractual parameters was 89%, with delayed-mode data delivery expected to be 94%. The data includes hourly observations of wind, temperature, humidity, air pressure, sunlight and rain.

Not only are the observations contributing to day-to-day weather forecasting, they are providing the first sustained look at how the ocean to the south of Australia directly exchanges heat with the atmosphere as part of the global climate system.

The Southern Ocean is responsible for around 30 per cent of the total global ocean uptake of human-induced CO₂ emissions. Waters formed at the surface in this region slide under warmer subtropical and tropical waters and carry CO₂ into the deep ocean, out of contact with the atmosphere.

This process also supplies oxygen for deep ocean ecosystems and nutrients to much of the global ocean.

The Sub-Antarctic Zone is changing with global warming but until the flux station's deployment, little was known about the potential impact of these changes.

The flux station's deployment and eventual retrieval by CSIRO scientific staff and the crew of the Marine National Facility Research Vessel Southern Surveyor was no mean feat, given the size of the waves and the buoy itself.

The SOFS buoy will be redeployed in the Southern Ocean in November after servicing. Now that IMOS has successfully recovered the SOFS buoy, a second buoy will now be built by WHOI, so in future deployments the buoys can be hot-swapped creating a continuous time series.



WA Government announces co-investment in IMOS

The Western Australian Government recently announced \$6 million funding over three years for the Western Australian node of the Integrated Marine Observing System (IMOS) as part of the 2011/12 State Budget.

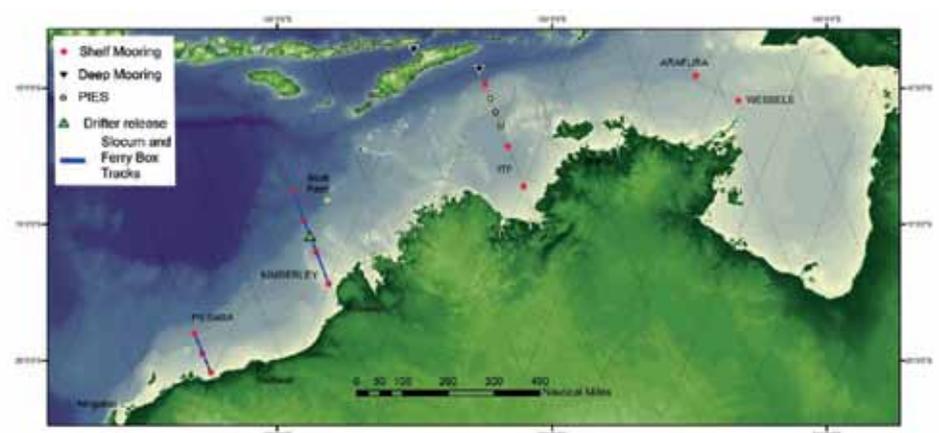
Through the Education Investment Fund (EIF) planning process (2009/10), IMOS began investing in northern Australian waters via the Bonaparte Gulf shelf mooring array, Indonesian Throughflow (ITF) deepwater mooring array, and an initial investment of \$1.1M to commence the Kimberley shelf mooring array. This scale of WA Government co-investment

Right: Proposed locations of the Pilbara and Kimberley arrays, with the ITF shelf and deep mooring arrays that were deployed in June 2010 and June 2011 respectively.

means that the complete package of Kimberley and Pilbara mooring arrays, glider deployments, and acoustic animal tracking arrays will now be achievable.

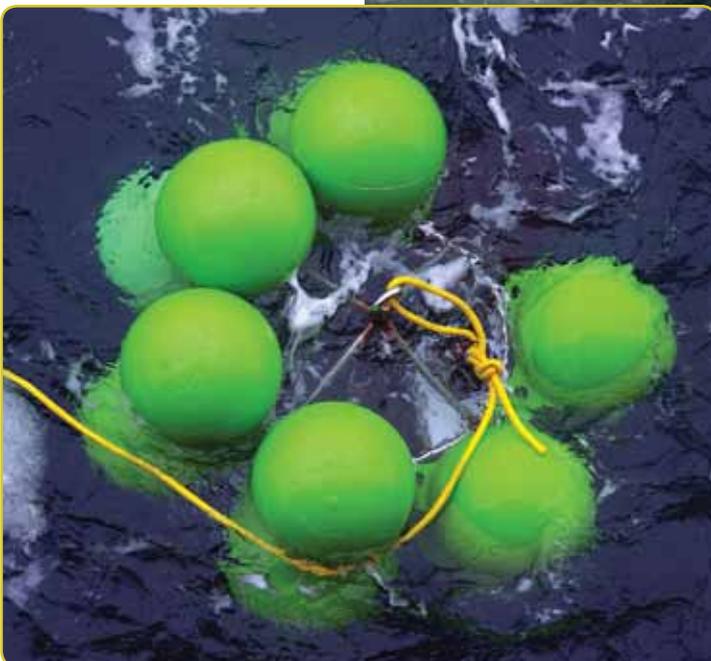
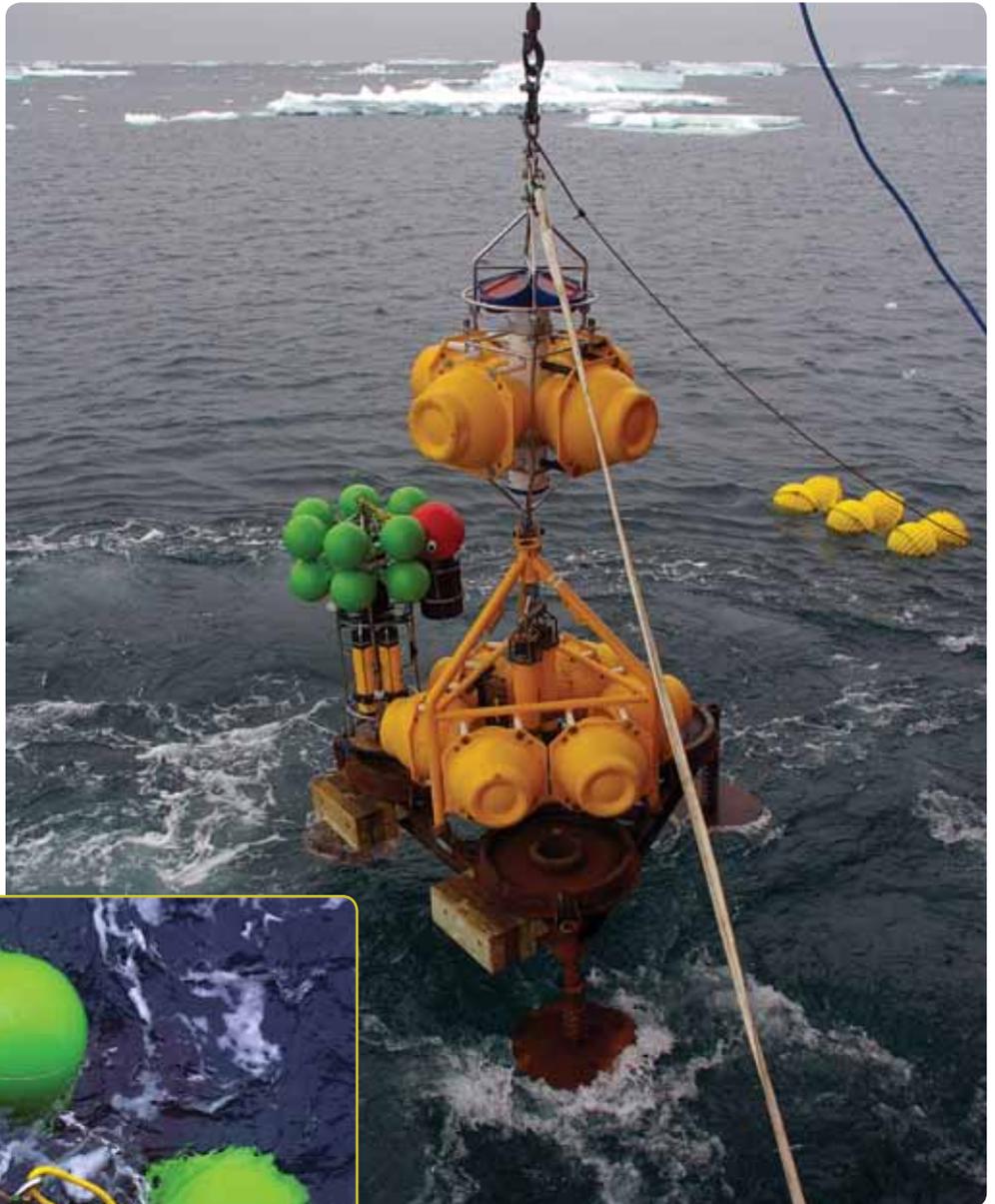
This is a fantastic outcome and will greatly enhance IMOS' monitoring

of northern Australian waters. Our thanks go to the WA Government Department of Commerce, and all in the WAIMOS Node community involved in achieving this result.



The first deep water mooring array was successfully deployed

The first IMOS deep water mooring array was deployed in January 2011 from the RSV Aurora Australis. The Polynya mooring array will monitor the transport and properties of Antarctic Bottom water that outflow to the deep Southern Ocean from the Antarctic continental shelf south of Australia. The mooring array will be deployed for 2 years and will be recovered and redeployed during the 2012-2013 austral summer. The moorings, designed and built in the CSIRO Marine and Atmospheric Research moorings workshop, are comprised of conductivity-temperature-depth sensors and current meters. The data that IMOS will recover from these deep water moorings will help scientists monitor how the global ocean circulation is changing.



One of the moorings that make up the Polynya array being deployed off the Adelie Land Coast.



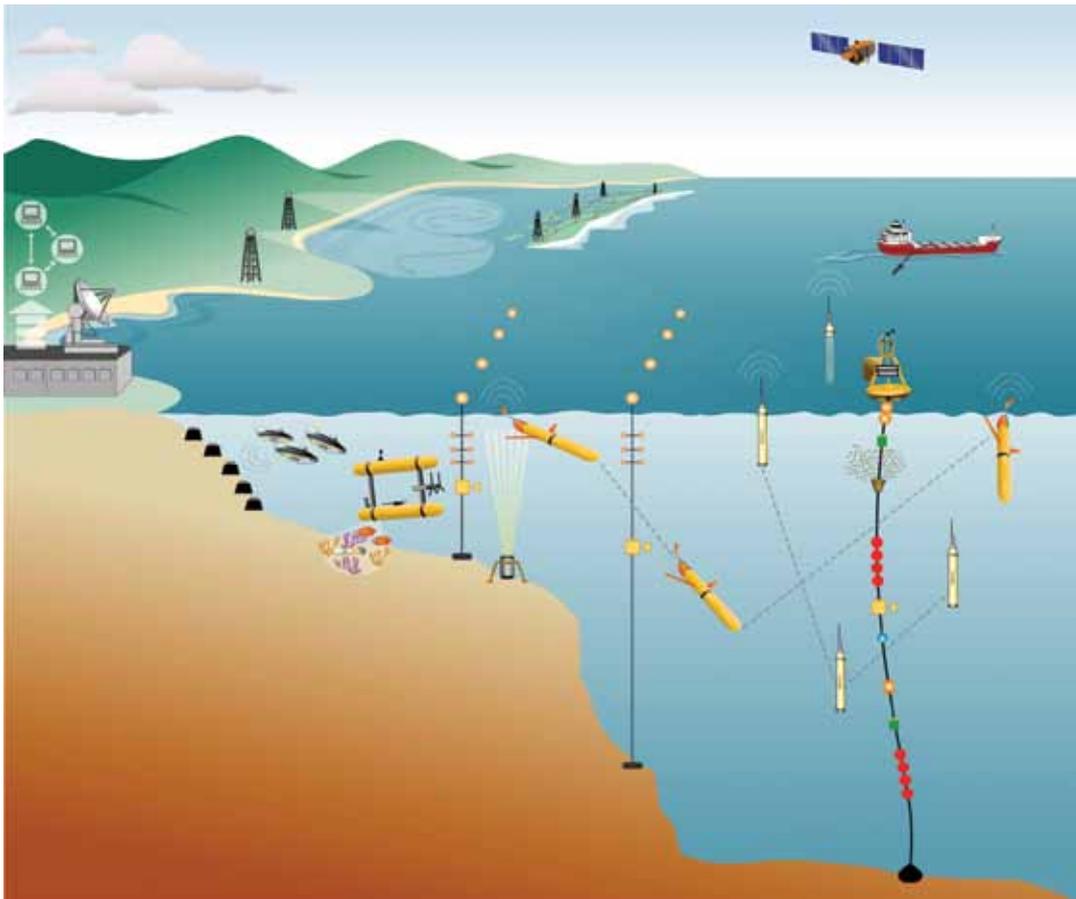


Diagram illustrating how the national IMOS program works. IMOS integrates several independent technologies and instruments, ranging from moored sensors and deep sea autonomous floats to acoustic tracking devices, radar imagery and remote satellites, among others, into research infrastructure covering a vast swath of Australia's large coastal and deep water marine territory. IMOS will generate critical data needed to support a diverse range of marine research projects.

For more information about IMOS please visit the website www.imos.org.au

General enquiries:

Integrated Marine Observing System (IMOS), University of Tasmania , Private Bag 110, Hobart, TAS, 7001 • +61 (03) 6226 7505 T • +61 (03) 6226 2107 F

Director

Mr Tim Moltmann
Tim.Moltmann@imos.org.au

Executive Officer

Mrs Jo Neilson
Jo.Neilson@imos.org.au

Project Officer

Dr. Marian Wiltshire
Marian.Wiltshire@utas.edu.au

Scientific Officer

Dr Katy Hill
Katy.Hill@imos.org.au

Office Assistant

Ms Virginia Bowen
Virginia.Bowen@utas.edu.au

Technical Director

Mr Simon Allen
Simon.Allen@imos.org.au

Facility Leaders:

Argo Australia

Dr Susan Wijffels
susan.wijffels@csiro.au

Enhanced Measurements from Ships of Opportunity (SOOP)

Mr Ken Ridgway
Ken.Ridgway@csiro.au

Australian Bluewater Observing System (ABOS)

Dr Tom Trull
Tom.Trull@utas.edu.au

Australian National Facility for Ocean Gliders (ANFOG)

Prof Charitha Pattiaratchi
chari.pattiaratchi@uwa.edu.au

Autonomous Underwater Vehicle Facility (AUV)

Dr Stefan Williams
stefanw@acfr.usyd.edu.au

Australian National Mooring Network

Dr Tim Lynch
Tim.Lynch@csiro.au

Australian Coastal Ocean Radar Network (ACORN)

Prof Mal Heron
mal.heron@jcu.edu.au

Australian Animal Tagging and Monitoring System (AATAMS)

Dr Rob Harcourt
rharcour@gse.mq.edu.au

Facility for Automated Intelligent Monitoring of Marine Systems (FAIMMS)

Mr Scott Bainbridge
s.bainbridge@aims.gov.au

eMarine Information Infrastructure (eMII)

Dr Roger Proctor
Roger.Proctor@utas.edu.au

Satellite Remote Sensing (SRS)

Dr Edward King
Edward.King@csiro.au

Node Leaders:

Blue water and climate

Mr Ken Ridgway
Ken.Ridgway@csiro.au

Queensland's IMOS (Q-IMOS)

Dr Peter Doherty
p.doherty@aims.gov.au

New South Wales IMOS (NSW-IMOS)

Dr Moninya Roughan
mroughan@unsw.edu.au

Southern Australia IMOS (SAIMOS)

Associate Professor
John Middleton
John.Middleton@sa.gov.au

Western Australia IMOS (WAIMOS)

Prof Charitha Pattiaratchi
chari.pattiaratchi@uwa.edu.au



IMOS is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative

This issue of marine matters was compiled by Dr Marian Wiltshire. Thanks to Helen Beggs, Christine Hanson and Martina Doblin for providing news items.