

## A new look for the IMOS Ocean Portal

The IMOS Marine Information team released a new look IMOS Ocean Portal in February. The website has had a major overhaul; redesigned to produce an Ocean Portal that is intuitive and engaging. We have improved both functionality and the user experience, so now it's as simple as 1-2-3 to download the wealth of IMOS data available for use in marine and climate research.

IMOS is not just deploying equipment in the oceans surrounding Australia, the data streams we collect are building long time series, and actually they are the research infrastructure we are creating and developing. The IMOS Ocean Portal ensures IMOS data is discoverable and accessible for use in the scientific and broader community.

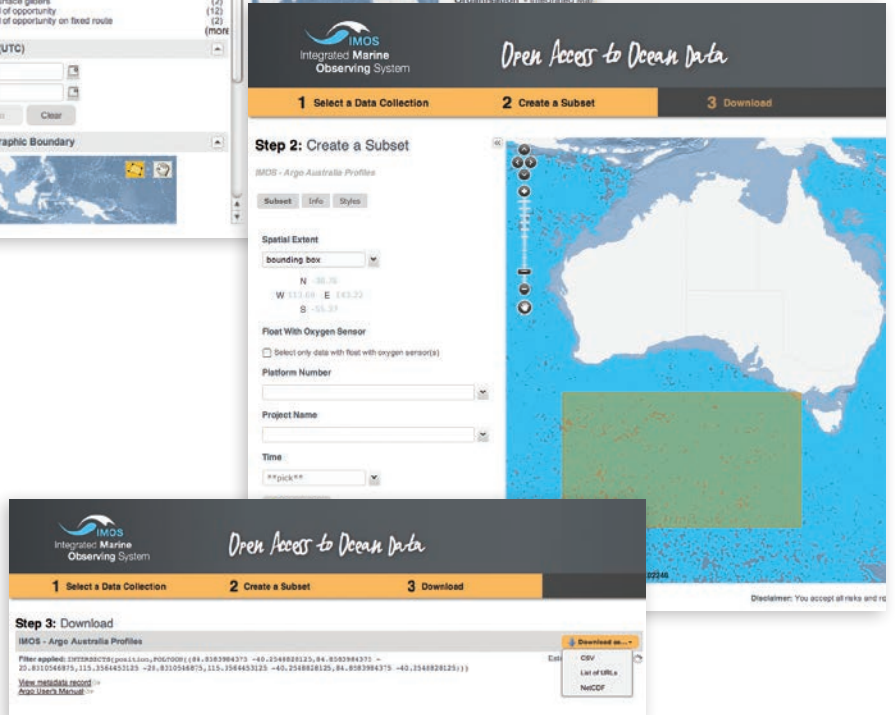
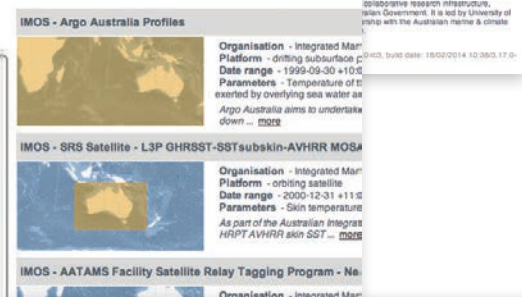
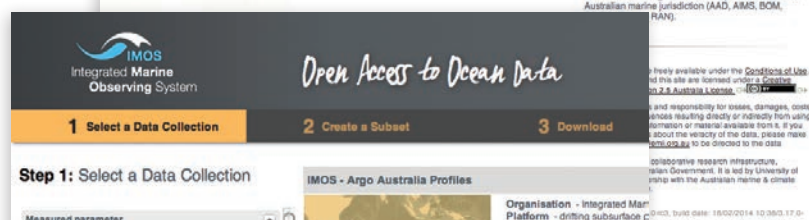
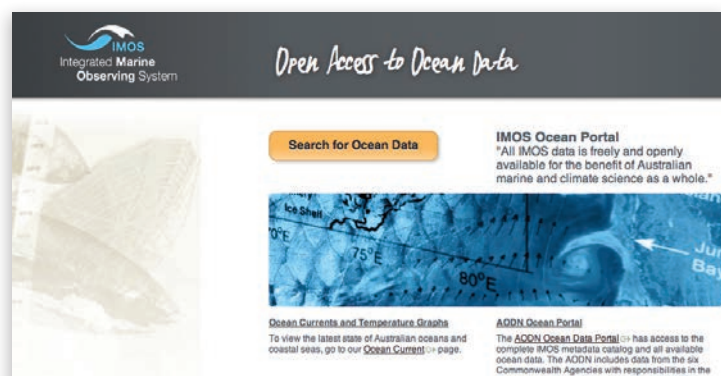
The Marine Information team have designed the new look Ocean Portal in response to user feedback, delivering a simple mechanism for:

1. data discovery and selection;
2. collating data sets across space and time; and
3. downloading the data in a suitable form for scientific use.

Taking the opportunity to completely redesign the Portal interface at the same time, IMOS now offers ocean data users a new web environment that 'flows' well. The Marine Information team believes the end result is an Ocean Portal that will tempt new and loyal users to explore the possibilities with IMOS datasets.

The new IMOS Ocean Portal is found at the same URL, <http://imos.aodn.org.au>.

Should you have any comments or require assistance please review the 'Help' link at the top right hand of the Portal – you may find your answer in our [User Guide](#), or send details directly using the 'Contact Us' link or email [info@emii.org.au](mailto:info@emii.org.au).



## director's corner

Tim Moltmann



Welcome to the first edition of Marine Matters for 2014, the eighth year of IMOS operation.

As a mature national collaborative research infrastructure, the performance of IMOS can be measured in terms of four key indicators:

- Successful deployment and recovery of marine observing equipment;
- Availability of data;
- Uptake and use of available data to do great science; and
- Relevance and impact of the science underpinned by IMOS observations and data across all relevant sectors of government, industry and society.

It is pleasing to see the stories in this edition of Marine Matters range across all four dimensions of performance.

The fundamental importance of continuing to collect high quality CTD data is highlighted. The value of repeat benthic surveys by the Autonomous Underwater Vehicle (AUV) Facility is demonstrated through application in marine heatwave research.

Open access to IMOS data continues to foster new and exciting science collaborations. Stories about participation in the Global Ocean Acidification Network, and biological 'footprint analysis' of National Reference Stations using ocean colour remote sensing data are great examples.

A key element of the IMOS strategy for ensuring that observations and data are taken up and used is establishment of partnerships with key marine and climate research programs across the Australian national innovation system. Stories on the eReefs modelling project



The IMOS office continues to rebuild, with Marian Wiltshire who has been on maternity leave rejoining IMOS and job-sharing the communication role with Jess Tyler. Emma Sommerville joined IMOS as Project Officer in early 2014 and Ana Lara-Lopez is our new Scientific Officer, replacing Shavawn Donoghue who is on maternity leave. Congratulations to Marian and Shavawn, and their families, on their lovely daughters. From left: Ana Lara-Lopez, Jo Neilson, Tim Moltmann, Marian Wiltshire, Donna Chilcott, Jess Tyler, Emma Sommerville.

in Queensland, and The Great Australian Bight Collaborative Research Program in South Australia are excellent examples.

In terms of relevance and impact, there are stories ranging across the IMOS stakeholder base. A review of the IPCC Fifth Assessment Report (AR5) and what it means for ocean observing in the Australian region sets a long term context. The OceanCurrent stories provide a much more immediate view. A new Argo animation aimed at school children reminds us that we need to reach out to voters and taxpayers, both current and future generations, and clearly articulate what we are doing and why it's important for the Australian people.

With strong, end-to-end performance now in place, IMOS can begin to shift its focus from negotiating the first decade to positioning for the decades to come. A new long term strategy (2015-25) has been developed by the IMOS Office and Advisory Board, and will be taken to stakeholder consultation in coming months. We look forward to your engagement with this important forward planning process.

IMOS 2015-25 is aimed at ensuring future generations of Australians have an adequate base of ocean information

upon which to make sensible decisions about sustainable development of Australia's vast and valuable marine estate. We are now well on the way to achieving this vision through IMOS. Sustaining and growing what IMOS currently has in place is an essential and increasingly urgent priority.

*Tim Moltmann*

## A new direction at OceanCurrent

Madeleine Cahill at CSIRO is now coordinating *OceanCurrent*, following in the footsteps of David Griffin, who has been providing us with his extremely valuable ocean observing insights since 2011. *OceanCurrent* has proven to be one of our most popular data delivery mechanisms, used by fishers, yachties, even swim race planners for essential insights into local conditions. For the marine science community in general it is an essential resource, actively used in research voyages, glider missions etc. We appreciate David's energy and enthusiasm for developing *OceanCurrent* to this level of sophistication.



## Annual planning meeting roundup

The 8th IMOS Annual Planning Meeting was held this year in Hobart, with a new structure and focus to help draw out the essential elements for IMOS into the future along the themes of science opportunities and implementation issues.

The early part of the meeting focused on the Nodes and their science activities: issues arising from the revision of Node Science Implementation Plans; science opportunities; and impediments to uptake and use across Facilities.

A series of invited talks was included to stimulate thinking, with a keynote presentation on ocean acidification by Dr Libby Jewitt, Director of NOAA's Ocean Acidification Program.

Libby spoke of the importance of tackling ocean acidification globally, with a high priority on multi-lateral engagement. An essential ingredient is the need to internationally coordinate and integrate the scientific effort and to achieve this, she is championing the cause of a new Global Ocean Acidification Observing Network (GOA-ON, see page 5).

A talk by CSIRO's Steve Rintoul on the IPCC's AR5 dealt with the key messages for ocean observing in the Australian region (see page 7), highlighting the important role of IMOS ocean observations to the report's critical findings.

CSIRO's Emlyn Jones provided an insight into the national reference stations (see page 10) and their biological 'footprint' – or area of coverage, and how this data can be potentially be used to study wider areas of coastal oceans and at different timescales.

Andrew Constable from the Australian Antarctic Division and Beth Fulton from CSIRO outlined the observational needs for ecosystem modeling – present and future.

Panel discussions on selected science and engagement topics included the

IMOS role as an observational base for ocean acidification, primary productivity and marine ecosystem research.

The ocean acidification discussion investigated the need for international standards for all aspects of monitoring so that there is 'internal consistency' in calibration of equipment, standards for measurement, technology delivery and 'harmonising' the effort across all these areas.

IMOS as an observational base for primary productivity research in Australia was another panel discussion, exploring the notion that ecosystem processes may be more important in the long term than 'snap shots' of individual components, and the consequences this may have for program design.

We were delighted to have representatives from the National Environmental Research Program (NERP) and the Australian Government's Environment Department join us in discussion.

The NERP's Peter Doherty (Tropical Ecosystems Hub Science Leader) and Nic Bax (Marine Biodiversity Hub Leader) were panel members in a session on how the NERP program can interface with IMOS to support the Department of the Environment. Charlton Clark and Barbara Musso attended for Parks Australia and Tim Moltmann, IMOS Director, moderated the forum.

The NERP Tropical Ecosystems Hub delivers water quality research for a healthy Great Barrier Reef partly through a modelling suite known as eREEFs, which requires IMOS data streams for essential calibration and validation, and an automated sensor network and reporting system for health of the Great Barrier Reef.

The Marine Biodiversity Hub is developing a national marine monitoring blueprint that will support the Department's needs for monitoring marine reserves, ecosystem health

and other regulatory priorities. IMOS is keen to collaborate on development of the blueprint.

The forum concluded that while both NERP Hubs are already using IMOS infrastructure to deliver on Departmental priorities, closer liaison between the NERP and IMOS communities could enhance the value of ocean observations to the Department of the Environment in the future.

*A special thanks to Donna Chilcott in the IMOS office for organising and coordinating an engaging and enjoyable meeting.*

### Invited presentations:

- Libby Jewitt (NOAA), Ocean Acidification
- Steve Rintoul (CSIRO), IPCC AR5
- Emlyn Jones (CSIRO), the ocean colour footprint of the IMOS National Reference Stations
- Andrew Constable (AAD) and Beth Fulton (CSIRO), Observations for ecosystem models.

### Panel discussion:

- IMOS as an observational base for ocean acidification
- IMOS as an observational base for primary production
- Strengthening the relationship with the Defence Maritime sector
- IMOS as an observational base for marine ecosystem research

### Group discussion:

- Is IMOS achieving its potential as a national system with global reach?
- Quality control of IMOS streams
- IMOS and modelling

## IMOS data-streams support informed management of the Great Barrier Reef

The eReefs modelling suite is the most ambitious simulation to date of the Great Barrier Reef (GBR) ecosystem. It is coupled with the Queensland Government's modelling of catchment processes, which predicts the annual discharge of sediments, nutrients, and pesticides from the major rivers to the coastal receiving waters.

The eReefs model predicts the transport and transformation of these elements after their entry to the marine environment to create a large-scale water quality model covering the entire GBR. This allows reef managers to know the impact of acute events like floods on the targets for water quality and to track the cumulative impacts of historical variations in water quality on aspects of ecosystem health. This same knowledge is also used by land managers to change industry practices towards reducing the escape of sediments, nutrients, and pesticides from agricultural landscapes.

Like all models, eReefs has to be calibrated and validated by data from

the domain that it seeks to simulate. IMOS data streams from sensors on oceanographic moorings, ships of opportunity, gliders, and remote sensing satellites are being used to validate the hydrodynamics, sediment transport and biogeochemistry in this model.

Speaking at the IMOS Annual Planning Meeting held in February (see page 3), Richard Brinkman (Node Leader Q-IMOS) explained that this kind of modelling would give managers an important opportunity to test different scenarios before spending large amounts of money in the field, and to establish the best return on investment from a choice of management actions. He also pointed out that the IMOS data streams in the GBR were few and came from a very sparse observing network. The multi-billion dollar value of the GBR provides a strong case for strengthening marine observations in north Queensland and it would be fatal for eReefs if the current data streams ended.

As an example of utility, severe outbreaks of the coral-eating Crown-of-Thorns starfish in the central GBR follow from

major flooding of the continental shelf between Cairns and Cooktown. The most likely cause is the delivery of extra nutrients in the flood waters that trigger algal blooms, which feed starfish larvae. The eReefs model was used to trace the relative contributions by different catchments to the nutrient budgets of this critical area, especially during recent wet seasons most likely responsible for triggering the current outbreak episode. These predictions were used to identify priority catchments for remedial action and will influence investment decisions (of almost \$400 million) within the Reef Plan overseen by the Australian and Queensland Governments.

The eReefs Project is a collaboration between the Great Barrier Reef Foundation, Bureau of Meteorology, Commonwealth Scientific and Industrial Research Organisation, Australian Institute of Marine Science, and the Queensland Government, supported by funding from the Australian Government's Caring for our Country, the Queensland Government, the BHP Billiton Mitsubishi Alliance, BHP Billiton, and the Science Industry Endowment Fund.



Satellite (MODIS) image of the Great Barrier Reef. (Image AIMS /NASA)

We are also pleased to congratulate Stefan Williams from the Australian Centre for Field Robotics at the University of Sydney on his Professorship, awarded late last year.



(Photo: The University of Sydney)



## The ocean today is warmer, and sea levels higher, than at any time since the instrumental record began: State of the Climate 2014.

The CSIRO and the Australian Bureau of Meteorology released their third *State of the Climate* report in March. It provides a summary of observations of Australia's climate and analysis of the factors that influence it.

Weather and climate touch all aspects of Australian life. The ocean drives the climate system, and the impacts of ocean variability and ocean change will affect our society across generations. Improving our understanding is fundamental to better decision-making by governments, industries and communities into the future.

In *State of the Climate* report, long-term trends in Australia's climate are discussed. This is the third biennial *State of the Climate* report. As with the earlier reports, the report focuses primarily on climate observations and monitoring carried out by the Bureau of Meteorology and CSIRO in the Australian region, as well as on future climate scenarios.

Key points for the ocean are:

- sea-surface temperatures in the Australian region have warmed by 0.9°C since 1900.

- the Earth is gaining heat, most of which is going into the oceans.
- global mean sea level increased throughout the 20th century and in 2012 was 225mm higher than in 1880.
- rates of sea-level rise vary around the Australian region, with higher sea-level rise observed in the north and rates similar to the global average observed in the south and east.
- ocean acidity levels have increased since the 1800s due to increased CO<sub>2</sub> absorption from the atmosphere.

Observations provided by Australia's Integrated Marine Observing System (IMOS) contribute to the report findings in four key sections:

Sea-surface temperature: remotely sensed sea surface temperature (SST) data are important inputs to climate models, and there is a need for high quality in-situ SST observations to improve validation of satellite SST and ocean models. IMOS provides streams of high quality, near real-time (within 24 hours), SST observations from 14 vessels in previously un-validated regions around Australia, such as coastal areas and the Southern Ocean.

Ocean heat content: ocean heat and salinity to a depth of 2,000 metres below the surface are observed by the global Argo float array. IMOS deploys 30 floats per annum through Argo Australia, which along with other national and international deployments has resulted in 10% of the global array of 3,800 floats delivering a continuous data stream for the Australian region.

Sea level: satellites monitoring the height of the ocean (called altimeters) are the tool of choice for studying sea level rise. Precise measurement from space pushes these satellite systems to their limits and some high quality measurements from within the ocean are required. State-of-the-art GPS buoys maintained by IMOS provide the only altimeter calibration and validation sites in the Southern Hemisphere.

Ocean acidification: ocean acidity is measured in units of pH, and is monitored globally via a number of platforms including a network of repeat hydrographic surveys, time-series stations, floats and glider observations, and volunteer observing ships. IMOS maintains three acidification time-series stations around Australia (Kangaroo Island, Yongala and Maria Island) as well as measurements from volunteer observing ships, and data from these stations is contributing to the new Global Ocean Acidification Observing Network (GOA-ON).

**For further information and to download the full report:**

Bureau of Meteorology  
[www.bom.gov.au/state-of-the-climate/](http://www.bom.gov.au/state-of-the-climate/)  
CSIRO  
[www.csiro.au/State-of-the-Climite-2014](http://www.csiro.au/State-of-the-Climite-2014)

### GOA-ON

The idea of international ocean acidification collaboration is gathering momentum, with 38 countries now participating in the Global Ocean Acidification Observing Network (GOA-ON).

Headed by the UK National Environment Research Council and the US National Oceanic and Atmospheric Administration (NOAA), this international effort has been initiated to facilitate merging regional and national monitoring programs into one program, and identifying areas of common concern, optimising resources and improving data quality and comparability.

Already, annual workshops on ocean measurements and coastal and shelf-sea measurements have been held since 2012.

#### GOA-ON's Goals

- Understand global ocean acidification conditions
- Understand the ecosystem response to ocean acidification
- Acquire and exchange data to optimize modelling

#### Contacts:

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(GOA-ON Co-chair)  
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NOAA: Dr Libby Jewitt  
(GOA-ON Co-chair)  
[Libby.jewitt@noaa.gov](mailto:Libby.jewitt@noaa.gov)



## How do we measure the ocean? Watch the new Argo animation to find out.

The new Argo stop-motion animation aims to inspire children (and adults) to engage with marine science. It is quirky, fun and informative at the same time. The animation explains what an Argo float is, how it operates and how all this data helps us to understand the ocean circulation and climate.

“The Argo animation came about after I saw Malou Zuidema’s fantastic ‘Forests of the Sea’ animation that she did for Lynchpin and the Bookend Trust. I thought communicating science in a fun way would be a great way to get kids more engaged with marine science. I also thought the Argo story would translate well into the medium of stop-motion animation,” says Esmee van Wijk, a CSIRO physical oceanographer who works on the Australian Argo program.

“Malou and I worked together to come up with a short story that explains the history of oceanography and ocean measurements and how Argo floats have become a great solution to measuring large parts of the ocean in an autonomous way. Besides explaining to kids how Argo floats work and what they do, we also wanted to showcase how the Argo data is used in real-world applications like climate and seasonal forecasting, scientific research and to help industry to predict ocean currents, temperature and wave height.”

Oceanographers have deployed more than 3500 robotic profiling floats into the global oceans as part of the international Argo program over the past 15 years. Argo floats measure water properties such as temperature, salinity and pressure from the surface to a depth of two kilometres. Floats can change their buoyancy by pumping oil into and out of an external bladder, which allows them to sink, drift with the ocean currents and measure data as they rise to the surface. The floats send their data and location back to processing centres on land via the satellite network. Each float repeats this cycle every ten days and can drift in the oceans measuring data for as long as four to seven years.

“We had a lot of fun creating the animation and thinking about how to illustrate and communicate the different parts of the Argo story. We hope people enjoy watching it as much as we enjoyed making it.”

**To watch the Argo animation visit:**  
<http://imos.org.au/argoanimation.html>



Stills from the Argo stop-motion animation.  
Credit: Malou Zuidema

**Credits >** Story: Malou Zuidema & Esmee van Wijk Artist: Malou Zuidema Scientist: Esmee van Wijk Voice-over: Jan Zika  
Thanks to: Australia Argo Team Supported by: CSIRO, Argo and IMOS

**For more information >** Science: [www.imos.org.au/argo/html](http://www.imos.org.au/argo/html) Art: [www.malouzuidema.com](http://www.malouzuidema.com)



# Making the IPCC Headlines

The Intergovernmental Panel on Climate Change (IPCC) 5th assessment report (AR5) 'Climate change 2013: the physical science basis' was a mammoth production: 209 lead authors, 9,200 cited publications and 54, 677 comments – each with an individual reply.

The report concludes that warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased

In a presentation to the IMOS Annual Planning Meeting 2014 (see page 3), Dr Steve Rintoul, a Coordinating Lead Author of the AR5 chapter on oceans, summarised some of the key conclusions of the report. Dr Rintoul is a physical oceanographer at CSIRO's Wealth from Oceans Flagship and the Antarctic Climate and Ecosystems Cooperative Research Centre and co-leader of the Bluewater and Climate Node of IMOS.

*"Many of the most important headlines of the IPCC assessment depended on ocean observations, including those collected by IMOS," Steve said.*

In particular, ocean observations underpinned the conclusions that:

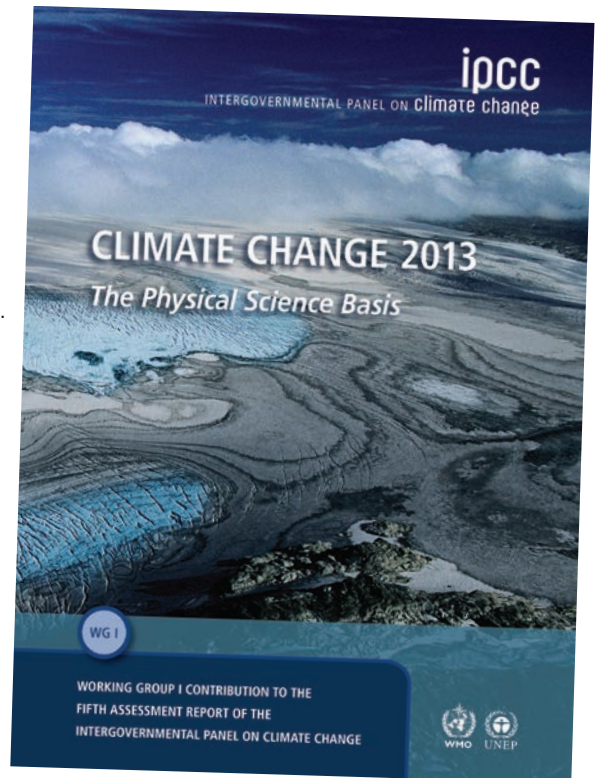
- 93% of the extra heat energy stored by the earth since 1970 is found in the ocean;
- human influence on the climate system is clear;
- global mean sea level rose by 0.19 m between 1901 and 2010, with faster rates of rise observed since 1993;
- the global water cycle has "spun up," as seen in measurements of ocean salinity;

- the oceans have absorbed 30% of human emissions of carbon dioxide, slowing the rate of climate change but at the cost of ocean acidification.

*"Australian users of IMOS data provided much of the most significant science on which AR5 conclusions were based, including studies of ocean heat content, ocean salinity, carbon uptake, and sea level rise," he said.*

Steve pointed out that gaps remain in the network of global ocean observations and these make climate change assessments a significant challenge. The most critical gaps, and the platforms that could fill them, include:

- sustained broad-scale temperature and salinity observations (must maintain Argo),
- deep ocean (must maintain deep hydrography and use new technologies when available),
- under ice (largest blind spot in ocean observing system; need ice-capable floats, instrumented seals, ice-tethered instruments),
- biogeochemistry (need autonomous sampling),
- ocean circulation (must maintain altimetry, tide gauge network),
- sea level (as above, plus improved understanding of vulnerability of ice sheets to ocean warming, including ocean sampling near ice shelves).



To be useful for climate change assessments like those of the IPCC, it is critical that these data streams are sustained. For many key ocean variables, there is still not sufficient information available to assess and interpret rates of change.

*"IMOS should be very proud of its achievement," he said. "Many of the key findings of the AR5 report relied on the sustained ocean measurements made by IMOS and its international partners in the global ocean observing system."*

For more information on the IPCC's report, visit [www.climatechange2013.org](http://www.climatechange2013.org).

# IMOS Postgraduate Student Profile

Students working with IMOS for their postgraduate research

## Paige Kelly

Institute for Marine and Antarctic Studies at the University of Tasmania



Paige Kelly's Honours project aims to improve existing knowledge of how the East Australian Current (EAC) drives distribution patterns of zooplankton, and how any changes in zooplankton distribution patterns may affect higher trophic levels.

Currently, there is no long-term documentation of changes in zooplankton composition off the east coast of Tasmania. However, recent studies suggest that the warmer waters transported by the EAC are causing an increase in warm water associated species, such as the copepods *Temora turbinata* and *Pleuromamma gracilis*. To build on existing knowledge, Paige is primarily investigating recent zooplankton distribution patterns (from 2009 onwards) at Maria Island. This site was chosen as the focus of her project because it is the location of the Tasmanian IMOS National Reference Station (NRS), and also because of the complex oceanography at the site. The summer waters are a mix of warm, saline, generally oligotrophic EAC water, and cold, less saline, nutrient rich subantarctic surface waters.

Warmer, oligotrophic summer waters have led to shifts in Eastern Tasmania surface zooplankton communities, such as in Storm Bay (southwest of Maria Island) in the past. For example, during one summer the increased influence of tropical waters led to the complete loss of the jack mackerel's (*Trachurus declivis*) main surface prey source: the

**Project:** *Drivers of Eastern Australia biology, with an emphasis on distribution patterns of zooplankton at Maria Island*

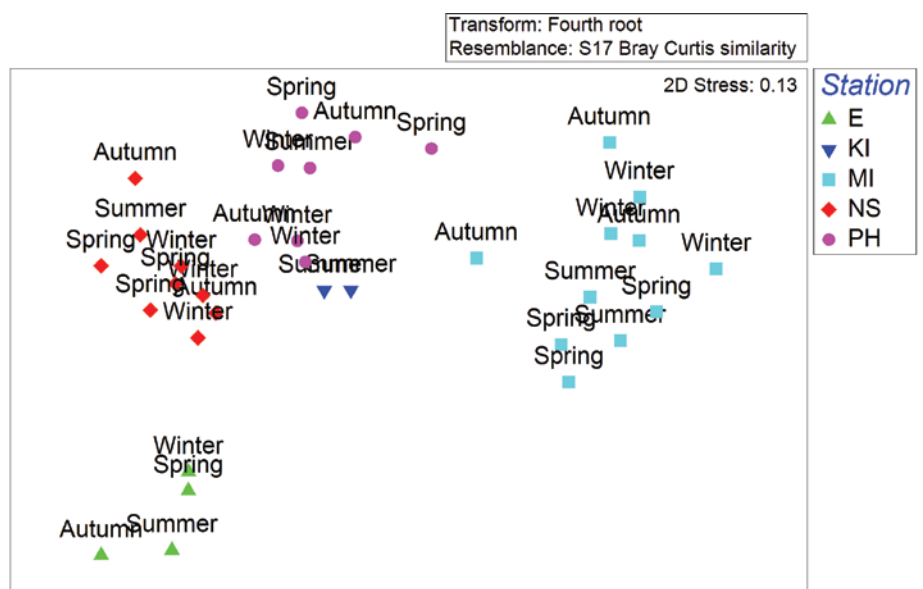
euphausiid *Nyctiphanes australis*. The absence of *N. australis* from surface waters contributed to the migration of jack mackerel to greater depths, which in turn resulted in the collapse of the purse seine fishery as fish could no longer be caught in surface waters.

Paige will compare the zooplankton distribution patterns at Maria Island with the other NRS locations around the country, including North Stradbroke, Port Hacking, Esperance, Kangaroo Island and Rottnest Island to identify any north-south or east-west trends. Paige will use physical, chemical and chlorophyll-a data to determine what is driving the observed changes in zooplankton distribution patterns. She will apply analytical methods that include Generalized Linear Modelling, Indicator Species Values and Multi-Dimensional Scaling (MDS).

As well as the physical, biogeochemical and zooplankton data collected at the Maria Island (MI), Port Hacking (PH), North Stradbroke (NS), Esperance (E), Kangaroo Island (KI) and Rottnest Island National Reference Stations, Paige will use IMOS data collected from the Australian Continuous Plankton Recorder (AusCPR) Survey. The AusCPR Survey observes plankton communities via a network

of Ships of Opportunity routes around Australia, and can provide a broader context to explore any zooplankton trends suggested by the NRS data.

The MDS ordination (below) has been used to show differences/similarities in zooplankton community composition across the NRS network. Each shape represents a sample at the matching site (according to the legend), and the samples have also been labeled with the season. The important feature is the distance between samples; those that are grouped closely together share a similar zooplankton community composition, while samples that are further apart have less similar community compositions. Maria Island, the site of most interest, has grouped most closely to Port Hacking and Kangaroo Island samples. As Maria Island is geographically closest to these two sites this is not unexpected. The Maria Island samples that group nearest to Port Hacking are autumn samples: as the EAC signal at Maria Island is strong during March, it is possible that the increased injections of warmer water have caused a surge in the presence of species usually found further north at Port Hacking.





## WAIMOS

### Coral ecosystems recovering relatively quickly to a marine heat wave

During the Australian summer of 2010-2011 the effects of one of the strongest La Nina events on record were widespread in the oceans around Australia, but in particular along the west coast where ocean temperatures were warmer than normal. The La Nina event in the tropical Pacific increased the flow of water through the Indonesian Throughflow and hence strengthened the Leeuwin Current, bringing warmer water southwards. Data from IMOS moorings offshore of Perth showed surface water temperatures up to four degrees higher than normal in February-March 2011. From recent research, it appears that local air sea interaction in the south-east Indian ocean also contributed to the amplitude of this event – termed Ningaloo Niño in recent literature.

The ‘marine heat wave’ had a profound effect on the marine ecosystems

along the Western Australian coast, prompting widespread coral bleaching from Ningaloo Reef in the north to Rottnest Island in the south. The IMOS Autonomous underwater vehicle (AUV) was able to capture and document this extreme episode with before (2010) and after (2011) images of the benthic ecosystem at Abrolhos Island, and has since surveyed the same site in 2012 and 2013.

Interestingly, researchers found that while the devastation to the coral reefs in the area was large, regrowth was surprisingly fast and widespread. Whilst the original plate corals have not recovered, other coral species have regenerated in their place, with approximately 50% of the lost area being replaced.

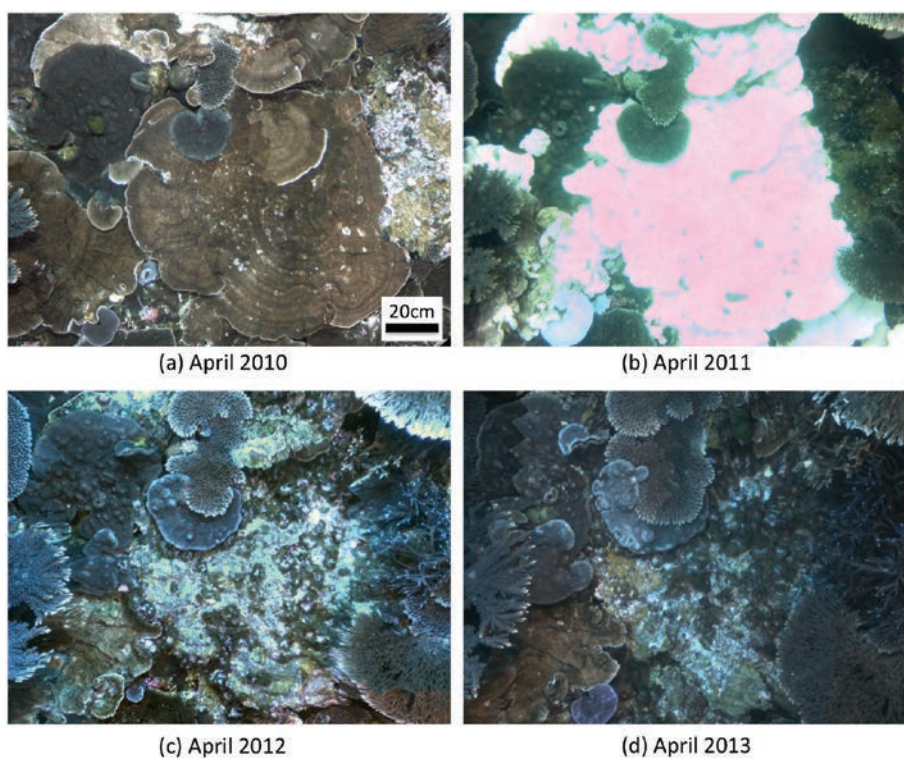
## SAIMOS

### New era of collaborative marine research in the Great Australian Bight

The new Great Australian Bight Collaborative Research Science program is a wide-reaching program being undertaken by CSIRO, Marine Innovation Southern Australia (MISA) and BP. In designing this exciting program, full advantage has been taken of IMOS Facilities already operating in the region, and of the potential for operation of other IMOS National Facilities to be efficiently and effectively extended into the region with modest co-investment.

Associate Professor Tim Ward has been appointed to lead the four-year \$20 million research program on the Great Australian Bight’s ecosystems, marine resources and socio-economic importance. The marine ecosystems of the Bight support globally important populations of seabirds and marine mammals, unique seafloor communities and valuable fishing, aquaculture and ecotourism industries.

More than 100 scientists and post-graduate students from CSIRO, South Australian Research and Development Institute (SARDI), the University of Adelaide and Flinders University are aiming to understand the oceanographic processes and linkages between the different components of the Bight ecosystem, and will establish the



BleachedMontipora\_RepeatImages2010-13.jpeg: Four repeat views of coral colonies from April 2010, April 2011, April 2012 and April 2013 in about 18m depth at the Abrolhos Islands. The 2011 image (b) is an actual image collected by the Sirius AUV. The images in 2010, 2012 and 2013 (a,c,d) are all reconstructed images that are built from a collection of images collected from different perspectives and “stitched” together to produce an image that looks like it was taken from exactly the same perspective as in 2011. Image Credit: Mitch Bryson.



Great Australian Bight Collaborative Research Science Program Manager, Associate Professor Tim Ward. (Photo: SARDI)

## FACILITY 6: Australian National Moorings Network

### Colourful observing footprints

knowledge and tools needed to support management decisions regarding the future sustainable use of the region.

“This new collaborative research program represents the next step in the evolution of our research in the Bight - bringing together Australia’s leading marine scientists we will develop new insights into how the system works,” Associate Professor Ward said.

The Collaborative Research Science Program to be undertaken by MISA, CSIRO and BP, represents a unique and cost-effective approach, forged between industry and science, to increase current understanding of the Great Australian Bight for the benefit of all stakeholders. It will be one of only a few whole of ecosystem studies undertaken in Australia.

The Collaborative Research Science Program brings together multidisciplinary research teams organised around seven research themes:

- oceanography;
- open-water (pelagic) ecosystem and environmental drivers;
- sea floor (benthic) biodiversity;
- ecology of iconic species and apex predators;
- petroleum geology and geochemistry;
- socio-economic analysis; and
- integration and modelling.

The research will build on data already collected from existing IMOS platforms including; gliders, moorings, biogeochemical sampling, tagged apex predators, acoustic receivers, ocean radar, bioacoustics, continuous plankton recorders and passive acoustic receivers. The data will be used in hydrodynamic ocean modelling, to identify hot spots of ecological activity, and assess spatial and temporal variation in food web dynamics.

The new data will also contribute to and be stored in the Australian Ocean Data Network.

Emlyn Jones from CSIRO has been assessing the ocean colour footprint of the IMOS National Reference Station (NRS) sites, showing that by combining the information taken from all sites around Australia’s coastline, biological dynamics at seasonal and longer time scales can be inferred for large portions of Australia’s shelf and regional seas.

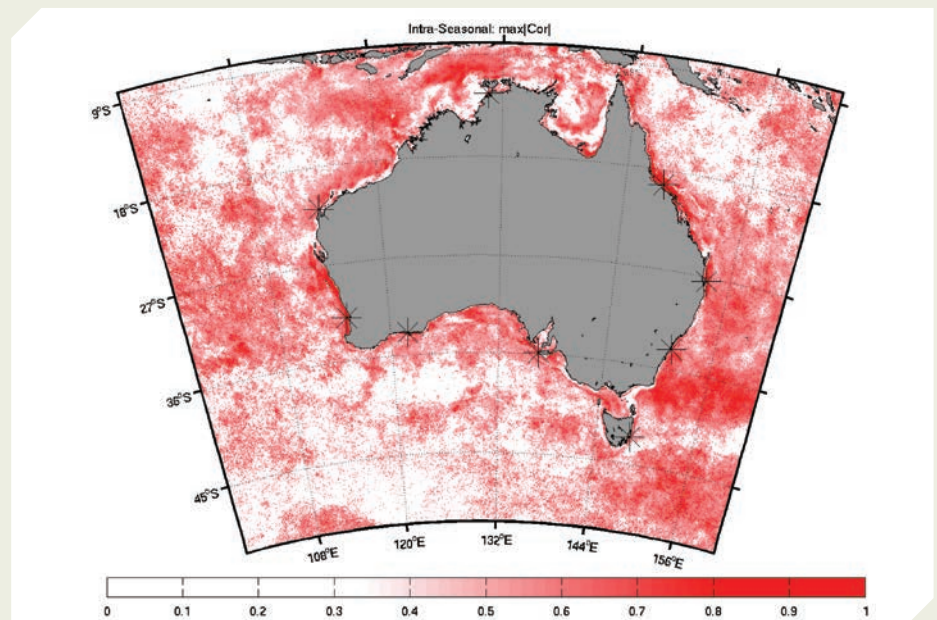
Presenting his work at the IMOS Annual Planning Day in February (see page 3), Emlyn showed a footprint of each reference station around Australia, indicating which areas of ocean are statistically comparable.

He then combined each NRS footprint making a national footprint, mapping where Australia’s coastline has high or low levels of data coverage at weekly, monthly and seasonal timescales.

This analysis showed where there are gaps in ocean observations, and highlighted where local ocean dynamics have a strong effect.

Armed with this data, he has been able to rank the reference stations according to the time scale they are best suited to capture, revealing that the NRS network alone is not able to provide information about nation-wide dynamics at weekly or monthly scales, but is useful at seasonal and longer time-scales.

Emlyn says “...the NRS network appears to be capturing the ocean color dynamics at seasonal time scales and longer, along our shelf and adjacent seas which are affected by our regional boundary currents. It is encouraging to see an objective analysis confirming that the NRS network is fulfilling its original design brief.”



## FACILITY 11: Satellite Remote Sensing



**Congratulations** to Dr Thomas Schroeder and Dr Nick Hardman-Mountford of CSIRO who have recently stepped up as Sub-Facility Co-Leaders in the IMOS Sub-Facility 11d: Satellite Remote Sensing – Ocean Colour. Sincere thanks goes to Dr Vittorio Brando who has led this Sub-Facility since the beginning of IMOS, and we wish him all the best with his Marie Curie Fellowship in Italy for two years.



## Data quality control

Back in late 2010–early 2011 the ANMN published a series of IMOS protocols for each of the nodes to standardise their SeaBird CTD profiling data collection and processing. These protocols not only aligned the methods for acquiring CTD data across nodes but also brought into being a series of QAQC checks for the various sensors utilised for monthly sampling at each of the NRS. At the time the protocols were peer reviewed and made available on the IMOS portal for general access.

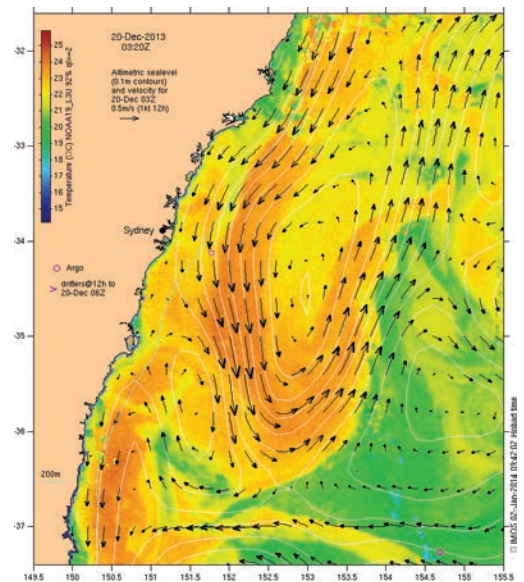
While the post processing protocols have generally been adopted across nodes, uptake of the pre-run checks for tracking sensor behaviour over time has been less so. Discussions at the recent QAQC conference in Hobart in December 2013 prompted a review of pre-run check methodology and uptake. The general consensus for nodes was that the pre-run checks were considered best-practice and that a more simplified version of the pre-run checks was required. Many of the nodes struggle to be able to attain all recommended checks, because access to additional facilities for lab-based comparisons, such as salinometers for salinity, is limited. A quicker and bare minimum version of the pre-run checking protocol is currently under production.

In the west, CSIRO technician Ian Darby has managed the profiling CTDs on behalf of WAIMOS for the last five to six years of NRS BGC sampling. Having worked intimately with IMOS profiling CTD data Ian recently made recommendations for improvements to the CTD post-processing protocols. These include: skipping the first 300 scans in the DATCNV sub-program to remove erroneous surface soak values (not always excluded in LOOPEDIT and BINA VG steps); setting SBE43 Oxygen sensor time offsets to 2 seconds in ALIGN and retaining ‘scans marked bad’ in the final BINA VG function. A revised version of the Post-Processing Protocol is to be revised by members of the Profiling CTDs working group for comment before being made available on the IMOS website mid-March 2014.

News from the IMOS *OceanCurrent* website: <http://oceancurrent.imos.org.au/>

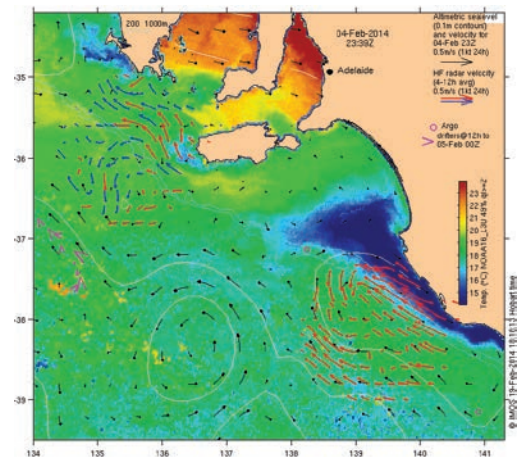
## Ocean current analysis for the Sydney to Hobart yacht race > 22 December 2013

The 2013 fleet negotiated three significant ocean eddies. The first, seen at right south-east of Jervis Bay on 20 December, was unfavourable, Skippers were probably keen to keep inshore of this, other factors being equal. The second was more important. Well-exploited all the way from 36S to about 39S, it could have given yachts a significant advantage (up to four hours) over those that do not find this river of southward-flowing tropical water. Finally, an isolated warm core eddy was off Tasmania’s Freycinet Peninsula (42S), potentially could have given a small boost to yachts keeping a bit farther east than others.



## Extreme Bonnie Coast Upwelling > 12 February, 5 March 2014

Winds associated with the combination of low atmospheric pressure over south east Australia and high pressure west of Tasmania around 4 February 2014 caused an extremely strong upwelling event stretching from the Eyre Peninsula to Portland, so this season can certainly be characterised as one that started early and included at least one extreme event. The surface velocities associated with the upwelling were measured by both the South Australian HF radars, confirming expectations from basic theory and numerical modelling that the flow is essentially alongshore in the upwelling region, with just a small component directed offshore to drive the upwelling. The dynamics is very different, and more complex, outside the continental



shelf in the deep ocean, where eddies exist and the wind-driven current is not constrained to follow the coast.

To find out more about what’s happening in Australia’s oceans, check out the IMOS *OceanCurrent* website.

IMOS has developed a 'circle diagram' to capture the complexity of engagement for IMOS as a broadly based research infrastructure program delivering to a national community, undertaking research of relevance across government portfolios (Federal and State), industries and communities.

**The diagram has five layers:**

1. IMOS at the core,
2. the ten operating institutions,
3. the broader research community,
4. various pathways for uptake and use of IMOS data and products, and
5. portfolios of relevance and impact.



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**For more information about IMOS please visit the website [www.imos.org.au](http://www.imos.org.au)**

IMOS is a national collaborative research infrastructure, supported by Australian Government. It is led by University of Tasmania in partnership with the Australian marine & climate science community.