marinematters

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Integrated **Marine Observing** System

IMOS News > For more IMOS news check the IMOS website **imos.org.au/news.html**

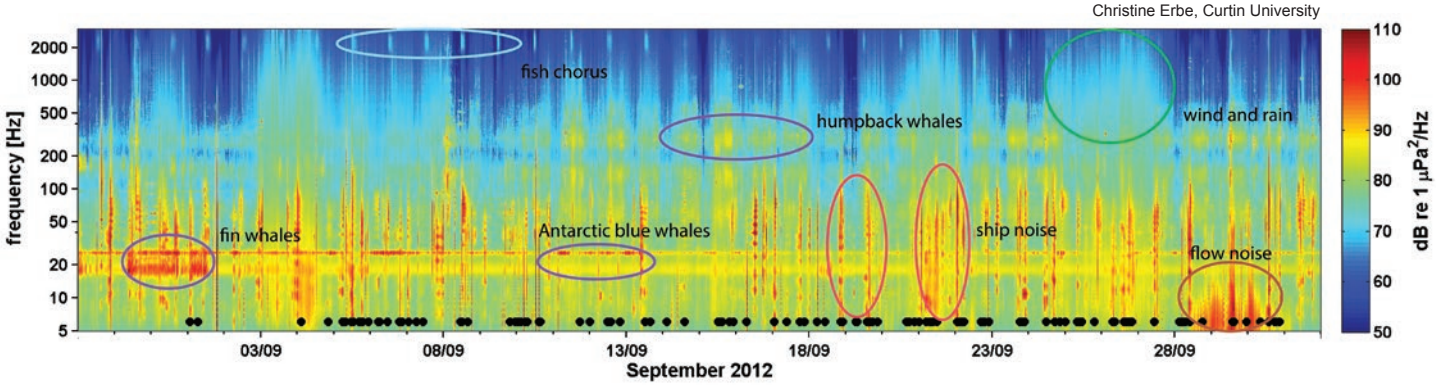
Perth Canyon soundscape dominated by whale song and fish choruses

The Perth Canyon is a submarine canyon off Rottnest Island in Western Australia and is an important feeding and resting ground for great whales on migration. In a recent study, acoustic, physical and biological data from IMOS moorings located in the region, along with weather and ship traffic data were used to characterise and quantify the marine soundscape of the Perth Canyon.

Overall biological sources are a strong contributor to the soundscape in the Canyon, with whales dominating seasonally at low and mid frequencies. Pygmy blue whales, fin whales, Antarctic blue whales, Antarctic minke whales and humpback whales were all heard in the canyon. At night, fish or invertebrate choruses dominated at high frequencies throughout the year. Ships contributed significantly at the low frequency band at all times of the day, throughout the year.

Passive acoustics is an efficient, cost-effective and autonomous way of monitoring animal visitation times and relative densities, and potential anthropogenic influences.

Christine Erbe, Curtin University



Spectrogram for September 2012 showing the main contributors to the marine soundscape in the Perth Canyon.

The full paper is available at Science direct: Erbe C, Verma A, McCauley R, Gavrilov A, Parnum I. 2015 The marine soundscape of the Perth Canyon. Progress in Oceanography, 137, 38-51. doi:10.1016/j.pocean.2015.05.015 | http://www.sciencedirect.com/science/article/pii/S0079661115001123

Rob Harcourt, Macquarie University

director's corner

Welcome to 2015 Christmas edition of Marine Matters.

It's amazing to be in our tenth year of operation, and to be actively planning for a second decade. This edition is full of stories that demonstrate the value of sustained investment in IMOS – its relevance to Australia's blue economy, and its importance in keeping us connected to a changing global ocean.

One example is the leading role IMOS is playing in the Australian Forum for Operational Oceanography (FOO). This is an exciting new initiative aimed at improving the safety and efficiency of marine industries, seed-funded by the Department of Industry Innovation and Science. FOO is bringing the R&D sector, government agencies, consultants and marine industries together in a way that has not been possible in Australia until now. This is exactly the sort of environment we need to create so as to enable innovative use of high quality ocean observations and numerical models to give Australian marine industries a competitive edge. And IMOS is front and centre.

Our research partnership with the new National Environmental Science Program (NESP) Marine Biodiversity Hub is another highlight. At the inception of IMOS, a strategic decision was made to invest not just in measurements of ocean physics for climate and weather research, but also in biological observations to support the study of marine ecosystems. We can see this paying off through the relationship with the Hub. Given that NESP is funded for six years, there is considerable potential to exploit the power of bringing together sustained biophysical observing, smart data management and policy relevant research.

Scientific knowledge and technological innovation are continuously evolving, and IMOS needs to respond as a dynamic research infrastructure. We are particularly pleased to see our relationship with the marine microbial community starting to flourish through the new partnership with Bioplatforms Australia, another capability funded under the National Collaborative Research Infrastructure Strategy (NCRIS). Microbial oceanography was just a 'gleam in the eye' in 2006, but it is likely to be core business for a marine observing system in 2026. This is a good example of IMOS positioning for the future.

We hope you enjoy these and all of the other stories in this edition of Marine Matters.

I would like to take this opportunity to wish you all the best for the festive season, and to thank our operators, users, investors and other stakeholders for the fantastic support they've provided during 2015. It's been another great year for the IMOS national collaboration.

Tim Moltmann

A new series of videos to highlight the collection, use and impact of IMOS data

There are many fascinating stories of marine observations and the people behind them. We tell these stories verbally, in print and in electronic media like websites and Facebook. Now you can meet the people behind the variety of marine observations that make up the IMOS data collection. IMOS introduced a brand new series of videos called 'IMOS in MOcean' in October.

In the first episode, Dr Michelle Heupel from the Australian Institute of Marine Science (AIMS) talks about her research tracking sharks. Michelle describes the surprising results that demonstrated the long-range migration of bull sharks from Sydney Harbour to the Great Barrier Reef. Michelle explains how knowledge of marine animal movements can inform decisions about marine resource management, for example when planning or managing marine protected areas.

The second episode examines carbon and heat transfer between ocean and atmosphere. CSIRO scientist, Tom Trull, explains how processes that exchange heat and carbon between the atmosphere and the Southern Ocean play a key role in global climate change. He also explains how IMOS measures these variables.

A number of other videos are being planned so that the collection of videos will eventually represent the diversity of data collections and collectors, partners and end-users. Keep an eye out for future episodes via the IMOS website http://imos.org.au/imosinmocean.html.

Launch of the IMOS Annual Highlights 2014-15

This Annual Highlights document covers the ninth year of IMOS operation. While the overall format is consistent with previous years, the internal structure has been modified to better align with the IMOS 2015-2025 Strategy, which is based around *Need, Capability,* and *Impact*.

Under each of the priority research themes in the document, the *Need* for systematic and sustained observing of Australia's marine environment is outlined. This is followed by a description of the observing and data management *Capability* created and developed through IMOS facilities. Highlights of *Impact* delivered using IMOS infrastructure are then provided for the year under review.

IMOS Director, Tim Moltmann writes in his overview, "the annual highlights for 2014-15 clearly demonstrate how impact is being delivered through systematic, sustained, integrated marine observing at a national scale. Something that simply couldn't be done without IMOS in place."

The ability to measure changes in ocean heat content with Argo floats is now at an unprecedented level, and observations from tagged elephant seals have created landmark datasets for temperature and salinity at high latitudes where other platforms can't go. Precision measurements used to validate satellite altimeters have improved the long-term record of sea level rise, and smart use of real time observations is enabling reporting of anomalous ocean conditions on a daily basis.

The ocean glider fleet has provided a step-change increase in availability of sub-surface measurements in the water column all around Australia, and use of autonomous underwater vehicles has enabled large-scale monitoring of kelp forests on the seafloor. The national animal tracking network is revealing previously unknown linkages between shark populations ranging over long distances, and acoustic observatories are allowing us to characterise and quantify the marine soundscape that includes both natural and man-made noise.

Many of the 2014-15 highlights are things that have been done for the first time in Australia.

The research has resulted in Australian scientists producing high impact science outputs with strong international collaboration. Journal publications using IMOS data increased by 36% year on year, with a significant number in prestigious international journals. Research projects using IMOS data increased by 20%, including new projects with direct application to policy setting and management of resources in the Australian marine environment.

The Annual Highlights document was published online and is available to download at **http://imos.org.au/highlights.html**

Connected by ocean

Thirteen Regional Alliances of the Global Ocean Observing System cover the Australasian region, East Asia, the Pacific, Indian and Atlantic basins, the Caribbean, Europe, and North and South America.

Australians live, work and play in a globally connected ocean and observing the ocean is a global enterprise. A high level of international cooperation is therefore required to provide the ocean information we need as a 'marine nation'.

IMOS has been formally recognised by the Intergovernmental Oceanographic Commission of UNESCO as one of thirteen Regional Alliances of the Global Ocean Observing System. Every two years, the leaders of these Alliances meet to review progress and make plans for next-stage implementation of the Global Ocean Observing System. The most recent meeting was held in Heraklion, Greece, on 22-24 September 2015.

IMOS Director, Tim Moltmann, attended the meeting and has returned to Australia excited by the level of international cooperation and collaboration.

"It was a very positive meeting," says Moltmann. "The global ocean observing community is working hard to broaden its relevance beyond ocean physics for climate, to encompass the full marine ecosystem from open-ocean to coast.

"This is challenging, but it is how we need to approach ocean observing. This is how the marine system actually works," he says.

The IMOS Director was elected as chair of the Regional Alliance Forum for the next two years. He succeeds Zdenka Willis, Director of US-IOOS who has chaired for the last four years.

"I'm honoured to have the support of my colleagues in taking on this role and I'm very excited by the opportunity we have in front of us," says Moltmann.

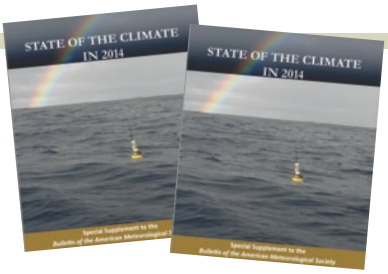
"Society has never had a greater need for ocean information and there is a well-connected global community in place to do the job," he says.

The NCRIS principles embodied by IMOS have undoubtedly contributed to it being so well recognised within the global ocean observing community.

"For big issues that no single institution or country can handle alone, collaboration is clearly the way to go," Moltmann concludes.

INTERNATIONAL REPORT CONFIRMS:

2014 was Earth's warmest year on record



IMOS data from Argo floats and ocean gliders contributed to NOAA's State of the Climate report published in July.

In 2014, the most essential indicators of Earth's changing climate continued to reflect trends of a warming planet, with several markers such as rising land and ocean temperature, sea levels and greenhouse gases – setting new records. These key findings and others can be found in the State of the Climate in 2014 report In 2014, the most essential indicators of Earth's changing climate continued to reflect trends of a warming planet, with several markers such as rising land and ocean temperature, sea levels and greenhouse gases – setting new records. These key findings and others can be found in the State of the Climate in 2014 report released by the American Meteorological Society (AMS).

The report, compiled by NOAA's Center for Weather and Climate at the National Centers for Environmental Information is based on contributions from 413 scientists from 58 countries around the world. It provides a detailed update on global climate indicators, notable weather events, and other data collected by environmental monitoring stations and instruments located on land, water, ice, and in space.

"This report represents data from around the globe, from hundreds of scientists and gives us a picture of what happened in 2014. The variety of indicators shows us how our climate is changing, not just in temperature but from the depths of the oceans to the outer atmosphere," said Thomas R. Karl, L.H.D, Director, NOAA National Centers for Environmental Information.

The report's climate indicators show patterns, changes and trends of the global climate system. Examples of the indicators include various types of greenhouse gases; temperatures throughout the atmosphere, ocean, and land; cloud cover; sea level; ocean salinity; sea ice extent; and snow cover. The indicators often reflect many thousands of measurements from multiple independent datasets.

The State of the Climate in 2014 is the 25th edition in a peer-reviewed series published annually as a special supplement to the Bulletin of the American Meteorological Society. The journal makes the full report openly available online. **https://www2.ametsoc.org/ams/index.cfm/publications/bulletin-of-the-american-meteorological-society-bams/state-of-the-climate/**

NESP Marine Biodiversity Hub launched in Hobart by the Hon Greg Hunt MP

Australia's Environment Minister, the Hon Greg Hunt MP, launched the Marine Biodiversity Hub, one of six hubs funded under the National Environmental Science Programme (NESP) in Hobart in late October.

$23.88 million is being provided to the Marine Biodiversity Hub for the research – as part of the Australian Government's $142 million National Environmental Science Programme (NESP). The six-year NESP initiative aims to help decision-makers understand, manage and conserve Australia's environment by funding world-class biodiversity and climate science.

The Marine Biodiversity Hub follows on from two earlier hubs and will support marine biodiversity management and conservation. The first and second marine hubs contributed biological knowledge for Australia's Commonwealth Marine Reserve network, and supported bioregional planning and management with new survey and monitoring methods, including for rare and threatened species, and studies of community views on marine conservation. The new Hub embraces more coastal issues and more listed species, and aims to achieve measurable improvements in the marine environment, through better management or actions such as coastal restoration.

"Australia's ocean territory is greater than its landmass, and most of the action lies beneath the surface, invisible to the naked eye," Hub Director, Professor Nic Bax says.

"The Hub brings together more than 100 scientists from 10 partner agencies to look beneath the ocean surface: to measure, predict and report on how the ocean is responding to pressures such as climate change and the use of marine resources from offshore shipping to coastal pollution."

"We use satellites and ships, remote cameras, gliders and robots from our partners including Australia's Integrated Marine Observing System to study ocean features such as canyons, seamounts, seabeds and upwellings," Hub Director, Professor Nic Bax says.

"Acoustic telemetry, DNA sampling and aerial photography are being used to track northern river sharks, white sharks, hammerhead sharks and right whales to support plans for their recovery."

IMOS Director, Tim Moltmann who attended the launch says "When IMOS was established a strategic decision was made to invest not just in measurements of ocean physics for climate and weather research, but also in biological observations to support the study of marine ecosystems. The Marine Biodiversity Hub is therefore a very important research partner for IMOS."

"We are both national programs with many partners in common. The Hub provides a major pathway for uptake and use of IMOS observations to do research that is highly relevant for policy and management. And through its own research projects, the Hub will add new data to the Australian Ocean Data Network."

"It's exciting to see the Hub launched. Given that it has a six year life, we expect the research partnership to be extremely productive."

> ***"Australia's ocean territory is greater than its landmass, and most of the action lies beneath the surface, invisible to the naked eye.***

Minister Hunt joined University of Tasmania scientists and volunteer divers on a Reef Life Survey at Tinderbox Marine Reserve south of Hobart before the launch. Image: Fraser Johnson

CO_2 uptake in the Southern Ocean is revived

A decade ago scientists feared that the ability of the Southern Ocean to absorb additional atmospheric carbon dioxide would soon be stalled. But the analysis of more recent observations using IMOS and other data show that this carbon sink reinvigorated during the past decade.

Several studies have suggested that the carbon sink in the Southern Ocean – the ocean's strongest region for the uptake of anthropogenic CO_2 – has weakened in recent decades. A study published recently in Science has demonstrated on the basis of multidecadal analyses of surface ocean CO_2 observations, that this weakening trend stopped around 2002, and by 2012, the Southern Ocean had regained its expected strength based on the growth of atmospheric CO_2. The study was carried out by an international research team led by Professor Nicolas Gruber and Dr Peter Landschützer from ETZ Zurich, and included Dr Bronte Tilbrook from CSIRO. Data collected as a part of the IMOS Ships of Opportunity Biogeochemistry project, led by Dr Tilbrook, has made a vital contribution to the study.

For the study, scientists analysed measurements of the concentration of CO_2 in the surface waters of the Southern Ocean south of 35°S, from which the flux of CO_2 across the air-sea interface can be computed.

They also compared the resulting fluxes with estimates based on measurements of atmospheric CO_2.

The surface CO_2 concentration of the Southern Ocean is being measured by research vessels or by specially equipped merchant ships as they travel along the major trade routes. The sampling and subsequent analysis is internationally standardised and coordinated. The SRV *Aurora Australis*, RV *Southern Surveyor* and SRV *Astrolabe* were instrumented with surface CO_2 measuring equipment and provided coverage in the Australian sector of the Southern Ocean. The Australian results were combined with data from other ocean regions to develop a database of uniformly quality controlled surface CO_2 observations known as the Surface Ocean CO_2 Atlas (SOCAT).

The large decadal variations in the Southern Ocean carbon sink suggest a rather dynamic ocean carbon cycle that varies more in time than previously recognized.

At present, the researchers are unable to predict how the net carbon uptake of the Southern Ocean is likely to evolve in the future.

"Our statistical model is not able to predict the future development," says Landschützer, "so it is very critical to continue measuring the surface ocean CO_2 concentrations in the Southern Ocean."

This is particularly important since current models are not able to reproduce the observed variations. Hence, long-term datasets are the only reliable means for determining the future evolution of the ocean's sink for carbon.

IMOS has a key role to play, providing vital information in our region of the ocean. The addition of new measurement platforms at the Southern Ocean Time Series and at CO_2 mooring sites will improve our capacity to diagnose the causes of the changes in the carbon sink strength.

The *Aurora Australis* is one of the vessels that was instrumented with surface CO_2 measuring equipment and provided coverage in the Australian sector of the Southern Ocean.
Image: Australian Antarctic Division.

A vision in blue – 10-year plan for the investment and research needed to grow and manage Australia's Blue Economy launched in Canberra

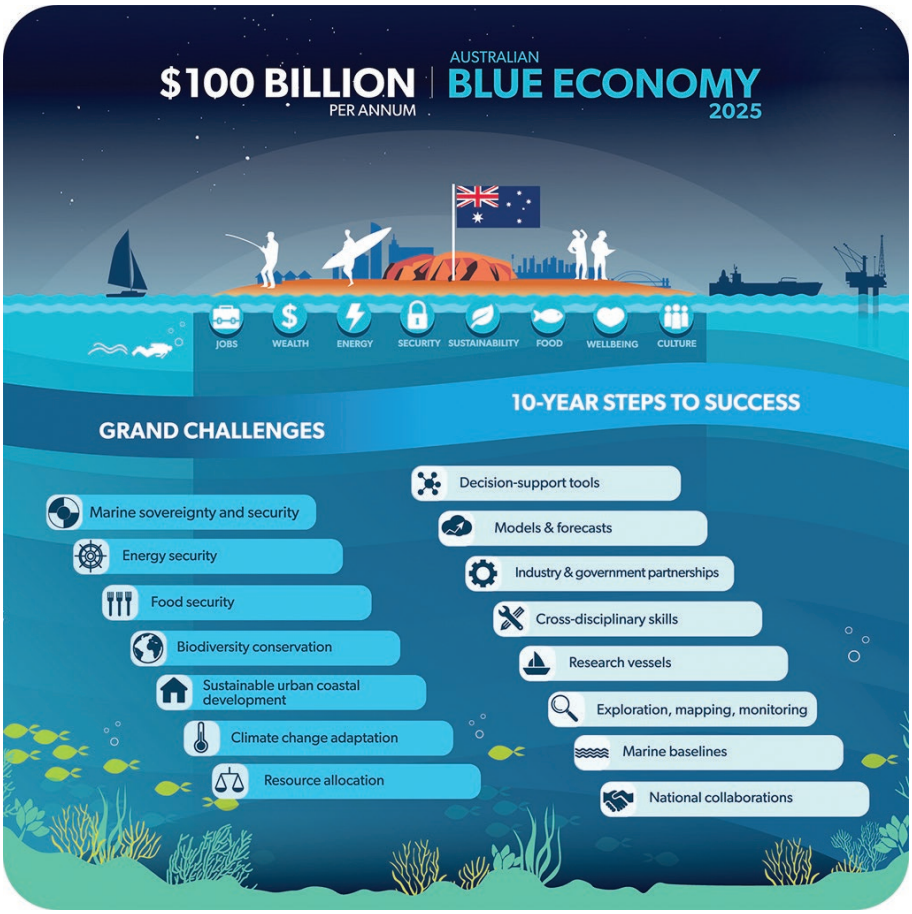
The National Marine Science Plan focuses on seven key challenges associated with our oceans that provides a template for striking a balance between reaping Australian ocean's economic potential and the need to safeguard its longer term health.

Australia's vast oceans are a vital part of the heritage, heart and economic future of our country. The value of this marine estate to the homes, work, play, energy, food, safety and security of all Australians is matched only by the enormous economic and environmental wealth that this national asset affords us.

IMOS celebrates the launch of an important document that highlights the need to invest in ongoing development of our capability to monitor coastal and ocean environments enabling decisions regarding our marine assets to be based on sound science.

IMOS Director, Tim Moltmann, who contributed to the development of the Plan through the National Marine Science Committee, says

"Marine science has very broad applicability. It is relevant to many sectors across industry, government and society. So it's important to have some way of bringing all these interests together. That's what the National Marine Science Plan is doing for us. Setting out the roadmap for a national marine research enterprise that's much more than just the sum of its parts."



The Seven grand challenges. Image: National Marine Science Plan

The consensus document from over 23 marine research organisations, universities and government departments and more than 500 scientists, provides a set of recommendations for science that will be at the heart of dealing with current and future challenges. The Plan outlines seven interconnected grand challenges facing Australia:

- marine sovereignty, security and safety
- energy security
- food security
- biodiversity, conservation and ecosystem health
- urban coastal environments
- climate variability and change
- resource allocation.

"In many respects, the process of creating and developing IMOS over the last decade is a demonstration of what the National Marine Science Plan hopes to achieve" says Moltmann. "With the observing system we've moved away from ad hoc, fragmented, proprietary approaches. We have a single national, collaborative, system that can be used by everyone. It's efficient, and effective."

The IMOS Director has recently taken over the role as the chair of the National Marine Science Committee, he succeeds John Gunn the previous chair.

Searching for the canaries of the marine world

The extensive marine observing capability of IMOS is playing a key role in an exciting new project on marine microbes. Bioplatforms Australia, another NCRIS capability like IMOS, has instigated a pioneering investigation into the life-sustaining microbes that inhabit our oceans.

The diversity and balance of marine microbes play a vital role in the health of our oceans and ultimately, the Earth's habitability.

Marine microbes make up the bulk of the oceans' biomass and have direct relevance to our welfare and economy by influencing fisheries and aquaculture yields, marine ecosystems and even global climate. As canaries provided an early warning sign of dangerous gases in coal mines, aquatic microbes can serve as early indicators of ocean health.

A new project, led by Bioplatforms Australia, will use IMOS's marine observing infrastructure, and apply its genomics network to perform DNA sequencing to generate the large-scale datasets scientists require to understand fundamental marine processes.

"It's fantastic to see this project underway"says IMOS Director, Tim Moltmann. "IMOS has been working with the marine microbial community for some time at the proof-of-concept level. But we needed the power of Bioplatforms Australia's genomics network to move from concept to large scale, national project. This is now happening with Bioplatforms Australia's support."

The nationally collaborative project involves scientists from the Australian Institute of Marine Science, CSIRO, Curtin University, Edith Cowan University, Macquarie University, Sydney Institute of Marine Science, University of NSW, University of Queensland and University of Technology, Sydney and will employ Australia's brand new research vessel *Investigator* for some of the sampling work.

> *"This project is a wonderful opportunity to bring marine microbiologists together with other marine scientists and to develop a sustained ocean observation system that goes all the way from genes to ecosystems*

Dr Torsten Thomas of The University of New South Wales, is one of the lead authors of the project proposal. The marine microbes project is built on the premise that a more complete understanding of marine microbial diversity and function will allow for better integration of microbial processes into predictive models. Dr Thomas says this is critical for determining how environmental changes will alter the structure and function of the base of the marine food web.

"This project is a wonderful opportunity to bring marine microbiologists together with other marine scientists and to develop a sustained ocean observation system that goes all the way from genes to ecosystems," says Dr Thomas.

Dr Lev Bodrossy of CSIRO, another leading scientist on the project, describes the project as a continental scale, long-term marine microbial observatory and points out that it is the first and only one of its kind and that it will provide an unprecedented insight into the secret life of the marine microbial community.

"This window to the marine microbial world will allow us to better understand how the millions of microbes in a drop of seawater keep our oceans healthy and functioning and support all other marine life from phytoplankton to whales," says Dr Bodrossy.

Since IMOS lent support to the first pilot project on long-term marine microbial observations around Australia in 2012, the initiative has grown into a nation-wide project and an incubator for new, strong collaborations in microbial oceanography.

"Two things have impressed me about this development" says IMOS's Tim Moltmann. "It's demonstrated how sustained investment in NCRIS is spawning new science opportunities across disciplines. And it's shown how enthusiastically our current generation of marine science leaders are embracing collaboration."

Successful Forum for Operational Oceanography (FOO) meeting and new website

IMOS played a key role in staging Australia's first Forum for Operational Oceanography (FOO) held in Fremantle, Western Australia on 21-23 July 2015.

With an eye to recent developments around the world, the purpose of the Forum was to bring together marine industries, service providers, government agencies, and research providers to consider how we can better utilise marine observations, modelling, and computational and information systems to enhance the social, economic and environmental benefits of Australia's vast and valuable marine estate.

The meeting was attended by 123 invited participants from 50 organisations, with good representation from all 'four pillars' of the Forum's stakeholder base.

"The Forum for Operational Oceanography will be very important for IMOS in the next stage of our development" says IMOS Director, Tim Moltmann. "We've done the hard yards in establishing and maintaining the system. It makes sense for our research community to be working more closely with the relevant government agencies and service providers towards a common goal of improving the safety and efficiency of marine industries. So the Forum is well-positioned to be a key enabler, helping high-quality marine science to deliver socio-economic benefits for Australia."

The meeting was sponsored by the Australian Government Department of Industry and Science, and the Minister for Industry and Science addressed the Forum on the morning of the second day. The Minister stressed the importance of the ocean to Australia, and commended the participants for coming together with a focus on bringing science, government services and industry application together with the aim of increasing ocean benefits to our island nation.

Following on from the successful meeting FOO is now online. A new website has been established and can be accessed at **http://www.foo.org.au/**.

The FOO website has two main objectives.

Firstly, it enables access to the excellent material developed in preparation for, during, and after the July 2015 event. This is an important stake-in-the-ground for Operational Oceanography in Australia, providing a comprehensive snapshot of where we are now. And an important baseline against which to measure future progress.

Secondly, we hope that the website will become a valued means of communication between Forum members, and that its content will grow over time based on member contributions.

www.foo.org.au

> *"It makes sense for our research community to be working more closely with the relevant government agencies and service providers towards a common goal of improving the safety and efficiency of marine industries.*

Change of leadership for the Southern Australia – IMOS (SAIMOS) Science Node

Dr Paul Van Ruth, of the South Australian Research & Development Institute (SARDI), is the new SAIMOS Node leader, and Dr Charlie Huveneers, of Flinders University, is the new deputy-Node leader.

Dr Paul van Ruth is a biological oceanographer with expertise in plankton ecology, physiology and productivity, and food web dynamics. His interests centre on the way in which variations in physical and chemical environmental parameters, whether driven by anthropogenic or climatic factors, shape marine planktonic communities and food web structure from global to local scales. His current role involves the design and implementation of studies of biological oceanography and plankton dynamics in Australian coastal waters which investigate the potential impacts of industrial, commercial and recreational activities on plankton communities and food web structure. Outcomes support the sustainable management of fisheries and aquaculture.

Paul was awarded his PhD from the University of Adelaide in 2009, having investigated spatial and temporal variation in primary and secondary productivity in the Great Australian Bight. He has been employed at the SARDI since 2002 and is currently a senior research scientist in biological oceanography.

Dr Charlie Huveneers leads the Southern Shark Ecology Group research lab at Flinders University. The group's research examines the ecology of sharks and rays to improve assessments of their vulnerabilities to human, environmental and climatic impact, and investigations of their movement dynamics and residency patterns using various tracking tools including acoustic telemetry and satellite tagging.

Charlie started his PhD at Macquarie University in 2003 on the biology and ecology of wobbegong sharks in relation to the commercial fishery in NSW. In 2007, he took up the position of Technical Officer in the Animal Tracking Facility of IMOS. In this position he deployed acoustic receivers around Australia and created a national network of acoustic telemetry users. He joined MISA through a joint position between SARDI - Aquatic Sciences and Flinders University where he acted as shark ecologist and Lecturer between 2009 and 2014. Since 2014, he has been at Flinders University full-time and is now a Senior Lecturer.

Our thanks to the outgoing SAIMOS Node Leaders, Associate Professor Simon Goldsworthy and Dr Sophie Leterme, who will remain involved in the science of the SAIMOS node.

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Dr Paul Van Ruth

Dr Charlie Huveneers

Improving fish size and quality in the South Australian Sardine Fishery

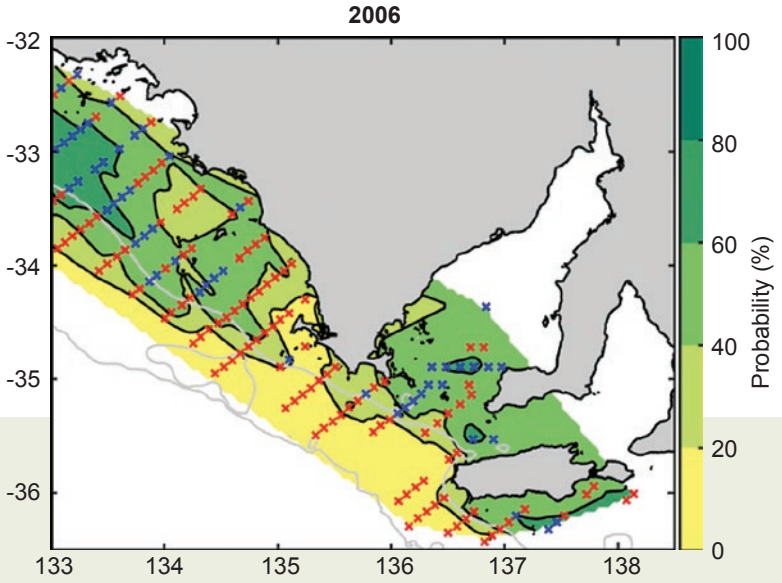
Remote sensed data from the IMOS Ocean Portal has been used in a Seafood Cooperative Research Centre (CRC) project designed to improve the profitability and sustainability of the South Australian Sardine Fishery. The project aimed to improve the size of fish taken in catches by implementing an industry monitoring program and developing an improved understanding of the preferred habitat for juvenile, adult and spawning Sardines.

This project was developed with the South Australian Sardine Industry Association (SASIA) and comprised two components with the common objectives of improving the profitability and sustainability of the fishery.

For the first component, SASIA was assisted by researchers from the South Australian Research and Development Institute (SARDI) in developing and implementing an autonomous near real-time harvest management system. The system involves fish measurement, data storage and spatial mapping. Data on fish length was input directly into a database using an electronic fish measurement board. Geographic information system (GIS) spatial mapping software was linked with the database to provide maps showing the spatial distribution of non-target sized fish. The mapping software was used to incorporate underlays of relevant remote sensed environmental information (i.e. sea surface temperature, surface chlorophyll a concentration) accessed through the IMOS Ocean Portal (**https://imos.aodn.org.au/**). Maps detailing changes in the spatial distribution of non-target sized fish can be updated fortnightly and disseminated to the fleet to allow fishers to optimise the size of fish taken.

To augment the near real-time harvest management system, the second component involved habitat suitability studies using generalised additive models (GAMs). GAMs were run to examine the environmental conditions that best explain the habitat preferences of juvenile and adult Sardines. Results showed that spatial (i.e. depth) and environmental variables can be used to explain and differentiate the habitat preferences of juvenile (i.e. small, non-target size) and adult (i.e. large, target size) Sardines, and spawning habitat. Analysis demonstrated that the GAMs had an acceptable level of predictive capability for juvenile and adult habitat and a good level of predictive capability for spawning habitat. The inclusion of available additional environmental factors (e.g. surface salinity and depth of the chlorophyll a maximum) provided improvements in the capacity to predict the distribution of spawning habitat.

The modelling studies demonstrated that remote sensed observations of key environmental predictors provided through IMOS can provide an acceptable level of habitat prediction for juvenile and adult Sardines. To make full use of these findings, SASIA has been trained by SARDI researchers from the Southern Australia Node of IMOS in accessing and incorporating remote sensed data from the IMOS data portal. This ongoing support will assist in the incorporation of remote sensed environmental parameters, averaged over time-scales ranging from several days to months, into maps showing the spatial distribution of non-target sized Sardines in relation to shifts in identified environmental drivers.



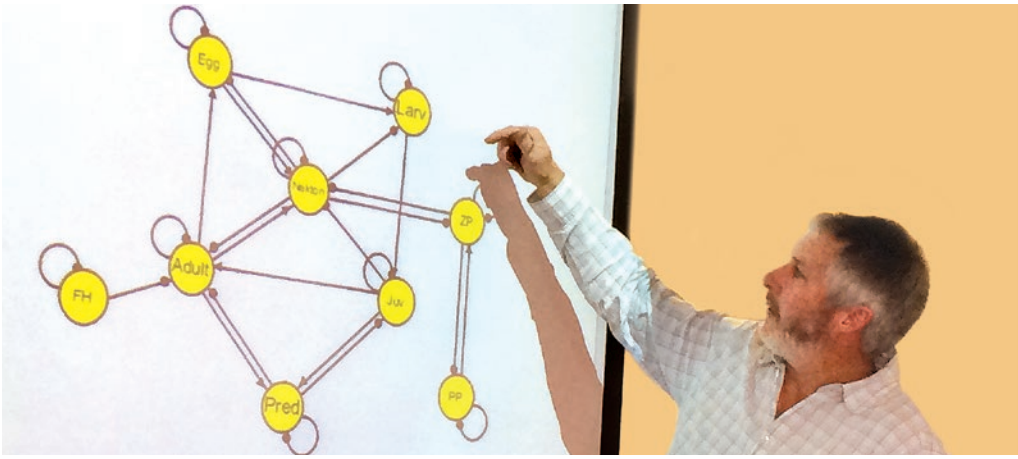
Probability (%) of potential Sardine spawning habitat predicted by the GAM model for the 2006 spawning season. The predicted Sardine habitat is overlaid with the actual egg presence (blue cross) and absence (red cross) data sampled during the 2006 Daily Egg Production Method survey. The habitat prediction map was constructed by excluding the respective year's survey data from the GAM model build. 200 m and 70 m isobaths are shown as grey lines.

news from the nodes

NSW-IMOS ecosystem workshop a success

NSW IMOS held an ecosystem workshop on 29 – 30 July 2015 at the Sydney Institute of Marine Science. There were 30 participants including university, government and IMOS stakeholders, with research interests spanning microbes to apex predators.

After a brief update from the node and facility leaders, Jeff Dambacher (CSIRO), our workshop moderator, provided an informative overview of modelling approaches, allowing the audience to warm up to the topic at hand. Jeff then asked participants to name their key research questions and identified that many node members are interested in fish production and water quality. This allowed us to explore the key physical drivers of light and nutrient availability in NSW coastal waters (day 1) and then develop a qualitative model to examine the question: "What scale of measurable primary productivity is relevant to sardine populations on the NSW shelf?" (day 2). Feedback from participants suggested that it was a useful process to hear and contribute to discussions about oceanographic and biological phenomena and conceptualise the links between nutrient enrichment and fisheries. Stay tuned for updates!



Jeff Dambacher discussing a qualitative model to examine the question: *"What scale of measurable primary productivity is relevant to sardine populations on the NSW shelf?"*

NSW IMOS thanks the NSW Research Attraction and Acceleration Program for supporting this ecosystem workshop, SIMS staff for providing technical assistance, and node participants for their interest and engagement. Node leader Martina Doblin would also like to thank Tim Ingleton and Robin Robertson for their leading contributions.

focus on facilities

ARGO FLOATS AND DEEP WATER MOORINGS

Natural iron fertilisation from Southern Ocean islands results in high primary production and phytoplankton biomass accumulations readily visible in satellite ocean colour observations. These images reveal great spatial complexity with highly varying concentrations of chlorophyll, presumably reflecting both variations in iron supply and conditions favouring phytoplankton accumulation.

A recent paper published by an Australian group used biogeochemical and bio-optical sensor results from profiling floats deployed in the Antarctic Circumpolar Current near the Kerguelen Plateau to examine the variation. The data were processed by the IMOS Argo and Deep water mooring facilities.

The paper demonstrates that whilst satellite remote sensing data observes the general spatial patterns of phytoplankton blooms well, the data has errors of up to two-fold in their total biomass because the satellites do not see below the surface of the ocean. Importantly, this problem cannot be fixed by using standard Argo float mixed layer depths to approximate the vertical biomass extent, because summer shoaling of mixed layer depth leaves significant biomass below the mixed layer.

The results are encouraging for the expanded use of autonomous observing platforms to study biogeochemical, carbon cycle, and ecological problems.

The paper is available at the Biogeosciences website: **www.biogeosciences.net/12/2707/2015/**

OCEAN GLIDERS

New deployment locations

Two new deployment locations have been added to the ocean glider facility schedule for 2015/16; the Great Barrier Reef near Townsville, and the Bass Strait.

The Australian Institute of Marine Science in collaboration with CSIRO and the IMOS ocean glider facility recently deployed a Slocum glider, which has been named "Amy", off Townsville. She was released at mid-shelf in Palm Passage and will cruise to the outer reef and back for approximately 2-3 weeks.

Amy's deployment is one of a series of planned glider missions over the next few months to support more comprehensive oceanographic observations. The data will be used to improve operational modelling as part of the eReefs project.

The second new ocean glider deployment will be in the Bass Strait in February 2016. Observations from the glider will be used by the South East Australia IMOS science node. The timing of the glider deployment is important as during summer Bass Strait is stratified, and therefore the surface data from the *Spirit of Tasmania* is less useful.

AIMS

Rob Gregor from CSIRO making final adjustments to the ballast of the Slocum glider.

NATIONAL MOORING NETWORK

Leadership change for the National Mooring Network

The National Mooring Network is the largest, most complex and most multi-institutional IMOS Facility. Four institutions (CSIRO, AIMS, SIMS/UNSW and SARDI) have day-to-day responsibilities for components of the National Reference Station and the regional shelf array networks.

The Facility has been reorganised, and moves from having a single Facility leader to a Facility steering committee. The Steering Committee is made up of David Hughes and Ming Feng (CSIRO), Craig Steinberg (AIMS), Moninya Roughan (UNSW), John Middleton (SARDI) and Emma Sommerville (IMOS Office). Craig Steinberg will chair the steering committee for the next two years, becoming the Facility Leader. Terms of reference and an action agenda are under development with support from the IMOS Office.

This new mode of governance and management will ensure we have appropriate mechanisms in place to discuss, agree on and implement IMOS-standard approaches to important issues with network-wide implications.

Our sincere thanks go to outgoing Facility Leader Dr Tim Lynch for his contribution to IMOS over the last six years, and we wish him all the best in the next stage of his career.

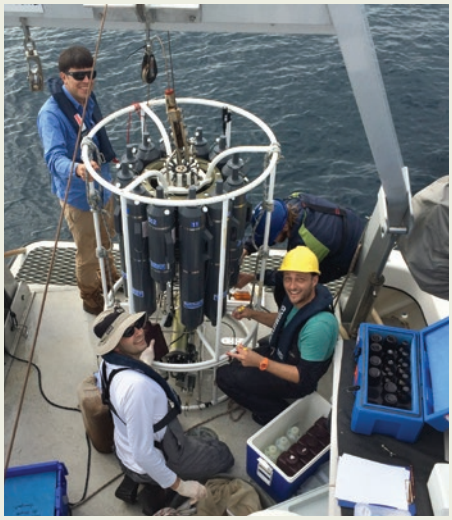
Craig Steinberg

High Speed Live Wire

Biogeochemistry (BGC) sampling at the National Reference Station off Sydney has just become more precise, is happening in real-time and at more than twice the speed thanks to IMOS funding and a recent upgrade of equipment by the NSW node. Moving to a rosette system with live data feed and larger sampling bottles, IMOS NSW has taken advantage of NSW Office of Environment and Heritage's state-of-the-art vessel RV *Bombora* to expand on the standard BGC platform and increase efficiency. Onboard the *Bombora*, sites along the IMOS Port Hacking transect can now be accessed at a top speed of 20-25 kts shaving significant sea-time off the monthly sampling run.

The setup better accommodates additional sampling for bacteria, larval fish and primary productivity. With the rosette, data is also delivered in real-time using a conductive cable (soon to be fibre-optic) through a deck box to a PC display. The real-time capability allows sampling of "true depths", almost immediately after the CTD profile is complete and structure of the water column has been determined. This speed of response is critical to some key measurements in the dynamic coastal environment. Previously, deciding how and where to sample required the CTD data to be downloaded and processed, taking up to 10-15 mins.

Timely and accurate sampling the chlorophyll maximum is essential as data is used for validation of satellite ocean colour and estimates of primary productivity. Thanks to IMOS and the combined efforts of Sydney Institute of Marine Science and NSW OEH, this method of BGC sampling is providing a significant value-add to the nationally significant Port Hacking time series.



The team undertaking sampling with the rosette system, clockwise from bottom left: Nahshon Siboni (UTS) and Derrick Cruz (UNSW) from Sydney Institute of Marine Science and Michael Sutherland and Tim Ingleton NSW Office of Environment & Heritage. Image: Jeff Miller NSW OEH.

OCEAN RADAR

IMOS welcomes Dr Simone Cosoli in his new role as Director of the Ocean Radar Facility

Dr Cosoli started in his new role as the Ocean Radar Facility Director at the University of Western Australia in August.

Since completing his PhD in Environmental science at the University of Venice in 2007 Dr Cosoli has been involved in research into the application and use of High Frequency (HF) radars.

"My research interests deal primarily with the application of HF radar measurements to coastal oceanography. More specifically, the validation of radar measurements and interpretation of "errors" or differences from other measurement techniques such as current meters or drifters, interpretation of the surface current maps and resolution of the temporal and spatial scales of motion, " Dr Cosoli said.

"In my opinion, understanding the reliability and accuracy and – most important of all, the limitations – of HF radars are fundamental steps to their improvement and make the best use of the information that we collect. Once we know how reliable the measurements are, we can then do our best to improve the information we collect. This will allow us to use ocean radar data to study the connection between ocean physics and biological responses."

"For example, currents contribute to the distribution of nutrients, which is particularly important for the efficient management of natural resources and fisheries."

"Waves and currents influence coastal erosion; we can use data to drive engineering interventions aimed at solving these problems. The data is also important for ships and for search-and-rescue activities, we can intervene in case of accidents at sea and improve the response capabilities. "

"I am very happy to be joining the technical team and the support staff of the Ocean Radar Facility at UWA."

Before moving to Perth, Dr Cosoli was a researcher at the Department of Oceanography of the Istituto Nazionale di Oceanografia in Trieste, Italy. He coordinated the HF radar activities in the Adriatic Sea and in the Central Mediterranean Sea - Sicily Channel, in collaboration with Italian and International partners from either Universities or research institutions.

Postgraduate student profile

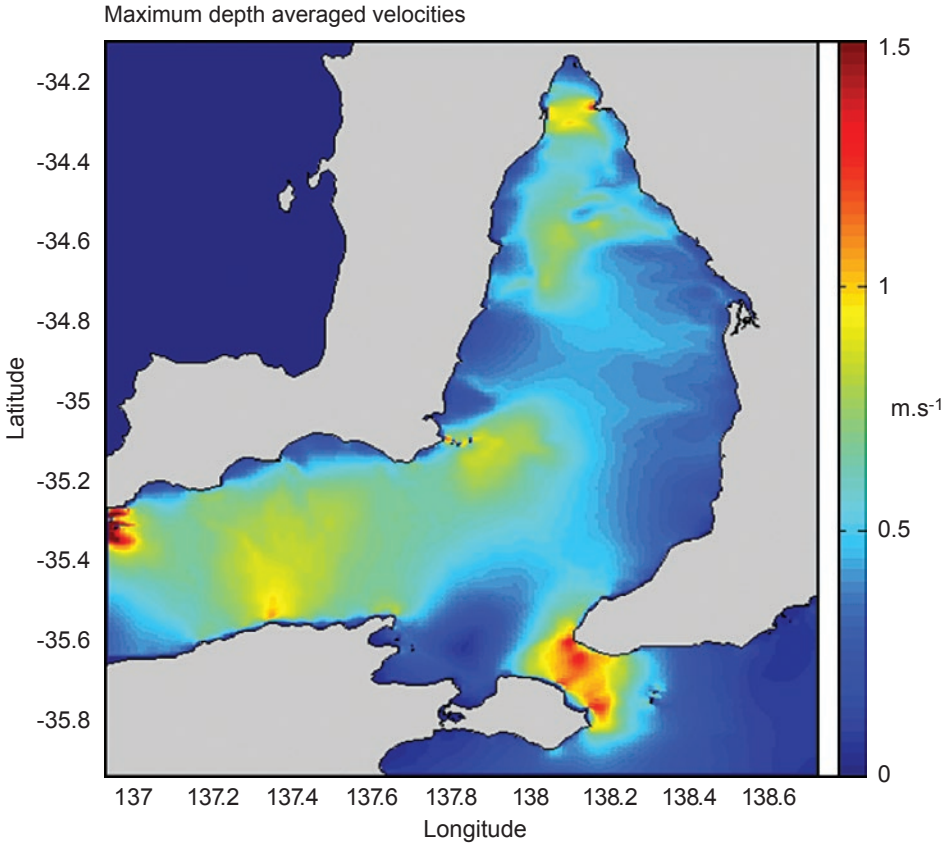
Students working with IMOS data for their postgraduate research

Henry Ellis | Adelaide University

Project title: The Ocean Dynamics of Gulf St. Vincent: A Numerical Study

The aim of Henry's postgraduate research is to determine the physical dynamics of ocean circulation within Gulf St. Vincent (GSV), South Australia. The project aims to achieve this through the creation of a high resolution near-shore numerical model. The understanding of the physical dynamics of Gulf St. Vincent has significance to the fisheries, government, transport and mining industries within the area. The expected outcome of the research is to generate a model of much higher resolution and reliability than has previously been achieved for the region. It is anticipated that this model can be used as a forecasting tool for near-shore hydrodynamics of the region, providing valuable information to the aforementioned industries and other ocean users. It is expected that the modelling will show GSV to behave in a similar manner to Spencer Gulf, a neighboring inverse estuary, albeit with differences induced by local geography, especially in regards to the presence of Kangaroo Island which acts to severely restrict connectivity of GSV with the open ocean.

The project is to be undertaken using the Regional Ocean Modelling Suite (ROMS) using data from a variety of sources, including mooring data from the IMOS Kangaroo Island National Reference Station, to calibrate and validate the numerical model. A bathymetric grid of 500m resolution is to be used for the bulk of the modelling, with the option to create higher resolution nested grids for areas of interest such as the Adelaide metropolitan beaches and the Port Adelaide region.



Maximum recorded depth integrated velocities for model domain during a 60 day tidal model simulation (m/s).

The IMOS 'circle diagram' which is designed to be read from inside to out, illustrates how the system is operated by selected institutions but available for use by the entire community through open data access, generating a wide range of outputs that are relevant across portfolios and sectors.

The diagram has five layers:

1. IMOS at the core,
2. the eight 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

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

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