Virginie Van Dongen-Vogels, AIMS

IMOS

marine matters

Integrated **Marine Observing** System

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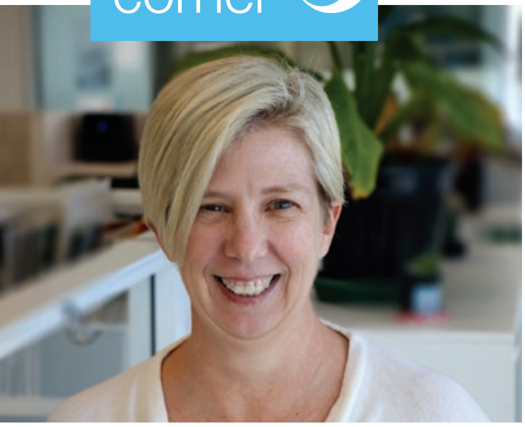
Introducing the IMOS New Technology Projects

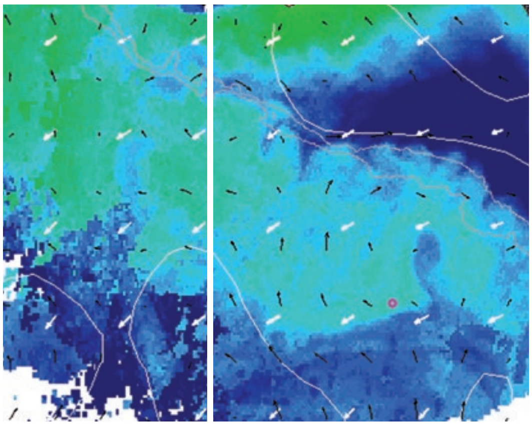
Find out more about the first three successfully funded New Technology sub-Facilities: Low cost wave buoy technology, Wind speed and direction extension, and Profiling moorings evaluation.

Tracking of marine predators to protect Southern Ocean ecosystems

Launch of the IMOS State and Trends of Australia's Oceans Report

IMOS ocean gliders help monitor the warming ocean temperatures on the GBR





Rob Harcourt, Macquarie University

Welcome to the first Marine Matters of 2020 and the first in my role as IMOS Director.

It has been a difficult start to the year with unprecedented bushfires followed by the COVID-19 pandemic. We are yet to realise the full implications of these events. COVID-19 is already causing significant changes, disruptions and delays for how we conduct science and run IMOS. There are challenging times ahead.

On a positive note, it was great to see many of you at the Annual Planning Meeting (APM) in Hobart. One of the main points of discussion at the APM was the new Decadal Strategy, 5 Year Plan and affiliated review of the current portfolio. These activities are designed to inform forward planning and will be launched in early 2021. The purpose of the review and strategy refresh is to ensure IMOS is poised for an anticipated call for bids for NCRIS support out to 2029.

In addition to the strategic planning process, I shared with the community my desire for IMOS to value-add to our existing data streams through integration and products to summarise and synthesise data to facilitate increased use by stakeholders. There is great capacity for IMOS to re-use data for purposes beyond their original use in individual Facility activities. I encourage you to consider ways we can more fully use the current observations and platforms to demonstrate the importance of and need for IMOS.

This edition of Marine Matters provides you with information and updates on a number of programs. This includes the release of the State and Trends of Australia's Oceans Report and details of how IMOS is helping measure and define marine heatwaves. We have also included updates on the New Technology Proving projects along with highlights from other Facilities. It has been a busy and productive period for IMOS and these outputs represent just some of the achievements of our amazing program.

Finally, I would like to say thank you to everyone who has worked so hard to get IMOS to where we are today and thank you in advance for the work you will do to help us ride out the COVID-19 situation. IMOS is built on the efforts, contributions, dedication and enthusiasm of our community. We recognise that and thank all of you for your efforts.

I hope you enjoy this edition of Marine Matters.

Michelle Heupel

Lea Walpole

Launch of the IMOS State and Trends of Australia's Oceans Report

Our first State and Trends of Australia's Oceans Report was launched in Hobart in early March.

Marine assessments are important tools for examining the state and trends of marine systems at regional, national, and global scales. The most robust assessments are data-driven and underpinned by time series of internationally accepted ecosystem indicators, based on measurement of physical, chemical, and biological variables.

The collation, synthesis, and reporting of meaningful indicators of marine ecosystem health provide information in a clear way to a broad, and often non-scientific audience.

IMOS is uniquely positioned to provide a range of time series data that can underpin assessments of Australia's vast and valuable marine estate.

The State and Trends of Australia's Oceans Report provides a baseline for contribution to marine assessments into the future. It was launched at the IMOS Annual Planning Meeting in Hobart, and is available via the State and Trends of Australia's Oceans Report website https://www.imosoceanreport.org.au/.

The time series included in the report provide scientifically robust information on state and trends of ecosystem indicators for Australia's vast and valuable marine estate.

Against a background of long-term global ocean warming and acidification, regional variations are revealed and the influences of seasonal climate variability and boundary current variability are shown. There is evidence of extreme events, such as marine heatwaves, increasing in frequency and intensity.

Importantly, numerous biological responses to change and variability in the physical/chemical environment are shown. Many of these have potential socio-economic and policy implications which are outlined in each of the time series' 'implications for people and ecosystems' sections.

The improved understanding of connections between physical, chemical, and biological variables provided in the State and Trends of Australia's Oceans Report is a significant step in describing these links and the ongoing changes they face. This in turn increases our confidence in modelling future states of the Australian marine environment, to inform government managers and policy makers, and marine industries, in the context of sustainable development.

The role of IMOS as a national research infrastructure is to build large datasets and long time series for use and reuse. The process to produce this report is designed to ensure that datasets and time series available within Australia are organised, analysed, and interpreted so that they can be used in relevant assessment and reporting processes.

Making our datasets and time series 'assessment ready' is part of the IMOS strategy to plan for impact. This includes data collected by IMOS facilities as well as additional data contributed by partners through the Australian Ocean Data Network (AODN).

ABOUT THE REPORT

The report brought together 70 scientists from across 16 institutions working with available datasets, mostly of ten years length or longer. New analyses were undertaken to produce scientifically robust information about the state and trends of ecosystem indicators relevant to the Australian marine environment and its bioregions.

A total of 27 time series datasets are included in the State and Trends of Australia's Oceans Report. They are grouped into four themes covering indicators of:

1. the physical and chemical environment;
2. biological productivity
3. water quality; and
4. marine animals (zooplankton, fish, sharks, and marine mammals).

Before IMOS was established there was no nationally-driven systematic and sustained collection of data from Australia's marine environment, limiting our ability to understand the state and trends of key ecosystem indicators. This report begins to address this huge gap.

The report contains succinct documents (of 4-6 pages) for each time series that are written in a common format by a group of subject matter experts.

There is a Rationale and a section on Implications for people and ecosystems. The analysis Methods used are explained. Results and Interpretation are provided through a combination of brief narratives and downloadable graphs and maps. Data Sources are acknowledged, and References to relevant scientific literature are provided.

Each time series document has been assigned its own digital object identifier (DOI).

The goal has been to ensure that the report will be relevant to national, global, and regional marine assessments and therefore useful to the scientific community, government managers and policy makers, and marine industries. ■

IMOS ocean gliders help monitor the warming ocean temperatures on the Great Barrier Reef

IMOS responded to the high ocean temperatures on the GBR in February this year by mobilising our glider fleet into regions of greatest concern.

Sea surface temperatures on the Great Barrier Reef (GBR) south of latitude 15°S were close to average in the first half of summer, but began increasing in mid-January and were above the 90th percentile from February 10 (as can be seen on the IMOS SSTAARS map on the **IMOS *OceanCurrent* website**). Mid-February is the danger period for coral bleaching on the GBR as it is the time of year when water temperatures are usually at their maximum.

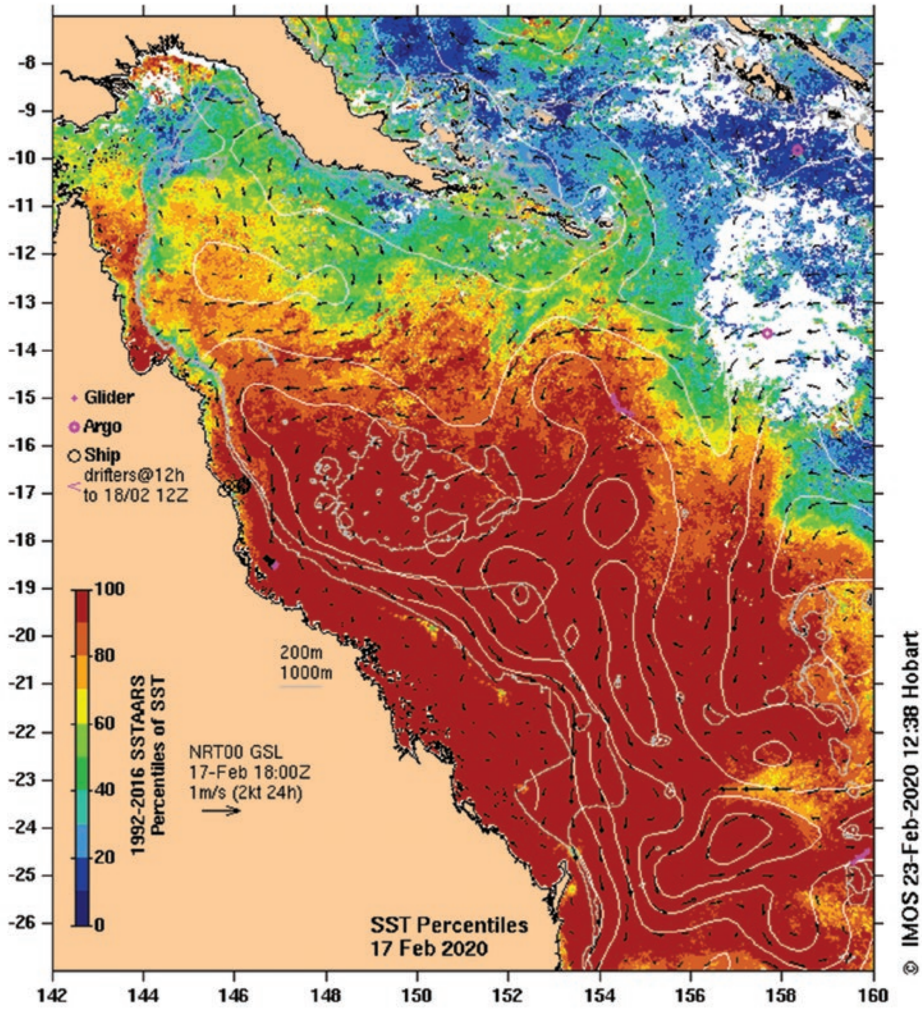
Temperature readings from marine weather stations operated by the **Australian Institute of Marine Science** (AIMS) also showed that sea surface temperatures throughout most of the GBR were 1 to 2.5°C above average.

AIMS worked closely with the Great Barrier Reef Marine Park Authority (GBRMPA) and specialists from other national and international agencies to ensure the most comprehensive understanding of conditions on the GBR were made available.

“Our knowledge and long-term understanding of northern Australian waters tell us warming oceans place enormous pressure on the Reef’s ecology. If heatwave conditions persist or worsen, we can expect corals to exhibit stress and experience some level of regional bleaching,” says AIMS Oceanographer Craig Steinberg.

Mr Steinberg says they received temperature data from satellites, AIMS’ marine weather stations, and the IMOS autonomous ocean glider, to monitor temperatures in real time. A network of more than 170 electronic temperature loggers is also deployed across the GBR.

“We have redeployed an IMOS underwater glider to areas of concern in the waters north-east of Townsville. With its on-board sensors, the glider provides our scientists with information about ocean properties at different depths of the water



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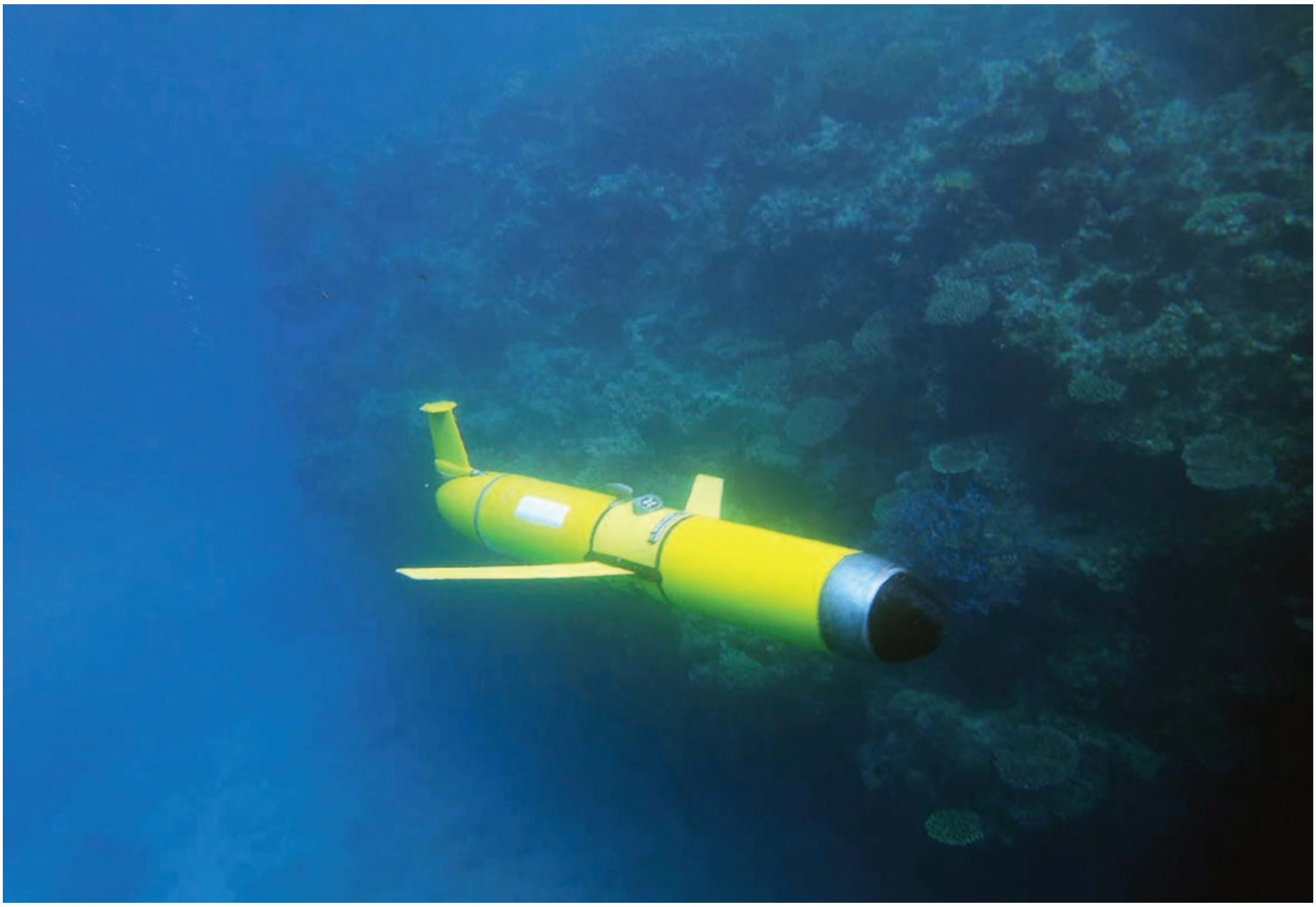


Dennis Stanley, UWA

column including temperature and light, to help explain any observed levels of coral bleaching. Knowing how deep the warm surface layer is, can help determine the depth corals are likely to experience heat stress," says Mr Steinberg.

In-water technology is critical to understanding current conditions and potential bleaching of the GBR. For example, ocean gliders operated by IMOS are being deployed specifically to monitor conditions around the reef and provide information about water temperature and conditions during this critical time.

"IMOS is uniquely placed to provide critical operational awareness of water temperature below the surface of the ocean and in cloudy conditions, when satellites can no longer see the Reef. IMOS is a key element of our broader operational information gathering system which includes coral health checks by divers, aerial coral bleaching surveys and citizen scientists," says Dr David Wachenfeld, Chief Scientist at the **Great Barrier Reef Marine Park Authority**.

All of the observations from the various platforms helped AIMS and GBRMPA understand the marine heat phenomena and, given the vast size of the Great Barrier Reef, prioritise locations to observe. Observations, in conjunction with scientific models, helped scientists predict regions that were most at risk of bleaching.

Unfortunately, IMOS had to retrieve our ocean gliders on the GBR in March due to the travel restrictions and limitations caused by the COVID-19 pandemic. However, scientists at AIMS and GBRMPA continued to closely monitor the situation throughout the heatwave event, with weekly Reef Health updates posted on the GBRMPA website **here**. The latest update as of 31 March stated that the current sea surface temperatures across the Great Barrier Reef were near average.

Reef-wide aerial surveys undertaken by the Australian Research Council Centre of Excellence for Coral Reef Studies at James Cook University to determine the extent and severity of coral bleaching concluded 27 March 2020. Unfortunately, the prolonged thermal stress observed over summer resulted in widespread moderate to severe bleaching across much of the GBR. ■

NEWS

Tracking of marine predators to protect Southern Ocean ecosystems

A recent study published in Nature examined tracking data from 4,060 individuals of 17 species of marine predators, including IMOS Animal Tracking data, and suggests a way to use such data to predict key ecological regions in the Southern Ocean.

Rob Harcourt, Macquarie University

Clive McMahon, SIMS/IMOS

Satellite tracking of marine predators in the Southern Ocean has revealed key ecological areas under disproportionate pressure from human activities. The results of this paper demonstrate the value of tracking data for informing conservation efforts.

The waters of the Southern Ocean encircle the Earth through the Drake Passage, the ocean region between the tip of South America and Antarctica. Because of this, the Southern Ocean has a key role in global climate and ocean circulation. The Southern Ocean is also home to a range of unique fauna.

Southern Ocean ecosystems are under pressure from resource exploitation and climate change. Therefore, considerable interest has developed in the long-term conservation of the Southern Ocean, but authorities face the challenge of implementing conservation goals within existing management frameworks.

An important step in addressing this challenge is to identify regions that should be considered for protection, because of their high biodiversity, biological productivity or importance for certain life-history stages of species.

The distribution and demography of marine predators provides a viable basis for identifying regions, particularly in an area as vast and remote as the Southern Ocean. Spatial aggregations of predators at sea not only identify areas that are important for predator species, but also areas of broader ecosystem importance, such as regions of elevated productivity and biomass at lower trophic levels.

Tracking data were collected between 1991 and 2016 using electronic tags attached to birds and marine mammals. The tags provided location estimates (obtained using satellite information or other methods) as the animals migrated.

The authors used some of these data (for 2,823 individuals) to develop predictive models to identify crucial habitats in the Antarctic region for all of the predator species combined. These integrated results provide a spatially defined assessment of areas of high biodiversity that includes species across multiple levels of the food chain in the Southern Ocean.

The research provides strong evidence in support of the ecological importance of existing and proposed Southern Ocean marine protected areas.

The authors conclude that the Southern Ocean can be an exemplar of how science, policy and management can interact to meet the challenges of a changing planet. In the Southern Ocean, these challenges will be considerable, and will include increased fishing pressure as the global demand for marine resources grows. The results highlight where future science-informed policy efforts might best be directed, including both adaptive spatial protection and improved robust management of fisheries. Similar synthetic approaches should capitalize on the increasing amount of tracking data that are being collected through large-scale initiatives to indicate regions in need of protection globally. ■

To read the full paper:

Hindell MA, Reisinger RR, Ropert-Coudert Y *et al.* 2020 Tracking of marine predators to protect Southern Ocean ecosystems. *Nature*. **https://www.nature.com/articles/s41586-020-2126-y**

Introducing the New Technology Projects

The establishment of the IMOS New Technology Proving Facility represents a significant and exciting new opportunity for the IMOS community with a focus on increasing efficiency, effectiveness and expansiveness of current ocean observing platforms currently used by IMOS.

The first three successfully funded New Technology sub-Facilities are:

- **Low cost wave buoy technology**
- **Wind speed and direction extension**
- **Profiling moorings evaluation**

SUB-FACILITY: LOW COST WAVE BUOY TECHNOLOGY

The Low-Cost Wave Buoy Technology sub-Facility, led by Professor Ryan Lowe from the University of Western Australia, will seek to test and develop methods of integrating this low-cost technology within in situ observation networks.

The sub-Facility will focus primarily on Spotter Wave Buoys, developed by Sofar Ocean Technologies. These wave buoys are significantly less expensive than conventional wave buoys, are smaller in size and easier to deploy.

Low Cost Wave Buoy Technology sub-Facility aims to assess the performance of Spotter wave buoys over a wide range of oceanic conditions, assess mooring designs, and determine their reliability for long-term deployments compared to conventional wave buoys.

Through an international collaboration between wave researchers and industry (technology developers/providers), this project will represent a critical step in researching the capability and robustness of this emerging wave measurement technology into operational capability while accelerating the wide-spread uptake of the technology for research and operational use – both within IMOS and internationally.

The sub-Facility will include world-leading researchers and technicians from the University of Western Australia (UWA), University of Melbourne, Deakin University, CSIRO, the Australian Institute of Marine Science (AIMS), and Sofar Ocean Technologies.

Three sites have been chosen to test this technology; the first site is in Albany in Western Australia, the second in Victorian coastal waters, and the third will be based off northern Australia, co-located with a new IMOS wave buoy to be deployed by AIMS.

There is substantial demand for wave observations throughout Australia, given the importance for research, marine industries, government agencies and service providers.

Historically in situ measurement of waves has been mostly conducted by State Government agencies and industry. Industry data has not generally been publicly available, and whilst the State Government data has been available it has been concentrated in relatively shallow coastal waters.

The new IMOS investment in low coast wave buoys has the potential to fill a significant gap in offshore wave measurements. This sub-Facility aims to develop confidence in lower cost wave buoy technology, with the potential to dramatically expand the number of sites where waves can be measured.

Carly Portch, The University of Western Australia, Coastal and Ocean Dynamics Group

SUB-FACILITY: WIND SPEED AND DIRECTION EXTENSION

The Wind Speed and Direction sub-Facility, led by Professor Ian Young at the University of Melbourne, aims to provide a global database of calibrated and validated wind speed direction sourced from scatterometers in Australian coastal waters in addition to acquiring global scatterometer data from both previous and existing satellite missions. Data will be calibrated against buoy data, creating a continuous global record from 1992 to present.

This sub-Facility has already delivered a new global ocean wind speed and direction database which is publicly available via the **AODN Portal**.

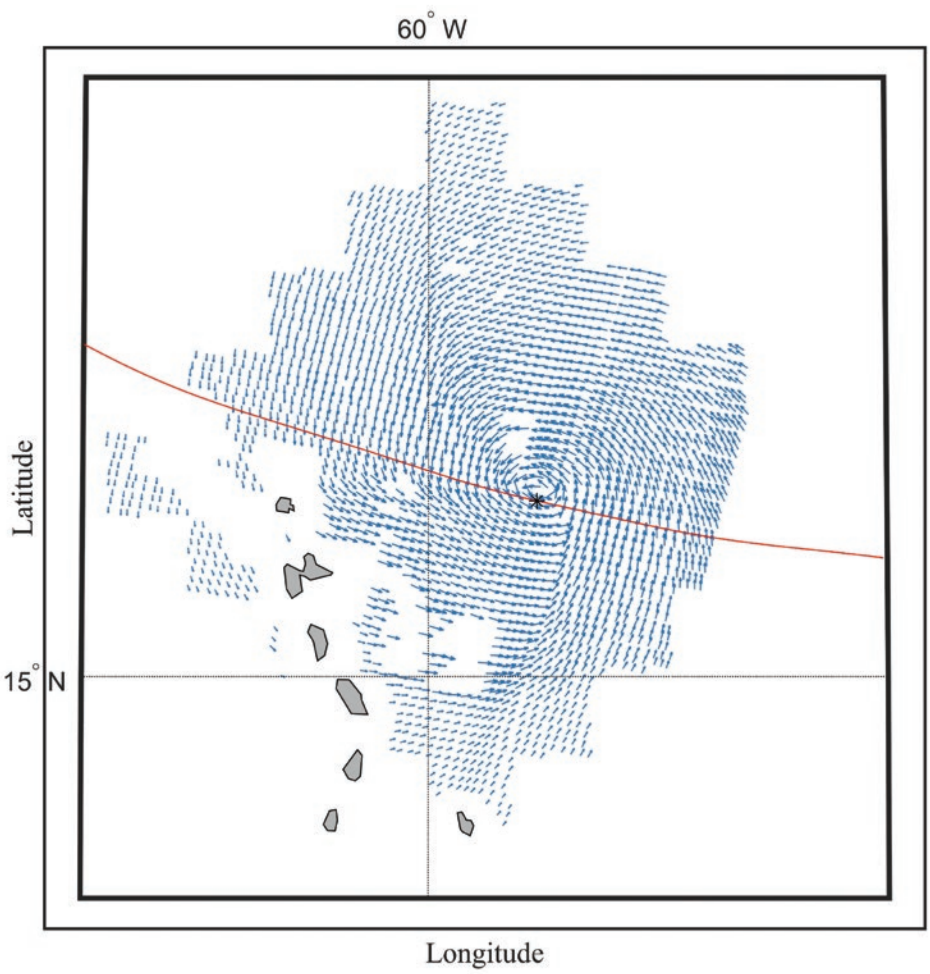
A scatterometer is a microwave radar sensor used to measure the reflection or scattering effect produced while scanning the surface of the earth from an aircraft or a satellite. The scatterometers have been carefully calibrated against ocean buoys to form a consistent global dataset of wind speeds over this period.

The scatterometers measure winds across a 25km resolution grid and typically cover the whole globe at this resolution twice per day. This new IMOS dataset represents the only repository of its type; where data from all such missions can be found in a single location and calibrated in a consistent manner.

Understanding the ocean wind and wave climate is necessary for a range of operational oceanographic applications including offshore operations/ engineering such as oil and gas and the emerging ocean renew able energy industry, fisheries, ship navigation and coastal and harbour management.

Further, an accurate understanding of the wind climate both globally and in the Australian region will have important economic and societal impacts. An enhanced understanding of wind conditions can help reduce operational costs for offshore activities, produce more accurate circulation and wave prediction models, and an enhance capability to predict episodic coastal inundation.

Recent global studies have demonstrated that over the past 30 years global wind speeds and wave heights have been increasing, with the largest increases not in the mean conditions but the extremes. This finding suggests that climate change may have an important impact on extreme meteorological conditions. The data used in these studies has predominantly been from altimeters. Although altimeters are an important source for wave measurements, the scatterometer provides an order of magnitude more wind speed data than an altimeter. Therefore, this database will become a major resource for both global and regional climate studies.



Wind speed vectors measured by the Oceansat-2 scatterometer as it passed over Hurricane Earl in the Caribbean in 2010. The clear vortex structure of this Category 4 hurricane is clearly measured by the scatterometer.

SUB-FACILITY: PROFILING MOORINGS EVALUATION

The Profiling Moorings Evaluation sub-Facility will trial the deployment of two different commercially available profiling mooring platforms (Mclane Prawler and Delmar Wirewalker) for a range of oceanographic environments and applications. The project seeks to determine the operational needs of these profiling systems and assess increases in sampling efficiencies and spatial resolution of data through the water column. The sub-Facility is led by Andrew Martini from CSIRO, in partnership with Craig Steinberg from the Australian Institute of Marine Science (AIMS).

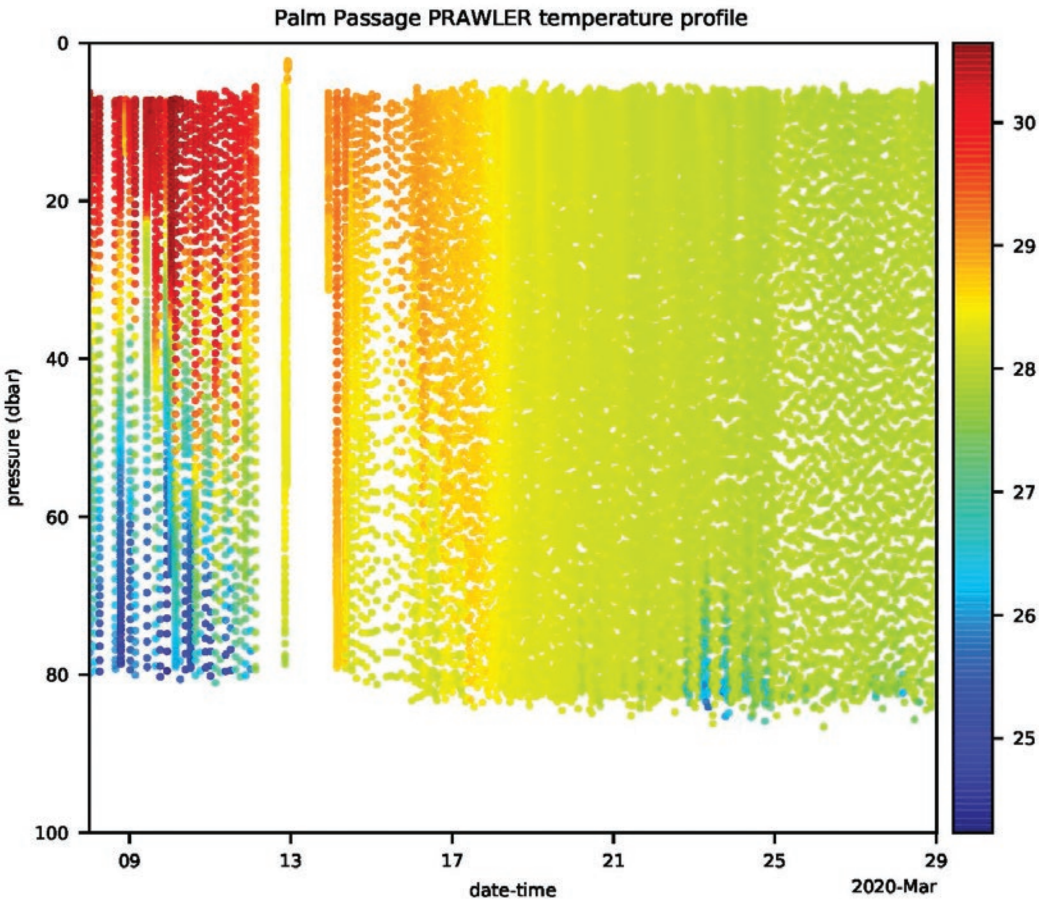
During this assessment phase, the two profiling mooring systems will be co-located in a range of ocean environments to ensure reliability and longevity over long deployment periods.

The first deployment of the two systems was completed in March just south of Myrmidon Reef in Queensland by staff from AIMS and CSIRO. The moorings will remain at the site for two months to allow the systems to be tested in a tropical environment. Fortuitously the deployment captured the end of a marine heatwave that has resulted in the most widespread bleaching observed in the Great Barrier Reef. This tropical site will allow the project to assess how the systems function with higher levels of potential bio-fouling associated with warmer water.

Subsequent deployments will take place in Storm Bay, Tasmania; Two Rocks, Western Australia; and the Capricorn Channel, Queensland. Each of these deployments will test the systems for various aspects:

- Storm Bay: a temperate location, will test the systems over an increased deployment timeframe (four months) and a more hazardous location. Importantly, this site is similar to the conditions at the IMOS National Reference Stations at Maria Island, Port Hacking and Kangaroo Island.
- Two Rocks; the systems will be deployed at a depth of 500m for four months, this site will test the deeper profiling capabilities of both systems.
- Capricorn Channel: this final location will test the profiling systems in a high current environment.

Profiling moorings will provide gains in efficiency as there is a reduction in the number of sensors required in the mooring system as a single multi-sensor package moves up and down powered by surface waves and buoyancy or weight depending on the instrument type. Standard in-line



This plot of temperature data is from the Prawler profiling mooring deployed south of Myrmidon Reef. The plot demonstrates the temperature stratification in early March; a hot surface layer of > 30 deg C extended down to 20-30m, with an underlying cold water intrusion of ~25 deg C. By March 13 the wind and waves had increased, cooling the surface and also mixing the warmer water downwards to be ~28.5 deg C. The water column continued to cool through the rest of March. Credit: Pete Jansen, CSIRO.

moorings require multiple instruments at fixed points along the wire. The single sensor package used here reduce not only the initial and replacement capital costs for the instrumentation, but also instrumentation servicing, calibration and repair costs. Importantly, more frequent physical and biogeochemical variables can be monitored throughout the water column with the larger suite of sensors on a single instrument.

Expressions of Interest Process underway for a second round of projects

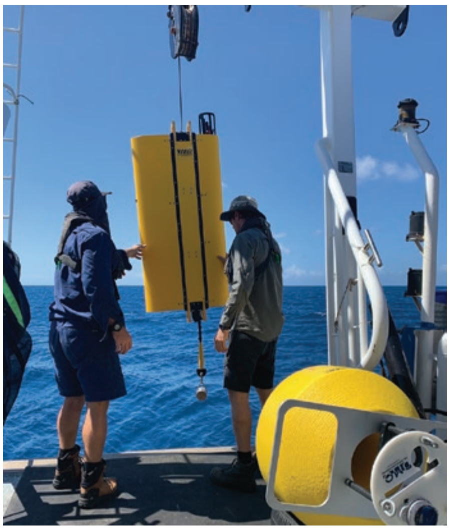
In its second year the IMOS New Technology Proving Facility will prioritise opportunities that can improve efficiency or effectiveness (in either equipment or software/data resources), fill existing gaps (e.g. biological observing), create impact and enhance our outputs. This includes the potential for products or software platforms that increase the uptake, use and applicability of existing IMOS data streams.

The Expressions of Interest process is currently underway with the next round of successful projects starting from the beginning of September 2020. ■

For more information: http://imos.org.au/facilities/newtechnologyproving/

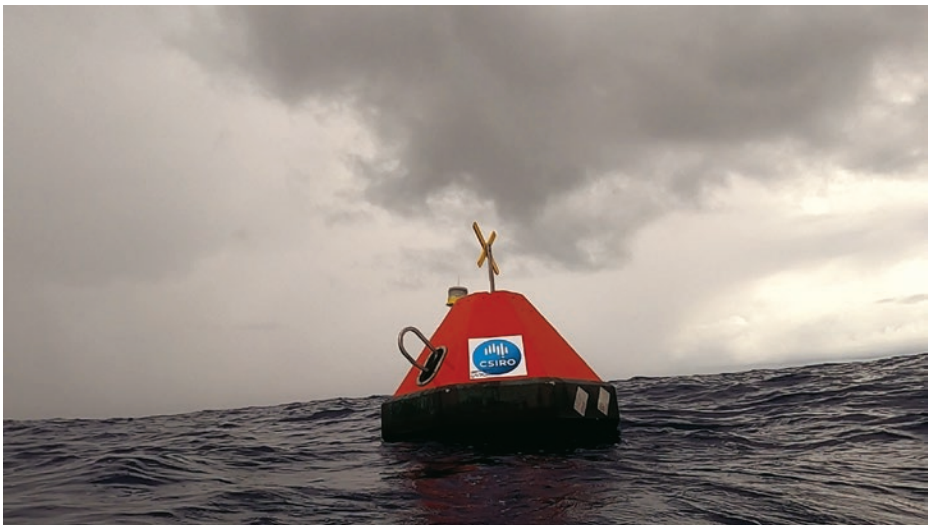
Craig Steinberg, AIMS

John Luetchford observing the Wirewalker surface buoy and mooring after deployment south of Myrmidon Reef.



Virginie Van Dongen-Vogels, AIMS

The Wirewalker profiling mooring being deployed off the RV Cape Ferguson by John Luetchford and Chris Bartlett as a part of the commissioning.



John Luetchford, AIMS

The prawler surface buoy deployed just South of Myrmidon Reef providing data via satellite of the water column properties and the vertical motion to ratchet the prawler up the mooring wire.

Bonney Coast Upwelling for 2020 from IMOS *OceanCurrent*

Whilst the Bonney coast upwelling season started slowly this summer, it has developed into an extremely strong upwelling event late in the season.

The Bonney coast upwelling season developed slowly this summer with the first signs of cold coastal water appearing in late December but consistent upwelling-favourable winds since early February have resulted in an extremely strong upwelling event late in the season. The peak occurred in mid-March (see top figure at right) with the plume of water extending right across the shelf and well into Long Bay to the northwest. The SST anomaly indicates water temperatures were more than 3°C cooler than SSTAARS mean climatology. The two less reliable upwelling regions, off western Kangaroo Island and western Eyre Peninsula, also show significant cold water plumes.

When the cold, nutrient-rich water is brought up to the light, phytoplankton in the water are able to multiply and this productivity can be seen with images of Chlorophyll-a. The complexity of the response is evident in the image from March 11 (see bottom figure at right). The bloom is strong at the edges of the plume while there is almost nothing happening at the centre. This pattern probably reflects the strength of the upwelling event. Water that is upwelled initially (at the outer edge of the plume in this case) will have brought phytoplankton up from the mixed layer (where phytoplankton are often found). Whereas the lack of pigment at the centre of the plume suggests the water has come from well below the mixed layer and it will take a little time for the phytoplankton response to develop in this water. In later images, e.g. March 15, there is a strong chlorophyll-a signal on the Bonney Coast shelf.

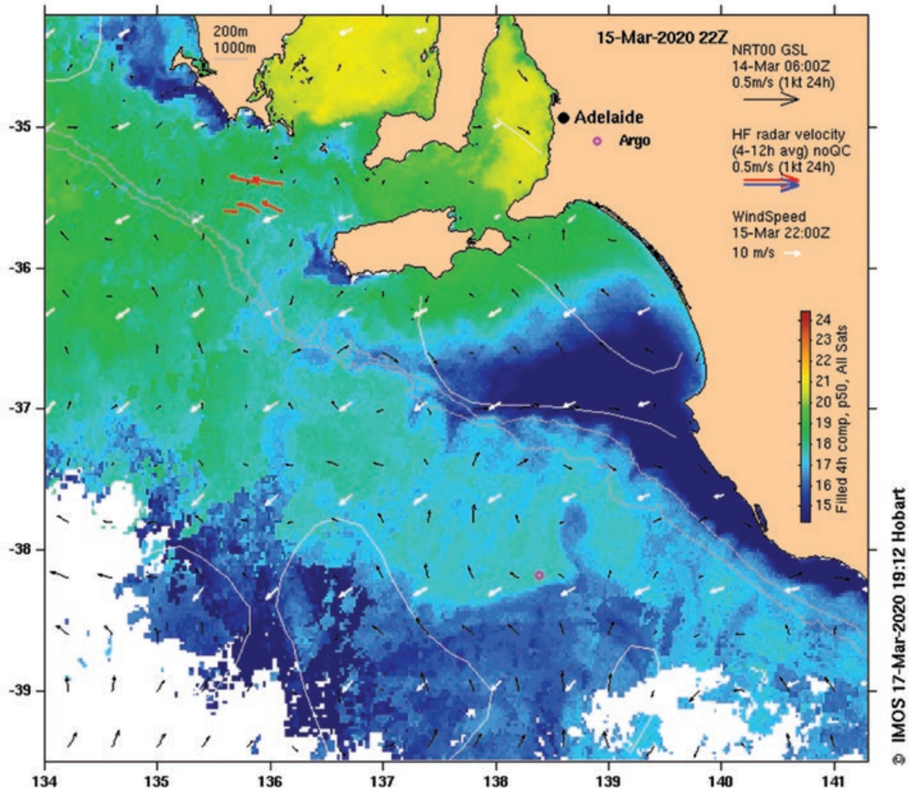


Figure 1: Four hour SST at 22:00 15 March 2020.

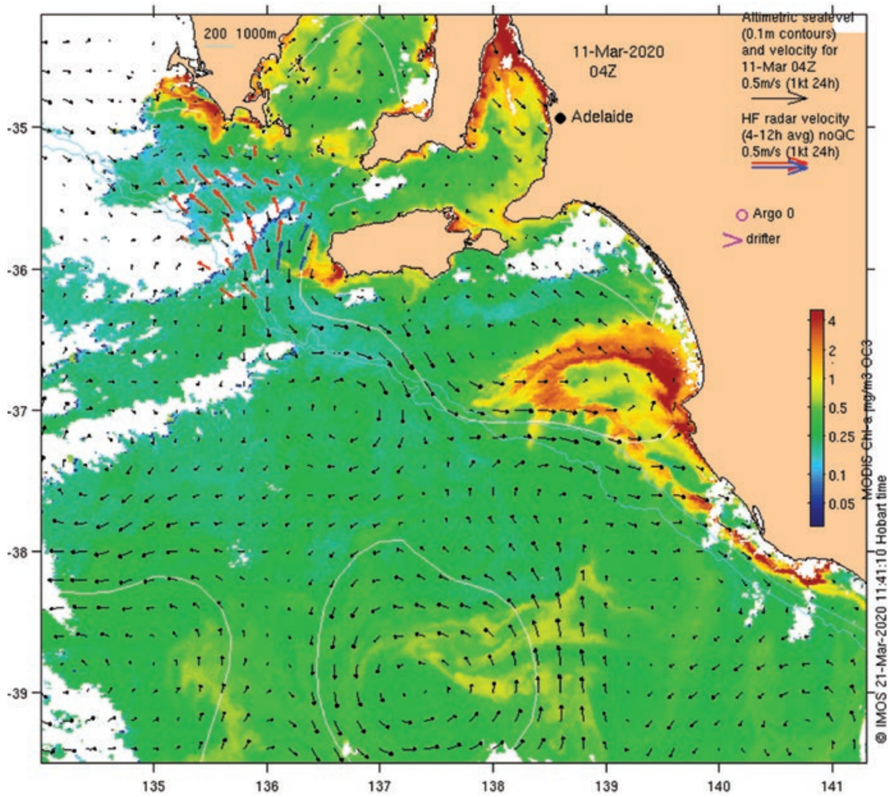


Figure 2: Satellite chlorophyll-a at 4:00 11 March 2020.

The beautiful wave-like features all along the outer edge of the cold water plume (Figures 1&2) are most likely due to the shear between the plume and the water offshore. Despite the cloud, we can occasionally see (in video of the SST) the plume pushing up to the northwest in pulses around March 6-8 and again March 15. Surface velocities (red arrows) from the SA Gulfs radar indicate north-westward velocities of up to 0.4m/s on the shelf. It certainly would have been a good time to have the scheduled Bonney Coast glider deployment, but unfortunately glider deployments have had to be suspended due to the COVID-19 pandemic. ■

For more up to date ocean information around Australia visit IMOS *OceanCurrent*.

Amaranta Focardi

Macquarie University

PROJECT TITLE:

Structure of the microbial communities in marine hotspots for climate change.

Amaranta Focardi was awarded a Ph.D. in December 2019 and currently works in the Paulsen Lab at Macquarie University. Amaranta's PhD was supported by the award of an International Macquarie University Research Excellence Scholarship.

James O'Brien

University of Technology Sydney

PROJECT TITLE:

Chemical signalling and cycling in a changing ocean: Will environmental shifts alter the microbial-scale interactions that control marine sulphur cycling?

James O'Brien is a Doctoral candidate working in the Ocean Microbiology Group in the C3 Institute. He is supported by a UTS Doctoral scholarship and Supervised by Prof. Justin Seymour and Dr Katherina Petrou.

Marine microbes play a critical role in cycling the Earth's major elements. These microbes consist of primary producers, heterotrophic bacteria and viruses. Interactions between these groups dictate the health of the marine ecosystem by driving primary productivity and influencing climatic processes. Given the ocean-scale implications these micro-scale interactions may have, Amaranta and James have focused on identifying key microbial players and associations that influence both the carbon and sulphur cycle.

Picophytoplankton (< 3um) are some of the most abundant primary producers. Together with bacteria and viruses they contribute to the export of carbon from the surface to the deep ocean. Coupling metagenomic data from the Australian Microbiome initiative, and high-throughput cytometry data Amaranta aimed to elucidate the diversity and role of picophytoplankton and their viruses (Fig.1) in the context of carbon cycling within the East Australian Current (EAC) system. Characterizing the contribution of different microbial groups to the carbon biomass is crucial to predict the future productivity of oceanic regions. This study has provided a first insight into the viral genetic makeup (Focardi et al 2020) and their impact on primary producers within the EAC system, and highlighted the importance of cyanobacteria and their viruses for the carbon flux in the EAC.

Microorganisms govern the ocean's carbon, nitrogen and sulphur cycles, which in turn control marine productivity and the influence of the ocean on climate. An important chemical within the ocean's sulphur cycle is dimethylsulphoniopropionate (DMSP). DMSP is best known as the precursor to dimethylsulphide (DMS), a chemical that can influence climate due to its role in cloud condensation. An important group of marine bacteria that transform DMSP to DMS are the *Roseobacters*, a clade of bacteria that also exhibit important ecological associations with phytoplankton. James has used the Marine Microbes time-series to monitor seasonal and spatial variation of key sulphur cycling microbes including *Roseobacters* at the IMOS National Reference Station sites such as Maria Island (Fig.2), with the goal of identifying the microbiological interactions governing important sulphur cycling processes in the Australian ocean.

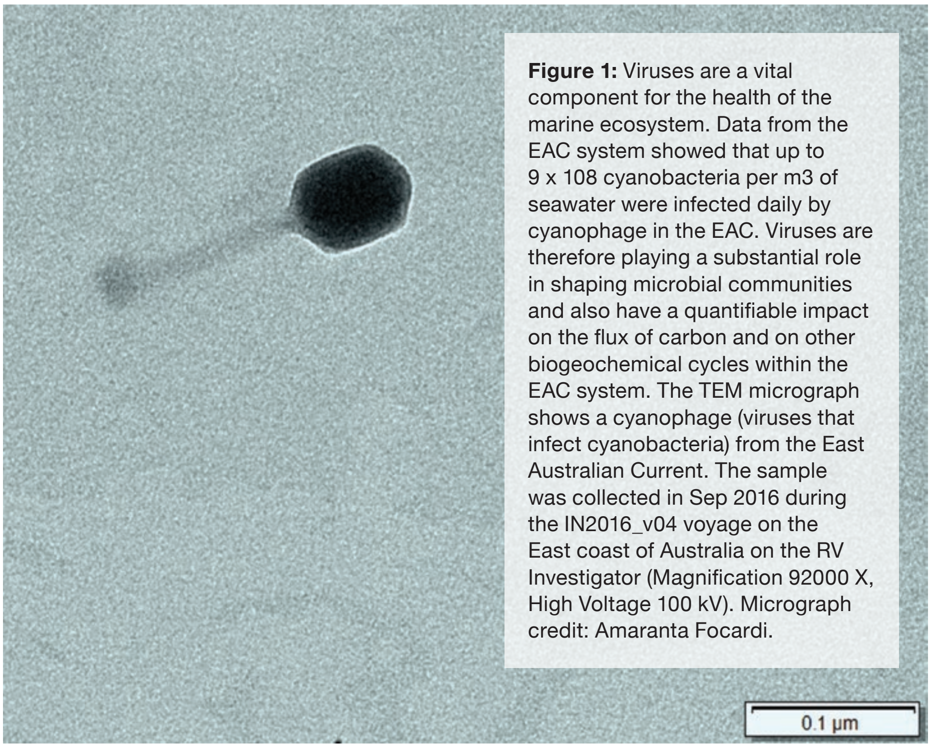


Figure 1: Viruses are a vital component for the health of the marine ecosystem. Data from the EAC system showed that up to 9 x 108 cyanobacteria per m3 of seawater were infected daily by cyanophage in the EAC. Viruses are therefore playing a substantial role in shaping microbial communities and also have a quantifiable impact on the flux of carbon and on other biogeochemical cycles within the EAC system. The TEM micrograph shows a cyanophage (viruses that infect cyanobacteria) from the East Australian Current. The sample was collected in Sep 2016 during the IN2016_v04 voyage on the East coast of Australia on the RV Investigator (Magnification 92000 X, High Voltage 100 kV). Micrograph credit: Amaranta Focardi.

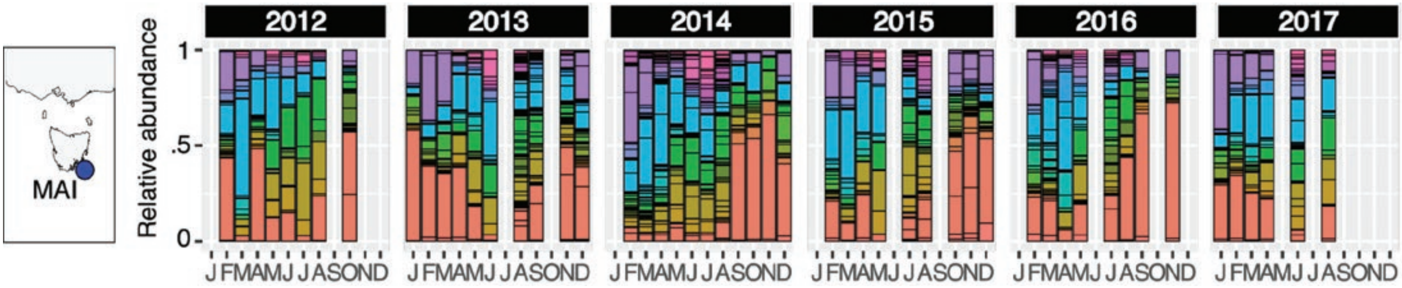


Figure 2: Marine *Roseobacters* are a dominant but genetically diverse group of bacteria capable of "free-living" and "particle-associated" lifestyles. Analysis of the Marine Microbiome data stream from the National Reference Station at Maria Island, Tasmania (MAI) shows seasonal fluctuations in dominant genetic populations of Marine Roseobacter between Feb 2012 and Aug 2017. Subsequent correlation with the phytoplankton data stream is helping to pinpoint which Roseobacter-phytoplankton species interactions are important for studying the processes that contribute to the net production of DMSP.

In May 2019, Amaranta and James both embarked on the RV *Investigator* (voyage IN2019_v03) to participate in a leg of the 2nd International Indian Ocean Expedition (IIOE-2). This 30-day voyage was a latitudinal study along the 110˚E meridian (Fig.3) where they monitored the influence that phytoplankton, bacteria and viruses have on important biogeochemical cycling processes. During the voyage Amaranta and James coordinated the collection of over 400 samples for high-resolution cytometric analyses of viruses, bacteria and eukaryotes and 300 samples to characterise the genetic composition microbial communities as part of the Australian Microbiome Initiative, a program that IMOS supports through our Marine Microbiome Initiative Facility **http://imos.org.au/facilities/marinemicrobiomeinitiative/**.

Focardi, A.; Ostrowski, M.; Goossen, K.; Brown, M.V.; Paulsen, I. Investigating the Diversity of Marine Bacteriophage in Contrasting Water Masses Associated with the East Australian Current (EAC) System. Viruses 2020, 12, 317.

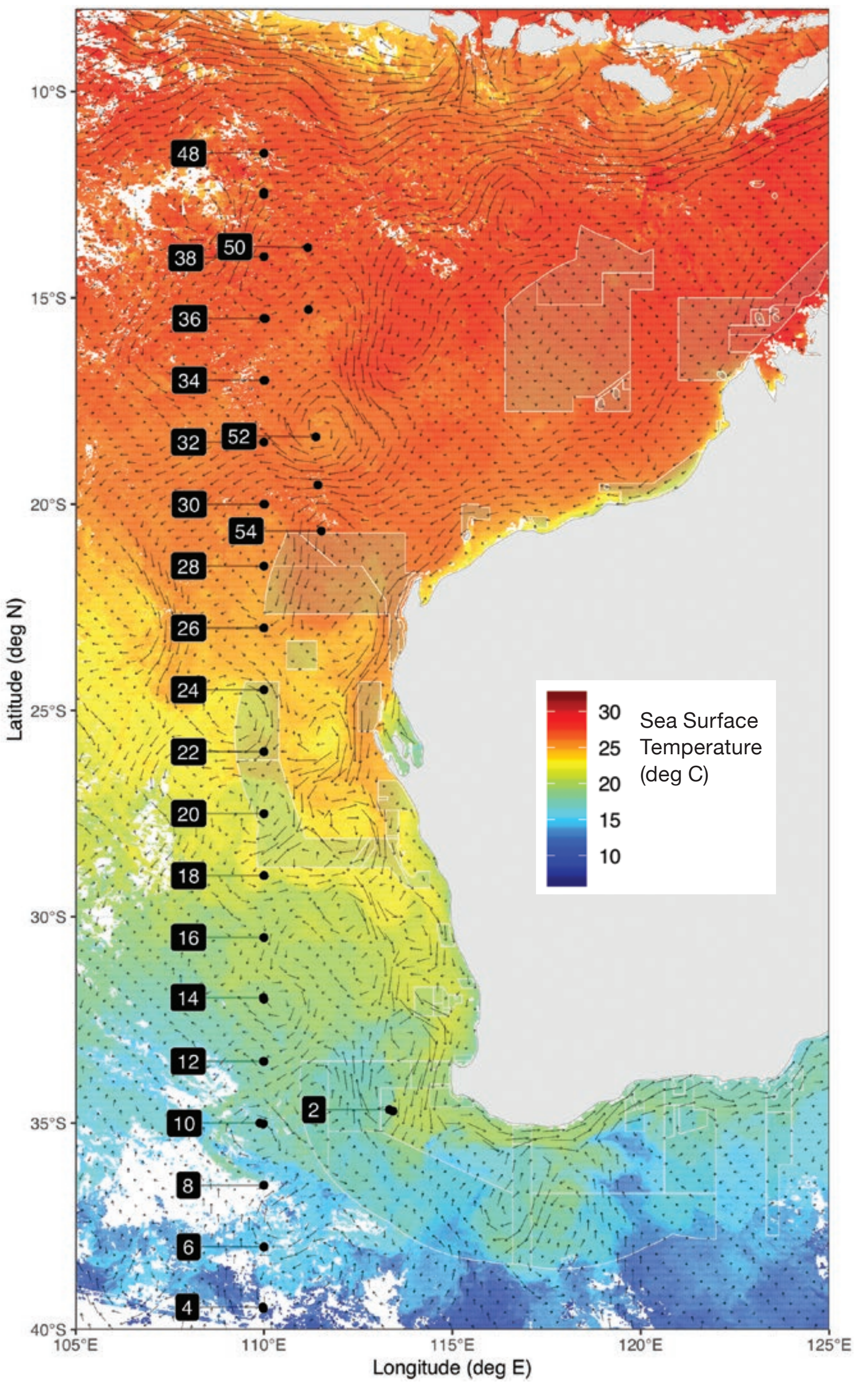
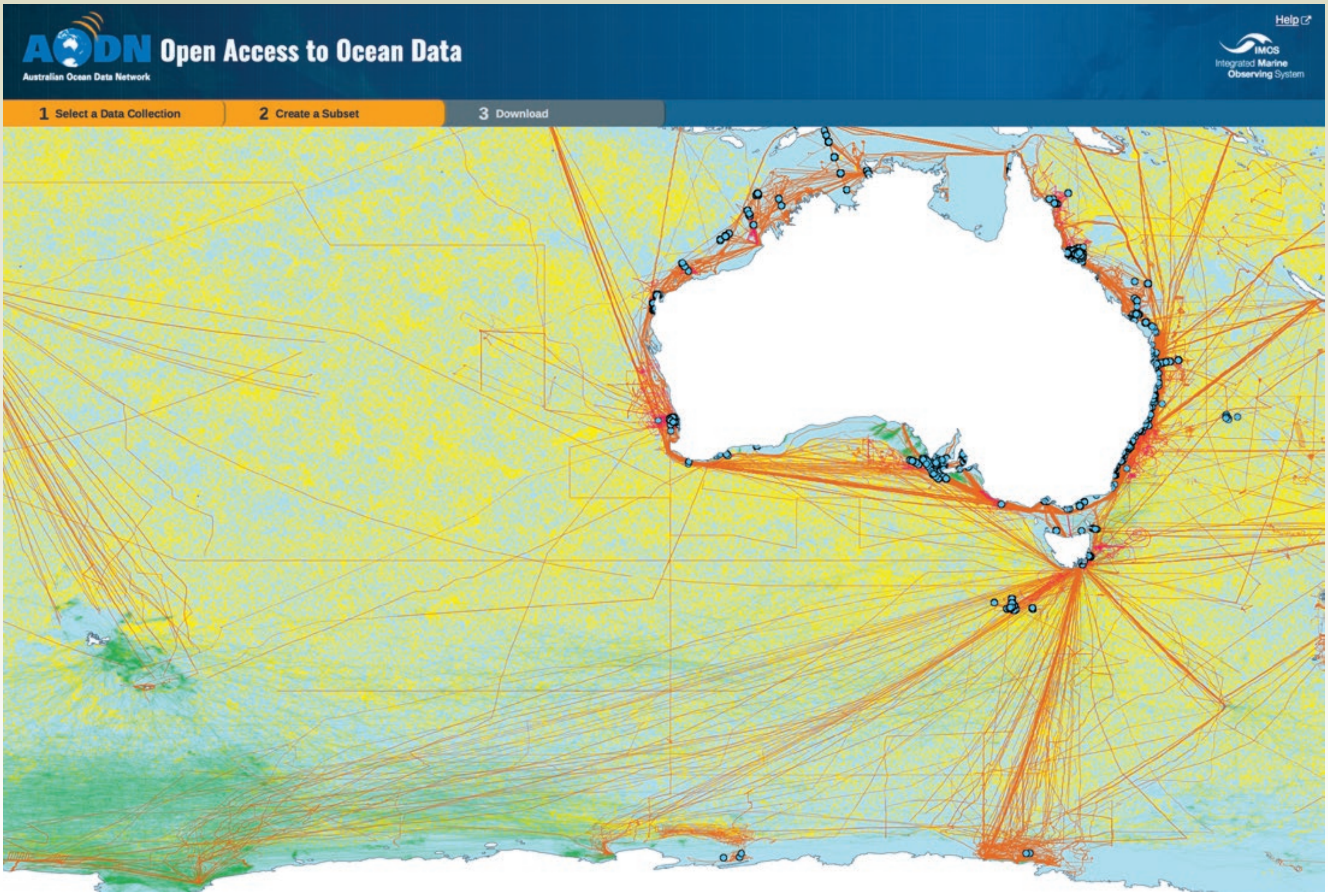


Figure 3: A latitudinal study of the composition of microbial communities in the Indian Ocean is currently being analysed as part of the Australian Microbiome Initiative. This figure highlights the source of over 300 samples taken along the International Indian Ocean Expedition 2 110˚E transect May –June 2019. Areas of particular interest for Amaranta and James are Station 18–22 (Abrolhos Marine Park) and Station 52 (an eddy in the aftermath of cyclone Veronica [18th–31st March 2019]).



The **AODN Portal** provides access to all available Australian marine and climate science data and provides the primary access to IMOS data including access to the IMOS metadata.

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