IMOS

marinematters

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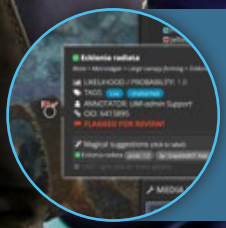
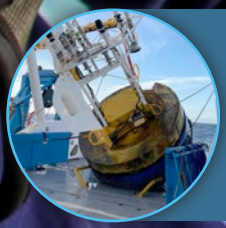
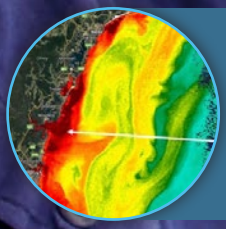
Microplastics contamination near the IMOS Yongala National Reference Station mooring.



Introducing the Understanding of Marine Imagery sub-Facility



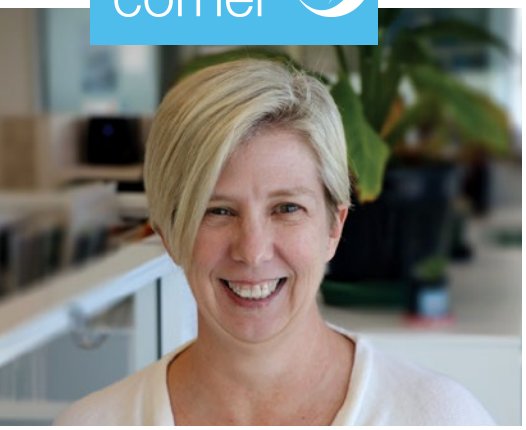
Recovery of the 10th Southern Ocean Flux Station mooring

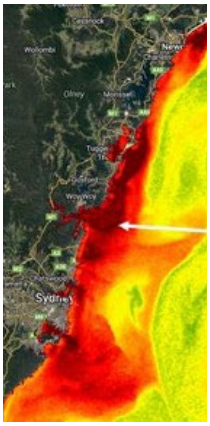


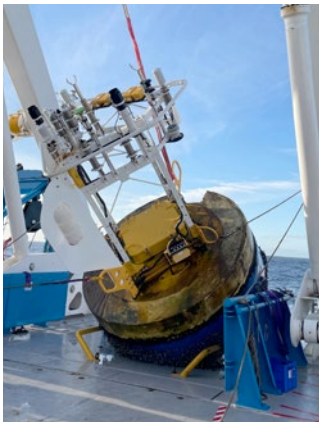
IMOS Ocean Glider sampling freshwater inflows off Sydney

Marie Roman, AIMS

director's corner







IMOS acknowledges the Traditional Custodians and Elders of the land and sea on which we work and observe and recognise their unique connection to land and sea. We pay our respects to Aboriginal and Torres Strait Islander peoples past and present.

Welcome to the June 2022 edition of Marine Matters.

This edition of *Marine Matters* includes a range of exciting updates and events happening in and around IMOS. A couple of the updates included in this edition are really timely happenings. The first of these is the use of IMOS gliders to examine the flood plume off the coast of NSW after the recent rain and flooding events. Chari and the glider team are helping shed light on the scale and extent of these plumes.

The second timely topic is work that the AIMS team have done as part of the microplastic New Technology Proving project. We had a unique opportunity to work with Lisa Blair to collect microplastic samples as she sailed solo, non-stop and unassisted around Antarctica. While Lisa successfully broke the world record, she also took the time to collect environmental samples to support environmental and climate research. These data will create a unique baseline to underpin current and future research in the region.

This issue also includes an introduction to the Understanding of Marine Imagery sub-Facility. The Understanding of Marine Imagery sub-Facility provides a platform for annotating benthic imagery and making annotation data available to others. Through a common platform and accumulating database of annotations we are hoping to underpin machine learning and artificial intelligence to help process images and reduce the amount of labour required. If you collect benthic imagery, or know someone who does, they should check out what the Understanding of Marine Imagery sub-Facility has to offer.

We're also bringing you an update on some new multi-decadal ocean temperature time-series and climatologies. These are available for use and we encourage you to see how you might be able to apply them.

As always, the IMOS community has been busy producing outputs and here we loop you in on a decade of air-sea flux and biogeochemistry observations at the SOTS site and a great new online book on earth observation. We are also providing a peek behind the curtain of what is happening amongst the CPR community.

Finally, we've been providing updates on the Roadmap and Investment Plan via the Bulletin so there isn't any additional news other than to say stay tuned – the rest of the year is bound to be interesting.

I hope you enjoy this edition of *Marine Matters*.

Dr Michelle Heupel
IMOS Director

Ocean Beach (Tas), Lea Walpole

The 2021 National Research Infrastructure (NRI) Roadmap has been released

The Government will invest $900 million over five years on the tools, technology and skills to make Australian research even more globally competitive.

The Roadmap identifies needs and sets priorities for future investment in Australia's national research infrastructure. It will guide the 2022 Research Infrastructure Investment Plan, and seeks to maintain Australian excellence in research and innovation and support Australia's ability to address emerging research challenges.

The 2021 National Research Infrastructure Roadmap suggests further investment and step-change investment in world-leading environmental and climate infrastructure to underpin Australia's national adaptation strategy. This is a testament to the high value and ongoing need for IMOS and other environmental observations.

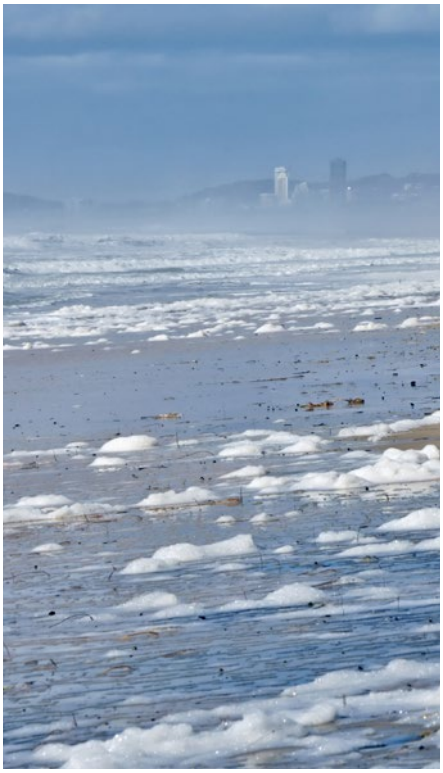
The joint media release of Acting Minister for Education and Youth the Hon Stuart Robert and Minister for Science and Technology the Hon Melissa Price, notes: *The NRI roadmap recommends continued investment in research infrastructure, including the Australian National Fabrication Facility, Australian Research Data Commons, Bioplatforms Australia, and Integrated Marine Observing System.*

This recognises the impact IMOS is already delivering to Australia and signals the additional benefit we can create into the future.

The Government will respond fully to the roadmap's recommendations in its 2022 Research Infrastructure Investment Plan to be released later this year.

The 2021 National Research Infrastructure Roadmap can be accessed at https://www.dese.gov.au/national-research-infrastructure/resources/2021-national-research-infrastructure-roadmap ■

Application of IMOS data to analysis and conclusions in the 2022 IPCC working group II report



***The Intergovernmental Panel on Climate Change (IPCC) Working Group II Climate Change 2022: Impacts, Adaptation and Vulnerability* report was released on 28 February 2022.**

The report outlines the major impacts from climate-driven extreme events like unprecedented heatwaves, drought, bushfire, floods and storms, along with climate-induced risks to communities, infrastructure and livelihoods from sea level rise and other future climate impacts even under low warming scenarios.

The report's 18 chapters examine specific topics such as biodiversity, water, food and human health, along with assessing those implications for specific regions, including Australasia. It explores the continuing trends in biodiversity loss and natural resource overconsumption in addition to growth of cities and the inequalities associated with increased population of urban areas.

The impacts of climate change are increasing in frequency and intensity around the world including life-threatening heatwaves, floods, storms, and droughts. Evidence indicates these events are happening simultaneously in one place, causing cascading and compounding impacts.

IMOS and the report

IMOS contributions cover the breadth of our program including long-term and recently established observing capabilities.

The 2022 IPCC Report includes 64 publications using data from IMOS infrastructure which were cited 90 times.

Significantly, these publications cover a range of IMOS Facilities including Argo Floats, Ships of Opportunity, Deep Water Moorings, Ocean Gliders, Autonomous Underwater Vehicles, National Mooring Network,

Animal Tracking, Australian Ocean Data Network, IMOS OceanCurrent, and Satellite Remote Sensing.

Data from some of IMOS' newer Facilities such as Surface Waves and Event Based Sampling were used in publications cited in the report providing an early demonstration of their value for understanding climate change.

Publications using IMOS data ranged across the physical, chemical and biological variables we observe in Australia's oceans.

Importantly, 55% of the publications using IMOS data were recently published (in the last three years) and 53% hadn't been previously used in other policy documents.

How IMOS will contribute to adaptation and climate resilience into the future

Climate change is increasing pressure on our natural environment, communities, infrastructure and economic sectors including agriculture, fisheries, finance and tourism.

- Coastal erosion and inundation from sea level rise and extreme weather events are affecting the many Australians who live close to the coast.
- Climate change is disrupting the ability of our farmers and fishers to produce food sustainably and profitably.
- Ocean warming will increase the loss and degradation of coral reefs, kelp forests and their associated biodiversity due to rising sea temperatures and marine heatwaves.

Sustained ocean observing provided through IMOS plays a key role in delivering information to underpin management and policy decisions for Australia's adaptation options and pathways.

There is an extensive range of stakeholders who need information about climate change to ensure planning includes preparedness for future conditions. These stakeholders go beyond marine industries to include city planners, governments, defence, emergency services, finance and insurance agencies, business operators, the Bureau of Meteorology, Traditional Owner communities and the general public.

Australia needs a coordinated and cohesive approach to observing and understanding climate change and related coastal dynamics – IMOS provides a pathway as a well-established, collaborative program that delivers on a national scale.

Through maintaining IMOS' delivery of important, high quality ocean observations and an expansion to incorporate coastal observations, Australia would have the full ocean observing package from the open ocean to the coast with associated data products to underpin management and industry decision making. This information is crucial for future planning and our ability to de-risk our communities and industries.

If you would like to download this article as a factsheet click here. ■

IMOS Ocean Glider sampling freshwater inflows off Sydney

Written by Chari Pattiaratchi

The greater Sydney catchment received significant rainfall in January to April 2022. On the 7th and 8th of April there was heavy rainfall over the region with many sites recording 30 to 80 mm of rainfall, with totals of over 200 mm being recorded at a few sites on 7th April.

This meant many sites recorded close to or more than their April monthly average in a single day. This extreme rainfall in the Sydney catchment resulted in large turbid freshwater flows into the ocean. Coincidently, as part of the routine IMOS Ocean Glider deployments, an ocean glider was sampling the ocean in the vicinity of the high outflows. These outflows consisted of high chlorophyll waters and were clearly visible on the ocean colour image obtained by the Sentinel-3 satellite on 10 April 2022 (Figure 1). The ocean glider was located off Hawkesbury River outflow on the same day.

Time series of salinity, chlorophyll florescence and CDOM (chromophoric dissolved organic matter) obtained from the glider demonstrate the vertical extent of the freshwater inflows (Figure 2). The glider reached the closest point to shore around 12:00 on 12 April 2022 in 50 m of water and indicates that the lower salinity water extended to ~30m water depth with the distribution patterns of chlorophyll florescence and CDOM were associated with the lower salinity water.

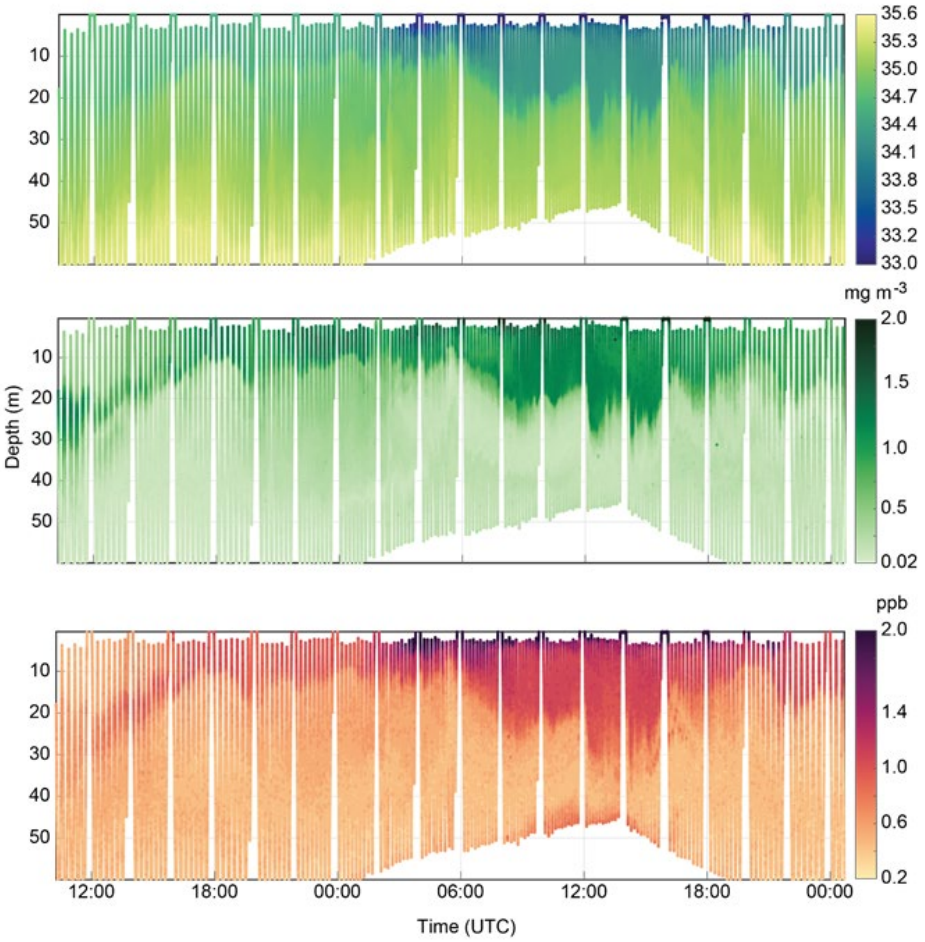
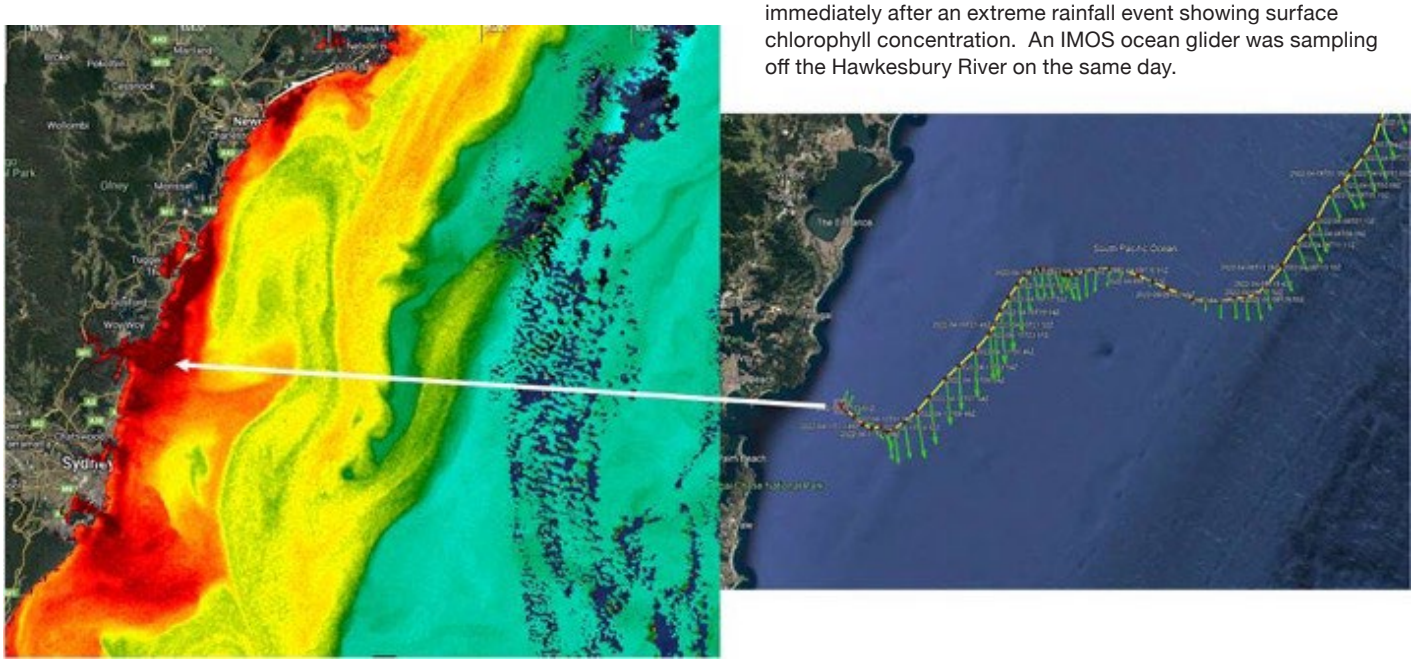


Figure 2: Time series of ocean glider data (salinity, chlorophyll fluorescence and CDOM) acquired on 11-13 April 2022 of the NSW coast offshore of Hawkesbury River.

Figure 1: Sentinel-3 Ocean colour image obtained on 10 April immediately after an extreme rainfall event showing surface chlorophyll concentration. An IMOS ocean glider was sampling off the Hawkesbury River on the same day.



SS Yongala shipwreck – plastics indicate a 'broad wide water' issue

Written by Cherie Motti

A recently published study by the Australian Institute of Marine Science has found marine plastic pollution contaminating the waters near the IMOS SS Yongala National Reference Station (NRS) mooring, located in the Central Great Barrier Reef World Heritage Area (GBRWHA) within Bindal Sea Country.

Marine plastic pollution has become a global environmental concern. Marine plastics can be of various shapes (e.g., fibres, fragments, beads), colours, sizes, and polymer compositions (e.g., polyester, polyethylene, nylon), and are readily transported by surface winds and currents over great distances across ocean basins, ultimately accumulating in ocean gyres.

As the climate changes and extreme weather events (e.g., cyclones, floods) continue to increase in frequency and severity, it has been predicted that this will cause an increase in plastic pollution levels and transport in the marine environment. This has serious implications for marine animals, with marine plastics associated with animal entanglement, ingestion, gut blockage, and even changes in behaviour.

The risks and potential effects of marine plastic pollution in the GBRWHA are only now being investigated. The AIMS Microplastic Team (Marine plastic pollution | AIMS) has established the first long-term marine plastic monitoring program at the IMOS SS Yongala NRS, the ship's name originating from the Aboriginal *janalakawi* meaning "broad wide water". This program is measuring the baseline status of microplastic pollution at the site and examining changes in trends over time.

The monitoring program incorporates environmental (e.g., wind speed, currents, salinity from the NRS mooring) and plastic (i.e., polymer type, shape, size, and colour) parameters to reveal the type and extent of marine plastic pollution, and changes in levels month-to-month.

Surface seawater samples collected continuously over a three-year period between 2016 and 2019 were found to contain mostly microplastics (i.e., plastics less than 5 mm in size) made of polyethylene or polypropylene fragments, and polyester fibres. The levels of contamination found by the study range between 0.01 to 0.95 plastics per cubic meter of surface water, matching contamination estimates of neighbouring GBR areas. No changes were observed in the plastic levels over the three-year period.

Despite relatively consistent levels over years, plastic levels did vary monthly. Months reporting higher plastic loads generally correlated to lower wind speeds. Calm conditions generally have minimal surface water mixing allowing low density plastics to float and concentrate. Windy conditions can cause wave action and mixing, with plastics possibly being pushed to deeper waters. Large spikes in plastic contamination coincided with two severe weather events, Cyclone Debbie in 2017 and the North Queensland Floods in 2019, with plastic being introduced from land-runoff.

This study serves as the first temporal assessment of plastic pollution in the GBRWHA and highlights the pervasiveness of plastics and microplastics even in pristine marine environments. This information improves our understanding of the overall risk of plastic contamination surrounding the SS Yongala NRS site, its inhabitants, and the GBRWHA more broadly.

The findings emphasise the need for long-term and on-going monitoring of the marine environment and marine life for plastic contamination. This study is the first step in developing an Australia-wide long-term marine plastic monitoring program, the IMOS New Technology Proving Microplastics sub-Facility program (operated by AIMS) is an extension of this work.

For further information on long-term monitoring of plastics on in Australian waters and impacts of microplastics on marine life please contact the AIMS Microplastics Team. ■

Marie Roman, AIMS

Lisa Blair sails into Albany breaking the Antarctic circumnavigation world record

Corrina Ridgeway

During her 92 days at sea Lisa has been continuously collecting mircoplastics samples for IMOS.

Australian solo sailor Lisa Blair sailed into Albany, Western Australia on Wednesday morning, completing her unassisted circumnavigation of Antarctica in 92 days, 10 days faster than the previous record holder, Fedor Konyukhov.

Lisa sailed between a latitude of 45 and 60 degrees south around Antarctica covering over 16,516 nm.

Lisa has a passion for a healthy ocean and planet, so during this voyage Lisa collected oceanographic data and microplastics samples.

IMOS provided funding for the microplastics sampling equipment installed on Lisa's yacht, and for the analysis of the microplastics samples by researchers at the Australian Institute of Marine Science (AIMS).

"I would like to congratulate Lisa on achieving such a historic journey, and commend her for her initiative and commitment to collecting microplastics samples in this remote and under sampled location for IMOS," said IMOS Director Dr Michelle Heupel.

"These data will shed light on the prevalence of microplastics in Antarctic waters, creating a unique baseline for current and future research in the region."

Lisa had a research unit on her yacht that measured various water parameters such as temperature, salinity and carbon dioxide. The research unit was also used for microplastics monitoring, by trapping microplastics on specially designed filters, which Lisa collected daily, stored on board, and brought back for analysis.

Dr Cherie Motti leads the team at AIMS who will be analysing the samples, and said Lisa's continual sampling of the water was a first for the Southern Ocean.

"We know very little about the abundance of plastic fragments in the Southern Ocean, so we have been excited to work with Lisa to ensure she can collect the most reliable information from this remote area. The data she is collecting will provide valuable insights into the prevalence of microplastics, and the threat they pose to the region," said Dr Motti. ■

Facility profile: Understanding of Marine Imagery

IMOS has established a national repository for annotated imagery for the growing collection of georeferenced benthic imagery collected from the oceans around Australia.

Transforming benthic imagery into quantitative information for science and policy decisions, requires substantial effort by human experts. Groups tend to handle the collected data in different ways, using different sampling techniques, different annotation tools and even referring to the same taxa by different names.

The lack of established channels for data processing and the absence of a national repository results in significant lags between data collection and scientific discovery.

To address this gap the IMOS Understanding of Marine Imagery sub-Facility is developing a repository using open-source infrastructure to help transform the huge volumes of collected images into useful data products for science objectives, and allows the annotated marine imagery to be shared amongst a broad range of users and stakeholders.

Having a national repository of data that has been annotated in a consistent format opens up the possibility of answering 'big picture' questions and provides opportunities to access large data sets for training machine learning algorithms and artificial intelligence to help process images and reduce the amount of labour required.

This type of data is of interest for marine scientists studying benthic habitats and organisms ranging from nearshore to continental shelf break ecosystems. To date this imagery and annotations have been used to inform the management of state and commonwealth marine parks, ecosystem-based fisheries management, pest species management and quantifying the impacts of climate change.

The repository is called Squidle+ and is a web-based framework with a user-friendly interface that integrates data management tools with an advanced annotation system. It expedites the delivery of survey data and facilitates seamless tools for downstream analysis of the imagery.

The architecture integrates with existing cloud-based repositories, eliminating the need to copy and duplicate these large datasets. Tools include map-based exploration interfaces, annotation summaries, advanced annotation workflows with QA/QC features, and a comprehensive Application Programming Interface (API) which enables the creation of custom reporting/analytics dashboards using external scripting languages like Python and R. The API also facilitates integration with external systems (like the AODN portal, Seamap Australia, etc.) Sharing, collaboration and release of datasets are managed through user groups with granular permissions.

The platform offers different annotation modes (whole-frame, points, polygons) and is designed to be media-type agnostic (images, videos, large-scale mosaics). It has integrated QA/QC tools, which enable cross-validation between human annotators and between humans and algorithms. It supports multiple vocabularies that are standardised using inbuilt translation tools, allowing data export in a vocabulary of a user's choosing. This facilitates data reuse, syntheses between projects and large-scale training of machine learning algorithms.

Squidle+ currently has 7,420,874 images imported from 11,753 deployments in 569 campaigns from eight platforms, including the IMOS Autonomous Underwater Vehicles and National Reef Monitoring Network Facilities. Users need to register before they can begin annotating images. To date, 1,202 users have registered and contributed over 2,325,027 annotations. ■

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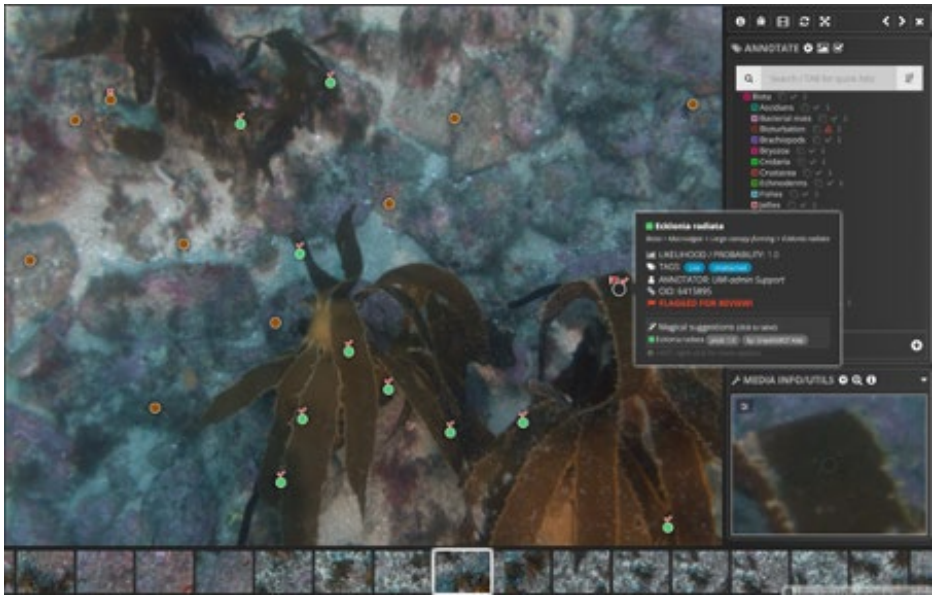
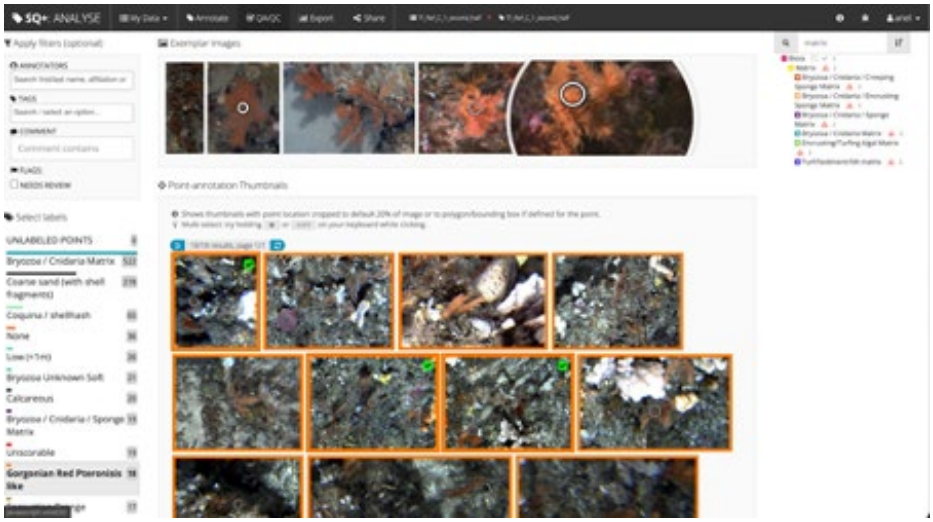


Annotation interface showing review flag features, tag modifiers and supplementary label suggestions from an ML algorithm (with agreements) for Golden Kelp (*Ecklonia radiata*).



QA/QC tools, showing exemplars enabling rapid checking and relabelling, filterable by annotator, tags, comments and whether flagged for review.

Map interface showing campaigns and deployments providing an entry point to exploring the data and tools for selecting datasets for further analysis.

New multi-decadal ocean temperature time-series and climatologies have been published in Nature Scientific Data using IMOS mooring data.

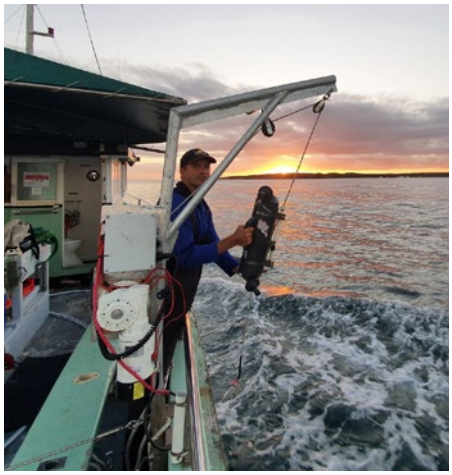
The team at the Coastal and Regional Oceanography Lab at UNSW have created 17 new ocean data products from four long-term monitoring sites around Australia (Maria Island, Rottnest Island and two sites at Port Hacking). The sites were started by CSIRO in the 1940's but have been continued by IMOS since 2009 as a core component of our network of National Reference Station Moorings.

The authors have packaged the multi-decadal, multi-depth, multi-platform temperature time-series at each site and produced a range of daily temperature climatologies from different data combinations and time periods.

The new data products will be useful for studies of ocean temperature variability, trends, anomalies and change. The products are open-access, and are provided as NetCDFs. If you are not familiar with this format then check out this **code** demonstrating how to load netCDFs, create plots, and export data as CSV files using either R, Python or MATLAB. ■

For more details:

Roughan, M., Hemming, M., Schaeffer, A. et al. Multi-decadal ocean temperature time-series and climatologies from Australia's long-term National Reference Stations. *Sci Data* 9, 157 (2022). https://doi.org/10.1038/s41597-022-01224-6



N. Doszpot

Nahshon Siboni (University of Technology Sydney) deploying a Niskin bottle at the Port Hacking site.

Recovery of the 10th Southern Ocean Flux Station mooring: A decade of air-sea flux and biogeochemistry observations in the Southern Ocean

Written by Elizabeth Shadwick

The Southern Ocean absorbs a great deal of heat and carbon dioxide from the atmosphere and helps to shape the climate in Australia and around the world. This oceanic service comes at a cost – the waters of the Southern Ocean are becoming warmer, fresher, less oxygenated and more acidic – the consequences of these changes are difficult to observe and remain poorly understood.

The IMOS Southern Ocean Time Series (SOTS) allows an integrated and ongoing assessment of the processes that control carbon cycling in the subantarctic Southern Ocean – now recognised as globally important in removing carbon dioxide from the atmosphere.

The recent recovery of the 10th IMOS Southern Ocean Flux Station (SOFS-10) platform represents huge logistical and engineering achievement as well as an exciting scientific milestone. Decadal assessments of changing physics, biology, and chemistry of the subantarctic Southern Ocean are now possible with the data generated at the SOTS site.

Observations collected by the SOFS mooring indicate an increase in atmospheric CO_2 from roughly 374ppm in late 2011 to 396 ppm in May 2022 (see Figure 1); this change of approximately 22 ppm over the last decade, or ~2.2

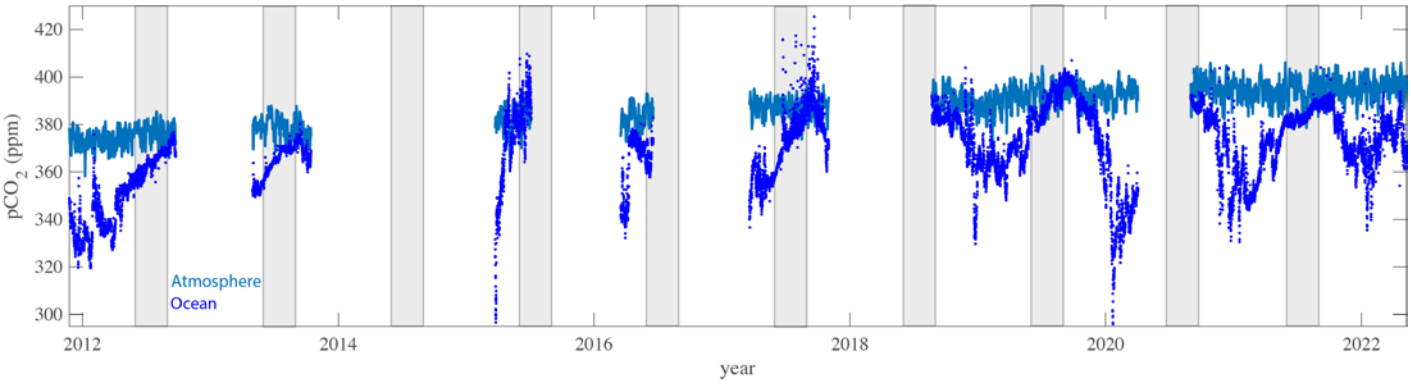


Figure 1: The atmospheric and surface ocean CO_2 timeseries measured by the Southern Ocean Flux Station since late 2011. Shaded areas indicate the winter season. The seasonal range in surface ocean CO_2 can exceed 100 ppm (i.e., from a minimum of 300 ppm in summer to a maximum of 400ppm in winter), complicating decadal assessments of anthropogenic change.

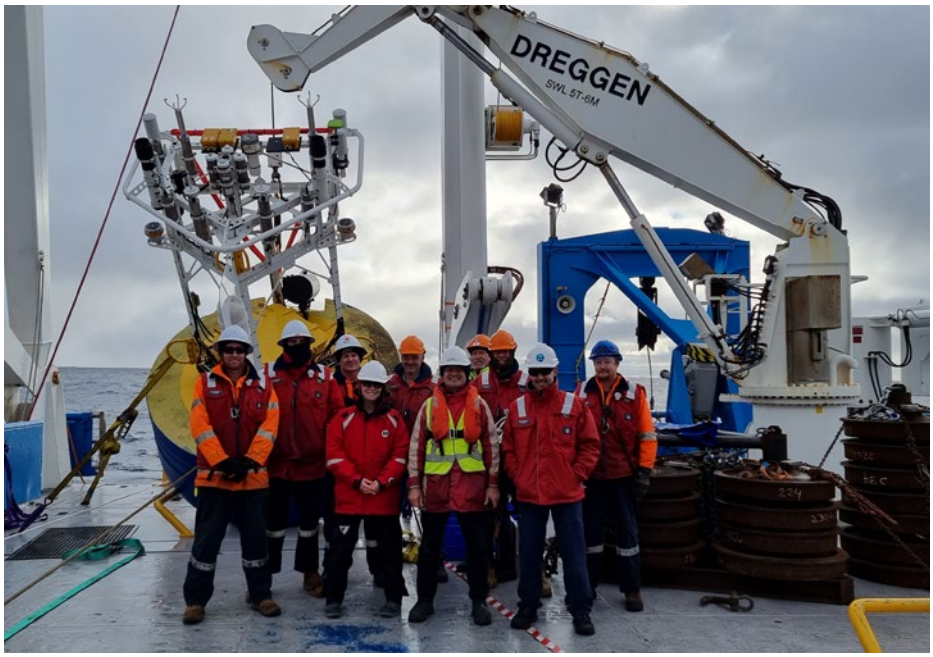
ppm/yr, is consistent with observations from the Cape Grim Baseline Air Pollution Station in northwestern Tasmania.

The ocean response to this change is controlled by both physical and biological processes and varies with season and from one year to the next (Figure 1, Shadwick *et al*., 2022). Deciphering between natural variability and climate change requires observations sustained over many years. The IMOS SOTS Facility is the only long-term air-sea flux and biogeochemistry mooring in the Southern Ocean; observations collected at the SOTS site are essential to provide advice about how climate variability is affecting us now and is likely to affect us in the future. ■

Reference:

Shadwick, E.H., A.S. Rigual-Hernández, R.S. Eriksen, P. Jansen, D.M. Davies, C.A. Wynn-Edwards, A. Sutton, C. Schallenberg, E. Shulz, and T.W. Trull. 2022. Changes in Southern Ocean biogeochemistry and the potential impact on pH-sensitive planktonic organisms. Pp. 14–15 in Frontiers in Ocean Observing: Documenting Ecosystems, Understanding Environmental Changes, Forecasting Hazards. E.S. Kappel, S.K. Juniper, S. Seeyave, E. Smith, and M. Visbeck, eds, A Supplement to Oceanography 34(4), https://doi.org/10.5670/oceanog.2021.supplement.02-06.

The SOTS moorings are operated through a partnership between IMOS, CSIRO, the Bureau of Meteorology, and the Australian Antarctic Program Partnership, with ship support from the Marine National Facility.



David Flynn, CSIRO

The SOFS-11 surface float is prepared for deployment.

Elizabeth Shadwick, CSIRO

The SOFS-10 surface float just after recovery on IN2022_v03.

IMOS data highlighted in new volume of the online book Earth Observation: Data, Processing and Applications

***Earth Observation: Data, Processing and Applications* is an Australian Earth Observation community undertaking to describe earth observation data, processing and applications in an Australian context and includes a wide range of local case studies to demonstrate Australia's increasing usage of earth observation data.**

This online book aims to consolidate earth observation teaching resources in Australia and encourage a greater number of tertiary courses involving earth observation in Australia.

The online book has been published across three volumes

- Volume 1: Data (2018)
- Volume 2: Processing (2018–2020)
- Volume 3: Applications (2021–2022)

Volume 3 is the latest volume to be published and introduces the Australian terrestrial and aquatic environment in terms of geography, climate, biota, and resource management, then covers a broad range of application areas reliant on earth observation data.

IMOS is featured frequently in Volume 3B – Surface Waters, (IMOS is mentioned 183 times), including data from the following Satellite Remote Sensing sub-Facilities including Sea Surface Temperature (SST) Products, Ocean Colour, Satellite Altimetry Calibration and Validation, and Surface Waves, as well as highlighting the contribution of several other IMOS in situ data streams including Argo Floats, Ocean Gliders and Ships of Opportunity SST. Specific case studies are included to demonstrate individual applications and feature IMOS.

Download the online volumes here: https://www.eoa.org.au/earth-observation-textbooks

The publication of this work has been jointly sponsored by the following organisations: Cooperative Research Centre for Spatial Information (CRCSI), Commonwealth Scientific and Industrial Research Organisation (CSIRO), Geoscience Australia (GA), Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC), and FrontierSI. ■

IMOS Plankton Team contributes to the Australian National Maritime Museum

Written by Jason D. Everett, Ruth Eriksen, Frank Coman, Emily Jateff and Anthony J. Richardson

It started with a plankton biologist and a marine archaeologist sharing a love of plankton on an *RV Investigator* voyage, and it ended with a Continuous Plankton Recorder (CPR) permanently hanging in the Australian National Maritime Museum in Sydney as part of the *One Ocean, Our Future* exhibition.

Emily Jateff, a marine archaeologist and Curator, Ocean Science & Technology at the Australian National Maritime Museum, was onboard the RV Investigator in 2018 from Brisbane to Hobart when she stepped in to help Ruth Eriksen. Ruth, a phytoplankton taxonomist with the IMOS Plankton Team at CSIRO was towing the CPR and sampling plankton from the ships underway system. Emily would often join Ruth and Gustaaf Hallegraeff for live imaging sessions on the microscope. The photo of the living foraminifera, which adorns the base of the CPR exhibit, was taken by Ruth and Emily at one of these sessions. Emily fell in love with the CPR, and all the plankton it sampled, and on this voyage the seeds were sown for a 60-year old unused CPR to make its way to the Australian National Maritime Museum. There it has been professionally curated as a permanent acquisition, and a part of the *One Ocean, Our Future* exhibition.

The first CPR was towed over 1300 miles in Antarctic waters in 1925–1926 by Sir Alister Hardy. This device was then modified and has remained relatively unchanged since the 1930s. Since then it has been towed over millions of miles, and collected plankton from around the world. The samples collected by the Global Alliance of CPR surveys (GACs), of which the IMOS Australian Plankton Survey is a part, are used in a range of ways, including to improve taxonomic knowledge, understand phenology, fisheries and climate change. Within IMOS the CPR is towed by commercial shipping partners who volunteer their

crew to take charge of the deployment and retrieval while at sea. The samples are then transported to Hobart and Brisbane where they are sorted, counted and identified by the IMOS Plankton Team.

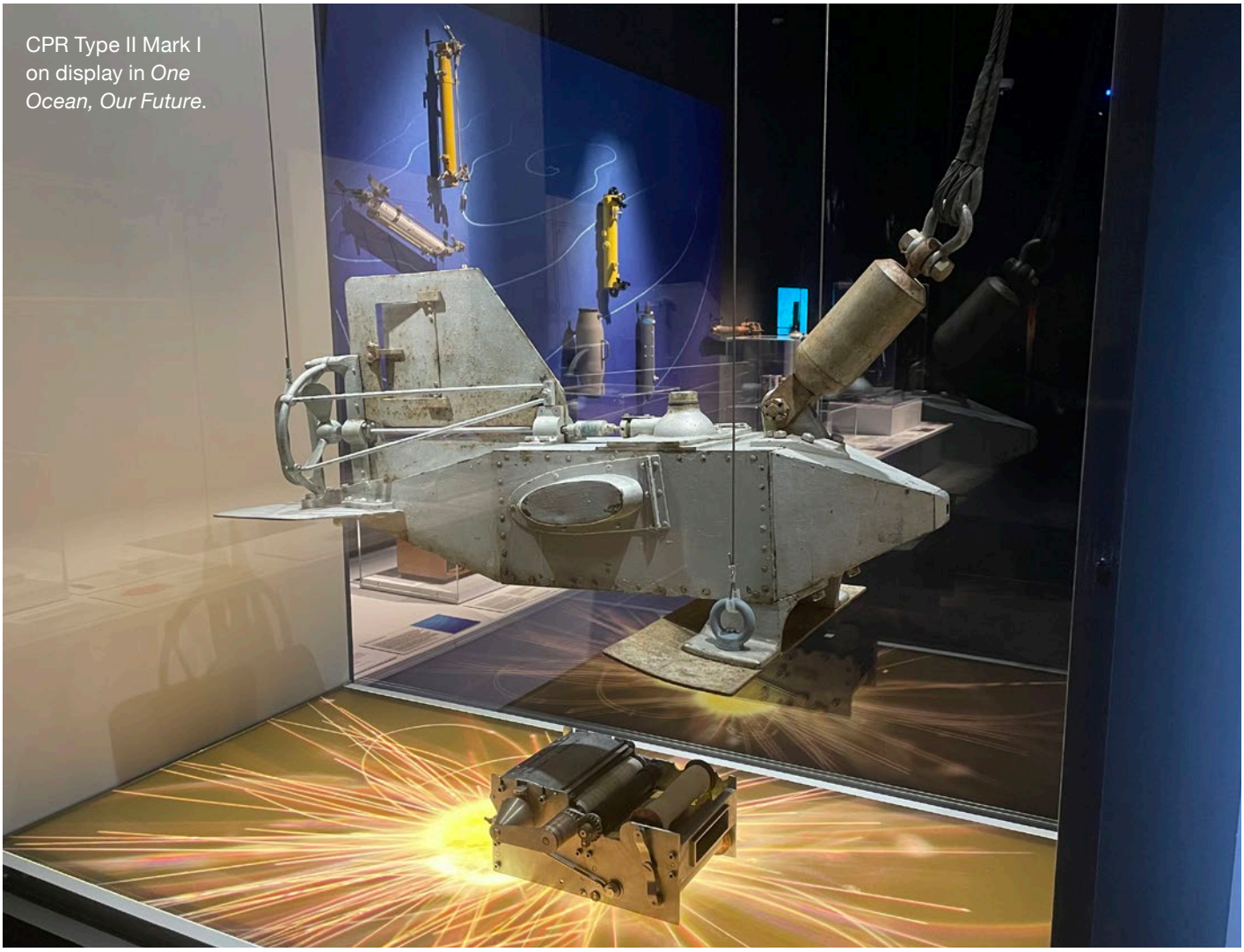
This particular CPR has an interesting back story. It originally came from the University of Queensland (UQ) Zoology in the early 2000s. There was a major clean up, and no one knew what the CPR was and so it was disposed of. Kevin Townsend, Station Manager at UQ Moreton Bay Research Station, retrieved it from a dumpster and took it to the field station. There, when Anthony Richardson (UQ/CSIRO) was teaching a field course on plankton in 2015, Kevin showed him the device. Anthony knew it was an old CPR and Kevin gave it to CSIRO. It was on display in the plankton lab at CSIRO in Brisbane for 6 years before Emily from the Australian Museum found out about it from discussions with Ruth Eriksen on their cruise together. CSIRO then donated the CPR to the Australian National Maritime Museum. The device is believed to be 60-70 years old.

CSIRO has enquired with the Marine Biological Association of the UK, who, along with its predecessors, have run the CPR survey since the 1930s. Despite having records going back nearly 90 years, there is no record of this particular CPR being made and shipped to Australia. It is a CPR Type II Mark I, which means it is most likely one of the two earliest CPRs used in Australia: CPR 13 (~1940) or CPR 105 (1966). While the CPR has been covered with a couple layers of paint over the years, the Museum's conservation team attempted to image the CPR 13 with UV light, but analyses have so far been unsuccessful. The exact age and who brought it to Australia remains a mystery.

One Ocean, Our Future is on now through October 2022 at the Australian National Maritime Museum, after which it will tour nationally and internationally. The CPR is proposed to tour with the exhibition. ■

Australian National Maritime Museum

The CPR in the Australian National Maritime Museum's Conservation Laboratory getting prepped for the exhibition.



CPR Type II Mark I on display in *One Ocean, Our Future*.

Jason D. Everett, The University of Queensland

Data from the latest Biogeochemical Argo float deployment

Written by Tom Trull, Peter Strutton, and Christina Schallenberg

IMOS successfully deployed a Biogeochemical (BGC) Argo float in the Indian Ocean capable of measuring the full set of six BGC variables (oxygen, nitrate, pH, chlorophyll, particulate organic carbon from optical backscatter, and solar radiation), as recommended by the international Biogeochemical Argo program.

Deployment was scheduled for July 2021 during an *RV Investigator* survey of Australia's new Gascoyne Marine Park, but after that voyage was cancelled by COVID concerns, deployment was achieved in November 2021 with the help of the Bureau of Meteorology during servicing of a tsunami warning buoy. After an initial period of higher frequency profiling, the float is operating on the standard global array mission of parking at 1000 m depth with profiles from 2000 m to the surface every 10 days.

Science targets for the float mission include:

1. comparing fluorescence and solar radiation attenuation-based estimates of phytoplankton biomass, which the float reveals as occurring below the depth of satellite ocean colour retrieval (Figure 2)
2. mapping and examining the likely origins of the shallow subsurface oxygen minima and associated elevated nitrate concentrations that occur in this region (Figure 3), and
3. understanding their role in the control of ocean productivity and biomass.

We expect that this float deployment will promote further combined use of dissolved (oxygen, nitrate, pH) and particulate (chlorophyll, particulate organic carbon) measurements to understand the dynamics of ocean biogeochemical and biological processes and their responses to climate change. ■

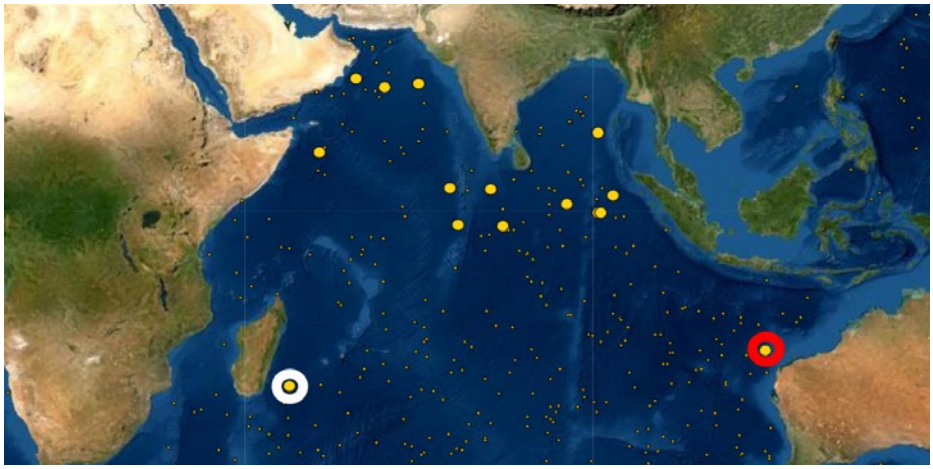


Figure 1: Active BGC-Argo floats in the non-polar Indian Ocean as of April 2022, as mapped by the European Argo Fleet Monitoring service. The new float (WMO ID 5906661), manufactured by Teledyne-Webb Research, is circled in red and measures all 6 BGC variables. The float circled in white is capable of all these variables except solar radiation. The other BGC floats, shown by large yellow dots, have more limited capabilities (all can measure chlorophyll, but none can measure radiation, nitrate, or pH). The much more abundant small yellow dots indicate Argo floats capable of measuring only temperature and salinity.

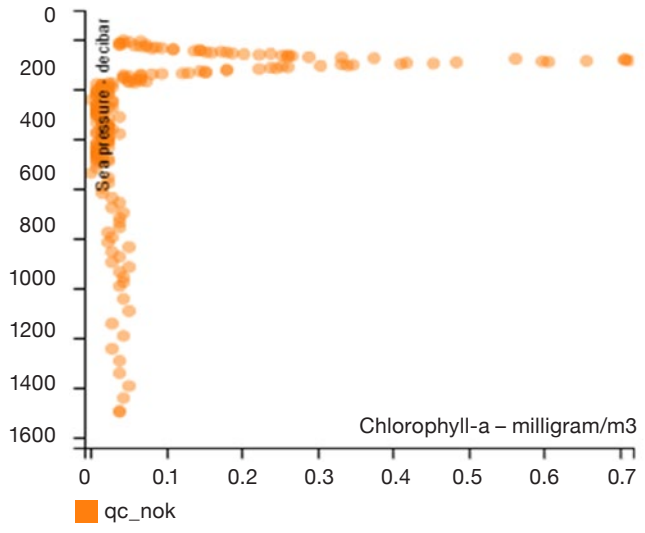


Figure 2: Most recent (3 April 2022) fluorescence-derived chlorophyll-a profile showing the very deep and very strong sub-surface phytoplankton biomass abundance, that lies below the depth of satellite retrieval.

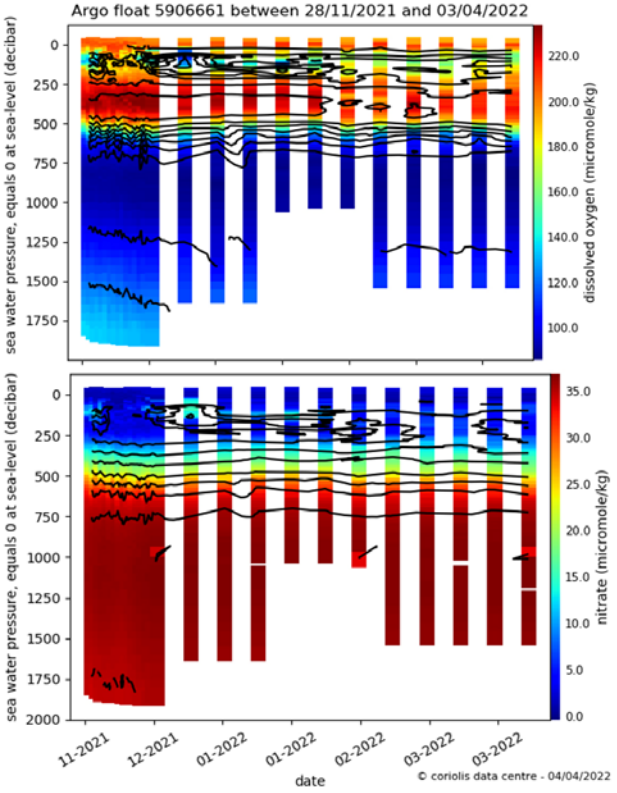


Figure 3 (right): Section plots of dissolved oxygen (top) and nitrate (bottom), courtesy of the European Argo Fleet Monitoring Service from the first few months of autonomous observations by BGC-Argo float 5906661 off Northwest Australia. Note the low oxygen waters (coloured yellow/green) near 100m depth and their occasional association with higher nitrate (coloured green).

New surface waves product added to IMOS OceanCurrent

Written by Salman Saeed Khan and Mark Hemer

The product provides up to date wave conditions around Australia, with data gathered from Australia's coastal wave buoy network, several satellites and the Bureau of Meteorology's AUSWAVE-R model.

The new product, 2-hourly maps of surface waves, is added to the suite of visualisations already available on the IMOS OceanCurrent website. The new maps present a combination of near real-time wave information from Australia's in-situ wave buoy network, several satellite platforms (radar altimeter and Synthetic Aperture Radar (SAR) missions), and the near real-time modelled wave field from the Australian Bureau of Meteorology's (BoM) AUSWAVE-R model.

This combined spatial representation of modelled, in-situ, and satellite data complements buoy data time-series available from the State and Commonwealth agencies that operate each buoy. Each operator's buoy data page can be accessed by clicking on the buoy location on the maps.

High seas contributing to the recent significant NSW coastal erosion event, following weeks of intense storms and severe weather, were well captured in the new IMOS-OceanCurrent surface waves product (Figure 1). The BOM-NSW issued a severe weather warning on 9th Mar 2022 for damaging surf on the central and southern parts of the NSW coast (Figure 2), following the high waves generated from a low-pressure system/ east coast low in the Tasman Sea.

Significant wave heights of 5-6 m were recorded by wave buoys at Eden and Port Kembla (Figure 1a, purple arrows). Offshore, the low-pressure system generated even higher wave – heights up to 7 m – as observed by satellite altimeter passes and predicted by BoM's AUSWAVE-R model (Figure 1b). Note that buoy measurements nearest in time and all available satellite passes within +/- 3 hours of the background AUSWAVE-R wave field are displayed. The 6-hour window allows sufficient buoy measurements and satellite passes to be available for spatial display with the caveat that some loss of agreement of wave information between various data sources can be expected. The maps also include the mean wave periods and peak wave direction of the longer swell waves from Sentinel-1 SAR passes (black, white, and grey circles). However, none of these passes coincided over the region of interest to be useful in this event.

The IMOS-OceanCurrent wave product has been made possible thanks to provision of wave data from several sources including State and Commonwealth Government wave buoy custodians, sourced through IMOS Australian Ocean Data Network (AODN) National wave buoy data archive, satellite altimeter wave height data from RADS, Sentinel-1 near real time SAR wave data from IMOS-AODN, and BoM's AUSWAVE-R background wave field.

The latency of all these datasets is variable, but usually less than 24 hours. For a forecast of surface wave height, please refer to the BOM's website. ■

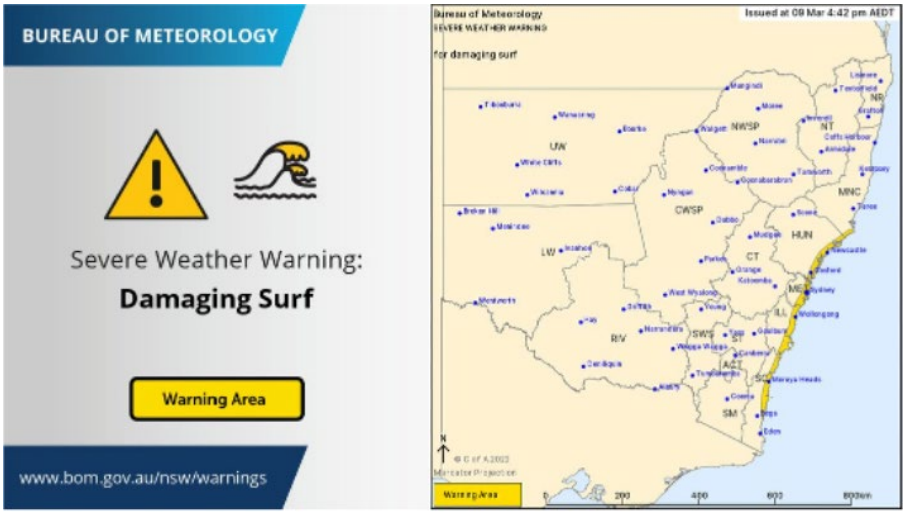


Figure 2: BOM- NSW damaging surf warning along the central and southern NSW coast.

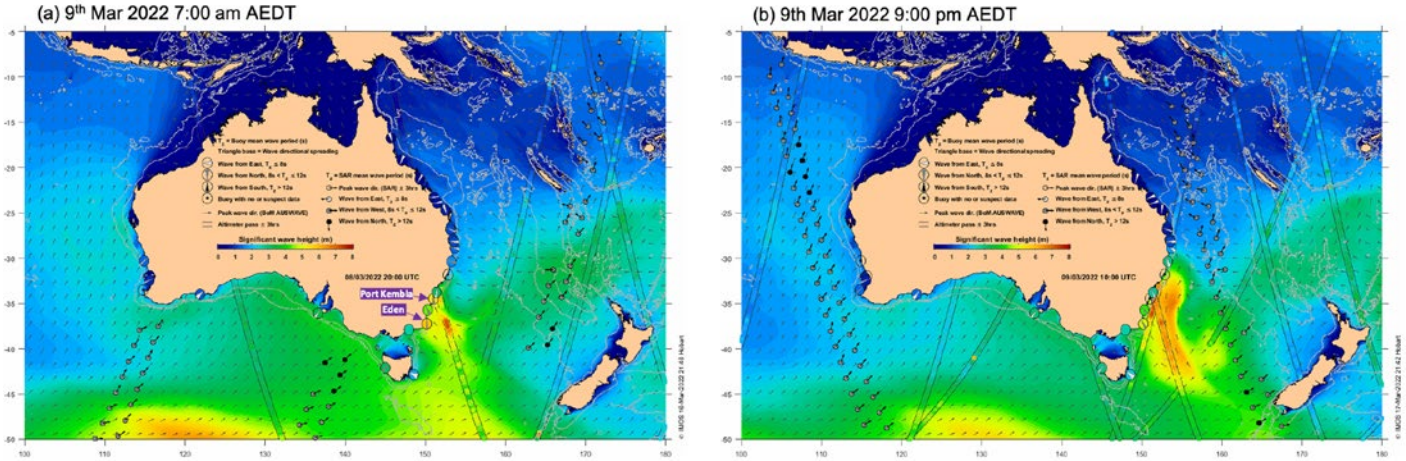
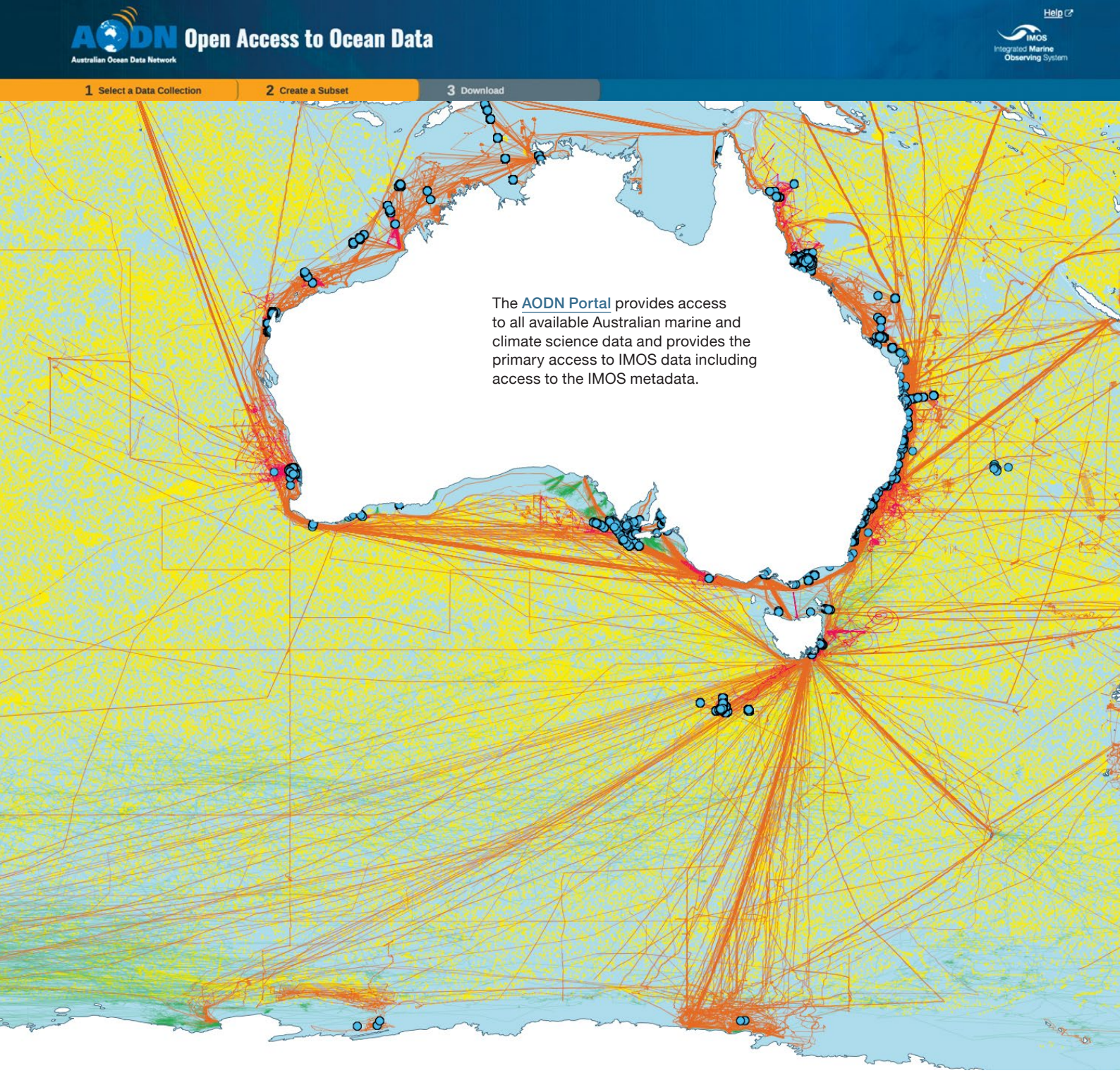


Figure 1: Damaging surf along the southern and central NSW coastline. Approx. 6 m and 5 m significant wave heights recorded by wave buoys at Eden and Port Kembla, respectively, and even higher significant wave heights (~7 m) recorded offshore by satellite altimeters and predicted by AUSWAVE-R.



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

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