IMOS Integrated Marine Observing System

marinematters

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CELEBRATING 20 YEARS
OF SUSTAINED MARINE OBSERVING

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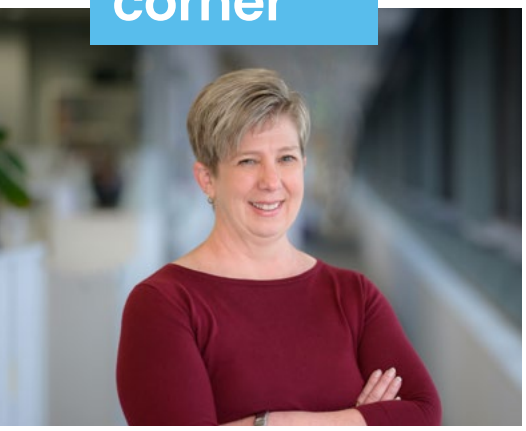
Dearna Bond

Director's corner



IMOS acknowledges the Traditional Custodians and Elders of the land and sea on which we work and observe, and recognise them as Australia's first marine scientists and carers of sea Country. We pay our respects to Aboriginal and Torres Strait Islander peoples past and present.

Welcome to the June 2026 edition of Marine Matters

This year we have the honour and opportunity to celebrate 20 years of IMOS ocean observing. The 2026 Annual Meeting included a focus on what the program has achieved to date and acknowledging the contributions of the many people who helped us navigate to this milestone.

For the first time ever, IMOS held a Technicians Summit in conjunction with the Annual Meeting which provided a great opportunity to recognise and award some of the technicians that work to operate IMOS infrastructure smoothly and safely. We have provided some information about the awardees and their contributions here to continue to recognise their contributions. This recognition also coincides with the Oceanographic Calibration Facility having completed its 10,000th instrument calibration. This is one example of how technical staff help ensure the excellence of IMOS observations.

Other relevant news from the marine science community comes in the form of the new National Marine Science Strategy launched in Canberra this March. The new strategy lays out priorities for the future, while recognising IMOS, our vessels, field stations and other infrastructure as critical underpinnings to achieving scientific aspirations and objectives.

This issue also covers a range of other issues including project updates, retrospective analyses of IMOS capabilities and an update on the South Australian harmful algal bloom.

It has been a very busy start to the year and I look forward to continued recognition and celebration of IMOS as the year progresses, including a bumper issue of Marine Matters later this year.

As always, thank you to everyone who has taken time to contribute and share your stories, updates and information with us. Your efforts and engagement exemplify the relevance and success of IMOS.

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

Dr Michelle Heupel
IMOS Executive Director

Dearna Bond

IMOS marks 20 years of ocean observing at the 2026 Annual Meeting

CELEBRATING 20 YEARS
OF SUSTAINED MARINE OBSERVING

The IMOS community recently came together in nipaluna, Hobart to celebrate two decades of nationally coordinated ocean observing at the 20th Anniversary Annual Meeting. The milestone event highlighted the critical role of IMOS, enabled by National Collaborative Research Infrastructure Strategy, in delivering long-term observations that underpin marine science, climate research, and decision-making.

The three-day program brought together researchers, technicians, partners and stakeholders for a series of engaging and insightful presentations spanning IMOS's past, present and future. Opening with a Welcome to Country by Uncle Dougie and remarks from IMOS Chair, John Gunn, set the tone for reflection and forward thinking. Keynotes from Susan Wijffels and Michelle Heupel explored the evolution and impact of ocean observing across Australia and globally.

A strong focus on Indigenous engagement featured throughout the program, including a keynote from Paul Sinclair, Director of Mirri Mirri, and updates on IMOS Indigenous partnerships. Presentations from Tonya Grant and Larissa Hale highlighted the importance of collaboration, knowledge sharing, and supporting Indigenous-led initiatives in ocean science.

The meeting also showcased IMOS's data legacy and future through sessions on the Australian Ocean Data Network, along with retrospectives across key Facilities and programs. These included ocean colour, Argo floats, ocean carbon chemistry, satellite altimetry, plankton observations, and long-term time series, demonstrating the breadth and continuity of IMOS observations over 20 years.

"Funding long-term monitoring is always difficult and it is a testament to the IMOS community that we have reached 20 years. The success of IMOS is grounded in the contributions of dedicated partners, researchers and technicians producing high quality data and outputs. IMOS is an amazing asset to Australia and I look forward to seeing what we will celebrate after 30 years," Michelle Heupel, IMOS Executive Director.

Day three featured international and industry perspectives, including updates on the Global Ocean Observing System and CoastRI, alongside reflections on national facilities such as the National

"Funding long-term monitoring is always difficult and it is a testament to the IMOS community that we have reached 20 years.

Reference Stations, Ocean Gliders, and the Australian National Mooring Network. Together, these sessions reinforced IMOS's role within a broader global observing system.

A dedicated Technician Summit and recognition session acknowledged the vital contributions of technical staff, whose expertise underpins the success and reliability of IMOS operations. Their work was celebrated as essential to sustaining high-quality, long-term ocean observations. The Technical Summit provided an opportunity for networking, knowledge exchange and the inception of an IMOS Community of Practice.

A special reception at Government House ahead of the conference dinner added to the significance of the occasion, providing an opportunity for the community to connect and celebrate the milestone together.

The meeting concluded with reflections, recognition awards, and a forward-looking discussion on IMOS's future directions. As IMOS enters its third decade, the Annual Meeting reaffirmed the strength of its community and its ongoing commitment to delivering the observations needed to understand and manage Australia's oceans.

IMOS extends its thanks to all speakers, staff and attendees who contributed to making the 20th anniversary meeting such a memorable and successful event. ■

John Gunn, IMOS Governing Board Chair, Michelle Heupel, IMOS Executive Director, Her Excellency the Honourable Barbara Baker, Governor of Tasmania, Professor Rufus Black, Vice-Chancellor, University of Tasmania.

Photos: Dearna Bond

Dearna Bond

Umesh Ranasinghe, IMOS

Dearna Bond

Dearna Bond

IMOS Technical Excellence Recognition Awards

IMOS recognised outstanding technical contributions by staff to the success of Australia's Integrated Marine Observing System at the Annual Meeting in Hobart in March. Award winners were either individuals or teams who have demonstrated excellence, innovation, knowledge sharing and dedication in supporting IMOS ocean observing operations.

IMOS TECHNICAL EXCELLENCE AWARDS

Claire Davies

As the Biogeochemical Coordinator for the IMOS National Reference Stations, Claire has ensured the seamless delivery of monthly physical, chemical, and biological data across the network. Her technical excellence and leadership have been critical to maintaining long-term, high-quality time series.

Claire is a co-designer and co-developer of the Biological Ocean Observer an innovative data-delivery platform that significantly improves accessibility, interoperability, and analysis of IMOS biological data.

IMOS TECHNICAL EXCELLENCE AWARDS

Jack Beardsley

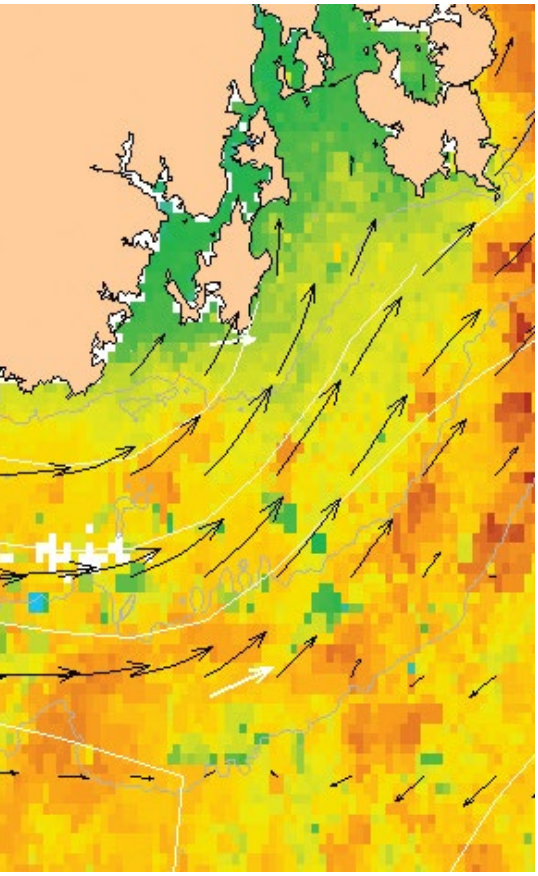
Central to the success of the IMOS Satellite Altimeter Calibration and Validation sub-Facility is the sustained contribution from Jack Beardsley. Jack has demonstrated sustained technical excellence over his ~13 years of service to his role which involves coordinating the preparation, deployment and data management of GNSS equipped buoys in Bass Strait. Jack has the rare mix of practical field capability combined with exceptional computational and data management skills making him an incredible asset for IMOS.

IMOS TECHNICAL EXCELLENCE AWARDS

Craig Hanstein

Over the past 15 years, Craig has demonstrated exceptional technical expertise and unwavering commitment to IMOS programs, establishing himself as an indispensable leader in oceanographic research support and contributing to peer-reviewed best practices.

Craig has been the driving force behind the IMOS XBT Ships of Opportunity sub-Facility technical coordination, orchestrating all operational aspects of this climate monitoring program. He has personally completed more than 30 voyages aboard merchant vessels, performing XBT observations that contribute vital ocean temperature data to global datasets.



IMOS TECHNICAL EXCELLENCE AWARDS

Roger Scott

Roger is a Software Engineer whose sustained technical excellence, reliable deployment and maintenance of data processing systems, and straight-forward problem-solving skills have solidly advanced real-time operations across four IMOS facilities/sub-facilities (Argo Floats, BGC Argo, IMOS OceanCurrent and Satellite Remote Sensing) for at least 10 years. His contributions include software engineering, hardware diagnostics, ocean data acquisition and real-time processing, and user interface design.

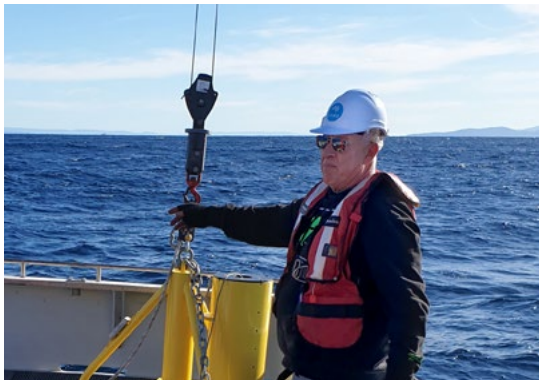
The biggest differential in Roger's work is his deep understanding of how ocean data is collected and used by ocean experts, enabling him to build systems that are robust, efficient, and expandable—supporting evolving scientific needs and delivering national and international impact.

IMOS TECHNICAL EXCELLENCE AWARDS

Tim Fountain

Tim has provided exceptional support to IMOS coastal moorings for many years. He has demonstrated sustained technical excellence through planning of voyages and preparation of moored infrastructure for the National Reference Stations at Maria and North Stradbroke Island since the earliest days of their instrumented inception. He has developed a number of innovations around mooring designs and associated recovery tools which have made the mooring systems more reliable and the deployment and recovery operations safer and more streamlined.

He has also heavily supported the IMOS Satellite Altimetry and Ocean Acidification moorings, through mooring preparation and voyage participation.



IMOS TECHNICAL EXCELLENCE AWARDS

IMOS Ocean Acidification Moorings team:

Erik van Ooijen

Tim Lane

Tim Fountain

The Ocean Acidification Moorings team have worked for many years on a technically challenging project to deploy acidification surface moorings, often in difficult conditions, and provide high-quality data streams over the past decade.

The team have delivered robust observational capacity with safe operations for almost 100 deployments since the beginning of the project. This capacity is not available anywhere else in the Southern Hemisphere. At all times these three people have been engaged in revising, documenting procedures, and passing their knowledge on to other staff to deliver high quality and impactful IMOS data that is recognised internationally.








Photos: Matt Marrison, CSIRO

IMOS TECHNICAL EXCELLENCE AWARDS

IMOS Coastal Wave Buoys team:

Thiago Caminha

Carlin Bowyer

Matt Hatcher

Although the IMOS Coastal Wave Buoy Facility is relatively new the technical team has already made significant contributions to IMOS' wave observing capability. The team leads the deployment and maintenance of Western Australian (WA) coastal wave buoys but also supports operations of IMOS wave buoys all around Australia.

Through their experience, the team has demonstrated sustained technical excellence, contributed to innovation in ocean observing, and led efforts in collaboration and knowledge sharing.

IMOS TECHNICAL EXCELLENCE RECOGNITION

Acoustic Telemetry team – IMOS Animal Tracking:

Emma Bowen

Yuri Niella

Jarrod McDonald

Sam Allan

The Acoustic Team have and continue to make an outstanding technical contribution to marine science in Australia, in the field, at the desktop, and around the meeting room.

It is the Acoustic Team's ability to innovate and deliver 'in-water' solutions, to engage a large community of science collaborators, and to see the data collection through to availability/uptake/use that makes their achievements truly outstanding.

IMOS TECHNICAL EXCELLENCE RECOGNITION

CSIRO Calibration Lab team:

Kai van den Hoff

Brendan Coulson

Nicole Morgan

The CSIRO Calibration Facility plays a critical role in delivering one of IMOS's core requirements: traceable, high-quality data to support reliable ocean science. Using NATA-certified equipment and procedures, the facility ensures rigorous quality control and calibrates IMOS instruments (from a number of IMOS Facilities including National Reference Stations, Deep Water Moorings, Satellite Altimetry Calibration and Validation) to a level of accuracy and precision that meets or exceeds manufacturer standards.

IMOS TECHNICAL EXCELLENCE RECOGNITION

Jim LaDuke

Jim has been a stalwart of instrument support for IMOS for many years. Jim has demonstrated sustained technical excellence through repair, configuration, deployment, recovery and download of instruments for the National Reference Stations at Maria and North Stradbroke Island since the earliest days of their instrumented installation.

He has also heavily supported the Southern Ocean Timeseries, EAC Deepwater Arrays, Satellite Altimetry and Ocean Acidification moorings, through instrument preparation and voyage participation.

IMOS TECHNICAL EXCELLENCE RECOGNITION

Mark Snell

Mark has worked under the IMOS National Mooring Network Facility, WA moorings sub-Facility, for more than a decade, and also worked with the IMOS Ocean Colour sub-Facility. Mark has also assisted the IMOS Argo facility's deployment in the west, as well as various Ship of Opportunity activities. Mark has made an excellent contribution in delivering technical and logistical support for a diverse IMOS facilities in delivering long term data streams for over a decade.

IMOS TECHNICAL EXCELLENCE RECOGNITION

Ryan Crossing

Ryan has worked under the IMOS National Mooring Network Facility, WA moorings sub-facility, for more than a decade, and also worked with the IMOS ocean colour sub-Facility. Ryan also takes the responsibility of managing our fieldwork vessel and coordinating the fieldwork. He led the effort to keep our research vessel in the west, which ensures the success and safety of our mooring observation project. Ryan has made an excellent contribution in delivering technical and logistical support for a diverse IMOS facilities in delivering long-term data streams over a decade.

IMOS TECHNICAL EXCELLENCE RECOGNITION

National Reef Monitoring Network team:

Toni Cooper

Lizzi Oh

Benedicte Pasquer

Man Fai (Raymond) Ng

Huaizhi (Havier) Dai

Toni, Lizzi and Bené represent the core team responsible for development of the National Reef Monitoring Network (NRMN) since 2018/2019 and have continued to improve and expand it to become one of the most well-used IMOS products and well-respected ecological datasets globally. Raymond and Havier from AODN have contributed more recently.

Talking sea Country business in East Arnhem Land

In December 2025, IMOS Indigenous Partnerships Coordinator, Tonya Grant, travelled across East Arnhem land in the Northern Territory to meet with Indigenous sea ranger groups on Country.

The Roadshow Trip was facilitated by Australian Institute of Marine Science (AIMS) Indigenous Partnerships Coordinator Fallon Hines based in the Darwin office, and accompanied by Carl Grant (AIMS Senior Indigenous Partnership Coordinator) and Dr Michelle Dyer (Senior Research Scientist, First Nations Innovation) of the AIMS Indigenous Partnerships (IP) Townsville team. The trip was a fantastic opportunity to meet with sea ranger groups on Country. Discussions focused on sea Country business including presenting information about IMOS.

"Eastern Arnhem land is incredibly special, and it was a privilege for the team to meet with Traditional Owners across this breathtaking landscape on their country," Tonya Grant, IMOS Indigenous Partnerships Coordinator | Yuru, Yidinji and Australian South Sea Islander.

Tonya introduced IMOS to the rangers, who showed great interest, particularly when made aware of the current absence of IMOS facilities in their sea Country. Ranger groups shared their monitoring experience; past, present, and future aspirational.

The AIMS Indigenous Partnerships team discussed the Northern Australian Marine Monitoring Alliance (NAMMA) training manual and micro-credential opportunities with rangers, highlighting formal training pathways for capacity building. Delivered in partnership with Registered Training Organisations, these micro-credentials build skills and strengthen ranger capability in sea Country management.

Additionally, Dr Michelle Dyer spoke about the IP Team's new social science capability highlighting the potential for future Indigenous science research. Dr Dyer let sea ranger groups know about her position within the team and potential work in future.

Discussions were successful with Ranger Coordinators wishing to connect with team members for further talks on IMOS and interest in NAMMA micro-credentials. ■

AIMS

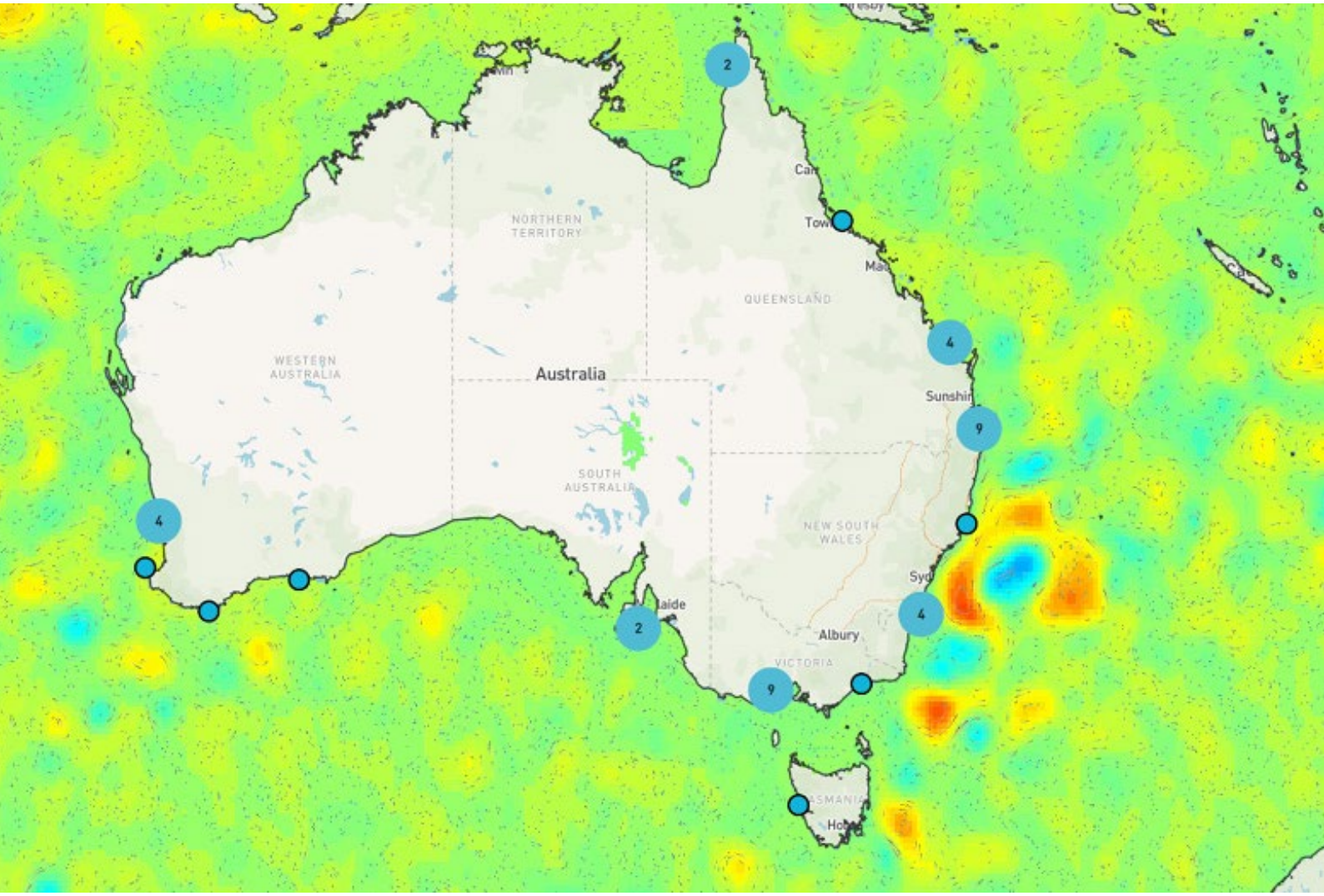
Marranbala Rangers.

AIMS

Dhimurru Ranger Office team

Introducing IMOS Live

IMOS has launched the beta release of IMOS Live, a web-based application designed to provide streamlined access to Australia's marine data.



The platform serves as a central hub for viewing Near Real-Time IMOS products, including satellite-derived data, wave data from buoys and more, offering a practical tool for researchers, government managers, and the broader oceanographic community.

One of the primary advantages of IMOS Live, is its ability to facilitate the joint visualisation of spatial satellite imagery with point-source time-series data. This allows users to directly compare broad-scale environmental patterns with specific observations from wave buoys and moored instruments.

To support field operations and on-site monitoring, the interface is optimised for mobile devices and small screens, ensuring that users can access reliable data while working in the field.

Furthermore, the application includes a feature for downloading map views as PNG files, making it simple to incorporate high-quality visualisations into technical reports, academic publications, and presentations.

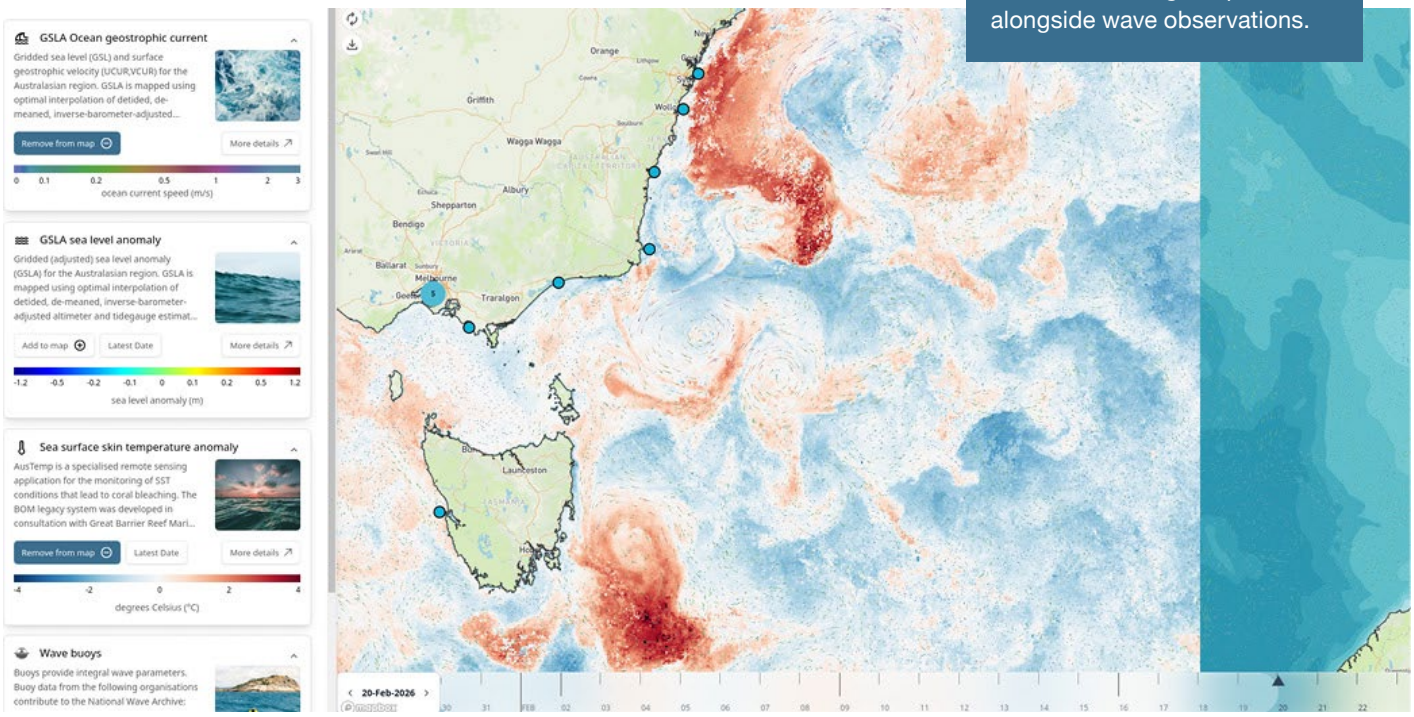
"The IMOS Live website visualisations allowed me to study the strength of the ocean currents around the coral atolls of the Coral Sea that I am mapping for

> "These visualisations helped me to understand the relationship between the strength of the flows and the geomorphology of the reefs.
>
> Eric Lawrey, Knowledge Systems Manager, Australian Institute of Marine Science

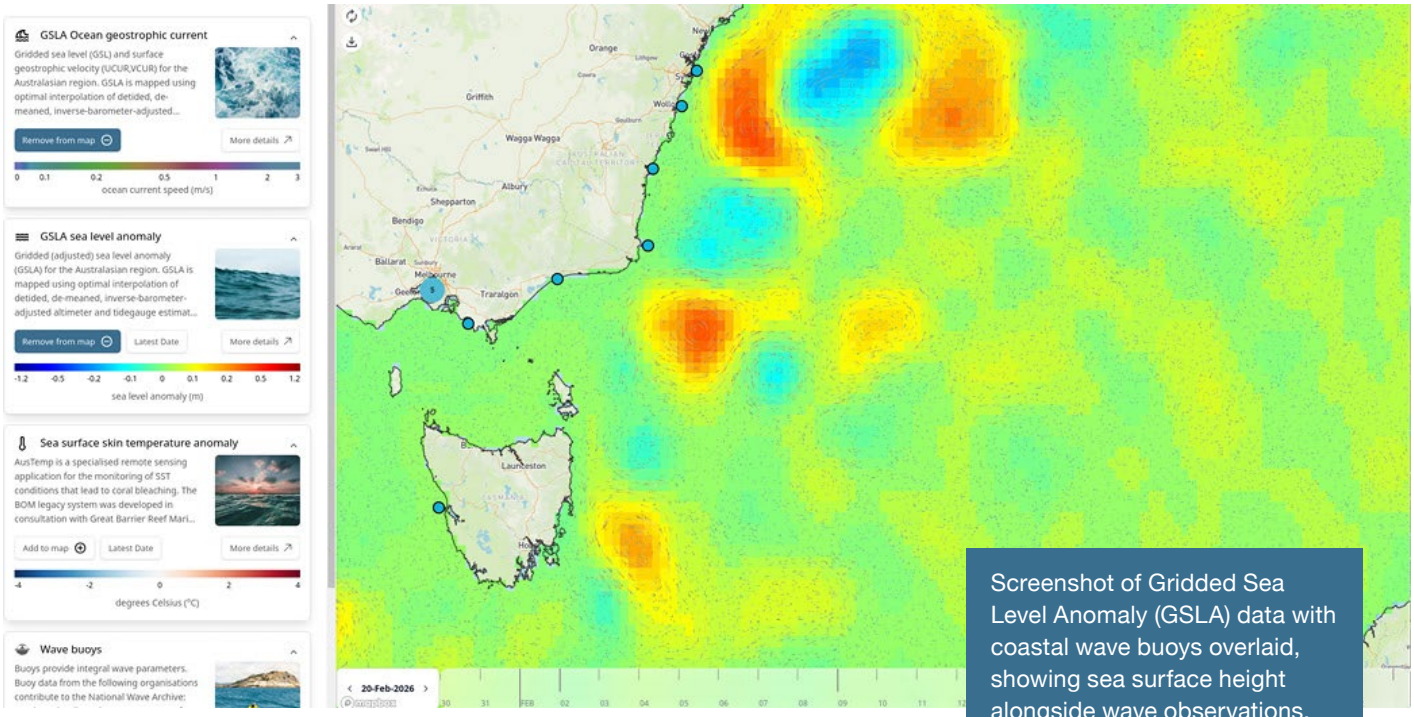
Parks Australia. These visualisations helped me to understand the relationship between the strength of the flows and the geomorphology of the reefs," said Eric Lawrey, Knowledge Systems Manager, Australian Institute of Marine Science.

As we move beyond the initial beta launch in mid-March, we intend to significantly expand the platform's capabilities. Future updates will include integrating additional data layers, such as AusTemp Degree Heating Days (DHD), and marine heatwave tracking indicators. We also plan to broaden our data reach by incorporating an expanded national array of wave buoys and additional data from the national mooring reference stations network.

These ongoing developments aim to provide a more comprehensive and accessible view of Australia's state of the ocean. We encourage all interested users to explore the platform during the beta phase and look forward to your feedback as we continue to refine this resource. ■



Screenshot of Sea Surface Temperature anomaly (SSTa) data with coastal wave buoys overlaid, showing temperature alongside wave observations.



Screenshot of Gridded Sea Level Anomaly (GSLA) data with coastal wave buoys overlaid, showing sea surface height alongside wave observations.

Australia launches National Marine Science Strategy 2026–2036 to secure a sustainable Blue Future

Australia's leading marine scientists, government agencies, and industry partners launched the National Marine Science Strategy 2026–2036 in March at Parliament House. The decade-long roadmap is designed to strengthen the nation's ocean science capability and support the sustainable growth of Australia's blue economy while delivering broader societal, environmental, and cultural benefits.

Developed through an extensive national consultation involving more than 500 experts from over 120 organisations, the Strategy sets out a coordinated vision for marine science investment, collaboration and innovation over the next ten years.

The Strategy comes at a critical time. Australia's oceans are undergoing rapid environmental and economic change, with climate impacts intensifying, new ocean industries emerging, and increasing pressures on marine ecosystems and coastal communities. At the same time, demand for ocean knowledge is growing across government, industry and society to support evidence-based decision-making.

The Strategy will guide national research priorities to help Australia respond to major challenges facing the ocean — including climate change, coastal hazards, biodiversity loss, and emerging maritime security threats — while enabling sustainable growth in marine industries and delivering benefits for communities, environmental stewardship, and national wellbeing.

Australia's blue economy contributed $203 billion to the national economy in 2023 and supported more than 700,000 jobs, spanning industries such as fisheries, aquaculture, shipping, tourism, offshore energy, and marine technology.

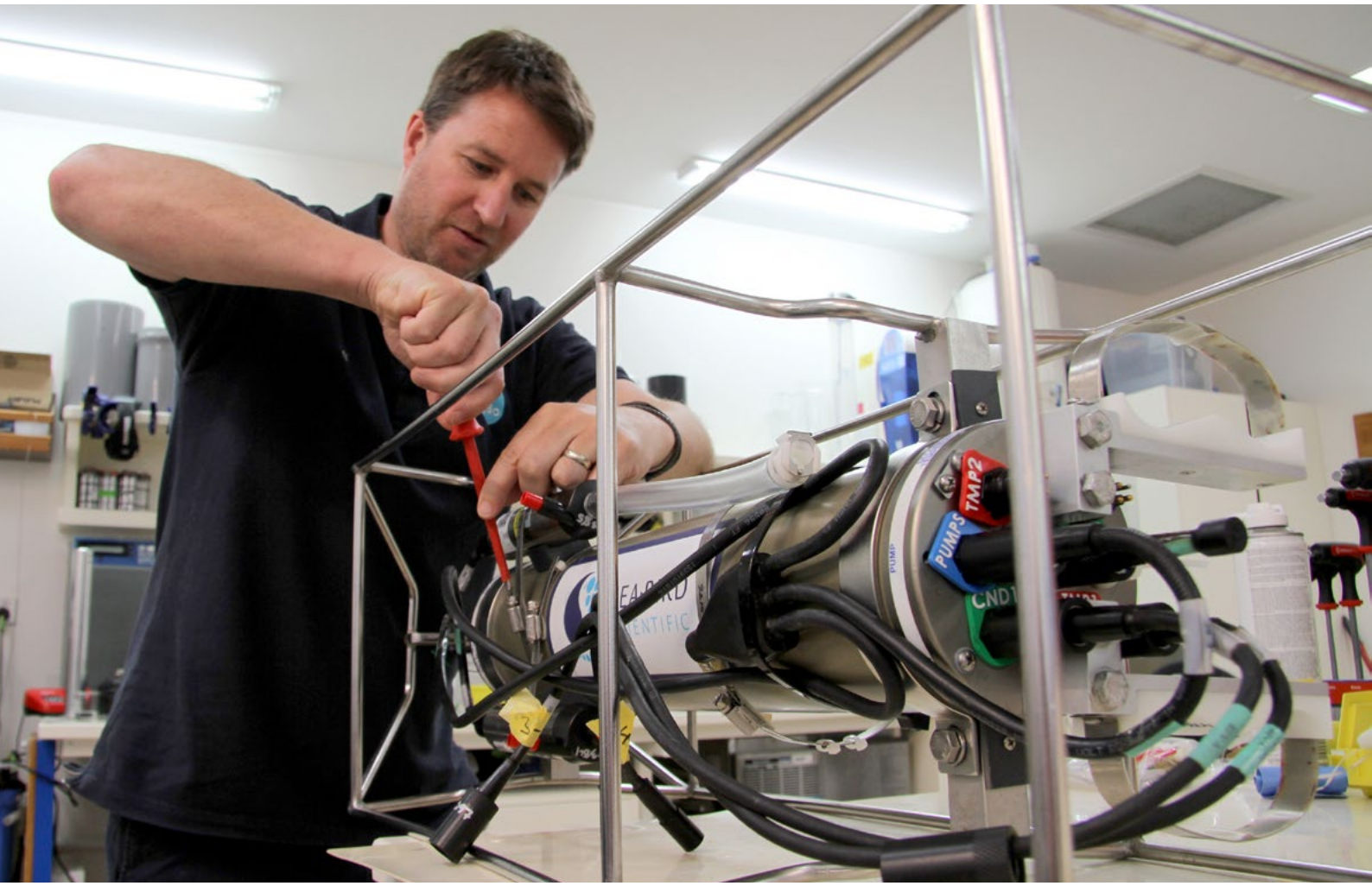
With 87% of Australians living near the coast and one of the largest marine jurisdictions in the world, the nation's prosperity, security, culture, and environmental future are deeply connected to the health and management of its oceans.

"This Strategy reflects a shared, nationally agreed view of where and how coordinated marine science effort can deliver the greatest impact over the coming decade," said Prof. John Gunn, chair of the National Marine Science Committee. ■

Senator the Hon Murray Watt, Minister for the Environment and Water at the Strategy launch.

> "This Strategy reflects a shared, nationally agreed view of where and how coordinated marine science effort can deliver the greatest impact over the coming decade.
>
> Prof. John Gunn, chair of the National Marine Science Committee

Oceanographic Calibration Facility achieves 10,000th instrument calibration



Matt Marrison, CSIRO

As IMOS entered its 20th anniversary year, the Oceanographic Calibration Facility operated by CSIRO, Australia's national science agency, also achieved a major milestone: the calibration of its 10,000th oceanographic instrument – the IMOS National Reference Station at Maria Island, Tasmania!

Based at the CSIRO Marine Laboratories in Hobart, Tasmania, the Oceanographic Calibration Facility (the 'Facility') is accredited by the National Association of Testing Authorities (NATA) to ISO 17025 standards. This is an international standard that sets the requirements for the competence, quality and reliability of testing and calibration laboratories.

Of note, it is the only facility accredited to this standard and able to deliver this extensive range of marine instrumentation calibrations in the southern hemisphere.

The Facility provides the specialised, controlled environment, measurement equipment, references traceable to international standards and expertise. Oceanographic instruments used by IMOS, CSIRO's Marine National Facility and other clients in Australia, New Zealand and regionally, are tested, calibrated and prepared for deployment; and also undergo post-deployment calibration to quantify the gradual change in sensitivity during deployments (called 'drift').

Sensors used by IMOS Facilities, including the National Reference Stations, and other long-term observing platforms pass through the Facility, ensuring they meet the highest standards before entering (or re-entering) the ocean observing system.

CSIRO's Kai van den Hoff, Manager of the Oceanographic Calibration Facility, said the Facility plays a critical role in ensuring the accuracy and reliability of oceanographic measurements that underpin marine science and climate data.

"Our process begins with the meticulous calibration of sensors and instruments used in ocean observations, including Conductivity-Temperature-Depth (CTD) sensors and other oceanographic equipment," Kai said.

"Each instrument undergoes rigorous verification against traceable standards to maintain compliance with ISO/IEC 17025, ensuring global confidence in the data produced."

Calibration of each instrument involves several key steps:

- **Instrument Receipt and Inspection:** Verifying identification, condition, and documentation.

- **Reference Standard Comparison:** Using certified standards to adjust and validate instrument readings.
- **Uncertainty Analysis:** Calculating and documenting measurement uncertainty for transparency and scientific integrity.
- **Certification and Documentation:** Issuing calibration certificates that confirm traceability to standards, and further analysis of instrumentation performance.

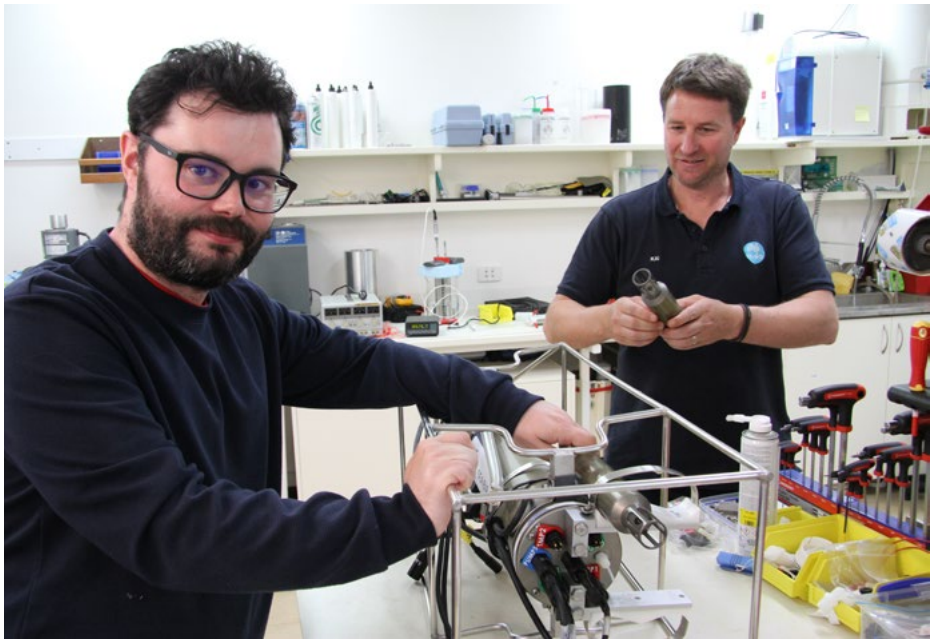
Why accuracy is important

Accurate oceanographic data is essential for understanding climate, ocean circulation, and marine ecosystems. Even tiny errors in salinity or temperature measurements can lead to significant inaccuracies in climate models and resource management decisions.

By maintaining a world-class calibration facility in Hobart, we support Australia's leadership in marine science and ensure that data collected from our oceans meets the highest standards of precision and reliability.

Reaching the 10,000th instrument mark highlights Australia's sustained investment in reliable, long-term marine research infrastructure. A key part of this infrastructure is the centralised calibration of IMOS instruments at CSIRO Marine Laboratories in Hobart, using common procedures, and internationally recognised references. This ensures ocean measurements collected around the country, from northern Australia to the Southern Ocean, are consistent and comparable over time and with measurements made by researchers in all other nations.

This centralised approach strengthens the scientific value of long-term IMOS datasets and underpins the continuity and reliability of the National Reference Stations, which track changes in marine ecosystems, climate and biogeochemical processes over periods of decades.



Dearna Bond, CSIRO

"One of IMOS's greatest strengths is being a trusted provider of accurate, high-quality data. The CSIRO Oceanographic Calibration Facility team is critical to ensuring the accuracy of oceanographic measurements that underpin the many applications of these data. We are lucky to have this capability in Australia," said Michelle Heupel, IMOS Executive Director.

A national calibration service supporting real-world decision-making

The Facility calibrates Conductivity–Temperature–Depth (CTD) instruments along with dissolved oxygen, optical, turbidity and other oceanographic sensors from a wide range of manufacturers. A full calibration typically takes one week, and each instrument is returned with a comprehensive calibration report.

Conductivity, temperature and pressure sensors are the primary tools used by scientists to measure ocean conditions and are calibrated to extraordinary accuracy in the Calibration Facility – temperature calibration is typically within 0.0015°C, for example. Precision measurements of ocean physics are critical to understanding how both coastal environments and deep ocean systems are changing over short, medium and long time-scales.

Supporting Australia's understanding of a changing ocean

The high-quality calibrated data collected by these instruments have direct impacts on society. They are used to:

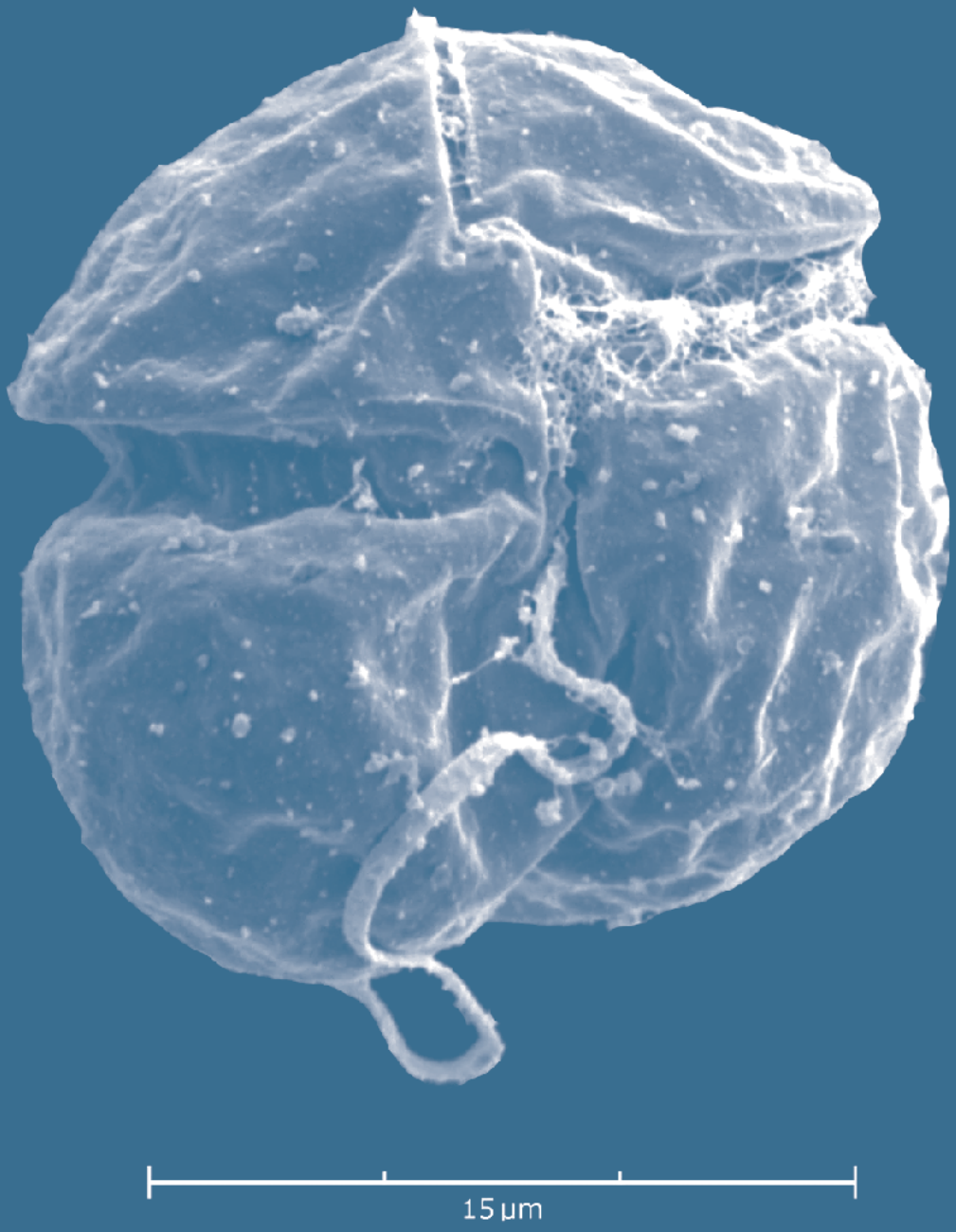
- monitor marine heatwaves and long-term ocean warming
- support fisheries and aquaculture planning
- inform marine park and coastal zone management
- improve weather and climate prediction
- detect ecosystem and water-quality changes.

As IMOS marks 20 years of observing Australia's changing oceans, the calibration of the Facility's 10,000th instrument represents a significant scientific and national capability milestone, celebrating the people, infrastructure and partnerships that ensure Australia continues to measure its oceans with world-leading accuracy. ■

> "Each instrument undergoes rigorous verification against traceable standards to maintain compliance with ISO/IEC 17025, ensuring global confidence in the data produced.
>
> Kai van den Hoff, CSIRO

Researchers find harmful algae species wasn't new to South Australian waters

Going back through archived DNA from water samples, scientists have found that the species chiefly responsible for South Australia's persistent harmful algal bloom has been present for at least a decade.



A scanning electron microscope image of *K. cristata*.

The coastline of South Australia has been affected for nearly a year by an unprecedented harmful algal bloom which has led to the deaths of millions of fish and sharks, impacted marine mammals and birds and affected the health of some people.

The origins of this event remain the topic of intense discussion and investigation among both the public and scientific community.

New collaborative research involving the University of Technology Sydney (UTS), the South Australian Research and Development Institute (SARDI), CSIRO, Australia's national science agency, and the Integrated Marine Observing System (IMOS) has revealed the species of algae dominating this bloom has long been a natural resident in South Australian waters.

During 2025, *Karenia cristata* was identified as one of the main species dominating the bloom and releasing a biotoxin called brevetoxin. It is a species not previously known to cause such significant impacts on marine ecosystems and had been only recorded twice before anywhere in the world.

According to UTS's Professor Shauna Murray, who first identified this species as the culprit producing brevetoxins in Australian waters, "We isolated *Karenia cristata* cells and grew them in our laboratory and then used a series of molecular genetic methods to identify and quantify them in South Australian waters since March 2025. We found *K. cristata* cells were producing high levels of brevetoxins, which hadn't been known before."

"There are multiple ecological factors influencing the growth of *K. cristata*, beyond oceanographic conditions. It might be some time before we untangle all of them," Professor Shauna Murray.

The sudden emergence of *K. cristata* and its unprecedented impacts have raised concerns and debate among the public about where it has come from. Now, by using archived DNA retrieved from seawater samples collected during the past decade by IMOS and managed by CSIRO, the research team has shown that the harmful species has had regular, albeit low levels of presence in South Australian waters since sampling began in 2016, but that during 2025 there was a massive increase in its abundance.

Professor Justin Seymour, who leads the Ocean Microbiology Group within the Climate Change Cluster at UTS, said, "After helping to identify the species dominating the bloom, we were next keen to work out its origins in an effort to understand why it has apparently appeared all of a sudden with such devastating impacts."

The research team took advantage of a library of archived DNA samples that had been collected near Kangaroo Island as part of the IMOS Marine Microbiome Initiative, which has been using genomic techniques to characterise the microbiology of marine environments around the Australian continent for more than 10 years.

CSIRO researcher and leader of the IMOS Marine Microbiome Initiative Dr Jodie van de Kamp said, "A fundamental part of our program is the long-term storage of DNA samples. This enabled us to go back and analyse this extensive, decade-long collection, providing a window into past conditions and increasing our understanding of the current algal blooms in South Australia. We don't always know which rare members of the microbiome may one day become problematic, nor do we always have the tools to measure them. The value of these archived DNA samples and the important role of the IMOS Marine Microbiome program is that it provides vital insights for understanding current conditions and managing future challenges."

When analysed using new approaches developed to identify *K. cristata*, it was found that this harmful algal species was always present during the entire period that samples have been collected in South Australian waters.

"However, in 2025 something happened in the environment that made it dramatically increase in abundance. Finding out what caused this increase is our next objective," said Professor Seymour.

Researchers at SARDI are now linking this historical data with measurements of ocean conditions in an attempt to tease out the processes leading to its increased occurrence, using a forensic oceanographic approach.

Associate Professor Mark Doubell, Oceanography Subprogram Leader at SARDI, is leading this effort. "Understanding the environmental conditions and locations associated with the presence of these harmful algae will provide critical capacity for early identification, tracking and the forecasting of blooms," he said.

Professor Murray said pinning down the causes of this devastating event is likely to be very complex. "There are multiple ecological factors influencing the growth of *K. cristata*, beyond oceanographic conditions. It might be some time before we untangle all of them. This first step in finding *K. cristata* in samples from a number of years ago is important, and we are now finalising the analysis of these data to submit them for peer review."

This work has nonetheless solved one of the mysteries surrounding the South Australian harmful algal bloom, the Executive Director of IMOS, Dr Michelle Heupel said. "The challenges facing Australia's oceans are immense. IMOS delivers sustained ocean observations that underpin the collaborative research crucial for understanding events such as the harmful algal bloom in South Australia and assist with forecasting of similar events and their impacts on marine ecosystems."

This story was originally published by University of Technology Sydney. ■

> "The value of these archived DNA samples and the important role of the IMOS Marine Microbiome program is that it provides vital insights for understanding current conditions and managing future challenges.
>
> Dr Jodie van de Kamp

Lost Wilsons Promontory Wave Buoy Completes Extraordinary Tasman Voyage, Inspires Cross-border Ocean Science Engagement

Written by Daniel Ierodiaconou

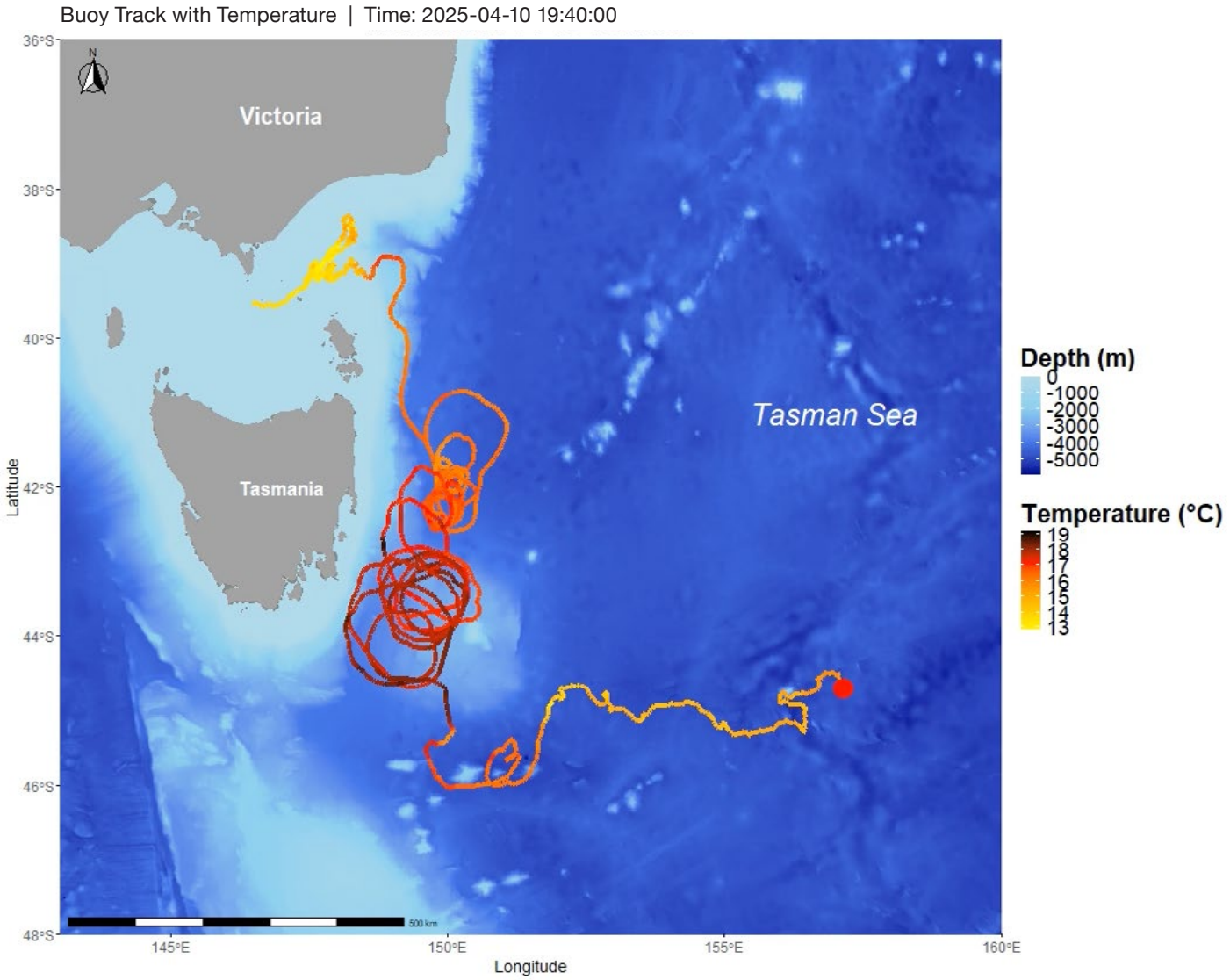
A wave buoy deployed off Wilsons Promontory as part of Australia's Integrated Marine Observing System (IMOS) Coastal Wave Buoys Facility has achieved an unexpected journey across the Tasman Sea—and sparked a unique classroom connection between coastal scientists and school-kids at Halfmoon Bay School on Stewart Island, New Zealand.

The Sofar Spotter wave buoy, deployed as part of the near-shore coastal observing infrastructure operated by IMOS Coastal Wave Buoys Facility, supported by Deakin University in Victoria, was located 45km south of the most southern point of mainland Australia off Wilsons Promontory.

The wave buoy broke free from its moorings in late 2024 after a significant storm event. Once offshore, the buoy became caught in one of the large anticyclonic eddies that spin off the East Australian Current (EAC)—part of the powerful system of gyres that circulate warm water through the Tasman Sea. Despite multiple retrieval attempts, the sensor unit exited Bass Strait via the Bass Canyon entering the EAC and its GPS track was captured in imagery showing a voyage down the current and then eastwards across the Tasman until growth on its solar panel depleted its battery levels and communication was lost.

Following months of silence, the buoy re-established communication and transmitted data and location again in October 2025—on the shores of Stewart Island, south of New Zealand. (>3000 km from was originally deployed).

"The remarkable journey of the Wilsons Promontory wave buoy highlights the versatility of these sensors. They can collect critical ocean data whether anchored or drifting. Strong westerly winds and harsh Southern Ocean weather



likely carried the buoy south of New Zealand—an area known for some of the largest waves ever recorded in the Southern Ocean," said Dr Salman Khan (CSIRO), leader of IMOS Satellite Remote Sensing Surface Waves sub-Facility.

Within 24 hours a local fisher Ty Jenkinson volunteered to recover the device. The buoy then made its way to Halfmoon Bay School where a class dialled in to Deakin Marine facilities at the Warrnambool Campus where students went on a virtual tour, before guiding them to open the wave buoy and turn off the unit.

"Our students were super excited to hear about the journey the wave buoy went on, and how it was brought back to Halfmoon Bay by one of our student's dad, who is also a fisherman," said Alison Fitzsimons, Junior Room Teacher at Halfmoon Bay School/ Te Kura o Rakiura.

"It's a wonderful reminder that ocean science connects people across vast distances," said Professor Daniel Ierodiaconou, Lead Scientist for CoastRI. "From Wilsons Promontory to Stewart Island, this buoy has shown how the ocean links our two nations – not just physically, but through curiosity and collaboration."

This serendipitous journey also highlights the broader national initiative led by IMOS. The IMOS Coastal Wave Buoys Facility has deployed 23 new buoys around Australia, complemented by 37 partner-deployed units, creating a coast-spanning network of near-real-time wave and sea-surface temperature data. "While the IMOS Coastal Wave Buoy Facility focuses on sustained observations from moored wave buoys, this unexpected dataset highlights the potential application for drifting wave buoys, "said the Facility lead Dr Mike Cuttler from the University of Western Australia.

"IMOS Coastal Wave Buoys, a key investment of the CoastRI initiative, is enabling unprecedented access to high-quality data that's essential for forecasting hazards, guiding sustainable development, and protecting the ecosystems and communities that depend on our dynamic coastal zone," said Professor Daniel Ierodiaconou.

The Wilsons Promontory buoy is one of several operated within the IMOS Coastal Wave Buoys Facility that has developed a public facing page at https://auswaves.org, which collates national wave-buoy data and presents it in a user-friendly portal for researchers, planners, industry and the community.

IMOS and CoastRI are enabled by the National Collaborative Research Infrastructure Strategy (NCRIS). ■

Students opening the wave buoy to turn off the unit.

Halfmoon Bay students with the recovered wave buoy.

Tracking sea-level rise: IMOS delivers critical satellite validation

The sea level climate data record derived from satellite altimetry underpins how we understand the ocean and its response to a changing climate. By capturing measurements of waves, tides, circulation and long-term sea level trends, this record provides critical evidence for science, policy and decision-making. Ensuring its accuracy through rigorous calibration and validation is essential, forming a fundamental component of global satellite mission design and delivering confidence to users.

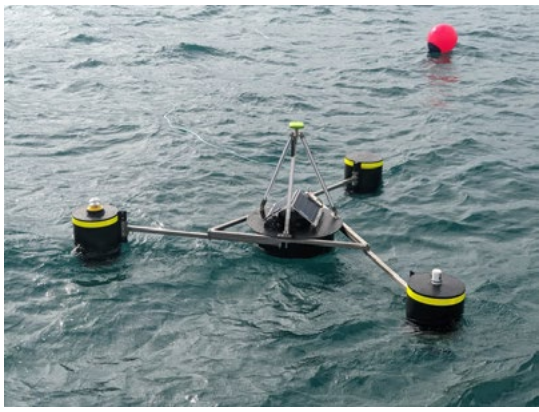
Australia relies on satellite altimeter missions operated by international partners, including NASA, NOAA, CNES, EUMETSAT and ESA. The IMOS Satellite Altimeter Calibration and Validation sub-Facility plays a critical national role by delivering 'absolute calibration' of these satellite measurements directly to mission agencies. Since its inception, the facility has supported a succession of landmark missions, including TOPEX-Poseidon, the Jason series, Sentinel-3A and 3B, and Sentinel-6 Michael Freilich.

Ongoing innovation has seen the Facility expand its reach into the Southern Ocean, enabling validation of wave measurements from newer missions such as CFOSAT. More recently, it was temporarily enhanced to support the transformative SWOT mission, and is now focused on Sentinel-6B, the latest addition to the global altimetry constellation.

"Internationally recognised, the IMOS Satellite Altimetry Calibration and Validation sub-Facility has been continuously selected to contribute to science and validation teams led by global mission agencies. Its work has helped validate the satellite-derived sea level climate record to sub-centimetre precision, providing a robust foundation for understanding sea-level rise and its acceleration over the past three decades," said Associate Professor Christopher Watson, Facility Leader.

At the core of this capability is a long-term in situ observing system, including moored measurements of bottom pressure, temperature, salinity and ocean currents, alongside surface observations from GNSS-equipped buoys. These complementary datasets not only enable high-precision satellite validation, but are also openly available and widely used, from supporting fisheries and offshore industries to advancing oceanographic research in regions such as Bass Strait.

To date, Satellite Altimetry Calibration and Validation data has been used to produce **139** publications, **37** projects, **53** policy documents and **87** presentations. ■



Christopher Watson, UTAS

CSIRO ocean sensor deployment technicians ready the Jason II mooring for redeployment, Storm Bay, Tasmania.

Carlie Devine, CSIRO

From field collection to IMOS integration: Near-real-time marine imagery workflows in IMOS Understanding of Marine Imagery Squidle+ platform.

Written by Emma Flukes and Lizzie Oh

During a recent Institute for Marine and Antarctic Studies (IMAS) undergraduate field trip to Maria Island, Tasmania, students learnt diver based benthic survey methods based on the *Reef Life Survey* protocol, a component of the IMOS National Reef Monitoring Network Facility.

Seafloor imagery was collected systematically along 50 metre transects and organised each evening into a standardised format for ingestion by Squidle+, the collaborative marine imagery platform that underpins the IMOS Understanding of Marine Imagery Facility. Imagery and associated metadata were uploaded from the field each night using satellite internet connectivity, enabling ingestion and availability for annotation within Squidle+ by the following day.

This workflow established a near-real-time connection between field data acquisition and analysis. During afternoons on the island, students learnt major habitat species by examining samples collected during the morning and matching them to exemplar image catalogues generated from pre-existing image labels in Squidle+. Students then annotated the imagery in Squidle+ using a Reef Life Survey classification scheme, generating structured, standards-aligned scientific observations.

Through Squidle+'s semantic translation capability, students were also able to examine how these annotations mapped to alternative classification frameworks. This experience provided students with the opportunity to see how field observations are transformed into interoperable scientific data within a structured marine observing system.

From an infrastructure and data integration perspective, this activity demonstrated the effectiveness of the IMOS Understanding of Marine Imagery Facility in enabling efficient transfer, ingestion, and management of marine imagery, even from remote locations.

From a teaching perspective, the workflow provided students with practical experience across the full data lifecycle – from acquisition through to annotation and integration within national and international observing infrastructure. This exposure supports the development of core skills in marine data collection, standardisation and analysis, and demonstrates how locally collected observations can contribute to broader, coordinated marine observing efforts. ■

Students uploading and annotating the imagery.

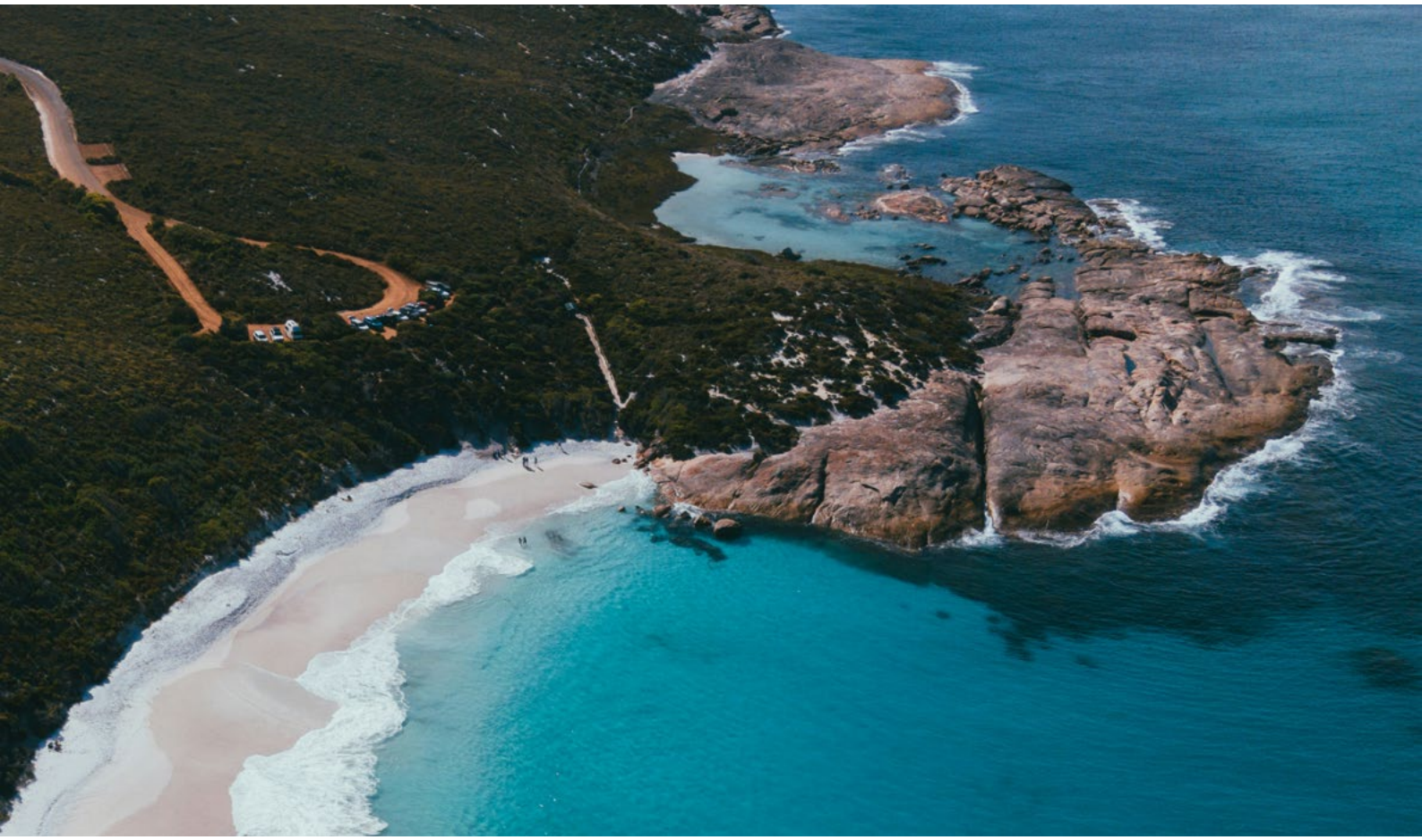
Tallulah McElduff

Students examining samples collected during the morning and matching them to exemplar image catalogues.

Survey sites.

Students diving at Maria Island, Tasmania.

Making marine environmental data more assessment-ready



Australia's marine research system generates vast volumes of high-quality data, held across national institutions and programs. However, these datasets are not always readily usable for applications such as State of the Environment reporting, environmental approvals or economic accounting. This creates inefficiencies and limits timely, informed decision-making.

A project developed as part of the IMOS Data Uplift program and supported by the National Environmental Science Program Marine and Coastal Hub (NESP MaC Project 5.9), is addressing this challenge by developing new tools that transform complex datasets into consistent, accessible, 'assessment-ready' products. These data pipelines streamline the path from observation to application, supporting reporting, planning and policy.

This project draws on datasets from multiple repositories, which are harmonised, integrated and quality-controlled before being made publicly accessible through the IMOS AODN. Additional processing, including aggregation and formatting, ensures the data can be readily used in environmental assessment and decision-making contexts.

Importantly, the project does not create new data. Instead, it enhances how existing datasets are organised and delivered, aligning them to common standards, linking them to national systems, and providing them in efficient, cloud-optimised formats.

A key focus of the project was identifying datasets that would deliver the greatest value for environmental decision-making. Through a national workshop with government, research and industry partners, priority datasets were selected based on their relevance and readiness for development within the project timeframe.

"These datasets were chosen because they cover the main areas needed for marine assessment, including habitats, species and pressures. As the datasets are built within the national data infrastructure, they are automatically updated as new data becomes available. This ensures that these products remain relevant for future reporting cycles and ongoing management needs," said Eduardo Klein-Salas, IMOS Project Leader.

The final selection of six datasets spans critical components of the marine environment, including habitats, species and human pressures. These include a national seagrass dataset, seabird observations, kelp observations, reef benthic surveys, dugong aerial surveys, and vessel tracking data, together providing a strong foundation for assessment and reporting across Australia's coasts and oceans. ■

From surface to seafloor: sustaining the longest deep-ocean time series in the Southern Ocean

Loading the first SOFS buoy onto the Marine National Facility *Southern Surveyor* in 2010.

Rob Wiltshire

IMOS provides a crucial baseline to track climate change with moorings in the remote and extreme environment of the Southern Ocean.

The IMOS Southern Ocean Time Series (SOTS) observatory moorings are deployed approximately 500 kilometres southwest of Tasmania in the sub-Antarctic Zone (140°E, 47°S), one of the most remote and storm-lashed regions on Earth. This critical observatory provides year-round, high-frequency data in a region responsible for ~40% of the total global ocean uptake of human-induced CO_2 emissions, and 75% of the additional heat that these emissions have trapped on Earth.

The Southern Ocean Time Series observatory comprises two deep-water moorings: the Southern Ocean Flux Station (SOFS), which focuses on heat, oxygen, and CO_2 fluxes across the air–sea interface as well as the physical conditions and biological processes that control them, and the Subantarctic Zone (SAZ) sediment trap mooring, which focuses on quantifying the transfer of carbon to the ocean interior by sinking particles, providing samples for ecological, palaeo-proxy, and carbon flux estimates.

The Southern Ocean Time Series observatory provides crucial data in this under-sampled region to monitor for climate change, ocean acidification, and biological carbon cycling.

The SOTS programme is part of the OceanSITES global network of fixed time-series stations and contributes data to the Global Carbon Project and the Surface Ocean Carbon Atlas (SOCAT).

IMOS can only deploy these moorings in this remote location through a collaboration with Australia's national science agency, CSIRO, the Bureau of Meteorology, and the Australian Antarctic Program Partnership.

Each year the team travel south on CSIRO research vessel (RV) *Investigator* to retrieve the deep water mooring after deploying a replacement — a complicated task that, in rough conditions, is no easy feat.

Dr Elizabeth Shadwick, IMOS Facility Leader and CSIRO Principal Research Scientist, describes the SOFS mooring as an observatory which is anchored to the seafloor.

"There is an anchor made up of a stack of train wheels, which weighs about 3000 kilograms, and then lots of line which runs to the surface. A big float, that's about the size of a car, sits on the ocean surface and is heavily instrumented with sensors, which allow us to make measurements of the atmosphere as well as the ocean. Under that is wire which contains a further set of instruments that allow us to observe the properties of the subsurface ocean."

To date, Southern Ocean Time Series data has been used to produce **306** publications, **27** projects, **46** policy documents and **49** presentations. Two recent papers highlight the importance of sustained observations at the site.

Dr Shadwick is the lead author on a paper that used observations collected at the SOTS site between 1997 and 2022, to present the seasonal variability in upper-ocean hydrography, biogeochemistry, phytoplankton and microplankton community composition, and diversity, along with particulate organic and particulate inorganic carbon export to the deep ocean.

This climatological view of the region is complemented by a review of recent findings underpinned by observations collected by the SOTS observatory and highlighting the ongoing need for long time series to better understand the Subantarctic Ocean and its response to a changing climate.

The paper concluded that by continuing the observational records acquired at the SOTS site, the progress of ocean acidification, deoxygenation, and availability of iron and other nutrients as inputs to broader assessments of expected changes in marine ecosystems can be made. Improved understanding of the mechanisms controlling heat and carbon uptake by the ocean will be used to improve their representation in models and forecasts, which are the tools needed to provide advice about climate variability and its likely future impacts on biogeochemical cycles and marine ecosystems.

Dr Haifeng Zhang and Dr Eric Schulz, researchers at the Bureau of Meteorology, have also published a paper that examines over 13 years of data from 12 Southern Ocean Flux Station (SOFS) mooring deployments to explore the characteristics and temporal climatology of air–sea heat flux in the Southern Ocean.

Over the study period, the average annual net heat flux at the SOFS site is -14.6 ± 5.4 W m^{-2} – a net ocean heat gain. This is the first estimate of the net heat exchange at a Southern Ocean site that is based on a multi-year record of high-quality measurements, offering direct evidence of the ocean region's absorption of heat.

Additionally, a case study highlights a strong horizontal sea surface temperature gradient (3.4°C over 35.5 km) that resulted in a significant net heat flux difference of up to 242.5 W m^{-2}, which showed that the environmental conditions in this region may shift dramatically over short temporal or spatial scales.

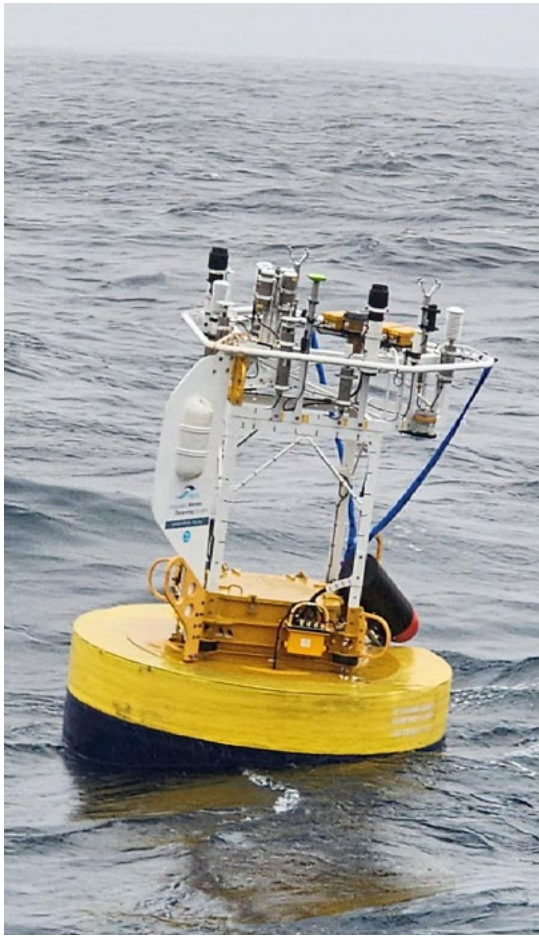
IMOS has sustained the longest time series of Southern Ocean observations operated by any nation, contributing to the global effort to understand ocean dynamics and their role in climate and responses to anthropogenic emissions.

The IMOS Southern Ocean Time Series is supported by multi-year grants of sea time on RV Investigator from the CSIRO Marine National Facility.

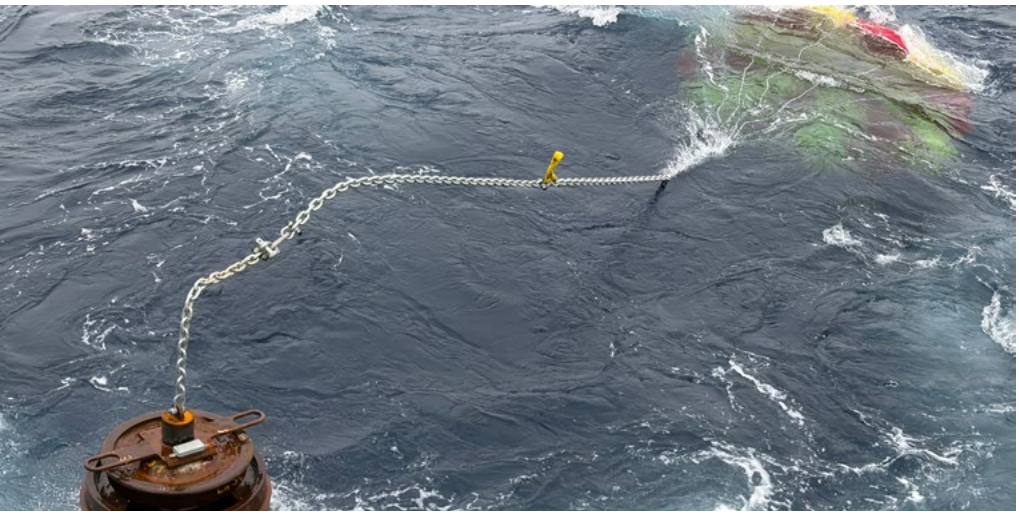
The CSIRO Marine National Facility is supported by the National Collaborative Research Infrastructure Strategy (NCRIS). ■

Ruth Eriksen, CSIRO

Dr Elizabeth Shadwick with the SOFS mooring before the recent deployment voyage.



Rod Palmer, CSIRO



Tim Lane, CSIRO

SAZ sediment trap mooring anchor and parachute.

Deirdre Hanrahan-Tan

Institute for Marine and Antarctic Studies (IMAS), University of Tasmania

Genomics of Southern Ocean Carbon Pump

The Southern Ocean is a key basin regulating global climate with intrinsic links to nutrient availability and global transfer via mechanisms of the Biological Carbon Pump and the Antarctic Circumpolar Current. It is becoming ever more pertinent to consider ocean microbiomes to better understand complex biogeochemical pathways.

This postgraduate project aims to address questions regarding microbial contributions to the Biological Carbon Pump (carbon export and remineralization) in the Southern Ocean. This will be achieved through Illumina metagenomic sequencing of Environmental DNA (eDNA) from organic material captured in sediment trap samples from the IMOS Sub-Antarctic Zone (SAZ) mooring. The SAZ sediment trap mooring is deployed as part of the IMOS Southern Ocean Time Series (SOTS) observatory.

Bacteria, Archaea and Eukarya kingdoms including Protista and Fungi will be targeted to provide a holistic profile of the particle-associated community at depth. By leveraging the unique SOTS archive, this project will contribute a critical dataset currently absent from global surveys (Boeuf et al. 2019, Preston et al. 2020, Cardozo-Mino et al. 2023, Faure et al. 2026).

It is expected that ocean biogeochemistry will influence the broader community composition, limiting some taxa while having negligible effects on others (Shadwick et al. 2024, Latour et al. 2024). Conversely, key microbial groups – diatoms, coccolithophores, N2-fixing cyanobacteria, and picocyanobacteria – are known to influence marine biogeochemical cycles (Boyd et al. 2010).

Biological factors including community interactions (symbiotic, pathogenic), and trophic cycling adds complexity, leading to distinct microbial communities (Sow et al. 2022). Focus on climate events such as heatwaves, or more gradual changes in seasonal flux events may be interesting focal points to observe if microbial populations are impacted. If so, could these population shifts be proxies for future scenarios? Gaining a picture of microbial changes across depth strata and temporal scales in parallel with biogeochemical pathways is paramount and may provide insight to interannual flux variability of organic carbon in one of the most important and productive global oceans.

Close-up of McLane Sediment Trap collection cups post recovery.

SAZ McLane Sediment Trap assembly prior to deployment.

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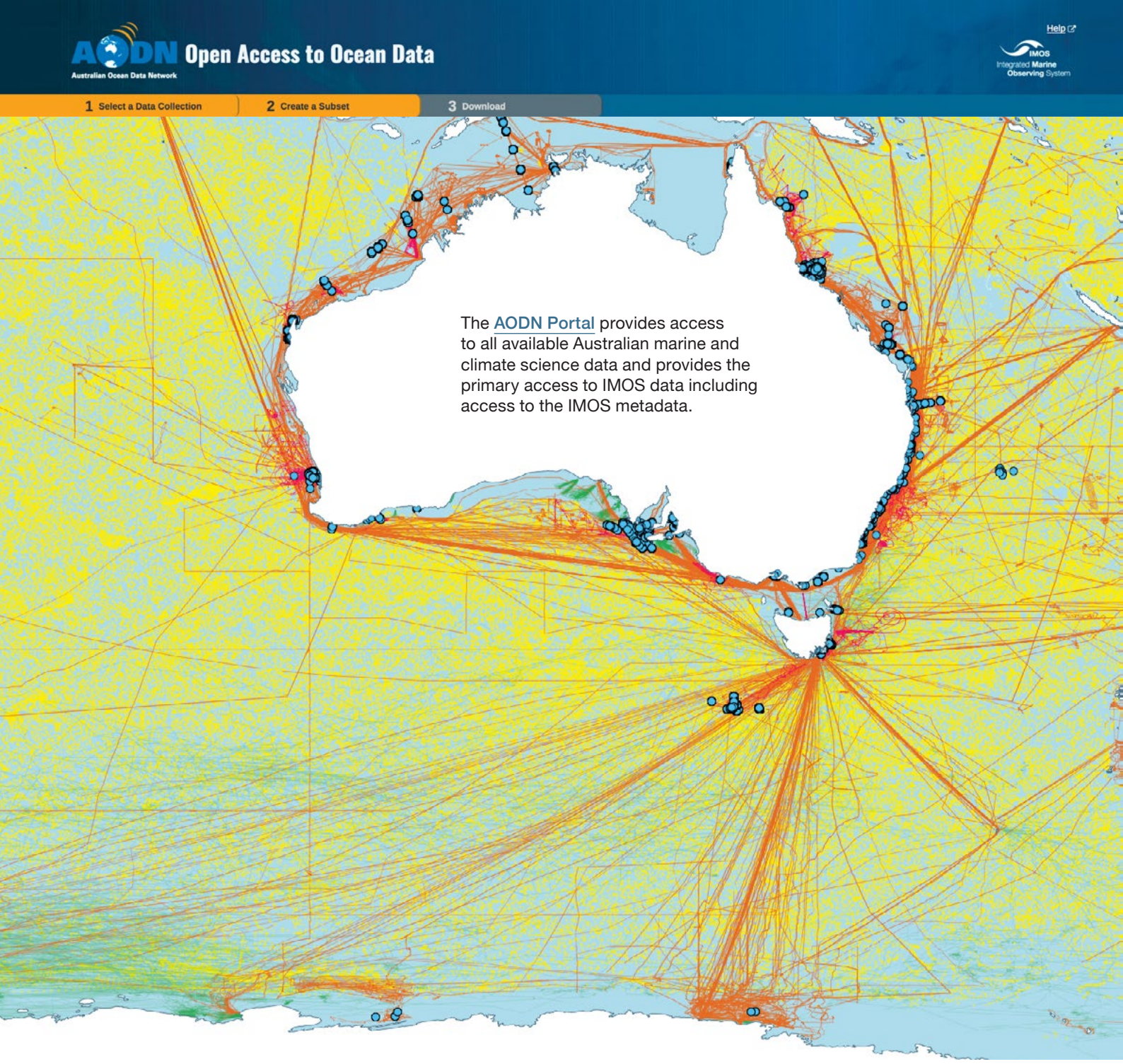

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For more information about IMOS please visit the website www.imos.org.au