IMOS

Integrated **Marine Observing** System

2022–2023 HIGHLIGHTS

Enabling research that delivers benefits across Australian society, its environment, and its economy.

Director's Overview

In 2023 the Integrated Marine Observing System (IMOS) celebrates its 17th year of operation and the amazing milestone of having collected and delivered one billion ocean measurements! This is a huge achievement and a tangible demonstration of what IMOS delivers for Australia and the world.

IMOS
Integrated **Marine Observing** System

Photo: Yasha Hetzel, the University of Western Australia

As you'll see in this year's highlights, IMOS has made significant contributions to education and research in Australia with almost every research university in the country having published using IMOS data. This use speaks to the reach and applicability of ocean observations and IMOS data.

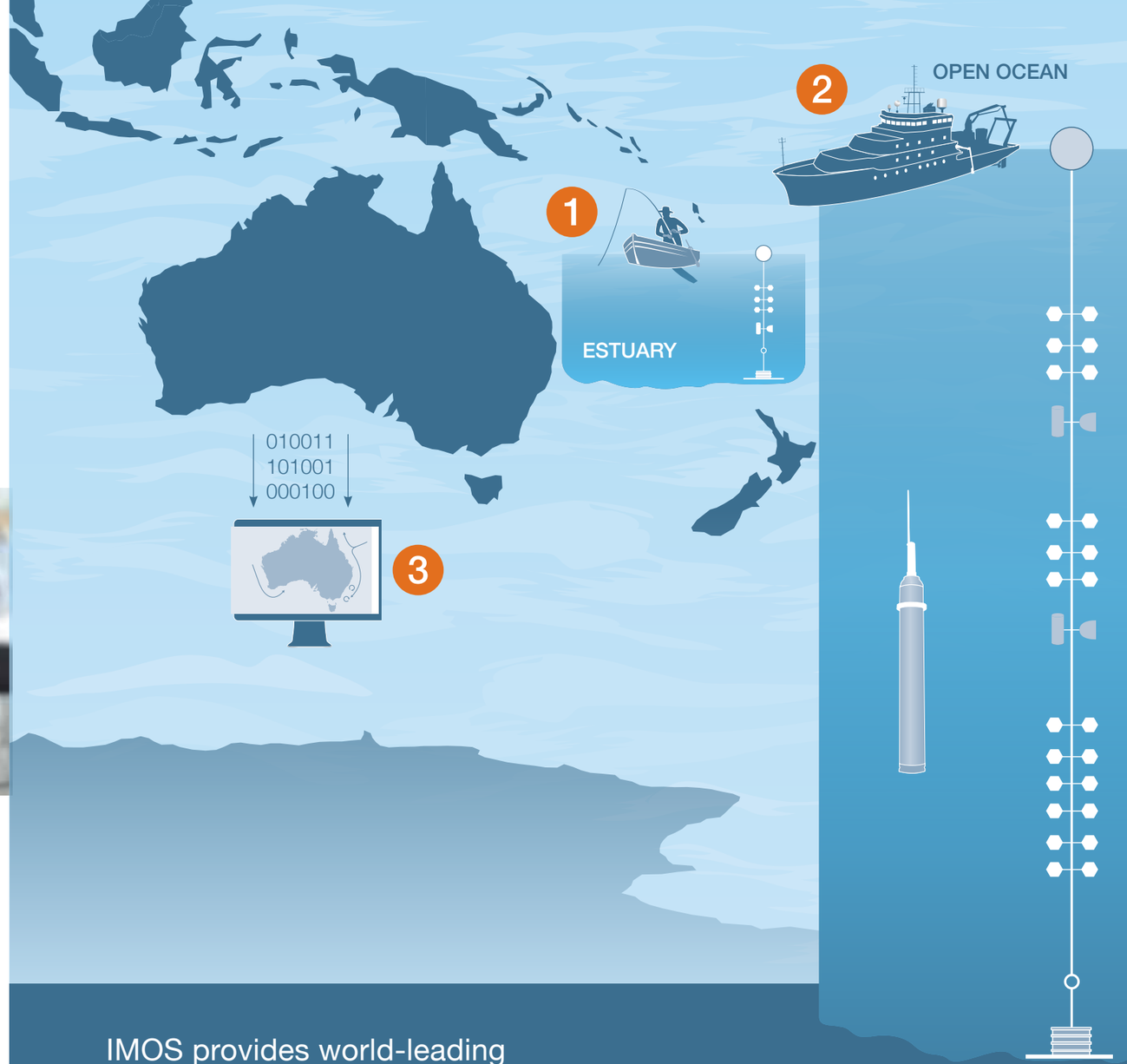
This year also included a range of firsts and significant accomplishments. IMOS is delivering a ground-breaking Data Management System (DMS) to underpin the Reef 2050 Integrated and Reporting Program (RIMReP) for the Great Barrier Reef. The DMS will combine ocean observations with socio-economic data and Traditional Ecological Knowledge to produce a unique platform for holistic perspectives and decisions. Data integration is also at the forefront of the Biological Ocean Observer platform which combines physical and biological data to help users more easily address complex ecological questions. Data collections of wind and wave data have also provided centralised data to support a range of models and analyses within and beyond Australia.

IMOS observing capabilities have also gone from strength to strength in 2022–2023 through new partnerships with fishers and Fisheries Research and Development Corporation (FRDC) to collect water temperature data from fishing equipment. This partnership fills an important data gap in nearshore regions while providing valuable information to fishing operations. IMOS Ocean Gliders and the Ningaloo Radar have helped capture rare events and provide critical data in under-observed areas, while the Satellite Calibration and Validation Facility is providing crucial underpinning for the new NASA Surface Water Ocean Topography (SWOT) satellite mission. The Animal Tracking Facility expanded into Queensland creating an extensive collaborative network providing critical data to inform state resource management. These activities could not be delivered without support and coordination from IMOS.

IMOS also facilitated a unique set of observations via Lisa Blair's world record solo sail around Antarctica. As Lisa sailed she collected microplastic samples which revealed plastics were present in even the most remote ocean locations. This data set will serve as a critical baseline for the future as we work to eliminate plastic pollution.

These are only a few of the many amazing achievements within IMOS and as always, I extend sincere thanks to thank all of our partners, collaborators and supporters who help make IMOS successful. The success of IMOS is based on your efforts and contributions. I hope you enjoy our highlights from this year and I look forward to what we can collectively achieve as we move into the new phase of NCRIS funding.

Michelle Heupel
IMOS Director



IMOS provides world-leading environment and climate research infrastructure, able to respond and adapt to address challenges.

As IMOS grows and evolves it will

1. Observe from the open ocean into estuaries
2. Collect data from the tropics to Antarctica
3. Convert data into information

IMOS Integrated **Marine Observing** System

IMOS HIGHLIGHTS **2022–2023**

National data asset of in-situ wave observations

This IMOS-led project, supported by the ARDC, has created an enhanced national data asset of Australian in-situ wave observations from Commonwealth agencies, state agencies, universities and private industries. Wave dynamics are critical for operational efficiency and navigational safety in marine industries such as fisheries, shipping, and offshore operations, coastal development and leisure activities.

Ocean radar monitoring the Ningaloo Current

The cooler waters of the Ningaloo Current flowing northward along the shelf have spared Ningaloo Reef from damaging coral bleaching events despite the last three years of La Niña conditions elevating water temperatures. The IMOS ocean radar at Ningaloo has proven to be a valuable new tool for monitoring and understanding the influence of the Ningaloo Current in this important region.

New way to visualise IMOS biological data

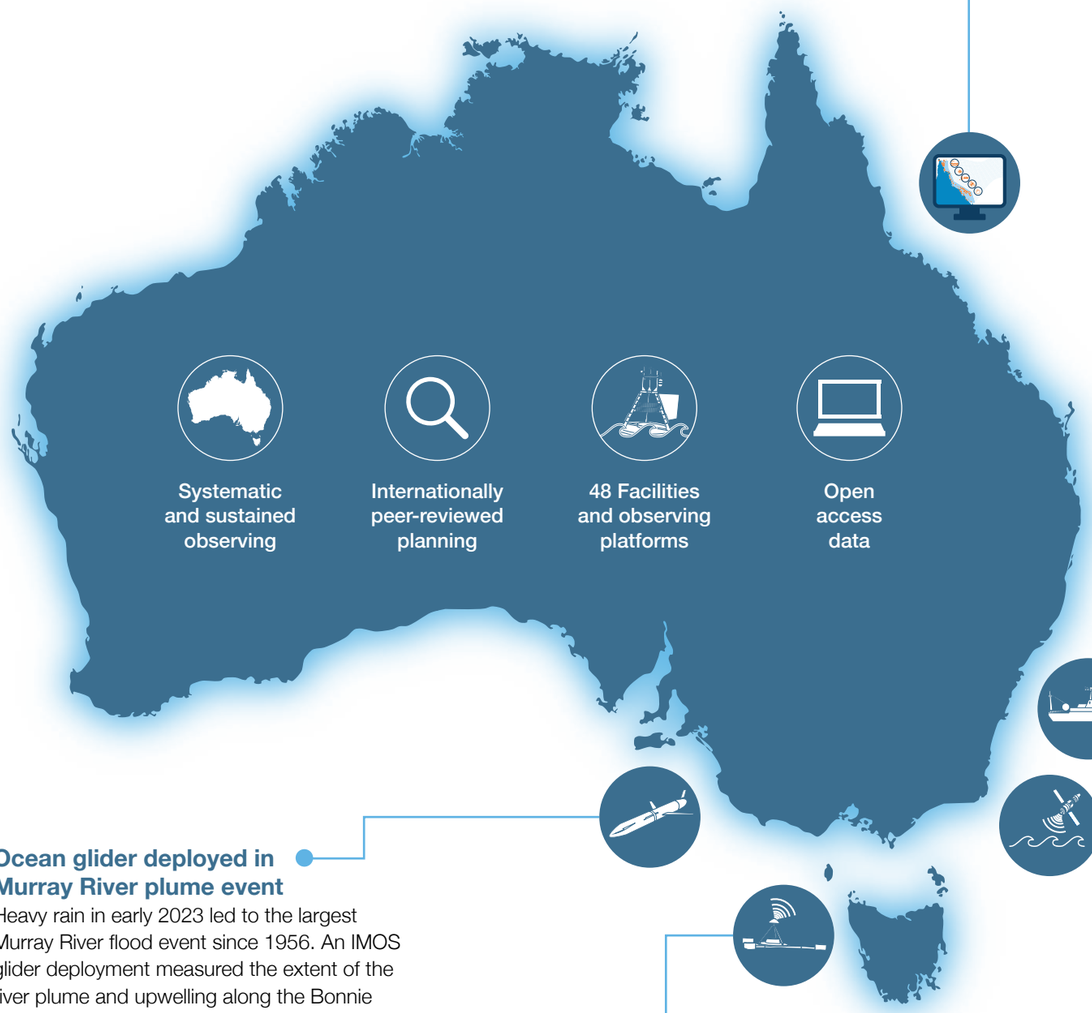
The Biological Ocean Observer integrates, analyses and visualises data from IMOS platforms around Australia, quickly allowing users to explore temporal and seasonal trends through plots for phytoplankton, zooplankton, larval fish and microbial data. The website makes it easier for scientists, industry, policy makers and the public to view and analyse trends in biological data to help understand our ocean estate.

Microplastic contamination in the Southern Ocean

IMOS funded microplastics sampling on Lisa Blair's yacht during her record-breaking solo circumnavigation of Antarctica, enabled collection of data from this remote area. Initial analysis has revealed microplastics are present in every daily sample. Further analysis will provide valuable insights into the prevalence of microplastics and the threat they pose to the region.

Single system for Great Barrier Reef data

IMOS is building a fit-for-purpose Data Management System (DMS) for the Reef 2050 Integrated Monitoring and Reporting Program (RIMReP). The DMS will combine ocean observations with socio-economic data and Traditional Ecological Knowledge into a single critical platform, which will provide data for current and future reef management.



Ocean glider deployed in Murray River plume event

Heavy rain in early 2023 led to the largest Murray River flood event since 1956. An IMOS glider deployment measured the extent of the river plume and upwelling along the Bonnie coast revealing high chlorophyll concentrations at the surface near the river mouth, and even higher concentrations in the sub-surface distant from the river mouth, demonstrating the importance of sub-surface data.

Calibration for SWOT satellite mission

IMOS deployed new satellite calibration and validation technology in Bass Strait during the critical 90-day Fast Sampling Phase of the Surface Water Ocean Topography (SWOT) satellite mission when the satellite flew over the site once a day. The new technology delivered measurements to underpin the accuracy of SWOT with early data already providing unparalleled resolution of fine scale ocean dynamics.

Extended animal tracking coverage in Queensland

IMOS has facilitated a strong alliance of multiple collaborators in Queensland resulting in 345 acoustic telemetry stations spanning 16.7 degrees of latitude. The collaborators tagged 812 animals, including sharks relevant to bather safety, species of conservation interest, and important fishery species and the boosted telemetry network increased detections in Queensland coastal waters, with more than 2.09 million detections recorded.

Collecting data using commercial fishing vessels

FishSOOP, an FRDC funded pilot project, is working with fishers to collect real-time ocean observations where they matter most, allowing skippers to relate their catches to temperature and depth information. In the long-term the data will help understand our changing marine environment and its impact on fish distribution and abundance and support fisheries stock assessment models.

Wind speed database covering coastal waters

IMOS has delivered a km-resolution ocean wind speed and direction database over Australia, New Zealand, Western Pacific islands, and the Maritime continent, capturing the spatial variability of coastal ocean winds over a 250 km swath. These data capture sub-mesoscale air-sea interactions and improve forcing in numerical models useful for offshore industry (oil and gas, fisheries, shipping, offshore wind), protection and management of coasts, habitats, and infrastructure.

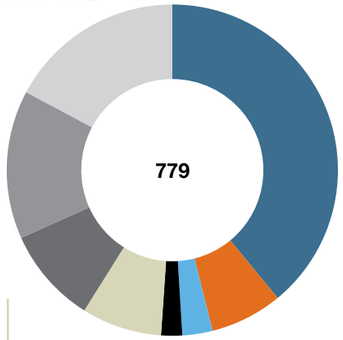
Over a billion ocean measurements

In 2023 IMOS reached the milestone of collecting and delivering over one billion ocean measurements. These measurements are freely available and discoverable through the IMOS Australian Ocean Data Network (AODN) Portal. IMOS is focussed on providing greater accessibility to the wealth of data we collect, finding innovative ways to deliver data to improve decision-making, support operational needs, improve safety and efficiency of marine operations, and underpin weather forecasting and prediction.

Use and Users of IMOS Data

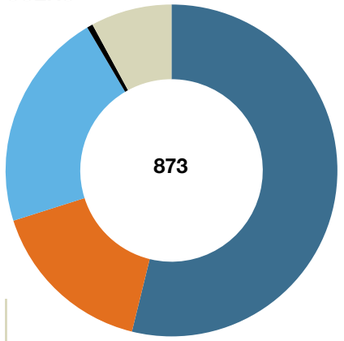
The core uptake and use of IMOS data is measured in terms of numbers of journal articles, reports, theses, research projects, postgraduate student projects, products, conference presentations, training, and education. The use and users are provided below for the 2022–23 financial year. These uses are fully listed in the IMOS Impact Database.

UPTAKE AND USE



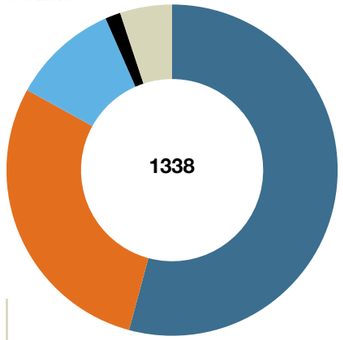
- Projects
- Journal articles
- Reports
- Theses
- Other
- Postgraduate projects
- Conference presentations, training & education
- Products

UNIQUE AUSTRALIAN USERS*



- University
- Government departments
- PFRAs†
- Industry
- Other

UNIQUE INTERNATIONAL USERS*



- University
- Government departments
- PFRAs†
- Industry
- Other

* These users are identified from publications, reports and other outputs. These numbers do not include the broader user base of IMOS data, including those who use IMOS OceanCurrent, THREDDS and other products.

† Publicly funded research agencies (PFRAs)

Financial Summary

A summary of the IMOS finance for the 2022-23 financial year:

FINANCIAL OVERVIEW	**2022–2023**	**2021–2022**
Capital	2,692,768	4,039,095
Personnel	14,067,975	14,083,741
Other	6,767,469	5,617,662
Expenditure relating to NCRIS Funds	**23,528,212**	**23,740,498**
Cash Co-investments	3,111,820	4,689,949
In-Kind Co-investments	30,229,749	27,462,919
Total - Resources utilised	**56,869,781**	**55,893,366**

Full-time equivalent staff numbers	**FTE 2022-23**	**FTE 2021-22**
NCRIS Funded	102.53	97.67
Co-investment funded	32.86	46.78
Total FTE Staff	135.39	144.45

IMOS and Higher Education

As a national research infrastructure IMOS strives to support scientific excellence in Australia by empowering the next generation of marine and climate scientists with ocean data.

University use of IMOS data

IMOS tracks and records the use of our data in scientific publications and an analysis of 2607 publications in our Impact Database reveals how Australian universities are using the wealth of IMOS data in research.

- **All top research intensive (Group of Eight) Australian universities published with IMOS data in 2022-23.**
- **All of the top 20* Australian universities have published with IMOS data over the life of the program.**
- **98% of Australian research universities have published with IMOS data over the life of the program.**

* Based on QS World University Rankings https://www.topuniversities.com/qs-world-university-rankings

Research Training

IMOS data plays an important role in the training and development of the next generation of marine and climate scientists who are undertaking research and developing Science, Technology, Engineering and Mathematics (STEM) skills for application in Australia's blue economy.

IMOS data is included in teaching units at Australian universities including the University of Tasmania, the University of Western Australia, Deakin University and the Sydney Institute of Marine Science, with students learning how to access, analyse and interpret data from IMOS.

Over 384 students have completed postgraduate research projects using IMOS data, with a further 62 students currently working on IMOS ocean measurements in their projects.

Since 2013 the Sydney Institute of Marine Science (SIMS), in partnership with Macquarie University, the University of NSW, the University of Sydney and the University of Technology Sydney, has run a Master's degree course called Topics in Australian Marine Science (TAMS).

This course is unique in that the core of the course is built around IMOS – understanding how different measurement platforms work and exploring the data that these platforms collect. Students combine attending seminars and lectures with hands on practicals and personal assignments, all built around access to IMOS data and the tools available to visualise and analyse it.

The course is in its 11th year, with the 2023 cohort being the largest yet with 59 students learning about the wealth of IMOS data available.

Over 300 Master's students have taken TAMS with graduates going on to work in higher education, as environmental consultants, within government, and at environmental capital firms that fund conservation projects in Asia.

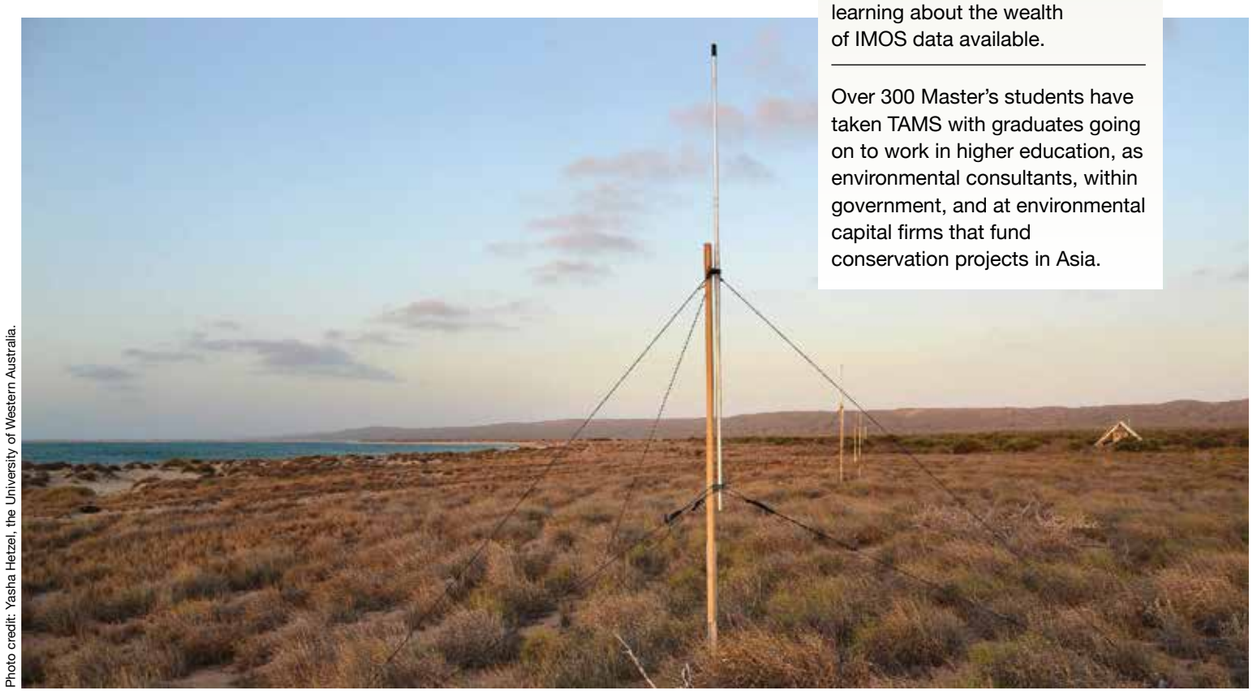


Photo credit: Yasha Hetzel, the University of Western Australia.

NCRIS
National Research Infrastructure for Australia
An Australian Government Initiative

Australia's Integrated Marine Observing System (IMOS) is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS). It is operated by a consortium of institutions as an unincorporated joint venture, with the University of Tasmania as Lead Agent. **www.imos.org.au**

PRINCIPAL PARTICIPANTS

University of Tasmania (Lead Agent)

Australian Government

Australian Institute of Marine Science

Australian Government Bureau of Meteorology

CSIRO

Government of South Australia

SARDI South Australian Research and Development Institute

The University of Western Australia

sims sydney institute of marine science

UTS

The University of Sydney

Macquarie University

UNSW Sydney

SIMS is a partnership involving four universities.

ASSOCIATE PARTICIPANTS

Curtin University

Australian Government Department of Climate Change, Energy, the Environment and Water Australian Antarctic Division

Australian Antarctic Program

Deakin University

The University of Melbourne

IMOS thanks the many other organisations who partner with us, providing co-investment, funding and operational support, including investment from the Tasmanian, Western Australian and Queensland State Governments.

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.

PARTNERS

CO-INVESTORS AND OPERATIONAL PARTNERS • Australian Antarctic Program Partnership • Austral Fisheries • Australian Longline • Australian Museum • Australian Wildcatch Fishing • BHP Billiton • Defence Science and Technology Group • Department of Agriculture and Fisheries, Qld • Department of Climate Change, Energy, the Environment and Water, Reef Trust • Department of Defence • Department of Environment and Science, Qld • Department of Fisheries, WA • Department of Jobs, Tourism, Science and Innovation, WA • Department of Planning and Environment, NSW • Department of Primary Industries and Regional Development, WA • Department of Regional NSW • Department of State Growth, Tas • Department of Transport, WA • Environmental Protection Authority, SA • Environmental Protection Authority, Victoria • Flinders University • Geoscience Australia • Great Barrier Reef Foundation • Greybits Engineering • Griffith University • James Cook University • Macquarie University • Manly Hydraulics Laboratory • Marine National Facility • Minderoo Foundation • Monash University • Murdoch University • Oceanographic Field Services Pty Ltd • OMC International • Parks Australia • Parks Victoria • Pilbara Ports Authority • Queensland Museum • Reef Life Survey • Research Attraction and Acceleration Program, NSW • Royal Australian Navy • RPS MetOcean Pty Ltd • South Australia Water • Sydney Water Corporation • TT Line • University of New South Wales • University of Queensland • University of the Sunshine Coast • University of Sydney • University of Technology Sydney • Voyager Seafoods • Woodside Petroleum Pty Ltd • **INTERNATIONAL COLLABORATORS** • Centre National de la Recherche Scientifique, France • European Space Agency • First Institute of Oceanography, China • French Polar Institute • Hokkaido University, Japan • Institut Polaire Français Paul-Emile Victor, France • LOCEAN, France • National Aeronautics and Space Administration, USA • National Centre for Space Studies (CNES), France • National Institute of Water and Atmospheric Research, New Zealand • National Oceanic and Atmospheric Administration, USA • National Science Foundation, USA • Natural Environment Research Council, UK • Ocean Tracking Network • Scripps Institution of Oceanography, USA • Sealord, New Zealand • Shanghai Ocean University, China • Sofar Ocean Technologies • Southern Ocean Observing System • St Andrews University • Stockholm University, Sweden • TOSCA Dumont d'Urville expedition, France • Woods Hole Oceanographic Institution, USA • **RESEARCH PARTNERSHIPS AND COLLABORATORS** • Australian Research Data Commons (ARDC) • Australia's Academic and Research Network (AARNET) • ARC Centre of Excellence for Climate Extremes • ARC Centre of Excellence for Climate System Science • ARC Centre of Excellence for Coral Reef Studies • Atlas of Living Australia • Biopixel Oceans Foundation • Bioplatforms Australia • Blue Economy Cooperative Research Centre • Bluelink Ocean Forecasting • CSIRO Centre for Southern Ocean Hemisphere Oceans Research • Department of Climate Change, Energy, the Environment and Water • eReefs • Fisheries Research and Development Corporation • Fishwell Consulting • Global Ocean Observing System • Great Barrier Reef Marine Park Authority • Lisa Blair • National Environmental Science Programme Marine and Coastal Hub • Ningaloo Research Program • Queensland Department of Agriculture and Fisheries (QDAF) Fish Aggregation Devices Program • QDAF Shark Control Program • Reef and Rainforest Research Centre • Reef 2050 Integrated Monitoring and Reporting Program (RIMReP) • Tasmanian Partnership for Advanced Computing (TPAC) • Terrestrial Ecosystem Research Network • Western Australian Marine Science Institution (WAMSI) • Various ARC-funded Projects

Cover image: Nick Thake