Integration of Multibeam Bathymetry, Sub-Bottom Profiler and Water Column Acoustics in Support of Australian Marine Science

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FEMME 2023, Edinburgh

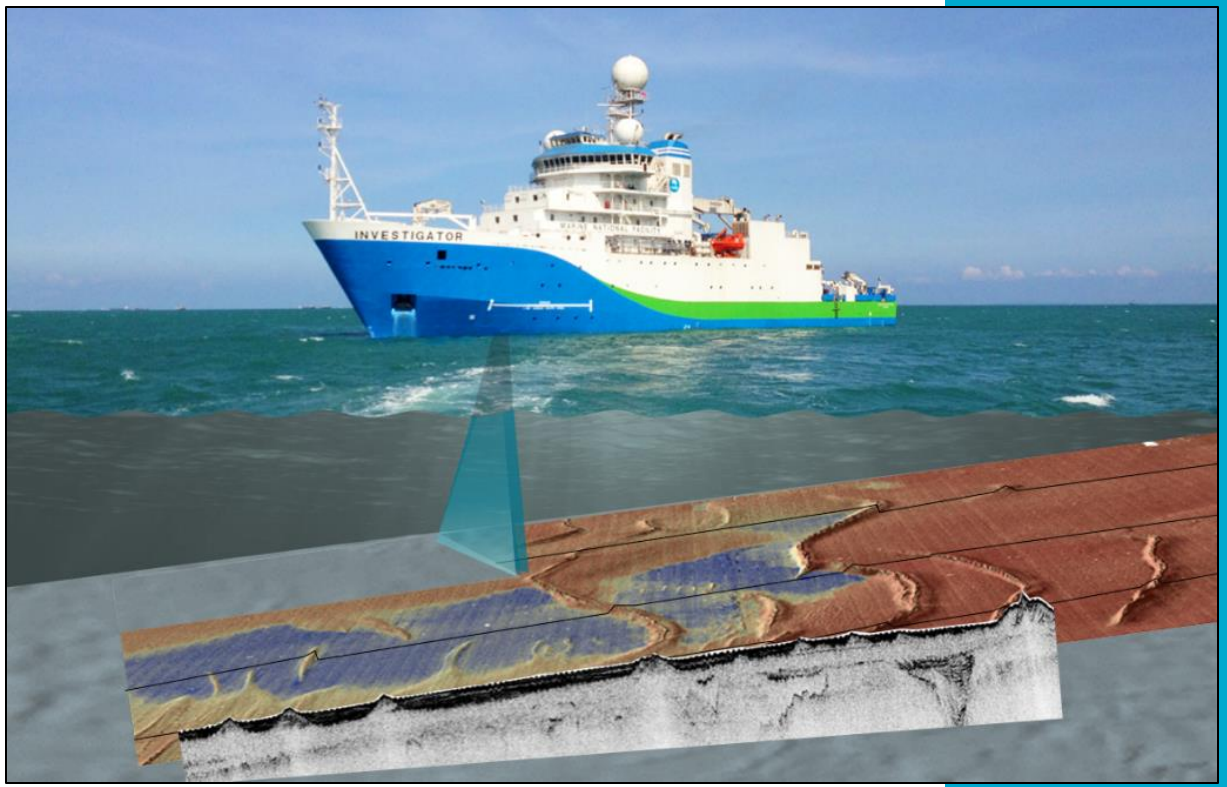
Operated by CSIRO, Australia's National Science Agency,
on behalf of the nation

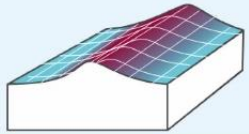
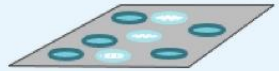
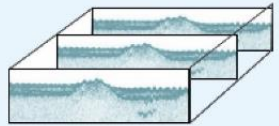
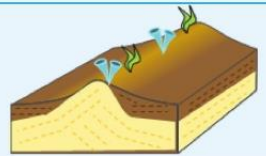
Photo: Tim Pasmore, QUT

Australian Seafloor Mapping Context

Exclusive economic zone: ~10.1 million km^2
(less than 40% bathymetry coverage)

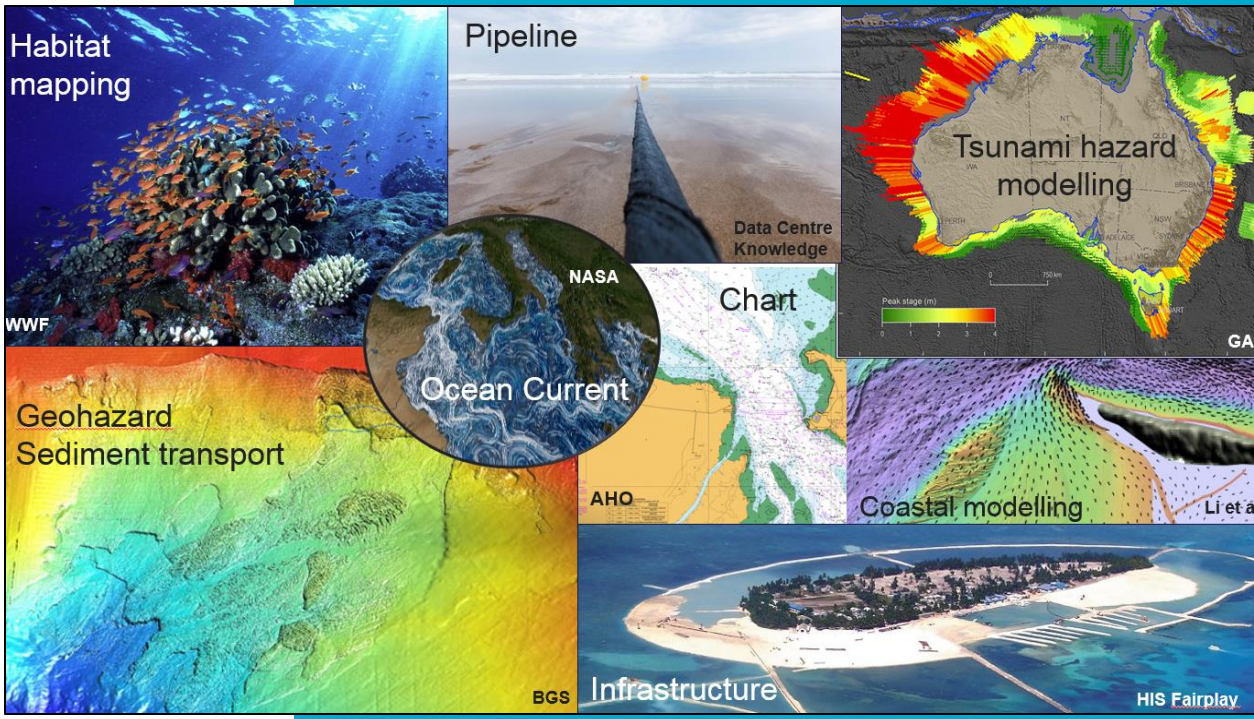
RV Investigator Mapping



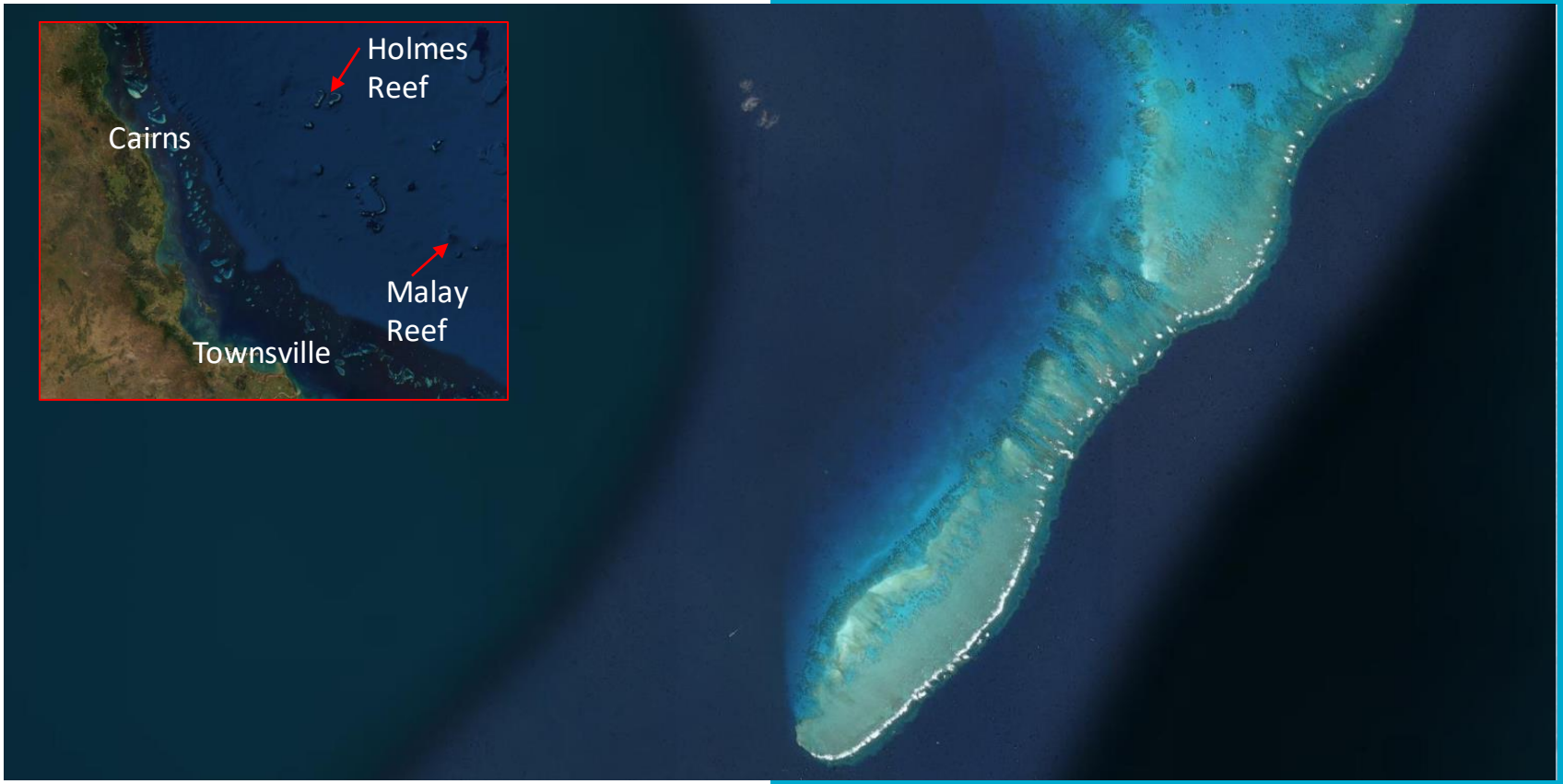
Bathymetry	
Backscatter	
Sediment samples	
Sub-bottom profiles	
Biological samples	
Integration	

Why is it important?

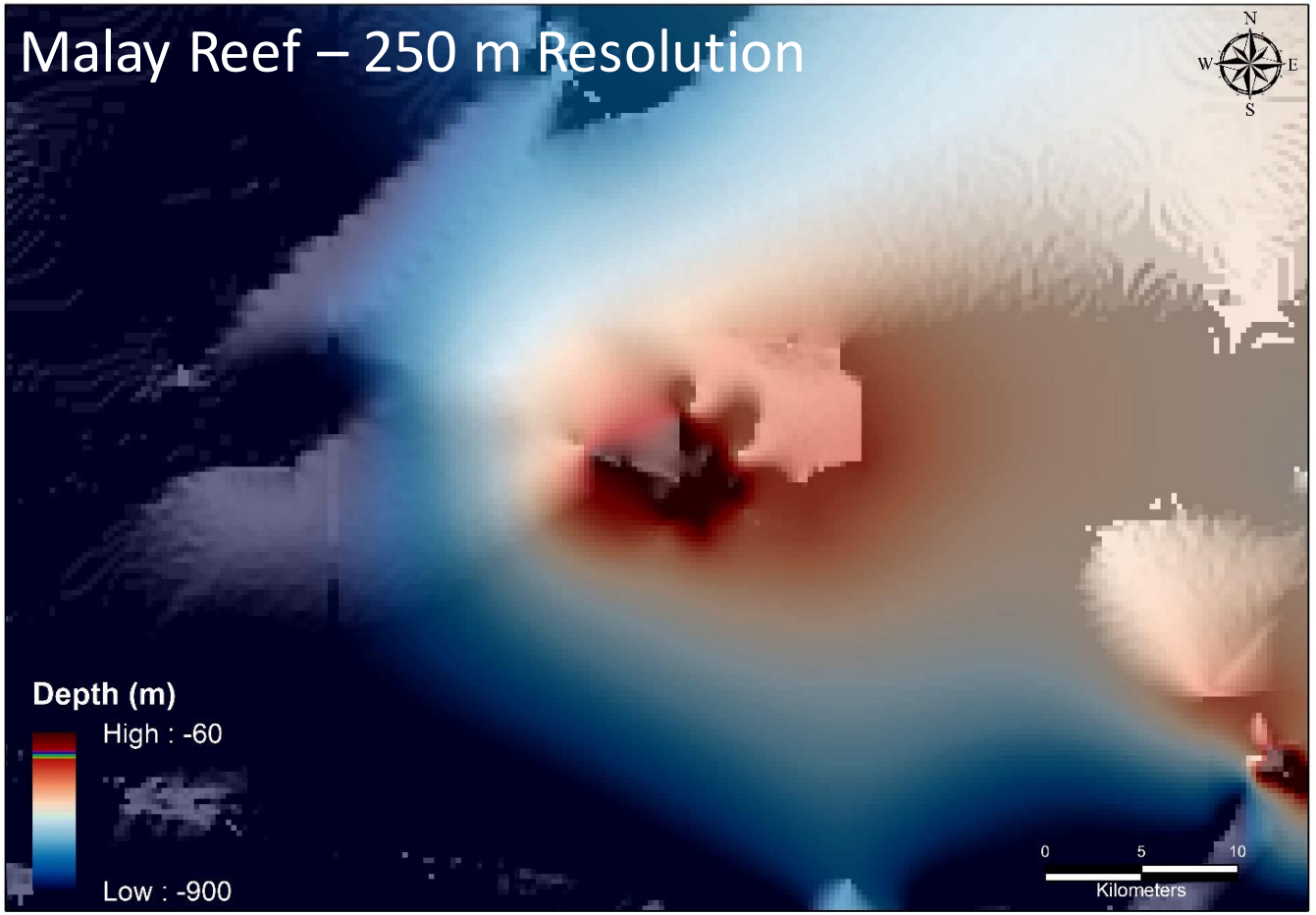
- Sustainable development
- Climate predictions
- Renewable energy
- Hazard modelling
- Safe navigation
- Resource management
- Habitat identification
- Geological understanding



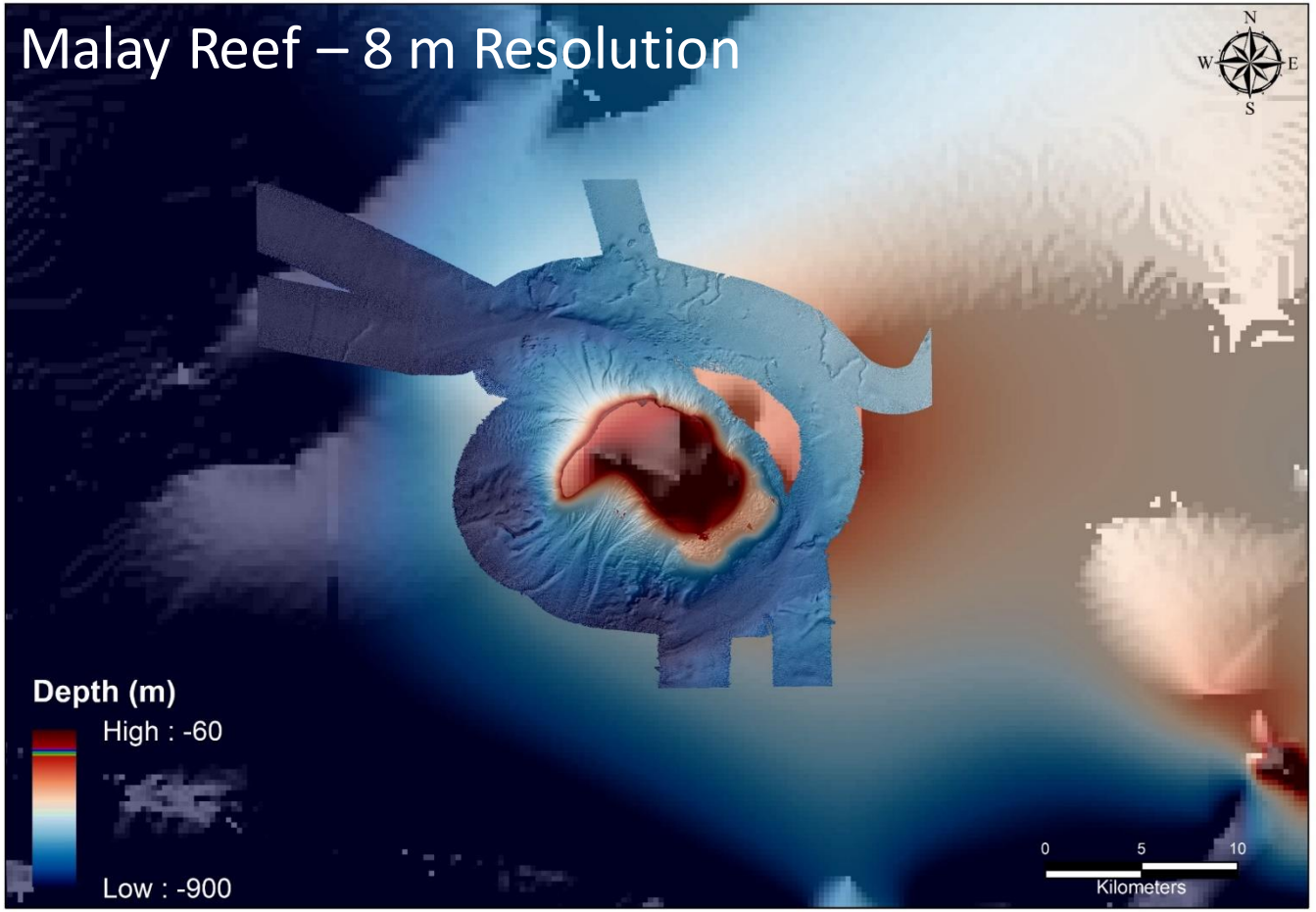
Holmes Reef Bathymetry



Malay Reef – 250 m Resolution



Malay Reef – 8 m Resolution



Marine National Facility

What is the MNF?

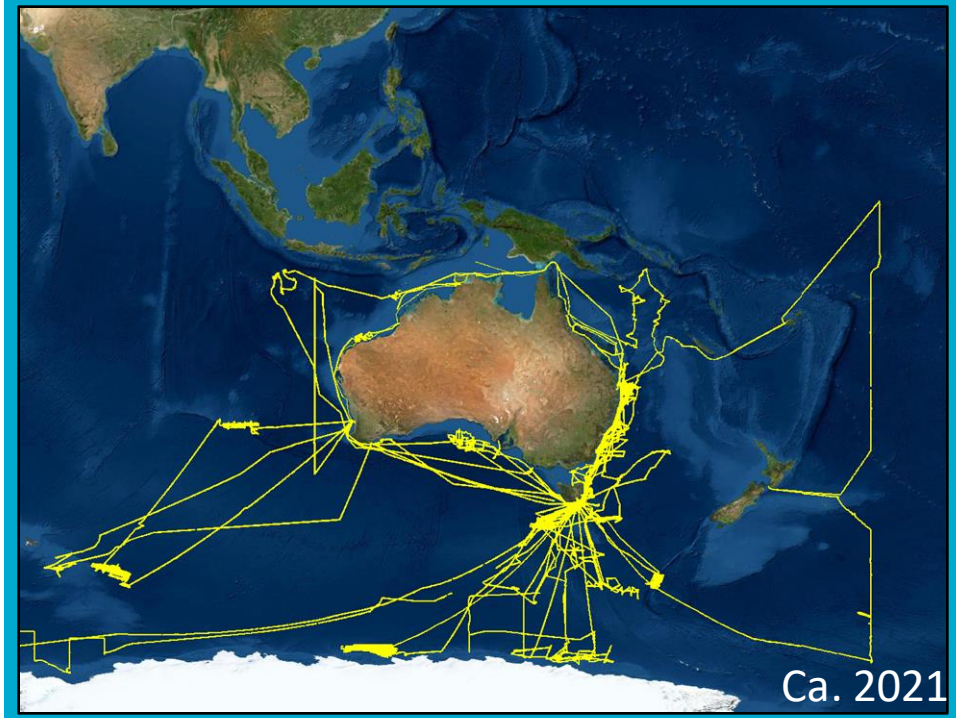
What is the MNF?

- The MNF is a national blue-water research capability funded by the Australian Government and operated by CSIRO on behalf of the nation.
- It includes the ocean-class research vessel (RV) Investigator, a suite of scientific equipment, voyage and technical expertise and 40 years of open access marine data.
- Sea time on RV Investigator is awarded to Australian researchers and their international collaborators through a competitive application process.

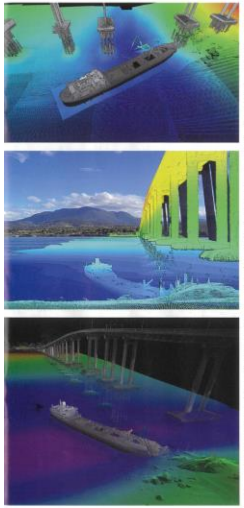
Our capabilities

- We can survey tropics to Antarctica.
- Voyages up to 60 days and 10,000 nautical miles.
- 24/7 operations.
- 300 operational days annually
- 60 participants (40 scientists and technical staff, 20 crew).
- 5 support teams on board

RVI is currently on its 100th voyage



GSM team



soundings, further spatial context is provided, indicating precisely how the shipwreck is orientated and where it rests with respect to the bridge and adjacent eastern shoreline.

Production of the digital twin

At the completion of the survey, Jacobs and CSIRO independently performed various phases of data processing and cleaning to remove unwanted 'noise'. The dataset was also reduced to a common spatial coordinate system (GDA 2020, MGA55) and vertical datum (AHD: Australian Height Datum). CSIRO performed much of its bathymetry data processing and visualisation using a combination of industry standard software suites including Teledyne CARIS HIPS and SIPS, QPS Qimera and Fledermaus, and Pointerra3D.

Once completed, CSIRO combined both the surface and subsurface data to create a combined point cloud dataset. The resulting 3D imagery of the merged digital twin products are featured here.

Use and utility of the digital twin

The digital twin is important in spatially capturing not only the wreck itself, but also the surrounding environment including the Tasman Bridge, the riverbed between the eastern and western shorelines and sections of the shoreline too. While this provides a holistic conceptualisation of the wreck and its setting, each survey point is precisely spatially referenced and therefore can be used for accurate measurements. This opens an avenue for researchers to assess the condition of the wreck, associated features and surrounding riverbed. From an engineering standpoint, the terrestrial laser data of the bridge provides a wealth of data that is fundamental for any future bridge infrastructure planning, upgrades and monitoring purposes.

CSIRO expertise and capabilities

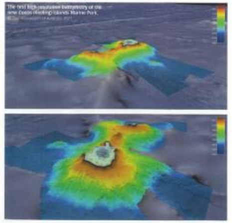
CSIRO has diverse expertise in its marine GSM team, comprising certified hydrographic surveyors, geophysical surveyors, acousticians, GIS specialists and data management professionals. The team primarily supports the CSIRO Marine National Facility and the advanced ocean research vessel, RV Investigator. However, GSM also undertakes shallow water mapping and survey projects through the Shallow Survey Facility (SSF). The SSF collaborates with researchers and stakeholders nationally on projects of varying scope, from renewable energy developments to habitat mapping projects and everything in-between.

Acknowledgements

CSIRO would like to thank Paul Digney and Jacobs for partnering on this project. Our thanks also extend to internal collaborators, including Dave Kruse (Master of RV South Cape) and Matt Marrison (CSIRO Corporate Affairs). We also acknowledge the CSIRO Engineering and Technology Strategic Project Program for supporting this project. ■

Data collected during the 2021 survey has been used to produce an ultra-high-resolution digital twin of the SS Lake Illawarra wreck, riverbed and the Tasman Bridge.

Cocos Keeling Islands MP



World-first bathymetry of marine park

For several weeks in October, scientists aboard the CSIRO research vessel RV *Investigator* conducted a world-first survey of marine biodiversity in the newly established Cocos (Keeling) Islands Marine Park. The 35-day voyage, led by the Museums Victoria Research Institute, also enabled the team to capture the first high-resolution bathymetry of the new marine park, revealing in incredible detail the ancient underwater mountain that lies beneath these idyllic tropical islands.

Nelson Kuna, one of two hydrographic surveyors on board from CSIRO, said that very little high-resolution mapping had been done in the Marine Park prior to this voyage.

"We've used the full ocean-depth mapping capabilities of RV *Investigator* to completely survey around the Cocos (Keeling) Islands, from coastal depths less than 100 metres all the way down to the abyss some 4,800 metres below," said Nelson. "The data set now covers a substantial area of the new marine park and shows the Cocos (Keeling) Islands as the twin peaks of a massive seamount that rises nearly 5,000 metres from the surrounding seafloor," he said.

"We also revealed, among the many fascinating features, a smaller peak on the ridge between the north and south islands, rising to approximately 350 metres below sea level. It's truly an honour to see, for the first time, this stunning marine geomorphology revealed from the deep."

The mapping will provide important information for Parks Australia, which manages the Cocos (Keeling) Island Marine Park, along with the newly established Christmas Island Marine Park, as part of the Australian Marine Parks network.

The 3D geospatial products were produced aboard RV *Investigator* by combining the newly acquired CSIRO data with other extant datasets, including from the Australian Hydrographic Office (LIDAR bathymetry-elevation), GEBCO2022 (background bathymetry) and Geoscience Australia AusSeabed (background bathymetry). The 3D products were produced using QPS Fledermaus. RV *Investigator* captured the bathymetry using its gondola mounted Kongsberg EM122 multibeam echosounder. ■

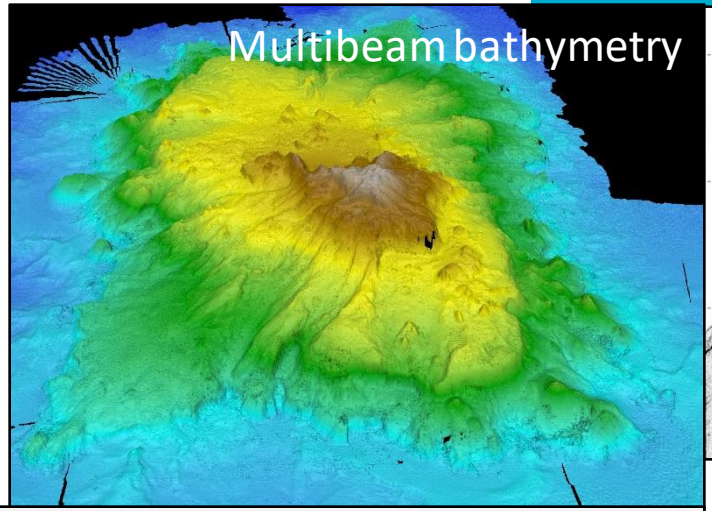
Upcoming Events

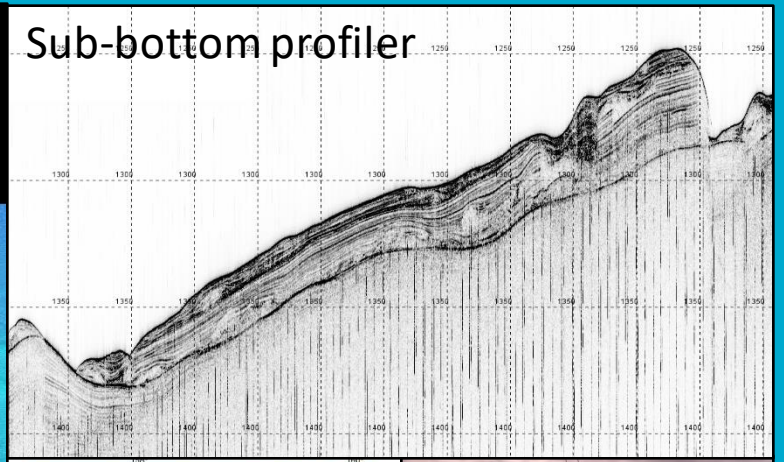
- 23-24 February ISNSW Annual Conference 2023 — surveyors.org.au
- 2 March WA Digital Twin Summit & APSEA-WA
- 15-16 March Geo Connect Asia 2023
- 20-22 March APAS2023 Conference — apas.org.au
- 21 March Global Surveyors' Day 2023
- 23-24 March CSA of NSW Easter Conference 2023
- 2-5 May Geospatial World Forum 2023
- 10-11 May Locate23
- 23 May-1 June FIG Working Week 2023
- August AIMS 2023 National Conference
- 14-18 August 31st International Cartographic Conference and 19th General Assembly

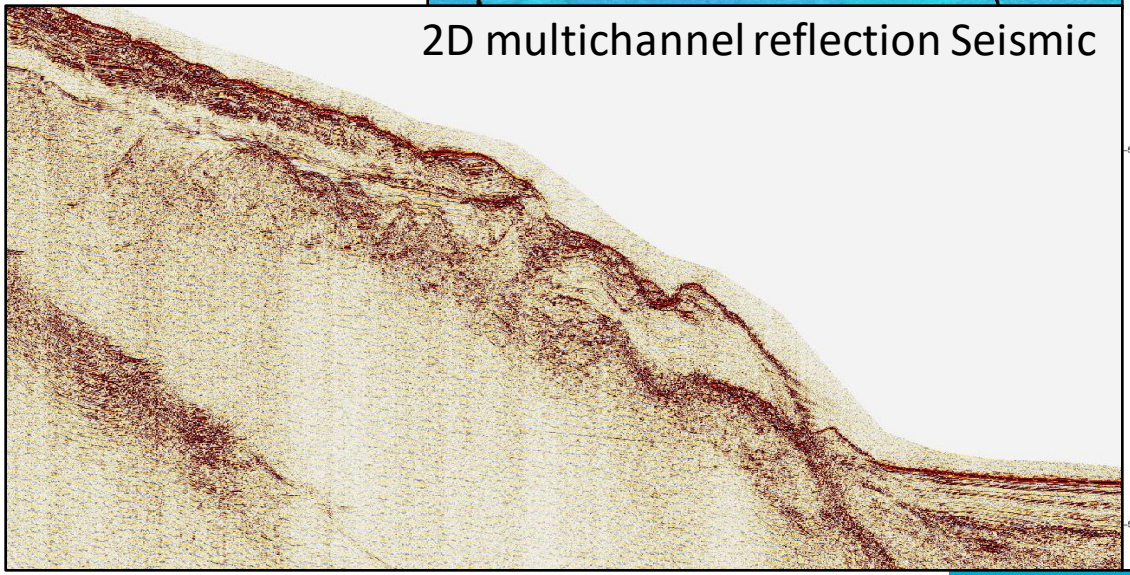
For more events, go to www.spatialsource.com.au/event-listing

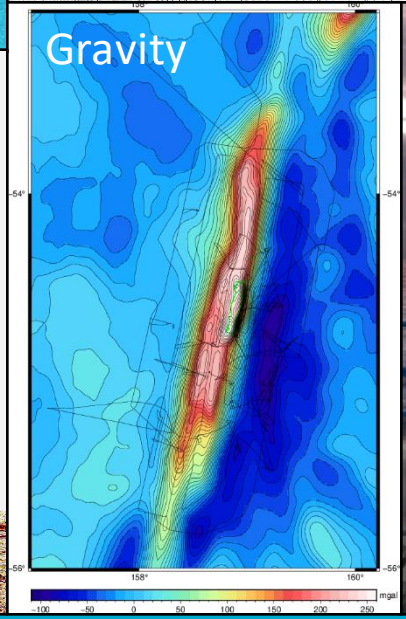
Solving a maritime mystery

Data we collect

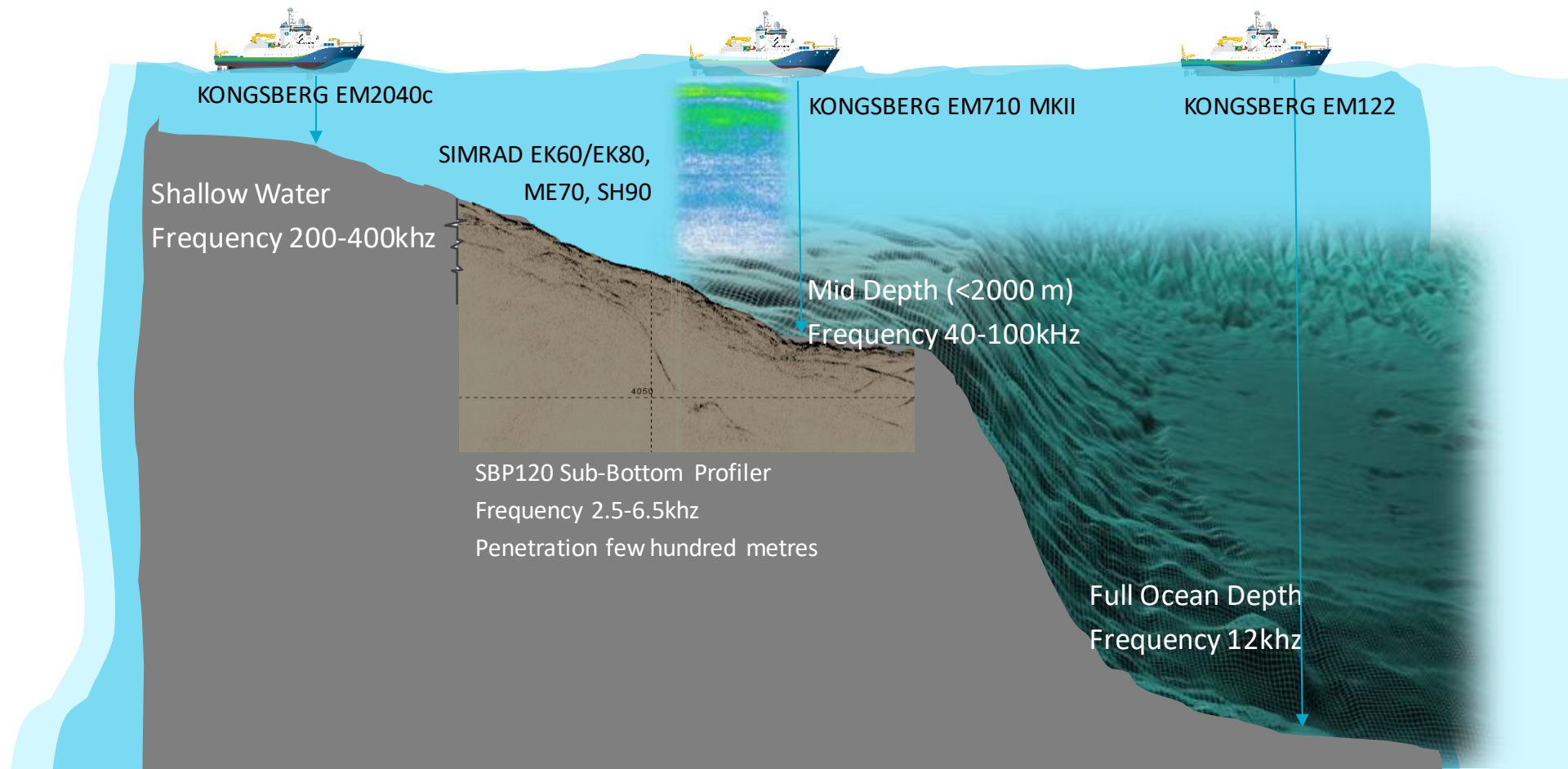




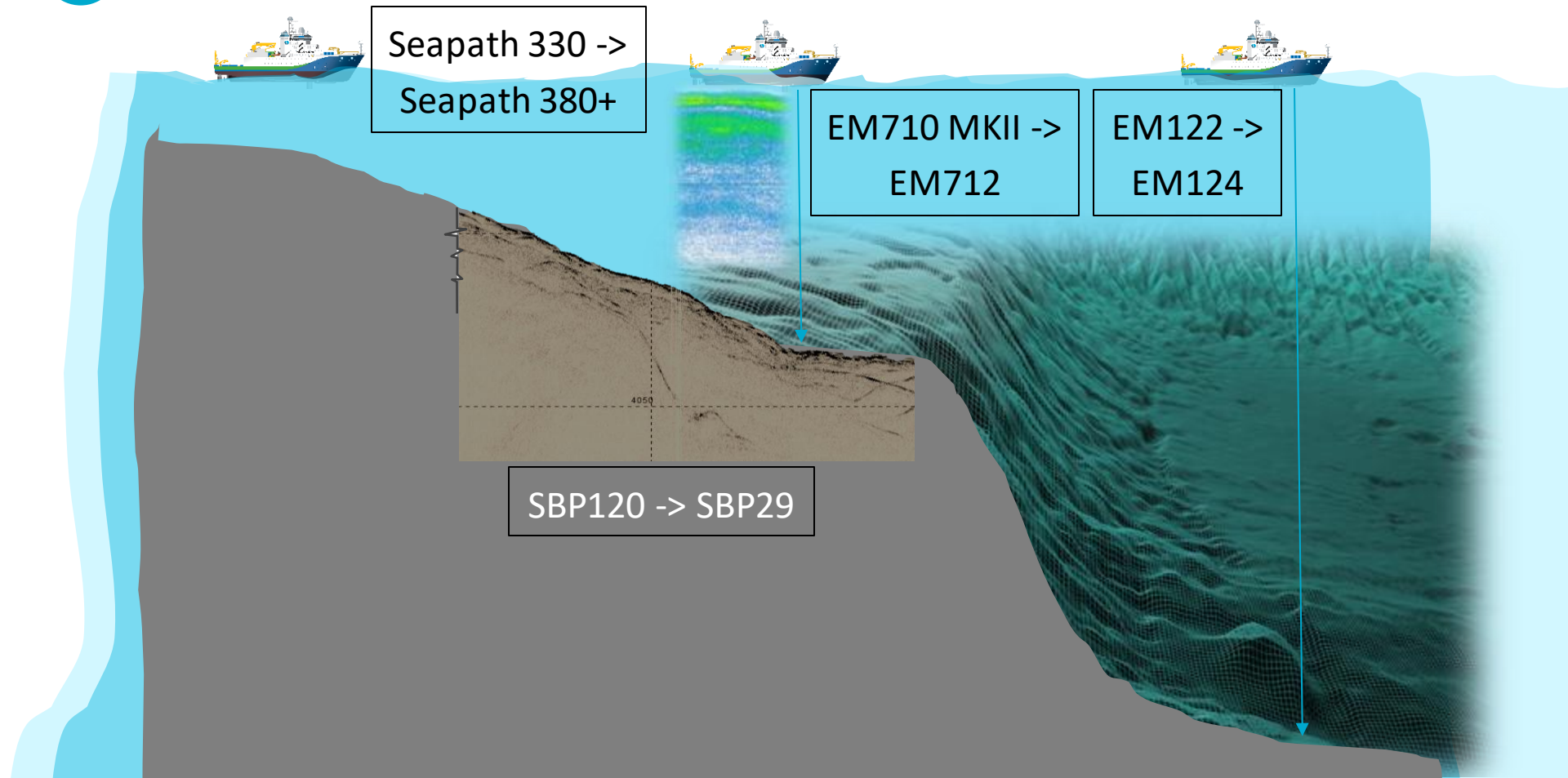




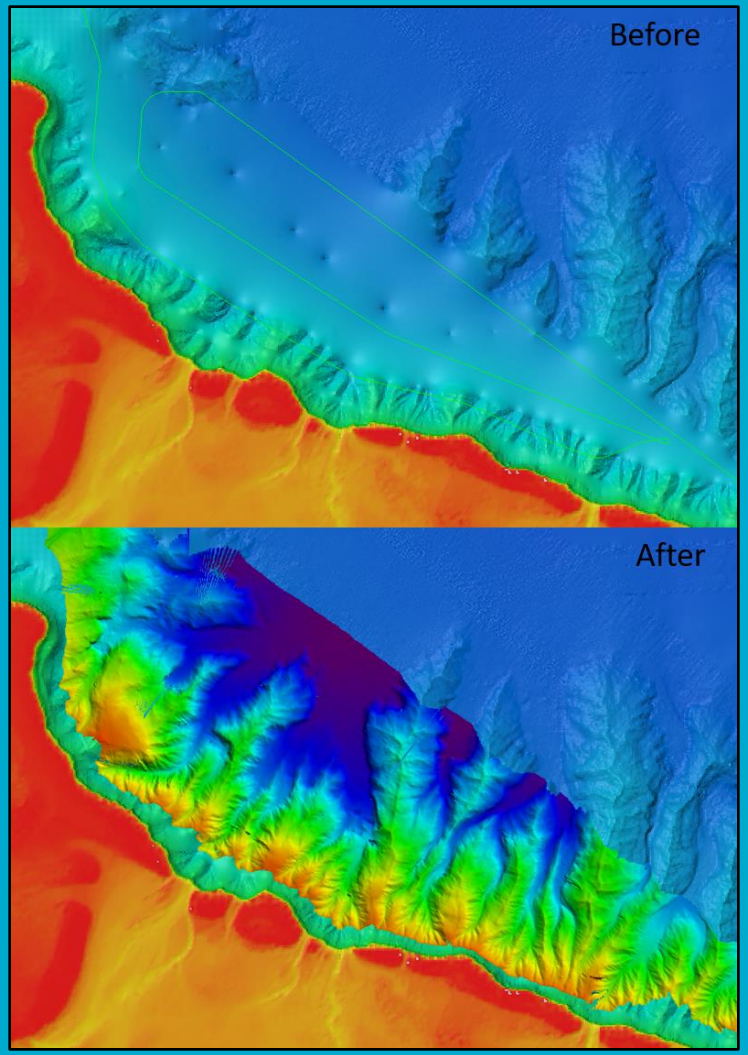
Seafloor Mapping Systems



Seafloor Mapping Systems to Upgrade



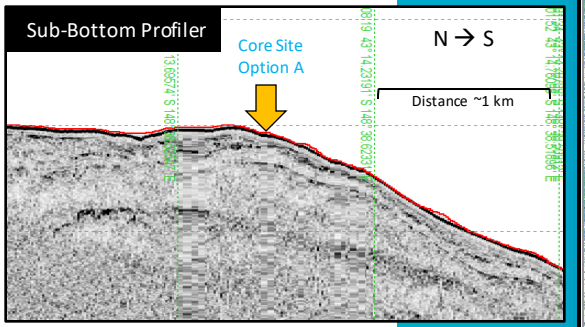
Use cases of Kongsberg systems

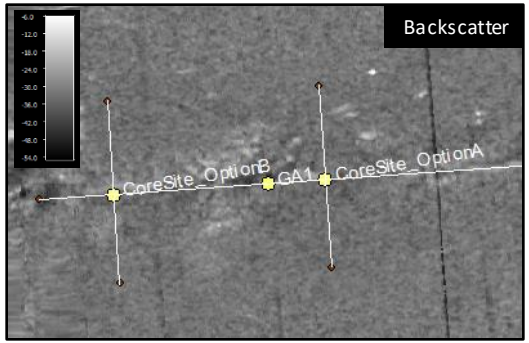


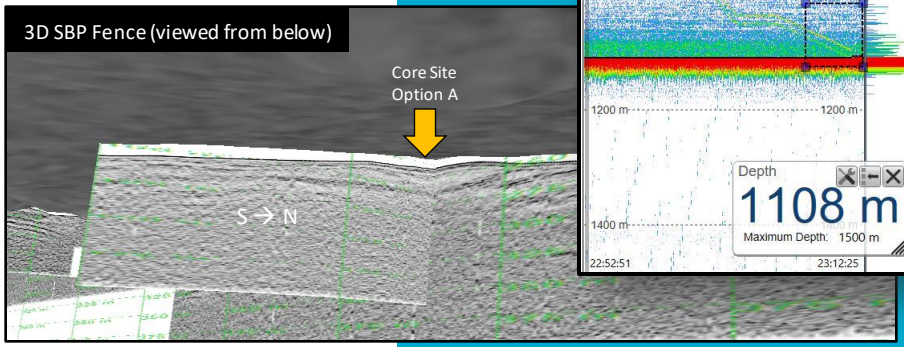
Marine National Facility

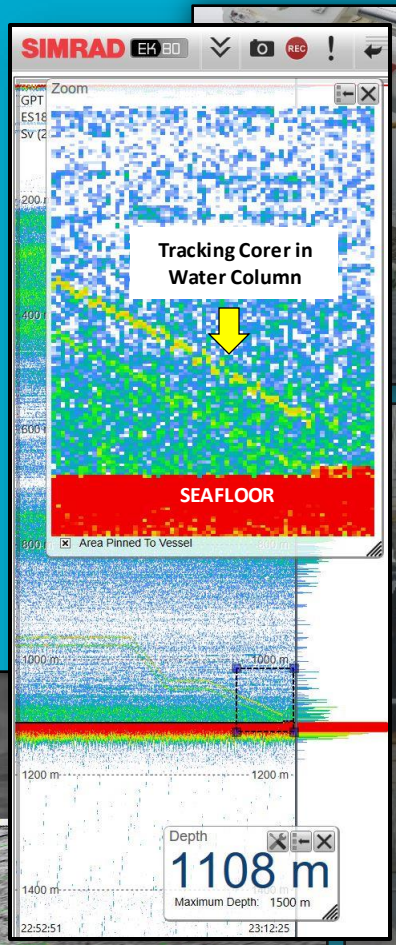
Supporting Coring Ops

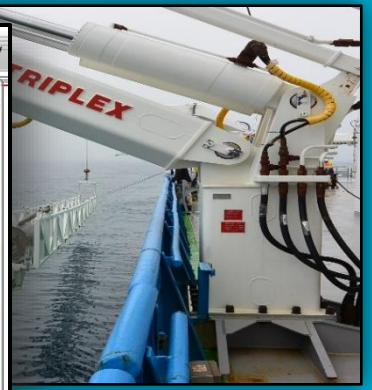
Identify sediments and sub-surface features

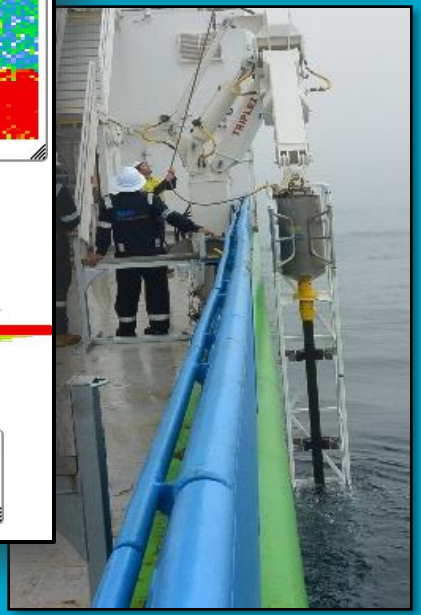








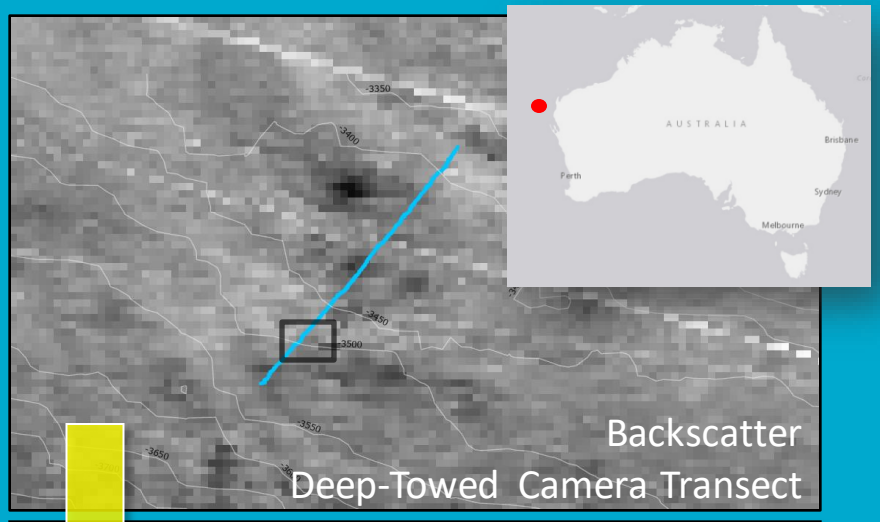


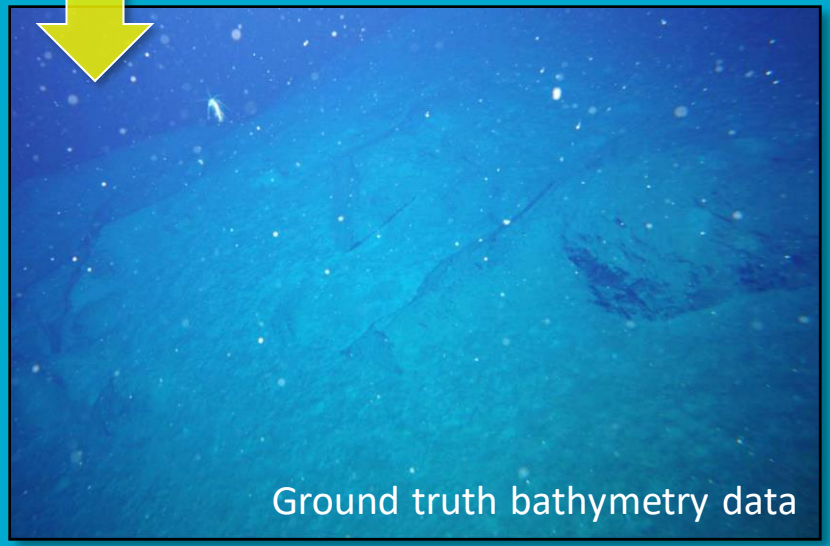


Supporting Deep-Towed Camera

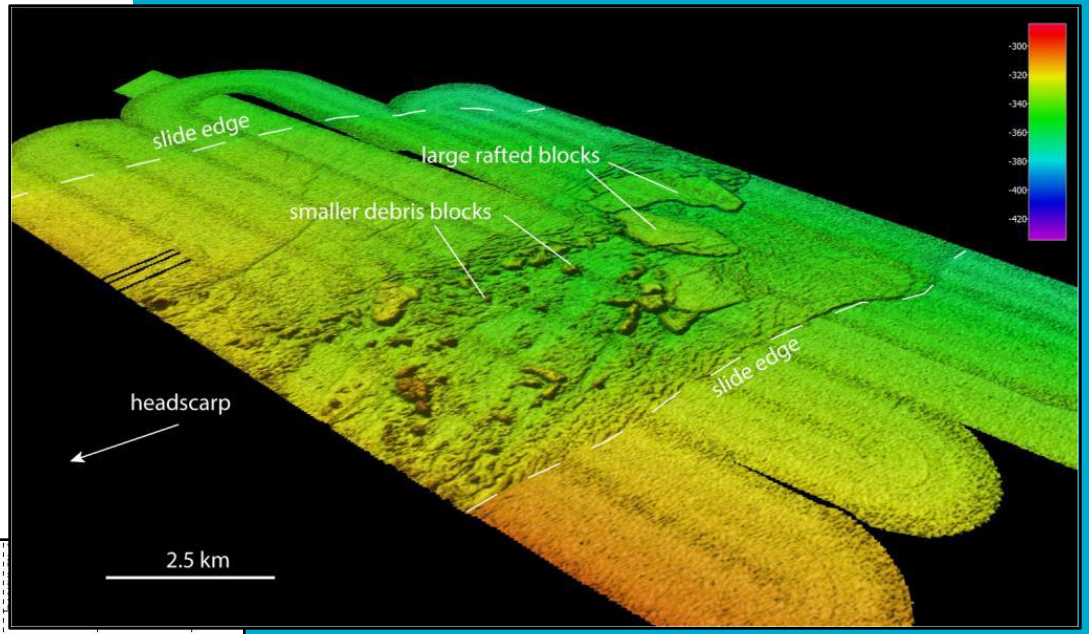
Deciding Where to Sample

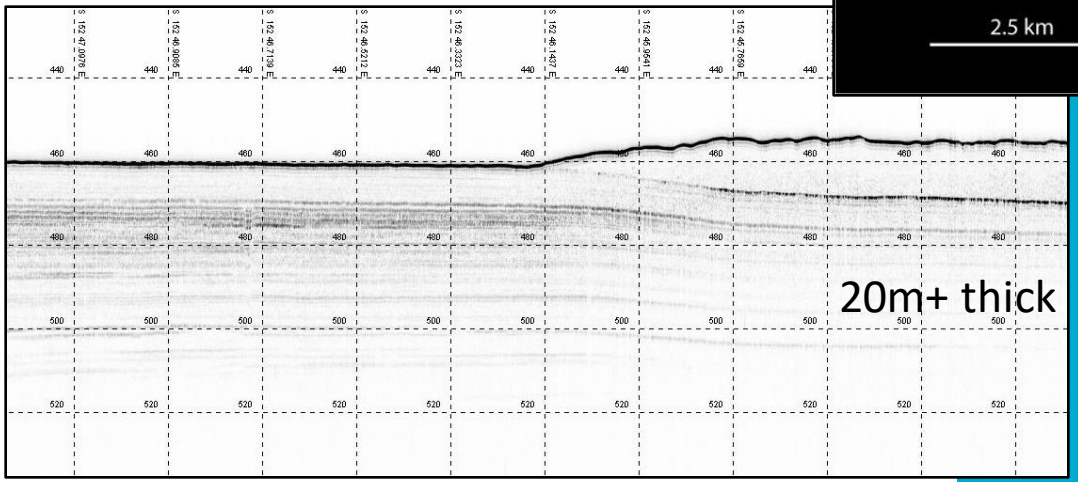
Phil Vandenbossche, Amy Nau & Chris Berry





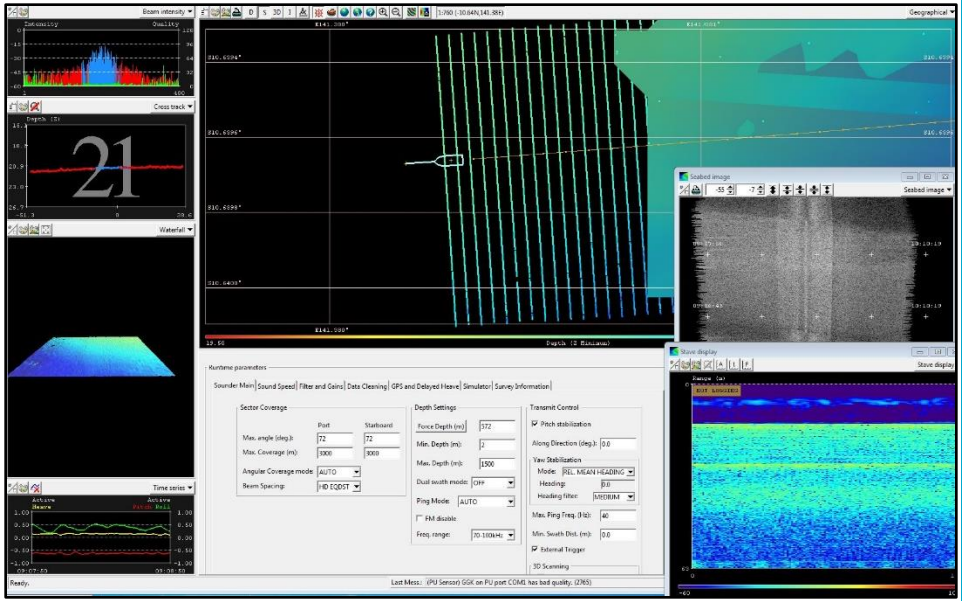
Swain Slide Volume

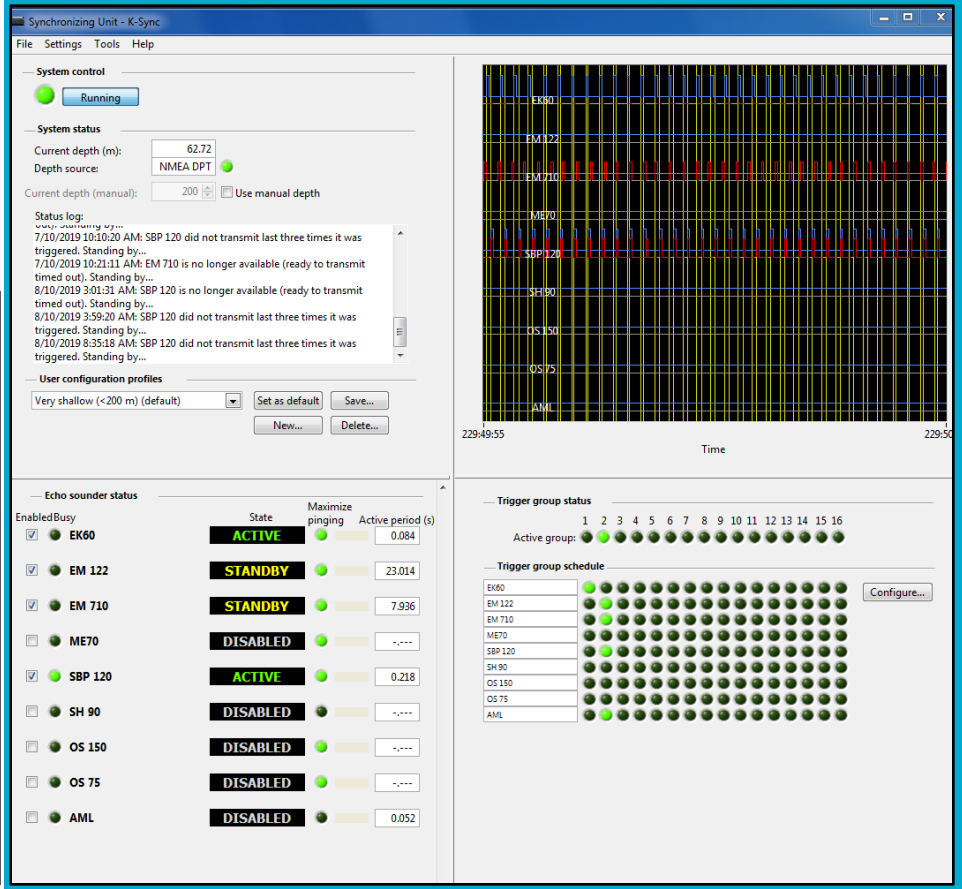




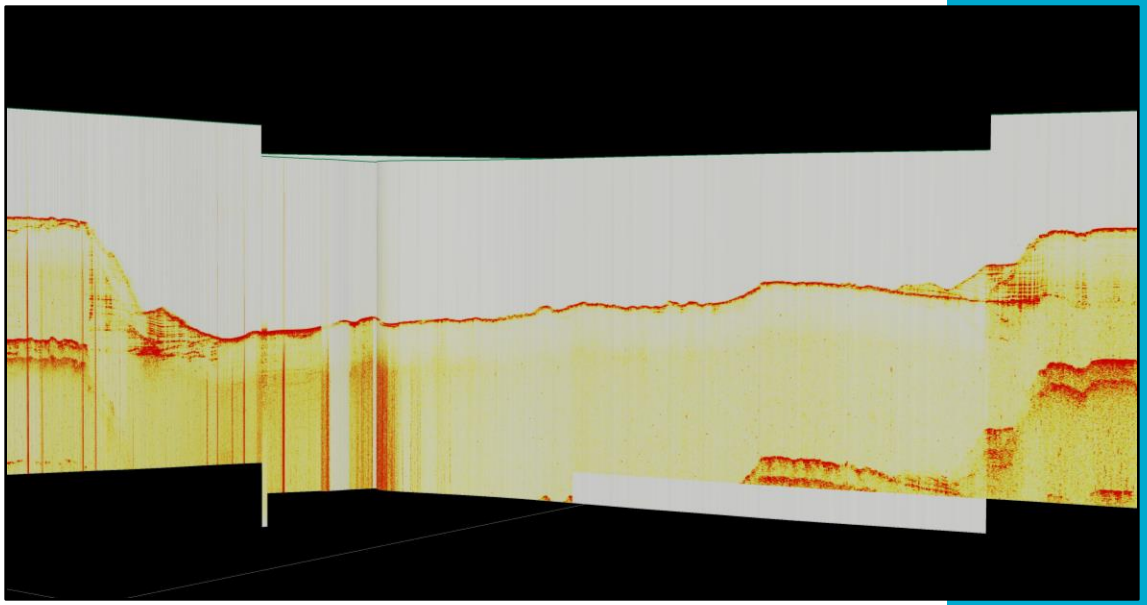
Marine National Facility

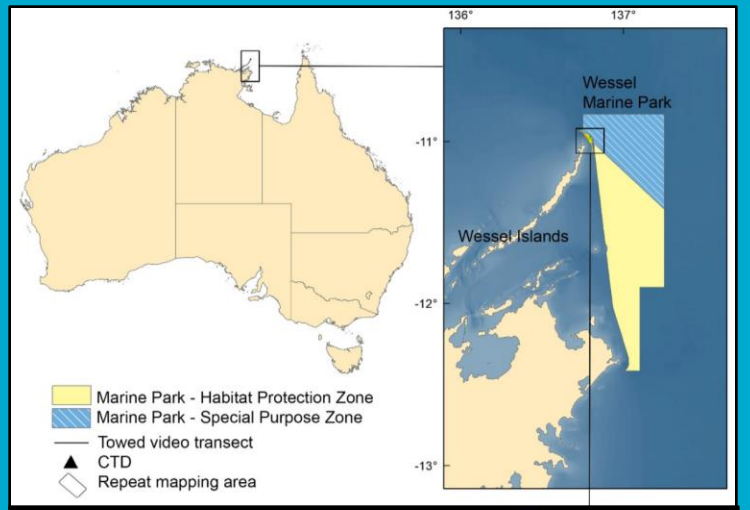
Shallow Mapping and K-Sync

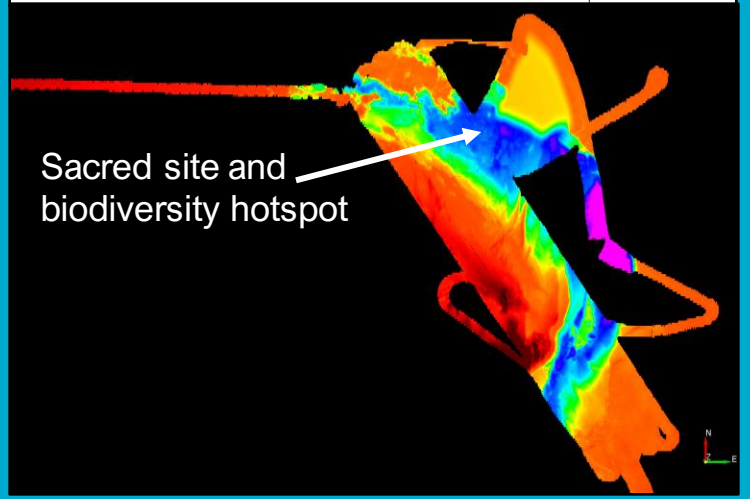




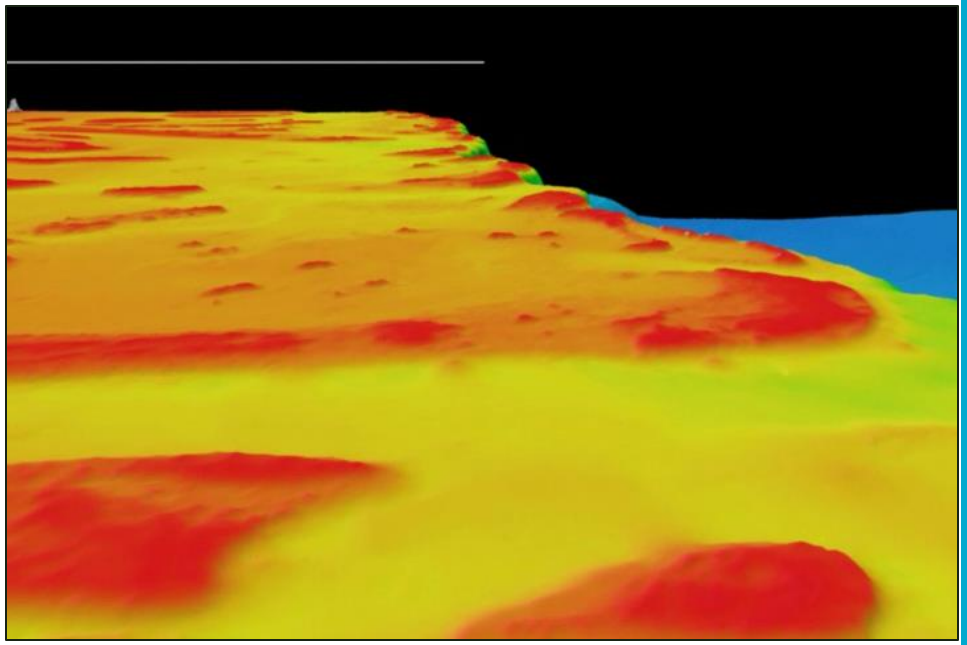
Mapping a sacred site

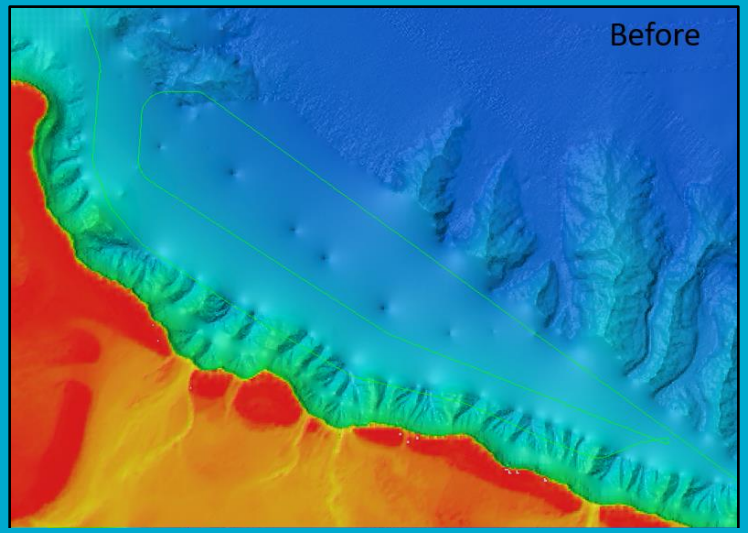




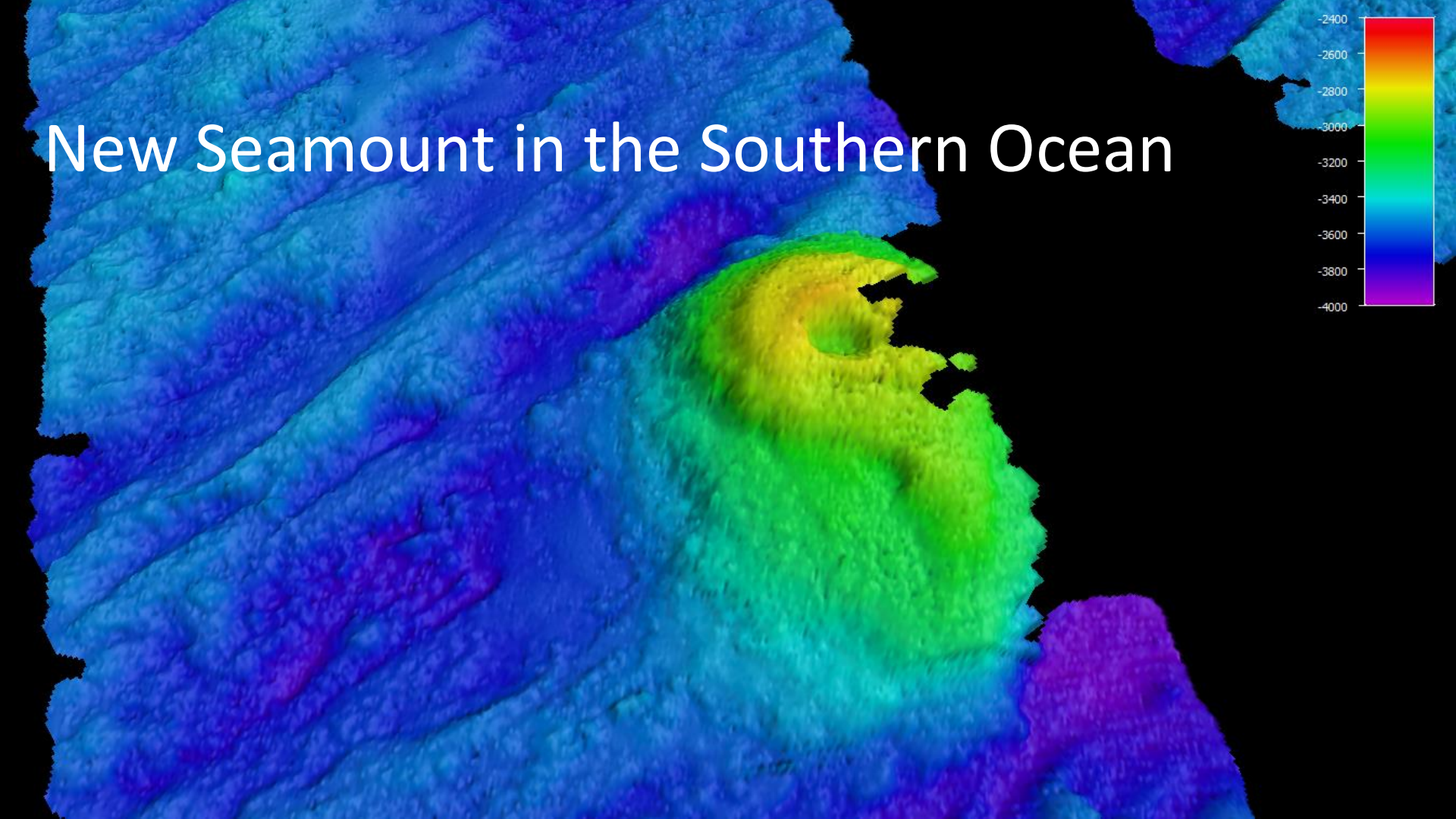


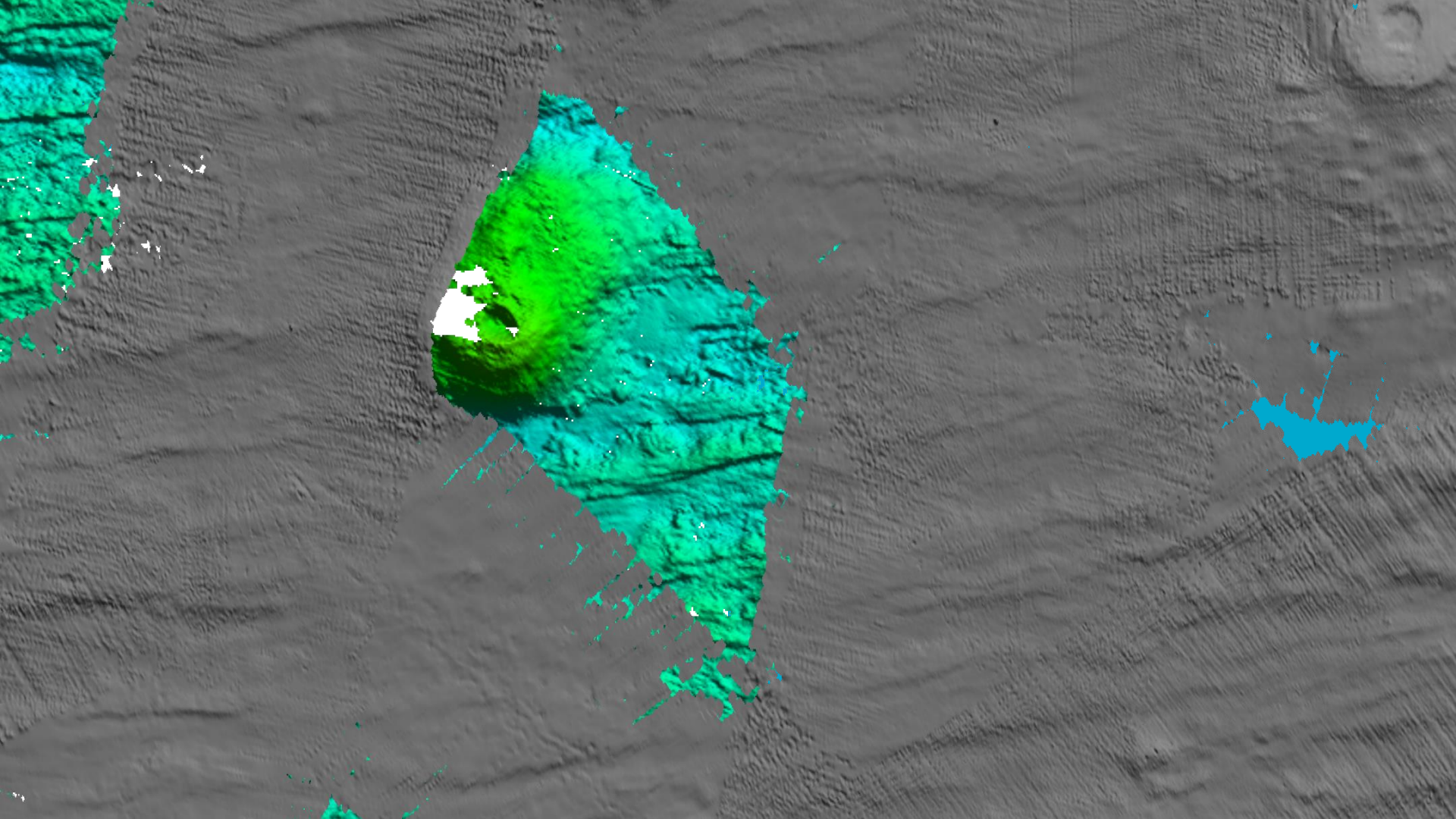
Stapleton Canyons



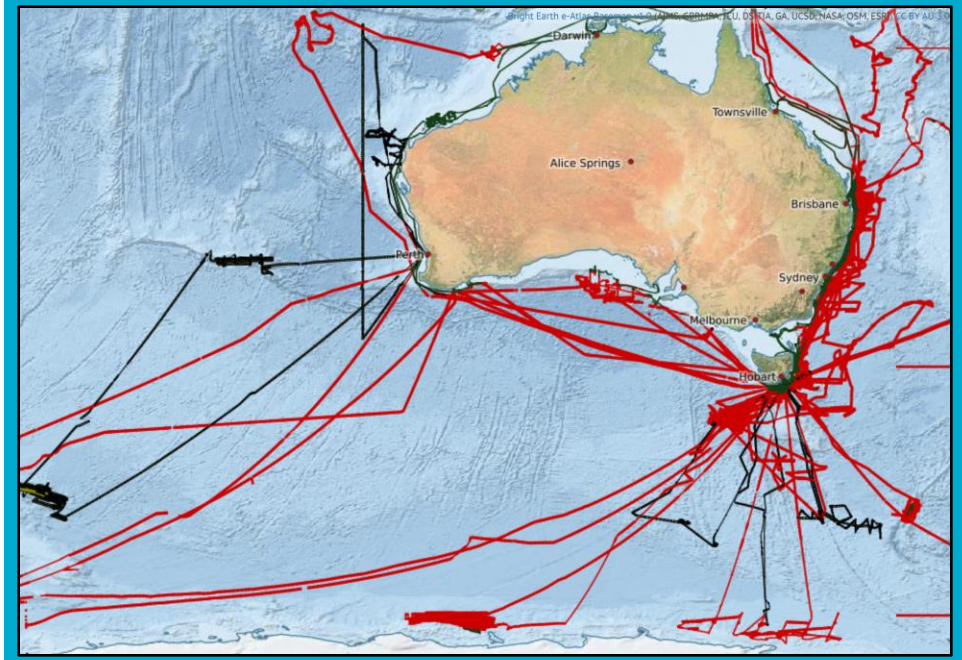


New Seamount in the Southern Ocean





Access Data


Darwin
Townsville
Alice Springs
Brisbane
Perth
Sydney
Melbourne
Hobart

Marine National Facility

Access our data

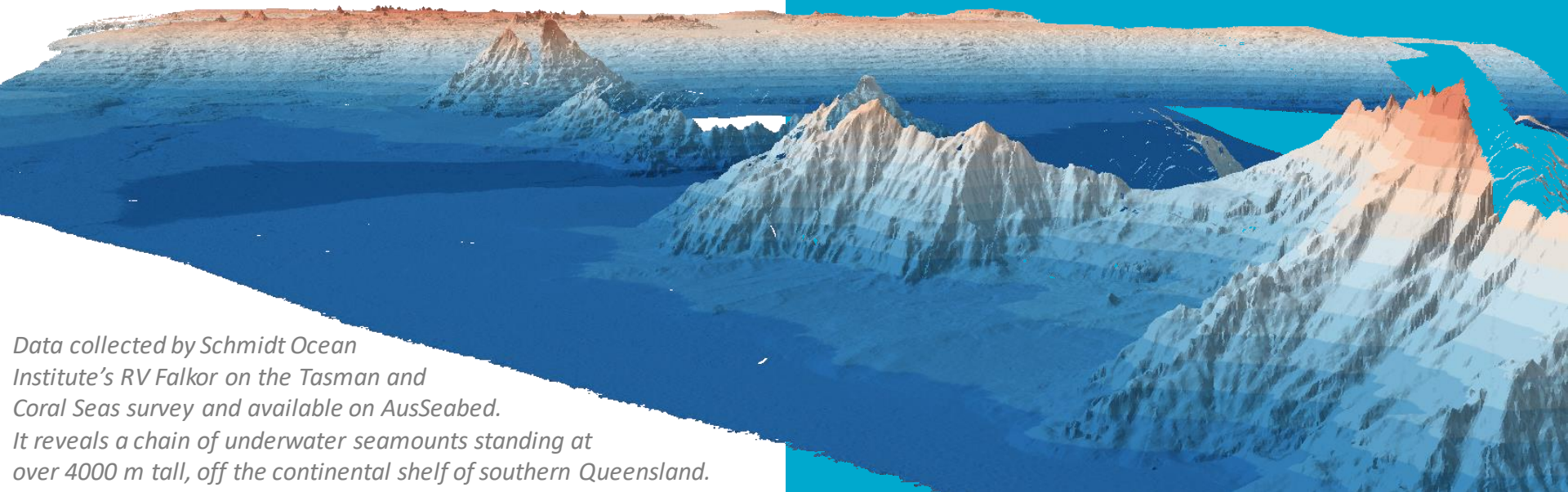
NCMI Information and Data Centre

research.csiro.au/ncmi-idc

Last year to AusSeabed:
Record 36 data publications =
1,361,220 Sq.km of new data

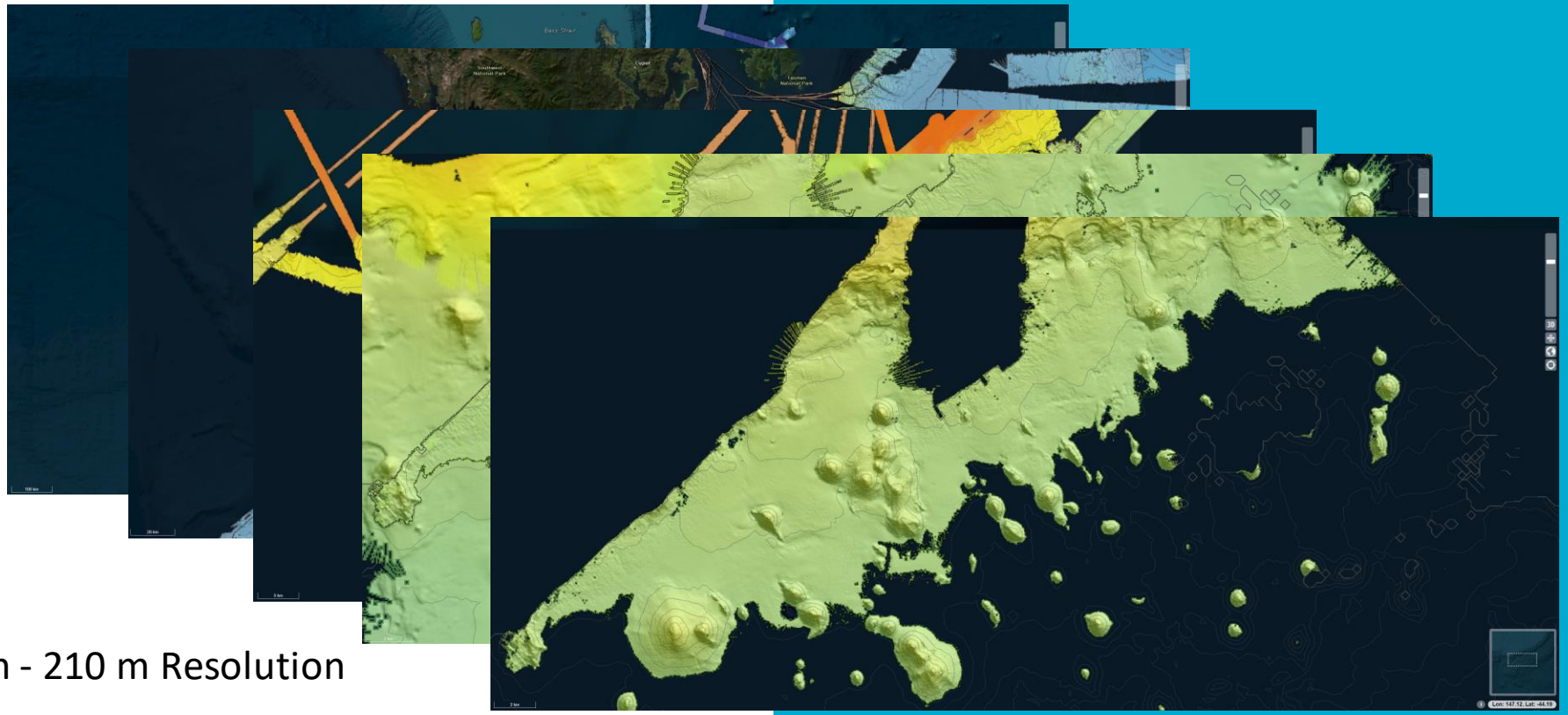
AUS SEABED

ausseabed.gov.au



Data collected by Schmidt Ocean Institute's RV Falkor on the Tasman and Coral Seas survey and available on AusSeabed. It reveals a chain of underwater seamounts standing at over 4000 m tall, off the continental shelf of southern Queensland.

Multi-Resolution Grids



5 m - 210 m Resolution

Access our data

CSIRO National Collections and Marine Infrastructure

Data Trawler - Dataset download

NCMI Information and Data Centre » Applications » Data Trawler

marine.csiro.au/data/trawler

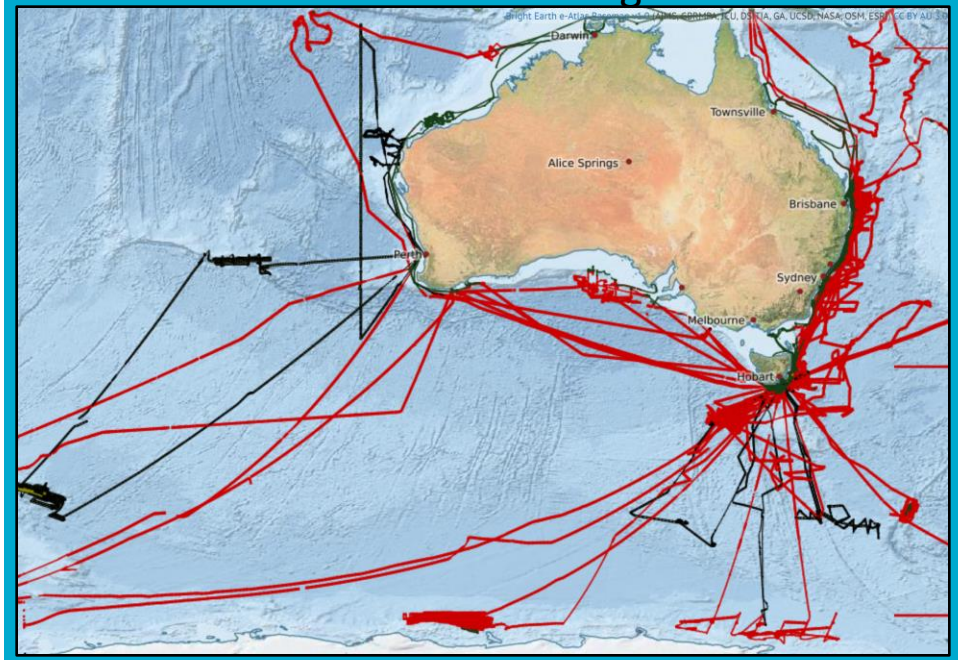
CSIRO National Collections and Marine Infrastructure

Geophysical Survey and Mapping - Search

NCMI Information and Data Centre » Applications » Geophysical Survey and Mapping

marine.csiro.au/data/gsm

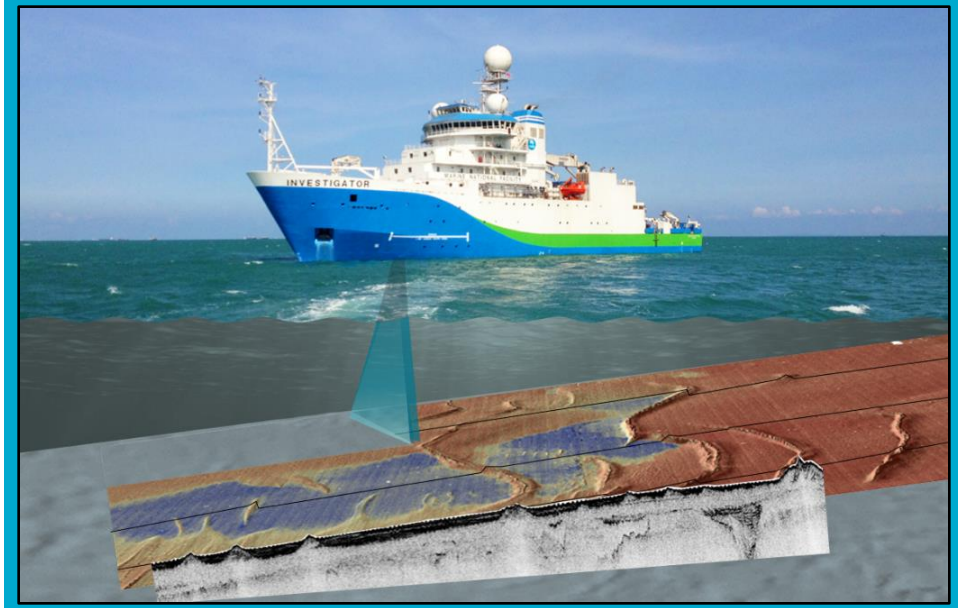
MBES: 3 million km^2/0.6 million km line length
.....and counting



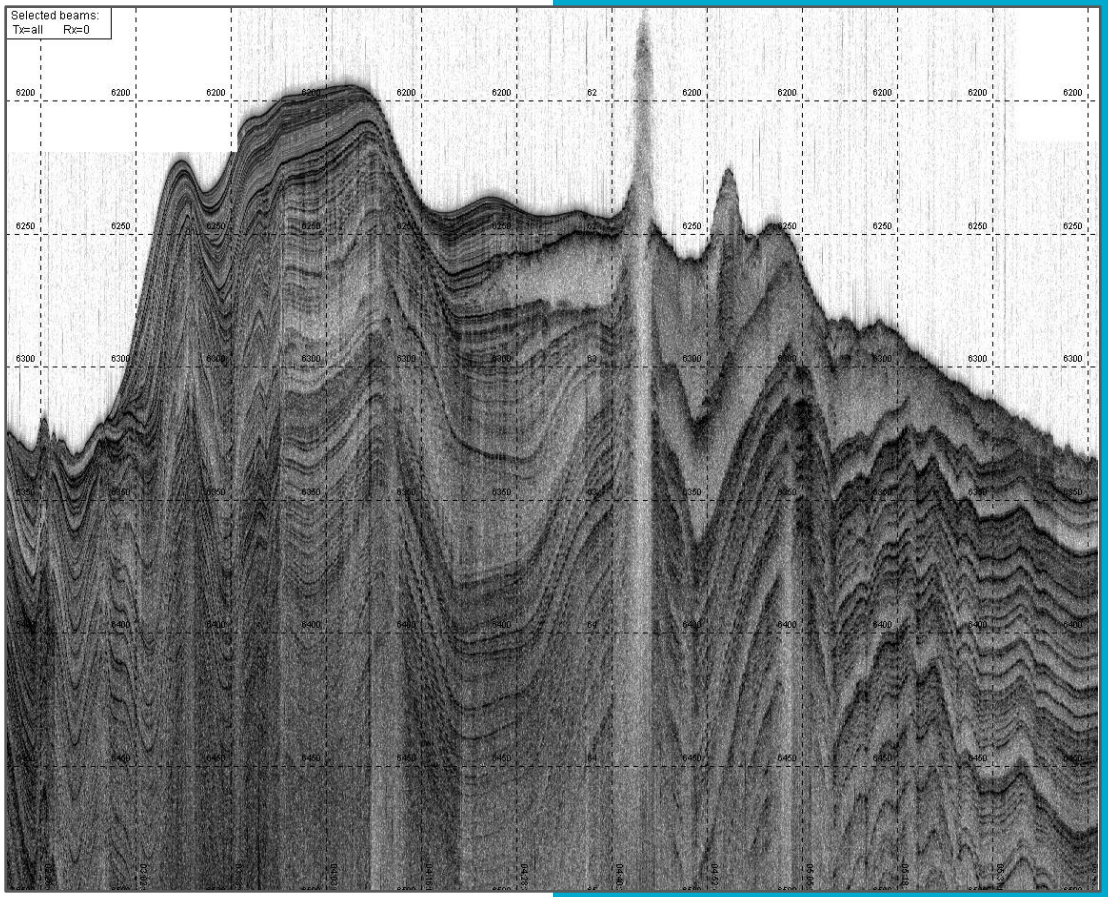
Multibeam holdings

Apply for sea-time

- Primary, Supplementary and Piggyback applications
- Open application calls – (mnf.csiro.au)
- 2026/2027 season: Call for sea time May 2024.

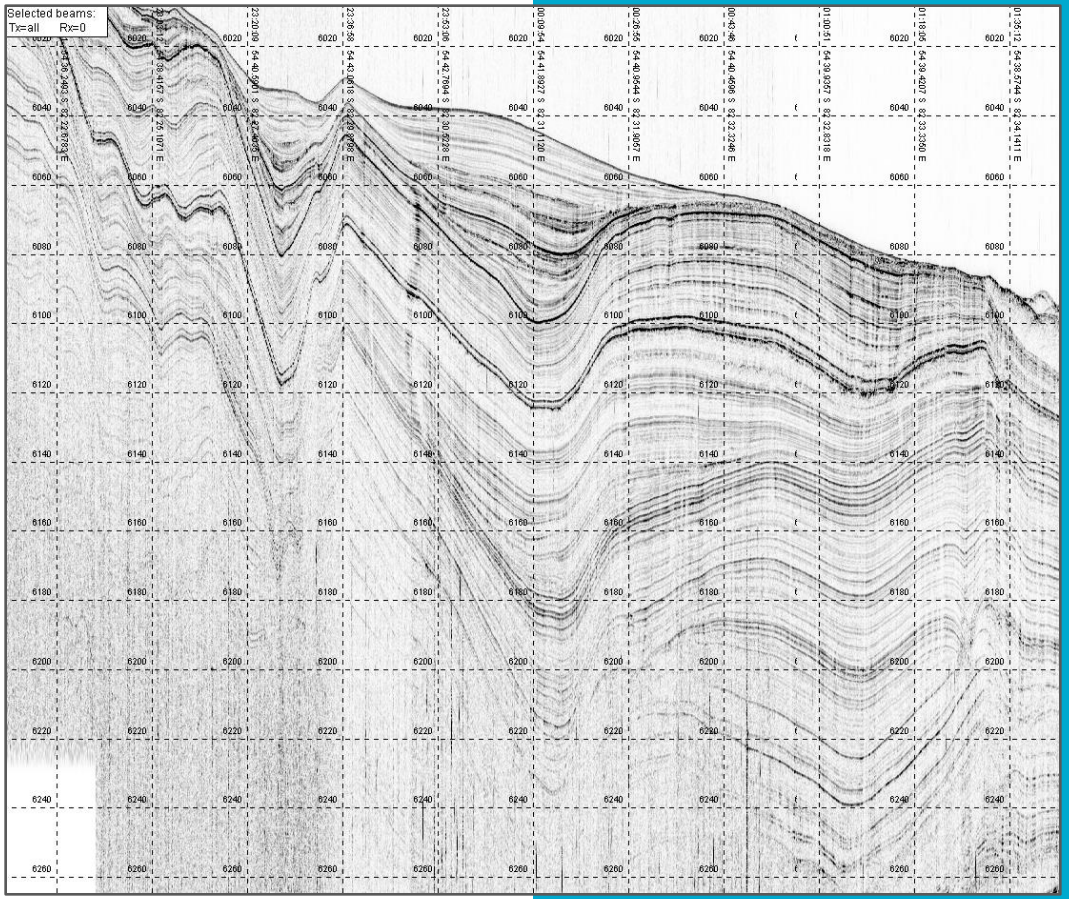


Gallery



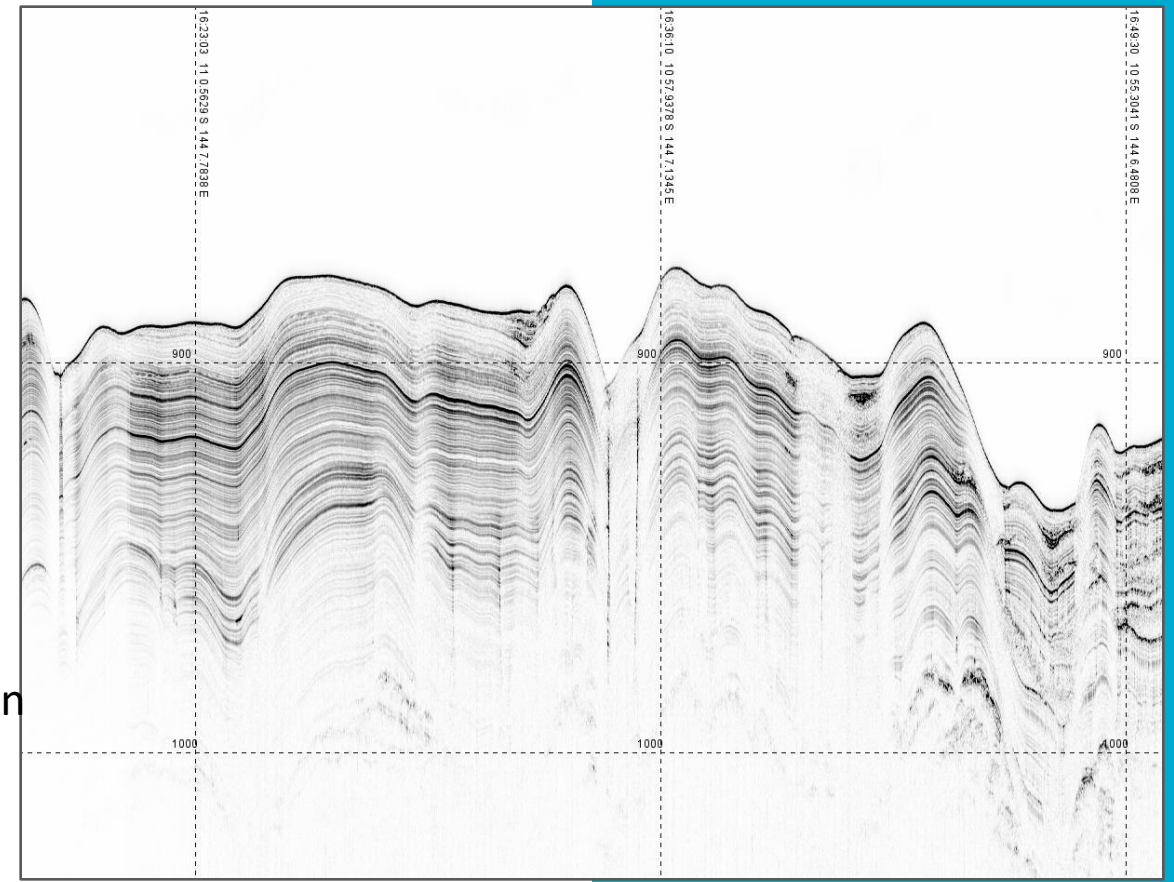
250m+ Penetration

Gallery



200m+ Penetration

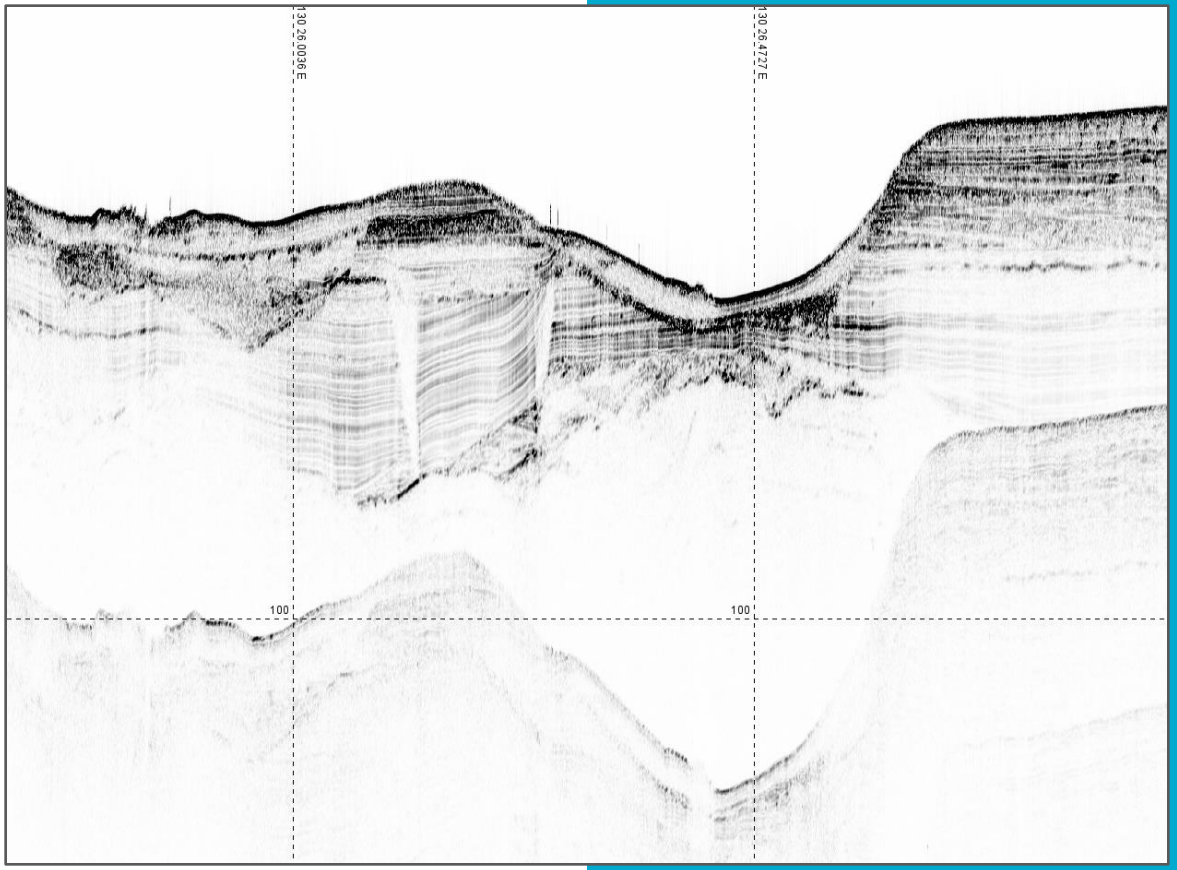
Gallery



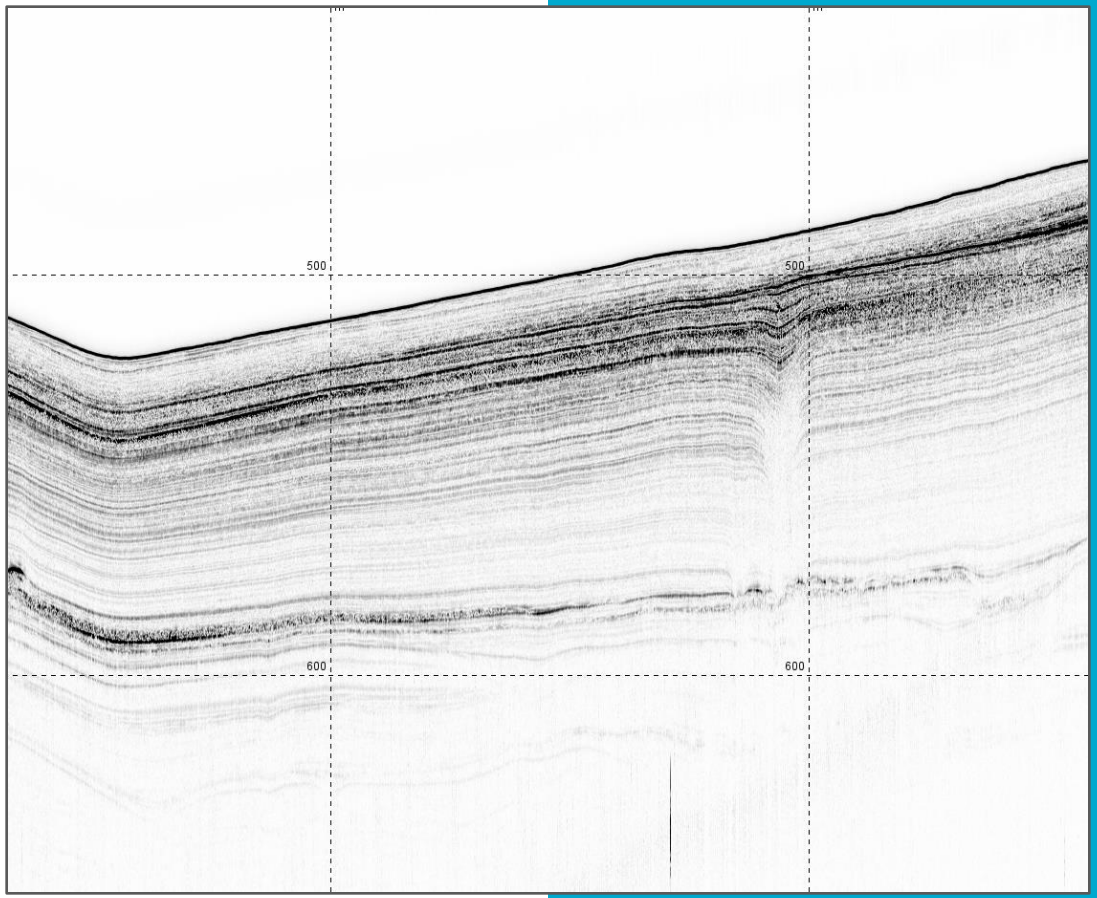
~100m Penetration

Marine National Facility

Gallery

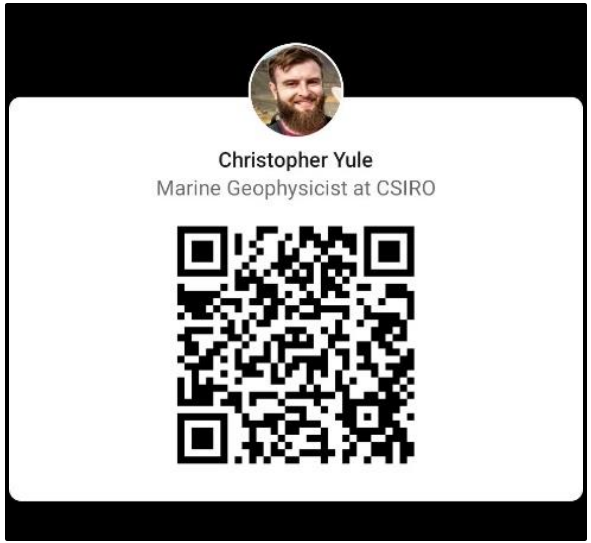


Gallery



100m+ Penetration

Thank you



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