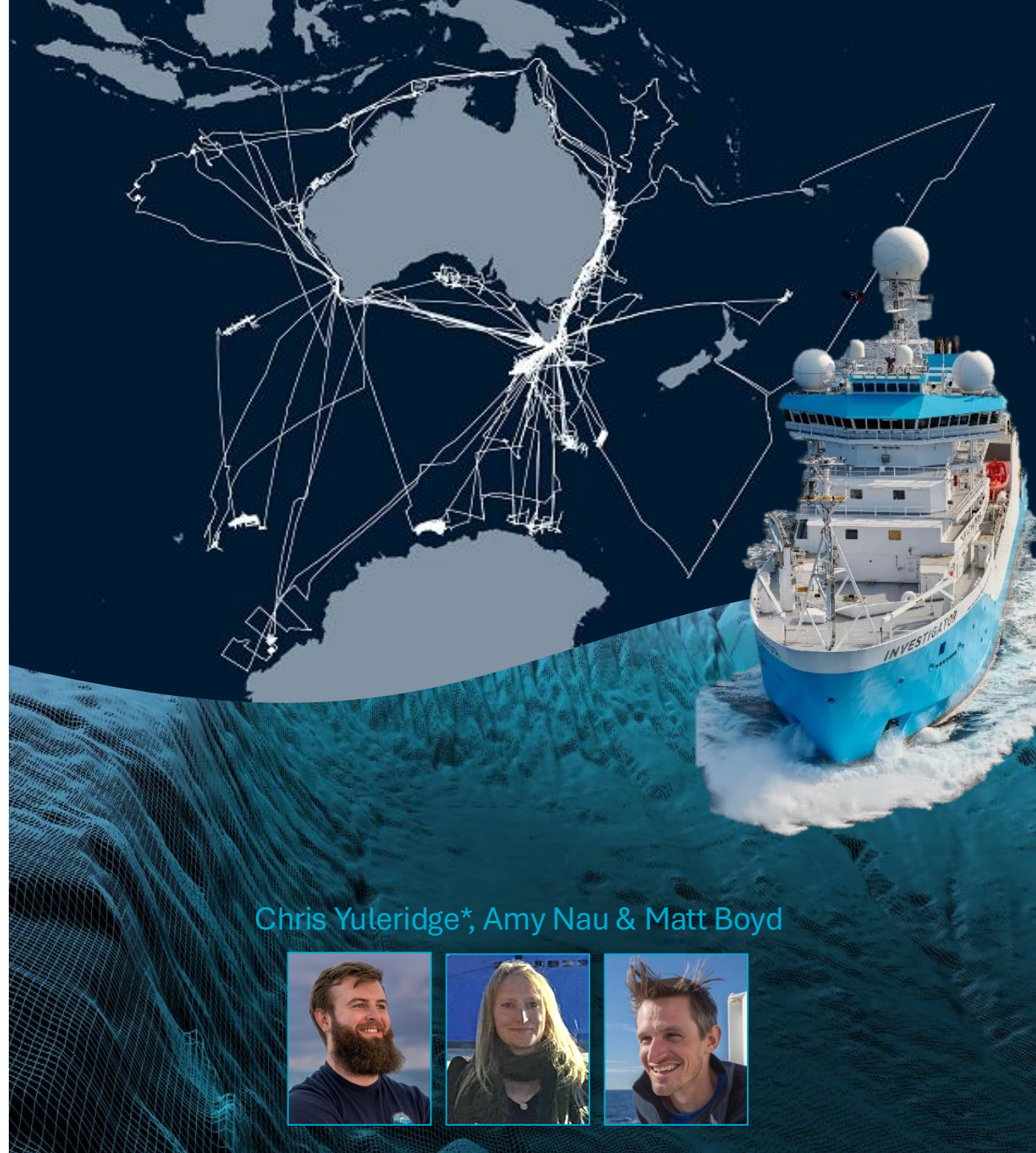




CSIncRO: CSIRO's establishment and continued development of acoustic synchronisation protocols using K-Sync

FEMME 2026, Genoa, Italy



Chris Yuleridge*, Amy Nau & Matt Boyd





Contents

- Marine National Facility & RV *Investigator*
- CSIncRO: K-Sync Protocols
 - IN2026_V04: Great Barrier Reef Marine Park
- Case Studies of Effective Use of CSIncRO:
 - IN2025_V06: Coral Sea, Tasmanid Seamounts
 - IN2025_V05: Tonga, Hunga Tonga-Hunga Ha'apai
- Access Data and Sea time
- Questions

Marine National Facility & RV *Investigator*



The **MNF** is a national collaborative research infrastructure funded by the Australian Government & operated by **CSIRO** on behalf of the nation.

Dedicated ocean research capability for Australia:

- *RV Investigator*
- Scientific equipment
- Technical expertise
- Access to 40 years of data

Marine National Facility & RV *Investigator*



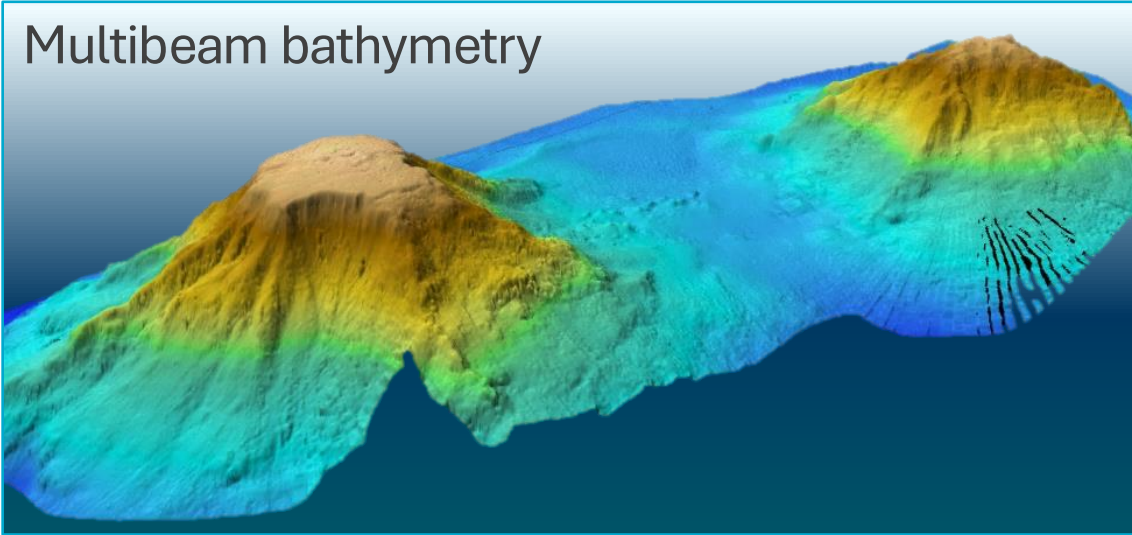
RV *Investigator* - multidisciplinary research operating from equator to ice edge

- ▲ Geoscience
- 🌊 Oceanography
- ☀️ Atmospheric
- 🐟 Biological

- 94 m length, 60 day endurance and ~10,800 NM range
- 300 days of marine research each year
- 40 researchers/technicians and 20 crew
- 5 core technical support teams & a voyage manager, providing 24hr support

Mapping data we collect

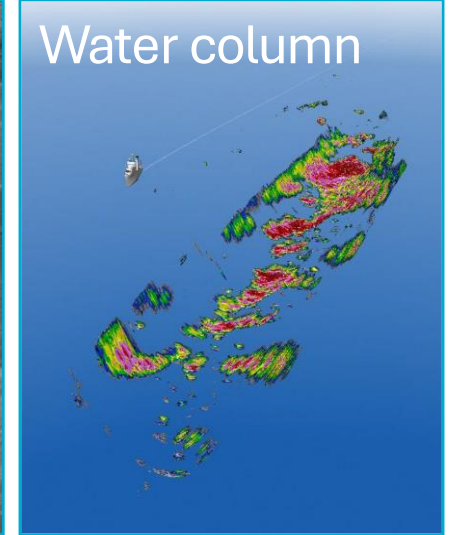
Multibeam bathymetry



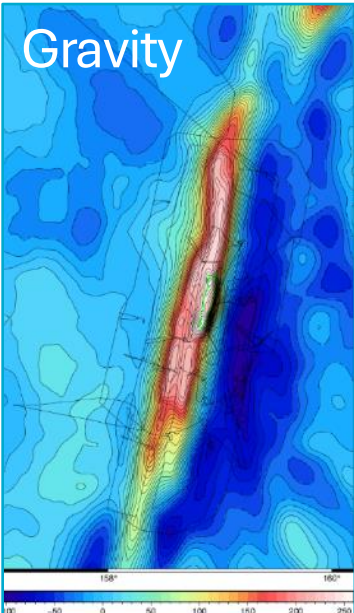
Backscatter



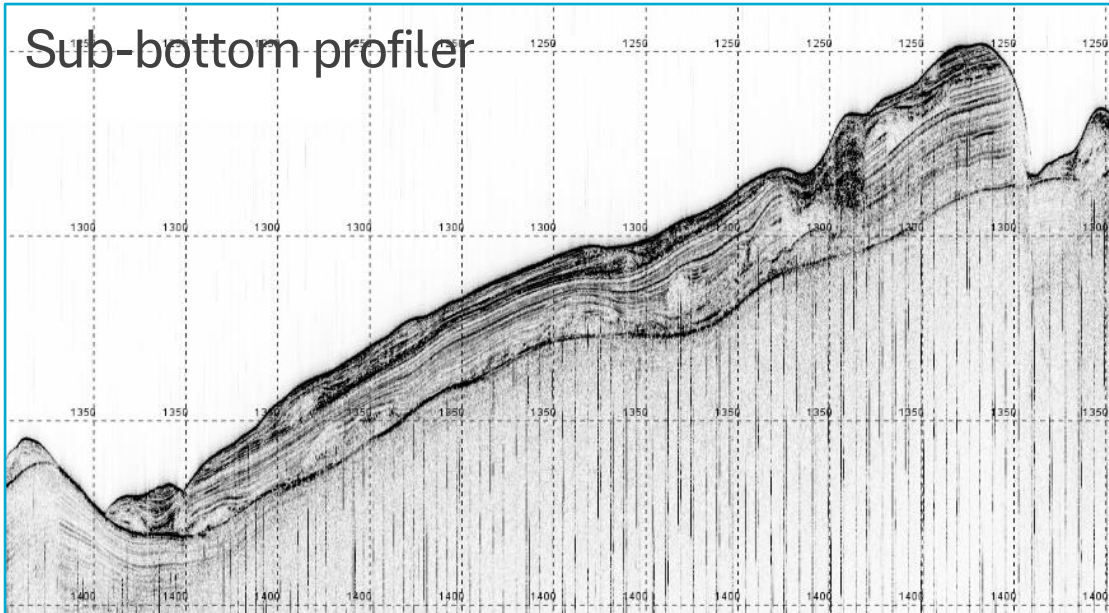
Water column



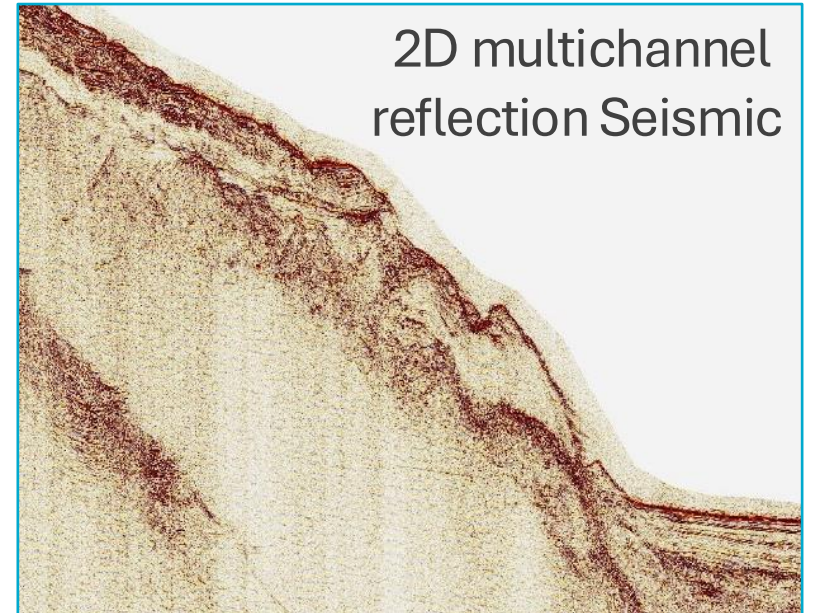
Gravity



Sub-bottom profiler



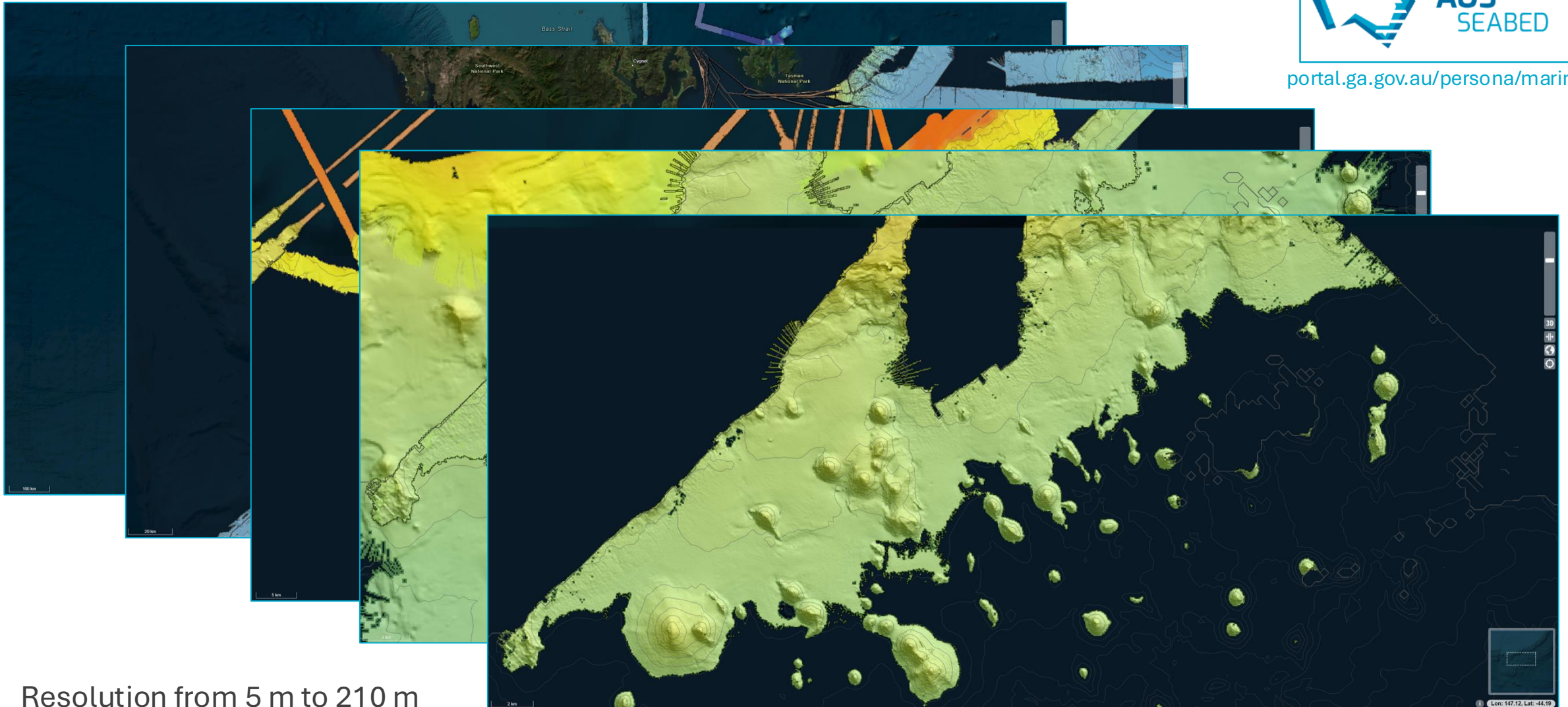
2D multichannel
reflection Seismic



Multi-resolution bathymetry grids



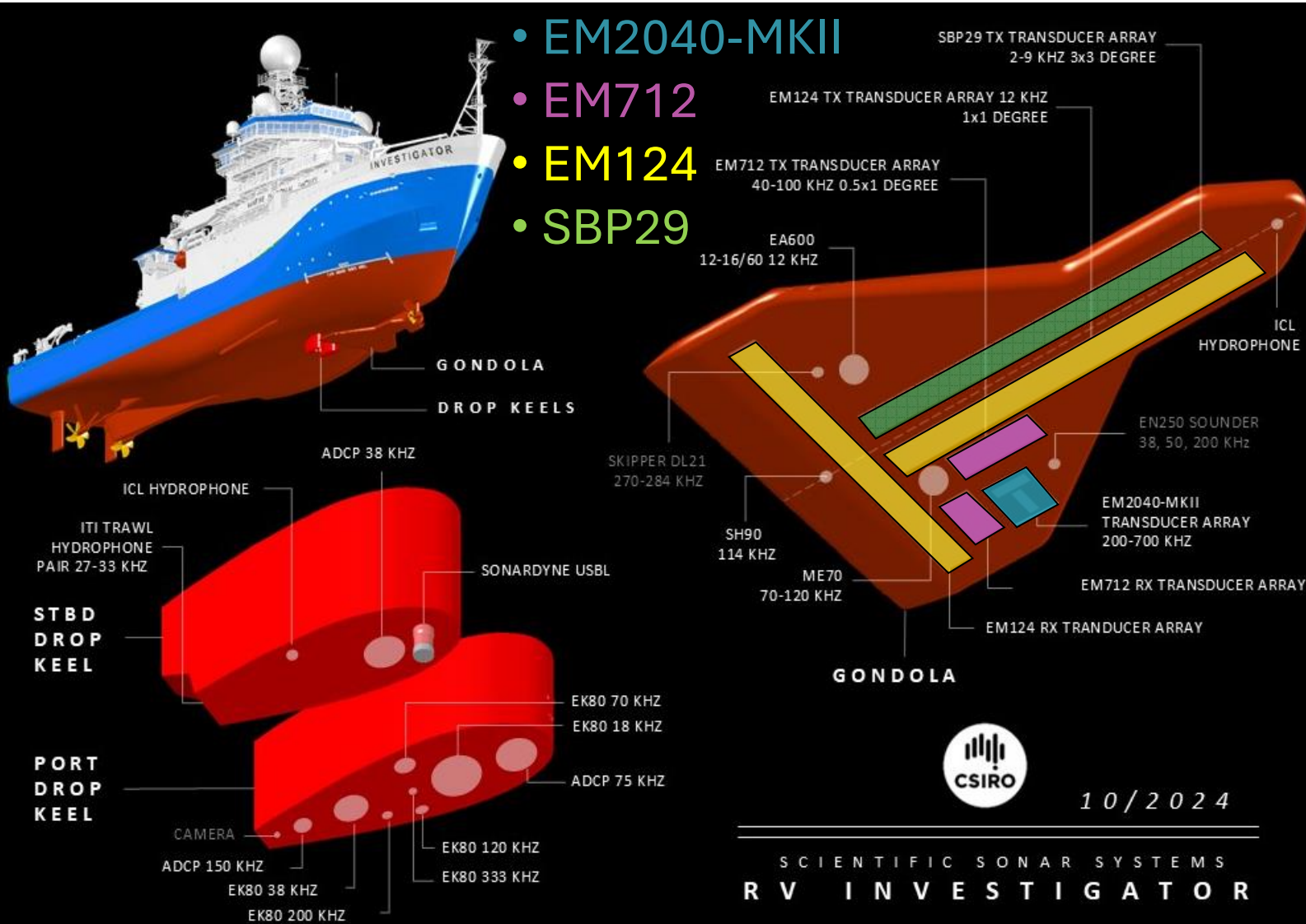
portal.ga.gov.au/persona/marine



Resolution from 5 m to 210 m



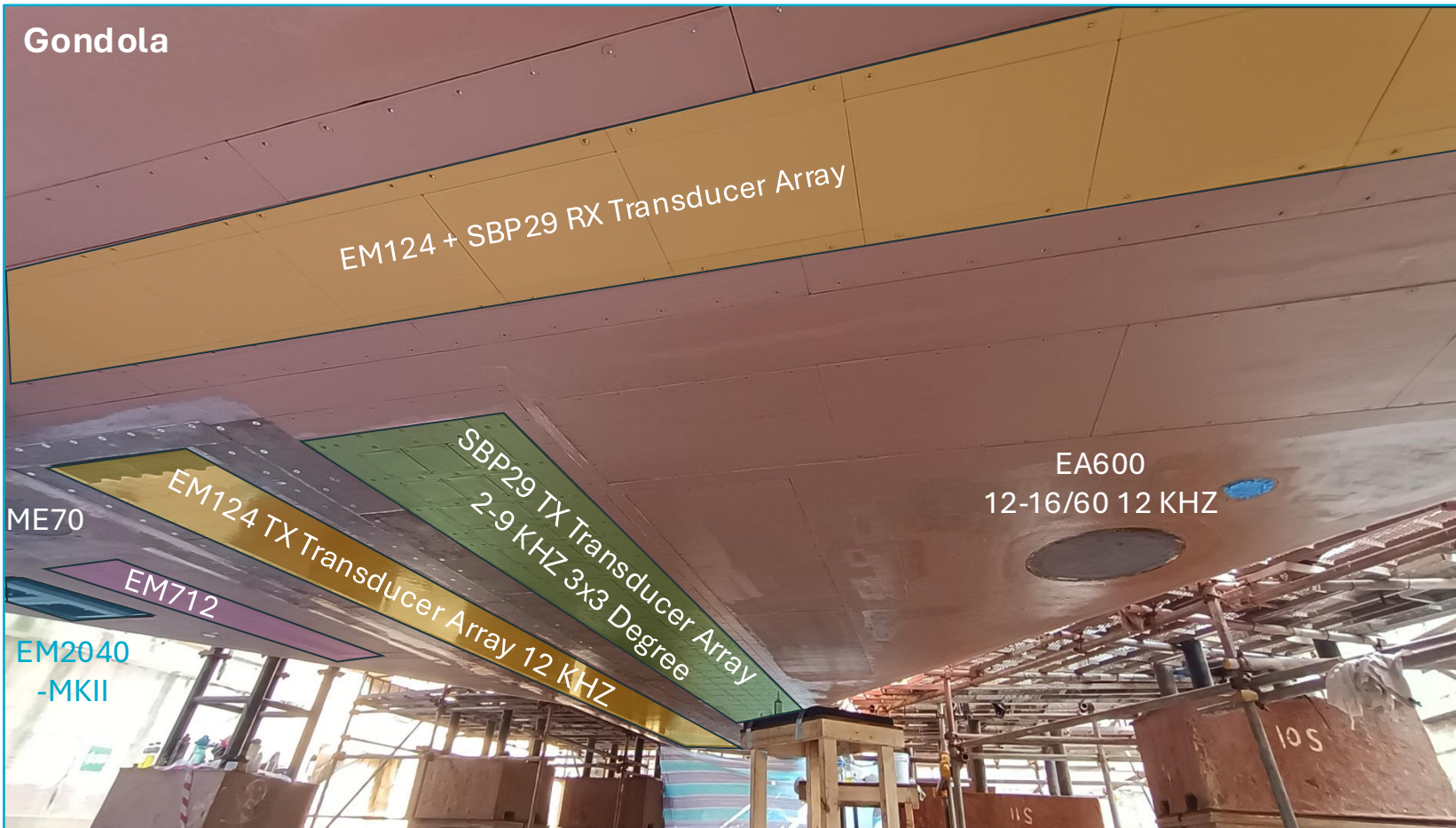
New Echosounders, Future of Marine Discovery





Installing Sounders 2024

Gondola

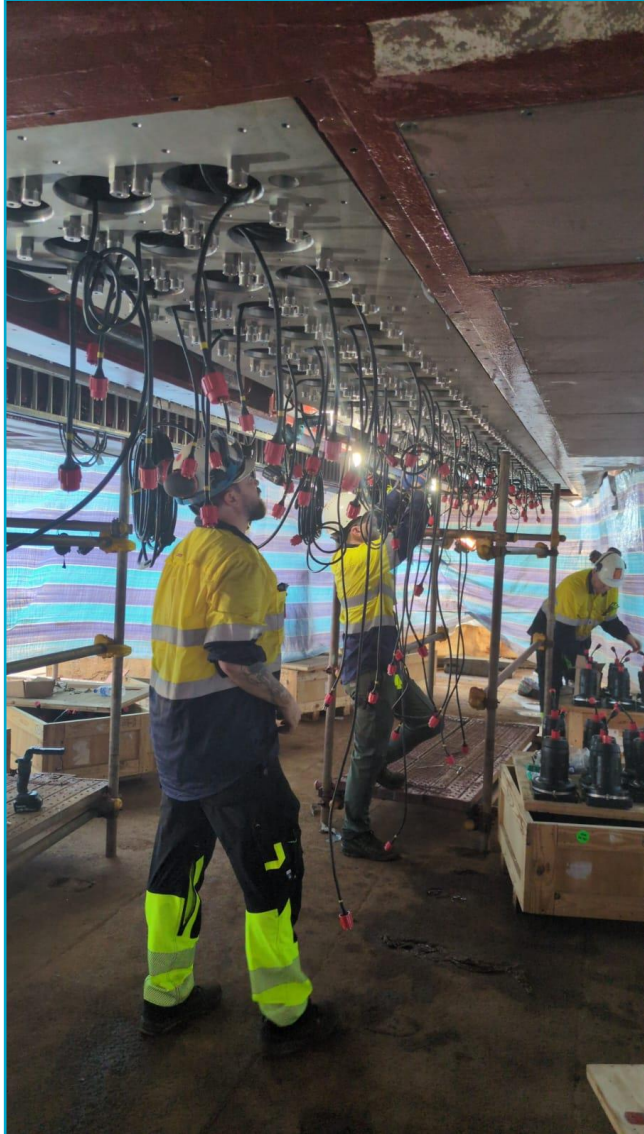


Transducer faces on the base of the gondola ↑
Transducer faces on the base of the port drop keel →

Port Drop Keel



Installing Sounders 2024



CSIRO and Kongsberg supervising Kim

*Working on the underside
of the SBP29*



Dan approves



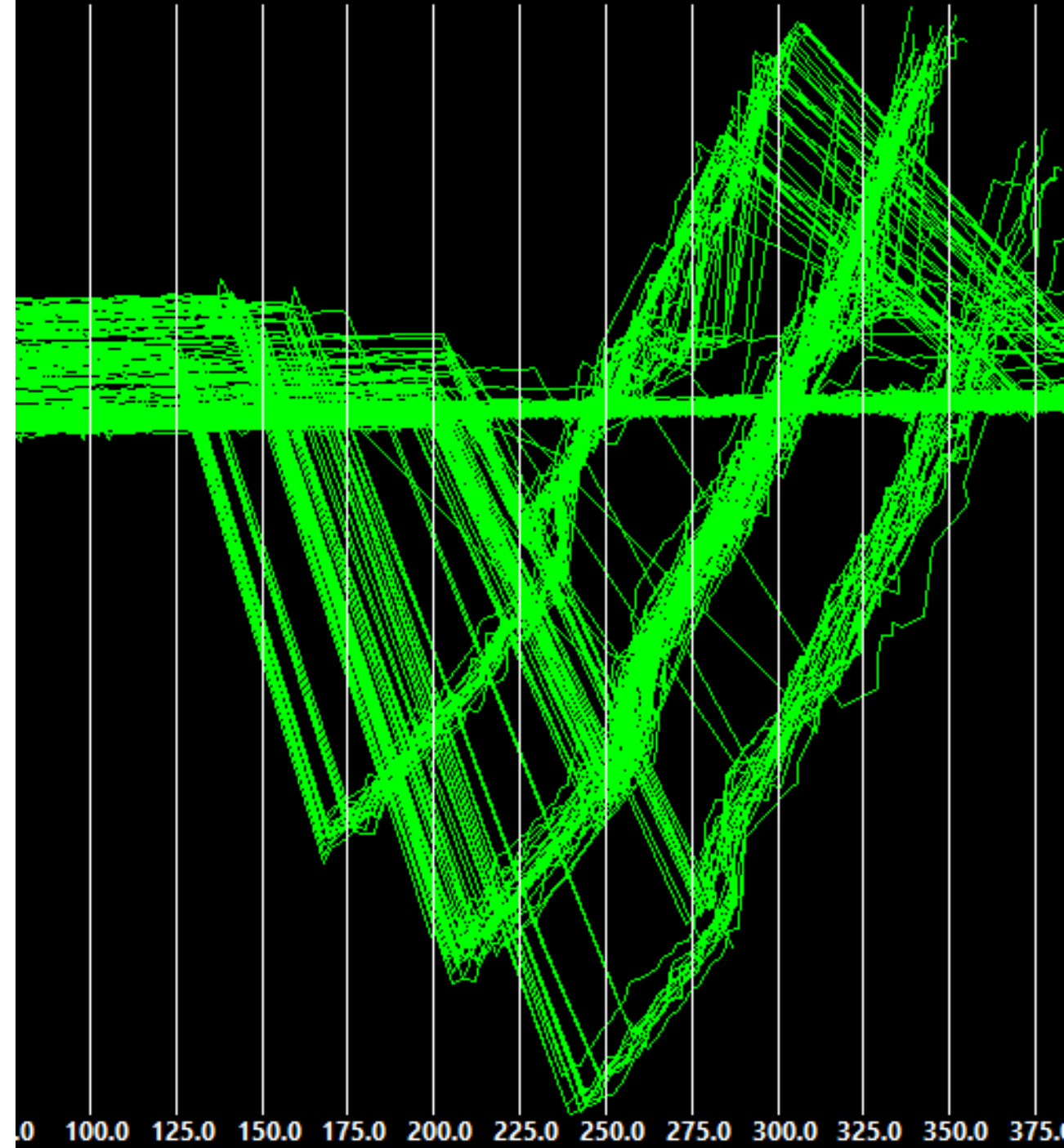
Transceiver
room



Everything is connected
through K-Sync
version ~~2~~ 3(?)



CSIncRO: K-Sync Protocols





CSIncRO: Ksync Protocols

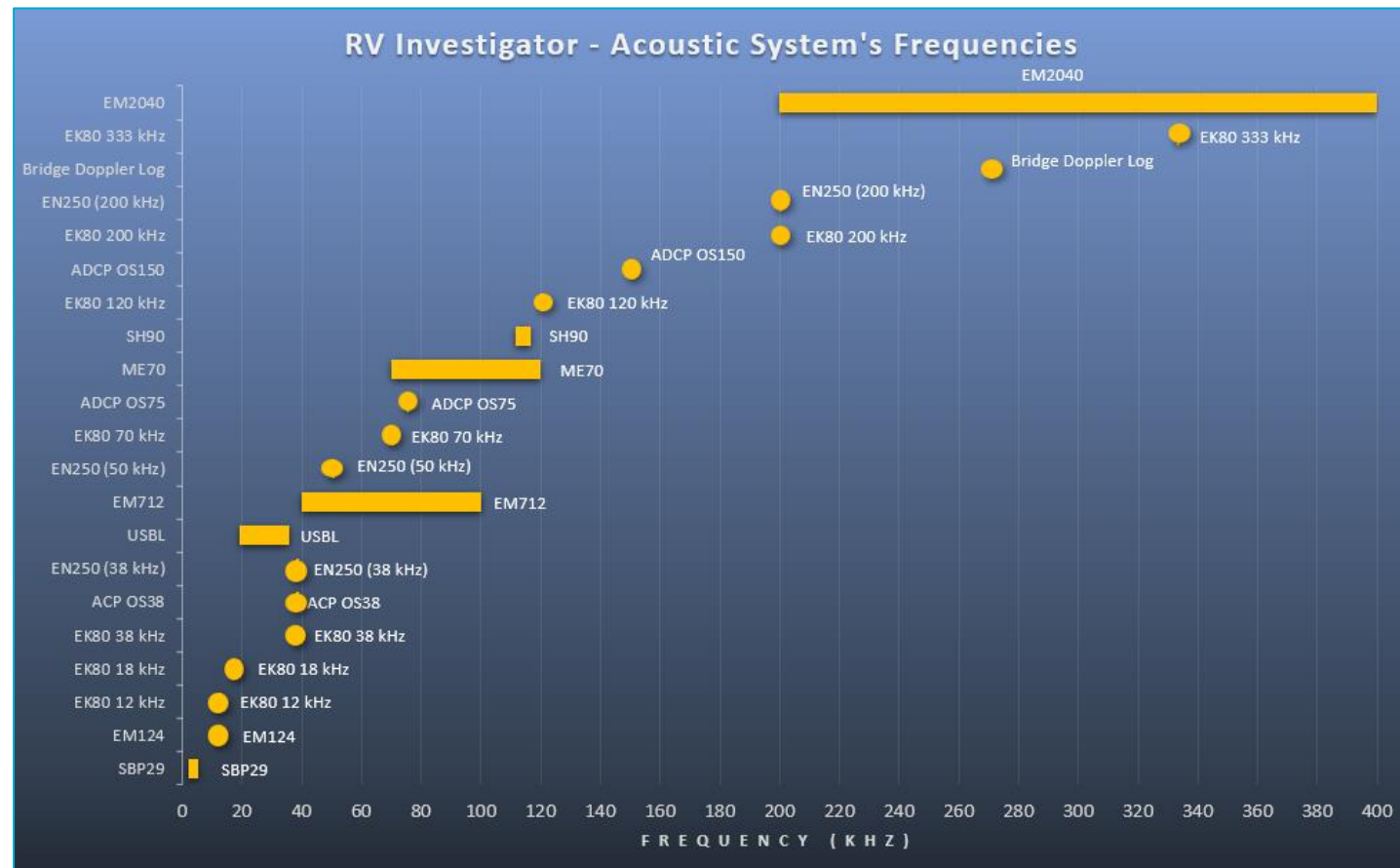
Why Ksync?

RV Investigator operates many acoustic systems including conflicting frequencies across all depth profiles

- Science participants require synchronous operation of conflicting systems
- Operational challenges considered an opportunity for innovation

Implementation:

- Systematic testing on sea trials to find optimal combinations / groups
- Started with EK80 optimization
- Recently updated systems required re-evaluated protocols adjusted for new noise signatures and addition of the EM2040



Range → System ↓	0-120 V. Shallow	120-250 Shallow	250-1000 Medium	>1000 Deep
EM2040	X	Optional		
EM712		X	X	
EM124			>500	X
EK80	X	X	X	X
OS75			X	X
OS150	X	X	X	X
SBP29	X	X	X	X



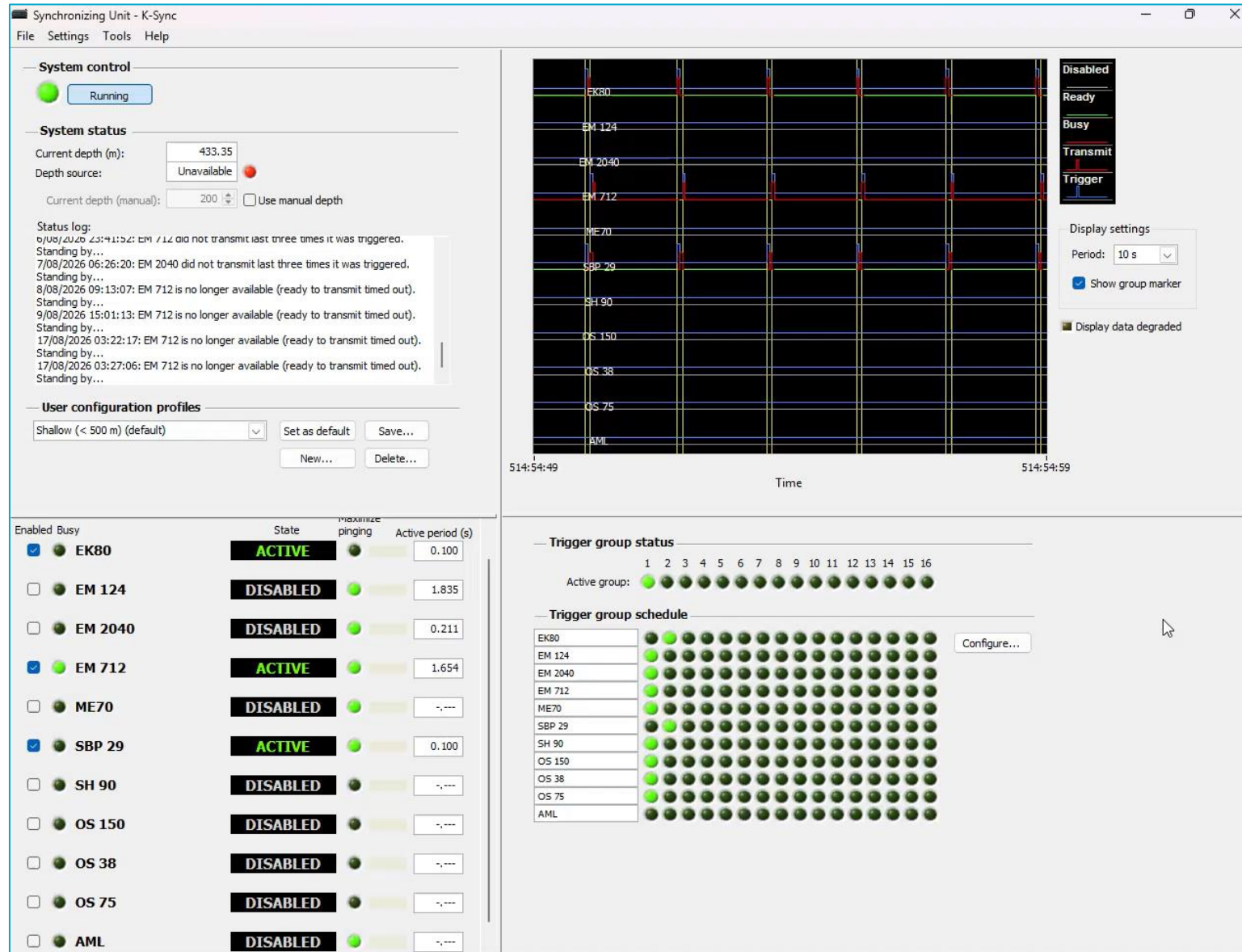
CSIncRO: Ksync Protocols

Very Shallow 0-120 m	System	Shallow 120-250 m
Group 1: External input (300kHz)	EM2040	Group 1: External input, beam angles 65 max (optional)
OFF	EM712	Group 1: External input, beam angles 65 max
OFF	EM124	OFF
Group 2: 250m range, 400 ms fixed period	EK80	Group 2: 250m range, 400 ms fixed period
OFF	OS38	OFF
OFF	OS75	OFF
Group 1: Bottom track	OS150	Group 1
Group 1 & 2: Ricker, External Input	SBP29	Group 1,2: Ricker, External Input

Medium 250-1000 m	System	Deep >1000 m
OFF	EM2040	OFF
Group 1: External input, beam angles 65 max	EM712	OFF
Group 1: External input, beam angles 65 max, >500m	EM124	Group 1: External input, beam angles 65 max
Group 1: 1500m range, 2100 ms	EK80	Group 1: 1500m range, CSinCRO-DPT, Master (Ksync v2 only)
OFF	OS38	OFF
Free run	OS75	Free run
Free run	OS150	Free run
Group 1: Linear chirp, External Input	SBP29	Group 1: Linear chirp, External input



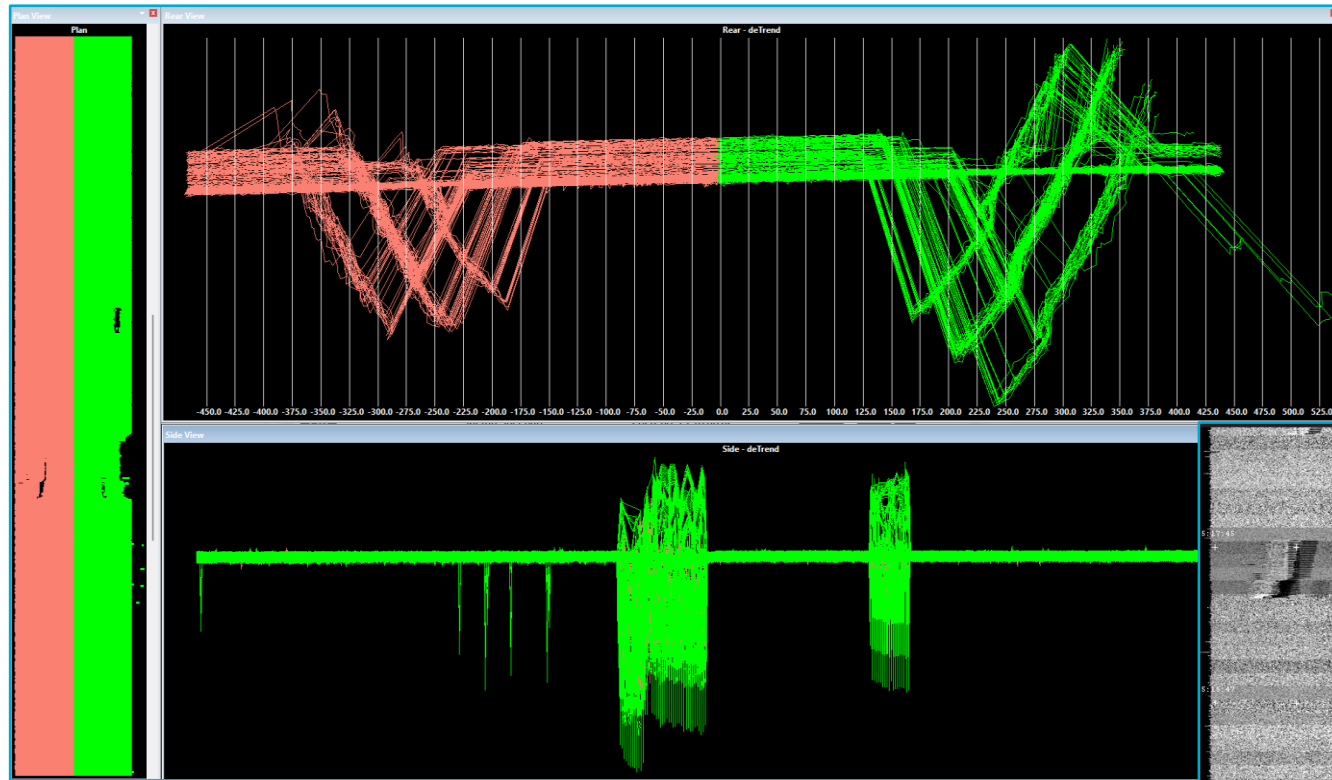
CSIncRO: Typical settings in mid-water



Real-time capture
from IN2026_V04

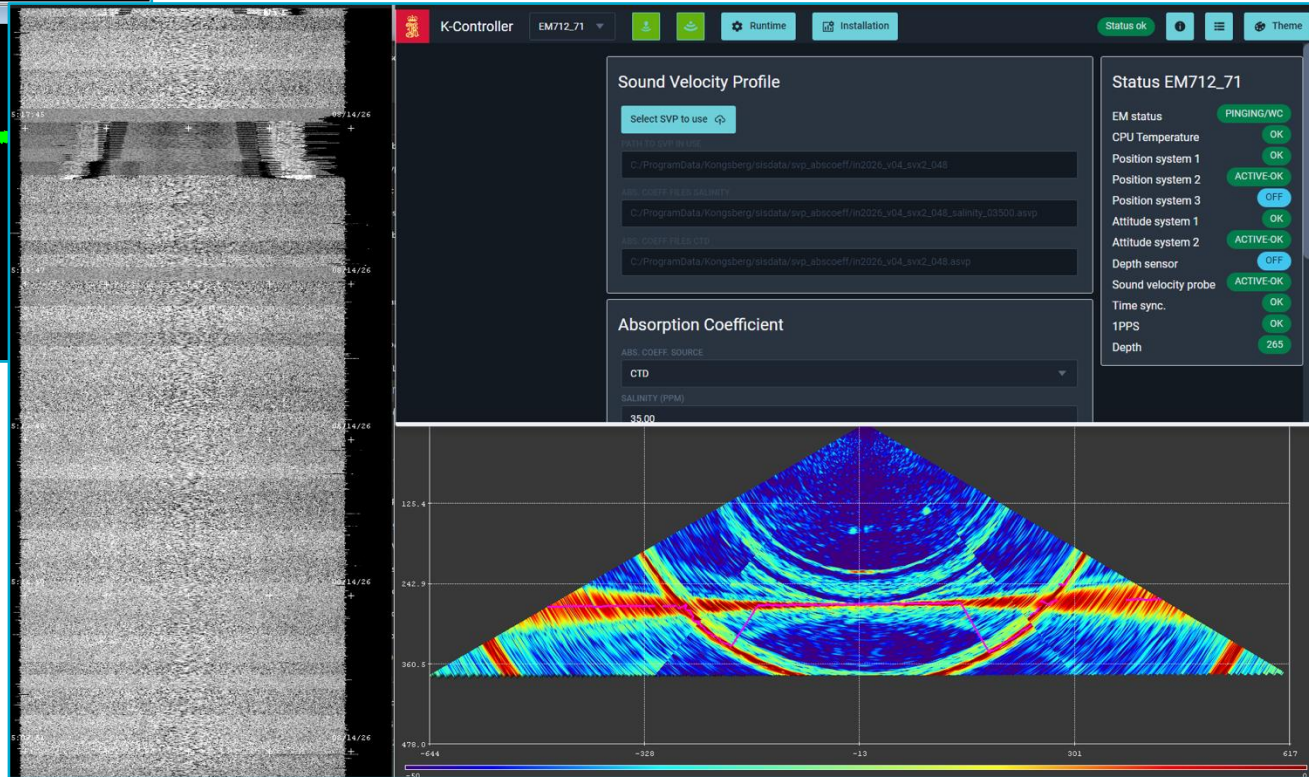


CSIncRO: Unsynced SBP noise in EM712



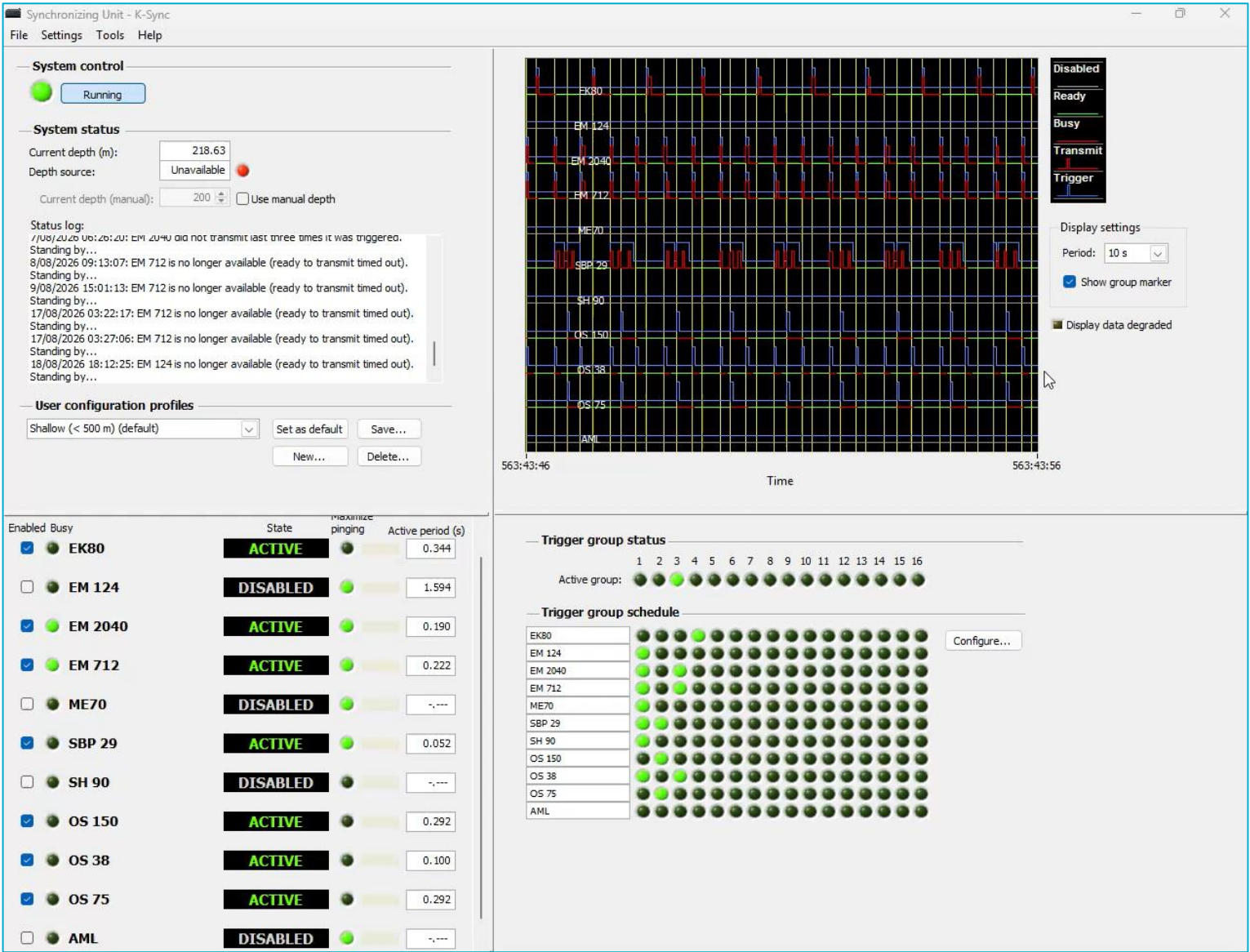
Caris display of interference

SIS5 display of interference in water column and backscatter



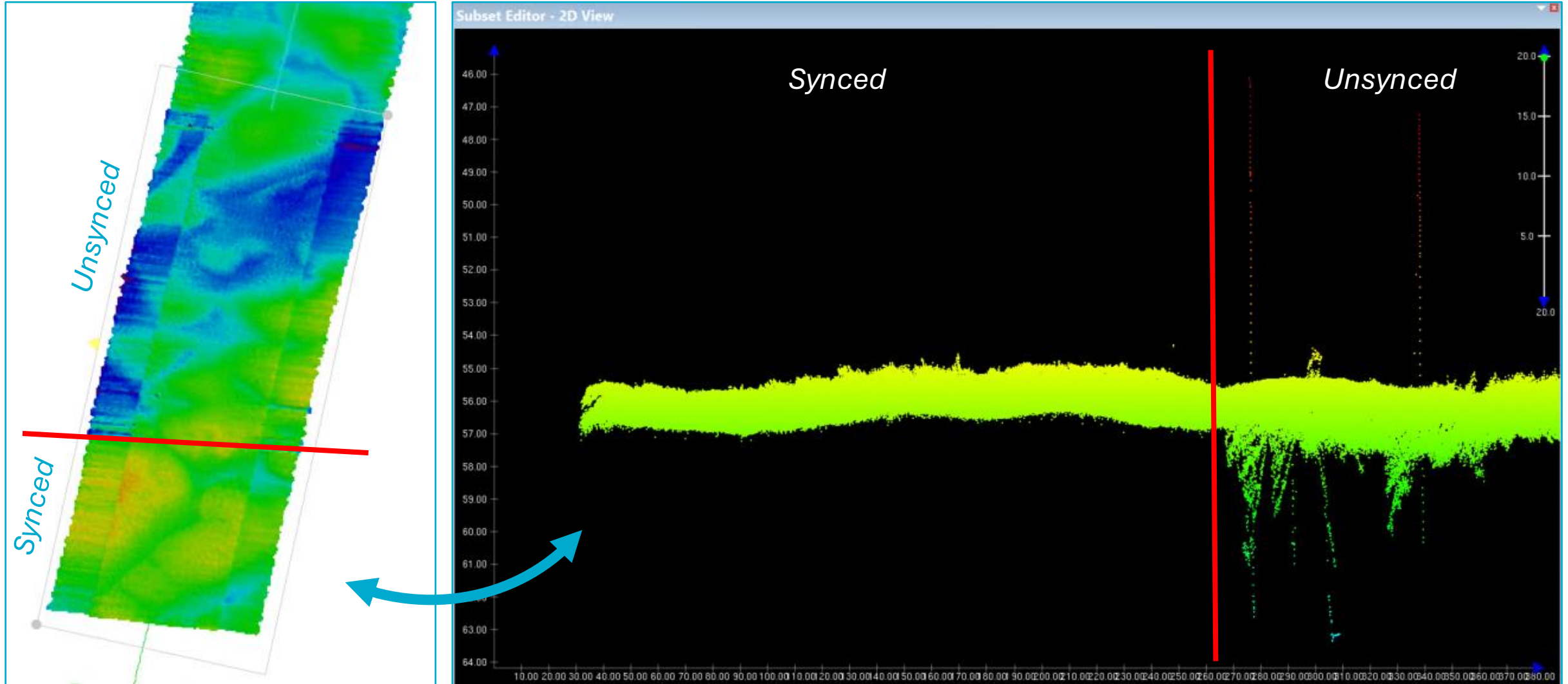


CSIncRO: Syncing 7 Sounders (under 100 m)



Real-time capture
from IN2026_V04

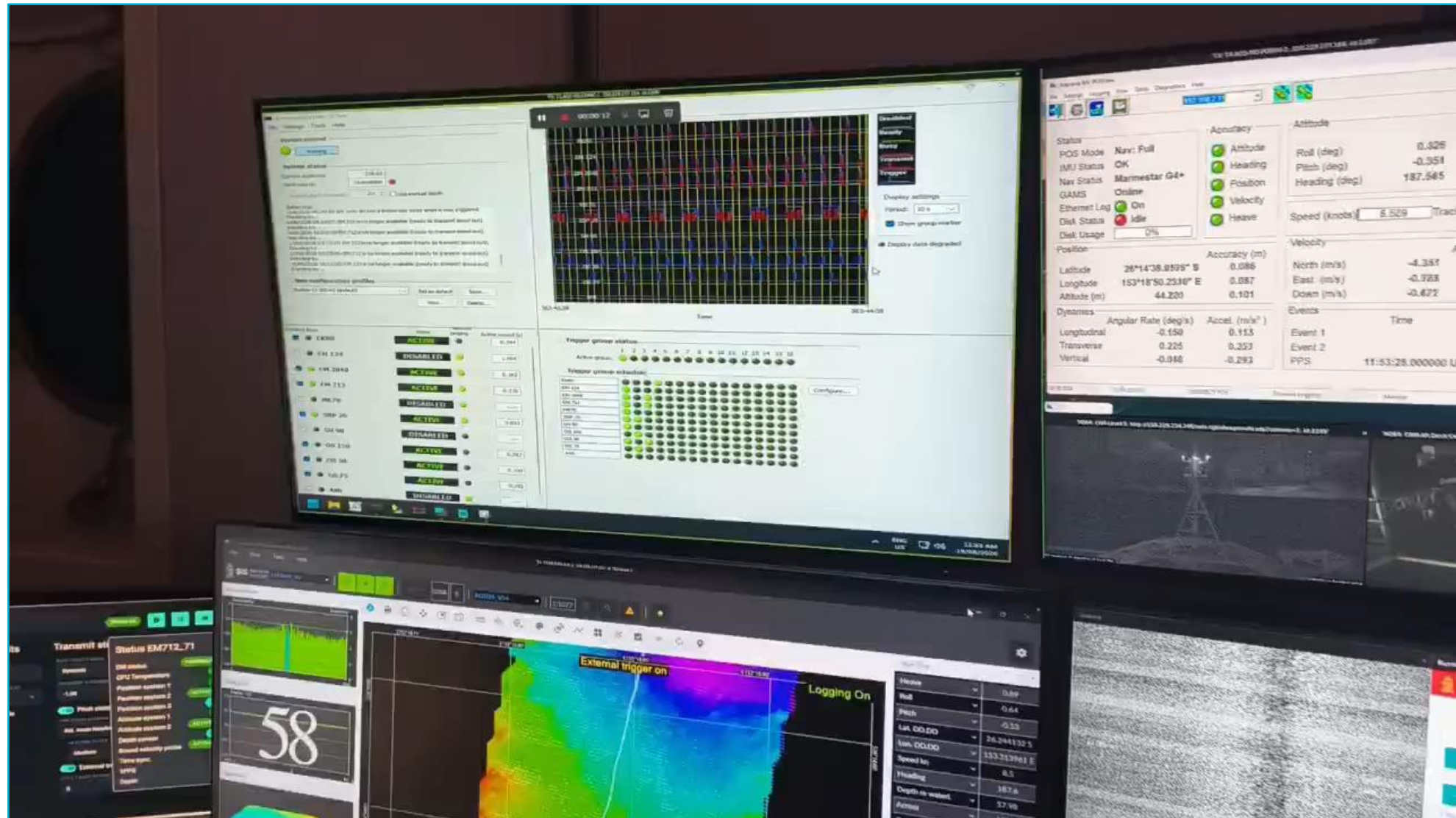
CSIncRO: Syncing 7 Sounders (under 100 m)



Caris displays of EM2040 and EM712 data synced and unsynced

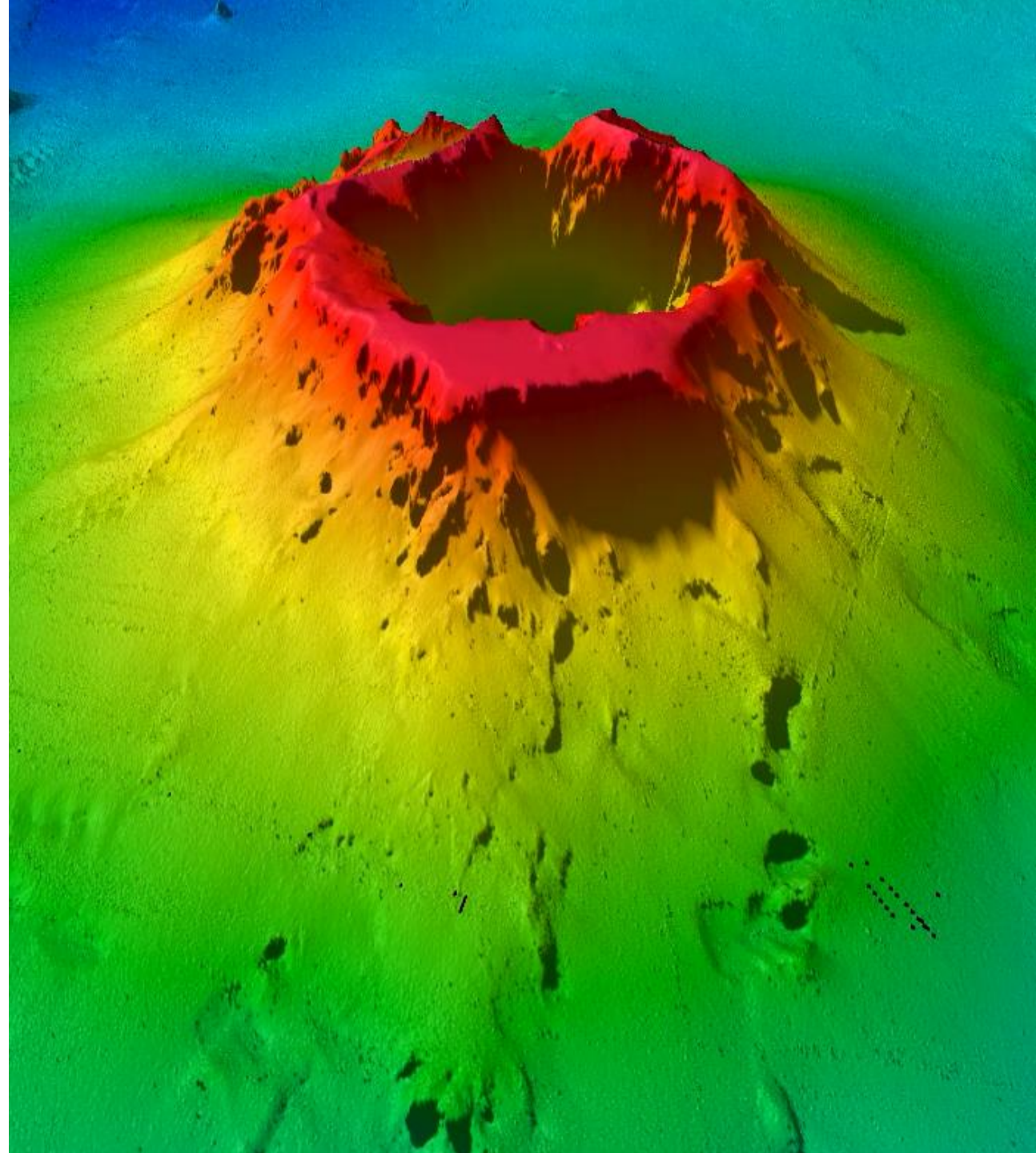


CSIncRO: Syncing 7 Sounders (under 100 m)



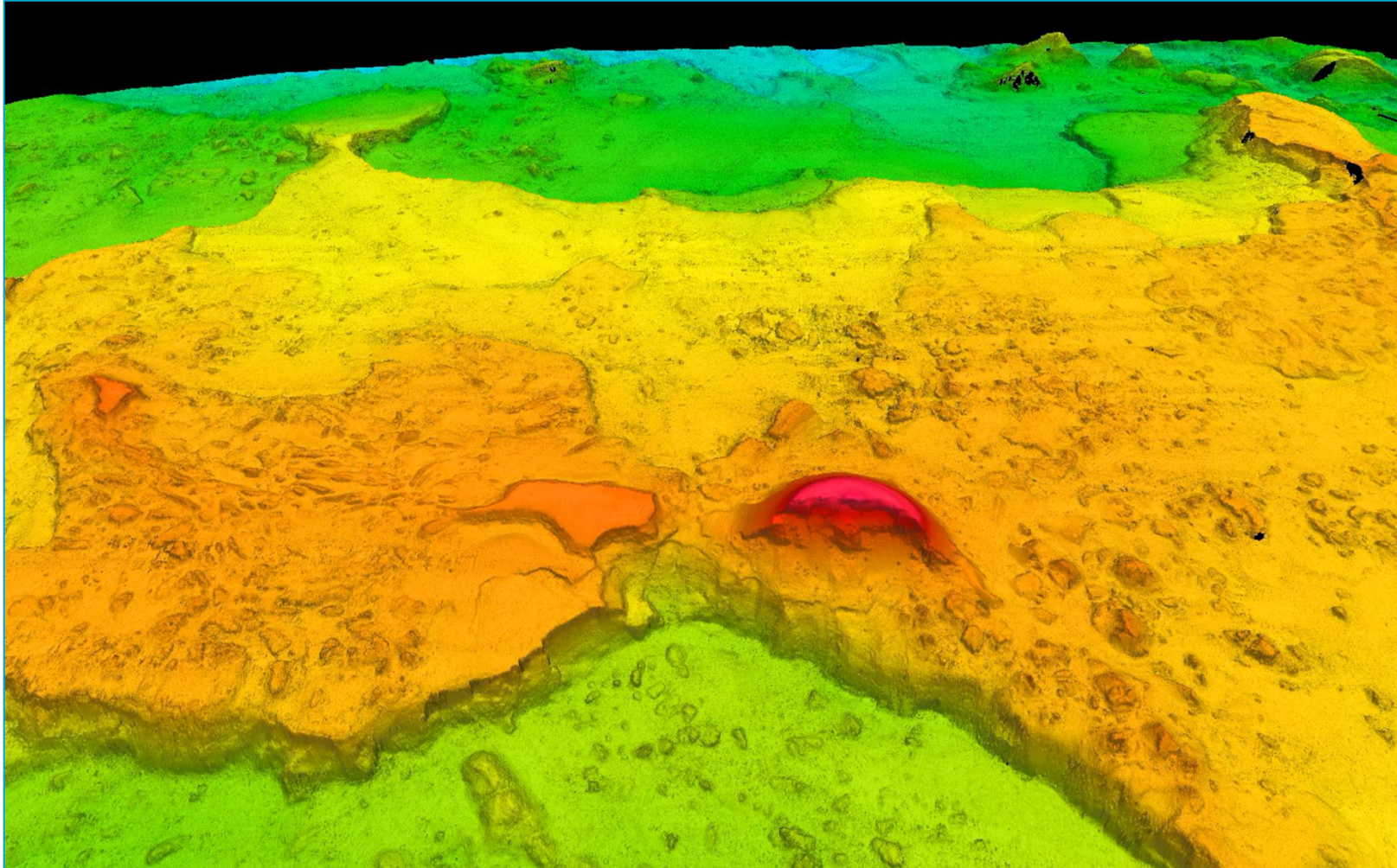
Real-time capture from IN2026_V04

Case Studies of Effective Use of CSIncRO





Coral Sea, Tasmantid Seamounts (IN2025_V06)



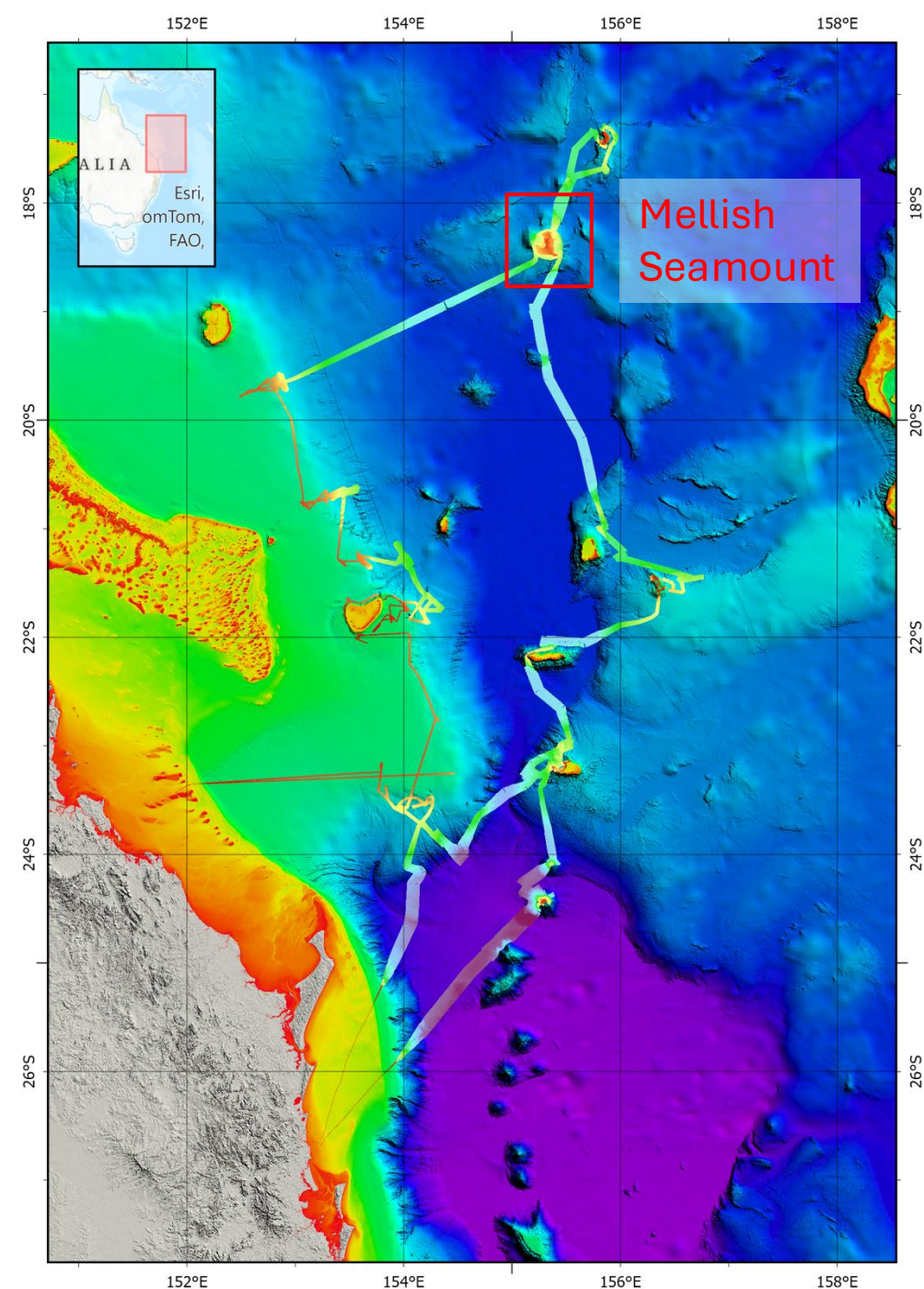


Coral Sea, Tasmantid Seamounts

Research Question: Are marine ecosystems on this extinct volcanic chain well understood?

- Coral Sea Marine Park ~1,000,000 km²
- Protects 34 reef areas, and 67 cays and islets
- Focus on the Tasmantid Seamount Chain
- Understanding of regional biodiversity
- Inform management by Parks Australia

*IN2025_V06 multibeam bathymetry
overlay on regional grid*





Coral Sea, Tasmanid Seamounts

- Mapped majority of the Mellish Seamount with 3 new multibeam (EM124, EM712, EM2040)
- Confirmed 30 m deep navigational hazard
- Identified new atoll reef

Map product illustrating the geometry of the Mellish Seamount including a 30-meter-deep active reef system

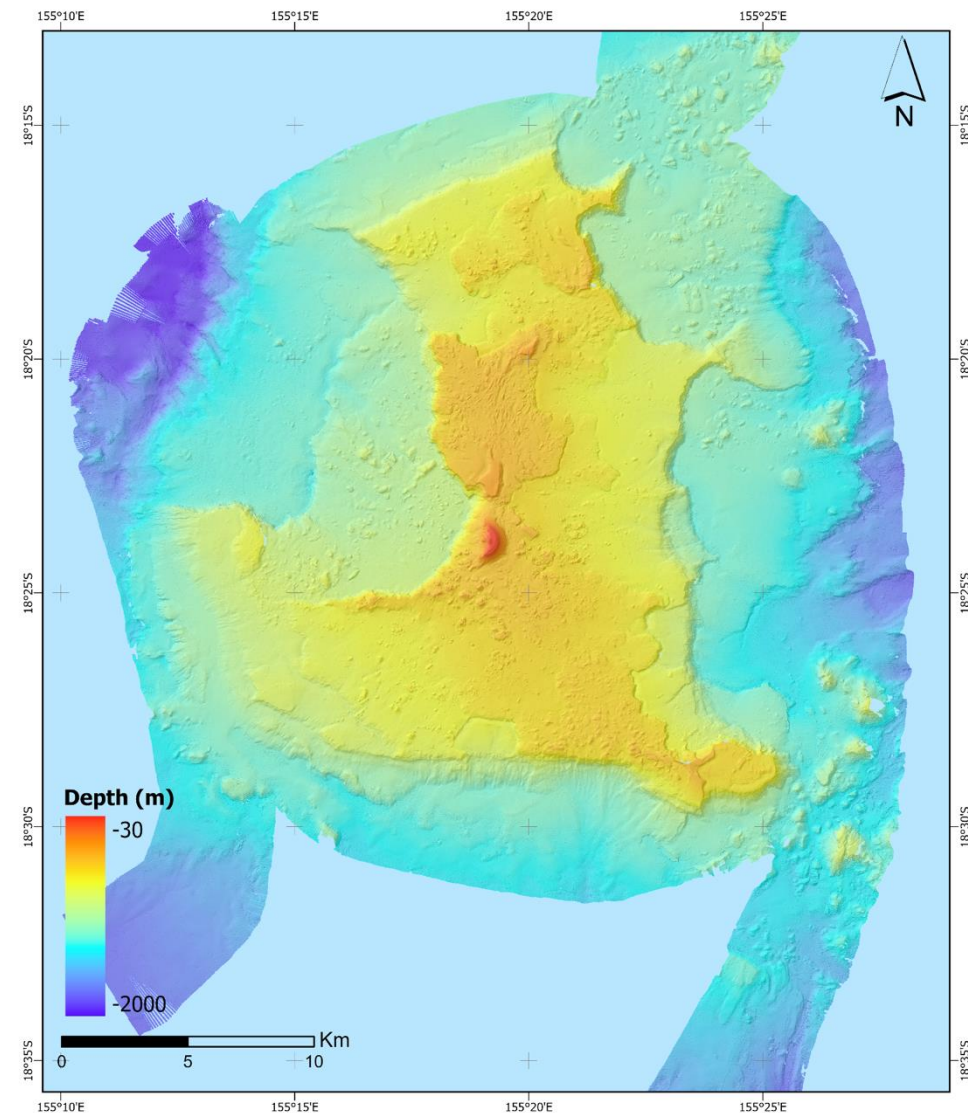


Marine
National Facility

AUSTRALIA'S NATIONAL
SCIENCE AGENCY

RV Investigator Voyage IN2025_V06

Mellish Seamount, Tasmanid Seamount Chain, Coral Sea Marine Park

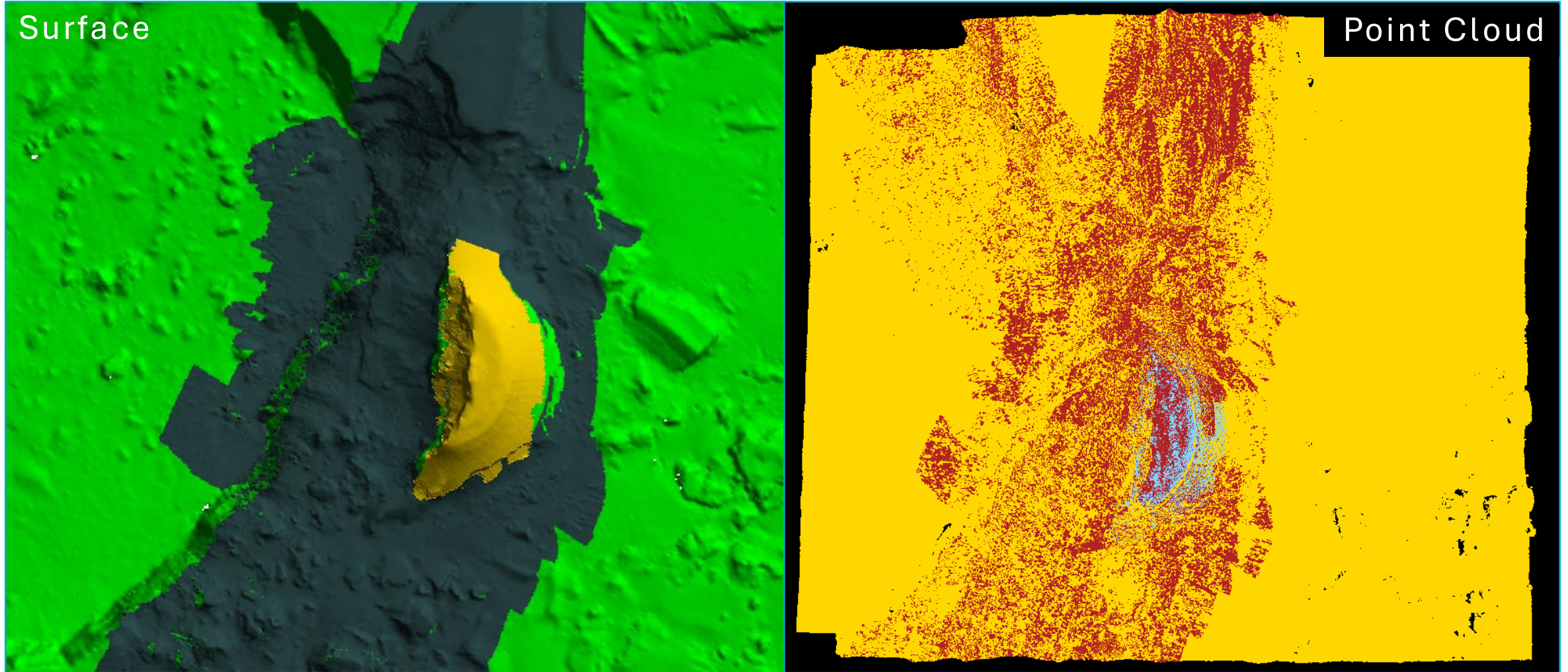


As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Unlocking a better future for everyone.

ACKNOWLEDGEMENTS
Esri, TomTom, Garmin, NOAA/NASA, USGS

Coral Sea, Tasmanid Seamounts

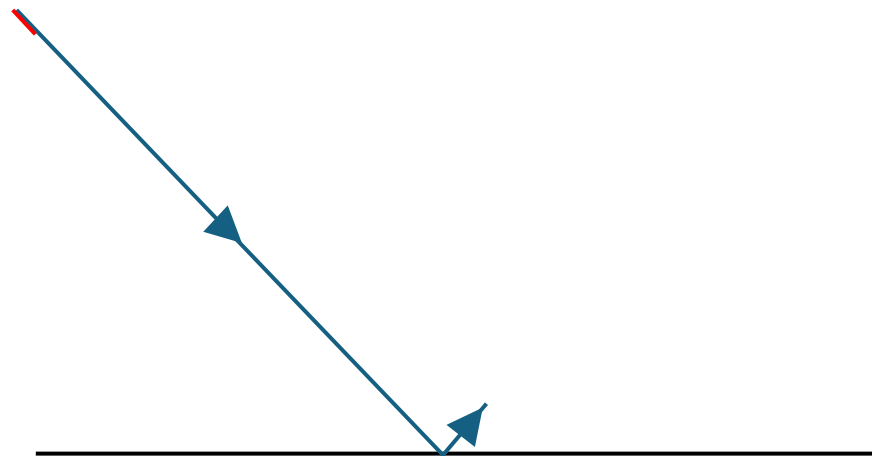


Green = EM124, Grey = EM712, Yellow = EM2040

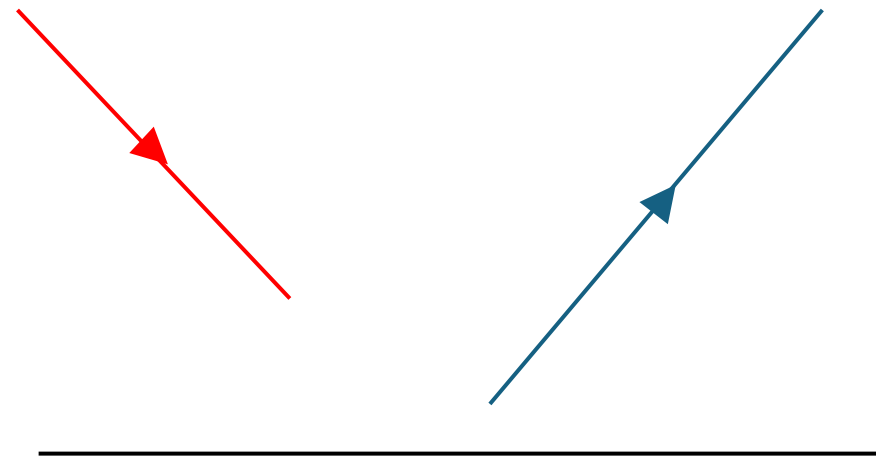
Yellow = EM124, Red = EM712, Blue = EM2040

Ping Rate: Golden Ratio

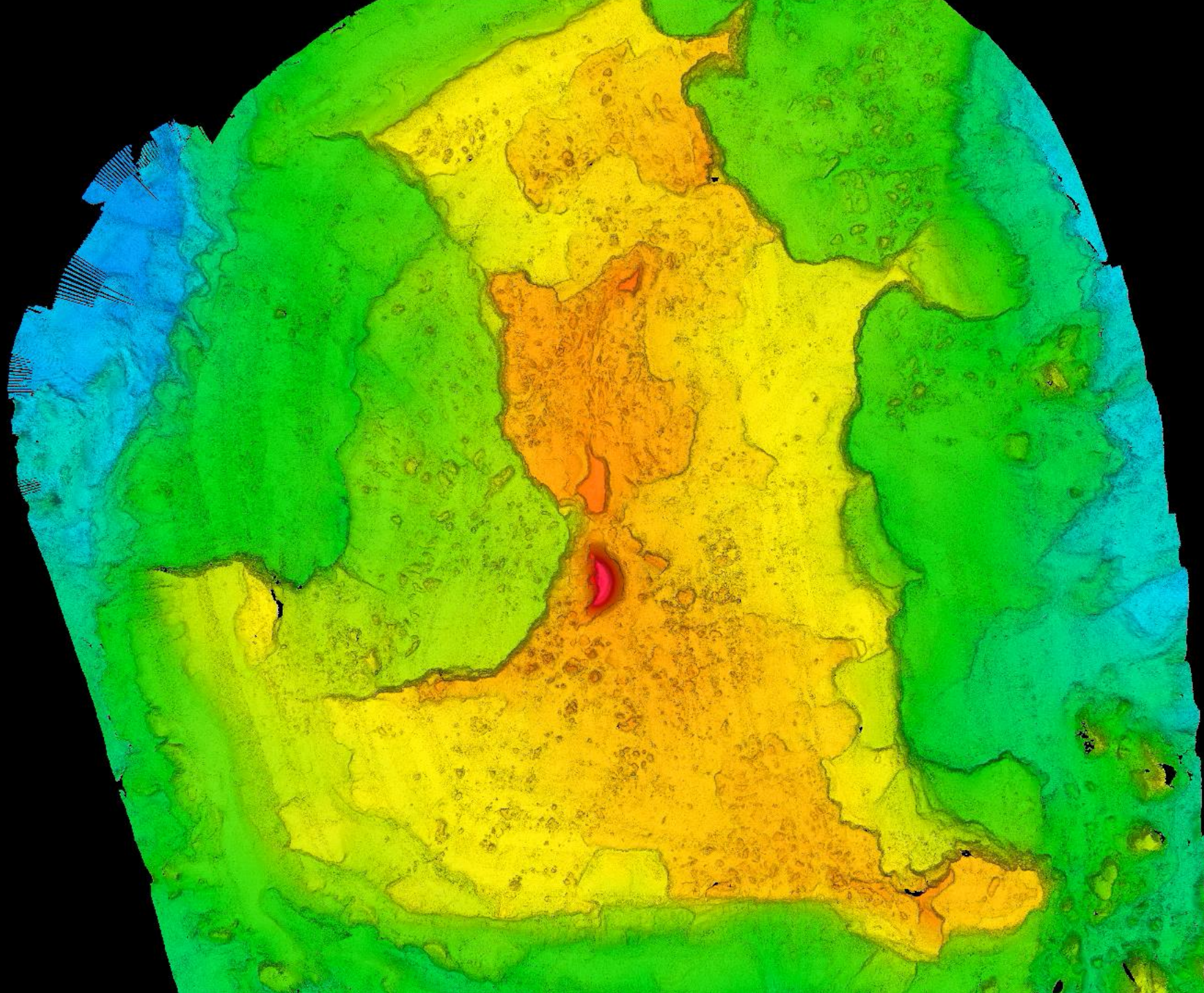
- Automatically adjusted the ping rate to $\frac{2}{3}$ water depth
- Maximises ping rate while minimising interference
- The first ping is returning $\frac{1}{6}$ water depth before next ping starts
- No overlapping bottom interaction within ping cycle



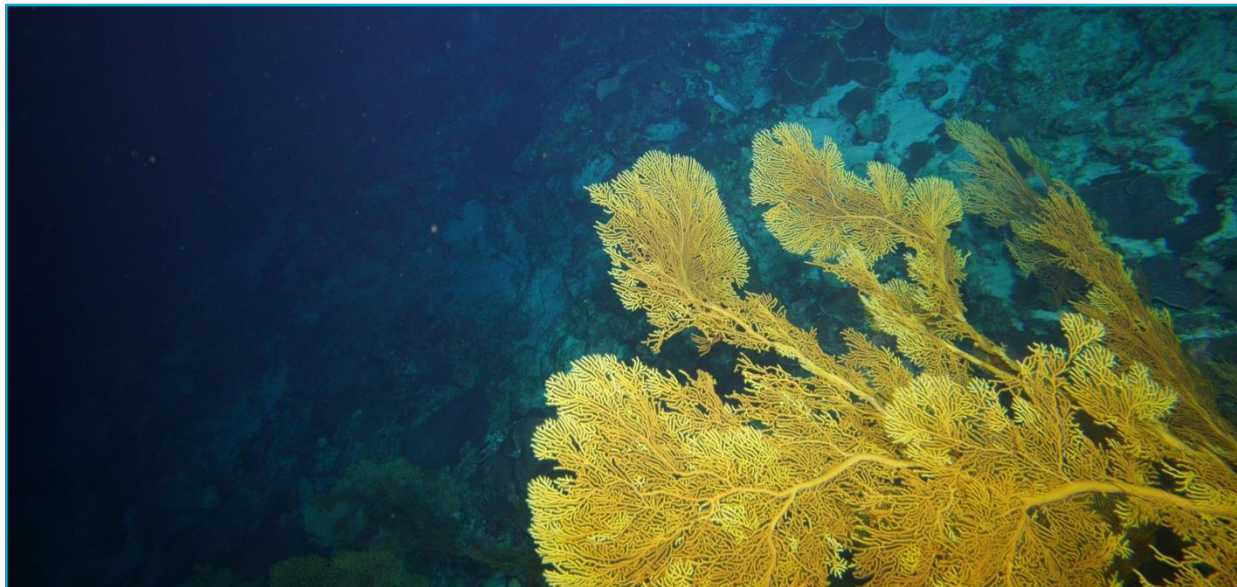
Ping 1: Travels $\frac{2}{3}$ water depth
Ping 2: Starts



Ping 1: Reaches receiver
Ping 2: Travels $\frac{1}{3}$ water depth

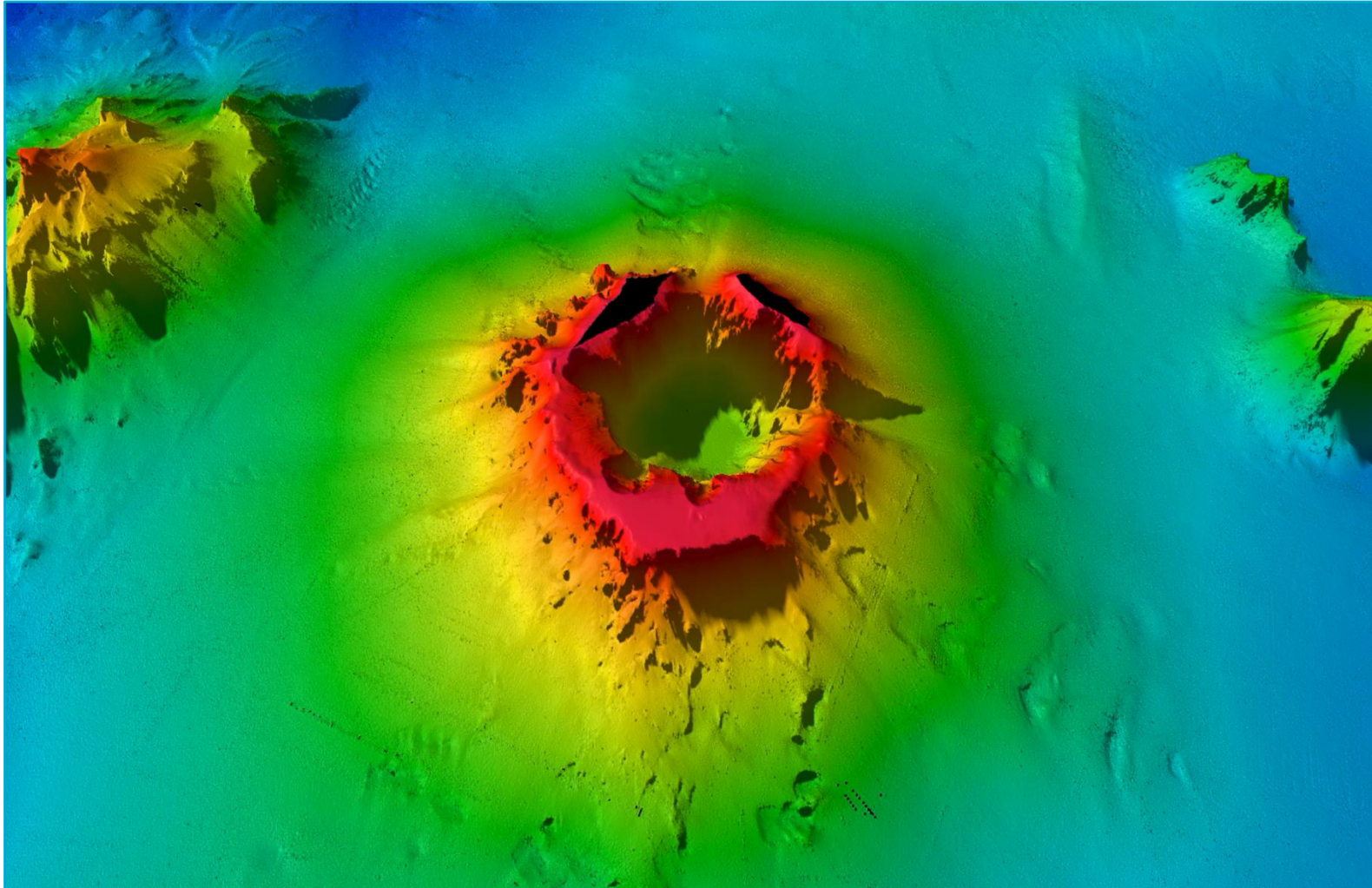


Previously Undocumented Reef





Tonga, Hunga Tonga-Hunga Ha'apai (IN2025_V05)



UNIVERSITY of
TASMANIA
UTAS led voyage



Tonga, Hunga Tonga-Hunga Ha'apai

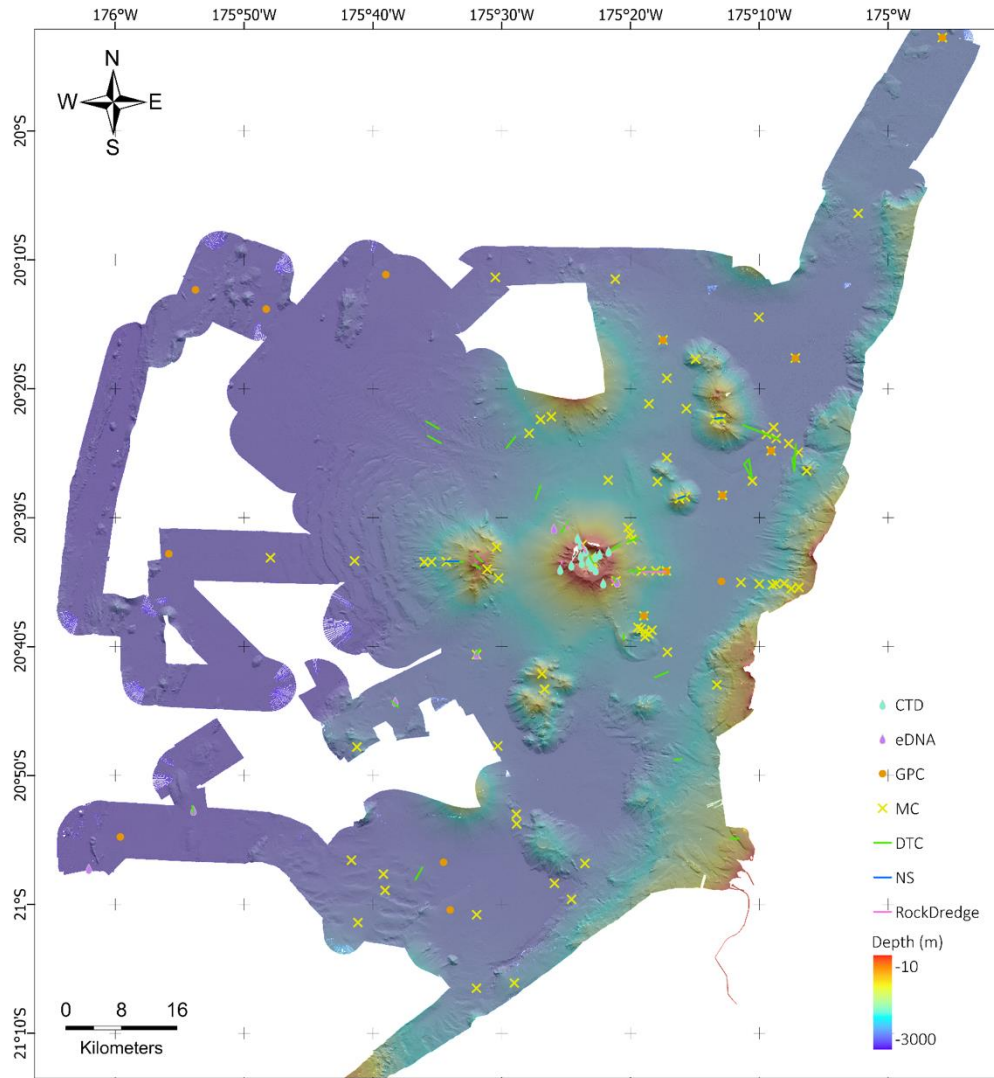
Research Question: 2022 eruption was much larger than expected, why?

- Most powerful eruption in 110 years
- Eruption column reached 58 km high (no modern precedent)
- Global shockwave
- Regionally significant tsunami
- Damage to seafloor infrastructure
- An 850-meter-deep crater formed

*Emergent volcanic edifice of Hunga Tonga
– Hunga Ha'apai. Credit: CSIRO*



Tonga, Hunga Tonga-Hunga Ha'apai



- Three multibeam systems (EM124, EM712, EM2040)
- >170 seafloor sampling operations
- Gas plumes identified in EK80
- Provide data to Pacific Island nations for natural disaster risk management to help protect:
 - Island communities from tsunamis
 - Fisheries and food security
 - Infrastructure (communication cables)

*Bathymetry and Sampling
from IN2025_V05*

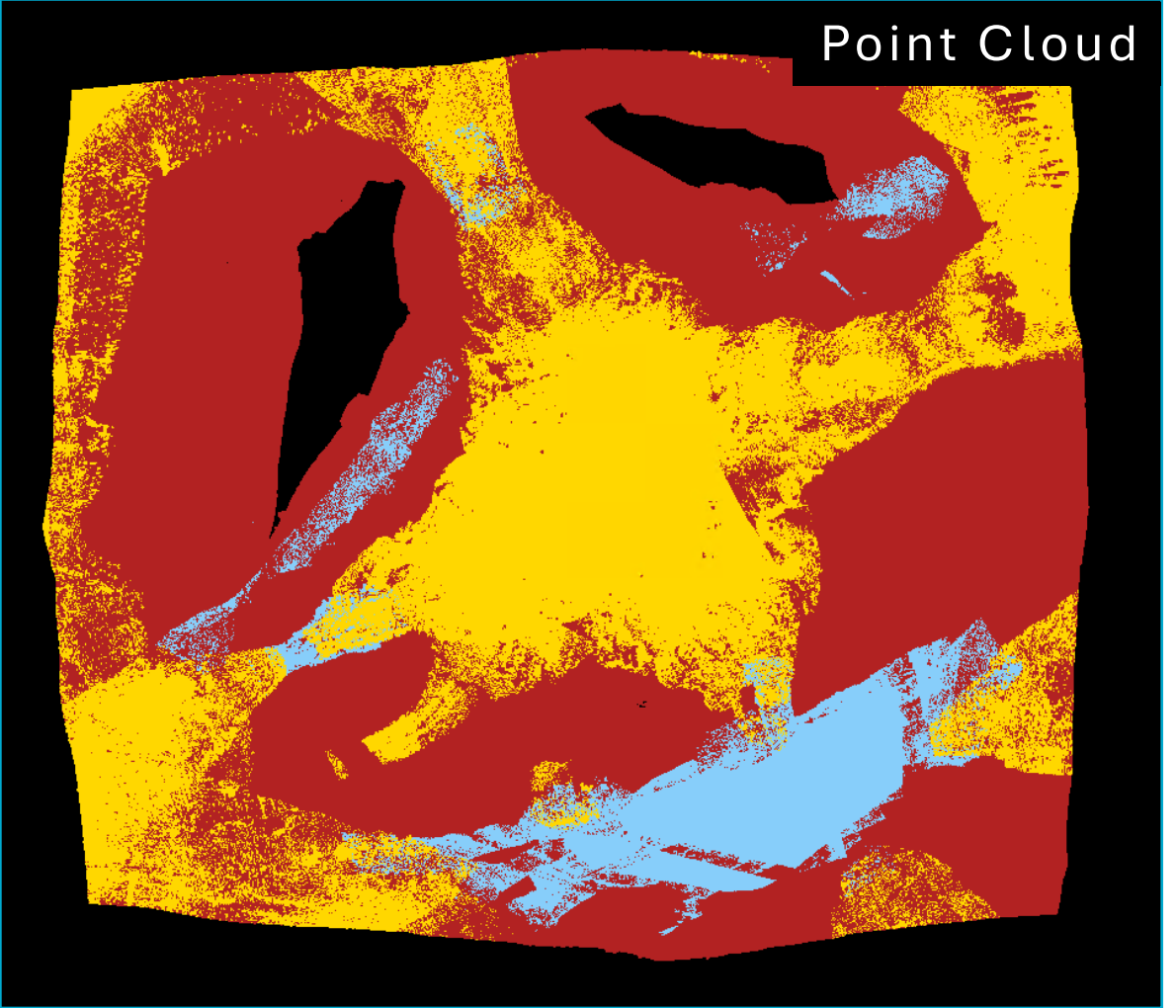
Tonga, Hunga Tonga-Hunga Ha'apai

Surface

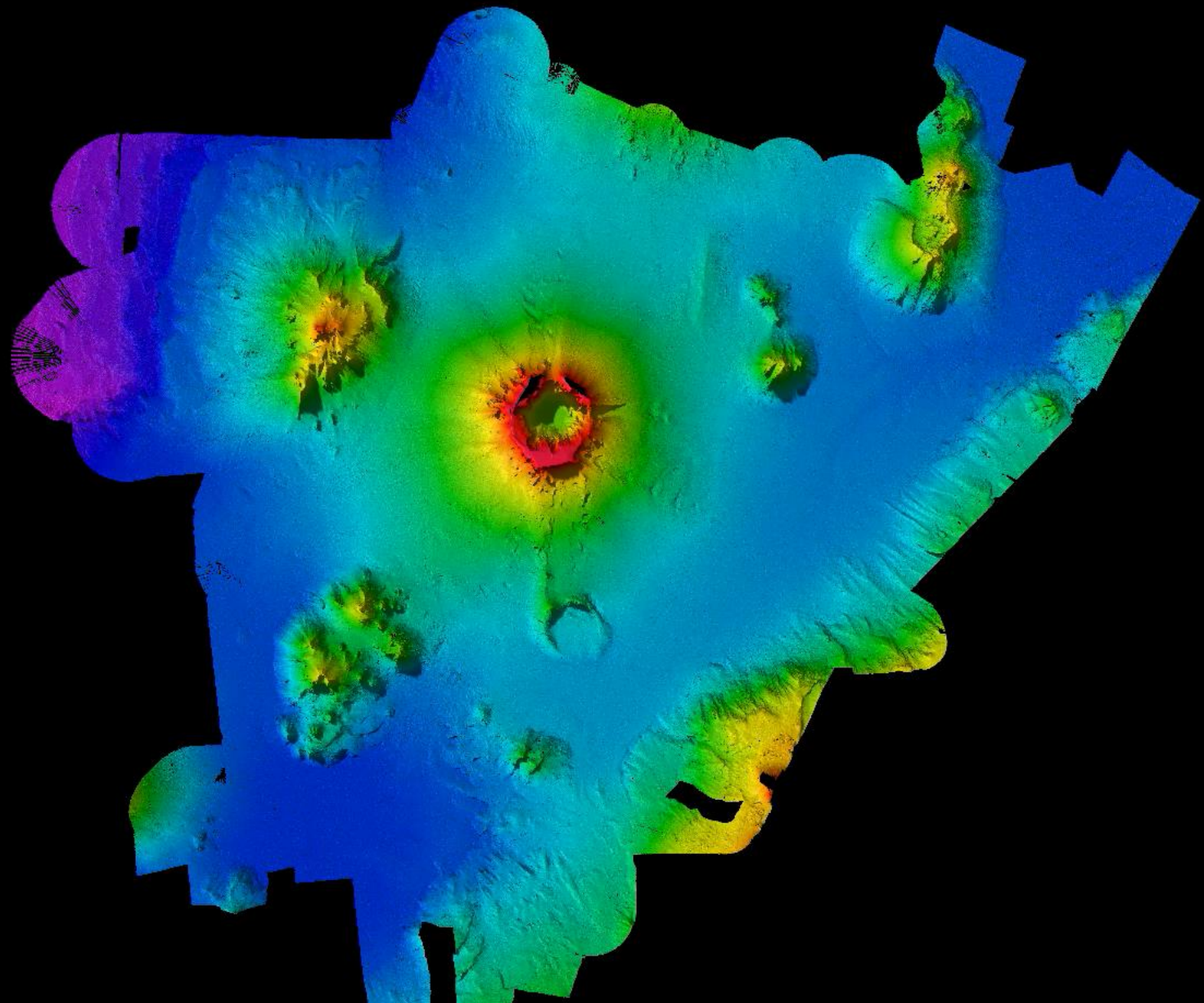


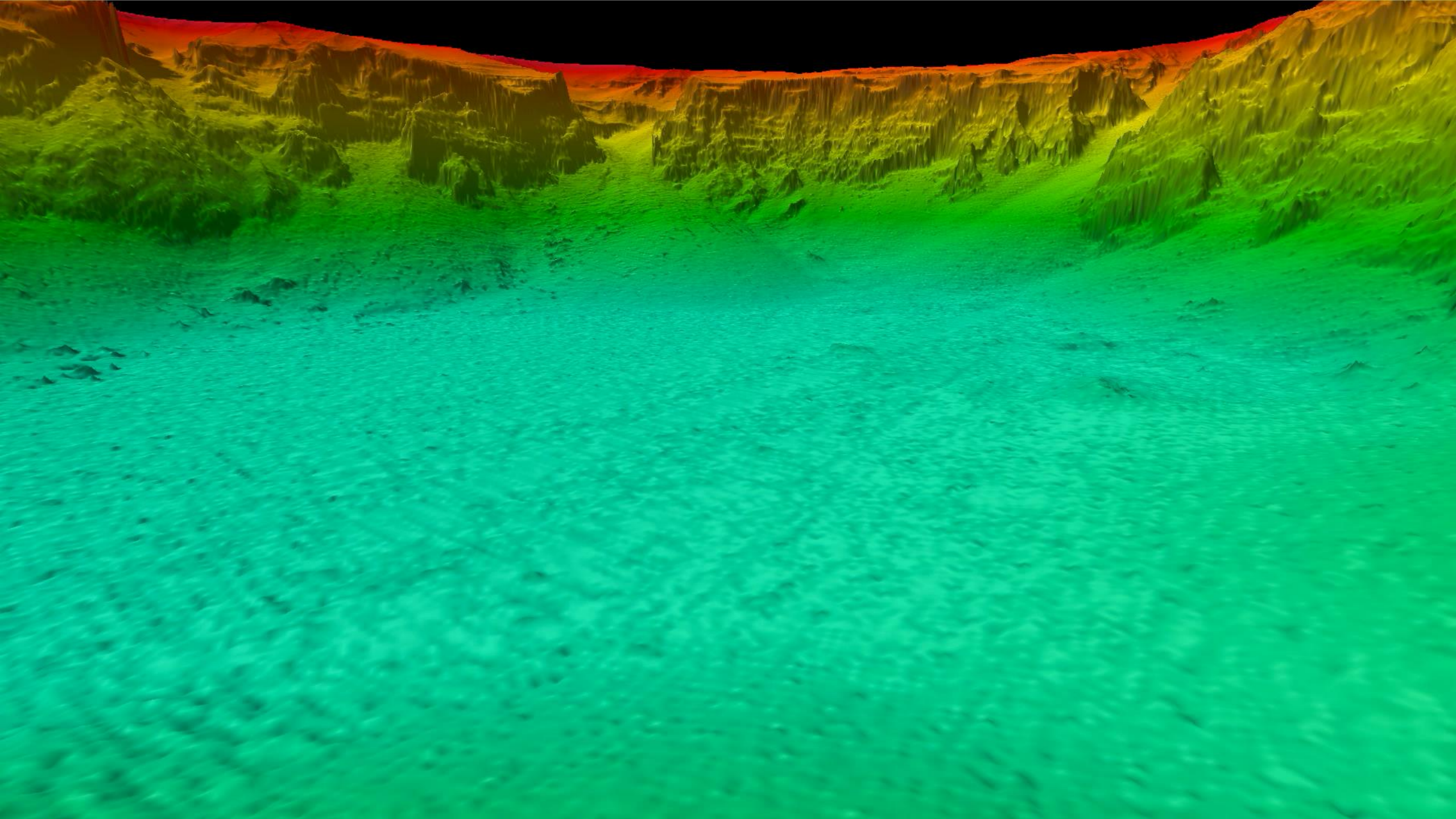
Green = EM124, Grey = EM712, Yellow = EM2040

Point Cloud



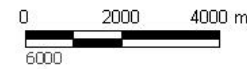
Yellow = EM124, Red = EM712, Blue = EM2040







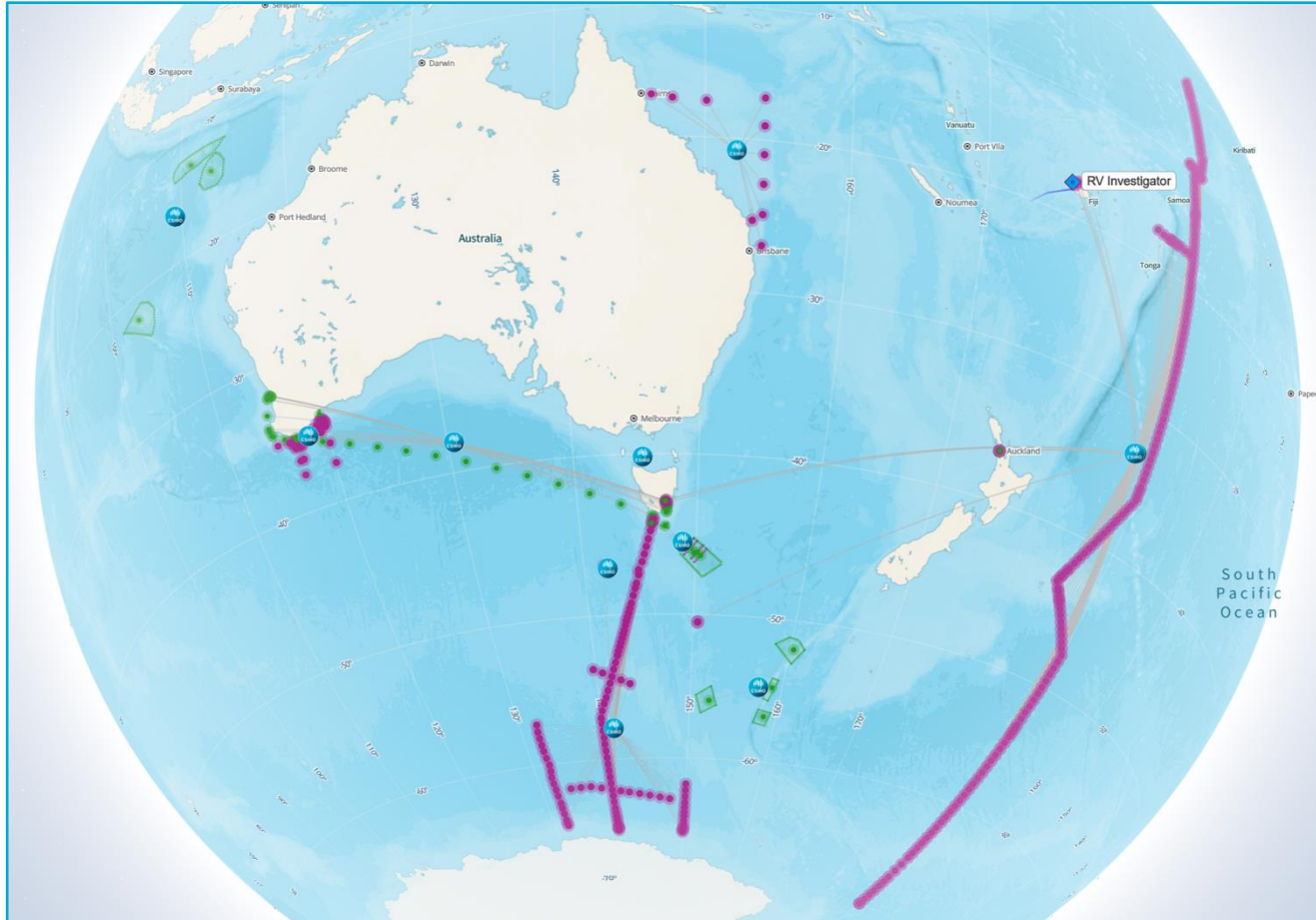
Line: LineHUN05_Seis05A_Processed



2025 HTHH Seismic Survey



CSIncRO: Next Steps



Upcoming RV Investigator voyages across the southern hemisphere demonstrating significant scope of work undertaken by CSIRO

- Protocols for increased ping rate without compromising data quality
- Expand protocol matrix for more scenarios
- Refine protocols for ADCPs
- Experimental vs observational trials
- New versions of K-Sync (2 or 3?)

Access Data and Sea time





Access Our Data



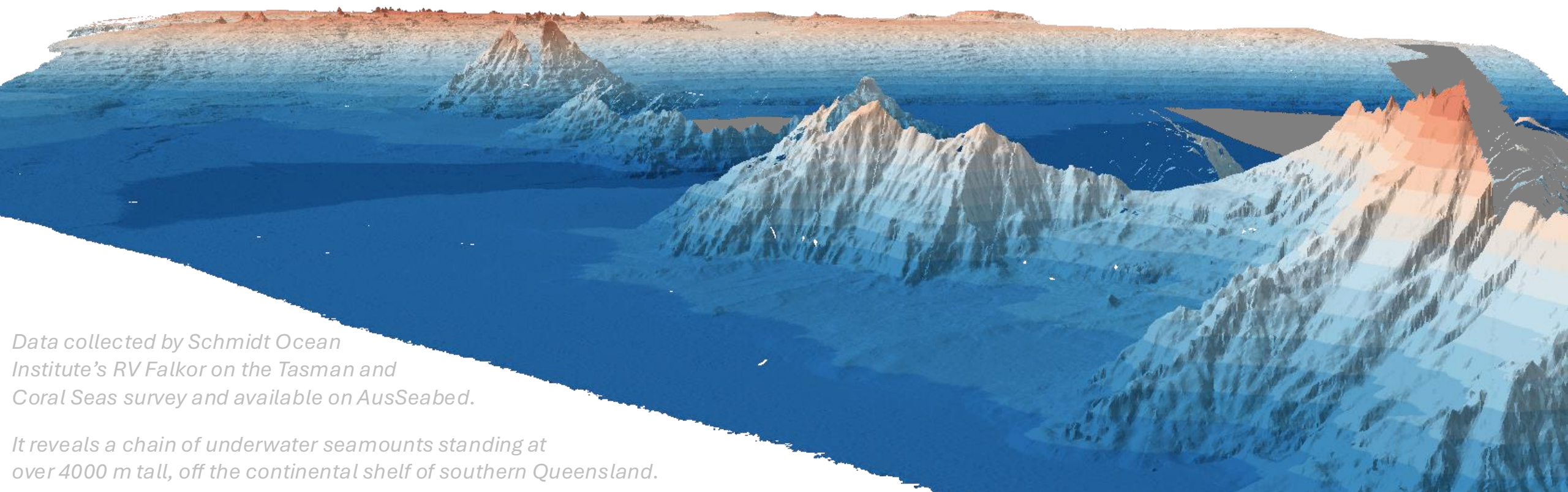
NCMI Information and
Data Centre

research.csiro.au/ncmi-idc



AUS
SEABED

portal.ga.gov.au/persona/marine



*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.*



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

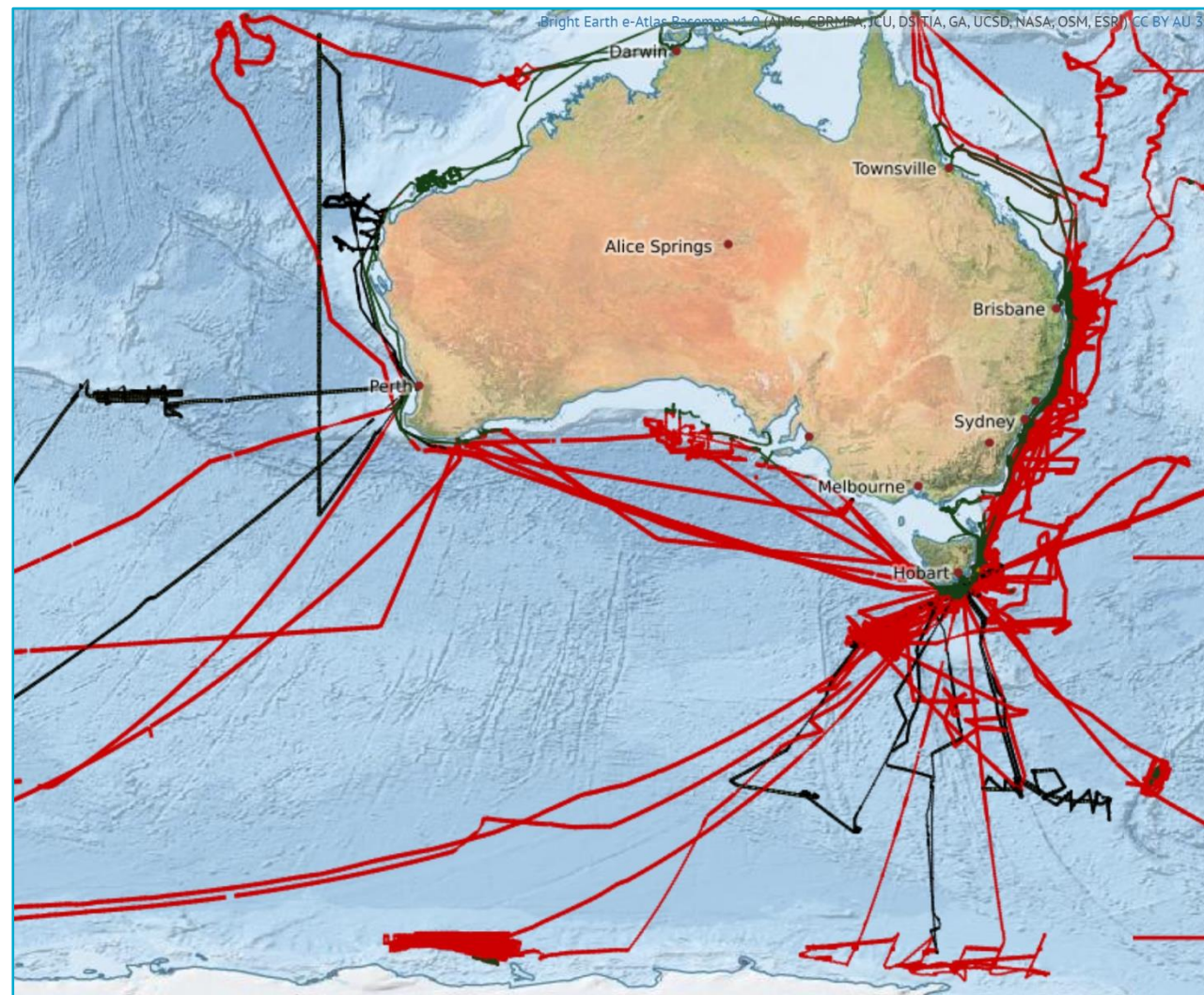


CSIRO National Collections and Marine Infrastructure

Geophysical Survey and Mapping - Search

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

marine.csiro.au/data/gsm



CSIRO NCM multibeam holdings



Apply for Sea-Time

Applications can only be made by Australian Researchers BUT **International Researchers can be co-investigators**

Fully funded grants for sea time on RV *Investigator* are awarded via 3 pathways:

- Primary Applications – due January 2027 (2029/30)
- Supplementary Applications – CLOSED (2027/28)
- Piggyback Applications – CALL OPEN (2027/28)

Applications are independently assessed on:

- Research Quality
- Research Benefit





Acknowledgements & References

Acknowledgements

- CSIRO, MNF & Support Teams
- Chief Scientists & Principal Investigators
- Crew of the RV *Investigator*
- Third party data and products (AusSeabed, Australian Hydrographic Office, GEBCO, Geoscience Australia, and Parks Australia)

References

- <https://australianmarineparks.gov.au/> & <https://australianmarineparks.gov.au/maps/>
- <https://www.csiro.au/en/about/facilities-collections/MNF/Research-vessel-Equipment-Data/RV-Investigator>
- <https://www.csiro.au/en/news/All/Articles/2024/December/RV-Investigator-is-the-GOAT>
- <https://www.ga.gov.au/scientific-topics/national-location-information/dimensions/oceans-and-seas>
- Australian Hydrographic Office 2021, Royal Australian Navy Laser Airborne Depth Sounder (LADS) survey HI529, DSID2317238HI529 (2012), Dataset.
- GEBCO Compilation Group 2024, GEBCO 2024 Grid (doi.org/10.5285/1c44ce99-0a0d-5f4f-e063-7086abc0ea0f)





Questions Welcome

