Forum for Operational Oceanography

FOO 2021

- First virtual FOO
- Three themed sessions
- Maintaining engagement
- Identifying themes
- Capturing feedback

Waves and Currents

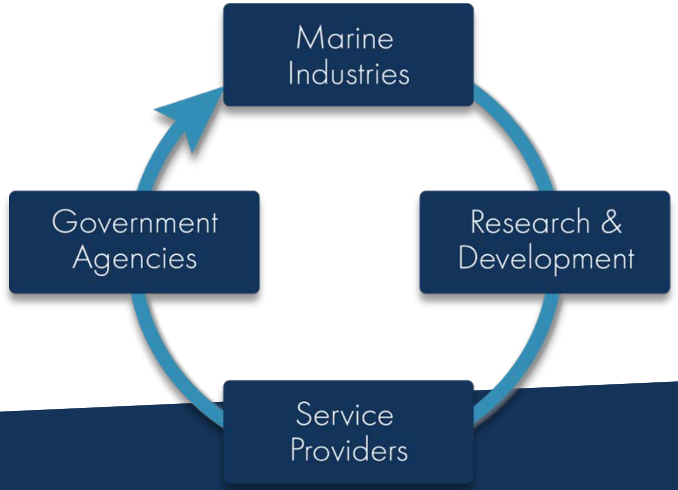
- End-user applications of models
  - Search and rescue; oil spills
  - High risk – need for accuracy
- Environmental applications by industry – coastal processes/sediment transport
- Provision of pollution control tools, marine asset risk tools, route planning optimisation for fuel efficiency, etc.
- Port operations: data and information needed in a changing shipping environment
- Bureau's operational space and delivering to end-users and decision support.
- Bluelink and TIDE updates

Climate, marine heatwaves, & temperature

- Priority areas to help industry deal with climate extremes
- Risk management and advanced warning mechanisms
- Seeking greater interdisciplinary engagement to deal with fisheries management
- Seasonal fluctuations and operational impacts
- Engagement across the FOO pillars

Megafauna interactions with industry

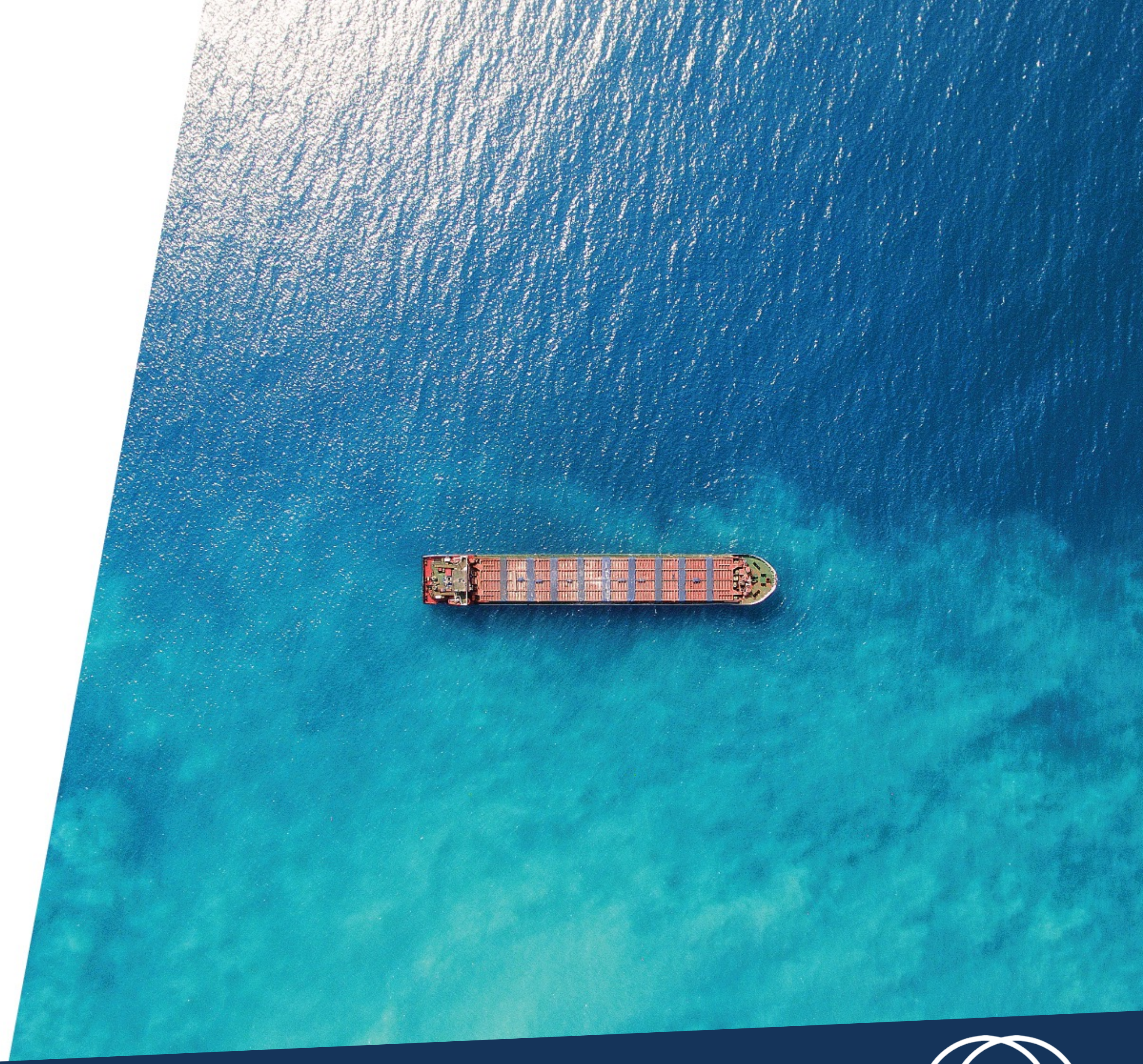
- Tracking of threatened and migratory species
- Working with management and industry for continental-scale tracking
- Acoustic telemetry on oil and gas infrastructure research
- Collection of oceanographic data by megafauna for the benefit of… megafauna.



FOO Spotlights

- Wanted to maximise the engagement opportunity of FOO 2021, and invited people to submit mini-posters to:
  - inspire future collaborations;
  - update the community on some new or ongoing research;
  - pitch a problem for the FOO community;
  - promote a fabulous idea for operational oceanography.

See these on each session's webpage (scroll to the bottom)



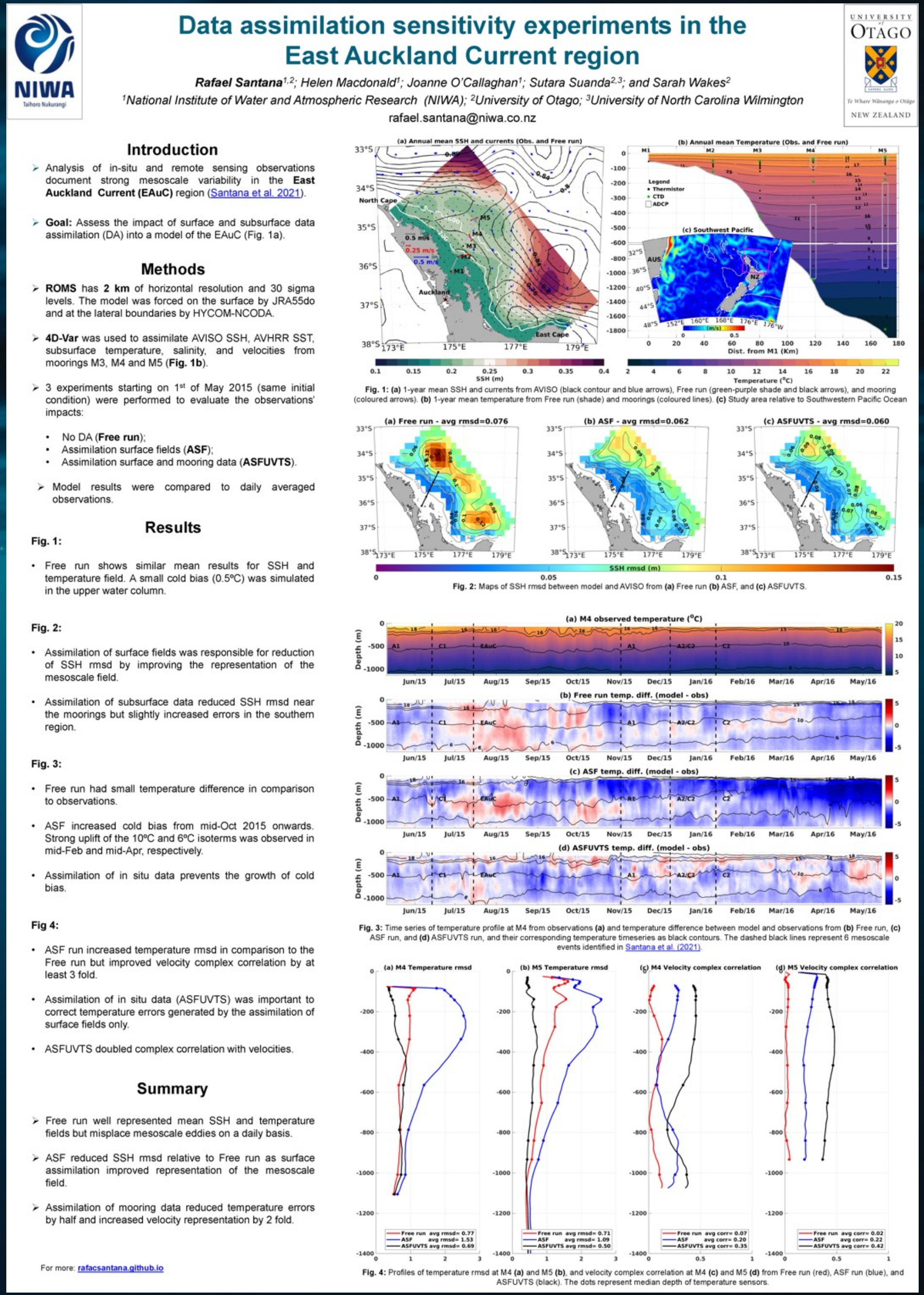
FOO Spotlights: Waves and Currents

Rafael Santana and the team

NIWA and the University of Otago

Data assimilation sensitivity experiments in the East Auckland Current region

http://bit.ly/FOOWaves

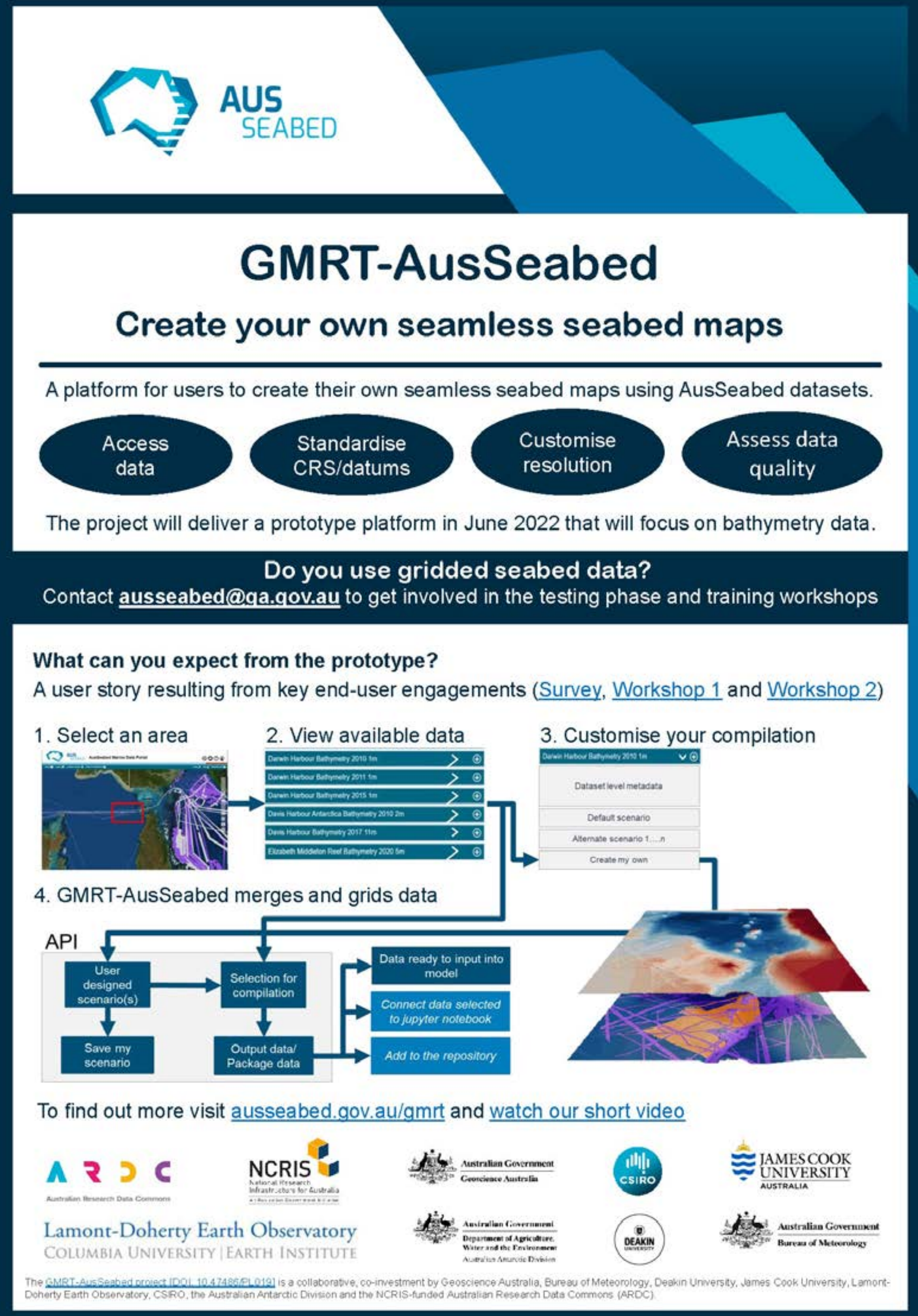


FOO Spotlights: Waves and Currents

Joshua Sixsmith and the team
AusSeaBed

Create your own bathymetry compilations with GMRT-AusSeabed

https://www.foo.org.au/forum/foo-2021/wavescurrents/



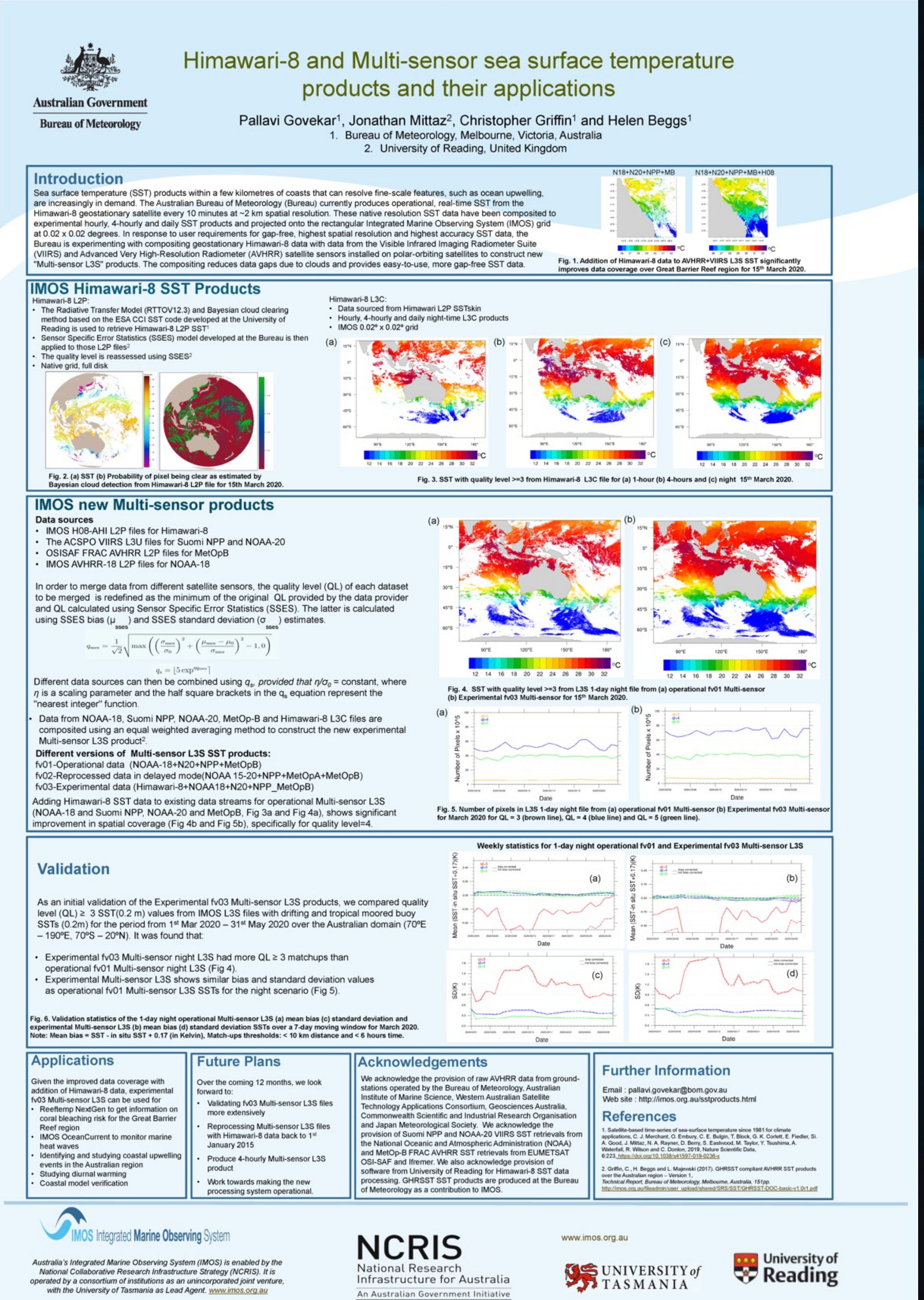
FOO Spotlights: Climate, Marine Heatwaves and Temperature

Pallavi Govekar and the team

BOM and University of Reading

Himawari-8 and Multi-sensor sea surface temperature products and their applications

http://bit.ly/FOOClimate



FOO Spotlights: Climate, Marine Heatwaves and Temperature

Pete Strutton and the team
UTAS and CSIRO

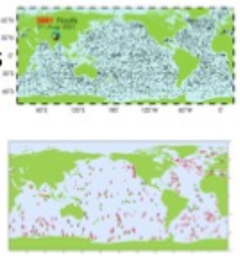
Autonomous floats and high resolution modelling: potential applications

http://bit.ly/FOOClimate

Autonomous floats and high resolution modelling: potential applications

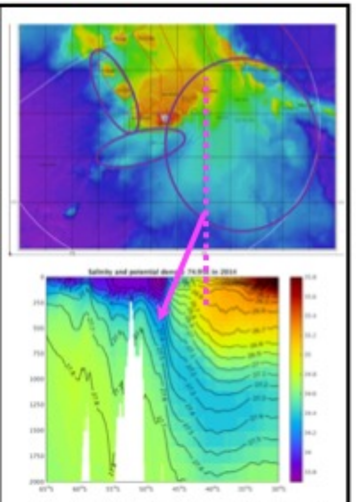
The UTas and CSIRO Argo and modelling groups (pete.strutton@utas.edu.au)

- The global Argo array has been tracking ocean heat uptake and sea level rise for 2 decades: >3,000 floats
- Great progress is being made towards a 1,000 float global biogeochemical (BGC) Argo array: T&S + nutrients, biomass, O_2, pH, light
- At the same time, models can assimilate these data for hindcasts and future projections

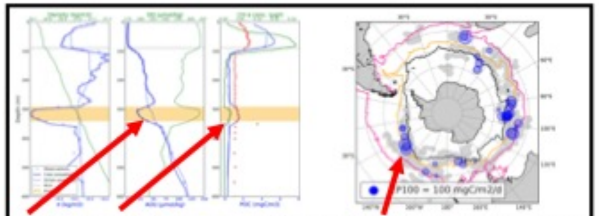


Where are the potential future uses? Fisheries, surveillance...

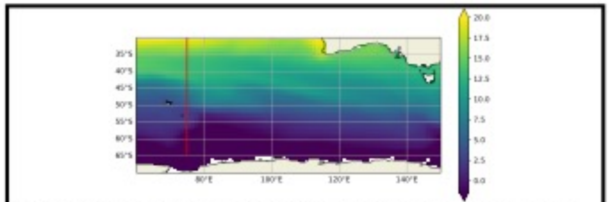
- Floats provide several different measures of water masses, ocean chemistry and productivity...
- ...at a range of spatial and temporal scales, suitable for pelagic and demersal applications
- Data assimilating hindcasts show change that has already occurred
- Future projections of varying lengths and spatial resolution are possible
- Consultation with potential end users is an important next step to understand needs



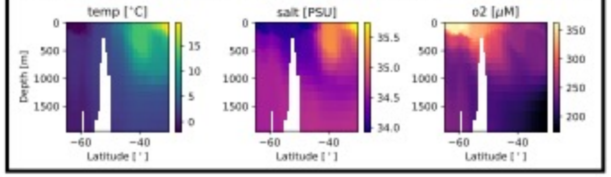
Sections from data assimilating models identify water mass changes (Peter Oke, CSIRO)



O_2 and particles identify biomass subduction (Llort et al., 2018)



Large scale models with BGC are approaching 10km resolution future runs (Hayashida and the COSIMA modelling community)



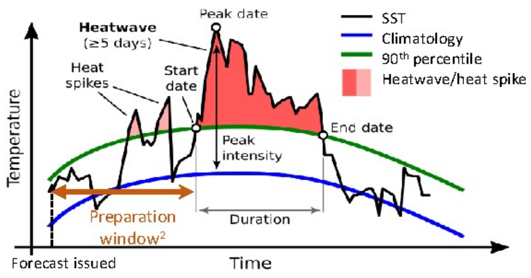
FOO Spotlights: Climate, Marine Heatwaves and Temperature

Claire Spillman and the team
BOM and CSIRO
Marine Heatwave Prediction
http://bit.ly/FOOClimate

MARINE HEATWAVE PREDICTION

Claire Spillman (BoM), Grant Smith (BoM), Alistair Hobday (CSIRO) and Jason Hartog (CSIRO)

What is a marine heatwave?



A marine heatwave is defined as when sea surface temperatures (SST) exceed the 90th percentile for 5 or more consecutive days.[1]

Marine heatwaves can occur year round, though usually have the greatest impacts in summer. Severity of impacts depend on event duration, intensity, extent and timing.

What's the big deal?

Marine heatwaves can have devastating impacts on marine systems and industries.

Marine heatwaves

System impacts
- Thermal limits exceeded
- Changes in fish growth
- Toxic algal blooms
- Coral bleaching
- Changes in abundance & distributions
- Increased disease risk

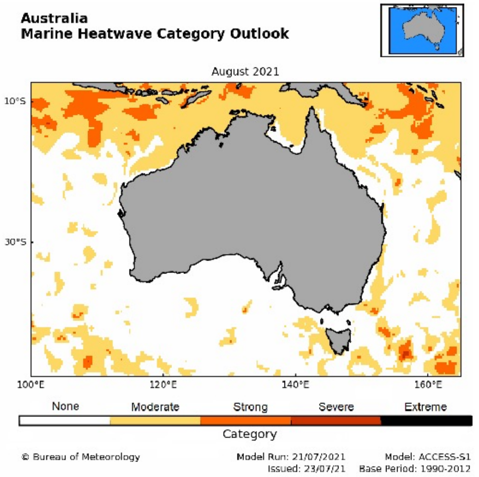
Operational impacts
- Fishery closures
- Smaller catches
- Poor fish quality
- Changing fishery yields & locations
- Spend longer at sea
- Biodiversity loss
- Beach closures

Industry & community impacts
- Decreased resilience
- Increased costs
- Reduced profitability
- Food insecurity
- Illegal fishing
- Reduced employment
- Less valuable alternatives

Predicting marine heatwaves

The Bureau of Meteorology and CSIRO have a 3 year project to research and develop prototype ACCESS-S seasonal marine heatwave forecast tools.

These cutting edge decision support tools will predict marine heatwave likelihood, intensity and location in the coming months.



Prototype marine heatwave forecast for August 2021

Advance warning of these extreme events provides a preparation window[2] for marine users. This allows for proactive management responses to mitigate impacts, increasing system and industry resilience in a warming climate.

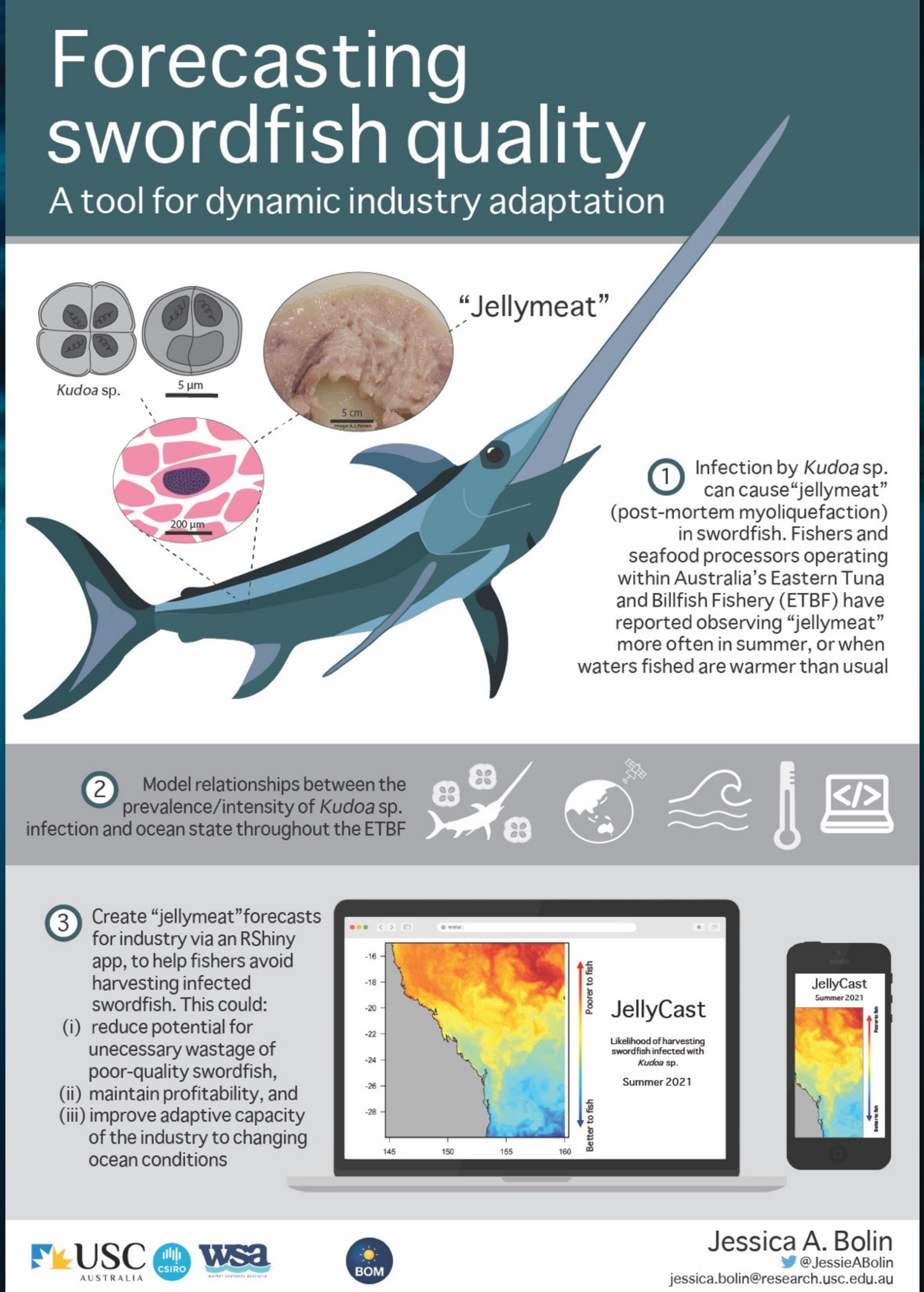
1. Hobday et al 2016 2. Spillman et al in review

Contact: claire.spillman@bom.gov.au

FOO Spotlights: Climate, Marine Heatwaves and Temperature

Jessica Bolin
University of the Sunshine Coast
Forecasting swordfish quality: a tool for dynamic industry adaptation

http://bit.ly/FOOClimate



FOO Spotlights: Megafauna Interactions

Kylie Scales – University of the Sunshine Coast
Can we predict fisheries-wildlife interactions in dynamic seascapes?
http://bit.ly/FOOMegafauna

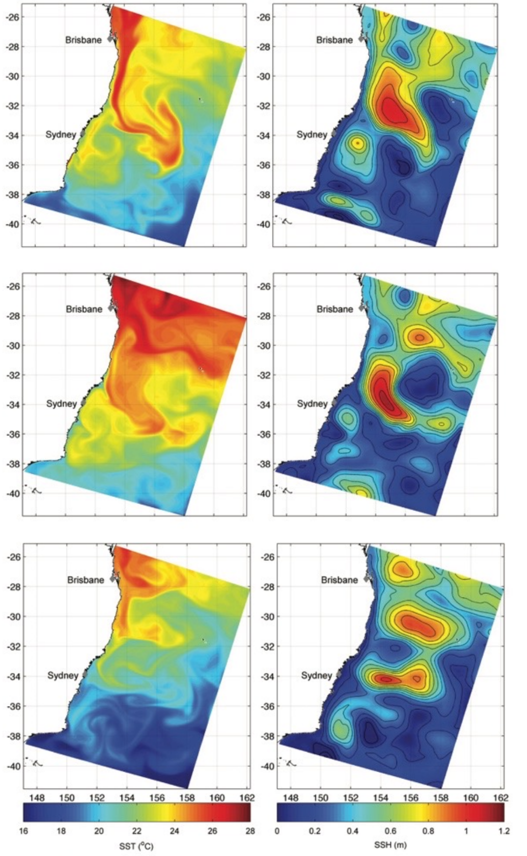
Can we predict fisheries-wildlife interactions in dynamic seascapes?

Marine wild-capture fisheries operate in heterogeneous and dynamic systems. The distributions of both target species and non-target species are driven by multiple interacting processes, which influence the spatio-temporal dynamics of fishing behaviour, and the relative risk of unwanted interactions with threatened, endangered and protected species.

Dynamic predictive modelling of the relative likelihood of occurrence of target and non-target species with respect to physical conditions can inform dynamic management. This project uses high-resolution physical data fields from a data-assimilative Regional Ocean Modelling System (ROMS) for the East Australia Current region (UNSW) to elucidate the drivers underlying fisheries-wildlife interactions in Australia's Eastern Tuna and Billfish Fishery.

Ocean state & variability | Fishing effort | Marine megafauna habitats

Satellite remote sensing | Ocean models | Fisheries logbooks, EM | Vessel tracking (AIS, VMS) | Satellite tracking



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Australian Government
Australian Research Council
Australian Government
Australian Fisheries Management Authority
UNSW SYDNEY

FOO Spotlights:
FOO 2021

Stef Stimson

RBR

Expansion of the RBRcervello for Multi-Instrument Capability in Real-time

http://bit.ly/FOObeyond

RBR rbr-global.com

Expansion of the RBRcervello for Multi-Instrument Capability in Real-time

Stef Stimson, stef.stimson@rbr-global.com

RBR Ltd, Hobart

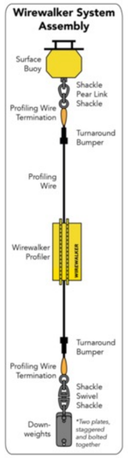
Since 1973, RBR has been designing and manufacturing oceanographic instruments in its Ottawa, Canada headquarters. From the ocean abyss to the polar ice cap, and on every continent, RBR sensors track water parameters: temperature, depth, salinity, dissolved gases, pH, and many others.

This spotlight article details the evolution of the RBR Mooring Line Modem (MLM) and RBRcervello to allow multi-instrument moorings to report their data in real-time.

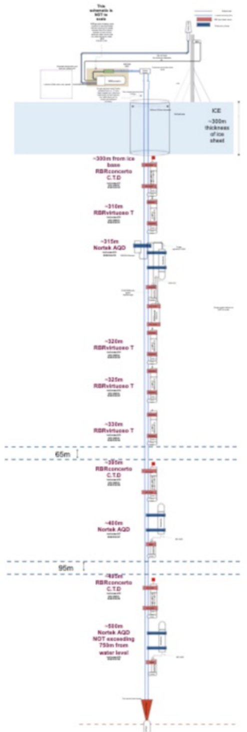
RBR's inductive modem communication system, the MLM-1000, was developed to provide fast communication with deployed instruments over several thousand metres of jacketed wire. It uses an inductive signal to bring data to the surface via the mooring line at speeds up to 4800 baud, where the seawater acts as the return to complete the circuit.

Instruments are connected to a sub-surface modem (SSM), either directly integrated or via a cable, and the jacketed cable feeds through the coupler for data transmission. This allows flexibility in where the instruments are mounted. A head end modem is used at the surface to provide control and connect to the user's data logger / telemetry system.

The DMO Wirewalker is a vertically profiling platform, powered by ocean waves, that uses the RBR mooring line modem as the profiling wire to bring data from instruments in the profiling body to the surface buoy.



To expand the Wirewalker's capability, RBR then developed the RBRcervello as the "brain" of the system. In addition to controlling the mooring line communications, the RBRcervello also provides data storage and data telemetry (via GSM and Iridium). This allowed the data from the RBR instrumentation in the profiling body to be brought to the surface and be telemetered to the world in real-time. Reconfiguring of the on-board instrumentation via the telemetry is also possible.



In the most recent evolution of the RBRcervello, RBR has worked extensively with two international organisations to develop the RBRcervello's capabilities to allow it to communicate with multiple instruments on a single mooring line and not just the one in a profiling body. This has been specifically valuable for a current project in Antarctica requiring under ice, multi-instrument, multi-year, real-time measurements. The collaboration in this project has included customised transit cases that are then used at site as permanent enclosures, buried in the snow, for insulation.

The systems that have been delivered to date host multiple RBR instruments as well as Nortek Aquadopp's (see right), acquiring data to a depth of ~750m.

Although this collaboration focused specifically on a design evolution with the upper ~300m frozen in the ice and measuring below the ice, this system can equally work from a surface buoy or vessel, reporting in real-time from all sensors, expanding the possibilities for moored, or drifting, ocean column monitoring.

FOO Spotlights: FOO 2021

Anna Riddell – Geoscience Australia
Height Systems in Australia - Introducing the AVWS and AUSHYDROID http://bit.ly/FOObeyond

Australian Government
Geoscience Australia

Height Systems in Australia

Introducing the Australian Vertical Working Surface and AUSHYDROID

Anna Riddell[1], Jack McCubbine[1], Zarina Jayaswal[2]
[1]Geoscience Australia
[2]Australian Hydrographic Office

Which height do I use?

The connection of land and sea datums in Australia remains a challenge considering that we do not currently have a model of the vertical separation between the defined global Earth-centred reference frame and local maritime chart datums.

Welcome to AVWS

The Australia Vertical Working Surface (AVWS) is a reference surface for heights that works on and offshore and forms part of the Australian Geospatial Reference System (Figure 1). AVWS is a model of gravity that provides the offset between the ellipsoid (common height reference used by Global Navigation Satellite Systems, GNSS in an Earth-centred frame) and the quasigeoid, and does not suffer from the same biases and distortions in the Australian Height Datum (AHD). AVWS heights can be computed directly from GNSS without needing to connect to survey mark infrastructure and has an accuracy of 4-8 cm, which presents an improvement on the accuracy previously available from AUSGeoid models (~8-13 cm).

What is a Quasigeoid?

The Australian Gravimetric Quasigeoid (AGQG) is a model of the gravity field across the Australian region and like the AUSGeoid model which is used to derive AHD heights, the AGQG model can be used to compute AVWS heights. The latest AGQG model (AGQG2017) was determined from ~1.8 million onshore gravity values provided in the Australian National Gravity Database, offshore satellite altimetry derived gravity anomaly values from Sandwell et al. (2014), the global gravity model (EGM2008), and the national digital elevation model DEMH1s. A detailed description of the procedure used to create the model is given in Featherstone et al. (2018).

An online tool is available to transform between ellipsoidal and AVWS heights and also provides uncertainty estimates [https://geodesyapps.ga.gov.au/avws]

Figure 2 shows the different surfaces that heights can be observed to or derived from with respect to an ellipsoid, geoid or quasigeoid surface.

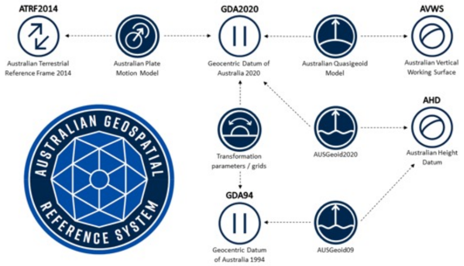


Figure 1: The Australian Geospatial Reference System is the collection of datums, reference frames and working surface used to define the latitude longitude, height, orientation and gravity across Australia.

AUSHYDROID

One of the complexities of hydrographic surveying is the relationship between chart datum and the reference ellipsoid. To allow for the reduction of this data to chart datum a new separation model is required to augment traditional tidal models. The new AUSHYDROID is intended to be a model of chart datum (lowest astronomical tide) and will be based in-part on AGQG2017, tide gauge data and models of the mean dynamic topography. It will provide a mechanism to reduce ellipsoidal heights from GNSS to chart datum to facilitate high accuracy surveys in the maritime environment.

AUSHDROID will have a number of benefits that will contribute to Australia's blue economy including:

- Linking bathymetry and land based observations through a common reference frame;
- Enabling the definition of coastlines and inter-tidal zones on a national scale;
- Assist in defining maritime baselines, marine cadastres and claims of sovereignty; and
- Provide a baseline for sea-level rise estimates and climate change strategies for coastal infrastructure.

Future Work

There are known issues that any model faces and that is no different for the existing models of gravity across Australia, particularly in coastal areas. To ensure the seamless integration of gravity data onshore and offshore, we are filling in the areas of interest with airborne gravity data. A large project to acquire airborne gravity data across Eastern Victoria is underway and a state-wide survey of NSW is being developed.

AUSHYDROID is being established to maintain models that to relate land and sea datums in Australia's ocean regions.

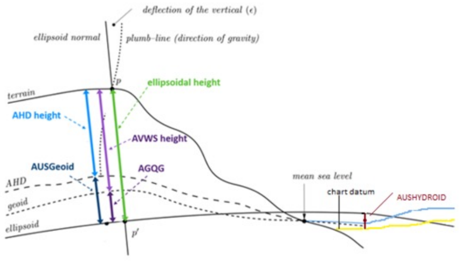


Figure 2: The AGQG model (dark purple) enables users to convert ellipsoidal heights (green) to AVWS heights (light purple).
The AUSGeoid model (dark blue) enables users to convert ellipsoidal heights (green) to derived AHD heights (light blue), ICSM, 2021.

REFERENCES

Featherstone, J. *et al.*, (2018), The first Australian gravimetric quasigeoid model with location-specific uncertainty estimates, JoG, 92(2), 149-168.

ICSM, (2021), AVWS Technical Implementation Plan, https://www.icsm.gov.au/publications/australian-vertical-working-surface-technical-implementation-plan-v16

Sandwell, D. *et al.*, (2014), New global marine gravity model from CryoSat-2 and Jason-1 reveals buried tectonic structure, Science, 346(6205), 65-67.

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Winners: Spotlights

- Joshua Sixsmith et al (Waves and Currents)
- Jessica Bolin (Climate, Marine Heatwaves and Temperature)
- Kylie Scales (Megafauna Interactions with Industry)
- Stef Stimson (FOO 2021)

Congratulations!

Thank you to all participants.

The FOO Secretariat (IMOS Office) will be in touch.

Forum for Operational Oceanography

FOO Report

- Produce a report of the FOO 2021 proceedings so we can make sure we stay on track with our objectives
- That will be drafted in the IMOS Office, go to session speakers and leads, then out to the registrants and the website.

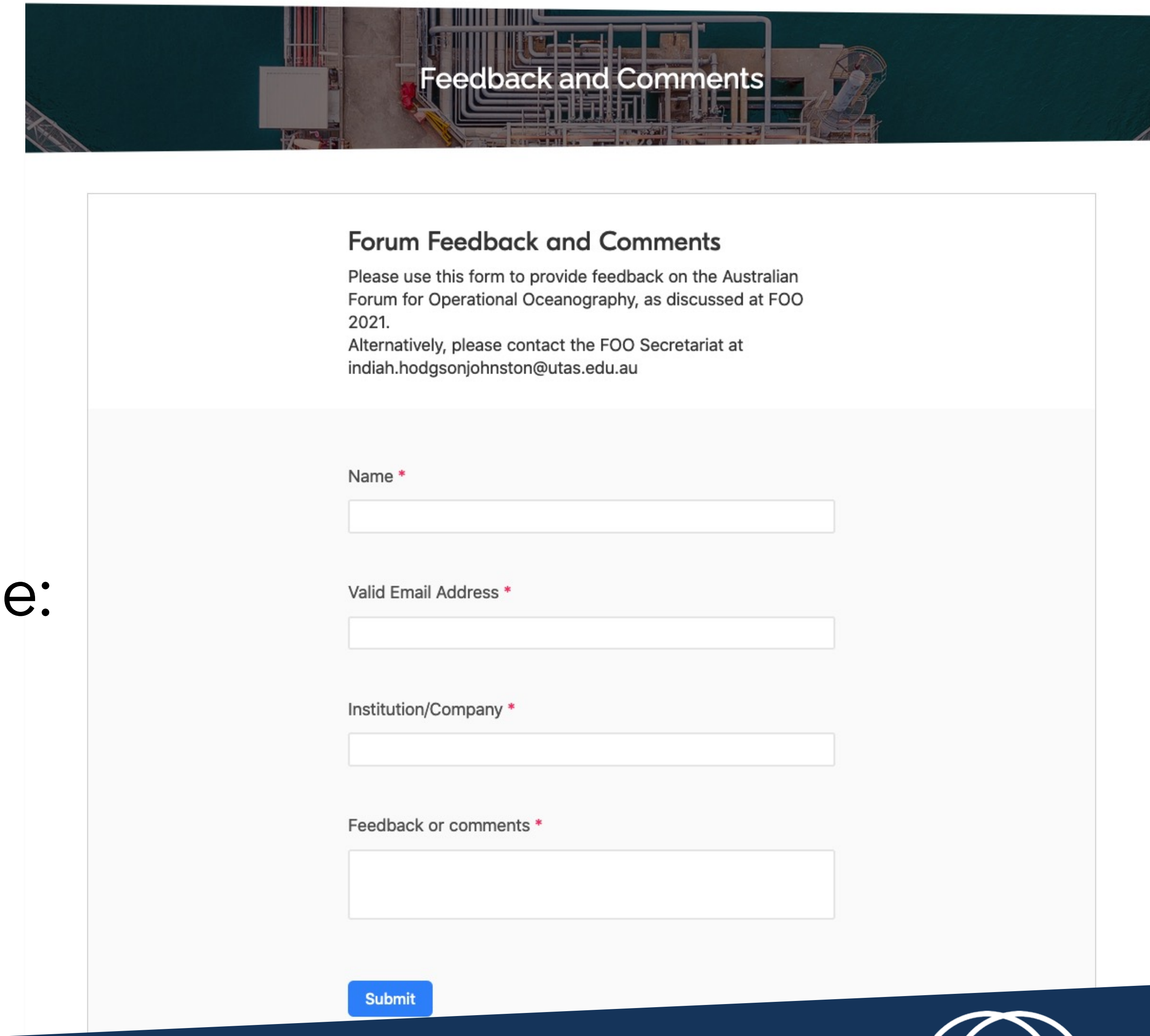
- Presentations will be on website - once permissions and access is sorted (only with permission)

- Recordings won't be made public

Getting in touch

- Today, please use Sli.do (#FOOBeyond) during the Q&A
- Contact the FOO Secretariat (IMOS Office)
- Or feedback form on the website:

https://bit.ly/FOO-21


Feedback and Comments

Forum Feedback and Comments

Please use this form to provide feedback on the Australian Forum for Operational Oceanography, as discussed at FOO 2021.
Alternatively, please contact the FOO Secretariat at indiah.hodgsonjohnston@utas.edu.au

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Institution/Company *

Feedback or comments *

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