Photo: Fishwell

Fishing Vessels as Ships of Opportunity (FishSOOP)

Democratizing Coastal Ocean Observing Through Widespread, Low-Cost, (Robust, Research Quality, Real-Time, Reciprocal) Ocean Data Collection

Moninya Roughan, Ian Knuckey, Veronique Lago, Stella Caon, Matt Irwin, Bryce Nurnaitis

mroughan@unsw.edu.au

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

UNSW SYDNEY

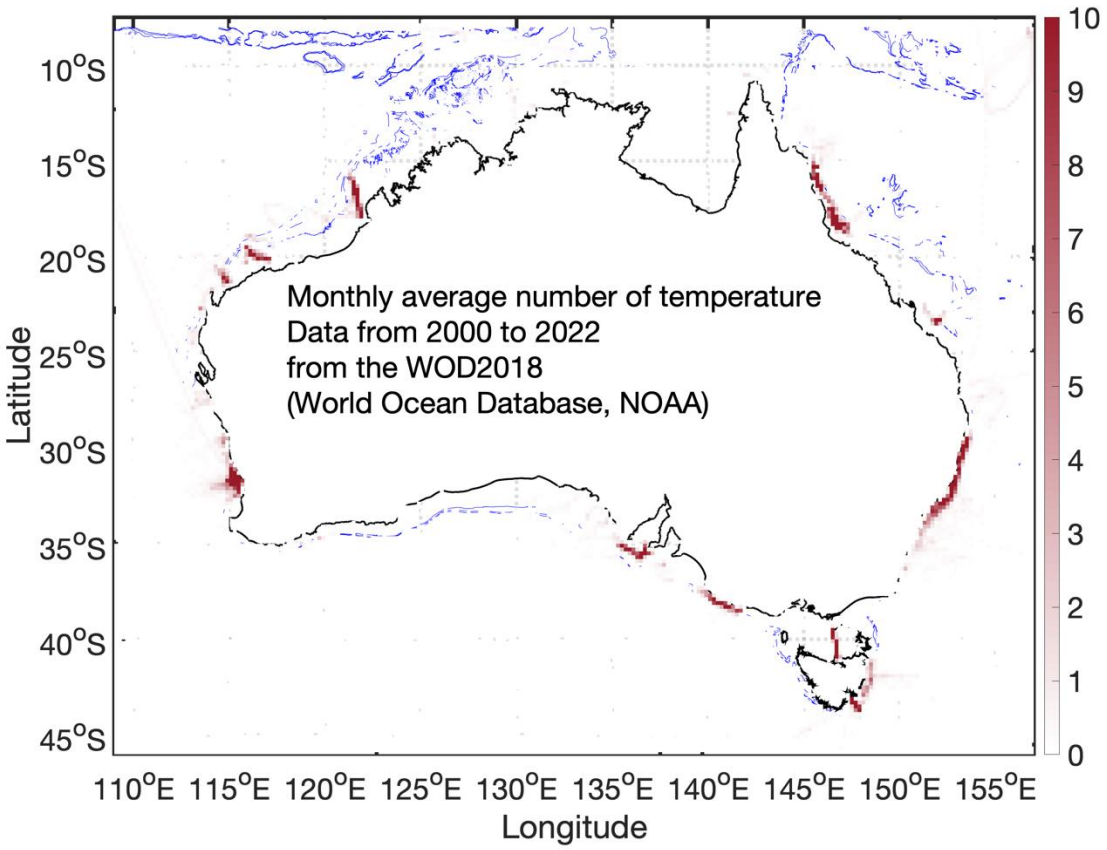
IMOS Integrated Marine Observing System

FRDC

fishwell CONSULTING

Australian Government
Australian Fisheries Management Authority

Our Marine estate is largely under sampled



(even with the huge GOOS/ IMOS effort)

- Shelf regions are under observed (below the surface), and regions of high variability.
- Shelf regions are the focal point of our blue economy
- Models are only as good as the data used to validate them.
  - Patchy observations –> poor quality models.
- Most sub-surface data (e.g. moorings) are not real time.

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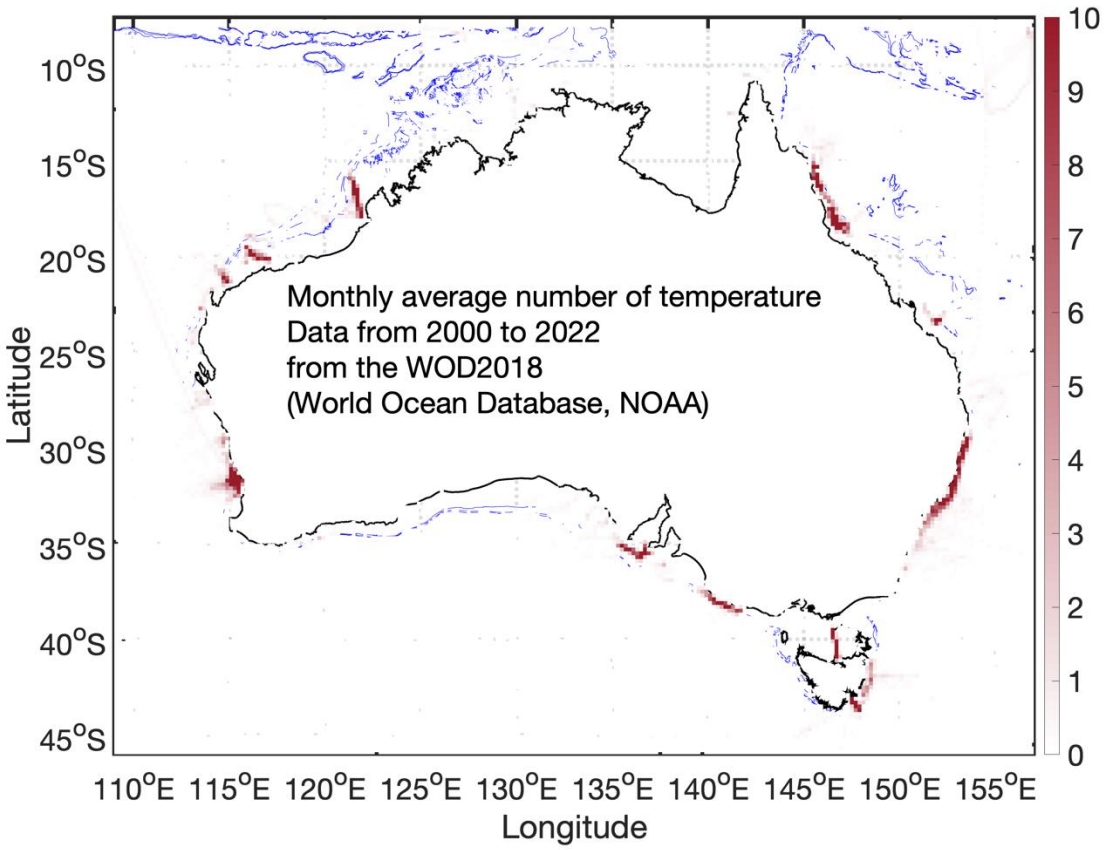

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We need more real time (sub surface) data.....

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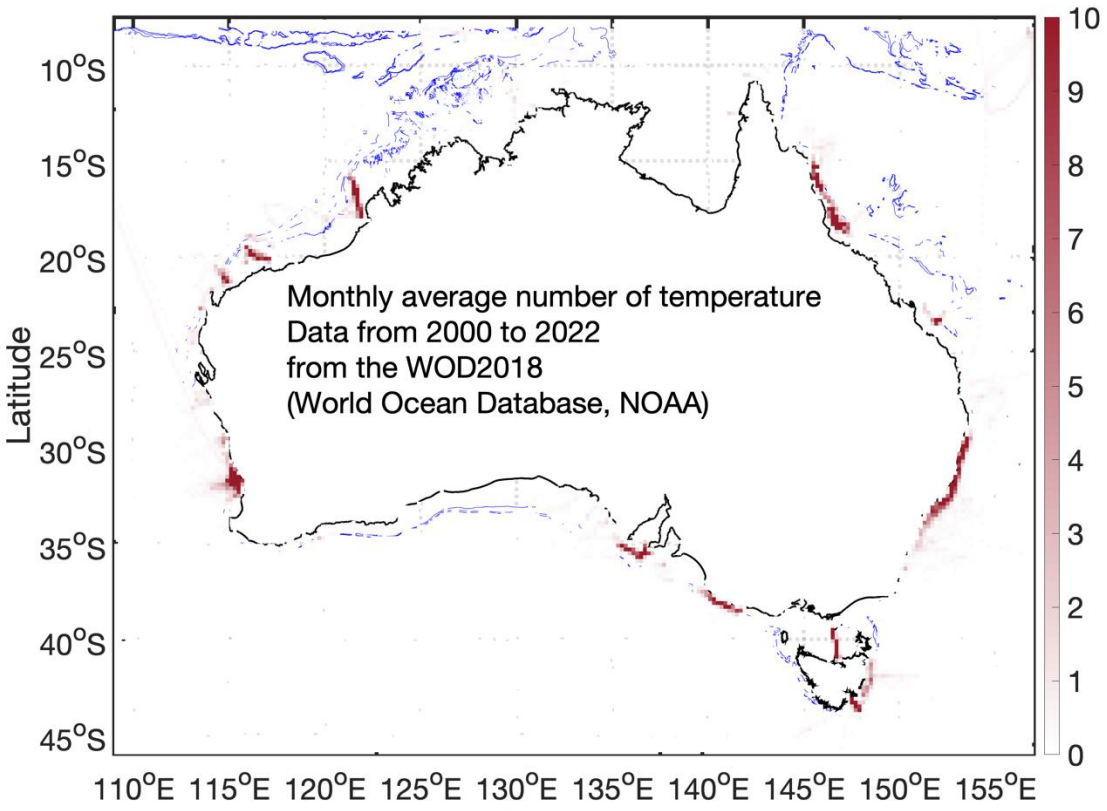
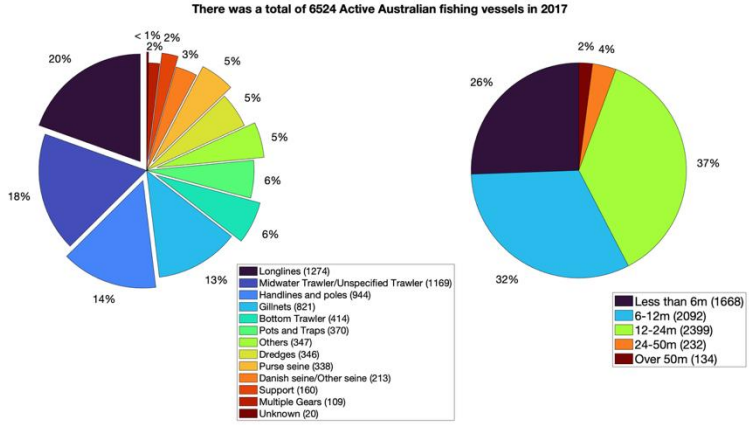
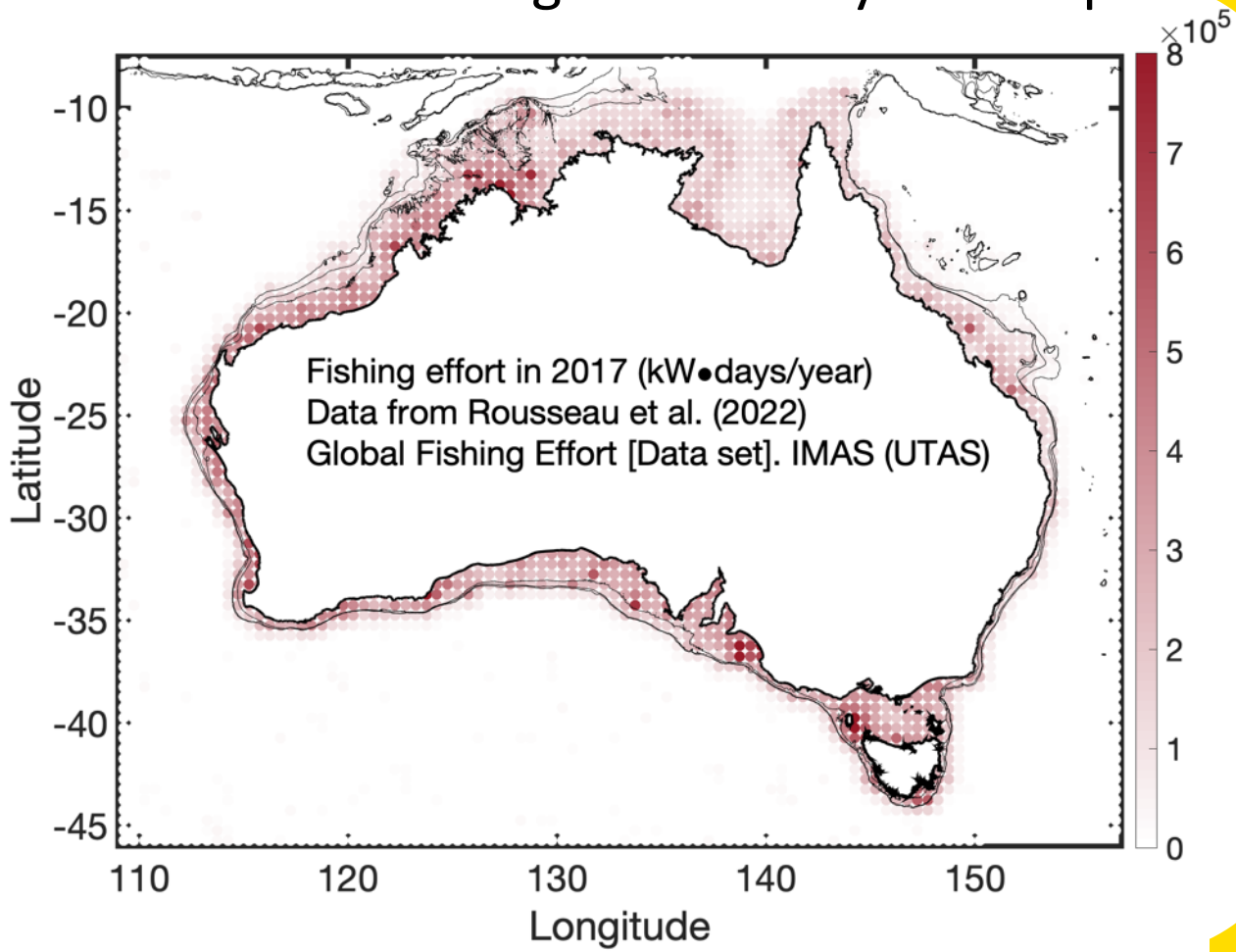
Our Marine estate is largely under sampled





AND… the fishing community can help



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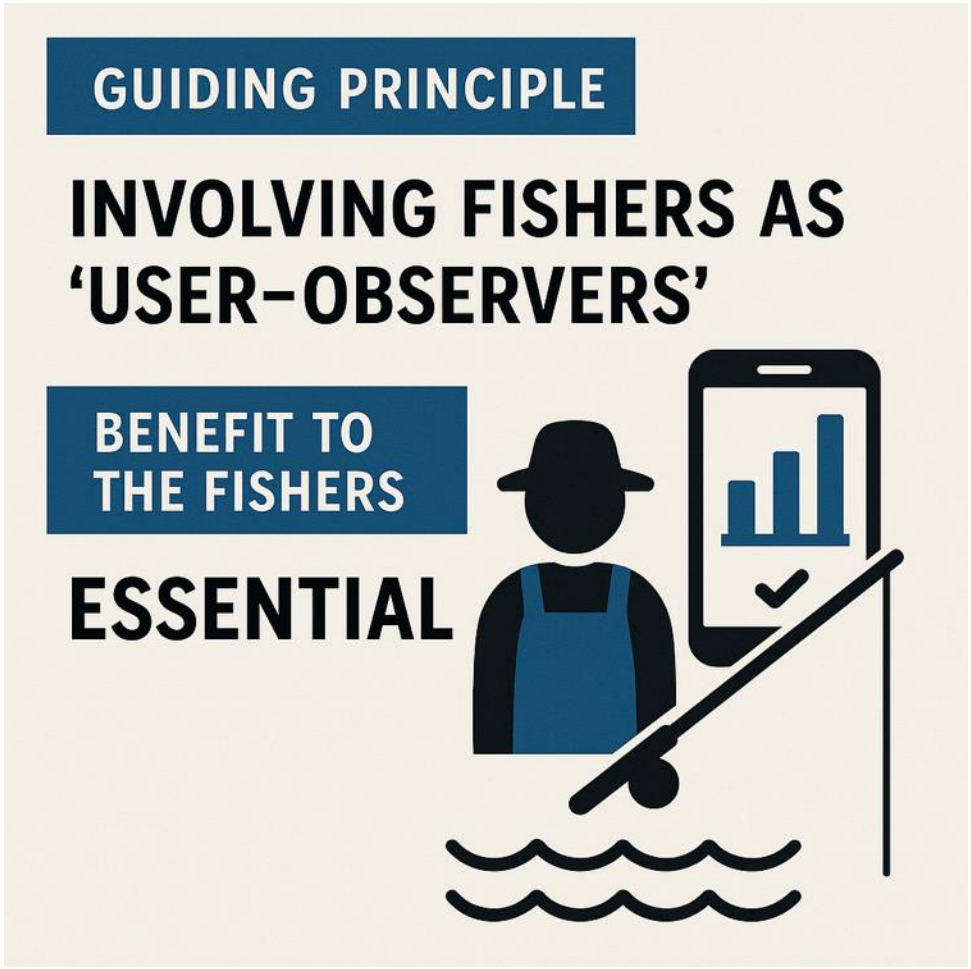
The Challenge – To involve Fishers as Oceanographers!



Reciprocal

- Mutual Benefit - -> Data user-observer
- Autonomous – No human intervention
- Anonymous – No Fishing / catch information

Rigorous

- Research quality instruments for high quality science
- FAIR data
- Best practice QA/QC

Robust / Reliable

- Harsh operating environment.
- Easy to use – Attaches to fishing gear (set n forget)
- Data offloads and is transmitted reliably

Real Time

- Operational decision making
- Ocean forecasting

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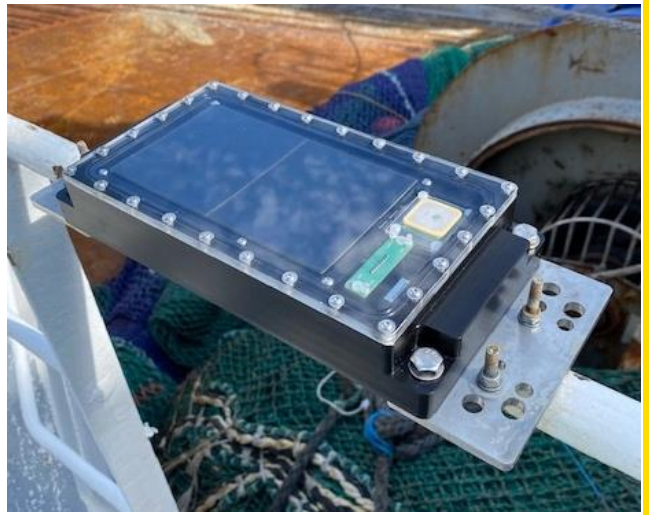
Design and build ‘fit for purpose’ Temperature - Depth sensor

Rigorous, Research quality

- Temperature accuracy of **0.05ºC (closer to 0.01ºC)**
- Depth rated to 200m, 1000m, 2000m (new in 2024) accuracy 1%
- Returned to manufacturer for calibration and re-battery



Reliable

- No human intervention - for daily operations, fishers want to fish
- Pressure triggered start and stop variable sampling (1s profiling)
- Bluetooth offload in seconds, every set

Real Time - Hands off

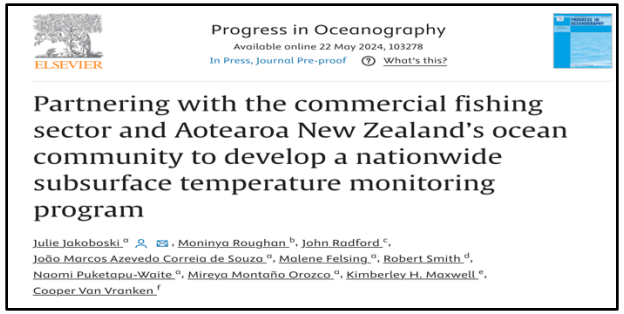
- Autonomous Comms - Solar Powered deck unit for GPS position and communications
- Automated data offload and transfer to the cloud (cellular or satellite)
- Data returned in minutes to the fisher that collected it.

Robust and low cost

- T and P only,
- 2 year battery life

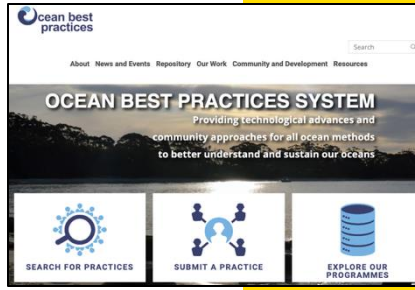
ZEBRA-TECH LTD
www.zebra-tech.co.nz

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI


Progress in Oceanography
Available online 22 May 2024, 103278
In Press, Journal Pre-proof What's this?

Partnering with the commercial fishing sector and Aotearoa New Zealand's ocean community to develop a nationwide subsurface temperature monitoring program

Julie Jakoboski [a], Moninya Roughan [b], John Radford [c], João Marcos Azevedo Correia de Souza [a], Malene Felsing [a], Robert Smith [d], Naomi Puketapu-Waite [e], Mireya Montaño Orozco [a], Kimberley H. Maxwell [e], Cooper Van Vranken [f]



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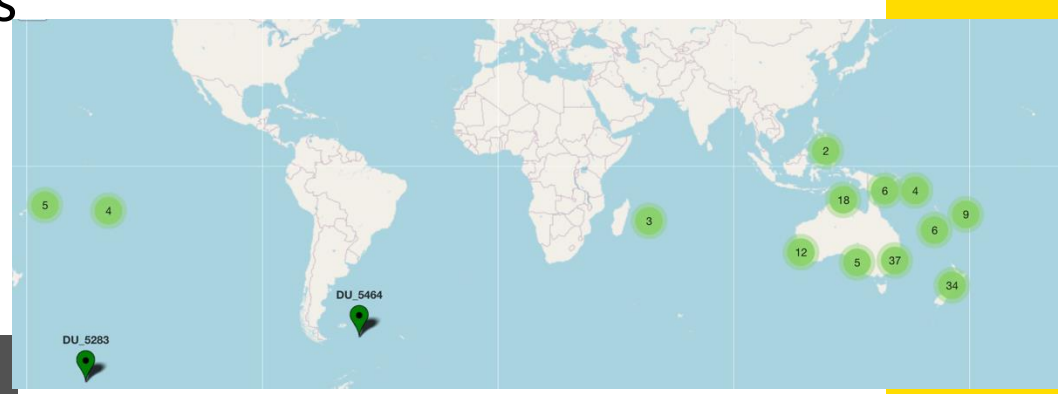
Growth since 2017 → ~ 180 vessels across the Indo Pacific

- Moana Project NZ (2017-2023) – 100 Vessels
- Pilot Project – in Eastern Australia (2023-2024) – 17 vessels
- Transition to IMOS + co-investment – 56+ active vessels
- SPC – 24/ 50 Vessels western Central pacific
- Colto – 5/ 6 Vessels southern ocean



Western Rock Lobster
World leading sustainable fishery

COLTO
TOOTHFISH · SUSTAINABLE. HEALTHY. DELICIOUS.

SPC
Secretariat of the Pacific Community

Tuna Australia

fishwell CONSULTING

Australian Government
Australian Fisheries Management Authority

FRDC
FISHERIES RESEARCH & DEVELOPMENT CORPORATION

NORTHERN TERRITORY GOVERNMENT

University of the Sunshine Coast Australia

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Moana PROJECT

NSW GOVERNMENT
Chief Scientist & Engineer

CHARLES DARWIN UNIVERSITY AUSTRALIA

Australian Marine Parks

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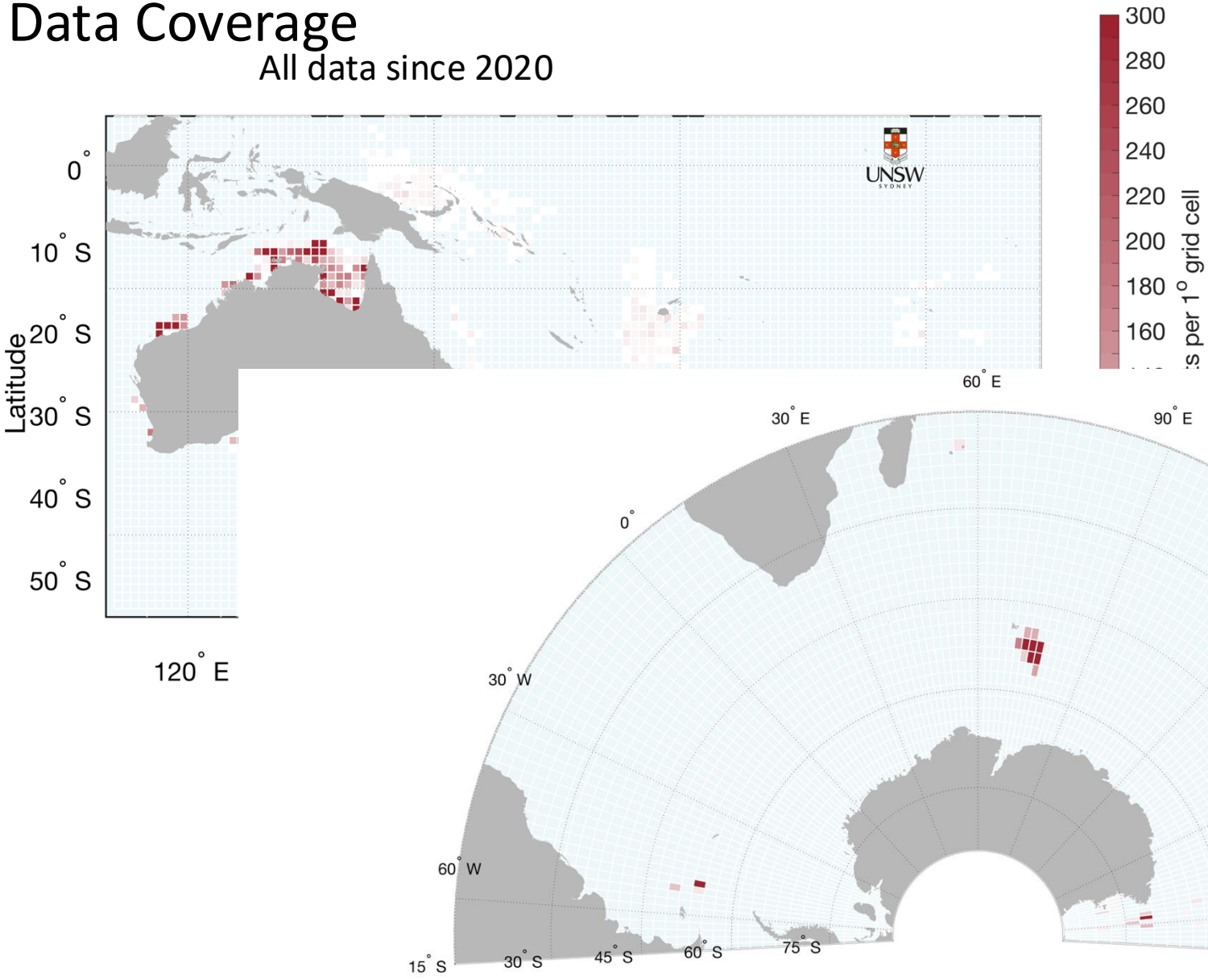
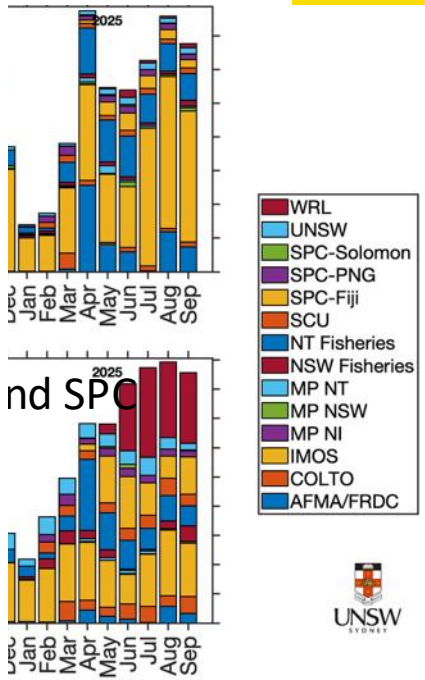
Data Coverage

All data since 2020



Sub surface ocean temperature data

To depths of 2000m



nd SPC

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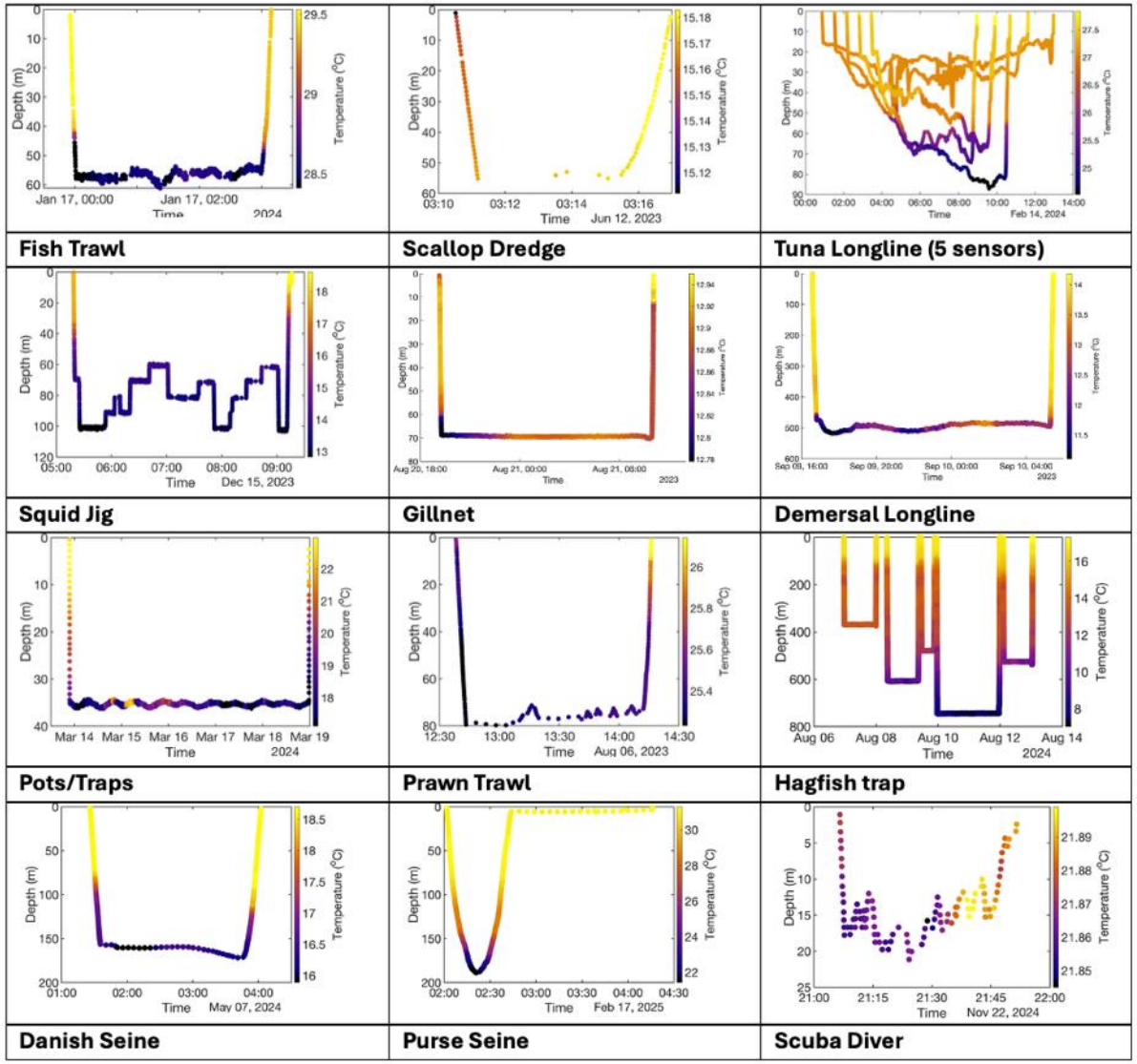
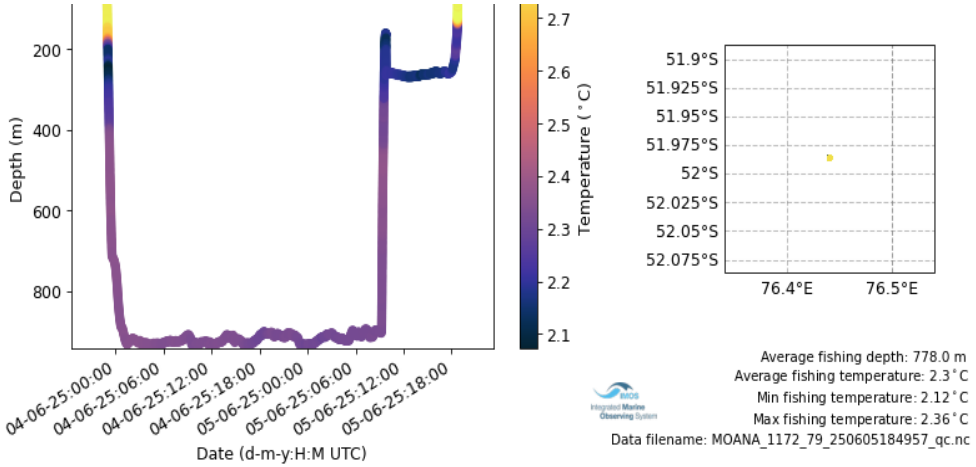
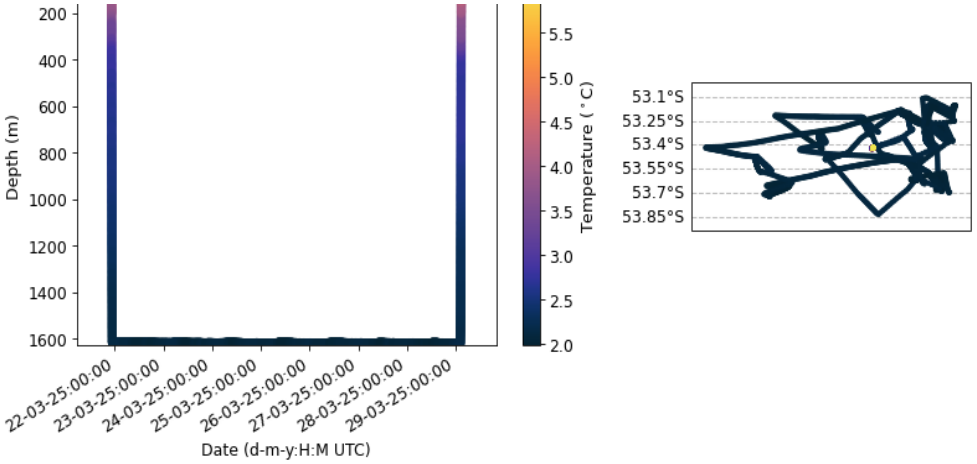
What do the data look like – LOTS of sub surface/ bottom temp data.

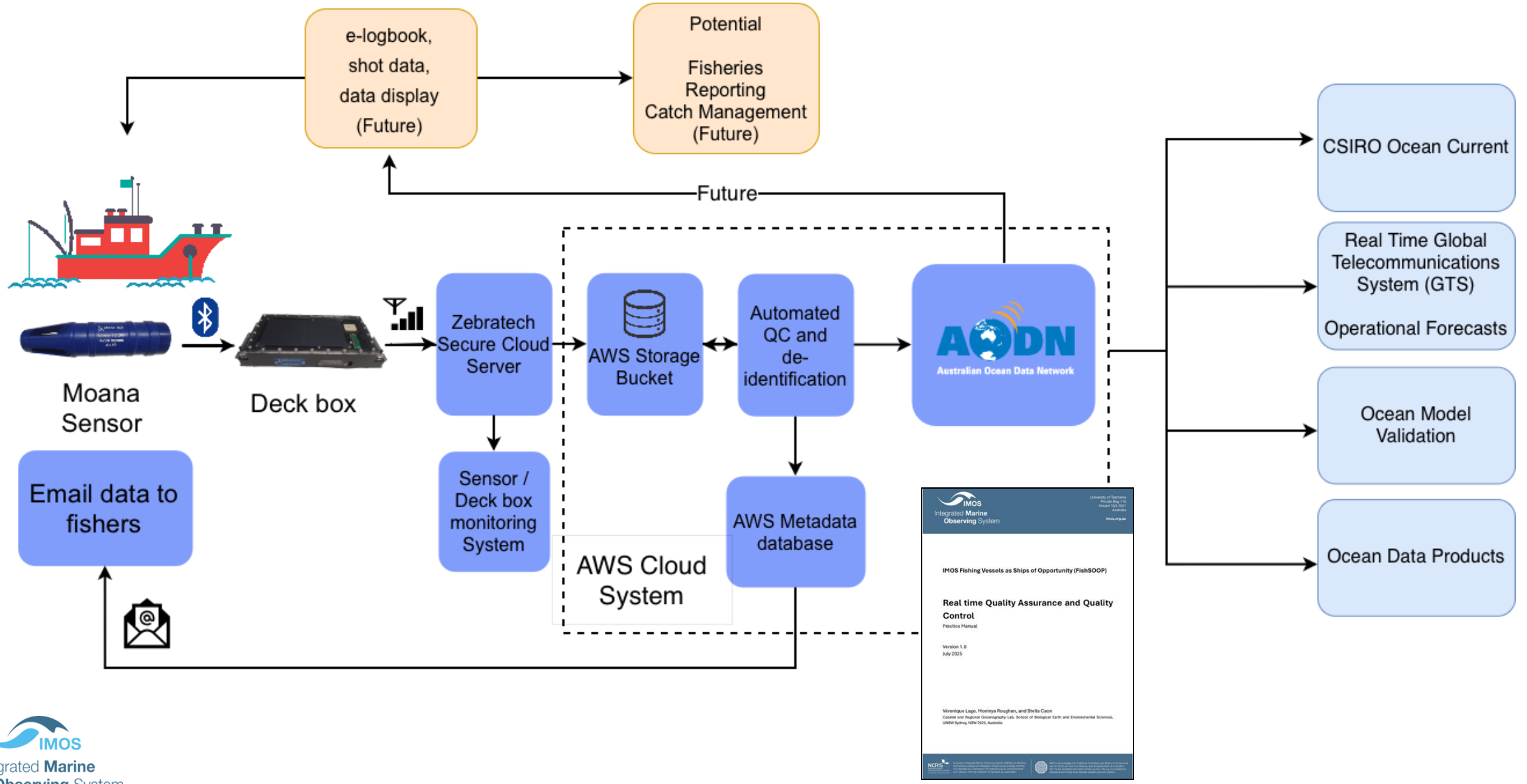
- Different Fishing methods have different profiles.







Data pathway – Rigorous, Research Quality Data



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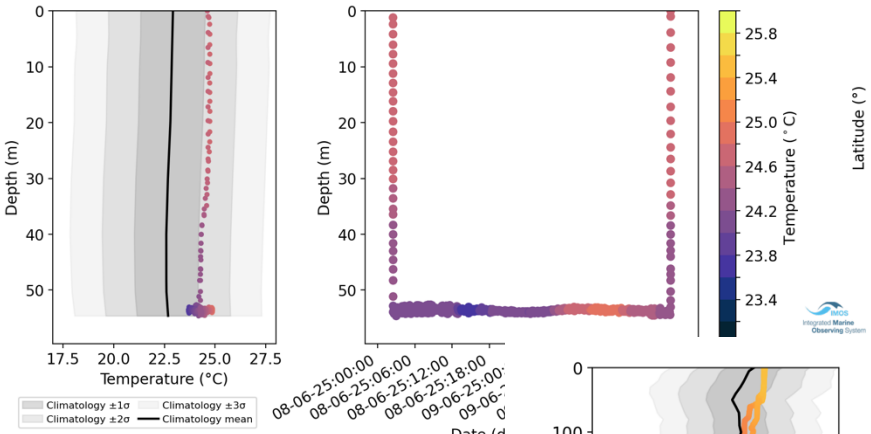
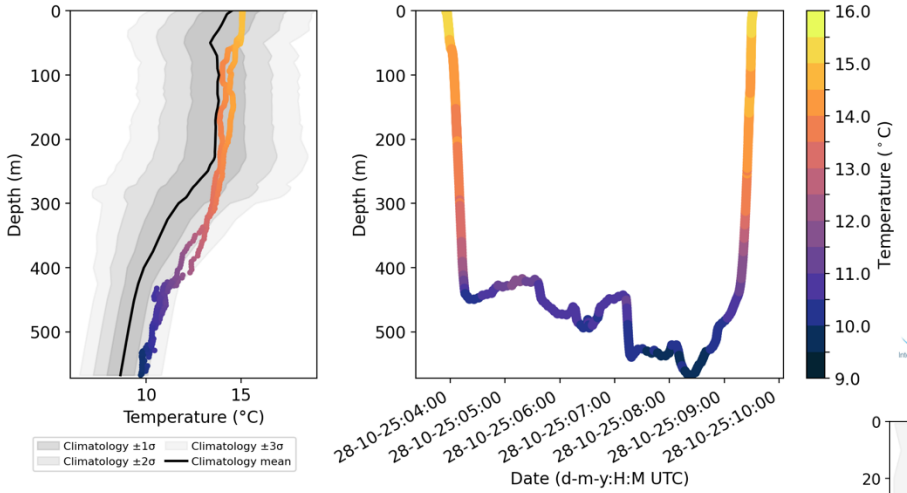
Data delivery – User Observers get their data first

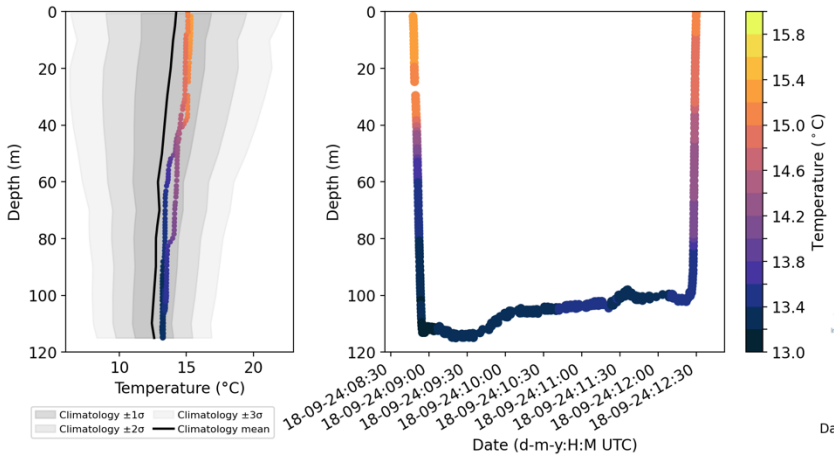


Plot of the profile map and context against CARS climatology
Data as CSV (with QC flags)
Brief statistics

Moana serial number	784					
Download time	03/07/2023 05:47:49					
Deck unit serial number	5328					
Moana calibration date	21/02/2023					
Moana Battery	3.52 (V)					
Date quality controlled	2023-07-04T21:01:09 +0000					
Vessel Name	Saxon Onwards					
Vessel ID	416699					
Cellular upload position	NA					
Deck unit battery voltage	3.66					
QC_FLAG Key	1=good 2=probably good 3=probably bad 4=bad					
	DATETIME [UTC]	LATITUDE	LONGITUDE	TEMPERATURE [degC]	DEPTH [m]	QC_FLAG
0	2023-07-03T04:55:07	-43.93118	150.462223	12.76	1.9	1
1	2023-07-03T04:55:11	-43.931195	150.462041	12.76	3.0	1
2	2023-07-03T04:55:13	-43.931195	150.462041	12.76	4.5	1
3	2023-07-03T04:55:16	-43.931195	150.462041	12.76	5.6	1
4	2023-07-03T04:55:19	-43.931156	150.46193	12.76	8.3	1
5	2023-07-03T04:55:22	-43.931156	150.46193	12.76	9.8	1
6	2023-07-03T04:55:24	-43.931156	150.46193	12.76	11.1	1
7	2023-07-03T04:55:26	-43.931156	150.46193	12.76	12.3	1
8	2023-07-03T04:55:28	-43.9311	150.461813	12.76	14.0	1
9	2023-07-03T04:55:29	-43.9311	150.461813	12.76	15.3	1
10	2023-07-03T04:55:32	-43.9311	150.461813	12.76	17.0	1
11	2023-07-03T04:55:34	-43.9311	150.461813	12.76	18.2	1
12	2023-07-03T04:55:35	-43.9311	150.461813	12.76	19.1	1
13	2023-07-03T04:55:37	-43.9311	150.461813	12.76	20.1	1
14	2023-07-03T04:55:38	-43.931035	150.461675	12.76	21.2	1
15	2023-07-03T04:55:40	-43.931035	150.461675	12.76	23.0	1
16	2023-07-03T04:55:42	-43.931035	150.461675	12.76	24.2	1
17	2023-07-03T04:55:44	-43.931035	150.461675	12.76	25.8	1
18	2023-07-03T04:55:46	-43.931035	150.461675	12.76	26.9	1
19	2023-07-03T04:55:49	-43.93102	150.461531	12.76	28.3	1
20	2023-07-03T04:55:51	-43.93102	150.461531	12.76	30.1	1
21	2023-07-03T04:55:54	-43.93102	150.461531	12.76	32.0	1
22	2023-07-03T04:55:57	-43.93102	150.461531	12.76	33.5	1
23	2023-07-03T04:55:58	-43.930983	150.461403	12.76	34.5	1
24	2023-07-03T04:56:00	-43.930983	150.461403	12.76	35.6	1
25	2023-07-03T04:56:02	-43.930983	150.461403	12.76	37.1	1
26	2023-07-03T04:56:04	-43.930983	150.461403	12.76	39.1	1
27	2023-07-03T04:56:06	-43.930983	150.461403	12.76	40.3	1
28	2023-07-03T04:56:08	-43.930955	150.461275	12.76	41.6	1
29	2023-07-03T04:56:11	-43.930955	150.461275	12.76	42.7	1
30	2023-07-03T04:56:15	-43.930955	150.461275	12.75	44.6	1
31	2023-07-03T04:56:17	-43.930955	150.461275	12.75	46.7	1
32	2023-07-03T04:56:20	-43.930953	150.461146	12.74	48.0	1



Maximum cast depth: 567.5 m



Maximum cast depth: 113.6 m
Average cast temperature: 13.34 ° C
Min cast temperature: 13.24 ° C
Max cast temperature: 13.41 ° C
Data filename: MOANA_0480_432_240918123115_qc.nc

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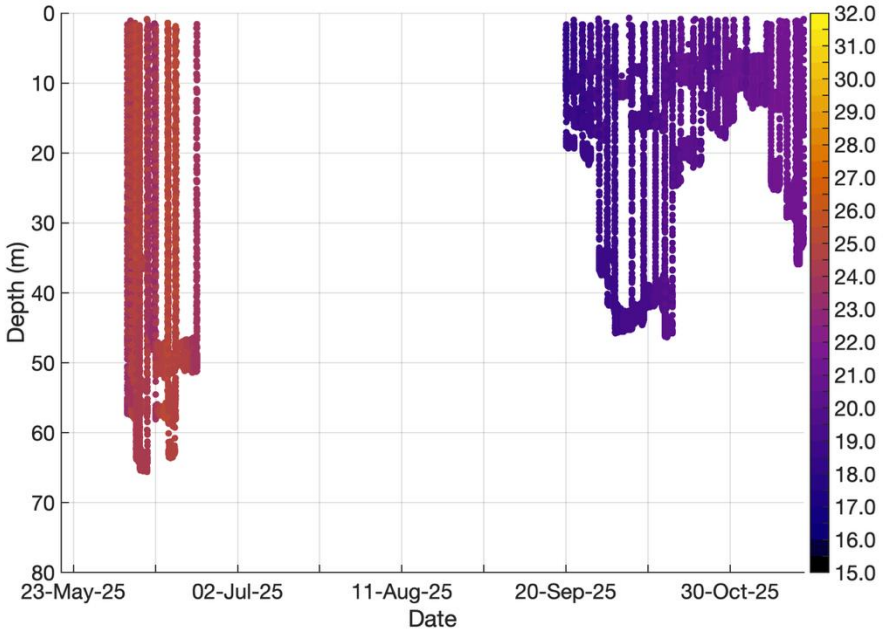
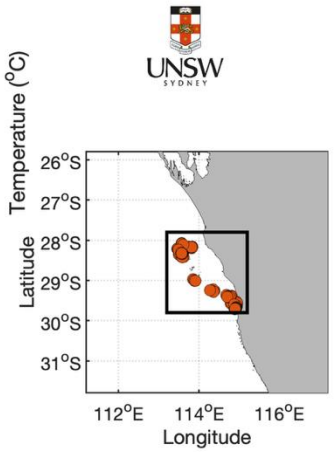
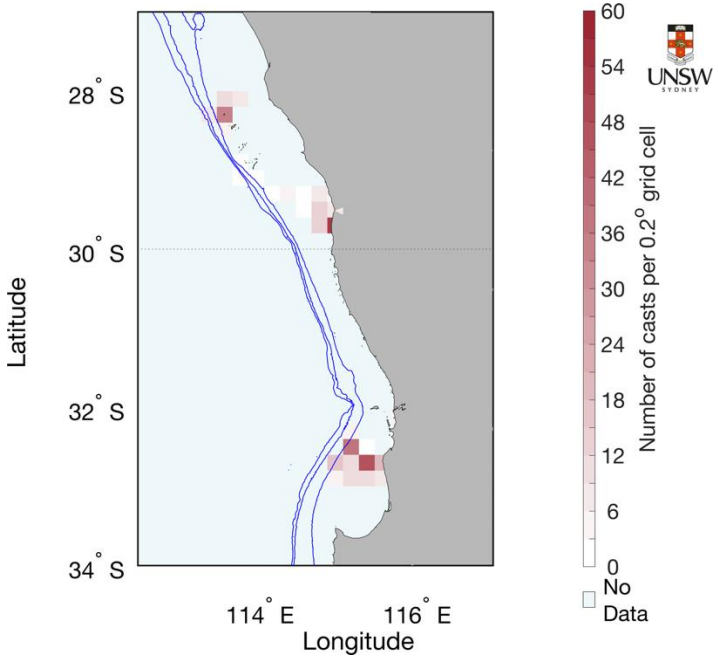
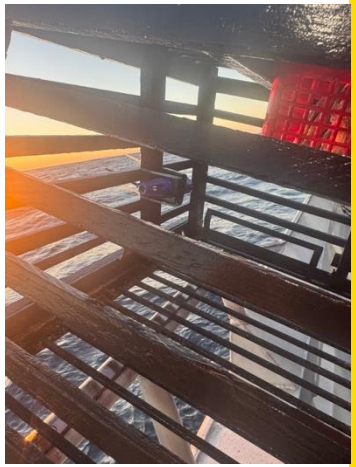
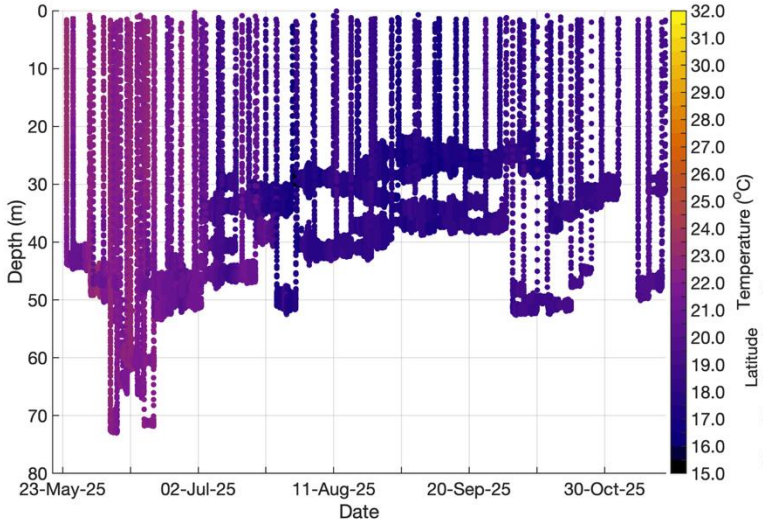
Western Rock Lobster – Collaboration (2/10 vessels)

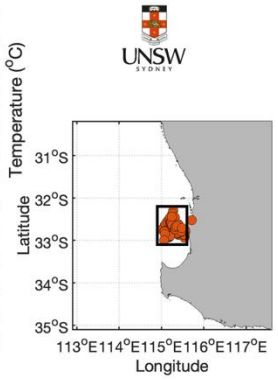












More from Chris King Tomorrow –
WRL digital strategy and data uptake

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Western Rock Lobster
World leading sustainable fishery

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Operational Benefits: Transport of live Hagfish

- Use Case
  - Temperature is measured at 500-800m depth on the trap where fish are caught
  - Live fish are returned to the surface and held in a holding tank
- Operational Action
  - Fisher receives data (email) in real time
  - Adjusts temperature in the holding tank to that at catch depth
- Outcome
  - Reduced animal stress

Improved fish quality at market ($)

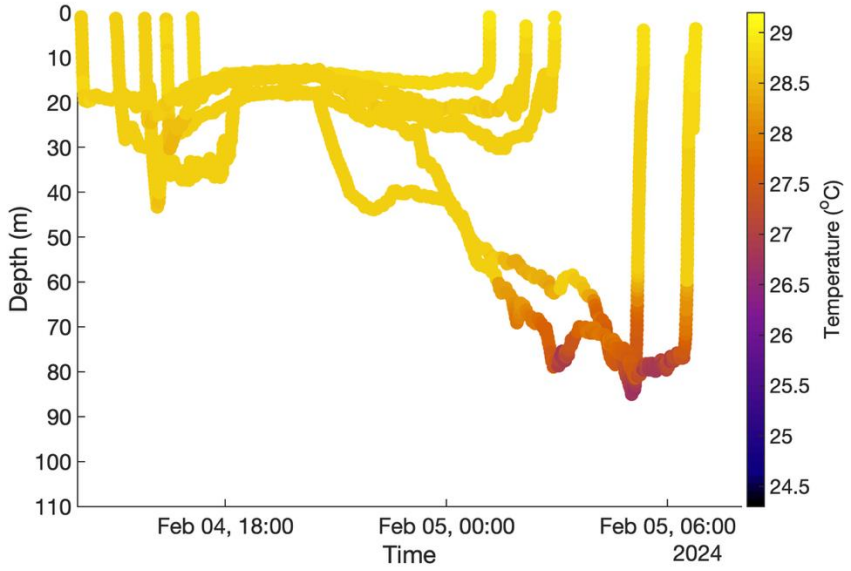
“Transformative”

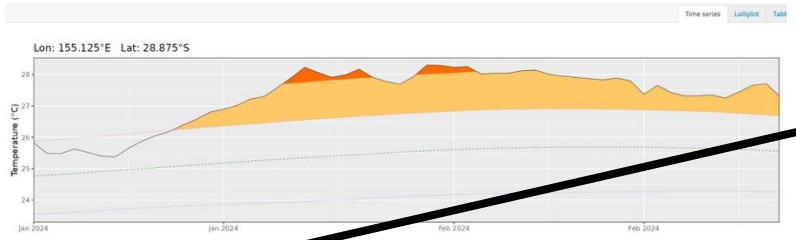
Photo credit: Australian Museum

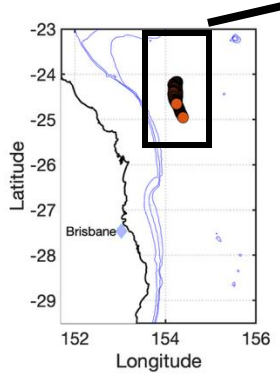
Photo credit: Bryce Nurnaitis, Fishwell

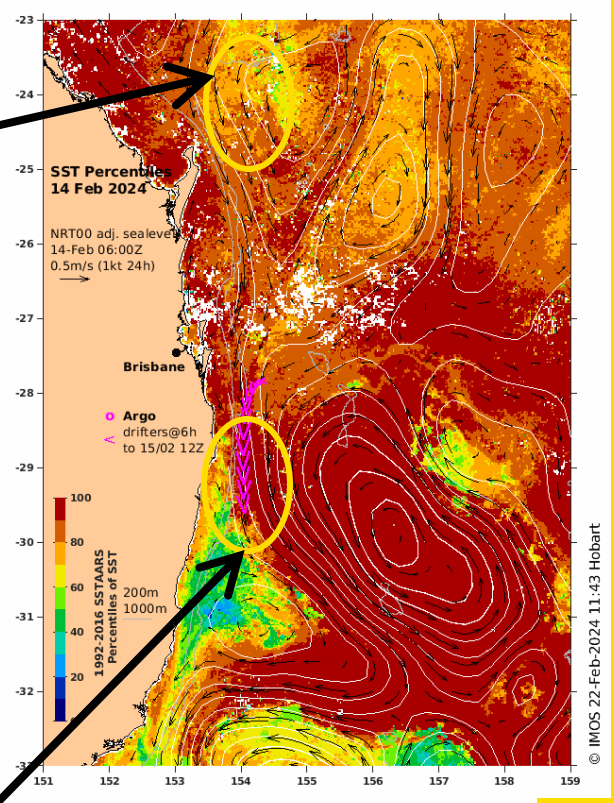
IMOS Integrated Marine Observing System

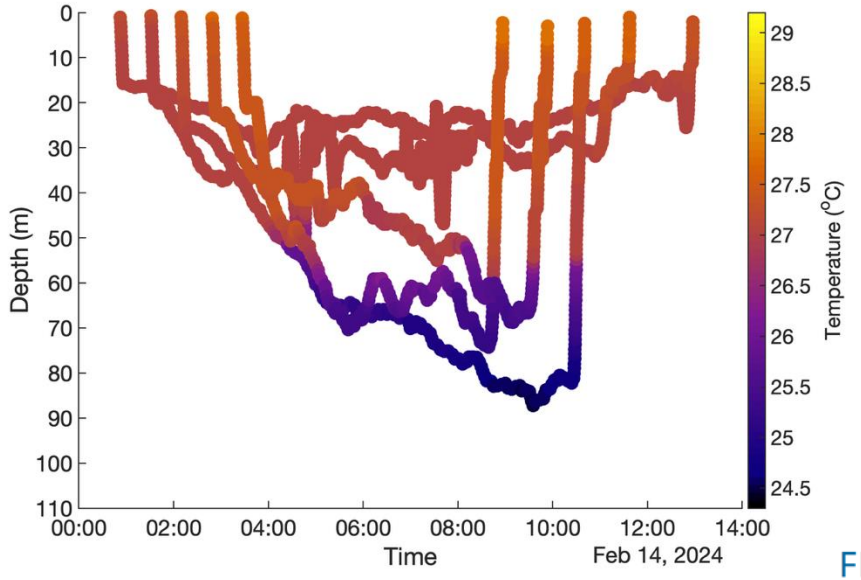
Application – observing subsurface MHWs where fishing occurs

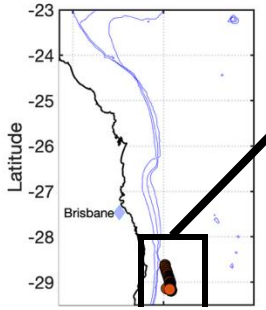












FISHING FOR OCEAN DATA IN THE EAST AUSTRALIAN CURRENT

By Véronique Lago, Moninya Roughan, Colette Kerry, and Ian Knuckey

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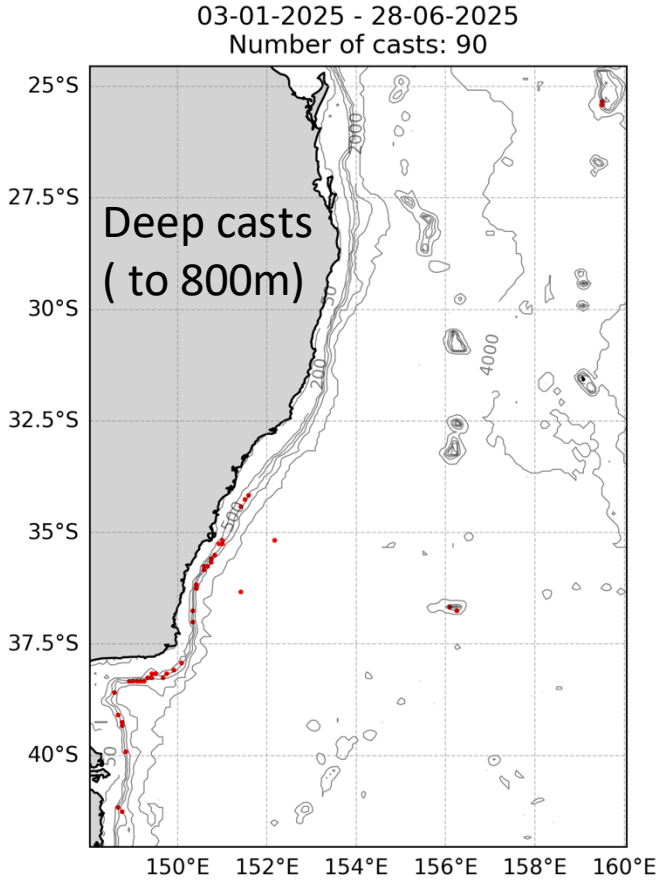
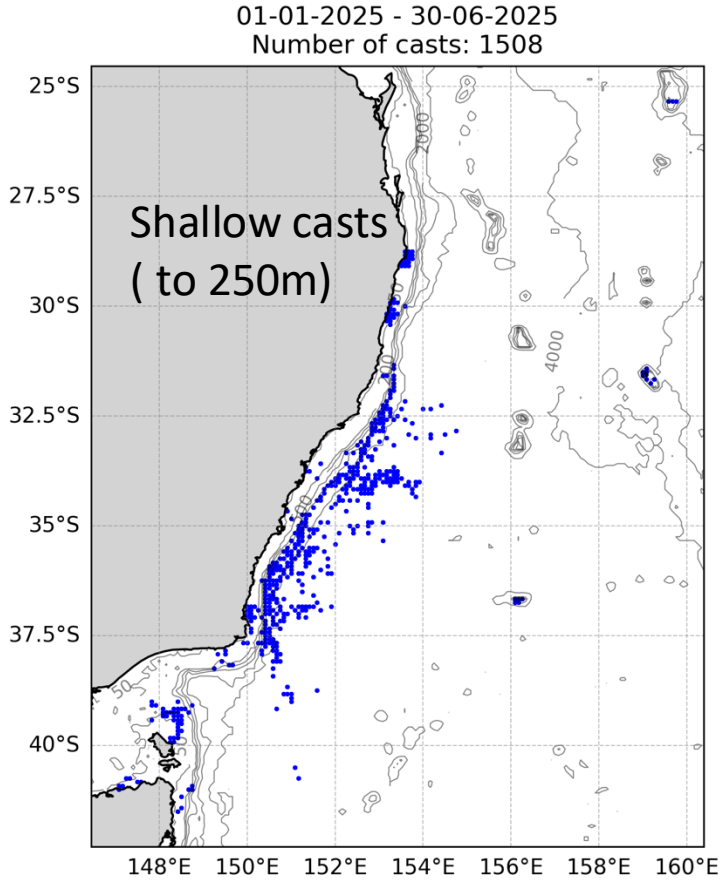
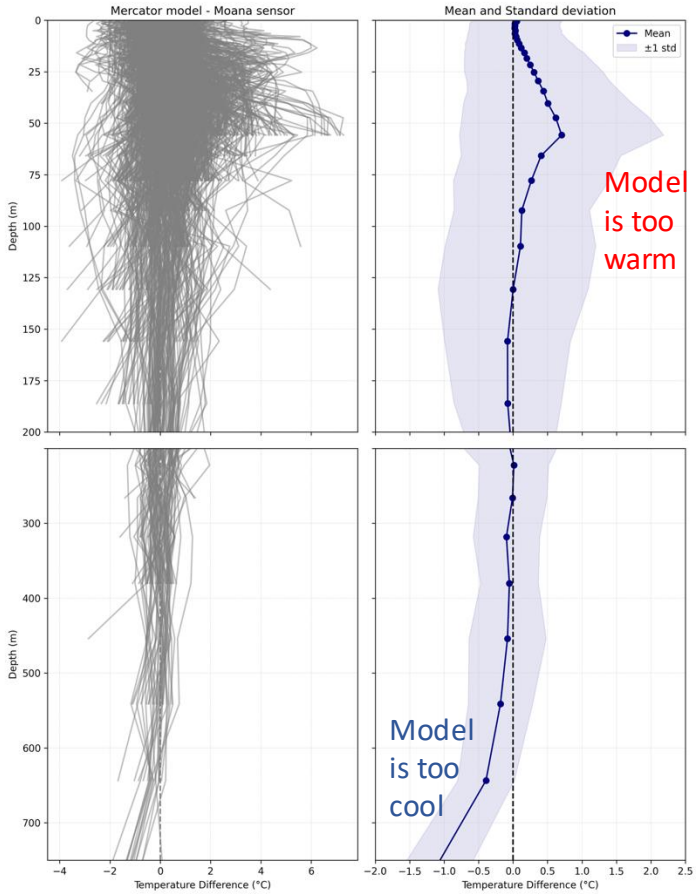
Model - Data Comparisons European (Mercator) Ocean Forecasts







Model minus sensor,
Positive - Model is too warm (25-100m)
Negative - Model is too cold (650-800m)

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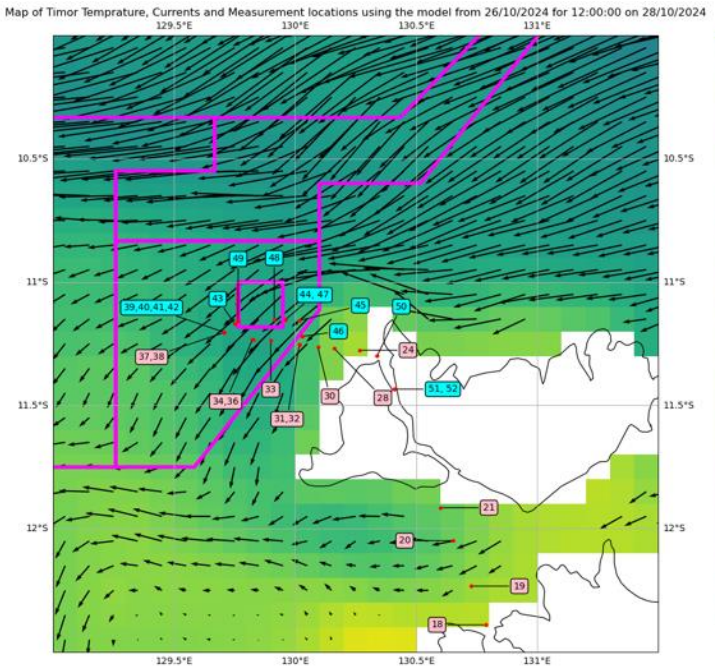
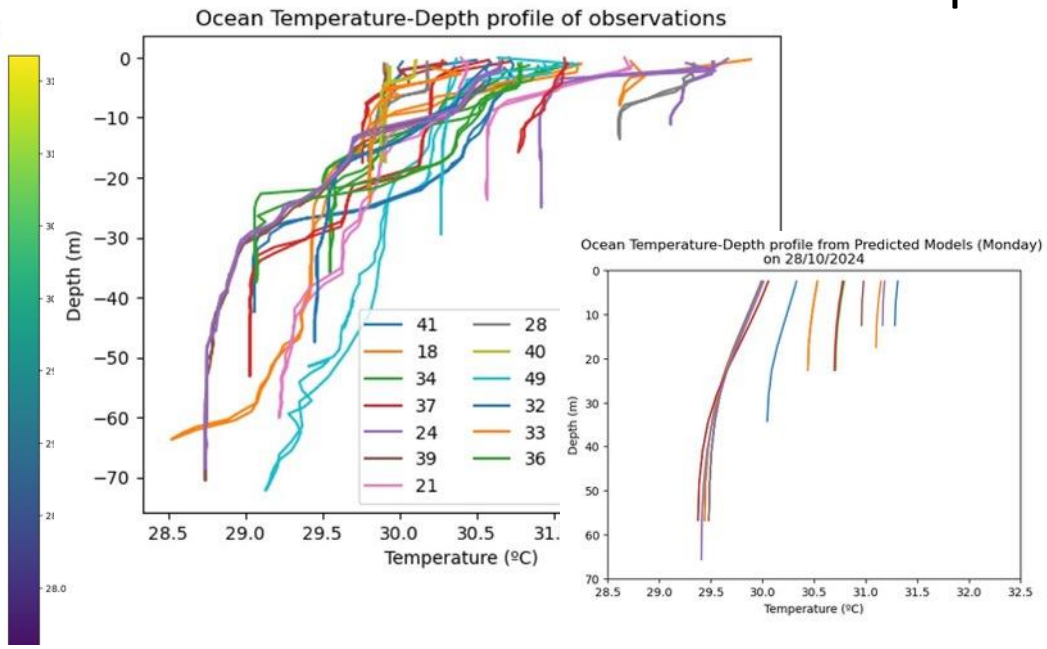
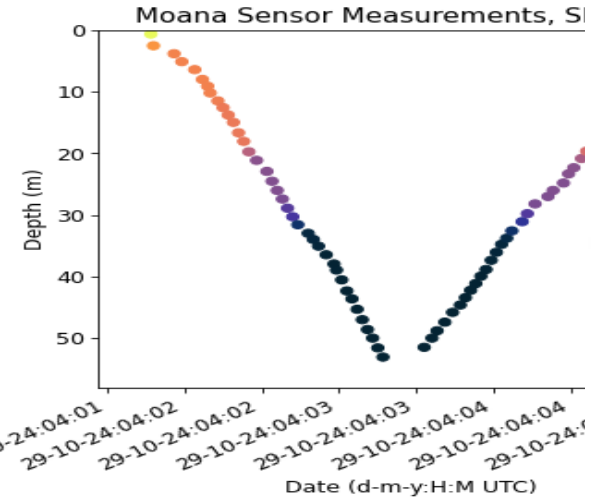
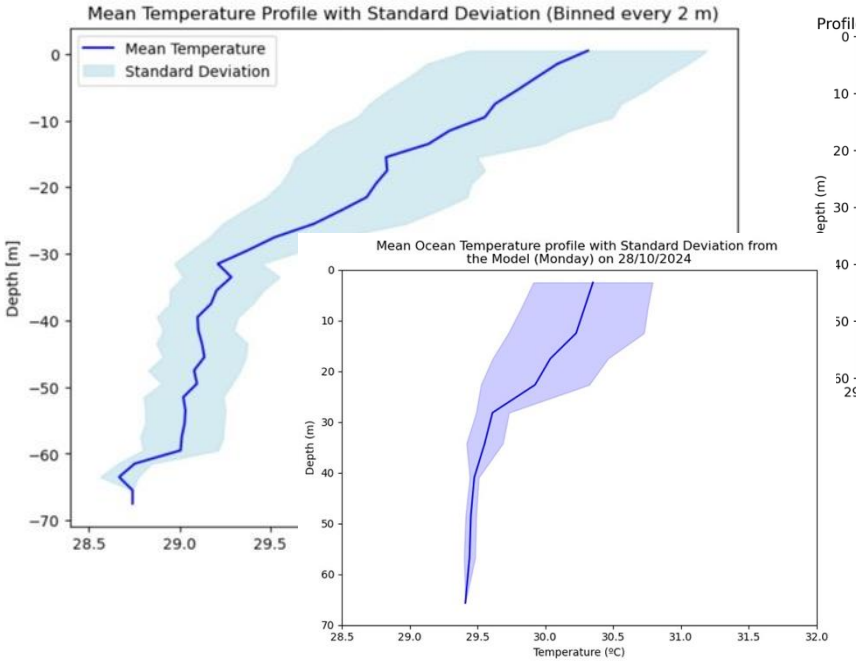
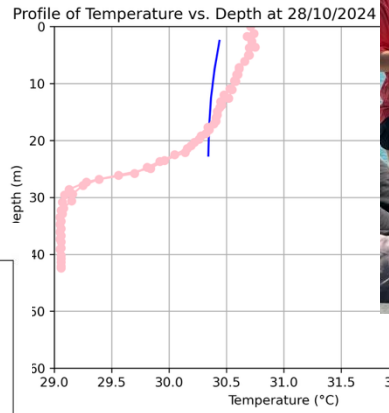
Citizen Scientists - Model Evaluation - Data Comparisons











Ocean Maps

- Ocean Forecasts for NT from BoM (G. Brassington)
- Comparisons against data for model evaluation
- Stratification, UOHC for MHWs, and TC predn.

Australian Government
Director of National Parks

Australian Marine Parks

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Funded by UNSW and Parks Australia

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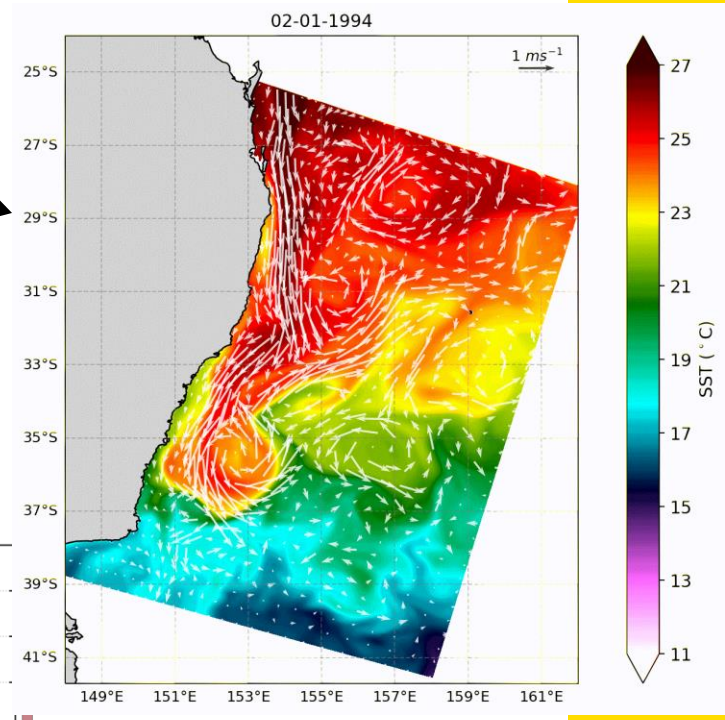
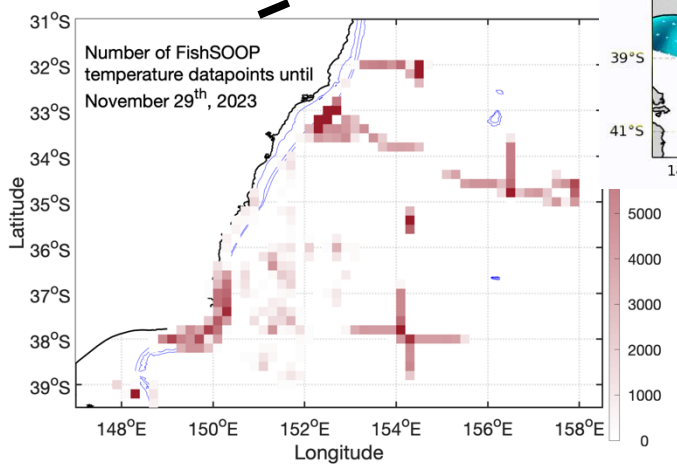
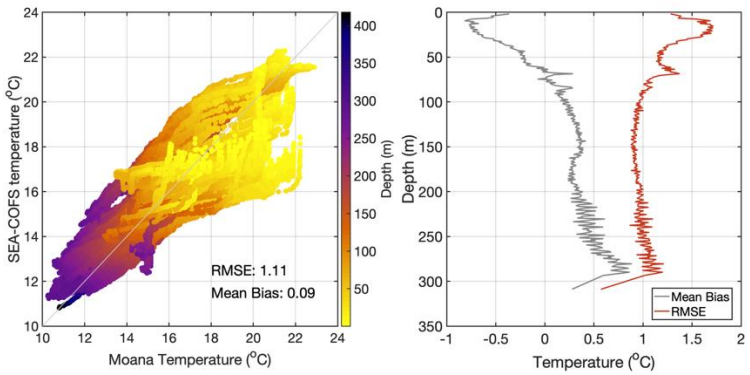
Data Uptake - Model Assimilation and Validation

Sth East Australian Coastal Ocean Forecast System (SEA-COFS)

- Near real time data streams for model data assimilation
- Collaborating with Coastal ocean modelling Commons (ACCESS-NRI)
- Developing tools & case studies







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2021 2030 United Nations Decade of Ocean Science for Sustainable Development

ACCESS Australian Earth System Simulator

NCRIS National Research Infrastructure for Australia An Australian Government Initiative

Led by Colette Kerry

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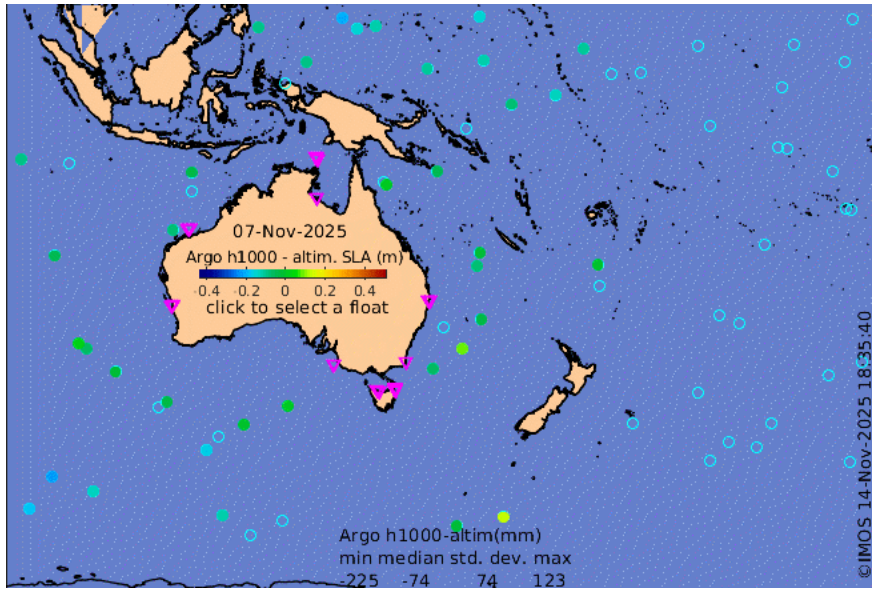
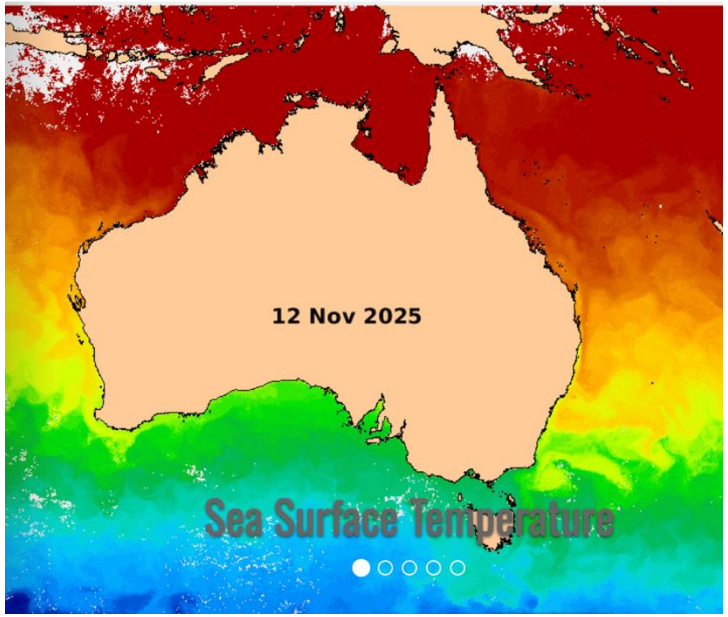
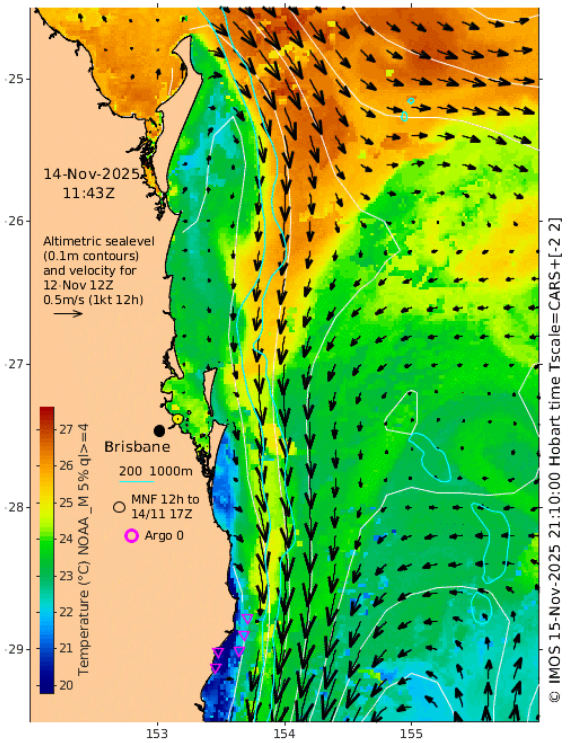
Fish SOOP Data - live on Ocean Current (soon!)







OceanCurrent

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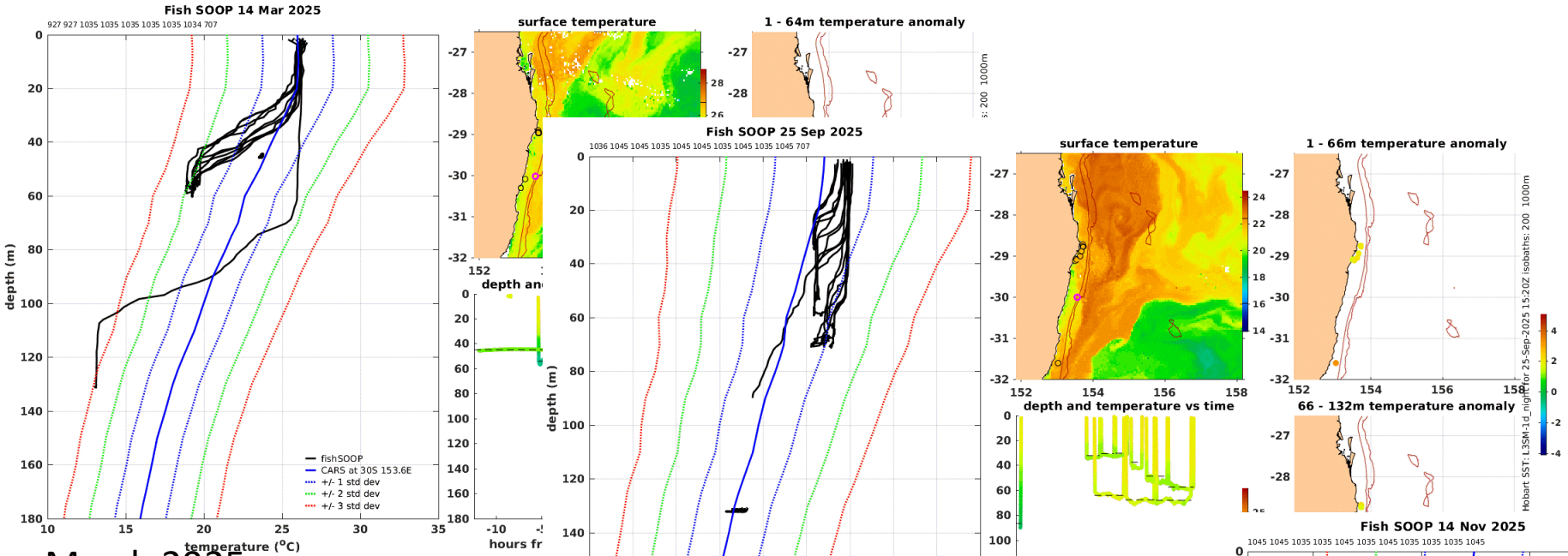
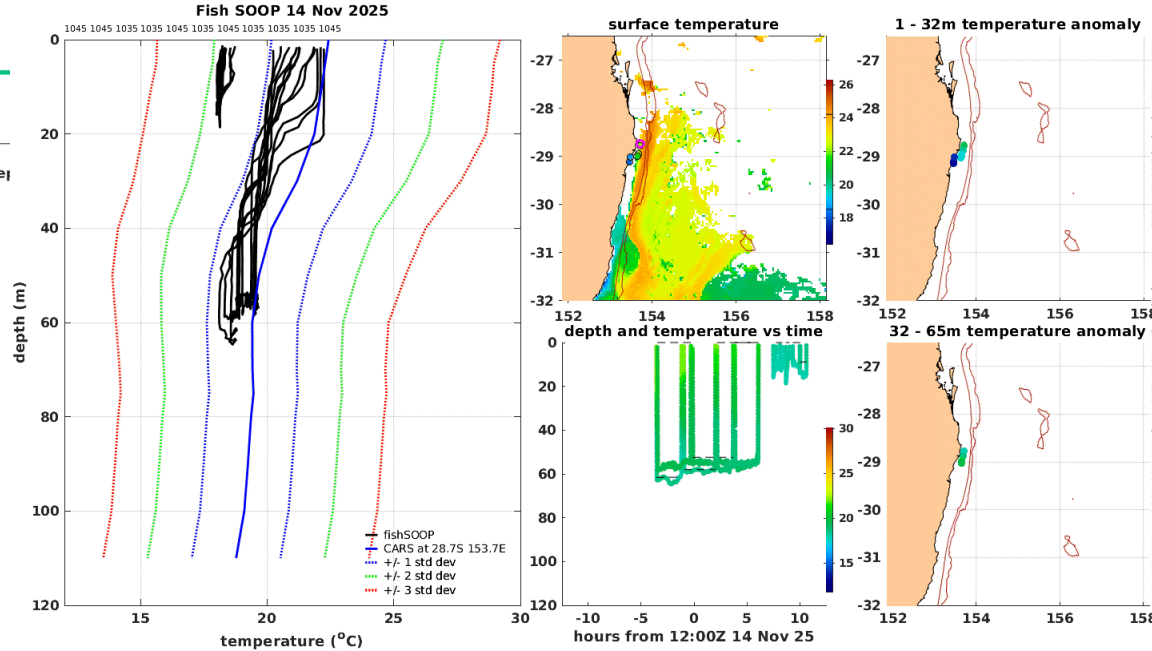


March 2025

Sept 2025



OceanCurrent

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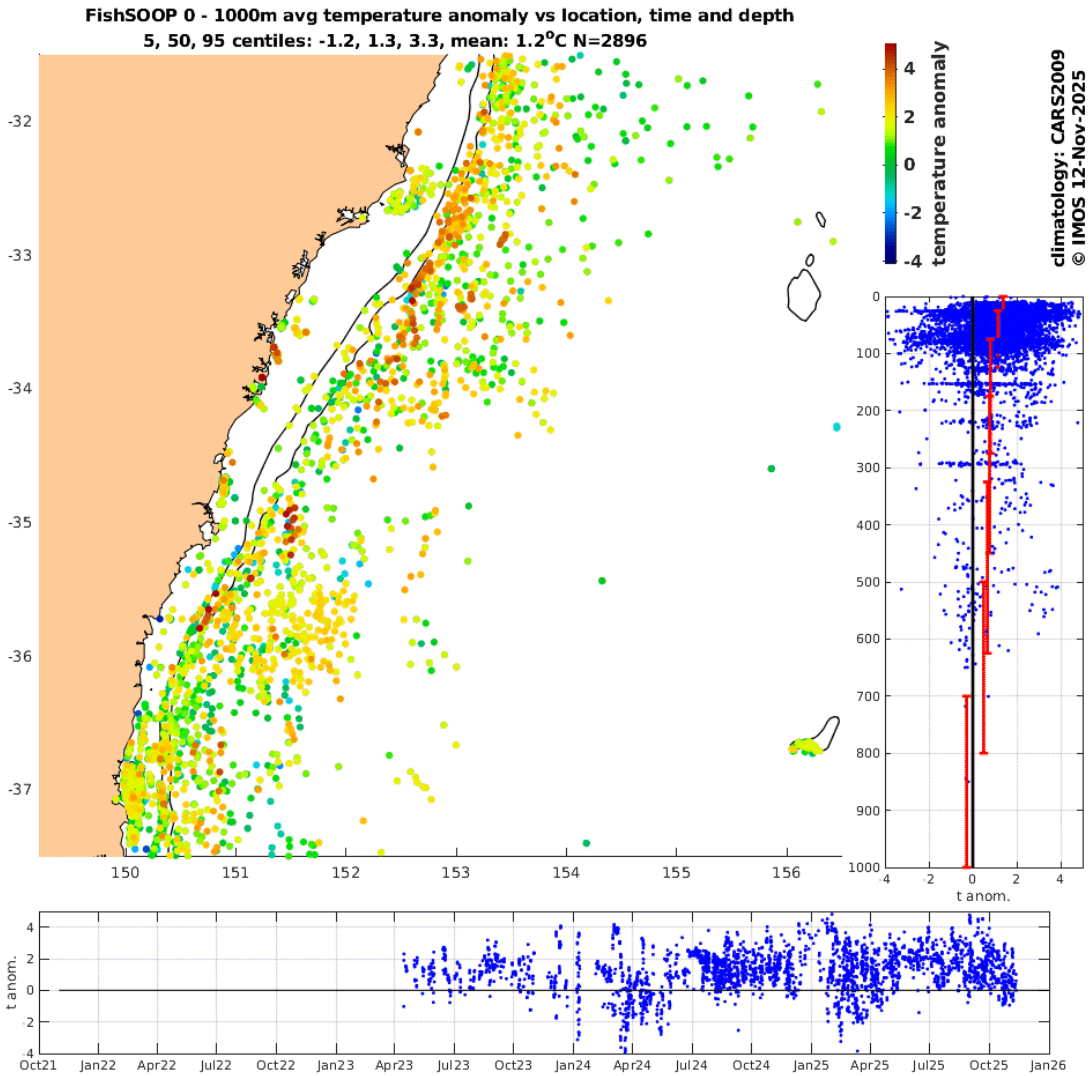

Anomaly plots through depth and time
Compared to CARS2009

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OceanCurrent

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Capacity Building across the South Pacific with SPC – 2025 PI-FVON PI GOOS

Tuna is a $5B Industry

Growth:

- 50 Vessel trial
- Began in January 2025
- Successful Installations on 24 vessels:
  - Papua New Guinea (6)
  - Solomon Islands (2)
  - Fiji (10)
  - French Polynesia (5)
  - Samoa (1)
- Further expansion in the coming months
  - Tonga, FSM, Marshall Islands, New Caledonia etc.

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Pacific Community
Communauté du Pacifique

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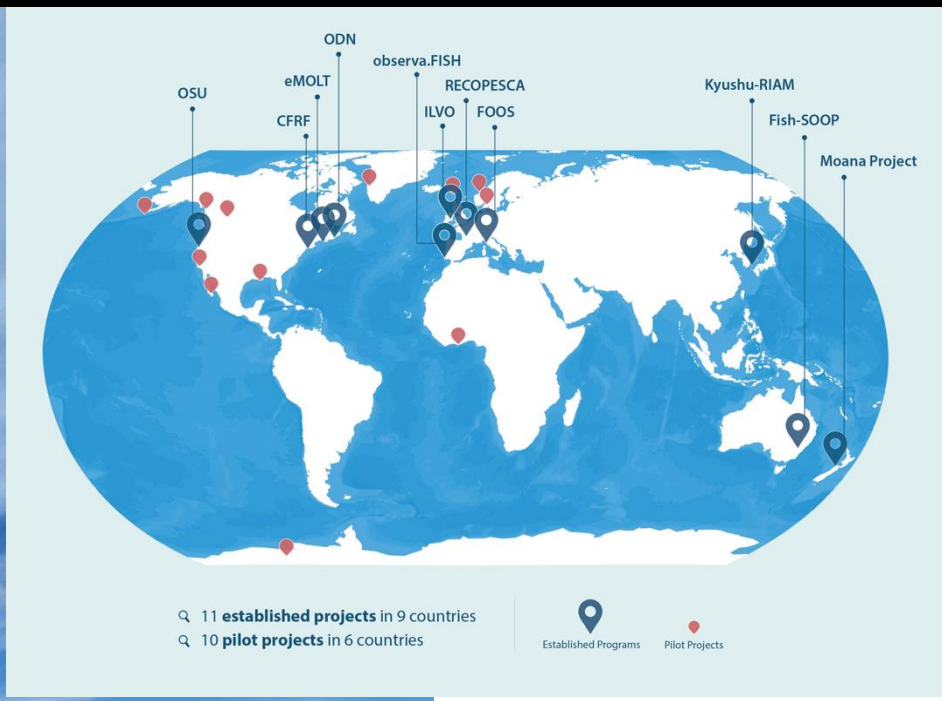
THE FISHING VESSEL OCEAN OBSERVING NETWORK

Steering Committee: Cooper Van Vranken, A. Miguel Piecho-Santos, Julie Jakoboski, Christopher Cusack, Patrick Gorringe, Michela Martinelli, Moninya Roughan, João de Souza, Peter McComb, George Maynard, Shinichiro Kida, Hassan Moustahfid

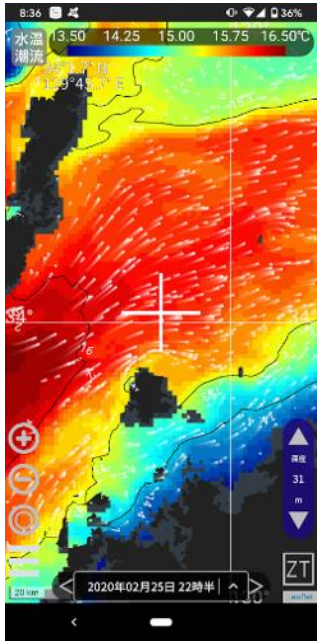
Secretariat: Aubrey Taylor, Emilie Brévière, Rita Esteves, Matt Irwin, Dustin Colson Leaning

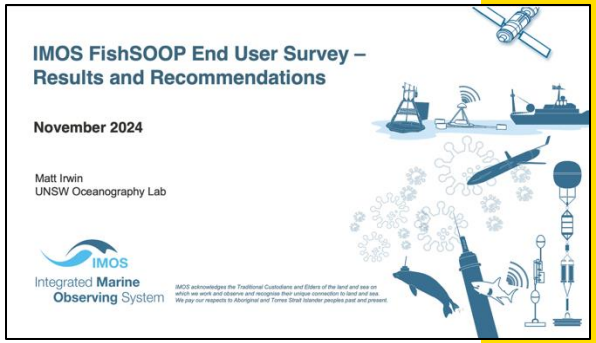
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

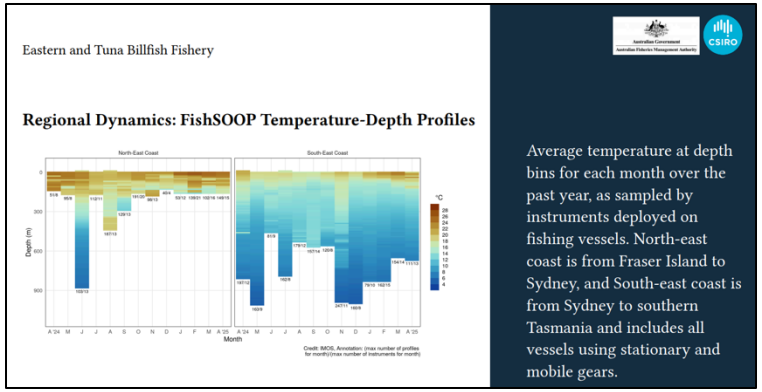


~600 Vessels
~ 15 countries

Data Uptake, Use and Impact - Data Products for better Operational outcomes







Dashboard with data products
- Thermocline depth
- Mixed Layer depth
- Bottom temp
- Climatologies + anomalies
- Sink rates

Data integration into existing products
- E-log Books
- Time Zero
- Ocean Current
- Fish-Ops (WRL)

Data integrated into management reports (AFMA)

Data layers from models / forecasts
- Currents – Subsurface
- Mixed layer depth
- Thermocline depth
- Specific isotherm depth
- Bottom temperature

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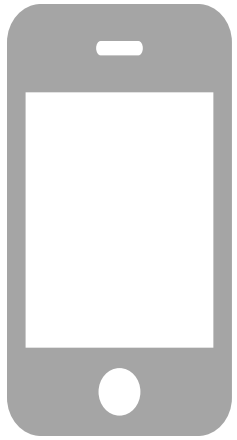
Thanks to all the collaborators, co-investors, participants and data users

Expression of Interest

Newsletter

Integrated Marine Observing System (IMOS) – IMOS is a national collaborative research infrastructure supported by Australian Government.

Questions?



Take a picture to access our EAC papers

www.oceanography.unsw.edu.au

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Many thanks to the Coastal and Regional oceanography Team

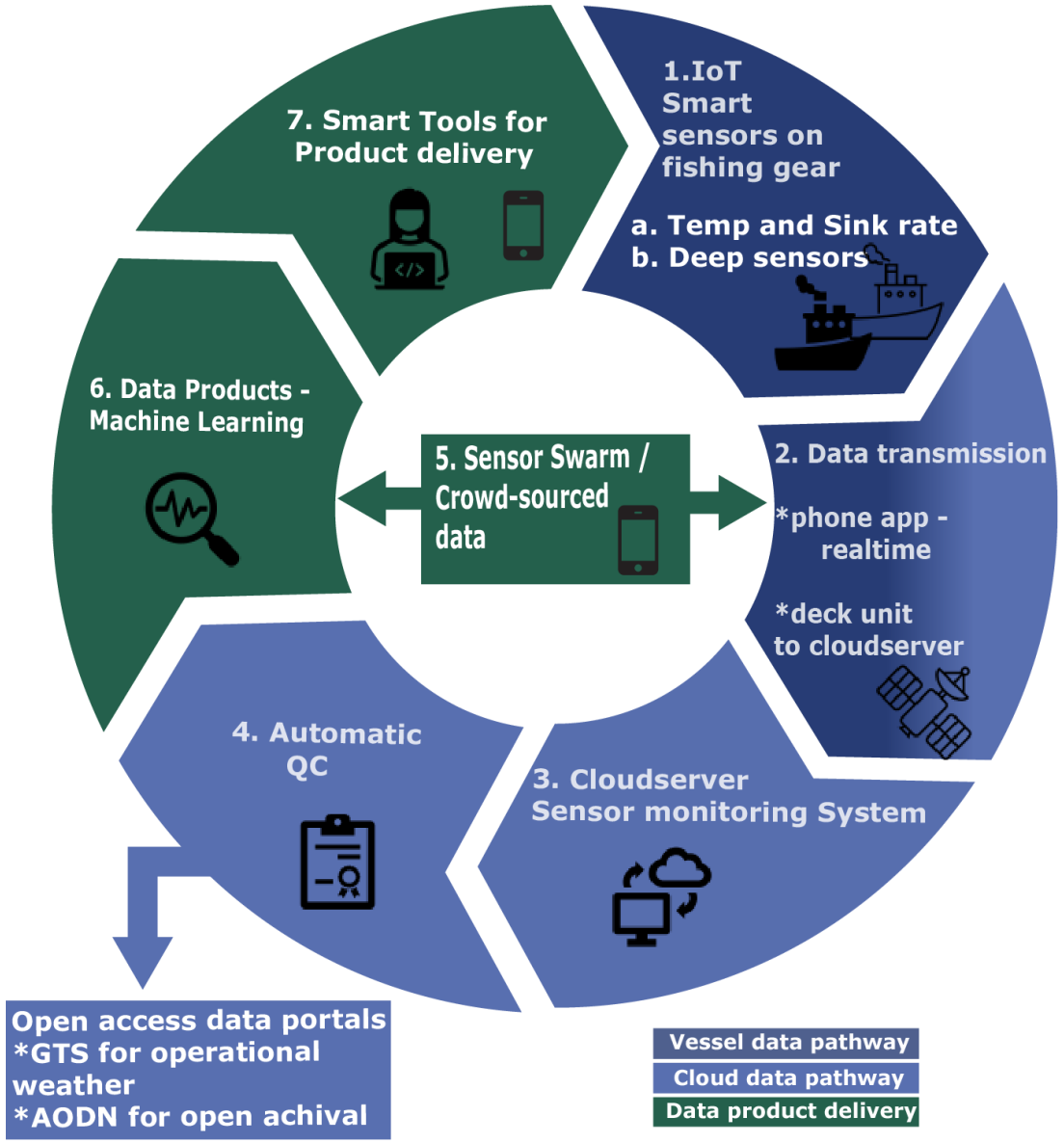
Australian Government
Australian Research Council

Australian Government
Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education

Australian Government
Australian Fisheries Management Authority

The full circle data pathway – Smart Tools for Product delivery

Further Opportunity



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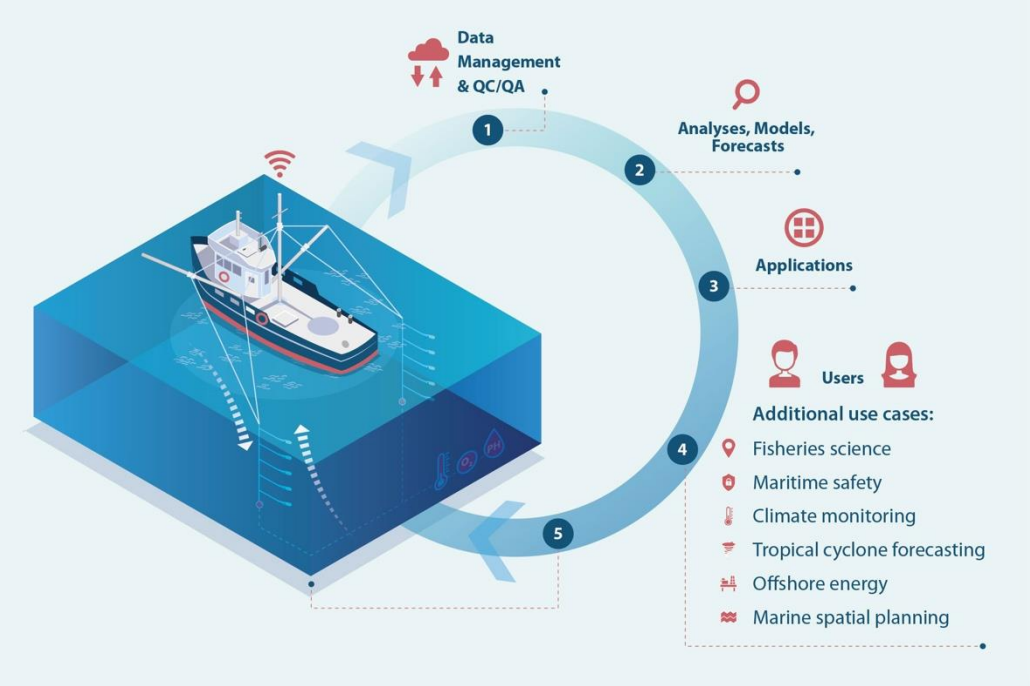
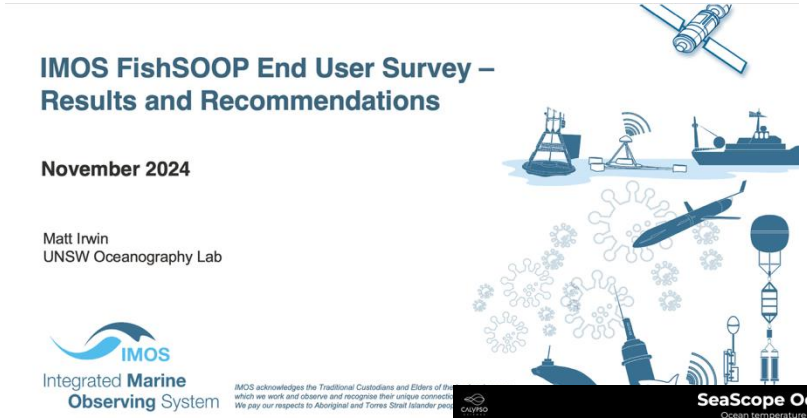
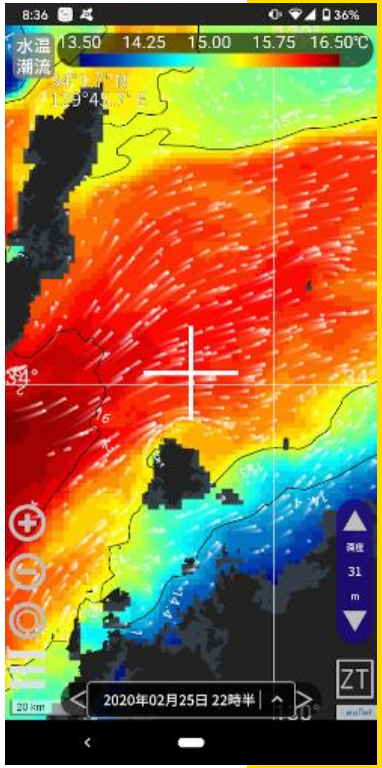
Future Opportunities

- Data Use and Impact - Fisheries Management applications
- Increase the fleet size to fill spatio-temporal data gaps (WA, SA, QLD, Southern ocean)
- Development of data products
  - Ocean data products and data delivery tools.
- Remote data delivery options out of cellular / starlink
  - Vessel Monitoring System (VMS) data integration for remote data delivery – CLS (Lord Howe / Norfolk / NT / Tuna Australia)
  - SpaceX SIM to Satellite in remote regions
- Navigation software integration
  - Time Zero?
  - Windy?
- E-log book integration
  - Olrac, FishServ, other

Data Uptake, Use and Impact - Data Products for Operational benefit







Data products from profiles
- Thermocline depth
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Data Uptake

Prof Kylie Scales U Sunshine Coast

Collaboration with Tuna Australia

- Improve understanding of the physical drivers of catchability of commercially valuable tuna
- Understand climate impacts and risks to the Australian tuna fishing industry.
- Build ecological data products and near-term forecasts to inform industry and management authorities.
- Provide industry and management authorities with new information regarding the catchability of key species
- Contribute to the development of sustainability initiatives in the Australian tuna longline fishery.

National Industry PhD Program

Josh Easman
PhD Student
2026-2029

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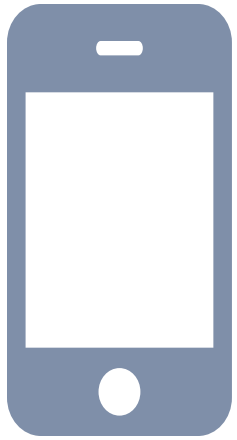
Questions?



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IMOS Integrated Marine Observing System

New South Wales Integrated Marine Observing System (NSW-IMOS)

FRDC

Australian Government
Australian Research Council

Australian Government
Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education

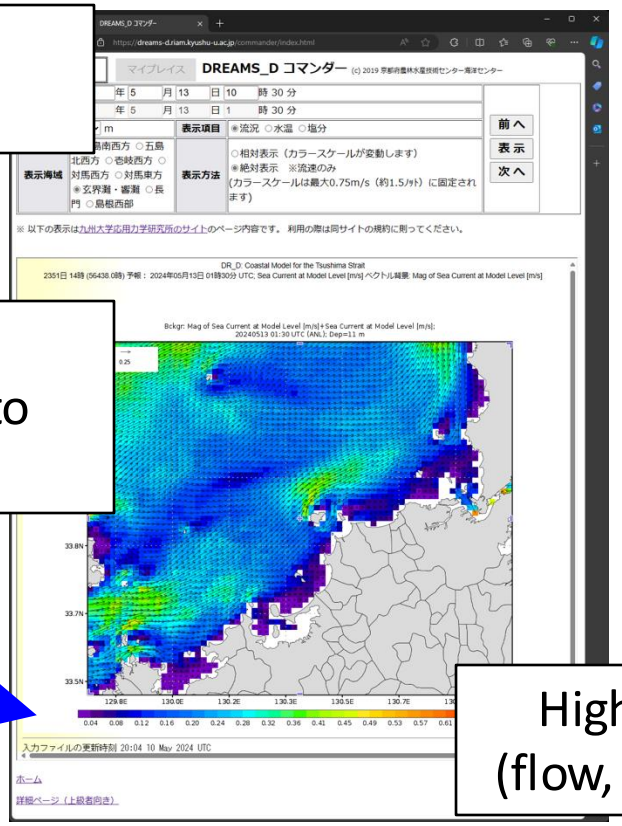
Australian Government
Australian Fisheries Management Authority

SFiN (Smart Fishing Network) FVON Japan

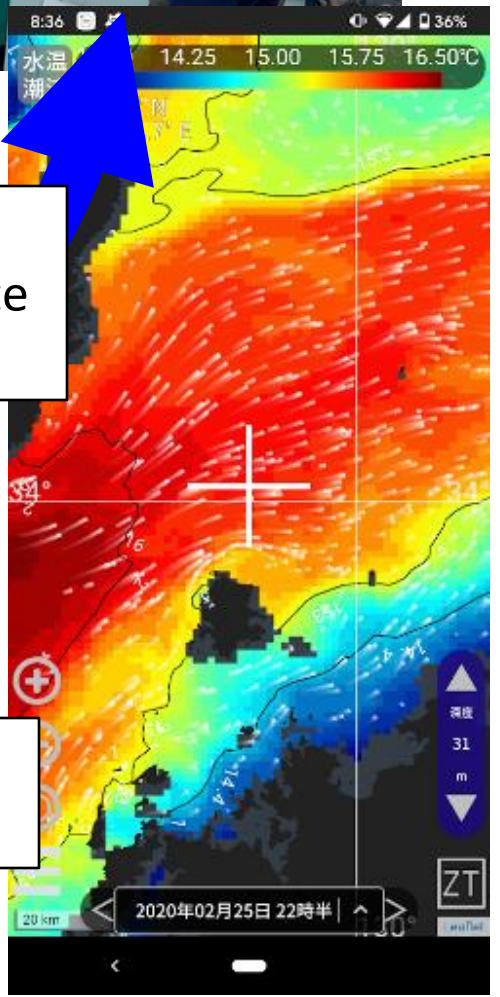
Naoki Hirose, Shin Kida and Colleagues

CTD obs by fishers using compact CTD

Upload data Automatically to cloud



Viewer App for fishers to use on site “Smart” fisheries



High Res ocean forecast (flow, temperature, salinity)

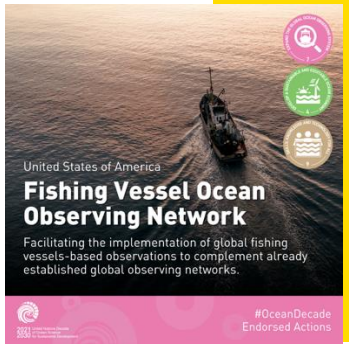
https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2024.1457272/full

Technical Specs for the sensors

Moana specifications and requirements	
Temperature Range	-2 °C to 35 °C
Temperature Accuracy	0.05°C
Temperature Resolution	0.001 °C
Temperature Response Rate	1 second
Pressure accuracy	0.5% of rated pressure range
Battery life and calibration duration	2 years
Weight with protective tough jacket	100g
Memory capacity	31,146 data records
Communication range	30 meters
Deck-box specifications and requirements	
Battery endurance without solar charge	4 weeks
Power sources	Solar and/or USB-C
Transmission	Cellular or Wi-Fi
Position accuracy	6.3 m error with 95% confidence interval of 13.8 m
Position logging rate	15 seconds
Memory capacity	8GB

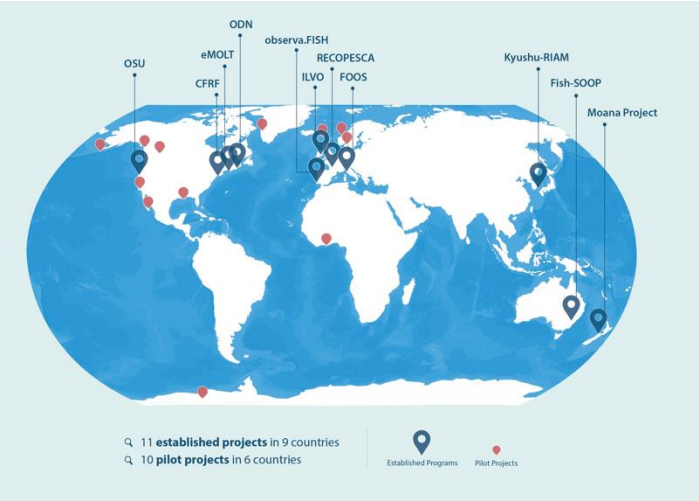
Global Ocean Observing System -

FVON International Endorsed as emerging network



International group
Best practices, coordination, data and equipment standards
Data hubs / Data Assembly centers
Become part of the Global Ocean Observing System (GOOS)

The Global Ocean Observing System



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Int

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FVON International Steering Committee

- FVON International Steering committee meeting held at 2024
- Governance and
- Self funding growth models
  - Steering Committee – MR
  - Secretariate – MI
  - Data Quality Control - VL

Van Vranken et al. (2023).
https://www.frontiersin.org/articles/10.3389/fmars.2023.1176814/

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