Crowd Sourcing Ocean Observations for Ocean Forecasting Data Assimilation

Date: 30 June 2022

Presenter: Julie Jakoboski

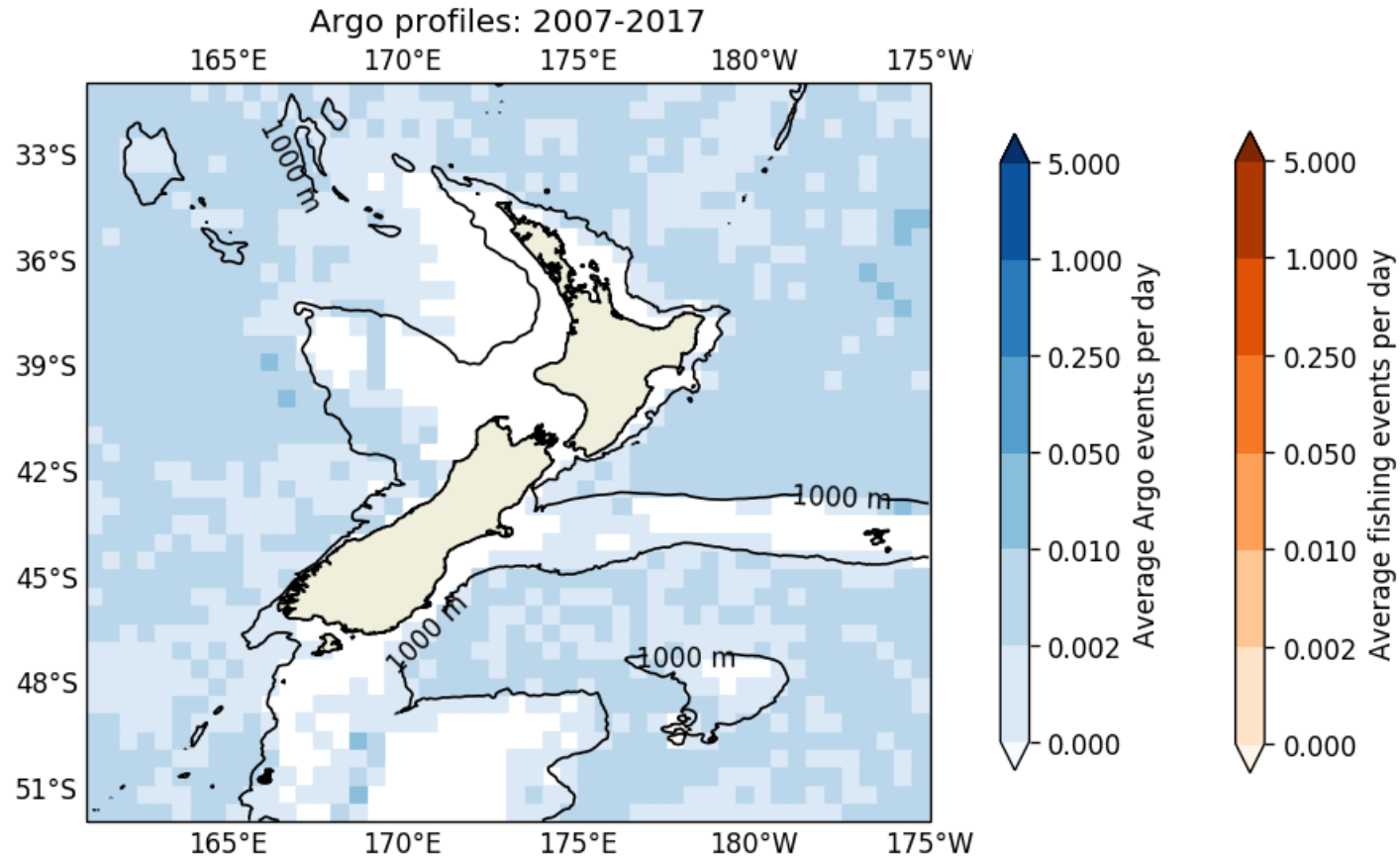Organisation: MetOcean Solutions (Meteorological Service of New Zealand)

The Moana Project and Te Tiro Moana: Eyes on the Ocean

Goal: Revolutionize Ocean Observing and Modelling in New Zealand to support the Blue Economy by providing accurate ocean data, hindcasts and forecasts and data products. Specifically:

- Creating a cross-cultural ocean knowledge platform to support iwi interests.

- Applying the 'internet of things' concept to achieve smart and sustained nation-wide ocean observing capability; liberating/discovering existing ocean observations.

- Develop NZ's first nation-wide, open-access, ocean modelling system elucidating ocean dynamics and marine heatwaves.

- Predicting the source, transport and settlement of marine taonga species from national to regional scales to support sustainable management.
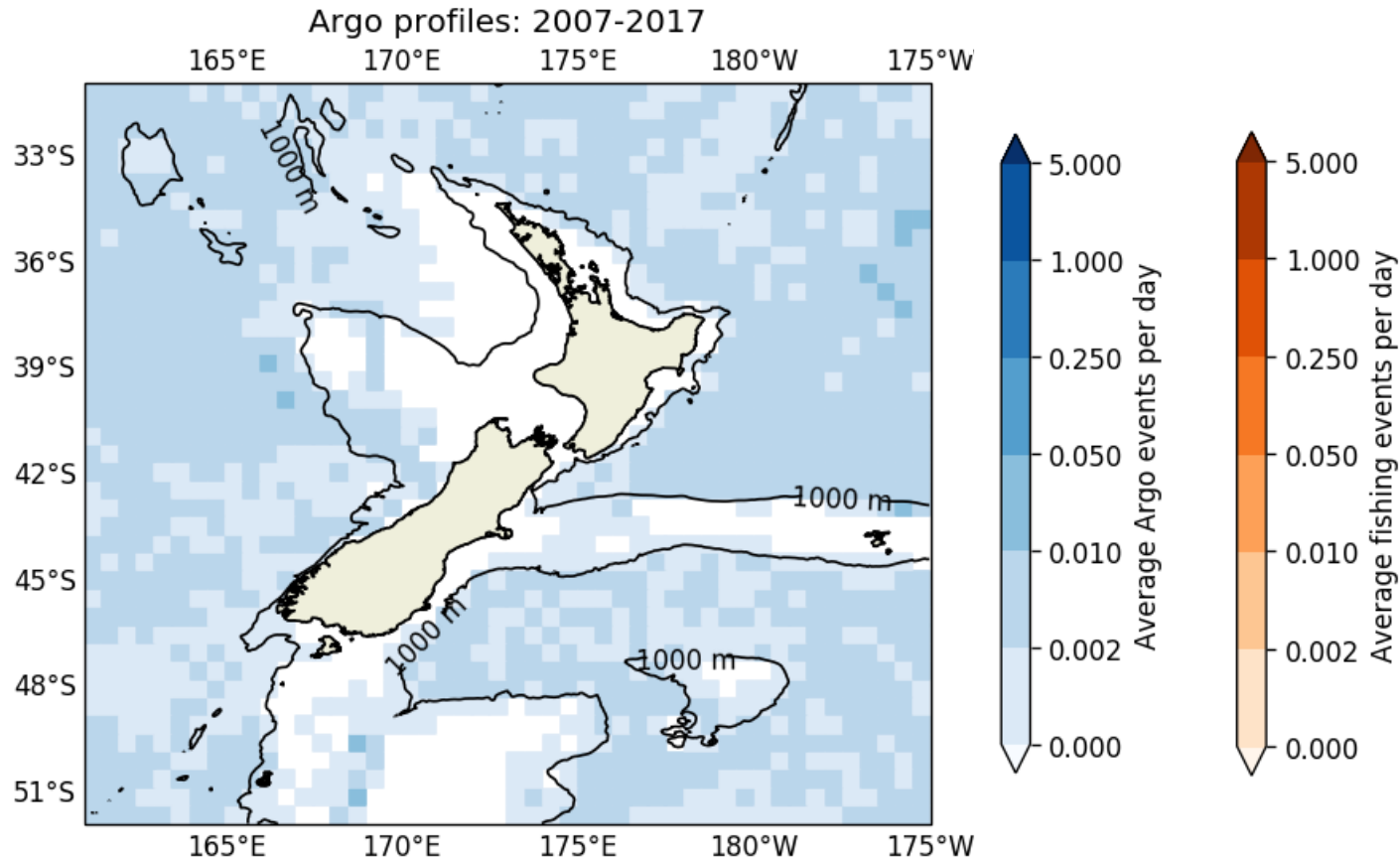

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Te Tiro Moana Sensors

Argo profiles: 2007-2017

Incorporating untapped resources to fill the gap

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Te Tiro Moana Sensors

Argo profiles: 2007-2017

Average Argo events per day

Average fishing events per day

Incorporating untapped resources to fill the gap

4.4 million square kilometers of Exclusive Economic Zone (EEZ).[1]

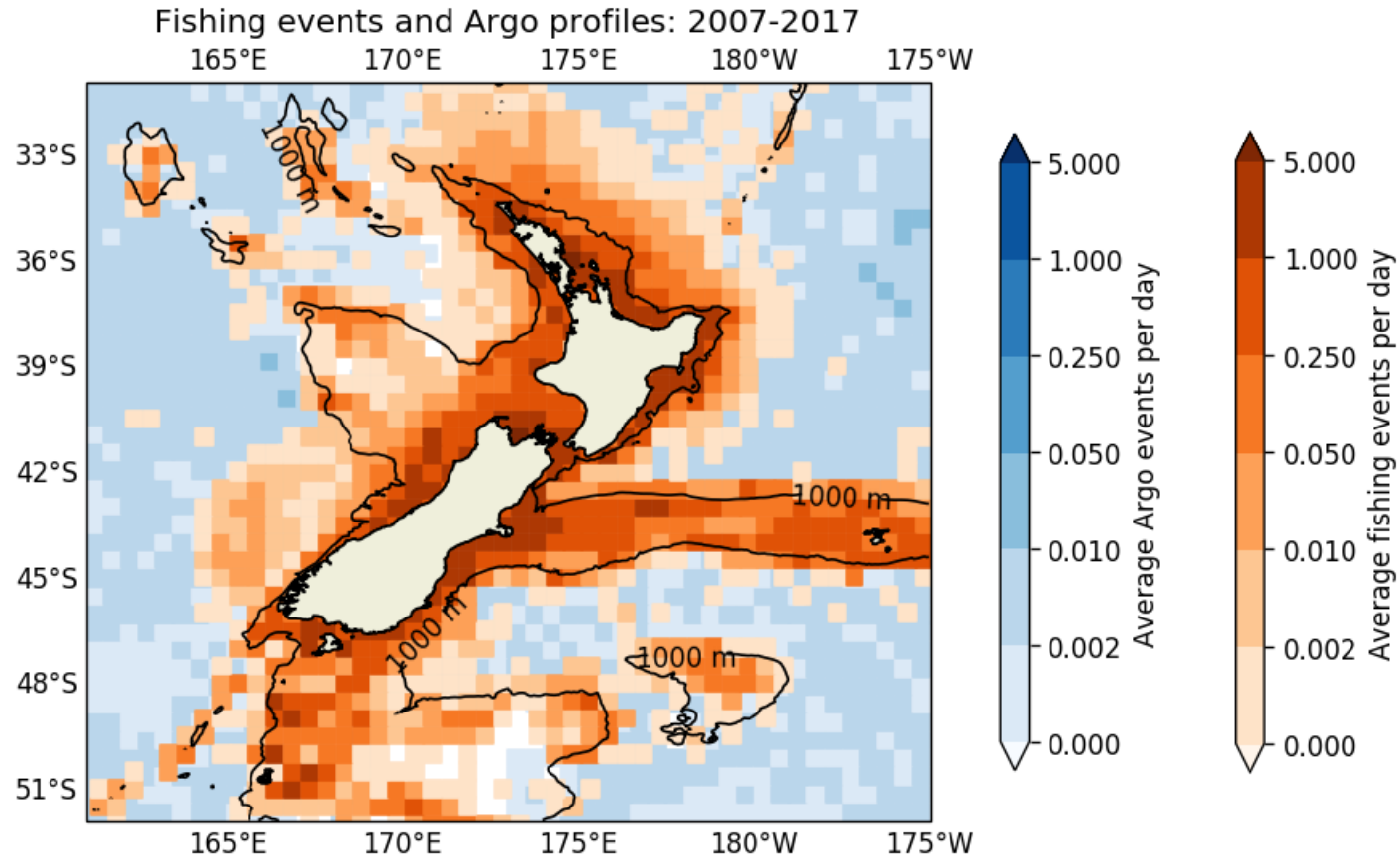**700 000** NZ people fish in the sea each year, spending around **$946 million**.[1]

~ 950 commercial fishing vessels

$7.7 billion estimated as the total marine economy value added in 2013.[2]

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Te Tiro Moana Sensors

Fishing events and Argo profiles: 2007-2017

Fishing event data were provided by the New Zealand Ministry for Primary Industries (MPI) and prepared by David Middleton of Pisces Research Ltd.

Incorporating untapped resources to fill the gap

For more information: Van Vranken et al., 2020, "Fishing gear as a data collection platform: Opportunities to fill spatial and temporal gaps in operational sub-surface observation networks", *Frontiers in Marine Science*.

Mangōpare Temperature and Depth Sensor

- Developed in collaboration with technology partner Zebra-Tech lead by John Radford

- "Mangōpare" named by Danny Paruru (Whakatōhea iwi)

- Installed on 150+ vessels so far via partnership with Deepwater Group, FINZ, NZ Rock Lobster, Seafood NZ Magazine, all 3 biggest NZ fishing companies + others, Independent fishers, research and education vessels

- International collaboration: Berring Data Collective, Ocean Data Network, University of New South Wales, IMOS and FRDC Australia, sensor trials and programmes abroad

- Near real-time data return and sensor requirements met
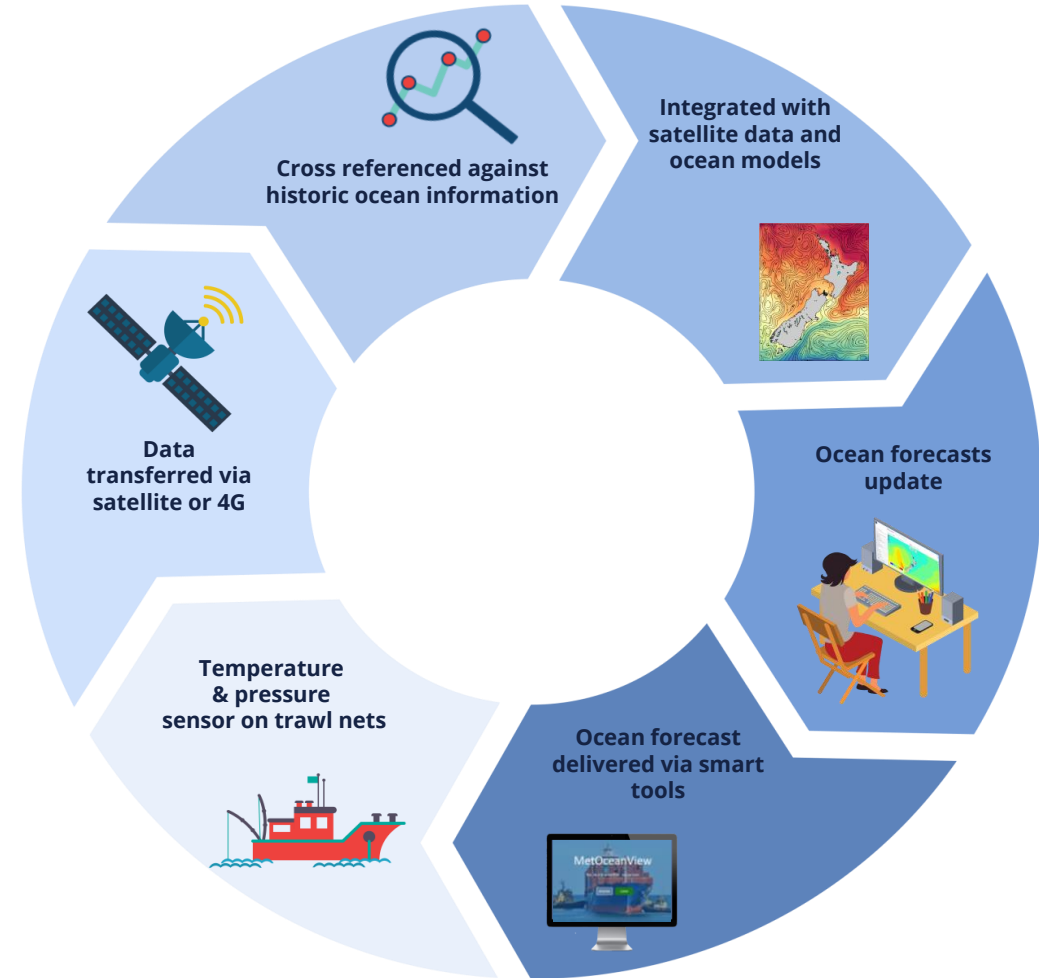
Mangōpare Sensor Requirements

- No human intervention required for daily operations, sensor start and stop triggered by pressure change, automated data offload and transfer to the cloud

Sensor

- Mounted on and withstands impact from a range of fishing gear
- Low cost, lightweight, battery life of 2 years
- Temperature accuracy of 0.1^{o}C

Deck Unit

- Solar powered
- Cellular and Wi-Fi versions developed
- Over the air firmware update capability
- Tough Polyethylene housing
- Versatile and simple mounting arrangement
- Provides GPS location for sensor measurements

Wide Range of Mounting Options

- Tough jacket to withstand harsh conditions
- Developed with fisher feedback
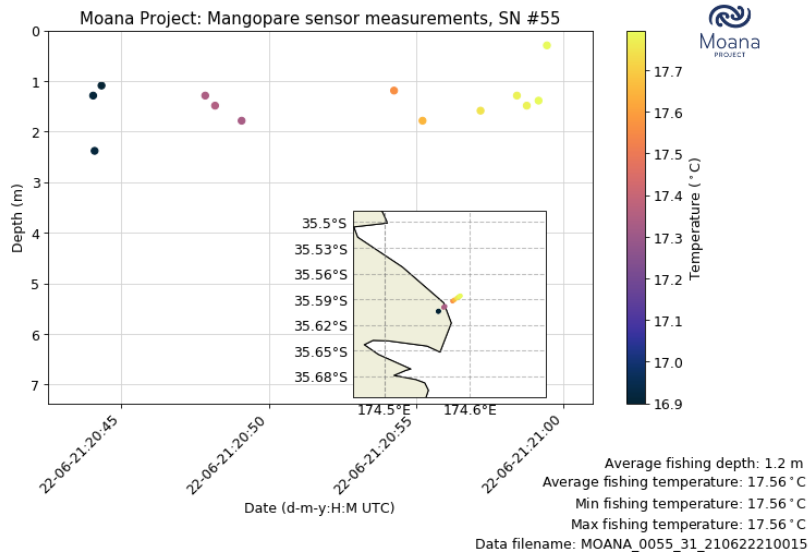- Versatile and flexible options
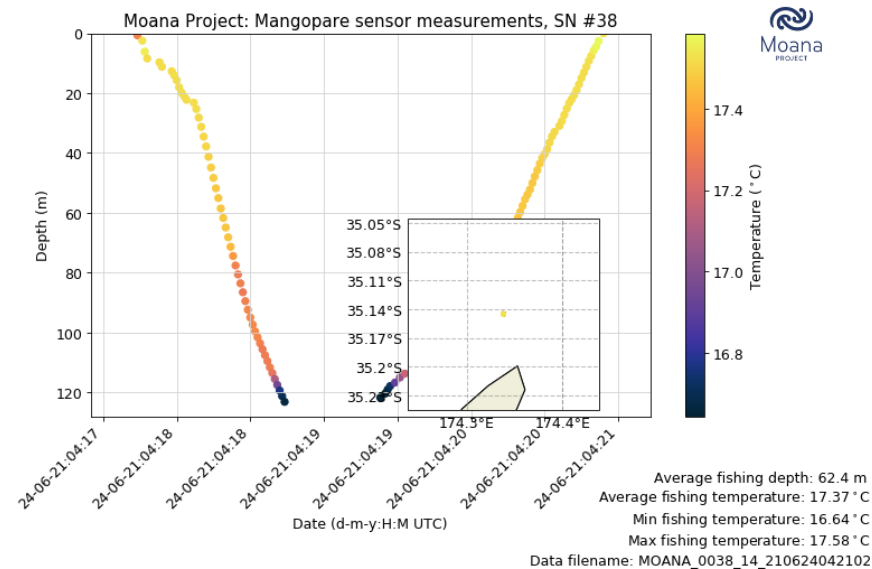
Research Deployment via Manual Cast

Deploy the Mangōpare sensor from different platforms:

Stationary: Weight to keep the profile straight, success!
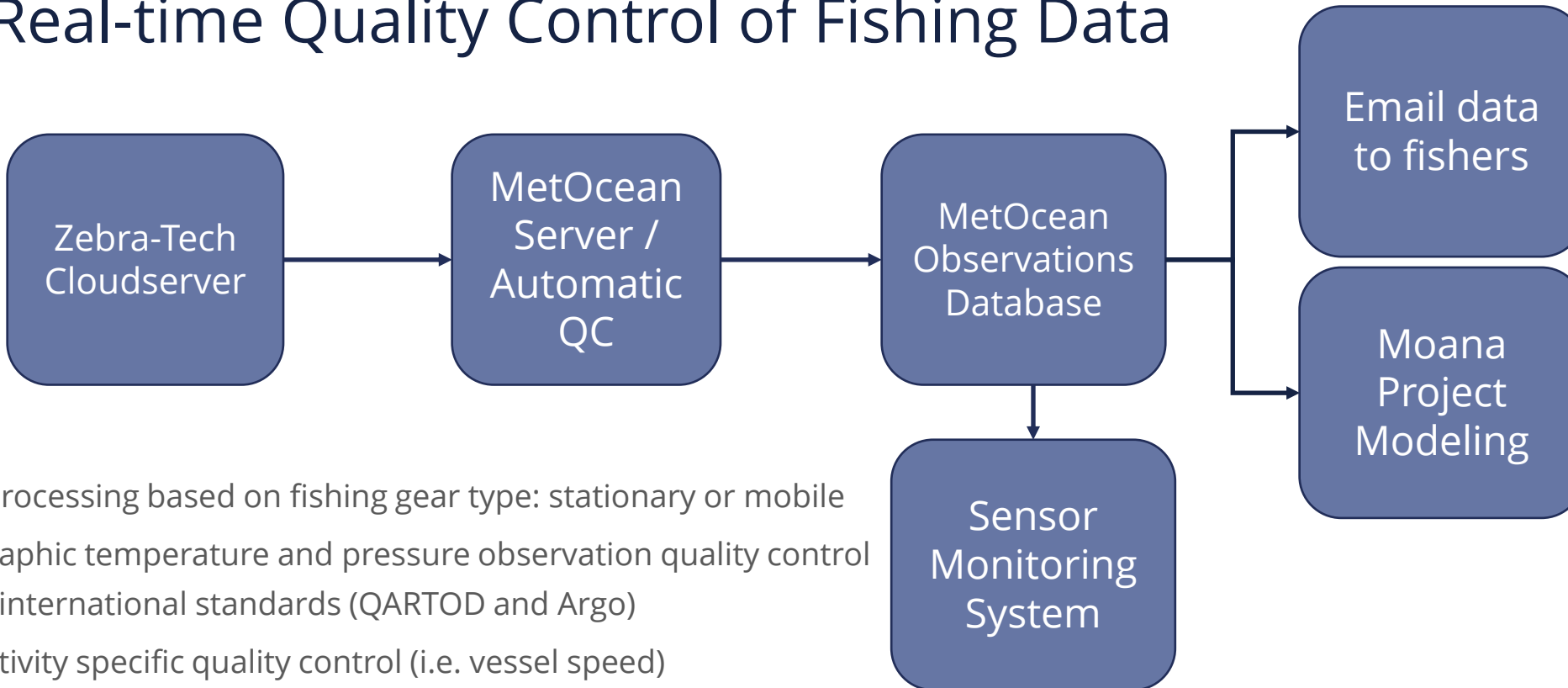
Mobile (towing): More weight and less speed

Stationary deployment

Initial towing tests

Near Real-time Quality Control of Fishing Data

```
Zebra-Tech
Cloudserver  →  MetOcean
                Server /
                Automatic
                QC         →  MetOcean
                              Observations
                              Database      →  Email data
                                                to fishers

                                            →  Moana
                                               Project
                                               Modeling

                                            ↓
                                            Sensor
                                            Monitoring
                                            System
```

- Position processing based on fishing gear type: stationary or mobile
- Oceanographic temperature and pressure observation quality control based on international standards (QARTOD and Argo)
- Fishing activity specific quality control (i.e. vessel speed)
- Quality-controlled data goes into MetOcean observations database
- Sensor monitoring system indicates if sensor is active, battery life, calibration, etc
- Observations automatically emailed to vessel owners/fishers
- Modeling team accesses measurements via observations database
- Fishing positions are not shared unless permission given

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Return Measurements to Vessel / Data User

- Automatic emails: summary statistics, plot, processed csv spreadsheet
- FishServe website (https://www.fishserve.co.nz/)
- **Feedback from seafood/fishing sector**
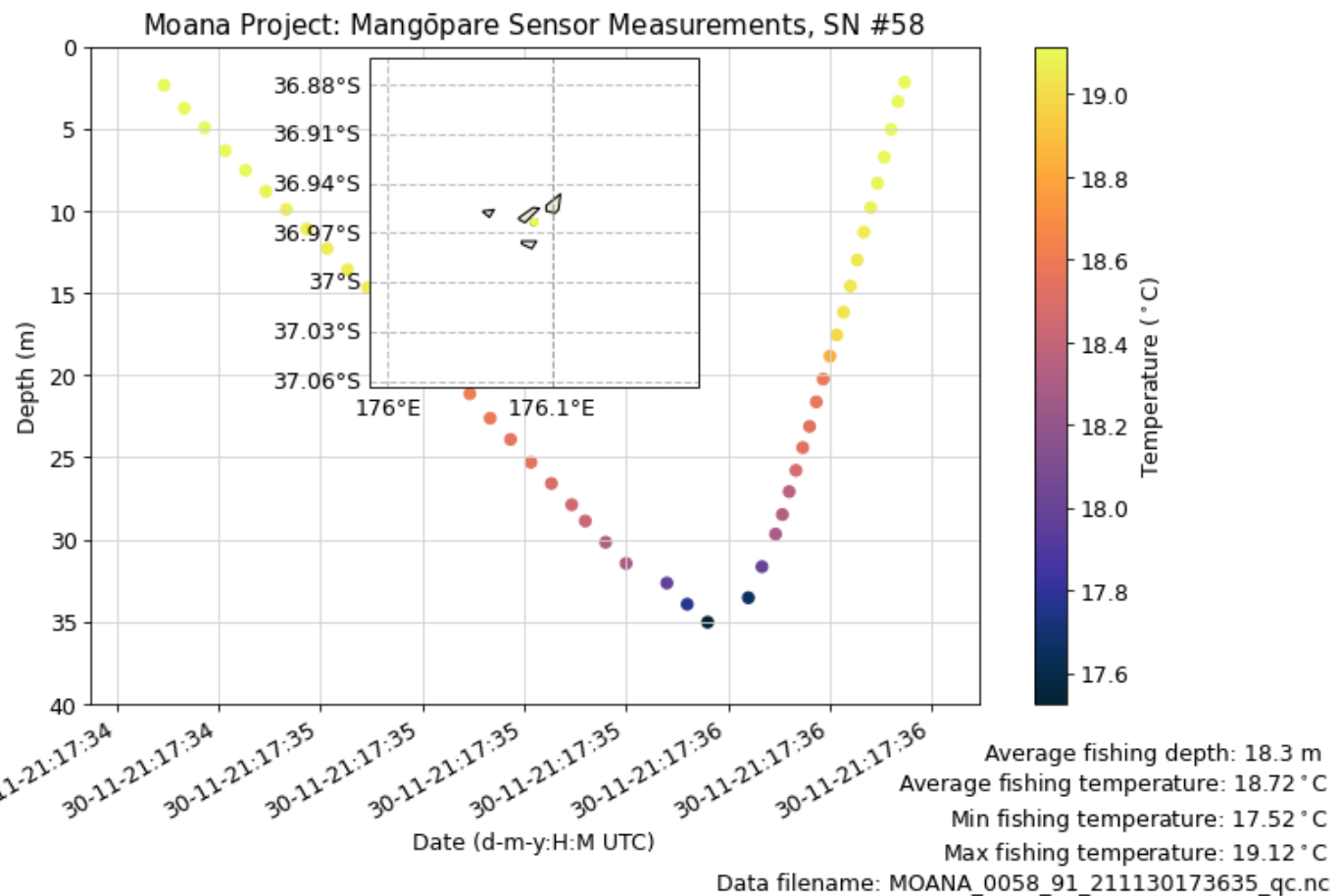
Mangopare Serial Number 58 Temperature and Depth Data for Spirit of NZ from 2022-05-22T18:20:40 to 2022-05-22T18:20:52

M mangopare_emails@metocean.co.nz
   To: sonz@spiritofadventure.org.nz   Mon 5/23/2022 1:07 PM

Vessel Information
Vessel name: Spirit of NZ
Time Range: 2022-05-22T18:20:40 - 2022-05-22T18:20:52
Vessel email: sonz@spiritofadventure.org.nz

Data Summary

	Maximum	Minimum	Average
Temperature	17.20°C	17.20°C	17.20°C
Depth	4.27 m	1.29 m	2.70 m

Please see the attached Mangōpare temperature sensor data for the vessel above. If you have any questions or comments, please contact julie.jakoboski@metocean.co.nz. This is an automatic email that is generated within 24 hours of data transmission from Spirit of NZ.

The information contained in this email message (including any attachments) is STRICTLY CONFIDENTIAL. If you are not the intended recipient then please notify the sender immediately and then delete the e-mail. Anyone other than the intended recipient must not use, disclose, copy or distribute this message, the information in it, or any attachments.

Mangōpare sensor and deck unit provided by Zebra-Tech, Ltd, Nelson, New Zealand as part of the Moana Project. Data quality-control and visualisation by MetOcean Solutions, a Division of the Meteorological Service of New Zealand. The Moana Project is funded by the New Zealand Ministry of Business, Innovation, and Employment (MBIE) Endeavour Fund.

Errors: None

Moana Project: Mangōpare Sensor Measurements, SN #58

Average fishing depth: 18.3 m
Average fishing temperature: 18.72 °C
Min fishing temperature: 17.52 °C
Max fishing temperature: 19.12 °C
Data filename: MOANA_0058_91_211130173635_qc.nc

# Mangōpare Sensor Roll Out - Current Status

As of 25 June 2022:

- Number of current participating vessels: 150+

- Total profiles reported: 12,002

- Total measurements: 5.1 million

- Deepest profile: 1,507 m

- Combined time underwater by all sensors: 3,565 days

- Most measurements in a deployment: 31,144
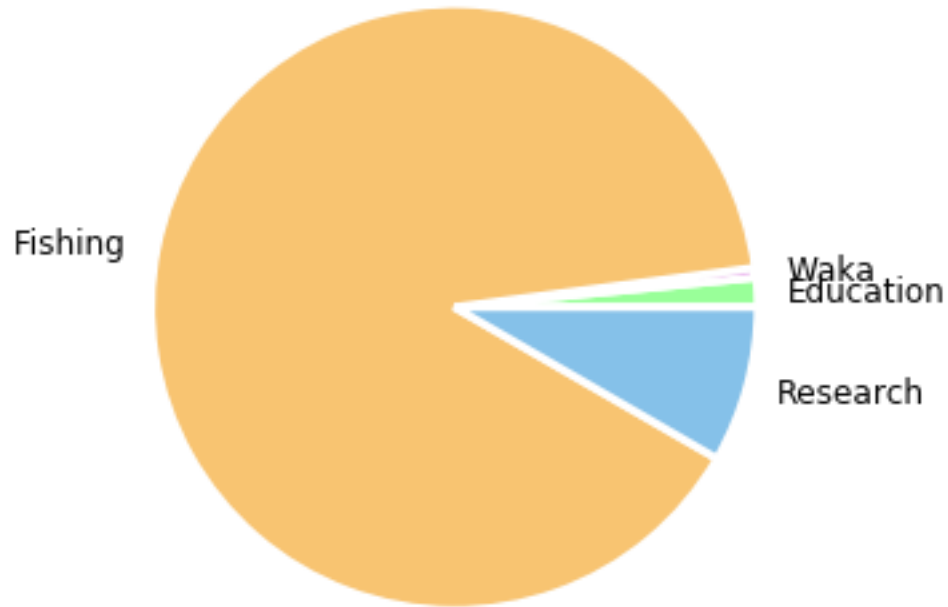
Strategy: the Year of the Rollout!

- Expanding team effort to reach 300+ sensors by Sept 2022

- Coordinating with fishing sector / organisations -> all hands on deck

- Continuously improving the system

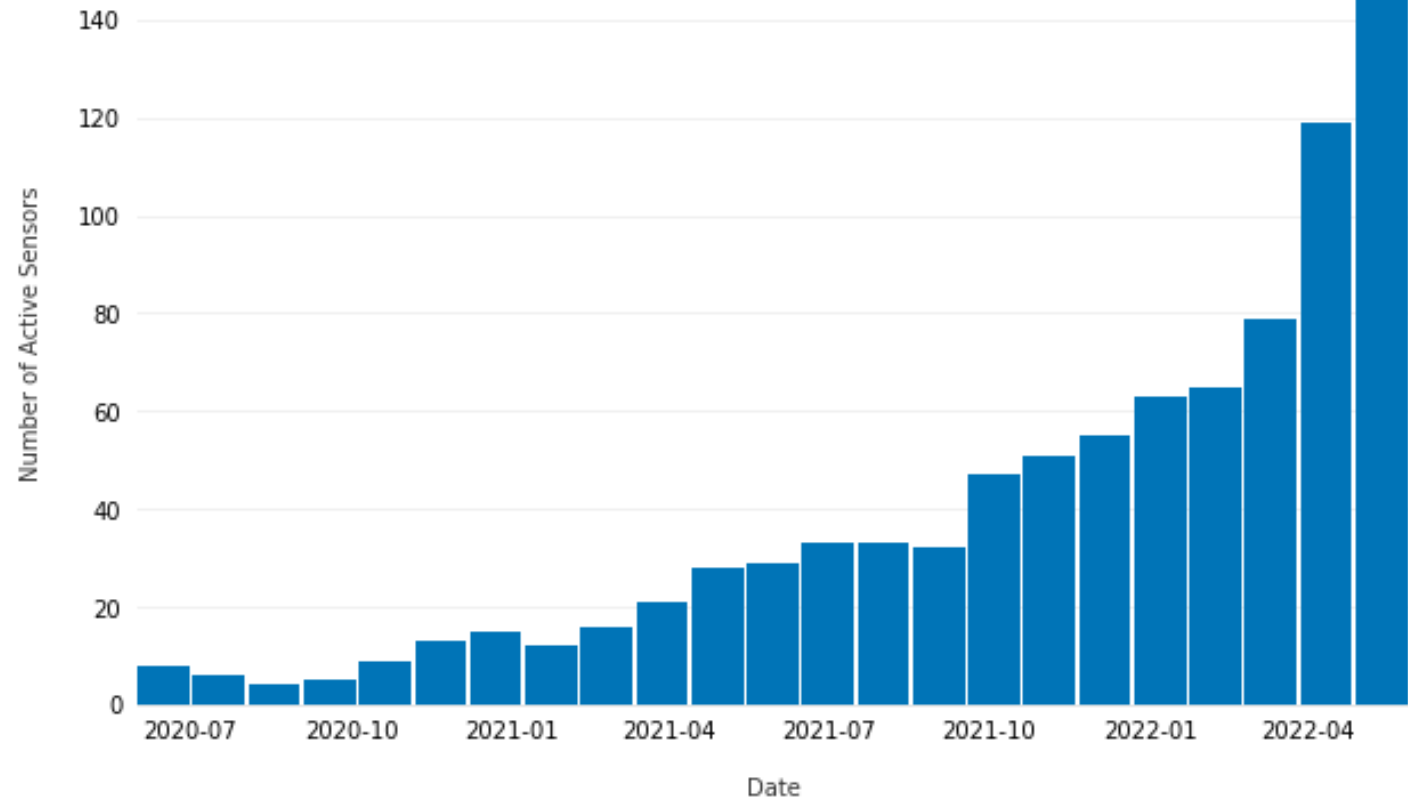Average Mangōpare Deployments: 2020-06-16 through 2022-06-25
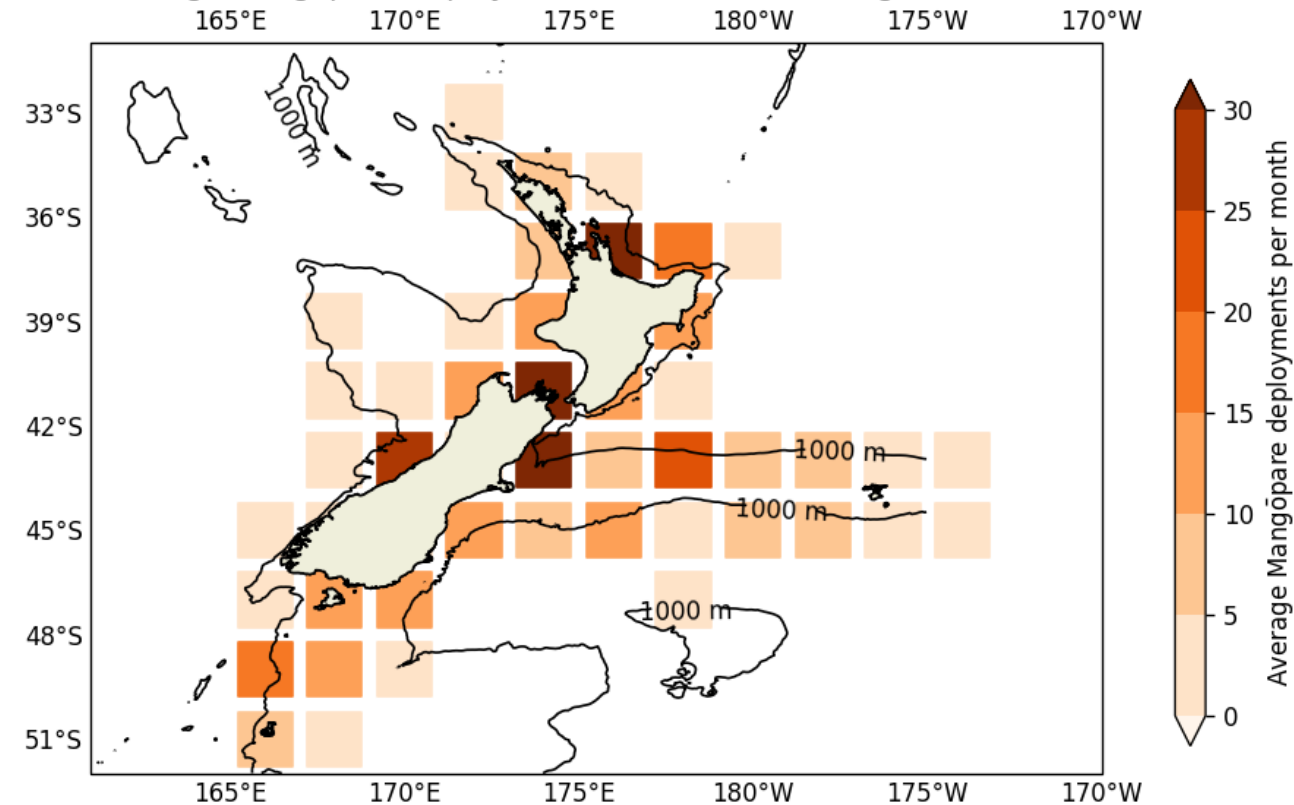
Mangōpare Sensor Programme Update

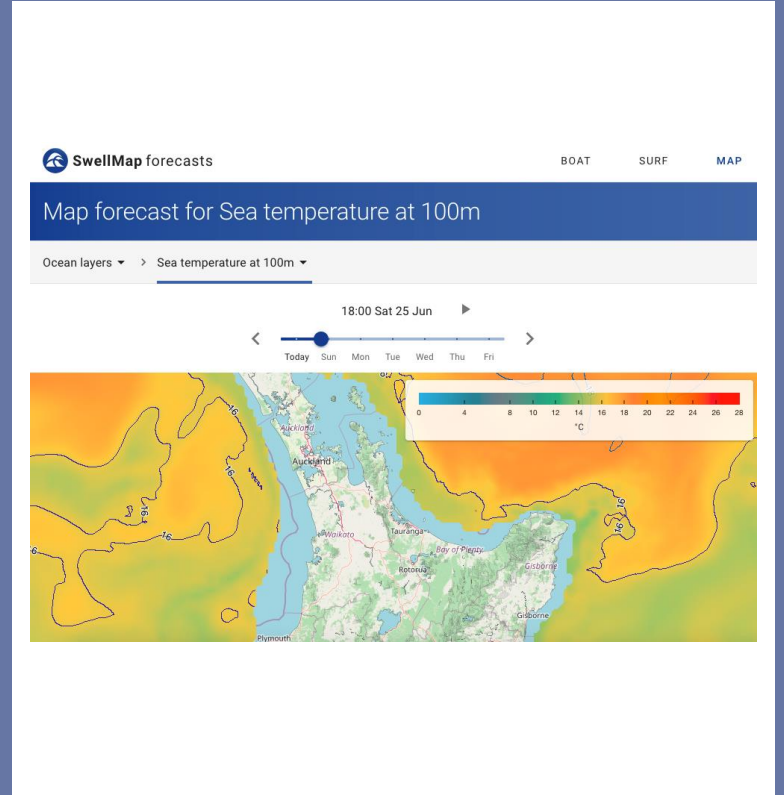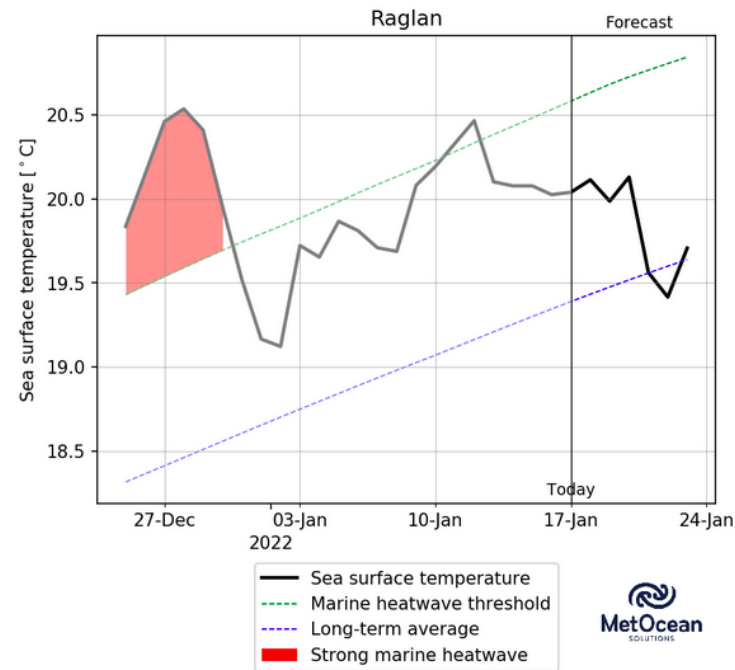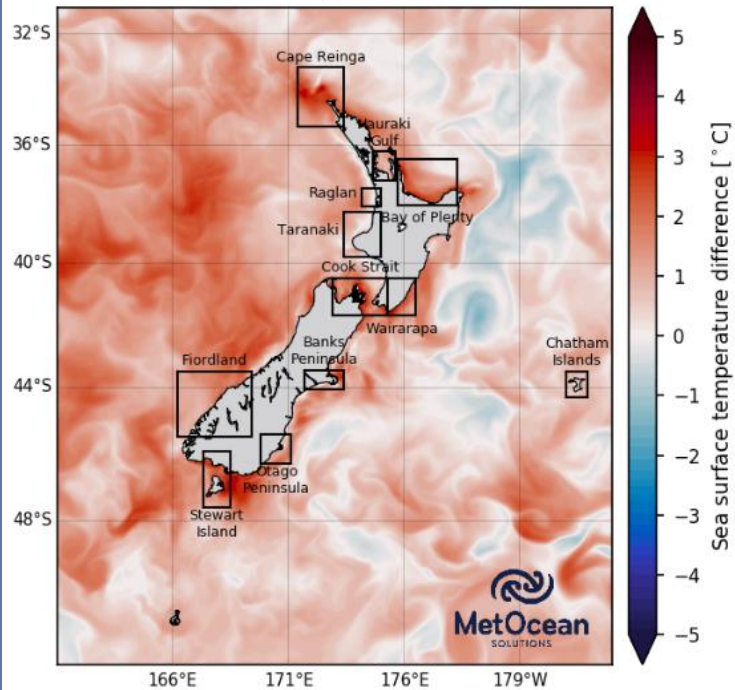

Sensor Deployment Progress: Vessel Type

Number of Mangōpare Sensors Active By Month

Sensor Data → Moana Project Ocean Models

Mangōpare Sensor Newsletter

1 November 2011 Sample

You are receiving this email as a valued contributor to the Moana Project's Mangōpare temperature sensor programme. Please click unsubscribe at the bottom of the email if you do not want this newsletter.

Kia ora, and welcome to the third fishing newsletter from the Moana Project team. In this newsletter we provide updates and news around the Mangōpare sensor programme.

Thanks to you, we now have the following:

- Moana profiling systems on fishing boats: 39
- Total deployments: 4333
- Total number of temperature measurements: 1.99 million
- Most measurements from one sensor: 15,511
- Time spent underwater by all sensors: 1239 days
- Deepest measurement recorded: 1507m

Automatic email system is now live

We are pleased to announce that the new automatic emailing system is now live. Data received from the Mangōpare sensor are now automatically processed and sent back to the user in a closed loop system.

The team has been working hard to ensure the system is flawless, and after many trial runs, edits and updates it is now operatio changing users over from the manual data delivery to system (for those who opt-in) and are looking forwar temperature and depth measurements back to the v them quickly and efficiently.

Mangōpare sensor in Holland

The brown shrimp fishery in Holland has around 220 catching around 5500 tonnes per year. The shrimp ar peeling and processing, and then distributed through

Sensor user spotlight

Crayfisher Graham Taylor. Mangōpare sensor on a cray pot.

We caught up with one of the sensor's first trial users, Graham Taylor, to hear from him about the Mangōpare sensor programme. Graham is a crayfisher based in Picton with a boat operating out of Port Underwood. "As a local fisher I'm always keen to support initiatives for improving information and science."

How did you join the programme?
"We were involved in the early development trialing the first units, it was good working with John Radford at Zebra-Tech - we had a bit of to-ing and fro-ing in the beginning but once we ironed things out it was seamless. We don't have to do anything other than lift our sensor pot and reset it. It's all
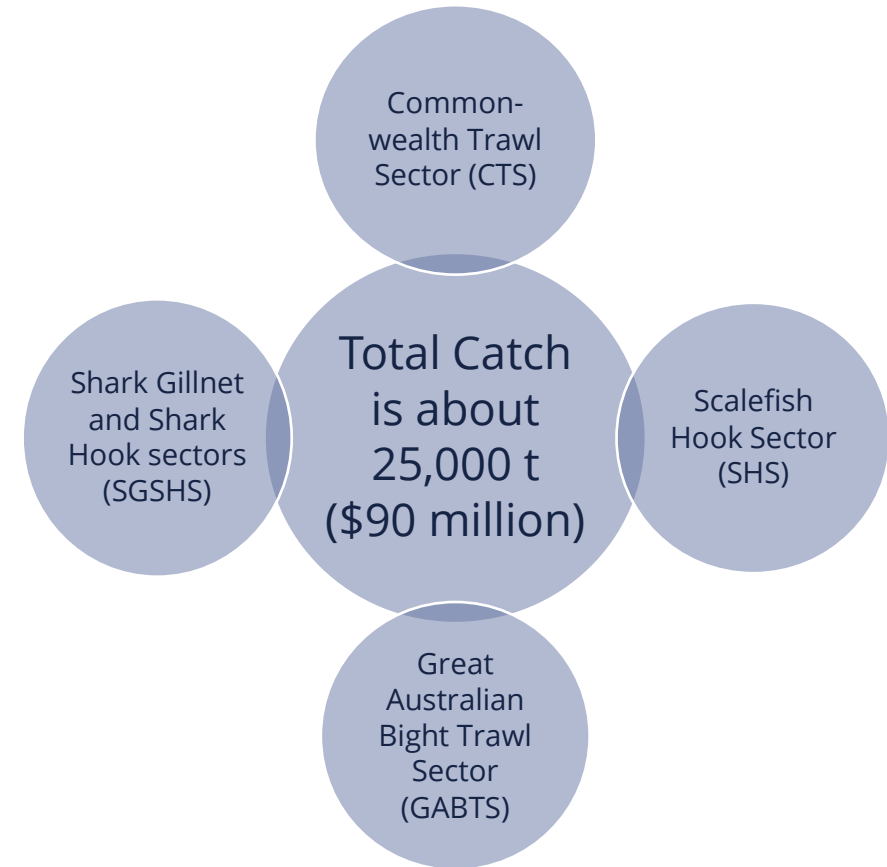
Beyond New Zealand's Waters: Looking forward in Australia

Proof of concept programme co-funded by FRDC and IMOS:

- Two-year project from 1 July 2022 through June 2024

- Fishwell Consulting (Dr Ian Knuckey), IMOS (Dr Paul Van Ruth) and UNSW (Prof Moninya Roughan)

Motivation:

- Commonwealth-managed Southern and Eastern Scalefish and Shark Fishery (SESSF) operates in the centre of Australia's oceanographic climate change hot spot

- SESSF provides most of the fresh fish into the Sydney and Melbourne markets
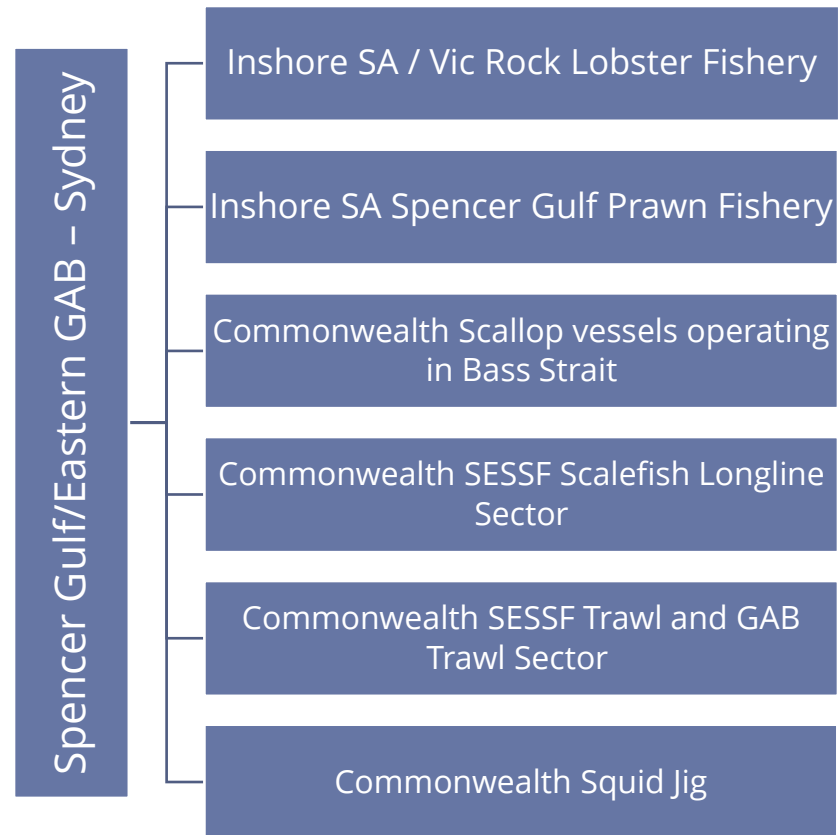
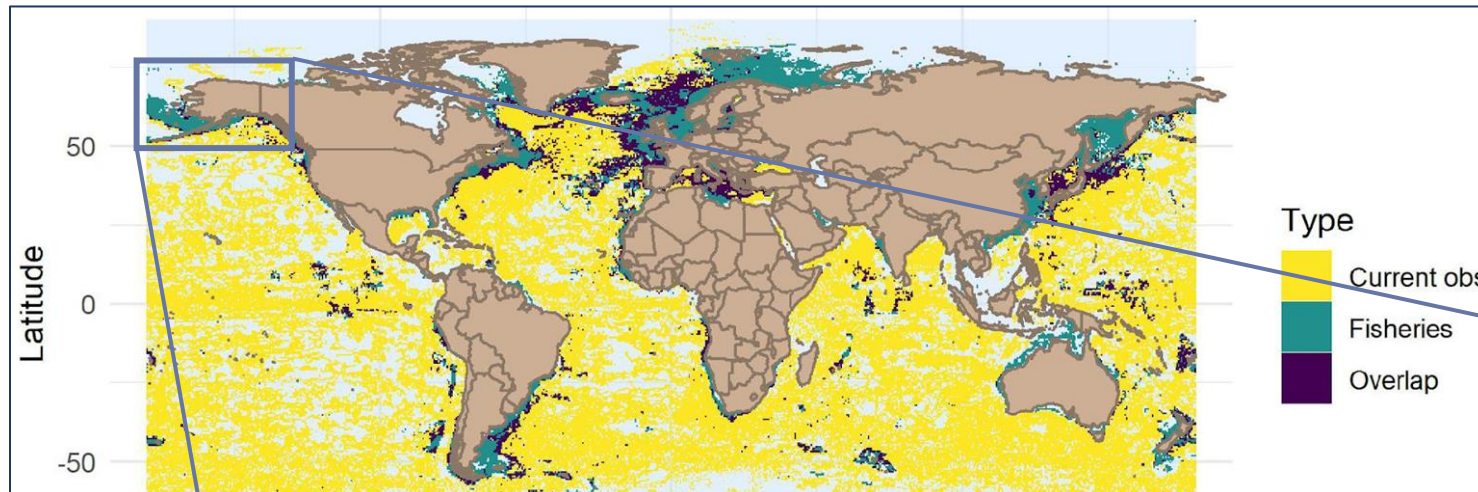# Beyond New Zealand's Waters: Looking forward in Australia

Average Mangōpare Deployments: 2011-11-01 through 2020-06-16
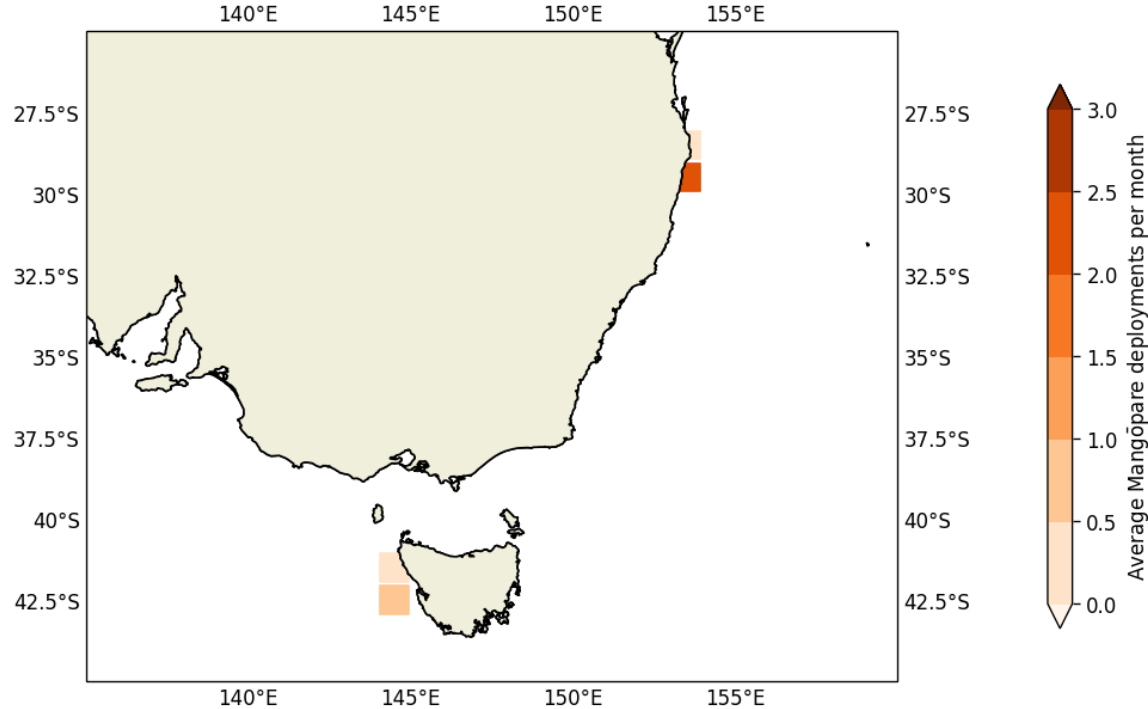
- Trial: 17 vessels across southeastern Australia
- Proof of concept: a range of gear types, fishing depths and methods to trial
- 2-5 sensors per vessel
- Working on near real time data pathways to IMOS and seafood sector data repositories

Spencer Gulf/Eastern GAB – Sydney

- Inshore SA / Vic Rock Lobster Fishery
- Inshore SA Spencer Gulf Prawn Fishery
- Commonwealth Scallop vessels operating in Bass Strait
- Commonwealth SESSF Scalefish Longline Sector
- Commonwealth SESSF Trawl and GAB Trawl Sector
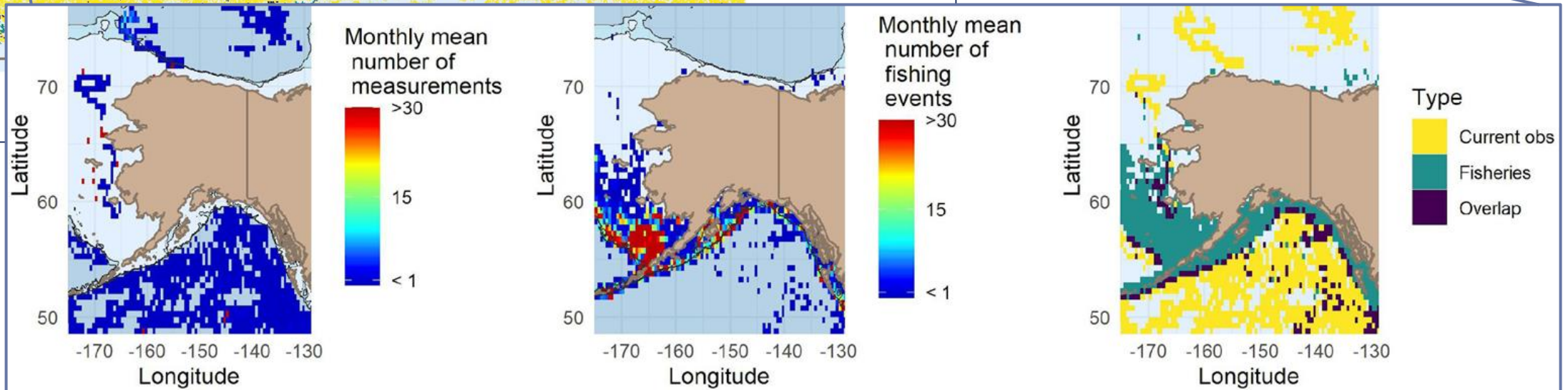- Commonwealth Squid Jig

Beyond New Zealand's Waters: an International Vision

Fishing lines up precisely with coastal and shelf-sea gaps in sub-surface data coverage.

Pattern repeated around the world.

Van Vranken, C. H., Vastenhoud, B. M. J., Manning, J. P., Plet-Hansen, K. S., Jakoboski, J., Gorringe, P., & Martinelli, M. (2020). Fishing gear as a data collection platform: Opportunities to fill spatial and temporal gaps in operational sub-surface observation networks. Frontiers in Marine Science, 7, 864.

Beyond New Zealand's Waters: an International Vision

Salmon Trolling
South East Alaska

Trawl Door
Sensor mount,
Long Island, NY

Lobster Trap
Casco Bay, Maine

Fishing Vessels as Ocean Observing Platforms: Benefits and Impacts

- Improved understanding of ocean dynamics (i.e. marine heatwaves): operational ocean model data assimilation, improved forecasts and hindcasts

- Access to data: measurements made public when possible and agreed upon

- Contribution to marine environmental knowledge to support sustainability

- Custom products and tools to support productivity, operational efficiencies, catch optimization

- Contribute to fisheries management decision making

- Community engagement

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Contact: Julie.Jakoboski@metocean.co.nz
info@moanaproject.org
http://www.moanaproject.org

Thank you ☀️

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