Argo New Zealand National Report, March 2024.

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1. **The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2023)**

a. **floats deployed and their performance:**

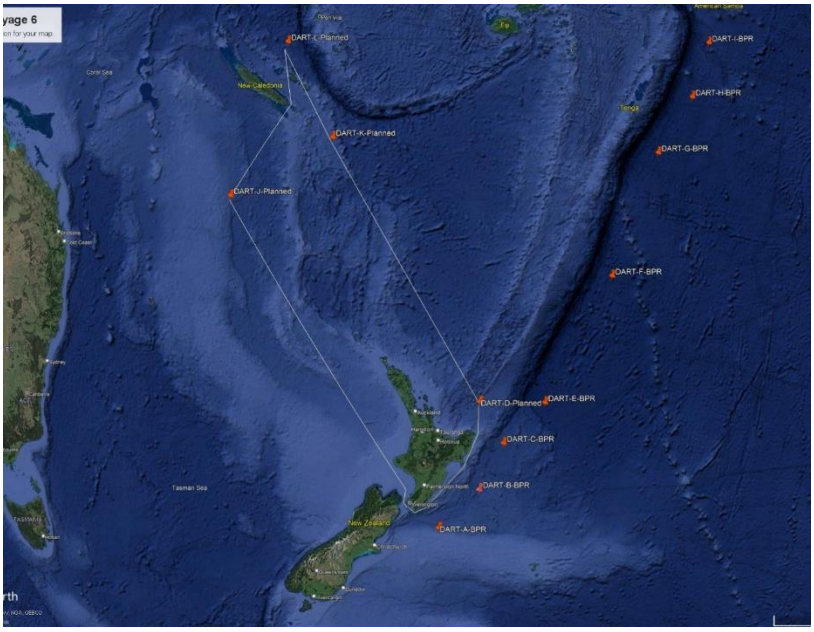
2 Solo2 floats are in the process of being purchased this financial year. These floats will be deployed on the Kaharoa II deployment voyage (starting March 2025- see later).

2 Apex floats funded by the Antarctic Science Platform were deployed in the Ross Sea (~77˚S) in January 2022 from vessel San Aotea II. Unfortunately, one of the floats went under the ice sheet after 9 profiles and has not reported since.

1 further Apex float was purchased by the Antarctic Research Programme for deployment in the Ross Sea in summer 2023/2024. Unfortunately, its delivery was too late to be deployed this Antarctic field season: it will be deployed next Southern Hemisphere summer.

New Zealand also facilitated the deployment of floats from other countries:

11 SIO Solo2 floats were deployed during a Tsunami monitoring buoy servicing (DART) voyage in May 2023:



DART voyage track

Four SIO Deep Solo floats were deployed during a Deep Argo sensor development voyage (see later):

Deep Solo deployments

SIO float number	WMO number	Deployment date	Deployment lat	Deployment lon
6103	5906932	04/05/2023	35.02°S	179.43°W
6104	5906933	04/05/2023	35.01°S	179.43°W
6102	5906931	07/05/2023	34.50°S	179.21°W
6105	5906934	07/05/2023	34.50°S	179.21°W

Deploying Deep Solo serial number 6102. Photo: Steve Diggs (SIO).

One British Antarctic Survey (BAS) ARVOR I NAOS (PI: Pierre Dutrieux) was deployed at ~78˚S, 174˚W from Laura Bassi icebreaker. The NIWA contact is Craig Stevens.

Five floats from Fisheries and Oceans Canada (PI: Chris Gordon) ARVOR I NAOS were deployed from the Italian icebreaker Laura Bassi: one near the ice shelf front, one on the central Ross Sea continental shelf, three on the slope current. NIWA contact Craig Stevens and Denise Fernandez.

ARVOR BAS float deployed in the Ross Sea. Photo: Craig Stewart (NIWA).

b. technical problems encountered and solved:

The NZ Solo2 floats from previous years deployments are functioning well. The first Antarctic deployment (7900924) stopped transmitting after 9 cycles, but it was deployed very close to the ice shelf edge and it is assumed it went under the ice cavity.

A temperature/comms issue with the recent deployment of NKE ARVOR floats in the Ross Sea was reported by Craig Stewart: "The issue we experienced with NKE ARVOR float startup was failure of the final step – the beeping which confirms satellite communications and final internal checks. Both floats had made the initial two checks – i.e. the 5 clicks and the 5 pump activations after magnet removal (we didn't add water to the CTD intake for concerns on freezing). Both floats were used from cold (i.e. deck temperature – possibly around -5˚C). I suspected that the lack of beeping may be a cold related issue, so on a subsequent deployment attempt an hour later I allowed both floats to warm towards room temperature over a 20-minute period before starting. Both floats worked perfectly after this. In retrospect I should have warmed all floats to at least above ~0˚C to minimise ice forming on the float before the first dive after deployment."

Other partners will report on their floats.

c. status of contributions to Argo data management (including status of high salinity drift floats, decoding difficulties, ramping up to include BGC or Deep floats, etc):

none

d. status of delayed mode quality control process:

DMQC on NZ Solo2 floats is performed by Scripps Institution of Oceanography (John Gilson).
DMQC on the NZ Apex float in the Ross Sea is performed by CSIRO (Esmee van Wijk).

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo, and funding for sustaining the core mission and the enhancements: BGC, Deep, Spatial (Polar, equator, WBCs)

NIWA New Zealand Argo float funding continues on a year-to-year basis at the level of two core floats per year. There is increasing local interest in BGC floats, but feedback has been that BGC purchases will take the place of Core purchases, with limited additional funding. The intention is that the interested scientists set the priorities.
This past year has seen another New Zealand group purchase and deploy floats. The Antarctic Science Platform (ASP) purchased and deployed two Apex floats in the Ross Sea. A further Apex float has been purchased but will not be deployed until next Southern Hemisphere summer. The ASP hopes to purchase a 4-parameter BGC float in 2024.

Funding for personnel is via a research programme, also funded year-to-year and a contract with Scripps Institution of Oceanography associated with the R/V Kaharoa charter. This supports of the order of 2 months of personnel time.

3. **Summary of deployment plans (level of commitment, areas of float deployment, Argo missions and extensions) and other commitments to Argo (data management) for the upcoming year and beyond where possible.**

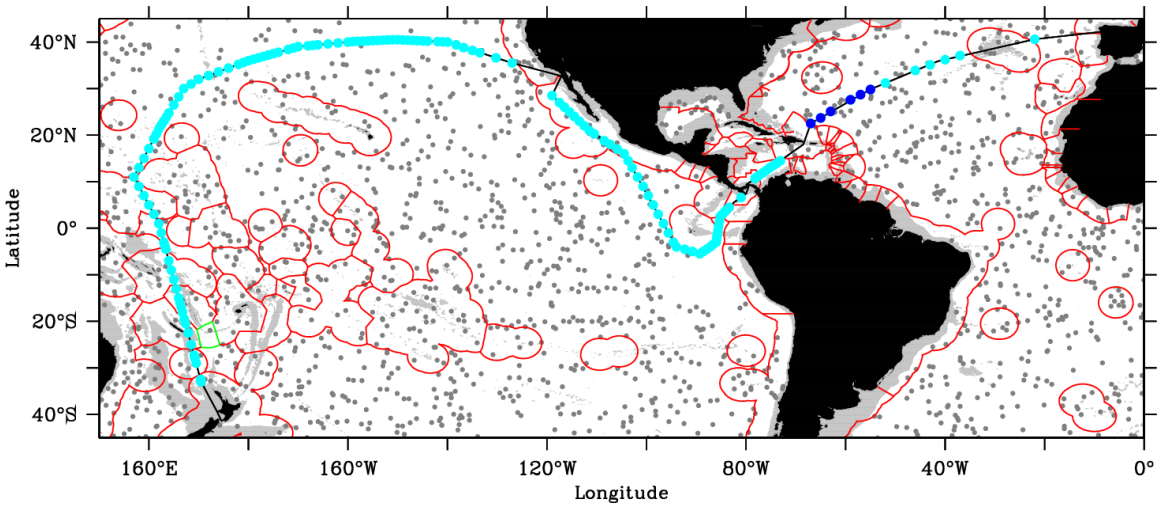
New Zealand floats: planned purchase and deployment of 2 Solo2 floats in the South Pacific as part of the Kaharoa II delivery voyage.

Deployments for other countries:

a) Kaharoa II delivery voyage.

Kaharoa II in final build stages. Photo: Greg Foothead.

There is a large deployment voyage planned in conjunction with the Kaharoa II delivery voyage. This voyage will deploy 58 Core floats and 6 Deep floats on the first leg and a further 88 Core floats on the second leg. Floats are supplied by SIO, UW, WHOI, CSIRO and NIWA (NZ).



Delivery voyage deployment plan. (John Gilson, SIO).

Total Floats = 143

Core: (123)

UW 46

SIO 53

WHOI: 15

CSIRO: 7

NZ: 2

Deep: (7)

SIO 7

BGC: (13)

WHOI: 2

SIO: 2

UW: 9

b) **R/V Tangaroa Tsunami servicing voyages** (southwest Pacific): June/July 2024. SIO is planning deployments.

c) **R/V Tangaroa Ross Sea voyage** January/February 2025. There is interest from SIO in deploying ~12 Core floats and 4 Deep floats. Also interest from Canada about deploying floats.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers. Please also include any links to national program Argo web pages to update links on the AST and AIC websites.

Argo data and products are routinely used in research, including physical oceanography, marine ecosystems, climate and fisheries.

Deep Argo Development Voyage 3.

An R/V Tangaroa research voyage focusing on Deep Argo sensor development and the SW Pacific Deep western Boundary Current was completed in May 2023. The work was a collaboration between NIWA (New Zealand), Scripps Institution of Oceanography, NOAA and Sea Bird Scientific.

Details:

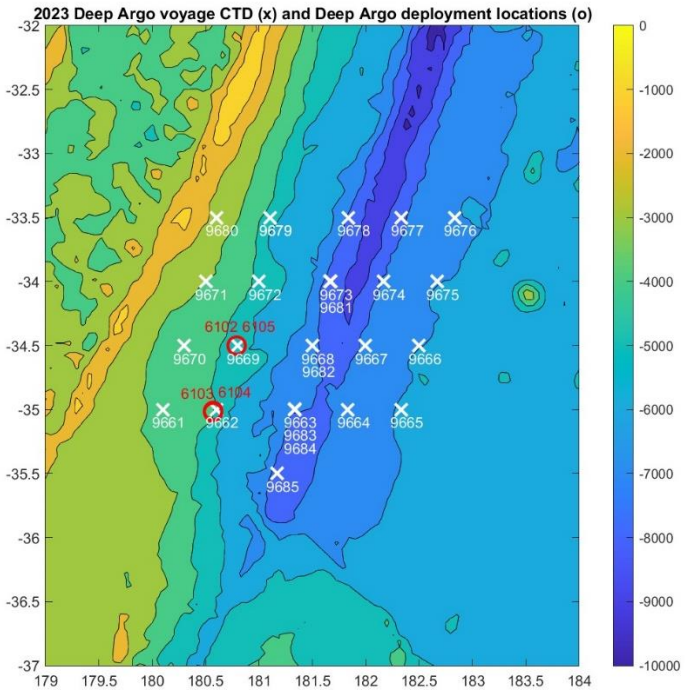
TAN2307: Deep Argo 2023 (Deep Western Boundary Currents) 2 – 16 May 2023

Lead organisation: NIWA

Funding: NIWA SSIF, NOAA

Collaboration: Scripps Institution of Oceanography (Nathalie Zilberman), Sea Bird Scientific Dave Murphy), NOAA

Voyage Leaders: Phil Sutton/Denise Fernandez (NIWA)

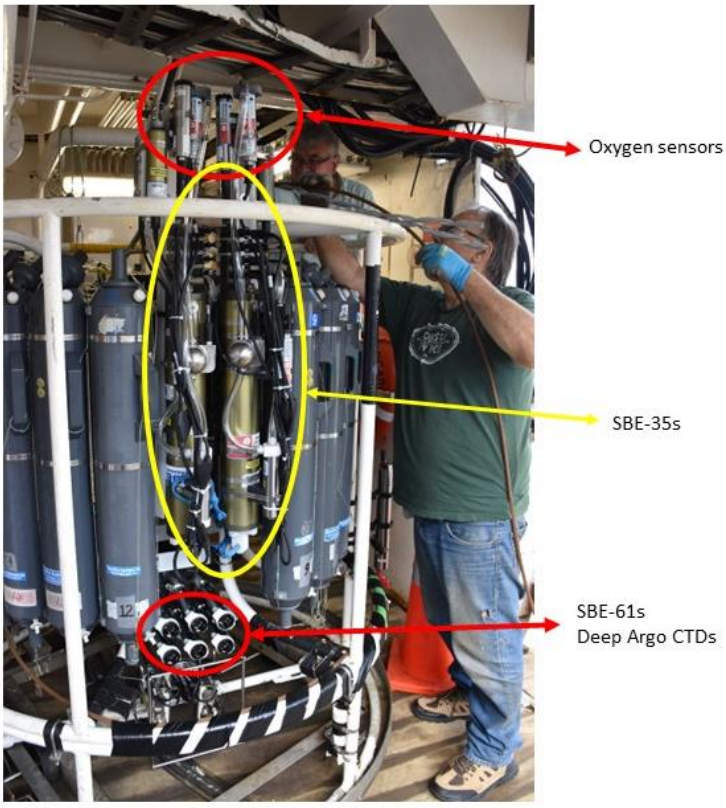


The station locations (white x) and Argo float deployment locations (red circles) overlaid on bathymetry.

Deep Argo target sensor accuracies are ±0.002 PSS-78 (salinity), ±0.001°C (temperature) and ±3 dbar (pressure) (Roemmich et al., 2019b; Zilberman et al., 2023). While present sensors are meeting these requirements, there is still room for improvement, in particular for the conductivity and pressure sensors. The study region is ideal for sensor development work because the ocean properties are relatively constant and stable below 4000m.

There were two initiatives targeting core sensor improvement on this voyage:

A) Sea-Bird Scientific (SBS) is presently the sole manufacturer of 6000m Deep Argo sensors. SBS personnel participated in the voyage testing prototype equipment. Six experimental Deep Argo CTD packages were attached to the shipboard carousel for intercomparison tests and individual experimental conductivity cells were installed in place of the shipboard secondary conductivity cell on selected CTD casts.



Matt Walkington (NIWA) preparing the CTD package. Two SBE-25s with dissolved oxygen sensors were mounted in two Niskin Bottle locations. Six experimental SBE-61s were mounted horizontally above the 9plus to place their seawater intakes close to that of that of the shipboard unit. Photo: Steve Diggs (SIO).

B) Two RBR Deep CTD packages were mounted on the CTD carousel for intercomparison and testing.

RBR CTD equipped with two RBR dissolved oxygen sensors. Photo: Steve Diggs, SIO.

Dissolved oxygen has not been one of the core Deep Argo measured parameters to date. However, deep dissolved oxygen would be very useful for studying deep water mass property and age changes. In pursuit of this goal, Nathalie Zilberman (SIO) arranged for all of the major dissolved oxygen sensor manufacturers to provide sensors for intercomparison.

All of the sensor work (pressure, conductivity and dissolved oxygen) was predicated on highly-accurate data being collected by the shipboard CTD. This was achieved by calibrating all of the shipboard sensors both before and after the voyage and also through on-board conductivity calibrations to correct the shipboard CTD conductivity sensors and chemical Winkler titrations to calibrate the shipboard CTD dissolved oxygen sensors.

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by OceanOps,

the coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report.

No issues beyond those faced universally, i.e., funding, EEZ permissions.

6. **To continue improving the quality and quantity of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include any CTD station data that was taken at the time of float deployments this year. Additionally, please list CTD data (calibrated with bottle data) taken by your country in the past year that may be added to the reference database. These cruises could be ones designated for Argo calibration purposes only or could be cruises that are open to the public. To help CCHDO track down this data, please list the dates of the cruise and the PI to contact about the data.**

CTD data from the Deep Argo Development Voyage will be provided for the reference database. We are waiting on a post-voyage pressure sensor calibration.

7. **Argo bibliography (Bibliography | Argo (ucsd.edu))**

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Santana, R., MacDonald H., O'Callaghan, J., Powell, B., Wakes, S., Suanda, S. 2023. Data assimilation sensitivity experiments in the East Auckland Current system using 4D-Var. Geoscientific Model Development 16 913) 3675-3698 https://doi.org/10.5194/gmd-16-3675-202

8. How has COVID-19 impacted your National Program's ability to implement Argo in the past year? This can include impacts on deployments, procurements, data processing, budgets, etc.

No substantial covid issues in the past year. There are still covid requirements for using NIWA vessels, although these are being relaxed.

9. Does your National Program have any deployment plans for RBR floats in the next couple of years? If so, please indicate how many floats will you be buying in 2023 and 2024 (if known) and where they might be deployed.

New Zealand currently has no intention to purchase RBR CTD floats. We will deploy other nations' RBR-equipped floats (e.g. SIO, CSIRO).

10. Other/Outreach

A New Zealand-Wellington local school participated in a hands-on experiment consisting of decorating Styrofoam cups which were taken onboard R/V Tangaroa and deployed on deep CTD casts. After the voyage the cups were returned to the class and the students found out the effect of water pressure on the cups: the pressure of the water expelled the air out of the foam and shrank the cups. Students learned about that, as a contrast with the floats and other hard solid instruments deployed in the deep ocean, animals are adapted to the environment they live in and some of them, like whales and seals, have the ability to dive deep by safely collapsing their lungs and drawing oxygen from the blood and muscles.