26th Meeting of the International Argo Steering Team

Host: Scripps Institution of Oceanography
La Jolla, CA USA
14 – 18 April 2025

AST-26 Google Drive link
AST-26 Action Items

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OneArgo

Welcome (Margaret Leinen)

Dr. Margaret Leinen welcomed everyone to Scripps and recognized the importance of Argo in ocean observation. She reminded everyone of Scripp's long involvement in Argo and was optimistic about scientists from around the world working together to gather fundamental observations.

Logistics (Megan Scanderbeg)

Megan noted restrooms, water station and Wi-Fi password.

Objectives of the meeting (AST co-chairs)

Susan Wijffels started by focusing on some of the recent successes of Argo including the delivery of the 3 millionth profile and progress on increasing robustness of new mission technology and data management methods. She welcomed new nations including Colombia and Argentina who assisted with float deployments and advertised the new map available on OceanOPS showing float locations colored by deployment country. She also noted that float lifetimes continue to rise and noted that this needs to be our focus, especially for Deep and BGC floats. National programs should try to ensure that their teams participate in and support the Technical Community of Practice's efforts to improve float lifetimes through the sharing of knowledge among Argo technicians and float manufacturers.

Over the past year, there has been lots of engagement at key intergovernmental meetings and fora like the G7, UN Ocean Decade and with large groups like the WMO, OceanPredict, CLIVAR and the IOC. Thank you to all who have contributed to these efforts. She pointed out that after meetings with some of our operational super users, the message is that our netCDF files are too complex, unwieldy and slow to ingest. She encourages Argo to consider how to operationalize the efforts to produce easier to use Argo products. She recognized that DACs are struggling and asked national programs what we can do as a community to help. Finally, she assessed progress towards implementing OneArgo and how to establish a realistic timeline to full implementation. The question remains as to whether Argo should re-balance investments between core, Deep and BGC now.

Status of Action items from AST-25 (Megan Scanderbeg)

Megan reviewed the status of the AST-25 actions and asked about the status of several actions that were not known. Overall, 25 actions were completed, 10 were not done and most of those are being carried over to AST-26 actions. Seven are in progress and will continue to be monitored either through ADMT actions or through modified AST-26 actions. One action was canceled.

A brief discussion took place for Action 11, which was related to the exploration of the possibility of purchasing floats through WMO on behalf of a few countries. Victor indicated that this would be done through a Long-Term Agreement (LTA) that would establish the price of floats between the WMO and manufacturers. This LTA would set a fixed float price for a specified period (1 to 3 years). However, customs duties would still be paid and the WMO would also impose a tax rate of 7%. The LTA would not guarantee the purchase of instruments; it is not a purchase order. While there is an additional tax, Victor stated that some nations may still want to consider it as the price is determined for several years and it makes the purchasing process easier for them.

Action 1: AST Exec to discuss the possibility of interested National Programs working with Victor Turpin to establish a Long-Term Agreement to purchase floats through WMO. **Who**: AST Exec, interested National Programs, Victor Turpin

Tracking of OneArgo status and implementation: overall picture by OceanOPS & discussion (Victor Turpin, AST co-chairs to lead discussion)

OneArgo Monitoring Document Summary

Overview

This presentation by Victor Turpin from Ocean-Ops focused on developing a methodology to monitor the OneArgo program implementation, analyzing fleet performance, and assessing international contributions. Extensive analysis of the OneArgo implementation is available at : https://www.ocean-ops.org/share/Argo/Doc/AST_26.pdf

OneArgo combines several distinct missions:

- **Core Mission (T/S 2K)**: Merges Extended Global Argo (including Polar Argo Mission) (85%) and Double Density (15%) missions in 3°×3° grid cells
- **Deep Argo Mission**: Targets ocean areas deeper than 2000m in 5°×5° grid cells
- **BGC Argo Mission**: Encompasses five biogeochemical variables (BBP, Chl-a, Irradiance, O_2, NO_3, pH) 6°×6° grid cells

Four implementation indicators were developed:

- **Activity**: Number of operational floats within mission design
- **Intensity**: Number of floats deployed in past 12 months
- **Density**: Spatial distribution evaluation of operational floats
- **Coverage**: Number of adequately sampled design elements

The integrated OneArgo implementation metrics are calculated by counting each of the three main missions equally, currently showing 50% implementation.

National Contributions (2023-2024)

The USA dominates contributions across all missions:

- 57% of BGC floats - with over 80% of 5 sensor floats
- 52% of Core floats

- 40% of Deep floats

This heavy reliance on one country poses sustainability risks to the program.

Fleet Performance Issues

- 10% of deployed floats fail within the first year
- Increasing proportion of early failures is reducing overall fleet life expectancy
- Early failure rates vary by program, platform, deployment basin, and time period
- Float survival rates in the first 10 cycles haven't improved in a decade and have slightly decreased compared to 20 years ago. This is likely due to the fact that new float types (BGC and Deep) are being deployed, but also that floats deployed by ships of opportunity typically have higher failure rates than those from dedicated charters.

International Participation

The program has grown to 53 countries (23 countries implementing Argo float array and 30 additional countries facilitating Argo implementation through EEZ access and/or ship support), showing expanding global engagement.

Recommendations

1. **Prioritize Deep and BGC Missions**: New resources should focus on these missions to maximize OneArgo program impact
2. **Improve Early Float Performance**: Address high early failure rates to enhance fleet efficiency
3. **Increase International Contributions**: Reduce over-reliance on USA by encouraging greater participation from other nations

Questions for AST Decision

- Is there agreement on the use of the integrated OneArgo implementation methodology?
- What are the life expectancy targets: 5 years for BGC/Deep floats, 6 years (220 cycles) for Core floats?
- What is the target for Coverage and Density targets (currently 60% and 85% respectively)?

Bottom Line

While OneArgo shows progress with 50% implementation and growing international participation, the program faces sustainability challenges from an over-dependence on the US program and US Projects as well as low but persistent early float failure issues that require attention.

There was discussion on the OneArgo implementation indicator and overall, it was agreed that a straightforward, easy to understand indicator is needed to use as a communication tool. There was discussion on whether the metric should account for cost in some manner, such as cost per profile. However, the present calculations indicate that the global core/BGC and Deep Missions all cost a similar amount and thus the ⅓ weighting seems sensible. There was agreement that the indicator should be discussed within the AST executive committee and when a decision is reached, it should be displayed on the AST website.

Action 2: Add a simple indicator of status towards OneArgo completion on AST website. **Who**: Megan Scanderbeg, Victor Turpin, Orens de Fommervault, AST co-chairs.

There was discussion around how to define the float lifetime for OceanOPS to use when calculating KPIs and it was agreed to ask the Mission chairs to provide realistic float lifetimes to OceanOPS for this purpose.

Action 3: Ask BGC, Deep, Polar Mission chairs to provide realistic average float lifetimes for OceanOPS to use when calculating KPIs. **Who**: BGC, Deep and Polar Mission chairs and Victor Turpin.

OneArgo implementation issues

OceanOPS operational update (Victor Turpin)

Float Stickers: OceanOPS lost the capacity to purchase and distribute stickers to manufacturers in 2024. They're exploring alternatives through IFREMER and considering two solutions: providing digital sticker versions to manufacturers or generating them on request.
Float Recovery: There's been an increase in onshore float recoveries (4-5 per year over the last 2 years). There is a need for clearer guidance on storage and handling of the floats, including possible waste disposal, and lithium battery management. In the discussion, it was agreed that a guide should be developed with float recovery information, including how to store floats and possible disposal information if no float owner can be identified or if recovery is not feasible.
Float Plan Management: At the last ADMT meeting, it was requested that OceanOPS improve the float deployment plan submission process to allow for plans to be submitted without WMOs attached. By decorrelating the WMO and the deployment plans, it might make it easier to submit deployment plans and it removes the need to release WMOs for floats that did not end up being deployed. Some work was done to improve management of plans by float type and variable which was tested with GO-BGC programs and Argo Germany, covering ~400 deployment plans from April 2025 to December 2026.
New Tools:

- BGC monitoring by variable with monthly/yearly maps and KPIs
- Sensors performance monitoring tool
- Neglected profiles identification tool (developed with EuroArgo)

Training Program: Regular online training sessions for how to utilize the capabilities of the OceanOPS Argo site are planned throughout 2025-2026, covering topics from BGC functionalities to expert mapping tools.
AMRIT Project: A European initiative (April 2024-March 2028) to develop the European Ocean Observing System Technical Support Center using open-source code and agile methodology.

In the discussion, it was noted that it would be helpful to have a document available when a float needs to be recovered. Given the experience of float recovery over the past several years, it was

agreed that a document like this would be helpful. Several individuals and teams agreed to help develop it.

Action 4: OceanOPS, TCoP, Fiona Carse and Megan to develop a document on safe practices around float recovery. This should include information on safe storage and possible disposal if no float owner can be found. **Who**: OceanOPS, TCoP, Fiona Carse, Megan Scanderbeg

EEZ and GOOS concurrences (Victor, 10 min)

EEZ Deployment Analysis: A study from 2014-2023 (available here: https://www.ocean-ops.org/share/Argo/Doc/NoteOnArgoCoverageInEEZ_Final.pdf) showed concerning trends in Exclusive Economic Zone deployments, with administrative complexity and costs creating barriers that risk reduced coverage in foreign EEZs. This was sent to the IOC Working Group on Ocean Observations under Areas of National Jurisdiction, and there were subsequent discussions with the AST co-chairs.
PI-GOOS Leadership: The new Chair aims to establish regional agreements to facilitate ocean observation in Pacific Island EEZs.
WMO Procurement: Investigation into purchasing floats through WMO Long-Term Agreements, which could offer fixed pricing and potentially facilitate EEZ deployments, though questions remain about customs and shipping benefits.

In discussion, it was suggested to approach the Caribbean Institute for Meteorology and Hydrology to discuss a regional agreement regarding deployments in EEZs. Victor Turpin has agreed to take this action on.

AIC, OceanOPS funding (Breck Owens)

Over the past year, a task team of the Ocean Coordination Group (OCG) developed a new Service Level Agreement (SLA) scheme between the observing networks and OceanOPS. This scheme was approved at the recent OCG-16 meeting and will be implemented for FY2026. There are now three levels of support, Baseline, Standard (+) and Advanced, which involves different levels of both support and funding. OceanOPS support for Argo has been at the Advanced level and Argo funding has been appropriate for this support.

Support from the usual 8 Argo national and regional groups for OceanOPS and an Argo Director fund for 2024 was $189,542. Monaco contributed $36,190 to support Orens de Fommervault half-time as the BGC Argo project coordinator. Prior to AST-26, this support was deemed to be discontinued. During the presentation, it was announced that the Monaco support would continue and that support for the rest of Orens' salary is likely. The Director funds are used for travel and are now available for others beside the Director.

The present OceanOPS budget is roughly $1M, which includes contributions from (a) host country support (France), IOC and WMO for ~$400K and (b) $600K contributions from the various networks. Presently Victor Turpin (0.75 FTE) and Orens de Fommervault (0.25 FTE) are funded

by OceanOPS. An SLA will be signed between OceanOPS and Argo later this year for the Advanced level Service Agreement for ~$186K. This will fund Victor Turpin for 1.0 FTE, and means that we can expect continued support for Argo from OceanOPS using existing levels of support from Argo national and regional groups. Arrangements for separate funding now promised by Monaco to fund Orens de Fommervault are to be determined.

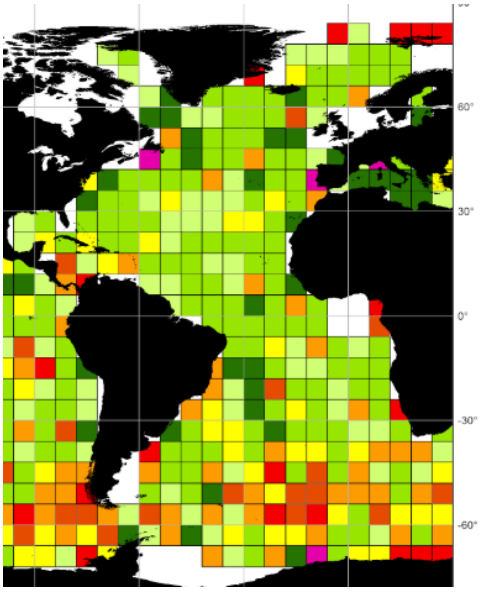
Action 5: As part of the Argo/OceanOPS SLA, a task list and annual work plan will be developed and maintained by the AST Exec, and progress reported to the Exec. **Who**: AST Exec.

Basin deployment coordination (Fiona Carse, Tammy Morris, Sarah Purkey, Shigeki Hosoda)

A summary for the Atlantic, Pacific and Indian Ocean basin deployment coordination was presented. Since 2022, each group has met 2 – 4 times per year to share deployment plans, opportunities and to discuss sharing access to these opportunities among nations. All groups receive excellent support from Victor Turpin at OceanOPS. A brief summary from each group is included below.

Atlantic:

The North Atlantic remains over-populated with core Argo floats at 153% of needed coverage. However, the South Atlantic is now much improved – it is now at 98% activity, with only 10 more floats needed to reach 100%. The main success to report this year is filling the gap in the central South Atlantic between 20-30 S (RRS James Cook deployed US, German and UK floats in February 2025). The balance between the basins has improved since 2023. Since 2022, deployments have been declining toward the target while the core mission density and coverage remain high in the global Atlantic. This means float performance is higher. The main gap is now in the central Atlantic, south of ~ 40 S, and parts of the Southern Ocean Atlantic sector (contact Fiona Carse)

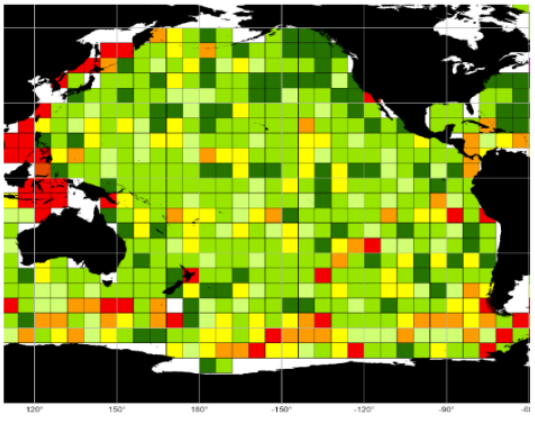


Argo float density/Age for February 2025

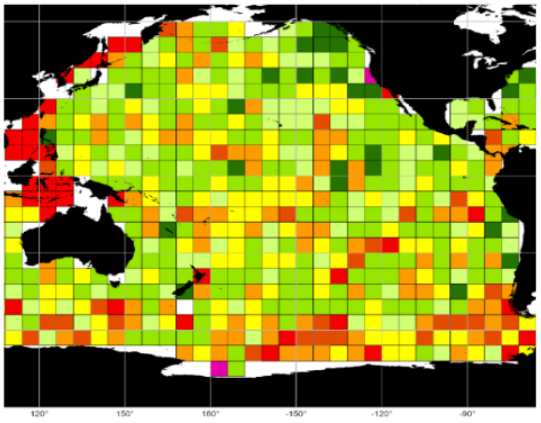
Pacific:

Pacific coverage is pretty good right now. The global team has successfully filled in some holes identified last year: 153 floats deployed on the Kaharoa II delivery voyage (March 2024) and 107 floats deployed on Kaharoa II South Pacific Cruise (November 2024). Salinity and temperature coverage was roughly equal, for the first time since the fast salty drifters became a problem, showing that the Pacific is recovering well from the ASD era (contact Sarah Purkey and Shigeki Hosoda).

Current and projected density of Argo floats in the pacific

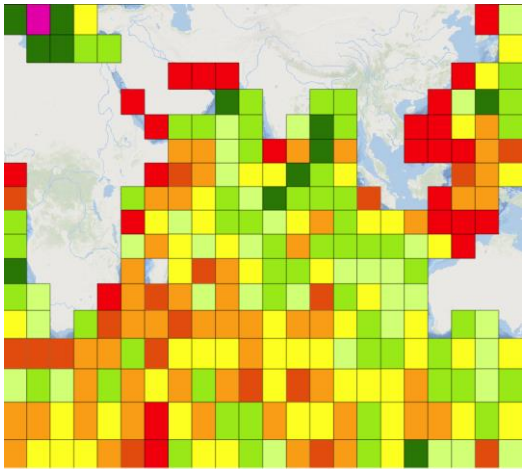


Current Argo float density



"Projected" Argo float density January 2025

Indian:
Tamaryn Morris and the float hub at Cape Town continue to be a great resource for the Argo community. During 2024, 3 x BSH floats were deployed from SA Agulhas II (SANAE relief voyage) - these floats have transited towards the Indian Ocean; and 9 x BSH floats were deployed from R/V Sonne (SO308) between Madagascar and Australia. The south-west Indian is the main focus of concern; it is projected to worsen (contact Tamaryn Morris).



Density vs Argo 2020 Density on 8 April 2025

National Programs reporting one success or challenge

Australia reported that they have gotten through all their DMQC tasks and have been doing regional assessments of DMQC for all floats, not just Australian ones and have found an overadjustment in the Coral Sea.

Canada reported that they are procuring 27 BGC floats in 2025-26 including ones with an RBR tridente and an OPUS nitrate sensor. However, BGC and Deep funding is on research grants and not sustained funding.

China reported that there is a human resource challenge at the CSIO DAC. Deploying new BGC floats is very challenging due to the data management requirements. China also has no operational funding for floats.

Europe reported that IFREMER recovered 10 floats with a catamaran. They found this to be very efficient, and they plan to recover 10% of floats per year to reduce waste and to learn more about how to recycle float parts. They also highlighted the IPCC infographic they produced which is

interactive and useful for demonstrating Argo's valuable contribution to the IPCC 2021 report. See the communications section at the end of the report for more details.

France reported on their experience with Vendee-globe where floats were deployed via sailboat in the southern Atlantic.

Germany has hired two early-career employees to help with technical issues like preparing floats. They reported that a deployed float in the Arctic showed up again after wintering under the sea ice, which was great. Work continues on the DMQC of floats in the Baltic with a workshop planned for the summer.

India has had funding issues since COVID but just received an increase in funding to 50 floats/year through 2026: 40 core and 10 BGC. After that, the plan is to increase BGC float numbers. In addition, float deployments are expanding to the Southern Ocean. India is looking for ships to deploy floats and is interested in connecting with the basin wide planning coordination groups to learn more. Finally, they reported that Argo data are being assimilated in modelling systems within India.

Italy reported that they are receiving a new batch of BGC floats soon, including ones equipped with new sensors for backscatter and nitrate.

Japan reported that the OneArgo proposal is still not funded but remains alive. In the meantime, Japan is lobbying for OneArgo and expanding communications around Argo's usefulness, especially in fisheries communities. As part of this process, the Japan Argo program is being reorganized to improve the collaboration between JMA and JAMSTEC.

Korea reported that together KMA and KIOST deployed 8 Argo floats and is developing DMQC capability with academic partners like JJ Park. They are continuing with plans to develop a coastal Argo float and have just started OneArgo meetings inside Korea including KMA, KIOST and fisheries.

New Zealand reported that funding remains a challenge. This year, they were able to purchase one BGC float, but no core floats. They were able to purchase two additional BGC floats from another funding stream. The Kaharoa II is running and deploying Argo floats.

Norway deployed several core, BGC, and Deep floats in the Norwegian seas. Often the floats stay in one place, but some floats move more when deployed in the middle of the Greenland basin. They are trying to park them deeper to keep them in the region. Some of the BGC floats have a UVP sensor which is of interest to biologists.

South Africa has purchased 6 core NKE floats and plans to deploy them in the Indian ocean.

UK reported that the British Antarctic Survey (BAS) joined the UK Argo team. This has added 25 new floats, and some have microstructure in addition to CTD and oxygen. This is the 10th year of

flat funding in the UK which has resulted in buying 1-2 less core floats per year. Project funding only has been found for BGC and deep floats.

US reported that they deployed 448 floats last year – thanks in part to the Kaharoa II which did two Argo voyages. 150 BGC floats were deployed which was a huge milestone.

Update on near surface sampling audit after AST-25 recommendation (Brian King)

Brian King reported on an audit of near surface sampling conducted in the days prior to AST-26. He found that progress was made up to 2023 but has since stalled. During the discussion, it was pointed out that this could be addressed during the purchasing stage where users can ask for a 'standard Argo profile'. The Technical Community of Practice (TcoP) group has agreed to take on the task of setting up standard Argo profile sampling strategies with each manufacturer.

Action 6: AST to work with TCoP on standard float missions. **Who**: TcoP and AST float type experts.

Action 7: AST requests that when ordering floats, National Programs should specify that floats sample up to the top 2db. **Who**: National Programs

OneArgo data management

Plans for JSON schema for decoded float data (Pelle Robbins/Ben Greenwood)

The US Argo consortium Data Task Team is working to develop a new standard for a common intermediate file format in the chain of real-time processing. Currently there is a great variety of unique software packages for processing raw Argo telemetry and the lack of shared formats in this stage hinders the ability to share code amongst institutions. We are building a JSON file format as a means to simplify exchange of data within the US consortium and to work towards a more common codebase. The goal of this project is to have standardized format to store the information telemetered by the float prior to any further data processing. This can benefit both the task of creating NetCDF files for the GDAC as well as serving a common input for other operational tasks such as monitoring fleet status, supporting piloting tasks, and troubleshooting problematic platforms. Furthermore, keeping a record of decoded telemetry will provide greater transparency regarding which bits of information are directly reported by a float and which bits are inserted by later post-processing software. WHOI is currently implementing a preliminary version of this format as the standard output of the new S2-BGC decoder and for exchange with partner institutions AOML and MBARI.

In the discussion, there were some exchanges on how manufacturers can best support this effort, and the most flexible option would be to request manufacturers provide decoders that decode into this JSON format.

Min/max test results & how they are implemented (C. Coatanoan)

Due to the anomalies observed on the real time profiles submitted to the GDAC, an additional quality control is carried out at GDAC Coriolis using the min/max method. This method (developed by Jérôme Gourrion) alerts DACs to anomalies in their floats (measurements that fail the automatic tests at DAC level and possible drifts) so that they can be corrected, the aim being to ensure the highest quality Argo dataset.

In this method, local validity intervals (min and max threshold reference fields) are used to estimate whether observed values are considered good or bad. Every hour, a comparison of this method's thresholds with the new profiles arriving in the Coriolis database lists the profiles that have failed the minmax test. A visual check is carried out, and quality indicators are modified, if necessary, in the Coriolis database. Anomalies may concern a spike, incorrect measurements, wrong position, drift, etc. If the operator considers that the min/max is not correct, a threshold change is made, increasing the ranges a little to ensure that the same correct profile is not found again.

Twice a day, a script lists the profiles for which corrections have been made to the flag. A message is then sent to each DAC concerned, and an update of the files is requested so that the cleanest Argo data set is available as quickly as possible. The message is also available on the GDAC ftp site (https://data-argo.ifremer.fr/etc/ObjectiveAnalysisWarning/). If a drift is observed, the information is updated in a table, available in the monthly report (https://data-argo.ifremer.fr/etc/Report_ObjectiveAnalysisWarning/). In this table, the DACname, float wmo, PI name, first cycle and last cycle on which the drift was observed are indicated.

Over the last few years, many floats have been detected with drift and are still incorrectly QC’d at the DAC level. Some DACs are waiting for feedback from PIs/DM operators before putting the float on the exclusion list. To avoid these bad profiles circulating in the data stream without correction, PIs are asked to take note of the table available in the monthly report and send feedback to DACS for better quality control. Other information is also presented in this report and may be useful to PIs for better quality control of their floats. A close exchange between DACs, PIs and DM operators is necessary. At the last ADMT, we defined a number of actions. To enable DACs to implement the min/max method “automatically”, a python version is already available, but Jérôme Gourrion is working on a version of the min/max code that is more suitable for automatic use by DACs. DACs also need to contact PIs for floats that have been on the table for a while. But we also ask PIs and DM operators to check the table in the monthly report that is sent to the generic email addresses (wmo-dm or wmo-dm-dm), and we also encourage them to ask their DACs to make implementation of the min/max results a priority as soon as possible.

In the discussion, the AST agreed that this test should be implemented as automatically as possible and reiterated that it should be a high priority for DACs and PIs. Overall, the test is

thought to produce very few false positives and DACs and PIs were asked to monitor this and report back any false positives to Coriolis over the next year. Depending on the results, this test could be recommended as a real time QC test that could be implemented at DACs, even without the visual check. If data are marked bad in real time, they can always be rescued in delayed mode and it has been well documented that if bad data is ingested into operational centers in real time, it can be very difficult to remove or repair the impact on the analysis.

Action 8: National programs to examine the data identified as bad in the min/max test and flag as needed. Track any 'false positives' and report to Coriolis (Christine Coatanoan). The ultimate goal is to implement this at the DACs as a new RT test. **Who**: DACs, PIs

Feedback from ADMT-25 (ADMT co-chairs)

Megan Scanderbeg reported on behalf of Claire Gourcuff and the ADMT. This report provides an overview of Argo Data Management Team (ADMT) activities as presented in April 2025. Here are the key points:

Data Management Highlights

- Changes coming to data delivery at GDACs (Global Data Assembly Centers) and GTS (Global Telecommunication System)
- DACs (Data Assembly Centers) are understaffed, and prioritization of tasks is needed
- Challenges continue around DAC collaboration, but steps are being taken starting with delivery of metadata in a consistent manner
- The team is adopting new technologies for cloud-based data serving and coding collaboration
- Quality-control work continues but faces challenges with increased workload

Data Quality Status

- 89% of eligible observations have completed delayed mode quality control (target: 75%)
- Temperature profiles with a QC flag of ‘1’ is at 94% (target: 90%)
- Salinity profiles with a QC flag of ‘1’ is at 81% (target: 90%)
- In general, Dmode of core variables in profile files is going well, but some factors/ tasks can make the process harder - deep floats and the need to determine CPcor, initial TBTO contamination, etc.
- Dmode work for trajectory files is gearing up. Only a few groups are producing these files and but more are poised to start creating them. The value of a Dmode trajectory workshop will be considered at the next ADMT meeting.

Data Distribution

- 85% of data reaches GTS within 6 hours (improved).

- WIS2 (next-gen WMO Information System) became operational in January 2025
- Argo GDAC dataset has reached 3 million profiles
- Data accessible via multiple services (https, ftp, ERDDAP, AWS S3, Argovis)

Technological Developments

- New cloud data formats being tested (ZARR, PARQUET)

- Argovis operational version (live) and demo including all information from Argo netCDF files (offline for now)
- Transitioning to additional controlled vocabularies for metadata
- JSON metadata schema for delivering float and sensor metadata is ready to go and manufacturers are asked to start implementing it, and to start supplying these files to customers along with the hardware.
- DACs are asked to implement time-of-day sampling metadata
- Ice-avoidance TT created an ice detection metadata scheme for polar deployments & DACs are asked to implement this

Challenges and Questions for AST

- Whether 3-hour timeliness at DACs should be prioritized over the current 6-hour target. ADMT co-chairs were tasked with enquiring what would be needed for DACs to move to a three hour target.
- Prioritization needed for BGC parameter implementation on GTS/WIS2
- Determining responsibility for creating cloud-friendly data formats. Working group set up to develop guidelines for defining and acceptabing ‘Argo products’ to be served at GDACs

The report emphasizes ongoing efforts to improve data quality, accessibility, and technological infrastructure while highlighting resource constraints and the need for clear priorities from leadership.

Action 9: Survey DACs to enquire how hard it will be to move to deliver data within 3 hours – include encouragement that operational centers are asking for this now (for T/S) . **Who**: ADMT co-chairs

Action 10: Create a group, including scientists, to help develop clear guidelines for defining and accepting ‘Argo products’ to be served on GDACs. **Who**: Peter Oke, Nicolas K, Henry B, Annie, Raphaelle Sauzede, GDAC leads

Easy OneArgo data product (Annie Wong)

Annie Wong presented a new set of data products from Coriolis, called EasyOneArgo. The team at Coriolis includes Thierry Carval, Laure Fontaine and Jean Philippe Rannou. The goal of the

EasyOneArgo data products is to provide good quality Argo data to users in the simplest way, without the need for reading QC flags, data mode, or data manuals. Two datasets have been produced so far: EasyOneArgoTS and EasyOneArgoTSLite. Two other datasets: EasyOneArgoBGC and EasyOneArgoBGCLite, are currently in the works.

In discussion, Peter Oke noted that modelers would likely be very excited with this product and noted that they often work with potential temperature rather than in-situ temperature. It was clarified that only good triplets are ingested meaning that good T/P pairs are not. The header file currently includes data mode, so data can be filtered to allow only delayed mode data, if desired. Citation documentation is in progress.

Reference data (Sarah Purkey)

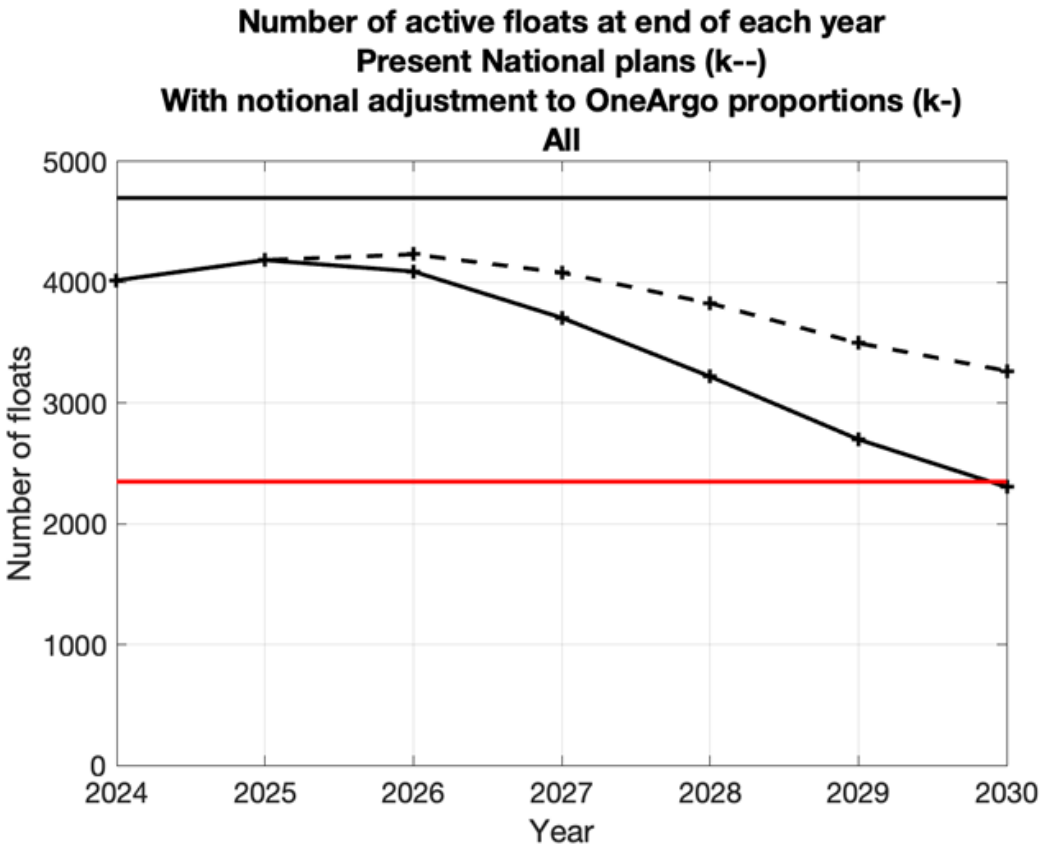
CCHDO is the international hydrographic office responsible for collecting and curating high quality ship based hydrographic survey data. The data is provided to IFREMER to be ingested into Argo reference databases for core, Deep and BGC QC. CCHDO provides public and private data to Argo in its standardized CF-netCDF form ('merged data') for Argo DMQC groups. Typically, when data is submitted to CCHDO, it is posted "as received" within 48 hours, and then "merged" into the standard form based on priorities. Data of high importance to Argo can be requested to be merged quickly by sending a request to CCHDO or communicating these needs with Sarah Purkey. CCHDO asks that data be submitted following the new submission guidelines and will prioritize merging of data that follows the template. This year, 128 bottle stations and 174 CTD stations were either updated or added to the public repository. Five new non-public cruise data for Argo QC only were submitted to CCHDO. The AST is encouraged to remind their colleagues to continue submitting data.

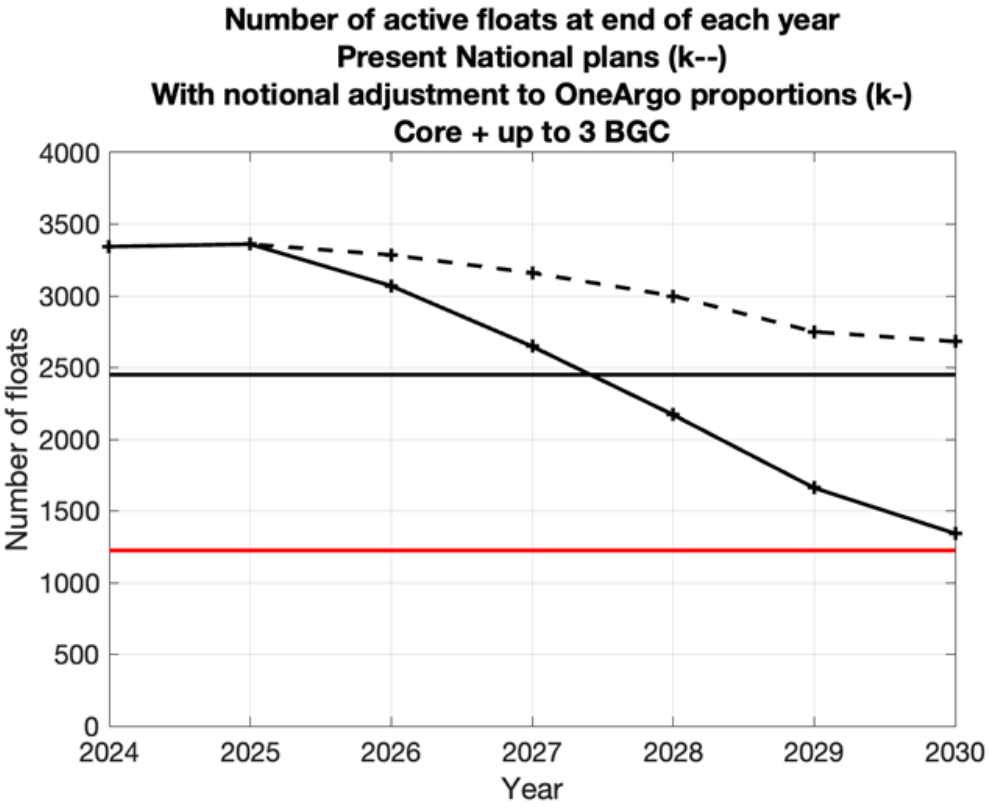
In the discussion, it was noted that many National Reports included reference data that may be accessible to Argo. An action was created to see if this data could be integrated into the CTD reference database.

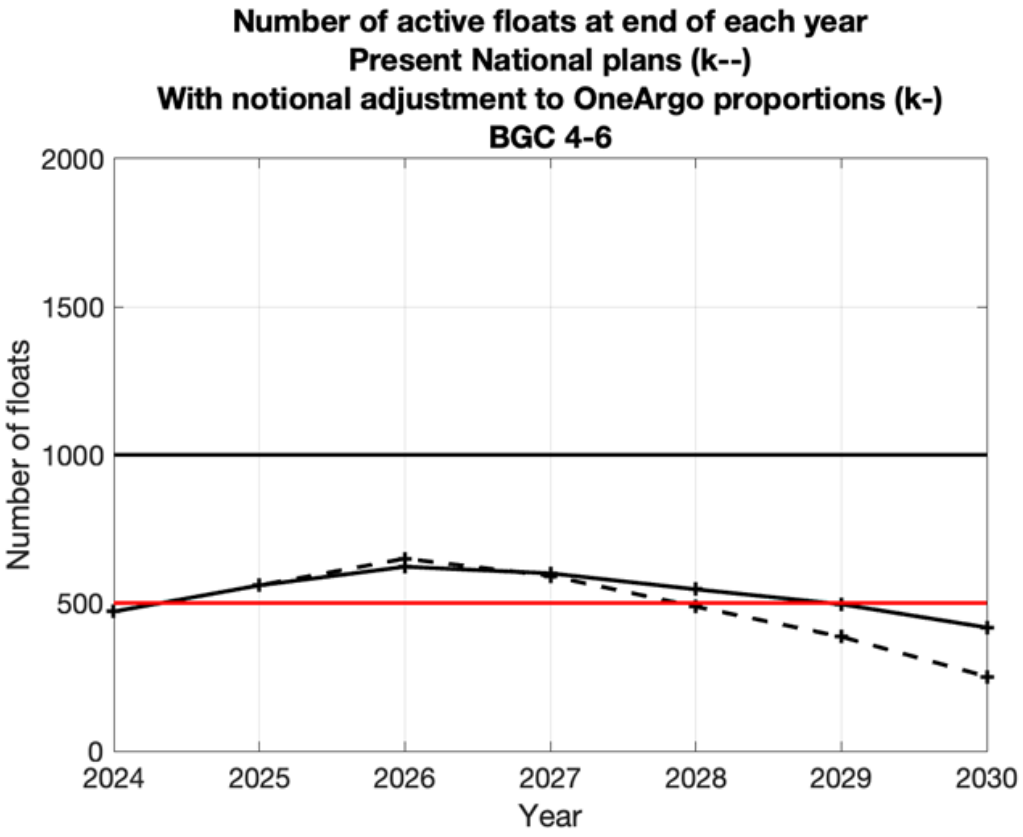
Action 11: Ask Christine Coatanoan to explore the value and feasibility of sourcing the reference data sets noted in the National reports to AST. Report back to ADMT on what might be involved in accessing & using these data. **Who**: Christine, National Programs.

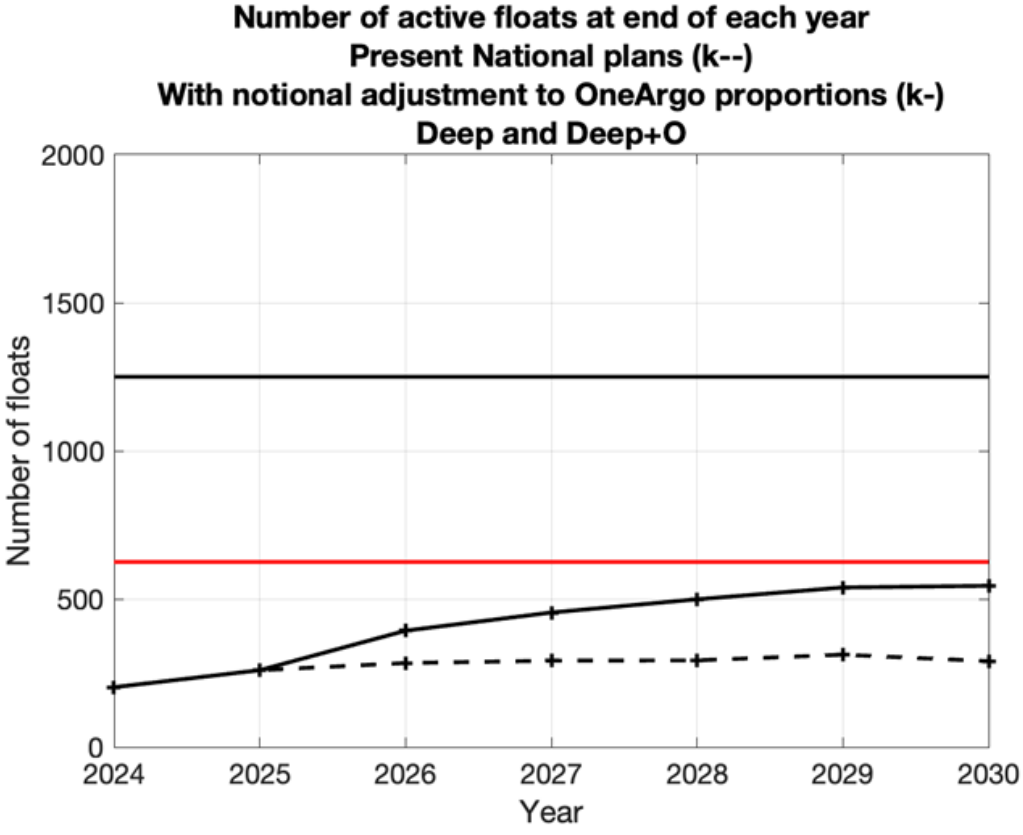
Projection of array status and commitments (Brian King)

Brian King updated the analysis done last year to predict the array status based on known or estimated commitments from the various nations. This year China and India were included in the analysis which was helpful. He modeled two scenarios: 'business as usual' and redistributing resources into OneArgo proportions from 2026 onwards.


Number of active floats at end of each year
Present National plans (k--)
With notional adjustment to OneArgo proportions (k-)
All
Number of floats
Year
5000
4000
3000
2000
1000
0
2024
2025
2026
2027
2028
2029
2030


Number of active floats at end of each year
Present National plans (k--)
With notional adjustment to OneArgo proportions (k-)
Core + up to 3 BGC
Number of floats
Year
4000
3500
3000
2500
2000
1500
1000
500
0
2024
2025
2026
2027
2028
2029
2030


Number of active floats at end of each year
Present National plans (k--)
With notional adjustment to OneArgo proportions (k-)
BGC 4-6
Number of floats
2000
1500
1000
500
0
2024
2025
2026
2027
2028
2029
2030
Year


Number of active floats at end of each year
Present National plans (k--)
With notional adjustment to OneArgo proportions (k-)
Deep and Deep+O
Number of floats
2000
1500
1000
500
0
2024
2025
2026
2027
2028
2029
2030
Year

Many in the audience stated that these diagrams have been useful and the AST plans to continue asking National Programs for their commitment predictions through 2030.

There was also a brief discussion on groups that have done studies on the impact of a decrease in core floats and it was suggested to write a review paper on these.

Action 12: National Programs to maintain commitments spreadsheet until 2030 (and beyond), even when uncertain. **Who**: Megan Scanderbeg to request with National Reports.

Action 13: Assemble a team to write a review paper on studies of the impact of Argo data on products and services - seek Argo users in the authorship. **Who**: Susan Wijffels, Blair Greenan, Fiona Carse, Peter Oke, Candice Hall, Herve Claustre, Toshio Suga, Raphaelle Sauzede.

National updates:

USA (Sarah Purkey, Greg Johnson)

The US Argo consortium consists of six US institutions, including AOML, MBARI, PMEL, SIO, UW, and WHOI. Each institution has a team that contributes to float production and/or data management. AOML serves as the US Data Assembly Center (DAC). MBARI is the newest member and contributes to BGC sensor development and real and delayed-mode BGC data processing.

The US currently operates 2,299 active floats (55% of the global array), including 386 BGC floats and 124 deep floats. This year, the US deployed 307 core floats, 22 deep floats, and 120 BGC floats spanning the global ocean, including the Arctic. The US chartered two Kaharoa II voyages this year to deploy floats, including its delivery voyage from Spain to New Zealand.

The US DAC welcomed new leadership this year with the hiring of Candice Hall and the retirement of Claudia Schmid. The US DAC currently houses 52% of the core profiles. During FY2024, the US DAC processed data for 2,032 active floats, totaling 86,283 profiles. The US GDAC is also in a period of transition, as it will be moved off the US GODAE server. NCEI is prototyping a new cloud service, and development is underway.

US Argo continues to invest in technological advancement and performance. The US has seen substantial improvement in the cost per profile through the extension of float lifetimes. This is achieved by both continuous investment in technology and thorough float checkouts prior to deployment. The US works closely with commercial partners to identify and fix issues before deployment.

This year, the US PIs also contributed to numerous datasets that leverage Argo data. Wijffels et al. (2024) produced a new high-resolution Argo data climatology that combines Argo profiles with

satellite sea level and winds. Zilberman et al. (2025) developed a new Argo trajectory product, and Sharp et al. (2023) used machine learning algorithms to provide a three-dimensional, time-evolving dissolved oxygen global product. Finally, Deep Argo is now being utilized for annual deep ocean heat assessments (Johnson and Purkey, 2024).

Future funding for US Argo remains uncertain. Currently, core and deep funding is primarily provided by NOAA OAR. If funding is reduced or eliminated, this will have a significant impact on the US's ability to maintain 50% of the global array. The BGC floats have been funded by the GO-BGC project, an NSF five-year MSRI, which concludes next year. A follow-on proposal is still pending at NSF.

Euro-Argo ONE EU project (Yann-Hervé de Roeck)

The Euro-Argo ONE project is a recently awarded EU funded project. It will allow Euro-Argo ERIC, the legal and organisational framework supporting and coordinating the European contribution to the Argo programme, to align with the OneArgo ambition. Its overarching objective is to scale-up Euro-Argo ERIC's capabilities, sustainability and resilience to ensure Europe's ability to take its share of the global OneArgo array implementation. It is timely to present to the European Commission a structure that is able to receive direct support, at least for the provision of data for operational users, to be considered in the new multiannual financial framework of the EC, starting 2028.

To this end, the 23 partners of Euro-Argo ONE will:

- Tailor a comprehensive design of OneArgo for its European implementation.
- Escalate Euro-Argo ERIC's efficacy in delivering OneArgo data and services.
- Address the environmental challenges of OneArgo operations (e.g., recovery and refitting) and engage with the supplier industry.
- Improve OneArgo products and services and maximise their impact for operational users and broader scientific communities.
- Consolidate Euro-Argo ERIC leadership and collaborations within the international and European ocean observation landscape; and,
- Demonstrate and promote the value of OneArgo for societal challenges.

The slides of the presentation showed all tasks of the 5 work packages.

Euro-Argo ONE outcomes will be presented at the forthcoming ASTs. Its deliverables are public and meant to be shared with- and useful to the global Argo community, as were the outcomes and deliverables of Euro-Argo RISE project.

Japanese report on impact of no TBTO in CTDs (Shigeki Hosoda)

TBTO (Tributyltin oxide) is used in the SBE41 CTD to prevent biofouling, but due to environmental and human health concerns, a pilot test was initiated in 2005 to evaluate the feasibility of operating without TBTO. The goal of this experiment was to confirm whether the target salinity accuracy (±0.01 psu) could be kept throughout the float's lifetime without TBTO. JAMSTEC deployed four

Argo floats (4900717, 4900718, 5900808, 5900809) without TBTO; 4900717 and 4900718 in the Eastern Subpolar North Pacific where the phytoplankton bloom is enhanced in spring, while 5900808 and 5900809 in the western Subtropical North Pacific. All four floats used the Argos-2 telecommunication system and completed their missions for 3-4 years without any trouble. Initial profiles in 5900808 and 5900809 indicated no bias in comparison with ship CTD cast data at deployment point. During the lifetime of floats, no adjustments or modifications were needed with WJO and OW delayed-mode quality control methods. Even though Argos floats stayed at the sea surface for several hours in the subpolar region, there were no impacts on the absence of TBTO. These results suggest that removing TBTO from the CTD would not result in biofouling in these two areas. However, further experience is needed to assess potential biofouling effects on float sensors, especially in marginal seas and coastal areas where the risk of biofouling may be higher.

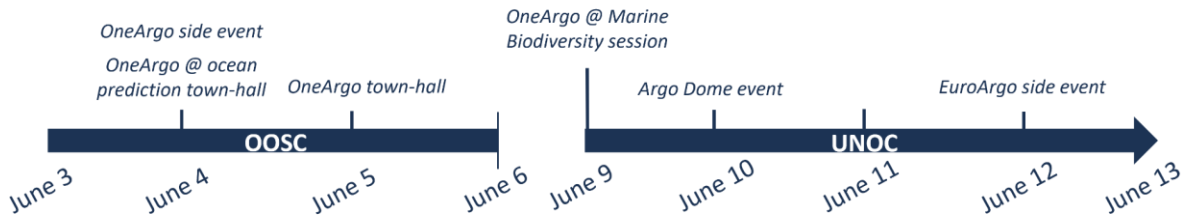
The AST was happy to revisit the issue of TBTO on floats and asked countries who deploy floats without TBTO to report back at AST-27 with further results.

Action 14: Encourage national programs to try deploying floats without TBTO (dummy plug), and report back to AST-27 on the number deployed and any impact on CTD data quality. **Who**: Steve Jayne to coordinate, Steve Riser (deployed floats in the NE Pacific), Birgit Klein (deployed in Atlantic), Shigeki Hosoda

OneArgo at the OOSC/UNOC (Orens de Fommervault)

This presentation highlights OneArgo's significant engagement in the 3rd UN Ocean Conference (UNOC-3), taking place June 9–13, 2025, in Nice, France, alongside the One Ocean Science Congress (OOSC) from June 3–6. This high-level international event, co-organized by France and Costa Rica under the auspices of the UN, is expected to bring together over 30,000 participants from more than 100 countries, including heads of state, government representatives, scientists, and stakeholders from across the ocean community.

OneArgo will have a prominent presence at the OOSC, with 8 talks, 10 posters, and a dedicated town-hall session. Additionally, OneArgo will be featured in key side events, in particular in the EU Ocean Digital Pavilion and in the Villefranche-sur-mer Green zone. An artistic exhibition of decorated Argo floats will also be on display across the Green Zone.



BGC-Argo Introduction and status (Hervé / Ken / Orens)

Hervé welcomed everyone to the BGC Argo session with the positive news that for the first time, the target number of floats deployed (200) was exceeded with 230 deployments. Overall, 60% of the BGC floats are oxygen only from 18 countries and 40% are 5 – 6 parameter floats. This recent success in float deployments and gap filling has largely been due to the US NSF effort.

Action 15: BGC Mission Team to communicate (mathematically) what the coverage metric is for the BGC array so that OceanOPS can implement it. **Who**: BGC Argo Mission co-chairs, Victor Turpin, Orens de Fommervault

BGC implementation

National Reports

Australia (Peter Strutton) :

Australia has 21 operational BGC floats with 3+ sensors and deployed 5 BGC Argo CTS5 Jumbo floats with FLBB and an optode as well as 5 oxygen only floats. Fleet missions have been updated to take an extra noon profile every 30 days for floats with radiometers. Trajectory files in v3.2 with DOXY in-air adjustments are close to operational. The current funding extends to June 2027 at the level of about 2 floats per year. Future plans include trying new sensors and continuing to look for more secure and sustained funding.

Canada (Katja Fennel)

Canada deployed 23 BGC Argo floats in 2024 and Katja mentioned several research highlights based on BGC Argo float data. The BGC Argo funding in Canada is not long term and mainly comes from research awards.

China (Xiaogang Xing)

In 2024, China deployed 4 BGC-Argo floats, all in the Northwest Pacific Ocean, and Chinese scientists published 30 BGC-Argo-related papers. In 2025, China plans to deploy 4 BGC-Argo floats, 2 in the Tropical Western Pacific and 2 in the Indian Ocean. Additionally, Xiamen University has a procurement plan for 28 BGC-Argo floats, including 17 HM-2000 floats equipped with oxygen and other optical sensors, and 11 NKE CTS5 floats (6 equipped with C-Rover transmissometers, 4 with UVP6, and 1 with a Ramses irradiance and radiance spectrometer). However, China still lacks long-term funding support for sustained BGC-Argo operations.

EU + Pol., Bul., Fin., Den., Spa. (Yann-Hervé de Roeck) :

The infographics about Argo in the last IPCC report was outlined.

Norway (Kjell Mork)

Norway deployed 3 BGC Argo floats in 2024 and 16 are still active. There are plans to recover two BGC floats with UVP6 in the Norwegian Sea during May or June 2025 at which point the images will be downloaded and analyzed. There is increasing interest among Norwegian biologists in the data from the UVP6 sensor. NorArgo will receive 1.5 million Euro to order core, deep and BGC floats and a new proposal will be submitted soon for the funding of 55 floats with a focus area of the Nordic Seas and the Arctic.

France (Hervé Claustre)

France continues to focus on hyperspectral radiometry from 13 floats and financially supports the BGC Argo website and communication efforts. Herve noted that the Frontiers for Young Minds article has been translated into 14 languages. He noted that current funding extends to 2027 and that no long term sustained funding has yet been identified.

Germany (Meike Martins)

Germany deployed 8 BGC Argo floats and 12 oxygen only floats in 2024 in a variety of locations globally. There are deployment plans for 35 BGC and oxygen only floats in 2025 also spread throughout the Atlantic and Pacific. Future plans include annual purchase of 6 BGC and 18 core + oxygen floats through 2028.

India (Uday Bhaskar)

India deployed 8 BGC Argo floats in 2024 and plans to deploy another one in 2025. There are 15 active BGC floats at this time and future deployments are waiting until the pH sensor is more reliable. DOXY data is processed in real time according to ADMT real time QC manual and adjusted data is produced using a gain factor from the SAGE tool and the audit report made by Josh Plant. CHLA data is processed in real time according to the ADMT real time QC manual. Adjusted CHLA data has yet to be implemented. BBP700 also needs to be processed in real time and adjusted data needs to be implemented. The current funding cycle is secure until March 2026 and the next cycle will be from 2026 – 2031.

Italy (Giorgio Dall'Olmo)

Italy deployed 11 BGC Argo floats in 2024 and plans for many more deployments in 2025 in the Med Sea and Nordic Seas. A DOXY DMQC operator is being trained and BBP DMQC will be developed in collaboration with LOV. There are plans to test alternative BGC sensors.

Japan (Tetsu Fujiki)

Japan deployed 4 BGC Argo floats in 2024 and plans for 30+ floats to be deployed in 2025, mostly in the Pacific and Southern Ocean. JMA handles real time decoding and adjustments for oxygen and nitrates. Historical data with real time QC will be submitted to the GDACs soon and hopefully implemented in real time by the fall. JAMSTEC does DMQC on oxygen and pH already and will submit dmode nitrate soon. There are plans to try out new sensors.

New Zealand (Philip Sutton)

New Zealand deployed its first two BGC Argo floats in January 2025 in collaboration with Argo Australia. The data management is currently handled by US for T/S and Australia for BGC. There are plans to apply for 1 BGC float every two years to be deployed in the Southwest Pacific and 1 – 2 BGC floats every two years to be deployed south of 60S.

USA (Ken Johnson)

The US deployed 120 floats in 2024 and plans to deploy another 120+ in 2025 and 2026. There were a variety of platforms and sensors deployed, but the floats had 5 or 6 BGC sensors. BGC data are being sent to the GTS now and work is ongoing to incorporate BGC data into the trajectory v3.2 files. A new version of SAGE (SAGE v2) was rolled out which includes pH pump offset adjustments. There has been increased collaboration among US Argo members on BGC Argo data management tasks. Float lifetimes for US BGC floats are at 5 years which means a deployment rate of ~100 floats per year for the US to sustain an array of 500 floats. Funding is uncertain.

UK (Nathan Briggs)

2024 UK Float updates

- 18 Active ASBAN floats (29% of global 6-parameter BGC floats; 12.5% of Irradiance floats)
- 8 “ASBAN” 6-Parameter BGC Argo floats deployed in North and South Atlantic (5 remaining – no further funding)
- 1 Experimental float with UVP deployed (recovery intended August 2025)
- 1 ASBAN float lost prematurely in shallow water off Greenland

2024 UK Data management

- BODC has added DMQC capability for Nitrate and pH
- DOXY: 16 floats (1500 profiles) processed in 2024
- Nitrate and pH: 14 floats (1200 profiles) processed in 2024
- BODC plans to add Irradiance DMQC in 2025

UK “profile-selling” pilot

- Deploying project pays $13k towards fleet data transmission and management costs and makes calibration measurements, in exchange for the right to direct the timing of 35 “extra” profiles during the first year (on top of the core Argo mission).
- Deploying project can also decide deployment location as long as ≥100 km from nearest BGC float. Four floats have been deployed under this scheme (two this year).

BGC-Argo Implementation Plan Revision (Hervé Claustre / Orens de Fommervault)

The initial plan, written in 2016, called for an array of 1000 BGC floats with 6 sensors. The current status in 2025 is ~740 active floats and the majority 400 floats have 5 – 6 sensors. However, full operational implementation has not been achieved. Even so, scientific outcomes have outpaced

expectations, and it is time to reassess the plan based on results and impact. Some research and management topics need to be revisited to provide more context and rationale. It would be beneficial to make synergies between other observing systems, fisheries and modeling. In addition, some new research topics are emerging, and all these changes could be done to better reach (new) users. Some questions to consider in the next year include what is the role for floats with 3 – 5 sensors and should targets vary by region? How best to integrate new sensors and foster synergy with experimental projects.

Long term funding

Most BGC Argo data delivery depends on research funds which vary widely in scale from small (1 – 2 floats) to large-scale efforts. Despite growing value, Argo National Programs are struggling to secure long-term, sustainable funding. How can we raise the visibility of OneArgo within society and among decision and policy makers?

Many major initiatives assume that OneArgo and other ocean observations are funded, which is not true. Currently, OneArgo appears only essential at the foundations of the data value chain. We need to move Argo further up the value chain. This involves getting data that users want; continuing data management and improving documentation; developing value-added products and providing simple user interfaces; finally building partnerships with public services and industry, training Argo ambassadors and publishing use cases to convince funders of the societal return on investment.

OneArgo's impact remains indirect and it might be essential to do a socio-economic impact assessment.

Outlook for some countries (Ken Johnson / Orens de Fommervault)

The US BGC-Argo projects currently supply the bulk (~75 to 80%) of the 5 and 6 sensor floats needed to reach the target of 1000 BGC floats in the Implementation Plan. US projects currently have about 240 floats available or on order for deployments through 2026. After that time, no significant amounts of funding are presently available. A renewal proposal to NSF has been submitted that would acquire 110 6-sensor floats per year, but no decision has been made. Survival rates and maximum lifetimes of US floats show that a reduction in float deployments from 125/year to 110/year should be enough to sustain an array of 500 operating floats. Funded or planned acquisitions of BGC floats in other nations total about 61 floats in 2027.

BGC-Argo floats are primarily acquired through short-term science projects and long-term support for BGC-Argo is rare. Moving to more sustained support will likely require development of a group of outside users who would be highly motivated to use float data. A unique feature of BGC-Argo is the ability to provide quality controlled data in real-time. Development of real-time products based on the float data may be one pathway to the goal of developing motivated users. These products may be used in fisheries management, carbon management and marine carbon dioxide removal.

Discussion for promoting sustained fundings (Hervé Claustre)

The discussion focused on the difficulty of securing long-term funding for OneArgo, which currently relies on short-term research projects. Despite its societal value, OneArgo lacks visibility among funders and policymakers. Examples from EU and UN programs show ocean data is often assumed to be available without recognizing the need for sustained support.

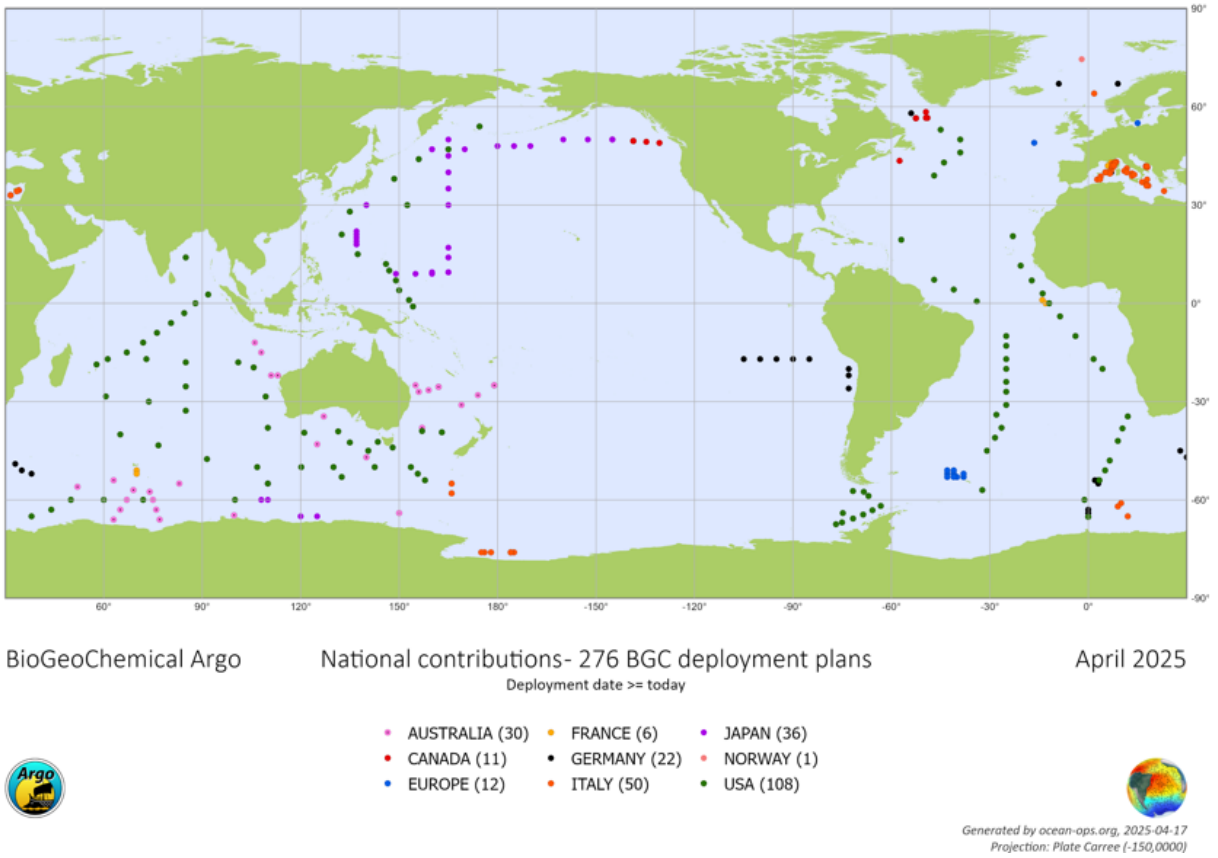
To address this, Hervé proposed rethinking OneArgo's role within the marine data value chain, strengthening partnerships, co-developing products with users, demonstrating socio-economic impact and conducting value assessments. Transitioning to a more "operational" funding model through national agencies (similar to what is in place for weather observations) is regarded as key to maintaining the network's sustainability.

During the discussion, it was noted that sometimes Argo's impact is sometimes indirect and this should be better documented. The US has started on this effort, led by Candice Hall, and it could be expanded to the international level. Part of the impact of Argo is through products that include Argo data and sometimes other data sources and Argo needs to do a better job of working with these products to have them include Argo's DOI in their citations. In addition, Susan Wijffels stated that we need to find high level government champions in a few countries to help identify the additional funding needed.

Past Deployments, Future Plans, and Gap Filling (Orens de Fommervault)

This presentation reviews the progress made since 2024 in addressing observational gaps through targeted BGC-Argo deployments. Most gaps have now been filled, and key performance indicators are improving, thanks to good coordination and planning.

Looking at the future, 276 deployments of BGC-Argo floats are planned and declared in OceanOPS—about 200 in 2025, 44 in 2026, and 12 beyond 2027. Several of them target remaining gap areas.



While the outlook is positive, the deployment of floats with 5+ sensors is still too low to meet OneArgo goals, and a long-term vision (beyond 2027) for sustaining the BGC-Argo network is still lacking.

Global Ocean Carbon Implementation Plan (Ken Johnson)

BGC Argo is part of an observing system that includes ships, satellites and floats that work together to make up the Integrated Ocean Carbon Observing system. Various components of this system have implementation plans, some of which are currently undergoing revision. BGC Argo has an implementation plan from 2016. This plan will be updated and needs to improve sections on synergies with other observing partners. The Integrated Ocean Carbon Research (IOC-R) plan is in revision, but presents more of a broad view of possibilities rather than a detailed implementation. In addition, an integrated plan document has just been initiated by Adrienne Sutton as co-chair of IOCCP that ties GO-SHIP, SOCAT/SOCONET and BGC-Argo together.

Strengthening Relationship with other groups

GO-SHIP (Brendan Carter)

Brendan Carter was invited to emphasize the importance of strengthening collaborations between the GO-SHIP and BGC-Argo communities. His presentation highlighted the strong complementarity between the two programs. GO-SHIP provides high-precision reference measurements that are essential for validating BGC-Argo sensors and developing reliable calibration algorithms. Conversely, BGC-Argo offers the broad temporal and spatial coverage that ship-based programs like GO-SHIP cannot achieve alone, helping to fill observational gaps and extend the reach of reference data. Closer and more structured collaboration between GO-SHIP and BGC-Argo is essential. This includes coordinated deployments, shared calibration efforts, and joint planning, especially as new versions of GLODAP and calibration algorithms like ESPER are developed.

SOCAT / SOCONET (Rick Wanninkhof)

Rick Wanninkhof was invited to highlight the importance of strengthening collaboration between BGC-Argo and traditional carbon observation systems. His presentation emphasized that closer integration is crucial. High-quality surface water CO_2 data, such as those from SOCONET and BGC-Argo—which provide important physical and biogeochemical variables—offer complementary strengths. Improved coordination would enhance data accuracy, enable better product development and support long-term climate monitoring goals. Rick underscored that the synergies between these systems must be fully exploited now to avoid regrets in the future.

IOCCP/GOOS BGC (Véronique Garçon)

Véronique Garçon presented an update from the International Ocean Carbon Coordination Project (IOCCP), with a clear emphasis on reinforcing synergies with BGC-Argo. Her presentation outlined IOCCP's strategic role in designing a global ocean carbon observing system, stressing the importance of cross-network integration, especially among SOCONET, GO-SHIP, and BGC-Argo. IOCCP is also leading the formalization of SOCONET as a GOOS network and aligning efforts with initiatives such as the Global Greenhouse Gas Watch and GOOS Carbon Plan. This cross-network collaboration is foundational to delivering coordinated, policy-relevant ocean carbon observations with quantified uncertainties.

IOCCG (Hervé Claustre)

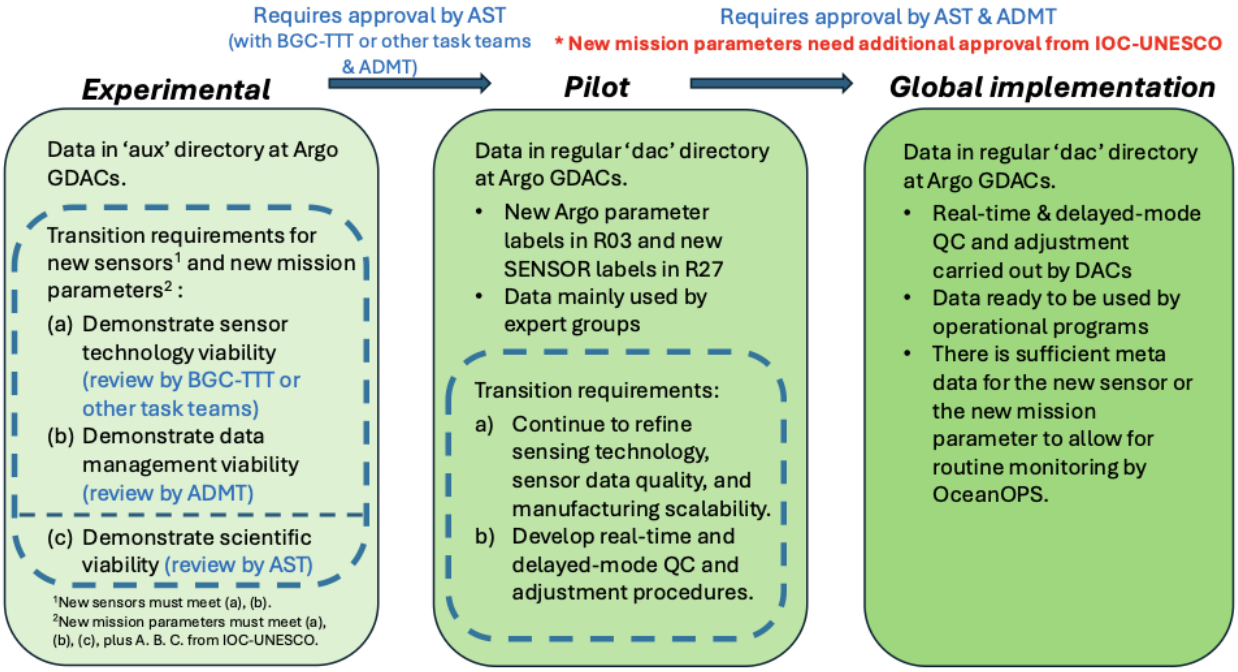
Models (Alexandre Mignot)

Alexandre Mignot presented how Mercator Ocean International actively integrates BGC-Argo data across its modeling workflows, underscoring the critical role of this collaboration. BGC-Argo observations are essential for optimizing model parameters, particularly to improve representation of seasonal pCO_2 cycles and zooplankton dynamics, areas where current models underperform. These data also serve as independent validation sources, especially in remote ocean regions

where traditional observations are limited. Strengthening collaboration with BGC-Argo is central to new initiatives, such as global data assimilation projects and research on ocean alkalinity enhancement.

Framework for adding new sensors / parameters in Argo (Henry Bittig / Annie Wong)

Henry Bittig presented the document on “Framework for adding new sensors and new parameters in Argo”. This document was first presented in the ADMT meeting in Trieste, in October 2024. The goal of the document is to describe the pathway to admit new sensors and new parameters into Argo, through the 3 phases: experimental, pilot, and global implementation. The pathway follows the guidelines approved by IOC-UNESCO for new mission parameters, but is expanded to include new sensors, and with added consideration for the Argo data system in order to prevent it from being overburdened unnecessarily. In this framework, some experimentation will progress to the pilot phase or global implementation, but some will remain in the experimental phase indefinitely. The authors of the document aimed to have it finalised before the end of 2025.



Action 16: AST members to read and comment on the "Framework for adding new sensors and new mission parameters in Argo" by 16 May 2025. **Who**: AST members

BGC sensors /Technology Task Team (TTT)

a. Brief intro/summary of TTT activities over the last year (Yui) : 5 min

A brief summary of the BGC Technology Task Team activities over the last year was presented.

First, abbreviated terms of reference were presented, which includes tracking and assessing performance of currently approved BGC sensors; create a framework for adding/approving new BGC sensors; and create a framework for assessing performance and interoperability of new BGC sensors. Good progress has been made on all three fronts. First, plots for BGC sensor performance, sorted by parameter/sensor model/deployment year, are now provided by OceanOPS. Second, several TTT members contributed/led the effort to draft a document for adding new sensors and parameters in Argo (see above). Finally, several working groups were established to coordinate with manufacturers, and coordinate laboratory and field experiments.

Intercomparison of BBP and CHLA: Lab and field for Tridente + Eco, and future plans(Giorgio Dall'Olmo)

The presentation begins with a recap of the conclusions from the ADMT regarding the comparison of chlorophyll-a fluorescence measurements using excitation at 435 nm and 470 nm. Contrary to theoretical expectations, both channels exhibit similar fluctuations in the fluorescence-to-Chla concentration ratio. Preliminary results suggest that, for now, the 435 nm channel is not a suitable candidate to replace the 470 nm channel. Further investigations are needed to assess whether the 435 nm channel could be useful for CDOM correction and/or provide insights into phytoplankton community composition.

Preliminary results from comparisons between ECO (SBS) and Tridente (RBR) sensors are then presented, based on laboratory experiments and CTD-Rosette measurements. These results show good agreement in the lab, with species-dependent variations in slope being comparable. At sea, the results demonstrate very strong collinearity between the sensors for both Chla and BBP, but with slope variations depending on RBR calibration. Older Tridente sensors align more closely with ECO for Chla measurements, but less so for BBP.

Finally, the presentation highlights ongoing community efforts toward sensor intercomparisons. Multiple initiatives are underway in laboratories, on rosette casts, and on profiling floats with dual sensors, led by LOV, OGS, NOC, Dalhousie, and SIO.

Intercomparison of Radiometry: Lab and field (Xiaogang Xing)

We evaluate the performance of three 4-channel irradiance radiometers (Sea-Bird OCR-504, RBR quadrante, and SIAT SLIM-I4) through laboratory and in situ experiments. Based on the experiment results, for improving the temperature correction and dark-signal drift identification for the Argo irradiance data, we recommend that manufacturers equip radiometers with internal temperature sensors, output internal temperature data, and provide temperature correction coefficients in calibration files. Furthermore, we propose three technical criteria for Argo float radiometers: radiometric accuracy within ±3%, radiometric stability within 1% for irradiance and 0.1% for PAR, and dark-signal stability better than 0.005 μW/cm²/nm for irradiance and 0.03 μmol/m²/s for PAR. These criteria are essential for ensuring reliable, consistent, and interoperable BGC-Argo datasets, as well as for facilitating the integration of new radiometers into the Argo

program.

Initial PAR algorithms evaluation (Edouard Leymarie)

During AST24, it was decided to measure irradiance by default at the following wavelengths: 380, 443, 490, and 555 nm, thereby eliminating the direct measurement of PAR. This parameter, which is important for the program, must now be retrieved through modeling. This presentation compares the two PAR models introduced during the last ADMT meeting (J. Pitarch et al. and R. Frouin et al.), including a modified version of the first model, which now accounts for depth. The comparison was conducted at LOV using data from five "ProVal" prototype profilers, and at MBARI using the SEABASS database.

The initial observation is that the outputs of both models are less noisy and visibly more accurate at depth compared to direct OCR measurements. The relative errors of the estimated PAR with respect to the measured PAR are then presented. For both datasets and both models, the errors are on average below 3%, with depth-dependent biases reduced. The depth at which PAR equals 15 µmol/m²/s is also compared. Differences between the models and direct measurements are on average less than 1 meter.

It is proposed to continue these comparisons to support the selection of a strategy for the next AST/ADMT.

Update from the 3rd channel of bio-optical sensor WG (Nathan Briggs)

Two of the six BGC Argo parameters, chlorophyll fluorescence (FChl) and optical backscattering (bb), are measured exclusively in the Argo fleet by combined optical scattering and fluorescence instruments capable of making two or three independent optical measurements (currently ECO and MCOMS instruments from Seabird Scientific). The de-facto standard is to measure at minimum FChl with an excitation wavelength of 470 nm (FChl470) and bb at a wavelength of 700 nm (bb700). However, there is no Argo standard regarding a third channel. Currently ~50% of floats with bio-optics measure fluorescence of colored dissolved organic matter (FDOM), ~10% measure a second FChl or bb channel (FChl435, bb470, or bb532), and ~40% have no third channel. During the last ADMT, interest was expressed in a working group to advise on the relative merits of different options for this “third channel” on BGC Argo floats. Work was divided into two steps: Step 1 (Nov 2024-): Individual assessment of each option in separate working groups. Assessment of second FChl and bb channels is underway in existing FChl and bb working groups. A new FDOM working group was created to assess the state of technology and scientific value of FDOM measurements on Argo. The working group has met twice, and preliminary findings are that global-scale FDOM measurements have value as a tracer of cumulative organic matter decomposition in the ocean, independent of dissolved O2, helping to further constrain global circulation and biogeochemistry. In addition, FDOM provides an additional constraint on the behavior of light in the ocean, helping to improve optical models and proxies, most notably correcting FChl measurements for the effects of FDOM, and also identifying spikes in bb due to

zooplankton attracted to the float vs. passively sinking particles. Technology evaluation underscored the serious issues with Seabird calibrations that currently prevent global-scale analysis, but should be correctable going forward, and possibly going backwards as well. Instrument sensitivity was identified as poor on ECO sensors, but good on MCOMS and the upcoming RBR Tridente sensor. Step 2 (May 2025-) will be to form the third-channel working group with experts on each option to discuss the relative benefits of each option together. First meeting will be in May 2025.

BGC-Argo data management

ADMT summary/key points to mention, ie GitHub (Tanya Maurer / Catherine Schmechtig)

This year marked the start of a new agenda format for ADMT, with BGC topics spanning the second and third day, rather than opening the meeting. There was also heavy presence from the newly formed Technological Task Team (TTT), whose scope is to assist the ADMT with decisions and management related to technical aspects of profiling float sensors. This team is led by co-chairs Edouard Leymarie and Yui Takeshita. There were a number of general meeting takeaways, but one theme common across all Argo programs is that DACs are spread very thin. We're making a lot of progress on delayed mode, adjusted data and GTS transfers but there is still a lot to be done, both through the incorporation of new sensors and platforms, as well as in the enhancement of preexisting data streams. Routine monitoring of BGC data quality is still very much a crucial component of the BGC data management scope and some DACs just do not have the capacity to do it rigorously. There is thus a need for improved real-time tests and supplementary audit development, as well as better characterization of bias and uncertainties across the BGC parameters. There has also been a growing interest in development of a more modernized system. BGC is remaining involved in this effort, including leaning more heavily on GitHub for tracking actions and assigning leads to various tasks. And there is also a need for better connection and support for our user base; the complexity of our data system remains difficult for users to navigate, thus there remains a strong push for product development.

The second day of ADMT was focused on BGC sensors, led by the TTT chairs. An official document outlining the framework for accepting new sensors within Argo was presented. This is a really important document for the DACs – as we expand and DACs continue to be overworked, having a structure in place to both guide and protect their efforts is crucial. One sensor that falls into this framework at the experimental phase is the FLBBFL, which includes the new fluorometer at 435 nm. There was some discussion at ADMT about this new sensor. They are beginning to proliferate within the array, but the scientific relevance still needs to be proven. Both exhibit linearity with respect to Chla and similar interspecies variability, but 435 tends to be noisier and also subject to interference from CDOM. CDOM was also a topic of discussion at the meeting. We received an update from Seabird as to the status of the calibration history and issues therein – and how to potentially adjust sensors calibrated in error prior to January 2023. But the ADMT

still needs to decide how to implement this and track it within the data system, there's still some concern with vetting the correction.

BGC data management topics were covered on day three of ADMT. The data management team has made great strides in terms of increasing the amount of high-quality adjusted data over the past few years across the chemical parameters, with the majority of data in Dmode, but there is still more work to be done. In support of that effort, the community has been coming together for routine task team meetings, and has also been collaborating more on software tools, including a new version of Sage in the works at MBARI that specifically addresses adjustment of the pH pump offset where applicable. NOAA PMEL has been working in collaboration with Argo Canada to produce a python version of Sage as well. There is also strong desire to expand our community auditing to pH and nitrate, which, if designed thoughtfully enough, could be implemented in a real-time capacity. Logan Grady (MBARI) has been working on this, with the objective of catching degrading sensors in between those time points of DMQC (prior to getting caught by a cruder range check). Oxygen data also received a lot of discussion – it is the most prevalent of the BGC sensors and yet small, second order, issues remain. Oxygen response time bias correction is something that MBARI has just begun implementing for inactive floats, although there is limited capacity for global implementation. There's also concern about accuracy and bias near zero in oxygen minimum zones, as well as in the deep ocean so a WG has been identified to look further into this.

DMQC meeting(s) (Tanya Maurer / Catherine Schmechtig)

This presentation informed the AST community of the plans currently in development for future BGC-DMQC workshops. The importance of cross-DAC collaboration within Argo on this topic cannot be understated. Many DACs are behind in rolling out D-mode and A-mode data pathways for the BGC parameters. This impacts users through reduced data availability (raw BGC parameter data quality is unfit for most scientific applications). Thus, bringing the community together to standardize methods and processes, improve data quality and eliminate inconsistencies is a top priority. The first in-person BGC DMQC workshop was hosted by IMEV in Villefranche sur Mer, France in January 2023. We are currently organizing the second in-person DMQC workshop, to be held at WHOI, the week following ADMT26. This will be a 2.5 day hybrid meeting (Oct 27-29, 2025). The agenda and further details will be forthcoming. An additional development on this topic includes the organization of smaller rotating zoom workshops throughout the year to focus on DMQC issues and examples. Nicola Guisewhite (MBARI, nicolag@mbari.org) has volunteered as lead-facilitator and will be identifying speakers, topics and managing the schedule. Currently we have three tentative zoom meetings on the schedule through the end of August. A full schedule, as well as log-on details, will be available soon on the bio-Argo website.

BGC supporting products, a data management perspective (Tanya Maurer)

It has been identified that developing and maintaining BGC-Argo supporting data products is a high-priority need in terms of supporting and expanding our user-base. What is not always clear

is what defines an Argo data product, and where the line is drawn for what should be produced within Argo (and directly supported by data managers) and what should be produced outside of Argo. Given the increasing overhead involved in maintaining and enhancing the Argo data system, and further into the development of complex user products, it's important to have the AST's input in guiding DAC managers in these matters/efforts. One case example that could fall into either an externally served product or an internal Argo data system enhancement is the management of the parameter, PAR. Given the move to 4-channel OCR without PAR (replacement at 555nm), it is now suggested that this parameter be calculated using an algorithm (there are two under development). Should calculated PAR and measured PAR be stored in the same way within the Argo data system? Or, should only measured PAR be reported at the GDAC level, and estimated PAR be calculated outside of the DACs (and served elsewhere)? This is a debate that requires guidance from the AST in terms of how the DACs should move forward, although, given that these two algorithms are still under development, it is likely that we are not prepared to answer this question at this time.

Action 17: Ask BGC ADMT to create a proposal for computed PAR and measured PAR with a recommendation on how to handle this data. Could be within the data stream or separate product. Would also be helpful to know how you suggest serving the data, i.e. through the DACs or at the GDACs. **Who**: Tanya Maurer, Eduoard Leymarie and Catherine Schmechtig

Summary of RT Chla slope, status and next step (Catherine Schmechtig / Raphaelle Sauzede)

This presentation provided an update on the real-time (RT) correction of chlorophyll-a (Chla) derived from Argo fluorescence data (FChla). The Chla correction accounts for dark offset (sensor-specific), non-photochemical quenching (NPQ), and physiological ratio corrections. A new dataset, semi-automatically adjusted for delayed-mode (DM) correction following the method proposed by C. Schmechtig (2022), is now available on SEANOE (Schmechtig et al., 2024), ensuring consistency across DACs.

To improve the RT correction, a global climatology of the physiological ratio between FChla and Chla was generated using SOCA 3D-gridded products of fluorescence and radiometric parameters (e.g., ED490 and KD490). Based on Morel et al. (2007), this approach enabled the derivation of a physiological ratio climatology and the creation of a 1°x1° Look-Up Table (LUT) for global RT correction.

The new RT correction was evaluated against both satellite-derived Chla and HPLC in-situ measurements. While a slight global Chla underestimation remains (validation against HPLC)—likely due to current NPQ correction limitations in RT—the updated RT correction significantly reduces Chla overestimation in the Southern Ocean.

The spatial analysis of the physiological ratio revealed higher variability from one pixel to another with latitude than longitude, with local changes typically under 25%, supporting stable RT correction as floats generally remain within narrow latitudinal bands.

The LUT is distributed as a NetCDF file with comprehensive metadata for operational integration. Initial feedback has been positive. The next steps include finalizing the associated white paper, completing implementation tests, and coordinating a synchronized deployment across DACs.

Hyperspectral data calibration (Catherine Schmechtig)

21 floats (APEX and PROVOR) are equipped with TriOS Ramses hyperspectral radiometers measuring upward radiances and downwelling irradiances.

Applying the new framework “going from the experimental phase to the pilot phase” (Bittig’s presentation), this presentation illustrates the data management viability (BGC-ADMT) and the technical viability (TTT) for the Ramses downwelling irradiance spectrum (endorsed as a key variable by IOC).

We present how the data are homogenized (APEX/PROVOR), calibrated, stored and findable (aux index : https://data-argo.ifremer.fr/etc/argo-index/argo_aux-profile_index.txt) in the Coriolis aux directory (https://data-argo.ifremer.fr/aux/coriolis). We also present some preliminary and encouraging intercomparison results between Ramses irradiances and SOCA irradiances (Renosh et al., 2023), derived from BGC-Argo OCR irradiances.

Regarding the data management, there is still an open question to AST and ADMT: “How to store the wavelengths of the measurements, (configuration, profile)?”. For the technical viability, the intercomparisons will be pushed further in the coming months. Once both points are addressed, we are planning to ask ADMT26 and AST27 to accept the Ramses irradiances in the pilot phase.

Products

Introduction : 4D-BGC SCOR WG (Jon Sharp & Raphaelle Sauzede)

This presentation introduced the mission of the 4D-BGC SCOR Working Group 168, which aims to coordinate and make recommendations for the development of gridded four-dimensional data products from Biogeochemical-Argo observations. The WG's objective is to facilitate discussion and coordination among different scientific communities around developing, validating, and distributing 4D-BGC products from observational datasets, with a focus on the BGC-Argo array. The goal of this initiative is to significantly enhance access and utility of BGC-Argo observations through 4D-BGC products, and thus refine our understanding of ocean biogeochemistry, improve models and reanalysis products, and inform policy decisions. Key deliverables include an online product repository, a synthesis paper, and capacity-building tools to support ocean biogeochemistry research and climate change studies. The new BGC-Argo data product webpage was presented, along with the ongoing webinar series. The work of SCOR 4D-BGC WG has extended beyond its 21 members and people interested in joining the discussions of the group are welcomed.

Intercomparison DOXY (Jon Sharp)

This presentation described an ongoing effort led by Takamitsu Ito of Georgia Tech, and with international participation, to critically compare mapped data products of dissolved oxygen using observations collected by shipboard titrations, ship-deployed CTD, and Argo floats. The group's first objective is to have different research groups apply their mapping techniques to a common observational dataset and compare the results to identify discrepancies specific to the mapping approaches. Initial results indicate that depth-resolved global means from all mapping approaches considered generally agree within 1 micromole per kilogram; differences among mapping methods are generally larger than differences between slightly different input datasets; finally, some regional discrepancies in seasonality and decadal-scale changes are evident among mapping methods.

Contribution of 4D-BGC products to Argo data management (Raphaelle Sauzede)

This presentation highlighted the progressive integration of 4D-BGC products (developed using the SOCA method) into Argo data management. Since the publication of the SOCA method in 2016, successive milestones have included the operational release of SOCA-based BBP and Chla products via the Copernicus Marine Service used notably to release the yearly BBP audit since 2021, the development of SOCA-light used both for DM Chla correction, and the creation of a physiological ratio LUT for new RT adjustments. Most recently, SOCA has been used as a BGC-Argo emulator to support new quality evaluation workflows against in situ reference data.

In conclusion, SOCA-based 4D-BGC products have become a valuable asset for both scientific and operational applications, such as model initialization and data assimilation. Their use has significantly enhanced BGC-Argo data management by improving QC procedures, Chla estimates, and better understanding of bio-optical to biogeochemical relationships.

Benefit of BGC-Argo products to end-users : fisheries example (Mary Margaret Stoll)

This presentation described a project that leverages 4D, Argo-based data products of ocean biogeochemistry to develop seasonal species distribution models (SDMs) for an economically important migratory fish species. Models were developed to predict species presence from environmental predictors, and it was found that subsurface information can produce more accurate SDMs than surface information alone and that biogeochemical information can provide value to SDMs, especially in specific regions and seasons. This work emphasized an exciting use case for Argo-derived products that could provide significant added value to ecosystem and fisheries modelers.

Deep Argo Introduction and status (Nathalie/Virginie)

Deep Argo has become the main source of deep ocean temperature and salinity. This is an important milestone to share with funding agencies. Deep Argo-based literature is growing and has shifted from authorship led by PIs to colleagues outside the Deep Argo community.

Nathalie Zilberman and Virginie Thierry presented updates on the status of the Deep Argo array on behalf of the Deep Argo Mission Team. 224 Deep Argo floats are currently active, including 165 floats profiling to 6000-m, and 59 floats profiling to 4000-m. Although the need to implement Deep Argo is recognized at the international level, only 18% of the global Deep Argo array is funded. Supplemental support and additional national Deep Argo partners are urgently needed.

As of March 2025, there are ~90 Deep Argo float deployments planned for 2025. This yearly deployment rate is 28% higher than last year. Although the planned Deep Argo deployment rate of 2025 is encouraging, it is 3 times lower than the mission's objective of 266 deployments/year needed to implement the global 1,250 Deep Argo float array (when using an average Deep Argo float longevity of 4.7 years).

The change from "2" and "3" to "1" in Adjusted mode QC flags in Real Time is expected to increase visibility of the Deep Argo dataset among the scientific community (e.g. Ocean Predict and Satellite community). Deep Argo has started a 2-year transition that will consist of decreasing parking depth from near bottom levels to the recommended 1000-m value consistent with the Core and BGC missions, and deploying Deep Argo floats in unsampled deep-ocean regions.

Following the introduction, there was a discussion on how to expand the user base and there was a suggestion that global distribution would greatly increase the number of publications. Peter Oke also suggested that it might be helpful to ask operational centers if they would be willing to advocate for Deep Argo. There was a short discussion on how best to acknowledge Deep Argo and what is the value of citing Argo vs Deep Argo vs OneArgo. The BGC Argo community is trying to identify papers by their variable, but it was suggested to change the citation to 'OneArgo' rather than 'Argo'. This was not finalized, but the best recommendation to cite Deep Argo remains challenging.

Deep Argo implementation

National Report

US (Nathalie Zilbermann)

24 – 26 Deep Argo float deployments are planned in 2025 in the Atlantic, Indian and Southern Oceans. Technology development has continued and an article on the impact of compressibility on conductivity measurements from SBS Argo CTDs has been submitted to JTECH based on a collaboration between SeaBird, SIO and NIWA. Deployment of two SIO Deep SOLOs with a Keller pressure sensor are planned for late 2025. Testing of the SIO firmware to collect profiles

on ascent and descent is ongoing and a deployment planned for late 2025. The new antenna designed by IDG for Deep SOLO floats to increase float longevity under ice continues with plans for deployment in late 2025. As with all R&D work done by IDG, the results will be shared with MRV for implementation on MRV Deep SOLOs. Work is being done with UW, JAMSTEC and OSEAN to develop a 6000m MOBY float.

Australia (Esmee Van Wijk)

CSIRO has deployed 13 floats into the Australian Antarctic Basin since 2019.
Of these, 4 are still alive (one from 2019 and 3 from 2024). From our batch of 8 floats deployed in early 2024 we experienced 5 early failures. One float disappeared after 6 days with no information as to the cause. The float was not near ice. Another float disappeared after the first deep dive to 4000m, which may be a possible failure at high pressure? Two floats started to send intermittent bad pressure values (after 5 months and 11 months respectively). After sending an abort code of 2, the float does not leave the surface and no longer profiles. The last float was thought to have a hydraulic leak as the float had erratic behaviour in parking and profiling depths. This stabilised around profile 100 but then developed CTD profiling issues (dropped the upper portion of the CP, starting around 200 to 600m) before failing at profile 127.

We have 4 MRV Deep SOLO floats in the lab that we held over for deployment due to early failures of our last batch of floats. We hope to deploy these in late 2025/early 2026. We are talking with MRV and Seabird to further understand the issues. Two things might help to diagnose failures 1). Introducing a relative humidity sensor into the SBE61's. 2). Investigating the intermittent bad pressure issue and capturing more information to enable the differentiation of bad values from a non-response and then the subsequent interactions with CTD and float firmware.

We have an additional 8 floats on order due to arrive in the second half of 2025. We will likely deploy these in the Australian Antarctic Basin and work northwards to expand out and fill the gaps in the array. We are looking into the possibility of deployments in the waters surrounding the Kerguelen Plateau next season where few floats are currently deployed. Looking forward, we have additional funding for a further 4 floats (Antarctic grant) and 8 floats over the next 2 to 3 years.

Canada (Blair Greenan)

Ocean Networks Canada (ONC) purchased 18 NKE Deep ARVOR DO floats and started to deploy these floats in 2023. The focus has been on deploying in the NE Pacific (10 Active, 1 failed float), with an opportunistic deployment of two floats in the Southern Ocean (Drake Passage). These floats are currently the only deep float with DO sensors in the Northeast Pacific. To date, this pilot deep array has collected 469 profiles (near full depth in this region). One float failed in September 2024 with the cause unknown and one of the remaining active floats has a defective dissolved oxygen sensor. The maximum number of profiles reached with the floats so far is 70. Three of the remaining five floats are planned for deployment in the Northeast Pacific in May 2025

on the CCGS Laurier. The science questions being investigated include: interannual and long-term changes in deep ocean oxygen inventories and temperature, an “updated” volumetric estimate of low-oxygen water masses, and monitoring low oxygen events and variability in primary productivity in the NE Pacific using mass balance models. ONC is developing a research proposal that would support deployment of up to five floats per year over five years. We discussed a request from a researcher to park the floats deeper than the standard 1,000 m parking depth to study deep circulation in the northeast Pacific. The general consensus is that the floats should continue to park at the standard depth and if there is interest in studying the deep circulation that research funds should be sought to support that with additional Argo floats.

China (Zhaohui Chen)

In the Western Pacific, 30 floats (Xuanwu) were deployed between late 2024 and early 2025. Of these, 10 were deployed in the Kuroshio Extension region during late 2024, while 20 were deployed in early 2025. Unfortunately, 2 floats have failed: one due to a suspected water leakage and another due to a CTD malfunction. Currently, there are 30 active floats (28 newly deployed and 2 deployed in 2023). The parking stability of each float is generally good, except for two floats.

We have two upcoming cruises planned and will prepare 25 additional floats. Most of these will be deployed along the 150°E meridian, with some also positioned south of Japan and east of the Philippines. By the end of 2025, we anticipate having over 50 active floats in the Western Pacific.

Japan (Shigeki Hosoda)

As of April 2025, 9 deep Argo floats (Deep APEX and Deep NINJA models) are active, and 2 Deep NINJA floats were deployed in the Southern Ocean in 2024/2025. In the 9 active floats, WMOID:7900874 might be terminated, as over two years have passed since its last data transmission. For all deep Argo floats, salinity drift corrections are applied as needed using the OW method, following the optimal Cpcor correction for pressure dependence. The delayed-mode data (D-files) are scheduled to be submitted by this fall. Additionally, 8 to 10 new Deep NINJA floats equipped with RINKO AROD-FT oxygen sensors are planned for deployment. Current deployment plans are assigned as 6 Deep NINJA in the western North Pacific Ocean and 4 Deep NINJA in the Southern Ocean.

JAMSTEC is also planning a new 7-year mid-term research program starting around April 2026 (still under discussion), which will include further deep Argo float deployments to support the global deep Argo mission. Continued sensor and float development efforts are underway, including improvements to CTD sensors, RINKO and other biogeochemical sensors, Deep NINJA, and the MOBY floats. An experiment is also planned this summer to investigate pressure-dependent temperature bias in deep Argo CTD sensors, using both SBE61 and 41CP sensors, with reference to Uchida et al. (2008,JTECH).

France & EU (Virginie Thierry)

Europe

There are currently 4 operational floats (EuroSea project): 2 are approaching their end of life, 1 has been deployed in 2023 and 1 has been re-deployed in **June 2024.**

Future plans: 1 recovered float will be re-deployed once received after refurbishment (hopefully in 2026). The Euro-Argo ERIC is leading initiatives to develop advocacy towards the European Commission, in particular in the context of the Copernicus Programme: (1) Ongoing discussions between Euro-Argo office and key persons in the European Commission showing encouraging perspectives; (2) WG set-up to pursue this long-term effort collaboratively among Euro-Argo partners at political level (3) Euro-Argo office involved in a project funded by the European Environmental Agency, in charge of the in situ component of Copernicus (all domains); (4) Discussions with scientists in Monitoring and Forecasting Centres and Satellite agencies (ESA, EUMETSAT) – communication channels are being established.

France

As of today, 31 Deep-Arvor floats are active. In 2024, 19 floats were deployed and 12 Deep-Arvor-O2 floats were purchased. The paper Thierry et al., 2025 “Intercomparison of extended-depth SBE41CP, SBE61 and RBRargo|deep6k CTDs for Deep-Argo application using three and two-headed Deep-Arvor floats” (https://doi.org/10.1175/JTECH-D-24-0051.1) is now published in JTECH. In 2025, we expect to deploy 11 Deep-Arvor (5 in the Southern Ocean, 5 in the North-Atlantic and 1 in the East-Pacific near Costa-Rica). While we expect to purchase about 20 Deep floats/year (~10 Deep4k and ~10 Deep6k) over 2025-2027, there is no funding beyond 2028, yet. We are actively working to get more sustained funding for the French contribution to OneArgo. There is an ongoing analysis of the 2 Deep-Arvor floats equipped with 2 O2 sensors (Aanderaa and ARD-FT) and deployed in 2024 during the CROSSROAD cruise. Results will be presented at the next ADMT meeting (we need at least 1 year of data to evaluate corrections). As part of the Euro-Argo One project, we will revisit the Deep-Argo uncertainty analysis in North Atlantic and Nordic seas (Collab. with IMR, IEO-CSIC, BSH) to optimize float deployments.

Norway (Virginie Thierry on behalf of Kjell Arne Mork)

Since 2019, Argo-Norway has deployed 10 Deep Arvor floats (all with DO), 3 are still active. In 2025, there will be no deployment of deep floats, but 6 Deep Arvor+DO will be ordered and deployed in 2026. We do DMQC of deep floats and estimate new Cpcor values: 2 of 10 deployed deep floats had abrupt salinity drift (ASD).

Spain (Virginie Thierry on behalf of Alberto)

Since 2015, Argo-Spain deployed 3 Deep-Arvor floats. Argo Spain funds fully depend on Spanish Ministry of Science, Innovation, and Universities. If funds are sustained on time, Argo Spain plans to purchase at least 1 Deep Argo float per year. IEO-CSIC provides technical and logistical support to IFREMER in the development of Deep Argo floats and contributed to the publication Thierry et al. 2025.

As part of the Euro-Argo One project (1) IEO-CSIC will contribute to revisit the Deep-Argo uncertainty analysis in the North Atlantic and Nordic seas. (2) IEO-CSIC leads a task to implement an advanced recovery strategy of Argo floats, focused especially on BGC and Deep floats.

Italy (Virginie Thierry on behalf of Giulio Notarstefano)

Since 2016, Italy (through OGS) has deployed 10 Deep-Argo floats in the Mediterranean Sea (eight in the Hellenic Trench region and two in the Central Ionian Sea). Six of the deployments occurred on the western side of the Hellenic Trench (Ionian Sea), and two on the eastern side (Rhodes gyre).

Starting in 2023, the standard mission configuration includes a 10-day cycle and a very deep parking pressure, helping floats remain in the deeper parts of the basin and avoid drifting toward shallow waters or coastlines. As of April 2025, three Italian Deep-Argo floats are actively operating. A total of 529 deep profiles have been collected between 2016 and early 2025.

Although several failures occurred during the early phase of the Italian Deep-Argo initiative, deployments since 2019 have shown improved reliability. The overall success rate is around 50%, rising to 70% for floats deployed from 2019 onward (5 out of 7 floats have performed well or are still operating).

OGS receives annual national funding from the Italian Ministry of Research and University, mainly dedicated to core Argo activities, with a small portion allocated to Argo extensions. In 2022, the Ministry funded the ITINERIS project—a 2.5-year initiative to purchase 12 Deep-Argo floats. These, along with an additional float funded through the regular national contribution, will be deployed across deep Mediterranean areas between 2025 and 2028. The goal is to demonstrate the value of deep-ocean observations and secure long-term funding for the

Deep-Argo extension in the region.UK (Brian King)

5 Deep APEX were deployed in the Argentine Basin in January 2021 and three are still profiling 4+ years later with the data looking very good from the SBE61. The one MRV Deep SOLO is working well, but data flow at BODC needs to be fixed. UK continues to apply for additional funding for Deep Argo floats and in the meantime, assist PMEL by receiving and checking out their MRV Deep SOLOs en route for deployment in the South Atlantic via UK Research Vessels.

Long term funding (Nathalie Zilberman / Virginie Thierry)

Supplemental Deep Argo partners are urgently needed to accelerate the implementation of the global array. The scientific value of the Deep Argo dataset is limited by the dearth of floats currently active and wide regions that are not sampled.

Despite only 16% of the global array being implemented, Deep Argo has become the main source of deep ocean T/S data. This needs to be better communicated.

There is the potential for diversification of Deep Argo funding and applications such as the bathymetry detection and oxygen sensors on more deep floats.

It would be useful to promote case studies in poorly sampled regions – eg collaborative work with modeling and satellite communities.

It was suggested during discussion that it might be beneficial to identify science meetings where Deep Argo sessions could be requested, perhaps in partnership with GO-SHIP or other communities that rely on Deep Argo data. The purpose of these would be to spread the message that the Deep Argo float technology is ready, there are already significant amounts of science-ready data being delivered to the community and the Deep Argo Mission is moving to a more operational mode.

Action 18: BGC Mission Team in collaboration with Deep Mission Team to articulate the cost and identify the benefits of including oxygen on all Deep floats. **Who**: BGC and Deep Mission co-chairs

Action 19: Identify scientific conferences to target for holding science sessions on Deep Argo to emphasize the technological readiness and live data stream of the mission. Could ask early adopters to come and advocate for Deep Argo. Ocean Sciences, AGU, EGU. Report to AST Exec. **Who**: Deep Argo Mission co-chairs

Deep sensors including Q&A w/ manufacturers

SBE61 and SBS61 (Nathalie Zilberman)

Nathalie Zilberman presented collaborative work with Dave Murphy, Robert Ellison, Jeff Sherman, Kyle Grindley, Jochen Klinke, and Charlie Branham on performance assessment of a new pressure sensor model integrated on the Deep Argo SBE61 CTD in the field. The SBE61 has a Kistler pressure sensor, while the SBS61 will have a Keller pressure sensor.

NOPP Deep Argo floats deployed in 2021, 2022 and 2023 provided instrumental results on the capacity of Keller sensor prototypes to advance pressure accuracy to within 1-2 dbar of standalone Quartzdyne measurements and reduce drift at deep parking pressure (> 3000 dbar). The leakage issue on the NOPP Deep SOLO floats is now well understood by SeaBird. Keller was able to reproduce in the lab the drift observed at high pressure in the field, and increased pressure accuracy to 0.01% FS (0.6 dbar @ 6000 dbar). SIO will deploy 2 Deep SOLO floats with SBE61 CTDs equipped with new Keller prototype (instead of Kistler) and standalone Quartzdyne sensor November 2025. In 2025 and 2026, SIO and Sea-Bird Scientific will continue the evaluation of the Keller sensor performance based on Quartzdyne comparisons collected from the Deep SOLO floats.

Action 20: Form a working group to model the pressure dependence of biases in the (Kistler) sensors to see if a bias correction scheme can be found. **Who**: Nathalie Zilberman, John Gilson, Sarah Purkey, Pelle Robbins, Virginie Thierry

RBR CTD and DO (Matt Dever, RBR)

The presentation provided a high-level review of the status of characterization of both the RBR*coda* T.ODO optode and the RBR*argo*|deep6k. All 6 important characteristics for an ocean oxygen optode have been studied and documented: Accuracy, compressibility, response-time, dynamic response, stability, and field validation. A manuscript was submitted to *Methods* in February 2025, and another manuscript describing the calibration and performance of the RBR*coda* T.ODO is in preparation. Additional work on better characterizing the compressibility of the optode is planned for the summer of 2025.

The same criteria were explored for the RBR*argo*|deep6k, highlighting the parallels in the analysis and methods with the RBR*argo*|2k CTD. The performance of the RBR*argo*|deep6k has been studied and documented in a recent paper published by Dever et. al.
Based on the progress so far, both instruments seem to correspond to the “pilot phase” requirements of the newly developed framework for sensor acceptance.

In the discussion, there was a push from the AST to test this sensor more either through integration onto floats or other platforms since a full depth 1 - 2db resolution profile would be beneficial.

Rinko DO (Kanako Sato)

The presentation provides the current performance of AROD-FT, which is an optical dissolved oxygen sensor for Deep float, and which was developed by JFE Advantech in collaboration with JAMSTEC. 14 deep floats with AROD-FT were deployed since 2017 in the North Pacific and the Southern Ocean. As a result of analyzing their data, their storage drift was found to be -4.96±2.10 micro mol/kg. The temporal drift of AROD-FT at depths deeper than 2500 immediately after float deployment was found. According to the result of the analysis, candidates for them are the number of cycles and magnitudes of pressure, temperature, and DOXY. It is the next step to identify the factors of them. JAMSTEC will deploy 10 DeepNINJAs with AROD-FT in this fiscal year. We continue to monitor and evaluate the performance of AROD-FT, in particular, the long term temporal drift of AROD-FT as well as the temporal drift at deep layer immediately after float deployment.

Deep Argo updates

New 6000-m Deep Argo float (Corentin Renaut)

This presentation introduces the Deep-6000 profiling float, a collaborative effort between Ifremer and NKE. The float is designed to operate at depths up to 6000 dbar, covering 99% of the ocean's area, and is capable of up to 250 cycles with a weight of 41 kg. The development timeline, from 2021 to 2025, includes key milestones such as prototype testing, industrialization contracts, and the qualification of composite housing and hydraulic systems. The float performs Argo-type

profiles during ascent, featuring continuous pumping and spot sampling capabilities, and offers high configuration flexibility for alternate depths. It integrates Iridium and Rudics communication systems and can accommodate up to four external sensors. The presentation emphasizes ongoing development and potential enhancements, with future plans aimed at further improving its capabilities.

In the discussion, the AST was excited to see another 6000db Deep Argo float coming to market.

Deep Argo KPIs and Deep density maps (Victor Turpin)

Victor presented maps produced annually, monthly and ad hoc that are of interest to the Deep Argo community. There are Deep design maps, density and projected density maps, and coverage maps. One ad hoc map produced recently showed the launch location of the 840 floats deployed on GO-SHIP lines from January 2012 to January 2023. Victor also showed a line plot with the number of Deep Argo profiles and GO-SHIP T/S profiles starting in 2000. There are plans to improve this plot and add it to the AST website. If anyone needs a map that is not currently regularly produced, please speak to OceanOPS.

Action 21: Update the map of float deployments from GO-SHIP yearly and include it on the OceanOPS static map page. **Who**: Victor, Orens

Action 22: Produce a comparison time series of the number of ship-based vs Argo profiles collected annually - from CORA or WOD. Deep, BGC (oxygen/nitrate), Polar, and core Argo. **Who**: Victor, Deep & BGC Mission co-chairs, Christine Coatanoan, Megan Scanderbeg

Action 23: Produce a new edition of 'OneArgo Databytes' focused on Deep Argo topics. **Who**: Megan Scanderbeg, Deep Mission co-chairs, Fiona Carse

Deep Argo science talks

Deep Argo Data Reduce Uncertainty and Increase Spatial Resolution of Decadal Deep and Abyssal Ocean Temperature Trends (Greg Johnson from PMEL)

This talk presented new, better spatially resolved global maps of decadal and multidecadal deep (2000-4000 dbar) and abyssal (4000-6000 dbar) ocean temperature trends using historical shipboard and Deep Argo data collected from 1970 to 2024 (see https://doi.org/10.1029/2024GL111229). The maps showed the now familiar pattern of strongest abyssal and deep warming in the Southern Ocean, around Antarctica, with weaker abyssal warming rates apparent in the western South Atlantic, the Pacific, and much of the Indian Ocean. However, detailed features like the western intensification of abyssal warming trends in the

Southwest Pacific Basin and the warming on the western flank of the Mid-Atlantic Ridge in the tropical North Atlantic, both consistent with a slowdown in Antarctic Bottom Water northward transport, were apparent. Furthermore, the global integral of these estimates yields a heat gain of 36 (±8) TW, where the 5-95% uncertainties were about half of those from an updated estimate using repeat hydrographic section data only. Both the increased detail and the reduced uncertainties were facilitated by the inclusion of Deep Argo data in the analysis.

Deep Argo Observations in the Fracture Zones of the Southwest Indian Ridge (Viviane de Menezes)

Deep Argo bathymetry product (Nathalie Zilberman and Megan Scanderbeg)

Nathalie Zilberman presented results on the scientific value of Deep Argo to measure ocean bathymetry. This work was made in collaboration with Megan Scanderbeg, Kevin Balem, Thierry Schmitt, Pauline Weatherall, Virginie Thierry, Esmee Van Wijk, and David Sandwell. Estimated vertical accuracy of Deep Argo bathymetry (based on the pressure performance of the CTD sensor and distance between the pressure sensor and seafloor upon bathymetry detection) is 4.3-4.4 m at 4000-6000 m depth; this is better than nominal sounding accuracy of 0.2% depth (8-12 m at 4000-6000 m). Spatial uncertainty of Deep Argo-derived ocean bathymetry inferred from horizontal float displacement between bathymetry detection and GPS positioning at the surface, is typically < 1.5 km, about 10 times better than satellite-derived data. Integration of ocean depths collected from Deep Argo floats over the last 11 years generates 50-200-m range improvement in the GEBCO grid in regions where Deep Argo observations are available. On average, 66% of Deep Argo profiles collected between 2014-2024 encounter the seafloor and report bathymetry measurements. The amount of Deep Argo data reaching the seafloor can be increased by setting maximum profiling pressure to exceed the maximum expected depth on a larger number of floats. Once fully implemented, Deep Argo could accumulate 30,000 bathymetry measurements per year.

Deep Argo data management (Virginie Thierry and Cecile Cabanes)

As of April 2025, 482 active and non-active deep floats have generated 55,805 profiles managed by 7 DACs: AOML, BODC, Coriolis, CSIO, CSIRO, JMA, and MEDS. 88% of the salinity profiles are corrected using a new CPcor value (either in A mode or D mode).

The real time procedures for Deep Argo data has been changed (see last version of the Argo QC Manual released the February, 20 2025) with new QC flags (see table) and, based on SBS recommendation, a new default Cpcor value to be used in RT and DM unless an optimized has been provided by the PI. The default value is now −11.7e−8 $dbar^{-1}$ for both SBE61 and Deep SBE-41CP.

RAW DATA ('R' MODE)	**ADJUSTED DATA ('A' MODE) (after CPCOR adjustment)**
> 2000 dbar	
PRES_QC = '~~2~~ 1'	PRES_ADJUSTED_QC = '~~2~~ 1'
TEMP_QC = '~~2~~ 1'	TEMP_ADJUSTED_QC = '~~2~~ 1'
PSAL_QC = '3'	PSAL_ADJUSTED_QC = '~~2~~ 1'
~~Do not distribute raw data on GTS.~~ Distribute raw data on GTS if real-time adjusted data are not available.	Distribute real-time adjusted data on GTS if available.
<= 2000 dbar	
PRES_QC = '1'	PRES_ADJUSTED_QC = '1'
TEMP_QC = '1'	TEMP_ADJUSTED_QC = '1'
PSAL_QC = '1'	PSAL_ADJUSTED_QC = '1'
Distribute raw data on GTS if real-time adjusted data are not available.	Distribute real-time adjusted data on GTS if available.

Transition from regional pilot array to global implementation (Nathalie Zilberman)

Nathalie made three recommendations to transition from regional pilot arrays to global implementation in order to significantly increase the scientific value of the Deep Argo array. The recommendations are as follows:

- Park at 1000m (goal to accomplish full transition over the next 2 years)
- Prioritize deployments in unsampled regions (starting in 2025)
- Priority for SIO to complete testing of new Deep SOLO firmware and share R&D work with MRV (objective to finalize the firmware by 2026 and share with MRV when finalized)

These recommendations were accepted with the understanding that many floats currently deployed may not be able to immediately switch to parking at 1000m.

Polar Argo Mission

Polar Argo Introduction and Status

The Polar Argo Mission Team is the newest mission in Argo, starting in 2023. Nicolas Kolodziejczyk from France and Esmee van Wijk from Australia are the co-chairs. Our membership has grown in the past two years to 38 members from 16 countries.

The terms of reference are available online:

https://argo.ucsd.edu/expansion/polar-argo/

The group meets every 3-4 months for ~1.5 hrs to discuss technical and scientific topics including the ice avoidance algorithm, float performance issues, mission parameters etc. There is a dedicated science talk at each meeting with a guest speaker. We also discuss implementation issues such as deployment opportunities, monitoring, Polar Argo design, and best practices for deployments.

In the northern polar latitudes, there are 79 active floats in the OceanOPS defined 'Arctic' basin and 128 if all floats north of 60N are included. The array has grown over time since the first deployments in the early 2000's and currently around 15 floats per year are deployed.

In the Southern Ocean there are 268 floats active in the Southern Ocean basin as defined by OceanOPS and 273 active if you include all floats beyond 60S. Deployments have grown over time and are now between 40-45 per year. The Southern Ocean remains under-sampled (see OceanOPS Density/Age map).

We are looking at target densities in the arrays compared to global core Argo (at 95%). Density is defined as the number of grid elements of the design that meet or exceed the target of operational floats in each cell (%). The Arctic is sitting at 90% and the Southern Ocean at 84%. Note for the Southern Ocean the seasonal cycle is evident with more floats returning in summer (peaks) and less floats telemetering in winter (troughs). For monitoring the array, we need to look at the upper part of that curve (i.e. peaks) when most floats have returned from beneath ice. The trend in both basins has been upwards. That said, the Southern Ocean is still the least well-sampled region in the global oceans. Activity (number of operational floats in the design grid) is 114% in the Arctic but the caveat there is that the OceanOPS grid for the Arctic currently excludes the ice covered interior and the Beaufort, Barents and Chukchi Seas. In the Southern Ocean we're at around 71%.

The average age at failure for floats is around 4-5 years for Southern Ocean floats and 4 years for Arctic floats, now about equivalent to core Argo. (Note this metric is likely conservative as it doesn't account for the potentially long-lived floats deployed in recent years).

Polar Argo Implementation - Polar Argo National Reports

Australia

In 2024/2025 Australia deployed 13 floats south of 60S (2 BGC, 2 open ocean core and 9 Antarctic shelf floats). For the 9 Antarctic shelf floats (3 of which were funded by a non-Argo ARC grant), 4 have optodes and 4 have ice guards. Deployment plans for 2025/2026 include 9 core floats south of 60S (open ocean), aiming for the region around the Kerguelen Plateau which is under-sampled. We will also deploy 4 Antarctic shelf floats and between 8 to 12 Deep Argo floats.

We value the international cooperation and collaboration from our Japanese and German colleagues who have helped us to deploy floats from their vessels in the last year. In turn, Australia is providing RT and DM support to NZ for their floats in the Ross Sea, and we have helped to coordinate deployments from the RV Nuyina and RV Investigator for our Italian, German, UK and US colleagues. This international collaboration and willingness to help each other is a strength of the international Argo program.

Canada

In 2024, 2 core ARVORs were deployed in the Beaufort Sea (4902565, 4902558, Sept 2024). One float (4902565) failed at deployment and we never heard back from it. Then, 2 deep ARVORs with DOXY sensors have been deployed in Drake passage. WMOs 4902639, 4902639. (Ocean Networks Canada should be credited as they purchase/manage these floats in collaboration with DFO/MEDS).

In 2025, 2 core ARVORs were deployed in Ross Sea (Collaboration with NZ “Antarctic Sea-Ice Switch project). WMOs 4902698, 4902704. 2 core ARVORs were deployed in Drake passage (WMOs 4902694, 4902703). 2 core ARVORs (1 SBE and 1 RBR) are planned for deployment in the Beaufort in September.

In 2026, Canada is looking ahead to a similar NZ collaboration for Ross Sea deployments around February 2026. This time 2 core APEX floats are planned to be deployed (1 with SBE CTD, 1 with RBR).

Finland

In the Arctic Ocean, the deployment historically concentrates on the Barents Sea: latest deployments in Winter 2022 and floats presumed lost since then. Future deployments will depend on funding. Finland also operates in the Baltic Sea which has seasonal ice cover. The Bothnian Bay, the Northern part of the Baltic Sea, is used as a test bed for ISA systems. Finland has plans to keep at least one float active in the area constantly throughout 2024-2025. The area is guaranteed to be ice free in summer, so float recovery is more likely. Both Teledyne’s APEX and

NKE's Arvor type of floats in icy conditions will also be tested. Finland will contribute to the Euro-Argo ONE project for consolidation of Argo in the Marginal Seas and the Arctic.

France

France contributes to deployments in both hemispheres.

In the Southern Ocean, France deployed floats in cooperation with Germany (AWI), Australia (CSIRO) and Italy (OGS), in the context of the EURECCA-ASFAR project (PI: J.B. Sallée). The focal element of EURECCA-ASFAR's fieldwork is the Antarctic continental shelf. The experiments are divided into two main components: in the Weddell Sea: Ocean heat transport towards the continental shelf and in ice shelf cavities; In the Ross Sea**:** Production of dense water on the continental shelf and its export down the continental slope to form Antarctic Bottom Water. In January 2025, 5 Arvor core floats were deployed by PolarStern (PS146) in the Weddell Sea. In February 2025, 5 Arvor TSO2 floats were deployed by the Laura Bassi (XL) from ASFAR frame. In January 2024, 5 Deep Arvor floats were deployed from Investigator (IN2024).

In the Arctic Ocean, France has deployed since 2019 in the Arctic Ocean, Baffin Bay and Nordic Seas. In the context of ARcticGO and MAD-Strat project, 10 Core floats have been deployed between 2021-2023 in the Nansen Basin. 2 Core floats will be deployed in 2025 in the Nansen Basin in cooperation with Germany (AWI, PS149). The float 6903119 deployed at the North Pole in 2021, has drifted out of the ice pack in 2023 through the Fram Strait collecting more than 120 profiles under the ice.

Germany

Germany contributes to deployments in both hemispheres.

In the Southern Ocean, Germany has deployed floats in the framework of OCEAN:ICE, VERTEXSO, Denman Glacier Initiative 2025, in cooperation with BSH and AWI, NPI and CSIRO. In January-February 2025 core floats were deployed in the Weddell Sea with a bottom parking mode mission to ease the post-processing for under ice profile positioning.

In January 2024 4 core floats were deployed in the Amery ice shelf region in grounding mode on the PS140 as part of the EU project OCEAN:ICE. The Amery shelf includes regions of major dense water formation.

In Cooperation with NPI in King Haakon VII sea**,** 6 BGC-Argo floats have been deployed from NPI-ships in the Southern Ocean in January 2024 and 2025. The floats drift in the sea ice zone (2024) and the sub-Antarctic (2025) of the Weddell Gyre where they provide critical data on phytoplankton blooms and biological carbon export.

In the Denman Glacier region, the international Denman Glacier Initiative 2025 project (Australia, UK, Germany, Italy…), core floats have been deployed to monitor enhanced melt and an

important outlet glacier of the Shackleton Ice Shelf, which could contribute up to 1.5 m to the global sea level rise.

In the Arctic Ocean, the cooperation between AWI and BSH contributes a yearly minimum of 2 floats deployed on ArcWatch cruises since 2020. Early deployments occurred along the continental margin north of Svalbard, then in 2023 and 2024 to direct seeding in the Eastern Eurasian Basin.

Italy

In February 2025, Italy (OGS) deployed floats on the Ross Sea Shelf: 7 TS-DO and 1 TS in the framework of the GLOB project. Italy operates the maintenance and relocation of 3 TS and 1 TS-D. The fleet is completed by two TS that were released in February 2024 and are still active in the area.
The plan for 2026 is deployments in the Ross Sea: 1 TS-DO in the framework of the IOPPIERS (Ice-Ocean Past and Present Interactions in the Eastern Ross Sea) Project; and 4 TS-DO and 1 BGC in the context of the MORSea (Marine Observatory in the Ross Sea). In the Southern Ocean, in the Atlantic Sector, 3 TS-DO will be deployed in the framework of the ACCESS (Antarctic Circumpolar Current Eddies Survey and Simulations) Project.

Japan

In 2024/25, Japan (JAMSTEC) deployed 1 BGC float (120°E) and 2 Deep floats (120°E & 125°E) floats by TR/V *Umitaka-maru* (Red). In 2025/26, Japan plans to deploy : 2 Deep floats from TR/V *Umitaka-maru* (along 110°E) and 2 Deep and 1 core floats by Icebreaker *Shirase* (TBD). On the *Shirase* cruise, Japan is coordinating deployment of 7 BGC floats (max.) from the GO-BGC project (PI: Dr. Talley, SIO).

New Zealand

New Zealand's areas of preferential deployments are essentially (but not exclusively) the South Pacific, Tasman Sea, the Southern Ocean and the Ross Sea including the shallow (600 m) continental shelf. The data management for NZ floats currently relies on our international collaborators in the US (J. Gilson @SIO) and Australia (C. Schallenberg; Esmee van Wijk @CSIRO).

The funding request will be through the New Zealand Antarctic Science Platform (ASP). ASP funded 2 BGC floats and 1 core float deployed in February 2025 during RV Tangaroa voyage to the Ross Sea.

1 core-Argo float and 2 Biogeochemical-Argo floats will be applied for every 1 to 2 years to be deployed south of 60°S, preferentially in the Ross Sea. Future deployments depend on confirmation of funding but likely will occur on transit and on Ross Sea shelf during RV Tangaroa voyage in Jan-Feb 2027.

Norway

In 2024, Norway deployed 6 Argo floats: 4 BGC PROVOR floats in the Nordic Seas and 2 core ARVOR floats north of Svalbard. In 2025, Norway has so far deployed 4 floats (1 BGC PROVOR and 3 core ARVOR) in the Nordic Seas. Norway now has ~35 operative floats in the Polar region.

The plan for 2026 is to deploy a minimum of 14 floats: 6 Deep Arvor, 4 BGC PROVOR, and 4 core ARVOR floats. The focus area for deployments will be in the Nordic Seas.

Poland

Since 2009, 2-3 Argo floats are deployed yearly by the Institute of Oceanology Polish Academy of Sciences (IOPAN) in the Greenland and Norwegian seas during the IOPAN annual AREX cruise in the Arctic. 3 floats were deployed in 2024 (2 Core and 1 BGC) along 75°N section in eastern Nordic Sea, i.e. two in the Atlantic inflow and one in the recirculating branch in the Greenland Gyre. Since 2023, additional experiments have taken place in the summer with Argo floats in the Arctic fjord Hornsund (Svalbard).

Polish activities under EuroArgo are funded by the ArgoPoland program – national infrastructure funding scheme extended for the second period 2022-2026. Commitments for 2023/2024/2025, are annual deployment of 2 Arvor floats with CTD and O2 sensors and ISA in the eastern Norwegian/Greenland Sea and one experimental float for Horsund.

UK

From the 1st Jan 2024 to the 31st March 2025, the UK has deployed 14 floats below 60°S : 10 NKE floats + 4 ALAMO floats deployed as follows : 1 BGC PROVOR, 9 core (2 APEX, 7 ARVOR), 4 ALAMO.

The UK plans to deploy 15 regular Argo and 1-4 ALAMO floats by the end of March 2026 : in November 2025 in Drake Passage from RV Sir David Attenborough (passage leg southbound) : 1 core APEX-SBE and 4 core ARVOR-I. Between November 2025 and February 2026, from Science cruises to Southern Ocean (SE Pacific and SW Atlantic sectors, details TBC), from RV Sir David Attenborough : 8 core ARVOR-I ; and between January and February 2026, in the Amundsen Sea, from RVIB Araon :2 ARVOR-I and 1-4 ALAMO.

USA

In 2024, 4 floats (2 ALTO/RBR & 2 ALAMO/SBE) were deployed in the Beaufort Gyre from R/V Sikuliaq: 3 are working well before ice-over and 1 had a very noisy SBE CTD.
Work on improving the ice avoidance autonomy on ALTO floats continues. We use updated ice avoidance parameters from a machine-learning model. The chosen threshold is -0.5°C over a range of 30-10 dbar.

In fall 2025, 4 RBR ALTO floats will be deployed in the Beaufort Gyre.

Funding has been received from NOAA to deploy biogeochemical floats (possibly equipped with the Low-Power Detector) in the Beaufort Gyre 4 ALTO/RBR with oxygen to be deployed in fall 2026.

Engineering work has yet to begin to integrate the WHOI Acoustic Communications Group's Low-Power Detector into the commercial ALTO float platform from MRV (still awaiting funding from ONR to do the engineering work). The Low-Power Detector listens for acoustic transmissions from ice buoys that are part of the ONR-sponsored Arctic Mobile Observing System.

Polar Argo Design

An early draft of the re-design of the Polar Argo array was presented to the AST by the Polar Argo mission co-chairs to ensure we received feedback and guidance on the extensions and design considerations at the beginning of the process. We discussed appropriate grid cell size, either 3 x 3 degrees, or 3 deg latitude and 150 km in longitude in relation to the decreasing scales of motion as you move towards the high latitudes. Other design considerations include depth threshold for inclusion to the grid, sea ice boundaries and masks, and how to deal with cells that overlap with sea ice and land.

There was a robust discussion of the draft design, particularly of the extension to the shallow Arctic basins and surrounding seas and to the Antarctic continental shelf, particularly, in the context of EEZ considerations and overall balance of floats in the array. Many questions and points were raised that must be considered further. It was noted that this was the first of many discussions to come and that it would be discussed first at the bi-monthly AST exec meetings with a view to reporting back and requesting feedback from the broader Argo community.

Main comments:

- Need to consider the implications of an extension to the shallow polar seas for the core program and seek feedback around potential EEZ issues
- Would an extension to the shallow polar seas risk diverting resources from core Argo?
- Questions around data quality and DMQC (Polar Argo mission to investigate and report back)
- Can float models be re-programmed to the core mission if floats drift out into the open ocean (Yes, for main float models deployed so far, i.e. Arvor and APEX. ALAMO floats are restricted to sampling depths of ~1250 dbar but to date, only a handful have been deployed).

Design questions to consider:

- Appropriate grid cell size? Either 3 x 3 degrees in latitude and longitude or 3 degrees in latitude and ~150 km in longitude.
- Which ice boundaries to use for exclusion (fast ice, ice shelf mask, multiyear ice, sea ice concentration threshold (25%, 50%?)
- How to deal with partial cells (overlap with land and sea ice)

- Extension to the continental shelf of Antarctica
    - Depth criteria for inclusion/exclusion
- Extension to the ice-covered Arctic basins and shallow seas
    - Depth thresholds for inclusion/exclusion, set distance from the coast, or overall targets by basin instead of grid cells?

The Polar Argo Mission team will prepare a document to guide feedback and circulate this to AST members. In the meantime, we welcome feedback from the AST on any of the points raised above, or other considerations. The feedback received will be discussed further at the AST exec meetings to determine the next steps. Please send your feedback to Megan Scanderbeg and the co-chairs of the Polar Argo Mission Team (Nicolas Kolodziejczyk and Esmee Van Wijk).

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Action 24: In reporting floats deployed into Polar oceans, separate out floats deployed in open ocean vs floats on shelf/shelf break to track deployment trends. It would also be helpful to track where the floats end up. **Who**: Polar Mission Team

Action 25: AST and Polar Mission members to give feedback on the draft Polar Argo Mission design presented at AST-26, and the associated proposal of on shelf coverage. Feedback to be sent to Polar Mission co-chairs and Megan Scanderbeg. **Who**: AST and Polar Mission Team

Action 26: AST exec to synthesize feedback on Polar Mission design and discuss next steps with Polar Mission Team. **Who**: AST exec

Best practice paper update

A best Practice Document is being drafted. It will be a follow on of the Morris et al. 2024ab (Core BP) and Bittig et al., 2019 (BGC BP). The document will include types of Polar Argo Floats, mission configurations recommendations (sampling, ice algorithm setting, …), recommendation on handling floats and deployment recommendations, and data management recommendation. A first draft will circulate before the next AST.

Action 27: Ask Polar AMT to develop a Best Practices document for polar Argo float deployments and link to Float Deployment webpage on AST website. **Who**: Polar Argo Mission co-chairs.

Other : projects, presentations at conferences (Arctic summit, OOS UNOC, ...)

Polar Argo will interact with Euro-Argo One (Kick off meeting on 17-19 Feb. 2025, Paris, France) in the Arctic task to consolidate Polar Argo design and implementation. An Argo Arctic Workshop will take place in June 2026 in the framework of the EA One.

PAMT has been/will be presented :

- oral presentation ASSW2025, 20-28 Mar. 2025, Boulder, Colorado
- poster presentation OOS2025 (pre-UNOC), 3-6 Jun. 2025, Nice, France
- oral presentation EGU2025, 27Apr.-2May/2025, Vienna, Austria

Polar Argo in the field

SOCCOM (Alison Gray/Steve Riser/Tanya Maurer)

In the US, the Southern Ocean Carbon and Climate Observations and Modeling Program (SOCCOM) has recently been renewed for another 3 years. The goal of the program since its inception in 2015 has been to maintain an array of 180-200 BGC floats in the Southern Ocean, with many of them operating under the seasonal Antarctic sea ice cover and to analyze the data from these observations. In recent years the number of funded floats has declined, with the present array consisting of 147 operating floats. During the most recent ice season (March 2024-January 2025) we collected 480 under-ice profiles from 25 floats. Since the beginning of SOCCOM, 10616 BGC profiles from under the ice have been collected. Most of these profiles are from 5-sensor floats (CTD plus oxygen, nitrate, pH, chlorophyll fluorescence, and backscatter), though in the past year we have been deploying a few 6-sensor floats (OCR as the 6th sensor). This is likely to become the default configuration in the future. In 2023 we deployed 5 floats in shallow water on the Ross Sea shelf; 4 of those floats survived for one year but only one survived for a second year. A paper describing the results of the Ross Shelf deployments recently was published (Cao et al., 2024, Deep-Sea Research, DOI:10.1016/j.dsr2.2024.105436). We are presently discussing whether or not to carry out more deployments on the Antarctic shelf in the future.

Southern Ocean (Esmee van Wijk)

A series of talks were presented covering the breadth of the work that is being done by national members in the Polar Argo program.

Southern Ocean Science Highlights:

- A new Southern Ocean Climatology by Yamazaki et al. 2025,JGR Oceans, DOI: 10.1029/2024JC020920. The impact of the under-ice Argo data in the seasonal ice zone is most apparent in the winter months with a 1C change in Jun and Sep temperature at 100m depth in the subpolar zone and a decrease in the interpolation error by 1C.

- Douglas et al. 2024 Ocean Science https://doi.org/10.5194/os-20-475-2024 uses BGC-Argo data to check how much chlorophyll *a* (and particulate organic carbon, POC) the satellite misses in the sea ice zone. Missing this data affects satellite estimates of productivity (NPP) in the sea ice region (which use chlorophyll *a* or similar variables as input).
- Sallée et al., 2024 Ocean Science, https://doi.org/10.5194/os-20-1267-2024 deployed 7 acoustically-tracked floats in the Weddell Sea, providing year-round hydrography and circulation and showing Ice Shelf Water blocks modified Warm Deep Water access to the Filchner Ice Shelf cavity.
- Hancock et al. 2025 JGR Oceans, DOI: 10.1029/2024JC021393 studied an acoustically tracked float trapped in an anticyclonic eddy that spun down under the Stancomb-Wills Ice Tongue, entraining warmer, saltier water to the ice shelf base.
- Falco et al. 2024 *Nat* Comms, https://doi.org/10.1038/s41467-024-54751-8 deployed floats near the Ross Ice Shelf providing estimates of high salinity shelf water, ocean heat content and basal melt rates from the float data.
- Girton et al. 2019, DOI: 10.23919/OCEANS40490.2019.8962744 deployed acoustically-tracked floats near the Dotson Ice Shelf obtaining a dataset of bathymetry, ice shelf draft, halocline temperature and depth from within the ice shelf cavity. High-latitude velocity data from EM-APEX floats is potentially impacted by solar geomagnetic storms in the Southern Ocean with a correlation seen between the power spectra of EM-APEX east velocity and east magnetic field data derived from closest magnetometer station.

ARcticGO (Nicolas Kolodziejczyk)

Arctic basins undergo rapid change and warming, leading to dramatic loss of sea ice especially during summer. The Arctic is interesting as a more seasonal sea ice regime, which enhances the seasonal freshwater cycle and changes the ocean circulation and sea-ice-atmosphere interactions.

Feasibility of better observing the seasonal and marginal ice zone (MIZ) from Argo floats, as well using Argo floats under permanent sea ice pack, has been tested in the ARcticGO project (2021-2023). 10 floats have been deployed in the Nansen Basin : 4 at the North Pole and 6 in the MIZ, north of the Svalbard. Of the 4 floats deployed at the North Pole, 2 have sent back profiles and 1 has drifted under the ice pack to the Fram strait, collecting under ice profiles for 3 years. Model simulations using VirtualFleet software have been undertaken to determine the optimal parking depth to favor the optimal cycling and drift velocity out the ice pack. From floats deployed in the MIZ, floats have drifted along the Eurasian continental slope up to the eastern Eurasian basin, off to the Eastern Siberian Sea. Floats with an ISA turned off have been allowed to send more profiles and GPS fix even during winter in regions with lower ice concentrations.

Scientific work has started with these first Argo observations, including also the floats deployed by the European community (and thanks!) in the Nansen Basin, to document the Near Surface Temperature Maximum (NSTM). NSTM are near surface inversions of temperature profiles under a sharp halocline formed during the melting season, mainly in the MIZ. They allow storing an

amount of heat in the subsurface that can play a role in modulating the sea-ice interaction. The NSTM seems to be ubiquitous over the Arctic Basin but has never been documented in the Eurasian Basin.

Acoustic floats (Craig Lee)

Presentation of under ice acoustic positioning and communication experiments for glider and Argo floats in the Beaufort Gyre. 2 Scripps SOLO acoustic floats Argo floats have been successfully deployed in 2024 with under ice positioned profile from acoustic system. Plans for future 12-14 floats to be deployed in 2026/2027 have been presented.

Float updates

Core floats

SOLO-II (N. Zilberman)

Nathalie Zilberman presented an assessment of SOLO-II float performance. S2As from MRV and SOLO-IIs from Scripps represent ~25% of the Argo array. Out of 1036 active floats, 595 (57%) are SOLO-IIs and 441 (43%) are S2As. The average SOLO-II float-related failure rate is 10% between 2017-2024. Highest failure value occurred in 2021 (30%) due to a bad antenna batch from MRV. Some cases of flooding and unexplained failure have been detected since 2019: 2019 (2%,2%), 2020 (4%,4%) & 2021 (3%,1%), 2022 (2%,6%). Scripps has implemented additional leak tests. The failure rate of the SBE41 CTD averaged between 2017-2019 (~6%) has been reduced to 2% or less since 2020. The average combined float and SBE-41 failure rate is 13% for SOLO II over the past 8 years. To conclude, SOLO-II shows great performance with a small (13%) overall (sum of float and CTD) early failure rate over the past 8 years. Scripps is investigating cases of flooding in collaboration with Sea-Bird Scientific. A new antenna design (IDG/Maxtena) is under testing in the field to reduce cases of float failure.

Arvor (Corentin Renaut)

This presentation provides an update on the 2024 deployments and survival rates over the past 7 years. It details the new developments made by NKE, including a new hardware board that features a new graphical user interface for configuration. The presentation also highlights the latest issues with Arvor, and the solutions provided by NKE to address them, such as Arvor with RBR running out of batteries prematurely and reset-offset issues at the surface. It concludes with an analysis of the ending causes for Arvor deployments in 2024.

ALTO (Steve Jayne)

The MRV ALTO float continues to be developed and tested. New stable firmware has been tested that improves the ice avoidance algorithm. However, inconsistent production quality has been an

issue and has resulted in slow throughput in our float checkout process which delays the deployment of floats with RBR CTDs. Development work continues on a BGC version of the ALTO float equipped with RBR sensors.

MRV S2A (Pelle Robbins)

The MRV S2-A continues to be an essential core platform for both WHOI and PMEL. There have now been 900 S2-A floats deployed for the Argo program, starting in 2011. Of these, half (450) are active and currently make up about 11% of the global Argo fleet. Improved battery technologies are leading to longer float lifetimes, but the impacts of pandemic are still being manifested in sporadic problems associated with build quality and consistency. Improvements in manufacturing protocols and checkout procedures are catching more problems prior to deployment. We estimate at least 1% of WHOI S2A floats have been temporarily captured by fishing vessels and later returned to the ocean.

APEX (Alison Gray/Steve Riser)

The UW version of APEX floats continues to work well, both in core and BGC versions. In the past year UW has deployed a total of more than 100 floats built from these versions. The floats generally work quite well, with over half the core floats lasting for 7 years or more, and over half the BGC floats lasting for at least 5 years. As with any float model, there are always new challenges that arise that must be dealt with. For the past several years we have seen a problem with the air bladders in our floats that result in the float not having sufficient buoyancy at the surface to raise the satellite antenna high enough to successfully transmit. After several years of searching for the cause of this bladder issue, we finally discovered that the manufacturer of the bladder changed the coating on the inside of the bladder sometime in 2018, resulting in the observed intermittent failures noticed on floats after about 2020. This coating was removed from the manufacturing process early in 2024. As a test, UW deployed 13 floats in the N. Pacific in 2024 with the new, fixed bladders. After more than 6 months in the water none of these test floats has shown any bladder problems, and we conclude that the problem has been fixed satisfactorily. A second problem recently noticed is premature failure of some BGC floats due to an apparent seawater leak. The onset of this problem occurs around profile 60, and by profile 120 the float has died in many cases. We are still searching for the exact cause of this leak. It is conjectured that the leak could be around an O-ring at a sensor port on the upper end cap, but this is yet to be verified. We hope to be able to recover a float affected by this problem in the next few months in order to determine the cause of the leak.

BGC floats

BGC Navis (Steve Riser and Aidan Thayer)

Both UW and WHOI have been deploying SeaBird BGC-Navis floats as part of the GO-BGC project since 2020. There have been a number of problems with these floats, including problems with the buoyancy engine, sensor issues, and general quality control problems. Over this time, we have maintained a nearly weekly dialogue with SeaBird consisting of discussions about these issues and how to improve the quality of the floats. Based on issues discovered during pre-deployment lab checkout, a sizable number of floats from both institutions needed to be returned to SeaBird for repairs prior to deployment. These problems included bladder problems (a coating on the bladders, when mixed with oil, clogged the high pressure valve in the floats), and noise in the SeaBird dissolved oxygen sensor data on some floats. These problems occurred on a number of floats, and there were other types of problems that only appeared once or twice on floats related to faulty manufacturing. All of these problems were eventually addressed by SeaBird and fixed. In the past year SeaBird has introduced a new version of BGC-Navis, referred to as the Navis-Nautilus, which has successfully updated the design of the BGC-Navis which has been marketed since 2014. The Nautilus has a new and more reliable buoyancy engine, improved internal design (i.e., layout of the internal components), more batteries (capable of >250 profiles to 2000 m), more efficient communications protocol (Zmodem replaces Xmodem), and the capability of being a 6-sensor BGC float. UW has successfully deployed 5 of these floats in the N. Pacific, with no problems appearing so far. In the future, it is planned that the Nautilus will replace the present version of BGC-Navis.

PROVOR (Edouard Leymarie)

This presentation provides an update on the NKE BGC-Provor float. The older CTS4 version (referred to as PROVOR_III in metadata) is now at the end of its production. The standard version is now the CTS5 (referred to as PROVOR_V), which is also available in a Jumbo version—20 cm longer and offering 60% more battery capacity. The differences between the CTS4 and CTS5 are mainly due to new electronics, enabling a more powerful onboard software. This, in turn, allows for the integration of new sensors and the use of a GUI for mission programming.

Statistics are presented on the nearly 100 CTS5 units deployed to date: 63% are still active, with an average of 90 cycles and 1.5 years of operation. Notably, almost 20% of the floats have been recovered—mostly not due to failure, but because of their high cost and often prototype status.

On the technological development side, two new sensors are being introduced: OPUS for nitrate measurements and Tridente for chlorophyll-a and BBP. Also noteworthy are the Rockland turbulence sensor and a new passive acoustic sensor capable of measuring wind and rainfall which measure parameters that are not part of the approved parameters for Argo. The deployment of floats with these sensors would need to follow all guidelines for ‘non-Argo’ floats described here: International Oceanographic Commission & Argo | Argo and here: What makes a float part of Argo? | Argo.

BGC SOLO (Sarah Purkey)

The BGC SOLO is a six sensor BGC Argo float model based on the energy-efficient SOLO-II core model. The BGC SOLO carries all SBE sensors and measures Dissolved Oxygen, Nitrate, pH,

backscatter, chlorophyll fluorescents, and downwelling irradiance in addition to the core parameters. The BGC SOLO was developed in 2022 by SIO's IDG lab and has since been licensed to MRV systems to be built and sold commercially. To date, 27 floats have been deployed and are performing well overall, with the first float having completed over 418 cycles. MRV is ramping up production and plans to produce 12 units per quarter this year. New firmware is expected in the summer of 2025 to fix some known firmware issues.

Under-ice floats

SOLO Arctic float (Dan Rudnick)

Dan Rudnick reported on the progress with the Arctic SOLO float developed at IDG at Scripps. The objective was to modify the SOLO-II to add acoustic navigation while subsurface while keeping the satellite communication during the ice-free summer. This is possible due to an array of moored acoustic sources. The Arctic SOLO-II has a hydrophone port, hardened antenna plus a guard, a RUDICS modem, additional memory, an elongated top cap, interface with acoustic scheduler board and it integrates acoustics into the data stream.

An Arctic SOLO was deployed through the ice in March 2024 and reported data in July 2024 when there was no ice at the surface. The last report was from October 2024. Two other Arctic SOLOs were deployed in September 2024. The prototype floats are on a 4 day cycle with 1.5 day drifts at 200m and 800m to get acoustic receptions. 35Hz receptions were heard at both drift depths with 85% heard overall. 925Hz receptions were mainly at shallow drift depth only with 39% heard. Positions were calculated from the acoustic receptions and merged with GPS positions to provide a complete trajectory. Acoustic positions had good N-S positioning, but E-W position was highly dependent on the E source.

Overall, the three prototype deployments have been successful with most acoustic transmission received and 12 more will be deployed this summer, followed by 14 in 2026.

Deep floats

Deep SOLO (Nathalie Zilberman)

Nathalie Zilberman presented an assessment of SIO Deep SOLO float performance. 30% (68 out of 224) active Deep Argo floats are Deep SOLO floats built at Scripps (RED rounded symbols). All but 4 (old models) SIO Deep SOLO floats collect profiles during descent and ascent to contribute to near real time Argo data. 1 Deep SOLO float with new firmware to park shallow and collect measurements upon ascent and descent is under testing. Failure rate due to SBE-61 CTD between 2017-2024 (7%) is comparable to float failure (13%). Some cases of float loss occurred due to SBE-61 CTD or pressure-only sensor failure. There is a need to improve capacity to determine if the SBE-61 CTD data is error free, identify marginal cable problems, and distinguish

failures due to communication, SBE-61 CTD, and pressure-only sensor. Deep SOLO and SOLO-II floats show similar float-related failure rates over the past 8 years (13% & 10%). The failure rate of SBE61 averaged over the past 8 years (7%) is slightly higher than SBE41 (3%). To conclude, Deep SOLO shows overall good performance. The failure rate of the Deep SOLO (20%, including float + CTD) 6-8 years after deployment is approaching the SOLO II (13%). Recommendations for SeaBird Scientific are to (1) Update firmware to better assess data error and missing measurements, and diagnose communication, SBE-61 CTD and pressure sensor problems, and (2) Install a humidity sensor on Deep Argo SBE-61CTDs to better define causes of failure. Scripps is planning to deploy 2 Deep SOLO floats in 2025 with improved Keller pressure sensor on the SBS61 prototype. Future plans for 2025 also include to deploy 1 Deep SOLO with new IDG antenna design to increase float longevity under ice.

Deep Arvor (Corentin Renaut)

This presentation provides an update on the 2024 deployments and survival rates over the past 6 years. It details the ending causes for Deep-Arvor deployments in 2024. The presentation concludes with the new developments for Deep-Arvor, including the double dissolved oxygen sensors with Rinko AROD-FT and Aanderaa 4330DW. These Deep-Arvor units were deployed in August 2024 in the North Atlantic, along with Deep-Arvors released from a benthic structure.

MOBI/OSEAN (Shigeki Hosoda and Steve Riser)

The MOBY (4K) floats, designed for tomographic applications and extended for hydrographic observations down to 4000 meters, can be equipped with an SBE61 CTD and a Hydrophone (MERMAID) sensor. The observation operations have generally been stable and reliable as a deep Argo platform, with few issues encountered when bottom-hitting occurs, leading to adjustments in profiling and parking depths to minimize these occurrences. However, some modifications are still required for the firmware and data format to align with Argo data flow. For example, there have been occasional communication system instabilities, requiring retries during the float's time at the sea surface (1-2 hours or more).

Regarding the development of the MOBY (6k: 6000m), significant progress has been made. The internal mechanical design has been re-engineered for operation at pressures up to 600 bars, with a new hydraulic circuit rigorously tested under lab conditions at 600 bars and +4°C. Long-term cycling tests have been conducted to assess the reliability of all subsystems, and ongoing pressure testing is evaluating the external casing at 670 bars. All electronic components are now finalized and ready for integration. The first sea trials are planned for early May 2025, followed by deep-sea deployment in Greece during the summer. The software development for the MOBY (6k) includes actuator control for depths of up to 6000 meters, incorporating all functions managed by the 4000m profilers (e.g., SBE61, lander). It also includes management of the RBRargo3 CTD (pending equipment validation), fixes to issues encountered during ground contact (such as discontinued CTD profiles or emergency ascents), improved multi-sensor management, and optimization of data transfer.

In the discussion, there was considerable enthusiasm for a new Deep Argo platform that is reasonably priced.

Xuanwu (Zhaohui Chen)

A newly designed shell for the Xuanwu float, featuring a buoyancy compensation module, has been tested. This module consists of six elastic elements that adjust their volume to provide additional buoyancy. As the float descends, these elements are compressed, allowing them to generate extra buoyancy when the float ascends. We estimate that this module can reduce energy consumption by up to 20% per cycle.

Currently, we have deployed four floats east of the Philippines. Two of these floats are equipped with buoyancy compensation modules, while the other two are not. Monitoring the oil pumped into the bladder revealed that the passive buoyancy compensation system demonstrated stability and efficiency, reducing oil demand by nearly 50%.

Regarding our grounding detection strategy, we define grounding as the average speed of the float being less than 1 cm/s over a 40-minute period. All floats deployed in the Kuroshio Extension region, where water depths are generally less than 6,000 meters, were selected for this assessment. Ideally, the maximum profiling depth should align with this depth; however, in some areas with nominal depths below 6,000 meters, observed float depths are often lower than expected. This suggests that the float did not reach the bottom, yet it mistakenly recorded that it had. We believe the current grounding strategy may be overly simplistic or too conservative. Moving forward, we require a more refined and precise grounding detection strategy to ensure that floats can accurately reach and observe the deepest parts of the water.

ASD update (Birgit Klein, Delphine Dobler)

This presentation gave an update on the monitoring of floats with conductivity cells affected by ASD. The symptoms of ASD have been monitored since 2018 through a joint spreadsheet which is updated continuously by the DMQC operators. After the manufacturing change at SBS, which remedied the encapsulant problem of the serial number range 10482-11252, performance of the fleet looks good. Only 34 out of the 3045 floats that have CTD SN > 11252 are concerned with ASD (with a minor increase of 10 since ADMT-24). 220 floats are now listed as ASD In the recall range (10482-11252) and numbers went up by 40 since ADMT-24. The number of profiles lost to scientific analysis is now slowly decreasing from a peak near 18% in 2021-2022. The warranty negotiations with SBS are well underway. The affected institutions have received their certificates and mostly have already spent them in recent orders or will do so in the near future. The EuroArgo Eric continues to investigate the serial number range 8050 - 8761 which had a high occurrence of ASD floats and will make an effort to recover as many as possible for inspection at SBS.

Core CTD Sensors

SBE CPcor (Marialena Christopoulou, recorded)

SBS reviewed field and laboratory estimates of CPcor and have come to a new recommended standard value for all conductivity cells made with urethane encapsulants. The errors due to CPcor variability are small and do not merit individual cell calibrations.

Results from this study combined with Deep Argo float measurements will be submitted as a peer review manuscript.

Action 28: CPcor task team to review and assess SBE work and recommendation of a new CPcor value for the SBE61. Report to AST Exec and then ADMT. **Who**: Virginie, Annie, Greg Johnson, CPcor task team.

Action 29: Assess the scientific impact of using a new CPcor value in SBE41CP. **Who**: Greg Johnson to lead.

Action 30: ADMT to discuss if and how best to implement the new CPCOR value in SBE41CP in the historical Argo dataset, decided via #27 and #28. **Who**: Annie to lead.

RBR (Mat Dever, recorded)

A recorded presentation was provided to review the current state of the RBR-equipped Argo floats. After reviewing deployments and float failures, an analysis of the onboard dynamic correction algorithm was provided over a range of floats and profiles. Based on the results provided, a request to end the global pilot phase of the onboard dynamic corrections was put forward. The AST voted unanimously that the RBR 2K CTD with the onboard dynamic correction now qualified for the status of “global implementation”.

The overall performance of the RBR fleet was reviewed by characterizing the stability of both pressure and salinity measurements. A request to the AST was put forward to formulate a recommendation on the rate at which programs should aim to diversify their sensors on Argo floats.

Technical Community of Practice report: (Pat McMahon/Chris Gordon)

The Argo Technical Workshop, held in Seattle from September 9–13, 2024, brought together 68 participants from nine countries in an open, collaborative format hosted by the University of Washington. The event fostered inclusive engagement between float users and manufacturers, focusing on the full lifecycle of Argo floats—from construction to deployment and recovery.

The workshop's sessions followed a structured flow where vendors addressed predefined questions about float design and manufacturing, followed by end users sharing operational experiences. Interactive panel discussions allowed for open Q&A. Hands-on breakout sessions and lab visits further deepened technical understanding.

Key actions identified during the workshop include:

- Improving fault identification and record keeping, especially during float testing and deployment preparation.
- Enhancing understanding of float failure modes by encouraging broader data sharing and failure analysis across user groups, with reporting at Argo Tech meetings.
- Promoting use of the Argo Tech GitHub repository to track issues and share best practices.
- Expanding the Argo Technician's Community of Practice (CoP) to include manufacturers, reinforcing collaborative problem-solving.

Looking ahead, the community will continue quarterly open online meetings and biennial workshops, ensuring inclusive participation from both users and manufacturers.

Action 31: AST requests that Argo National Programs ask their technical people to join the TCoP and take part in its virtual meetings. AST leadership would like to hear from National Programs on the reasons why it is difficult to take part in the TCoP, and what can be done to help. **Who**: National Programs

Manufacturer session

In this afternoon session, manufacturers were sent a list of questions ahead of time and asked to respond to them. After that, any time left remaining in their time slot would be for discussion. Overall, there interactions were very useful and Argo thanks all the manufacturers for participating. To provide feedback on the structure of the afternoon, please email argo@ucsd.edu.

All manufacturers listed below participated in the session, but some chose not to send a summary.

Platforms: – 15 min each

a. SBE
b. TWR
c. MRV
d. NKE
e. TSK

Float Update

TSK has deployed a total of 38 Deep NINJAs, and there are 5 current active floats. One is a BCG float with a DO and FRRF sensor, on a twice-a-day schedule. The other four are all equipped with a DO sensor, and performing 4000m profiles on a 10-day cycle. TSK produced 10 Deep NINJAs for 2025, and we anticipate JAMSTEC to deploy 8-10 Deep NINJAs in 2025

Challenges and Updates

The Deep NINJA has not been as reliable and long lasting as we had hoped. We re-engineered our buoyancy engine, to improve the efficiency and potential failure points. At the same time, we are maximizing our battery capacity. We are anticipating a life expectancy of 150 - 4000m profiles with a DO sensor.

Tariff

TSK does not anticipate a drastic increase for the Deep NINJA in price due to tariffs. The major component that might be affected is the Sea-bird CTD, which is imported from the US to Japan. The vast majority of components are sourced in Japan.

JSON

TSK is working with JAMSTEC to write the new firmware to comply with the new AST JSON requirements. We anticipate updating all the new Deep NINJAs that will be deployed in 2025.

CTD Sensors – 20 min each

f. SBE
g. RBR

A review of the latest developments at RBR was provided: The status of the documentation effort of calibration protocols, the testing of the upcoming new pressure sensor, and the availability of metadata for our sensors. The current status of implementation for the different platforms was provided, as well as a transparent discussion about RBR sensor pricing. A proposal to end the pilot phase for both the onboard dynamic corrections and the RBR*argo*|2k was put forward. The AST informed RBR that the RBR*argo*|2k CTD was no longer in the pilot phase and was now moved to the final “globally implemented” status. Celebrations ensued.

2. 16:00 BGC Sensors: 15 min each
    a. Trios

The hyperspectral sensor RAMSES and the spectral photometer OPUS were presented. The interfaces, calibration and temperature correction were touched briefly.

TriOS has not made any significant changes in the last year. The possibility to save energy on the OPUS must be considered carefully, since it takes some severe intervention in the software and some changes in the hardware as well.

b. Aanderaa
c. JFE

JFE Advantech has been studying the pressure dependence of the ARO-FT/AROD-FT and is developing a unique Cp coefficient for each DO sensor to improve the accuracy of data collected by Argo floats, with a focus on deep Argo applications.

d. RBR

A review of the latest developments in the BGC sensors at RBR was provided. Main focus was put on the recent work to conduct an in vivo experiment for the RBR*tridente* fluorometer channels. An emphasis was put on the results – good repeatability across sensors, high linearity in the sensor response– but also on the effort put in carefully documenting the experiment so it can be reproducible by anyone interested in doing so.

Recent work to characterize the RBR*quadrante* was shown: the development of a UV wavelength and the characterization of the cosine response of the sensor, as well as the work completed to investigate float configuration and shading impact on radiometric measurements on a MRV BGC float.

e. SBE

In the CTD session, there was some discomfort expressed by AST members in rushing ahead to change the value of CPcor as it will have an impact on the dataset. The AST asked for time to read the paper written by SBE and Argo scientists and to possibly have access to the data used to make the CPcor determination to better understand the issue. SBE thanked the AST for their comments and stated that they are confident in their CPcor value and the recommendation to use it, but can wait on implementing the new CPcor value at this point.

Action 32: Ask DACS to record CTD configs in float metadata and perform audit prior to ADMT and present it there. **Who**: John Gilson, Megan Scanderbeg

Action 33: Explore how to encourage greater transparency around sensor prices. Tender procurements should ask for itemized costs. **Who**: AST exec

Demonstrating OneArgo's value

Argo bibliography & web sites updates (Megan Scanderbeg, Orens de Fommervault)

Megan and Orens presented updates to the AST and BGC Argo websites. Both websites had visitors from around the world and the top pages were the home page and data access related pages. Megan noted that the redesigned ADMT website is almost ready and once that has been completed, some of the material on the AST website will shift to the ADMT website. Megan stated that the AST website needs some updating and a task team was formed to help agree on content.

On the BGC Argo website, a new product page has been added as well as one for social networking.

The Argo bibliographies were updated and over 600 papers were found in the past year with four new countries contributing a first author paper: Barbados, Estonia, Jamaica and Malta. More than 45 different journals have published more than 25 Argo papers. Overall, the trends continue to go up for the number of papers published each year. In terms of citing Argo data in the paper, roughly 50% of papers published using GDAC data cited the Argo DOI or the official Argo Acknowledgement. The other way to cite Argo data is to cite the Argo data paper and the number of papers doing that has sharply increased since the paper was published in 2020. When looking at all papers that used Argo data, many of which could be from sources other than the GDAC, less than 20% cited the DOI, the Argo Acknowledgement or the Argo data paper. Work could be done to reach out to major Argo product creators to ask for an Argo citation in addition to their product citation.

Action 34: Update references to RBR 2K CTD with onboard dynamic correction on AST website to reflect 'global implementation' status. **Who**: Megan Scanderbeg and Annie Wong

Action 35: Form a team to work on refreshing the AST website. **Who**: Megan Scanderbeg, Greg Johnson, Candice Hall, Blair Greenan, Victor Turpin, Peter Oke, Orens de Fommervault

Action 36: Once Framework is approved (intersessionally), update information on AST website. **Who**: Annie Wong, Megan Scanderbeg

OneArgo as part of UN Ocean Decade (Megan Scanderbeg, Orens de Fommervault)

Megan and Orens briefly updated the AST on UN Ocean Decade topics over the past year. They started by thanking Susan, Tammy and Orens for attending the 2024 Conference in Barcelona. 2025 marks the halfway point in the decade and there will be a mid-term review this year in addition to a review and update to the decade action framework. Work to add Argo to ODIS stalled in the past year due to some funding and technical issues but will resume this summer. They thanked everyone for interacting with the Decade on Argo's behalf and will file the annual report on 30 April 2025.

Action 37: Small working group to draft a 'call to action' for AST approval and to propose to the OOSC Townhall & then share on social media. **Who**: Herve, Toshio, Birgit, Susan, and Nathalie, Virginie, Orens

OneArgo communication

Megan and Orens reported back on communication efforts made over the past year by the entire Argo team which included mentions in GOOS and NOAA press releases and BGC Argo and OneArgo Data Byte newsletters. EuroArgo created an infographic on Argo's contribution to the IPCC 6th report (view and interact with the graphic here: Argo and climate change | Argo).

Action 38: Include a map of locations of profiles that have changed in past XX months/years in 'OneArgo DataBytes' and elsewhere on websites. **Who**: Megan Scanderbeg, Fiona Carse

OneArgo Outreach

Orens and Megan reported on various outreach efforts done across Argo including numerous user workshops, adopt a float programs and the First LEGO League Challenge. A comic book for kids entitled, 'Journey with Ocean Observers' was published and translated.

Social Media

Orens and Megan noted that most Argo related accounts have migrated from Twitter/X to Bluesky and LinkedIn. When posting, please remember to include #argofloat in your post.

Action 39: AST programs to alert their communication teams to 'amplify' stories with #argofloat, #argofloats. **Who**: National Programs

Brochure (Victor Turpin)

Victor presented the latest draft of the OneArgo brochure planned for release in time for the UN Ocean Decade Conference in Nice in June 2025. Overall, it was well received and the AST thanks Emanuela Rusciano for leading this effort.

UNOC review paper (Hervé Claustre)

The paper has been published – thank you to Virginie Thierry, Herve Claustre and team for working to publish the paper in time for the UNOC meeting in Nice, France in June 2025. The paper was written in collaboration with Argo users to advocate for support to implement OneArgo. The link is here: Frontiers | Advancing ocean monitoring and knowledge for societal benefit: the urgency to expand Argo to OneArgo by 2030.

Fisheries Science Talks

Two scientists involved in fisheries were invited to talk including William Cheung from UBC and Cisco Werner from NOAA. Both talks were interesting and helpful for understanding how Argo can support fisheries management. The AST thanks both speakers for their time and look forward to further interactions in the future.

New ML forecast system, Peter Oke

Peter described a data-driven analog forecasting for regional sea-level anomaly (SLA) that uses along-track altimeter observations to identify archived ocean states that most closely match present conditions. The evolution of analogs are then assembled into an ensemble forecast. It

was shown that 15-day SLA forecasts for regional domains outperforms traditional operational forecasts in 80% of cases. Work is underway to extend the system to forecast 3d temperature, salinity, and BGC parameters.

Upcoming International science workshops (Orens de Fommervault)

The presentation outlines key upcoming international science meetings relevant to the Argo community. These include major events such as the EGU in Vienna, the UNOC in Nice, the Pan-CLIVAR Meeting in Bali, COP 30 in Brazil, and the OSM in Glasgow. A Google Spreadsheet with further details will be updated soon :
https://docs.google.com/spreadsheets/d/1xoTDysJ4cwJWyrNVxMI_fLlF2qVZfxWB8U5BmLF1NVQ/edit?usp=sharing

Euro-Argo Science Meeting will be held in Crete, Greece on 22 - 25 September 2025. It is open internationally.

Future Argo Meetings (Megan Scanderbeg)

ADMT-26, 20 - 24 October, 2025 at Woods Hole
2nd BGC ADMT Workshop, 27 - 29 October, 2025 at Woods Hole [now moved to a virtual event]
AST-27, April 2026 in South Africa

AST membership & other business

Megan Scanderbeg noted that Ukraine has deployed their first floats and were able to join the AST meeting remotely this year. Brazil and Argentina were also active in Argo over the past year after a break. Colombia also joined the Argo community this year. Any country involved in Argo is welcome to nominate an AST member to participate in the yearly AST meeting. See the AST Terms of Reference here: Argo Steering Team | Argo. If a change is needed in AST members listed on the AST website, please email argo@ucsd.edu.

Open Discussion

Two topics were discussed in this session including a revisitation of the ‘Framework for accepting new sensors’ document and the format of the AST meeting going forward.

In the discussion around the Framework document, it became clear that newer members of the Argo community are not aware of all the issues surrounding parameters, EEZs and the IOC. Several actions were created to help bring clarity to the issue and National Programs were

asked to be vigilant about deploying floats in EEZs. If needed, please apply for MSR clearance, especially when floats are being deployed into EEZs or at risk of drifting into EEZs. This webpage was created on the AST website to provide some information: https://argo.ucsd.edu/about/international-oceanographic-commission-argo/

Action 40: Ask OceanOPS to verify that they are monitoring AUX directory parameters. summary of what is there & some investigation into compliance. **Who**: OceanOPS

Action 41: Ask OceanOPS to notify National Program lead when one of their floats with extra sensors/params get close to EEZs. **Who**: OceanOPS

Action 42: Ask OceanOPS share their list of countries that have given concurrence for deployments within EEZs: **Who**: OceanOPS

Action 43: Ask OceanOPS to verify the list of emails of Argo National Contact Points yearly (maybe even via google sheets). **Who**: OceanOPS

Action 44: Give an overview/history of IOC and EEZs and deployments. **Who**: AST co-chairs

The second discussion topic was about how to best utilize the annual, week long AST meetings. The general consensus was that there was not enough discussion, but that it is important to include oral National Reports. More feedback is welcome prior to the AST-27 meeting next year.

Action 45: Include oral OneArgo National reports at AST-27. **Who**: AST co-chairs & exec team

Action 46: AST exec to reflect on AST-26 meeting format and find ways to effectively make needed decisions at yearly meetings. Meeting participants to send in ideas/suggestions to mscanderbeg **Who**: AST and AST exec

Argo Steering Team Meeting (AST-26)
La Jolla, CA USA 14 – 18 April, 2025
Host: Scripps Institution of Oceanography

AST-26: 14 April 9h00 – 18 April 15h00
Location: Scripps Seaside Forum

AST-26 Google Drive link
Zoom registration link for open sessions:
https://ucsd.zoom.us/meeting/register/a0xdyAXRQQujtUn-ggb49A

Blue text indicates a virtual speaker.

Monday: OneArgo
Slack monitor for morning: Nathalie
Slack monitor for afternoon: Virginie

1. 09:00 am Welcome (Margaret Leinen, 15 min)
2. Logistics (Megan Scanderbeg, 5 min)
3. Objectives of the meeting (AST co-chairs, 15 min)
4. Status of Action items from AST-25 (Megan Scanderbeg, 15 min)
5. Tracking of OneArgo status and implementation: overall picture by OceanOPS & discussion (Victor (15 min), AST co-chairs to lead discussion, 30 min)

10:30 - 10:50am Break

6. 10:50am **OneArgo implementation issues**
    a. OceanOPS operational update (10 min - Victor)
    b. EEZ and GOOS concurrences (Victor, 10 min)
    c. AIC, OceanOPS funding (Breck Owens, 10 min)
    d. Basin deployment coordination (Fiona Carse, Tammy Morris, Sarah Purkey, Shigeki Hosoda 15 min)
    e. National Programs reporting one success or challenge (45 min)
    f. Update on near surface sampling audit after AST-25 recommendation & where unpumped data should be stored and shared (AST-25 Action #8) (Brian King, 15 min)

12:30 - 13:30 Lunch

7. 13:30 OneArgo data management
    a. Plans for JSON schema for decoded float data (Pelle Robbins/Ben Greenwood, 10 min)
    b. Min/max test results & how they are implemented (C. Coatanoan, recorded, 15 min)
    c. Easy OneArgo data product (Annie Wong, 10 min)
    d. Feedback from ADMT-25 including: (ADMT co-chairs, 40 min)
    e. Reference data (Sarah Purkey 15 min)

8. 14h50 Projection of array status and commitments (Brian King, 20 min)

15:10 - 15h30 Break

9. 15h30 National updates:
    a. USA (Sarah Purkey, Greg Johnson, 20 min + 10 min discussion)
    b. Euro-Argo ONE EU project (Yann-Hervé, 15 min)
10. 16h15
    a. Japan report on impact of no TBTO in CTDs (Shigeki, 15 min)

Tuesday: BGC Argo
Slack monitor for morning: Peter Oke
Slack monitor for afternoon: Breck Owens

11. 9:00 BGC-Argo Introduction and Status (Hervé): 15 min

12. 9:15 BGC implementation: 80 min
    a. National Report (Orens): 40 min
        i. Australia (Peter): 3min
        ii. Canada (Katja): 3 min
        iii. China (Xiaogang): 3 min
        iv. EU + Pol., Bul., Fin., Den., Spa. (Yann-Hervé): 3 min
        v. Norway (Kjell): 3 min
        vi. France (Hervé): 3 min
        vii. Germany (Meike): 3 min
        viii. India (Pattabhi Rama Rao): 3 min
        ix. Italy (Giorgio): 3 min
        x. Japan (Tetsu): 3 min
        xi. New Zealand (Philip Sutton): 3 min
        xii. USA (Ken): 3 min
        xiii. UK (Nathan) : 3 min

b. Past Deployments, Future Plans, and Gap Filling (Orens) : 10 min
c. Long term funding : 30 min
    i. Discussion for promoting sustained fundings (Hervé) : 15 min
    ii. Outlook for some countries (ken) : 15 min

10:35 - 11:00 Break

13. 11:00 a. BGC-Argo Implementation Plan Revision (Hervé) : 15 min

14. 11:15 a. Global Ocean Carbon Implementation Plan (Ken) : 15 min

15. 11:30 a. Strengthening Relationship with other groups : 65 min
    i. GO-SHIP (Brendan) : 15 min
    ii. SOCAT / SOCONET (Rick) : 15 min
    iii. IOCCP/GOOS BGC (Veronique) : 15 min
    iv. Models (Alexandre Mignot) : 15 min
    v. IOCCG (Hervé) : 5 min

12:30 - 13:30 Lunch

16. 13:30-13:45 Framework for adding new sensors/parameters in Argo (Henry) :15 min

17. 13:45 -14:30 BGC-Argo sensors & Tech. Task Team
    a. Brief intro/summary of TTT activities over the last year (Yui) : 5 min
    b. Intercomparison of BBP and Chla: Lab and field for Tridente + Eco, and future plans(Edouard, Nathan) : 10 min
    c. Intercomparison of Radiometry: Lab and field (Xiaogang) : 10 min
    d. Initial PAR algorithms evaluation (Edouard): 10 min
    e. Update from the 3rd channel of bio-optical sensor WG (Nathan) : 10 min

18. 14:30-15:30 BGC-Argo data management
    a. ADMT summary (Tanya): 15 min
    b. DMQC meeting(s) (Tanya): 10 min
    c. BGC-Argo supporting products (including, computing PAR – how to store in the data system?) (Tanya): 10 min
    d. Summary of RT chla slope, status and next step (Raphaelle): 15min
    e. Hyperspectral data calibration (Catherine) : 10min

19. 15h30-16h15 BGC-Argo Data Products

a. Introduction : 4D-BGC SCOR WG (Jon Sharp & Raphaelle): 10 min
b. intercomparison DOXY (Jon Sharp) : 10 min
c. Contribution of 4D-BGC products to Argo data management (Raphaelle) : 10 min
d. Benefit of BGC-Argo products to end-users : fisheries example (Mary Margaret Stoll) : 15 min

Need to end day by 16h00, maybe 16h15 to allow time for others to come in for talks.

Tuesday evening reception:

16h30 - 17h30: **Talks**
16h30 - 16h45: John Gould on the pre-Argo era through to the beginning of Argo
16h45 - 17h00: Brian King on the International Collaboration and Argo's success
17h00 - 17h15: Dan Runick on the importance of research and development to Argo
17h15 - 17h30: Josh Willis on the synergies between Argo and the satellite community

17h30 - 19h30: drinks and light appetizers

Wednesday: Deep Argo & Polar Argo
Slack monitor for morning: Orens
Slack monitor for afternoon: Ken

Deep Argo

20. 8:30 Deep Argo Introduction and status (Nathalie/Virginie): 15 min

21. 8:45 Deep Argo implementation (1 hour 45 min)
    a. National Report (~5-10 min by countries) : 1 hour 30 min
        1. US (Nathalie)
        2. Canada (Blair)
        3. China (Zhaohui)
        4. Japan (Shigeki)
        5. France & EU (Virginie)
        6. Norway (Virginie on behalf of Kjell Arne)
        7. Spain (Virginie on behalf of Alberto)
        8. Italy (Virginie on behalf of Giulio)
        9. UK (Brian)
        10. Australia (Esmee)
    b. Discussion: Long term funding (15 min)

10:30 - 10:50 Break

22. 10:50am Deep sensors including Q&A w/ manufacturers (1 hour 10 minutes)
    a. SBE61 and SBS61 (15 min, Nathalie)
    b. RBR CTD and DO (25 min, Jean-Michel/Mat)
    c. Rinko DO (15 min, Kanako)
    d. Discussion (15 min)

23. 12:00 Deep Argo updates (30 min)
    a. New 6000-m Deep Argo float (15 min, Corentin Renaut)
    b. Deep Argo KPIs and Deep density maps (15 min, Victor)

12:30 - 13:30 Lunch

24. 13:30 Deep Argo science talks (45 min)
    a. Deep Argo Data Reduce Uncertainty and Increase Spatial Resolution of Decadal Deep and Abyssal Ocean Temperature Trends (15 min, Greg J. from PMEL)
    b. Deep Argo Observations in the Fracture Zones of the Southwest Indian Ridge (15 min, Viviane de Menezes)
    c. Deep Argo bathymetry product (15 min, Nathalie and Megan)

25. 14:15 Deep Argo data management (15 minutes,Virginie and Cecile)

26. 14:30 Transition from regional pilot array to global implementation (15 min, Nathalie)
27. 14:45 Discussion (15 min)

15:00 - 15:30 Break

28. **Polar Argo Mission (2 hours total)**

Polar Argo Introduction and Status (10 minutes) Esmee

Polar Argo Implementation (55 minutes)

- National Reports (recent/future deployments, funding) Nicolas (25)
- Oceanops design proposal (Arctic/SO) Nicolas/Esmee (30)

Best practice paper update (5 minutes) Nicolas

Polar Argo in the field (30 minutes)

- Southern Ocean (15) Esmee
- SOCCOM (5) Alison Gray Steve Riser
- ARcticGO (10) Nicolas
- Acoustic floats (10) Craig Lee

END of DAY: 17h30

Thursday (closed morning):
Slack monitor for morning: Victor
Slack monitor for afternoon: Nicolas

29. Float updates
    a. 9:00am Core floats (10 min each)
        i. SOLO-II (N. Zilberman)
        ii. Arvor (Corentin Renaut)
        iii. ALTO (Steve Jayne)
        iv. MRV S2A (Pelle Robbins)
        v. APEX (Alison / Riser reaching out to other APEX users)
    b. 9:50am BGC floats (10 min each)
        i. BGC Navis (Alison / Steve Riser and Aidan Thayer)
        ii. PROVOR (Edouard Leymarie)
        iii. BGC SOLO (Sarah Purkey)

10:30 - 10:50am Break

    c. 10:50am Under-ice floats
        i. SOLO Arctic float (10 min, Dan Rudnick)
    d. 11:00 Deep floats (10 min each)
        i. Deep SOLO (Nathalie Zilberman)
        ii. Deep Arvor (Corentin Renaut)
        iii. MOBI/OSEAN (Shigeki Hosoda and Steve Riser)
        iv. Xuanwu (Zhaohui Chen)
30. 11:40am ASD update (Birgit Klein, Delphine, 15 min)
31. 11:55pm Core CTD Sensors
    a. SBE cpcor (Marialena Christopoulou, recorded, 15 min)
    b. RBR (Mat Dever, recorded, 15 min)

12:15 - 13:45 Lunch with lab tour from 12:45 - 13:45

Thursday afternoon
This session is open and will feature vendor presentations focused on platform, CTDs and BGC sensors. Session will start with update from the Argo TCoP

32. 13:45 Technical Community of Practice report: (Pat McMahon/Chris Gordon, 15 min)
33. 14:00 Platforms: – 15 min each
    a. SBE

b. TWR
c. MRV
d. NKE
e. TSK

15:15 – 15:35 Break

34. 15:35 CTD Sensors – 20 min each
    a. SBE
    b. RBR
35. 16:15 BGC Sensors: 10 min each
    a. Trios
    b. Aanderaa
    c. JFE
    d. RBR
    e. SBE

Friday:
Slack monitor for morning: Toshio

36. 9am Demonstrating OneArgo's value
    a. Argo bibliography & websites updates (Megan Scanderbeg, Orens de Fommervault 15 min)
    b. OneArgo as part of UN Ocean Decade (Megan Scanderbeg, Orens de Fommervault, 10 min)
    c. OneArgo communication
        i. Newsletter / workshop / webinar / publications (Orens, Megan 10 min)
        ii. Social Media (Orens, Megan 5 min)
    d. Outreach effort (Orens, Megan 5 min)

37. 9:45 am Showcasing the Impact of OneArgo During UNOC/OOSC
    a. OneArgo's Presence at the OOSC/UNOC (orens 10min)
    b. UNOC review paper (Hervé Claustre, 10 min)
    c. Brochure (Victor Turpin, Orens, 10 min)

10:15 - 10:30 Break

38. 10:30am Fisheries Science Talks
    a. William Cheung, UBC (15 min + questions)
    b. Evan Howell, Cicso Werner, NOAA (15 min + questions)

39. 11:10am New ML forecast system, Peter Oke (15 min + questions)

40. 12:00pm Upcoming International science workshops (Orens, Megan 15 min)
    a. EGU in Vienna, April 27 - May 2, 2025
    b. UN Ocean Decade, June 2025 in France : (https://oceandecade.org/news/united-nations-general-assembly-adopts-resolution-confirming-2025-edition-of-un-ocean-conference-in-france/)
    c. Euro-Argo Science Meeting in Greece on 22 - 25 September 2025. (Nicolas)
    d. Pan-CLIVAR meeting in Bali, Indonesia on 22-26 September 2025
    e. UN Climate Change Conference (COP30) in Belém, November 2025 (Redirect Notice)
    f. Ocean Sciences in Glasgow, on 22 - 27 February 2026

41. 12:15pm Future Argo Meetings (Megan)
    a. ADMT-26, 20 - 24 October, 2025 at Woods Hole
    b. 2nd BGC ADMT Workshop, 27 - 29 October, 2025 at Woods Hole
    c. AST-27, April 2026 in South Africa
42. 12:20 AST membership & other business

12:30 - 13:30 Lunch

43. 13:30 Open Discussion as needed
    a. How to define, produce and serve Argo products?
    b. Discuss updated Framework for approval
    c. Review of PAL sensor usage
    d. General format of AST meeting
44. 14:30 Review of action items

15:00 END of meeting

Number	Action	Status	Owner	Due date	Notes
1	AST Exec to discuss the possibility of interested National Programs working with Victor Turpin to establish a Long-Term Agreement to purchase floats through WMO	Not started	AST Exec, interested National Programs, Victor Turpin	AST-27	*Notes*
2	Add a simple indicator of status towards OneArgo completion on AST website	Not started	Megan Scanderbeg, Victor Turpin, Orens de Fommervault, co-chairs	ADMT-26	share plan with AST exec
3	Ask BGC, Deep, Polar Mission chairs to provide realistic average float lifetimes for OceanOPS to use when calculating KPIs	Not started	misson co-chairs, Victor Turpin	6/1/2025	*Notes*
4	OceanOPS, TcoP, Fiona Carse and Megan to develop a document on safe practices around float recovery. Provide information on safe storage and possible disposal for both float owners and other entities involved.	Not started	TCoP chairs, Megan S., Fiona Carse, ????	9/1/2025	*Notes*
5	As part of the Argo/OceanOPS SLA, a task list and annual work plan will be developed and maintained by the Argo Exec, and progress reported to the Exec	Not started	AST Co-chair and Mission co-chairs, Victor Turpin	ADMT-26	*Notes*
6	AST to work with TCoP on standard float missions	Not started	TCoP and AST (need volunteers from AST to help and review - pair AST person BGC, Deep and Core for each float type), John Gilson - SOLO, Steve Jayne - ALTO, Alison - UW APEX, Fiona - APEX, Arvor?, Provor?	9/1/2025	*Notes*
7	AST requests that when ordering floats, National Programs should specify that floats sample up to the top 2db.	In progress	National Programs	AST-27	*Notes*
8	National programs to examine the data identified as bad in the min/max test and flag as needed. Track any 'false positives' and report to Coriolis (Christine Coatanoan). The ultimate goal is to implement this at the DACs as a new RT test	Not started	National leads to inform National DACs	ADMT-26	If decision made at ADMT to implement as a R
9	Survey DACs to enquire how hard it will be to move to deliver data within 3 hours – include encouragement that operational centers are asking for this now (for T/S)	Not started	ADMT co-chairs to survey to DACs	ADMT-26	*Notes*
10	Create a group, including scientists, to help develop clear guidelines for defining and accepting 'Argo products' to be served on GDACs.	Not started	Peter Oke, Nicolas K, Henry B, Annie, Raphaelle Sauzede, GDAC leads, and ????	ADMT-26	Add paragraph to GDAC cookbook
11	Ask Christine Coatanoan to explore the value and feasibility of sourcing the reference data sets noted in the National reports to AST. Report back to ADMT on what might be involved in accessing & using these data	Not started	Christine Coatanoan, Sarah Purkey	ADMT-26	This is a report at ADMT-26 & then make decis
12	National Programs to maintain commitments spreadsheet until 2030 (and beyond), even when uncertain	Not started	National program leads	1 month before AST-27	Megan to include in call for National reports. (
13	Assemble a team to write a review paper on studies of the impact of Argo data on products and services - seek Argo users in the authorship	Not started	Susan Wijffels, Blair Greenan, Fiona Carse, Peter Oke, Candice Hall, Herve Claustre, Toshio, Raphaelle Sauzede	6/1/2025	seasonal forecasting through to ocean forecas
14	Encourage national programs to try deploying floats without TBTO (dummy plug), and report back to AST-27 on the number deployed and any impact on CTD data quality.	Not started	Steve Jayne to coordinate, Steve Riser, Birgit Klein, Shigeki Hosoda	AST-27	*Notes*
15	BGC Mission Team to communicate (mathematically) what the coverage metric is for the BGC array so that OceanOPS can implement it.	Not started	BGC Mission Team cochairs and Victor Turpin	ADMT-26	*Notes*
16	AST members to read and comment on the "Framework for adding new sensors and new mission parameters in Argo" by May 16, 2025.	Not started	AST and mission team members. To be revised and approved by authors and the AST Exec. Then circulated to AST for final sign off	5/16/2025 for revisions. clear	*Notes*
17	Ask BGC ADMT to create a proposal for computed PAR and measured PAR with a recommendation on how to handle this data. Could be within data stream or separate product. Would also be helpful to know how you suggest to serve the data, ie through the DACs or at the GDACs.	Not started	Tanya Maurer, Eduoard Leymarie and Catherine Schmechtig	ADMT-26?	Write proposal of how this will be stored either
18	BGC Mission Team in collaboration with Deep Mission Team to articulate the cost and identify the benefits of including oxygen on all Deep floats.	Not started	BGC and Deep co-chairs	AST-27	all 4000m floats can measure oxygen; may ha

Number	Action	Status	Owner	Due date	Notes
19	Identify scientific conferences to target for holding science sessions on Deep Argo to emphasize the technological readiness and live data stream of the mission. Could ask early adopters to come and advocate for Deep Argo. Ocean Sciences, AGU, EGU. Report to AST Exec	Not started	DAMT co-chairs and ????	8/12/2025	*Notes*
20	Form a working group to model the pressure dependence of biases in the (Kistler) sensors to see if a bias correction scheme can be found	Not started	Nathalie, John Gilson, Sarah Purkey, Pelle?, Virginie?	progress at ADMT-26; final at /	*Notes*
21	Update the map of float deployments from GO-SHIP yearly and include on OceanOPS static map page	Not started	Victor Turpin and Orens de Fommervault	AST-27	*Notes*
22	Produce a comparison time series of the number of ship-based vs Argo profiles collected annually - from CORA or WOD. Deep, BGC (oxygen/nitrate), Polar, and core Argo	Not started	Megan, Victor, Deep/bgc chairs, Christine	AST-27	*Notes*
23	Produce a new edition of 'OneArgo Databytes' focussed on Deep Argo topics	Not started	Nathalie/Sarah, M. Scanderbeg, Fiona Carse, Virginie	ADMT-26	*Notes*
24	In reporting floats deployed into Polar oceans, separate out floats deployed in open ocean vs floats on shelf/shelf break to track deployment trends. It would also be helpful to track where the floats end up.	Not started	Polar mission Team/Victor?	AST-27	*Notes*
25	AST and Polar Mission members to give feedback on the draft Polar Argo Mission design presented at AST-26, and the associated proposal of on shelf coverage. Feedback to be sent to mscanderbeg@ucsd.edu as well as Polar Mission chairs Nicolas Kolodziejczyk (nicolas.kolodziejczyk@univ-brest.fr) and Esmee van Wijk (Esmee.vanWijk@csiro.au)	Not started	Nicolas, Esmee	10/01/2025	*Notes*
26	AST Exec to synthesize feedback on Polar Mission design and discuss next steps with Polar Mission Team.	Not started	AST Exec	10/15/2025	*Notes*
27	Ask Polar AMT to develop a Best Practices document for polar Argo float deployments and link to Float Deployment webpage on AST website	In progress	Polar co-chairs	AST-27	*Notes*
28	CPCOR task team to review and assess SBE work and recommendation of a new CPCOR value for the SBE61. Report to AST Exec and then ADMT	Not started	Virginie, Annie, Greg, CPCOR Task Team	ADMT-26	*Notes*
29	Assess the scientific impact of using a new CPCOR value in SBE41CP	Not started	greg to lead?	ADMT-26	*Notes*
30	ADMT to discuss if and how best to implement the new CPCOR value in SBE41CP in the historical Argo dataset, decided via #27 and #28	Not started	Annie to lead	ADMT-26	*Notes*
31	AST requests that Argo National Programs ask their technical people to join the TCoP and take part in its virtual meetings. AST leadership would like to hear from National Programs on the reasons why it is difficult to take part in the TCoP, and what can be done to help.	In progress	National Programs	*Due date*	could have lab visits or ways to get around lan
32	Ask DACS to record CTD configs in float metadata and perform audit prior to ADMT and present it there	Not started	John Gilson, Megan	ADMT-26	*Notes*
33	Explore how to encourage greater transparency around sensor prices. Tender procurements should ask for itemized costs	Not started	AST Exec	6/1/2025	*Notes*
34	Update references to RBR 2K CTD with onboard dynamic correction on AST website to reflect 'global implementation' status	Not started	Megan & Annie	*Due date*	*Notes*
35	Form a team to work with Megan on refreshing the AST website	Not started	Megan, Greg Johnson, Candice Hall, Blair Greenan, and Victor Turpin, Peter Oke, Orens de Fommervault	AST-27	*Notes*
36	Once Framework is approved (intersessionally), update information on AST website	Not started	Annie, Megan	ADMT-26	*Notes*
37	Small working group to draft a 'call to action' for AST approval and to propose to the OOSC Townhall & then share on social media	Completed	Herve, Toshio, Birgit, Susan, and Nathalie, Virginie, Orens	june 2025	OOSC has occurred, so action is done
38	Include map of locations of profiles that have changed in past XX months/years in ‘OneArgo DataBytes’ and elsewhere on websites	Not started	Megan, Fiona,	*Due date*	*Notes*
39	AST programs to alert their communication teams to 'amplify' stories with #argofloat, #argofloats	Not started	National Programs	june 2025	*Notes*

Number	Action	Status	Owner	Due date	Notes
40	Ask OceanOPS to verify that they are monitoring AUX directory parameters. summary of what is there & some investigation into compliance	Not started	Victor Turpin and Orens de Fommervault, Catherine Schmechtig	ADMT-26	*Notes*
41	Ask OceanOPS to notify National Program lead when one of their floats with extra sensors/params are getting close to EEZs	Not started	Victor Turpin and Orens de Fommervault	ADMT-26	*Notes*
42	Ask OceanOPS share their list of countries that have given concurrence for deployments within EEZs	Not started	Victor Turpin and Orens de Fommervault	ADMT-26	*Notes*
43	Ask OceanOPS to verify list of emails of Argo National Contact Points yearly (maybe even via google sheets)	Not started	Victor Turpin	AST-27	*Notes*
44	Give overview/history of IOC and EEZs and deployments	Not started	AST co-chairs	AST-27	*Notes*
45	Include oral OneArgo National reports at AST-27	Not started	AST co-chairs, AST exec	AST-27	*Notes*
46	AST exec to reflect on AST-26 meeting format and find ways to effectively make needed decisions at yearly meeting. Meeting participants to send in ideas/suggestions to argo@ucsd.edu	Not started	AST exec	6/12/2025	*Notes*
	Action		*Owner*	*Due date*	*Notes*

First Name	Last Name	Affiliation
Kohen	Bauer	Ocean Networks Canada
Clare	Bellingham	NOC/BODC
Henry	Bittig	IOW
Jodi	Brewster	University of Miami/CIMAS
Nathan	Briggs	National Oceanography Centre
Cecile	Cabanes	CNRS
Sergio	Cambronero Solano	Laboratoire d'Oceanographie de Villefranche, CNRS-SU / Universidad Nacional de Costa Rica
Fiona	Carse	Met Office
Brendan	Carter	Unaffiliated
Zhaohui	Chen	Ocean University of China
hervé	claustre	CNRS & Sorbonne University
Christine	Coatanoan	IFREMER
Giorgio	Dall'Olmo	OGS
Yann-Hervé	De Roeck	Euro-Argo ERIC
Delphine	DOBLER	Euro-Argo ERIC
Kevin Niklas	Dr. Wiegand	Federal Maritime and Hydrographic Agency (Germany)
Cedrick	Estelhomme	University of Miami
rita	esteves	IPMA
Jon	Fajans	Xylem
Katja	Fennel	Dalhousie University
Denise	Fernandez	NIWA
Hartmut	Frenzel	UW / NOAA-PMEL
Tetsuichi	Fujiki	JAMSTEC
Véronique	GARCON	CNRS/IPGP
John	Gilson	UCSD
Christopher	Gordon	Fisheries and Oceans Canada
John	Gould	National Oceanography Centre, Southampton, UK
Alison	Gray	University of Washington
Blair	Greenan	Fisheries and Oceans Canada
CANDICE	HALL	DOC/NOAA
Mizue	Hirano	JAMSTEC
Shigeki	Hosoda	JAMSTEC
Steven	Jayne	WHOI
Hwajin	Jeon	Korea Ministry of Oceans and Fisheries (MOF)
HyeongJun	Jo	National Institute of Meteorological Sciences
Kenneth	Johnson	MBARI
Gregory	Johnson	NOAA/PMEL

S.P.	Johnson	University of Miami
Hyoun-Woo	Kang	Korea Institute of Ocean Science and Technology
Shota	Katsura	Tohoku University
Baek-Jo	Kim	National Institute of Meteorological Sciences, KMA
EunJin	Kim	Korea Institute of Ocean Science & Technology
Brian	King	National Oceanography Centre
Birgit	Klein	Bundesamt fuer Seeschifffahrt und Hydrographie
nicolas	Kolodziejczyk	UNIVERSITE DE BREST
Dirk	Koopmans	National Oceanography Centre, UK
Edouard	Leymarie	LOV - CNRS
Zenghong	Liu	Second Institute of Oceanography, Ministry of Natural Resources
Meike	Martins	BSH, Germany
Tanya	Maurer	MBARI
Elena	Mauri	OGS
Pat	McMahon	CSIRO
Melissa	Miller	Scripps Institution of Oceanography
Kjell Arne	Mork	Institute of Marine Research
Tamaryn	Morris	SAEON
Jaya	Nair	UM - CIMAS
Jaqui	Neibauer	University of Washington
Griet	Neukermans	Ghent University, Belgium
David	Nicholson	WHOI
Giulio	Notarstefano	National Institute of Oceanography and Applied Geophysics (OGS)
Kyunghee	Oh	Korea Institute of Ocean Science & Technology
Peter	Oke	CSIRO
Emily	Osborne	NOAA/AOML
Breck	Owens	Woods Hole Oceanographic Institution
JongJin	Park	Kyungpook National University
Orens	Pasqueron de Fommervault	IOC/UNESCO - OCEANOPS
Sarah	Purkey	SIO
Krissy	Reeve	Alfred Wegner Institute
Corentin	Renaut	IFREMER
Stephen	Riser	University of Washington
Pelle	Robbins	Woods Hole Oceanographic Institution
Dean	Roemmich	SIO UCSD
Daniel	Rudnick	Scripps Institution of Oceanography

Rick	Rupan	UW
Edward	Ryan	Uni of Miami / CIMAS
A. Miguel	Santos	IPMA-Portuguese Institute for the Sea and the Atmosphere
Kanako	Sato	JAMSTEC
Raphaelle	Sauzede	CNRS
Megan	Scanderbeg	Scripps Institution of Oceanography
Alvaro	Scardilli	Servicio de Hidrografía Naval - Argentina
catherine	schmechtig	CNRS
Jon	Sharp	CICOES / NOAA PMEL
Emily	Smith	NOAA
Yumi	Song	Kyungpook National University
Mary Margaret	Stoll	University of Washington
Toshio	Suga	WPI-AIMEC, Tohoku University and JAMSTEC
Phil	Sutton	NIWA
Yui	Takeshita	MBARI
Virginie	Thierry	LOPS/Ifremer
Anh	Tran	Department of Fisheries and Oceans Canada
Victor	Turpin	OceanOPS/WMO
TVS	Udaya Bhaskar	INCOIS, MoES, Govt. of India
Kamila	Walicka	NOC
Qi	Wang	Fisheries and Oceans Canada
richard	wanninkhof	NOAA/AOML
Susan	Wijffels	Woods Hole Oceanographic Institution
Taylor	Wirth	Scripps Institution of Oceanography
Annie	Wong	Scripps Institution of Oceanography
Xiaogang	Xing	Second Insitute of Oceanography, MNR
Ya	Yang	FIO
Yang	Zhang	School of Marine Science and Policy, University of Delaware
Nathalie	Zilberman	Scripps Institution of Oceanography
Esmee	van Wijk	CSIRO, Hobart, Australia
Abdallah	Daher	CIMAS/AOML
Lynne	Talley	UCSD SIO
Aexandre	Mignot	Mercator ocean International
Takuya	HASEGAWA	JMA
Tetjana	Ross	Fisheries and Oceans Canada, Institute of Ocean Sciences
Chihiro	Kawamura	Japan Meteorological Agency
Mayu	YAMAMOTO	JMA
Anouska	Panton	BODC (UK)

Peter Teye Busumprah	Busumprah	Ghana Ocean Climate Innovations Hub
Andrea	McCurdy	UCAR
Charles	Branham	Sea-Bird Scientific
Marialena	Christopoulou	Sea-Bird Scientific
Mathieu	Dever	RBR
Rob	Ellison	Supplier
Anthony	Escarcega	TSK
Jon	Fajans	Xylem
Theresa	Friske	MRV Systems
Jostein	Hovdenes	Aanderaa Data Instruments AS
Genevieve	Howell	Sea-Bird Scientific
Clara	Hulburt	Teledyne Webb Research
Greg	Johnson	RBR
Jochen	Klinke	Sea-Bird Scientific
Yusuke	Kojima	TSK
Jean-Michel	Leconte	RBR
Brian	Leslie	Teledyne
HUA	LI	JFE Advantech Co. Ltd
Jesse	Noble	Teledyne Marine
David	NOGRE	nke Instrumentation
Aaron	Ramsey	RBR
Eric	Rehm	Sea-Bird Scientific
Harald	Rohr	TriOS M&D GmbH
Daniel	Ryan	Teledyne
Jérôme	Sagot	nke instrumentation
Shinichi	Takai	JFE Advantech co.,ltd.
Shawn	Vasquez	MRV Systems, LLC
Kenji	Yamamoto	TSK
Calvin	Lwin	Sea-Bird Scientific
kat	C	Teledyne
Andrea	Fassbender	
Steve	Diggs	
Michiko	Yamamoto	
Donata	Giglio	Colorado University
Josh	Willis	JPL
Bruce	Coruneulle	

Argo Australia National Report 2025 – AST26

Peter Oke[1], Lisa Krummel[2], Jenny Lovell[1], Annie Foppert[3,4], Pat McMahon[1], Gabriela Pilo[1], Steve Rintoul[1,4], Tatiana Rykova[1], Christina Schallenberg[1], Roger Scott[1], Dirk Slawinski[1], Peter Strutton[3], Esmee Van Wijk[1,4]

[1]CSIRO Environment; [2]Bureau of Meteorology; [3]University of Tasmania, [4]Australian Antarctic Program Partnership

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)

a. Float deployments and their performance

Between April 2024 and April 2025, Argo Australia have deployed 55 floats, including 44 core floats, 7 BGC floats, and 4 under-ice floats in the Antarctic shelf (Figure 1). That includes 42 Arvor, 6 Apex, and 7 Navis floats. We deployed floats from the RV Investigator, Antarctic Aurora, RV Kaharoa II, RV Whale Song, RV Sonne, RSV Nuyina, RV Umitaka Maru, MV L'Astrolabe, RV Tangaroa, HMNZS Aotearoa, and the Shirase (Japanese Icebreaker). All floats deployed since April 2024 are still operating, with no early failures.

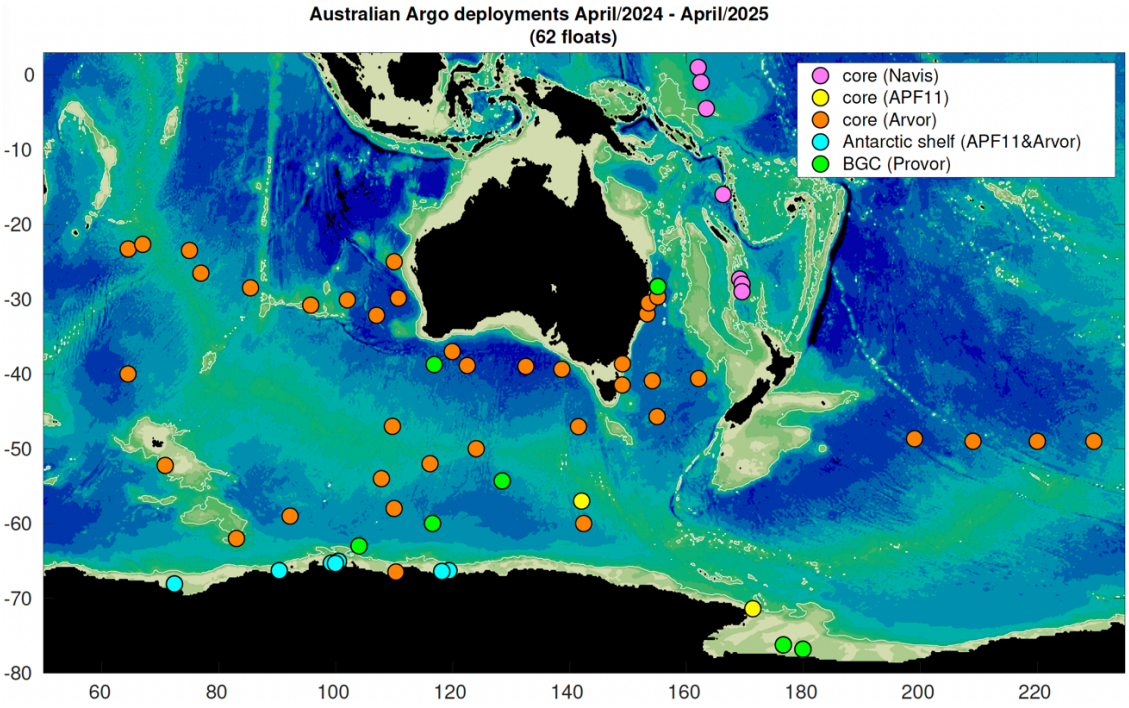


Figure 1: Map showing deployment locations between April 2024 and March 2024.

In total, the Australian DAC is managing 315 operational floats, of which 25 are BGC and 4 are Deep.

We did not deploy any Deep floats in the past year. We had planned to deploy 4 Deep floats in late 2024/early 2025 but these floats have been held back whilst the early failures of Deep floats deployed in the previous summer are investigated.

From our batch of 8 MRV Deep SOLOs deployed in Jan-Feb 2024, we have had 5 early failures. Two floats died early (one after 6 cycles with no information to help identify a cause and the other float after 18 cycles with a slight increase in relative humidity in the profile prior to failure). A third float had erratic park and profile behaviour that might be related to a pump leak (debris in the oil) that eventually stabilised after cycle 97. It then started dropping the upper few hundred metres of the continuous profile data and eventually stopped responding to the resume/reset commands. A further two floats stopped functioning after 27 and 38 good cycles respectively. The floats sent back intermittent bad pressures (abort code of 2) and eventually do not leave the surface. The floats still report position but no profile data and essentially become surface drifters.

MRV and Seabird are investigating the issues, and we hope to hear back on this issue soon so that we can reschedule our remaining 4 float deployments. The three remaining Deep floats are performing well (including under ice) and have returned 61, 68 and 70 cycles respectively. One of our very early Deep floats (7900637) is a stellar performer and still alive after 6+ years (it has returned 244 cycles).

A map of deployments is shown in Figure 1. We even selflessly deployed a float in the northern hemisphere (at 1°N) to support our northern hemisphere partners, and to repay them for deploying in our hemisphere so willingly for so long[1].

b. technical problems encountered and solved

We continued to play a leading role in the Argo Technician's Community of Practice. Together with Rick Rupan, Bill Dullea, Elizabeth Steffan and Chris Gordon, Pat McMahon organized and co-chaired a Technical Workshop at the University of Washington. The workshop was attended by 68 participants from 9 countries. The workshop was fully open with hands-on breakout sessions with floats from each mainstream manufacturer. The open collaboration fostered stronger industry relationships that will help promote the sharing of best practices across the global Argo community.

Figure 2: Group photo at recent Argo Technical Workshop at UW.

[1] You're welcome.

We reconfigured the battery layout of Teledyne APF11 Argo floats to accommodate an additional DD pack and deployed a 100% lithium powered APF11 with 5 x DDLi battery packs. This increased the total stored energy of the float by over 20%, extending the projected float life by more than 50 profiles, significantly enhancing operational efficiency.
https://fleetmonitoring.euro-argo.eu/float/5905592

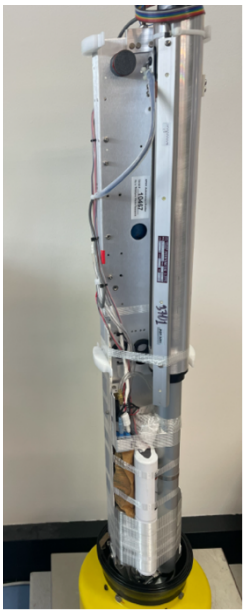
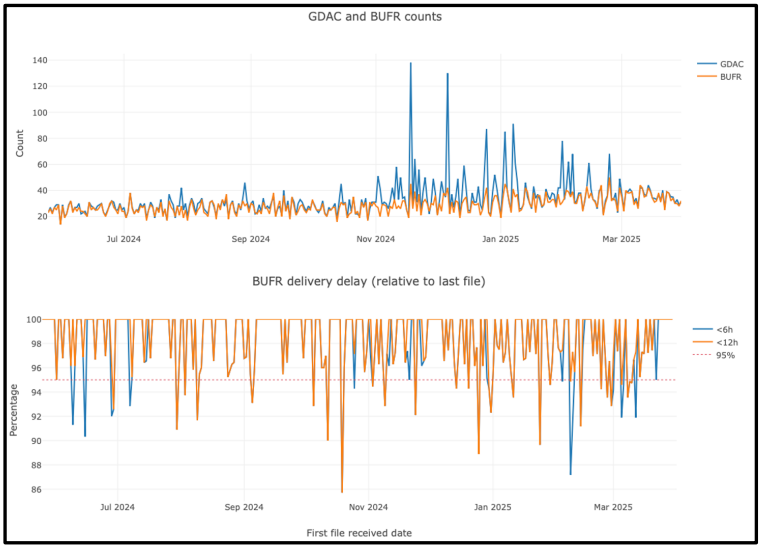


Figure 3: Photos showing how we configured additional battery packs.

We continue to experience problems in data transmission from APF11s due to buoyancy issues (presumably sticky bladder issues). We put these floats (in ice-free regions) in recovery mode about once a month so that floats stay at the surface for 2 days, or more, allowing us to retrieve data from all un-transmitted. These floats have been challenging to manage, and more expensive than normal.

c. status of contributions to Argo data management

i. the status of your DAC, if applicable



Argo Australia currently manage about 364 active floats, delivering around 35 BUFR files a day (Figure 4). We have delivered between 30 and 140 files to the GDAC per day, with higher numbers during the Southern Hemisphere summer, when Southern Ocean floats can transmit their under-ice profiles measured during winter. For most of the time, over 90% of the BUFR files are delivered within 6 hours.

Figure 4: (top) number of files delivered to WMO (BUFR files, orange) and the GDACs (nc files, blue) daily; (bottom) percentage of BUFR files created within 6 h (blue) and 12 h (orange) after profile data has been sent by the floats.

ii. status of high salinity drift floats

A summary of PSAL drift for floats processed this year:

- 16 had sudden onset uncorrectable PSAL with no adjustment required prior to the failure. Of these 4 delivered no good profiles, 4 <50 good profiles, 4 <100 good profiles, 4<150 good profiles

- 16 had PSAL drift corrected with OWC that become uncorrectable before the float died. Of these 3 became uncorrectable before cycle 50, 4 before cycle 100, 5 before cycle 150, 4 before cycle 202

- 29 had PSAL drift or offset that was corrected for some cycles and had no uncorrectable cycles. Of these 3 had fresh offset throughout

- A number of floats (~15) had fresh offset data in early cycles, some for as long as 20 cycles, possibly attributable to TBTO contamination. This represents almost 5% of the floats processed, but may be an under-estimate.

iii. decoding difficulties and highlights

In June 2024 we officially deactivated our Matlab-based RT processing code, making the new Python-based RT processing code (aka PyRT, read 'pirate') our official code. To achieve this, we migrated all the floats that were being processed in Matlab to then be processed in PyRT, with the new code sending the netcdf files to the GDACs.

Migrating our floats from Matlab to PyRT was not a simple task. We had 3 people (2 RT Operators and 1 DMQC Operator) comparing the R-, meta-, and tech-files of 160 floats created by Matlab and by PyRT to make sure the new netcdf files created by PyRT would align well with the legacy files on the GDAC. We had to do this because PyRT creates netcdf files with more information than the legacy Matlab system (e.g., two profiles within a file, one with continuous and one with spot sampling). As we compared the R-files created by Matlab and PyRT we also noticed differences in how the QC tests were applied – because of subjective interpretation of the manual at the time of coding. One example: the MEDD test was being done from the bottom to the surface in Matlab, but in the opposite direction in PyRT, leading to different results. This has been communicated to the custodians of the MEDD test available on github and has been addressed.

Our migration to PyRT was successful at CSIRO. We had no outages during the migration, and we had, and continuously have, systems in place to monitor the data processing in real-time. The migration to PyRT also meant that our Rtraj files are now all in accordance with the ADMT latest standards (with BGC data in Rtraj files to be made available on the GDACs soon). We are still to implement PyRT redundancy in the Bureau of Meteorology (BOM), our partner. However, we already have redundancy in receiving SBD data (going to both CSIRO and the BOM, in addition to the floats' manufacturers). We still have our redundant system of two servers (in two different states of Australia), and BGC data coming through the CLS server.

iv. real time BGC implementation

BR files are produced and submitted to the GDACs in real time. We have implemented BGC data into the Rtraj files and are at final stages of checking before making them available at the GDACs. In-air DOXY coefficients are now updated using the web-interface of PyRT (our python-based RT processing system).

We update the adjustments for our BGC sensors (DOXY, NITRATE, PH) every ~6 months. We have implemented BBP and CHLA RTQC and adjustments (adjustments only for CHLA; no adjustments are recommended for BBP). So far, we've mostly used SAGE for calculating the adjustments on DOXY, NITRATE and PH, but we are now transitioning to using in-air oxygen adjustments, working with Henry Bittig to calculate these off the new traj files. While this transition is in progress, and with some of our DOXY floats residing in areas where in-air calibrations are the only possible way to get a good adjustment, some floats are lagging behind getting their adjustments calculated, but they should all be up to date in a few months.

v. real time Deep implementation

Our current array of Deep floats is only sampling during the descent (due to the inability to decouple ascent and descent sampling). We intend to sample the top few hundred metres on the ascent routinely (for operational data uses) with future Deep floats. We understand there are floats in the water now that are testing firmware that allows ascent and descent sampling levels to be programmed separately, once that is made available on commercial floats, we will implement it.

d. status of delayed mode quality control process

Since April 2024, we have processed 331 floats through DMQC, including 21 with RBR_ARGO3 CTDs and one with RBRoem_v1.16. We have uploaded Dfiles for 98% of eligible profiles and have a raw percentage of 93% Dfiles on the GDACs.

It has been our experience that the US GDAC is not always reliable. We have had several outages ranging from a few hours to a few days over the last year. This affects RT and DM submission. When it happens we still submit to the French GDAC.

We're not producing BD files yet, but we expect to begin producing these in the next 6 months.

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

Argo Australia has funding secured until 2028. This includes support for salary and operating costs for the Australian Argo Program, including Core, BGC, and Deep Argo.

In 2025, we expect to acquire 33 Core floats (including 4 AAPP-funded ice floats), 8 Deep floats, and deploy 3 BGC floats. Core and BGC floats are funded from a strong partnership between IMOS, CSIRO (reviewed

annually), the Australian Department of Defence (reviewed annually), BoM (reviewed annually), and AAPP (contracted until 2029). BGC floats are funded by IMOS, CSIRO, UTAS, and AAPP. Deep floats are funded by AAPP and CSIRO. The sustained funding available only allows purchase of 2-3 BGC-Argo floats annually. We therefore spend considerable time applying for other funding sources for BGC-Argo (Australian Research Council, Schmidt Foundation).

Argo Australia has one Argo technician (Pat McMahon); two scientists running real-time operations, including development and maintenance of our RT system and decoding for all floats (Roger Scott and Gabriela Pilo); two Core DMQC Operators (Jenny Lovell and Tatiana Rykova), one BGC DMQC Operator (Christina Schallenberg), and one Polar DMQC Operator (Esmee Van Wijk) – all supported by one scientific programmer (Dirk Slawinski). The Australian program is led by Peter Oke. Christina Schallenberg and Pete Strutton co-lead our BGC program and Steve Rintoul leads our Deep program. Esmee van Wijk co-chairs the Polar Argo Mission Team. In total, Australian Argo draws on ~6 FTE.

Argo Australia intends to continue providing AUD$100K funding to support operations of the RV Kaharoa II, and AUD$30K (indexed annually) funding to support OceanOps.

3. **Summary of deployment plans: as was done last year, please fill out this spreadsheet to help us understand the progress towards implementation of OneArgo. There is one new column this year for floats being deployed with experimental sensors such as UVP, C-sensor, etc. This spreadsheet is to be returned separately by 17 March to help prepare for the meeting. It can be sent to Megan or dropped in this folder link.**

Our planned deployments are summarized in Figure 5. We are encouraged by the innovation shown by NKE and have agreed to purchase and deploy 9 Arvor V2s in the coming year.

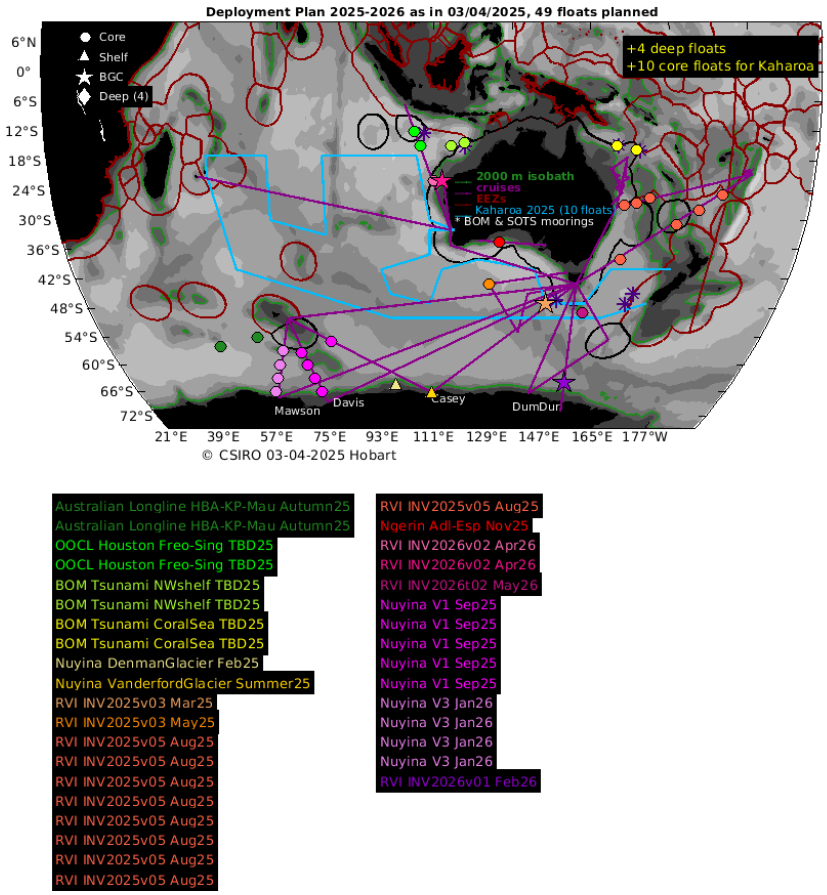
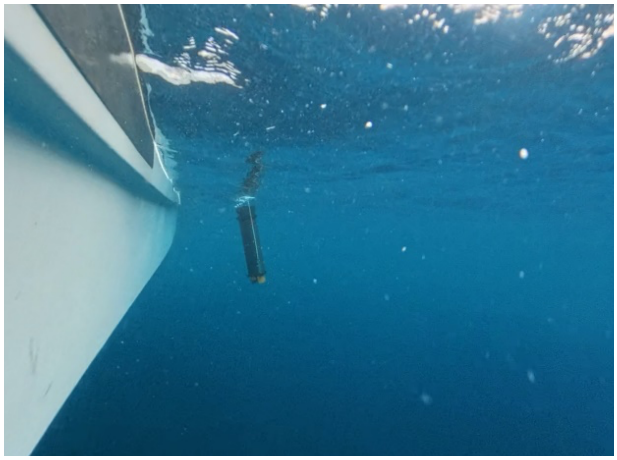


Figure 5: Deployment plan for Argo Australia, showing planned deployments by float type and by cruise.

4. Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.

We deployed five floats that were equipped with ice guards (both pole and eggbeater style Figure 6) and deployed in the seasonal ice zone to test if they increase survivability of floats and to gain opportunistic measurements of sea ice draft.

Figure 6: Pole type ice guard (left) and eggbeater type ice guard (right) on TWR APEX APF11 floats.



Pat McMahon has continued with the development of a shallow, low-cost float. This has included submission of one patent application Underwater Vessel, Australian Patent Application number 2024902143. We recently tested the float to a depth of 135m and aim to test to 200m later this year once we install a GPS module on the float.

Figure 7: Photo of the prototype shallow float during testing.

For BGC-Argo floats, we have settled on NKE as our preferred float for the time being, and have started adding hyperspectral irradiance sensors to our future float orders (instead of the 4-channel OCR sensor). We also recently deployed a float with UVP (in collaboration with the University of Tasmania).

Argo Australia continues to coordinate the Argo DMQC Discussion series. A record of meetings is maintained here. DMQC discussions are held every two months. The next meeting, scheduled for May, will be the 20th meeting of this community. The meeting continues to be well-attended, with 28 participants at the last meeting (meeting 19), the highest attendance at this forum to date.

Figure 8: Screenshot of participants at a recent Argo DMQC Discussion.

5. **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 Argo websites.**

Argo data are used operationally to underpin Australia's short-range ocean forecast system (OceanMAPS; www.bom.gov.au/oceanography/forecasts/), ocean, and seasonal prediction systems (POAMA; www.bom.gov.au/climate/ocean/outlooks/).

A new version of the Bluelink ReANalysis has been disseminated (BRAN2023). BRAN2023 includes incremental improvements over the previous version and includes BGC. Details are at: https://dx.doi.org/10.25914/2wxj-vt48.

6. **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. Also, during the AST-26 plenary, **each national program will be asked to mention a single highlight or issue via a very brief oral report.**

We are concerned that the Argo community may be "over-correcting" salinity, as part of the DMQC process, in the Coral Sea. We are analysing data from 289 floats in the Coral Sea (146-164°E, 25-10°S). Of these floats, the difference between PSAL_ADJUSTED and PSAL suggests that OWC has been applied to up to 116 floats – 40% of floats. We expected that OWC would only be applied to about 10% of floats (perhaps 20% after ASDs appeared). Of the corrections, the majority of disseminate PSAL_ADJUSTED fresher than PSAL. Our analysis is too preliminary to draw solid conclusions, but we are beginning to suspect that the deep salinity in the Coral Sea is slowly changing, and that our community is unintentionally "masking" this signal. This analysis is being led by Tatiana Rykova and will be raised at a future DMQC Discussion.

7. **Outreach and communication: please describe, in brief, outreach efforts within your national program over the past year. Also, if you've issued any communications, press releases, participated in articles, etc, please send the links. We are considering our social media strategy, so please let us know which social media you engage with and the corresponding handles.**

We were involved in production of a special Issue of Frontiers in Marine Science on, "Demonstrating Observation Impacts for the Ocean and Coupled Prediction". The special issue included many demonstrations of the impact of Argo on data-assimilating forecast and reanalysis systems. This was an initiative under SynObs, UN Decade Project under OceanPredict. The editorial for the special issue is accepted and will be published soon (doi: 10.3389/fmars.2025.1588067).

Peter Oke gave a presentation on "the potential of Argo data to improve coupled numerical weather prediction" at the 8th WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction and Earth System Prediction. There were three oral presentations inn plenary that demonstrated the impact of Argo on ocean or coupled prediction (by Oke, Thierry, Remy). These

presentations included strong advocacy for the Argo Program to WMO. Workshop recommendations included:

> 3.1.4. To sustain routine observations of the ocean temperature and salinity profiles (for example, Argo, gliders).
>
> 3.1.5. To further enhance capability to measure deep-ocean physical parameters and ocean biogeochemical

Other comments in the final report include:

- Argo DA has a large impact on ocean and NWP at all ranges.
- Argo is currently research-funded. It needs to be funded in the same way as atmospheric observations.
- Argo extension will help to constrain the representation of ocean heat and freshwater contents in Western Boundary Currents (WBCs) and the interannual variability in the tropics.
- Argo observations strongly constrain the large-scale vertical structure of the ocean temperature and salinity analysis up to 2000 m.

Based on a peer-reviewed paper published in May 2024, we published a piece in the Australian Conversation https://theconversation.com/floating-robots-reveal-just-how-much-airborne-dust-fertilises-the-southern-ocean-a-key-climate-shock-absorber-225793.

We've been deploying floats off voyages from the CAPSTAN Australian sea training program (~yearly voyages). These voyages offer learning and development opportunities for university students, trainers and Chief Scientists. Before the voyage, we give a talk about the Argo program, how the floats work, deployment practices, and the scientific reasons to why we're deploying a float at a specific location. It has been a rewarding experience.

We also discuss Argo data in relation to other ocean data though our partner projects (e.g., Argo profiles under a tropical cyclone, and outlook for national yacht race).

We contribute to an Instagram account that may occasionally publish stories/posts about Argo: imos_australia

Argo also has a features prominently in CSIRO's outreach initiative INVESTIGATE (a container that immerses the public into ocean science done onboard the RV Investigator) – see here (glimpse of Argo at 1:13).

8. **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.**

Table 1: Table of reference CTDs and details of buddy Argo float deployments.

Deployment date & time	Lat	Lon	Ship	Voyage	CTD#	Argo PI
2024-01-22 09:11:00	-63.8786	140.0050	RVI	2024_01	020	Rintoul
2024-01-24 13:39:00	-62.0200	132.0000	RVI	2024_01	023	Rintoul
2024-01-25 10:02:00	-63.0040	131.9682	RVI	2024_01	025	Rintoul
2024-01-30 03:11:00	-62.9990	122.9980	RVI	2024_01	031	Rintoul
2024-01-30 14:42:00	-54.4823	122.9960	RVI	2024_01	032	Rintoul
2024-02-02 11:10:00	-63.6540	113.3060	RVI	2024_01	036	Rintoul
2024-02-03 11:24:00	-62.7830	113.3160	RVI	2024_01	038	Rintoul
2024-02-05 11:47:00	-61.6577	114.1569	RVI	2024_01	043	Rintoul
2024-07-01 20:13:29	-28.3052	155.1012	RVI	2024_04	116	Shallenberg
2024-12-28 10:45:00	-38.7430	116.8650	Sonne	SO308/2	1	Shallenberg
2024-12-29 23:48:00	-38.8770	122.5130	Sonne	SO308/2	3	Oke
2025-01-01 07:13:00	-38.9970	132.5370	Sonne	SO308/2	5	Oke
2025-01-02 22:33:00	-39.3730	138.6880	Sonne	SO308/2	7	Oke
2025-01-07 22:11:00	-40.9100	154.1680	Sonne	SO308/2	13	Oke
2025-01-09 21:06:00	-40.6230	162.0730	Sonne	SO308/2	15	Oke
2025-03-10 09:03:37	-38.6400	149.0500	RVI	2025_01	006	Oke
2025-03-26 10:14:00	-65.3040	99.2665	Nuyina	Denman	45	Rintoul
2025-03-25 21:36:00	-65.3445	99.9660	Nuyina	Denman	43	Rintoul

9. **Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.**
   There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)). If you know of any doctorate theses published in your country that are missing from the list, please let me know. Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

Argo Australia PIs: Peter Oke, Pete Strutton, Steve Rintoul, Christina Schallenberg, Phillip Boyd, Felicity McCormack, Esmee van Wijk, Denise Fernandez (NZ)

We value the bibliography and use it often to inform reports to our funders. We do not have a c comprehensive list of papers using Core or Deep floats. But BGC Argo papers missing from the Bibliography (not all from the past year) follows:

Vives, C.R., Schallenberg, C., Strutton, P.G., Boyd, P.W. (2024). Biogeochemical-Argo floats show that chlorophyll increases before carbon in the high-latitude Southern Ocean spring bloom, Limnology & Oceanography Letters, in press, doi: 10.1002/lol2.10322

Schallenberg, C., Strzepek, R.F., Bestley, S., Wojtasiewicz, B., Trull, T.W. (2022). Iron limitation drives the globally extreme fluorescence/chlorophyll ratios of the Southern Ocean. Geophysical Research Letters 49 (12), e2021GL097616

Su, J., Schallenberg, C., Rohr, T., Strutton, P.G., Phillips, H.E. (2022). New estimates of Southern Ocean annual net community production revealed by BGC-Argo floats. Geophysical Research Letters, e2021GL097372

Tang, W., Llort, J., Weis, J., Perron, M.M.G., Basart, S., Li, Z., Sathyendranath, S., Jackson, T., Sanz Rodriguez, E., Proemse, B.C., Bowie, A.R., Schallenberg, C., Strutton, P.G., Matear, R., Cassar, N. (2021). Widespread phytoplankton blooms triggered by 2019-2020 Australian wildfires. Nature, https://doi.org/10.1038/s41586-021-03805-8

Su, J., Strutton, P., Schallenberg, C., 2021. The subsurface biological structure of Southern Ocean eddies revealed by BGC-Argo floats. Journal of Marine Systems, 220, 103569.

BGC Argo theses from the University of Tasmania missing from the list:

- https://figshare.utas.edu.au/articles/thesis/The_Southern_ocean_s_biological_response_to_atmospheric_iron_fertilisation/26123578
- https://figshare.utas.edu.au/articles/thesis/Regional_variability_of_the_Southern_Ocean_spring_bloom/25143761
- https://figshare.utas.edu.au/articles/thesis/Carbon_export_and_mesoscale_eddy_structure_in_the_Southern_Ocean_revealed_by_BGC-Argo_floats/26027068

10. Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2025 and 2026 (if known) and where they might be deployed.

We are closely monitoring the performance of floats deployed with RBR sensors and intend to resume purchasing floats with RBR CTDs soon.

ARGO National Report 2024: Bulgaria

Violeta Slabakova, Atanas Palazov and Ivelin Petkov

Institute of oceanology – BAS

March 2025

1. Status of implementation

The BulArgo programme is a component of the project MASRI – Infrastructure for Sustainable Development of Marine Research and Participation in European Infrastructure (Euro-Argo). (http://masri.io-bas.bg/), a part of the National roadmap for scientific Infrastructure (2020-2027) of the Republic of Bulgaria.

The BulArgo programme comprises a consortium of three scientific organizations: Institute of Oceanology (IO-BAS) in Varna, Sofia University "St. Kliment Ohridski" and National Institute of Meteorology and Hydrology in Sofia.

Since 2011, IO-BAS has deployed a total of 17 floats under the BulArgo programme, which is the Bulgarian contribution to the Euro-Argo ERIC infrastructure. The floats have provided approximately 3000 profiles of which 1 800 include DOXY measurements (Fig.1). Currently the number of active floats in the Black Sea is 11 out of which 9 are operated by Bulgaria.

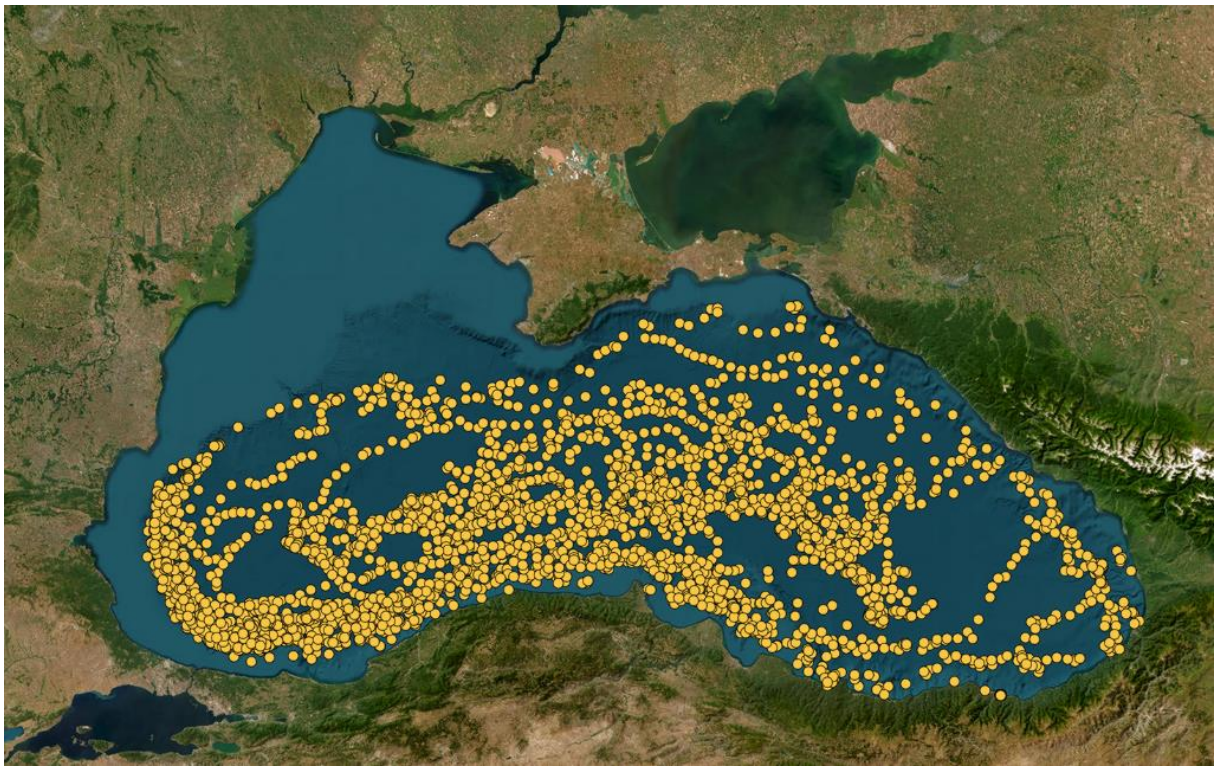


Figure 1. Profiles of the BulArgo programme (2011-2025)

a) Floats deployment and their performance

During 2024, two BulArgo floats were deployed in the Black Sea under the framework of the MASRI project. Both floats were ARVOR - DO – I, manufactured by NKE (France). The floats integrate an Iridium satellite telemetry system which provides a dual telecommunication capability, allowing real-time modification of their configuration.

The first float (WMO 7902191) was deployed on June13, 2024 in the Georgian Black Sea waters from board of R/V Mare Nigrum during H2020 DOORS project cruise (MN256). One month later, the second float (6990663) was deployed in the Bulgarian Black Sea waters during R/V Akademik survey.

Both floats were programmed to cycle between the surface and 2000 dbar every 10 days. Currently, the floats are operational. The status information for the Bulgarian floats deployed in the Black Sea during 2024 is presented on Table 1.

Table 1. Status information for the floats deployed in the Black Sea during 2024

Model	WMO	Deployment date	Deployment time	Latitude, N	Longitude, E	№ of Cycles	Status
ARVOR-DO	7902191	13/06/2024	14:02:00	41.7255	41.2344	24	active
ARVOR- DO	6990663	10/03/2024	07:15:00	42.8346	28.8267	24	active

b) Technical problems encountered and solved

Delayed or partial transmissions have been observed on several Argo floats operating in the Black Sea.

c) Status of contributions to Argo data management (including status of conversion to V3 file, formats, pressure corrections, etc.)

After the float deployments, detailed technical information was provided to the Euro-Argo ERIC Office and uploaded to the OceanOps website. The BulArgo program is aware of the changes in technical and metadata formats and ensures the necessary information is provided.

d) Status of delayed mode quality control process

The BulArgo programme does not have the human resources and capacity to implement delayed mode quality control of the Argo data. The delayed mode quality control of the T/S data from BulArgo floats is carried out by the MedArgo data center (OGS, Italy)

2. Present level and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

In 2024, Bulgaria remains a committed member of the Euro-Argo ERIC. The national funding for 2024 covers float procurement, deployment, and communication costs. Three staff members at IO-BAS are engaged Euro-Argo and BulArgo activities. They do so besides their other duties with minimum financial support by MASRI.

3. Summary of deployment plans (level of commitment, areas of float Deployment, low or high resolution profiles, extra sensors, Deep Argo) and other commitments to Argo (data management)for the upcoming year and beyond where possible)

In 2025, IO-BAS plans to deploy:

- ✓ ARVOR -DO float in the Romanian Black Sea waters during AQUARUIS cruise (if granted)
- ✓ ARVOR – DO and ARVOR- (RBR) in the Bulgarian Black Sea waters

Given the evolving geopolitical situation in the Black Sea, the deployment plan may be subject to changes or delays.

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

4.1. Operational and scientific use of Argo data

BulArgo focuses on both research topics and marine climate monitoring of the Black Sea. Argo data are routinely assimilated into the BS-MFC operational Black Sea forecasting system of the Copernicus Marine Environment Monitoring Service (CMEMS). Argo data are being used by researchers from the Black Sea countries to improve the understanding of Black Sea physical and biogeochemical properties and to validate numerical models.

The BulArgo program website (https://bulargo.io-bas.bg/) serves as a platform to showcase and promote the activities of Argo, Euro-Argo, and BulArgo programmes. The site is regularly updated with the latest information, offering data access for all floats operating in the Black Sea and highlighting Bulgarian Argo activities, news, and data from Argo floats. The website is continuously upgraded, with the addition of more images and videos documenting float deployment activities.

5. Outreach and communication:

In 2024, several dissemination activities were carried out by the BulArgo program team, including:

- Training for Georgian scientists on Argo float technology, including onboard testing and float deployment. R/V Mare Nigrum, June 2024, H2020 DOORS cruise №3.

- Presentation of the EA ERIC and BulArgo activities to the students from Spain, Italy, Estonia, Croatia, Turkey and Bulgaria during their visit to the Institute of oceanology in Varna, Bulgaria (Mar 2024).

- Presentation of Argo floats technology to the participants in the First Lego League (FLL) competition - Season DIVE (SUBMERGED) (4 Nov, 2024).

- Joint presentation by Euro-Argo ERIC and IO-BAS on Climate Argonauts at the Beautiful Science Festival in Varna, Bulgaria, on October 27, 2024. (https://beautifulscience.bg/en/produkt/climate-argaunauts/)

6 Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo.

Non.

7. 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.

At all deployment locations a deep CTD station was taken. The ship-data will be sent to Argo (Reference Database).

8 Does your National Program have any deployment plans for RBR floats in the next couple years?

Planned in 2025.

9 Black Sea Ago bibliography for 2024

Çokacar, T. (2024), Cold Intermediate Water Formation in the Black Sea Triggered by March 2022 Cold Intrusions, Journal of Marine Science and Engineering, 12(11), doi: https://doi.org/10.3390/jmse12112027.

Kubryakov, A. A., A. G. Zatsepin, O. S. Puzina, and S. V. Stanichny (2024), The impact of vertical mixing on the variability of salinity in the Black Sea pycnocline: Role of winter convection, vertical shear and mediterranean waters injections, Deep Sea Research Part I: Oceanographic Research Papers, 208, 104321, doi: https://doi.org/10.1016/j.dsr.2024.10432 1

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Polonsky, A. B., and A. A. Valle (2024), Reasons for the Long-Term Variability of the Dissolved Oxygen Concentration in the Upper Layer of the Black Sea, Dokl. Earth Sc., 516(1), 768-773, doi: https://doi.org/10.1134/S1028334X24600853

Zhuk, E. V., and N. V. Markova (2024), Geoinformation System for Argo Floats Drift Assessment: The Black Sea Case, Physical Oceanography, 31(4), doi: http://www.physical-oceanography.ru/repository/issues/2024/04/07/20240407.pdf

E. V. Stanev, C. B. Gramcianinov, J. Staneva, V. Slabakova (2024) Thermohaline Intrusions as Seen by Argo Floats: The Case of the Black Sea, Journal of Geophysical Research: Oceans, https://doi.org/10.1029/2024JC021762

Argo Canada – Report of Activities for 2024

Submitted by: Blair Greenan, Katja Fennel, Tetjana Ross, Clark Richards, Chris Gordon, Anh Tran, Qi Wang, Roberta Hamme, Kohen Bauer and Marcel Babin

26th meeting of the Argo Steering Team (AST-26)

Location: Hybrid (La Jolla, CA & Virtual)

14-18 April 2025

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)
    a. floats deployed and their performance
        i. For Jan-Dec 2024, Argo Canada deployed a total of 38 floats.
        ii. Float Types:

            - 14 ARVOR-SBE (DFO/DND)
            - 1 ARVOR-RBR (DFO)
            - 2 ARVOR+DO (DFO/UVic)
            - 8 Deep ARVOR+DO (ONC)
            - 10 PROVOR CTS4 (DFO/UVic)
            - 3 PROVOR CTS5 (Dalhousie)

        iii. Deployment Regions:

            - 5 - Ross Sea
            - 2 - Drake Passage
            - 6 - Indian Ocean
            - 12 – North Atlantic Ocean
            - 11 – North Pacific Ocean
            - 2 – Beaufort Sea

        iv. Multiple floats (4902531, 4902669) in the Ross Sea, Beaufort Sea, Baffin Bay emerged from under ice to report profiles.
        v. More details are available at: Argo Canada Development Blog: 2024

b. technical problems encountered and solved

Overall this has been a relatively smooth year technically. Argo Canada has been deploying NKE floats in the recent past which have been a very reliable platform. This year, we received our first order of Teledyne APEX floats. Ahead of their deployment we have been relying on the expertise of Teledyne and the Argo technical community to ensure successful deployment and operation of the floats.

i. One deployed float (4902565 ARVOR-SBE) in the Beaufort Sea never properly activated and/or returned any technical or profile data. Unfortunately this float should not have been deployed, and although a technical issue may contributed to the loss of this float, we attribute the loss to user error rather than a problem with the float.
ii. One ARVOR-SBE float experienced vacuum pressure issues and was not deployed, returned to NKE, and repaired. Currently this float is being shipped back to the Institute of Ocean Sciences (IOS).
iii. NKE & RBR recalled 2 ARVOR-RBR floats for investigation as a number of this model across the Argo network were experiencing a rapid power drawdown resulting in premature end of float life. No systematic problem was discovered and these floats are being returned to IOS, ready to deploy.
iv. One ARVOR-SBE float (4902653) deployed off South Africa failed after 4 profiles, reason still to be determined.
v. Any other ARVOR floats that have failed to report as expected this year are in marginal ice zones, and we expect/hope to hear from them in their respective summer seasons.

c. status of contributions to Argo data management including:
   i. the status of your DAC, if applicable

MEDS currently acquires data from 196 active floats. The data processing system runs every 3 hours. The profile, technical, trajectory and meta file of core Argo floats are transmitted to the GDAC in NetCDF format. For BGC and Deep Argo floats, all NetCDF files are available at the GDAC, except for the trajectory NetCDF files.

From January 2024 to January 2025, on average, 530 messages were issued monthly on the Global Telecommunication System (GTS) in BUFR format, of which 87% of the data were within 12 hours of the floats reporting. All temperature, salinity, and adjusted chlorophyll-A data are issued to the GTS in BUFR format.

MEDS completed the development of encoding BGC variables in BUFR format for GTS transmission. The program has been tested and implemented at the US Argo DAC, AOML. The program is written in Java and is available at https://github.com/trana99/ArgoBufrEncoder/tree/master

ii. status of high salinity drift floats

In the 17 DMQCed floats of last year, high salinity drifts were detected for floats 4902445, 4901824, 4901823, and 4901822. Float 4902445 failed the min/max test and was flagged in the Ifremer monthly anomaly report. This float is still active but has been grey listed due to the high salinity drift. Another 6 floats (4902555, 4902444, 4902447, 4902595, 4902653, 4902657), flagged by the monthly anomaly report, are actively being worked on and should be resolved shortly.

iii. decoding difficulties

All of the decoders for the current active floats were developed. We have a new Teledyne Apex Webb float type which we'll need to develop the module to handle this float type. At the moment of preparing this report, we have no difficulties in decoding data transmitted by floats. However, we are still having some difficulties to create the trajectory NetCDF file version 3.2 that will completely pass the GDAC file format checker without any warnings.

iv. real time BGC implementation

MEDS processes data transmitted by 20 BGC floats in real-time. All variables (oxygen, chlorophyll-A, pH, BBP and irradiances) with exception of nitrate, which currently has QC flags of 0, are quality controlled in real-time. Only one float with a Nitrate (SUNA) sensor is operational at this time, and the QC process for it will be completed and tested shortly. Chlorophyll-A is also adjusted in real-time. A test version of the regionally defined chlorophyll adjustment (Suazède) has also been implemented and will be able to be deployed quickly following AST/ADMT approval for that adjustment.

v. real time Deep implementation:

MEDS processes data transmitted by Deep Arvor floats in real-time. Data are quality control as described in the Argo quality control manual for CTD and Trajectory Data version 3.6.1. Pressure, temperature and salinity from Deep Argo floats are adjusted in real-time using the new Cpcor_new= –13.5e–8 $dbar^{-1}$

d. status of delayed mode quality control process

In early 2024, the core DMQC process was interrupted due to a shortage of staff. Starting from August 2024, a new core DMQC operator filled the position, to resume the regular DMQC process at MEDS, address the backlog, and maintain and document the internal DMQC code and tools. As of February 10th 2025, about 2528 profiles from 17 core Argo floats have been DMQCed since last year. Approximately 64% of eligible

profiles have been DMQC'd at least once, 68% of eligible floats have been DMQC'd at least once for salinity, while 50% of floats have been DMQC'd at least once with both salinity and pressure. The backlog of core DMQC is persistent and will still be the priority of this year.

As for the internal MATLAB package, the majority of the scripts were developed between 2017 and 2019, and the first stable release was published in the private DFO-MEDS repository on GitHub in 2023. The following changes have been made since last year to improve the functionality of the DMQC package:

• Implemented the thermal mass correction

• Aligned the major scripts with evolving NetCDF formats, including variable name updates and profile number modifications

• Addressed existing bugs

• Updated the OWC method with the most recent climatology and reference database

The monthly anomaly reports issued by Ifremer (French GDAC) were carefully reviewed and the anomalies were flagged and updated to GDAC NETCDF files.

DOXY is the only BGC variable currently being DMQCed. As our floats with additional sensors (FLBB, pH) have begun to age, there will be a priority to DMQC those variables in the coming year. This will likely be handled by the same operator performing DOXY DMQC.

At the time of writing this report, 2034 of 10656 (19.3%) eligible DOXY profiles are in D-mode. An additional 1374 (13.0%) are in A-mode.

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

Financial resources

Argo Canada has ongoing funding for the O&M expenditures related to the International Argo program. The majority of these expenditures are related to Iridium telecommunications costs which are managed by Shared Services Canada (SSC) and paid for by DFO. The Iridium SBD and RUDICS services are provided by MetOcean Telematics, which has a contract to supply Iridium services to the whole of the Government of Canada. A request for proposals for a new contract to provide Iridium services is posted and closes March 3, 2025.

Capital for float purchases by the Government of Canada is requested annually and the amount allocated is typically confirmed early in the fiscal year which starts on April 1st. The Government of Canada (DFO and Department of National Defence – DND) committed $416k CAD for

purchases of core TWR APEX floats in the Fiscal Year 1 April 2024 to 31 March 2025. The funding resulted in the acquisition of 14 core Argo floats (7 SBE CTD, 7 RBR CTD). This represents a slight reduction in DFO/DND procurements relative to the preceding year.

The project “A BGC Argo Program for the NW North Atlantic Ocean” led by Dalhousie University and the Memorial University of Newfoundland, has been funded by the Canadian Foundation for Innovation (CFI), Research Nova Scotia (RNS), and the province of Newfoundland for a total cost of $8.8M. Five NKE PROVOR CTS5 floats have been deployed and an additional 27 floats were ordered from NKE in September 2024. All PROVOR floats will be equipped with an SBE CTD, OCR (4 wavelengths), pH, Aanderaa DO, RBR tridente (2 chl, 1 bbp), and extra battery (Jumbo CTS5). 16 of the floats will also be equipped with an Opus nitrate sensor. Delivery schedule: 10 in June 2025, 8 in October 2025 and 9 in January 2026. Furthermore, 2 NKE floats from Takuvik that were previously deployed in Baffin Bay and have been recovered, will be refurbished by NKE. They are equipped with an SBE CTD, SBE OCR, SBE Eco-puck, Aanderaa DO, and a SUNA nitrate sensor.

CFI funding held jointly by the Universities of Victoria and British Columbia (C-PROOF) has been providing BGC sensors for floats deployed in the Northeast Pacific. This funding had ended with final purchases in 2023, and the team is working on a new CFI proposal that -if funded- would provide more BGC floats for the northeast Pacific. In March 2023, five DFO PROVOR CTS4 floats were delivered with SUNA (nitrate) sensors plus the jumbo option (purchased by UVic) – two of these were deployed in 2024. In addition, two PROVOR floats (oxygen, nitrate, irradiance, chlorophyll, and backscatter sensors) were purchased by UVic and delivered in October 2023. However, the radiometers were delivered with wavelengths that did not meet the requirements, and new radiometers to replace them were received from NKE in Feb 2025. The remaining five C-PROOF BGC floats are planned for deployment in the northeast Pacific in 2025 and 2026.

In 2023, Ocean Networks Canada (ONC) received 18 NKE Deep ARVOR floats, which can profile to 4000 m and carry Aanderaa 4330 dissolved oxygen sensors. 13 of these floats have been successfully deployed to date, 11 in the NE Pacific (6 in 2024) and 2 floats in the Southern Ocean (both in Feb 2024). The remaining 5 floats will be used to maintain the array established in the Northeast Pacific.

Since 2016, Takuvik has deployed 24 BGC Argo floats (funding being provided by French and Canadian projects, each up to 50%), which have acquired more than 2,500 profiles (temperature, salinity, backscattering coefficient at 700 nm, radiometric data along 4 channels, as well as concentrations of a) dissolved oxygen, b) chlorophyll-a, c) colored dissolved organic matter, d) nitrate.

The development of close links between the Argo Canada program and both the operational meteorology and operational oceanography R&D activities at the Canadian Meteorological Centre (Dorval, Québec) has been beneficial. An inter-departmental (Environment and Climate Change Canada, Department of National Defence, Fisheries and Oceans) Memorandum of Understanding entitled CONCEPTS (Canadian Operation Network of Coupled Environmental PredicTion Systems) has provided strong advocacy for the Argo program and has facilitated the financial support from DND.

Human resources

The following people contribute to the logistics and data management for Argo Canada:

- Anh Tran (DFO, MEDS, Ottawa) – DAC lead, RTQC Operator
- Qi Wang (DFO, MEDS, Ottawa) – DMQC Operator (core Argo)
- Andrew Stewart (DFO, OSB, Ottawa) – National Manager, Ocean Monitoring and Observing
- Tyler Emmott (DFO, OSB, Ottawa) – Float procurement, contracting
- Blair Greenan (DFO, BIO, Halifax) – AST member, Argo Canada lead
- Chris Gordon (DFO, BIO, Halifax) – DMQC Operator (BGC), deployment planning, logistics, performance monitoring
- Clark Richards (DFO, BIO, Halifax) – Research scientist, Argo Polar Task Team member, RBRArgo data task team member, argoFloats R package developer/maintainer
- Adam Hartling (DFO, BIO, Halifax) – Field support
- Tetjana Ross (DFO, IOS, Sidney) – Research scientist, Pacific deployment planning, Canadian member of the International Deep Argo Mission Team
- Lindsay Mazzei (DFO, IOS, Sidney) – Field support
- Katja Fennel (Dalhousie University, Halifax) – Canadian member of the International BGC-Argo Steering Committee
- Adam Stoer (Dalhousie University, Halifax) – PhD student
- Dan Kelley (Dalhousie University, Halifax) – argoFloats R package developer/maintainer
- Kohen Bauer (Ocean Networks Canada) – Principal Investigator and DMQC operator, Deep Argo
- Roberta Hamme (University of Victoria, Victoria) – Professor, UVic Argo lead
- Herminio Folio Neto and Jeannette Bedard (Ocean Networks Canada) – DMQC Operators, Deep Argo

In addition to the above people, we benefit from the technical support of many sea-going staff that follow pre-deployment protocols and perform the float deployments.

National Coordination

With increasing participation in the Argo program within Canada, both in core Argo, BGC-Argo and Deep Argo, it was decided to establish a new governance structure in 2018. The Canadian Argo Steering Team (CAST) provides scientific leadership and oversees the development and implementation of the Canadian contribution to the International Argo Program. The CAST is chaired by Blair Greenan and meets annually prior to the Argo Steering Team meeting.

The Canadian Biogeochemical-Argo Committee facilitates the implementation of the Canadian contribution to the Biogeochemical-Argo program by coordinating and advising national efforts and acting as liaison to the International Biogeochemical-Argo Steering Committee. The Committee is chaired by Katja Fennel.

3. Summary of deployment plans: as was done last year, please fill out this spreadsheet to help us understand the progress towards implementation of OneArgo. There is one new column this year for floats being deployed with experimental sensors such as UVP, C-sensor, etc. This spreadsheet is to be **returned separately by 17 March** to help prepare for the meeting. It can be sent to Megan or dropped in this folder link.

   In 2025, Argo Canada plans to deploy approximately 25 floats in the Northeast Pacific, North/South Atlantic, and in polar regions:

   - 16 Core
   - 1 BGC (2-3 sensors)
   - 5 BGC (4-6 sensors)
   - 3 Deep + O

4. Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.

   Dalhousie University has ordered floats from NKE with new sensors such as the RBR Tridente and the Opus nitrate sensor. These floats will be deployed in the next few years with an intent to evaluate the performance of these sensors.

5. 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 Argo websites.

   The Canadian Centre for Meteorological and Environmental Prediction (CCMEP) uses observations from the Argo array for a variety of operational and research applications. These include direct assimilation into operational weather and environmental prediction systems, monitoring of forecast quality (verification), and well as detailed research to improve model physics (e.g. further development and optimization of model parameterizations) and data assimilation (e.g. Observing System Experiments). The CCMEP Global and Regional Ice Ocean Prediction Systems (GIOPS and RIOPS) provide daily estimates (analyses) of ocean and sea ice properties using a multi-variate data assimilation system assimilating Argo observations together with other sources of in situ temperature and salinity, satellite altimetry, and sea surface temperature data. GIOPS analyses are used to initialize the ice-ocean components of the coupled Global Deterministic Prediction System (GDPS), responsible for providing operational medium-range weather forecasts for Canadians. GIOPS analyses are also used to initialize the operational forecasts from the Canadian Seasonal-Interannual Prediction System (CanSIPS). Temperature and salinity from GIOPS analyses are also used to represent the baroclinic effects in the Global Deterministic storm Surge Prediction System (GDSPS). RIOPS analyses are produced in a model that includes tides and provides daily three-dimensional state of the ocean estimates for Canada's three coastlines on a domain covering the North Pacific, Arctic, and North Atlantic Oceans. Coastal forecasts are produced for the east and west coast of Canada at 2km resolution using spectral nudging to RIOPS analyses. More Argo data is needed in the Arctic

to improve the performance of the CCMEP data assimilation systems, and to provide a reliable dataset for verifications, e.g., the new CAPS (Canadian Arctic Prediction System) which will be implemented in March 2025.

Argo data is used in the verification of ocean prediction systems in support of the OceanPredict Inter-comparison and Validation Task Team. Comparisons of Argo and model profiles are available on https://navigator.oceansdata.ca. The Department of National Defence (DND) scientists, operational oceanographers and sonar operators routinely use real time Argo vertical profiles to assess model performance and, in some instances, use as data to compute acoustic range predictions, both at sea and in the Meteorology and Oceanography Centres (Esquimalt and Halifax). DND uses the web-based Ocean Navigator tool to assist with these activities.

The Argo Canada web site is maintained by Fisheries and Oceans Canada at http://www.isdm.gc.ca/isdm-gdsi/argo/index-eng.html. A deployment planning and history website is available at Argo Canada Development Blog: Deployment Planning. A repository of Argo-related code under development through DFO has been made available on Github at https://github.com/argoCanada. Repositories include the under-development python BGC DMQC tools, the argoFloats and argodata R packages, a python package for finding and working with Argo data (argopandas), and an informal blog used to highlight interesting floats and issues encountered when working on Argo DMQC.

Dalhousie University and the University of Newfoundland are leading an infrastructure project for implementation of a regional BGC Argo array in the northwest North Atlantic with funding from the Canada Foundation for Innovation, Research Nova Scotia, and the province of Newfoundland. Research questions to be addressed include the sensitivity of carbon sequestration and ocean ventilation in the Labrador Sea to changing atmospheric and oceanic conditions, new approaches to biological rate measurements using Argo measurements (e.g., NCP, vertical carbon flux), assessment of the skill of climate models in the region, and implementation of a data-assimilative physical-biogeochemical ocean model for the region. As part of the project, a Canadian adopt-a-float program was launched (https://adopt-a-float.ocean.dal.ca/). The Canadian BGC Argo website is maintained by Katja Fennel's research group at http://bgc-argo.ocean.dal.ca/

Research efforts at the University of Victoria currently focus on improving oxygen optode calibration protocols using in-air measurements and on estimating biological carbon export in the NE Pacific from two methods 1) oxygen utilization rates from subsurface changes in oxygen and 2) surface ocean oxygen mass balance. Argo Canada floats carrying oxygen sensors in the NE Pacific are a primary emphasis.

6. 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. Also, during the AST-26 plenary**, each national program will be asked to mention a single highlight or issue via a very brief oral report**.

Argo Canada encourages the AST to continue support for the Basin Planning Working Groups. This has improved information-sharing among the groups deploying floats and is helping to identify deployment opportunities.

7. Outreach and communication: please describe, in brief, outreach efforts within your national program over the past year. Also, if you've issued any communications, press releases, participated in articles, etc, please send the links. We are considering our social media strategy, so please let us know which social media you engage with and the corresponding handles.

   The Canadian adopt-a-float program (https://adopt-a-float.ocean.dal.ca/) is led by Dalhousie University with support from DFO and the University of Victoria. Activities in 2024 included several school visits to the Bedford Institute of Oceanography, where students learned about Argo and the ocean monitoring work done by DFO, and got to name and sign an adopted float. Most classes have been at the high school level, owing to a specific ocean-based course in the Nova Scotia curriculum ("Oceans 11"). In October 2024, we had our first adopt-a-float with an elementary class (Grade 6, as a school visit rather than a visit/tour at BIO), which was a great success. Based on completed visits from 2024 and ones already-booked for 2025, we expect to reach approximately 6-8 classes across the province (i.e., not just in Halifax) this year. A major boost to the uptake of the program in 2024 followed attendance at the Association of Science Teachers conference in Nova Scotia.

   Roberta Hamme (UVic) leads a variety of Argo outreach activities. In 2024, she led 6 hour-long workshops for Grades 4-6 through the summer Science Venture program on Robots in the Ocean. Participants brainstorm essential requirements for robots, explore how Argo floats fulfill those requirements, and do a hands-on activity exploring changing the density of an object by changing its volume so it floats or sinks in water (usually ending in a water fight in good weather). She also led an activity for grade 5 at a local school to make Cartesian divers, exploring the importance of change pressure on engineering Argo floats.

8. 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.

   CCHDO currently acquires Line-P data directly from the https://waterproperties.ca/linep website. MEDS will send CTD data collected by other DFO institutions to NOAA NCEI and then the data will be available to CCHDO.

9. Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.
   There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)). If you know of any doctorate theses published in your country that are missing from the list, please let me know.

Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

Journal Publications

Carranza, M. M., M. C. Long, A. Di Luca, A. J. Fassbender, K. S. Johnson, Y. Takeshita, P. Mongwe, and K. E. Turner (2024), Extratropical storms induce carbon outgassing over the Southern Ocean, npj Climate and Atmospheric Science, 7(1), 106, doi: https://doi.org/10.1038/s41612-024-00657-7

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Fujii , Y., E. Remy, M. A. Balmaseda, S. Kido, J. Waters, K. A. Peterson, G. C. Smith, I. Ishikawa, and K. Chikhar (2024), The international multi-system OSEs/OSSEs by the UN Ocean Decade Project SynObs and its early results, Front. Mar. Sci., Volume 11, https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2024.1476131/full

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Ph.D./M.Sc. Thesis

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Mehlmann, Melina (2024) An Evaluation of Global Ocean Models in the North Atlantic using BGC-Argo Observations, MSc thesis, Dalhousie University. https://dalspace.library.dal.ca/items/644c902a-8be8-4b50-923b-24471e392760

Books

Nothing to report

10. Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2025 and 2026 (if known) and where they might be deployed.

    Argo Canada is committed to deploying additional floats equipped with RBR CTDs. The DFO procurement plan for 2025 is not known at this time, but we expect to procure about 50% of our core Argo floats (TWR APEX) with RBR CTDs.

    Dalhousie University and the Memorial University of Newfoundland are procuring 27 BGC Argo floats (NKE PROVOR CTS5) with the RBR Tridente sensor over the period of 2025-26.

Argo Chinese National Report 2024

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1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)

a. floats deployed and their performance

In 2024, China deployed 18 floats in the northwestern Pacific Ocean and Bering sea, including 4 HM2000, 10 deep XUANWU, 2 PROVOR_CTS4 and 2 NAVIS floats. The details of these floats are shown in Table 1.

Table 1. Details of the floats deployed in 2024

Float model	Number	Sensor	Region	Owner
HM2000	4	SBE41	Bering sea	FIO, MNR
XUANWU	10	SBE61	NW Pacific	Laoshan Lab
PROVOR_CTS4	1	SBE41, Aanderaa 4330, ECO_FLBBCD, OCR504, SUNA	NW Pacific	Hainan Tropical Ocean University
PROVOR_CTS4	1	SBE41, Aanderaa 4330, ECO_FLBBCD, OCR504, SUNA, SeaFET	NW Pacific	Hainan Tropical Ocean University
NAVIS (with rechargeable battery)	2	SBE41, SBE63, MCOMS_FLBB2, SeaFET	NW Pacific	CSIO

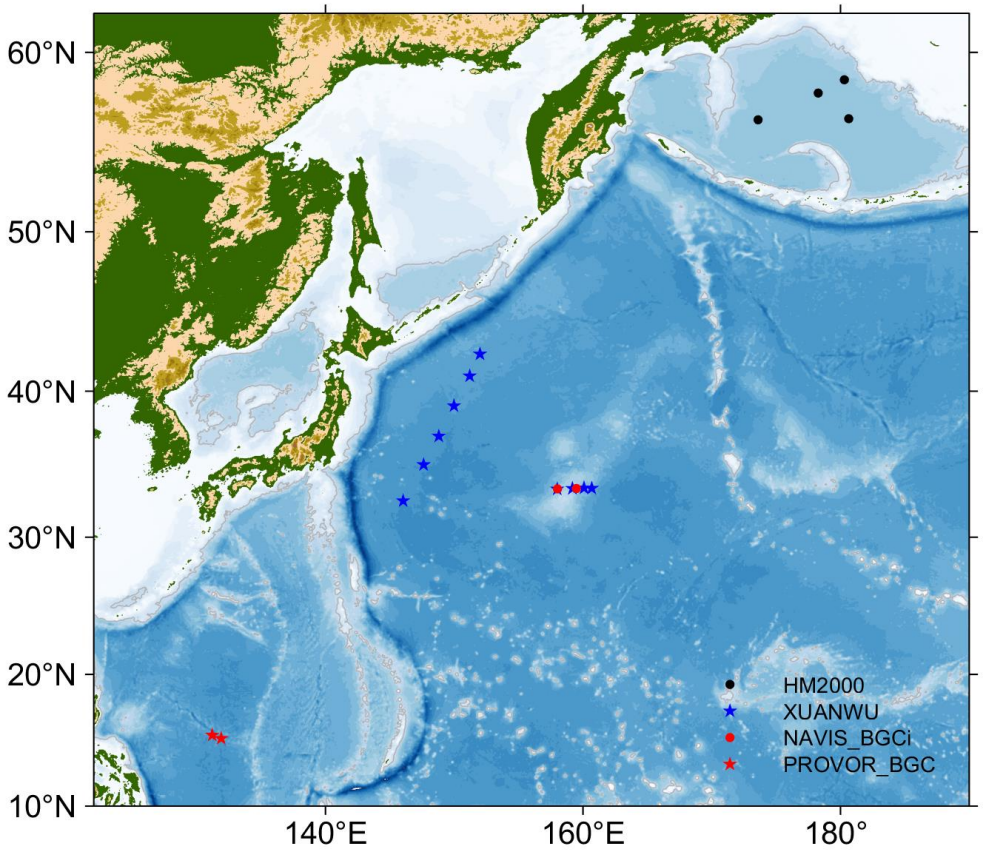


Fig.1 Launch locations of the Chinese floats in 2024

b. technical problems encountered and solved

Two NAVIS_BGC floats with SeaTrac rechargeable battery have the same ballasting problem as the deployment of two NAVIS_BGC floats in 2023, which resulted in too shallow profiling depth even if we adjusted their DeepProfileBuoyancyPosition through the Iridium system. Therefore both of the floats cannot harvest much energy from the less temperature difference and stopped transmission by January 2025.

c. status of contributions to Argo data management including:

i. The status of your DAC, if applicable

CSIO acquired data from 80 active floats in 2024. The data processing chain including 5 float models runs every 1~3 hours. The profile, technical, trajectory and meta file of all floats are submitted to GDAC in NetCDF format. During 2024, 4,152 core profiles plus 1,340 DOXY, 1,025 CHLA, 1,812 BBP, 238 CDOM, 1,029 IRRADIANCE, 414 NITRATE and 702 pH profiles had been processed. All the Core and DOXY profiles were issued to the GTS in BUFR format via CMA.

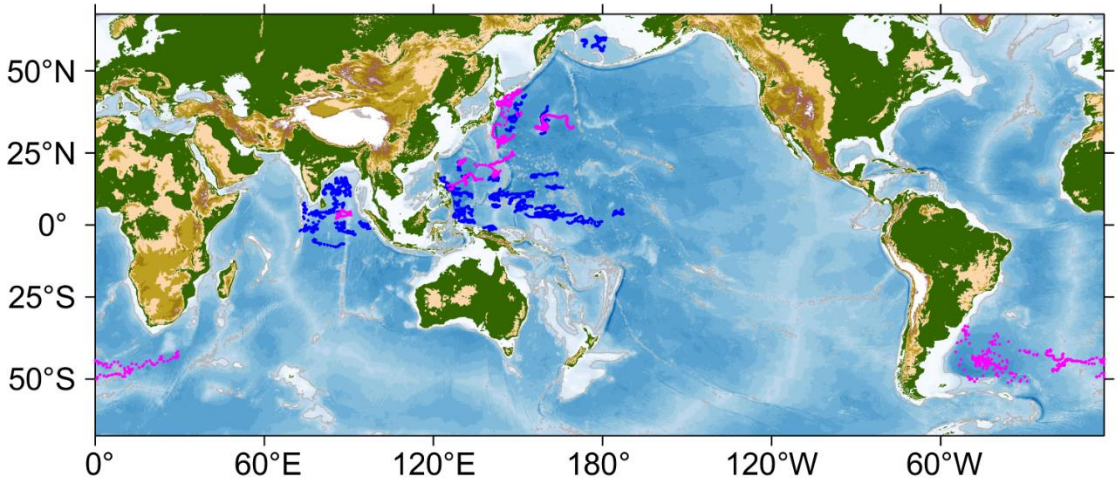


Fig.2 Locations of core (blue) and BGC (red) profiles.

ii. Decoding difficulties

CSIO developed the decoders for all the operational floats. Table-driven method is being employed in reading binary messages for PROVOR floats and creation of NetCDF files. After the ADMT-25 meeting, we have updated our system for creation of new version of trajectory file.

iii. Real-time Deep implementation

CSIO receives deep XUANWU data from Laoshan Laboratory and processes in real-time. Salinity profiles are adjusted in real-time using the new CPcor provided by the Argo quality control manual.

d. status of delayed mode quality control process

Last year, CSIO had sent about 7132 D-files of Core Argo to GDACs. As of now, the DMQC processing for the RBR float data is ready at any time (only one RBR float has been deployed so far). In addition, with the help of Dr. Tanya Maurer, CSIO can handle the DMQC of dissolved oxygen profiles using SAGE toolbox, and the DMQC for other BGC parameters is still under learning.

For deep XUANWU floats, we conducted salinity adjustment using the new CPcor estimated by shipboard CTD data if applicable.

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)

The deployment of float for China Argo still relies on research and special programs undertaken by institutions and universities. 30 XUANWU floats operated by Laoshan Laboratory will be deployed this year, and 7 of them have been deployed until last month. The funding for 28 BGC floats purchases including 11 NKE products and 11 HSOE products have been secured by Xiamen University. 2 BGC floats will be purchased and deployed by Third Institution of Oceanography (TIO), MNR. For Core float deployments, we still have no operational funding from the government.

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.

In 2025, about 32 floats are expected to be deployed. Among them, 30 XUANWU floats are from Laoshan Laboratory and 2 BGC PROVOR floats are from TIO.

Float model	Number	Owner	Launch region	Launch time
XUANWU	20	Laoshan Lab	Northwestern Pacific	February-April
XUANWU	10	Laoshan Lab	Northwestern Pacific	Second half of 2025
PROVOR_CTS5	2	TIO, MNR	Northwestern Pacific	Second half of 2025

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 are routinely assimilated into the MaCOM ocean forecasting system run by NMEFC (National Marine Environmental Forecasting Center, MNR); the near real-time post-QC'd global Argo T/S profiles provided by CSIO are being applied in the IAP (Institute of Atmospheric Physics, Chinese Academy of Sciences) reanalysis dataset and contributed to the release of the annual report of the global ocean temperature in Januray 2025.

CSIO maintains the website of the China Argo Real-time Data Center (https://www.argo.org.cn) where the implementation status of China Argo, real-time data display including profiles, float trajectory, profile data, the derived products and status of global Argo are accessible. A global deep Argo website is also maintained by CSIO (http://deep.argo.org.cn/).

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 the AIC, 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. Also, during the AST-23 plenary, each national program will be asked to mention a single highlight or issue via a very brief oral report.

None.

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.

7 full-depth CTD casts obtained from the deployments of Argo float were submitted to Coriolis data center.

7. Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)**) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.**

There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)**). If you know of any doctorate theses published in your country that are missing from the list, please let me know.**
Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

The list of publications not listed in the Argo bibliography

Euro-Argo Report – AST26

The Euro-Argo ERIC (European Research Infrastructure Consortium) organises and federates European contributions to Argo (www.euro-argo.eu). The Euro-Argo ERIC and its governance structure (Council, Management Board and Science and Technological Advisory Group) was set up by the European Commission in May 2014, with 9 funding countries. Currently the Euro-Argo ERIC has twelve members and one candidate member. The Euro-Argo ERIC is made up of a central office based in France (Ifremer, Brest) and distributed national facilities (Figure 1). The distributed national facilities operate with direct national resources. As part of the Euro-Argo Research Infrastructure, they agree to a multi-annual commitment of resources (in particular in terms of floats to be deployed and for the data system), and to coordinate their activities through the Euro-Argo ERIC. The Euro-Argo ERIC delegates some of its activities to the national facilities who have the relevant expertise (e.g., data management and quality control, float deployment), and according to their areas of responsibility.

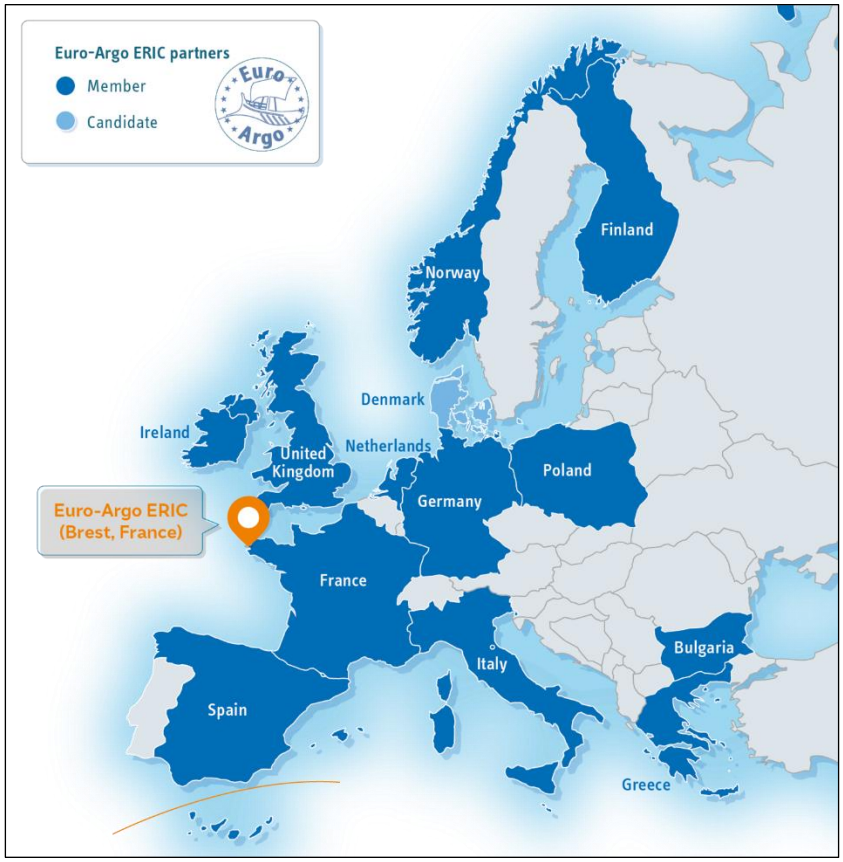


Figure 1. Euro-Argo ERIC membership in 2024

This report presents the contribution of EU funded Argo activities as well as the integrated view of EU plus national European contributions.

1. **The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)**

    a. **floats deployed and their performance**

Float deployed

In 2024, according to declarative numbers on OceanOPS, **186 floats were deployed by Euro-Argo** (235 in 2023), including **only 1 EU-funded float** and 185 funded by national members. Table 1 below shows the repartition of floats per variable measured and per type of floats. The EU-funded float is a Deep-O_2 float redeployed in the Greenland Sea after being recovered in the South Atlantic Ocean and sent to nke for refit (float initially funded by the AtlantOS EU project).

Table 1. European floats deployed in 2024, per parameter measured (blue, 7 first columns) and per type of float (green, 7 last columns) following the AST classification.

	Variables							Float types						
	T&S	O2	Chla	BBP	NO3	Irradiance	pH	core	core+ O2	2-3 var BGC	4-6 var BGC	Deep	Deep +O2	**Total (floats)**
EU funded	1	1	0	0	0	0	0	0	0	0	0	0	1	**1**
Member states	185	87	25	25	15	23	19	98	37	5	25	0	20	**186**
total	**186**	**88**	**25**	**25**	**15**	**23**	**19**	**98**	**37**	**5**	**25**	**0**	**21**	**186**

In March 2025, about 80% of the floats deployed in 2024 are still active (148). Most of the inactive ones are presently under ice, and about 10 floats are dead for technical or unexplained reasons.

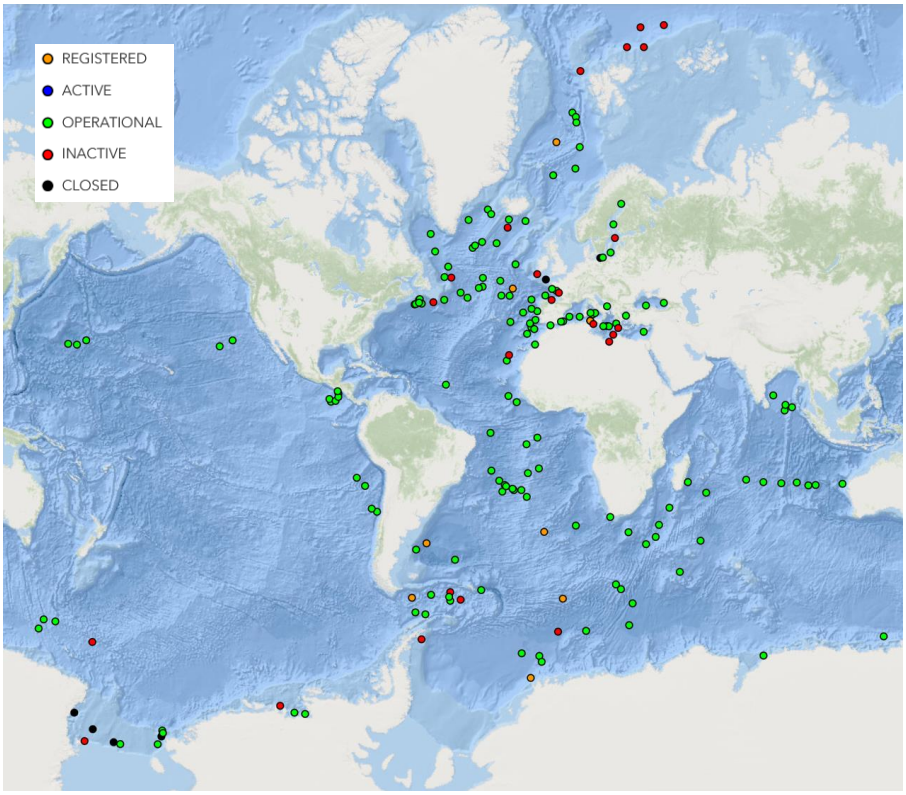


Figure 2. Floats deployed by Euro-Argo in 2024 (latest location as of 28 March 2025). Credit: OceanOPS.

In 2024, Euro-Argo continued the implementation in its usual areas of interest, i.e., Nordic Seas, Atlantic Ocean, European Marginal Seas, Southern Ocean and Arctic Ocean. Floats were also deployed in the Pacific and Indian Ocean as part of the international effort to fill observation gaps (Figure 2).

The European contribution to the Deep-Argo mission was higher than last year: **21 Deep floats** deployed in 2024 versus **8 in 2023** (15 in 2022), accounting for a delay in 2023 deployments. Euro-Argo deployed **14 BGC floats with 6 variables** (17 last year), and almost half of the total number of Euro-Argo floats deployed in 2024 are **equipped with an oxygen sensor (47%).**

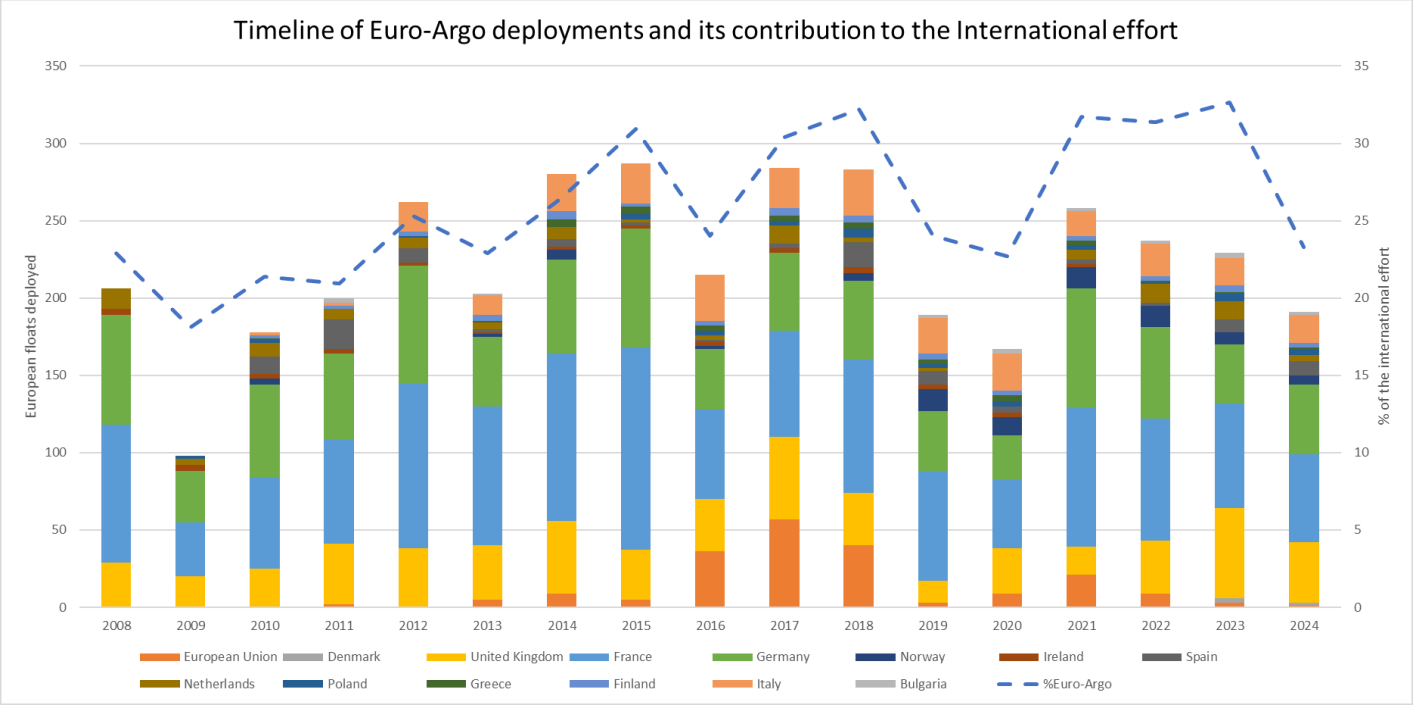


Figure 3. Number of floats deployed per year. Colors show the national programmes.

For the 4th consecutive year, the annual number of Euro-Argo deployments is decreasing (Figure 3), and is now below 200 floats - whereas it is estimated that Euro-Argo should deploy ~300 units annually to achieve its objective to implement 25% of the OneArgo array.

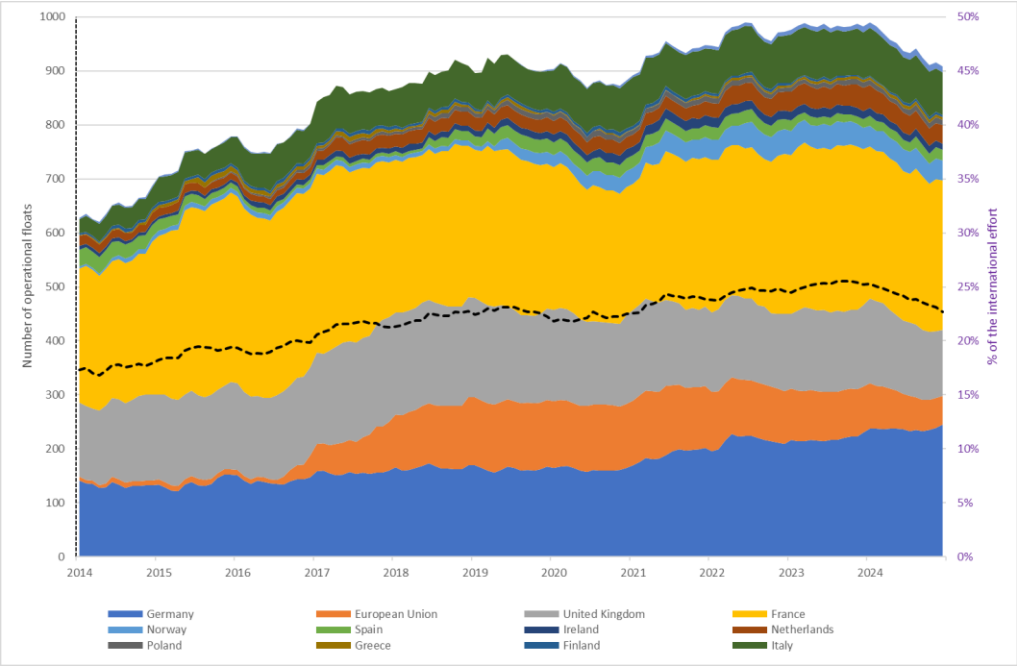


Figure 4. Number of European operational floats as a function of time. Colors show the national programmes.

Similarly, the number of Euro-Argo operational floats (Figure 4) is declining, with ~910 active floats at the end of 2024. This is due to the decrease in number of deployments in the past years, and **now a sharp drop of the European Union contribution is clear since the 2016-2018 MOCCA EU-project fleet is dying and not being replaced** (dark orange in Figures 3 & 4). No new initiative has replaced or pursued this 150-float investment to become a sustained co-funding from the EC.

This decrease is slightly compensated by overall increased float's reliability (not shown), but some missions (Deep, BGC) still show shorter lifetimes.

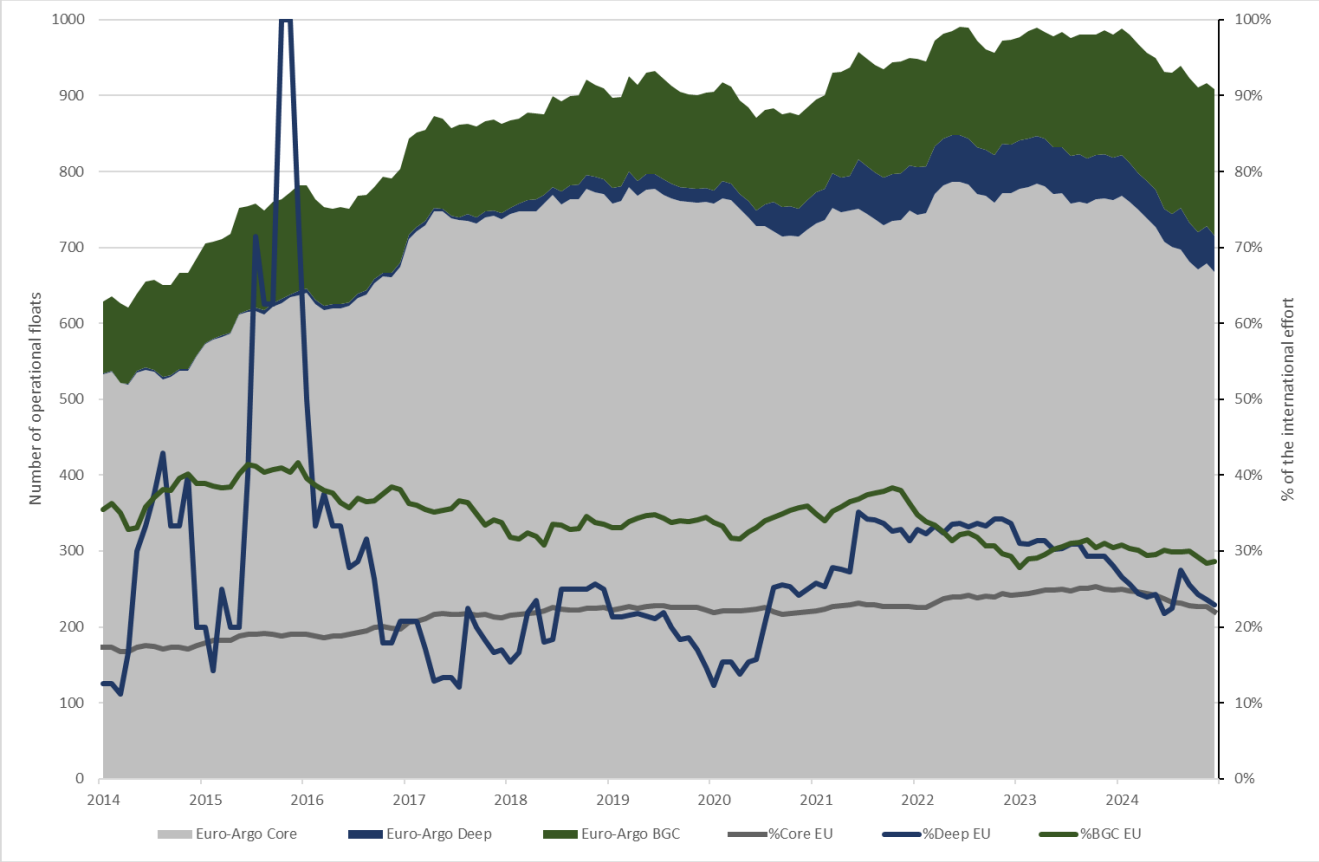


Figure 5. European operational floats as a function of time, for the core-Argo, BGC-Argo and Deep-Argo missions.

Regarding the different missions (Figure 5), our contribution to Core is still predominant but globally decreasing, BGC is increasing and Deep slowly decreasing. Our current implementation with respect to our 2030 strategy (25% of OneArgo) is quite below objectives, especially for the BGC and - above all - Deep missions.

In all cases (number of deployments, number of active floats, share of the international effort), **Euro-Argo contribution is decreasing**.

2024 inactive floats

Table 2 below shows the results of Euro-Argo analysis of ending causes for all Euro-Argo floats that reported a last position in 2024.

Table 2. Ending causes of European floats which died in 2024, grouped by ending causes categories.

Ending causes of the 213 Euro-Argo floats that became inactive in 2024	**Nb floats**
battery_end_of	71
battery_end_of,stuck_on_surface	59
unknown	36
recovered_intentional	13
battery_end_of,recovered_intentional	8
battery_failure,stuck_on_surface	5
battery_end_of,stuck_on_surface,beached	3
recovered_unintentional	2
sensor_ctd,stuck_on_surface	2
sensor_ctd,stuck_on_surface,beached	2
iced	2
unknown,stuck_on_surface	2
sensor_ctd,unknown	1
unknown,recovered_unintentional	1
unknown,location	1
stuck_on_surface,beached	1
unknown,sensor_other,grounded	1
telemetry,unknown	1
internal_vacuum	1
sensor_ctd,recovered_unintentional	1
Total	**213**

On the 213 Euro-Argo floats that became inactive in 2024:

- **141 (66%) worked until battery exhaustion**. A bit less than half of them ended drifting at the surface (known Arvor behaviour)
- **25 (12%) have been recovered** (4 unintentionally, caught by a ship)
- On the 56 remaining floats, below is a description of ending causes (non-disjoint set) status:
    - 6 beached to shore
    - 7 experienced a CTD sensor issue or failure
    - 2 left permanently under ice
    - 7 were Arvor RBR floats, including 5 that had a very rapid battery failure (currently still unexplained reason)
    - About 40 became inactive for unknown or unexplained reasons

- Some technical issues could be determined for 2 floats: internal vacuum or telemetry

Table 3. Performances of 141 Euro-Argo floats that became inactive in 2024 having exhausted their batteries

PLATFORM_ TYPE	Nb floats	Average of AGE (years)	StdDev of AGE (years)	Average of NB_CYCLES	StdDev of NB_CYCLES
APEX	32	6.3	2.1	264	57
ARVOR	81	6.1	1.7	313	122
ARVOR_D	17	3.4	0.3	127	12
NAVIS_EBR	4	6.7	0.8	246	31
NOVA	1	7.3		269	
PROVOR	2	7.2	0.3	284	18
PROVOR_III	3	3.7	2.0	222	55
PROVOR_V	1	3.0		344	
Total	**141**	**5.8**	**1.9**	**275**	**114**

Recoveries

Euro-Argo maintains several KPIs on the number of recovered floats per year:

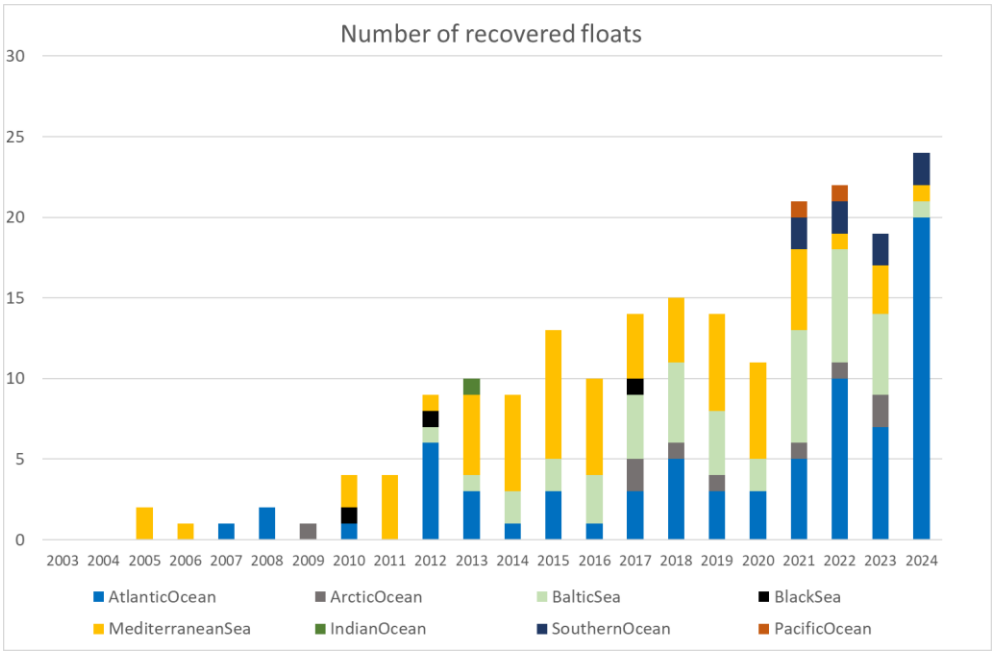


Figure 6. Number of Euro-Argo floats recoveries per year of recovery. Colors show the region of the recovered floats.

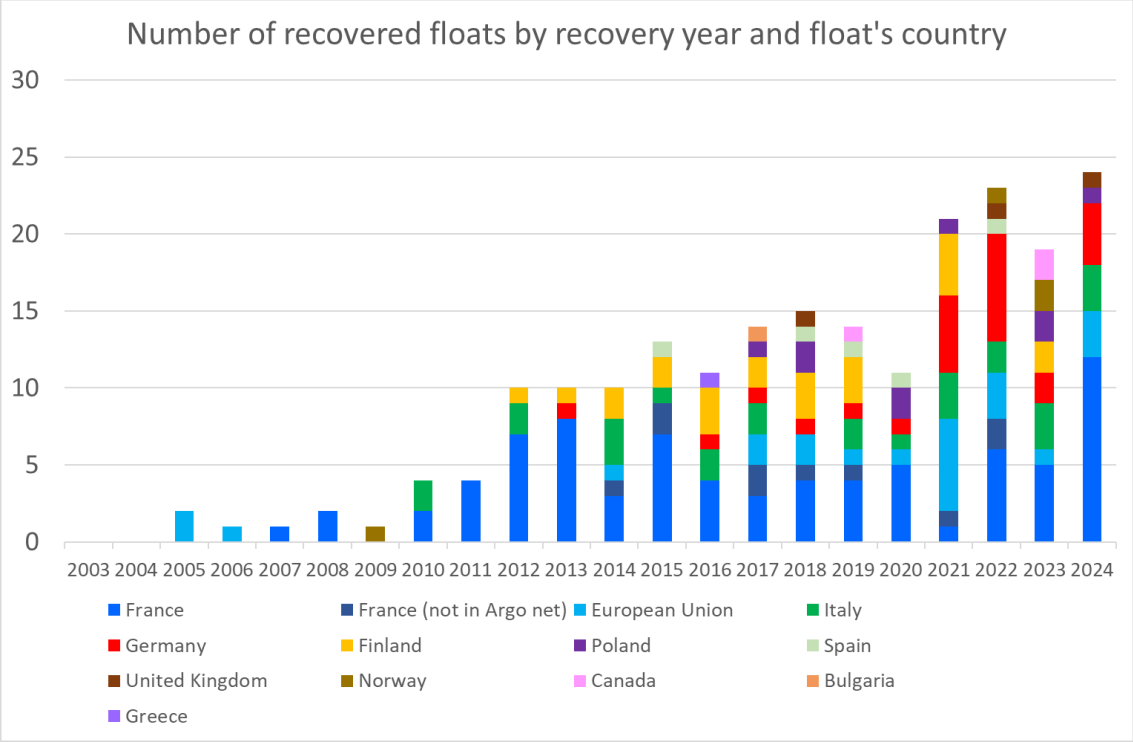


Figure 7. Number of Euro-Argo floats recoveries per year of recovery. Colors show the national program of the recovered floats (may be different from the recovery ship and/or person who organised the recovery).

Euro-Argo is engaged in developing an Argo recovery pilot programme, and aspires to increase the number of recoveries in the coming years. Several European and national projects are and will support these activities (e.g., GEORGE and Euro-Argo ONE EU-projects).

b. technical problems encountered and solved

See national reports of Euro-Argo members.

c. status of contributions to Argo data management including:

i. the status of your DAC, if applicable

All European floats data are decoded and processed in Real Time by Coriolis and BODC DACs (respectively 84% and 16% of the 44427 European profiles in 2024), and DMQC of T and S parameters is currently shared between 7 institutes (BSH, OGS, Ifremer, BODC, IMR, IOPAN and IEO). European partners are also strongly involved in the development of DMQC procedures and their implementation for Deep Argo and BGC Argo (especially for BBP, Chl-A and Irradiance) or for Argo operating in specific areas (e.g., Baltic Sea), as well as in the monitoring of high salinity drifting floats.

ii. **status of high salinity drift floats**

iii. **decoding difficulties**

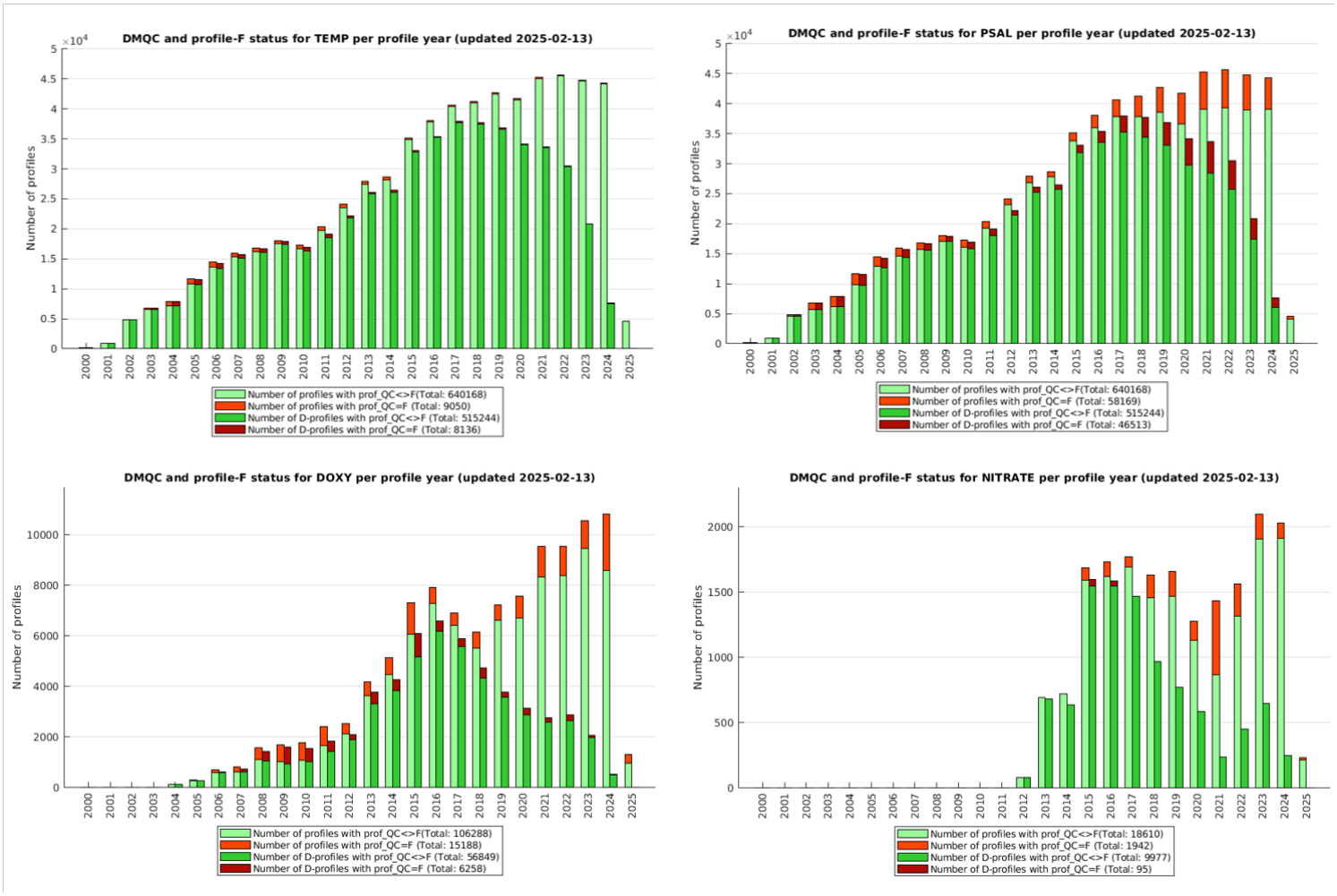
iv. **real time BGC implementation**

v. **real time Deep implementation**

See UK and French national reports.

d. status of delayed mode quality control process

Figure 8 shows the status of DMQC of European profiles (Coriolis and BODC DACs) and their quality, for each of the 8 OneArgo parameters.



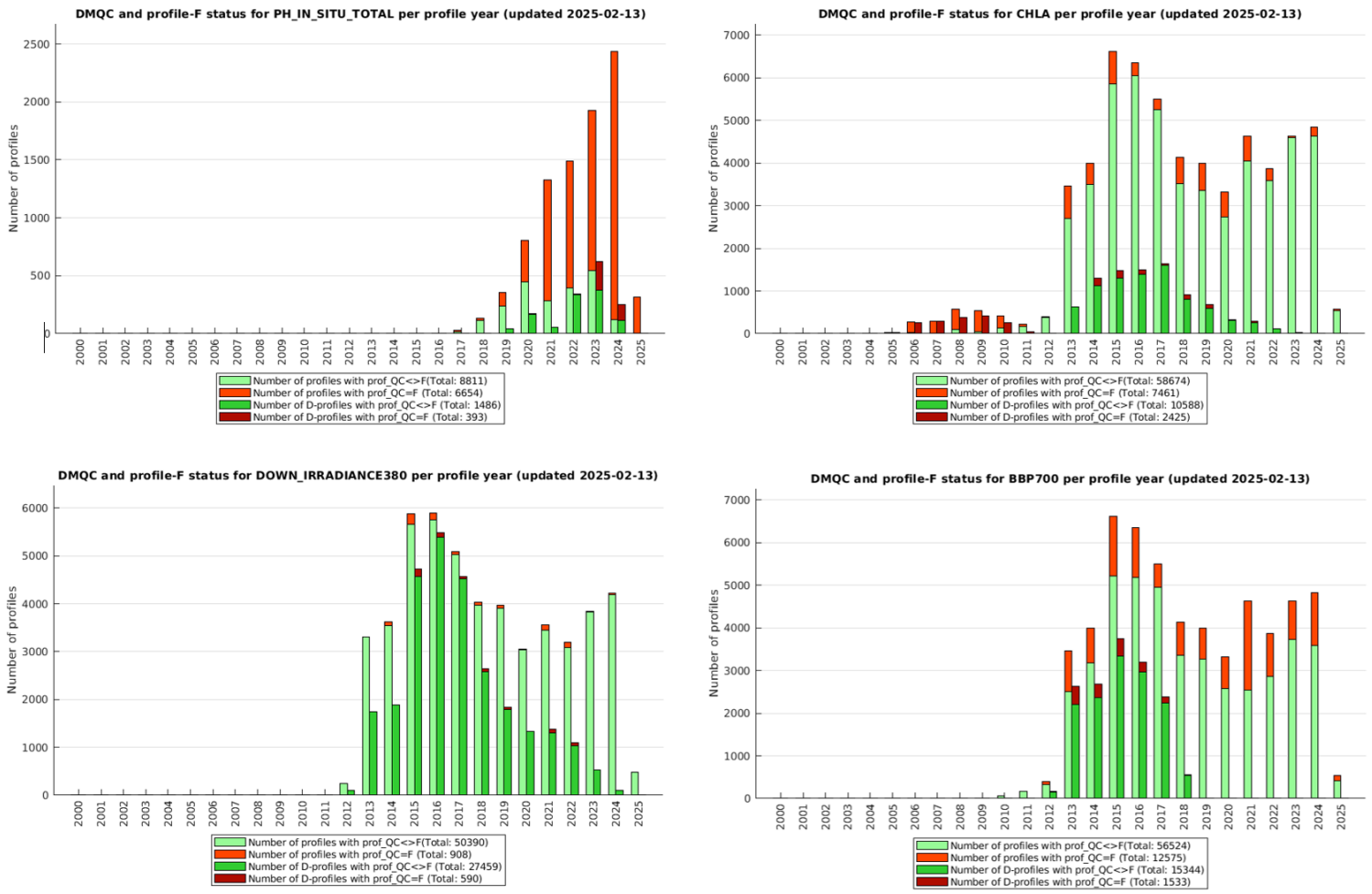


Figure 8. European DMQC status and data quality, in number of profiles, as a function of the year of observation, for each of the OneArgo variables. Light red/green is for RT profiles and dark red/green is for DM profiles.

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

In 2024, the Euro-Argo ERIC office was a team of ~8 FTE (5.9 permanent, 1 project-funded and 0.75 consultant). This team supports European countries to sustain and optimise the European contribution to the Argo International programme, and comes in addition to the national members' personnel. The office team salaries are funded thanks to money coming from both Euro-Argo membership fees paid by the countries (long term commitments) and EU-funded project grants.

Apart from 10 floats funded through Horizon Europe TRICUSO project (other projects only fund Argo related activities / salaries) there is currently no secured plan to get resources from the EU to buy and operate floats.

However, the office team, together with the Euro-Argo members, are putting a lot of efforts in advocacy activities towards the European Commission and its various components, and in particular in the context of the Copernicus Programme, one of the main European users of Argo data. Contacts have been made with key people within the European Commission instances and a Working Group including Euro-Argo representatives of Euro-Argo Management Board and Council has been set-up to pursue this long-term effort collaboratively at the political level.

Activities are also undertaken with Copernicus Entrusted Entities (e.g., Mercator Ocean International, EUMETSAT, ECMWF, etc.). Some discussions occurred in 2023 between Euro-Argo (office) and both the satellite agencies (ESA and EUMETSAT) and modelers in charge of the Monitoring Forecasting Centres of the Copernicus Marine Service (COINS project). Euro-Argo organised, in collaboration with the European Environmental Agency (EEA) which is in charge of the *in situ* component of Copernicus, a fruitful workshop at Mercator Ocean International in March 2024 in order to (i) better assess the needs of these key Argo data users and (ii) discuss leads to co-advocate for increased European fundings for the OneArgo implementation in Europe. A report summarizing the discussions and providing recommendations is available here. These activities will be continued in the framework of the newly awarded Euro-Argo ONE EU project, in collaboration with Euro-Argo members and through the EEA-funded project IDEA, one objective of which is to define the new Copernicus strategy in terms of in situ data from 2028 onwards.

3. **Summary of deployment plans: as was done last year, please fill out this spreadsheet to help us understand the progress towards implementation of OneArgo. There is one new column this year for floats being deployed with experimental sensors such as UVP, C-sensor, etc. This spreadsheet is to be returned separately by 17 March to help prepare for the meeting. It can be sent to Megan or dropped in this folder link.**

See this table for EU-funded floats.

The table below presents the aggregated deployment plans for 2025 and 2026 for all Euro-Argo national + European contributions, per float types and deployment basin:

Euro-Argo consolidated plans	2025	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O	Total (any float type)
Nordic Seas (Norwegian, Iceland, Greenland Sea)		9	2		3			14
Mediterranean Sea		7	8		17		5	37
Black Sea		1	2					3
Baltic Sea			4	2				6
Southern Ocean (< 60°S)		55	10	1			5	71
Arctic Ocean		2	1					3
Global Ocean		100	35	7	13	3	6	164
Total		**174**	**62**	**10**	**33**	**3**	**16**	**298**

Euro-Argo consolidated plans	2026	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O	Total (any float type)
Nordic Seas		2	6		4	2	3	17
Mediterranean Sea		2	6	4	7		3	22
Black Sea		1	2					3
Baltic Sea			3	2				5
Southern Ocean		10	7		12			29
Arctic Ocean		12						12
Global Ocean		74	33		14		10	131
Total		**101**	**57**	**6**	**37**	**2**	**16**	**219**

4. **Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.**

See national reports of Euro-Argo members.

As part of the EU-funded GEORGE project, a recovery cruise (NAARCO) was jointly organized by Ifremer/Argo-France and Euro-Argo. It took place in the North Atlantic on board Skravik's catamaran MORSKOUL. The goal of NAARCO was to act as a proof of concept, demonstrating that a dedicated Argo recovery cruise using a low-carbon footprint vessel can provide an effective solution. The MORSKOUL vessel is at 47.5-foot catamaran, operated by the local company Skravik which provides support services for low-carbon scientific operations at sea aboard sailboats. During the cruise, 10 Argo floats were successfully recovered: 5 Deep Arvor (equipped with O2 sensor) and 5 Arvor (core-Argo). They were either reaching the end of their life (around 10 cycles worth of remaining battery) or had deficient sensors (high salty drifts). To prove the efficiency of such a project, NAARCO needed to:

- Collect a significant number of floats either in end of life or somehow deficient;
- Operate in a high-sea area representative of the Argo network on a consistent scale;
- Have a low-carbon footprint;
- Be cost-effective in terms of the value of the collected floats.

All goals were met, although the cost-effectiveness still needs to be quantified by considering the cost of refitting the recovered floats.

5. **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 Argo websites.**

At the European level, the main operational users of Argo data are Copernicus, ESA, EUMETSAT and ECMWF.

6. **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. Also, during the AST-26 plenary, each national program will be asked to mention a single highlight or issue via a very brief oral report.**

Euro-Argo partners (floats under the Argo-France, Argo-Italy and NorArgo programmes) are still waiting for **10 certificates** in the framework of Seabird Abrupt Salinity Drift (ASD) warranty. The certificates were first requested mid-2024, but despite several interactions, including the provision of additional material showing evidence of ASD (late 2024), nothing has been received up to now. The last email to enquire about the certificate status was sent to Seabird in January 2025.

European partners are experiencing lead time and delays for receiving floats after maintenance that affect their planning. In addition, we are also facing increasing logistics and customs issues.

7. **Outreach and communication: please describe, in brief, outreach efforts within your national program over the past year. Also, if you've issued any communications, press releases, participated in articles, etc, please send the links. We are considering our social media strategy, so please let us know which social media you engage with and the corresponding handles.**

An analysis of the importance of Argo as a source of information for the last IPCC report was carried out, that led to the publication of an Infography, available here: https://infogram.com/argos-contribution-to-ipcc-reports-1h9j6q7pkj5954g

The Euro-Argo office team was also involved in the development of the international OneArgo brochure and co-authored the Greenan et al. (2024) paper published in Frontier for Young Mind.

The Euro-Argo office participated in the Adopt A Float programme, in collaboration with Argo-France, speaking in several classrooms in the Brest region and in other regions in France (remotely). The initiative is also being developed in various other European countries.

In early 2025, Euro-Argo left the X social media and opened an account on Bluesky: https://bsky.app/profile/euro-argo.eu. In parallel, it was also decided to enhance Euro-Argo's presence on Linkedin.

8. **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.**

See national reports of Euro-Argo members.

9. **Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.**
There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)). If you know of any doctorate theses published in your country that are missing from the list, please let me know. Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

See national reports of Euro-Argo members.

10. **Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2025 and 2026 (if known) and where they might be deployed.**

None of the few European floats (EU-funded) to be deployed in the coming years are equipped with RBR sensors. However, in the event of additional substantial grants from the European Union, Euro-Argo would follow the AST recommendations on the proportion of RBR-equipped floats.

Argo France National Reports
Argo Steering Team Meetings 26

1. **The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)**
    a. **floats deployed and their performance**

Deployments (59)

59 floats were deployed in 2024:

- **30** T/S Core (including 4 Arvor-C),
- **2** T/S/O2,
- **6** BGC ,
- **19** Deep.

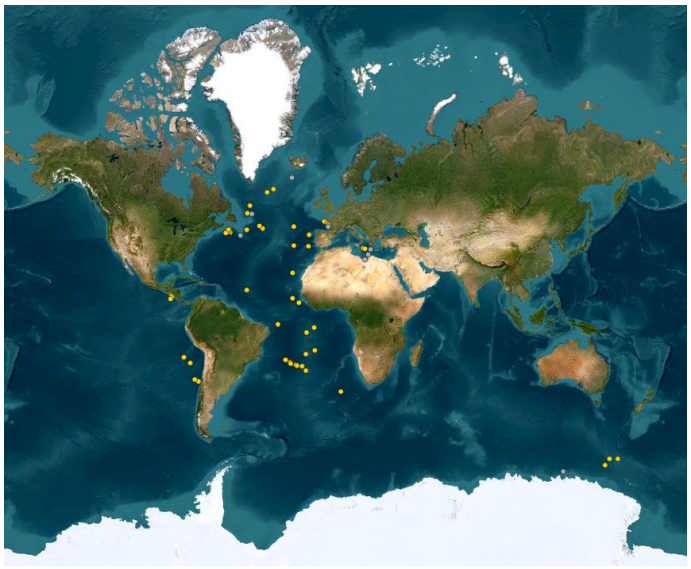


Figure 1 : Argo France 2024 deployments

The majority of 2024 deployments took place in the North Atlantic (CROSSROAD campaign) and South Atlantic (PIRATA and Vendée Globe). Two GMMC campaigns enabled deployments in the Pacific (SEPICAF & ARGO-DOME). One campaign took place in the Southern Ocean with the CSIRO Investigator. Finally, 5 TS floats were deployed in the Mediterranean during a SHOM campaign (Fig. 1).

Fleet monitoring

To date (January 2025), of the **59 floats deployed in 2024** :

- **52** are active (6 under ice)
- **2** ARVOR have reached the end of their battery life (SHOM high-frequency sampling),
- **2** ARVOR RBR have disappeared due to a problem identified but not resolved by nke/RBR,
- **1** Deep has disappeared without explanation,
- **1** Arvor-C has been trawled.
- **1** BGC (CTS Jumbo) disappeared probably due to sensor flooding issues,

The French fleet operational at the beginning of 2025 is made up of **67% ARVOR T/S, 11% DEEP, 6% T/S/O2 and 16% BGC.**

54 French floats disappeared in 2024, mainly due to battery depletion (>67%). **13** (~25%) of these floats were recovered at sea before disappearance (NAARCO and Arvor-C campaigns).

The **average age of the disappearances is 3.6 years**, mainly due to the low life expectancy of Deep Arvor.

b. technical problems encountered and solved

Deployments of Arvor-RBR floats were interrupted last year due to premature failure of few units. After investigation by RBR and NKE, no problems were detected. The deployments resumed, but we carefully monitor Arvor-RBR floats currently at sea.

c. status of contributions to Argo data management including:

i. the status of your DAC, if applicable

A detailed report on Coriolis DAC/GDAC data management activity for ADMT25 is available:

Carval, T., Coatanoan C., Schmechtig C., Racape V., Rannou J.- P., Dobler D. (2024). Argo data management report 2024, Coriolis DAC & GDAC & A-ARC. Ref. Ifremer/irsi/isi-dti/rap-24-024. Ifremer. https://doi.org/10.13155/102566

ii. status of high salinity drift floats

- 10 warranty SBE41 CTD replacement credit provide by SBE were used in 2024.
- 7 floats are on Euro-Argo's list for a second request to SBE

iii. decoding difficulties

N/A

iv. real time BGC implementation

A new Real Time (RT) correction for the physiological ratio, incorporating geographical variations, was proposed in 2023 and accepted at AST25 in March 2024. This correction is based on SOCA products from the BGC-Argo database. It has been thoroughly evaluated, notably by comparison with DM-qualified data, and the results presented to ADMT25 .Operational implementation of this correction in RT is scheduled for 2025. A paper will present this correction in detail. This new HLC correction in RT will pave the way for the qualification of HLC data in DM, minimizing the gap between the two and improving the quality of HLC datasets.

v. real time Deep implementation

RT and DM data management of Deep-Argo float data is implemented at Coriolis.

Argo-France is taking part in the international working group tasked with establishing and documenting the procedure for time-delay processing of Deep Argo floats. In particular, a procedure for correcting a pressure-dependent bias linked to the compressibility term (CpCor) has been established, and a code has been made available: https://github.com/ArgoDMQC/DM_Cpcor. This year, a follow-up to these corrections was presented at ADMT25 and led to an update of the data management document with a new value of the Cpcor used to correct salinity data in real time and new flag assignment 1 below 2000db (QC= 1).

vi. real time and delayed mode Trajectory implementation

An automated processing chain to operate real-time QC on trajectories, to be able to distribute qualified "RTraj" Argo files in a systematic way that can be used for real-time current products. It is daily updated and available from https://doi.org/10.48670/moi-00041

This work is a first step towards setting up the delayed-time QC protocol for Argo trajectory measurements, so as to be able to distribute qualified Argo "Dtraj" files to the community. Finally, in collaboration with the Coriolis data center, Argo France has initiated the implementation of a procedure for transferring ANDRO trajectory history files controlled in delayed mode Argo 'Dtraj' format to the Coriolis data center, enabling the distribution of trajectory data in Real Time with Real Time QC. This will be embedded in the UE project Euro-Argo One (2025-2028).

d. status of delayed mode quality control process

Core and Deep

This year, consistency checks were carried out for the AARC region, enabling analysis of DM salinity data from 3,814 floats. For each float, we used the OWC method with a standard set of configuration parameters. We then checked a float's DM salinity correction only if the results obtained differed significantly from those obtained by the float's PI. We were then able to isolate a small number of floats for which the salinity profiles were subject to additional checks: sections along the float's trajectory, comparison of certain profiles with the closest reference data or with the closest real-time Argo data available, if necessary. Finally, where necessary, we suggested that the float's DM or PI operator modify the salinity corrections. The AARC web page lists the floats for which the PI or DM operator has been notified (https://www.umr-lops.fr/en/SNO-Argo/Activities/A-ARC/Consistency-checks-of-DM-salinity-corrections).

This year, we processed around **72 floats (including 38 deep floats)**. Within this framework, Argo-france maintains the OWC code, which is the one recommended for calibrating salinity data from Argo

floats.We develop and maintain the DM_FLOATS processing chain, used by LOPS operators, subcontractors and various European operators.

BGC

In 2024, a significant effort was devoted to the qualification of Delayed Mode (DM) radiometric data. **32 floats** were processed, representing **5226 profiles**, by applying the correction method described by *Jutard et al.* (2021). However, some data could not be qualified, notably from floats without drift data or night-time measurements, making the method inapplicable. Alternative approaches are currently being developed to find suitable solutions for correcting these particular floats.

In 2024, the method was applied to a majority of floats (of all nationalities) to demonstrate its applicability on a global scale, irrespective of the presence of radiometers on the floats. This development was made possible by the development of SOCA-light, a neural network-based method for generating synthetic radiometric profiles for floats without radiometers (*Renosh et al.*, 2023). A qualified global CHL dataset has been published on SEANOE, detailing delayed-mode CHL processing (https://doi.org/10.17882/102324).

The BBP audit accessible online (ftp://ftp.mbari.org/pub/BGC_argo_audits/BBP700) since June 2021 was updated at the end of 2024.The anomaly report was presented at ADMT25 at the end of 2024. The audit is proposed thanks to the comparison of BBP measurements with reference data corresponding to BBP weekly climatological fields (SOCA product). The updated audit enabled a total of ~140,000 BBP profiles to be inspected in 2024, of which ~500 profiles were flagged as abnormal (~0.5% of data compared with 1% last year). This improvement in the quality of the BBP database is due in particular to the application of real-time QC proposed by *Dall'Olmo et al*, 2023 to BBP data from coriolis during 2023.

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

Argo France secured funding for Core-Argo, which is about **1,1M€/year** with stable man power implication of **13** pers./year. Project-based fundings support Argo-France for the Deep and BGC missions, for data management (about 2,7M€/an). Some of those projects contribute as well to R&D on floats (Deep6000) and BGC sensors.

Expected floats funding by Argo France for 2025-2029:

	Core	Core + O2	BGC (4-6 EOVs)	Deep + O2	Expended sensors	**Total**
2025	45	13	11	11		**80**

(funded)						
2026 **(funded)**	30	10	10	10		**60**
2027 **(funded)**	20	7	18	21	10	**76**
2028 **(funded)**	30	7	9	21	4	**71**
2029 **(not yet funded)**	26	10	20	24		**80**

3. **Summary of deployment plans: as was done last year, please fill out this spreadsheet to help us understand the progress towards implementation of OneArgo. There is one new column this year for floats being deployed with experimental sensors such as UVP, C-sensor, etc. This spreadsheet is to be returned separately by 17 March to help prepare for the meeting. It can be sent to Megan or dropped in this folder link.**

It is planned to deploy over **70 floats in 2025** over 13 regular or specific campaigns (Fig. 2).

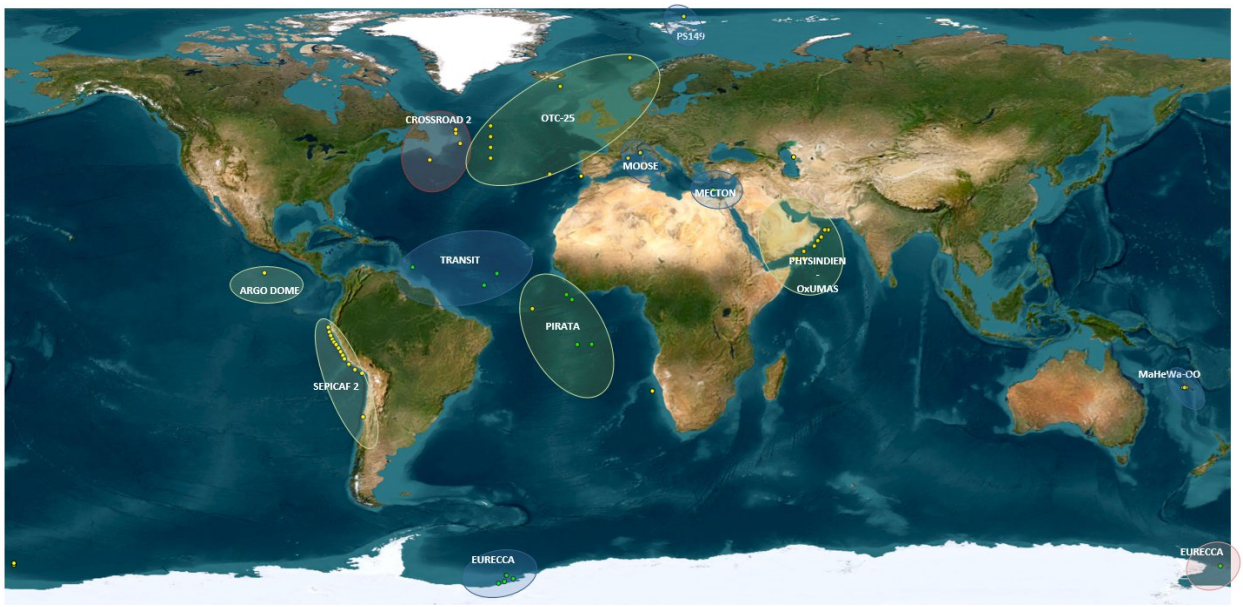


Figure 2 : Region of Argo France floats deployments for 2025

4. **Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.**

- New NKE PFV2 card on Arvor has been implemented. 4 prototypes deployed at sea by NKE, 8 floats already acquired by Argo-France, first two deployments planned this summer in the Med and in Nansen Basin (New version of the Ice Algorithm to be tested) .
- Development of a new Deep 6000 ?float model is ongoing. Prototypes should be tested at sea in 2025.
- BGC sensors ?
- Two Deep-Arvor equipped with an Aanderaa and an AROD-FT optodes have been deployed in 2024. First results will be presented at next ADMT meeting.

5. **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 Argo websites.**

Argo France web page : https://www.argo-france.fr/

Argo France products :

- **ISAS**, temperature, salinity and oxygen gridded fields : https://doi.org/10.17882/52367. The new ISASO2 fields (decadal and pentadal mean field) from available DMQC DO Argo data have been released in 2024 (https://doi.org/10.17882/52367), along with *Kolodziejczyk et al.* (2024) describing the dataset on : https://doi.org/10.5194/essd-2024-106.

- **ANDRO** product (Atlas of Argo Trajectories) is updated each year. The Andro atlas and the Finnish climatology on an ISAS grid (0.5°x 0.5°) of float speeds at DOI: https://doi.org/10.17882/47077.

- Globally interpolated product of **Chlorophyll-a and particulate backscatter coefficient, transformed into particulate organic carbon**: https://doi.org/10.48670/moi-00046. This product provides quarter-degree fields with weekly resolution over the period 1998-2022, as well as monthly resolution for climatological products. This product is derived from the machine learning method SOCA (*Sauzède et al.* 2016; *Sauzède et al.* in prep.).

- **Vertical profiles of nutrient concentration (nitrates, phosphates and silicates) and carbonate system variables (total alkalinity, dissolved inorganic carbon, pH and partial pressure of carbon dioxide)** is distributed and updated annually in Copernicus Marine Services: https://doi.org/10.48670/moi-00048. It is derived from Carbonate system and Nutrients concentration from hYdrological properties and Oxygen using a Neural-network (CANYON, *Sauzède et al., 2017*; *Bittig et al.* 2018).

6. **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. Also, during the AST-26 plenary, each national program will be asked to mention a single highlight or issue via a very brief oral report.**

- Difficulties to get answers from Seabird to our questions
- Highlight : NAARCO recovery cruise : In Spring 2024 a 1-month recovery cruise was conducted in cooperation with Euro-Argo in the North Atlantic. It allowed to recover 10 Argo floats (5 Arvor and 5 Deep Arvor) using a small sailing vessel. This low cost / low carbon cruise acted as a proof of concept that together with opportunistic float recoveries there is probably a way to reduce Argo environmental impact (i.e lost floats) without any increase in fuel consumption due to standard vessel operations. Most of the recovered floats have been fully refitted at low cost (compared to cost of acquiring new floats) and will be re-deployed this summer in order to validate float recovery and refit options. Our target is to continue recovering 25% of our floats in the coming years

7. **Outreach and communication: please describe, in brief, outreach efforts within your national program over the past year. Also, if you've issued any communications, press releases, participated in articles, etc, please send the links. We are considering our social media strategy, so please let us know which social media you engage with and the corresponding handles.**

- In 2024, Argo France was present at the Mer&Education summer school (interdisciplinary training for secondary school teachers; https://nouveau.univ-brest.fr/mer-education/)
- Vendée Globe: The UNESCO/IFREMER/IMOCA/Vendée Globe collaboration will have enabled the deployment of 10 Argo-France floats during the 2024 Vendée Globe, generating exceptional media coverage for the Argo program (https://www.vendeeglobe.org/article/tout-ce-quil-faut-savoir-sur-le-materiel-scientifique-embarque).
- Adopt A Float program: During the 2023-2024 school year, nearly 2,000 "Ocean Voyagers" pupils, from the 1st section of kindergarten (3 years old) to the 2nd year of BTS (20 years old), took part in the Adopt A Float educational adventure. Students from mainland France, the French overseas departments and territories (Mayotte, Martinique), Belgium, Italy, Spain, England and the United States adopted a profiling float. In all, no fewer than 55 Argo floats were adopted from the world's oceans. For the new school year 2024-2025, adopt a float continues to expand, with almost 90 classes in France (metropolitan France + French Polynesia) and abroad (Belgium, Italy, Spain and Costa Rica). In particular, the program is strengthening its European dimension as part of the Euro-Argo ONE project, with an Italian initiative being rolled out this year. This new impetus aims to involve a wider community of educators - particularly teachers and students - in learning about ocean sciences.

- Argo presentation at Ministry level (Education and Fisheries)

- Argo mentioned in various media reports (TV, radio)

8. **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**.

Argo France is responsible for the CTD reference database. A new release has been issued in Febreurary 2024 (see https://doi.org/10.13155/102566).

9. **Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.**
There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)). If you know of any doctorate theses published in your country that are missing from the list, please let me know. Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

A total of 44 research articles were co-authored by authors affiliated to a French laboratory, and 3 theses using Argo data were defended at a French university. The list of publications and thesisis provided on the Argo France website: https://www.argo-france.fr/Bibliographie.

10. **Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2025 and 2026 (if known) and where they might be deployed.**

Argo France aim to deploy about 50% of its core floats with RBR CTD.

German National Report 2024 for Argo Steering Team Meeting AST25

Submitted by Birgit Klein and Meike Martins on behalf of Argo Germany

The AST requests a National Report from each country involved in implementing the Argo array prior to the yearly AST meetings. These reports help inform all Argo participants of the status of each National Program, help guide the AST meetings, and gather information for Argo websites and international reports. Please use the questions below to help produce your report and send it to Megan Scanderbeg or drop it into the National Reports folder by **4 April.**

AST-26 folder link: https://drive.google.com/drive/folders/1Bq-xLWzdZ7k-cGsTNbqvnJkyZc9Y3ZIx?usp=sharing

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)
    a. floats deployed and their performance

        In total 41 floats were deployed by Argo Germany covering the entire global ocean. 40 were purchased by BSH from the operational budget funded by the BMDV and one additional float was coming from institutional funds of the AWI. The 41 floats include 13 floats with supplementary oxygen sensor and 8 BGC floats.

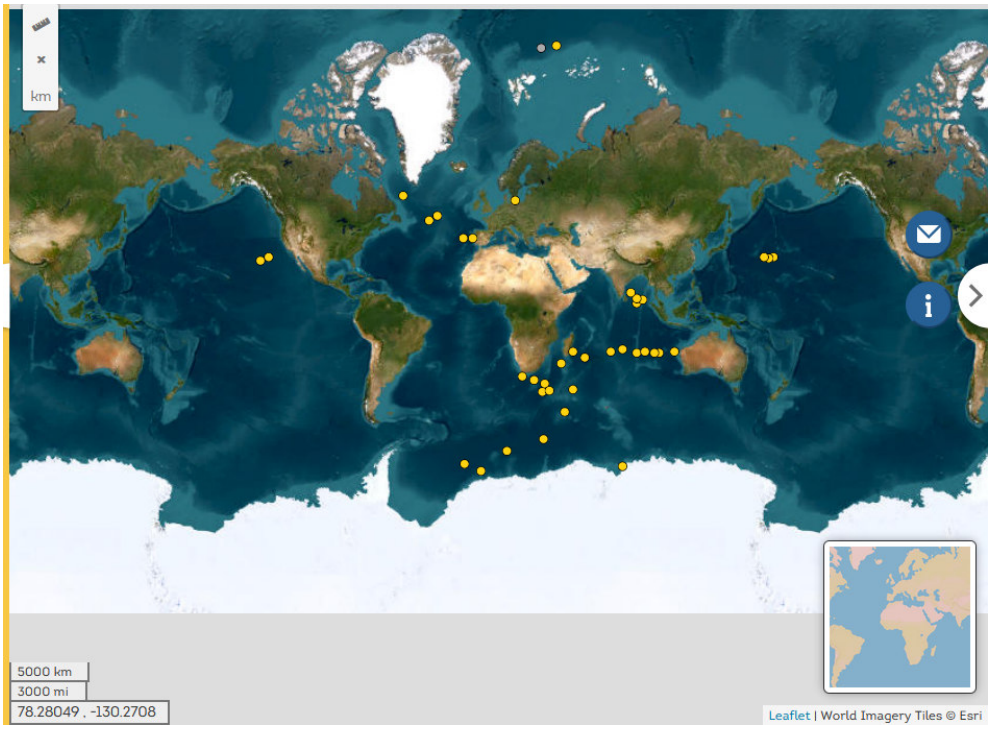


Fig. 1: 2024 deployments by Argo Germany.

The relatively low numbers of deployments in 2024 are related to delays in cruises, now postponed to 2025. The deployments were performed during 11 individual cruises, mostly from research vessels, but also with the help of the German and the Portuguese Navy.

b. technical problems encountered and solved

Two of our floats equipped with pH sensor were sent back to the manufacturer in 2022 because of a recall and have been returned from SBS after inspection. They are now scheduled for deployment in 2025.

Our deployments in the Arctic proper during PS144 have shown mixed results. Two of the four float did not report any data yet. No reason for this could be discerned.

c. status of contributions to Argo data management including:

Germany is not running a national DAC. All German floats are handled by Coriolis DAC in France.

The status of the ASD floats from the German program has been documented in the joint excel spreadsheet curated by Coriolis until the end of 2024. No more new incidences were encountered in the past year. The European fleet which is partly handled by BSH did show however a few more cases, which have been notified to SBS.

d. status of delayed mode quality control process

BSH had adopted floats from all German universities and agreed to perform similar services for the AWI floats. The status of delayed mode quality process for German core floats is remaining at high levels (90-95%). The DMQC of old NEMO floats from AWI could be finalized in 2024, followed up by a reprocessing of technical files. The production of D-files for these floats has started late 2024 and should be finished during the first quarter of 2025.

Ramping up DMQC procedures to include BGC operations has still been hampered by the limited personal resources. In the second half of 2024 the workforce for Argo Germany was finally increased by two new members. The training of the new staff has been started and progress in the BGC DMQC is expected in 2025.

Delayed mode quality control of floats in the Baltic were discussed by a small international group during workshops in Sopot (18.04-19.04.2023), Bergen (16.10-19.10.2023) and Sopot (24.09-26.09.2024). During these hands-on workshops all groups with floats in the Baltic were present and adapted a processing chain developed by IMR. We expect the processing chain to be finalized in September 2025 during a follow-up-meeting. This close cooperation was extended to the BGC parameters in 2024 (oxygen data).

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

   The BMDV (Federal Ministry for Digital and Transport) has approved to increase the budget for the implementation of One Argo and to switch the national contribution to a mix of 36 core floats, 14 deep floats and 12 BGC floats annually and supply more funding. The budget was increased by 350.000 € in 2023 and will ramp up to an increase of 1.1 Mio. € in 2026 which amounts to a total budget of 1.9 Mio € in 2026 (excluding costs for personal). Due to the strong price increase of the floats (specifically the BGC sensors) the increased funds are insufficient funds to cover the full implementation of OneArgo. BSH has informed the ministry about the need of a further increase starting in 2027 and postponed implementation of Deep Argo until then.

   BSH has established a tender with 2 manufacturers, NKE and Bornhöft (TWR), in order to ease the procurement of floats. It has started in 2024 and is running for 4 years.

   Birgit Klein of the Federal Maritime and Hydrographic Agency (BSH) has continued to coordinate the national Argo Germany program and is also responsible for data management of the core floats. All matters related to procurement, logistics, technical monitoring, float deployments and satellite data transmission are handled by now by Greta Markfort and Celine Naderipour who have joined the team during 2024. The national BGC group established in 2020 involves four research institutes: AWI, GEOMAR, ICBM and IOW and Meike Martins from BSH.

   A complete list of people involved is given below:

Name and institution	Area of expertise
Birgit Klein (BSH)	National program lead, research scientist (C-Scope, EuroArgo One), DMQC operator (core Argo)
Meike Martins (BSH)	Research scientist (EuroArgo One), DMQC operator (BGC Argo), float procurement, logistics
Kevin Wiegand (BSH)	Research scientist (EuroArgo One) (only after Feb 2025),
Greta Markfort (BSH)	Technician, float procurement, technical support, and performance monitoring (since October 2024)
Celine Naderipour (BSH)	Technician, float procurement, technical support, and performance monitoring (since August 2024)
Arne Körtzinger (GEOMAR)	Research scientist, BGC group, DMQC expert pH-sensor (BGC sensors)
Tobias Steinhoff (GEOMAR)	Research scientist, BGC group, DMQC expert pH-sensor (BGC sensors)
Cathy Wimart-Rousseau (GEOMAR)	Research scientist, BGC group, DMQC expert pH-sensor (BGC sensors) until May 2024
Rainer Kiko (GEOMAR)	Research scientist, expert UVP sensor
Henry Bittig (IOW)	Research scientist (C-Scope), BGC group, DMQC expert (BGC sensors)
Oliver Zielinski (IOW)	Research scientist, BGC group

Hendrik Bünger (ICBM)	Research engineer, BGC group, DMQC expert radiometry (BGC sensors); until end of 2024
Jochen Wollschläger (ICBM)	Research scientist, BGC group, radiometry
Rohan Henkel (ICBM)	Research engineer, BGC group, technical support
Olaf Boebel (AWI)	Research scientist, RAFOS technology
Marcus Janout (AWI)	Research scientist, project Ocean:Ice
Alexander Haumann (AWI)	Research scientist, project VERTEXO
Benjamin Rabe (AWI)	Research scientist, project ArcWatch
Krissy Reeve (AWI)	Research scientist, Weddell Gyre

Table 1: People involved in Argo in Germany and their associated institutes.

3. Summary of deployment plans: as was done last year, please fill out this spreadsheet to help us understand the progress towards implementation of OneArgo. There is one new column this year for floats being deployed with experimental sensors such as UVP, C-sensor, etc. This spreadsheet is to be **returned separately by 17 March** to help prepare for the meeting. It can be sent to Megan or dropped in this folder link.

Deployment year:	2024					
Float Type:	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O
A. Funded	20	13	4	4	0	0
B. Business as usual/Reasonable expectation						
C. Proposed, with a reasonable chance of success						
D. Aspirational						
E. Other						
Totals	20	13	4	4	0	0

Table 2: deployments carried out in 2024

	Table completed by : *Birgit Klein*													Argo program: *Argo Germany*						
Deployment year:	2025							2026							2027						
	Core	Core + O	Core + 2-3	Core + 4-6	Deep	Deep +	Exp sensor	Core	Core + O	Core + 2-3	Core + 4-6	Deep	Deep +	Exp sensor	Core	Core + O	Core + 2-3	Core + 4-6	Deep	Deep +	Exp sensor
A. Funded	59	25	2	7	0	0	2	18	18		6	0	0	1	18	18		9		0	1
B. Business as usual/Reasonable expectation											2										
C. Proposed, with a reasonable chance of success																					
D. Aspirational																					
E. Other																					
Totals	59	25	2	7	0	0	2	18	18	0	8	0	0	1	18	18	0	9	0	0	1

Table 3: deployments to be carried out in 2025-2027. Full table 2025-2030 uploaded on AST drive

4. Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.

   BSH has finished the joint research project C-Scope end of 2024. It was funded by BMBF and focused on synergies of marine carbon observations from ship-based sources and Argo floats. Other project partners as GEOMAR and IOW will continue working (development/tests of pCO2 sensors) in the European research project GEORGE (2023-2027).

   Another large European research project called EuroArgo One has started in 2025 and is devoted to foster the European implementation of OneArgo. BSH, GEOMAR and IOW are partners in the project.

   AWI is continuing its monitoring of the Southern Ocean in the Helmholtz funded Program HAFOS (The Hybrid Antarctic Float Observing System) with increased attention on ice shelves. Early 2025 a HAFOS expedition in the Weddell Gyre deployed 25 iceApex and deploying 6 sound sources with enhanced focus on the southern and western Weddell Sea.

   The German annual user workshop for 2024 was held as a hybrid event on17.06.2025. The meeting was well attended and provided a good forum for users to share their scientific work and methods.

   Germany contributes to the NAARC and joined recently the SOARC. Researchers from German institutions have continued to contribute recent CTD data to the Argo climatology.

5. 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 Argo websites.

   BSH is maintaining and updating the Argo Germany web site. It provides information about the international Argo Program, German contribution to Argo, Argo array status, data access and deployment plans.

   https://www.bsh.de/DE/THEMEN/Beobachtungssysteme/ARGO/argo_node.html

   Currently no statistics of Argo data usage are available. The German Navy uses Argo data on a regular basis for the operational support of the fleet. The SeaDataNet portal uses German Argo data operationally for the Northwest European Shelf. Argo data are routinely assimilated into the GECCO reanalysis, which is used for the initialization the decadal prediction system MiKlip and other operational forecasting systems.

6. 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. Also, during the AST-26 plenary**, each national program will be asked to mention a single highlight or issue via a very brief oral report**.

   An increasing concern additional to strong price increases is the high lead time between orders and delivery. This is complicating the logistics and is challenging in terms of meeting budgets in FY.

   The time taken up to deal with the logistics of float deployments seems to have increased considerably during past years and places a big burden on small teams such as at BSH. Delayed cruises, changed ports and difficult shipping logistics have mounted last year.

7. Outreach and communication: please describe, in brief, outreach efforts within your national program over the past year. Also, if you've issued any communications, press releases, participated in articles, etc., please send the links. We are considering our social media strategy, so please let us know which social media you engage with and the corresponding handles.

   Organization of the national user work shop 17.06.2024

   Social media posts on linkedin and twitter (until end of 2024)

   - BSH contribution about the Argo Program
   - Presentation at the Extreme-weather-congress Hamburg 24.-25.9.2024
   - Press release (22.8.) about the Argo float deployments of the German Navy

   Presentation of Argo at the Open ship day: Hamburg port 09-12.5.2024

   Participation to G7 policy brief

Briefing of the German Navy 29.8.2024

Participation to the ESFRI (European Strategy Forum on Research Infrastructures) exchange 4.9. in Bonn

Exhibition of an Argo Demo-float and a poster at the German Climate Congress (DWD) (German contribution to the climate monitoring) 23.10.2024, Hamburg

Participation to the Antarctica in Sync preparation meeting 11.09-12.09.2024

German translation of the Frontiers for the young mind article Keeping an Eye on Earth's Oceans With Argo Robots by Greenan et al. and publication in https://culture-ocean.com/resources/ocean-collection/float_Greenan(2023)_DE.pdf

C-Scope project videos https://www.youtube.com/watch?v=E_GlVV_-cMs

https://oceandecade.org/actions/c-scope-in-action/

8. 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.

   During some of the deployments organized by the BSH reference CTD profiles were taken, the principal investigators are asked to provide the data as soon as they are calibrated. We will then exchange them with Coriolis.

9. Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.
   There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)). If you know of any doctorate theses published in your country that are missing from the list, please let me know. Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

Mirja Schoderer, Henry Bittig, Birgit Klein, Ramona Hägele, Tobias Steinhoff, Karel Castro-Morales, Arne Körtzinger, Leticia Cotrim da Cunha, Anna-Katharina Hornidge, From individual observations to global assessments: tracing the marine carbon knowledge value chain, Ocean and Society, 2025, Volume 2, https://doi.org/10.17645/oas.8891, 2025.

Sebastian Brune and Vimal Koul, Impact of ocean data assimilation on the sub-polar North Atlantic in MPI-ESM, Quarterly Journal of the Royal Meteorological Society, Volume151, Issue767, https://doi.org/10.1002/qj.4922, January 2025

Foltz GR, Eddebbar YA, Sprintall J, Capotondi A, Cravatte S, Brandt P, Sutton AJ, Morris T, Hermes J, McMahon CR, McPhaden MJ, Looney LB, Tuchen FP, Roxy MK, Wang F, Chai F, Rodrigues RR, Rodriguez-Fonseca B, Subramanian AC, Dengler M, Stienbarger C, Bailey K and Yu W, Toward an integrated pantropical ocean observing system. Front. Mar. Sci. 12:1539183, doi: 10.3389/fmars.2025.1539183, 2025

Roch M, Brandt P and Schmidtko S (2023), Recent large-scale mixed layer and vertical stratification maxima changes. Front. Mar. Sci. 10:1277316. doi: 10.3389/fmars.2023.1277316

Ismail, M. Furquon Azis, Karstensen, Johannes, Ribbe, Joachim, Arifin, Taslim, Chandra, Handy, Akhwady, Rudhy, Yulihastin, Erma, Basit, Abdul und Budiman, Asep Sandra (2023) *Seasonal mixed layer temperature and salt balances in the Banda Sea observed by an Argo float.* Geoscience Letters, 10 (1). Art.Nr. 10. DOI 10.1186/s40562-023-00266-x.7

Wimart-Rousseau, Cathy , Steinhoff, Tobias , Klein, Birgit, Bittig, Henry C. und Körtzinger, Arne (2024) *Technical note: Assessment of float pH data quality control methods – a case study in the subpolar northwest Atlantic Ocean.* Biogeosciences (BG), 21 (5). pp. 1191-1211. DOI 10.5194/bg-21-1191-2024.

Purkiani, K.**,** K. Jochumsen**,** J.-G. Fischer (2024), Observation of a moderate Major Baltic Sea inflow in December 2023, *Scientific Reports*, 14, 16577, doi:10.1038/s41598-024-67328-8.

Lentz, S., Brune, S., Kadow, C. et al. Improving ocean reanalyses of observationally sparse regions with transfer learning. Sci Rep 15, 2640 (2025). https://doi.org/10.1038/s41598-025-86374-4

Stanev, E. V., Gramcianinov, C. B., Staneva, J., & Slabakova, V. (2024). Thermohaline intrusions as seen by Argo floats: The case of the Black Sea. Journal of Geophysical Research: Oceans, 129, e2024JC021762. https://doi.org/10.1029/ 2024JC021762

10. Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2025 and 2026 (if known) and where they might be deployed.

    Germany is contributing to the diversification of CTD sensors by purchasing RBR sensors on argo floats and deploying them. In 2024, one float with RBR-sensor was deployed within the Mediterranean Water off the Iberian coast. 2 more sensors will be deployed in the Azores region in 2025. Moreover, 5 RBR sensors on floats will be deployed in the North Atlantic in September

2025. We will buy 8 more RBR sensors (4 with additional oxygen sensors) in 2025 to be probably deployed in 2025, latest in 2026.

Our initial plan to purchase half of our core floats with RBR sensors were halted and awaited results of a recall action by NKE to inspect some early failures of the floats with RBR sensors. However, the action did not show any systematic error so we will continue to furnish about half of our core floats with RBR sensors in the coming years.

GREEK ARGO PROGRAMME

PRESENT STATUS AND FUTURE PLANS

D. Kassis and G. Korres
HCMR
March 2025

1. Background and organization of GREEK ARGO activities and implementation status

Greece established national contribution to the ARGO project through national funding to the Greek Argo programme (2012-2015). The programme was co-financed by Greece and the European Union. Through the national programme Hellenic Integrated Marine Inland water Observing Forecasting and offshore Technology System (HIMIOFoTS) www.himiofots.gr (2018-2021), HCMR has established further contribution to the ARGO project. Since November 2021, when HIMIOFoTS finished, there is not any existing national funding for Greek Argo.

1.1 Floats deployed and their performance

During 2024, one (1) Argo float was deployed in the Greek Seas under the framework of the Greek-Argo RI activities, and the Euro-Argo ERIC cooperation activities. The float was an Arvor-I of the Italian Argo fleet and was deployed by the Greek Argo team under the field activities co-operation framework in the Mediterranean Sea. The float was deployed on 10/3/2025 in the Libyan Sea, at the Cretan Passage during the Greek WFD spring period sampling. Further information on these missions are available in the Euro-Argo fleet monitoring tool (https://fleetmonitoring.euro-argo.eu/dashboard?Status=Active).

Table 1. Active floats and new deployments performed from Greek Argo team during 2024

A/A	Float type	WMO	SERIAL NUMBER	Deployment Date	Deployment time	Deployment Latitude	Deployment Longitude	Available profiles	Status
1	ARVOR I	2903898	AI2632-23EU016	10/03/2024	04:40	35.11	23.92	72	Active

All floats have been integrated in the MedArgo project. The raw data of the Greek float are delivered at the Coriolis data Centre where the real time quality control takes place while the delayed mode quality control of the data will be processed by the MedArgo Centre at OGS.

1.2 Floats recovered

No float recoveries were performed within 2024.

1.3 Technical problems encountered and solved

Based on previous experience on platform monitoring systems, HCMR has been utilizing an automatic alerting system (http://poseidonsystem.gr/alerts/?m=2) for the monitor of basic parameters of the floats' location and data transmission. This system has been partially updated

to enhance the operational monitoring needs of the Euro-Argo RISE coastal deployment needs for the 6903288 float deployed in 2020. The automatic alerting system incorporated additional features for the real-time monitoring of crucial parameters that described the float's operation. Such are the bathymetry and the maximal depth reached by the float in order to keep track of grounding events. The alerting system is based in pre-defined thresholds and an alert message is transmitted in cases the monitored parameters overcome these thresholds. Thus, similar to the alerting messages whether there are delays or major differences in the transmission time, alert messages were sent to the PI when profiling or parking pressure was recorded to be less than 155.0 dbar or in cases the float is approaching towards the shore.

1.3 Status of contribution to Argo infrastructure, data management and delayed mode quality control process

HCMR has run an extended network of buoys within the Aegean and Ionian Seas including the multi-parametric M3A observatory of the Cretan Sea and a deep sea (2000 m) bottom platform which is part of the EMSO network and has been deployed in the Ionian Sea (POSEIDON & POSEIDON-II monitoring, forecasting and information systems). HCMR also operates the Hellenic National Oceanographic Data Centre (HNODC) established in 1986, as part of the National Centre for Marine Research (NCMR). HNODC operates as a National Agency and is responsible for processing, archiving and distributing marine data. HNODC is also developing techniques for oceanographic data processing and data base maintenance. Furthermore it promotes the International Exchange of Data in the frame of its cooperation with the "Intergovernmental Oceanographic Commission IOC) of UNESCO as it is responsible for the coordination of International Data Exchange (IODE) in Greece.
HCMR operates a large-scale integrated infrastructure that includes all marine observational systems together with ocean engineering infrastructures. Regarding the delayed mode data processing HCMR has a capability of a delayed-mode quality control for the Greek Argo data. The delayed mode quality control of the data delivered from the Greek Argo float are currently processed by the MedArgo data centre. HCMR considers the possibility of further developing a delayed-mode data processing for ARGO profiles collected within the Eastern Mediterranean region. HCMR may also contribute to the improvement of the delayed mode quality control processing conceding CTD data collected through several HCMR research cruises. HCMR operates the Med Sea data portal that was set up for the needs of Copernicus CMEMS services. Within this framework HCMR is in charge of validating biochemical data from Argo floats that are operating in the Mediterranean.

2. Present level and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo

2.1 Existing funding for Greek Argo

The procurement, deployment and operation costs of the first Greek float launched in 2010/2011 were covered by HCMR internal funds. During 2012, Greece established national funding to the Greek Argo programme through the General Secretariat of Research and Technology (GSRT), Ministry of Education, Lifelong Learning and Religious Affairs (funding agency). A major achievement is that Greece participates to the European infrastructure E-A ERIC as a full member. Until recently, the only existing national funding for the Greek Argo was through HIMIOFoTS national RI through which the purchase of 6 floats is finalized and covered the deployment needs for 2021 and 2022.

2.2 On the future funding, organization and planning for Greek Argo

Efforts from the Institute of Oceanography of HCMR for further national funding for the long-term sustainability of Greek Argo are ongoing. Since HIMIOFoTS RI has ended in 2021, several actions have been undertaken by the Greek Argo team towards the General Secretariat of Research and Innovation (GSRI) in order the latter to contribute for the Greek Argo programme continuation and sustainability. Within 2023, a small national funding to cover the basic needs of operational oceanographic activities was expected, postponed for 2024 but until now it has not been released. HCMR has asked budget for BGC floats from structural-recovery funds through the Ministry of Environment, these funds will be allocated mainly for MSFD and WFD monitoring capacity. The purchase of 9 BGC floats is envisaged on behalf of HCMR whilst, 2 more BGC floats are required by the Greek Fisheries Institute.
As part of the Euro-Argo, HCMR has undertaken all necessary efforts and managed to establish long term national funding for the E-A ERIC infrastructure and to meet the standards of a full member. Regarding the Greek Argo RI annual contribution to Euro-Argo RI an indicative estimation is the following:

Personnel committed/dedicated to Euro-Argo activities (person months/year):

- National representation, member commitments: 2.5
- Float preparation, deployments, procurements: 1

Personnel committed/dedicated to Greek-Argo activities (person months/year):

- Greek Argo coordination and management: 2
- Float preparation, deployments, procurements: 2
- Monitoring of the fleet performance: 2
- Data management and analysis: 3

3. Summary of deployment plans

Greece has deployment capabilities for the Aegean, the Ionian Sea and the central Levantine basin. Float deployments in 2025 will be performed according to the plans of the Greek-Argo research infrastructure. The main goal within 2025 is to continue the efforts for a sustainable funding scheme for the Greek-Argo infrastructure in accordance with the Euro-Argo infrastructure. In 2025, a new tender is envisaged for the purchase of 9 BGC floats. Future deployments are a function of the operational needs of the Greek Argo network and the current coverage of areas of interest. Although the final decisions for the areas that floats will be deployed may change, the plan for 2025 includes:

- 1 float deployment in the South Aegean
- 1 float deployments in the North Aegean
- 1 float deployment in the Ionian Sea

4. Summary of national research and use of Argo data

4.1. Operational and scientific use of Argo data

An important part of the Greek-Argo activities is the exploitation of Argo data for operational forecasting as well as for research applications. Along this direction, HCMR established a network of relevant Greek scientific groups mainly from Universities and Research Institutes which constitute the Greek Argo Users group/network. These different groups are already using or will be using ARGO data in ocean/atmospheric forecasting, climate studies and for educational purposes. It is expected that the Greek Argo Users Group will further grow and expand its activities concerning the scientific exploitation of Argo data and the cooperation among Greek scientists. The next step will be the expansion of the Greek Argo network in more members. The network is already in contact with many organizations / agencies / institutions and it is foreseen that the establishment of the Euro-Argo ERIC will increase the interaction of the Greek Argo Users Group with the European and international ARGO scientific community in the near future.
Additionally, Argo data are used for educational purposes in some Greek University Departments. Due to HCMR initiatives within Euro-Argo, Greek Argo, Euro-Argo RISE, and SIDERI programmes to contact potentially interested Greek and other scientists from the eastern Mediterranean region and inform them about the benefits of Argo programme. An increasing demand for Argo data along the Aegean and Ionian Sea for both scientific and educational purposes has been registered.

4.2. Dissemination activities of the Greek Argo– links with Euro-Argo infrastructure

During 2019 the Greek Argo RI hosted the 7th Euro-Argo Science Meeting that took place in Athens on 22-23 October. The meeting has been successful and managed to bring together users of Argo data providing an opportunity for high-level science interactions. Similarly, HCMR Argo team organized the 1st Mediterranean and Black Seas Argo workshop (https://www.euro-argo.eu/News-Meetings/Meetings/Others/Mediterranean-and-Black-Seas-workshop), under Euro-Argo RISE activities, in April 2021, and is further preparing a follow-up to the workshop special session in the upcoming HCMR's Marine and Inlands Waters Symposium in September 2022 (https://symposia.gr/special-sessions/). Within 2019 several dissemination activities were carried out by the Greek Argo RI such as the participation of Greek Argo in the 2019 Researchers Night and the educational activities for high school students throughout the year. However, during 2020, similar activities were cancelled due to the Covid-19 situation. In 2021, presentations of the Greek Argo and the Euro-Argo activities have been made at high schools of Athens during 2021, and at the University of Aegean (Marine Sciences department) in November 2022 following the previous in November of 2016. Within 2022, several activities were performed mainly under the Euro-RISE H2020 project that ended in December 2022. More specifically, in January 2022, a report was published from the meeting organized by HCMR in collaboration with the Euro-Argo Office within the framework of the 9th EuroGOOS International Conference 2021 Marine Research Infrastructures Side Event 5th May 2021 "Cooperation Framework between Marine RIs".
In September 2022, the Greek infrastructure organized a special session entitled "Argo floats contribution to the marine research and operational monitoring of the Mediterranean Sea – Evolution, Achievements, and Future Needs" within the framework of the Marine and Inland Waters Research Symposium, Argolida, Greece. In the session, scientists specializing in Argo activities in the Mediterranean were invited and hosted, while the several papers were also presented.
In October 2022, the Greek Infrastructure participated in the 7th Argo Science Workshop, Brussels, Belgium, October 2022 where the work "An update of North Aegean hydrography derived from autonomous profiling floats" was presented.

Several educational and outreach activities were also performed targeting high school teachers and students. In February 2022 a presentation of Greek Argo activities was given to students and teachers of the 6th General Lyceum of Egaleo. In May 2022 a presentation of Greek Argo activities was given to students and teachers of the 7th High school of Nikaia. In July 2022 a presentation of Greek Argo was given in an educational activity that took place by the municipality of Derveni, Corinthia. During November-December 2022, two more presentations and dissemination of material took place in high schools of Attica.

By the end of 2013 Greek Argo has launched its web page: www.greekargo.gr that demonstrates and promotes Greek-Argo and Euro-Argo activities. At the end of 2014 Greek-Argo web portal was upgraded providing information and data access from all floats operating in the Mediterranean and presenting all Greek Argo activities, news and data from Greek Argo floats. A continuous upgrade is ongoing integrating more images and videos from Greek Argo deployment activities. Furthermore, new education material has been released and a school visit programme has been established since 2015.
The Greek Argo and Euro-Argo Research Infrastructures, along with the Euro-Argo RISE project, are demonstrated on the POSEIDON updated web page, https://poseidon.hcmr.gr/components/observing-components/argo-floats. The POSEIDON system is the operational monitoring and forecasting system for the Greek Seas and many of its forecasting components use T/S Argo profiles for data assimilation purposes. The POSEIDON web page is also hosting the links to the Euro-Argo educational web site as well as to the floats from each European country. The above links along with other informative material (Euro Argo leaflet, focused questionnaire) were forwarded directly to all active and potential users of Argo data in Greece. Many research groups filled and sent back the questionnaire providing valuable feedback to HCMR team. Furthermore, the Euro-Argo poster and leaflet translated in Greek and they are hosted in the POSEIDON website.

5. Greek Argo contribution to Argo bibliography

5.1 Operational oceanography and ocean forecasting

Med-Argo data have been already used as independent data in order to assess the impact of remote sensed and Ferry-box SSS data assimilation into the Aegean Sea hydrodynamic model component of the POSEIDON system running operationally at HCMR within the framework of POSEIDON system.

Med-Argo data are routinely assimilated (using localized Singular Evolutive Extended Kalman filtering techniques) on a weekly basis in three different modelling forecasting components (Mediterranean $1/10^o$ resolution, Aegean Sea $1/130^o$ resolution and Ionian – Adriatic Sea at $1/50^o$ resolution) of the POSEIDON operational system.

Some of the results of the works described above are included in the following scientific publications:

Ntoumas, M.; Perivoliotis, L.; Petihakis, G.; Korres, G.; Frangoulis, C.; Ballas, D.; Pagonis, P.; Sotiropoulou, M.; Pettas, M.; Bourma, E.; Christodoulaki, S.; Kassis, D.; Zisis, N.; Michelinakis, S.; Denaxa, D.; Moira, A.; Mavroudi, A.; Anastasopoulou, G.; Papapostolou, A.; Oikonomou, C.; Stamataki, N. The POSEIDON Ocean Observing System: Technological Development and Challenges. *Journal of Marine Science and Engineering. 2022*, *10*, 1932. https://doi.org/10.3390/jmse10121932

Bourma E, Perivoliotis L, Petihakis G, Korres G, Frangoulis C, Ballas D, Zervakis V, Tragou E, Katsafados P, Spyrou C, Dassenakis M, Poulos S, Megalofonou P, Sofianos S, Paramana T, Katsaounis G, Karditsa A, Petrakis S, Mavropoulou A-M, Paraskevopoulou V, Milatou N, Pagonis P, Velanas S, Ntoumas M, Mamoutos I, Pettas M, Christodoulaki S, Kassis D, Sotiropoulou M, Mavroudi A, Moira A, Denaxa D, Anastasopoulou G, Potiris E, Kolovogiannis V, Dimitrakopoulos A-A, Petalas S, Zissis N. The Hellenic Marine Observing, Forecasting and Technology System—An Integrated Infrastructure for Marine Research. *Journal of Marine Science and Engineering*. 2022; 10(3):329. https://doi.org/10.3390/jmse10030329

Petihakis, G., Perivoliotis, L., Korres, G., Ballas, D., Frangoulis, C., Pagonis, P., Ntoumas, M., Pettas, M., Chalkiopoulos, A., Sotiropoulou, M., Bekiari, M., Kalampokis, A., Ravdas, M., Bourma, E., Christodoulaki, S., Zacharioudaki, A., Kassis, D., Potiris, E., Triantafyllou, G., Tsiaras, K., 2018: An integrated open-coastal biogeochemistry, ecosystem and biodiversity observatory of the eastern Mediterranean-the Cretan Sea component of the POSEIDON system. *Ocean Science*, *14*(5), 1223-1223.

L. Perivoliotis , G. Petihakis , M. Korres , D. Ballas , C. Frangoulis , P. Pagonis , M. Ntoumas , M. Pettas , A. Chalkiopoulos , M. Sotiropoulou , M. Bekiari , A. Kalampokis , M. Ravdas , E. Bourma , S. Christodoulaki , A. Zacharioudaki , D. Kassis , M. Potiris , G. Triantafyllou , A. Papadopoulos , K. Tsiaras and S. Velanas, 2017. The POSEIDON system, an integrated observing infrastructure at the Eastern Mediterranean as a contribution to the European Ocean Observing System. Proceedings of the 8th EuroGOOS International Conference, 03-05 October 2017, Bergen, Norway

Kassis, D., Korres, G., Konstantinidou, A., Perivoliotis, L., 2017. Comparison of high-resolution hydrodynamic model outputs with in situ Argo profiles in the Ionian Sea. Mediterranean Marine Science, 0, 22-37. doi:10.12681/mms.1753

Kassis, D., Konstantinidou, A., Perivoliotis, L., Korres, G., 2015. Inter-comparing numerical model simulations in the Ionian Sea with Argo T/S profiles for the period 2008-2012. In proceedings of the 11th Panhellenic Symposium on Oceanography and Fisheries, p.945-948, ISBN 978-960-9798-08-2

Kassis D., Perivoliotis L. & G. Korres, 2014. Greek Argo: Towards monitoring the Eastern Mediterranean - First deployments preliminary results and future planning. In proceedings of the 7th International Conference on EuroGOOS, Lisbon – Portugal, 28-30 October 2014

Korres, G., M. Ntoumas, M. Potiris and G. Petihakis, 2014. Assimilating Ferry Box data into the Aegean Sea model. Journal of Marine Systems, 140 (2014) 59–72

Korres, G., K. Nittis, L. Perivoliotis, K. Tsiaras, A. Papadopoulos, I. Hoteit and G. Triantafyllou, 2010. Forecasting the Aegean Sea hydrodynamics within the POSEIDON-II operational system. *Journal of Operational Oceanography*, Vol. 3, nu. 1, 37-49.

Korres, G., K. Nittis, I. Hoteit, and G. Triantafyllou, 2009: A high resolution data assimilation system for the Aegean Sea hydrodynamics. *Journal of Marine Systems*, 77, 325-340.

Korres, G., K. Nittis, L. Perivoliotis, G. Triantafyllou and M. Chatzinaki, 2009. The Aegean Sea –Poseidon model. Hellenic Centre For Marine Research, Greece.

5.2 Ocean science and environmental studies

Med-Argo data are currently used by a small group of researchers in Greece for studies of water mass characteristics and climatic signals of the different deep basins of the Mediterranean Sea. The continuous record of T/S characteristics provides insight in the seasonal and inter-annual variability of the Mediterranean Sea and its sub-basins. A number of publications and scientific results have been released regarding the Greek Argo acquired data during the last 4 years.

Publications in scientific journals and conferences proceedings:

Potiris, M., Mamoutos, I. G., Tragou, E., Zervakis, V., Kassis, D., & Ballas, D. (2024, August). Dense water formation variability in the Aegean Sea from 1947 to 2023. In *Oceans* (Vol. 5, No. 3, pp. 611-636). MDPI.

Potiris, M., Mamoutos, I. G., Tragou, E., Zervakis, V., Kassis, D., & Ballas, D. (2024). Dense water formation in the North–central Aegean Sea during winter 2021–2022. Journal of Marine Science and Engineering, 12(2), 221.

Ntoumas, M., Perivoliotis, L., Petihakis, G., Korres, G., Frangoulis, C., Ballas, D., ... & Stamataki, N. (2022). The POSEIDON Ocean Observing System: Technological Development and Challenges. *Journal of Marine Science and Engineering*, *10*(12), 1932.

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Call for National Reports for Argo Steering Team Meetings

National Report – INDIA

Submitted by – E. Pattabhi Rama Rao, Group Director, ODICT, INCOIS

1. **The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)**

   a) *Floats deployed and their performance:*

   INCOIS has contributed a total of 585 floats to the international Argo programme to date. During the 2024-25 period, INCOIS deployed 48 Argo floats in the Indian Ocean, comprising 40 Core Argo floats and 8 Biogeochemical (BGC) floats. Currently, 113 Argo floats remain active and are transmitting data. All data from these active floats are processed and submitted to the Global Data Assembly Centre (GDAC).

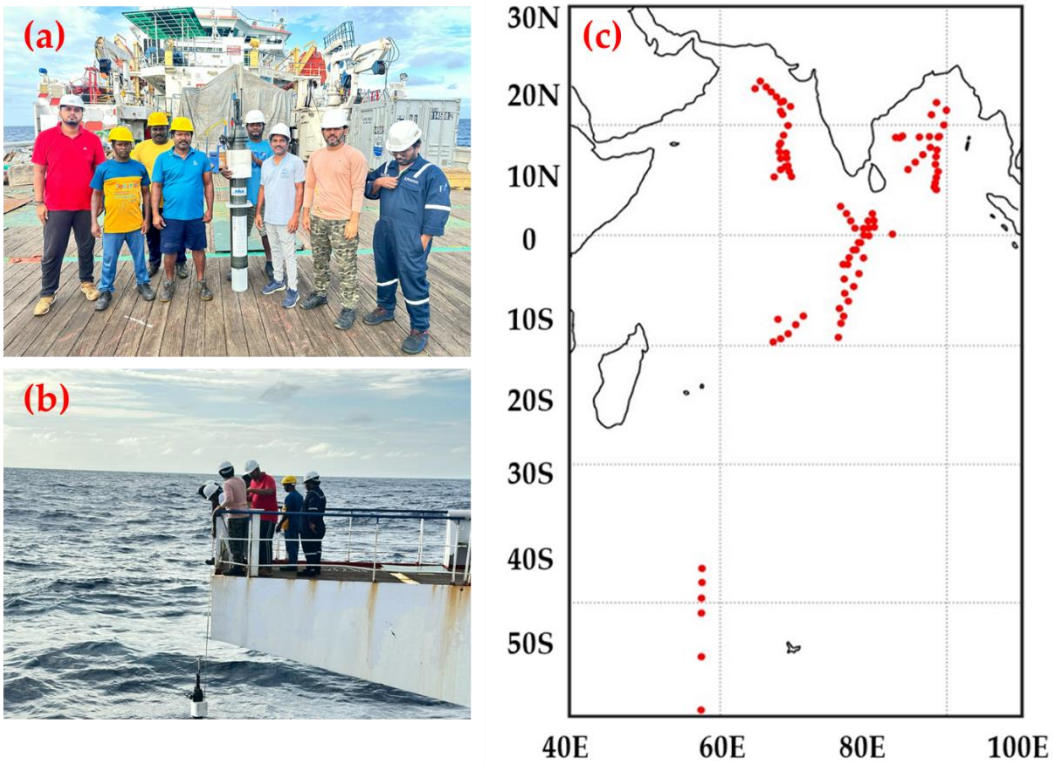

Figure (a) INCOIS team onboard RV Sagar Nidhi during deployment cruise (b) deploying floats in the ocean and (c) the deployment locations of 92 Argo floats since 2023

   b) *Technical problems encountered and solved:*

   INCOIS procured 6 BGC Argo floats in 2023 and an additional 6 in 2024, all equipped with pH sensors from M/s Teledyne Webb Research (TWR). Of the 12 floats procured, 4 were deployed; however, the pH sensors in these floats began malfunctioning within months after deployment. INCOIS raised this issue with M/s TWR, and following detailed discussions with the sensor manufacturer, Seabird, M/s TWR confirmed that the pH sensors have inherent issues, though the root cause remains unidentified.

c) *Status of contributions to Argo data management:*

All the floats deployed by India were processed in real time and the profiles were submitted to GDAC. Further INCOIS is also archiving all the profiles pertaining to the Indian Ocean for internal use and also generation of gridded product pertaining to the Indian Ocean.

d) *Status of delayed mode quality control process:*

The OWC software is being used for performing DMQC. All eligible floats were being passed through Delayed Mode Quality Control and 47% of the profiles were DMQCed and uploaded on to GDAC.

2. Present level of, and prospects for, national funding for Argo

The Indian Argo Project is fully funded by the Ministry of Earth Sciences (MoES), Government of India. INCOIS has recently placed a purchase order for 40 Core Argo floats and 10 BGC Argo floats, with deployment planning to be finalized across various Indian Ocean sectors (Bay of Bengal, Arabian Sea, Equatorial Indian Ocean, and Southern Ocean) based on ship-time availability. Additionally, INCOIS has initiated the procurement process for 50 more floats (40 Core and 10 BGC) for the fiscal year 2025-26. A dedicated team of five scientific and technical personnel supports the project, handling float deployment, data management, and analysis. Funding remains stable as of now, with prospects for sustaining the Argo program objectives.

3. Summary of deployment plans

INCOIS aims to address data gaps in the Indian Ocean by strategically deploying Argo floats across various sectors. Deployment locations will be finalized based on cruise approvals, opportunities for collaboration with research institutions, and the availability of approved funds. In March 2025, INCOIS placed a purchase order for 50 Argo floats (40 Core and 10 BGC), with an additional procurement process initiated for 50 floats (40 Core and 10 BGC) for 2025-26. The deployment plan spreadsheet will be completed and submitted as requested.

4. Summary of research and development efforts over the past year

Operational: Since April 2024, approximately 2,500 temperature and salinity profiles from INCOIS-maintained Argo floats have been transmitted to the Global Telecommunication System (GTS). These data are assimilated into ocean models to generate global ocean analyses, which are critical for the Indian Meteorological Department's monsoon forecasts. The analysis products are accessible via the INCOIS Live Access Server (las.incois.gov.in).

Research: Argo data supports extensive research on Indian Ocean dynamics, cyclone and monsoon systems, heat content, thermosteric sea level components, and validation of ocean general circulation models (OGCMs) by Indian institutions and university students. INCOIS continues to collaborate with vendors and partners to improve float performance by reporting the issues identified in the deployed floats.

5. Summary of national research and operational uses of Argo data

INCOIS hosts the Argo Regional Centre (ARC) for the Indian Ocean (http://www.incois.gov.in/argo/ARDCenter.jsp), providing access to Argo data from floats deployed by India. Data are processed, gridded, and made available through the INCOIS Live Access Server (ILAS) and ERDDAP site (http://erddap.incois.gov.in/erddap/index.html). Value-added products, including time series and spatial plots, are accessible at https://incois.gov.in/argo/ANDCProducts.jsp. INCOIS also acquires supplementary datasets (e.g., CTD, XBT, subsurface moorings) from principal investigators whenever available for quality control purposes.

6. Issues for consideration by the Argo Steering Team

INCOIS highlights the persistent issue with pH sensors in BGC Argo floats procured in 2023 and 2024 from M/s Teledyne Webb Research. The root cause of the malfunctions remains unresolved as per the information received from the float manufacturer M/s TWR, impacting data quality. INCOIS seeks guidance from the Argo Steering Team on addressing this challenge and improving sensor reliability.

7. Outreach and communication

INCOIS engages with over 5,000 college and university students annually through interactive sessions, showcasing operational oceanography and observation platforms like Argo floats. These efforts aim to inspire future oceanographers and raise awareness of INCOIS's contributions. Social media engagement includes:

- **Facebook:** https://www.facebook.com/people/INCOISofficial/
- **LinkedIn:** https://in.linkedin.com/company/indian-national-centre-for-ocean-information-services-incois-
- **X:** https://x.com/ESSO_INCOIS

Figure: In one of the live interactive sessions with university students, INCOIS scientist explains about the Argo float

8. CTD cruise data for the reference database

During 2024-25, INCOIS did not collect reference database CTD data at float deployment sites. However, efforts continue to acquire CTD, XBT, and subsurface mooring data from principal investigators for quality control purposes. Any relevant CTD data collected in the future will be shared with the community, including cruise dates and principal investigator contacts.

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10. Deployment plans for RBR floats

INCOIS has no specific plans to deploy RBR CTD floats in 2025 or 2026 at this stage. However, INCOIS is open to considering RBR float deployments if recommended by AST, with decisions contingent on funding and operational priorities.

Submitted by: G. Notarstefano (OGS), E. Mauri (OGS), Giorgio Dall'Olmo (OGS), Massimo Pacciaroni (OGS), Antonella Gallo (OGS), Emanuele Organelli (CNR-ISMAR) and Giovanni La Forgia (CNR-ISMAR)

Report on the Italian Argo Program for 2024

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)

a. Floats deployed and their performance

A total of 18 Italian floats were deployed in 2024 (see Tables 1 and 2 for details). These floats were Arvor TS DO, Arvor-Ice TS and TS DO, and Deep-Arvor designs manufactured by NKE (France). All floats transmit data via Iridium telemetry.

Floats were deployed from R/V Ammochostos (Cyprus), R/V Aegaeo (Greece), R/V Gaia Blu (Italy), Ship Aviva (Malta), R/V Laura Bassi (Italy), and Pampero II (Poland) for the Mediterranean and R/V Laura Bassi for the Southern Ocean with the help of colleagues from Greece, Malta, Italy and Cyprus.

Mediterranean and Black Sea deployments

Ten units were released in the Mediterranean (9 Arvor TS DO and 1 Deep-Arvor, see Table 1 for details). The Core-Argo floats have a park pressure at 350 dbar and maximal profiling depth at 2000 dbar while the Deep-Arvor was configured with a maximal profiling depth and parking depth at 4000 dbar, and a cycle time of 10 days. One Arvor TS DO float was deployed in the Sicily Channel and parked on the sea bottom to limit horizontal displacement and to sample that shallow area: the cycle time was set to 5 days and the parking depth was adjusted in order to be always greater than the maximum bathymetry. Three Arvor TS DO were released in the Tyrrhenian Sea, one in the Southern Adriatic, one in the Cretan Passage, one in the Levantine and two in the Alboran Sea. The Deep-Arvor was deployed in the Central Ionian Sea.

Model	WMO	Depl. Date	Lat	Lon	Cycles	Last Date	Lat	Lon	Status*	Cyc.**
Arvor – T/S Diss. Oxy	2903898	10-Mar-2024 04:40	35.11	23.91	71	01-Mar-2025 07:44	37.19	21.49	A	5
Arvor – T/S Diss. Oxy	4903782	28-Apr-2024 13:23	40.65	13.53	126	03-Mar-2025 05:43	39.77	11.74	A	5
Arvor – T/S Diss. Oxy	3902484	15-May-2024 08:15	34.28	33.03	58	01-Mar-2025 23:47	33.61	31.93	A	5
Arvor – T/S Diss. Oxy	7901135	20-May-2024 18:03	35.96	14.18	65	09-Nov-2024 21:57	36.56	12.04	D	5
Arvor – I DEEP	6990658	16-Aug-2024 16:10	35.69	17.73	22	02-Mar-2025 04:51	35.79	16.15	A	10
Arvor – T/S Diss. Oxy	2903928	25-Sep-2024 12:55	39.46	12.96	32	02-Mar-2025 19:44	40.24	12.63	A	5
Arvor – T/S Diss. Oxy	4903817	26-Sep-2024 01:30	40.02	11.59	32	03-Mar-2025 19:45	40.07	11.12	A	5
Arvor – T/S Diss. Oxy	3902626	17-Oct-2024 15:55	41.47	17.20	28	03-Mar-2025 18:04	41.68	17.85	A	5
Arvor – T/S Diss. Oxy	4903818	21-Oct-2024 11:19	36.67	-1.01	27	03-Mar-2025 09:48	37.24	0.37	A	5
Arvor – T/S Diss. Oxy	7901134	21-Oct-2024 19:53	36.31	-2.98	27	02-Mar-2025 20:12	36.16	-4.16	A	5

**Status in early March 2025: A = active, D = dead*

***Cycle: Length of cycle in days*

Table 1. Status information for the 10 Italian floats deployed in the Mediterranean Sea during 2024.

South Atlantic, South Pacific and Southern Ocean

With the help of Italian colleagues onboard the R/V Laura Bassi and in collaboration with the *Parthenope* University: a total of 3 Arvor TS and 5 Arvor TS DO all equipped with ice-detection software were deployed (2 out of 8 were recovered and re-deployed), in the Ross Sea. The adopted configuration in the Ross Ice Shelf Polynya consisted of a cycle time of 7 days and a park and maximum profile pressure of 1000 dbar (i.e. a park pressure at the seafloor).

Model	WMO	Depl. Date	Lat	Lon	Cycles	Last Date	Lat	Lon	Status*	Cyc.**
Arvor – T/S ICE	5907101	25-Jan-2024 02:34	-75.11	163.83	74	07-Feb-2025 13:53	-74.66	165.69	recovered	7
Arvor–T/S DO ICE	6990623	27-Jan-2024 16:56	-77.18	169.19	7	04-Mar-2024 12:41	-77.39	169.77	D	7
Arvor–T/S DO ICE	3902580	28-Jan-2024 13:36	-77.39	174.17	63	17-Feb-2025 17:42	-76.32	173.05	recovered	7
Arvor–T/S DO ICE	5907090	29-Jan-2024 10:43	-77.70	-178.52	60	19-Feb-2025 17:33	-77.50	-178.58	recovered	7
Arvor–T/S DO ICE	1902686	01-Feb-2024 09:42:	-77.99	-160.28	57	21-Feb-2025 05:34	-77.66	-161.12	A	7
Arvor–T/S ICE	4903795	02-Feb-2024 00:52	-77.16	-158.99	56	20-Feb-2025 17:36	-77.26	-159.54	recovered	7
Arvor–T/S ICE	5907104	02-Feb-2024 04:36	-76.72	-158.71	57	27-Feb-2025 19:31	-76.67	-159.05	A	7
Arvor–T/S DO ICE	5907091	02-Feb-2024 06:09	-76.48	-158.29	56	20-Feb-2025 17:45	-76.44	-159.30	A	7

*Status in early March 2025: A = active, D = dead

**Cycle: Length of cycle in days

Table 2. Status information for the 8 Italian floats deployed in the Ross Sea during 2024.

Overall status at the end of 2024

In summary, at the end of 2024, the Argo-Italy program had a total of 80 active floats, including 34 in the Mediterranean Sea (Figure 1), and 46 in the South Pacific, South Atlantic, and Southern Oceans (south of 60°S, see Figure 2).

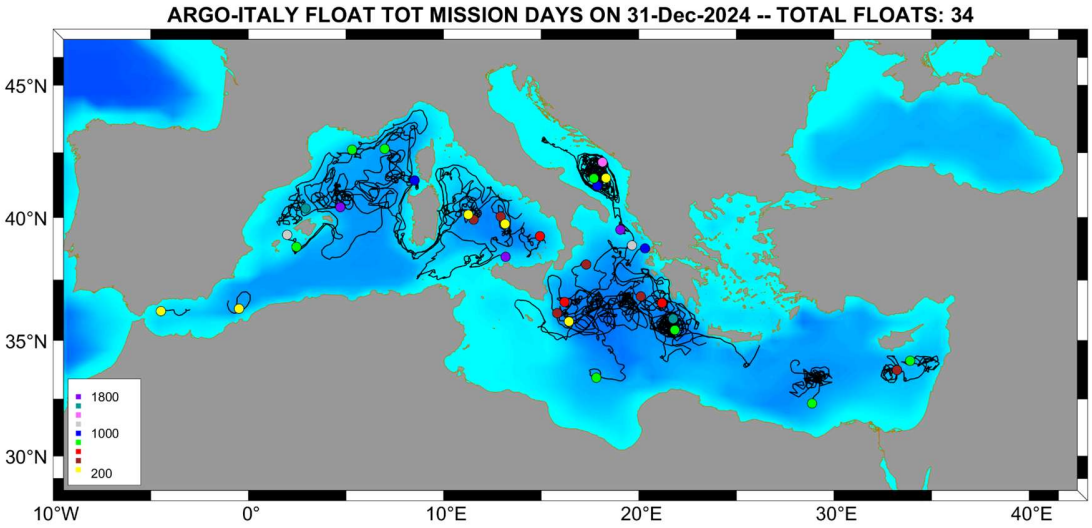

Figure 1. Trajectories and positions (circle symbols) on 31 December 2024 of the 34 Argo-Italy floats active in the Mediterranean Sea. Circles are color coded as a function of float age in days.

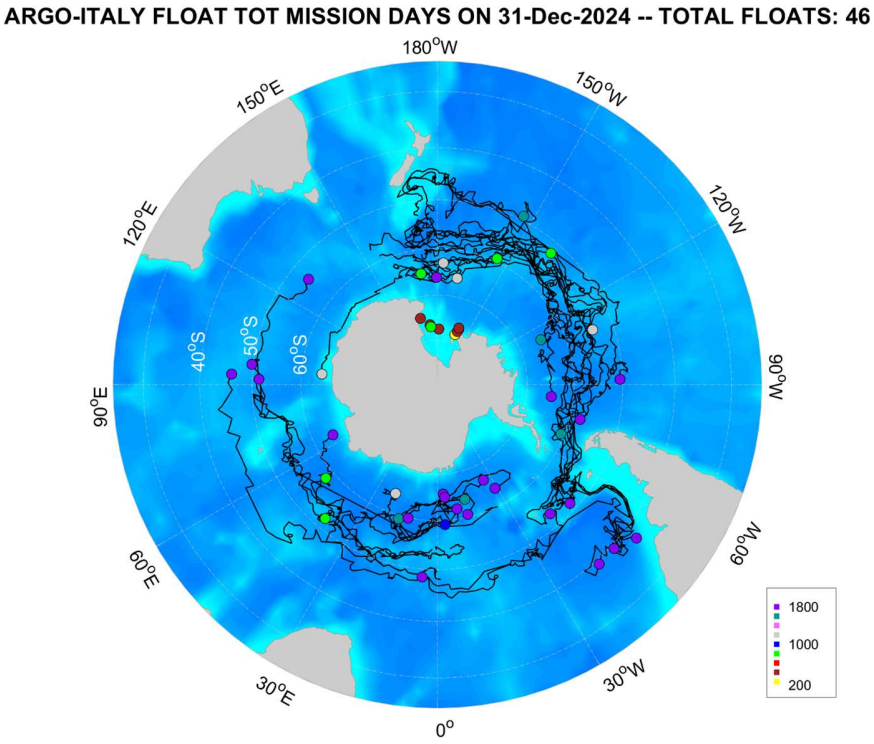

Figure 2. Trajectories and positions (circle symbols) on 31 December 2024 of the 46 Argo-Italy floats in the South Pacific, South Atlantic and Southern Oceans. Circles are color coded as a function of float age in days.

The temporal evolution of the number of active floats is shown in Figure 3 with weekly resolution, along with the annual numbers of float deployments and float deaths for the period 2012-2024. In 2024, the float population ranges from approximately 80 to 90 active instruments. The number of decommissioned floats is nearly offset by new deployments.

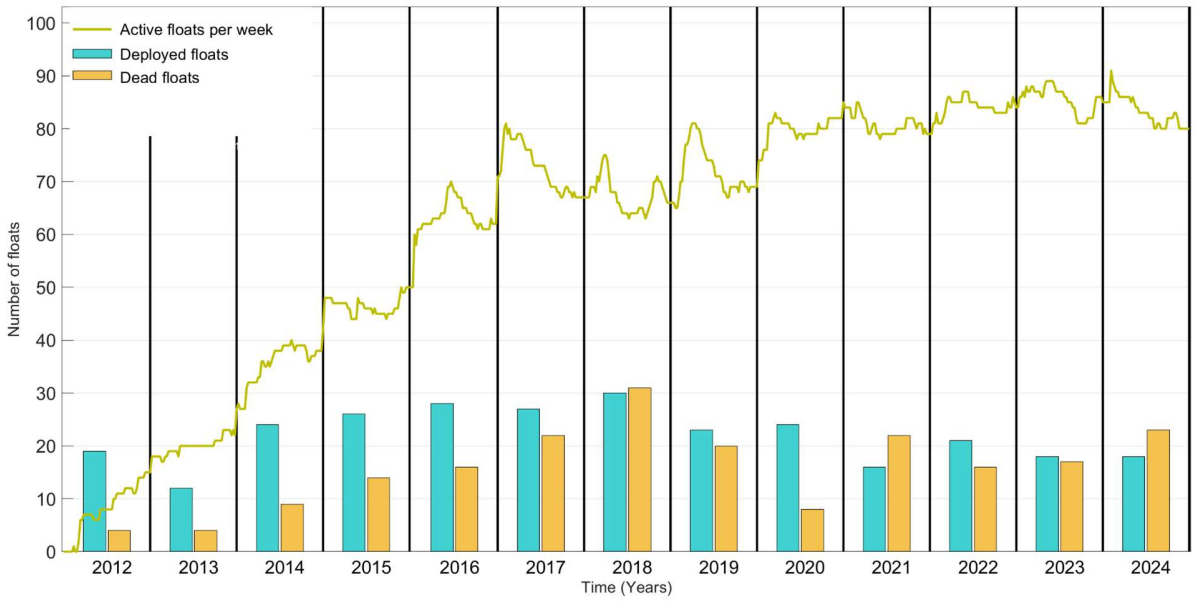

Figure 3. Temporal evolution of the number of Argo-Italy active floats with weekly resolution and histogram of the annual float deployments and losses.

Since 18 February 2012, a total of 286 Argo-Italy floats have been deployed, 167 in the Mediterranean and Black Seas and 119 in the Southern Hemisphere oceans. Over a 13 year period, they have provided about 47,000 CTD profiles. Figure 4 presents a histogram depicting the number of floats across selected CTD profile classes. Figure 5 illustrates the evolution of the Italian float fleet over time by showing the number of float profiles categorized by main float types. In this diagram, Core and Core DO floats are grouped; Bio floats are intended as floats equipped with sensors for measuring 2 to 6 BGC parameters. The density coverage in the Mediterranean Sea is reported in Figure 6.

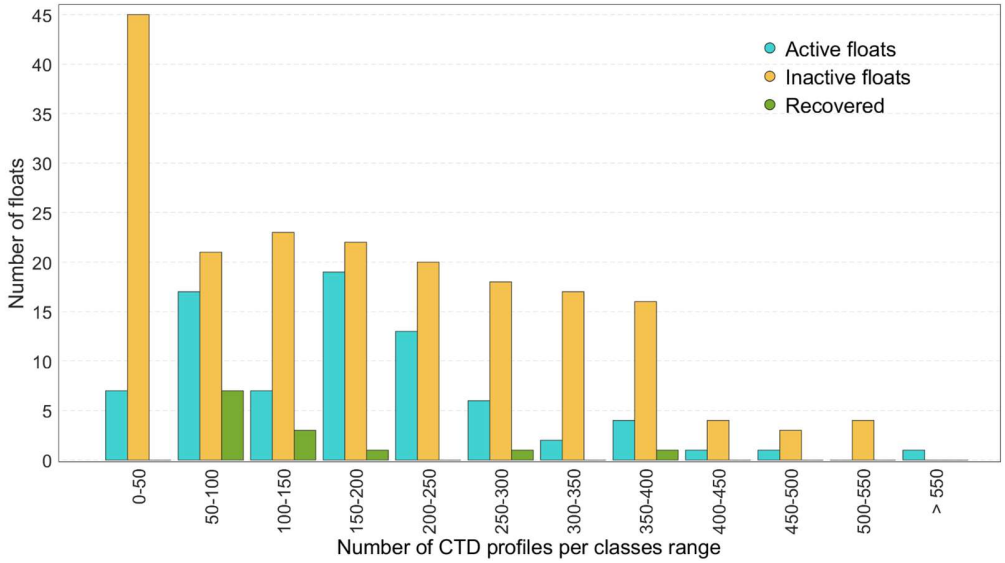

Figure 4. Histogram of the number of floats in selected CTD profile classes at the end of 2024 (orange: dead float, cyan: alive at the end of 2024, green: recovered).

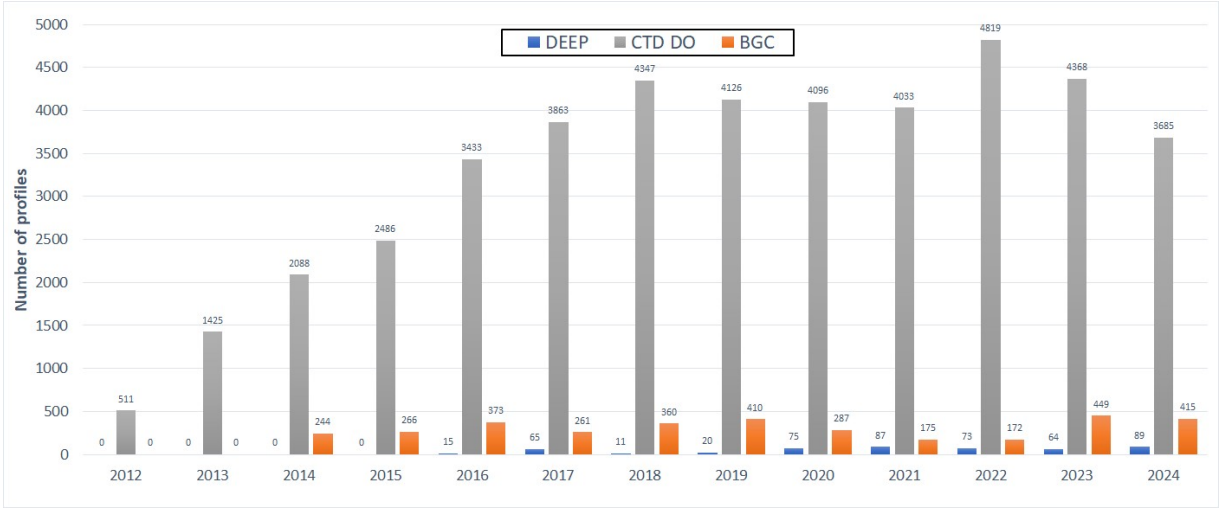

Figure 5. Number of float profiles from 2012 to 2024 sorted by main float types (orange: Bio floats, blue: Deep floats, grey: core and core DO floats).

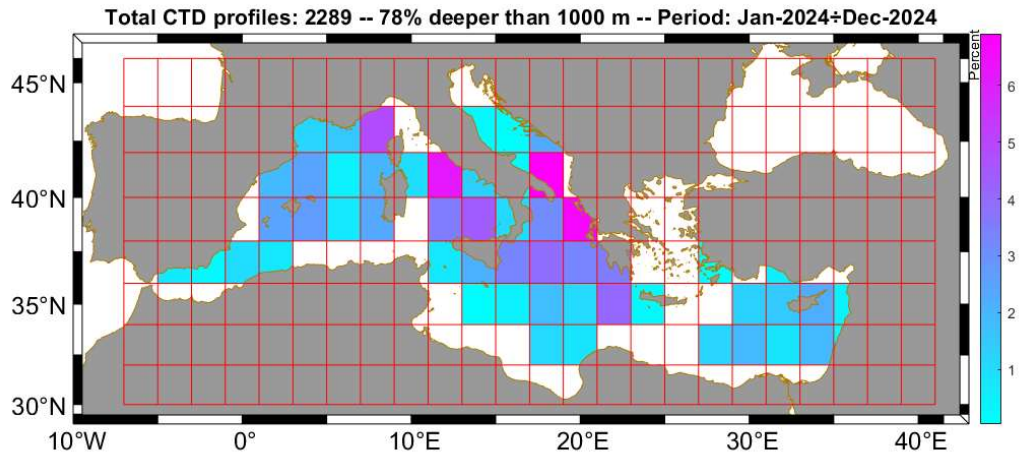

Figure 6. Density map of CTD profiles in 2024.

b. Technical problems encountered and solved

N/A

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)

The data management for the Italian fleet is primarily handled by the Coriolis GDAC. Metadata and data are available in near real-time through the Coriolis web site. The status of high salinity drift is regularly updated on the dedicated share file available at https://docs.google.com/spreadsheets/d/1TA7SAnTiUvCK7AyGtSTUq3gu9QFbVdONj9M9zAq8CJU/edit#gid=1096144849

For each Deep-Argo float analyzed in delayed mode, the following spreadsheet is updated with the optimal CPcor value applied:

https://docs.google.com/spreadsheets/d/1ai1I0gzyHHRv_n6t2M3BMWVBp1F9XO4L2XB1YhBni9U/edit?gid=278821204#gid=278821204

Plans are in place to train members of staff on the DMQC of DOXY and NITRATE.

d. Status of delayed mode quality control process

The delayed mode quality control (DMQC) of the physical data (pressure, temperature and salinity) provided by the Italian floats was done for approximately 77,5% of eligible

floats (200 out of 258 eligible floats) deployed between 2009 and 2023 in the Mediterranean and Black Seas, and Southern Ocean (all information and statistics to create the D-files have been sent to Coriolis). Physical data were quality controlled in delayed-mode following the standard Argo procedure. In particular, the OWC method in conjunction with other procedures is adopted to check and adjust the salinity data. The OWC is a statistical method based on the comparison between float salinity profiles and an accurate historical reference dataset. The high-quality ship-based CTD reference data from the near-surface to depths more than 2000 m, for QC purposes of Core and Deep-Argo float data in the Mediterranean and Black seas, was reviewed and improved. OGS collected CTD data from several research institutes at regional level and from the main European Marine Services in order to complement the official reference dataset. The reference dataset was quality controlled to obtain a good spatial distribution with more recent/contemporaneous data to reduce the effects of both the inter-annual and the seasonal variability of the Mediterranean Sea, mostly in the upper and intermediate layers of the water column. In order to obtain an even more accurate reference dataset, the procedure developed at BSH is being adapted to marginal seas to find errors, suspicious data, large time gaps, etc. Due to the high natural variability in the water column of the Mediterranean Sea, additional qualitative checks (i.e., a comparison between nearby floats and analysis of the deepest portion of the temperature-salinity diagram) are used in conjunction with the OWC method to better interpret results and hence provide an improved quality control analysis. OGS continuously implements these procedures to better adapt them to marginal seas in order to obtain data of increasingly high quality. OGS is committed to carrying out DMQC on all the Core-Argo floats of the Mediterranean and Black seas, and on some core floats in the World Ocean, as part of the Euro-Argo RISE, MOCCA project and other European projects over the coming years.

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

The Italian Ministry of Research has provided funding to buy 17 floats in 2024, including 15 Core-Argo with dissolved oxygen sensors, and 2 Core-Argo equipped with the RBR CTD. In addition, the Italian human resources per year devoted to Argo-Italy was about 50 man-months for scientific, administrative and technical personnel involved in the project in 2024. It is expected that the same level will be maintained in 2025. The Italian Ministry of Research has committed to provide funds in order to sustain the Italian contribution to Argo which is considered a high-priority infrastructure in the National Research Infrastructure Plan (PNIR). In addition to Italian national funding, in 2024 OGS received funding from the Italian PNRA (Programma Nazionale di Ricerche in Antartide) for personnel (about 8 man months) dedicated to activities related to Argo.

The ITINERIS-PNRR project [2022-2025, €5.85M] enabled Argo Italy to align with the new vision of the global Argo program by acquiring profilers dedicated to the BGC Argo and Deep Argo

missions. Therefore, in the next 5 years, Argo Italy is expected to undergo an expansion phase in terms of personnel and areas of scientific expertise, which will support new lines of research and generation of new funding.

On average over the 2020-2024 period, excluding ITINERIS-PNRR, competitive funding acquired per year grew from €43k/year before 2022 to €209k/year after 2022. This growth, which we expect to sustain over time, demonstrates Argo Italy's new capacity to support the new staff mentioned above in the medium term.

The instrumentation and management of the core-Argo mission will continue to be supported by structural funding. In the long term, we aim to demonstrate the socio-economic as well as scientific utility of the new BGC and Deep Argo missions to extend structural funding to them.

The ITINERIS floats are expected to be deployed starting from 2025 by OGS and CNR-ISMAR. At least 16 BGC and 3 Deep Argo floats will be deployed in 2025 in targeted areas of the Mediterranean Sea. BGC floats will be equipped with sensors for measuring 3, 4 or 5 EOV (pH excluded). Moreover, some of them will be supplied with a double nitrate sensor (SUNA and OPUS), double optical sensor (RBR Tridente and SBS ECO Triplet), UVP6-LP, RAMSES Hyperspectral radiometer, IMU sensor.

3. **Summary of deployment plans: as was done last year, please fill out this spreadsheet to help us understand the progress towards implementation of OneArgo. There is one new column this year for floats being deployed with experimental sensors such as UVP, C-sensor, etc. This spreadsheet is to be returned separately by 17 March to help prepare for the meeting. It can be sent to Megan or dropped in this folder link.**

   The Italian deployment plans from 2025 to 2028 have been provided as a separate contribution at https://drive.google.com/drive/folders/1a_hOVSpGMKajxd91Lv_fmP4IsmMnouNM, as requested. The main areas of interest are the Mediterranean and the Southern Oceans. Since 2023 it has been decided to equip the entire Core-Argo fleet with the dissolved oxygen sensor given the importance of this variable in water mass characterization and biogeochemical processes.

   Over a longer time frame, Italy is primarily interested in maintaining mainly its contributions to the Core mission and supporting the BGC and Deep Argo missions as long as funds are available for these extensions.

4. **Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.**

   Under the ITINERIS projects, with the aim of reducing costs and energy consumption, our vision is to compare sensors that measure the same variable and demonstrate their reliability and potential interchangeability. In the next few years, data obtained from dual-sensor floats (one

traditional and one innovative) will be analyzed and presented to the scientific community and reported in scientific publications.

We also aim to rationalize the network of observations (in terms of number of floats and sensors for specific areas) in collaboration with operational modelers, including using ML/AI methods to reconstruct the most expensive BGC variables.

5. **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 Argo websites.**

Operational ocean forecasting
Data from core- and BGC-Argo floats in the Mediterranean Sea are routinely used for assimilation and forecast validation into the operational Mediterranean marine forecasting center (Med-MFC) run by the Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) and the National Institute of Oceanography and Applied Geophysics (OGS). Med-MFC provides 3D daily physical and biogeochemical fields of the Mediterranean that are available on the Copernicus Marine Service at https://data.marine.copernicus.eu/products?facets=areas%7EMediterranean+Sea. Assessments done by the Med-MFC have clearly demonstrated the positive impact of Argo data on ocean analyses and predictions (Coppini et al., 2023).

Specifically for the biogeochemical operational component, work done by OGS during 2024 included the inclusion of the assimilation of synthetic nitrate profiles computed using the novel PPCon Neural Network (Pietropolli et al., 2023). The new component demonstrated improvement in biogeochemical model results (Amadio et al., 2024) and overcame the drastic decrease of nitrate sensors in the Mediterranean sea starting from 2022.

Additionally, skill performance metrics of the Med-MFC biogeochemical predictions are operationally computed using BGC-Argo data and published regularly in the OGS webpage of the operational results (medeaf.ogs.it/nrt-validation).

Work done at OGS in 2024 also included the implementation of a novel 1D physical-biogeochemical model framework (GOTM-FABM-BFM, Lazzari et al., 2022; Alzarez et al., 2023) that uses Argo and BGC-Argo data as virtual mooring for forcing and assimilation in the Mediterranean Sea. The new model framework has been used for model optimization and parameterization testing to support the development of the operational Marine Copernicus model for Mediterranean biogeochemistry.

Ocean science
Argo data are being used by several researchers in Italy to improve the understanding of marine properties (e.g. circulation, heat storage and budget, and mixing) in both the Mediterranean Sea and the Southern Ocean. Biogeochemical-Argo data are being used to explore carbon fluxes and analyse the impact of extreme events on marine ecosystem structure and functioning, as well as to develop and validate new satellite products.

Web pages

The websites for the Italian contribution to Argo (Argo-Italy) are http://argo.ogs.it/#/. The link to the Mediterranean & Black Sea Argo Centre (MedArgo) is http://argo.ogs.it/medargo/.

6. **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. Also, during the AST-26 plenary, each national program will be asked to mention a single highlight or issue via a very brief oral report.**

   N/A

7. **Outreach and communication: please describe, in brief, outreach efforts within your national program over the past year. Also, if you've issued any communications, press releases, participated in articles, etc, please send the links. We are considering our social media strategy, so please let us know which social media you engage with and the corresponding handles.**

   In 2024, OGS launched the Adopt-a-Float program, attracting participation from three schools of different levels and grades. These classes adopted a float and tracked it throughout the school year, monitoring its data. Both teachers and students engaged in meetings and exchanges with the OGS team, culminating in a presentation of their findings at the end of the year.

   As part of the Big Science Business Forum 2024—a business-focused conference on high technology and a key meeting point between research infrastructures and industry in Europe—scientific outreach activities were conducted during visits to research institutions within the Scientific and Innovation System of Friuli Venezia Giulia.

8. **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.**

   OGS is committed to keeping the Mediterranean and Black Sea reference dataset up-to-date. For this purpose, OGS collects CTD data from different sources (Mediterranean and Black Sea riparian countries, national and European repositories) on a yearly basis. All non-restricted data are sent to the Coriolis GDAC for quality control, as some data policies do not allow the use of those data for scientific purpose and publication.

9. **Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.**
There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)). If you know of any doctorate theses published in your country that are missing from the list, please let me know. Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

Argo PIs: Elena Mauri and Giorgio Dall'Olmo (OGS), Emanuele Organelli (CNR-ISMAR)

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10. **Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2025 and 2026 (if known) and where they might be deployed.**

OGS bought one Arvor I equipped with the RBR CTD sensor in April 2023 and the float has not yet been deployed due to early failures of Arvor floats equipped with RBR CTD in 2024. It seems now that the problem was well investigated and that no further issues have been raised. Hence, this float will be deployed in 2024.

Other two Arvor with the RBR CTD were bought in autumn 2024 and they will be delivered in mid 2025.

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Japan Argo Report for Argo Steering Team Meetings, April 2025

1. **The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)**
   a. **Floats deployed and their performance**

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed 14 Core, Biogeochemical (BGC) and Deep Argo, and Argo equivalent floats from January to December 2024: 9 for Core Argo (APEX), 4 for BGC Argo (BGC-NAVIS), 1 for Deep Argo (Deep NINJA). The four BGC NAVIS floats equipped with SBE63 DO sensors, Deep SUNA nitrate sensors, and FLBBCD chlorophyll and backscattering sensors were deployed in the western subarctic North Pacific in October-November 2024. The one Deep NINJA float was equipped with AROD-FT (RINKO) DO sensors. Since 1999, JAMSTEC has deployed 1461 Core, Deep and BGC Argo, and Argo equivalent floats. The current positions of all active Japanese Argo floats are shown in Fig.1. Float deployments are usually conducted in collaboration with agencies, institutes, universities, and high schools. In 2024, One float was deployed in the North Pacific Ocean by a voluntary cargo ship of a Japanese merchant ship company, NYK.

The Japan Meteorological Agency (JMA) deployed 17 Argo equivalent floats (4 PROVORs and 13 ARVORs) in the seas around Japan from January to December 2024. All the floats get 2,000 dbar T/S profiles usually every 5 days for operational ocean analysis and forecast. Among 425 floats (18 PROVORs, 194 APEXs, and 213 ARVORs) that JMA has deployed from 2005 to 2024, 51 floats (4 PROVORs and 47 ARVORs) are active as of the end of December 2024, while 17 floats (17 ARVOR floats) terminated the transmission in 2024. JMA deployed 2 PROVORs and 2 ARVORs from January to February 2025.

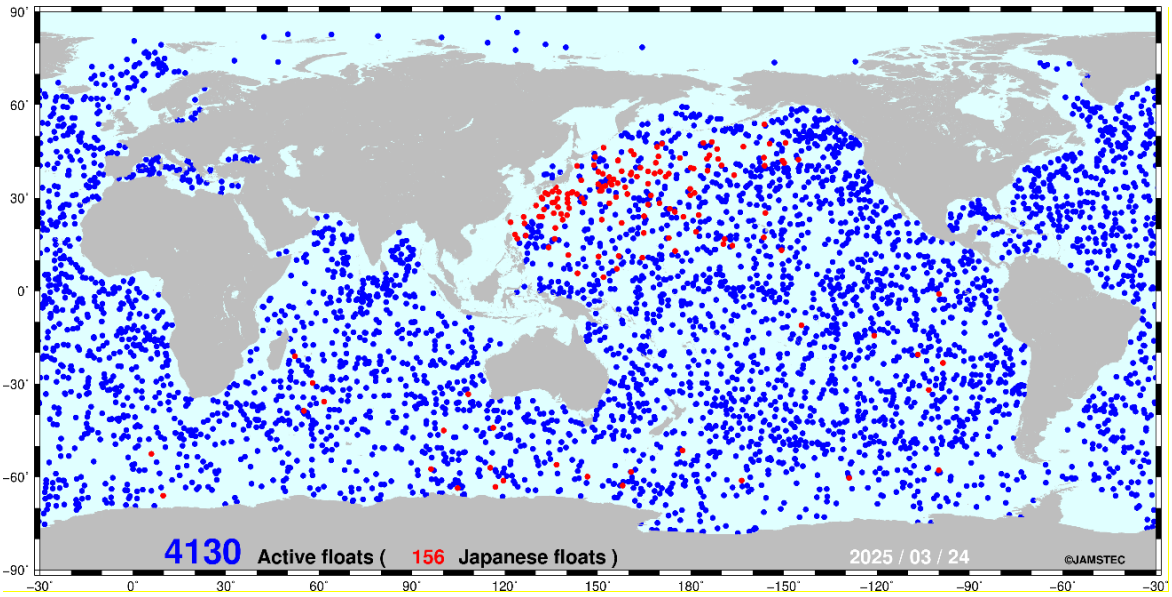

Figure 1: The distribution of active Argo floats. The red dots represent active Japanese floats.

b. Technical problems encountered and solved

(i) Sensor screening for SBE41 conductivity and pressure sensors

JAMSTEC developed a CT sensor screening system, J-Calibration, for the use of the SBE41 by Sea-Bird Scientific (SBS) and is now in operation (Hosoda et al., 2018). Natural seawater is used for the screening, instead of artificial seawater, to adapt in-situ observation without artificial biases, and the screening is judged based on salinity values instead of conductivity values. As a result, precise temperature control is no longer required, which makes the screening process to be more efficient. In 2024, 29 conductivity (C) sensors were checked by the screening, and one of them was identified as potentially faulty and sent back to TWR(SBS). JAMSTEC also conducted pressure (P) sensor screening using a Deadweight Tester (DWT). A total of 28 pressure sensors were tested, and one of them was found to be questionable. The faulty sensor was returned to SBS for repair. Looking ahead, we aim to improve the screening process for greater efficiency and validate the results by comparing them with actual observations. Also, we are investigating screening methods for RBR CTD sensors to validate using seawater.

(ii) pH sensor failure (Seafet)

Because of the announcement of their pH sensor error by SBS on May 25, 2023, which experienced a high failure rate in 2022, the deployment of JAMSTEC's floats with pH sensors has been suspended. At the end of March 2025, we received the floats with the updated pH sensors. We will deploy the floats in April and beyond.

c. Status of contributions to Argo data management including:

i. Status of Japan DAC

The Japan DAC, JMA has operationally processed data from all of Japan's Argo and Argo-equivalent floats including 160 active floats as of March 17, 2025. 11 Japanese PIs agree to provide data for the international Argo. Almost all core data from those floats are transmitted to GDACs in the netCDF format and also issued to GTS using the BUFR codes after real-time QC on an operational basis. The Japan DAC has completed the Cpcor adjustment for deep Argo floats, the processing of the PROVOR float newly deployed by JMA, and the replacement of the Argo-processing server. JAMSTEC implements real-time salinity adjustment based on the Argo QC Manual ver. 3.8 every cycle and JMA uses it in real-time. Frequent position rotations within JMA and ongoing human resource shortages make it challenging to complete ADMT action items in a timely manner. Additionally, the Japan DAC members lack expertise in biogeochemical (BGC) parameters and their sensors, which makes it more difficult to establish and maintain our data processing chains.

ii. Status of high salinity drift floats

Conductivity sensors of 100 floats with SBE41/41CPs and/or SBE61in Japan, including Core, BGC, and Deep floats, suffered from Abrupt Salty Drift (ASD). 25 of them are still active. They were deployed until 2021. 84 of them have serious ASD and have S profiles unable to be adjusted. About 45% of 100 sensors were within SNs of SBE41cp and SBE61 announced by SBS as compensable. Because of ASD, we have lost about 7,000 salinity profiles since 2015, mainly in the northwestern Pacific Ocean, at a rate of about 800~900 profiles every year. The number of profiles suffered by ASD is equivalent to 10%. SBS offered 20.25 credits of SBE41 as the ASD warranty. We have shared this information with ADMT through the working group. In the Argo QC procedure, most of the salinity profiles with ASD were flagged as probably bad or bad in all layers. Because Japanese active floats suffering from ASD were deployed until 2021, the number of Japanese active floats suffering from ASD and their uncorrectable S profiles is expected to decrease.

iii. Decoding difficulties

JMA finds it difficult to decode the BGC parameters because the Japan DAC members lack expertise in BGC parameters and their sensors. JAMSTEC deals with lots of decode-type floats, APEX, Navis, and Deep NINJA floats, etc. Appropriate decoding programs provided by manufacturers are quite helpful for us to apply our data processing system without creating a decoding program from the float manual. Insufficient provided decoding programs, such as including the wrong format or different code from the float manual, make us waste human resources and time. When a new BGC sensor is delivered for the first time, checking data processing and developing appropriate programs by experts must be required, which can be time-consuming.

iv. Real-time Deep implementation

The Japan DAC has completed the Cpcor adjustment for deep Argo floats.

v. Others

To update the QC procedure of DOXY data better than the existing DOXY QC one, JAMSTEC is evaluating the data quality of ARO-FT and AROD-FT (for deep floats), manufactured by JFE Advantech. The specifications of them are higher accuracy (± 2 µmol/kg or ± 2% of FS) and faster response time (< 1 sec). To achieve accuracy, multi-point calibration was generally conducted in the laboratory before deployment. Further, to check the performance of the calibration, we examined the accuracy of DOXY data obtained from arbitral 10 floats with ARO-FT and 5 floats with AROD-FT. By comparing DOXY values of ARO-FT/AROD-FT with those of ship bottle sampling data at deployment position, we found negative drifts (more than 5 µmol/kg) and biases depending on oxygen concentration. The negative drifts and biases can be corrected by applying a linear relationship of DOXY between oxygen measurements of

ARO-FT/AROD-FT and bottle data. By checking ARO-FT measurement in-air, the temporal drift of ARO-FT is slightly larger than that of Optode4330 manufactured by Aanderaa, while its individual dependency is smaller in comparison with the Argo DOXY criteria. The carry-over coefficients are relatively large, which may be caused by remaining water drops on the membrane of ARO-FT when the sensor is in the air. Therefore, JFE Advantech improved the film stopper. We also found the temporal drift of AROD-FT, increasing with pressure and oxygen concentration in deeper layers, the amount of which is large in the first 10~20 days and then gradually decreases. The Optode4330 mounted on an APEX Deep float was also found to have a similar tendency of temporal drift. Since slightly large temporal drifts are detected in ARO-FT and AROD-FT during storage before deployment, we are investigating the cause and resolution.

d. Status of delayed mode quality control process

JAMSTEC submitted the delayed-mode QCed Core files of 8,076 profiles in 2024, and the total number of submitted delayed-mode QCed Core data (P, T, and S) to GDACs is 218,349 profiles as of December 2024. About 82.4% of Japanese Core profiles are published in GDAC as delayed-mode QCed profiles as of December 2024. Regarding deep Argo floats equipped with SBE61, we have adjusted the salinity data of deep floats by using optimal CPcor for each Deep float. When our deep float is launched, shipboard-CTD observation with water sampling is basically carried out for estimating individual optimal CPcor. Regarding BGC Argo floats, we submitted BD files with delayed-mode QCed DOXY and pH in 2024. Both account for about 10% of all profiles for each DOXY and pH. Based on the result of the evaluation of ARO-FT's performance, we suggested the correction method of DOXY measured by ARO-FT and updated the data processing manual and the quality control manual for DOXY of ADMT. Now, BGC-ADMT members are reviewing them.

JAMSTEC has started to correct NITRATE by using the SAGE software, which was released by MBARI, after JAMSTEC fixed the issue of garbled characters appearing in SAGE. JAMSTEC has also begun to work on CHLA correction. We plan to submit BD files with dQCed NITRATE and CHLA as well as DOXY and pH. We are also preparing a tool to correct the time of the float clock. We will start to make d-mode trajectory files of Iridium telecommunication floats which are not necessary to correct their position and to submit them to GDAC.

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

The level of funding in JAMSTEC is decreasing in FY2025. In FY2025, funding for purchasing float is mostly cut, and funding for sustaining the OneArgo mission is 5-10% less than FY2024 because FY2025 is the last year of the 7-year mid-term plan since FY2019. Deployment floats in FY2025 are provided from stored ones that were previously bought, including Core, Deep, and BGC floats. The level of human resources is 4 persons in FY2025, which is mostly even in the previous

year. However, the amount of dmQC and PARC tasks is increasing, which makes it absolutely difficult to cover OneArgo operational tasks. We are making a new strategy for the next mid-term plan, which starts in 2026.

JMA will allocate an operational budget to purchase 16 Core floats with Iridium communication in FY2025. JMA has a plan to purchase 14 Core floats with iridium communication every fiscal year, after FY2026.

Ongoing and future expected extra funding regarding related OneArgo

The CREST project "Ocean Carbon," funded by Japan Science and Technology Agency (JST), was initiated in October 2023, related to OneArgo for a 5.5-year plan (1.8M USD, https://www.jst.go.jp/kisoken/crest/en/research_area/area2023-2.html). This research project aims to elucidate the carbon exchange process between the atmosphere, land, and ocean, in order to gain an integrated understanding of the ocean-CO2 relationship and create innovations to address climate changes. The team of Tohoku University, JAMSTEC, the University of Tokyo, and the Meteorological Research Institute will develop sensors, evaluate their accuracy, and conduct multi-variable high-precision observations related to next-generation Argo observations. In 2025, one Provor CTS-5 with a UVP sensor will deploy in the cruise of Shinsei-Maru KS25-4 and recover to validate the UVP data.

Habitable Japan: 5-year research funding (Grant-in-Aid for Transformative Research Areas (A); 1.5M USD), aiming to “Sustainability of atmospheric and oceanic environment as a survival basis of island country Japan” (https://hotspot3.aori.u-tokyo.ac.jp/en/) was funded in 2024. One of the teams is an ocean observational group and is planning to deploy 3 BGC Argo floats with Oxygen, Chla, pH, and backscatter sensors around the Kuroshio Extension to clarify the physical-biogeochemical relationship associated with biological production/decomposition.

The "Advanced Institute for Marine Ecosystem Change (WPI-AIMEC)" jointly proposed by Tohoku University and JAMSTEC was started in FY2023 as a new center of the World Premier International Research Center Initiative (WPI). The WPI-AIMEC considers the integrated analysis of OneArgo data with other biological data as one of its major research activities and will deploy 2 BGC Argo floats with Chl-a and backscatter sensors in 2025. In addition, 2 BGC Argo floats with UVP sensors and 6 UVP sensors for ship observation will test their performance. Those research activities will contribute to future generation of OneArgo.

In addition, Tohoku University's joint proposal with JAMSTEC and JMA, "Establishment of the Integrated Global Ocean Observing System 'OneArgo' and Promotion of Ocean Interdisciplinary Research" was included in Roadmap 2023 (A basic concept for the promotion of large-scale academic research projects) by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The plan is to conduct observations covering 20-25% of the entire OneArgo area, as well as data management and analysis, over a 10-year period. The inclusion in Roadmap 2023 does not mean that the project will be immediately funded, but it is an endorsement that the project should be given priority. WPI-AIMEC will be the lead institute in moving forward with

the budget request for FY2026. This plan will also include major investments in human resources and relevant facilities.

3. Summary of deployment plans

JAMSTEC will deploy 51 floats for 15 Core, 16 Core+O2, 8 Deep+O2, 12 BGC floats (Core+4~6 params) in 2025. The Deep Argo float is Deep NINJA with RINKO ARO-FT oxygen optode sensor. The BGC Argo floats are BGC Navis and BGC APEX, partly equipped with Oxygen (RINKO ARO-FT, SBE63), pH (SeaFET), Nitrate (Deep SUNA), and Chla/bbp (FLBB2, FLBBCD). Another 4 BGC floats (one for BGC Navis, 3 for BGC APEX; Core+4~6params) are planned to deploy in 2025 depending on the cruise.
JMA plans to deploy 14 Argo equivalent floats (12 floats will be deployed in the western boundary region) around Japan in FY2025. All the JMA floats are identical to the Core Argo floats except that they are usually operated in a 5-day cycle to be synchronized with JMA's real-time ocean data assimilation and forecast system.
JMA continues serving as the Japan DAC. JAMSTEC will continue running the Pacific Argo Regional Center for the upcoming year.

4. Summary of research and development efforts over the past year to try new sensors or improve float technology, including new collaborations with vendors or other partners.

Toward next-generation OneArgo observation (ArgoMIX, MOBY, and FRRF)

JAMSTEC is examining constructing "ArgoMIX" and joining to Argo array as "next generation Argo." To support achieving ArgoMIX, JAMSTEC examined field tests using 3 microALTO with fast response thermistor sensors (FPO7) and/or shear sensors in collaboration with Rockland and MRV in Dec. 2024 and is planning to May 2025. Based on the comparison with ship turbulence measurements (VMP-X and L-ADCP etc.), the performance of floats and turbulent measurements were good, and further analysis is ongoing.

JAMSTEC also deployed two Mermaid-Argo floats with SBE61 CTD in June 2023, called "MOBY", from OSEAN (France) in 2023, as a check of ability for the deep Argo float platform. The floats are still working. Although one of the Mermaid sensors was troubled, their performance is mostly good. The 4000m MOBY float is expected to be a formal deep Argo platform and 6000m MOBY floats will be expected to provide in the future.

The fast repetition rate fluorometer (FRRF) is one of the active chlorophyll fluorescence techniques and can measure a single-turnover fluorescence induction curve in photosystem II (PSII) (Kolber et al., 1998). The PSII parameters derived from this curve provide insights into the physiological state of phytoplankton, such as iron and nutrient limitation, photoacclimation, and photoinhibition. These parameters can also be used to estimate chlorophyll *a* concentration and gross primary productivity. Since 2021, JAMSTEC has been developing the Deep NINJA float equipped with an FRRF, in collaboration with Kimoto Electric and TSK. As part of the experimental phase for this new sensor, a NINJA float with an FRRF was deployed in the Southern Ocean in March 2025. Furthermore, since 2024, JAMSTEC has been developing a power-saving and compact FRRF through a three-year plan with Kimoto Electric and L&F, supported by the CREST program of JST.

5. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.

JMA issues operational ocean analysis and forecast by using satellite data and in-situ data, including the global Argo BUFR messages. Daily, 10-day mean and monthly products of subsurface temperatures and currents for the seas around Japan and the North Pacific, based on the output of the real-time ocean data assimilation system (MOVE/MRI.COM-JPN), are distributed through the JMA website (in Japanese). Numerical outputs of the system are available from the NEAR-GOOS Regional Real Time Data Base (https://www.data.jma.go.jp/goos/data/database.html) operated by JMA. Monthly diagnosis and outlook of El Niño-Southern Oscillation based on the outputs of the Ocean Data Assimilation System and the Seasonal Ensemble Prediction System (an ocean-atmosphere coupled model) are also operationally distributed through the JMA website (in Japanese) and the Tokyo Climate Center (TCC) web site (https://ds.data.jma.go.jp/tcc/tcc/products/elnino/). These systems were upgraded in Feb. 2022 (for descriptions of the new systems, please refer to https://ds.data.jma.go.jp/wmc/products/elnino/move_mricom-g3_doc.html and https://ds.data.jma.go.jp/wmc/products/model/outline/cps3_description.html. The ocean-atmosphere coupled model is also used for seasonal forecasts of climate in Japan. The model products for seasonal forecast are available from the WMC website (https://ds.data.jma.go.jp/wmc/products/model/).

JAMSTEC provides gridded products of objectively mapped temperature and salinity field data (Grid Point Value of the Monthly Objective Analysis using Argo float data: MOAA-GPV) and gridded mixed layer depth with its related parameters (Mixed Layer data set of Argo, Grid Point Value: MILA-GPV). These products have two versions for each dataset; one is estimated by using mainly real-time QC Argo profiles, and another is by using mainly delayed mode QC Argo profiles. MOAA GPV version 2 will be released soon. The updates since version 1 are 3-dimensional (horizontal and temporal) OI objective analysis and the increase in layers from 25 to 66 layers. The data set is monthly and every 10 days.

JAMSTEC has been providing objectively mapped velocity field data based on YoMaHa'07 (version September 2010), and Argo temperature and salinity profile data put through more advanced automatic checks than real-time quality controls (Advanced automatic QC Argo Data version 1.2a) since October 2014. JAMSTEC has also provided scientifically quality controlled data of Deep NINJA floats for convenient use on scientific or educational purposes. The QC is based on comparisons with highly accurate shipboard CTD observations conducted near float observations.

The Pacific Argo Regional Center (PARC) is operated by JAMSTEC, providing information about consistency checks of float data related to delayed-mode QC through the website. Although it had been operated by IPRC and JAMSTEC since 2006, IPRC terminated to co-operate due to their funding and human resource issues. In 2024, JAMSTEC renewed the PARC website (https://www.jamstec.go.jp/PARC/). JAMSTEC added the statistics of Core and BGC profiles in the Pacific to the sites. Also, JAMSTEC added meta-information on floats in the Pacific, their time section figures, and time series of error magnitude on floats with data that deviate significantly

from MOAA GPV. You can see the activities of the Pacific Deployment Coordination Group on this site, including information on future OneArgo float density maps for deployment plans, past meeting reports, and mailing list members. The maps for the aiming deployment plan show the expected density of the OneArgo array in the Pacific Ocean after 1, 2, and 3 years, using G-YoMaHa, which is objectively mapped velocity at 1000 dbar.

ESTOC (Estimated state of ocean for climate research) is a JAMSTEC product, an integrated dataset of ocean observations, including Argo data by using a four-dimensional variational (4D-VAR) data assimilation approach. ESTOC is the open data that consists of not only physical but also biogeochemical parameters for 60 years from 1957 to 2016 (See the website in JAMSTEC, https://www.godac.jamstec.go.jp/estoc/e/). The dataset was updated for physical parameters for 65 years from 1957-2022

JCOPE is a research project for the prediction of oceanic variation using ocean models with the assimilation of remote-sensing and in-situ data, which is managed by JAMSTEC. In 2019, JCOPE2M, which is an updated version of JCOPE2/FRA-JCOPE2 reanalysis covering the Northwestern Pacific, was released. The Argo data are used by way of GTSPP. The hindcast data 6 months back and the forecast data 2 months ahead are disclosed on the following website: https://www.jamstec.go.jp/jcope/htdocs/e/home.html. More information is shown at https://www.jamstec.go.jp/jcope/htdocs/e/distribution/index.html. In 2022, JCOPE-FGO, a reanalysis product covering a quasi-global ocean, was released: https://www.jamstec.go.jp/jcope/htdocs/e/distribution/fgo.html.

FRA-ROMS is the nowcast and forecast system for the Western North Pacific Ocean developed by Japan Fisheries Research and Education Agency (FRA) based on the Regional Ocean Modeling System (ROMS). FRA-ROMS was operated from May 2012 to March 2022. In March 2022, FRA began operating FRA-ROMSII, a system based on FRA-ROMS with improved model performance in the Japan Sea. FRA-ROMSII was updated to FRA-ROMSIIv2 in January 2025, improving the accuracy of the reanalysis data in the Oyashio area and the East China Sea, and extending the data period to 30 years. The outputs of FRA-ROMSIIv2 are used primarily for fisheries resource surveys and are provided every week through the website: https://fra-roms.fra.go.jp/fra-roms/index.html/.

Tohoku University has released a gridded dataset of subsurface chlorophyll maximum depth, using Chl-a measurement data in the World Ocean Database 2018 (Boyer et al. 2018) and the Global Ocean Data Analysis Project version 2.2019 Release (Olsen et al., 2019). The Chl-a measurement data includes Argo profile data as well as bottle samples, CTD fluorescence, gliders, and so on. This gridded dataset can be downloaded on the websites (http://caos.sakura.ne.jp/sao/scm/).

6. Issues that Japan Argo wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo.

EEZs clearances for the Marine Scientific Research (MSR) procedure for Argo float deployed had been simplified following IOC Resolution XLI-4, which is performed by OceanOPS. Most coastal

states have simplified their procedures regarding Argo deployment and drifting in the EEZ by providing information through the NFP. However, in some cases (especially for tropical Pacific island countries), the fee was demanded for applications if floats deploy in EEZs where MSR applications are required (in the case of Japan, drifting into the EEZ of a coastal state that has not established an NFP). It is necessary to work with the Argo community and OceanOPS to promote a better understanding of the Argo program in these coastal states.

7. Outreach and communication

A national program Argo webpage works for them and has recently been updated as a site to exchange information between domestic and international programs (https://www.jamstec.go.jp/J-ARGO/?lang=en). Some JAMSTEC researchers contributed to the Japanese translation of "Keeping an Eye on Earth's Oceans With Argo Robots" published in Frontiers for Young Minds (https://kids.frontiersin.org/articles/10.3389/frym.2023.943491).

8. CTD station data that was taken at the time of float deployments this year and CTD data (calibrated with bottle data) taken by Japan in the past year that may be added to the reference database.

After the last upload of CTD data to the CCHDO website in February 2024, which was included in the national report the year before last, we have uploaded 226 CTD cast data as "Private for Argo" in the western North Pacific.

9. Papers published by scientists within Japan in the past year using Argo data, including non-English publications.

(1) Articles

2024

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(2) Doctorate thesis

N/A

10. Deployment plans for RBR floats in the next couple years

In 2025, JAMSTEC will deploy 1 RBR APEX float for Argo equivalent. The RBR Argo equivalent floats will be deployed in the western equatorial Pacific region, observing the air-sea interaction regarding MJO and ENSO. In 2026 and after, we do not have fixed plans to get them yet.

ARGO National Report 2024 – The Netherlands

1) **Status of implementation**
   The Dutch Argo program started in 2004 and is run by the Royal Netherlands Meteorological Institute (KNMI).
   The Netherlands are a founding member of the Euro Argo ERIC.
   Contribution to the Argo array:
   - 119 floats have been purchased since 2004
   - 41 are working
   - 6 are ordered for 2024 and will be deployed later this year

2) **Present level of (and future prospects for) national funding for Argo including summary of human resources devoted to Argo**.
   In their observation strategy adopted in 2006 KNMI has expressed the intention to deploy about 7 floats per year.
   Presently, the Netherlands only contributes to the core mission.
   One person (Andreas Sterl) is working on ARGO. He does so besides his other duties.
   Together with the NIOZ (Netherlands Institute for Sea Research), KNMI is working on a restructuring of the Netherlands Argo contribution.

3) **Summary of deployment plans.**
   Six floats will be deployed in the southern Atlantic Ocean later this year.

4) **Summary of national research and operational uses of Argo data**
   Argo data and/or products derived from Argo data are used to initialize climate models by groups at KNMI and Utrecht University.
   Process studies using Argo data are performed at the Netherlands Institute for Sea Research (NIOZ).

5) **Issues that your country wishes to be considered (and resolved) by AST regarding the international operation of Argo**
   Nothing.

6) **CTD data uploaded to CCHDO**
   No.

7) **Bibliography**
   -

8) **COVID-19 impact**
Not any more.

9) **RBR sensors**
10 floats with RBR CTDs have been deployed so far. Results are positive.
Floats ordered for 2024 will have RBR sensors, too.

Argo New Zealand National Report, March 2025.

Phil Sutton and Denise Fernandez.

National Institute of Water and Atmospheric Research (NIWA), Wellington, New Zealand

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)

a. floats deployed and their performance:

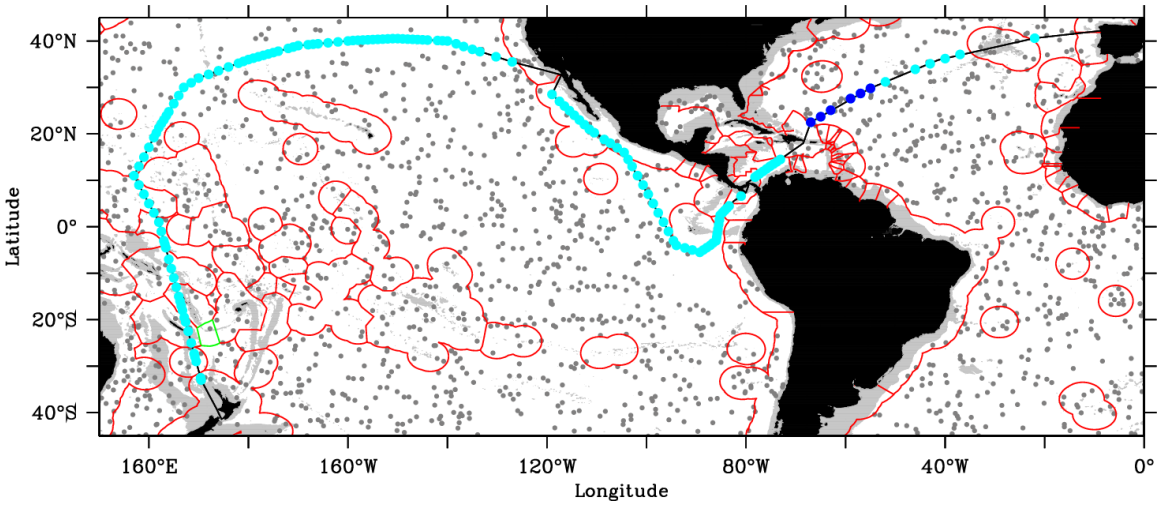
1) 2 Solo2 floats purchased by NIWA were deployed during the R/V Kaharoa II delivery voyage:
   790115 (SIO 3271) deployed 6 August 2024 at 22.50°S, 167.90°E
   790116 (SIO 3272) deployed 9 August 2024 at 33.00°S, 170.50°E
2) 1 Apex Core float purchased by the Antarctic Science Platform (ASP) was deployed by HMNZS Aotearoa Vessel:
   7900694 deployed 3 February 2025 from HMNZS Aotearoa at 71.39°S, 171.35°E
3) 2 NKE Provor CTS5 BGC floats purchased by the ASP were deployed in shallow (~600m shelf waters) during an R/V Tangaroa Antarctic voyage:
   7900693 deployed 28 January 2025 from R/V Tangaroa at 76.82°S, 179.92°E
   7900970 deployed 28 January 2025 from R/V Tangaroa at 76.23°S, 176.57°E

Photo: Svenja Halter

NKE Provor CTS5 just after deployment in the Ross Sea

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

1) Kaharoa II delivery voyage: 146 Core floats and 6 Deep floats supplied by SIO, UW, WHOI, CSIRO and NIWA (NZ) were deployed



Kaharoa 2 delivery voyage route (John Gilson)

2) 10 SIO Solo2 floats were deployed in January 2025 during an R/V Tangaroa Antarctic voyage.
3) 2 Canadian Core Arvor floats were deployed from HMNZS Aotearoa in the Southern Ocean (Ross Sea gyre region) in February 2025:
   4902704, deployed at 73.59°S, 172.39°W on 4 February 2025 and 4902698 deployed at 74.80°S, 175.21°W on 5 February 2025.

b. technical problems encountered and solved:

None.

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 for the 2 BGC Argo floats and the Apex float in the Ross Sea is performed by Esmee van Wijk, Christina Schallenberg and Gabriela Semolinopilo from CSIRO.

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

NIWA New Zealand Argo float funding is on a year-to-year basis. The 2024-2025 funding was allocated towards a BGC float reflecting increased local interest in BGC Argo. An MRV BGC float is in the process of being purchased (delayed by sensor delivery). The intention is to alternate annually between purchasing 2 Solo2 Core floats and a single BGC float.

This past year has seen another New Zealand group purchase and deploy floats. The Antarctic Science Platform (ASP) purchased and deployed two NKE Provor BGC floats in the Ross Sea. The ASP hopes to purchase 2 floats biennially.

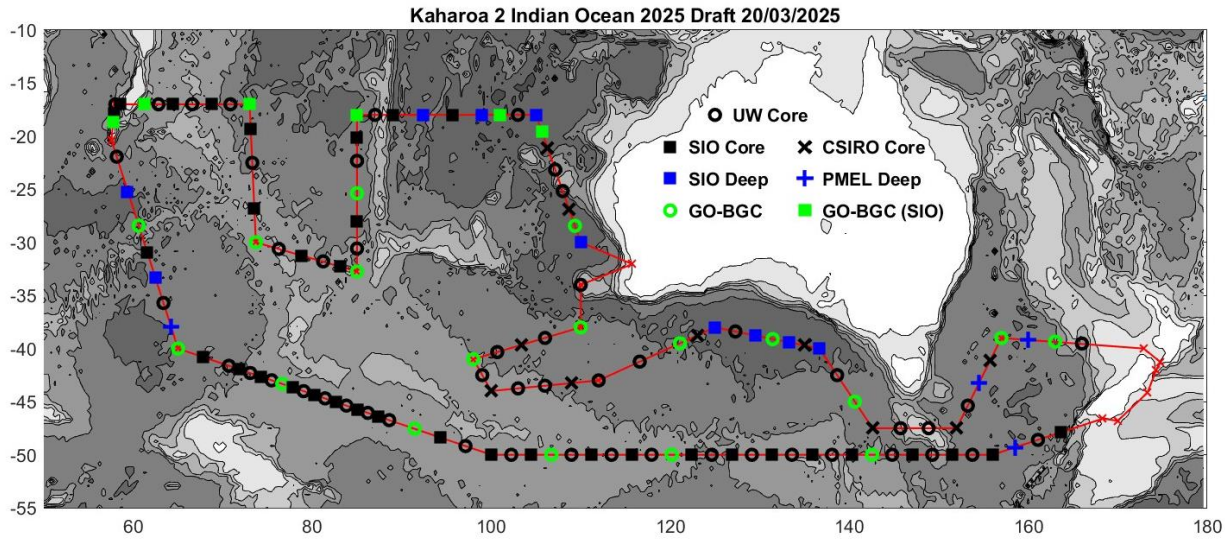
Funding for personnel is via research programmes, also funded year-to-year and a contract with Scripps Institution of Oceanography associated with the R/V Kaharoa II charter. This supports of the order of 4 months of personnel time.

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: complete purchase of MRV BGC float. Apply for funding for 2xSolo2 core floats.

Deployments for other countries:

a) **R/V Tangaroa Tsunami servicing voyage** (Dart Voyage) (southwest Pacific): July 2025. SIO is planning deployments.
b) **R/V Kaharoa II Indian Ocean deployment voyage.** (November 2025-February 2026) A collaboration between SIO, UW, CSIRO, PMEL and NIWA.



Planned deployment locations for 2025 Kaharoa II Indian Ocean voyage

Current planning is for 133 float deployments comprising:

UW Core:	50
SIO Core:	35
CSIRO Core:	10
GO-BGC:	18
GO-BGC (SIO):	6
SIO Deep:	10
PMEL Deep:	4

4. Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.

None.

5. 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.

6. 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, e.g., funding, EEZ permissions.

7. **Outreach and communication: please describe, in brief, outreach efforts within your national program over the past year. Also, if you've issued any communications, press releases, participated in articles, etc, please send the links. We are considering our social media strategy, so please let us know which social media you engage with and the corresponding handles.**

There was Extensive media coverage of New Zealand's first BGC deployments of two floats during the Antarctic voyage from NIWA, ASP and also from Antarctica NZ: TAN2502 voyage update – 31 January 2025 | NIWA ; Tangaroa voyage 2025 | Antarctica New Zealand

8. **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.**

New Zealand data has not historically been provided to CCHDO. NIWA is redeveloping its CTD capability and we hope to provide data in the near future.

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

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10. 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 may deploy other nations' RBR-equipped floats (e.g. SIO, CSIRO).

Argo National Report March-2025 – Norway

Submitted by Kjell Arne Mork (IMR) on behalf of NorArgo

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (majorachievements and problems in 2024)

   Argo Norway (NorArgo, https://norargo.hi.no) is the Norwegian contribution to the Euro-Argo European research infrastructure (ERIC), and some points in this report are therefore (also/instead) included in the report from Euro-Argo. Focus area for Argo Norway is the Nordic Seas (Greenland, Iceland, and Norwegian Sea) and Arctic.

   a. floats deployed and their performance

   In 2024, Norway deployed **6 Argo floats**:
   - 2 BGC-floats (6 bgc-variables)
   - 2 BGC-floats (4 bgc-variables = Bio floats)
   - 2 core floats

   b. technical problems encountered and solved

   - One BGC-float (PROVOR float: WMO 6990639) deployed in 2024 has an issue with communication. The reason is not clear and the problem is not solved.
   - Some BGC floats (PROVOR floats) had some issues with pH sensors, producing bad data.

   c. status of contributions to Argo data management

   All our floats are processed at the DAC in the Coriolis Centre.

   Four (4) floats deployed 2019-2020 (6903556, 6903557, 6903561, 6903562) had fast salinity drift (ASD). SBE will grant warranty credit (100%) for these floats.

   d. status of delayed mode quality control process

   We do DMQC of our floats that were deployed in 2019 and later while Argo Germany did DMQC for our “older” floats. We do DMQC of core, bgc and deep floats.

   We have done DMQC of temperature/salinity for most of our floats deployed in 2019 and later. Exceptions are floats deployed in the shallow Barents Sea where reference data are missing. However, work is ongoing to collect reference data also for the Barents Sea. There are now some delay in DMQC of core data since our DMQC-person quit and we need to find someone else to do the job.

For the BGC-floats we have done DMQC for oxygen, nitrate, pH and Chl-a for some floats. There are issues with several pH-sensors that are uncorrectable.
NORCE is responsible for the DMQC of oxygen and pH, while IMR is responsible for the DMQC of T/S, nitrate, chlorophyll, backscatter (not done so far), and irradiance (not done so far).

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

   Financial resources
   The funding has been a combination of self-financed (i.e., funded by Institute of Marine Research) and funding from the Research Council of Norway (RCN, Ministry of Education and Research) during 2012-2015 and 2018-2024. In 2025 we again we receive funding from the RCN for 1,5 M€ for the extension of the national Argo infrastructure project (NorArgo2). With this funding we will purchase core, BGC and deep floats to be deployed in the Nordic Seas and Arctic (Polar). A new project proposal will also be submitted to the RCN in 2025.

   Human resources
   Number of human resources vary over years due to the level of funding. The last years NorArgo2 had approximately 30 person months per year and more than 10 people contribute from six Norwegian institutes (IMR, Norce, NERSC, MET.no, Akvplan-niva, UoB). This includes Argo monitoring, logistic, deployment, quality control, and data management.

3. Summary of deployment plans: as was done last year, please fill out this spreadsheet to help us understand the progress towards implementation of OneArgo. There is one new column this year for floats being deployed with experimental sensors such as UVP, C-sensor, etc. This spreadsheet is to be **returned separately by 17 March** to help prepare for the meeting. It can be sent to Megan or dropped in this folder link.

   In 2025, we will deploy 4 Argo floats in the Nordic Seas: 1 x BGC (4 bgc-var.) and 3 x core floats.

4. Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.

   In 2023 we deployed two BGC-floats with UVP6 and transmissometer sensors. In 2025, we willrecover these two floats and download the images from the UVP6. There is increased interests in Argo among biologists in Norway due to the UVP6 sensor.

5. 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 Argo websites.

Argo Norway focuses on both research topics and marine climate monitoring of the Nordic Seas. There is an increasing interest in using Argo data in Norway, and two climate centres are now using the data operationally in climate models (NERSC and MET.no). For instance, the operational TOPAZ4 modeling system assimilates Argo data into the ocean model to provide forecast product for the Nordic Seas and Arctic Ocean under the EUs Copernicus Marine Environment Monitoring Services (CMEMS, http://marine.copernicus.eu/).
The present scientific topics are mainly within the Nordic Seas (Norwegian, Iceland and Greenland Seas) and Arctic, including:

- Heat and fresh water contents in the Nordic Seas are regular updated
- Water mass changes in relation with biological activities. This topic is also one of the reasons that we have included bgc sensors on the Argo floats.
- Studies that involve the mixed layer, primary production, and carbon cycle.

6. 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. Also, during the AST-26 plenary**, each national program will be asked to mention a single highlight or issue via a very brief oral report**.

7. Outreach and communication: please describe, in brief, outreach efforts within your national program over the past year. Also, if you've issued any communications, press releases, participated in articles, etc, please send the links. We are considering our social media strategy, so please let us know which social media you engage with and the corresponding handles.

   We have a national Argo web site (NorArgo, https://norargo.hi.no) where news are distributed, and an operational Argo web site where data can be viewed and downloaded (https://norargo-map.hi.no/). In NorArgo we also have a user forum with representative persons in different fields (biology, fishery, education, ….) that meet once per year.

8. 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.

   At all deployment locations a CTD station with water samples are normally taken. All ship CTD-data are sent regular to the ICES, EUs CMEMS, and World Ocean Database.

9. Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.
   There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)). If you know of any doctorate theses published in your country that are missing from the list, please let me know. Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

   No new articles to add that are not included in the Argo bibliography.

10. Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2025 and 2026 (if known) and where they might be deployed.

    No RBR-floats will be deployed this year, but we plan to purchase some floats with RBR-sensors in the future (TBD).

Argo-Poland National Report 2024

Małgorzata Merchel, Waldemar Walczowski

IO PAN, Sopot, Poland, 07.02.2025 r.

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)

Argo-Poland is conducted by the Institute of Oceanology of the Polish Academy of Sciences (IOPAN). Since 2009, the Institute has deployed 45 floats, 26 of which were launched in the Nordic Seas from the vessel *r/v Oceania* and three in the same region aboard *r/v Horyzont II*. Since November 2016, IOPAN has also deployed 16 floats in the Baltic Sea, all from *r/v Oceania*.

a. floats deployed and their performance

In 2024, Poland launched four floats from *r/v Oceania*, a vessel operated by Institute of Oceanology Polish Academy of Sciences (IO PAN). Three floats were deployed in the Nordic Seas, and one in the Baltic Sea.

Two Argo floats (WMO 7902196, 7902197) were launched in the Nordic Seas in early July 2024 at coordinates 74.98 °N, 08.53 °E and 75.00 °N, 15.34 °E, respectively (Figure 1). Both instruments are ARVOR floats, manufactured by NKE, equipped with an Iridium data transmission system and ice-avoidance algorithms. The parking depth was set at 1000 dbars, and the profiling depth at 2000 dbars. The floats have cycles of 10 days. In addition to standard CTD measurements, these floats also measured dissolved oxygen. Both floats operated throughout 2024, transmitting approximately 20 complete sets of hydrographic data (CTD and dissolved oxygen) each by the end of the year.

At the same time, IOPAN deployed its first Biogeochemical Argo (BGC Argo) float (WMO 7902195) in the Arctic region at coordinates 74.98°N, 2.96°E (Figure 1). The device is a PROVOR float equipped with an Iridium data transmission system. It was programmed with a parking depth of

1000 dbars, a profiling depth of 2000 dbars, and a 4-day cycle. In addition to standard CTD measurements, the BGC float measured four additional seawater properties: dissolved oxygen concentration, chlorophyll-a concentration, irradiance, and CDOM. This float operated throughout 2024 and transmitted 43 complete sets of BGC data by year-end.

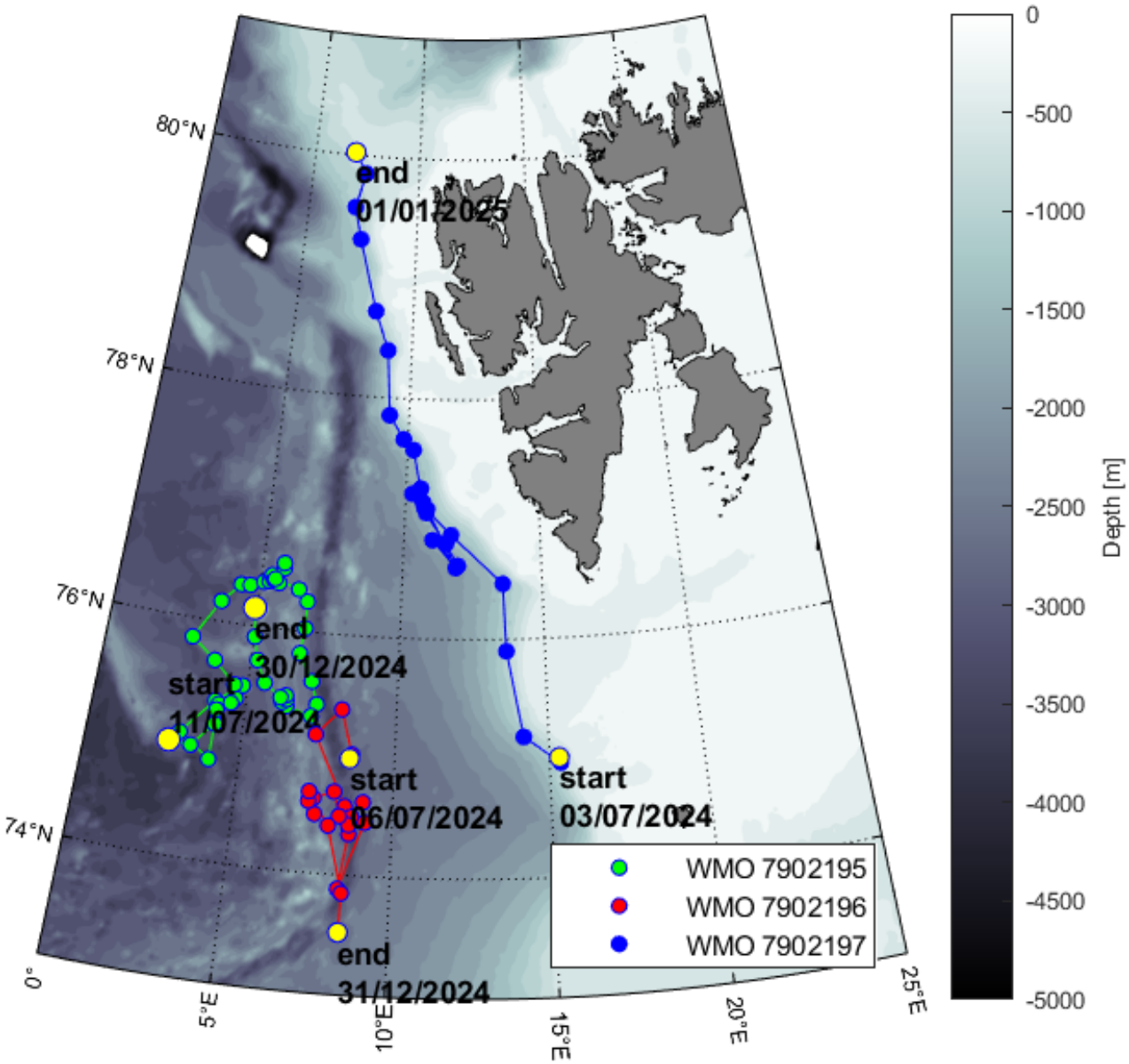

Figure 1. Positions of deployment and trajectories of three Argo floats deployed in the Nordic Seas by Argo-Poland program in July 2024.

In the Baltic Sea, one Argo float was deployed from *r/v Oceania* in May 2024 during a standard hydrodynamic cruise. The float (WMO 7902194) was launched in the Bornholm Basin at coordinates 55.23°N, 16.16°E (Figure 2). This ARVOR-type float, equipped with an Iridium data transmission system, measured standard CTD parameters as well as dissolved oxygen. The float's parking depth was set deeper than the seabed to restrict its movements, effectively using it as a virtual mooring. It remained operational throughout 2024, transmitting 104 complete sets of hydrographic data (CTD and dissolved oxygen) by the end of the year.

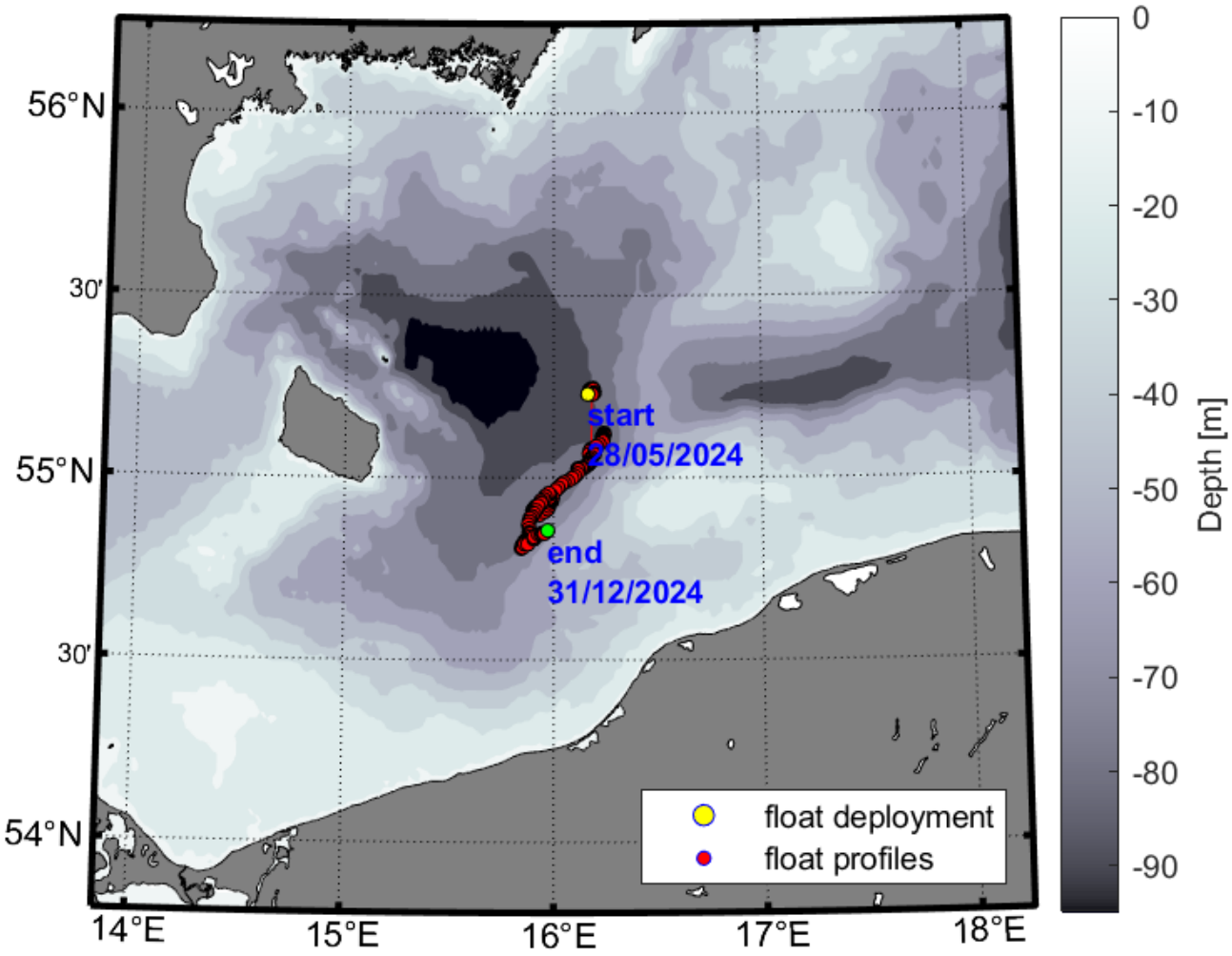

Figure 2. Positions of deployment and trajectories of one Argo float deployed in the Baltic Sea by Argo-Poland program in May 2024.

b. technical problems encountered and solved

The Polish float WMO 1902682 (AI2632-23EU003) experienced a pressure sensor failure, resulting in incorrect pressure readings and preventing it from diving. The float drifted on the surface for several weeks. The possibility of recovery was considered, but it was not feasible from our side, so potential partners in the Baltic Sea region were contacted.

Eventually, the float was located near Trelleborg, Sweden. After recovery, it was sent to the NKE manufacturer, where the CTD sensor was replaced. The float is now scheduled for testing before its planned redeployment in the Baltic Sea.

c. status of contributions to Argo data management.

Data from Arctic and Baltic floats have been submitted to the Ifremer Argo Center, where they have been processed and made available online. Additionally, the Institute of Oceanology of the Polish Academy of Sciences (IO PAN) has contributed CTD data collected by the *r/v Oceania* during AREX cruises in the Nordic Seas (2000–2018) and the Baltic Sea (2016–2021) to the Argo reference database.

d. status of delayed mode quality control process

The Institute of Oceanology of the Polish Academy of Sciences (IOPAN) has been conducting delayed mode quality control (DMQC) on data from Arctic floats deployed since 2018. Additionally, Argo Poland actively contributes to the development of DMQC procedures for data collected by Argo floats deployed in the Baltic Sea. For Arctic floats deployed prior to 2018, DMQC is carried out by BSH (Federal Maritime and Hydrographic Agency) in Hamburg, Germany.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

In 2021, the Institute of Oceanology of the Polish Academy of Sciences submitted an application to the Ministry of Science and Education for funding the Argo-Poland consortium. This consortium comprises the Institute of Oceanology PAN, the Institute of Geophysics PAN, and the Polish Naval Academy. In 2022, the Polish Ministry of Science and Education approved funding for the consortium, ensuring financial support for the next five years.

3. Summary of deployment plans.

Argo-Poland plans to deploy at least three floats each year, with two placed in the European Arctic and at least one in the Baltic Sea. In 2025, an additional two floats are planned for deployment - one in the Baltic Sea and the other in the Norwegian Sea, both on the shelf.

4. **Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.**

The Institute of Oceanology of the Polish Academy of Sciences (IO PAN) conducts the long-term Nordic Seas observation program, AREX. Argo floats serve as a valuable complement to the measurement data collected by the r/v Oceania. This is particularly important for studying the seasonal variability of water mass properties (as AREX cruises are conducted only in summer) and the pathways of sea currents in the Svalbard region. For more details, visit the IO PAN Argo webpage.

In the Baltic Sea, Argo float data are utilized to monitor the inflow of salty waters from the North Sea. Additionally, these data provide valuable insights into oxygen content at various depths of the Baltic Sea and the pathways of sea currents. Argo data are also an integral part of modeling efforts in the SatBaltyk project.

Furthermore, Argo data are actively used in projects such as 4DBALTDYN (Baltic Sea Dynamics through 4D Modelling and Integrated Earth Observation) and SufMix (Turbulent Mixing in the Slupsk Furrow).

5. **Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo.**

   There are no issues to report.

6. **CTD stations**

   In 2024, three Polish floats were deployed during the IOPAN Arctic cruise AREX, during which approximately 200 CTD profiles were conducted. Additionally, one float was launched in the Baltic Sea during a Baltic cruise. CTD stations were also carried out immediately prior to the deployment of the floats. IOPAN can provide data from these four stations for comparison with data from the Argo floats.

   The remaining data from the Nordic Seas and the Baltic Sea will be accessible via the IOPAN database.

   Contact point: Waldemar Walczowski, walczows@iopan.pl.

7. **Argo blibliography**

   Merchel M., Walczowski W., Rak D., Wieczorek P., The use of Argo floats as virtual moorings for monitoring the South Baltic Sea, Oceanologia, 66 (1), 99-110, https://doi.org/10.1016/j.oceano.2024.01.002.

Bulczak, A.I., Nowak, K., Jakacki, J., Muzyka, M., Rak, D. and Walczowski, W., 2024. Seasonal Variability and Long-Term Winter Shoaling of the Upper Mixed Layer in the Southern Baltic Sea. Continental Shelf Research, p.105232, https://doi.org/10.1016/j.csr.2024.105232.

Rak, D., Przyborska, A., Bulczak, A.I., Dzierzbicka-Głowacka, L., 2024. Energy fluxes and vertical heat transfer in the Southern Baltic Sea. Frontiers in Marine Science, 11, p.1365759, https://doi.org/10.3389/fmars.2024.1365759.

Two other scientific papers using data from Argo floats are in preparation.

8. **How has COVID-19 impacted your National Program's ability to implement Argo in the past year?**

   COVID-19 had no impact on the deployment and recovery of floats.

9. **Does your National Program have any deployment plans for RBR floats in the next couple years?**

   There are plans to purchase one RBR float, provided it includes an oxygen sensor.

Argo-Spain National Report 2024

Alberto González (IEO-CSIC), Lara Díaz-Barroso (SOCIB), Irene Lizarán (SOCIB), Pedro Vélez-Belchí (IEO-CSIC), Joaquín Tintoré (SOCIB)

1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2024)

a. floats deployed and their performance

Argo Spain contributed to extending the international Argo network during 2024 deploying floats in the Atlantic Ocean and Mediterranean Sea. These deployment missions were coordinated by the Spanish Institute of Oceanography (IEO-CSIC) and the Balearic Islands Coastal Observing and Forecasting System (SOCIB). The specifications of the deployments by area are shown below.

Atlantic Ocean

Within the framework of the biannual oceanographic cruises RAPROCAN, STOCA and RADCAN, together with the collaboration of other IEO-CSIC research groups, a total of 6 floats were launched in the Atlantic Ocean by IEO-CSIC (Table 1). All of them were deployed into three areas mainly: The Canary Basin, the Cantabrian Sea and the Gulf of Cadiz. All the deployed floats corresponded to Core Argo floats.

Western Mediterranean Sea

During the SOCIB Canales Spring 2024 and SOCIB Canales Autumn 2024 oceanographic cruises, Spain deployed one core Argo float in each campaign. Additionally, in November 2024, during the SOCIB-IMEDEA EBAMAR cruise, another core Argo float was deployed, using the R/V SOCIB as a ship of opportunity in all cases (Table 1).

In total, 3 core Argo floats were deployed across these missions. Two of these cruises are part of the SOCIB 'CANALES' endurance line, which aims to deepen the understanding of the state and variability of the Balearic Sea, further consolidating and advancing scientific research in the region.

WMO	Deployment date	Deployment location	Cruise
7901142	21/01/2024	36°03'15.5"N, 7°20'10.3"W	STOCA2401
7901143	21/01/2024	36°20'10.0"N, 7°13'08.0"W	STOCA2401
3902505	13/05/2024	39°16'39.0"N 1°58'33.6"E	SOCIB Canales Spring 2023
1902720	25/08/2024	36°03'09.4"N, 7°20'03.5"W	STOCA2408
6990667	26/08/2024	36°21'47.5"N, 7°14'57.5"W	STOCA2408
1902721	29/08/2024	40°41'26.9"N, 9°36'37.8"W	RCAN2408
7902224	30/08/2024	42°40'26.0"N, 9°20'25.8"W	RCAN2408
3902614	06/11/2024	38°59'58.9"N 0°44'13.2"E	SOCIB Canales Autumn 2023
4903829	13/11/2024	39°10'12.0"N 3°11'34.8"E	SOCIB-IMEDEA EBAMAR Nov 2024

Table 1. Deployment information related to Spanish deployed floats during 2024.

Different preset configurations were used before each mission. On the one hand, all Core Argo floats were configured to dive up to 2000 dbar and 1000 dbar of parking depth. All floats worked in cycles of 10 days in the Atlantic Ocean and 5 days in the Mediterranean Sea.

Active Spanish floats in 2024

In summary, 19 Spanish floats have been active during 2024 in the Atlantic Ocean and the Western Mediterranean Sea.

b. technical problems encountered and solved

During 2024, IEO-CSIC received feedback from the manufacturer (NKE Instrumentations) about the two floats sent for inspection in 2023. One of the floats was quickly returned to the IEO-CSIC as no problems were detected and the other one is still in repair. On the other hand, IEO-CSIC detected a bug in the configuration process of the float prior deployment. It was reported to the customer service and satisfactorily solved by the manufacturer. This bug apparently came from a firmware

issue in this batch of floats, a topic that was mentioned by the manufacturer during the Argo Tech Meeting celebrated in Seattle.

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)

After each deployment, detailed technical information is provided to the DAC in charge of the floats (Coriolis) and the AIC. The Argo-Spain program is aware of the changes in the technical and metadata data formats and is providing the necessary information.

d. status of delayed mode quality control (DMQC) process

Argo-Spain mainly deploys floats in the Atlantic Ocean and the Mediterranean Sea. In terms of DMQC, Argo-Spain, through IEO-CSIC, manages its floats that operate in the Atlantic Ocean, and the *Instituto Nazionale di Oceanografia e di Geofisica Sperimentale* (OGS) manages all the floats that operate in the Mediterranean Sea, including floats of Argo-Spain.

In terms of the floats for which Spain is responsible for the DMQC process, 53 out of the 76 Atlantic floats have been processed, including 1 (WMO 6901273) in the year 2024. IEO-CSIC is in conversations with IFREMER to improve its own DMQC routine based on Euroargodev's repository.

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 OneArgo mission: Core, BGC, Deep, Spatial (Polar, equator, WBCs)

Spain has participated in the international Argo program since its inception and is currently a member of the European Research Infrastructure Consortium Euro-Argo (ERIC). Spanish participation in Argo began in 2002 through a first European project, and since then, a total of 115 Argo floats have been deployed. Among these, 76 floats have been deployed in the Atlantic Ocean, and 34 floats have been deployed in the Mediterranean Sea (one of them never communicated, WMO 4903635). Additionally, 4 floats have been donated to other countries: 2 floats to Costa Rica, 1 float to Morocco, and 1 float to Mexico.

In 2022, the agreement was renovated between the Ministry of Science and Innovation, IEO-CSIC and SOCIB (Disposición 14622 del BOE núm. 214 de 2022), assuming the financial commitment that Spain participates as a full member of the ERIC Euro-Argo. The interest in such participation was demonstrated in the process of prioritizing Spain's participation in European research infrastructures, as detailed in the document on the Spanish Strategy for participation in scientific infrastructures and international organizations. At the end of 2024, the first monitoring meeting between the three

member institutions was held. Additionally, it was agreed that an annual monitoring meeting would take place.

However, the Argo-Spain program currently lacks proper long-term funding for the deployment of Argo floats. The contribution to the Euro-Argo ERIC is secured and sustained through membership payments from the Spanish Ministry of Science, Innovation, and Universities, as well as SOCIB. Additionally, the availability of extra funding relies on access to infrastructure calls. Both IEO-CSIC and SOCIB are committed to ensuring deployments of at least 3 floats per year, and its transmission costs. Also, IEO-CSIC funds the scientific coordination (1.5 person/month per year).

At the end of 2021, SOCIB received funding from NextGenerationEU/PRTR to ensure the purchase and deployment of floats in the Mediterranean Sea during the next few years.

The personnel of Argo-Spain during 2024 consisted of the following individuals from IEO-CSIC and SOCIB:

IEO-CSIC:

- 1 technician working 75% of their time.
- 1 Principal Investigator (PI) working 30% of their time.

SOCIB:

- 1 student working 50% of their time.
- 1 technician working 50% of their time.
- 1 technician working 10% of their time.
- 1 researcher working 15% of their time.
- 1 PI working 5% of their time

3. **Summary of deployment plans: please see the separate documents explaining the longer term outlook this year as a response to G7 requests. This spreadsheet is to be returned separately ASAP to help prepare for the meeting. It can be sent to Megan or dropped in the folder link containing the instructions.**

This information is included in the European deployment planning statistics for subsequent years, which is located in the "national_deployment_information" folder of the AST65. However, we attach below individually the theoretical contribution of Argo-Spain for the coming years (Table 2).

SPA	2024						
	Total	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O
Nordic Seas	0						
Mediterranean Sea	3	3					
Black Sea	0						
Baltic Sea	0						
Southern Ocean	0						
Arctic Ocean	0						
Global Ocean	6	6					
Total	**9**	9	0	0	0	0	0
SPA	**2025**						
	Total	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O
Nordic Seas	0						
Mediterranean Sea	3	3*					
Black Sea	0						
Baltic Sea	0						
Southern Ocean	2	1	1				
Arctic Ocean	0						
Global Ocean	13	8	2			3	
Total	**18**	12	3	0	0	3	0
SPA	**2026**						
	Total	Core	Core + O	Core + 2-3 BGC	Core + 4-6 BGC	Deep	Deep + O
Nordic Seas	0						
Mediterranean Sea	3	3					
Black Sea	0						
Baltic Sea	0						
Southern Ocean	0						
Arctic Ocean	0						
Global Ocean	10	8	2				
Total	**13**	11	2	0	0	0	0

Table 2, Potential deployments of Spanish floats (float types and corresponding quantities) projected for the coming years as part of Euro-Argo ERIC

*One of these floats will be a coastal model.

4. **Summary of any research and development efforts over the past year to try new sensors or improve float technology. This could include new collaborations with vendors or other partners.**

IEO-CSIC is part of the team that developed the experiment based on sensor intercomparison mounted in deep argo floats. A scientific communication titled "*Intercomparison of extended-depth SBE41CP, SBE61 and RBRargo|deep6k CTDs for Deep-Argo application using three and two-headed Deep-Arvor floats*" led by Virginie Thierry was accepted by the end of 2024.

On the other hand, Euro-Argo secured funding from the European Commission during 2024 to launch the Euro-Argo ONE [2025-2027] project. Both IEO-CSIC and SOCIB will lead a task dedicated to develop a global strategy to achieve a more efficient and sustainable Argo network through the recovery of Argo floats. The manufacturer NKE Instrumentations appears as a partner among all participants and is planned to work side by side to improve float technology.

5. **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 are widely used by Spanish researchers to advance the understanding of climate and ocean variability. Additionally, operational ocean forecasting models rely on Argo data for model assessments and improvements through data assimilation. Key examples include:

- Western Mediterranean Operational Forecasting System (WMOP)
- Atlantic-Iberian Biscay Irish-Ocean Physics Analysis and Forecast (IBI-MFC)
- Mediterranean Sea Physics Reanalysis (Med MFC)

As part of its commitment to the Argo program, SOCIB has generated a data product compiling all historical Argo deployments conducted by SOCIB, ensuring accessibility to the deployment records: SOCIB Argo Profiling Floats, DOI: https://doi.org/10.25704/yb5v-yx90

Additionally, SOCIB contributes to the monitoring and visualization of sub-regional ocean indicators through the Sub-regional Mediterranean Sea Indicators tool. This operational product provides continuous and timely information on ocean state and variability at multiple temporal scales (from daily events to interannual/decadal trends). It is designed for use by the scientific community, marine science educators, decision-makers, and environmental agencies, incorporating Argo data as a fundamental source: Sub-regional Mediterranean Sea Indicators

For more information on the Argo Spain national program, visit: www.argoespana.es

6. **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. Also, during the AST-26 plenary, each national program will be asked to mention a single highlight or issue via a very brief oral report.**

No issues.

7. **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.**

A CTD cast is performed after most of the Argo-Spain deployments.

8. **Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.**
   There is also the thesis citation list (Thesis Citations | Argo (ucsd.edu)). If you know of any doctorate theses published in your country that are missing from the list, please let me know.

   Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

- Arumí-Planas, C., Dong, S., Perez, R., Harrison, M. J., Farneti, R., & Hernández-Guerra, A. (2024). *A multi-data set analysis of the freshwater transport by the Atlantic meridional overturning circulation at nominally 34.5°S.* Journal of Geophysical Research: Oceans, 129, e2023JC020558. https://doi.org/10.1029/2023JC020558
- Camprubí, L. (2024). *Jason y los argonautas: temporalidad, usabilidad y conocimiento tácito en el monitoreo oceánico de Argo.* Asclepio, 76(2), e25. https://doi.org/10.3989/asclepio.2024.25

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9. **Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats you will be buying in 2024 and 2025 (if known) and where they might be deployed.**

At the moment, this option is not contemplated in the short term.

U.S. Argo National Report to AST-26, April 14th 2025

Organization of U.S. Argo:

The U.S. Argo Program consists of a seven-institution consortium that includes principal investigators from Scripps Institution of Oceanography (SIO), Woods Hole Oceanographic Institution (WHOI), the University of Washington (UW), the Atlantic Oceanographic and Meteorological Laboratory (AOML), the Pacific Marine Environmental Laboratory (PMEL), Monterey Bay Aquarium Research Institute (MBARI), and presently the Naval Research Laboratory (NRL/Monterey). Float technology development, production, acquisition, logistics, deployment, array monitoring, and data management functions are distributed among these institutions on a collaborative basis. The program is supported by two primary funding sources. The National Oceanic and Atmospheric Administration (NOAA) primarily funds the Core, Deep and some BGC floats and supports the US DAC. The U.S. National Science Foundation supports the U.S. BGC float program through the Global Ocean Biogeochemistry Array (GO-BGC) and Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM) programs.

In addition to the float-providing and data management activities, the U.S. Argo Consortium works collaboratively with closely related programs, including:

- Argo New Zealand is the largest deployer of U.S. Argo floats through designed deployment voyages of RV Kaharoa (jointly supported by Argo USA, New Zealand, and Australia) and deployment opportunities on RV Tangaroa.
- A NOPP project for validation and improvement of the Deep Argo SBE-61 CTD.
- National Academy of Sciences Gulf Research Program's support for 25 Argo floats in the Gulf of Mexico.

The contributions of these and other Argo partner projects are gratefully acknowledged.

The NOAA support for U.S. Argo Consortium is in its final year of a 5-year cycle, beginning in July 2020 and extending through June 2025. The next 5-year cycle is proposed to start in July 2025. The next Work Plan for U.S. Argo includes milestones and growth of the U.S. contribution toward a unified Core/BGC/Deep international Argo Program termed *OneArgo*.

The NSF GO-BGC funding is also approaching its final year of a 5-year cycle, ending November 2026. A GO-BGC II follow-on to continue deploying ~125 BGC floats a year has been proposed to NSF.

Objectives:

The U.S. Argo Consortium is funded by NOAA on a year-to-year basis. There is uncertainty in the level of funding that will be available to support the next 5-year Work Plan for 2025 to 2029. The projections included in this plan starting in July 2025 are optimistic, in that they involve a ramp-up to full One Argo implementation over the length of the proposal as quickly as thought

feasible by each partner institution, generally approaching full strength by year 3. The plan proposes that all float-providing institutions will participate in both Deep and BGC Programs, and the U.S. Argo consortium will carry out data management. Actual funding levels are likely to be less than the ideal scenarios, in which case the highest priority will be sustaining the Core Argo array.

Status of U.S. Core Argo implementation:

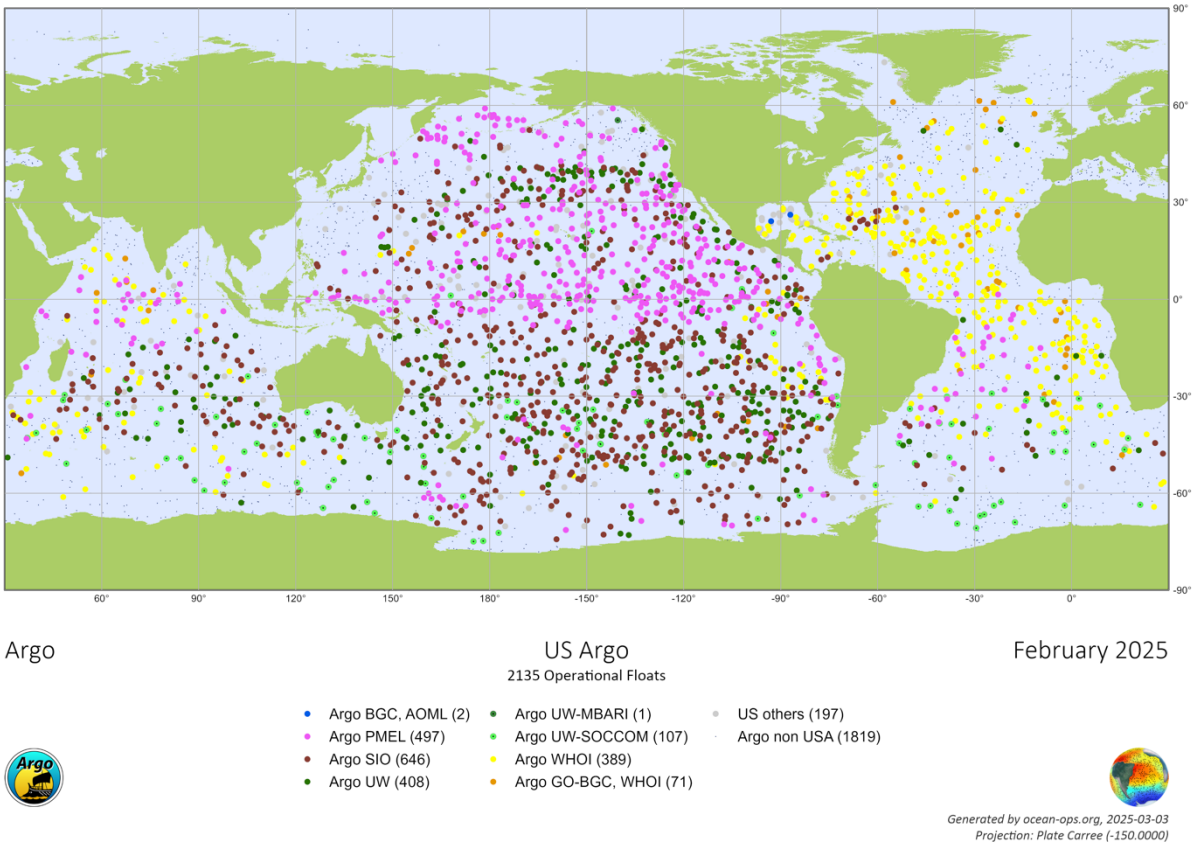

Fig. 1*: Location of operational U.S. Argo Program, SOCCOM, GO-BGC, and other U.S. Argo equivalent floats as of February 2025 (Source: OceanOPS).*

As of April 2025, there were 2299 operational U.S. Argo floats (see Fig. 1 for February 2025 locations), including 385 BGC and 122 Deep. Support levels for U.S. Core Argo floats, provided primarily through NOAA, have remained relatively flat since 2004, with some recent augmentations. Inflationary losses have been offset by increases in float lifetimes, with over 83% of floats deployed in 2018 still operational as of April 2025, and an increase in BGC float deployments funded by NSF.

Further increases in lifetime are expected through the continuing identification of short-term and long-term failure modes and improved battery technologies. However, the present number of

yearly deployments may not be sufficient to sustain the level of U.S. Argo floats, especially if NSF funding does not continue.

Year deployed	Number deployed	Number operational (3/2024)	% operational (3/2024)
2014	236	2	1%
2015	258	27	10%
2016	293	80	27%
2017	308	186	60%
2018	243	196	80%
2019	246	201	81%
2020	249	207	83%
2021	257	180	70%
2022	231	201	87%
2023	177	165	93%
2024	303	277	91%

Table 1: *Number of U.S. Core Argo floats deployed in each year from 2014 through 2025 and the number still operational as of April 2025 (Source: OceanOPS). A major focus of the U.S. Argo Consortium is extension of float lifetimes and reduction of early float failures.*

Impacts of the Covid-19 pandemic included limitations on all institutional laboratory activities for physical distancing, a substantial reduction in available deployment opportunities by the research fleet, supply chain difficulties that have adversely affected float manufacture, sea freight delays, and inflation. Nonetheless, the relatively long life of Argo floats mitigated the Covid-19 reduction in activities, as evidenced by the small decline in numbers of operational US Argo floats over the past several years. Furthermore, as noted below, deployments were catching up in 2024.

In 2024, the US Argo Program deployed 448 Argo floats, in support of all 3 missions (Fig. 2). This year, there was an increase in Core Argo floats deployed due to two Kaharoa II cruises, including the delivery voyage of the Kaharoa II, allowing for the deployment of a surplus of floats from 2023 (Table 1). US Argo also deployed 115 BGC floats, mostly funded by NSF's GO-BGC and SOCCOM, and 22 Deep floats, mostly funded by NOAA.

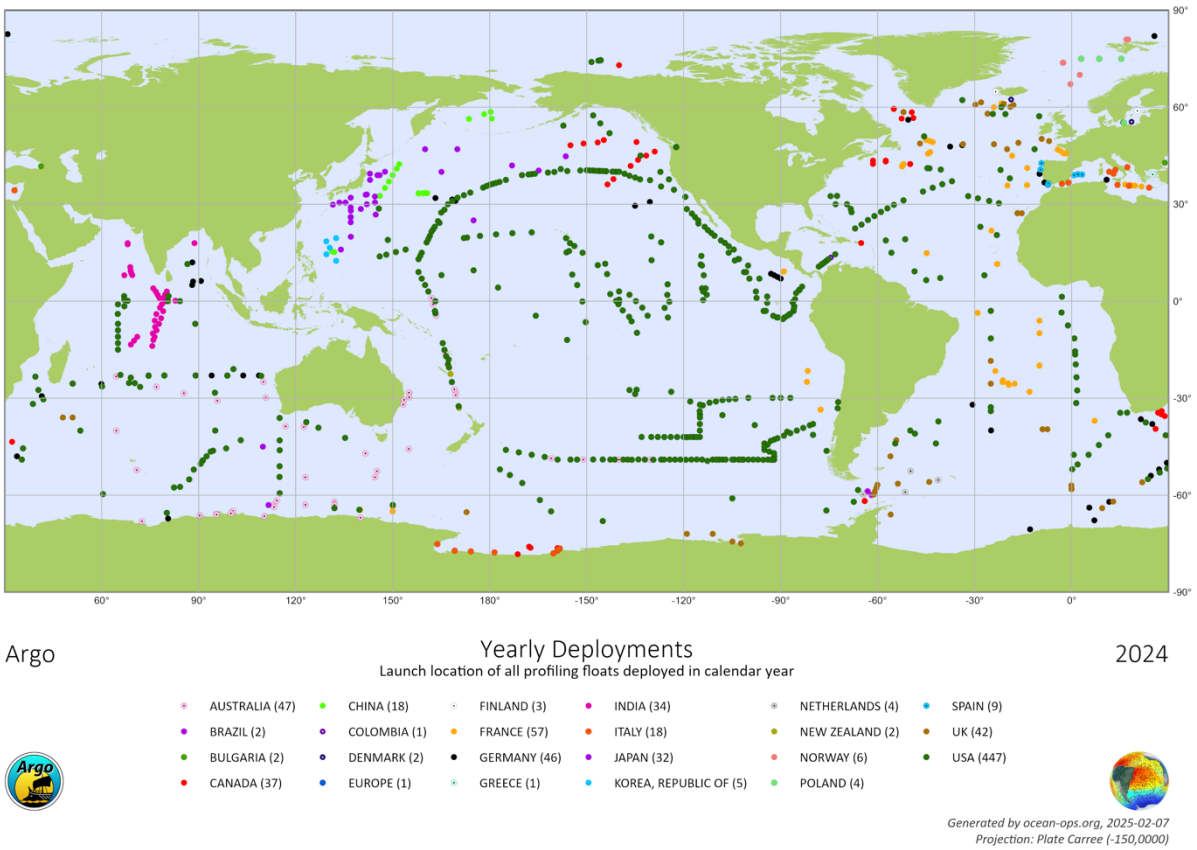

Fig. 2: *Locations of US Argo floats deployed in green during 2024 and still operational as of February 2025. This year, the US Argo funded two Kaharoa II cruises to deploy floats, including the delivery voyage from Spain to New Zealand (Source: OceanOPS).*

Support for the U.S. Argo Consortium includes float production and deployment; technology improvement; communications; data system development and implementation for real-time and delayed-mode data streams; participation in international Argo coordination, technical workshop, and science workshops; contributions to Regional Centers; and outreach activities. Work is ongoing to assess the accuracy of CTD data used for the core Argo mission. Salinity drift in recent cohorts of Argo floats is being closely monitored collaboratively with the CTD manufacturer. An alternative Core CTD manufacturer is entering pilot status with the intent of limiting risk to the Argo Program. The U.S. Argo Consortium is actively involved in testing, quantifying sensor biases, and contributing to the pilot array of RBR CTD equipped floats.

Deep Argo:

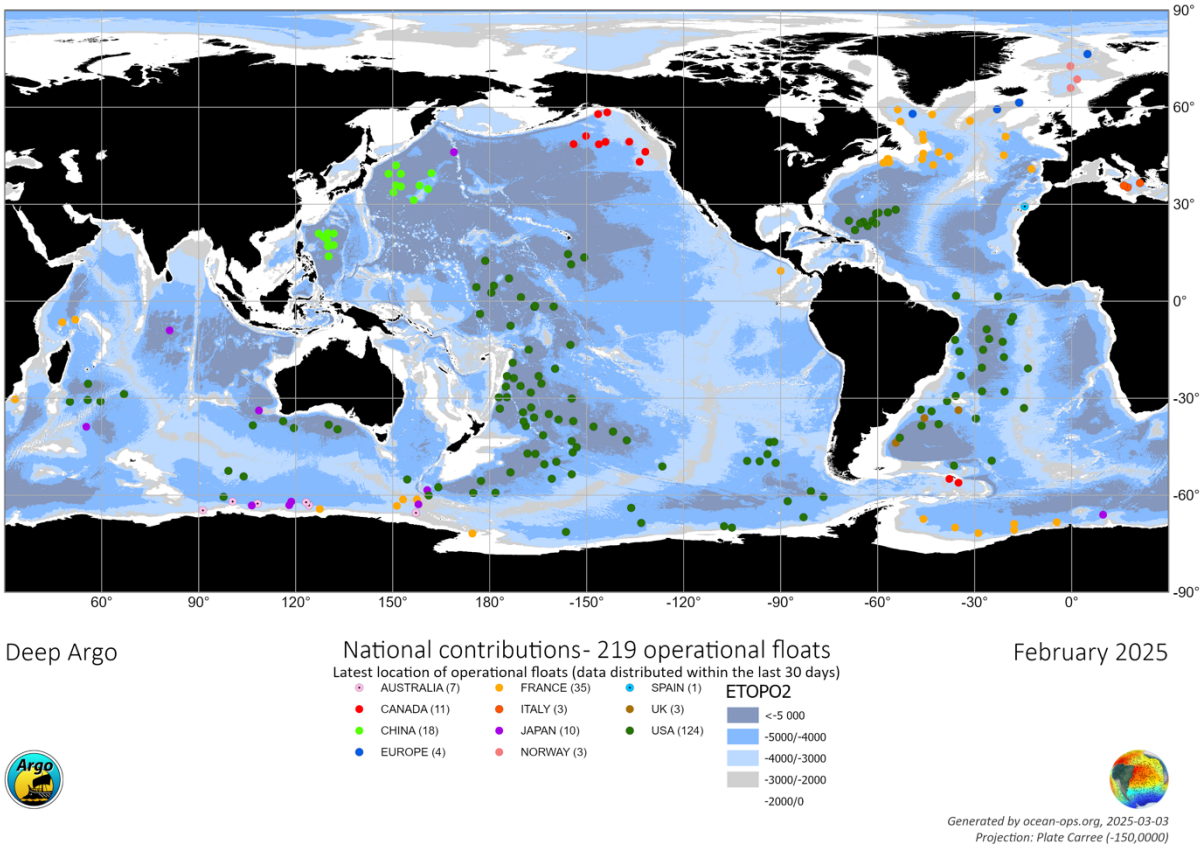

Fig. 3*: Location of all 219 operational Deep Argo floats, as of February 2025, by National Program, with the 124 operational U.S. Deep Argo floats indicated by dark green filled circles (Source: OceanOPS).*

In 2011–2015, the U.S. Argo Consortium carried out development and testing of Deep Argo floats, with successful prototype float deployments in 2013–2015. U.S. Deep Argo floats profile to pressures as great as 6000 dbar, and recent versions with hybrid lithium batteries are capable of more than 250 cycles. Deployment of U.S. Deep Argo regional pilot arrays began in the SW Pacific Basin in 2016, in the South Australian Basin in 2016, in the western North Atlantic in 2017, in the Australian Antarctic Basin in 2018, in the western South Atlantic in 2019, in the SE Pacific Sector of the Southern Ocean and western Indian Ocean in 2023, with operational US Deep Argo floats in all of those regions (Fig. 3).

Testing of Deep Argo float models continues as well as testing of SBE-61 CTD accuracy and stability. The SBE-61 has not yet achieved its aspirational goals of ± .001°C, ±.002 psu, and ± 3 dbar, but is progressing relative to them. In partnership with U.S. Argo, a 3-year National Ocean Partnership Program award is funded for improvement of the SBE-61. A collaborative U.S./New Zealand/SeaBird Scientific cruise on RV Tangaroa took place in April 2023 for testing/validation of new SBE-61 conductivity and pressure sensors.

BGC Argo:

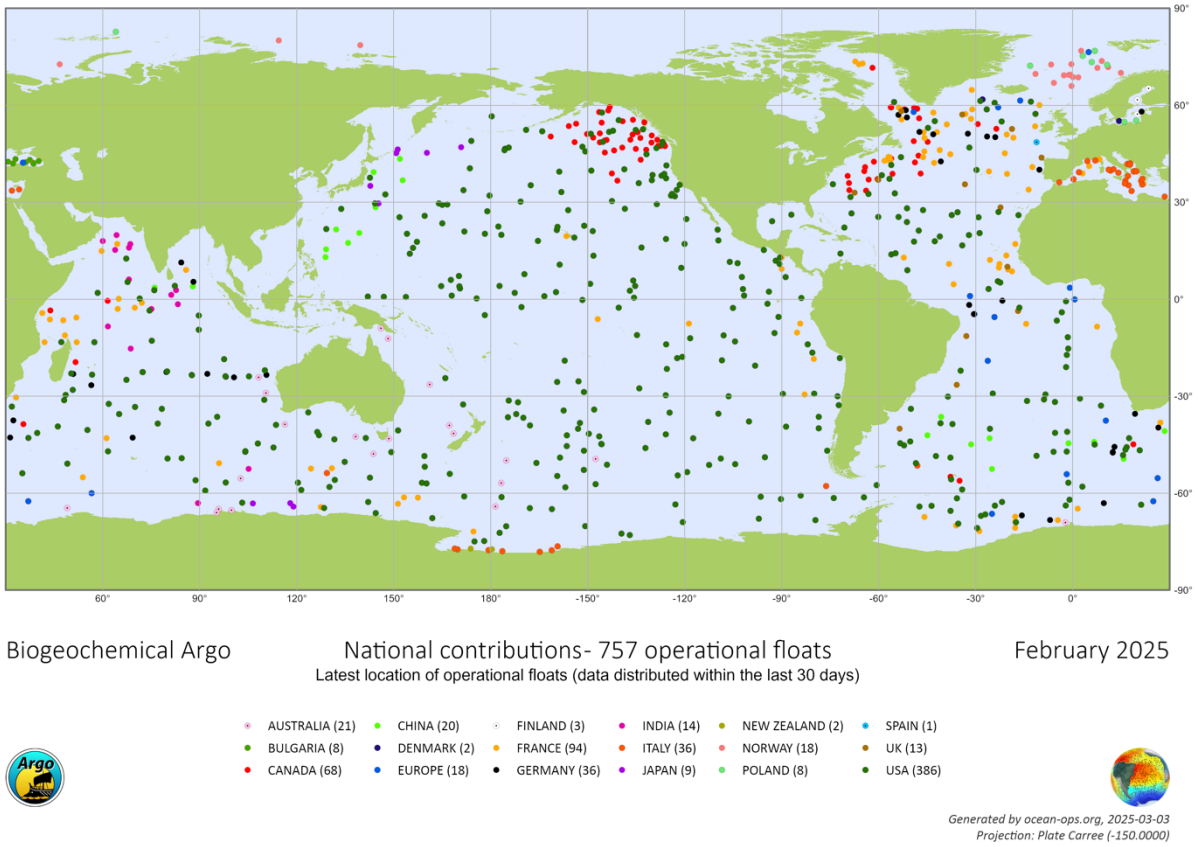

Fig. 4: *Locations of 757 operational BGC-Argo floats as of February 2025, including 386 US Argo floats, mostly from SOCCOM and GO-BGC. US BGC floats are indicated as dark green filled circles (Source: OceanOPS).*

Since 2012 the U.S. Argo Consortium has carried out testing and deployment of Biogeochemical (BGC) Argo floats. The present versions of these floats cycle 0–2000 m at 10-day intervals and, in addition to the CTD, carry sensors for dissolved oxygen, nitrate, pH, chlorophyll fluorescence, and particulate backscatter. A major NSF proposal (SOCCOM) started in 2014 to deploy a 200-float array of BGC floats in the Southern Ocean. A second major NSF proposal (GO-BGC) was funded in 2020 for global deployments of up to 500 BGC floats over a 5-year period. Two funded NOPP proposals between 2020-2023 have implemented technology improvements to the BGC SOLO and BGC NAVIS Argo float models and have deployed 15 BGC floats in the equatorial Pacific. As of January 2025, US BGC floats, mostly from SOCCOM and GO-BGC, with several US Argo Consortium contributions, number 386 of the total 757 operational BGC Argo floats (Fig. 4), with 335 of the US's 386 BGC floats measuring at least five BGC variables.

Plans:

The highest priority in 2025 for the U.S. Argo program is to (1) sustain the Core Argo array, (2) continue to build out the global BGC array, and (3) maintenance of regional pilot arrays for Deep. Specific plans for float deployments in 2025, as they evolve, are posted on the AIC

deployment planning web page. Funding levels for the U.S. Argo Consortium in FY2025 are not yet finalized but planning is based on a roughly match with FY2024 levels.

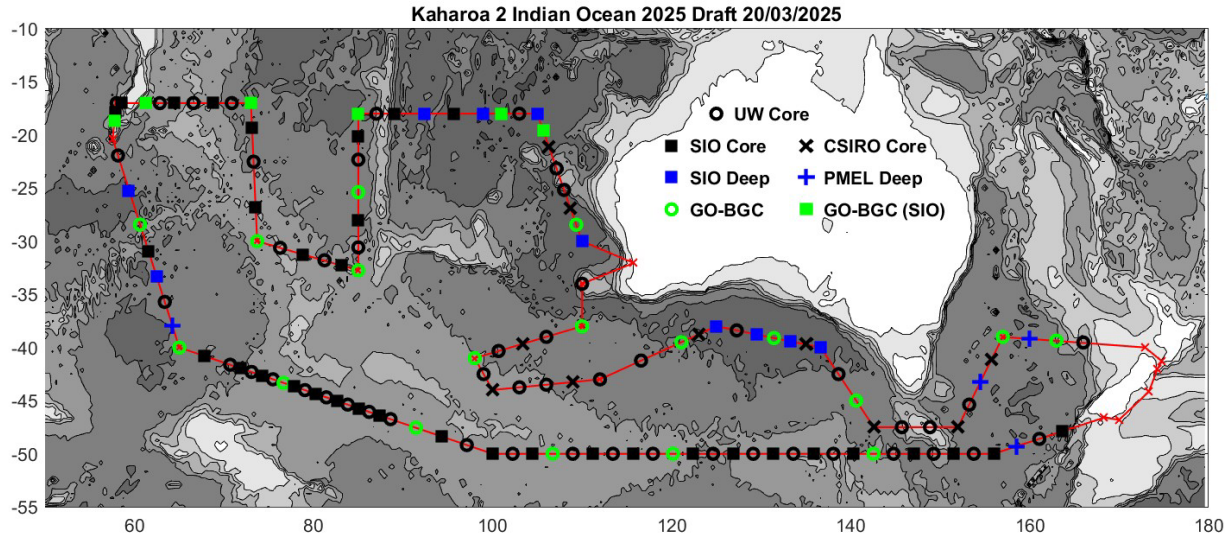

Fig. 5: *Cruise track and deployment plan for the 2025 Kaharoa II voyage with planned core (black), BGC (Green) and Deep (Blue) locations indicated.*

Data management

The U.S. Argo Data Assembly Center (DAC) is based at NOAA/AOML. Real-time data from all U.S. Argo floats are distributed via the GTS and to the Global Data Assembly Centers (GDACs). The systems developed at AOML are operational on a primary server housed at AOML and also run on AOML's Argo mirror server at a cloud service provider. These systems apply internationally-agreed Argo-specific quality control tests and generate data files for the user communities that comply with the Argo standards. The U.S. Argo DAC has expanded its decoding and quality control capabilities to include the full suite of BGC data, currently able to accept BGC data from APEX, NAVIS and SOLO-family floats. Delayed-mode quality control and other data management functions of the core parameters are carried out by the float-providing institutions. The real-time and delayed mode adjustment of the BGC parameters for GO-BGC and SOCCOM floats are performed at MBARI. The AOML data center serves as the national focus for data management and is the conduit for delayed-mode data to pass between the PIs and the GDACs.

In addition to the national DAC, a GDAC is presently run as part of the GODAE server, located at the Naval Research Laboratory, Monterey. The two GDACs at NRL/Monterey and IFREMER/Brest are mirror images in their assemblies of Argo data from all international partners, and are responsible for dissemination of the data. A GDAC refresh by another U.S. provider is in an early stage of development. Several U.S. institutions participate in Argo Regional Center activities.

UK Argo Report for Argo Steering Team meeting (14-18 April 2025)

1. One Argo implementation status

a. Floats deployed and their performance

During 2024 we deployed **33 floats**; of these, 24 were core floats and 9 were BGC floats.

The 24 core floats comprised 12 APEX SBE, 7 APEX RBR and 5 ARVOR SBE. The 9 BGC were all ASBAN PROVOR floats (2 CTS4, 4 CTS5, 3 CTS5 Jumbo). In addition, 2 Brazilian core ARVOR SBE floats deployed in February were adopted by UK Argo in July. No Deep floats were deployed.

From 1 January 2025 to 20 March 2025, we deployed a further 10 floats, comprising: 9 core (5 APEX SBE, 2 APEX RBR, and 2 ARVOR SBE) and 1 BGC (PROVOR CTS5-Jumbo). The 2 core ARVOR were funded and deployed by University of Cambridge.

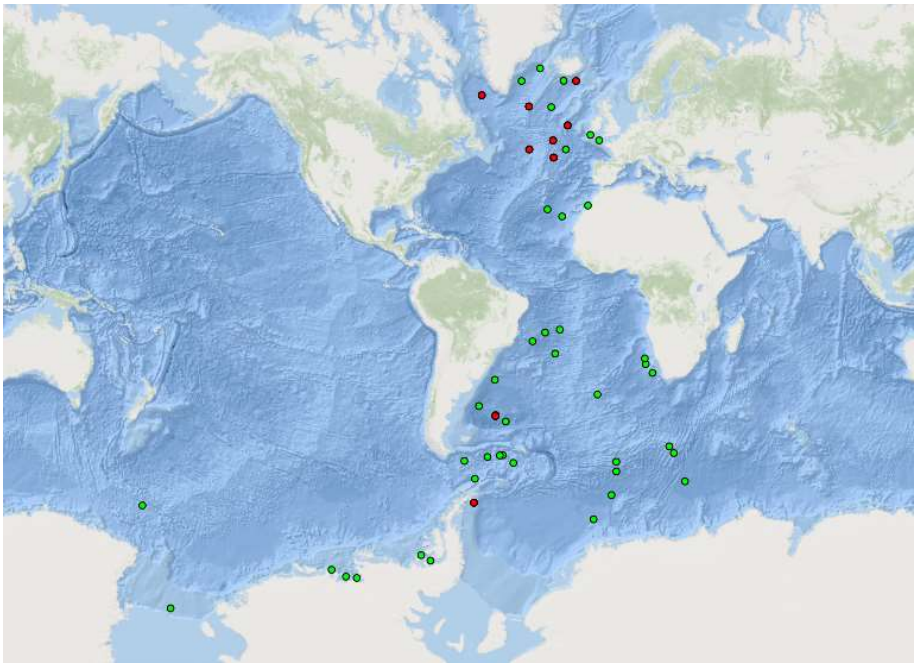

Figure 1. Showing the latest reported locations of the 51 UK Argo floats deployed between 1 January 2024 and 20 March 2025, where green = core (41); red = biogeochemical floats (10). Plotted using OceanOPS website on 20/03/25.

Figure 2: Recent deployments of UK floats: Students from the @oceanx Young Explorers Program deploy a UK Argo float from OceanXplorer as part of the OceanX and OceanQuest "Around Africa" expedition, WMO 1901930, 02/03/25 (left); APEX SBE, WMO 7902225, before deployment from RRS James Cook. Brazil Basin, 19/01/25 (centre, A. Rochner, Met Office); CTS5 Jumbo, WMO 6990670, before deployment from RRS James Cook. Brazil Basin, 19/01/25 (right, A. Rochner, Met Office).

As of 20 March 2025, the UK has 134 operational floats (i.e. for which real-time data have been made available during the previous month) as shown in Figure 3.

The 134 operational floats returning data include 113 core, 18 Biogeochemical and 3 Deep. Details of float types are shown below:

- 89 core APEX with SBE CTD
- 16 core APEX with RBR CTD
- 8 core ARVOR with SBE CTD
- 13 PROV-BIO CTS4, 6-parameter
- 5 PROV-BIO CTS5-Jumbo, 6-parameter
- 3 APEX DEEP

Our Deep SOLO float, deployed in Dec 2022, in the South Atlantic, Argentine Basin (WMO ID 2903791) is experiencing some technical difficulty with data delivery but still operational.

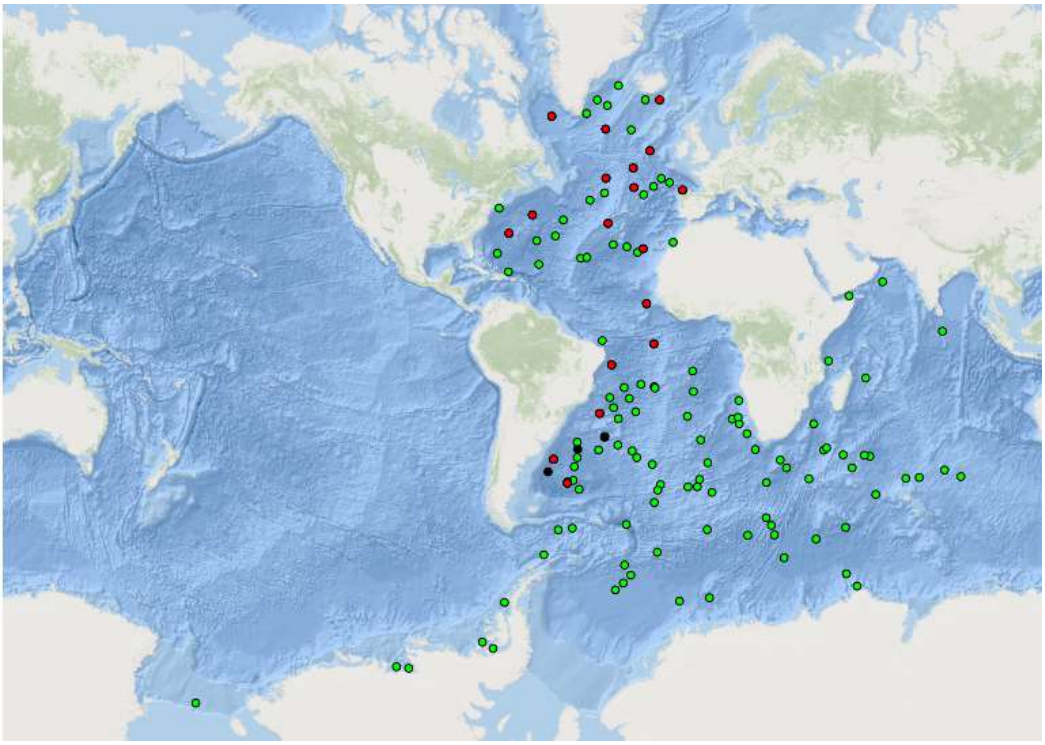

Figure 3. Showing the locations of all 134 UK floats delivering data as of 20 March 2025, where green = core (113); red = biogeochemical floats (18), black = deep floats (3). Plotted using OceanOPS website on 20/03/25.

MOCCA floats

At the beginning of 2024 BODC were still processing real time data for 45 MOCCA (core NKE ARVOR) floats which has reduced to 25 at the beginning of 2025. The oldest of the floats remaining is 8 years old https://fleetmonitoring.euro-argo.eu/float/3901938.

b. Technical problems encountered and solved

Float failures

Of the 33 core floats deployed between 1 January 2024 and end March 2025 we have experienced 3 float failures.

Two APEXs failed immediately after deployment, with no messages received:

- APEX RBR-L3 WMO 4903833, deployed in Argentine Basin in November 2024
- APEX SBE WMO 7902228, deployed in Drake Passage in November 2024

And one ARVOR has failed:

- ARVOR 22UK006 (6990631) that was deployed in January 2024 was stuck in 'end of life' mode and could not be put into mission mode – this float has since ceased to transmit and has now been deactivated.

In addition, two other ARVORS were fished

- 1902115, deployed 19 June 2024, fished out by Spanish fishing vessel 'Punta Vixia' at 50° 02'.5 N, 009° 58'.5 W on approx. 20 September 2024, and returned to Castletownbere, Ireland, then held by Marine Institute staff (thank you, MI!). The float is still in Ireland, will be assessed at MI and likely returned to NKE for repair/refurbishment (photo to the right, thanks to Castletownbere Harbour Master)
- 1902116 was recovered to Roscoff, France in summer 2024. It is with NKE, as SeaBird are unable to repair the CTD (price to repair is greater than a new CTD) it will be scrapped/recycled in France.

In better news, all 10 of the BGC floats deployed since January 2024 seem to be working well. We have experienced loss/ failure of 4 BGC floats deployed since 2022:

- New for 2024/5: CTS4 deployed (24/7/22) and lost (22/02/24) on the Greenland shelf (WMO 6904185)
- Three losses that happened in 2023, previously reported at AST#25
    - CTS4 deployed August 2023 in Florida Straits, failed to surface (WMO 6990515)
    - CTS4 deployed March 2023 near Portugal, stuck at surface (WMO 3901579)
    - CTS5 (WMO 6990516) deployed during PICCOLO cruise in Weddell Sea during February 2023 is assumed to have failed, it measured 5 profiles, the last profile received in March 2023.

APEX Core

We had deployed 16 APEX floats that are at risk of a fast salty drift, these were deployed before the problem was known. Of these 16, 10 are no longer operating (as of 20 March 2025). Of the surviving 6, two are on the grey list for PSAL drift (1901925 and 3901556), and four are mostly passing real time PSAL QC with flags of 1. We had five undeployed APEX floats that were at risk of the fast salty drift problem, these have since been recalled and repaired. Four have been deployed recently and are all showing good data so far. The final one is due to be deployed in Drake Passage/Southern Ocean in November 2025:

- SN 8469, WMO 1901929, deployed by OceanXplorer in March 2025 (2 profiles)
- SN 8470, WMO 1901930, deployed by OceanXplorer in March 2025 (2 profiles)
- SN 8580, WMO 1902108, deployed by James Cook during AMT in December 2024 (11 profiles)
- SN 8581, WMO 1902113, deployed by James Cook during AMT in December 2024 (10 profiles)
- SN 8471, to be deployed by Sir David Attenborough in Drake Passage in November 2025.

We also received two free CTDs under SeaBird's ASD warranty, which were offset against our 2024 order for APEX-SBE floats with Teledyne Webb.

For some time, it has been known that APEX floats can have GPS issues due to a 'sticky bladder'. We noticed some of our APF11i floats often failed to make a GPS fix when delivering the profile data, but have the second fix, taken prior to diving, reported in the following cycle in 10 days' time. We retrieve this fix to enable us to process the previous profile's data, but it always means that the profile is 10 days late on the GDAC and at the GTS. At its worst the issue was regularly experienced by 33 APF11i floats. Following contact with TWR and some configuration changes we've seen an improvement and now have **9 affected floats** as of 20 March 2025. This issue has affected our GTS timeliness quite significantly in 2024 but that is now improving. The table below shows APEX serial number, WMO ID and deployment date of the remaining affected floats.

SN	*WMO*	*deployed*
9196	*6903761*	*14-OCT-21*
9197	*1901934*	*06-DEC-21*
9007	*1901928*	*21-FEB-21*
9201	*1902081*	*17-MAY-22*
9484	*1902088*	*08-FEB-23*
8986	*6903760*	*15-OCT-21*
09597	*5906983*	*15-AUG-23*
9476	*2903897*	*10-NOV-23*
9195	*6903758*	*21-FEB-22*

APEX floats with RBR CTD

We procured our first six APEX-RBR floats in 2015 and since then have deployed 29 APEX-RBR, 9 since January 2024. As of 20th March 2025, there are 16 APEX-RBR delivering data to the GDACs and GTS. We presently have 7 APEX-RBR floats in stores with some of them scheduled for deployment later in 2025.

APEX Deep

We presently have three APEX Deep floats operating in the Argentine Basin region of the SW Atlantic: 3901560 deployed December 2020, 3901565 in January 2021, and 3901567 deployed in March 2021. Our Deep SOLO, deployed in December 2022, is still operational but experiencing temporary data delivery issues at the DAC.

We have no firm plans to buy more Deep floats at present. However, we aspire to buy and deploy 15 Deep floats (without oxygen sensors) between 2026 and 2030.

Bio-geochemical Argo

We presently have 18 active BGC floats. Real-time data processing is fully set up for all BGC float types.

We have now deployed 22 ASBAN six-parameter PROVOR CTS4 and CTS5 floats (9 in 2024). As described above in the float failures sections, two of the floats failed immediately post deployment: one is drifting at the surface after repeatedly aborting its descents (WMO 3901579); the other deployed in shallow water in the Florida Straits, failed to surface (WMO 6990515). An additional float failed checkout prior to deployment due to a sim card connection issue and has now been repaired. A CTS4 float (WMO 6904185) deployed on the Greenland shelf on 24/7/22 ceased transmitting on 22/02/24 and is assumed lost. We have five remaining ASBAN CTS5-Jumbo floats in stock, which we aim to deploy over the next 2-3 years. The ASBAN floats are all performing well so far, except for the pH sensors, which have had a high failure rate. As part of the NERC-funded PICCOLO project, we attempted to deploy two PROV-BIO Jumbo CTS5 floats in the Weddell Sea in February 2023. One failed whilst still on deck and was returned to the UK and later repaired by NKE. It was subsequently deployed on 16th February 2024 (WMO 6990516) – it performed 5 profiles but has not been heard from since 25th March 2024 – it seems likely that it went under ice and failed.

BODC have worked with the international community to resolve incorrect pH values below 800m for CTS5 floats. This involved adding more coefficients to the metadata input.

BODC also resolved an issue where nitrate data was not being delivered in CTS5 files, this was caused by a missing calibration, details of which are noted in the Argo user manual.

c. Status of contributions to Argo data management

Internal Argo system improvements

BODC has undertaken some development work in recent months.

As of 24 March 2025, BODC is running Coriolis decoder version 070a. The recent update involved looking at our architecture, efficiency and robust testing methods by the Argo team.

BODC software developers have implemented logging within Argo scripts to display on an internal monitoring dashboard, processed through a CouchDB database with a frontend website that can be used to easily see logs and when they were created. The hope is that this can lead to further development and that going forwards Argo logs will be more centralised, issues in Argo processing will be more detectable and logs will have long-term storage, allowing them to be more searchable and discoverable.

The workflow for the 1 UK Deep SOLO float was made operational.

BODC's servers were migrated from CentOS 7 to Rocky 8 Linux. Rocky 8 will remain supported until May 2029. This improves the security of our servers by ensuring that we avoid end-of-life products and continue to receive necessary updates. This involved intensive testing by the team to ensure data flows remained operational.

Real-time processing activities

BODC endeavors to address any QC changes needs identified by the Objective Analysis reports and Altimetry QC issued by Ifremer and OceanOPS on a regular basis and made updates to the meta files following reports from the GDAC file checker. However, BODC has not yet implemented the salinity correction for our APEX-RBR floats, so the data are still being flagged as 3 which means these data are not yet being assimilated into our operational forecast models. We believe these data could be flagged as 9 (GTSPP flag - 9 'Good for operational use; caution; check literature for other uses', as they are almost certainly good enough to assimilate in operational models.

The Met Office is in the final stages of testing and implementing new code to include BGC_ADJUSTED data in our BUFR messages to be shared on the GTS. We aim to have this operational by summer 2025.

Parameter	BUFR Sequences
Dissolved oxygen	3-06-044
Chlorophyll-A	3-06-045
Dissolved nitrate	3-06-046
Sea water pH	3-06-047
BBP700	3-06-048

NVS

BODC hosts the NERC vocabulary server and continues support and management of the Argo vocabulary task team. There have been created including 23 new concepts and 228 new mappings within 8 existing collections. The works has been undertaken under the ADMT tasks:

Action #35 creation of a Jupyter notebook to help users access the NVS via the SPARQL endpoint.

Action #36 to find a machine-to-machine solution to find identical sensors. The suggested solution is to apply 'SYN' mappings to identical sensors that have changed manufacturer. (ongoing)

Ongoing discussion and works on addition of new collections owned by OceanOPS for populating PROGRAM_NAME, DEPLOYMENT_PLATFORM, PROJECT_NAME.

Additionally, the team started to migrate the ArgoVocabs Github space into the new OneArgo Github space so that ADMT would have governance and tracking of new vocabulary and format issues.

Meetings and trainings

BODC actively contributed to activities related to the Argo DMQC discussion group, focusing on estimating the best practices, guidance and examples on how to treat salinity data that are affected by sensor drift to produce optimal adjustment in D-mode. This involved actively contributing to updating the shared list of floats affected by the salty drift and reviewing best practices and procedures for DMQC operators of core Argo floats. Moreover, we are also taking an active role in the BGC task team, Polar Argo team, AVTT and DAC task team.

BODC has continued working on expanding its internal capabilities and provides a series of training courses from real-time and delayed mode to other team members.

d. Status of delayed mode QC process

Core Argo

From March 2024 to March 2025 BODC Argo submitted to GDAC 86 core Argo floats with new and updated 19,180 core profiles in D-mode. This includes 68 Argo floats (with ~15,200 D-mode profiles) DMQC-ed and 18 Argo floats (with ~3,980 D-mode profiles) analyzed and delivered by external European partners – BSH and OGS.

BGC Argo

BODC is continuing regular quality control analysis and data delivery of DOXY, Chlorophyll-A, Nitrate, Irradiance and BBP parameters in the real-time Adjusted mode.

BODC is currently able to analyze in delayed mode DOXY data. In 2024, BODC has increased its capability and now is able to process and deliver in delayed mode two new BGC parameters: pH and Nitrate. These parameters are analyzed by adopting the SAGE software. We used the https://github.com/catsch/DM_FILLER software for allowing applying corrections in D-mode BGC floats, generation and population of the D-mode NetCDF files.

From March 2024 to March 2025 BODC Argo undertook the DMQC analysis of the following BGC parameters:

16 DOXY parameters with ~1,539 profiles
14 Nitrate and pH parameters with 1,262 profiles

The DMQC analysis for Irradiance BGC Argo floats for Argo PROVOR is planned to be undertaken in 2025.

2. Funding levels

The UK Argo programme is undertaken through a partnership between the Met Office (which is an Executive Agency owned by the Department for Science, Innovation and Technology, DSIT) and the National Oceanography Centre (NOC, which includes BODC, an independent self-governing organisation). In addition, the British Antarctic Survey (BAS) joined the programme in June 2024. The Met Office are responsible for programme management and coordination, procurement of mainly core floats, organizing and preparing them for deployment, their telecommunications (costs) and international funding contributions (OceanOPS and Euro-Argo). NOC and BODC have responsibility for Argo science and data management respectively. NOC have the lead on Deep Argo and play the lead role in the expansion of the UK programme into BGC-Argo. BAS provides expertise in deploying floats at high latitudes.

Met Office

UK Argo funding to the Met Office is provided by DSIT mainly through the Hadley Centre Climate Programme (HCCP), for which the Department for Energy Security and Net Zero (DESNZ) is the primary customer, with an additional contribution through the Public Weather Service (PWS) Programme. The Met Office's contribution to Argo is mainly covered under the HCCP workplan for the three-year period April 2024 to March 2027. The level of regular funding has remained flat for the last ten years, meaning that we can buy fewer floats each year. There is unlikely to be any additional end-of-year underspend funding in future years to enable extra floats to be procured. During the year 17 core ARVOR floats were purchased by the Met Office to be delivered in March 2025.

NOC

NOC funding for Argo is primarily from NERC (Natural Environment Research Council) under National Capability (NC) lines which cover Argo data management (through NC Environmental Data Services funding) and Argo science. Core BODC Argo national capability funding from NERC remains static for 2023-24 and 24-25 and is therefore decreasing in real terms. NC cuts are anticipated for NERC FY 25/26, but the Argo element is being protected with cuts being made in other areas of activity. The current level of funding cannot cover all the increasing, mandatory demands for OneArgo.

The UK Argo contributes to the Euro Argo One program funded from the Horizon Europe. Project started from January 2025 and aims to scale-up Euro-Argo ERIC's capabilities, sustainability and resilience to ensure Europe's ability to take its share of the global OneArgo array implementation. The project aims for sustaining the coordinated European contribution to the international Argo programme, fostering science & technology advancements, developing Euro-Argo data services for science and society, engaging users and society across science, education and outreach and consolidating Euro-Argo governance.

AMRIT started in March 2024 and is a 4-year European Research and Innovation project focused on strengthening and integrating Europe's marine research infrastructures. AMRIT brings together 26 partners across Europe to design and implement a fully integrated EOOS Technical Support Centre, ensuring seamless operation and coordination of marine observation platforms and data systems. AMRIT will be supporting the Euro-Argo ERIC marine research infrastructure as well as the other MRI's.

BODC has been unable to source sustainable funding to support SOARC functions, so the ARC remains unfunded in the UK to date, however, is a member of the Polar Argo mission supporting the SOARC goals.

BAS

The BAS contributions rely on funding from NERC. BAS joined UK Argo in spring 2024, represented by Pierre Dutrieux. Pierre is also a member of the Polar Argo team. BAS deploys Argo floats for research purposes in both the Southern Ocean and seasonally ice-covered regions in the northern hemisphere. The floats listed below are from NERC or ARIA UK project funding. Fourteen fully-funded core ARVOR deployments are planned by BAS out to 2028.

- Jan 26: 2 ARVOR-I profilers in the Amundsen Sea
- Aug 26: 4 ARVOR-I profilers in NW Greenland Fjord
- Aug 26: 4 ARVOR-I profilers in SE Greenland Fjord
- Jan 27: 2 ARVOR-I profilers in the Amundsen Sea
- Jan 28: 2 ARVOR-I profilers in the Amundsen Sea

BAS also deploys ALAMO floats, which are not part of the Argo system but generate similar real-time data. During March 2025, BAS deployed four ALAMO floats near the Totten and Denman ice shelves. At least 3 additional ALAMO floats will be deployed in the next few years as part of funded NERC grants.

UK Argo aspirations

Our aspirations are to contribute 10% of each of the BGC and Deep Argo arrays, and to continue to provide 5% of the Core floats deployed. This could be achieved by deploying 25 BGC floats per year, with a projected lifetime of four years this would lead to a sustained fleet of 100 BGC floats. Deployment of 25 each of Deep and Core floats per year, with a five-year lifetime would ramp up to a sustained fleet of 125 of each float type. The UK would then maintain a fleet of 350 floats (100 BGC, 125 each Core and Deep), about 8% of the total anticipated global fleet. However, funding for this, at around five times the present level, is not in place and would require significant additional investment.

Human resources

Staff members working on UK Argo, their institution and effort on Argo during 2024 are given below.

Met Office – 0.86 FTE (calendar year 2024)
Fiona Carse, Jon Turton, John Hankins, Alex Collins

NOC, Science Team – 0.7 FTE (March 2024 - March 2025)
Brian King, Nathan Briggs, Darren Rayner

NOC, BODC Team – 1.9 FTE (March 2024 – March 2025)
Emma Gardner, Kamila Walicka, Clare Bellingham, Katy Baldwin, Roseanna Wright, Danielle Wright, Anouska Panton. The BODC development team also provides support.

British Antarctic Survey
Pierre Dutrieux – 0.05 FTE (April 2024 – March 2029)

Total: 3.51 FTE

3. Deployment plans

The Met Office aims to deploy around 25 core floats per year; however, the present flat funding level will only permit this for a few more years as we run down our stock of floats. For BGC and Deep floats, the number of floats bought and deployed remains dependent on project-based research funding. We have submitted the spreadsheet showing expected deployments out to 2030, as requested.

As noted earlier, as of 20th March 2025, UK Argo has deployed 10 floats during 2025: 9 core (5 APEX SBE, 2 APEX RBR, and 2 ARVOR SBE); and 1 BGC (PROVOR CTS5-Jumbo).

We aim to deploy a total of 29 core floats later in 2025 and in early 2026, assuming all pass pre-deployment checks, including:

Core floats

European Shelf / NE Atlantic, DY195 Discovery CARES cruise, west of Ireland, May 2025:
2 core ARVOR-SBE *[set to rapid cycling]*
SW Indian, OceanX, August-September 2025 (via Tammy Morris, Cape Town):
3 core APEX-RBR
W Indian near Mauritius, OceanX, August-September 2025 (via Tammy Morris, Cape Town):
1 core APEX-SBE
NW Indian, OceanX, August-September 2025 (via Tammy Morris, Cape Town):
5 core APEX-SBE
SE Atlantic, SA Agulhas II Gough Cruise, October-December 2025 (via Tammy Morris):
2 core APEX-RBR
SW Atlantic, Argentine Basin, Sir David Attenborough passage leg southbound, October 2025:
1 core APEX-SBE
1 core APEX-RBR
Drake Passage, Sir David Attenborough passage leg southbound, November 2025:
1 core APEX-SBE
4 core ARVOR-I
Science cruises to Southern Ocean (SE Pacific and SW Atlantic sectors, details tbc), Sir David Attenborough, November 2025 – February 2026:
8 core ARVOR-I
NE Atlantic, DY204 Discovery RAPID East mooring cruise, February 2026:
1 core APEX-SBE

BGC floats

The remaining stock of five ASBAN six-parameter PROVOR BGC floats will be deployed between 2026 and 2028. All will be deployed in the Atlantic, exact locations are not yet decided.

4. Summary of any R&D efforts over the past year to try new sensors or improve float technology

PROVOR CTS5 with FloatRider Microstructure sensor package (will also measure T, S, O): Bieito Fernandez-Castro, University of Southampton, has one float of this type already, and has recently been awarded funding to purchase 25 more. The floats will be purchased during 2026/7, will have their data managed at BODC and will likely be recorded in OceanOPS as ‘UK Argo Equiv’.

- 10 floats from REMIX-TUNE: "Redefining the role of mixing in ocean overturning and ventilation" (European Research Council grant)
- 15 floats from POLEMIX: "Autonomous profiling observations to unravel the role of mixing in North Atlantic climate tipping points" (Forecasting Tipping Points programme under ARIA, a UK public body funded by Department for Science, Innovation & Technology). Three of the 15 floats are for R&D and are likely to be recovered often, the other 12 will be operational.

PROVOR CTS5 BGC float with UVP and “optical sediment trap”: NOC has deployed one float in the Labrador Sea as part of the ReBELS project, carrying a UVP camera to image particles and zoopankton, plus a vertically-mounted beam transmissometer “optical sediment trap”. The float is sampling in an intensive 1.5 day cycle (noon and midnight) for a full year to test the ability of the UVP sensor to detect diel vertical migrations of zooplankton. NOC will attempt to recover the float in August 2025.

5. National research and operational uses of Argo data

By NOC

Argo data are used widely within NOC, where the science applications include:

- measurement of evolution and drivers of mixed layer processes in the (Indian Ocean);
- inventory and evolution of heat and freshwater establishing controls on budgets (both regional and global);
- deep heat content (N Atlantic).
- Data product produced using Argo data: At NOC we produce a 4-D global map of Argo T and S data at 2 degree lat and long resolution from 60S to 60N. The data are gridded in 10-day windows using objective mapping on sigma-1 or neutral density levels and then interpolated back to 20 dbar vertical resolution. This is generally updated towards the end of each calendar year. A time series of global heat content is calculated and reduced to annual averages and then incorporated into the synthesis of global heat content calculations led by K von Schuckmann. The full 4-D gridded fields can be made available by contacting Brian King at NOC.

NOC is currently leading BGC Argo deployments on behalf of the broader UK community. Data are being used in recent, current and upcoming projects for:

- Generating 4D fields of particle size in the ocean for an array of applications including biological pump study.
- Investigating global drivers of variability in ocean carbon storage by sinking organic particles.
- Investigating nutrient transport by the Gulf Stream and its variability
- Tracking the transport of Greenland glacial meltwater into the Labrador Sea via its coloured dissolved organic matter signature.
- Quantifying particle sinking rates and rates of particle fragmentation in the ocean.
- investigating export fluxes and efficiency in hypoxic ocean regions.
- GLOBESINK and BIO-CARBON: A two-year NOC-led project called GLOBESINK started in August 2022 to generate a global dataset of particle size and downward particulate organic carbon flux from BGC Argo measurements of optical backscattering. This dataset contributes to the wider NERC BIO-CARBON programme, which aims to improve our ability to predict changes in biological carbon update by the oceans. One output of the project will be a publicly available particle dataset using BGC Argo data through 2022 (to be delivered in 2025). NOC has obtained funding to maintain this product through 2029 as part of the single center NERC bid AtlantiS. New BIO-CARBON projects

PARTITRICS and IDAPro, led by NOC and University of Southampton, have deployed two UK BGC Argo floats and fund their data delivery and QC, and also deploy three French BGC Argo floats. The float data are being used for estimates of primary production, net community production, and downward POC flux as part of 2024 BIO-CARBON fieldwork.

- ReBELS: In August 2024, the ReBELS project deployed, in the Labrador Sea, one ASBAN-UK full BGC float and one custom BGC Argo float carrying additional sensors: UVP for particle size and zooplankton, and "optical sediment trap" for particle flux. This project combines a mooring, four gliders, and two cruises to study three major pathways of biological carbon uptake in across a full annual cycle. The experimental float carrying the UVP is profiling intensively, and an attempt will be made to recover it in 2025 to download the full UVP data, with the intention to re-deploy.
- PhD studentships: Currently, five NOC-led PhD projects have a large component utilizing BGC Argo data. One focuses on net community production in the Weddell Gyre, another is exploring methods to optimally interpolate subsurface chlorophyll data, and a third is looking into the drivers of variability in the remineralization depth of sinking organic carbon in the ocean. A fourth NOC-based project led by the University of Southampton will develop methods to QC and correct pH data from BGC Argo. A fifth project plans to use UVP particle size data from BGC Argo floats to study global-scale patterns in particle sinking speed.

By British Antarctic Survey

Argo data in Polar regions are used widely within BAS, for general research purposes in themes itemized below, and as a part of dedicated UK and EU programs. Research themes include:

- Antarctic shelf seas heat and salt content variability, and its connection with local and remote sources,
- Greenland fjords heat and salt content variability, and its connection with local and remote sources,
- Impact of ocean variability on ice shelf and marine terminating glacier melt, its impact on ice sheet dynamics, and implication for global sea level
- Interannual to decadal variability in abyssal water formation, its impact on global thermohaline circulation and the climate engine

The data, integrated in global and regional databases such as OCEAN ICE D1.1[1], is further utilized to evaluate and calibrate numerical ocean and climate models, including international intercomparison exercises, for example Ice Sheet Model Intercomparison Project for CMIP6/CMIP7.

By Met Office

All core Argo data are used operationally. Some BGC data are being assimilated in research activity:

[1] Southern Ocean (90°S-45°S) conservative temperature and absolute salinity profiles compilation (OCEAN ICE D1.1), see 10.17882/99787

- They are routinely assimilated into its FOAM (Forecasting Ocean Assimilation Model) suite which is run daily and produces 2 analysis days and a 7-day forecast, and into the 1.5 km high-resolution North-west European Shelf Seas model (AMM15).
- Since June 2022 the Met Office has run a global coupled ocean-atmosphere NWP (numerical weather prediction) model that assimilates ocean temperature and salinity profiles. The high-resolution UK area atmospheric NWP model takes time-varying sea surface temperature fields from AMM15. Hence the temperature and salinity profile data impacts both weather forecasts and short-range ocean forecasts.
- Initial conditions for coupled monthly-to-seasonal forecasts are taken from the global coupled NWP system so the Argo data are used to initialise these forecasts and are used in ocean reanalyses.
- Argo data are also used in the initialisation of ocean conditions in climate models run to make decadal predictions.
- Near-surface Argo data are used to validate the output from the Met Office's OSTIA (Operational Sea Surface Temperature and Sea Ice Analysis).
- We have been doing an impact study (OSE) for Argo as part of the SynObs UN Decade project led by Yosuke Fujii. A preliminary paper on that was published in 2024: https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2024.1476131/full
- BGC-Argo data is being assimilated for research purposes into both global and North-west European Shelf Seas models, with a potential view to assimilating it in the Met Office operational physical-biogeochemical North-west European Shelf Seas model in future.

In the Met Office Hadley Centre for Climate Science and Services, Argo data is in the following products:

- EN4 contains in-situ ocean temperature and salinity profiles and objective analyses. It is updated monthly using real-time Argo profiles and GTSPP data, and annually using delayed-mode Argo profiles (and WOD, GTSPP and ASBO data). EN4 is freely available for scientific research use (see http://www.metoffice.gov.uk/hadobs/en4/). The latest version is EN.4.2.2, which includes a fresh download of all the source data and a substantial update to the XBT/MBT correction schemes. EN.4.2.2 contains four ensemble members where previously there was only two. There is also a new product user guide (based on both the Argo Users' Manual and the HadIOD user guide), including FAQs and example code. EN4 is also forming part of a GEWEX EEI project comparing Ocean Heat Content calculated from reanalyses, in situ data and satellite products (the project website is https://sites.google.com/magellium.fr/eeiassessment/dissemination/documents?authuser=0). EN4 will be updated during summer 2025, to create EN4.2.3. This version will for the first time include all Argo QC flags (previous versions include QC flags for only the delayed-mode and adjusted real-time data).

- HadIOD (Hadley Centre Integrated Ocean Database) is a database of in situ surface and subsurface ocean temperature and salinity observations supplemented with additional metadata including bias corrections, uncertainties and quality flags. The dataset is global from 1850-present with monthly updates. The current version is HadIOD.1.2.0.0, the chief sources of data are ICOADS, EN4 and CMEMS drifting buoy data. This product has been available to the public since mid-2020 via https://www.metoffice.gov.uk/hadobs/.

Met Office science uses of the EN4 product include Ocean Heat Content (OHC) analysis, contributions to BAMS, Ocean Obs'19 White Paper, an Earth Energy Imbalance paper (von Schuckmann et al., 2020)[2], and an Indicators of Global Climate Change paper (Forster et al., 2023)[3].

6. Issues for AST for consider

Could real time APEX-RBR salinity data that has not been corrected be flagged as 9 (GTSPP flag - 9 'Good for operational use; caution; check literature for other uses', as, in our experience, they are good enough to assimilate in operational models.

The future of OneArgo implementation – due to changes taking place in the US.

7. Outreach and communication

UK Argo BlueSky handle https://bsky.app/profile/ukargo.bsky.social

UK Argo web page https://www.ukargo.net/ . Note the page is currently out of date, it will be updated soon.

UK Argo Facebook page https://www.facebook.com/UKArgofloats/

“NOC ambassador adding ocean science to latest round-the-world challenge” article from NOC News in Sept 2024 https://noc.ac.uk/news/noc-ambassador-adding-ocean-science-latest-round-world-challenge

8. CTD data

When the UK notifies float deployments with OceanOPS, BODC includes any information about nearby or simultaneous CTD casts if the scientists on board the deploying ship provide this. It is written in the Description free text box in the notification form. Sometimes our floats are deployed from passage legs or ships of opportunity. In these cases, no matching CTD casts are available. All CTD data from UK cruises is best obtained from BODC, using the enquiries@bodc.ac.uk contact address.

[2] https://doi.org/10.5194/essd-12-2013-2020
[3] https://doi.org/10.5194/essd-16-2625-2024

9. Bibliography

UK Argo PIs are Jon Turton, Fiona Carse, Brian King, Nathan Briggs, Giorgio Dall'Olmo (up to 2022) and Pierre Dutrieux (since June 2024). The UK last provided a bibliography for AST#25 (in March 2024).

Included below is a list of 29 papers published since 1st January 2024, with at least one author based at a UK institution. The search was carried out using Web Of Science, using keyword "Argo" and refining by country (England, Scotland, Wales, Northern Ireland). Note there are 25 papers 2024 and 4 in 2025. PhD theses are not included in this list.

2024

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Balan-Sarojini, B; Balmaseda, MA; Vitart, F; Roberts, CD; Zuo, H; Tietsche, S; Mayer, M (2024). Impact of ocean in-situ observations on ECMWF sub-seasonal forecasts.
FRONTIERS IN MARINE SCIENCE, 11, doi:10.3389/fmars.2024.1396491

Balmaseda, MA; Sarojini, BB; Mayer, M; Tietsche, S; Zuo, H; Vitart, F; Stockdale, TN (2024).
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FRONTIERS IN MARINE SCIENCE, 11, doi:10.3389/fmars.2024.1456013

Capotondi, A; Rodrigues, RR; Sen Gupta, A; Benthuysen, JA; Deser, C; Frölicher, TL; Lovenduski, NS; Amaya, DJ; Le Grix, N; Xu, TT; Hermes, J; Holbrook, NJ; Martinez-Villalobos, C; Masina, S; Roxy, MK; Schaeffer, A; Schlegel, RW; Smith, KE; Wang, CZ (2024).
A global overview of marine heatwaves in a changing climate.
COMMUNICATIONS EARTH & ENVIRONMENT, 5, 1, doi:10.1038/s43247-024-01806-9
Chen, XY; Quartly, GD; Chen, G (2024).
Eddy Detection Inverted from Argo Profiles to Surface Altimetry.
JOURNAL OF ATMOSPHERIC AND OCEANIC TECHNOLOGY, 41, 6, doi:10.1175/JTECH-D-22-0147.1

de Froe, E; Yashayaev, I; Mohn, C; Vad, J; Mienis, F; Duineveld, G; Kenchington, E; Head, E; Ross, SW; Blackbird, S; Wolff, GA; Roberts, JM; Macdonald, B; Tulloch, G; van Oevelen, D (2024).
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Douglas, CC; Briggs, N; Brown, P; Macgilchrist, G; Garabato, AN (2024).
Exploring the relationship between sea ice and phytoplankton growth in the Weddell Gyre using satellite and Argo float data.

OCEAN SCIENCE, 20, 2, doi:10.5194/os-20-475-2024

Fujii, Y; Remy, E; Balmaseda, MA; Kido, S; Waters, J; Peterson, KA; Smith, GC; Ishikawa, I; Chikhar, K (2024).
The international multi-system OSEs/OSSEs by the UN Ocean Decade Project SynObs and its early results.
FRONTIERS IN MARINE SCIENCE, 11, doi:10.3389/fmars.2024.1476131

González-Haro, C; Isern-Fontanet, J; Turiel, A; Merchant, CJ; Cornillon, P (2024).
Structural and Dynamical Quality Assessment of Gap-Filled Sea Surface Temperature Products.
EARTH AND SPACE SCIENCE, 11, 10, doi:10.1029/2023EA003088

Hakuba, MZ; Fourest, S; Boyer, T; Meyssignac, B; Carton, JA; Forget, G; Cheng, LJ; Giglio, D; Johnson, GC; Kato, S; Killick, RE; Kolodziejczyk, N; Kuusela, M; Landerer, F; Llovel, W; Locarnini, R; Loeb, N; Lyman, JM; Mishonov, A; Pilewskie, P; Reagan, J; Storto, A; Sukianto, T; von Schuckmann, K (2024).
Trends and Variability in Earth's Energy Imbalance and Ocean Heat Uptake Since 2005.
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Han, GY; Quartly, GD; Chen, G; Yang, J (2024).
Satellite-observed SST and chlorophyll reveal contrasting dynamical-biological effects of mesoscale eddies in the North Atlantic.
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Henson, S; Bisson, K; Hammond, ML; Martin, A; Mouw, C; Yool, A (2024).
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Evaluation of the effects of Argo data quality control on global ocean data assimilation systems.
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Livanou, E; Sauzede, R; Psarra, S; Mandalakis, M; Dall'Olmo, G; Brewin, RJW; Raitsos, DE (2024).
Evaluating MULTIOBS Chlorophyll-a with Ground-Truth Observations in the Eastern Mediterranean Sea.
REMOTE SENSING, 16, 24, doi:10.3390/rs16244705

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GEOSCIENTIFIC MODEL DEVELOPMENT, 17, 16, doi:10.5194/gmd-17-6415-2024

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Evolution of oxygen and stratification and their relationship in the North Pacific Ocean in CMIP6 Earth system models.
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Pillar, HR; Hetherington, E; Levin, LA; Cimoli, L; Lauderdale, JM; van der Grient, JMA; Johannes, K; Heimbach, P; Smith, L; Addey, CI; Annasawmy, P; Antonio, S; Bax, N; Drake, HF; Escobar, E; Elsler, LG; Freilich, MA; Gallo, ND; Girard, F; Harke, MJ; Jones, DOB; Joshi, S; Liang, XF; Maroni, PJ; Sarti, O; Stefanoudis, PV; Sulpis, O; Trossman, D (2024). Future directions for deep ocean climate science and evidence-based decision making.
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10. RBR deployment plans

The Met Office received delivery of eleven APEX-RBR-L3 floats from Teledyne Webb in March 2024. We do not presently have any core floats with RBR CTDs on order. Our current plans for deploying core floats with RBR CTDs are detailed in section 3, above. We will deploy six APEX-RBR floats between April 2025 and February 2026. After these planned deployments, we will have one APEX-RBR in stores. We do not yet have deployment plans beyond February 2026.