

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.

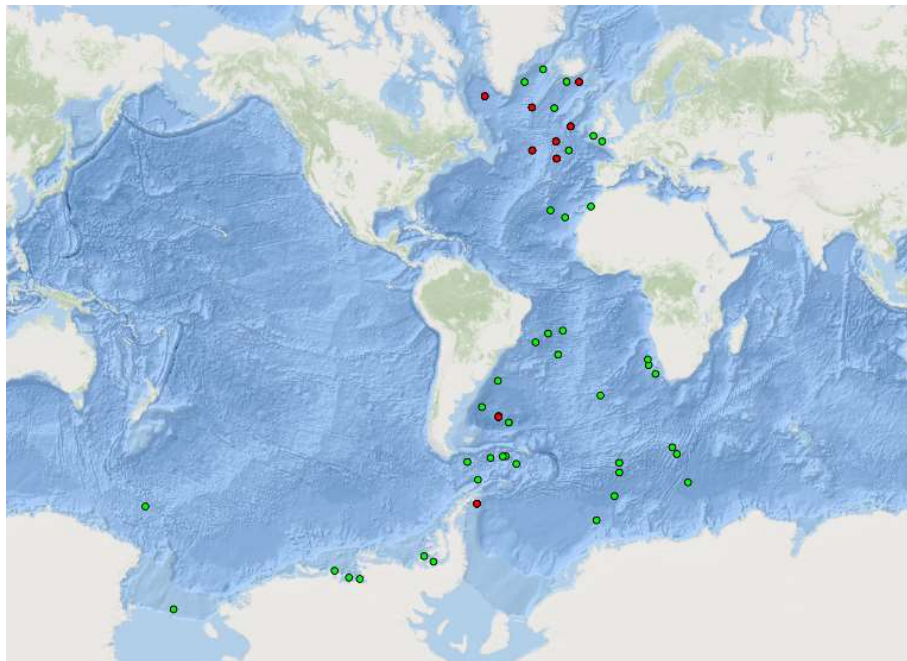


Figure 1. Showing the latest reported locations of the 51 UK Argo floats deployed between 1 January 2024 and 20 March 2025, where green = core (41); red = biogeochemical floats (10). Plotted using OceanOPS website on 20/03/25.



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.

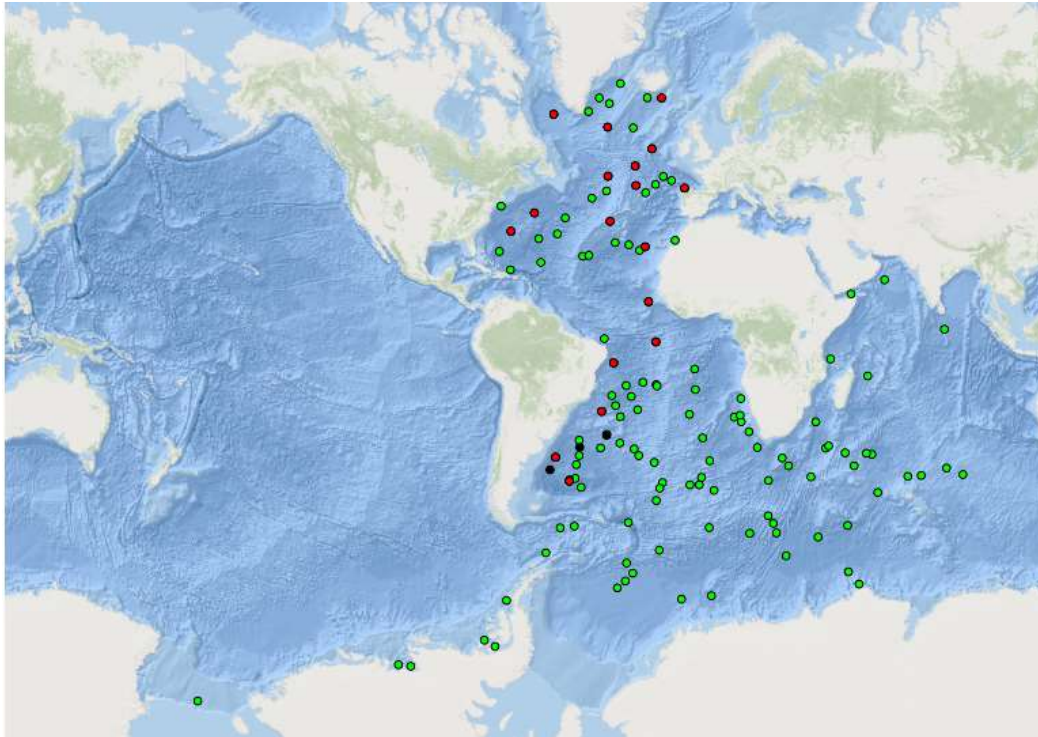


Figure 3. Showing the locations of all 134 UK floats delivering data as of 20 March 2025, where green = core (113); red = biogeochemical floats (18), black = deep floats (3). Plotted using OceanOPS website on 20/03/25.

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.

| <i>SN</i> | <i>WMO</i> | <i>deployed</i> |
|-----------|------------|-----------------|
| 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 (GTSP 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 zooplankton, 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 uptake 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 D1.1¹, 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 GTSP data, and annually using delayed-mode Argo profiles (and WOD, GTSP 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 (GTSP 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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On the Variability of Phytoplankton Photophysiology Along a Latitudinal Transect in the North Atlantic Surface Ocean.

JOURNAL OF GEOPHYSICAL RESEARCH-BIOGEOSCIENCES, 129, 9, doi:10.1029/2023JG007962

Balan-Sarajini, 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; Sarajini, BB; Mayer, M; Tietsche, S; Zuo, H; Vitart, F; Stockdale, TN (2024).

Impact of the ocean in-situ observations on the ECMWF seasonal forecasting system.

FRONTIERS IN MARINE SCIENCE, 11, doi:10.3389/fmars.2024.1456013

Capotondi, A; Rodrigues, RR; Sen Gupta, A; Benthuisen, 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).

Characterizing regional oceanography and bottom environmental conditions at two contrasting sponge grounds on the northern Labrador Shelf.

BIOGEOSCIENCES, 21, 23, doi:10.5194/bg-21-5407-2024

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.

SURVEYS IN GEOPHYSICS, 45, 6, doi:10.1007/s10712-024-09849-5

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ENVIRONMENTAL RESEARCH LETTERS, 19, 10, doi:10.1088/1748-9326/ad7049

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ENVIRONMENTAL RESEARCH LETTERS, 19, 2, doi:10.1088/1748-9326/ad1e7f

Ishikawa, I; Fujii, Y; de Boisseson, E; Wang, YG; Zuo, H (2024).

Evaluation of the effects of Argo data quality control on global ocean data assimilation systems.

FRONTIERS IN MARINE SCIENCE, 11, doi:10.3389/fmars.2024.1496409

Livanou, E; Sauzede, R; Psarra, S; Mandalakis, M; Dall'Olmo, G; Brewin, RJW; Raitos, 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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REMOTE SENSING, 16, 18, doi:10.3390/rs16183396

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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.

BIOGEOSCIENCES, 21, 17, doi:10.5194/bg-21-3985-2024

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Ciavatta, S; Lazzari, P; Alvarez, E; Bertino, L; Bolding, K; Bruggeman, J; Capet, A; Cossarini, G; Daryabor, F; Nerger, L; Popov, M; Skakala, J; Spada, S; Teruzzi, A; Wakamatsu, T; Yumruktepe, VC; Brasseur, P (2025).

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PROGRESS IN OCEANOGRAPHY, 231, doi:10.1016/j.pocean.2024.103384

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Identifying Ocean Submesoscale Activity From Vertical Density Profiles Using Machine Learning.

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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.