



Best practices document for float deployments into EEZ

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Disclaimer

Following document is attempting to clarify complex issues, going far beyond ocean observations, and on which there is no strict international consensus. This clarification is however needed for a day-to-day implementation of Argo national and multinational programmes. This document does not replace the interpretation and application of the United Nations Convention on the Law of the Sea at a national level.

The recommendations, depiction and use of boundaries, geographic names and related data included in this document are not warranted to be error free nor do they imply official endorsement or acceptance by the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The ideas and opinions expressed in this publication are those from the authors and do not commit any of these organizations.

EXECUTIVE SUMMARY

Argo, the global array of 4000 profiling floats, is today an operational pillar of the Global Ocean Observing System infrastructure, delivering critical data for ocean and climate research, for operational services including short to long range and extreme weather forecasts. The “OneArgo¹” future vision, expanding its capabilities in space (denser in key regions), to full-depth and biogeochemical variables, sets a new target to 4700 units. OneArgo implementation has started but faces difficulties since deep and multidisciplinary floats are three times more expensive than the standard floats, and national budgets do not follow yet. The recent international context with the pandemic first and then the rising inflation is adding more pressure to the Argo implementers, consequently we can note the first sign of coverage decrease after two decades of remarkable progress. Deploying a thousand units per year to sustain such a global array is challenging and it requests a strong international cooperation and coordination, an optimal use of academic ship time, and innovative use of private sector and civil society ships.

Exclusive Economic Zones (EEZs) represent a third of the ocean observing region targeted by the Argo program. Deploying Argo floats in foreign countries' EEZs remains challenging, significantly lowering deployment plans and then Argo coverage in some regions. International Oceanographic Commission (IOC) of UNESCO resolutions on Argo (Resolution XX-6 and Resolution EC-XLI.4) have been implemented to comply with United Nations Convention on the Law of the Sea (UNCLOS) and Member States transparency demand and facilitate EEZ access for floats. Argo would not have been implemented without such support. However, the resulting Argo guidelines do not cover the deployments directly into EEZs, which is in most cases left to bilateral Marine Scientific Research clearance processes.

Today Argo is becoming more integrated and multilateral than it was in the past. To micromanage a dynamic array, where gaps appear and disappear at the discretion of subsurface currents, multinational research and chartered cruises are used to optimally and collectively seed ocean basins. Meeting the demand for a 6-month advance clearance request becomes inapplicable in the overall Argo workflow. Consequently, Argo coverage remains poor in some coastal states' regions, and societal services quality decreases. Is it reasonable to not facilitate float deployments in regions of frequent storm events in a context of unprecedented global warming and projections on growing storm frequency and intensity?

A favourable changing international context is seeing ocean related environmental issues higher in the agenda with the enhanced support of key international stakeholders in the Argo program, like the World Meteorological Organization and its Unified Data Policy². Opportunities to simplify EEZ access exist.

The European Union could be a pioneer in these solution spaces, providing a homogeneous and responsive procedure for MSR clearances, or better, seek a global concurrence from its Members for float deployment in all areas under EU Members jurisdiction.

Solutions must be found at international level to facilitate this Sisyphean work. If a global political consensus can't be obtained to open World 'EEZ to this critical program, an operational application of the UNCLOS must be shaped and implemented as soon as possible.

¹ <https://argo.ucsd.edu/argo-beyond-2020/>

² https://library.wmo.int/doc_num.php?explnum_id=11256

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1 Definitions

Here below are a few definitions to clarify several concepts used in this document.

1.1 Marine Scientific Research

Marine scientific research (MSR) is internationally regulated by the UNCLOS. Coined the “constitution for the oceans³”, the UNCLOS sets out States’ rights and obligations in the world’s ocean, including the rules of MSR “which strike an equitable balance between the interest of the research state and the interest of the coastal state in whose economic zone or continental shelves the research is being carried out”. To pursue MSR in an EEZ or continental shelves, a clearance from the coastal state is mandatory, six months ahead of the operations.

1.2 OceanOPS

Formerly known as JCOMMOPS, OceanOPS includes the Argo Information Center (AIC). OceanOPS is the joint WMO-IOC/UNESCO Support Center for oceanography and marine meteorology. OceanOPS mission⁴ is to monitor and report on the status of the global ocean observing system and its networks⁵ to use its central role to support efficient observing system operations, to ensure the transmission and timely exchange of high quality metadata, and to assist free and unrestricted data delivery to users across, operational services, climate and ocean health.

OceanOPS was actually created in 2001 to help Member States to comply with UNCLOS for the implementation of Argo, amongst other support functions for the global ocean observing system. OceanOPS was formalized as a WMO office in France in 2019, and all of its staff members (8 persons) are international civil servants.

1.3 Argo Program

Argo is implemented at national level, through 20 to 30 contributing countries, and coordinated through an international infrastructure, including an Argo Steering Team⁶, supported by a Data Team⁷ and other regional or mission based task teams, and supported actively by OceanOPS technical coordination.

The Argo Steering Team has defined a framework⁸ for entering Argo as the use of profiling floats is increasing, with a growing diversity of sensors, users and applications.

National Argo Programs are bound to one country only and have a unique lead or operating Agency. Hence each float has a clear responsibility chain and set of contact points. Some floats can have an “international flag”: Euro-Argo ERIC (European Research Infrastructure Consortium) or other international organizations can operate floats.

Float ownership can be transferred between entities (to facilitate cooperation and foster new partners engagement), including with civil society or private entities. Generally, OceanOPS certifies such

³ http://www.un.org/Depts/los/convention_agreements/texts/koh_english.pdf

⁴ <http://www.ocean-ops.org/strategy>

⁵ https://www.goosocan.org/index.php?option=com_content&view=article&id=291&Itemid=439

⁶ <http://www.argo.ucsd.edu/>

⁷ <http://www.argodatamgt.org/>

⁸ <https://argo.ucsd.edu/expansion/framework-for-entering-argo/>

donations through appropriate letters. OceanOPS metadata⁹ clarifies the ownership of each profiling float and relevant responsibilities.

Argo floats data are used for climate research, and for short to long range weather predictions. Actually the latter application boosted the Argo development in the 2000s, as a complement to satellite altimetry data to develop operational oceanography services. Floats are used as well for extreme weather events intensity tracking and forecasting. Specific hurricane floats can be deployed around a storm (see Woods Hole Oceanographic Institution work¹⁰), but standard floats can also be configured through satellite uplink to perform high frequency and shallow profiles around a specific area. Argo data are used eventually to preserve safety and mitigate damages to society.

Hurricane tracking falls under the Yankov Statement and subsequent state practice. Floats deployed for this purpose are not engaged in MSR and do not need permission to enter an EEZ six months in advance (which would not make any sense anyway).

More generally, floats are deployed mainly to fill gaps in a global array, even if a few research contributions, pilots and initiatives occur regionally (see equivalent floats below, and map in annex) and represent less than 5% of Argo.

While Argo could have been seen as a research project in the early 2000s, it became the core dataset for the development of operational oceanography and marine meteorology. The debate remains open on the fact that Argo is or is not MSR, but the interpretation and application of UNCLOS certainly leaves some space for improvement and flexibility.

1.3.1 Argo Vs non-Argo floats

Profiling floats can be deployed by scientific institutions for research, meteorological agencies, float and sensor manufacturing companies for testing purposes, private entities (e.g. oil & gas) for their surveys, navies, etc.

Some of these floats enter the Argo framework, and have the Argo label, some do not. We can classify profiling floats under 3 categories: Argo, Argo equivalent, non-Argo.

1.3.2 Argo

A float funded and operated through a national Argo program, **fully complying with Argo framework and best practices for sampling and data flow.**

An Argo profiling float will include:

- the official Argo label certifying this endorsement (sticker affixed on float hulls at manufacturer's level)
- a pre-deployment notification via OceanOPS system and required updates
- a post deployment notification when float approaches some specific EEZs as warned by OceanOPS operational system
- standard metadata submitted to OceanOPS
- free and unrestricted data sharing according to Argo standards (real-time and high-quality delayed mode), for all sensors.

⁹ <http://www.ocean-ops.org/metadata>

¹⁰ <https://www.whoi.edu/oceanus/feature/oceanography-takes-flight/>

- real-time tracking via OceanOPS
- approved sensors
- responsibility to secure beached instruments (with OceanOPS monitoring and guidance)
- best practices for sampling strategies (cycle time, drift/profile depths, with regional specificities)

1.3.3 Argo equivalent

A profiling float funded and operated through ad hoc or research projects, not necessarily complying with Argo best practices for sampling, but **sharing data according to Argo standard and complying with Argo notification regimes**. Extra sensors can be piloted, but all data must be made available without any restriction.

1.3.4 non-Argo

Profiling floats operated at regional (e.g. micro floats for hurricane tracking), national or international level (e.g. Earthscope oceans¹¹) not complying with any best practices for sampling, having other sensors (e.g. passive acoustic) not complying with the Argo framework.

These floats are not part of Argo and therefore not allowed to put the Argo sticker. Some of these floats share data (e.g. on the Global Telecommunication System of WMO), which can be very important for some operational users, and consequently needs to be monitored by OceanOPS.

¹¹ <https://geoweb.princeton.edu/people/simons/earthscopeoceans/index.html>

2 Background

Since the 2000s, profiling floats are mainly deployed in the framework of the international Argo program through strong principles of transparency and openness. About 17000 units have been deployed so far. Argo data are critical to observe our changing climate and accurately forecast weather at sub-seasonal to seasonal timescales, and more recently they are also used in short range weather forecasts and extreme event predictions.

With 4000 operational units, Argo represents today half of the Global Ocean Observing System (GOOS¹²) in-situ infrastructure monitored by OceanOPS and has an ambitious multidisciplinary plan, called “OneArgo”, to upgrade this infrastructure at regional level, at depth, and with 6 additional biogeochemistry variables.

After a period of growth (2000-2010), and a light expansion to higher latitudes and marginal seas (2010-2015), Argo has reached a plateau and is now showing the first signs of a decrease (due to flat or decreasing national budgets), and investments in expensive technologies to go deeper or measure more biogeochemical parameters. All that is being catalyzed by the worldwide context, including pandemics impacts and growing inflation. Argo is a masterpiece to the understanding of ocean heat and carbon budgets, acidification and deoxygenation. It is expected this network will keep growing and diversifying in the future for the common good.

However several challenges remain regarding law of the sea in general, which has not changed at the speed of the evolution of Argo, from a pilot project in 2000 to an operational pillar of the global ocean observing system.

The current legal framework, UNCLOS, or at least its practical application, does not appear to be compatible with the reality of the implementation of an operational ocean observing system serving science, but also sustained observations supporting operational services for critical societal benefits. This framework was designed in the context of national academic cruises operating large multidisciplinary surveys, and not of a modern observing system mainly based on autonomous platforms, drifting everywhere freely and serving free and unrestricted data in real-time for many societal applications.

The deployment of Argo floats in high seas is regulated through specific guidelines, agreed by the IOC/UNESCO Member States through two resolutions.

The implementation of these guidelines is facilitated by the joint WMO-IOC/UNESCO center for oceanography and marine meteorology, OceanOPS. OceanOPS is tracking the Argo implementation, planning, status and data availability, and delivers several tools and services in support of Argo implementers and coastal states.

The deployment of Argo floats directly into Members Exclusive Economic Zones (EEZ) is regulated through the UNCLOS, mostly on a bilateral basis and according to the interpretation of UNCLOS by both implementer and coastal states. Complying with this regulation is challenging on a day-to-day basis for Argo operators deploying about 900 units per year. As a result, and when there is no simple pathway to comply with UNCLOS, most of the institutes simply avoid deploying their floats in EEZs, which represent 30% of the world's ocean surface.

¹² <https://www.goosoocean.org/>

However, some exceptions do exist where deployments in other countries' EEZ is facilitated. Some coastal states have concurred with the deployment of Argo floats in their EEZ under some conditions. Others have decided to clear Argo from Marine Scientific Research (MSR) procedure to simplify the deployment of floats (or drifters) in their EEZ (e.g. United States of America). Is Argo float observation Marine Scientific Research observation? While there is no legal definition of MSR in the UNCLOS, there is no international consensus on this question either. There is a substantial number of coastal states that argue in favor of the six month rules on the basis of Art. 258 and 246 of the UNCLOS.

More generally other cooperative arrangements, often bilateral, can facilitate such deployments in waters under national jurisdictions.

It is also interesting to realize that Argo is not the only observing system operating at sea. There is a large diversity of instruments (including marine animals) that deliver sustained data and for which there is no or less guidance for the application of such legal framework.

This document recalls how to apply these guidelines in practice and provides a few recommendations for a way forward in the European context, as tasked by the Euro-Argo RISE project. The European Union might be a good test case to harmonize practices, and to operationalize the application of UNCLOS for Argo, and beyond, through clear processes.

3 Argo Resolutions and Decisions

The implementation of the Argo program has been guided by IOC/UNESCO Member States and a set of resolutions and guidelines to meet coastal states transparency demand in the UNCLOS context. In this document, we will refer to the “**e-notification**” made routinely through OceanOPS for all Argo float deployments according to Resolution XX-6 and to the “**bilateral notification**” made by implementing entities according to resolution XLI-4. Both procedures can be regrouped under the “Argo notification regime”.

Resolution XX-6 ([IOC,1999](#)¹³) requested Argo implementers to notify, reasonably in advance and through appropriate channels, any Argo float deployment in the high seas that might drift into Member States EEZ.

To that end, Argo National Focal Points (NFPs) were designated by IOC Member States and WMO Members, following joint IOC-WMO circular letters, the latest is dated from 2016. The list and details of Argo NFPs is available at: <http://www.ocean-ops.org/board?t=Argo&groupid=22> Any update on Argo NFPs designation should be sent by IOC national delegations to the IOC secretariat: ioc-secretariat@unesco.org

Practically, each float deployment plan is registered at OceanOPS, with core metadata and a unique WMO identifier, ideally in advance of the deployment, and an electronic notification is automatically issued to all Argo National Focal Points. The notification email includes a map, float key metadata, and links to track it in real-time and access its data (see notification email in the annex 1). Updates can be generated if reality at sea was different from the initial plan which is often the case, and a new email is generated. OceanOPS verifies routinely that floats notified are effectively delivering data in real-time and delayed mode as specified in Argo rules.

The Argo Steering Team reserves itself the right to refuse a float in the Argo framework for which the notification was made far too late after the deployment date.

Resolution EC-XLI.4 ([IOC, 2008](#)) offered then the possibility to coastal states, through official request to IOC/UNESCO secretariat, to be formally and bilaterally notified of float drift into its EEZs by implementers.

The following Member States have made such a request: **Argentina, Brazil, Chile, China, Ecuador, Egypt, Greece, India, Peru, Russia, Tunisia, Turkey.**

OceanOPS has implemented a warning system which is routinely checking the floats drift in these EEZs and generate reports for implementers so they can - when appropriate - notify the coastal state. The OceanOPS Information System routinely checks if any float's latest location is closer than 100 nautical miles from the declared EEZs of these 12 coastal states (source: www.maritimeboundaries.com). When the intersection matches (through a Geographical Information System analysis), the system logs the event for this float and the concerned coastal state. Every week, a summary report is sent to all concerned implementers (pdf format, see annex), including all floats approaching a given coastal state, and contact details for the Argo NFPs. Implementer has the action to acknowledge receipt of this on the OceanOPS website, float per float, and take any required step (e.g., a bilateral notification). As long as this acknowledgment is not made, floats will continue to appear in the reports. If acknowledgment is made, the next iteration of the

¹³ https://www.ocean-ops.org/share/Argo/Doc/IOC_Resolution_XX-6.pdf

warning system will omit that float for that coastal state. A float is flagged once and only once for a given coastal state.

This resolution and resulting guidelines clarified the right for the coastal state to request the implementer to stop data transmission when the float operates in its EEZ for “*data of direct significance for the exploration and exploitation of natural resources*”. A procedure, triggered by OceanOPS warning and notification system, would inform national and global Argo data centers to stop distributing these data. As this situation happened only once in the history of Argo, the procedure was not operationalized.

Finally, this resolution acted on the fact that Argo was no more a pilot project but a “program” to be sustained for the long run and for the common good.

More recently, the IOC Member States have agreed with **Decision EC-LI/4.8** ([IOC, 2018](#)¹⁴) to have BioGeoChemical Argo floats and their 6 core variables covered by the same notification regime as standard Argo floats, together with a framework to evolve the float sensor packages in agreement with Member States.

Overall, if these resolutions provide rather clear guidelines for a practical implementation, through OceanOPS support center, they show some limitations as well:

- Deployment of floats directly into EEZ is not covered through an homogeneous and efficient procedure
- Some Member States do not have any Argo focal point, and some do not have active email addresses
- Guidelines work in a bilateral way, while Argo implementation is becoming more multilateral, including with partners from private sector or civil society.
- The sequestration of data in EEZ is enabled, which seems paradoxical with the level of challenge we are facing on ocean health and climate monitoring, and the necessity to equip all Member States with warning systems for extreme events and prepare climate warming mitigation policies.

Those resolutions are the two legal pillars of Argo implementation in the high seas. Without the existence of those resolutions, Argo implementers would have had to obtain a clearance six months in advance for each EEZ the float would possibly encounter in its 5 to 10 years lifetime. But it is challenging to accurately forecast through numerical models the autonomous drift of a float along that time frame. Also non-Argo float implementers have difficulties to apply UNCLOS rigorously and are therefore encouraged to join the Argo program for this and many other advantages.

However, if you want a float to operate in the EEZ, to fill gaps in the global array or densify the network in key regions you need to go there and deploy the instrument. Hence, we have some guidelines for the deployment in high seas, but we don't for deployments into EEZ which represent a third of the ocean and therefore are more difficult to sustain.

¹⁴ <https://unesdoc.unesco.org/ark:/48223/pf0000265129>

4 Deployments within EEZ

Coastal States need to give consent to the conduct of MSR in their EEZ, and implementers need to request this clearance 6 months ahead:

UNCLOS Article 248: Duty to provide information to the coastal State

States and competent international organizations which intend to undertake marine scientific research in the exclusive economic zone or on the continental shelf of a coastal State shall, not less than six months in advance of the expected starting date of the marine scientific research project, provide that State with a full description of:

- (a) the nature and objectives of the project;*
- (b) the method and means to be used, including name, tonnage, type and class of vessels and a description of scientific equipment;*
- (c) the precise geographical areas in which the project is to be conducted;*
- (d) the expected date of first appearance and final departure of the research vessels, or deployment of the equipment and its removal, as appropriate;*
- (e) the name of the sponsoring institution, its director, and the person in charge of the project;*
- (f) the extent to which it is considered that the coastal State should be able to participate or to be represented in the project.*

While the requirement is clear, how to do it in practice is more challenging, and depends on each coastal state. This report does not itemize the clearance pathways for all coastal states, which would be a very useful source of information and an area for future work for e.g. OceanOPS.

The European Union, through the EOOS¹⁵ (European Ocean Observing System) and its implementation body EuroGOOS, or any EU agency or *competent international organization* with this specific expertise, could be commissioned to facilitate this for its members through a “central clearance office”, acting on behalf of members or linking with members.

Applications could be made via OceanOPS to facilitate the workflow for all parties and enable some tracking and feedback loop as its system holds most of the requested information, and has already some technical capacity (see IOC Resolution/Decisions implementation).

EOOS is working with OceanOPS to increase and adapt to the European context and priorities, the services provided by OceanOPS internationally. This specific support to MSR requests could be one of the important future functions of OceanOPS for EU members.

Exceptions:

There are some exceptions to art. 248 application. Some Member States have concurred with the deployment of Argo profiling floats in their EEZs, provided the free and unrestricted data exchange and the transparent implementation through OceanOPS monitoring and Argo notification regime. These agreements were communicated to OceanOPS through letters that can be obtained on demand.

¹⁵ <https://www.eoos-ocean.eu/>

While the UNCLOS does not clearly define marine scientific research (MSR), some Member States consider that some marine data collection activities are not MSR, including Argo.

Overall, the list of countries facilitating EEZ access for float deployments is the following:

- Canada
- Mauritius
- Mozambique
- United Kingdom (all UK maritime areas)
- United States of America
- Pacific Islands :
 - Cook Islands,
 - Fiji,
 - Kiribati,
 - Marshall Islands,
 - Nauru,
 - New Caledonia,
 - Niue,
 - Papua New Guinea,
 - Samoa,
 - Solomon Islands,
 - Tonga,
 - Tuvalu,
 - Vanuatu

Please consult with OceanOPS for latest updates on this list which is to be taken with a lot of caution. Some of these exceptions have a clear and written background, some others do not or have a written background that could be seen as obsolete, as provided by multinational structures that do not exist anymore.

Member States could be simply asked to provide this overall concurrence, through a circular letter e.g., but this trivial action appears too sensitive to be executed.

However, another article of the UNCLOS could provide a way forward:

UNCLOS Article 247: Marine scientific research projects undertaken by or under the auspices of international organizations

A coastal State which is a member of or has a bilateral agreement with an international organization, and in whose exclusive economic zone or on whose continental shelf that organization wants to carry out a marine scientific research project, directly or under its auspices, shall be deemed to have authorized the project to be carried out in conformity with the agreed specifications if that State approved the detailed project when the decision was made by the organization for the undertaking of the project, or is willing to participate in it, and has not expressed any objection within four months of notification of the project by the organization to the coastal State.

The IOC procedure on art. 247 was adopted in 2005 but has not yet been implemented.

Argo is a program of WMO and IOC/UNESCO (see Resolution's text) therefore, we could imagine a consolidated implementation and deployment plan assembled by a set of Members (e.g. Euro-Argo

ERIC members) for a particular time period, or for a specific region or large cruise (take the example of the regular Kaharoa cruises¹⁶ across Pacific Islands see annex 3), without avoiding any EEZ, focusing on sustaining an optimal array.

The plan would be gathered by OceanOPS as done today, and reported to Member States for information and for global clearance. This would have the advantage to equally inform Member States of the project, gather their feedback and support, and take note of the absence of consent to adapt the plan until it gets full approval of all coastal states concerned. OceanOPS could work with WMO and IOC/UNESCO on piloting the application of this article.

4.1 Guidelines summary

	Deployment in High Seas	Deployment into an EEZ	Drifting into an EEZ	Drifting into another EEZ
Argo	e-notification in advance (deployment plan)	e-notification + MSR clearance with some exceptions	Nothing, except: Bilateral notification as requested by 12 Member States	Nothing, except: Bilateral notification as requested by 12 Member States
Non-Argo	No guidelines	MSR clearance 6 months in advance of the operation	MSR clearance 6 months in advance of the operation	MSR clearance 6 months in advance of the operation

This table shows the relative benefits of the Argo guidelines: there is no need to do MSR clearance for each EEZ the float is likely to drift into, but rather to pay attention to the dozen of Member States that wish to be informed whenever a float approaches their EEZ after notification by OceanOPS.

¹⁶ <http://www.ocean-ops.org/share/Argo/Maps/kaharoa.png>

5 Challenges & Opportunities

5.1 Deployments

Deploying a thousand units every year is a serious challenge in logistics. Between the production by small industries, the testing by laboratories, the deployment plans drafting, the shipping to the port, and finally the deployment location from a ship, there are many months with a lot of expected and unexpected changes, and a small time window for doing a MSR clearance request based on some uncertainties.

Commonly, deployments are organized through research vessels (R/V) operated by oceanographic institutions. The paperwork is generally managed through specific international divisions, used to apply for MSR as needed. Hence float operators do not need to take care of this.

The recent years have highlighted the challenge of maintaining the operational Argo array. The COVID pandemic and the recent increase of fuel price have additionally raised pressure on the historical capacity to deploy floats. The academic ship time available is not on the rise and generally R/V survey the same areas of national interest. For operational, coverage and financial optimization, Argo float deployments are more and more organized through “unconventional” channels such as multinational Argo deployment cruises, through R/V or dedicated charters, private sector and civil society opportunities (e.g. world round sailing races).

The Argo community is regularly organizing multinational deployments from the same R/V and Argo floats deployed as an opportunistic activity within a research cruise with already well-defined objectives and for which the MRS is planned. In this context, the country operating the R/V does not necessarily want to apply for MSR for the country operating the floats, especially if the country operating the R/V doesn't have other activities planned in a country EEZ. MSR clearance then becomes more complex to apply and represents an important administrative burden for the float operators that often lead to the abandonment of the deployment even if it would have been important for operational services.

The Argo community is increasingly using dedicated charter missions (Kaharoa, BlueObserver e. g., see annexe 3) to proactively fill gaps through optimized cruise tracks and sustain an optimal float coverage. One must imagine a ship loaded with 100 units from ten different nations. A deployment plan is prepared well ahead, but it is very difficult to tell which float from which nation will be deployed at way-point X. This depends on the ordering of storage on board e.g. Also, the reality of operations at sea often requires making last minute decisions to deploy a float at another place than expected. There is willingness to apply for MSR on such cruises, to cover large gaps in EEZs (e.g. Pacific ocean), but how can we proceed in practice to facilitate procurement of the clearances in time for ten Coastal States? For some coastal states it is feasible but for some others it is more difficult.

In the case where our partners are from the private sector, or civil society, we rarely have the lead time to organize these opportunistic deployments and apply for MSR clearances at least 6 months in advance.

When we ask skippers to deploy floats during their race, it is rather hard to plan a specific location in advance as their track will vary according to weather and starting racing choices. We generally ask them to deploy floats south of a specific latitude, or from a given date or after rounding one of the three capes, trying to avoid any EEZ.

Overall the EEZ issue is adding another complexity making operators deciding e.g. to deploy just outside the EEZ. This does not make any sense when we are trying to monitor ocean processes that

are transboundary. One could trivially summarize all this as the “EEZ chilling effect”. Eventually, this is 30% of the world's oceans facing the risk of poor Argo coverage. Quantitatively the number of floats deployed in EEZ is stable (about 30% as required), but qualitatively large EEZ areas and marginal seas remain uncovered (see annexe 3).

Consequently, as the profiling float technology has been improved to operate in coastal areas (see Euro-Argo-RISE deliverable D6.8 “Recommendations to operate shallow coastal float in European Marginal Seas”) and deployment practices are diversifying due to increasing optimization needs, it appears that supporting the community in fulfilling legal requirements to deploy floats in EEZ is becoming more and more strategic for the program.

5.2 Ownership

In practice, every profiling float holds a national flag. This flag is clarified through the OceanOPS metadata and tracking system. This reference is important for the monitoring and reporting of Argo national commitments and identifying the contact points as appropriate for communications. For data users, float ownership has no meaning and users just want data of optimal quality, coverage, and timeliness.

For EEZ issues, these flags are one of the reasons for our difficulties.

Some floats have EU flags, as purchased, and operated through the EuroArgo ERIC office, and some can hold a United Nations flag. Several initiatives will soon enable the purchase of profiling floats and other instruments through the World Meteorological Organization. (Similar initiatives occurred with IOC in the past). OceanOPS will operate them for and with Members.

There will likely be more of these “international” units in the future. In such cases EEZ issues must be managed by the coordinating offices, EuroArgo ERIC or WMO-IOC/OceanOPS e.g. This can be a solution space for facilitating EEZ issues management. All Argo floats could be considered the same for notifications and clearance regimes and handled by a central office such as OceanOPS. This would be much more efficient and robust, to the benefit of coastal states and implementers.

5.3 Other observing networks

We should also note that the historical programmes of WMO providing weather and ocean data from merchant ships, or surface drifters or even from planes and radiosonde balloons are preserved from any MSR clearances processes. Why would a temperature and salinity measurement from an Argo float be more sensitive than the same observation made by a drifter, a ship or even a satellite? Solid arguments to unconstrain Argo program against certain rules exist.

5.4 WMO & IOC

While the WMO has recently completed its reform and placed the Earth Monitoring System approach at the center of its activities, it has consequently put the ocean higher on its agenda, conscious that services its Members provide need ocean data. The famous quote from C. McLean (NOAA) summarizes this well: *“if you like your 7 day weather forecast, thank an oceanographer”*.

Raising the profile and value of the Argo program (and its future vision “OneArgo”) to WMO Members is a critical action to perform in the next few years. Many more Members would be supportive of Argo and facilitate its implementation if only they were informed of the challenges and benefits. When we think that some Small Islands Developing States, or “Large ocean states” (as 99% of their territory is ocean) would like more observing systems in their waters, and that Argo implementers avoid deploying in their EEZ, we have a clear opportunity to resolve two challenges together.

In this context, the recent WMO Unified Data Policy¹⁷ represents a major decision taken by the WMO Members to enrich the international background of climate reports, safety frameworks, and overall responsibilities for Members to facilitate observations and data sharing:

(...)

(1) Members shall provide on a free and unrestricted basis the core data that are necessary for the provision of services in support of the protection of life and property and for the well-being of all nations, at a minimum those data described in Annex 1 [note that annex 1 include ocean temperature and salinity] to the present resolution, which are required to monitor and predict seamlessly and accurately weather, climate, water and related environmental conditions;
(2) Members should also provide the recommended data that are required to support Earth system monitoring and prediction activities at the global, regional and national levels and to further assist other Members with the provision of weather, climate, water and related environmental services in their States and Territories. Conditions may be placed on the use of recommended data; (...)

For weather, climate and ocean, Argo data matches the “core” data of the WMO Unified data policy for temperature and salinity and the “recommended” data for biogeochemistry and biology. One could think then that some of the past decisions on the Argo guidelines at IOC/UNESCO on the possibility of data sequestration by coastal states becomes obsolete or at least asymmetrical.

That said, the new WMO approach offers certainly some potential to gain further support from Members for an operational implementation of this critical infrastructure, regarding cooperation, data and metadata management, operations and of course law of the sea. Since the WMO reform, OceanOPS is fully part of the organization, within the Infrastructure Department and Earth System Monitoring division, and will work with the secretariat and Members to progress on these issues. It will keep working with IOC/UNESCO as well, leading this international effort, as it did in the past through its involvement in the works of the Advisory Body of Experts on the Law of the Sea, and through the information and reports it provides to Members and Member States on the status of the Argo network.

These international organizations have some regional offices that offer some additional space for discussion and opportunities for improvements. Indeed, they could be key resources to propose some regional pilot (in the context of art. 247 or not) and facilitate EEZ access for the region they represent.

Some of the recommendations and solution spaces summarized in the next section of this report were already discussed during the workshop on Ocean Observations in Areas under National Jurisdiction held in February 2020 at IOC/UNESCO¹⁸.

This report was finally submitted to IOC/UNESCO Members at its June 2022 session¹⁹. Unfortunately, some of the recommendations identified in the expert workshop (e.g. art 247.) didn't trigger any appetite for Members to do some piloting for any operational progress, but rather requested the Members to further feedback on their experience. The Argo community is willing to continue the work on those recommendations to trigger some piloting experiments.

¹⁷ https://library.wmo.int/doc_num.php?explnum_id=11256

¹⁸ https://www.goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=26607

¹⁹ <https://oceanexpert.org/document/30583>



Another important work is being carried out in the context of the EuroSea project²⁰ which is assembling feedback and suggestions to facilitate ocean observations in EEZ and thinking on the future regulation of ocean observations in the European Union (see D1.7²¹).

²⁰ <https://eurosea.eu/deliverables/>

²¹ <https://eurosea.eu/deliverables/>

6 Actions and recommendations

We can note and summarize a few technical challenges and opportunities identified in this report, as well as itemize some actions and recommendations:

- The lack of clear contact points, standardized forms, and national “MSR clearance offices” in every coastal state
- The timing: a delay of six months to obtain a clearance is too long to be added in the current workflow of cruise and deployment plans
- The management of multinational deployments cruises
- A more “international management” of floats with regard to law of the sea issues building on the capabilities and services of OceanOPS
- Continuous participation to the work of IOC/UNESCO, WMO, GOOS to make progress on these issues
- Value demonstration of the Argo program to WMO Members and IOC/UNESCO Member States
- Improved cooperation with IOC and WMO regional offices
- A close cooperation with EuroArgo ERIC office (OceanOPS and Euro Argo office are in the same building)

Action 1: Gather feedback on this Euro-Argo RISE report with a wider community and exchange with EuroSea and further partners and experts.

Action 2: Review the list of Argo (and GOOS) national focal points with IOC/UNESCO so that we can have a communication channel for all coastal states, in particular for EU Members.

Action 3: Keep working with European bodies (EOOS, EuroGOOS, EuroArgo) to improve the tools and services delivered by OceanOPS and adapt them to European priorities.

Action 4: Contribute to the 2023 IOC Assembly, gathering Argo issues and challenges (this report should be useful).

Action 5: Introduce this report, the challenges identified and recommendations to the appropriate European forum. EuroArgo can help to identify the right forums and opportunities.

Action 6: Keep communicating on the value of Argo applications to WMO, IOC/UNESCO and EU Members, on the growing use of Argo data in coupled ocean-atmosphere models.

Recommendation 1: Euro-Argo to work with all its members and EuroGOOS/EOOS members to seek a global concurrence for Argo floats deployments following up on the United Kingdom or USA examples allowing deployment in their EEZ without MSR.

Recommendation 2: EuroArgo to work with Portugal to find a solution for the persistent gap in the Azores region. The South Mediterranean Sea, East Black Sea are also important targets.

Recommendation 3: Pilot a regional implementation for art. 247 with support from an international organization, and/or its regional offices. (e.g. EuroArgo consolidated deployment planning in a region which needs coverage improvement, such as in the Caribbean region)

Recommendation 4: Encourage the harmonization of MSR clearance requests amongst EU members (e.g. standard forms, web-based submissions), shortening the 6-month delay, and use OceanOPS as a tool to facilitate this.

Recommendation 5: Pilot MSR requests of international floats: truly European floats operated by Euro-Argo office, or floats funded through the WMO or private sector and operated by OceanOPS.

Recommendation 6: invite European profiling float operators, if any, to join the Euro-Argo effort and benefit from its expertise and support services.

7 Annex 1: e-notification exemple

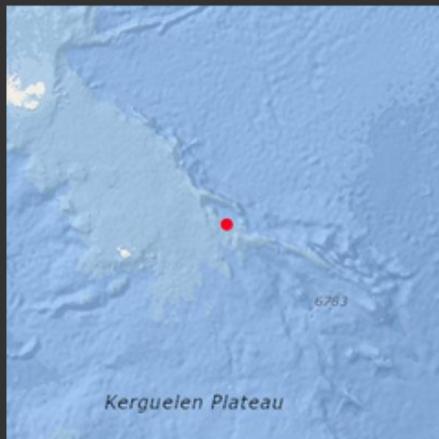
To: argo-notif@jcommgops.org
 Subject: [argo-notif] New Argo Deployment Notification (AUSTRALIA - Argo AUSTRALIA) 5905510

New Argo Float Deployment Notification, according to the IOC Resolution XX-6:
https://www.ocean-ops.org/share/Argo/Doc/IOC_Resolution_XX-6.pdf

Notification Date: 2022-04-25T13:10:00+0000
 Country: Australia
 Program: Argo AUSTRALIA
 Contact:

- Lovell, Jenny (jenny.lovell@csiro.au)
- Semolini Pilo, Gabriela (gabriela.semolinipilo@csiro.au)
- Oke, Peter (peter.oke@csiro.au)
- Hanstein, Craig (craig.hanstein@csiro.au)
- Schallenberg, Christina (sch557@csiro.au)

Reference:	5905510
WMO-GTS ID:	5905510
Telecom:	1331
Telecom. type:	IRIDIUM
Internal ID:	
Serial number:	1331
Deployment Date:	2022-04-12T14:44:00+0000
Lat:	-52.1600
Lon:	77.3100
Score:	0.00
Warning: location not within High Seas and some zones are conflictual	
Model:	NAVIS_EBR
Cycle (hours):	262.8500
Drifting pressure (dbar):	1000.0000
Profiling pressure (dbar):	2000.0000
Sensors:	CTD_PRES, CTD_CNDC, CTD_TEMP
Ice Detection Software:	No
Ship:	AURORA AUSTRALIS (09AR)



10°10-degree box centered around the deployment position.

Color code by score: red (score = 0); orange (0 < score ≤ 0.25); yellow (0.25 < score ≤ 0.5); green (0.5 < score ≤ 0.75); dark green (0.75 < score ≤ 1)

Check platform position from the interactive map: <https://www.ocean-ops.org/board/wa/InspectPtfModule?ref=5905510>

Printable report available here: <https://www.ocean-ops.org/board/wa/PDFReport?ref=5905510>

For more information please contact the Argo Information Centre (support@ocean-ops.org), in charge of the implementation and maintenance of this intergovernmental procedure.

This message is sent to all Argo National Focal Points, and its content is under the responsibility of the Argo programme above.

8 Annex 2: EEZ warning system and report

Example of automated report when float approaching EEZ.

Argo Information Centre

Maritime Zones Monitoring System

Report Date :
19/08/2022 - 08:00 GMT

Implementing State :
Italy

Coastal State :
ARGENTINA

The depiction and use of boundaries, geographic names and related data shown on maps and included in lists, tables, documents and databases in this report are not warranted to be error free nor do they imply official endorsement or acceptance by the Intergovernmental Oceanographic Commission of UNESCO.

AIC version 2.0

Floats approaching maritime zones ($\Delta = 100$ nautical miles)

WMO Identifier	Notification Date	Launch Date	Launch Latitude	Launch Longitude	Latest Position Date	Latest Position Latitude	Latest Position Longitude	Argo Program	Float Model	Sensors	Track
6901815	2018-07-20	2013-01-15	-60.0	175.0	2019-03-12	-47.32	-13.39	Argo ITALY	ARVOR	PRES, TEMP, CNDC	GIS KML
6903255	2022-08-19	2019-02-28	-63.98	0.1	2022-04-15	-67.168	-27.461	Argo ITALY	ARVOR	PRES, TEMP, CNDC	GIS KML
6903232	2022-08-19	2018-02-25	-56.98	153.44	2022-08-15	-61.681	-75.109	Argo ITALY	ARVOR	PRES, TEMP, CNDC	GIS KML
6903254	2022-08-19	2019-02-09	-57.0013	168.1839	2022-08-14	-54.268	-43.328	Argo ITALY	ARVOR	PRES, TEMP, CNDC	GIS KML
6903213	2022-08-19	2017-01-03	-61.03	177.26	2022-08-07	-58.373	-65.216	Argo ITALY	ARVOR		GIS KML
6901814	2018-08-10	2013-01-15	-61.5	175.0	2019-06-30	-39.328	-40.184	Argo ITALY	ARVOR	PRES, TEMP, CNDC	GIS KML
6903183	2020-04-03	2016-01-17	-51.98	173.18	2022-06-06	-54.172	40.997	Argo ITALY	NOVA	PRES, OPTODE_DOXY, TEMP, CNDC	GIS KML
6901841	2020-12-18	2015-01-03	-53.001	163.0473	2021-04-03	-54.335	-48.645	Argo ITALY	ARVOR	PRES, TEMP, CNDC	GIS KML
6901840	2021-06-11	2015-01-03	-55.0	162.8546	2021-05-13	-45.07	-58.697	Argo ITALY	ARVOR	PRES, TEMP, CNDC	GIS KML
6903182	2021-07-30	2016-01-18	-53.0	173.17	2022-08-14	-46.062	-6.633	Argo ITALY	NOVA	PRES, TEMP, CNDC	GIS KML

Use the links to the Argo Information Centre website in the tables for more information about the float, the program and the contacts points. Track Points and Line are both available in KML files.

AIC version 2.0

Legend

PRES	CTD_PRES	CTD Pressure Sensor
CNDC	CTD_CNDC	CTD Conductivity Sensor
TEMP	CTD_TEMP	CTD Temperature Sensor
OPTODE_DOXY	DOXY_OPTODE	Dissolved Oxygen OPTODE Sensor

References

[IOC Resolution XX-6](#)

[IOC Resolution XLI-4](#)

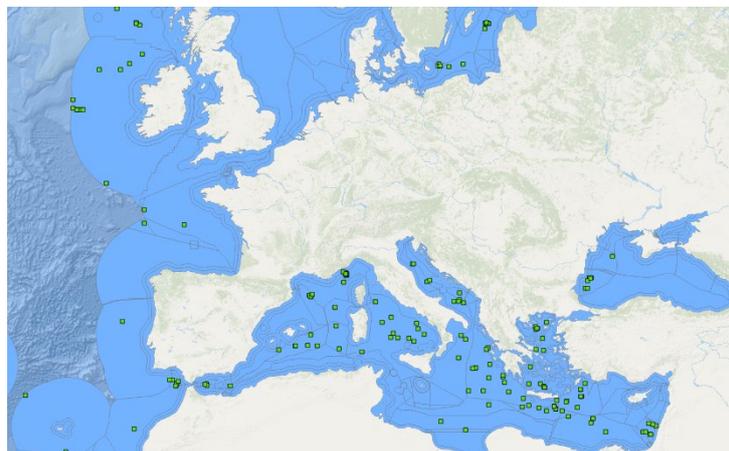
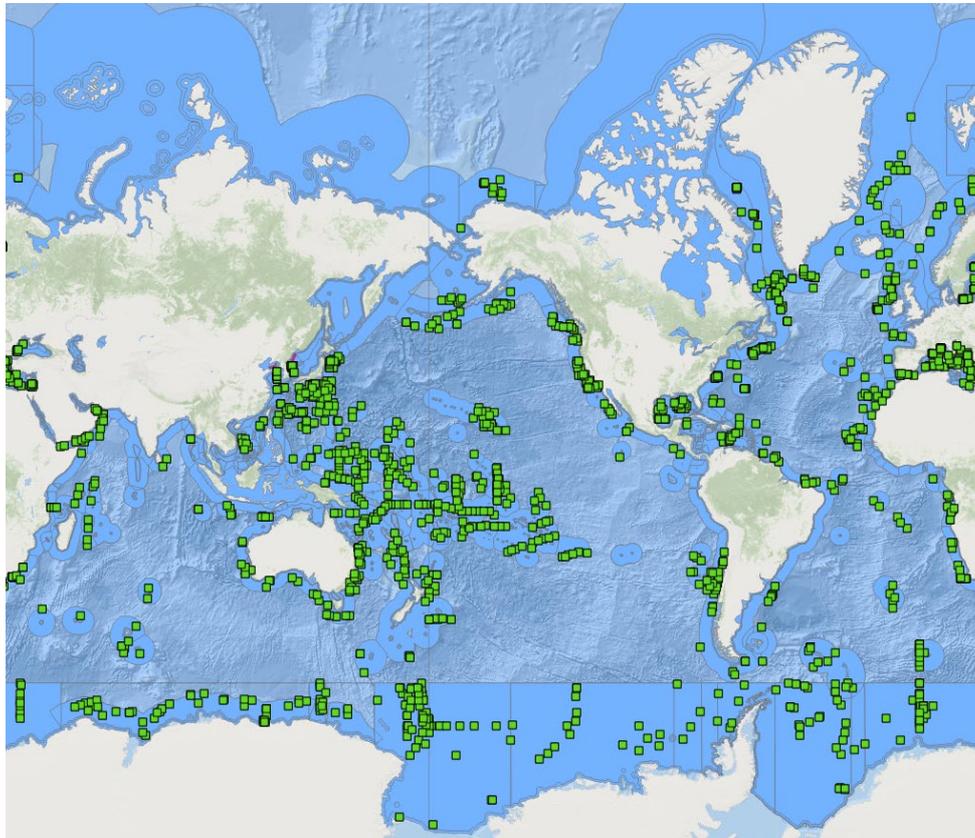
AIC version 2.0

Contacts

PROGRAM	NAME	ADDRESS	EMAIL	TEL	FAX
Argo ITALY	Poulain, Pierre-Marie	Mobile Autonomous Oceanographic Systems (MAOS) Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) Borgo Grotta Gigante, 42/c 34010 Sgonico (Trieste) Italy	ppoulain@inogs.it	+39 040 2140322	+39 0402140266
Argo ITALY	Pacciaroni, Massimo	OGS - Trieste - Italy	mpacciaroni@inogs.it	+39 040 2140 217	
Argo ITALY	CANCOUËT , Romain		romain.cancouet@euro-argo.eu	(+33) 2 29 00 85 48	

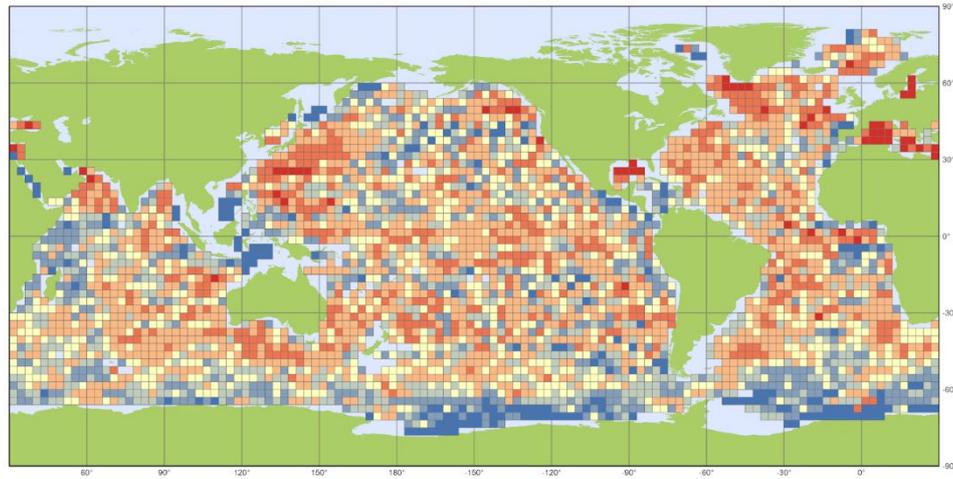
AIC version 2.0

9 Annex 3: Status of Argo deployment in EEZ



Argo deployment locations into EEZs from 2017 to 2021, and zoom on European region

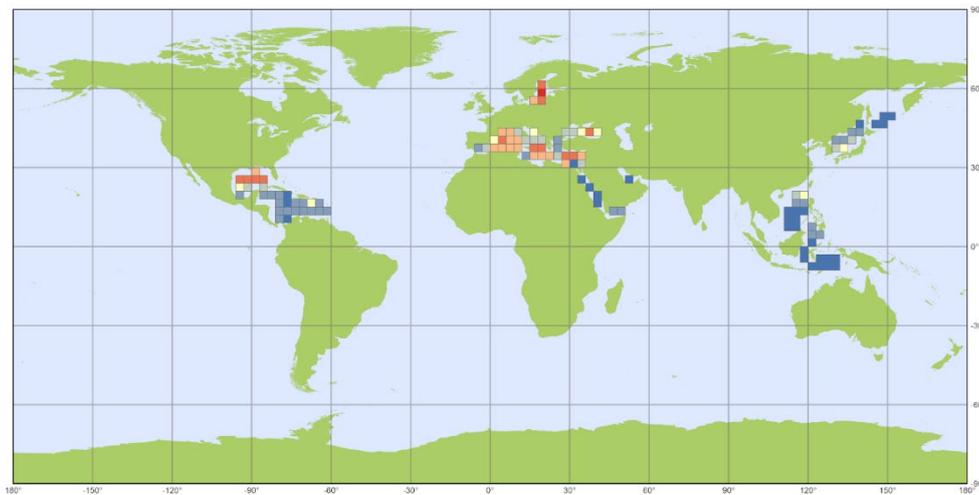
Large areas in EEZ in Europe (e.g. Azores, Norway, Portugal) and beyond (e.g. South America, Central America, Africa, North East Arabian Sea, Russian Seas) are weakly covered by Argo deployments.



Argo Yearly Coverage 2021
Average of monthly observations distributed at GDACs over calendar year

0.00 (209)	1.01 - 2.00 (587)	3.01 - 6.00 (1191)	> 15 (58)
0.01 - 1.00 (476)	2.01 - 3.00 (641)	6.01 - 15.00 (481)	

Generated by ocean-ops.org, 2022-03-04
Projection: Plate Carree (-150,0000)

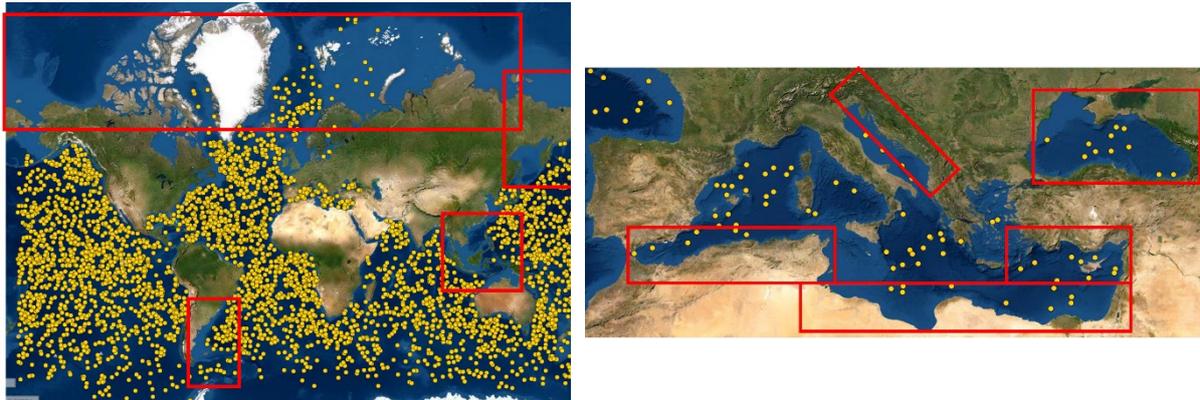


Argo Yearly Coverage - Marginal Seas 2021
Average of monthly observations distributed at GDACs over calendar year

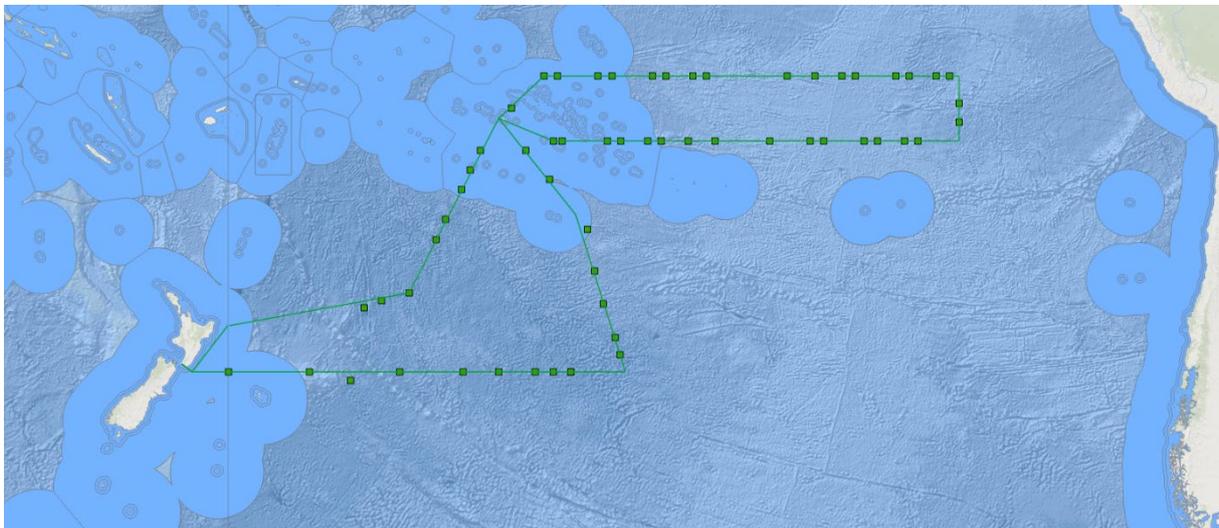
0.00 (31)	4.01 - 8.00 (14)	12.01 - 24.00 (15)	60.01 - 1000.00 (1)
0.01 - 4.00 (31)	8.01 - 12.00 (8)	24.01 - 60.00 (13)	

Generated by ocean-ops.org, 2022-03-04
Projection: Plate Carree

Argo 2021 time/space data coverage, with a zoom on marginal seas where density is to be doubled. These maps show the average number of monthly observations in 3x3 degrees boxes. Many EEZ are in blue, traducing the low observing intensity of Argo in these regions.



Some challenging areas identified by EuroArgo office



Karahoa cruise deployment plan and EEZ - December 2022.

The Kaharua charter cruise is deploying Argo floats from multiple countries (US, Australia, New Zealand) mostly in the High Seas apart from New Zealand (1 float) and French Polynesia EEZ (16 floats). Other EEZ in the region are not visited by the cruise.



2021-22 BlueObserver IRIS cruise, chartered by USA, Canada and EuroArgo

About 100 units were deployed in the Atlantic Ocean. This cruise could have filled up the persistent gaps in the Azores, Brazilian or west African coast EEZs, but the lack of time and pathway for MSR clearance resulted in deployment in high seas only, except for UK/St Helena EEZ which provided a global concurrence.