



Consolidating the European leadership in the implementation of OneArgo

12 June 2025



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Infrastructures and Services

Panel & Agenda

- Charlina Vitcheva, Director General, DG Mare, European Commission
- Alessandra Cacciari, Programme Officer – EU Policies-Copernicus, DG DEFIS, European Commission
- Brian King, Co-Chair of the International Argo Steering Team, National Oceanography Centre, UK
- Karina von Schuckmann, Senior Advisor in Ocean Science for Policy, Mercator Ocean International
- Yann-Hervé De Roeck, Director General, Euro-Argo ERIC (convener)

15:30-15:50 Tour de table, presentation of OneArgo, its usage by CMEMS, its challenges

15:50-16:15 Questions to the panel: how to consolidate the European leadership in the implementation of OneArgo?





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Brian King

Co-Chair, Argo Steering Team





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Argo evolution

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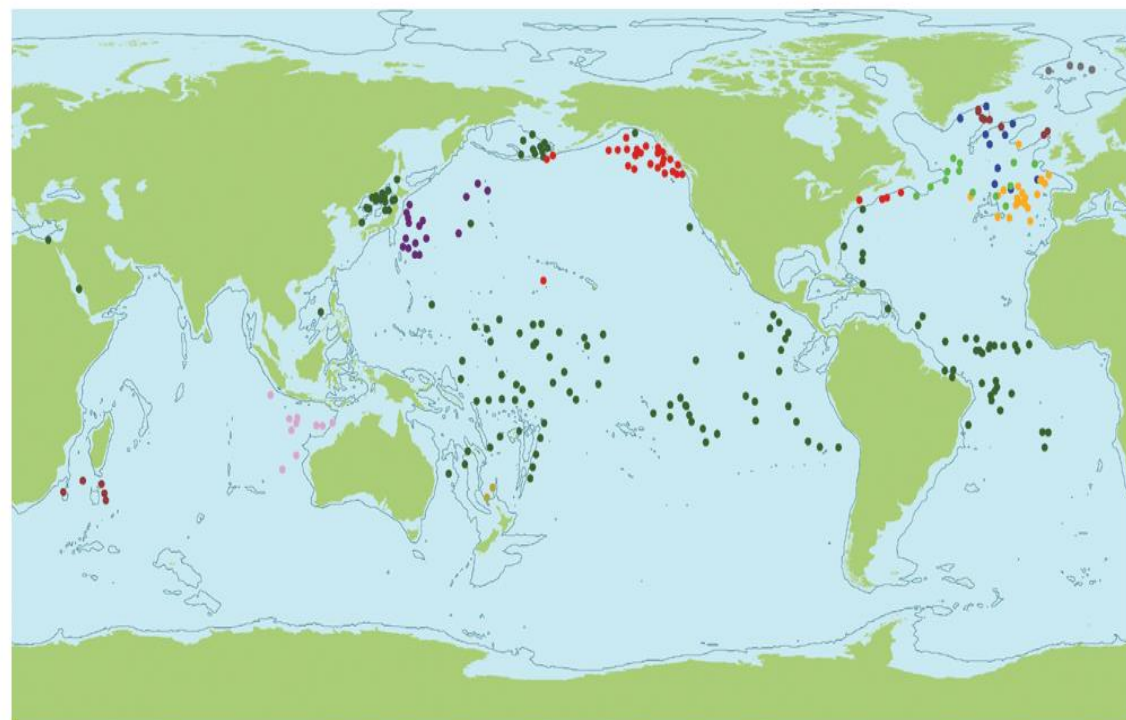


Origin and establishment of Argo, 2000-2010

- Initial design of 3000 floats, what we now call the Core mission: open ocean; deep water; ice-free; upper 2000 metres; temperature and salinity
- One country (USA in 1998) committed to a share, and 8 other countries + EU had followed within a year
- It took time to build up the array – 7 years to reach 3000 floats

2001

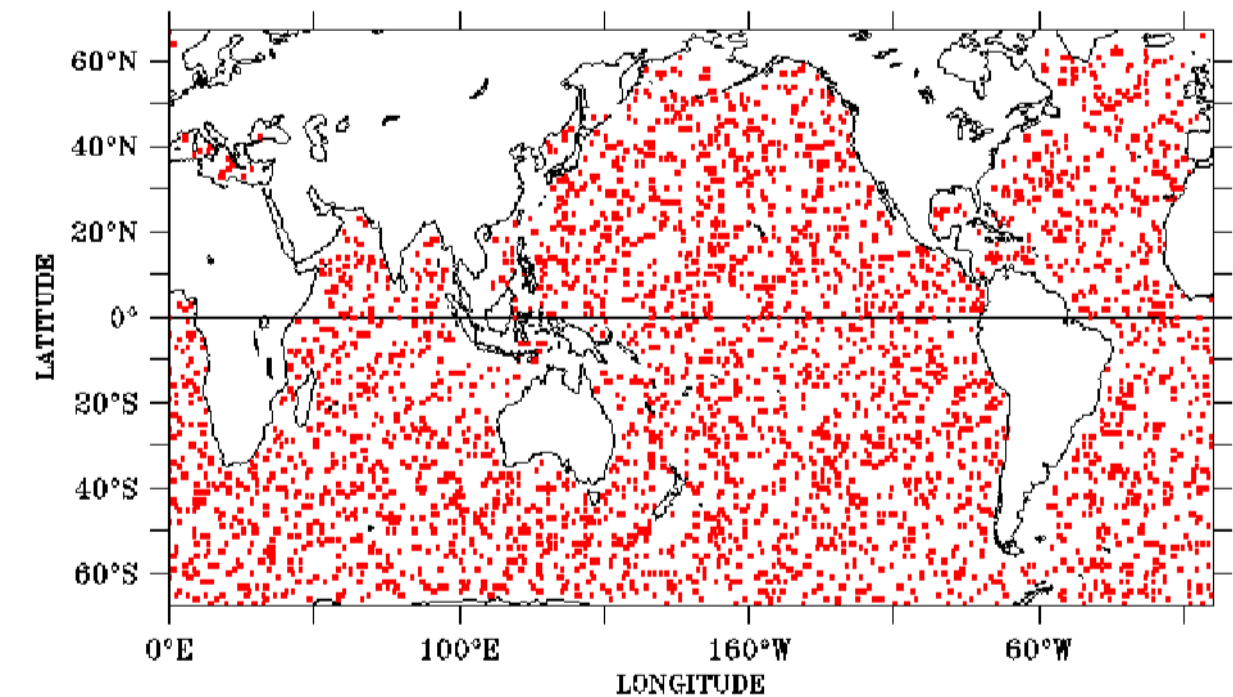
Argo Status as of November 2001 (262 Floats)



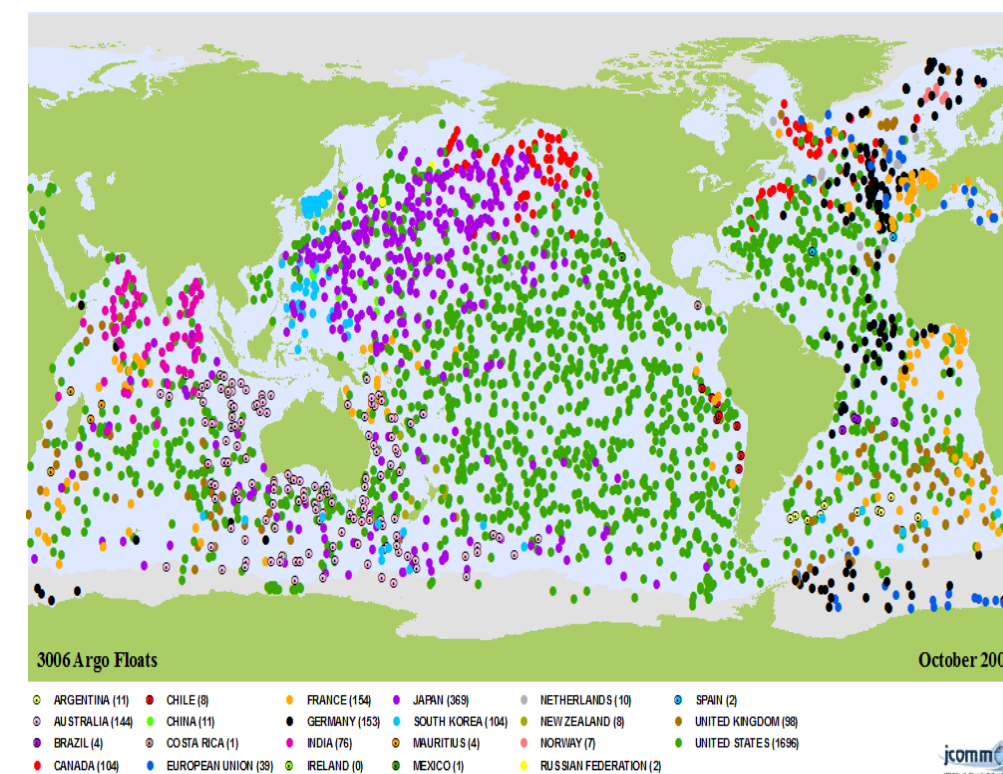
- Australia (10)
- Canada (31)
- Denmark (5)
- European Union (10)
- France (20)
- Germany (13)
- Japan (17)
- New Zealand (2)
- United Kingdom (13)
- United States (141)

— 2000m isobath

Design, 1998



2007





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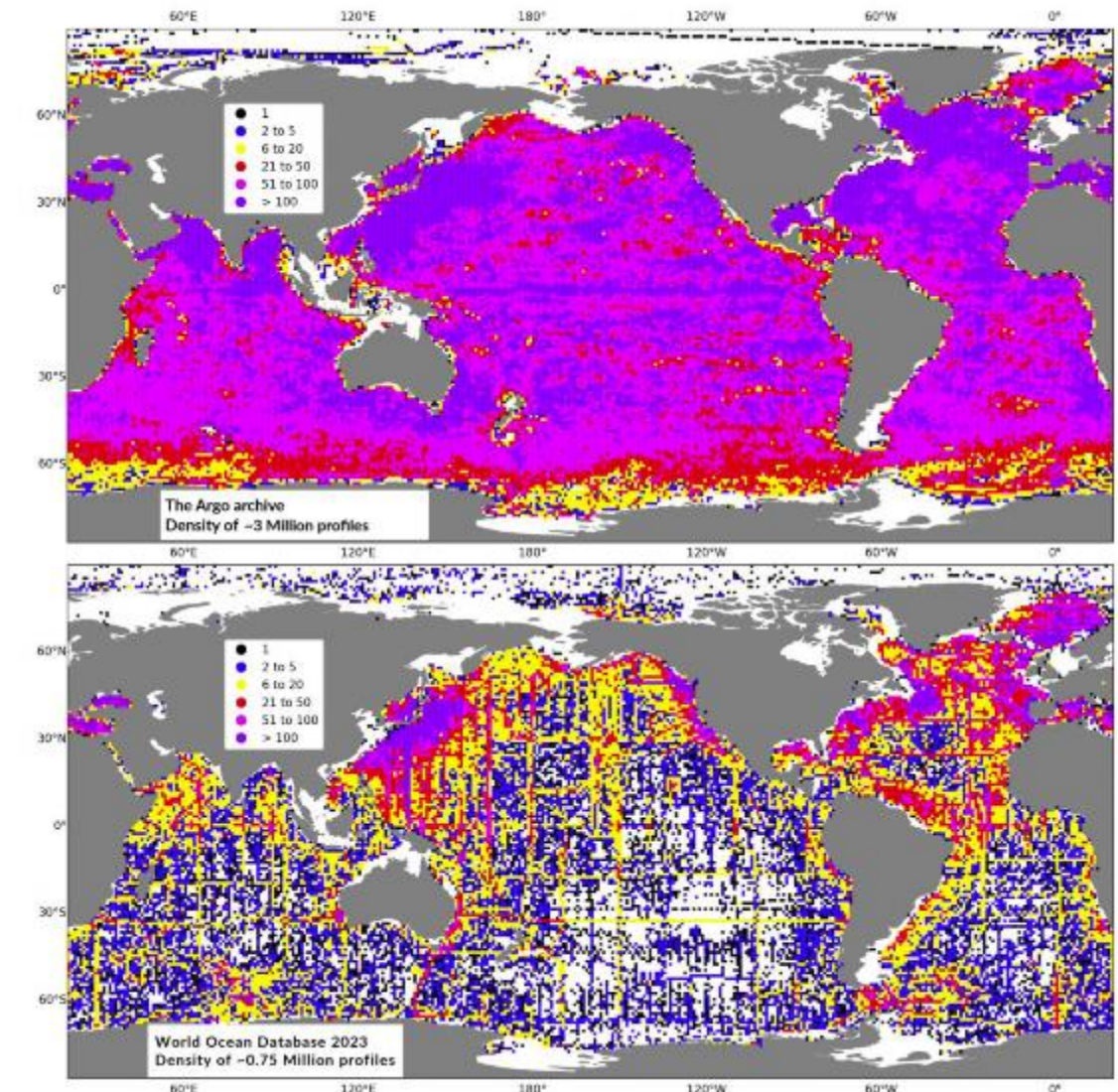
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Achievements from the Core mission

- Real-time data delivery down to 12 hours for NWP
- Overwhelming majority of the subsurface (3-D) ocean data for:
 - Ocean prediction
 - Reduction of uncertainty of the Earth heat budget
- Describing changes to the planetary water cycle
- Transformed the amount of subsurface data for all kinds of research
- Widespread data delivery, freely available from
 - Argo Global Data Assembly Centre (full dataset)
 - Copernicus Marine Service (value-added products)

Argo
25 years



Ships
100 years



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Growth from 2010 to 2020: exploiting and expanding Argo capabilities

- Marginal seas, eg Mediterranean
- Under ice capability developed
- Enhanced tropical sampling, especially Pacific
- BioGeoChemical (BGC) capability developed, new sensors and platforms

Oxygen

Nitrate

pH

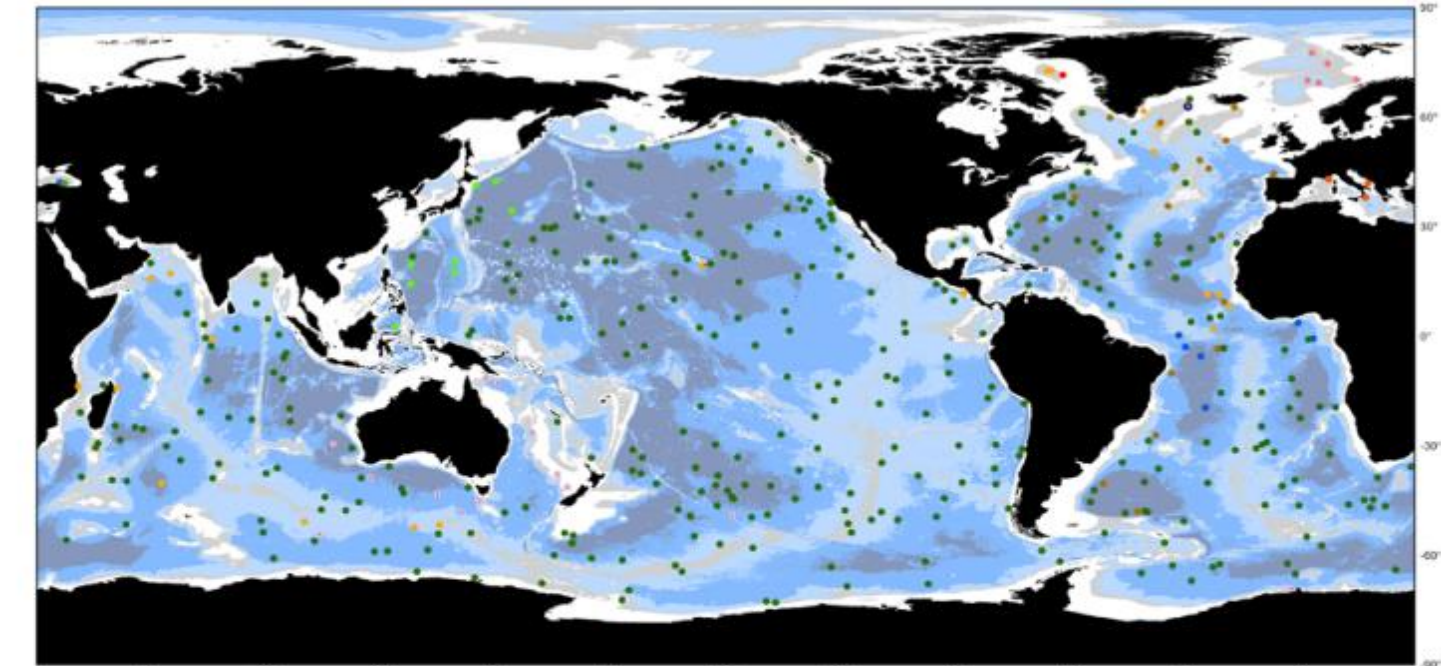
Chlorophyll

Particle backscatter

Solar radiance

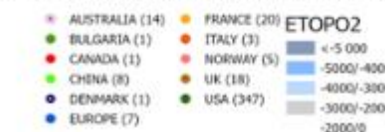
- Deep capability developed (6000 metres), new sensors and platforms

- **Geographical extension and enhanced spatial sampling led to a 4000 float array**

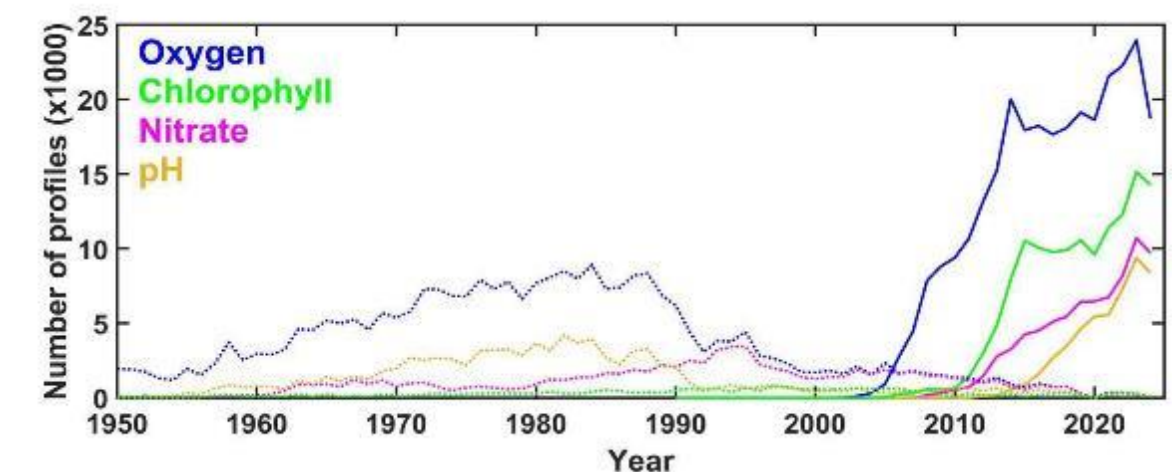


Floats sampling 5 or 6 Argo BGC variables- 425
Latest location of operational floats (data distributed within the last 30 days)

April 2025



Generated by ocean-ops.org, 2025-05-06
Projection: Plate Carree (-150,0000)



Number of BGC profiles per year



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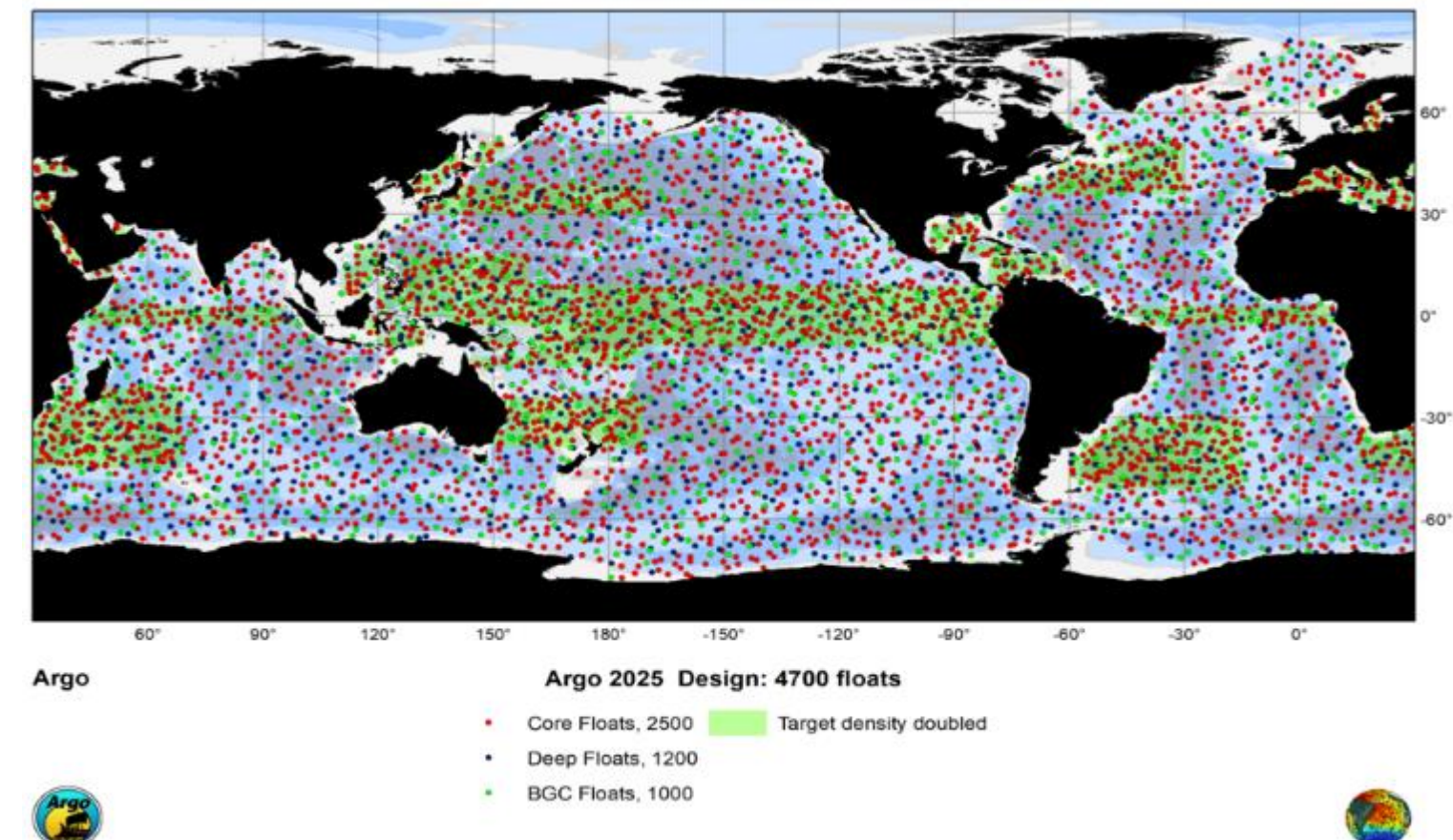
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The OneArgo design, 2020 onwards

- At the OceanObs19 conference, starting the UN Decade, the OneArgo design brought together the newly-published BGC and Deep Missions, and the emerging Polar Mission.
 - Floats delivering the BGC and Deep Missions would also be required to meet the requirements of the Core Mission, for maximum efficiency.
 - Planning and program governance has also been consolidated into single meetings of the Argo Steering Team.
 - Compared with the Core Mission, The OneArgo design includes
 - More under-ice floats, the Polar Mission
 - Enhanced sampling in the tropics
 - Enhanced sampling in highly variable Western Boundary regions
- A total of 4700 floats
- 1000 BGC floats
 - 1250 Deep floats
 - 2450 other Core-only floats





New applications possible with OneArgo

- Full closure of the global **sea level** and **heat budget** - directly observing deep ocean contribution
- Tracking **ocean overturning and ventilation**
- The environmental **context and impacts of Deep Sea Mining**
- Contribution to mapping the sea floor **bathymetry**
- Tracking changes to ocean habitats: **de-oxygenation**, de-nitrification, ocean **acidification**, light levels
- Towards routine **ecosystem monitoring** - phytoplankton forms, biomass and growth.
- Quantification of **ocean carbon cycling and uptake** -both the physical and biological pumps; tracking **large-scale mCDR impacts/efficacy**
- Enable the development of marine ecosystem forecasting systems to support **management of living marine resources/fisheries**
- Tracking the **health of deep Marine Protected Areas**.
- **By the time OneArgo is fully implemented, operational forecast groups will include BGC parameters, and global in situ data will be needed to initialise and evaluate models, just as for physical parameters now**



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Towards implementing OneArgo

- Any group that has commented on OneArgo has eagerly endorsed OneArgo as desirable; notably the G7 Future of Seas and Ocean Working Group has called for it to be implemented by 2030
- At least 12 UN Decade actions expect to utilise OneArgo data to reach their objectives
- The global annual cost of OneArgo will be 100M Euro per year, across all global partners
- Since float lifetimes are 5 years, we need a sustained deployment 20% of the array each year, so there is a minimum of 5 years to ramp up to the full design, once procurements and deployments begin
- The BGC array is about 40% complete so can ramp up quicker
- The Deep array has many basins with no observations, so will take a full 5 years



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The need for OneArgo

In this WMO news brief, I counted 8 references to past results or needed future actions in which Argo is a central, majority or sole source of data

- “It takes place as record ocean heat and acidification harm marine ecosystems and economies, and rising sea levels”
- “Record ocean temperatures and acidification are inflicting severe and long-lasting damage”
- “This is having a tsunami-like impact on sustainable development of the ocean and resulting in billions of dollars of damage to the Blue Economy”
- “To do this, we need scientific cooperation, data exchange and knowledge. Coupled with political will”
- “Ocean observations are an integral part of WMO weather and climate monitoring activities as well as services such as El Niño/La Niña seasonal outlooks”
- “WMO is a co-sponsor of the Global Ocean Observing System hosted by the Intergovernmental Oceanographic Commission of UNESCO. The "eyes" of its thousands of observing platforms feed weather forecasts, early warnings and climate prediction”



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2025 UN Ocean Conference: Turn the Tide

NEWS

09 June 2025

The United Nations Ocean Conference 2025 has opened in Nice with strong calls to accelerate action to protect the ocean from people and to protect people from the ocean. It takes place as record ocean heat and acidification harm marine ecosystems and economies, and rising sea levels and more intense storms threaten coastal communities.



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Karina von Schuckmann

Mercator Ocean international





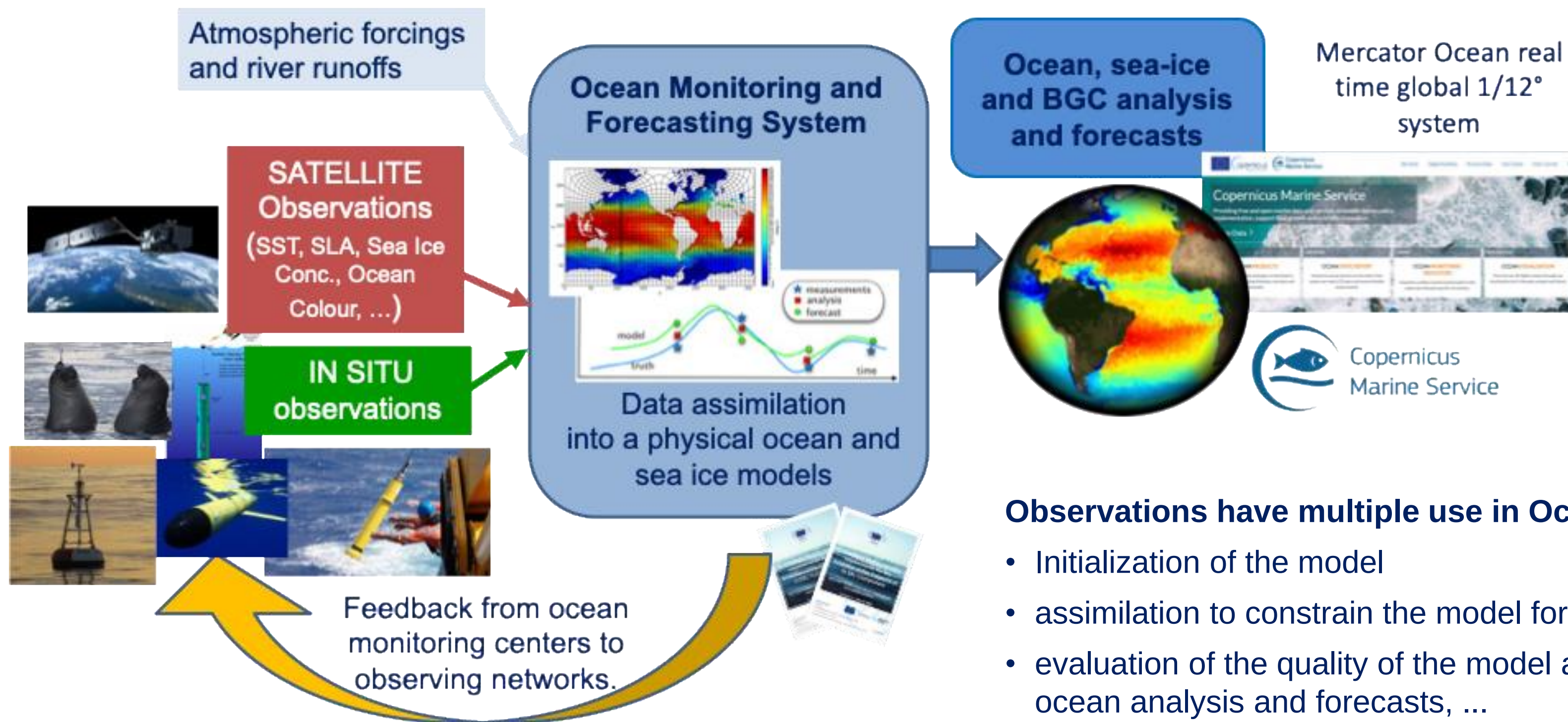
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Argo and Ocean Prediction



A schematic view of an ocean prediction system





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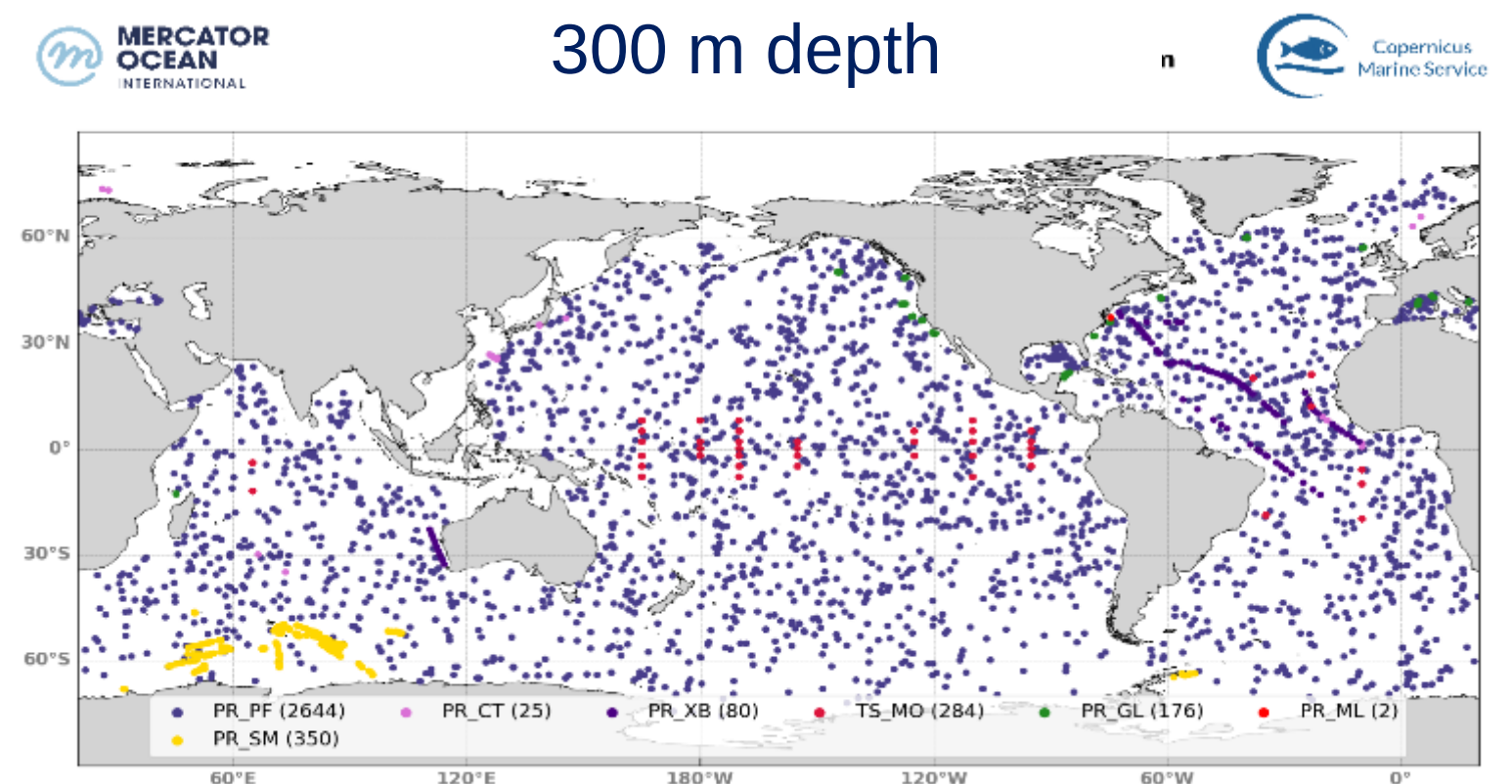
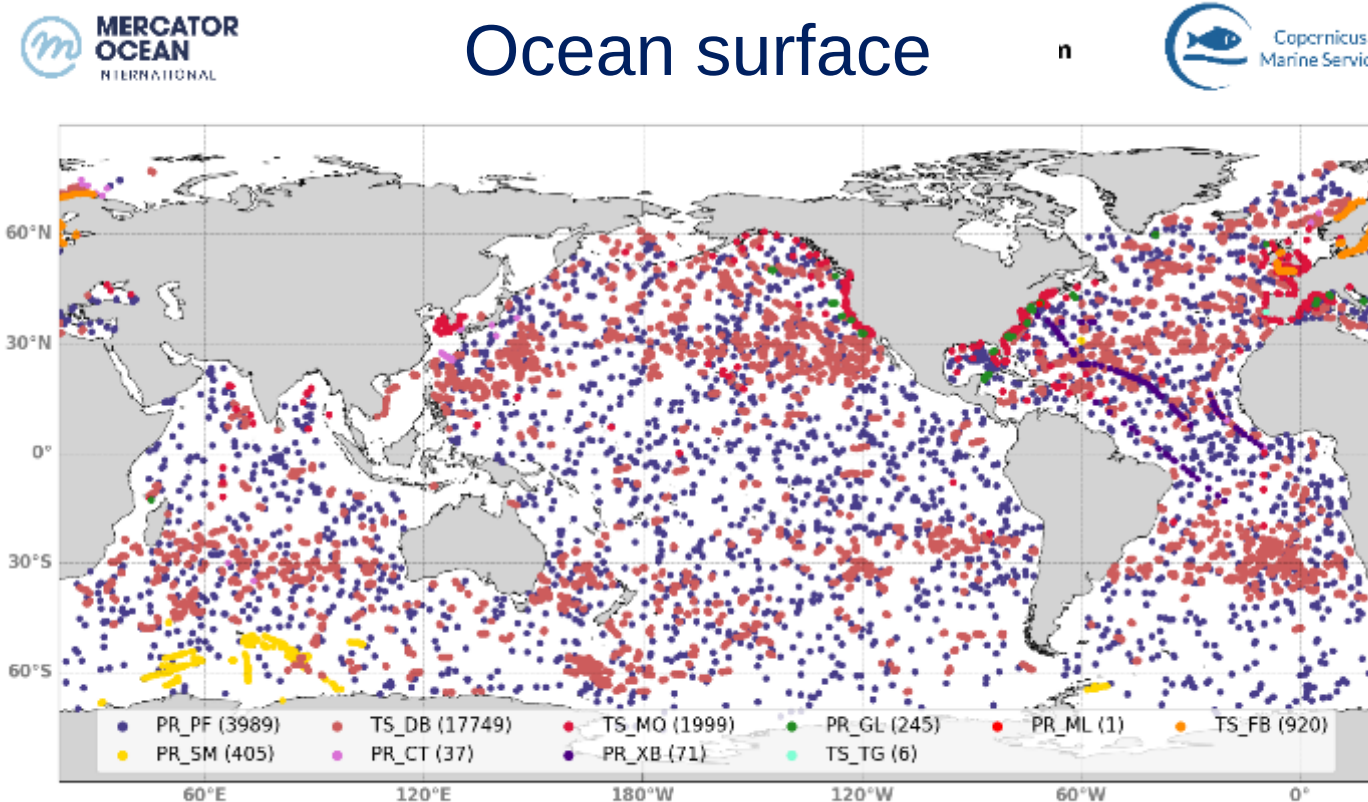
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Argo and Ocean Prediction



Argo: the primary source of 3-D ocean information globally

drifting buoys,
sea mammals,
Argo floats,
moorings,
gliders,
ferry-box, ...



In Situ temperature observations assimilated for a week in 2024 in the global ocean 1/12° system



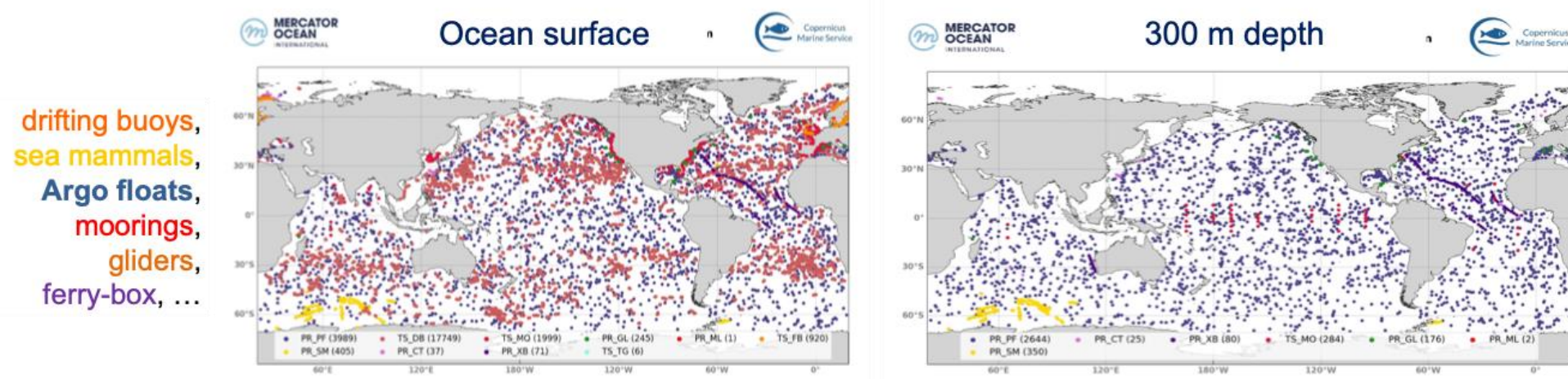
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Argo and Ocean Prediction



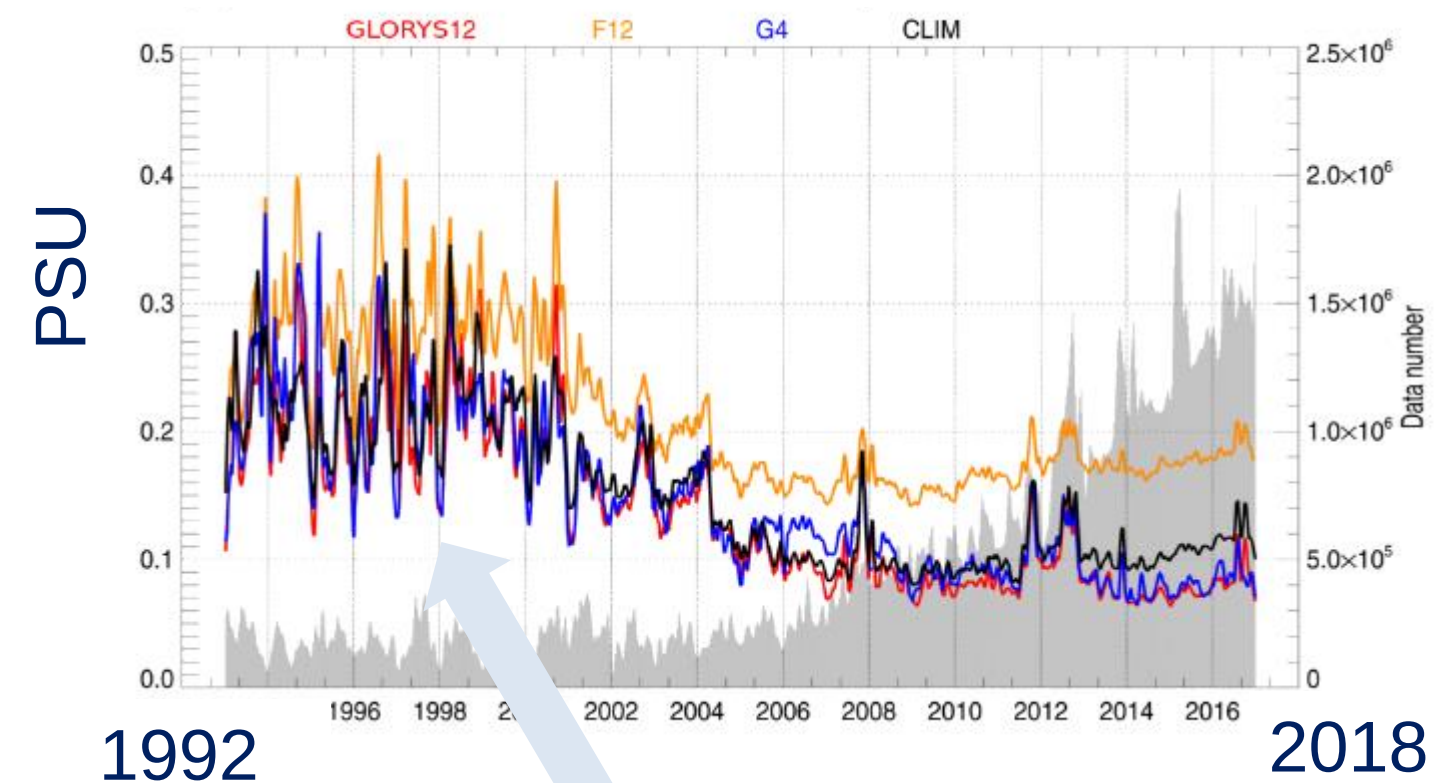
Argo: the primary source of 3-D ocean information globally



In Situ temperature observations assimilated for a week in 2024 in the global ocean 1/12° system

The accuracy of the ocean analysis and forecasts highly rely on the **availability and quality** of the assimilated **observations**.

0-2000m salinity : Models – Observations in RMS



Not enough observation for accurate uncertainty estimates before the Argo era



How the deep OneArgo array will improve the global $\frac{1}{4}^\circ$ ocean (re)analysis?

Below 2000 m depth,
ocean model analysis are
underconstrained and can
show unrealistic deep
trends.

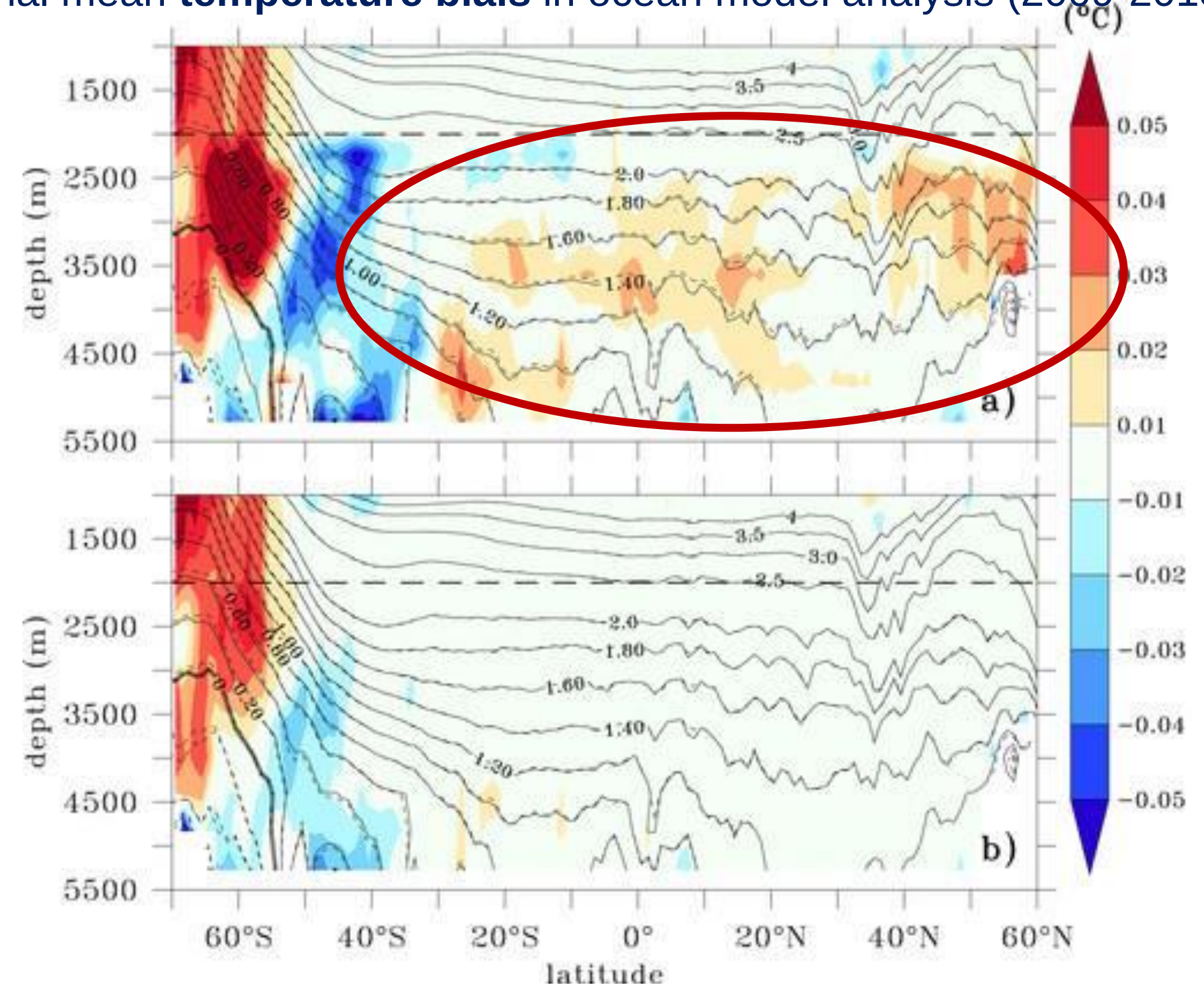


Deep Argo observations
can significantly reduce
analysis and forecast
errors in the deep ocean
when assimilated.

without deep Argo
observations
assimilated

**with planned
deep OneArgo**
observations
assimilated

Zonal mean **temperature biai**s in ocean model analysis (2009-2013)

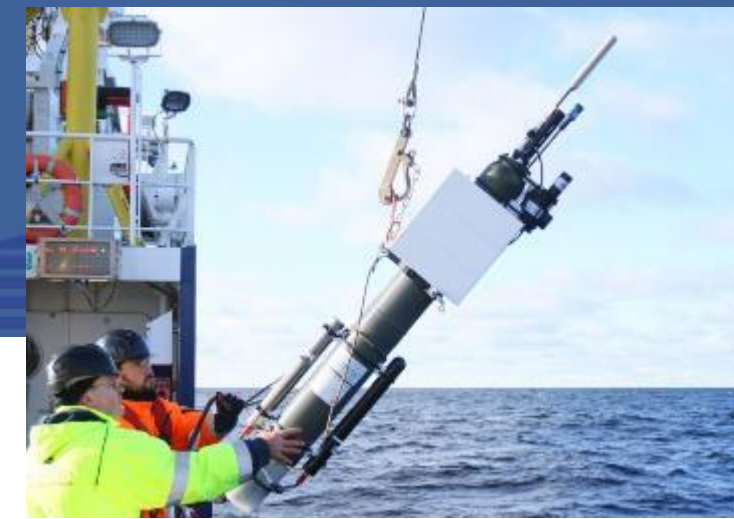




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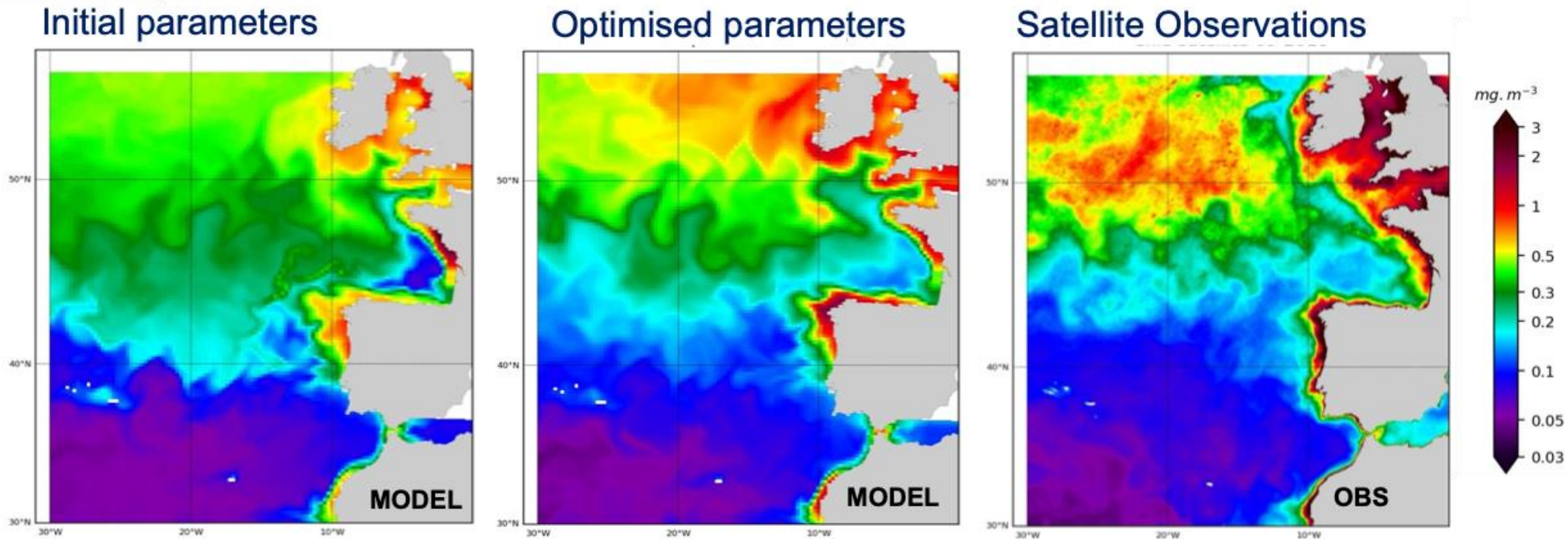
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Argo and Ocean Prediction



Optimization of the BioGeoChemical PISCES model parameters with Argo observations

Chlorophyll-a
- September
2018



Improved representation of the North Atlantic bloom compared to satellite observations with the optimized model parameters:

- Better representation on the South-North Chlorophyll-a gradient
- Reduction of the normalized BIAS by 30 % and the RMSE by 10%.

Q. Hyvernats, in preparation

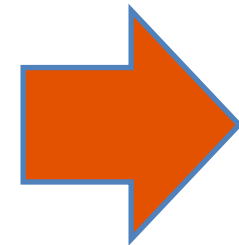
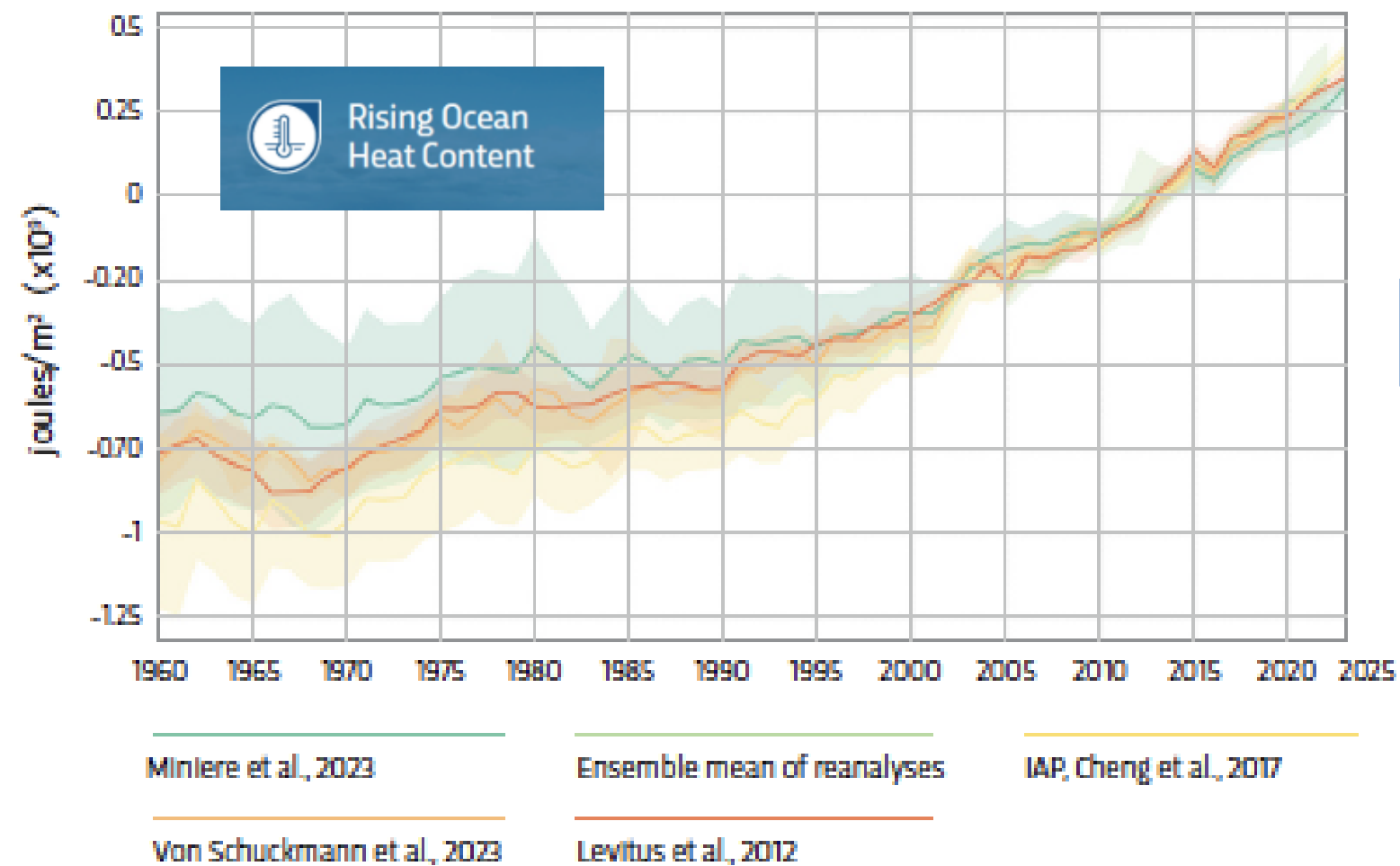


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Argo and Climate Research

When the Ocean is warming we know that the Earth is out of energy balance at the top of the Atmosphere...



EARTH'S ENERGY IS OUT OF BALANCE

Earth's energy imbalance grew by 0.29 watts per square metre per decade between 1993-2022.



Argo provides us the root measure to monitor how much and how fast heat is accumulating in the Earth climate system, determining a measure of planetary warming

Excess Energy Accumulation

Atmosphere

≈ 1%

Ice

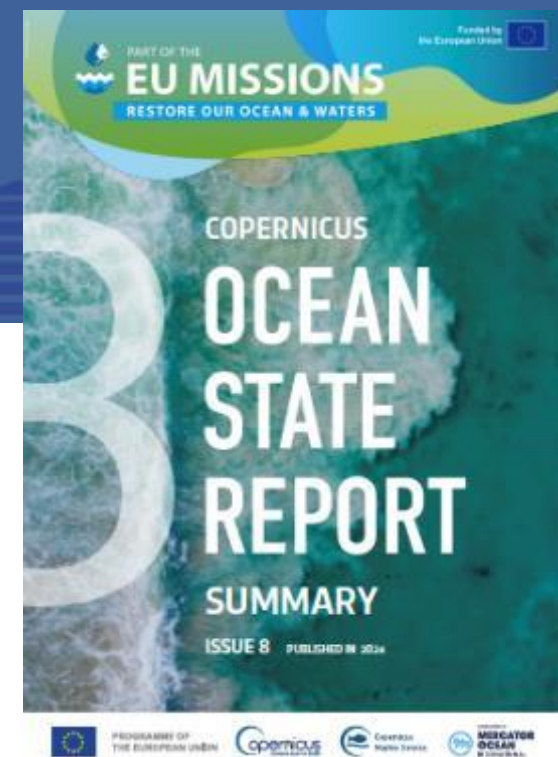
≈ 4%

Land

≈ 5%

Ocean

≈ 90%





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Yann-Hervé De Roeck

Director General
Euro-Argo ERIC





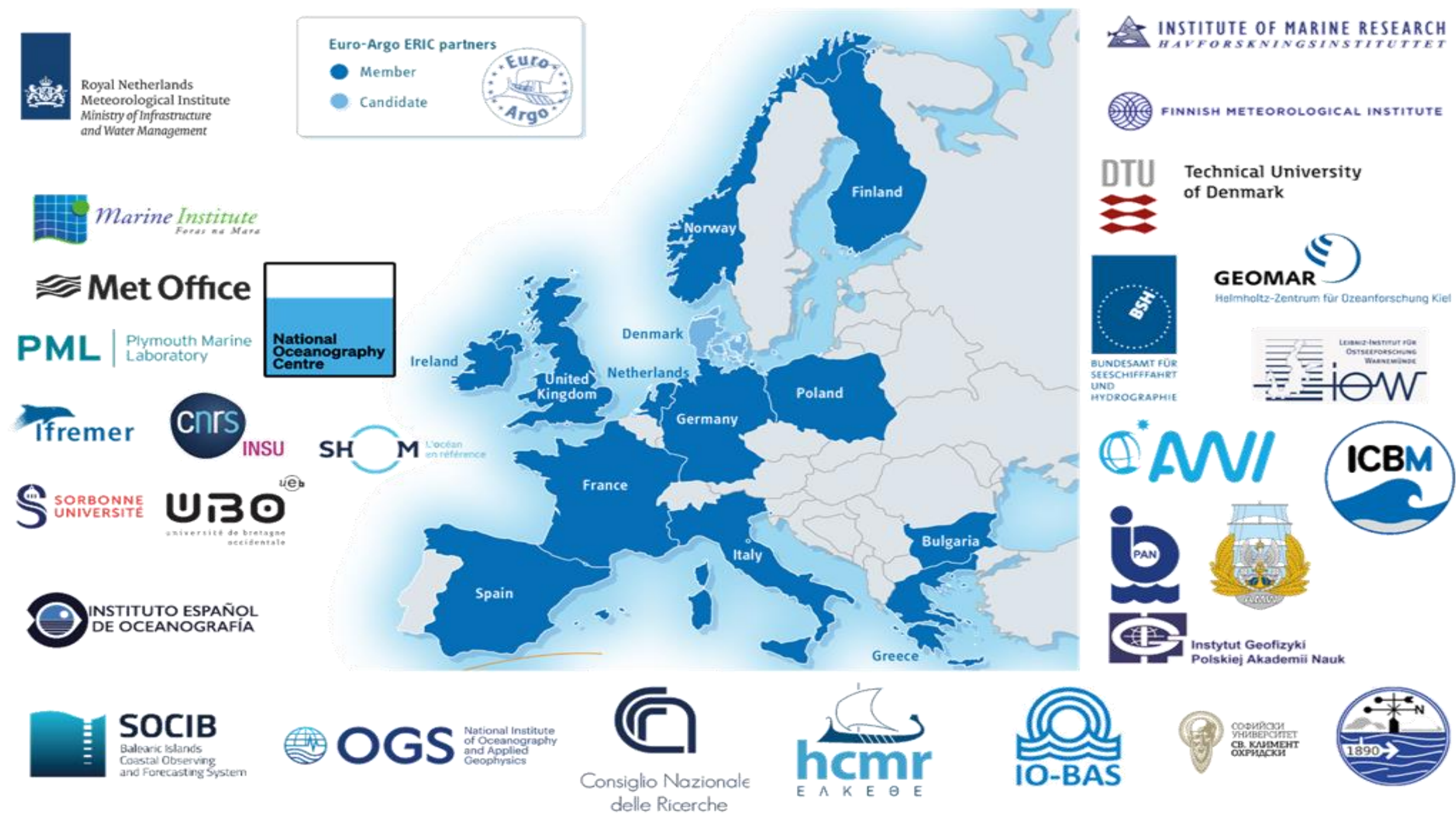
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European contributors to the Argo programme

- The **Euro-Argo European Research Infrastructure Consortium** is composed of **12 countries** and **1 candidate**
- Office hosted by Ifremer (France)
- 30 entities





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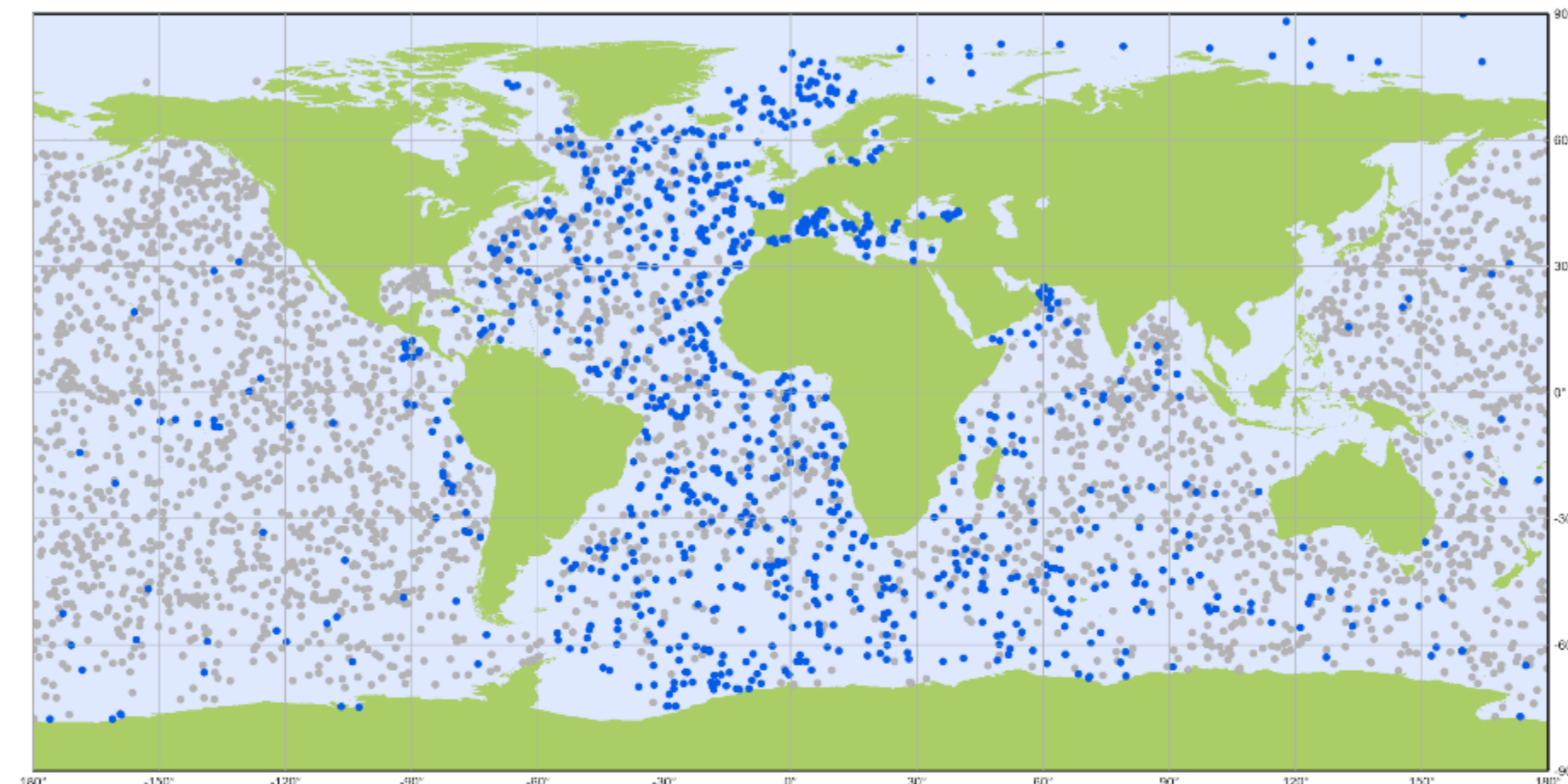
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- Euro-Argo ERIC sustains and optimises the European contribution to the international Argo programme, providing, deploying and operating ~25% of the global fleet so far
- Euro-Argo ERIC able to initiate network upgrades in response to specific European research interests, especially:
 - towards marginal seas and high latitudes
 - biogeochemistry (BGC) variables to study ecosystems
 - greater depths, till the abyss

specific European operational services, especially:

- Copernicus in situ TAC, CMEMS
 - Satellite calibration and validation
 - Regulations: Marine Strategy & Water Framework Directives
- Euro-Argo ERIC develops with other Marine Observation Ris (ICOS, EMSO, EMBRC, ...) common operational tools, bricks of the future EOOS, throughout projects like



Argo

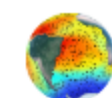
EuroArgo

May 2025

European contribution to the Argo program via EuroArgo Research Infrastructure
Latest locations of operational profiling floats (data distributed within the last 30 days)



• Argo EU (961) • Argo non EU (3183)



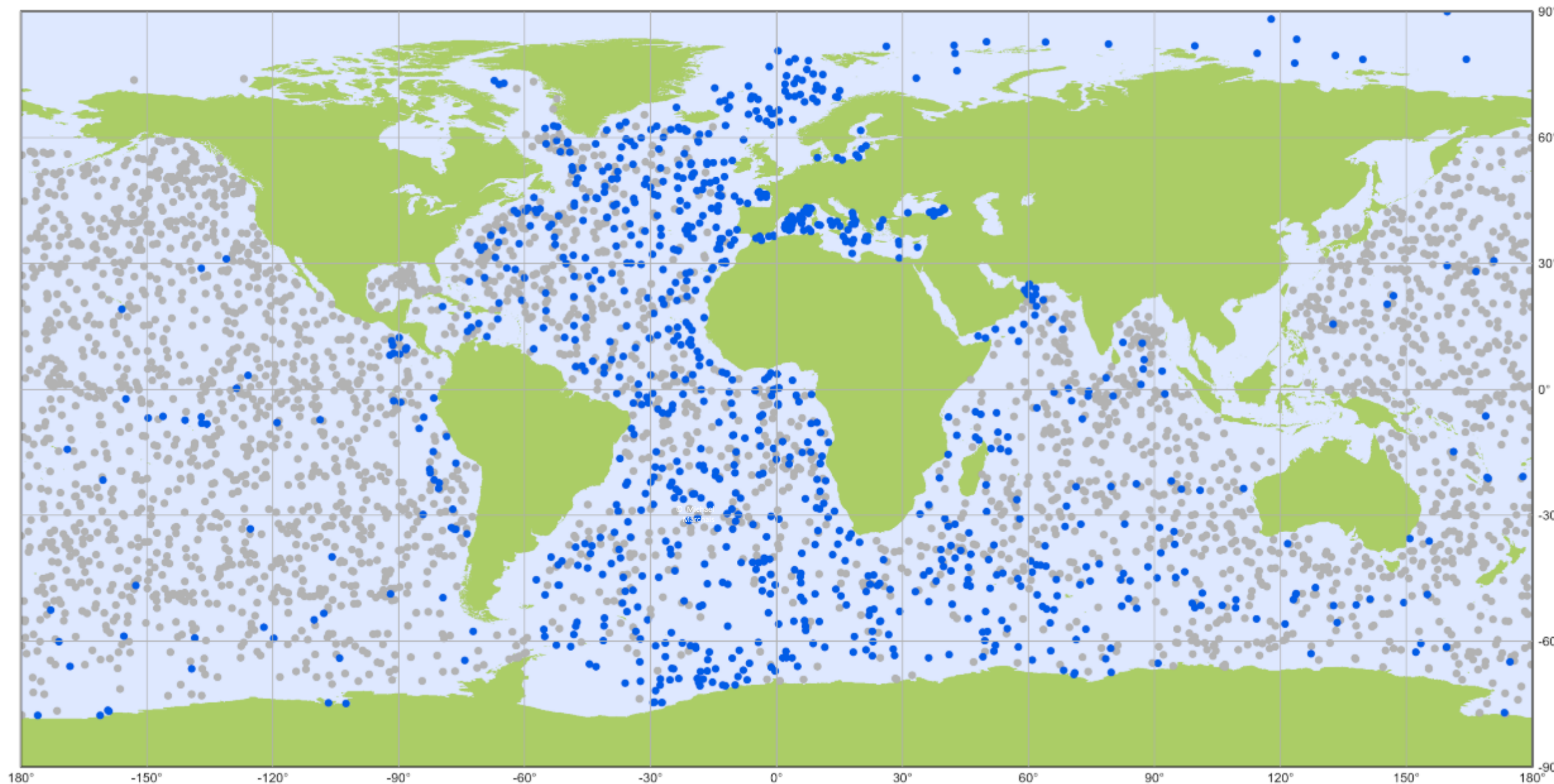
Generated by ocean-ops.org, 2025-06-06
Projection: Plate Carree





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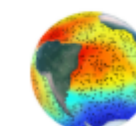
Argo

EuroArgo

May 2025

European contribution to the Argo program via EuroArgo Research Infrastructure
Latest locations of operational profiling floats (data distributed within the last 30 days)

• Argo EU (961) • Argo non EU (3183)



Generated by ocean-ops.org, 2025-06-06
Projection: Plate Carree

EU
contribution
23%

USA
contribution
55%

5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0

Euro-Argo's contribution to:

■ Deep mission

■ BGC mission

■ Core mission

2000 2008 2024 Target by 2030

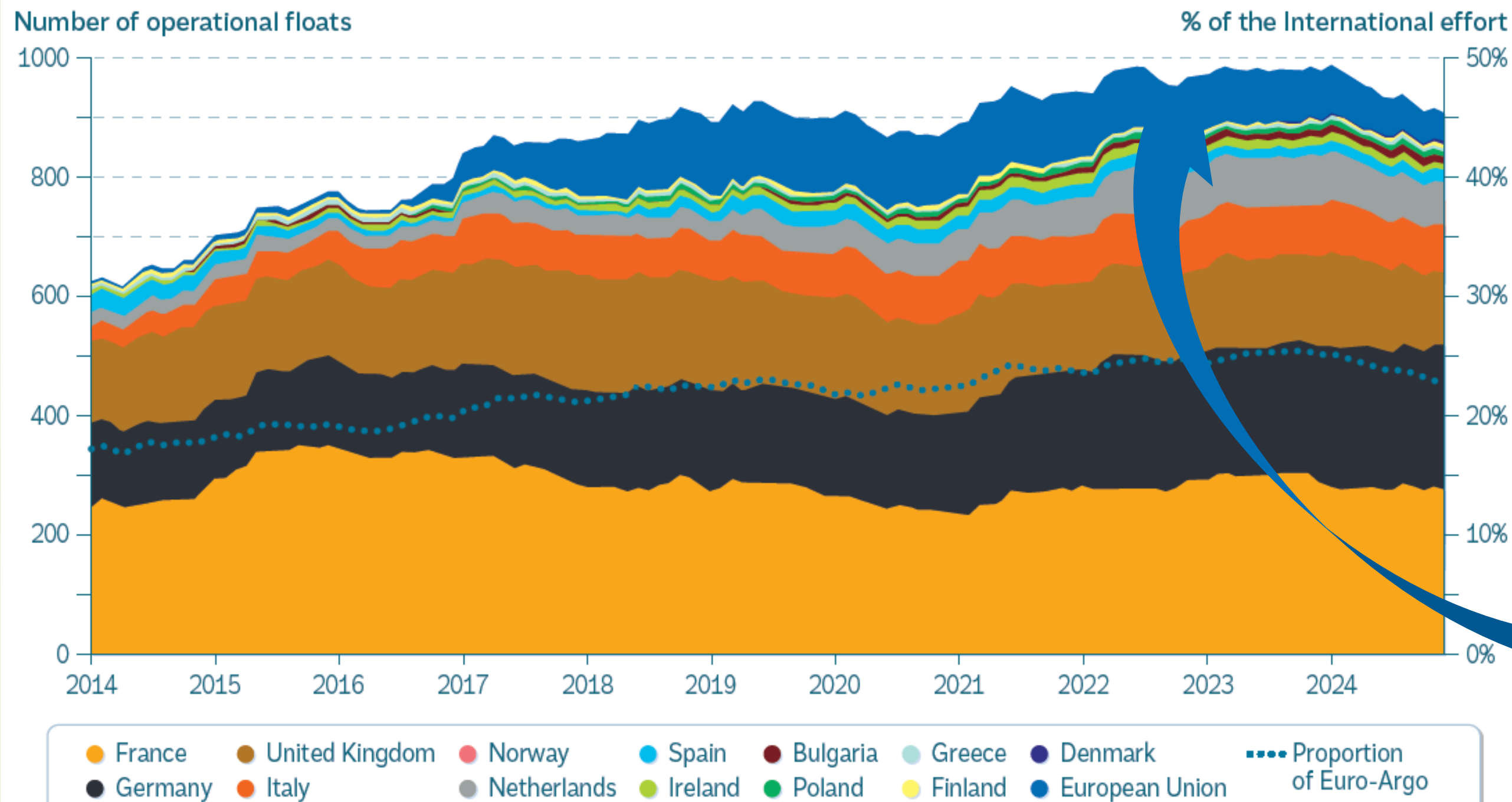


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→ Number of Euro-Argo operational floats (active at given time)



Operational floats:
Dropping below the
global engagement

23%

**EU project floats
are dying out**
e.g., MOCCA



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Readiness to deliver OneArgo

- The global Argo community has an excellent track record of delivering what is promised, and more
- Argo open data and shared standards are widely emulated in other ocean observing networks
- Commercial suppliers are ready to ramp up production, but capability will be lost if we delay implementation
- Europe has well-established infrastructures

Coriolis data centre is the world leader, as an Argo Global Data Assembly Centre

Copernicus Marine Service is a primary point of entry for aggregated data and products

NKE in France is the biggest commercial supplier of floats outside the USA

The Euro Argo ERIC is effective in coordination of European effort, and technical support for smaller EU national programs





Present status

	Active floats	% of active global floats	GDP (USD Tr) World Bank 2023	Contribution index Floats/TrGDP
Total	4054			
USA	2300	57	27.7	83.0
EuroArgo ERIC (12)	949	23	18.9	50.1
EU+UK+Norway (29)	949	23	22.5	42.3
Other int'l (9)	805	20		

- Argo has been reliant on the USA for Core Argo and the pilot/demonstration phases of OneArgo
- The 5 biggest national programs from ERIC members (France, Germany, UK, Italy, Norway) + the European Commission funding, provide 90% of the European contribution with 75% of the GDP

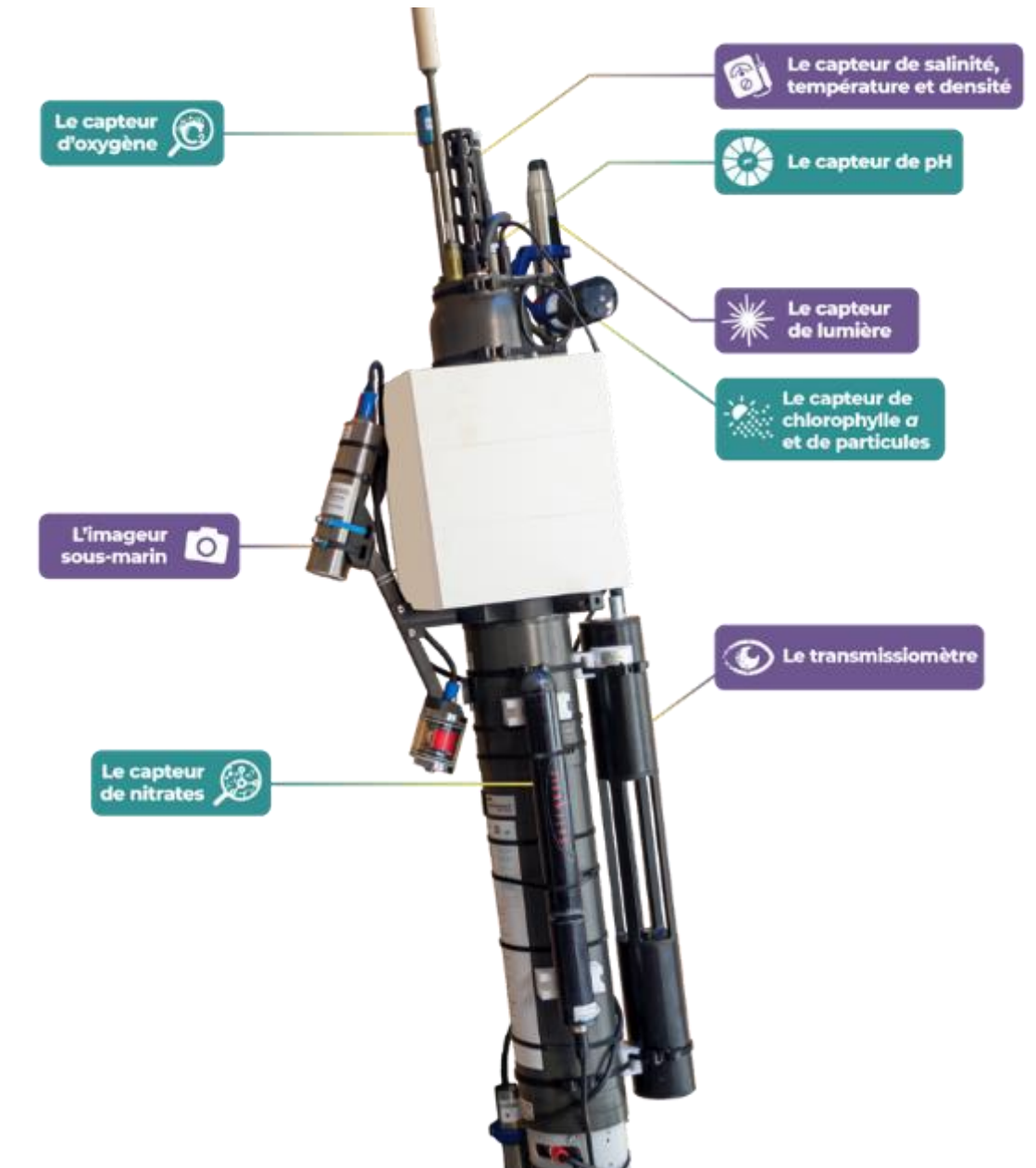


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- ✓ Euro-Argo raising capacities to implement OneArgo: BGC, Deep, Polar challenges
- ✓ Europe needs to raise its share of the international Argo programme
- ✓ How to increase the financial resources of the European Argo programme to take a leading role and meet the requirements of operational users?





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Alessandra Cacciari

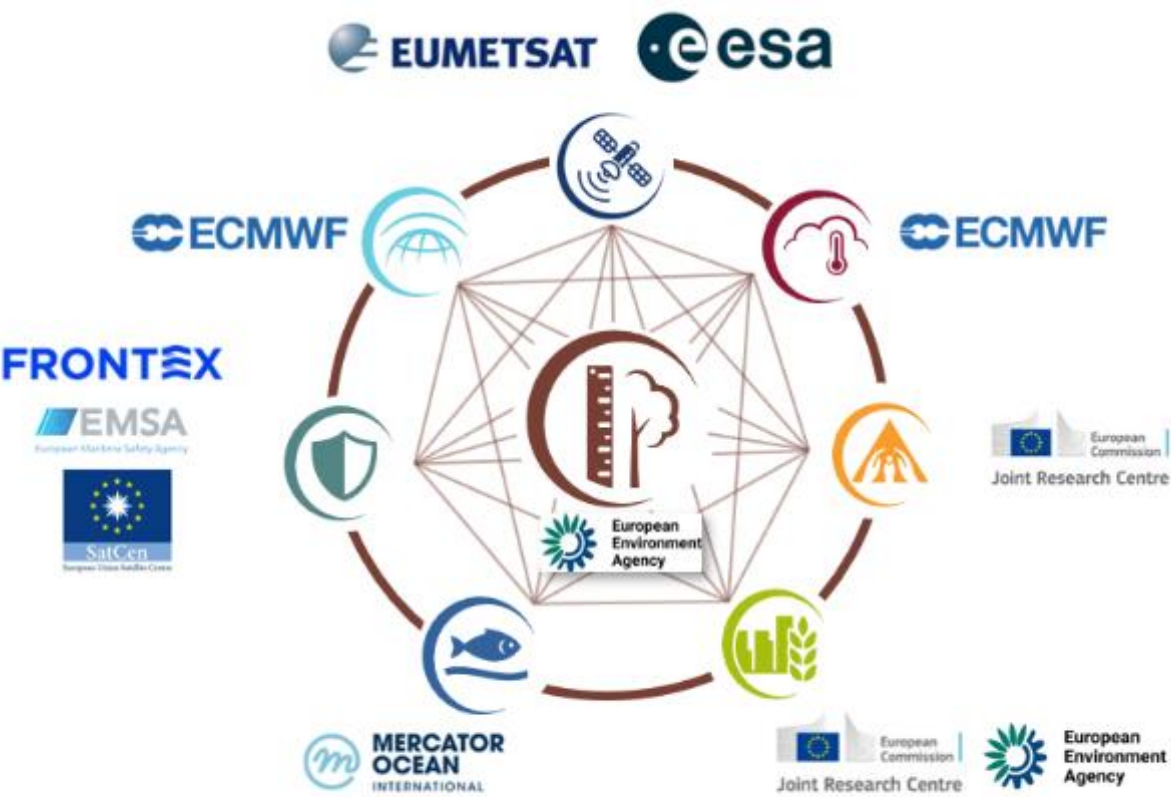
Programme Officer – Earth Observation unit –
Directorate for Defence Industry and Space
European Commission



Copernicus In Situ component

Copernicus in-situ data: observations, geospatial reference and ancillary data licensed or provided for use in Copernicus

- Production and validation in Copernicus services
- As stand-alone observation products
- calibration/validation of satellite sensors



The Entrusted Entities manage and use in-situ data daily to meet their operational needs

The EEA In-Situ cross-cutting coordination steps in when a coordinated, programmatic approach is needed across Copernicus





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Charlina Vitcheva

Director – General for Maritime Affairs &
Fisheries

European Commission



The EU Ocean Pact for Ocean Observation

- Ocean Observation *is the foundation of marine knowledge*, our only pathway towards **credible** science, **efficient** policy making and a **competitive, sustainable** Blue Economy.
- EuroArgo, as part of One Argo, *is a cornerstone of the Global Ocean Observing System* – sustainability and longevity of the system should be a common priority, **through tangible action**.
- The European Commission *is already* undertaking work with its Member States **to increase coordination and transparency of ocean observation** – aiming towards efficiency gains, observation gaps reduction and support of EU technological innovation.

*Through the EU Ocean Pact, the European Commission commits to launch an ambitious Ocean Observation initiative **which will connect, scale, govern and secure European ocean observing capacities** and will actively seek collaboration with international partners, **to secure and support the global infrastructure we all depend on, including OneArgo.***



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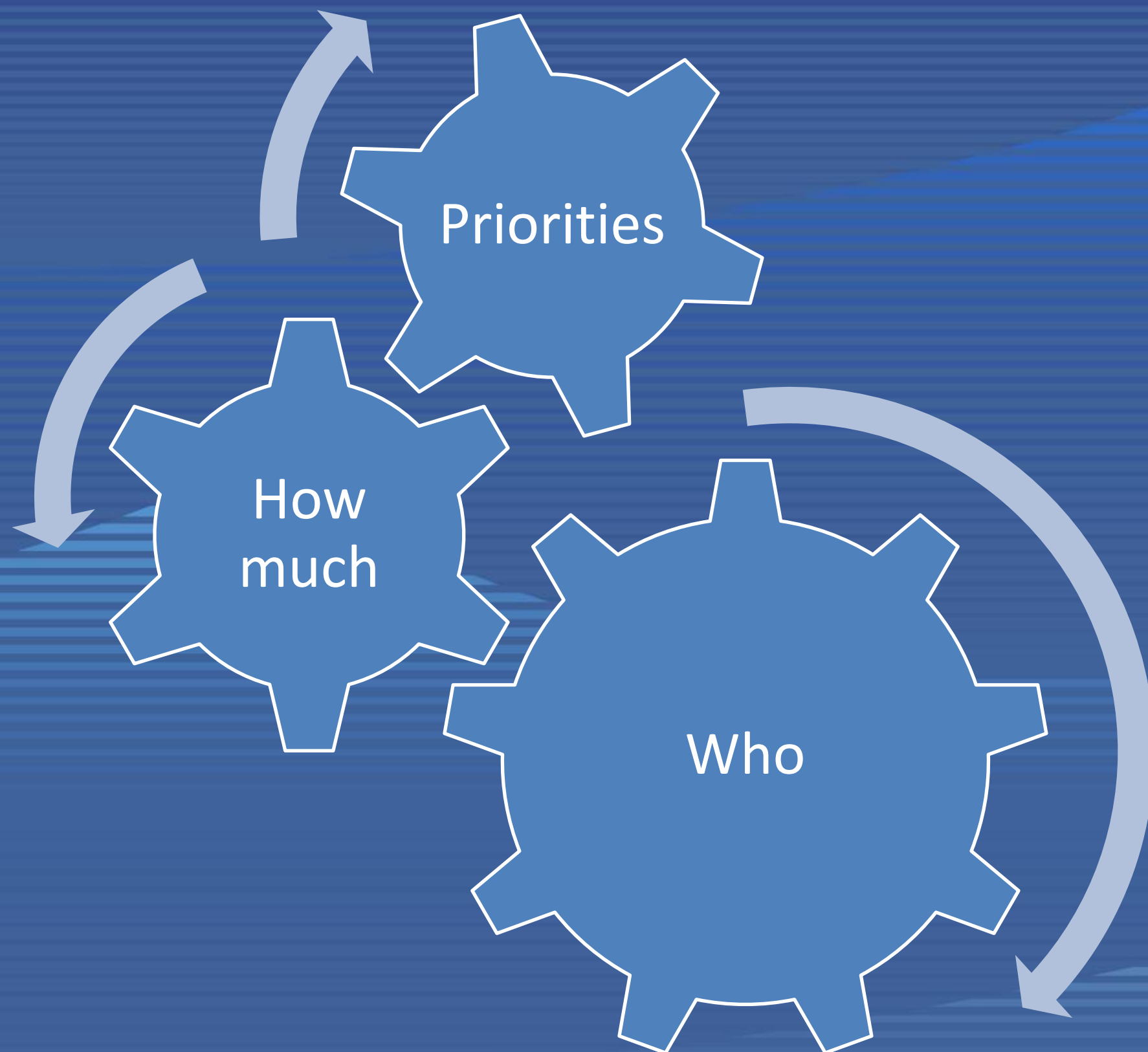
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Question time





- What is the advice of the OneArgo community to Europe, Members and Commission, to be able to step up?
- What are the needs and expectations of CMEMS vis-à-vis Argo and OneArgo? Prioritization of needs? Necessity to fund observation/data acquisition?
- How does DEFIS plans to face in-situ data requirements of Copernicus services in light of stagnating national investments, increasing costs of in-situ ocean observation and geopolitical changes: future in-situ strategy of Copernicus?
- How does DG MARE plan to address the needs for Argo data and other in-situ data in light of stagnating national investments, increasing costs and geopolitical changes while ocean observation is a cornerstone of the EU Ocean Pact (e.g., MSFD monitoring) and a strict requirement for its EMODNet & EDITO services?



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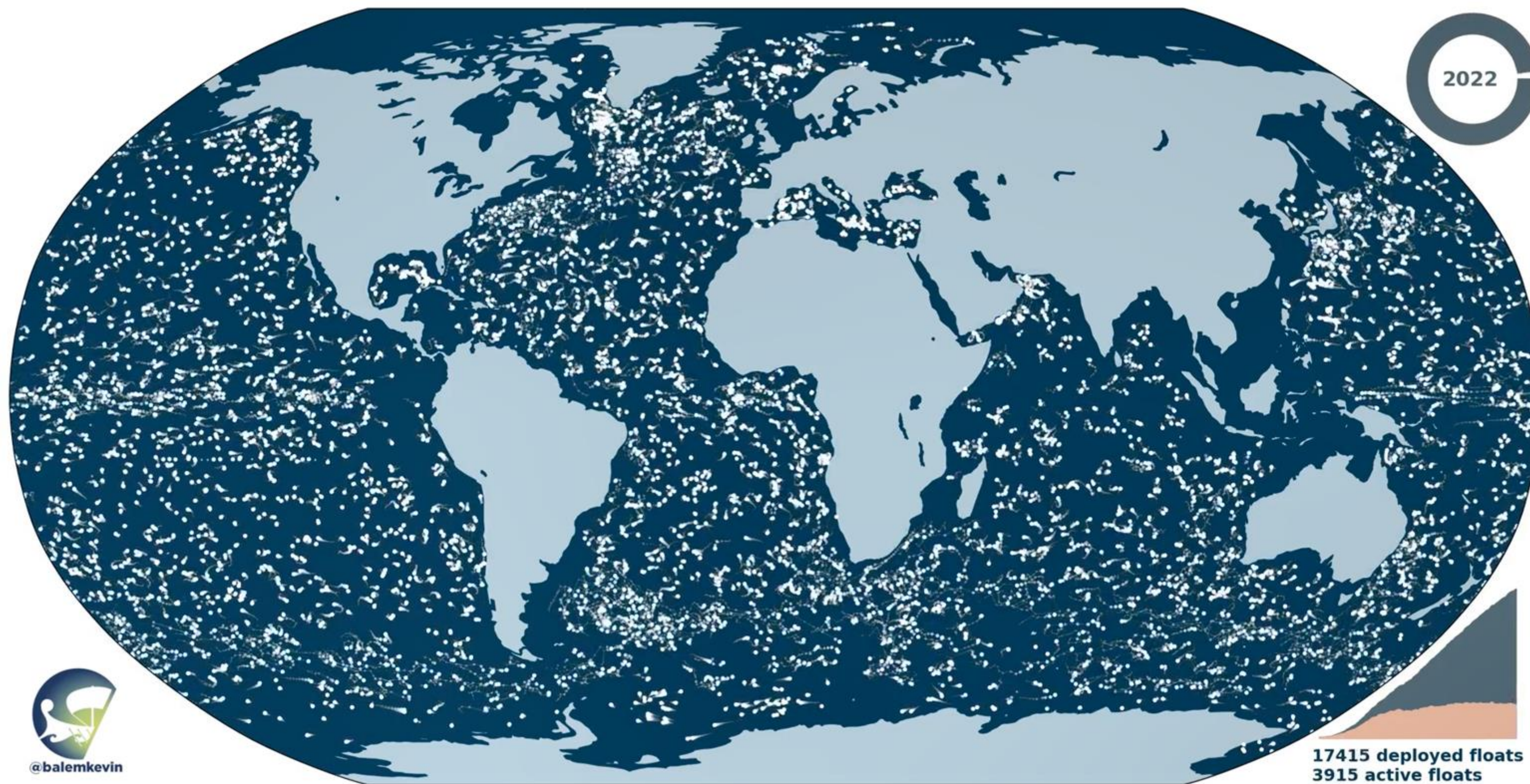
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Requirement for resources

- As with the start of Argo, the best chance for OneArgo to become reality is for one nation, or group of nations, to commit to implementing the OneArgo design, and to lead others to follow
- It is unlikely the USA will provide that lead
- If Europe wants and needs to see OneArgo become reality, it should take that lead, by committing to implement 50% of OneArgo
- This will require 50M Euro per year across all the European partners, including any direct contribution from the European Commission. This is an increase by a factor of 4 over present European funding.
- Research funding managers have made it very clear that the funding required for Europe to deliver 50% of OneArgo will not be found from research budgets. It will require an act of political will
- Europe leading OneArgo would ensure European policy makers, agencies and researchers have access to the measurements required to describe, predict and manage the oceans
- If the WMO wants to make global assessments of the sustainable development of the ocean, for example understanding and tracking global acidification, then OneArgo is the program, probably the only program, that can provide the required data
- Billions of Euro/\$ of sustainable ocean resources can be managed in exchange for a relatively small investment, but the need to act is urgent



<https://www.youtube.com/watch?v=HmtEhgVxuRU>



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Messages from DG-Mare

- *The importance of Euro-Argo and OneArgo as baseline resources that fundamentally support the work of a wide range of stakeholders across different sectors is a given.*
- *The European Commission's response through the Ocean Pact shows a comprehensive and ambitious plan, giving Ocean Observation the necessary place and attention: at the foundation of Marine Knowledge, the source of comprehensive marine data, the fuel behind digital applications.*
- The Ocean Pact is very ambitious in that account: The European Commission will step *up efforts by launching an ambitious ocean observation initiative*, including for the coastal and deep sea, *assuming a leading international role, to deliver critical information to all marine actors and sectors.*



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Messages from DG-Mare

- The EU Ocean Observation Initiative, which will cover observation campaigns, governance and coordination of ocean observation – at the European level at least, data processing, infrastructures and the provision of key services, will be the next chapter in the discovery of our planet's inner space and ***will connect, scale, govern and secure ocean observing capacities.***
- Through this action, the European Commission recognises ***and aims to support the different components of EuroArgo and OneArgo*** – and other fundamental Ocean Observing infrastructures.



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Thank you!

