Overview about Argo, float types, and implementation of OneArgo

Yann-Hervé De Roeck, Euro-Argo ERIC Office

Marginal Seas Argo DMQC workshop,
Tuesday 18 April 2023

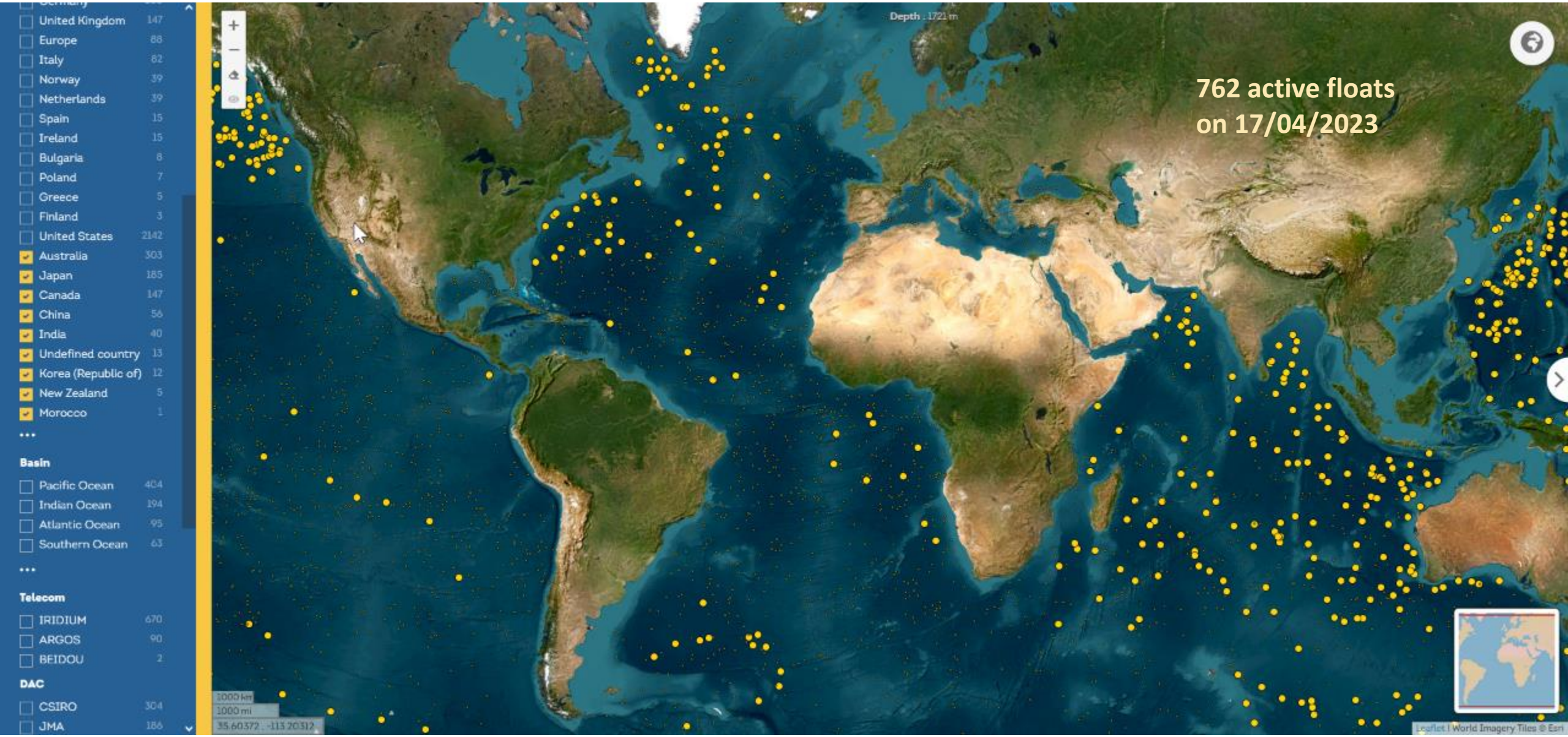
- **What is OneArgo and what is Euro-Argo ERIC**
- **Core, Deep and BGC programmes and float types**
- **Implementation issues**

BACKGROUND: ARGO, A GLOBAL *IN-SITU* OBSERVING SYSTEM

BACKGROUND: EURO-ARGO, 1/4th of ARGO

BACKGROUND: USA contributions (1/2 of ARGO)

BACKGROUND: ARGO, other international contributions



The Euro-Argo Research Infrastructure

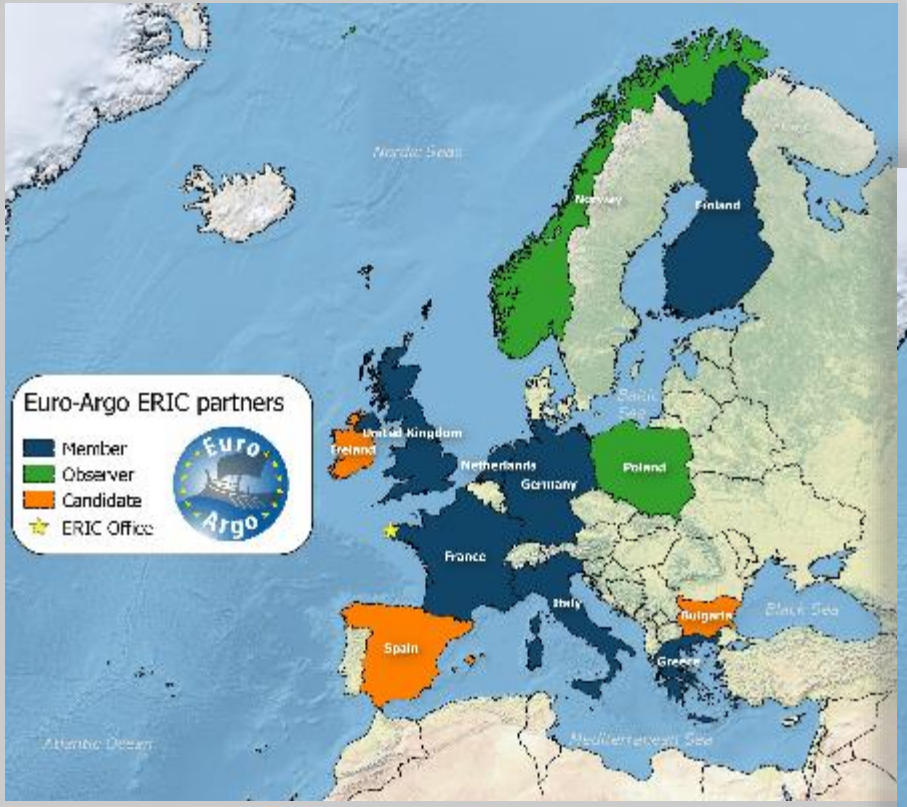
Objective:

- **to coordinate, optimize and sustain the European contribution to the global Argo network (1/4 of the network)**

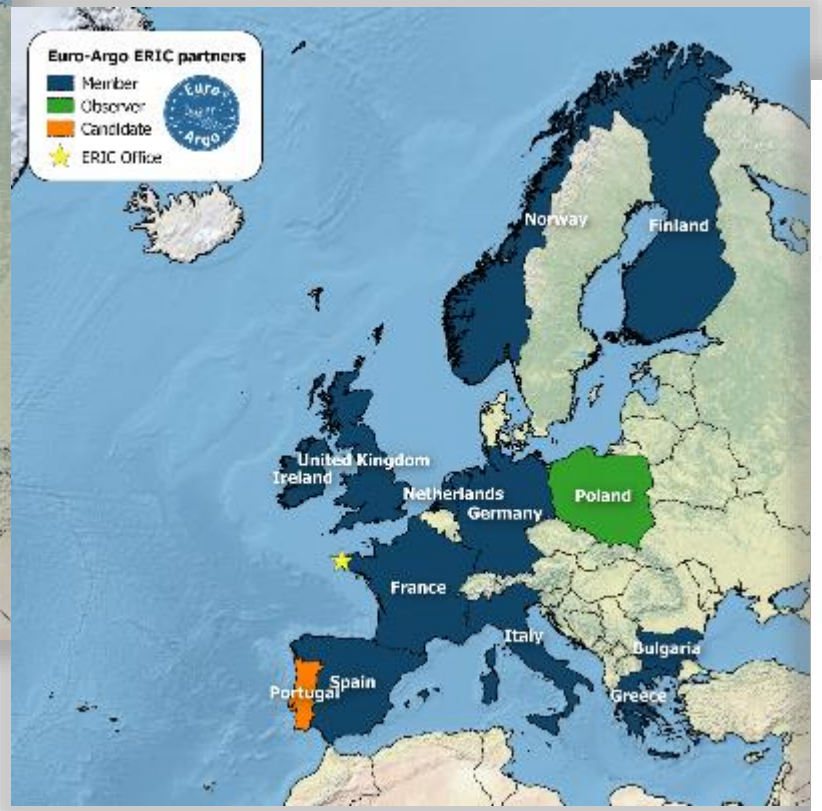
Status:

- **a European Research Infrastructure Consortium (ERIC) created in May 2014, as a Landmark in the roadmap of the European Strategy Forum on Research Infrastructures**
- **since it is hosted by France, this status is transcribed into a non-for-profit association**
- **other ERICs in the marine domain:**
  - **EMSO, Eu. Multidisciplinary Seafloor and water column Observatory -> global Ocean Sites**
  - **ICOS, Integrated Carbon Observation System -> global SOCAT**
  - **EMBRC, European Marine Biological Resource Centre -> global**
  - **And other ERICs-to-be: EuroGOSHIP, JERICO 2 (coastal monitoring), GROOM (gliders)...**

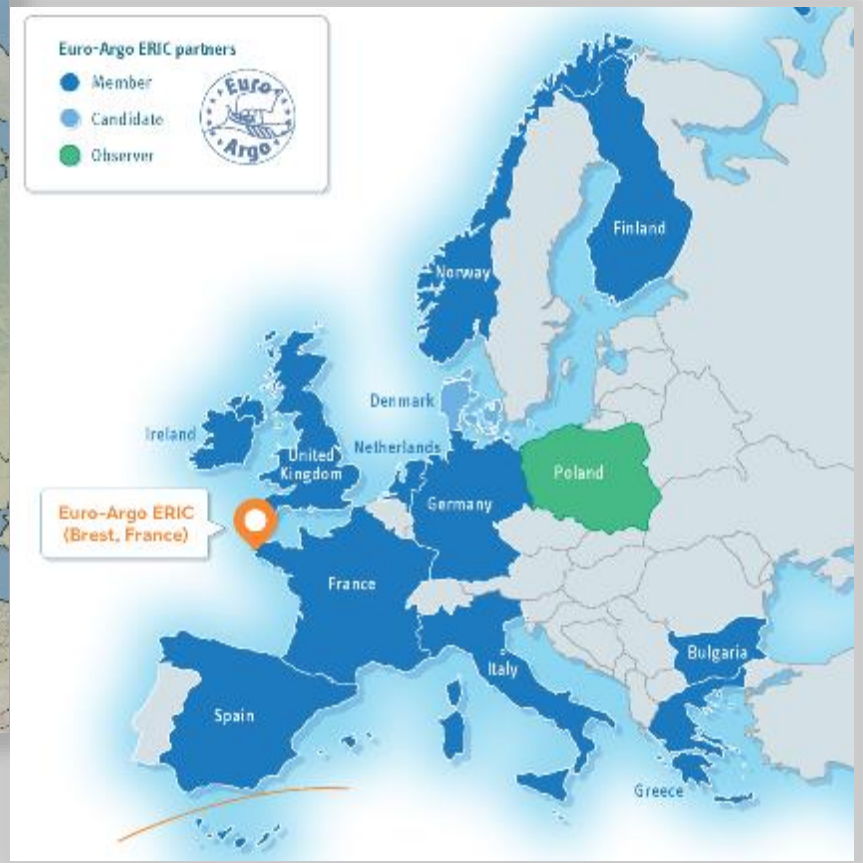
Legal establishment: expansion of membership



2014



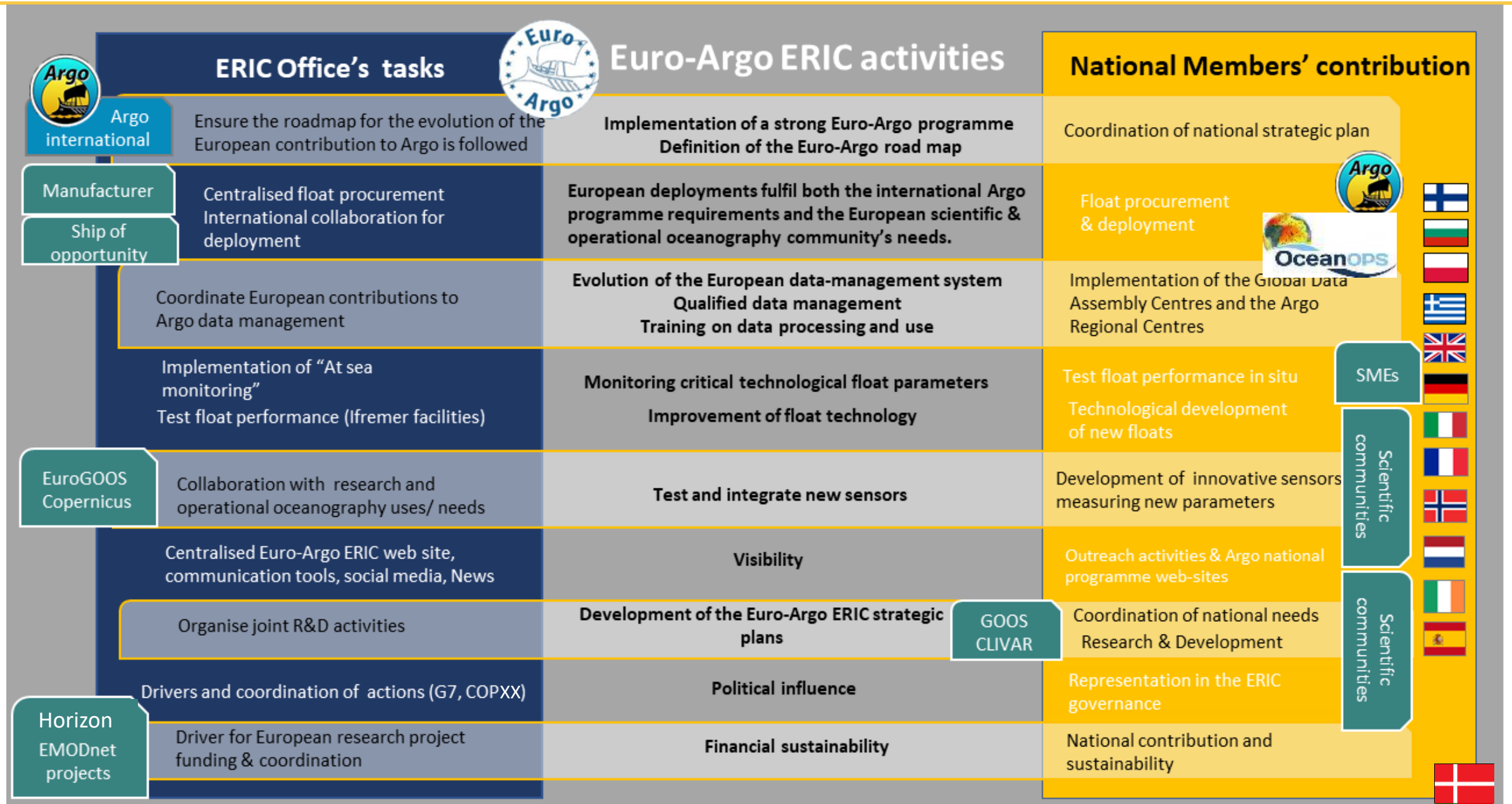
2019



2022

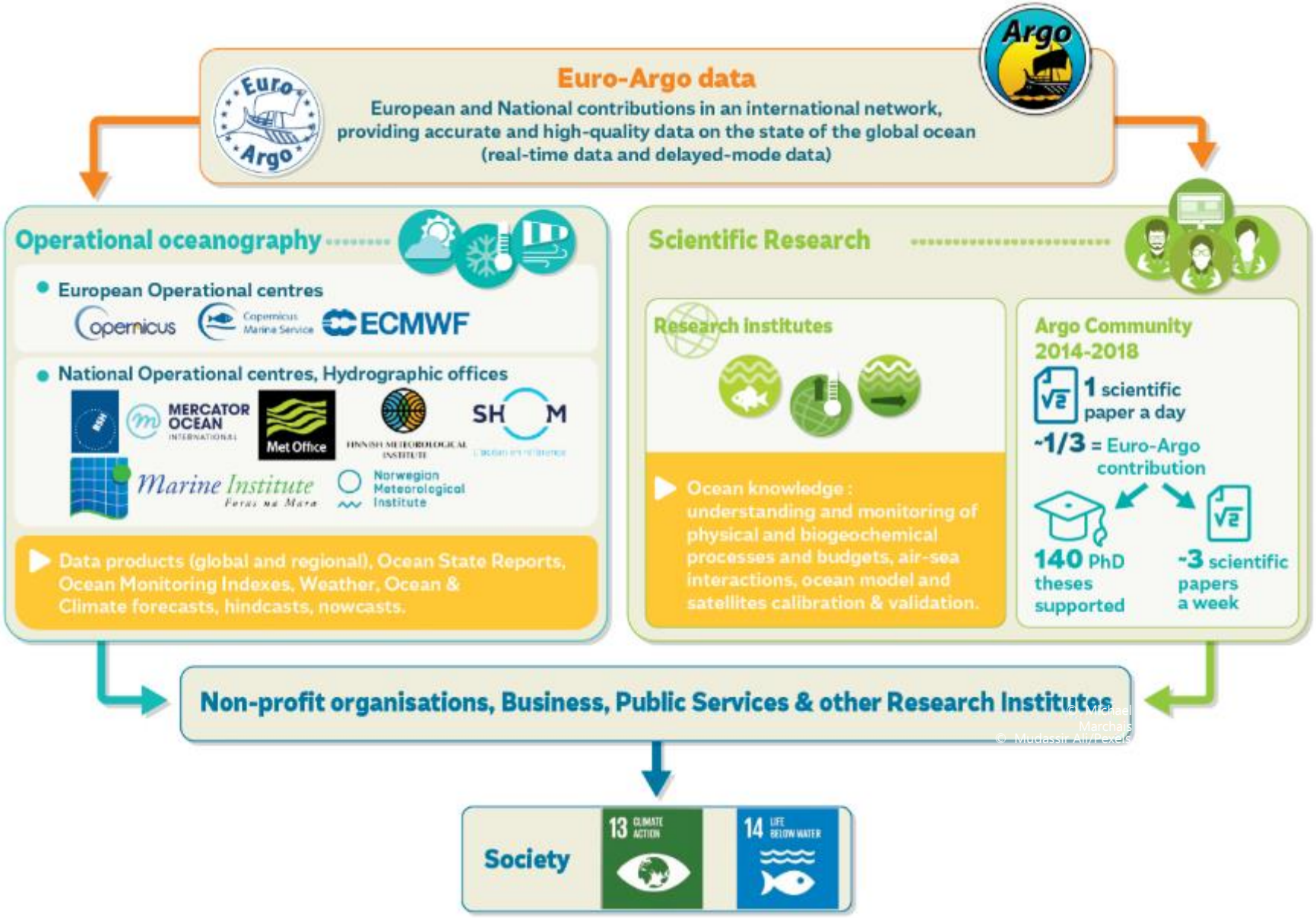
Now:
12 Members, 17 Institutes
150 Scientists, 100 ships

Distribution of ERIC activities



DATA ACCESS TO DIFFERENT STAKEHOLDERS

Euro-Argo benefits for science and operational oceanography



ASSESSMENT OF EURO-ARGO SUPPORTING RESEARCH

→ Data access in average

633 VISITORS PER MONTH (AVERAGE)

5218 SESSIONS

4,53 TERABYTES OF DATA FILES DOWNLOADED

→ Number of publications

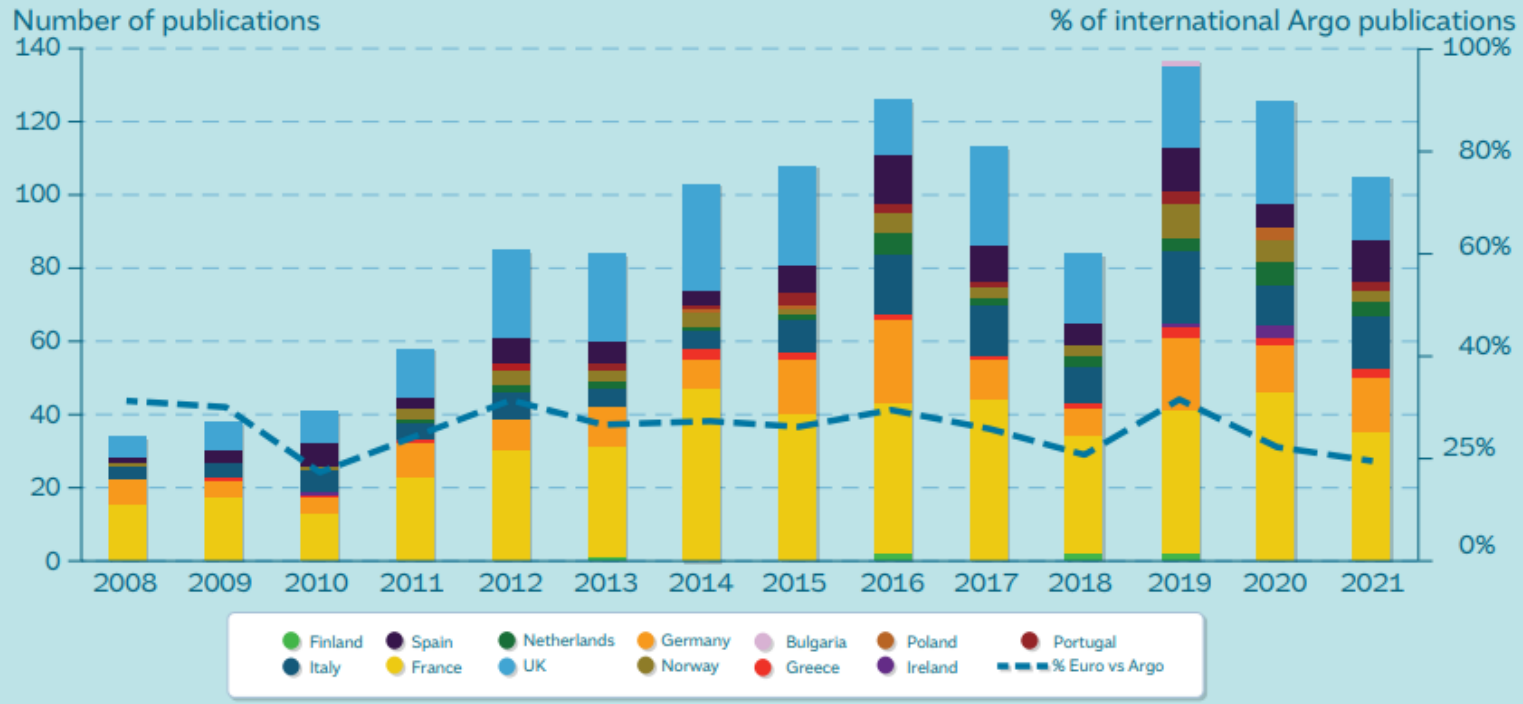
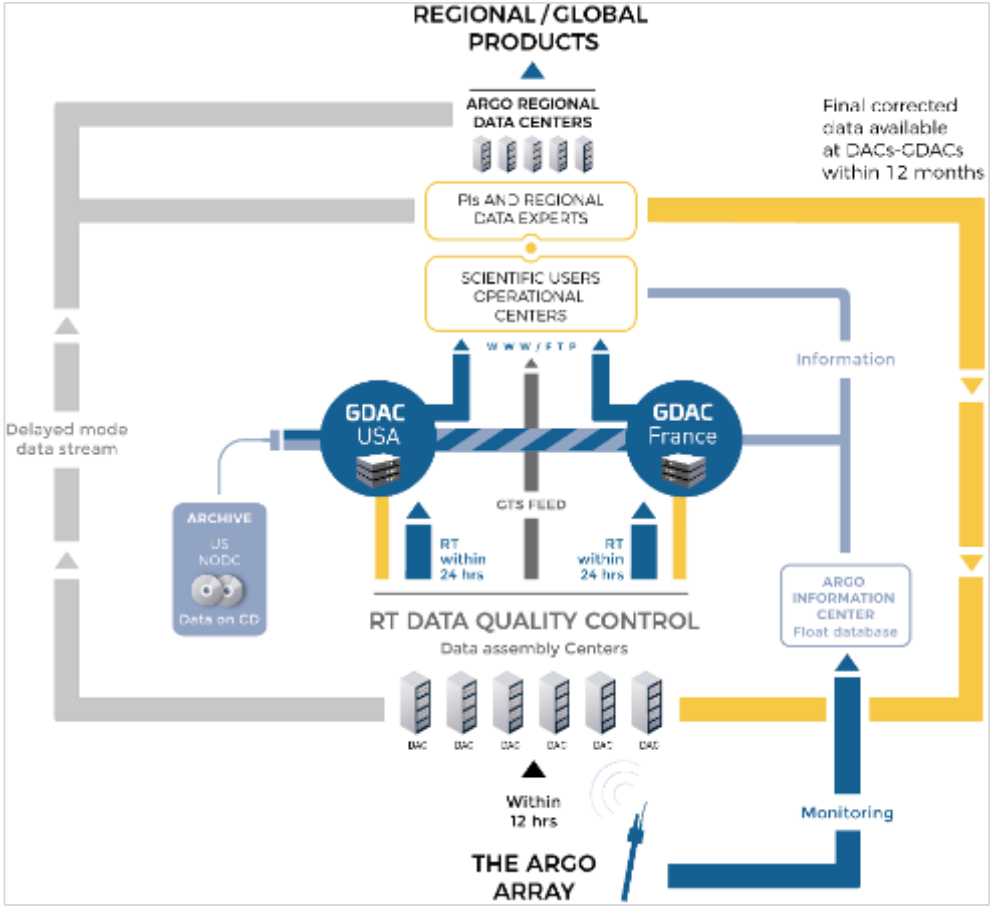


Figure 16: Euro-Argo publications per year (defined as publications using Argo data with first author's affiliation in a European country) in number of publications (left axis) and in percentage of the international Argo publications (right axis).

DATA MANAGEMENT SYSTEM: EURO-ARGO IMPORTANT CONTRIBUTOR



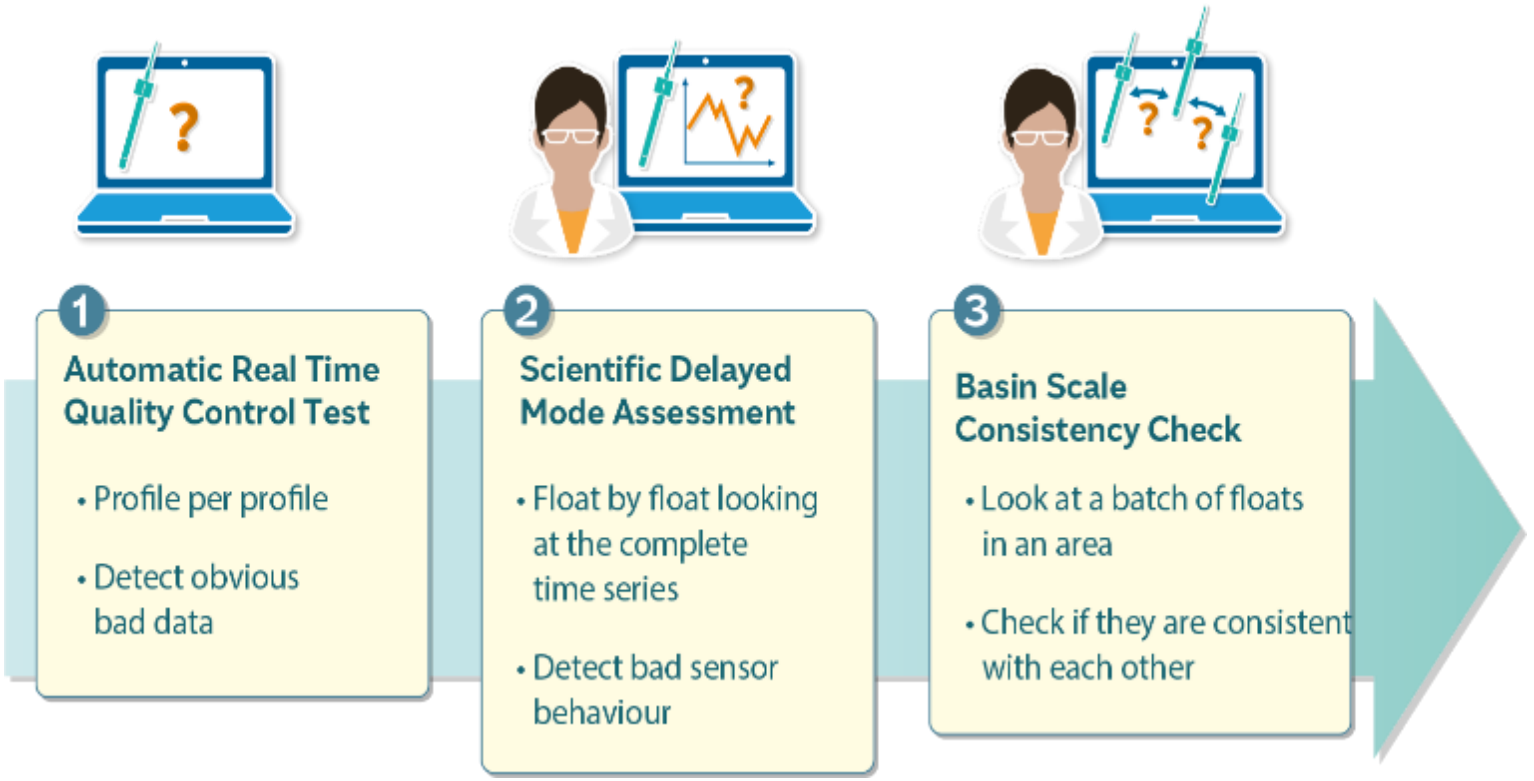
Data are managed **at international level**:

- Floats send their measurements to DACs, where raw data are processed and sent to the 2 GDACs:
  - ✓1 GDAC in Europe (Coriolis/Ifremer)
  - ✓2 DACs in Europe (Coriolis/Ifremer, France and BODC, UK)
- 3 ARCs are coordinated by Eu partners:
  - ✓Atlantic ARC (Ifremer, France)
  - ✓Southern Ocean ARC (BODC, UK)
  - ✓Med & Black Seas ARC (OGS, Italy)
- Argo Information Centre (AIC) at OceanOPS:
  - ✓Registration of floats
  - ✓Information on data (“metadata”)

Data system existed before the Euro-Argo ERIC set-up => ERIC, with support from EU projects, helped to enhance the existing elements and develop new ones needed for the extensions

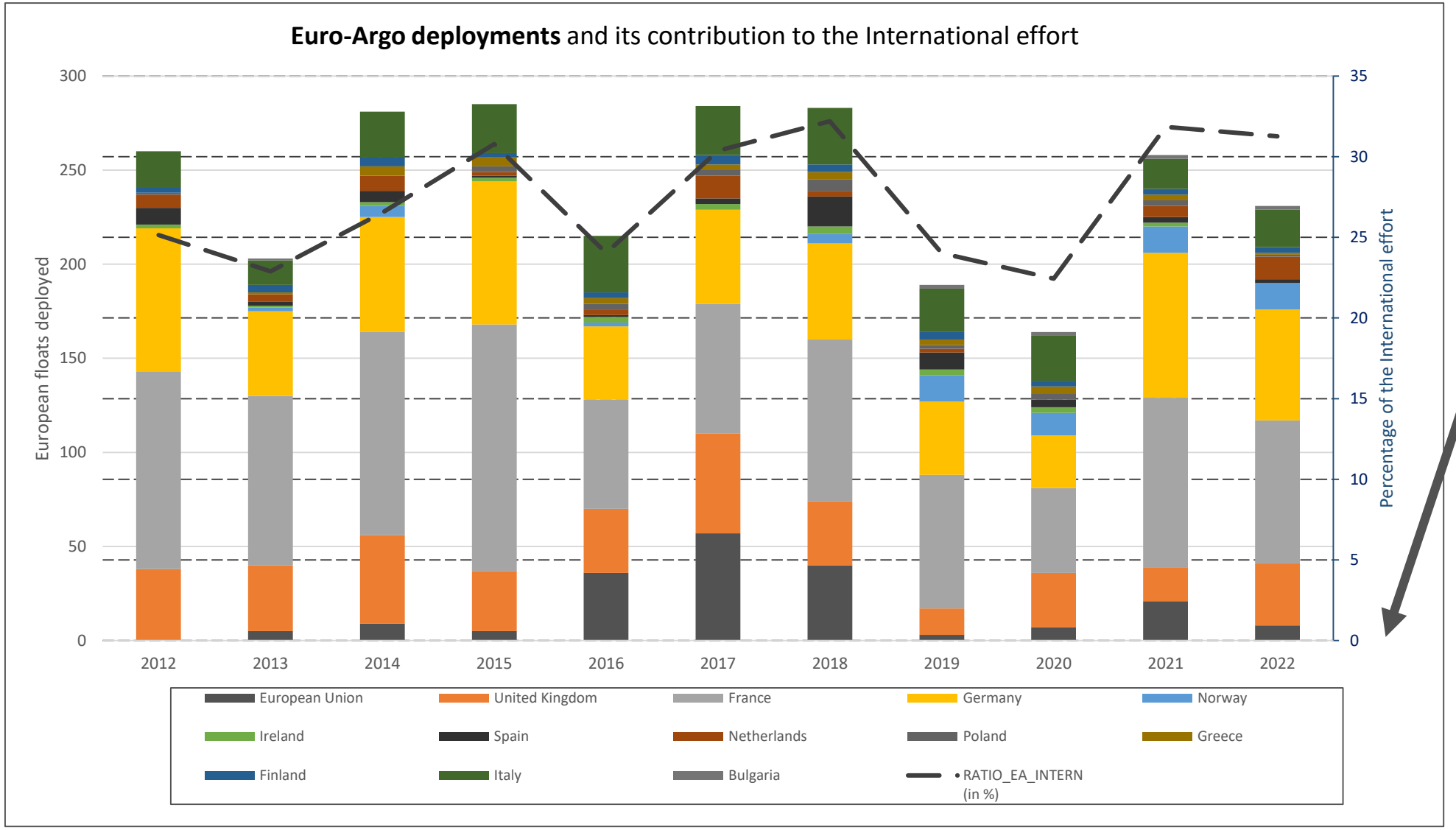
DATA MANAGEMENT SYSTEM: TWO DATA FLOWS

- **Real Time**
  - ✓12 hours max
  - ✓Automatic Quality Control tests
  - ✓Operational applications
- **Delayed Mode**
  - ✓12 months
  - ✓Detailed time serie analysis and corrections
  - ✓Ocean & climate science applications



Additional analysis are then completed at bassin scales (Argo Regional Centres)

European float deployments



Fluctuating direct Eu funding:

- **DG Mare MOCCA project**
- **DG Research EA-Rise, EuroSea, soon George**

Types of floats

ARVOR

APEX

NAVIS

NEMO

PROVBIO

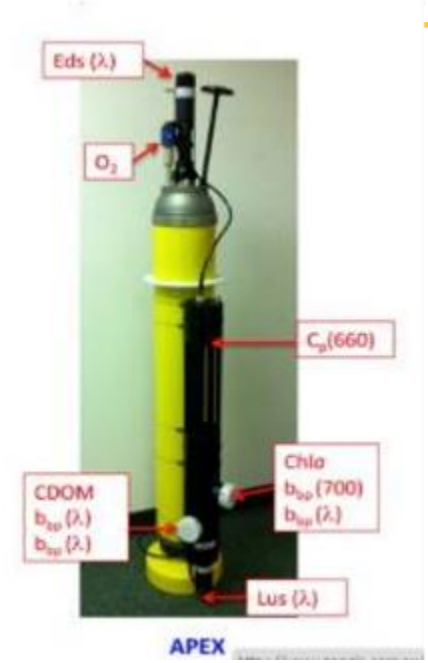
DEEP ARVOR

Deep APEX

Types of floats: the BGC maze

Parameter	Sensor	Application
Oxygen	Fluorescence Quenching	Anoxia and suboxia, Carbon Uptake
pH	Ion Sensitive Transistor	Acidification, Carbon Uptake
Nitrate	UV Light Absorption	Nutrient Availability for Carbon Uptake, Harmful Algal Blooms
Chlorophyll	Chlorophyll Fluorescence	Phytoplankton blooms, Carbon Uptake
Backscatter	Optical Backscatter	Particulate Carbon production, Carbon Uptake
Irradiance	Wavelength selective light Sensor	Light Availability, Carbon Uptake

NAVIS PROVOR



APEX

Float manufacturer	Float types	No. floats deployed (approx.)	Biogeochemical sensors used
Teledyne Webb Research (TWR)	Apex	348	b_{bp}[1], chl a, O_2, NO_3, pH
University of Washington*	Apex(-UW)	412	b_{bp}, chl a, O_2, NO_3, pH
NKE Instrumentation	ARVOR, PROVOR	396	Radiometry, b_{bp}, chl a, O_2, NO_3, pH
Sea-Bird Scientific	Navis	67	Radiometry, b_{bp}, chl a, O_2, NO_3, pH
WHOI*	SOLO	35	O_2
MetOcean	NOVA	34	O_2
Optimare GmbH	NEMO	24	O_2
The Tsurumi-Seiki Co., Ltd. (TSK)	NINJA	2	O_2
MRV Systems	S2A	2	O_2

[1] *Suspended particles via particulate optical backscattering b_{bp} measurements (Cetinić et al., 2012). *Non-commercial.*

ONE-ARGO STRATEGY AS OF 2020

In Frontiers in Marine Science,
https://doi.org/10.3389/fmars.2019.00439

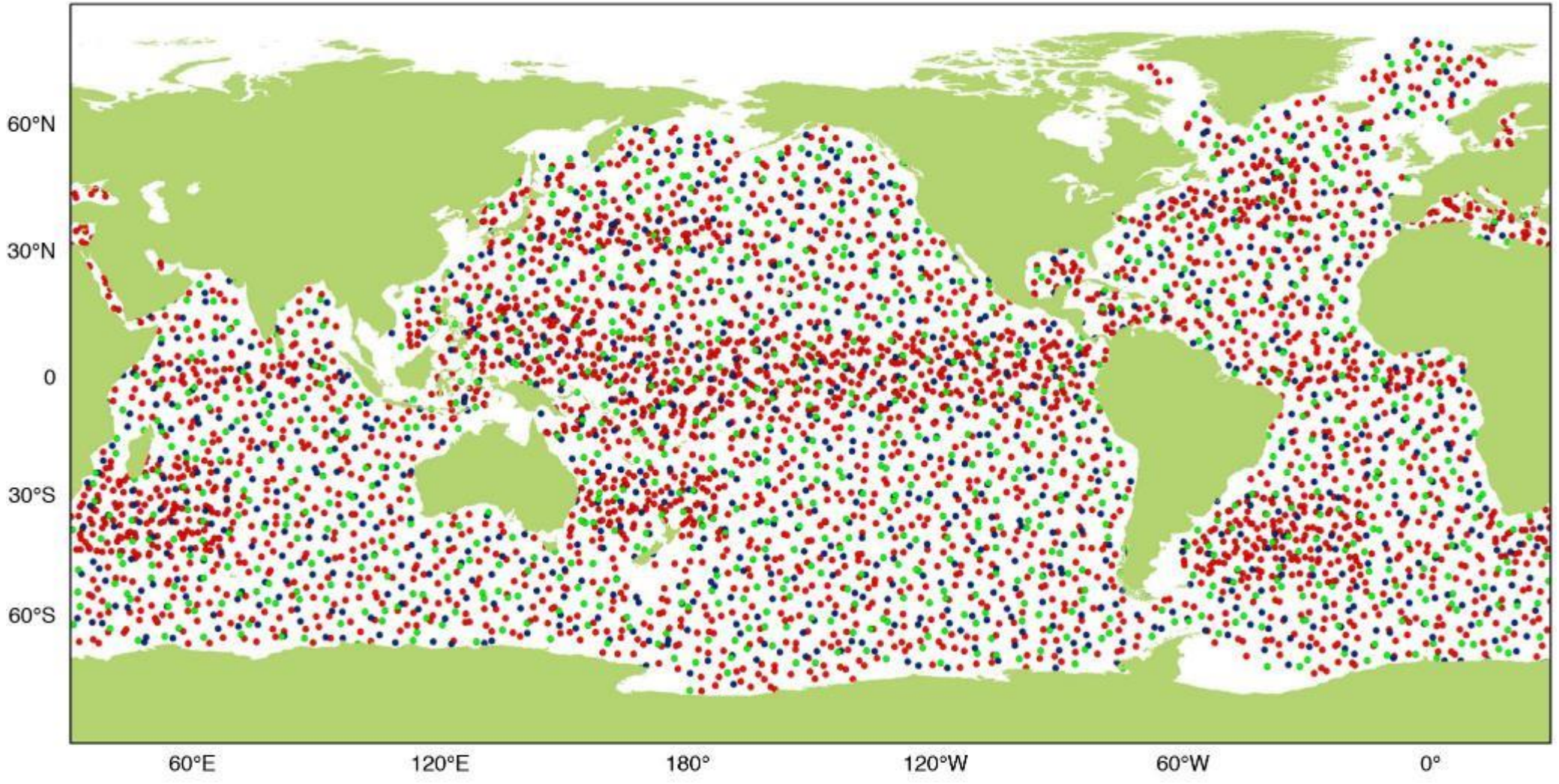
On the Future of Argo: *A Global, Full-Depth, Multi-Disciplinary Array*

Dean Roemmich, Matthew H. Alford, Hervé Claustre, Kenneth Johnson, Brian King, James Moum, Peter Oke, W. Brechner Owens, Sylvie Pouliquen, Sarah Purkey, Megan Scanderbeg, Toshio Suga, Susan Wijffels, Nathalie Zilberman, Dorothee Bakker, Molly Baringer, Mathieu Belbeoch, Henry C. Bittig, Emmanuel Boss, Paulo Calil, Fiona Cane, Thierry Carval, Fei Chai, Diarmuid Ó. Conchubhair, Fabrizio d'Ortenzio, Giorgio Dall'Olmo, Damien Desbruyeres, Katja Fennel, Ilker Fer, Raffaele Ferrari, Gael Forget, Howard Freeland, Tetsuichi Fujiki, Marion Gehlen, Blair Greenan, Robert Hallberg, Toshiyuki Hibiya, Shigeki Hosoda, Steven Jayne, Markus Jochum, Gregory C. Johnson, Kiflyong Kang, Nicolas Kolodziejczyk, Arne Körtzinger, Pierre-Yves Le Traon, Yueng-Djern Lenn, Guillaume Maze, Kjell Arne Mork, Tamaryn Morris, Takeyoshi Nagai, Jonathan Nash, Alberto Naveira Garabato, Are Olsen, Rama Rao Pattabhi, Satya Prakash, Stephen Riser, Catherine Schmechtig, Claudia Schmid, Emily Shroyer, Andreas Stert, Philip Sutton, Lynne Talley, Toste Tanhua, Virginie Thierry, Sandy Thomalla, John Toole, Ariel Troisi, Thomas W. Trull, Jon Turton, Pedro Joaquin Velez-Belchi, Waldemar Walczowski, Huili Wang, Rik Wanninkhof, Amy F. Waterhouse, Stephanie Waterman, Andrew Watson, Cara Wilson, Annie P. S. Wong, Jianping Xu and Ichiro Yasuda

Design element 2x indicates doubled density (i.e., 2 floats per 3° square)	Active floats	Status
Global – Original	3000	Implemented
Global – Antarctic	290	Pilot completed; implementation not resourced
Global – Arctic	70	Pilot underway
Global – Marginal Seas (2x)	220	Implemented where regional GOOS alliances are active
Global – Total	**3580**	
Tropical Enhancement(2x)	560	W. Pacific implementation prioritized, but not resourced
Western Boundary Current Enhancement (2x)	460	Kuroshio pilot completed. Final design still in development.
Argo2020 Design	**4600**	

The needed number of deployments per year is equal to the number of active floats divided by the mean float lifetime, presently about 4.2 years. The number of floats is inclusive of Core Argo. Deep Argo, and BGC Argo floats, forming a single integrated Argo Program.

ONE-ARGO STRATEGY AS OF 2020

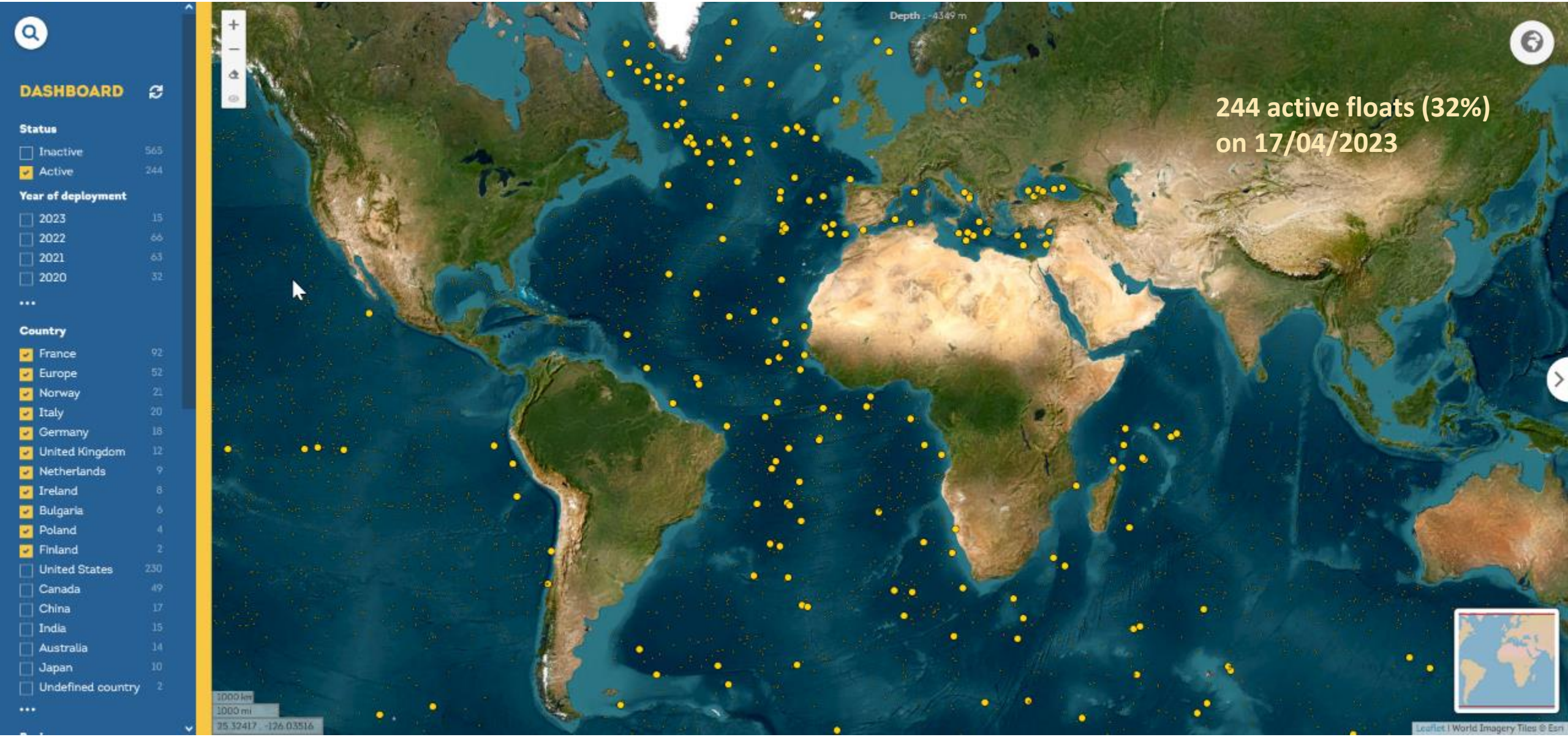


EURO-ARGO STRATEGY FOR THE NEXT DECADE

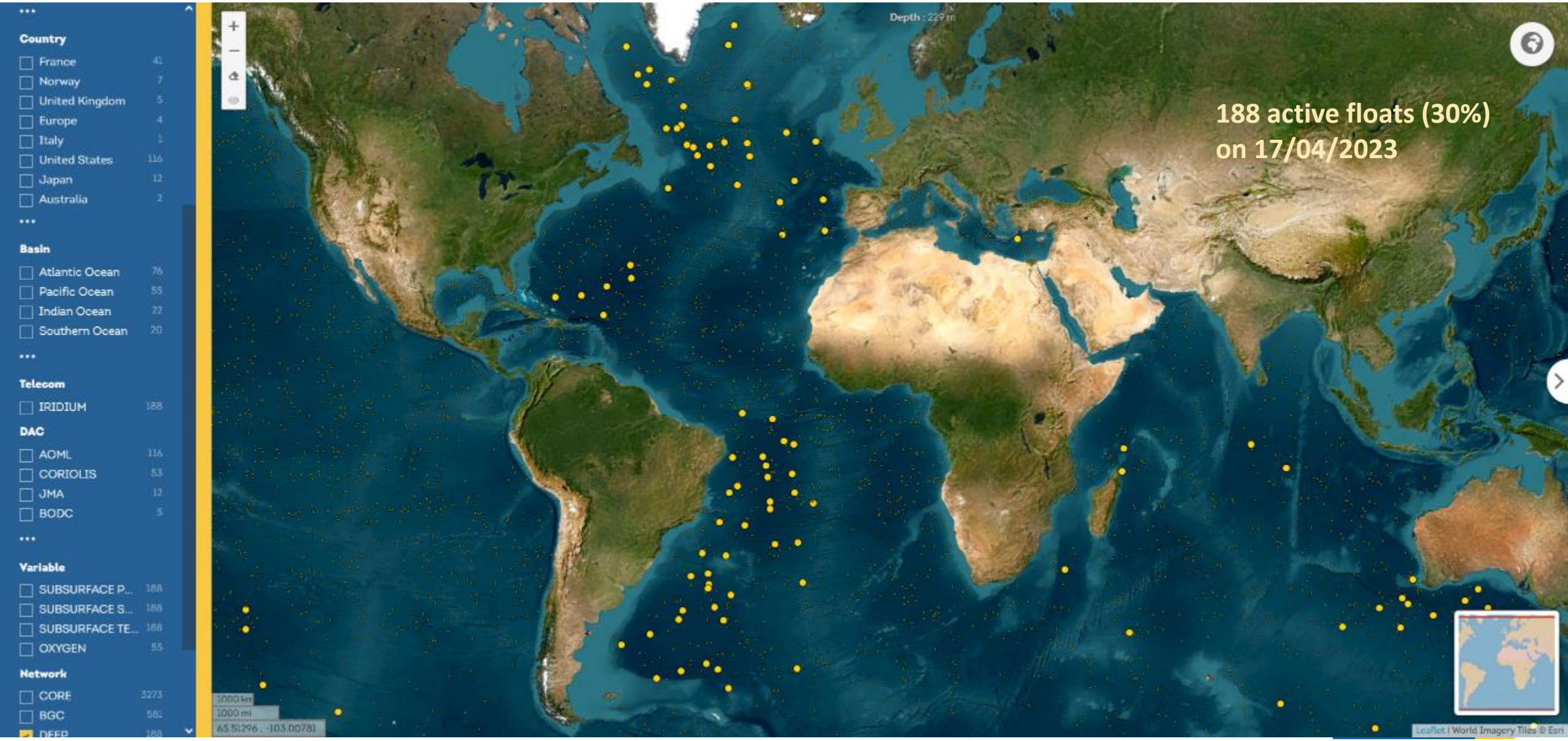
- Main Challenges:
  - **Maintain** the Research Infrastructure,
  - Implement the network extension towards **DEEP** (**abyssal ocean,** 4000 to 6000m), BGC (**biogeochemistry)**, partially **ice covered** areas and marginal seas (**shallow** waters regions).
- Euro-Argo developed its strategy in coherence with Argo international:
  - Sustain the core T&S mission, with an emphasis in Western Boundary regions,
  - Monitor European marginal seas (Baltic, Mediterranean & Black seas),
  - Monitor high latitudes,
  - Monitor the abyssal oceans: 1/4 of the global Argo-BGC network
  - Monitor ecosystem parameters: 1/4 of the global Deep-Argo network

BACKGROUND: BGC worldwide

BACKGROUND: Euro-Argo BGC



BACKGROUND: DEEP worldwide



BACKGROUND: Euro-Argo DEEP

EURO-ARGO ERIC: CHALLENGES

- OneArgo is globally 3 times more expensive than previous Argo programme and needs updating
  - Deep instruments are 2,5 times more expensive
  - BGC instruments are 4 to 7 times more expensive
  - Deep-BGC arises…
- Oxygen is a priority, considered as a mini-BGC and also on DEEP
- CO_2 is an issue, sensors in development and not yet one of the 6 variables
- BGC RQC and DMQC are complex, require more experts: will it be *in-kind* contribution?
- Operationnal data providing will extend: Copernicus, MSFD monitoring, Digital Twin of the Ocean…

EURO-ARGO.EU

euroargo@ifremer.fr
@EuroArgoERIC