

# Overview about Argo, float types, and implementation of OneArgo

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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



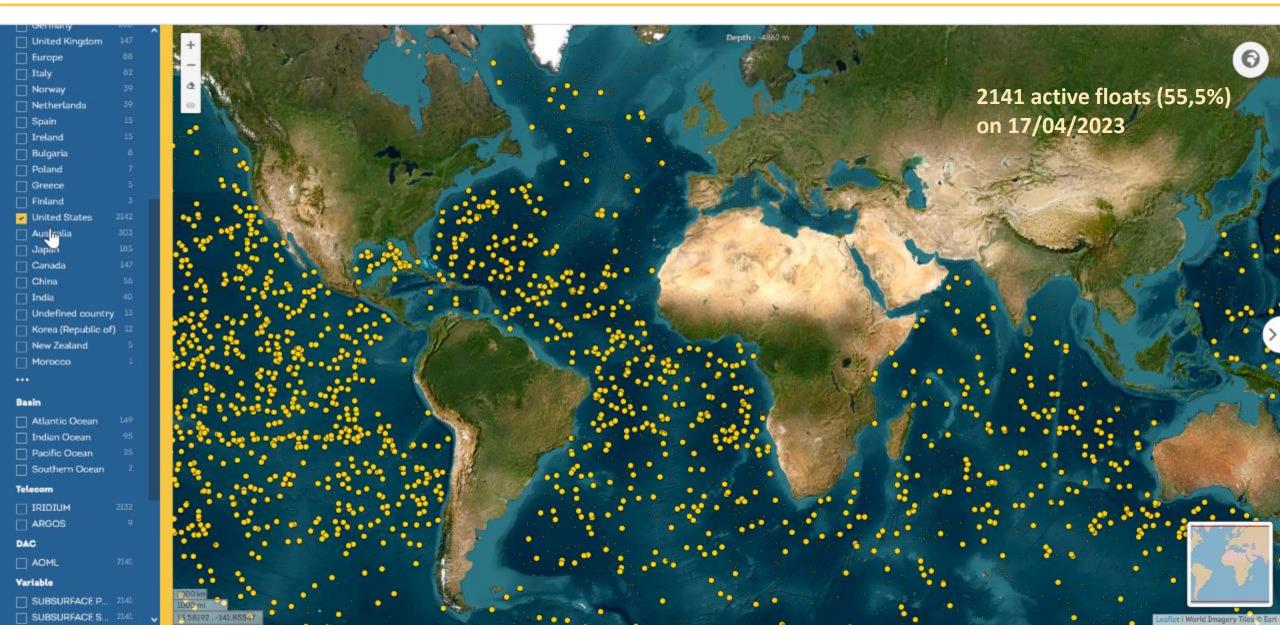


# BACKGROUND: EURO-ARGO, 1/4th of ARGO



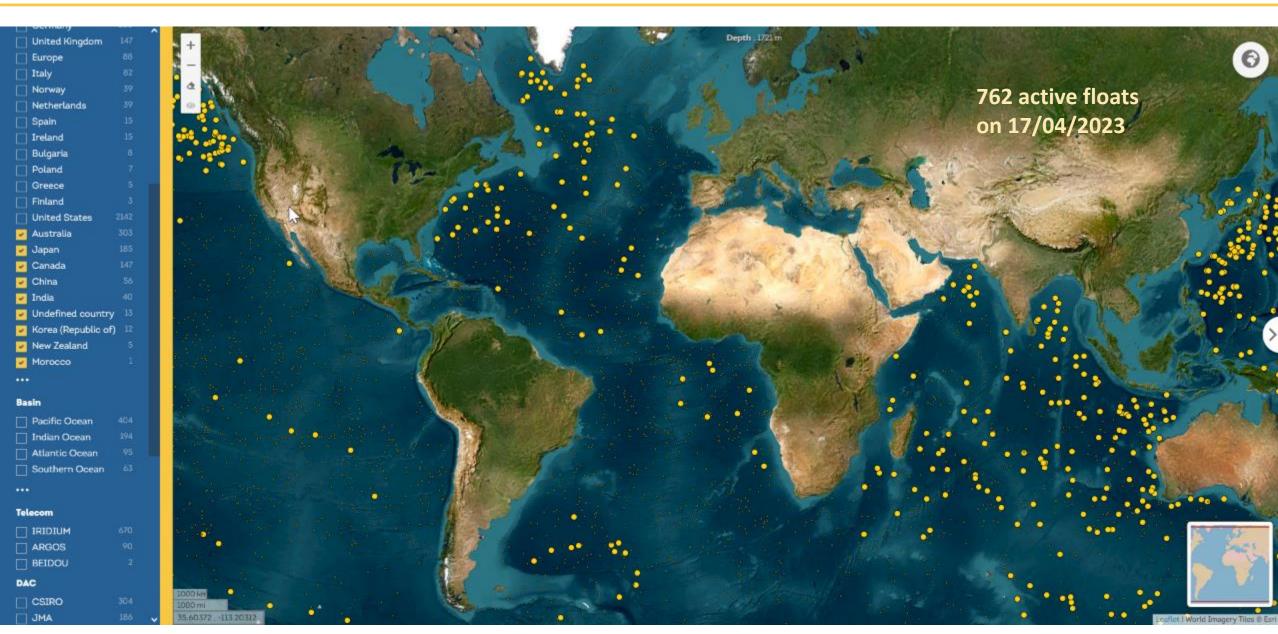


# **BACKGROUND: USA contributions (1/2 of ARGO)**





# **BACKGROUND: ARGO, other international contributions**





# The Euro-Argo Research Infrastructure

#### **Objective:**

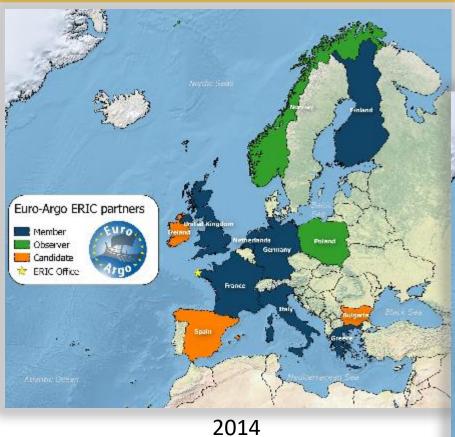
 to coordinate, optimize and sustain the European contribution to the global Argo network (1/4 of the network)

#### **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



Observer Candidate ERIC Office

2019



Now:

12 Members, 17 Institutes
150 Scientists, 100 ships

2022



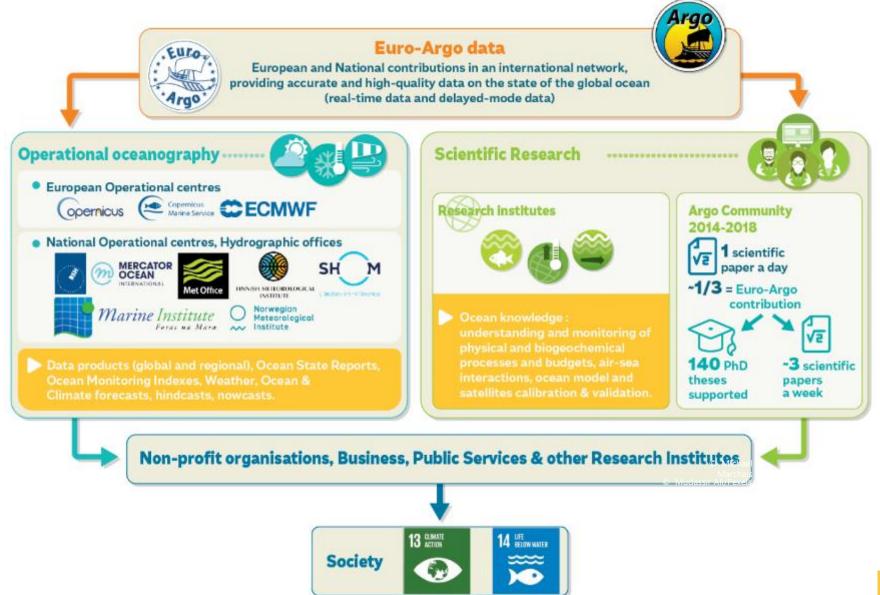
# **Distribution of ERIC activities**

Argo	ERIC Office's tasks	Euro-Argo ERIC activities	National Members' co	ntributio	
Argo international	Ensure the roadmap for the evolution of the European contribution to Argo is followed	Implementation of a strong Euro-Argo programme  Definition of the Euro-Argo road map	Coordination of national strategic p	olan	
Manufacturer Ship of opportunity	Centralised float procurement International collaboration for deployment	European deployments fulfil both the international Argo programme requirements and the European scientific & operational oceanography community's needs.	Float procurement & deployment Ocean	Argo	
	Coordinate European contributions to Argo data management	Evolution of the European data-management system Qualified data management Training on data processing and use	Implementation of the Giopai Data Assembly Centres and the Argo Regional Centres		
	Implementation of "At sea monitoring" Test float performance (Ifremer facilities)	Monitoring critical technological float parameters Improvement of float technology	Test float performance in situ Technological development of new floats	SMEs 8	
EuroGOOS Copernicus	Collaboration with research and operational oceanography uses/ needs	Test and integrate new sensors	Development of innovative sensors measuring new parameters	Scientific communities	
Horizon	Centralised Euro-Argo ERIC web site, communication tools, social media, News	Visibility	Outreach activities & Argo national programme web-sites		
	Organise joint R&D activities	Development of the Euro-Argo ERIC strategic GOOS plans CLIVAR	Coordination of national needs Research & Development	Scientific	
	rivers and coordination of actions (G7, COPXX)	Political influence	Representation in the ERIC governance	ific nities	
EMODnet projects	Driver for European research project funding & coordination	Financial sustainability	National contribution and sustainability		



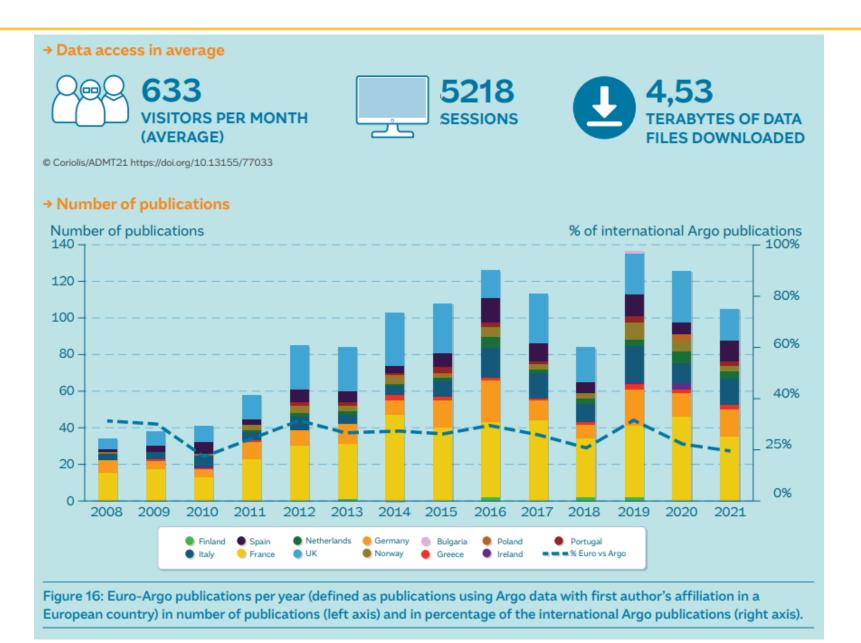
# **DATA ACCESS TO DIFFERENT STAKEHOLDERS**

Euro-Argo benefits for science and operational oceanography



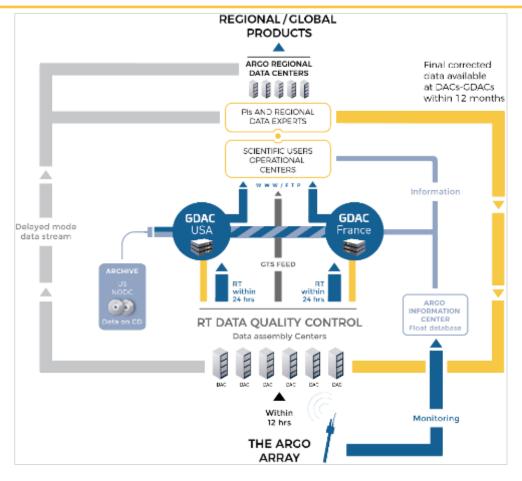


# **ASSESSMENT OF EURO-ARGO SUPPORTING RESEARCH**





## **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



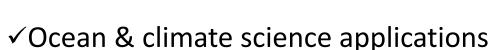
#### **DATA MANAGEMENT SYSTEM: TWO DATA FLOWS**

#### Real Time

- ✓12 hours max
- ✓ Automatic Quality Control tests
- ✓ Operational applications

#### Delayed Mode

- ✓12 months
- ✓ Detailed time serie analysis and corrections







- Profile per profile
- Detect obvious bad data



#### Scientific Delayed Mode Assessment

- Float by float looking at the complete time series
- Detect bad sensor behaviour



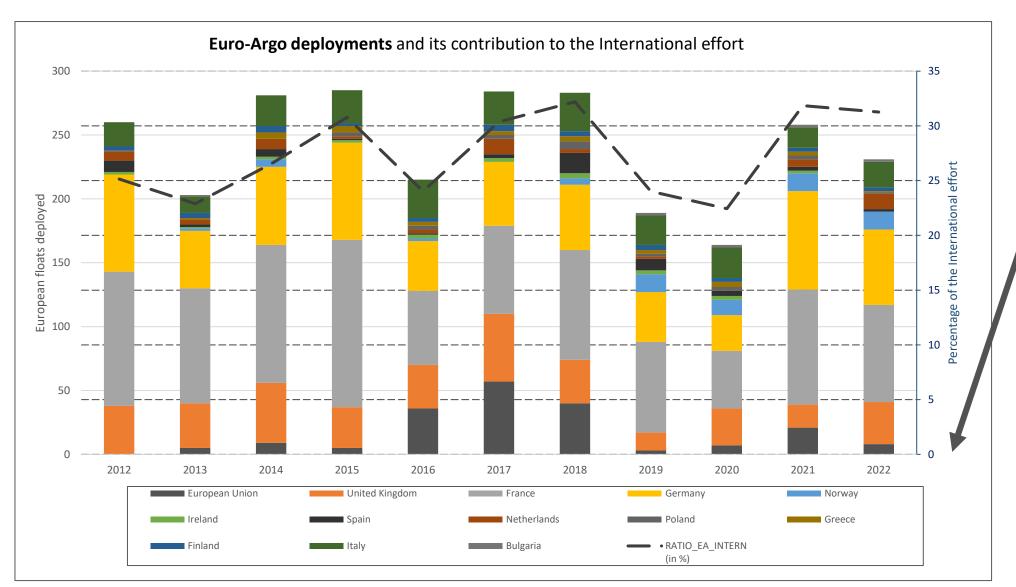


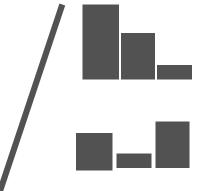
- Look at a batch of floats in an area
- Check if they are consistent with each other

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**





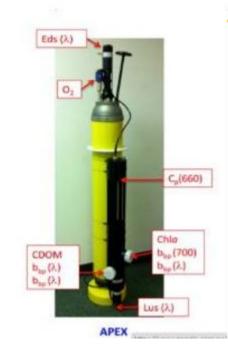
Deep APEX



# **Types of floats: the BGC maze**

Parameter	Sensor	Application
Oxygen	Fluorescence Quenching	Anoxia and suboxia, Carbon Uptake
рН	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





	No. floats				
Float manufacturer	Float types	deployed (approx.)	Biogeochemical sensors used		
Teledyne Webb Research (TWR)	Apex	348	b <sub>bp</sub> <sup>1</sup> , chl a, O <sub>2</sub> , NO <sub>3</sub> , pH		
University of Washington*	Apex(-UW)	412	b <sub>bp</sub> , chl a, O <sub>2</sub> , NO <sub>3</sub> , pH		
NKE Instrumentation	ARVOR, PROVOR	396	Radiometry, b <sub>bp</sub> , chl a, O <sub>2</sub> , NO <sub>3</sub> , pH		
Sea-Bird Scientific	Navis	67	Radiometry, b <sub>bp</sub> , chl a, O <sub>2</sub> , NO <sub>3</sub> , pH		
WHOI*	SOLO	35	O <sub>2</sub>		
MetOcean	NOVA	34	O <sub>2</sub>		
Optimare GmbH	NEMO	24	O <sub>2</sub>		
The Tsurumi-Seiki Co., Ltd. (TSK)	ALMIN	2	O <sub>2</sub>		
MRV Systems	S2A	2	O <sub>2</sub>		

<sup>&</sup>lt;sup>1</sup>Suspended particles via particulate optical backscattering b<sub>bp</sub> 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

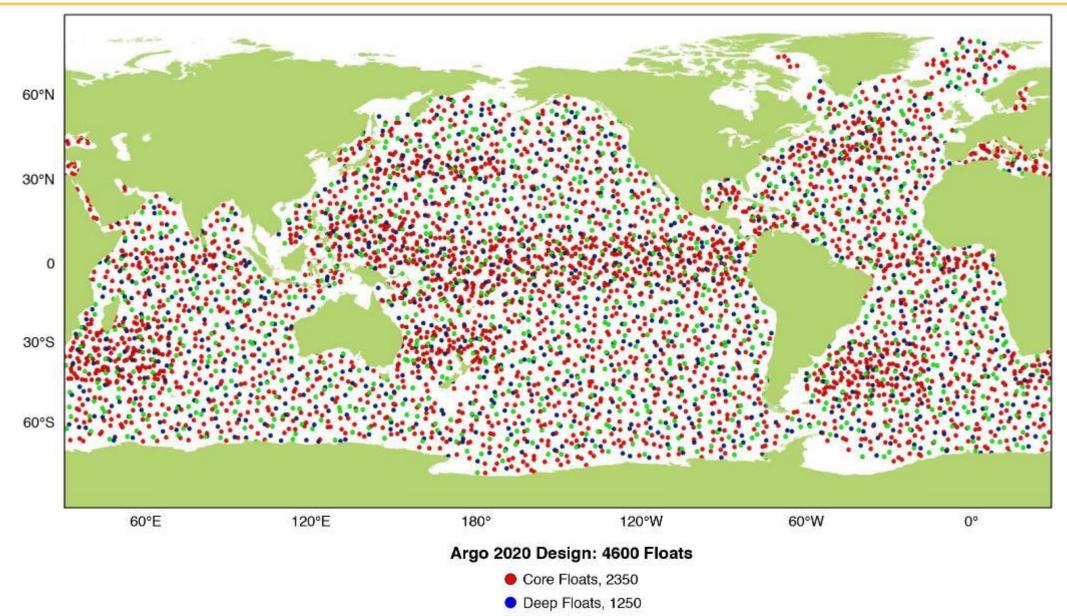
On the Future of Argo: A Global, Full-Depth, Multi- Disciplinary Array
Dean Roemmich <sup>L+</sup> , Matthew H. Alford <sup>L+</sup> , Hervé Claustre <sup>2+</sup> , Kenneth Johnson <sup>2+</sup> , Brian King <sup>4+</sup> ,
James Moum <sup>6*</sup> , Peter Oke <sup>6*</sup> , W. Brechner Owens <sup>7*</sup> , Sylvie Pouliquen <sup>6*</sup> , Sarah Punkey <sup>6*</sup> ,
Megan Scanderbeg <sup>1</sup> *, Toshio Suga <sup>5</sup> *, Susan Wijffels <sup>71</sup> , Nathalie Zilberman <sup>1</sup> *, Dorothee Bakker <sup>10</sup> .
Molly Baringar <sup>11</sup> , Mathicu Belbeoch <sup>12</sup> , Marry C. Bittig <sup>2</sup> , Emmanuel Boss <sup>12</sup> , App. Paulo Calil <sup>14</sup> ,
Eiona Carue <sup>ta</sup> , Ei Thierry Caruel <sup>a</sup> , Ei Fei Chai <sup>ta</sup> , Diarmuid Ó Conchubhair <sup>17</sup> , Ei Fabrizio d'Ortenzio <sup>a</sup> ,
<ul> <li>Giorgio Dall'Olmo<sup>10</sup>, pp Damien Desbruyeres<sup>0</sup>,</li></ul>
🕒 Gael Forget <sup>es</sup> . 🌒 Howard Freeland <sup>es</sup> . 🔝 Tetsuichi Fujiki <sup>es</sup> . 🎒 Marion Gehlen <sup>es</sup> . 💮 Blair Greenan <sup>es</sup> . 📄 Robert
Hallberg <sup>26</sup> , Toshiyuki Hibiya <sup>27</sup> , ਆ Shigeki Hosoda <sup>23</sup> , Steven Jayne <sup>7</sup> , Markus Jochum <sup>26</sup> , Cregory C.
Johnson <sup>20</sup> ,
Yueng-Djern Lenn™.
Jonathan Nashi, Alberto Naveira Garabato <sup>4</sup> , Are Olseni <sup>2</sup> , Rama Rao Pattabhi <sup>28</sup> , Satya Prakashi <sup>28</sup>
Stephen Riser 5, Catherine Schmechtig 6, Claudia Schmid L, Claudia Schmid Andreas Sterf L.
Philip Sutton <sup>42</sup> . 🔃 Lynne Talley <sup>1</sup> . 🕵 Toste Tanhua <sup>52</sup> . 🍘 Virginie Thierry <sup>9</sup> . 🔃 Sandy Thomalla <sup>45</sup> . 🔝 John
Toole <sup>7</sup> , Ariel Troisi <sup>64</sup> , Thomas W. Trull <sup>6</sup> , Jon Turton <sup>18</sup> , Pedro Joaquin Velez-Belchi <sup>66</sup> ,
Waldemar Walczowski <sup>48</sup> , Haili Wang <sup>40</sup> , Rik Wanninkhof <sup>13</sup> , Arny F. Waterhouse <sup>3</sup> , Stephanie Waterman
49, Andrew Watson <sup>49</sup> , Cara Wilson <sup>60</sup> , Annie P. S. Wong <sup>18</sup> , Jianping Xu <sup>16</sup> and Lichino Yasuda <sup>60</sup>

Decian element Ov indicates	Active	Status
Design element 2x indicates doubled density (i.e., 2 floats per 3° square)	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. Fina 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**



BGC Floats, 1000

**JCOMMOPS** 



### **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





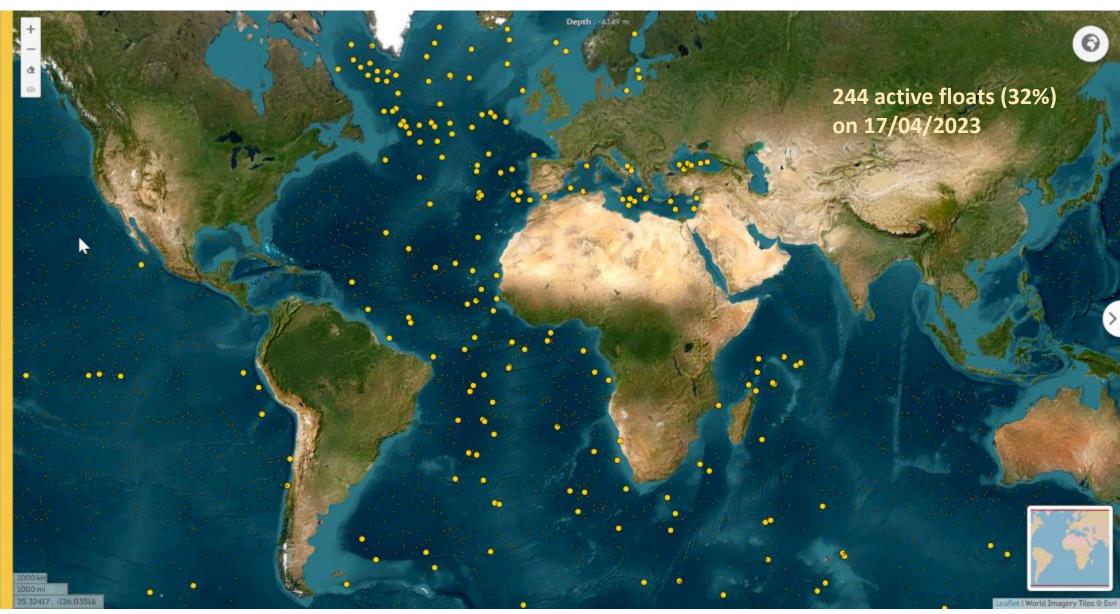
# **BACKGROUND: BGC worldwide**





# **BACKGROUND:** Euro-Argo BGC

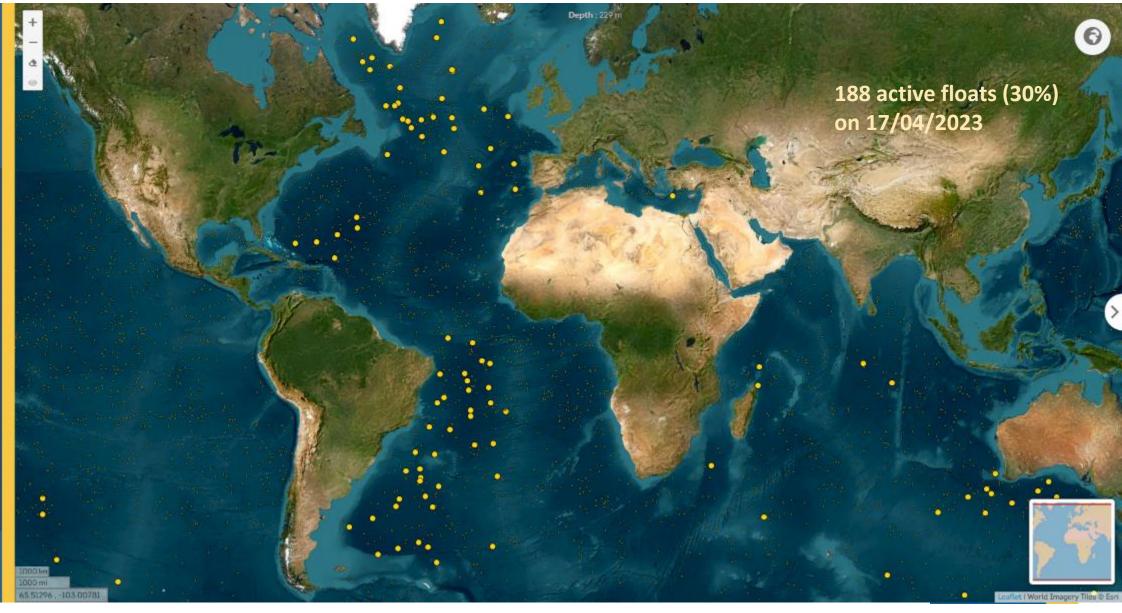






# **BACKGROUND: DEEP worldwide**

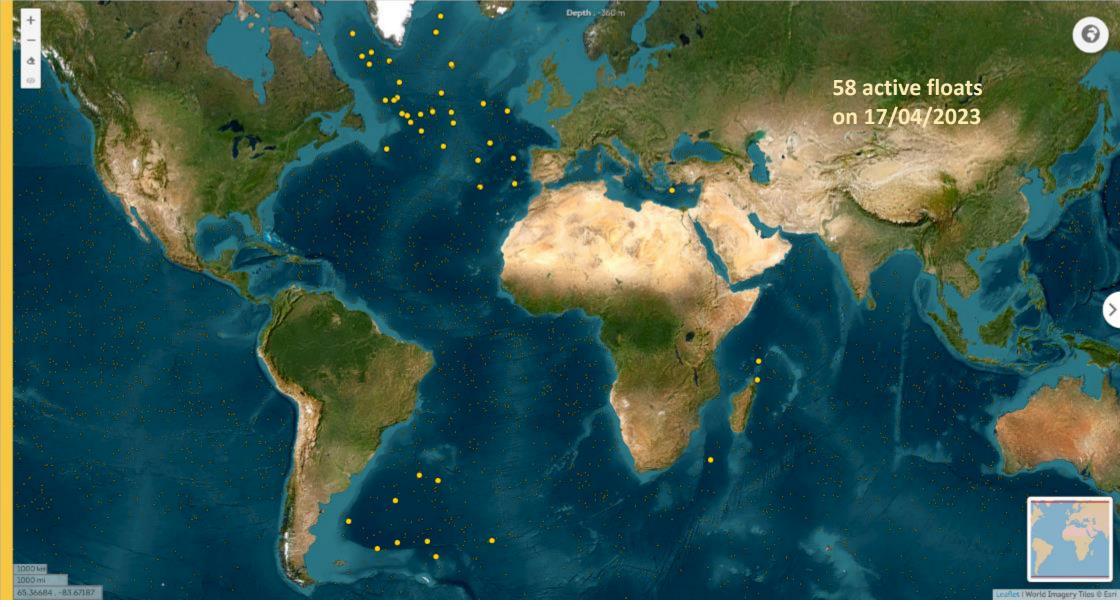
***	^
Country	
France	41.
☐ Norway	7
United Kingdom	5
Europe	4
Italy	1
United States	116
Japan Japan	12
Australia	2
***	
Basin	
	76
Atlantic Ocean Pacific Ocean	55
Indian Ocean	22
Southern Ocean	20
Soddiein ocean	
***	
Telecom	
☐ IRIDIUM	188
DAC	
AOML	116
CORIOLIS	53
☐ JMA	12
BODC	
	1/2
****	
Variable	
SUBSURFACE P	188
SUBSURFACE S	188
SUBSURFACE TE	188
OXYGEN	55
Network	
CORE	3273
BGC	581
DEED	188 🕶





# **BACKGROUND:** Euro-Argo DEEP





- 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<sub>2</sub> 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...



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