ANR Equipex+ ARGO 2030

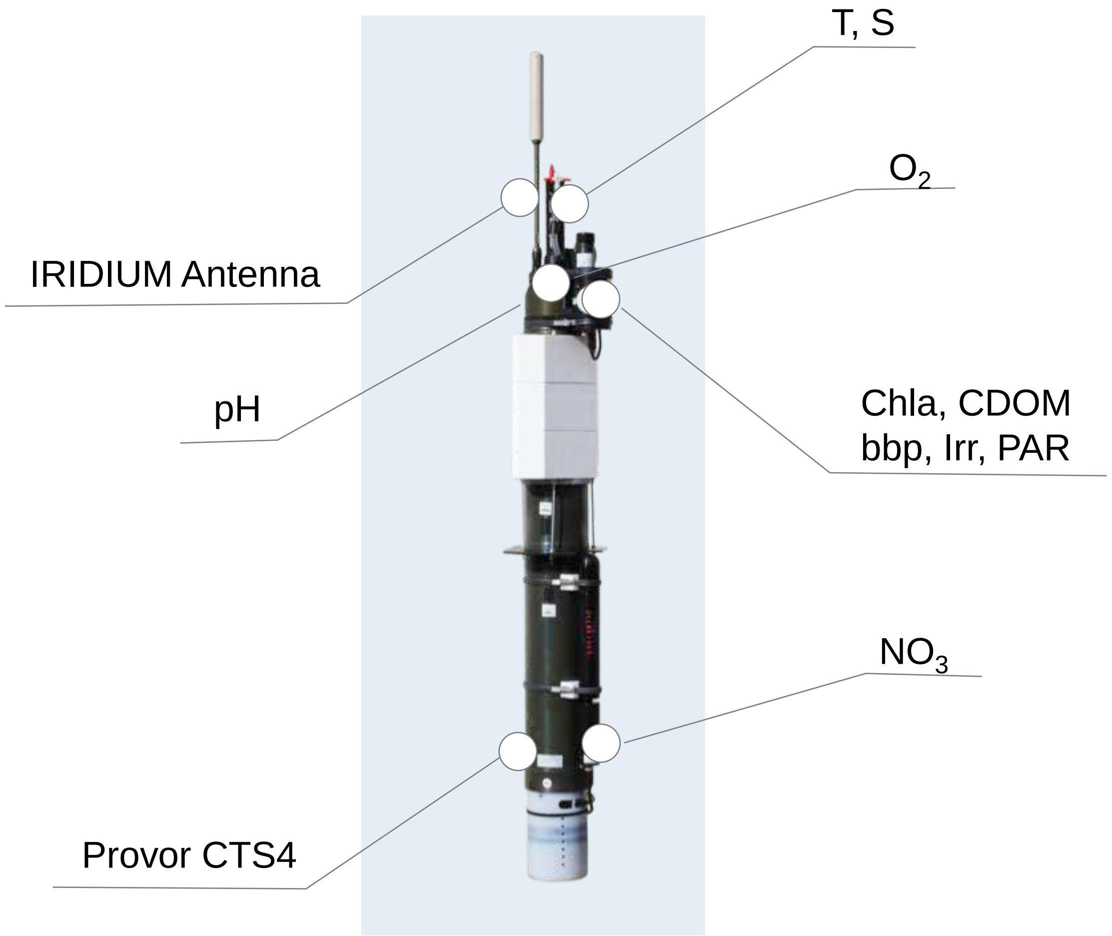
Co-lead between Ifremer (V. Thierry) and Sorbonne Université (F. D'Ortenzio)
2021-2028, submitted

- **Argo-2030 proposes to consolidate the french contribution to BGC-Argo (WP1)**
- **Argo-2030 also proposes to prepare Argo's next phase by testing and validating a second generation of BGC (WP2) and Deep-Argo (WP3) floats that will dramatically increase the network's scientific potential.**
- Argo-2030 will be completely integrated into Argo-France. It will maintain France as the European leader and key international actor of the Argo program.
- Partnership between Ifremer – Sorbonne Université – CNRS/INSU and UBO
- Laboratories: LOPS – LOV – Ifremer/RDT – Ifremer/IRSI

	WP0	WP1	WP2	WP3	Total
Requested Budget	454k€	2 233 k€	2 131€	2 254k€	**7 071 381 €**
Human ressources	134 mm	64 mm	98.5 mm	79 mm	375 mm

WP1. Consolidation of the global BGC-Argo network
WP leader F. d’Ortenzio (SU/LOV)

The main objective of the Argo-2030 WP1 is to contribute to the consolidation of the global BGC-Argo network, by acquiring 20 BGC-Argo floats.



An Argo-2030 BGC-Argo is

- based on a NAOS WP3 floats
- systematically equipped of NO3 and pH sensors

Argo 2030 will enable Argo- France to reach its international commitments to deploy about 13-15 BGC-Argo floats per year over 2021-2028.

WP1. Consolidation of the global BGC-Argo network

The Argo-2030 WP1 BGC-Argo floats will be distributed to, and deployed by, the French research community.

Floats will be distributed through an annual tender, after independent evaluation by the LEFE GMMC committee

WP2. Exploring marine biogeochemistry and ecology from the upper ocean to the twighlight zone with BGC-ECO-Argo floats

WP leader J. Uitz (SU/LOV)

Why?

1. Biogeochemical impact

Upper trophic levels play a key role in processes of potentially critical biogeochemical importance, (e.g. zooplankton active vertical migrations, production of sinking fecal particles or fragmentation of aggregates), which may largely control the transfer of carbon from the euphotic to the twilight zone (100–1000 m). Yet, these processes remained rarely investigated and their biogeochemical impact poorly characterized and quantified on relevant space and time scales.

2. Pelagic fishery and ecosystem management

Zooplankton and micronekton also constitute trophic links between phytoplankton and top predators (fishes, marine mammals). Thus, **upper trophic levels shape marine resources with large societal and economic implications** that need to be accounted for.

WP2. Exploring marine biogeochemistry and ecology from the upper ocean to the twighlight zone with BGC-ECO-Argo floats

How?

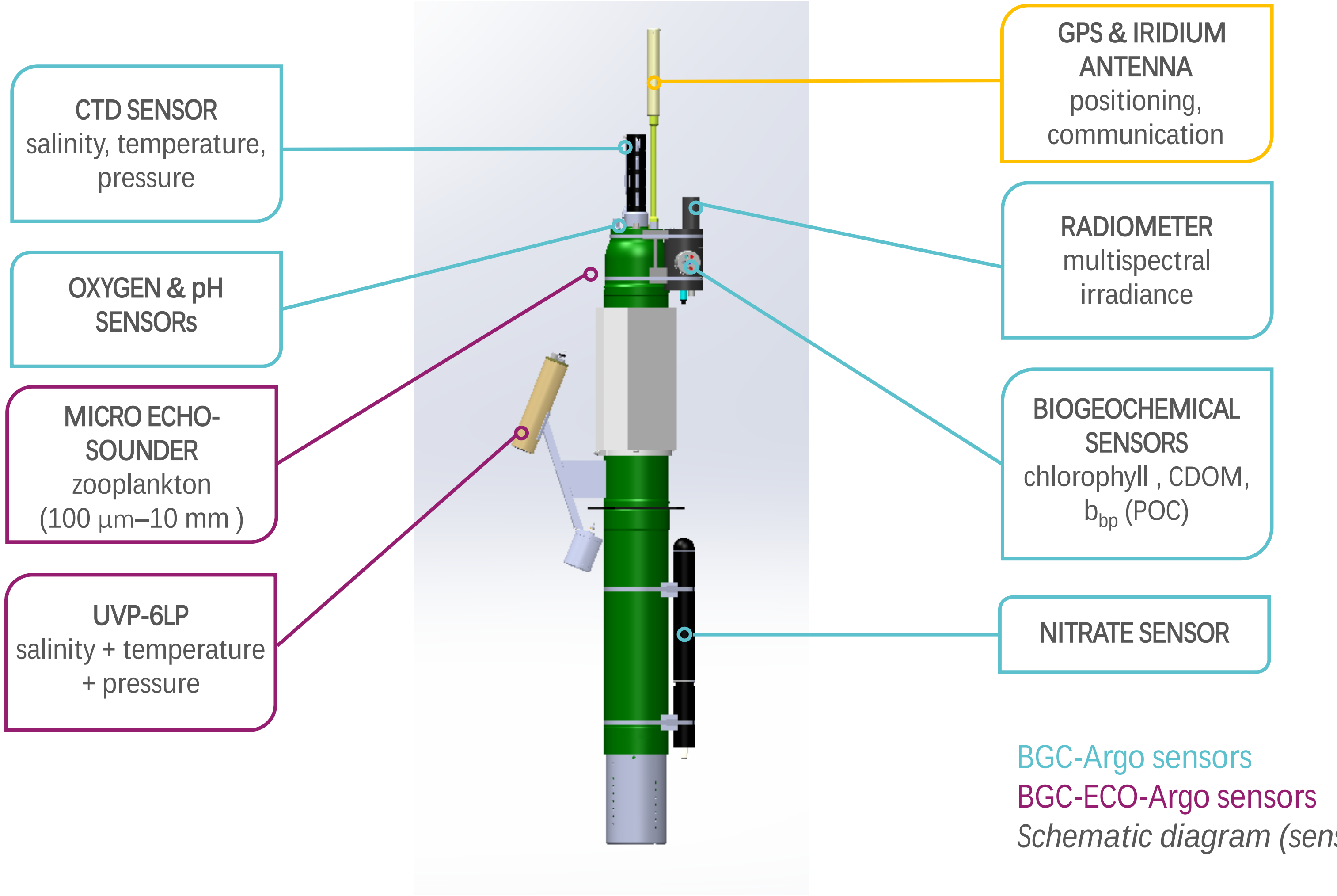
Standard sensors on BGC-Argo floats already yield insights into phytoplankton and small particle-driven processes, the upper trophic levels remaining unmonitored.

Thus we propose to implement novel mature technologies of imaging and acoustic sensors

1. **A low-power miniaturized version of the Underwater Video Profiler (UVP6-LP)**: Can size particles within the 100 μm–10 mm range and determine zooplankton biomass and composition.
2. **A low-power active high-frequency micro-echo sounder (μ-ES)**: Detects plankton and micronekton (2–20 cm) as well as marine snow (1 mm–30 cm).

In addition, the standard BGC-Argo sensors (fluorometer, backscatterometer, and irradiance sensors, SeaBird-WET Labs) will be substituted by more competitive improved sensors developed by French companies

WP2. Exploring marine biogeochemistry and ecology from the upper ocean to the twighlight zone with BGC-ECO-Argo floats



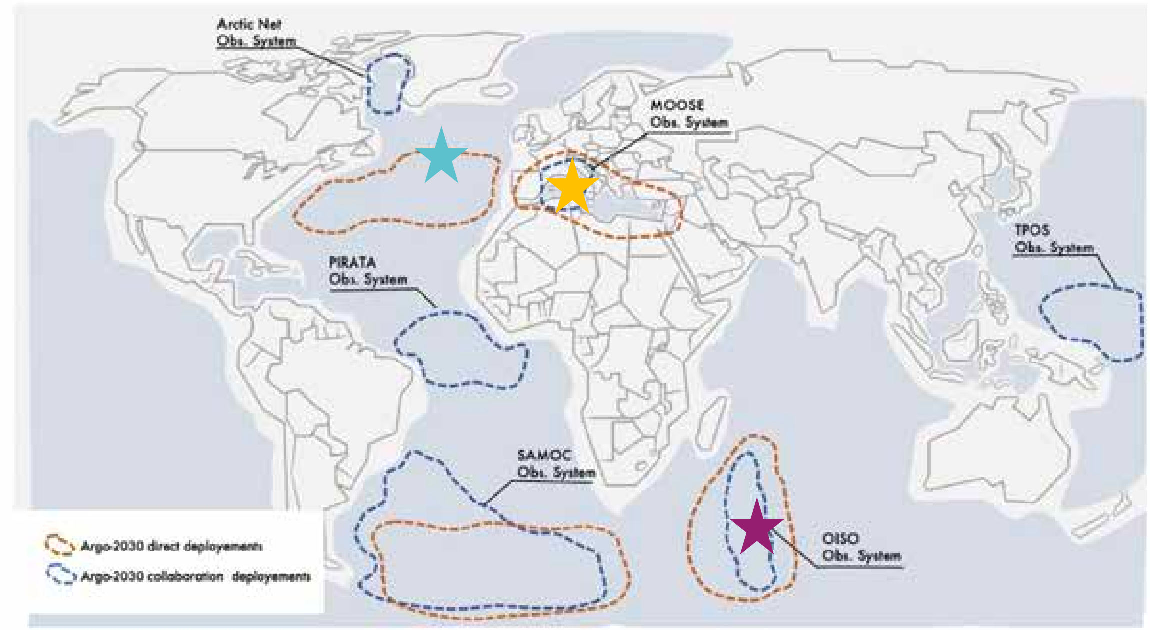
Schematic diagram (sensors positioning not definitive)

WP2. Exploring marine biogeochemistry and ecology from the upper ocean to the twighlight zone with BGC-ECO-Argo floats

Where?

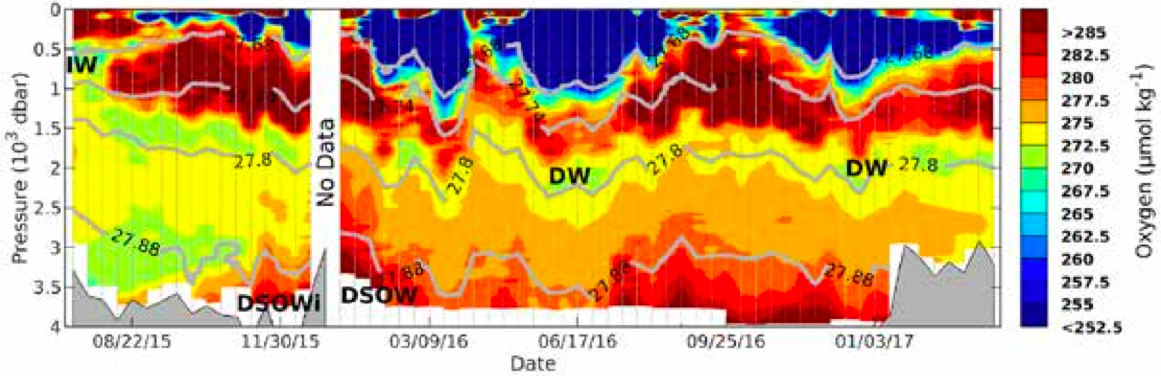
The proposed 15 BGC-ECO-Argo floats will be deployed, in priority, in regions with recurrent phytoplankton blooms, driven by a variety of physico-chemical factors and upper trophic levels playing a potentially important biogeochemical role.

These regions also cover a latitudinal gradient of phenology, from temperate to subpolar and polar areas.



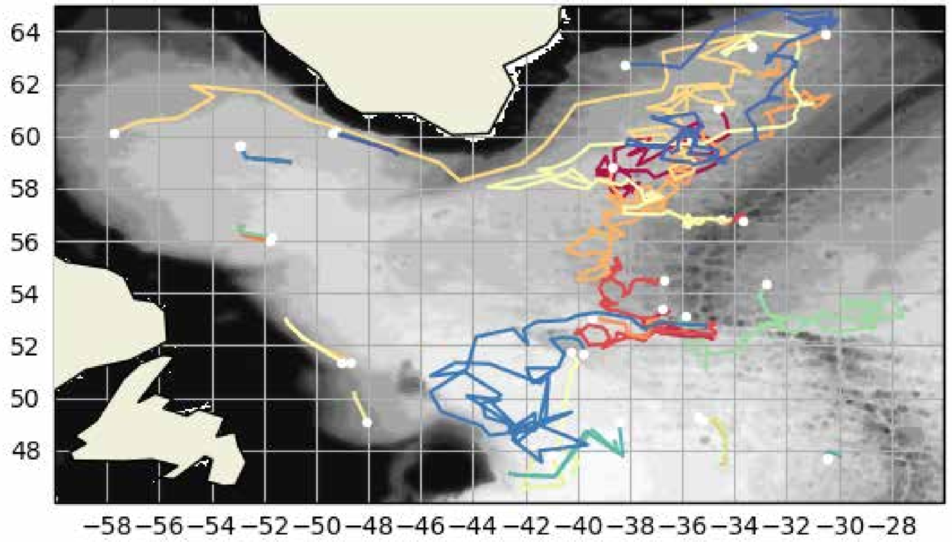
WP3. Monitoring abyssal oceanic layers with Deep-6000 Argo floats with oxygen sensors
WP leader D. Desbruyères (Ifremer/LOPS)

O_2 concentration near Charlie Gibbs Fracture Zone (Racapé et al, 2019)



...yielded new insights into deep water mass circulation and mixing in a region essential for climate variability...

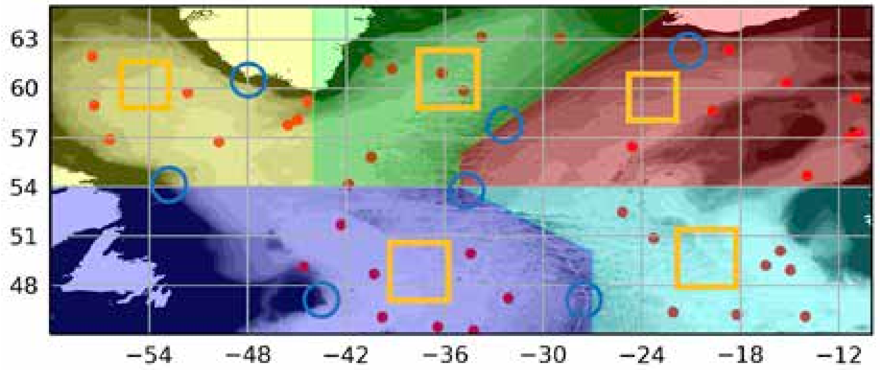
The Deep-Arvor 4000



Deep-Arvor trajectories in the SPG

NAOS "Deep-Argo" target: the deep layers of the Subpolar North Atlantic. About 30 float deployed and 1500 0-4000m profiles...

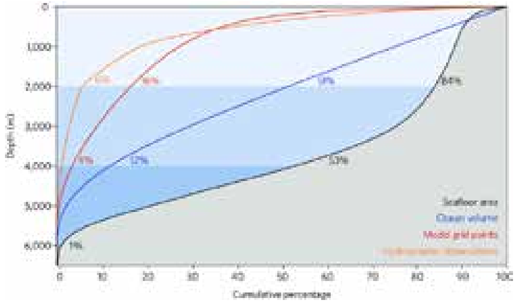
Targeted sustained array and deployment locations



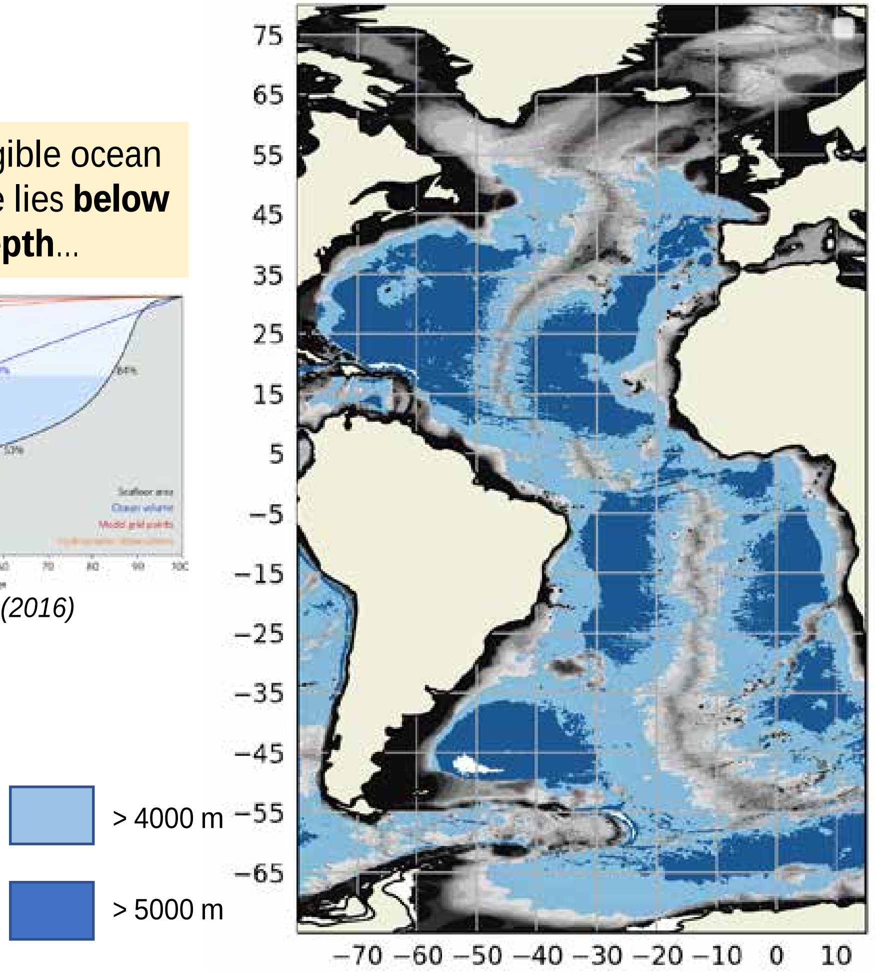
...and motivated a forthcoming monitoring of deep physical and biogeochemical inventories through a sustained regional array of 40 Deep-Arvor O_2 4000 m.

WP3. Monitoring abyssal oceanic layers with Deep-6000 Argo floats with oxygen sensors

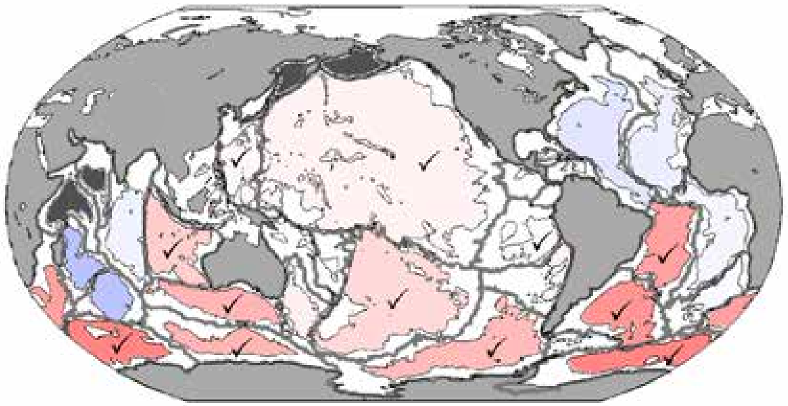
But a non-negligible ocean area and volume lies **below 4000 m depth**...



De Lavergne et al (2016)



Abyssal (>4000m) temperature trends (Desbruyères et al 2016)

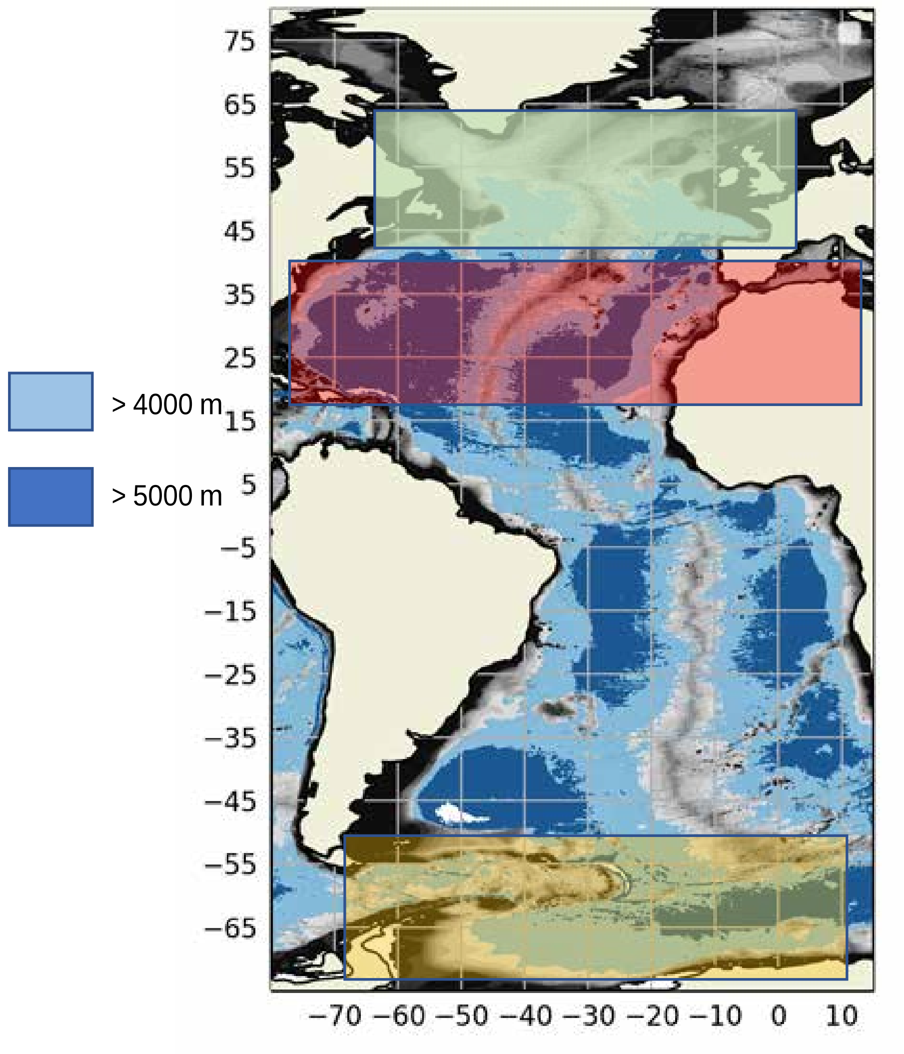


... where the most significant **abyssal warming and freshening** has been detected from repeated ship-based measurements.

Monitoring this key climate signal and more generally the propagation of abyssal water masses above the ocean bottom, requires **adequate Argo equipment.**

The main objective of **WP3** is to strengthen the French/European contribution to the Deep-Argo Program, by **acquiring and deploying 24 Deep-Arvor** floats with oxygen sensors **capable of reaching 6000 m depth.**

WP3. Monitoring abyssal oceanic layers with Deep-6000 Argo floats with oxygen sensors



Deep-Arvor 4000 array in the subpolar North Atlantic

Deep-Arvor 6000 array in the subtropical North Atlantic

Deep-Arvor 6000 array in the subantarctic Atlantic

Capacity to sample both deep (2000-4000 m) and abyssal (>4000 m) areas through a **cost-effective strategy**: regional balance between the **Deep-Arvor 6000** and the twice-cheaper **Deep-Arvor 4000**. The **Atlantic** sector will be a priority target with three deployment zones.

Extension of multi-sensor floats (e.g. O_2) to the ocean floor, thereby launching the monitoring of **biogeochemical properties** throughout the full-water column.

Planning

ARGO-2030 schedule

			2021	2022	2023	2024	2025	2026	2027	2028
WP0	Coordination									
		Annual meetings	X	X	X	X	X	X	X	X
		Project report	X	X	X	X	X	X	X	X
	Data processing									
		Annual report	X	X	X	X	X	X	X	X
WP1	Implementation phase									
		Equipement order	X			X				
		Equipement delivery		X			X			
		Float attribution (GMMC)		X	X	X	X	X	X	X
	Operating phase	Data analysis								
		Annual report	X	X	X	X	X	X	X	X
WP2	Implementation phase									
		Equipement order			X					
		Equipement delivery				X				
	Operating phase	Preparation								
		Data analysis								
		Annual report	X	X	X	X	X	X	X	X
WP3	Implementation phase									
		Equipement order				X		X		
		Equipement delivery					X		X	
	Operating phase	Preparation								
		Data analysis								
		Annual report	X	X	X	X	X	X	X	X