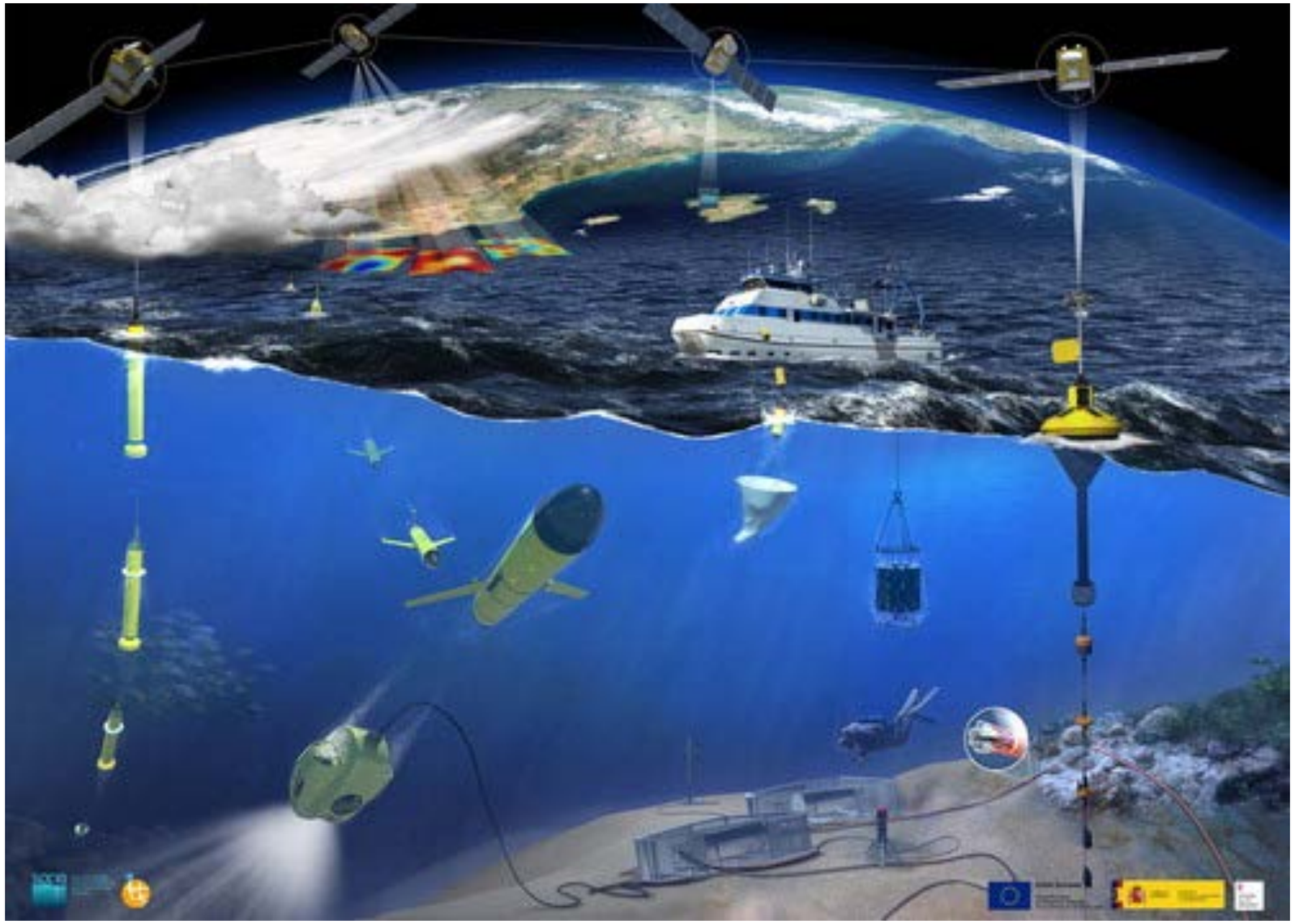
Multi-scale products from Argo float deployments during regional cruises

Ignasi Vallès-Casanova, Josep L. Pelegrí, Dorleta Orúe-Echevarria, Joaquin Salvador

Institute of Marine Sciences ICM
CSIC Consejo Superior de Investigaciones Científicas
UPC
Co-funded by the European Maritime and Fisheries Fund

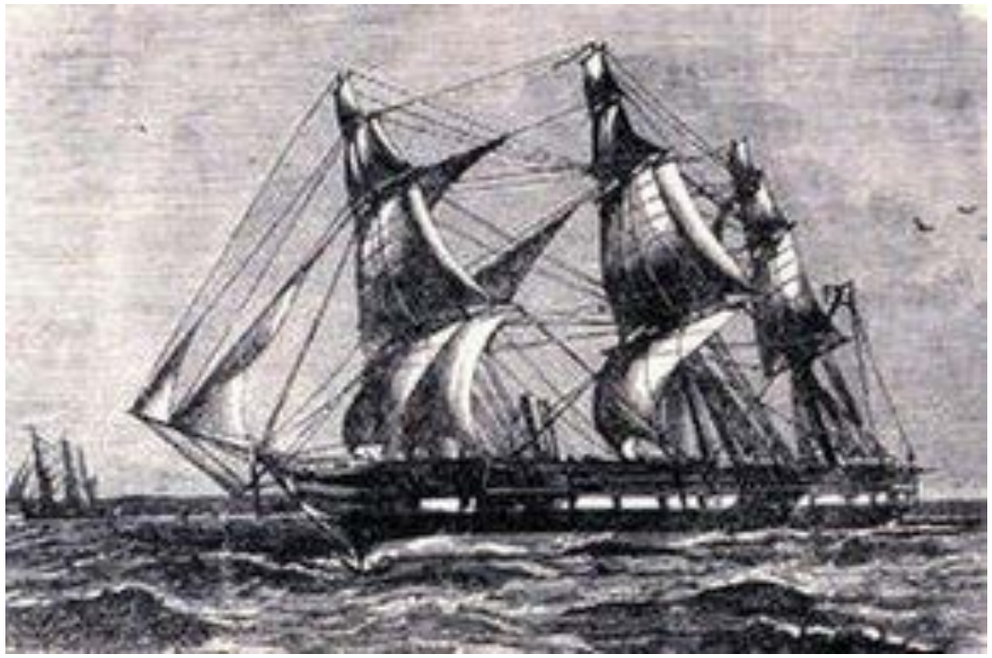
October 23rd, 2019

Multi-platform observations provide a synoptic picture of subsurface properties



Limitations —> Expensive gear, mostly used to describe coastal systems

Oceanographic data collection in the open ocean



Research vessels

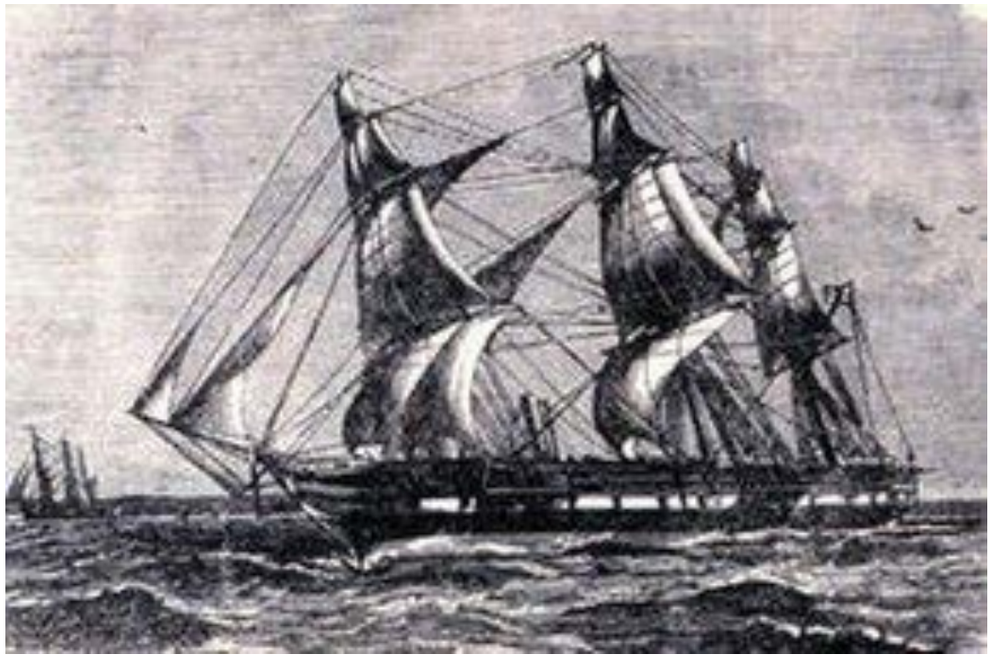
++ Pros ++

- Selection of sampling site
- Near-synoptic picture
- Regular and high resolution grid

- - Cons - -

- Expensive
- Sampling of multiple variables
- Spatio-temporal limitation

Oceanographic data collection in the open ocean



Research vessels

++ Pros ++

- Selection of sampling site
- Near-synoptic picture
- Regular and high resolution grid

- - Cons - -

- Expensive
- Sampling of multiple variables
- Spatio-temporal limitation

Argo floats (since 2017)

++ Pros ++

- Global coverage
- Immediate data access
- Temporal continuity

- - Cons - -

- Low resolution
- Irregular sampling

Objectives

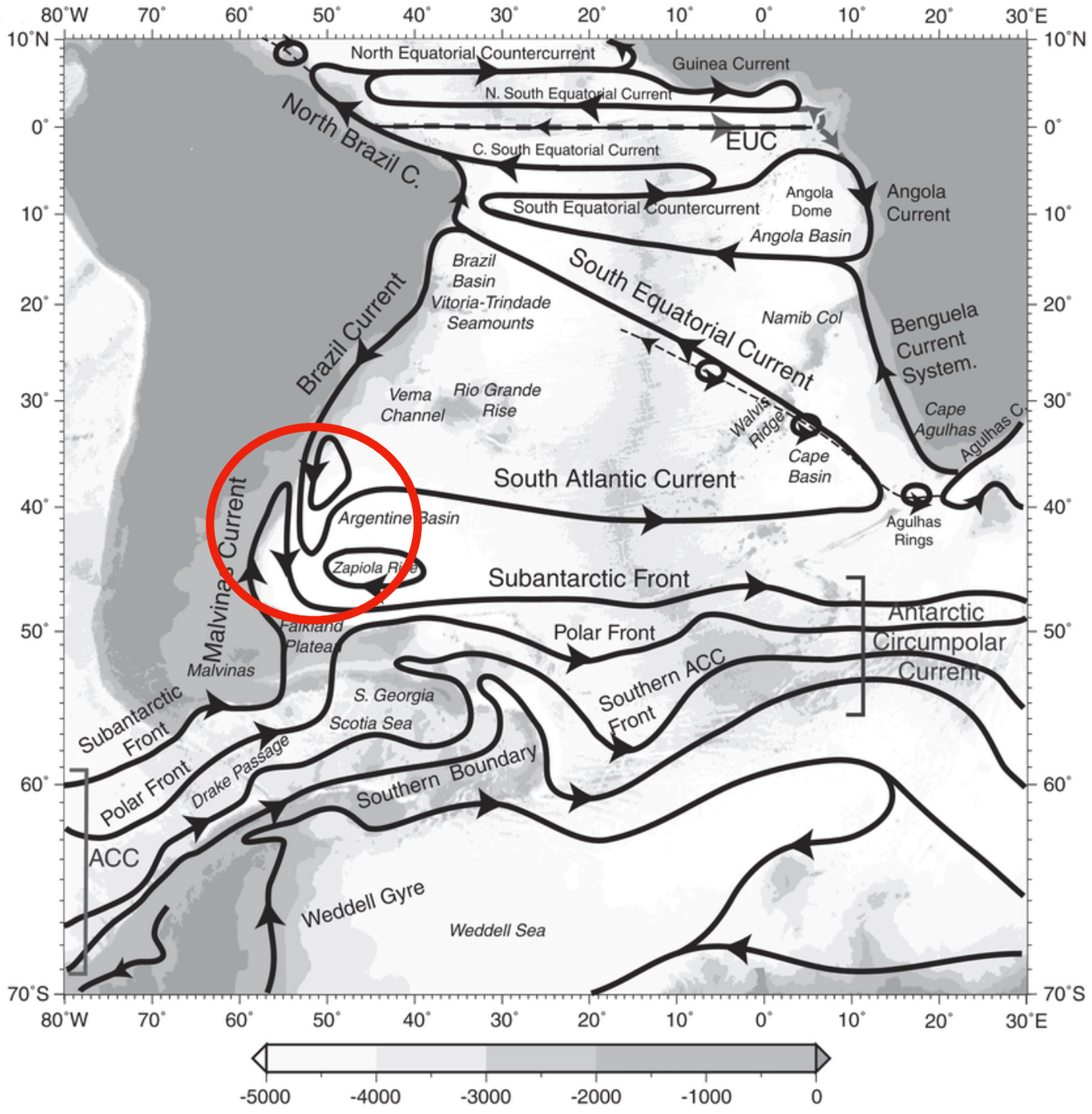
1) Provide the best possible multi-scale perspective of the study region.

2) Increase the operational value of oceanographic cruises.

We use float data of different types:

- Standard Argo.
- High resolution Argo (Argo-HF).
- Purpose floats.

Our study system is the Brasil Malvinas Confluence



Talley et al. (2011)

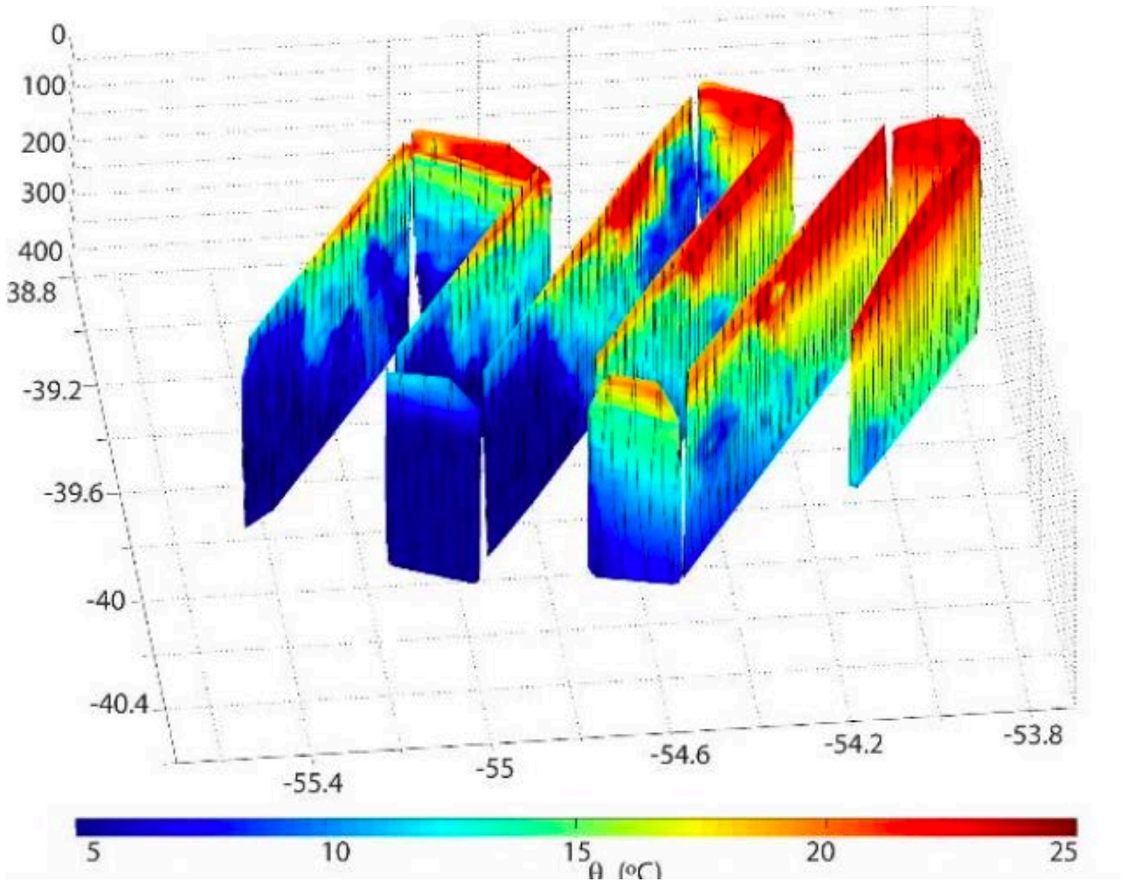
- The Brazil and Malvinas Currents collide in the southeastern margin of South America, with several remarkable properties:

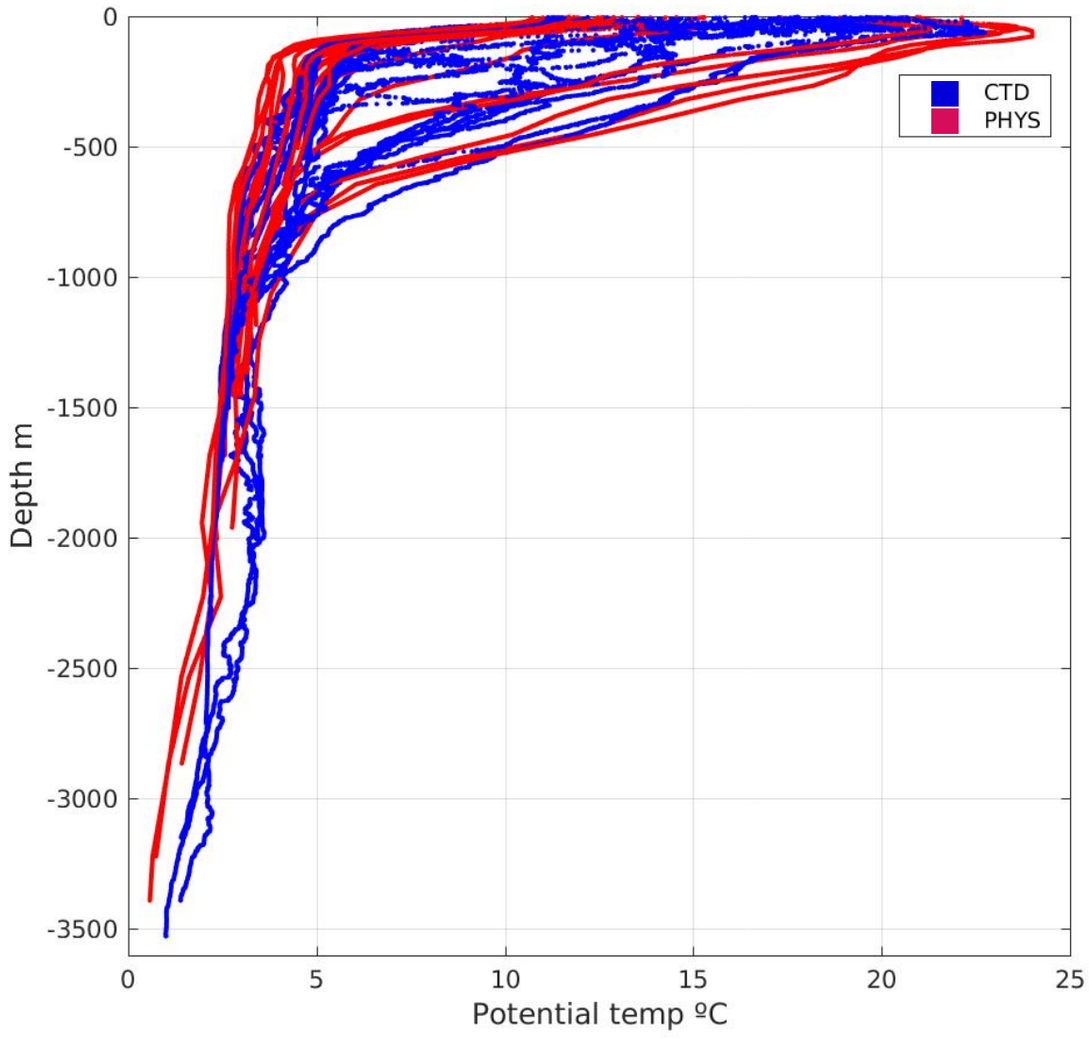
- Substantial seasonal variability in its latitudinal position (38ºS in summer and 35ºS in winter).

- Intense thermohaline front with high meso and sub-mesoscale variability.

- The frontal system leads to a very intense eastward flow - with peak surface velocities near 2 m/s - that feed the South Atlantic Current.

Vertical structure of the frontal system is not well-resolved by global models.





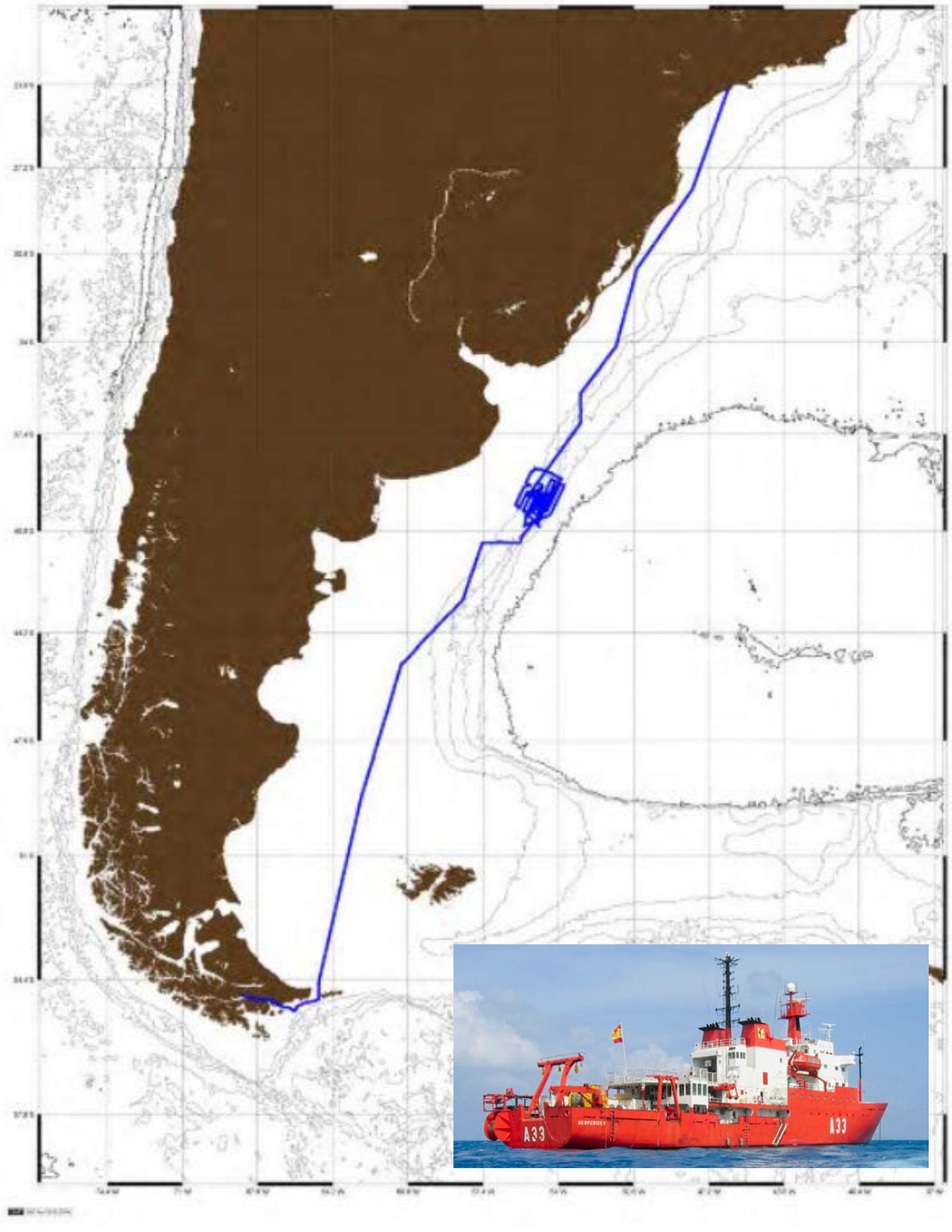
Orúe-Echevarria et al. (2019)

Substantial subsurface intrusions across the frontal system

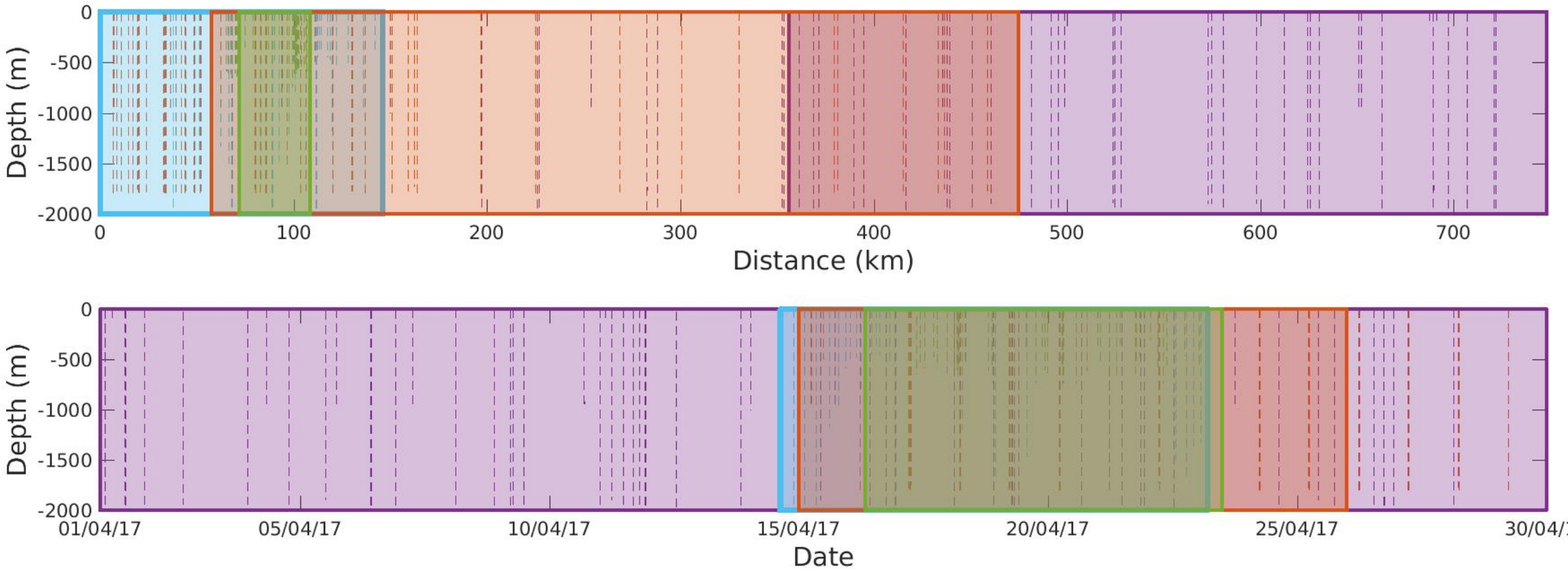
The oceanographic cruise VaDeRetro-BMC in April 2017 (from 08/04 to 25/04)

Multi-platform strategy:

- Hydrographic stations (CTD+LADCP)
- Autonomous devices (APEX+ Argo High Frequency)
- Sea-Soar
- Drifter buoys
- Continuous sampling (ADCP+SST+SSS+meteo+CO2)
- Micro-profiler
- Biogeochemical sampling



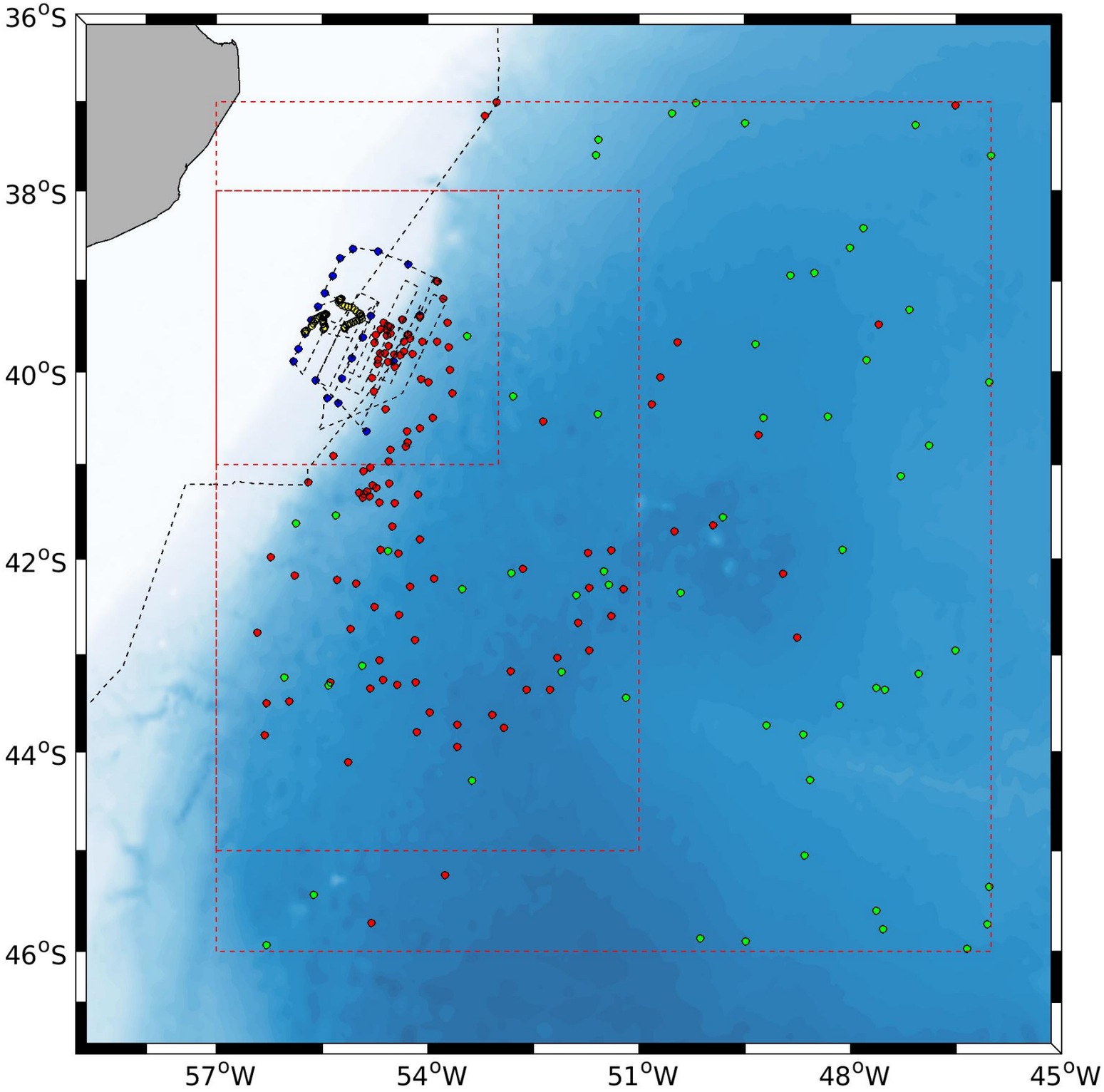
Profile sampling summary: along track casts as function of distance (top) and time(bottom)



CTD
Argo-HF
Argo
APEXi

Method	First profile date	Sampling period (days)	Number of profiles	Depth avg. (m)	Area coverage (km2)
CTD	14/04/2017	9	24	913.08	38620
APEXi	15/04/2017	8	42	307.58	2174.5
Argo-HF	15/04/2017	20	60	878.27	63384
Argo	01/04/2017	30	55	818.49	911440

Profile sampling summary



Multi-scale gridding procedure

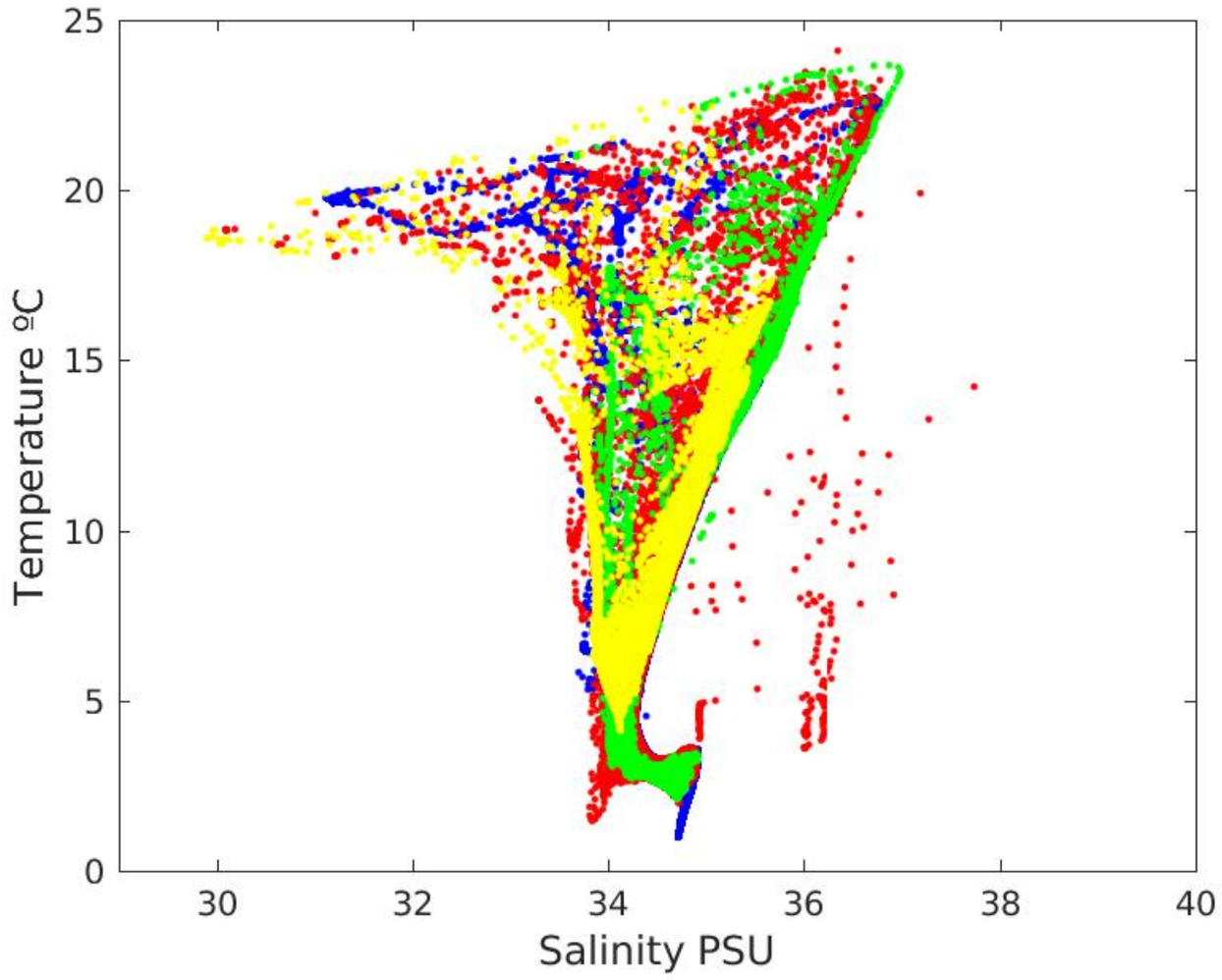
1) Data cleaning T/S

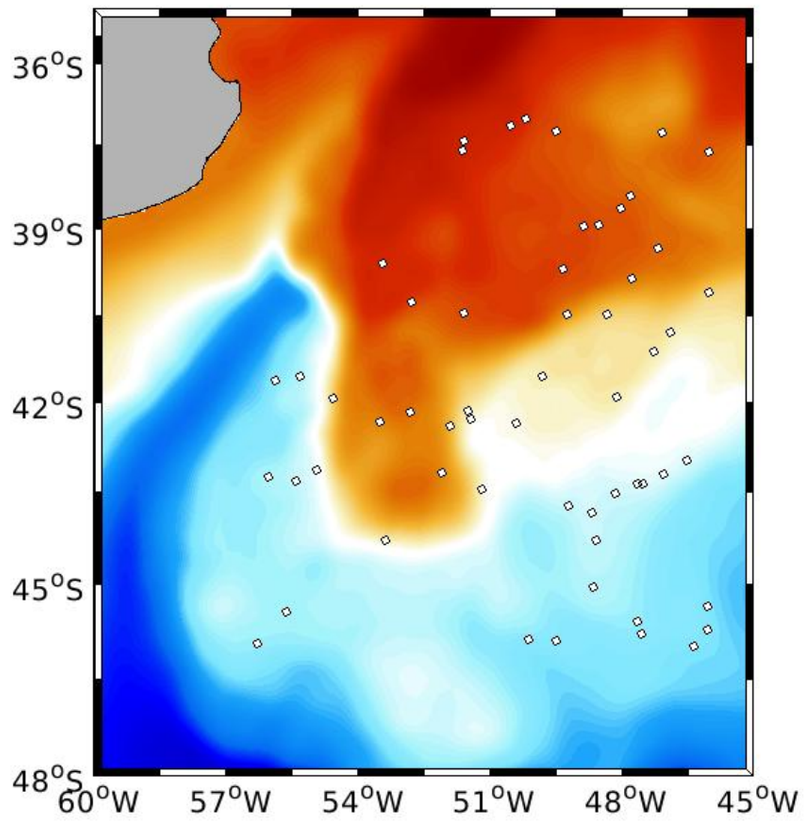
2) Cell size range

$$\frac{h_{ij}}{2} \geq p \geq h_{ij(P=5\%)}$$

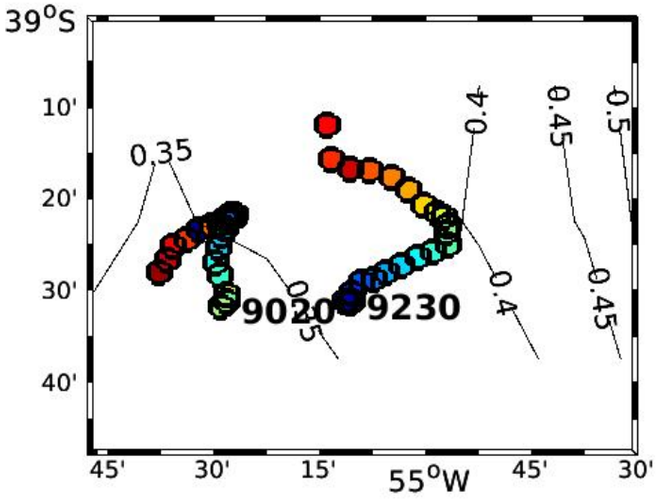
3) Universal kriging

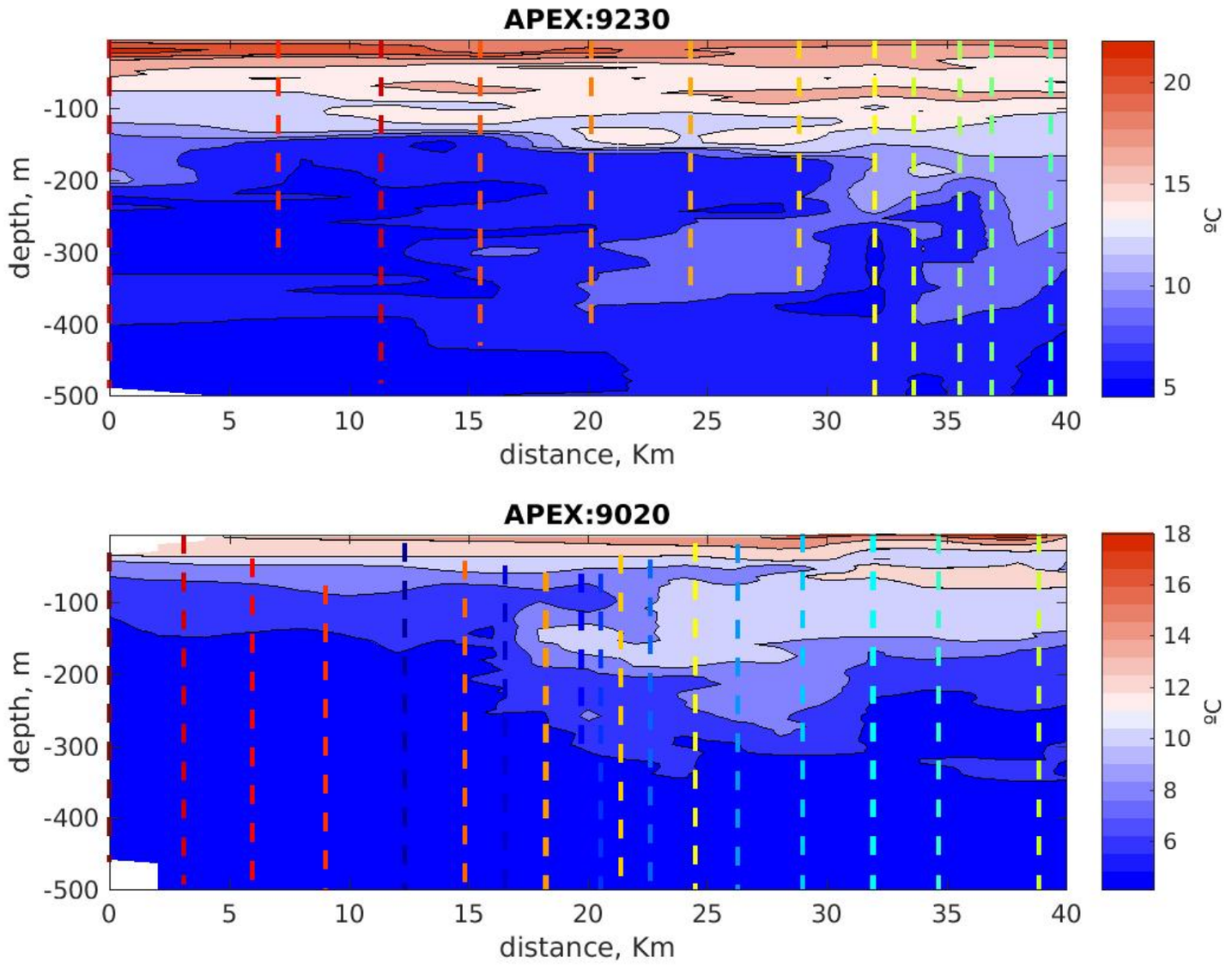
$$Z(s) = \mu(s) + \varepsilon(s)$$



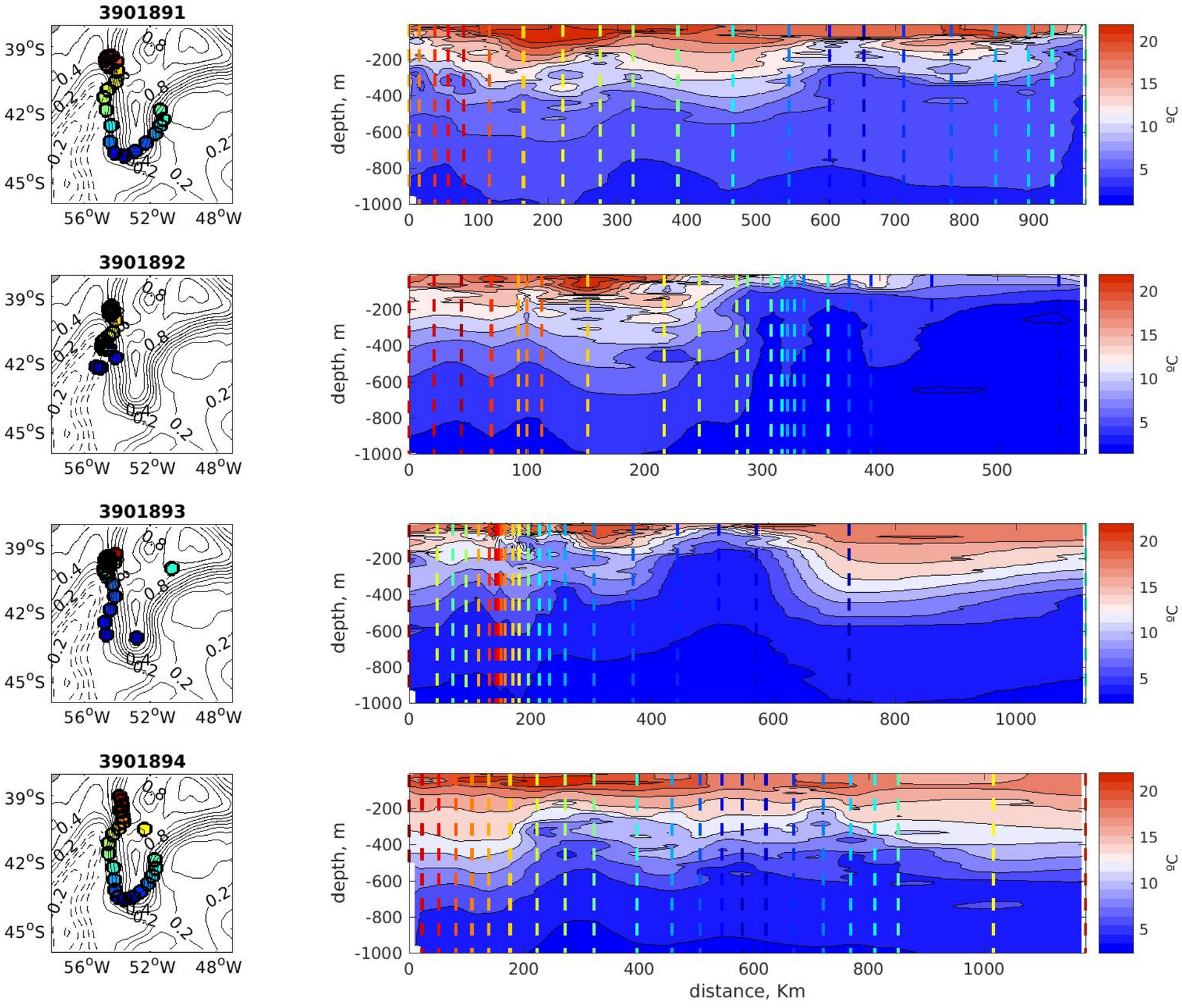


High-resolution sampling of vertical structure



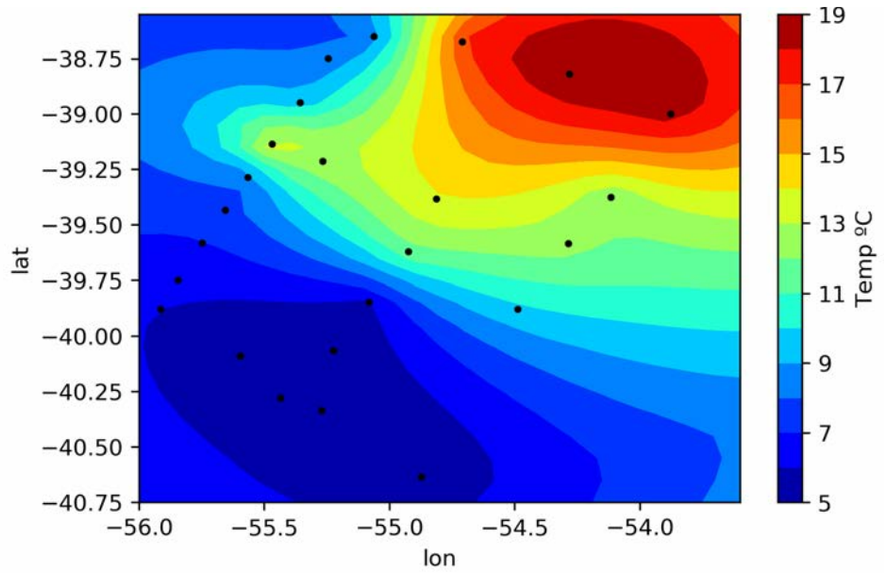


High-resolution sampling of Brasil Current Overshoot

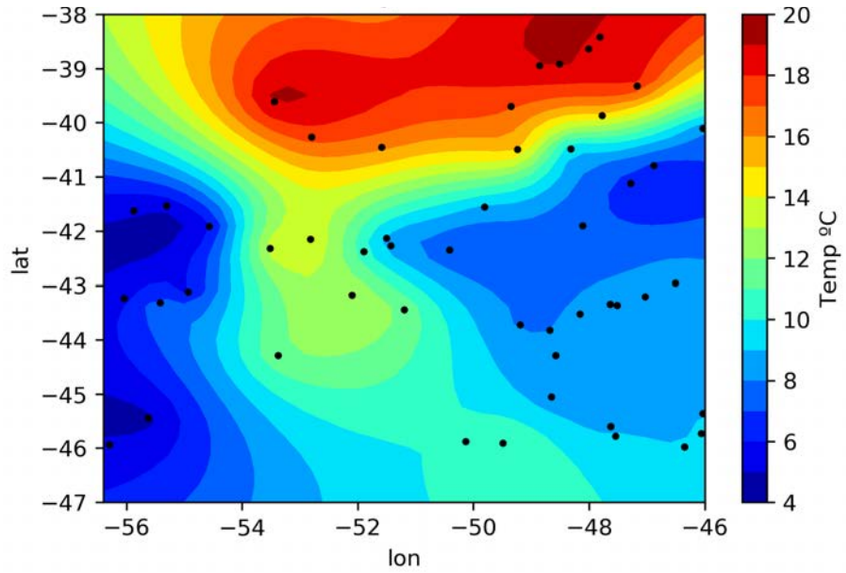


Ocean temperature at 100 dbar

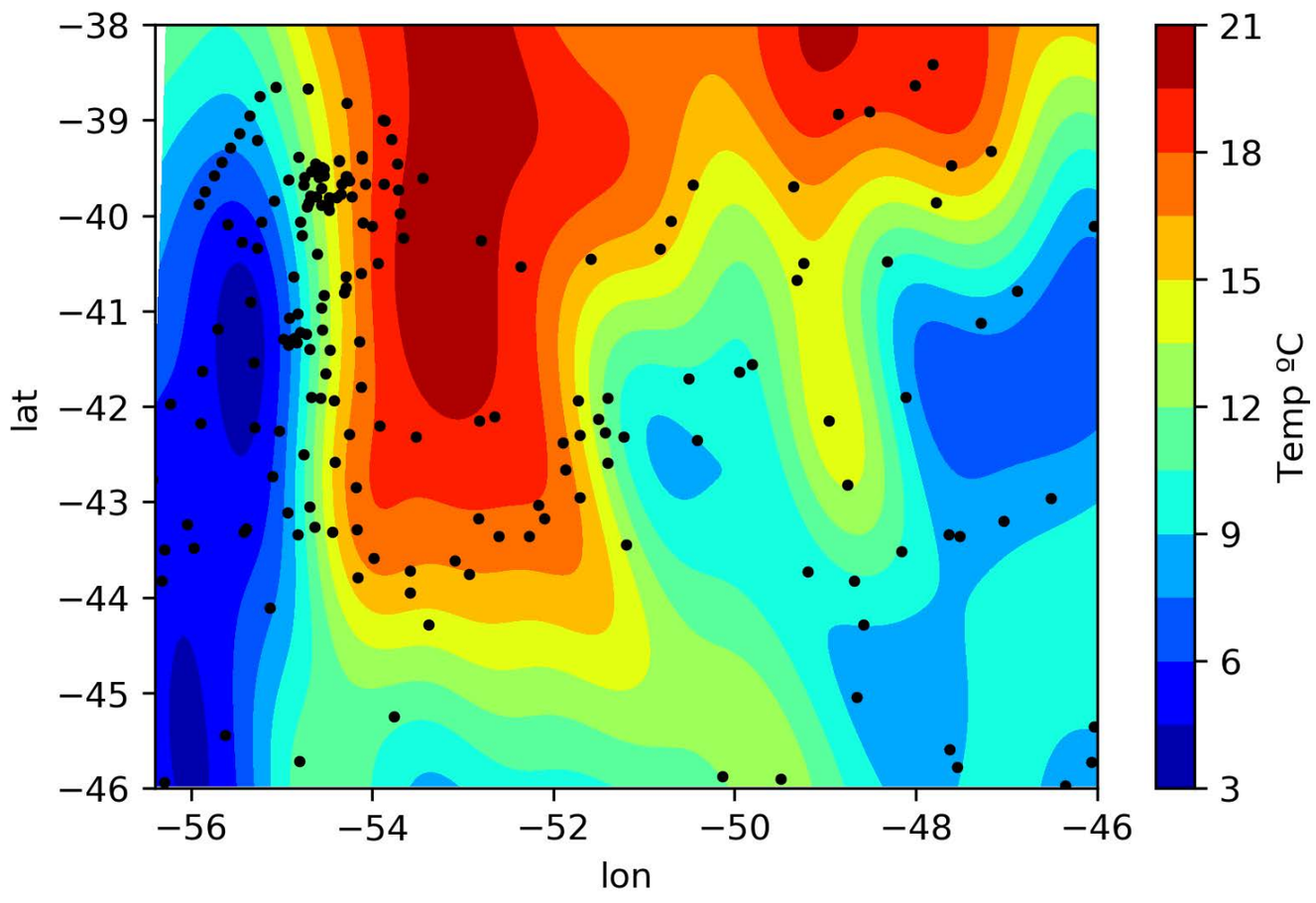
0.1ºx0.1º / 10 days / CTD



0.3ºx0.3º / 30days / Argo std



0.05ºx0.05º / 20days / CTD+Argo HF+Argo std



1) The deployment of Argo floats during a regional hydrographic cruise proves to be highly beneficial.

2) In this study case, the Argo floats had a 10-day initial period with daily sampling (high-resolution Argo) and were complemented with the launching of two additional floats that, during this same period, continuously sampled the upper 400 m of the water column.

3) The outcome is a multiple optimised view of the study region, from a large area with low spatial and temporal resolution to smaller regions where the spatio-temporal resolution is maximum.

4) The combination of the multiple platforms leads to an operational methodology that can be applied to critical oceanic regions.

FREE CATALAN POLITICAL PRISONERS!

Thank you for your attention!