Argo in boundary currents: study cases using the VirtualFleet software

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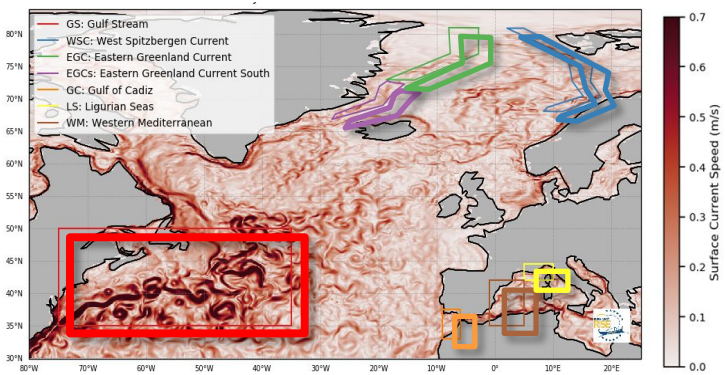
Motivation: Use Argo floats to better capture the complex ocean interior structure and variability of BC.

Objective: Recommend an observation strategy for turbulent BC regions of interest of the Euro-Argo partners

Method: Analysis of simulated float trajectories in BC regions with different mission configurations and deployment positions.

Tool: Virtual fleet python library.

https://github.com/euroargodev/VirtualFleet



Boundary currents of interest for the Euro-Argo RISE partners

"Virtual Fleet" uses oceanparcels to simulate Argo floats. It can be seen as a convenient wrapper around Parcels that is fully dedicated to virtual Argo floats.

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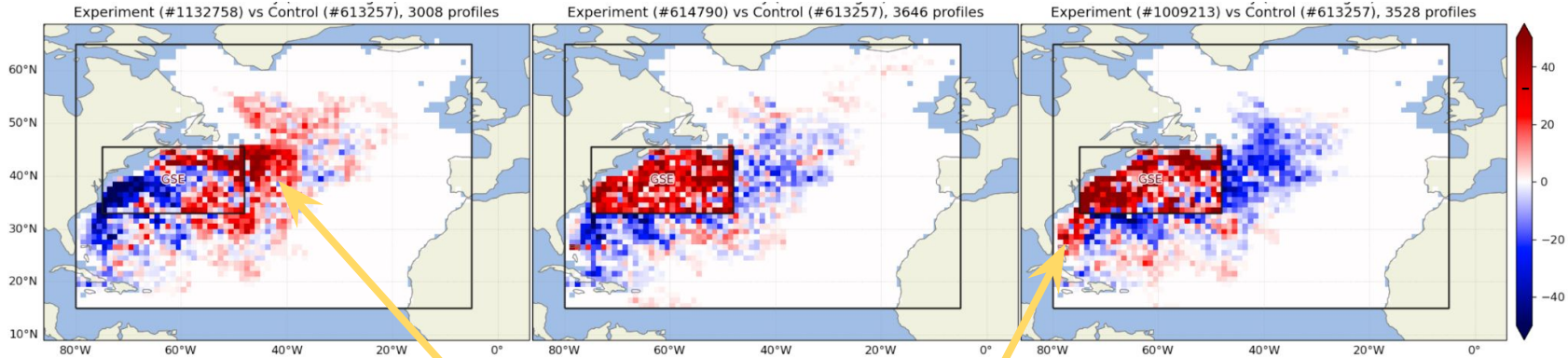
Gulf Stream Extension

- *Velocity field*: CMEMS GLOBAL Reanalysis, 1/12, 50 levels, 1993 onward, daily
- *Control simulation*: Real Argo deployment plan (2008-2018)
- *Experiment simulation*: Change Floats config. when they enter the GSE area
- Then we do comparison of the 10 years profiles density on a 1x1 grid

5 days cyc. / 500db drift **5 days cyc. / 1000db drift** **5 days cyc. / 1500db drift**



Change in number of profiles in 1x1 cells

Too shallow: floats drifting too fast out of the box

Too deep: floats taken in the under current, drifting upstream the GSE

Standard drifting depth: Homogeneous profiles density increase

All experiment results at: https://github.com/euroargodev/VirtualFleet_GulfStream

Nordic Seas

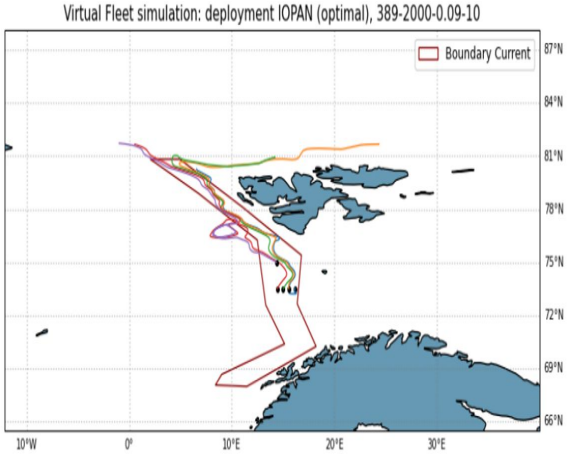
Initial simulations

- Find the optimum deployment positions from the AREX-IOPAN station grid to
  - sample along WSC
  - reach the ECG
- Find the best mission configuration to sample the BCs using an optimization algorithm
  - WSC: parking at 389 m w. 10 days cycle
  - ECG: parking at 311 m w. 7 days cycle

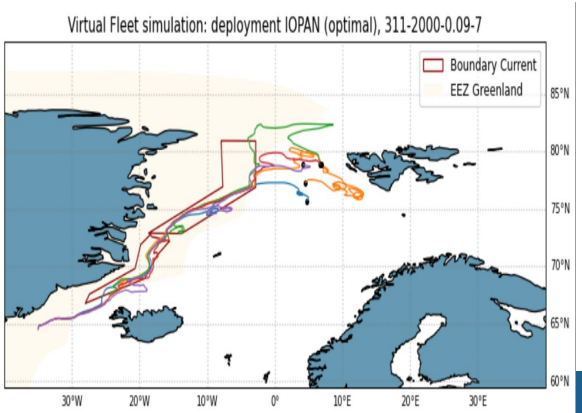
Future work

- Run new simulations with the current version of the Virtual fleet library that manages grounding.

- New simulations are underway to test these configurations with more floats, deployed on different years to cover interannual variability.



Best float trajectories in the WSC (200 days simulations, 2019)



Best float trajectories reaching the ECG (200 days simulations, 2019)

Velocity field: CMEMS GLOBAL Reanalysis, 1/12, 50 levels, daily

Mediterranean Sea

Velocity field: CMEMS Mediterranean Sea Physics Analysis and Forecast, 1/24º, 141 vertical levels, daily

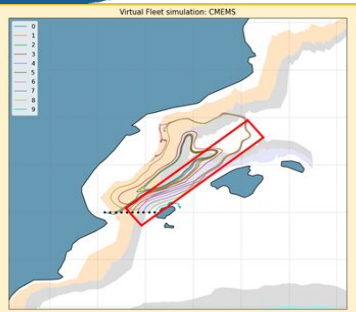
Time of simulation: 500 days

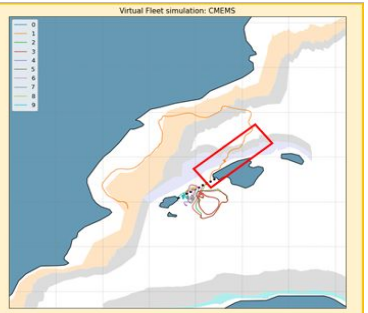
Experiment simulation: Select the best launching point of the SOCIB Canales endurance line. Then, select the best mission parameters (testing parking depth, depth and cycle)

Ibiza Chanel | **Mallorca Chanel**

1st Step → select the launching point

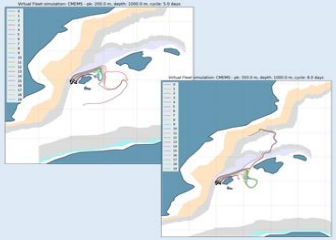
Standard mission parameters (Med Sea)
Parking Depth (m): 350
Depth (m): 1000
Cycle (days): 5

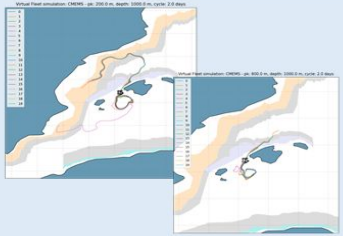




2nd Step → select the optimal configuration

Mission paramters tested:
Parking Depth (m): 200, 350, 400, 500, 600, 800, 900, 1000
Cycle (days): 2, 4, 5, 6, 8, 10

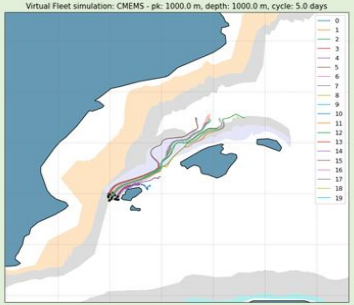


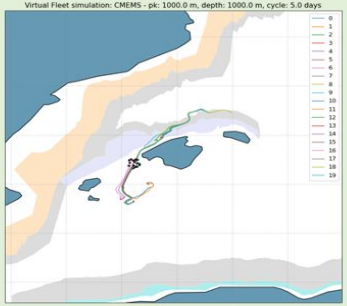


RESULTS

Best deployment area and configuration

Parking Depth (m): 1000
Depth (m): 1000
Cycle (days): 5





Future steps:

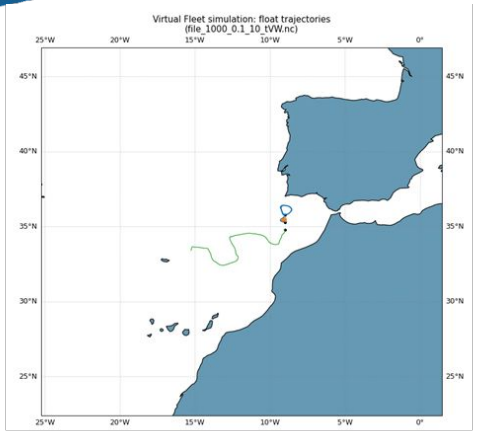
Extending the grid and performing an experiment with random positions (all Western Mediterranean)

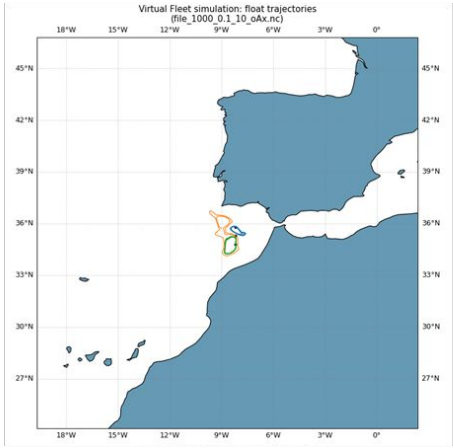
Identify optimal deployment zones and configurations for the rest of the BCs (Northern and Algerian Current)

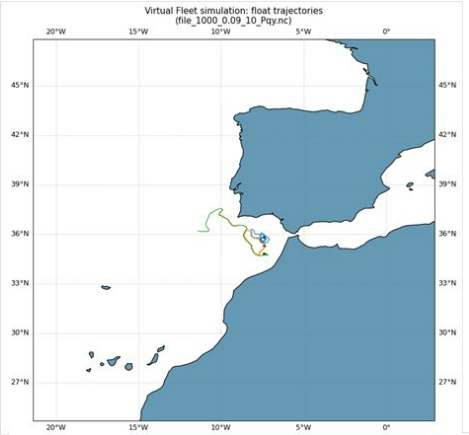
Acting as a virtual mooring

Gulf of Cadiz

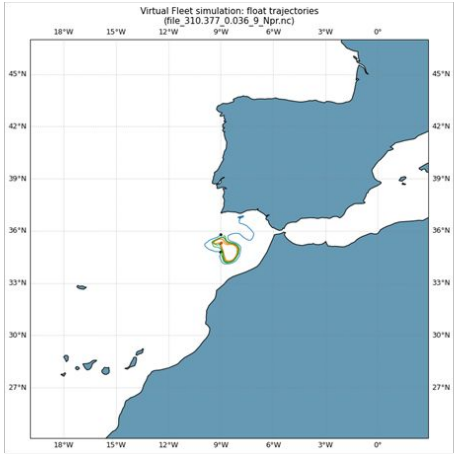
Core Argo Configuration

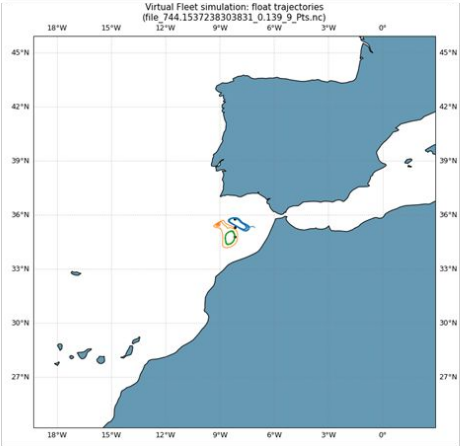


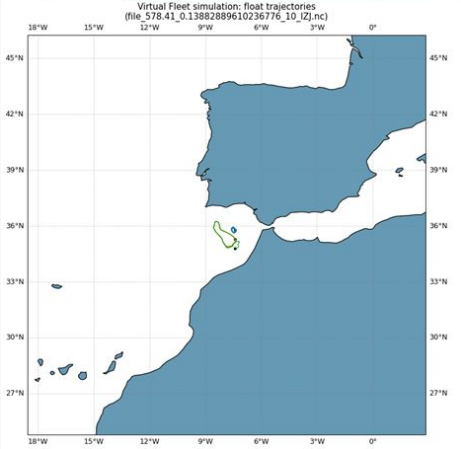




Optimised Configuration







Argo in boundary currents: study cases using the Virtual Fleet

https://github.com/euroargodev/VirtualFleet

RECOMMENDATIONS

Gulf Stream Extension

- Simulations used to reproduce a realistic long-term Argo array sampling, and determine the impact of deployment plan or configuration parameters changes.
- 2-ways comm. “online” *changes of the cycling frequency to 5 days* leads to a 40/50% increase in profiles density in the high EKE region
- this has a “reasonable cost” of: <25% decrease in profile density up and downstream of the region, *where sampling remains above Argo target*.

West Spitzbergen Current (Nordic Seas)

- Deployments inside and towards the southern end of the current
- Shallower parking depth of 350 m

Balearic Current (Mediterranean):

- Floats *deployed inside/close the current* are more likely to follow the current
- Better results with a parking depth of 1000 m that is deeper than the standard 350 m used in the region.

Gulf of Cadiz:

- Reducing parking depth 310-744 m keeps the floats inside the region of interest.

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