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PRE-SWOT Cruise Report. Mesoscale and sub-mesoscale vertical exchanges from multi-platform experiments and supporting modeling simulations: anticipating SWOT launch (CTM2016-78607-P)

Gérald Grégori

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Gérald Grégori. PRE-SWOT Cruise Report. Mesoscale and sub-mesoscale vertical exchanges from multi-platform experiments and supporting modeling simulations: anticipating SWOT launch (CTM2016-78607-P). 2019, 10.20350/digitalCSIC/8584 . hal-02192569

HAL Id: hal-02192569

<https://amu.hal.science/hal-02192569v1>

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CRUISE REPORT

Mesoscale and sub-mesoscale vertical exchanges from multi-platform experiments and supporting modeling simulations: anticipating SWOT launch (PRE-SWOT)



Version – V5.0
29 November 2018



The research leading to these results has received funding from the Spanish Research Agency and the European Regional Development Fund (AEI/FEDER, UE) under grant agreement (CTM2016-78607-P) - project PRE-SWOT (Mesoscale and sub-mesoscale vertical exchanges from multi-platform experiments and supporting modeling simulations: anticipating SWOT launch)

Citation

Barceló-Llull, B., A. Pascual, L. Díaz Barroso, A. Sánchez-Román, B. Casas, C. Muñoz, M. Torner, E. Alou, E. Cutolo, B. Mourre, J. Allen, G. Aulicino, A. Cabornero, N. Calafat, E. Capó, Y. Cotroneo, F. Cyr, A. Doglioli, F. d'Ovidio, F. Dumas, J.-G. Fernández, L. Gómez-Navarro, G. Gregori, J. Hernández-Lasheras, A. Mahadevan, E. Mason, A. Miralles, D. Roque, M. Rubio, I. Ruiz, S. Ruiz, E. Ser-Giacomi and T. Toomey. PRE-SWOT Cruise Report. Mesoscale and sub-mesoscale vertical exchanges from multi-platform experiments and supporting modeling simulations: anticipating SWOT launch (CTM2016-78607-P). 138 pp. <http://dx.doi.org/10.20350/digitalCSIC/8584>

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Project Full Title		Mesoscale and sub-mesoscale vertical exchanges from multi-platform experiments and supporting modeling simulations: anticipating SWOT launch (PRE-SWOT)	
Award NO:		CTM2016-78607-P	
Funding Agency		Spanish Research Agency and the European Regional Development Fund (AEI/FEDER, UE).	
Lead Institution		Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC)	
Lead Center		Instituto Mediterráneo de Estudios Avanzados, IMEDEA(CSIC-UIB)	
PIs		Dr. Ananda Pascual and Dr. John T. Allen	
Period of Performance		03/02/2017 – 03/01/2019	
Deliverable	Cruise Report	Date	November 2018
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1 ABSTRACT

The PRE-SWOT experiment was conducted onboard R/V García del Cid between 5 and 17 May 2018 in the southern region of the Balearic Islands (western Mediterranean Sea). PRE-SWOT aimed at anticipating the daily high-resolution 2D SSH fields that Surface Water & Ocean Topography (SWOT) will provide during the fast sampling phase after launch in selected areas of the global ocean; one of them being the region around the Balearic Islands. In situ systems, including 2 gliders, 12 drifters, CTD, ADCP, and more than 2000 water samples, were collected in synergy with satellite data and modeling simulations to determine physical and biochemical ocean variability. This experiment will contribute to the preparatory SWOT cal/val activities and was coordinated with the PROTEUS-SWOT cruise (R/V Beautemps-Beauprè).

2 BACKGROUND AND MOTIVATION

Understanding the relationship between physical and biological processes is crucial for prediction of the marine ecosystem response to changes in Earth's climate. For any given external forcing, the ocean responds with a range of dynamic ocean processes that act to minimize the potential energy of the system. These processes invoke vertical exchanges of water, heat, salt and momentum through the water column. In consequence these processes also transport biologically available essential nutrients upwards into the sunlit upper ocean, and the resultant biologically-fixed carbon downwards out of this 'photic' zone. Modeling studies of frontal regions (Lévy et al., 2001; Mahadevan 2006) suggest that vertical exchange is enhanced at density fronts. Unfortunately, it is not yet possible to make direct measurements of vertical velocities of magnitudes less than 1000 m/day. Instead, they must be inferred from balanced 3D observation of the density field through the integration of Omega equations (Tintoré et al., 1991; Allen and Smeed 1996; Rudnick et al., 1996; Allen et al., 2001; Gomis et al., 2001; Rodríguez et al., 2001; Vélez-Belchí et al., 2001; Pascual et al., 2015; Barceló-Llull et al., 2017a). A key problem that has to be overcome when trying to obtain accurate estimates of the vertical exchanges from in-situ observations is related to the difficulty in collecting high-resolution data that is also quasi-synoptic (Allen et al., 2001; Gomis et al., 2005). Observing the associated fluxes of water properties has been notoriously difficult.

The three-dimensional pathways followed by water parcels between the surface mixed layer and stratified thermocline are affected by intense vertical velocities at fronts, compounded by strong horizontal transports. At fronts, and within small eddies, horizontal flow experience strong strain, as well as strong shear in both the horizontal and vertical directions. The vertical component of the vorticity is as large as the planetary vorticity, and the resulting sub-mesoscale dynamics deviate from the largely two-dimensional transport associated with quasi-geostrophic dynamics. Evidence for strong vertical transport is found in chlorophyll-*a* (chl *a*) particulate organic matter, and oxygen, which are all enhanced at the near-surface by photosynthesis. For example, Ruiz et al., (2009) and Cotroneo et al. (2016) show filaments of chl *a* being subducted downward along sloping isopycnal surfaces at the highly unstable Alboran front in the Alboran Sea and the Algerian Basin, respectively.

3 OBJECTIVES

The objective of PRE-SWOT is to quantify and improve our large scale integrated understanding of horizontal and vertical exchange associated with oceanic mesoscale and sub-mesoscale features (e.g., fronts, meanders, eddies and filaments) through the combined use of in-situ and satellite data in synergy with numerical models. The ultimate goal is to enhance our understanding of the impact of fine scale processes on biogeochemical variables. PRE-SWOT is a multi-platform high-resolution experiment conducted in the energetic zone of the Western Mediterranean that will be sampled by SWOT during the 60-day fast phase after launch providing daily high-resolution SSH measurements (see Figure 1). The focus is on a range of scales (15-100 km) traditionally not resolved by conventional altimeters but in which the wide swath altimeter SWOT will make the next big observational breakthrough in earth observation.

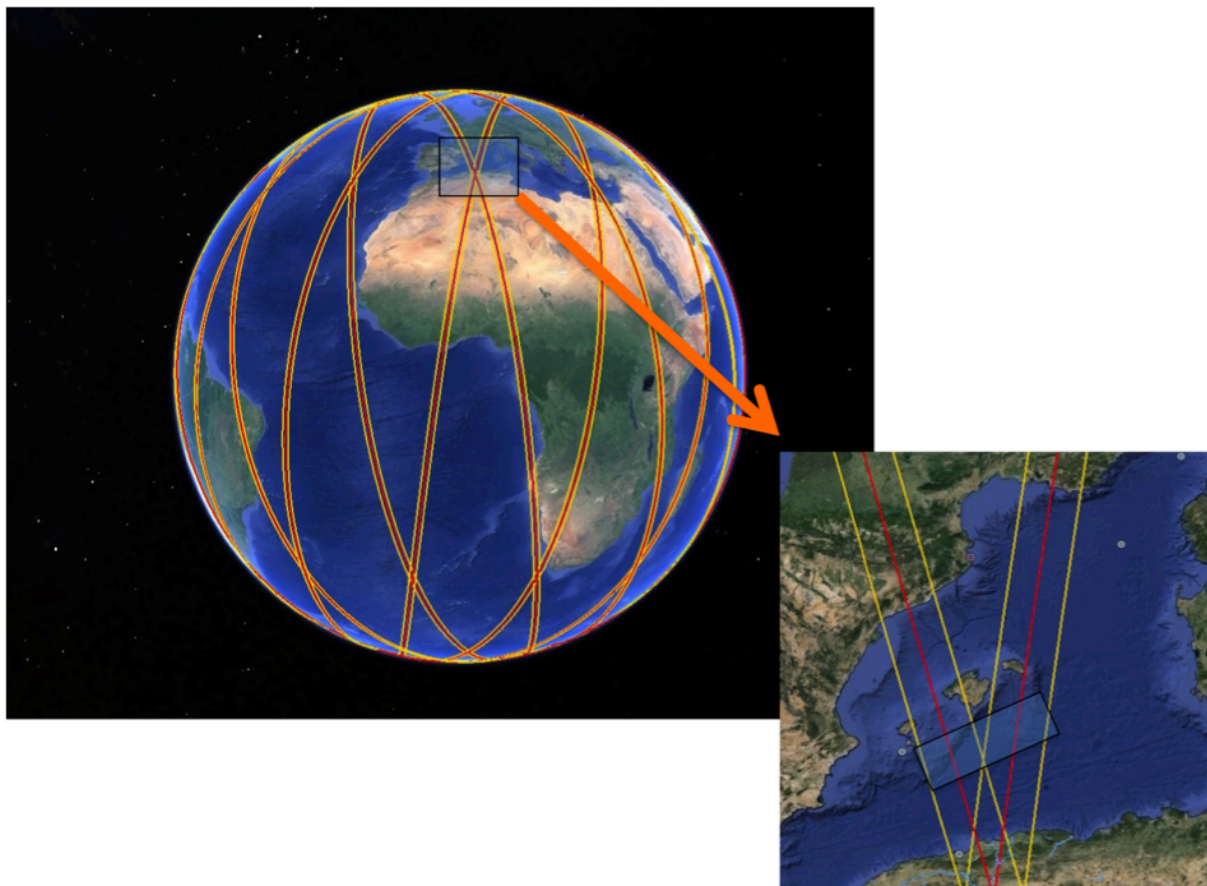


Figure 1. Approximate area of study (rectangle in the inset panel) in the western Mediterranean showing the SWOT mission swaths during the fast phase after launch.

4 FIELD EXPERIMENT

The PRE-SWOT experiment was conducted onboard R/V García del Cid (Figures 2 and 3) between 5 and 17 May 2018 in the southern region of the Balearic Islands (western Mediterranean Sea). In situ systems, including 2 gliders, 12 drifters, CTD, ADCP, and more than 2000 water samples, were collected in synergy with satellite data and modeling simulations to determine physical and biochemical ocean variability. This experiment will contribute to the preparatory SWOT cal/val activities and has been coordinated with the PROTEUS-SWOT cruise (R/V Beautemps-Beauprè, Figure 4).



Figure 2. View of R/V García del Cid.



Figure 3. Aerial view of R/V García del Cid during the cruise captured by a drone.



Figure 4. View of R/V García del Cid during the cruise with the R/V Beutemps Beauprès on the horizon.

4.1 PARTICIPANTS

NAME	INSTITUTION	ROLE/TASK
Ananda Pascual	CSIC	Scientific coordination (PI) Chief scientist
Benjamín Casas	CSIC	Technical coordination
Lara Díaz Barroso	CSIC	Biogeochemical samples and analysis
Bàrbara Barceló	CSIC	Drifter deployment, CTD and samples
Antonio Sánchez	CSIC	Drifter deployment, CTD and samples
Laura Gómez Navarro	CSIC/IGE	Drifter deployment, CTD and samples

Eugenio Cutolo	CSIC	Drifter deployment, CTD and samples
Andrea Cabornero Suárez	SOCIB	Biogeochemical samples and analysis
Enrico Ser-Giacomi	LOCEAN	Drifter deployment, CTD and samples

Table 1. Cruise (Leg-1) participants, institutions, and role in the cruise.

NAME	INSTITUTION	ROLE/TASK
Cristian Muñoz	SOCIB	Chief scientist
Lara Díaz Barroso	CSIC	Biogeochemical samples and analysis
Bàrbara Barceló	CSIC	CTD and samples
Laura Gómez Navarro	CSIC/IGE	CTD and samples
Noemí Calafat	CSIC	Biogeochemical samples and analysis
Andrea Cabornero Suárez	SOCIB	Biogeochemical samples and analysis
Tim Toomey	CSIC	CTD and samples
Esther Capó	CSIC	CTD and samples

Table 2. Cruise (Leg-2) participants, institutions, and role in the cruise.

NAME	INSTITUTION	ROLE/TASK
------	-------------	-----------

John T. Allen	SOCIB	Scientific coordination (co-PI)
Marc Torner	SOCIB	Glider preparation and piloting
Baptiste Mourre	CSIC	ROMS numerical simulation (downscaling)
Simón Ruiz	CSIC	Scientific support
Guillermo Vizoso	CSIC	Data visualization
Eva Alou	SOCIB	Biogeochemistry
Albert Miralles	SOCIB	Glider preparation and piloting
Evan Mason	CSIC/U. Washington	Eddy tracking
Irene Lizarán	SOCIB	Drifters
Inmaculada Ruiz	SOCIB	Data management
Miguel Ángel Rújula	SOCIB	Data management
Francesco d'Ovidio	LOCEAN-CNRS	Scientific coordination (PI –BIOSWOT)
Yuri Cotroneo	U. Parthenope	ABACUS Glider
Giuseppe Aulicino	U. Parthenope	ABACUS Glider

Table 3. Land participants.

4.2 OCEANOGRAPHIC CONTEXT FROM REMOTE SENSING

Remote sensing imagery helped to determine the position of oceanic features to be sampled during the cruise. Satellite data were essential for the design of the experiment (Figure 5). Altimetry, SST and ocean color imagery were considered.

Satellite images are available at this folder:

SST from MODIS:
<https://drive.google.com/drive/folders/1owoYislaOqxbgZZU6PS8l80d0mU7AfzZ>

Altimetry:

<https://drive.google.com/drive/folders/1tgJtTqAS1opjga4iTBduJnu8fQzMagMs>

Ocean color:

https://drive.google.com/drive/folders/19bLSVw3VcT1-K1dHns_HbcX6PkAHROyV

Other satellite images were also generated and provided by the colleagues at MIO. They are available at:

[http://www.mio.univ-](http://www.mio.univ-amu.fr/SPASSO/PREBIOSWOT/Figures_web/AVISO_vel_20180328.png)

[amu.fr/SPASSO/PREBIOSWOT/Figures_web/AVISO_vel_20180328.png](http://www.mio.univ-amu.fr/SPASSO/PREBIOSWOT/Figures_web/AVISO_vel_20180328.png)

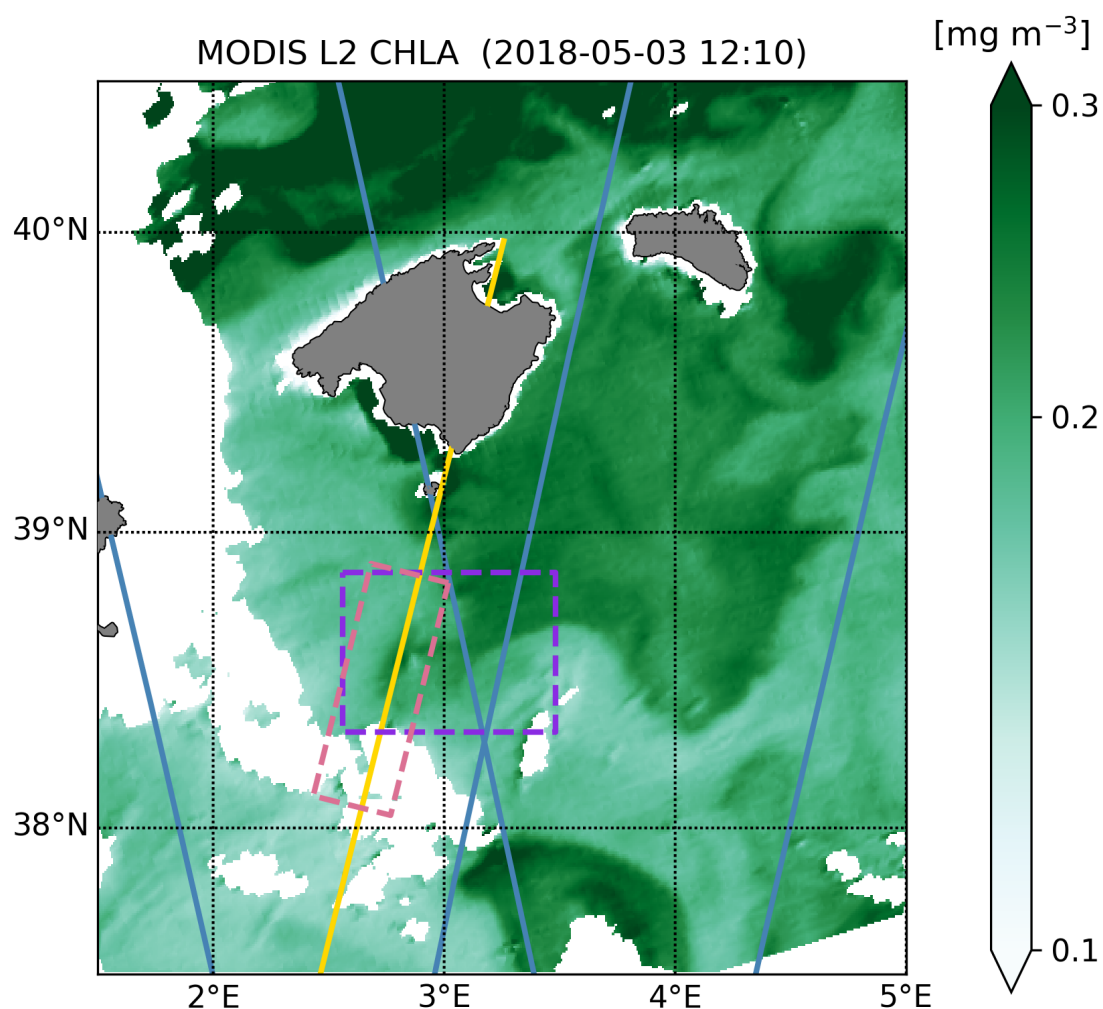


Figure 5. Chl *a* image (MODIS Level-2 product). Blue solid lines represent the limits of SWOT swaths during the fast-sampling phase. Yellow line represents the Sentinel-3 track 244 on 13-05-2018. Purple box delimits the regular grid performed during Leg 1 of the PRE-SWOT cruise. Pink box delimits the Leg 2 sampling region.

4.3 MULTI-PLATFORM IN-SITU OBSERVATIONS

4.3.1 CTD, ADCP and Water samples

CTD, ADCP and water samples (Chl *a*, oxygen, nutrients) were gathered from the R/V García del Cid. The Leg-1 multi-sensor experiment consisted in a high-resolution CTD regular grid (10 km separation, see Figure 6) to recover the small scales to be observed by SWOT (wavelengths down to 40 km, according to Gómez-Navarro et al., 2018). The maximum depths of the CTD casts were 500 m (pink dots in Figure 6) and 1000 m (one out of three stations, blue dots in Figure 6). Water samples for oxygen, Chl *a* and nutrient determination were taken in some stations chosen from remote sensing Chl *a* maps to analyze the main observed features (green dots in Figure 6). Additional samples were collected for calibration purpose (yellow stars in Figure 6).

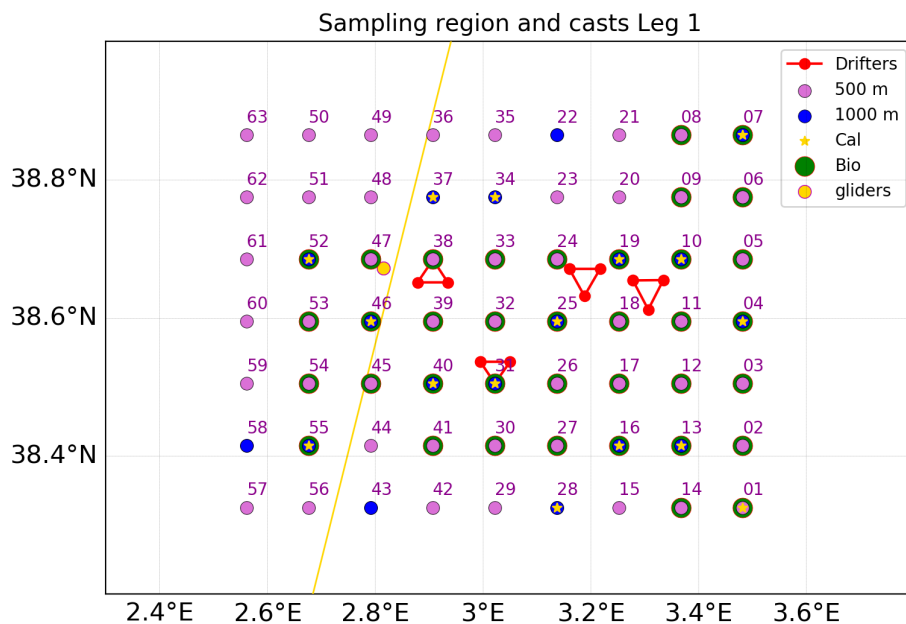


Figure 6. Leg 1 rosette casts. Yellow line represents the Sentinel-3 track 244 overflow on 13-05-2018.

Leg 2 focused on performing 4 transects parallel to Sentinel-3A track 244 (Figure 7). ADCP data were continuously recorded at a speed of around 8 knots during the two legs of the experiment.

During both Legs, one Slocum and one SeaExplorer gliders equipped with CTD, oxygen sensors and fluorimeter followed the Sentinel-3A 244 track (see details in section 4.3.2).

CTD data are available at:

https://drive.google.com/drive/folders/17tGEAe8_qXSnx0pO9a_UvXEB2ZeKLOYg

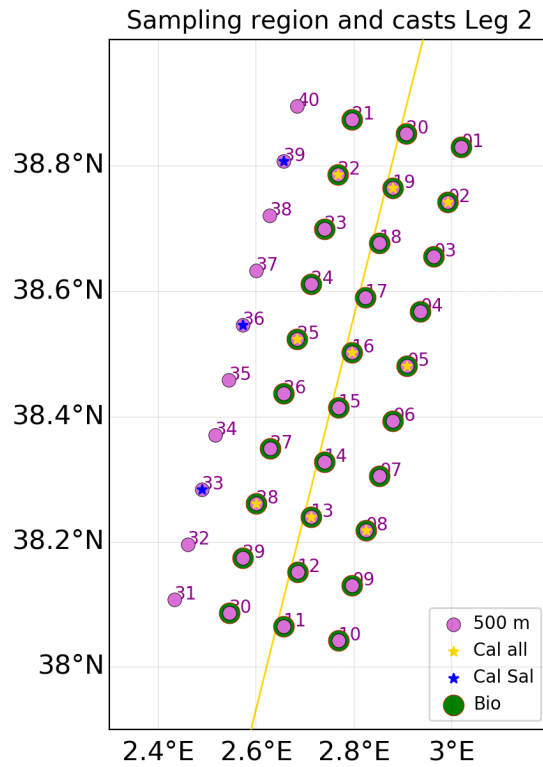


Figure 7. Leg 2 rosette casts. Yellow line represents the Sentinel-3 track 244 overflow on 13-05-2018.

Annex 2 describes the CTD data processing methodology.

Annex 3 explains the calibration methodology followed for the CTD data.

Annex 4 describes the ADCP data acquisition method.

Annex 5 shows the processing methodology for the ADCP data.

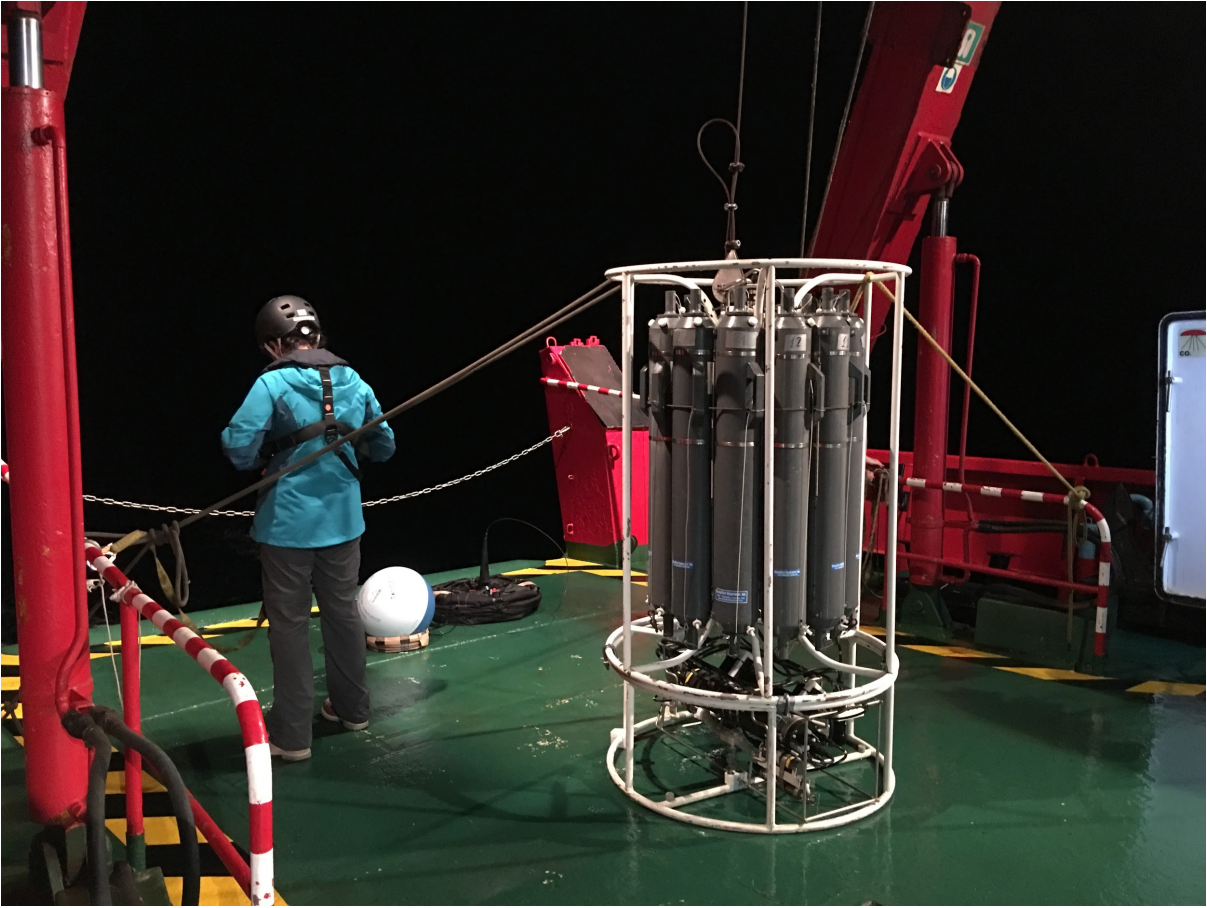


Figure 8. Rosette of the R/V García del Cid.



Figure 9. Rosette deployment.

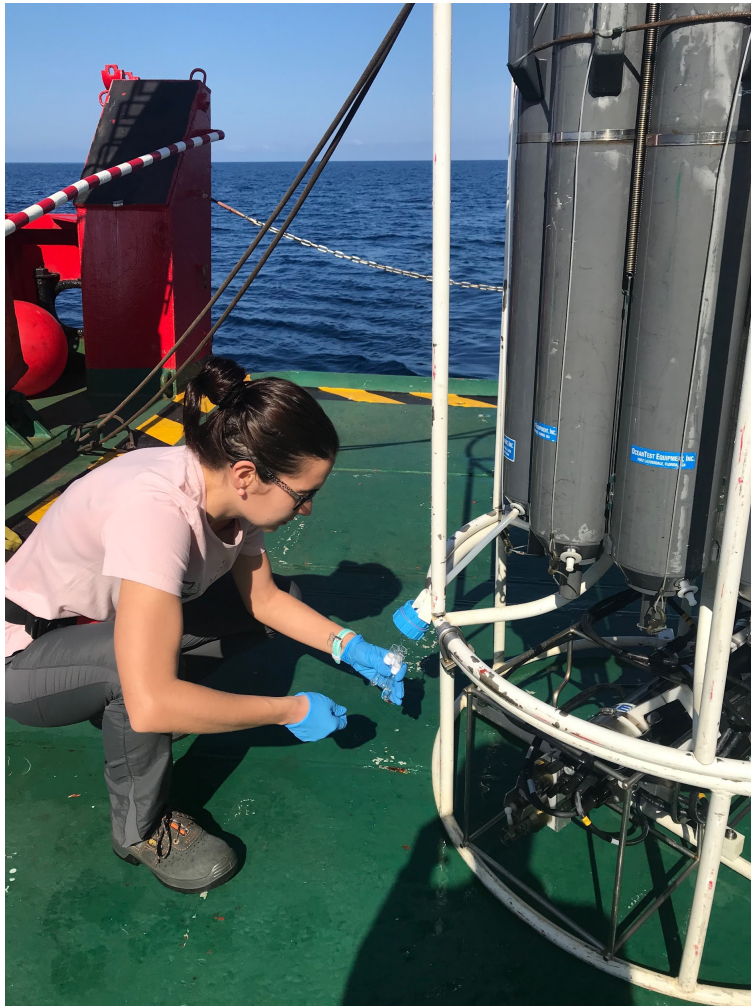


Figure 10. Collection of water samples after the CTD cast.

4.3.2 Gliders

One Slocum (owned and operated by SOCIB) and one SeaExplorer (owned and operated by MIO) underwater gliders equipped with CTD, oxygen sensors and fluorimeter (to measure turbidity and chl *a* concentration) were deployed to sample the study area. The running operation costs of the glider unit from the SOCIB glider facility are covered by PRE-SWOT project (Open Access application).

In addition to the measured parameters stated above, the SeaExplorer was equipped with 2 MiniFluos, a new sensor capable of measuring fluorescent dissolved organic matter (DOM), including organic pollutants such as Polycyclic Aromatic Hydrocarbons (PAHs).

Glider profiles extended to a depth of 650 m for both units (Figure 11). The sampling strategy was based on parallel transects of 100 km length shifted about 5 km. In order to complete the mission in 10 days (total duration), the gliders started their return trip after the 5th day.

Working plan:

All aspects related to the Launching, Survey and Recovery of the SLOCUM glider were covered by SOCIB Glider Facility. The Launch and Recovery of the SeaExplorer were carried out by SOCIB and the Survey by MIO.

Prior to the beginning of the mission, gliders were prepared and a specialized technician from SOCIB managed laboratory operations (ballasting, calibration, informatics, data management and other required operations) and deployment of the instrument.

In a second step, the gliders were deployed close to the release points south of Mallorca (3 May 2018). The mission plan contemplated 2 phases (Figure 12): Firstly, a transit (also serving as test and validation) between the launching waypoint and the survey start-waypoint (N38.94253 E2.96987). Secondly, two legs during which the SOCIB glider sampled right over SENTINEL-3 track 244 whilst MIO glider navigated 5 km east to this satellite-swath in parallel with SOCIB glider. This survey lasted for 10 days and ended with the gliders having covered a round-trip over its respective track and when they hit the survey start-waypoint. From there, MIO glider initiated its return to the initial launching-waypoint (N39.31977 E2.54728), to be recovered by SOCIB field-team, whilst SOCIB glider remained in the water and transited to a close location to execute a different survey (ABACUS-IV project funded by the JERICO-TransNational Access program). (See more details in Annex 6 and Annex 7).

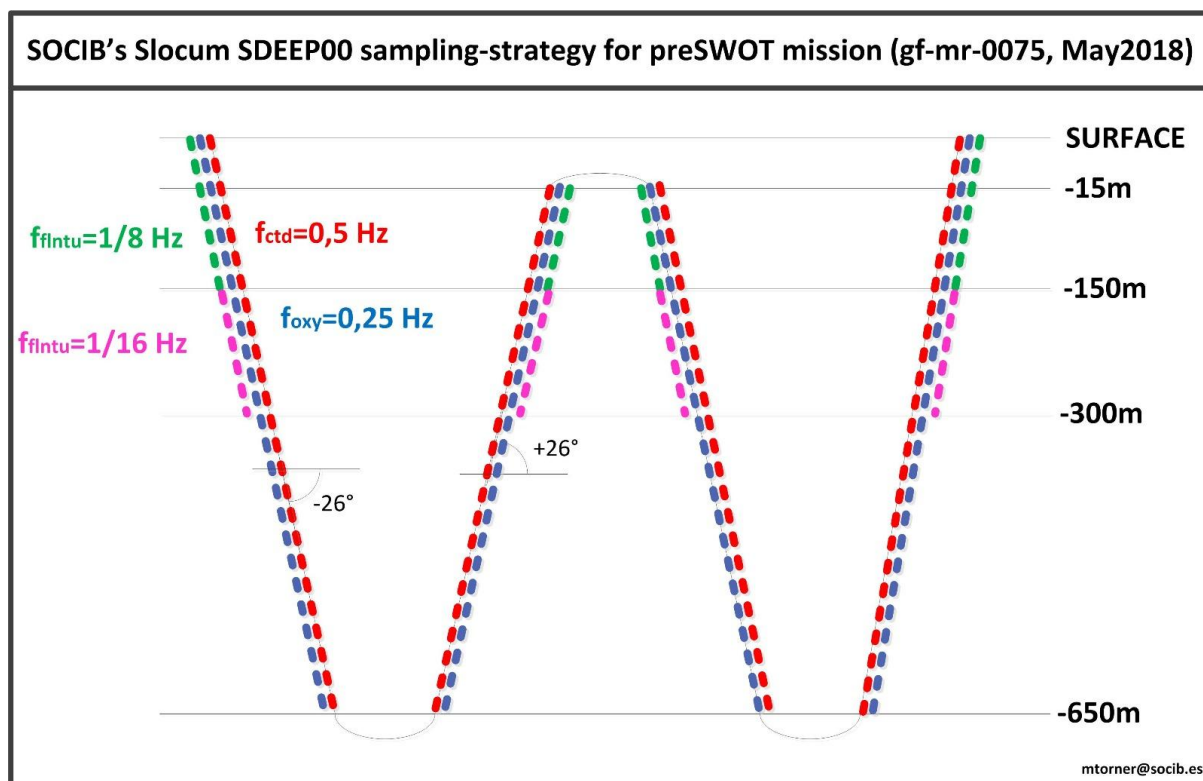


Figure 11. SOCIB glider sampling strategy.

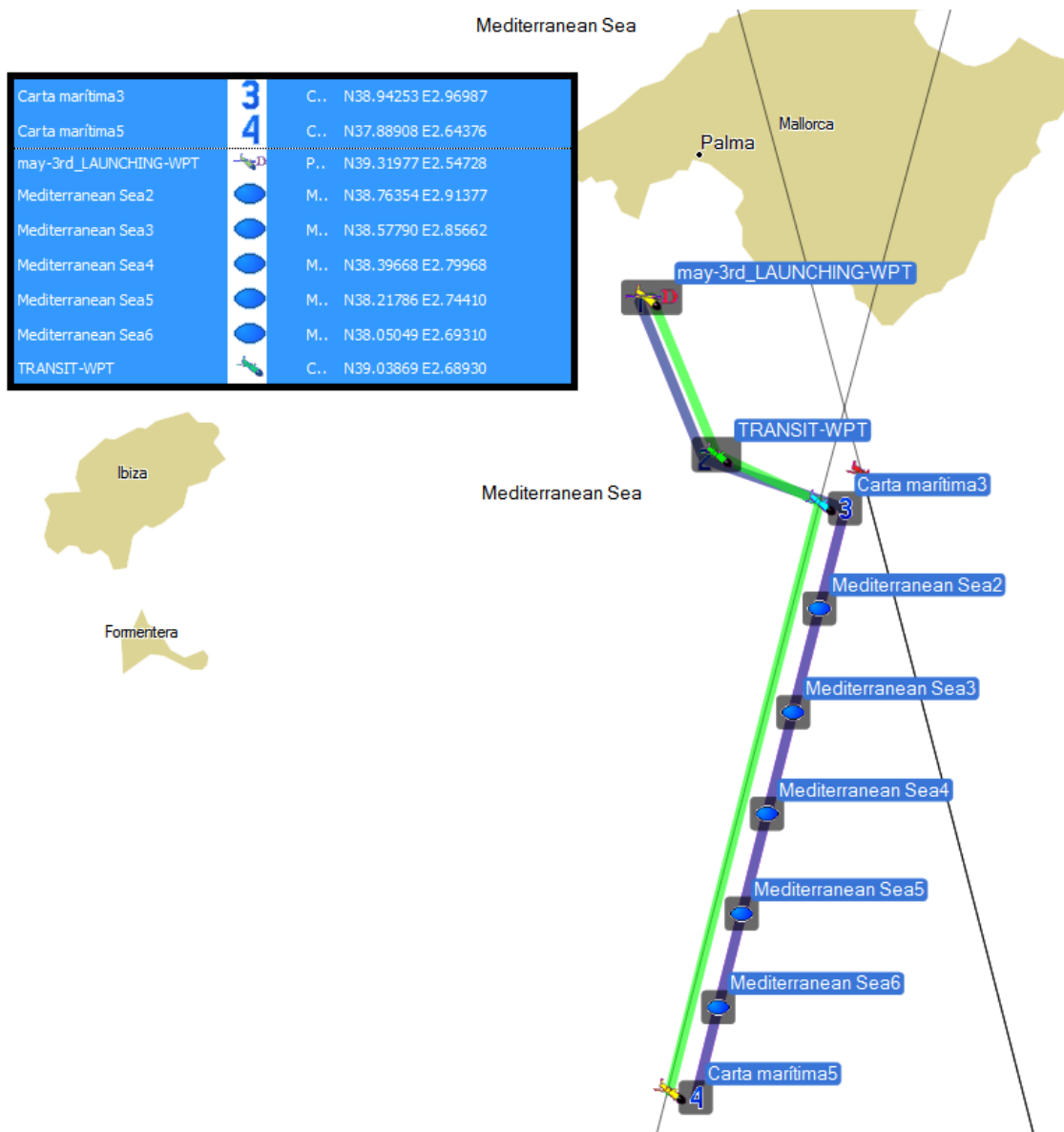


Figure 12. Glider Routes (GREEN for the SOCIB glider and BLUE for the MIO glider). LAT-LON coordinates can be found at the top-left chart.



Figure 13. SOCIB and MIO glider units (Slocum and SeaExplorer, respectively) during the deployment.

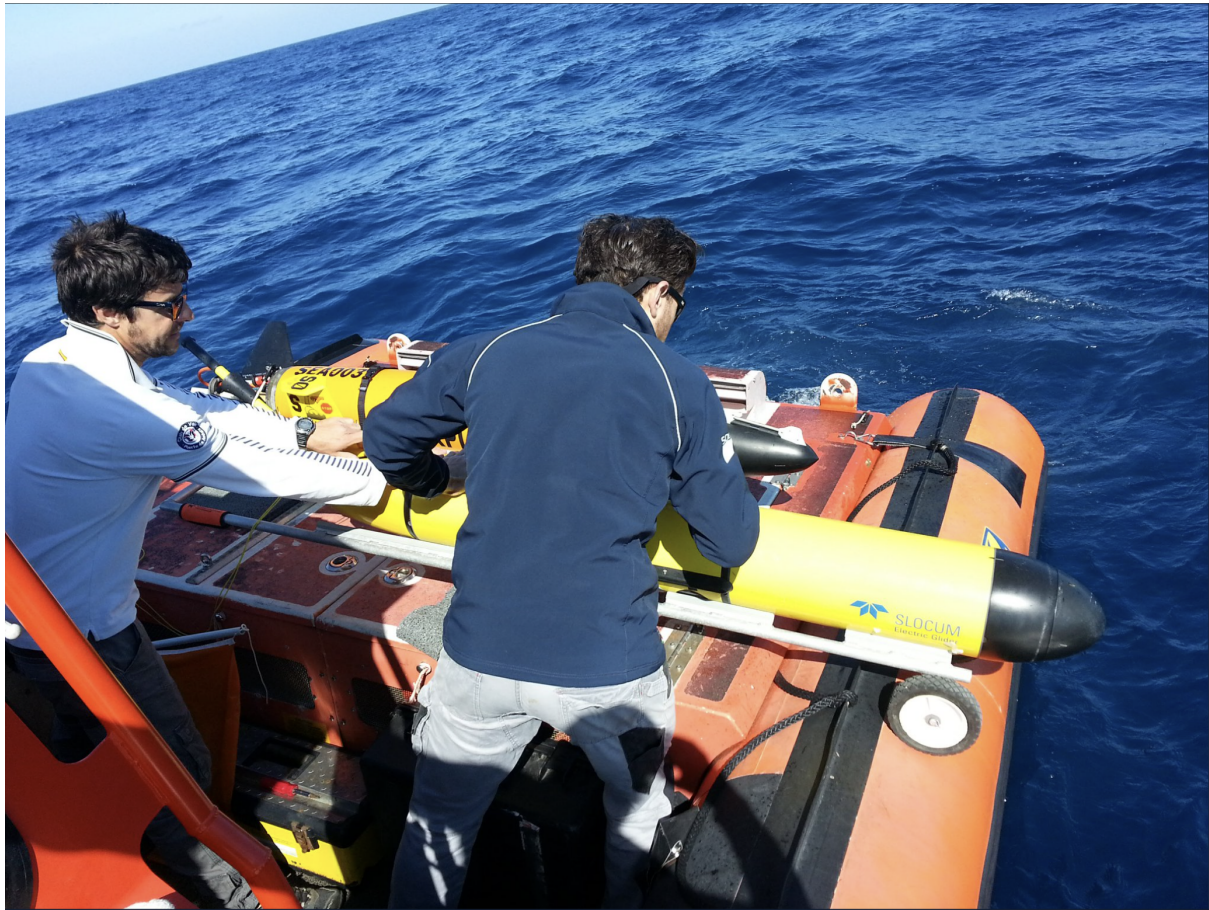


Figure 14. Deployment of the SOCIB Slocum glider.

Finally, SOCIB staff processed and delivered the data of the SOCIB unit (ANNEX 6), while MIO staff processed the data of MIO unit. Scientists from IMEDEA, CSIC-UIB, SOCIB, MIO and U. Parthenope are involved in the data analysis.

Glider data are available here: <http://apps.socib.es/dapp/>

4.3.3 Drifters

12 surface SVP drifters were deployed within the domain. Surface currents derived from drifters were used to study the temporal and spatial variability of the region and to detect convergence and divergence. In addition, drifter observations are useful for validation of altimetry, glider, models and CTD derived geostrophic velocities. The deployment strategy addressed the goal to sample frontal areas and try to detect convergence/divergence. For that purpose, the drifters were deployed in triangles with drifter separation of 5 km. The exact position of deployment was determined based on the position of frontal areas retrieved from ocean color images (See Annex 8).

Drifter data are available here: <http://apps.socib.es/dapp/>



Figure 15. Drifter deployment.

4.3.4 [Modelling-WMOP](#)

High-resolution numerical models are able to represent the full evolution of oceanic structures in the three spatial dimensions, thus providing a complementary and very valuable source of information to describe and understand mesoscale and submesoscale processes. At the same time, the realistic generation and evolution of such processes still remains very challenging due to the chaotic nature of the oceanic flow, making direct model-data comparisons often hazardous at the smallest scales.

The WMOP model (Juza et al. 2016) is used in this project to provide high-resolution model simulations over the study area. WMOP is based on a 2 km-resolution regional ocean configuration of the ROMS model implemented over the Western Mediterranean Sea. The model is forced by high-resolution winds (5 km, 3 hours). The system is run every morning, producing a 3-day forecast of ocean temperature, salinity, sea level and currents. The model represents the ocean variability from the (sub-)meso- to the basin-scale. In the framework of PRE-SWOT, three aspects of the model have been specifically developed to provide support to the project:

- 1) An ad-hoc web-based visualization of the model results, displaying maps of surface temperature, salinity, height, currents, temperature and salinity gradients, relative vorticity and horizontal divergence, focused on the sampling area. The visualization interface also includes model comparisons to altimetry and satellite SST. (See [PRE-SWOT experiment - SOCIB WMOP images](#))

2) Pre-operational data assimilation. In this initial period of the PRE-SWOT project, the WMOP data assimilation module has been developed, allowing us to assimilate observations from along-track satellite altimetry, L4 gridded SST and temperature and salinity profiles from Argo floats. A Local Multimodel Ensemble Optimal Interpolation scheme has been used, as already tested in past Alborex (Pascual et al., 2017) and REP14 (Hernandez-Lasheras and Mourre, 2018) sea trial experiments. The system was made pre-operational a few days before the campaign, so as to support the planning of drifter deployments. The web interface was duplicated to also show images from the data-assimilative simulations. Virtual drifter trajectories were also produced to help the design of the drifter deployment. We plan to use this data assimilation setup to generate a WMOP reanalysis over the sampling period, assimilating the full set of reprocessed observations including the dense CTD survey.

3) Model grid refinement through two-way nesting: These new 2km-resolution data-assimilative simulations were used to initialize a very-high resolution simulation of the PRE-SWOT sampling area. A two-way nesting approach was applied to reach a resolution of 400m likely to better represent sub-mesoscale processes. This very high-resolution will be further analyzed in the second part of the project in terms of eddy kinetic energy, vertical velocities and surface trajectories.

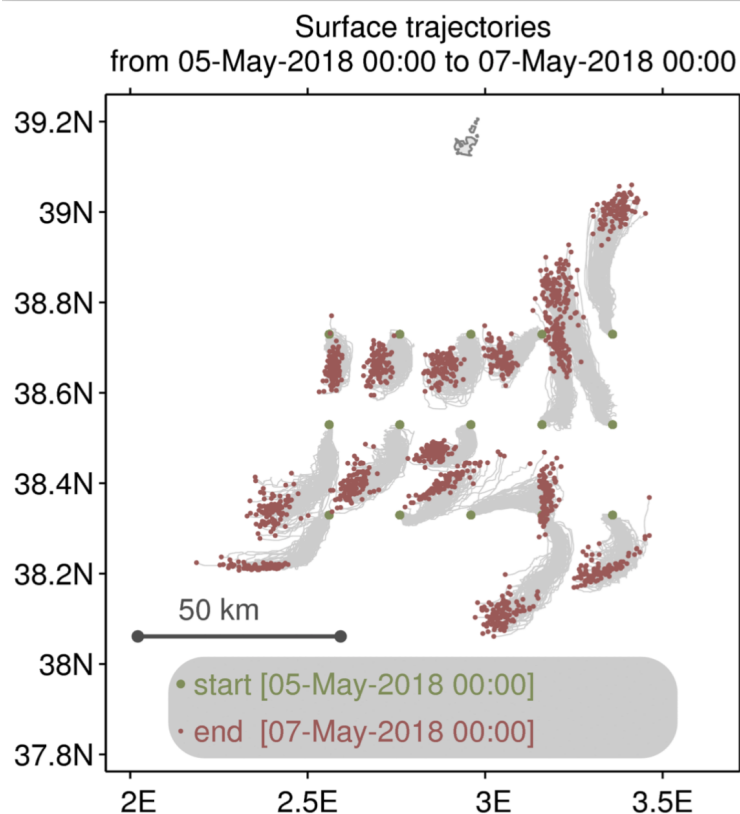


Figure 16. Surface trajectories simulated from WMOP data-assimilative outputs (WMOP_ASSIM) to support the drifters deployment.

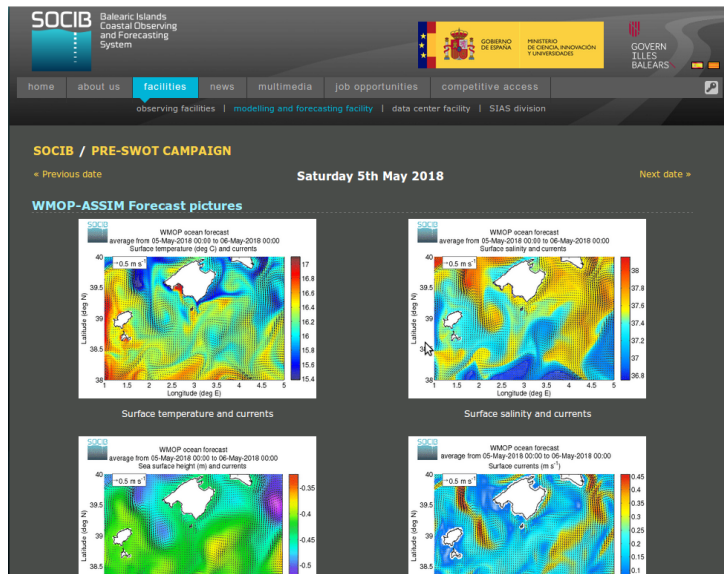


Figure 17. SOCIB web interface presenting forecast images from WMOP_ASSIM.

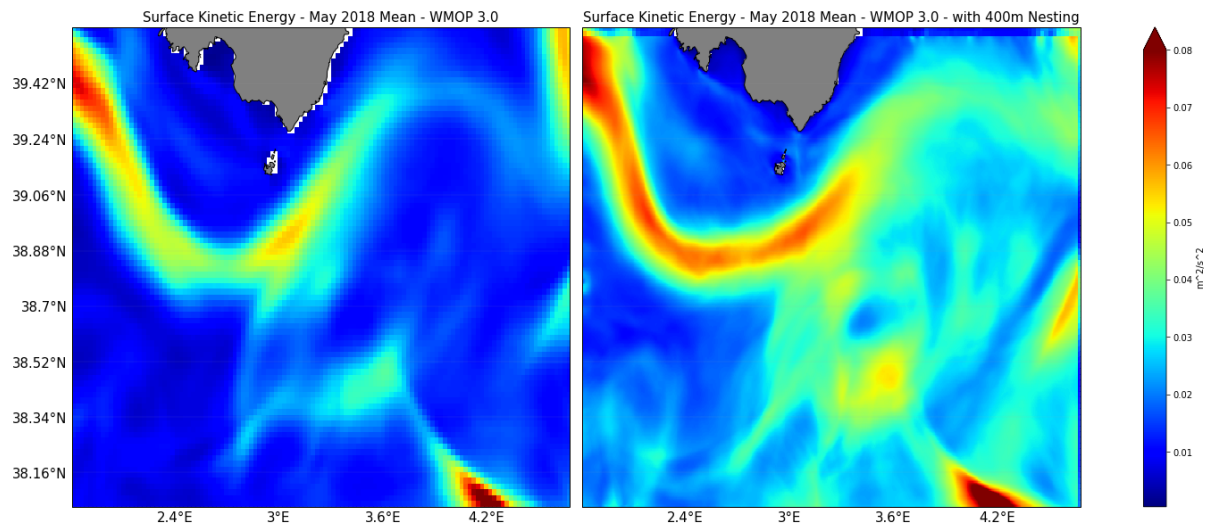


Figure 18. Surface Kinetic Energy - comparison between the WMOP model versions with 2km and 400m resolution.

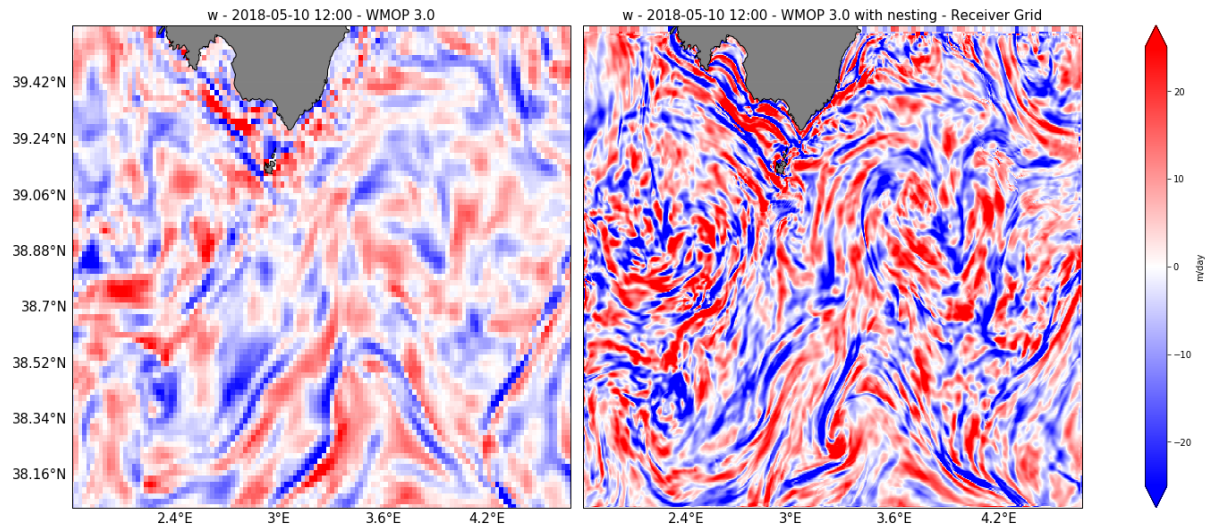
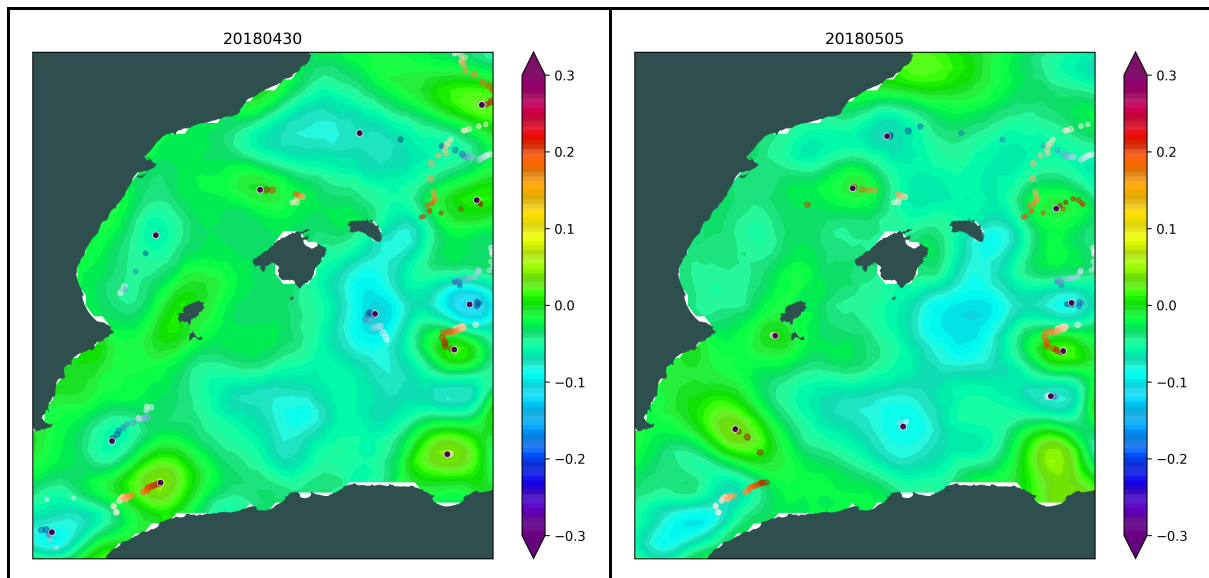


Figure 19. Vertical Velocity - comparison between the WMOP model versions with 2km and 400m resolution.

4.3.5 Eddy Identification and Tracking

Mesoscale eddies in the western Mediterranean are identified and tracked for the periods prior to, during and after the PRE-SWOT cruise. The py-eddy-tracker code (Mason et al., 2014) is used with gridded near-real-time SLA data supplied by Copernicus (CMEMS). Selected daily snapshots at 5-day intervals of eddy positions indicate no eddy detections in the PRE-SWOT study region during the cruise (Figure 20). Outside of the study region, an anticyclone is tracked north of Mallorca, and a cyclone appears to the south of the island on around 10 May.



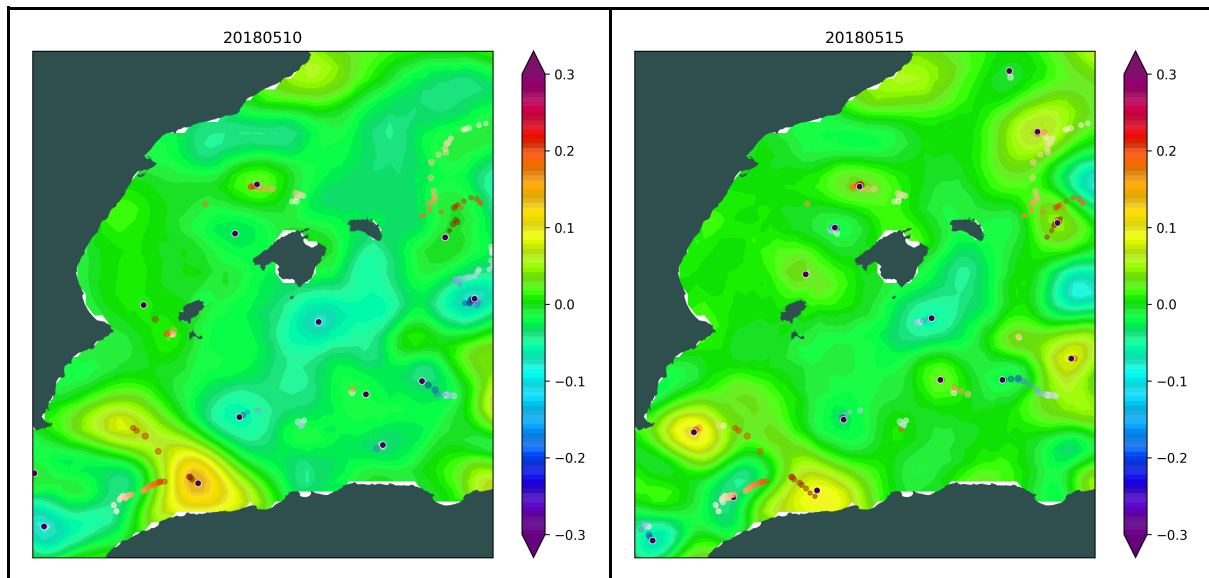


Figure 20. Active cyclones (blue) and anticyclones (red) in the PRE-SWOT study region identified by the py-eddy-tracker in sea level anomaly fields on 30/4/2018, 5/5/2018, 10/5/2018 and 17/5/2018. Bold black dots indicate current position of each eddy.

4.3.6 Biogeochemical Sampling

CTD and water samples to measure dissolved oxygen, chl *a*, nutrients, pigment signatures (HPLC) and phytoplankton were gathered from the R/V García del Cid. The exact location was fixed based on the presence of interesting dynamical structures.

To calibrate the CTD biogeochemical data:

Dissolved oxygen

Discrete water samples (Winkler's method, Langdon 2010, see protocols) were taken every one out of three stations at a maximum of 3 depths (25, 200 and bottom). We chose depths of varying oxygen concentrations (in order to sample the full spectrum of oxygen concentrations). A logbook was generated during the cruise which includes more details on sampling depths, replicates and parameters sampled at each station.

Samples were analyzed on board after an 8-48 h period in darkness through a titration procedure with potentiometric endpoint detection (Metrohm 888 Titrator).

The final dissolved oxygen dataset has been produced post-cruise following the analysis of the data.

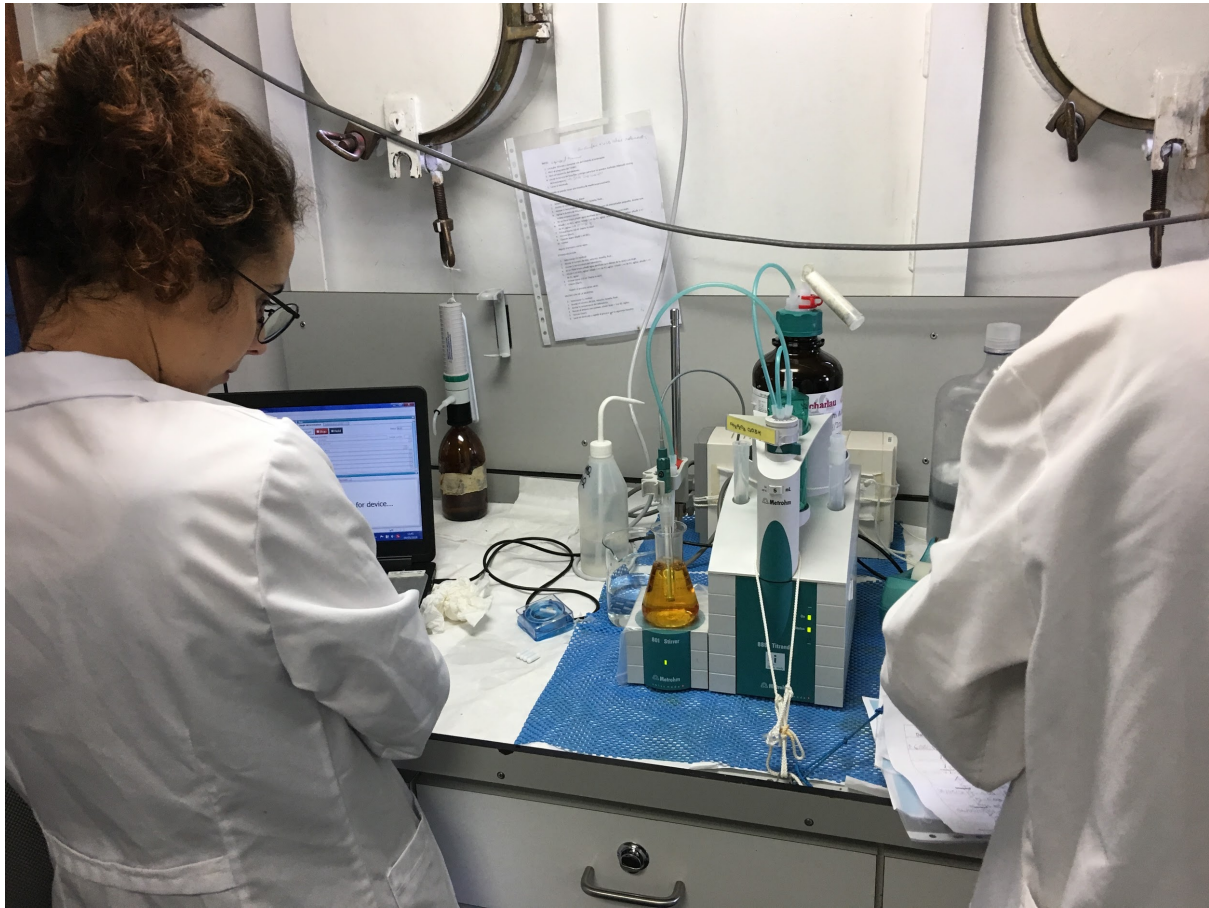


Figure 21. Oxygen analysis on board the R/V García del Cid during the PRE-SWOT experiment.

Chl *a* concentration

Samples to calibrate chl *a* concentration were taken at the same stations as the oxygen samples at 4 depths (5, 25, DCM, 125). At certain stations a sample at 500 m depth was collected. Post-cruise chl *a* determination has been carried out at IMEDEA, CSIC-UIB by fluorometry (Turner 10-AU fluorometer, see available protocol).

Salinity

Salinity samples were collected at 16 stations in leg 1 and in 12 stations in leg 2 (maximum, minimum and intermediate values).

To study the physical structures:

Nutrients

Samples for inorganic nutrient concentration were taken at all stations at a maximum of 9 depths. Samples were kept frozen at -20°C at the IMEDEA, CSIC-UIB until analysis.

Phytoplankton community composition

Samples were taken on each station at the deep chlorophyll maximum (DCM) for general cell identification (cells fixed in Lugol's solution, Utermöhl 1958). Samples for microscopy are analyzed post-cruise at IMEDEA, CSIC-UIB.

High Performance Liquid Chromatography (HPLC)

Pigment samples for High Performance Liquid Chromatography (HPLC) analyses were taken on each station at 2-3 depths (surface, DCM). The total fraction was collected and a volume of 2 L filtered through a GF/F filter (retaining microorganisms larger than the nominal pore size of 0.7 μm). Samples are stored at IMEDEA, CSIC-UIB (-80°C) until analysis.

Fluorescence Spectrofluorimetry (SEA003 MiniFluo calibration)

In order to calibrate both MiniFluo sensors on glider SEA003, fluorescence spectrofluorimetry (calculation of excitation-emission fluorescence matrices) was performed on water collected at one CTD cast. Near the end of Leg 2, while the ship was along Sentinel 3 track and not too far from the gliders, a cast was performed with the rosette with water collection at 12 depths (approx. 5m, 10m, 20m, 30m, 40m, 50m, 75m, 100m, 200m, 300m, 500m and 650m). For each sample, a small volume of water (~200ml) was saved in provided glass jars. Each jar needed to be rinsed 3 times before being completely filled and marked. To avoid any contamination, this procedure was performed with gloves. After the jars were filled, they were conserved at ~4°C for the remaining of the cruise and until they were shipped for analysis. Once back on land, the samples were placed in an isothermal cooler and shipped to Stéphane MOUNIER - Laboratoire MIO.

5 PRELIMINARY RESULTS

5.1 MEANDERING SALINITY FRONT

The region analyzed is characterized by a meandering salinity front in the upper layers which dominates the density distribution.

CTD fields were objectively interpolated onto a regular grid with a horizontal resolution of 2 km and a vertical resolution of 5 m (Barceló-Llull et al. 2017b) with correlation scales $L_x=L_y=20\text{km}$ (Figures 22-26).

The salinity map at 5 m depth (Figure 22) reveals the presence of a meandering salinity front with saltier water at the northeastern edge of the region and fresher water at the southeastern edge. Salinity dominates the density structure. Oxygen has higher concentration values at the saltier edge of the front. The temperature map at 5 m depth shows a meridional distribution with cooler water at the eastern region and warmer water at the western.

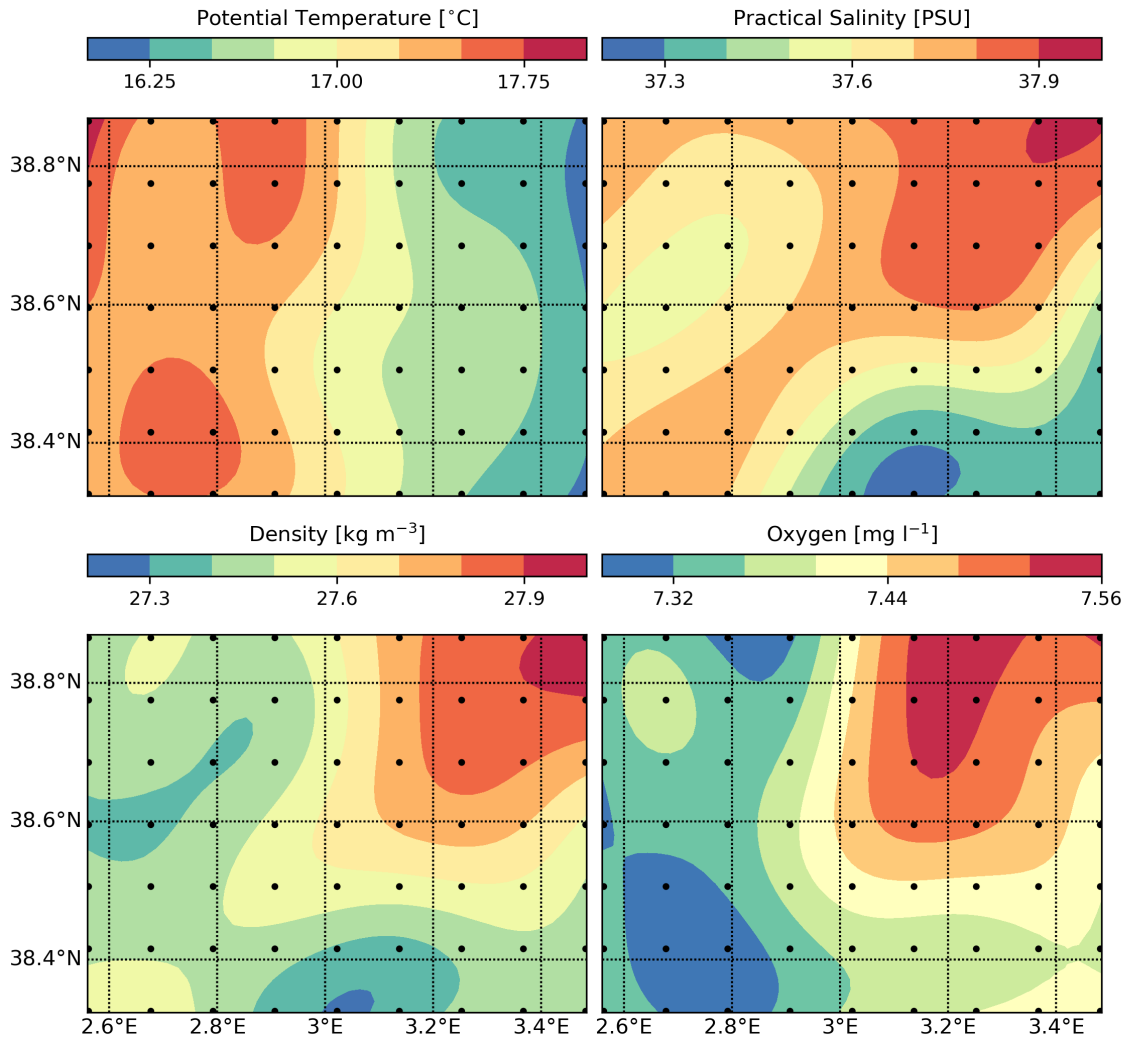


Figure 22. Potential temperature, practical salinity, potential density anomaly and oxygen at 5 m depth from Leg 1 CTD data. Dots show the position of the CTD casts.

The temperature structure at 50 m depth follows the salinity front; warmer water is located at the fresher side (signal of recent Atlantic water), while cooler water is situated at the saltier side (Figure 23). Oxygen distribution at this depth is not related to the salinity front.

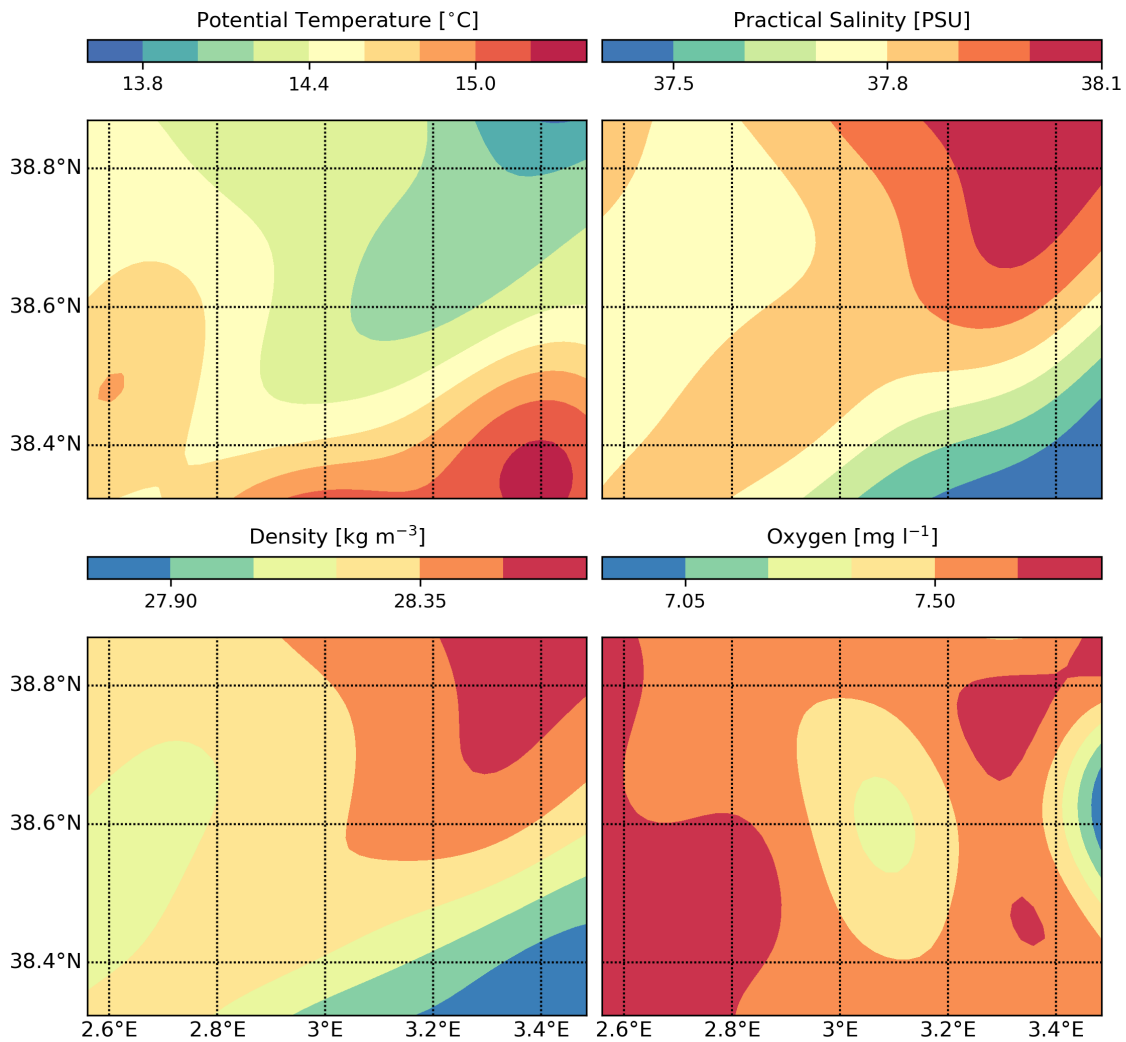


Figure 23. Potential temperature, practical salinity, potential density anomaly and oxygen at 50 m depth from Leg 1 CTD data.

The salinity front is not apparent below 200 m depth. At this depth, maximum salinity values are density compensated by temperature maximum values (Figure 24).

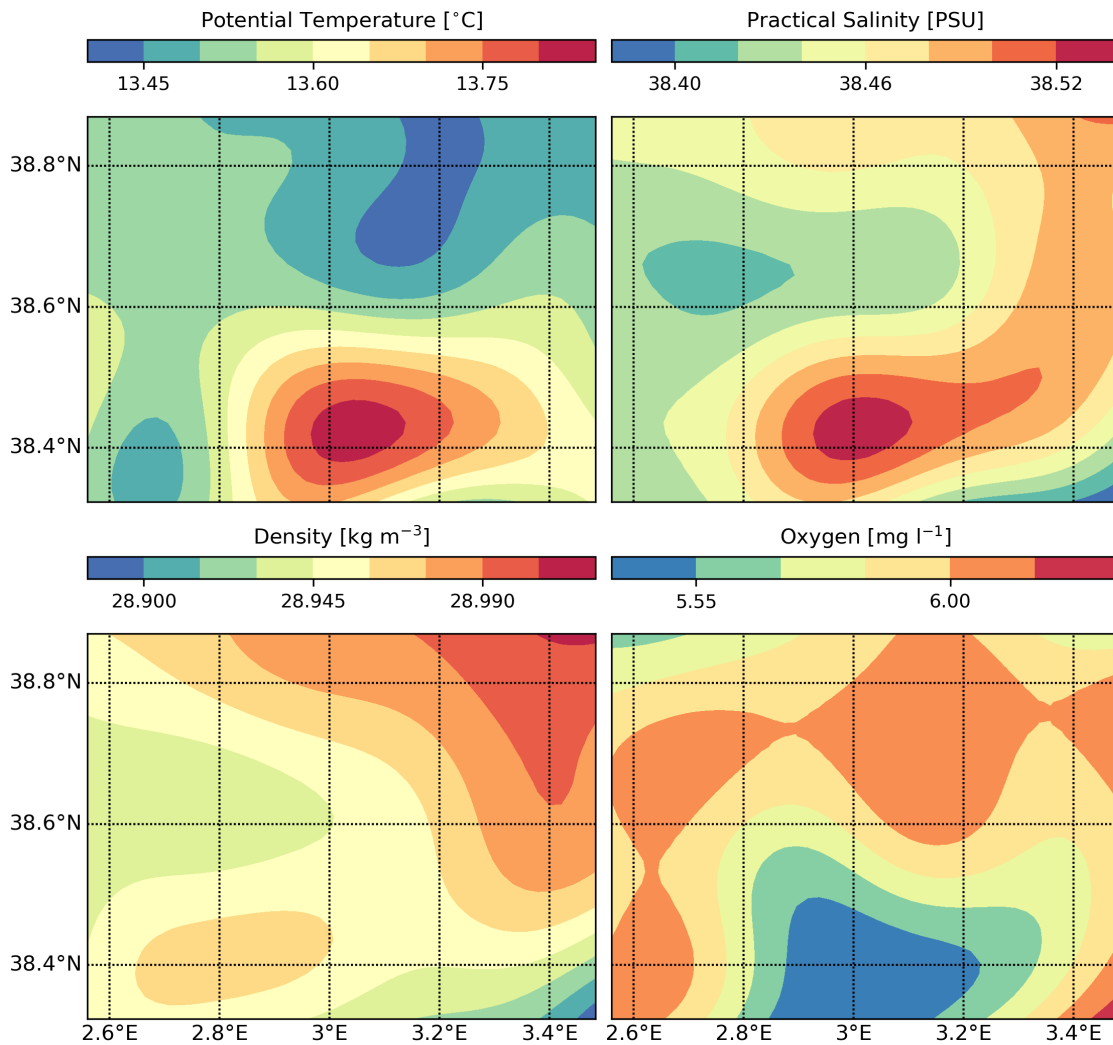


Figure 24. Potential temperature, practical salinity, potential density anomaly and oxygen at 200 m depth from Leg 1 CTD data.

At 300 m depth, maximum salinity values are density compensated by temperature maximum values (Figure 25). The region characterized by saltier and warmer water has lower values of oxygen. Maximum concentration of oxygen is distributed along the region of minimum temperature and salinity (distribution observed until 500 m depth).

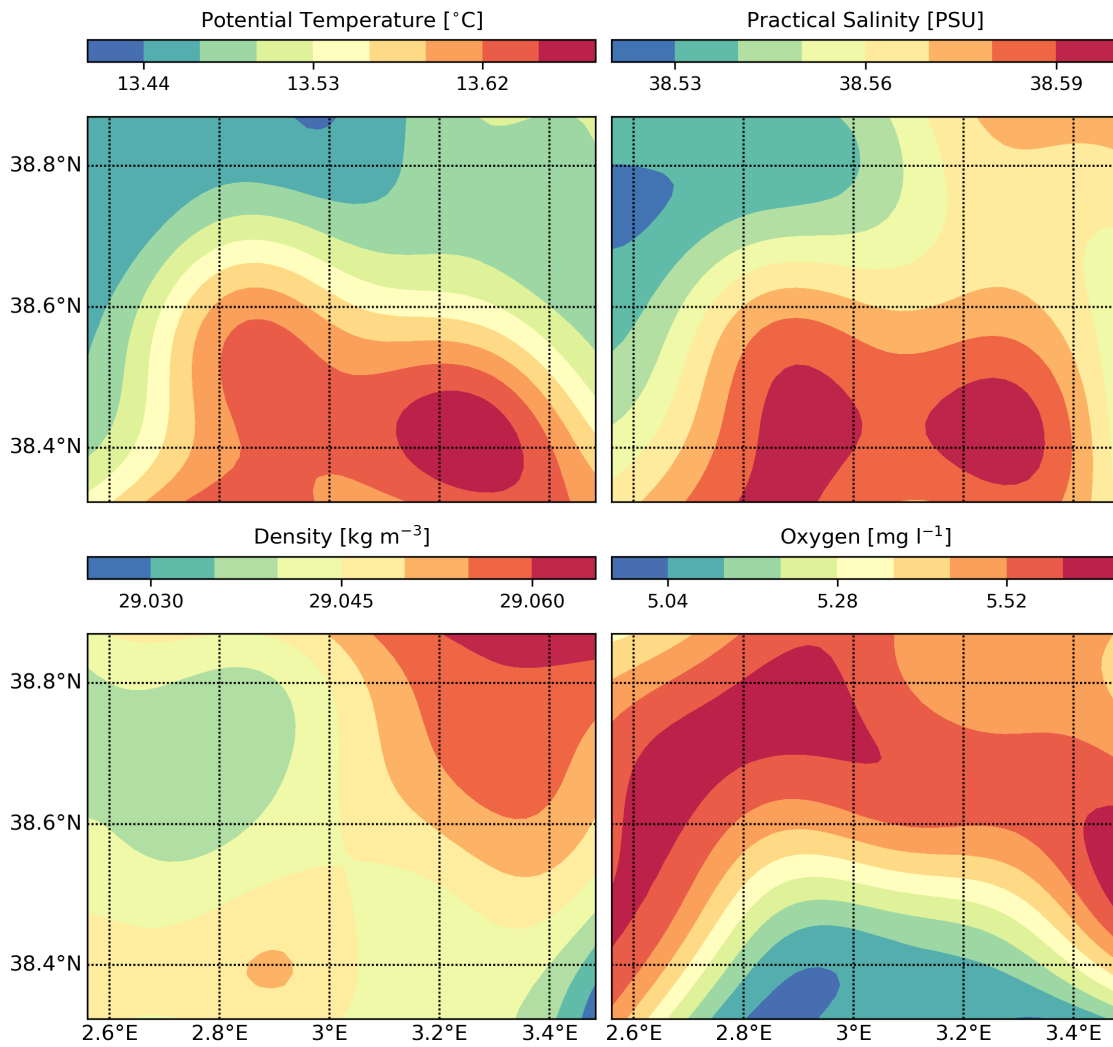


Figure 25. Potential temperature, practical salinity, potential density anomaly and oxygen at 300 m depth from Leg 1 CTD data.

At 700 m depth, salinity and temperature are maximum at the northwestern corner of the sampling region, coinciding with maximum values of oxygen (Figure 26).

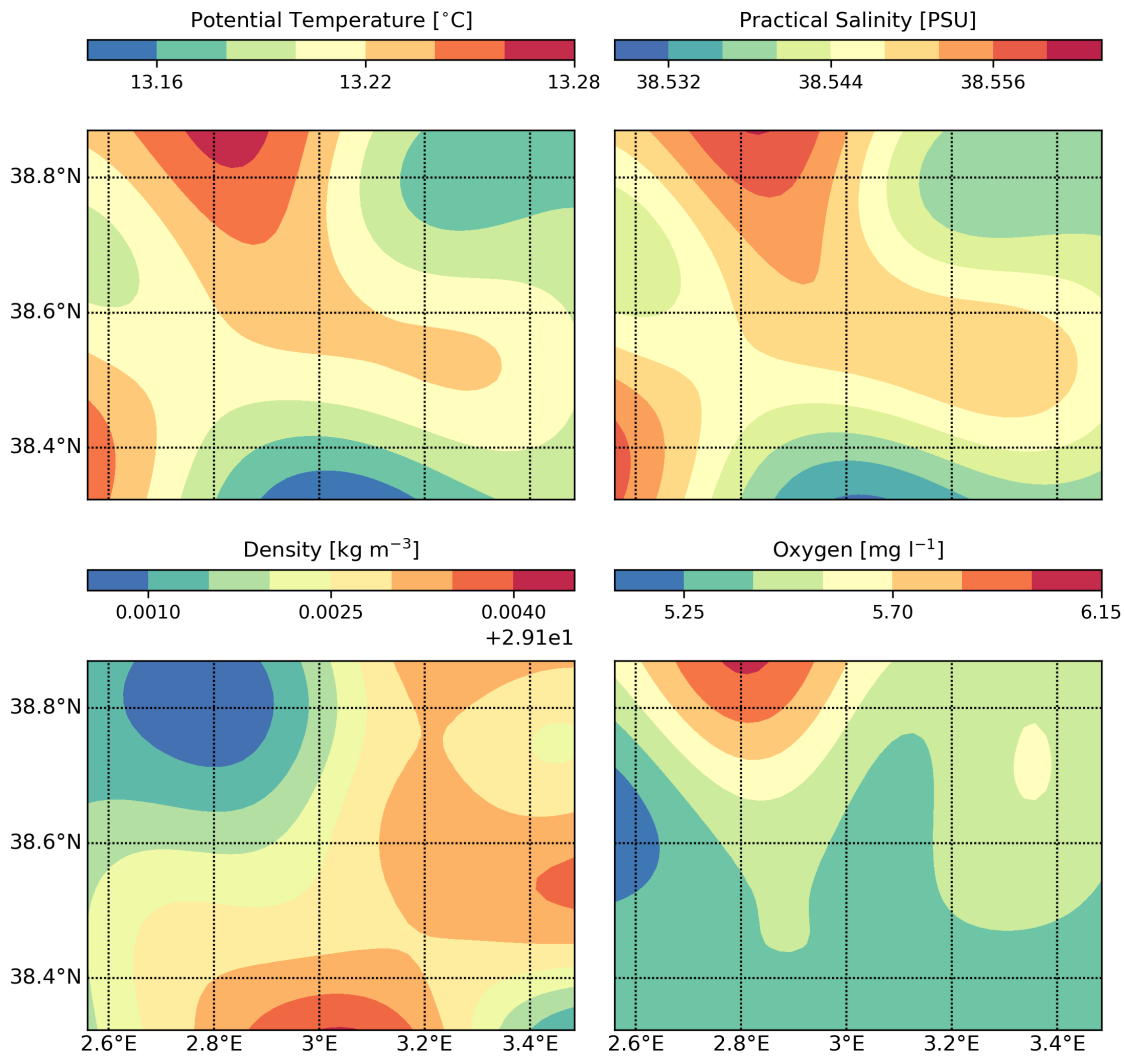


Figure 26. Potential temperature, practical salinity, potential density anomaly and oxygen at 700 m depth from Leg 1 CTD data.

Through T-S diagrams we can detect the presence of Levantine Intermediate water as a local maximum of temperature and salinity, and Western Mediterranean Deep water with temperature values lower than 13°C. There is no evidence of Western Mediterranean Intermediate water. At 50 m depth there is a branch of saltier local Atlantic water with higher concentration of oxygen than the fresher recent Atlantic water (Figure 27 and 23). At 300 m depth, higher temperature and salinity values are associated with lower oxygen concentration (Figures 27 and 25). At depths higher than 500 m, the oxygen concentration is almost constant.

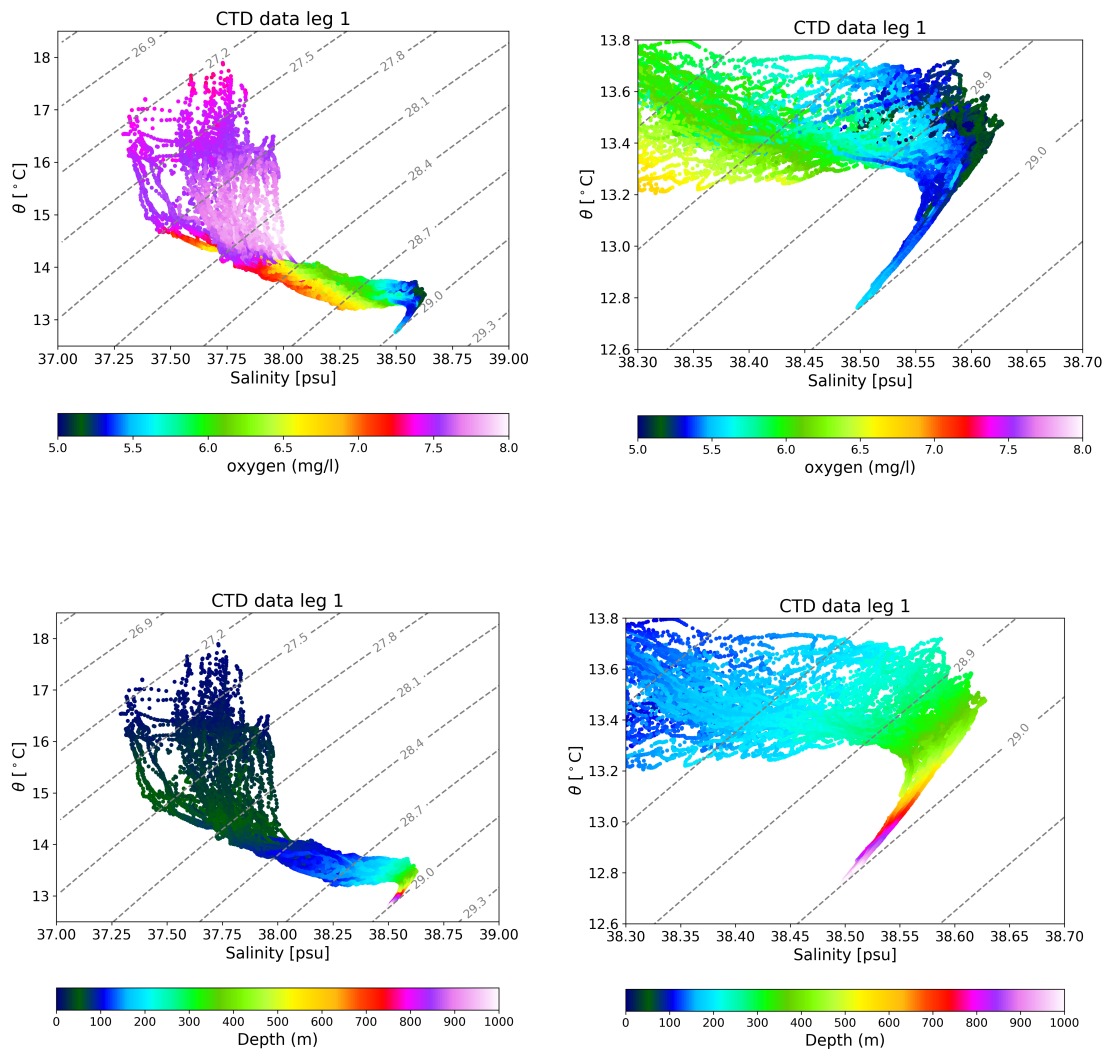


Figure 27. Temperature-salinity diagrams with Leg 1 CTD profiles. Color in top (bottom) plots represents the oxygen concentration (depth). The right column is a zoom of the left column.

5.2 DYNAMIC HEIGHT, ADT AND ASSOCIATED GEOSTROPHIC VELOCITIES

Dynamic height shows smaller structures than those shown by the Absolute Dynamic Topography (ADT).

Dynamic height inferred using density data objectively interpolated with a correlation scale of 20 km shows smaller structures than those shown by the Absolute Dynamic Topography (Figures 28 and 30). Dynamic height inferred with a correlation scale of 100 km shows the smoothing observed in ADT (Figure 29).

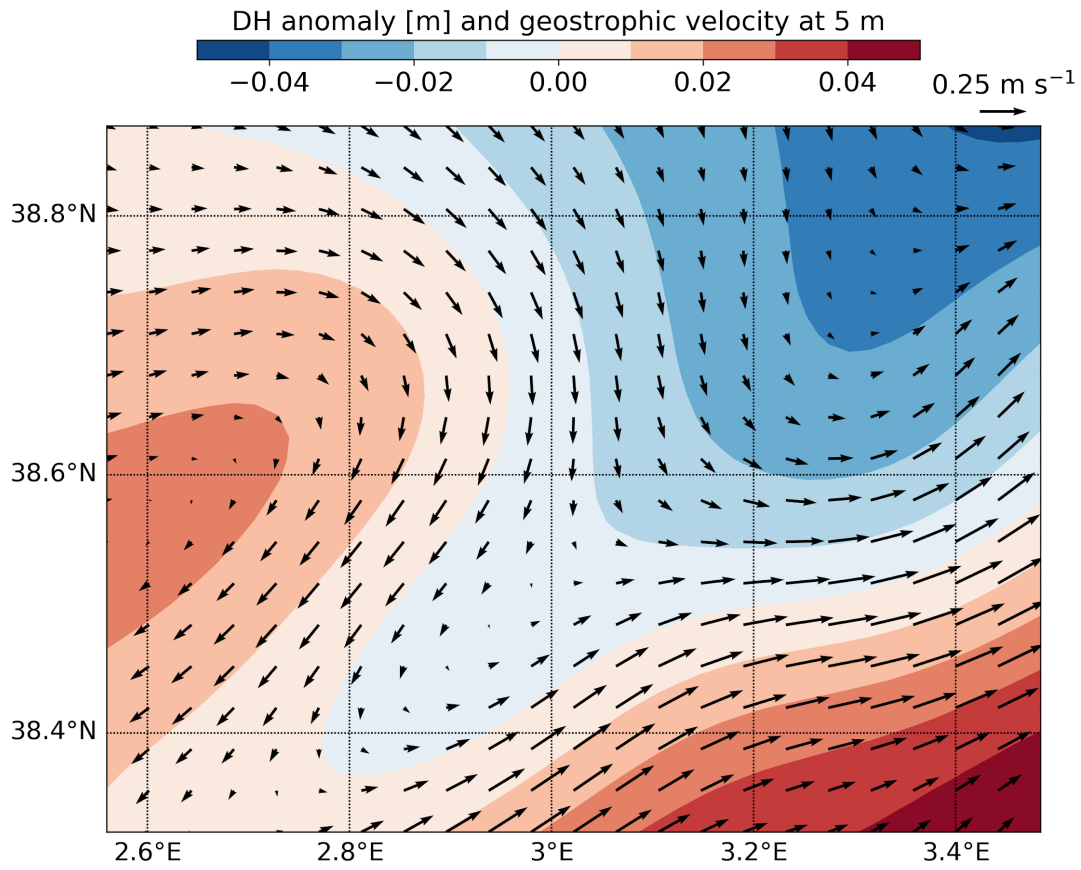


Figure 28. Dynamic height anomaly at 5 m depth inferred using Leg 1 density data objectively interpolated with $L_x=L_y=20\text{km}$. We assume a level of no motion at 1000 m depth. Geostrophic velocity vectors at 5 m depth are estimated through thermal wind balance.

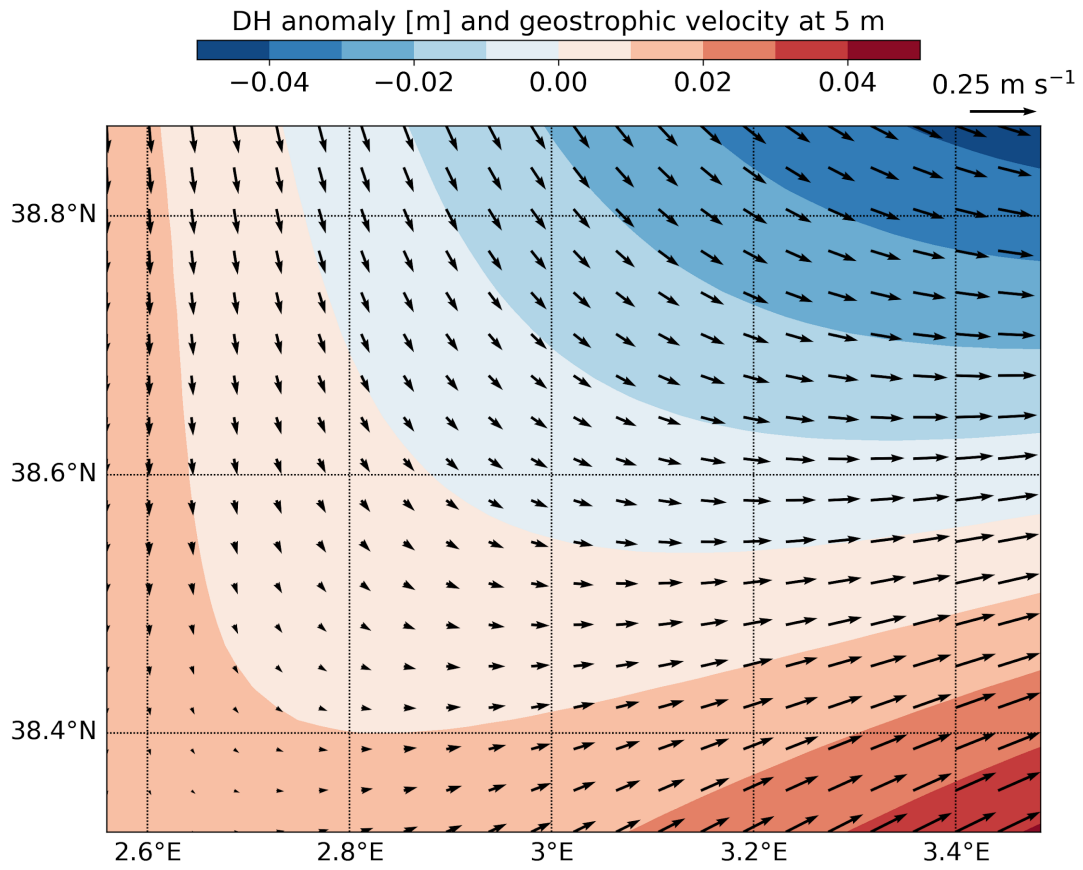


Figure 29. Dynamic height anomaly at 5 m depth inferred using Leg 1 density data objectively interpolated with $L_x=L_y=100\text{km}$. We assume a level of no motion at 1000 m depth. Geostrophic velocity vectors at 5 m depth are estimated through thermal wind balance.

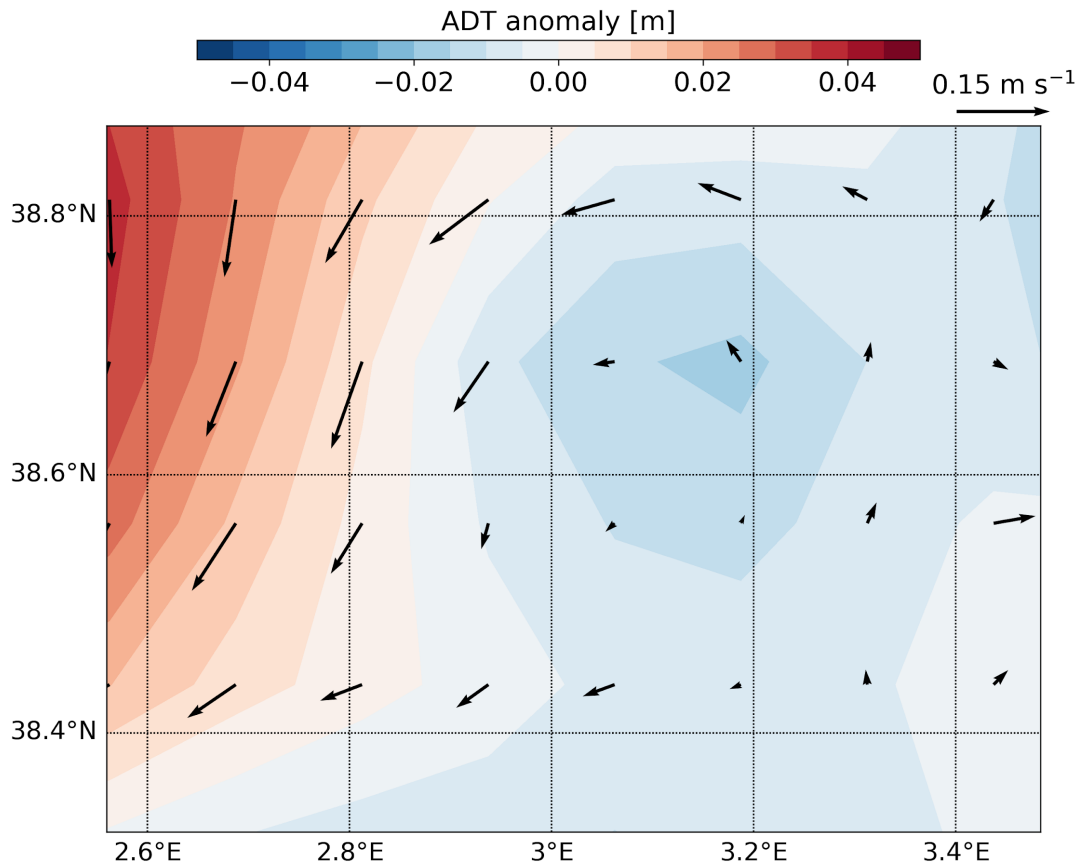


Figure 30. Absolute dynamic topography (ADT) anomaly from CMEMS on 03-05-2018 and derived geostrophic velocity vectors. Note that the scale vector is different from the previous figures.

5.3 DRIFTER TRAJECTORIES

Geostrophic and ADCP velocities are in good agreement with the trajectory followed by the drifters.

Geostrophic velocity inferred from the objectively interpolated density field ($L=20\text{km}$) is in good agreement with the trajectory followed by the drifters released during the cruise (Figure 31). The post-processed ADCP data vertically smoothed with $L_z=60\text{m}$ and objectively interpolated ($L_x=L_y=20\text{km}$ and an uncorrelated noise of 18%) also shows good agreement with the drifter trajectories (Figure 32). The derived geostrophic velocity field from ADT does not explain the eastward displacement of drifters (Figure 33).

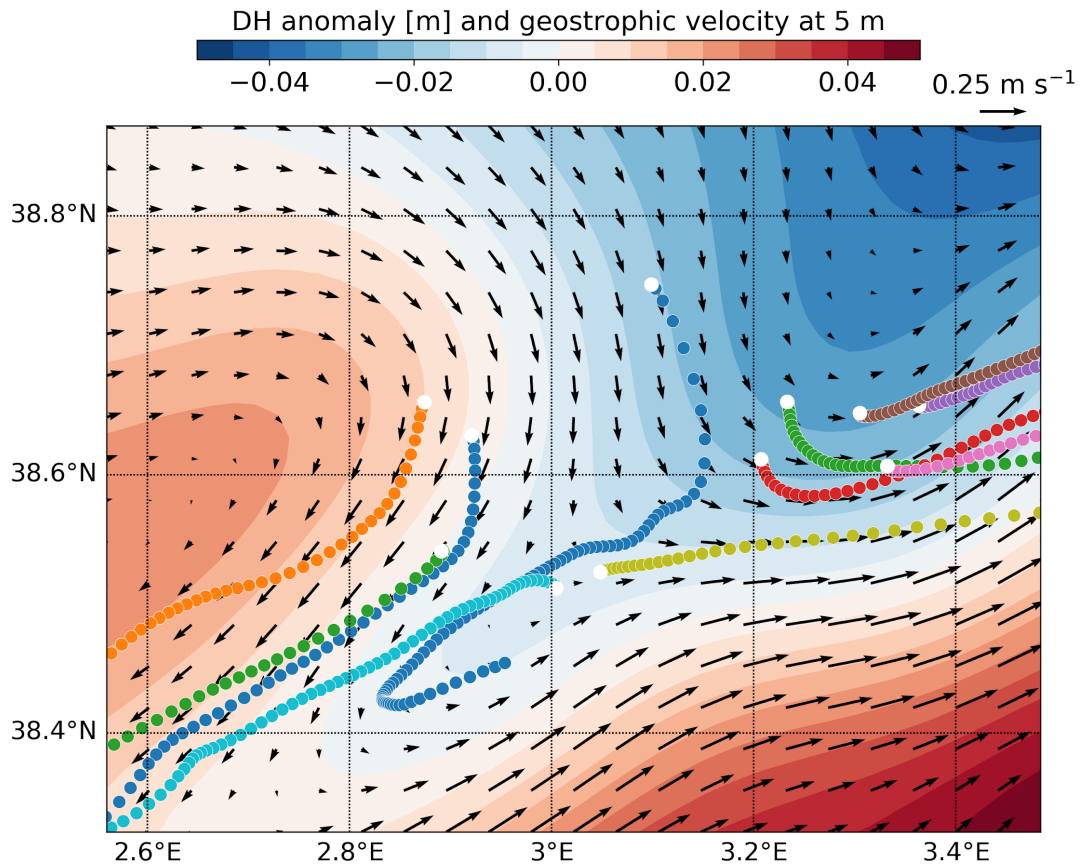


Figure 31. Dynamic height anomaly at 5 m depth inferred using Leg 1 density data. We assume a level of no motion at 1000 m depth. Geostrophic velocity vectors at 5 m depth are estimated through thermal wind balance. Dots show the trajectories followed by the drifters released during the PRE-SWOT experiment for the period 5-13 May (white dots are the release positions).

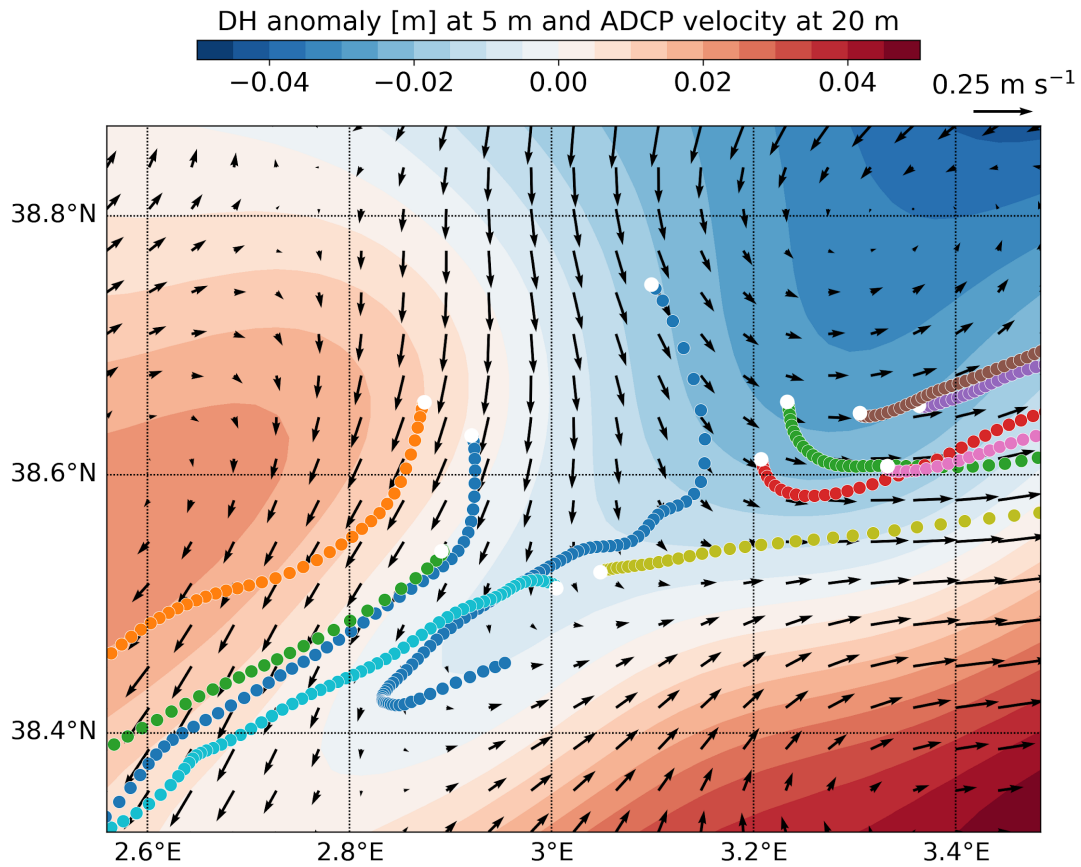


Figure 32. Dynamic height anomaly at 5 m depth inferred using Leg 1 density data. We assume a level of no motion at 1000 m depth. ADCP velocity vectors at 20 m depth. Post-processed ADCP velocity has been vertically smoothed with $L_z=60\text{m}$ and objectively interpolated onto a regular grid with a horizontal resolution of 2 km and a vertical resolution of 5 m considering $L_x=L_y=20\text{km}$ and assuming an uncorrelated noise of 18% of the signal energy. Dots show the trajectories followed by the drifters released during the PRE-SWOT experiment for the period 5-13 May (white dots are the release positions).

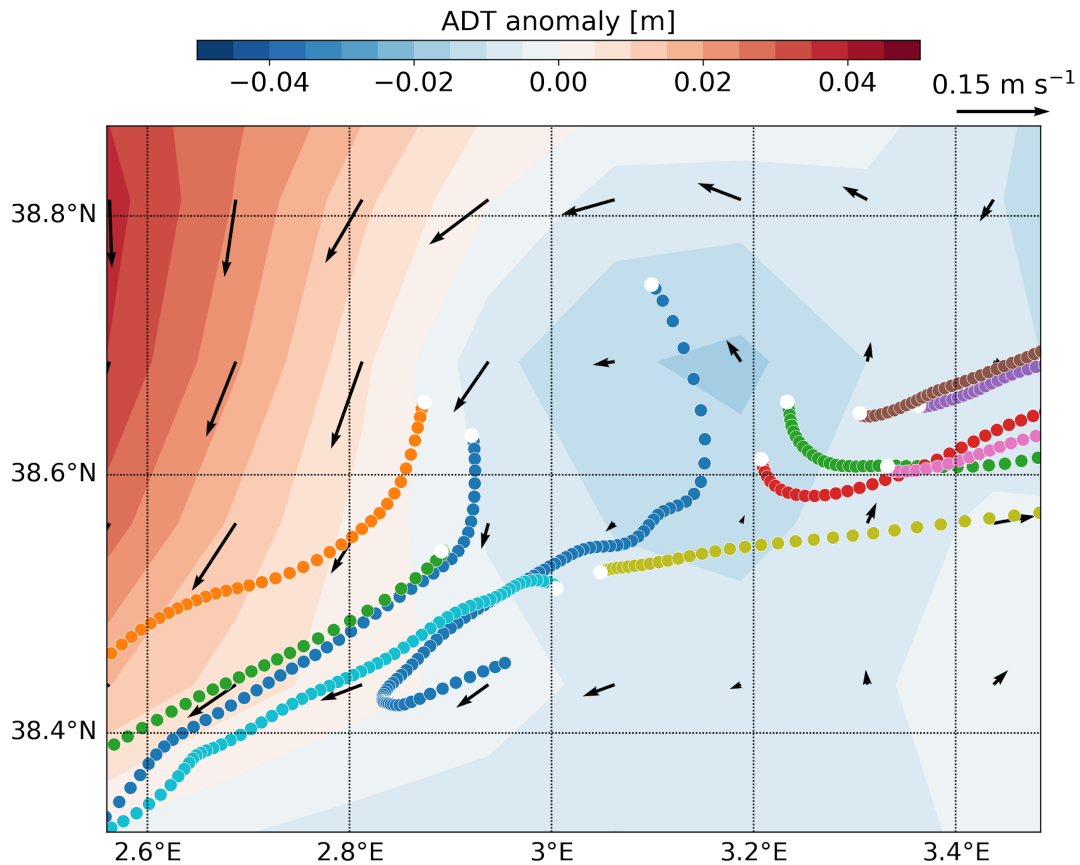


Figure 33. Absolute dynamic topography (ADT) anomaly from CMEMS on 03-05-2018 and derived geostrophic velocity vectors. Dots show the trajectories followed by the drifters released during the PRE-SWOT experiment for the period 5-13 May (white dots are the release positions).

5.4 AGEOSTROPHIC VS GEOSTROPHIC VELOCITIES

The objectively interpolated ADCP velocity has important differences with respect the geostrophic velocity, indicating that the ageostrophic component may have an important contribution on the dynamics of this region.

Processed ADCP velocity has been vertically smoothed with $L_z=60\text{m}$ and objectively interpolated onto a regular grid with a horizontal resolution of 2 km and a vertical resolution of 5 m considering $L_x=L_y=20\text{km}$ and assuming an uncorrelated noise of 18% of the signal energy (inferred as the ratio of noise to signal variance considering an instrumental error with a standard deviation of 0.01 m/s; Gomis et al., 2001, Allen et al., 1997).

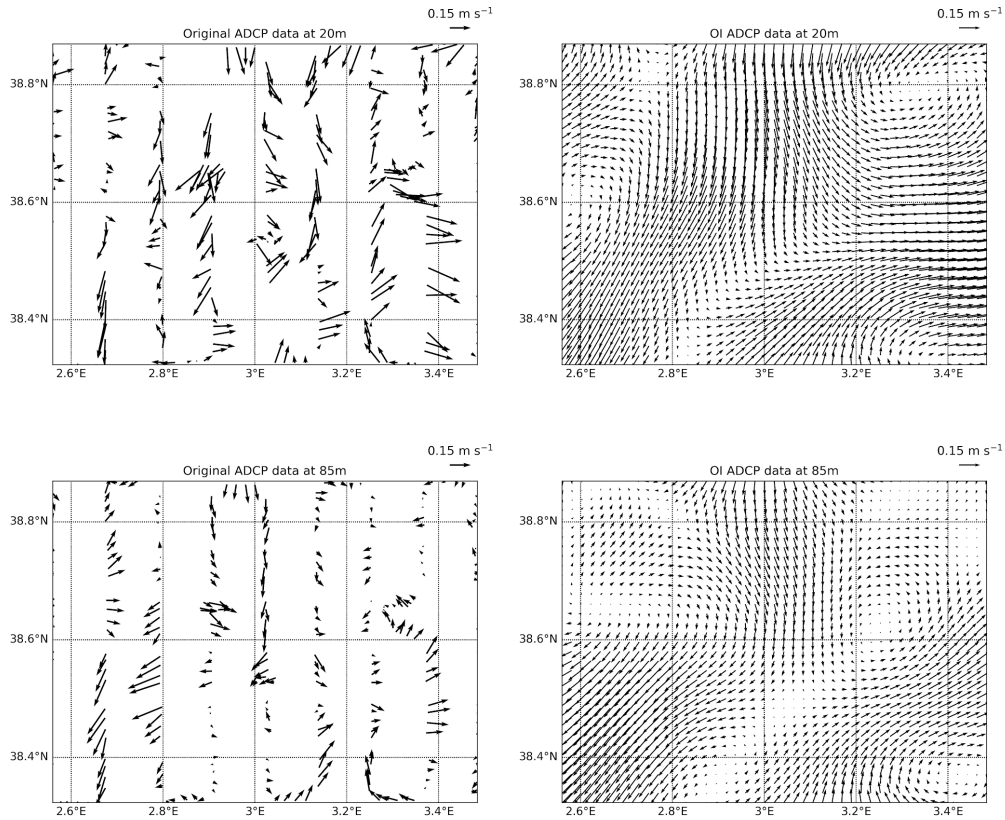


Figure 34. Map at 20 m (top) and 85 m (bottom) depth of the (left) processed ADCP data vertically smoothed with $L_z=60\text{m}$ and interpolated onto a vertical axis with a vertical resolution of 5 m, and (right) ADCP data objectively interpolated onto an horizontal grid with a horizontal resolution of 2 km using $L_x=L_y=20\text{km}$; at 20 m (top) and 50 m (bottom) depth.

The ADCP velocity is a measure of the total horizontal velocity and the ageostrophic component can be obtained as $\mathbf{u}_{\text{ageo}} = \mathbf{u}_{\text{ADCP}} - \mathbf{u}_{\text{geo}}$. Maps of \mathbf{u}_{ageo} and \mathbf{u}_{ADCP} (Figure 35) show that remarkable differences in the velocity direction are observed in the southeastern and northwestern regions of the domain, and in magnitude in the top center and southwest sides of the domain; indicating that the ageostrophic component of the horizontal velocity may have an important contribution on the dynamics of this region. The ageostrophic component of the horizontal velocity has similar order of magnitude as its geostrophic counterpart (Figure 36). However, we note that the geostrophic velocity is inferred assuming a level of no motion at 1000 m depth and the ADCP velocity also includes the barotropic component of the horizontal velocity. Also, from 500 to 1000 m the CTD data has less data points that could imply an additional smoothing to the interpolated CTD data. The ADCP field also presents smaller features on the southeastern and northwestern corners of the domain that could be due to the higher resolution along meridional transects of ADCP data compared to CTD stations and also to potential artifacts of OI close to the boundaries that may affect the estimation of the derivatives involved in U_{geo} .

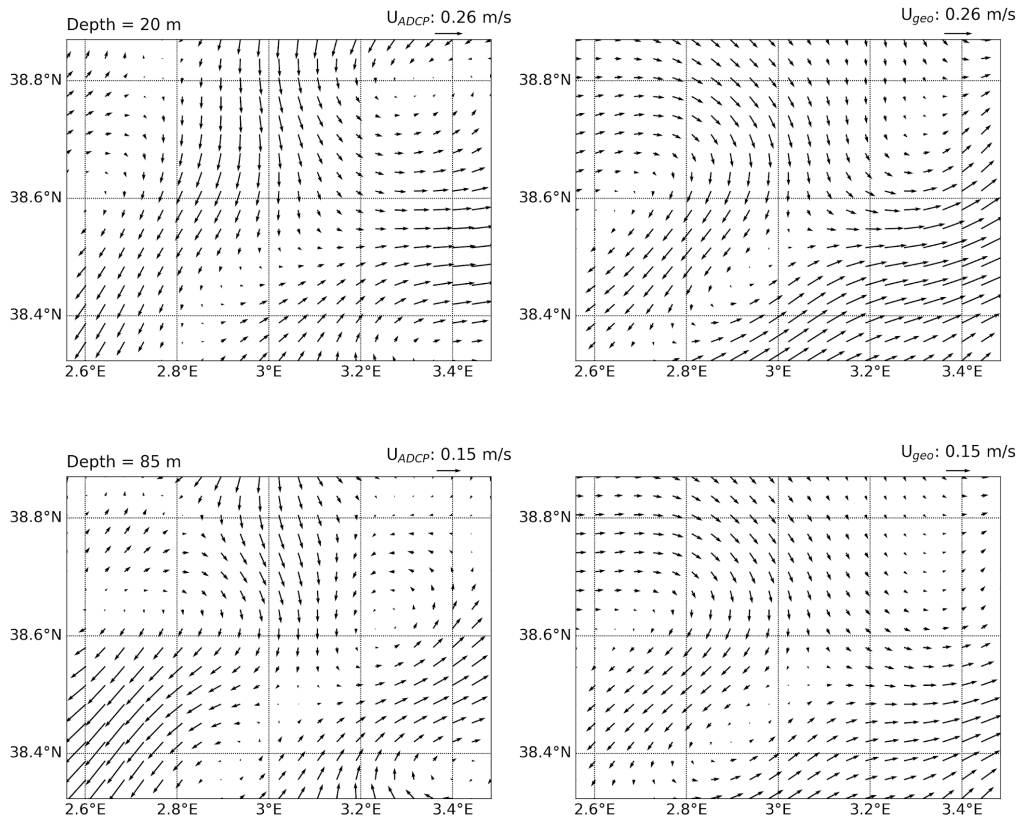
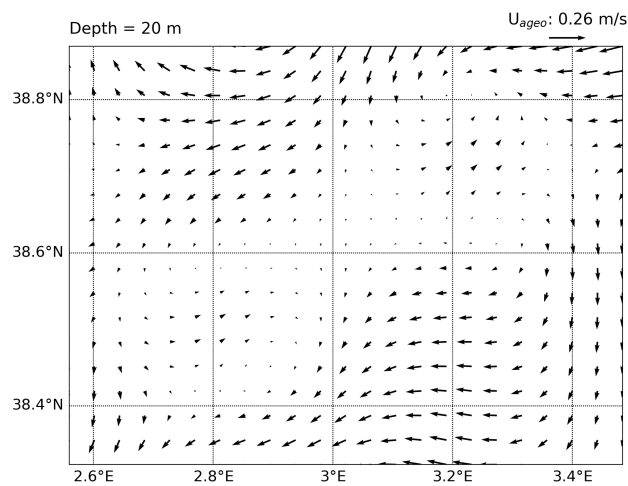


Figure 35. Maps at 20 m (top) and 85 m (bottom) depth of the ADCP velocity (left) and geostrophic velocity inferred with CTD density data (right).



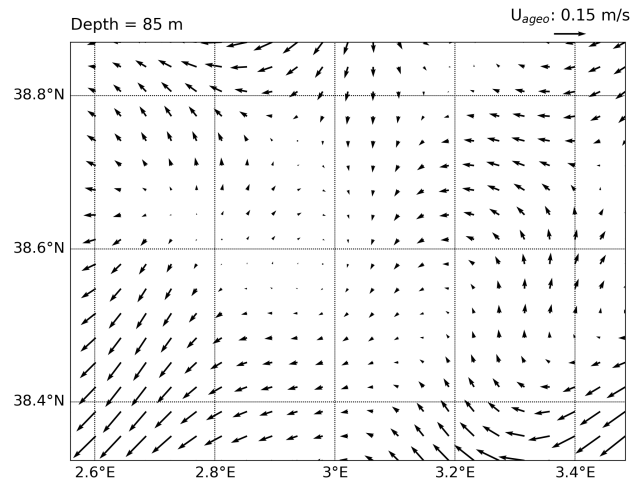


Figure 36. Map at 20 m (top) and 85 m (bottom) depth of the ageostrophic velocity ($\mathbf{u}_{\text{ageo}} = \mathbf{u}_{\text{ADCP}} - \mathbf{u}_{\text{geo}}$) with the same arrow scale as in the previous Figure.

5.5 POST-CRUISE ANALYSIS OF THE BIOGEOCHEMICAL DATA.

Oxygen and chlorophyll a (chl a) calibration

The dissolved oxygen concentration obtained using the Sea-Bird 43 (SBE 43) on board the R/V García del Cid was compared to Winkler Titration (Metrohm 888 Titrator). The results of this comparison are shown in Fig. 37 (oxygen = $1.0657 \cdot \text{CTD oxygen} - 0.8753$ and $R^2 = 0.9966$, $n = 67$, see Uchida et al. (2010) for more details on CTD oxygen calibration). We noticed the highest residuals (SBE 43 sensor-in situ water samples) related to the surface, this is often seen, probably because of the high variability in near-surface oxygen and the sensor instability at the beginning of the cast.

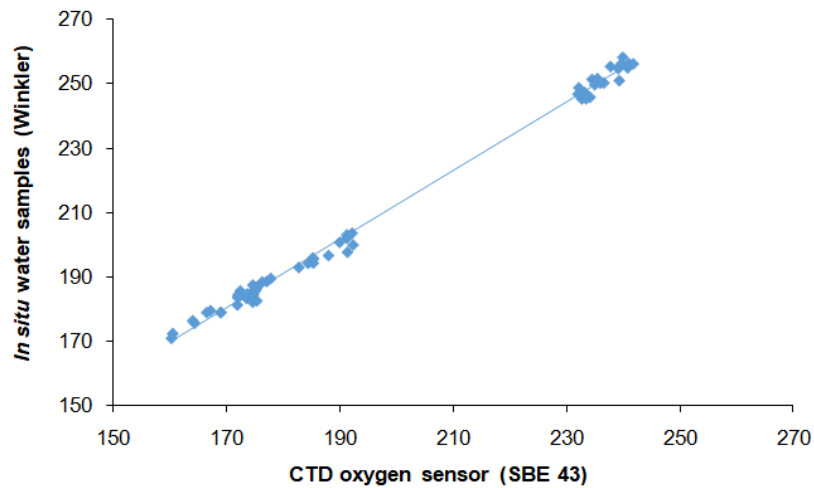


Figure 37. Comparison of the dissolved oxygen (in $\mu\text{mol/l}$) obtained from the in situ water samples (analytical results) and the CTD data (sensor Seabird SBE 43) during PRE-SWOT cruise.

To estimate the total chlorophyll a (*chl a*) concentration, a proxy for phytoplankton biomass, at each station during the cruise, 1 L of water from 4 depths was filtered through Whatman GF/F filters and extracted for 24 h in 90% acetone for post-cruise fluorometric determination (Turner Designs fluorometer) following (Parsons et al. 1984, Estrada 2012). These results can be used to calibrate the CTD fluorometer (see Fig. 38 for the comparison, $\text{chl } a = 8.6903 \cdot \text{fluorescence} - 0.2092$ and $R^2=0.7388$). The results suggested that there is an offset to be applied to the CTD data set (*chl a* pigment content at 500 m $\text{chl } a=0.005 \text{ mgm}^{-3}$ and the value obtained with the sensor=0.03 volts, $n=16$, averaged values). During the second day of analyses, we detected a potential problem during extraction affecting some samples (data not shown). This was suggested by the low values obtained after the determination; these results were not included in the comparison.

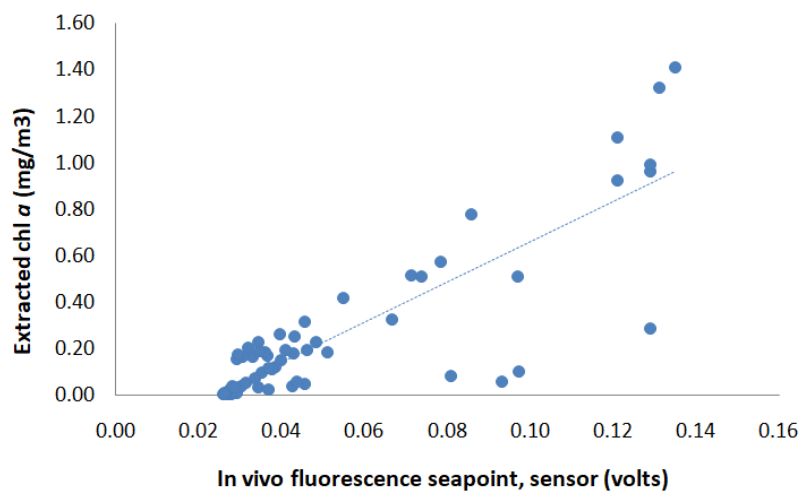


Figure 38. Comparison between the extracted *chl a* (mg/m^3) and the in vivo fluorescence CTD data (Sea point sensor, volts).

The correlation is better for Leg 2 (B, Fig. 39) than for the Leg 1 (A, Fig. 39), probably because in the first cruise leg we found a front between Recent Atlantic Water and Resident Atlantic Water. However, for leg 2 the results show a good correlation ($R^2=0.9464$).

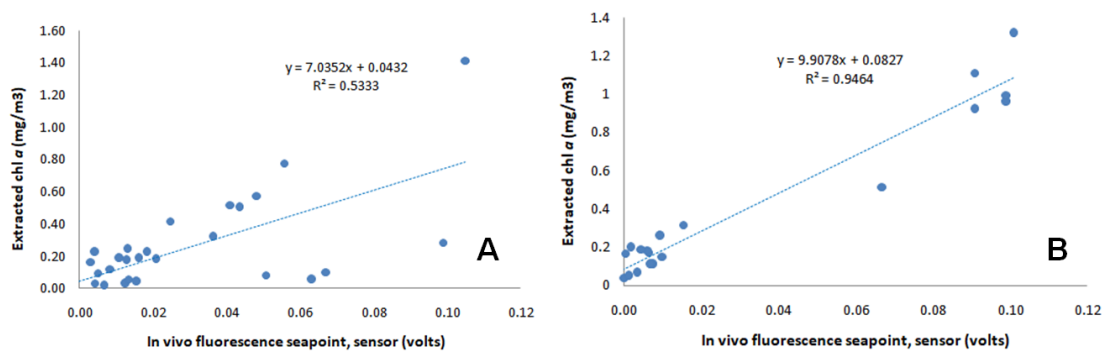


Figure 39. Comparison between the extracted chl *a* (mg/m³) and the in vivo fluorescence CTD data (Sea point sensor, volts) for Leg 1 (A) and Leg 2 (B).

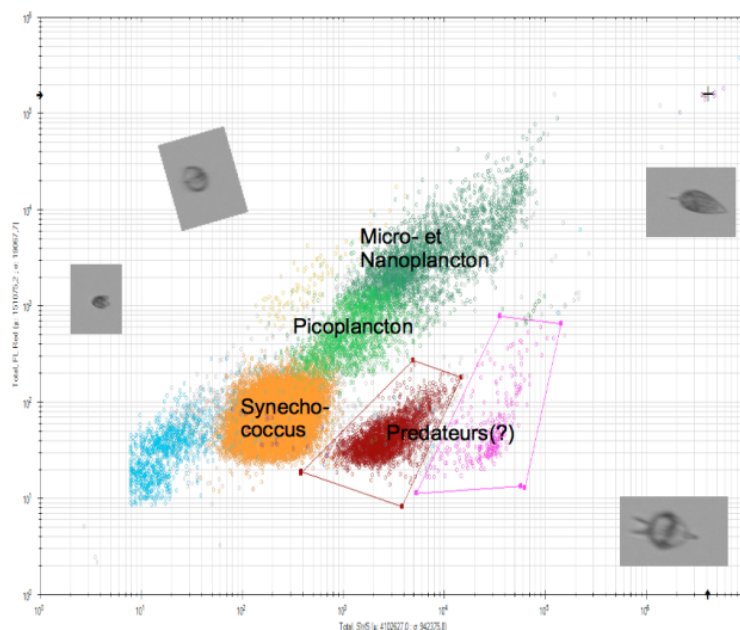


Figure 40. Analysis of the phytoplankton community in the study area by an automated flow cytometer (Cytosense) installed onboard R/V Beautemps Beauprè, on the seawater supply from the thermosalinometer (source: MIO).

Post-cruise analyses, Nutrient in situ samples, pigments (HPLC) and phytoplankton (microscopy).

Nutrient samples for leg 1 have been sent to the Instituto de Ciencias Marinas (ICMAN-Cadiz) to be analyzed. The rest of the samples are stored at -20°C in the IMEDEA, CSIC-UIB.

After the analysis, the results for Nitrate (NO₃) samples for Leg 1 (Fig. 41) shows that the higher concentration of nitrate is moving from 3.4°E to 2.8°E and down from 200 to 600 m (in red, Fig. 42). So, here we can see the movement to the front, where the richer water corresponds to more recent Atlantic Water inflow.

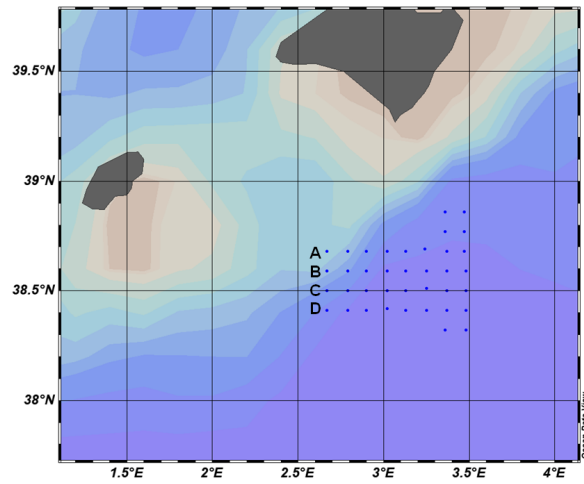


Figure 41. Location of the sampling stations during Pre-SWOT cruise (Leg 1).

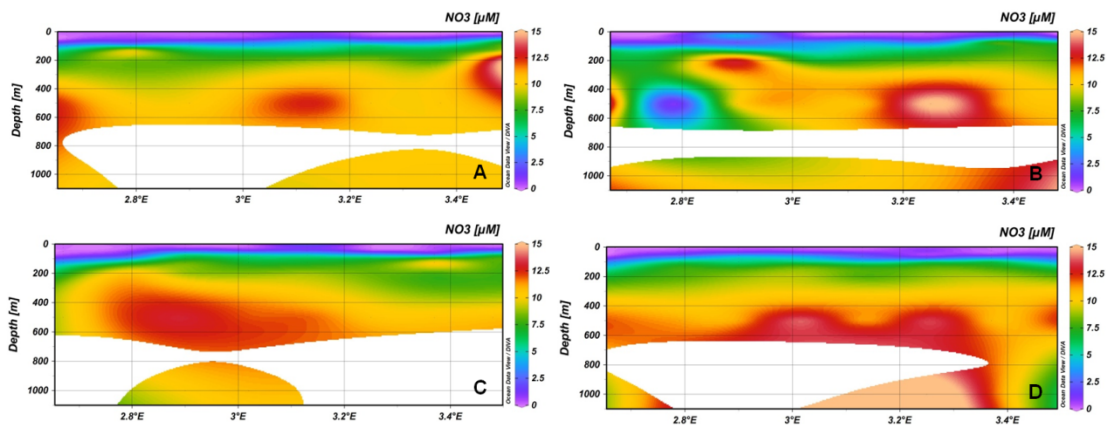


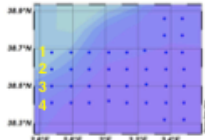
Figure 42. Distribution of in situ NO_3 concentration (μM) during the Pre-SWOT cruise (Leg 1).

Regarding pigment data, there has been a first collaboration with the Universitat de les Illes Balears (UIB). A trial was performed with some samples and two different methods were applied (Zapata et al. 2000, and Van Heukelem and Thomas 2001). The resulting peaks were not very clear for a good quantification and only the carotenoids and xanthophylls were detected. Also there was a problem with the retention times, making the identification of the pigments more difficult. One solution would be use samples from the Canales cruise and perform another trial using some mixed standards.

The phytoplankton samples for community composition will be analyzed in due course, depending on the results.

Maximum values of nitrate (NO_3) are located at the saltier side of the front.

The concentration of NO_3 increases from the surface to 125 m depth (Figure 43). Through maps of NO_3 and salinity we observe that at 75, 100 and 125 m depth the maximum values of NO_3 are located at the saltier side of the front (Figure 44).



ZONAL SECTIONS

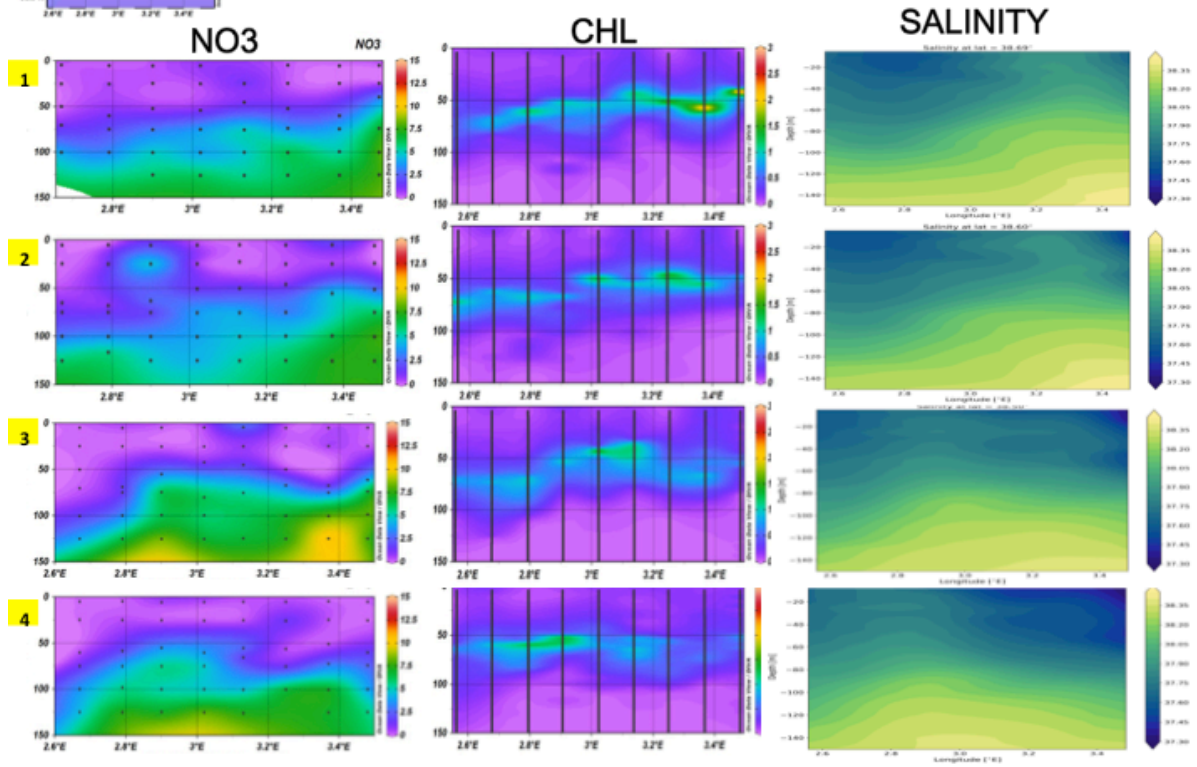


Figure 43. Meridional sections of NO_3 (left), $\text{Chl } a$ (middle) and salinity (right) between the surface and 150 m depth. The NO_3 distribution follows the distribution of maximum salinity between the surface and 150 m depth. Maximum values of $\text{Chl } a$ are observed along the halocline.

HORIZONTAL SECTIONS

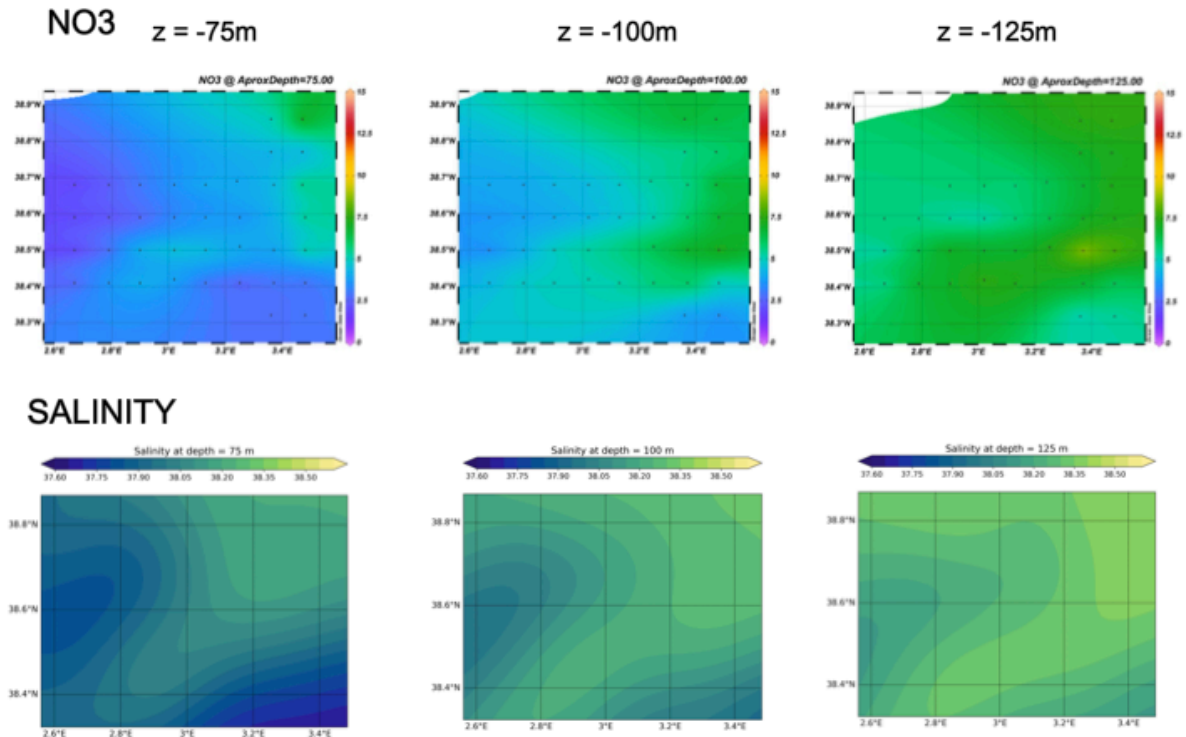


Figure 44. Maps of NO₃ (top) and salinity (bottom) at 75, 100 and 125 m depth. The distribution of the maximum concentration values of NO₃ are located at regions with high salinity, being maximum at 125 m. Below this depth, the NO₃ concentration decreases.

6 DATA MANAGEMENT PLAN

Document reference:

<http://repository.socib.es/repository/entry/show?entryid=e702745b-6fba-476c-8930-fb557b32e2c1>

This document outlines how research data from project PRE-SWOT are managed, stored, documented and secured throughout the project as well as planning for what will happen to the data after completion of the project (R/V, SVP Drifters, and gliders).

The data management plan is intended to provide descriptive details of the data, the processes, the decisions, as well as identifying roles and responsibilities. This also includes a long-term data sharing and preservation plan to ensure data are publicly accessible beyond the life of the project.

7 CONTRIBUTIONS FROM OTHER INSTITUTIONS

SHOM: PI F. Dumas: SHOM participated with the R/V Beautemps-Beaupré, operating in the area in the period 28 April - 14 May. The ship was some days ahead of the mission (i.e. from 26 April 8 am to 29 April 8 am) at Palma harbor. It was an opportunity to meet at that moment for some very last adjustments. Their main objectives were: an underway, quasi-synoptic hydrographic survey of the area with a towed instrument (SeaSoar) down to 500m; ADCP measures (currents and possibly nekton); high resolution phytoplankton community structure (surface) by automated and high frequency flow cytometry (Cytosense, contribution of the BIOSWOT project); and 12 holey sock drifters drogued at various depth. The main strategy was a repeated zig-zag (no or very few fixed stations).

BIOSWOT (LOCEAN and MIO): PI workpackage experiments: A. Doglioli (MIO); PI project F. d'Ovidio (LOCEAN): BIOSWOT; PI cytometry: G. Gregori (MIO). MIO contributed with an automated flow cytometer; one glider with CTD and a hydrocarbon sensor; and SPASSO near-real-time analysis for potential adaptive strategies.

PARTHENOPE UNIVERSITY: Y. Cotroneo (PI) and G. Aulicino contributed to the glider data analysis and joined the discussion of the large PRE-SWOT dataset. Additionally, the glider data acquired since 2014 during the ABACUS (Algerian Basin Circulation Unmanned Survey) missions in the same study area funded by JERICO-Next TransNational Access program, and the experience gained in the multiplatform data comparison provided an useful term of comparison (not showed) for the PRE-SWOT data.

8 OUTREACH

ACTIVITIES WITH KIDS

In the framework of the PRE-SWOT project, the PI Ananda Pascual and collaborator Francesco D'Ovidio gave a talk in the primary school of Esporles to explain the importance of remote sensing and in situ observations of the ocean. Also, it was organized an outreach activity with kids at IMEDEA(CSIC-UIB) to adopt and paint a drifter workshop.

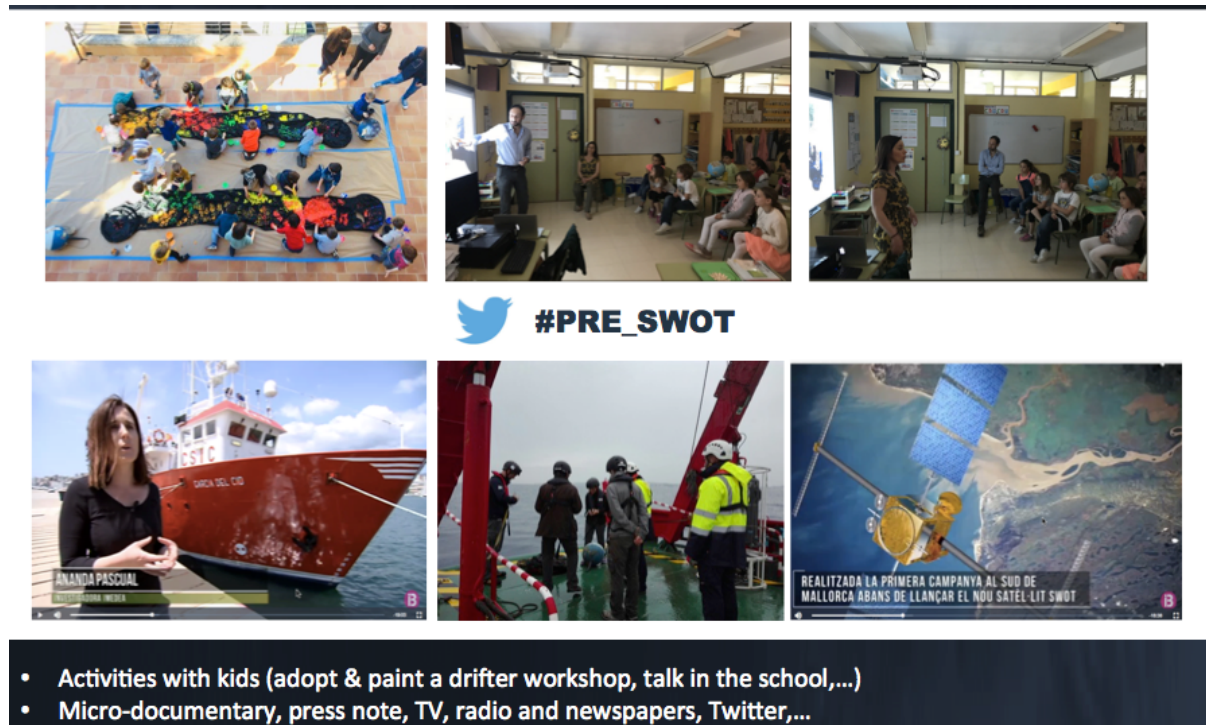


Figure 45. Summary of outreach activities.

PRESS RELEASE

A press release was published to communicate to the media the start of the field experiment:

https://imedea.uib-csic.es/communication_details.php?id=1580&tp=n#.W_fPSSdRdsg

The new was published on local and national newspapers, and also came on TV.

The PI of the project was interviewed on radio and TV.

↻ Pablo Rodríguez Ros i 3 més han retuitat



Balears Fa Ciència IB3 @BalearsFCiencia · 4 de maig

🌊 Dissabte a les 11h vos contarem que és la campanya oceanogràfica #PRE_SWOT on participen @IMEDEA_UIB_CSIC i @socib_icts i contactarem amb @anandapascual1 des del vaixell oceanogràfic García del Cid del @csic
👉 Més info a goo.gl/WBd8MX i goo.gl/Tphvff



💬 7 ❤️ 14 ✉️

PRE-SWOT DOCUMENTARY

In English: https://youtu.be/u3bQ0r_zepA

In Spanish: https://youtu.be/kx_xGUubRI

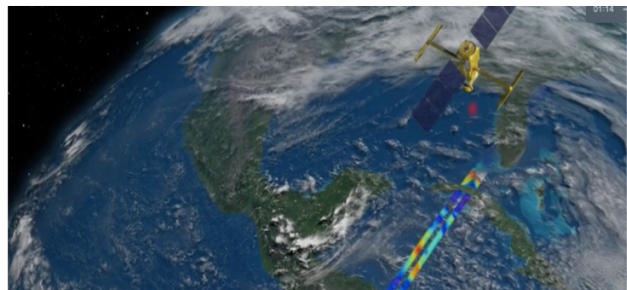


Figure 46. Screenshots from PRE-SWOT microdocumentary.

TWITTER

We used the hashtag **#pre_swot** to report the field experiment in real time as well as all the news related to the project: https://twitter.com/search?q=%23pre_swot&src=typd

♥ A Enric Culat i 1 altre els agrada



IMEDEA (UIB-CSIC) @IMEDEA_UIB_CSIC · 24 d'abr.

Hoy hemos dado una charla, en el marco del proyecto **#PRE_SWOT**, a 25 niños y niñas de 3º de Primaria del CEIP Gabriel Comas i Ribas de **#Esporles**
[facebook.com/pg/imedeadivul...](https://www.facebook.com/pg/imedeadivulga) **#IMEDEADivulga**

Tradueix el tuit



🔄 Pelopantón 🗺️ i 2 més han retuitat



SOCIB @socib_icts · 23 de març

Hoy nos hemos divertido aprendiendo qué es un drifter o boya de deriva, con I@s peques del CEIP Gabriel Comas i Ribas. Esta boya pasará un colorido mensaje por la capa superior del océano global mientras toma datos (T^a, salinidad...) en el marco del proyecto [#PRE_SWOT](#)

🌐 Tradueix el tuit



💬 6 ❤️ 16 ✉️

🔄 C E Watkins i 1 altre han retuitat



Ananda Pascual @anandapascual1 · 3 de maig

Cerrando plan de campaña, preparando los gliders, muestras de biogeoquímica, nota de prensa,... [#PRE_SWOT](#) @IMEDEA_UIB_CSIC @socib_icts

🌐 Tradueix el tuit



💬 3 ❤️ 14 ✉️

A Ananda Pascual li agrada



IMEDEA (UIB-CSIC) @IMEDEA_UIB_CSIC · 3 de maig

Se inicia la campanya oceanogràfica **#PRE_SWOT** a bordo del García del Cid (CSIC) @IMEDEA_UIB_CSIC @socib_icts imedeia.uib-csic.es/communication_...



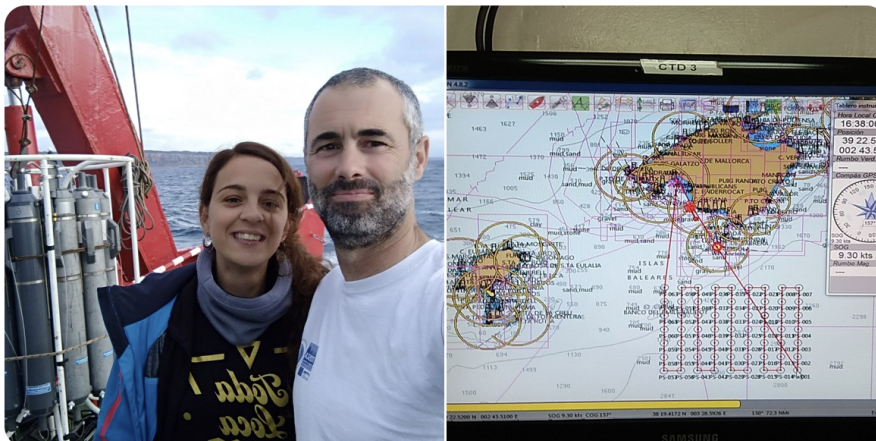
🗨️ 7 🍷 15 ✉️



Benjamín Casas @BenCasas · 5 de maig

Comenzando la campanya oceanogràfica **#PRE_SWOT**. Esta mañana hemos trabajado en la bahía de Palma y ahora ponemos rumbo a la zona de estudio en el sur de Cabrera

🌐 Tradueix el tuit



🗨️ 5 🍷 22 ✉️



Bàrbara Barceló-Llull @bbarcelo_ocean · 4 de maig
Wet lab in R/V García del Cid #PRE_SWOT @IMEDEA_UIB_CSIC @socib_icts

Tradueix el tuit



1 8



Bàrbara Barceló-Llull @bbarcelo_ocean · 4 de maig
Our office for the next days! #PRE_SWOT @IMEDEA_UIB_CSIC @socib_icts

Tradueix el tuit



1 11

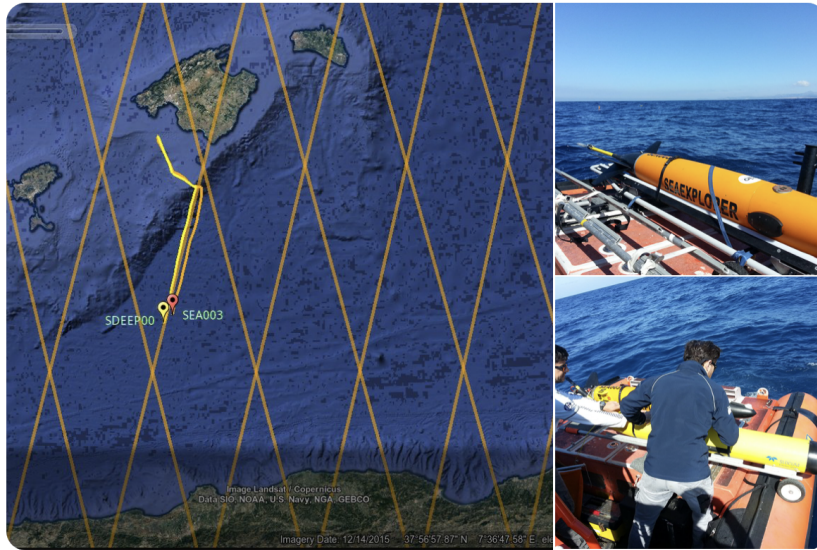
C E Watkins i 1 altre han retuitat



SEA003 @sea003_glider · 9 de maig

As part of **#PRE_SWOT** campaign, I was deployed last week with my new best friend SDEEP00 from @socib_icts. Separated by 5km, we successfully followed one #Sentinel3 and today we started our way back home! @IMEDEA_UIB_CSIC @anandapascual1 @MIOceanologie @DFO_Science @SeaExplorerUUV

Tradueix el tuit



1 12 22

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- 2) Pascual, A.; Ruiz, S.; Sanchez-Roman,A.;Gomez-Navarro, L.; Barcelo-Llull, B.; Diaz-Barroso, L.; Chabert, P.; Cutolo E.; Freilich, M.A.; Heslop, E.; Casas,B.; Torner, M.; Mourre, B.; Alou, E.; Cotroneo,Y.; Aulicino,G.; Mason, E.; Mahadevan, A.; Tintore, J.; D'Ovidio, F.; Fablet, R.; Allen, J. Review: Overview of Fine-scale Multiplatform Experiments in the Southwest Mediterranean Sea: Lessons Learnt in the Last Five Years. 25 Years Of Progress in Radar Altimetry Symposium. 24-29 September 2018. Ponta Delgada, Sao Miguel Island Azores Archipelago, Portugal. Type of participation: Oral
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ACKNOWLEDGEMENTS

PRE-SWOT project (CTM2016-78607-P) is funded by the Spanish Research Agency and the European Regional Development Fund (AEI/FEDER, UE). We express our gratitude to the technical staff (UTM- CSIC) and crew of R/V García del Cid for supporting our work at sea.

DATA AVAILABILITY

All data collected during the PRE-SWOT experiment will be made publically available before the end of the project assigning a Digital Object Identifier (DOI) to make them easily and uniquely citable.

For requests please contact the PI: ananda.pascual@imedea.uib-csic.es.



Figure 47. Group photo with scientists, crew and UTM technicians.

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ANNEX 1: ONBOARD DIARY

Ananda Pascual and Cristian Muñoz

Diario de abordo

HORAS: UTC

Sábado 5 de mayo 2018

06:00 – 07:40. Video. John prepara configuración ADCP con David (Roque).

07:40 – 12:00. Zarpamos. Tareas de video en la Bahía de Palma (CTD, oxígenos, chl,). El estado de la mar es bueno. Lluvea.

12:00 – 14:54 Seguimos con video en puerto (Ariadna). John comprueba ADCP, parece que ha habido algunos problemas en el fichero de configuración. Se encuentra el error.

14:54 Zarpamos rumbo a lanzar los primeros 3 drifters. Navegamos a 9 nudos. El estado del mar es bueno. Deja de llover. Tránsito gradiente de salinidad termosal: 37.74 (38°44' 21.00" N – 3° 7' 4.20" E) - 37.95 (38° 40' 29.22" – 3° 12' 56.40" E). Reunión con Oscar (primer oficial).

21:42 Lanzamos primer triplete de drifters (21:42; 22:22, 23:00). Triángulo separado de 5 km entre estaciones 24 19 25 18. No tenemos wifi desde las 20:40 aprox. Internet solo en puente. Avistamiento de unas 80 medusas pelagia noctiluca (22:20, 38°40'15.60"N, 3° 13' 1.80" E)

Domingo 6 de mayo 2018

02:00 aprox. Llegada a CTD01 (profundo, calibración: salinidad, chl, oxígeno + biología – nutrientes, phyto, HPLC). Se hará biología en todas las estaciones del primer transecto (se irá decidiendo después para las demás. Calibración en profundas (1000 m). El mar está más movido.

06:12 CTD03 – termosal marca salinidad 37.31. ADCP un tanto extraño. Luego descubrimos con Benja que estábamos graficando velocidad total (barco incluido). Lo pintamos referido a la navegación. Los datos son bastante ruidosos 75KHz bins de 8-16 m hasta 800 m. Aún así en el transecto 1 aparece una señal bastante coherente de velocidad hacia el este con picos de hasta 50 cm/s

CTD05 - Valores altos de chl. ADCP max orden 50 cm/s (entre estaciones 4-5)

CTD11 – Corrientes muy débiles

Se lanza segundo triplete de drifters.

Lunes 7 de mayo 2018

Mar en calma. Calor y sol, alguna nube, se despeja a mediodía
00h26 UTC Medusas CTD13: 38° 24' 57.6" N, 3°22' 1.80" E

Tiempos:

70 min (CTD profundo - 1000 m)

40 min (shallow)

45 min (transito) - 10 km

Son unos tiempos superiores a lo que habíamos estimado con Benja, ya que el posicionamiento y aceleración cuesta más que

Todo en orden. Turnos funcionan muy bien. Empezamos a procesar datos (Bàrbara: ADCP, Enrico: termosalinógrafo, David: CTD con ODV). Discusiones científicas muy interesantes entre todos!

Contacto con los franceses. Francesco envía unas imágenes SAR interesantes (giro anticiclónico). Francesco informa de que se cancela el avión. Varios mails y discusión con Franck Dumas.

Activamos un drifter en cubierta para que parezca en el dapp la posición del barco.

Primer análisis de oxígenos en tiempo record (2 horas) durante las estaciones 20-21.

Martes 8 de mayo 2018

Mar en calma. Calor y sol.

Comunicación con Marc. Gliders avanzan bien. Slocum más rápido que SeaExplorer. Luego nos damos cuenta de que hay corrientes hacia el sur, tal y como se ve en los mapas de altimetría.

Se lanza tercer triplete de drifters.

Por la noche parece que el chigre da algunos problemas, hay que largar casi el doble de cable. Baja más despacio.

Miércoles 9 de mayo 2018

Seguimos con buen estado del mar. Calor y sol, alguna nube
Cuando empiezo mi turno (06:00 UTC) se está haciendo el CTD40.

El chigre va mejor (podemos seguir bajando a 1 m/s).

Durante la noche el ADCP (estación 41) ha marcado corrientes intensas hacia el sur de 50 cm/s aprox. Se lanza el último triplete de drifters. Todos ya están en el agua y transmitiendo (excepto uno que parece que ha tenido algún problema).

Empezamos a planificar la Leg-2. Contacto con Franck. Se hará un CTD de intercalibración en la estación 37 del leg-1 el domingo 13 a las 14h.

Segundo análisis oxígeno durante las estaciones 41 hasta la 44. Se fundió el puerto USB que conecta el ordenador con el titrando. Se tiene que repetir. Se tarda 4 horas.

Jueves 10 de mayo 2018

El mar está un poco más picado. Amanece muy nublado.
Cuando empiezo mi turno (06:00 UTC) se está haciendo el CTD55.

Se han visto medusas en la estación 52 (38°41' 12.00" – 2°40' 44.40"E)
07:30: Llama Alex (capitán) al laboratorio. Delfines en la proa! Precioso!!!

Encuentro con el Beautemps Beauprè para el domingo 13 de mayo a las 14h en las coordenadas (38° 46' 30.00" N 2° 54' 27.00" E)

Foto grupo 16:30. Los oficiales con los galones. 3 líneas gruesas (oficial primera), hélice -> máquinas. Ancla -> puente.

Mar de fondo

Después de cenar visita a las máquinas
El termómetro del termosol está en el laboratorio húmedo. Se mide la temperatura del agua que llega a través de una tubería que se va calentando a través del barco y con el contacto con el casco se va calentando. Comparamos

DAY 1 - 13/05/2018

BO Garcia del Cid left Palma Port at 13:10 UTC in a sunny afternoon. Wind blew at 13kn from the west and heading towards first CTD station PS2_040 at an average speed of 9.6kn. First watch started at 14:00 UTC.
At 13.45 UTC the VM-ADCP was switched on in bottom track with file PRESWOT_021. The sea was slight with a low swell crossing to the vessel starboard.
At 14:20 UTC and 15:55 UTC dolphins were watched in the bow. VM-ADCP PRESWOT_021 file was stopped at 17:59 UTC.
Second watch started at 18:00 UTC
PS2_040 CTD started at 18:04 UTC and back on deck at 18:35 UTC. Wind blew at 6.8kn from the north and the sea still slight with a low swell crossing to the vessel starboard.
At 18:40 started heading towards PS2_039 CTD station at an average speed of 8.3kn. At 18.47 UTC the VM-ADCP was switched on in bottom track mode and file name PRESWOT_022.
Sunset was at 18:53 UTC.
PS2_039 CTD started at 19:27 UTC and safely back on deck at 20:05 UTC.

PS2_038 CTD started at 20:56 UTC and safely back on deck at 21:35 UTC.

Third watch of the day started at 22:00 UTC.

DAY 2 - 14/05/2018

First watch of the day started at 02:00 UTC.

PS2_037, PS2_036, PS2_035 and S2_034 CTD stations were performed without incidents.

At 03:07 UTC we left PS2_034 towards the intercomparisson CTD meeting point located at N38 31.905 E2 16.083.

At 03:12 UTC the VM-ADCP was switched on in water track mode and file name PRESWOT_023.

At 05:15 UTC BO Garcia del Cid arrived to the meeting point, where the BHO Beautemps-BauprÈ was already waiting.

At 05:30 UTC SHOM vessel launched the boat and thre people came onboard, showed them the vessel and exchanged wine.

Second watch of the day started at 06:00 UTC.

At 06:42 UTC the VM-ADCP file PRESWOT_023 was restarted by PRESWOT_024 to catch the transit back to PS2_033.

At 06:52 UTC, second watch started with the intercomparisson CTD cast, that was synchronized with SHOMs CTD. Downcast velocity was 0.5m/s. Wind blew at 11.9 kn from the west and smooth sea with a low swell coming from 246j. CTD was back on deck at 07:24 UTC.

Third watch started at 10:00 UTC.

PS2_033 CTD started at 09:53 UTC. At 10:30 UTC, just before retrieving the CTD from the water, the secondary engine distribution broke down and the fire alarm rised. Then the power supply was partialy affected and we had to wait until hydraulics worked again. CTD was safely recovered at 10:48 UTC.

At 10:53 UTC the VM-ADCP file PRESWOT_024 was restarted by PRESWOT_025 to catch the las section of the western transect that ended with CTD station PS2_031.

PS2_032 CTD started at 11:41 UTC and safely back on deck at 12:17 UTC.

PS2_031 CTD started at 13:05 UTC and safely back on deck at 13:32 UTC.

At 13:41 UTC the VM-ADCP file PRESWOT_025 was restarted by PRESWOT_026 to catch the transit between PS2_031 to PS2_030. Wind intensity dropped down to 1.4 kn coming from the south-west and calm sea.

Fourth watch started at 14:00 UTC.

At 14:21 UTC the VM-ADCP file PRESWOT_026 was stopped just arriving to PS2_030 CTD station. CTD was deployed at 14:25 UTC and recovered at 15:15 UTC, where VM-ADCP file PRESWOT_026 was restarted by PRESWOT_027 in the begining of the second transect.

PS2_029 CTD started at 16:03 UTC and finished at 16:43 UTC.

PS2_028 CTD started at 17:37 UTC.

Fifth watch started at 18:00 UTC and CTD was recovered at 18:22 UTC.

Sunset was at 18:53 UTC.

PS2_027 CTD started at 19:10 UTC and finished at 19:53 UTC.

PS2_026 CTD started at 20:47 UTC and finished at 21:28 UTC.

Sixth watch of the day started at 22:00 UTC.

DAY 3 - 15/05/2018

PS2_025 CTD started at 22:28 UTC and finished at 23:07 UTC.

PS2_024 CTD started at 00:02 UTC and finished at 00:40 UTC. A big bank of jellyfishes (pelagia noctiluca) was identified during this station.

First watch of the day started at 02:00 UTC.

PS2_023, PS2_022 and PS2_021 CTD stations were performed normally.

At 05:32 UTC the VM-ADCP file PRESWOT_027 was stopped during the performance of PS2_021 CTD station. File PRESWOT_028 was started in water track mode at 05:53 UTC to cover the transit towards the SENTINEL transect (PS2_020 to PS2_011).

Second watch of the day started at 06:00 UTC.

Conditions this morning were excellent, completely sunny, with the wind blowing at 4.4kn from the north and the sea was calmed (glassy).

At 06:45 UTC the VM-ADCP file PRESWOT_028 was stopped just arriving to PS2_020 CTD station.

At 06:49 UTC, Marc sent us the last 3 positions received by the SeaExplorer glider.

PS2_020 CTD started at 06:53 UTC and finished at 07:37 UTC.

File PRESWOT_029 was started in water track mode at 07:38 UTC to cover the SENTINEL transect (PS2_020 to PS2_011).

PS2_019 CTD started at 08:29 UTC and finished at 09:11 UTC.

At 09:17 UTC Frederic Cyr contacted us to coordinate and ultimate details about the glider recovery operation intended to be in N38 27.758 E2 47.125.

Third watch of the day started at 10:00 UTC.

PS2_018 CTD started at 10:03 UTC and finished at 10:45 UTC.

PS2_017 CTD started at 11:40 UTC and finished at 12:15 UTC.

At 12:00 UTC, Nagib Bhairy contacted with us for providing a last glider position update and agreed to make the glider emerge at 14:30 UTC close to the recovery position.

PS2_016 CTD started at 13:07 UTC and finished at 13:44 UTC. Bottle 10 didn't close, same as previous station, thus Quim (UTM-CSIC) decided to replace it for another one.

Fourth watch of the day started at 14:00 UTC.

At 14:00 UTC a man over board exercise simulation was performed, including butakoff manoubers and ancillary boat launching. The exercise finished around 16:07 UTC and the BO Garcia del Cid started heading towards an estimated position for

the glider recovery. Glider emerged at 14:27 UTC at 3 cables of distance from the vessel. David (CSIC) got onto the ancillary boat for the recovery operation.

At 14:33 UTC the glider was localized by the ancillary boat and David (CSIC) managed to recover the glider drop weight without losing it, becoming the first ever non-seaexplorer user that was able to recover the drop weight.

At 14:52 UTC the glider was safely recovered on deck.

PS2_GLIDER_CALIBRATION CTD started at 15:06 UTC and finished at 16:03 UTC.

PS2_015 CTD started at 16:42 UTC and finished at 17:26 UTC.

Glider (including conductivity cell but not the pump) was rinsed with freshwater and the fins were unassembled at 17:50 UTC.

Fifth watch of the day started at 18:00 UTC.

PS2_014 CTD started at 18:24 UTC and finished at 19:04 UTC.

Bottle 10 still had problems with the closure. Cristina (UTM-CSIC) replaced the nylon lineyard from bottle 10 to make it a bit tighter than it was before.

Sunset was at 18:54 UTC. The night was clear, wind blowing from southwest at 4.8kn and a calmed glassy sea.

PS2_013 CTD started at 19:55 UTC and finished at 20:41 UTC.

Bottle 10 worked fine and did not present further leaks.

PS2_012 CTD started at 21:29 UTC and finished at 22:12 UTC.

Sixth watch of the day started at 22:00 UTC.

File PRESWOT_030 was started in water track mode at 23:51 UTC to cover the transit towards the eastern transect (PS2_011 to PS2_010).

DAY 4 - 16/05/2018

PS2_011 CTD started at 23:04 UTC and finished at 23:45 UTC.

PS2_010 CTD started at 00:40 UTC and finished at 01:18 UTC.

File PRESWOT_031 was started in water track mode at 01:22 UTC to cover the eastern transect (PS2_010 to PS2_001).

First watch of the day started at 02:00 UTC.

PS2_009 CTD started at 02:06 UTC and finished at 02:59 UTC.

PS2_008 CTD started at 03:58 UTC and finished at 04:50 UTC.

PS2_007 CTD started at 05:47 UTC and finished at 06:36 UTC.

Second watch of the day started at 06:00 UTC. It was a sunny morning with a calm rippled sea and the wind blowing from southwest at 8.7kn.

PS2_006 CTD started at 07:36 UTC and finished at 08:18 UTC.

PS2_005 CTD started at 09:09 UTC and finished at 09:48 UTC.

Third watch of the day started at 10:00 UTC.

PS2_004 CTD started at 10:43 UTC and finished at 11:21 UTC.

PS2_003 CTD started at 12:17 UTC and finished at 12:53 UTC.

PS2_002 CTD started at 13:46 UTC and finished at 14:24 UTC.

Fourth watch of the day started at 14:00 UTC.

PS2_001 CTD started at 15:23 UTC and finished at 16:10 UTC, then BO Garcia del Cid started to navigate back to Palma Port. At 17:30 UTC dolphins were watched in the bow. File PRESWOT_032 was stopped at 17:46 UTC and PRESWOT_033 was started at 17:49 UTC in bottom track until 20:10 UTC. At 22:04 UTC BO Garcia del Cid was in Palma port.

ANNEX 2: CTD PROCESSING

Benjamín Casas

Pre-SWOT CTD Data report

2018-08-08

During the oceanographic campaign Pre-SWOT were completed two mesh of stations in order to know the properties of the seawater in the study area. In the first part of the cruise, LEG 1, a total of 63 station were performed in 6 days. LEG 2 includes 40 stations collected during 3 days.

At each station a probe were deployed with the vessel-winch until 500m / 1000 m depth. The probe includes a CTD SBE911plus and a rosette with 12 oceanographic bottles.

The detail of the instrument and sensors includes in the probe are shown in the table:

MANUFACTURER:	SEABIRD		
MODEL:	SBE911plus CTD		
SN:	0914		
SENSOR	MODEL	S/N	Cal. date
TEMPERATURE:	SBE3P	6000	28-May-14
CONDUCTIVITY:	SBE4C	3120	17-Mar-14
PRESSURE:		0814	23-Sep-14
OXYGEN:	SBE43	1278	12-Apr-16
TRANSMISSOMETER:	WetLabs	CST-974DR	08-Jun-16
TURBIDITY:	SeaPoint	STM 13425	
FLUOROMETER:	SeaPoint	2766	
IRRADIANCE:	Biospherical	70160	24-Dec-07




Table 1: Description of used CTD.

For controlling the SBE911plus, was used the file **201805-SBE9-0914.XMLCON**. The information contained in that file is available in Annex 2.1.

Complementary to the SBE911plus data, water samples were collected with the rosette at various depths for measuring *in situ* salinity, dissolved oxygen and fluorescence in order to apply corrections to the conductivity, oxygen and fluorescence sensors.

Data processing

The data obtained with the SBE911plus were processed using the Sea-Bird Electronics package SBE Data Processing Version V7 23.2 (for details refer to SBE Web site).

This software includes routines for transform the hexadecimal files registered by the SBE911plus to ASCII format, pre-process the data, including filtering and correcting some data, and finally produce an decimated data file.

The steps followed during that procedure are described in the below.

Step 1: Data conversion

The first step of the procedure consists in transform the hexadecimal data to a, ASCII format. Datsnv reads in the raw data file (*.hex) output by the acquisition software (SeaSave V2) and converts the raw binary data to engineering units using manufacturer supplied calibration constants (*.cnv).

Step2: Split

This routine split each file in an up and down casts. The new files were named as d*.cnv (downcast) and u*.cnv (upcast). Bad data were excluded.

Step 3: Wild edit

A de-spiking routine was run on pressure, temperature and the oxygen sensors. The data was scanned twice calculating the standard deviation (SD) of a set number of scans, setting values that are outside a set number of standard deviations of the mean to bad data values. The scan range was set to 100 measurements (equivalent to 4 s of data), with first pass of 2 x SD (2 sigma) as the threshold and a second pass 7 x SD (7 sigma). The second pass is lower than the BODC norm, however it performed slightly better for the Pre-SWOT datasetd. Bad data were excluded.

Step 4: Filter

This step performs a low pass filter of the data. A low-pass filter smoothes high frequency (rapidly changing) data. To produce zero phase (no time shift), the filter is first run forward through the data and then run backward through the data. This removes any delays caused by the filter. Following BODC standards filter is run on pressure to smooth out any instrument response time issues, with a time constant set to 0.15 s low pass filter A and to 0.5 s for low pass filter B.

Step 5: Align CTD

In this step, the routine aligns, in time, oxygen data relative to pressure. This ensures that calculations of dissolved oxygen concentration and other parameters are made using measurements from the same parcel of water. The BODC shift the Oxygen sensor relative to the pressure data by 2 seconds compensating for lags in the sensor response time, in Pre-SOWT the oxygen sensor was set to advance by 3 s following the manufacturer recommendation.

Step 6: Cell thermal mass

The effect of thermal 'inertia' on the conductivity cells was removed using the conductivity thermal mass correction routine, celltm. This routine uses a recursive filter to remove conductivity cell thermal mass effects from the measured conductivity. It should be noted that if spikes exist in the former they are amplified in the latter thus this routine should only be run after wildedit and other routines that flag or exclude 'bad' data values. The parameters used were: thermal anomaly amplitude, $\alpha = 0.03$, and thermal anomaly time constant, $1/\beta = 7$ for both sensors.

Step 7: Loop edit

This routine marks a scan with badflag if scan fails pressure reversal or minimum velocity test, or to eliminate surface soak data. Minimum CTD velocity was set at 0.25 ms⁻¹, window size is 300 s, the surface soak depth is 10 m, with a minimum soak depth of 5 m and a maximum of 20 m.

Step 8: Derive

In this step are calculated depth, salinity, density and sigma, based on EOS-80 equations (Practical Salinity) for plots etc.

Step 9: Bin average

The 24 Hz data was averaged based on pressure data, in 0.5 db bins. Note this binning routine is the last routine performed, after 'bad' data had been excluded by the previous routines.

Step 10: Bottle summary

This routine grouped the readings of the sensors in the moment of firing each bottle and summarize it in a *.bti file

Screen shots of the Seabird processing routines with parameters and options selected are provided as a reference in Annex 2.1: Figures.

ANNEX 2.1: Figures

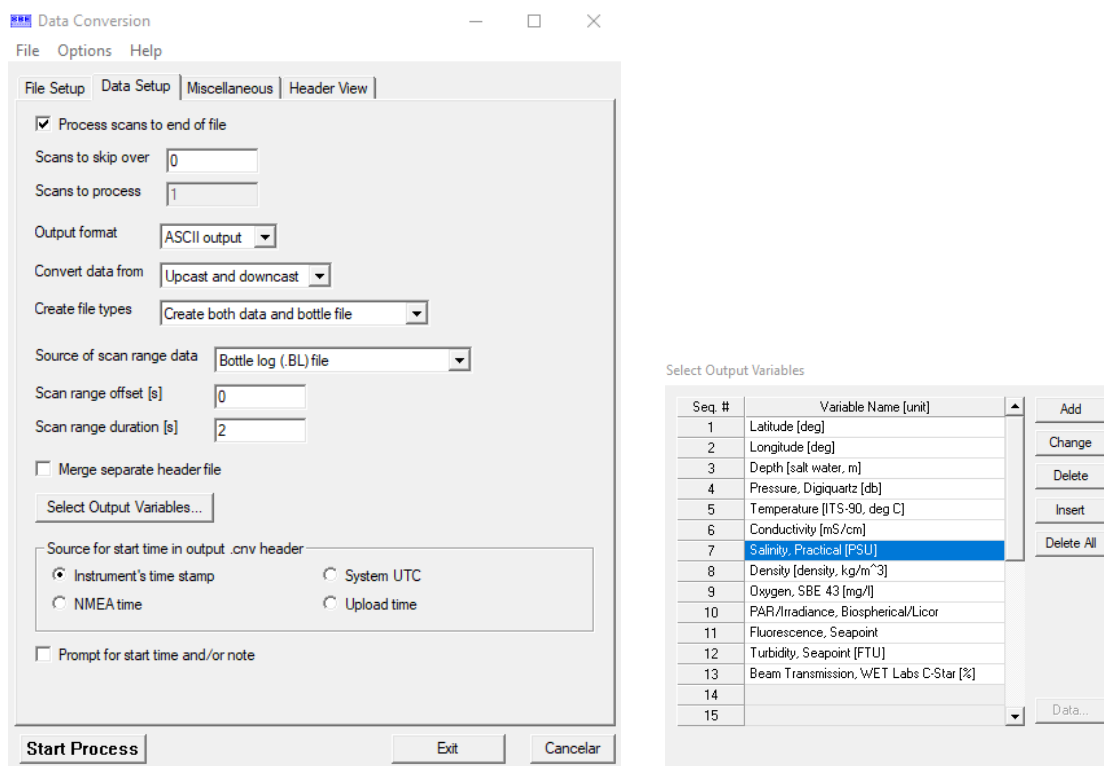


Figure 1: Screen shots of the Seabird Data Conversion routine

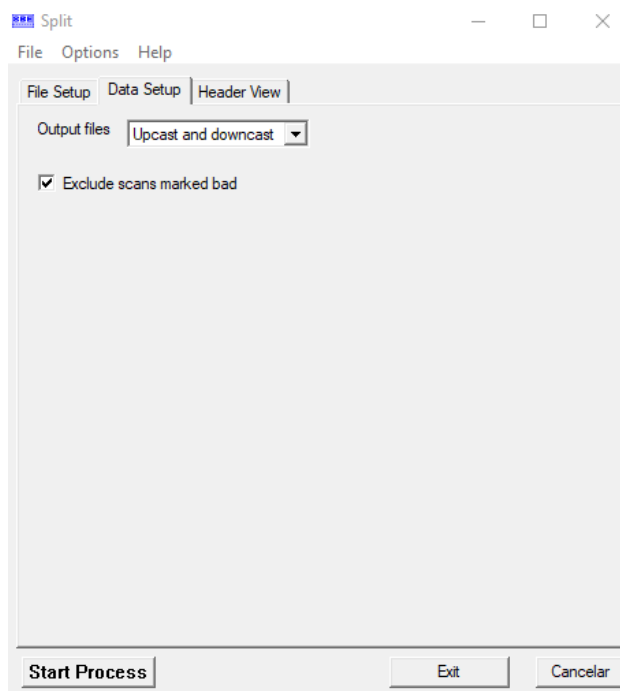


Figure 2: Screen shots of the Seabird Split routine

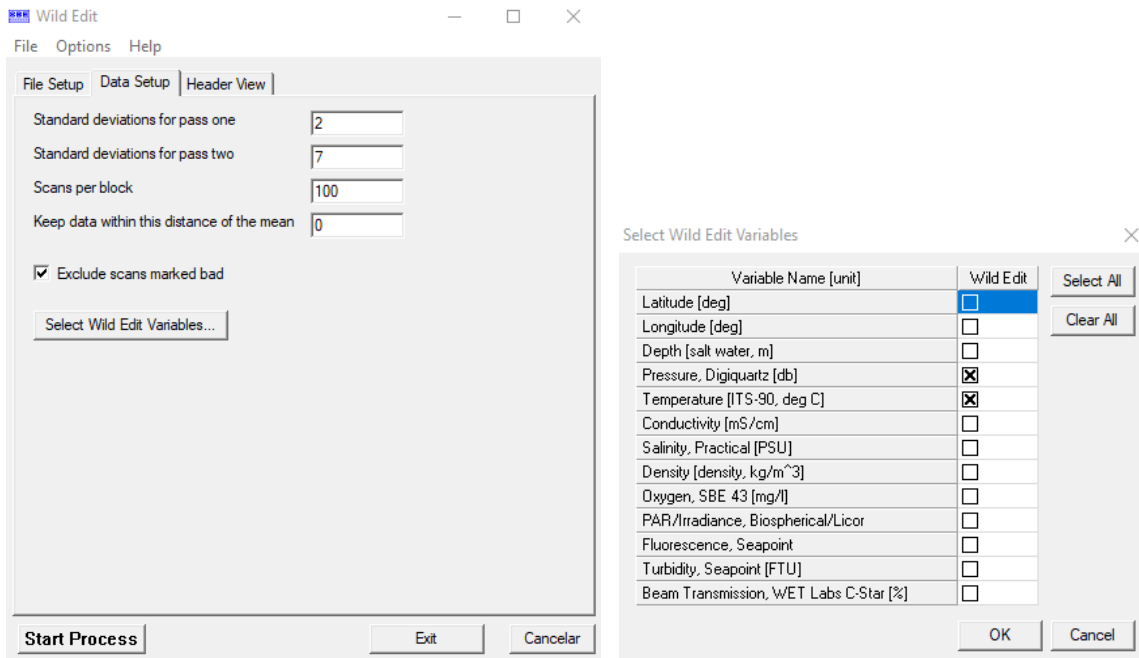


Figure 3: Screen shots of the Seabird Wild edit routine

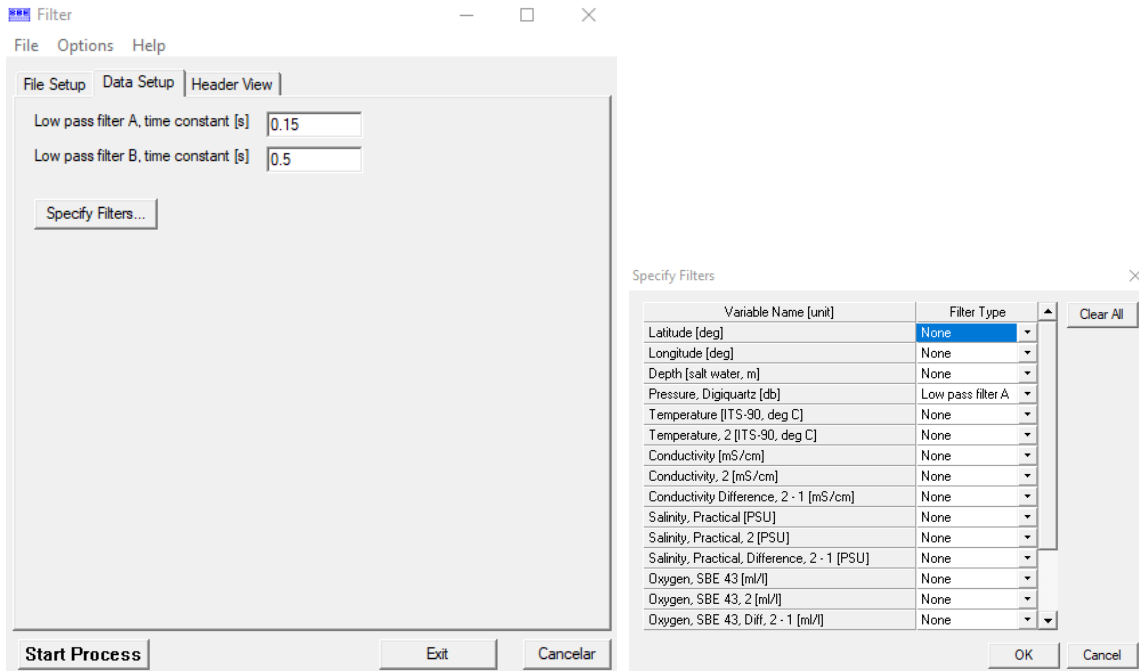


Figure 4: Screen shots of the Seabird Filter routine

Enter Advance Values ×

Variable Name [unit]	Advance [s]	Clear All
Latitude [deg]	0	
Longitude [deg]	0	
Temperature [ITS-90, deg C]	0	
Conductivity [mS/cm]	0	
Salinity, Practical [PSU]	0	
Density [density, kg/m ³]	0	
Oxygen, SBE 43 [mg/l]	3	
PAR/Irradiance, Biospherical/Licor	0	
Fluorescence, Seapoint	0	
Turbidity, Seapoint [FTU]	0	
Beam Transmission, WET Labs C-Star [%]	0	

OK Cancel

Figure 5: Screen shots of the Seabird Align CTD routine

Cell Thermal Mass _ □ ×

File Options Help

File Setup Data Setup Header View

Correct primary conductivity values

Temperature sensor to use: Primary

Thermal anomaly amplitude [alpha]: 0.03

Thermal anomaly time constant [1/beta]: 7

Correct secondary conductivity values

Temperature sensor to use: Secondary

Thermal anomaly amplitude [alpha]: 0.03

Thermal anomaly time constant [1/beta]: 7

Start Process Exit Cancelar

Figure 6: Screen shots of the Seabird Cell thermal mass routine

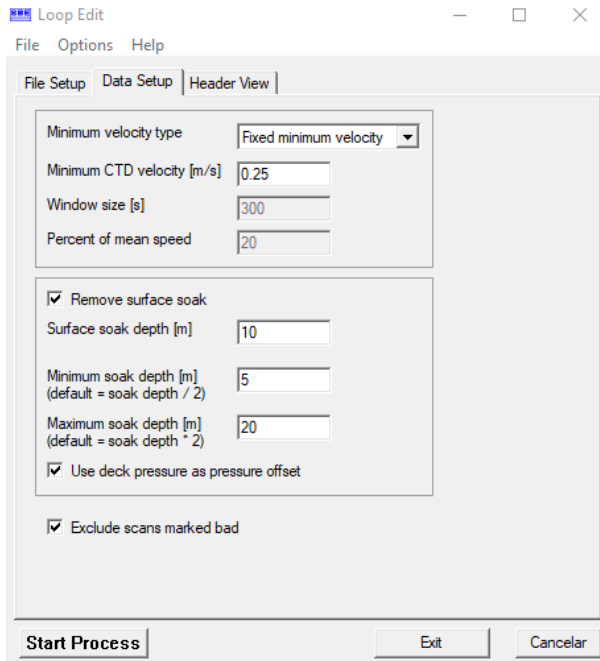


Figure 7: Screen shots of the Seabird Loop edit routine

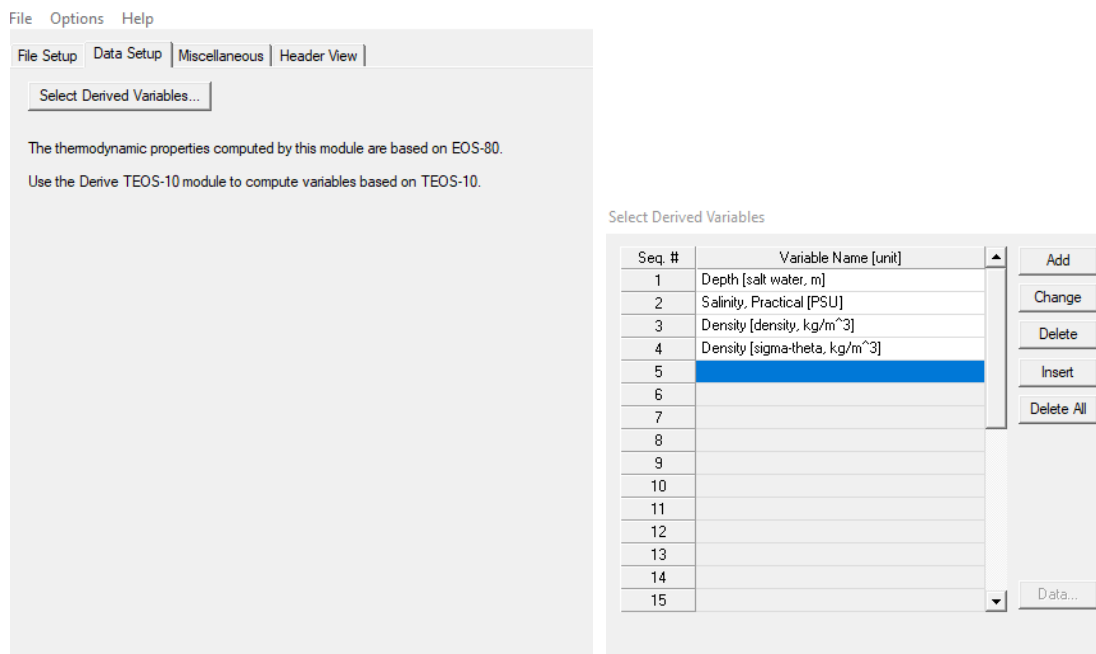


Figure 8: Screen shots of the Seabird Derive routine

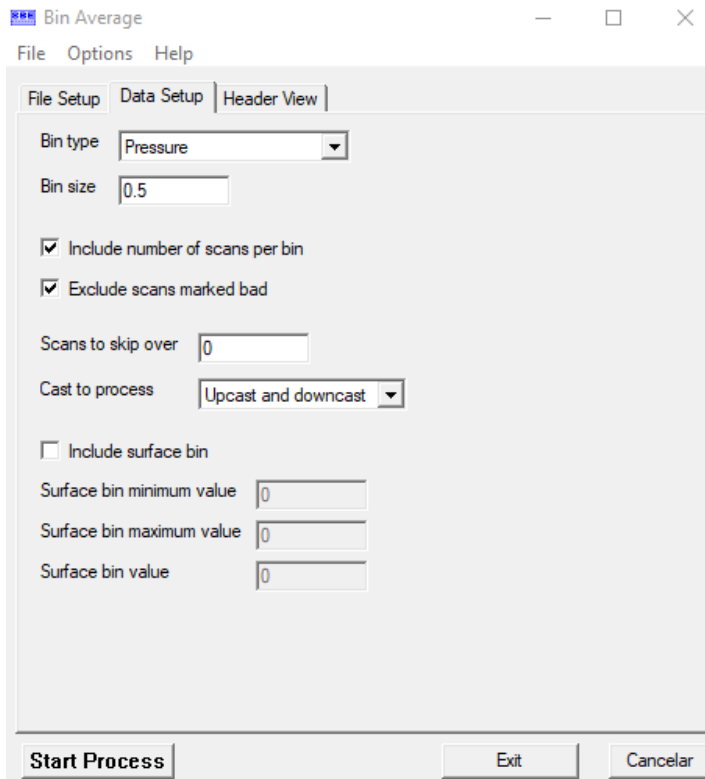


Figure 9: Screen shots of the Seabird Bin Average routine

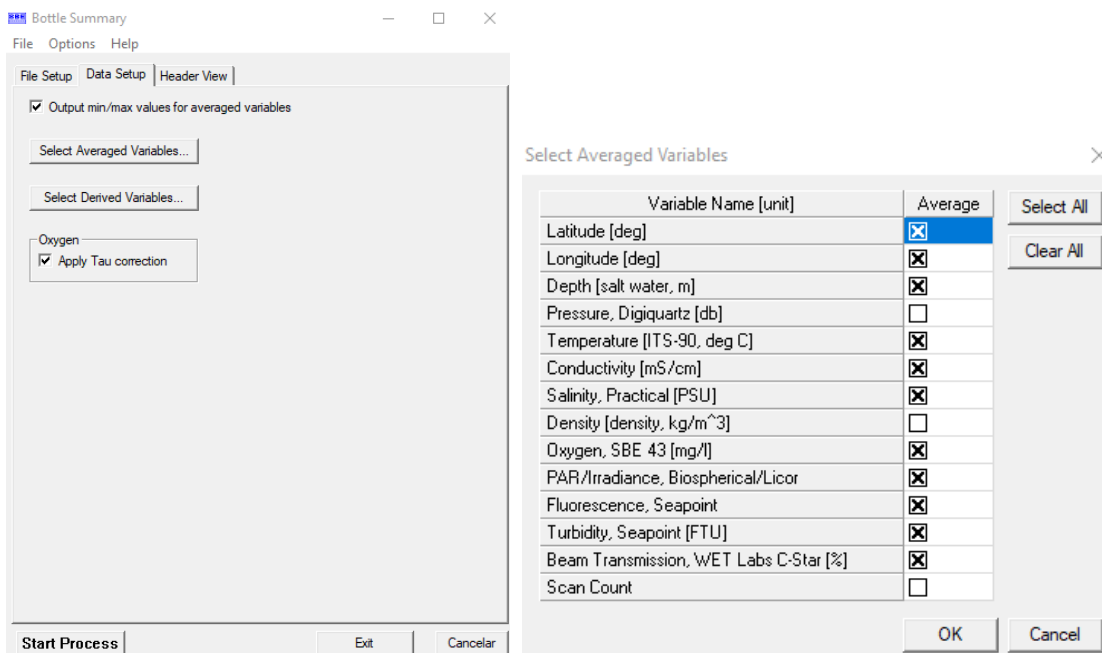


Figure 10: Screen shots of the Seabird Bottle summary routine

ANNEX 2.2 Configuration CTD file

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<?xml version="1.0" encoding="UTF-8"?>
<SBE_InstrumentConfiguration SB_ConfigCTD_FileVersion="7.2.6.4.0" >
  <Instrument Type="8" >
    <Name>SBE 911plus/917plus CTD</Name>
    <FrequencyChannelsSuppressed>2</FrequencyChannelsSuppressed>
    <VoltageWordsSuppressed>0</VoltageWordsSuppressed>
    <ComputerInterface>0</ComputerInterface>
    <!-- 0 == SBE11plus Firmware Version >= 5.0 -->
    <!-- 1 == SBE11plus Firmware Version < 5.0 -->
    <!-- 2 == SBE 17plus SEARAM -->
    <!-- 3 == None -->
    <DeckUnitVersion>1</DeckUnitVersion>
    <ScansToAverage>1</ScansToAverage>
    <SurfaceParVoltageAdded>0</SurfaceParVoltageAdded>
    <ScanTimeAdded>0</ScanTimeAdded>
    <NmeaPositionDataAdded>1</NmeaPositionDataAdded>
    <NmeaDepthDataAdded>0</NmeaDepthDataAdded>
    <NmeaTimeAdded>0</NmeaTimeAdded>
    <NmeaDeviceConnectedToPC>0</NmeaDeviceConnectedToPC>
    <SensorArray Size="11" >
      <Sensor index="0" SensorID="55" >
        <TemperatureSensor SensorID="55" >
          <SerialNumber>6000</SerialNumber>
          <CalibrationDate>28-May-14</CalibrationDate>
          <UseG_J>1</UseG_J>
          <A>0.00000000e+000</A>
          <B>0.00000000e+000</B>
          <C>0.00000000e+000</C>
          <D>0.00000000e+000</D>
          <F0_Old>0.000</F0_Old>
          <G>4.38220119e-003</G>
          <H>6.71965219e-004</H>
          <I>2.72723533e-005</I>
          <J>2.15141803e-006</J>
          <F0>1000.000</F0>
          <Slope>1.00000000</Slope>
          <Offset>0.0000</Offset>
        </TemperatureSensor>
      </Sensor>
      <Sensor index="1" SensorID="3" >
        <ConductivitySensor SensorID="3" >
          <SerialNumber>3120</SerialNumber>
          <CalibrationDate>18-Mar-14</CalibrationDate>
          <UseG_J>1</UseG_J>
          <!-- Cell const and series R are applicable only for wide range sensors. -->
          <SeriesR>0.0000</SeriesR>
          <CellConst>2000.0000</CellConst>
          <ConductivityType>0</ConductivityType>
          <Coefficients equation="0" >
            <A>0.00000000e+000</A>
            <B>0.00000000e+000</B>
            <C>0.00000000e+000</C>
            <D>0.00000000e+000</D>
            <M>0.0</M>
            <CPcor>-9.57000000e-008</CPcor>
          </Coefficients>
          <Coefficients equation="1" >
            <G>-1.01686724e+001</G>
            <H>1.46620854e+000</H>
            <I>2.93425686e-004</I>
            <J>5.70928557e-005</J>
            <CPcor>-9.57000000e-008</CPcor>
            <CTcor>3.2500e-006</CTcor>
            <!-- WBOTC not applicable unless ConductivityType = 1. -->
            <WBOTC>0.00000000e+000</WBOTC>
          </Coefficients>
          <Slope>1.00000000</Slope>
          <Offset>0.0000</Offset>
        </ConductivitySensor>
      </Sensor>
      <Sensor index="2" SensorID="45" >
```

```

<PressureSensor SensorID="45" >
  <SerialNumber>0814</SerialNumber>
  <CalibrationDate>23-Apr-14</CalibrationDate>
  <C1>-4.534216e+004</C1>
  <C2>7.025490e-001</C2>
  <C3>1.441800e-002</C3>
  <D1>3.916100e-002</D1>
  <D2>0.000000e+000</D2>
  <T1>3.039632e+001</T1>
  <T2>-7.467699e-005</T2>
  <T3>3.876050e-006</T3>
  <T4>4.809280e-009</T4>
  <Slope>0.99994428</Slope>
  <Offset>0.53713</Offset>
  <T5>0.000000e+000</T5>
  <AD590M>1.288700e-002</AD590M>
  <AD590B>-8.362590e+000</AD590B>
</PressureSensor>
</Sensor>
<Sensor index="3" SensorID="38" >
  <OxygenSensor SensorID="38" >
    <SerialNumber>1278</SerialNumber>
    <CalibrationDate>12-Apr-16</CalibrationDate>
    <Use2007Equation>1</Use2007Equation>
    <CalibrationCoefficients equation="0" >
      <!-- Coefficients for Owens-Millard equation. -->
      <Boc>0.0000</Boc>
      <Soc>0.0000e+000</Soc>
      <offset>0.0000</offset>
      <Pcor>0.00e+000</Pcor>
      <Tcor>0.0000</Tcor>
      <Tau>0.0</Tau>
    </CalibrationCoefficients>
    <CalibrationCoefficients equation="1" >
      <!-- Coefficients for Sea-Bird equation - SBE calibration in 2007 and later. -->
      <Soc>4.6548e-001</Soc>
      <offset>-0.5040</offset>
      <A>-3.6620e-003</A>
      <B> 1.7101e-004</B>
      <C>-2.6768e-006</C>
      <D0> 2.5826e+000</D0>
      <D1> 1.92634e-004</D1>
      <D2>-4.64803e-002</D2>
      <E> 3.6000e-002</E>
      <Tau20> 1.0600</Tau20>
      <H1>-3.3000e-002</H1>
      <H2> 5.0000e+003</H2>
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</Sensor>
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    <CalibrationDate></CalibrationDate>
    <OutputType>2</OutputType>
    <Free>1</Free>
  </NotInUse>
</Sensor>
<Sensor index="5" SensorID="11" >
  <FluoroSeapointSensor SensorID="11" >
    <SerialNumber>2766</SerialNumber>
    <CalibrationDate></CalibrationDate>
    <!-- The following is an array index, not the actual gain setting. -->
    <GainSetting>0</GainSetting>
    <Offset>0.000</Offset>
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</Sensor>
<Sensor index="6" SensorID="42" >
  <PAR_BiosphericalLicorChelseaSensor SensorID="42" >
    <SerialNumber>70160</SerialNumber>
    <CalibrationDate>24-12-2007</CalibrationDate>
    <M>1.00000000</M>
    <B>0.00000000</B>
    <CalibrationConstant>17064846416.00000000</CalibrationConstant>
  </PAR_BiosphericalLicorChelseaSensor>
</Sensor>

```



```

<Multiplier>1.0000000</Multiplier>
<Offset>-0.0857000</Offset>
</PAR_BiosphericalLicorChelseaSensor>
</Sensor>
<Sensor index="7" SensorID="71" >
<WET_LabsCStar SensorID="71" >
<SerialNumber>CST-974DR</SerialNumber>
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<M>25.9770</M>
<B>-1.4590</B>
<PathLength>0.000</PathLength>
</WET_LabsCStar>
</Sensor>
<Sensor index="8" SensorID="33" >
<OBS_SeapointTurbiditySensor SensorID="33" >
<SerialNumber>STM 13425</SerialNumber>
<CalibrationDate></CalibrationDate>
<!-- The following is an array index, not the actual gain setting. -->
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</OBS_SeapointTurbiditySensor>
</Sensor>
<Sensor index="9" SensorID="0" >
<AltimeterSensor SensorID="0" >
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</AltimeterSensor>
</Sensor>
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<SerialNumber></SerialNumber>
<CalibrationDate></CalibrationDate>
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<Free>1</Free>
</NotInUse>
</Sensor>
</SensorArray>
</Instrument>
</SBE_InstrumentConfiguration>

```

ANNEX 3: CTD CALIBRATION

John Allen and Cristian Muñoz

SOCIB

Report on Delayed Mode calibration of CTD data

Pre-SWOT cruise

06/05/18 – 15/05/18

V-1.1.0

John Allen, Cristian Muñoz

SOCIB-Office of the Director

Document type:	Internal report
Date:	August 3rd 2018 (update 20 August 2018)

Description:	This document describes the Delayed Mode calibration of CTD data for the Pre-SWOT cruise.
Authors:	J Allen, C Muñoz
Supervision:	
Involved Personnel:	J Allen, L Diaz-Barroso, I Lizaran, C Muñoz

DOCUMENT VERIFICATION LIST

Date:	Checked by (name)	SOCIB division	Ref.
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DOCUMENT DISTRIBUTION LIST

Date:	Distribution to:

CHANGE RECORD

#	Date	Description	Author	Checked by
	20/08/18	Updated for total salinity bottles, required due to non-standard naming convention.	J Allen, C Muñoz	

1. Objective

This report presents the field calibration of the conductivity data from CTD stations carried out during the PreSWOT cruise, on board B/O Garcia del Cid in May 2018, to water bottle salinity analyses carried out in the laboratory following the completion of the cruise.

The salinity analyses were carried out on the 22nd and the 23rd May, i.e. just over one week after the end of the PreSWOT cruise.

2. Method

The calibration of the pre-swot data simply followed SOCIB's routine CTD delayed mode field calibration processing toolbox to align the SeaBird data with salinity bottle samples. This is described in the 'Physical Oceanography Work Package' report/guidelines <https://drive.google.com/open?id=0BzRXzkorOLAsTIRYazJSVS1TNGM>, under work package 2, Procedure for correcting CTD salinity.

The basis for DMP of the vessel CTD data follow the SeaBird guidelines, <https://www.seabird.com/model-number-list>, SeaBird 9plus CTD, Downloads, Application Note 31, and apply a gradient operator calibration to conductivity of the form

$$\text{conductivity} = A * \text{conductivity measured}$$

The details are in the meta-data for the corrected variables; which will also be on Thredds when the catalogue is next updated

3. Analysis details

Water bottle salinities were determined on SOCIB's Guildline Portasal salinometer, by Irene Lizaran and others involved in the Pre-SWOT cruise. After analysis, a total of 48 bottle sample values were available for field calibration of the CTD data.

Pairs of salinities for each bottle stop, $\text{Salinity}_{\text{ctd}}$ and $\text{Salinity}_{\text{bot}}$, were then examined as residuals, $\text{Salinity}_{\text{bot}} - \text{Salinity}_{\text{ctd}}$. Wild outliers in the residuals were removed manually, in this case 12 samples (3,6,8,13,14,16,18,19,21,33,35 and 39), followed by two automatic iterative passes to remove outliers greater than 2 S.D. from the mean and then subsequently 1 S.D. from the mean. The remaining water bottle salinities were converted to conductivities for the mean sensor temperature and pressure in the SeaBird bottle file (.btl). The pairs of conductivities, Cond_{ctd} and Cond_{bot} , were then used to solve for the gradient operator A as,

$$A = \frac{\sum \text{Cond}_{\text{bot}} \text{Cond}_{\text{ctd}}}{\sum (\text{Cond}_{\text{ctd}})^2} = \frac{\overline{\text{Cond}_{\text{bot}} \text{Cond}_{\text{ctd}}}}{(\overline{\text{Cond}_{\text{ctd}}})^2}.$$

4. Further comparisons

In addition I compared Theta/S profiles between Pre-SWOT and Canales April 2018 as a double check. To my eye the finally calibrated pre-SWOT could be 0.002 more saline compared with Canales.

5. Conclusions

The necessary correction for conductivity of the form;

$\text{conductivity} = A * \text{conductivity measured}$, where $A = 0.999843$ for conductivity sensor 00. The CTD used during PreSWOT unusually carried only one set of physical sensors

We believe the final salinities are good to ± 0.002 , as can be seen in Figure 1.

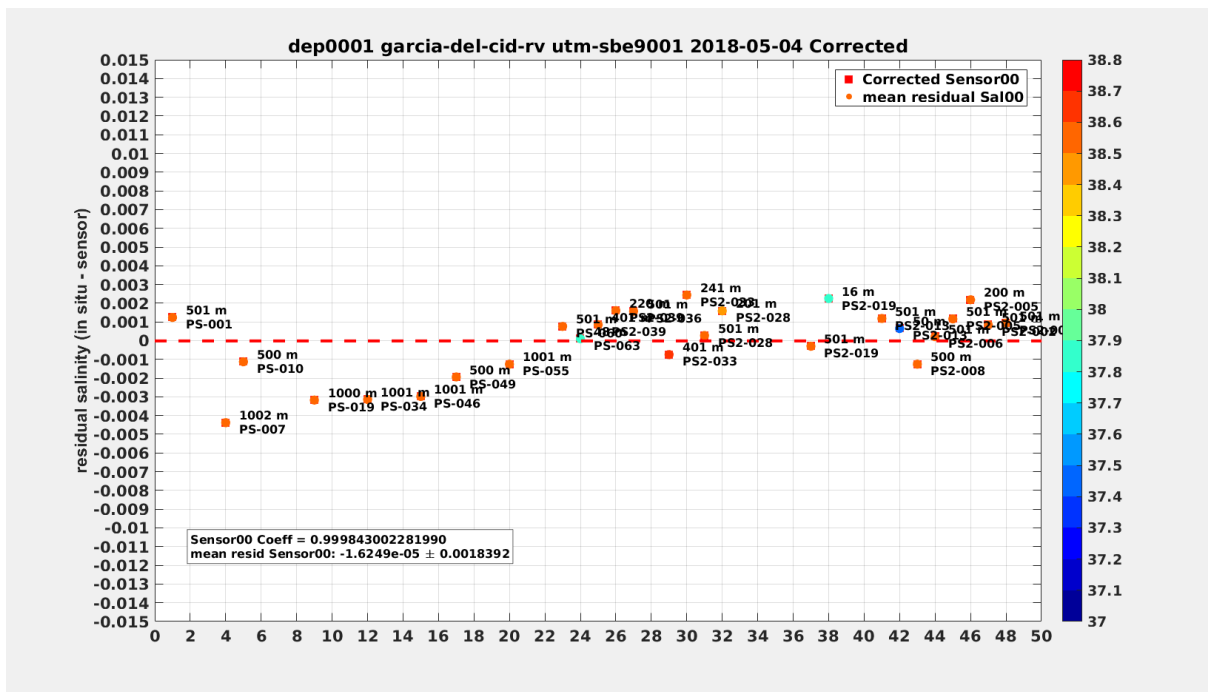


Figure 1: Salinity residuals to bottle samples following calibration.

Any further correction to calibrated Canales April 2018 data would not be justifiable as the two cruises were not in the same place, or truly contemporary; also such a difference is well within the combined confidence level of Pre-SWOT (0.002), and Canales (0.002); better than or as good as that to which SeaBird believe that their CTDs can be calibrated (i.e. 0.003).

ANNEX 4: ADCP ACQUISITION

David Roque

**INFORME DE EQUIPOS ACÚSTICOS Y
ELECTRÓNICOS EN LA CAMPAÑA PRE-
SWOT**

Título. Informe de equipos Campaña PRE-SWOT

Autor. UTM

Dpto. Departamento de Acústica, departamento de electrónica e instrumentación.

Fecha. 17-05-2018

Páginas. 16

1. INTRODUCCIÓN

Campaña COSTEM_1

Las técnicas utilizadas en la campaña han sido:

- Multihaz bifrecuencia, de 50 kHz (aguas profundas) y de 180 kHz (aguas someras).

Técnicos:

Cristina Álvarez, Quim Rabada; (Ingeniería Electrónica e Instrumentación). David Roque;(Acústica),

INSTRUMENTACIÓN ACÚSTICA Y GEOFÍSICA

SONDA MONOHAZ Kongsberg EA-640

Descripción

Esta sonda monohaz se ha utilizado para la navegación del barco. Sus datos no son registrados por ningún equipo.

Incidencias

Durante el primer día de la campaña (05/05/2018), la sonda, al estar en zonas profundas (> 2000 metros), la pantalla de la profundidad aparecía siempre 0, por la mañana se resolvió este problema aumentando la duración del pulso a 4.096 ms (estando antes a 1.024ms).

Doppler ADCP RDI 75 KHz

Descripción

Incidencias

ELECTRÓNICA E INSTRUMENTACIÓN

1. INTRODUCCIÓN.

Campaña PRE-SWOT (14 días)

1.-Dos fases con 63 y 40 estaciones de CTDs y obtención de datos de corriente con el doppler

2.-Datos de corriente con el ADCP

3.-Lanzamiento de drifters

Investigador Principal: Ananda Pascual

Jefe Científico: Ananda Pascual

2. Incidencias.

03/05/2018

Montaje del ADCP DE 75 KHZ, y de la sonda EA640.

El montaje se realizó por José Luis Pozo, Javier Prades y David Roque.

Lo primero que se ha realizado han sido las conexiones del ADCP, donde se han integrado tanto la posición como el sistema de posicionamiento inercial.

El sistema de posicionamiento inercial viene del F180 MRU, que está en 19200 bd y se le ha insertado al VmDas en el COM 6.

El caso de la posición, este viene de los datos de la Giro del puente, ya que está a 4800 bd. En este caso la elección de los datos del Gyro es porque los datos de posición de la MRU tienen una velocidad muy alta y el sistema dice que no puede leer tanta información. Se ha insertado en el COM 5.

Para el caso de la sonda EA640, se ha añadido tanto la posición como el heading, y la velocidad del barco por los siguientes puertos:

MRU: puerto serie 4 (MRU)

Rumbo: Puerto serie 5 (VTG y HDT)

Posición: Puerto serie 5 (GGA).

Hubo problemas con la entrada del black box debido a que uno de los conversores estaba mal puentado. Se quitó y funcionó todo correctamente.

04/05/2018

Tránsito a Palma de Mallorca.

Durante el transito se chequeó la sonda EA640 que funcionó correctamente y se puso en funcionamiento el ADCP con el archivo de configuración de:

UNIBARNA2_BB&NB_8M_100M_BT.txt.

Todo funciona correctamente hasta la llegada a Palma de Mallorca.

El archivo creado se ha nombrado como PRESWOT001

Estos datos han sido almacenados en una carpeta de PRESWOT llamada BARCA-MALLORCA (así lo ha nombrado el investigador John Allen)

05/05/2018

Primer día de campaña.

De 8 a 14 se realizó una grabación de un documental para el proyecto. Durante este tiempo el investigador John Allen ha generado dos archivos de configuración del ADCP con los que se trabajarán.

Un archivo se ha generado con Bottom Track y el otro se ha realizado con Water track.

Los nombres de los archivos son:

PRESWOT_BT_8M

PRESWOT_WT_8M

Los archivos se han aumentado a un tamaño de 100 Mb y se han modificado la duración de los archivos STA (2 minutos) y los LTA (10 minutos).

Se ha tenido que reinstalar el WinADCP ya que al cargar los archivos el programa se apagaba. Una vez vuelto a instalar el programa todo ha funcionado correctamente.

Mientras que se sale a grabar se enciende el ADCP para chequear que la configuración funciona correctamente. Aparte esta salida sirve para observar la calibración del instrumento.

A la vuelta a puerto se chequean los datos y se observa que no hay muchos datos, debido a que la profundidad donde hemos estado ha sido de 30 metros, obteniendo únicamente 2 bins.

John Allen chequea los datos y observa que en el archivo de configuración no ha pulsado la opción SET PROFILE PARAMETERS. Se ha pulsado esta opción y se han vuelto a guardar los archivos de configuración.

A las 17 se sale de puerto rumbo a la estación PS001. Una vez que se ha salido de puerto se conecta el ADCP con el archivo PRESWOT_BT_8M y la sonda.

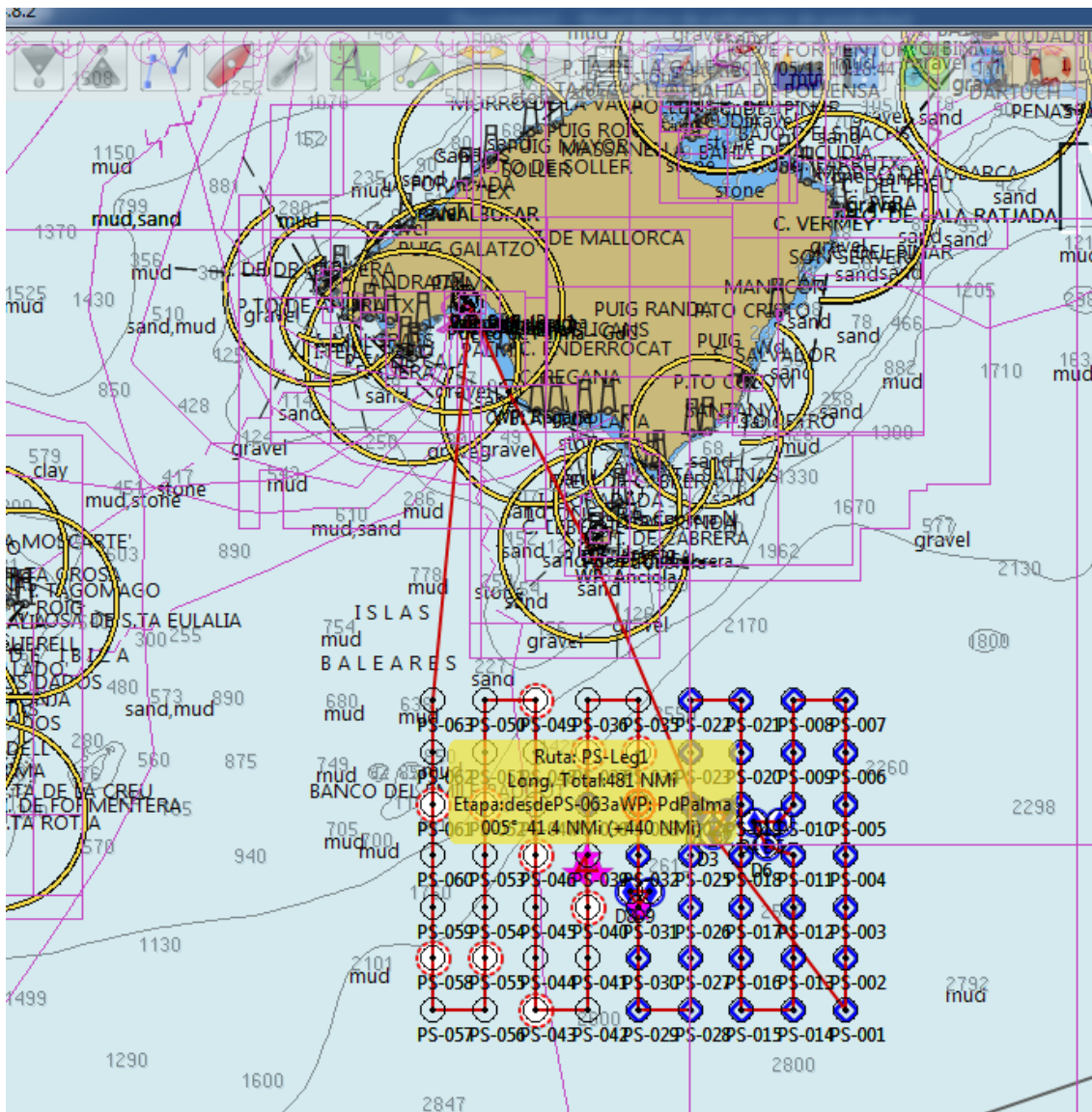
Durante el tránsito a la primera estación, por la noche, se debería haber cambiado el archivo de configuración al de Water Track, ya que las profundidades son mayores de los 1000 metros, pero no había ningún científico para hacerlo, por lo que se quedó con este archivo hasta el comienzo del primer transecto de la malla de estaciones.

Por otro lado, la sonda, al estar en zonas profundas (> 2000 metros), la pantalla de la profundidad aparecía siempre 0, por la mañana se resolvió este problema aumentando la duración del pulso a 4.096 ms (estando antes a 1.024ms).

06/05/2018

Segundo día de campaña

Se empieza a hacer la malla de estaciones. En total hay 9 transectos latitudinales. Se empieza por el más hacia el este. El criterio para crear los archivos es encender el ADCP al principio de la sección latitudinal y cerrarlo en el final del transecto.



Durante el tránsito entre las secciones se realiza otro archivo de modo longitudinal.

Todos los archivos de la campaña han sido generados con el archivo de configuración de PRESWOT_WT_8M, ya que las profundidades siempre han sido superiores a los 2000 metros.

A continuación, se pone una tabla con los archivos generados:

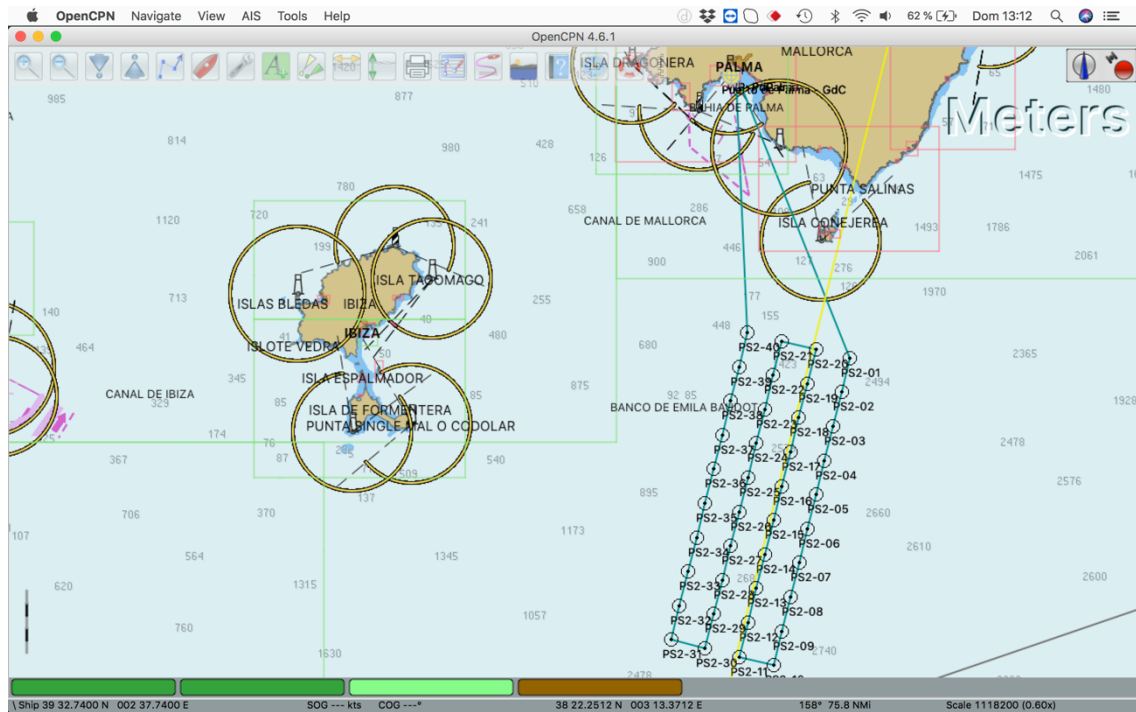
FICHERO	FECHA INICIO	HORA INICIO	FECHA FIN	HORA FIN	TRANSECTO
PRESWOT003	06/05/18	03:26	06/05/18	12:28	PS001-PS007
PRESWOT004	06/05/18	13:50	06/05/18	14:22	PS007-PS008

PRESWOT005	06/05/18	15:09	07/05/18	02:31	PS008-PS014
PRESWOT006	07/05/18	03:34	07/05/18	04:24	PS014-PS015
PRESWOT007	07/05/18	05:17	07/05/18	15:59	PS015-PS021
PRESWOT008	07/05/18	16:22	07/05/18	17:10	PS021-PS022
PRESWOT009	07/05/18	18:56	08/05/18	05:00	PS022-PS028
PRESWOT010	08/05/18	06:42	08/05/18	07:38	PS028-PS029
PRESWOT011	08/05/18	08:19	08/05/18	20:27	PS029-PS035
PRESWOT012	08/05/18	21:01	08/05/18	21:45	PS035-PS036
PRESWOT013	08/05/18	22:40	09/05/18	09:00	PS036-PS042
PRESWOT014	09/05/18	09:32	09/05/18	10:10	PS042-PS043
PRESWOT015	09/05/18	11:30	09/05/18	20:02	PS043-PS049
PRESWOT016	09/05/18	20:45	09/05/18	21:31	PS049-PS050
PRESWOT017	09/05/18	22:16	10/05/18	07:49	PS050-PS056
PRESWOT018	10/05/18	08:24	10/05/18	09:10	PS056-PS057
PRESWOT019	10/05/18	09:52	10/05/18	18:12	PS057-PS063
PRESWOT020	10/05/18	18:59	11/05/18	05:49	Vuelta a Palma BT

Durante la vuelta la profundidad era menor de 700 metros se ha vuelto a poner el archivo de configuración con el bottom track.

13/05/2018

Se sale de puerto a las 15:00 para realizar el LEG2 de la campaña PRE-SWOT.



Se llega a la primera estación (PS2-40) a las 18:00 UTC.

A continuación, se pone una tabla con los archivos generados:

FICHERO	FECHA INICIO	HORA INICIO	FECHA FIN	HORA FIN	TRANSECTO
PRESWOT021	13/05/18	13:57	13/05/18	17:59	PALMA-PS040
PRESWOT022	13/05/18	18:46	14/05/18	02:22	PS2040-PS2031
PRESWOT023	14/05/18	03:12	14/05/18	06:40	PS2034-CTDFRANCES
PRESWOT024	14/05/18	06:42	14/05/18	09:52	CTDFRANCES-PS2033
PRESWOT025	14/05/18	10:58	14/05/18	13:18	PS2033-PS2031
PRESWOT026	14/05/18	13:41	14/05/18	14:21	PS2031-PS2030
PRESWOT027	14/05/18	15:14	15/05/18	05:31	PS2030-PS2021
PRESWOT028	15/05/18	05:53	15/05/18	06:43	PS2021-PS2020
PRESWOT029	15/05/18	07:38	15/05/18	23:02	PS2020-PS2011
PRESWOT030	15/05/18	23:52	16/05/18	00:40	PS2011-PS2010
PRESWOT031	16/05/18	01:22	16/05/18	15:29	PS2010-PS2001
PRESWOT032	16/05/18	16:26	16/05/18	17:46	PS2001-PALMA (WT)
PRESWOT033	16/05/18	17:49	16/05/18	20:10	PS2001-PALMA (BT)

Se finaliza el ADCP el 16/05/18 en la bahía de Palma.

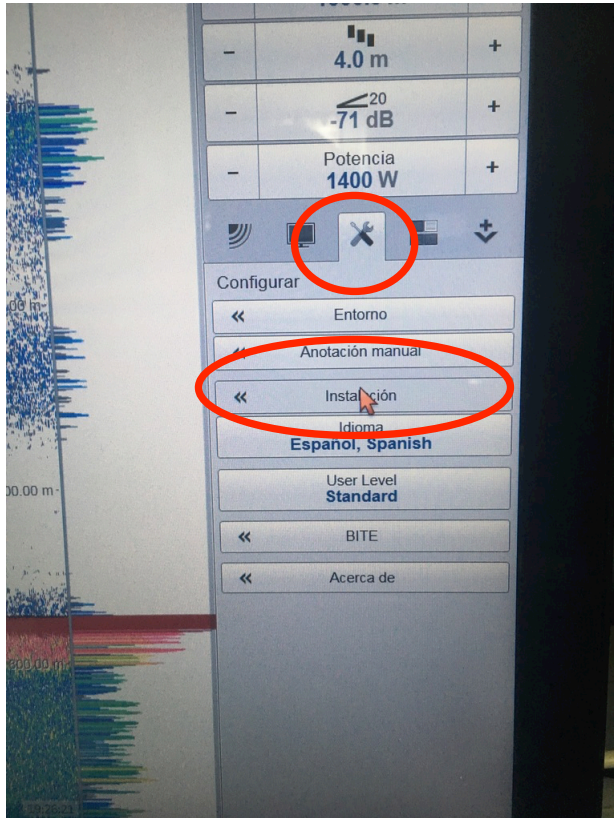
Durante la segunda fase no ha habido ninguna incidencia ni con el Doppler ni con la sonda.

CONFIGURACION DE LA SEÑAL DE SALIDA DE LA SONDA EA640

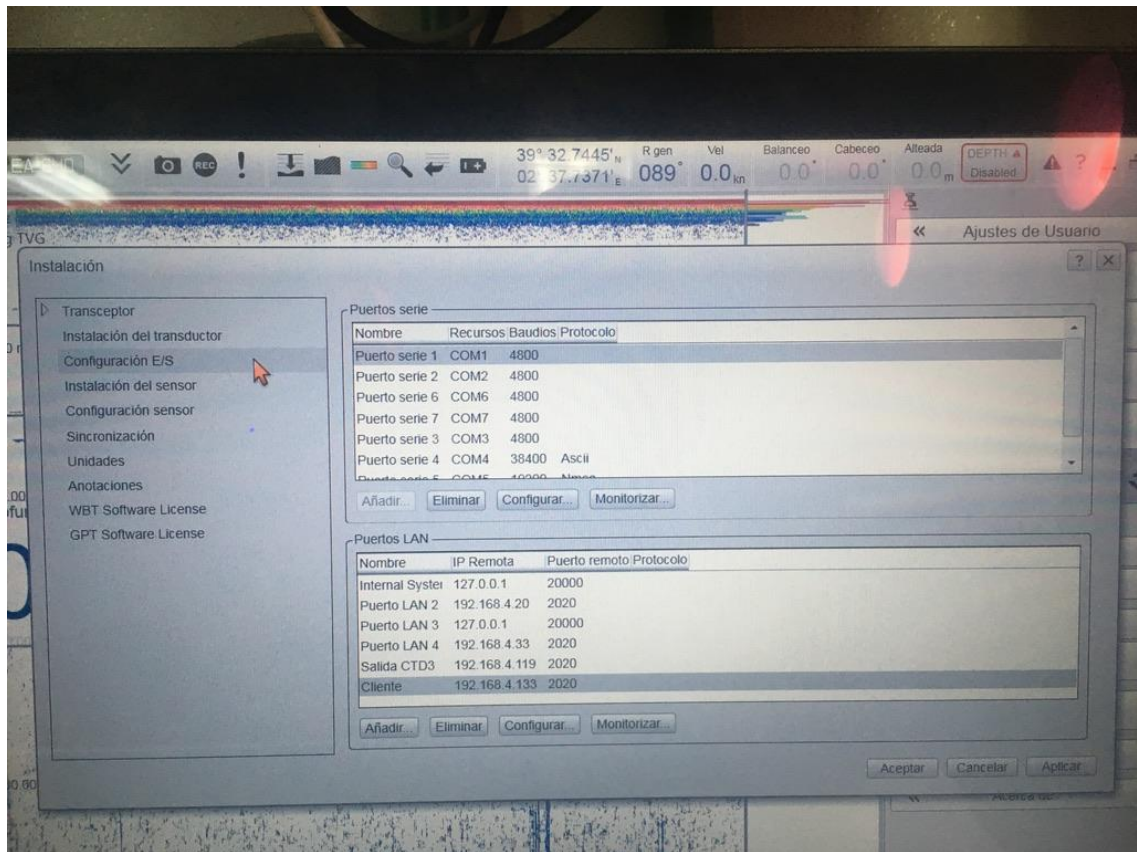
Para poder configurar la salida de la sonda EA640, es necesario:

1.- Meterte en el ordenador de la sonda EA640, abrir el programa EA640.

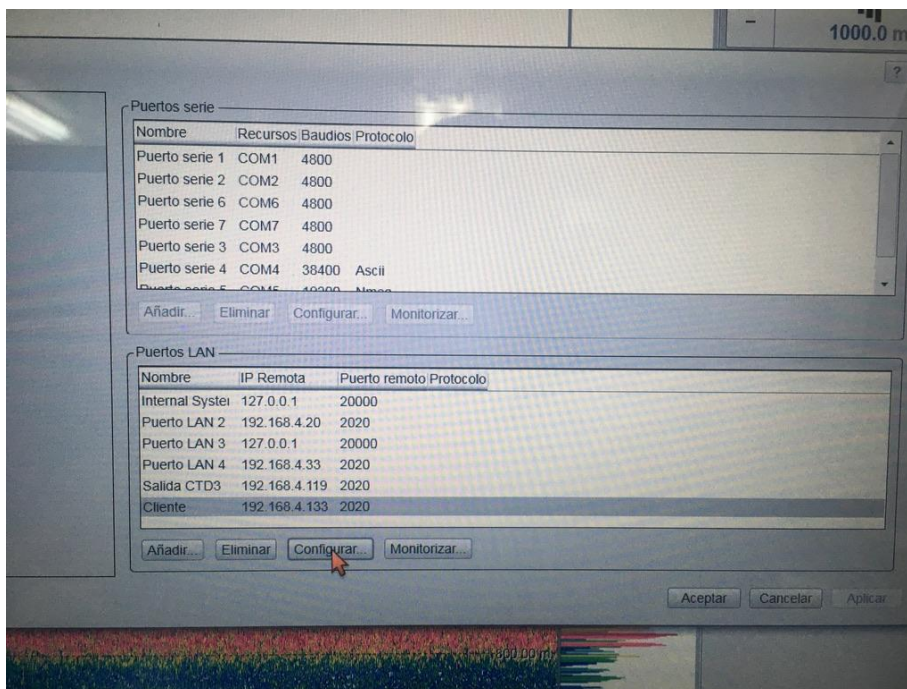
2.- Dentro del programa en la parte derecha hay un set de pestañas. Dentro de la pestaña central que es de **configuración**, hay una pestaña llamada **instalación**.



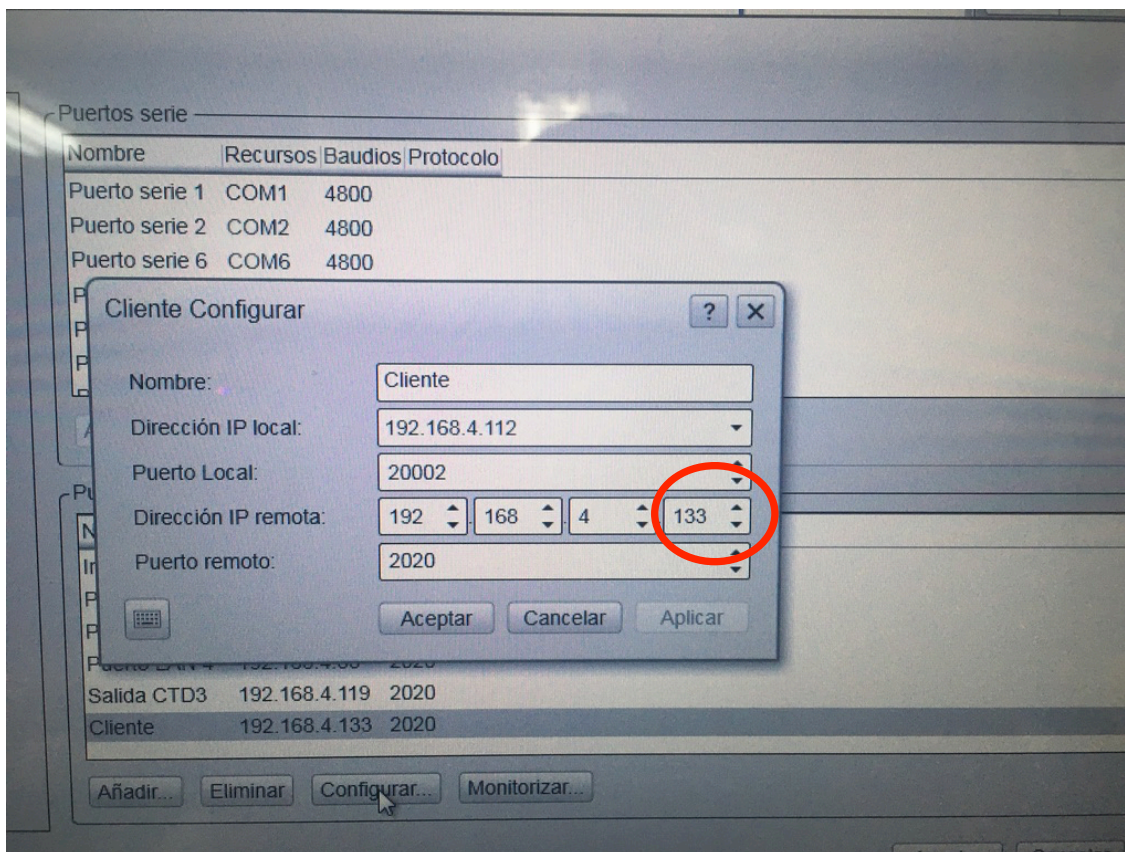
3.- En la pestaña nueva que aparece en instalación, el tercer item empezando por la parte superior se llama **CONFIGURACION E/S**.



El cuadro que aparece en la parte inferior derecha de esta ventana llamada **puertos LAN**, hay un item llamado **cliente**.

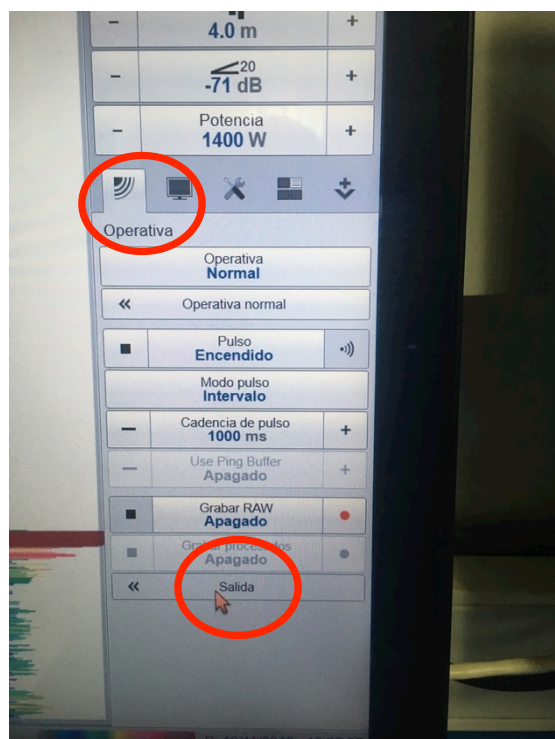


4.- Se pincha en **Cliente** y se da a la pestaña de configurar. Dentro de esta pestaña UNICAMENTE hay que modificar la dirección IP remota del ordenador al que quiere que se le aparezca la sonda.



CONFIGURACION DE NUEVO PUERTO LAN PARA LA SALIDA DE DATOS DE LA SONDA EA 640

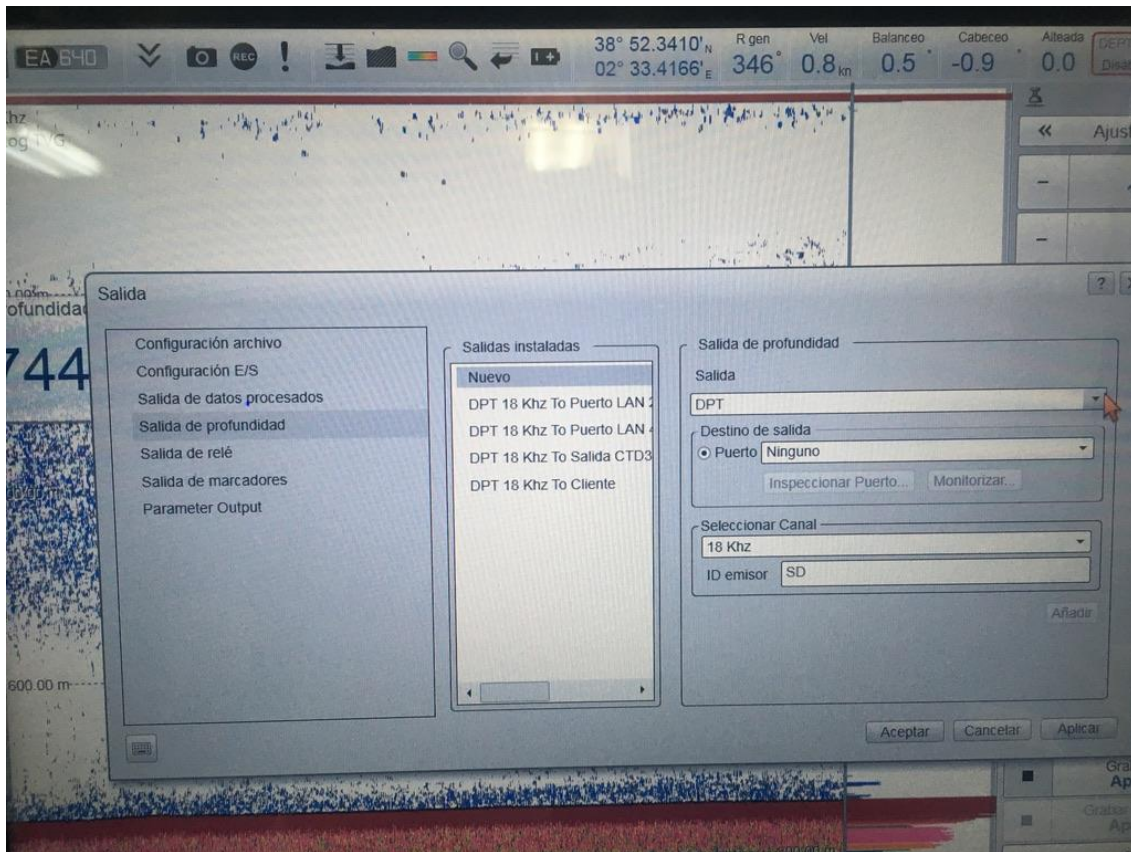
Para poder añadir una nueva salida de los datos de sonda es necesario meterse en el programa de la sonda EA640, y en el set de pestañas hay que meterse en la primera opción empezando por la izquierda llamada **OPERATIVA**. Dentro de esta opción, en la parte inferior, hay una pestaña llamada **Salida**.



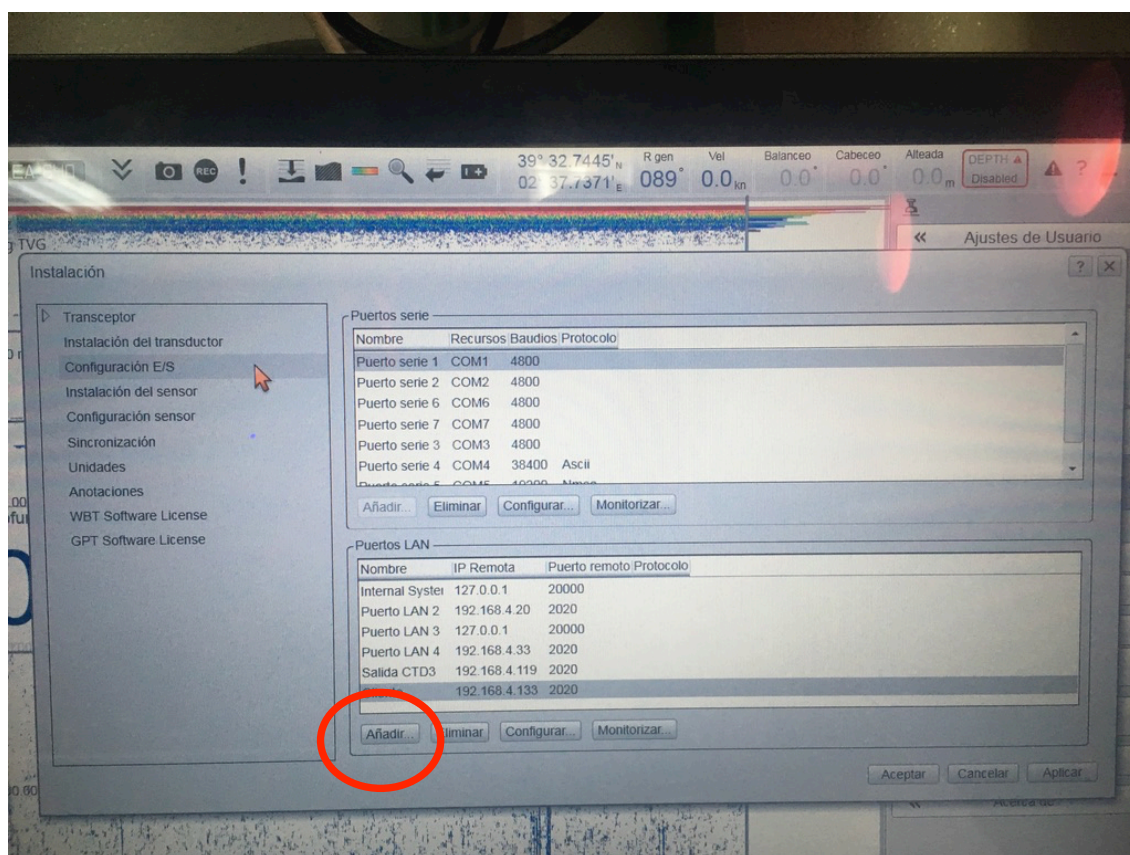
En la nueva ventana, izquierda, la cuarta arriba hay un

de Salida, en la parte opción empezando por display que pone **Salida de**

profundidad. Si pulsamos en esta opción, podemos hacer click en nuevo y configurar el LAN de salida, poniendo el tipo de salida que queremos (DBS,DBT,DPT,...).



A que puerto queremos que salga esta salida (si queremos uno nuevo debemos de crearlo previamente en: CONFIGURAR-INSTALACION-CONFIGURACION E/S-PUERTOS LAN-AÑADIR)



Seleccionar el canal (18 KHz) y en ID emisor poner "SD"

IMPORTANTE: Algunas veces hemos visto durante la campaña que las salidas de profundidad instaladas se borran, si no sale la señal hay que chequear en este punto (operativa-salida-salida de profundidad-salidas instaladas)

ANNEX 5: ADCP PROCESSING

Eugenio Cutolo and Simón Ruiz

To properly process the output data coming from the onboard Doppler ADCP 75Hz, a set of tools was used, which had been created by the University of Hawaii in the context of UHDAS (University of Hawaii Data Acquisition System)¹.

Usually it is quite common referring to this software as “CODAS processing”, since such procedures were developed around the CODAS format (Common Ocean Data Access System). CODAS processing can be used for data that have already been averaged, or for single-ping data.

In matter of facts the data acquisition during the campaign was carried out through the official software provided by *TRDI* (the ADCP manufacturer), named *VmDAS*. The postprocessing instead was carried out by CODAS since it is well capable of post-processing data acquired by *VmDAS*. In particular, we started from the *STA* files (Short Time Averaged) which contains data averaged every 2 minutes.

The first step concerned the loading of those data into the *CODAS* database, through the creation of a parameters file. In this last there were specified some descriptive informations about the campaign as the name and the period and more important the minimum acceptable percentage good of the pings, in our case we have chosen 30.

Since the output data were already calibrated onboard with *VmDAS*, it was not necessary to apply, as a subsequent step, a correction related to the rotation angle (i.e. between the boat and the instruments) but just a general check. In particular the resulting calibrations values were the following: amplitude = $1.0008 + -0.0001$ (should be close to 1) phase = $0.14 + -0.0114$ (should be close to 0).

With the tools included in CODAS it is possible to manually edit the profiles, looking for spikes and adjust the relevated sea bed but in our case these operations were not necessary considering the good work resulting from the automatic correction/detection. A few spikes present in the data were simply removed with an iterative 3-sigma filtering.

Finally some netCDF files were created, including also the information related to the boat. Those last ones are important to properly define selection criteria about the data while analyzing, for instance, velocity or acceleration thresholds.

In our case we carried out various tests with thresholds involving the boat speed and acceleration, but they did not work properly due to the numerous changes of the boat speed, during the campaign. Consequently, the final criteria was based on the removal of data collected when the boat was close to the CTD stations. In detail all the data present inside squares with 0.03 degree side centered on the CTD stations have been removed

To realize some plot showing the horizontal velocities at different depths the data were averaged with temporal bins of 8 minutes.

A detailed guide to the installation and use of CODAS can be found in the notes².

¹ https://currents.soest.hawaii.edu/docs/adcp_doc/

² https://currents.soest.hawaii.edu/docs/adcp_doc/codas_doc/CODAS_quickdoc.html

ANNEX 6: SOCIB GLIDER MISSION

Marc Torner and Albert Miralles

1. Mission Name		<i>preSWOT2018 (codename)</i>																	
		<i>IMEDEA, CSIC-UIB_OA_preSWOT_MAY2018_SDEEP00_GFMR0075 (full-name)</i>																	
2. Platform Model		<i>Electric Glider. SLOCUM G2 1000m</i>																	
3. Platform ID / Name / WMO Code		<i>U243 / SDEEP00 / 68457</i>																	
4. Related Platforms / Missions		<ul style="list-style-type: none"> • <i>SEA003: Sea-explorer glider, owned by MIO, surveying in the frame of synoptic BIOSWOT2018 experiment. (contact person: Andrea M. Doglioli <andrea.doglioli@mio.osupytheas.fr>)</i> • <i>ABACUS4-2018: Jerico-Next TNA mission concatenated with preSWOT2018 (contact person: Yuri Cotroneo <yuri.cotroneo@uniparthenope.it>)</i> 																	
5. Start Date		<i>03/may/2018 (this is the glider launch-day. Glider preparation began on 24/Apr/18)</i>																	
6. End Date		<i>15/may/2018 (Glider was not recovered but left, and configured, to concatenate with next survey: ABACUS4-2018)</i>																	
7. Total Days		<i>13 (days-in-water)</i>	8. Total distance (Km / Nm) <i>163 Nm</i>																
9. Survey Area		<i>Western Mediterranean Algerian Basin</i>																	
10. Objective(s)	<i>The general objective of this project is to quantify and improve our large scale integrated understanding of vertical exchanges associated with oceanic mesoscale and sub-mesoscale features (e.g., fronts, meanders, eddies and filaments) through the combined use of in-situ and satellite data in synergy with numerical models.(for more details contact the PI of the preSWOT experiment: Ananda Pascual <ananda.pascual@IMEDEA, CSIC-UIB.uib-csic.es>)</i>																		
11. Scientific Sensors		<table border="1"> <thead> <tr> <th><i>Sensor Type</i></th> <th><i>Manufacturer</i></th> <th><i>Serial Number</i></th> <th><i>Last-Calibration Date</i></th> </tr> </thead> <tbody> <tr> <td><i>CTD (pumped)</i></td> <td><i>SBE</i></td> <td><i>0064</i></td> <td><i>05/Dec/2016</i></td> </tr> <tr> <td><i>FLNTU</i></td> <td><i>WebLABS</i></td> <td><i>3711</i></td> <td><i>16/Dec/2016</i></td> </tr> <tr> <td><i>OXYGEN</i></td> <td><i>AADI</i></td> <td><i>1409</i></td> <td><i>14/Feb/2017</i></td> </tr> </tbody> </table>		<i>Sensor Type</i>	<i>Manufacturer</i>	<i>Serial Number</i>	<i>Last-Calibration Date</i>	<i>CTD (pumped)</i>	<i>SBE</i>	<i>0064</i>	<i>05/Dec/2016</i>	<i>FLNTU</i>	<i>WebLABS</i>	<i>3711</i>	<i>16/Dec/2016</i>	<i>OXYGEN</i>	<i>AADI</i>	<i>1409</i>	<i>14/Feb/2017</i>
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12. Number of Profiles		<table border="1"> <thead> <tr> <th><i>Sensor Type</i></th> <th><i>Number of Vertical Profiles</i></th> <th><i>Total Vertical Maneuvers (ascends+descends)</i></th> <th><i>Sampled Vertical-Distance (meters)</i></th> </tr> </thead> <tbody> <tr> <td><i>CTD (pumped)</i></td> <td><i>404</i></td> <td rowspan="3"><i>407</i></td> <td><i>165057</i></td> </tr> <tr> <td><i>FLNTU</i></td> <td><i>403</i></td> <td><i>89156</i></td> </tr> <tr> <td><i>OXYGEN</i></td> <td><i>403</i></td> <td><i>165425</i></td> </tr> </tbody> </table>		<i>Sensor Type</i>	<i>Number of Vertical Profiles</i>	<i>Total Vertical Maneuvers (ascends+descends)</i>	<i>Sampled Vertical-Distance (meters)</i>	<i>CTD (pumped)</i>	<i>404</i>	<i>407</i>	<i>165057</i>	<i>FLNTU</i>	<i>403</i>	<i>89156</i>	<i>OXYGEN</i>	<i>403</i>	<i>165425</i>		
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13. Significant Events	<ul style="list-style-type: none"> • <i>First ever a SOCIB glider was deployed along a SEA-EXPLORER glider model</i> • <i>SENTINEL-3 overflight (swath #244) during the first leg (North to South) of the scientific survey of the SOCIB glider</i> • <i>Mission concatenated with ABACUS-4. The proximity of the PRESWOT end-wpt, with ABACUS-4's, made feasible to move from one survey area to the other just in time for ABACUS-4 to begin.</i> • <i>The SOCIB glider found favorable currents during the first leg although it was not that problematic during the return trip</i> 																		
15. Principal Investigator		<table border="1"> <thead> <tr> <th><i>(Title) Name</i></th> <th><i>Email</i></th> <th><i>Tel#</i></th> </tr> </thead> <tbody> <tr> <td><i>(PhD) Ananda Pascual Ascaso</i></td> <td><i>ananda.pascual@IMEDEA, CSIC-UIB.uib-csic.es</i></td> <td><i>+34 971 611 732</i></td> </tr> <tr> <td><i>(PhD) John Allen</i></td> <td><i>jallen@socib.es</i></td> <td><i>+34 971 439 765</i></td> </tr> </tbody> </table>		<i>(Title) Name</i>	<i>Email</i>	<i>Tel#</i>	<i>(PhD) Ananda Pascual Ascaso</i>	<i>ananda.pascual@IMEDEA, CSIC-UIB.uib-csic.es</i>	<i>+34 971 611 732</i>	<i>(PhD) John Allen</i>	<i>jallen@socib.es</i>	<i>+34 971 439 765</i>							
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<i>(PhD) John Allen</i>	<i>jallen@socib.es</i>	<i>+34 971 439 765</i>																	
16. Institute	<i>IMEDEA, CSIC-UIB (http://IMEDEA, CSIC-UIB.uib-csic.es/) SOCIB (www.socib.eu)</i>																		

17. Project Affiliation (web-site)	<i>n/a</i>
18. Partnership Participation	<i>IMEDEA, CSIC-UIB, SOCIB, MIO (https://www.mio.univ-amu.fr/?lang=en)</i>
19. Glider Software Version	<i>Nav: v7.21 LISST, Payload: v7.21</i>
20. Data Retrieval	<ul style="list-style-type: none"> • <i>RT: both engineering (SBD) and scientific (TBD) near-real-time pair of files transmitted, during the whole mission, during each surface in between each two consecutive dives</i> • <i>DM: wireless download, along with the mission which followed (ABACUS-IV), via radio link to not disassemble the glider</i>
21. Compass Calibration	<i>Neither compass calibration nor error-measurement was done during the pre-mission period (due to timing and logistics restrictions). Since SDEEP00 will not suffer modifications before it is redeployed for CANALES-JUNE-2018, compass error-measurement was performed in June 2018. See 20180612_U243_CEM_PRE_canalesJun2018 report for more information</i>
22. Battery Type	<i>Official/Factory Lithium Pack (based on ELECTROCHEM cells) with a nominal battery capacity of 700Ah approx.</i>
23. Battery Consumption (Ah)	<i>78.6459Ah (mission_start: 45.4231Ah ; mission_end: 124.069Ah)</i>
24. Data Available From	<i>http://thredds.socib.es/thredds/fileServer/auv/glider/sdeep00-scb_sldeep000/L2/2018/dep0023_sdeep00_scb-sldeep000_L2_2018-05-03_data_dt.nc</i>
25. Further Details	<i>glidertech@socib.es (technical aspects) & glider.data@socib.es (scientific data)</i>

26. General Map



http://apps.socib.es/dapp/?deployments=801-13-0-FFFF00&layers=isobaths,ocean_basemap&units=scientific

27. Detailed Map

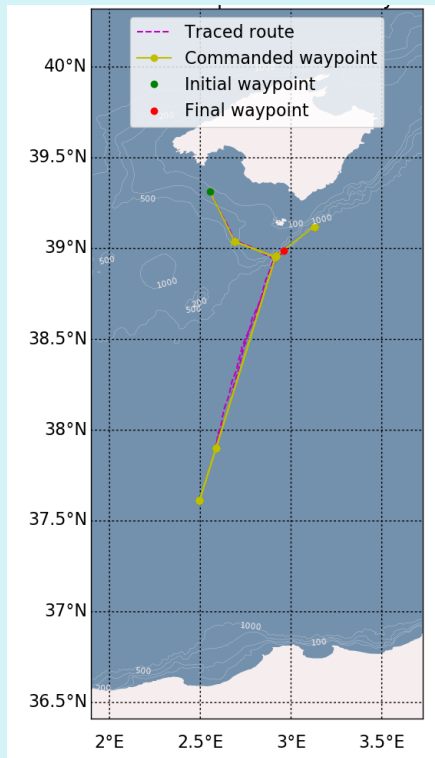


Fig 2.1 Map showing both the commanded route and the resulting track

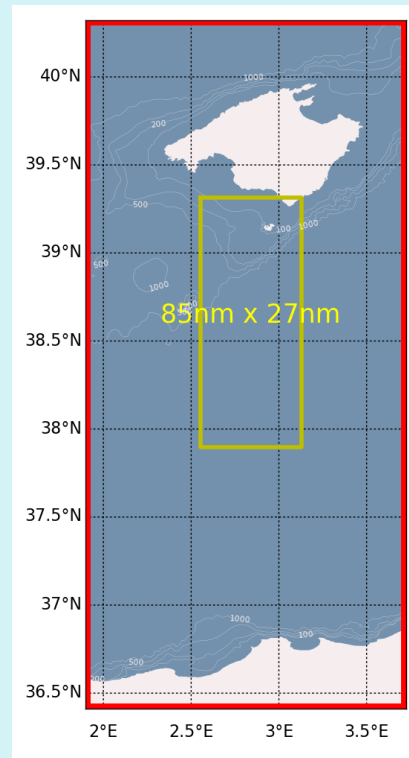
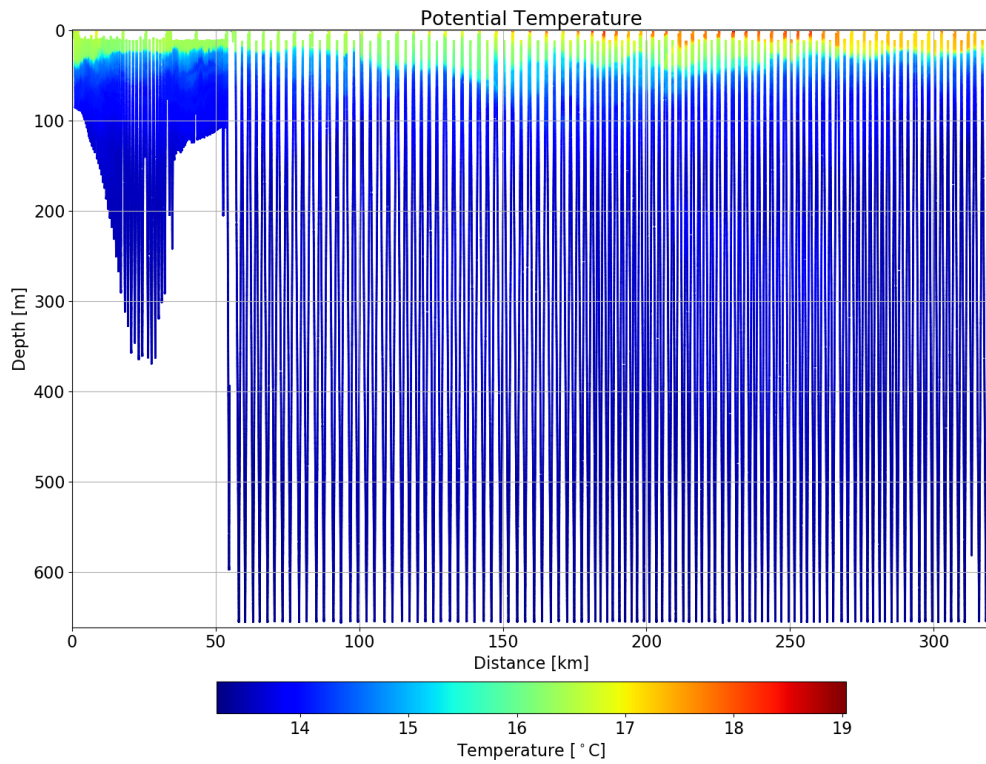


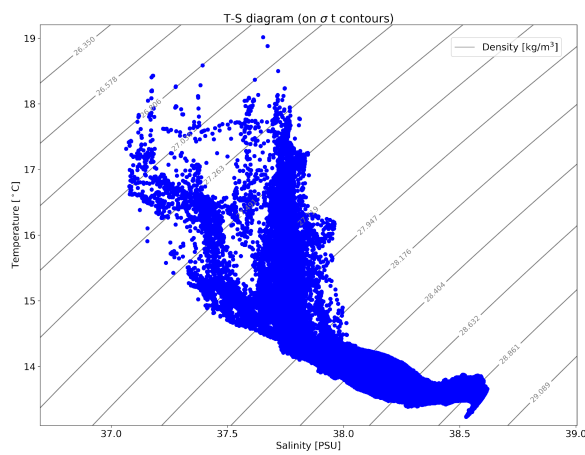
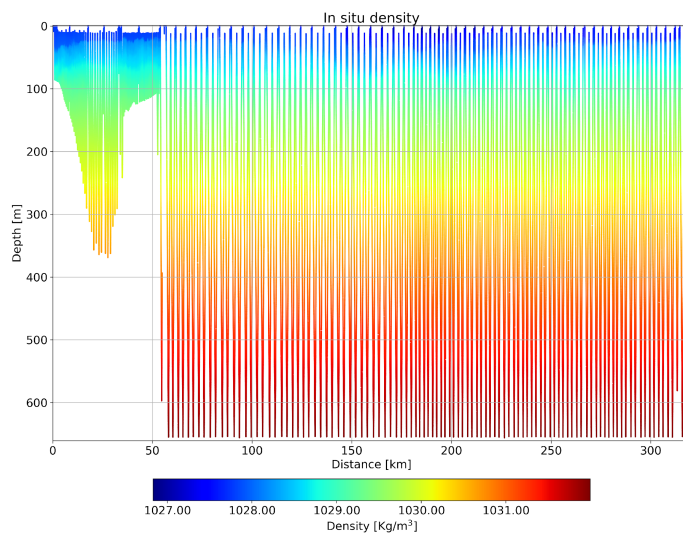
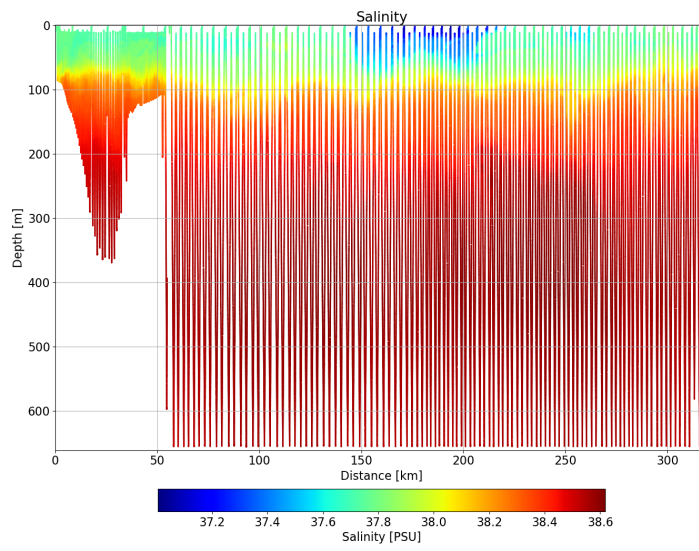
Fig 2.2 Location and dimensions of this mission's bounding box

28. Scientific Preliminary Review

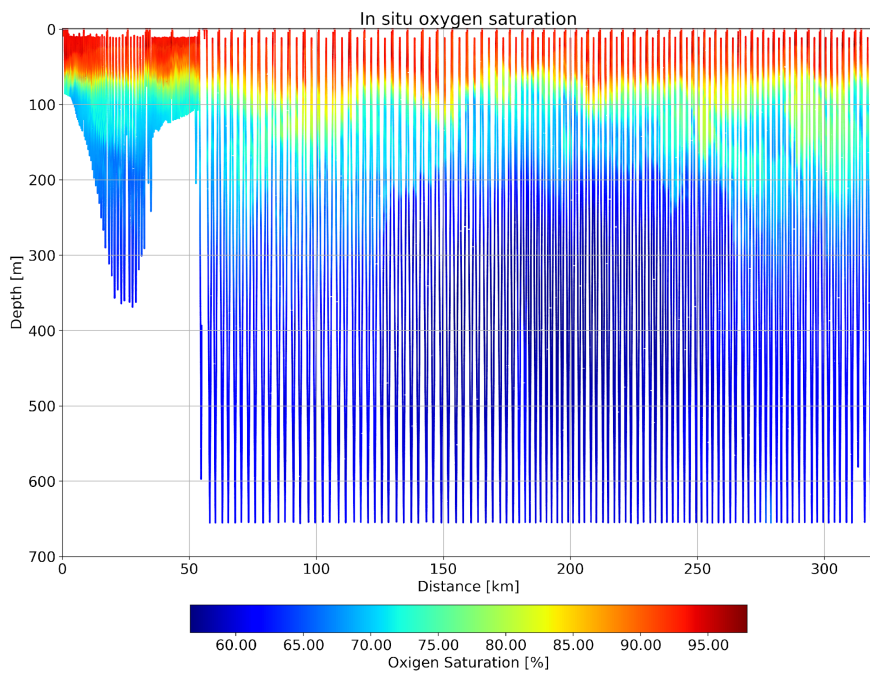
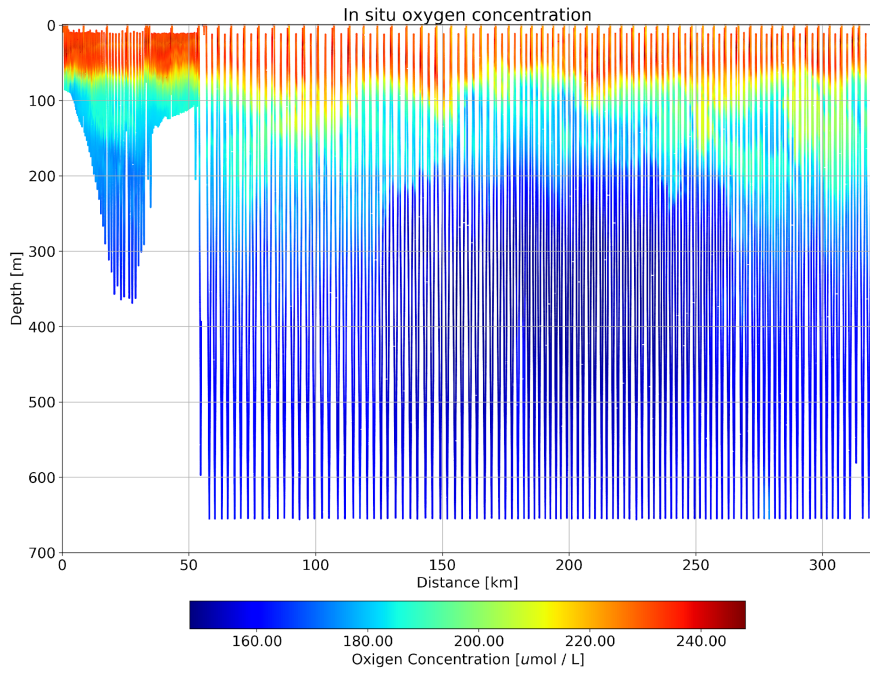
CTD



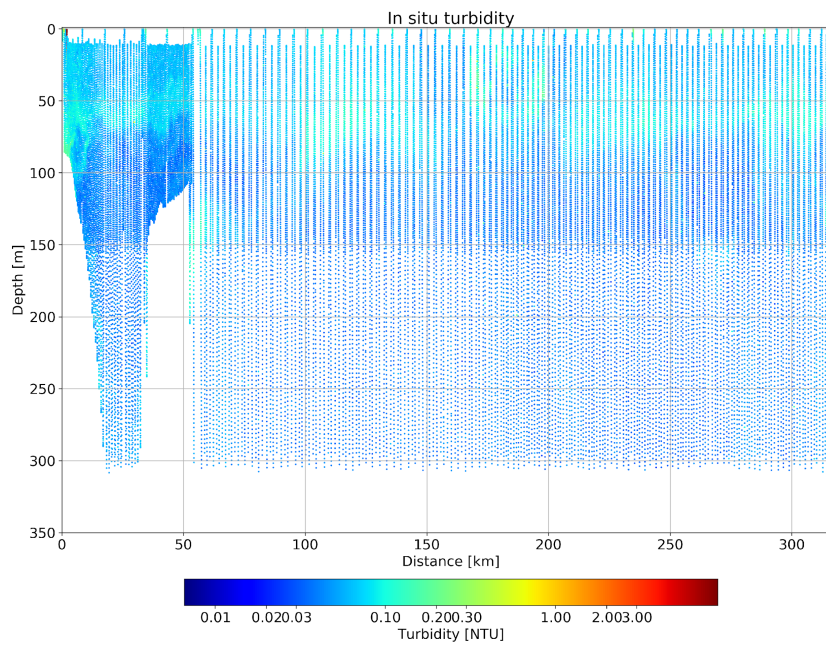
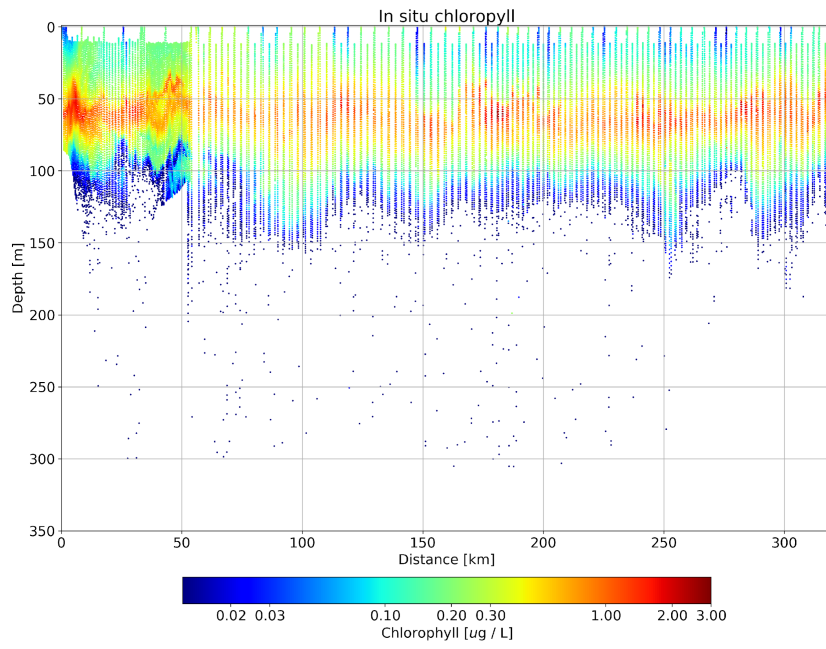
28. Scientific Preliminary Review



OXYGEN



TURBIDITY & CHLOROPHYL



ANNEX 7: MIO GLIDER MISSION

Frédéric Cyr, Andrea Doglioli

1. Mission Name		<i>BIOSWOT2018 (codename)</i>																									
2. Platform Model		<i>Electric Glider. SeaExplorer</i>																									
3. Platform ID / Name / WMO Code		<i>SEA003</i>																									
4. Related Platforms / Missions		<ul style="list-style-type: none"> • <i>PreSWOT2018: Slocum glider owned by Socib also participated to this mission (see previous annex)</i> 																									
5. Start Date		<i>03/may/2018 (this is the glider launch-day.</i>																									
6. End Date		<i>15/may/2018 (Glider recovered by Garcia del Cid crew)</i>																									
7. Total Days		<i>13 (days-in-water)</i>	8. Total distance (Km / Nm) <i>N/A</i>																								
9. Survey Area		<i>Western Mediterranean Algerian Basin</i>																									
10. Objective(s)	<p><i>This is a joint deployment with Socib Slocum glider (see Annex 6). The general objectives are thus the same. In addition, and as part of BIOSWOT project, this glider is equipped with 2 MiniFluos in order to provide refinement for the characterization dissolved organic matter in the frontal zones. For more details contact the PI of the BIOSWOT experiment: Andrea Doglioli <andrea.doglioli@univ-amu.fr></i></p>																										
11. Scientific Sensors	<table border="1"> <thead> <tr> <th><i>Sensor Type</i></th> <th><i>Manufacturer</i></th> <th><i>Serial Number</i></th> <th><i>Last-Calibration Date</i></th> </tr> </thead> <tbody> <tr> <td><i>CTD (pumped)</i></td> <td><i>SBE</i></td> <td><i>0094</i></td> <td><i>11/Nov/2016</i></td> </tr> <tr> <td><i>FLBBCD</i></td> <td><i>WebLABS</i></td> <td><i>4083</i></td> <td><i>7/Jul/2015</i></td> </tr> <tr> <td><i>OXYGEN</i></td> <td><i>SBE</i></td> <td><i>0249</i></td> <td><i>3/Jun/2016</i></td> </tr> <tr> <td><i>MiniFluo-UV1</i></td> <td><i>Alseamar</i></td> <td><i>0014</i></td> <td><i>3/Jul/2017</i></td> </tr> <tr> <td><i>MiniFluo-UV2</i></td> <td><i>Alseamar</i></td> <td><i>0013</i></td> <td><i>3/Nov/2015</i></td> </tr> </tbody> </table>			<i>Sensor Type</i>	<i>Manufacturer</i>	<i>Serial Number</i>	<i>Last-Calibration Date</i>	<i>CTD (pumped)</i>	<i>SBE</i>	<i>0094</i>	<i>11/Nov/2016</i>	<i>FLBBCD</i>	<i>WebLABS</i>	<i>4083</i>	<i>7/Jul/2015</i>	<i>OXYGEN</i>	<i>SBE</i>	<i>0249</i>	<i>3/Jun/2016</i>	<i>MiniFluo-UV1</i>	<i>Alseamar</i>	<i>0014</i>	<i>3/Jul/2017</i>	<i>MiniFluo-UV2</i>	<i>Alseamar</i>	<i>0013</i>	<i>3/Nov/2015</i>
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<i>MiniFluo-UV2</i>	<i>408</i>		<i>N/A</i>																								
13. Significant Events	<ul style="list-style-type: none"> • <i>See previous annex</i> 																										

14. Mission Summary

14.1 Introduction

SEA003 was deployed by F. Cyr (Now DFO, but former postdoc at MIO) in conjunction with Socib Slocum glider SDEEP00. Piloting was ensured by N. Bhairy and F. Cyr.

14.2 Pre-mission Report

This deployment was possible thanks to in kind support by Socib (successful proposal by A. Doglioli and F. Cyr)

14.3 Preparation

SEA003 was prepared by N. Bhairy at MIO. glider was shipped to Socib/IMEDEA, CSIC-UIB weeks before the deployment.

14.4 Launching

This field operation (03/May/2018) was conducted by 1 SOCIB-ETD and 1 SOCIB-GF members on board SOCIB-I (9m Hurricane Zodiac). Exceptionally, Dr. Frederic Cyr (Fisheries and Oceans Canada, Frederic.Cyr@dfo-mpo.gc.ca) participated in this operation as field-pilot of the MIO's SEA003. Remote piloting of SDEEP00 was undertaken at IMEDEA, CSIC-UIB's glider-control-room by 1 SOCIB-GF additional member. Gliders were released in N39° 19.110' E02° 32.718' (SDEEP00) and N39° 18.498' E02° 33.318' between 09:05am,utc and 11:10am,utc. In spite of the expected technical inconveniency, derived from the goal of launching gliders of two different models, one of them, the Sea-Explorer, first ever seen by SOCIB-GF, the operation was an operative and tactical success (environmental conditions were quite good). Both gliders executed buoy-tethered test-dives prior to the initial dive of each mission. The major difficulty was to overcome the low 3G/GSM cellular signal in the area.

14.5 Survey

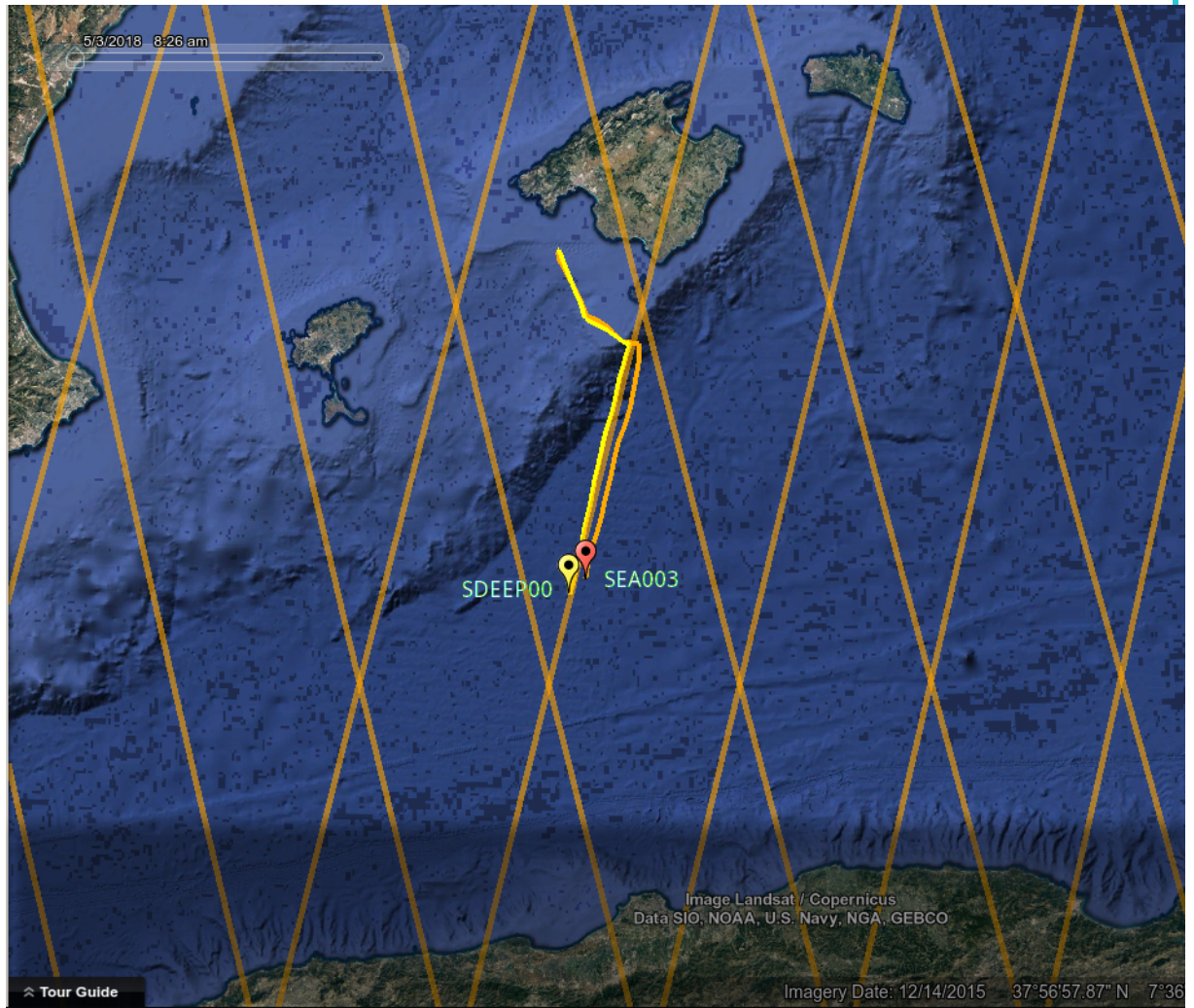
In general terms, it was very successful. The main preliminary objectives were all accomplished without major setbacks. The absence of critical situations resulted in no emergency actions.

14.6 Recovery

SEA003 was recovered 15 May 2018 by Garcia del Cid crew. Socib personnel carefully took care of preparing the glider for its shipment back to MIO in France.

15. Principal Investigator	<i>(Title) Name</i>	<i>Email</i>	<i>Tel:</i>
	<i>(PhD) Andrea Doglioli</i>	<i>andrea.doglioli@univ-amu.fr</i>	<i>+33(0)486090608</i>
	<i>(PhD) Frederic Cyr</i>	<i>Frederic.Cyr@dfo-mpo.gc.ca</i>	<i>+1 709 722-8137</i>
16. Institute	<i>MIO (http://www.mio.univ-amu.fr) DFO (http://www.dfo-mpo.gc.ca/)</i>		
17. Project Affiliation <small>(web-site)</small>	<i>N/A</i>		
18. Partnership Participation /	<i>IMEDEA, CSIC-UIB, SOCIB</i>		
19. Glider Software Version	<i>CCU version 2.1.0 / Software 2.4.4</i>		
20. Data Retrieval	<i>N/A</i>		
21. Compass Calibration	<i>Compass calibrated in France prior to shipping</i>		
22. Battery Type	<i>N/A</i>		
23. Battery Consumption (Ah)			
24. Data Available From	<i>Frederic.Cyr@dfo-mpo.gc.ca</i>		
25. Further Details	<i>Frederic.Cyr@dfo-mpo.gc.ca</i>		

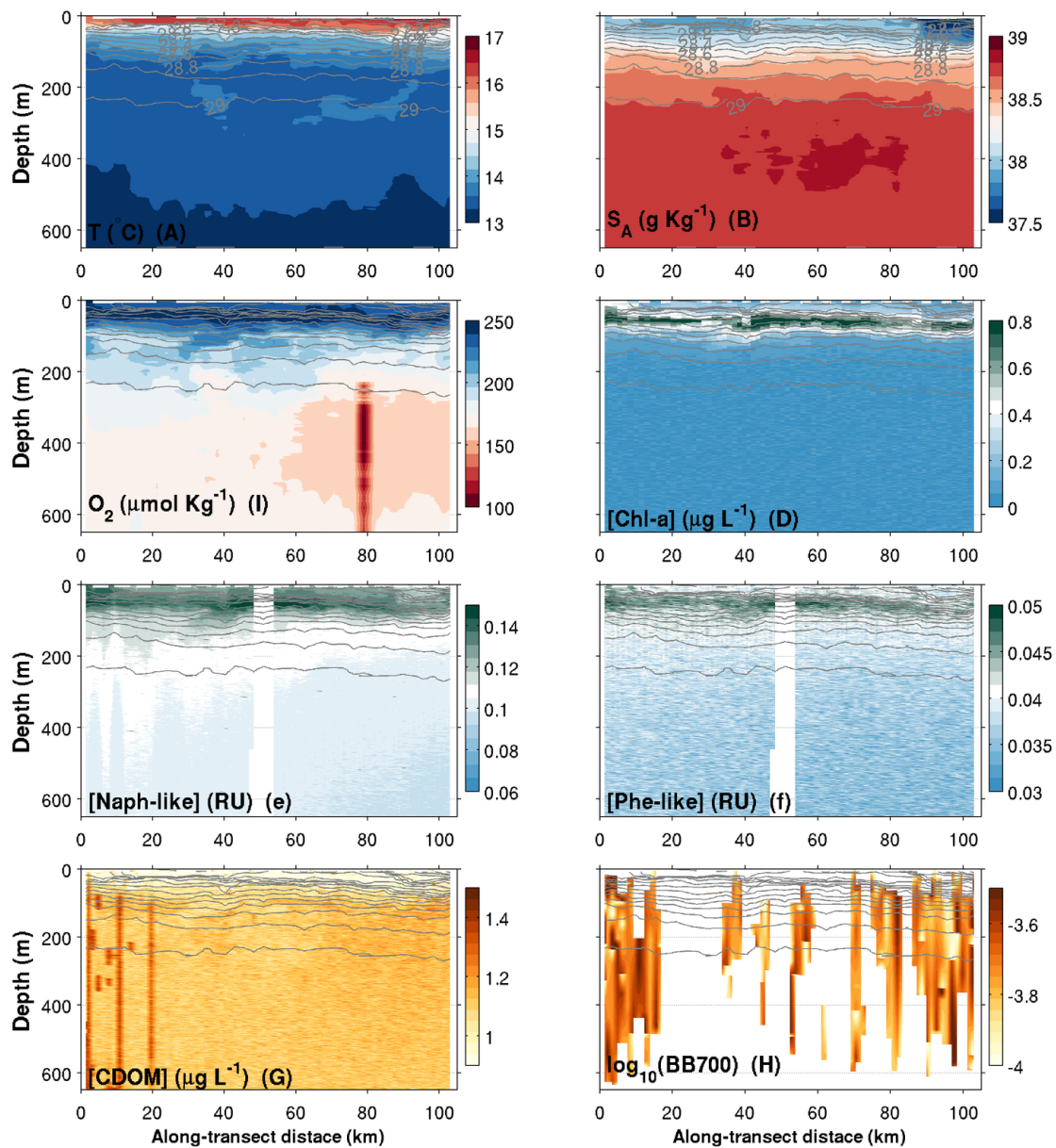
26.
General
Map



Gliders SEA003 and SDEEP00 followed one Sentinel track (orange lines). The two glider tracks are separated by a horizontal distance of about 5km. SEA003 realized a return transect of a little more than 100km.

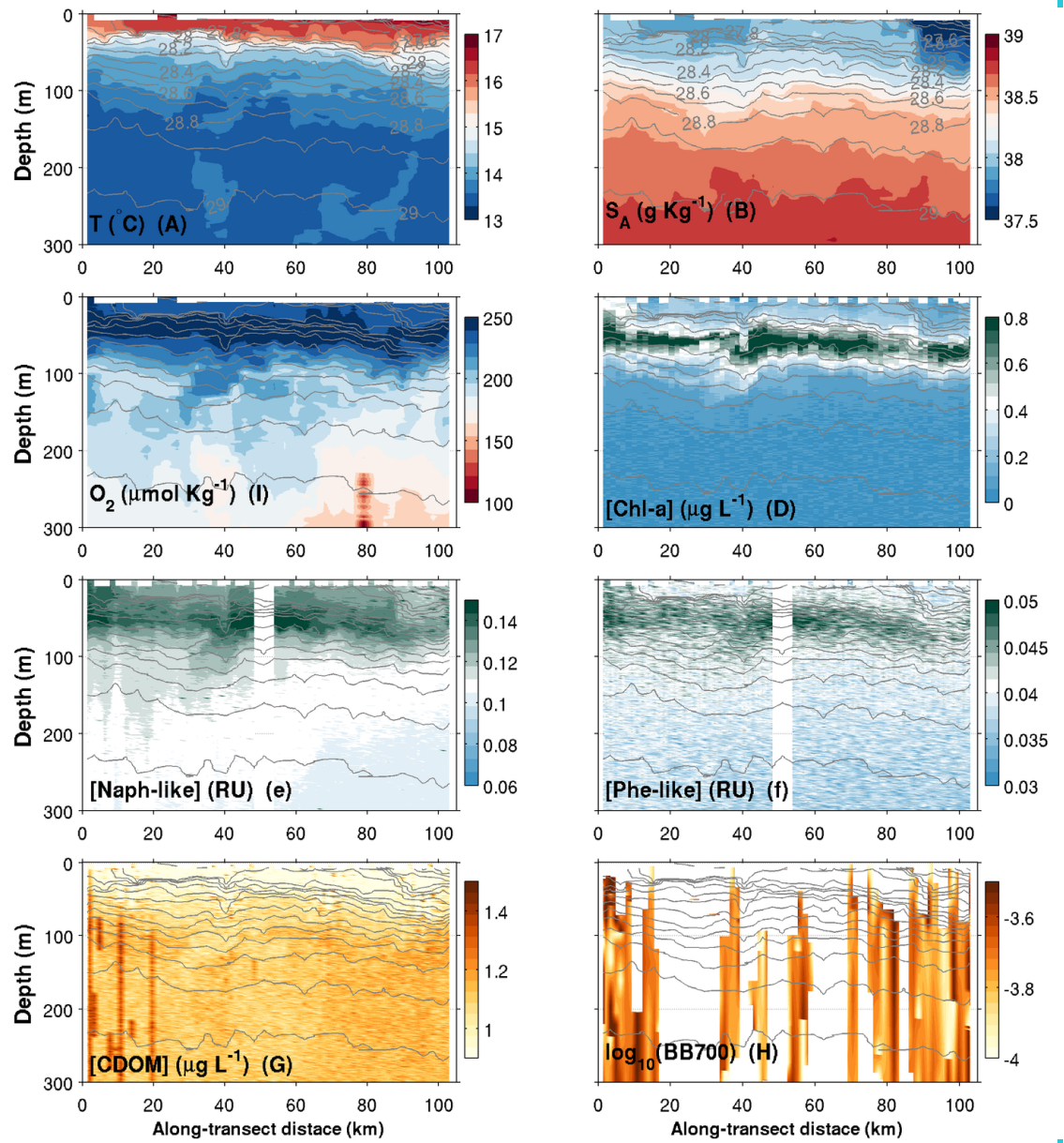
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OUTBOUND TRANSECT



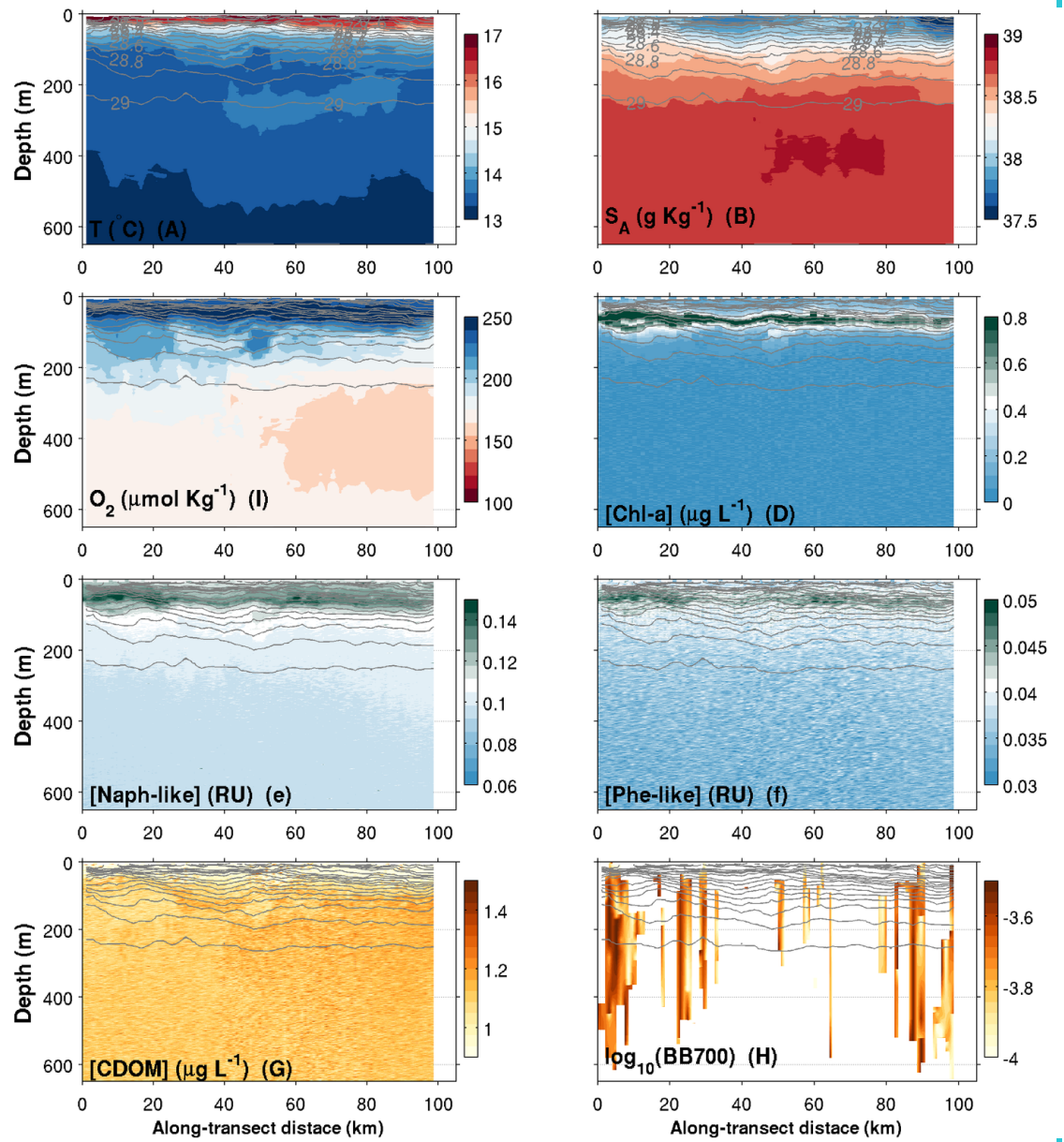
Outbound transect (full depth). BB700 did not work properly. Spikes in CDOM (before 20km) and in Oxygen (near 80km) are not realistic. Naph-like and Phe-like signal are measured by MiniFluo-UV1 sensors.

27. Scientific Preliminary Review

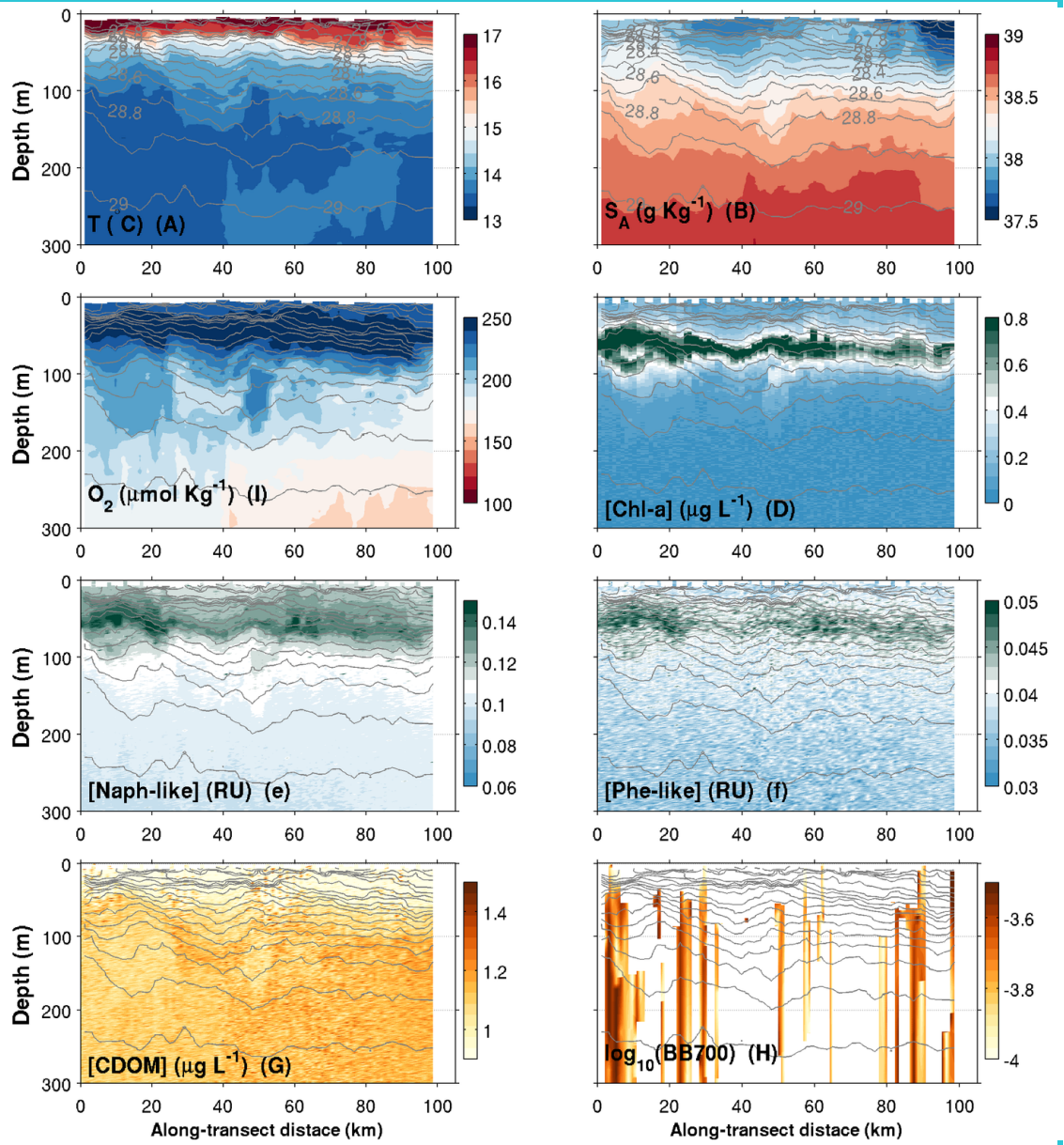


Same as previous Figure, but zoom in top 300m of the water column

INBOUND TRANSECT



Inbound (return) transect (full depth). As for the outbound transect, BB700 did not work properly. The rest of the sensors worked better than during the outbound transect.



Same as previous Figure, but zoom in top 300m of the water column

ANNEX 8: SVP DRIFTER DEPLOYMENT LOG SHEET

ID SOCIB Data Center	ID Serial Number	Drifter provider	Latitude (°N)	Longitude (°E)	Date (DD/MM/ YY)	Hour (UTC)
SCB-SVP040	300234066303410	Dbi	38°40'15.00"	3°09'45.00"	5/5/18	21:42:11
SCB-SVP041	300234066303440	Dbi	38°40'15.60"	3°13'01.80"	5/5/18	22:22:00
IME-SVP026	300234066305420	Dbi	38°37'48.00"	3° 11'17.90"	5/5/18	23:00:00
IME-SVP027	300234066305430	Dbi	38°39'21.60"	3°20'2.94"	6/5/18	19:24:47
IME-SVP028	300234066305440	Dbi	38°39'15.00"	3°16'47.28"	6/5/18	20:01:36
IME-SVP029	300234066306020	Dbi	38°36'45.60"	3°18'27.00"	6/5/18	20:36:14
IME-SVP030	300234066306050	Dbi	38°30'27.84"N	3°1'34.80"E	8/5/18	12:31
IME-SVP031	300234065488860	Dbi	38°31'55.522"N	3°2'44.803E	8/5/18	13:00
IME-SVP032	300234065488930	Dbi	38°32'13.26"N	2°59'56.52"E	8/5/18	13:12
IME-SVP033	300234065488950	Dbi	38°41'1.80"N	2°54'5.60"E	9/5/18	1:59
IME-SVP034	300234065488960	Dbi	38°39'6.00"N	2°52'42.00"E	9/5/18	2:20
IME-SVP035	300234065489920	Dbi	38°39'7.50"N	2°56'13.02"E	9/5/18	2:49

ANNEX 9: CTD STATION POSITIONS AND SAMPLING

Note

Biological sampling (Bio.): nutrients (Nuts), high performance liquid chromatography (HPLC), phytoplankton (Phyto)

Calibration sampling (Cal.): oxygen, chl *a*, salinity (Sal)

Leg-1

Station	Date Time (UTC)	Latitude	Longitude	CTD depth (m)	Bottom depth (m)	Sampling Depth of samples (m)	
						Bio.	Cal.
PS_001	May 06 2018 02:16:39	38° 19.55' N	003° 28.96' E	1001.51	2689	Nuts: 1000, 500, 200, 125, 100, 75, 66, 25, 5 HPLC: 500, 66, 5 Phyto: 66	Oxygen: 1000, 200, 25 Chl a: 500, 125, 66, 25, 5 Sal: 500
PS_002	May 06 2018 04:27:24	38° 25.03' N	003° 29.01' E	601.10	2651	Nuts: 600, 500, 200, 125, 100, 75, 60, 25, 5 HPLC: 60, 5 Phyto: 60	Sal: 500
PS_003	May 06 2018 05:58:26	38° 30.41' N	003° 28.96' E	501.11	2554	Nuts: 500, 200, 125, 100, 75, 61, 25, 5 HPLC: 61, 5 Phyto: 61	
PS_004	May 06 2018 07:26:41	38° 35.83' N	003° 28.96' E	1001.97	2502	Nuts: 1000, 467, 200, 125, 100, 75, 52, 25, 5 HPLC: 52, 5 Phyto: 52	Oxygen: 1000, 200, 25 Chl a: 467, 125, 52, 25, 5 Sal: 25
PS_005	May 06 2018 09:26:32	38° 41.22' N	003° 28.88' E	502.08	2489	Nuts: 500, 200, 125, 100, 75, 41, 25, 5 HPLC: 41, 5 Phyto: 41	
PS_006	May 06 2018 10:59:45	38° 46.48' N	003° 28.87' E	501.09	2446	Nuts: 500, 200, 125, 100, 75, 56, 25, 5 HPLC: 56, 5 Phyto: 56	

PS_007	May 06 2018 12:37:46	38° 51.95' N	003° 28.88' E	1001.951	2419	Nuts: 1000, 500, 200, 125, 100, 75, 51, 25, 5 HPLC: 51, 5 Phyto: 51	Oxygen: 1000, 200, 25 Chl a: 500, 125, 51, 25, 5 Sal: 1000
PS_008	May 06 2018 14:29:07	38° 51.94' N	003° 21.93' E	501.58	2385	Nuts: 501, 201, 125.7, 100.1, 75.5, 45.7, 26.1, 5.3 HPLC: 45.7, 5.3 Phyto: 45.7	
PS_009	May 06 2018 16:02:17	38° 46.58' N	003° 21.99' E	500.60	2443	Nuts: 500, 200, 125, 100, 75.7, 50.6, 25, 4.6 HPLC: 125, 50.6, 4.6 Phyto: 125, 50.6	
PS_010	May 06 2018 17:43:02	38° 41.19' N	003° 22.04' E	1000.94	2480	Nuts: 1000, 500, 200, 125, 100, 75, 60, 25, 5 HPLC: 125, 60, 5 Phyto: 125, 60	Oxygen: 1000, 200, 25 Chl a: 500, 125, 60, 25, 5 Sal: 500
PS_011	May 06 2018 21:12:57	38° 35.79' N	003° 22.04' E	501.08	2482	Nuts: 500, 200, 125, 100, 75, 55, 25, 5 HPLC: 55, 5 Phyto: 55	
PS_012	May 06 2018 22:51:31	38° 30.35' N	003° 22.07' E	504.55	2625	Nuts: 500, 200, 125, 100, 75, 67, 25, 5 HPLC: 67, 5 Phyto: 67	
PS_013	May 07 2018 00:27:19	38° 24.97' N	003° 22.03' E	1000.44	2656	Nuts: 1000, 500, 200, 125, 100, 72, 50, 25, 5 HPLC: 500, 72, 5 Phyto: 72	Oxygen: 1000, 200, 25 Chl a: 500, 125, 72, 25, 5 Sal: 25
PS_014	May 07 2018 02:46:27	38° 19.57' N	003° 22.07' E	502.08	2681	Nuts: 502, 200, 124, 100, 72, 50, 25.3, 5 HPLC: 75, 50, 5 Phyto: 75, 50	

PS_015	May 07 2018 04:33:04	38° 19.54' N	003° 15.05' E	500.60	2664		
PS_016	May 07 2018 06:13:37	38° 24.88' N	003° 15.05' E	1001.49	2662	Nuts: 1000, 500, 200, 100, 75, 56, 25, 5 HPLC: 56, 5 Phyto: 56	Oxygen: 1000, 200, 25 Chl a: 500, 56, 25, 5 Sal: 500
PS_017	May 07 2018 08:31:10	38° 30.46' N	003° 15.15' E	514.45	2597	Nuts: 500, 200, 125, 100, 67, 50, 25, 5 HPLC: 67, 5 Phyto: 67	
PS_018	May 07 2018 10:07:57	38° 35.81' N	003° 15.10' E	500.56	2555	Nuts: 500, 200, 125, 100, 75, 46, 25, 5 HPLC: 46, 5 Phyto: 46	
PS_019	May 07 2018 11:40:18	38° 41.16' N	003° 15.09' E	1000.47	2540	Nuts: 1000, 500, 200, 125, 100, 74, 52, 25, 5 HPLC: 52, 5 Phyto: 52	Oxygen: 1000, 200, 25 Chl a: 500, 52, 25, 5 Sal: 1000
PS_020	May 07 2018 13:54:44	38° 46.56' N	003° 15.10' E	501.08	2539		
PS_021	May 07 2018 15:36:15	38° 51.86' N	003° 15.11' E	501.07	2478		
PS_022	May 07 2018 17:19:40	38° 51.90' N	003° 08.15' E	1000.92	2328		
PS_023	May 07 2018 19:48:22	38° 46.49' N	003° 08.17' E	500.58	2504		
PS_024	May 07 2018 21:21:46	38° 41.09' N	003° 08.23' E	500.58	2531	Nuts: 500, 200, 125, 100, 75, 45, 25 HPLC: 45 Phyto: 45	
PS_025	May 07 2018 22:55:14	38° 35.77' N	003° 08.18' E	1000.49	2559	Nuts: 1000, 500, 200, 125, 100, 75, 50, 23, 5 HPLC: 50, 5 Phyto: 50	Oxygen: 1000, 200, 23 Chl a: 500, 125, 50, 23, 5 Sal: 23

PS_026	May 08 2018 01:13:34	38° 30.38' N	003° 08.25' E	500.10	2621	Nuts: 500, 200, 125, 75, 45, 25, 4.7 HPLC: 45, 4.7 Phyto: 45	
PS_027	May 08 2018 03:05:55	38° 24.96' N	003° 08.22' E	500.60	2644	Nuts: 500, 201, 126, 100, 65, 55, 25, 5 HPLC: 65, 55, 5 Phyto: 65, 55	
PS_028	May 08 2018 05:06:35	38° 19.52' N	003° 08.22' E	1000.97	2667		Oxygen: 1000, 200, 25 Chl a: 500, 125, 65, 25, 5 Sal: 500
PS_029	May 08 2018 07:32:55	38° 19.71' N	003° 01.27' E	500.61	2671		
PS_030	May 08 2018 09:06:37	38° 25.09' N	003° 01.40' E	500.10	2664	Nuts: 500, 200, 125, 100, 75, 60, 25, 5 HPLC: 60, 5 Phyto: 60	
PS_031	May 08 2018 10:51:15	38° 30.38' N	003° 01.32' E	1000.46	2591	Nuts: 1000, 500, 200, 125, 100, 80, 42, 25, 4.7 HPLC: 80, 42, 4.7 Phyto: 80, 42	Oxygen: 1000, 200, 25 Chl a: 500, 125, 42, 25, 4.7 Sal: 1000
PS_032	May 08 2018 14:18:31	38° 35.78' N	003° 01.37' E	500.21	2542	Nuts: 500, 200, 125, 100, 75, 50, 25, 5 HPLC: 50, 5 Phyto: 50	
PS_033	May 08 2018 16:08:04	38° 41.13' N	003° 01.34' E	500.58	2522	Nuts: 500, 200, 125, 100, 75, 54, 25, 5 HPLC: 54, 5 Phyto: 54	
PS_034	May 08 2018 18:04:36	38° 46.45' N	003° 01.39' E	1001.46	2458		Oxygen: 1000, 200, 25 Chl a: 500, 125, 52, 25, 5 Sal: 1000

PS_035	May 08 2018 20:22:37	38° 51.83' N	003° 01.35' E	500.59	2373		
PS_036	May 08 2018 21:52:39	38° 51.90' N	002° 54.42' E	501.07	2029		
PS_037	May 08 2018 23:25:07	38° 46.47' N	002° 54.46' E	1000.93	2482		Oxygen: 1000, 200, 25 Chl a: 500, 125, 61, 25, 4 Sal: 25
PS_038	May 09 2018 01:12:33	38° 41.13' N	002° 54.39' E	500.59	2587	Nuts: 500, 200, 125, 100, 75, 52, 24, 5 HPLC: 52, 5 Phyto: 52	
PS_039	May 09 2018 04:05:17	38° 35.73' N	002° 54.40' E	500.59	2589	Nuts: 500, 200, 125, 100, 75, 63, 25, 5 HPLC: 63, 5 Phyto: 63	
PS_040	May 09 2018 05:36:24	38° 30.37' N	002° 54.42' E	1001.95	2615	Nuts: 1000, 500, 200, 125, 100, 75, 55, 25, 5 HPLC: 55, 5 Phyto: 55	Oxygen: 1000, 200, 25 Chl a: 500, 125, 55, 25, 5 Sal: 1000, 125
PS_041	May 09 2018 07:22:31	38° 24.95' N	002° 54.39' E	501.12	2650	Nuts: 500, 200, 125, 100, 75, 55, 25, 5 HPLC: 55, 5 Phyto: 55	
PS_042	May 09 2018 08:53:50	38° 19.55' N	002° 54.44' E	504.07	2681		
PS_043	May 09 2018 10:22:36	38° 19.55' N	002° 47.47' E	1000.98	2647		
PS_044	May 09 2018 12:09:02	38° 24.89' N	002° 47.72' E	500.10	2640	Nuts: 500, 200, 125, 98, 75, 58, 25, 5 HPLC: 58, 5 Phyto: 58	

PS_045	May 09 2018 13:32:02	38° 30.35' N	002° 47.66' E	501.09	2623	Nuts: 200, 125, 100, 75, 69, 25, 5 HPLC: 69, 5 Phyto: 69	
PS_046	May 09 2018 15:05:17	38° 35.75' N	002° 47.52' E	1000.96	2580	Nuts: 1000, 500, 200, 116, 100, 75, 68, 25, 5 HPLC: 116, 68, 5 Phyto: 116, 68	Oxygen: 1000, 200, 25 Chl a: 500, 116, 68, 25, 5 Sal: 1000, 200
PS_047	May 09 2018 17:09:30	38° 41.10' N	002° 47.54' E	501.10	2593	Nuts: 500, 200, 125, 100, 75, 60, 25, 5 HPLC: 60, 5 Phyto: 60	
PS_048	May 09 2018 18:38:10	38° 46.57' N	002° 47.51' E	501.57	2018		
PS_049	May 09 2018 20:01:24	38° 51.91' N	002° 47.50' E	500.08	1226		Chl a: 500, 125, 53, 25, 5 Sal: 500, 125
PS_050	May 09 2018 21:30:03	38° 51.93' N	002° 40.55' E	500.57	746		
PS_051	May 09 2018 23:07:54	38° 46.63' N	002° 40.68' E	501.10	1047		
PS_052	May 10 2018 00:39:48	38° 41.22' N	002° 40.73' E	1000.45	1883	Nuts: 1000, 500, 200, 100, 70, 50, 25, 5 HPLC: 70, 5 Phyto: 70	Oxygen: 1000, 200, 25 Chl a: 500, 125, 50, 25, 5 Sal: 1000, 25
PS_053	May 10 2018 02:48:06	38° 35.76' N	002° 40.68' E	500.09	2287	Nuts: 500, 200, 125, 100, 75, 65, 25, 5 HPLC: 65, 5 Phyto: 65	
PS_054	May 10 2018 04:29:52	38° 30.36' N	002° 40.63' E	500.59	2273	Nuts: 500, 200, 125, 100, 70, 50, 25, 5 HPLC: 70, 5 Phyto: 70	

PS_055	May 10 2018 05:57:27	38° 24.94' N	002° 40.63' E	1003.43	2323	Nuts: 1000, 500, 200, 125, 100, 75, 60, 25, 5 HPLC: 60, 5 Phyto: 60	Chl a: 500, 125, 60, 25, 5 Sal: 1000, 25
PS_056	May 10 2018 07:50:42	38° 19.51' N	002° 40.65' E	515.46	2343		
PS_057	May 10 2018 09:15:13	38° 19.43' N	002° 33.66' E	501.58	2343		
PS_058	May 10 2018 10:42:22	38° 24.97' N	002° 33.81' E	1000.95	2336		
PS_059	May 10 2018 12:28:54	38° 30.35' N	002° 33.62' E	501.64	2038		Sal: 500
PS_060	May 10 2018 13:48:57	38° 35.73' N	002° 33.70' E	501.09	1344		
PS_061	May 10 2018 15:19:32	38° 41.17' N	002° 33.72' E	501.60	913		Sal: 500
PS_062	May 10 2018 16:39:14	38° 46.57' N	002° 33.73' E	501.56	721		
PS_063	May 10 2018 18:13:31	38° 52.02' N	002° 33.65' E	507.01	743		Sal: 47

Leg-2

Station	Date Time (UTC)	Latitude	Longitude	CTD depth (m)	Bottom depth (m)	Sampling Depth of samples (m)	
						Bio.	Cal.
PS2_040	May 13 2018 18:04:25	38° 53.65' N	002° 41.03' E	501.07	650		
PS2_039	May 13 2018 19:26:30	38° 48.52' N	002° 39.52' E	502.57	961		Sal: 400, 220
PS2_038	May 13 2018 21:03:10	38° 43.29' N	002° 37.91' E	501.11	1151		

PS2_037	May 13 2018 22:27:51	38° 37.98' N	002° 36.15' E	526.85	1445		
PS2_036	May 13 2018 23:52:12	38° 32.82' N	002° 34.40' E	501.11	2235		Sal: 500, 250
PS2_035	May 14 2018 01:10:18	38° 27.52' N	002° 32.70' E	501.61	2408		
PS2_034	May 14 2018 02:29:32	38° 22.30' N	002° 30.98' E	501.62	2672		
CTD_cal	May 14 2018 06:51:55	38° 31.71' N	002° 15.86' E	501.12	1181		
PS2_033	May 14 2018 09:52:55	38° 16.96' N	002° 29.43' E	501.13	2674		Sal: 400, 240
PS2_032	May 14 2018 11:43:52	38° 11.82' N	002° 27.65' E	501.60	2674		
PS2_031	May 14 2018 13:04:44	38° 06.57' N	002° 26.02' E	501.11	2692		
PS2_030	May 14 2018 14:26:32	38° 05.20' N	002° 32.73' E	501.11	2697	Nuts: 500, 200, 100, 75, 53, 25, 5 HPLC: 500, 53, 5 Phyto: 53	
PS2_029	May 14 2018 16:05:00	38° 10.72' N	002° 34.58' E	501.62	2685	Nuts: 500, 200, 125, 100, 75, 55, 25, 5 HPLC: 55, 5 Phyto: 55	
PS2_028	May 14 2018 17:38:25	38° 15.81' N	002° 36.10' E	501.62	2672	Nuts: 500, 200, 125, 100, 75, 50, 25, 5 HPLC: 50, 5 Phyto: 50	Oxygen: 500, 200, 25 Chl a: 500, 125, 50, 25, 5 Sal: 500, 200

PS2_027	May 14 2018 19:10:27	38° 21.07' N	002° 37.73' E	500.62	2648	Nuts: 500, 200, 125, 100, 53, 25, 5 HPLC: 53, 5 Phyto: 53	
PS2_026	May 14 2018 20:46:14	38° 26.14' N	002° 39.39' E	500.20	2637	Nuts: 500, 200, 125, 100, 71, 50, 25, 5 HPLC: 71, 5 Phyto: 71	
PS2_025	May 14 2018 22:29:40	38° 31.42' N	002° 41.08' E	502.11	2630	Nuts: 500, 200, 125, 100, 83, 50, 25, 5 HPLC: 83, 5 Phyto: 83	Oxygen: 500, 200, 25 Chl a: 500, 125, 83, 25, 5 Sal: 200, 25
PS2_024	May 15 2018 00:04:34	38° 36.68' N	002° 42.67' E	500.10	2650	Nuts: 500, 200, 125, 100, 75, 65, 25, 5 HPLC: 65, 5 Phyto: 65	
PS2_023	May 15 2018 01:38:34	38° 41.91' N	002° 44.25' E	501.08	2487	Nuts: 500, 200, 125, 100, 70, 50, 25, 5 HPLC: 70, 5 Phyto: 70	
PS2_022	May 15 2018 03:18:30	38° 47.21' N	002° 46.07' E	501.07	1858	Nuts: 500, 200, 125, 100, 75, 50, 25, 5 HPLC: 50, 5 Phyto: 50	Oxygen: 500, 200, 25 Chl a: 500, 125, 50, 25, 5 Sal: 500, 25
PS2_021	May 15 2018 05:01:26	38° 52.42' N	002° 47.66' E	501.07	1016	Nuts: 500, 200, 100, 70, 50, 25, 5 HPLC: 70, 5 Phyto: 70	
PS2_020	May 15 2018 06:52:58	38° 51.13' N	002° 54.33' E	500.56	2265	Nuts: 500, 200, 125, 100, 75, 63, 25, 5 HPLC: 63, 5 Phyto: 63	

PS2_019	May 15 2018 08:29:14	38° 45.90' N	002° 52.69' E	501.08	2005	Nuts: 500, 200, 125, 100, 75, 60, 25, 5 HPLC: 60, 5 Phyto: 60	Oxygen: 500, 200, 25 Chl a: 500, 125, 60, 5 Sal: 500, 15
PS2_018	May 15 2018 10:09:21	38° 40.65' N	002° 51.15' E	501.58	2600	Nuts: 500, 200, 125, 100, 75, 63, 25, 5 HPLC: 63, 5 Phyto: 63	
PS2_017	May 15 2018 11:41:28	38° 35.38' N	002° 49.50' E	501.04	2611	Nuts: 500, 200, 125, 75, 62, 25, 5 HPLC: 62, 5 Phyto: 62	
PS2_016	May 15 2018 13:08:24	38° 30.19' N	002° 47.82' E	501.10	2622	Nuts: 500, 200, 125, 100, 70, 50, 5 HPLC: 70 Phyto: 70	Oxygen: 500, 200 Chl a: 500, 125, 70, 5 Sal: 500, 15
PS2_glider _calibratio n	May 15 2018 15:07:11	38° 27.55' N	002° 47.95' E	656.99	2629		Chl a: 650, 500, 300, 200, 100, 75, 50, 40, 30, 20, 10, 5
PS2_015	May 15 2018 16:43:07	38° 24.91' N	002° 46.06' E	500.59	2646	Nuts: 500, 200, 125, 100, 70, 50, 25, 5 HPLC: 50, 5 Phyto: 50	
PS2_014	May 15 2018 18:23:06	38° 19.67' N	002° 44.43' E	500.61	2652	Nuts: 500, 200, 125, 100, 75, 65, 25, 5 HPLC: 65, 5 Phyto: 65	
PS2_013	May 15 2018 19:53:22	38° 14.43' N	002° 42.80' E	501.12	2694	Nuts: 500, 200, 125, 100, 75, 50, 25, 5 HPLC: 50, 5 Phyto: 50	Oxygen: 500, 200, 25 Chl a: 500, 125, 50, 25, 5 Sal: 500, 50

PS2_012	May 15 2018 21:29:02	38° 09.20' N	002° 40.80' E	500.11	2703	Nuts: 500, 200, 125, 100, 75, 45, 25, 5 HPLC: 45, 5 Phyto: 45	
PS2_011	May 15 2018 23:05:10	38° 03.98' N	002° 39.38' E	502.50	2730	Nuts: 500, 200, 125, 100, 75, 59, 25, 5 HPLC: 59, 5 Phyto: 59	
PS2_010	May 16 2018 00:41:08	38° 02.57' N	002° 46.03' E	501.11	2730	Nuts: 500, 200, 125, 100, 75, 51, 25, 5 HPLC: 51, 5 Phyto: 51	
PS2_009	May 16 2018 02:06:48	38° 07.84' N	002° 47.51' E	500.61	2717	Nuts: 500, 200, 125, 100, 75, 64, 25, 5 HPLC: 64, 5 Phyto: 64	
PS2_008	May 16 2018 03:59:22	38° 13.20' N	002° 49.37' E	500.61	2714	Nuts: 500, 200, 125, 100, 75, 66, 25, 5 HPLC: 66, 5 Phyto: 66	Oxygen: 500, 200, 25 Chl a: 500, 125, 66, 25, 5 Sal: 500, 5
PS2_007	May 16 2018 05:48:15	38° 18.49' N	002° 51.04' E	515.46	2676	Nuts: 500, 200, 125, 100, 75, 63, 25, 5 HPLC: 63, 5 Phyto: 63	Sal: 500
PS2_006	May 16 2018 07:35:52	38° 23.65' N	002° 52.74' E	501.64	2660	Nuts: 500, 200, 125, 100, 79, 50, 25, 5 HPLC: 50, 5 Phyto: 50	
PS2_005	May 16 2018 09:08:34	38° 28.91' N	002° 54.39' E	501.09	2614	Nuts: 500, 200, 125, 100, 75, 68, 25, 5 HPLC: 68, 5 Phyto: 68	Oxygen: 500, 200, 25 Chl a: 500, 125, 68, 25, 5 Sal: 500, 200

PS2_004	May 16 2018 10:46:19	38° 34.11' N	002° 56.02' E	501.15	2573	Nuts: 500, 200, 125, 100, 70, 50, 25, 5 HPLC: 70, 5 Phyto: 70	
PS2_003	May 16 2018 12:18:26	38° 39.36' N	002° 57.69' E	500.10	2540	Nuts: 500, 200, 125, 100, 70, 52, 25, 5 HPLC: 52, 5 Phyto: 52	
PS2_002	May 16 2018 13:47:37	38° 44.49' N	002° 59.41' E	500.57	2498	Nuts: 500, 200, 125, 100, 75, 56, 25, 5 HPLC: 56, 5 Phyto: 56	Chl a: 500, 125, 56, 25, 5 Sal: 500
PS2_001	May 16 2018 15:24:19	38° 49.80' N	003° 01.08' E	501.57	2394	Nuts: 500, 200, 125, 100, 75, 50, 5 HPLC: 50, 5 Phyto: 50	