

## TNA PROJECT REPORT

### 1. Project Information

<b>Proposal reference number</b>	JN-CALL 2_4
<b>Project Acronym (ID)</b>	ABACUS-4
<b>Title of the project</b>	Fourth Algerian BASin Circulation Unmanned Survey
<b>Host Research Infrastructure</b>	SOCIB Glider Facility (SOCIB-GF)
<b>Starting date - End date</b>	<b>Total project duration:</b> November 15 2017 – July 15 2017  <b>Glider activities at sea:</b> ABACUS 4 LEG 1 15/Nov/2017 - 13/Dec/2017 ABACUS 4 LEG 2 15/May/2018 – 07/Jun/2018
<b>Name of Principal Investigator</b> <b>Home Laboratory</b> <b>Address</b> <b>E-mail address</b>	Yuri Cotroneo Università degli Studi di Napoli “Parthenope” Centro Direzionale Isola C4 – Napoli, Italy yuri.cotroneo@uniparthenope.it

### 2. Project objectives

ABACUS 4 focuses on the characteristics of the Algerian Basin (AB) circulation. The AB is dominated by the presence of energetic mesoscale structures that usually cannot be monitored by standard resolution surveys. Through its activities, ABACUS 4 project contributes to the collection of high resolution data in this area.

The main objectives ABACUS 4 are:

- To continue the time series of oceanographic data collected in the AB along the endurance line between Mallorca and Algeri during the previous ABACUS missions.
- To identify the physical and biological properties of the surface and intermediate water masses between Balearic Islands and Algerian coasts;
- To collect data across mesoscale structure eventually crossed;
- To understand sub-basin dynamics;
- To assess the ocean description capabilities of several satellite products when approaching coastal areas, also comparing them to glider in situ data;
- To validate the new along-track (L3) and gridded interpolated maps (L4) altimetry products provided by the Sentinel-3 altimetry mission and other satellites in the western Mediterranean Sea.

ABACUS 4 has realized two glider missions in the study area during autumn 2017 and spring 2018.

The autumn leg (ABACUS 4.1) realized in November/December 2017 allowed us to extend the dataset previously collected in the area in 2014, 2015 and 2016.

The spring leg (ABACUS 4.2) realized in May/June 2018 is the first dataset collected during a different





season in the framework of ABACUS and was associated to the PRE –SWOT survey of the northern part of the Algerian Basin through high-resolution multi-platform multidisciplinary synoptic experiment.

### 3. Main achievements and difficulties encountered

Data collected during the ABACUS 4 mission allowed:

- A real time monitoring of the main physical and biochemical properties of the water column during two different seasons;
- The extension of the glider high resolution dataset in the Algerian Basin;
- New ideas and data for the research activities connected to mesoscale eddy and sub-mesoscale processes.

From a technical perspective, the glider:

- spent 29 days in water for ABACUS 4.1 realizing 2 Mallorca – Algeri complete transect
- spent 24 days in water for ABACUS 4.2 leg 1 realizing 2 Mallorca – Algeri complete transect
- collected about 500 complete profiles along the 4 planned transect;
- was overflown twice by SENTINEL-3 satellite;
- navigated four times the SENTINEL-3 target groundtrack.

Problems encountered during the ABACUS 3 mission due to glider over-buffering were solved and no gap is present in the acquired data.

The ABACUS team faced the following difficulties:

- Scheduling work to guarantee satellite overflights;
- Need to reduce time at surface to avoid collisions;
- Need to break to surface every second cast, in order to sample the very surface layer was not possible due to safety reason. Then a turning depth in the first ten meters was adopted;
- Anomalous negative chlorophyll concentration values collected during the ABACUS 4.2 leg were discarded during the QC procedures so limiting chlorophyll observations at about 150 meters depth.

### 4. Dissemination of the results

1) Data collected during ABACUS 4 can be downloaded through the SOCIB DAPP.

ABACUS 4.1:

[http://thredds.socib.es/thredds/catalog/auv/glider/sdeep04-scb\\_sldeep004/L2/2017/catalog.html?dataset=auv/glider/sdeep04-scb\\_sldeep004/L2/2017/dep0010\\_sdeep04\\_scb-sldeep004\\_L2\\_2017-11-15\\_data\\_dt.nc](http://thredds.socib.es/thredds/catalog/auv/glider/sdeep04-scb_sldeep004/L2/2017/catalog.html?dataset=auv/glider/sdeep04-scb_sldeep004/L2/2017/dep0010_sdeep04_scb-sldeep004_L2_2017-11-15_data_dt.nc)

ABACUS 4.2:

[http://thredds.socib.es/thredds/catalog/auv/glider/sdeep00-scb\\_sldeep000/L2/2018/catalog.html?dataset=auv/glider/sdeep00-scb\\_sldeep000/L2/2018/dep0024\\_sdeep00\\_scb-sldeep000\\_L2\\_2018-05-15\\_data\\_dt.nc](http://thredds.socib.es/thredds/catalog/auv/glider/sdeep00-scb_sldeep000/L2/2018/catalog.html?dataset=auv/glider/sdeep00-scb_sldeep000/L2/2018/dep0024_sdeep00_scb-sldeep000_L2_2018-05-15_data_dt.nc)

2) Data collected during ABACUS, ABACUS 2 and ABACUS 3 can be downloaded from the webpage <http://apps.socib.es/data-catalog/#/data-products/abacus>.



A DOI was assigned to this dataset to cite as "Budillon, Giorgio; Cotroneo, Yuri; Aulicino, Giuseppe; Fusco, Giannetta; Heslop, Emma; Torner Tomas, Marc; Tintoré, Joaquin (2016). SOCIB TNA Algerian Basin Circulation Unmanned Survey - ABACUS (2014-2016) - DATASET. <https://doi.org/10.25704/b200-3vf5>".

- 3) The results achieved during this and the previous ABACUS glider missions have been presented at international conferences as the METROLOGY FOR THE SEA Conference (Naples, October 2017) and the EGU General Assembly 2018.

More recently a contribution has been submitted to ESA Ocean Salinity Science Conference to be held in Paris, November 2018.

October 2017

“IMEKO TC19 workshop on the Metrology for the Sea”

“Algerian Basin Circulation Unmanned Survey – ABACUS: glider missions to monitor Mediterranean water characteristics and relevant mesoscale features during fall 2014-2016”

Y. Cotroneo, G. Aulicino, S. Ruíz, A. Pascual, A. Sanchez Roman, G. Fusco, M. Torner, E. Heslop, J. Tintoré, G. Budillon.

April 2018

“EGU General Assembly 2018”

“Monitoring the Algerian Basin through glider observations, satellite altimetry and numerical simulations along a SARAL/AltiKa track”

Giuseppe Aulicino, Yuri Cotroneo, Simon Ruiz, Antonio Sanchez-Roman, Ananda Pascual, Giannetta Fusco, Joaquin Tintoré, and Giorgio Budillon

“EGU General Assembly 2018”

“Algerian Basin Circulation Unmanned Survey –ABACUS: High resolution repeated glider missions to monitor Mediterranean water characteristics from basin- to mesoscale”

Yuri Cotroneo, Giuseppe Aulicino, Simon Ruiz, Ananda Pascual, Antonio Sánchez Román, Giannetta Fusco, Marc Torner, Emma Heslop, Giorgio Budillon, and Joaquin Tintoré

- 4) Last results have been submitted to appropriate, internationally recognized and peer reviewed journals.

“Monitoring of the Algerian Basin through glider observations, satellite altimetry and numerical simulations along a SARAL/AltiKa track”. Giuseppe Aulicino, Yuri Cotroneo, Simón Ruíz, Ananda Pascual, Antonio Sanchez Roman, Giannetta Fusco, Joaquín Tintoré, Giorgio Budillon.

Journal of Marine Systems Volume 179, pages 55-71. [doi.org/10.1016/j.jmarsys.2017.11.006](https://doi.org/10.1016/j.jmarsys.2017.11.006)

- 5) We realized seminars for graduate and post-graduate students, at Università degli studi di Napoli “Parthenope” and Università Politecnica delle Marche.

- 6) A Master degree thesis project was realized and discussed in “Advanced Physics and Applied Mathematics at the UNIVERSITAT DE LES ILLES BALEARS on the “Mesoscale oceanic convergence and divergence: Quasi-geostrophic theory, analytical modelling and observations” by Daniel Rodríguez Tarry on the basis of ABACUS data and analysis

## 5. Technical and Scientific preliminary Outcomes

Through its activities, ABACUS-4 project contributed to data collection in the Southern European Seas, one of the main EU maritime policy objectives, as outlined in the Marine Strategy Framework Directive (MSFD). In particular, the high resolution of glider data and the efforts to get simultaneous satellite altimetry data along the same groundtrack, allowed us to observe and describe the oceanographic characteristics of the area at several time and spatial scales.

ABACUS 4 has realized a glider mission in the Algerian Basin splitted into 2 legs during autumn 2017 and spring 2018 sampling the water column up to 1000 m depth with the spatial resolution of about 2 Km.

The autumn leg (ABACUS 4.1) realized in November/December 2017 and extend the dataset previously collected in the area in autumns 2014, 2015 and 2016.

The spring leg (ABACUS 4.2) realized in May/June 2018 is the first dataset collected during spring in the framework of ABACUS and constitutes the starting point for the observation of the seasonal variability in the area.

Additionally, this leg is part of the PRE SWOT activities including a multiplatform survey of the area and calibration of glider CTD with the onboard rosette of the SOCIB research vessel.

Figures 1 shows the map and the Theta/S diagram of the entire ABACUS 4 mission.

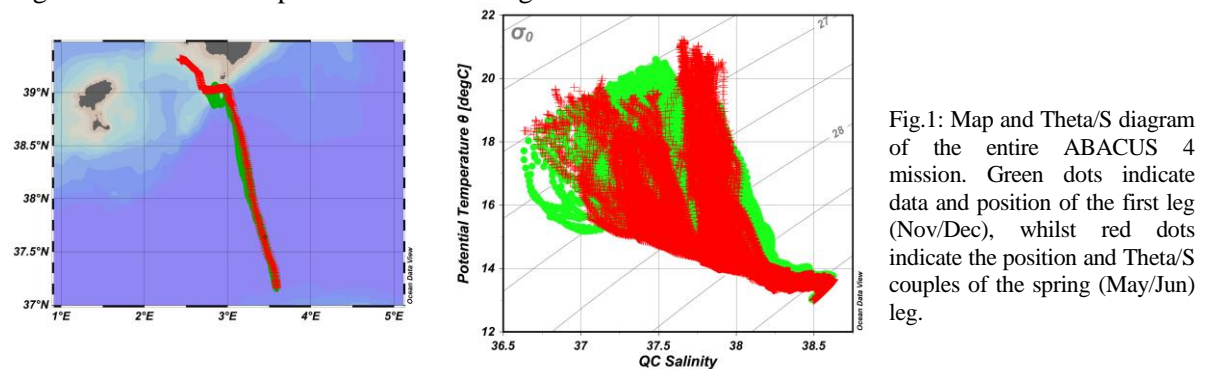


Fig.1: Map and Theta/S diagram of the entire ABACUS 4 mission. Green dots indicate data and position of the first leg (Nov/Dec), whilst red dots indicate the position and Theta/S couples of the spring (May/Jun) leg.

ABACUS 4 observations have been quality controlled and analysed following the procedures developed during the previous ABACUS projects. Main steps follow:

- 1) After the mission, data were transferred from the internal glider memory to the SOCIB Data Center where pre-processing, quality control and validation were carried out and production of level 1 and level 2 data occurred;
- 2) A second quality control process was applied in order to identify any persistent spike in the data and reduce the possible noise of the signal;
- 3) A final visual check was performed on the single profiles and on the  $\theta/S$  diagram.

The quality controlled dataset was then used to realize a preliminary analysis focused on the identification of water masses and on their location along depth and latitude. Along the ABACUS 4 transects, the main Mediterranean water masses were identified and several mesoscale and sub-mesoscale processes like eddies and filaments were observed.

As an example, figures 2 and 3 show the vertical sections for the first 350 m depth of potential temperature, salinity, chlorophyll-a and oxygen concentration between Mallorca and the Algerian coasts from 25<sup>th</sup> May to 3<sup>rd</sup> June 2018, one of the four transects realized during the mission.

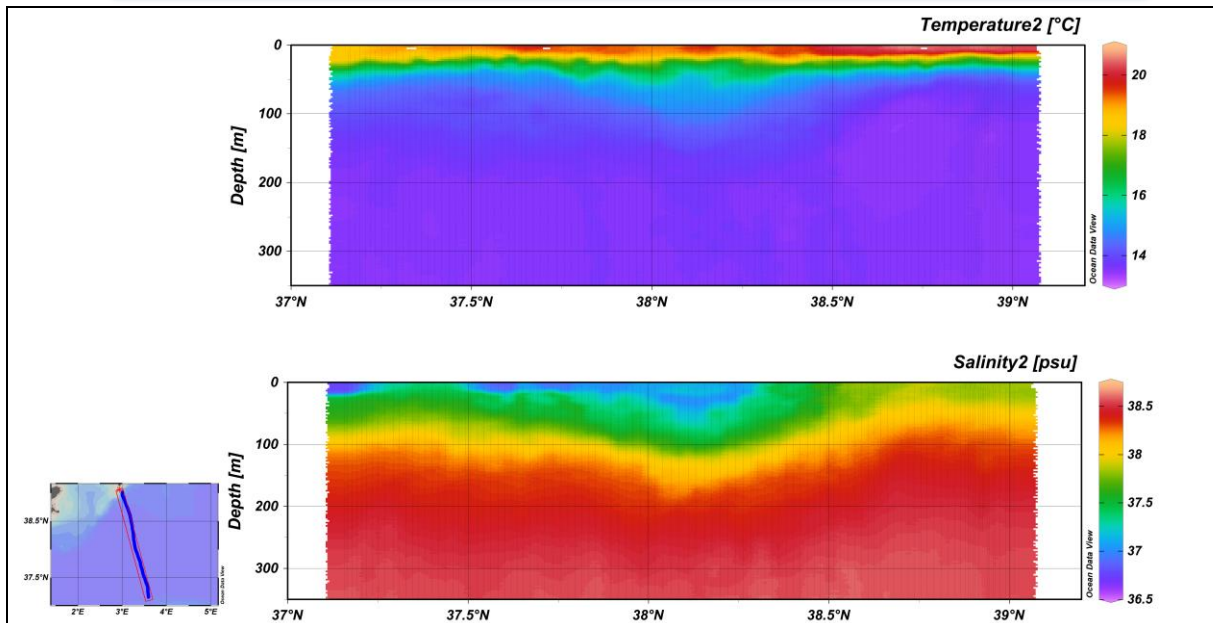


Fig. 2: Vertical sections of Potential Temperature and Salinity between Mallorca and the Algerian coasts during ABACUS 4.2 second transect.

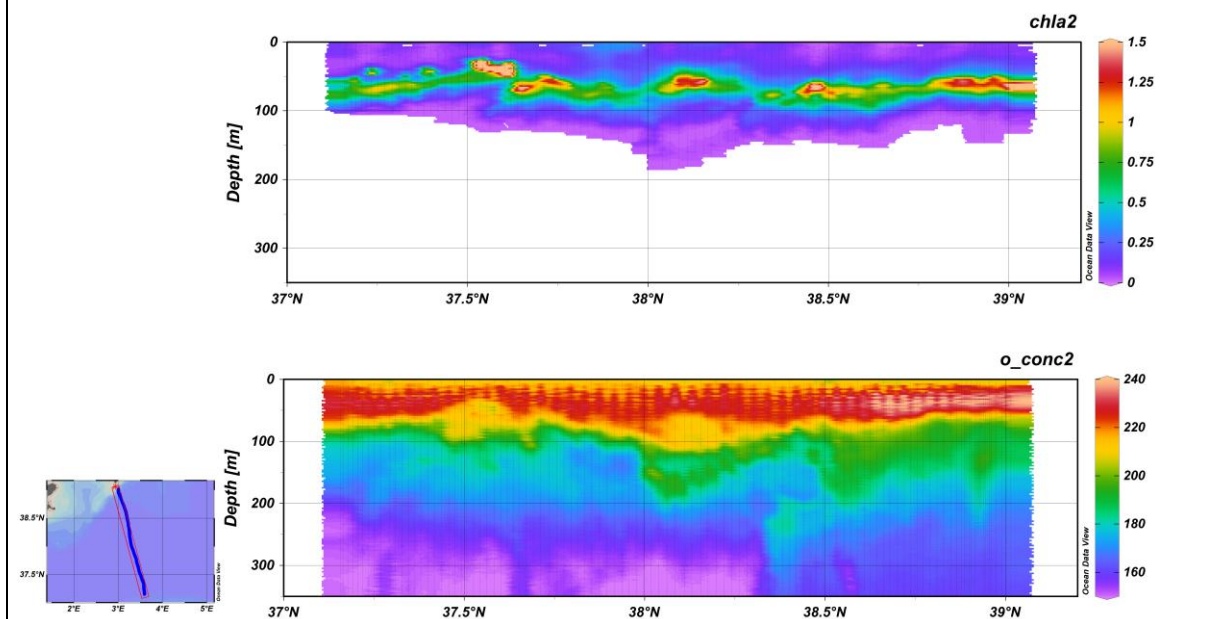


Fig. 3: Vertical sections of Chlorophyll and Oxygen concentration between Mallorca and the Algerian coasts during ABACUS 4.2 second transect.

From a first analysis of the data the following preliminary observations can be done:

- Levantine Intermediate Water – LIW is observed at expected depth along the transects;
- The glider only reached the northern edge of the Algerian current – AC
- A mesoscale anticyclonic eddy is evident in ABACUS 4.2 at about 38.2°N
- The subsuction of Oxygen is evident in the northern part of the observed eddy
- A submesoscale structures, possibly an AC filament, is evident in the southern part of the ABACUS 4.2 transect.



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SUBMITTED, 26 JULY 2018