Author's Response to the comments on "The AlborEX dataset: sampling of submesoscale features in the Alboran Sea"

C. Troupin et al.

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Contents

1 General response

Dear Editor,

please find our new manuscript on "*The AlborEX dataset: sampling of submesoscale features in the Alboran Sea*".

The manuscript has been entirely revisited, based on the comments by the three reviewers.

1.1 New co-authors

We wish to add the following co-authors for their contributions:

- Antonio Tovar-Sánchez, Instituto de Ciencias Marinas de Andalucía, (ICMAN – CSIC), Puerto Real, Spain and
- Eva Alou, SOCIB,

who were responsible for the acquisition and processing of these data during and after the cruise, and

- Inmaculada Ruiz, SOCIB

for her contribution to the Quality Control of the data.

1.2 Main changes

The main modifications can be listed as follows:

1. General improvement of the structure: the structure of the manuscript has been modified and the order of some of the sections modified. For example the quality control, quality flags and the processing levels are defined before in the manuscript (now in Section 2).
2. The Quality Control, which was mentioned as a weakness, has been rewritten: first there is a new section describing the general procedure (not depending on the platform), then for each platform, the specificities of the QC are listed. In addition, the complete, technical document listing all the checks applied to the data for each type of sensor, is added as a new reference.
3. The configuration of the instruments, which was missing in the original manuscript. Similarly to the QC, a new subsection "*Configuration*" is added for each type of sensor.

These changes made the new manuscript more self-consistent.

Files missing in the initial submission have now been added (Level 1 for the ARVOR-C float, Level 1 corrected for the CTD, biochemical data).

1.3 Data distribution

Another significant improvement is related to the data distribution: instead of single files available through the Zenodo platform, the whole dataset is now available in the SOCIB data catalog: doi:10.25704/z5y2-qpye. The user experience is greatly enhanced as the landing page in the catalog directly provides an overview of the available data (platform by platform) and lists the different data sources along with plotting, subsetting and downloading tools and services.

The rest of the present document provides:

- the point-by-point response to the three reviews,
- the list of all relevant changes made in the manuscript, and
- a marked-up manuscript version obtained using the `latexdiff` tool.

Figure 1: AlborEx dataset in the SOCIB data catalog

2 Reply to Referee #1

We wish to thank the Reviewer for their constructive comments that really underline the aspects of the paper that needed to be further developed.

This article (categorized as "review") by Troupin et al. is addressing a multidisciplinary data set collected in the western Mediterranean Sea during the AlborEX campaign. During the campaign in-situ observing devices (ships, floats, gliders, drifters...) have been used (described here) but also satellite data. In the manuscript some aspects of the data set are described. As it stands now I do not recommend publication in ESSD. For the review I followed the ESSD evaluation criteria and also considered the general scope of the journal (as described on the website).

First - Is this a "review" article? ESSD defines review articles as: "...may compare methods or relative merits of data sets, the fitness of individual methods or data sets for specific purposes, or how combinations might be used as more complex methods or reference data collections." As I read it from the manuscript this is not the case. The current version of the manuscript reads more as a copy of data information from individual reports and the data section in scientific publications related to the experiment. As it stands, I do not see the criteria for a "review" type article fulfilled.

We acknowledge the reviewer's comment concerning the nature of the article. We made a mistake during the submission process. Referring to the ESSD web page, we read that "Articles in the data section may pertain to the planning, instrumentation, and execution of experiments or collection of data.", and this is indeed the objective we had when submitting the manuscript. However in the Submission page, the "Manuscript Type" did not offer the possibility to select it, hence we took another one which seemed the closest. We have contacted the editorial office concerning this and the manuscript type was changed on September 18, 2018.

Significance

Three sub-criteria to evaluate:

• Uniqueness: It should not be possible to replicate the experiment or observation on a routine basis. Thus, any data set on a variable supposed or suspected to reflect changes in the Earth system deserves to be considered unique. This is also the case for cost-intensive data sets which will not be replicated due to financial reasons. A new or improved method should not be trivial or obvious. The data set is unique. (rating: 1 Excellent)

Thank you for the appreciation

• Usefulness: It should be plausible that the data, alone or in combination with other data sets, can be used in future interpretations, for the comparison to model output or to verify other experiments or observations. Other possible uses mentioned by the authors will be considered.

The current manuscript does not provide information that promote the reuse of the data set (it may for subsets). No attempt is made to provide a structured overview about the workflow that is linked to the creation of the data set and, equally important, the QA/QC are not provided in a transparent way. For example, in the netcdf data files I see different QC flags provided – one is for example "SOCIB Quality control Data Protocol". What does that mean? This is not an international standard. A data set description, as envisioned in this ESSD submission, should exactly describe such non-standard QC procedures. Which QA and

QC methods were applied (give brief description, DOIs if applicable)?

We agree with the reviewer and to address these issues:

- A new section dedicated to data reuse has been be added (see below) and
- the section "*3.3.2 Quality control*" has been expanded and made more explicit.

Added text:

2.1 Data Reuse

Three main types of data reuse are foreseen: 1. model validation, 2. data assimilation (DA) and 3. planning of similar in situ experiments.
With the increase of spatial resolution in operational models, the validation at the smaller scales requires high-resolution observations. Remote-sensing measurements such as SST or chlorophyll-a concentration provides a valuable source of information but are limited to the surface layer. In the case of the present experiment, the position, intensity (gradients) and vertical structure of the front represent challenging features for numerical models, even when data assimilation is applied (Hernandez-Lasheras and Mourre, 2018)).
The AlborEx dataset can be used for DA experiments, for example assimilating the CTD measurements in the model and using the glider measurements as an independent observation dataset. The assimilation of glider observations has already been performed in different regions (e.g. Melet et al., 2012; Mourre and Chiggiato, 2014; Pan et al., 2014) and has been shown to improve the forecast skills. However the assimilation of high-resolution data is not trivial: the the background error covariances tends to smooth the small scale features present in the observations.
Finally, other observing and modeling programs in the Mediterranean Sea can also benefit from the present dataset, for instance the Coherent Lagrangian Pathways from the Surface Ocean to Interior (CALYPSO) in the Southwest Mediterranean Sea (Johnston et al., 2018). Similarly to AlborEx, CALYPSO strives to study a strong ocean front front and the vertical exchanges taking place in the area of interest (see `https://www.onr.navy.mil/Science-Technology/Departments/Code-32/All-Programs/Atmosphere-Research-322/Physical-Oceanography/CALYPSO-DRI` for details).

We also complement the introduction with references to other studies using multi-platform approaches in the same area.

Added text:

Similar studies comparing almost synchronous glider and SARAL/AltiKa altimetric data on selected tracks have also been carried between the Balearic Islands and the Algerian coasts (Aulicino et al., 2018; Cotroneo et al., 2016).

I also miss any information how/if this data is disseminated via international data centres and how the data QC and dissemination is coordinate with the respective observing networks (Argo, DBCP, . . .). Seadatanet is been mentioned in the text but it is unclear which specific recommendations are given.

(rating: 4 poor)

All the data presented in this paper are open data and can be accessed through the SOCIB Data Center in a few clicks, without any registration. Moreover, the data API (`http://api.`

socib.es) strongly improves the data access to users and the dissemination to national or international data centers, which can easily establish a data transfer if they want to include SOCIB data into their portal.

As of today, many international databases exist and frequently, new ones are created with new projects, making the data landscape complex and the making it tedious to extensively document the data flow between SOCIB data and those databases. For instance:

- all the drifters data are transmitted to the Mediterranean Surface Velocity Programme (MedSVP, http://doga.ogs.trieste.it/sire/medsvp/);
- Most of the data are transmitted to the Mediterranean Operational Network for the Global Ocean Observing System (MONGOOS, http://www.mongoos.eu/data-center);
- MONGOOS sends the data to the In Situ Thematic Assembly Center (INSTAC) of the Copernicus Marine Environment Monitoring Service (CMEMS, http://www.marineinsitu.eu);
- The PROVBIO float is available in OAO database (Villefranche-sur-mer, http://www.oao.obs-vlfr.fr/maps/en/
- The Argo floats and drifters data are transmitted to the CMEMS INSTAC.
- ...

Our approach to guarantee that the data are available to the widest community consists of

1. Having the data easily accessible in a standard format (netCDF) through standard protocols (HTTP, OPEnDAP, ...), and without any registration. This means that any user or entity can download all the files and include them in their portal or database.
2. Providing an efficient data API to make easier the data discovery: the role of the API is really to allow users to make request such as:
   - "provide me all the observations measured by the platform X (glider, drifter)" or
   - "provide me all the observations in the region located in the area Y during a given time period."

The explicit mention to SeaDataNet is made because of their Regional Data Products, which we believe are of crucial importance for the scientific community needing a complete set of historical, in situ data. The data transfer from SOCIB to SeaDataNet is foreseen in the future.

• Completeness: A data set or collection must not be split intentionally, for example, to increase the possible number of publications. It should contain all data that can be reviewed without unnecessary increase of workload and can be reused in another context by a reader.

It is difficult to evaluate this point. However, the nutrient data is not mentioned but is, according to Pascual et al. 2017 part of the AlborEX campaign. I would expect that these data set are described here as well (and respective QC (e.g. GO-SHIP nutrient manual??) and associated uncertainty estimates.

(rating: 2 to 3)

We agree with this suggestion and will add a specific section dedicated to the nutrient data. In relation to these data, we wish to add to the list of co-authors:

- Antonio Tovar-Sánchez, Instituto de Ciencias Marinas de Andalucía, (ICMAN – CSIC), Puerto Real, Spain and
- Eva Alou, SOCIB,

who were responsible for the acquisition and processing of these data during and after the cruise.

We have now included the dissolved inorganic nutrients measured during Alborex in the new file AlborexPerseus2014_LabSamplesNutrients_L1.nc, available at https://repository.socib.es:8643/repository/entry/show?entryid=07ebf505-bd27-4ae5-aa43-c4d1c85dd500. The files still has to be included to the general thredds directory of SOCIB.

This text was added to the new manuscript:

Added text:

Samples for nutrient analysis were collected in triplicate from CTD Niskin bottles and immediately frozen for subsequent analysis at the laboratory. Concentrations of dissolved nutrients (Nitrite: NO_2^-, Nitrate: NO_3^- and Phosphate: PO_4^{3-} were determined with an autoanalyzer (Alliance Futura) using colorimetric techniques (Grasshoff et al., 1983). The accuracy of the analysis was established using Coastal Seawater Reference Material for Nutrients (MOOS-1, NRCCNRC), resulting in recoveries of 97%, 95% and 100% for NO_2^-, NO_3^- and PO_4^{3-}, respectively. Detection limits were NO_2^-:0.005 μM, NO_3^-: 0.1 μM and PO_4^{3-}: 0.1 μM.

Data quality

The data must be presented readily and accessible for inspection and analysis to make the reviewer's task possible. Even if a data set submitted is the first ever published (on a parameter, in a region, etc.), its claimed accuracy, the instrumentation employed, and methods of processing should reflect the "state of the art" or "best practices". Considering all conditions and influences presented in the article, these claims and factors must be mutually consistent. The reviewer will then apply his or her expert knowledge and operational experience in the specific field to perform tests (e.g. statistical tests) and cast judgement on whether the claimed findings and its factors – individually and as a whole – are plausible and do not contain detectable faults.

I touched on that already under "Usefulness". In the manuscript no transparent QC assessment is presented. What were the methods of processing (provide key steps, DOI at least). What were, including quantification of uncertainties and qualification via flags, the results of the QA/QC procedures? Which were the major shortcomings of the data acquisition process and what could be done better in the future? For example, has the drifter data included in the European E–SurfMar data base and also in the DBCP global drifter data sets? Have the recommendations (Best Practices, Protocols) from E–SurfMar / DBCP considered? It looks like no commonly agreed standard has been used for some parameters – as "SOCIB Quality control Data Protocol" suggest? (rating: 3)

The QC procedure is described in the document

QUID_DCF_SOCIB-QC-procedures.pdf

SOCIB Quality Control Procedures
Data Center Facility

September 2018
DOI: doi:10.25704/q4zs-tspv

The procedure in based on the commonly agreed standards.

The article has been re-organised and for each type of platform, a description of the quality checks performed on the corresponding data has been added.

Which were the major shortcomings of the data acquisition process and what could be done better in the future?

Possibly the glider sampling strategy could be improve by increasing the relative frequency of surfacing, in order to have more information on the variables near the surface.

Presentation quality

Long articles are not expected. Regarding the style, the aim is to develop stereotypical wording so that unambiguous meaning can be expressed and understood without much effort. The article should express clearly what has been found, where, when, and how. The article text and references should contain all information necessary to evaluate all claims about the data set or collection, whether the claims are explicitly written down in the article, or implicit, through the data being published or their metadata. The authors should point to suitable software or services for simple visualization and analysis, keeping in mind that neither the reviewer nor the casual "reader" will install or pay for it.

mostly OK (given the limitation outlined in the previous points). It would be useful to include a brief introduction into the "design of the experiment. Visualisation tools are not given.
(rating: 2-3)

A section "*Design of the experiment has been added*" in Section 2, after the "*General oceanographic context*" References to existing visualisations tools have been provided in a new section "*4.3 Data reading and visualisation*". It is worth mentioning here that a set of Python functions are provided to read, process and visualise the content of type of file.

Added text:

2.2 Design of the experiment

The deployment of in situ systems was based on the remote-sensing observations described in the previous Section. Two high-resolution grids were sampled with the research vessel, covering an approximative region of 40 km $\times$ 40 km. At each station, one CTD cast and water samples for chlorophyll concentrations and nutrients analysis were collected. The thermosalinograph observations were also used in order to assess the front position.
One deep glider and one coastal glider were deployed in the same area with the idea to have butterfly-like track across the front. These idealised trajectories turned out to be impossible considering the strong currents occurring in the region of interest at the time of the mission. The 25 drifters were released close to the frontal area with the objective to detect convergence and divergence zones. Their release locations were separated by a few kilometers.

Also, when accessing the data through the catalog (doi:10.25704/z5y2-qpye), users have access to different viewers (depending on the type of data), in one click, as shown in the figure below.

The following paragraph has been added:

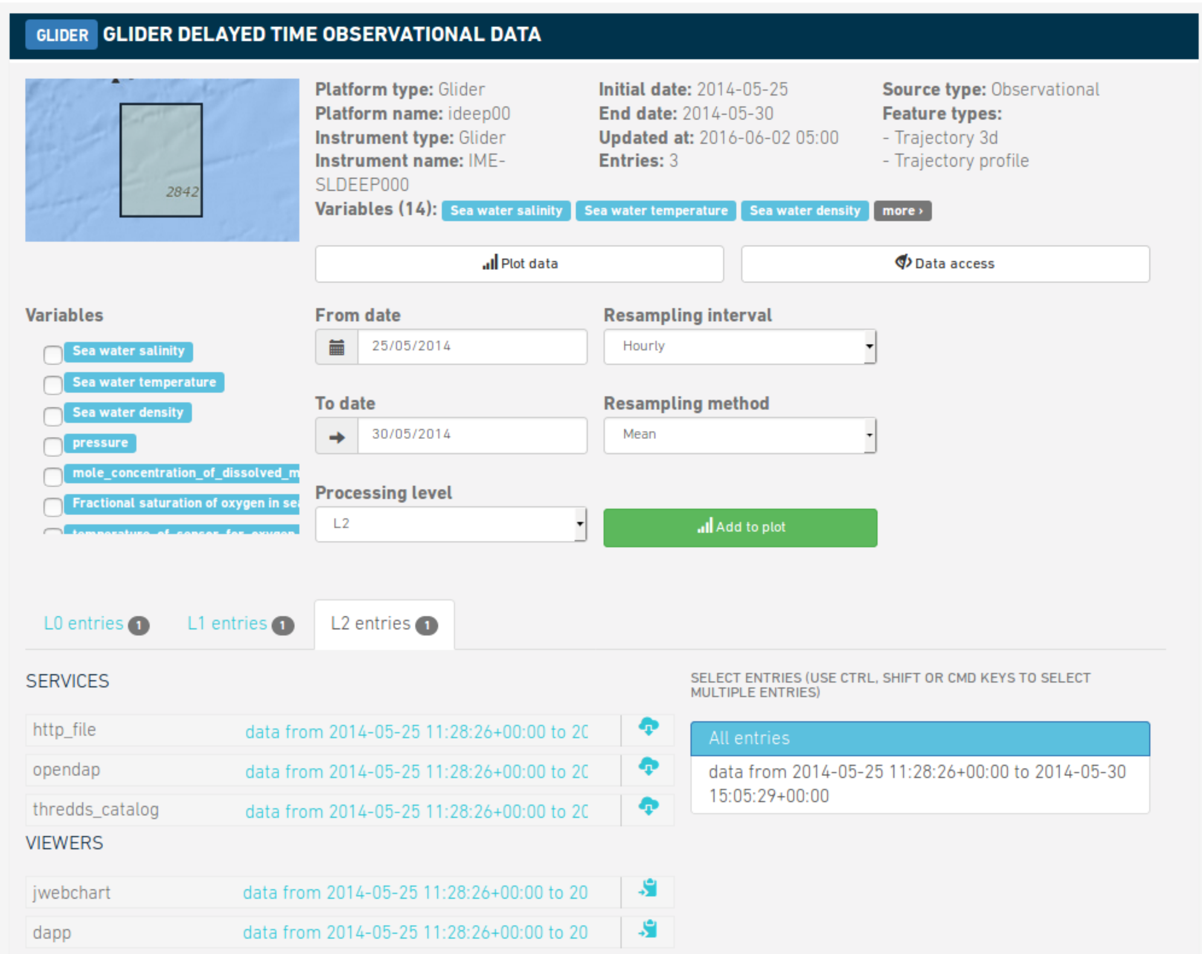


Figure 2: Access to the deep glider data: the in-house viewers are listed in the bottom left corner.

Added text:

When accessing the data catalog, users are provided a list of in-house visualisation tools designed to offer quick visualisation of the file content. The visualisation tools depend on the type of data: *JWebChart* is used for time series; *Dapp* displays the trajectory of a moving platform on a map; the *profile-viewer* allows the user to select locations on the map and view the corresponding profiles.

2.3 Specific comments

P2/l.4: I do not agree with the statement: "a perfect observational system would consist in dense array of sensors present at many geographical locations, many depths and measuring almost continuously a wide range of parameters..." – this "generalization" is trivial and useless. From an observing design point of view a "perfect" observing system must follow a design that will record only the observations that are needed to analyse the problem. As such the perfect observational system always depends on motivation for the experiment (or the problem in more general words) - in some cases a "perfect observing system" may comprise only one single sensor at one single depth at different locations if this has been found a sufficient approach for solving the problem (e.g. estimating global warming through a global tomography array). Please reformulate the statement along those lines.

We agree that this formulation was not adequate and rephrased this part following this comment, as follows:

Added text:

To properly capture and understand these small-scale features, one cannot settle for only observations of temperature and salinity profiles acquired at different times and positions, but rather has to combine the information from diverse sensors and platforms acquiring data at different scales and at the same time, similarly to the approach described in Delaney and Barga (2009). This also follows the recommendation for the Marine Observatory in Crise et al. (2018), especially the co-localization and synopticity of observations and the multi-platform, adaptive sampling strategy. We will refer to this as multi-platform systems, by opposition to experiments articulated only around the observations made using a research vessel. Further details can be found in Tintoré et al. (2013).

3 Reply to Referee #2

3.1 General comment

Please find below my review of the manuscript entitled "The AlborEX dataset: sampling of submesoscale features in the Alboran Sea" by Troupin et al. I think the data and the paper are relatively well presented. I especially enjoyed that all the files are netCDF format. While the data are limited to a very local application (a 6-day experiment from one sub-region of the Mediterranean Sea), the data are in high-quality and may be useful for process-related studies. Overall, the manuscript may be suitable for publication after moderate reviews. This decision is detailed below.

3.2 Major comments

My major concerns on the actual version of the paper are the following: 1. I think the text is not well organized. Some info on the data is find in Section 2 (AlborEX mission) and in Section 3.3 (Data Processing). This spreading of information makes the search for information through the paper difficult. I would bring Section 3.3. earlier in the paper and avoid to spread the information for each platform in different sections. Some specific comments below are related to this problem (e.g. mention of flags even before introducing them).

The Section 3.3. has been moved earlier in the text, in the Section 2, so that the reader is aware of the processing and Quality Control done of the data. The information is now provided in two subsections:

- "*2.4 Processing levels*", which has been extended and made clearer following other comments
- "*2.5 Quality control*", where the general procedure is made explicit.

2. The QC control is a weakness in this manuscript as it suggests that some QC is done, but it is not very clear on which data and how it is done. For some instruments, QC flags and their meaning are embedded in the files (e.g. float and drifters), but some doesn't (glider files). This inconsistency is not so much a problem to me as long as it is clearly stated in the paper which files contains QC flags. These quality flags should however be defined in the text. There are several mentions of "quality flags" in the text and figure caption, but little explanation is provided on these. Figure 12 has 9 quality flags that are not even described (although I see their meaning in drifters and float files). Where the QC is easy to reference (e.g. "file generated with Socib glider toolbox vX.X", or "File QC done using Socib standard procedure following a procedure described in a certain paper", etc.), it should be mention in the netCDF file as well.

To address these comments:

1. A new table stating the meaning of the quality flag has been created (Table 2).
2. A subsection "QC tests" has been inserted at the end of Section 2 to explain the general procedure for the quality control.
3. In Section 3, for each platform type, a description of the specificities of the QC has been appended.

Concerning the glider data: the toolbox referenced in the manuscript does not apply quality checks on the data in its current version. QC have been implemented but are still in testing phase. Once they are validated, the files will be reprocessed and made available.

More generally, a lot of efforts have been made to ensure that the provided data are of the highest quality, even if that was not reflected in the submitted manuscript. All the SOCIB quality checks are explicitly described in the following document:

and more tests are progressively developed in the current battery.

3. Why all processing level are not provided? The text suggests that all levels are provided (e.g. Table 3), but at the moment mostly L1 is provided. For gliders, L1 and L2 are provided. For the Float, L1 is provided for Arvor-A3 and Provor-Bio, but L0 for Arvor-C. Why? No explanation for this is provided (I think float data should be provided in L1 and L2 level as well). If some QC is applied on L1, maybe L0 should be provided as well to the future user? For glider L2 data, a choice is made regarding the vertical binning of the profiles. Which size these vertical bins are? This information should be provided somewhere.

Following the definitions adopted at the SOCIB data center, Level 2 only exists for glider measurements: it means that we go from 3-dimensional trajectories to a time series of profiles (the observations are spatially interpolated. The description of the processing levels has been edited and clarified in the new manuscript.

Missing L1 for Arvor-C: this comes from an oversight: the file has been made available in the new version of the dataset. The link to the thredds catalog is: `http://thredds.socib.es/thredds/catalog/drifter/profiler_drifter/profiler_drifter_arvorc001-ime_arvorc001/L1/2014/catalog.html?dataset=drifter/profiler_drifter/profiler_drifter_arvorc001-ime_arvorc001/L1/2014/dep0001_profiler-drifter-arvorc001_ime-arvorc001_L1_2014-05-25.nc`

For the glider data gridding (from L1 to L2): the referee is correct, this has to be explained in the manuscript.

The gridding is performed by the function `gridGliderData` (`https://github.com/socib/glider_toolbox/blob/master/m/processing_tools/gridGliderData.m`), designed to get the glider trajectory data over instantaneous homogeneous regular profiles. By default, the vertical resolution (or step) is set to 1 meter in the present version of the processing, though it can be adapted by the user. For the spatial and temporal coordinates: they are computed as the mean values of the cast readings. For the variables: a binned is performed, taking the mean values of readings in depth intervals centered at selected depth levels.

These explanations are not in the new manuscript in the Section dedicated to the Processing levels.

4. Nowhere the sensor configurations are specified. I think a table gathering this information is worth it. For each platform, the list of sensor should be presented with their configuration (sampling frequency, ADCP ping-per-ensemble, ADCP vertical bin size, etc.). This should include all variables collected, for example, from the ship meteo station from which little information (or none) is present in the text. Same for the glider where there is Chl-a and turbidity data in the files, but these were not mentioned in the text. A table gathering this information would be useful.

We agree with the suggestion and provided this information in the manuscript. Instead of a table, we feel it is better to have the information distributed in each subsection referring to the different platforms. The manuscript has been modified accordingly.

5. A table regrouping all the platform with their basic configuration as well as their number of casts (when it applies) should be provided (sort of extended Table 3).

For each platform, we indicated the basic configuration as well as the number of casts (for CTD, gliders and Argo floats).

3.3 Text-specific comments

- Figure 1 too small (should take page width) - Figure 2 too small (should take page width)

Figures 1 and 2 have been enlarged in the new manuscript

- Figure 2 caption: there is mention of "flag data equal to 1" while these flag are not introduced in the text.

SST is not part of the dataset, we just use them to illustrate the situation during the mission, this is why we did not go into details concerning the flag = 1, which is explicitly described in the caption (good data).

- p.7, L1: The "total number of valid measurement" is not very useful. I would rather put the number of valid casts (see comment above on a new table with this info).

We agree. The number of valid measurements (for the gliders) has been removed and replaced by the number of casts, in the new manuscript.

- p.7, L6: "a spatial interpolation is applied on the original data, leading to the so-called Level-2 data, further described in Sec. 3.3." What does 'spatial interpolation' means? Section 3.3 is not very explicit on this. I know you mean that the glider yos have been separated into downward and upward casts and then assigned to a geographical coordinate, but maybe this should be stated explicitly (and I don't think "spatial interpolation" is an accurate description). Moreover, Is there any vertical interpolation done? Because there are still some NaNs in L2 data.

The referee is right, it is not exactly an interpolation that is performed, but a spatial gridding. The gridding is performed by the function `gridGliderData`, designed to get the glider trajectory data over instantaneous homogeneous regular profiles. By default, the vertical resolution (or step) is set to 1 meter. For the spatial and temporal coordinates: they are computed as the mean values among cast readings. For the variables: a binned is performed, taking the mean values of readings in depth intervals centered at selected depth levels. The NaN are indeed not removed by the binning process, but will be discarded or flagged once the file are re-processed with the new version of the Glider Toolbox.

This has been amended in the new manuscript, in the section that describes the different processing levels.

Added text:

Level 2 (L2) : this level is only available for the gliders. It consists of regular, homogeneous and instantaneous profiles obtained by gridding the L1 data. In other words, 3-dimensional trajectories are transformed into a set of instantaneous, homogeneous, regular profiles. For the spatial and temporal coordinates: the new coordinates of the profiles are computed as the mean values of the cast readings. For the variables: a binning is performed, taking the mean values of readings in depth intervals centered at selected depth levels. By default, the vertical resolution (or bin size) is set to 1 meter. This level was created mostly for visualization purposes.

- p.7, L15: "Interestingly, all the drifters exhibit a trajectory close to the front position" → Not clear what "trajectory close to the front means". Moreover, is that really surprising that surface drifter would aggregate on a front?

We remove the "Interestingly", as indeed it is expected and rephrased it to: "All the drifters moved along the front position (deduced from the SST images), until they encounter the Algerian Current".

- Figure 8 caption: "for the duration of the mission" → You mean the ship mission? Or the AlborEX campaign?

We meant for the AlborEX mission; this has been made explicit in the new manuscript. The caption now reads:

Added text:

Surface drifter trajectories. For the sake of simplicity and clarity, the temperature, when available, is only shown for the duration of the AlborEx mission (May 25-31, 2014)

- Figure 10: plots on the right column are of little information here (too low resolution to mean something), I would remove.

We agree that the resolution is not as good as the Arvor-C float, but for completeness we would prefer not to discard them.

- Table 1: "Period" should be replaced by "cycle length" as referred to in the text (Section 2.2.4).

Modified as suggested.

- Table 1: netCDF file for Provor-bio indicates deployment end date 2015-04- 24T12:02:59+00:00, which is different from this table.

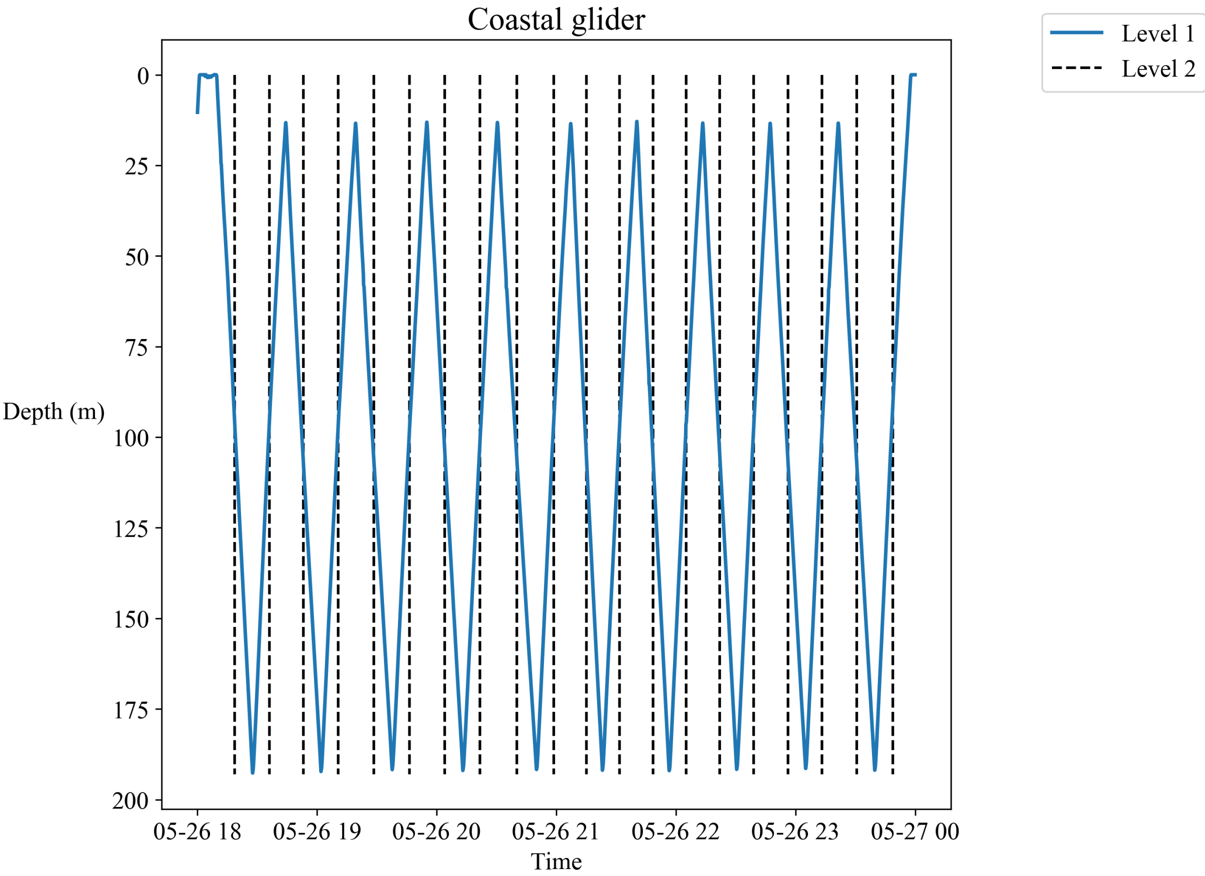
The correct date is indeed 2015-04-24T12:02:59+00:00. The table has been modified accordingly.

- Figure 11 caption: "quality flag" not defined.

Quality flag with a value of 1 (meaning "good data") is specified in the caption. We added a complete description in the text concerning this part.

- Section 3.3.1: A Section on processing levels, but they are not all provided. Why? I think all levels should be provided. This is related to a previous comment.

The origin of the initial decision of not providing the L0 data for all the files is twofold: For some platforms (gliders), the L0 files are rather large and contain many variables related to



the platform engineering, no to oceanography. Even if the files were not provided through the Zenodo platform, they are still publicly available using the SOCIB thredds server. In the new version of the manuscript, we adopted a new way to distribute the data (the data catalog), in which the data files corresponding to all the processing levels are made available.

- p.14, Level 2 (L2): "obtained by interpolating the L1 data" → How L2 is obtained by "interpolating" L1? Isn't L1 cut into casts that makes L2?

Correct. It is not an interpolating but a gridding. The explanation of how this gridding is performed has been added to the manuscript.

- p.14, Level 2 (L2): "It is only provided for gliders, mostly for visualization and post-processing purposes: specific tools designed to read and display profiler data can then be used the same way for gliders." → Is there a problem with this sentence? I don't understand it.

We removed the part of the sentence starting with "post-processing purposes"

- Section 3.3.1 / Table 3: Is L1 level for float equivalent to L2 level for glider? For consistency, I think profiling float should have L1 and L2 data as well since these instruments have similarities on the way they profile the water column...

The L1 glider data consists of a 3-dimensional trajectories, which means that both the longitude, latitude and depth change with respect to time. The Level 2 aims to have the same data on vertical profiles: the longitude and latitude don't change for a given profile. This is illustrated in the figure below.

- p.12, L1: "This type of current measurements requires a careful processing in order to get meaningful velocities from the raw signal" → Why? What are the limitations that makes this instrument more sensitive compare to other ones?

The main reason for this sensitivity is the fact that the vessel's velocity is one or two order or magnitudes greater than the currents that have to be measured. It is thus critical to have good measurements of the vessel heading and velocity.

A sentence has been inserted at the beginning of that paragraph and we removed the sentence "*hence it is relevant to have a quality flag (QF) assigned to each measurement*".

- p.12, L4: "Figure 12 shows the QF during the whole mission." → How QF are calculated?

The QC procedure for the VM-ADCP is complex as it involves tests on a large number of variables such as:

Bottom Track Direction

Bottom Track Velocity

Bottom Track error on velocity

Bottom Track Depth from beam

Sea water noise amplitude

...

with dependencies between them but also variables related to the vessel position and behavior (pitch, roll, speed, ...). The tests adopted are listed in the reference QUID document:

QUID_DCF_SOCIB-QC-procedures.pdf

SOCIB Quality Control Procedures
Data Center Facility
September 2018
DOI: doi:10.25704/q4zs-tspv

and the new manuscript now contains a summary of the ADCP QC procedure.

Added text:

The vessel's velocity is one or two order or magnitudes greater than the currents that have to be measured, hence this type of current measurements requires a careful processing in order to get meaningful velocities from the raw signal. The QC procedure for the VM-ADCP is complex as it involves tests on more than 40 technical and geophysical variables (SOCIB Data Center, 2018). The different tests are based on the technical reports of Cowley et al. (2009) and Bender and DiMarco (2009), which aim primarily at ADCP mounted on moorings. The procedure can be summarised as follows:

1. Technical variables: valid ranges are checked for each of these variables: if the measurement is outside the range, the QF is set to 4 (bad data). Example of technical variables are: bottom track depth, sea water noise amplitude, correlation magnitude.
2. Vessel behaviour: its pitch, roll and and orientation angles are checked and QF are assigned based on specific ranges. In addition the vessel velocity is checked and anomalously high values are also flagged as bad.
3. Velocities: valid ranges are provided for the computed current velocities: up to 2 m/s, velocities considered as good; between 2 and 3 m/s, probably good, and above 3 m/s, bad.

- Figure 12: Too small.

the figure has been enlarged in the new manuscript.

- Figure 12 and text below: 9 different quality flag are presented without any introduction on how they are calculated. The new paragraph in the same section (see comment before) now explains how the quality flag are assigned.

- Section 3.3.2 is very short. Should be re-worked following comments above. We agree that the section dedicated to the Quality Control was too short. The QC are now described as follows: A general description in Section "2.5.2 QC tests" and Specific explanations of the tests performed for each platform, making that part more self-contained.

3.4 Comments on data files

The dataset consists of a relatively large number of files. I did my best but it was nearly impossible to review them all in details.

We really appreciate your time to extensively check of the files.

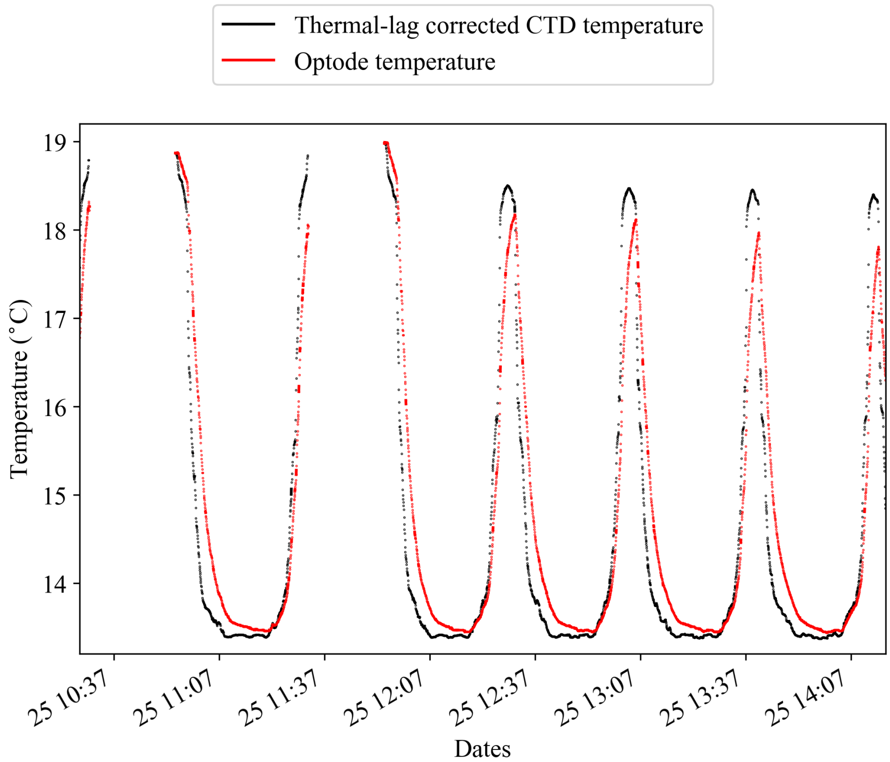
Here are some comments: - There are very large spikes in deep glider turbidity

yes, as the provided datasets for gliders have not undergone the quality checks (yet), there are still spikes and bad values for some of the variables. The text has been modified accordingly.

- There are missing data for about 10h in deep glider data between May 25-26. Unless I missed it, no explanation for this are provided.

The referee is right, some data are missing because the glider payload suffered an issue with the data logging software, resulting in no data acquisition during a few hours, during which the problem was being fixed. After that the data acquisition could be resumed.

This explanation has been added to the corresponding section in the new manuscript.



Added text:

On May 25 at 19:24 (UTC), the deep glider payload suffered an issue with the data logging software, resulting in no data acquisition during a few hours, during which the problem was being fixed. After this event, the data acquisition could be resumed on May 26 at 08:50 (UTC).

- Oxygen data for both glider seems to suffer from thermal lag problems

Yes it is true, we have reached the same conclusion when checking the oxygen data. The issue comes from the sensitivity of the optode to the temperature and the time response of the temperature sensor.

Comparing the temperature obtained with the glider CTD and the temperature of the oxygen sensor (next Figure) also highlights the lag existing between the 2.

To the extent of our knowledge, there is not yet an agreement from the community on how to correct this lag. Nicholson and Feen (2017) proposed a calibration based on the measurements made with the glider optode of the oxygen partial pressure of the atmosphere. Such a procedure can be contemplated in the near future.

Added text:

Finally, oxygen concentration measurements (not shown here) seem to exhibit a lag. According to Bittig et al. (2014), this issue is also related to the time response of oxygen optodes. As far as we know, there is not yet an agreement from the community on how to correct this lag, this is why the data are kept as they are in the present version, though we don't discard an improvement of the glider toolbox to address this specific issue.

- Provor-bio datafile contains levels down to over 7000 m. Some problems are found: 1. Why such long level dimension?

The 7000 comes is the depth dimension, as shown by the "`ncdump -h`" output:

```
dimensions:
    time = UNLIMITED ; // (71 currently)
    depth = 7118 ;
    name_strlen = 49 ;
```

But it does not mean that the maximal depth is actually 7000 m or deeper, as it depends on the vertical resolution. Here the deepest measurements are on the order of 1000 m. The profiles from PROVBIO are shown in the next 2 figures.

2. No good data is found below ~325m, although Table 1 suggest that the float is profiling to 1000m

We confirm that the float acquired data up to approx. 2000 m, even though the vertical resolution is not as high as near the surface. We reproduce (see below) the Figure 10 from the manuscript, this time without limiting the depth range, in order to confirm the availability of data at that depth.

- Arvor A3 data file suffers from similar problem: file contains data only down to 115m while Table 1 says 2000m

For the Arvor A3 we confirm that profiles are available up to approx. 2000 m. The "115" mentioned above are in fact the number of vertical levels provided in the file, not the final depth. Also see the figure above for the data availability.

- Arvor-C data file (only L0 provided) do not contain metadata (no file attributes, etc.). In addition, missing data (at least for temperature) appears to me as very large numbers (9.969210e+36) that makes them difficult to manipulate.

The L0 file with the metadata and the L1 file have been prepared and are now available. The link to the thredds catalog are provided below: L0: http://thredds.socib.es/thredds/catalog/drifter/profiler_drifter/profiler_drifter_arvorc001-ime_arvorc001/L0/2014/catalog.html?dataset=drifter/profiler_drifter/profiler_drifter_arvorc001-ime_arvorc001/L0/2014/dep0001_profiler-drifter-arvorc001_ime-arvorc001_L0_2014-05-25.nc L1: http://thredds.socib.es/thredds/catalog/drifter/profiler_drifter/profiler_drifter_arvorc001-ime_arvorc001/L1/2014/catalog.html?dataset=drifter/profiler_drifter/profiler_drifter_arvorc001-ime_arvorc001/L1/2014/dep0001_profiler-drifter-arvorc001_ime-arvorc001_L1_2014-05-25.nc

R/V Socib CTD and thermosalinograph files say that units of temperature are "C". I prefer the convention from glider files which uses "Celsius".

We take note of the suggestion and will perform the modification in a new release of the data files, as it involves a re-processing of several files from other missions). The referee is totally right, as the Unidata documentation (https://www.unidata.ucar.edu/software/netcdf/netcdf/Units.html) states that "Celsius" should be used, "C" meaning "Coulomb".

3.5 Minor comments

- p.2; L23: "makes it possible" → makes possible

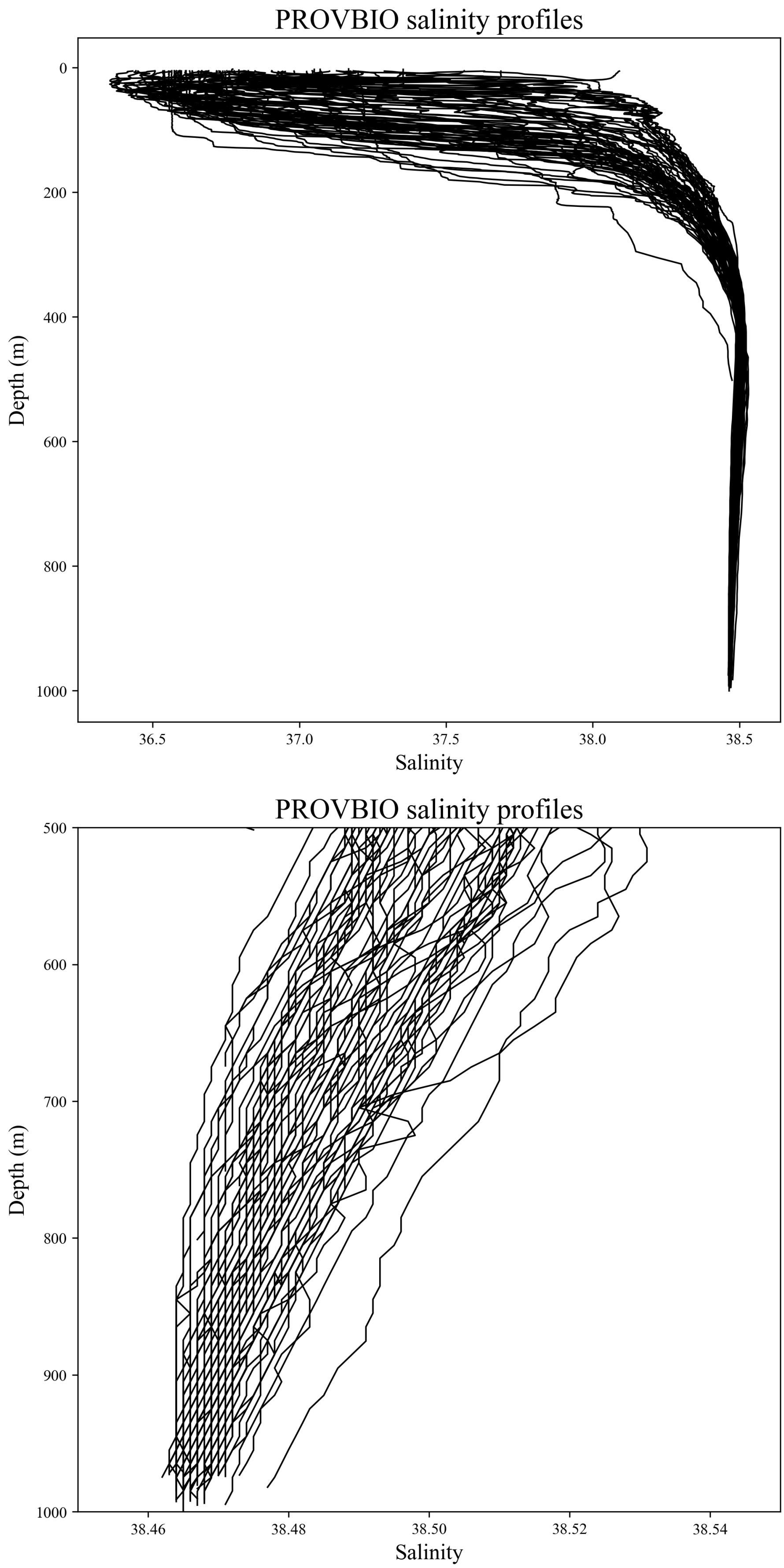


Figure 3: Salinity profiles acquired by the PROVBIO float. The 2nd panel depicts the profile in the 500–1000 m layer.

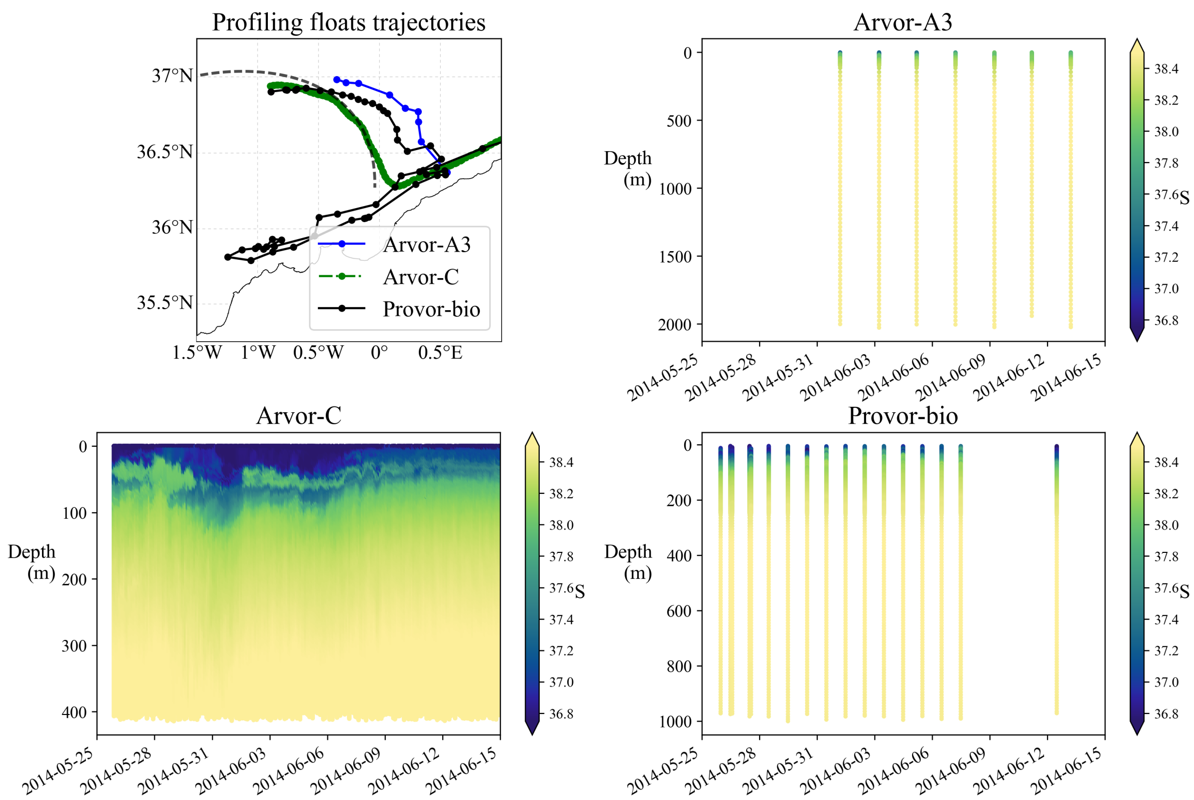


Figure 4: Adapted figure 10 of the manuscript, with the maximal depth of the profiles displayed.

corrected

- p.2; L23: "creation and publication of aggregated datasets covering the Mediterranean Sea" → SeaDataNet is not only about the Mediterranean replaced by "covering different European regional seas, including the Mediterranean Sea"

- p.2; L32: "thanks due to" → thanks to

corrected (removed "due")

- Section 2.2.1: "CTD surveys" or CTD legs?

corrected (legs)

- Glider L1 files (e.g. `dep0012_ideep00_ime-sldeep000_L1_2014-05-25_data_dt.nc`) say that the project is "PERSEUS". Is that right? There is no mention of the AlborEX project in the file header.

Correct, AlborEx was the Subtask 3.3.4 of PERSEUS project, but in this case AlborEx was not explicitly mentioned in the file header. This will be added during the next re-processing of the data files.

- p.10, L1: problems with latitude longitude degree symbol.

corrected

- p.10, L5: temperature, salinity and T,S is use on the same line. Please homogenize.

replaced by "In addition to these variables"

- p.12, L17: "Network Common Data Form (netCDF, `https://doi.org/(http://doi.org/10.5065/D6H70CW6`, last accessed on August) 3, 2018)" Is there a mis-placed parenthesis?

Corrected, the "(" after `.org` has been removed.

- p.13, L2: problem with file name (too long for page)

Corrected (new line added).

- p.16, L25: How stable in time the python codes made available on Github will be?

Generally, reading netCDF files with Python is an easy task, as it is with other languages (MATLAB, Julia, R), so we do not expect any difficulties for the data users. Here what we did is to provide a set of the Python codes written to show how to read the data and reproduce the plots of the papers, as we think it might save time if somebody wants to create something similar, or even reproduce the paper plot.

With Python it is relatively straightforward to use virtual environment, which allows one to work with specific version python modules. If a user works with a virtual environment which has the same packages versions as those specified on GitHub (file `requirements.txt`), then the code will run (since the netCDF files will be the same).

Even if issues occur, we think that providing the codes employed to manipulate the data files, along with the data, is a step toward the reproducibility of the results.

4 Reply to Referee #3

4.1 Major comments

- What are the instruments specifications? A list of the parameters measured by each platform along with the corresponding sensor name must be provided for the CTD, glider and profiling floats.

The instrument specifications have been added in the manuscript: for each platform, a subsection "*Configuration*", containing the information about the platform and variables, has been added.

- Were they any water sample taken during the cruise in order to calibrate the CTD, or chlorophyll-a fluorescence? More than four years after the experiment, I expect this calibration to be done. These are mentioned p16 l22. Along the same lines, a list of future QC to be applied is advocated p15. I would be reluctant to use such a data set. My conception of publishing a data set in such a journal is that final QC should be performed beforehand, and future users should not worry about it.

You are right, water samples were collected.

The CTD data calibrated using the bottle data are available as a new processing level called `L1_corr`, and now described in the manuscript. Concerning the chlorophyll-a fluorescence calibration: it is correct that the calibration has not yet been performed. The decision to publish the data in the present state comes from a balance between:

- The will to share as soon as possible that dataset with the research community interested in the submesoscale, knowing that articles using the dataset have already been published.

- The need to have the best quality for the dataset.

Even if there may still be room for improvement in terms of quality control, for instance by creating new quality checks, our conviction is that the dataset in its current state is mature enough to be employed by other researchers

- Section 2.2.2: It is never specified that the gliders were set to surface every 3 (deep) and 10 (shallow) dives. Estimates of depth-average currents by gliders between consecutive surfacing should be mentioned. Those are essential to infer geostrophic velocities. The sampling strategy unfortunately divides by 3 and 10 the number of current estimations. What was the aim of this sampling strategy? Moreover, when the glider does not spend equally distributed time at each depth level, depth-average currents can not be treated as such anymore. How does the QC deal with this issue? To my mind, this is a real weakness of the glider dataset, especially in an experiment dedicated to submesoscale. I discovered this point by looking at the glider data. Readers should be made aware of this in the manuscript.

Thanks for mentioning this issue. It is indeed something that was not properly addressed in the initial manuscript.

We also believe that it is essential

- to have measurements near the surface to tackle oceanic processes and
- the highest frequency of profiles near the surface in order to properly estimate the depth-integrated velocity.

The reason why the gliders did not go to the surface for every profile arises from safety concerns: the intense marine traffic (see for example the density maps of MarineTraffic) and the existence of a Traffic Separation Scheme (TSS) near the sampling area were taken into account for the decision to limit the glider surfacing.

We added a paragraph in the subsection "*Configuration*" with the "*Gliders*" section:

Added text:

Due to safety concerns, both the deep and coastal gliders had their surfacing limited: the deep glider came to the surface one in every 3 profiles, while the coastal gliders came out one in every 10 profiles. While this strategy does not appear optimal in a scientific point of view (loss of measurements near the surface, meaning of the depth-average currents), the priority was set on the glider integrity.

- Section 3.3.2: How in-house QC differ from international standard for profiling floats and gliders?

In-house quality control are in fact based on international standards. The idea is not to reinvent the wheel but to use what already exists and add other contributions whenever possible. All the QC are detailed in:

QUID_DCF_SOCIB-QC-procedures.pdf

SOCIB Quality Control Procedures
Data Center Facility

September 2018
DOI: doi:10.25704/q4zs-tspv

and the quality control is re-organised as follows:

1. A general section explaining the approach for the quality control.
2. For each platform, a sub-section describing the specificities in terms of QC.

As all the procedures are explained in the aforementioned document, for the sake of conciseness, we prefer to keep a summarised version in the manuscript.

4.2 Specific comments

p2 l32 "thanks due"

corrected

p6 l2: Specify the glider type and sensors

Coastal: Teledyne Webb Research Corp. Slocum, 1st generation, shallow version (200 m)

Deep: Teledyne Webb Research Corp., Slocum, 1st generation, deep version (1000 m)

This information is now included in Table 3 in the subsection "*3.2.1 Configuration*" related to the Gliders, along with the sensors and other technical data.

Overall, the descriptions of all the instruments and sensors have been extended and improved.

p10 l1: wrong degree symbol, please also correct other instances.

Corrected

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5 Marked-up manuscript version

The AlborEX dataset: sampling of submesoscale features in the Alboran Sea

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Abstract. AlborEX (Alboran Sea Experiment) consisted of a multi-platform, multi-disciplinary experiment carried out in the Alboran Sea (Western Mediterranean Sea) between May 25 and 31, 2014. The observational component of AlborEx aimed to sample the physical and biogeochemical properties of oceanographic features present along an intense frontal zone, with a particular interest in the vertical motions in its vicinity. To this end, the mission included 1 research vessel (66 profiles), 2 underwater gliders (adding up ~~554~~ 552 profiles), 3 profiling floats and 25 surface drifters.

Near real-time ADCP velocities were collected nightly and during the CTD sections. All of the profiling floats acquired temperature and conductivity profiles, while the Provor-bio float also measured oxygen and chlorophyll-a concentrations, colored dissolved organic matter, backscattering at 700 nm, downwelling irradiance at 380, 410, 490 nm, and photo-synthetically active radiation (PAR).

In the context of mesoscale and submesoscale interactions, the AlborEX dataset constitutes a particularly valuable source of information to infer mechanisms, evaluate vertical transport and establish relationships between the thermal and haline structures and the biogeochemical variable evolution, in a region characterised by strong horizontal gradients provoked by the confluence of Atlantic and Mediterranean Waters, thanks to its multi-platform, multi-disciplinary nature.

The ~~most recent version of the dataset is available at~~ dataset presented in this paper can be used for the validation of high-resolution numerical models or for data assimilation experiment, thanks to the various scales of processes sampled during the cruise. All the data files that make up the dataset are available in the SOCIB data catalog at https://doi.org/10.25704/z5y2-qpye. The nutrient concentrations are available at https://repository.socib.es:8643/repository/entry/show?entryid=07ebf505-bd27-4ae5-aa43-c4d

1 Introduction

The variety of physical and biological processes occurring in the ocean at different spatial and temporal scales requires a combination of observing and modelling tools in order to properly understand the underlying mechanisms. Hydrodynamical models make it possible to design specific numerical experiments or simulate idealised situation that can reproduce some of these processes and assess the impacts of climate change. Despite the continuous progresses made in modeling (spatial resolution, parameterization, atmospheric coupling, ...), in situ observations remain an essential yet challenging ingredient when addressing the complexity of the ocean.

~~The perfect observational system would consist in dense array of sensors present at many geographical locations, many depths and measuring almost continuously a wide range of parameters. Obviously such a system is not the reality: researchers have to rely on the combination of various platforms during a limited period of time, each platform measuring a given set of variables at different spatial and temporal resolutions, spatial coverage, accuracy and depth levels~~To properly capture and understand these small-scale features, one cannot settle for only observations of temperature and salinity profiles acquired at different times and positions, but rather has to combine the information from diverse sensors and platforms acquiring data at different scales and at the same time, similarly to the approach described in Delaney and Barga (2009). This also follows the recommendation for the Marine Observatory in Crise et al. (2018), especially the co-localization and synopticity of observations and the multi-platform, adaptive sampling strategy. We will refer to this as multi-platform systems, by opposition to experiments articulated only around the observations made using a research vessel. Further details can be found in Tintoré et al. (2013).

The western Mediterranean Sea is a particularly relevant region for multi-platform experiments, thanks to the wide range of processes taking place and intensively studied since the work of Wüst (1961) on the vertical circulation: influence on climate (e.g., Giorgi, 2006; Giorgi and Lionello, 2008; Adloff et al., 2015; Guiot and Cramer, 2016; Rahmstorf, 1998) and sea-level change (e.g., Tsimplis and Rixen, 2002; Bonaduce et al., 2016; Wolff et al., 2018), thermohaline circulation (e.g., Bergamasco and Malanotte-Rizzoli, 2010; Millot, 1987, 1991, 1999; Skliris, 2014; Robinson et al., 2001), water mass formation and convection process (e.g., MEDOC-Group, 1970; Stommel, 1972; Send et al., 1999; Macias et al., 2018), mesoscale (e.g., Alvarez et al., 1996; Pinot et al., 1995; Pujol and Larnicol, 2005; Sánchez-Román et al., 2017) and submesoscale processes (e.g., Bosse et al., 2015; Damien et al., 2017; Margirier et al., 2017; Testor and Gascard, 2003; Testor et al., 2018). Other recent instances of multi-platform experiments in the Mediterranean Sea were focused on the Northern Current (December 2011, Berta et al., 2018), deep convection in the Northwestern Mediterranean sea (July 2012–October 2013, Testor et al., 2018), the Balearic Current system (July and November 2007, April and June 2008, Bouffard et al., 2010) and coastal current off west of Ibiza island (August 2013, Troupin et al., 2015). Similar studies comparing almost synchronous glider and SARAL/AltiKa altimetric data on selected tracks have also been carried between the Balearic Islands and the Algerian coasts (Aulicino et al., 2018; Cotroneo et al., 2016).

Recently, the efforts carried out by data providers and oceanographic data centers through European initiatives such as SeaDataNet (http://seadatanet.org/) makes ~~it~~ possible the creation and publication of aggregated datasets covering different

European regional seas, including the Mediterranean Sea (Simoncelli et al., 2014), upon which hydrographical atlas are build (e.g. Simoncelli et al., 2016; Iona et al., 2018b). These atlas are particularly useful for the description of the general circulation, the large-scale oceanographic features or for the assessment of the long-term variability (Iona et al., 2018a). However their limitation to temperature and salinity variables (as of July 2018) and their characteristic spatial scale prevent them to be employed for the study of submesoscale features.

The AlborEx multi-platform experiment was performed in the Alboran Sea from from May 25 to 31, 2014, with the objective of capturing meso and submesoscale processes and evaluating the interactions between both scales, with a specific focus on the vertical velocities. The observing system, described in the next section, is made up of the SOCIB coastal R/V, 2 underwater gliders, 3 profiling floats and 25 surface drifters, complemented by remote-sensing data (sea surface temperature and chlorophyll concentration). The resulting data set is particularly rich thanks ~~due~~ to the variety of sensors and measured variables concentrated on a relatively small area.

Section 2 strives to summarize the motivations behind the sampling and deployments. The presentation of the available data is the object of the Section 4.

2 The AlborEx mission

The mission took place from May 25 to May 31, 2014 in the Alboran Sea frontal system (Cheney, 1978; Tintoré et al., 1991, see Fig. 1), scene of the confluence of Atlantic and Mediterranean waters. The mission itself is extensively presented in Ruiz et al. (2015) and the features and processes captured by the observations are discussed in Pascual et al. (2017). Olita et al. (2017) examined the deep chlorophyll maximum variation combining the bio-physical data from the gliders and the profiling floats. The present papers focuses solely on the description of the original dataset, graphically summarised in Fig. 1).

2.1 General oceanographic context

The definitive sampling area was not firmly decided until a few days before the start of the mission. Prior to the experiment, satellite images of sea surface temperature (SST) and chlorophyll-a concentration were acquired from the Ocean Color Data server (https://oceandata.sci.gsfc.nasa.gov/, last accessed August 3, 2018) in order to provide an overview of the surface oceanic features apparent in the Alboran Sea. A well-defined front separating Atlantic and Mediterranean waters and exhibiting filament-like structures was selected as the study area (see rectangular boxes in Figs. 1 and 2).

The pair of images indicates that the front position slightly changed between May 25 and 30. An anticyclonic eddy centered around 36°30'N, 0°30'W, according to altimetry data (not shown), slowly followed an eastward trajectory in the following days. Other SST images during the period of interest (not shown here) displayed different temperature values near the front, yet the front position remains stable.

2.2 ~~In situ data~~Design of the experiment

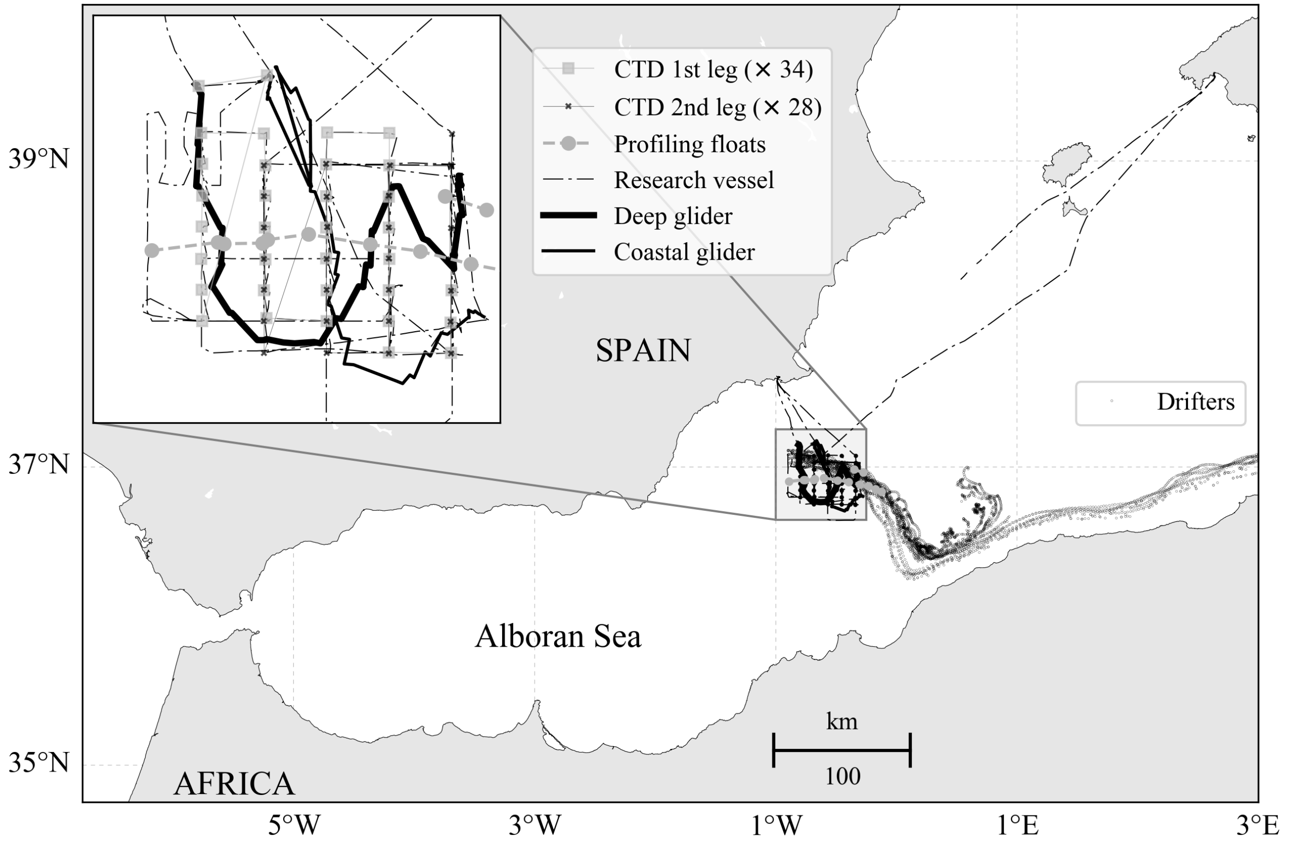

Figure 1. Area of study, positions and trajectories of the main platforms. The close-up view on displays the glider and the CTD measurements.

The deployment of in situ systems was based on the remote-sensing observations described in the previous Section. Two high-resolution grids were sampled with the research vessel, covering an approximative region of 40 km × 40 km. At each station, one CTD cast and water samples for chlorophyll concentrations and nutrients analysis were collected. The thermosalinograph observations were also used in order to assess the front position.

One deep glider and one coastal glider were deployed in the same area with the idea to have butterfly-like track across the front. These idealised trajectories turned out to be impossible considering the strong currents occurring in the region of interest at the time of the mission.

The 25 drifters were released close to the frontal area with the objective to detect convergence and divergence zones. Their release locations were separated by a few kilometers.

2.3 Data reuse

Three main types of data reuse are foreseen: 1. model validation, 2. data assimilation (DA) and 3. planning of similar in situ experiments.

With the increase of spatial resolution in operational models, the validation at the smaller scales requires high-resolution observations. Remote-sensing measurements such as SST or chlorophyll-a concentration provides a valuable source of information but are limited to the surface layer. In the case of the present experiment, the position, intensity (gradients) and vertical structure of the front represent challenging features for numerical models, even when data assimilation is applied (Hernandez-Lasheras and Mourre, 2 .

The AlborEx dataset can be used for DA experiments, for example assimilating the CTD measurements in the model and using the glider measurements as an independent observation dataset. The assimilation of glider observations has already been performed in different regions (e.g. Melet et al., 2012; Mourre and Chiggiato, 2014; Pan et al., 2014) and has been shown to improve the forecast skills. However the assimilation of high-resolution data is not trivial: the the background error covariances tends to smooth the small scale features present in the observations and the high density of measurements may require the use of super-observations (averaging the observations in the model cells). Another complication arises from the fact that the observational errors are correlated, while data assimilation schemes often assume those errors are not correlated.

Finally, other observing and modeling programs in the Mediterranean Sea can also benefit from the present dataset, for instance the Coherent Lagrangian Pathways from the Surface Ocean to Interior (CALYPSO) in the Southwest Mediterranean Sea (Johnston et al., 2018). Similarly to AlborEx, CALYPSO strives to study a strong ocean front front and the vertical exchanges taking place in the area of interest. For details on the mission objectives, see https://www.onr.navy.mil/Science-Technology/Departments/Code-32/All-Programs/Atmosphere-Research-322/Physical-Oceanography/CALYPSO-DRI, last accessed December 17, 2018.

2.4 Processing levels

For each of the platform described in Sec. 2, different processing are performed with the objective to turn raw data into quality-controlled, standardised data directly usable by scientists and experts. Specific conventions for data managed by SOCIB are explained below.

All the data provided by SOCIB are available in different, so-called processing levels, ranging from 0 (raw data) to 2 (gridded data). The files are organized by *deployments*, a deployment being defined as an event initiated when an instrument is put at sea and finished once the instrument is recovered from sea. Table 1 summarizes the deployments performed during the experiment and the available processing levels.

Level 0 (L0) : this is the level closest to the original measurements, as it is designed to contain exactly the same data as the raw files provided by the instruments. The goal is to deliver a single, standardised netCDF file, instead of one or several files in a platform-dependent format.

Level 1 (L1) : in this level, additional variables are derived from the existing ones (e.g., salinity, potential temperature). The attributes corresponding to each variable are stored in the netCDF file, with details of any modifications. Unit conversion are also applied if necessary.

Level 1 corrected (L1_corr) : this level is only available for the CTD: a corrective factor is obtained by a linear regression between the salinity measured by the CTD and that measured by the salinometer. The files corresponding to that processing levels contain new variables of conductivity and salinity to which the correction was applied. Additional metadata regarding the correction are also provided in the file.

Level 2 (L2) : this level is only available for the gliders. It consists of regular, homogeneous and instantaneous profiles obtained by gridding the L1 data. In other words, 3-dimensional trajectories are transformed into a set of instantaneous, homogeneous, regular profiles. For the spatial and temporal coordinates: the new coordinates of the profiles are computed as the mean values of the cast readings. For the variables: a binning is performed, taking the mean values of readings in depth intervals centered at selected depth levels. By default, the vertical resolution (or bin size) is set to 1 meter. This level was created mostly for visualization purposes.

The glider data require a specific processing to ingest and convert the raw data files produced by the coastal and deep units. This is done within a toolbox designed for this purpose and extensively described in Troupin et al. (2016), the capabilities of which includes metadata aggregation, data download, advanced data processing and the generation of data products and figures. Of particular interest is the application of a thermal-lag correction for un-pumped Sea-Bird CTD sensors (Garau et al., 2011), which improves the quality of the glider data.

Table 1. Characteristics of the instrument deployments in AlborEx.

Instruments	Number of deployments	Initial time	Final time	Processing levels L0	L1	L2
Weather station on board R/V	1	2014-05-25	2014-05-02	✓	✓	
ADCP on board R/V	1	2014-05-25	2014-05-02	✓	✓	
CTD	1 (66 stations)	2014-05-25	2014-05-02	✓	✓	
Gliders	2	2014-05-25	2014-05-30	✓	✓	✓
Surface drifters	25	2014-05-25	beyond the experiment	✓	✓	
Profiling floats	3	2014-05-25	beyond the experiment	✓	✓	

2.5 Quality control

Automated data QC is part of the processing routine of SOCIB Data Center: most of the datasets provided with this paper come with a set of flags that reflect the quality of the measurements, based on different tests regarded the range of measurements, the presence of spike, the displacement of the platform and the correctness of the metadata.

The QC are based on existing standards for most of the platforms. They are extensively described in the Quality Information Document (SOCIB Data Center, 2018). The description platform by platform is provided in the next Section.

2.5.1 Quality flags

The flags used on the data are described in Tab. 2.

Table 2. Quality Control Flags.

Code	Meaning
0	No QC was performed
1	Good data
2	Probably good data
3	Probably bad data
4	Bad data
6	Spike
8	Interpolated data
9	Missing data

2.5.2 QC tests

The main tests performed on the data are:

range: depending on the variable considered, low and high threshold are assigned. First there is a global range: if the measured values falls outside, then the flag is set to 4 (bad data). Then a regional range test is applied: the measurements outside this range are assigned the flag 2 (probably good).

spike: the test consists in checking the difference between sequential measurements (i.e. not measured at the same time). For the $\jmath$-th measurement:

$$\text{spike} = \left| V_\jmath - \frac{V_{\jmath+1} + V_{\jmath-1}}{2} \right| - \left| \frac{V_{\jmath+1} - V_{\jmath-1}}{2} \right|$$

When the spike value is above the threshold (depending on the variable), the flag is set to 6.

gradient: it is computed for the variables along different coordinates (horizontal, depth, time).

stationarity: it aims to checks if measurements exhibit some variability over a period of time, by computing the difference between the extremal values over that period.

It is worth mentioning the tests described above are not yet applied on the glider data, since their processing is done outside of the general SOCIB processing chain, but the tests have been implemented in the glider toolbox (Troupin et al., 2016, and available at https:/ and will be made operational once they have been properly tested and validated.

As the new files will not be available before a full reprocessing of all the historical missions, the decision was taken to provide the data files in their current state. A new version will be uploaded as soon as the processing has been performed.

3 In situ observation

Whereas the remote sensing measurements helped in the mission design and the front detection, in situ observation were essential to fulfill the mission objectives. The different platforms deployed for the data collection are presented hereinafter.

3.0.1 ~~Research vessel~~

3.1 Research vessel

The SOCIB coastal research vessel (R/V) was used to sample the area with vertical profiles acquired though the CTD. Two distinct CTD ~~surveys~~ legs were performed on a 10 km × 5 km resolution grid, as depicted in Fig. 3: the first survey was run from May 26 to 27 and consisted of 34 casts along 5 meridional legs. The second survey took place from May 29 to 30 and was made up of 28 casts. The casts from both surveys were performed at almost similar locations in order to allow for detecting changes between the two periods. On average the profiles reached a maximal depth of approximatively 600 m.

The distinct water properties on both sides of the front are evidenced by the T-S diagrams in Fig. 4, where the colors represent the fluorescence. The salinity range north of the front is roughly between 38 and 38.5, with the exception of a few measurements, and confirms the nature of the Mediterranean Water mass. The fluorescence maximum appears between 14 and 15°C. South of the front the salinity range is wider while the temperature values are similar to the north.

In addition to the CTDs, the R/V thermosalinograph continuously acquired temperature and conductivity along the ship track, from which near surface salinity is derived (Fig. 5). The R/V weather station acquired air temperature, pressure, wind speed and direction during the whole duration of the mission. Direct measurements of currents were performed with acoustic Doppler current profiler and are presented in Sec. 3.5.

3.1.1 ~~Gliders~~Configuration

The CTD rosette was equipped with:

- a Sea-Bird SBE 911Plus, 2 conductivity and temperature sensors and 1 pressure sensor units,
- a SBE 43 oxygen sensor,
- a Seapoint [FTU] fluorescence and turbidity sensor.

The GEONICA METEODATA 2000 weather station measured the following variables: air pressure, temperature, humidity, wind speed and direction, with a resolution of 10 minutes. The continuous, near-surface measurements of temperature and salinity are provided by a SeaBird SBE21 thermosalinograph.

3.1.2 Quality control

The general checks described in Sec. 2.5.2 (i.e., ranges, spike, gradient and stationarity) are applied on the temperature, salinity, conductivity and turbidity. The threshold values are detailed in the corresponding tables in the QC procedure document

(SOCIB Data Center, 2018). As mentioned in Sec. 2.4, netCDF files with a correction applied on the salinity and conductivity are also provided (L1_corr).

3.2 Gliders

To collect measurements addressing the submesoscale, two gliders were deployed on May 25 inside the study area. The coastal glider carried out measurements up to 200 m depth and the deep glider up to 500 m. The horizontal resolution was about 0.5 km for the shallow and 1 km for the deep glider. The initial sampling strategy consisted in two 50-km long, meridional tracks, 10 kilometers away one from the other, and to repeat these tracks up to 4 times during the experiment. However, due to the strong zonal currents in the frontal zone, different tracks (Fig. 6) crossing the front several times were made instead.

On May 25 at 19:24 (UTC), the deep glider payload suffered an issue with the data logging software, resulting in no data acquisition during a few hours, during which the problem was being fixed. After this event, the data acquisition could be resumed on May 26 at 08:50 (UTC).

~~The total number of valid measurements (i.e., discarding the bad and missing values) acquired are 121513 for the deep glider and 226717 for the coastal.~~ The mean vertical separation between 2 consecutive measurements is around 16 cm. Figure 7 displays the temperature and salinity sections obtained with the 2 ~~devices~~vehicles. The high density of measurements makes it possible to distinguish small-scale features on both sides of the front, such as strong lateral gradients, subduction or filament structures.

The gliders follow a 3-dimensional trajectory in the water column but for some specific usages it is sometimes more convenient to have the glider data as if they were a series vertical profiles. To do so, a ~~spatial interpolation~~ binning is applied on the original data, leading to the ~~so-called Level-2 data, further~~ L2 data, as described in Sec. 2.4.

3.2.1 ~~Surface drifters~~Configuration

The information concerning the two gliders is summarised in Tab. 3. Due to safety concerns, both the deep and coastal gliders had their surfacing limited: the deep glider came to the surface one in every 3 profiles, while the coastal gliders came out one in every 10 profiles. While this strategy does not appear optimal in a scientific point of view (loss of measurements near the surface, meaning of the depth-average currents), the priority was set on the glider integrity.

3.2.2 Quality control

Before the deployment, glider compass was calibrated following Merckelbach et al. (2008). The thermal-lag happening on the un-pumped Sea-Bird CTD sensors installed on the deep and coastal gliders is corrected using the procedure described in (Garau et al., 2011).

The checks not yet applied but planned for the next release of the Glider toolbox include: the removal of NaN values, the detection of impossible dates or locations, valid ranges (depending on depth) for the variables, spikes, gradients and constant value over a large range of depths in the profiles. The tests performed that the constant value check proved useful

Table 3. Characteristics of the gliders.

	Coastal glider	Deep glider
Manufacturer	Teledyne Webb Research Corp.	Teledyne Webb Research Corp.
Model	Slocum, G1, shallow version (200 m)	Slocum G1 Deep
Battery technology	Alkaline C-cell	Alkaline C-cell
Software version	7.13 (navigation), 3.17 (science)	7.13 (navigation), 3.17 (science)
On-board sensors	CTD (S.B.E.)	CTD (S.B.E.)
	Oxygen: OPTODE 3835 (Aandera)	Oxygen: OPTODE 3830 (Aandera)
	Fluorescence-Turbidity: FLNTUSLO (WetLabs)	Fluorescence-Turbidity: FLNTUSLK (WetLabs)
Number of casts	160	392
Total distance (km)	127	118
Max. depth (m)	200	500

for conductivity (and hence density and salinity). A new version of the present dataset will be released once these new checks are made operational.

Finally, oxygen concentration measurements (not shown here) seem to exhibit a lag. According to Bittig et al. (2014), this issue is also related to the time response of oxygen optodes. As far as we know, there is not yet an agreement from the community on how to correct this lag, this is why the data are kept as they are in the present version, though we don't discard an improvement of the glider toolbox to address this specific issue.

3.3 Surface drifters

On May 25, 25 Surface Velocity Program (SVP) (SVP, Lumpkin and Pazos, 2007) drifters were deployed in the frontal area in a tight square pattern with a mean distance between neighbor drifters around 3 km. In the Mediterranean Sea, they have been shown to provide information on the surface dynamics, ranging from basin scales to mesoscale features or coastal currents (Poulain et al., 2013). Almost all the drifters were equipped with a thermistor on the lower part of the buoy to measure sea water temperature.

11 out the 25 drifters, especially those deployed more to the south, were captured by the intense Algerian Current and followed a trajectory along the coast until a longitude about 5°30'E. The other drifters were deflected northward about 0°30'E, then veered northwestward or eastward and described cyclonic and anticyclonic trajectories, respectively. Interestingly, all the drifters exhibit a trajectory close to All the drifters moved along the front position (deduced from the SST images), until they encounter the Algerian Current (Fig. 8).

On average the temporal sampling resolution is close to one hour, except for 2 drifters for which the intervals are 4 and 5 hours. The velocities are directly computed from the successive positions and highlight the strength of the Algerian Current with velocities on the order of 1 m/s (Fig. 9).

3.3.1 ~~Profiling floats~~Configuration

The drifters deployed during the experiment are the mini-World Ocean Circulation Experiment SVP drifters. These drifters are made up of a surface buoy that includes a transmitter to relay data and a thermistor to measure the water temperature near the surface; the buoy is tethered to a holey-sock drogue centered at 15 m depth. The possible loss of the drogue is controlled with a tension sensor located below the surface buoy.

15 drifters were manufactured by Pacific Gyre and 10 by Data Buoy instrumentation (DBi). All the drifters contributed to the Mediterranean Surface Velocity Programme (MedSVP).

3.3.2 Quality control

Tests are applied on the position (i.e. on land), velocity and temperature records (valid ranges and spikes). Checking the platform speed is particularly relevant, as abnormally high values are intermittently encountered. See SOCIB Data Center (2018) for the threshold values used in the checks. In addition, the method developed by Rio (2012) is used to improve the accuracy of the drogue presence from wind slippage Menna et al. (2018).

3.4 Profiling floats

Three profiling floats were deployed in the same zone as the drifters, on May 25 (see Tab. 4). Their configuration depends on the float type: the Arvor-C has higher temporal resolution (hours) and does not go much deeper than 400 m. The A3 and Provor-bio platforms are usually set to have cycle length between 1 and 5 days, with the bio reaching maximal depth on the order of 1000 m. The floats constitute an essential tool in order to monitor the mesoscale (Sánchez-Román et al., 2017). The trajectories (Fig. 10) clearly show that profiles were acquired in the frontal area, before the floats were eventually captured by the Algerian Current.

The Arvor-C trajectory closely follows the front position until a latitude of 36~~o~~°30'N, accounting for 455 profiles in the vicinity of the front. This is probably due to its configuration: its high frequency temporal sampling makes it possible to spend more time in the near-surface layer and hence the float follows the front better than the 2 other float types. Its last profile was taken on June 14, 2014, at an approximative location of 36~~o~~°15'N, 4°E, then it drifted at the surface.

~~The 2 Arvor-type~~

3.4.1 Configuration

The 3 floats provided temperature and salinity profiles thanks to the Sea-Bird CTD. In addition to ~~T and S, the Provor-bio~~ these variables, the PROVBIO (PROVOR CTS4) platform measured biochemical and optical properties: colored dissolved organic matter (CDOM), chlorophyll-a concentration, backscattering (650 nm), dissolved oxygen concentration and downwelling irradiance (380, 410, 490 nm) and photosynthetically active radiation (PAR). Table 4 reports the main deployment characteristics. All the floats are manufactured by NKE (Hennebont, France). The profiles were performed around local noon time and were used in combination with the glider measurements to study the deep chlorophyll maximum (DCM) across the front (Olita et al., 2017).

~~Profiling floats trajectories (top-left panel) and salinity from May 25 to June 15, 2014.~~

Table 4. Characteristics of the profiling floats.

Platform	~~Initial time Final time~~ Final date	Maximal depth (m)	Cycle length ~~Period~~	No. of profiles ~~Number of profiles~~ Mission
~~Arvor-A3~~ ARVOR-A3	~~2014-05-25~~ 2014-06-17	2000	1 day	3
~~Arvor-C~~ ARVOR-C	~~2014-05-25~~ 2014-06-17	400	1.5 hour	~~455~~ 144
~~Provor-bio~~ PROVOR CTS4	~~2014-05-25~~ 2015-04-24	~~2014-07-13~~ 1000	1 day until June 7, then 5 days	9

3.4.2 ~~Current profiler~~

3.5 Current profiler

The Vessel Mounted-Acoustic Doppler Current Meter Profiler (VM-ADCP) ~~operating at 153 kHz~~ acquired velocity profiles approximatively every 2 minutes during nighttime (22:00–6:00 UTC) at a speed of 10 knots and during the CTD surveys (see Fig. 3). The measurement accuracy is on the order of 0.01 m/s. The measurements were vertically averaged over 8 m depth bins.

The velocities exhibit a dominant eastward current with speed locally larger than 1 m/s and that signal is clearly visible in the first 100 m of the water column. The velocity field is illustrated in Fig. 11 where each velocity vector is shown as a bar with a color depending on the intensity. The vertical structure is also displayed along with the front position.

3.5.1 Configuration

The current profiler is an Ocean Surveyor ADCP, manufactured by Teledyne RD Instruments and operating at a frequency of 150 KH. This instrument was configured with 8-m depth bins and a total of 50 bins. Final velocity profiles were averaged in 10-minute intervals. The transducer depth is approximatively 2 m.

The position and behavior (heading, pitch and roll) of the research vessel is obtained with an Ashtec 3D GPS 800 ADU positioning system that provides provide geographical positions with a 10-20 cm accuracy and heading, pitch and roll with an accuracy on the order of 1°. The instrument was calibrated to correct the misalignment angle and scaling factor. The technical report referring to this platform is available in the Annex II of Ruiz et al. (2015).

3.5.2 Quality checks

~~This~~ The vessel's velocity is one or two order or magnitudes greater than the currents that have to be measured, hence this type of current measurements requires a careful processing in order to get meaningful velocities from the raw signal~~, hence it is~~

relevant to have a quality flag (QF)assigned to each measurement. The quality checks applied for this platform were adapted from the quality control (QC hereinafter) relative to the ADCP mounted on a mooring. . The QC procedure for the VM-ADCP is complex as it involves tests on more than 40 technical and geophysical variables (SOCIB Data Center, 2018). The different tests are based on the technical reports of Cowley et al. (2009) and Bender and DiMarco (2009), which aim primarily at ADCP mounted on moorings. The procedure can be summarised as follows:

1. Technical variables: valid ranges are checked for each of these variables: if the measurement is outside the range, the QF is set to 4 (bad data). Example of technical variables are: bottom track depth, sea water noise amplitude, correlation magnitude.

2. Vessel behaviour: its pitch, roll and and orientation angles are checked and QF are assigned based on specific ranges. In addition the vessel velocity is checked and anomalously high values are also flagged as bad.

3. Velocities: valid ranges are provided for the computed current velocities: up to 2 m/s, velocities considered as good; between 2 and 3 m/s, probably good, and above 3 m/s, bad.

Figure 12shows The application of all these tests lead to Fig 12, which illustrates the QF during the whole mission. The 3 main periods during which the ADCP was turned off are shown as grey areas. In addition, no measurements are available in the first meters of the water column, due to the position of the ADCP on the ship, at a depth of approximately 2 m.

Overall the quality of the data tends to deteriorate when the depth increases, as reflected by the bad and missing values. In the first 200 m, about 95% of the measurements are considered as good. Below 200 m, the ratio drops to 57% with more than 21% of missing values. Note that the flags 5 (, 7 and 8 were not used in this case but kept in the plot.

3.6 Nutrients

Samples for nutrient analysis were collected in triplicate from CTD Niskin bottles and immediately frozen for subsequent analysis at the laboratory. Concentrations of dissolved nutrients (Nitrite: NO_2^-, Nitrate: NO_3^- and Phosphate: PO_4^{3-} were determined with an autoanalyzer (Alliance Futura) using colorimetric techniques (Grasshoff et al., 1983). The accuracy of the analysis was established using Coastal Seawater Reference Material for Nutrients (MOOS-1, NRCCNRC), resulting in recoveries of 97%, 95% and 100% for NO_2^-, NO_3^- and PO_4^{3-}, respectively. Detection limits were NO_2^-:0.005 μM, NO_3^-: 0.1 μM and PO_4^{3-}: 0.1 μM.

4 Description of the database

The AlborEx mission generated a large amount of data in a region sparsely sampled in the past. The synergy between lower-resolution (CTD, drifters, floats) and high-resolution data (ADCP, gliders) makes this dataset unique for the study of submesoscale processes in the Mediterranean Sea. Moreover its multidisciplinary nature makes it suitable to study the interactions between the physical conditions and the biogeochemical variables.

4.1 File format and organisation

The original data files (i.e. obtained directly from the sensors and with a format depending on the manufacturer) are converted to Network Common Data Form (netCDF, https://doi.org/http://doi.org/10.5065/D6H70CW6, last accessed on August 3, 2018), an Open Geospatial Consortium (OGC) standard widely adopted in atmospheric and oceanic sciences. Each file contains the measurements acquired by the sensors as well the metadata (mission name, principal investigator, . . .). The structure of the files follows the Climate and Forecast (CF) conventions (Domenico and Nativi, 2013) and are based on the model of OceanSITES (Send et al., 2010).

4.2 File naming

In order to keep the file names consistent with the original database, it is decided to keep the same file names as those assigned by SOCIB Data Center. Let us decompose one file name into its different parts:
`dep0007_socib-rv_scb-sbe9002_L1_2014-05-25.nc`

`dep0007` indicates the number of the deployment, where deployment is the equivalent to the start of a mission or survey with a given platform. The deployment ends when the mission is over or if the platform stops acquiring data.

`socib-rv` is the code for the platform, in this case the SOCIB coastal research vessel.

`scb-sbe9002` is the instrument identifier, here the CTD SeaBird 9Plus. Note that the instrument is described in the metadata of the netCDF file.

`L1` is the processing level (see Sec. 2.4).

`2014-05-25` is the deployment date (year-month-day).

Now the general naming is defined, Tab. 5 list below the different files made available in the dataset.

4.3 Data ~~processing~~reading and visualisation

~~For each of the platform described in Sec. 2, different processing are performed with the objective to turn raw data into quality-controlled, standardised data directly usable by scientists and experts. Specific conventions for data managed by SOCIB are explained below.~~

4.3.1 ~~Processing levels~~

~~All~~ The standard format (netCDF) in which the data files are written makes the reading and visualisation straightforward. A variety of software tools such as ncview, ncBrowse or Panoply are designed to visualised gridded fields. Here the data provided ~~by SOCIB are available in different so-called processing levels, ranging from 0 (raw data)to 2 (gridded data). The files are organized by *deployments*, where a deployment is defined as an event initiated when an instrument is put at sea and finished~~

Table 5. Platform corresponding to the different files.

File name
dep0023_socib-rv_scb-rdi001_L1_2014-05.nc
dep0007_socib-rv_scb-sbe9002_L1_2014-05-25.nc
dep0001_drifter-svp***_scb-svp***_L1_2014-05-25.nc
dep0005_icoast00_ime-slcost000_L1_2014-05-25_data_dt.nc
dep0012_ideep00_ime-sldeep000_L1_2014-05-25_data_dt.nc
dep0001_profiler-drifter-arvora3001_ogs-arvora3001_L1_2014-05-25.nc
dep0001_profiler-drifter-arvorc_socib_arvorc_L0_2014-05-25.nc dep0001_profiler-drifter-arvorc_socib_ar
dep0001_profiler-drifter-provbioll001_ogs-provbioll001_L1_2014-05-25.nc
dep0015_socib-rv_scb-met009_L1_2014-05-25.nc
dep0015_socib-rv_scb-pos001_L1_2014-05-25.nc
dep0015_socib-rv_scb-tsl001_L1_2014-05-25.nc
dep0015_socib-rv_scb-tsl001_L1_2014-05-25_HR.nc

*** in the file names stands for 3 digits.

once the instrument is recovered from sea. Table 1 summarizes the deployments performed during the experiment and the available processing levels. consist of trajectories (surface or 3D), profiles, trajectory-profile, which can be easily read using the netCDF library in different languages (Tab. 6).

Level 0 (L0) : this is the level closest to the original measurements, as it contains exactly the same data as the raw files provided by the instruments, but in a single file.

Level 1 (L1) : in this level, additional variables are derived from the existing ones (e.g., salinity, potential temperature). The attributes corresponding to each variable are stored in the netCDF file, with details of any modifications. Unit conversion are also applied if necessary.

Level 2 (L2) : this level consists of regular, homogeneous and instantaneous profiles obtained by interpolating the L1 data. It is only provided for gliders, mostly for visualization and post-processing purposes: specific tools designed to read and display profiler data can then be used the same way for gliders.

The glider data require a specific processing to ingest and convert the raw data files produced by the coastal and deep units. This is done within a toolbox designed for this purpose and extensively described in Troupin et al. (2016), the capabilities of which includes metadata aggregation, data download, advanced data processing and the generation of data products and figures . Of particular interest is the application of a thermal-lag correction for un-pumped Sea-Bird CTD sensors installed on Slocum gliders (Garau et al., 2011), which improves the quality of the glider dataExamples of reading and plotting functions, written in Python, are also provided (Troupin, 2018). They allow users or readers to get the data from the files and reproduce the same figures as in the paper, constituting a good starting point to carry out further specific analysis.

Table 6. Characteristics of the instrument deployments in AlborExNetCDF libraries for various languages.

Instruments Programming language	Number of deployments Initial time Final time Library
Python	L0 L1 L2 https://github.com/Unidata/netcdf4-python
Weather station on board R/V Fortran	1 2014-05-25 2014-05-02 https://github.com/Unidata/netcdf-fortran
ADCP on board R/V C	1 2014-05-25 2014-05-02 https://github.com/Unidata/netcdf-c
CTD Javascript	1 (66 stations) 2014-05-25 2014-05-02 https://www.npmjs.com/package/netcdf4
Gliders Octave	2 2014-05-25 2014-05-30 https://github.com/Alexander-Barth/octave-netcdf
Surface drifters Julia	25 2014-05-25 beyond the experiment https://github.com/Alexander-Barth/NCDatasets.jl
Profiling floats MATLAB	3 2014-05-25 beyond the experiment Native support since version R2010b

4.3.1 Quality control

Automated data QC is part of the processing routine of SOCIB Data Center: most of the datasets provided with this paper come with a set of flags that reflect the quality of the measurements, based on different tests regarded the range of measurements, the presence of spike, the displacement of the platform and the correctness of the metadata.

Drifters: checks are performed to remove bad positions (i.e. on land) and spikes in the trajectory. For the SVP drifters, the method developed by (Rio, 2012) is used to improve the accuracy of the drogue presence from wind slippage (Menna et al., 2018).

Profiling floats: standard tests are performed to check the time and the position accuracy. Variable ranges are checked at each depth.

For some platforms, the automated QC are not implemented yet: a set of quality checks have been added to the glider toolbox (Troupin et al., 2016, and available at https://github.com/socib/glider_toolbox) and are in testing phase at the time of the writing. The QC included tests on NaN values, impossible date or location, valid ranges (depending on depth) for the variables, spikes, gradients and flat lines (constant value over a large range of depths) in profiles. The later check proved useful for conductivity (and hence density and salinity). This new QC step will then be included to the general procedure and new netCDF files will be produced and made available as a new version of the present dataset. the situation is similar to the gliders: new tests have been recently added to the processing chain at SOCIB, hence the AlborEx CTD profiles will have to be reprocessed in order to assign the quality flags to the measurements. These tests are essentially based on the range of measured values depending on each variable and When accessing the data catalog, users are provided a list of in-house visualisation tools designed to offer quick visualisation of the file content. The visualisation tools depend on the presence of strong vertical variations spike within a profile. type of data: *JWebChart* is used for time series; *Dapp* displays the trajectory of a moving platform on a map; the *profile-viewer* allows the user to select locations on the map and view the corresponding profiles.

As the new files will not be available before a full reprocessing of all the historical missions, we decided to provide the data files in their current state. A new version will be uploaded as soon as the processing has been performed.

5 Conclusions and perspectives

The AlborEx observations acquired in May 2014 constitutes a unique observational data set that captured mesoscale and submesocale features in a particularly energetic frontal zone in the western Mediterranean Sea. The potential uses of the dataset can be separated in different topics:

- Hydrodynamics model validation: with their increasing resolution, models are becoming able to properly reproduce small-scale structures, but the correct timing and location of these features remain a challenging topic.
- High-resolution remote-sensing data validation: high quality in situ measurements of the sea surface are essential for the validation of operational product such SST or Ocean Color.
- Study of mechanisms: the Mediterranean Sea is often referred to as a laboratory for oceanography and in particular the Alboran Sea is the stage of intense processes of mixing, subduction and instabilities.
- Assessment of mechanisms responsible for intense vertical motions.

The version of the dataset described in the present paper contains files that have been processed and standardised so that they are directly usable by scientists without having to perform unit or format conversions from the manufacturer raw data files.

Updates will be performed when new versions of the files or new files are made available.

6 Code and data availability

Following SOCIB general policy, the data are made available as netCDF files through the SOCIB Thematic Real-time Environmental Distributed Data Services (THREDDS) Data Server, a standard way to distribute metadata and data using a variety of remote data access protocols such as OPeNDAP (https://www.opendap.org), Web Map Service (WMS) or direct HTTP access. In addition, the whole AlborEx dataset has been assigned a Digital Object Identifier (DOI) to make them it and uniquely citable. The most recent version of the dataset is accessible from http://doi.org/10.25704/z5y2-qpye and the nutrient data, in process of being included in the catalog, are available at https://repository.socib.es:8643/repository/entry/show?entryid=07ebf505-bd27-4ae5-aa43-c4d1c85dd500

Upgrades will be performed periodically with the implementation of fresh or better QCs on sensors such as the ADCP, CTD or gliders. The new releases will be available using the same Zenodo identifier, but with be assigned a different version number, each version having its own DOI. Files not available at the time of the writing will also be appended to the original database.

Concerning the improvement of the quality control, it is worth mentioning the new tests that will be implemented in the SOCIB Glider Toolbox (Troupin et al., 2016).

The checks performed on the ADCP velocities involve a set of parameters that can also be fine-tuned to improve the relevance of the quality flags. Nevertheless, noticeable changes are not expected with respect to the quality flags displayed in Fig. 12.

Finally, the quality of the CTD and the glider profiles can be improved by using the salinity measurements of water samples collected during the mission. This type of correction might not be essential for the study of mesoscale processes but is crucial when one is focused on long-term studies and when a drift can be observed in the salinity measurements.

A set of programs in Python to read the files and represent their content as in the figures presented through the paper are available at https://github.com/ctroupin/AlborEX-Data. The programs are written in the form of documented Jupyter notebooks, a web application that combines code fragment, equations, graphics and explanatory text (http://jupyter.org/, last accessed 14 August, 2018) so that they can be run step by step. The figures colormaps were produced using the `cmocean` module (Thyng et al., 2016).

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Competing interests. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Disclaimer. The authors do not accept any liability for the correctness and appropriate interpretation of the data or their suitability for any use.

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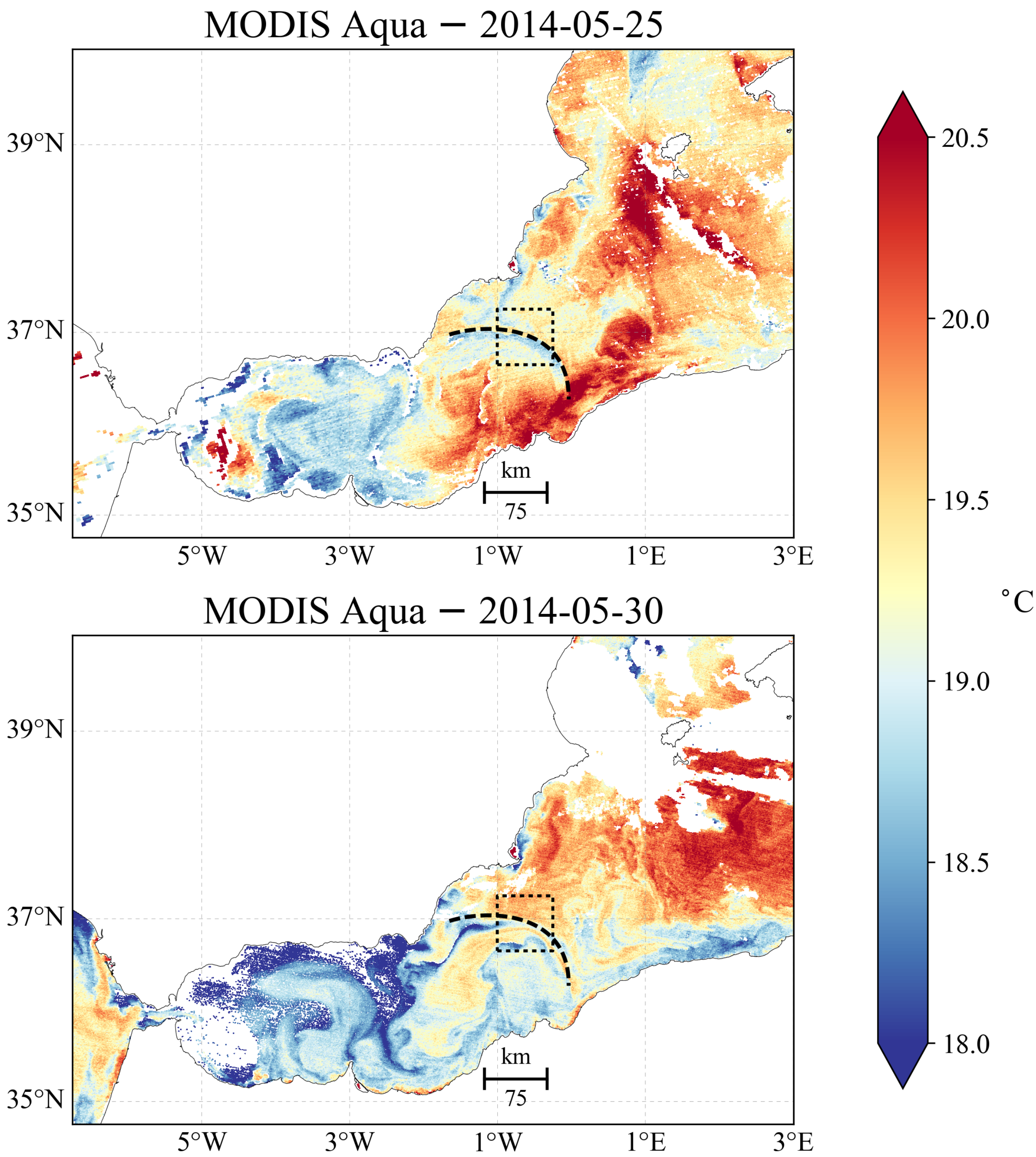

Figure 2. Sea surface temperature in the western Mediterranean Sea from MODIS sensor onboard Aqua satellite corresponding to May 25 and 30, 2014. The dashed black line indicates the approximative position of the front based on the temperature gradient for the period 25–30 May. Level-2, 11 μm, night-time images were selected. Only pixels with a quality flag equal to 1 (good data) were conserved and represented on the map. ~~Note that the~~ The same front position is used in the subsequent figures.

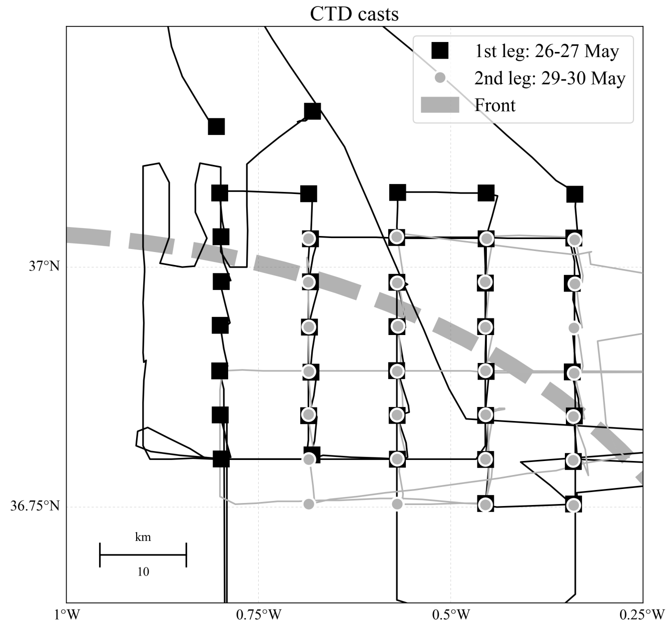

Figure 3. The CTD casts were organised in 5 legs that crossed the front and were repeated over 2 periods, at the beginning and the end of the mission..

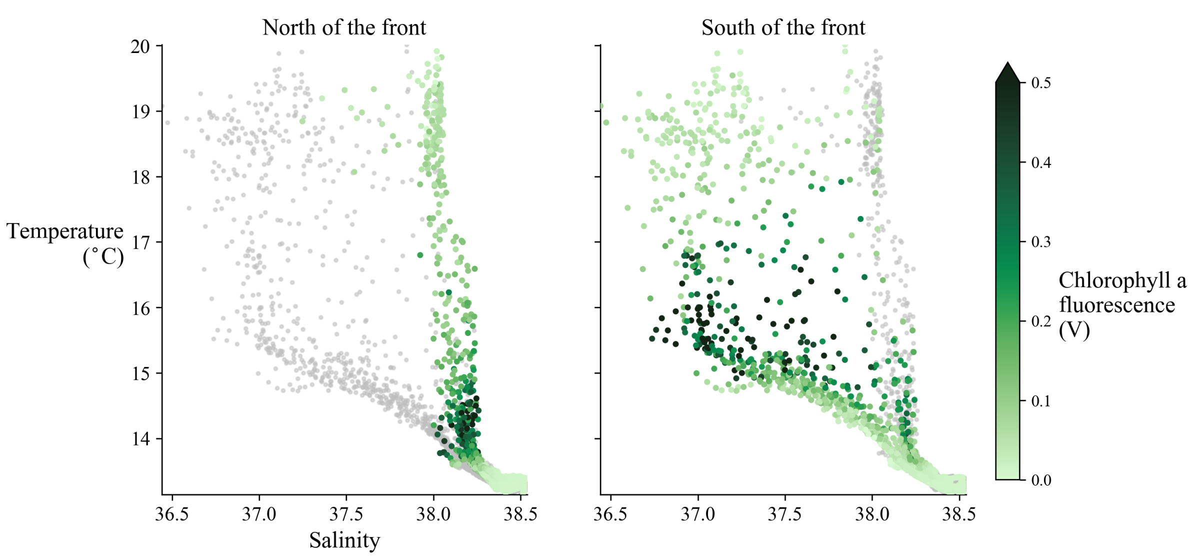

Figure 4. The T-S diagrams are shown separately for the casts located north and south of the front (broad, dashed line) .

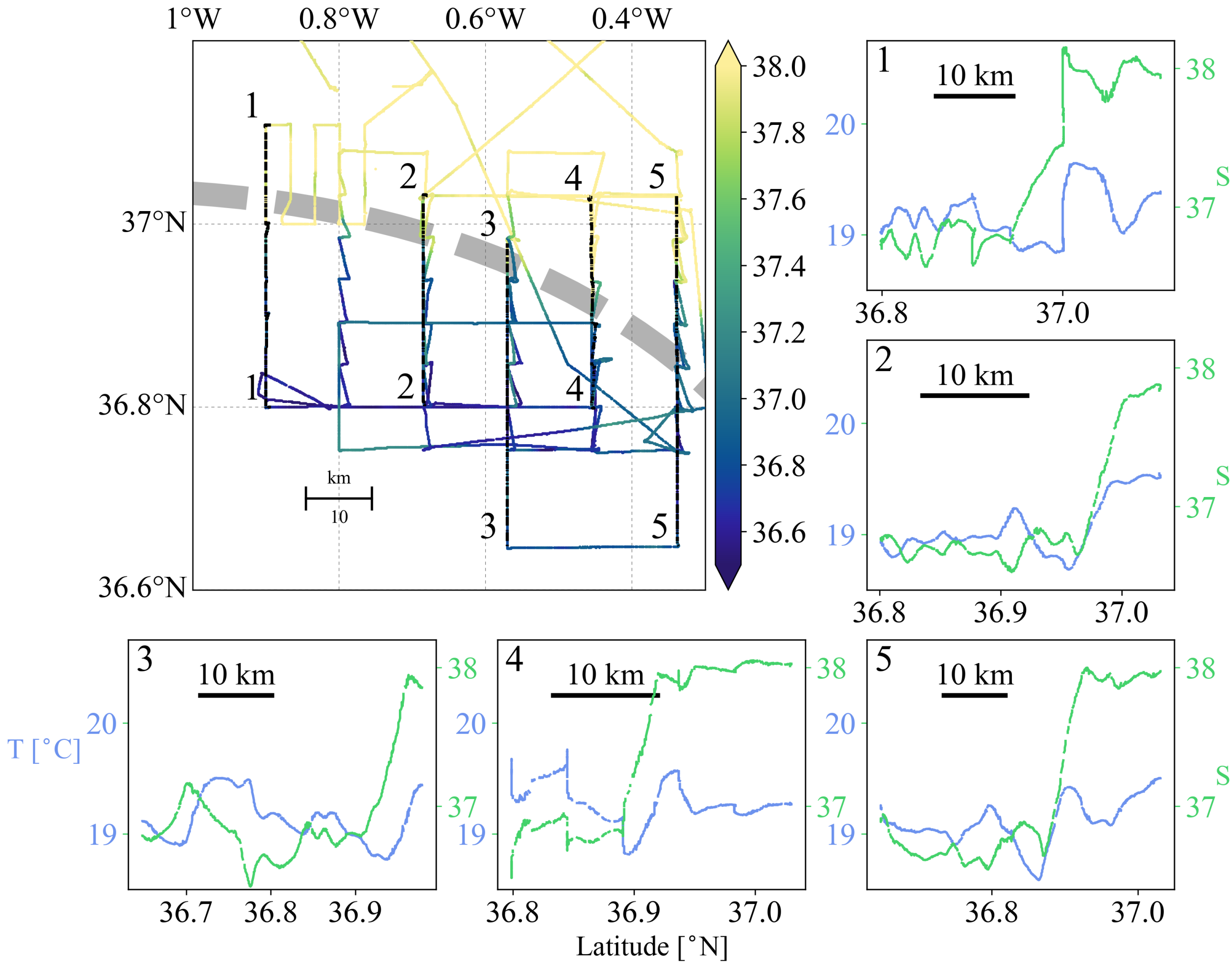

Figure 5. The near-surface salinity (colored dots) measured by the thermosalinograph evidences the strong horizontal gradients, in agreement with the front position as obtained using the SST (broad, dashed line). The 5 subplots depict the temperature and salinity along select meridional tracks.

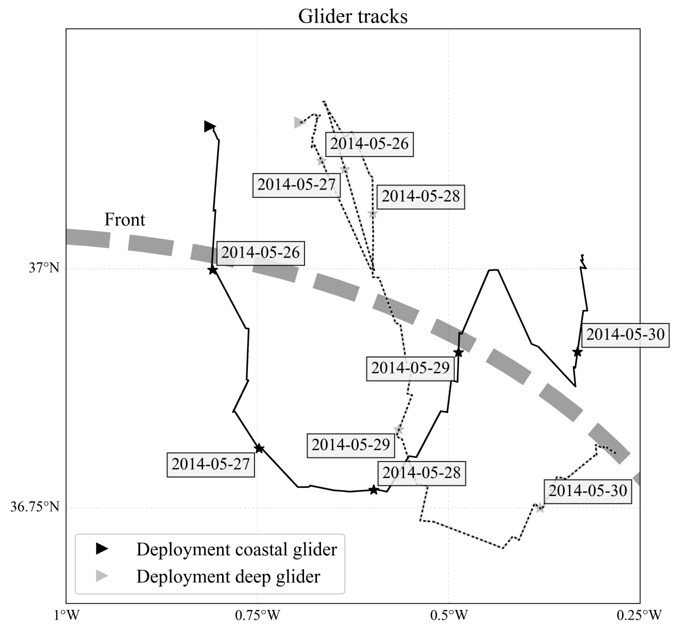

Figure 6. Deployment positions and trajectories of the gliders. Different time instances separated by one day are indicated on the tracks to provide a temporal dimension.

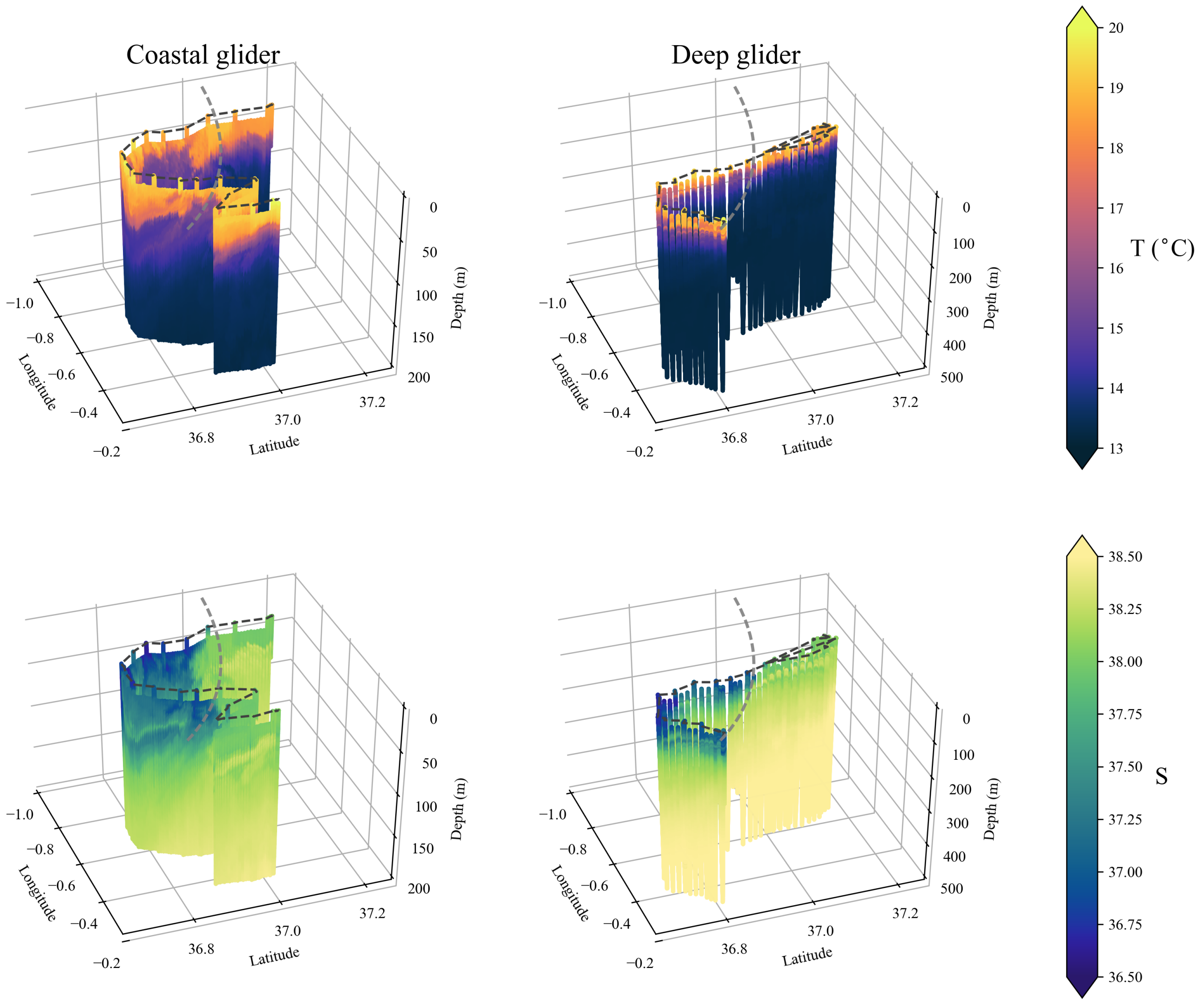

Figure 7. Temperature (top) and salinity measured by the two gliders. The approximative front position at the surface is shown as a dashed, grey line.

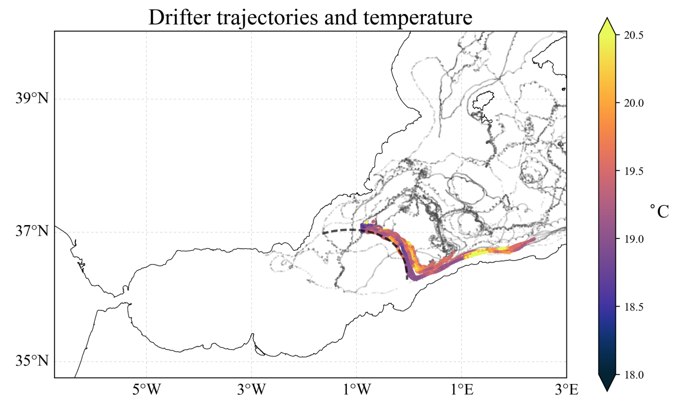

Figure 8. Surface drifter trajectories. For the sake of simplicity and clarity, the temperature, when available, is only shown for the duration of the AlborEx mission (May 25-31, 2014).

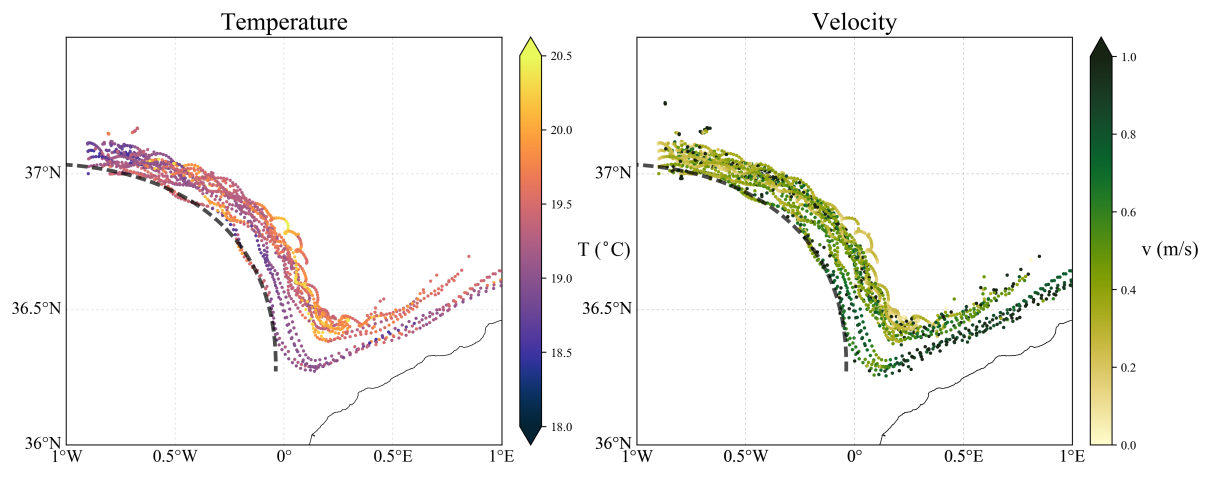

Figure 9. Drifter temperature (left-hand side) and velocity in the area of study.

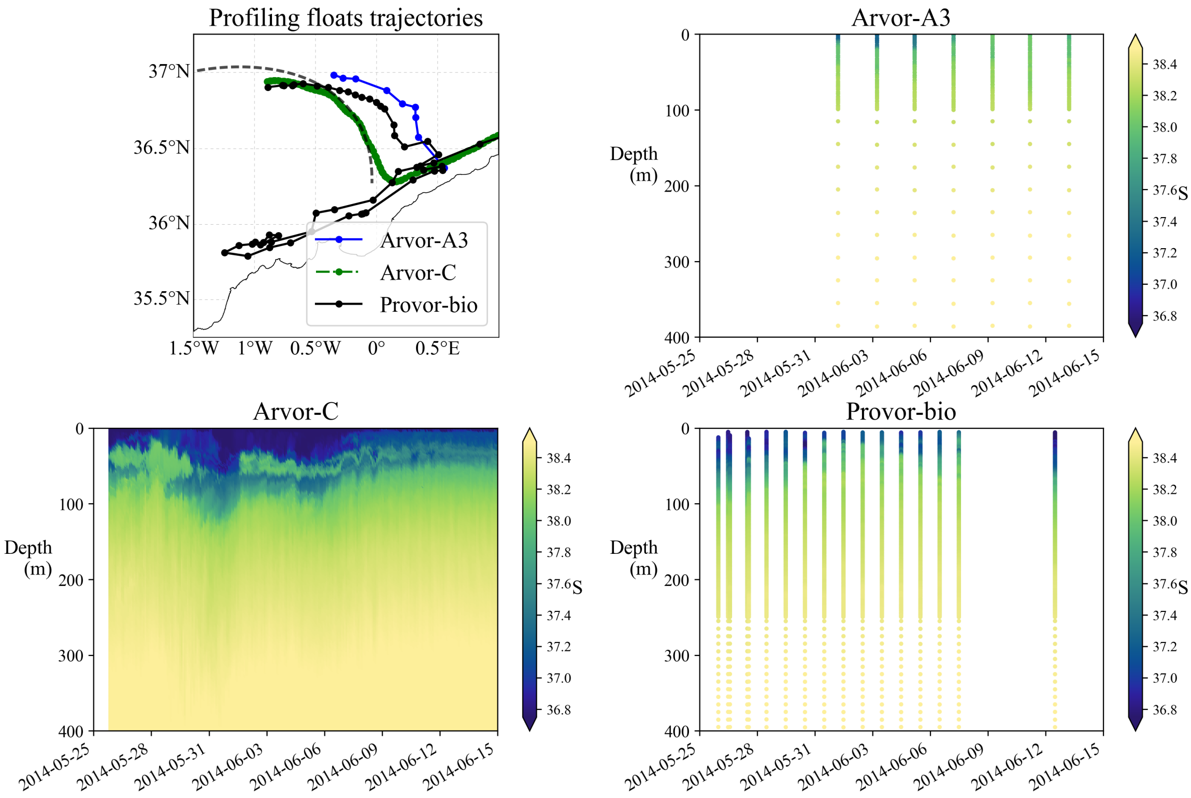

Figure 10. Profiling floats trajectories (top-left panel) and salinity from May 25 to June 15, 2014.

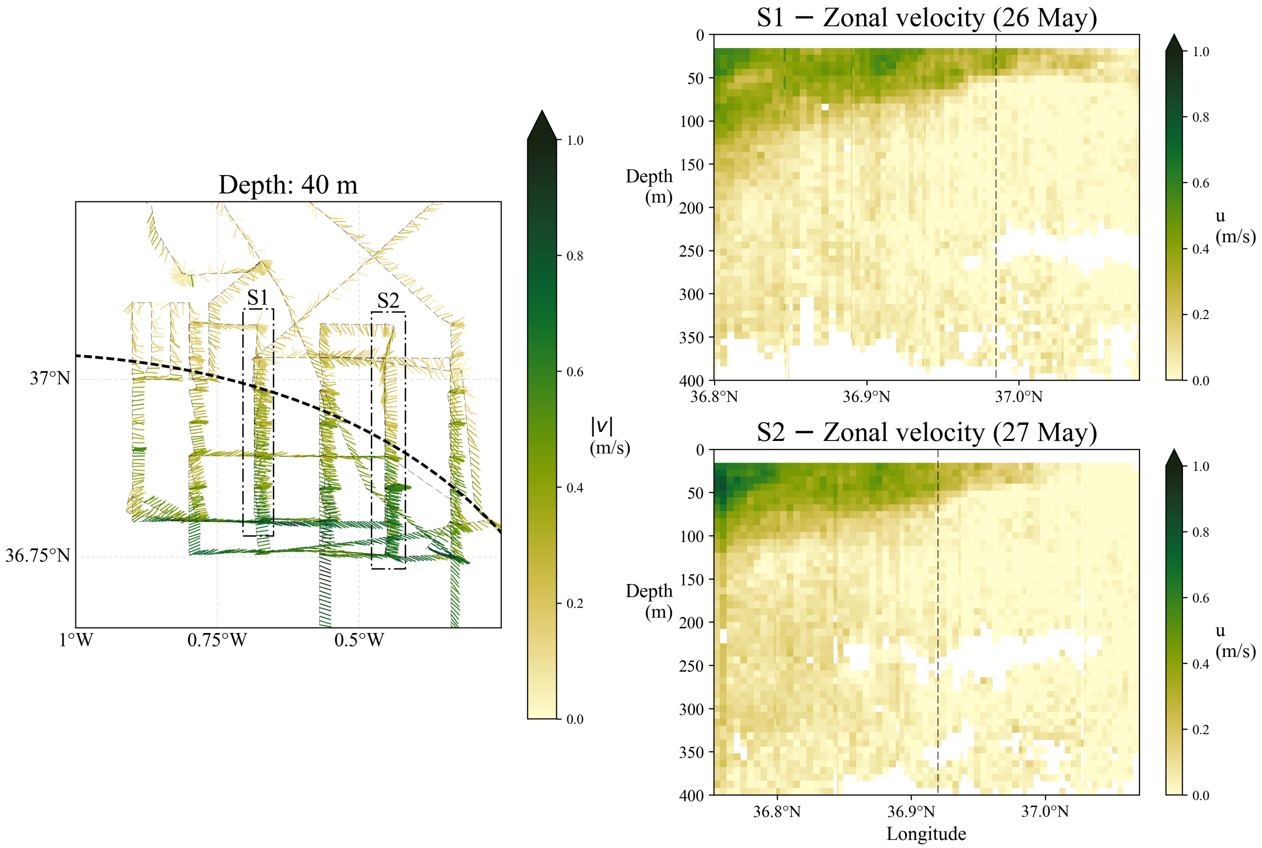

Figure 11. Velocity field obtained with the ADCP at a 40 m depth (left panel) and sections of zonal velocity on May 26 (S1) and 27 (S2). The locations of the sections are indicated by dashed rectangles on the map. Only data with a quality flag equal to 1 (good data) are represented

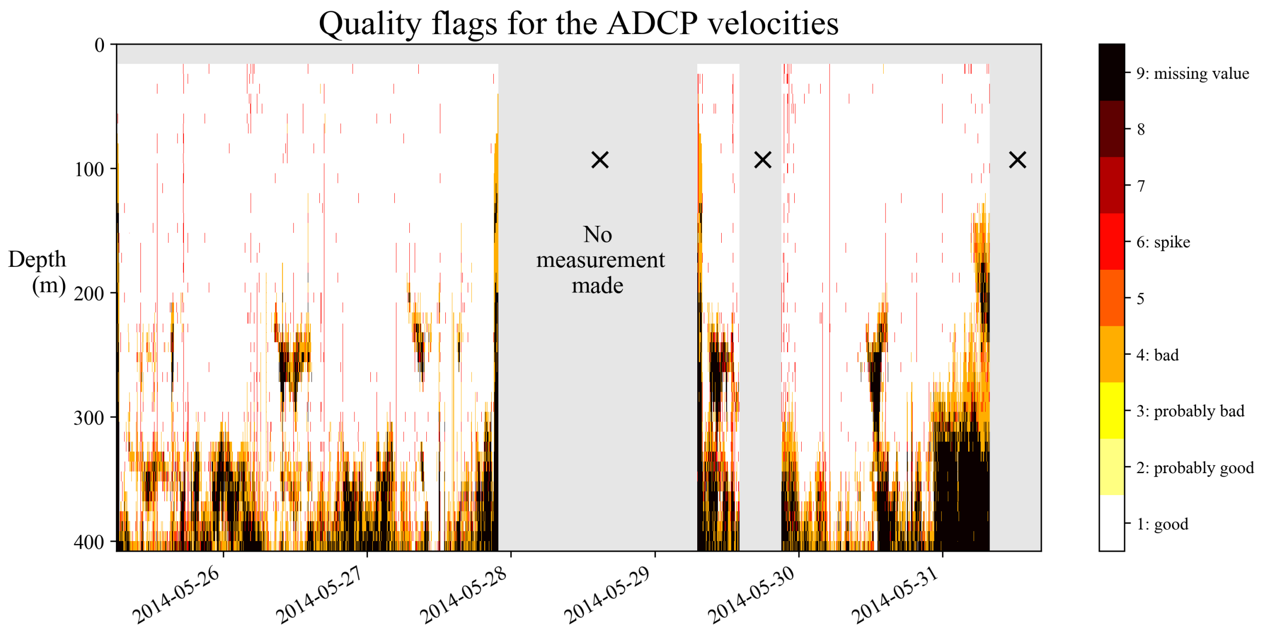

Figure 12. Quality flags for the velocity measurements. The areas marked with a × are those during which the VM-ADCP was no acquiring measurements.