APPENDIX 3

TA PROJECT REPORT (TEMPLATE)

(see following pages)

TA PROJECT REPORT PACKAGE

- The completed and signed forms included in this package should be sent by email to jerico.ta@marine.ie and **jerico**-s3**@ifremer.fr** within **one month after the completion of the TA project** by the User Group Leader.
- **Refunding of the TA reimbursement to the user group will be processed as soon as these forms will be submitted**.
- The TA project report will be published in the JERICO-S3 website. The report, as well as other information collected with the attached forms, will be used to report to the European Commission.
- **Please note that any publication resulting from work carried out under the JERICO-S3 TA activity must acknowledge the support of the European Commission – H2020 Framework Programme, JERICO-S3 under grant agreement No.871153.**

1. Project Information

Proposal reference number[1]	**JS3_CALL_4_ 4065_LISTEN**
Project Acronym (ID)[2]	LISTEN
Title of the project[3]	Glider Mission to Resolve Mixing in the Southern Baltic
Host Research Infrastructure[4]	Glider Mia + Profiler
Starting date - End date[5]	24.04.2023 - 10.10.2023
Name of Principal Investigator[6] **Home Laboratory** **Address** **E-mail address** **Telephone**	Anna Bulczak Ul. Powstańców Warszawy 55, 81- 712 , Sopot, Poland abulczak@iopan.pl

2. Project objectives[7] (250 words max.)

The main aim of the project is to perform high-resolution CTD, oxygen and chlorophyl A transect along and across the Slupsk Furrow in the Southern Baltic Sea using an ocean glider to complement and enhance the IO PAN standard ship-borne measurements. The goal is to study water mass structure, stratification and mixing processes in the Slupsk Furrow, which is a key area for the transport and mixing of highly saline and oxygen-rich inflow waters originating from the Major Baltic Inflows towards the central and eastern Baltic.
The secondary objective of the project is focused on field testing of the system for acoustic data transfer between the glider and a sub-surface mooring, developed during a BIOGLIDER project. This is a step towards application of gliders as data messengers for harvesting measurements records from underwater platforms in the future ocean observing systems.

3. Main achievements and difficulties encountered (250 words max.)[8]

The glider successfully collected oceanographic data (temperature, salinity, chlorophyll a, turbidity, and partially dissolved oxygen) during 10 days from 8-18 May 2023 along the section in the Slupsk

[1] Reference number assigned to the proposal by the TA-Office.
[2] User-project identifier used in the proposal.
[3] Title of the approved proposal. The length cannot exceed 255 characters
[4] Name of the installation/infrastructure accessed with this project. If more than one installations/infrastructures are used by the same project, please list them in the box.
[5] Specify starting and end date of the project (including eventual preparatory phase before the access).
[6] Fill in with the full contact of the Principal Investigator (user group leader).
[7] Write the short-term, medium and long-term objectives of the project. Use no more than 250 words.
[8] Describe briefly the main achievements obtained and possible impacts, as well as possible difficulties

Furrow in the Southern Baltic Sea. However, the oxygen sensor stopped working and after some time, which later caused a failure of all sensors. Therefore, much shorter data set was collected than initially planned (Fig.1 black lines) covering only part of the long transect along the Slupsk Furrow (Fig. 1, yellow line). The glider was successfully recovered on May 30.

For the acoustic experiment, the mooring equipped with hydroacoustic modem was deployed and the glider was equipped with GAN (Glider Acoustic Node). The glider was deployed to perform predefined flights in vicinity of the mooring. Due to technical problem with buoyancy package and very strong current at the location, it was not possible to fly the glider along the required path. Acoustic communication was achieved only for modem technical commands without transferring data packages. The main achievement of the acoustic experiment was to prove a concept of the external GAN setup on a glider for acoustic communication and to gather technical data for improving the GAN design and future integration.

4. Dissemination of the results[9]

The plan is to present the results of the LISTEN project at the national and international conferences and/or workshops in 2024, particularly at "IV Polish Conference of marine research" and the 5th Baltic Earth Conference, which will be held between 13. May 2024 and 17. May 2024 in Jūrmala, Latvia.
One publication in scientific international journal is also planned, to be submitted in 2024.
Information about the acoustic communication experiment was included in the presentation 'Bioglider: an integrated glider solution for enhancing environmental knowledge' during the OCEANS 2023 Gulf Coast conference, IEEE Oceanic engineering society, Sep 2023, Biloxi, US.

5. Technical and Scientific preliminary Outcomes (2 pages max.)[10]

The CTD , dissolved oxygen measurements and ocean currents were conducted from the research vessel RV Oceania within the Slupsk Furrow on May 9, 2023, at stations spaced at 5 nautical-mile intervals, one day prior to the commencement of glider profiling operations (see Figure 1). Subsequently, the vessel assumed a position approximately 3 kilometers behind the glider to preclude any potential collision, adopting a westerly drift with a velocity of 1 kilometer per hour, mirroring the glider's course. Continuous ocean current measurements were performed using 150 kHz vessel-mounted ADCP. The Microstructure measurements were undertaken at hourly intervals, corresponding to 1 kilometer separation, using a Vertical Microstructure Profiler (VMP250) of Rockland Scientific. This VMP data collection transpired approximately 3 hours to the east of the

encountered during the execution of the project. Use no more than 250 words.

[9] Describe any plan you have to disseminate and publish the results resulting from work carried out under the Transnational Access activity in JERICO -S3: scientific articles, books - or part of them -, patents, as well as reports and communication to scientific conferences, meetings and workshops. Highlight peer-reviewed publications. **Note that any publications resulting from work carried out under the JERICO -S3 TA activity must acknowledge the support of the European Commission – H2020 Framework Programme, JERICO -S3 under grant agreement No. 871153.**

[10] Describe in detail results and main findings of your experiment at the present stage.

glider, spanning from 10:00 AM on May 10, 2023, to 10:00 PM on May 11, 2023, and from 12:30 PM on May 12, 2023, to 4:00 AM on May 15, 2023.

In total, the VMP recorded 294 profiles, distributed across 98 stations, each separated by 1 km, with a minimum of 3 profiles performed at each station. The VMP measurements were constrained by temporal and logistical limitations, necessitating their cessation on May 15, 2023, after covering the deepest segment of the basin. Owing to complications with the oxygen sensor, the glider was only able to profile a single extended section along the Slupsk Furrow, as indicated by the yellow trajectory in Figure 1, spanning from May 10, 2023, to May 18, 2023. The subsequent recovery and retrieval of the glider occurred on May 30, 2023.

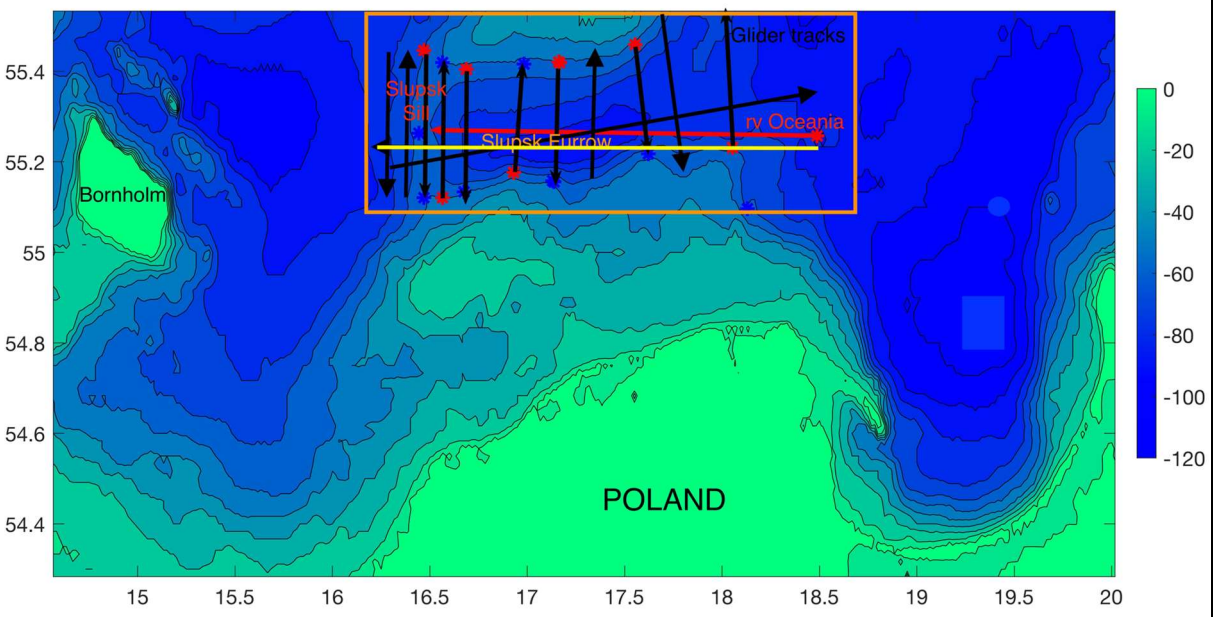


Figure 1. Map of the study. The initial mission plan is shown in black, the actually measured track is shown in yellow and the rv Oceania ship track is shown in red. Colours represent bathymetry [m].

The preliminary glider-derived data underwent a post-processing procedure. The data quality assessment adhered to established best practices as stated in the: Argo Quality Control Manual, the Real Time Quality Control of biogeochemical measurements (2011) MyOcean, and the Delayed Mode QA/QC Best Practice Manual (2021), in alignment with the standards set forth by IMOS Ocean Gliders.

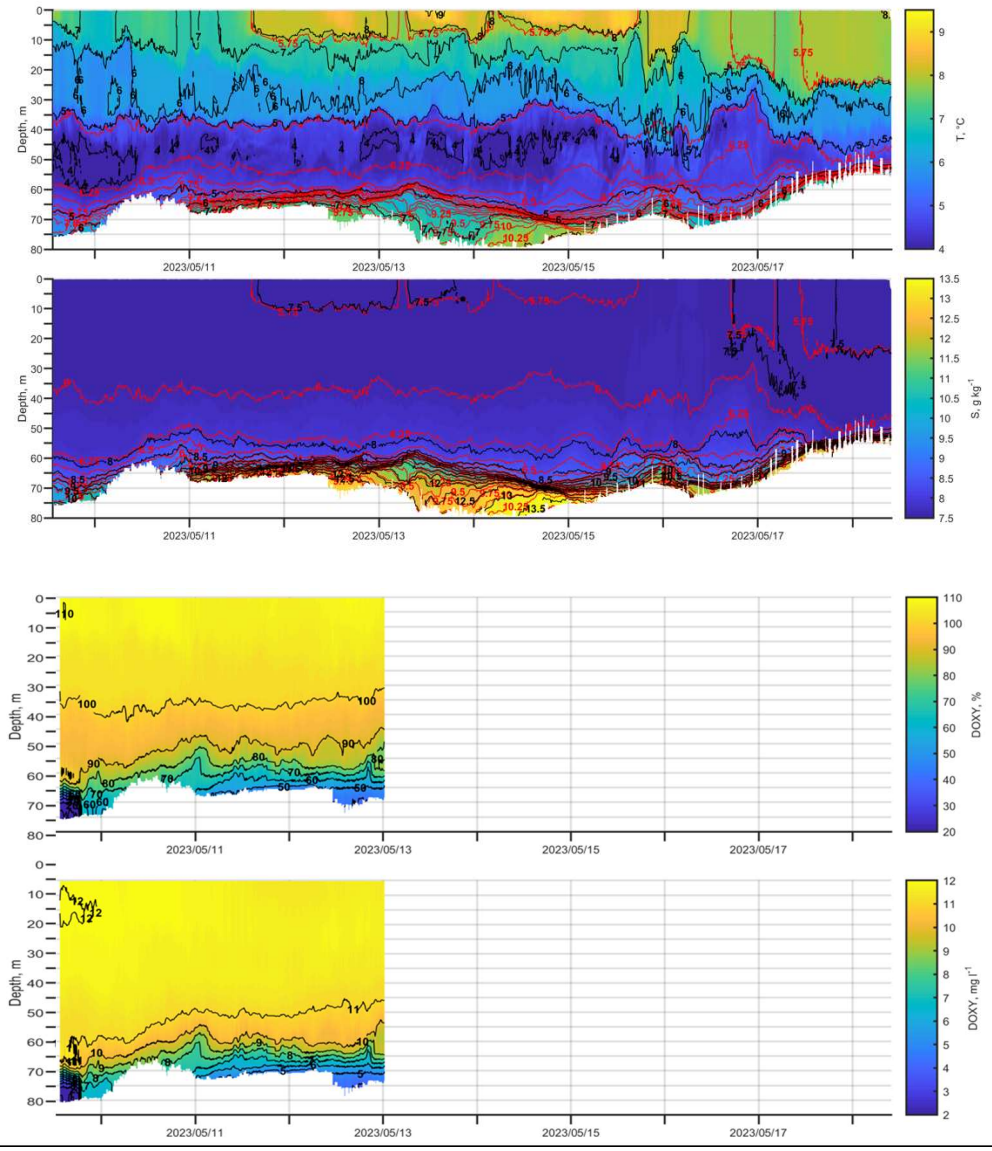
Prior to binning, science variables, with the exception of oxygen, were subjected to filtration using a single-pole filter method as proposed by Fofonoff et al. (1974). Evaluation of sensor response was accomplished by comparing consecutive profiles. Time coefficients spanning the range from 0 s to 2 s in 0.1 s increments were employed, with the mean area determined using the trapezoidal method and root mean square error (RMSE) computed between profiles. Subsequently, median values for each time coefficient were compared. The implementation of response time during post-processing served to diminish disparities between successive temperature and conductivity profiles.

However, the glider-derived oxygen concentration data was omitted due to the distinct response times of the oxygen and temperature sensors, which approximate ~25-30 s and ~10 s, respectively.

To approximate true oxygen values, oxygen saturation was re-calculated to its phase, following the methodology outlined by Bittig et al. (2014, 2017). This approach facilitated the estimation of sensor response and the filtering of phases that could subsequently be utilized to recompute oxygen

saturation using CTD temperature data. The outcomes of this post-processing are visually depicted in Figure 2, portraying 3D fields encompassing temperature, salinity, chlorophyll-A, turbidity, oxygen saturation, and oxygen concentration.

The results show that chlorophyll-A data notably exhibits diurnal variability, with elevated concentrations near the surface during daylight hours and decreased concentrations during the night. This diurnal variation is indicative of vertical phytoplankton migrations (such as dinoflagellates, chlorophytes etc.), which are particularly pronounced in the western Słupsk Furrow, possibly influenced by an increase in solar radiation over deployment time. The water temperature data manifest substantial spatial and temporal fluctuations, characteristic of the region in May. The presence of internal waves or sub-mesoscale eddies is discernible in the temperature and salinity/density data, particularly in the vicinity of the Słupsk Sill. Conversely, turbidity exhibits limited variability along the transect, with minor changes near the seabed attributed to heightened sediment transport and slight surface variations, likely a consequence of plankton activity, as a similar pattern is evident in the chlorophyll-A data and surface temperature measurements.



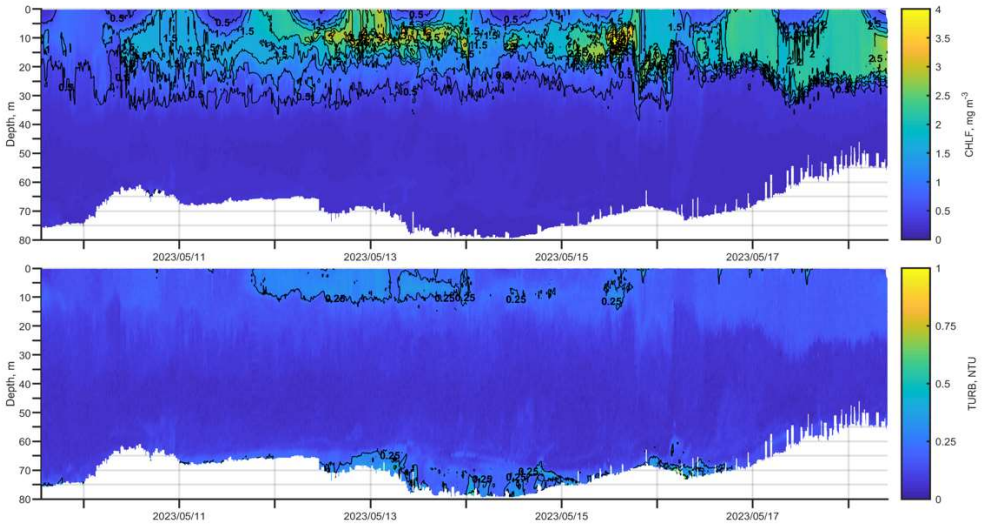


Figure 2. From the top: temperature, salinity with potential density contours overplotted in red, oxygen saturation, dissolved oxygen concentration, chlorophyl-A and turbidity, along the transect in the Slupsk Furrow.

For the acoustic experiment, the mooring equipped with hydroacoustic modem was deployed and the glider was equipped with GAN (Glider Acoustic Node consisting of the acoustic modem, data integrator and buoyancy package). The glider was deployed and performed predefined flights in vicinity of the mooring. The GAN setup was tuned during the experiment but due to technical problem with buoyancy package and very strong current at the location, it was not possible to fly the glider along the required path. In result, only technical part of acoustic communication was achieved without transferring any data packages. However, the main achievement of the acoustic experiment proving a concept of the external GAN setup on a glider for acoustic communication and gathering technical data for improving the GAN design and future integration. Due to the limited time of acoustic experiment (most of TA time was devoted to the main experiment) it was not possible to repeat glider deployment with the improved GAN setup, but it is foreseen in the future projects.
All glider data is available from:

[Sopot,Poland], [25/10/2023]

Location and date

Signature of principal investigator