APPENDIX 3

TA PROJECT REPORT

(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.**

TA PROJECT REPORT

1. Project Information

Proposal reference number[1]	22/1002929

[1] Reference number assigned to the proposal by the TA-Office.

Project Acronym (ID)[2]	GliderBloom
Title of the project[3]	**Use of FMI glider during the EMB-cruise GER – Fin – GER 2023/07**
Host Research Infrastructure[4]	**Finnish Meteorological Institute - FMI Baltic Sea Glider**
Starting date - End date[5]	01/07/2023 – 15/09/2023
Name of Principal Investigator[6] **Home Laboratory** **Address** **E-mail address** **Telephone**	Henry Bittig Leibniz-Institute for Baltic Sea Research Warnemünde IOW, Seestraße 15, 18119 Rostock, Germany henry.bittig@io-warnemuende.de

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

The objective of this project was to use a FMI's Baltic Glider to support a field campaign consisting of a combination of two observing vessels (the VOS Finnmaid and the RV Elisabeth Mann Borgese) focusing on nitrogen dynamics and its relationship to cyanobacterial bloom in the Baltic Sea by increasing the vertical and temporal coverage of the planned research.

FMI's new G3 glider "Koskelo" in the area N-NW off Hiiumaa island inside Estonian EEZ. The planned mission of the glider was a 5nm virtual mooring section between lanes of the traffic separation zone. The path crossed the deepest part of the mouth of the Gulf of Finland. We planned to run the mission in Finnish EEZ waters SW off the Hanko peninsula as a secondary option.

The vessels FINNMAID and EMB, which were involved in the study, passed the line at a distance of about 2-3 nm. FINNMAID passed the area every few days, and EMB twice during its cruise.

"Koskelo" glider has a varied sensor set consisting of a SBE CTD, an Aanderaa oxygen optode, a SBE SeaOWL fluorometer, and, as new sensors, Sequoia's Glider-LISST particle analyzer and Tau transmissometer.

[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.

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

We aimed to run the missions with the Slocum G3 glider “Koskelo” inside the Estonian EEZ. After getting permission to enter Estonian waters, we had to state that this time, the permission conditions were too demanding for us to implement the original plan. Thus, we had to change to our backup plan to operate in the Finnish EEZ waters instead.
There were also problems with the sensors of the new glider, so we carried out the study with FMI's Slocum G2 glider "Uivelo". This device just came back from service and calibration. “Uivelo” has the same set of sensors as “Koskelo” (SBE CTD, Aanderaa oxygen optode, and SBE SeaOWL fluorometer) except Sequoia sensors.
For Uivelo, the shallower section on the Finnish side was more suitable, because its buoyancy adjustment margin would not have been enough in the deeper and saltier (more dense) conditions of the Estonian side.
From 11th July to 1st August ”Uivelo” made 20 back and forth segments between two waypoints (59°29.7456’N 022°43.323’E) and (59° 28.2186’N 022° 34.833’E). It measured 3030 profiles with maximum depths of ca. 70 m. ”Uivelo” was recovered by the Finnish Coastal Guard on 2nd August East of the research area. ”Uivelo” managed to follow the mid-line of the safety area quite well.

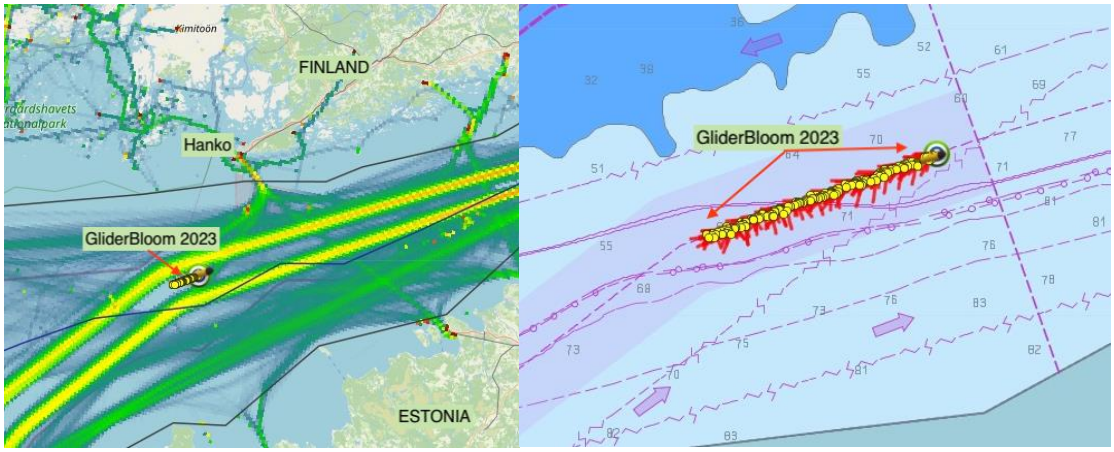

Fig 1. GliderBloom missions was the first mission ”Uivelo” had after factory maintenance and calibration in Spring 2023.

4. Dissemination of the results[9]

The data measured by ”Uivelo” will be openly available in the FMI ERDDAP service (https://ocean-erddap.fmi.fi/erddap/).

[8] Describe briefly the main achievements obtained and possible impacts, as well as possible difficulties 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

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

The aim of the supporting observations performed by the Baltic glider is to provide vertical information on water column properties before, during and after the research cruise. The main benefit of this dataset relies in its high spatial and temporal resolution that provide valuable information on the physical and biogeochemical context where the detailed observation will be carried out by the two first observing platforms.

(1) Hydrological context

The vertical structure of the water column in the area was stable during the glider mission with a relatively strong pycnocline centered around 20m that separate the warm surface mixed layer from the deeper cold and more saline waters. As seen in figure 2, both the thermocline and halocline progressively deepen from around 15m early July to 30m at the end of July. At depth, an intrusion of a saline water mass (more than 9 psu) occurred at depth mid-July, disrupting the stability of the deep water. The density of the water masses seems to be mainly controlled by temperature variations in surface water, while it is clearly controlled by variations of salinity deeper than 50 m (cf. TS diagram in figure 2).

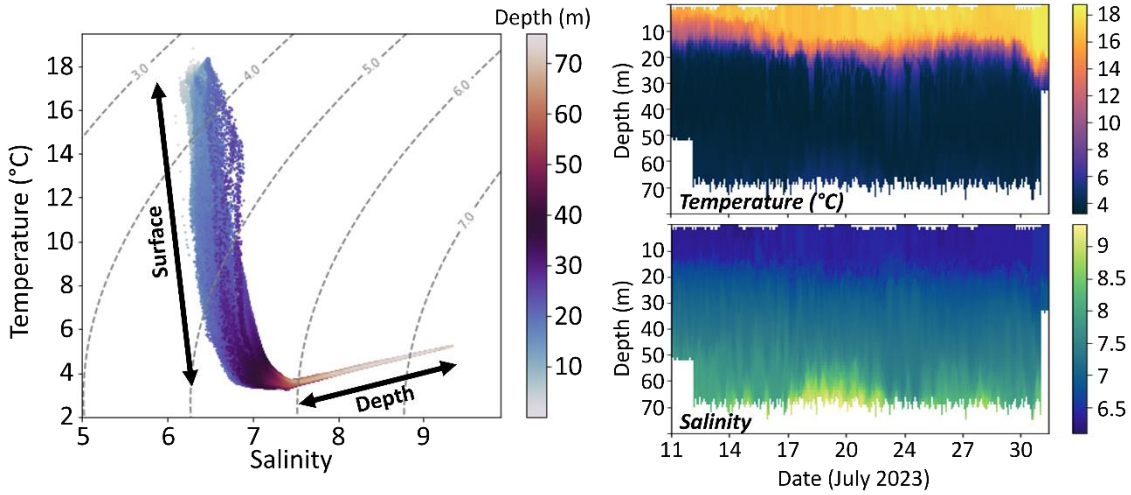

Figure 2: Temperature vs. salinity diagram of all the profiles sampled by the glider as well as variation of temperature and salinity during the GliderBloom mission.

(2) Biogeochemical processes

*Phytoplankton activity: The fluorescence of chlorophyll measured by the glider is a good proxy of autotrophic activity and primary production, although this parameter can be potentially subject to attenuation when light is too intense close to the surface of the water column and need to be corrected from this effect. Backscattering fluorescence on the other hand, could be considered as a proxy of particles suspended (living cells as well as detritus) in the water column.

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.

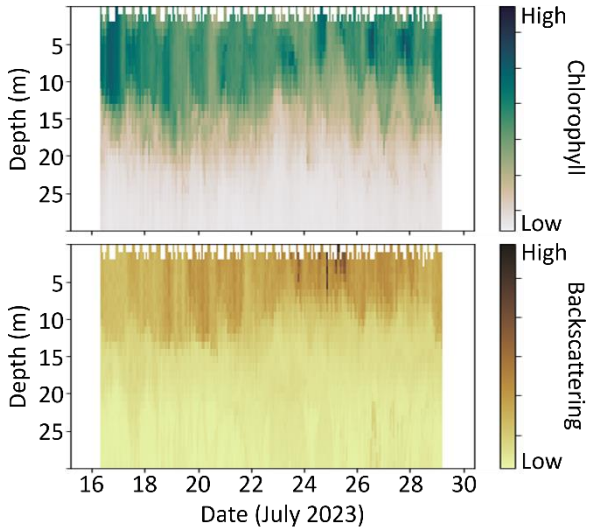

Figure 3: Temporal and spatial variations of the chlorophyll fluorescence and backscattering measured by the SeaOWL fluorometer carried by the glider during the GliderBloom mission.

As expected, these two parameters seem to be strongly correlated, with higher magnitude measured in the mixed layer (figure 3). Interestingly, chlorophyll fluorescence exhibits clear periodic oscillations at the end of the glider mission, which can be likely associated with diurnal migration of phytoplankton in the mixed layer (between 10 and 20 m), benefiting from light near the surface and accessing nutrients concentrated at the vicinity of the thermocline.

*Respiration and remineralization: Dissolved oxygen displays a distribution that is characteristic for the Baltic Sea with decreasing concentrations towards deeper water (figure 4).

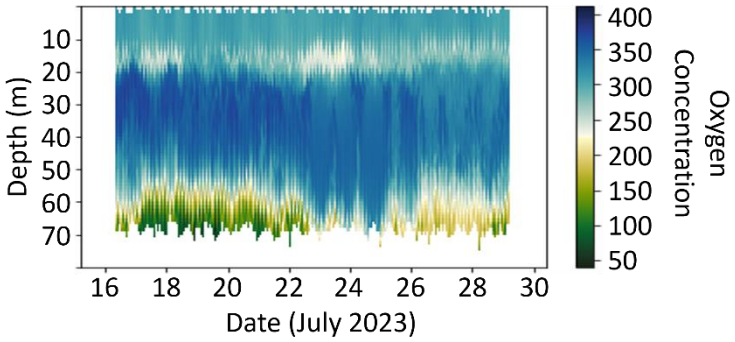

Figure 4 Temporal and spatial variations of the oxygen concentration measured by the Aanderaa optode mounted on the glider during the GliderBloom mission.

We did not observe any deep anoxic layer along the glider path and an intrusion of more oxygenated waters, perhaps associated with some mixing event, occurred between July 23rd and 25th. The water column displayed a subsurface minimum in oxygen concentration centered between 15-20 m during the whole glider mission. This could be associated with zooplankton respiration grazing on phytoplankton or bacterial remineralization of organic matter. However, this hypothesis needs to be supported by data collected from the ships (phytoplankton and zooplankton community inventories and/or bacterial production experiments).

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(3) Next steps and other outcomes

Data analysis is still in progress, FMI team still need to finalize the numerical tools that will be used to calibrate and control the quality of the biogeochemical parameters measured by the glider. This involved comparison with data collected from the ships during the cruise as well as other internal standardized methods.

On a different aspect, this TNA project highlighted the fact that the use of gliders often has legal restrictions when operated in different territorial waters (EEZ), i.e. cross-border use of gliders in territorial waters is not automatically granted. An application to obtain a permit to deploy the glider in Estonian water was made and supported by a document describing how the glider operations are conducted the safety regarding other pleasure and fishing boats during the glider mission is monitored and ensured. Permit was eventually granted but with high constraints regarding the glider mission leading FMI team to change the location of measurements back to Finnish water. This pointed out the need of designing a more official document demonstrating the strength and reliability of glider operating at sea that can be used by the community and will satisfy the authorities.

Rostock, 11 Dec. 2023

Location and date

Signature of principal investigator

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