

Response to Reviewer 4 for “Eight years of continuous Rockall Trough transport observations using moorings and gliders”

We thank the reviewers for their constructive comments which help us improve the quality of our manuscript. Below, we provide detailed responses to each comment.

During the revision, we are implementing the following improvements to the transport calculations, which we are making independently to strengthen the analysis:

- **Extending the mooring dataset to 10 years**, now overlapping with the entire glider observation period. We are changing the title of the manuscript to reflect this update: “A decade of continuous Rockall Trough transport observations using moorings and gliders”
- **Correcting the EOF analysis** by using the original time steps of glider transects instead of 15-day averages, which previously included an irregular number of transects.
- **Correcting an error in the new methodology**: The EOF analysis and regression are applied to velocity anomalies. In the earlier version, we mistakenly subtracted the glider mean at EB1 and RTADCP positions from EB1 data and GLORYS12V1 output instead of subtracting the mean of each respective dataset. This introduced a systematic offset, which has now been corrected. The glider mean field is added at the final step to define the mean of the reconstructed section, eliminating the need for bias correction of the GLORYS12V1 output.

Review of the manuscript egusphere-2025-3167.pdf

General comments

The manuscript, entitled “Eight years of continuous Rockall Trough transport observations using moorings and gliders”, presents new estimates of the European Slope Current (ESC) and North Atlantic Current (NAC) volume transports through the Rockall Trough (RT), adding two years to the existing time series. For the first time, heat and freshwater transports are also presented. The new data set includes temporal overlap of mooring and glider data from the ESC. The authors have developed a new methodology, where mooring and glider data are combined, allowing for better estimates of the ESC transports. The new methodology gives a better representation of the Eastern Wedge covering the ESC, with the undercurrent now visible in the data. Interestingly, they also find, that the variability of the ESC seems independent from the NAC variability. Over the eight years of observations, the total RT transport does not have a significant trend. The manuscript highlights the benefits of

combining various data sets to get a better representation and understanding of physical processes in the ocean.

Generally, the manuscript is within the scope of OS and the language is fairly good. But the lack of consistency in e.g. figures and abbreviations gives the impression that the manuscript is written in a hurry and that the authors have not spent enough time on polishing the manuscript. Also, the discussion is relatively short and appears more like a summary of the results section, while the results are discussed already in that section.

Thus, major revisions are needed before publication in Ocean Science.

Thank you for your thorough feedback. We appreciate your observations regarding consistency, language, and the need for a more comprehensive discussion. In response, we are undertaking major revisions to the manuscript. Specifically, we are reviewing and refining the structure, text, figures, and captions to improve clarity, completeness, and consistency. Additionally, the discussion section is being substantially rewritten to provide a deeper interpretation of the results rather than a summary

Specific comments

Abstract

Line 8-9: Here you say, that you have produced, for the first time, a continuous ESC transport time series, but as I understand, the volume transport is an update of Fraser et al., 2022. On the other hand, heat and freshwater transports for ESC and RT are presented for the first time. I suggest that you highlight that in the abstract.

Thank you for this helpful observation. You are correct that the volume transport represents an update of Fraser et al. (2022), while the heat and freshwater transports for the ESC and RT are presented for the first time. We are revising the abstract to clearly emphasize this distinction and are ensuring it accurately reflects the full scope of the analysis.

Introduction

Line 15-16: The listing of impacted regions could be rearranged in order of appearance downstream of RT, i.e. Arctic last.

Thank you for this suggestion, we are editing the sentence accordingly.

Line 29: “together with”

This is being changed.

Data and Methods

In your description, you use both “glider” and “gliders”. I suggest being consistent.

Thank you for highlighting. We are editing the text accordingly to use gliders.

Line 59: Cross-hatched region is not visible on a print out. See also comments to Figure 1 below.

Thank you for highlighting. The revised Figure 1 does not include the cross-hatched area anymore.

Line 61: Should it be “**an** SBE41”?

We are editing the sentence to: “All gliders are equipped with SBE41 CTD sensors, which...”

Line 91-95: See comments to Figure 1 below.

See answer to Figure 1 comment below.

Line 107-108: This sentence gives the impression that no data exist from the RTADCP. Please modify.

Thank you for pointing this out. The RTADCP was deployed in the ESC core in 2014 but only the first 8 months of data could be recovered. Any other attempt to recover data from later deployed ADCPs failed as the instruments were severely damaged presumably through fishing activities (Houpert et al., 2020). The old Rockall Trough transport product hence relies on ocean reanalysis output, which is bias-corrected by the available 8-month RTADCP time series, to reconstruct the northward flow of the ESC following (Houper et al., 2020; Fraser et al., 2022). We are adding this information to the data and method section for clarity.

Line 159: Please add, that Eq. 3-5 are given in section 3.4.

Thank you for this suggestion. We are removing the sentence and are incorporating the relevant information directly after introducing the equations to improve clarity.

Line 185 and 189: How did you select the reference values? Please clarify in the text.

Thank you for pointing this out. As mentioned in our responses to Reviewer 3 (answer to L185, page 5), the reference temperature and salinity are defined as the mean values observed at WB1 and WB2, which are located in the southward-flowing current west of the NAC (Figure 1b in manuscript). This choice sets the mean heat and freshwater transport through the western wedge to zero, so that the transports calculated for the mid basin and eastern wedge primarily reflect the signals of the NAC and ESC, respectively. We are including this information in the manuscript for clarity.

Results

I suggest that you add a table listing the various transport values given in the text and maybe also correlation coefficients. A table gives a better overview and it is easier for the reader to compare the different branches.

Thank you for this suggestion, we are adding tables with the important transport statistics in the result section where appropriate.

Line 200: Please specify Figure 5a.

This is being done.

Line 203: Please add Sv to the transport values.

For the revised and extended transport calculations (April 2020 – Feb 2023), the mean transport for the glider and the new eastern wedge reconstruction is 1.0 ± 0.3 Sv, while the old methodology gives 1.5 ± 0.2 Sv. The uncertainties overlap, so although the agreement is marginal, the estimates agree within their respective uncertainties. We are editing the paragraph accordingly.

Line 224: Replace “small” with “close to zero”

See answer to lines 185 and 189

Line 225: “an increasing trend”? Are these trends significant?

We are updating the trends according to the revised and extended transport time series. We are including a table in the supplementary information that reports these trends along with their significance. All trends for the western wedge and the mid basin are significant, except for the freshwater transport in the mid basin, and we do not find significant trends in the eastern wedge transports.

Discussion

As mentioned above, the discussion is relatively short and is more like a summary of the Results section. Must be rewritten into a proper discussion section.

Thank you for this suggestion. We agree and are restructuring the manuscript accordingly. Specifically, we are changing the title of the section to “Conclusion” and are adding an additional discussion section.

Line 265: “controlled by”

This is being changed.

Figures and legends

Figure 1: This figure needs some updates. Firstly, the resolution in both panels is too low.

The map must be marked with an a). The green circles are not very visible and it is hard to see, that there actually are three of them. The speed on the map seems okay, but what are the arrows based on? I do not have comments on the swirls here and there, but the arrow located at $\sim 12^{\circ}\text{W}$; $\sim 64^{\circ}\text{N}$ is flowing in the wrong direction! See e.g. Hansen et al., (2023, Fig 14) or Orvik and Niiler (2002, Fig 1 and 3b).

Hansen et al., 2023 (<https://doi.org/10.5194/os-19-1225-2023>); Orvik and Niiler 2002 (<https://doi.org/10.1029/2002GL015002>)

The hydrographic section in b) is from Frazer et al. 2022 (their Fig 1.b in a good resolution), but the resolution here is too low to see details in the figure. Houpert et al., 2020 have a similar figure (their Fig 2.a) and they nicely define the WW, MB and EB areas on top of the section. Together with the limit at depth, this would give a much better illustration of which area the three transport estimates are calculated for. As the figure is now, the cross-hatching is hard to see, especially on print, and the different symbols on the surface are not described. Please update the figure and legend accordingly.

Thank you for your suggestions. We are revising Figure 1 and its caption to enhance clarity, completeness, and consistency, and we are correcting the representation of the sketch currents accordingly.

Figure 2: Fine resolution. The names on the top are cruise id's? Please clarify in the legend.

Thank you for highlighting this point. We are revising Figure 2 to ensure consistency with the other figures and are removing the cruise names for improved clarity.

Figure 3: Please use “°W” for consistency with other figures.

Thank you for your suggestion. We are revising Figure 3 accordingly to ensure consistency with the other figures

Figure 4: Blue square marks the RTADCP – right? This information should also be added to Figure 1b.

Thank you for pointing this out. We are revising Figure 4 to be consistent with Figure 1.

Figure 5: The figure legend is insufficient. Reference to a) and b) is missing. The black dotted lines and the vertical bars (in b) are not described in the legend. Moving on to figures 6, 7 and 8, you here use the colors blue, orange and green for MB, EW and WW – but they are not consistent in all figures. Please select one color for each region and use them consistently.

Please do not re-use these colors in Figure 5 (except for the EW color). What is the temporal resolution in a)?

Thank you for highlighting. We are revising Figure 5 and caption for clarity and consistency (see Figure 1 in our response to Reviewer1, page 3).

Figure 6: Please repeat the description of the numbers in the panels.

Thank you for highlighting this point. We are revising the caption of Figure 6 to ensure completeness and clarity.

Figure 7: Please add more details to the legend and include ref to all panels. The red lines (solid and dotted) in b, d and f are not very visible. Please modify.

Thank you for highlighting this point. We are revising the Figure 7 and caption to ensure completeness and clarity.

Figure 8: Please be consistent in the use of colors and avoid to use orange for temperature in a) and blue for WB1/2 in b). You should probably also avoid to use red and green in the same figure.

2nd line in legend should read “(b) isolating”.

Thank you for your suggestion. We are revising the Figure 8 and caption to ensure completeness and clarity.

Supplementary

The title is different from the manuscript title.

Thank you for highlighting. We are editing the title accordingly.