

Response to Reviewers

Dear Reviewers,

Thank you for giving me the opportunity to submit a revised draft of our manuscript titled "Munition Piles in the German Baltic Sea: Inventory and Maritime Hazard Perspectives" to Earth System Science Data. We appreciate the time and effort that you have dedicated to providing your valuable feedback on my manuscript. We are grateful for your insightful comments on our paper, which helped us incorporate meaningful improvements into the manuscript. In the manuscript, we highlighted the changes. Below are your comments with our responses and description of changes made to the manuscript.

Reviewer 1

General Comments

Comment: The authors present two datasets describing the occurrence of munition piles and their spatial distribution in relation to maritime activities. Dataset A is publicly available. However, within the manuscript, a non-public link is cited, while the publicly accessible link is provided only in the Data Availability section. This inconsistency should be harmonized (see also specific comments).

Response and changes: We corrected the reference in the manuscript. It now points to the dataset publication on PANGAEA. We also slightly adapted the description of the two datasets in Section 1.

Comment 1: Dataset B, which represents a subset analyzed in greater detail, is not yet accessible. Consequently, statements based on this dataset cannot be reviewed properly.

Response and changes: As pointed out in our previous response (<https://doi.org/10.5194/essd-2025-795-AC1>), the subset is a supplement to the article (<https://essd.copernicus.org/preprints/essd-2025-795/essd-2025-795-supplement.zip>). We are happy to receive additional comments.

Comment: Overall, the manuscript is understandable and methods are described in great detail, aside from minor issues (see specific comments).

Response: Thank you very much for your kind review.

Specific Comments

Comment: Please define the term living dataset.

Response and changes: We added a paragraph on the living dataset concept. ESSD provides additional information here: https://www.earth-system-science-data.net/living_data_process.html.

Comment: What do you understand under the term munition properties? Please define in more detail.

Response and changes: We added a non-exhaustive list of munition properties to the text.

Comment: When is a pile a pile? How do you define that an object is belonging to a pile and when do you characterize it as scattered object, respectively? For example, is number of objects or the distance of the objects relevant to define a pile?

Response: This question addresses an important limit when using sonic data (MBES) for visual annotation. It is not possible to define exact cut-off criteria for the number of objects or distance. Experience shows that visual inspection of munition piles often reveals that the MBES annotation serves as an initial indication for a point of interest that needs to be studied more closely. Any cut-off criterion would therefore be a pseudo-precise definition.

Changes: We added a few explanatory sentences as well as an example MBES raster and photomosaic to better demonstrate the workflow and the limits of visual MBES annotation.

Comment: As source for Dataset A is given Frey et al. 2026a. This reference is not public available. At the end of the manuscript you refer to Pangaea. I guess it's the same dataset? Use this reference also in chapter 1.

Response and changes: We corrected the reference in the manuscript. It now points to the dataset publication on PANGAEA. We also slightly adapted the description of the two datasets in Section 1.

Comment: Chapter 3: Which area is covered by MBES data. Please highlight in Figure 2. Including Lübeck Bay. See also comment for Figure 2.

Response: We produced a map showing the maritime activities for the surroundings of the Kolberger Heide dumpsite. We also added the MBES data coverage from the cruises that are mentioned in Section 3.1.1.

Changes: The new map (Kolberger Heide) was added, the existing map was updated (Lübeck Bay), and a minor change was made to the body of the text to refer to the figure.

Comment: Chapter 3.1: The Authors refer the description of the dump sites to other publications. Nevertheless, a short summary would be good.

Response: This is the only comment that we respectfully reject. Certainly, it is always possible to add more information. However, we are convinced that reiterating knowledge here, which is provided in a well-structured manner in other publications, has only limited value. The paper at hand will be lengthened by descriptions of site geology or historical information, but neither will add to the understanding of the reader concerning munition pile properties and maritime hazard implications. We would like to maintain focus for the dataset description and assessment.

Changes: No changes were made.

Comment: Chapter 3.1.2, line 181: please spell out the term OFOP.

Response and changes: We spelt out the term 'Ocean Floor Observation Protocol' (OFOP).

Comment: Chapter 3.2, line 210: Frey et al. 2026b is reference not public available. In my opinion, this is critical because details about the data origin are important information.

Response: We agree with this statement. We did not publish the document yet to ensure that it is aligned with this paper's post-review method description. The reference is going to be published by June 30, 2026.

Changes: No changes were made in the text.

Comment: Chapter 3.2, line 211 f: I'm wondering which parameter are discussed in this manuscript. Please elaborate. I guess the authors describe this later. However, here the reader is left in the dark.

Response and changes: We added two sentences that clarify which maritime uses are assessed and how this is done. More details are provided further down in the same section. We also slightly restructured the first two paragraphs of Section 3.2.

Comment: Chapter 3.2, line 230 f: I guess using ship type depending traffic density from one year is principally ok, but it is not true that 2022 is the only available year. HELCOM provides ship density maps, distinguishing vessel types, since 2006.

Response: Thank you for pointing this out. When an updated version of the dataset will be published, we will repeat this assessment but include vessel traffic data from all or at least recent years to increase the representativeness of the analysis.

Changes: The respective sentence in the paper was adapted.

Comment: Chapter 3.2., line 241 f: The HELCOM data were converged into three categories. Why were these three categories choosen? Why was the category fishing vessels not choosen? I guess fishing activities are more impacted by munition than for example passenger vessels.

Response: It is true that fishers are impacted more strongly by munitions than passenger or cargo vessels. And it would be highly desirable to assess this situation more closely. However, AIS data are not suitable for an assessment of fishing activity, since they only track where a ship is located, not whether it is actively fishing. Instead, one would need to use vessel monitoring system (VMS) data. Such data is available in the dataset HELCOM 2023b. However, it has a crude resolution (using c-squares). Therefore, only the last brief paragraph of Section 4.3 is dedicated to this issue and data.

Changes: We adapted the text so it is more transparent regarding the available types in the HELCOM AIS dataset and how they were merged. It also provides a rationale for the selection of the three categories for this paper.

Comment: Figure 2: It is inconsistent that the maritime activities are only shown for Lübeck Bay and not for Kiel Bay.

Response: We produced a map showing the maritime activities for the surroundings of the Kolberger Heide dumpsite. We also added areas that are used by the military.

Changes: The new map (Kolberger Heide) was added, the existing map was updated (Lübeck Bay), and a minor change was made to the body of the text referring to the figure.

Comment: Chapter 4.1, line 268 f: By whom or which method have been the munition piles confirmed? Please clarify.

Response: Confirmation was done by the authors and their colleagues during the same cruises during which MBES data were collected.

Changes: We added the list of means of confirmation and refer back to section 3.1.1 to clarify that confirmation work is done during our cruises.

Comment: Chapter 4.1, line 293 "In summary, a typical munition pile in the German Baltic Sea ...": There are much more dumping sites in the German Bight (e.g. Mecklenburg Bight, Pommeranian Bight). Are sure, that these have similar characterized. Otherwise replace German Baltic Sea by "study area".

Response: We have also surveyed the dump sites in Mecklenburg Bight (there are only two piles) and near Falshöft (no piles, only individual objects). Other areas in the German Baltic Sea are not known to be dump sites but to be contaminated by munitions for other reasons.

Changes: Nevertheless, we followed your suggestion, since it is more precise wording.

Comment: Figure 3, legend: Number of piles instead of objects?

Response and changes: Thank you for spotting this error. We corrected the map.

Comment: Chapter 5, line 401 f: replace German Baltic Sea by study area (see comment above).

Response: We have also surveyed the dump sites in Mecklenburg Bight (there are only two piles) and near Falshöft (no piles, only individual objects). Other areas in the German Baltic Sea are not known to be dump sites but to be contaminated by munitions for other reasons.

Changes: Nevertheless, we followed your suggestion, since it is more precise wording.

Comment: Chapter 5, line 409: The historical data don't match with this study. Summarize shortly why.

Response and changes: We iterated the numbers from the extrapolation and the historical records as well as the potential explanations for the gap.

Technical Comments

Comment: Values and units are not consistently separated from one another. Some are separated by spaces, while others are not. Thousands separators are not used consistently.

Response and changes: We corrected value and unit separation as well as thousand separators.

Reviewer 2

General Comments

Comment: This manuscript presents a comprehensive, well-documented, and highly valuable dataset on munition piles in the German Baltic Sea. The methodology is clearly documented, the data products are of high quality, and the manuscript is well structured and easy to follow. The dataset will be of considerable interest to researchers, environmental managers, and maritime stakeholders concerned with underwater munitions, environmental monitoring, and marine spatial planning.

The manuscript represents a significant contribution to the availability of high-quality marine environmental data and provides an important basis for future research and management activities in the Baltic Sea region.

I consider the manuscript to be scientifically sound and suitable for publication in ESSD. Only technical clarifications and editorial improvements may be considered during the final revision process.

Response: Thank you very much for your kind review.