Reviewer #2:

General Comments:

The manuscript provides valuable insights into the ecological changes within the Lena Delta, leveraging satellite imagery and field data to map vegetation and habitat distributions. This work is timely and contributes significantly to our understanding of Arctic ecosystems' responses to climate change. However, several areas require further detail and clarification to enhance the manuscript's impact and utility for future research.

Major Comments:

Data Source and Acquisition Transparency:

Suggestion: Provide detailed information on data sources, including satellite data acquisition dates, sensor types, and ground truth data origins. This detail will help verify the reliability and applicability of the data used.

- Thank you, we included a table in the supplements that highlights the different datasets, their inputs and sources. In addition, we provide more details in the data availability chapter. The revised figure 1 should also provide a better description and support for understanding the individual datasets as well as their differences.

Methodology on Multi-source Data Fusion:

Suggestion: If the study integrates multiple data sources (e.g., different satellite sensors, ground measurements), describe the fusion methods, including how resolution, coverage time, and accuracy differences were addressed.

- Spatial Interpolation and Scaling Methods:

Suggestion: Detail the spatial interpolation or scaling methods used, their justification, and potential impacts on dataset accuracy and reliability.

- We combined the two review comments as they refer to the methods. Sorry about the confusion, we realized that the former version of Figure 1 could be misleading, making it seem that we applied technical data fusion. In this study, we did not apply a technical data fusion method, specifically not a pixel-level multi-scale data fusion. We used the field data to decide which habitat classes could be assessed and how to characterize them (e.g. table 2 in the manuscript). We named this process in the former Figure 1 ‘habitat characterisation’ with arrows leading from the boxes of the 3 field data products to the box of ‘habitat characterisation’. New: we now deleted the two arrows that are the cause for confusion (one arrow leading directly from the field

data to the central Lena Delta classification (Landgraf et al. 2022), one arrow leading directly from the field data to the disturbance map (Heim and Lisovski 2023).

Revision: i) updated figure 1; ii) 2 new technical figures in appendix visualizing data sources and steps to produce a) the central Lena Delta classification and b) the Lena Delta habitat map and iii) new table S3 in appendix with detailed overview on input data and characteristics.

Furthermore, we added a new subsection '4.4 Classification accuracy and representativeness' to also address other comments and to further discuss the use of field work and satellite data (LL560-572).

Temporal and Spatial Scale:

Temporal-Spatial Coverage and Representativeness:

Suggestion: Discuss whether the dataset's temporal-spatial coverage adequately represents the Lena Delta's seasonal and multi-year variations and its potential impact on ecosystem change analysis.

- We included an entire section in the discussion dealing with temporal and spatial accuracy and representativeness of our datasets.
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Choice of Temporal-Spatial Resolution:

Suggestion: Justify the chosen temporal-spatial resolution, including how the balance between data processing capabilities and analysis needs was achieved and the potential impact of different resolutions on result interpretation.

- These are very good points. We discuss this in the text LL513-524 and LL 573-584
- The land cover map from Schneider et al. (2009) is based on two cloud-free Landsat images from June/July 2000 and 2001, the ESA CCI land cover 2018 map is based on summer images as well. Hence, the images used for this habitat classification were acquired at a similar time as for the ESA CCI product and we do not expect differences based on changes on the ground due to this temporal concurrence. In the almost 20-year difference between Schneider et al. (2009) and this habitat map we do expect changes in vegetation composition. Overall, it is challenging to obtain sufficient cloud-free images during the summer months to fully cover the entire Lena

Delta for a classification project and to depict a specific phenological state. Therefore, we created a Sentinel-2 composite mosaic based on the maximum NDVI value per pixel from June to September. With this we ensure to have the peak vegetation and phenology season represented as input for the habitat classification as much as possible and increase comparability to other classification studies despite a temporal mismatch.

- The field data was acquired during a field trip in July-August 2018, primarily focusing on 30 m x 30 m homogeneous vegetation and land cover plots. Additionally, we relied on Sentinel-2 images for the different classifications that were also acquired in summer 2018, covering the same period as the field trip, and have a spatial resolution of 20 m. The temporal overlap of the field work and the satellite image acquisitions ensures consistency across the different datasets and represents a close relationship between datasets and products obtained in the field (dataset 1, 2 and 3) and the results derived from the satellite images that use the field data as input. As Sentinel-2 images have a small geolocation error, we could link our field plot locations directly with the satellite images. Furthermore, the sampling and measurement design of the plots with 30 m x 30 m ensured a reliable link to the satellite data with similar spatial resolution, as we followed the recommendations on ESU. The RGB NIR Sentinel-2 bands have a spatial resolution of 10 m and the red edge (NIR) and SWIR bands a spatial resolution of 20 m, and even if we downsampled the bands to 10 m the spectral information is sustained.

Accuracy and Uncertainty:

Accuracy Assessment:

Suggestion: Include additional accuracy assessment metrics beyond classification accuracy, such as user accuracy, producer's accuracy, and Kappa coefficient, to comprehensively evaluate the dataset's quality.

- We have revised our approach to assess classification accuracy. Several reasons lead to the fact that we are not able to perform independent classical cross-validation and quantitative assessments. We have, however, discussed the accuracy etc. in more detail and added an entire section in the discussion.

Uncertainty Analysis:

Suggestion: Conduct a quantitative analysis of uncertainties in the dataset, including those arising from data sources, classification methods, and choice of temporal-spatial resolutions. Discuss the potential impact of these uncertainties on ecosystem analysis and interpretation.

- Concerning the question of temporal-spatial resolution, please see the answer to your previous comment.

Minor Comments:

Language and Expression: Ensure consistency in terminology throughout the manuscript. For instance, clarify the use of "habitat types" vs. "vegetation types" and maintain consistent use throughout.

- Thanks, you are right, we were not quite consistent within our manuscript. We made changes throughout the document for consistency. However, other studies often performed land cover classifications and called them accordingly, hence, we used this term when comparing to our habitat classification.

Figures and Tables: Enhance the readability of figures by adjusting label sizes and including legends directly on figures for clarity. Ensure tables detailing methodologies are clear and abbreviations are defined.

- Thank you. We adapted the figures and ensured increased readability.

Supplementary Information: Consider adding supplementary material detailing the technical specifications of satellite images, field equipment, and data analysis algorithms.

- Thanks, we created the above described overview table for the supplementary material.

Conclusion:

This study presents important findings on the Lena Delta's ecological dynamics. Addressing the above suggestions will strengthen the manuscript, making it a valuable resource for the scientific community interested in Arctic ecosystems and climate change impacts.

- Thank you very much for your constructive review and feedback.