Reply to the reviewers' comments (RC1) on "Circum-Arctic Sediment PROvenance Database (CASPROD): A database of mineralogy and geochemistry for the Circum-Arctic surface sediments" by Yao et al.

I have reviewed the manuscript that presents the Circum-Arctic Sediment PROvenance Database (CASPROD). This database combines four key provenance proxies: Sr–Nd isotopes, detrital zircon U–Pb ages, clay mineral assemblages, and detrital mineral proportions from 4308 sampling stations across the Arctic Ocean. By synthesizing data from 117 previously published studies and incorporating newly available datasets from previously underrepresented regions, the authors have developed an important community resource for Arctic sediment provenance research and paleoenvironmental reconstructions. The manuscript is well-written and scientifically rigorous. I believe it is suitable for publication in ESSD, after minor revisions.

Reply: We sincerely thank the reviewer for the positive evaluation and feedback on our manuscript. We are very encouraged by the recognition of the CASPROD database as a valuable community resource for Arctic sediment provenance and paleoenvironmental research. We have carefully considered all the comments and suggestions provided below and have revised the manuscript accordingly to further improve its quality. The changes have been highlighted in blue color in the revised manuscript.

Comment 1: DIVA is an appropriate method for spatial interpolation here, but I think the manuscript would be benefit from a brief discussion on the spatial uncertainty of the interpolated dataset. Regions such as parts of the Canada Basin and Canadian Arctic Archipelago, have sparse sampling, so their interpolated values might carry relatively high uncertainty. Pointing out these potential limitations would be important for anyone who intends to run quantitative analyses on this database.

Reply:

We agree with the reviewer that discussing spatial uncertainty is crucial for the appropriate quantitative use of the CASPROD database, particularly in regions with sparse sampling coverage. To address this, we have added a paragraph in Section 2.6

(*Data interpolation*) of the revised manuscript. We point out that while the DIVA (Data-Interpolating Variational Analysis) method effectively accounts for topographic barriers (such as coastlines and ridges), the reliability of the interpolated grids remains inherently constrained by regional data density. We have highlighted the Canada Basin and parts of the Canadian Arctic Archipelago as specific areas where lower sampling density results in higher interpolation uncertainty, and we caution users to exercise care when performing localized quantitative analyses in these zones.

"Although the DIVA method successfully integrates topographic features and complex coastlines to optimize spatial continuity, the accuracy of the interpolated values remains highly dependent on data density. In well-sampled regions, such as the Chukchi Sea, Laptev Sea, and parts of the Barents-Kara Seas, the grid cells represent robust local signals. Conversely, in regions with sparse sampling coverage, most notably parts of the deep Canada Basin and portions of the Canadian Arctic Archipelago, the interpolated values carry relatively higher uncertainty. Consequently, the interpolated results in these data-sparse or unsampled areas should be treated with caution and utilized primarily as a qualitative reference."

Comment 2: The Arctic environment is changing rapidly, such as, intensified riverine discharge, sea-ice retreat, enhanced permafrost thaw... For this reason, surface sediments collected at different times might reflect partially different source configurations. I advise the authors to add a brief comment on the potential temporal heterogeneity within the compiled dataset, and how users might consider this when interpreting the data.

Reply:

We agree with the reviewer that the rapid, modern environmental changes in the Arctic (e.g., accelerated sea-ice retreat, enhanced permafrost thaw, and changing riverine fluxes) raise interesting questions regarding potential temporal heterogeneity in surface sediment samples. However, we suggest that this temporal heterogeneity does not significantly bias the baseline spatial patterns established in CASPROD, making its impact negligible for broader geological and paleoenvironmental applications.
To clarify this for database users, we have added a paragraph addressing this potential temporal heterogeneity in Section 2.3 (*Dataset description*) of the revised manuscript.

“Although the depositional ages of these surface and core-top samples may vary slightly, they are all concentrated within the Holocene. Over this relatively short geological timescale, the primary circum-Arctic sediment source configurations and geological basements have remained remarkably stable. Consequently, any minor variation in depositional age among these surface and core-top sediments is practically negligible when utilizing CASPROD as a baseline to track provenance shifts over longer geological timescales, such as Quaternary glacial-interglacial cycles.”