Dear Editors and Reviewers,

We thank both reviewers for their thorough evaluation and constructive comments, which have helped us improve the quality and clarity of our manuscript. Below we provide a detailed response to each reviewer.

Response to RC1

We appreciate the insightful comments regarding the magnitude of improvement, small-scale noise, continental shelf limitations, validation coverage, and regional features.

- **Magnitude of Improvement**: We have revised the conclusion to explicitly acknowledge the limited global improvement (0.2–0.5%) compared to CLS18, while emphasizing the regional advances, particularly in the Arctic and Nordic Seas.
- **Small-Scale Noise**: Figure 5 has been updated with a spectral analysis over a larger region to reduce the influence of local structures. We also discuss why synthetic observations can affect large-scale energy (up to 1000 km), noting that synthtics fields not only add small-scale variability but also reinforce large-scale geostrophic currents. The CNES-CLS18 and 22 solutions may be contaminated by noise at scales below 40 km (where the energy decay slope becomes weaker). This noise likely originates from in situ observations, from residual ageostrophic signals or poorly corrected temporal variability.
- **Continental Shelf Limitations**: We have expanded the discussion to explain why MDT remains problematic over continental shelves, which represents a significant challenge for future developments.
- **Validation Coverage**: We have highlighted the sparse in situ data coverage.
- **Regional Features**: The discussion of Arctic improvements has been strengthened, including the Beaufort Gyre representation and its unrealistic extension into the Canadian Archipelago. We also emphasized the improved resolution of the NwAFC along the Mohn Ridge in the Nordic Seas.

Response to RC2

We thank the reviewer for pointing out the need for more methodological details and a critical discussion of the results.

- **Lagrangian Filtering**: We have added a description of the Lagrangian filtering method applied near the coast, l’objectif de ce filtrage est de diminuer les vitesses normales à la côte dans la bande côtière où l’on sait que l’erreur de la MSS est plus forte ainsi que celle du géoide. Dans la zone du Mid Atlantic Bigth, ces vitesses normales moyennes le plus proche des côtes sont réduite de 6cm/s à 3cm/s.
- **Observation Errors**: Additional details have been added in the Methods section regarding the errors associated with the synthetic fields. In particular, we included a more detailed description of the error assigned to HF radar velocities in the Mid-Atlantic Bight. In this region, two velocity datasets were used: one derived from drifter observations and another from HF radar measurements. We also reformulated the passage that might have given the impression that only HF radar velocity data were used.
- **Spectral Analysis**: Figure 5 has been updated with a spectral analysis over a larger region to reduce the influence of local structures. We also discuss why synthetic observations can affect large-scale energy (up to 1000 km), noting that synthtics fields not only add small-scale variability but also reinforce large-scale geostrophic currents. The CNES-CLS18 and 22 solutions may be

contaminated by noise at scales below 40 km (where the energy decay slope becomes weaker). This noise likely originates from in situ observations, from residual ageostrophic signals or poorly corrected temporal variability.

- **Critical Discussion of Results**: We agree that the validation results presented in Section 4 do not show significant improvement of the new solution compared to the previous one, except for the Arctic Ocean. Both Section 4 and the conclusion have been revised to discuss these results more critically. In particular, we agree that the results in Section 4.2.2.1 show that the large-scale component of CNES-CLS22 MDT is less accurate than that of CNES-CLS18 MDT, with the main differences between the two solutions stemming from their first-guess fields. It is this large-scale gradient that causes the significant discrepancy in transport. Section 4.2.2.1 has been revised accordingly, as well as the conclusion.
- **Annotated PDF**: Most of the minor comments and typos noted in the attached PDF have been addressed.

We believe these revisions significantly improve the manuscript and address all concerns raised by the reviewers. We thank you again for your valuable feedback.

Sincerely,

On behalf of all co-authors