General Comments:

This manuscript presents a vertical gravity gradient anomaly (VGGA) model constructed based on the DTU21 mean sea surface model. The research is thorough and meets quality standards. This makes me willing to apply this model in my future work. However, several issues need to be addressed before publication, particularly in terms of organization and clarity. These improvements would enhance the paper's readability and impact.

Major Comments:

1. **P1, l10:** Replace "actual ocean environment" with "real ocean environment."
2. **P1, l12-13:** Rephrase for clarity: "The comparison between the VGGA and the SIO V32.1 model shows a residual mean of -0.08 Eötvös (E) and an RMS of 8.50 E, demonstrating high consistency on a global scale."
3. **P1, l16:** Consider using "multidirectional" instead of "multi-directional" for a more modern and streamlined expression.
4. **P2, l29:** Specify that the paper used V_{XX}, V_{YY}, and V_{ZZ}.
5. **P2, l44:** Maintain consistency in terminology. Since "gradients of gravity" was used earlier, ensure it is used consistently instead of "gravity gradients."
6. **P3, l86:** Replace "mean sea surface" with its abbreviation MSS after first defining it. Refer to the https://www.earth-system-science-data.net/submission.html#reference for consistency.
7. **P4, l118:** Clarify that only the "curv" dataset of SIO V32.1 was used, rather than the entire dataset. Update Figure 4 accordingly.
8. **P5, l128:** The model's name, SDUST2023VGGA, is acceptable; however, inconsistent use of VGGA throughout the text creates confusion. Ensure a clear distinction is made.
9. **P6, Fig 1:** While Arial font is acceptable, the latitude/longitude labels and partition indices lack clarity and should be improved. For Fig 2, the title should include "example," as seen in Fig 3, to account for the partition changes beyond 60° latitude.
10. **P6, l155:** Resolve the inconsistency between VGGA and SDUST2023VGGA to avoid reader confusion.
11. **P7, l161:** Address grammatical issues in this line.

12. **P7, l175:** Reorganize the language to improve clarity and readability.
13. **P7, l184:** Use "geoid" instead of "geoid structure," and enhance the explanation of Equation (6).
14. **P8, Fig 3:** The use of bold Arial font enhances visibility. Apply this style to Fig 1 for consistency.
15. **P8, l186:** Replace "multiple directions" with "multidirectional," and revise Equation (10) to align with the weighted least squares method described earlier.
16. **P8, l189:** Consider replacing "formula" with "equation," as it is more commonly used in technical writing.
17. **P8, l198:** The formatting of equations is acceptable and aligns with journal requirements.
18. **P9, l203:** Replace "directions" with "components" for technical accuracy.
19. **P9, l207:** Ensure matrices are consistently printed in boldface.
20. **P10, Fig 4:** The handling of overlapping partitions is explained in Fig 4 but is not adequately addressed in the text. Add a clear explanation.
21. **P9, l217:** State the degree and order of XGM2019e used in model construction.
22. **P9, l218:** There seems to be an extraneous “)” that might be a typographical error. Additionally, the term "estimated" could be replaced with a more precise term. Reorganizing this paragraph would enhance readability and clarity.
23. **P12–13:** While the analysis is comprehensive, some referenced articles appear tangential to the main findings and might not directly support the conclusions. Consider removing or replacing them with more directly relevant studies. Additionally, ensure consistent usage of latitude and longitude references throughout.
24. **P14, l305:** The term "additional" might not accurately describe the filtering process. It would be clearer to specify that the three-sigma criterion filters 1.41% of the data.
25. **P15, Fig 7:** Correct discrepancies in labels and data in the top-right corner of the figure.
26. **P15, l330:** Remove repeated text caused by potential copy-paste errors.
27. **P18, l354:** Simplify "residual values" to "residuals" per the https://www.earth-system-science-data.net/submission.html.
28. **P19, l379:** Correct noun errors in this line.
29. **P19, l389:** Merge "The modeling results in different regions are shown in Figure 10." with

the previous paragraph for better flow.

30. **P20, Fig 9:** While the color scheme is visually appealing, bolden the text to improve clarity.
31. **P21, Fig 10:** Thicken the axis lines for better readability.
32. **P22, l428:** to improve the organization and readability of the manuscript, I recommend that this section be moved to a separate subsection under Section 5. Additionally, while the results presented here reflect an initial attempt by the authors, and the manuscript appropriately acknowledges their limitations, these results still offer some level of validation for the accuracy of the model.
33. **P22, l429:** Use the format "hereafter referred to as SDUSTVGGA" consistently throughout the text for clarity.
34. **P23, Fig 11:** Consider splitting this figure into two for better presentation.
35. **P24, l480:** Rewrite the conclusion to remove redundant expressions and incorporate specific details from the results and analysis.
36. **P28, l594:** The citation of Kim et al. does not convincingly support the manuscript's findings and should be removed.