Dear Reviewer 1,

Thank you very much for your valuable suggestions and comments. We have carefully considered all of your comments and revised the manuscript accordingly. Your constructive suggestions have helped us improve the overall quality of the manuscript. We have addressed each comment point by point, and our detailed responses are provided below in red.

Comment: This manuscript develops the global DOV dataset based on SWOT/KaRIn wide-swath altimetry data using a novel local geoid fitting method. It also establishes the associated gravity anomaly model. Both products are provided on a 1′ × 1′ grid over ocean regions. The study makes effective use of the two-dimensional spatial information provided by SWOT wide-swath observations and offers valuable data resources for global marine gravity field research.
The manuscript is generally well organised. Comparisons with existing high-precision global products and validation against shipborne gravity observations provide a relatively comprehensive assessment of the datasets. The reported global validation residual of 3.82 mGal against shipborne gravity observations indicates good performance. The analyses under different topographic and water-depth conditions help readers understand the applicability of the products.
Based on this, I have some comments and questions. After the authors make the minor revisions, it could be accepted.
Reply: Thanks for your suggestions and comments. We have addressed each comment point by point, and our detailed responses are provided below.

Specific comments
Comment1: P3L100: I think you could just use one of these terms, "oblique" or "diagonal direction ", which have the same meaning.
Reply1: Thanks for your suggestions and comments. We apologize for the redundant wording in the original manuscript. Following your suggestion, we have removed “diagonal” and retained “oblique” to avoid redundancy. The revised sentence is as follows:

“This allows residual geoid height gradients to be extended beyond the along-track direction to the cross-track and oblique directions.”

Comment2: P4L129: Please provide the calendar dates corresponding to SWOT cycles 002–034 and specify the version and spatial and temporal resolution of the ADT product. Maybe you can provide more information about the ADT model.
Reply2: Thank you for your valuable comments. Following your suggestion, we have added the calendar dates corresponding to SWOT cycles 002–034 and provided additional information on the version, spatial grid resolution, temporal resolution, and mapping method of the ADT product. Specifically, SWOT cycles 002-034 span from August 11, 2023 to June 29, 2025. The ADT data used in this study are from the SSALTO/DUACS experimental Level-4 multimission gridded product, version 2.0.1, with a spatial grid resolution of 1/8° (7.5′) and a daily temporal resolution. We used the ADT data covering the same period as the SWOT observations, from August 11, 2023 to June 29, 2025. In addition, we have further clarified that the product is generated using the

Multiscale Interpolation Ocean Science Topography (MIOST) mapping approach to combine observations from multiple satellite altimetry missions.
We have supplemented the relevant content in Section 2.1 and highlighted the changes in red within the manuscript.

Comment3: P6L182: This study has compiled a large amount of shipborne gravity measurements, which serves as an important reference for model validation. I have a question: is there any overlap between the NCEI and JAMSTEC datasets? Furthermore, did you process the data regionally or by individual cruise track?
Reply3: Thank you very much for this valuable comment. Following your suggestion, we re-examined all shipborne gravity data and checked for duplicate records within the compiled dataset as well as overlaps between the NCEI and JAMSTEC datasets. We found that two of the originally compiled 490 cruise files were completely identical in terms of longitude, latitude, and gravity anomaly values. One of these files was therefore identified as a duplicate and removed, reducing the number of independent shipborne cruise tracks used for subsequent processing and model validation from 490 to 489.
In addition, an exact-coordinate comparison between the NCEI and JAMSTEC datasets identified collocated observations with identical longitude and latitude coordinates but different gravity anomaly values. Since the quality control of the shipborne gravity data in this study uses the XGM2019e_2159 reference gravity anomaly model as the benchmark, we adopted the same reference-field-based quality-control framework for these collocated observations and retained the observation with the smaller absolute residual relative to XGM2019e_2159 at each location. This treatment avoids repeated weighting of the same location in the subsequent model validation statistics. After removing the duplicate cruise and resolving the collocated observations, the relevant statistics and model validation results were recalculated using the revised shipborne dataset.
Regarding the processing strategy, the shipborne gravity observations were processed and quality-controlled separately for each individual cruise track rather than being processed as a single regional dataset. First, gross errors were removed using the three-sigma criterion with the XGM2019e_2159 reference gravity anomaly model as the benchmark, and constant bias and linear drift were corrected through linear fitting along each individual cruise track. Subsequently, to reduce the redundancy associated with the densely sampled shipborne observations, a 0.5-km median filter was applied separately to each cruise track. Finally, the processed cruise-track data were merged for global and regional model validation.

We have made the corresponding revisions in Section 2.3 and updated the relevant statistical information in the Abstract, Section 4.3, and the Conclusions. All changes are highlighted in red in the revised manuscript. For clarity, the updated shipborne-data quality statistics (Table 1), global model-validation statistics (Table 6), and regional model-validation statistics (Table 7) are provided below.
Table 1. Statistics of the differences between shipborne gravity anomalies and the XGM2019e_2159 reference gravity anomaly model (Unit: mGal)

Data Status	Model	MAX	MIN	MEAN	STD	RMS
Before Processing	XGM2019e_2159	933.10	-1001.81	1.45	8.95	9.07
After Processing	XGM2019e_2159	86.85	-99.48	-0.01	4.66	4.66

Table 6. Statistics of Differences Between Shipborne Gravity Anomalies and Gravity Anomaly Products (Unit: mGal)

Region	Product	MAX	MIN	MEAN	STD	RMS
Global [-77.6°, 77.6°]	SIO V33.1 GRA	86.60	-105.33	0.08	4.51	4.52
	DTU21GRA	87.53	-101.03	0.00	4.04	4.04
	SWOT_04GRA	87.30	-100.48	0.16	4.11	4.11
	SDUST2025GRA	86.72	-108.02	0.00	3.82	3.82
Middle and Low Latitudes [-60°, 60°]	SIO V33.1 GRA	86.60	-99.90	0.13	4.28	4.28
	DTU21GRA	87.53	-101.03	0.01	3.89	3.89
	SWOT_04GRA	87.30	-100.48	0.18	3.87	3.87
	SDUST2025GRA	86.72	-100.31	0.02	3.69	3.69
High Latitudes [-77.6°, -60°); (60°, 77.6°]	SIO V33.1 GRA	78.71	-105.33	-0.49	6.41	6.43
	DTU21GRA	68.03	-84.11	-0.17	5.31	5.31
	SWOT_04GRA	80.28	-97.00	-0.10	6.07	6.07
	SDUST2025GRA	72.20	-108.02	-0.13	5.01	5.01

Table 7. Statistics of Differences Between Shipborne Gravity Anomalies and Gravity Anomaly Products in Different Regions (Unit: mGal)

Region	SIO V33.1 GRA		SWOT_04GRA		DTU21GRA		SDUST2025GRA	
	MEAN	RMS	MEAN	RMS	MEAN	RMS	MEAN	RMS
A	0.62	3.56	0.75	3.35	0.50	3.43	0.55	3.33
B	0.33	4.72	0.35	4.14	0.16	4.13	0.19	3.83
C	-0.49	3.77	-0.47	3.40	-0.60	3.39	-0.54	3.27
D	0.17	2.64	0.03	2.41	0.18	2.60	0.17	2.37

Comment4: P7L196: Figure 1 identifies four regions, A–D, but the caption does not explain these boxes until the results section later in the text. It would be better to describe their characteristics and locations here, helping readers relate Figure 1 to the subsequent regional validation statistics.

Reply4: Thank you very much for your valuable suggestion. Following your suggestion, we have added brief location descriptions of Regions A-D to the revised caption of Figure 1, so that readers can directly relate these regions to the subsequent regional validation results when first viewing the figure. The detailed characteristics of these regions are discussed in Section 4.2 of the manuscript. Therefore, only brief location information is provided in the figure caption here. The specific revision is as follows:

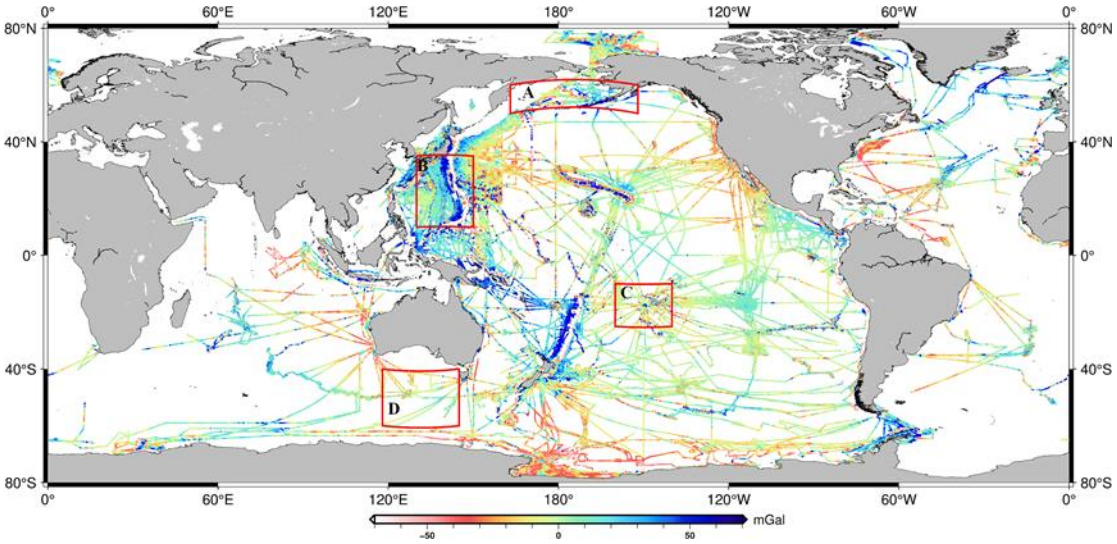


Figure 1. Spatial Distribution of Processed NCEI and JAMSTEC Shipborne Gravity Anomaly Data Since 1990. Regions A-D denote four regional validation areas: A, the Aleutian Islands region (163°E-155°W, 50°-60°N); B, the eastern Philippine Sea (130°-150°E, 10°-35°N); C, the Society Islands region (160°-140°W, 25°-10°S); and D, the region south of Australia (118°-145°E, 60°-40°S).

Comment5: P10L277: The manuscript explains the kernel of the IVM and the need to calculate the inner-zone contribution, but the implementation remains briefly described. Please specify how the inner-zone radius is determined and provide the approximate formula used, or give detailed references.

Reply5: Thank you very much for your valuable suggestion. Following your suggestion, we have supplemented Section 3.2 with the method used to determine the innermost zone and further clarified its specific implementation. The corresponding revision is as follows:

"The corresponding formula can be expressed as follows:

$$\begin{cases} \Delta g(P) = \dfrac{s_0 \gamma_0}{2}(\xi_\varphi + \eta_\lambda) \\ s_0 = \sqrt{(\Delta x \Delta y)/\pi} \end{cases} \tag{9}$$

where $\Delta g(P)$ denotes the gravity anomaly contribution obtained from the innermost zone, ξ_φ denotes the derivative of ξ in the north-south direction, η_φ denotes the derivative of η in the east-west direction, s_0 is the radius of the innermost zone, and Δx and Δy denote the grid intervals of ξ and η, respectively."

Comment6: P10L287: I am very interested in Kriging interpolation. It is an effective method for filling in the gaps. Please describe the variogram model used for Kriging interpolation and the criteria for selecting neighbouring valid observations.

Reply6: Thank you very much for your valuable suggestion. The Kriging interpolation method and parameter settings adopted in this study follow the approach of Ya et al. (2026). Since the variogram model and the selection of neighbouring valid observations are described in detail in that study, only a brief reference was provided in the original manuscript. In this study, Kriging interpolation adopts a spherical variogram model. Neighbouring valid observations are selected using a local 24′ × 24′

sliding window. For the nadir gap, valid observations on both sides of the gap are used for interpolation. For the inter-pass gaps, considering that adjacent passes are not observed simultaneously, interpolation is performed separately for each swath to reduce the influence of temporal variability, using valid observations from the side of each swath adjacent to the gap.

We have supplemented the relevant description of the Kriging interpolation in Section 4.1.1 and highlighted the changes in red in the revised manuscript.

Comment7: P19L494: Please identify the source and version of the bathymetric model used in the correlation analysis and describe the slope calculation and band-pass filtering methods.
Reply7: Thank you very much for your valuable suggestion. The GEBCO2025 bathymetric dataset is used in the correlation analysis. To calculate the seafloor topographic slope, the gradients of the band-pass-filtered bathymetric data in the east–west and north–south directions are calculated separately, and the root sum of their squares is used to represent the topographic gradient magnitude, which characterizes the intensity of seafloor topographic variations within the corresponding wavelength band. The band-pass filtering is performed using a frequency-domain filtering method based on the two-dimensional fast Fourier transform (2-D FFT).

We have supplemented the relevant descriptions of the bathymetric data source, the calculation of the topographic gradient, and the band-pass filtering method in Section 4.2.2 and highlighted the changes in red in the revised manuscript.

Comment8: P19L509: “Within the 10-50 km wavelength range, however, the correlation between SDUST2025DOV and seafloor topographic slope is lower than that of SWOT_04DOV.” The conclusion requires a regional qualification. It is not a universally applicable finding, as the correlation coefficients for both components in Region A are slightly higher than those for SWOT_04DOV.
Reply8: Thank you very much for your valuable suggestion. We apologize for the overly general statement in the original manuscript. Within the 10-50 km wavelength range, the correlation between SDUST2025DOV and seafloor topographic slope is slightly higher than that between SWOT_04DOV and seafloor topographic slope in Region A, whereas it is slightly lower in Regions B, C, and D. The lower correlations between SDUST2025DOV and seafloor topographic slope observed in Regions B-D may be partly related to the different data versions and processing strategies adopted by the two products.

We have revised the corresponding description in Section 4.2.2 and highlighted the changes in red in the revised manuscript.

Comment9: P22L572: Table 3 shows RMS values, whereas parts of the discussion and tables refer to STD. Please check and ensure consistency between the reported statistics and the terminology used in the text. Provide a unified statistical indicator.
Reply9: Thank you very much for your valuable suggestion. We apologize for the incorrect description of the statistical indicator in the original manuscript. We have carefully checked and revised the relevant text in Section 4.2.2 and have consistently used RMS throughout. The changes

are highlighted in red in the revised manuscript.

Comment10: The key processing steps are currently distributed across Sections 3 and 4. Please consider adding a flowchart to summarise the processing workflow.

Reply10: Thank you very much for your valuable suggestion. Following your suggestion, we have added a flowchart to summarize the overall processing workflow for constructing the SDUST2025DOV and SDUST2025GRA datasets. The flowchart integrates the key steps described in Sections 3 and 4.1 and provides a clearer overview of the complete dataset generation procedure. The specific revisions are as follows:

"The main steps in constructing the SDUST2025DOV and SDUST2025GRA datasets include the processing of SWOT/KaRIn altimetry observations, interpolation and matching of the ADT data, geoid height calculation and outlier rejection, DOV determination based on local geoid fitting, multi-cycle averaging at corresponding observation locations, DOV gridding, gap filling and anomalous-value replacement, and gravity anomaly recovery using the inverse Vening-Meinesz formula. The overall processing workflow is shown in Fig. 2.

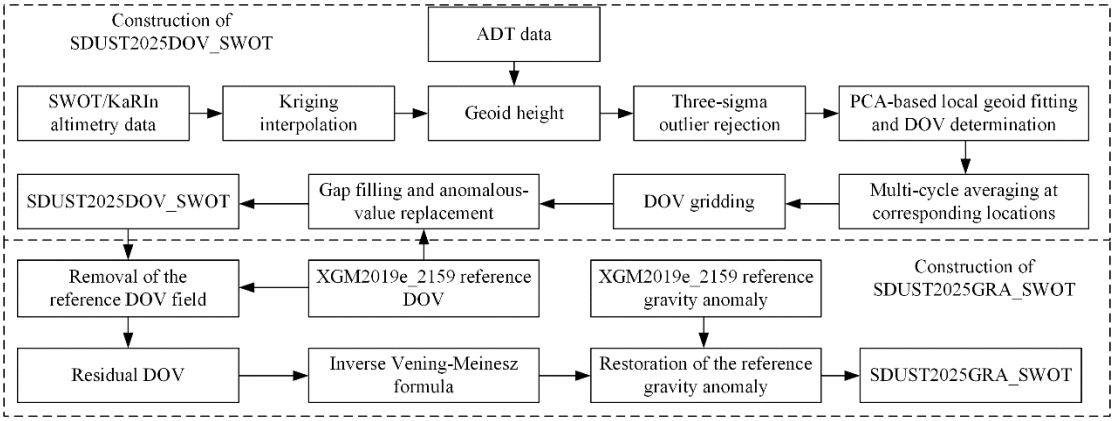


Figure 2. Processing workflow for constructing the SDUST2025DOV and SDUST2025GRA datasets."

Comment11: Local fitting for DOV estimation is an important feature of this study. However, XGM2019e_2159 remains involved in filling selected grid points and in subsequent gravity anomaly recovery. For readers, distinguishing between calculation strategies will be quite confusing. Please make the relevant statements consistent and clarify which calculations do not employ the RCR strategy, whether the RCR strategy is required, and which part it should be applied.

Reply11: Thank you very much for your valuable suggestion. We apologize that the scope of the RCR strategy was not sufficiently clear in the original manuscript, which may have caused confusion regarding the calculation strategies adopted at different stages. The statement that the proposed approach does not rely on the conventional RCR strategy refers specifically to the DOV estimation based on local geoid fitting. In this step, geoid heights are directly derived from the SWOT/KaRIn sea surface height observations and ADT data, and the DOV is subsequently determined through local PCA-based plane fitting without first removing the XGM2019e_2159 reference gravity field. XGM2019e_2159 is only used in the subsequent treatment of a small number of DOV grid points, including the replacement of anomalous grid points and the filling of grid points without valid SWOT/KaRIn observations. These operations are different from the conventional

RCR procedure for DOV estimation, in which a reference field is first removed, the residual field is calculated, and the reference field is subsequently restored.
For the subsequent derivation of SDUST2025GRA from SDUST2025DOV, a reference-field-based remove-compute-restore strategy is applied. Specifically, the XGM2019e_2159 reference DOV field is first removed from SDUST2025DOV, the residual gravity anomalies are then recovered using the inverse Vening-Meinesz formula, and the XGM2019e_2159 reference gravity anomalies are finally restored to obtain the complete SDUST2025GRA dataset.

Following your suggestion, we have carefully reviewed and revised the relevant descriptions, and the changes are highlighted in red in the revised manuscript.

Technical corrections
Comment12: P2L36: Does “SWOT_04GRA” refer to “grav_SWOT_04” from SIO?
Reply12: Thank you very much for your valuable suggestion. Yes, SWOT_04GRA in this manuscript refers to the grav_SWOT_04 gravity anomaly model released by SIO. We have clarified this naming convention in the revised manuscript.

Comment13: P2L61 and L555: Replace “Anderson” with “Andersen” to match the corresponding reference entries. And please check each one carefully.
Reply13: Thank you very much for your valuable suggestion. We apologize for the spelling errors in the original manuscript. Following your suggestion, we have corrected “Anderson” to “Andersen” and carefully checked the author names and corresponding citations throughout the manuscript to ensure consistency with the reference list.

Comment14: P2L61: Remove the extra “;”in “Jin et al., 2022;)”.
Reply14: Thank you very much for your valuable suggestion. We apologize for the incorrect punctuation in the original manuscript. Following your suggestion, we have removed the extra semicolon after “Jin et al., 2022”.

Comment15: P2L62: You’d better say “conventional nadir altimeters provide relatively limited information in the cross-track direction.”
Reply15: Thank you very much for this comment. Following your suggestion, we have revised this sentence to “conventional nadir altimeters provide relatively limited information in the cross-track direction.”

Comment16: I am not sure whether this is an issue with my viewer or a problem with the version of the manuscript itself, but some words contain spaces within their spelling—for example, "continuo us" on P2L53, "relative ly" on P2L62, and “multip le” on P3L67. Please check the manuscript.
Reply16: Thank you very much for this comment. After checking the manuscript, we found that these unexpected spaces within words were likely introduced during the PDF generation process, as they do not appear in the original Word document. Following your suggestion, we have carefully checked the entire manuscript and re-examined the revised PDF to ensure that such spacing issues have been eliminated.

Comment17: P9L254: Change “η represent” to “η represents.”
Reply17: Thank you very much for this comment. We have corrected “η represent” to “η represents” in the revised manuscript.

Comment18: P20L512: I suggest once again that you check the product naming conventions used in the SIO, or ensure that a consistent set of names is used throughout the manuscript.
Reply18: Thank you very much for this comment. Following your suggestion, we rechecked the official naming conventions of the products released by SIO and standardized the product names used throughout the manuscript. For consistency in terminology throughout this study, we standardized the naming of all comparison products as follows: the north_33.1 and east_33.1 DOV products are collectively referred to as SIO V33.1 DOV, while grav_33.1 is referred to as SIO V33.1 GRA. Similarly, north_SWOT_04 and east_SWOT_04 are collectively referred to as SWOT_04DOV, while grav_SWOT_04 is referred to as SWOT_04 GRA. The DTU21Gra gravity anomaly product is referred to as DTU21GRA.

We have added a clarification of the product naming conventions in Section 2.2 and highlighted the changes in red in the revised manuscript.

Comment19: P26L689: The expression “carried out the experimental results” is not professional. Please provide a new statement on author contributions.
Reply19: Thank you very much for this comment. We apologize for the inappropriate expression in the original manuscript. Following your suggestion, we have carefully reviewed and revised the author contribution statement to describe the actual contributions of the authors more clearly and professionally. The specific revisions are as follows:

“SB conducted the experiments and contributed to writing the manuscript. YJ and XL provided comments and suggestions on the study.”

Comment20: P26L709: Please check the reference format and ensure it is consistent.
Reply20: Thank you very much for this comment. Following your suggestion, we have carefully checked the format of all references and standardized the author names, punctuation, journal titles, volume and page information, publication years, and DOI information to ensure consistency throughout the reference list.

Thank you again for your valuable comments and suggestions. They are very helpful for revising and improving our manuscript and also provide important guidance for our future research.