Reviewer 1:

The study derives a crucial shallow-water depth model over island areas in South China Sea (SCS) using the satellite-derived bathymetry technique. The results demonstrate that the computed model has significant improvements compared to traditional models, providing a reference for mapping shallow water depths close to islands over SCS. The article is well-prepared, the theoretical framework and numerical experiments are well presented. Some minor revisions are as follows:

1. P3, L105: GEBCO_2024 was recently released, the authors may consider to replace GEBCO_2023 by GEBCO_2024 for numerical experiments.

Response: The authors thank the reviewer for these beneficial comments. The authors conducted a reassessment of the latest GEBCO_2024 model. Overall, the performance of coastal shallow water bathymetry in GEBCO_2024 shows little improvement over GEBCO_2023 in the South China Sea (SCS) area, despite significant differences between the two models (Figure 1 below, the differences can exceed 100 m). This may be due to the lack of incorporation of high-precision shallow water bathymetric data in GEBCO_2024. Specifically, validation results in Lingyang Reef indicate that the SDB model demonstrates better consistency with airborne LiDAR data compared to GEBCO_2024, with RMSE values of 1.10 m for satellite-derived-bathymetry (SDB) and 32.38 m for GEBCO_2024. Furthermore, comparisons across six typical reef areas revealed that GEBCO_2024 still exhibits relatively low modeling accuracy in the shallow waters of the SCS. Based on the comments of the reviewer, the authors have replaced the GEBCO_2023 model with GEBCO_2024 in the revised manuscript. Please refer to Pages 21 to 25 (Figures 12 to 14 and Tables 3 to 5) for more information.

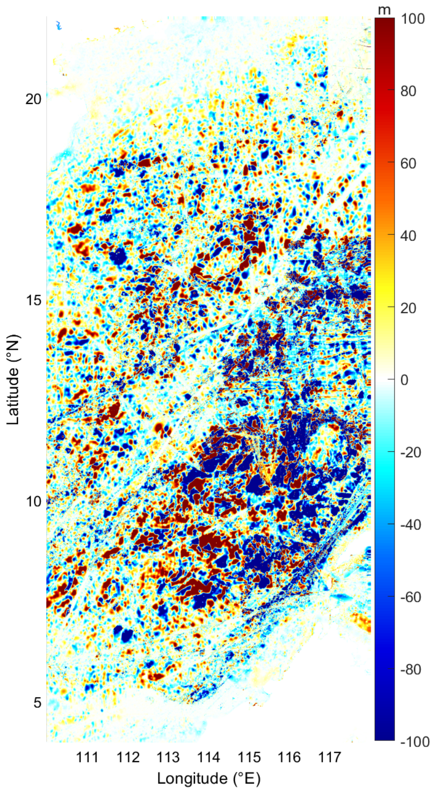

Figure 1 Differences between GEBCO_2024 and GEBCO_2023

2. P6, L160: The intelligibility of Figure 2 should be improved since the distribution of ICESat-2 data are not clearly observed over some islands.

Response: The authors thank the reviewer for these beneficial comments. The authors apologize for the reduced image clarity due to PDF processing. Based on the comments of the reviewer, the authors have re-adjusted the image quality to enhance clarity. Additionally, the authors have added the subplots of Figure 2 to the Supplementary Material to provide a clearer presentation of the distribution of ICESAT-2 data (both training and validation datasets) utilized in the SDB modeling process. Please refer to the Supplementary Material part for more information.

3. P7, L190: Why you needed to remove deep-water effects in SDB modeling? The authors may include the possible reasons.

Response: The authors thank the reviewer for these beneficial comments. According to the study by Jia et al. (2023), correcting for deep-water effects in SDB modeling helps mitigate sun glint effects, which in turn improves the accuracy and robustness of depth estimations derived from optical images. In addition, by determining the reference radiative energy in the deep-water region and removing it from the shallow-water region, the reflection energy from the water surface and water column is eliminated, leaving only the energy reflected from the seafloor. This establishes an accurate relationship between seafloor reflection energy and water depth, and significantly improves the accuracy of the SDB. Based on the reviewer's comments, the authors added more explanation about the reason of removing deep-water effects. Please refer to Page 7 Line 191 for more information.

4. P8, L200: Figure caption of Figure 3. The text "and the cyan dotted boxes in (b) and (c) indicate typical nighttime and daytime ICESat-2 tracks, respectively" can be revised as "and the cyan dotted boxes in (b) and (c) indicate the typical nighttime and daytime ICESat-2 tracks shown in Figures 6 and 7, respectively" to make it clear.

Response: The authors thank the reviewer for these beneficial comments. Based on the comment of the reviewer, the authors have refined this statement in the revised manuscript. Please refer to Page 8, Line 205 for the updated version.

5. P11, L305: "where, S1 and…" should be revised as "where S1 and…".
P15, L355 and 360: what is 'n' meaning in Eqs. (10) and (11), every variable in these equations should be predefined.

Response: The authors thank the reviewer for these beneficial comments. Based on the comment of the reviewer, the authors have carefully revised the imprecise statements. Additionally, in Eq. 10 and 11, n represents the number of spectral bands used for regression modeling. Specifically, SDB modeling in this study is performed using three bands (red, green, and blue). The authors have corrected this issue in the revised manuscript and thoroughly reviewed the parameter definitions in other equations. Please refer to Page 15, Line 362 for more information.

Reference

Jia, D., Li, Y., He, X., Yang, Z., Wu, Y., Wu, T., and Xu, N.: Methods to Improve the Accuracy and Robustness of Satellite-Derived Bathymetry through Processing of Optically Deep Waters, Remote Sens., 15, 5406, https://doi.org/10.3390/rs15225406, 2023.

Reviewer 2:

The authors have revised the manuscript based on the previous comments and proposals. Some comment and proposals are following.

[1] The method used should be present in section Abstract.

Response: The authors thank the reviewer for these beneficial comments. In this study, the authors utilized a linear band model (LBM) for satellite-derive-bathymetry (SDB) modeling. Based on the comment of the reviewer, the abstract has been updated to include details about the modeling approach, please refer to Page 1 Line 21 of the revised abstract.

[2] How to unify the depth datum of all models of all islands in the study?

Response: The authors thank the reviewer for these beneficial comments. Indeed, the vertical datum of the raw ICESAT-2 photon data provided by NASA were unified to the WGS-84 ellipsoid. In this study, the ICESAT-2 photon data were processed to provide prior water depth information for SDB modeling, and were adjusted to the DTU21MSS through refraction correction and depth calculation (Eq. 9 of the manuscript). As a result, all SDB results within the study area were referenced to the DTU21MSS datum (Wu et al., 2023). For more detailed explanations regarding the vertical datum, please refer to Page 12 Line 315 and Eq. 9 of the revised manuscript.

[3] In situ depth data are commonly used to validate the depth models. But there is no in situ depth data around some islands.

Response: The authors thank the reviewer for these beneficial comments. The authors agree with the reviewer that in situ depth data (e.g., multibeam sounding data) can provide a better and more independent validation of SDB results. However, given that the SDB results in this study encompass over 120 islands and reefs spanning more than 1000 km in the South China Sea (SCS), and that the sounding data in this region are available only for waters deeper than 500 m, it is not feasible to conduct a comprehensive validation using in situ sounding data. Therefore, the authors acquired airborne LiDAR data in Lingyang Reef to perform an accuracy assessment in a localized area. Meanwhile, the distribution of ICESAT-2 data allows for more convenient global model validation (Ma et al. 2020, Wu et al., 2023). It is important to note that, in consideration of the spatial coverage of ICESAT-2 tracks, the authors manually selected entire tracks of data for training or validation purposes, with each track being used for only one purpose (either training or validation). This ensures the independence of the data. Based on the comment of the reviewer, more explanation about the validation data is added in the revised manuscript, please refer to Page 5 Line 150 for more information.

[4] How about the dependence of the method used on the sea water quality and water color?

Response: The authors thank the reviewer for these beneficial comments. The LBM used in SDB is indeed influenced by water quality and water color. Specifically, water quality factors such as turbidity and clarity affect light penetration depth, which in turn influences the usability and quality of ICESAT-2 water depth data. Similarly, water color, influenced by factors like chlorophyll-a concentration and suspended particulate matter, alters the optical properties of water, influencing the relationship between Sentinel-2's RGB bands and ICESAT-2-derived water depths. However, in SCS region, the water quality is generally better, with superior clarity compared to areas such as river mouths. Thus, the LBM can achieve reasonable SDB results in this region. Future research plans to explore more comprehensive algorithms to incorporate multi-parameters in model training, which aims to improve the accuracy and robustness of SDB modeling by better accounting for the complex interactions between water quality, water color, and topographic features. Based on the comments of the reviewer, additional information has been added to the discussion and conclusions sections. Please refer to lines Page 23 Line 554 and Page 26 Line 595 in the revised manuscript for more details.

Reference

Wu, Y., Li, Y., Jia, D., Andersen, O. B., Abulaitijiang, A., Luo, Z., and He, X.: Seamless seafloor topography determination from shallow to deep waters over island areas using airborne gravimetry, IEEE Trans. Geosci. Remote Sens., 61, 1–19, https://doi.org/10.1109/TGRS.2023.3336747, 2023.

Ma, Y., Xu, N., Liu, Z., Yang, B., Yang, F., Wang, X. H., and Li, S.: Satellite-derived bathymetry using the ICESat-2 lidar and Sentinel-2 imagery datasets, Remote Sens. Environ., 250, 112047, https://doi.org/10.1016/j.rse.2020.112047, 2020.