Response to Referee #2 Comments

We are grateful to the reviewer for the helpful feedback. By taking these suggestions into account, we have revised the manuscript. At the same time, we have addressed all the comments here, point by point responses to the comments are listed in red.

Referee #2 Comments:

The authors present a new global gridded sea level anomaly (SLA) dataset, named PolyU2025 SLA, designed for climate research applications. This dataset is derived from satellite altimetry observations and is evaluated against the operational climate sea level product distributed by the Copernicus Climate Change Service (C3S) and in situ dataset.

This work represents a useful contribution by providing a complementary gridded SLA dataset based on an independent processing and mapping framework. The dataset has a spatial resolution of 0.25° × 0.25° and covers the period from January 1993 to December 2024, which makes it relevant for long-term climate studies.

The manuscript is well structured and detailed. The description of the altimetry and tide gauge (TG) datasets is clear. The methodology is well presented, including a clear description of the processing workflow (corrections, cross-calibration, filtering, subsampling, and mapping).

An intercomparison between the PolyU 2025 and C3S datasets is provided, along with a quantitative validation against in situ TG observations. The results indicate that the PolyU 2025 and C3S datasets are broadly consistent in terms of large-scale climate signals, which is further supported by the in situ validation. The manuscript also evaluates performance in key regimes, including climate signal retrieval, coastal regions, and the open ocean.

The dataset is publicly accessible via Zenodo (https://doi.org/10.5281/zenodo.17810525), covering the period 1993 – 2024, and appears usable in its current format.

Major comments

Line 351 and following:

The statement "positive variance differences, where PolyU exhibits higher SLA variance than C3S⋯" appears inconsistent with the corresponding figure. Visually, PolyU seems to exhibit overall lower SLA variance than C3S. The regions of positive variance difference are not clearly identifiable.

Response: Thanks. We agree that the previous description was not sufficiently accurate and could lead to confusion. After re-examining Fig. 5, we found that the most pronounced variance differences are mainly negative, indicating that C3S generally exhibits higher SLA variance than PolyU in many dynamically active regions. The regions with positive variance differences are relatively localized and less visually prominent. We have revised the corresponding text to correct this interpretation and to more carefully describe the spatial patterns shown in Fig. 5.

At the monthly timescale, the interpretation is also unclear. Could you please revisit this paragraph and clarify the description to ensure consistency with the figure.

Response: Thanks. We agree that the previous interpretation at the monthly timescale was not sufficiently clear. We have revisited and revised the paragraph to ensure consistency with Fig. 5.

To clarify the interpretation, we added time-series comparisons at nine representative points located in dynamically active regions where relatively large variance differences are observed. These points are marked in Fig. 5, their coordinates are listed in Table 3, and the corresponding PolyU and C3S SLA time series and difference series are presented in the new Fig. 8. The revised text clarifies that the two products generally show consistent monthly temporal evolution, while their differences are mainly reflected in the amplitude of short-term/local variability rather than systematic biases. This revision provides a clearer explanation of the monthly-scale differences shown in Fig. 5.

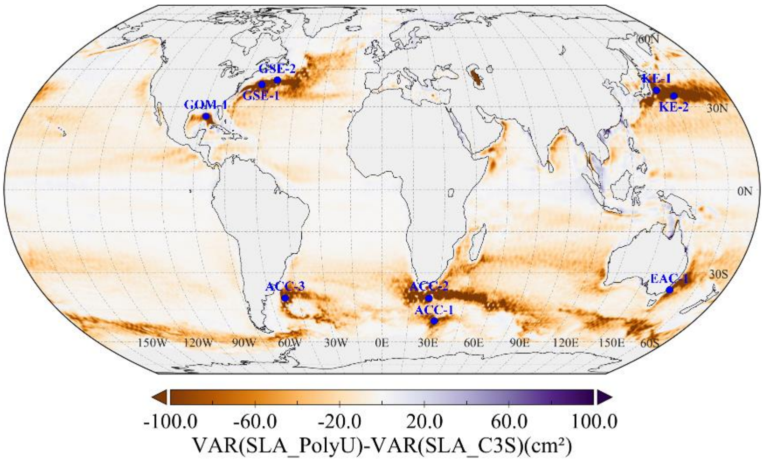

Figure 5. The spatial distribution of the SLA variance differences between the PolyU and C3S products over the January 1993–December 2024 period. Nine representative locations in dynamically active ocean regions, marked by blue dots, are selected for subsequent time-series comparisons.

Table 3. Geographic coordinates of the nine selected points in dynamically active ocean regions.

Region	Point Name	Longitude	Latitude
Antarctic Circumpolar Current	ACC-1	30.125	-49.875
	ACC-2	24.125	-39.125
	ACC-3	308.125	-40.125
East Australian Current	EAC-1	151.625	-36.125
Gulf of Mexico	GOM-1	272.125	26.125
Gulf Stream Extension	GSE-1	295.875	38.125
	GSE-2	303.875	40.125
Kuroshio Extension	KE-1	145.125	36.625
	KE-2	152.125	34.625

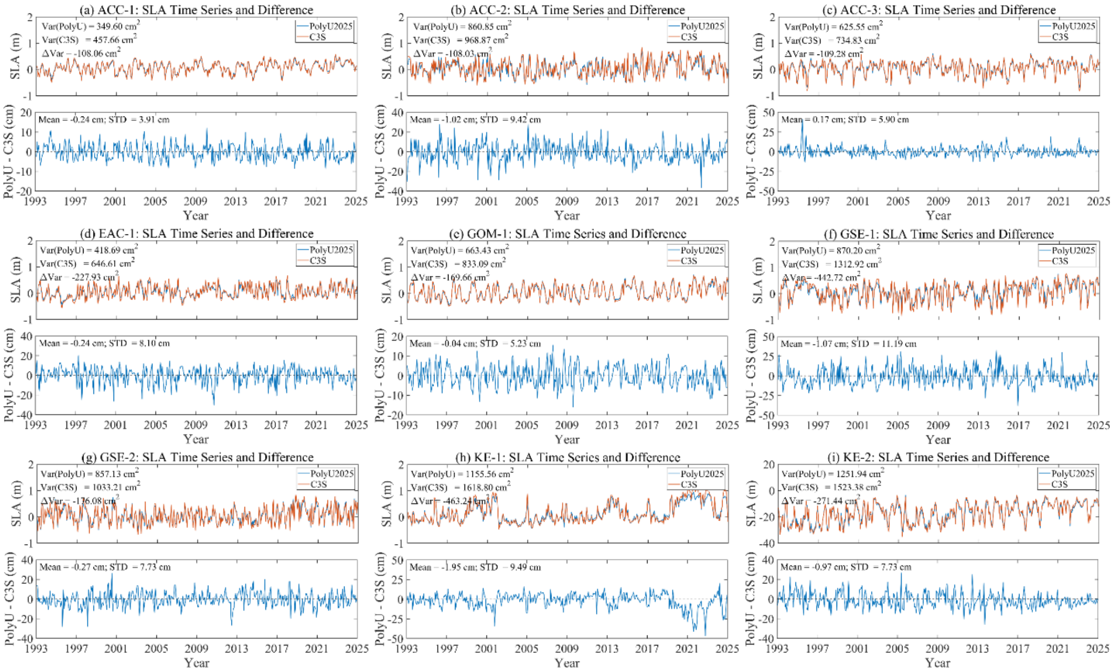

Figure 8. SLA time series and their differences between the PolyU and C3S gridded SLA products at nine selected points (locations shown in Fig. 5).

Discussions: Although the differences between the PolyU and C3S datasets are small, could you discuss potential solutions to improve PolyU reconstruction in coastal regions at short timescales?

Response: Thanks. We agree that, although the differences between the PolyU and C3S datasets are generally small, SLA reconstruction in coastal regions remains challenging, particularly at short timescales. Coastal altimetry observations can be affected by land contamination, complex coastlines, tidal correction errors, wet tropospheric correction errors, sea state bias correction errors, and reduced numbers of valid observations. Therefore, there is still room for further improvement in reconstructing short-timescale sea level variability in coastal regions.

In the revised manuscript, we have added a discussion of potential future improvements following the reviewer's suggestion. Specifically, future versions of the PolyU product could be improved by: using coastal-oriented altimetry reprocessing and waveform retracking methods to enhance the quality of near-coastal along-track observations; adopting more accurate and higher-resolution geophysical correction models, particularly for tides, dynamic atmospheric correction, wet tropospheric correction, and sea state bias correction; applying coastal-adaptive covariance models or spatial interpolation strategies during gridding to better represent complex coastal variability; and incorporating new-generation wide-swath altimetry observations such as SWOT, tide gauge records, or regional ocean models to better capture short-timescale SLA variability in coastal regions. These improvements could further enhance the accuracy and reliability of future PolyU datasets in coastal regions and at short timescales.

Minor comments

Section 3.4:

The covariance function is defined as purely spatial. Do you think it would be worth considering the inclusion of temporal decorrelation in future reprocessing efforts. This aspect could be briefly discussed in the discussion section.

Response: Thanks. We agree that temporal decorrelation may be a relevant factor in some altimetry gridding applications, particularly when observations over a wider temporal window are jointly processed or when higher-temporal-resolution products are generated. However, in this study, the SLA gridded fields are constructed independently on a monthly basis, and only altimeter observations within each individual month are used for the corresponding monthly solution. Therefore, the temporal window is relatively limited.

In addition, before LSC gridding, the multi-mission altimeter observations within the same month are processed through crossover adjustment. This step reduces inconsistencies among different satellite missions, tracks, and observation times, and partly corrects differences caused by intra-monthly time-varying ocean signals. Therefore, the observations entering the LSC gridding procedure are expected to have good internal consistency.

Within this processing framework, the main role of LSC is to use the spatial correlation structure of the observations to interpolate irregular along-track measurements onto regular monthly SLA grids. Therefore, the use of a purely spatial covariance function is considered appropriate, and the explicit inclusion of a temporal decorrelation term is not a necessary step in the current monthly processing framework. We have clarified this point in the revised manuscript.

Figure 4a:

Is there an explanation for the apparent increase in maximum SLA differences after 2017? Have you investigated the geographical locations of these maxima? It would be useful to clarify whether this behavior is linked to anomalies in the C3S product, the PolyU dataset, or both.

Response: Thanks. We re-examined the grid-point locations corresponding to the monthly maximum SLA differences after 2017. The results show that these relatively large maximum differences mainly occur in dynamically active regions with strong sea-level variability, such as western boundary current extensions, the Southern Ocean, and some coastal and shelf regions. In these regions, strong mesoscale eddies, frontal structures, and short-timescale sea-level variability can produce large spatial gradients. Therefore, small differences between the two products in the local SLA amplitude, phase, or spatial position can be amplified.

Further inspection shows that, at these maximum-difference locations, the PolyU and C3S SLA values often have opposite signs, which leads to amplified local differences when the two products are subtracted. Although the monthly maximum differences in Fig. 4(a) increase after 2017, they do not show a persistent upward trend afterwards, but instead remain within a relatively stable range of variability. Therefore, this behavior more likely reflects the amplification of local differences in the representation of short-timescale SLA signals at a small number of grid points in dynamically active regions, rather than a systematic anomaly in either product or a long-term drift between the two products.

Because the monthly maximum difference is an extreme statistic, it is highly sensitive to a small number of local grid points and cannot represent the overall global-scale differences between the two products. As shown in Fig. 4(b), the monthly mean differences are generally close to zero, and the STD does not show a comparable abrupt increase, indicating that PolyU and C3S remain generally consistent in their monthly-scale SLA representation. Therefore, the increase in the monthly maximum differences after 2017 has limited influence on the overall consistency assessment. We have clarified this point in the revised manuscript.

Figure 4b:
Please correct the y-axis label to: Mean SLA variance
Response: Thanks. It has been addressed in the revised manuscript.

Final assessment
The dataset and manuscript are of good overall quality and provide a valuable contribution to the community. With minor clarifications and corrections, particularly regarding the interpretation of variance differences, the work would be suitable for publication.
Response: We sincerely thank the reviewer for the positive evaluation of our dataset and manuscript, and for the constructive suggestions. We have revised the manuscript accordingly, particularly clarifying the interpretation of variance differences. The changes have been marked in revision mode in the revised manuscript.