# GCL-Mascon2024: a novel satellite gravimetry mascon solution using the short-arc approach

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## Responses to reviewers

Dear Chief Editor, topic editor, reviewers, and community,

On behalf of all authors, we express our great appreciation to the Chief Editor, topic editor, reviewers, and community for their constructive and valuable comments and suggestions on our manuscript entitled "GCL-Mascon2024: a novel satellite gravimetry mascon solution using the short-arc approach" [ESSD-2024-512].

We have carefully studied the comments from reviewers and the community and then tried our best to revise our manuscript according to their valuable suggestions. The black text denotes the comments, while the red text contains our responses. Modifications made to the manuscript in response to these comments are highlighted in red italics. Besides, all the revised parts are in red in the revised paper. Please find the revised version attached, which we would like to submit for your kind consideration.

Hope you can consider a possible publication. We are looking forward to hearing from you. Thank you very much.

Yours sincerely,

Jiangjun Ran

## Community Comment #1

This paper presents some novel work for a new mascon result, particularly in the design of regularization matrix.

**Response:**

Thank you very much for your constructive comments on our manuscript. There is no doubt that these comments are valuable and very helpful for revising and improving our manuscript. Below is the point-by-point response to the specific remarks.

I woud like to know the underlying considerations behind different resolutions for ocean and land regions ( 400×400 km vs. 300×300 km).

**Response:**

We sincerely appreciate your valuable comments. Our design considerations for the dual-resolution strategy in ocean and land regions are as follows.

1. Land Mascon Resolution (300×300 km)

Over the land, the mascon size (300×300 km) aligns with GRACE's effective spatial resolution (~300 km), ensuring optimal recovery of surface mass transport signals (e.g., hydrology, ice sheet changes).

2. Ocean Mascon Resolution (400×400 km)

During the initial mascon determination, Atmospheric and Ocean De-aliasing models (i.e., AOD1B) are applied to mitigate high-frequency signals in background force modeling. AOD1B product provides a priori information about temporal variations in the Earth's gravity field caused by global mass variability in the atmosphere and ocean. However, there are still residual unmodeled high-frequency signals and errors over the ocean. These residuals are analogous to those in temporal gravity field spherical harmonic solutions (i.e., L1b -> L2), where open-ocean residual analysis is a standard approach to evaluate the accuracy of different spherical harmonic solutions (e.g., Darbeheshti et al., 2024; Zhou et al., 2024). To absorb such uncertainties and minimize their propagation into land signals, we intentionally defined ocean mascons with a coarser resolution (400×400 km). Furthermore, employing coarser-resolution oceanic mascons serves to minimize the parameter space and enhance the numerical stability of the inverse problem.

Reference
Darbeheshti, N., Lasser, M., Meyer, U., Arnold, D., and Jaggi, A.: AIUB-GRACE gravity field solutions for G3P: processing strategies and instrument parameterization, Earth System Science Data, 16, 1589-1599, https://doi.org/10.5194/essd-16-1589-2024, 2024.
Zhou, H., Zheng, L., Li, Y., Guo, X., Zhou, Z., and Luo, Z.: HUST-Grace2024: a new GRACE-only gravity field time series based on more than 20 years of satellite geodesy data and a hybrid processing chain, Earth System Science Data, 16, 3261-3281, https://doi.org/10.5194/essd-16-3261-2024, 2024.

The design of the MVRCN matrix lacks specific explanation for oceanic regions, and similarly, analysis of the results.

**Response:**

We sincerely appreciate your valuable comments. Following your suggestion, we have explained how the values in oceans are derived in the revised manuscript (Lines 158-162 of the revised manuscript) and the analysis of the ocean signals (Lines 510-517 of the revised manuscript).

*Following a standardized processing workflow (Watkins et al., 2015; Save et al., 2016; Loomis et al., 2019; Tregoning et al., 2022), the uncorrected mascon solutions (i.e.,* $\mathrm{MASCON}_{Uncorrected}$ *, we will return to that point in Sect. 2.5) are systematically integrated with the aforementioned corrected components to generate corrected mascon grids. The formula to generate the corrected mascon grid is*

$$\mathrm{MASCON}_{Corrected} = \mathrm{MASCON}_{Uncorrected} - \mathrm{MASCON}_{C_{20}} + \mathrm{SLR}_{C_{20}} + \mathrm{DEG1} - \mathrm{GIA} + \mathrm{GAD}\,. \qquad (4)$$

*GRACE satellite gravity measurements over oceanic regions directly correspond to ocean bottom pressure variations at spatial scales of ~300 km (Watkins et al., 2015). Figure 13 illustrates the time series of basin mass variations derived from different mascon solutions. To assess the quality of our solutions for ocean signals, we compute the correlation coefficients between GCL-Mascon2024 and the RL06 mascon solutions released by GSFC, CSR, and JPL. The resulting correlations are 95.7%, 98.0%, and 98.2%, respectively, indicating a high level of consistency between our products and official mascon products.*

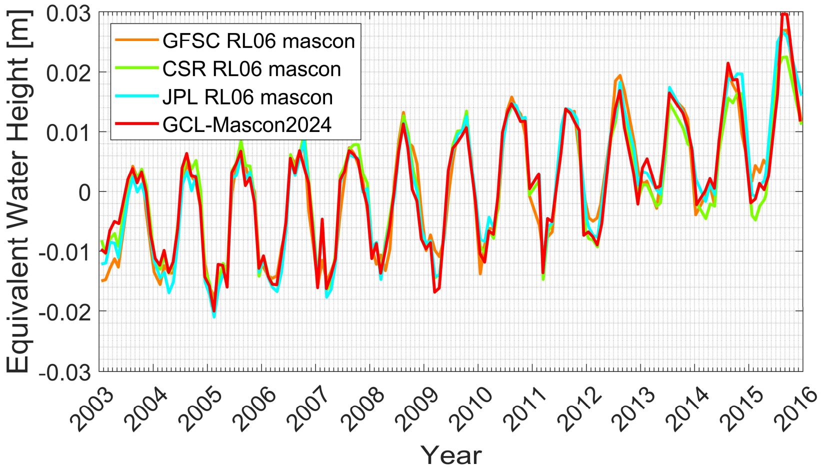


*Figure 13. Comparison of GRACE-derived mass anomaly time series (expressed in equivalent water height, EWH) over the global sea from different mascon solutions.*

Figure 8, Panel (b): y-axis label may be corrected from “mE/Hz1/2” to "m/Hz1/2"; Panel (d): to "m/s/Hz1/2".

**Response:**

We sincerely appreciate your valuable comments. We have corrected this typo in the revised version of the manuscript. Please kindly refer to the following figure.

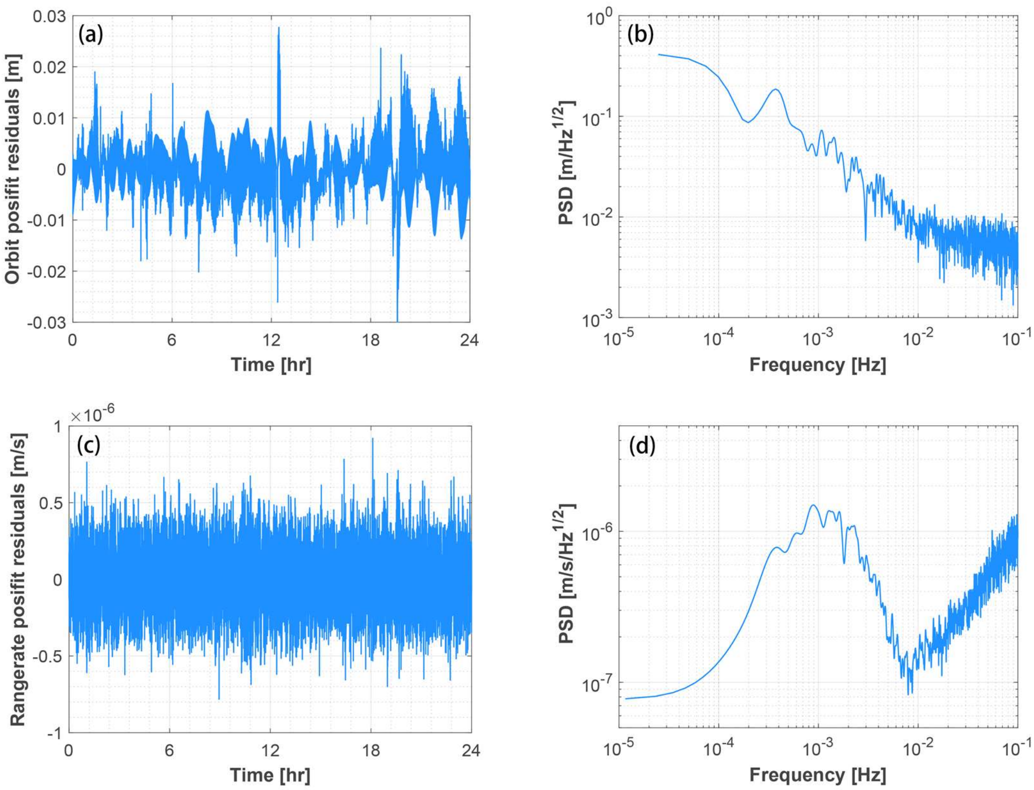


*Figure 2. Time series and power spectrum densities (PSD) of postfit residuals from orbit and KBR range rate*