

Formal Review of ESSD-2021-137 (Horwath et al., 2021)

This manuscript provides a fairly comprehensive analysis of global sea level and ocean mass budget and uncertainty characterization. It is well written and organized, and my comments are mostly minor and can help the authors to improve the presentation. There are some issues the authors need to clarify.

Comments:

- 1) In the abstract, the authors discussed the SLB and OMB analyses for two periods (P1 & P2). However, for P2 only the mass term was discussed here. The steric component should be discussed as well.
- 2) Line 39: “... sea-level change and its contributions.” “Contributors” appears to be the right word to use here.
- 3) Lines 108-110: References are needed to support the conclusions. “GRACE analyses suggest LWS gains and therefore a negative GMSL contribution from LWS” – I believe this was based on only one previous study (Reager et al., 2016). Some other later studies came to a completely different conclusion. In addition to the two (Cáceres et al., 2020; Gutknecht et al., 2020) cited later in Discussion by the authors, I would suggest to also cite Kim et al. (2019), the first to have reported a different and opposite GRACE LWS contribution to GMSL. A brief discussion of the different LWS estimates is needed here.
Kim, J.-S., Seo, K.-W., Jeon, T., Chen, J., & Wilson, C. R. (2019). Missing hydrological contribution to sea level rise. Geophysical Research Letters, 46. <https://doi.org/10.1029/2019GL085470>
- 4) Line 144: “other” should be added to the list, consistent with other occurrences.
- 5) Line 174: “The SLB The presentation of the result needs substantial improvements. The authors should at least provide a clear definition of the two studied drainage basins, and show how the defined GRACE mascons are configured in the basins. The two maps in Figure 1 are simply not sufficient. The authors should also provide a plot showing GRACE-derived ice mass change time series for the two basins.
- 6) Line 226: Please clarify what interpolation method(s) is (are) used here.
- 7) Lines 267-268: CMEMS provides altimeter sea level anomaly grids for the entire altimeter period, the authors need to explain why they decided to combine the two datasets (CCI sea-level record & CMEMS) to get the GMSL series and not use the CMEMS series for consistency.
- 8) Lines 365-366: “It is relatively common for there to be layers with no observations, sometimes in the upper ocean and often at depth.” Please rephrase this sentence. It doesn’t sound grammatically correct.
- 9) Lines 494-498: The authors used CSR, JPL and GFZ GRACE RL06 SH gravity solutions (together with ITSG-Grace2018), but decided to use old generations of geocenter (Swenson et al., 2008) and SLR C20 series (GRACE TN-11), which were prepared for GRACE RL05 solutions. Are there any logical reasons for not using the RL06 supplementary datasets? Using RL05 SLR C20 may be fine, but the new RL06 geocenter

series are expected to have substantially different effects on GRACE ocean mass rate estimates.

- 10) Lines 499-509: Please clarify which ICE6G GIA model was used. The authors cited Peltier et al. (2015), which is an outdated version. After fixing some error(s), Peltier et al. (2018) released an updated version of the model, ICE6G_D.

As seen from the two comments above (9 & 10), the GRACE related analyses in the current study are not up to the current standards. The authors need to either provide a convincing reasoning or update the analyses using the current standards.

- 11) Figure 10: The authors may choose some colors to better distinguish the curves (red and magenta are not a good pair).
- 12) Line 1144: “We cannot attribute the misclosures in the budgets of linear trends, ...” Please consider rephrasing this sentence. “We cannot attribute the misclosures in the budgets of linear trends to any particular error source, ...” ?
- 13) Lines 115-1156: “The unassessed atmospheric water content contribution (cf. Sect. 3.8) could add to the misclosure, though.” Please consider rephrasing this sentence.
“The unassessed atmospheric water content contribution (cf. Sect. 3.8) could contribute to the misclosure, though.”?
- 14) Line 1182: “are0.26” -> “are 0.26”
- 15) Lines 1216-1220: “Errors in ...” It is unclear what are really discussed here. Do those cited values (e.g., $-1.37 \pm 0.17 \text{ mm yr}^{-1}$) represent estimates rates with uncertainties? If so, the values for Antarctic (-0.14 ± 0.09) and Greenland (0.02 ± 0.02) do not sound right.
- 16) Lines 1284-1287: “we have provided ...” It is not clear what the “start of our survey” is referred to. Please be more specific.

Jianli Chen