Comment on essd-2022-219
Anonymous Referee #2


Recommendation: minor to major revisions.

Summary

Here the authors use multi-satellite altimeter data, including HY-2A products to retrieve and provide global gravity anomaly model (i.e., the SDUST2021GRA) on a 1′x1′ grids over the global ocean. The dataset is obtained after preprocessing SSH measurements and then by calculating along-track geoid gradients. The SDUST2021GRA is then compared with DTU17 and SIO V30.1 products. Finally, shipborne gravity from NCEI is used for assessing SDUST2021GRA, as well as DTU17 and SIO V30.1, providing a robust inter-comparison among these products. The main outcome is that the accuracy of SDUST2021GRA results to be better than the DTU 17 and SIO V30.1 ones over the in the global ocean and, in particular, in coastal (?) areas and in areas that are characterized by many islands.
General comments

The authors provide a well-documented dataset, also discussing its potential in different region of the global ocean. The methodology they pursued looks rigorous and the assessment of accuracy is solid. The authors, however, need to improve the writing of several parts (see specific comments). In particular, English grammar is very poor and the structure of several paragraphs looks often confusing.

Finally, the authors should make a better effort in stressing the usefulness of the SDUST2021GRA, highlighting gaps of the existing products (in both introduction and conclusions).

Specific and minor comments

Lines 39-42: the HY-2A satellite mission (and the payload) should be better introduce in this paragraph.

Line 48-49: rephrase as “GM in LSC is determined by the iteration method which is proposed by Zhu et al. (2020)”

Line 57: rephrase as “…limited memory of the computer (Figure 1)”

Line 58: rephrase as “…marked from L1 to L18; from 80°S to 80°N, regions are marked from B1 to B8”

Figure 1: caption of this figure should be improved by providing all the necessary details, i.e., what the colours indicate for the three different latitude belts; the authors should also write here what is indicated in line 59 regarding the B and L markers; I would also suggest to indicate in caption that shipborn traks are reported in blue, etc.
Line 63: I guess the authors can indicate from the beginning that they are using the version 3.0 of the L2P products “Non-time critical Level 2 Plus (L2P) Version 3.0 products...”, without adding any additional sentence below.

Line 71: rephrase as “altimetry data is gradually improved through the years. ERS-1 was launched before 1990”.

Line 80: as for several sentences, there is no need to write “as listed”, “as showed”, etc. It’s much simpler to write, e.g., “ERM is marked with an '_B' after the satellite name (Table 1).”

Line 83: I do not think here is necessary to re-write “The study area is divided into multiple regions.” I would remove this sentence.

Section 2.3.1: This whole section is really hard to follow. Rather than presenting the EGM2008 and the XGM2019e model at the beginning, I would suggest to change the logical thread, starting from (and improving) the last paragraph and, in particular, from lines 104-106.

Line 108: Is this first sentence really useful? It actually does not add any info.

Line 109: is this SIO 30.01, according to Table 2?

Line 119: rephrase as “…different countries and institutions in different time; a feature that requires some processing”.

Line 121: rephrase as “Geoid heights can be calculated from SSHs by subtracting the dynamic topography”.

Line 123: do the authors mean ”MDT-CNFS-CLS18 (Mulet et al., 2021) is the most updated MDT model released by AVISO”? 

Line 133: rephrase as “Moreover, there are some long-wavelength errors in shipborne gravity.”
Line 134: please, correct “which are caused by drifts in gravimeter readings”.

Line 149: I would simply write, for instance, “are parameters obtained, for each cruise, by least-square fitting from Eq. (1)”.

Line 154: rephrase as “gravity anomalies can be obtained from”.

Line 160: “Jason-2/GM altimeter data are from GDRs whose...” is already said in section 2.2 (no need to repeat here).

Equation (2): I would suggest to place dα immediately after (or before) the fraction lines.

Line 169: rephrase as “...and that of T/P ellipsoid, i.e., dα is the difference between...”.

Figure 2: the authors should provide a proper caption for this figure (e.g., all symbols are missing; define dashed line, etc.).

Line 190: is there any reference for this sentence?

Line 219: rephrase as “The noise variance of SSHs can be obtained by...”.

Lines 238-272: as I indicated in the general comments, a scheme (i.e., a figure) that can summarize this whole processing chain would be helpful. Figure 3 is introduced later on and it is not exhaustive.

Lines 274: the IVM formula was already introduced in Line 47. Here I would rephrase the sentence as “Vening-Meinesz Formula can be used to determine DOVs from gravity anomalies, so The inverse of Vening-Meinesz formula is used...”

Line 306 (and Figure 5): the authors should indicate in Figure 5 all geographical names that are mentioned in the text, i.e., the Aleutian Islands and the Philippon Islands. I would also indicate in Figure 5 the area that will be discussed in Figure 6, i.e., the South Sandwich Trench.
Line 307: I guess this is a “Moreover” rather than a “Meanwhile”. In the same line, what do the authors mean with “special submarine topography”? Which kind of characteristics they want to highlight?

Line 325: I would rename this title as “4.2 Shipborne gravity data assessment”.

Figure 8: to make the reading of this figure straightforward, I would indicate in each panel the corresponding B region (i.e., B1 for panel (a), B2 for panel (b), and so on..).

Line 332-339: this whole reasoning regarding L regions along B2 is not clearly coming out from Figure 8b (unless I am missing something). The authors should help the reader in visualizing from the data this interesting analysis.

Line 341: rephrase as “Second, four typical ocean areas, marked as A – D, are selected for analyzing”

Lines 350-352: here it is not clear what the authors mean with “open ocean” and “offshore” areas. Does “offshore” mean off coastal areas? The authors should indicate this in a clear way. Moreover, the authors should also provide some discussion regarding why “SDUST2021GRA has the best accuracy in the offshore areas and the areas with many islands” (see general comment).

Line 359: what do the authors mean with “global”? Do you mean “global area” or “all domain”? lease, rephrase.

Line 371: same as above.

Line 380: rephrase as “SSHs are used to construct”.

Line 397: same as for lines 371 and 359.

Table A1: insert border line between the different L regions.