

Earth Syst. Sci. Data Discuss., referee comment RC1  
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## Comment on **essd-2021-293**

Anonymous Referee #1

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Referee comment on "A 30-year monthly 5-km gridded surface elevation time series for the Greenland Ice Sheet from multiple satellite radar altimeters" by Baojun Zhang et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-293-RC1>, 2021

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Review of manuscript "A 30 year monthly 5 km gridded surface elevation time series for the Greenland Ice Sheet from multiple satellite radar altimeters" submitted to Earth System Science Data (<https://doi.org/10.5194/essd-2021-293>)

The manuscript uses a long record of satellite altimeter from ERS-1, ERS-2, Envisat and Cryosat-2 to construct a database of surface elevation change (SEC) of Greenland ice sheet at monthly temporal resolution and 5x5 km spatial grid resolution. The authors used an updated strategy plane-fit method to cross-calibrate data from the different missions, a large dataset to correct for the intermission bias and a method to suppress the interpolation error. Results are validated using NASA's IceBridge airborne data over Greenland and ESA's Climate Change Initiative

Given the ongoing impact of global warming on Arctic environment, the subject is timely and the output dataset is certainly needed. The advantage of this dataset resides in its longest record so far (30 years), making use of a series of multiple satellite altimetry missions. In addition to validation against external data, the authors claim the reliability of the dataset based on the methods used to eliminate system biases between the altimeter systems. This seems logical but I have a concern about the validation. What is being offered is just a comparison against the external data (IceBridge), which still have their sources of error although laser altimeter is known to be more accurate than radar altimeter. Cross comparison is always good but it does not necessarily mean validation.

Data on regions that experience thinning and thickening of the elevation are presented with explanation related to meteorological and environmental factors and links to previously established data. This is useful information. Similar useful information is presented on regional volume change in relation to NAO and this is supported by findings from previous studies.

Overall, I think the authors are presenting a credible study and the database adds to the

growing number of studies on surface elevation, and eventually mass balance, of Greenland ice sheet using the existing longest altimeter data record so far.

General comments:

- Nothing is mentioned about elevation change from ICESat. A couple of sentences in the Introduction and comparison of results would be useful (if results from ICESat exists), e.g., is thinning along the west coast – is it also confirmed from ICESat?.
- While there are comments on thinning of the ice sheet in the west coast, no comments are offered about thickening of the ice sheet in the east coast, particularly south of 73 deg. latitude. (Figure 6 shows much less fluctuations in the King Christian X Land)
- As the title asserts, data are available on monthly basis. However, data are presented in all graphs on yearly basis. It would be nice to present the change in elevation in summer compared to winter somewhere in the manuscript, or at least comment on this aspect.
- Only hints on the method of calculation of volume change are mentioned in the Introduction and Section 2.6. A few lines to describe the calculations can be inserted at the end of Section 2.3 or in a dedicated section.
- Why is the difference between ATM data and the present data large in the peripheral areas of Greenland, where the SE is low? Larger uncertainty in the derived elevation?
- In section 4.1, error sources are described. Can you attach numerical figures of uncertainty due to each source?
- I think there is inconsistency between using SEC and SE. Please check.
- I could not determine the correctness of equations 1-5.
- Not sure what you mean by "surface aspect" in Fig. 1.

Minor specific comments:

Abstract:

The sentence "The accuracy and reliability of the time series is reliable". Then the following sentence has more quantitative data in the comparison. There is no need for the first sentence then.

Introduction:

Line 24: does GrIS really contribute to the sea level rise 1.4 times more than the Antarctic ice sheet? We know that melting GrIS has increase the sea level by about 1 cm in the past 3 decades. It would be better to quote actual numbers of sea level rise caused by Greenland and the Antarctic melting instead of just quoting the ratio.

Line 90: ICE-1 re-tracker for ERS-1, ERS-2, OCOG re-tracker for Cryosat-2 .... Etc. It would useful if the authors add references to those methods.

Results:

Line 249: "Six of the eight drainage system ....". Can you show those drainage areas on the map?

Line 282: "... have been given in the figures mentioned here". Which figures?