

Zhang et al. presented a new dataset of the surface elevation changes over the Greenland Ice Sheet at monthly intervals spanning 30 years from 1991 to 2020. The long records build on careful corrections of the biases within and between four satellite radar altimeters based on plane-fitting. The authors used empirical orthogonal functions obtained from the 30-year observations (esp. the later, more accurate and complete measurements from Envisat and CryoSat-2) to fill in spatial gaps and reconstruct 5-km-resolution gridded fields.

Since this is a data-oriented journal, my comments below are mainly from a data user point of view. I also provide some technical and editorial comments at the end.

The data provided through the National Tibetan Plateau/Third Pole Environment Data Center are freely accessible through the link provided. The data file in NetCDF format can be easily read. I did run into a few issues listed below.

- (1) The description of the field ‘elev_interp’ is “interpolated surface elevation timeseries base on EOF Reconstruction and Kriging” and differs from what are shown in Figures 3b and 3e (and stated in the figure caption) as they are only from EOF reconstruction. Then I found it confusing as in the manuscript on line 160, where it is stated that “The missing values in the retained gridded time series are interpolated using ordinary kriging”, implying that the final interpolated results are indeed based on both EOF reconstruction and kriging. If this is the case, is it still fair to compare your results with those only using kriging (as in Figure 3)?
- (2) The field ‘elev_interp’ seems to contain large outliers. Taking the one for February 1992 as an example, the minimum and maximum values of SE are -459 m and 558 m, versus -216 m to 34 m in the non-interpolated field. Similarly, larger positive and negative values are found along coastal regions as we can tell from comparing Figures 3b and 3e. These make me wonder how reliable are the monthly, interpolated fields. Even the authors chose not to use them when comparing with the CCI products (Line 339). Could the authors provide guidance for (i) the cautions users need to take when using the monthly, interpolated fields and (ii) handling outliers in these fields?
- (3) Related to the reliability, the uncertainties provided are definitely helpful. Yet, as they were approximated by deviations from a regular trend + acceleration + seasonal time series (eq. 9), is it possible that these uncertainties, esp. the ones for interpolated SE, are underestimated?
- (4) The description and names of many variables in the NetCDF file contain spelling errors, e.g., ‘longitudt’ should be longitude; ‘latitudt’ should be latitude; ‘degress_north’ should be ‘degrees_north’; ‘Baisn Num’ should be ‘Basin Num’ and is based on Zwally et al., 2012 Antarctic and Greenland Drainage Systems. None of these affect the use of the data, but there are too many typos in the meta data.

Methodology description needs to be improved.

Section 2.3 largely builds on the authors’ previous work on the Antarctica Ice Sheet and published in Remote Sensing. Yet, I found this subsection difficult to read, largely due to the repeated use of same or very similar letter symbols in eqs. 1-5 but they actually have different meanings. Some terms are not introduced at all, such as $(-1)^{AD}$ in eq. 1 and $(-1)^{im}$ in eq. 2. This section needs to be rewritten to improve its clarity.

Section 2.4 and result parts related to EOF: this is relatively new in this work and needs further analyses and discussion in terms of the validity of assumptions, quality of the interpolated results. For instance, the assumption behind EOF is that the spatial patterns of elevation changes “are stationary in time” (Line 53), which do not hold as evident in Figures 4 and 5 and numerous studies. How would temporal variations of spatial patterns, esp. those during the ERS period and the later Envisat-CryoSat-2 period, affect the EOF reconstruction?

It is not clear to me what is the authors’ basis for claiming “the superiority” of EOF over kriging (Line 73-74). My concern, as raised above, is unreliable EOF reconstruction and the large values along the coast.

In the volumetric time series (Figures 6-8), it would be helpful to add the ones based on the CCI products with associated uncertainties as another cross-validation.

Figure 8c shows a sharp volumetric increase at the beginning of the time series (more than 300 km³ from 1992 to 1993). This doesn’t seem to be correct. Could you double-check or validate with independent data?

Minor comments:

It is important to mention EOF in the abstract.

Line 48: specify what kind of data

Line 57: ‘Therefore ...’; I don’t see a causal link between the limitations of the other approaches and the solution to be offered by data combination. Or is something missing in this last sentence of the paragraph?

Line 93-95 fit better in methodology.

Line 208: change ‘derived from’ to ‘caused by’

Line 227: ‘Greenaldn’ should be ‘Greenland’

Line 298: what is ‘official relocation’?