

Interactive comment on “About the consistency between Envisat and CryoSat-2 radar freeboard retrieval over Antarctic sea ice”
by S. Schwegmann et al.

We thank the reviewer for his/her comments. In general, we find them positive and helpful for identifying points where a more rigorous analysis would be needed. Detailed response to the comments can be found below.

Anonymous Referee #2

This paper discusses the comparability of sea-ice freeboard retrievals from two different satellite sensors as an initial step to eventually establish a long-term (up to 20 years) historical data record of Antarctic sea-ice freeboard – when data from ERS1 and ERS2 can be included. This is a very important step towards a better understanding of Antarctic sea ice and its variability. It is crucial research to be undertaken. I am very pleased to see this issue being addressed, but I have concerns regarding the addition of sea-ice volume estimates into the manuscript. While the quantification of sea-ice thickness (and subsequently volume) is regarded as the holy grail by some researchers in the field, I would suggest to refrain from it here and stick to what the title describes: sea-ice freeboard retrieval. There are too many uncertain variables (snow thickness, and snow, ice and water densities) required for the computation of sea-ice thickness from surface elevation (sea-ice freeboard above a reference surface, ideally local sea level).

The reviewer is correct that too large uncertainties still exist to give a solid volume estimate but our SIV estimates are not meant to be such. We have included them, as stated in the manuscript, to show the impact of discrepancies between the radar freeboards on sea-ice volume (SIV) results. But we takes this comment as an indication that we must be clearer on our motivation in the revised version. We clarify that these should not to be taken as absolute values but more of a sensitivity study on the radar freeboard.

I would suggest to show the common ground, i.e. the reference surface, from both sensors independently and discuss how well they compare.

This will be an important light to shine on the negative freeboard measurements and discussion as well. I would like to suggest a more rigorous statistical analysis of the data at hand (rather than adding more derived variables, see above). Maybe the authors could show quantiles of differences (regional and temporal) in the sea surface height reference data and the freeboard data and possibly derive principle component analysis from that. This would yield a much better handle on when and where the data compare well, and provide the grounds for a discussion of why they compare well (or not).

These are good suggestions from the reviewer (to include the local sea level and the quantiles of differences) and we shall include it in the revised manuscript.

While satellite sensors are getting better constantly, the consistency of a long-term data set of sea-ice freeboard from multiple sensors and different missions is of vital importance. It might be worthwhile to consider degrading the more recent (presumably higher resolution, more precise) data set, in order to achieve a compatible data set of which the errors/caveats are well known. What would be needed to produce such a consistent data set?

After receiving the comments of both reviewers, we have decided to reprocess both CryoSat-2 and Envisat time series with a common mean sea surface height product (DTU13). At the time of writing this, the freeboard processing with DTU13 has already been made. The CryoSat-2 data will be gridded on the same grid projection and resolution as Envisat - that is, the EASE-2 100 km Antarctic grid. For the grid this was already the case for the original manuscript (see P4898, lines 5-7). The 25 km grid we only tested to see if the change of resolution has an effect on the biases (P4903, line 15 onwards).

Specific comments:

- p.4895 l. 25: GLAS on ICESat is not a current altimeter in space (ICESat was decommissioned in Aug. 2010)

The reviewer is of course correct. This will be revised to put ICESat in the past tense.

- p. 4897 l. 23 sqq.: why the introduction the terms 'seasonal' and 'perennial' sea ice, when 'first year' and 'multi year' is widely accepted;

We shall use first year and multi year in the revised manuscript.

- p. 4899 l. 23 & p. 4901 l. 1: I would like to see a further justification for the radar freeboard cut-offs for the two sensors. How many values are actually discarded?

The cutoff limits are generous estimates based on our experience with the along-track orbit data. This will be described in more detail in the revised document. The fraction of freeboard values below the lower threshold will change with the reprocessing effort and will be reported in the revised manuscript.

- Amundsen/Bellingshausen seas should be consistently abbreviated as 'ABS' (Figure 2 top-left and elsewhere)

And it will be in the revised manuscript.