

Interactive comment on “Four decades of surface elevation change of the Antarctic Ice Sheet from multi-mission satellite altimetry” by Ludwig Schröder et al.

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Dear Etienne Berthier,

Thank you for your comment. We appreciate the thorough and insightful reviews. We think that the comments will contribute to a major improvement of the manuscript. We believe that we will be able, by a major revision of the manuscript, to address all raised concerns. In some more detail, we plan to address the concerns as follows.

Clear description of the methodology: We agree that the methodology has to be described in more detail. This is a straightforward task because naturally all the details

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are at our hand. We will give comprehensive details about the parameters, outlier criteria and error propagation of each step in the processing of the SEC grid. However, with regard to readability of the main manuscript, we decided to include this as a section in the supplementary material.

Uncertainty characterisation: Together with the detailed description of the methodology, will describe how we derive uncertainty estimates. We will outline which additional uncertainty is introduced due to the different processing steps, e.g. due to the intermission offset correction or interpolation, and support this estimate by validation with independent data.

Validation: We will follow the reviewers' suggestion to include ICEBridge data into our validation. In fact, comparison with ICEBridge is already implemented in our suite of analysis tools. We note, however, that validation will always remain incomplete. The first flights contributing to ICEBridge level 4 (dH/dt) data are from 2002. We do not have any older data for ground truthing. As another validation approach, we will improve the way we are comparing altimetry results with atmospheric modeling results: We will use results of a firn densification model (FDM) driven by modeled surface mass balance (SMB). We will provide statistical evidence on the degree of agreement of interannual variations from altimetry and FDM, as an upper bound on the uncertainty of either approach (altimetry and modeling) to capture SMB-driven interannual variations. We note that this approach has limited value for validating long-term trends induced by dynamic imbalance or by long-term SMB trends. However, this approach allows us some validation back to the 1970's.

Furthermore, we will follow the suggestion to include a conversion from volume to mass, which allows direct validation against GRACE and SMB modeling results, even though with the inclusion of the additional uncertainty of the volume-to-mass conversion. We decided to include the mass change results in the revised version.

Lack of new insights on ice sheet change: Even though we think that all the potential

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insights into ice sheet processes cannot be exploited in this single manuscript, we will illustrate the new insights from our new dataset for two case studies: one addressing the long-term change in Wilkes Land (elaborating on the results shown in Figure 5b) and one on the SMB-driven interannual variations represented on a time series level.

We hope, that these changes will satisfy the reviewers and that they find the revised paper suitable for publication.

Best regards, on behalf of all co-authors, Ludwig Schröder

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