The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC1
https://doi.org/10.5194/tc-2021-19-RC1, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on tc-2021-19

Ted Scambos (Referee)

Referee comment on "TanDEM-X PolarDEM 90□m of Antarctica: generation and error characterization" by Birgit Wessel et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-19-RC1, 2021

Review ---TanDEM-X PolarDEM 90m of Antarctica: Generation and error characterization

Birgit, H. Martin, W. Christian, B. Adina, O. Niclole…

The study describes the assembly and processing of a new DEM of Antarctica produced by X-band interferometry using the TanDEM-X and TerraSAR-X satellites, with a gridding scale of 90 m. The DEM is exceptionally complete (99.991% of the continent mapped) and has a new derived ice sheet edge (coastline). Validation of the DEM over blue ice areas shows that in regions of near-zero radar penetration into the snow-ice surface (and little surface elevation change), the new DEM matches ICESat data very well.

The paper is fairly well-written and well-described, and the authors are very clear about how they build the DEM. However, the DEM is intentionally left unadjusted for X-band penetration below the snow surface, although the offset between ICESat and the TanDEM-X DEM is well described and has interesting regional variations. However, it's unclear what surface is being measured – how would this surface be described? Firn level at which a large fraction of X-band radar energy is scattered back? This makes the DEM hard to use for things not related to radar studies. It also calls into question the nature of the local topography (scales of 1 – 5 ice thicknesses, horizontally) that is being measured. In many areas of East Antarctica, this is unlikely to be parallel to the air-snow interface because of strong variations in backscatter associated with local variations in deposition and sublimation.

The authors need to consider some glaciological processes that they may not be aware of – sub-glacial lake drainages in the Recovery Ice Stream explain some of the shifts they see; Thickening in the LarsenC and thnning along the George VI southern coast and Amundsen Sea coast should be discussed as indicators of major mass balance changes --- also the Dotson Ice Shelf region.

The paper is fine as it stands, with minor edits; but the authors need to make clear how the DEM can be used. It is not suitable for mass-balance related change detection studies, because of the fuzzy nature of the correlation surface measured in the DEM; even a comparison with a repeat DEM by TanDEM-X would be more a study of backscatter changes at depth than elevation. Also not suitable for determining the surface slope for ice velocity studies, at least not in detail.

It would be good to see detailed profile comparisons between this DEM and ICESat elevations, REMA elevaitons, CryoSat-2 elevations in several key areas – a good figure to add.

But the careful processing and blending of the data -do- make the data set useful. Figure 10 and 11 are worth more analysis and comparison with other backscatter data sets (e.g. Radarsat or ERS-1, 2 at C-band, PALSAR-2 at L-band)

I suggest that the paper could be acceptable with 'major' revisions, but mostly in terms of how the result is described and what it might be used for.

Numerous short comments are in the annotated .pdf file uploaded with this review.

Please also note the supplement to this comment:
https://tc.copernicus.org/preprints/tc-2021-19/tc-2021-19-RC1-supplement.pdf