The Cryosphere Discuss., 8, C234–C238, 2014
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The Cryosphere Discussions
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Interactive comment on "The Greenland Ice Mapping Project (GIMP) land classification and surface elevation datasets" *by* I. M. Howat et al.

Anonymous Referee #1

Received and published: 14 March 2014

GIMP land classification and surface elevation datasets – TCD 2014 - Review Howat, Negrete, Smith

This manuscript reports on the latest GIMP Greenland imagery, classification and topography datasets that represent a major improvement on previously available products. They are likely to be widely used and much valued by the cryospheric science community. As such, this description of the methods and products is very useful and important, though there are some areas in the right-up and analysis that could be improved.

The datasets:

I was unable to find the image mosaics and associated metadata on

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bprc.osu.edu/GDG/data.php, and so I cannot comment on their quality. This hinders the review process.

I was able to download the mask, DEM and hillshade datasets, which are impressive in their resolution with few significant artefacts.

Perhaps the main issue is that there is a 0.5 pixel mismatch between the edges of the tiles of masks versus the DEM and hillshade tiles i.e. the grids are misaligned. This sort of drift commonly occurs when reprojecting or interpolating – the grids should be snapped to exactly the same grid.

In the DEM tiles, there is a 1-pixel edge artefact where the surface abruptly steps up in height e.g. the sea goes from 30 m to ∼37 m and back down to 30 m e.g. in tile 4-4 at 1171614 m north.

Of lesser concern: there is a discretisation issue in open ice-sheet areas where the surface height steps up and down in 1 m increments in oddly geometric (i.e. non-physical) patterns (e.g. at 452778m, -1570164 m).

There are isolated pit artefacts (e.g. at 466229, -826599 in tile 4-5) but these appear very rare.

The hillshade product has speckle (that seems not always to reflect speckle in the DEM) and a 2-pixel blank gap between tiles but this is of little concern as this is a display product (rather than e.g. a modelling product).

The manuscript:

Section 3 – image mosaic

The USGS L1T images are (presumably) orthorectified with a different, older DEM (not the one presented here) which presumably means that there are substantial mismatches between this new DEM and the image mosaic where the new DEM captures relief in higher resolution than the old. Presumably this is not captured in the 'image

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geo-registration error' in the metadata, as it would be unknown to USGS. The obvious solution is to orthorectify the images to the new DEM rather than the old. It may be that this is such a substantial task that it is beyond this project – is this so? What are the implications for the image mosaic? Page 458, line 11 – what is the evidence for the assertion that the Radarsat images have smaller errors?

Section 4

Manual digitisation of the entire coast at high resolution is an impressive effort! The authors describe 3 error sources but for source 2 (image geo-registration), what about the error contribution from using orthorectified images that used the old DEM (assuming this was done)? Perhaps of similar order to the errors quoted?

Section 5

Page 459, line 23: "Due to the failure of stereo-photogrammetric methods for Digital Elevation Model (DEM) extraction on featureless ice and snow surfaces, the difficult logistics involved in aerial LiDAR surveying, and the latitudinal limit of the Shuttle Radar Topography Mission, the coverage and accuracy of elevation data for polar regions are poor, especially over the interiors of ice sheets." - This simply isn't true. What about ERS-1, ERS-2, Envisat, ICESat and Cryosat2??? Page 460, line 3: the radar altimeter used by Bamber et al. would not have been a SAR altimeter.

Section 5.1

Which ICESat product - GLA12? Is Shepherd et al., 2012 the original reference for the filtering technique? (unlikely) Page 460, line 26: the variations are not month-to-month, they are intercampaign. The Borsa reference focuses on one aspect of the intercampaign bias. From this paragraph, it is not clear that the authors have corrected the intercampaign biases or applied other corrections in an appropriate way. More and better detail is needed here.

Section 5.3

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This seems to be a nicely thought-through filtering approach, though in future a median-based filter may more effectively remove this sort of outlier than a mean-based one because the median itself is less affected by the outliers at each iteration.

Section 5.7 Errors and artefacts

This section estimates error based on the mismatch of the DEM to ICESat reference heights. This is useful but does not constitute a thorough error budget. It doesn't, for example, include the errors in the ICESat heights themselves. Also, the mismatch statistics are given as RMS but this masks any potential systematic bias in the DEM vs ICESat heights. It may be that the process of fitting the DEM to the ICESat point cloud results in a zero-mean difference in heights but this isn't shown. The question is: are the validation errors normally distributed around zero (no bias) or not? I suggest calculating the mean differences as well as the RMS, and also plotting the distribution of the differences to demonstrate normal distribution. Also, the authors assert that the validation error is dominated by slope – I suggest calculating the validation error by slope class (e.g. 0-1 degree, 1-2 or similar). Plot the distributions for these classes to look for bias and non-normal distribution. This error-by-slope-class would allow users to calculate the error anywhere in the data simply from the slope. Furthermore, I suggest producing a map from the actual validation errors so that the spatial distribution of both the ICESat validation data and the error magnitude are clearly shown. This would have the advantage of making clear where temporal changes in height have led to large apparent validation errors.

Section 6 Conclusions

These aren't really conclusions, they're pointers to the datasets and an indication of future work.

Figure 2 – this figure is too small and dark to make the point that the authors want it to make.

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In various places: some typos and grammatical errors that should be obvious in proof reading.

Interactive comment on The Cryosphere Discuss., 8, 453, 2014.