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Earth System Science Data Discussions

Interactive comment on "A new 100-m Digital Elevation Model of the Antarctic Peninsula derived from ASTER Global DEM: methods and accuracy assessment" *by* A. J. Cook et al.

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General Comments

A. J. Cook et al. present a new DEM for the Antarctic Peninsula, which is based on an improved version of the ASTER Global DEM. The manuscript motivates the requirements for the new DEM and introduces the used datasets with their limitations. The methodology comprises the exclusion of erroneous patches in the raw data and the filling of the corresponding gaps with contour specific interpolation algorithms. The DEM is evaluated in terms of horizontal and vertical accuracy using ICESat altimetry, GPS and SPIRIT DEMs. The DEM is provided on the NSIDC website in standard formats

which can easily be loaded into any GIS software. The corresponding Metadata is good (apart from the given "elevation difference", see below). Strengths and weakness of the final product are described and error estimates are provided.

The newly derived DEM will be (and already is) useful in future studies regarding the Antarctic Peninsula and I recommend the publication of the dataset and the corresponding article in ESSD. I attached questions, remarks and suggestions which I hope will help to improve the current version.

Reinhard Drews

Specific Comments (not in order of importance)

- Currently it seems that not all available ground-truth data is used to evaluate the vertical accuracy of the DEM. Five ICESat tracks (covering a sub-scene of the new DEM) are shown, but I think there are more tracks available. I suggest to include a histogram which shows the deviation of the new DEM to IceSAT tracks covering the entire area of interest. The deviation can also be color coded in Figure 5 to visualize spatial trends. The GPS evaluates the DEM on peaks only. On p. 369, line 12 LVIS elevation data from Operation IceBridge is cited and seems to be available. Is any airborne profile at hand which covers for example the longitudinal profile of a glacier? Do you have any other GPS profiles? With an extension of the ground-truth data it becomes more clear that the new DEM is an improvement over existing DEMs (particularly with respect to the SPIRIT data).

- The authors compare their new DEM with RAMPv2, the ASTGTM, SPIRIT and use ICESat as a reference. If I follow their reasoning correctly, the GLAS/ICESat 500 m DEM (DiMarzio et al. 2007) as well as the 1 km ICESat/ERS DEM (Bamber et al. 2009) are excluded due to the coarser grid spacing. However, for Antarctic-wide DEMs the latter is always somewhat of a compromise which accounts for the varying density of available datapoints used for the interpolation. With respect to the RAMPv2, the authors should justify that the 200 m postings are sufficiently supported by real (e.g.

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not interpolated) datapoints which were used to generate the RAMPv2-DEM. In my experience from other coastal sectors in Antarctic, the RAMPv2 was less suited than the DEMs from Bamber and DiMarzio in spite of the seemingly higher horizontal resolution. If this is different for the Antarctic Peninsula it should be explained in this publication.

- Along this line: R. Bindschadler's 15-m coastal DEM is not yet mentioned (Bindschadler et al., 2011, The Crysophere). It also includes ASTER data . No mosaicked version of this DEM is available, but the individual tiles are archived at NASA and distributed upon request.

- All the DEMs mentioned in the two comments above use ICESat tracks. In case those DEMs are compared to the new DEM, this should be done along independent ground-truth data (see first comment).

- There is a lot of DEMs with different abbreviations (ASTER-GDEM, ASTGTM, new DEM, SPIRIT DEM, RAMPv2,...). It is helpful for the reader to have one table with the abbreviations summarized.

- p. 369, line 17: I consider the more recent DEMs from Bamber and DiMarzio as more reliable (but this may depend on the region). I also think that these models are by now more widely used (e.g. in InSAR applications) than the RAMPv2.

- p. 372, line 7: This statement should be corrected. The ASTER GDEM has been used in the IPY project "Antarctic Surface accumulation and ice discharge" (Bindschadler et al, 2011, The Cryosphere) during which a coastal DEM around the Antarctic perimeter has been derived.

- p. 368, line 25 and p. 373, line 5: The "recognized techniques" are not explained to the reader. If you refer to the paragraph on p. 372 lines 7-24 reference it. If not, mention the techniques you are referring to and state why these techniques do not fulfill your requirements.

- p. 373 line 10-13: Could be moved to the place where the RAMPv2 DEM is first

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introduced.

- p. 373, line 23: Stating that the method is “new” does not coincide with stating on the following page (line 7) that “This method has already been [. . .] applied in producing topographic maps [...]”. I have the feeling that I am missing a crucial point in your methodology here. Try to make that more clear.

- p. 374, line 15: I don’t understand how using a 32-bit floating point format reduces elevation errors. I suggest to rephrase or delete that sentence.

- p. 374, line 24: “using GIS hydrology and filtering tools” is unspecific. I suggest to explain in more detail what was done here. From my understanding, this is how you create contour lines across across poor quality regions in the ASTER DEM which seems not unimportant to me.

-p. 375, line 10: Specify which “grounding line” (Rignot GRL 2011, Bindschadler TC 2011,...?) you used to define the boundary of the DEM. What is the reasoning not to include the ice-shelf elevation?

- p. 375, line 20: Specify the blend method (linearly?)

- p. 375, line 28: “filtering” and “clipped” seems unspecific. What filter did you use for the noise reduction, and what are the clipping values?

- p. 377, line 4ff: (see also second comment) It is totally appropriate to evaluate the DEM along ICESat tracks. However, I do not understand why you restrict the analyses only to a subset of your DEM. Why not take more ICESat profiles across the entire DEM? This would improve the statistics (and it becomes more likely that an ICESat track hits the pits and spikes of the GDEM).

- p. 377, line 15: You state the temporal elevation differences must be taken into account, however, in the following error analysis I don’t see how this is done.

- p. 378, line 22: Is there a reference for the DEM for aerial photographs? How was

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its vertical accuracy deduced and what is the “0.5 m” referring to (deviation from the mean, RMSE) ? Currently the given values are hard to assess.

- p. 379, line 14ff: This statement comes somewhat as a surprise. In Figure 8 it appears that the SPIRIT DEMs cover larger parts of the Peninsula. If SPIRIT DEMs are the better choice, should we rather use those than the new DEM? Somewhere in the manuscript (e.g. introduction) the relation between the SPIRIT DEMs and the new DEM should be explained both in terms of coverage and in terms of data quality. Also reference Figure 6 at this point which already compares SPIRIT data with the new DEM.

- p. 379, line 6: Why would you expect some kind of bias in North-South direction?

- Figure 1: Mark “pits/spikes” in the ASTER GDEM with arrows.

- Figure 2: Maybe choose a different color table for people with difficulties to distinguish red and green colors.

- Figure 3: In the lower right corner of (B) contour lines appear to cross, this seems odd, but could be a graphics issue.

- Figure 5: Move the specifics of the ICESat tracks to a footnote in the corresponding tables.

- Figure 6 A,B,C,D,E: I find it more helpful to plot the elevation differences rather than the absolute values (deviations of 10-20 m are hard to see on a absolute scale from 0 to 2000 m). What does HASL stand for (height above sea level?)?. If so, it should be move to the y-label as the reference should be the same for all datsets. The abbreviation ASTGTM is introduced in a header of a table and people will not find it immediately. See comment about DEM abbreviations.

- Figure 7: Since there is some space in the ocean, you can locate an overview map marking the location of Ryder Bay. The term “high-accuracy” could be quantified by inserting numbers. Which line is the blue line?

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Technical Corrections

- Metadata on NSIDC website: the “elevation difference of approximately 3 m” is not well defined and only reflects the deviation from the mean, not the RMSE which is larger. I suggest to use “Mean” and “RMSE” as done in the manuscript.

- Why is there a “-” in “100-m digital Elevation Model” but no dash in any other units?

- In the current format internet resources are referenced with the corresponding URL. According to the ESSD Guidelines they should have a Title, URL, Access date and Year.

- p.365, line 5: I don’t understand the “neighbouring” marine-terminating glaciers. The glaciers are neighbour to what? Maybe rephrase.

- p. 369, line 14: Instead of citing the DLR homepage it is potentially better to cite a (conference) paper which outlines the TanDEM-X mission (e.g. Gantert et al. , “TerraSAR-X, TanDEM-X, TerraSAR-X2 and their applications”, Synthetic Aperture Radar (APSAR), 2011 3rd international Asia-Pacific conference, IEEE 2011). I have currently no access to the PDF and cannot judge the content of the paper.

- p. 374, line 18: “Using a GIS,...” later on you use “ArcGIS”. This leaves the impression that you used two GIS software packages, if so state the name of both.

- p. 375, line 16: The fact that data volume increases should not be a reason for larger grid sizes. I suggest to remove that half-sentence.

- p. 376, line 21: The abbreviation ICESat has been used earlier.

- p. 378, line 7: remove “also”

- p. 378 , line 23: “produced” – “has been produced”

- p. 379, line 9: “Kaab et al.” – “Kääb et al.”

- Figure 4: now the dash moved to the right: “100 m-DEM” :-)

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Interactive comment on Earth Syst. Sci. Data Discuss., 5, 365, 2012.