

Interactive comment on “An improved Antarctic dataset for high resolution numerical ice sheet models (ALBMAP v1)” by A. M. Le Brocq et al.

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Firstly, thanks to the editor and two reviewers for considering the manuscript worthy of acceptance into ESSD subject to minor revisions. The reviewers raise a number of helpful and constructive comments which are addressed below. Two points are highlighted as needing further guidance from the editor, one relating to the reproduction of Fig 2, the second relating to the documentation that is supplied with the netcdf file (both reviewer #1).

Responses:

Reviewer #1 (Malte Thoma)

Specific comments to the manuscript:

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Abstract: * I4 & I14: The authors use the expression "high resolution [numerical] ice sheet modelling" twice, without explaining what "high resolution" means. Please be more specific.

Response: This is hard to define exactly, however, it is meant as a contrast to the 10s km resolutions employed in the past. A description has been added to the first time it is used in the introduction: '(grid resolution of ≤ 5 km compared to 20-50 km previously)'

1 Introduction

p197 * I4p The authors write: "However, these models are only as good as the data that are input" I don't think this is correct, or to be more precisely this is about the definition of the term 'model'. If you consider a 'model' to be a computer program only, you don't change its 'good'ness by the quality of the input data. Hence, I would reformulate: "However, the RESULTS of these models are only as good as the quality of the input data"

Response: Changed

* I6p You should also mention that SICOPOLIS and ELMER/Ice are also available under reasonable software licences can be downloaded as well.

Response: Changed

* I10 remove 'the'

Response: Changed

* I17 I don't understand this statement "BEDMAP unsuitable for the current generation of ice sheet models" Either BEDMAP is not good enough for any ice sheet model or it can be used if it is modified (as the authors did). Without a definition of 'current generation' this expression is not clear.

Response: This has been modified to refer to ice sheet modelling in general

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* I24 remove 'a'

Response: Changed

* I25p ... used for other purposes, the user should be aware ...

Response: Changed

p198

* I2 ... includes the most up-to-date versions of boundary conditions required to ...

Response: Changed

* I9 If this sentence "... is available in the documentation file provided with the data." refers to this document <http://doi.pangaea.de/10013/epic.34211.d001> I have to admit, that I don't feel comfortable with it. The structure of that document (from February 2010 is VERY similar to the manuscript. Actually I think this is a former version of the manuscript itself and not the proclaimed 'More specific detail'. I am very sorry, but as a reviewer with a limited amount of time I don't have the capability to read the former version of the same manuscript, too. I strongly suggest to remove the February version from Pangaea and add a simple README file, which only contains ADDITIONAL information and does not repeat anything already described in the manuscript.

Response: I am happy to do as the reviewer suggests, could the editor provide further guidance on this matter?

* I17 I have to admit, that I (as a proponent of open source software) do have my caveats to suggest the commercial software in this manuscript. There are many many free tools to read netcdf data (which is a free format anyway). Hence I would recommend to remove Matlab and ArcGIS from the manuscript. It could be replaced with: "Many tools are available to convert the data. For example >ncdump<, >ncks<, and nco< can be used to extract ASCII data, >ncview<, >panoply<, and >GMT< could be used to view the data and mathematical operations can applied with >nco< or >GMT<.

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In addition some commercial programs are also able to interpret netcdf files."

Response: The suggested text has been inserted, however the original reference to the commercial software has been retained as many users will have access to tools such as Matlab and ArcGIS at their institutions, and may have more experience of using them than the more specific netcdf software.

* I19p I appreciate that the parameters for the projection are given. But the lat/lon information belongs also into the netcdf file (see above).

Response: See the response to the dataset comments below.

p 199

2 Masks: * In this section you describe the masks >mask< >mask+< (or >mask_plus<), and >glmask<. What about >umask< and >bmask<? They should be described, too.

Response: These are referred to in section 3.6, these are different masks from the other general masks described in this section.

* I25 What is the bases for the velocity? Is it observed (source) or is it modelled (how)? OK, this is explained on p200I9. However, I suggest to reorder this information.

Response: A reference to the relevant section has been added here to inform the reader that more explanation is coming.

p200

* I18 The expression >ice plain< is not well known and should be explained in detail. Is it defined as >ice sheet< or >ice shelf<, or is it a third type of ice? (see above)

Response: The authors think this is adequately explained by the explanation in brackets after its first use.

* I22 (10 s km) is the 's' a typo?

Response: No, it was meant to indicate it is 'tens of km', an 'of' has been included

* I21 The authors use the expression 'often' and then refer to PIG and Slessor GI. I wouldn't consider two glaciers as 'often'. I'm sure there are more >wrong< GL, hence I'm not sure if 'notably' is the correct expression here.

Response: There are other examples of this (e.g. Totten glacier), however, the most notable of these are Pine Island Glacier and Slessor Glacier. This section has not been changed.

p201

* I1 'perhaps' is not a good wording in a scientific paper, from my point of view. Don't speculate, but make your statement! No one will blame you if you have good arguments ;-)

Response: 'Perhaps' this is just a manner of speaking! It is a fair point, the sentence has been reworded to read 'is, therefore, more reliable...'

3 Ice sheet configuration

3.1.1 Grounded Ice

* I disagree with the order of the presentation in this subsection. It is hard to understand. Please reformulate. Suggestion: 1. Describe which datasets are used 2. How they are merged 3. What is the difference between Isrf and topog 4. What is the difference to2

Response: Changed

* I13 The 50m seems to be arbitrary. Where does this value come from?

Response: This is an arbitrary value, but is a sensible arbitrary value, as these areas are mostly small islands that will have limited ice thickness. This value is applied to very few grid cells.

3.1.2 Floating Ice

p204

* 17 A firm correction over the ocean seems useless. This should be removed from the dataset and filled with NAN (-9999)

Response: Values were supplied over all the domain for simulations which predict ice sheet advance. Beyond sensible interpolation bounds, the average value was given, anyone who doesn't like this value can easily identify it and remove it.

* 18 I do understand the meaning of H_i , but is the sentence in the brackets good English? I find it hard to understand.

Response: the word 'resulting' has been included to clarify the sentence.

p205

* 120 The authors describe in detail how the ice thickness has been calculated, however, in the netcdf only `>usrf<` and `>lsrf[2]<` are included. Therefore it is not clear to me what is meant with " actual ice thickness ... is incorporated into the dataset" For my example figure I subtracted `lsrf` from `usrf`.

Response: the following clarification has been added '(i.e. `usrf - lsrf`, Fig. 3c)'

3.2 Ice surface

* p206 What is JLB/JAG ?

Response: This is defined on line 2 of this page

p207 * 1. It may be only 0.1% of the grounded cells, but these are all(!) along the grounding line and/or below ice shelves. This changes the 544 grid cells to a significant amount! This should be mentioned.

Response: These are not near the grounding line or under ice shelves, that is the point of having the two treatments so this does not happen at the grounding line. Near the grounding line the surface is kept consistent (treatment 2).

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* What about subglacial lakes, in those areas, the ice is also floating. What does the algorithms indicate there? And how is this treated?

Response: Subglacial lakes are not treated here, the entire column is assumed to be ice, and the region is assumed to be grounded.

3.4 Sub Ice-shelf bathymetry

* I21 I disagree with this sentence. To my knowledge there are some ice shelves with a reasonable bathymetry. E.g. Amery, Fimbulisen, GeorgeIV. I don't suggest to include all this data, I only suggest to reformulate this sentence.

Response: This is true, it was meant that there was little data in BEDMAP, this has been clarified.

* I22pp The sentence " In BEDMAP, ... that were used led to ... which did not ..." It hard to follow.

Response: This has been changed to: 'The interpolation algorithms employed by BEDMAP led to sub ice-shelf bathymetry values that caused many ice shelves to ground.

p 208 * I13 From my point of view the PIG is part of the Amundsen Sea.

Response: Yes it is, but it is treated differently, so it has its own separate section.

* I15 This paragraph is surly worth to note! If BEDMAP has a shift and an offset (how much?) this is important to pronounce! However, it does not only refer to this section, hence move it to a more appropriate place. Did the authors found the shift values (dx=3134m, dy=1866m) as an analytical result from comparing different projections or are they just found by trial and error?

Response: This shift is purely the difference between the spatial reference of the ice thickness grid and the bathymetry grid. It is assumed that this was a mistake in the original BEDMAP dataset. This sentence has been clarified to indicate the origin of the

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shift amounts.

p210

* I26 The original dataset is discussing this issue is Galton-Fenzi, B.K., Maraldi, C., Coleman, R., and Hunter, J.: The cavity under the Amery Ice Shelf, East Antarctica. Journal of Glaciology, 54 (188), 881-887, 2008. (Ralph Timmerman, personal communication ;-) Please adjust the citation.

Response: Changed

p212

* I11 On which ground do the authors claim "...which should be below sea level ..."?

Response: (according to the MOA mask) has been added

* I19 "...ice thickness above buoyancy..." I'm not sure what the authors mean with this expression. If the ice is 1000 m thick and we assume an ice density of 918 kg/m^3 and a water density of 1028 kg/m^3 , than the 'buoyancy'-level would be at $1000 \text{ m} * \frac{918}{1028} = 893 \text{ m}$. Hence, the 'ice thickness above buoyancy' would be $1000 \text{ m} - 893 \text{ m} = 107 \text{ m}$. However, I don't see the meaning in this value.

Response: The reviewer's calculation is not calculating the ice thickness above buoyancy, as they are assuming that all the ice is floating already, and calculating the proportion of the ice which would be in/out of the water. The purpose of the ice thickness above buoyancy is to calculate how much ice there is 'extra' over what would be buoyant in the given water depth. For example, if the 1000 m of ice existed in water depth of 500 m, the thickness above buoyancy would be $1000 + \frac{1028}{918} * -500$ (assuming no firn correction) = 440 m. Whereas, if the 1000 m of ice existed in a water depth of 800 m, it would have a thickness above buoyancy of 104 m, much closer to flotation. If the ice existed in 1000 m of water, the result would be negative, indicating that the ice would float.

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Therefore, the ice thickness above buoyancy indicates how close to flotation the ice is, and also where the ice is actually floating (negative values). The calculation here indicates that the grounding line is now in better agreement with the expected grounding line (from MOA) than BEDMAP.

p214

* I don't understand this sentence: "The data were provided in lat-lons, but are also based on a geographic grid." From my point of view a 'geographic grid' implies lat-lon.

Response: This has been clarified to read: 'The original data are gridded on a geographic (lat-lon) grid, so when they are projected...'

p215

* I9 Remove "It is hoped that" * I10 Period after "community." and remove the second part of the sentence.

Response: The 'hope' here is that the need for consistency has been demonstrated, hence the second part of the sentence is considered very important. The sentence has been adjusted to reflect this more clearly.

* I12 replace ", as with" with ", as well as"

Response: Changed

* I14 remove "the"

Response: I'm not sure which 'the' is being referred to, the sentence makes sense as it is.

Tables: Table 1: * I wouldn't consider a >Name< a >Data Source< perhaps the column title could be adjusted?

Response: This has been adjusted to Data Source / Provider

* An additional column containing the section where a specific field is described in

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detail would be nice.

Response: This is a good idea and has been added.

* mask+ is named mask_plus in the netcdf file

Response: This is essentially the same thing.

Table 2: * mask+ contains also values of 1 and 2. What do they mean?

Response: These correspond to the values in mask. 'Mask+ also contains the base values from 'mask'.' has been added for clarification.

Figures: General: Most figures are too small to identify the details. I am aware that this is most probably a (bad) limitation of the ESSDD-pdf. I would encourage the author as well as the editor to discuss this repeating problem with the publisher.

Response: Apart from Fig.2, the figures are quite clear.

Fig.1 * What is >ipmask<?

Response: this mask was mistakenly called 'gmask' in the manuscript, it should be ipmask, the manuscript has been adjusted accordingly.

* The expression >ice plain< is not well known and should be explained in detail. Is it defined as >ice sheet< or >ice shelf<, or is it a third type of ice? (see above)

Response: As the response above suggests, the authors consider this to be sufficiently explained in the text above.

Fig.2 * I really like the idea behind this flow diagram. However, it is nearly unreadable. Please ensure that it is reproduced larger in the final version.

Response: There is a sufficient amount of detail in the pdf that it can be 'zoomed in on', however, in the final pdf this may be a problem. One solution could be to split it into subfigures and spread it across a number of pages. Could the editor provide some advice on this problem please?

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Fig.3 * Caption: d) is not consistent with bold (a)-(c)

Response: This was altered during the generation of the ESSDD pdf, this is a typesetting issue...

* b) The data contains values up to 42.4 m of firn. Adjust the color scale accordingly (and remove the firn thickness over the ocean).

Response: This colour scale was chosen to increase the contrast in the figure.

* I'm not convinced by the color scale of a), c), and d). I attached an example showing much more details. This should be changed for all subfigures.

Response: This has been redrawn.

Fig.6 * See comment above to p212, l19

Response: See response above.

Specific comments to the dataset (netcdf): * -9999 is used as a >missing_value<, however, they missed to add this standardised attribute to the variables. The following command executed from a shell will fix this bug for each variable very easily: > ncatted -a missing_value"o,f,-9999 ALBMAPv1.nc * The geographical coordinates (lat/long) for each grid coordinate should be included into the dataset. * The ice thickness could be included, too. This would make life easier for some modellers. * I'm missing some >global attributes< and would suggest to add some, e.g.: > ncatted -a Authors,global,c,c,"A.M. Le Brocq, A.J. Payne, and A. Vieli" ALBMAPv1.nc > ncatted -a resolution_dx,global,c,f,5.0 ALBMAPv1.nc > ncatted -a resolution_dy,global,c,f,5.0 ALBMAPv1.nc > ncatted -a rho_ocean,global,c,f,"1028 km/m³" ALBMAPv1.nc > ncatted -a rho_ice,global,c,f,"918 km/m³" ALBMAPv1.nc * Finally you might want to remove the >history< > ncatted -a history,global,d" ALBMAPv1.nc

General response: These are all useful points, however this manuscript needs to describe v1 that has already been released, hence these changes will not be made to v1,

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as they are not of fundamental importance. They will be taken into account for v2.

Reviewer #2 (Ginny Catania)

General Comments:

This manuscript nicely summarizes the steps taken by the authors in order to present an Antarctic data set for the ice sheet modelling community. The authors clearly outline each of the data sets, subsequent processing steps (if any) and how they overcame any specific challenges in order to produce a complete and consistent data product that is much better than what currently exists. My only general concern is the lack of error reporting. Instead, the authors leave this for reader to compile from the list of data sources. While I am not an ice sheet modeller, I understand that without a good understanding of the dataset errors it is difficult to understand how good model results are. I would suggest that even a brief summary of reported errors from each of the data sources is better than no error reporting at all. Better yet, would be a section on how the processing steps outlined here have affected errors in the data.

Response: A good understanding of errors is important as the reviewer suggests, however with a number of the datasets it is hard to quantify and is likely to be spatially variable. Therefore, giving only a short summary of errors could be ambiguous, and going into too much detail would make the paper less concise. The authors consider that directing the reader to the original papers reduces confusion and duplication.

Technical Corrections: Edwards, 2008 looks like an interesting paper but I could not find the reference in the reference list. Please double check all references in the text.

Response: This was included in the submitted manuscript, it appears to have been omitted in the ESSDD pdf. The reference is: 'Edwards, L.A. (2008) Satellite Interferometry and Tracking data: Antarctic Velocity Map Generation, Validation and Application. Unpublished PhD thesis, University of Bristol, UK.'

Pg. 200, line 11: add an 's' to 'small outlet glacier' and it is unclear what 'coherent

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enough' means? Does this mean that velocities were not available for these small glaciers or that velocities were not consistent across them?

Response: This is related to how they appear on a 5 km grid, they may only cover a few cells, hence, for modelling applications this is not very practical.

Pg. 201, line 1: what about using the ICESat-derived grounding line? This gives the location of ice shelf flexure. I believe this has been published by Fricker for many locations (if not the entire ice sheet).

Response: Unfortunately I don't think this covers the areas in question.

Pg. 202, line 11: Should be "All of the bathymetry datasets: : :"

Response: Changed

Pg. 203, line 27: what is "firn data" thickness? density? This is not clear. Ah, I see on the following page you mention the firn "value" of 16.5 m so I assume that the output is thickness. I would say that more clearly and change the word "value" to "thickness".

Response: This is a firn 'correction', not a thickness. The word 'correction' has been added on this line.

Pg. 206, line 10: Should be ": : :inherent errors, it is probably: : :"

Response: Changed

Pg. 210, line 5: should "was" be "were"?

Response: this has been changed to "bottoms' of the troughs were"

Pg. 210, 15: perhaps change "leads to" to "identifies"?

Response: it doesn't really 'identify' them, as it is not certain that they exist, the just occur because of the interpolation method.

Pg. 210: line 26: Change to ": : :ridge appearing at the grounding line of the glacier"?

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Response: the ridge is not at the grounding line, this has been clarified by adding: 'towards the coastal end of the ice shelf'

Pg. 215, line 3: ": : :data provided were interpolated on to: : :"

Response: Changed

Interactive comment on Earth Syst. Sci. Data Discuss., 3, 195, 2010.

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