

Interactive comment on “Sediment loading in Fennoscandia during the last glacial cycle” by Wouter van der Wal and Thijs Ijpelaar

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Received and published: 16 June 2017

author reply in between « and »

The manuscript is well written in terms of structure and English, but some improvements should be done. Many are of rather technical nature, but should be addressed carefully. I am willing to recommend publication after moderate revision.

« We are grateful to the reviewer for the effort and the helpful comments »

Title: as you deal with the Barents Sea, it should be included in the title. I'm reluctant to accept the term "sediment loading" in the title as you have erosional, thus unloading processes in your model as well. One can extend this discussion with the term "glacial-induced sediment redistribution" or "glacially induced sediment redistribution"

C1

used later in the manuscript. Are you sure that your model includes glacially induced processes only? What about the "normal" erosion-transport-sedimentation process during the last glacial cycle up to now? In some areas in your research area was no or only little glacially influenced redistribution of rock material, in other areas the normal rock material redistribution is altered by the glaciation, but one may question what is "normal" in this sense. What is in common is certainly that you are talking about the main exogene processes. Nonetheless, I would like you to think about the term you are using and use it already in the title. My suggestion would be "Effects of exogene processes in Fennoscandia and the Barents Sea during the last glacial cycle on glacial isostatic adjustment observations".

« We agree that the title can be improved by a better specification of the region and processes involved. It is a good point that there is likely also 'normal sedimentation'. However, the word 'exogene' can mean different things and would not make the title clearer in our opinion. We opt for: "Effect of sediment redistribution in Fennoscandia and the Barents Sea during the last glacial cycle on GIA observations" »

Abstract: L8 remove "postglacial rebound, or"

« done »

L17 specify "at most several"

« replaced by "up to 2 m" which is the largest difference found at one of the RSL sites shown in figure 7. l 18 »

L20 change GPS -> GNSS and introduce abbreviation

« done »

L21 GRACE abbreviation unexplained

« done »

Main text: P2L20 uplift rates of deformation and gravity change

C2

« changed to “deformation rates and gravity rates” »

Equation 1: what is SL?

« added before the equation »

Equation 2: what is L and S?

« L is added before equation 2 and S is now explained after the equation »

Equation 4: what is h_j and C_j ?

« added »

P3 second last: comma missing: Earth, the ice

« added »

Figure 1: switch x and y axes, then the figure is easier to get

« done »

Section 3.2: although dealing with longer time spans, it'd be good to mention the works by Zieba and co-authors (Zieba et al. 2016, 2017).

« Thanks for pointing us to this reference. We think Zieba et al (2016) is relevant. a reference is added in p6l19 »

Figure 2: needs lat-lon information

« Figure 2 is used to show the labels of events. Figure B.1 and B.2 which show the shape of the events and the magnitude now have lat-lon information »

P6L15: add Sed1, 2 and 3 to the min, max and moderate explanation.

« done »

P7L2: Table A4

C3

« done »

Figures 3, 4 and 5 are awkward due to missing lat-lon info, different projection and more (Figure 3: why is it location of erosion events in the caption, but spatial distribution of sediment contours when referred to in the text? What are the colors? Name of areas? Why is there no contribution from land?;

« Figure 4 is removed. Legend and lat-lon information is added to what is now figure B.1 and B.2. The word 'shape' is now used in the text and in the caption. A legend and latitude and longitude information are added. »

Figure 4: add information on blue and red, i.e. what is erosion what deposition. Amantov et al. (2011) seem to have a very fine resolution including major river systems, while Fig. 5 is rather coarse. Please explain in the text.

« Figure 4 is removed. In the caption of figure 5 (now B.2) is explained how values are obtained from spline interpolation »

Figure 5: color scale missing; figure not referenced in the text!)

« color scale is added, and a reference to the figure in Appendix B.2 »

As these figures are of rather technical nature, I strongly suggest to move this part to the supplement, i.e. P6L16 to P9L2, and summarize briefly in 1-2 sentences that you developed in addition to sed1,2,3 two more models based on Amantov et al., and that further info how you got these models can be found in the appendix. Also mention briefly the differences between Amantov 1 and 2.

« This is a good suggestion. We moved the material to Appendix B. »

To fill the space, I suggest to add a new Figure 3 showing a comparison of sed1,2,3 and Amantov1,2 similar as the old Figure 4, i.e. the total load change in metres of sediment thickness. Then you can explain this figure with the differences between the models.

C4

P8L6: I understand that due to proprietary reasons Amantov's model is not available, however, it should be possible to clarify via e-mail to Amantov or Willy Fjeldskaar if the saturation is at 300 m or any value above...

« This has been clarified. 300 m was not a cut-off in the color scale, but was a maximum set for sediment thickness based on modelling. The plateau shape is not entirely realistic, this can be seen as reflecting the (considerable) uncertainty in sediment modelling (Amantov, personal communication). This is added to appendix B.2. Based on this information, the Amantov 2 model is no longer necessary and removed from the paper. The Amantov1 model is simply called 'Amantov'. »

P9L2: Please mark in Table A2, e.g. with a star, which features were added to Amantov 1 and 2.

« The features that were meant were the large scale failure events for Sed1 listed in table A.5. This has been clarified in Appendix B.2 »

P9L7: it is rather the Oslo Graben area than the center of the continent where the largest uplift is found.

« replaced by: "between south Norway and Sweden" »

Table 1: comparing Sed1,2,3 with Amantov 1,2 it appears that the first underestimate GISR by mainly about a factor of 2 in view of the latter

« added in the caption of figure 5 "It can be seen that the Amantov model results in values that are a factor two or three larger." »

P11L18: add "(not shown)"

« the figure has been added »

P12L4: the value of 0.016 might be ok from the math but is from my perspective overly optimistic in this regard. We know meanwhile from GNSS that the value is something like 10+ mm/a. Depending on longer time spans, reference frame issues, better correc-

C5

tion models for the atmosphere, tropospheric delay etc. the value may change, but not to 9.5 mm/a or less or to way more than 11 mm/a. Anything in between is well covered by the uncertainties. Analysing GRACE instead, you'll see that the maximum value can be 0.9, 1.2 or even 1.5 microGal/a depending on the solution centre, used filter, time span etc. This is not at all covered by such a small value. You need to specify this for the reader. In view of the max gravity rate you get (Table 1) the sediments loading effect appears to be negligible for now. Also, even if you use a cut-off of degree 60, GRACE data are still filtered and thus you should filter the GISR result as well then.

« discussion added on page 11 »

P12L16: affects -> affected; remove "location"

« done »

Table A4: add min, max, moderate to Sed1,2,3.

« done »

Add data for Amantov1,2. What about the source areas? There is no information listed here nor in the main text. How are the continents treated? Please add!

« The source areas are taken from the reference, see figure B.2 and the comment on mass conservation in (now) appendix B.2 »

Finally: will the models (at least Sed1,2,3) be available for download somewhere so that other can use them?

« The sediment will be made available on the university webpage of the first author once the personal pages from our university are reinstated »

Please also note the supplement to this comment:

<http://www.solid-earth-discuss.net/se-2017-18/se-2017-18-AC2-supplement.pdf>

