Solid Earth Discuss.,
doi:10.5194/se-2017-18-RC2, 2017

Solid Earth
Discussions
Open Access
EGU

Interactive comment on "Sediment loading in Fennoscandia during the last glacial cycle" *by* Wouter van der Wal and Thijs IJpelaar

Anonymous Referee #2

Received and published: 28 March 2017

This study presents an analysis of sediment redistribution effects during the last glacial cycle on often used glacial isostatic adjustment (GIA) quantities. Such effects are in discussion for way more than a decade now and works by Dalca et al. (2013) and Ferrier et al. (2014) provided insight in the importance to incorporate this process in GIA modelling. This also shows the trend to upgrade specific models to advanced Earth System models. Van der Wal & IJpelaar present now results for Fennoscandia and the Barents Sea, an area well investigated in view of GIA, and show partly remarkable effects on relative sea-level, uplift and gravity change data. The authors developed 5 different sediment redistribution models and thus are also able to show some uncertainty of this effect.

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.

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 extent this discussion with the term "glacial-induced sediment redistribution" or "glacially induced sediment redistribution" 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".

Abstract:

L8 remove "postglacial rebound, or"

L17 specify "at most several"

L20 change GPS -> GNSS and introduce abbreviation

L21 GRACE abbreviation unexplained

Main text:

P2L20 uplift rates of deformation and gravity change

Equation 1: what is SL?

Equation 2: what is L and S?

Equation 4: what is h_j and C_j?

P3 second last: comma missing: Earth, the ice

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

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).

Figure 2: needs lat-lon information

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

P7L2: Table A4

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

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...

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

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

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

P11L18: add "(not shown)"

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 correction 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.

P12L16: affects -> affected; remove "location"

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

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

References

Zieba, K., Felix, M., Knies, J., 2016. The Pleistocene contribution to the net erosion and sedimentary conditions in the outer Bear Island Trough, western Barents Sea. arktos 2, 1-17.

Zieba, K., Omosanya, K.O., Knies, J., 2017. A flexural isostasy model for the Pleistocene evolution of the Barents Sea bathymetry. Norw. J. Geol. 97(1), 1-19.

Interactive comment on Solid Earth Discuss., doi:10.5194/se-2017-18, 2017.