Review paper: *Fast uplift in the Southern Patagonian Andes due to long and short term deglaciation and the asthenospheric window underneath*, V. Muller, P. Sternai, and C. Sue

General Comments

This paper is dealing with GIA and LIA modelling to explain the Earth deformation observed in South Patagonia. The paper is written in good English and illustrated with appropriate Figures and Tables. The authors performed a lot of computations and expose interesting results addressing a current scientific question. Nevertheless, some essential points are missing. Therefore, I recommend the publication of this paper in EGUSphere after major corrections in line with my suggestions in the comments below. I'm sure that the authors would be able to do it properly and it would certainly add value to the paper and to the reliability of the results.

Kind regards,
Joelle NICOLAS.

Specific comments

Despite the paper is well written and the results are interesting, some key points are not explained or even mentioned. These are essential to be considered to increase the reliability of the results and convince the reader.

I wonder why the two effects LIA and GIA are never added before the comparison between model and observations, as well as why the actual ice melting is not considered. Indeed, the actual uplift signal observed is the combination of visco-elastic response of the crust to GIA, LIA and actual ice melting. What about the current ice melting signal (and acceleration) in the study as the corresponding elastic deformation is not negligeable at all?

Please explain how the GNSS and remote sensing velocities were estimated as well as for which period and in which reference frame they are expressed. This is extremely important because, depending on the duration of the time series analysed and on the parameters used to process the observations, the vertical velocity results obtained may vary considerably. And then, the comparison won't have the same relevance with respect to the models computed in this paper. Indicate also what remote sensing satellite and data were used.

I'm surprised that the authors don't mention any comparison with GRACE observations.

Which ice model was used?

Explain why it is relevant to consider only one LIA model. Would it be possible to add some error bars on this model?

Explain why the post-LGM model set 2 is flat in the second part and no small linear trend was considered and why the two models doesn't reach the same ice thickness at time 0.

It is unclear how the deformation resulting from the unloading were computed. Did the authors used Green's function and Love numbers or other methods?

It would be interesting to explain why the maximum rate of uplift occurs at 300-400 km (Fig. 4-6). It would also be helpful to show the same plots with the cumulative effect of GIA and LIA as well as the differences between the two GIA models.

In the discussion section, the period corresponding to results are not clearly indicated. The authors should specify to which period their uplift values refer.

Separate discussion and conclusion sections, with a more complete discussion with at least a more detailed comparison with actual uplift observations and how the results are consistent with other studies considering other period of times, other areas? The authors can have a look to the publications of Hilary R. Martens et al. (e.g. https://doi.org/10.1093/gji/ggw087), A. Richter et al. (e.g. https://doi.org/10.1016/j.epsl.2016.07.042), H. Lau (e.g. https://doi.org/10.1016/j.epsl.2018.12.009) or Yan Hu and Jeffrey Freymueller (e.g. https://doi.org/10.1029/2018JB017028).

Technical corrections

l. 42: I suggest adding the corresponding ice mass involved.

l. 74-75: How were estimated the surfaces and volumes?

l. 83: Explain GNSS when first used.

Section 2.2: Explain the relevance of the different values retained (e.g. l. 159, 160, 182, 184).

l. 173: Explain what x and y directions correspond to.

Section discussion: It is not easy to follow the discussion and to understand which column of Table 2 the reader needs to refer. Clarify this.

l. 281: Is it really "a few mm/yr" as in Table 2 values range from 2 to 19 mm/yr?

l. 290-292: Reformulate the sentence.

l. 294: Which satellite?

l. 333: It would be nice to put a more recent value.

Figure 1b: What data were used for the background color? How were obtained the GPS vertical velocities?

Figure 3: Explain how the velocity vectors were obtained and indicate the corresponding error bars. What about Model set 2?

Fig. 4: What does the distance refer to? To the center of the ice?

Fig. 7: Why not use the same scale for both sets? So, it is not easy to compare the two model sets of post-LGM. It would be very useful to add a vertical bar corresponding to the present-day epoch. It is important to be able to compare to the actual geodetic and remote sensing observations. It is not clear which way the time is going. Is it since the glacial maximum or in relation to the present day? Please clarify it.

Table 1: I suggest starting with the ice and arranging the rows from surface to deepest. Adding information on the depths concerned would be a good idea.

Table 2: Review the number of significant digits. Clearly indicate where the current period is in the table, so that it is easy to know which values to compare the observations with.