Reply to comments of REVIEWER 3: Geruo A

Dear Editor, dear Dr. A,

Hereby we respond to the comments (in blue). In the annotated revised manuscript, the modifications made are marked in bold face and a label “R3-N” is found on the margin of the manuscript (where this is permitted by LaTeX), where R3 stands for Reviewer 3 and N is the point made by Reviewer 3 (labels are defined, in blue, in this letter).

We hope that we have responded satisfactorily to the constructive comments received, and we are looking forward to have your feedback.

Note that we have also corrected a few typos, added some references, improved the text in a few places, and re-edited some of the figures and tables.

Kind regards

Giorgio Spada & Daniele Melini

Urbino, 20 September 2019.

Interactive comment on “SELEN4 (SELEN version 4.0): a Fortran program for solving the gravitationally and topographically self-consistent Sea Level Equation in Glacial Isostatic Adjustment modeling” by Giorgio Spada and Daniele Melini

Comments by Reviewer: Geruo A

Point R3-0

The manuscript describes an updated numerical model that solves the sea level equation. Compared with its previous iterations, the new model now accounts for shoreline migration and rotational feedback, and it features enhanced portability and computational efficiency. The theory session is generally easy to follow. The result session provides a clear overview of the model configuration (i.e. ice and Earth model inputs) and highlights the newly implemented features (i.e. shoreline migration and rotational effects). The manuscript fits the scope of the journal and it is generally well written. I have a few minor comments listed as follows.

We thank Geruo A for his positive evaluation and for the suggestions made. We have made efforts to address all his comments; when not, a justification is given. See the details given below.

Point R3-1

The authors first define the sea level as B = -T (Eq. 3 and Page 3, Line 21), and later express it in Eq. 16 as the difference between the sea surface height and the height of the solid Earth surface. I think Eq. 16 is a more intuitive definition of the sea level. Based on this equation, it is also straightforward to define topography as T = -B. I suggest the authors introducing Eq. 16 before Eq. 2. Following this definition, the ocean function can also be defined immediately (O = 1 when B>0 with no grounded ice).

This section of the manuscript has been rephrased, in order to define topography (T) in terms of sea level (B), as also suggested by Reviewer 1. See also Points **R1-6** and **R2-7.**

Point R3-2

Figure 8. Please consider increasing the range of the color scale to make the plot less saturated.

While the two top panels are a bit saturated, the two bottom ones are not (see min/max values in the caption). Using two different scales for the top and bottom hinder a easy intercomparison between the fingerprints, so we have decided to leave the figure as it stands**.**

Point R3-3

Page 15, Line 15 to the end of session 3.3.2. It would be helpful to clarify the typical range of errors of tide gauge measurement. I think this would help the readers understand the significance of the difference among the reported model runs.

This is a very useful suggestion, and we thank the Reviewer for that. We make this point when we compare the ‘best’ SELEN prediction (R100/L512/I5) to the original implementation of ICE-6G_C(VM5a).

Point R3-4

Table 5. The label and the caption of Column (e) should be ICE-6G instead of ICE-5G.

Yes. We have made this change.

Point R3-5

Page 16, Line 1. Please clarify how the coherence between the two predictions is quantified.

For coherence we mean that the two predictions have the same sign. We avoid using this term and rephrase, now.

Point R3-6

Page 16, Line 20. It would be helpful to clarify that the “direct effect” is associated with the change in centrifugal potential. This would help the readers follow the discussion at Lines 21-25.

Right, OK.

Point R3-7

Page 17, Lines 19-25. This part of the conclusion focuses on the computational aspect of the model while the current result session is not organized in a way to highlight this aspect. It would be helpful to include a brief summary in the result session to justify this part of the conclusion, especially regarding the second point at Line 21.

In this part of the conclusions, we just want to briefly highlight the major improvements we implemented in SELEN4 from a technical and practical standpoint. We think that it is it not worth discussing technical aspects like code organization or customization of input files in the main paper, since these are illustrated in detail in the user guide. On the other hand, we agree with the Reviewer that our statement about code parallelism on line 21 needs some quantitative support, so now we explicitly refer to the supporting material, where the scaling of SELEN4 has been thoroughly characterized.