

## Response to reviewer #1

*We appreciate the reviewers for giving valuable comments and are pleased to resubmit this manuscript. The comments are in blue text and our responses in black and italic text.*

This paper presents new GIA modelling that uses two different ice loading histories (ICE6G and Nice6g...), alongside two values for mantle viscosity (weak and strong) to simulate spatiotemporal changes in RSL in the Indian Ocean facing sector of East Antarctica (Enderby Land and Mac Robertson Land). These modelled RSL histories are then compared to (mostly) previously published RSL reconstructions to assess which ice loading history and mantle viscosity are most consistent with the data. My understanding is that the Nice6g refinement was motivated by new cosmogenic data that shows a difference in deglaciation age from that applied in the ICE6G model. So to test if the refinement is appropriate this study uses it to model RSL.

In these terms this is a solid study but I find the main body of text quite difficult to follow if my understanding of the broader motivation is correct. The introduction would benefit from an expanded and explicit paragraph on the aims and objectives of this specific study. the last sentence (lines 75-76) doesn't fully articulate this.

*We have rewritten the last sentence of the introduction as 'Therefore, in this study, we established a sea-level dataset for the LHB and PB regions, including the newly obtained data for the LHB, and assessed the validity of the modified ice-loading history using the established dataset and the GIA modelling to identify the spatial variation in ice-mass changes in these regions.'*

I also think the paper slightly overstates its "sea level" reconstruction aspect. I appreciate the work that goes into recalibrating datasets so they are internally consistent and how this is done needs to be documented. But as far as I can tell the paper uses previously published RSL reconstructions supplemented by some new ages which, while I agree should be included, don't really change the RSL story. I think the paper would benefit from trimming down the RSL data side of things and being more focussed on, and expanding, the modelling aspect. It is, at heart, a modelling paper and should wear that badge with pride so-to-speak. One way to do this would be to remove "3.1 RSL reconstructions" from results and move it to a new section before the methods that covers "study sites". This could describe both the deglaciation story (and the difference in timing relevant to ice loading histories) and the RSL curves (supplemented with new data).

*We have added the section of 'sea-level data' after introduction section.*

Similarly, the discussion covers a lot of material (i.e., lines 232-259) that, although relevant, would be better placed before results as it really sets the scene for the study (i.e., shows the different deglaciation timeframes) rather than being a point of discussion for the results of the work done here (i.e. GIA modelling). I then think the discussion needs a restructure, I'm not sure exactly how. Maybe discuss LHB and PB separately first before making comparisons. I think there are some interesting points here but they are quite hard to pull out from a discussion that jumps about so much.

I want to be supportive of this paper and think there is a body of work here that will be a good addition to our understanding of EAIS history and RSL change. However i think to realise its full potential and ensure it is picked up upon it needs some significant restructuring to more clearly state its motivation and focus more on the results of this study rather than re-discussing previous work.

*Thank you for the valuable comments. Based on your suggestion, we have changed the structure of the manuscript. By moving and removing the descriptions of surface exposure dates, we have focused more on the modelling aspects.*

### **Specific comments**

Title: I don't think this title is appropriate. It doesn't really describe what this work did or what its contribution to knowledge is. "Refined ice loading histories improve fit of GIA models to relative sea level data in East Antarctica" is just one that comes to mind (I'm not a modeller so this maybe a poor suggestion). but i think something that better describes the work/conclusion of this paper is needed.

*Thank you for the suggestion. We have changed the title as "Spatial variation in Holocene sea-level change revealed by the timing of ice-mass loss in East Antarctica".*

Lines 50 - 55: Think the overall picture of RSL change needs to be described in the intro (or in a new section as suggested above)

*We have added these to the new section.*

Lines 62 - 67: Not needed, there is no new TCN data being presented so a description of the method in any form is not required.

*We have removed the sentences.*

Line 69: Ok so studies show difference in timing to that used in ICE6G...what did ICE6G use?

The data from 42 GPS sites, 62 SEDs, 12 Holocene sea-level records, and 9 continental shelf sedimentary facies are used in ICE-6G (Argus et al., 2014), cited from Whitehouse et al. (2012). However, these datasets do not include SED data from Rayner Glacier (White and Fink, 2014), Gjelsvikfjella (Suganuma et al., 2022), and Soya Coast (Kawamata et al., 2020).

Throughout the paper the authors refer to Nice6gSi6g\_09-05\_PART. This is really awkward to read inline and i wonder if it should be referred to more simply e.g., Suganuma ice history (vis a vis ICE6G).

*We have changed the name as mod-I6G\_DML.*

My understanding is that the high marine limit on Skarvsnes is related to neotectonics but this isnt discussed anywhere. It has implications about the utility of the RSL record at this site for constraining GIA models. cf. discussion on lines 242-242.

*Thank you for the suggestion. We have added this to the discussion (L258).*

Lines 244-259 belong in an introduction or study site section.

*We have moved these sentences to the introduction.*

Fig 2. Units on colour bars missing. Coastline is really not clear. Label panels A/B with ice loading model.

*We have revised the figure as follows.*

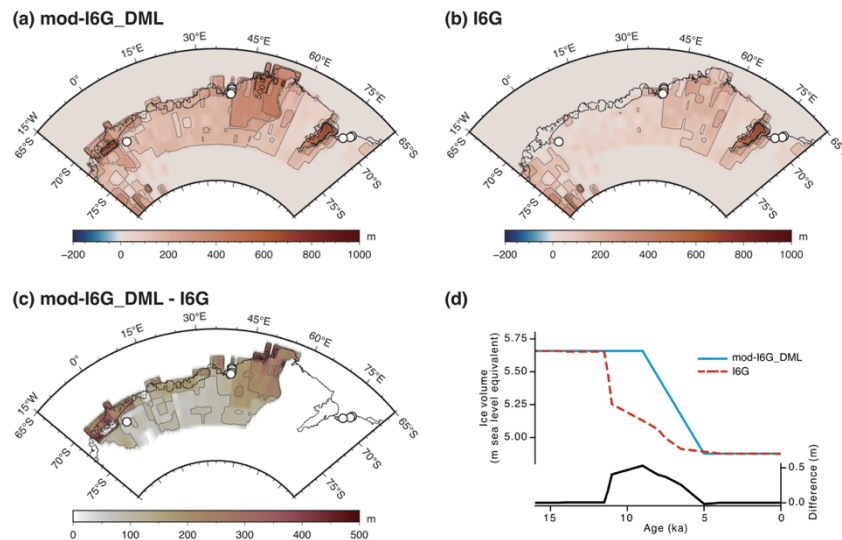


Figure 3: Ice loading at 9 ka using the (a) mod-I6G\_DML model and (b) I6G model. (c) portrays the offset between (a) and (b). (d) Up: The red and blue lines denote the volume change in ADS 5-7 estimated using the I6G and mod-I6G\_DML models. Bottom: The difference between these models. (a-c) Circles indicate the RSL sites considered in this study.

Fig 3. Is Nice6gSice6g the same as ICE6G, check labels below panel C.

We have revised the figure as follows.

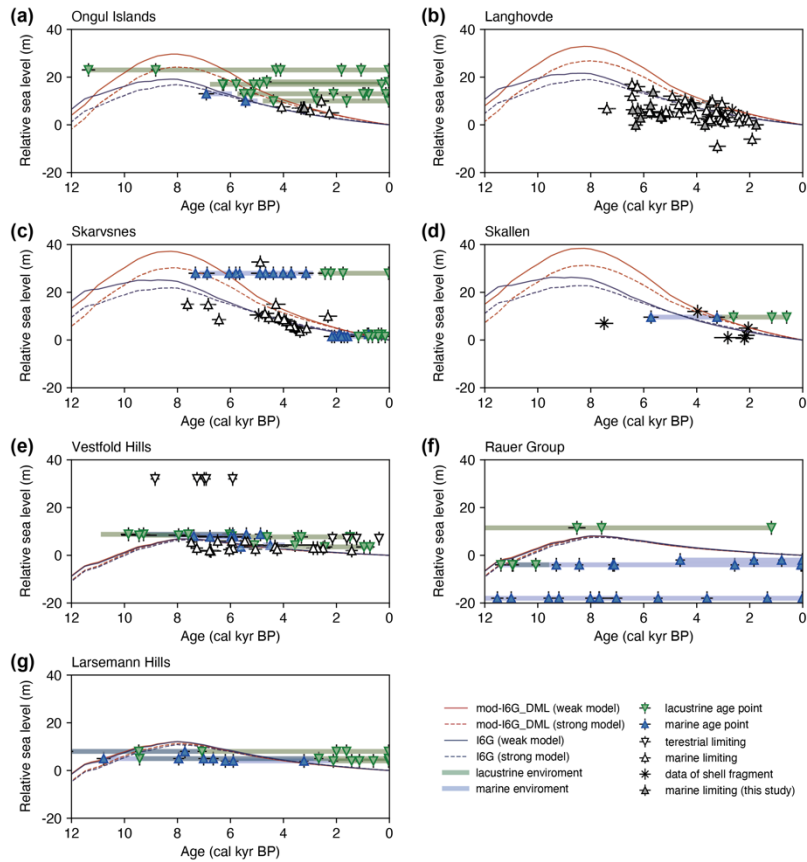


Figure 2: RSL data and GIA-predicted RSL over the past 12,000 years for (a) Ongul Islands, (b) Langhovde, (c) Skarvsnes, (d) Skallen, (e) Vestfold Hills, (f) Rauer Group, and (g) Larsemann Hills. Blue and red lines are the GIA-predicted RSL using the I6G and mod-I6G\_DML, respectively. Solid and dashed lines denote the weak and strong models of rheology, respectively. Black upward-pointed triangles denote marine limiting of RSL data in this study. White upward- and downward-pointed triangles denote previously reported marine and terrestrial limiting. Crosses denote the data from shell fragments. Blue upward- and green downward-pointed triangles indicate age points of marine and lacustrine environments obtained from isolation basin sediments, and blue and green thick lines represent durations of marine and lacustrine environments, established by Bchron (Haslett and Parnell, 2008). Age uncertainty is two sigma.

Fig 5. Colour scheme should be divergent around zero surely? really hard to see at a glance where RSL is higher/lower than present. I would label the panels with the ice loading model/viscosity used. Its hard to keep referring back to the caption.

We have revised the figure as follows.

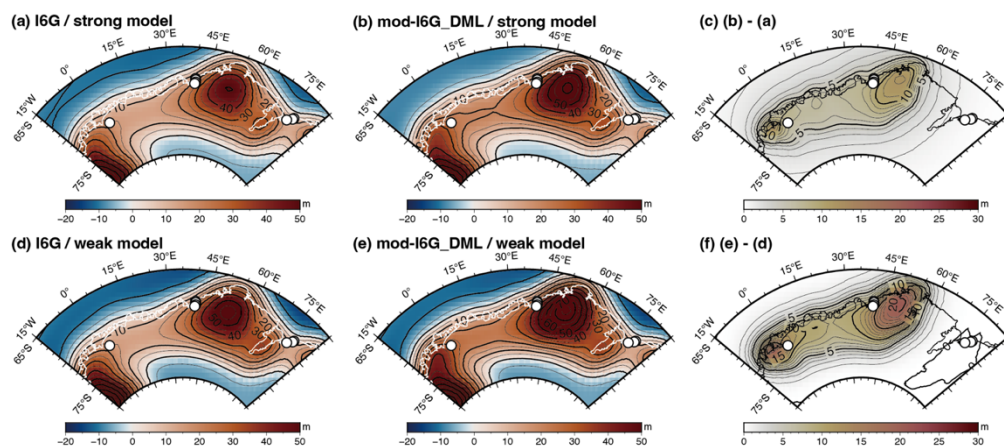


Figure 4: Spatial distribution of relative sea-level (RSL) at 8 ka, based on the different ice-loading histories and rheology models used in this study. Circles indicate the discussed RSL sites for (a) I6G and (b) mod-I6G for the strong model. (d) I6G and (e) mod-I6G\_DML outputs for weak model. (c) portrays the offset between (a) and (b). (f) presents the offset between (d) and (e).

We appreciate for your comments and look forward to your reply.

Sincerely,

Takeshige Ishiwa, Ph.D.