Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-304-RC2, 2020

Geoscientific Model Development Discussions

Interactive comment on "Simulating the Early Holocene demise of the Laurentide Ice Sheet with BISICLES (public trunk revision 3298)" *by* Ilkka S. O. Matero et al.

Alexander Robinson (Referee)

robinson@ucm.es

Received and published: 19 January 2020

This manuscript presents a numerical study of the Laurentide deglaciation between 10-8 kyr ago in the region of Hudson Bay, with a specific focus on the 8.2 kyr event. The authors use an innovative approach, by applying the BISICLES ice-sheet model with an adaptive mesh that provides high resolution in dynamic regions. Transient climatic forcing is obtained by interpolating from GCM snapshots through the deglaciation. The experiments successfully reproduce a meltwater pulse with reasonable timing resulting from the separation of two ice domes and increased ablation and ice discharge. I believe that it is quite an interesting study worthy of publication. But I do have trouble

seeing the relevance to GMD. Furthermore, significant revisions are needed to improve the manuscript.

Relevance to journal. I am surprised to see this manuscript submitted to GMD. The main focus of the work seems to be on the scientific results, namely studying the plausibility of the saddle-collapse in Hudson Bay and quantifying rates of FWF and uncertainties. Personally, as it is written now, I would see this paper fitting much better in a journal such as Climate of the Past or even The Cryosphere.

Spin-up time versus experiment. It is clear that significant adjustment occurs in the experiment at the start around 10 kyr. The initialization using ice temperatures from a previous experiment can be seen to have worked reasonably well, as the adjustment seems to complete within just 500 yr or so. Likely this is partly a result of the climatic forcing driving the simulation in the right direction, which is quite interesting in itself. But what is considered part of the experiment itself (that is worth analyzing in terms of volume and distribution, etc.) versus what is just removing inconsistencies due to initialization is not clear from the text and figures. I was surprised to see the detailed figures of just 50 yr of run time, and no figures of the "realistic" ice sheet at, e.g., 8.5 kyr when the authors consider the model to be spun-up. Given the unprecedented resolution of the model, it would be nice to see velocity distributions before during and after the pulse too. I would therefore suggest revising the results section significantly along these lines. Also, note, switching between model years and years is confusing, so I would suggest sticking to just years, which allows comparison with data.

Model resolution. A big emphasis is given to the unparalleled high resolution of the current approach. However, it seems that the authors would have achieved essentially the same results with the $\Omega 0$ setup with no mesh refinement (Fig. 6a). This is touched upon briefly in the text, but the overall feeling from the work is that the authors believe the higher resolution is needed. If this is true, it should be demonstrated more convincingly. For example, I am not convinced that the $\Omega 1$ setup with no isostatic rebound is more realistic than would be an $\Omega 0$ setup with isostatic rebound.

Organization. The Introduction, Discussion and Conclusions are clear and well written. However, the remaining structure of the paper is somewhat hard to follow. In particular, there seems to be some redundancy between the model description and the experimental setup that could be eliminated (e.g., Section 3 versus Section 4.4).

Figures. The quality of figures needs to be improved. Some are not legible (eg, Fig. 9), some contain unexplained features (white rectangles?), etc. Also, for the time series, I would recommend separating the volume and FWF curves into different panels, since these are important curves for the work and difficult to understand as currently plotted.

Please find other more specific comments below.

P1L17: This statement sounds a bit strange: “The new model configuration presented here provides future opportunities to quantify the range of plausible amplitudes and durations of a Hudson Bay ice saddle collapse meltwater pulse and its role in forcing the 8.2 ka event.” <= Is this not done in this manuscript directly?

P2L2: Ice Sheet => ice sheet

P2L9: did fully => did not fully

P2L15: kilometre => kilometre-scale [in many places]

P3L6: snow accumulation, ablation => snow accumulation and ablation

P3L26: dynamical => dynamic

P5L15: Define ‘r’ in flotation equation.

P5L20: The imposed geothermal heat flux sounds more like an experimental setup parameter rather than part of the model description. I would note that this is also already described again later in that section.

Figure 1: The saturated color scale is difficult to see. Consider adding some contours as well. Panels (a) and (b) would perhaps be easier to see if plotted on a projection.

Also, please label the x- and y-axes.

P8L26: I believe the lack of isostatic rebound could be far more important than indicated. Were any tests performed even with a simpler ice sheet model turning on and off isostasy to quantify its impact? Also, it is quite impressive that including isostatic rebound results in 90% computational slowdown – can you explain why?

P8L26: Add UniCiCles reference, or rephrase.

P9L8: my experiment => our experiment

Figure 2: Quality needs to be improved significantly. Color scale in panel (a) makes it difficult to distinguish regions. Can you also explain the border rectangular region? I assume this is outside of the domain of the simulation and therefore should not appear here.

P10L5: inversed => inverted

P11L24: Which range? One value was specified?

P11L32: adn => and

P12L5: First sentence of this paragraph is unnecessary.

P12L7: ‘standard’ could either be in italics, or in quotes, but both is perhaps not necessary.

P12L15-20: Details of this adjustment do not seem important and could be omitted.

P15L8: Typo “reconsutrction”

P19L2-5: Check units!

Figure 9: Legends too small.

P23L25: than the => than that of the

2019.

C5