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The Cryosphere Discussions

Interactive comment on "Brief Communication: Can recent ice discharges following the Larsen-B ice-shelf collapse be used to infer the driving mechanisms of millennial-scale variations of the Laurentide ice sheet?" *by* J. Alvarez-Solas et al.

Anonymous Referee #2

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1 Overview

This paper quantifies the influence of ice-shelf collapse on ice-stream motion in the Laurentide ice-shelf, with the intent of understanding whether this could be the cause of Heinrich events. It is the first such paper to do this, and whether this mechanism is viable is something worth investigating. I am half-convinced by this paper, but General Points 2-7 give my reasons for wondering whether a more detailed study will give different results. A particular concern is that there is no effort to demonstrate that the

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calculated speed-ups are sufficient to have caused HE's.

I think that more modelling results are needed, and particular attention needs to be paid to Point 7; could these episodes be causes of Heinrich Events. This is not the same as saying that model runs need to be done; more needs to be presented to show how the mecahnisms works, and whether it is a viable explanation for HEs.

2 General Points

1. 3117. I understood that one of the mysteries of HEs was that they occurred during cold periods. I understand that increasing melt is a modelling mechanism for getting rid of ice-shelves, but what is the justification for having ice-shelves break-up during cold periods? Do you reject this correlation? - or can you think up of a justification?

2. The grid resolution is not mentioned at all, - looking at Figure 2, I would guess that it is 20km. I am concerned that low resolution has enhanced the upstream propagation of effects, in the same as numerical diffusion is stronger in coarse grids. You certainly need to quote the grid resolution, and you need to demonstrate that it is not exaggerating the horizontal extent of propagation.

3. There are quite a few similar calculations regarding the effect of removing buttressing - for example Payne et al. , GRL, 2004; Nick et al., Nature Geoscience, 2009. A comparison of your results with theirs would be useful. They show broadly the same pattern.

4. Figure 1. The graphics are pretty poor - are you plotting the LIS as such to make it comparable with Le Brocq's data? It doesn't really work. A minium level of detail is a contour map of LIS with velocity magnitude color-coded on, so that we

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can see what is being modelled. I don't see the point of having the zoom of the Peninsula.

5. Likewise, why plot the velocity data from the Crane Glacier. This is a tiny glacier; what are your reasons for expecting this to scale up? Surely the topographic setting is completely different?

6. There is no indication of the amount of grounding-line retreat. I would expect Figure 2 to show this. What is the origin in both cases - the maximum grounding line? You need to mark where the grounding line is on each of the lines.

7. While ice velocities do increase markedly, they only increase by a factor of two. How much extra ice is released, with the melting of the shelf and the increased ice flow. Isn't the period of increased velocity determined by the period over which you increase the melt? Would there by a HE signal if you allowed the shelf to regrow immediately.

3 Minor Points

1. 3115: lines 25. References to Alley and Whillans, Vaughan and others a bit out-of-date; the observations cited later on surely suggest opposite?

2. 3117 What is MacAyeal's L1 equation?

3. 3118 'spreads anisotropically' - a bit clumsy. Do you mean that it's an ice tongue, extending farther in the predominant flow direction?

4. 3119 'half as sensitive' - not a clearly defined phrase. The index on the buttressing parameter is around half that of the index on the thickness. Make this statement more precise.

5. Figure 2. What is the cause of the velocity oscillations? Presumably numerical - shouldn't we be worried?

Interactive comment on The Cryosphere Discuss., 5, 3113, 2011.