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# *Interactive comment on* "A computationally efficient depression-filling algorithm for digital elevation models applied to proglacial lake drainage" *by* Constantijn J. Berends and Roderik S. W. van de Wal

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We like to thank the reviewer for his comments on the manuscript and would hereby like to address the concerns he raised.

In Italics the comments, below our rebuttal

*This study contrasts with my approach, briefly described in T P 2006 that focused on coarsening the hydrological DEM resolution to the resolution of the ice sheet grid while preserving routing pathways. It would be worth a few sentences comparing the two approaches with respect to computational speed and accuracy given the different*



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Discussion paper

*tradeoffs between the two approaches and the contextual accuracy of the ice margin.*

We agree that a comparison of the two methods in terms of computational speed is of added value to the manuscript. Although we don't have the code from T P 2006, we worked along the concepts of their algorithm during the start of our project, but quickly concluded that this approach was computationally more expensive. This is mainly because the drainage pointer approach must be applied to the whole region, meaning that, although it has a larger scope, it needs to operate on every grid cell. Our approach only treats the flooded grid cells of a designated drainage basin. For the case considered our code is a factor 5 faster. This will be described in a separate section in the manuscript

*The last point needs to be underlined as the uncertainties in paleo ice sheet margins will always be much larger than 1 km (and I don't see 1 km grid resolution continental scale ice sheet models running glacial cycles anytime soon). Heck, there are few locations along the Laurentide ice sheet where we will confidently never know the ice margin location to even + 40 km resolution at any given time barring some new dating technique)*

We agree that the uncertainty in ice margin reconstructions will likely never reach the 1 km resolution described in our manuscript, at least not everywhere. However, we believe that this does not detract from the added value of a 1 km lake reconstruction over a 40 km version. Most topographical features that would limit the water level of such a lake through draining, such as river valleys, have horizontal dimensions that are far smaller than 40 km, meaning that a 40 km analysis would overlook these features and thereby overestimate the water volume. Hence solving at 40 km introduces a systematic error, which is only partly related to the uncertainty in the location of the ice margin. A 1 km analysis strongly reduces this systematic error. We will add a few sentences to the "Introduction" section of the manuscript to clarify this point and quantify the difference in calculated water volume.





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*:: 29 Tarasov and Peltier, 2004).*
*inappropriate reference, should be Tarasov and Peltier, 2005 and 2006*

We apologize for this erroneous reference and will correct this.

*:: Lake Agassiz.... 6 It is therefore important to accurately model the extent and volume of the lake over time*
*Tarasov and Peltier, 2006 would I think be a relevant reference for this since they model Lake Agassiz (other North Am pro-glacial lake) evolution*

We agree that this is a relevant reference and will add this to the manuscript.

*::the largest of which is Lake Agassiz, along the southern margin of the ice-sheet. Lake Agassiz ... :: Doing this requires an accurate treatment of the large changes in the land-mask that occur where the ice-sheet covers most of the Canadian Arctic Archipelago and blocks the Hudson Strait. This changes the location where lake outflow reaches the sea over time*
*The above is geographicallyincorrect and has no relevance to Lake Agassiz. Neither the Canadian Arctic Archipelago (CAA) nor Hudson Strait ice were drainage blocks for Lake Agassiz. The possible northern drainage outlet for Lake Agassiz is the Mackenzie River delta which is outside of the CAA. Ice across Hudson Bay and Northern Ontario is what dammed the lake in the direction of Hudson Strait drainage according to consensus geological inferences (cf eg, Dyke, 2004). And the 8.2 ka (not 8.4) drainage was for proglacial Lake Ojibway not Agassiz.*

We agree that the manuscript may be confusing here - indeed, we do not wish to suggest that any drainage events happened through the CAA. However, our manuscript does not concern any particular drainage event. It proposes a mathematical algorithm, which can be used as a tool to study such events. We have chosen a model-generated ice sheet configuration, which allows for a (perhaps unrealistically) large proglacial lake to form, because this creates the most computationally expensive setting, and therefore optimally illustrates the advantages of our approach - a configuration, which indeed





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may never have existed in reality. We will clarify this reasoning in the manuscript.

*Given that no one will be running 1km grid resolution ice sheet models for glacial cycle contexts (given "proglacial" in the title) in the foreseeable future, give the interpolation time to provide a complete time budget*

We agree, and will provide these numbers in the manuscript.

*: Supplement*
*I have not been able to test the code since the required netcdf files are not on this server. But I have a few suggestions:*
*1) the ReadMe.txt should provide command line examples how to run the scripts (so that the reader doesn't have to dig right away into the code to see if there are any arguments that need passing).*

We agree, and will add these examples to the ReadMe.txt file.

*2) Verify that the code runs on octave. What is the point of using open source publishing to publish something that requires a close source app especially when an open source alternative is available?*

We agree, and are currently working on this. We do not expect any trouble, since the codes only use very basic function calls, all of which (including the NetCDF package) are available in Octave. We will include functional Octave scripts in the supplementary material.

*3) add the required net-cdf files for the sample scripts on the GMD page (as a separate supplement...)*

The required NetCDF files are freely available online and can be found with their own separate DOI, which is mentioned in the "Code and data availability" section of the manuscript. However, we have indeed discovered that not all internet browsers and search engines handle DOI's equally. We will therefore add the URL for the NetCDF files.





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