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Towards More Physically Constrained Freshwater Injection and the Role of Gateways in Glacial Runoff Export from the Arctic Ocean

Ryan Love (1), Lev Tarasov (2), and Alan Condron (3)

(1) Memorial University of Newfoundland, Physics and Physical Oceanography, St. John's, Canada (rlove@uottawa.ca), (2) Memorial University of Newfoundland, Physics and Physical Oceanography, St. John's, Canada, (3) Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, USA

The transition from the Bolling Allerod (BA) to the Younger Dryas (YD) was one of the largest amplitude cooling events of the last deglaciation. Traditionally this transition is considered to have been initiated by re-routing of glacial runoff due to deglaciation (Broecker et. al, 1989). In paleoclimate simulations, freshwater hosing in large bands across the North Atlantic is still frequently used as a means to induce rapid and large scale changes in simulated climate, this transition being one common example. However, results from Condron and Winsor (2012) demonstrate that the distrbution of glacial runoff in the open ocean (ie. beyond the Western Boundary Current) does not well agree with the commonly used hosing regions. Furthermore, using realistic glacial discharge routing for injecting glacial runoff in non-eddy permitting climate models introduces biases due to unresolved eddies and coastal boundary currents. We address these issues through freshwater fingerprint products and further investigation of glacial runoff transport in a glacial ocean.

Condron and Winsor's study uses an eddy permitting model configuration for a Last Glacial Maximum (LGM) background climate with associated changes to land-sea mask and model bathymetry. However, by the time of the BA-YD transition, a number of changes to circulation pathways around the Arctic arose due to the opening of the Barents-Kara sea and the potential opening of the Bering Strait. As such, we extend the work of Condron and Winsor through additional freshwater injection experiments focusing on this and other gaps, such as the unrealistic meltwater volume, in the original investigation for examining initiation of the YD. Our extensions center around using more realistic glacial runoff volumes and distributions, as constrained by the deglacial chronology of Tarasov et. al. (2012), and by examining the role of the Bering Strait and the Barents-Kara sea in the transport of the injected runoff. We do so using the same eddy permitting numerical model of the global ocean for both a LGM and BA-YD transitional climate and ocean bathymetry. Through these experiments we generate freshwater fingerprint products, maps of where the glacial runoff enters the open ocean, for glacial runoff injection experiments through the Mackenzie river basin. Finally, these fingerprints can be used in place of hosing regions in the North Atlantic or Ruddimen's belt, as has been often used in experiments focusing on rapid glacial climate change.

Broecker, W.S., et. al., Routing of meltwater from the Laurentide Ice Sheet during the Younger Dryas cold episode. Nature, 341 (6240), 318–321, 1989

Condron, A., Winsor, P., Meltwater routing and the younger dryas. 109(49):1992819933, doi:10.1073/pnas.1207381109, 2012

Tarasov, L., Dyke, A. S., Neal, R. M., Peltier, W.R., A data-calibrated distribution of deglacial chronologies for the North American ice complex from glaciological modeling, EPSL, 315–316, pg. 30-40, https://doi.org/10.1016/j.epsl.2011.09.010, 2012