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Towards more physically constrained freshwater injection and its associated impact on paleoclimate variability

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Freshwater forcing (or commonly, “hosing”) has been proposed as a causal mechanism for the onset of the Younger Dryas period and may play a role in other centennial to millennial climate events outside the last deglacial period. However, paleoclimate modelling experiments attempting to infer the role of freshwater forcing have low confidence due to at least two major issues. First, previous attempts at reproducing the observed variability through freshwater forcing experiments have often utilized unrealistically large freshwater volumes and adhoc injection regions. Second, boundary currents and the associated transport of freshwater sourced from land based ice are to date not resolved (except for a few exceptions) in paleo model experiments. Despite these limitations, freshwater forcing is frequently utilised as a means to induce rapid and large scale changes in simulated paleoclimate.

Few studies have examined the effect of using more realistic freshwater distributions and/or a concurrent hierarchy of climate models. To quantify the impact of these freshwater distributions, we sample from the global runoff and calving flux output of the glacial systems model of Tarasov et. al., 2012 as input into our hierarchy of climate models. Furthermore, we address the issue of resolution in part by extracting transport pathways from one of the few experiments that has been conducted at the eddy permitting scale in the global ocean, that of Condron and Winsor, 2012. With these enhancements, we re-examine the role of freshwater forcing in the climate system during glacial conditions. In particular, we quantify the impact of a more realistic freshwater distribution upon the strength of ocean circulation and heat transport to high latitudes.