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Testing massive Arctic sea ice export as a trigger for abrupt climate change

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The discharge of freshwater from glacial lakes to the North Atlantic is repeatedly cited as the main trigger for abrupt centennial to millennial length climate change during the last deglaciation. Broecker et al., (1989) was a proponent of this idea suggesting that abrupt re-routing of pro-glacial lake freshwater to the North Atlantic through the St. Lawrence Valley weakened the strength of the AMOC. Yet, evidence for this is lacking, freshwater estimates in these lakes are relatively small and flood durations are rather short (<5 years), suggesting that floods may not have been the only mechanism driving these climate shifts. Using sophisticated ocean modeling, it has been shown that the release of freshwater originating from the Arctic is more effective at weakening the AMOC compared to freshwater released further south.

Here we investigate whether the break-up and mobilization of thick Arctic sea-ice would have supplied enough freshwater to the Nordic Seas to sufficiently cause dampening of the AMOC and hinder NADW formation in the sub-polar North Atlantic. We use numerical climate models to assess 1) the maximum thickness of sea ice that can be formed during glacial periods and the volume of freshwater in the ice, 2) the mechanism which caused the collapse and mobilization of arctic sea-ice into the North Atlantic and 3) the impact of melting sea-ice on global ocean circulation. This hypothesis focuses on the potential impacts of sea-ice as a forcing mechanism for abrupt climate change events on geologic time scales.