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Simulating the natural variability of the freshwater budget of the Arctic ocean from the mid to late Holocene using LOVECLIM

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The influence of freshwater on the long term climatic variability of the Arctic region is currently of significant interest. Alterations to the natural variability of the oceanic, terrestrial and atmospheric sources of freshwater to the Arctic ocean, caused by anthropogenic induced warming, are likely to have far reaching effects on oceanic processes and climate. A number of these changes are already observable, such as an intensification of the hydrological cycle, a 7% increase in Eurasian river runoff (1936-1999), a 9% reduction of sea-ice extent per decade (1979-2006), a 120km northward migration of permafrost in Northern Canada (1968-1994), and air temperatures 6°C warmer, in parts, from 2007 to 2010, when compared to the 1958-1996 average. All of these changes add another layer of complexity to understanding the role of the freshwater budget, and this makes it difficult to say with any certainty how these future changes will impact freshwater fluxes of the Arctic gateways, such as the Bering Strait, Fram Strait, Canadian Arctic Archipelago and the Barents Sea inflow. Despite these difficulties, there have been studies that have integrated the available data, from both *in situ* measurements and modelling studies, and used this as a basis to form a picture of the current freshwater budget, and then project upon these hypotheses for the future (Holland *et al*., 2007). However, one particular aspect of these future projections that is lacking is the accountability of how much future variance is attributable to both natural variability and anthropogenic influences.

Here we present results of a mid to late (6-0ka) Holocene transient simulation, using the earth model of intermediate complexity, LOVECLIM (Goosse *et al*., 2010). The model is forced with orbital and greenhouse gas forcings appropriate for the time period. The results will highlight the natural variability of the oceanic, terrestrial and atmospheric components of the freshwater budget, over decadal and centennial timescales. When computing the freshwater budget for the period, where *in situ* measurements are available, LOVECLIM has been shown to perform reasonably well. The intention here is not to present a fully quantitative assessment of the freshwater budget of the Arctic Ocean as such, but to highlight the natural variability of the freshwater budget and its individual components. We hope that this inspires other modelling groups to take a similar approach and work towards understanding the natural variability of the freshwater budget over timescales longer than current measurements allow, and modelling studies have previously attempted.

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