

**Title:** Modelling the dynamic response of Belcher Glacier (Devon Island, Nunavut) to seasonal surface melt

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**Abstract:** Widespread speedup of tidewater-terminating glaciers in Greenland and the Canadian high-Arctic has been observed in recent years, along with significant seasonal variability in glacier flow rates. These changes have potential contributions from oceanic and atmospheric drivers through: (1) perturbations to the terminus boundary condition as a result of warm water entering the fjords, and (2) increased surface melt, in response to atmospheric warming, reaching the bed and promoting glacier slip. We examine the influence of these two processes on Belcher Glacier, a large fast-flowing tidewater outlet of the Devon Island ice cap in the Canadian Arctic. Our study uses a hydrologically-coupled ice-flow model to estimate glacier flow changes as a result of loss of sea-ice buttressing and hydrologically-driven seasonal dynamics. Daily runoff from five sub-catchments provides seasonal forcing for the model simulations. We use data from two melt seasons and present results that contrast the seasonal evolution of the subglacial drainage system and glacier velocity over the two years. Model results are compared with surface velocities derived from remote sensing and GPS measurements. Sea-ice and tidal effects are found to have a minor influence on glacier flow speed in comparison to seasonally-enhanced speed-up as a result of meltwater drainage.