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Observing iceberg size distributions and implications for calving processes

Connor Shiggins et al.

Icebergs are a key component of the ice-ocean interface, and provide the opportunity to gain insight into calving processes, and freshwater budgets in fjords and oceans amongst others. Iceberg area and volume distributions have been characterised for a handful of sites across the Greenland Ice Sheet, though a greater spatial and temporal range of data are required to understand how iceberg dynamics vary between different glaciers. Here we present iceberg area and volume distributions from 141 ArcticDEM scenes from 2010-2017 for 19 marine-terminating glaciers in Greenland, with 588,856 icebergs automatically detected.

The data show emerging evidence for more positive power law slope values (i.e. glaciers with larger icebergs) at glaciers with mean terminus depths exceeding 230 meters. However, the range of these values are generally consistent once a depth of 230 metres is exceeded. Glaciers with shallower depths can generate similar iceberg distributions, though typically these provide more negative exponents (i.e. are dominated by smaller icebergs).

Our results allow a characteristic range of iceberg size distributions to be defined for glaciers with mean terminus depths greater than 230 metres, which is likely controlled by a change in dominant calving processes at/near these depths. While shallower glaciers can in some cases provide similar distributions, most observations show distributions dominated by smaller icebergs. Together these suggest that mean terminus depth exerts a fundamental control on calving processes and the resulting iceberg size distributions.

Having the capability to constrain expected iceberg distributions from these data will be useful for understanding controls on calving processes, how fjord freshwater fluxes may evolve, and characterising how the size of icebergs that are exported from fjords will change as Greenland's marine-terminating glaciers continue to retreat.

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