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Rapid response of Helheim Glacier, Greenland, to climate variability over the last century

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Ice mass loss from Greenland and Antarctic ice sheets contribute approximately half of the current global sea level rise and in recent years the Greenland Ice sheet is observed to increase its mass loss rapidly. The quasi-simultaneous acceleration, thinning and retreat of the largest outlet glaciers (Jakobshavn, Helheim and Kangerdluqssuag) in the early 2000s suggested a common climate forcing and increasing air and ocean temperatures were indicated as potential triggers.
We present a new record of calving activity of Helheim Glacier, East Greenland, extending back to c. 1890 AD. This record was obtained by analysing sedimentary deposits from Sermilik Fjord, where Helheim Glacier terminates, and uses the annual deposition of sand grains as a proxy for iceberg discharge. The 120 year long record reveals large fluctuations in calving rates, but that the present high rate was reproduced only in the 1930s. A comparison with climate indices indicates that high calving activity coincides with increased Atlantic Water and decreased Polar Water influence on the shelf, warm summers and a negative phase of the North Atlantic Oscillation. Our analysis provides evidence that Helheim Glacier responds to short-term (3-10 years) large-scale oceanic and atmospheric fluctuations.