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Synchronous inter-hemispheric alpine glacier advances during the Antarctic Cold Reversal

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The termination of the last glaciation in both hemispheres was a period of rapid climate oscillations superimposed on the overall warming trend, resulting from large-scale reorganizations of the atmospheric and oceanic circulation patterns in both hemispheres. Environmental changes during the deglaciation have been inferred from proxy records, as well as by model simulations. Several oscillations took place in both the northern and southern hemispheres caused by melt water releases such as during the Younger Dryas in the north and the Antarctic Cold Reversal in the south. However, a consensus on the hemispheric linkages through ocean and atmosphere are yet to be reached. Here we present a new multi-proxy reconstruction from a sub-annually resolved lake sediment record from lake Lusvatnet in arctic Norway suggesting inter-hemispheric climate linkages during the Bølling/Allerød time period. Our reconstruction of the Lusvatnet cirque glacier shows a synchronous glacier advance with the Birch-hill moraine complex in the Southern Alps, New Zealand, during the Intra Allerød Cooling. We propose these inter-hemispheric climate oscillations to be forced by the northward migration of the southern Subtropical Front during the Antarctic Cold Reversal. Such a northward migration of the Subtropical Front is shown in model simulation and in palaeorecords to reduce the Agulhas leakage impacting the strength of the Atlantic meridional overturning circulation. The Bølling-Allerød time period was a warm interval in the North Atlantic with a strong Atlantic meridional overturning circulation setting the stage for the later fresh water forcing of the Younger Dryas cold reversal with reduced overturning. Two minor cold reversals, the Older Dryas and the Intra Allerød Cooling, took place during this time span and we suggest a reduction in the Agulhas leakage during peak cooling over Antarctica as the mechanism teleconnecting arctic rapid climate oscillations with rapid climate oscillations in Antarctica during the Bølling/Allerød. Our high-resolution reconstructions provide the basis for an enhanced understanding of the tiny balance between migration of the Subtropical Front in the Southern Ocean and the teleconnection to the northern hemisphere via the Agulhas leak.