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Rapid oceanic and atmospheric changes at the end of the Younger Dryas cold period

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The Younger Dryas (YD) was a period of rapid cooling resulting from large-scale reorganizations of the atmospheric and oceanic circulation patterns at the end of the last glaciation. Environmental changes associated with the YD have been inferred from a large variety of proxy records in both hemispheres, as well as by model simulations. However, a consensus on how the event was triggered, stabilized, and ended is yet to be reached. Here we present multi-proxy reconstructions from a sub-annually resolved sediment record from Lake Kråkenes in western Norway and a marine core from the North Atlantic (MD99-2284), showing that the late YD climate experienced large amplitudes in variability related to the inflow of warm Atlantic water to the Nordic Seas. The sediment core has a well-constrained age-depth model and the rapid sedimentation rate allows a high-resolution record to be obtained. A striking feature, as observed from reconstructed sea surface temperature (SST), is the high amplitude shifts in SST associated to the period constrained by the Vedde Ash and the YD-Preboreal transition. These shifts represents SST changes from 3°C to about 6-9°C. The first, and also the major SST peak seen in MD99-2284, appears to occur about 100 years later compared to the shift observed in the Ti count rate record from Kråkenes. The periods of increased ocean warming and increased salinity imply that the polar water residing in the North Atlantic was periodically replaced with sub-polar water-masses after 12.15 kyr. This “flickering” represents rapid alterations in heat-exchange related to sea-ice/ocean current adjustments to the strong extra-tropical thermohaline gradient in the Nordic Seas during the YD. We propose that periodic break-up of the sea-ice cover in the eastern North Atlantic freed the westerlies from their previously imposed zonal track, allowing increased ocean-atmosphere heat convection. The resulting fresh melt-water then initiated renewed sea-ice cover. Our high-resolution reconstructions are situated in an area that is very sensitive to changes in atmosphere and ocean circulation. They provide the basis for an enhanced understanding of the evolution and termination of the YD.