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Centennial scale climate change during the Holocene reconstructed from the sediments of Stazersee, Central Swiss Alps

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A 6.48-m-long sediment record from Stazersee, a small lake situated at 1809 m a.s.l. in the Central Swiss Alps, was analyzed for chironomid assemblages and sediment composition to reconstruct Holocene climatic change in the region. Radiocarbon ages on 16 terrestrial plant remains indicate that the core dates back to at least 10,600 calibrated C-14 years BP (cal. BP) and that sedimentation rates remained nearly constant after reforestation of Stazersee's catchment in the early Holocene. A total of 105 samples were analyzed for fossil chironomid assemblages. A chironomid temperature transfer function based on weighted averaging-partial least squares regression and chironomid assemblages in 274 lakes in Norway and Switzerland was used to reconstruct past July air temperatures. Results indicate July air temperatures of ~10-11ºC during the earliest Holocene, temperatures around ~12ºC during the period 10,000-4000 cal. BP, cooler temperatures around ~9ºC at 4000-2500 cal. BP, coeval with the neoglaciation of the region, and again warmer temperatures of ~10-12ºC after 2500 cal. BP. Accumulation rates of organic matter in the Stazersee sediments ranged from 0.001 to 0.003 g/cm2/yr and were highest during the early and mid-Holocene (10,000-4000 cal. BP). Accumulation rates of inorganic matter (IOM) varied distinctly at centennial scales during the Holocene, with values ranging from background levels of 0.002-0.005 g/cm2/yr to >0.01 g/cm2/yr during some depositional events. These large and abrupt changes in IOM accumulation rates strongly suggest that changes in erosive input from the lake catchment, transported into the lake via runoff, were responsible for the variation in IOM recorded in the sediments. A comparison of these runoff events with a record of ice-rafted debris in North Atlantic sediments reveals a nearly perfect agreement of the timing of phases of increased IOM deposition in Stazersee with periods of increased ice-rafting in the North Atlantic. Taken together, our results suggest that the temperature history at Stazersee was similar to that in other regions of Central and Western Europe, with highest temperatures in the early and mid-Holocene, but that the Central Alpine climate was characterized by distinct, centennial-scale variations in precipitation, which coincided with shifts in surface ocean currents in the North Atlantic.