

## **Climate change threatens archaeologically significant ice patches: insights into their age, internal structure, mass balance and climate sensitivity**

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Despite numerous spectacular archaeological discoveries worldwide related to melting ice patches and the emerging field of glacial archaeology, governing processes related to ice patch development during the Holocene and their sensitivity to climate change are still largely unexplored. Here we present new results from an extensive 6-year (2009–2015) field experiment at the Juvfonne ice patch in Jotunheimen in central southern Norway. Our results show that the ice patch has existed continuously since the late Mesolithic period. Organic-rich layers and carbonaceous aerosols embedded in clear ice show ages spanning from modern at the surface to ca. 7600 cal years BP at the bottom. This is the oldest dating of ice in mainland Norway. The expanding ice patch covered moss mats appearing along the margin of Juvfonne about 2000 years ago. During the study period, the mass balance record showed a strong negative balance, and the annual balance is highly asymmetric over short distances. Snow accumulation is poorly correlated with estimated winter precipitation, and single storm events may contribute significantly to the total winter balance. Snow accumulation is approx. 20% higher in the frontal area compared to the upper central part of the ice patch. There is sufficient meltwater to bring the permeable snowpack to an isothermal state within a few weeks in early summer. Below the seasonal snowpack, ice temperatures are between -2 and -4 °C. Juvfonne has clear ice stratification of isochronic origin.

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