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Synchrony between Greenland temperature change and wide-spread alpine glacial changes for the last four millennia

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Glacial melting at polar and alpine regions and associated sea-level rise is one of the major concerns in the future climate change induced by increasing greenhouse gases. However, how global to hemispheric temperature change will affect glacial advances/retreats is poorly understood. Here, we reconstructed the last 4000 years of Greenland temperature (a hemispheric temperature proxy) using argon and nitrogen isotopes in air bubbles in Greenland ice cores (GISP2). We found Greenland temperature changed synchronously with the wide-spread glacial advances/retreats (e.g., the Great Aletsch glacier in the Swiss Alps) for the last 4000 years in a multi-centennial to millennial scale. Especially, two periods, peaking around 600-500 B.C.E. (Iron Age Cold Epoch) and 1300-1850 C.E. (Little Ice Age) were the coldest periods of the last 4000 years at the time of near-global glacial advances. We hypothesize that signals of climate forcings (e.g., changes in solar activity) are amplified by ice-albedo feedback in polar and alpine regions so that common signals are recorded in the Greenland temperature and glacial histories.

Keywords: Greenland, Ice core, Gas analysis, Thermal diffusion, Firn