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A 10,500 year record of summer temperatures in Central Europe from cave glaciers

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A wealth of data has accumulated over the past decade on the links between the North Atlantic (NA) climate and ocean variability and its influence on the European climate. However, most of the studies have been restricted to the area in the immediate vicinity of the NA, with little or no data existing west of the Alps. This region lies at both the eastern limit of the direct influence of the NA climate, and the western one of the continental Asian climate, thus being of extreme importance in understanding the workings of climate and its forcings.

In this paper, we present a 10,500 years long record of climatic changes in Central Europe, based on stable isotope analyses of cave ice. The first order fluctuations broadly follow the orbitally induced Northern Hemisphere September insolation, with a minimum in the early Holocene, a slow climb towards a maximum at ∼5.0 ka, followed by a very slow cooling towards the present, accentuated after ∼0.5 ka. Superimposed on the long-term variation, a series of rapid cooling events are seen, the most notable ones being at 9.5 ka, 8.2 ka, 7.9 ka, 6 ka, 4.2 ka, 3.2 ka and 0.9 ka, agreeing remarkably well with the Bond events in the North Atlantic. We argue that the general trends of temperature changes in mainland Europe during the Holocene were governed by changes in solar output, this signal being transferred to our study region via changes in NA sea surface temperature, amplified by atmospheric dynamics.