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North Atlantic versus Mediterranean climate forcing in the southern Austrian Alps during the last 4000 years

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We estimated mean spring and autumn air-temperature anomalies (ST_{anom}, AT_{anom}) and the duration of ice-cover of high-alpine Lake Oberer Landschitzsee (2076 m a.s.l., Lungau, Austria, south of the main Alpine ridge) for the past 4000 years. Our estimates were based on siliceous microfossils (diatoms, chrysophyte stomatocysts) from a sediment core, transfer functions for the dates of spring and autumn lake-water mixing and their altitude/air-temperature relations. From 2000 B.C. until the Roman Period, ST_{anom} and AT_{anom}, which were inferred independently, were significantly correlated. This finding indicates common climate forcing. Both showed marked cooling periods with extended ice-cover between ca. 1500 to 1000 B.C. and 700 to 400 B.C., which corresponded with minima of the GRIP oxygen isotope (δ^{18}O) curve, and warm periods around 1800 B.C. (Early Bronze Age), ca. 1000 to 70 B.C (transition Bronze/Iron age), and ca. 200 to 400 A.D. (Roman Period). Phases of spring warming during Medieval times corresponded with Alpine summer proxy-data (tree-rings). The inferred temperature anomalies suggested that spring temperatures during these Medieval warm phases equalled or even slightly exceeded present values. Since Medieval times, ST_{anom} and AT_{anom}were decoupled. The long-term trend in AT_{anom} suggested that autums became warmer. We hypothesise that this decoupling reflects a change in major circulation mode. Most likely, the North-Atlantic (NAO) influence on climate in the Northern Mediterranean has become weaker since Medieval Times resulting in more continental climate conditions in Lungau.