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7000 year European climate record from the Ortles ice core

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In 2011 four ice cores were extracted from the summit of Alto dell'Ortles (3859 m), the highest glacier of South Tyrol in the Italian Alps. This drilling site is located only 37 km southwest from where the ∼5.2 kyrs old Tyrolean Iceman was discovered emerging from the ablating ice field of Tisenjoch (3210 m, near the Italian-Austrian border) in 1991. The excellent preservation of this mummy suggested that the Tyrolean Iceman was continuously embedded in coeval prehistoric ice and that additional ancient ice was likely preserved elsewhere in South Tyrol. Dating of the ice cores from Alto dell'Ortles based on 210Pb, 3H, beta activity and 14C determinations, combined with an empirical model (COPRA), provides evidence of a chronologically ordered ice stratigraphy from the modern glacier surface down to the bottom ice layers with an age of ∼7 kyrs, which confirms that ancient ice is preserved in this area of the Alps. Our results indicate that the drilling site was continuously glaciated on frozen bedrock since ∼7 kyrs BP. Absence of older ice on the highest glacier of South Tyrol is consistent with removal of basal ice from bedrock during the Northern Hemisphere Climatic Optimum (NHCO; 6-9 kyrs BP), the warmest interval in the European Alps during the Holocene. At the end of the NHCO temperatures started to decrease allowing the accumulation of cold ice on frozen bedrock. A short increase in precipitation at ∼7 kyrs BP could also have contributed to higher accumulation and ice thickening on Alto dell'Ortles. Although high precipitation did not persist during the mid-Holocene, progressively more favourable glacial conditions characterized the Eastern Alps at the end of the NHCO and glaciers extended in general to lower elevations, including the Tisenjoch (3210 m) where the Tyrolean Iceman was buried in snow and ice since 5.2 kyrs BP.