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Glacier evolution in the Alps during the early and mid-Holocene – new results from Tschierva and Pasterze glaciers

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Abstract

Current climate change strongly affects the glaciers in the Alps causing partly fast recession and collapses of glacier termini or even entire glacier tongues. This is a consequence of a strong temperature increase in the Alps that approximately doubles the global warming rates during the last decades. The ongoing recession indicates that extent and length of Alpine glaciers are not in equilibrium with current climate conditions. However, as these glaciers have shrunk, some of them have unveiled displaced and in-situ tree remains as well as other organic material and sediment profiles near their termini. Radiocarbon dates of organic material as well as calendar dates of tree remains established on the base of the Eastern Alpine Chronology prove that most of these finds date back to the early and mid-Holocene, allowing new insights in past glacier variability and evolution. Here we report new results from two Alpine glaciers. At the Tschierva glacier, Switzerland, the tree-ring series established for dozens of tree remains prove three multi-centennial to millennial long retreat phases around 4.0, 7.0 and 9.8 ka. These retreat phases were followed by advances of the Tschierva glacier beyond today's extent. At the glacier Pasterze, Austria, a c. 2.5 m long sediment profile with alternating organic and clastic layers was discovered at a site that got free of ice in 2010. Radiocarbon dates show that sedimentation took place between ca. 7.1 and 3.9 ka. Detrital tree remains sampled in the surroundings of this sediment date mainly into the same time period. A comparison of the results of both glaciers suggests a different sensitivity to past climate variability caused by varieties in size and topography.

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