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Always delayed? Holocene and current evolution of Pasterze Glacier, Austria

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The glaciers in the Alps are currently shrinking, in some cases dramatically, due to progressive warming. At some glaciers this recession has made it possible to find tree remains and other organic material at or near the termini. At Pasterze Glacier, such findings have been made since about 1990, allowing new insights into the Holocene evolution and variability of this glacier. Initially, only relocated wood and peat boulders were collected, but around 2010 an in-situ locality became ice-free. Tree remains and other organic material from this site have mainly provided dates for a period of more than a thousand years in the middle Holocene (around 6 ka) proving a continuously smaller extent of this glacier during this period compared to today. Furthermore, a comparative interpretation of all available, some 80 radiocarbon and dendro dates suggests that Pasterze Glacier was probably at least from about 10.2 ka to about 3.5 ka continuously shorter compared to the extent around 2010 AD. For the last nearly 2800 years there is no similar evidence of comparable small glacier extents. Finally, after the early- to mid-Holocene retreat phase, a relatively delayed increase of Pasterze Glacier during the early Neoglacial (in the Alps after about 4 ka) can be deduced. Other glaciers almost reached or even exceeded the later LIA dimensions already during this period.

Moreover, Pasterze Glacier is also lagging behind the current climatic changes, i.e., its extent is not in equilibrium with the current warming. This circumstance is not only proven by the rapid recession during recent years, but also by simulations with the glacier model OGGM. The simulation results show on the one hand that Pasterze glacier has to melt back for several more kilometres to reach equilibrium with the climatic conditions of 1980-2010. On the other hand, this also documents that the recent climate conditions are already sufficient to allow a recession comparable to the early and middle Holocene stages of this glacier. Both the delayed increase in extent during the early Neoglacial and the considerably delayed current recession can be explained by the size of the glacier and the topographic conditions.