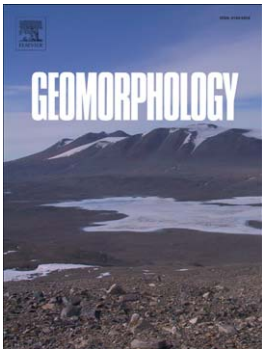

Funnel-shaped surface depressions – Indicator or accelerant of rapid glacier disintegration? A case study in the Tyrolean alps

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Funnel-shaped surface depressions – indicator or accelerant of rapid glacier disintegration? A case study in the Tyrolean Alps

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Abstract

Alpine glaciers have been retreating at extreme and historically unprecedented rates. While the general course of regional retreat rates reflects long-term climatic change, individual extreme events are closely related to the geomorphological settings and processes of the specific glacier. Nevertheless, these extreme events also influence the regional means and might be an important feedback mechanism accelerating the response of glaciers to climate change. In 2009, during the recent disintegration of the terminus of Gepatschferner (46°52‘30“N, 10°45‘25“E), a shallow circular depression appeared at the glacier tongue with a decrease of surface ice flow velocity to almost nil. In 2015 the area was ice-free. During a heavy precipitation event in August 2012, a subglacial sediment layer of more than 10 m was flushed out, which accelerated the subsidence of the ice surface.

The development of this 15 to 30 m deep depression was monitored with a combination of methods in high detail, including direct ablation measurements and a time series of seven high-resolution airborne laser DEMs, plus recordings of ice flow velocity and surface elevation with DGPS. The thickness of ice and sediment layers was measured with vibroseismic soundings in 2012 and 2013. Similar developments were observed at three other glaciers with extreme retreat rates. Our investigation suggests that this mechanism has a major impact on and can be read as an indicator of a nonlinear increased response of glaciers to climate change.