



## **Rapid supraglacial-lake to proglacial-lake transition in a sediment-rich environment (Pasterze Glacier, Austria)**

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Valley glaciers in the European Alps are rapidly receding at present and in many cases show signs of glacier disintegration. This highly dynamical glacial-proglacial transition zone might include debris-covered ice bodies of various dimensions. In case of valley overdeepenings lakes form in the proglacial area related to glacier recession, glacier surface lowering or by melting of the debris-covered ice bodies in the proglacial area. Glacier surface lowering in combination with glacier recession cause the flooding of the glacier margin in the basin forming a glacier-lateral to supraglacial lake.

We observed several large-scale ice-floating events between September 2016 and October 2018 at such a supraglacial lake adjacent to the largest glacier in Austria (Pasterze Glacier). The originally presumed proglacial lake seems to be rather a supraglacial lake covering large amounts of glacier ice, which steadily disintegrates forming icebergs.

Multiple data were used to better understand the processes acting at this glacial-proglacial transition zone: Time-lapse camera images with a sub-daily temporal resolution (2016-2018) covering the area of interest give insight into acting processes. Differential GPS was used mapping the superficial glacier boundary for the period 2003-2018. Digital terrain models derived from terrestrial laser scanning (2010-2018) and unmanned aerial systems/UAS (2016-2018) as well as orthophotos also derived from UAS (2016-2018) were analysed to quantify lake and glacier extent as well as landform changes. Several ERT-profiles measured in the proglacial area between 2015 and 2018 (n=16) revealed massive ice lenses and extensive ice layers exceeding 20 m in thickness covered by different types of sediments. Automatic weather station and ground temperature data give further insight in the thermal characteristics of the area of interest.

We conclude the following stages of process development at Pasterze Glacier: (a) rapid glacier recession into a basin overdeepened by the glacier; (b) glacial and glacio-fluvial sedimentation in the glacial-proglacial transition zone covering parts of the glacier or dead ice in the basin; (c) initial formation and enlargement of the glacier-lateral to supraglacial lake by steady melting and surface lowering of the glacier ice and debris-covered dead ice; (d) disintegration of glacier ice at the lake bottom or at the surface influenced by high water pressure along fractures showing signs of tilting, sudden disintegration and formation of icebergs; (e) steady melting of the floating icebergs accompanied by tilting events. The latter two stages are also relevant for tourists in the area because small-scale tsunami-like waves have been formed by such processes submerging the lake shore.