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Hydro-chemical detection of permafrost degradation in the Eastern European Alps - Implications for geomorphological process studies and natural hazard assessment

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The Gepatschferner glacier in the Upper Kaunertal valley is one of the fastest melting glaciers in the Eastern European Alps. With a retreat rate of around 110 m a-1 since the hydrological year 2012/ 2013, unconsolidated sediments of steep lateral moraines have been exposed to erosion, from which nowadays episodic and perennial springs well. We hypothesize that the springs indicate the melt out of dead ice lenses in areas below 2500 m, causing a potential significant morphological change in the moraines and a decrease of slope stability in the proglacial long after glacier retreat. However, permafrost degradation has not been considered so far in contemporary erosion measurements. The present study aims to identify the spring water's origin and displays first attempts of quantifying thermal erosion, which describes the matrix volume loss due to melting and drainage of ice water.

Samples were routinely analyzed for temperature, electrical conductivity, δ2H, and δ18O. Results support the hypothesis that certain springs derive from melting ice of similar isotopic signature as the glacier. In a second step, chosen samples were examined for the long-lived anthropogenic nuclide 129I. Since the 1950s the atmospheric abundance of 129I has significantly increased. Its occurrence in the water samples hints a surface contact of the waters in the last 65 years. Springs of ice origin show little 129I content and are believed to derive from dead ice by the glacier. First electric resistivity measurements support the hydro-chemical results and suggest the existence of ice lenses in the subsurface. Ice ablation and discharge measurements allowed first estimates of the thermal erosion volume caused by the melt out and drainage of ice lenses.