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Linking glacier surface changes to subglacial conduit locations for a temperate Alpine glacier

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It is well understood that topography near the snout of an alpine glacier may evolve quickly due to differential melting depending on exposure to solar radiation and on debris cover thickness. However, the positioning and shape of subglacial conduits underneath shallow ice may also have an important influence on ice creep and thereby on the topography of this region. This relationship could potentially be used to determine locations of subglacial conduits via the detailed observation of glacier surface changes.

We monitored the ice-marginal zone of the Otemma Glacier in the south-western Swiss Alps with daily UAV surveys at high spatial resolution and with a network of ablation stakes over a period of three weeks. After subtraction of melt measured with ablation stakes, we produced maps of changes in ice surface topography that are due to processes other than melt. In two consecutive summers we conducted three-dimensional GPR surveys in the same area of interest. By looking at these spatially dense grids of GPR measurements, we are able to identify the locations and shape of sub-glacial conduits underneath the ice marginal glacier tongue, for ice thicknesses between 20 m and 50 m. Superposition of the GPR-derived channel maps with those showing the topographic changes suggest a correlation between ice surface changes and processes operating at the glacier bed.

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