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Monitoring unstable parts in the ice covered Weissmies northwest face

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The glacierized northwest face of Weissmies gives rise to Triftgletscher in the Saas valley (Switzerland). Recently, climate-induced glacier thinning has weakened the buttressing effect of the steep ice masses on this glaciated face, creating new glacier instabilities (Fig. 1). In addition, high melt rates may have warmed the previously cold subglacial environment by releasing latent heat due to refreezing of meltwater. This process reduces the basal friction between ice and bedrock and further promotes instability. The situation is critical, because a ski resort, mountaineers climbing on the normal route to the popular Weissmies peak, and – in the case of a large event – human infrastructure in the Saas valley are exposed to the danger of a glacier break-off.

In 2014, a monitoring campaign was initiated. The ultimate goal is the detection of break-off precursors, such as exponentially increasing surface velocities (Failletaz et al., 2015). Since October 2014, an interferometric radar provides real-time measurements of surface displacements in line-of-sight. At the same time, photogrammetric processing of images from an automatic camera yields velocities in the plane normal to line-of-sight. L1-GPS sensor systems with wireless data transmission, installed directly on the unstable glacier part, serve as high-precision ground truth measurements of surface displacements. Finally, infrasound and seismometer arrays monitor acoustic and seismic emissions of even small-scale ice avalanches and englacial fracture development.

Here we discuss the results obtained so far. Despite an initial spring acceleration, the unstable glacier mass did not undergo a large-scale break-off event, in fact it decelerated during the unusually warm summer months. This is particularly surprising as surface velocities of other parts of the glacier steadily increased. An explanation remains elusive but likely involves subglacial processes and bedrock topography. Nevertheless, our results allow us to draw important conclusions regarding the suitability of different approaches to monitoring unstable glaciers.

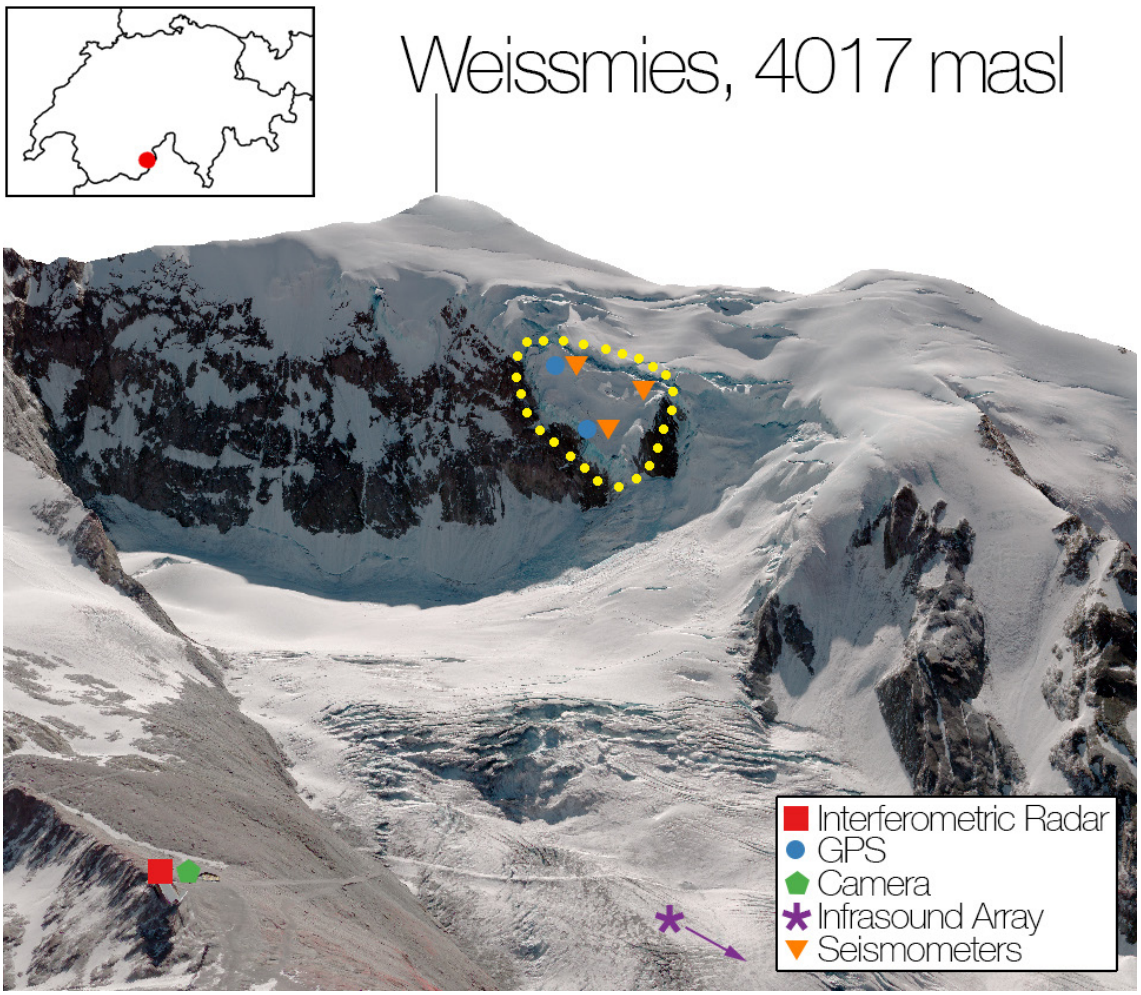

Figure 1. Trift glacier at Weissmies with an overview of the measurement methods. The unstable part of the glacier is circled in yellow dots.

REFERENCES

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