

Submitted Abstract

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Abstract

Glaciological phenomena can have a strong impact on human activities in terms of hazards and freshwater supply. Therefore, scientific observation and continuous monitoring are fundamental to investigate their state and recent evolution. Efforts in this field have been spent in the Grandes Jorasses massif (Mont Blanc area), where several break-offs and avalanches from the Planpincieux Glacier and the Whympser Serac threatened the Planpincieux hamlet in the past. In the last decade, multiple close-range remote sensing surveys have been conducted to study those glaciers.

Time-lapse cameras monitor the Planpincieux Glacier since 2013. Its surface kinematics is measured with digital image correlation. Image analysis allowed classifying different instability processes that cause break-offs and their volume estimation. Another objective of close range remote sensing and field measurements at this site deals with the validation of remote sensed data from satellite borne sensors. A robotised total station monitors the Whympser Serac since 2009. The extreme high-mountain conditions force to replace periodically the stakes of the prism network that are lost. Those investigations revealed possible break-off precursors and a monotonic relationship between glacier velocity and break-off volume, which might help for risk evaluation.

In addition to these permanent monitoring systems, single and multiple specific surveys have been carried out on different topics:

- Five campaigns with different commercial terrestrial interferometric radars have been conducted between 2013 and 2019.

- In 2020 two terrestrial GBSAR were installed for the improvement of the monitoring network of both glaciers. The adopted monitoring network is also composed by a Doppler radar that controls the potential detachment of ice blocks from the frontal part of the Planpincieux glacier.

- Helicopter-borne LiDAR, terrestrial laser scanner and structure from motion applied to photomosaics acquired by helicopter and UAV provided a series of high-resolution DTMs. Finally, new helicopter ground-penetrating radar campaigns were conducted in 2020 to evaluate the Planpincieux and Grandes Jorasses glaciers thickness.

- A field survey for basal temperature of the Whympser serac was carried out during 2020/21 to highlight its evolution since measurements of 1997 and as an input for modeling of possible future stability of the serac under future climate change scenarios.

The survey activity conducted in the Grandes Jorasses area in the last decade is probably one of the most variegated in the European Alps. Thereby, this area has become an open-air laboratory for experimenting new technological or methodological solutions for glaciological remote sensing monitoring which might be applicable in other contexts.