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Structural and hazard assessment of the Brenva rockslide scar (Mont-Blanc massif, Aosta Valley, Italy)

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The southeastern side of Mont Blanc is constituted of high granitic peaks affected by different degree of fracturing. In the last hundred years, two major ice-rock avalanche events took place on the Brenva Glacier involving volumes of more than 2×10^6 m^3. In September 2016, a volume of 35'000 m^3 detached from the previous rock avalanche scar and was deposited on the higher part of the Brenva Glacier. This new event has pushed Aosta Valley Autonomous Region authorities to investigate in more detail the "Sperone della Brenva" rock mass. Between July 2017 and October 2018, three Photogrammetric Points Clouds (PPCs) were generated using structure-from-motion techniques from hundreds of pictures taken during helicopter flights.

The structural analysis of PPCs enabled to identify four major fracture sets in the rock avalanche scar. By fitting planes deeply along these fractures, different potentially unstable volumes were calculated and several scenarios were defined. During autumn 2017, deformation of the rock wall was also monitored with a ground-based InSAR system. No significant mass movement was detected; nevertheless, three rockfall events occurred between July 2017 and October 2018, indicating that some activity remains.

Heliported infrared thermal images were also acquired in October 2018. Although thermal signatures are not simple to analyze at the rock face scale, thermograms show that some fractures are colder and residual ice areas display negative temperatures. Presence of water leaking on the rock wall is clearly visible on these images, suggesting that the interaction between permafrost and melted water influence greatly the stability of the Sperone della Brenva.

By combining all these observations, the scenarios have been ranked in hazard levels. If the collapse of mid-volumes of about 1×10^5 m^3 is rather likely within a short delay, the failure probability is lower for larger volumes. However, due to global warming and annual snow cover variations, the monitoring (measuring instruments and/or monitoring activity) needs to be continued in order to permanently re-evaluate the probability of failure of each scenario.