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Abstract

It is well known that bedrock geometry influences glacier surface morphology. Nevertheless, in mountain glaciers, direct observations are rare. We present a detailed research on the Planpincieux Glacier (NW Italy), where we measured the glacier thickness using ice-penetrating radar and reconstructed the bedrock topography in 2020. Besides, we surveyed the glacier surface morphology and kinematics using helicopter-borne structure from motion and digital image correlation of terrestrial images, respectively. Visual digital terrain analysis evidenced the presence of crevasses of recurrent position, with planimetric variations between 6-14 m. The crevasses' positions occur ~40 m downstream of bedrock knees. Moreover, the amplitude of glacier undulations is larger than that of bedrock, indicating that the effects of bedrock discontinuities are amplified on the glacier surface. Besides, we observed a correspondence between crevasses and kinematic domains. Thus, evidencing the direct influence of the bedrock topography on glacier morphodynamics.

Additionally, we analysed the morphological evolution of the unstable frontal sector of the Montitaz icefall, which represented a serious threat for the population in the last years due to potential collapse. Between 2014 and 2020, its thickness at the end of the ablation season remained approximately constant (i.e., ~24 m on average), but it retreated by approximately 60 m and the area was almost halved. On the other hand, we measured a volume decrease of this sector >30% between 20 July and 8 September 2020. Since the damages provoked by potential failure depend primarily on the involved volume, this finding demonstrates that high-frequency morphology monitoring is essential for correct glacial hazard assessment.