Debris cover development and its impact on the recent evolution of Infiernos glacier, Spanish Pyrenees

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Abstract

The North face of the Infiernos Peak (3,082 m a.s.l.), composed of Paleozoic metamorphic materials, hosts one of the smallest glaciers that still persists in the Pyrenees. As other glaciers in this mountain range, this one has experienced a strong decline in extent and thickness in the last years. However, this glacier has been covered by a particularly extensive debris cover (about 30 % of the glacier surface) as consequence of a recent rockfall, and the intense periglacial activity in the steep surrounding cirque walls. This work presents results of glacier area and ice thickness losses obtained with satellite, airborne LIDAR and UAV (Unmanned Aerial Vehicles) for the years 2011, 2020, 2021 and 2022, as well as a GPR (Ground Penetrating Radar) survey in 2021 to estimate remaining ice thicknesses. Additionally, thermometers were installed at various locations around the glacier in 2021. These thermometers were buried in the ground or holes drilled directly into the rock of the upper steep slopes of the glacier. The glacier has shown intermediate values of glacier shrinkage and wastage compared to other Pyrenean glaciers, but it is relevant that the areas covered by the thin debris cover have shown a marked attenuation in glacier thickness reduction compared to the debris-free areas. Ground and rock temperatures have allowed to determine the existence of permafrost in some places, as well as a high number of freeze-thaw cycles in the surroundings of the glacier, possibly contributing to the further increase of the debris cover over the glacier in the near future.