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Geomorphological constraints for tropical glacier retreat description and modelling: the MOTICE project in Nevado Coropuna and Quelcaya icecaps (Perú).

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Tropical glaciers are among the fastest retreating in the world. The two largest tropical glaciers are located in South Perú. Quelcaya icecap (-13.92°, -70.80°, 5650 masl) sits at the Eastern wetter fringe of the Andean Plateau, near the Amazon basin, from which it receives precipitation. Nevado Coropuna (-15.54°, -72.64°, 6377 masl), sits on a volcanic building at the arid, Western part of the Andean Plateau, under the influence of the Humboldt ocean current.

MOTICE is an ongoing project that will measure the retreat of Nevado Coropuna and Quelcaya since the 1950's. Glacier reach, mass balance and thickness will be measured using remote sensing, GPS, UAV and GPR, whereas deglaciated areas will be studied in terms of their geomorphology. Alongside climate data, the glaciological and geomorphological information will feed a glacier model that will try to replicate the retreat that has happened in the last 70 years. Once tuned, the model will be forced with different future RPC scenarios in order to know the future retreat of the two aforementioned icecaps. In this contribution we present preliminary results on the 1950's-present deglaciation landsystems and discuss their potential feed into glacier modelling.

In the case of Nevado Coropuna, results show a distinctive landform creation pattern between the North and South face, which we expect be linked to a differential retreat pattern. Northern proglacial areas predominantly feature a push-moraine/fluting landsystem that speaks of fast glacier motion and dynamic retreat, which is confirmed by the highest retreat rates in the whole icefield. Conversely, southern glacial landsystem show the typical setting of a stagnant glacier front, with debris covered glaciers, rock glaciers and a very limited frontal retreat. Recent rock glacier formation in high mountain environments has already been described in the Himalayas and might be

a beneficial process for the storage of frozen water resources, as rock glaciers are more resilient to melt than glaciers.

Deglaciation landforms in Quelcaya evidence a quick retreat pattern, which left frontal and lateral moraines, some of them currently enclosing proglacial lakes in the main valleys and series of push moraines in less enclosed slopes. Recent deglaciation in the SW and NE tips of the icefield has reached the plateau on which it sits. Deglaciated areas on the plateau only show lightly scoured bedrock surfaces, hence evidencing cold-based, motionless ice.

Overall, Quelcaya is retreating at a faster pace than Nevado Coropuna, mainly because its lower elevation, which is expected to be fully placed within the ablation zone before 2050. It is expected that the described glacial geomorphology will help our glacier model in two ways: 1. tune some parameters in it, such as ice velocity and 2. provide temporal constraints (mainly from moraines) to the deglaciation process between the 1950’s and the present time.