Geomorphological hazard and water stores controlled by the alpine cryosphere in the Eastern Italian Alps

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Numerous rockfalls and debris flows affecting the alpine areas of the European Alps are directly or indirectly linked to the current degradation of the mountain cryosphere. Indeed, glacier retreat and permafrost melt lead to increased availability of loose debris and decreased mechanical stability of alpine slopes and rock-cliffs.

The correct interpretation of such events and the establishment of the possible relationship to the alpine cryosphere imply a good knowledge of the spatial domains where current surface degradation processes occur. This knowledge is not easy to achieve, because processes and conditions governing the spatial distribution and degradation of the cryosphere are highly variable in space, and often occur under debris cover with variable thickness.

Water resources stored in debris-covered glaciers and in rock glaciers are also poorly known and often underestimated, for similar reasons. In high-relief areas like the Dolomites, inactive glaciers persist under debris, which insulate them from the atmosphere. The ice contained in rock glaciers is even more resilient to climatic changes, and can last for centuries or millennia.

This project aims at improving the knowledge of the spatial distribution of current glacial and periglacial domains in the Eastern Italian Alps, and to identify the underground thermo-hydrogeological conditions that control debris flows and rockfall phenomena at high altitude. The results of these investigations will make possible to attend in a more targeted way in the management of the hydrogeological risk in mountain environments. Another aim of the project is the improved quantification of the residual water stores contained in glaciers, ice cored moraines, and rockglaciers, and analyse the involved thermal processes governing these structures.

The project will exploit exiting datasets concerning the cryosphere in the Eastern Italian Alps, meteorological series, historical series of rockfalls and debris flow events, and information on the triggering factors, such as rainfall and seismic events. Investigation will include both regional-scale assessments and single case studies, selected as representative.

Regional scale assessments will be carried out using traditional approaches such as orthophotos analyses, and modern methods like multi-temporal DTM comparisons obtained by LiDAR or terrestrial/avionic photogrammetry, which will be used for time-lapse mapping of geomorphological active areas (i.e. areas with rock falls, debris flows, debris-covered ice and active rockglaciers).

Case studies of particular interest will be investigated in detail, performing specific terrestrial and drone-based laser scanning and photogrammetric surveys, combined with geophysics (electric/electromagnetic methods) and thermal monitoring (infrared camera and temperature monitoring sensors).

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