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Drivers of rockwall retreat and denudational hillslope processes in two selected cold climate and Mediterranean mountain environments

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Contemporary hillslope processes are extremely varied and are driven by a number of diverse physical, chemical, and biological processes. These processes span a wide range of spatial and temporal scales and are considered to react sensitively to climatic changes, anthropogenic impacts and other disturbances.
We present ongoing GFL research activities focussing on environmental drivers of rockwall retreat, and denudational hillslope processes in a cold climate mountain environment (western Norway) and in a Mediterranean mountain setting (eastern Spain). In detail, we explore the influence of (i) lithological and structural characteristics, (ii) the rockwall temperature regime and (iii) the connected relative importance of physical-, chemical- and biological processes on weathering and resultant morphologies under these two contrasting climates. Special focus is on possible effects of ongoing and accelerated climate change and on the question how these effects differ under the two distinct climates.
Our research is conducted on selected hillslope systems within two tributary valleys (max. elevation 2083 m a.s.l.) located on the western side of the Jostedalsbreen ice cap within the fjord landscape of western Norway. The lithology consists primarily of Precambrian granitic orthogneisses. The climate (slightly above sea level) is cool temperate oceanic with a mean annual air temperature of ca. 6°C and an annual precipitation sum of 1100 mm. January and February are the coldest months with mean monthly air temperatures below 0°C. Higher elevations are characterized by a distinct winter frost regime and a several months lasting closed snow cover. Maximum summer temperatures (June, July) are rarely exceeding 25°C but rockwalls having a favourable exposition can receive a rather high solar radiation.
The selected hillslope systems in eastern Spain (Calpe) are located within the Sierra de Bernia mountains (max. elevation 1126 m a.s.l.) which consist of glauconitic and bioclastic marine limestones with alterations of marl. The area is characterized by a mild Mediterranean climate with a mean annual air temperature of ca. 18°C and an annual precipitation sum around 400 mm (slightly above sea level). During the coldest months (January, February) it can be comparably cold even with frost and snow in the mountains although they are situated close to the coast. In contrast, maximum summer temperatures (July, August) can easily exceed 30°C and south-facing rockwalls are exposed to a high solar radiation.
Our investigations encompass detailed geological and geomorphologial mapping, the identification and monitoring of the most relevant hillslope processes in combination with detailed statistical analysis of meteorological data. The monitoring programme includes installed nets for collecting freshly accumulated rockfall debris, installed tracer lines and remote time-laps cameras for monitoring various mass transfers as well as near-surface and surface rockwall temperature sensors for monitoring the thermal rockwall regime.
An improved and more comprehensive understanding of how different environmental factors interact and control hillslope processes under two contrasting and changing climates is expected to be essential for predicting possible effects of ongoing climate change in sensitive mountain environments.