

Inventorying rock glaciers: The relevance of definitions, processes and base data

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Rock glacier inventories have been elaborated for many mountain regions during the last decades. Such inventories have been used for instance to determine the current (using intact rock glaciers) or the past extent (using relict ones) of mountain permafrost and its change over time. However, the recognition and delineation of a rock glacier is not always a trivial task in particular in cases where the “typical” rock glacier surface morphology with longitudinal and transversal ridges and furrows is missing. A further inventorying restriction is based on which genetic model for rock glacier formation is used or favored by the elaborator, i.e. glacier-derived rock glaciers (with massive sedimentary or “glacier” ice), talus-derived rock glaciers (dominated by congelation ice), or a mix thereof. In addition to that, relict rock glaciers are commonly more difficult to recognize and to delineate due to the decay of morphological features or the coverage by vegetation. In this regard the geomorphic concept of equifinality plays an important role because similar looking landforms might have been formed as a result of quite different sets of processes and time periods. Two examples illustrating this problem are as follows: (i) relict embryonal rock glaciers or protalus ramparts look very similar to pronival ramparts although the acting process was substantial different; (ii) multiple ridges at a presumed rock glacier front might have been formed by several phases of glacier advance forming a set of terminal moraines. Therefore, the elaboration of a rock glacier inventory is certainly influenced by subjectivity related to the expertise and field knowledge of the mapping person. A further crucial mapping restriction is based upon the used terrain (digital elevation models/DEM and maps) and optical (airborne, spaceborne) data. Under the assumption that improved data bases help to solve the problems mentioned above the authors of this abstract elaborated three generations of rock glacier inventories for the Federal Province of Styria (16,400 km²), Austria, during the last two decades – each time using the best data sources available. The first Styrian rock glacier inventory (StRG1) was elaborated in the mid-1990s using official maps, aerial photographs, and field verification. The second Styrian rock glacier inventory (StRG2) was elaborated in 2010-2011 using the StRG1, airborne orthophotographs, and photogrammetrically-derived DEMs with a 10m-grid resolution. Finally, the third Styrian rock glacier inventory (StRG3) was elaborated in 2014-2016 using the StRG2, airborne and spaceborne orthophotographs, and an airborne laser scanning-derived DEM with a 1m-grid resolution. The number of mapped rock glaciers increased from less than 400 listed in StRG1, slightly more than 400 in StRG2 to 710 in StRG3. The substantial increase in the number of rock glaciers in StRG3 is particularly related to the used laser scanning-based DEM because relict rock glaciers located at lower elevations in densely vegetated areas and forests have not been detected earlier. This contribution will present examples of inventoried rock glaciers and how their delineation and interpretation changed during the different inventory generations and hence contributes to the ongoing discussion about how to delineate and interpret rock glaciers.