Submitted Abstract

ID IMC22-FSAbstr- 495

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Country	Switzerland
Region	Western Europe
Title	Rock Glaciers Throughout The French Alps Accelerated And Destabilised Since 1990 As Air Temperatures Increased.
Keywords	Rock Glacier Destabilization, Permafrost Creep, Climate Change, Tipping Point
Type	List Of Focus Session
Focus Session ID	21

Abstract

In the past decades, the research community on alpine periglacial landforms reported several cases of increasing rock glacier displacement rates up to abnormally high values. This process is often bond with the development of surface features typical of landslide processes, such as crevasses and cracks. Existing studies of this phenomenon, commonly referred as “rock glacier destabilization”, have been limited to a small number of landforms and short time spans. This study aims to contribute to our understanding of rock glacier destabilization using a regional scale approach over a multi-decadal period. Our methodological pillar is the assessment of displacement rates on the basis of orthophoto comparison. First, we identified destabilizing landforms by coarsely evaluating displacement rates on all rock glacier in the French Alps since the 50s using readily available orthoimages provided by the national geographical institute. Then, we computed a database of orthoimages at high temporal resolution (5-10 years interval) for all destabilized rockglaciers in the region for the past seven decades, allowing the evaluation of the evolution of their displacement rates in greater detail. Our analysis shows that rock glacier velocities have significantly increased since the 1990s, concurrent with the development of destabilization in 18 landforms that represent 5% of the 337 active rock glaciers. This pattern of activity correlates with rising air temperatures in the region, which suggests that a warming climate plays a triggering role in this process. Surface crevassing shortly preludes the acceleration phase in most of the cases, although some landforms display crevasses in a quiescent phase for decades before destabilization onsets. Destabilized landforms can reach displacement rates up to 25 m/y, although most values range around 3-5 m/y. Destabilizing landforms show sliding dynamics, and this process lasts until a tipping point is reached and the destabilized mass is depleted or reaches flatter terrain.