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Link between surface temperature and documented rockfalls in the Mont Blanc massif rockwalls

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Recent studies show that rockfall activity has increased along the three past decades in high mountain areas, and permafrost degradation is regarded as the main triggering factor. 433 rockfalls affecting the steep rockwalls of the Mont Blanc massif have been inventoried and documented (time and precise location, topographical and geological settings, volume, conditions, etc.) from 2007 to 2011. With the aim of better understanding geomorphic processes, we address questions about the thermal state of the unstable rockwalls within this study area.
A statistical model of the Mean Annual Rock Surface Temperature (MARST) for the 1961-1990 period has been implemented on a 4-m-resolution DEM of the Mont Blanc massif. The model runs with Potential Incoming Solar radiation (PISR) calculated with GIS tools and air temperature parameters computed from Chamonix Météo France's records. 87 rockfalls are located at the geographical margins of the DEM, where the PISR calculation doesn't take account of the surrounding hillshading and biased MARST simulation. Thus, only 346 rockfalls were kept and linked to a MARST value after data sorting.
Preliminary results show that rockfalls occurred over a modelled MARST range of -6°C to 5°C. MARSTs ranging from -2.5°C to 2.5°C encompass about 60% of the rockfalls. The mean MARST value for the 346 rockfalls is of -0.9°C. Simulated warm permafrost areas (> -2°C) are therefore appearing as the most affected by instabilities. These first observations reinforce the hypothesis that permafrost degradation is likely the dominant triggering factor of these rockfalls.
The 1961-1990 period is supposed to be representative of the conditions at depth that are not affected by the recent climate warming. This means that the here presented results are mainly valuable for rockfalls related to pluri-decadal signal. But they also suggest that MARST model is an interesting tool to explore the link between rockwall instability and permafrost state. Simulations at various time scales would allow more precise reconstruction of the bedrock temperature during each year of rockfalls. Model possibilities and the related outcomings will be also presented.