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High morphogenic activity in the permafrost-affected rock walls of the Mont Blanc massif during the 2015 summer heat wave

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In order to test the geomorphological hypothesis on the link between permafrost degradation and rock wall destabilisation, we survey all the rockfalls that occur in the central part of the Mont-Blanc massif using a network of observers since 2007. 511 rockfalls (100 < V < 45,000 m3) have been documented, year 2015 included. Between 2007 and 2014, the average number of destabilizations was 44 (from 17 in 2014 with a cold summer to 72 in 2009 with a relatively hot summer). In 2015, 160 events were recorded i.e. 4 times more than the annual average of the previous years. That makes the year 2015 similar to 2003 that was characterized by its summer heatwave triggering 152 rockfalls in the area currently covered by the network of observers, as shown by the analysis of a SPOT-5 image.
Observations of 2015 are discussed and crossed with a statistical model of the Mean Annual Rock Surface Temperature (MARST) for the 1961-1990 period, implemented on a 4-m-resolution DEM of the Mont Blanc massif, and temperature measurements in three 10-m-deep boreholes at the Aiguille du Midi (3842 m a.s.l.), where the summer 2015 active layers have been the thickest since the start of measurements in 2009 (e.g. 3.6 m in the NE face against 2.9 m in average during the previous years). Before 2015, 90 % of the inventoried rockfalls occurred in areas where MARST is in the range -5 to 1°C, whereas only 50 % of the whole rock wall area above 2000 m a.s.l. covers this temperature range.

With an air 0°C isotherm which sometimes exceeded the summit of Mont Blanc (4809 m a.s.l.) during the 2015 Summer, conditions were particularly unfavorable for mountaineering. Numerous rescues were carried out to climbers technically blocked by uncommon conditions or injured by rockfalls. On the normal route to the summit of Mont Blanc, two administrative closures of the Goûter hut (3835 m a.s.l.) were necessary to prevent climbers from the huge risk of rockfalls in the access couloir, known for its rockfall activity since its snow/ice cover thaws earlier and earlier in the hot season. This raises the question of the future of mountaineering in certain high altitude areas in the context of global warming.