Geophysical Research Abstracts
Vol. 15, EGU2013-4963, 2013
EGU General Assembly 2013

Acquisition of the spatial temperature distribution of rock faces by using infrared thermography

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Rock temperature plays a central role for weathering and therefore influences the risk potential originating from rockfall processes. So far, for the acquisition of temperature mainly point-based measuring methods have been used and accordingly, two-dimensional temperature data is rare. To overcome this limitation, an infrared camera was used to collect and analyse data on the spatial temperature distribution on 10 x 10 m sections of rock faces in the Gesäuse (900m a.s.l.) and in the Dachsteingebirge (2700m a.s.l.) within the framework of the research project ROCKING ALPS (FWF-P24244). The advantage of infrared thermography to capture area-wide temperatures has hardly ever been used in this context.
In order to investigate the differences between north-facing and south-facing rock faces at about the same period of time it was necessary to move the camera between the sites. The resulting offset of the time lapse infrared images made it necessary to develop a sophisticated methodology to rectify the captured images in order to create matching datasets for future analysis. With the relatively simple camera used, one of the main challenges was to find a way to convert the colour-scale or grey-scale values of the rectified image back to temperature values after the rectification process. The processing steps were mainly carried out with MATLAB.
South-facing rock faces generally experienced higher temperatures and amplitudes compared to the north facing ones. In view of the spatial temperature distribution, the temperatures of shady areas were clearly below those of sunny ones, with the latter also showing the highest amplitudes. Joints and sun-shaded areas were characterised by attenuated diurnal temperature fluctuations closely paralleled to the air temperature. The temperature of protruding rock parts and of loose debris responded very quick to changes in radiation and air temperatures while massive rock reacted more slowly.
The potential effects of temperature on weathering could only be assessed in a qualitative way by now. However, the variability of temperatures and amplitudes on a rather small and homogeneous section of a rockwall is surprisingly high which challenges any statements on weathering effectiveness based on point measurements. In simple terms, the use of infrared thermography has proven its value in the presented pilot study and is going to be a promising tool for research into rock weathering.