

Combining time-lapse photography and multisensor data logging to monitor slope dynamics in the southern Japanese Alps

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Onsite time-lapse photography (TLP) is applied to visual monitoring of soil movements and rockfalls in an alpine zone (Mt. Ainodake area) of the southern Japanese Alps. The time-series images greatly improve understanding of slope processes in remote, seasonally inaccessible areas. TLP detects the timing of slope movements at a high time resolution. Stereographic view of successive images displays 3D slope dynamics that indicates the location and magnitude of displacement. When combined with sensor-based data logging, TLP allows more reliable evaluation of thresholds (environmental controls) for slope movements. This presentation demonstrates (1) how visual information improves the interpretation of both slow progressive soil movements (frost creep) and rapid temporary movements (rill erosion and rockfalls) and (2) how highly active is slope dynamics in the southern Japanese Alps that experience deep seasonal frost in winter and heavy rain storms in summer.

Continuous monitoring of a painted line drawn on a debris lobe highlights biannual shallow soil movements, mostly derived from diurnal frost heave by needle ice or shallow ice lens formation and approximated by the potential frost creep. The surface velocity shows a small interannual variation mainly reflecting snow conditions, but an extraordinary velocity is recorded once per decade. This is due to episodic rill erosion released when the topmost frozen soil is rapidly thawed and super-saturated by intensive rainfall during seasonal thawing periods.

Year-round TLP images of a rockslide scarp allows evaluation of the timing and magnitude of rockfalls at different scales. Close-up images of color-painted quadrangles (50 cm square) indicates centimeter- to decimeter-scale spalling events. Spalling activity reach a maximum at the beginning of seasonal thawing, when the rockwall experiences both diurnal freeze-thaw alternations within the outermost 20 cm and progressive warming of the still-frozen substrate. Stereographic view of successive images also identifies block-scale rockfalls. Such an event occurred between 16 h on 7 July and 8 h on 8 July 2011, triggered by nocturnal rainfall (total 33 mm).

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