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Multi-spectral terrestrial laser scanning for interpreting the controls on and changes to unstable rock faces

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Terrestrial laser scanning is now widely used for the morphometric characterisation of unstable slopes and the changes that they experience, an application to which the speed, resolution, range and precision of laser scanners is particularly well suited. All commercially available scanners, as active sensors, collect in addition to geometrical information, a measure surface character expressed through the intensity of the reflected laser pulse. More recently this has also been combined with RGB from CCD mounted either on or within the scanner system. The intensity of return is a function of geometry (incidence angle, surface texture and laser path length), environmental conditions (ambient light, survey design and airborne particles), and physical (electrical permittivity, magnetic permeability and conductivity). The physical controls are suggested here to relate closely to those factors which may act to promote rock slope instability and structure, for example the presence of moisture, rock mineralogy and oxidation. If the geometrical and environmental influences on return intensity can be controlled the physical influences potentially offer a considerable insight into the character of the surface under examination and its spatial variability.

This paper explores the controls on laser return intensity using three terrestrial laser scanners of different wavelengths (1550 μm, 905 μm and 532 μm), whereby a series of rock slopes of variable geology are scanned over two survey epochs. Geometrical changes to the slopes (rock falls) are calculated and then related spatially to the multi-spectral surface intensity. In addition, data is presented from monthly monitoring over a four year period, whereby the intensity signature from the rock face varies considerably on an annual cycle. The results suggest the potential value in using laser

reflectance intensity for unstable slope classification and characterization.