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Significance of soil moisture content for rockfall hazard assessment

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Rockfall modelling is an essential tool for hazard analysis in steep terrain. Calibrating terrain parameters ensures that the model results accurately represent the site-specific hazard. Parameterizing rockfall models is challenging because rockfall runout is highly sensitive to initial conditions, rock shape, size and material properties, terrain morphology, and terrain material properties. This contribution examines the mechanics of terrain scarring due to rockfall on the Port Hills of Christchurch, New Zealand. We use field-scale testing and laboratory direct-shear testing to quantify how the changing moisture content of the loessial soils can influence its strength from soft to hard, and vice versa.

We calibrate the three-dimensional rockfall model RAMMS by back analysing several well-documented rockfall events, adopting dry loessial soil conditions. We then test the calibrated "dry" model by adopting wet loessial soil conditions. The calibrated dry model over-predicts the runout distance when wet loessial soil conditions are assumed. We hypothesis that this is because both the shear strength and stiffness of wet loess are reduced relative to the dry loess, resulting in a higher damping effect on boulder dynamics. For realistic and conservative rockfall modelling, the maximum credible hazard must be assumed; for rockfall on loess slopes, the maximum credible hazard occurs during dry soil conditions.