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Quantifying the influence of rock shape on the run out of rock fall

James Glover (1), Nick Rosser (2), Werner Gerber (1), and Dave Petley (2)

(1) Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Switzerland (james.glover@wsl.ch), (2) IHRR, Department of Geography, University of Durham, UK. DH1 3LR

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The shape of falling rocks is an often cited factor influencing their trajectory during run out over terrain; few attempts have been made to quantify this effect. With the advancement of rock fall simulation codes to include 3D rock geometries (e.g. RAMMS rock fall, GEOTEST+Zinggeler), and new approaches to rock fall protection where the trajectories of rock falls are guided, understanding the influence of rock fall block shape is necessary. A first step is to assess the importance of rock shape for rock falls occurring on exfoliating rock walls. This contribution presents the details of the field work program designed to predict rock block shape from discontinuity data of the source zone, calibrated by comparison with deposited blocks across a range of differing geologies in alpine rock fall zones of the Albulapass, Grisons, Switzerland. We apply terrestrial laser scanning and traditional geological survey methods to gather discontinuity data from the rock mass free face and the geometry of deposits. Insights are gained to the fracture networks that are dominant in the release and shape, and magnitude of potentially released blocks. Volumetric and shape comparisons allow the role of dynamic fracture during the transport phase of rockfall to be assessed, while simultaneous deposit mapping enables the shape effect on rockfall trajectory to be examined in detail to build a series of shape-based inputs into future rockfall models.

Current laser scanning technology now facilitates the capture of richer data sets which can be used in discontinuity and deposit analysis for rock mass characterisation. There should be a move to incorporating these methods as standard in rock fall hazard modelling and mitigation approaches to match the advancements in rock fall modelling and rock fall protection solutions. Through this study a more complete description and specification of the design block for rockfall hazard assessment is anticipated. With detailed rockfall geometry information, design values for impact loads can now be better computed by integrating characteristic block shapes into increasingly powerful 3D rockfall simulations. Further, the testing and development of protection structures can be advanced to consider the influences of irregular and angular blocks during impact. A broader scope to this study is to be able to make comments relating block shape to their respective geological and structural settings governing their generation, with a view to the identification of hazardous rockfall formations.

Finally, it is evident that within the community of laser scanning practitioners there are a number of differing approaches to performing the laser scan and generating the respective data for rock mass and rockfall characterisation. In order to assess and compare the effectiveness and accuracy of the range of methods, the authors outline a proposal for a comparative study whereby groups employing laser scan technology to characterise rock masses are invited to capture, analyse and discuss data from the same actively rock failing slope. We propose that the results be pooled, analysed and drawn up in a joint publication on the application of terrestrial laser scanning methods for rock mass characterisation. The convening of practitioners at the EGU2011 provides the perfect opportunity to meet, discuss and initiate this proposed study.