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Using patterns of debris flow erosion and deposition in the Icelandic Westfjords to delineate hazard zones.

S. J. Conway (1), A. Decaulne (2), M. R. Balme (1), J. B. Murray (1), and M. C. Towner (3)

(1) Department of Earth and Environmental Sciences, Open University, United Kingdom (s.j.conway@open.ac.uk), (2) CNRS UMR6042 Geolab, University Blaise Pascal, Clermont-Ferrand, France., (3) Department of Earth Science and Engineering, Imperial College, London, United Kingdom

Debris flows pose a significant risk to infrastructure and people; hence the aim of this study is to better understand the behaviour of debris flows by studying examples from above the town of Ísafjörður in north-western Iceland. Debris flow is a recognised hazard in the region [1], but above Ísafjörður occurs with particularly high regularity [2] and can involve large volumes of debris. We have used airborne laser altimeter (LiDAR) and differential GPS data to produce isopach maps of flows that occurred in 1999, 2007 and 2008 above Ísafjörður and in adjacent valleys. Compared to observations from the literature, e.g. [3-5], these flows start depositing at unusually high slope gradients (up to 45°). However the larger flows are also unusually mobile compared to typical hill-slope debris flows [4], but they are not as mobile as channelized flows [6]. This means that for a given volume their run-out distance is much greater than expected and hence more likely to reach the town.

The volumes for the flows were calculated in two ways: firstly we were able to take the difference between the surfaces before (LiDAR) and after (dGPS) three small flows that occurred in 2008. Secondly, for flows prior to our 2008 LiDAR survey, we interpolated the pre-flow surface based on surrounding topography and measured differences from our post-flow surveys. The second method therefore has a tendency to over-estimate the flow volumes. The scheme for dGPS surveying involved obtaining numerous cross sections and taking long profiles along the channel and adjacent levees. Based on the volumes that we have calculated using these more accurate methods, we have increased the value of volume estimates for recorded historic debris flows reported by [2] and have revised the local denudation rate to 45 mm per 100 yr. Using the isopach maps and associated field observations we have found a relationship between slope and deposition volume, where the runout and pattern of deposition is a function of the slopes (calculated from digital elevation models) along the path of the flow. Using this relationship along potential flow paths identified with standard flow routing algorithms (e.g. [7]), we have highlighted several zones in the upper parts of the town that are at significant risk from debris flows. Most at risk are those areas of the town that have higher slope-angles and are without the protection of drainage ditches or small tree plantations, which would be reached by even a small flow. However in the worst case there are several areas below the ditches or trees that would be at risk if the flow was large, as the flow would reach a depth great enough to overcome these obstacles. The flows that we studied are composed of different source materials and are located in different geological settings, so we suggest that this method could be applied to any debris flow. Testing its applicability to other areas is an ideal avenue for future research.

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References cited: [1] Arnalds, Þ. et al (2002) Hazard zoning for Ísafjörður and Hnífsdalur Technical report, Veðurstofa Íslands. [2] Decaulne, A. et al (2005) Geogr. Ann., 87A(4), 487-500. [3] Larsson, S. (1982) Geogr. Ann., 64A(3-4), 105-125. [4] Lorente, A. et al (2003) Nat. Haz. & Earth Sys. Sci., 3(6), 683-692. [5] Rapp, A. and Nyberg, R. (1981) Geogr. Ann., 63(3-4), 183-196. [6] Rickenmann, D. (1999) Nat. Haz., 19(1), 47-77. [7] Marcello, R. (2008) GeoInformatica, 13(2), 1-9