



Using Topographic Derivatives of High Resolution Data on Earth and Mars to Determine Active Processes on Mars.

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One of the severest problems in the field of martian geomorphology is that of convergence of form (i.e. that dissimilar processes can produce similar looking landforms). Since the discovery of recently formed km-scale gullies [1] on the martian surface, debate has raged about whether these features formed by dry mass wasting, fluidisation by CO₂ gas, debris flow, unconcentrated water/brine flow, or by other, exotic processes. This is an important distinction, because if these gullies are found to be formed by water, which is currently unstable at the martian surface, then a mechanism has to be found to produce this water, and this has ramifications for our understanding of martian climate and hydrology.

We approach this problem by studying newly available high resolution (~ 1 m/pix) elevation models derived from stereo HiRISE (High Resolution Science Imaging Experiment) image pairs and comparing them to LiDAR datasets of analogous features on Earth. We have used hydrological topographic indices such as slope-area [e.g., 2], contributing area distribution [3] and the downslope index [4] to characterise slopes with known processes on Earth. We characterised slopes dominated by rockfall, debris flow and fluvial erosion. We then apply these same analysis techniques to gullied slopes on Mars and find that these slopes have a signal of both debris flow and fluvial processes. This suggests that Mars' recent climate has recently been more amenable to the existence of liquid water than has previously been assumed.

References: [1] Malin M. C. and Edgett K. S. (2000) *Science*, 288, 2330-2335. [2] Stock and Dietrich (2003) *Water Resour. Res.*, 39, doi:10.1029/2001WR001057. [3] McNamara et al. (2006) *Forest Ecology and Management*, 224, 147-156. [4] Hjerdt et al. (2004) *Water Resour. Res.*, 40, doi:10.1029/2004WR003130.