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Testing the Reliability of Manual Mapping of Glacial Landforms: Initial Results

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Mapped topographic features are important for understanding processes that sculpt the Earth's surface. Manual, interpretive, techniques for mapping are commonly used yet, it is difficult to assess their effectiveness. Here 'real' DEMs are modified by inserting 'synthetic' drumlins in to them [Hillier and Smith, 2012] for mappers to identify. Interactive maps are presented that display 12,121 outlines drawn by 25 interpreters searching for a total of 21,625 drumlins. Overall detection rates (i.e. $n_{coincident}/n_{total}$) are low at 34-40%, interestingly comparable to automated methods [Eisank et al., 2014], but reliability (i.e. $n_{coincident}/n_{mapped}$) is higher at 72-86%. A pilot study also indicates that drumlin height is the key dimension driving detectability, with rates decreasing from 100% to <25% with decreasing size. These are the first results giving such absolute values of effectiveness in this research area, permitted by the development of the synthetic DEMs. Arguments will always exist about how realistic any synthetic is, but we believe that this work demonstrates that the *a priori* known answers in synthetics will increase the number and strength of conclusions that it is possible to draw. Thus, this work also demonstrates the wider utility of synthetic DEMs in geomorphology.

The drumlins in the study area resemble UK drumlins, permitting extrapolation of the conclusions. The variation between interpreters (e.g., mapping philosophy, experience) and across the study regions (e.g., density of woodland) will be used to elucidate the characteristics governing drumlin detection and to suggest protocols for the manual interpretation of DEMs and identification of drumlins.

The data are also in *J. Maps* https://dx.doi.org/10.1080/17445647.2014.957251, co-authored with Arumgan, R., Barr, I., Boston, C., Clark, C., Ely, J., Frankl, A., Greenwood, S., Grosselin, L., Hättesrand, C., Hogan, K., Hughes, A., Livingstone, S., Lovell, H., McHenry, M., Munoz, Y., Pellicer, X., Pellitero, R., Robb, C., Roberson, S., Ruther, D., Spagnolo, M., Standell, M., Stokes, C., Storrar, R., Tate, N., Woodridge, K.