Pattern recognition of mass-flow deposits from airborne LiDAR

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Mass-flow deposits, potential construction aggregates, exhibit as fields of ridges varying in elongation and in surface stoniness and boulder clusterings (Sutinen et al., 2009a). Mass-flow morphologies are linked to conduit infill sedimentation. The sedimentation presumably was initiated by the subglacial earthquake event(s) associated with lithospheric plate stresses and glacial isostatic adjusment (GIA). Mass-flow sediments are moderately sorted diamictons with a fine-fraction conten less than 12% hence making them potential aggregates for construction purposes.

We aimed to develop a semi-automated pattern recognition approach to map mass-flow deposits as potential new aggregate materials using high-resolution airborne laser scanning (ALS) data. The study was conducted in the Kemijärvi mass-flow field, northern Finland, which has regional significance for aggregate production.

In the first stage, all hummocky features with a convex topographic form were delineated from the ALS derived DEM and its tilt derivative with an Object-Based Image Analysis algorithm developed in eCognition software. Then field recognizance was conducted to provide validation and calibration data for classification of the delineated hummocky landforms into mass-flow deposits and other landforms based on their surface stoniness. The presence of stones was detected from the last-return point cloud ALS data by producing a surface triangulation with a limited spatial angle on every point. The signal was then amplified by a neighborhood voting and cumulated to grid points for classifying each mass-flow polygon. The approach was successful and presents the first attempt to semi-autimatically map aggregate deposits from ALS data in Finland.

References:

Sutinen, R., Middleton, M., Liwata, P., Piekkari, M. and Hyvönen, E., 2009. Sediment anisotropy coincides with moraine ridge trend in south-central Finnish Lapland. Boreas 38, 638-646.