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Surface expression of intraplate postglacial faults in Sweden: from LiDAR data

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Large intraplate earthquakes, up to magnitude 8.0±0.3 (Lindblom et al. 2015) are inferred to have occurred in northern Fennoscandia at the end of, or just after the Weichselian deglaciation. More than a dozen large so-called postglacial faults (PGF) have been found in the region. The present-day microseismic activity is rather high in north Sweden, and there is a correlation between microseismicity and mapped PGF scarps: 71% of the observed earthquakes north of 66°N locate within 30 km to the southeast and 10 km to the northwest of PGFs (Lindblom et al., 2015).

Surface expressions of PGFs in Sweden have mainly been mapped using aerial photogrammetry and trenching (e.g. Lagerbäck & Sundh 2008). Their detailed surface geometry may be investigated using the new high-resolution elevation model of Sweden (NNH) that has a vertical- and lateral resolution of 2 m and 0.25 m, respectively. With NNH data, known PGFs have been modified, and a number of new potential PGFs have been identified (Smith et al. 2014; Mikko et al. 2015). However, the detailed variation of their surface expression remains to be determined.

Our main objective is to constrain the strike and surface offset (i.e. apparent vertical throw because of soil cover overlays the bedrock) across the PGF scarps. We anticipate using the results to constrain direction of fault motion and paleomagnitudes of PGFs, and in numerical analyzes to investigate the nature of PGFs.

We have developed a methodology for analyzing PGF-geomorphology from LiDAR data using two main software platforms (Ask et al. 2015): (1) Move2015 by Midland Valley has been used for constructing 3D models of the surface traces of the PGFs to determine apparent vertical throw. The apparent hanging- and footwall cut off lines are digitized, and subsequent computation of coordinates is rather time efficient and provide continuous data of fault and soil geomorphology that can be statistically analyzed; and (2) ArcGIS 10.3 by Esri has mostly been used to derive the slope model for the study area.

We successfully tested the methodology within a limited area of the Pärvie fault zone, which is the longest known PGF in the world (Ask et al. 2015). Here, we apply the methodology to PGFs in northern Sweden. Additionally, we are planning to analyse PGFs within a virtual reality environment utilizing the GeoVisionary software platform by Virtalis Ltd. in order to increase accuracy and efficiency and to decrease modelling uncertainties.

References

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