# HOW MAY GLACIAL REBOUND INFLUENCE SEISMIC ACTIVITY IN ICELAND?

**Björn Lund (1), Peter Schmidt (1), and Þóra Árnadóttir (2)**

*1. Department of Earth Sciences, Uppsala University, Uppsala, Sweden; 2. Nordic Volcanological Center, Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland*

## Abstract

The current warming trend started in the 1890s in Iceland, and the Icelandic ice caps have been generally retreating since then. The total volume of ice lost by Vatnajökull since 1890 is estimated at 435 $km^3$, equivalent to a 50 m thick layer over the entire glacier. Ice loss data from the other major Icelandic glaciers is scarcer, but they all indicate significant retreat since 1890. Using a model for the ice loss history of the Icelandic ice caps from 1890 to 2004, and a 3D finite element Earth model, we calculate the response of the Earth to the current deglaciation. The modelled uplift is compared to GPS data from countrywide campaigns in 1993 and 2004. These data show a broad region of rapid uplift in central Iceland, with velocities of up to 25 mm/yr, which our models reproduce well when all major ice caps in south-central Iceland are included. Our best-fit 1D Earth model has a 10 km elastic layer on top of a 30 km viscoelastic layer with viscosity 1e20 Pa s, overlying a viscoelastic half-space with viscosity 1e19 Pa s (Árnadóttir *et al.*, 2009). The inferred viscosity is higher than found by some previous studies that considered more spatially limited data sets.

We explore how 3D structures such as laterally varying lithosphere thickness, inclusion of a low-viscosity ridge system and lateral viscosity variation, all present in the complex structure of Iceland, affect the resulting uplift. Preliminary results indicate that data coverage near the glacial rims, or even better on nunataks, are essential to resolve such structures.

We use the modelled stress fields to investigate the effect of deglaciation on the stability of faults. Although the stresses can be readily used to calculate increasing or decreasing fault stability using e.g. the Coulomb Failure Stress (CFS) criterion, we show that such inferences need to take the background stress field into account. Utilizing simple models of the background stress field we show how seismicity is promoted in some areas and demoted in other. The affected areas are primarily below the ice caps and near their rims. The region between the Vatnajökull and Hofsjökull glaciers is particularly interesting as the glacially induced stresses are relatively large there and will interact with both the rift related and the local volcanic stress fields. We model this interaction at different depths to study the effect on fault stability and thus possible earthquake activity.

## Reference

Árnadóttir, T., Lund, B., Jiang, W., Geirsson, H., Björnsson, H., Einarsson, P. and Sigurdsson, T., 2009, Glacial rebound and plate spreading: results from the first countrywide GPS observations in Iceland, Geophys. J. Int., 177, 691-716.