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Current glacial isostatic adjustment in Iceland

B. Lund (1) and Th. Arnadottir (2)

(1) Uppsala University, Dept. of Earth Sciences, Uppsala, Sweden (bjorn.lund@geo.uu.se), (2) Nordic Volcanological Center, University of Iceland, Reykjavik, Iceland

Since temperatures in Iceland increased in the 1890's the island's ice caps have been thinning and retreating. This decrease in glacier load cause uplift which has recently been quantified by two nationwide GPS campaigns (termed ISNET) in 1993 and 2004. Approximately 120 campaign sites evenly distributed over the whole country indicate significant vertical velocities ($\sim$1 cm/yr) over a large part of central and southeastern Iceland. The horizontal velocities indicate that spreading is mainly accommodated within $\sim$100 km wide areas across the active volcanic zones.

Here we model the vertical velocity field using three-dimensional finite element models of glacial isostatic adjustment, where uniform melting of Iceland's four largest ice caps since 1890 is taken into account. The broad uplift pattern is well explained using a simple Earth model with a 10 km elastic layer underlain by a 30 km viscoelastic layer with viscosity $1{\cdot}10^{20}$ Pa s over a half-space with viscosity $1{\cdot}10^{19}$ Pa s. The data is rather sensitive to the viscosity assumed for the half-space and we suggest that viscosities in the range of 6-15$\cdot 10^{18}$ Pa s predict vertical velocities in reasonable agreement with the data. The total thickness of elastic and high viscosity layer is, on the contrary, poorly resolved and we discuss possible interpretations of this. Iceland's glaciers are known to have grown significantly from the time of the Nordic settlement, around 900 AD, into the Little Ice Age. We show that taking a longer glaciation history into account does not influence the inferred Earth model significantly. We also show how the current day velocity field is influenced by temporal variations in the deglaciation rate during the 20th century.