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The secular, postglacial gravity change in Fennoscandia – observations and findings

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The postglacial rebound, also known as glacial isostatic adjustment (GIA), is the Earth's response to changing ice loads. Fennoscandia is still recovering from the loads of the large ice sheets, covering the whole region, during the last glacial period.

The GIA-induced land uplift in Fennoscandia is well known and extensively studied. During the last centuries, it has been observed by means of relative sea level observations, repeated levelling and continuous GNSS time series. Many different land uplift models for Fennoscandia have been published through the years.

Another important observable of GIA is the secular gravity change, which is less used and investigated compared to deformation. Redistribution of masses within the Earth as well as on the surface, causes changes in the gravity field. So far, no complete model of the Fennoscandian GIA-induced gravity change has been released.

By combining information about the surface deformation and the gravity change, conclusions can be made on the underlying geophysical processes and the structure of the Earth.

Here we review the history of Fennoscandian observations of the GIA-induced gravity change. It starts in the 1960s with repeated relative observations along the so-called Fennoscandian land uplift gravity lines. The main purpose of these observations was to investigate whether the land uplift could be explained by a compressible or an incompressible Earth model. From the late 1980s the relative observations have been complemented, and gradually succeeded by repeated absolute observations. Today there are about 700 repeated absolute gravity observations available, spanning over three decades, distributed on some 50 stations all over Fennoscandia.

We have, for the first time compiled and analysed all repeated absolute gravity observations in Fennoscandia. From our findings, we suggest a model of the GIA-induced gravity change based on a state of the art land uplift model and a linear relation between the vertical deformation and the gravity change. Further we share our experiences of working with and combining absolute gravity data spanning over many years, collected with different instruments and by different organisations.