



Repeated terrestrial gravity measurements in the Fennoscandian Postglacial Rebound area: comparison of gravity change with observed vertical motion and with GIA models

Jaakko Mäkinen (1), Andreas Engfeldt (2), Olga Gitlein (3), Janis Kaminskis (4), Fred Kloppe (5), Tõnis Oja (6), Eimuntas Paršeliūnas (7), Bjørn Ragnvald Pettersen (8), Gabriel Strykowski (9), Herbert Wilmes (10), and the Relative and Absolute Gravity Team

(1) Finnish Geodetic Institute, Masala, Finland (JAAKKO.MAKINEN@FGI.FI, 00358 9 29555211), (2) Lantmäteriet, Gävle, Sweden, (3) Institut für Erdmessung, Leibniz Universität Hannover, Germany, (4) Latvian Geospatial Information Agency, Riga, Latvia, (5) National Oceanic and Atmospheric Administration (NOAA), currently at Micro-g Lacoste, Lafayette, CO, USA, (6) Estonian Land Board, Tallinn, Estonia, (7) Vilnius Gediminas Technical University, Lithuania, (8) Norwegian University of Life Sciences, Ås, Norway, (9) DTU Space, National Space Institute, Technical University of Denmark, Copenhagen, Denmark, (10) Federal Agency for Cartography and Geodesy (BKG), Frankfurt am Main, Germany

Relative high-precision measurements to detect the change in gravity differences due to the Fennoscandian Postglacial Rebound (PGR) were started in 1966 on an east-west line at the latitude 63°N in Finland (Kiviniemi, 1974). In 1967 the line was extended to Sweden and Norway by Rikets Allmänna Kartverk (now Lantmäteriet, Sweden) and Norges Geografiske Oppmåling (now the Norwegian Mapping Authority). Today the Fennoscandian Land Uplift Gravity Lines consist of four east-west profiles across the PGR area, along the approximate latitudes 65°, 63°, 61°, and 56°N. Repeated relative gravity measurements have been performed on them 1975–2000 (65°N), 1966–2003 (63°N), 1976–1983 (61°N), and 1977–2003 (56°N). The work has been coordinated by the Working Group for Geodynamics (WGG) of the Nordic Geodetic Commission (NKG). The line 63°N has most observations. From the measurements along it up to 1993, Ekman and Mäkinen (1996) deduced the ratio $-0.20 \mu\text{gal}/\text{mm}$ between surface gravity change and uplift relative to the Earth's center of mass. From 2003 on, the measurements on the line 63°N are continued using absolute gravity techniques.

Absolute gravity measurements in the Fennoscandian postglacial rebound area started in 1976 when a team from Istituto di Metrologia "G. Colonnetti" (Torino) measured six stations with the rise-and-fall gravimeter IMGC (Cannizzo et al., 1978). In 1980 two stations were measured by the team of the AN SSSR from Novosibirsk, using the gravimeter GABL (Arnautov et al., 1982). From the beginning the goal was to establish reference values for future remeasurement in order to detect gravity change due to the postglacial rebound. In 1988, regular repeat measurements were started by the Finnish Geodetic Institute (FGI) with the JILAg-5. An important advance was the introduction of FG5 gravimeters into the work by BKG (Frankfurt a/M) and NOAA (Boulder, CO) in 1993.

In 2003 annual large-scale campaigns with FG5 gravimeters started, coordinated by the NKG-WGG. This was prompted by the launch of the GRACE gravity satellite, which made it important to collect a comprehensive set of ground-truth values of gravity change during the lifetime of the satellite pair. The initial participation by the gravimeter teams of Leibniz Universität Hannover, FGI and BKG has since expanded to include the University of Life Sciences (Ås, Norway) and Lantmäteriet (Gävle, Sweden). At present some 50 sites have repeated absolute measurements and most of them are co-located with continuous GPS.

We give an overview of the sites, instrumentation, and campaigns of both relative and absolute gravity work. We then compare the observed gravity change with observed vertical motion and with gravity change predicted from geophysical models of the PGR.