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Gravity change in Finland 1962-2010 from the comparison of legacy relative measurements with new measurements made with the outdoor absolute gravimeter A10

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Finland belongs to the Fennoscandian postglacial rebound (PGR) area, with vertical velocities of up to 1 cm/yr and corresponding surface gravity rates as large as –2 microgal/yr. Information about the secular gravity change in Finland comes so far from three types of observations:

(1) repeated absolute gravity measurements at a limited number of laboratory-type stations, made by various teams and instruments since 1976,
(2) repeated relative measurements on the Fennoscandian Land Uplift Gravity Lines (1966–2003). These lines in East-West direction along the approximate latitudes 61, 63 and 65 degrees N,
(3) satellite gravimetry with the GRACE (2002–).

We are now in the process of adding a fourth dataset. In 2009–10 the Finnish Geodetic Institute (FGI) together with the Institute of Geodesy and Cartography (IGiK), Warsaw, re-measured and renovated the Finnish First Order Gravity Network (FOGN), using the A10-020 outdoor absolute gravimeter of the IGiK. The FOGN originally consisted of 42 stations mostly outdoors, typically on the stairs of churches and other monumental buildings. The purpose of the FOGN (or its re-measurement) is not geodynamical research but the provision of easily-accessible reference sites for tasks of practical relative gravimetry, primarily gravity mapping for geodesy, geology and applied geophysics.

However, as the FOGN was first measured in 1962 (with a Worden gravimeter) and re-surveyed in 1988 (with two LCR gravimeters), the time span of 48 years now provides the opportunity to extract a signal of gravity change from the comparison of the three campaigns. The accuracy of the 1962 measurements is limited, but on the other hand additional data at some stations is provided by North-South traverses measured from 1966 onwards for the calibration of LCR gravimeters.

During the 2009–10 campaigns altogether 51 old and new field sites were occupied with the A10-020. At 33 of them we are now able to compare the A10-020 results with the 1962 results. In part the comparison is provisional, as the vertical gradient of gravity has not yet been measured at all sites. We discuss the experience with the A10-020 and the accuracy achieved with it. We then estimate the gravity changes, and compare them with estimates from other sources and with PGR models. The remaining vertical gradients will be measured in 2011 after which a more complete evaluation can be done.