Superconducting gravimeter and absolute gravity measurements contribute to GGOS at Metsähovi, Finland

H. Virtanen, M. Bilker-Koivula, J. Mäkinen, M. Nordman, J. Virtanen

Finnish Geodetic Institute, Finland

heikki.virtanen@fgi.fi

The superconducting gravimeter (SG) of the Finnish Geodetic Institute, GWR T020 has operated continuously at Metsähovi Fundamental station, Finland since August 1994. Depending on frequency, it is capable of detecting gravity variations as small as 10^{-11} ms^{-2}. For a single event, the detection threshold is higher, typically about 10^{-9} ms^{-2}. Due to its high sensitivity and low drift rate, the SG is eminently suitable for the study of geodynamical phenomena through their gravity signatures. The SG at Metsähovi is a part of the GGP worldwide network, which consists of 24 working stations (status 2009). The instrument has been exploited extensively in the studies of Earth Dynamics, such as long-periodic seismology, Earth tides, and loading effects due to the atmosphere, the Baltic Sea and hydrology. The data processed at FGI has been presented in several papers that concern satellite gravity with CHAMP and GRACE.

Metsähovi is a multi-technique geodetic laboratory including absolute gravity (AG), permanent GPS, GLONASS, Satellite Laser Ranging (SLR), DORIS beacon and geodetic VLBI. All these techniques are influenced by the same environmental effects as sensed by the SG. With its high sensitivity, the SG is therefore an excellent tool for testing and validating the pertinent correction models used by the other techniques.

The SG is a relative instrument, which should regularly be compared or calibrated with an absolute gravimeter for determinations of drift and to remove big offsets. Regular AG measurements have taken place at Metsähovi between 1988 and 2002 with the JILAg-5 instrument and from 2003 onwards with the FG5-221. The AG data is used to connect SG data after long data gaps. Additionally, the scale factor of the SG has been checked regularly using simultaneous observations with the absolute gravimeters.

Conversely, the SG can be used to support AG observations. For this purpose, we have compared gravity data of SG and AG between 2004 and 2008. Yearly gravity variations due to hydrological effects (mainly groundwater) at Metsähovi can be up to $8x10^{-8}$ ms^{-2}. The hydrological signal is seen in both the SG and AG data. Most of the variations in the AG data are also seen in the SG data and can therefore be attributed to the same environmental effects that have proven to explain the SG variations. Discrepancies between SG and AG data may indicate problems with one of the instruments.