Summary of observations in Metsähovi 1994 – 2001 with T020

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Extended abstract

We present a short, all-around summary of the registration of superconducting gravimeter T020 (SG) at Metsähovi station for years 1994-2001. The gravity registration started at August 10 1994. The data of 20 days have been lost totally, the longest data gap has been 11 days. Detailed results of present research activities are given below. The studies comprise full gravity spectrum from microseism to Chandlerian periods. Metsähovi is a geodetic laboratory with large number of observation programs: permanent GPS, GLONASS, satellite laser ranging, DORIS beacon, absolute gravity and seismograph station (STS-2). In addition to gravity and air-pressure, various environmental quantities have been recorded. These include e.g. groundwater level, soil moisture, properties of snow, precipitation and other weather parameters. Though the gravimeter stands on the crystalline bedrock, gravity residuals correlate with the groundwater level, as shown in Figure 1. The top panel gives refined gravity record from 1994 to 2001. All known effects on gravity have been removed except the groundwater. Lower panel gives the groundwater level with the range of 2 metres.

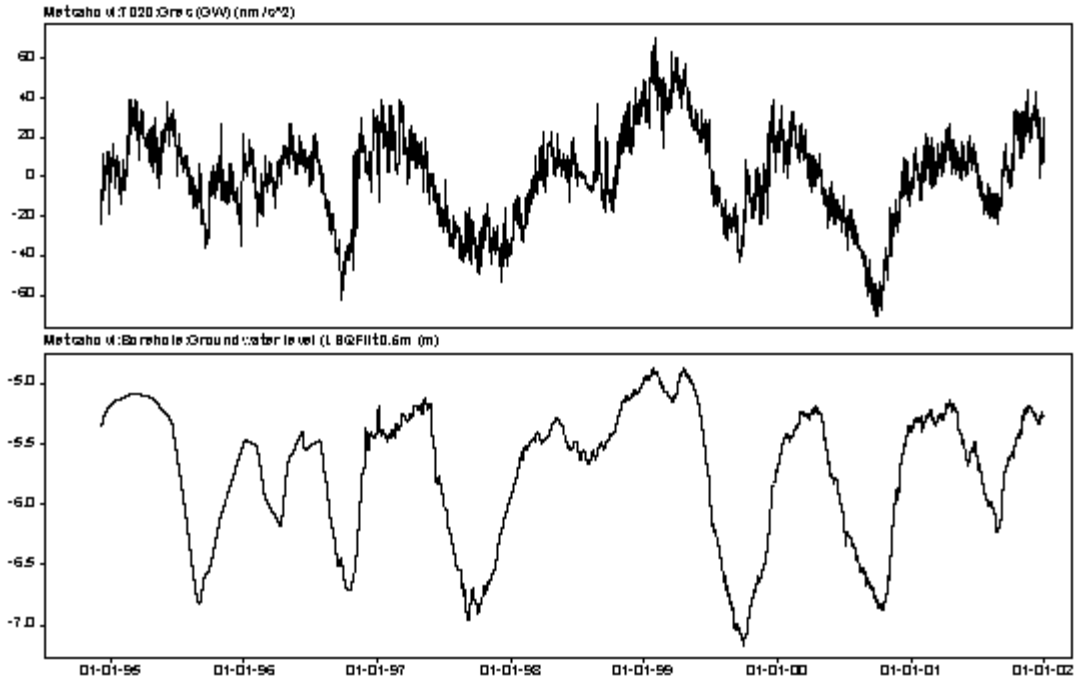

Figure 1. Top: The hourly gravity residuals from 1994 to 2001 excluding correction of groundwater (28 $ms^{-2}m^{-1}$). Bottom: The observed level of groundwater in the borehole near the gravity laboratory.

Results of some loading studies by atmosphere and by Baltic Sea are presented. To improve the correction of air-pressure, we have used regional data instead of single admittance by regression (3.10 $nms^{-2}hPa^{-1}$). For atmospheric loading calculations HIRLAM (High Resolution Limited Area Model) data (2000-2001) for North Europe were used. At the grid-points, spacing 44 km, surface pressure and temperature were given every 6 hours. The pressure field from 0.5° up to 10° was convoluted with the atmospheric load gravity Green's functions. We have applied the surface temperature and topographic corrections. Regional results were interpolated to hourly values. In the local zone (< 0.5°)

hourly local air-pressure observed at Metsähovi was used. The gravity was then corrected with calculated values, without any regression between gravity and local air-pressure.

The gravity station is about 15 km from the Baltic Sea. Metsähovi is 1000 km from the ocean, thus global ocean loading is relatively small. The tidal variation in the Baltic is of the order of centimetres only. The variation in the Baltic sea level is mostly non-tidal and driven internally by wind stress and air-pressure. The nearest tide gauge is in Helsinki at a distance of 30 km. The hourly data by several tide-gauges were available for years 2000-2001. As an example shown in the Figure 2, variation in the Baltic Sea level is directly seen in the gravity residual of the SG at Metsähovi.

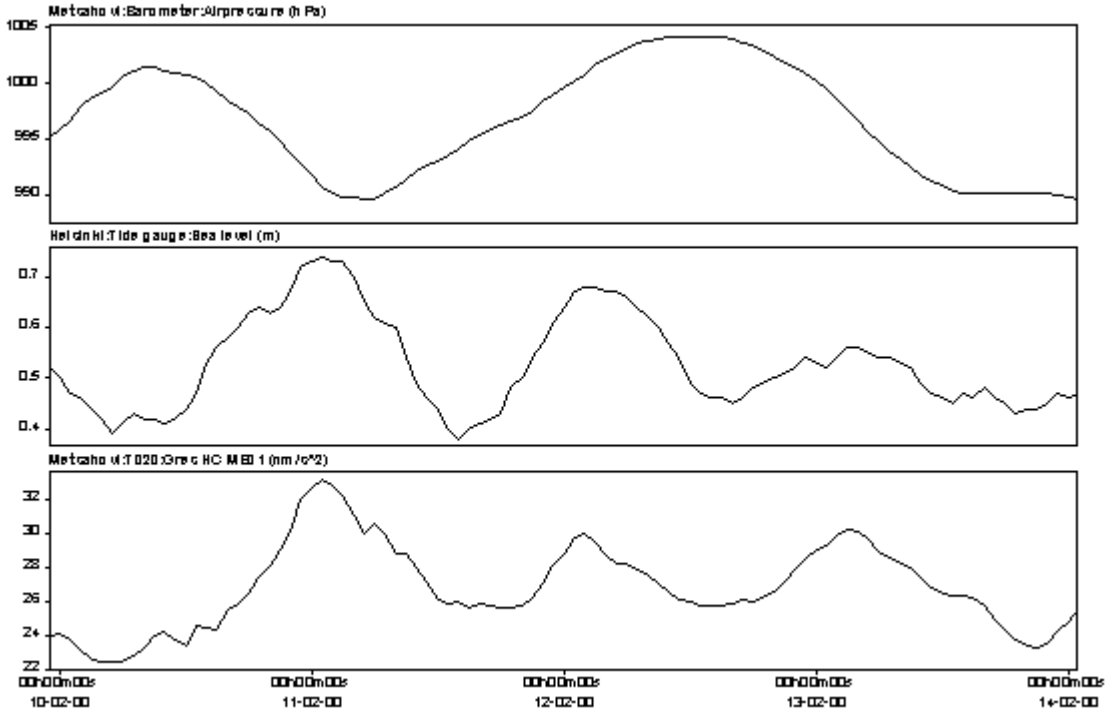

Figure 2. Top: Air-pressure at Metsähovi from 10th to 14th of February 2000 (hPa). Middle: The sea level at Helsinki (m). Bottom: The gravity residuals with HIRLAM corrected air-pressure (nms^{-2}).

Table 1. The effect of sea-level (SL) and air-pressure corrections on the gravity residuals from January 1 2000 to December 31 2001.

	RMS nms^{-2}	Regression $nms^{-2}m^{-1}$	Correlation	Reduction
Gres (Single 3.10)	9.2			0 %
Gres (HIRLAM)	9.5			-3 %
Gres (Single 3.10)/SL	7.9	21.6	0.51	+14 %
Gres (HIRLAM)/SL	7.4	27.6	0.63	+19 %

The standard atmospheric correction to gravity, using coefficient(s) obtained by regression from the local barometer, partly includes the effect of sea level. Independent atmospheric corrections using the pressure field from HIRLAM bring better out the loading effect of Baltic Sea level. The combination of HIRLAM for atmosphere and local tide gauge data for sea level reduces the gravity residual by 19%, compared with just a single admittance for local air pressure, as presented in Table 1.