Relative gravimeter calibration system for high accurate applications

Ludger Timmen[1], Manuel Schilling[1], Reinhard Falk[2], Alexander Lothhammer[2], Gerald Gabriel[3], Detlef Vogel[3]

[1] Leibniz Universität Hannover, [2] Federal Agency for Cartography and Geodesy, [3] Leibniz Institute for Applied Geophysics

Motivation: best possible scale definition for relative gravimeters

With state-of-the-art instruments and well controlled calibration lines (for long-term stability):

➡ Gravimeter calibration accuracy of 1×10^{-4} is a realistic objective

(e.g., gravity range Δg = 100 µm/s² → 10 nm/s² systematic error only)

Potential error sources have to be mastered:

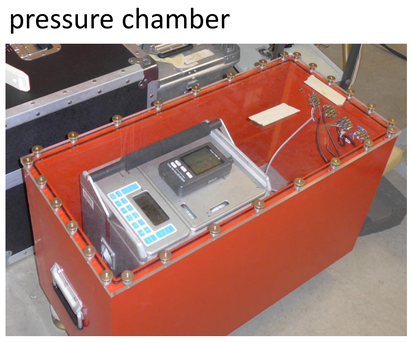
- Measuring uncertainty of relative gravimeters
- Scale accuracy as defined by absolute measurements in the Harz Mountains
- Temporal variation of the reference g-values of the calibration system
- Uncertainties of the vertical gravity gradients above the marked calibration points
- Instrumental air pressure effect of relative gravimeters due to insufficient or damaged sealing of the sensor housing
- Temporal instability of the electronic measuring and nulling system (feedback system) of the gravimeters

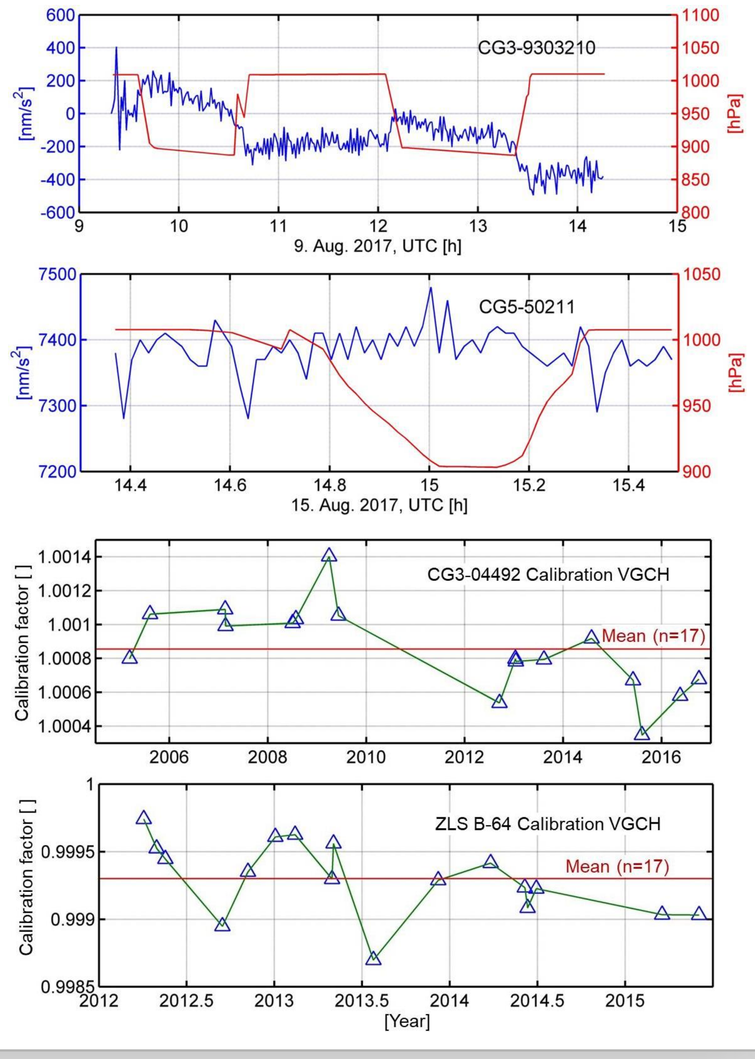
Absolute gravimetry on the Harz Calibration Line in 1986/87 and 2013

Absolute Points	δg/δh [µm/s²/m]	g(IfE, JILAg-3) [µm/s²]		g(BKG, A10-033) [µm/s²]		Δg [µm/s²]	Mittel [µm/s²]
Bad Harzburg 481	2.951	04/86 05/87	9811652.857	13.06.2013 09.09.2013	9811652.875	−0.018	9811652.866
Torfhaus 563	3.144	05/87	9810800.472	13.06.2013 17.06.2013	9810800.425	+0.047	9810800.448
Kriegsgräber 571	3.178	05/87	9810721.051	12.06.2013 17.06.2013	9810721.070	−0.019	9810721.060

Instrumental airpressure effect and feedback instablities

Testing pressure sealing of gravimeters in a pressure chamber



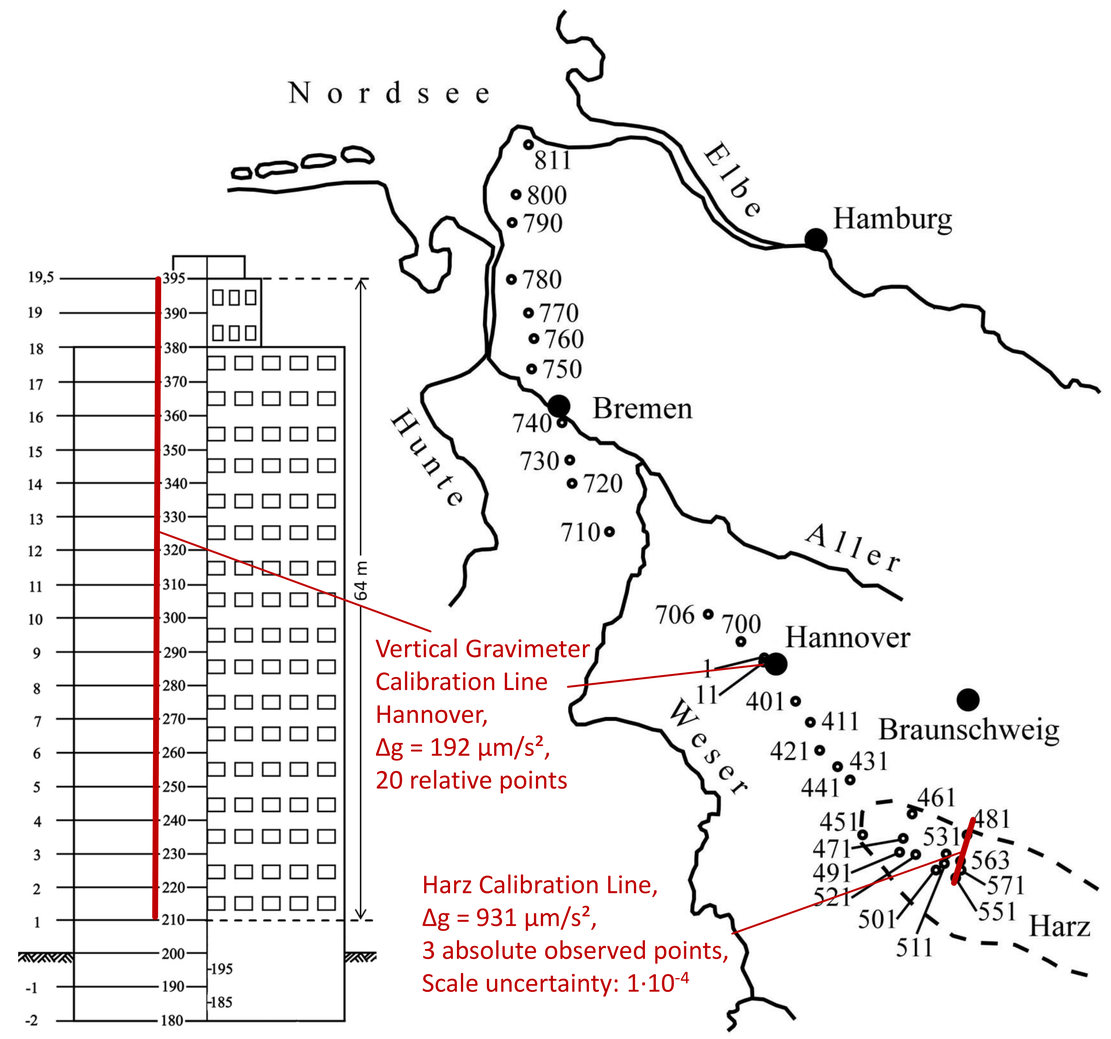


Calibration factors determined in the Gravimeter Calibration System Hannover for two gravimeters

- Scintrex CG3-04492
- ZLS Burris B-64

varying by 1×10^{-3} maximum

Gravimeter Calibration System Hannover



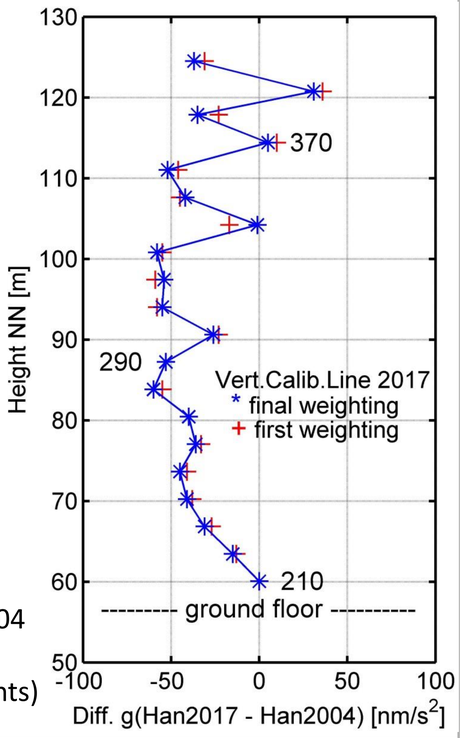
The Gravimeter Calibration System Hannover with its two most important parts (in "red"):

- Vertical Gravimeter Calibration Line Hannover (VGCH, 20-storey building, no absolute observations, indoor)
- Harz Calibration Line (3 absolute gravimetric points, outdoor)

Upgrade 2017 versus Solution 2004

- g-values for 3 absolute points of the Harz Calibration Line with s=50 nm/s² introduced („soft datum concept")
- Scale transfer from Harz to VGCH by 7 gravimeters with contemporary measurements in Harz/VGCH
- Controlled weighting to avoid dominance of a single instrument for scale transfer
- Additional 8 gravimeters for point densification in the VGCH („estimation of variance components")
- All g-values in the VGCH are defined at 0.250 m above floor (appr. sensor height)
- No points below 1st floor considered to avoid groundwater impacts on scale definition
- Only points along one vertical line considered
- Scale accuracy of Harz and Hannover lines: 2×10^{-4} expanded uncertainty (95% confidence)
- Main Δg-connection 210-370 in the VGCH obtained with s=11 nm/s² (1st to 17th floor, lift connection)
- No significant scale change for the base connections in VGCH (210-370) and Harz Calibration Line

Comparison of g-results of Upgrade 2017 with Solution 2004 of VGCH (first gravimeter weighting with estimation of variance components, final weighting with controlled weights)



References

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