Relative gravimeter calibration

Using absolute gravimetry for site by site recording of temporal gravity variations is the most common method to calibrate stationary relative gravimeters, specifically superconducting gravimeters (SG). This method is based on the assumption that both sensors record the same gravity signal. Actually, this condition is never perfectly fulfilled, even not when absolute gravimeters are involved. The main reasons are instrumental effects like drift. The situation dramatically gets worth when spring gravimeters are applied as reference due to their large and irregular drift behavior. Therefore it is necessary to investigate how drift related systematic errors can be reduced effectively.

The SG GWR C025 at theConrad Observatory is regularly calibrated by site by site observations with FG5 absolute gravimeters (AG). An observation period of at least seven days is required to achieve reliable results (Francis and Van Dam 2002). However, even in case of long registration intervals, the result is systematically distorted by unmodeled drift (e.g. Meurers 2002). Adjusting an appropriate drift model for the AG measurements is required (Fig. 1). Otherwise the resulting calibration factor converges to wrong numbers.

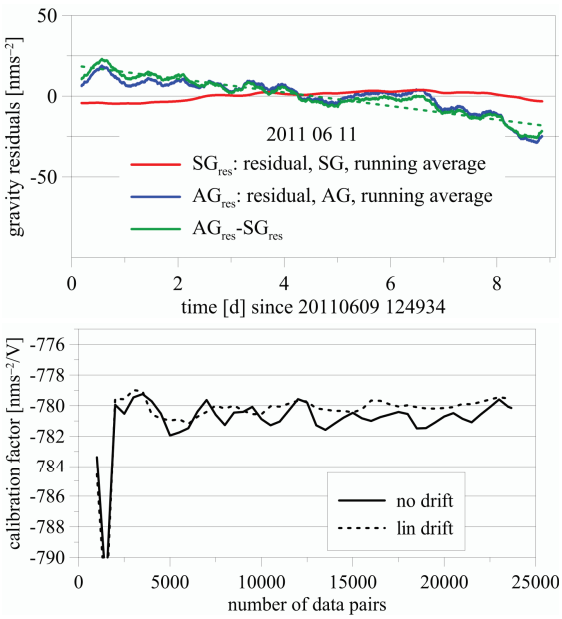

Figure 1: Determination of the SG calibration factor by co-located gravity observation using FG5-242. Top: running average of gravity residuals (red: SG, blue: AG, green: difference). Bottom: Dependency of the calibration factor on the number of used data pairs and on the applied drift model.
1st or 2nd order drift polynomials are sufficient for AGs, while spring gravimeters like a Scintrex CG-5 needs polynomial degree of 8 or even higher to successfully get rid of the drift problem. The correct degree has to be selected based on statistical analyses. Fig. 2 shows the calibration results achieved so far by using FG5 or JILA-g type AGs and a Scintrex CG-5, which has been precisely calibrated on the Austrian HCL vertical calibration line. With except of the first two CG-5 experiments all factors plot within the 1‰ error range which is the minimum requirement for modern tidal research.

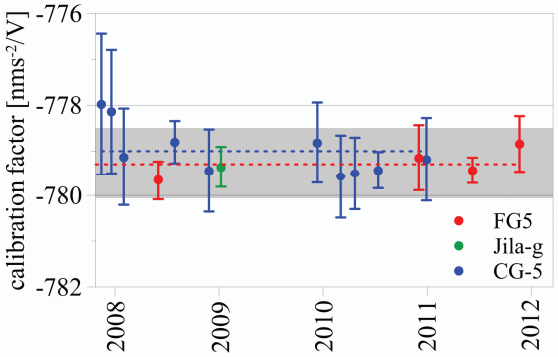

Figure 2: SG-calibration results achieved at Conrad Observatory using different types of gravimeters.

References:

Francis, O. and Van Dam, T. 2002. Evaluation of the precision of using absolute gravimeters to calibrate superconducting gravimeters, *Metrologia*, 39, 485–488.
Meurers, B. 2002. Aspects of gravimeter calibration by time domain comparison of gravity records, *Bull. d'Inform. Marèes Terrestres,* 135, 10643–10650.

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