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A new superconducting gravimeter station in Central Europe: the iGrav-027 at the Borowa Gora Geodetic-Geophysical Observatory – installation and first results

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Abstract: The gravimetric infrastructure of the Borowa Gora Geodetic-Geophysical Observatory of the Institute of Geodesy and Cartography, Warsaw, Poland, equipped so far with four LaCoste&Romberg model G gravimeters (3 of them with modern feedback systems) and the A10-020 field absolute gravimeter was enhanced in 2016 with a new iGrav-027 superconducting gravimeter. The iGrav-027 field gravimeter was delivered to the Observatory at the beginning of February 2016 and became fully operational late April 2016.
The paper describes major aspects of the installation of the instrument as well as some technical issues faced during its installation. It also presents results of the initial analysis of data collected during the first month of operation of the instrument. The iGrav-027 records have been compared with 2.5 day simultaneous records of the A10-020 gravimeter, as well as with data obtained from three LaCoste&Romberg gravimeters which are used at the Borowa Gora Observatory for acquiring tidal records. Initial analysis also includes the first attempt to determine the scale factor (part of the transfer function) for the iGrav-027 superconducting gravimeter.

Keywords: superconducting gravimeter, gravity variation, gravimetry

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1. Introduction

The first operational commercial superconducting gravimeters (SG) – model TT – were installed in Europe in the early 1980s in the Royal Observatory of Belgium (ROB) and the Institut für Angewandte Geodäsie (IfAG). Yet they required regular helium refill procedures which corrupted the collected gravity signal. Improvement in the development of the instruments, especially in terms of the cold-head cooling power, allowed the instruments to work for much longer periods of time. By the mid 1990s a significant number of instruments were distributed to scientific institutions around the world (Hinderer et al., 2015). On 1 July 1997 the Global Geodynamic Project (GGP) was initiated in order to use the global network of SG for scientific research. Within the GGP, until 2016, more than 30 SG instruments were the main contributors to the analysis of gravity variations (Crossley and Hinderer, 2009a; Crossley and Hinderer, 2009b). In 2016 it was decided that GGP should be terminated and its programme should be continued within the International Geodynamics and Earth Tide Service (IGETS). Over the years the SG gravimeters were also substantial contributors to the control of the gravimetric reference in absolute gravimeters, especially in comparison campaigns of absolute gravimeters. On the other hand, the SG data became an important tool for the validation of satellite gravity missions (Abe et al., 2012).

Over the 40 years since it was first developed, the SG has proved to be an extremely reliable instrument for determining gravity variations from 1 s periods to several years. Numerous SG instruments have operated for more than a decade without interruption. New possibilities exist for the research employing the use of SGs in hydrology, metrology, tectonics, and monitoring volcanoes as well as geothermal applications.

Further instrumental development allowed the size (and cost) of the instrument to be reduced. It resulted in developing the iGrav SG which proved to be as reliable as any other SG instrument developed before (Warburton et al., 2010). This paper describes the aspects of the installation of the iGrav-027 at the Borowa Gora Geodetic-Geophysical Observatory, located 50 km north of Warsaw, Poland. It is the first superconducting gravimeter in Poland. It allows the team of the Institute of Geodesy and Cartography, Warsaw, to undertake a wide range of tasks (mainly scientific) at a new, high quality level. The instrument will be employed for studies concerning geodynamics, hydrology, seismology as well as gravimetric metrology. The instrument is believed to be also a valuable tool to control the national gravity standard.

2. The superconducting gravimeter

The sensor of the majority of relative gravimeters is a test mass suspended on a spring. It is attached to the instrument chassis with a complicated mechanical system of levers. Due to the gravity change any movement of the test mass generates an electric signal (instruments with electronic feedback systems) which can be measured and recorded. The main disadvantage of spring relative gravimeters is the drift caused by thermal conditions and humidity (Palinkas, 2006) affecting the spring as well as other mechanical parts. Although the drift is minimized by providing very good thermal insulation, it still remains significant, unpredictable and ultimately very difficult to remove in post-processing.

The superconducting gravimeter (SG) solves the problem of non-linear drift by replacing the mechanical spring with the levitation of the test mass using magnetic suspension. This would not be anything special as the magnetic field could show drift too, indirectly induced by the impact of temperature and humidity on the electronic circuits. This is, however, where the superconductivity comes in providing a highly stable "spring" with minimal linear drift.

2.1. Construction and principles of operation

The major elements of the SG sensor are the levitated mass (sphere), the field coils, and the magnetic shield. The system is complemented by a displacement transducer, formed by a capacitance bridge that surrounds the sphere (Fig. 1) (Hinderer et al., 2015).

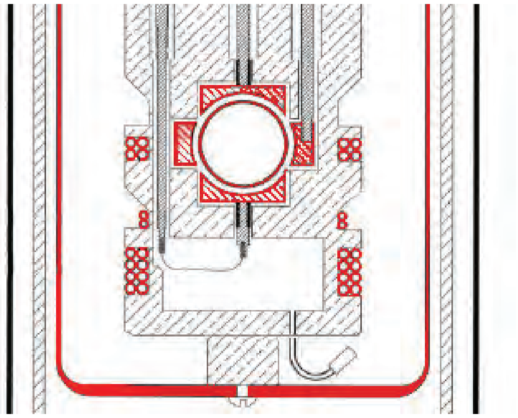

Fig. 1. The SG sensor (Hinderer et al., 2015)

The magnetic field is generated by two niobium wire coils (superconducting below a temperature of 9.2 K). Its stability depends on the zero resistance property of superconductors – after the currents are "trapped" they remain constant as no resistive losses are present. In the superconducting gravimeter iGrav the test mass is a small 2.54 cm diameter niobium sphere, which weighs about 5 grams. When current is trapped in the coils, perfectly stable currents are induced also on the sphere surface forcing it to levitation.

The current in the SG coils can be precisely adjusted to balance the gravity on the sphere at the centre of the displacement transducer. For the iGrav instrument these currents are set by the manufacturer during production and testing process. The ratio of currents in upper and lower coils is adjusted so that the magnetic force gradient (spring constant) is very weak. As a result, a very small change in gravity gives a large displacement of the test mass. This allows the instrument to achieve very high sensitivity.

Because the levitation is magnetic, changes in the Earth's magnetic field would seriously degrade its stability. A magnetic shield is used to isolate the space with the sensor from the geomagnetic field. To maintain superconductivity, the SG sensor operates in a bath of liquid helium at 4 K, inside a highly efficient vacuum-insulated dewar. The low temperature is maintained by an active cooling system consisting of the coldhead and the compressor.

2.2. Expected instrumental performance of the iGrav

At cryogenic temperatures all materials are very stable. Thus it is possible to keep the sensor at temperature stable within a few µK which ensures the iGrav stability within the specifications. Therefore, material "creep" and sensitivity to local temperature and humidity changes are totally eliminated (Hinderer et al., 2015). The sensor operating in such stable conditions ensures substantial reduction of instrumental impact on the observed gravity signal.

The low temperature in the iGrav is maintained by an active cooling system, so called cryo-cooler, allowing long term stable operation of the instrument with no loss of liquid helium. Thanks to that the iGrav can operate using only 16 liters of liquid helium. The two basic parts of the cryo-cooler are the coldhead (installed in the instrument) and the compressor (located apart) responsible for the coldhead operation.

According to the manufacturer (GWR, 2014), the expected parameters of the iGrav gravimeter are as follows:

- noise: 3 nm/s^2/Hz^{½}
  - precision in the frequency domain: sub-nGal (<10^{-2} nm/s^2);
  - precision in the time domain: 1 to 3 nm/s^2, one minute filtering;
- drift: less than 5 nm/s^2/month;
- scale factor: stable to better than one part in 10^4 for decades;
- linearity: linear to one part in 10^7.

3. Installation of the iGrav-027

3.1. The gravimetric laboratory

The iGrav-027 is the first superconducting gravimeter operating in Poland. It was installed in February/March of 2016 at the Borowa Gora Geodetic-Geophysical Observatory, situated 50 km north of Warsaw, and has been operational since the end of April 2016. Figure 2 shows the location of the Borowa Gora Observatory with respect to the nearest observatories equipped with superconducting gravimeters.

The iGrav-027 is located in a specially prepared chamber in the basement of one of the Observatory

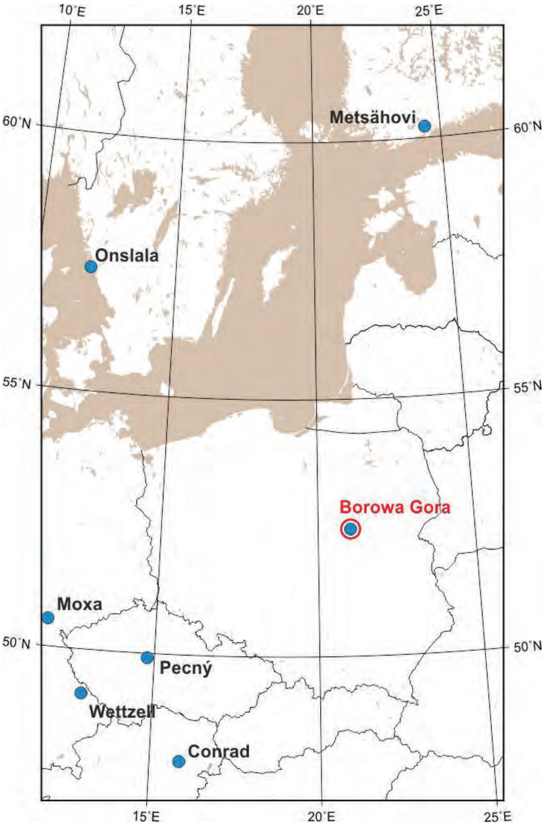

Fig. 2. Borowa Gora Observatory and the location of other SGs

buildings. It is separated from the compressor (part of the cryo-cooler system) operating in a separate room. The location of the gravimeter ensures a relatively stable temperature of 21°C ± 2°C throughout the year. The instrument is placed on a specially prepared concrete monument of 1.2 × 1.2 m horizontal and 1.5 m vertical dimensions (ca 1.3 m deep below floor level). The sensor of the instrument is located about 2 m below ground level, and the position and height of the instrument was determined to an accuracy of within a centimetre, before the installation.

The iGrav-027 is co-located in the same building with the A10-020 absolute gravimeter (Fig. 3). There are three well monumented pillars for absolute gravity determinations, which can be conducted along with the operating iGrav-027 (e.g. for the comparison with absolute gravimeters). The fully operational iGrav instrument together with the A10-020 gravimeter (participating in comparisons of absolute gravimeters) fulfills the basic requirements to become an important part of the currently ongoing redefinition of the global absolute gravity reference system.

3.2. Installation issues

The iGrav-027 superconducting gravimeter was delivered to the Borowa Gora Observatory in early February 2016 and its installation started in mid-February. During the initial filling up with helium gas, a leakage of helium was detected. In the course of finding the leak, the instrument had to be partially disassembled. The dewar head cover was removed and all parts of the gravimeter were thoroughly checked (Fig. 4). The cooling-down process was initiated after finding and fixing the leak. After successful He liquefaction up to 60% and the initialization of the sensor, additional unexpected issues occurred. Further liquefaction stopped due to the inability of the cryo-cooler to cool down the helium below 5 K. After more than one week the problem was diagnosed as a thermo-acoustic phenomenon called Taconis oscillations. These oscillations occur spontaneously at cryogenic temperatures. They pump energy making it impossible to cool the system down to the required temperature close to 4 K. The first solution tested was to attach a small cylinder, called a Taconis bottle, to the iGrav system (Fig. 5). As this solution was unsuccessful, the system hardware was reset and cleaned and then the whole installation procedure was repeated.

Fig. 3. Location of the iGrav-027 in the gravimetric laboratory building

The system was heated up to room temperature which took more than two weeks. Then, the instrument was inverted in order to remove any residual water ice and water from it. In addition, air at room temperature was blown into the instrument (Fig. 6). This procedure lasted for another few days.

The next step was to check and possibly improve the vacuum in the dewar. This was done with the use of a turbo pump which is a standard piece of equipment of the A10-020 absolute gravimeter. The vacuum refreshment was carried out overnight to assure the best possible vacuum level (Fig. 7).

The final step was to perform the cooling-down process again but this time with a larger 2 gallon Taconis bottle, permanently attached to the system. This was the solution tested and verified by the manufacturer on a similar system setup in the gravimeter manufacturer premises in San Diego. The cooling-down started on 15 April and near 100% of the required amount of liquid helium was achieved near the end of April 2016.

The final operational configuration (Fig. 8) assumes that the 2 gallon Taconis bottle will be permanently attached to the system to prevent Taconis oscillations from causing any more issues in the event of power failure at the Observatory.

4. Transfer function of the iGrav-027 sensor

In order to properly use the SG gravity record a transfer function must be determined. The transfer function contains the instrumental phase lag and the scale factor. For the group of the iGrav instruments the manufacturer suggests using the value of phase lag of 5.79 s (personal information, D. Crossley, 2016) for periods longer than 300 s. For periods shorter than 300 s the frequency response requires specific methods of phase lag determination (Warburton et al., 2010).

As the raw iGrav readout is given in volts a careful sensor calibration (scale factor determination) is needed. The initial calibration of the iGrav-027 sensor was carried out from 4 to 7 May 2016, within the period of the timewise nearest highest amplitude of tidal curve (Fig. 9).

There are various methods of testing SG gravimeters and determining their scale factor. They may employ absolute gravimeters (AG), relative

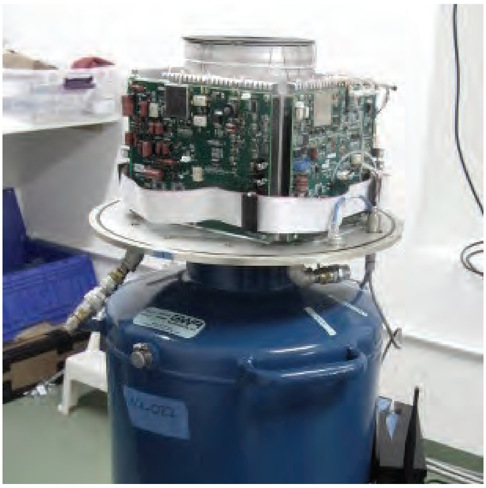

Fig. 4. Removal of the dewar head cover

Fig. 5. Approach to solve the issue of Taconis oscillations

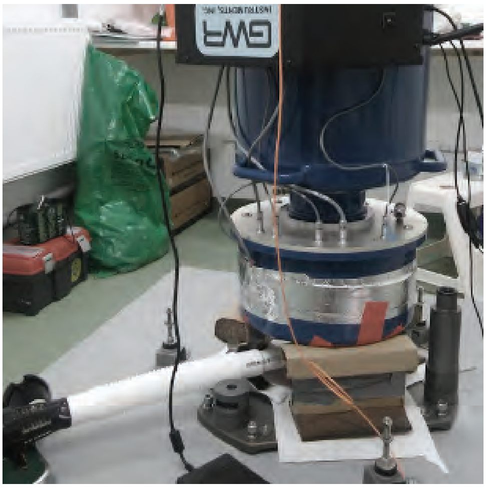

Fig. 6. Blowing out the remaining water and water ice

Fig. 7. Pumping the dewar vacuum insulation

Fig. 8. The iGrav-027 final setup

gravimeters (RG), and Earth tide models, with data processing using a least squares adjustment model (Meurers, 2012; Van Camp et al., 2016). The main issue with the calibration of an SG sensor is that it is far more precise than any instrument that can be used to calibrate it. In this study three methods were tested in order to perform the first evaluation of the iGrav-027 scale factor.

When applying method #1, 2.5 day co-located relative gravimeter records from three LCR gravimeters equipped with feedback systems were used. Two LCR instruments (G1012 and G1084) are calibrated at least once a year on a calibration gravimetric baseline of spans from 40 to 80 mGal. The scale factor determined on the calibration baseline for both instruments is at the level of 0.05%. The third LCR gravimeter (G1036), used for long-term recording of the tidal signal, also undergoes scale factor determination by means of co-located gravity measurements with two other gravimeters (Dykowski, 2012).

The main disadvantage of this method is the non-linear drift of the LCR instruments, which is difficult to evaluate. Any evaluation of the drift must be done with caution. On the other hand, the main advantage is the high sampling rate of the LCR records compared to AG records. It ensures high redundancy which theoretically improves the quality of an estimate using the least squares adjustment. The other advantage is the high precision of the LCR records. Yet one needs to have in mind that the least squares adjustment is sensitive to the number of data pairs, which might result in underestimation of the adjustment error.

For the scale factor determination of the iGrav-027, the LCR and iGrav data were resampled into 1 minute time series; the residual drift from both records was eliminated with a 3rd degree polynomial fitted into the time series of differences between gravity values obtained with the A10 gravimeter and corresponding ones from LCR and iGrav records. Correlation between all LCR gravimeters and iGrav data is presented in Figure 10. Scale factor values as well as associated accuracies are presented in Table 1. Scale factors determined with all three LCR gravimeters show good consistency at the level of 0.7%. Scale factors determined for the iGrav using the G1036 and G1084 records agree at the level of 0.1% (the G1012 instrument has larger

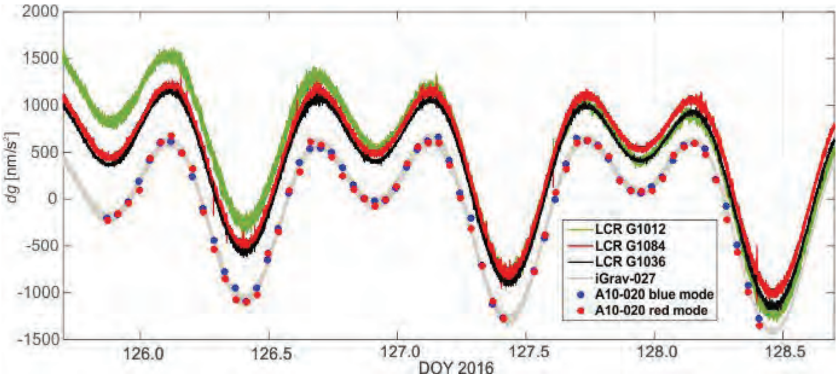

Fig. 9. Raw data from all relative gravimeters and the A10-020 absolute gravimeter used for calibration of the iGrav-027

scatter than the remaining two LCRs). The scale factor errors show very satisfying results with values below 0.1%, which is a recently suggested standard of accuracy for SG instruments (Van Camp et al., 2016).

When applying method #2 the measurements with the A10-020 absolute gravimeter were co-located with the iGrav-027 record. The main disadvantage of the method is the low precision of single set determinations, hence the calibration process requires a long measuring session up to one week (Van Camp et al., 2016) which further reduces the lifetime of absolute gravimeter mechanics, especially due to the high sampling rate required for the calibration. On the other hand, the main advantage is that the AG gives a reliable absolute, driftless reference for the calibration process.

The A10-020 gravimeter data consisted of pairs of so called 'red and blue' sets with 120 drops per set (measurements in two different laser frequencies) taken every hour. No corrections were applied to the gravity values obtained with the A10-020 gravimeter to make them consistent with the iGrav-027 record. The iGrav-027 drift was removed using a 3rd degree polynomial fitted to the time series of the differences between the iGrav-027 record and the corresponding gravity values obtained with the A10-020 within the 2.5 day session in the first month of operation of the iGrav-027. For gravity values obtained for red and blue sets as well as for their average, corresponding iGrav gravity values were calculated. No test of calibrating the iGrav-027 with the use of single A10-020 drops was performed since typical drop scatter of the A10 gravimeter, at the level of 400-500 nm/s^2, was considered too large. Correlation of the A10-020 and iGrav-027 data is shown in Figure 11. Scale factor values calculated for the A10-020 blue mode, red mode and their average as well as associated accuracies are presented in Table 1. Scale factor determined separately for red and blue modes show significant discrepancies, therefore only their average will be considered. Scale factors determined for the blue/red mode average show the agreement with the LCR determinations from 0.5 to 1.2%. The scale factor errors show good results with values around 0.7%.

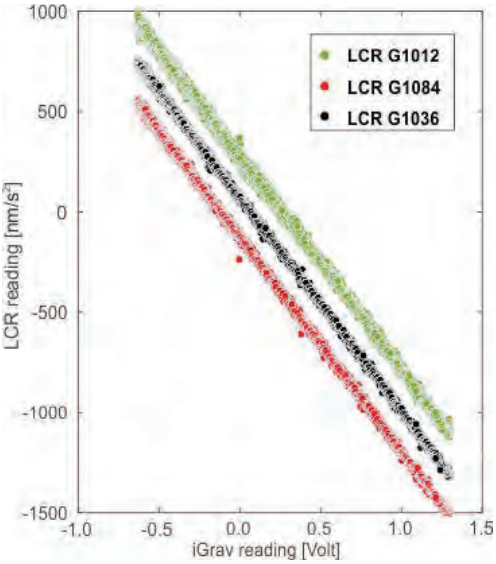

Fig. 10. Correlation between LCR and iGrav data

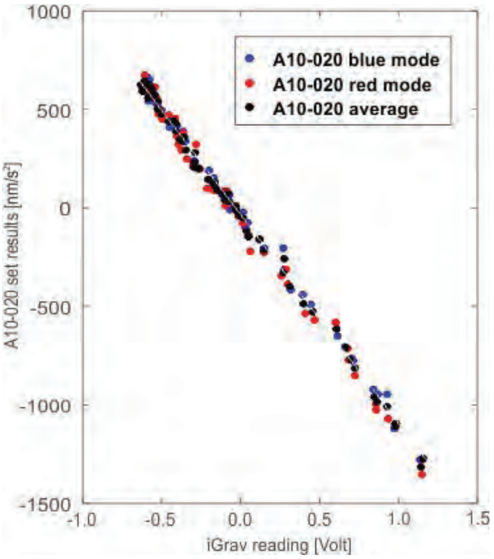

Fig. 11. Correlation of the A10-020 and iGrav data

Method #3 of calibration which was applied considered the use of the local tidal model (wave group frequency range from 0.7 to 3.9 cpd) based on 2 year LCR tidal records (Dykowski and Sekowski, 2014) to perform the tidal adjustment procedure. The main advantage of the use of the tidal model is that the reference data are essentially noiseless. Together with the high precision of SG results it can provide a very small error of the scale

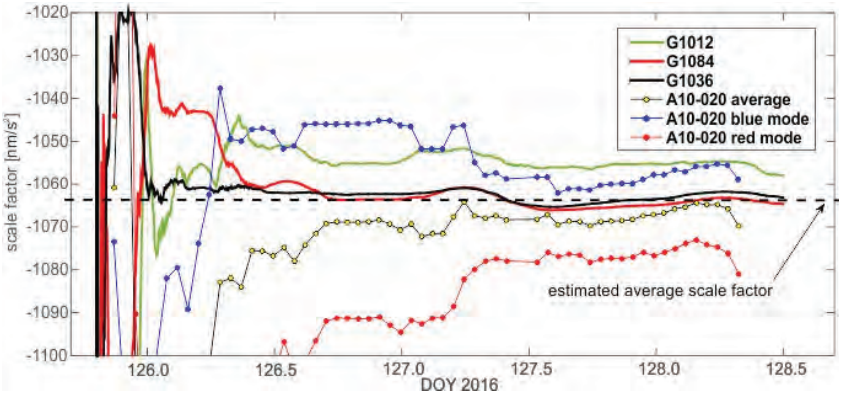

Fig. 12. Scale factor determination with the data of all gravimeters as a function of time

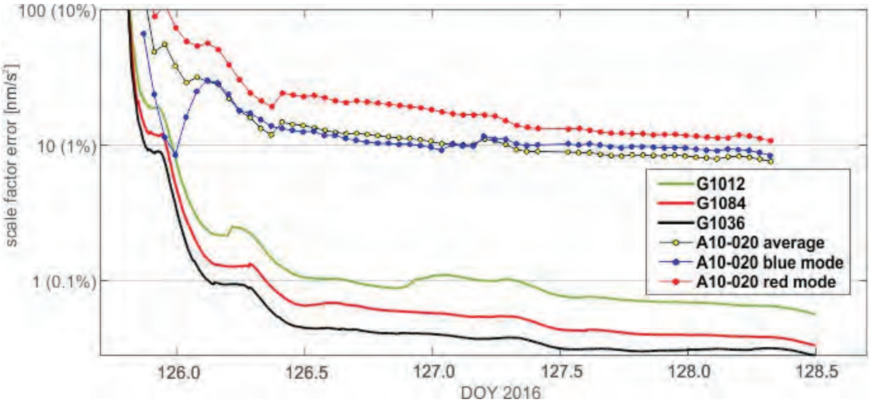

Fig. 13. Errors of scale factor determination with the data of all gravimeters as a function of time

factor determined. Yet the disadvantage is that the tide model does not consider other gravity variations (atmospheric, hydrological loading) within the calibration period. Thus its use for the determination of the calibration factor maybe biased. The results of the calibration with the use of the tidal model were thus not included in the final evaluation of the scale factor.

All calibrations were performed with the most common methodology via linear least squares fit. The scale factor k and its error m_k were determined and are presented as a function of time in Figures 12 and 13, respectively. The error of the scale factor of the iGrav-027 determined using the A10-020 data is visibly larger than the errors obtained using LCR data, yet consistent with the accuracies previously achieved to scale LCR gravimeters (Dykowski, 2012). The precision level of calibrations performed with LCR gravimeters is below 0.1% and is within the expectations for scale factor determination for superconducting gravimeters (Van Camp et al., 2016). Figure 13 presents the stabilization of the scale factor determination error for calibration methods with the use of LCR and A10 data, as a function of the length of the calibration period. For calibrations with LCR data the desired error of 0.1% is already achieved after one day and keeps decreasing after that. The final scale factor value of -1063.84 ± 4.87 nm/s²/V (0.46%) elected to be used was calculated as the average of scale factors determined with LCR and A10 data. Nonetheless, as the calibrations were performed in the initial phase of the iGrav-027 operation, further calibrations need to be conducted on a regular basis to evaluate the scale factor to the best possible level.

A summary of scale factor determinations as well as coefficients of correlation between LCR and iGrav-027 data as well as A10-020 and iGrav-027 data are presented in Table 1.

In all cases examined the correlation coefficient is very close to –1 which proves the very good consistency of compared datasets. The coefficient of correlation between LCR and iGrav-027 data is slightly closer to –1, compared to the coefficient of correlation between the A10-020 and iGrav-027 data, which indicates the usefulness of spring gravimeters for the determination of the scale factor of superconducting gravimeters.

Table 1. Summary of scale factor determinations by various methods

	Scale factor *k* [nm/s^2/V]	Scale factor error m_k [nm/s^2/V]	Scale factor error m_k [%]	Correlation coefficient
A10 avg	**–1069.74**	7.62	0.71	–0.9985
A10 blue	–1058.85	8.42	0.80	–0.9982
A10 red	–1080.94	10.81	1.00	–0.9971
G1036	**–1063.13**	0.28	0.03	–0.9999
G1012	**–1057.91**	0.56	0.05	–0.9994
G1084	**–1064.58**	0.33	0.03	–0.9998
Local tide	–1051.75	0.20	0.02	–0.9999
Mean	–1063.84	4.87	0.46	

5. Initial results

The first reliable gravity records were collected with the iGrav-027 in May 2016. Although data had to be corrected for gaps and jumps due to the still ongoing maintenance and fine tuning of the instrument, they were consistent enough for the initial analysis. The data were elaborated with the use of the software package for the analysis of the Time Series and Earth Tides TSoft (Van Camp and Vauterin, 2005). Raw gravity records were corrected for the Earth tides using a Tamura potential catalogue (Tamura, 1987), ocean loading (FES04) and barometric pressure with a standard −3.0 nm/s^2/hPa coefficient. Figure 14 presents raw residuals with the fitted two term exponential decay drift curve. The exponential decay function indicates that the instrument will reach linear drift smaller than 5 nm/s^2/month (expected parameter) by around day 50 of its operation. Yet the true drift elimination/evaluation will be better after at least one year of operation of the gravimeter. Such time is required

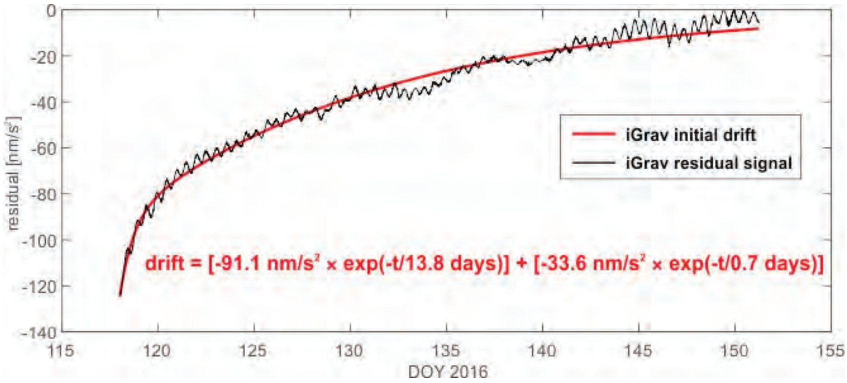

Fig. 14. Raw residual signal from the iGrav-027 with the drift fit using a two term exponential decay curve

for the initial evaluation of the local phenomena detected by the instrument. The exponential drift is the expected behaviour of the gravimeter tending to reach an internal thermal equilibrium after the initial setting.

Figure 15 presents the residuals of the iGrav-027 for the first month of its operation with the drift eliminated using a two term exponential decay function mentioned above. They contain a strong tidal term of 10 nm/s^2 peak to peak. The figure also shows absolute gravity determinations taken with the A10-020 absolute gravimeter, during the presented period. Both, A10 and iGrav results were corrected for the same phenomena (Earth tides/Ocean Tidal Loading/Atmospheric/Polar motion). Taking into account estimated uncertainty levels of the A10-020, at 40–50 nm/s^2 for laboratory stations (Dykowski et al., 2014), the results from the absolute gravimeter can be considered satisfactory. Gravity determinations with the A10-020 absolute gravimeter are consistent with iGrav residual gravity records to within 20 nm/s^2 which at least for the initial period shows better consistency of A10-020 results than expected.

Figure 16 presents the Power Spectral Density (PSD) (calculated with TSoft) from all relative gravimeters at Borowa Gora (iGrav-027 and 3 LCR G gravimeters) for the first 10 days of May 2016. The PSD was calculated after removing Earth tides, ocean loading, and residual drift on 1 second sampled raw data. It was smoothed with the 11 point moving window. Additionally a New Low Noise Model – NLNM (Peterson, 1993) is also presented in Figure 16. As expected, the PSD of the iGrav instrument stands out with the lower noise level by a few orders of magnitude than any

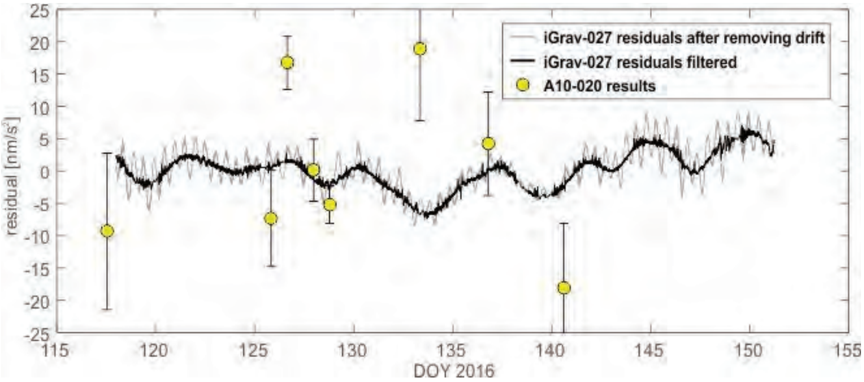

Fig. 15. Filtered residual signal with exponential drift removed

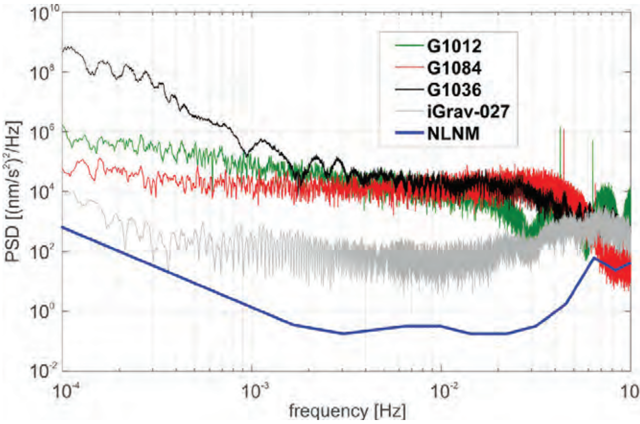

Fig. 16. Power Spectral Density (PSD) of all tide recording gravimeters at Borowa Gora (1–9 May 2016)

of the LCR gravimeters, especially in the seismic band from 1 to 10 mHz. Detailed comparisons with the NLNM to give a reasonable result should be performed with the use of data from a selected calm period of registration.

Further data analysis proved that the iGrav-027 meets its desired specification after filtering with a filtered signal (least squares bandpass filter, lower cutoff frequency: 0.167 mHz; higher cutoff frequency: 8.33 mHz; and windows size of 3001 terms) of peak to peak better than 2 nm/s^2 (in calm periods below 0.5 nm/s^2) and noise level in calm periods below 10 [(nm/s^2)^2/Hz] in the frequency range from 1 to 10 mHz.

6. Summary, conclusions and outlooks

The installation of the iGrav-027 – the first superconducting gravimeter in Poland – has been completed successfully. The gravimeter is currently located at the Borowa Gora Geodetic-Geophysical Observatory. Although some issues occurred during its installation, they have been successfully resolved and the instrument is fully operational. Within the first month of operation the iGrav-027 reached required noise level specifications and is expected to fulfil the low and linear drift expectations in the near future.

In order to properly assess the gravity signal from the instrument and evaluate its long term stability, further scale factor determinations will be undertaken with the use of various possible methods. The methods presented in this study for the initial scale factor determination show promising consistency yet are still not consistent enough among all methods to clearly fulfil the required accuracy of 0.1% for SG calibration (Van Camp et al., 2016). The iGrav-027 records co-located with LCR records showed especially promising results concerning the determination of the scale factor error (below 0.1%) as well as mutual agreement of the instrument records (below 0.7%). This approach requires further investigation.

The seismicity in the location of gravimeters needs to be evaluated for a future selection of a quiet period that will allow a reliable comparison of the PSD for the iGrav and LCR gravimeters with the NLNM. The first PSD analysis simply proved the superiority of the sensitivity of the iGrav-027 over LCR gravimeters.

The signal collected within the first month of operation of the iGrav-027 showed its precision below the level of 1 nm/s^2 which allows the collection of the highest quality tidal signal in the area of Poland.

As the instrument is fully operational and the complete tidal signal is being collected, future plans for its use can be drawn up. Several studies on, for example geodynamics, hydrology, seismology as well as gravimetric metrology can be considered. The new instrument can be a valuable tool for controlling the national gravity standard. With the iGrav-027 superconducting gravimeter and the A10-020 absolute gravimeter the Borowa Gora Observatory with three suitable pillars can successfully serve as a site for regional comparisons of absolute gravimeters. As the A10-020 is a regular participant of the international comparison campaigns of absolute gravimeters and the iGrav-027 instrument is operational, Borowa Gora becomes eligible to be an important component of the global absolute gravity reference system as a station with a continuous reference function.

The Borowa Gora Observatory with LCR-G1036 and iGrav-027 gravimeters has successfully joined the International Geodynamics and Earth Tide Service (IGETS) of the International Association of Geodesy.

Acknowledgements

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Nowa stacja z grawimetrem nadprzewodnikowym w Europie Środkowej: iGrav–027 w Obserwatorium Geodezyjno-Geofizycznym Borowa Góra – instalacja i wstępne wyniki

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Streszczenie: W 2016 roku infrastruktura grawimetryczna Obserwatorium Geodezyjno-Geofizycznego Borowa Góra – wyposażonego do tej pory w cztery grawimetry LaCoste&Romberg, model G (3 z nowoczesnym systemem odczytowym „feedback”) oraz przenośny grawimetr absolutny A10-020 – została rozszerzona o nowy grawimetr nadprzewodnikowy iGrav-027. Grawimetr iGrav-027 został dostarczony do Obserwatorium na początku lutego 2016 roku i pomyślnie uruchomiony pod koniec kwietnia 2016 roku.
Artykuł przedstawia najważniejsze aspekty instalacji instrumentu, jak również problemy techniczne napotkane podczas procesu instalacji. Przedstawiono także wyniki wstępnej analizy danych zebranych podczas pierwszego miesiąca pracy urządzenia. Zapisy grawimetru iGrav-027 zostały porównane z 2.5 dniowym ciągiem jednoczesnych zapisów grawimetrem A10-020 oraz z danymi uzyskanymi z grawimetrów LaCoste&Romberg, które są wykorzystywane w Obserwatorium Borowa Góra do rejestracji danych pływowych. W ramach analizy danych dokonano również wstępnego wyznaczenia współczynnika skali (jako część funkcji przejścia) grawimetru iGrav-027.

Słowa kluczowe: grawimetr nadprzewodnikowy, zmiany przyspieszenia siły ciężkości, grawimetria