Session 3: Monitoring of Absolute Gravimeters

Tuesday, April 12th 14:00 - 16:00 CEST

Sessions Chairs: V. Pálinkáš (Czech Republic) and R. Falk (Germany)

14:00 - 14:15 local **E. D. Antokoletz, H. Wziontek, R. Falk, A. Pasquaré, C. Tocho**
Combination of absolute and superconducting gravity observations at the Argentinean-German Geodetic Observatory (AGGO) and its contribution to the International Gravity Reference Frame (IGRF)

14:20 - 14:25 local **P. Dykowski, J. Kryński, M. Sękowski**
Gravity reference function at Borowa Gora Observatory, Poland

14:30 - 14:35 local **Vojtech Pálinkáš and Miloš Vaľko**
Comparison of absolute gravimeters at the Pecný station

14:40 - 14:45 remote **Xiao-Dong Chen**
Determination of scale factors of the three observatory superconducting gravimeters (OSGs) in China mainland

14:50 - 15:05 remote **V.A. Smith, G. Appleby, A. Susnik**
Monitoring AG Performance using Co-located Geodetic Techniques

15:10 - 15:25 remote **R. Falk, A. Engfeldt, J. Glässel, A. Hellerschmied, D. Iacovone, J. Kostelecky, V. Palinkas, M. Reich, A. Rülke, L. Timmen, C. Ullrich, M. Vaľko, A. Valluzzi, H. Wziontek, B. Zehetmeier**
Experiences from the comparison of absolute gravimeters in Wettzel 2021 WET_CAG2021

15:30 - 15:45 remote **Derek van Westrum**
Performance Characteristics of gPhoneX Continuous Relative Gravity Meters and an Argument for Their Use in Controlling Absolute Gravity Meter Comparisons

IGRF Workshop 2022
Leipzig, Germany, April 11-13 2022

Combination of absolute and superconducting gravity observations at the Argentinean-German Geodetic Observatory (AGGO) and its contribution to the International Gravity Reference Frame (IGRF

Ezequiel D. Antokoletz, Facultad de Ciencias Astronómicas y Geofísicas – Universidad Nacional de La Plata, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina, **Hartmut Wziontek,** Federal Agency for Cartography and Geodesy (BKG), Germany, **Reinhard Falk,** Federal Agency for Cartography and Geodesy (BKG), Germany, **Alfredo Pasquaré,** Argentinean-German Geodetic Observatory (AGGO), Argentina, **Claudia Tocho**, Facultad de Ciencias Astronómicas y Geofísicas – Universidad Nacional de La Plata, Comisión de Investigaciones Científicas (CIC), Argentina

The Argentinean-German Geodetic Observatory (AGGO) is a fundamental geodetic station located close to the city of La Plata, Argentina. Currently, at AGGO two gravity meters are operated: the superconducting gravimeter (SG) SG038, continuously recording gravity variations since 2016; and the absolute gravimeter (AG) FG5-227 which provides the station with an accurate gravity reference since 2018. The combination of both observations allowed not only the determination of the scale factor and instrumental drift of the SG038, but also the establishment of a gravity reference function supporting the future International Gravity Reference Frame (IGRF) on a regional level. The gravity reference function allows predicting absolute gravity values based on the SG observations and by this further monitoring of AGs. Recently, systematic deviations between this reference and the latest observations with FG5-227 observations up to a few µGal for some periods were detected. Therefore, the stability of the instrumental drift of the SG038 is re-evaluated, and possible AG offsets as well as alternative explanations are discussed.

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Gravity reference function at Borowa Gora Observatory, Poland

P. Dykowski, J. Kryński, M. Sękowski, Centre of Geodesy and Geodynamics, Institute of Geodesy and Cartography, **T. Olszak**, Department of Geodesy and Cartography, Warsaw University of Technology

Repeated monthly absolute gravity measurements are conducted with the A10-020 absolute gravimeter on three stations (two indoor, one outdoor) at the Borowa Gora Geodetic-Geophysical Observatory since 2008. In 2016 next to one of the indoor stations (BG-G2) the iGrav-027 superconducting gravimeter was installed and has been running continuously until now. In addition, between 2016 and 2021, repeated gravity surveys have been done with the FG5-230 absolute gravimeter (owned by the Warsaw University of Technology) at the Borowa Gora Observatory. The A10-020 gravimeter participated in the 2015 (also FG5-230) and 2018 international absolute gravimeter comparison campaigns in Europe.

Combined absolute gravity measurements and superconducting gravimeter records allow to evaluate the initial drift and long term stability of the iGrav-027 instrument and at the same time the performance and stability of the A10 and FG5 gravimeters, especially in between instrumental maintenance. Participation of the A10-020 and FG5-230 gravimeters in international gravity comparisons allowed to link the gravity reference function realized by the iGrav-027 gravimeter to the mean gravity reference level defined within the International Gravity Reference System (IGRS). This has proven to be very useful for a variety of applications with the use of both absolute gravimeters, especially during the Covid-19 pandemic and the inability to perform international absolute gravimeter comparisons.

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BGI BKG
Bureau Gravimétrique International
International Gravimetric Bureau

Comparison of absolute gravimeters at the Pecný station

Vojtech Pálinkáš and **Miloš Vaľko**, Research Institute of Geodesy, Topography and Cartography, Geodetic Observatory Pecný, Czech Republic

Gravity reference function at the Pecný station is determined from the combination of measurements with the absolute gravimeters FG5-215/HS5, FG5X-251/HS5 and the superconducting gravimeter OSG-050. Results of this combinations are showed together with the capability to calibrate absolute gravimeters.

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Determination of scale factors of the three observatory superconducting gravimeters (OSGs) in China mainland

Xiao-Dong Chen, State Key Laboratory of Geodesy and Earth Dynamics, Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences

Determination of scale factors of the three observatory superconducting gravimeters (OSGs) in China mainland are shown in the representation. These three stations are Wuhan, Lhasa and Lijiang, respectively. The OSG data of these three stations have been uploaded onto the IGETS (International Geodynamics and Earth Tide Service) database (http://isdc.gfz-potsdam.de/igets-data-base/). The calibration experiments were done with FG5 gravimeters. The results show that accuracies of scale factors of all the three OSGs meet the requirement of the IGETS, which is less than 0.1% for the relative accuracy.

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Monitoring AG Performance using Co-located Geodetic Techniques

Smith, V. A., BGS Space Geodesy Facility, **Appleby, G**., BGS Honorary Research Associate Space Geodesy Facility, **Susnik. A**., BGS Space Geodesy Facility

The co-location of multiple geodetic techniques provides scope for detailed inter-technique analysis. The Space Geodesy Facility (SGF), Herstmonceux, operates the geodetic techniques of absolute gravimetry, satellite laser ranging (SLR) and two GNSS receivers. Detailed analysis of all three are carried out on site, as well as the SGF being an International Laser Ranging Service Analysis Centre that contributes to the combined ILRS analysis product used to form the International Terrestrial Reference Frame. The close proximity of these techniques, within 15 metres of the AG (except one of the GNSS receivers at 100 m distance) enables comparison of the weekly geodetic product from each. It is shown that the GNSS and SLR results are in close agreement with the AG data and support both estimated and comparison-measured offsets.

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Experiences from the comparison of absolute gravimeters in Wettzel 2021 WET_CAG2021

Falk, R.[1], Engfeldt, A.[2], Glässel, J.[1], Hellerschmied, A.[3], Iacovone, D.[4], Kostelecky, J.[5], Palinkas, V.[5], Reich, M.[6], Rülke, A.[1], Timmen, L.[7], Ullrich, C.[3], Vaľko, M.[5], Valluzzi, A.[4], Wziontek, H.[1], Zehetmeier, B.[3], 1 - Federal Agency for Cartography and Geodesy, 2 - Lantmäteriet, Sweden, 3 - Federal Office of Metrology and Surveying (BEV), Austria, 4 - Agenzia Spaziale Italiana (ASI) / e-geos, Italy, 5 - Research Institute of Geodesy, Topography and Cartography, Czech Republic, 6 - GFZ German Research Centre for Geosciences,Germany, 7 - Leibniz Universiy Hanover, Germany

An additional comparison of absolute gravimeters took place between September and December 2021. Nine instruments including two instruments from NMI/DI and also two quantum gravimeters measured at least at two pillars in the new gravity lab of the Geodetic Observatory Wettzell/Germany. Results of different processing versions following the strategy for processing of comparisons (Palinkas et.al, 2021) will be presented and compared with the results of EURAMET.M.G-K3 in 2018 also in Wettzell. Conclusions for conducting future comparisons are derived.

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Performance Characteristics of gPhoneX Continuous Relative Gravity Meters and an Argument for Their Use in Controlling Absolute Gravity Meter Comparisons

Derek van Westrum, NOAA - National Geodetic Survey, USA

As part of its Geoid Monitoring Service (GeMS), the National Geodetic Survey (NGS) plans to observe multi-year changes in local gravity with an array of gPhoneX portable relative gravimeters at various locations across North America. Tests comparing the performance of the gPhoneX with a GWR superconducting gravimeter (SG), CT-024 at the Table Mountain Geophysical Observatory (TMGO) were conducted in late 2018. In 2019, numerous factors forced NGS to decommission its SG, and it was decided to replace it with a permanently installed gPhoneX. This unit allows for continuous observation of the gravity signal between bi-weekly FG5X measurements, and it will provide continuity of signal in absolute gravimeter intercomparisons. This is a crucial component in TMGO's role as a Gravity Reference/Comparison Station in the new International Terrestrial Gravity Reference System/Frame. In 2021, NGS got the opportunity to operate a second gPhoneX alongside its permanent unit to help further assess the instrument's precision. We will present the results of both the gPhoneX-vs-SG (four month) and gPhoneX-vs-gPhoneX (three month) comparisons with the two sets of instruments operating under identical conditions. The precision, accuracy, drift, and noise of the instruments will be explored in both the time and frequency domains, and in bands spanning microseismic to tidal frequencies. Comparisons with the FG5X absolute gravity meter time series will also be presented.