

EUREF 15: National Report of Austria

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1. Reprocessing of 4 densification networks

OLG (Observatory Lustbuehel Graz) as a joint cooperation of the AAS (Austrian Academy of Sciences) and the BEV (Bundesamt für Eich- und Vermessungswesen) has been acting also as an international analysis center for GNSS networks for more than 20 years. Apart from the EPN (European Reference Frame Permanent Network) sub-network four densification networks are permanently analyzed with regions in Austria, Central Europe, Greece and around the Arabian Plate (Figure 1). Now the international REPRO2 project makes it possible to reprocess data from the last 20 years by using reprocessed orbits and clocks and new models of the ionosphere and troposphere with the results showing minimal deviations of only a few millimeters. The first results and comparisons of the years 2006 up to 2008 are presented.

It is estimated that each year of REPRO2 will need up to two months of work. The improved knowledge about handling wrong or missing meta-information and the increased number of stations will compensate for this. It is assumed that the efforts will remain the same for each year. This would mean that 2015 the work of the years 2006-2013 might be finished. For the data from 2006 and before the amount of computer time will be reduced dramatically but the human input of organizing and pre-analysis will increase. There is hope to reduce the efforts to one month per year. REPRO2 should basically be terminated by the end of 2016. Another add-on will be started in 2017 to include all valid campaigns within and around Austria (about 300 sites) between 1992 and 2014. While the computation time can be neglected, the time for organization (e.g. correlation of different naming in Austria and internationally) is considerable.

Additionally a consistent time series is essential to estimate station velocities for geokinematics. Especially in areas with minor intraplate distortions a precision at the millimeter level is requested. We expect that REPRO2 will be completely finished in 2017!

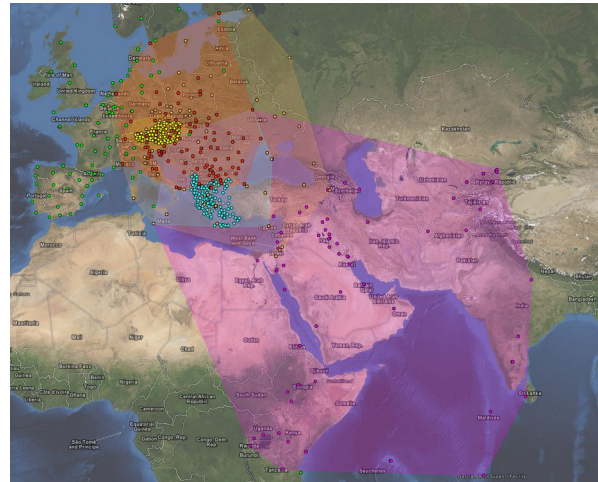


Fig. 1: Networks analyzed by OLG

2. APOS - Austrian Positioning Service

2.1 APOS - Production System

The APOS reference station network uses raw data from about 70 stations operated by national and international associate partners. In the middle of 2014 the APOS data processing center was migrated into a virtualized BEV IT-infrastructure. Nevertheless the APOS data processing redundancy concept enabled failure-free operation to the greatest possible extent (Figure 2). Currently APOS is running the “Trimble® Pivot Platform” - version 3.5.7.

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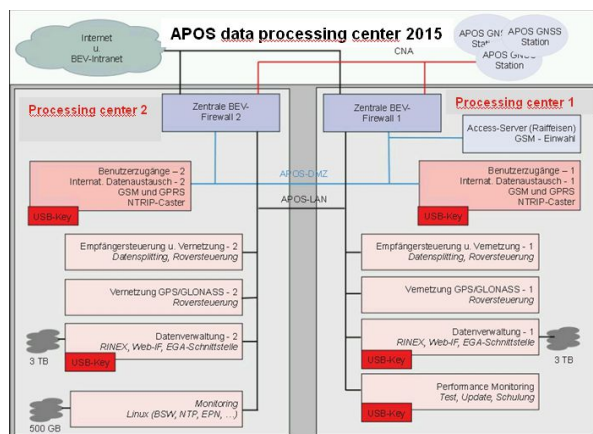


Fig. 2: APOS data processing center 2015

2.2 APOS - Commercial Aspects

Up to now more than 780 external customers, respectively more than 2,000 accounts of "APOS Real Time" in all kinds of working fields have been registered, i.e. a growth rate of ca. 30% compared with 2014. By April 2015 nearly 11,250 online hours had been counted (Figure 3). Due to the fact that Austria's biggest mobile communication provider announced the termination of the GSM/CSD service for the end of 2015, access to APOS real time services via GSM/CSD will be terminated as well in due time.

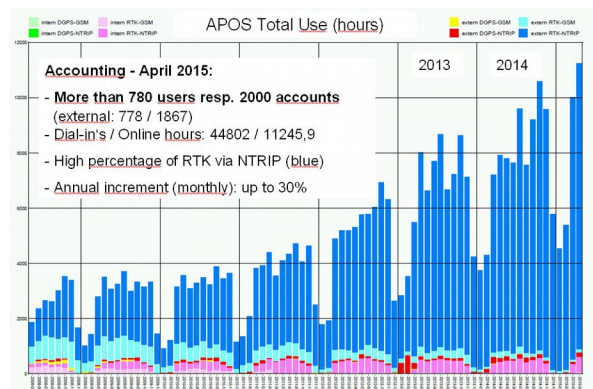


Fig. 3: User statistics

2.3 APOS - Outlook

The preparation for „Multi GNSS“ readiness will take bigger investments. We plan SW - upgrades at the processing center, new equipment at reference stations and the implementation of the PPP - technology. Additionally a new version of the BEV Shop APOS for improved download possibilities and VRS - RINEX - data delivery is planned. Optionally a web service for RINEX/baseline - processing is under way.

3. Gravimetry

3.1 Overview

In 2014 the absolute gravimeter FG5-242 was serviced at Micro-g. After returning from the service at the end of April, test measurements were performed in Vienna. Furthermore a comparison between the FG5X-216 of the University of Luxemburg and the FG5-242 was organized at the Walferdange Underground Laboratory for Geodynamics (WULG). The aim of this comparison was to ensure that there is a good agreement between these two gravimeters and to link the result to the CCM.G-K2 Key Comparison in the WULG in November 2013. It was important to re-estimate the degree of equivalence of the FG5-242 with the Key Comparison Reference Values (KCRV) of the CCM.G-K2 Key Comparison. The results show that the results of the FG5-242 are in agreement with the results of the FG5X-216 and therefore also with the KCRV [1]. The annual gravity observations at the station Obergurgl and at the ECGN¹ stations GRAZ, PFAN (Pfaender) and TRFB (Trafelberg) were skipped this year.

3.2 Hochkar Calibration Line

The Hochkar Calibration Line (HCL) was established in 1982 between Goestling/Ybbs and Hochkar and has been used yearly for calibrating relative gravimeters (Figure 4). Due to changes (constructions) in 2013 at the top station Hochkar it became necessary to define a new end-point combined with some new secondary points. The old absolute station itself was still unchanged but might be affected by the modifications in front of the building. Therefore the absolute observations were repeated with the FG5-242 at Hochkar and at Goestling, at the end points of the calibration line. The new absolute gravity results show a very good agreement at Goestling and a difference of about -20 microGal at Hochkar [2].

3.3 Absolute measurements in Slovenia

The existing gravity base network of Slovenia is related to 6 absolute gravity stations established in 1996 with the IMGIC absolute gravimeter. At two stations the observations were repeated with other absolute gravimeters in 1996 - 2000 (JILAg and FG5).

¹ European Combined Geodetic Network
(http://www.bkg.bund.de/geodIS/ECGN/EN/Home/homepage__node.html__nnn=true)

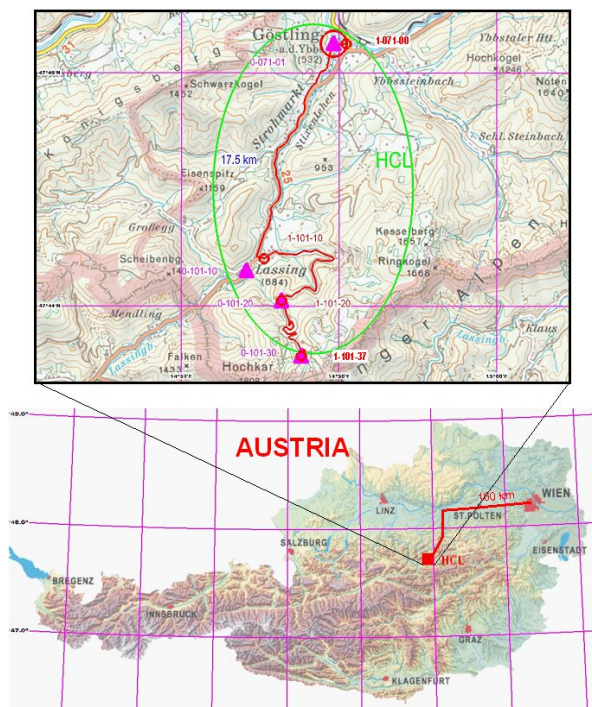


Fig. 4: Situation of the Hochkar Calibration Line

The complete basic gravimetric network of Slovenia is tied to these absolute gravity points and therefore it is depending on the measurement uncertainty of the absolute gravity measurements. The complete set of measurements was repeated in 2014 with the Austrian absolute gravimeter FG5-242 in a cooperation between the BEV (Austrian Federal Office of Metrology and Surveying) and the Slovenian Surveying and Mapping Authority. The vertical gradients were also measured at all 6 stations with the relative gravimeter Scintrex CG5. Deviations from $-25 \mu\text{Gal}$ up to $30 \mu\text{Gal}$ were detected.

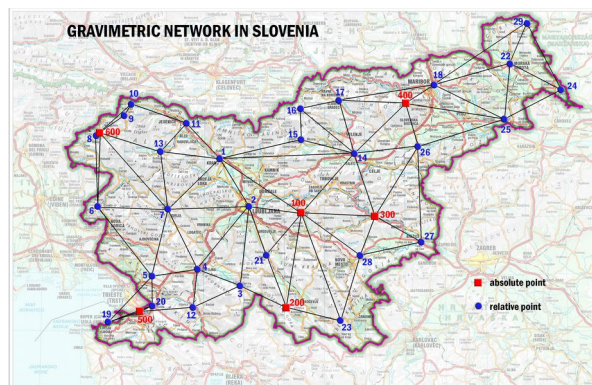


Fig. 5: Absolute gravity observations with FG5-242 in Slovenia 2014

4. Precise levelling

The precise levelling re-measurement was continued north over a distance of about 90 km from Krems to Horn and to the principal point Hutbigl. Hence the new precise levelling traverse in the eastern part of Austria is connected to Hutbigl. That will give us new information about vertical velocities in this part of Austria. A new kinematic adjustment of the levelling network in Austria is in progress.

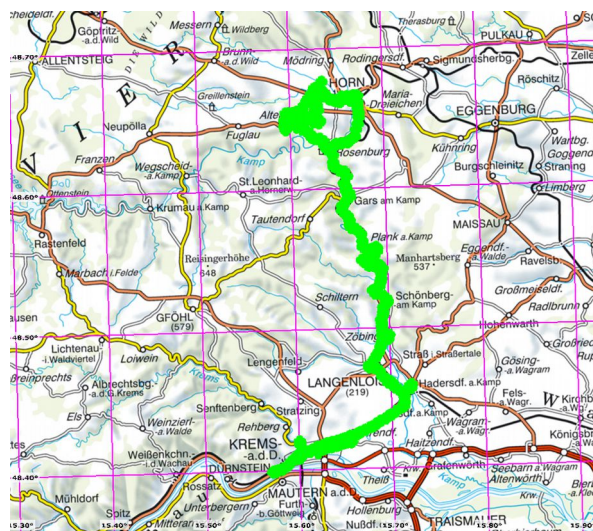


Fig. 6: Precise levelling activity in Austria 2014

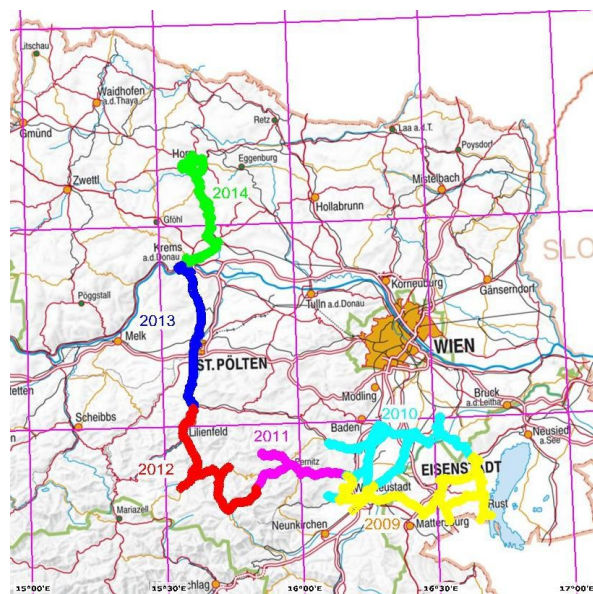


Fig. 7: Precise levelling since 2009

4.1 Principal Levelling Point Hutbigl

The Austrian levelling gist Hutbigl is one of the datum points in the EVRF 2007. It is situated in the most stable area in the eastern part of the Bohemian Massif in Austria in Gföhler Gneis.

This point shown in Figure 9 is also the zero point of the Austrian kinematic network of height changes (vertical velocities), the so called "Haupthöhenpunkt (HHP)" (Main Height Point).

The HHP consist of 3x3 groups of benchmarks arranged in a triangle of about 2 – 3 km side length established in 1987. Additionally older stable benchmarks in Horn, in Frauenhofen and in Altenburg were included. In Altenburg there are two absolute gravity stations. For checking the vertical stability of all these benchmarks we measured again in 1987, 2008, 1991 (2x) and 2014. The differences between 2014 and 1987 are shown in Figure 8. The results don't show significant changes in the heights respectively in vertical velocities: they are within the uncertainty of the levelling observations which are within the range of ± 0.5 - ± 0.7 mm/km for each levelling campaign [3].

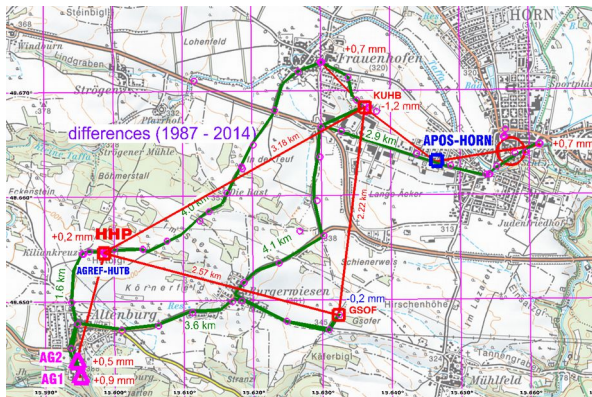


Fig. 8: Results of repeated measurements at Hutbigl



Fig. 9a+b: Principal Austrian Levelling Point Hutbigl

References:

- [1] Olivier, F., Baumann, H., Ullrich, Ch., ..., et.al.: CCM.G-K2 key comparison Final Report. Metrologia 52, IOPscience.
- [2] Ruess, D., Ullrich, Ch., 2015: Renewal of the Austrian Gravimeter Calibration Line HCL. VGI 3+4/2015, 182-187, Wien.
- [3] Ruess, D., 2015: GPS- und Nivellementmessungen für das Projekt GeNeSee und am Haupthöhenpunkt Hutbigl. BEV – Leistungsbericht 2014, http://www.bev.gv.at/pls/portal/docs/PAGE/BEV_PORTAL_CONTENT_ALLGEMEIN/0100_NEWS/NEWS-PDF/BEV_LEISTUNGSBERICHT_2014.PDF