EUREF National Report of Austria 2017

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1. Permanent Networks

OLG as a joint venture of the Federal Office of Metrology and Surveying (BEV) and the Austrian Academy of Sciences monitors parts of Africa, Asia and Europe by five networks of permanent GNSS stations in post-processing mode. EUREF (sub-network of the EPN, 95 stations, started 1996) and AMON (East Alpine Region, including APOS stations, 85 stations, started 2001, year 2006 reprocessed) are designed to realize the reference system ETRS89, whereas CERGOP (Central European Geodynamics, 85 stations, started 1999), GREECE (120 stations, started 2013) and MON (Plate Boundaries in the Eastern Mediterranean, 70 stations, started 2000) focus on geo-kinematics. At least once a year the cumulated time series of all networks except EUREF are analysed and station velocities are computed. Caused by the fact that the cooperation between the Austrian Academy of Science and the BEV will terminate at the end of this year the networks CERGOP, GREECE and MON are not longer processed by the new Analysis Center of BEV.

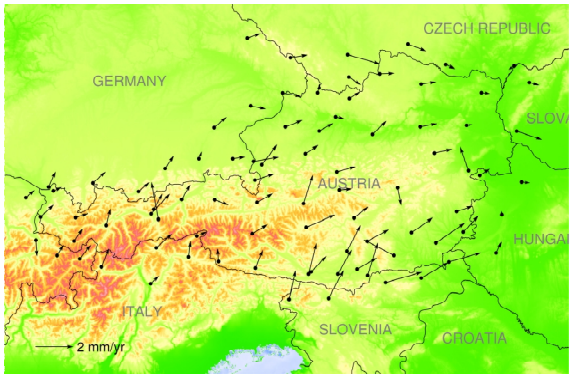

Fig. 1: Map of the network AMON with horizontal velocities of the cumulated time series 2000-2016

2. APOS - Austrian Positioning Service

2.1 APOS - Production System

Three new stations notably VKLB (Vöcklabruck), SPDR (Spittal/Drau) and HBLT (Heiligenblut) were built for replacement reasons in Upper Austria (VKLB) and Carinthia (SPDR, HBLT) (see Fig. 2). VKLB replaced WELS and GMUNDEN from mid-May on and switched into production mode. SPDR and HBLT shall replace the KELAG – reference stations in Western Carinthia within 2018 due to the termination of the cooperation between BEV/APOS and KELAG (KNG-Kärnten Netz GmbH) at the end of 2018.

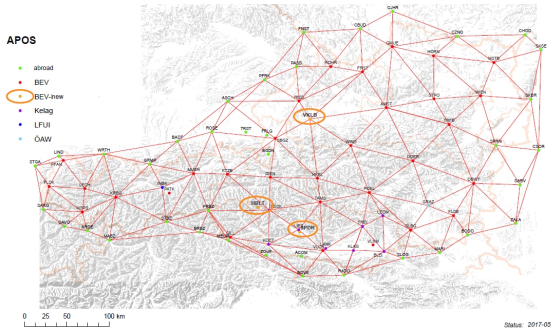

Fig. 2: APOS - network with the replacement stations

2.2 APOS goes multi - GNSS

The acquisition of new GNSS - equipment was accomplished in 2016 and the roll out should be done within the first quarter of 2018. Most of the Austrian APOS - reference stations will be equipped with Leica GR30 receivers and Leica AR25 antennas. Currently the five reference stations INBK (Innsbruck), OBWT (Oberwart), VLKM (Völkermarkt), SPDR and HBLT serve also as RTK - monitoring stations. As for the network-processing meanwhile the current Trimble TPP version 3.10.3 has replaced the

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older version. The enhancement of the commercial BEV Shop APOS regarding improvements for RINEX – generation and download possibilities as well as providing online calculation services and VRS-RINEX-data are rescheduled to 2018 or 2019. RINEX 3.x - data shall be provided in the course of 2018 to all customers.

3. Gravimetry

In 2016 absolute gravity measurements were performed at 9 stations in Austria using the FG5/242 absolute gravimeter (see Fig. 3). Two stations (CO - Conrad Observatory and Pfänder) are ECGN (European Combined Geodetic Network) stations. The results at the station Pfänder are in good coincidence with the FG5 measurements from 2011. At the station CO two long time absolute gravity measurements over 9 days and approx. 55000 drops were performed in 2016 to calibrate the superconducting gravimeter (GWR C025).

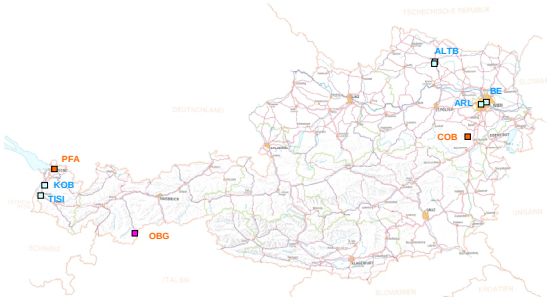

Fig. 3: Locations of Absolute Gravity stations in Austria, measured 2016

At CO the gravity results of the absolute gravimeter FG5-242 were compared to the results of the super conducting gravimeter GWR. The GWR leeks Helium (about 100 l/year) and the increased Helium concentration in the ambient air influences the rubidium-frequency normal. Since 2011 the oscillator pulse frequency of the Austrian FG5/242 and its drift rate are regularly checked at the BEV metrology department, so the oscillator influence on all gravity measurements is well known. The observation data of the FG5/242 and the SG were analyzed together and the results were presented at the 4th IAG Symposium on Terrestrial Gravimetry in St. Petersburg ("Gravity Monitoring at the Conrad Observatory (CO)" by Meurers, B., Ruess, D., Ullrich, Ch. and Nießner A.). The time series of FG5/242 and GWR match very good (see Fig. 4).

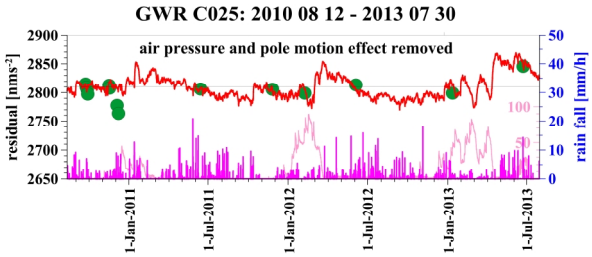

Fig. 4: Comparison of AG and SG residuals. Red: SG residuals, green: AG observations, magenta: hourly rainfall, pink: snow level [cm]

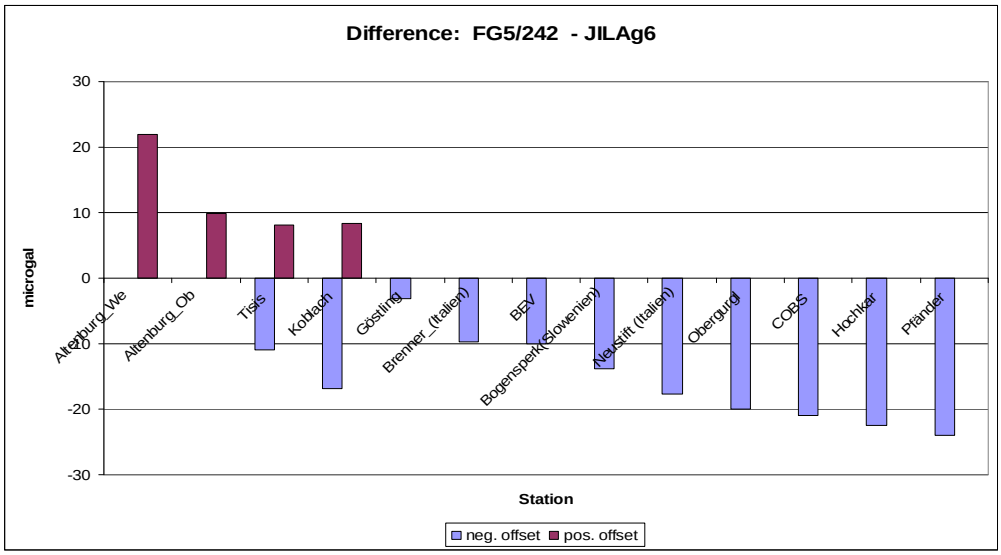

Fig. 5: Offset of JILAg-6 measurements to FG5/242 measurements

The other stations Tisis, Koblach and Altenburg (two sites) measured in 2017 are part of the Austrian gravity base net. These stations were measured for the first time more than 20 years ago and sometimes re-measured with the JILAg-6 absolute gravimeter. All together since 2010 more than 20 stations (Austria and abroad) were re-measured with the new absolute gravimeter FG5/242. On most of these stations offsets to the JILAg-6 absolute measurements are visible. For a further analysis 13 high quality stations were used. The comparison of JILAg-6 to FG5/242 results show a negative offset of most of the stations from 10 to 20 microGal (1 µGal = 10 nm/s²) (see Fig. 5). On an average for all stations the FG5/242 values are 9 microGal lower than the JILAg-6 values. Similar results were obtained from comparison of other JILA type gravimeters to FG5 types (The measuring offset of the absolute gravimeter JILAg-3 with respect to the FG5 instruments No. 101 (BKG) and No. 220 (LUH); L. Timmen, R. Falk, O. Gitlein, H. Wilmes). In future it is planned to re-measure more absolute stations with the FG5 for examining all the offsets to the JILAg-6 observations.

4. Precise Levelling

In 2016 the precise levelling project in the north-eastern part of Austria was finished with the last part from Waidhofen/Thaya via Heidenreichstein – Litschau to the Austrian/Czech border Schlag/Chlumec.

In the year before (2015) the line from Horn/ HUTB (Austria's main levelling point) via Waidhofen/Thaya to the Austrian/Czech border Fratres/Slavonice was re-measured (Fig. 6). This part shows a slight height decrease of about 10 mm between Horn and Waidhofen/Thaya after a time period of 74 years (1941–2015). Up to Waldkirchen there is no more decrease, only the last point at Fratres shows a 20 mm decrease. The re-measurements between Waidhofen and Litschau resp. the Border Schlag/Chlumec show a constant depression of 10 mm to HUTB like Waidhofen/Thaya.

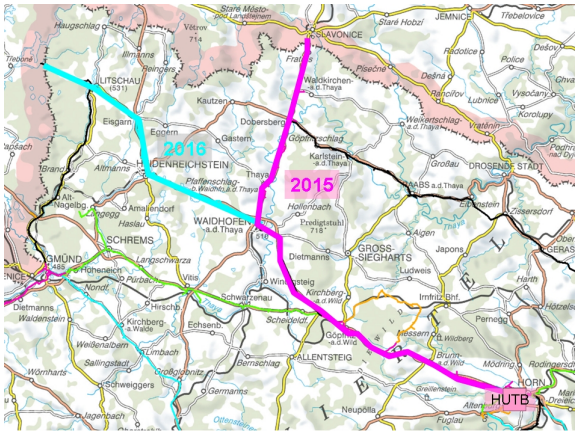

Fig. 6: Precise Levelling re-measurements in the northern part of Austria (Waldviertel)

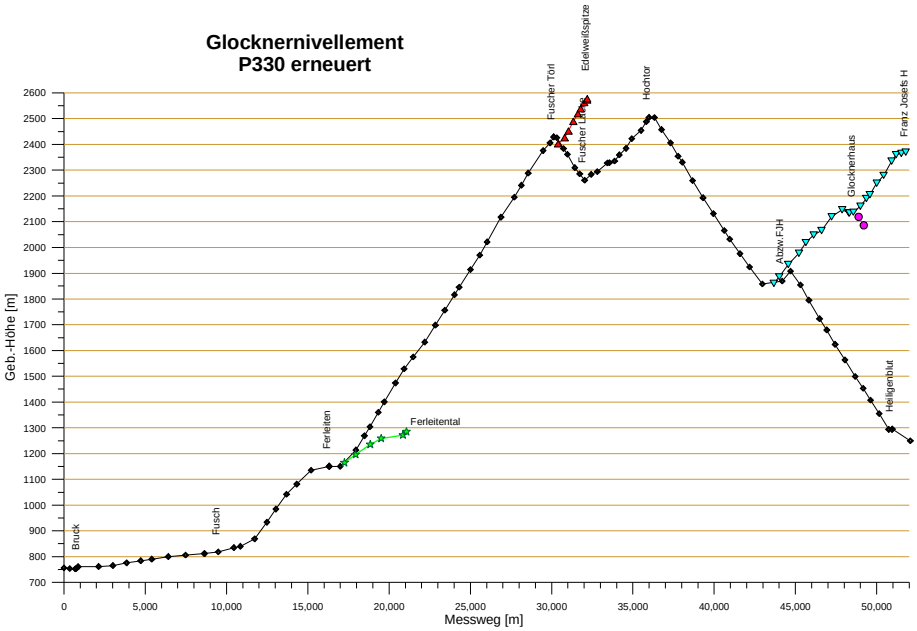

Fig. 7: Height profile of the Großglockner precise levelling line P330

In 2016 we also started the preparation of re-measurement of the levelling line at the Großglockner Hochalpenstraße. This is the oldest existing levelling line which was measured in 1948 and never re-measured since this time. This line is very important because it crosses the Alps near the highest peak of Austria (Fig. 8) and overrides a height difference of about 1800 m at a length of ~ 52 km (Fig. 7). Actually precise levelling on this road is a challenge particularly with regard to the bulk of touristic traffic in summer. It is assumed that the Austrian Alps are still uplifting by about 1-2 mm/year. In 2017 the re-measurement was started. It will close a gap of re-measurements between the northern part and the southern part of the precise levelling network of Austria. Together with elder measurements they will be used in a dynamic network adjustment.

5. GGOS CO

Since 2016 BEV hosts the Coordinating Office (CO) of the Global Geodetic Observing System (GGOS) of the International Association of Geodesy (IAG). It performs the day-to-day activities inside the organization and supports all other GGOS components through external and internal coordination and communication. The Coordinating Office actively promotes and represents Geodesy on international scientific conferences (EGU General Assembly or AGU Fall Meeting) or in political organizations (such as UN or GEO).

6. Migration of AC and DC to BEV Vienna

At the end of 2017 the contract (OLG) between the Austrian Academy of Sciences (AAS) and the Federal Office of Metrology and Surveying (BEV) will expire. To continue the long tradition of GNSS analysis and the contributions to EUREF, we decided to migrate the data center as well as the analysis center to the BEV. Embedded in the IT-infrastructure of the BEV the services reached a higher level of security and availability. We also used this transition phase to adapt all of our scripts and the data storage system. The transition from OLG to BEV was shown in the national report presentation of Austria at the EUREF Symposium 2017. Some new big data tools in the field of monitoring the data flow and the solutions are shown and clarify how big data can make our lives easier.

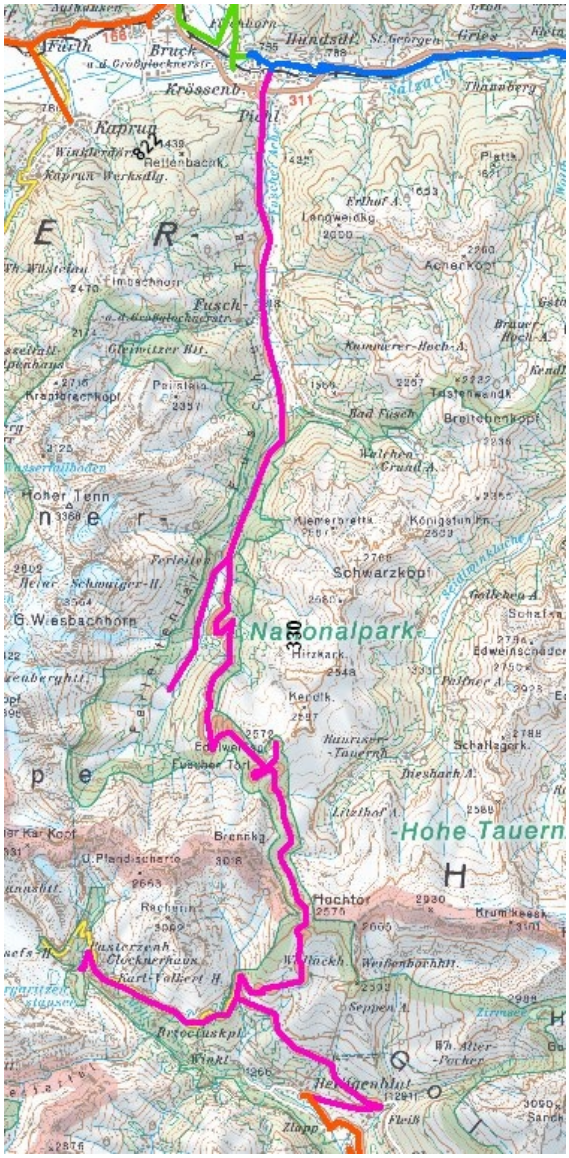

Fig. 8: Precise Levelling at the Großglockner Hochalpenstraße

Beginning with 2017.100 the transition was completed. The new data center is now reachable at ftp://gnss.bev.gv.at. The data structure at the ftp-server changed completely in relation to the old (OLG) server and is now quite similar to the second regional data center within EUREF ftp://igs.bkg.bund.de. The file upload can be done as “anonymous”, which means that no registration is needed. After several file checks the uploaded files are presented within the data structure. A requirement is that the files are official EPN-station- and true RINEX-files, otherwise the files will be deleted immediately.

To monitor the dataflow at this server, we decided to store all of our logfiles to a new database system called “elastic search” with the big beneficial effect that we can easily help our customers when problems with the file upload appear, and can easily find out when something runs in a mess.

The Analysis Center (AC) was also taken over from BEV. After a test phase of several weeks with the Analysis Coordinator and the Troposphere Coordinator we send our first contribution at GPS week 1954. At BEV AC we have the same network configuration with almost 100 stations than it has been at OLG AC.