Network Monitoring at the OLG Analysis Centre

Current Status and Intended Developments

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1. Introduction

One of the main tasks at the OLG AC is to compute regional networks of permanent GPS stations at a regular basis. This includes the tasks of data gathering, pre-processing including consistency checks, network processing, period analysing and general analysing. The networks processed consist of IGS/EUREF stations within Europe and the Near East and some additional Austrian stations not (yet) included into any international network. Apart from the results of numerical values for coordinates and zenith delays and their error matrices the behaviour of receivers and antennas and the movements of the stations are analysed.

2. Permanent Networks

Permanent networks are defined as networks of stations which should run permanently delivering data at certain epochs for the last period. Recently there are stations which deliver daily (24h) and hourly (1h) data. Although it is possible for some stations to deliver data in near real time or with a short delay the handling is still difficult and the target of such a quick monitoring and network processing is not yet seen. For Austrian DGPS stations there exists a monitoring system which relies on single station control using the code output. Therefore only conventional networks are processed. For all network processing the Bernese Software 4.2 is used, running the BPE (Bernese Processing Engine) automatically. The data gathering and the pre-Bernese processing including checks is done automatically with manual interference (e.g. deleting bad files) using perl scripts written at the OLG and teqc of UNAVCO. Important lines in the RINEX headers (e.g. receiver/antenna type) are overwritten using a file of constant parameters derived from the log sheets to be consistent.

2.1 EPN Sub-network OLG

The weekly contribution of the OLG AC consists of a network solution of 34 stations of the EPN network. The sub-network is mainly located in the eastern half of Europe including the Near East (Figure 1). Its maximum extension (Norway – Israel) is about 5 000 km. Ambiguity fixing is done by L5/L3 fixing using a prescribed baseline combination, if possible. In the first run CODE precise orbits are used because of their earlier availability. Major daily differences

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(lateral >10 mm, vertical >20 mm) are investigated manually and corrected, if possible. Then the network is recomputed with IGS orbits and delivered to the EPN.

2.2 ARE/CERGOP network

The network, first called ARE (Austrian Reference Extended) with international permanent stations surrounding Austria, grew in numbers and extension with the EPN network. It now consists of 42 stations. Included are all permanent stations of the CERGOP project which are international. Apart from the two regional aspects the third aim is to implement and test features which are not admitted in the EPN rules for processing sub-networks or work as an alternative. There L5/L3 and QIF ambiguity fixing results are both computed for comparison. The pre-processing starts with a minimum elevation angle of 5° and processing is done 10°. EUREF-stations and Austrian stations in active tectonic zones are mixed for a better detection of movements in the Alpine area. Only CODE orbits are used to provide earlier results. Because the epoch campaigns of CERGOP occur every second year this network is a tool to monitor movements in the meantime

2.3 MON network

The EUREF special project of Time Series Analysis divided the whole network into six regions. OLG AC has taken over the task of monitoring the region VI, Balkan and Anatolia. Up to now 13 stations (Figure 3, without the new station DYR2) are located there. As figure 3 shows the major known tectonic faults are not well covered, unfortunately. Only the North Anatolian fault has stations on both sides while other also active ones are still not observed permanently (e.g. the border between the Anatolian and the Arabian plate). The processing rules are the same as in the EPN sub-network except for the lower minimal elevation of 10° and the only usage of CODE orbits. For consistency the network is tied to the other networks by including the station GRAZ.

2.4 DGPS Austria network

Several Austrian stations are not included into the EPN network. They are intended to act as base stations for DGPS and kinematics GPS. Notwithstanding the near real time monitoring of the stations a permanent monitoring using post processing and precise orbits is felt to be necessary, because the other targets of them is to monitor the Austrian reference network and the tectonic movements within Austria. Now there are up to 16 stations (Figure 4) working or under construction, the number will grow in the next years. All public permanent stations are included into the network. Additionally to the processing features of ARE/CERGOP and MON networks DGPS Austria contains two sites with RTCM messages reconverted into RINEX files to test this method. It has been found for several years that those stations have the same accuracy as the original ones except of a much higher part of cycle slips coming from the clock jumps inherent of the RTCM format.

3. Other Tasks

3.1 Epoch networks

Three major epoch networks are processed occasionally. The first, CEGRN, was installed in 1994 by the CERGOP project and is observed at an annual or biennial basis, growing from 30 to 70 stations. Occupied for some days it delivers a densification of the network of permanent stations down to the level of 50-70 km. The processing follows the standards of EPN resulting

into solutions with the same accuracy as the EPN network. It can be seen as **one** weekly solution of EUREF with a densification network. The second network, established in 1994, monitors the northern part of the Adriatic micro plate, covering the region at the common borders of Austria, Italy and Slovenia. Different recent movements already detected are consistent with results from geophysical investigations. Because of the shorter baselines the repeatability is somewhat higher (daily 5-10 mm) than within the EUREF network, but the accuracy seems to be pretty the same one. The third major network, AGREF (Austrian Geodynamic Reference Frame), started in 1990. It covers Austria with more than 70 stations and some tenths of stations beyond the borders. Starting early some parts have not the recent standard accuracy while others, especially since 1994, are at the same level as modern EUREF and CEGRN epoch campaigns. Every year some stations are measured again and tested against their former results. Assuming that the known movements in Austria are very small and quite smooth, major jumps are seen as improvements or observation errors (recent or past).

3.2 Past and Future

A quicker network monitoring for some purposes is under construction. It would help to estimate zenith delays usable for meteorological purposes as well as to detect blunders in the network, improving the immediate usage of phase data. The question, how to trade accuracy against quick results, is not yet definitely answered. OLG AC tries to compute results within hours using ultra rapid orbits, a 24-hours wrap-around data set, a strongly constrained centre station (GRAZ) and soft constraints (±10 mm) to the other stations together with the BPE.

Encouraged by the good conversion from RTCM to RINEX in near real time OLG AC would like to take part by distributing GPS observations over the internet in the near future. Apart from the distribution format and the conversion it would be interesting to combine field data from unknown markers with actual observations of known permanent stations. Called “instant GPS” this procedure worked fine with GSM within quarters of hours, depending on the satellite distribution and the quality of field measurements.

For all Austrian permanent stations the antennas as well as the Radom cupolas have been tested and will be tested also in the future. Using the test beds at Graz and Vienna and the surrounding permanent stations the behaviour may investigated at the millimetre level.

A major concern is the automatic investigation of the produced time series of coordinates and zenith delays at a periodical level. By now the investigation is done manually and only occasionally.

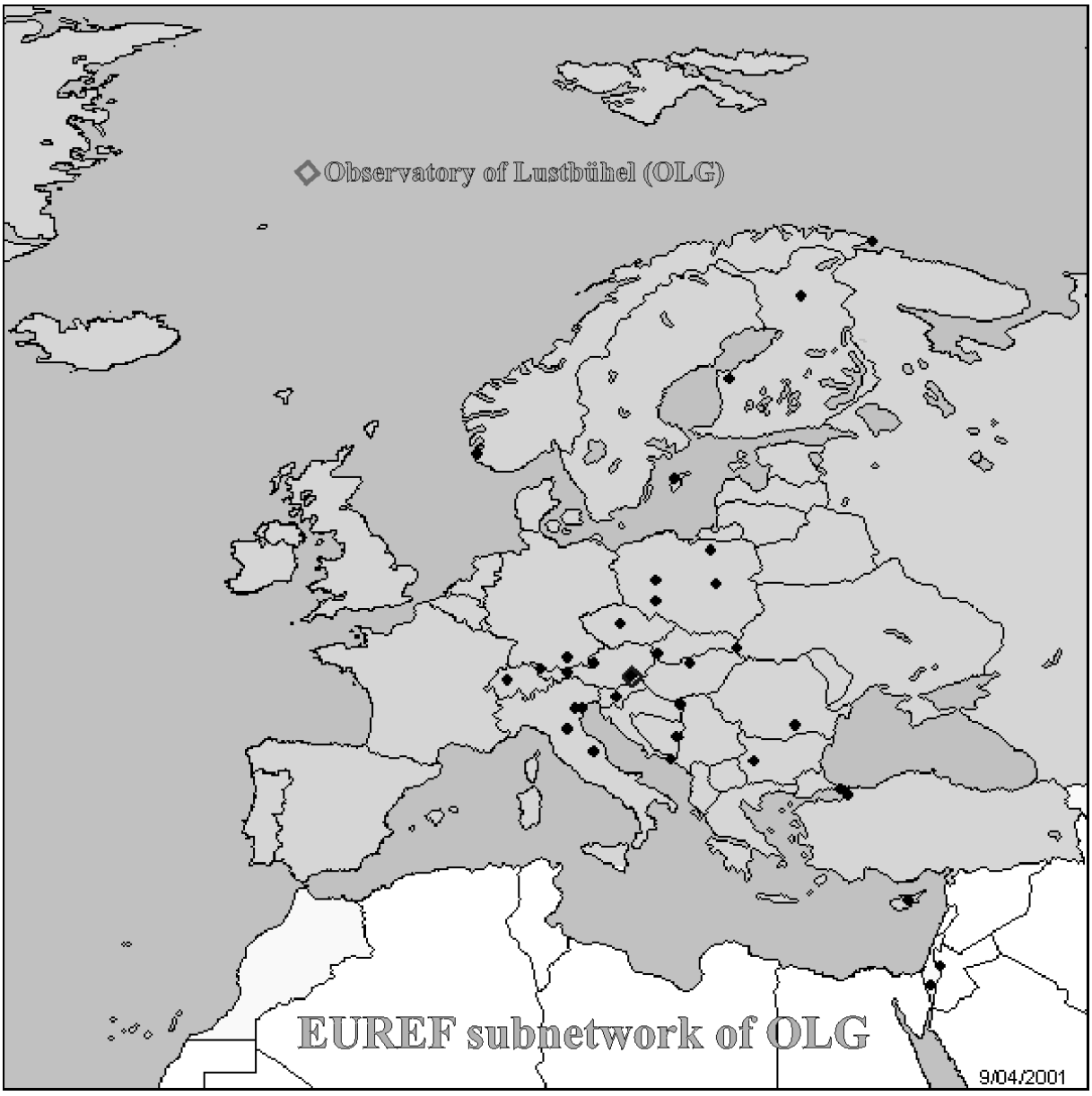

Figure 1. EPN Sub-network OLG (status first half of 2001)

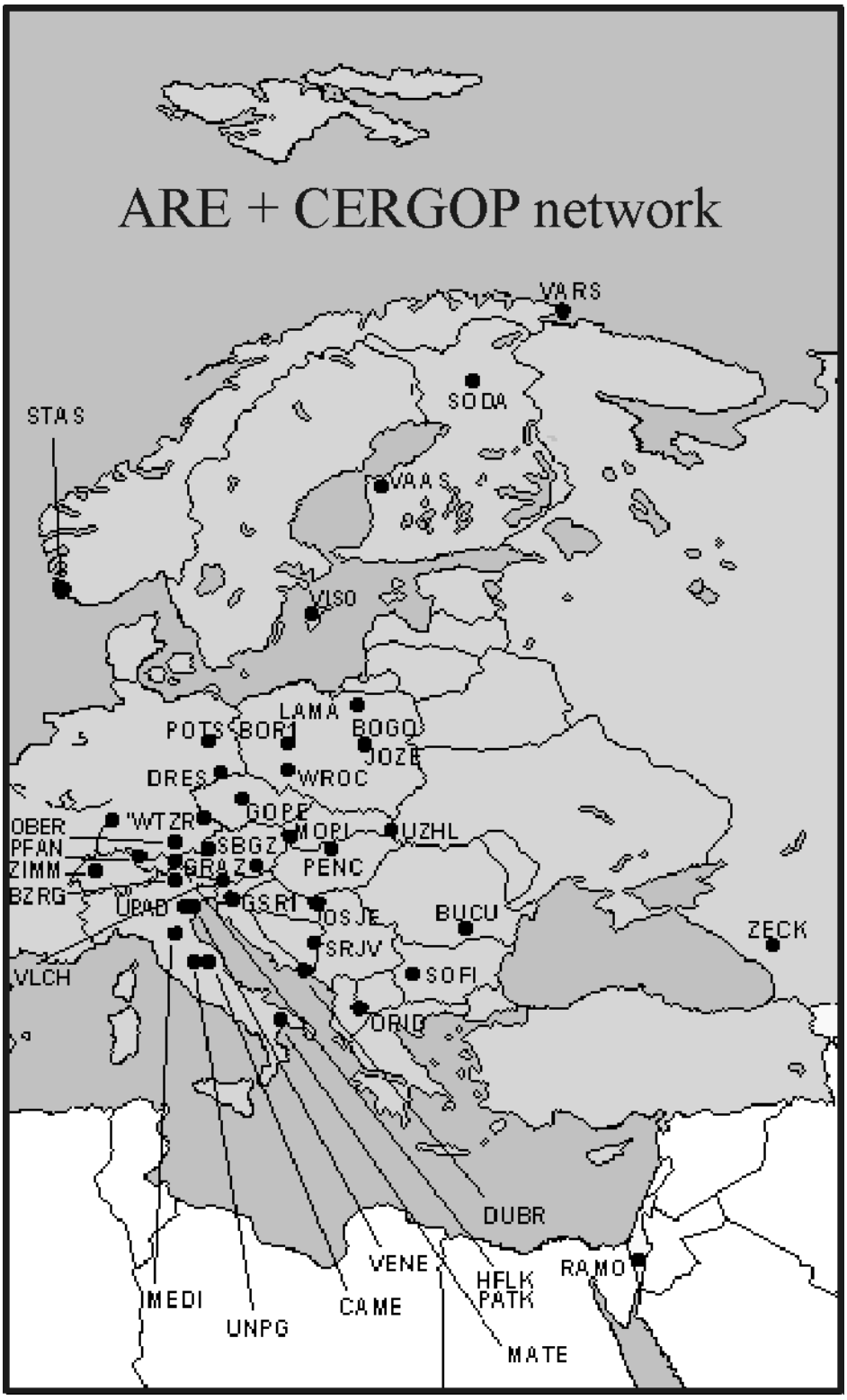

Figure 2. Austrian Extended and CERGOP network (status first half of 2001)

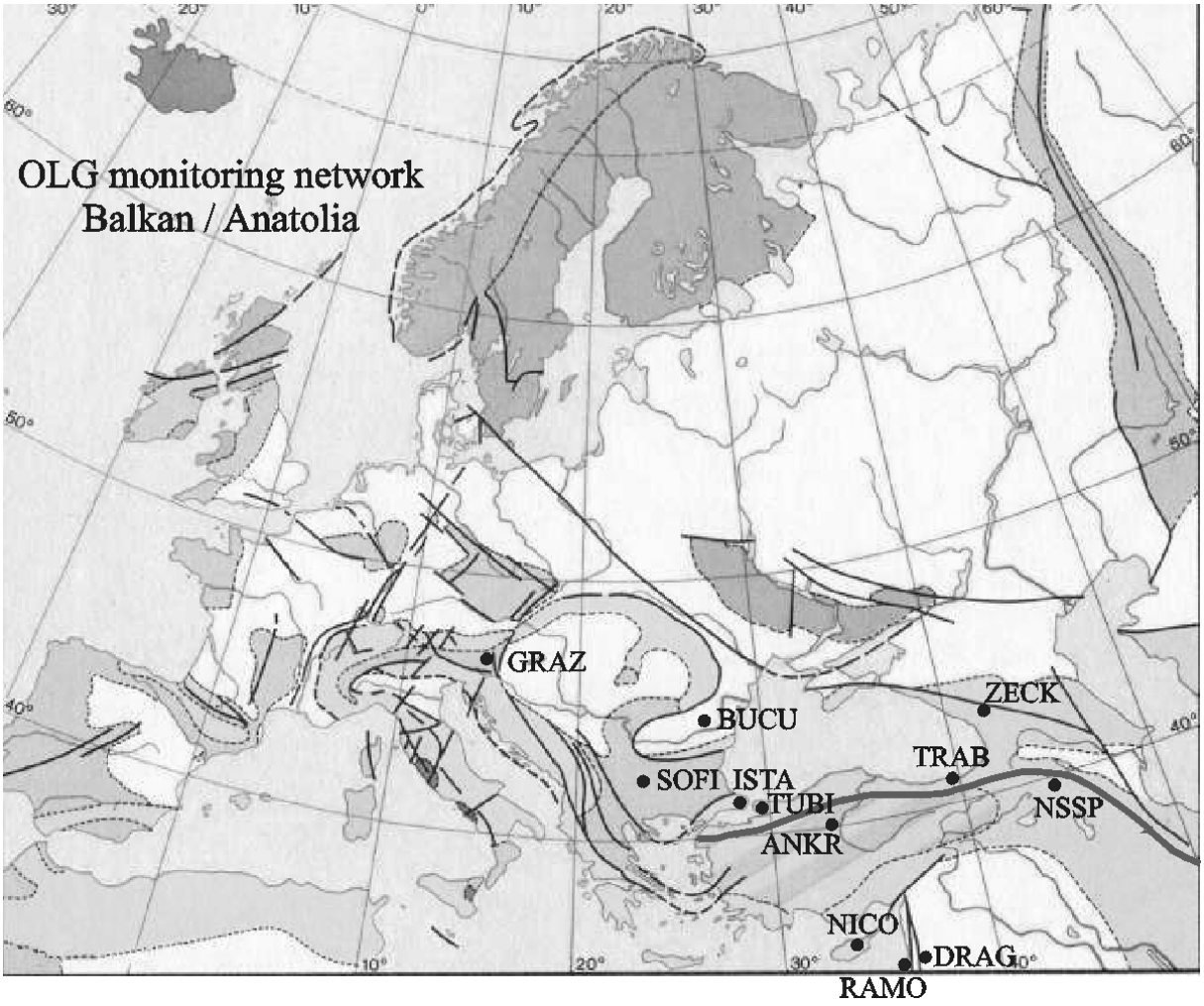

Figure 3. Monitoring network of region VI (status first half of 2001)

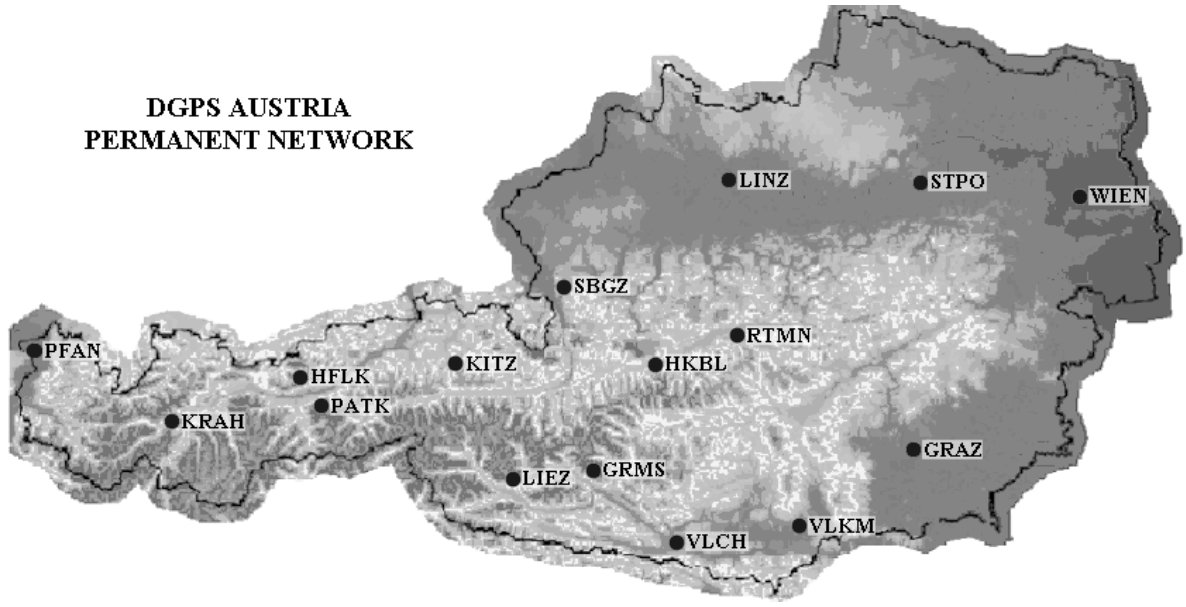

Figure 4. DGPS Austria network for DGPS, system maintenance and geodynamics monitoring (status 2001)