EUREF Symposium in Vienna, Austria, 1 – 4 June 2005

New Developments in EPN Analysis

H. Habrich

EPN Analysis Coordinator
Bundesamt für Kartographie und Geodäsie, Frankfurt, Germany

Abstract

Analysis centres process the hourly and daily GPS observations from EPN tracking stations and the results are then combined into the official EPN products. The majority of the analysis centres use the Bernese GPS Software for this task and the new software release 5.0 marks an important change in EPN analysis. Further EPN activities concentrate of studies to use GLONASS observations from EPN tracking sites and to densify the new ITRF realization by an EPN multi-year solution.

1 Introduction

The 16 EPN Local Analysis Centres (LACs) achieve the continuous analysis of observations of the EUREF GPS permanent network (EPN) and the EPN Analysis Coordinator (AC) and the special projects complete the final products. Although the general product types sustain over years, there is always the need to verify the product quality and to look for new worthwhile products. Against this background the following paragraphs report about a couple of activities to keep the EPN analysis mechanism close to the state-of-the-art and to evaluate some new ideas. A matter of special importance is the application of the newly released version 5.0 of the Bernese GPS Software, because 14 of the 16 LACs use it and also the sub-network combination is carried out with this software.

2 Bernese GPS Software V5.0 for Sub-Network Combination

Since the beginning of 2005 the ADDNEQ2 program of the Bernese GPS Software Version 5.0 has been used for the sub-network combination. 2 basic changes result from that technical innovation:

- Station coordinates are introduced as observations and the original numbers of phase observations are no longer used. That equals the number of unknown parameters to the number of station coordinates.
- „Minimum constraint conditions“ are applied to reference stations. The datum in general remains unchanged.

The new datum definition strategy causes no significant changes of the station coordinates, beside the reference stations. This behaviour was verified by a parallel combination of the sub-networks of GPS week 1302 with the old ADDNEQ and the new ADDNEQ2 program. Figure 1 shows the residuals of a Helmert transformation between the two approaches where only reference stations (marked with black squares) have significant residuals. The estimation of 3 Helmert parameters between the two network approaches results in 1.7/2.6/0.3 mm for North/East/Height components. These numbers may be considered as negligible for the datum fixing.

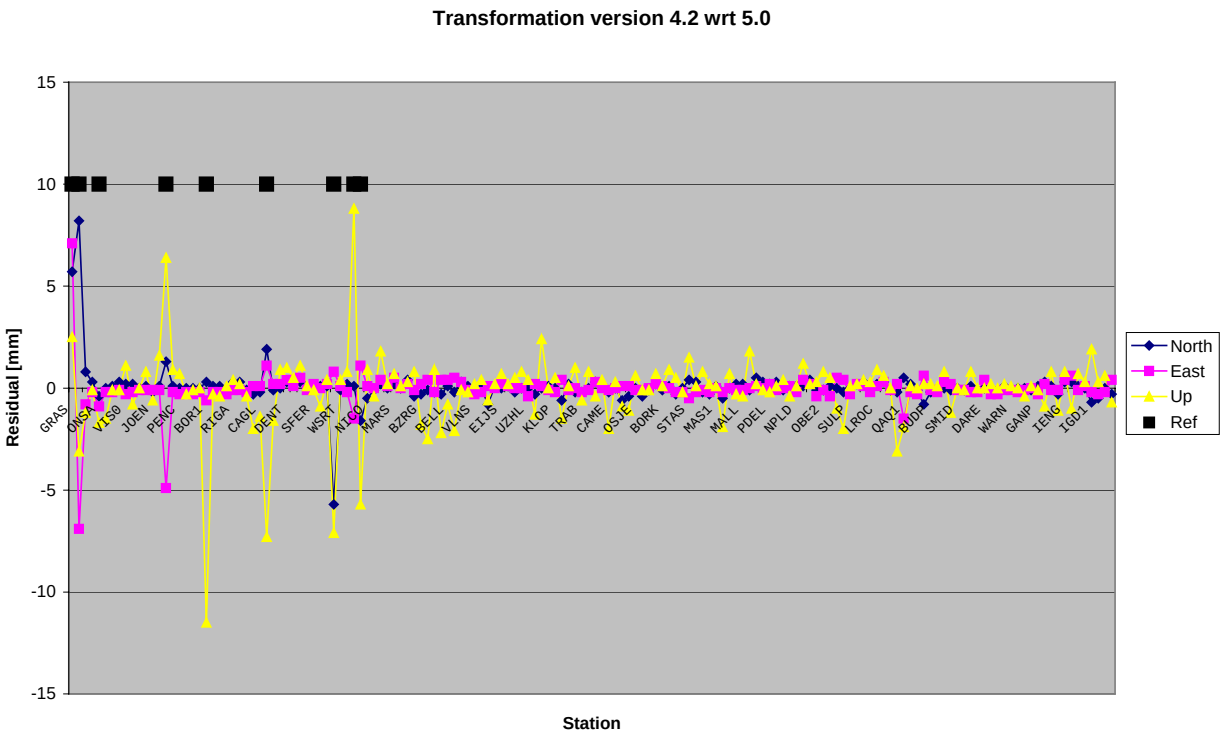

Figure 1: Comparison ADDNEQ w.r.t. ADDNEQ2 for Week 1302

3 Bernese GPS Software V5.0 for Sub-Network Analysis

The Bernese GPS Software version 5.0 has been released on May 24, 2004 and is now ready to be used by the LACs. The EPN coordination group agreed upon a two step procedure to introduce the new version into the EPN analysis, since the majority of the LACs use Bernese Software: Step 1 executes the change from version 4.2 to 5.0 and later on step 2 performs a change of processing options, e.g., estimation of tropospheric gradients. The change according to step 1 is in responsibility of each LAC individually, but a date for the step 2 change is not yet decided.

The EPN LAC-Mail No. 0486 that was distributed in April 2005 summarises the new processing options as follows:

- RNX2SNX PCF (as distributed with the software release) is used as „default“ with small changes,
- elevation cut off for observations has to be set to 10°,
- tropospheric gradients must not be submitted,
- all LACs apply common ocean loading coefficients.

The tropospheric gradient parameter have to be deleted from the normal equations before writing the final SINEX file, if a LAC estimates these parameters. The RNX2SNX PCF applies now a changed troposphere model (dry Niell a-priori model, estimation of wet Niell parameters) compared to the version 4.2 settings (no a-priori model, estimation of dry Niell parameters).

4 Combination of Daily Sub-Network Solutions

The Analysis Coordinator performed a study whereby he combined the daily EPN sub-networks as provided by two LACs and generated a daily combined network solution. This study follows two objectives:

- Originate a better visibility of short-term effects on coordinate time series, e.g., atmospheric pressure.
- Support external projects that apply daily solutions, e.g., European Sea Level Service (ESEAS)

The combination of daily solutions form the LACs is worthwhile, if the combined daily solutions show any benefit compared to the single daily solutions. No benefit could be confirmed within the scope of this study, where only daily solutions of 2 LACs have been combined. It is obvious to repeat the test with contributions from all 16 LACs. But at first potential users of a daily EPN combined product need to be identified, because further work requires a big effort.

5 Benefit of GLONASS for EPN

An initial analysis of GLONASS observations from EPN stations was carried out. Stations of the BKG EPN sub-network and additional German GPS/GLONASS permanent stations have been selected for processing at BKG as given in Figure 2.

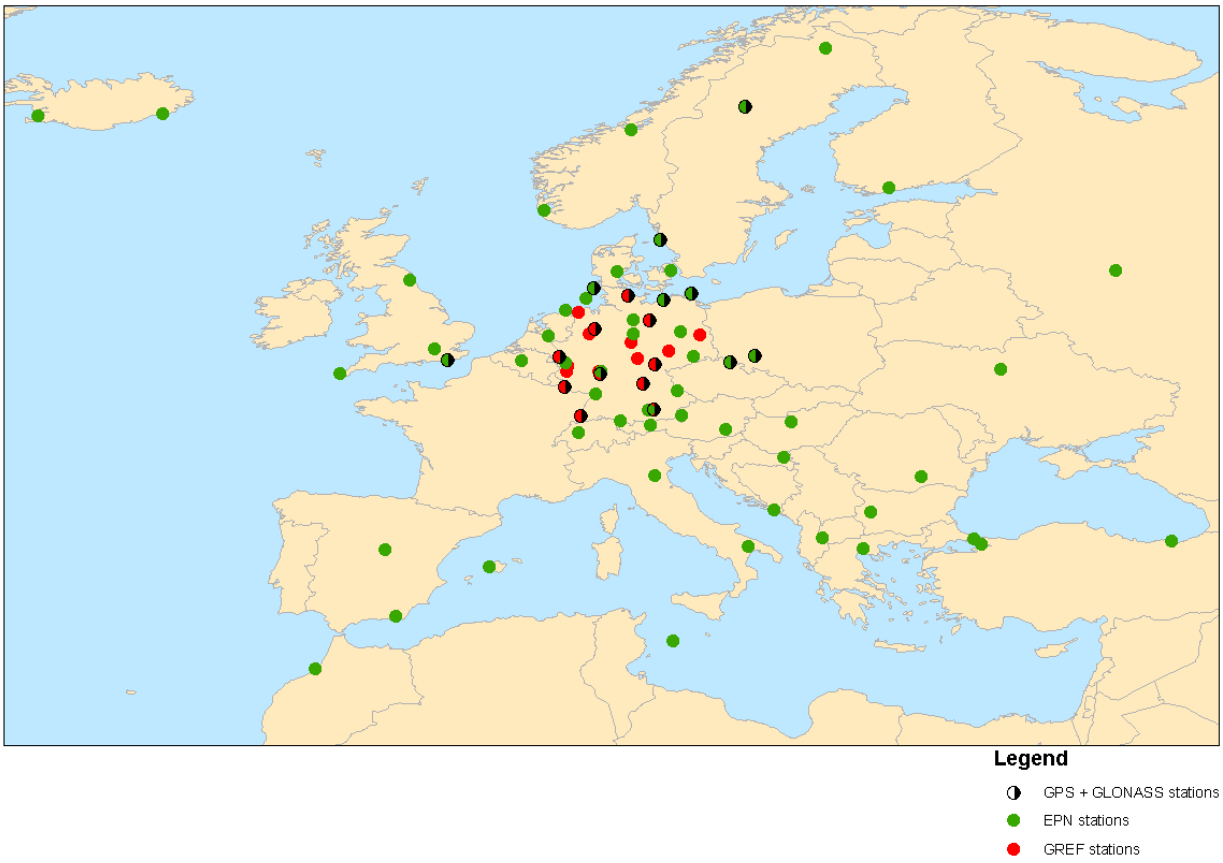

Figure 2: GPS/GLONASS Test Network

Table 1 summarizes key parameters from a “GPS only” and a combined GPS/GLONASS processing of the network. The additional GLONAS satellites lead surely to more ambiguities, but the reduced number of observations as listed in Table 1 could not yet be explained. It is obvious that the study needs further investigations, though the a-posteriori RMS remains unchanged after adding GLONASS.

	GPS	GPS/GLONASS
no. of station coordinates	234	234
no. of ambiguities	475	1122
no. of site troposphere parameters	1950	1950
no. of observations	233053	211148
a-posteriori RMS [mm]	1.2	1.2

Table 1: Statistics of Network Adjustment

6 Next ITRF Realization and the European Densification

The IERS distributed a Call for Participation on December 16, 2004 for „weekly“ SINEX files to be used for the next ITRF densification. A time series of station positions and EOPs from all techniques will be combined, where the EPN will contribute to the GPS technique with weekly SINEX files. These SINEX files have already been submitted to the IGS during the last year. EUREF was now asked to check the discontinuity table used by NRCan and Ambrus Kenyeres (Coordinator of the EPN Time Series Special Project) is comparing the IGS and EPN discontinuities.

The IAG sub-commission 1.3 „Regional Reference Frames“ initiated a regional densification of the new ITRF realization under responsibility of Zuheir Altamimi. Time-integrated solutions (positions and velocities) of 6 regional sub-commissions have been inquired and the EPN will contribute by a regional network for Europe. The computation of an EPN multi-year solution by the Analysis Coordinator is in work.

7 Summary

New developments with respect to analysis models and strategies as well as candidate products have been shown. These actions demonstrate the proceeding (not static) behaviour of EUREF’s EPN.

References:

EPN Central Bureau (2003): *Minutes of EUREF Analysis Workshop, Graz, September 18-19, 2003*, http://www.epncb.oma.be