

**Time & location:**

March, 23, 2015: 13:00 – 18:00, March, 24, 2015: 08:30 – 12:00

MUT Main Library, Sylwestra Kaliskiego 19

**AGENDA**

*Last update: March 10, 2015:*

1. Opening (Bruyninx)
2. Approval of minutes of 66<sup>th</sup> TWG meeting in Padova (all)
3. Review of Action Items from previous TWG meetings (all)
4. EUREF
  - a. EUREF ToR (Ihde)
  - b. EUREF elections 2015 (Ihde et al.)
5. EPN
  - a. EPN reprocessing 2 (Völksen)
  - b. EUREF Troposphere (Pacione):
    - b.i. Repro2
    - b.ii. Routine activities
    - b.iii. News from GRUAN meeting
  - c. EPN Real-Time Analysis Project, Broadcaster guidelines:
    - c.i. EPN Broadcaster Guidelines (Söhne, Bruyninx, Pacione et al.)
    - c.ii. Test Novatel SSR Receiver (Söhne, Neumaier)
  - d. EPN Densification (Kenyerer, Bruyninx, Caporali)
  - e. Duplicate 5-digit antenna numbers (Dach)
6. Working Groups
  - a. Multi-GNSS WG:RINEXRINEX3 toolkits (Brockmann, Dousa, Söhne)RINEX3 @ EPN  
CB and dataflow plans (Bruyninx)
    - a.i. Update on multi-GNSS processing and time scales (Caporali)
7. New ETRF2000 solution for Polish reference stations ASG-EUPOS (Ryczywolski)
8. CERGRN Campaign Validation (Caporali)
9. EUREF 2015 symposium (Ihde, Söhne)
  - a. Short Notes
  - a. Status of EPOS (Bruyninx)
  - b. EuroGeographics PosKEN & EUPOS (Ihde, Kenyerer)
  - c. UN-GGIM (Altamimi)
  - d. Status of ITRF2014 (Altamimi)
  - e. Plans for LAC Workshop and Fall TWG in Bern (Dach)
10. Action Items (all)

**Participants****TWG members:**

Z. Altamimi (ZA)  
E. Brockmann (EB)  
C. Bruyninx (CB)  
A. Caporali (AC)  
R. Dach (RD)



J. Dousa (JD)	
R. Fernandes (RF)	excused
H. Habrich (HH)	excused
J. Ihde (JI)	
A. Kenyeres (AK)	
M. Lidberg (ML)	excused
R. Pacione (RP)	
M. Poutanen (MP)	
W. Söhne (WS)	
G. Stangl (GS)	
K. Szafranek (KS)	
J. Torres (JT)	excused

**Guests:**

A. Araszkiewicz (AA)  
T. Liwosz (TL)  
C. Völksen (CV)  
M. Ryczywolski (MR)

## 1. Opening (Bruyninx)

In her property as chairwoman of the EUREF Technical Working Group (TWG), C. BRUYNINX opens the 67<sup>th</sup> meeting of the EUREF TWG, welcomes the participants and expresses her thanks to the Warsaw University of Armed Forces for the invitation and organization of this meeting. On behalf of the hosting Institution Prof. Sveta Viliewska welcomes the TWG and submits the best wishes for a successful meeting. A draft of the agenda has been distributed among the TWG. The participants accept the agenda after some minor corrections.

2. Approval of minutes of 66<sup>th</sup> TWG meeting in Padova (all)

The minutes are approved.

## 3. Review of Action Items from previous TWG meetings (all)

## 4. EUREF

## a. EUREF ToR (Ihde)

JI presents the new document of the ToR. Goal and Mission are now more clearly explained, as well the Organizational Structure. The structure of a Steering Committee is presented as an entity which prepares decisions to be made by the TWG. The TWG members discussed this possibility and the majority favors not to introduce a Steering Committee. The discussion then focuses on the voting right within the plenary. Currently the TWG proposes the candidates to be voted and the plenary ratifies. The TWG agrees that this is not a fair way of voting as it underweights some countries and overweights other countries, depending on the attendance at the plenary. Another option is that EUREF Representatives from contributing Nations are identified as active voters. However, in that case the TWG should keep a list of national representatives and voting should be done by email. JI points out that new rules should be discussed within the Assembly. He also suggests that

elections with the new rules are held in 2016. Special Projects should be removed and Pilot Projects should be created by the Working Groups. Hence they do not need to be included explicitly in the Technical Components. The Coordinators should be foreseen instead.

## b. EUREF elections 2015 (Ihde et al.)

An EUREF mail with the Candidates so far known has been circulated by the Secretary at the request of the chair of the Nominating Committee (JT). Nominations are open till end of April. In case more candidates are proposed for the same position (EUREF Chair, TWG Chair, EUREF Secretary), the TWG should vote at its next TWG meeting.

## 5. EPN

## a. EPN reprocessing 2 (Völksen; Araszkiewicz)

CV reviews the goals of EPN Repro2. Five GNSS LAC's are contributing (ASI, GOP, IGE, LPT and MUT). Combination will be done for coordinates/velocities by MUT and troposphere parameters by ASI. Each LAC provides at least one solution. Repro2 products by CODE are to be used for the analysis based on GAMIT and BERNESE, while the GIPSY analysis depends completely on the JPL reprocessed products. It is recommended to apply PCV with individual calibration for the antennas and to be consistent with the Guidelines for the EPN Analysis Centres. Benchmark tests with 4 weeks of data have already been completed in 2014. Contributions from all five ACs have been provided already. Additional contributions from MUT and GOP are going to be delivered. The contributions differ for the PCV model (type mean only, type mean plus individual calibrations), use of atmospheric loading (tidal and non-tidal, elevation cutoff angle and tropospheric mapping function (GMF, VMF1). A bug in the interpolation of the VMF within BSW affected some of the BSW solutions. A summary table with the various

contributions available at BKG is reviewed. GLONASS observations are included in the analysis since 2003 by LPT and IGE only. Most sites are present in 4 to 5 solutions. A combination based on normal equations is problematic with the ASI/GIPSY contribution since the normal equation cannot be restored (GIPSY uses a filter approach for estimating parameters). Using coordinates and the full covariance information instead of NEQ files offers an alternative. Combination of the Tropo products is done under the responsibility of ASI (see below). Scale and origin should be estimated in the combination, as orbits are fixed in direction only. AA reviews the combination for ASI, GOP, MUT, IGE and LPT: Helmert parameters, outliers are identified. GLOBK and ADDNEQ processings are compared. ASI contribution seems to introduce some noise which seems to be related to the combination strategy rather than to the quality of the solution.

#### b. EUREF Troposphere (Pacione)

##### Repro2

RP reviews the processing status. GO2 solutions (VMF1 mapping function) seems to differ considerably from the combined. The interpolation error in the BSW on the VMF1 causes some solutions for some sites to be unusable. The GO0 (GMF mapping function) solution seems better. Gradients computed with GAMIT (MUT) seem to be quite different from the average. ZPD are compared: EUR vs. VLBI vs. Radiosonde, and found to be within +/- 15 mm. It was decided that BKG should remove the GO2 solutions immediately and JD will upload the GO0 solutions instead.

##### Routine activities

Routine combination is done by ASI since GPS week 1800. The jump in the time series of the standard

deviation occurred at that GPS week can be related to a different way of flagging bad data/outliers or computing sigma. The following plots have been updated at EPNCB: ZTD time series and monthly mean; EUR vs. Radiosonde comparisons. EUR vs. VLBI comparisons are on standby due to some bugs in the VLBI time series which are under investigation by the IVS tropospheric coordinator.

#### News from GRUAN meeting

GCOS (Global Climate Observing System) reference upper air network is presented: it is a reference network designed to meet climate requirements to fill a major void in the current global observing system. Two GRUAN (GCOS Reference Upper-Air Network) sites are in the EPN (NYAL, SODA).

#### c. EPN Real-Time Analysis Project, Broadcaster guidelines: EPN Broadcaster Guidelines (Söhne, Bruyninx, Pacione et al.)

WS describes the structure of the document, to be added to the Data Center Guidelines. A Web page at the EPN is monitoring the performance of all the broadcasters. There is a regional improvement in consistency and quality of the data streams. EUREF IP mailing list has been reviewed and reactivated. Station GANP mixes NULL antenna with TRM, causing inconsistencies with antenna corrections. It is decided that as soon as the system detects a null antenna, it stops the casting of that stream.

#### Test Novatel SSR Receiver (Söhne, Neumaier)

First commercial receiver supporting corrections from regional or satellite/global sources. Corrections are accepted from Terrastar-D and

PACE for a PPP solution. However corrections from regional broadcasters can also be fed (e.g. CLK10 from BKG). Results seem very promising ( $\pm 20$  cm with 6 to 10 GPS satellites). Latency seems to increase with time, and a restart of the receiver is necessary. The comparison with BNC seems quite consistent.

d. EPN Densification (Kenyeres, Bruyninx, Caporali)

AK reports on the status of the densification which covers weeks 1400-1800. Data from Italy delayed because of DOMES/station name issues. Logfiles are missing from a number of sites. Working Group is needed for communication, share and distribute workload, product validation and publication of the results. Contributing analysis centers are reviewed. The operations of the WG are reviewed. Cooperation with EUPOS, CEGRN and EPOS are foreseen. New AC's are welcome.

In the EPN CB web page three types of densification sites are foreseen: EPN, active densification and proposed densification sites. The structure and content of the densification Web page is reviewed. The charter of the WG will soon be finalized.

e. Duplicate 5-digit antenna numbers (Dach)

BSW 5.2 has improved functionality to deal with duplicate antenna number for antennas with individual calibrations. RD reviews several options. EPN CB will generate the required metadata files and TWG members will test the proposed solution and provide feedback to RD.

5. Working Groups

a. Multi-GNSS WG:RINEX

a.i. BSW has an updated STA file which allows for checks of antenna type and serial number. Several options are reviewed. A key issue is to be able to manage the antennas

with individual calibration. RINEX3 toolkits (Brockmann, Dousa, Söhne)

EB reports on the Multi-GNSS Working Group. RINEX 3 QC monitoring using Anubis and BNC. This time 208 RINEX 2 sites are monitored. JD presents Anubis QC Tool version 1.3.2: this is fully support multi-constellations. Cycle slips are checked on all frequencies. Several options for data/NAV display, editing and merging are now available. WS reviews the BNC Quality checking. New PPP module implemented. Supports Galileo processing and BeiDou ephemeris decoding. Troposphere SINEX output, Rx2/3 compatibility. Editing and Quality Control is supported. RINEX3 @ EPN CB and dataflow plans (Bruyninx)

Increasing number of stations submitting RINEX 3.02RINEX. Sites Logs need to be updated for Galileo, SBAS etc. RINEX3 long station names (nine characters) are going to be introduced. Effort to make RINEX3 data more visible in the Web site.

a.ii. Update on multi-GNSS processing and time scales (Caporali)

Processing of selected EPN/MGEX sites with different receivers has continued in 2015. AC reports that the GLONASS time scale as defined by the data in the broadcast ephemeris is within few tens of nanoseconds from GPStime, depending on receiver type. Galileo time has been quite unstable in 2014, but has considerably stabilized in the past weeks, yet not enough to fulfill the specification of  $\pm 5$  ns relative to GPS time. Offsets of BeiDou time show an oscillatory pattern relative to GPS time, and are of the order of some hundreds of nsec. QZSS1 time seems to be nicely aligned to GPS time, within 10 ns. The monitoring will continue in the future and include more European receivers. The results are available in a dedicated web page of Rete GPS Veneto.

6. New ETRF2000 solution for Polish reference stations ASG-EUPOS (Ryczywolski)

MR describes the ETRS89 densification in Poland: 92 non-EPN ASG EUPOS permanent sites, 20 non-EPN sites in neighboring countries and 40 RPN\_A sites had been observed for almost 4 years. GPS and

GLONASS (when available) have been processed according to the EPN Guidelines. Long term solution was obtained by stacking the daily solutions. The value of the Translations was shown at only one epoch, whereas it would be desirable to show the Translations at the beginning and end of the ca. 4 years campaign to check if there is a trend. The obtained solution is compared to a previous realization in IGB05. The agreement is rather good in the horizontal. Also in the vertical, up to a nearly constant bias of a few mm. The TWG approves the methodology used and invites MR to submit the final report asap.

#### 7. CERGRN Campaign Validation (Caporali)

After reviewing the processing options of the 10 weekly campaigns spanning the interval 1996-2013, the results and the products to be validated are presented. Epoch sites should be validated at the campaign epochs as class B. Same with campaign sites occurring at different epochs, but with insufficient epochs or affected by discontinuities. For a limited number of sites with continuous time series spanning several campaigns, the option of Class A qualification can be examined. The effect of setting up discontinuities was discussed. It is difficult to understand discontinuities when successive samples of the coordinates are separated by two or more years. For this reason, and taking into account that some CERGRN sites are routinely processed and therefore the discontinuities are more precisely defined, it is recommended to consider the discontinuities from these sites, resulting from independent processing. EPN sites should be removed from the list of sites to be validated.

#### 8. EUREF 2015 symposium (Ihde, Söhne, Habrich)

- a. The details of the Symposium are reviewed. Particular attention is given to the invited (solicited) talks and to their coverage of specific critical items.

**AI10\_AgendaItem9\_TW67 on AC:** remember with a EUREF mail the deadlines, particularly for Hotel

reservation (April 21). Additional mail to potential presenters of orals/posters.

**AI11\_AgendaItem9\_TW67 on AC:** remember session chairs to identify keynote speakers and communicate them to the Organizers.

#### Short Notes

##### a. Status of EPOS (Bruyninx)

The EPOS project has been submitted (mid of January) and the evaluation is underway.

##### b. EuroGeographics PosKEN & EUPOS (Ihde, Kenyeres)

EuroGeographics has apparently no clear view how to continue, after the resignation of A. Oruba from the EUPOS Chair. JI intends not to participate in PosKEN any further, and complains about the lack of cooperation from EuroGeographics.

##### c. UN-GGIM (Altamimi)

The final resolution of the UN on GGRF finally endorsed February, 27. Special webpage <http://www.unggrf.org>.

- d. Status of ITRF2014 (Altamimi) 100 SLR sites contribute to ITRF2014, plus VLBI, GNSS and DORIS sites, for a total of 1000 sites and 2000 stations, as multiple techniques may be available at each site. However the true IGS sites are just 400. Draconitic effects, postseismic (non linear) deformations are included in the analysis. The solution should be ready by this summer.
- e. Organization of the LAC Workshop and EUREF TWG meeting (Dach). The selected room is Kuppelraum in the University main building. The time frame should be Tuesday October 13 (TWG) and 14-15 (LAC Workshop) 2015.

## 10. Action Items (all)

**AI1\_AgendaItem4\_TWG67 on JI:** to summarize the discussion on the ToR and prepare an improved draft of the ToR and Action Plan. JI to contact the TWG to find out attendees and date of a specific meeting within the EGU meeting in Vienna.

**AI2\_AgendaItem4\_TWG67 on ZA, JT (and all involved in nomination committee):** to inform TWG on details of submitted nominations

**AI3\_AgendaItem5a\_TWG67 on KS:** to test the various options to combine the various contributions.

**AI4\_Agenda Item5a\_TWG67 on CV:** encourages the LACs to provide homogenous solutions in respect for the impact of non tidal atmospheric loading.

**AI5\_AgendaItem5b\_TWG67 on RP:** get in touch with GRUAN to consider inclusion in the EPN of stations of GRUAN for quality control and cross checking.

**AI6\_AgendaItem5b\_TWG67 on CV:** based on the analysis of JD compile a list of bad EPN sites.

**AI7\_AgendaItem5c\_TWG67 on CB, WS and RP:** to finish the guidelines for broadcasters by the end of April 2015. Run at BKG a tool to monitor the contents of the real-time data streams.

**AI8\_AgendaItem5c\_TWG67 on All:**

review the Charter of the Densification WG by the end of April 2015. AK to provide final charter for approval at next TWG.

**AI9\_AgendaItem6\_TWG67 on WS, GS, CB and EB:** to propose an action plan by the next TWG on how to start providing RINEX 3 data (using the long filenames) at the EPN data centers RINEX

**AI10\_AgendaItem8\_TWG67 on AK and AC:** AK to provide to AC a list of discontinuities of CEGRN permanent sites for inclusion in the adjustment of the CEGRN Campaigns, asap. AC: to update the CEGRN multi-year combination and discontinuities to take the new info from AK into account.

**AI11\_AgendaItem9\_TWG67 on AC:** remember with a EUREF mail the deadlines, particularly for Hotel reservation (April 21). Additional mail to potential presenters of orals/posters to solicit their contribution.

**AI12\_AgendaItem9\_TWG67 on AC:** remember session chairs to identify keynote speakers and communicate them to the Organizers.