

Report of the WUT Analysis Centre

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EUREF Analysis Centres Workshop
Bern, October 14–15, 2015

This report contains EUREF and EUREF-related activities of the Warsaw University of Technology (WUT) Analysis Centre (AC) during the last 2 years.

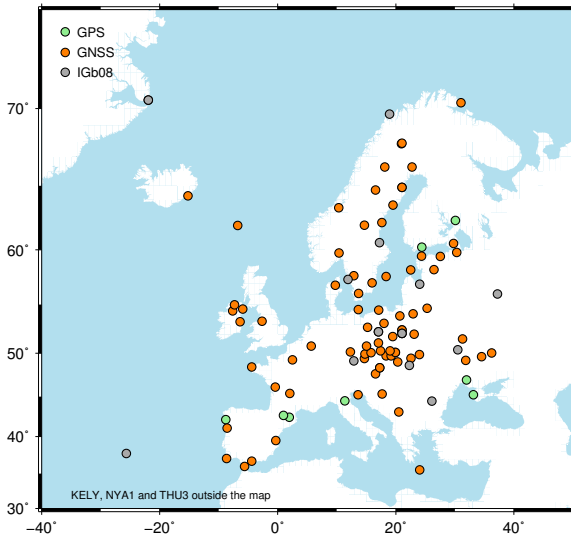
The following topics are presented:

- 1 Routine analysis:
 - Products
 - Network characteristics
 - Strategy description
- 2 New processing options results:
 - GMF vs. VMF1
 - impact of surface loading effects
- 3 Analysis of Poland's national GNSS reference network
- 4 Summary and outlook

Currently WUT Analysis Centre (AC) contributes to EPN with the following products:

- Final (since GPS week 861, July 1996)
 - weekly coordinate estimates
 - daily coordinate estimates
 - daily troposphere zenith delays and horizontal gradients
- Rapid (since GPS week 1565, January 2010)
 - daily coordinate estimates
 - fully automated process
 - since 2010, only 13 daily WUT solutions missing (0.6%)

WUT Subnetwork



Network status:

- 103 stations:
 - 88 GNSS
 - 17 IGB08
 - 1 inactive

Since 2013:

- 26 new
- 2 discontinued

Since GPS week 1765 we use Bernese GNSS Software 5.2 to process GNSS data. Main changes in our strategy include:

- Ambiguity resolution for GLONASS
- GNSS-specific PCVs used (if available)
- Global mapping function (GMF) used for troposphere zenith delay modelling
- Atmospheric tidal loading applied
- Consistency with IERS 2010 Conventions

Comparison of BSW 5.0 and 5.2 weekly solutions:

BSW version	Data span (GPS weeks)	Mean WRMS ¹ (mm)		
		N	E	U
5.0	1648-1764	1.05	0.89	2.82
5.2	1765-1860	0.96	0.83	2.64

¹ from CATREF stacking

Testing new processing options

With the new Bernese GNSS Software 5.2, we tested new processing strategies and their impact on GPS regional solutions:

- GMF/GPT vs. VMF1/ECMWF
- without and with applying non-tidal surface loading effects

Special tests performed:

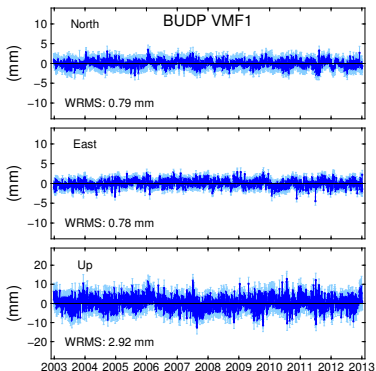
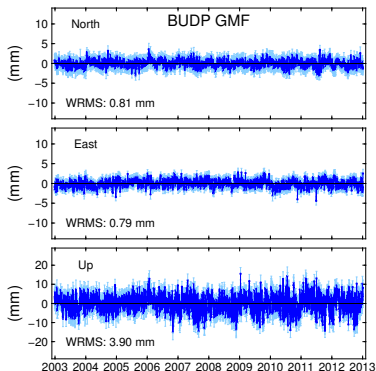
- 10 years of data
- 51 EPN stations (with min. 90% of data available)
- CODE Repro2 products
- NASA GGFC loading models applied at the observation level (computed variants in Table →)
- Daily and weekly solutions analyzed with CATREF software

Solution variant	ATM (1)	OCN (2)	HYD (4)
N0/G0	—	—	—
N1/G1	yes	—	—
N2/G2	—	yes	—
N4/G4	—	—	yes
N5/G5	yes	—	yes
N7/G7	yes	yes	yes

N_n - VMF, G_n - GMF

Results: GMF vs. VMF1

Solution type	ID	Mean WRMS (mm)		
		N	E	U
GMF/GPT	G0	1.12	0.98	3.69
VMF1/ECMWF	N0	1.11	0.98	3.35



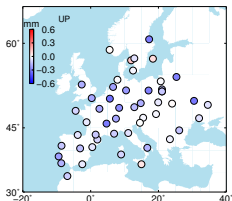
Results: impact of loading effects (1/2)

Mean WRMS of daily and weekly solutions

Solution type	Daily WRMS (mm)			Red. U wrt N0 (%)	Weekly WRMS (mm)			Red. U wrt N0 (%)
	N	E	U		N	E	U	
N0	1.11	0.98	3.35	—	0.82	0.71	2.14	—
N1	1.09	0.94	3.14	6.3	0.81	0.69	2.02	5.8
N5	1.08	0.94	3.05	9.0	0.80	0.69	1.88	12.3
N7	1.07	0.93	3.02	9.8	0.80	0.68	1.86	13.5

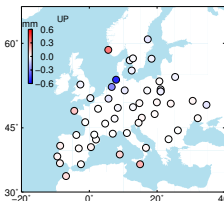
Repeatability reduction of daily solutions for each station:

N1-N0



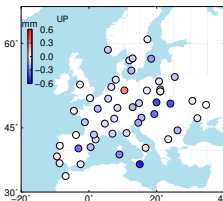
Mean red: 5.8%

N2-N0



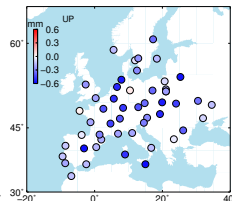
0.5%

N4-N0



4.8%

N7-N0



13.5%

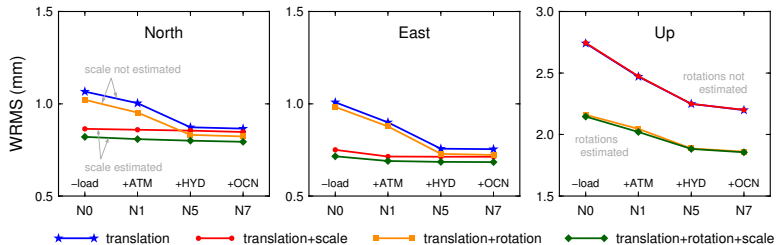
Results: impact of loading effects

GMF, VMF1

Solution type	Daily WRMS (mm)			Solution type	Daily WRMS (mm)		
	N	E	U		N	E	U
N0	1.11	0.98	3.35	G0	1.12	0.98	3.69
N1	1.09	0.94	3.14	G1	1.11	0.96	3.73
N5	1.08	0.94	3.05	G5	1.11	0.96	3.63
N7	1.07	0.93	3.02	G7	1.10	0.96	3.62

Nn - VMF1 used Gn - GMF used

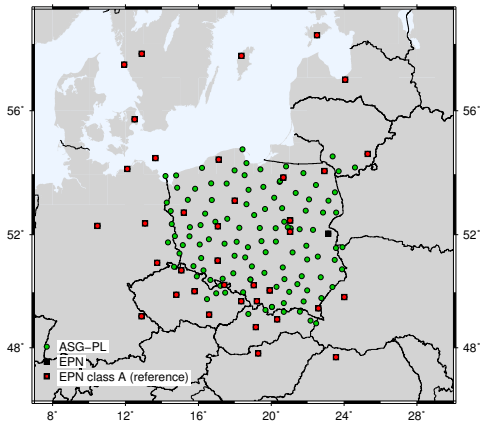
Reference frame definition



During 2014-2015, we cooperated with Polish Head Office for Geodesy and Cartography (Marcin Ryczywolski), on the reprocessing of Poland's national GNSS reference network, and on creating a new realization of ETRS89 for Poland.

- solution accepted as Class A standard by EUREF TWG in Leipzig this year (Resolution no. 2)
- daily solutions provided to EUREF Densification project

Poland's national GNSS reference network



- Bernese GNSS Software 5.2
- 3.7 years of GNSS data
- ~150 stations processed in total
- mean repeatability of daily coordinates:

N	E	U
(mm)	(mm)	(mm)
1.1	1.0	3.2

WUT AC EUREF and EUREF-related activities during the last 2 years:

- providing routine final and rapid GNSS solutions
- performing tests of new processing options
- participation in creation of a new reference frame for Polish reference GNSS network

Plans:

- change to VMF1 in our routine final solutions (within few weeks)
 - introduce atmospheric non-tidal loading corrections in routine analysis; remove the effect before submission to EUREF
- We still plan to contribute to EUREF with near-real time solutions.