

EPN Analysis Centres Coordinator Report

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Analysis Combination Centre

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This presentation will give an overview of the changes related to EPN Analysis Centres (AC), GNSS data processing options and the combination of AC solutions which were made during the last year.

Introduction – basic facts

The EPN Analysis Coordinator combines and analyses GNSS solutions computed by the EPN Analysis Centres

- 16 ACs regularly process GNSS data from 300+ EPN stations (distributed processing)
- Each AC provides solutions for its subnetwork in SINEX format:
 - final daily and weekly
 - some ACs in addition also provide rapid daily (11 ACs) and ultra-rapid (3) solutions
- AC solutions (daily final and rapid, and ultra-rapid) are combined using Bernese software
 - before combination, metadata (antennas, receivers, PCOs, eccentricities) provided in AC SINEX files are checked, and problematic stations are excluded
 - detected outliers are iteratively removed from AC solutions
- Final daily combined solutions are the input for the EPN multi-year solution.

EPN Analysis Centres description

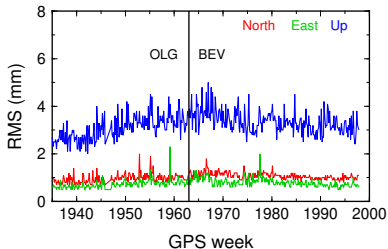
AC	Agency	Remark
ASI	Centro di Geodesia Spaziale, Italy	
BEK	Bavarian Academy of Sciences & Humanities, Germany	
BEV	Federal Office of Metrology and Surveing, Austria	New AC
BKG	Bundesamt fuer Kartographie und Geodaesie, Germany	
COE	Center for Orbit Determination in Europe, Switzerland	
IGE	Instituto Geografico Nacional, Spain	
IGN	Institut Geographique National, France	
LPT	Federal Office of Topography swisstopo, Switzerland	
MUT	Military University of Technology, Poland	
NKG	Nordic Geodetic Commision, Sweden	
OLG	Austrian Academy of Science, Austria	Former AC
RGA	Republic Geodetic Authority, Serbia	
ROB	Royal Observatory of Belgium, Belgium	
SGO	BFKH Satellite Geodetic Observatory, Hungary	
SUT	Slovak University of Technology, Slovakia	
UPA	University of Padova, Italy	
WUT	Warsaw University of Technology, Poland	

New EPN Analysis Centre

The Federal Office of Metrology and Surveying, Austria (BEV) AC took over the responsibilities of the Austrian Academy of Science (OLG) analysis centre.

- BEV solutions are used in official EPN combinations since week 1963. The same subnetwork of EPN stations is used as for OLG.

Below, RMS of daily station position residuals of OLG and BEV solutions with respect to combined solutions.



In October 25–26, 2017, the EPN Analysis Centres workshop was held in Brussels.

- Presentations and conclusions from the workshop can be found at the EPN CB webpage: http://www.epncb.eu/_newseventslinks/workshops/EPNLACWS_2017.

One of the objectives of the workshop was the improvement of EPN products.

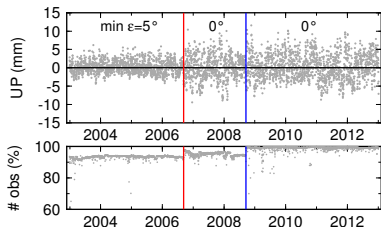
Harmonization of troposphere modelling

In order to try to improve the consistency of daily AC coordinate solutions, a harmonization of the troposphere modelling was agreed during the workshop. It was decided that since week 1980 (or earlier) onwards all EPN ACs will use the VMF1/ECMWF approach.

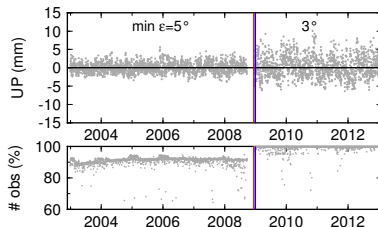
- at the time, 6 ACs used GMF/GPT approach, and 10 ACs used VMF1/ECMWF approach.

VMF1 vs. GMF: comparison of station height time series

One of the motivation of the harmonization of the troposphere modelling were discrepancies noticed in differences of the height component time series obtained using VMF1 and GMF.



BUDP00DNK



MLVL00FRA

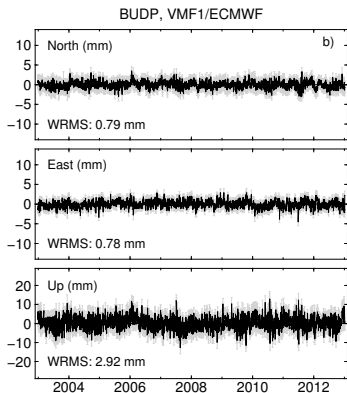
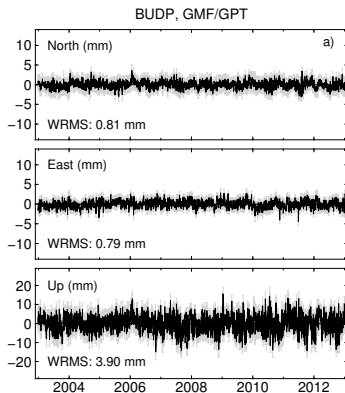
- high dependency on minimum elevation (red: change in minimum elevation, blue: receiver change)
- VMF1/ECMWF approach performs better when using low elevation data than GMF/GPT.

Remark: GPS processing: $\varepsilon = 3^\circ$, elevation weighting: $\sin^2 \varepsilon$.

Analysis Centres Workshop, Brussels, October 25-26, 2017

Example of coordinate time series: BUDP00DNK

■ comparison of GMF/GPT and VMF1/ECMWF



EPN Analysis Centres characteristics (October 2017)

AC	Software	Solutions ¹		# sites	Troposphere	ε	GNSS	VMF1
ASI	GOA 6.2	F	R	54	VMF1/ECMWF	3°	G	yes
BEK	BSW 5.2	F	R	97	VMF1/ECMWF	3°	GR	yes
BEV	BSW 5.2	F	–	101	VMF1/ECMWF	3°	GR	yes
BKG	BSW 5.2	F	R	117	GMF/GPT	3°	GR	–
COE	BSW 5.3	F	–	43	VMF1/ECMWF	3°	GR	yes
IGE	BSW 5.2	F	R	86	GMF/GPT	3°	GR	–
IGN	BSW 5.2	F	–	63	GMF/GPT	3°	GR	–
LPT	BSW 5.3	F	R	60	VMF1/ECMWF	3°	GREC	yes
MUT	BSW 5.2	F	–	144	GMF/GPT	3°	GR	–
NKG	BSW 5.2	F	–	88	VMF1/ECMWF	3°	GR	yes
RGA	BSW 5.2	F	–	55	VMF1/ECMWF	3°	GR	yes
ROB	BSW 5.2	F	R	97	GMF/GPT	3°	GR	–
SGO	BSW 5.2	F	R	42	VMF1/ECMWF	3°	GR	yes
SUT	BSW 5.2	F	–	59	VMF1/ECMWF	3°	GR	yes
UPA	BSW 5.2	F	R	57	GMF/GPT	3°	GR	–
WUT	BSW 5.2	F	R	118	VMF1/ECMWF	3°	GR	yes

¹ Solutions: F – final daily, R – rapid daily

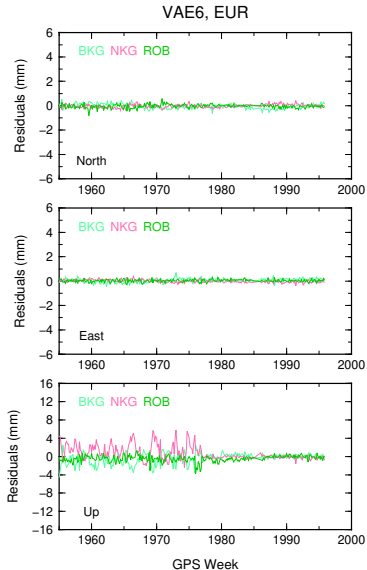
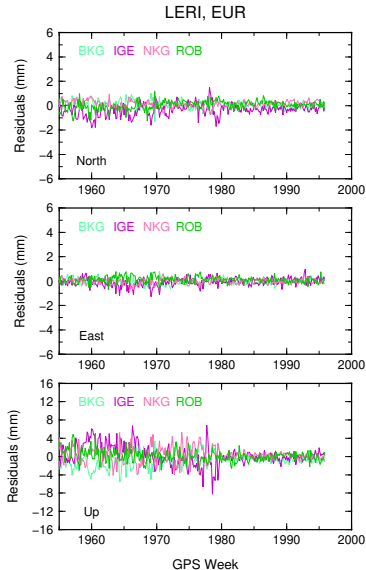
EPN Analysis Centres characteristics (May 2018)

AC	Software	Solutions ¹		# sites	Troposphere	ε	GNSS	VMF1
ASI	GOA 6.2	F	R	54	VMF1/ECMWF	3°	G	yes
BEK	BSW 5.2	F	R	97	VMF1/ECMWF	3°	GR	yes
BEV	BSW 5.2	F	–	101	VMF1/ECMWF	3°	GR	yes
BKG	BSW 5.2	F	R	117	VMF1/ECMWF	3°	GR	1976
COE	BSW 5.3	F	–	43	VMF1/ECMWF	3°	GR	yes
IGE	BSW 5.2	F	R	86	VMF1/ECMWF	3°	GR	1980
IGN	BSW 5.2	F	R	63	VMF1/ECMWF	3°	GR	1988
LPT	BSW 5.3	F	R	60	VMF1/ECMWF	3°	GREC	yes
MUT	GAMIT	F	R	144	VMF1/ECMWF	5°	GR	1980
NKG	BSW 5.2	F	–	88	VMF1/ECMWF	3°	GR	yes
RGA	BSW 5.2	F	–	55	VMF1/ECMWF	3°	GR	yes
ROB	BSW 5.2	F	R	97	VMF1/ECMWF	3°	GR	1977
SGO	BSW 5.2	F	R	42	VMF1/ECMWF	3°	GR	yes
SUT	BSW 5.2	F	–	59	VMF1/ECMWF	3°	GR	yes
UPA	BSW 5.2	F	R	57	VMF1/ECMWF	3°	GR	1979
WUT	BSW 5.2	F	R	118	VMF1/ECMWF	3°	GR	yes

¹ Solutions: F – final daily, R – rapid daily

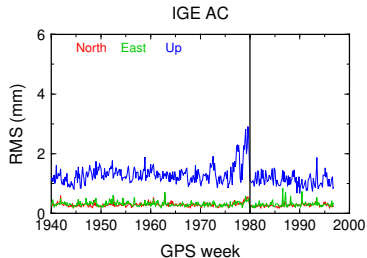
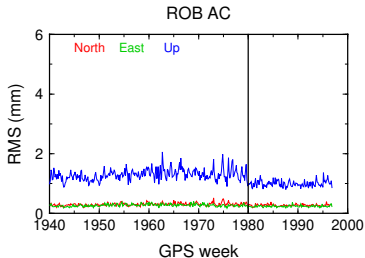
Since week 1980 MUT analysis centre also changed the BSW software to GAMIT.

Examples of AC station position residual time series

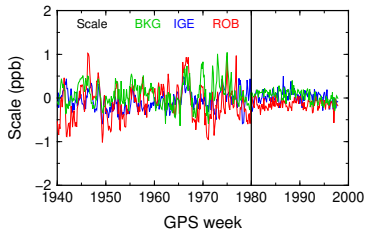


Impact of VMF1 modelling

RMSs of daily station position residuals wrt. to combined solutions:



Impact on the scale between AC solutions and combined solutions:



At the AC workshop, also the inclusion of Galileo observations in EPN operational analysis was discussed.

- Due to a low availability of ground antenna calibrations for Galileo observations, we decided to wait with the introduction of Galileo observations in operational processing.

However, since including Galileo into the EPN analysis is an important goal for the future, and since CODE Multi-GNSS consistent products are available, we would like to encourage EPN ACs to generate test solutions including Galileo observations, and provide such solutions to ACC for testing (in addition to operational solutions).

Station exclusions: daily excluded files

During the GNSS data processing ACs exclude stations according to information given in special files (excluded files) provided by the EPN CB. The exclusions can be made because of antenna, receiver or firmware change.

Since March 2018, in addition to the well-known weekly excluded files, also daily files are available at the EPN CB (EPN LAC Mail No. 2277).

- On the basis of daily excluded files, stations can be excluded from daily coordinate solutions only for a particular day (and not from the remaining days of the week),
- More data can be preserved in daily coordinate solutions.

Weekly excluded files should be used only for station exclusions from weekly coordinate solutions, and from troposphere solutions.

- The new EPN AC – BEV, took over the responsibilities of the OLG AC and started providing operationally final GNSS solutions,
- The switch from GMF/GPT to the VMF1/ECMWF approach was done. An improvement could be noticed in terms of consistency of AC coordinate solutions,
- EPN ACs are asked to provide GPS+GLO+GAL solutions to ACC for testing.