# EPN Analysis Centres Coordinator Report

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Analysis Combination Centre

EUREF Analysis Centres Workshop

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## Outline

- Recent activities of the EPN Analysis Combination Centre (ACC)
- New EPN Analysis Centre
- Proposal to harmonize troposphere modelling
- Improving rapid products

# Recent EPN ACC activities

- Change to daily combinations since week 1925 (EPN LAC mail 2134, EUREF mail 8861)
    - update of daily and weekly combinations reports (being sent via EUREF and EPN LAC mails)
    - update of EPN ACC webpage (`www.epnacc.wat.edu.pl`)
    - preparation of new scripts for AC SINEX files checking and email notifications
- Switch to the new reference frame
    - since week 1934 AC combinations are done in the IGS14 reference frame

# New EPN Analysis Centre

After 20 years of operation, due to retirement of Guenter Stangl, the OLG EPN AC has stopped its activities.

The responsibilities of the OLG EPN AC has been taken over by the Federal Office of Metrology and Surveing, Austria (BEV). The BEV EPN AC is managed by Philipp Mitterschifthaller.

# New EPN Analysis Centre

- The BEV solutions from weeks 1958-1962 were tested.
- Since GPS week 1963, BEV solutions are included in official combined solutions
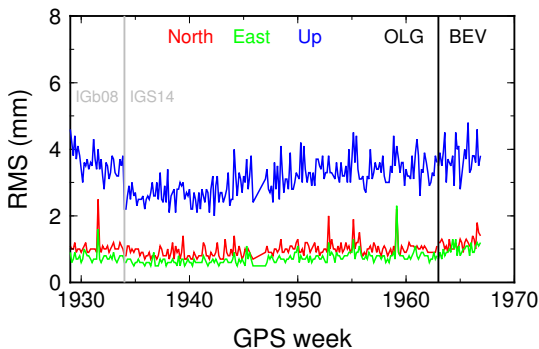
# EPN Analysis Centres characteristics

| AC | Software | Solutions[1] | | | # sites | Troposphere | $\varepsilon$ | GNSS |
|---|---|---|---|---|---|---|---|---|
| ASI | GIPSY 6.2 | F | R | N | 53 | VMF1/ECMWF | 3° | G |
| BEK | Bernese 5.2 | F | R | – | 97 | VMF1/ECMWF[2] | 3° | GR |
| BKG | Bernese 5.2 | F | R | N | 117 | GMF/GPT | 3° | GR |
| COE | Bernese 5.3 | F | – | – | 43 | VMF1/ECMWF | 3° | GR |
| IGE | Bernese 5.2 | F | – | – | 91 | GMF/GPT | 3° | GR |
| IGN | Bernese 5.2 | F | – | – | 64 | GMF/GPT | 3° | GR |
| LPT | Bernese 5.2 | F | R | N | 60 | VMF1/ECMWF | 3° | GREC |
| MUT | Bernese 5.2 | F | – | – | 144 | GMF/GPT | 3° | GR |
| NKG | Bernese 5.2 | F | – | – | 88 | GMF/GPT | 3° | GR |
| OLG/BEV | Bernese 5.2 | F | – | – | 106 | VMF1/ECMWF | 3° | GR |
| RGA | Bernese 5.2 | F | – | – | 56 | VMF1/ECMWF | 3° | GR |
| ROB | Bernese 5.2 | F | R | – | 98 | GMF/GPT | 3° | GR |
| SGO | Bernese 5.2 | F | R | – | 42 | VMF1/ECMWF | 3° | GR |
| SUT | Bernese 5.2 | F | – | – | 59 | VMF1/ECMWF | 3° | GR |
| UPA | Bernese 5.2 | F | R | – | 57 | GMF/GPT | 3° | GR |
| WUT | Bernese 5.2 | F | R | – | 119 | VMF1/ECMWF | 3° | GR |

[1] Solutions: **F**inal, **R**apid, **N**RT
[2] BEK switched to VMF1/ECMWF since week 1967 (October 2017)

# Harmonization of troposphere modelling

At the TWG meeting in Wrocław, Rosa Pacione (EPN Troposphere Coordinator) proposed to harmonize the modelling of the troposphere delays among ACs.

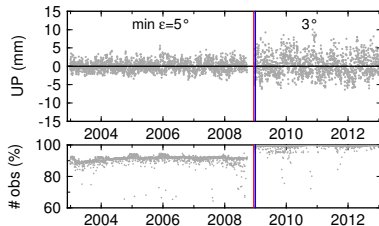Both approaches (VMF1/ECMWF and GMF/GPT) were compared wrt:

- coordinate differences
- coordinate repeatability

Coordinate differences between VMF1/ECMWF and GMF/GPT

- GPS observations processed with elevation mask $3°$
- elevation dependent weighting: $\sin^2 \varepsilon$
- horizontal gradients estimated (MF: Chen-Herring)
- high dependency on minimum elevation (red line: change in minimum elevation at receiver, blue: receiver change)
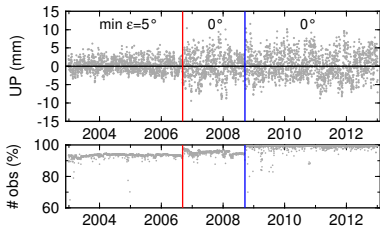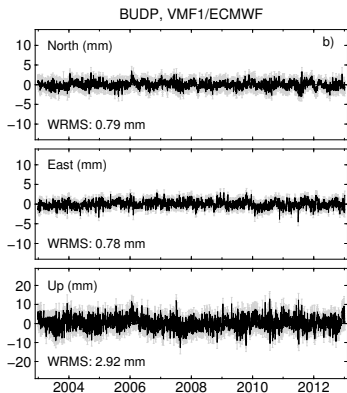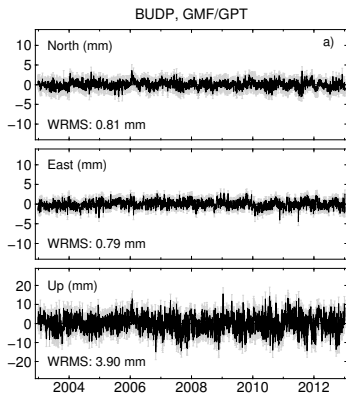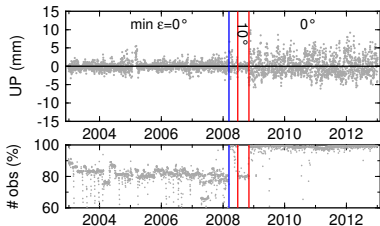

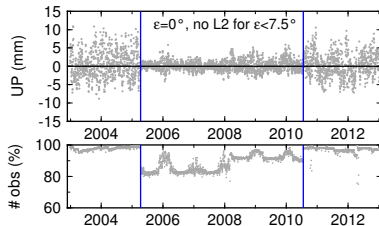
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- comparison of GMF/GPT and VMF1/ECMWF

Coordinate differences between VMF1/ECMWF and GMF/GPT

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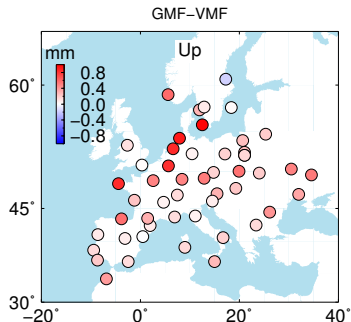


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# GMF vs. VMF, coordinate repeatability

| | Standard | | | ANTL applied | | |
|---|---|---|---|---|---|---|
| | WRMS (mm) | | | WRMS (mm) | | |
| Solution type | N | E | U | N | E | U |
| VMF1/ECMWF | 1.11 | 0.98 | 3.35 | 1.09 | 0.94 | 3.14 |
| GMF/GPT | 1.12 | 0.98 | 3.69 | 1.11 | 0.96 | 3.73 |

ANTL – atmospheric non-tidal loading



GMF–VMF

## Proposal

We propose that all ACs use VMF1/ECMWF approach:

- better consistency of the height component could be expected
- better repeatability of the height component
- EPN coordinate time series may be also better suited for geophysical interpretations
    - VMF1/ECMWF better reveals ANTL signal
    - GMF/GPT approach is known to absorb some part of ANTL

## VMF1 forecast grids

The possibilty to use VMF1 forecast grids was also tested.

| Solution type | WRMS[1] (mm) | | |
|---|---|---|---|
| | N | E | U |
| VMF1/ECMWF | 1.02 | 0.93 | 3.20 |
| VMF1/ECMWF forecast | 1.02 | 0.92 | 3.21 |
| GMF/GPT | 1.04 | 0.94 | 3.66 |

[1] Results for year 2012

- the use of forecast grids has also been recommended by J. Böhm (Rosa's personal communication)
- grids may be downloaded from: ggosatm.hg.tuwien.ac.at/DELAY/GRID/VMFG_FC
  - in case of password protection, access to grids will be provided to EPN ACs
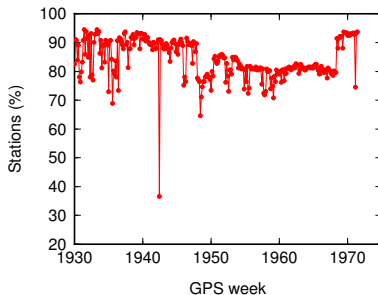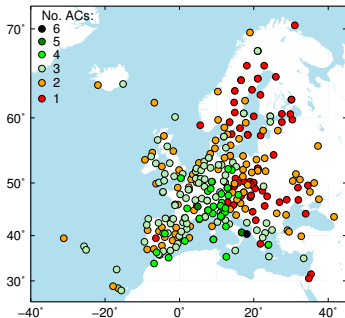
# VMF1 forecast grids

Rosa provided rapid results comparing GMF and VMF1 forcast (week 1970)
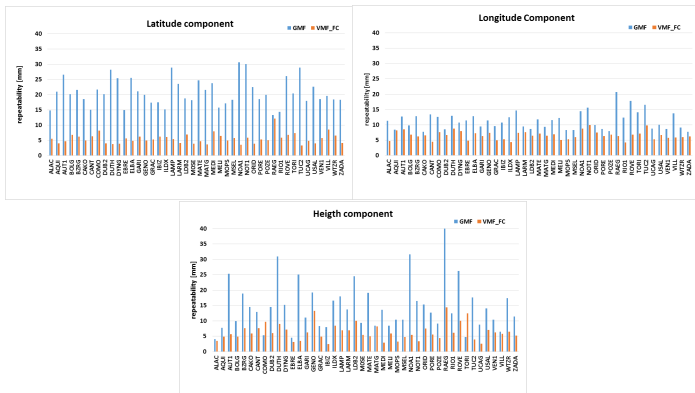


- in case of delays in availability of forecast grids, GMF/GPT approach could be used

# Rapid product

- 7-9 ACs contribute
- ~90% stations processed
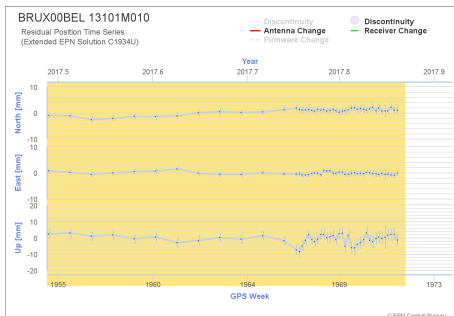- ~50% stations processed by 1 or 2 ACs

# Rapid product

The product is useful for coordinate monitoring and for outlier identification:

- relevant for ACs, ACC, and station managers as well

Therefore, ACs are asked to consider:

- including more stations in rapid solutions
- starting submitting rapid solutions.



www.epncb.eu/_productsservices/timeseries/

# Inclusion of new stations to EPN

New EPN stations:

- 48 new stations added in last 2 years
- some ACs more active
  - → imbalanced networks

To split the workload and to improve the inclusion procedure, all ACs are asked to be active on adding new stations to their subnetworks.

| AC | #sites | #new |
|---|---|---|
| ASI | 53 | 4 |
| BEK | 97 | 13 |
| BKG | 117 | 23 |
| COE | 43 | 0 |
| IGE | 91 | 16 |
| IGN | 64 | 0 |
| LPT | 60 | 5 |
| MUT | 144 | 9 |
| NKG | 88 | 19 |
| OLG/BEV | 106 | 6 |
| RGA | 56 | 0 |
| ROB | 98 | 26 |
| SGO | 42 | 0 |
| SUT | 59 | 11 |
| UPA | 57 | 11 |
| WUT | 119 | 16 |

# Summary

- The EPN BEV AC solutions has been tested and included into official EPN solutions
- Together with Troposphere Coordinator, we propose to adopt a VMF1/ECMWF as a mandatory approach within EPN
- ACs are asked to contribute to improving the rapid product