Report of the EPN Analysis Centres Coordinator

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Overview

The EPN Analysis Centres Coordinator (ACC) combines and analyses GNSS coordinate solutions computed by the EPN Analysis Centres (AC).

The presentation focuses on the activities of the ACC relevant for EPN GNSS analysis during the last year:

- status of AC and combined solutions
- new EPN product centre
- update of the guidelines for EPN Analysis Centres
- future AC and ACC related activities
- summary

EPN Analysis Centres description

AC	Agency
ASI	Centro di Geodesia Spaziale G. Colombo, Matera, Italy
BEK	Bavarian Academy of Sciences and Humanities, Germany
BEV	Federal Office of Metrology and Surveing, Austria
BKG	Bundesamt für Kartographie und Geodäsie, Germany
COE	Astronomical Institute, University of Bern, Switzerland
IGE	Instituto Geográfico Nacional, Spain
IGN	L'Institut national de l'information géographique et forestière, France
LPT	Federal Office of Topography swisstopo, Switzerland
MUT	Military University of Technology, Poland
NKG	Nordic Geodetic Commision, Lantmäteriet, Sweden
RGA	Republic Geodetic Authority, Serbia
ROB	Royal Observatory of Belgium, Belgium
SGO	Lechner Knowledge Center, Hungary
SUT	Slovak University of Technology, Slovakia
UPA	University of Padova, Italy
WUT	Warsaw University of Technology, Poland

Introduction – basic facts

- 16 EPN ACs regularly process GNSS data from $\sim$ 360 EPN stations
- ACs may provide 3 types of solutions for their subnetworks of EPN stations:
  - final weekly and daily (mandatory; delay up to 5 weeks)
  - rapid daily (recommended; delay up to 22 hours)
  - near-real time (recommended; delay: 1 hour)
- GNSS data processed according to the EPN analysis guidelines:

`https://www.epncb.eu/_documentation/guidelines/guidelines_analysis_centres.pdf`

- All AC solution types combined by ACC

EPN Analysis Centres characteristics

AC	Software	Solutions			# sites (new)	GNSS[1]
ASI	GipsyX 1.6	Final	Rapid	NRT	79 (3)	GRE
BEK	Bernese 5.2	Final	Rapid	–	112 (2)	GRE
BEV	Bernese 5.2	Final	–	–	177 (46)	GRE
BKG	Bernese 5.2	Final	Rapid	NRT	147 (13)	GRE
COE	Bernese 5.3	Final	–	–	40 (0)	GR
IGE	Bernese 5.2	Final	Rapid	–	90 (1)	GRE
IGN	Bernese 5.2	Final	Rapid	–	62 (0)	GR
LPT	Bernese 5.3	Final	Rapid	NRT	60 (0)	GRE
MUT	GAMIT 10.71	Final	Rapid	–	152 (4)	GE
NKG	Bernese 5.2	Final	Rapid	–	105 (4)	GRE
RGA	Bernese 5.2	Final	–	–	58 (6)	GRE
ROB	Bernese 5.2	Final	Rapid	–	110 (4)	GRE
SGO	Bernese 5.2	Final	Rapid	–	51 (4)	GRE
SUT	Bernese 5.2	Final	Rapid	NRT	61 (3)	GRE
UPA	Bernese 5.2	Final	Rapid	–	79 (8)	GRE
WUT	Bernese 5.2	Final	Rapid	–	144 (6)	GRE

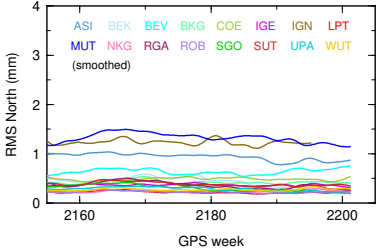
[1] GNSS: G – GPS, R – GLONASS, E – Galileo

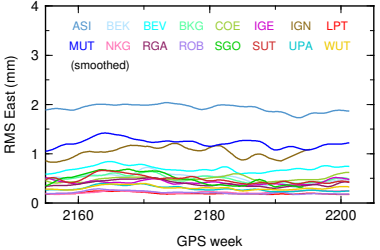
- Number of ACs processing EPN stations:

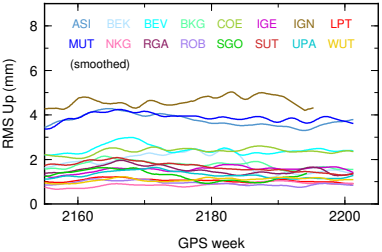
#ACs	#sites	% of sites
3	70	18.5
4	233	61.5
5	71	18.7
6	5	1.3

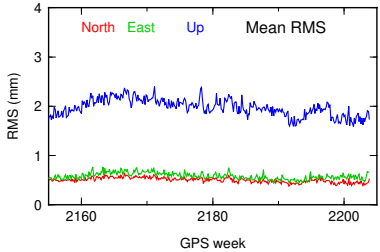
Combined solutions: AC solutions agreement (last year)

- RMSs of position residuals between each AC solution and combined solution





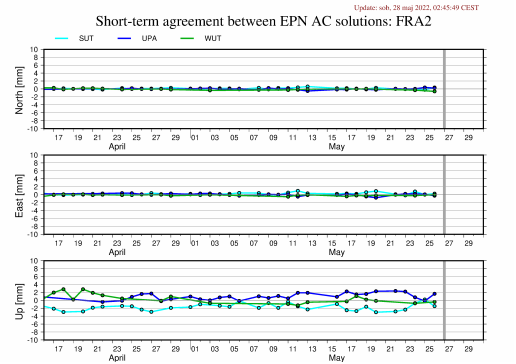




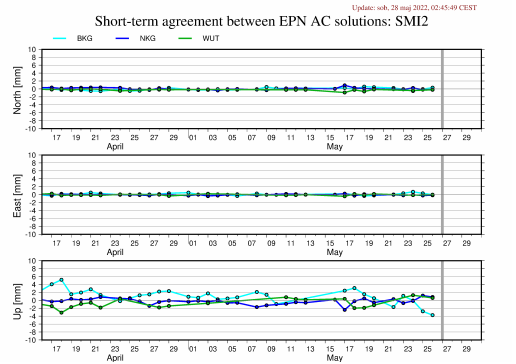
New stations included to EPN

Station	Start date	Analysis Centres	In combined solutions
ANK200TUR	05-09-2021	ASI, BEK, BEV, BKG	Final, Rapid
ARA200SVN	23-01-2022	BEV, BKG, RGA, SGO, UPA	Final, Rapid
BME100HUN	12-12-2021	ASI, BEV, SGO	Final, Rapid, NRT
BUDD00DNK	06-06-2021	BKG, NKG, ROB	Final, Rapid
DVCN00SVK	20-02-2022	BEV, BKG, SUT	Final, Rapid, NRT
FRA200UKR	09-01-2022	BEV, MUT, SUT, UPA, WUT	Final, Rapid, NRT
GOET00DEU	12-12-2021	BEK, BKG, ROB	Final, Rapid
KDA200SVN	23-01-2022	BEV, BKG, RGA, SGO, UPA	Final, Rapid
MLHD00IRL	18-07-2021	BKG, IGE, ROB	Final, Rapid
MUK200UKR	09-01-2022	BEV, MUT, SUT, UPA, WUT	Final, Rapid, NRT
PPSH00NOR	27-02-2022	BEV, MUT, NKG, WUT	Final, Rapid
PZA200SVN	23-01-2022	BEV, BKG, RGA, SGO, UPA	Final, Rapid
RAH100UKR	09-01-2022	BEV, BKG, UPA	Final, Rapid
RVNE00UKR	23-01-2022	ASI, BEV, UPA, WUT	Final, Rapid, NRT
SMI200DNK	27-06-2021	BKG, NKG, WUT	Final, Rapid
SUL500DNK	06-06-2021	BKG, NKG, ROB	Final, Rapid
TER200UKR	09-01-2022	BEV, BKG, UPA	Final, Rapid
WUTH00NOR	27-02-2022	BEV, BKG, MUT, WUT	Final, Rapid

New stations: rapid AC residuals



FRA200UKR



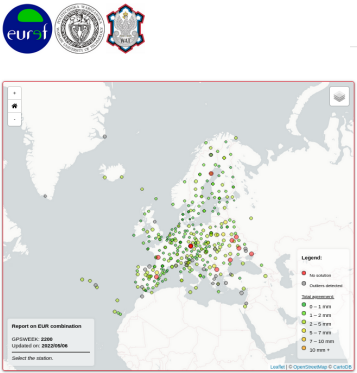
SMI200DNK

(Figures from ACC website: www.epnacc.wat.edu.pl/epnacc)

New EPN ACC website: www.epnacc.wat.edu.pl/epnacc

The EPN ACC website has been recently updated:

- new plots showing consistency of AC final and rapid solutions wrt combination for each EPN station
- new layout (not the main intention)



EPN Analysis Combination Centre

Weekly Daily EUREF EPN CB

Report of the combination of the EUREF weekly GPS solution

Since GPS week 1925 new approach for generate the weekly combined EPN coordinate solutions is used. Now, the daily EPN AC solutions are combined for each day of the week, and then the seven daily combined solutions are stacked into a weekly solution. The statistics on the daily agreement between individual solutions together with the consistency of combined daily solutions are presented on this webpage.

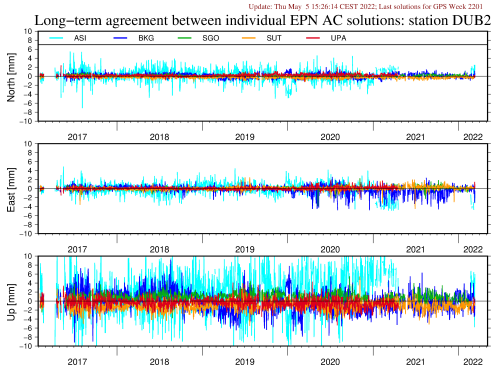
Consistency of stations position between contributed solutions:

The map below constitutes an extract from the latest Report on the combination of daily and weekly GNSS solutions from EPN Analysis Centres (AC), which is available on **Regional Data Centre**, located at BKG (Federal Agency for Cartography and Geodesy, Germany). --> Reports available here

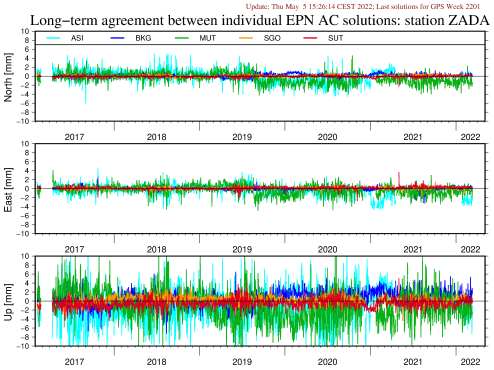
First layer of the main map ("EPN weekly solution") contains the mean weekly unweighted RMSs of station position residuals computed for each station in the combined solution. The mean RMSs, their daily changes and reapetability of final daily coordinates are displayed on popup boxes (click on the station that you are interesting). Any outliers in station positions excluded either from individual AC daily solutions during the combination stage, or from combined daily solutions during the comparison stage are marked in gray. Second layer ("Consistency with IGS") presents the station position residuals between the combined weekly solution (EUR) to the IGS14 (alignment to IGS14 use No-Net-Translation and minimum constraints).

Helmert Transformation Parameters

New EPN ACC website



DUB200HRV



ZADA00HRV

(Figures available for all EPN stations at: www.epnacc.wat.edu.pl/epnacc)

BEV as new EPN product centre

BEV (Federal Office of Metrology and Surveying, Austria) EPN data centre has extended its capabilities to receive and make available, in addition to RINEX data, also EPN products.

- Since March 2022 BEV ready to make available all AC and combined products
- The products are available at the following server:

`https://gnss.bev.gv.at/at.gv.bev.dc`

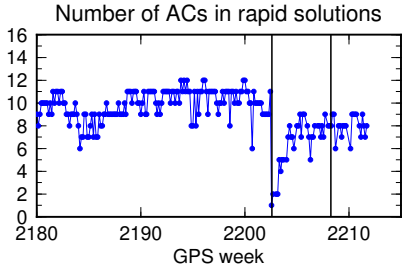
Final and rapid:
`https://gnss.bev.gv.at/at.gv.bev.dc/data/products/WWWWW/`

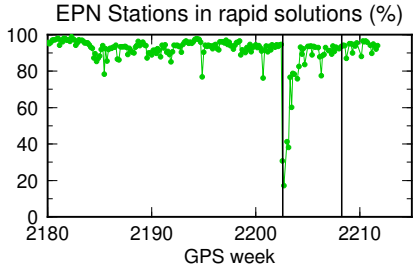
Near-real Time:
`https://gnss.bev.gv.at/at.gv.bev.dc/data/products/WWWWW/nrt[0-6]/`

- All ACs have been asked to upload their products independently to both BEV and BKG data centres

BKG data centre outage

- On March 25 BKG data center went down for about 5 weeks
- Problems with availabilty of AC and combined solutions (esp. rapid and NRT):
  - not all ACs started uploading solutions to BEV before BKG went down
  - some ACs were not prepared to download observations from BEV





- Final solutions for weeks 2197-2204 based on solutions of 14 ACs

We ask ACs, and also station managers, to upload products and data independently to both data centers (BEV and BKG)

Update of guidelines for EPN Analysis Centres

During the last year the guidelines for the EPN Analysis Centres were updated twice:

1. on October 1 2021
   - added recommendation about processing of Galileo observations
   - update of the EPN antenna model (e.g., repeated individual calibrations)
   - more details added concerning rapid and NRT solutions (e.g., different station networks than in final solutions allowed)
2. on May 18 2022
   - added information on BEV becoming EPN product centre

The guidelines are available at the EPN CB website:

`https://www.epncb.eu/_documentation/guidelines/guidelines_analysis_centres.pdf`

Future activities

Future activities related to ACs and ACC:

- switch to the IGS20/igs20.atx reference frame
- reanalysis of EPN data (repro3 project)
- using new Bernese GNSS Software, version 5.4
- analysis centres workshop

Upcoming switch to IGS20/igs20.atx

- Since week 1934 (January 29, 2017) all EPN products (AC and combined) have been expressed in the IGb14 reference frame
- Currently IGS is working on a new reference frame IGS20, which will be consistent with ITRF2020
  - expected switch to the IGS20 reference frame and the igs20.atx antenna model: October 2022
- Since EPN follows IGS in reference frame changes we also have to be prepared to switch to IGS20 at the same time.
- IGS20/igs20.atx also relevant for the EPN repro3 project
  - IGS20 will be consistent with IGS repro3 products

The usage of individual calibrations in EPN

In the light of upcoming switch to the IGS20/igs20.atx framework a discussion started within the EUREF GB about future usage of individual calibrations in EPN.

- Since 2006 the antenna model used in EPN has consisted of individual calibrations completed by IGS type mean antenna model
  - some individual calibrations without GLONASS or Galileo corrections (GPS used)
- New IGS antenna model igs20.atx for receiver antennas officially supports GPS, GLONASS and Galileo signals (and more)
  - better consistency of multi-GNSS analysis in EPN
  - better consistency with IGS analysis
- Pros and cons of using both models discussed by GB "antenna working group" and consulted with EPN ACs
  - decision on using only IGS type mean antenna model in EPN pending
  - details in Christof Völksen's talk on EPN repro3 project

EPN Analysis Centres Workshop

An EPN Analysis Centres Workshop planned in order to discuss details and potential issues concerning:

- the switch to the IGS20 reference frame
- EPN repro3 project

Hopefully, also to discuss initial experiences and results concerning:

- new options of Bernese GNSS Software version 5.4
- new IGS20/igs20.atx framework

The exact date has not been chosen yet, but most likely it will take place in October.

Summary

- EPN ACs and ACC continued operational activities
- BEV as new EPN product center
- Updated guidelines for EPN Analysis Centres
- Future AC and ACC activities:
  - switch to IGS20/igs20.atx
  - switch to new version of Bernese GNSS Software
  - repro3 analysis
- Analysis Centres workshop planned for October

We thank EPN ACs for their efforts in providing GNSS solutions to EPN!

Special thanks to BEV for becoming the EPN product centre!