

CEGRN reprocessing using repro2  
products

# CEGRN overview

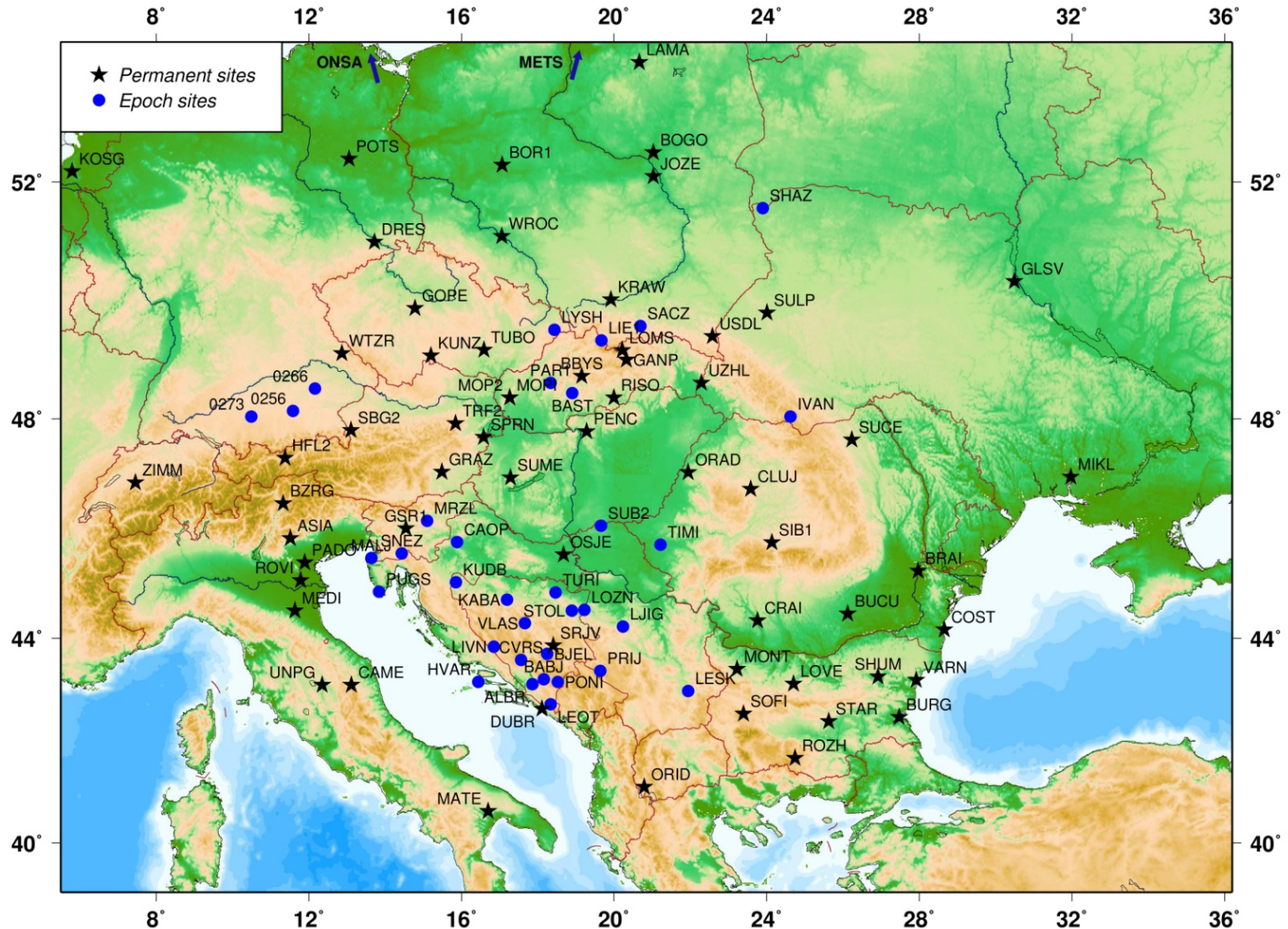
## CEGRN 2013

Country	Total	EPN	CEGRN	SAPOS
AUT	4	3	1	
BIH	24	1	23	
BUL	7		7	
CRO	5	5		
CZE	3	3		
GER	6	3		3
HUN	4	4		
ITA	7	5	2	
POL	8	7	1	
ROM	9	2	7	
SRB	9		9	
SVK	6	4	2	
SLO	1	1		
UKR	3	3		

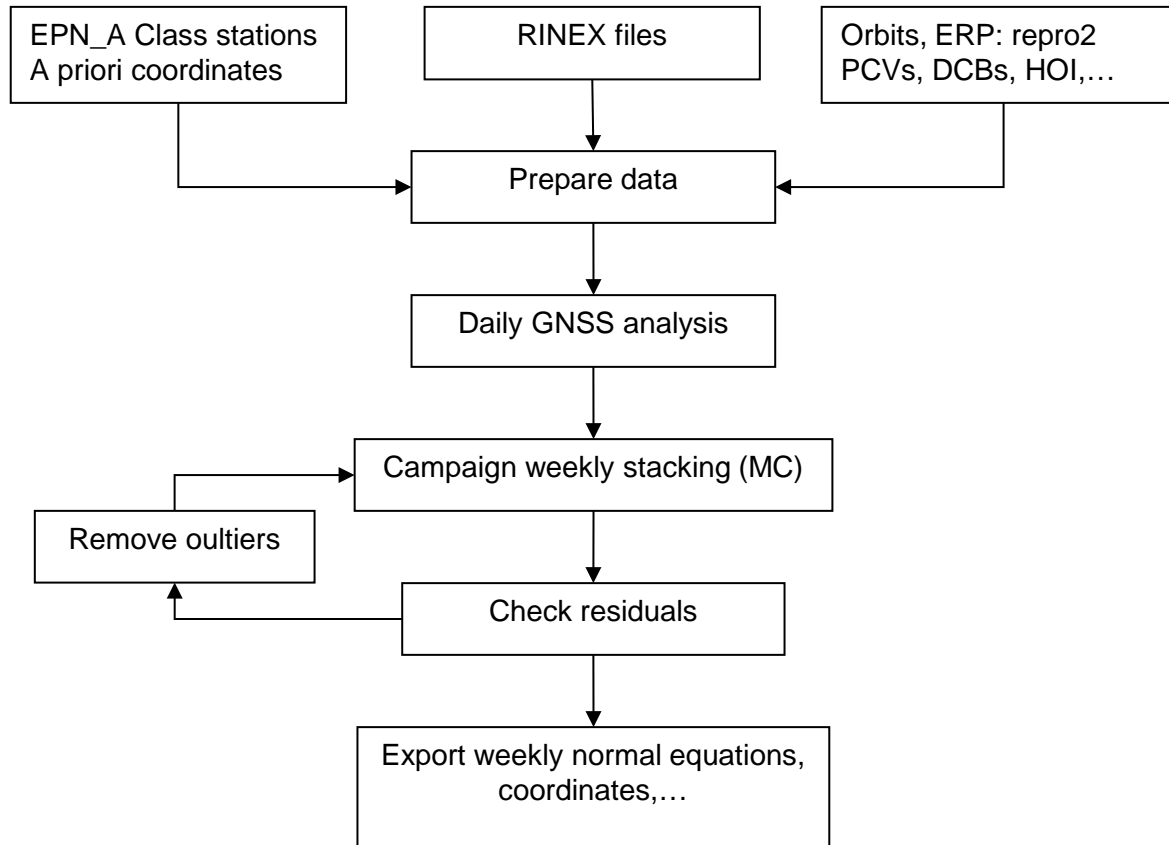
## SUMMARY

CAMPAIGN	PERIOD	COUNTRIES	SITES
<b>CERGN'94</b>	2-6 May, 1994	10	30
<b>CERGN'95</b>	29 May- June 3, 1995	11	36+5
<b>CERGN'96</b>	10-15 June, 1996	11	35+6
<b>CERGN'97</b>	04-10 June, 1997	12	35+10
<b>CERGN'99</b>	14-19 June, 1999	13 (extended network)	57 (29P+38E)
<b>CERGN'01</b>	17-23 June, 2001	13 (extended network)	51 (28P+23E)
<b>CERGN'03</b>	16-21 June, 2003	13 (extended network)	51 (28P+23E)
<b>CERGN'05</b>	20-25 June, 2005	14 (extended network)	94
<b>CERGN'06</b>	12-18 June, 2005	Only CGPS	44P
<b>CERGN'07</b>	18-23 June, 2007	14 (extended network)	95
<b>CERGN'09</b>	22-27 June, 2009	14 (extended network)	85
<b>CERGN'11</b>	20-25 June, 2011	14 (extended network)	74
<b>CERGN'13</b>	16-22 June, 2013	14	96

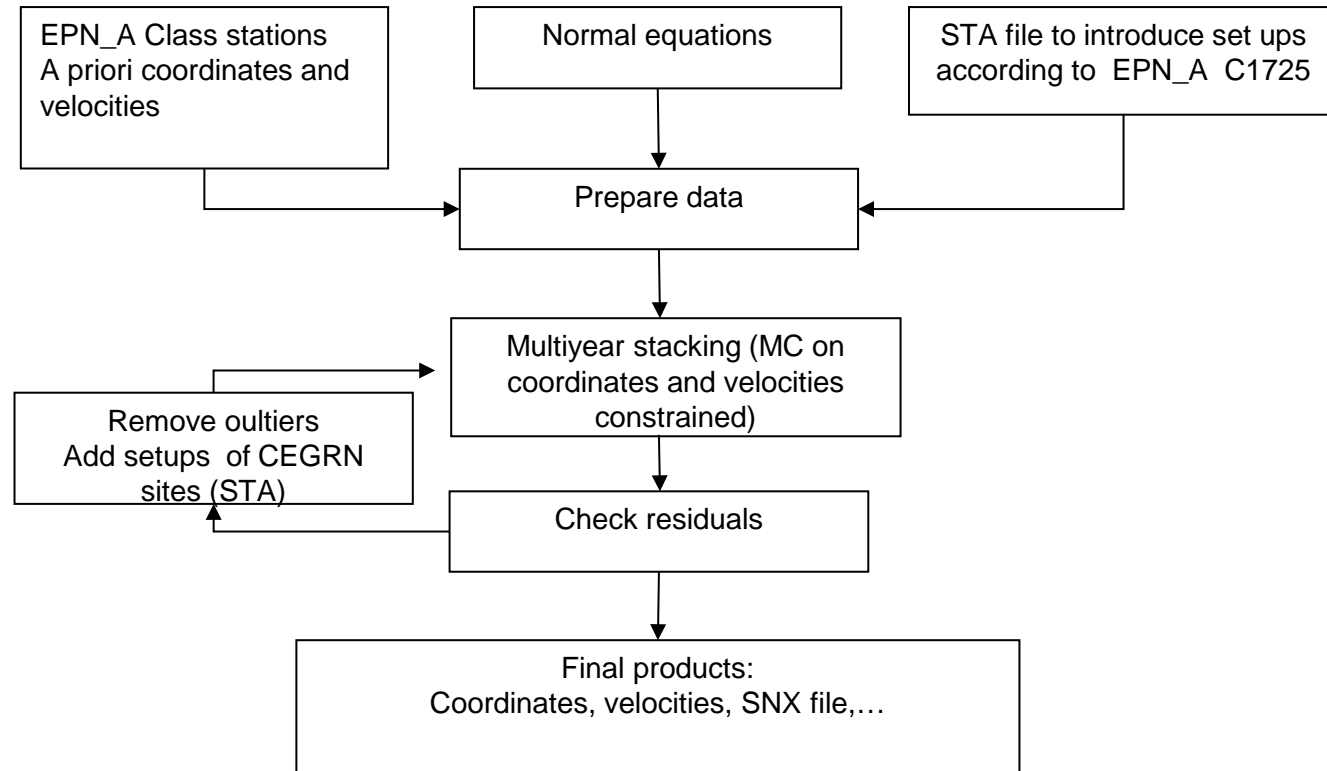
# CEGRN overview



# Processing of a weekly campaign (EUREF guidelines)



# Stacking of weekly campaigns (EUREF guidelines)





Map of Europe showing EPN and CEGRN stations. The map includes latitude and longitude coordinates (10° to 30° longitude, 40° to 50° latitude). Stations are marked with red dots and labeled with codes. A legend in the top right corner identifies 'EPN\_A STATIONS' and 'CEGRN STATIONS'.

# Summary of the considered parameters (BSW52)

- Orbits, ERP, Iono...
  - All needed products: IGb08 orbits, ERPs,... used. Source: CODE (repro2).
- Loading:
  - FES2004 ocean loading.
  - Atmospheric loading applied. Coeffs. for each site obtained from a gridded model (computed with GRDS1S2, from BSW52).
- Following the latest recommendations:
  - Cutoff angle: 3 deg.
  - ZTD parameters are estimated using WET GMF mapping function and CHENHER gradient estimation model.
  - Iono: No a priori model. Ionospheric effect removed by the “iono-free” linear combination. CODE’S Ionospheric data used to compute 2nd and 3rd order ionospheric corrections.
- Add discontinuity if the difference in coordinates is:
  - 6 mm in n or e,
  - 10 mm in u
- Final solution: MC to EPN\_A class sites (EPN\_A C1725): threshold 10 mm in any component.
- Antennas: G. Stangl prepared a file with the PCVs for all the antennas used.

# AR: distance-dependent strategy

**An advanced ambiguity resolution (AR) schema was used to compute the baselines:**

- Code-Based Widelane (WL) AR for baselines shorter than 6000 km, Melbourne-Wuebbena wide-lane and narrow-lane AR is computed.
- Phase-Based Widelane (L5) AR for baselines shorter than 200 km, the code-based wide-lane AR is replaced by a phase-only wide-lane with a subsequent narrow-lane AR.
- Quasi-Ionosphere-Free (QIF)AR for the remaining real-valued ambiguities for baselines shorter than 2000 km.
- Direct L1/L2 AR for baselines shorter than 20 km

## **AR Verification:**

Each baseline is processed by introducing the resolved integer ambiguities and checking the residuals. If there is any problem, the ambiguities are re-initialized.

WL ambiguity with non dual CODE data: important in the CEGRN campaign, with old receivers/antennas.



# Some remarks...

- Receiver related errors: the following missing receivers were manually added to the  $\{X\}$ /GEN/RECEIVER. file:
  - E\_GGD, copied from JPS E\_GGD
  - GB1000, copied from TPS GB-1000
  - GEOTRACER 100, copied from SPP GEOTRACER100
  - LEICA SR399, copied from LEICA SR399E
  - NET-G3, copied from TPS NETG3
  - ROGUE SNR-12 ACT, copied from ROGUE SNR-12
  - SR399, copied from LEICA SR399E
  - TPS HIPER\_GGD, copied from TPS EGGDT
  - TRIMBLE 4400, copied from TRIMBLE 4700
  - TRIMBLE 4800, copied from TRIMBLE 4700
  - “ “ (BLANK), Added dual code and phase frequencies for R and G by hand. Used in the CEGRN ADDNEQ in BSW52.
- Some \*.DCB needed files were missing: **P1P2** DCB files ( <ftp://ftp.unibe.ch/aiub/CODE/YYYY/>):
  - P1P2YYMM.DCB started being generated in 1997/10 (not really important in the DD model)

**We are dealing with data starting from 1996!!**

# Some remarks...

- 1996 Campaign (GPS week 0857, from dow 1 to 6). Wrong/non-existing antennas :
  - Most of the problems: TNONE instead of NONE (examples: BRSK, GRAZ, LAMA, METS,...). Others, following Antenna definition file (G. Stangl). Other examples:
    - 4000ST L1/L2 GEOD replaced in RINEX header by TRM14532.00 NONE in JOZE
    - DORNE MARGOLIN TNONE replaced in RINEX header by AOAD/M\_B DUTD in KOSG
    - 4000ST L1/L2 GEOD replaced in RINEX header by TRM14532.00 NONE in PENC
- 1997 Campaign (GPS week 0908 and 0909: using data from 0908 3 to 0909 2). Similar problems, solved with the antenna in the STA file (G. S.).
- 1999, WEEK 1014: using data from WEEK 1014 1 to 6 (DoY 165 to DoY 170).
  - Previous days only containing data from DRES (starting in DoY 160).
  - CSAN does not contain DUAL CODE data. Excluded.
- 2001, WEEK 1119: using data from WEEK 1119 1 to 6 (DoY 168 to DoY 174).
  - ASH701946.022 SNOW (does not exist) replaced in RINEX header by ASH701946.2 SNOW in GOPE. Does not agree with STA file (ASH701946.3 SNOW)

# Some remarks...

- 2003, WEEK 1223: using data from WEEK 1223 1 to 6 (DoY 167 to DoY 172).
  - TRM220020.00+GP NONE (does not exist) replaced in RINEX header by TRM22020.00+GP NONE in DISZ. Agrees with the STA file.
- 2005, WEEK 1328/1329: using data from WEEK 1328 1 to 1329 0 (DoY 171 to DoY 177).
  - PROBLEM: Sulp antenna is DOME, whereas it should be NONE (from STA file). Changed.
  - TPSPG3\_A1 NONE: **No R system PCVs** available. Found in:  
[http://rgp.ign.fr/STATIONS/antennes/TPSPG\\_A1+GP-A.ATX](http://rgp.ign.fr/STATIONS/antennes/TPSPG_A1+GP-A.ATX)
  - No EPHEMERIS available for 1329 0. File is corrupted. Anyway, not many sites to be computed.
- 2007, WEEK 1431/1432: using data from 1432 1 to 6 (DoY 169 to DoY 174):
  - RINEX data only available for 0256, 0266, 0273. 1432 0: few RINEX data. No RINEX data for the reference sites.
- 2009, WEEK 1537: using data from 1537 1 to 6 (DoY 173 TO 178)
  - 1537 0: few RINEX data. No RINEX data for the reference sites. Not computed.
  - LESK HAS NO PHASE DATA ON WEEK 1537. REMOVED IN STA FILE, TYPE 003
- 2011: No too many RINEX files available.
  - TPSREGANT\_DD E DOES NOT EXIST. COPIED FROM JPSREGANT\_DD\_E NONE
- 2013: No problems!!!

# Weekly results (repeatibilities)

Computed Sites	Repeatability (mm)				
	N	E	U		
50	1.54	1.16	3.82	CEGRN	1996
44	1.34	1.01	3.40	CEGRN	1997
62	1.46	0.97	3.73	CEGRN	1999
57	1.16	0.83	3.77	CEGRN	2001
77	1.20	0.93	3.19	CEGRN	2003
105	1.14	0.91	3.74	CEGRN	2005
95	1.37	1.23	4.06	CEGRN	2007
85	1.18	0.98	3.83	CEGRN	2009
60	0.82	0.90	3.24	CEGRN	2011
101	1.02	1.15	3.90	CEGRN	2013

- Outlier thresholds for the daily and weekly solutions are:
  - 5 mm for the E, N components,
  - 10 mm for the U component.
- Any value exceeding any of those thresholds has been considered as an outlier and removed from the daily stacking.
- Regarding the weekly solutions, an EPN\_A class site has been considered as a non-fixed site in the yearly stacking if the residual wrt the published value is >10 mm in any component.

# Combined results: individual vs combined Helmert 3D for all sites (EPN\_A+CEGRN)

Sol	Rms (m)	Translation (m)			Rotation (")			Scale (ppm)
		X	Y	Z	X	Y	Z	
1	0.00216	-0.0033	-0.0209	0.0057	0.0005	-0.0003	-0.0005	0.00004
2	0.00203	-0.0016	0.0366	-0.0083	-0.0009	0.0001	0.0008	0.00018
3	0.00235	-0.0078	0.0006	0.0053	0.0001	-0.0003	0.0002	0.00024
4	0.00158	0.0081	-0.0296	-0.0003	0.0007	0.0002	-0.0006	0.00016
5	0.00146	-0.0091	-0.0031	0.0088	0.0001	-0.0004	-0.0000	-0.00016
6	0.00212	-0.0025	0.0211	-0.0043	-0.0006	0.0000	0.0004	-0.00015
7	0.00269	0.0005	0.0075	0.0023	-0.0001	-0.0000	0.0002	-0.00087
8	0.00199	0.0050	-0.0106	-0.0038	0.0002	0.0002	-0.0003	0.00029
9	0.00153	-0.0018	-0.0049	-0.0003	0.0001	-0.0000	-0.0001	0.00038
10	0.00122	0.0028	-0.0001	-0.0012	-0.0000	0.0001	-0.0001	-0.00014

# Combined results: Helmert 3D “a priori” vs MC Adjusted EPN\_A

	N (mm)	E (mm)	U (mm)
RMS / COMPONENT	1.08	0.87	2.17
MEAN	-0.00	-0.00	-0.00
MIN	-2.31	-2.75	-5.45
MAX	2.69	1.76	4.89

NUMBER OF PARAMETERS : 7  
 NUMBER OF COORDINATES : 246  
 RMS OF TRANSFORMATION : 1.50 MM

## BARYCENTER COORDINATES:

LATITUDE : 48 28 58.41  
 LONGITUDE : 17 20 1.29  
 HEIGHT : -25.640 KM

## PARAMETERS:

TRANSLATION IN N : 0.09 +- 0.17 MM  
 TRANSLATION IN E : -0.08 +- 0.17 MM  
 TRANSLATION IN U : 0.00 +- 0.17 MM  
 ROTATION AROUND N-AXIS: 0 0 0.000138 +- 0.000087 "  
 ROTATION AROUND E-AXIS: 0 0 0.000249 +- 0.000079 "  
 ROTATION AROUND U-AXIS: - 0 0 0.000052 +- 0.000059 "  
 SCALE FACTOR : -0.00025 +- 0.00028 MM/KM

Fully excluded EPN\_A sites: METS210503S011, METS310503S011, UNPG312752M001

## Partially excluded:

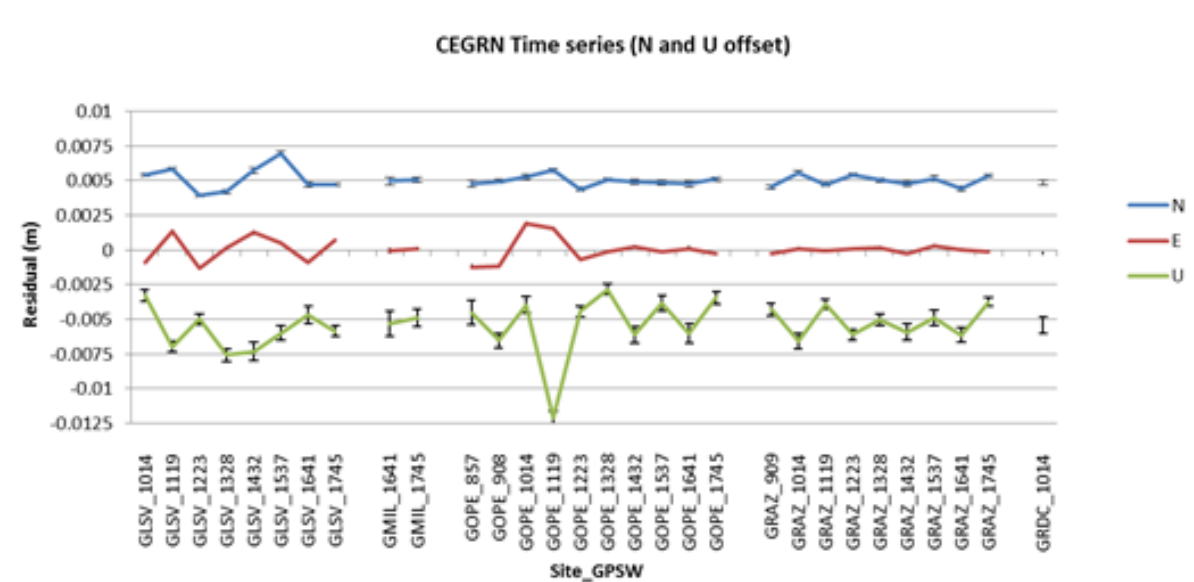
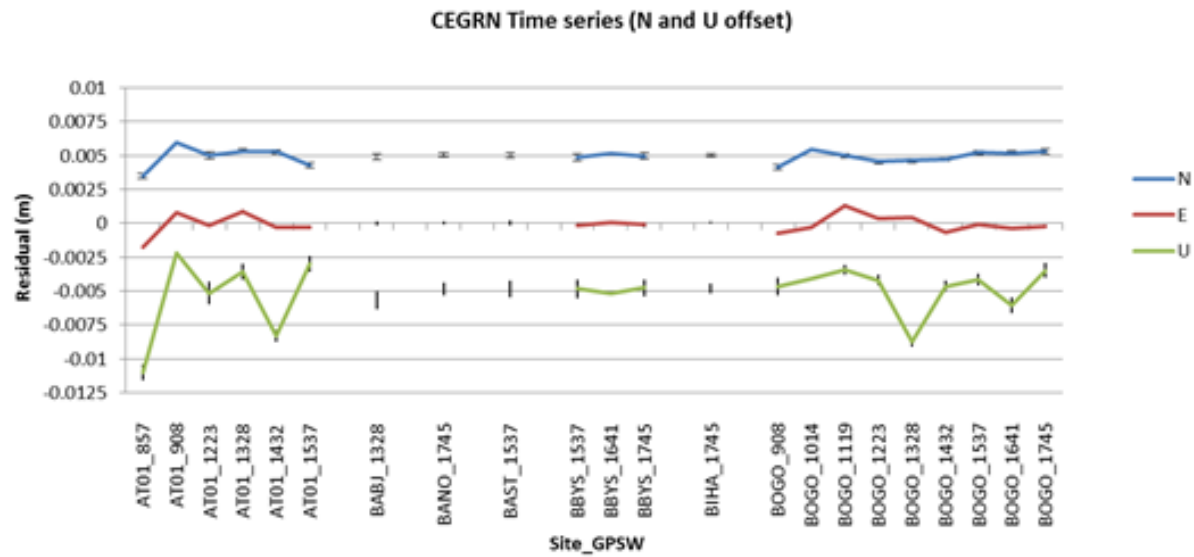
GRAZ111001M002	001	1996-06-11 00:00:00	1996-06-15 23:59:30	HIGH RESIDUAL
TUBO111503M001	001	1999-06-14 00:00:00	1999-06-19 23:59:30	HIGH RESIDUAL
UZHL112301M001	001	2001-06-23 00:00:00	2001-06-23 23:59:30	HIGH RESIDUAL

# List of deliverable files prepared

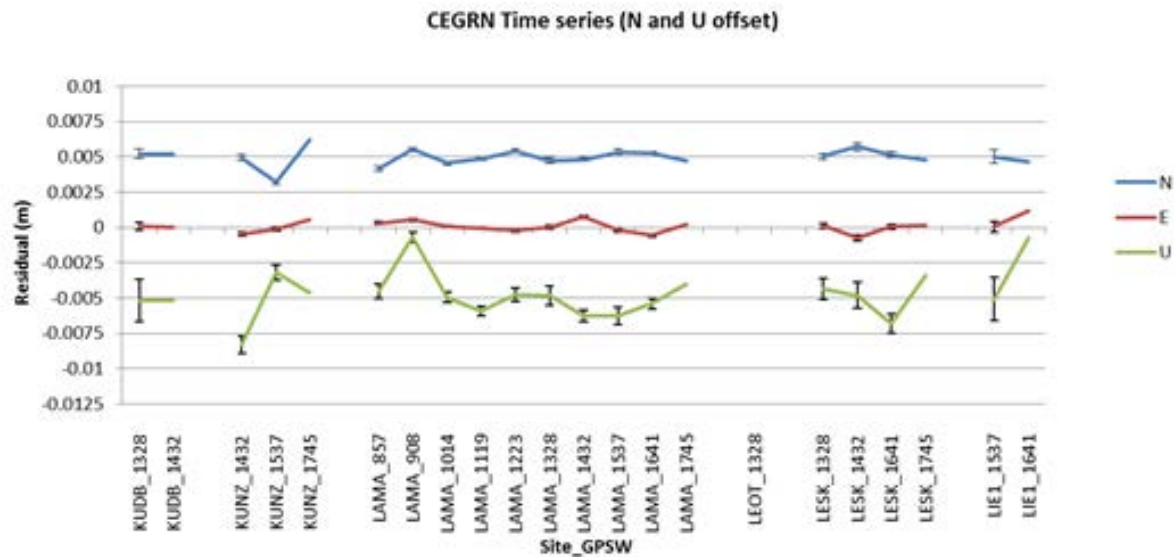
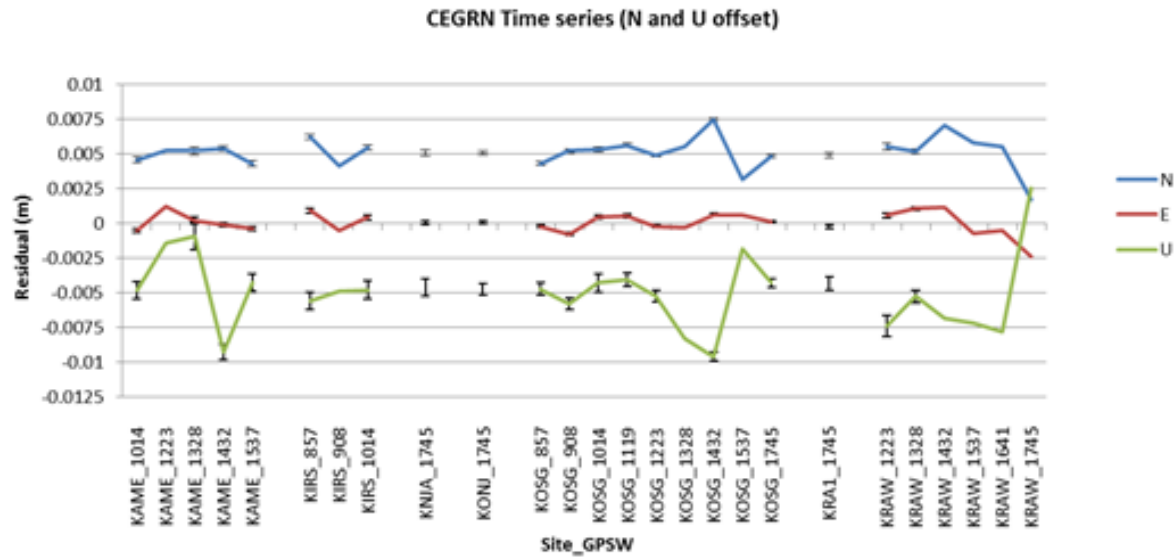
```
-- BSW52                BSW52 ORIGINAL FILES USED TO GET THE FINAL SOLUTIONS
|  |-- CEGRN52.CRD        CRD FILE
|  |-- CEGRN52.VEL        VEL FILE
|  |-- CEGRN.FIX          FIX FILE
|  |-- CEGRN.SIG          SIG FILE
|  `-- CEGRN.STA          STA FILE
-- COORDINATES          FOLDER THAT CONTAINS THE LIST OF COORDINATES AND VELOCITIES
|  |-- CEGRN.CRD          MC ADJUSTED COORDINATES OF THE CEGRN NETWORK, INCLUDING NOTES
|  |-- CEGRN.VEL          MC ADJUSTED VELOCITIES OF THE CEGRN NETWORK
|  |-- EPN_A.CRD          MC ADJUSTED COORDINATES OF THE REFERENCE SITES
|  |-- EPN_A.VEL          MC ADJUSTED VELOCITIES OF THE REFERENCE SITES
|  |-- REFSITES           LIST OF REFERENCE SITES
-- FORMS                FOLDER THAT WILL HOLD ALL THE FORMS OF THE SITES.
|  |-- blank.log          BLANK FORM
|  |-- CEGRN              LOGSHEETS OF ALL THE CEGRN SITES
|  `-- EUREF              LOGSHEETS OF ALL THE EUREF SITES, INCLUDING EPN_A CLASS
--- NOTPUBLISH-logsheets LOGSHEETS OF ALL THE SITES WHICH COORDINATES MUST NOT BE PUBLISHED
-- OUTPUTS              FOLDER THAT CONTAINS SOME OUTPUTS. POOR QUALITY SITES REMOVED.
|  |-- ALLNEUs.DAT        RESIDUALS IN NEU, INCLUDING GPSW AND RMS
|  |-- CEG-FREE.OUT        FREE NETWORK OUTPUT OF ADDNEQ2
|  |-- CEG-FREE.PLT        FREE NETWORK RESIDUALS PLOTS OF ADDNEQ2
|  |-- CEG-FREE.SUM        FREE NETWORK REPEATIBILITIES OF ADDNEQ2
|  |-- CEGRNOUT.OUT        MC NETWORK OUTPUT OF ADDNEQ2
|  |-- CEGRNOUT.PLT        MC NETWORK RESIDUALS PLOTS OF ADDNEQ2
|  `-- CEGRNOUT.SUM        MC NETWORK REPEATIBILITIES OF ADDNEQ2
-- SINEX                FOLDER THAT CONTAINS THE SINEX OUTPUTS
|  |-- CEG-FREE.SNX        FREE NETWORK SOLUTION. POOR QUALITY SITES REMOVED.
|  `-- CEGRNOUT.SNX        MC NETWORK SOLUTION. POOR QUALITY SITES REMOVED.
`-- UPASNX              SINEX FOR EACH OF THE CAMPAIGNS
```



# Some time series (residuals)...

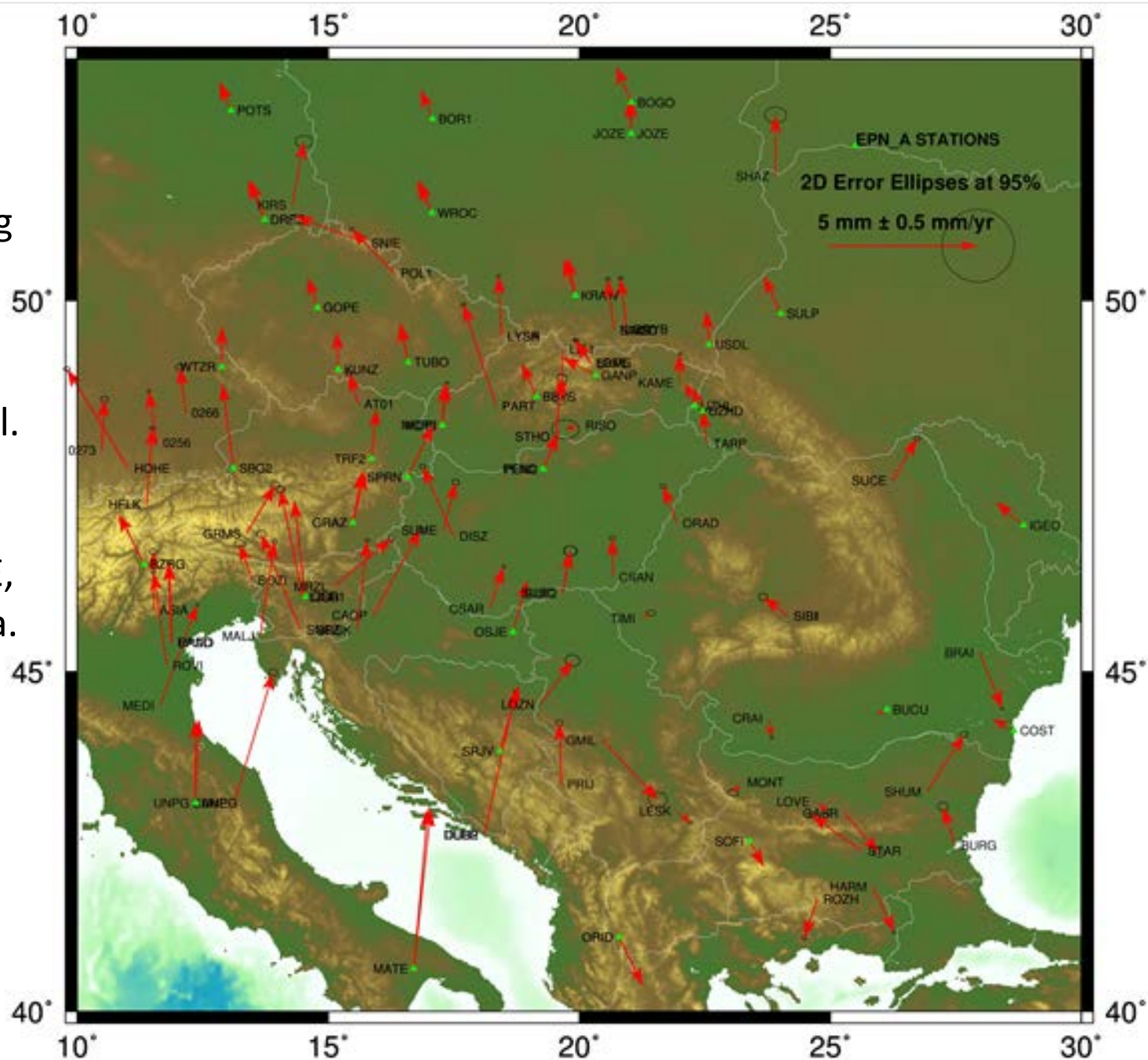


# Some time series (residuals)...

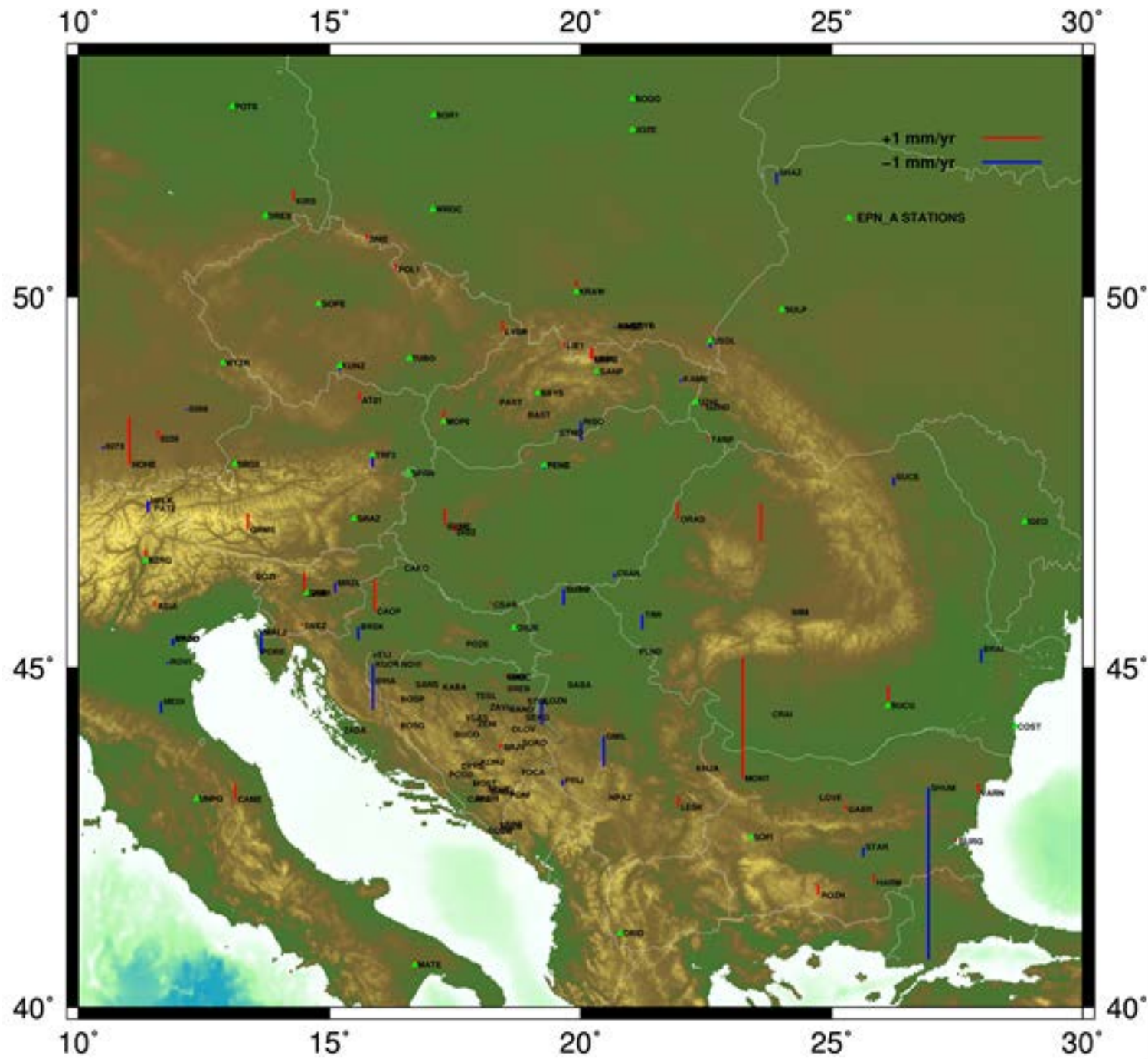


CEGRN:  
**2D** velocities  
 respect stable  
 Eurasian plate using  
 Euler rotation pole,  
 ITRF2000.

From Altamimi et al.  
 (2002):  
 Phi:  $57.965^{\circ}\text{N}$ ,  
 Lambda =  $-99.374^{\circ}\text{E}$ ,  
 Omega =  $0.260^{\circ}/\text{Ma}$ .



CEGRN:  
Vertical velocities



# List of sites for which we request validation (I)

STATION	YEARS OBSERVED	WEEKLY REPEATIBILITY (SOLS., REP. NEU MM)					REMARKS
AT01	1996-2009	AT01 11027M002A	2	1.81	1.90	6.63	Identical with HUTB
		AT01 11027M002B	4	0.45	0.61	2.41	
KUDB	2005-2007	KUDB 00000M000	2	0.35	0.08	0.22	
ORAD	2007-2013	ORAD 00000M001	3	1.14	0.15	2.51	
ROVI	2005-2013	ROVI 12769M001	4	0.90	0.23	2.22	
SHUM	2009-2013	SHUM 00000S001	2	0.37	0.12	0.43	
STAR	2009-2013	STAR 00000S001	3	0.27	0.67	1.31	
TRFB	2005-2007	TRF2 11047M002	2	2.60	1.33	35.21	Former EPN site, identical to TRF2 if different antenna height applied
		TRF2111047M002	3	1.01	0.97	9.98	

***Table 1. Stations proposed for evaluation observed more than 1 campaign.***



# List of sites for which we request validation (II)

STATION	YEARS OBSERVED	WEEKLY REPEATABILITY (SOLS., REP. NEU MM)						REMARKS
BRAI	2003-2007, 2009, 2013	BRAI 00000M001	4	0.80	1.33	0.55		
BURG	2009-2013	BURG 00000S001	3	1.09	0.61	0.67		
CLUJ	2003, 2005, 2007, 2009-2013	CLUJ 00000M000A	1	0.16	0.03	0.04		
		CLUJ 00000M000B	1	0.12	0.05	0.46		
		CLUJ 00000M000C	1	0.13	0.28	0.15		
		CLUJ 00000M000D	2	0.17	0.18	3.05		
HFLK	1996-1997, 1999-2007	HFLK 11006S003A	2	2.45	0.74	7.16		Former EPN site, identical to HFL2 if different antenna height applied
		HFLK 11006S003B	4	1.68	1.24	9.67		
		HFLK 11006S003C	2	1.97	0.25	17.45		
HOHE	1996-2003, 2005, 2007	HOHE 00000M000A	4	0.70	1.61	3.10		
		HOHE 00000M000B	1	0.16	0.13	1.84		
		HOHE 00000M000C	1	0.09	0.37	1.84		
KOSG	1996-2001, 2003-2009, 2013	KOSG113504M003	4	0.63	0.58	0.78	EPN A site	
		KOSG213504M003	4	1.71	0.62	3.73		
		KOSG513504M003	1	0.21	0.11	0.70		
LOMS	2005-2009, 2013	LOMS 00000M000A	3	1.46	0.62	1.22		
		LOMS 00000M000B	1	1.48	0.07	9.34		
LOVE	2009-2013	LOVE 00000S001	3	0.76	0.34	0.73		
RISO	2005, 2013	RISO 00000S001A	1	0.03	0.04	0.00		
		RISO 00000S001B	1	0.04	0.13	0.05		
ROZH	2005-2011, 2013	ROZH 00000S001A	4	0.55	0.61	1.62		
		ROZH 00000S001B	1	0.18	0.04	0.70		
SBGZ	1999, 2001-2005, 2007	SBG2 11031M002A	2	4.22	8.22	2.62		
		SBG2 11031M002B	3	2.10	4.34	1.5		
		SBG2111031M002	3	0.83	1.21	0.86		

SBGZ	1999, 2001-2005, 2007	SBG2 11031M002A	2	4.22	8.22	2.62	EPN A class site	
		SBG2 11031M002B	3	2.10	4.34	1.5		
		SBG2111031M002	3	0.83	1.21	0.86		
SIB1	2009, 2013	SIB1 00000M001	3	1.68	0.91	2.56		
		SIB1 00000M002A	1	0.00	0.24	1.71		
		SIB1 00000M002B	1	0.01	0.01	0.67		
SUCE	2003-2009, 2013	SUCE 00000M001A	4	1.22	2.91	2.28		
		SUCE 00000M001B	1	0.16	0.12	0.39		
SULP	1997, 1999-2001, 2003-2013	SULP 00000M000A	1	0.05	0.07	5.50		
		SULP 00000M000B	2	5.34	3.81	4.99		
		SULP212366M001	6	0.39	1.07	2.44		
SUME	2005-2007, 2009-2013	SUME 11215M001A	2	1.28	1.09	2.90		
		SUME 11215M001B	2	0.66	0.44	1.73		
VARN	2005, 2011, 2013	VARN 00000S001A	1	0.39	0.17	3.11		
		VARN 00000S001B	1	0.07	0.20	2.56		
		VARN 00000S001C	1	0.05	0.15	1.46		

Table 2. Stations proposed for evaluation, with discontinuities.

# List of sites for which we request validation (III)

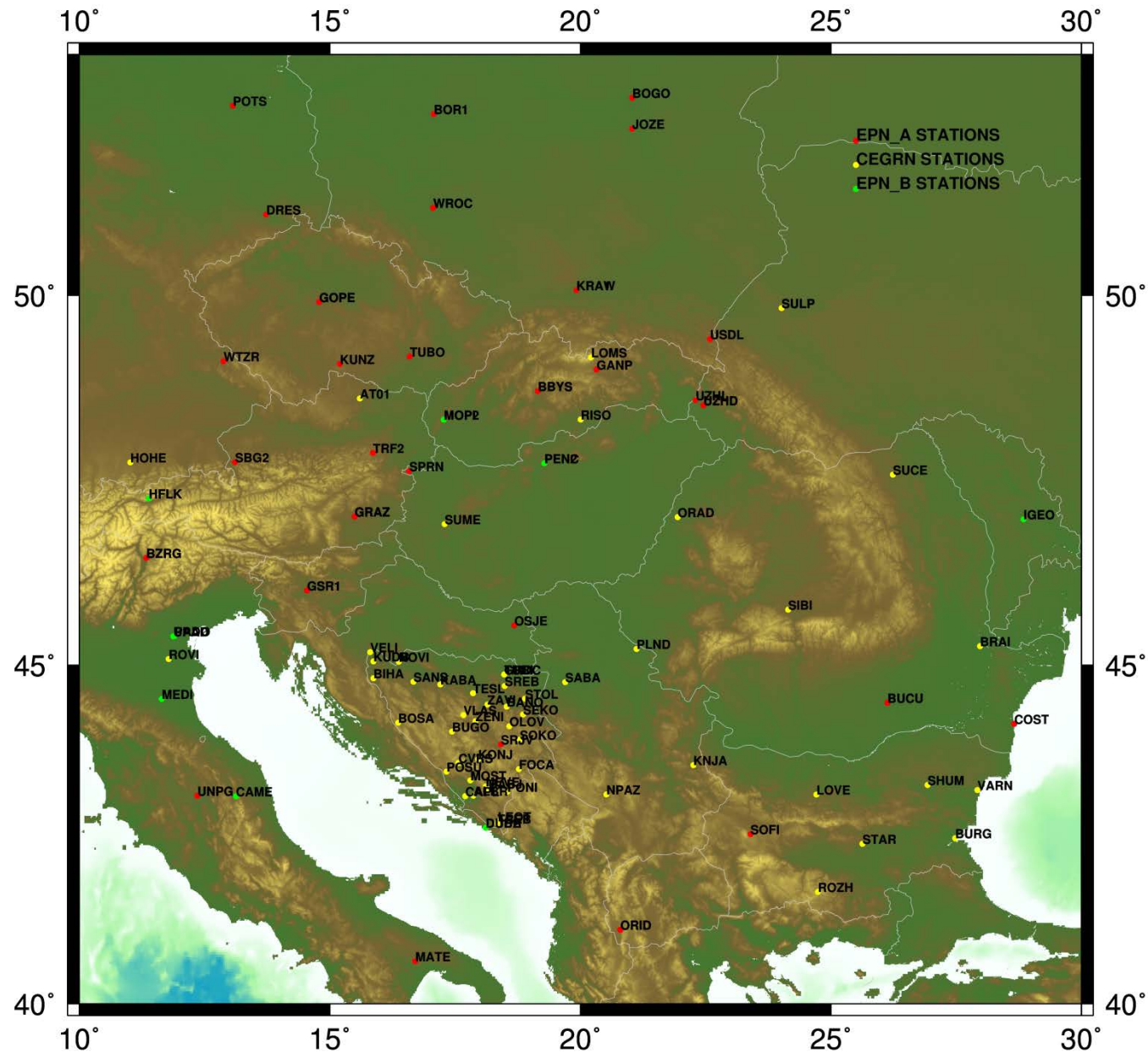
STATION	YEARS OBSERVED	WEEKLY REPEATABILITY (SOLS., REP. NEU MM)						REMARKS
ALBR	2005	ALBR 00000M000	1	0.05	0.06	0.58		
BABJ	2005	BABJ 00000M000	1	0.08	0.04	0.68		
BANO	2013	BANO 00000M000	1	0.04	0.05	0.16		
BIHA	2013	BIHA 00000M000	1	0.00	0.06	0.19		
BOSA	2013	BOSG 00000M000	1	0.02	0.07	0.22		Refers to BOSG (Bosanska Grahovo)
BUGO	2013	BUGO 00000M000	1	0.03	0.07	0.21		
CAPL	2013	CAPL 00000M000	1	0.06	0.09	0.28		
CVRS	2005	CVRS 00000M000	1	0.01	0.11	0.50		
FOCA	2013	FOCA 00000M000	1	0.07	0.07	0.23		
GRDC	1999	GRDC 00000M000	1	0.27	0.19	0.58		
KABA	2005	KABA 00000M000	1	0.12	0.03	0.21		
KNJA	2013	KNJA 12113M001	1	0.08	0.06	0.37		EPN candidate
KONJ	2013	KONJ 00000M000	1	0.05	0.07	0.23		
LEOT	2005	LEOT 00000M000	1	0.12	0.02	0.66		
MOST	2013	MOST 00000M000	1	0.06	0.08	0.26		
NEVE	2013	NEVE 00000M000	1	0.07	0.08	0.28		
NOVI	2013	NOVI 00000M000	1	0.00	0.05	0.19		
NPAZ	2013	NPAZ 12110M001	1	0.09	0.08	0.19		
OLOV	2013	OLOV 00000M000	1	0.05	0.05	0.18		
PLND	2013	PLND 12111M001	1	0.09	0.02	0.03		
PONI	2005	PONI 00000M000	1	0.07	0.04	0.56		
POSU	2013	POSU 00000M000	1	0.05	0.08	0.26		
SABA	2013	SABA 12112M001	1	0.07	0.01	0.03		
SANS	2013	SANS 00000M000	1	0.01	0.06	0.18		

SABA	2013	SABA 12112M001	1	0.07	0.01	0.03	EPN candidate
SANS	2013	SANS 00000M000	1	0.01	0.06	0.18	
SEKO	2013	SEKO 00000M000	1	0.05	0.05	0.16	
SOKO	2013	SOKO 00000M000	1	0.06	0.06	0.19	
SREB	2013	SREB 00000M000	1	0.04	0.04	0.14	
STOL	2005	STOL 00000M000	1	0.04	0.08	0.12	
TESL	2013	TESL 00000M000	1	0.03	0.05	0.17	
TREB	2013	TREB 00000M000	1	0.09	0.09	0.33	
TURI	2005	TURI 00000M000	1	0.02	0.01	0.16	
VELI	2013	VELI 00000M000	1	0.01	0.06	0.17	
VLAS	2005	VLAS 00000M000	1	0.03	0.03	0.49	
ZAVI	2013	ZAVI 00000M000	1	0.04	0.05	0.17	
ZENI	2013	ZENI 00000M000	1	0.04	0.06	0.19	

Table 3. Stations proposed for evaluation, with one campaign.



# List of sites for which we request validation (map)



# Last remarks

- We are presenting the CEGRN multiyear combination for its approval by the TWG.
- Having showed the results and the analysis strategy, we do believe the CEGRN network can be classified as a B Class network.
- After the mail received on October 28<sup>th</sup>, **all sites, including the Bosnian**, can now be included in the solution.
- We cannot but express our thanks to Medzida Mulic:

*Dear Prof. Caporali,*

*thank you for e mail. It is good to know that CEGRN is advancing. I would suggest to include Bosnian sites as public.*

*In a telephone call with a person from Geodetic Administration Nedžad Pasalic, several months ago I got answer that "BIHPOS coordinates are public anyhow!" But, I did not get any official letter answering on my question concerning public/restricted area for BIHPOS coordinate in CEGRN2013.*

*So, my suggestion is to include BIHPOS station as a **public** area.*

*Hopefully it is not going to have any negative consequences for me.*

*Kind regards,*

*Medzida*