



# **EPN ACC activities: combination of routine and reprocessed solutions**

***A. Araszkievicz, M. Figurski, T. Liwosz, K. Szafranek***

*Military University of Technology  
Warsaw University of Technology*



## EPN ACC activities: combination of routine and reprocessed solutions

EUREF Analysis Centers Workshop, 14-15 October, 2015, Bern, Switzerland

### ROUTINE PRODUCTS:

Final products: daily and weekly solution

*based on 16 individual EPN AC solutions*

Rapid products: daily solution

*based on 10 individual EPN AC solutions*

Ultra-rapid products: hourly solution

*based on 3 individual EPN AC solutions*

### SPECIAL PRODUCTS:

Daily combined solution from repro2



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ASI BEK BKG COE IGE IGN LPT MUT NKG OLG RGA ROB SGO SUT UPA WUT

**15# BERNESE, 1# GIPSY OASIS**

ASI BEK BKG COE IGE **IGN** LPT MUT NKG OLG RGA ROB SGO SUT UPA WUT

**15# REGIONAL, 1# GLOBAL**

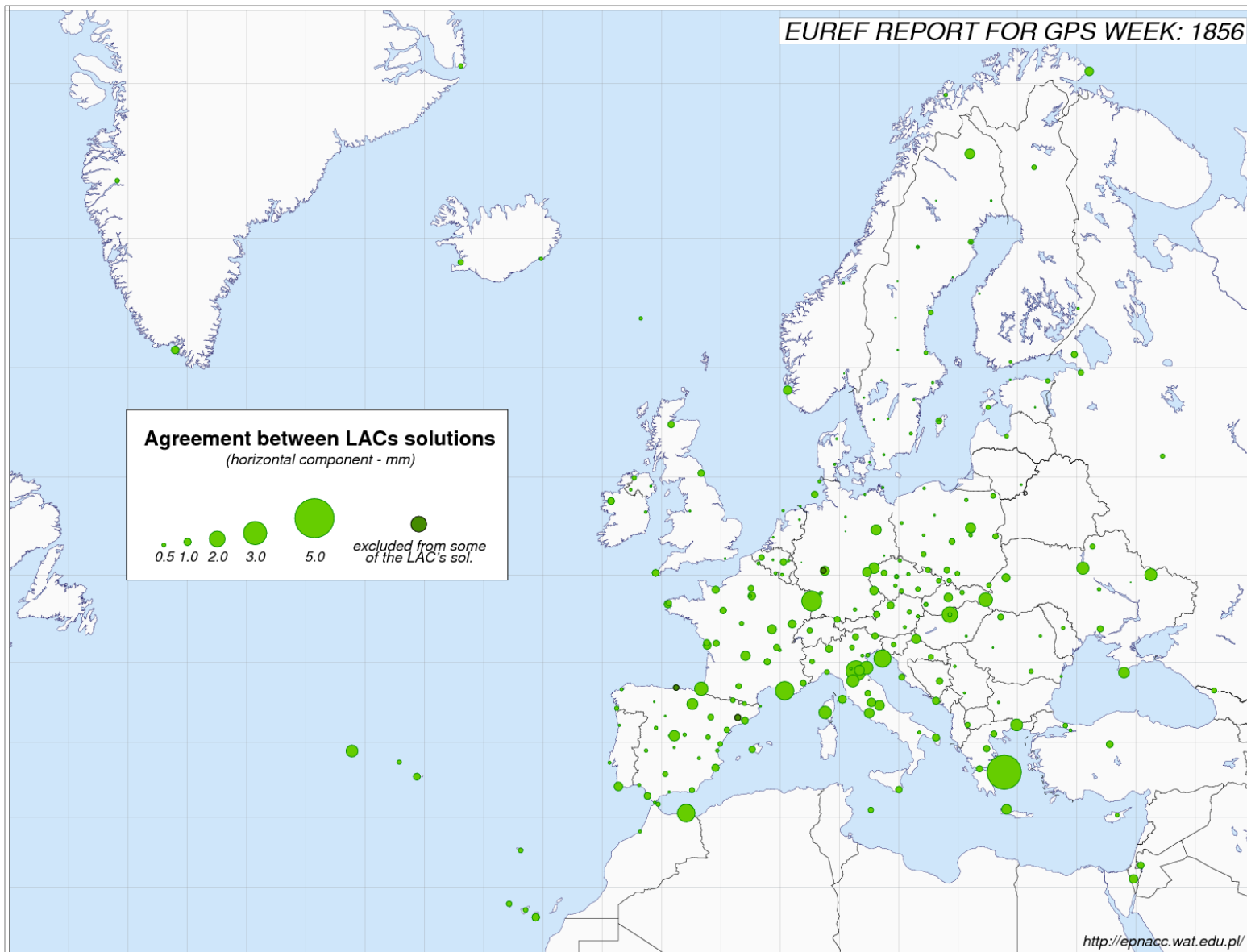
**ASI** BEK BKG COE IGE IGN LPT MUT NKG OLG RGA ROB SGO **SUT** UPA WUT

**14# GPS + GLONASS, 2# GPS only**



# EPN ACC activities: combination of routine and reprocessed solutions

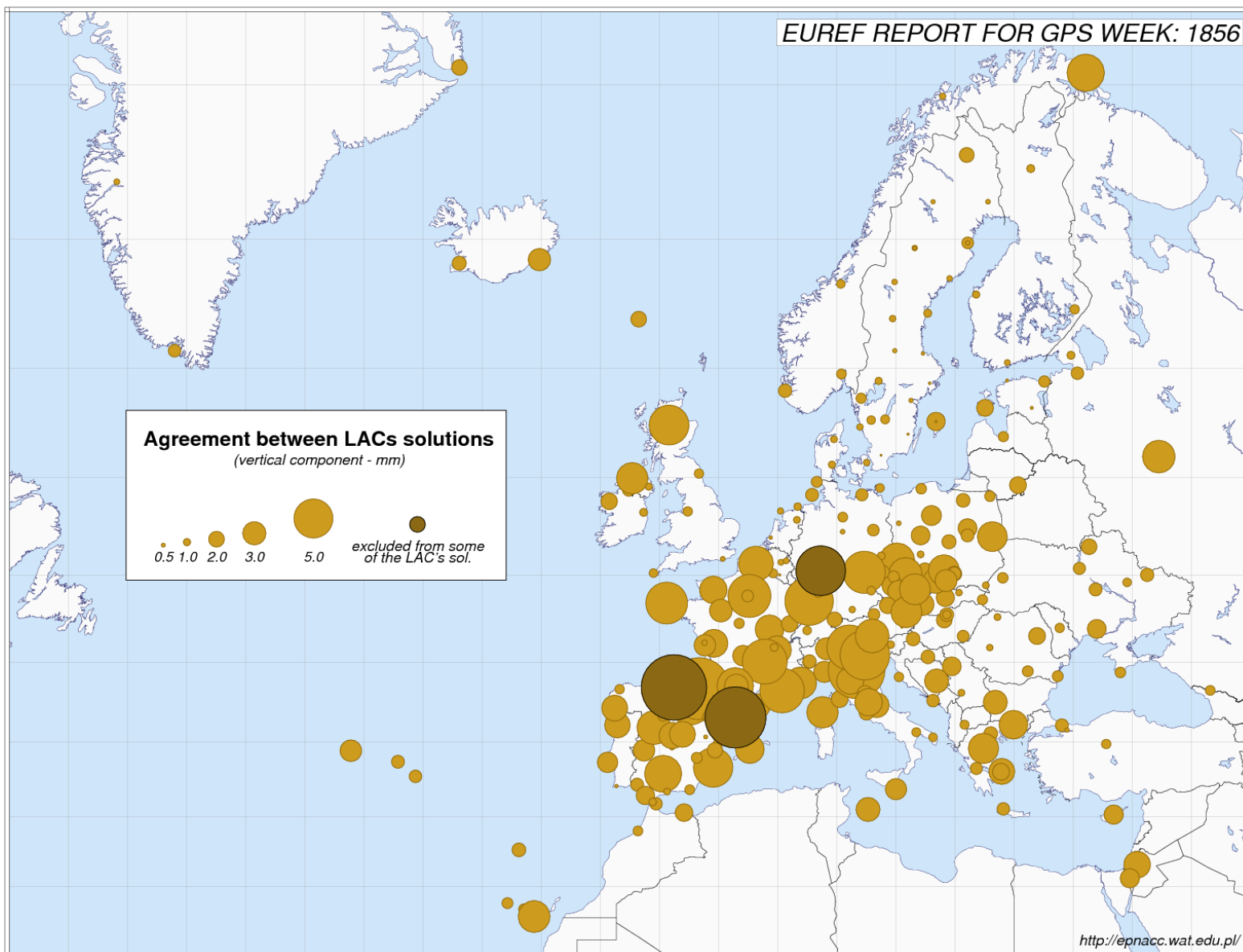
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# EPN ACC activities: combination of routine and reprocessed solutions

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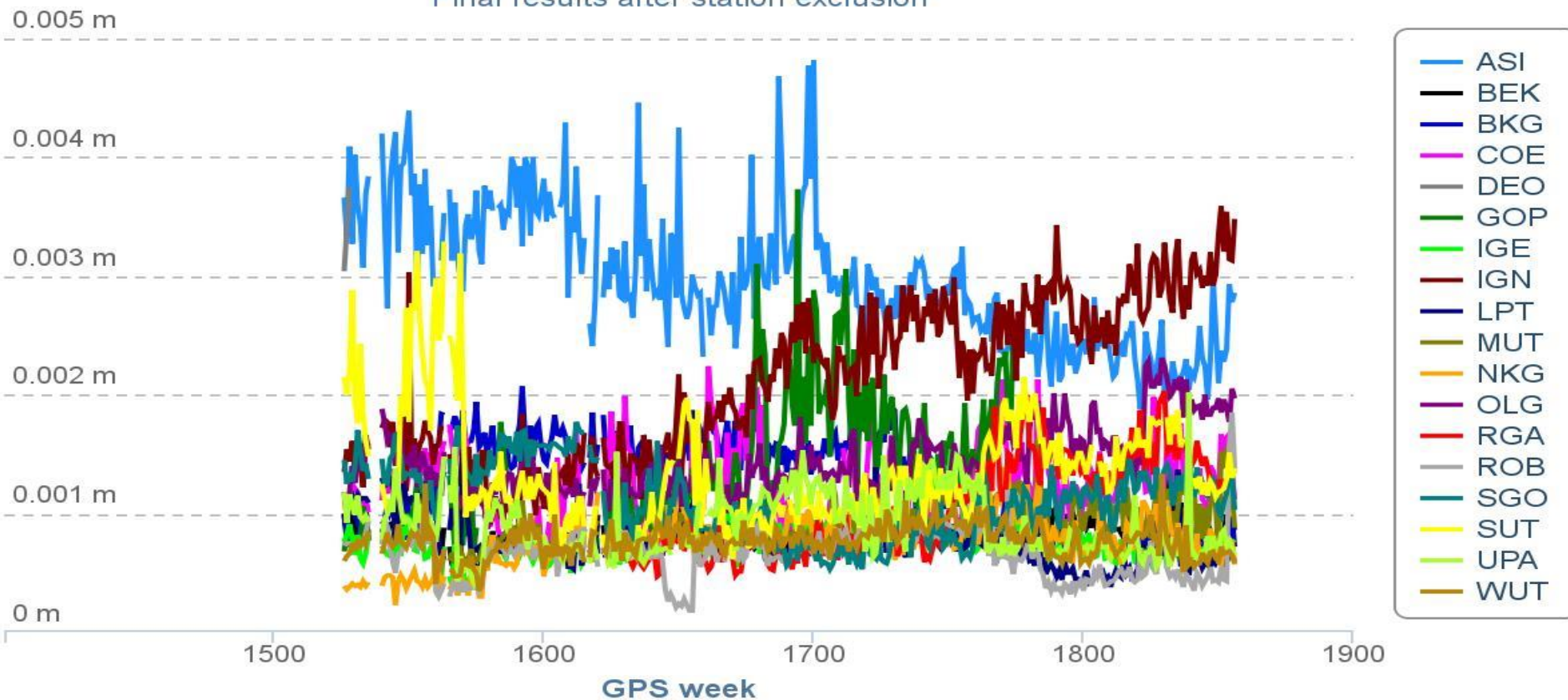


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## RMS of Helmert Transformation

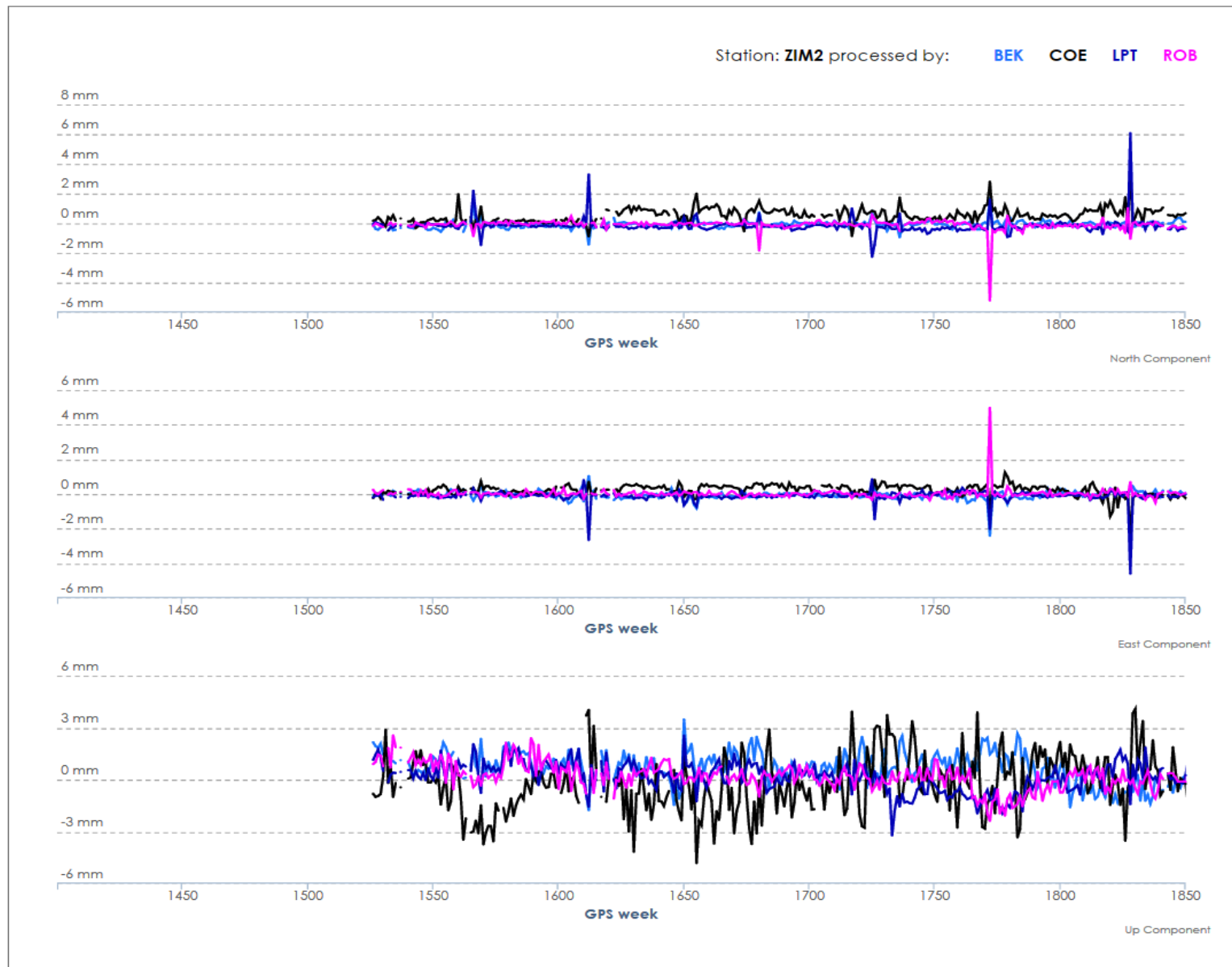
Final results after station exclusion





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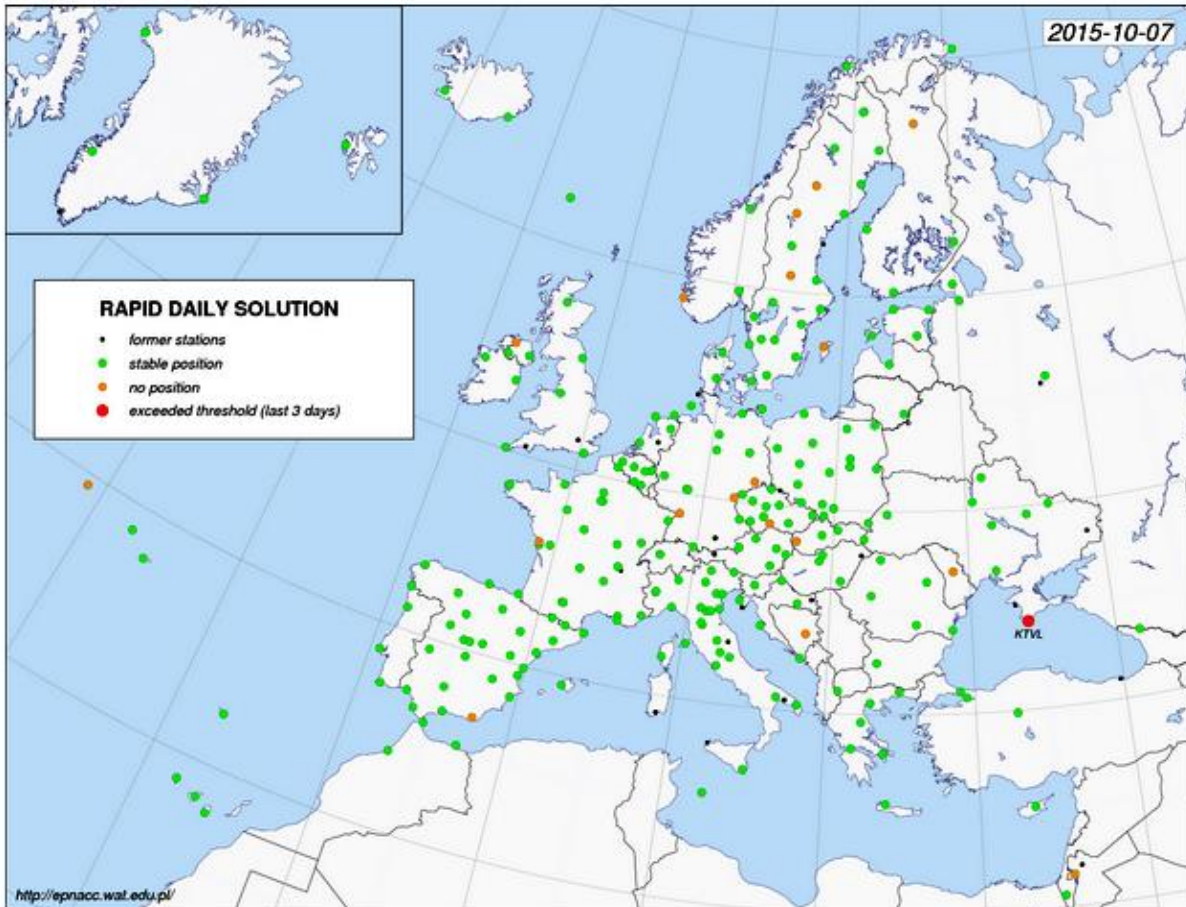
### **SPECIAL PRODUCTS:**

Daily combined solution from repro2



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STATUS FOR EPOCH: 2015-10-07 (DOY: 6)

-----  
List of the stations for which residual exceeded specified threshold (0.01/0.01/0.02)  
-----

NAME	North[m]	East[m]	Up[m]
------	----------	---------	-------

-----  
List of the stations without estimated crd.:  
-----

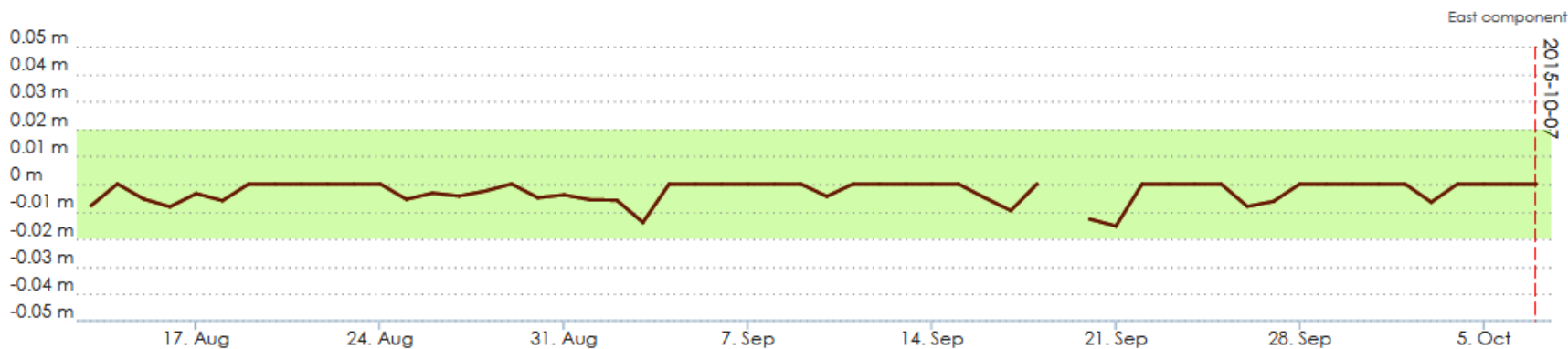
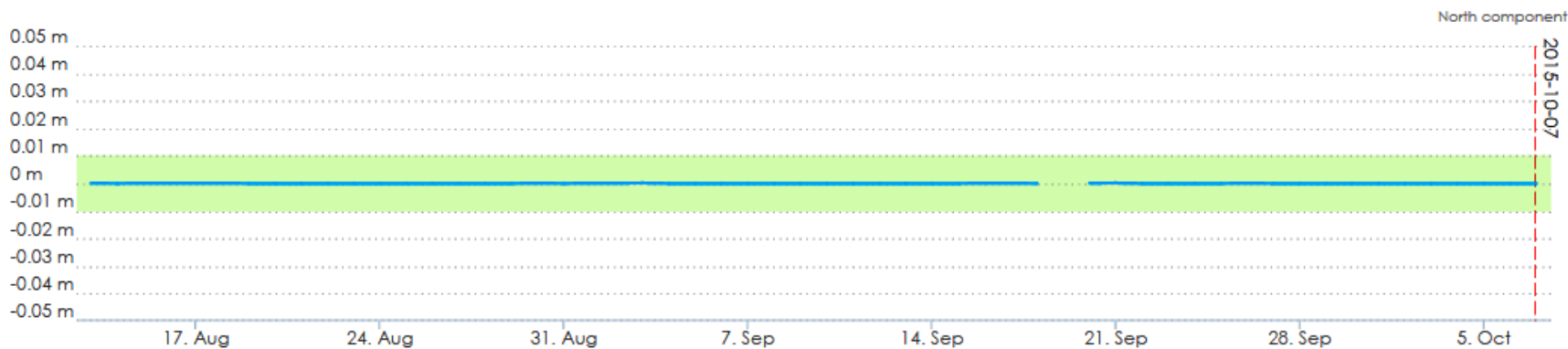
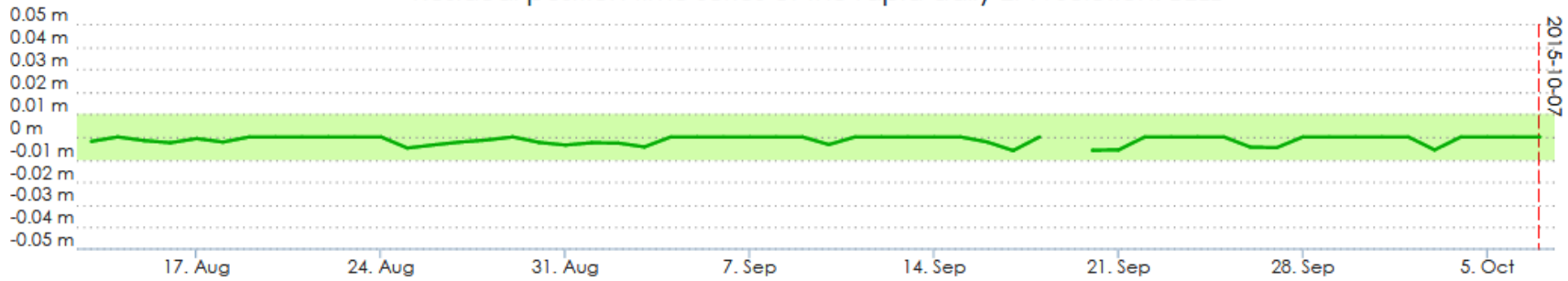
ALME	DRAG	DRES	FLRS	FOYL	IGEO	KARL	KTVL
KUNZ	LROC	MOP2	POUS	QAQ1	SODA	SRJV	STAS
VIL0	VIS6	LEK6	OST6				



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Residual position time series of the rapid daily EPN solution: **BELL**



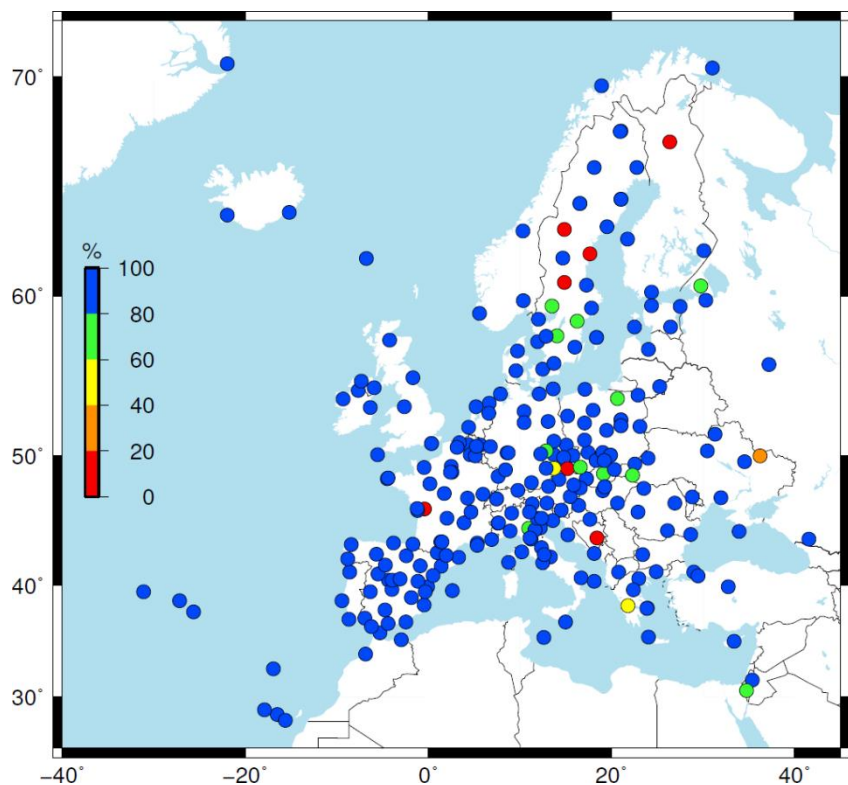
Up component



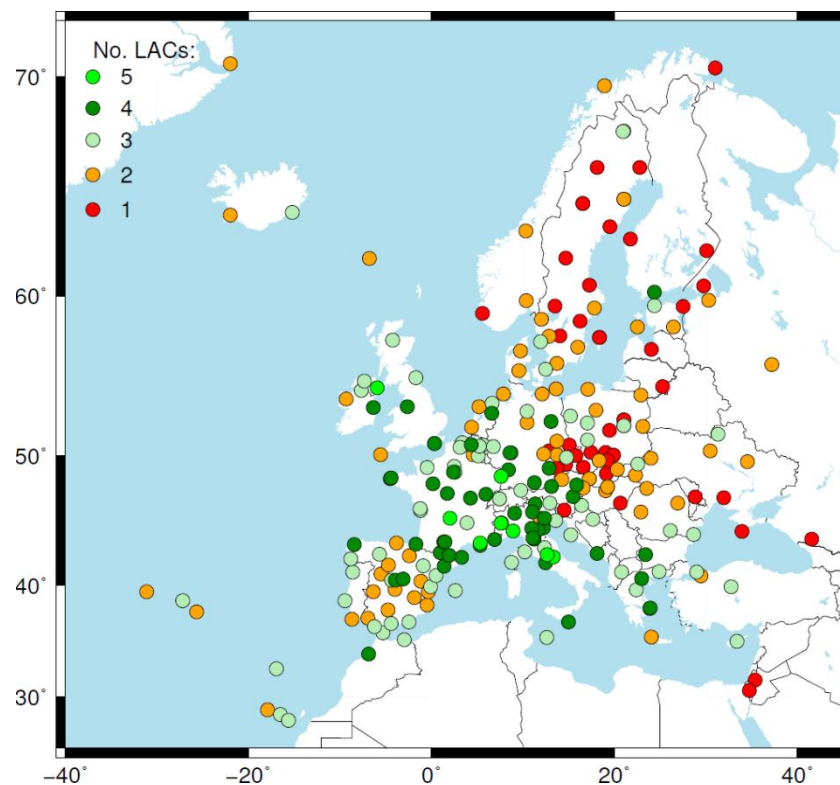


# EPN ACC activities: combination of routine and reprocessed solutions

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**Completeness of observations  
in rapid solutions  
(GPS weeks 1840-1845)**



**Number of LACs processing  
each EPN station (day1845 0)**



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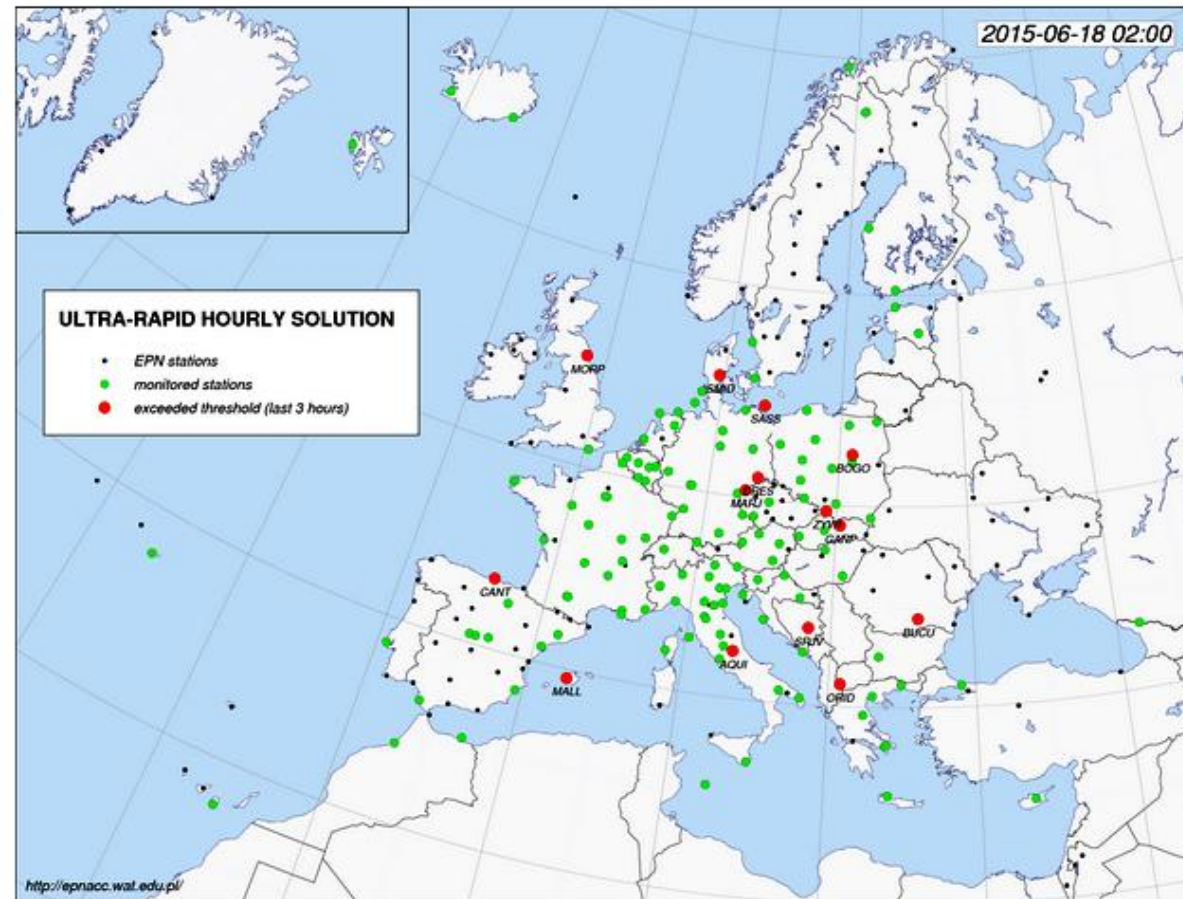
Daily combined solution from repro2





# EPN ACC activities: combination of routine and reprocessed solutions

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STATUS FOR EPOCH: 2015-06-18 (DOY: 169) 02:00

-----  
List of the stations for which residual exceeded specified threshold (0.01/0.01/0.02)  
-----

NAME	North[m]	East[m]	Up[m]
AQUI	0.0053	-0.0107	-0.0024
GANP	0.0117	0.0098	0.0063
MALL	0.0019	-0.0109	-0.0086

-----  
List of the monitored stations:  
-----

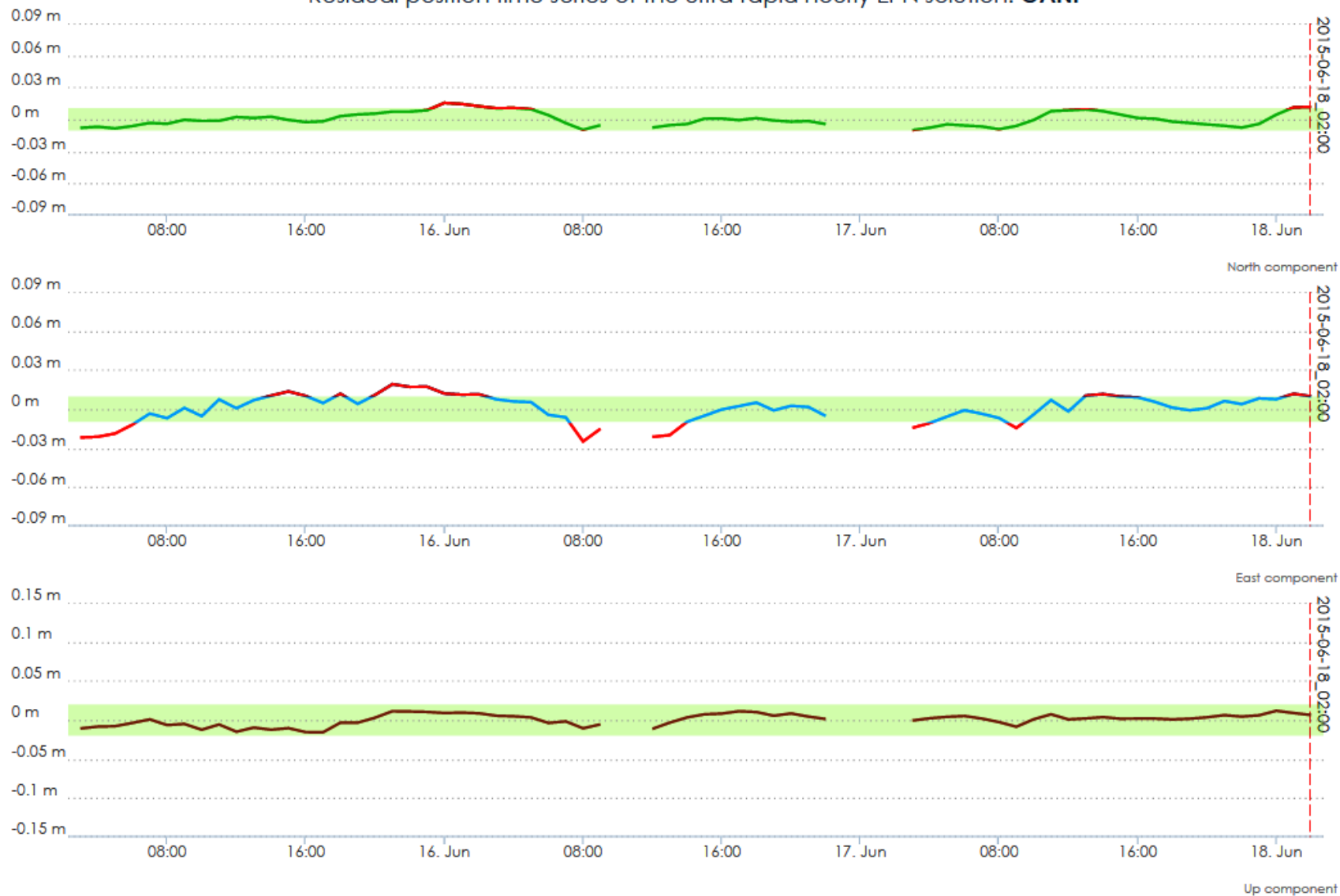
AJAC AQUI AUTN AXPV BADH BOGO BOR1 BORJ  
 BRST BRUX BSCN BUCU BUDP BYDG BZRG CANT  
 CASC COMO DELF DENT DOUR DRES DYNG EGLT  
 EIJS ENTZ EUSK GANP GENO GOPE GRAS GRAZ  
 GSR1 GUIP GWWL HELG HERS HERT HOBU HOFN  
 IENG ISTA JOZ2 JOZE KARL KIR0 KIRU KLOP  
 KRAW LAMA LAMP LIL2 LINZ LODZ M0SE MALL  
 MAN2 MARJ MARS MAS1 MATE MELI METS MLVL  
 MOP2 MORP NICO NOT1 NYA1 OBE4 ORID OROS  
 PADO PDEL PEN2 PENC PFA2 POTS POUS PTBB  
 PUYV RABT REDU REDZ REYK SASS SBG2 SFER  
 SMID SMNE SOFI SRJV SUR4 SWKI TERS TLMF  
 -----



# EPN ACC activities: combination of routine and reprocessed solutions

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Residual position time series of the ultra-rapid hourly EPN solution: **GANP**





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Daily solution combined from 5 individual solutions provided by ACs.

	<b>AS0</b>	<b>GO1</b>	<b>IG0</b>	<b>LP0</b>	<b>MU1</b>
<b>SOFTWARE</b>	GPSY 6.2	BSW 5.2	BSW 5.2	BSW 5.2	GAMIT 10.5
<b>GNSS</b>	G	G	G + R	G + R	G
<b>SOLUTION TYPE</b>	PPP	NET	NET	NET	NET
<b>STATIONS</b>	ALL EPN	ALL EPN	PART EPN	PART EPN	ALL EPN
<b>ORBITS</b>	JPL R2	CODE R2	CODE R2	CODE R2	CODE R2
<b>ANTENNAS</b>	IGS08	IGS08 + IND.	IGS08 + IND.	IGS08	IGS08 + IND.
<b>ATM. TIDAL LOADING</b>	-	-	+	+	+
<b>ATM. NONTIDAL LOADING</b>	-	-	-	-	-
<b>ELEVATION CUTOFF</b>	3	3	3	3	5
<b>SOLUTION</b>	INCOMPLETE COV	NEQ	NEQ	NEQ	COV
<b>TIME SPAN</b>	835-1772	836-1824	835-1816	835-1772	835-1771

Details in Session **EPN Reprocessing activities**

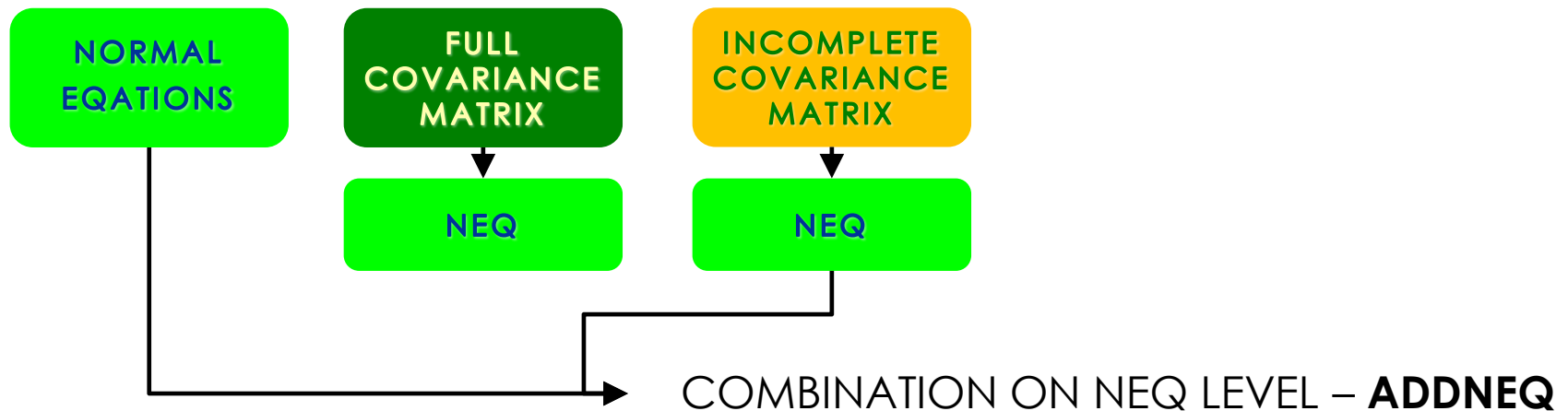


## EPN ACC activities: combination of routine and reprocessed solutions

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Main concerns regarding combined solution:

1. Various processing **tools**.
2. Different **extent** of processed networks.
3. Different **format of solution** (normal equations, covariance matrix or incomplete covariance matrix).





## **EPN ACC activities: combination of routine and reprocessed solutions**

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### **Combination:**

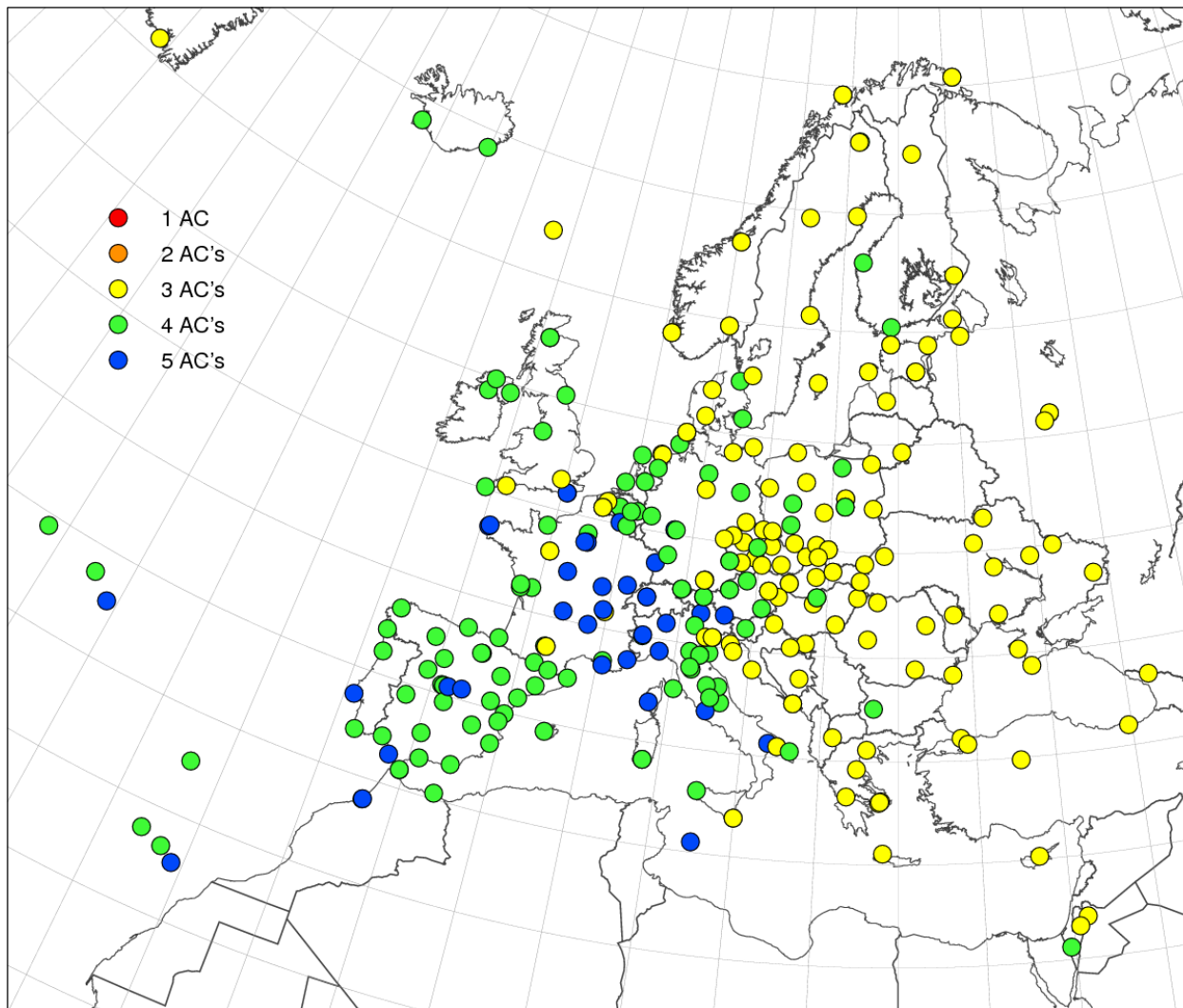
- Combination on the NEQ level.
- Bernese GNSS software 5.2 (ADDNEQ).
- Reference frame: IGb08
- Reference station elimination criterion: 10/10/25 millimeters (N/E/U).
- Station elimination criterion: 25/25/40 millimeters.





# EPN ACC activities: combination of routine and reprocessed solutions

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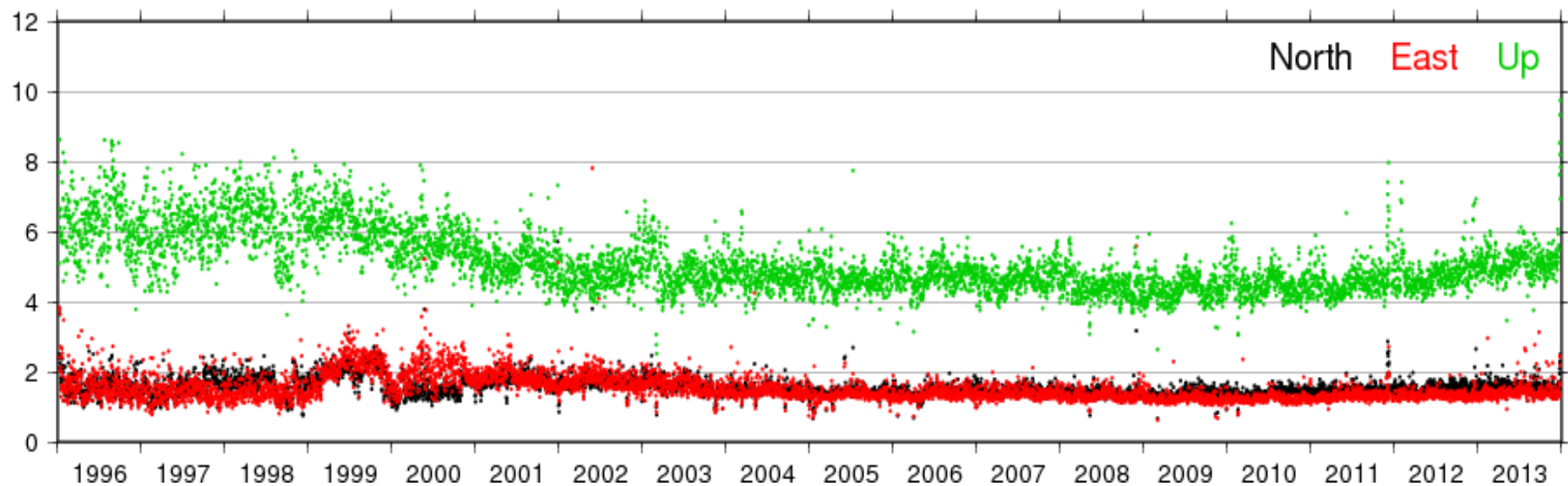


**Coverage by AC's (1996.0 - 2014.0) - only official EPN stations**



## EPN ACC activities: combination of routine and reprocessed solutions

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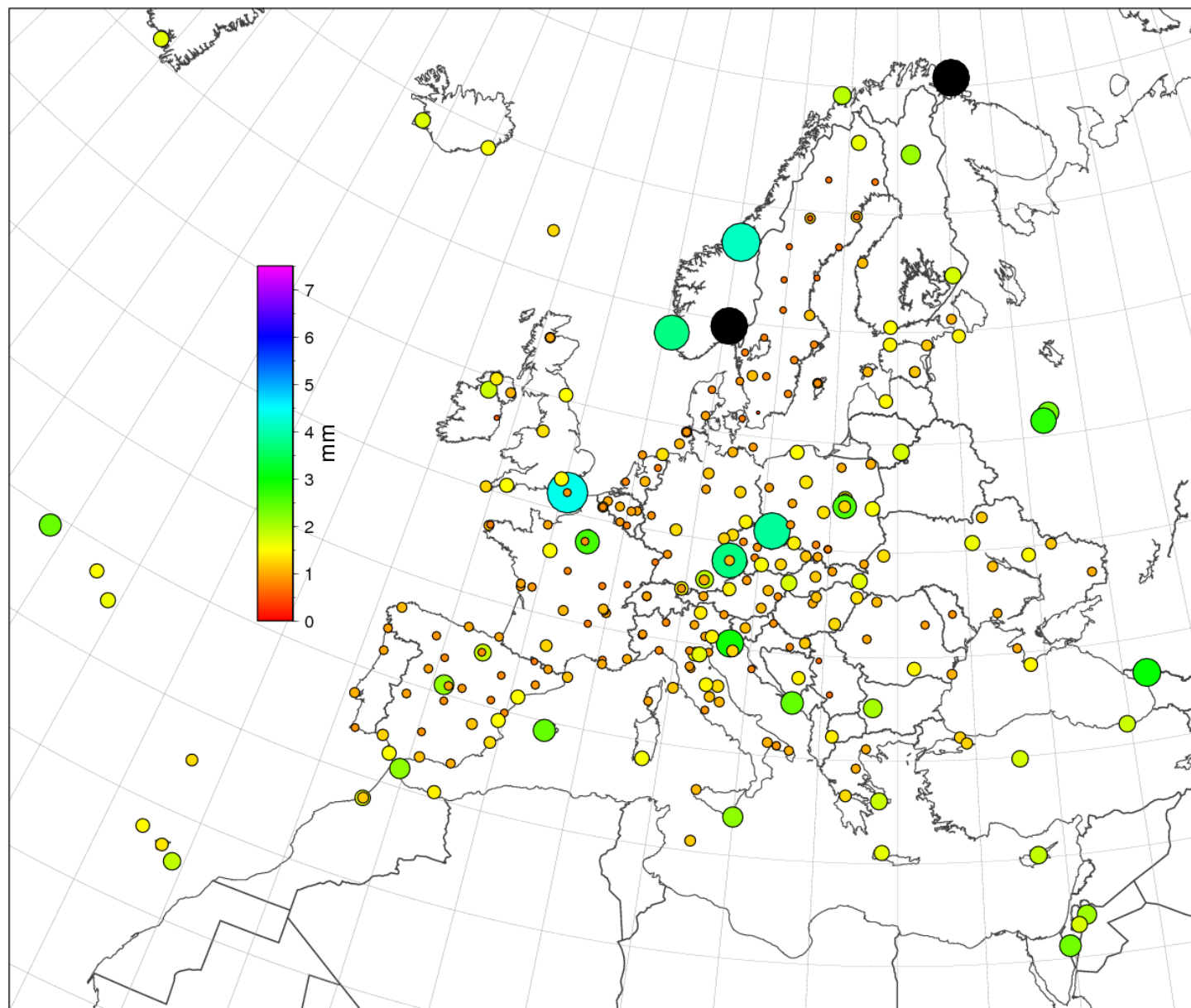


**Total agreement between individual solutions**



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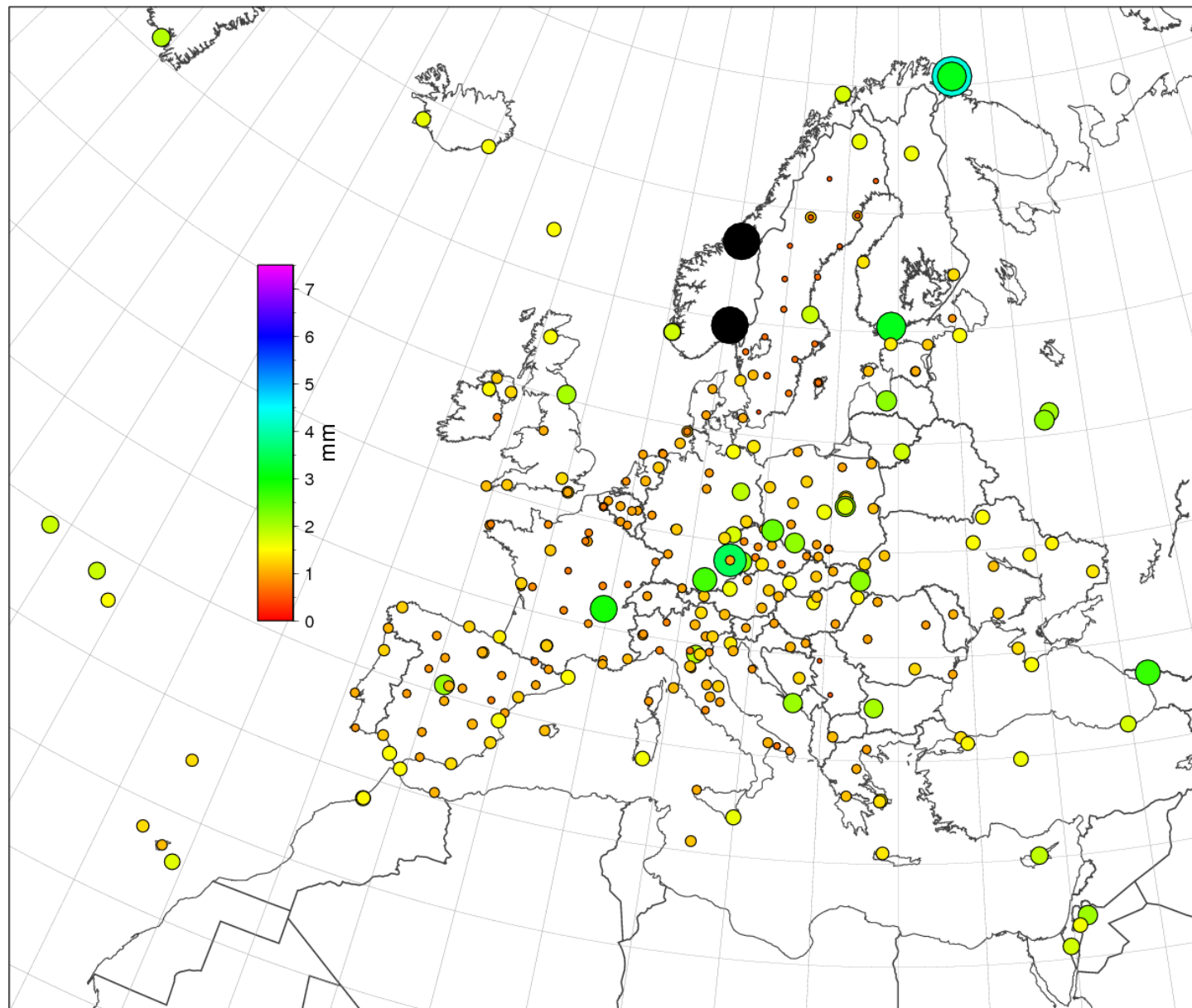


**Overall  
agreement  
(1996-2013)  
East component**



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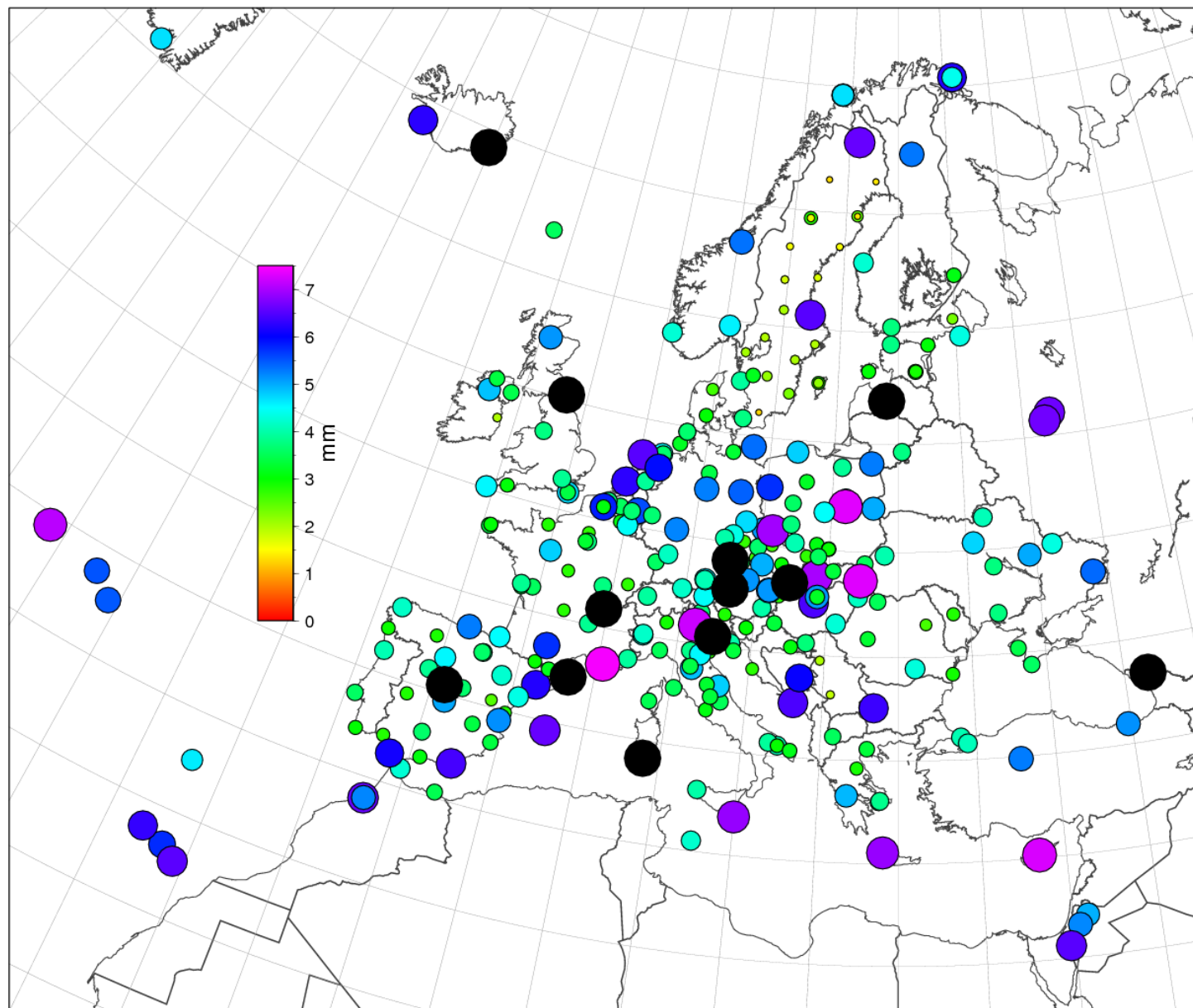
**Overall  
agreement  
(1996-2013)  
North component**



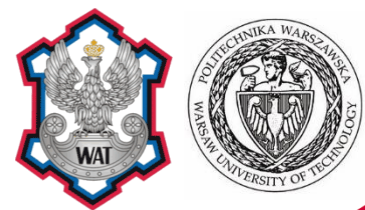


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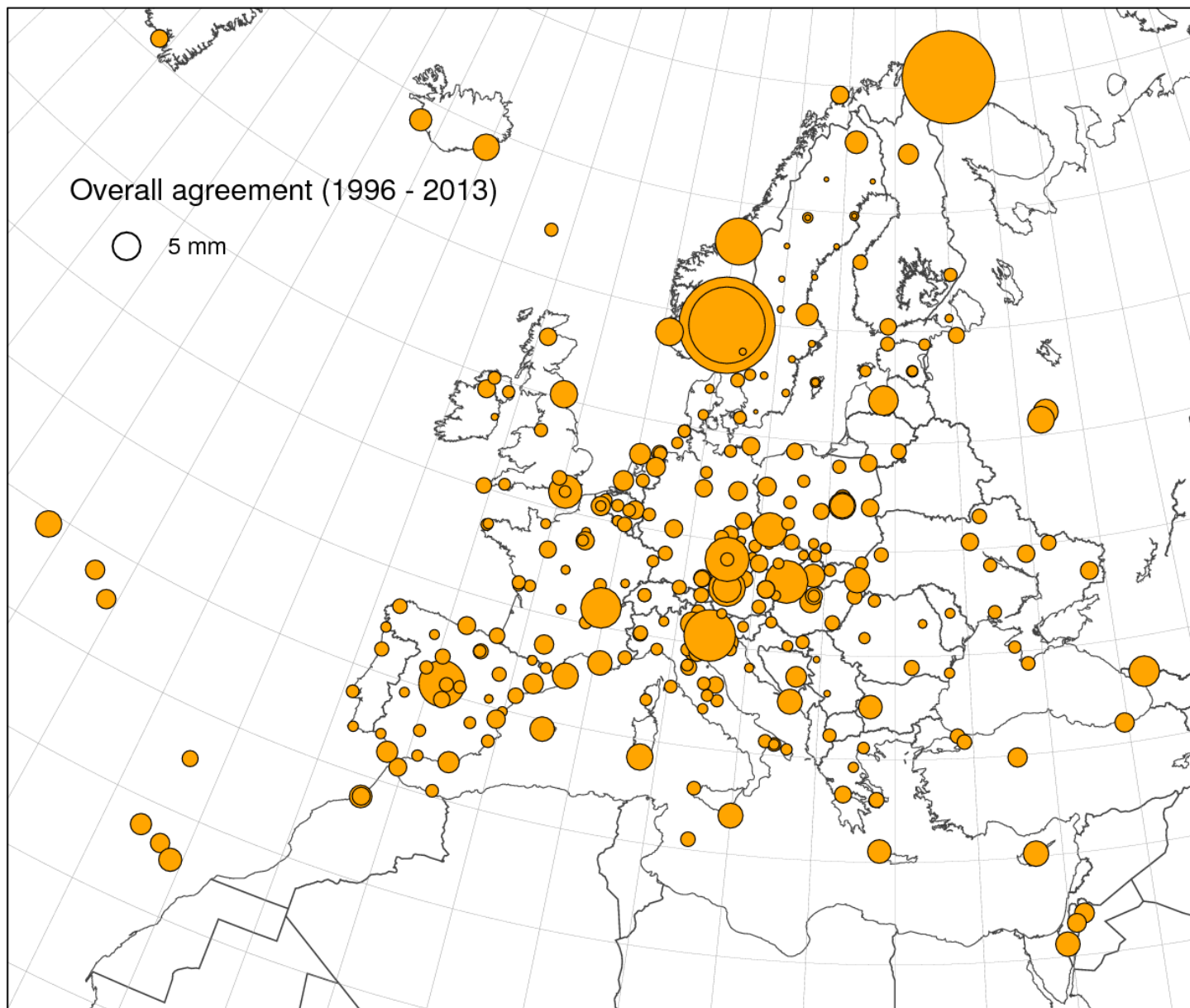
Overall  
agreement  
(1996-2013)  
Up component



# EPN ACC activities: combination of routine and reprocessed solutions

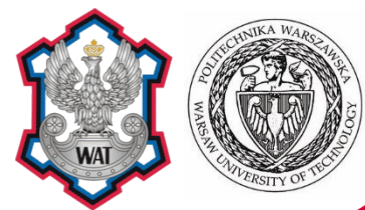
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## All stations



**Overall 3D  
agreement  
(1996-2013)**

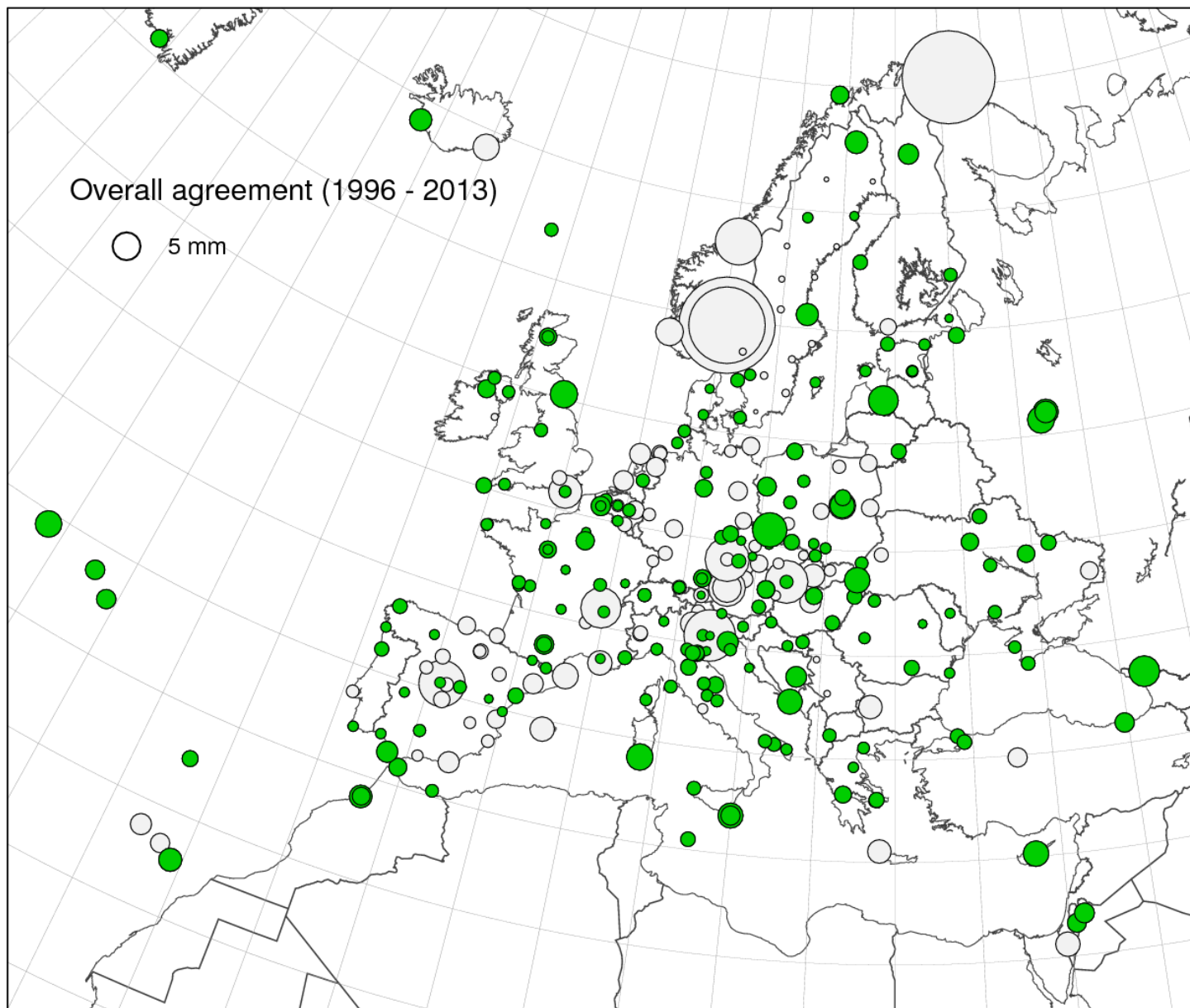




# EPN ACC activities: combination of routine and reprocessed solutions

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**Good agreement**



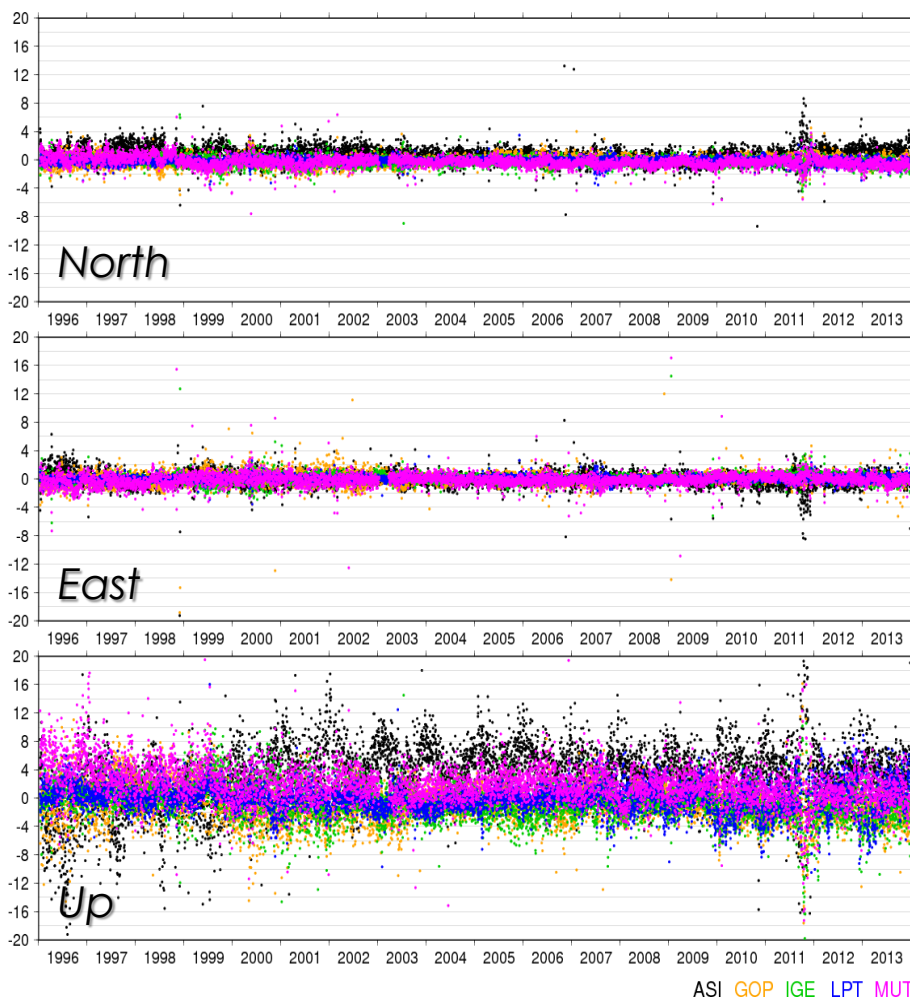
**Overall 3D agreement (1996-2013)**



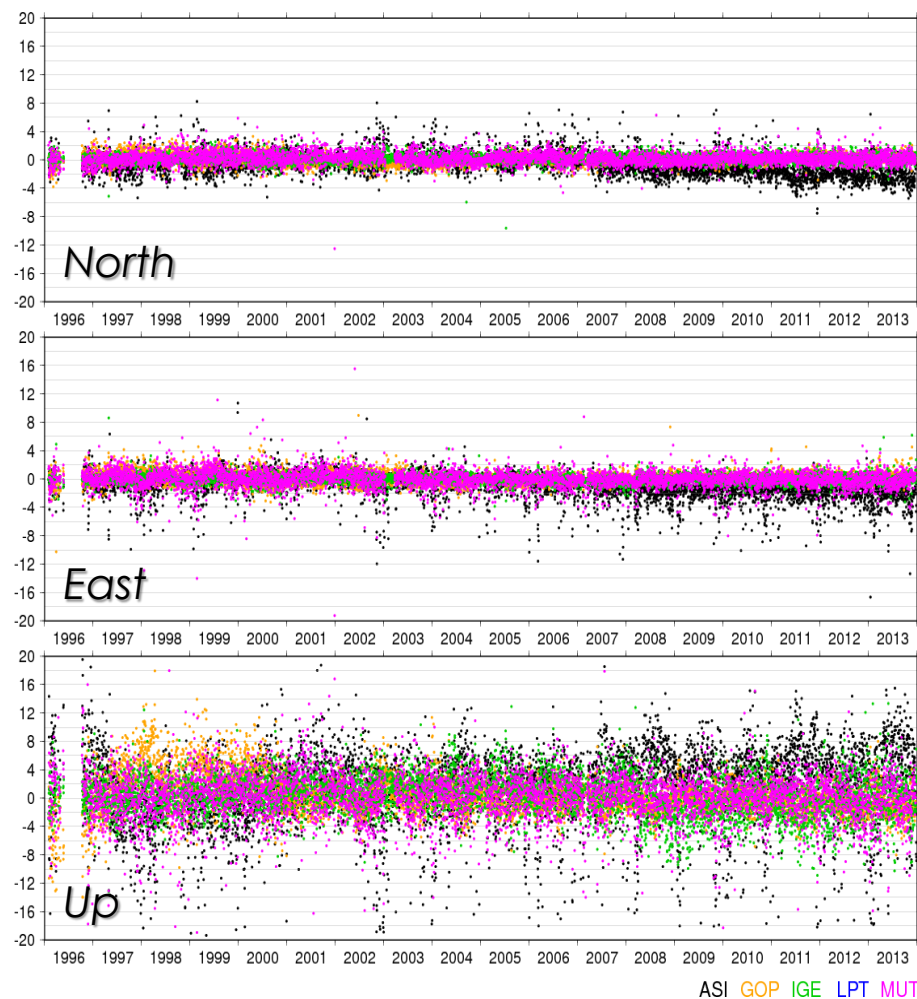
# EPN ACC activities: combination of routine and reprocessed solutions

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## Agreement between individual solutions (ZIMM)

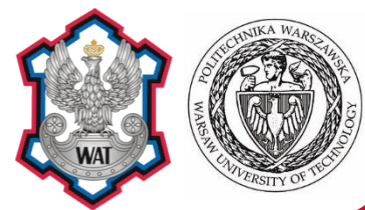


## Agreement between individual solutions (EBRE)



ASI GOP IGE LPT MUT

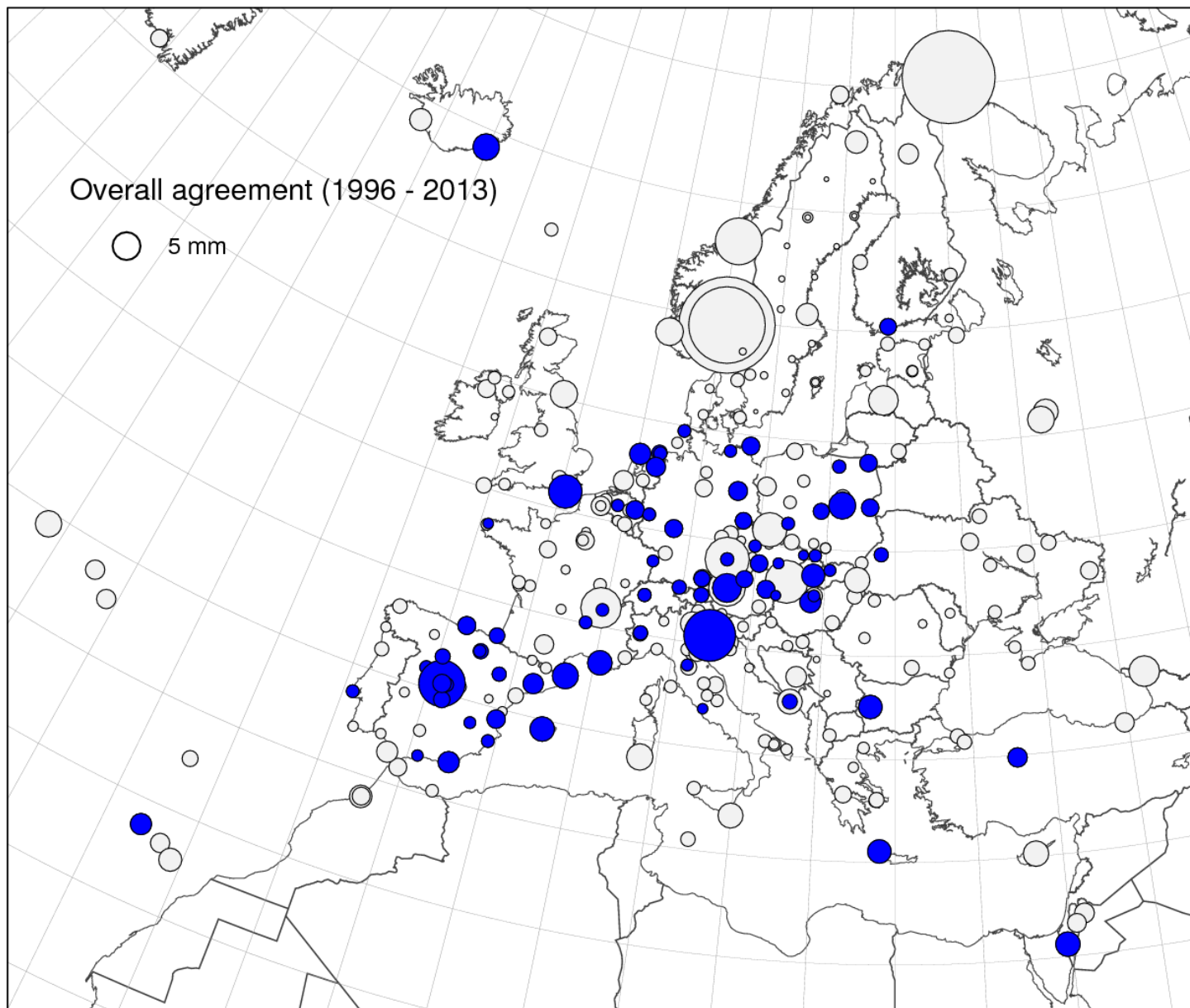
ASI GOP IGE LPT MUT



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## Temporary inconsistency



**Overall 3D  
agreement  
(1996-2013)**





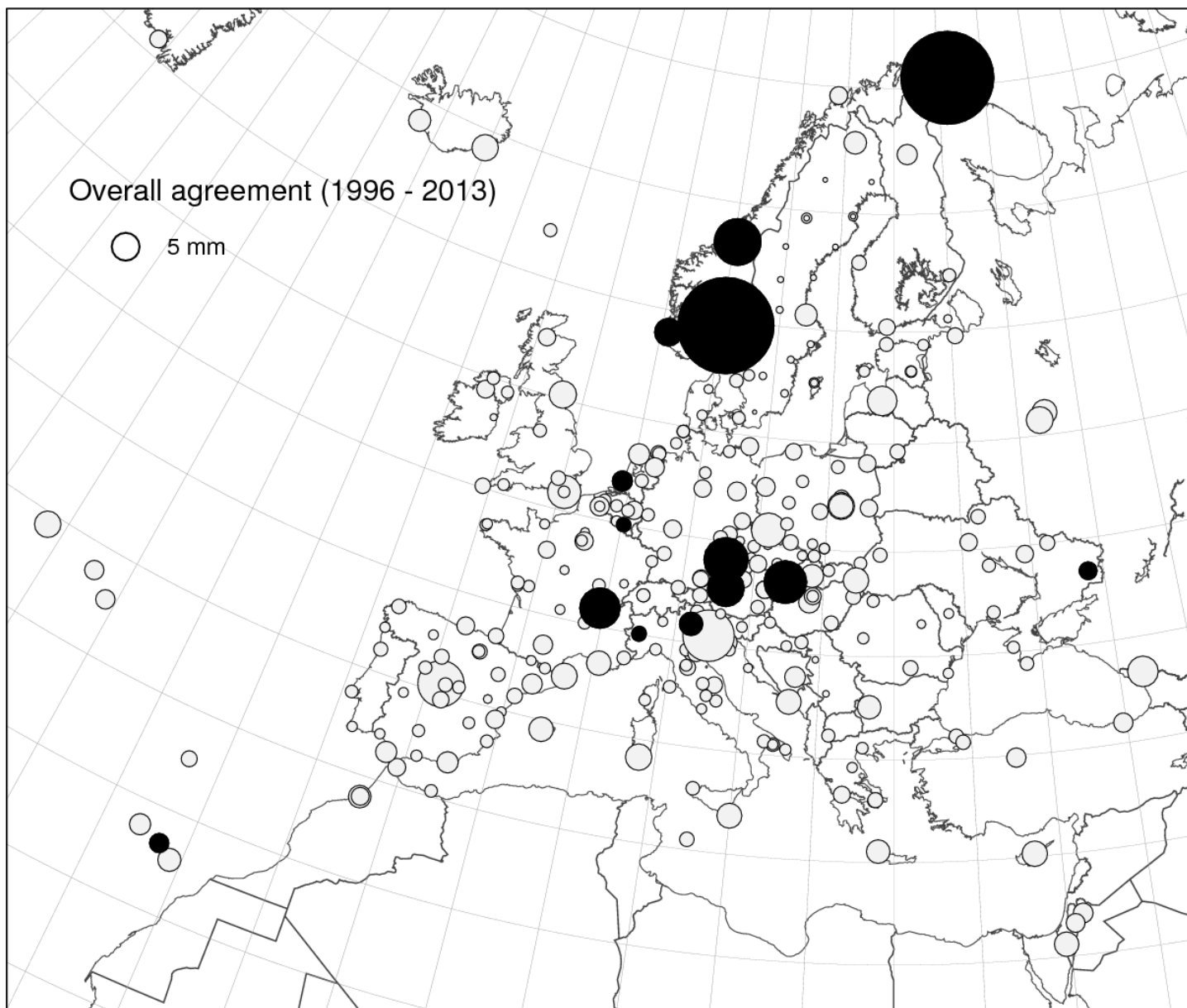
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## Entire period inconsistency

Overall agreement (1996 - 2013)

○ 5 mm

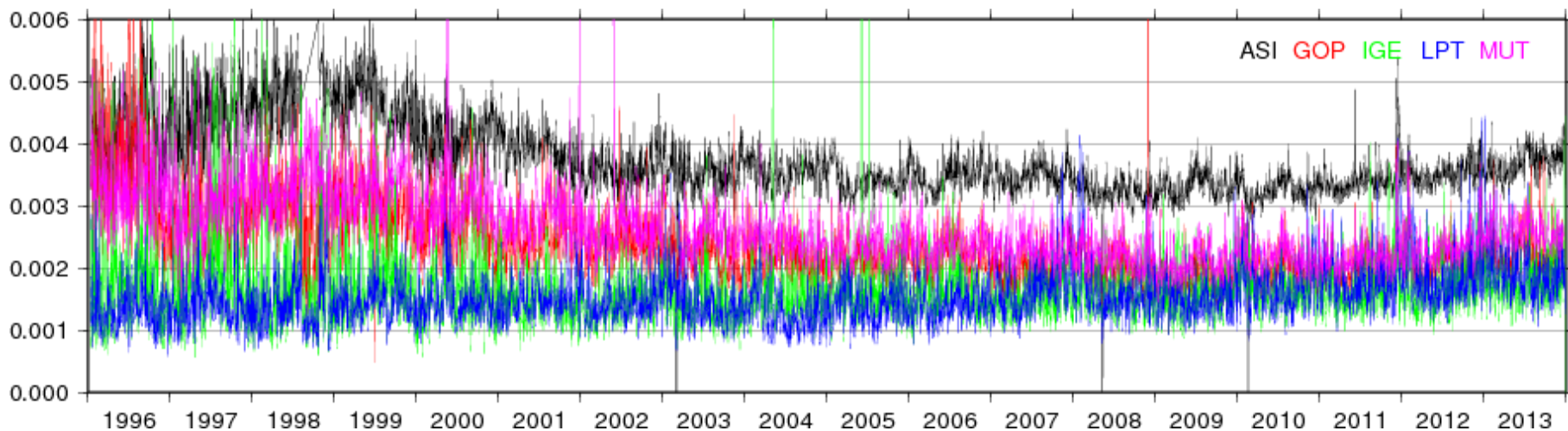


**Overall 3D  
agreement  
(1996-2013)**

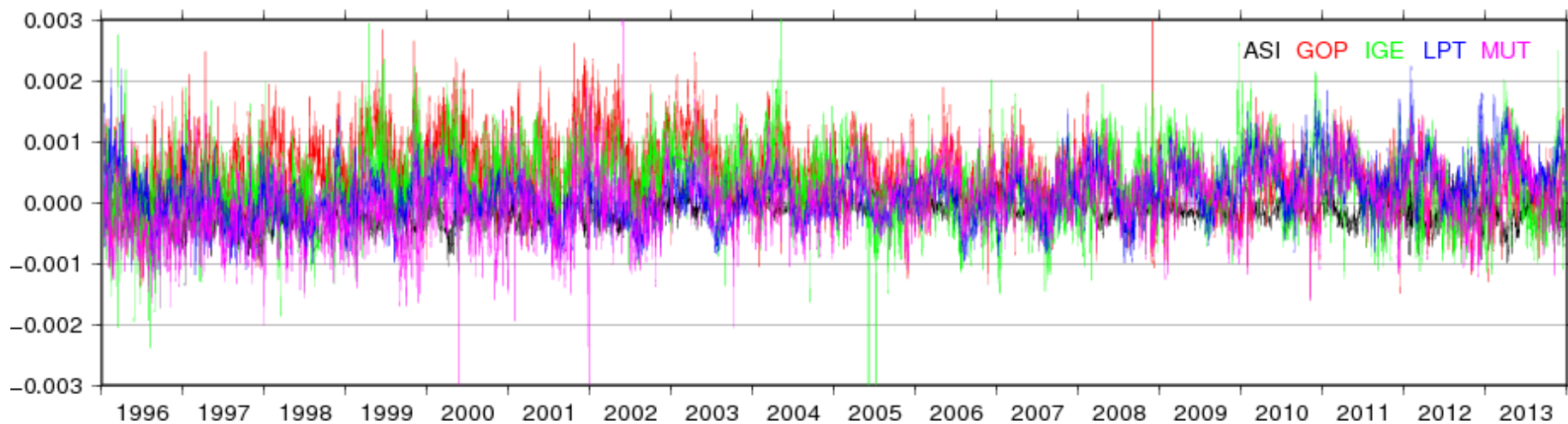


# EPN ACC activities: combination of routine and reprocessed solutions

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**RMS of Helmert transformation**

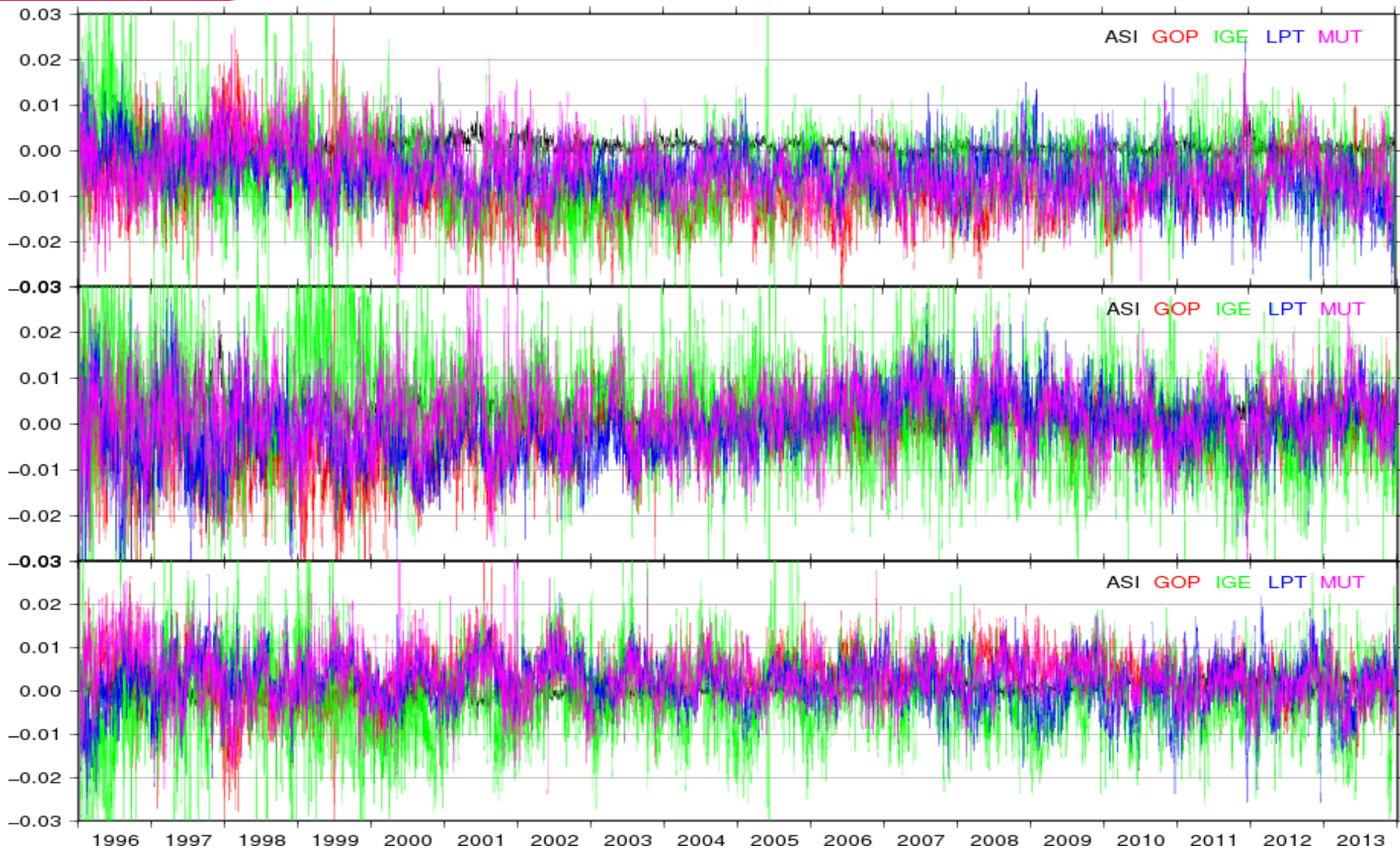


**Helmert transformation – scale parameter [ppm]**



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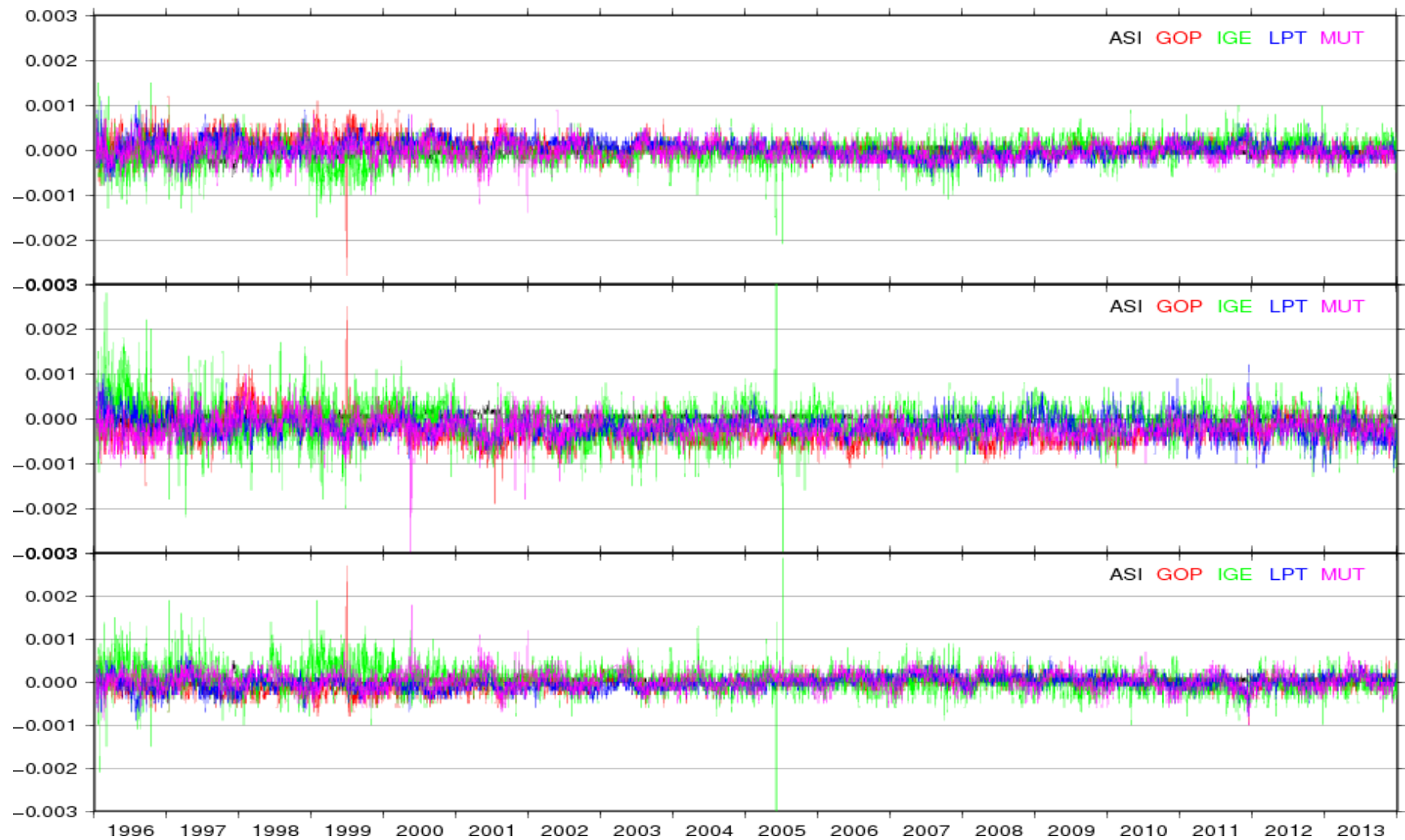
**Helmert transformation – translation [m]**



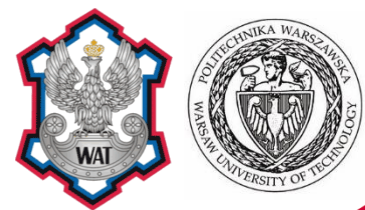


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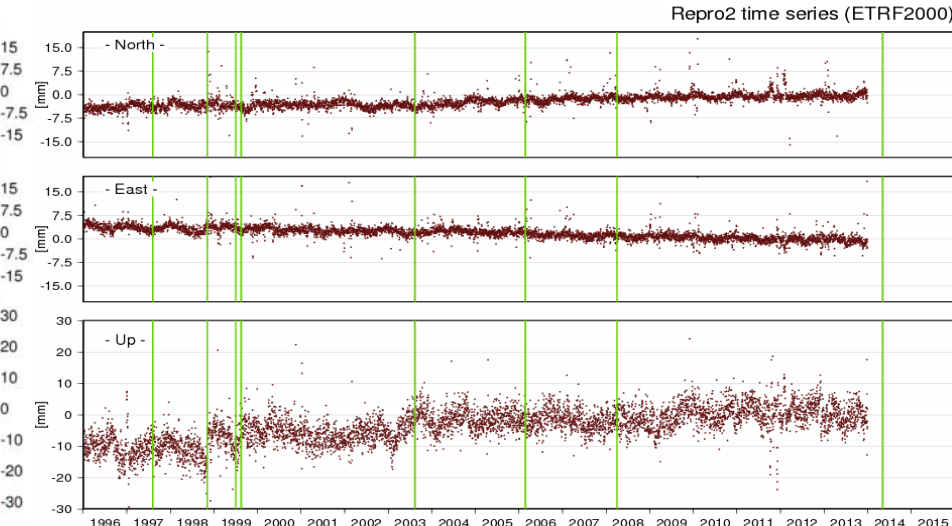
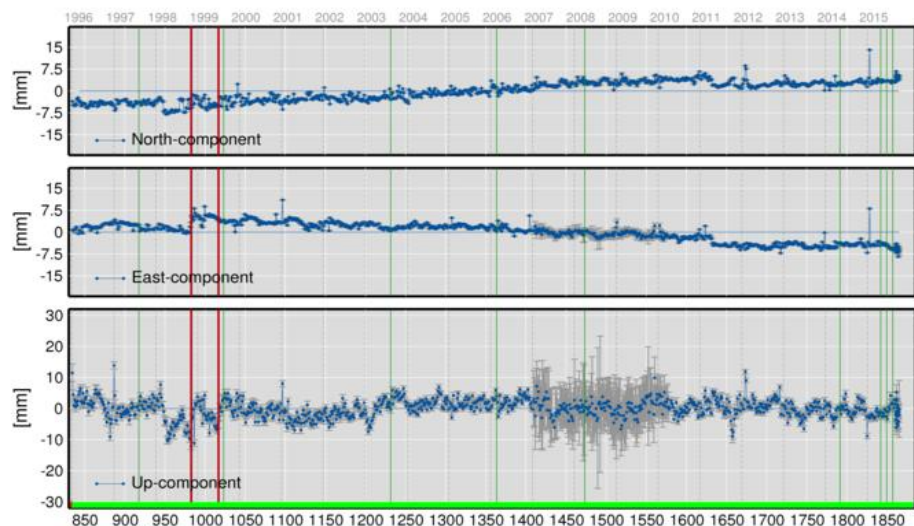
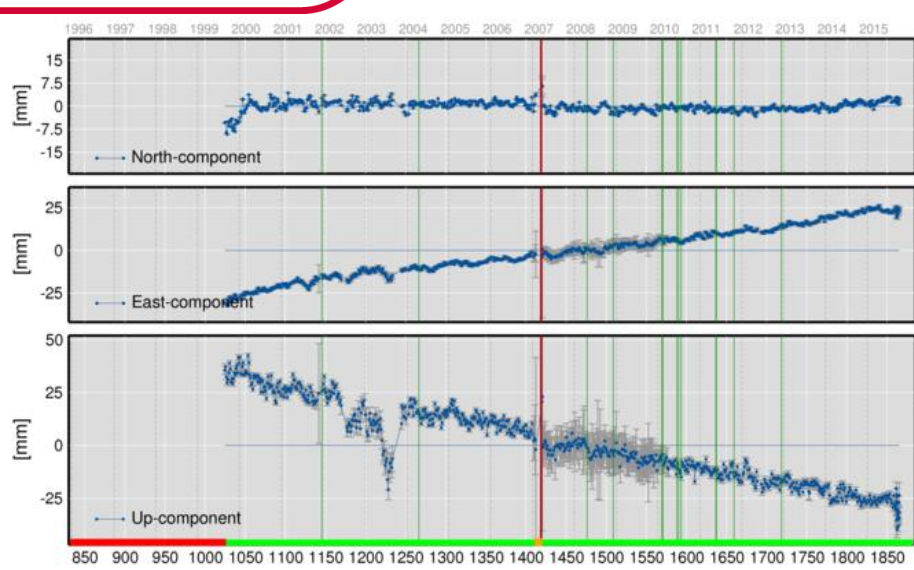


**Helmert transformation – rotation ["]**



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**Weekly EPN solution (repro1 + routine) and daily solution (repro2): stations ACOS and ZIMM**



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### **Conclusions and outlook:**

- **First combination of all submitted solutions was done – preliminary results.**
- **New combination after making decisions regarding:**
  - ✓ final selection of ACs' input solutions,
  - ✓ possible re-re-processing of selected input solutions,
  - ✓ corrections for selected stations before combination,
  - ✓ strategy of outliers and discrepancies elimination.
- **Analysis of problematic stations is needed.**
- **Solution will be used for:**
  - ✓ troposphere solution (R. Pacione),
  - ✓ cumulative solution (A. Kenyeres).
- **Analysis regarding CATREF software.**

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the Faculty of Civil Engineering and Geodesy of the MUT statutory research funds.*