

The Benchmark Test of the EPN-Repro2 Campaign

Christof Völksen ^{*)}
Andrzej Araszkiewicz ^{#)}
Rosa Pacione ⁺⁾
Brigida Pace ⁺⁾
Karolina Szafranek ^{#)}

^{*)} Bavarian Academy of Sciences and Humanities (BEK), Munich, Germany

^{#)} Military University of Technology (MUT), Warsaw, Poland

⁺⁾ e-GEOS, ASI/CGS-Matera (ASI), Matera, Italy



EPN-Repro2

EPN-Repro2 is the second reprocessing campaign organized under the umbrella of EUREF

Goals:

- Will be a continuation of the EPN-Repro1 campaign (but now IGS08)
- Response to the planned IGS repro2 campaign
- Generate consistent coordinates, velocities and troposphere parameters (ZTD) in one reference frame
- Supports the densification of the ITRF2013

EPN-Repro2

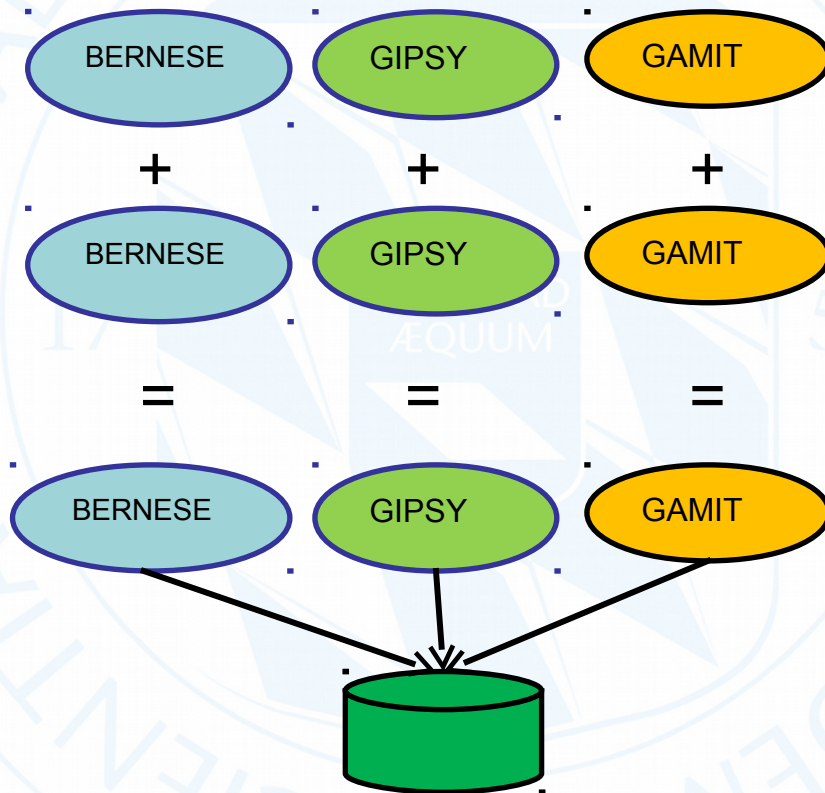
- Three LACs will analyse the entire EPN back to 1996
 - ASI - Centro di Geodesia Spaziale (GIPSY 6.2)
 - GOP – Geodetic Observatory Pecný (Bernese 5.2)
 - MUT - Military University of Technology (GAMIT 10.50)
- Analysis of sub-regional network of the EPN
 - LPT – Swisstopo (Bernese 5.2)
 - IGE – Instituto Geográfico Nacional España (Bernese 5.2)
- A regional analysis will be performed using IGS repro2 products
- Analysis strategy shall agree with the „Guidelines for EPN Analysis Centres (released Nov. 2013)
- **Test the performance based on a Benchmark Test**

Analysis for the Benchmark Test

Software (Release)	BERNESE 5.2 (Dec. 2012)	GAMIT 10.50 (July 2013)	GIPSY 6.2 (March 2013)
GPS / Ambiguity	Fix	Fix	PPP-Fix
GLONASS / Ambiguity	Yes/ Fix	-/-	-/-
Global Mapping Function (GMF)	Yes	Yes	Yes
Vienna Mapping Function (VMF)	Yes	Yes	Yes
2nd Order Ionosphere	Yes+more	Yes	Yes
IERS	IERS2010	IERS2010	IERS2010
Antenna PCV	Individual	Individual	Type Mean
Orbits	Code Repro	Code Repro	JPL Repro

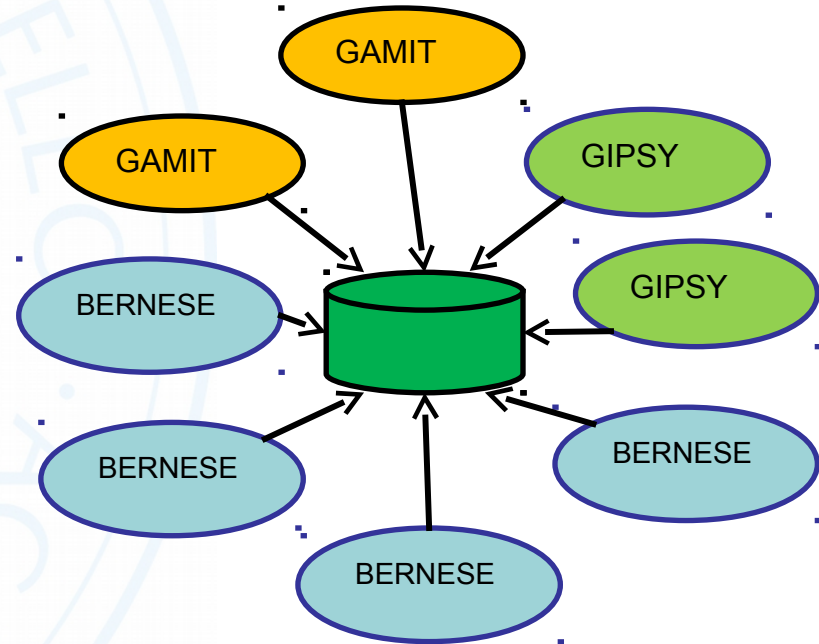
Combination of daily solutions?

By software packages



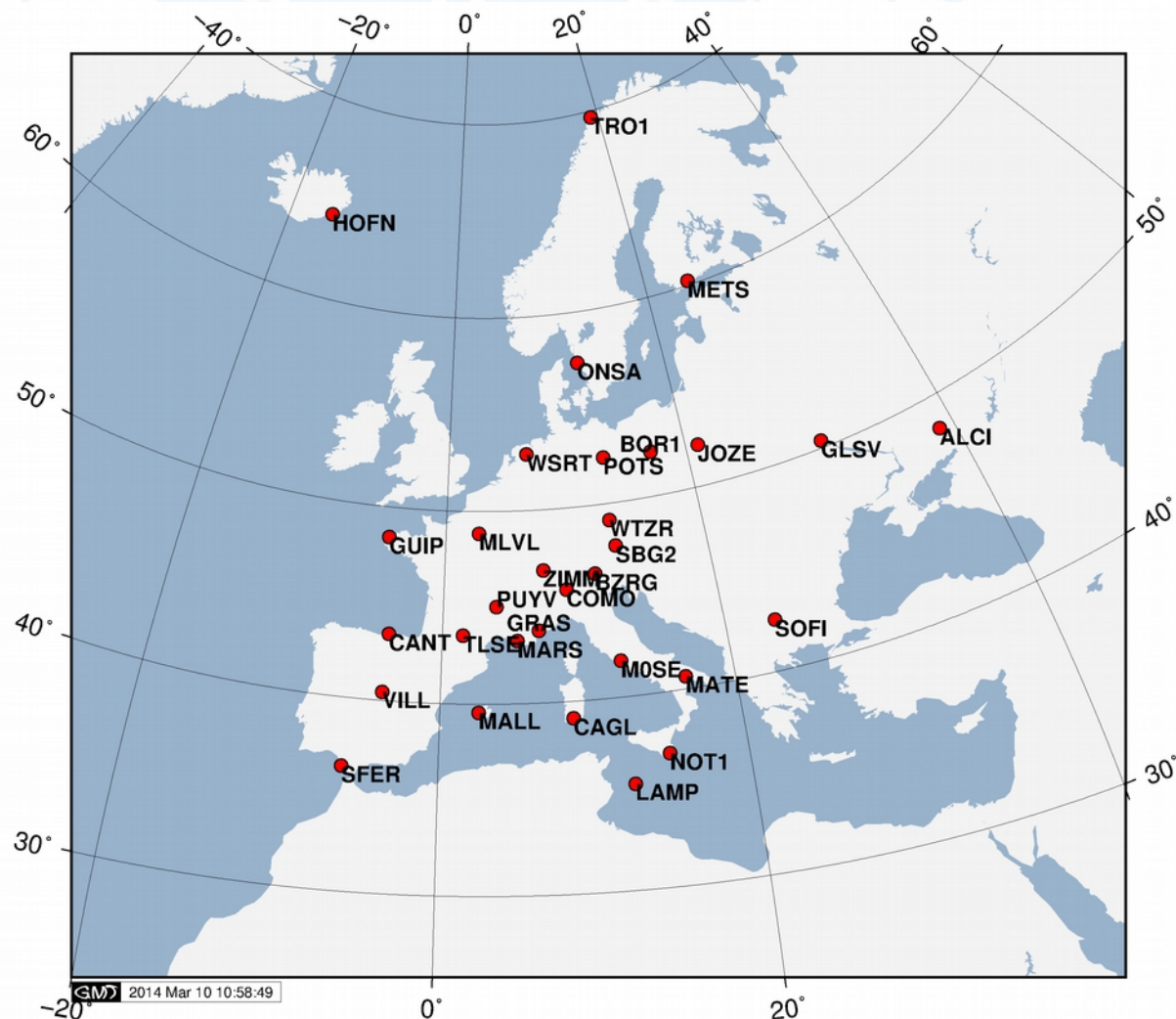
Equivalent impact by Bernese, GIPSY & GAMIT

Any daily solution /
EPN-Repro1



Dominated by BERNESE

EPN-Repro2 Benchmark: Network

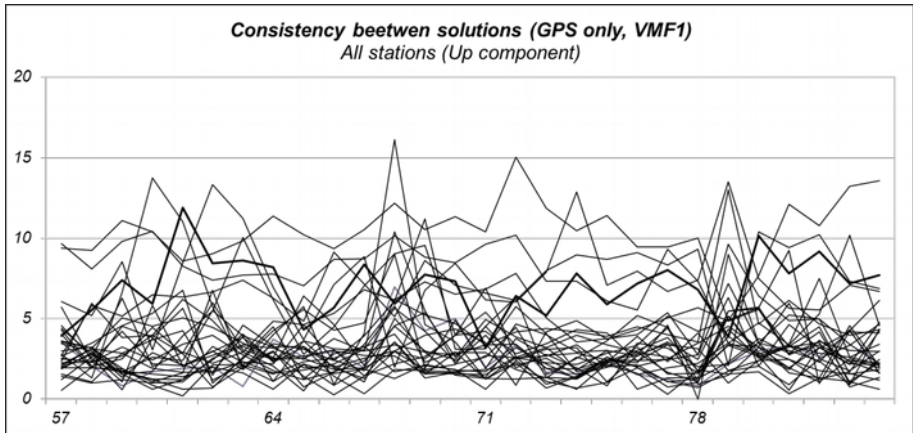
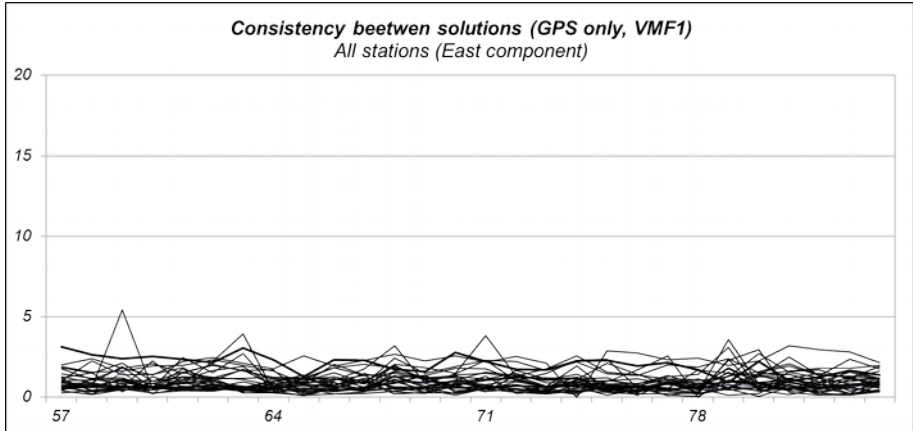
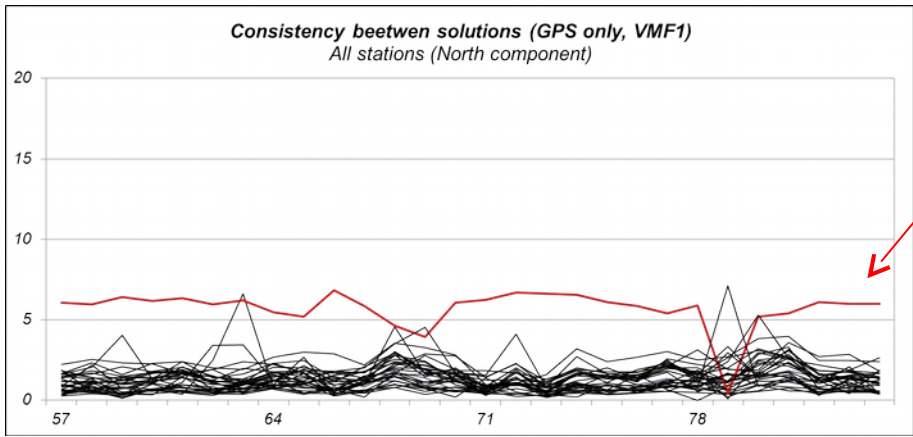


GNSS	#
GPS	32
GLONASS	21
Galileo	19

Replaced Repro1	NEW Repro2
MILO	M0SE
HFLK	SBG2
BRUS	WSRT
New	ZIMM
New	ZIM2

The Benchmark Test

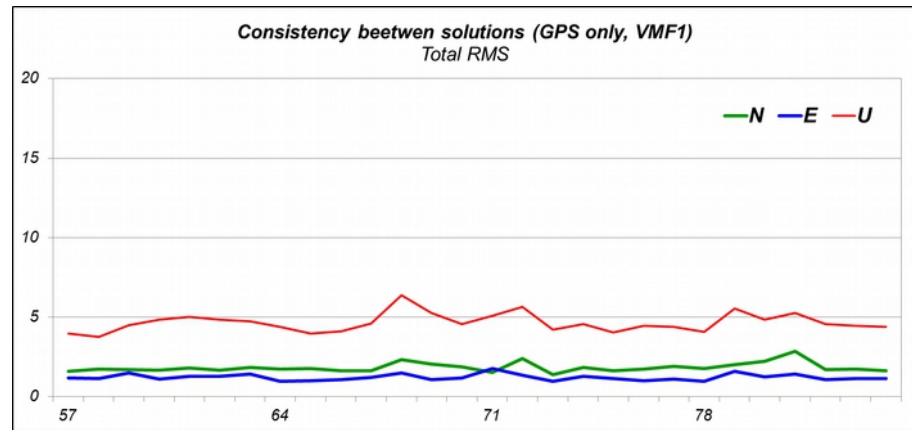
- Analyse GPS weeks 1677 to 1680 (include ion. Storm, March 7, 2012)
- GAMIT solution provided by MUT: **GPS + VMF**
- GIPSY solution provided by ASI (PPP): **GPS+VMF**
- Bernese solutions (4) provided by BEK:
 - GPS + GMF, GPS/GLONASS + GMF
 - **GPS + VMF**, GPS/GLONASS + VMF
- NEQ-combination was done by MUT (ACC)
 - Based on ADDNEQ2 (GPS only and VMF)
- Tropo-Combination was done by ASI
 - With new software



METS

	North	East	Up
Total	1.84	1.22	4.66
Min	0.58	0.42	1.84
	GRAS	GRAS	GRAS
Max	5.70	2.34	10.48
	METS	SOFI	SBG2

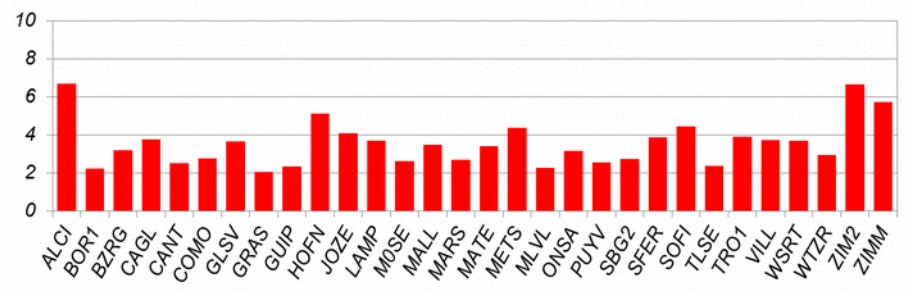
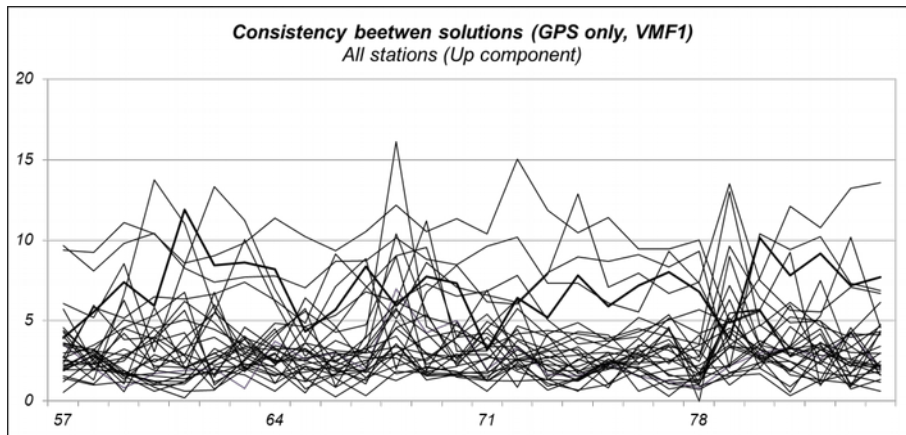
[Units in mm]



Neglecting Individual PCV

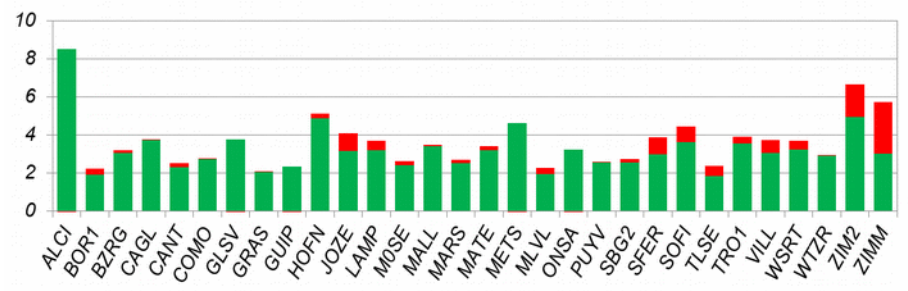
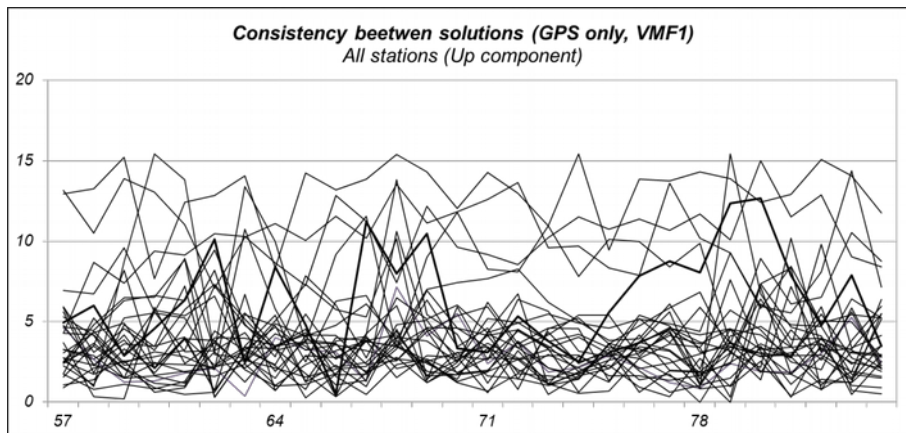
SITE	Antenna	Radome	Serial #	North [mm]	East [mm]	Up [mm]
BZRG	LEIAR25.R4	LEIT	25220	-1.0	-1.9	-1.7
CANT	LEIAR25.R\$	LEIT	25066	2.2	-1.2	1.7
HOFN	TPSCR3	CONE	70218	-0.1	1.1	1.2
METS	AOAD/M_T	NONE	519	11.5	-4.9	-1.5
SOFI	LEIAR25.R3	LEIT	60008	2.1	-2.3	7.1
WTZR	LEIAR25.R3	LEIT	20031	0.1	-0.6	-2.5
ZIM2	TRM29800.00	NONE	60369	0.2	1.1	0.7

Differences of site coordinates after neglecting individual PCV in PPP mode (GIPSY). Seven sites of the benchmark network are affected.



Total 3D RMS: 3.77 mm

Reweighting the PPP (GIPSY) solution (approach similar to BKG)

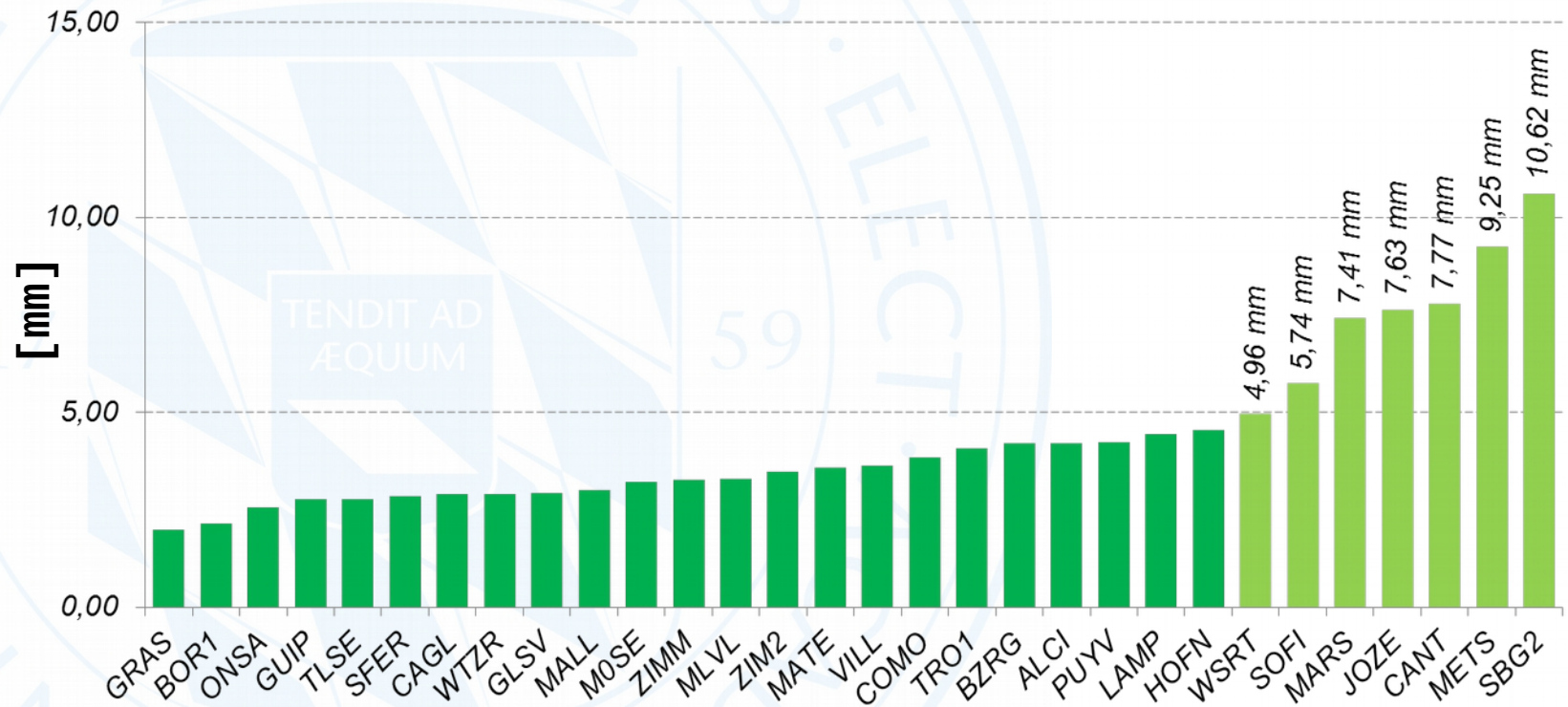


Total 3D RMS: 3.49 mm

Reweighted solution match less to combined solution, but final coordinate are more stable.

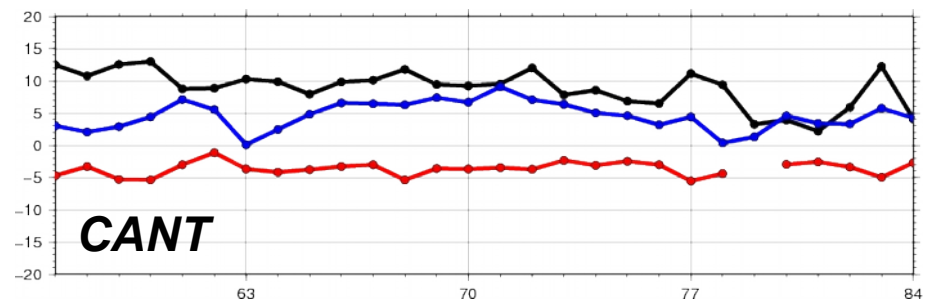
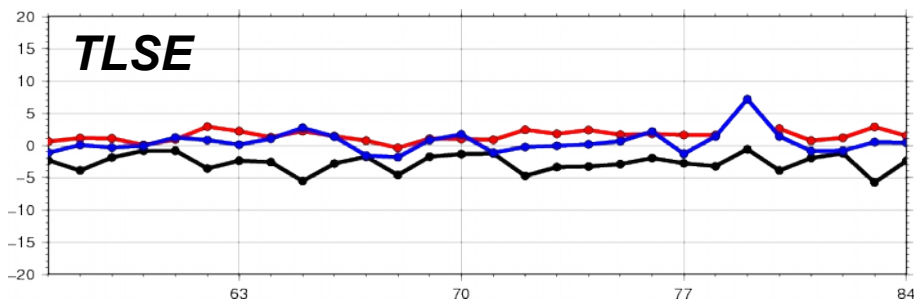
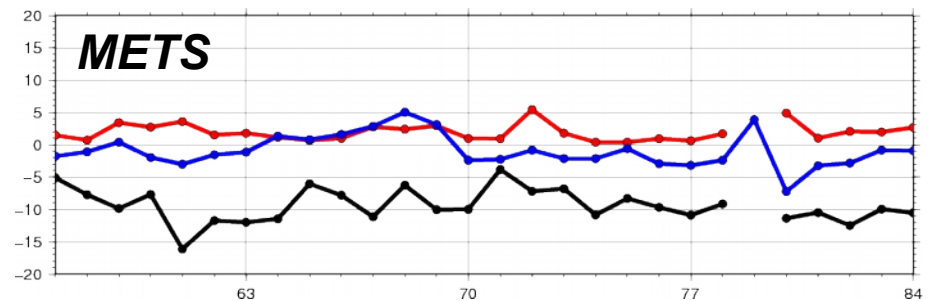
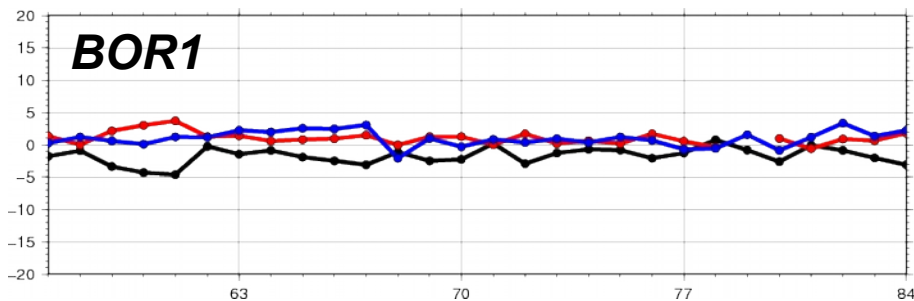
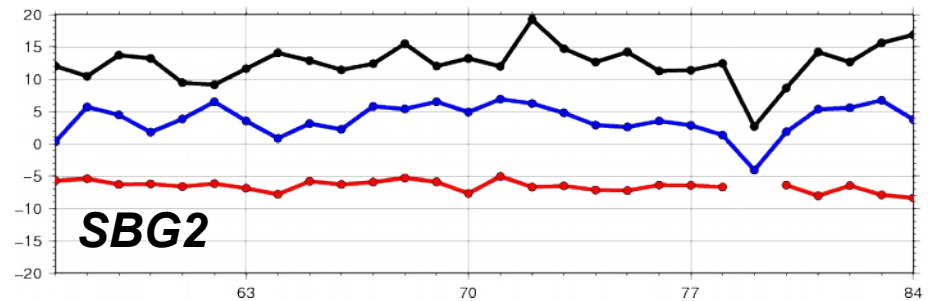
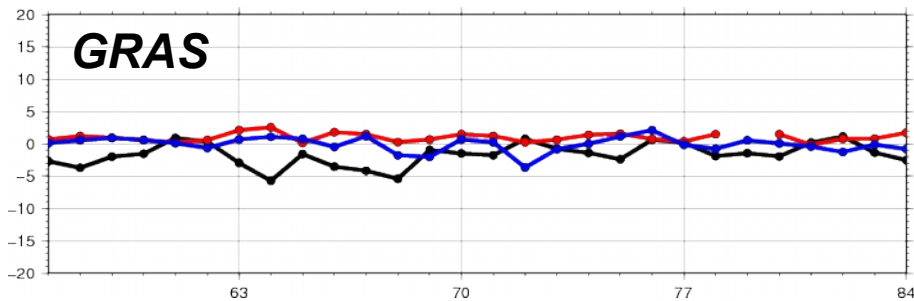
Units in mm

3D-RMS for each Site



Differences between position from each solutions and the combined solution – selected station, Up component.

GIPSY - **BERNESE** - **GAMIT**



Units in mm

Consistency of Bernese Solution

GGG - **GGV** - **G_G** - **G_V**

GGG: GPS/GLONASS, GMF

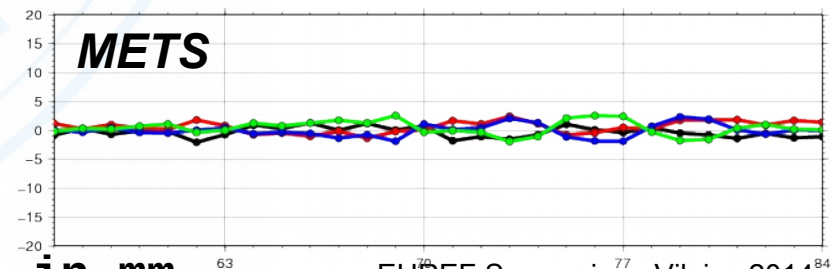
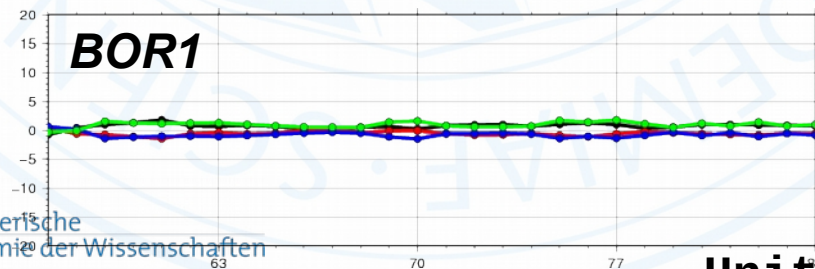
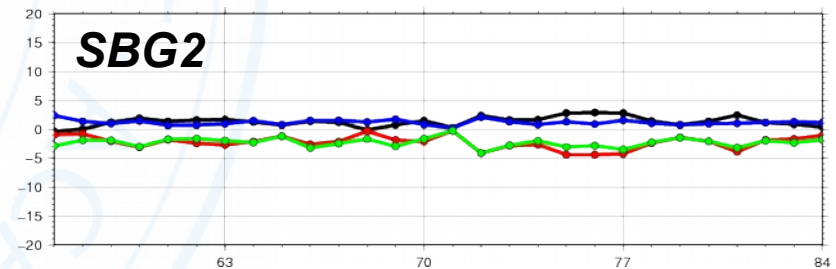
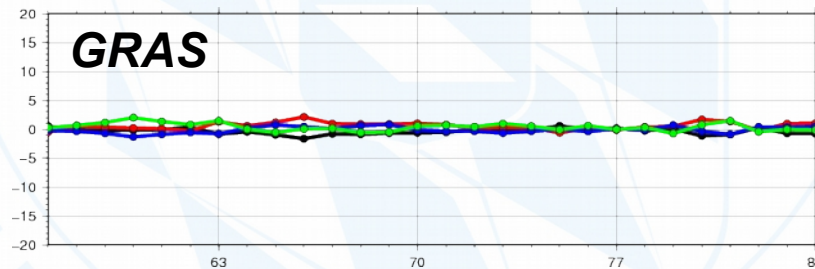
GGV: GPS/GLONASS, VMF

G_G: GPS/ - GMF

G_V: GPS/ - VMF

RMS	North [mm]	East [mm]	Height [mm]
G_G	1.82	1.72	3.09
G_V	1.30	1.16	2.89
GGG	1.81	1.59	3.06
GGV	1.20	1.06	2.90

Height-Component

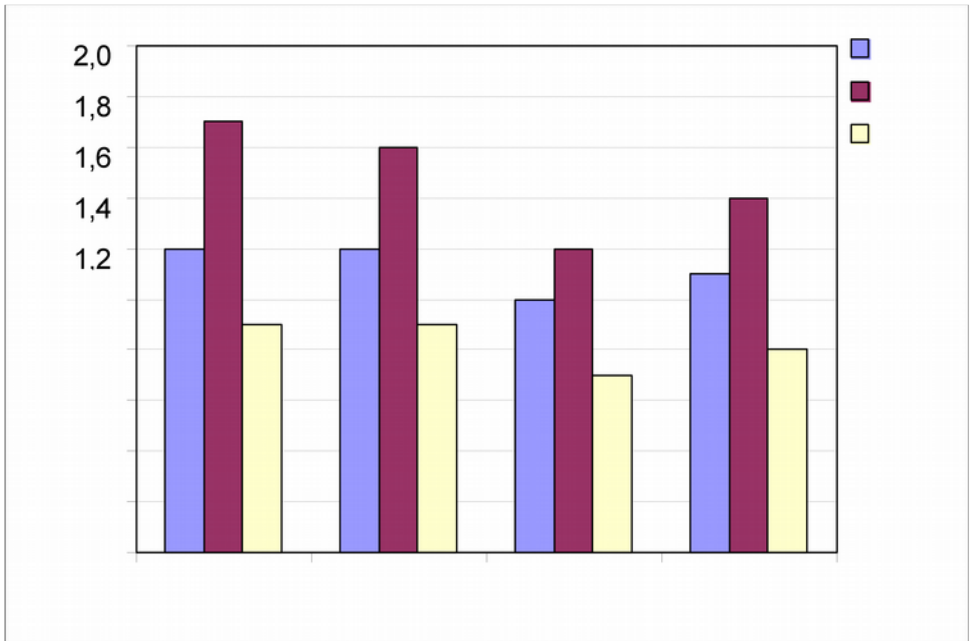
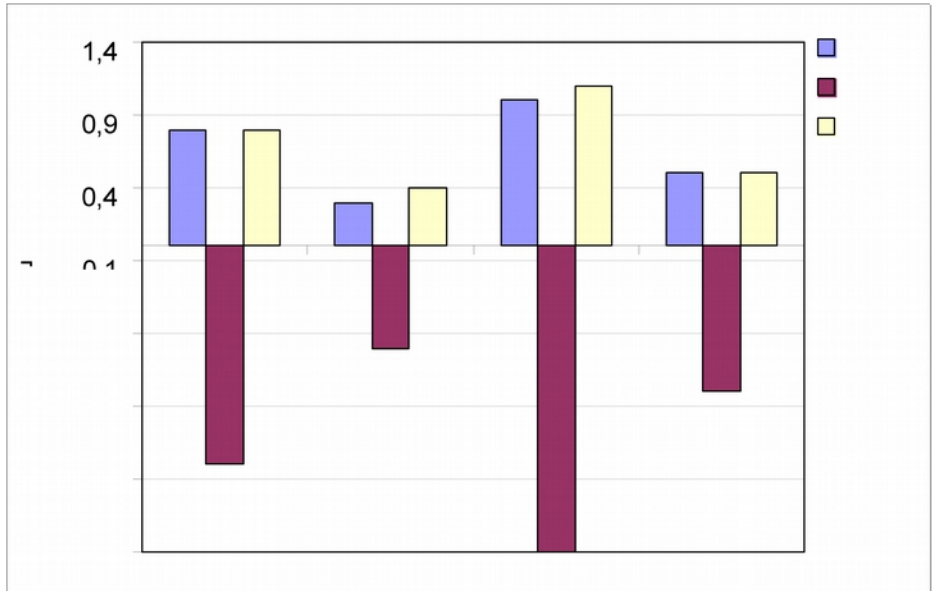
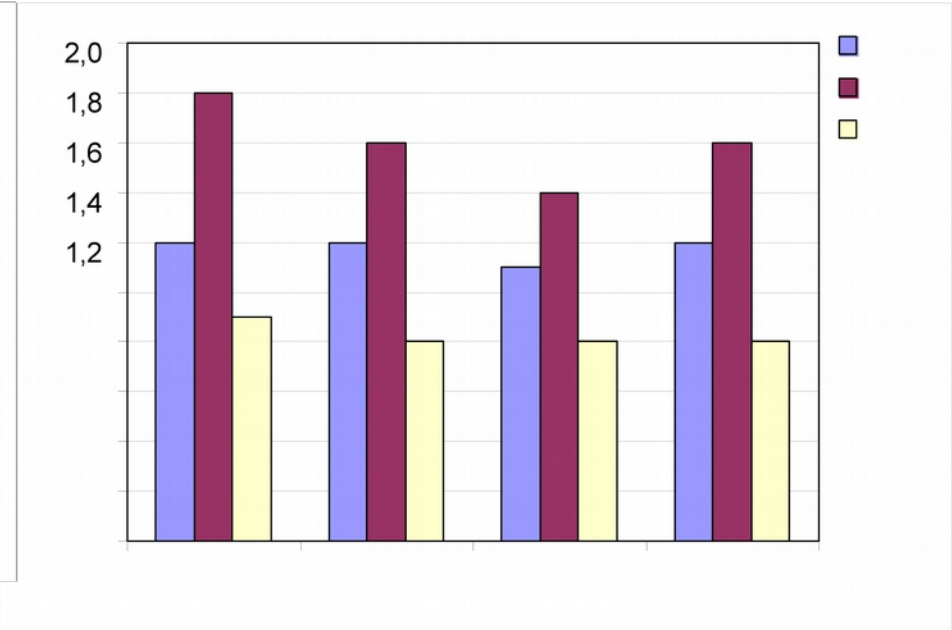
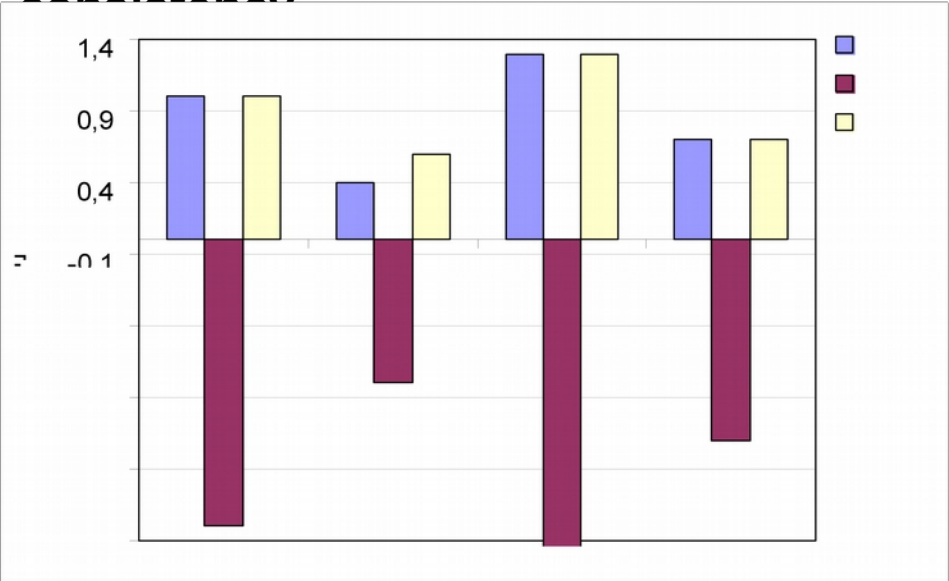


Units in mm

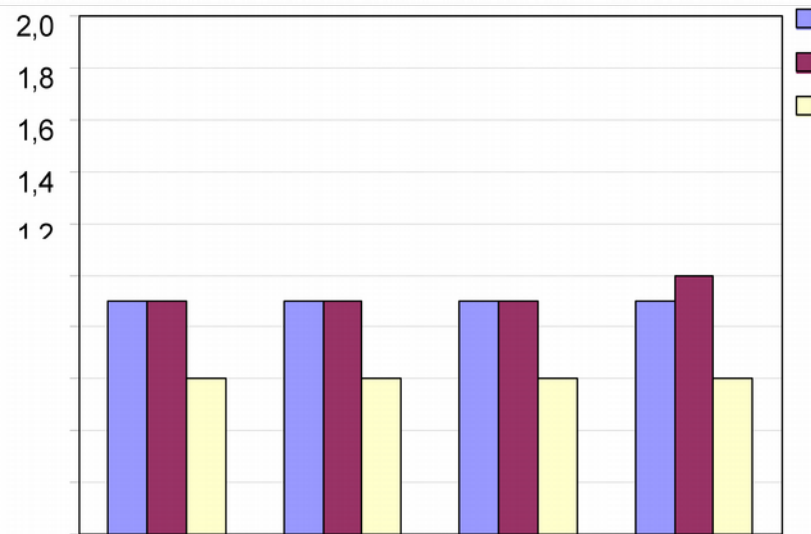
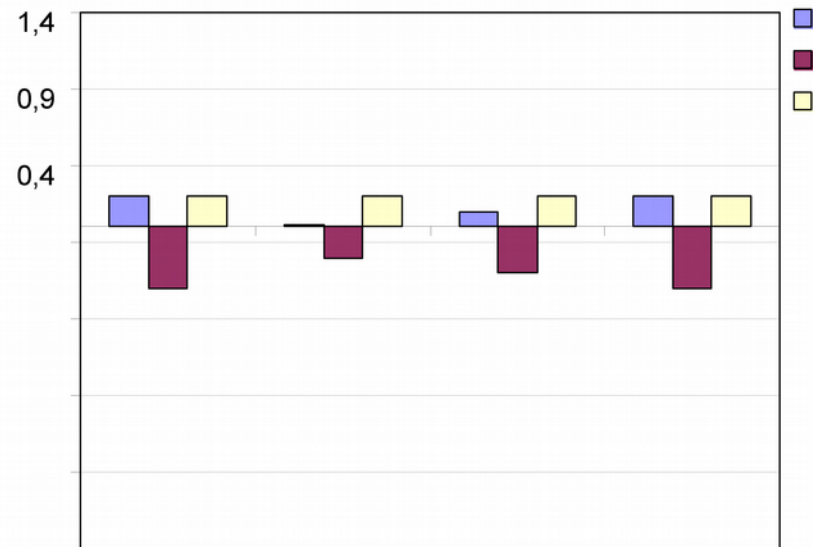
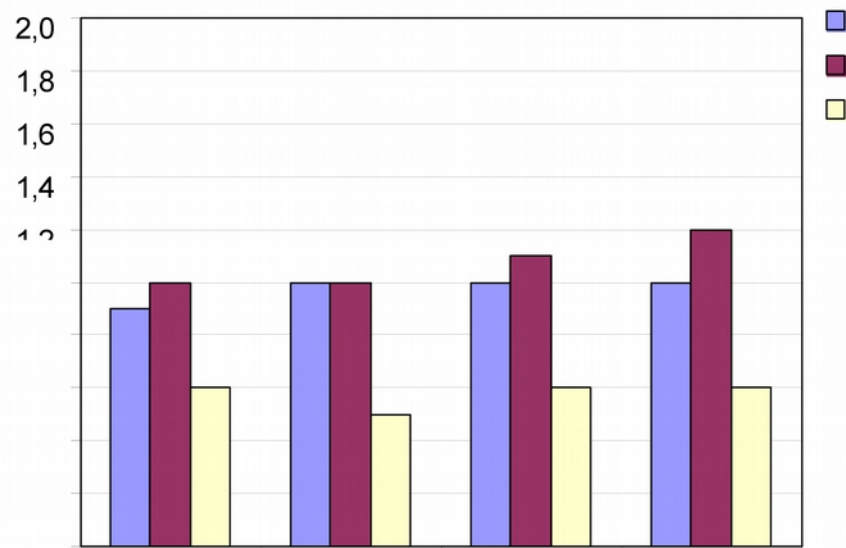
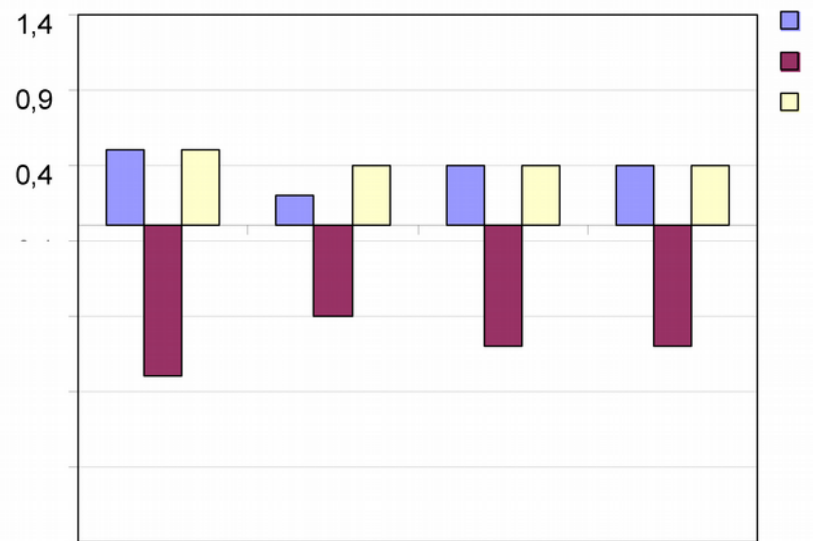
EUREF Symposium, Vilnius 2014

Troposphere Benchmark Campaign: ASI, MUT, G_G and GGG internal

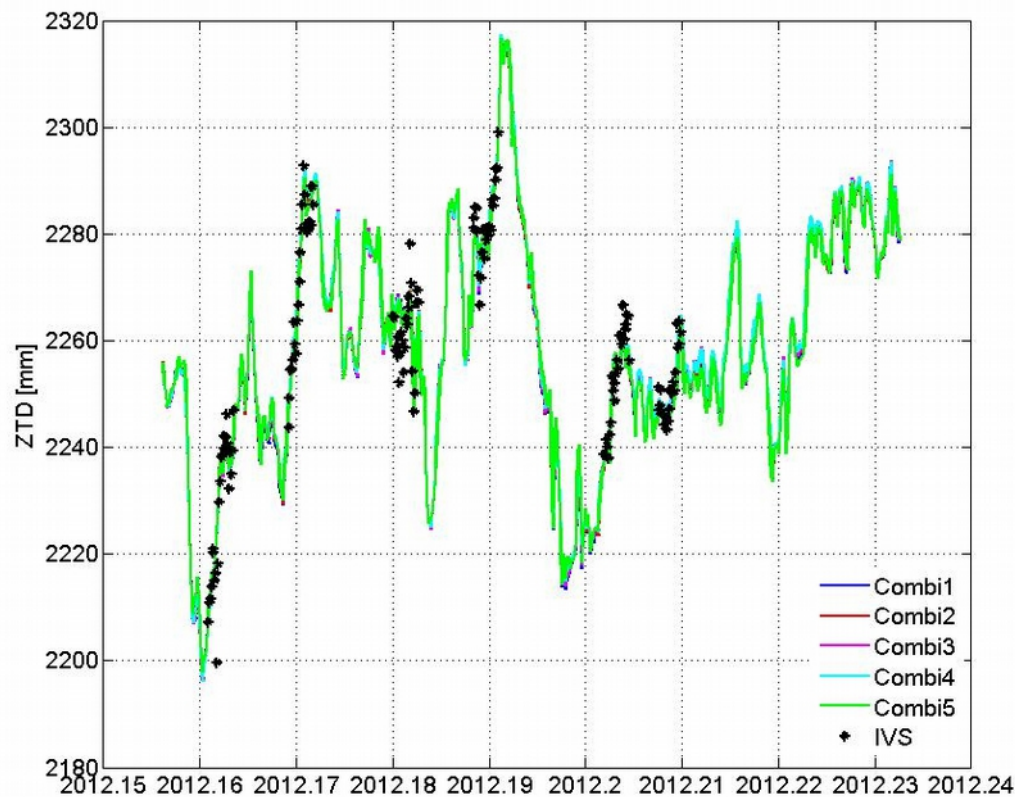
consistency



Troposphere Benchmark Campaign: ASI, MUT, G_V and GGV internal consistency



Repro2 Benchmark Campaign: IVS vs Combination at MATE



Legend

Combi1 ASIG_G MUT
 Combi2 ASIGGG MUT
 Combi3 ASIG_V MUT
 Combi4 ASIGGV MUT
 Combi5 Operational

	MEAN	
Combi1	-7.696	
Combi2	-7.838	
Combi3	-7.698	
Combi4	-7.844	
Combi5	-6.612	

Comparison table of IVS Rapid Combination vs
 Repro2 Benchmark combinations

Conclusions

- Basically the combination of the three solutions agree quite well
- The four Bernese solutions are internally consistent
 - The GNSS solution is as consistent as the GPS only solution
 - No reason to avoid the GNSS analysis
- Neglecting individual PCV may have a significant impact on the coordinate solutions (e.g. METS)
- Results from the combination of the troposphere parameters shows a good agreement
 - BERNESE is affected by a negative bias
 - BERNESE GPS+GLONASS VMF shows the best agreement to the combined solution