EPN-Repro2: Activities of the EPN Working Group on Reprocessing

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EPN-Repro 2

- Continuation of the activities started with the EPN-Repro1 campaign
- Response to the IGS Repro2 campaign
- Goal is the estimation of consistent coordinates, velocities and ZTD (Zenith Tropospheric Delay) for the EPN in one reference frame (IGb08)
  - Based on a regional network analysis
- Will support the densification of the new ITRF 2014
- Products will improve the realisation of the ETRS

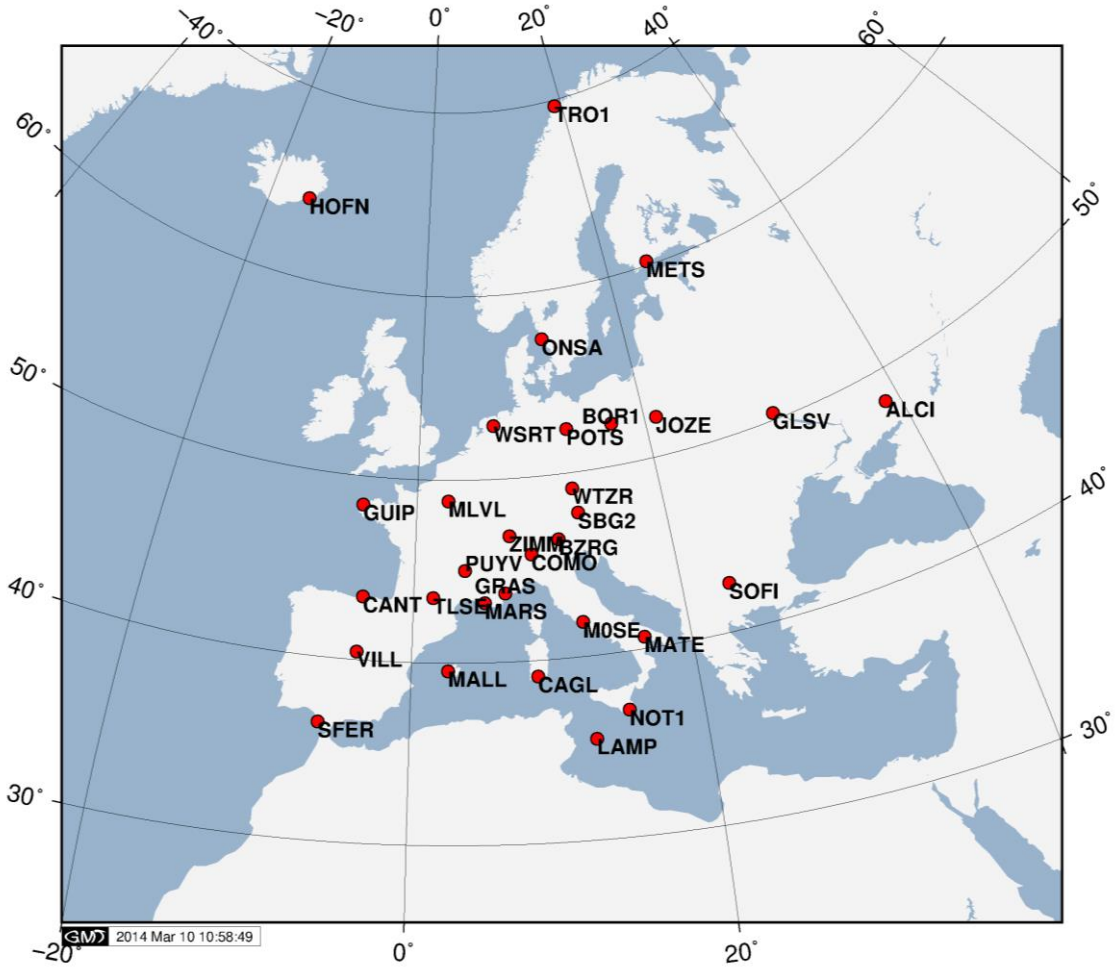
Contributors

- GNSS Analysis Centres (ACs)
  - Centro di Geodesia Spaziale, Italy (ASI)
  - Geodetic Observatory Pecny, Czech Republic (GOP)
  - Instituto Geografico National, Spain (IGE)
  - Swisstopo, Switzerland (LPT)
  - Military University of Technology, Poland (MUT)
- Combination of daily Normal Equations (NEQ):
  - Military University of Technology, Poland (MUT)
- Combination of Troposphere Parameters (ZTD):
  - Centro di Geodesia Spaziale, Italy (ASI)
- Coordination:
  - Bavarian Academy of Sciences and Humanities, Munich (BEK)

Specifications

- Each AC provides at least one solution
  - Some ACs will even provide up to 3 solutions
- Orbits to be used are CODE Repro2 products
  - ASI will apply JPL “preliminary” products (version 2.0), the JPL “final” reprocessed products (version 2.1) released Nov 7, 2014 → too late for ASI’s analysis
- Corrections for ***Phase Centre Variations*** (PCV) with individual calibration (IGS+EPN) are recommended
  - ASI will not be able to deliver products with individual PCV corrections
- Follow the guidelines for the EPN Analysis Centres!

Benchmark: Test of the strategies (4 weeks of Data)



GNSS	#
GPS	32
GLONASS	21
Galileo	19

- Performed Spring 2014
- IGE Autumn 2014

Internal consistency of some solutions:

- GOP (old):

SOL	PCV	Tropo	Elev.	S_N [mm]	S_E [mm]	S_h [mm]
GO0	IGS+EPN	GMF	3	1.47	1.61	4.87
GO1	IGS+EPN	VMF1	3	1.46	1.61	4.75
GO2	IGS+EPN	**VMF1**	**7**	**1.45**	**1.60**	**4.73**
GO3	IGS+EPN	VMF1	10	1.47	1.61	4.78

- LPT:

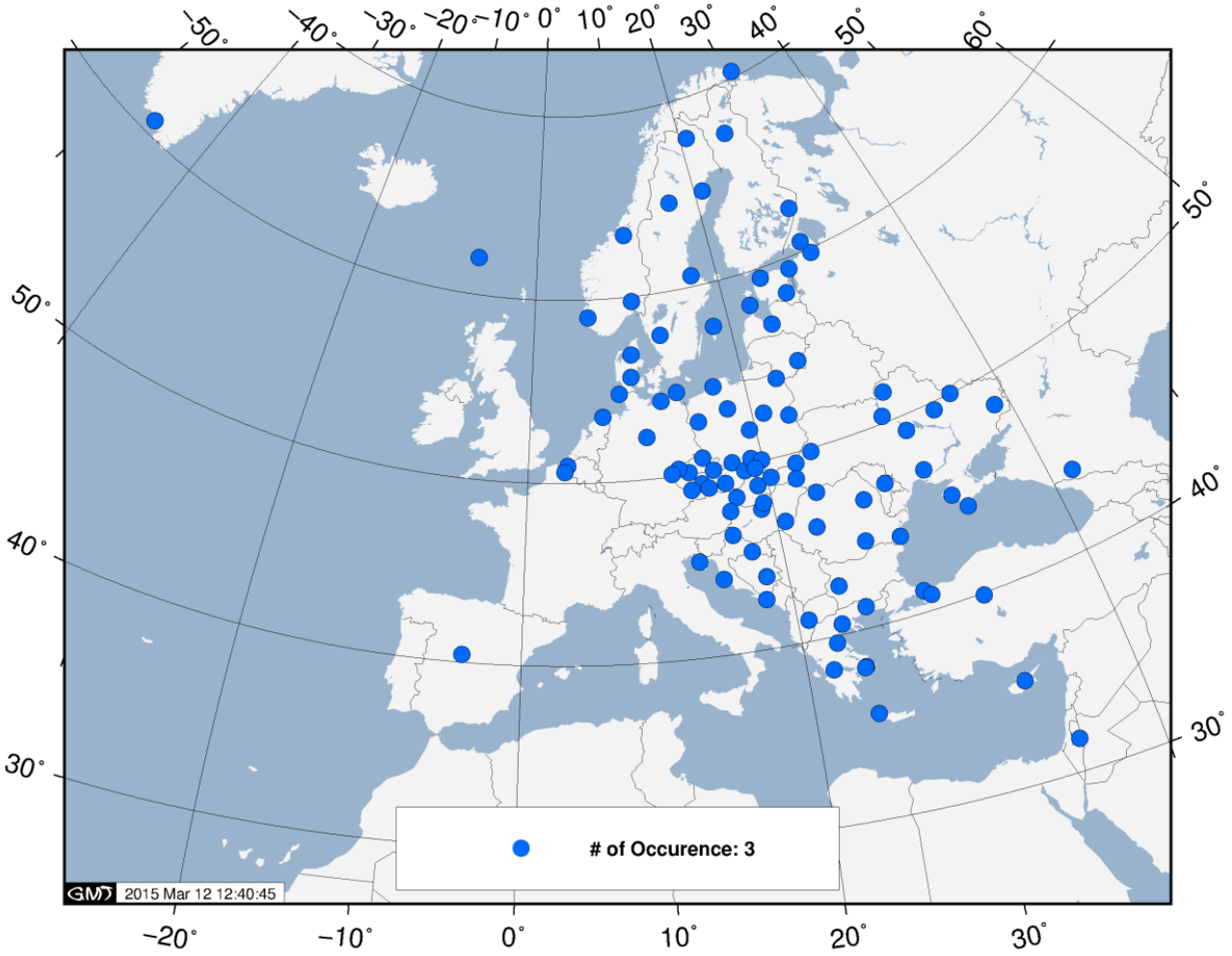
SOL	PCV	Tropo	NT-ATML	S_N [mm]	S_E [mm]	S_h [mm]
LP0	**IGS**	**GMF**	**No**	**1.49**	**1.46**	**4.70**
LP1	**IGS+EPN**	**VMF1**	**Yes**	**1.44**	**1.42**	**4.13**

NT-ATML: Non-tidal atmospheric loading

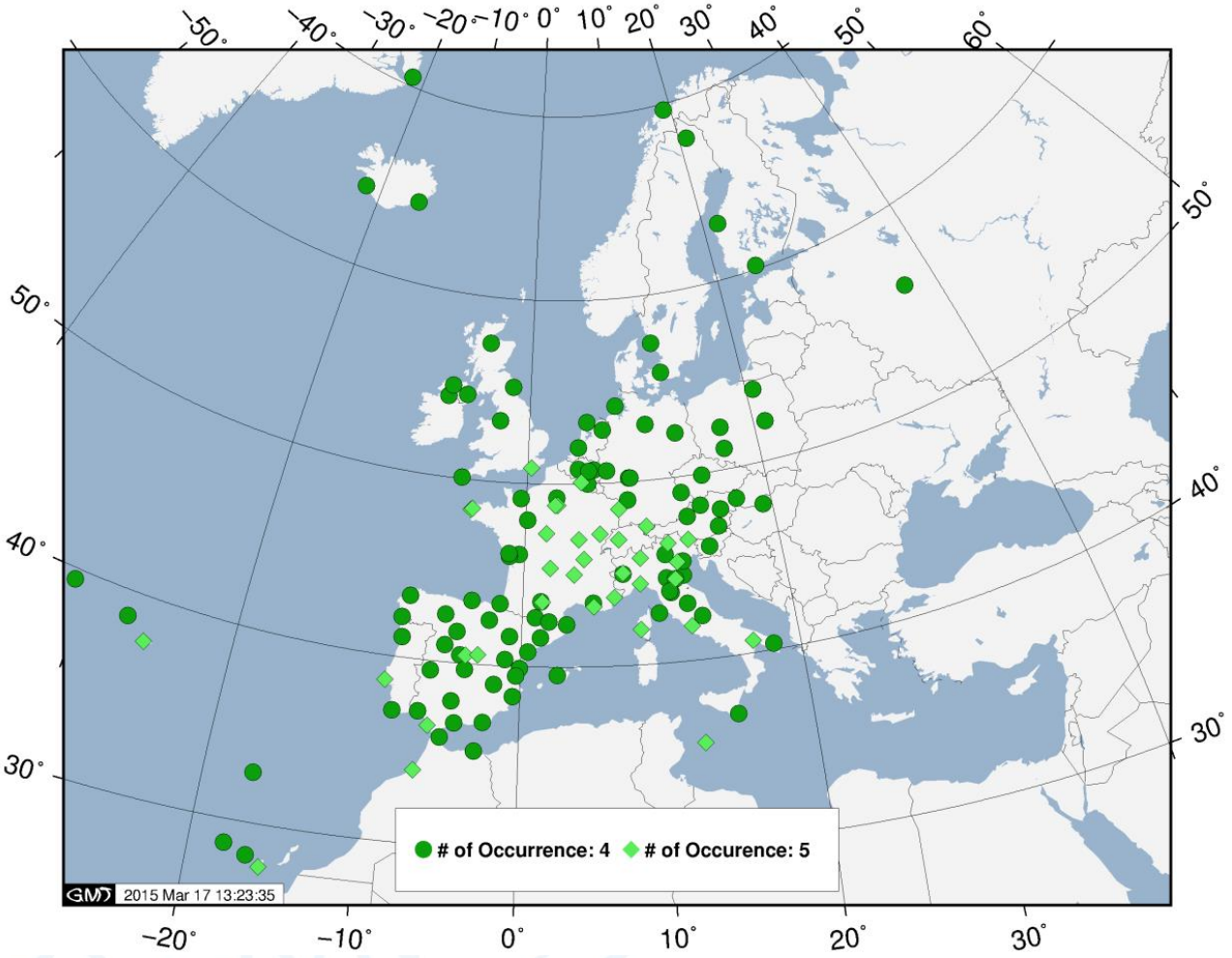
Contributions

	AS0	GO0	GO2	GO4	IG0	LP0	LP1	MU1	MU4
SW	GIPSY 6.2	BSW 5.2			BSW 5.2	BSW 5.2		GAMIT 10.5	
GNSS	**G**	**G**			**G + R**	**G + R**		**G**	
SOLUTION TYPE	PPP	NET			NET	NET		NET	
STATIONS	**ALL EPN+ IGS CORE**	**ALL EPN**			**PART EPN**	**PART EPN + IGS(8)**		**ALL EPN**	
ORBITS	**JPL R2 (prelim.)**	**CODE R2**			**CODE R2**	**CODE R2**		**CODE R2**	
ANTENNAS	**IGS08**	**IGS08 + IND.**			**IGS08 + IND.**	**IGS08**	**IGS08+ IND**	**IGS08+ IND**	**IGS08**
IERS	2010	2010			2010	2010		2010	
GRAVITY	EGM08	EGM08			EGM08	EGM08		EGM08	
TROPOSPHERE Estimated Param	ZTD (5min) GRAD (5min)	ZTD (1h) GRAD (6h)			ZTD (1h) GRAD (6h)	ZTD (1h) GRAD (24h)		ZTD (1h) GRAD (24h)	
MAPPING FUNCTION	VMF1	GMF	VMF1	VMF1	GMF	GMF	VMF1	VMF1	
ZTD/GRAD time stamp	hh:30 24 estimates/day	hh:30 24 estimates/day			hh:30 24 estimates/day	hh:00 (and hh:30) **24**(+24) estimates/day		hh:30 24 estimates/day	
IONOSPHERE	(HOI included)	CODE (HOI included)			CODE (HOI included)	CODE (HOI included)		CODE IONEX + IGRF11 (HOI included)	
REF. FRAME	IGb08	IGb08			IGb08	IGb08		IGb08	
OCEAN TIDES	FES2004	FES2004			FES2004	FES2004		FES2004	
T-ATML	NO	NO			YES	YES	YES	YES	
NT-ATML	NO	NO	NO	YES	NO	NO	YES	NO	NO
ELEV. CUTOFF	**3**	**3**			**3**	**3**		**5**	
Delivered SNX/TRO Files [from week to week]	**0835-1772**	**836-1771**			**835-1816**	**835-1772**		**835-1771**	

Sites Represented in three Solutions



Sites Represented in four or five Solutions

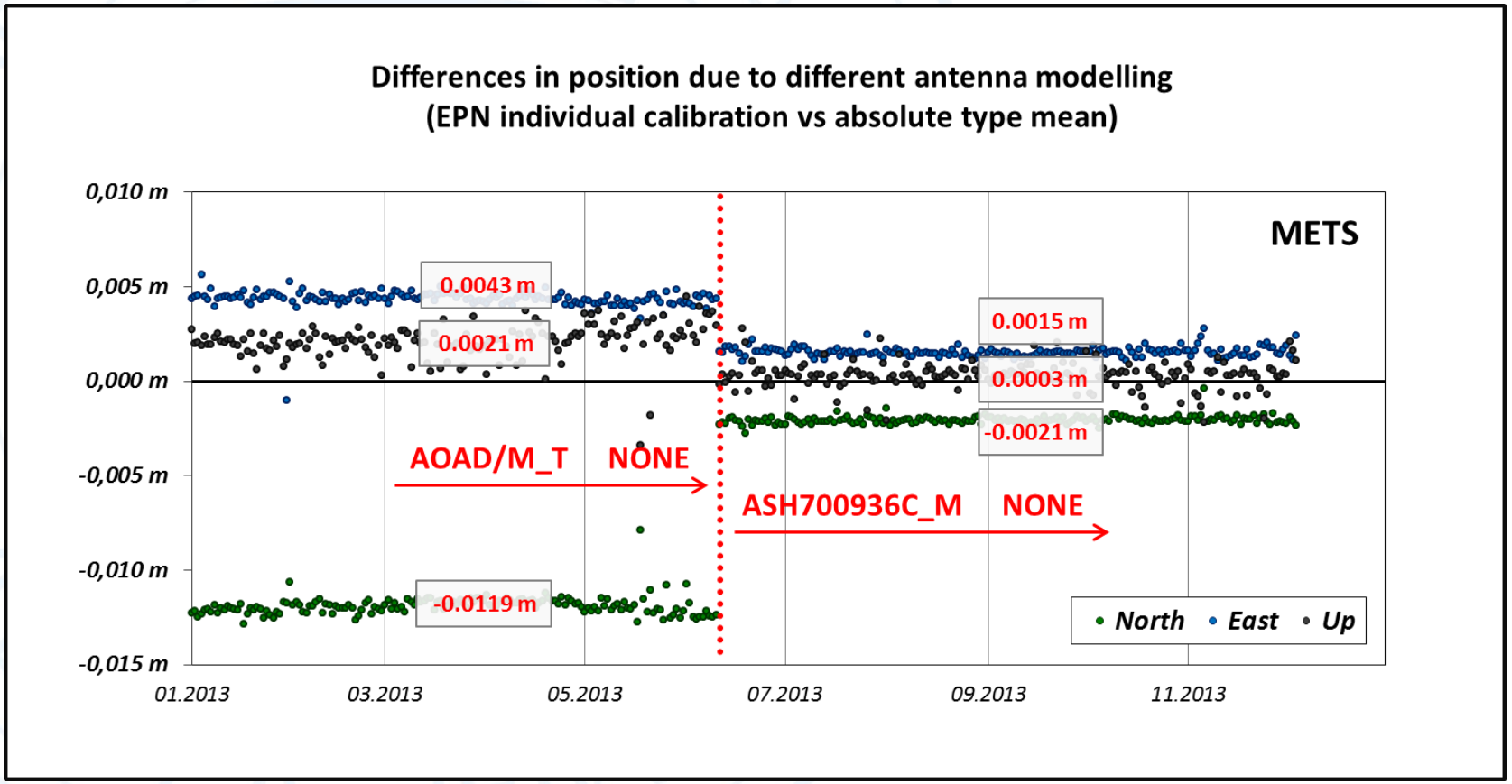


Not on map: NYA1 (4), SCOR (5)

Features of the solutions

- GLONASS
  - available since 2003, very few stations in the beginning
  - only used in solutions by LPT and IGE
- Different antenna PCV corrections used in the uploaded solutions („type mean“ and „type mean + individual)
  - Available solutions offer the possibility to elaborate the difference and generate corrections
- Orbits are mostly homogeneous (CODE Repro 2) with exception of ASI
- Mixture of solutions with or without correction for Non-Tidal-Atmospheric Loading (NT-ATML)

Differences between Antenna *Type Mean* and *Individual PCV*

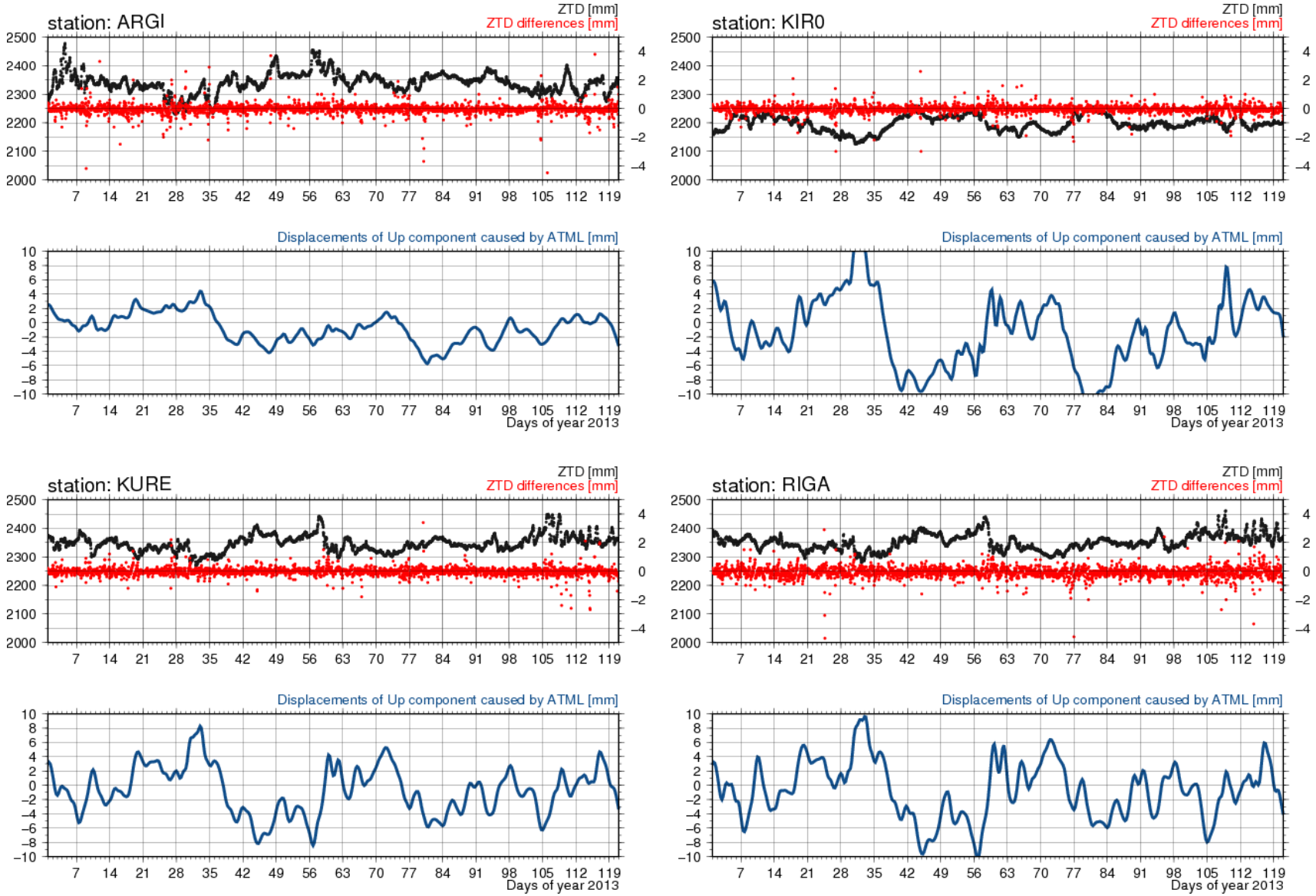


Neglecting Individual PCV (Benchmark)

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** **11.9**	**-4.9** **-4.3**	**-1.5** **-2.1**
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).

Impact of NT-ATL on ZTD & Height



Combination of the solutions

- Combination Centre is the Military University of Technology, Poland (MUT)
- Daily solutions will be combined either by ADDNEQ2 or CATREF
  - ADDNEQ2:
    - Combination on the Normal Equation Level (NEQ)
  - CATREF:
    - Either on the NEQ-Level or combination of parameters with the complete covariance information
- GIPSY-Solution is based on a filter approach (SRIF: Square Root Information Filter)
  - Reconstruction of NEQs is not strictly possible

EPN-Repro2 - Status

- Last contribution are expected in the next months
- Combination of the coordinate solutions has already been started (MUT)
- Troposphere parameter combination starts probably in June (ASI)
- Extension of the EPN-Repro2 analysis for 2014 is likely (GPS Weeks: 1773-1825)
- A large amount of data to be analysed
- Multi Year combination is still to be performed