

EUREF densification camapaign in Republic of Serbia

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OUTLINE

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- 2. Datum definition
- 3. Processing parameters
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Description of the campaign



Description of the campaign

- 20 EPN class A stations
- 48 stations from national permanent networks
 - 29 AGROS stations
 - 13 MAKPOS stations
 - 3 FOMI stations
 - 3 BULIPOS stations
- 19 field points
 - 6 EUREF BALKAN 98 Serbian block
 - 7 EUREF FYROM 96
 - 6 from SREF project

Description of the campaign EPN stations

4-char ID	Domes No.	Full Name	Net		ck			
AUT1	12619M002	Thessaloniki	EPN	A	fiducial	station,	Processed	data
BACA	11405M001	Bacau	EPN	A	fiducial	station,	Processed	data
BAIA	11406M001	Baia Mare	EPN	A	fiducial	station,	Processed	data
BUCU	11401M001	Bucuresti	EPN	A	fiducial	station,	Processed	data
BZRG	12751M001	Bolzano-Bozen	EPN	A	fiducial	station,	Processed	data
DEVA	11408M001	Deva	EPN	A	fiducial	station,	Processed	data
DUBR	11901M001	Dubrovnik	EPN	A	fiducial	station,	Processed	data
GRAZ	11001M002	Graz-Lustbuehel	EPN	A	fiducial	station,	Processed	data
GSR1	14501M001	Ljubljana	EPN	A	fiducial	station,	Processed	data
ISTA	20807M001	Istanbul	EPN	A	fiducial	station,	Processed	data
MATE	12734M008	Matera	EPN	A	fiducial	station,	Processed	data
ORID	15601M001	Ohrid	EPN	A	fiducial	station,	Processed	data
OROS	11207M001	Oroshaza	EPN	A	fiducial	station,	Processed	data
OSJE	11902M001	Osijek	EPN	A	fiducial	station,	Processed	data
PADO	12750S001	Padova	EPN	A	fiducial	station,	Processed	data
PENC	11206M006	Penc	EPN	A	fiducial	station,	Processed	data
SOFI	11101M002	Sofija	EPN	A,	Processe	ed data		
SRJV	11801S001	Sarajevo	EPN	A	fiducial	station,	Processed	data
WTZR	14201M010	Bad Koetzting	EPN	A,	Processe	ed data		
ZIMM	14001M004	Zimmerwald	EPN	Α	fiducial	station,	Processed	data

Description of the campaign



Description of the campaign Monument type for points from SREF project



Description of the campaign Monument type for EUREF points





Description of the campaign GNSS equipment

Trimble 5700, TRM41249.00 TZGD (mainly for AGROS stations)

Other equipment models used for the campaign

Receivers

 Trimble NETR5, Trimble NETRS, Trimble 4000 series, LEICA GRX1200GGPRO, LEICA SR530

Antennas

TRM39105.00 NONE, TRM55971.00 NONE, TRM29659.00
 NONE, LEIAT504GG LEIS, TRM33429.00+GP NONE

Description of the campaign Observation period

5 GPS weeks (1595-1599)

Observation period for the filed points was 5 days during the GPS week 1597



Description of the campaign Processing

- processing is done in October 2010 by Republic Geodetic Aurthority
- following the "Guidelines for EPN Analysis Centers"
- Bernese GPS Software, version 5.0, update February 18, 2010



Datum definition

Fiducial points

4-char ID	Domes No.	Full Name	Network
AUT1	12619M002	Thessaloniki	EPN A fiducial station, Processed data
BACA	11405M001	Bacau	EPN A fiducial station, Processed data
BAIA	11406M001	Baia Mare	EPN A fiducial station, Processed data
BUCU	11401M001	Bucuresti	EPN A fiducial station, Processed data
BZRG	12751M001	Bolzano-Bozen	EPN A fiducial station, Processed data
DEVA	11408M001	Deva	EPN A fiducial station, Processed data
DUBR	11901M001	Dubrovnik	EPN A fiducial station, Processed data
GRAZ	11001M002	Graz-Lustbuehel	EPN A fiducial station, Processed data
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SRJV	11801S001	Sarajevo	EPN A fiducial station, Processed data
ZIMM	14001M004	Zimmerwald	EPN A fiducial station, Processed data





Datum definition

Datum definition type

- Minimum constraint solution on fiducial stations
- Minimum constraint condition for translation
 and rotation parameters



- IGS final precise orbits, Earth rotation parameters, and satellite clock information
- CODE Ionosphere maps and Differential code biases for satellites and receivers
- absolute antenna model for antenna phase centre variations based on IGS05 model was used for processing
- converted epn_05_1604.atx to Bernese format
- individual antenna calibrations for 5 EPN fiducial stations listed in file above

Preprocessing

- single differences and marking of observations before cycle slip detection:
- elevation mask 3°, minimum time interval for continuous observation 361 seconds and max gap 181 seconds
- identification of data without cycle slips and in remaining data find if possible repair cycle slips at L3 linear combination



Receiver clock synchronization

- single point positioning for each station, using orbit and clock information
- code observation files

Elevation angel cutoff

- 3 degrees, elevation dependent weighting
- 10 degrees for QIF ambiguity resolution

Data sampling

- 30 seconds, QIF ambiguity resolution
- 180 seconds, for Final processing

Modeling troposphere

- Saastamoinen model in single point positioning
- Niell model for zenith path delay and mapping function
- Dry Neill as apriori troposphere model for zenith path delay in solving ambiguity float double differences solution

Modeling ionosphere

- Ionosphere free L₃ linear combination nearly complitly eliminates ionospheric refraction effects
- In QIF ambiguity resolution strategy the L1+L2 observable used then CODE ionosphere map was introduced

Handling of ambiguities

- ambiguity resolution is done baseline by baseline
- the quasi-ionosphere-free resolution strategy was used to resolve L1 and L2 ambiguities

cut-off angel used was 10°

Planetary Ephemeris – DE200

Ocean loading

- Model computed by H.G.Sherneck Onsala Space Observatory
- FES2004 model without correction for the centre of mass motion of the Earth for each station



Daily mean ambiguity resolution percentages



Results Repeatabilities Daily network solutions minimal constrained on fiducial stations are used for checking daily repeatability of coordinates for all stations in EUREF Serbia 2010.





Comparison with latest EUREF densification of ITRS

Comparison of ITRF2005/2010.631 coordinates vs. coordinates from EUREF solution EPN_A_ITRF2005_C1585



	tran minima imposed	slation l const d on fic	in raind ducial	translation and rotation in minimal constraind imposed on fiducial				
Station	N	E	U	N	E	U		
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		
AUT1 12619M002	-0.5	-1.8	-2.1	-1.4	-1.5	1.1		
BACA 11405M001	-0.1	-1.7	1.7	-0.7	-1.4	0.8		
BAIA 11406M001	0.1	-0.8	0.7	-0.4	-0.4	-0.9		
BUCU 11401M001	0.0	-2.2	-2.0	-0.6	-2.0	-1.5		
BZRG 12751M001	0.3	-0.4	3.0	0.4	0.0	1.2		
DEVA 11408M001	-1.1	-1.8	-0.1	-1.6	-1.6	-0.7		
DUBR 11901M001	-1.7	3.0	0.4	-2.0	3.2	1.5		
GRAZ 11001M002	-1.4	2.3	4.6	-1.5	2.6	3.3		
GSR1 14501M001	0.3	-0.2	0.1	0.3	0.2	-1.1		
ISTA 20807M001	1.5	1.2	-2.6	0.5	1.6	0.5		
MATE 12734M008	0.7	4.3	-2.7	0.2	4.5	0.4		
ORID 15601M001	0.4	-1.1	-2.8	-0.1	-0.9	-0.7		
OROS 11207M001	0.7	-1.1	0.7	0.4	-0.8	-0.3		
OSJE 11902M001	-1.0	-1.4	-0.7	-1.3	-1.1	-1.3		
PADO 12750S001	2.0	-0.1	1.6	2.0	0.1	0.7		
PENC 11206M006	-0.1	-0.6	3.6	-0.3	-0.4	1.6		
SRJV 11801S001	1.0	2.2	-4.0	0.6	2.3	-2.7		
ZIMM 14001M004	-1.1	0.4	0.6	-1.0	0.9	-1.8		
RMS / COMPONENT	1.0	1.9	2.4	1.1	1.9	1.5		



Alternative combined solution

- An alternative solution for the campaign was produced
- The difference from the final solution is in the datum definition type
- The campaign solutions on weekly basis are combined with weekly EPN solutions downloaded from ftp server BKG



Residuals final solution vs. combined solution with BKG weekly solution ; three rotation estimation



Residuals final solution vs combined solution with BKG weekly solution ; plain comparison







Comparison with previous ETRS89 densification

		6 par estimated			3	(t) pa:	r	DT.ATN			
	Station			U	N E U			N E U			
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	
	E818	-13.2	5.1	-2.7	-14.0	3.6	-5.6	-22.9	-0.6	-54.2	
	E819	-4.9	9.4	-12.9	-5.0	8.8	-13.3	-13.9	4.6	-61.9	
	E820	-3.2	-2.1	9.0	-3.9	-2.3	6.6	-12.9	-6.6	-42.0	
	E821	-2.1	-1.1	1.4	-2.2	-0.2	1.4	-11.1	-4.5	-47.3	
	E822	18.7	3.5	16.8	19.5	3.7	19.3	10.6	-0.6	-29.3	
	E823	4.7	-14.9	-11.5	5.6	-13.7	-8.5	-3.4	-17.9	-57.2	
V	RMS /	10.8	8.4	11.6	11.4	7.7	11.8	15.0	9.0	54.6	

Elevation cut – off test

•RGA is producing a test solution with cut-off angle 25°

•Comparison to the final 3° solution

•Big differences between these two solutions at stations with antenna Trimble Zephyr (TRM39105.00 NONE)



Elevation cut – off test





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Conclusions

- The internal quality of the solution is around 1 to 2 mm in and N and E and around 3 to 5 in U
- The coordinate recoveries of fiducial stations indicate that ITRF2005 for EUREF Serbia 2010 is realized to around 2mm in all three components
- Results from elevation cut off test show different level of accuracy depending on antenna type used and site dependent effects. The stations with non geodetic antennas have lower level of accuracy.
- Comparison with EUREF Balkan 98 campaign based on ITRF96 is at 20mm level compared in ETRF2000, except a shift in height of 4-5cm



Thank you for your attention