



TWG Working Conference, 08-09.11.2004 - Prague
EUREF



EUREF Related Activities in Romania

GPS EUREF Campaign - 2003

Romania

Tiberiu Rus

Councilor – Geodesy and Cartography Department

National Agency for Cadastre and Land Registration

(former National Office for Cadastre, Geodesy and Cartography)



TWG Working Conference, 08-09.11.2004 - Prague **EUREF**



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1. Background

EUREF - Terms of Reference (Bratislava – 2004)

➤ *“EUREF has been developing activities related to the establishment and maintenance of **ETRS89** (European Terrestrial Reference System) and EVRS (European Vertical Reference System). **ETRS89** provides geocentric, three dimensional positions with millimeter accuracy, in a unique homogeneous reference system for the whole Europe, while EVRS does the same for the height. These systems are the basis for geo-referencing in Europe, and have been **recommended for adoption** by the European Union, Eurocontrol and EuroGeographics. **ETRS89** is ideally suited, and commonly used, as the backbone for modern mapping and Earth Science applications in Europe.”*

➤ *“The **TWG (Technical Working Group)** is responsible, in general, for the control of EUREF activities and policy, and has the following specific tasks:*

- *Coordinate and develop the EPN (EUREF Permanent Network);*
- *Evaluate and classify results of GNSS campaigns presented to the TWG for acceptance as EUREF densification or extension;”*

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➤ ***ISO 19100 Requirements (Spatial Referencing by Coordinates)***

2. Introduction

- 2004 – Changes in the Representative organization in Romania:
 - ◆ NOCGC – National Office for Cadastre, Geodesy and Cartography became **NACLR- National Agency for Cadastre and Land Registration.**
- Need for EUREF in Romania:
 - ◆ *First attempt – 1994 – „Establishment of a GPS High Accuracy Geodetic Network in Romania” – IGFCOT + DTM + NGS – GPS campaign in 1994 – 7 epoch stations in RO, 4 days, Trimble 4000SSE receivers; Results not validated by EUREF*
 - ◆ *Second realization – 1999 – Establishment of EUREF-EPN station „**Bucu**” at **TUCE Bucharest by BKG Frankfurt a.M.***
 - ◆ *Third realization – **2003** – „**EUREF-RO**” – Campaign – 16-21 June, 2003.*



2. Introduction

Participating Institutions

„EUREF-RO“ 2003 – Campaign

- ◆ National Office for Cadastre Geodesy and Cartography (NOCGC) – Institute for Cadastre, Geodesy, Fotogrammetry and Cartography (ICGFC)
- ◆ Military Topography Directorate (DTM)

OBJECTIVE

- ◆ Realization of EUREF-RO nucleus including 12 stations: permanent (3) and epoch (9) stations



3. „EUREF-RO“ – Campaign –2003.

3.1 Equipments at Observed Stations



Point name	GPS receiver	Frequency	Antenna height
Permanent EUREF + IGS stations			
GRAZ 11001M002	ASHTech UZ-12	2	1.964
BUCU 11401M001 (TUCE)	ASHTech Z-XII3	2	0.082
JOZE 12204M001	TRIMBLE 4000SSE	2	0.198
PENC 11206M006	TRIMBLE 5700	2	0.030
SOFI 11101M002	AOA SNR-8000 ACT	2	0.220
EUREF Epoch stations			
CONS	LEICA SR520	2	0.000
GHEO	LEICA SR520	2	1.225
MOSN	LEICA SR520	2	0.000
OSOR	LEICA SR520	2	0.210
PIS1 (DTM)	TRIMBLE 4000SSI	2	0.234
SIRA (DTM)	JPS ODYSSEY	2	0.393
STAN	LEICA SR520	2	0.000
GPS permanent stations – RO			
BRAI	LEICA SR530	2	0.000
CLUJ	LEICA SR530	2	0.000
SIBI	LEICA SR530	2	0.000
SUCE	LEICA SR530	2	0.000
TIMI	LEICA SR530	2	0.000
New EUREF Epoch stations			
BUCA	LEICA SR520	2	0.238
FUN3	LEICA SR520	2	0.311



3. „EUREF-RO“ – Campaign –2003



3.2 Sessions

Session number	Start date and time		End date and time	
nnnn	yy mm dd	h m s	yy mm dd	h m s
1670	03 06 16	00 00 00	03 06 16	23 59 59
1680	03 06 17	00 00 00	03 06 17	23 59 59
1690	03 06 18	00 00 00	03 06 18	23 59 59
1700	03 06 19	00 00 00	03 06 19	23 59 59
1710	03 06 20	00 00 00	03 06 20	23 59 59
1720	03 06 21	00 00 00	03 06 21	23 59 59

3. „EUREF-RO“ – Campaign – 2003

3.3 Sessions – Station occupation

NUM	STATION	Sessions					
		1	2	3	4	5	6
606	GHEO	x	x	x	x	x	x
613	SUCE	x	x	x	x	x	x
185	BUCU 11401M001	x	x	x	x	x	x
602	BUCA	x	x	x	x	x	x
605	FUN3	x	x	x	x	x	x
609	PIS1	x	x	x	x	x	x
608	OSOR	x	x	x	x	x	x
604	CONS	x	x	x	x	x	x
610	SIBI	x	x	x	x	x	x
607	MOSN	x	x	x	x	x	x
611	SIRA		x	x	x	x	x
612	STAN					x	x



3.4 Observed stations – Apriori coordinates

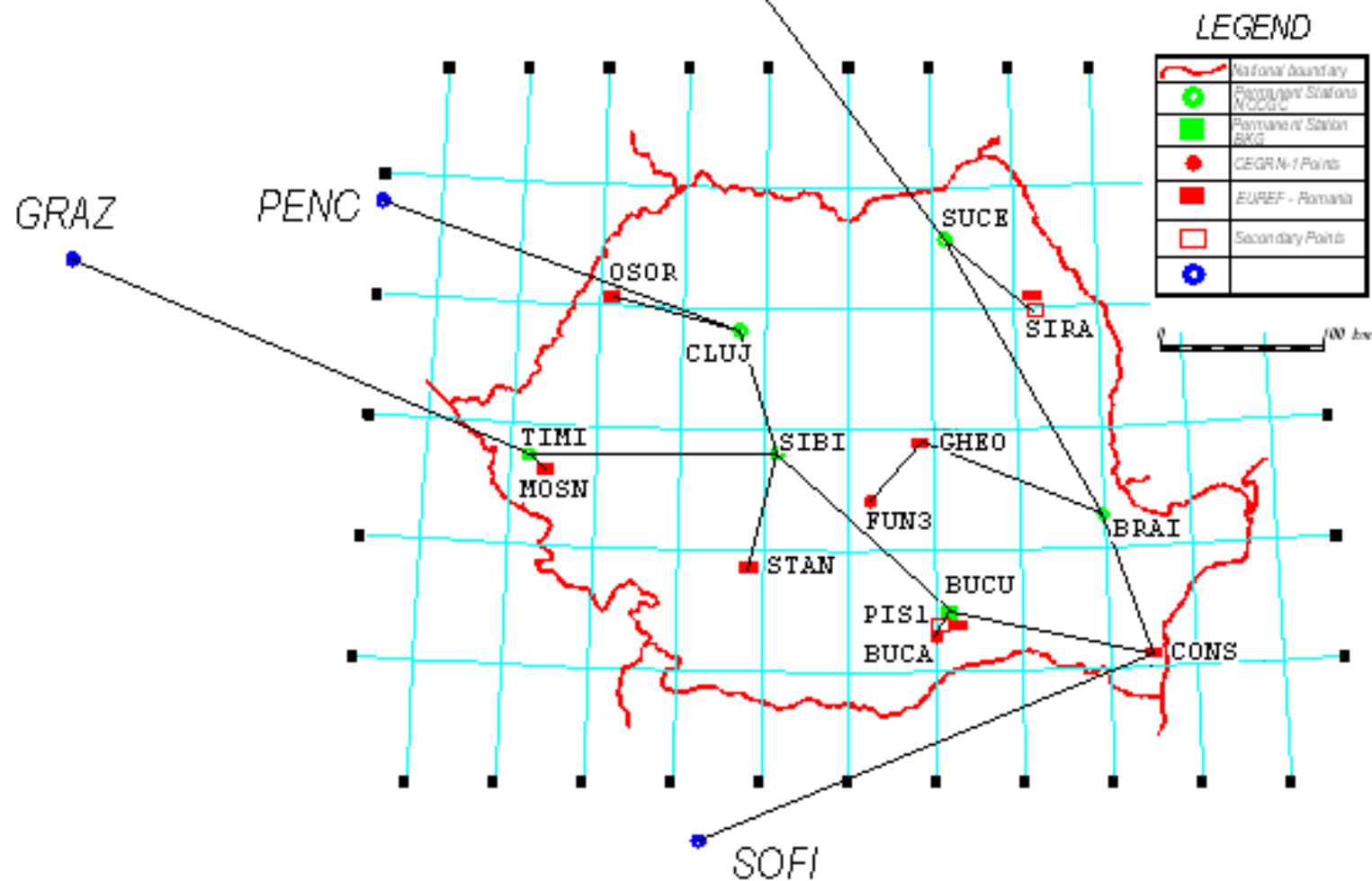
NUM	STATION NAME	ID	CODE	Apriori coordinates ITRF2000/ep.2003.46		
				X (m)	Y (m)	Z (m)
	Permanent EUREF + IGS stations					
151	GRAZ	GRAZ	11001M002	4194423.844	1162702.667	4647245.382
185	BUCUREȘTI	BUCU	11401M001	4093760.911	2007793.812	4445129.951
117	JOZEFOSLAW	JOZE	12204M001	3664940.197	1409153.847	5009571.371
124	PENC	PENC	11206M006	4052449.518	1417681.104	4701407.092
225	SOFIA	SOFI	11101M002	4319372.121	1868687.753	4292063.913
	Epoch EUREF stations (occupied also in 1994 campaign)					
604	CONSTANȚA	CONS		4023362.006	2190844.185	4422995.259
606	SFÂNTU GHEORGHE	GHEO		4005316.726	1937791.919	4555275.974
607	MOȘNIȚA	MOSN		4153381.883	1623172.835	4545098.172
608	OȘORHEI	OSOR		4034631.879	1631849.328	4647381.538
609	DEALUL PISCULUI	PIS1		4098324.116	2008703.338	4440510.250
611	SÂRCA	SIRA		3858207.918	1983195.101	4660287.472
612	STÂNCULEȘTI	STAN		4145351.245	1840743.951	4469798.177
	New GPS permanent stations					
610	SIBIU	SIBI		4066195.440	1822836.717	4548706.414
613	SUCEAVA	SUCE		3862362.949	1903613.934	4690000.060
	New GPS epoch stations					
602	MĂGURELE	BUCA		4104311.018	2006316.403	4436074.736
605	FUNDATA	FUN3		4057652.628	1913153.705	4520422.434

3. „EUREF-RO“ – Campaign – 2003

3.5 Data Processing

- **Location: ISR – Graz- AUSTRIA**
 - ◆ Software: Bern 4.2
 - ◆ Operators: Dipl.Ing. Daniela Dumitrascu & Ana Bercea
 - ◆ Supervisors: Dr. Peter Pesec, Günter Stangl, Dumitru Ghitau
- **Processing Strategy – EUREF Guidelines**
 - ◆ IGS precise orbits, ERPs, clocks and antenna phase centre corrections files;
 - ◆ minimum elevation angle 5°;
 - ◆ sampling rate 30s;
 - ◆ L5/L3 methods for fixing ambiguities;
 - ◆ atmospheric models: tropospheric model SAASTAMOINEN; meteo data EXTRAPOLATED;
 - ◆ reference station GRAZ (coordinates ITRF2000 epoch 2003.46);
 - ◆ for ITRF2000-ETRS89 transformation - solution constrained on GRAZ, JOZE and SOFI stations with coordinates at ITRF2000 epoch 2003.46;
 - ◆ processing - daily sessions and a combined solution.

„EUREF-RO” – Vectors.





3. „EUREF-RO“ – Campaign – 2003



3.6 RESULTS

UNWEIGHTED RMS VALUES WITH RESPECT
TO THE COMBINED SOLUTION (IN MM)

				1	2	3	4	5	6
COMBINATION	6	N	2.5	4.4	1.4	2.4	2.2	1.7	2.5
		E	3.0	5.1	1.7	1.3	4.3	2.2	2.0
		U	7.2	11.4	4.8	5.7	5.3	7.0	8.3

3. „EUREF-RO“ – Campaign –2003

3.6 RESULTS

- **2 Solutions:**
- **1) Graz – fixed on ITRF2000/epoch 2003.46;**
- **2) Graz, Joze, Sofi – fixed on ITRF2000/epoch 2003.46;**

Final solution = 2nd solution

NUM	STATION NAME	X(m)	Y(m)	Z(m)
606	GHEO	4005316.676	1937792.051	4555276.113
613	SUCE	3862362.921	1903614.066	4690000.237
185	BCU 11401M001	4093760.888	2007793.777	4445129.941
602	BUCA	4104310.960	2006316.539	4436074.864
605	FUN3	4057652.583	1913153.840	4520422.569
609	PIS1	4098324.094	2008703.490	4440510.417
608	OSOR	4034633.317	1631849.710	4647381.864
604	CONS	4023362.115	2190844.407	4422995.578
610	SIBI	4066195.419	1822836.862	4548706.585
607	MOSN	4153382.333	1623173.153	4545098.836
611	SIRA	3858207.836	1983195.209	4660287.591
612	STAN	4145351.271	1840744.115	4469798.379



3. „EUREF-RO“ – Campaign – 2003



3.7 RESULTS – ETRS89

Transformation from ITRF2000/2003.46 to ETRS89

[Boucher & Altamimi, version 5 / 12-04-2001]

$$X^E(t_c) = X_{YY}^I(t_c) + T_{YY} + \begin{pmatrix} 0 & -\dot{R}3_{YY} & \dot{R}2_{YY} \\ \dot{R}3_{YY} & 0 & -\dot{R}1_{YY} \\ -\dot{R}2_{YY} & \dot{R}1_{YY} & 0 \end{pmatrix} \times X_{YY}^I(t_c) \cdot (t_c - 1989.0)$$



3. „EUREF-RO“ – Campaign – 2003



3.8 RESULTS – ETRS89

STATION NAME	X(m)	Y(m)	Z(m)
GHEO	4005316.994	1937791.854	4555275.938
SUCE	3862363.242	1903613.876	4690000.067
BUCU 11401M001	4093761.206	2007793.576	4445129.764
BUCA	4104311.278	2006316.337	4436074.687
FUN3	4057652.898	1913153.640	4520422.392
PIS1	4098324.413	2008703.288	4440510.239
OSOR	4034633.621	1631849.511	4647381.686
CONS	4023362.443	2190844.210	4422995.404
SIBI	4066195.731	1822836.661	4548706.408
MOSN	4153382.633	1623172.947	4545098.654
SIRA	3858208.160	1983195.019	4660287.421
STAN	4145351.581	1840743.910	4469798.199

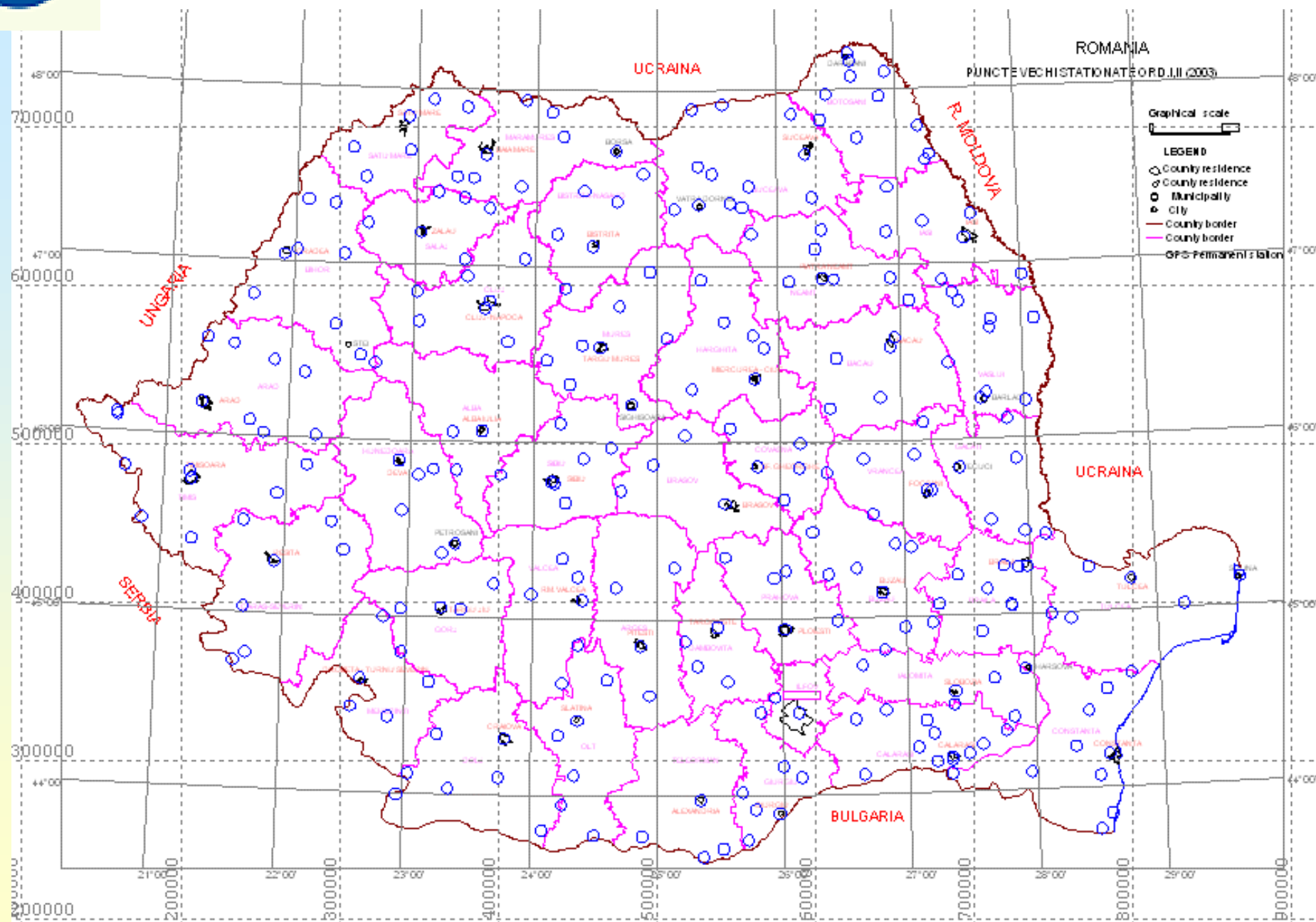


4. Conclusions.

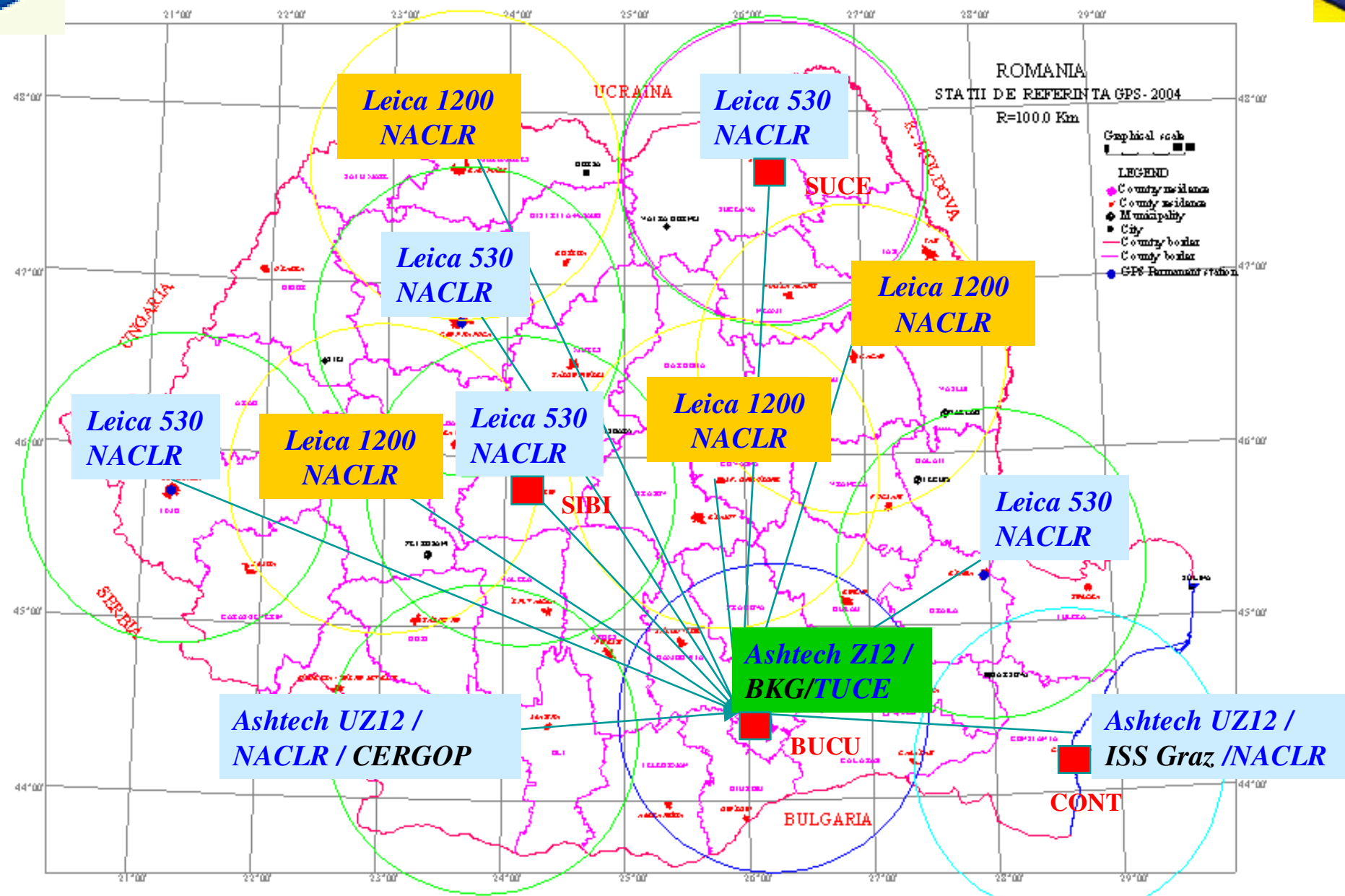


- ❑ *NACLR- new organised, promote the implementation of EUREF and ISO standards in Romania;*
- ❑ *EUREF – RO – 2003 GPS campaign was organized to establish ETRS89 in Romania including 3 perm.stations and 9 epoch stations;*
- ❑ *Data collecting and processing of EUREF-RO-2003 follows EUREF guidelines;*
- ❑ *Results of data processing with good accuracy;*
- ❑ *NACLR – ask TWG for validation of EUREF-RO 2003 campaign;*
- ❑ *NACLR – maintain the decision to establish 2-3 new EUREF-EPN stations in Romania.*

5. Class B GPS Network –2003

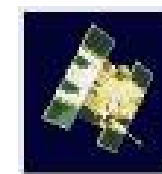
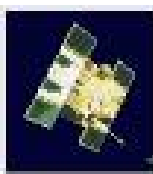
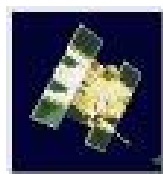
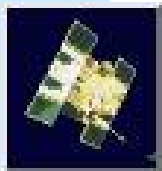


6. New Achievements - 2004



7. References

1. Claude Boucher, Zuheir Altamimi (2001 : Specifications for reference frame fixing in the analysis of a EUREF GPS campaign);
2. J. Bogusz, M.Figurski, M. Kruczyk, L. Kujawa, T. Liwosz, M. Pfeil, J. B. Rogowski (WUT LAC – Status report);
3. D.Ghitau, D.Dumitrascu, A.Bercea, F.Nastase – EUREF Romania 2003 – Technical Report;
4. G. Stangl, R. Weber, N. Höggerl, E. Fragner (EUREF – Austria 2002 ; EUREF – Campaign for the introduction of ETRS89 in Austria);
5. T. Soler, L. W. Hall – NGS, NOS, NOAA - Establishment of a GPS High Accuracy Geodetic Network in Romania (1995).



Thank you!

Contact:

rus@mail.utcb.ro

<http://www.ancpi.ro> (National Agency for Cadastre and Land Registration)



3. „EUREF-RO“ – Campaign –2003

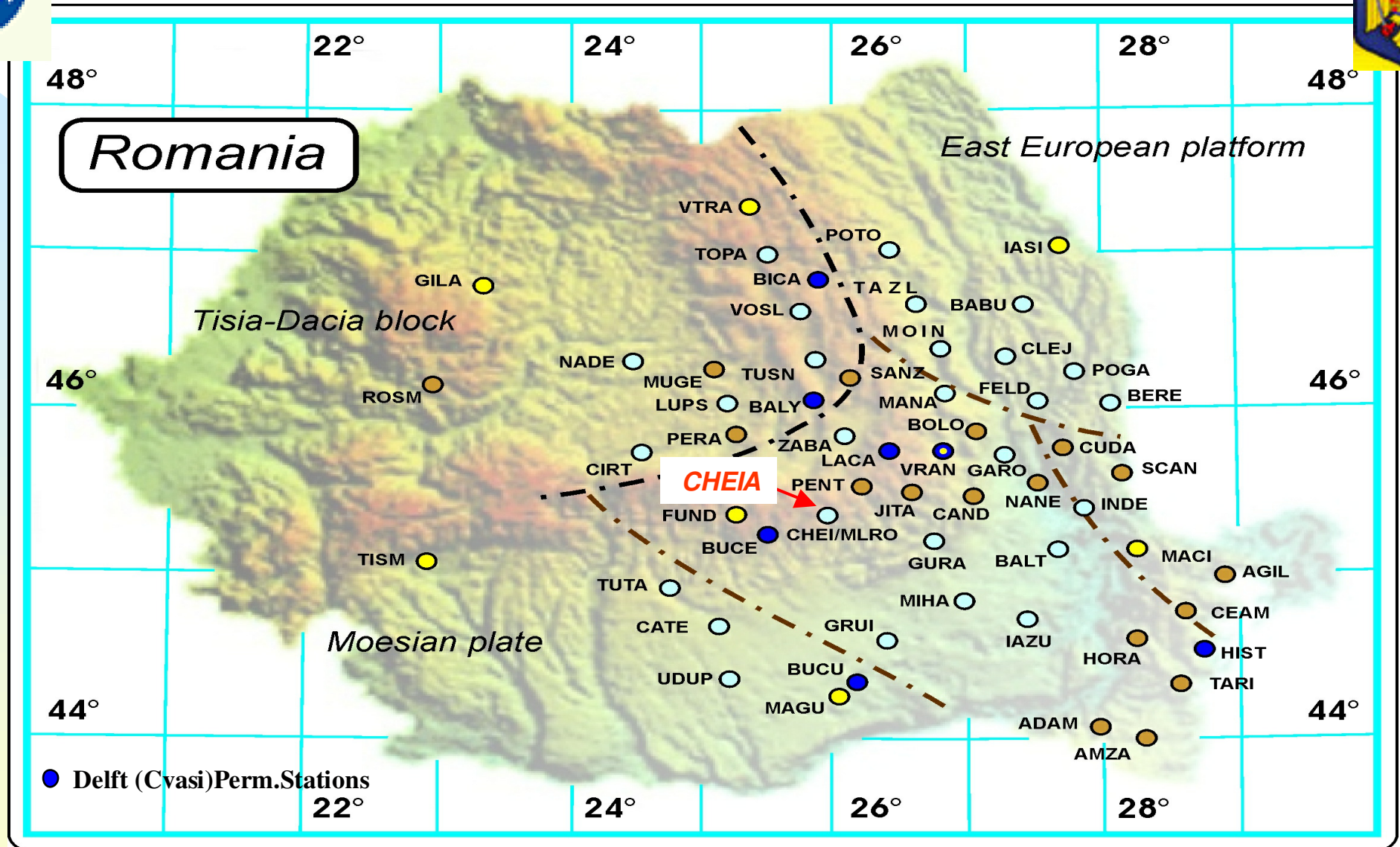
3.5 Data Processing

+SITE/ANTENNA

*SITE	PT	SOLN	T	DATA_START__	DATA_END_____	DESCRIPTION_____
TIMI	A	----	P	03:167:00000	03:172:86369	LEIAT504
BRAI	A	----	P	03:167:00000	03:172:86369	LEIAT504
GHEO	A	----	P	03:167:00000	03:172:86369	LEIAT502
SUCE	A	----	P	03:167:00000	03:172:86369	LEIAT504
BUCU	A	----	P	03:167:00000	03:172:86369	ASH700936D_M
BUCA	A	----	P	03:167:00000	03:172:86369	LEIAT502
FUN3	A	----	P	03:167:00000	03:172:86369	LEIAT502
PIS1	A	----	P	03:167:00000	03:172:86369	TRM22020.00+GP
CLUJ	A	----	P	03:167:00000	03:172:86369	LEIAT504
OSOR	A	----	P	03:167:00000	03:172:86369	LEIAT502
CONS	A	----	P	03:167:00000	03:172:86369	LEIAT502
SIBI	A	----	P	03:167:00000	03:172:86369	LEIAT504
PENC	A	----	P	03:167:00000	03:172:86369	TRM41249.00
MOSN	A	----	P	03:167:00000	03:172:86369	LEIAT502
SIRA	A	----	P	03:168:00000	03:172:86369	JPSODYSSEY_I
STAN	A	----	P	03:171:00000	03:172:86369	TRM22020.00-GP

-SITE/ANTENNA

*-----



GPS epoch and perm. stations installed by GIK/TU Delft in Romania



3. „EUREF-RO“ – Campaign –2003



3.6 RESULTS

NUM		STATION	RMS			

			N	E	U	
606	GHEO		1.8	0.7	6.9	
613	SUCE		1.2	1.2	4.3	
185	BUCU	11401M001	2.0	1.8	3.3	
602	BUCA		1.3	2.6	6.4	
605	FUN3		2.4	1.5	5.1	
609	PIS1		1.3	1.8	5.5	
608	OSOR		6.2	4.6	17.6	
604	CONS		2.2	1.4	4.5	
610	SIBI		1.5	1.0	3.5	
124	PENC	11206M006	2.1	2.2	4.8	
607	MOSN		3.5	2.2	5.6	
611	SIRA		2.5	3.3	11.9	
612	STAN		5.8	1.9	3.6	



3. „EUREF-RO“ – Campaign –2003



3.5 Data Processing

+SITE/RECEIVER

*SITE	PT	SOLN	T	DATA_START__	DATA_END_____	DESCRIPTION_____
TIMI	A	----	P	03:167:00000	03:172:86369	LEICA SR530
BRAI	A	----	P	03:167:00000	03:172:86369	LEICA SR530
GHEO	A	----	P	03:167:00000	03:172:86369	LEICA SR520
SUCE	A	----	P	03:167:00000	03:172:86369	LEICA SR530
BUCU	A	----	P	03:167:00000	03:172:86369	ASHTech Z-XII3
BUCA	A	----	P	03:167:00000	03:172:86369	LEICA SR520
FUN3	A	----	P	03:167:00000	03:172:86369	LEICA SR520
PIS1	A	----	P	03:167:00000	03:172:86369	TRIMBLE 4000SSI
CLUJ	A	----	P	03:167:00000	03:172:86369	LEICA SR530
OSOR	A	----	P	03:167:00000	03:172:86369	LEICA SR520
CONS	A	----	P	03:167:00000	03:172:86369	LEICA SR520
SIBI	A	----	P	03:167:00000	03:172:86369	LEICA SR530
PENC	A	----	P	03:167:00000	03:172:86369	TRIMBLE 5700
MOSN	A	----	P	03:167:00000	03:172:86369	LEICA SR520
SIRA	A	----	P	03:168:00000	03:172:86369	JPS ODYSSEY
STAN	A	----	P	03:171:00000	03:172:86369	TRIMBLE 4000SSE

-SITE/RECEIVER

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