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United Nations/Moldova/United States of America
Workshop on the Applications of Global Navigation Satellite Systems
17 – 21 May 2010 Chisinau, Republic of Moldova

Romanian Position Determination System - ROMPOS -

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CONTENT

- 1. Status of Geodetic Network
- 2. GNSS Network
- 3. ROMPOS Services
- 4. Cross border Data Exchange
- 5. TransDat Software (ETRS89 <> S42)
- 6. ROMPOS Applications
- 7. References

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Status of Geodetic Network

a. Triangulation network (Ist-Vth order) > *New Inventory*

b. Leveling network > EVRS (EVRF2007)

c. GNSS network (after 2004) > accent on development

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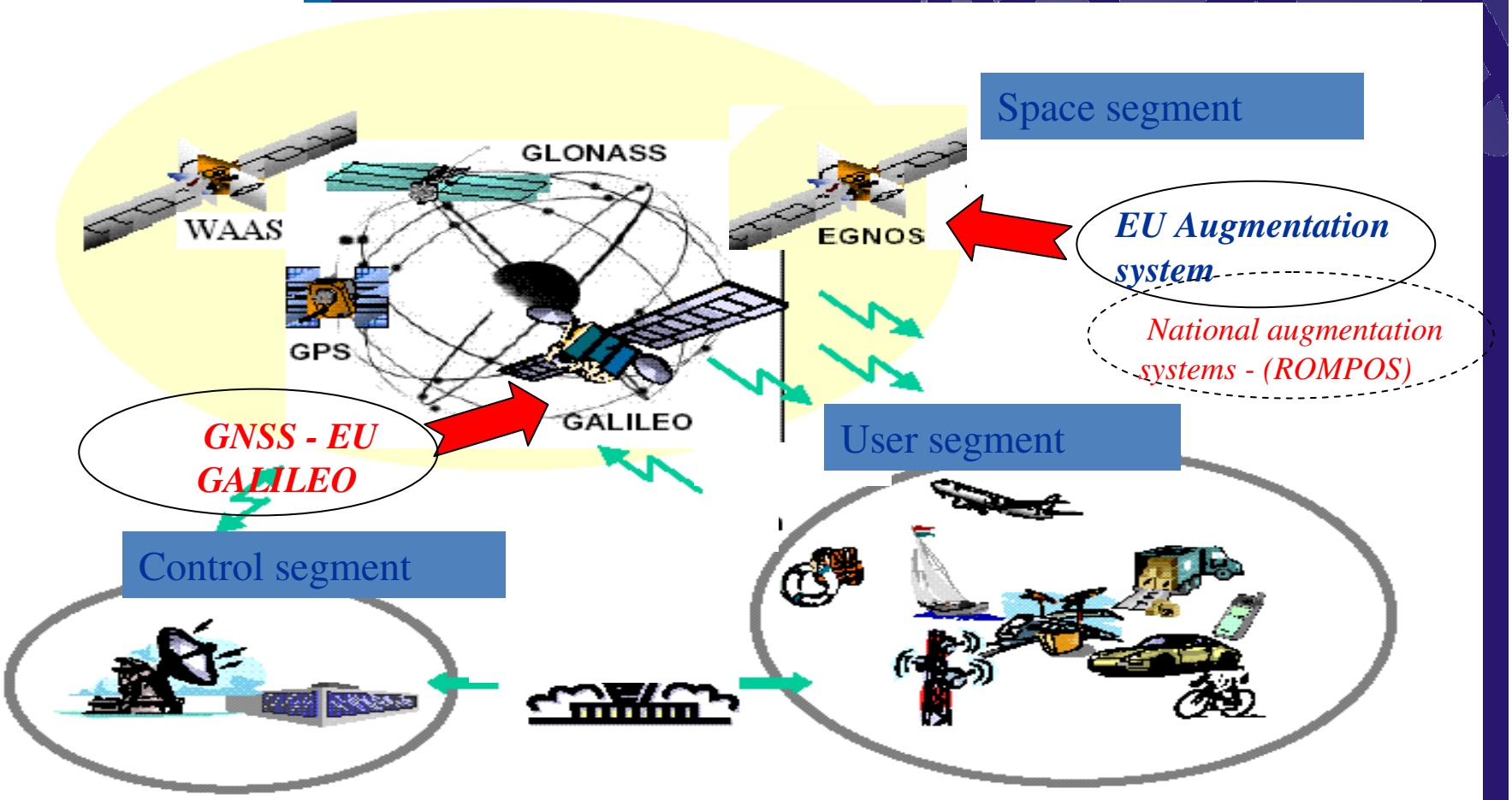
GPS/GNSS / Augmentation systems

- Global / Regional / National / Local



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ROMANIAN GNSS Network

(National Space Geodetic Network)

ETRS89 introduced official

Applications	Class	E (cm)	Realization by
First class national geodetic network Regional and local geodynamic, deformation projects, engineering surveying, et al.	**A**	**1.0**	***Permanent stations*** ***57 ANCPI*** ✓ ***+1 TUCE*** ✓ ***+ 15 new = 73 (2010)***
Second class national geodetic network connections to primary network, engineering surveying, landslides	**B**	**2.0**	***Epoch stations*** ***306 points*** ✓ ***(2003)***
Third class national geodetic network engineering surveying, cadaster	**C**	**3.0**	***about 4750 points*** ***(1pt/50km^2)~100 pts/county*** *Realization ~ 45%*
Fourth class national geodetic network cadaster, GIS et al.	**D**	**5.0**	***(1pt/5km^2)***

GNSS Network Class A is the core of ROMPOS

(Romanian Position Determination System)

CLASS A – GNSS Permanent Network
ROMPOS stations – 2007 : 48 GNSS stations

1999: 1 GNSS perm.station (Bucu)

2001: 7 stations

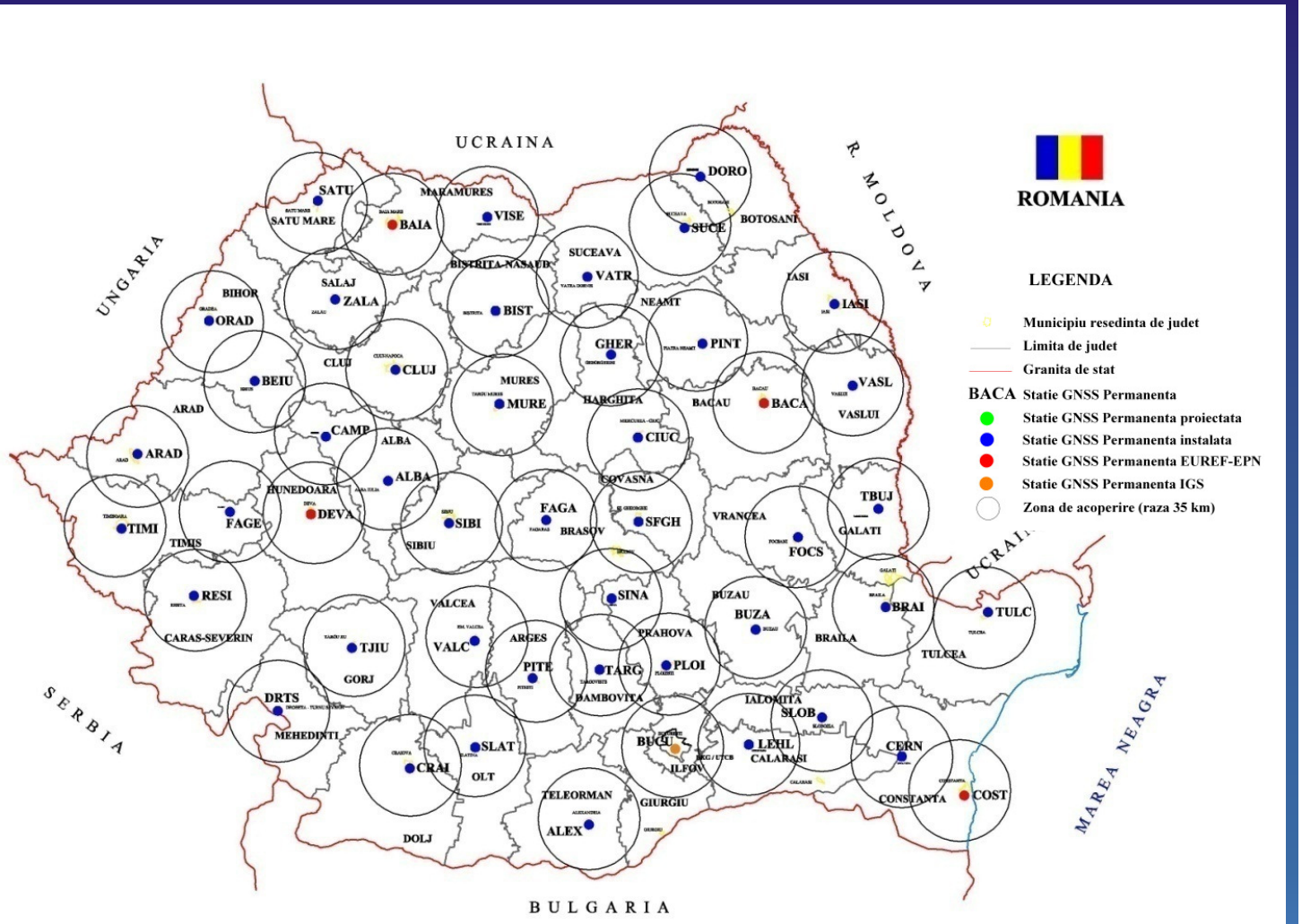
2004: 13 stations

2006: 28 stations

2007: 48 stations

2009: 58 stations

2010: 73 stations



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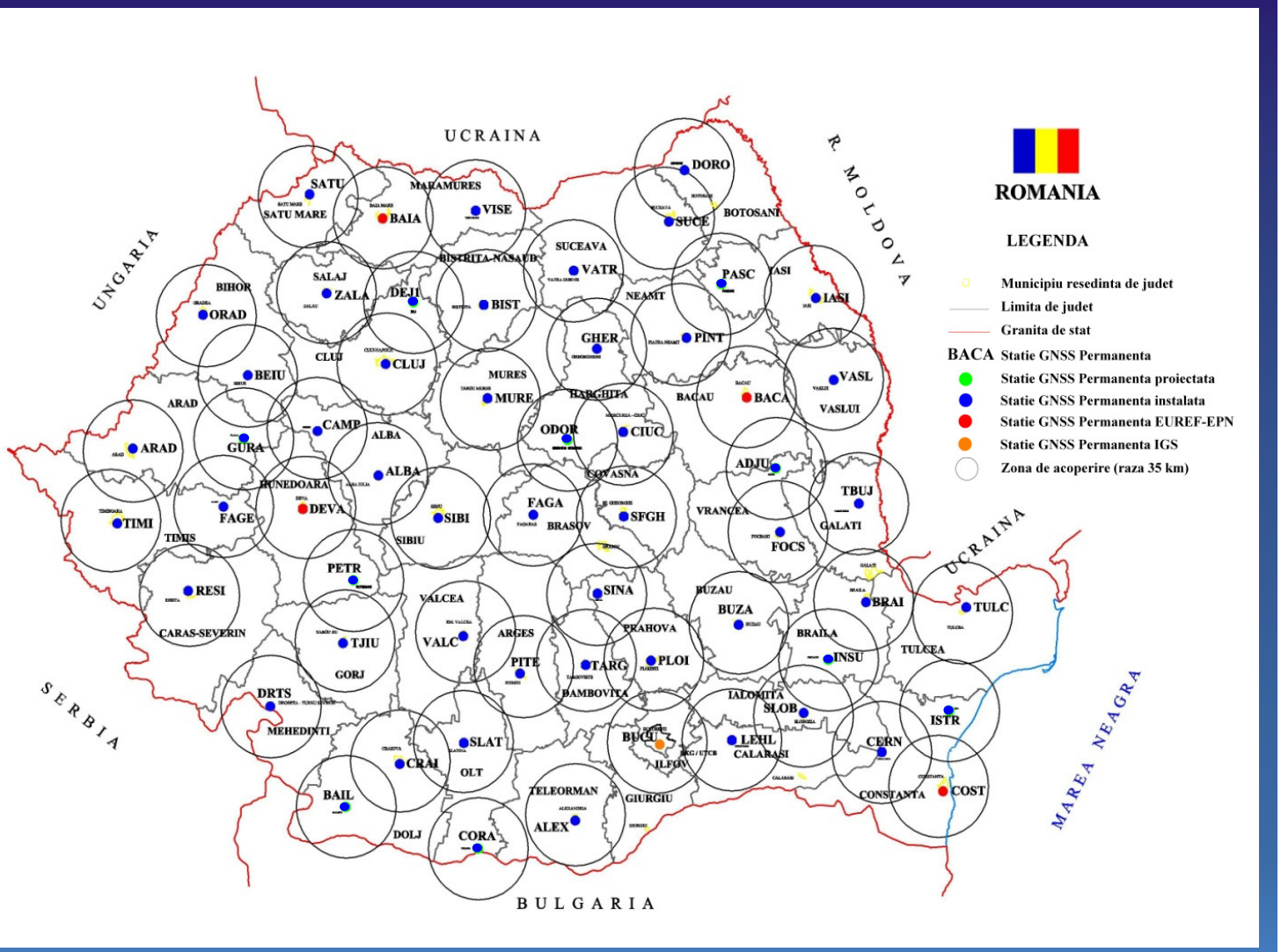
ROMPOS stations – beginning 2009 : 58 stations

(red circles – EUREF-EPN stations)

6 GPS and 52 GNSS (GPS+GLONASS)



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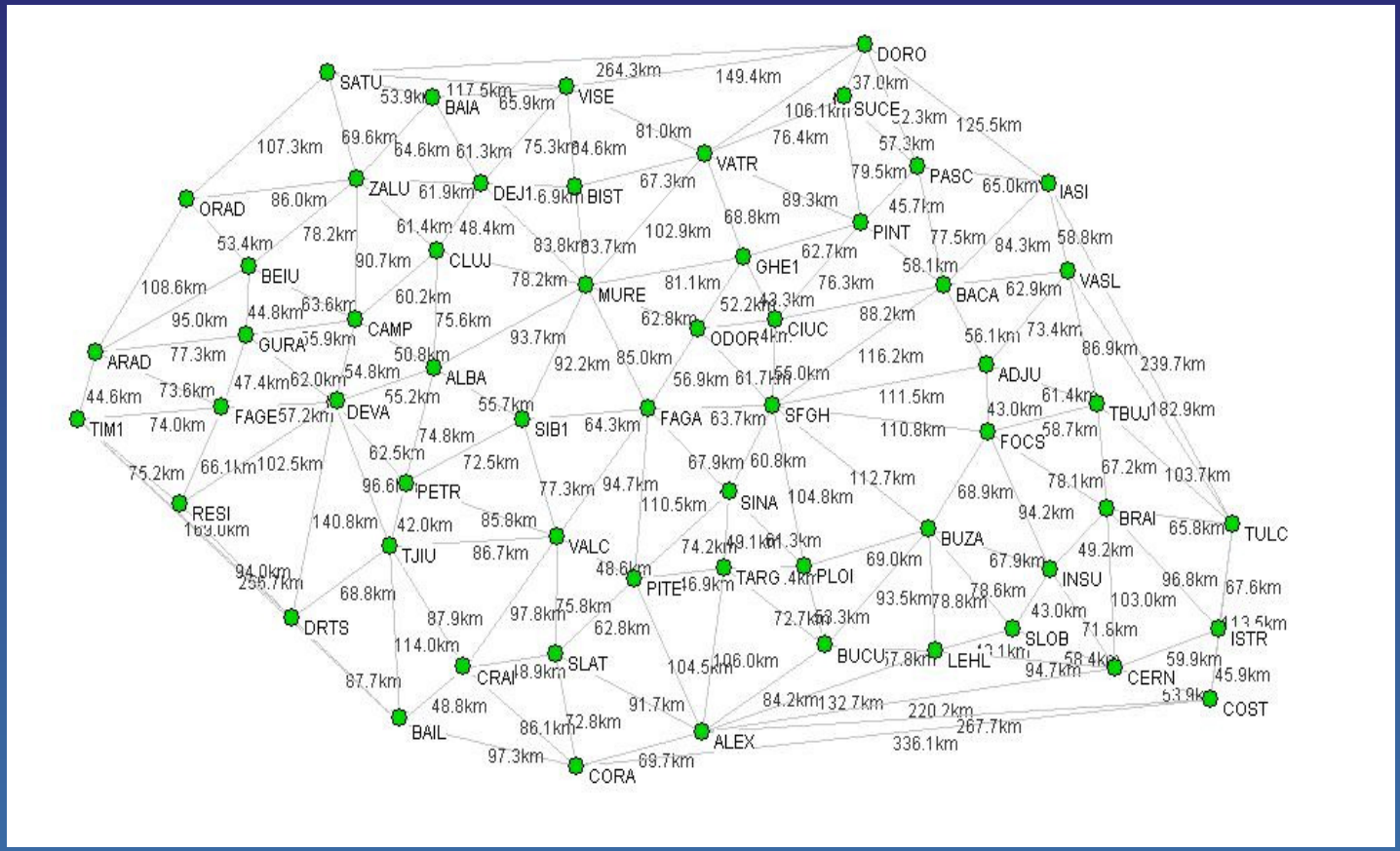
ROMPOS stations – spacing in km (with 58 stations)



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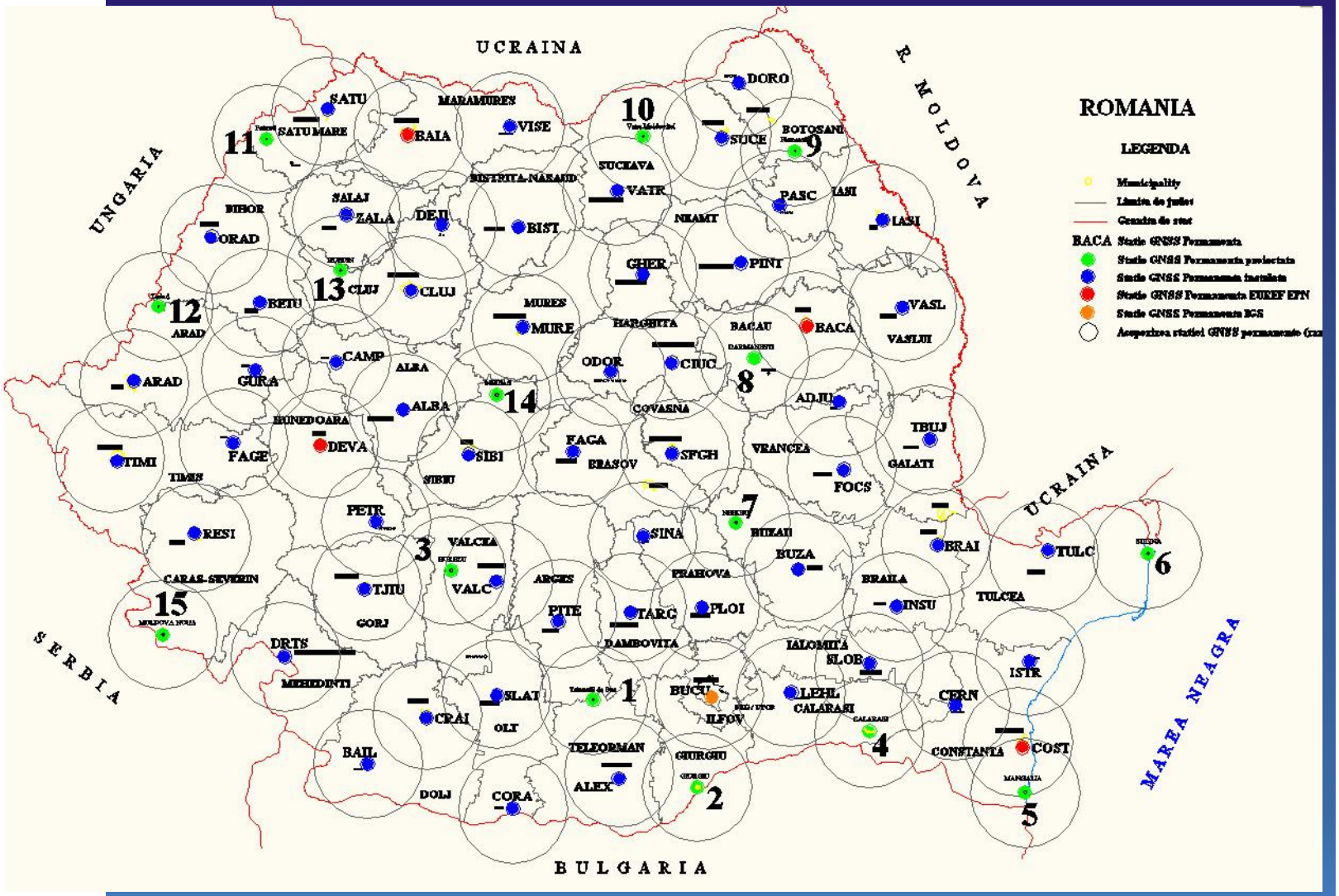
ROMPOS stations – 2010 : 73 stations

(black numbers – position of last 15 stations to be installed

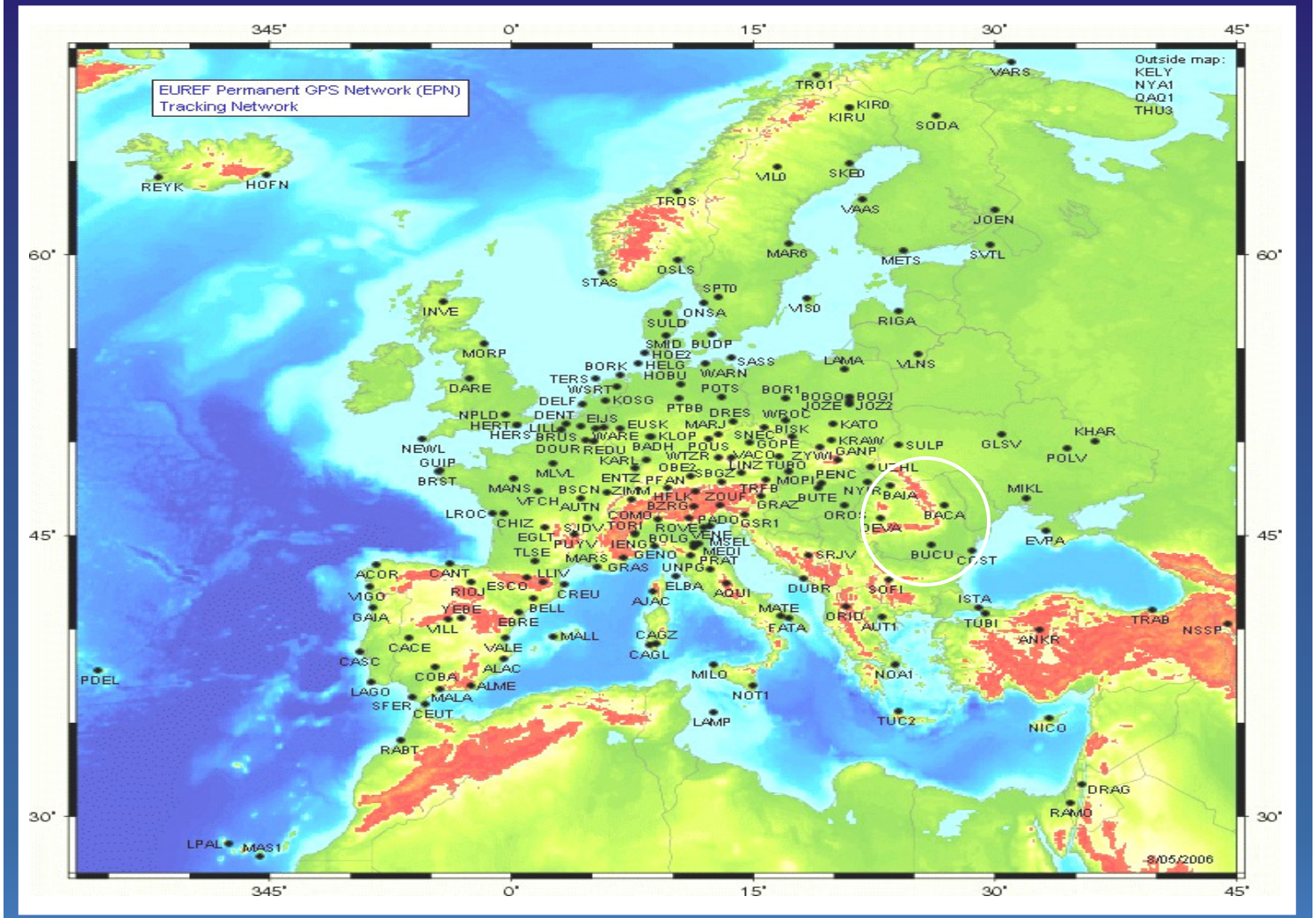


ROMP
Romanian Position Determinati

ROMPOS station information – included into EUPOS Station DataBase (IDs, coordinates, antenna, et al.)

EUREF-EPN stations – 5 stations

(1 GNSS and 4 GPS stations)



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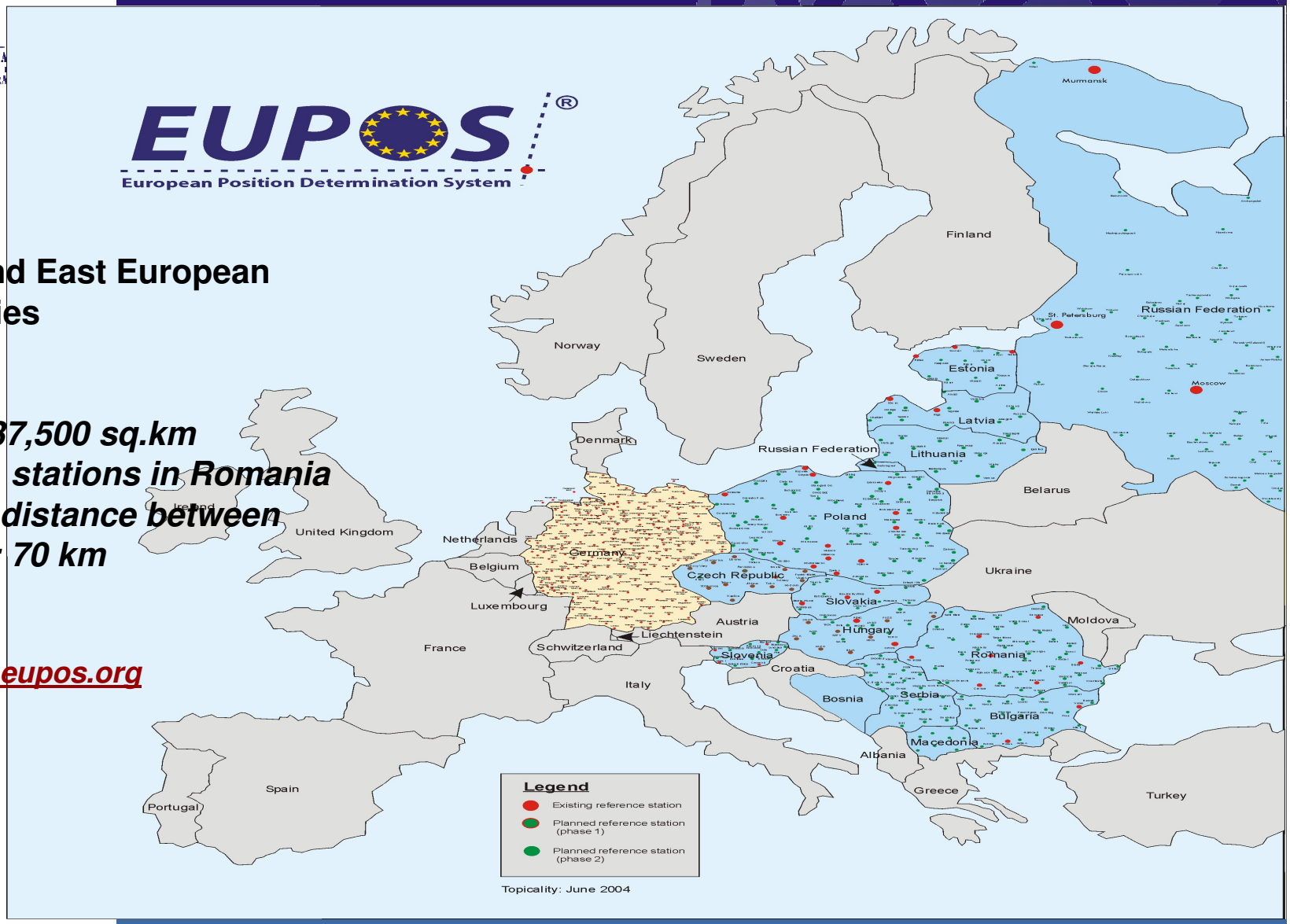
EUPOS®
European Position Determination System

Central and East European countries

Romania

- ***Area - 237,500 sq.km***
- ***73 perm. stations in Romania***
- ***Medium distance between stations: 70 km***

http://www.eupos.org



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ROMPOS stations – installation campaign 2009

(10 stations with financial support from PHARE)

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ROMPOS stations – installation campaign

(10 stations with financial support from PHARE)

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ROMPOS stations – installation campaign

(10 stations with financial support from PHARE)

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ROMPOS stations – installation campaign

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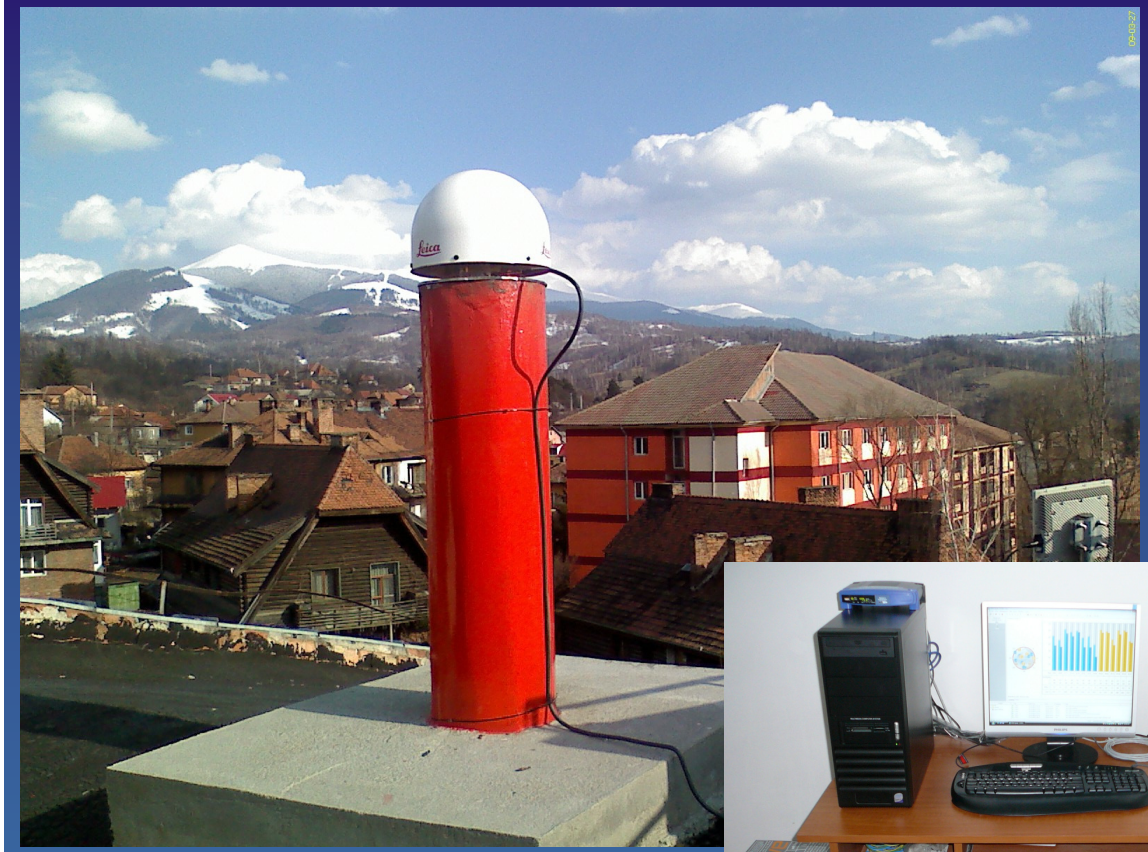

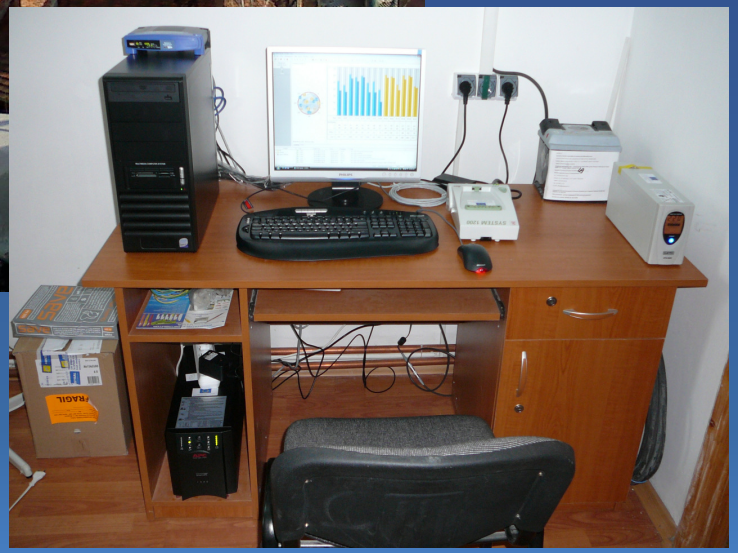

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ROMPOS stations – different antenna pillars

Slobozia

Bistrita

Tg. Jiu

Tg. Mures

Resita

Tulcea

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ROMPOS stations – main equipments (antenna types and receivers)

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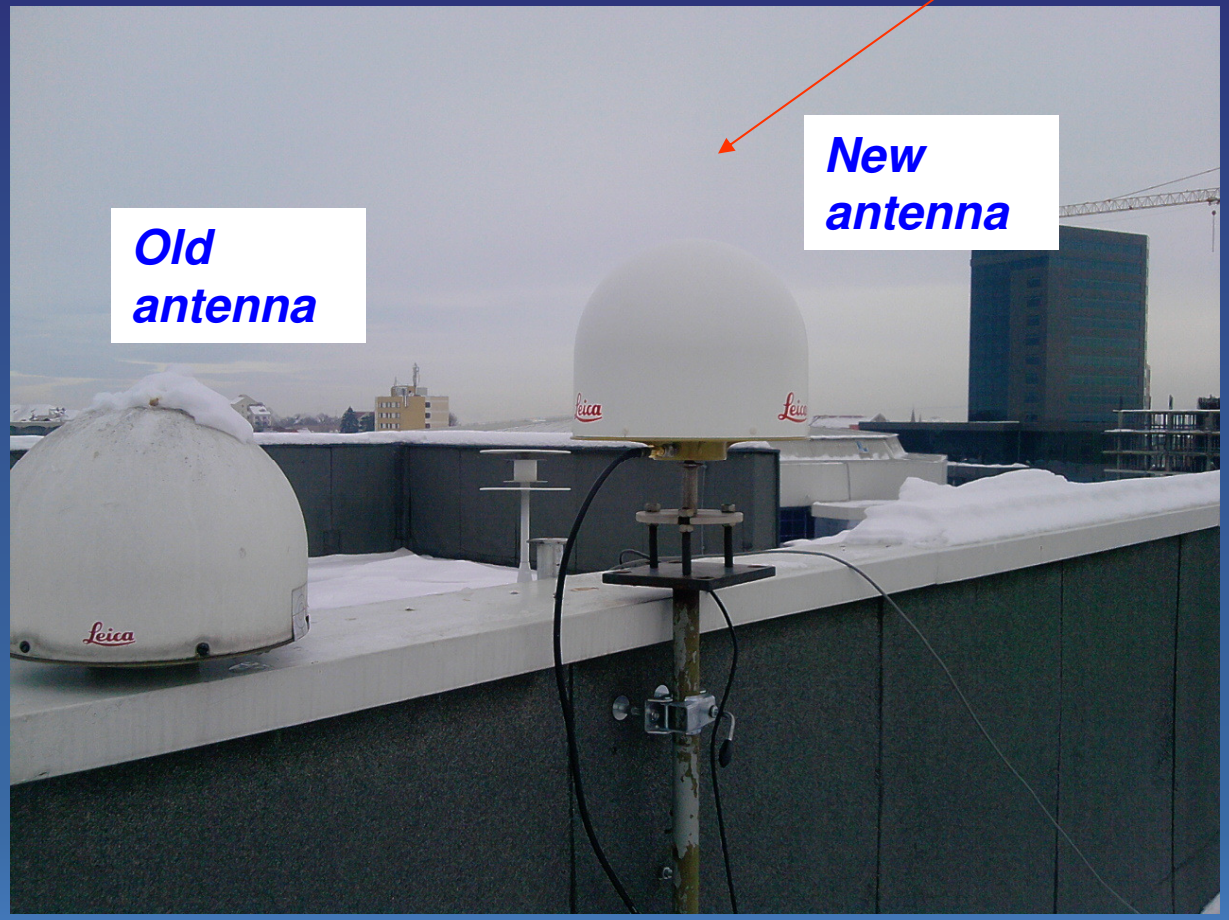
ROMPOS stations – modernization campaign

(December 2009)

6 GPS stations – Leica System 500
replaced by GNSS
Leica System 1200 GNSS+, AR25 antenna

Brai, Cluj, Fage,
Orad, Sib1, Suce,



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ROMPOS stations – difficult weather condition at SINA(ia) station – 2000m height in winter 2008/2009

August 28, 2008

March 23, 2009

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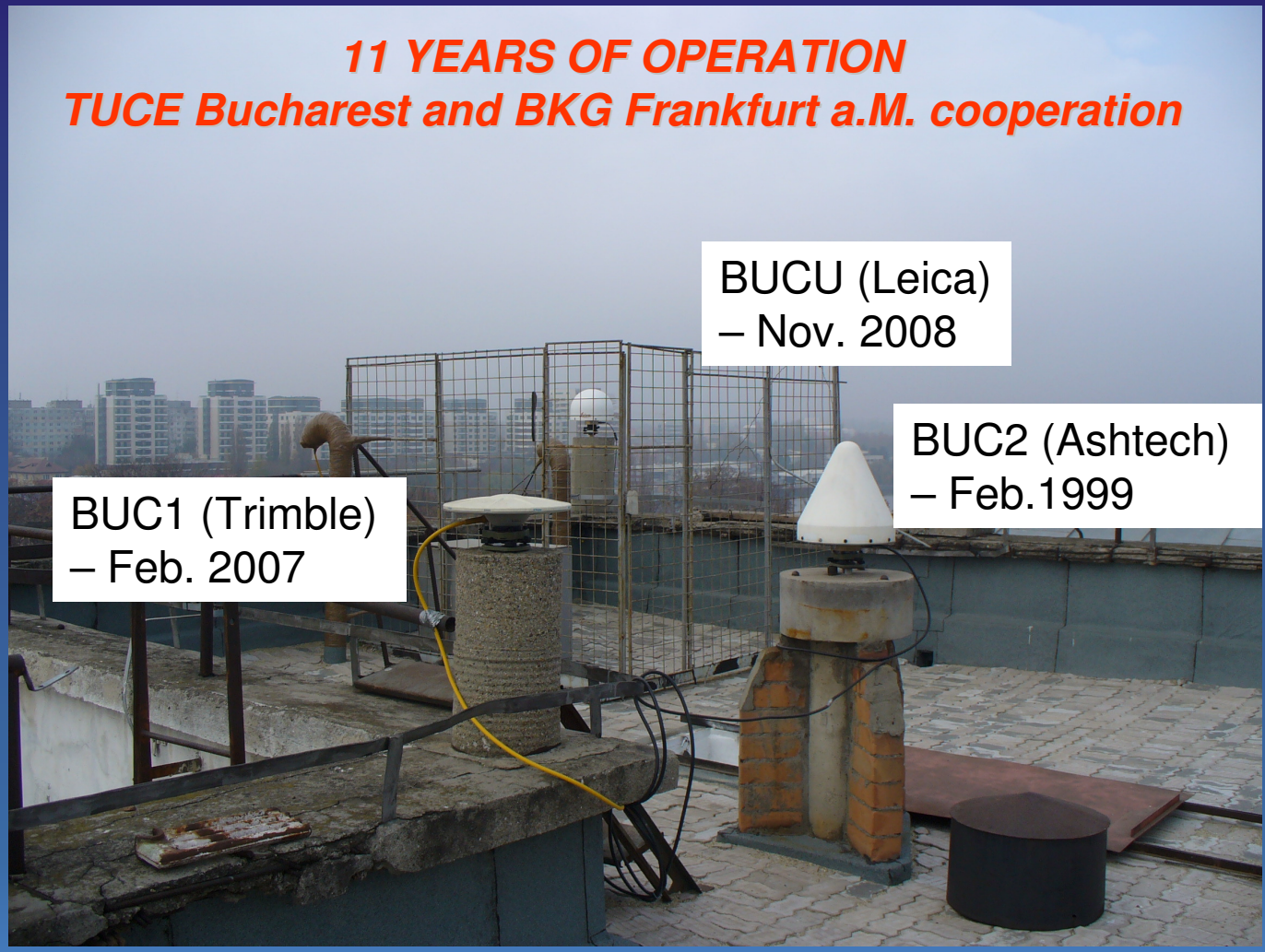
IGS station BUCU was modernized
2 stations (BUCU+BUC1) = GNSS
BUC2 = GPS old permanent station

11 YEARS OF OPERATION
TUCE Bucharest and BKG Frankfurt a.M. cooperation



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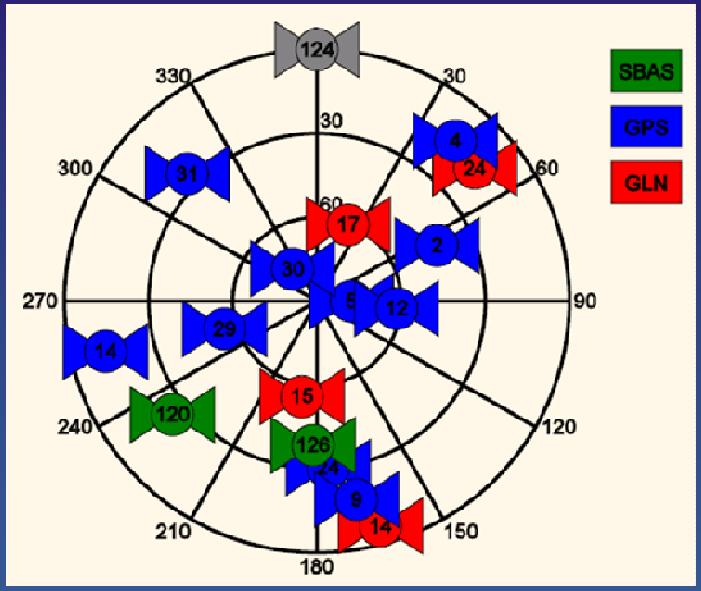
New and old equipments at BUCU

BUC1 (Trimble)

BUC2 (Ashtech)

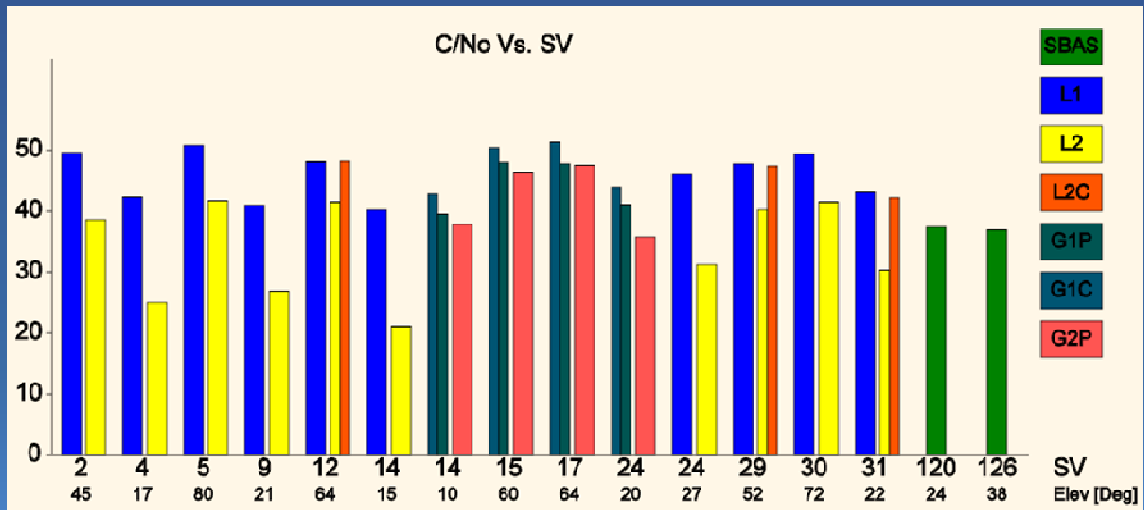
BUCU (Leica)

BUC2 (Trimble) GNSS station
(research station)

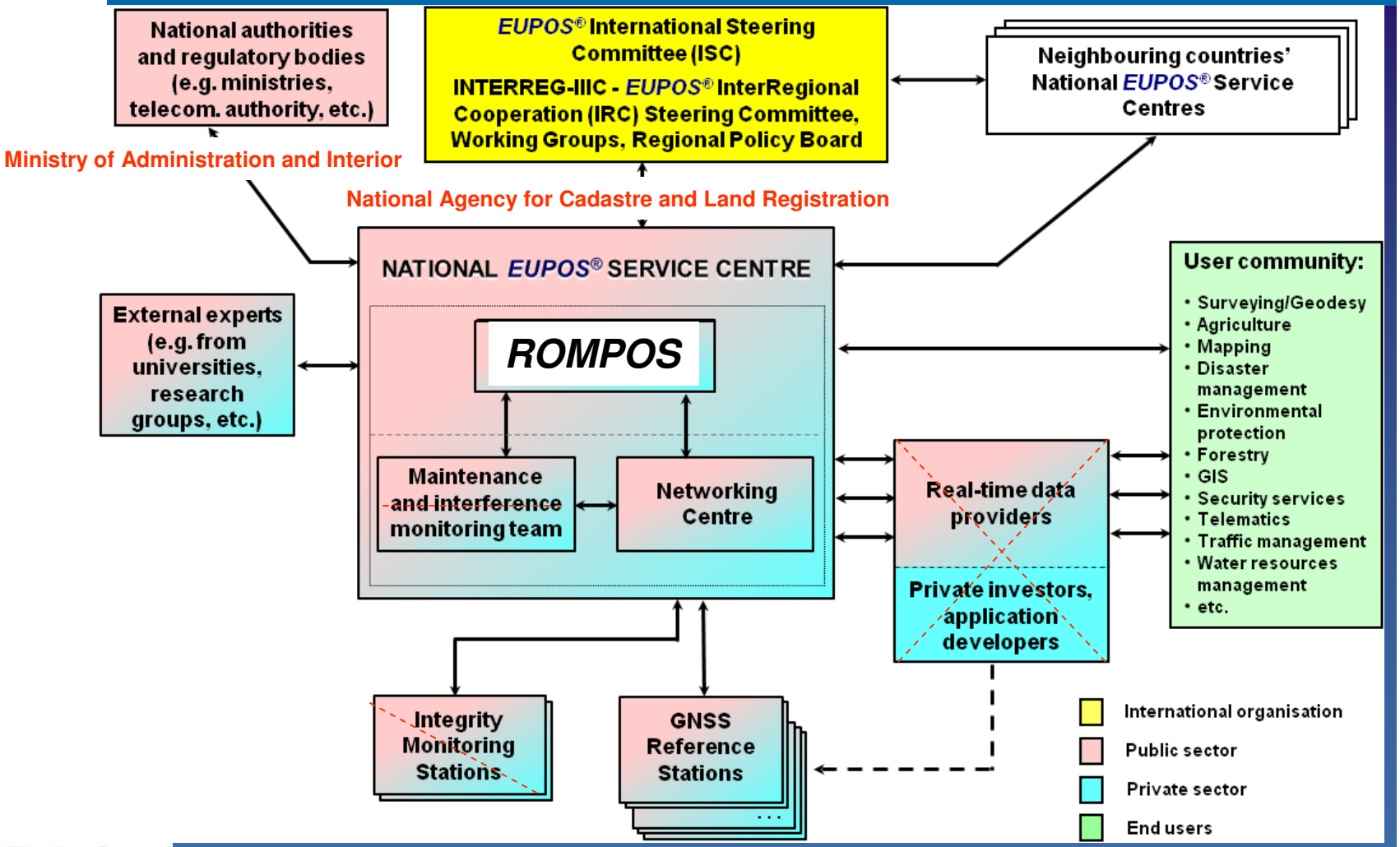


SV	Type	Elev. [Deg]	Azim. [Deg]	L1-C/No [dBHz]	L2-C/No [dBHz]	L1	L2	IODE	URA [m]	Type
2	GPS	44.15	68.51	49.5	38.2	C	E	26	2	II/IIA/IIR
4	GPS	16.45	41.96	39.8	22.9	C	E	23	2	II/IIA/IIR
5	GPS	79.84	78.32	51.2	41.4	C	E	25	2	II/IIA/IIR
9	GPS	20.41	168.65	41.3	25.6	C	E	60	2.8	II/IIA/IIR
12	GPS	63.78	91.02	49.5	41.0/49.4	C	E/C	13	2	IIR-M
14	GPS	14.31	258.84	39.9	20.6	C	E	57	2	II/IIA/IIR
14/4	GLONASS	9.54	163.66	42.3/39.2	39.4	C/P	P	3	N/A	M
15/0	GLONASS	59.21	189.94	49.5/47.4	46.0	C/P	P	3	N/A	M
17/-1	GLONASS	63.46	17.86	50.3/48.0	47.4	C/P	P	3	N/A	M
24/2	GLONASS	18.82	48.05	42.8/40.2	36.1	C/P	P	3	N/A	M
24	GPS	27.37	176.73	46.6	31.6	C	E	24	2.8	II/IIA/IIR
29	GPS	53.00	250.23	48.6	39.8/48.0	C	E/C	85	2.8	IIR-M
30	GPS	72.76	318.98	48.0	41.1	C	E	61	2.8	II/IIA/IIR
31	GPS	22.89	315.81	43.2	30.4/43.2	C	E/C	8	2	IIR-M
120	SBAS	24.37	231.76	37.3	-	C	-	124	N/A	-
126	SBAS	38.42	181.57	37.9	-	C	-	120	N/A	-

GPS, GLONASS and EGNOS data received at BUC1 station



National Service Centre - ROMPOS



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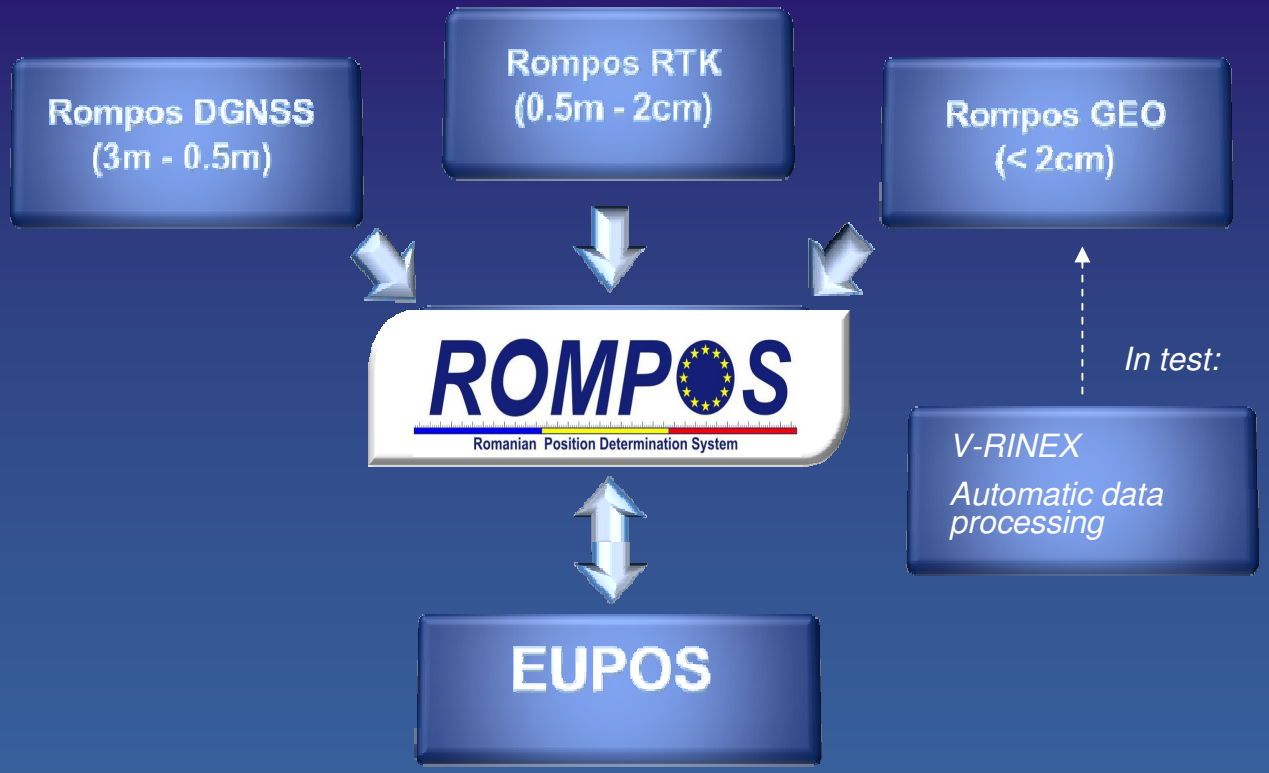
ROMPOS services



Launched : September 2008

ROMPOS-DGNSS&RTK – free of charge

ROMPOS-GEO - charged

EUPOS

17 Central end East European countries

More than 400 reference stations

Common standards

Similar products and services

ROMPOS
Romanian Position Determination System

ROMPOS users

Networking software achieved and installed in May 2009
(7 servers ; 4 clusters; > 1Tb)

About 450 registered users of ROMPOS-RTK

ROMPOS = Registered mark in Romania

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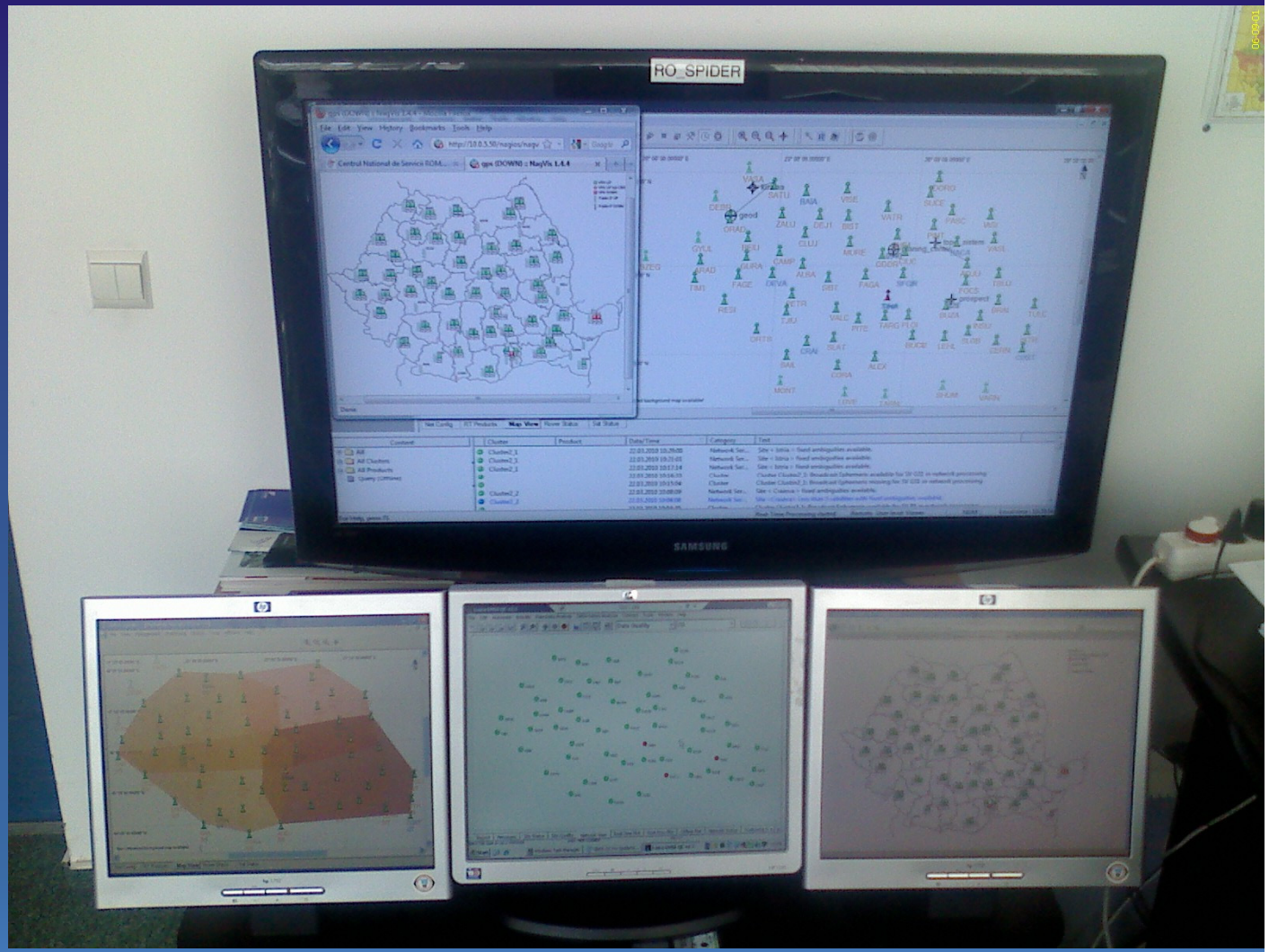
ROMPOS Services National Centre

Department of Geodesy and Cartography



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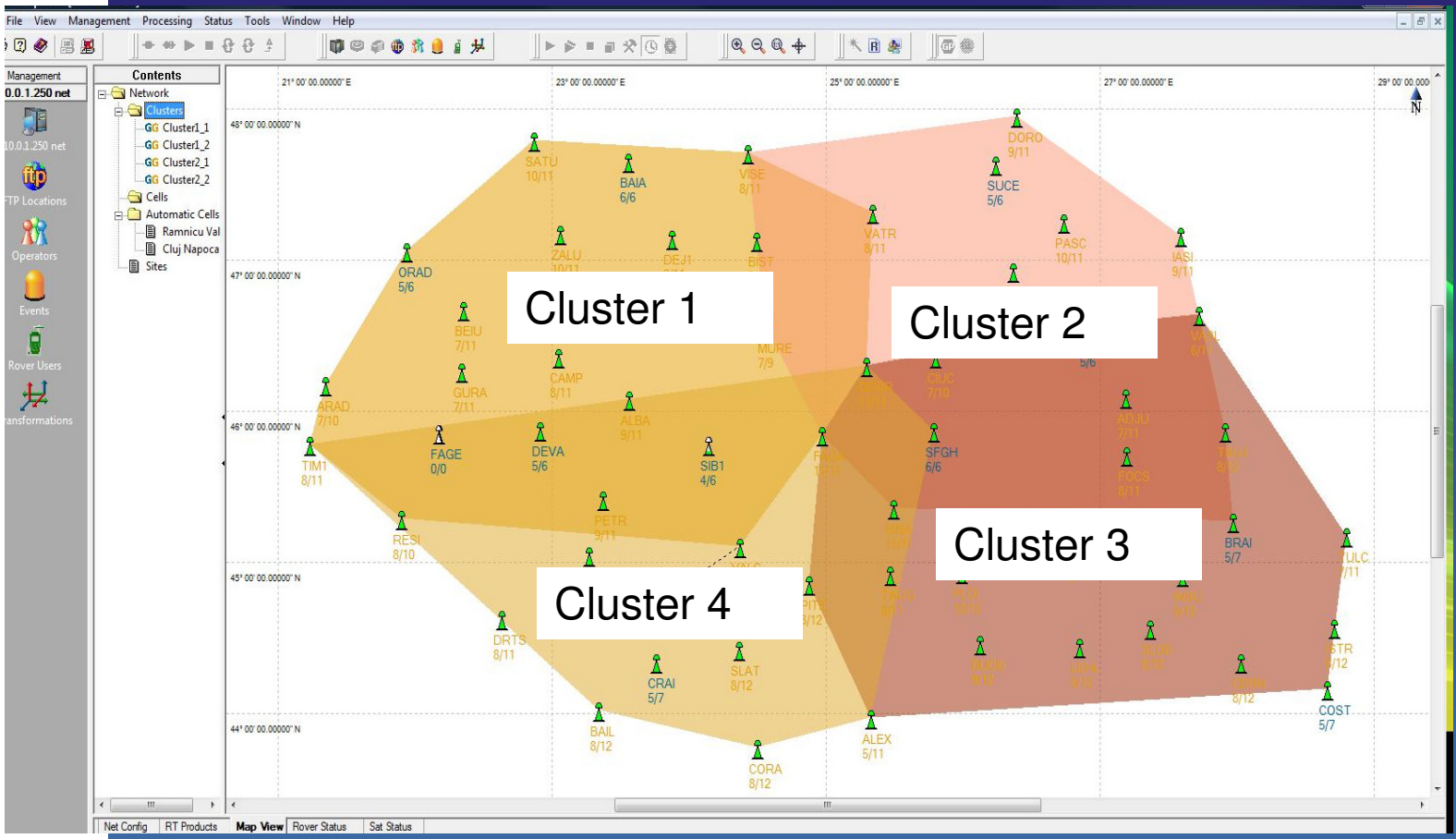
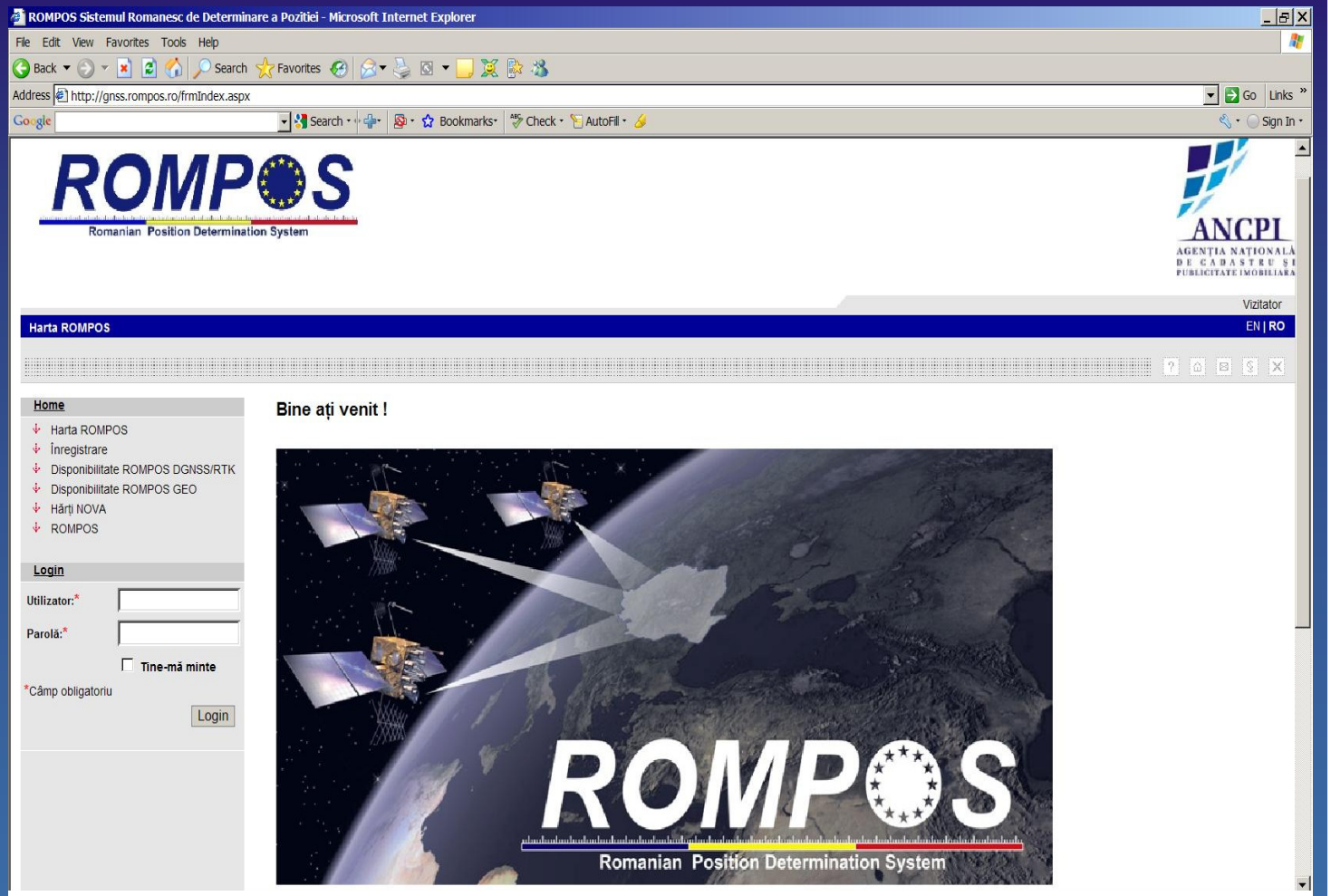
ROMPOS clusters

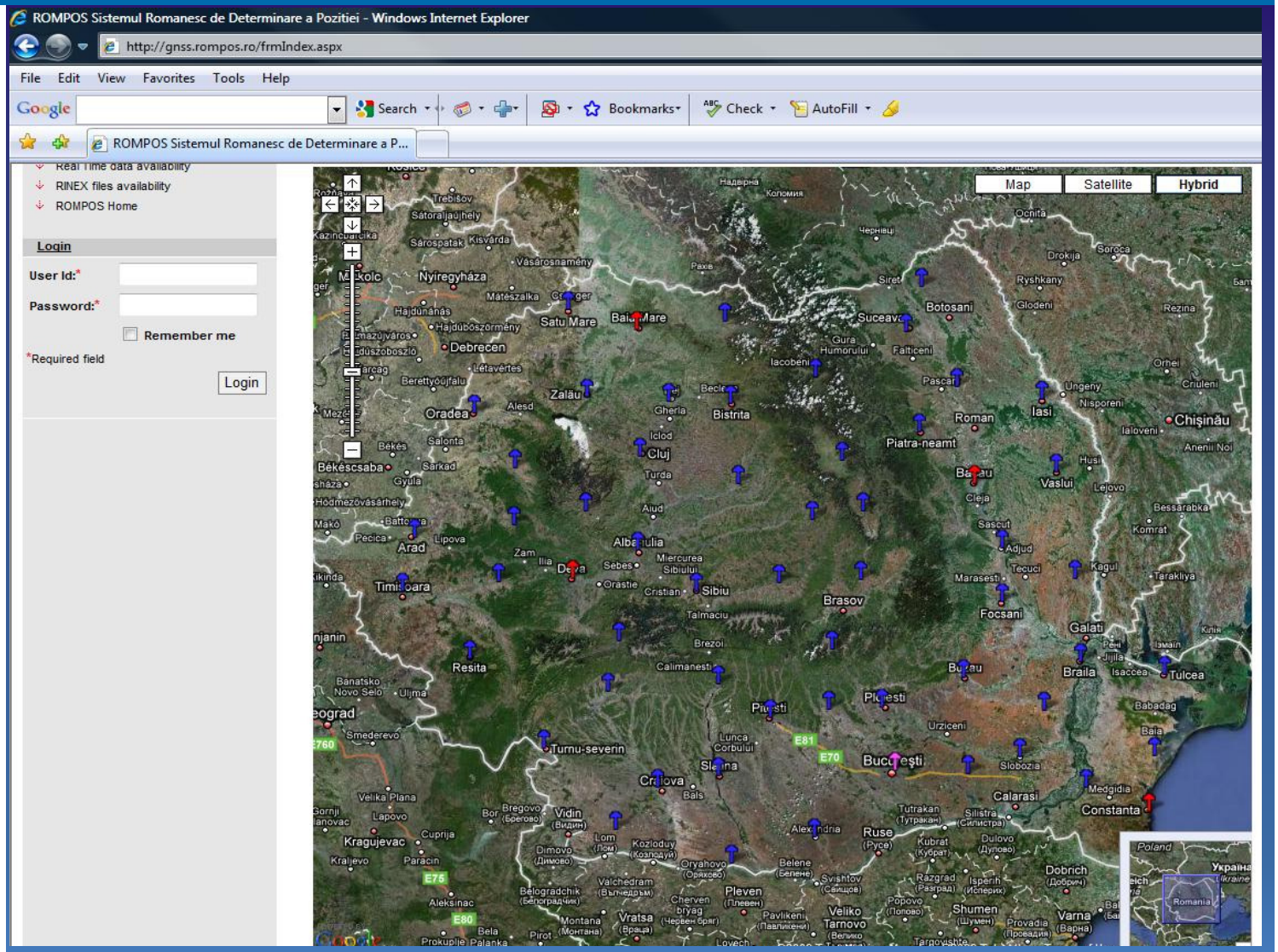


ROMPOS web site
www.rompos.ro



ROMPOS web site

General info on reference stations



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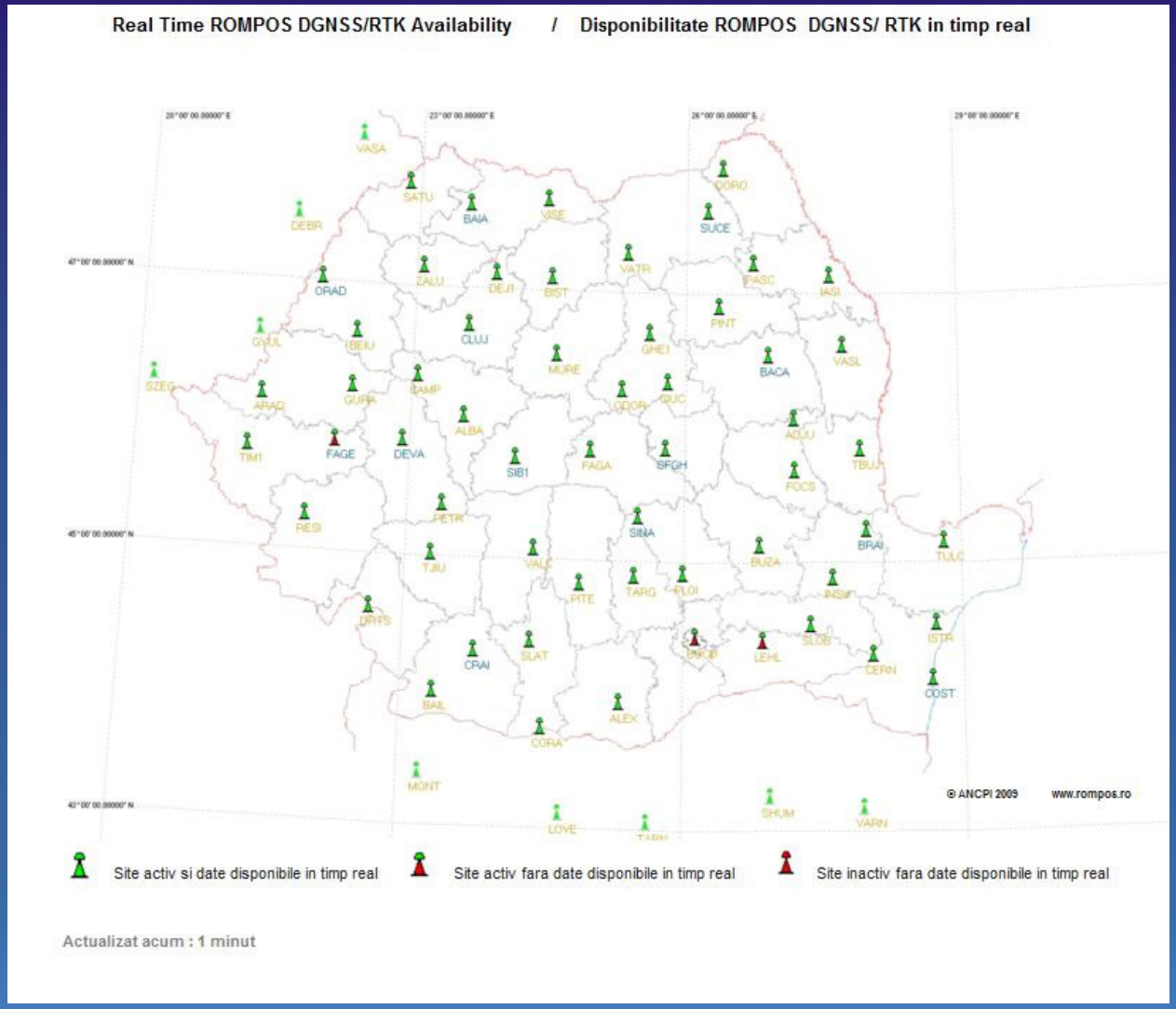
ROMPOS web site (realtime info) gnss.rompos.ro



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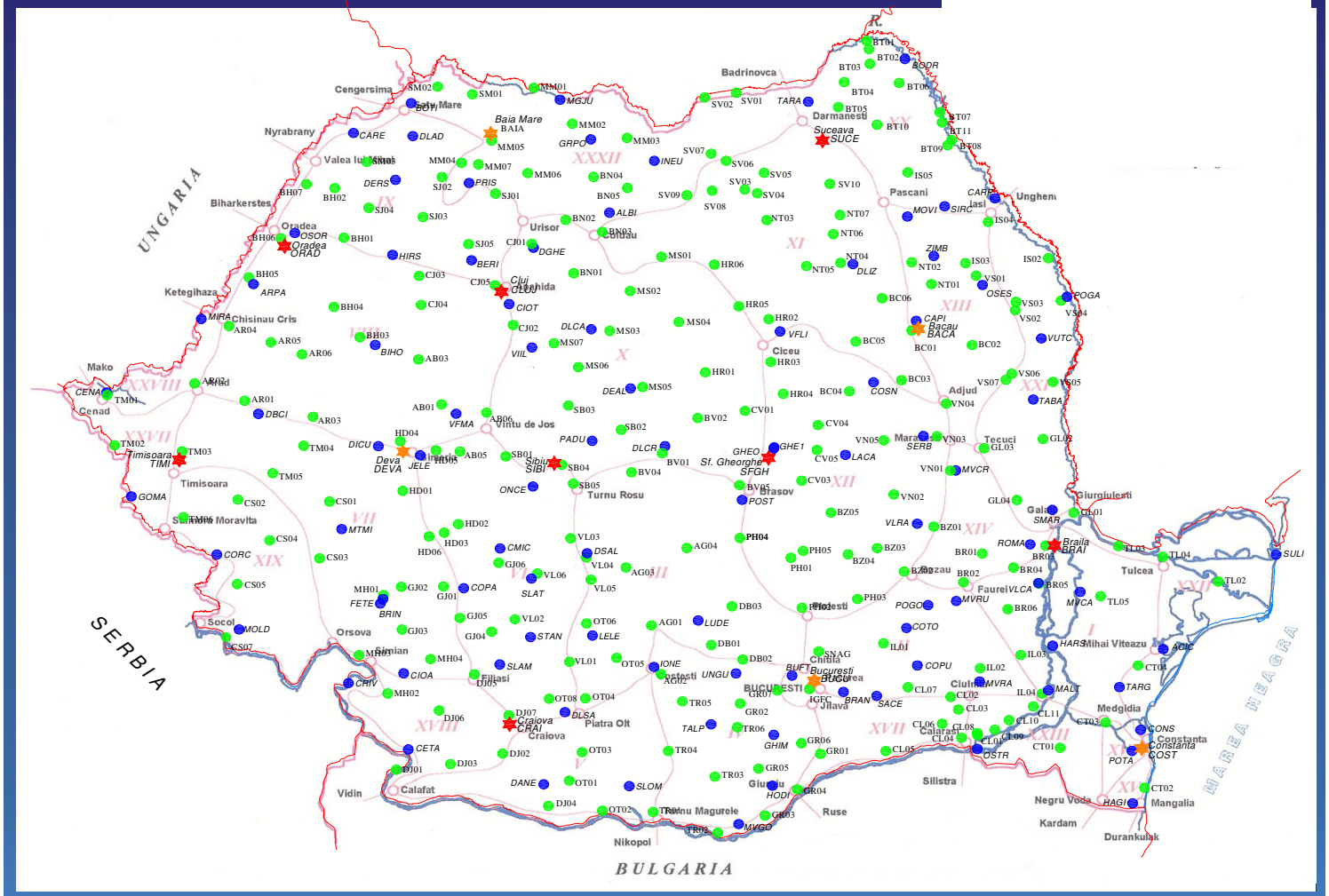
CLASS B – GNSS Network

306 epoch stations

GNSS network Class B



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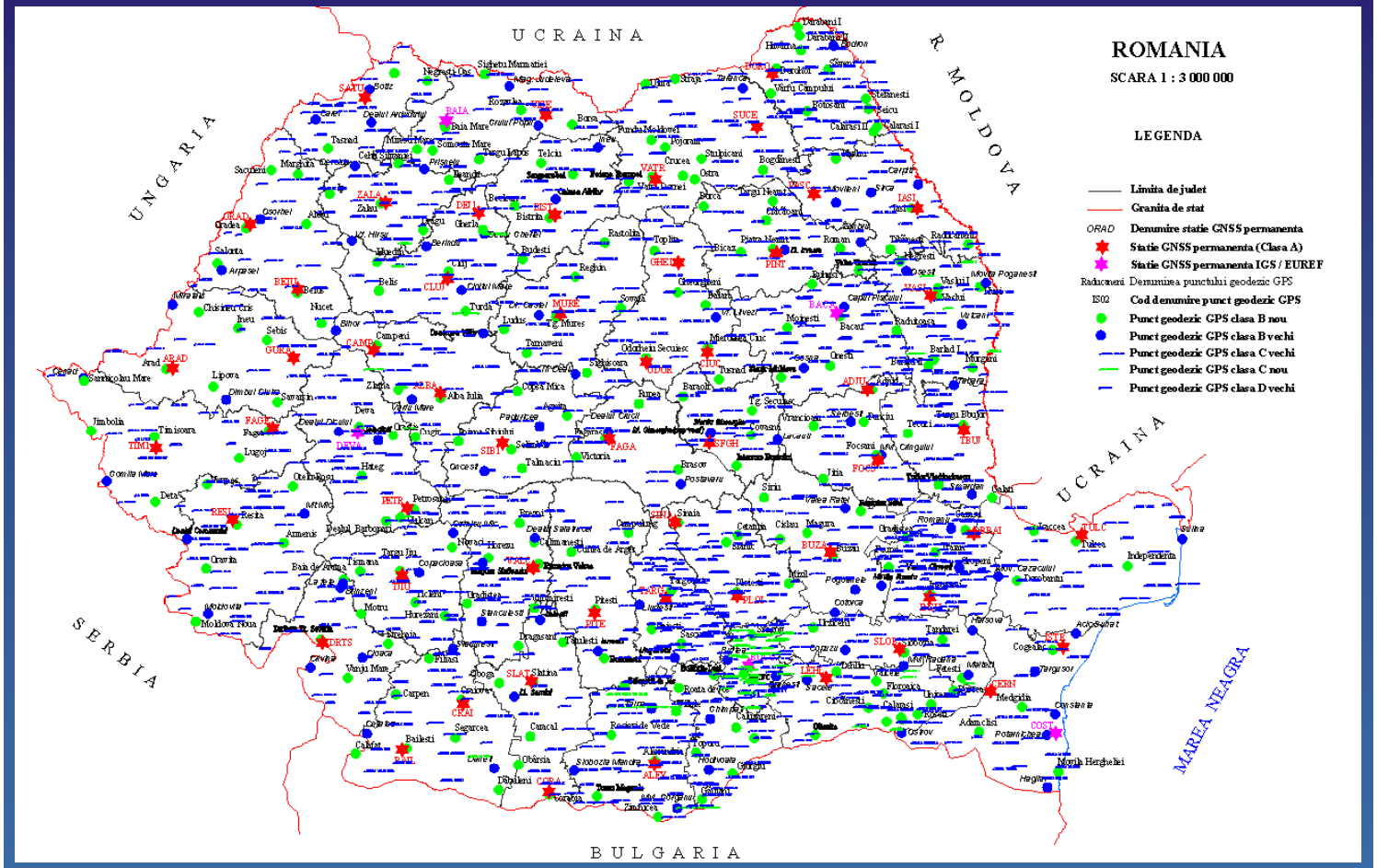
CLASS C – GNSS Network

~ 1500 epoch stations



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Cross border GNSS data exchange

Geodetic Data exchange

Special workshop organized by NACLR in 2008 (April) for geodetic data exchange under PHARE project connected with the 13th EUPOS-ISC conference in Bucharest.

GNSS Data exchange

Necessity for:

- *RTK services improvement*
- *Common Coordinate Reference System (ETRS89)*
- *Geodetic (GNSS) networks connection*
- *Better cooperation on geodetic research and applications*

Started in 2009

ROMPOS – GNSS Net (HU) ✓

ROMPOS – BULiPOS (BG)

To be started in 2010

ROMPOS – MOLDPOS (MD) ✓

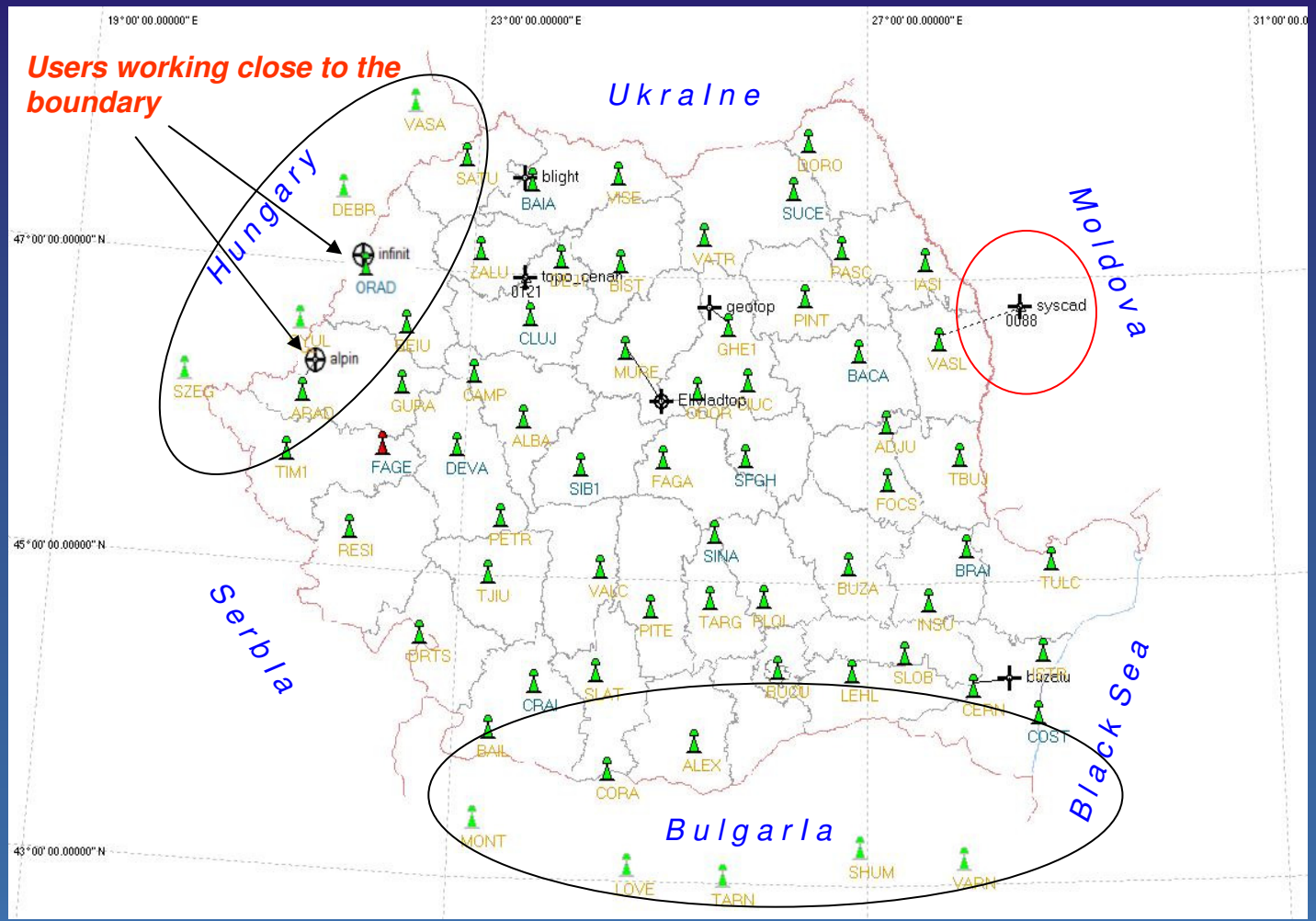
ROMPOS – ZAKPOS (UA)

✓ *- agreement already signed*

ROMPOS
Romanian Position Determination System

Cross border data exchange

Data exchange with neighbour countries:
HU: 4 stations
BG: 5 stations
MD: 6 stations
UA: 4-5 stations



Cross border data exchange ROMPOS-MOLDPOS

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Romania
6 stations

Republic of Moldova
6 stations

RO:

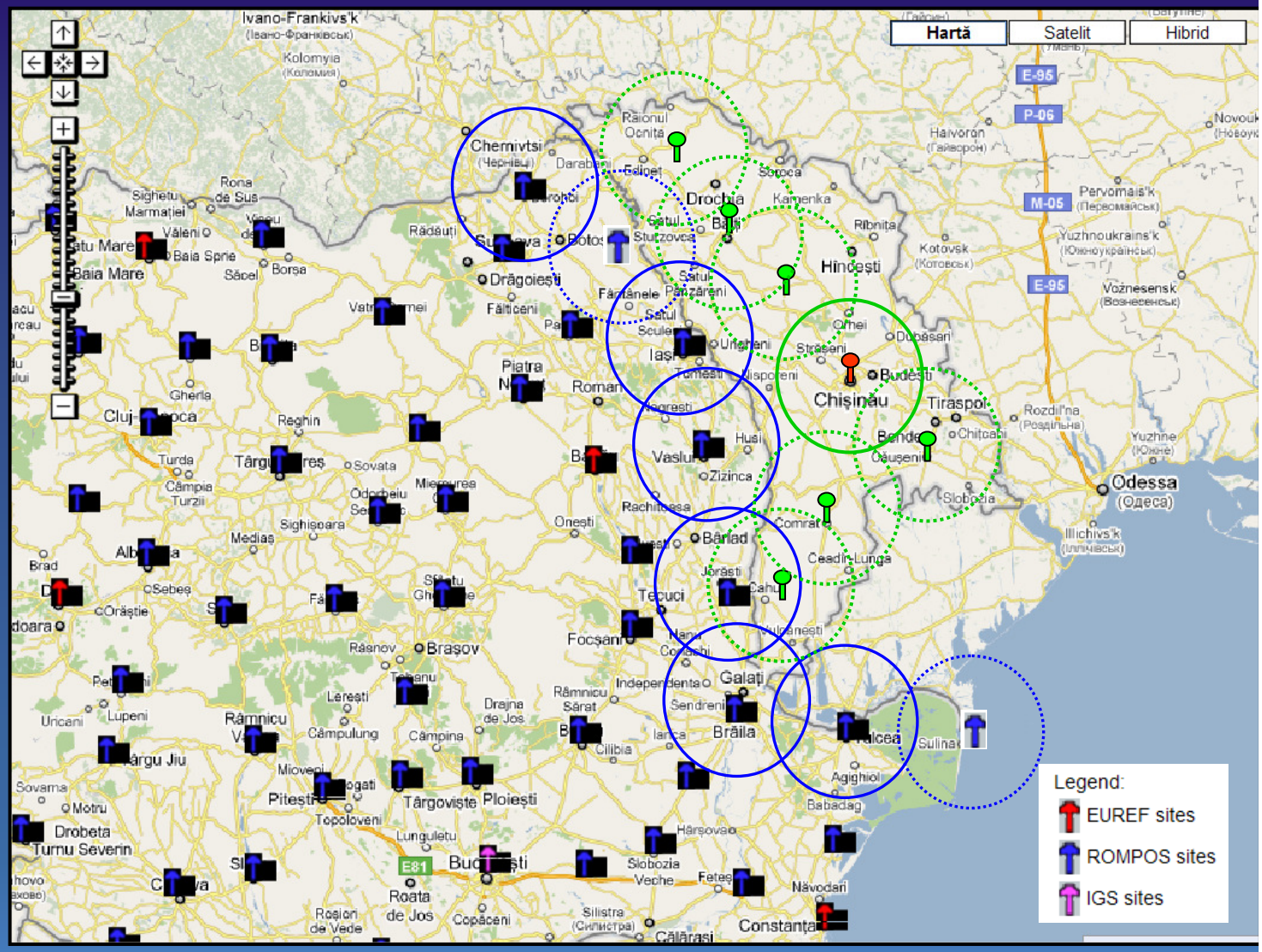
1. Dorohoi (DORO)
2. Flamanzi (FLAM)
3. Iasi (IASI)
4. Vaslui (VASL)
5. Targu Bujor (TBUJ)
6. Braila (BRAI)

MD:

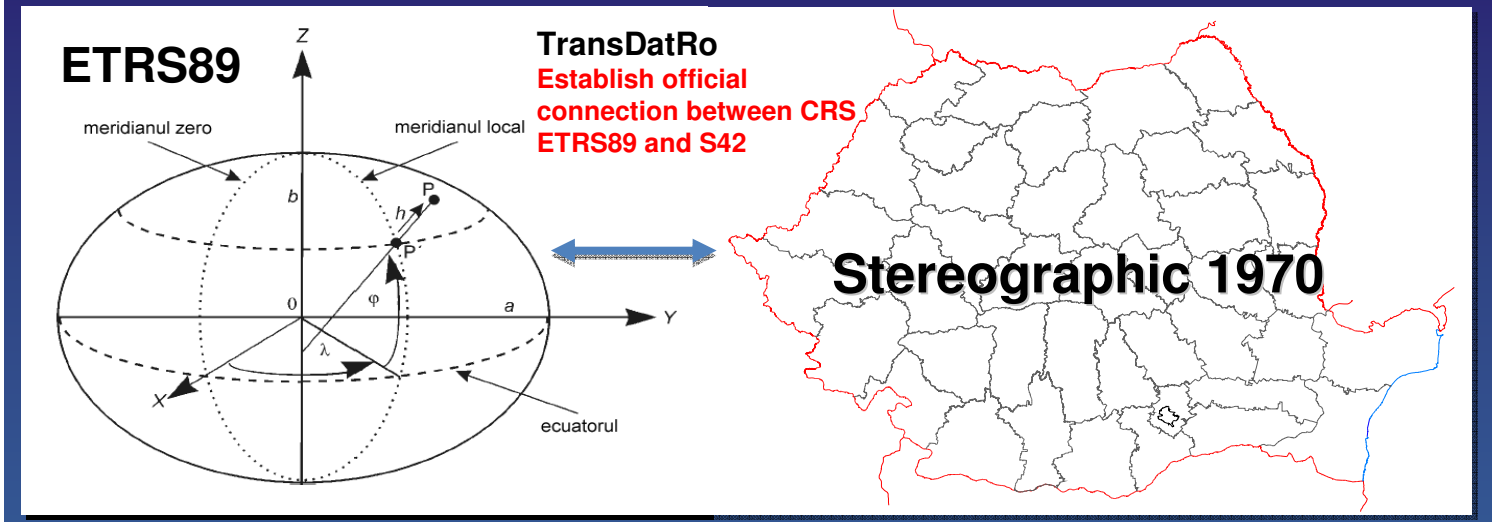
1. Cahul (CAHU)
2. Donduseni (DOND)
3. Balti (BALT)
4. Telenesti (TELE)
5. Causeni (CAUS)
6. Comrat (COMR)

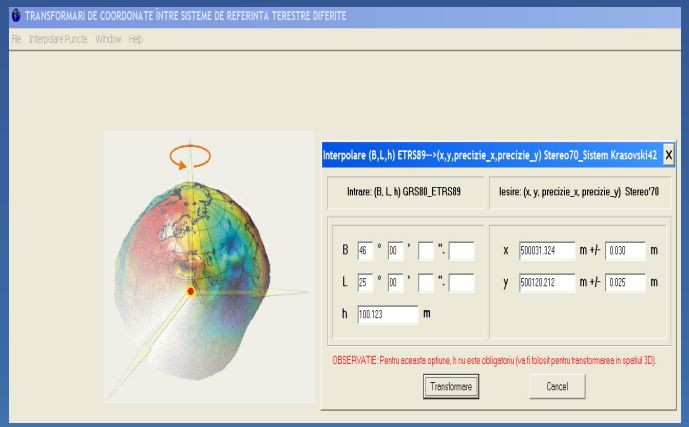
Agreement already signed !

ROMPOS
Romanian Position Determination System



TransDat software in Support of ROMPOS users





- May-July 2009 – dedicated GNSS observation campaign
- About 800 triangulation points observed
- Algorithm was implemented also in GNSS receiver's software by manufacturers

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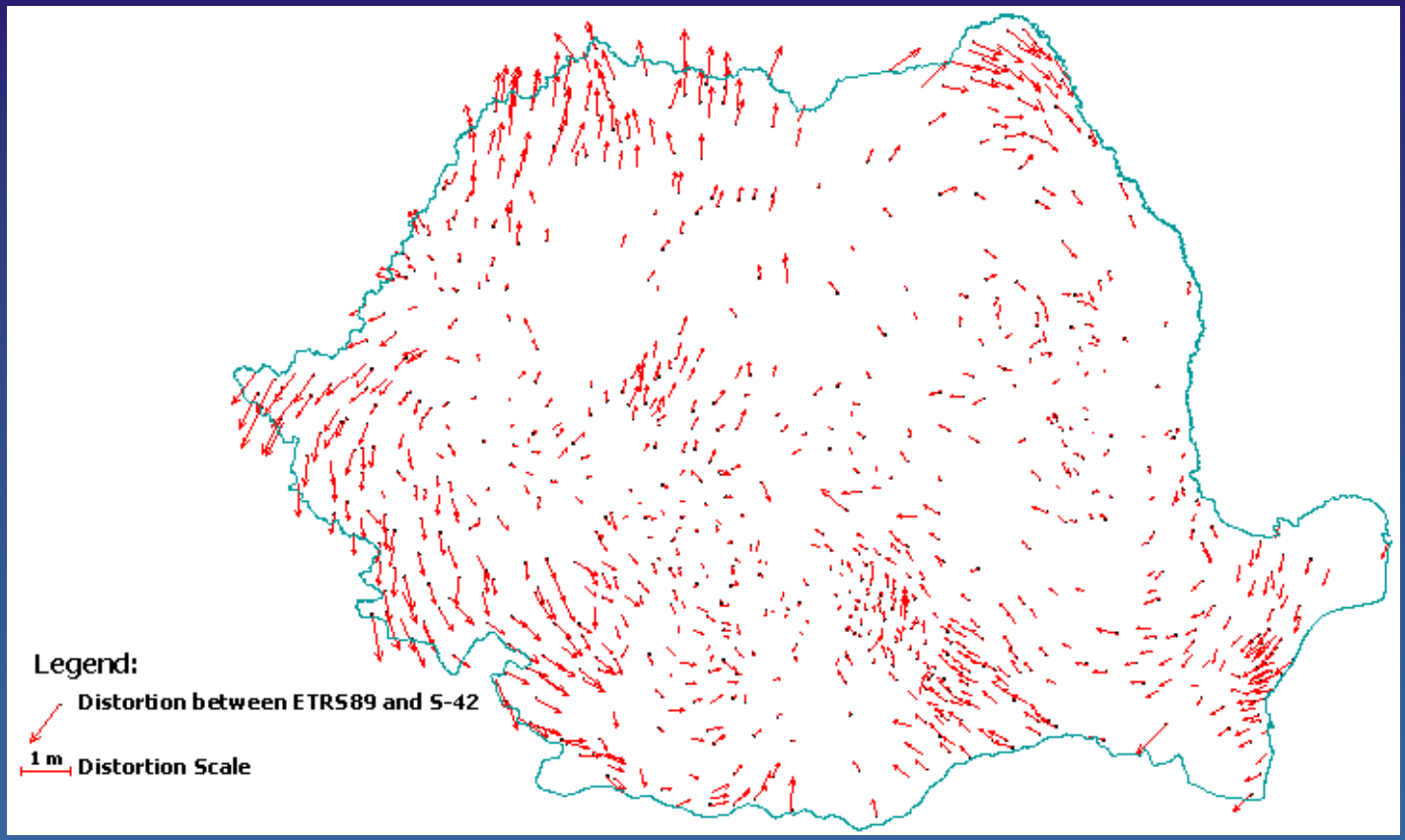
Distorsions situation between ETRS89 and S42 (summer of 2009)



(CSCS file – Country Specific Coordinate System)

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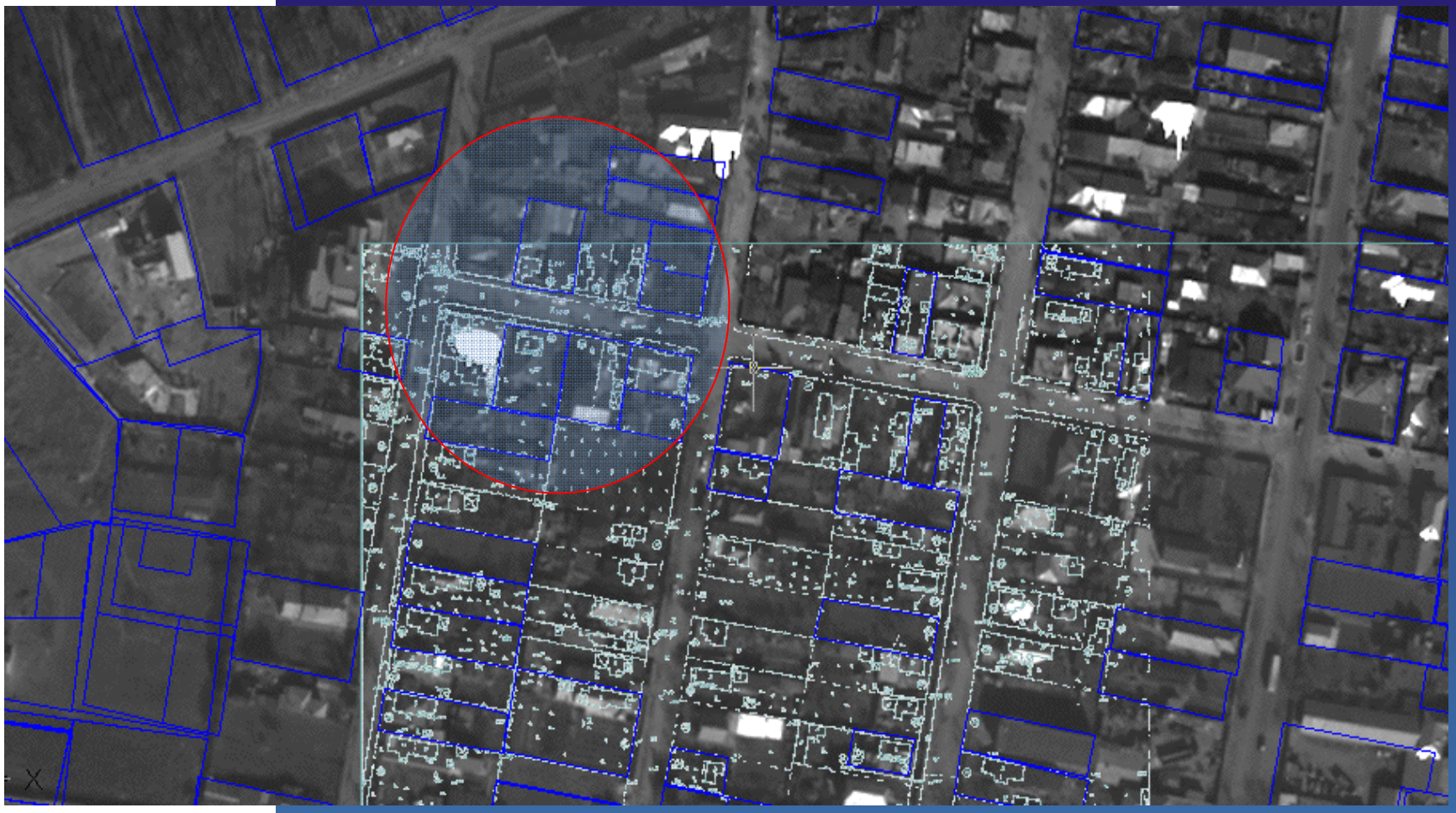
ROMPOS applications for Cadastre



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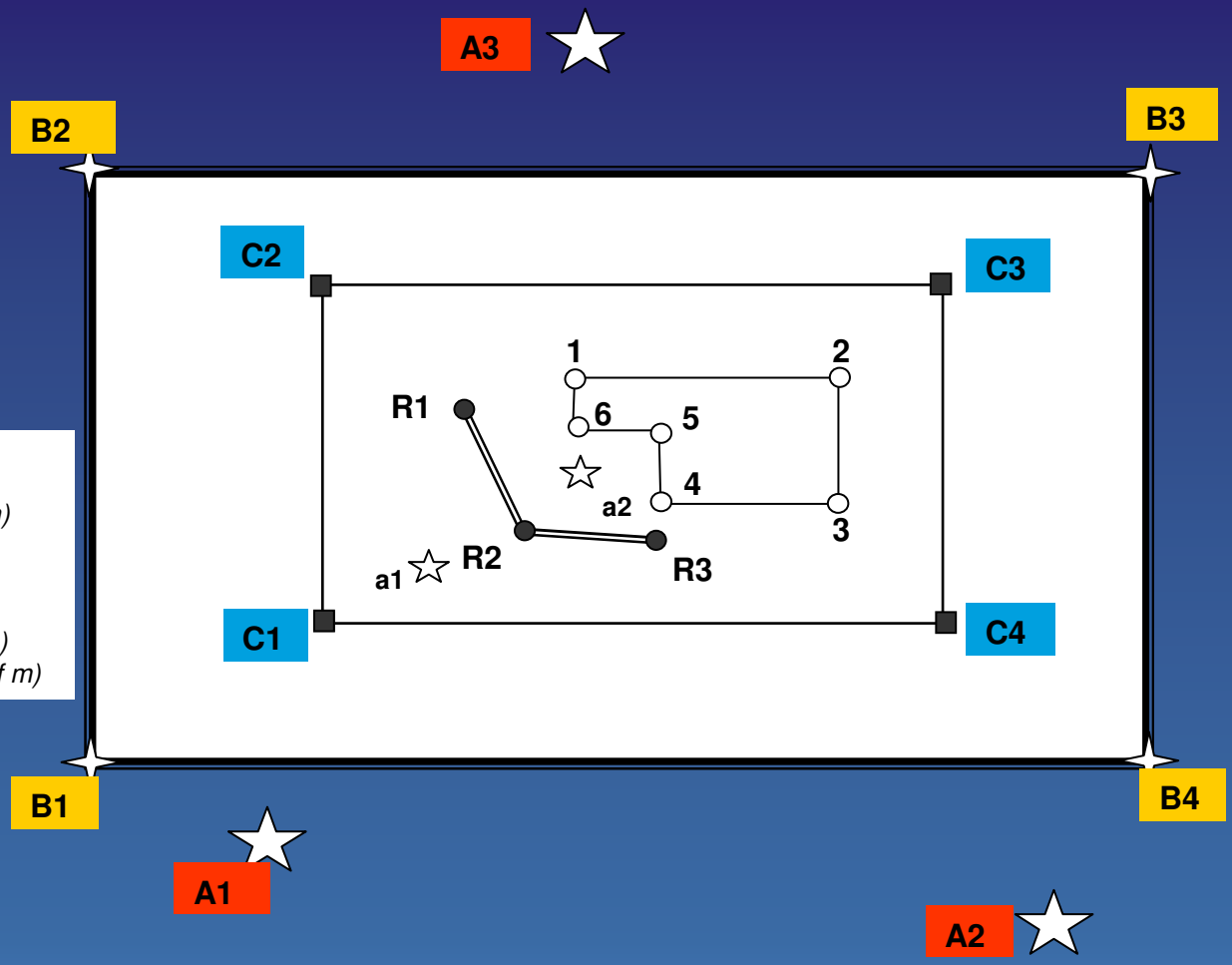
ROMPOS applications for Cadastre

New regulations adopted by NACLR for GNSS-RTK



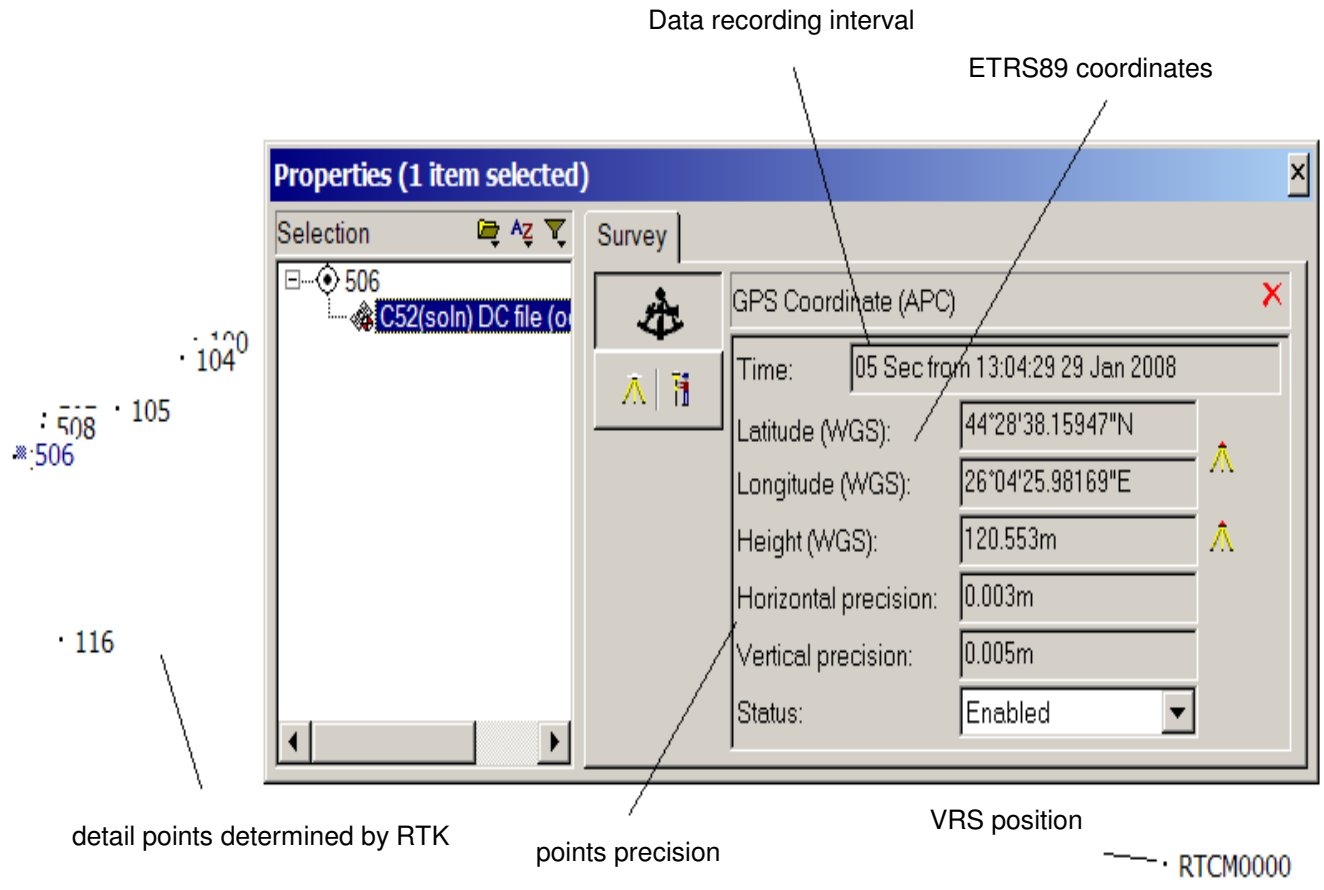
Legend

A *— Class A – real ref. stations (70-100 km)*
a *– virtual ref. stations (hundreds of m)*
B *– Class B (40 km)*
C *– Class C (10 km)*
R *– densification net (hundreds of m ... 1km)*
1,2,3,4,5,6 *– detail points (tens..hundreds of m)*

ROMPOS
Romanian Position Determination System

ROMPOS applications for Cadastre

Example ROMPOS-RTK positioning



ROMPOS applications for Cadastre

Example ROMPOS-RTK positioning

Job:ROMPOS Version:12.22 Units:Metres

RTCM1025 25 Oct 2008 Mode: RTK(VRS)

OCPIB

File with ellipsoidal coordinates in ETRS89, downloaded from GNSS controller

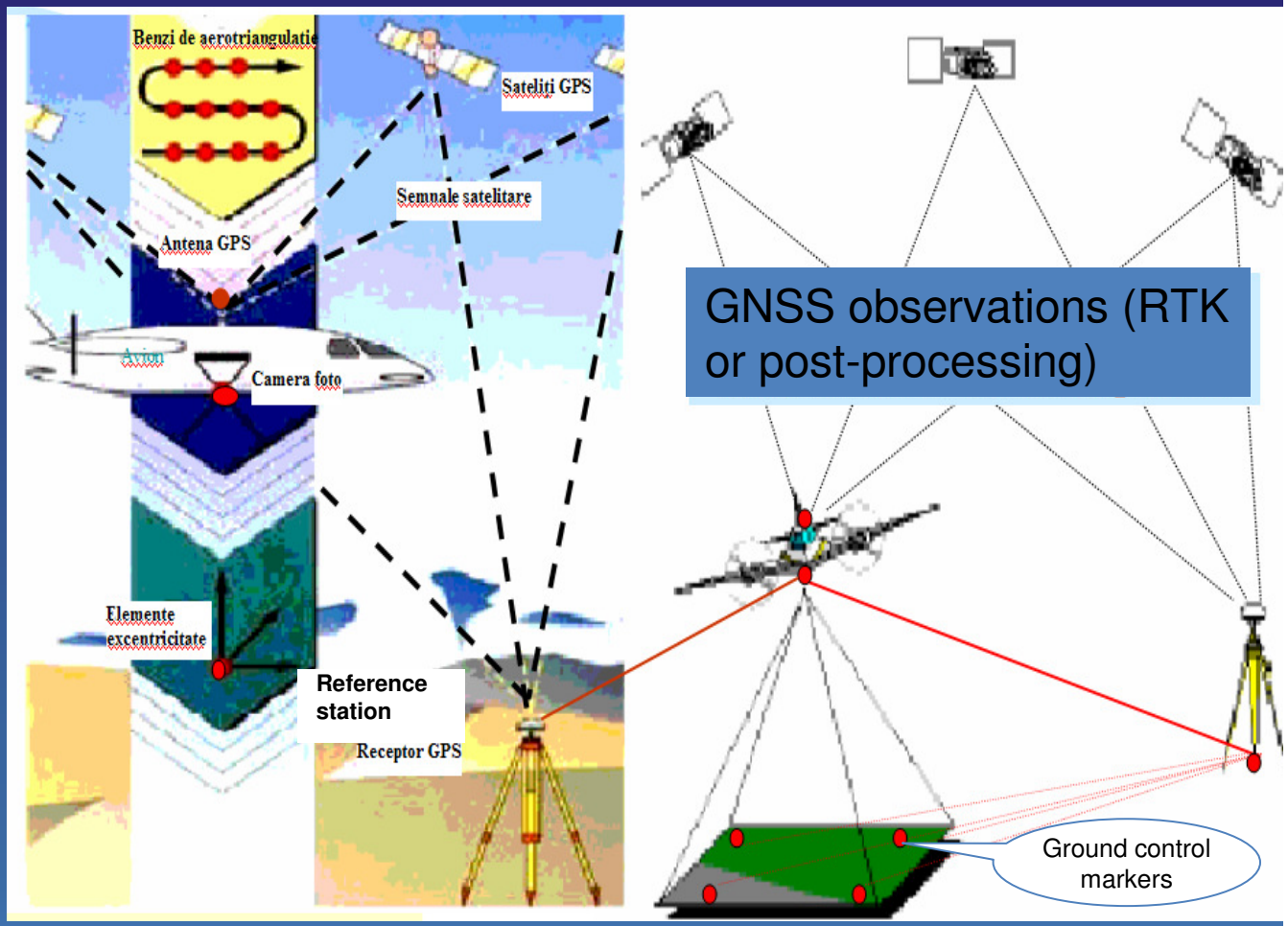
Name	Latitude	sigma	Longitude	sigma	Height	sigma	Code	Obs.
500a	44 28 22.20355	0.005	26 04 09.38213	0.006	85.931	0.015	point	*Init 1*
500b	44 28 22.20413	0.006	26 04 09.38303	0.007	85.934	0.017	point	*Init 2*
501a	44 28 22.46731	0.010	26 04 09.02061	0.009	85.902	0.010	point	*Init 1*
501b	44 28 22.46691	0.012	26 04 09.01970	0.010	85.904	0.011	point	*Init 2*
502a	44 28 22.59336	0.008	26 04 08.96355	0.011	85.693	0.006	point	*Init 1*
502b	44 28 22.59401	0.007	26 04 08.96370	0.009	85.666	0.004	point	*Init 2*

Init i – initialization no. i

File with projection coordinates in Stereo”70 CRS, after transformation with TransDatRo

Name	X	Y	Code
500a	330903.692	585190.863	point
500b	330903.710	585190.883	point
501a	330911.726	585182.766	point
501b	330911.714	585182.746	point
502a	330915.600	585181.454	point
502b	330915.620	585181.457	point

ROMPOS applications for aerotriangulation (photogrammetry)

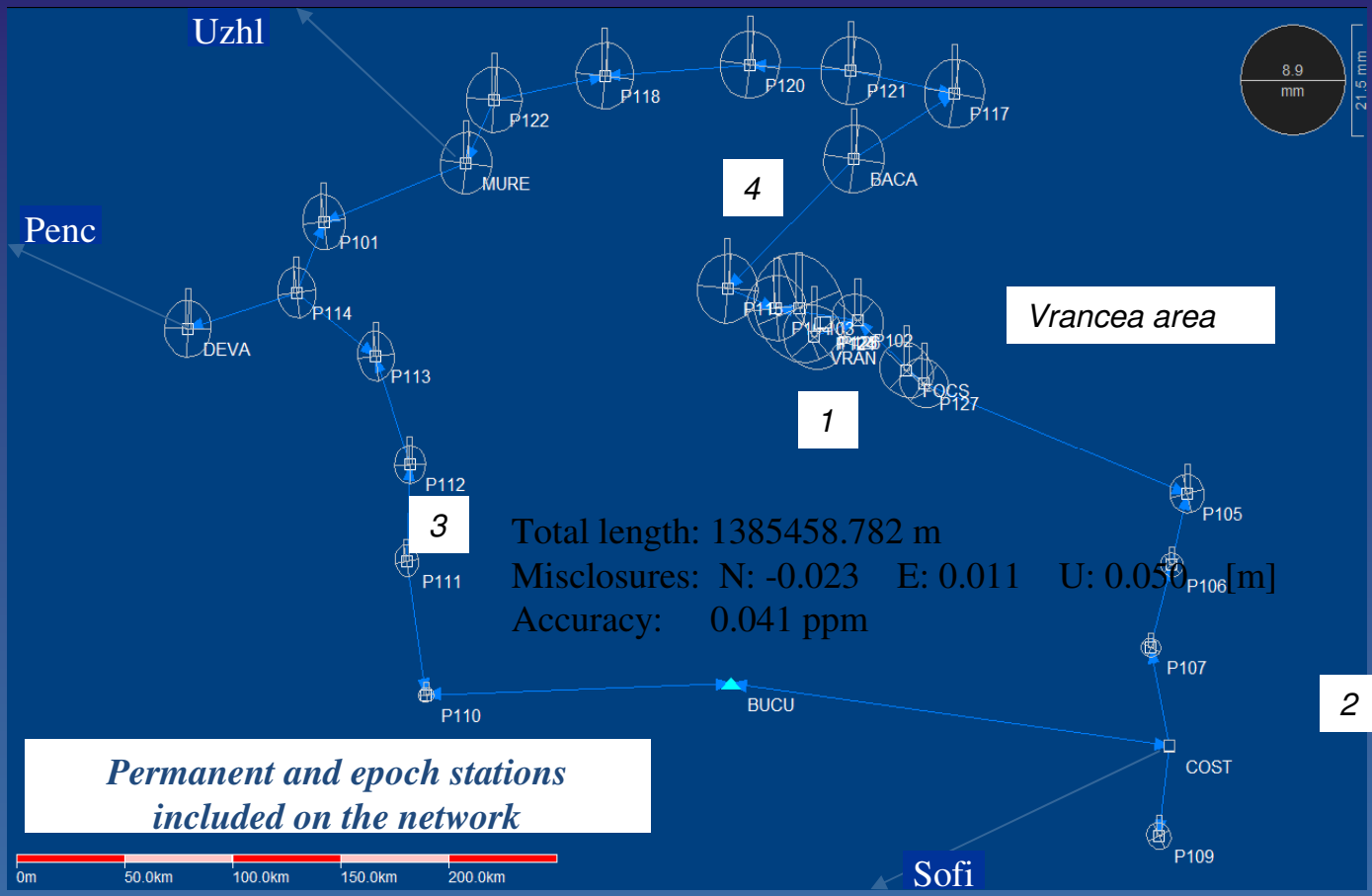


ROMPOS applications for geodynamic

Crustal movements in Romania including earthquake area (Vrancea).

Example:

GNSS network in Vrancea area and geodynamic traverses across the country; repeated (epoch stations) or continouos observations (permanent stations)



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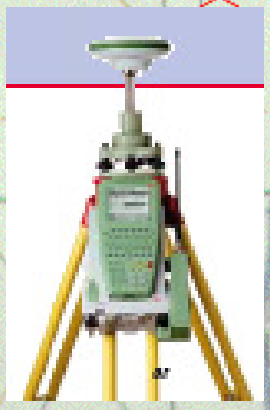
ROMPOS for disaster management (2006 Danube floods)

Based on ROMPOS-RTK service, flooded areas can be monitored in near real time on 2D or 3D positions;

Disaster management control centre can take decisions on real (not modeled) and accurate data.

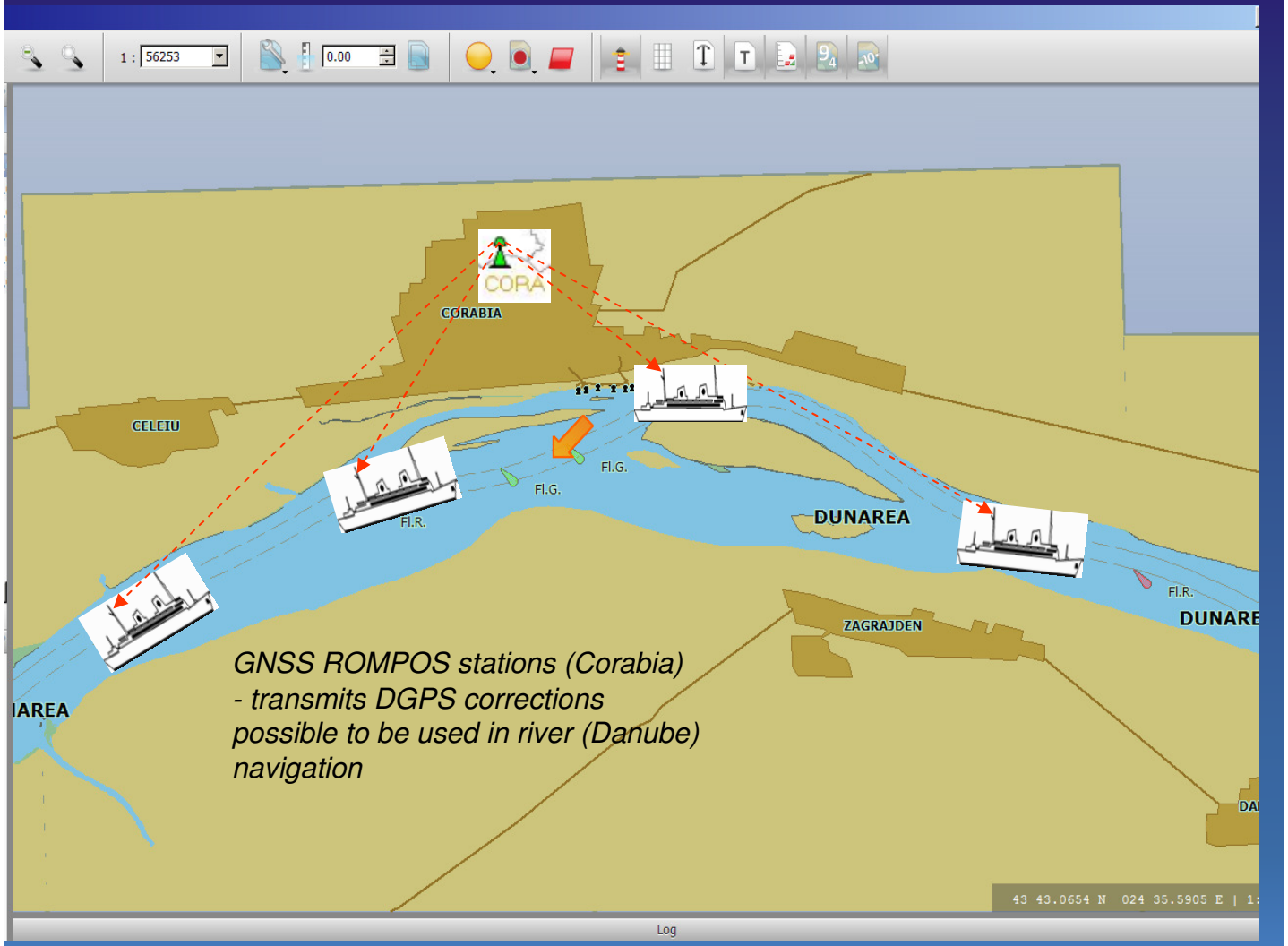


ROMPOS application for river or Black Sea coast navigation

Application:

Based on ROMPOS-DGNSS, river (sea coast) navigators can determine their position with dm accuracy

Equipment: *DGNSS or DGPS receiver connected to ROMPOS by internet (not radio);*



GNSS ROMPOS stations (Corabia) - transmits DGPS corrections possible to be used in river (Danube) navigation

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CONCLUSIONS

- ✓ National Agency for Cadastre and Land Registration (NACLR) realized ROMPOS according to EUPOS standards.
- ✓ NACLR has built up to the present a total number of 58 stations.
- ✓ There are included 6 GPS and 52 GNSS (GPS+GLONASS) stations. Six of the GPS stations were upgraded December 2010 to GNSS (Leica AR25 antennas);
- ✓ A number of 37 antennas of the stations are individual absolute calibrated.
- ✓ Until end of 2010 there are planned to be installed the last 15 stations up to 73 stations (without stations from neighbour countries).
- ✓ The networking software for ROMPOS was achieved (2009);
- ✓ GNSS data exchange with Republic of Moldova signed in 2010.
- ✓ GNSS data exchange with Hungary will be signed tomorrow !
- ✓ Practical data exchange with Bulgaria started;
- ✓ New proposal for data exchange with Ukraine;
- ✓ New regulations concerning the use of RTK method for cadastre are available for the ROMPOS users;
- ✓ There are about 450 registered users of the ROMPOS – RTK services; ROMPOS-RTK services are free of charge;
- ✓ There are much more ROMPOS applications to be investigated !

ROMPOS
Romanian Position Determination System

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întocmire a documentațiilor cadastrale în vederea înscrierii în cartea funciara;
• Decizia nr.1/2008 a Directorului Direcției de Geodezie şi Cartografie din cadrul ANCPI privind realizarea măsurătorilor GNSS cinematice;
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• European Position Determination System, Technical Standards, Revised 2nd Edition, 24 April 2008, Resolution of the International EUPOS® Steering Committee, 13th Conference, Bucharest, Romania, 23 – 24 April 2008
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www.rompos.ro
www.ancpi.ro
www.eupos.org

Thank you !

Cross border data exchange