

Summary of the determination and analysis of the ETRS89 coordinates for the GNSS Reference Station Network (Version: 2010)

Document References and approaches:

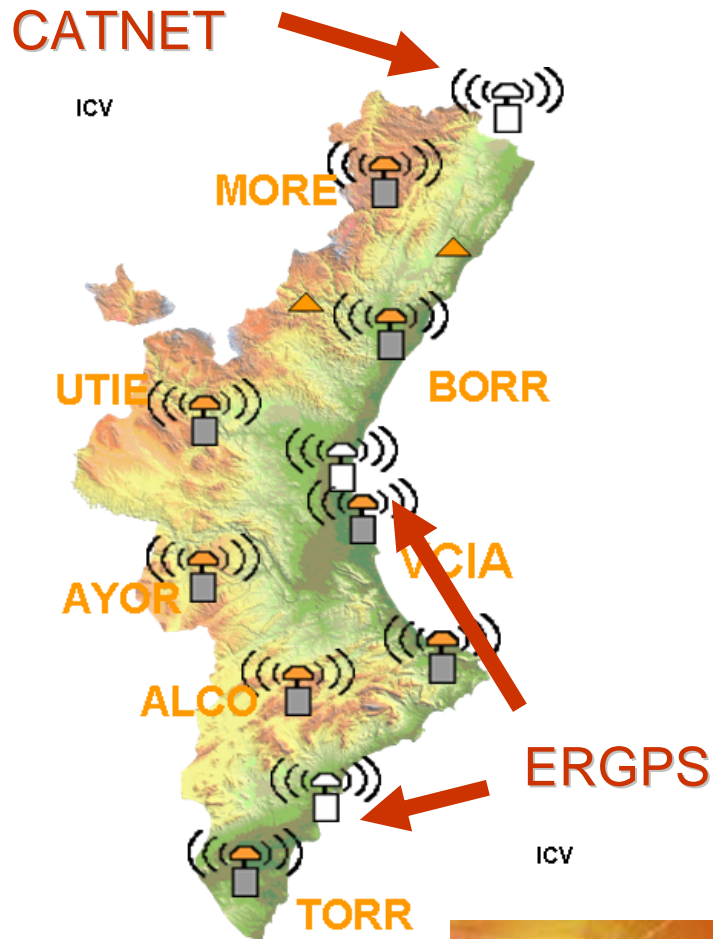
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- <http://www.epncb.oma.be/> . Guidelines for EUREF Densifications. 2009.
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Determination and analysis of the ETRS89 coordinates for the GNSS Reference Station Network

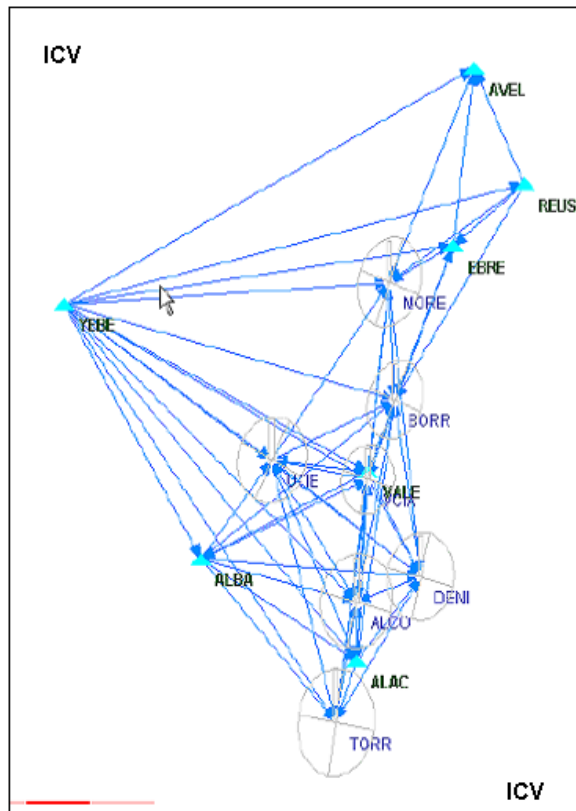
- Summary of the computations made to get ETRS89 coordinates (ICV, UPV).
- Comparison and analysis.
- Approach to transform into ETRS89-**ERGNSS**
IGNE reference frame solution.

ERVA Network



- Active network of the Valencian Community
- Developed by Valencian Cartographic Institute (www.icv.gva.es)
- Interoperability with other active networks: **ERGPS-IGNE**, **CATNET-ICC**, and CARM GNSS Network.
- Provides real time positioning by means of Network RTK solutions

1. ETRS89 coordinates of the ERVA Network

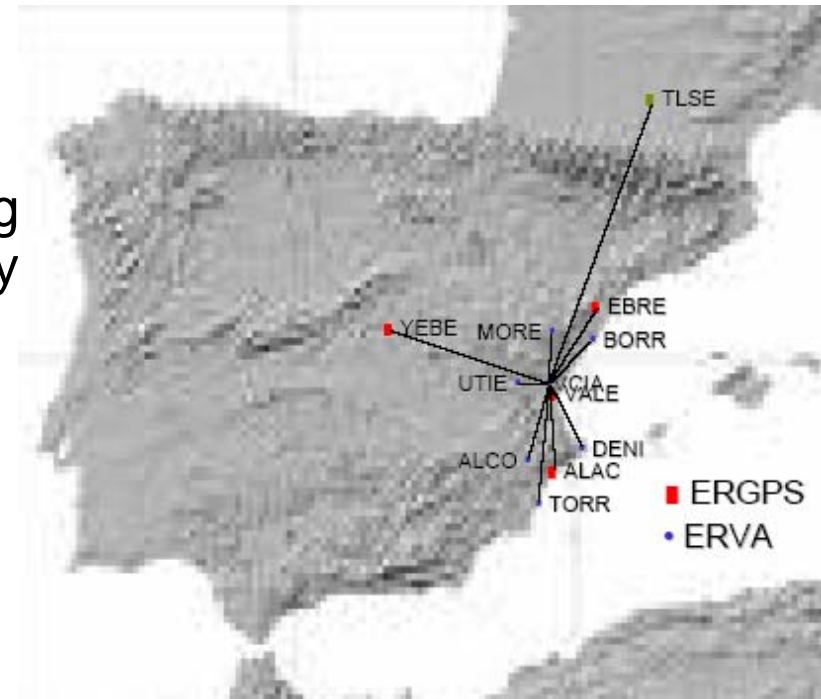


- In order to get ETRS89 coordinates solution, some GPS campaigns and GPS permanent stations data were processed by the ICV with **Gamit** and commercial software.
- Daily data files 30 sec for epoch 2006.72
- ETRS89 coordinates provided by IGNE for near **ERGPS** stations and some Catalonian **CATNET** stations were held fixed, and IGS Core Stations.
- Average precision 1 cm.

2. Processing strategy with Bernese V4.2

- New processing was done in co-operation with the Department of Cartographic Engineering, Geodesy and Photogrammetry of the Technical University of Valencia (Garcia Asenjo et al 2007).
- **Bernese V4.2** GPS Software on Windows 98SE PC platform
- Observations from three consecutive days with a data interval of 30 seconds.

- CODE precise orbits, EOPs and TRP files.
- JPL Planetary Ephemeris DE200.
- Use of FES2004 ocean loading displacement model data computed by Onsala Space Observatory.
- Application of the NGS APCV.
- QIF ambiguity resolution strategy.
- Free session solutions for every day.



Garcia-Asenjo et al 2007.

- The normal equations were combined using ADDNEQ program to compute final **IERS-ITRF05** solution (15th of February 2007-12:00 - **2007.123**).

Transformation into ETRS89

- The transformation from ITRF05 (2007.123) coordinates into ETRS89 was done following version 6 of Specifications for reference frame fixing in the analysis of a EUREF GPS Campaign.
- The first step is to transform into ETRS89 at epoch $t_c = 2007.123$
- The second step is to express coordinates in ETRS89 at $t = 1989.0$

ETRS89-ERVA07 coordinates expressed in the IGNE-ERGPS frame

- Considering the importance of ERVA07- ETRS89 coordinates being consistent with ETRS89-ERGPS coordinates, different transformations were tested and analyzed.
- Eventually, we found best to transform original ERVA07- ITRF05 (2007.123) into ETRS89-ERGPS by using the following three shifts in order to preserve the relative accuracy of the ERVA07-ITRF05 solution (Garcia-Asenjo et al 2007).

	Geocentric system translations		Local translations in YEBE
Tx	0.215 m. \pm 0.005 m.	Te	-0.304 m. \pm 0.005 m.
Ty	-0.316 m. \pm 0.005 m.	Tn	-0.360 m. \pm 0.005 m.
Tz	-0.276 m. \pm 0.005 m.	Tu	-0.003 m. \pm 0.005 m.

ETRS89-ERVA07 coordinates expressed in the IGNE-ERGPS07 frame

-ERVA07-ETRS89 coordinates obtained from ITRF05 (2007.123) using three shifts.

Site	Coordinates			Residuals		
	X(m)	Y(m)	Z(m)	N (mm)	E (mm)	U (mm)
YEBE	4848724.9083	-261632.4848	4123093.9076	-2.6	-8.4	1.3
TLSE	4627852.0246	119639.7415	4372993.2995	-	-	-
EBRE	4833520.3513	41536.8294	4147461.2963	-7.6	9.8	-14.4
VALE	4929534.0262	-29050.6809	4033709.9109	8.8	-3.9	-4.8
ALAC	5009051.3842	-42072.4750	3935057.4925	2.4	2.7	5.9
ALCO	4984687.4541	-41199.1765	3966605.9809	-	-	-
MORE	4849098.7552	-8595.4191	4130985.8136	-	-	-
DENI	4974895.8810	9000.7621	3978089.6893	-	-	-
BORR	4899519.2807	-7115.8225	4069961.4022	-	-	-
VCIA	4932702.9292	-29607.7882	4029833.0293	-	-	-
UTIE	4922873.2203	-103857.7337	4041693.7080	-	-	-
TORR	5033805.3609	-59823.0850	3903319.5082	-	-	-

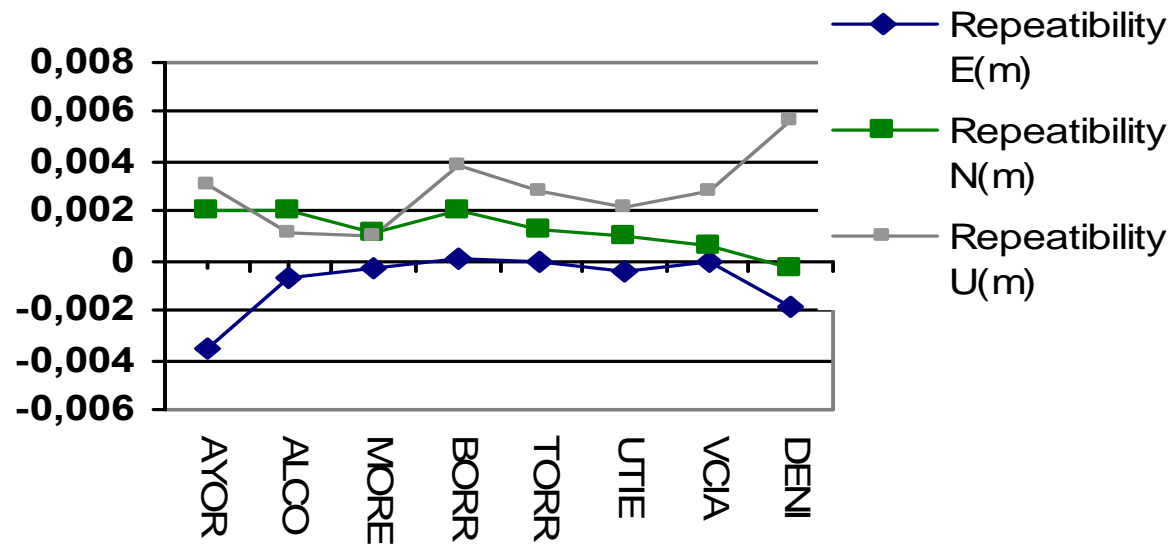
**ERVA07-ETRS89 (UPV) coordinates minus ERVA06-ETRS89 coordinates.
(Garcia-Asenjo et al 2007).**

Site	North (m)	East (m)	Up (m)
ALCO	-0.0055	0.0038	-0.0136
MORE	-0.0012	0.0030	-0.0288
DENI	0.0091	0.0122	0.0124
BORR	-0.0056	0.0073	-0.0178
VCIA	-0.0074	0.0167	-0.0183
UTIE	-0.0160	0.0026	-0.0126
TORR	-0.0010	0.0070	0.0092
Mean value	-0.004 ± 0.008	0.008 ± 0.005	-0.010 ± 0.015

Differences are mainly due to previous relative antenna phase center models used .

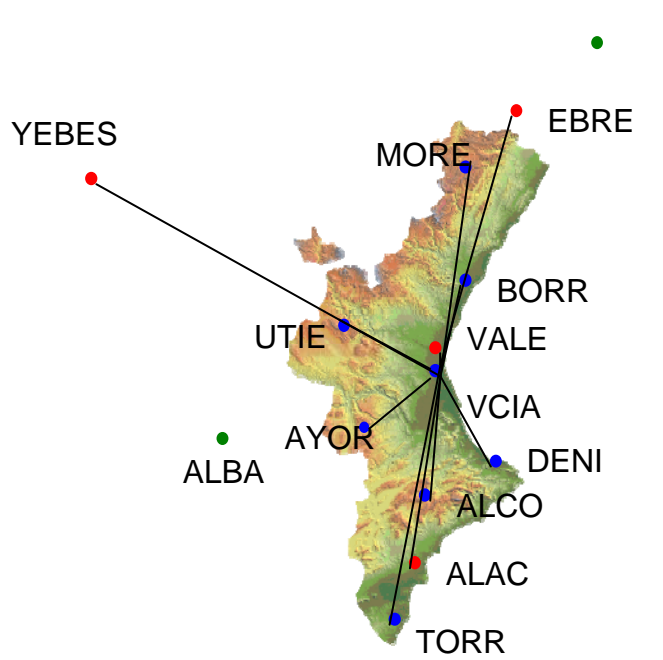
3. After IGN and EUREF processing changes (week 1400, ITRF2005 /IGS05, Absolute phase center antenna values), and changes of ERGNSS-IGN frame (<ftp://ftp.geodesia.ign.es>), new processing was done (ICV-Gamit) following the new processing strategy in order to assure consistency in ETRS89-ERVA08 coordinates expressed in the new 2008 IGNE-ERGNSS frame

3. ERVA08 ETRS89 /ETRF05 –ICV Network processing and adjustment (Epoch 2008.60)



Repeatability in ERVA08 ETRS89/ETRF05

Good Consistency between ERVA08 ETRS89/ETRF05 (ICV) frame and IGNE-ERVA ETRS89/ETRF05 (2007.81) frame.



North (m)	East (m)	Up (m)
-0,00660	0,00223	0,00580
-0,01120	-0,00135	-0,00119
0,00718	0,00736	0,00220
0,00352	0,00435	0,00557
-0,00111	-0,00118	0,00607
-0,00192	-0,00555	0,01502
0,01262	-0,00061	0,01419
-0,00630	0,00583	0,00461

**MEAN VALUE
and σ**

-0,0005 ± 0,0078 0,0013 ± 0,0043 0,0065 ± 0,0055

**ERVA08 ETRS89/ETRF05 (ICV) minus
IGNE-ERVA ETRS89/ETRF05 (2007.81) coordinates**