



The Role of EUREF within the European Geodetic Infrastructure

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**FIG Working Week, Marrakech, May 19,
2011**



CONTENT

- EUREF sub-commission
- European Terrestrial Reference System - ETRS89
- European Vertical Reference System - EVRS
- European Geodetic Infrastructure
- Summary



EUREF GOALS

Define, realise, maintain, provide access and promote the adoption of

- ETRS89
European Terrestrial Reference System
- EVRS
European Vertical Reference System



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MOTIVATION FOR CREATION OF ETRS89

ITRS coordinates : $\sim 2,5$ cm/y in Europe
→ unusable for day-to-day geo-referencing activities

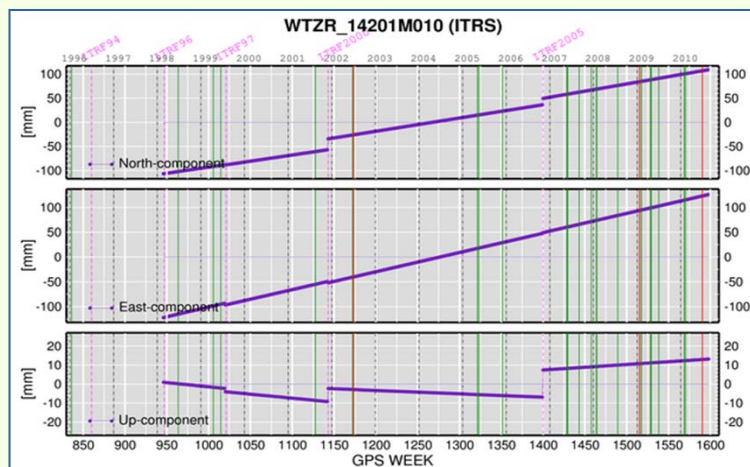
European Terrestrial Reference System 1989 (ETRS89)

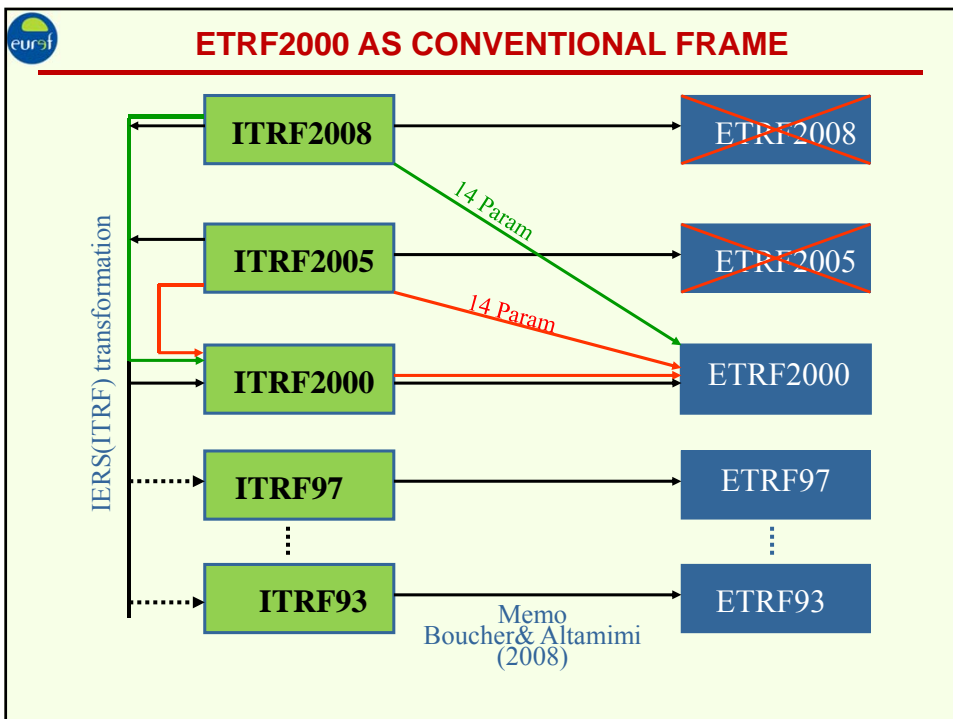
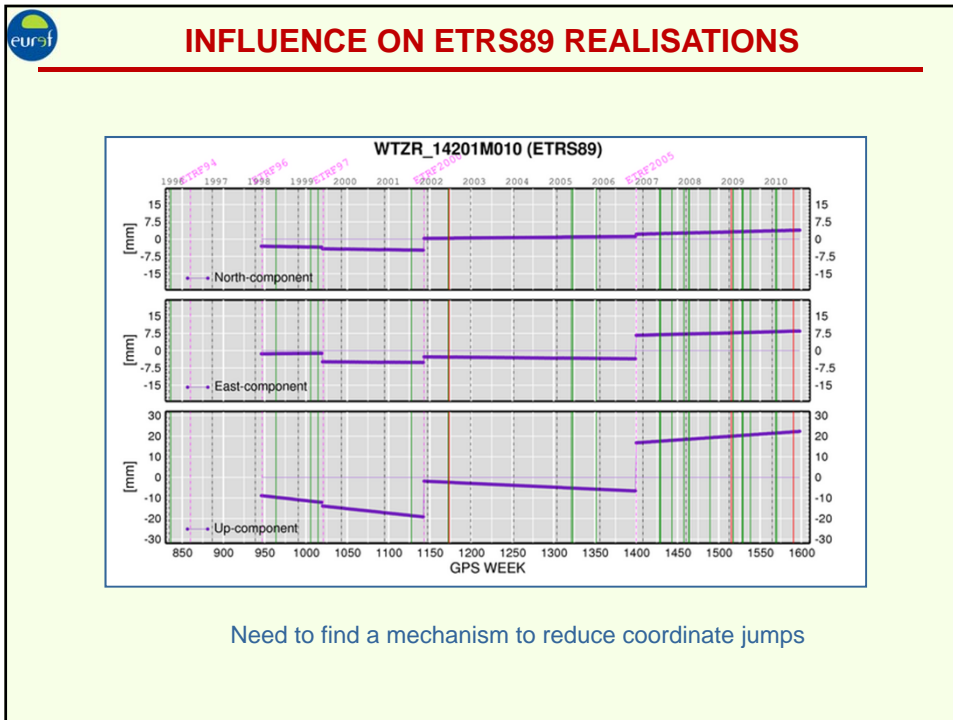
- coincident with ITRS at the epoch 1989.0
- fixed to the stable part of the Eurasian Plate
→ Coordinates expressed in ETRS89 have minimal time-dependency and are consequently useable for geo-referencing in Europe.

Transformations : $ITRF_{yy} \leftrightarrow ETRF_{yy}$ published in Memo (Boucher & Altamimi, 2008)



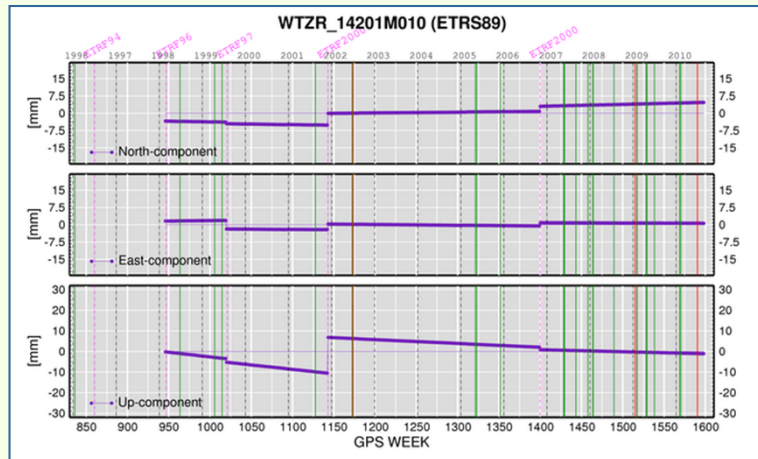
INFLUENCE OF SUCCESSIVE ITRS REALIZATIONS



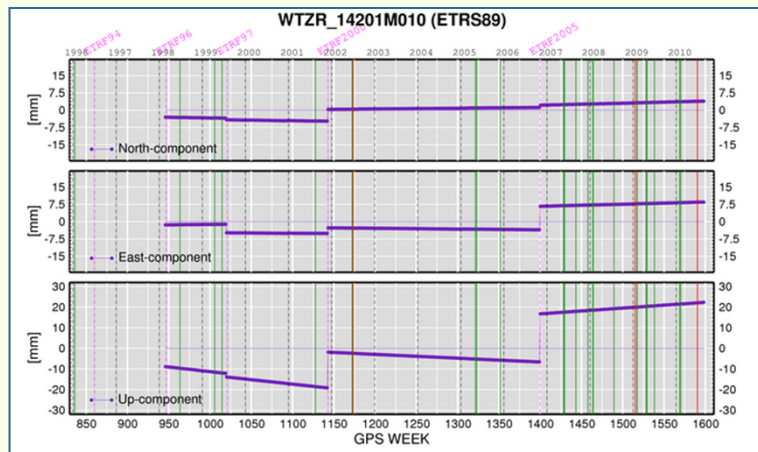




ETRF2000 AS CONVENTIONAL FRAME



BEFORE – WITH ETRF2005





ACCESS TO ETRS89

EUREF Permanent Network (EPN)

ITRFyy stations included in EPN



Classic method:

- 1) GNSS data + ITRS pos/vel.
- 2) Add densification sites
- 3) Perform network analysis
- 4) Express network in ITRFyy using selected set of ITRF reference stations
- 5) Convert ITRFyy to ETRF2000

Guidelines for EUREF Densifications (Bruyninx et al, 2010)



EPN CUMULATIVE SOLUTION

15-weekly updated EPN cumulative position/velocity solution

- Expressed in ITRF2005
- Using ITRF2005 discontinuities
 - + discontinuities for non-IGS stations
 - + discontinuities since last ITRFyy

Up to date ITRFyy positions/velocities with validity epochs

| ITRF2005 | epoch t_0 | Position (m) | | | Velocity (m/y) | | |
|---------------------|-------------|---------------------|---------------------|---------------------|------------------|-----------------|-----------------|
| | | x | y | z | V_x | V_y | V_z |
| 309/2006 - 149/2010 | 001/2005 | 4917536.945 ± 0.001 | -815726.211 ± 0.000 | 3965857.382 ± 0.000 | -0.0078 ± 0.0001 | 0.0195 ± 0.0000 | 0.0130 ± 0.0001 |
| 269/1999 - 308/2006 | 001/2005 | 4917536.950 ± 0.000 | -815726.209 ± 0.000 | 3965857.384 ± 0.000 | -0.0078 ± 0.0001 | 0.0195 ± 0.0000 | 0.0130 ± 0.0001 |
| 305/1998 - 268/1999 | 001/2005 | 4917536.953 ± 0.001 | -815726.209 ± 0.000 | 3965857.391 ± 0.001 | -0.0078 ± 0.0001 | 0.0195 ± 0.0000 | 0.0130 ± 0.0001 |

(<http://epncb.oma.be>)

- Possibility to use ITRF as well as non-ITRF stations as fiducial stations
- Need for classification of EPN stations



EPN SITE CLASSIFICATION

Class A

- Position: 1 cm-accuracy coordinates for any epoch of the station's lifetime
- Velocity repeatability < 0.5 mm/year
Determined by comparing the estimated velocities between successive cumulative solutions

Class B (mostly young sites)

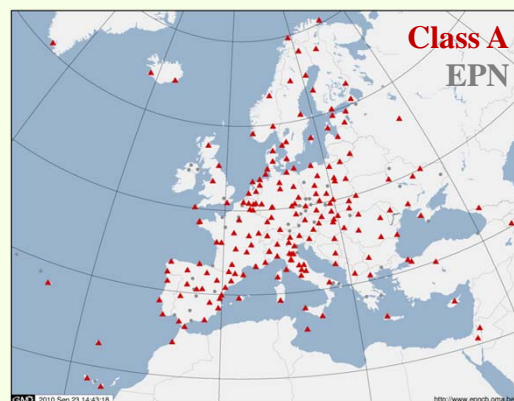
- Position: 1 cm-accuracy for epoch of minimum variance;
- Velocity repeatability > 0.5 mm/year - values not published.

(Kenyeres, 2010, BGG)



EPN CLASS A STATIONS


Class A sites: 199
EPN sites: 244



EUREF symposium, Florence, 2009

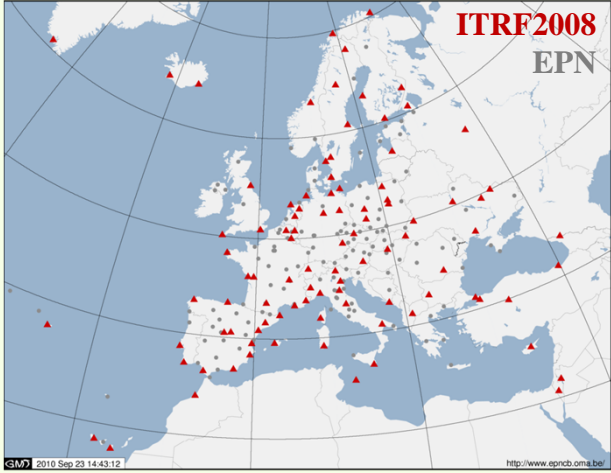
EUREF guidelines for Densifications of the ETRS89:

Fiducials: Class A stations and pos/vel. from cumulative EPN solution tied to ITRFyy


 **ITRF2008**

ITRF2008 stations:
129

EPN reprocessing in progress
EPN LAC Workshop:
18-19 Nov., Warsaw



GM 2010 Sep 23 14:43:12 <http://www.epncb.oma.be/>

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- EUREF Permanent Network - EPN
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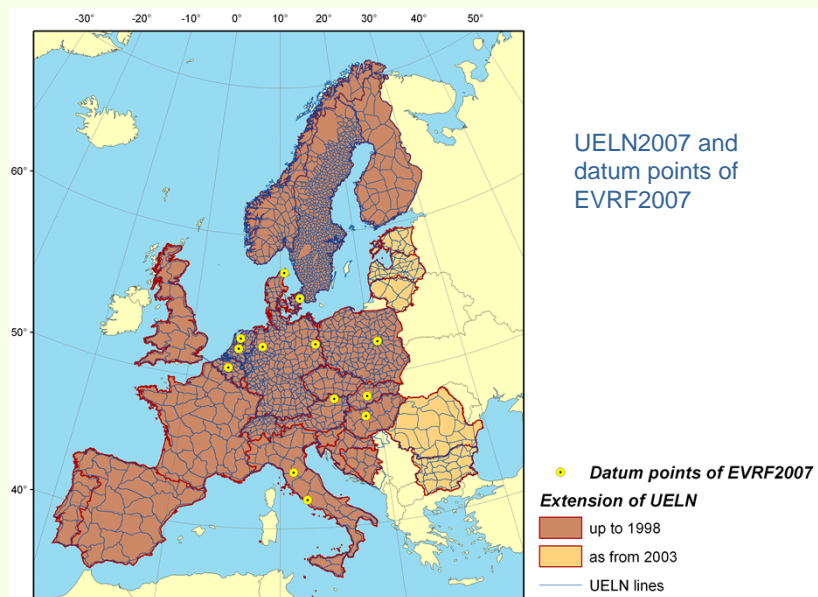


EUROPEAN VERTICAL REFERENCE SYSTEM

- Related European Vertical Datum (Normaal Amsterdams Peil)
- Gravity potential differences with respect to NAP or equivalent normal heights
- Realized by the Unified European Levelling Network (UELN)

connecting the first order levelling networks of European countries in a common network

LATEST EVRS REALIZATION: EVRF2007



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EVRF2007 – ADJUSTMENT PARAMETERS

- Datum realization by 13 datum points
- Reduction to the zero tidal system
- Reduction of the measurements to the epoch 2000 using the whole NKG2005LU model
- Number of adjusted levelling points 7900
- A-posteriori standard deviation referred to 1 km levelling distance 1.1 mm

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ADOPTION OF ETRS89/EVRS

- Large part of European NMCA have officially adopted ETRS89 and it is part of legal framework in many European countries (evolving process)
- EuroControl : ETRS89 is part of technical specifications
(European Organisation for Safety of Air Navigation)
- European Commission: recommendation to adopt ETRS89 as geodetic datum for geo-referenced information
- ETRS89/EVRS play a fundamental role in INSPIRE (Infrastructure for Spatial Information) with EU



INSPIRE Specification on Coordinate Reference Systems

Requirement 1 For the three-dimensional and two-dimensional (horizontal component) coordinate reference systems, the European Terrestrial Reference System 1989 (ETRS89) shall be used for the areas within the geographical scope of ETRS89.

| | | | |
|---------|---|------------|--------|
| INSPIRE | Reference: INSPIRE_Specification_CRS_v3.1.pdf | | |
| TWG-RS | INSPIRE Specification on Coordinate reference systems | 2010-04-26 | Page 7 |

Requirement 2 The International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS shall be used in areas that are outside the geographical scope of ETRS89.

Requirement 3 For the computation of latitude, longitude and ellipsoidal height, and for the computation of plane coordinates using a suitable mapping projection, the parameters of the GRS80 ellipsoid shall be used.



INSPIRE Specification on Coordinate Reference Systems

5.3 One-dimensional coordinate reference systems

The European Vertical Reference System (EVRS) [EUREF] is the vertical reference system recommended for Europe on land to express gravity-related heights. The most recent realisation of the EVRS is labelled European Vertical Reference Frame 2007 (EVRF2007). The definition of EVRS is described in the EVRS Conventions 2007.

The vertical reference systems for land existing in the MS can be expressed in the EVRS in their continental territories through their own realisations that are linked to the EVRF2007 solution. Future solutions of the EVRF will constitute an improvement and are considered realisations of the EVRS. The European continental territories of the MS constitute the geographical scope of the EVRS.

Since not all the vertical datums in use can be connected to the European vertical datum, it is necessary that the rules concerning the vertical datum also take into account areas that are not in the European continental territories. In this case, a locally or globally defined vertical reference system related to the Earth gravity field will be used to express gravity-related heights.

Requirement 8 For the vertical component on land, the European Vertical Reference System (EVRS) shall be used to express gravity-related heights for the areas within the geographical scope of EVRS.

Requirement 9 Other vertical reference systems related to the Earth gravity field shall be used to express gravity-related heights in areas that are outside the geographical scope of EVRS.



ETRS89 – NATIONAL CRS

Each country has each own National Coordinate Reference System (CRS)

- Link between CRS and ETRS89 necessary in order to change national reference system to ETRS89
- Information System (EUREF and EuroGeographics)
 - Description of all national CRS
 - Transformation parameters between CRS and ETRS89
 - provided and validated by NMCAs
 - On-line transformation services
 - 1-2 m accuracy (GIS applications)

 **ETRS89 – NATIONAL CRS** <http://www.crs-geo.eu/>

CRSEU Coordinate Reference Systems in Europe 

national CRS

- News
- CRS Overview
- CRS Description
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 - pan-European CRS
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Service

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Home > CRS Description > national CRS

Description of national Coordinate Reference Systems (CRS) of European Countries


Contains

- descriptions of Coordinate Reference Systems
- transformation parameters to pan-European CRS ETRS89, EVRF2000 and EVRF2007
- verification data for transformation
- online-transformation of single points for position from national CRS of a country to pan-European CRS ETRS89 for test and verification purposes

To get the information select a country in the list or click on the corresponding red dot in the map

| | | |
|------------------|--|------------------|
| Albania |  | Latvia |
| Austria | | Lithuania |
| Belgium | | Luxembourg |
| Bosnia / Herceg. | | Macedonia |
| Bulgaria | | Malta |
| Croatia | | Netherlands |
| Cyprus | | Northern Ireland |
| Czech Republic | | Norway |
| Denmark | | Poland |
| Estonia | | Portugal |
| Finland | | Romania |
| France | | Russia |
| Germany | | Slovak Republic |
| Gibraltar | | Slovenia |
| Great Britain | | Spain |
| Greece | | Sweden |
| Hungary | | Switzerland |
| Iceland | | Turkey |
| Ireland | | Ukraine |
| Italy | | |

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 **ETRS89 – ITRS** <http://epncb.oma.be/>

ORGANISATION TRACKING NETWORK **DATA & PRODUCTS** NEWS & MAILS FTP & WEB ACCESS

Creation, Management, Structure, Relation to IGS, Projects, Guidelines, FAQ Maps, Stations, Equipment & calibration, Station coordinates, Site log validation & submission **Data access, Analysis centres, Products, Time series, ETRS89/ITRS transformation, Formats** News, Mails, Calendar, Papers, Workshops, Web site history Anonymous FTP, Web site index, Related links

[DATA & PRODUCTS > ETRS89/ITRS TRANSFORMATION](#)

ETRS89/ITRS TRANSFORMATION

The following tool allows to transform coordinates (position and velocity) from any ETRFxx to any ITRFyy (or ITRFyy to ETRFxx). In case input and output coordinates are requested at different epochs, then site velocities are mandatory.

Input

Frame : ITRF2005
 Epoch : 2006 .00

Lines starting by # are treated as comments
 # Fields (in decimal format) should be separated by at least one space
 # Example with velocity - StationName(no space character) X[m] Y[m] Z[m] VX[m/yr] VY[m/yr] VZ[m/yr] :
 StationName 4027894.006 307045.600 4919474.910 0.01 0.2 0.03

Output

Frame : ETRF96
 Epoch : 1995 .45

StationName 4027894.0387 307043.4240 4919474.4772 0.0230 0.1825 0.0178

Options

show intermediate steps Change epoch format: Decimal Year.YYYY.DDD



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SUMMARY

- Implement the necessary projects for the long-term maintenance and improvements of the
 - European Terrestrial Reference System (ETRS89)
 - European Vertical Reference System (EVRS)
- Promote the adoption of the ETRS89 and EVRS in the European countries and European-wide organizations involved in geo-referencing activities



USEFUL LINKS

- EUREF <http://www.euref.eu/>
- EUREF Permanent Network <http://epncb.oma.be/>
- ETRS89 <http://etrs89.ensg.ign.fr/>
- EVRS <http://www.bkg.bund.de/geodIS/EVRS/>
- CRS (Information system for European Coordinate Reference Systems) <http://www.crs-geo.eu/>
- INSPIRE <http://inspire.jrc.ec.europa.eu/>