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 : ~2,5 cm/y in Europe
→ *unusable for day-to-day geo-referencing activities*

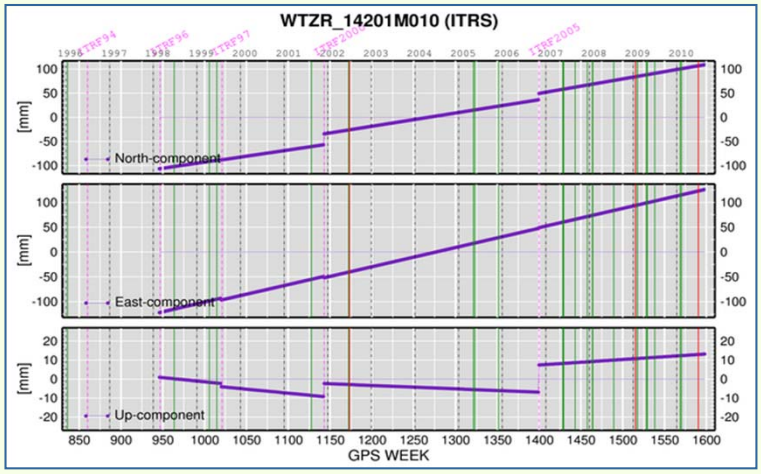
European Terrestrial Reference System 1989 (ETRS89)

- coincident with ITRS at the epoch 1989.0
- fixed to the stable part of the Eurasian Plate

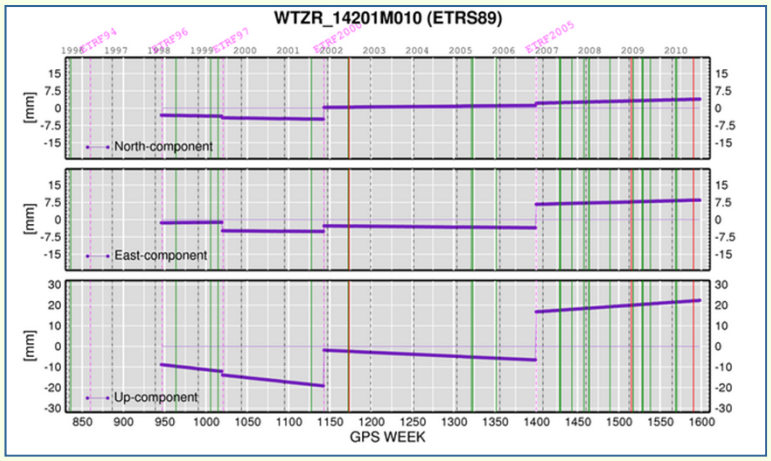
  → *Coordinates expressed in ETRS89 have minimal time-dependency and are consequently useable for geo-referencing in Europe.*

Transformations : ITRFyy ↔ ETRFyy published in Memo (Boucher & Altamimi, 2008)

INFLUENCE OF SUCCESSIVE ITRS REALIZATIONS

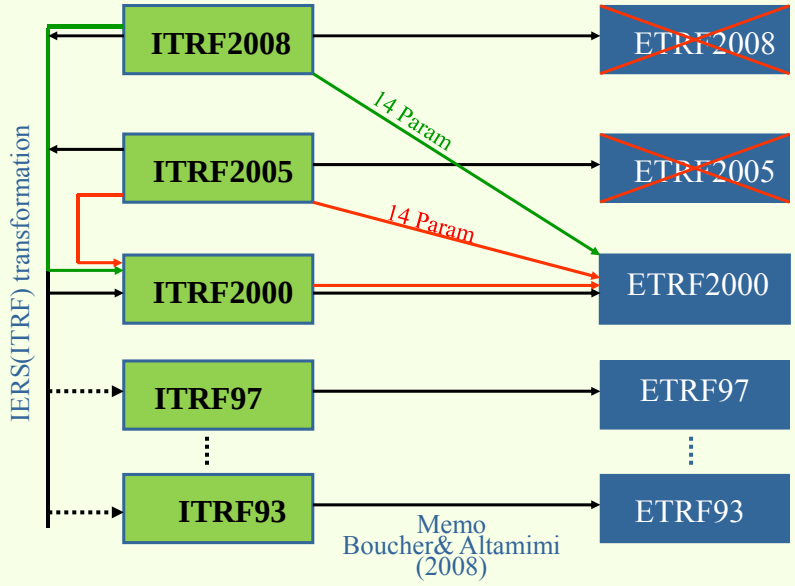


INFLUENCE ON ETRS89 REALISATIONS

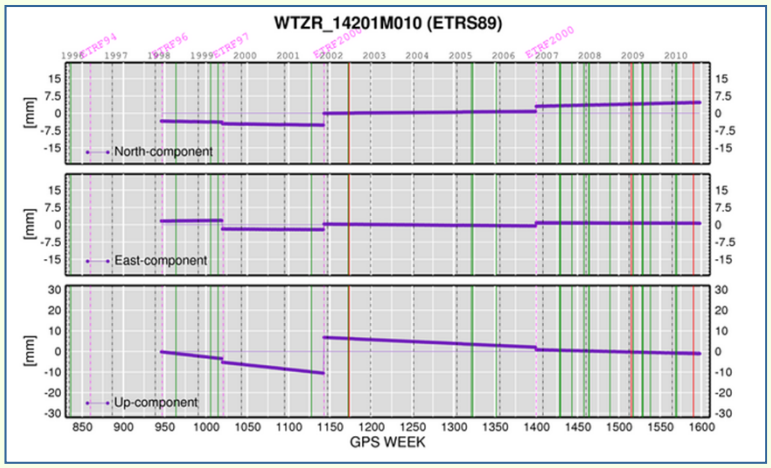


Need to find a mechanism to reduce coordinate jumps

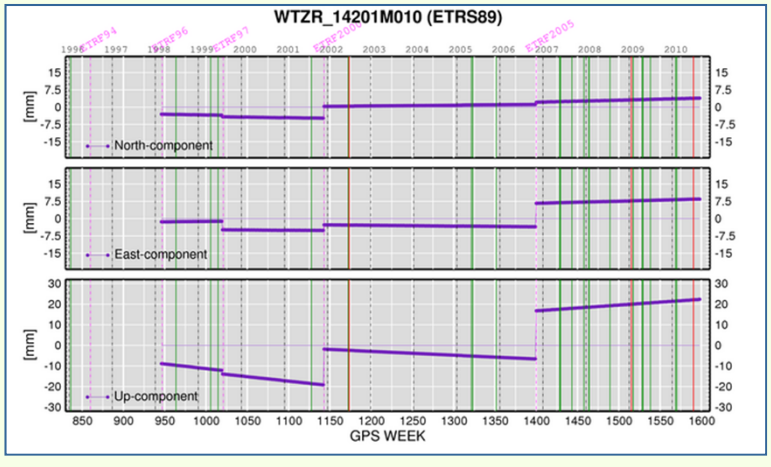
ETRF2000 AS CONVENTIONAL FRAME



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
  + discontinuties 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

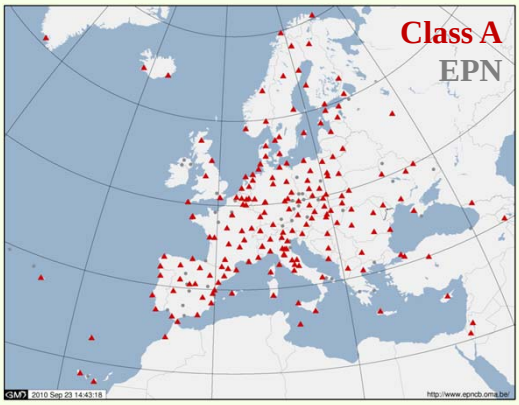
Class B (mostly young sites)

- 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

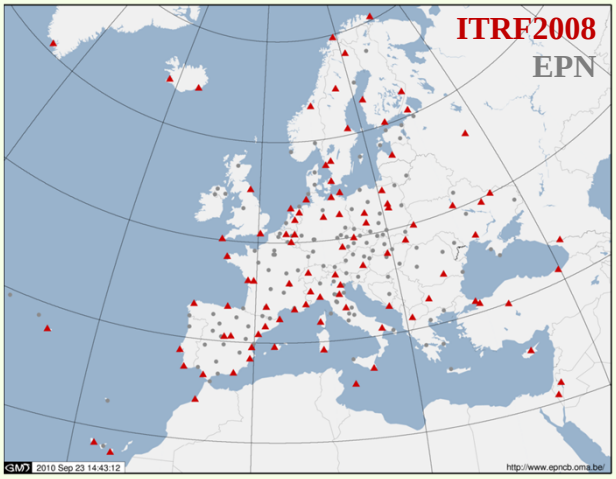


EUREF symposium, Florence, 2009
EUREF guidelines for Densifications of the ETRS89:
Fiducials: Class A stations and pos/vel. from cumulative EPN solution tied to ITRFyy

ITRF2008

ITRF2008 stations: 129

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



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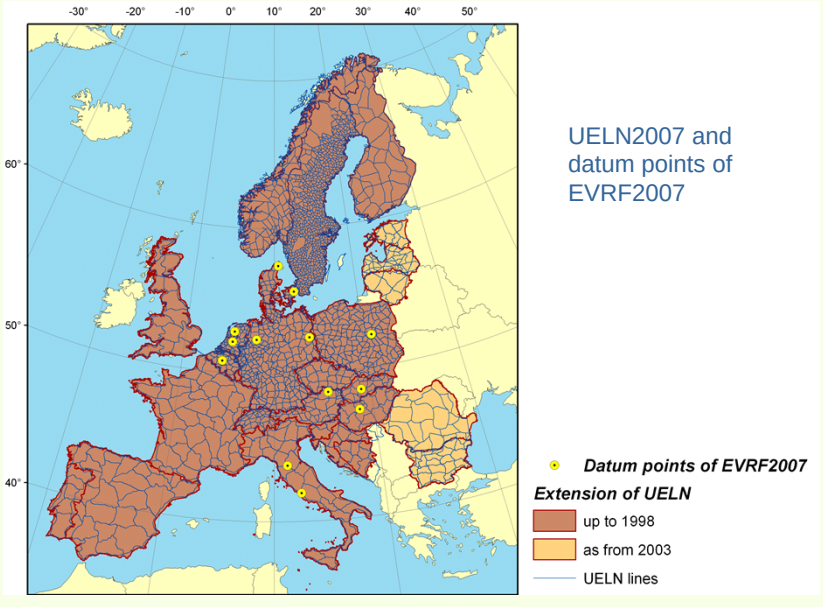
EUROPEAN VERTICAL REFERENCE SYSTEM

- 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



UELN2007 and datum points of 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.

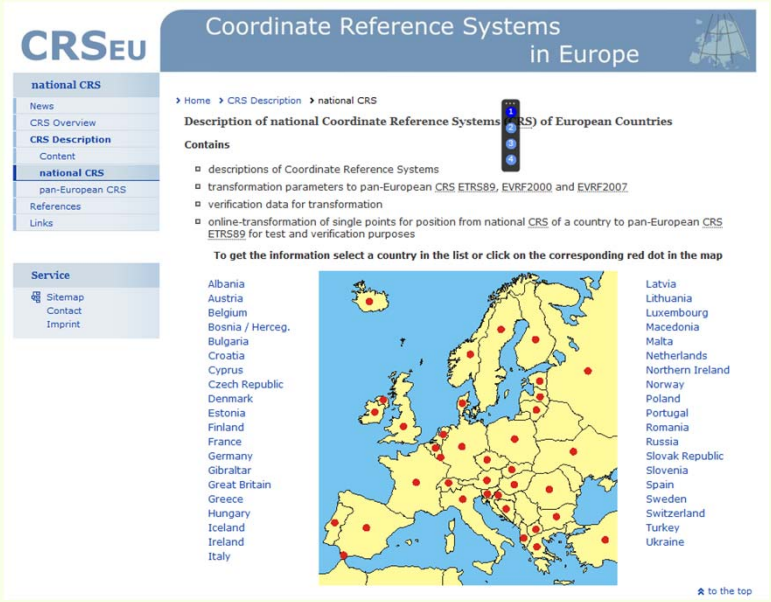
ETRS89 – NATIONAL CRS

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)

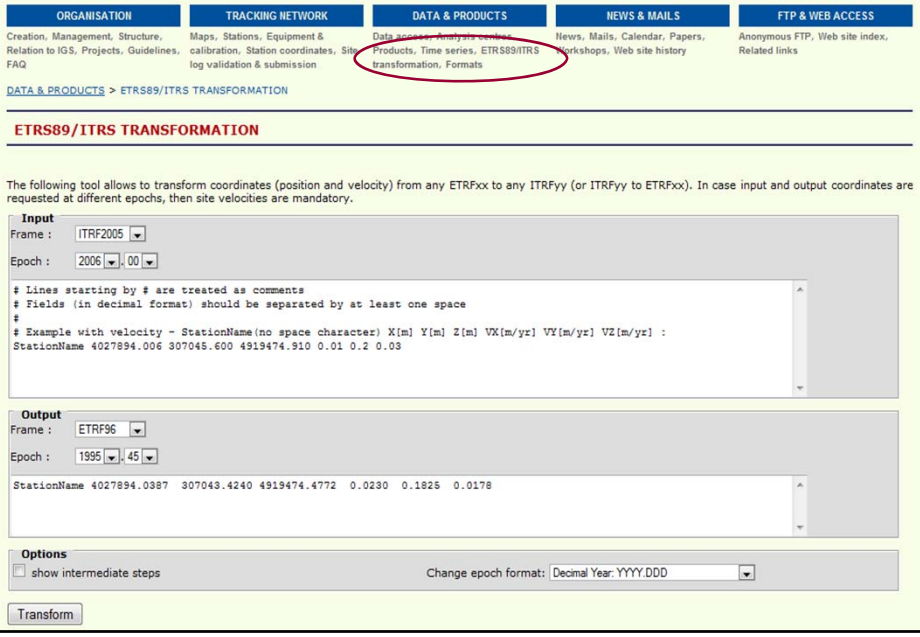
ETRS89 – NATIONAL CRS

http://www.crs-geo.eu/



ETRS89 – ITRS

http://epncb.oma.be/



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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/