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EUREF-TWG Project: Monitoring of official national ETRF coordinates on EPN web

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Goal of the project



National Reference Frame Realizations

- Usually defined based on campaigns (1990 – 2015)
- Based on different ETRF realizations
- Once determined reference frame is used to further densify national networks
- Difficult to change

EPN scientific Reference Frame Realization

- Defined on permanent stations
- Based on different ITRF realizations
- Used to define national ETRF realizations
- Changeable (ITRF change, repro changes, update presently every 15 weeks)



Project idea (unchanged since 2009)

- Collection of all EPN sites which are used in the countries for reference frame realization and which therefore have official national ETRF coordinates.
- Demonstration of the “homogeneity” of the ETRF realization
- Useful additional info on the EPN web (no control of the countries; publication only if agreed by countries)

«Historic» view back

- Activity start
 - LAC WS Frankfurt 2008: idea
 - EUREF Symposium Florence 2009: 15 countries were asked to deliver coordinates – all other countries were asked to report on it in the national reports

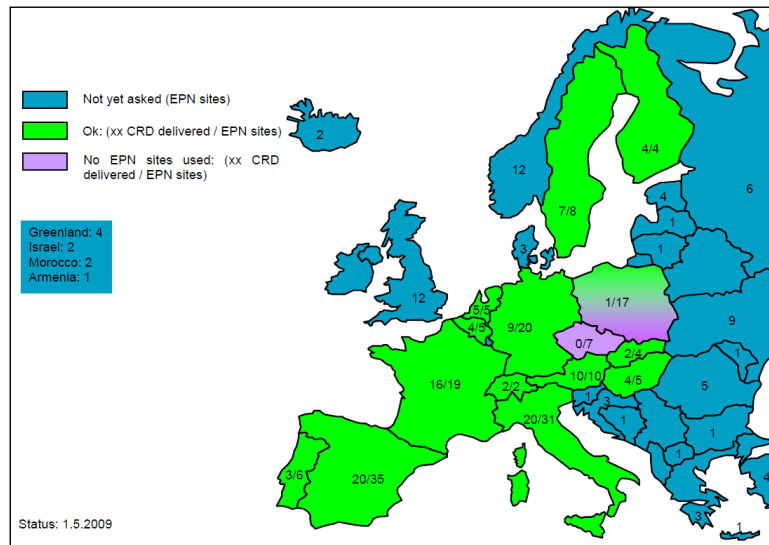


Fig 3: Distribution of the EPN stations with national official ETRF coordinates.

File name	Country	Reference frame
AUT 20090211.ETRF	Austria	ETRF00
BEL 20090127.ETRF	Belgium	ETRF2000
CHE 20081021.ETRF	Switzerland	ETRF93
DEU 20081104.ETRF	Germany	ETRS89
ESP 20090201.ETRF	Spain	ETRF05
FIN 20090119.ETRF	Finland	ETRF96
FRA 20090428.ETRF	France	ETRF93
HUN 20090120.ETRF	Hungary	ETRF00
ITA 20090101.ETRF	Italy	ETRF2000
NLD 20090325.ETRF	Netherlands	ETRF2000(R05)
POL 20090129.ETRF	Poland	ETRF05(R05)
PRT 20090402.ETRF	Portugal	ETRF89
SVK 20090421.ETRF	Slovakia	ETRF2000
SWE 20081024.ETRF	Sweden	ETRF97
Czech Republic	no EPN station with official national ETRF coordinates	

Tab 1: File contribution of the 15 countries of the pilot project containing national ETRF coordinates for EPN stations.



File format for information exchange



File name: SWE_200903013.ETRF

Station DOMES	X	Y	Z	Frame	Epoch	valid from	to
-----*-----**-----**-----**-----**-----**-----* **YYYY*mm*dd**YYYY*mm*dd**YYYY*mm*dd							
KIRO 10422M001	2248123.5038	865686.5326	5886425.5943	ETRF97	1999 07 01	1993 08 01	
MAR6 10405M002	2998189.7132	931451.5886	5533398.4735	ETRF97	1999 07 01	1993 08 01	
ONSA 10402M004	3370658.8318	711876.9387	5349786.7450	ETRF97	1999 07 01	1999 02 02	
SKE0 10426M001	2534031.1978	975174.4040	5752078.3436	ETRF97	1999 07 01	1993 08 01	
SPT0 10425M001	3328984.8136	761910.0660	5369033.4748	ETRF97	1999 07 01	1995 12 01	2007 06 08
SPT0 10425M001	3328984.8211	761910.0677	5369033.4857	ETRF97	1999 07 01	2007 06 08	



File name: SWE_20150413.ETRF

New sites

Updated info

Station DOMES	X	Y	Z	Frame	Epoch	valid from	to
-----*-----**-----**-----**-----**-----* **YYYY*mm*dd**YYYY*mm*dd**YYYY*mm*dd							
ARJ6 10428M002	2441772.8324	799272.2168	5818730.2508	ETRF97	1999 07 01	2011 07 29	
KIRO 10422M001	2248123.5038	865686.5326	5886425.5943	ETRF97	1999 07 01	1993 08 01	2012 06 30
KIRO 10422M001	2248123.5029	865686.5321	5886425.5921	ETRF97	1999 07 01	2012 07 01	
LEK6 10433M002	3022567.2656	802951.3059	5540685.8563	ETRF97	1999 07 01	2011 06 15	
LOV6 10434M002	3104211.1206	998381.5785	5463295.5800	ETRF97	1999 07 01	2011 08 26	
MAR6 10405M002	2998189.7132	931451.5886	5533398.4735	ETRF97	1999 07 01	1993 08 01	2012 06 30
MAR6 10405M002	2998189.7120	931451.5880	5533398.4714	ETRF97	1999 07 01	2012 07 01	
NOR7 10410M003	3199101.5637	932233.0146	5420316.8707	ETRF97	1999 07 01	2011 06 22	
ONSA 10402M004	3370658.8318	711876.9387	5349786.7450	ETRF97	1999 07 01	1999 02 02	2012 06 30
ONSA 10402M004	3370658.8305	711876.9382	5349786.7430	ETRF97	1999 07 01	2012 07 01	

History kept





Reference solution changes

- 2008:
 - ITRF05 densification solution of the EPN (dec. 2008)
 - aligned to ITRF2005 with minimum constraints
 - data from 0860 – 1355 [same as ITRF2005, Dec. 2005; before Nov. 2006 (week 1400)] **EPN_ITRF_C1355.SNX**
 - based on relative antenna phase center variation model
- 2009: updated solutions every 15 weeks
- 2012: after 80 weeks gap, repro1, abs PCVs, class A+B
EPN_A_ITRF2005_C1600 -> EPN_A_IGS08_C1680
- 2013: 30 weeks gap
EPN_A_IGS08_C1680 -> EPN_A_IGb08_C1710



Coordinates on EPN web: Example

<http://www.epncb.oma.be/networkdata/siteinfo4onestation.php?station=TLSE>

➔ <http://www.epncb.oma.be/productsservices/coordinates/crd4station.php?station=TLSE>



OPERATIONAL CENTRE **CNES**

OTHER NETWORKS IGS, IQS, ECGN

EPN INCLUSION Since 006/1980 (GPSweek No.)

INACTIVITY PERIODS None

COORDINATES Published positions/velocities in ITRS and ETRS89

INDIVIDUAL ANTENNA CALIBRATIONS None

1. Densification coordinates

5. National coordinates

1. POSITIONS/VELOCITIES PUBLISHED BY EUREF

EUREF has classified TLSE03FRA (Toulouse, France) as a class A station which means that it can be used as fiducial station for EUREF densifications.

LATEST RELEASE

EPN_A_ETRF2000_C1875.SSC - EPN_A_IGb08_C1875.SSC (February 19, 2016)

ETRF2000	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
253/2012 - 353/2016	001/2005	4627852.065 ± 0.001	119639.750 ± 0.000	4372993.321 ± 0.001	-0.0003 ± 0.0001	0.0000 ± 0.0000	-0.0005 ± 0.0001
059/2010 - 252/2012	001/2005	4627852.067 ± 0.001	119639.755 ± 0.000	4372993.321 ± 0.001	-0.0003 ± 0.0000	0.0000 ± 0.0000	-0.0005 ± 0.0001
348/2003 - 051/2010	001/2005	4627852.067 ± 0.000	119639.754 ± 0.000	4372993.320 ± 0.000	-0.0003 ± 0.0001	0.0000 ± 0.0000	-0.0005 ± 0.0001
140/2001 - 095/2003	001/2005	4627852.064 ± 0.000	119639.755 ± 0.000	4372993.317 ± 0.000	-0.0003 ± 0.0000	0.0000 ± 0.0000	-0.0005 ± 0.0001

IGb08	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
253/2012 - 353/2016	001/2005	4627851.830 ± 0.001	119640.011 ± 0.000	4372993.556 ± 0.001	-0.0116 ± 0.0001	0.0194 ± 0.0000	0.0119 ± 0.0001
059/2010 - 252/2012	001/2005	4627851.833 ± 0.001	119640.017 ± 0.000	4372993.556 ± 0.001	-0.0116 ± 0.0001	0.0194 ± 0.0000	0.0119 ± 0.0001
348/2003 - 051/2010	001/2005	4627851.833 ± 0.000	119640.016 ± 0.000	4372993.555 ± 0.000	-0.0116 ± 0.0001	0.0194 ± 0.0000	0.0119 ± 0.0001
140/2001 - 095/2003	001/2005	4627851.830 ± 0.000	119640.017 ± 0.000	4372993.553 ± 0.000	-0.0116 ± 0.0001	0.0194 ± 0.0000	0.0119 ± 0.0001

Click [HERE](#) to see a plot of how the station positions between successive cumulative solutions agree with each other.

➤ PREVIOUS RELEASES

2. POSITIONS/VELOCITIES PUBLISHED BY THE IGS

LATEST RELEASE

IGb08.CRD (October 4, 2012) - more information

IGb08	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
065/2010 - 233/2012	001/2005	4627851.829 ± 0.001	119640.018 ± 0.001	4372993.554 ± 0.001	-0.0114 ± 0.0001	0.0193 ± 0.0000	0.0121 ± 0.0001
340/2003 - 197/2009	001/2005	4627851.831 ± 0.001	119640.016 ± 0.001	4372993.553 ± 0.001	-0.0114 ± 0.0001	0.0193 ± 0.0000	0.0121 ± 0.0001
365/2000 - 342/2003	001/2005	4627851.831 ± 0.001	119640.017 ± 0.001	4372993.553 ± 0.001	-0.0114 ± 0.0001	0.0193 ± 0.0000	0.0121 ± 0.0001

➤ Previous releases

3. POSITIONS/VELOCITIES PUBLISHED BY THE IERS

LATEST RELEASE

ETRF2000(14R) not yet ready

ITRF2014_GNSS.SSC.txt (January 21, 2016)

ITRF2014	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
248/2012 - 365/2014	001/2010	4627851.768 ± 0.001	119640.109 ± 0.001	4372993.610 ± 0.001	-0.0115 ± 0.0000	0.0193 ± 0.0000	0.0120 ± 0.0000
055/2010 - 248/2012	001/2010	4627851.771 ± 0.001	119640.112 ± 0.001	4372993.611 ± 0.001	-0.0115 ± 0.0000	0.0193 ± 0.0000	0.0120 ± 0.0000
start - 055/2010	001/2010	4627851.773 ± 0.001	119640.111 ± 0.001	4372993.610 ± 0.001	-0.0115 ± 0.0000	0.0193 ± 0.0000	0.0120 ± 0.0000

➤ Previous releases

4. POSITION PUBLISHED WEEKLY IN THE EPN COMBINED SOLUTION

IGS08	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
059/2010 - 065/2016	062/2015	4627851.698 ± 0.000	119640.228 ± 0.000	4372993.689 ± 0.000	NA	NA	NA

5. POSITIONS PUBLISHED BY THE COUNTRY

The official ETRS89 coordinates used in France are maintained by IGN. This agency is fully responsible for the information kindly provided to the EPN.

Valid (from - to)	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
248/2012 - now	001/2009	4627852.089	119639.749	4372993.328	NA	NA	NA
159/2010 - 248/2012	001/2009	4627852.085	119639.756	4372993.321	NA	NA	NA
335/2003 - 159/2010	001/1993	4627852.058	119639.767	4372993.312	NA	NA	NA
004/2001 - 335/2003	001/1993	4627852.085	119639.763	4372993.319	NA	NA	NA

Following a recent initiative of the EUREF Technical Working Group (Monitoring of official national ETRF coordinates on EPN web), the differences between the national coordinates and the latest cumulative EPN solutions (section 1) are regularly monitored. They are given in two maps: [horizontal differences] and [vertical differences].

EPN CB - ROB

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Apr 12, 2016



EPN08 coordinates/vel: Example TLSE

Latest release

1. POSITIONS/VELOCITIES PUBLISHED BY EUREF

EUREF has classified TLSE00FRA (Toulouse, France) as a **class A station** which means that it can be used as fiducial station for EUREF densifications.

LATEST RELEASE

EPN_A_ETRF2000_C1875.SSC - EPN_A_IGb08_C1875.SSC (February 19, 2016)

ETRF2000	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
253/2012 - 353/2015	001/2005	4627852.065 ± 0.001	119639.750 ± 0.000	4372993.321 ± 0.001	-0.0003 ± 0.0001	0.0000 ± 0.0000	-0.0005 ± 0.0001
059/2010 - 252/2012	001/2005	4627852.067 ± 0.001	119639.755 ± 0.000	4372993.321 ± 0.001	-0.0003 ± 0.0001	0.0000 ± 0.0000	-0.0005 ± 0.0001
348/2003 - 051/2010	001/2005	4627852.067 ± 0.000	119639.754 ± 0.000	4372993.320 ± 0.000	-0.0003 ± 0.0001	0.0000 ± 0.0000	-0.0005 ± 0.0001
140/2001 - 095/2003	001/2005	4627852.064 ± 0.000	119639.755 ± 0.000	4372993.317 ± 0.000	-0.0003 ± 0.0001	0.0000 ± 0.0000	-0.0005 ± 0.0001

IGb08	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
253/2012 - 353/2015	001/2005	4627851.830 ± 0.001	119640.011 ± 0.000	4372993.556 ± 0.001	-0.0116 ± 0.0001	0.0194 ± 0.0000	0.0119 ± 0.0001
059/2010 - 252/2012	001/2005	4627851.833 ± 0.001	119640.017 ± 0.000	4372993.556 ± 0.001	-0.0116 ± 0.0001	0.0194 ± 0.0000	0.0119 ± 0.0001
348/2003 - 051/2010	001/2005	4627851.833 ± 0.000	119640.016 ± 0.000	4372993.555 ± 0.000	-0.0116 ± 0.0001	0.0194 ± 0.0000	0.0119 ± 0.0001
140/2001 - 095/2003	001/2005	4627851.830 ± 0.000	119640.017 ± 0.000	4372993.553 ± 0.000	-0.0116 ± 0.0001	0.0194 ± 0.0000	0.0119 ± 0.0001



EPN Reference solutions 2008 - 2016

LATEST RELEASE

EPN_A_ETRF2000_C1875.SSC - EPN_A_IGb08_C1875.SSC (February 19, 2016)

Previous releases

Click [HERE](#) to see a plot of how the station positions between successive cumulative solutions agree with each other.

PREVIOUS RELEASES

- + EPN_A_ETRF2000_C1860.SSC - EPN_A_IGb08_C1860.SSC (December 7, 2015)
- + EPN_A_ETRF2000_C1845.SSC - EPN_A_IGb08_C1845.SSC (September 4, 2015)
- + EPN_A_ETRF2000_C1830.SSC - EPN_A_IGb08_C1830.SSC (May 3, 2015)
- + EPN_A_ETRF2000_C1815.SSC - EPN_A_IGb08_C1815.SSC (January 22, 2015)
- + EPN_A_ETRF2000_C1800.SSC - EPN_A_IGb08_C1800.SSC (October 27, 2014)
- + EPN_A_ETRF2000_C1785.SSC - EPN_A_IGb08_C1785.SSC (July 9, 2014)
- + EPN_A_ETRF2000_C1770.SSC - EPN_A_IGb08_C1770.SSC (February 3, 2014)
- + EPN_A_ETRF2000_C1755.SSC - EPN_A_IGb08_C1755.SSC (January 8, 2014)
- + EPN_A_ETRF2000_C1740.SSC - EPN_A_IGb08_C1740.SSC (August 8, 2013)
- + EPN_A_ETRF2000_C1725.SSC - EPN_A_IGb08_C1725.SSC (May 20, 2013)
- + EPN_A_ETRF2000_C1710.SSC - EPN_A_IGb08_C1710.SSC (April 2, 2013)
- + EPN_A_ETRF2000_C1680.SSC - EPN_A_IGS08_C1680.SSC (October 16, 2012)
- + EPN_A_ETRF2000_C1600.SSC - EPN_A_IGb08_C1600.SSC (October 23, 2010) - [more information](#)
- + EPN_A_ETRF2000_C1585.SSC - EPN_A_IGb08_C1585.SSC (August 4, 2010)
- + EPN_A_ETRF2000_C1570.SSC - EPN_A_IGb08_C1570.SSC (March 23, 2010)
- + EPN_A_ETRF2000_C1555.SSC - EPN_A_IGb08_C1555.SSC (December 10, 2009)
- + EPN_A_ETRF2000_C1540.SSC - EPN_A_IGb08_C1540.SSC (August 15, 2009)
- + EPN_A_ETRF2000_C1525.SSC - EPN_A_IGb08_C1525.SSC (September 17, 2009)
- + EPN_A_ETRF2000_C1510.SSC - EPN_A_IGb08_C1510.SSC (September 17, 2009)
- + EPN_ETRF_C1355.SSC - EPN_IGb08_C1355.SSC (December 12, 2008) (see [The EUREF Densification of the ITRF2005](#))



National coordinates: Example TLSE

Thanks for agreeing on one agency if several agencies are responsible in a country

Responsible Agency

5. POSITIONS PUBLISHED BY THE COUNTRY

The official ETRS89 coordinates used in France are maintained by **IGN**. This agency is fully responsible for the information kindly provided to

Valid (from - to)	epoch t_0	Position (m)			
		X	Y	Z	
248/2012 - now	001/2009	4627852.069	119639.749	4372993.326	M
169/2010 - 248/2012	001/2009	4627852.065	119639.756	4372993.321	M
335/2003 - 169/2010	001/1993	4627852.058	119639.767	4372993.312	M
004/2001 - 335/2003	001/1993	4627852.065	119639.763	4372993.319	M

Following a recent initiative of the EUREF Technical Working Group (Monitoring of official national ETRF coordinates on EPN web), the cumulative EPN solutions (section 1) are regularly monitored. They are given in two maps: [horizontal differences] and [vertical differences].

Countries are responsible for the information in this section

Links to differences to actual EPN densification



Update of country information

- Country files: 15 (2008) -> 30 (2016) countries
- Bigger update / validation of country files May 2015 (before Leipzig EUREF symposium) – mainly confirmations received that information is still valid
- Updates: totally 36 changes (keeping the history in the ETRF files) in 8 years
-> national ETRF coordinates are quite stable and do not change a lot
- Maintenance of an e-mail list of responsible persons per country

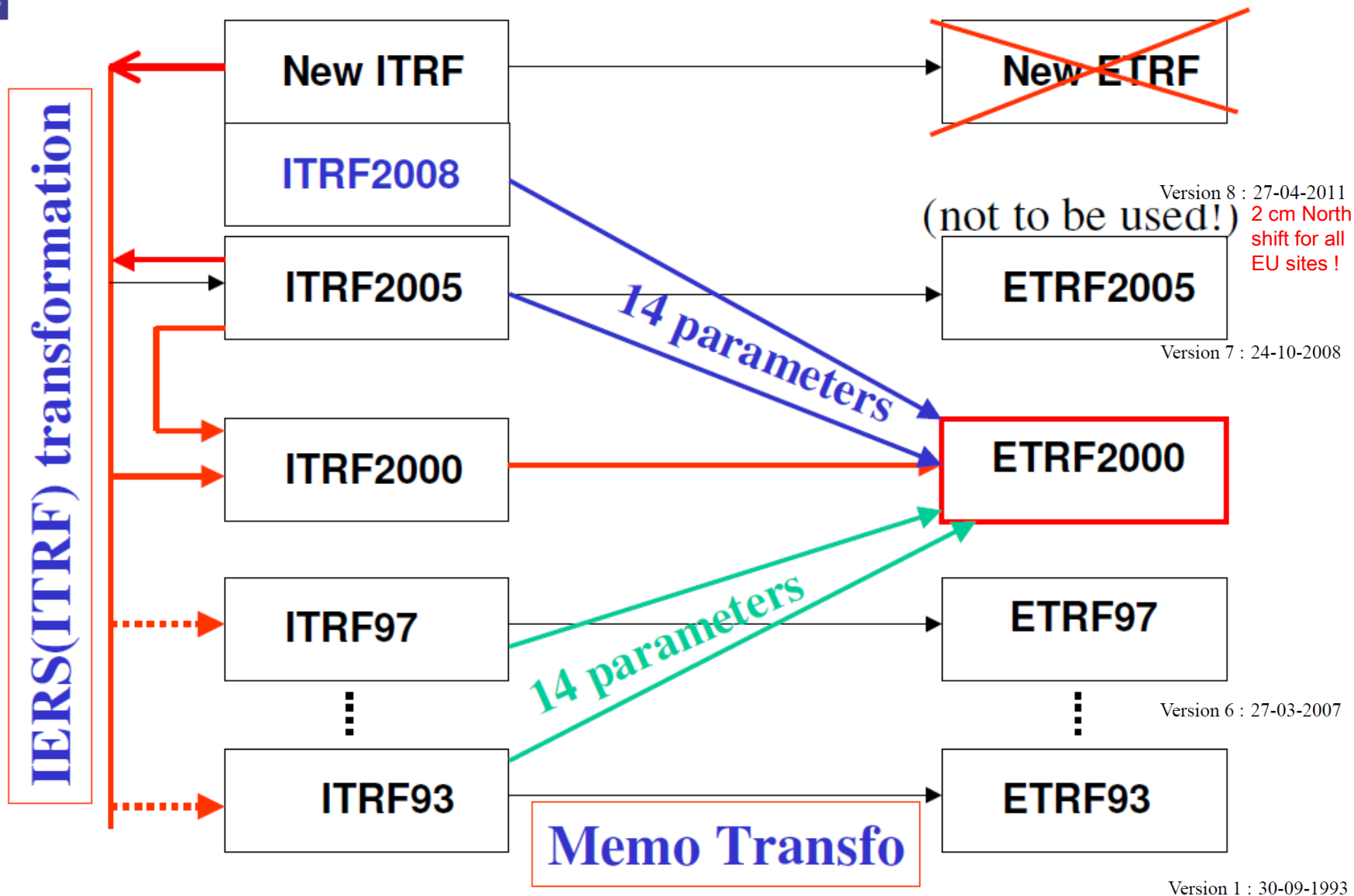


Frame names

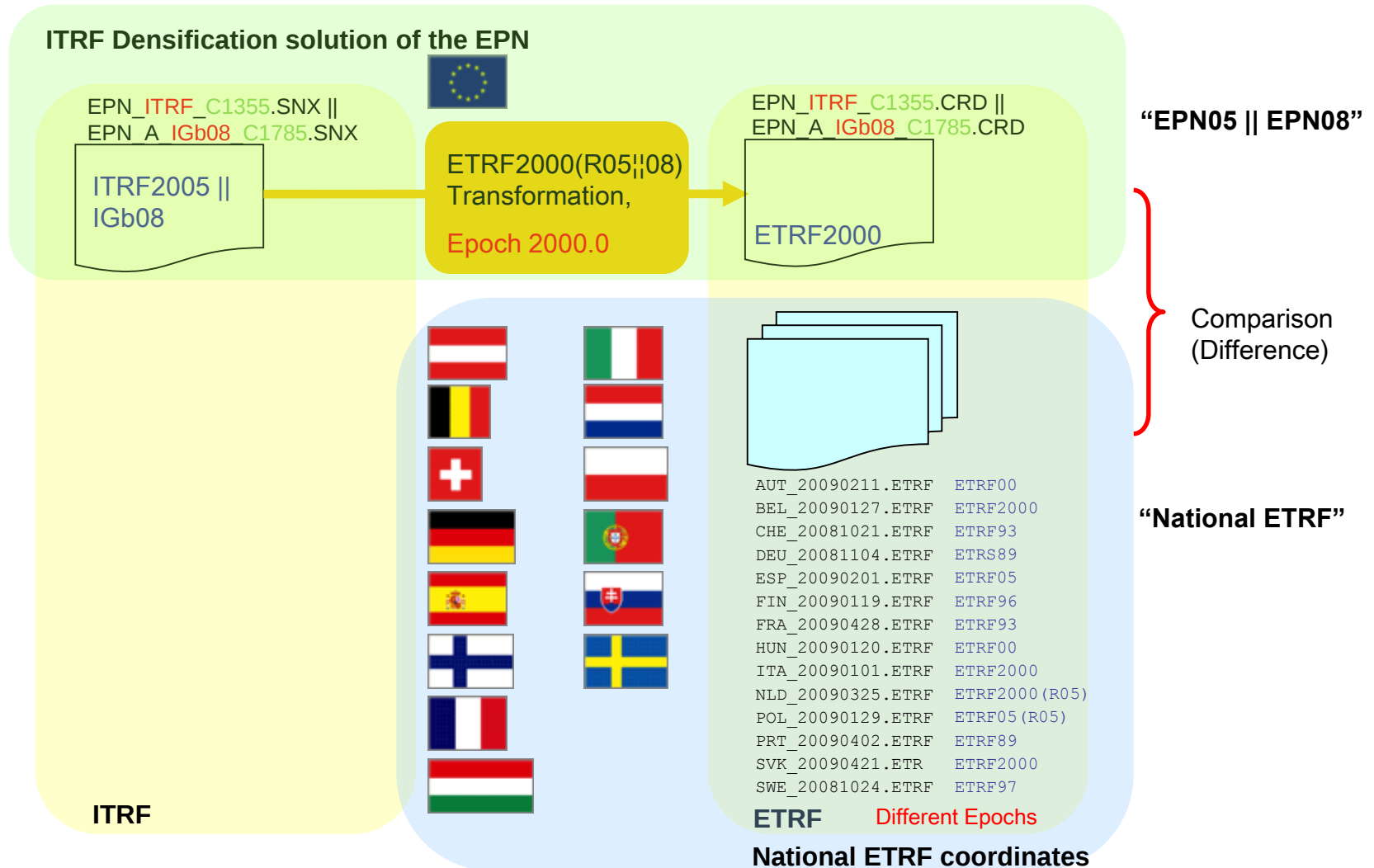
- 30 countries
- Various reference frames (and reference epochs)

COU	Frame Name
AUT	ETRF00
BEL	ETRF2000
BGR	ETRF2000
CHE	ETRF93
CZE	ETRF2000 (R05), ETRF89
DEU	ETRF2000 (R05,R08)
DNK	ETRF92
ESP	ETRF2005
EST	ETRF96
FIN	ETRF96
FRA	ETRF93, ETRF2000 (R05)
GBR	ETRF97, ETRF2000
GRC	ETRF05
HRV	ETRF2000 (R05)
HUN	ETRF00
IRL	ETRF89
ITA	ETRF2000
LTU	ETRF2000
LVA	ETRF2000
MDA	ETRF97
MKD	ETRF2000 (R05)
NLD	ETRF2000 (R05)
NOR	ETRF97
POL	ETRF2000 (R05)
PRT	ETRF97
ROU	ETRF2000
SRB	ETRF2000 (R05)
SVK	ETRF2000
SVN	ETRF05
SWE	ETRF97

ITRFyy to ETRFyy



Comparison with EPN densification: Method used

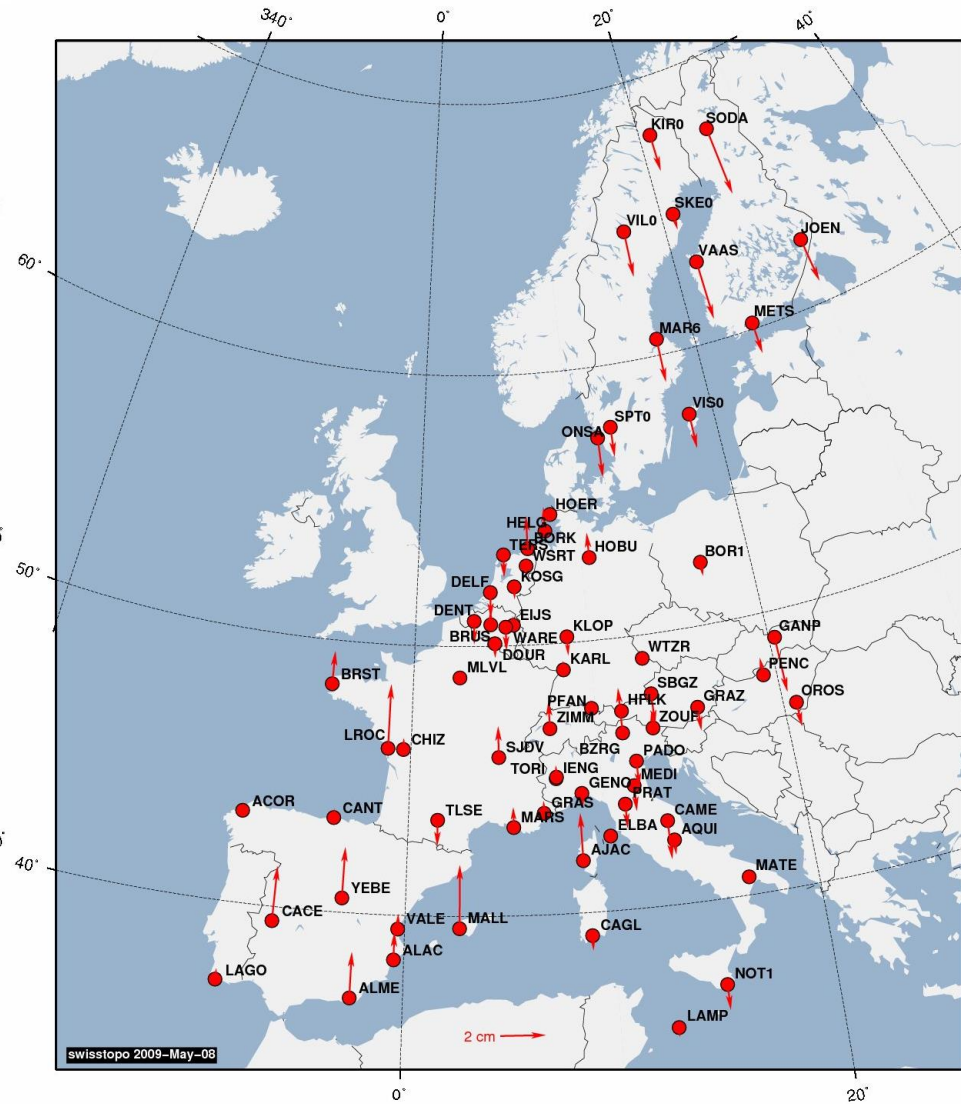




Comparison with EPN05 densification

Diff: horizontally + vertically

2008





Comparison with EPN reference solution

121 stations

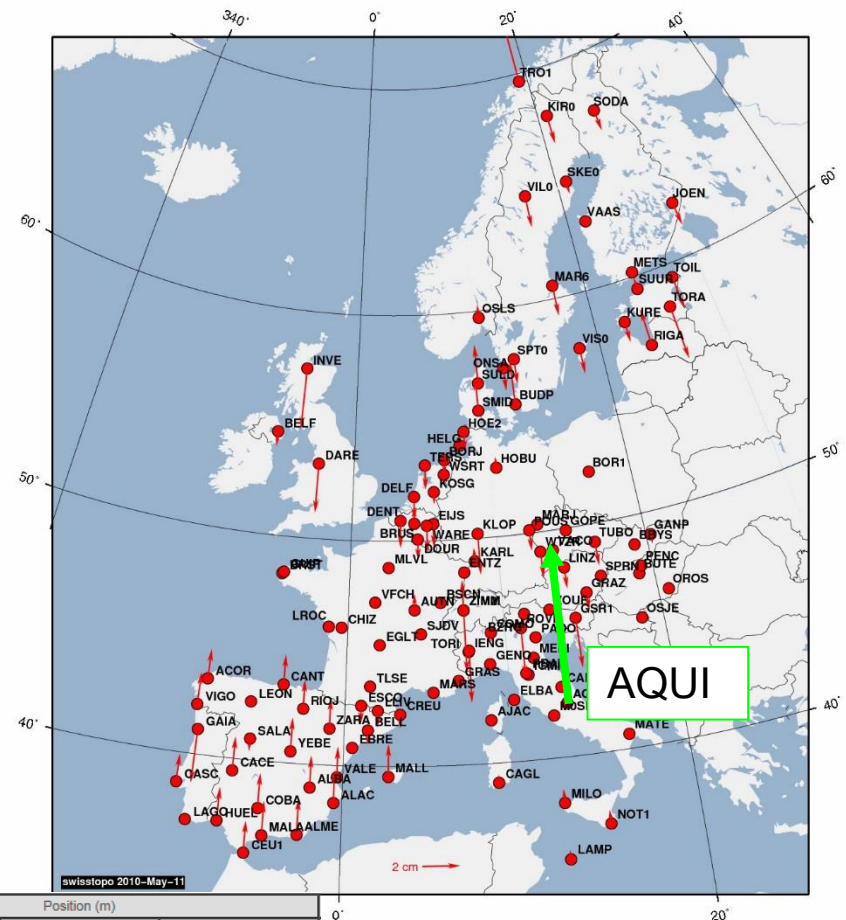
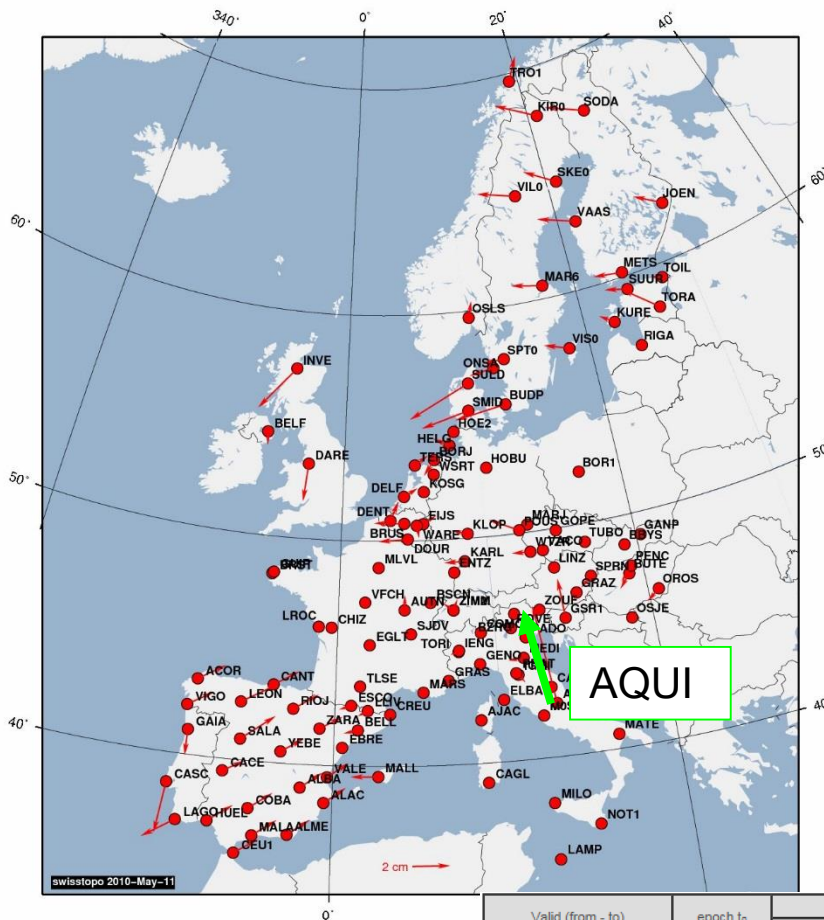
22 countries

2011

horizontally

vertically

at country
specified epoch



Valid (from - to)	epoch t_0	Position (m)		
		X	Y	Z
096/2009 - now	001/2008	4592507.822	1089876.104	4276392.677
001/2008 - 095/2009	001/2008	4592507.851	1089876.105	4276392.773



Comparison with EPN08 reference solution

192 stations (only class A, C1725)

2013

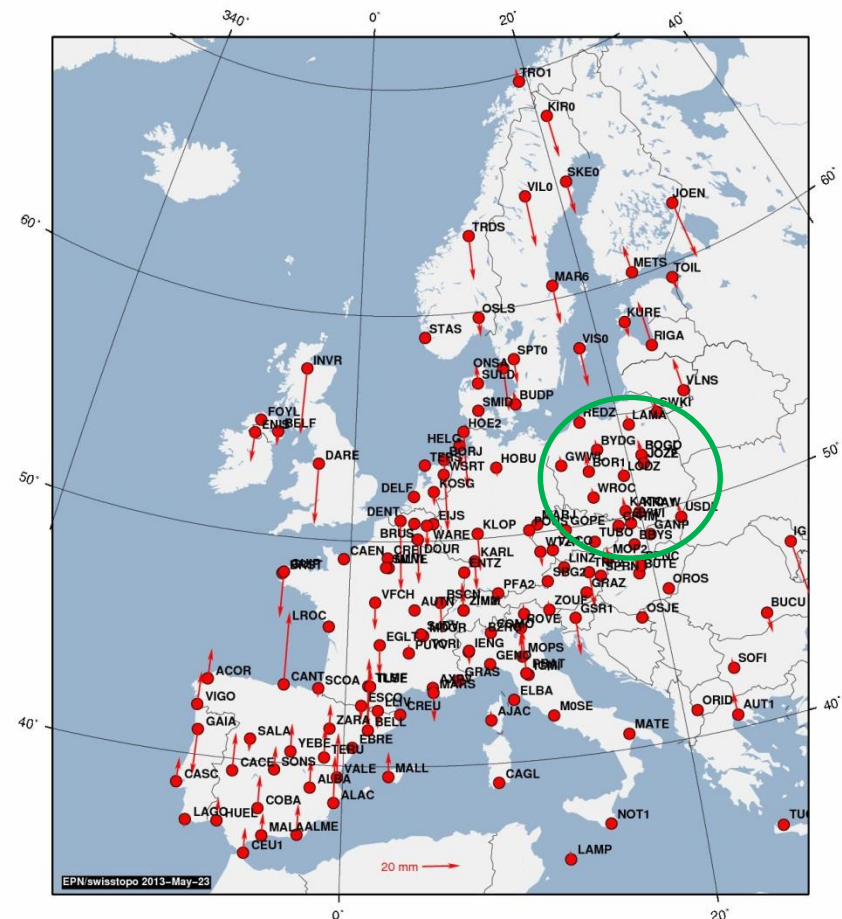
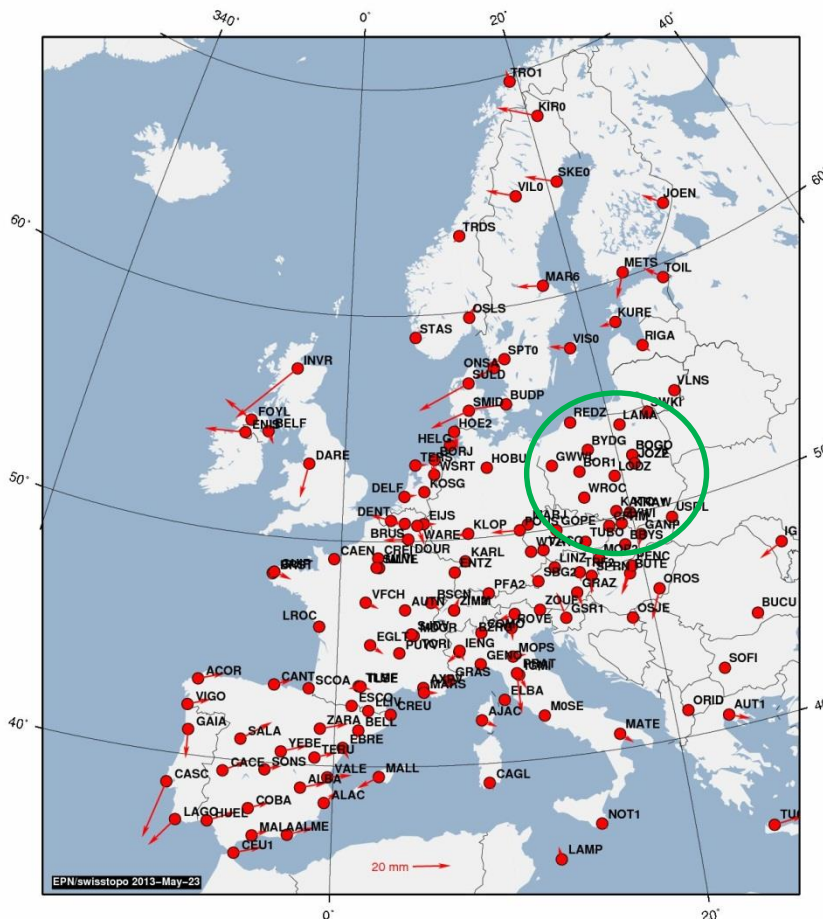
horizontally

28 countries

vertically

at country
specified epoch

New Polish official
ETRF coordinates





Comparison with EPN08 reference solution

221 stations (only class A, C1785)

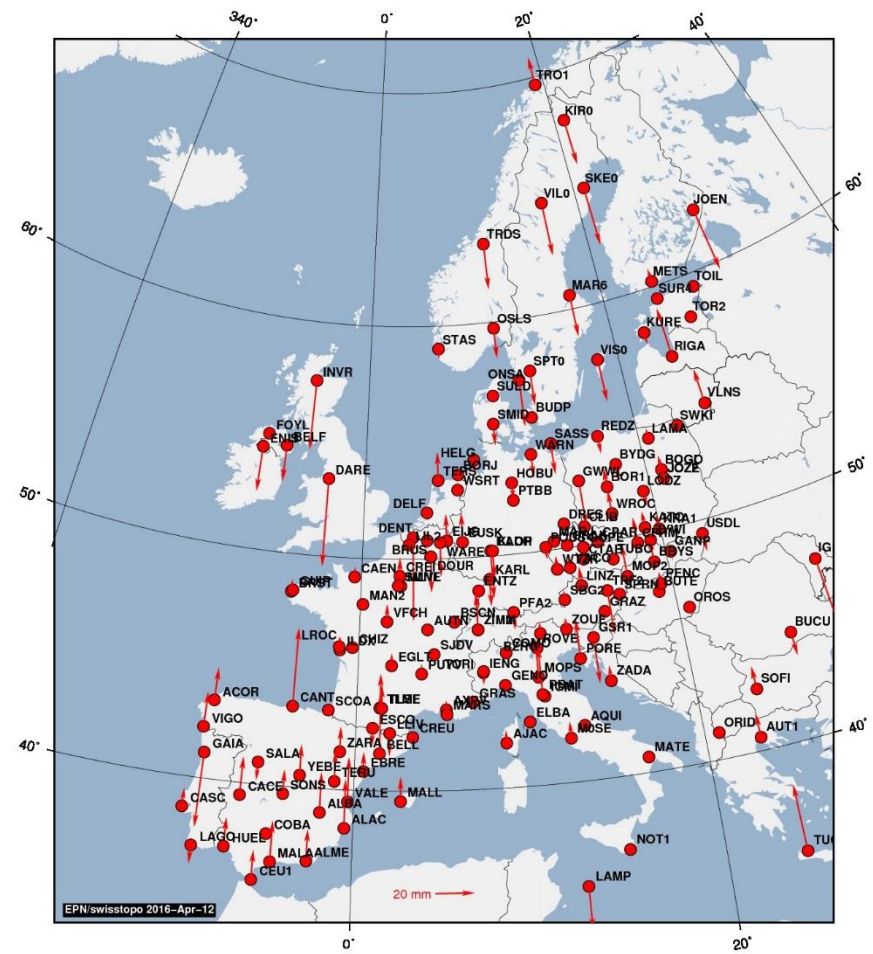
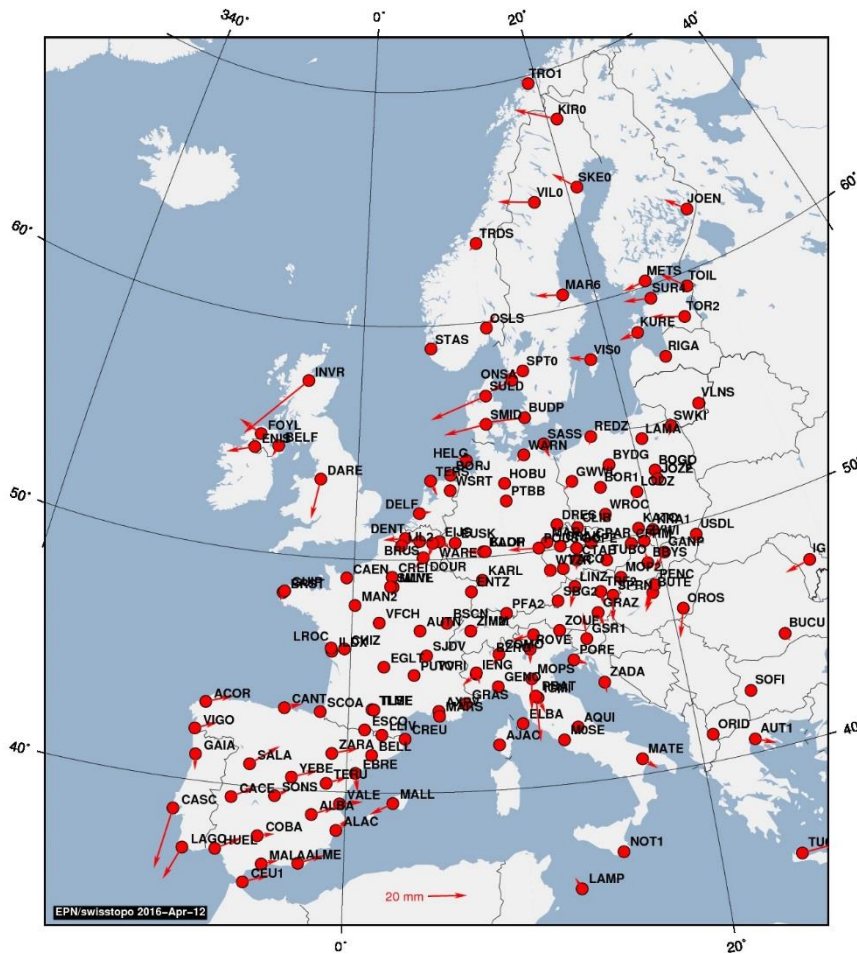
2016

horizontally

30 countries

vertically

at country
specified epoch





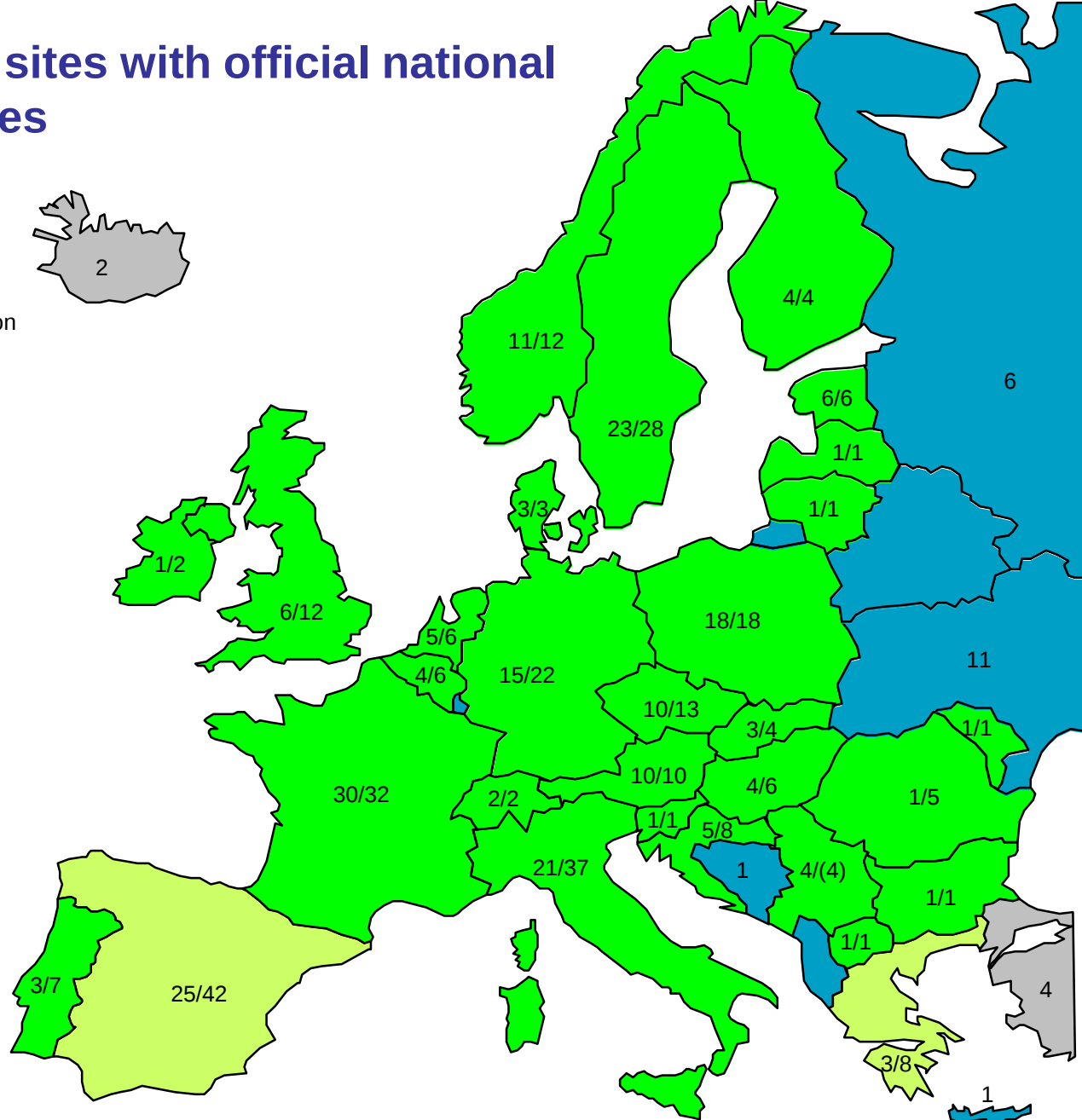
Comparison national with EPN ETRF coordinates: remarks

- Differences of upto 3 cm are expected due to
 - different ETRFYY definitions and reference epochs
 - transition from campaign to permanent stations
 - different analysis models and software used
 - different station setups (antenna changes) – most recent EPN station setup was used for the comparisons
 - mapping agencies cannot change coordinates frequently
 - location on “non-stable plate” (South Italy)
- **Generally, a nice homogeneous picture demonstrating the realization accuracy of ETRS in Europe**



Number of EPN sites with official national ETRF coordinates

- No information (EPN sites)
- Ok: (CRD delivered / EPN sites)
- Coordinates delivered, but no publication on EPN (CRD delivered / EPN sites)
- Out of geographical scope of ETRS (EPN sites)



Greenland:5
Israel: 2
Jordan: 1
Morocco: 2
Armenia: 1
Faroe:1

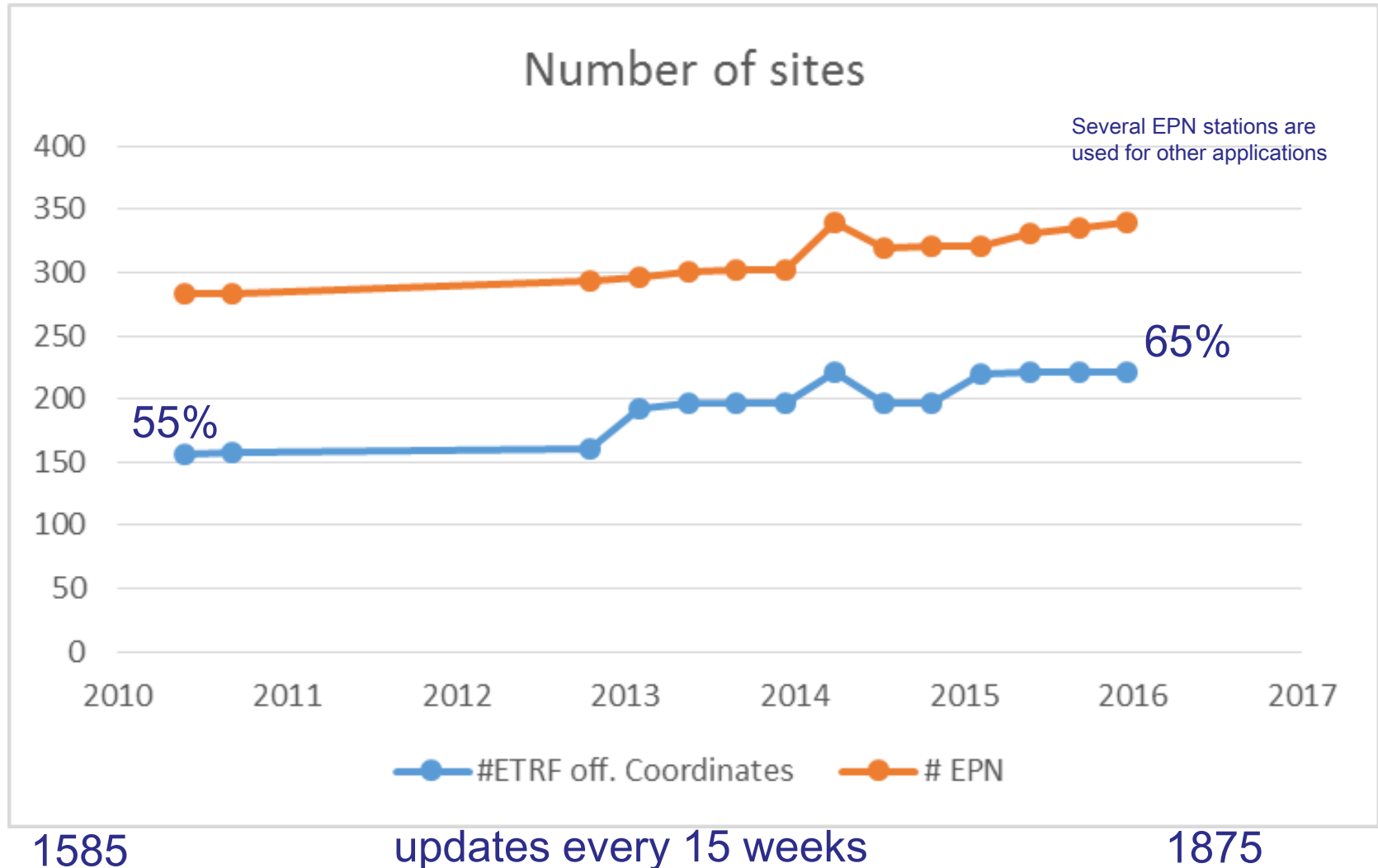
Official ETRF coordinates:
30 countries
221 sites

EPN: 42 countries
340 active sites

Status National: April 2016
EPN: April 2016

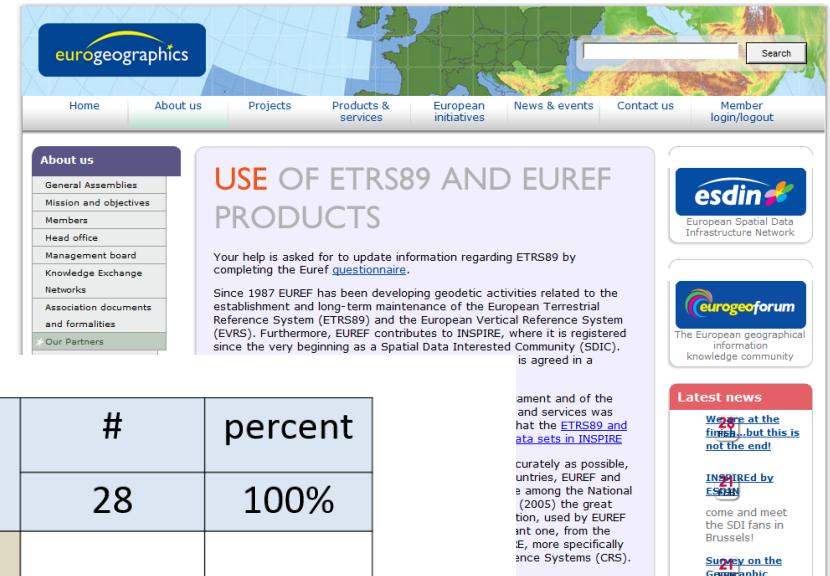


Number of sites with national ETRF coordinates



Questionnaire: Usage Products

- 2011 questionnaire to Mapping Agencies



Number of countries	#	percent
	28	100%
CRS description of ETRS89 realisation		
in CRS-EU information system	16	55%
in other data base eg. EPSG	17	60%
Monitoring ETRF coordinates	19	70%
ITRF2008 introduction	14	50%

J. Ihde, J. Torres, J. Luthardt: Information about the use of ETRS89 and EUREF Products, Chisinau. 2011



Conclusions (from 2009) – still valid

- Countries did a great job computing ETRF coordinates for permanent EPN stations !!!
- Scientific coordinates released by EUREF are a usefull reference (collaboration of many countries)
- Proof of the „compatibility“ within Europe, which is essential for projects within INSPIRE and EuroGeographics
- Integration of national coordinates into EPN and/or EU-CRS webpage prove the collaboration on an European level
- Advantage also for EUREF in case of datum definition discussions if the used coordinates in the countries are known.



Reminder

- Keep in mind to change the country information file in case of coordinate changes (same if responsible persons are changing)
- Countries who not yet participate are kindly invited to join
- Thank you!

Acknowledgements



- Thanks to all already contributing and all future contributing countries
- Thanks also to A. Kenyeres (EPN densification solutions) and C. Bruyninx and D. Mesmaker for the information on the EPN stations and published coordinates.