Schweizerische Eidgenossenschaft
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Project: Monitoring of official national ETRF coordinates on EPN web

E. Brockmann

Proposal: official national ETRF coordinates on EPN web site

- Starting point:
  - EPN web portal gives detailed information on coordinates. coordinates are mainly “scientific” oriented:
    - weekly
    - ITRF / ITRF-densification ETRF coordinates
    - EPN cummulative coordinate sets

- Goal: Collection of all EPN sites which are used in the countries for reference frame realization and which therefore have official national ETRF coordinates

- Project started at TWG Meeting Munich / LAC Meeting Frankfurt End of 2008; 15 countries asked to deliver coordinates

Status of the EPN

38 countries

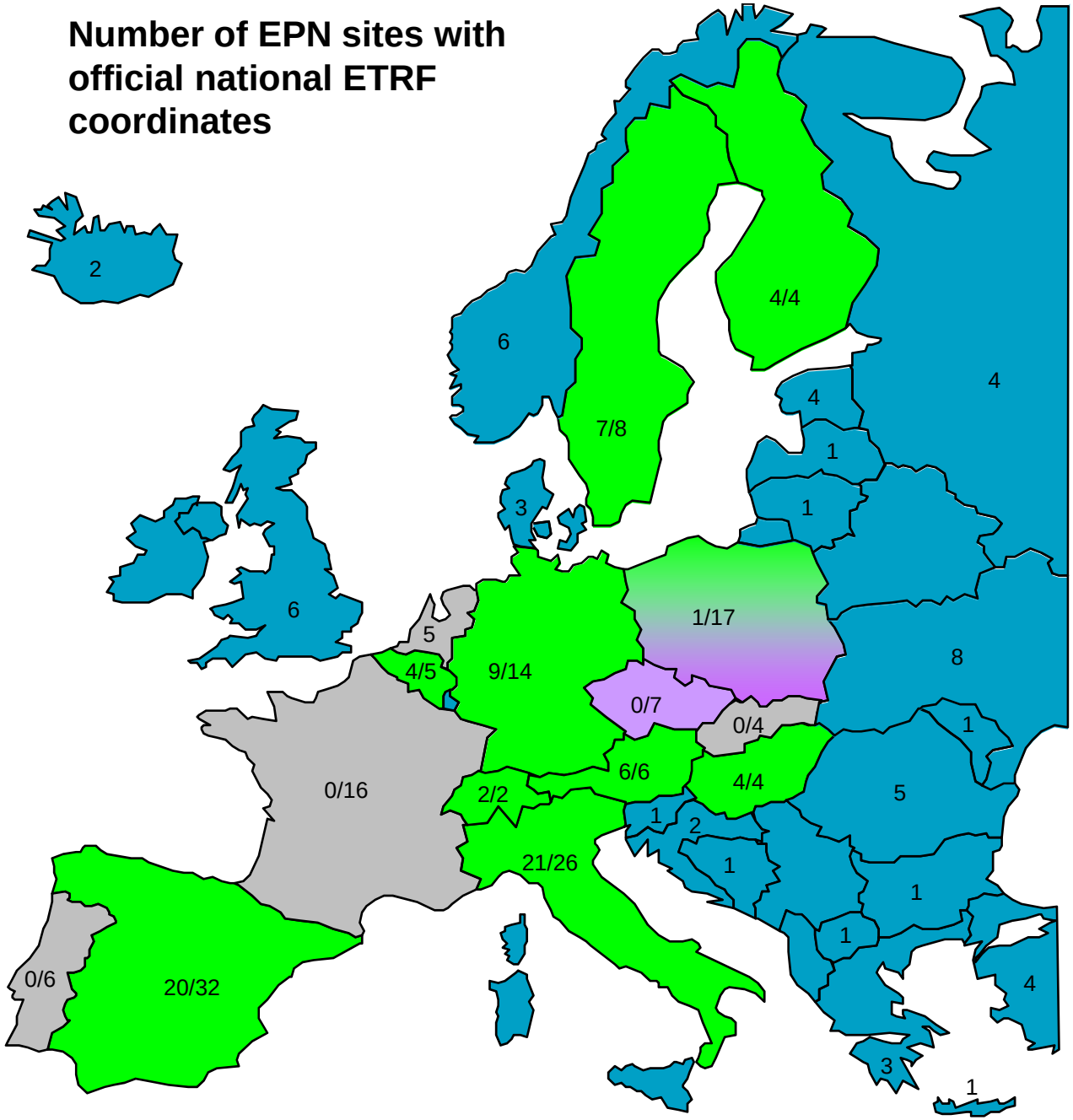
218 sites

Status: 12.2.2009

Number of EPN sites with official national ETRF coordinates

Greenland:3
Israel: 2
Morocco: 1
Armenia: 1

- Not yet asked / EPN sites
- Ok: xx delivered / EPN sites
- Problems to deliver: xx delivered / EPN sites
- No EPN sites used: xx delivered / EPN sites
- No answer: xx delivered / EPN sites



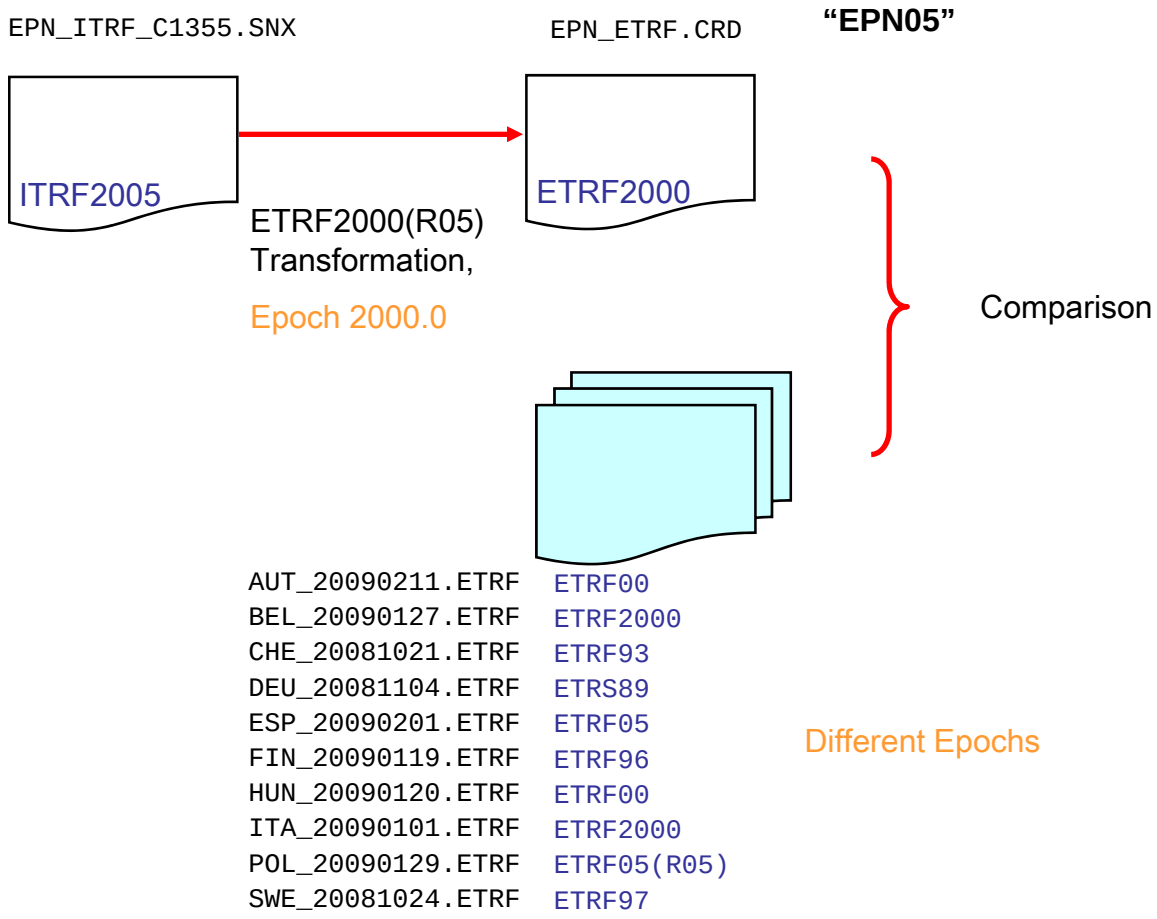
10 / 15 countries sent coordinates

Partly more site coordinates delivered (additional national + outside of the country)

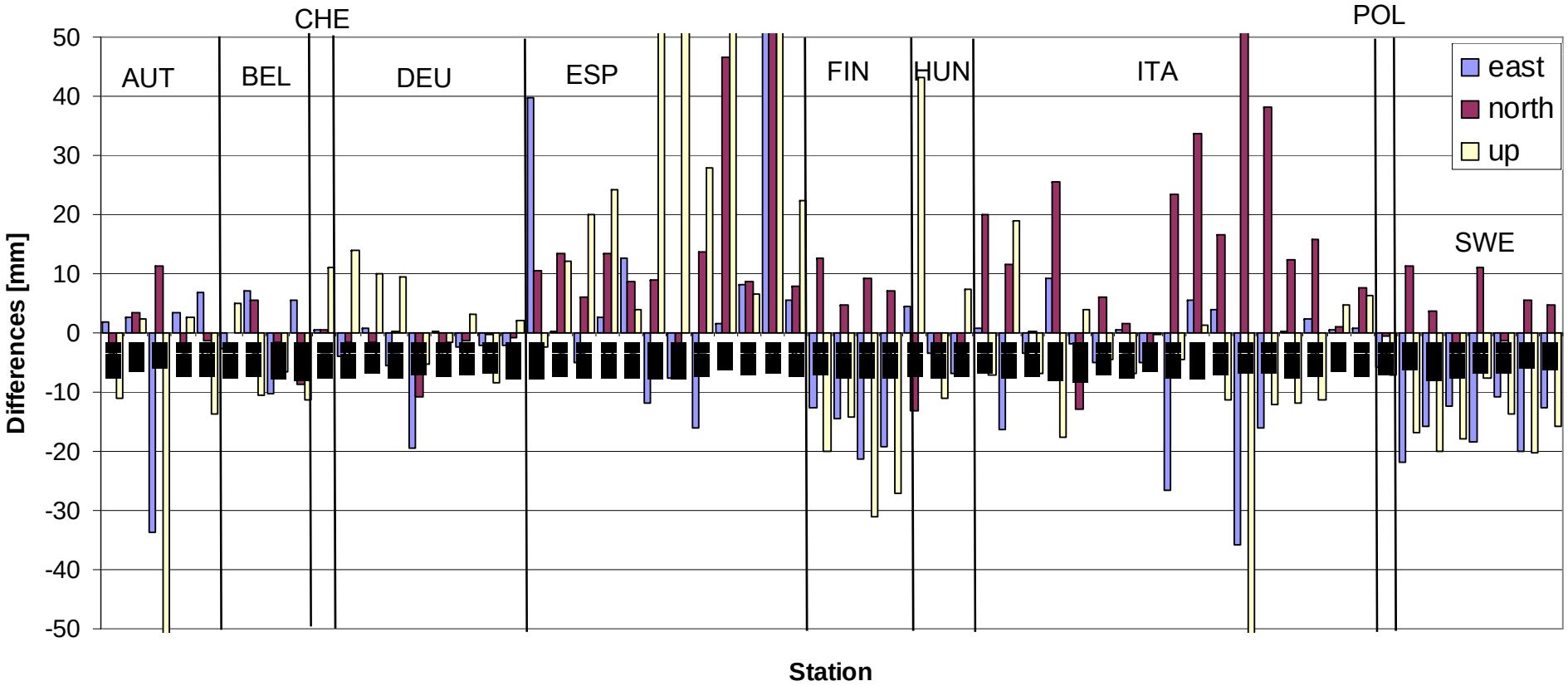
Status: 12.2.2009

Comparison with EPN05 densification Method

ITRF05 Desnification solution of the EPN (Nov. 2008)

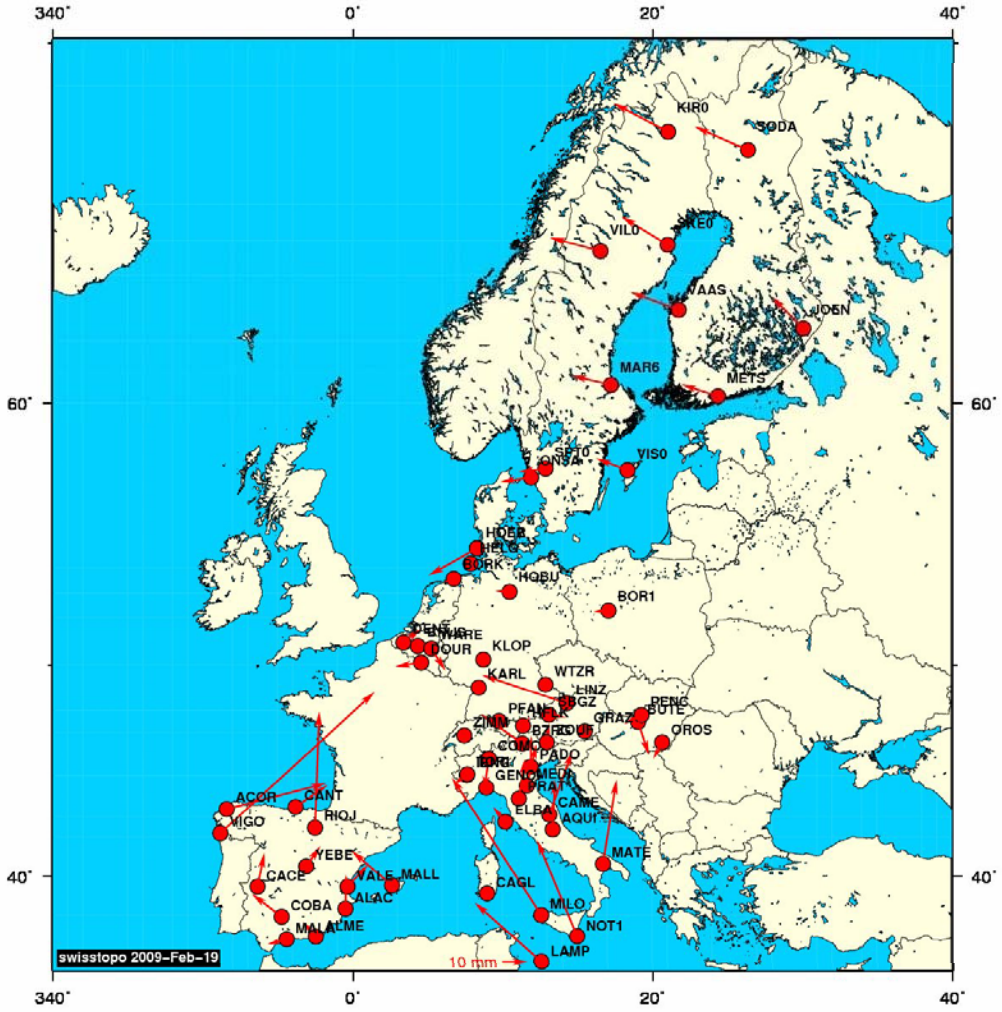


Comparison with EPN05 densification Differences

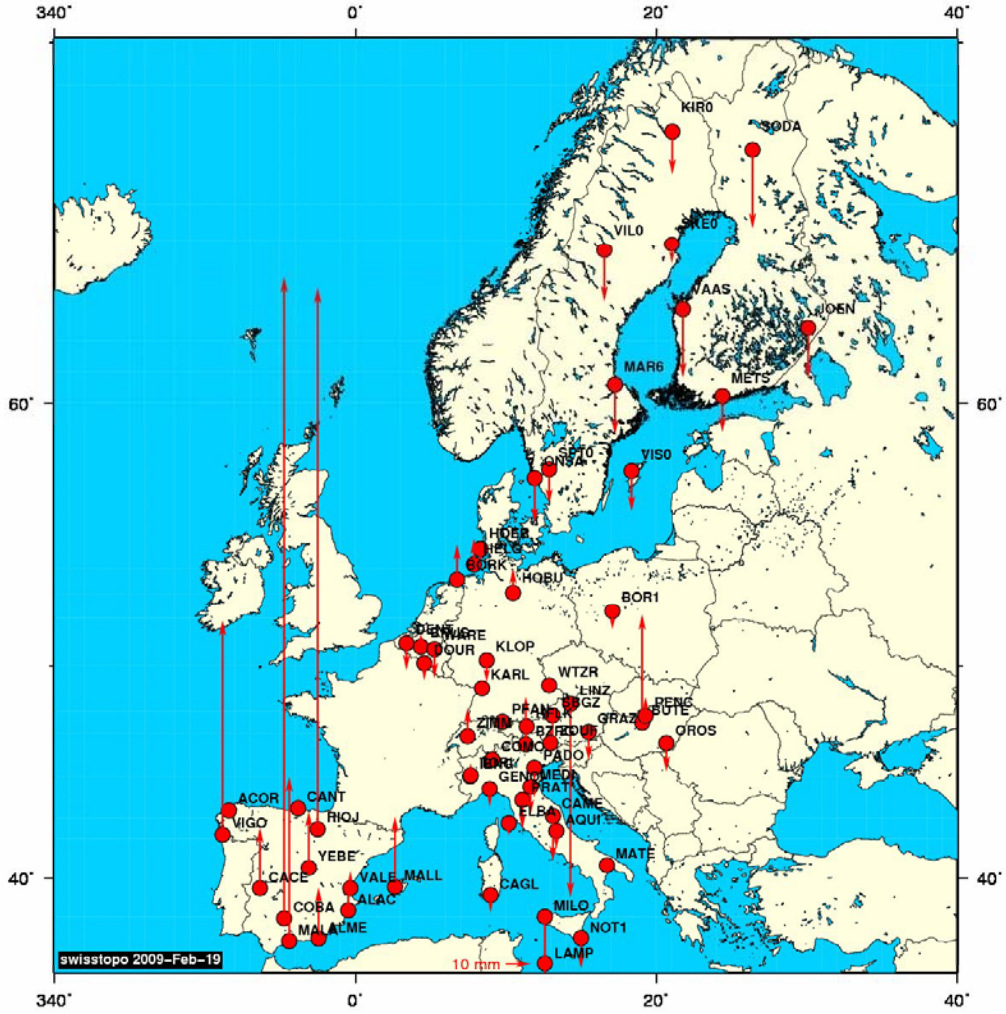


- 57 sites, 6 outliers
- Mean bias in mm (E,N,U): -4, 5, -2 mm
- Mean std in mm (E,N,U): 10, 10, 14 mm

Comparison with EPN05 densification Differences: horizontally



Comparison with EPN05 densification Differences: vertically



Comparison with EPN05 densification Problems / Outliers

- > 5 cm horizontally + vertically
  - Austria: LINZ (provided national ETRF coordinates agree with the EPN05 densification for site epoch 2001 – 2002)
  - Spain (upto 25 cm up): MALA, RIOJ (EPN05 bad); VIGO, COBA (?)
  - Italy: MILO EPN05 bad + tectonical movement South Italy

- Normal effects due to different ETRFYY definitions and due to location on “non-stable plate” (Scandinavia, Italy)

To do / questions

- Feedback to the countries which sent data
- Ask the other countries for a contribution
  - E-mail directly ¦¦ with the invitation to the EUREF Symposium?
  - Contact persons (technically – administrative)?
  - Is the topic something, we should ask to document also in the national reports?
- Time schedule: presentation of these results (as motivation for other countries to deliver results) ¦¦ as much as possible results already at the EUREF Symposium


euref

Example EPN coordinates ITRF/ETRF

ZIMM

To obtain the site positions at an epoch t different from t_0, apply the site velocities: $X(t) = X(t_0) + (t-t_0)*V_X$; $Y(t) = Y(t_0) + (t-t_0)*V_Y$; $Z(t) = Z(t_0) + (t-t_0)*V_Z$
Periods indicated in red are of reduced quality (e.g. caused by short observation history) and should be used with care.

1. EPN POSITIONS/VELOCITIES

1. A) Positions/velocities published by EUREF (release Dec. 2008)

ETRF2000*	epoch t_0	Position (m)			Velocity (m/y)		
		X_{EPN}	Y_{EPN}	Z_{EPN}	VX_{EPN}	VY_{EPN}	VZ_{EPN}
182/96 - 310/98	2000.0	4331297.342 ± 0.000	567555.634 ± 0.000	4633133.720 ± 0.000	0.0012 ± 0.0001	0.0004 ± 0.0000	0.0020 ± 0.0001
310/98 - 365/05	2000.0	4331297.331 ± 0.000	567555.637 ± 0.000	4633133.708 ± 0.000	0.0012 ± 0.0001	0.0004 ± 0.0000	0.0020 ± 0.0001

*ETRF2000 is the conventional reference frame used to realise the ETRS89

ETRF2000(R05) Trafo parameters

ITRF2005	epoch t_0	Position (m)			Velocity (m/y)		
		X_{EPN}	Y_{EPN}	Z_{EPN}	VX_{EPN}	VY_{EPN}	VZ_{EPN}
182/96 - 310/98	2000.0	4331297.141 ± 0.000	567555.787 ± 0.000	4633133.883 ± 0.000	-0.0126 ± 0.0001	0.0180 ± 0.0000	0.0127 ± 0.0001
310/98 - 365/05	2000.0	4331297.130 ± 0.000	567555.789 ± 0.000	4633133.871 ± 0.000	-0.0126 ± 0.0001	0.0180 ± 0.0000	0.0127 ± 0.0001

1. B) Positions/velocities published by the IERS

Last ETRS89/ITRS realization (release July 2006):

ETRF2000(R05)	epoch t_0	Position (m)			Velocity (m/y)		
		X_{IERS}	Y_{IERS}	Z_{IERS}	VX_{IERS}	VY_{IERS}	VZ_{IERS}
start - 310/98	2000.0	4331297.341 ± 0.001	567555.635 ± 0.000	4633133.719 ± 0.001	0.0000 ± 0.0001	-0.0003 ± 0.0001	0.0004 ± 0.0001
310/98 - 365/05	2000.0	4331297.332 ± 0.001	567555.636 ± 0.000	4633133.709 ± 0.001	0.0000 ± 0.0001	-0.0003 ± 0.0001	0.0004 ± 0.0001

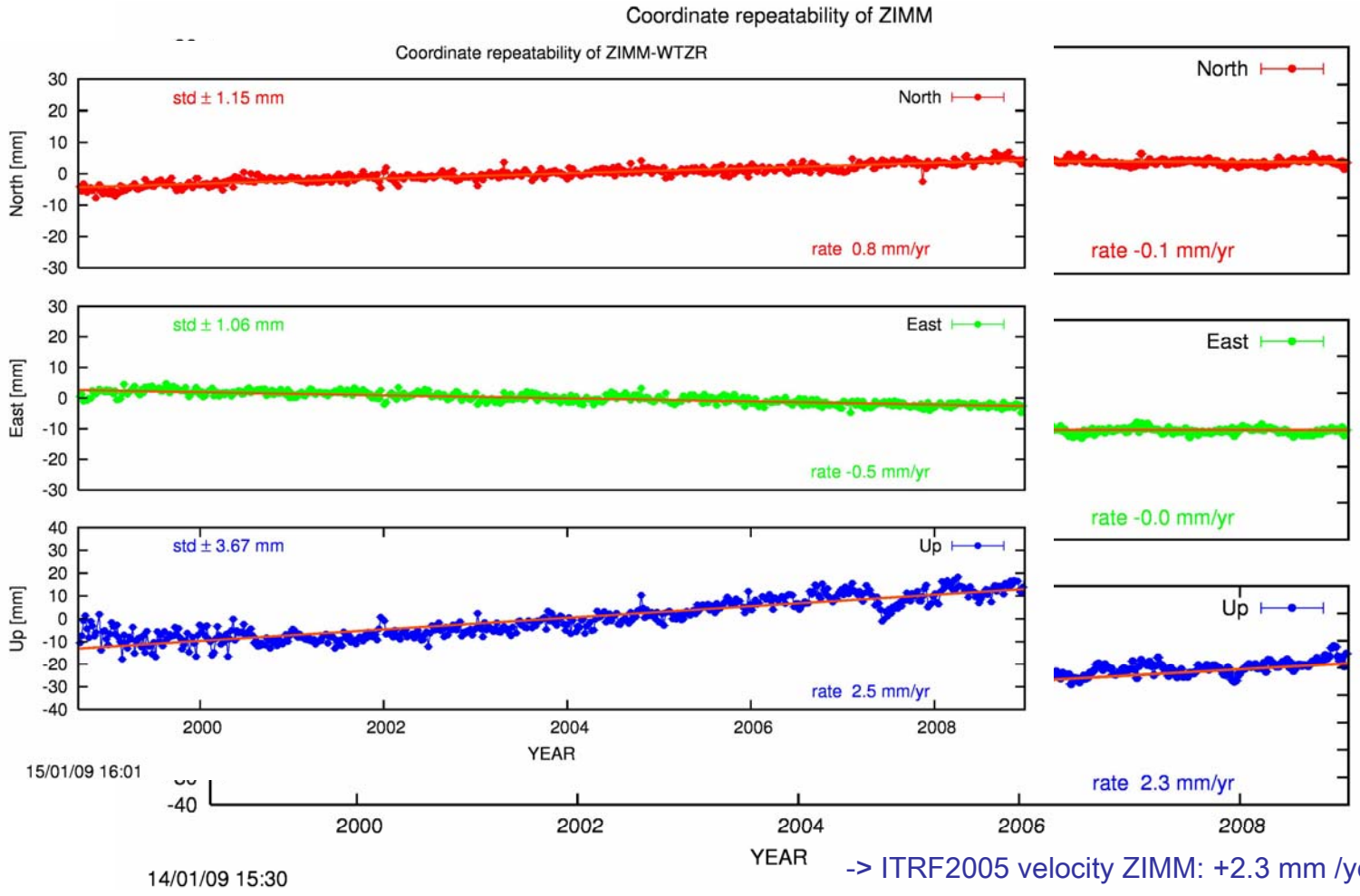
ETRF2000(R05) Trafo parameters

ITRF2005	epoch t_0	Position (m)			Velocity (m/y)		
		X_{IERS}	Y_{IERS}	Z_{IERS}	VX_{IERS}	VY_{IERS}	VZ_{IERS}
start - 310/98	2000.0	4331297.140 ± 0.001	567555.787 ± 0.000	4633133.882 ± 0.001	-0.0126 ± 0.0001	0.0181 ± 0.0001	0.0127 ± 0.0001
310/98 - 365/05	2000.0	4331297.131 ± 0.001	567555.789 ± 0.000	4633133.872 ± 0.001	-0.0126 ± 0.0001	0.0181 ± 0.0001	0.0127 ± 0.0001

-> ITRF2005 EPN05 densification ZIMM: +2.3 mm /year
WTZR: +0.8 mm /year
ZIMM-WTZR: +1.5 mm /year ≠ 2.5 mm/year

Timeseries AGNES

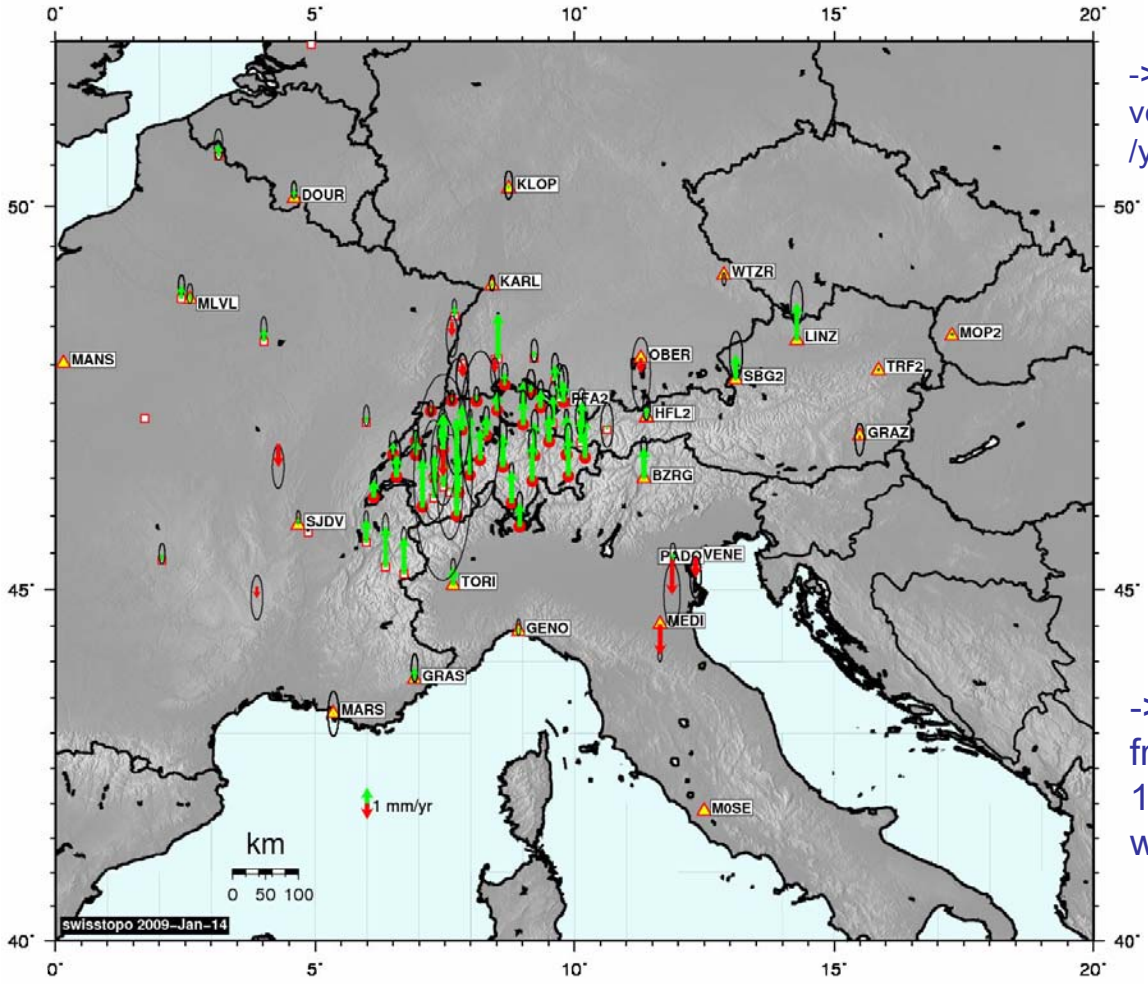
10 years weekly solutions, velocities estimated;
Datum definition: ZIMM (ITRF2005 vertical velocity)



-> ITRF2005 velocity ZIMM: +2.3 mm /year

-> ITRF2005 velocity WTZR: +1.5 mm /year
ZIMM-WTZR: 0.8 mm / year ≠ 2.5 mm/year

Velocities AGNES: vertical relative to ITRF2005 ZIMM



-> reasonable ITRF2005 velocities ZIMM: +2.3 mm /year

-> comparison with results from levelling basing on 100 years of observations will be done

Relative velocity-"constraints": 0.001 mm/year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Proposal: official national ETRF coordinates on EPN web site

- EUREF main goal: **maintenance of the reference frame** realized by
  - campaigns (“historically”, EUREF TWG classification + EUREF campaign database)
  - permanent networks
- coordinates of permanent stations:
  - EPN web portal gives detailed information on coordinates. coordinates are mainly “scientific” oriented:
    - weekly
    - ITRF / ETRF coordinates
    - EPN cummulative coordinate sets
  - EPN stations are also used to realize the national reference systems, which are mostly aligned to ETRS

Proposal: official national ETRF coordinates on EPN web site (2)

EPN

National level (e.g. CH)

COORDINATES from last weekly EPN solution, EPN cumulative and IERS in ITRS or ETRS89

	epoch t_0	X_{weekly}	Y_{weekly}	Z_{weekly}
IGS05	2008.66 (Wk No 1495)	4331297.0169 ± 0.0008	567555.9454 ± 0.0003	4633133.9816 ± 0.0009

	epoch t_0	Position (m)			Velocity (m/y)		
		X_{EPN}	Y_{EPN}	Z_{EPN}	VX_{EPN}	VY_{EPN}	VZ_{EPN}
ITRF2005 (from 182/96)	2000.0	4331297.1430 ± 0.0000	567555.7870 ± 0.0000	4633133.8850 ± 0.0000	-0.0131 ± 0.0001	0.0179 ± 0.0000	0.0123 ± 0.0001
ITRF2005 (from 310/98)	2000.0	4331297.1310 ± 0.0000	567555.7900 ± 0.0000	4633133.8720 ± 0.0000	-0.0131 ± 0.0001	0.0179 ± 0.0000	0.0123 ± 0.0001
ITRF2005 (from 309/06)	2000.0	4331297.1300 ± 0.0010	567555.7920 ± 0.0000	4633133.8720 ± 0.0010	-0.0131 ± 0.0001	0.0179 ± 0.0000	0.0123 ± 0.0001
ETRF00(R05) (from 182/96)	2000.0	4331297.3420 ± 0.0000	567555.6350 ± 0.0000	4633133.7270 ± 0.0000	0.0007 ± 0.0001	0.0002 ± 0.0000	0.0016 ± 0.0001
ETRF00(R05) (from 310/98)	2000.0	4331297.3300 ± 0.0000	567555.6380 ± 0.0000	4633133.7130 ± 0.0000	0.0007 ± 0.0001	0.0002 ± 0.0000	0.0016 ± 0.0001
ETRF00(R05) (from 309/06)	2000.0	4331297.3290 ± 0.0010	567555.6400 ± 0.0000	4633133.7130 ± 0.0010	0.0007 ± 0.0001	0.0003 ± 0.0000	0.0016 ± 0.0001

	epoch t_0	Position (m)			Velocity (m/y)		
		X_{IERS}	Y_{IERS}	Z_{IERS}	VX_{IERS}	VY_{IERS}	VZ_{IERS}
ITRF2005	2000.0	4331297.1400 ± 0.0010	567555.7870 ± 0.0000	4633133.8820 ± 0.0010	-0.0126 ± 0.0001	0.0181 ± 0.0001	0.0127 ± 0.0001
ITRF2005 (from 310/98)	2000.0	4331297.1310 ± 0.0010	567555.7890 ± 0.0000	4633133.8720 ± 0.0010	-0.0126 ± 0.0001	0.0181 ± 0.0001	0.0127 ± 0.0001
ITRF2000	1997.0	4331297.1820 ± 0.0020	567555.7300 ± 0.0010	4633133.8450 ± 0.0020	-0.0138 ± 0.0004	0.0185 ± 0.0002	0.0100 ± 0.0005
ITRF2000 (from 312/98)	1997.0	4331297.1770 ± 0.0020	567555.7320 ± 0.0010	4633133.8400 ± 0.0030	-0.0138 ± 0.0004	0.0185 ± 0.0002	0.0100 ± 0.0005
ITRF97	1997.0	4331297.1970 ± 0.0020	567555.7370 ± 0.0010	4633133.8360 ± 0.0020	-0.0115 ± 0.0005	0.0177 ± 0.0004	0.0107 ± 0.0005
ITRF96	1997.0	4331297.2010 ± 0.0030	567555.7400 ± 0.0020	4633133.8430 ± 0.0030	-0.0111 ± 0.0003	0.0173 ± 0.0004	0.0126 ± 0.0003

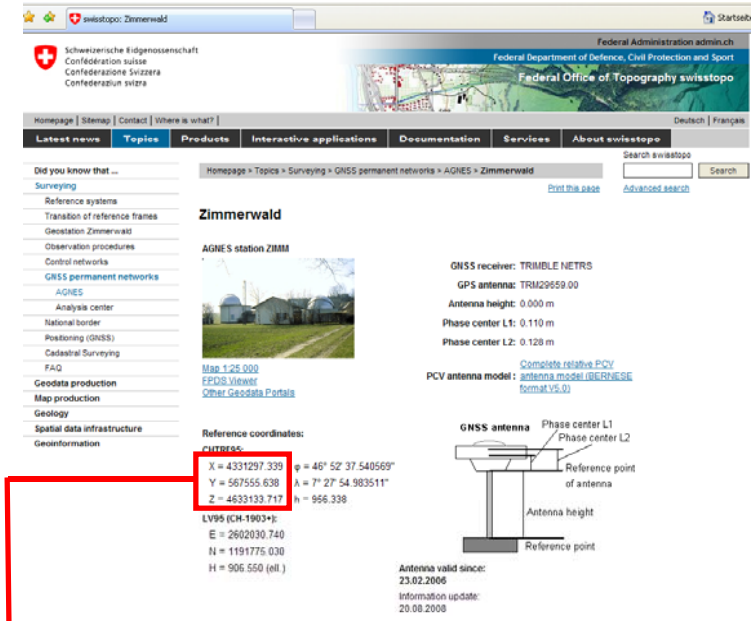
	epoch t_0	Position (m)			Velocity (m/y)		
		X_{IERS}	Y_{IERS}	Z_{IERS}	VX_{IERS}	VY_{IERS}	VZ_{IERS}
ETRF2005	2000.0	4331297.3480 ± 0.0010	567555.6410 ± 0.0000	4633133.7270 ± 0.0010	0.0012 ± 0.0001	0.0005 ± 0.0001	0.0020 ± 0.0001
ETRF2005 (from 310/98)	2000.0	4331297.3390 ± 0.0010	567555.6430 ± 0.0000	4633133.7170 ± 0.0010	0.0012 ± 0.0001	0.0005 ± 0.0001	0.0020 ± 0.0001
ETRF2000	1989.0	4331297.3470 ± 0.0040	567555.6330 ± 0.0020	4633133.7170 ± 0.0040	-0.0007 ± 0.0004	0.0001 ± 0.0002	-0.0001 ± 0.0005
ETRF2000 (from 312/98)	1989.0	4331297.3420 ± 0.0040	567555.6350 ± 0.0020	4633133.7120 ± 0.0050	-0.0007 ± 0.0004	0.0001 ± 0.0002	-0.0001 ± 0.0005
ETRF97	1989.0	4331297.3310 ± 0.0040	567555.6360 ± 0.0030	4633133.7010 ± 0.0040	0.0015 ± 0.0005	-0.0004 ± 0.0004	0.0008 ± 0.0005
ETRF96	1989.0	4331297.3310 ± 0.0030	567555.6430 ± 0.0030	4633133.6930 ± 0.0030	0.0020 ± 0.0003	-0.0009 ± 0.0004	0.0026 ± 0.0003

international

national

If station used in national networks basing on ETRS

ETRF93	Epoch 1993.0	4331297.339	567555.638	633133.717



Personal communication (e-mail) from NMA / using standardized file format

Proposal: official national ETRF coordinates on EPN web site (3)

Displaying of “official national ETRF coordinates” for stations used within EPN and national permanent networks on the EPN web site (optional for NMA’s)

- ☺ EUREF underlines the position as an umbrella of the national mapping agencies; the link EPN <-> NMA is visible on the web + info must flow
- ☺ for EUREF and all users of the data of the station: differences of “official national” to “scientific” ETRF coordinates. (evtl. “displacement” map of the differences show how well ETRS is realized: problems for sites / entire countries) “**ETRS89 proof**”
- ☺ for the mapping agencies: EPN monitors the compliance with ETRF scientific solutions as an service for the contribution countries; EUREF knows better about the used national coordinates in case of new reference frame definitions ETRF00(RYY).
- ☺ NMA’s provide information to the EPN (not only receiving info)

Proposal: official national ETRF coordinates on EPN web site (4)

Displaying of “official national ETRF coordinates” for stations used within EPN and national permanent networks on the EPN web site (optional for NMA’s)

😐 to be done (EUREF TWG + EPN CB + NMA):

- list of EPN stations, which are part of national reference networks collection of the coordinates
- document about update procedure (changes are extremely rare; history is sufficiently archived by NMAs)
- include info to the EPN web site; optional: generation of an downloadable coordinate file; generation of “difference” plots

Remarks, Comments, Suggestions?

- idea was positivly supported at the LAC workshop in Frankfurt in October, 22-23, 2008
- agreed / ensured tasks:
  - E. Brockmann: collection of information
  - C. Bruyninx: inclusion to the EPN web page

File format for information exchange

File name: CHE_200810021.ETRF

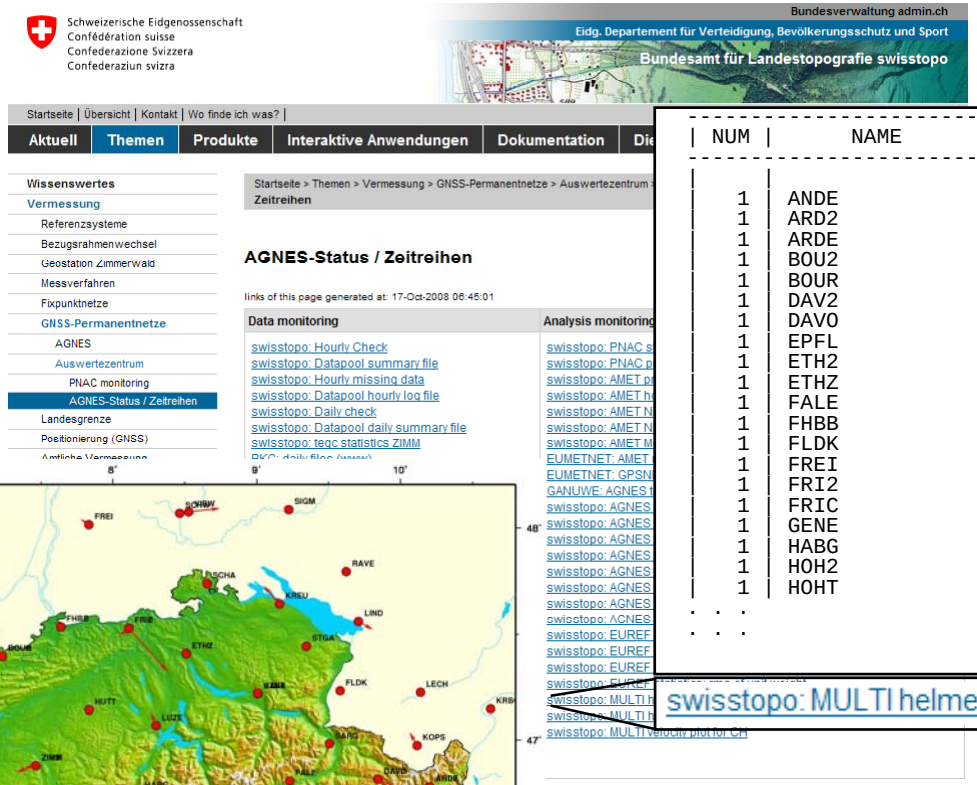
Station DOMES	X	Y	Z	Frame	Epoch	valid from to	remark
ZIM2 14001M008	4331300.1443	567537.0824	4633133.4977	ETRF93	1993 01 01	1995 01 01	
ZIMM 14001M004	4331297.3388	567555.6380	4633133.7174	ETRF93	1993 01 01	2007 11 09	

File name: SWE_200810024.ETRF

Station DOMES	X	Y	Z	Frame	Epoch	valid from to	remark
KIR0 10422M001	2248123.5038	865686.5326	5886425.5943	ETRF97	1999 07 01		
MAR6 10405M002	2998189.7132	931451.5886	5533398.4735	ETRF97	1999 07 01		
ONSA 10402M004	3370658.8318	711876.9387	5349786.7450	ETRF97	1999 07 01		
SKE0 10426M001	2534031.1978	975174.4040	5752078.3436	ETRF97	1999 07 01		
SPT0 10425M001	3328984.8211	761910.0677	5369033.4857	ETRF97	1999 07 01	2007 06 08	
VIL0 10424M001	2620258.8912	779137.9797	5743799.2762	ETRF97	1999 07 01		
VIS0 10423M001	3246470.5614	1077900.3132	5365277.9025	ETRF97	1999 07 01		

Example swisstopo

Difference between
“official” and
scientific coordinates



NUM	NAME	FLG	RESIDUALS IN MILLIMETERS		
1	ANDE	E T	0.6	-1.3	1.6
1	ARD2	E T	-8.6	4.9	-10.0
1	ARDE	E T	-6.9	4.7	-6.4
1	BOU2	E T	1.2	-1.0	-0.4
1	BOUR	E T	-0.3	-1.1	-0.2
1	DAV2	E T	-4.2	5.6	-5.6
1	DAVO	E T	-3.2	6.5	-4.5
1	EPFL	E T	1.3	-0.2	0.5
1	ETH2	E T	1.2	-0.3	0.1
1	ETHZ	E T	-0.6	0.1	-0.5
1	FALE	E T	-0.2	-0.8	0.3
1	FHBB	E T	0.9	-1.3	-0.2
1	FLDK	E T	0.2	-0.3	-2.0
1	FREI	E T	0.8	-1.3	0.2
1	FRI2	E T	-4.7	6.7	19.4
1	FRIC	E T	-1.5	-1.4	-0.3
1	GENE	E T	1.7	-1.0	-2.2
1	HABG	E T	1.4	0.3	-2.3
1	HOH2	E T	1.0	-1.0	1.1
1	HOHT	E T	-4.6	-1.6	-6.4

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swisstopo: MULTI helmert to official crd