



- Validation of ITRF2008 -> ETRF2000(R08) transformation**
- IGS2008/ITRF2008 validation**

E. Brockmann



Validation scheme

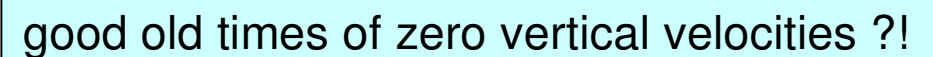
- Input: 4 coordinate sets at epochs (2000, 2005, 2010, 2015) with 43 EPN sites
 - ITRF2008 (direct set from SINEX)
 - ITRF2005 (ITRF05+IGS05, AJAC from EPN-Dens.)
- Method: Transformation according Memo V8.0
- Output: 4 coordinate sets at epochs (2000, 2005, 2010, 2015) with 43 EPN sites
 - ETRF2000 (R05)
 - ETRF2000 (R08)



ITRF05 (big ...)



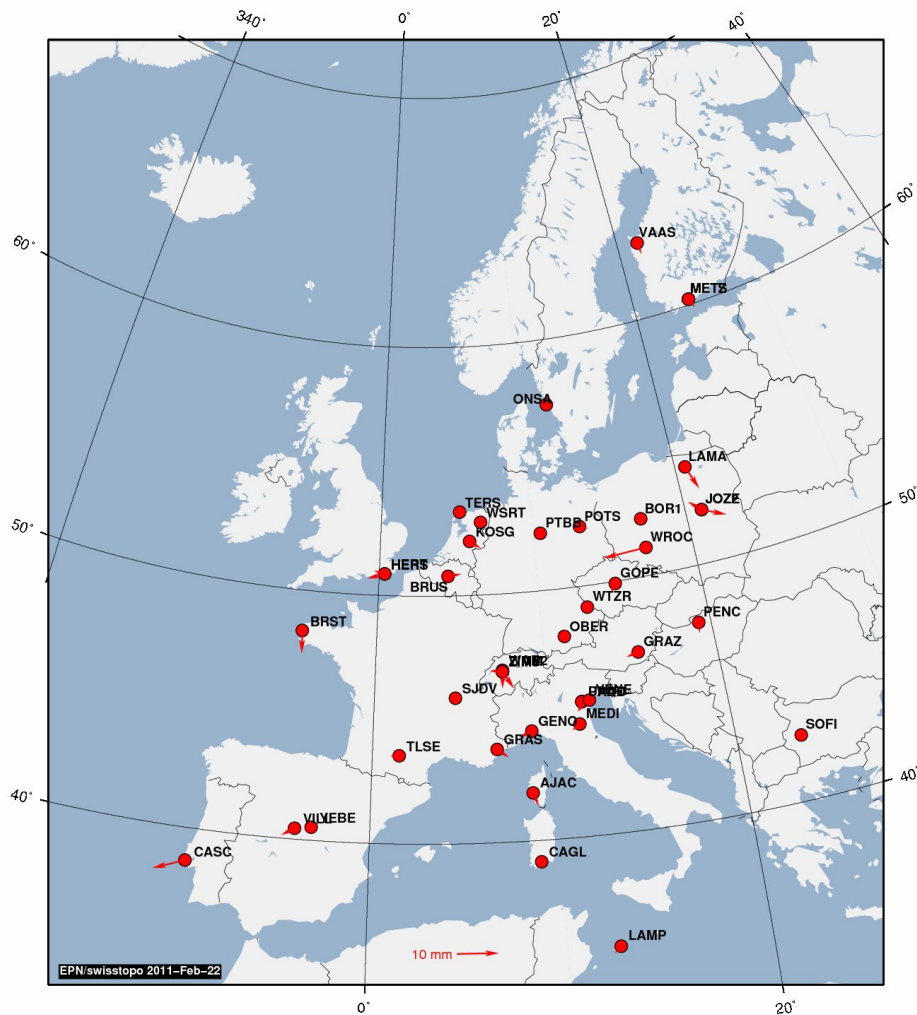
ITRF08



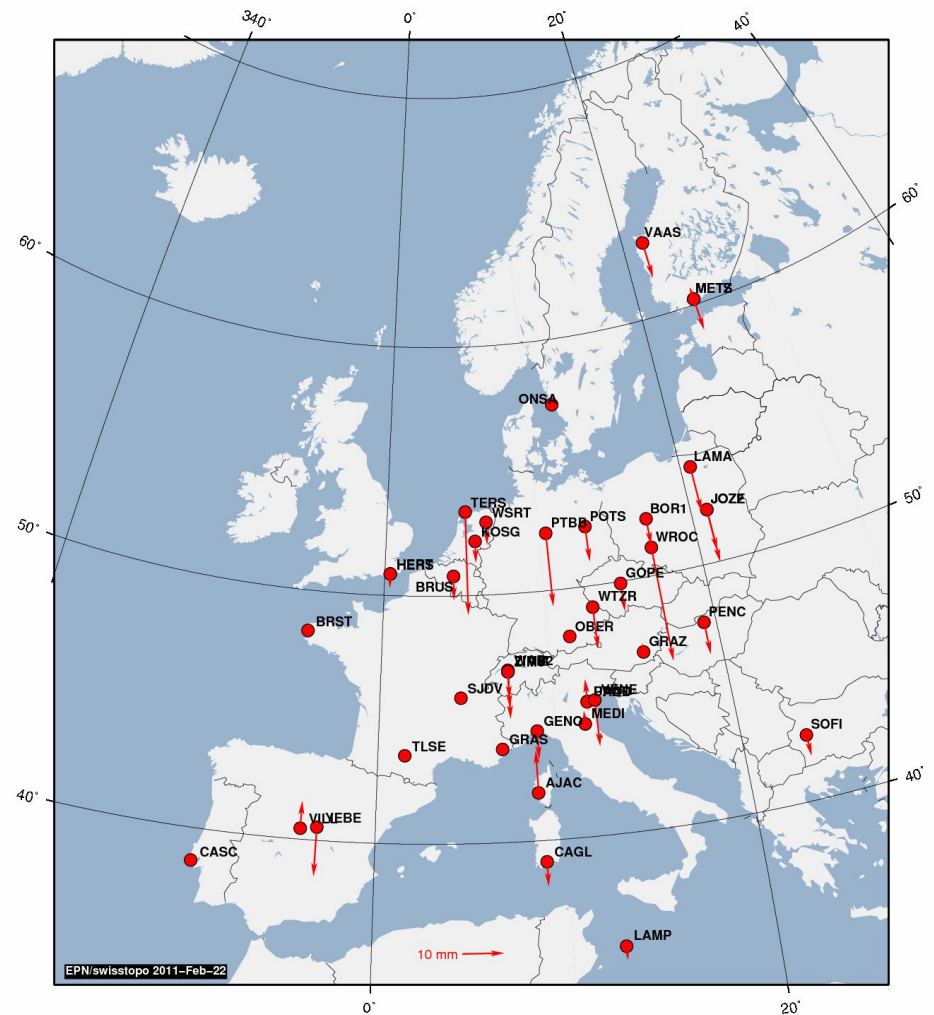


Coordinate differences ETRF2000 (R08) – (R05): Epoch 2000

horizontally



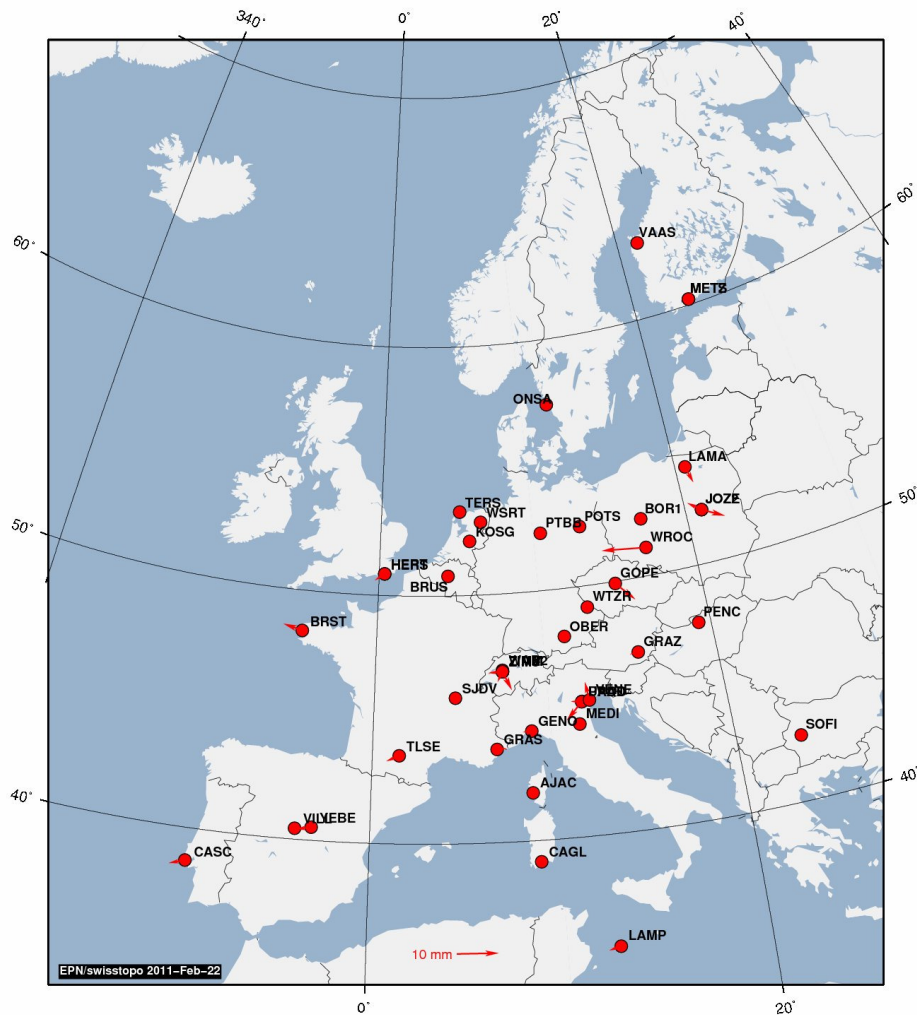
vertically



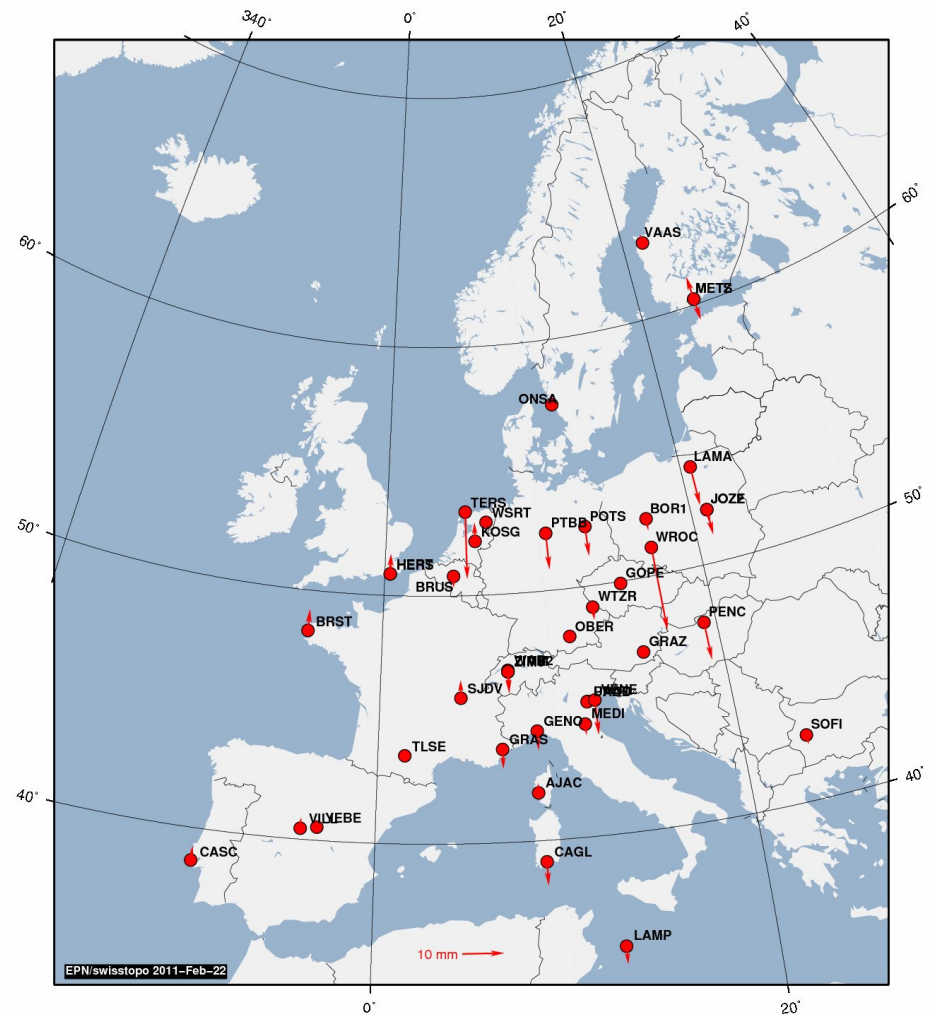


Coordinate differences ETRF2000 (R08) – (R05): Epoch 2005

horizontally



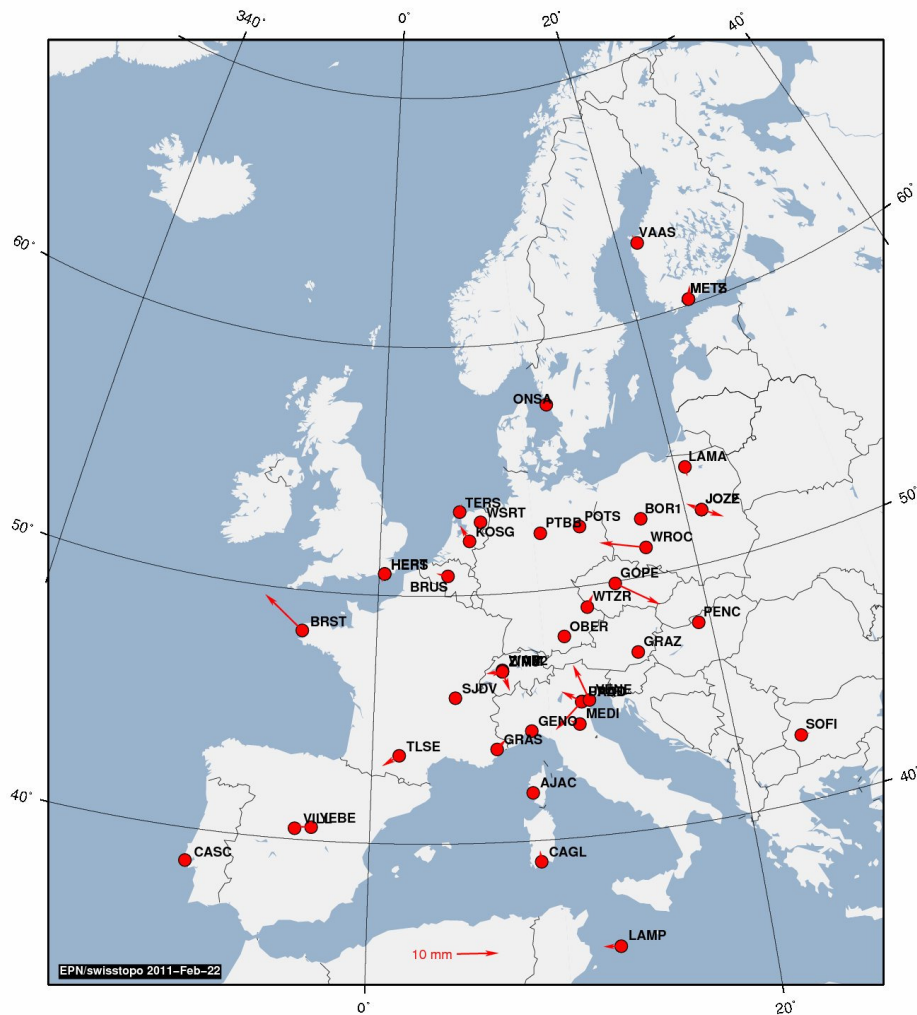
vertically



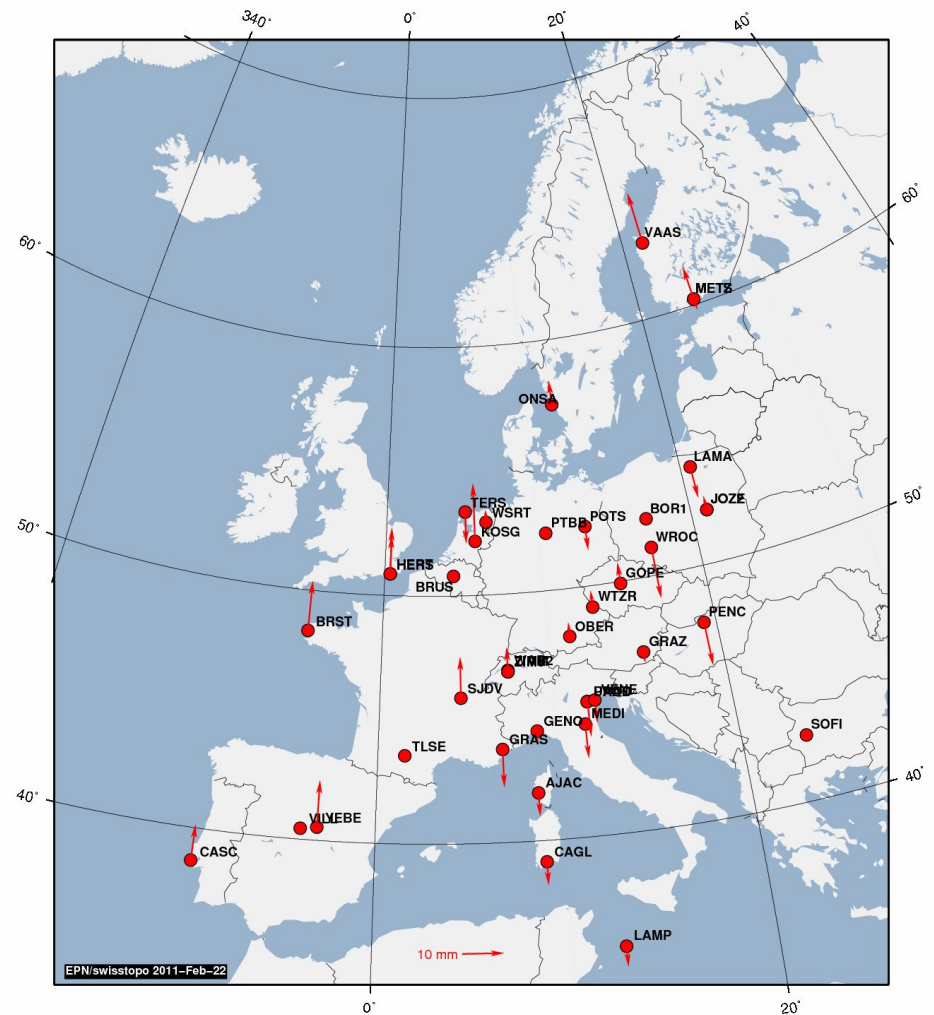


Coordinate differences ETRF2000 (R08) – (R05): Epoch 2010

horizontally



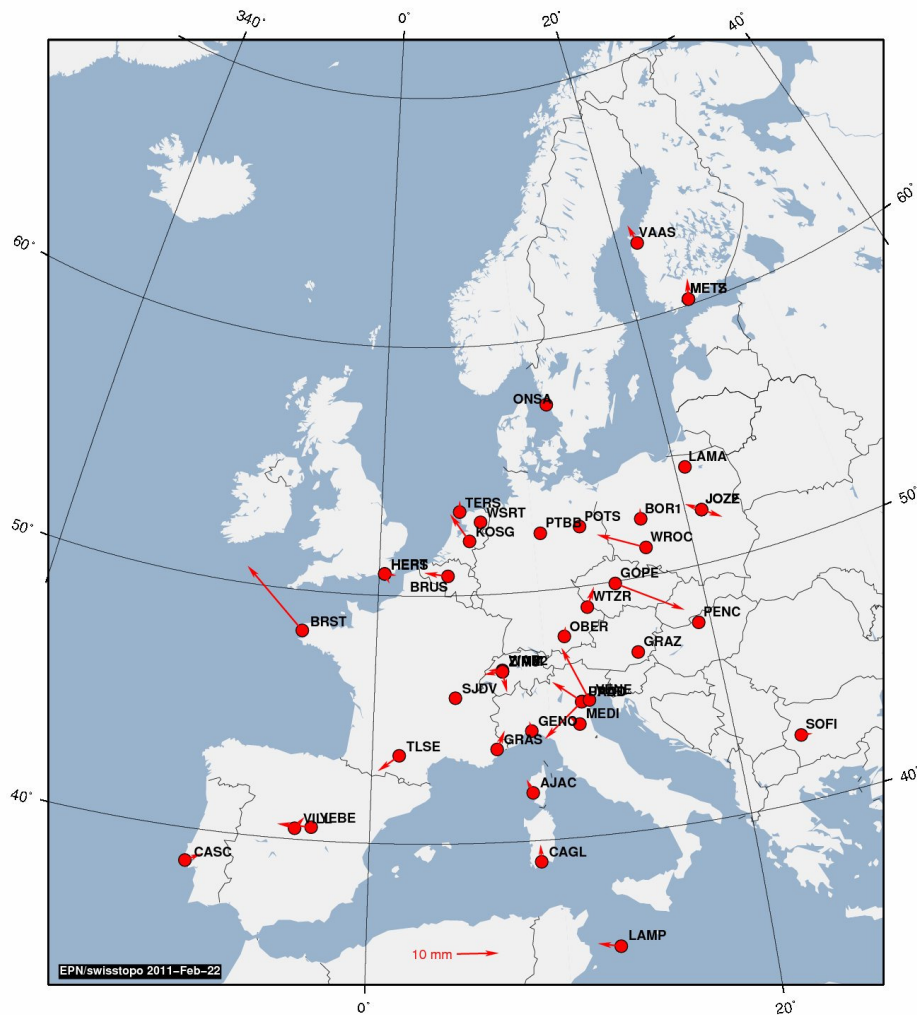
vertically



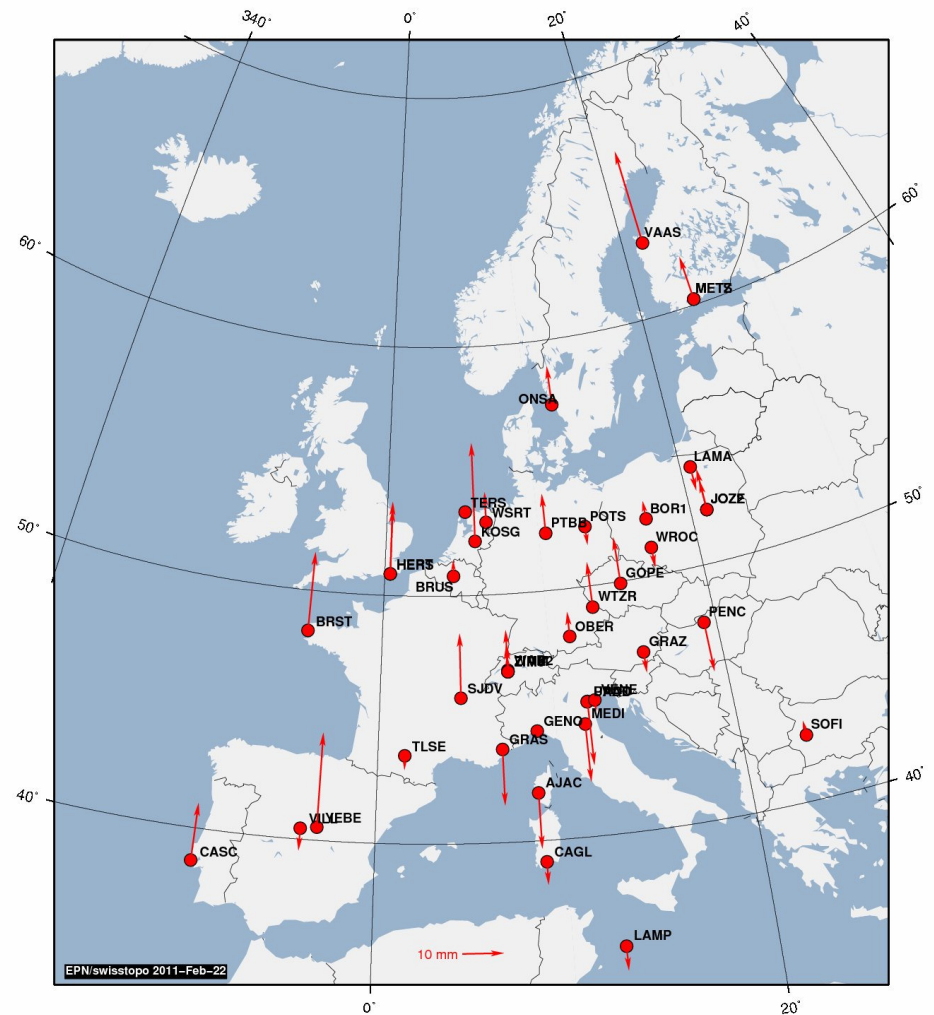


Coordinate differences ETRF2000 (R08) – (R05): Epoch 2015

horizontally



vertically

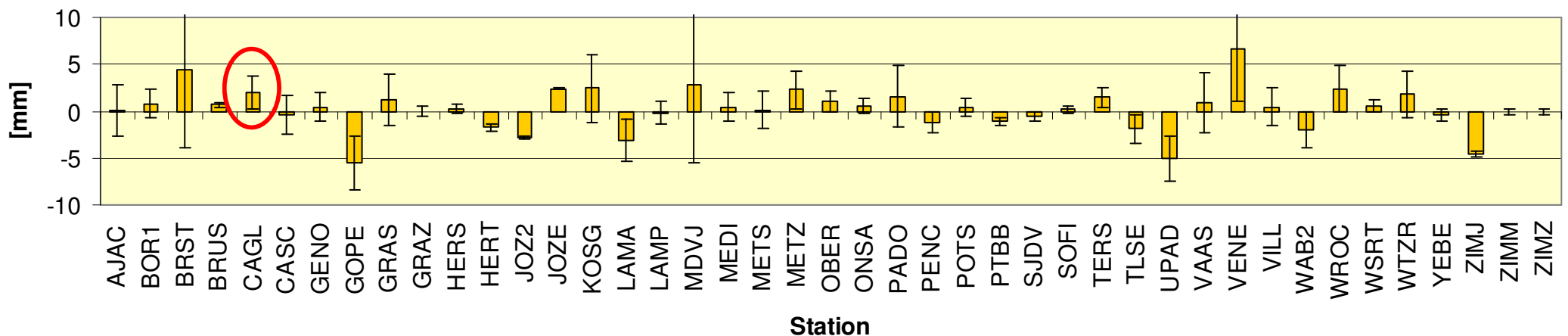


Mean Difference ETRF2000 (R08) – (R05)

- Input: raw difference ETRF2000(R08) - ETRF2000(R05)[Epoch]
 - Epoch = {2000;2005;2010;2015}
 - 43 sites
- Example: CAGL:

Diff. E08 – E05 [mm]	dNorth	dEast	dUp
2000:	-0.1	-0.5	-5.8
2005:	1.3	-0.4	-5.7
2010:	2.7	-0.2	-5.6
2015:	4.1	0.0	-5.5
Mean ± STD	2.0 ± 1.8	-0.3 ± 0.2	-5.6 ± 0.1

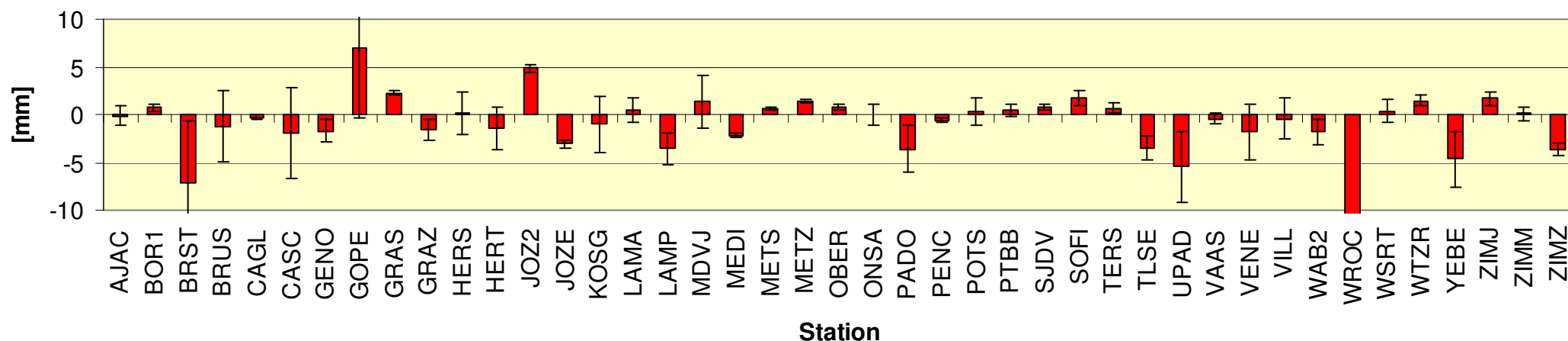
ETRF2000 Difference from I08/I05 Epochs 2000-2015: North



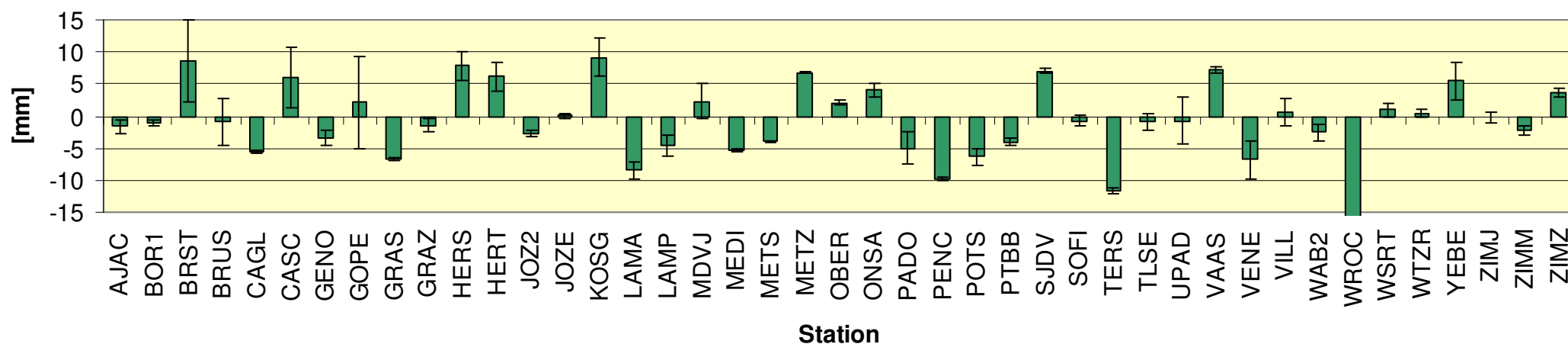


Mean Difference ETRF2000 (R08) – (R05) (2)

ETRF2000 Difference from I08/I05 Epochs 2000-2015: East

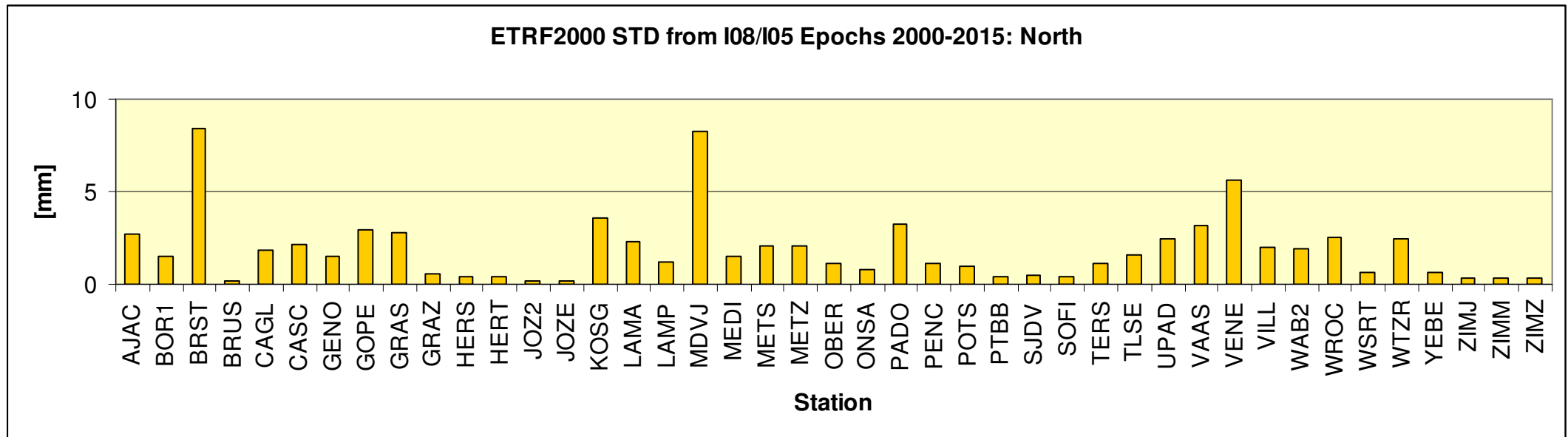


ETRF2000 Difference from I08/I05 Epochs 2000-2015: Up



Mean STD ETRF2000 (R08) – (R05)

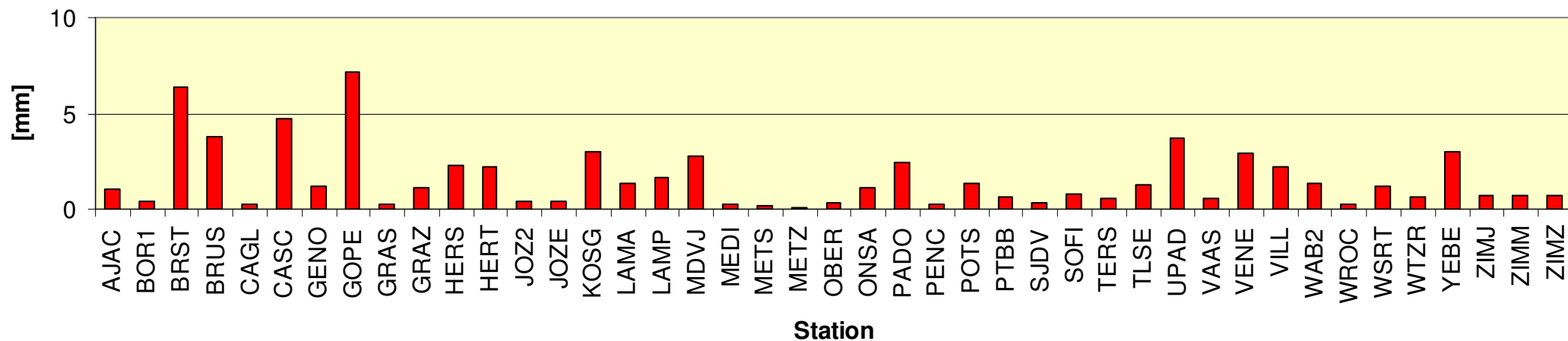
only size of the error bars



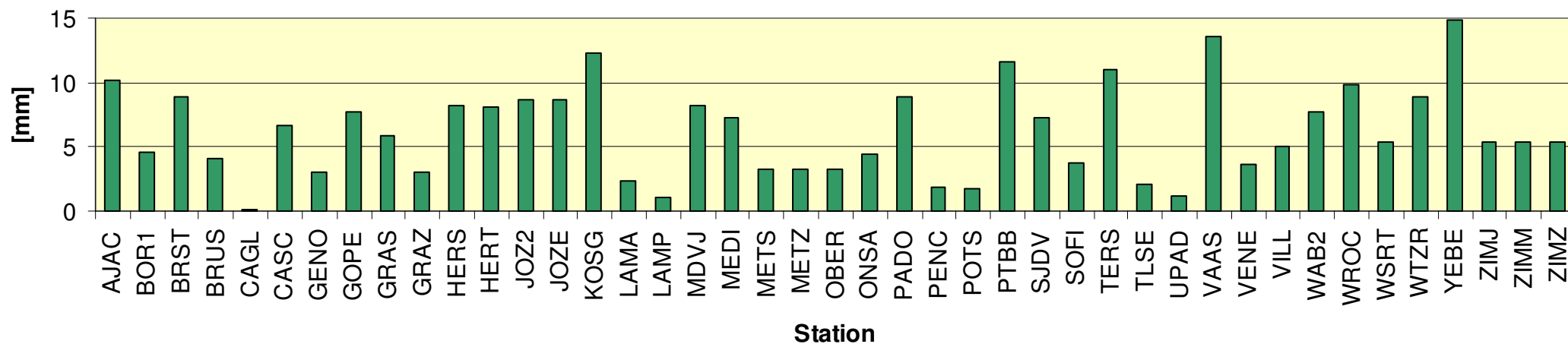


Mean STD ETRF2000 (R08) – (R05) (2)

ETRF2000 STD from I08/I05 Epochs 2000-2015: East



ETRF2000 STD from I08/I05 Epochs 2000-2015: Up



Stability of ETRF coordinates in time

or: is ETRF2000(R05) or ETRF2000(R08) more stable?

- Example ZIMM

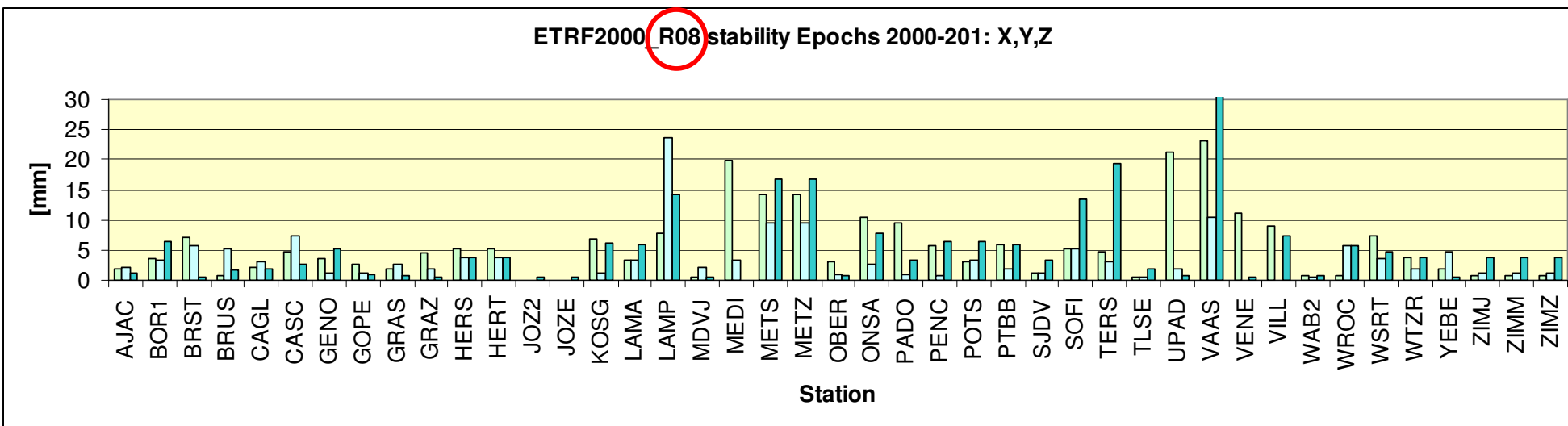
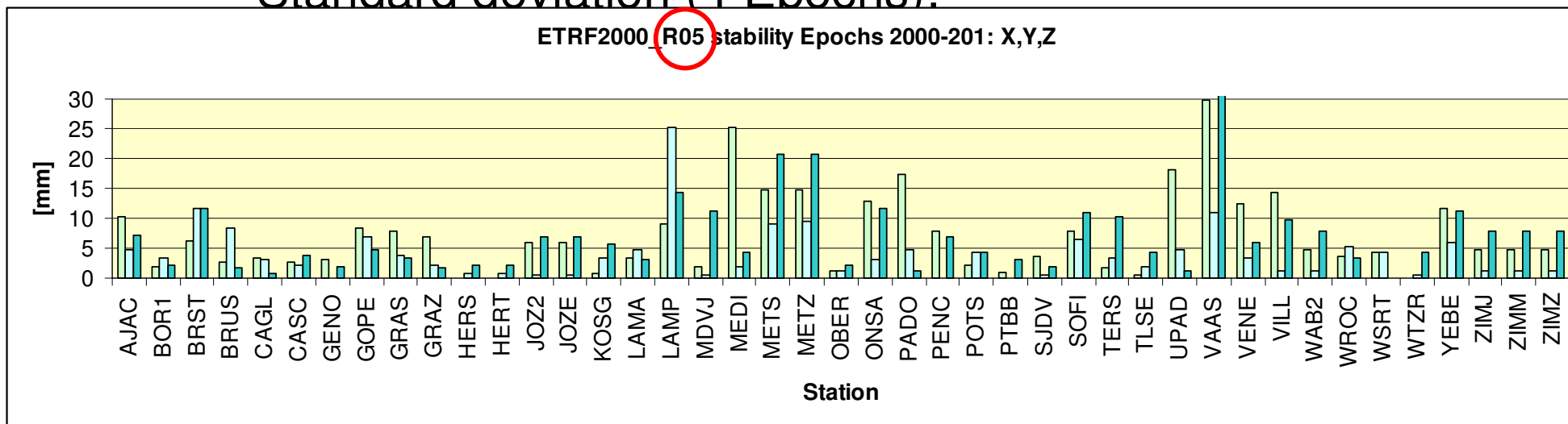
ETRF2000 (R05)	X [m]	Y [m]	Z [m]		dx	dy	dz
2000	4331297.326	567555.638	4633133.705		-5.5	1.5	-9.0
2005	4331297.330	567555.637	4633133.711		-1.8	0.5	-3.0
2010	4331297.333	567555.636	4633133.717		1.8	-0.5	3.0
2015	4331297.337	567555.635	4633133.723		5.5	-1.6	9.1
Mean / std	4331297.332	567555.637	4633133.714		4.7	1.3	7.8

ETRF2000 (R08)	X [m]	Y [m]	Z [m]		dx	dy	dz
2000	4331297.332	567555.638	4633133.711		0.5	1.7	-2.8
2005	4331297.333	567555.637	4633133.714		1.1	0.6	0.3
2010	4331297.333	567555.636	4633133.717		1.8	-0.4	3.3
2015	4331297.334	567555.635	4633133.720		2.5	-1.4	6.3
Mean / std	4331297.333	567555.637	4633133.716		0.9	1.3	3.9

- Goal: as stable as possible in time for sites on stable European plate

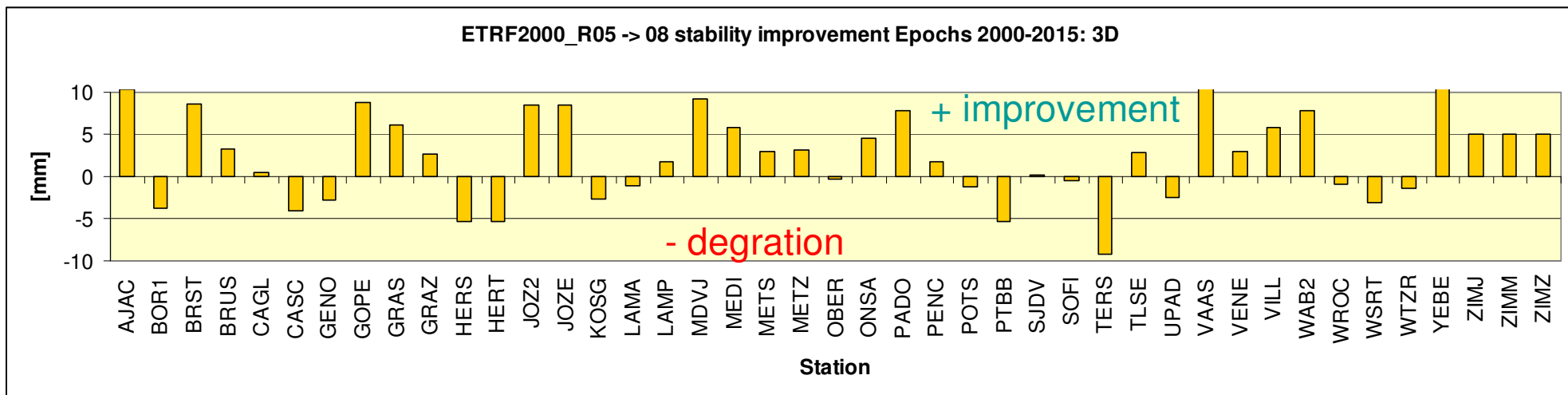
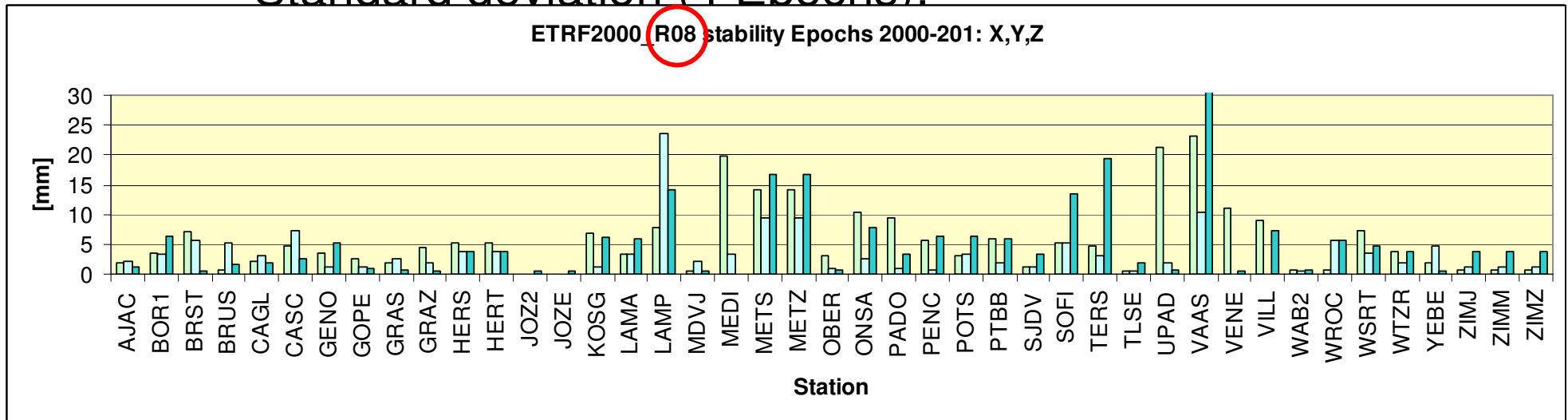
Stability of ETRF coordinates (2)

- Standard deviation (4 Epochs):



Stability of ETRF coordinates (3)

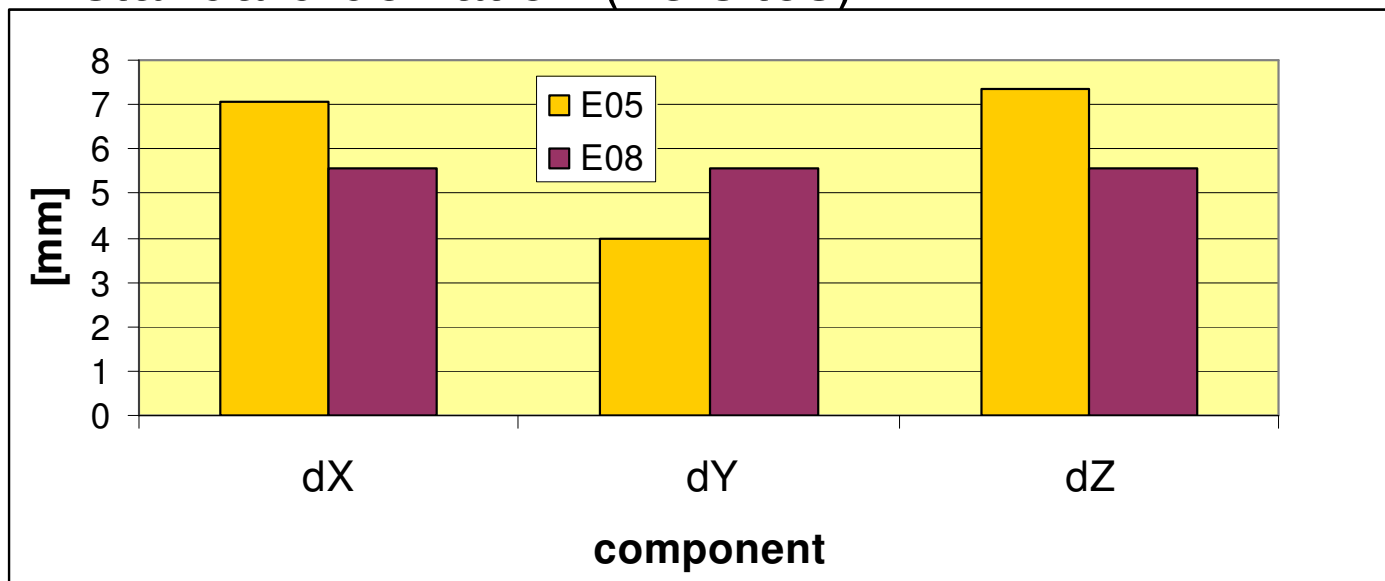
- Standard deviation (4 Epochs):



Stability of ETRF coordinates (4)

- Most of the 43 sites stable well below 1 cm STD (3-Dim.)
- Unstable sites (post-glacial rebound, ...) bigger differences
- ETRF2000(R08) is in average of the 43 sites more stable in time as ETRF2000(R05)
- Improvement mainly in height due to smaller ITRF2008 velocities

□ standard deviation (43 sites):



Conclusion ETRF2000

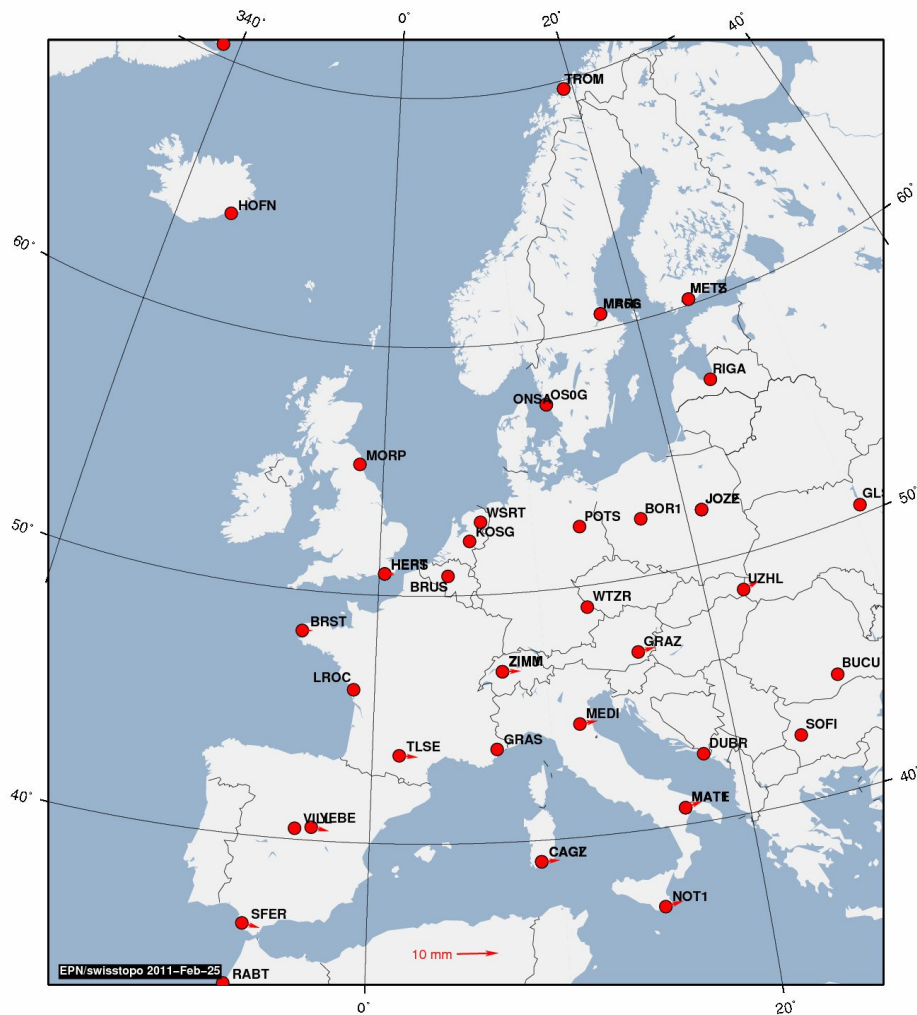
- No bigger differences of ETRF2000(R05) and (R08), but small „sliding“ changes in time (especially station height)
 - Mean epoch 2007.5 bias free (3-Dim.)
 - Height bias: -10 mm at epoch 2000, +10 mm at epoch 2015
- ETRF2000(R08) coordinates are more stable in time (especially due to smaller ITRF2008 vertical velocities).
- Nevertheless, ITRF2008 contains EPN sites with bigger vertical velocities:
 - < -2 mm/yr: 3 sites (ACOR, ZWEN, TERS)
 - > 2 mm/yr: 32 sites mostly post-glacial rebound; SASS, CREU)not suited for reference frame realizations in ETRF2000!
- Todo:
 - exclusion of sites ACOR, ZWEN, TERS, SASS, CREU (and Nordic stations?) as reference sites for EPN densification solutions based in ITRF2008



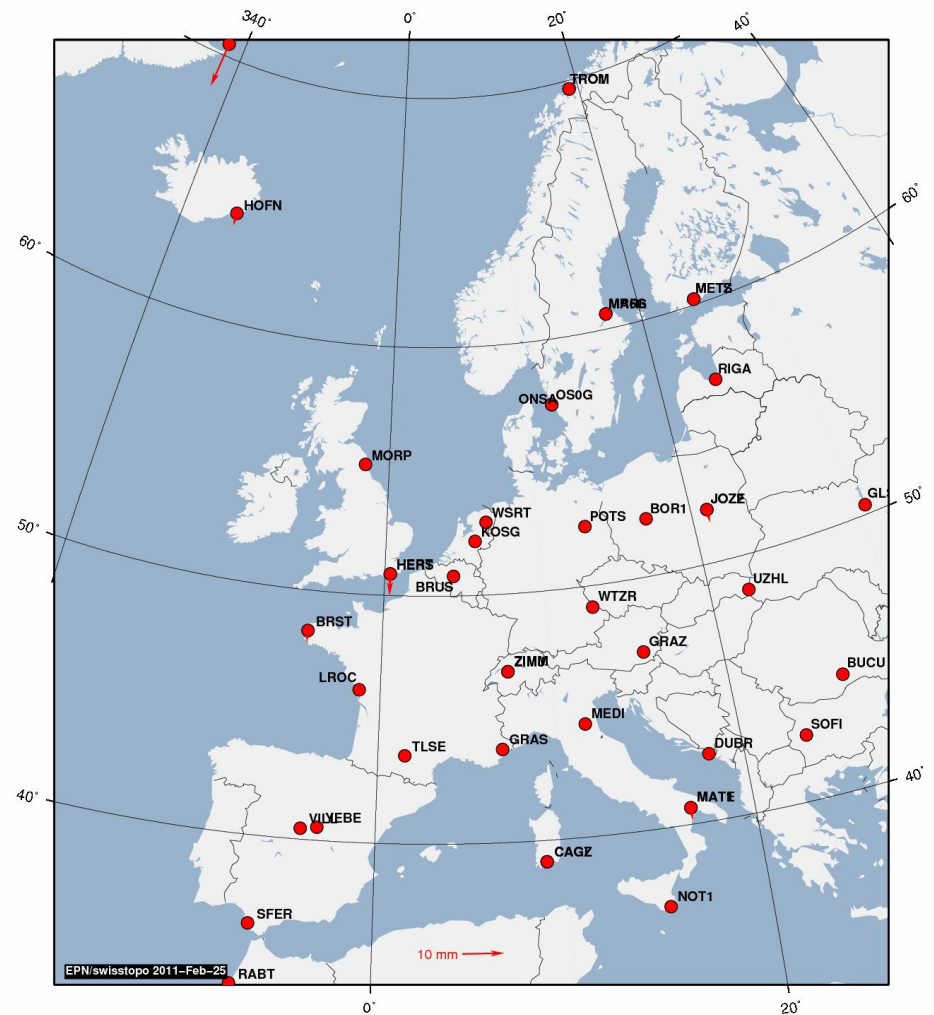
ITRF2008 – IGS2008

same size as
ETRF2000
differences...

horizontally

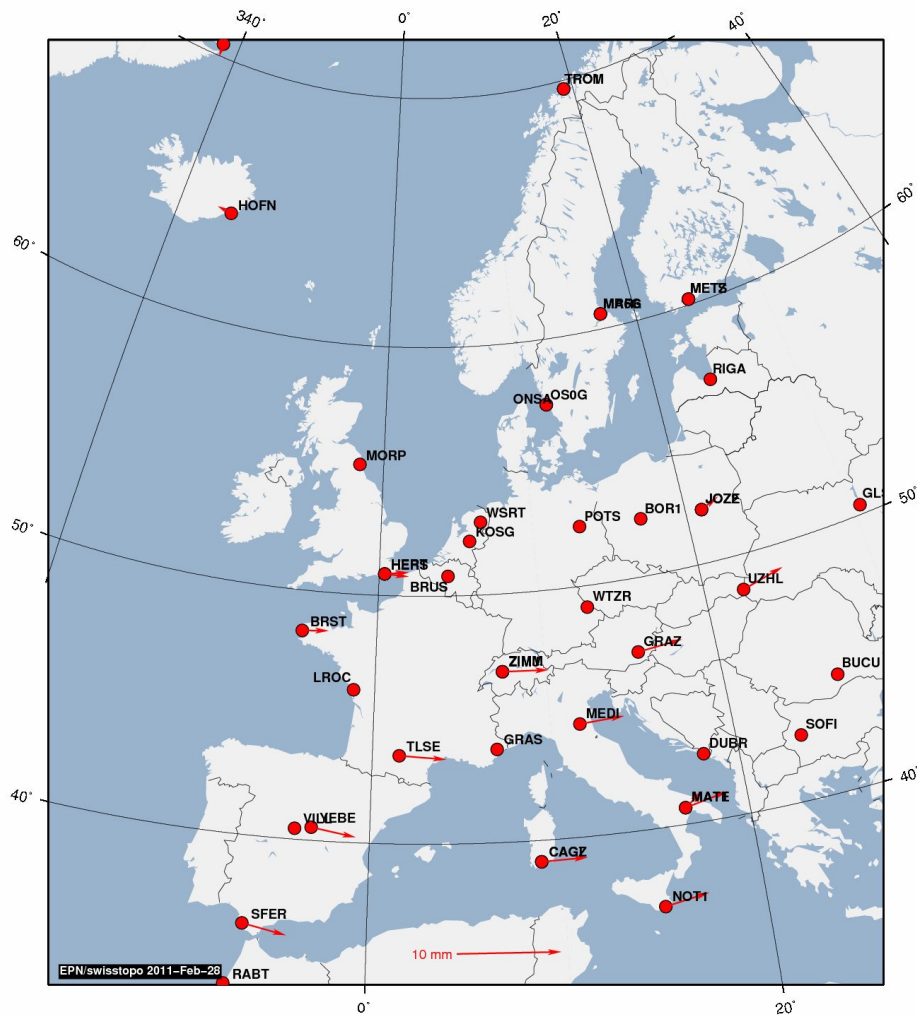


vertically

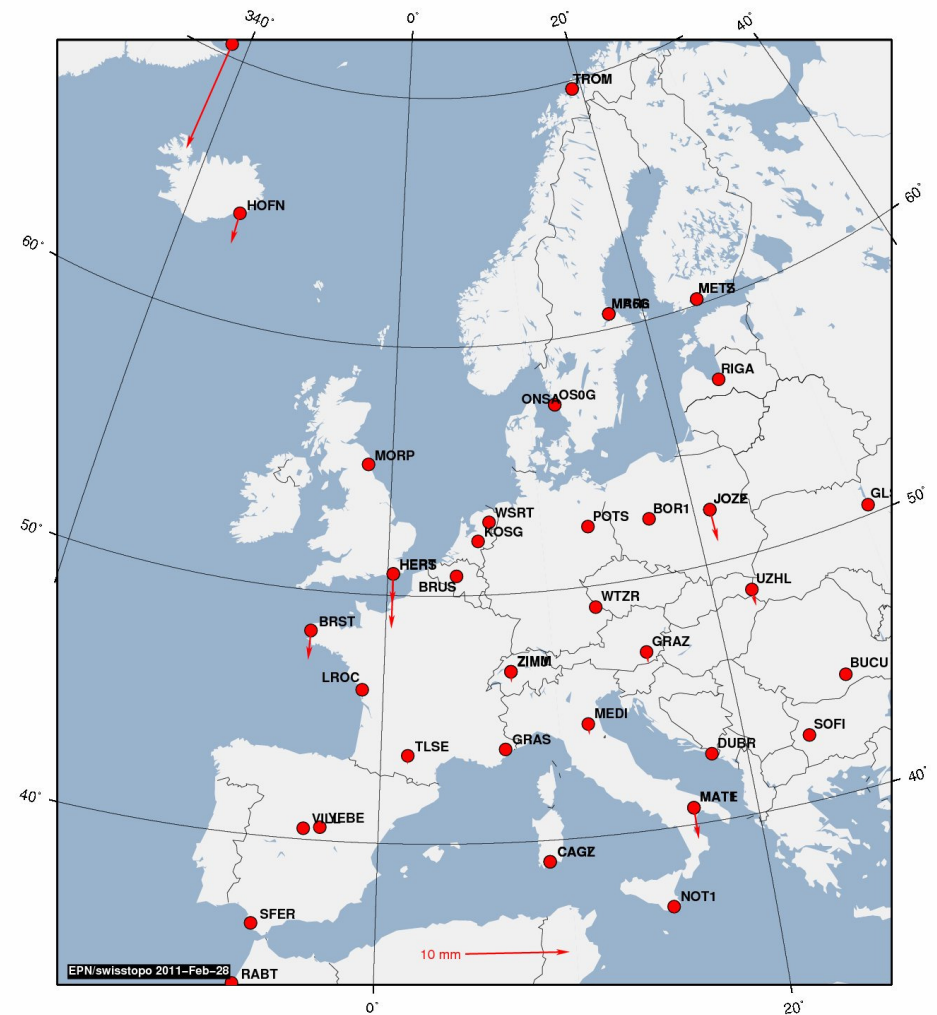


ITRF2008 – IGS2008 (zoom)

horizontally



vertically





ITRF2008 – IGS2008 (2)

- Global: 258 sites, only 3-translation Helmert para. < 0.3 mm, std N 1.1 mm E 1.6 mm U 1.4 mm
- EU: 68 sites, only 3-translation Helmert para. < 1 mm, std N 0.5 mm E 1.8 mm U 1.2 mm
- Max: **East: POL2 5.7 mm**; and 8 Chokering antenna bias: CAGL,SFER,ZIMM,GRAZ,MEDI,NOTO,YEBE,MAT1
3.6 - 3.8 mm

Antenna values: Trimble chokering

- East L3 influence of 3.15 mm simply from antenna model
~ coordinate Helmert: 3.6-3.8 mm

Antenna	IGS05.ATX [mm]				IGS08.ATX [mm]			IGS08 - IGS05 [mm]			
	Lx	north	east	up	north	east	up	Lx	north	east	up
TRM29659.00 (GPS Choke)	L1	-0.06	-0.91	91.95	0.19	0.23	90.99	L1	0.25	1.14	-0.96
	L2	-0.16	0.16	120.49	-0.01	0.00	120.40	L2	0.15	-0.16	-0.09
								L3	0.40	3.15	-2.30
TRM59800.00 (GNSS Choke)	L1	0.37	0.86	90.02	0.45	1.02	89.81	L1	0.08	0.16	-0.21
	L2	0.09	0.01	119.89	-0.04	-0.35	120.03	L2	-0.13	-0.36	0.14
								L3	0.40	0.96	-0.75
Difference	L1	0.43	1.77	-1.92	0.26	0.79	-1.18				
	L2	0.25	-0.15	-0.60	-0.03	-0.35	-0.37				
	L3	0.71	4.74	-3.99	0.71	2.55	-2.43				



Conclusion ITRF2008-IGS2008

- ITRF2008-IGS2008: East-differences 3.7 mm for some GPS Choking stations
- Differences small for transformation to ETRF2000 but significant for scientific multi-annual solutions.
- From theoretical point of view / densification of the IGS network: EPN also need to switch to IGS2008 (at least for reprocessing)