

On the transformation from ITRF to ETRF2000

- Recall TWG Recommendation: ETRS89/ETR2000
- Procedure of ITRF_{yy} ==> ETRF2000 transformation
- Example of numerical application
- Conclusion

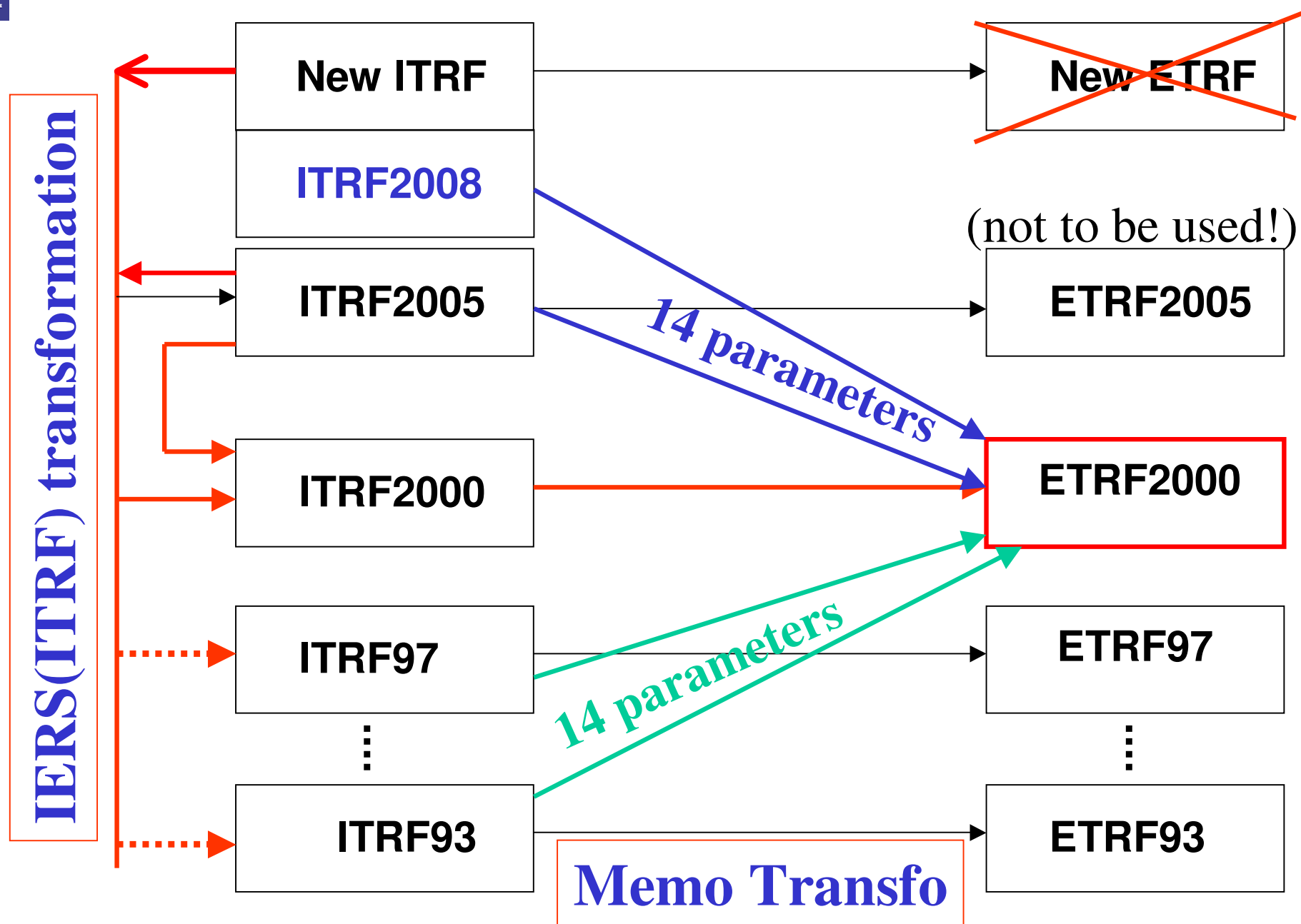
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Contribution by Bruno Garayt

TWG Recommendation

- Adopte ETRF2000 as a conventional frame of the ETRS89 system
- Provide transformation parameters (14) from ITRF_{yy} to ETRF2000
- Goal:
 - harmonize the ETRS89 realization overall Europe
 - avoid coordinates jumps due to reference frame change

ITRFyy to ETRFyy



Transformation ITRF_{yy} ==> ETRF2000

Table 5: Transformation parameters from ITRF_{yy} to ETRF2000 at epoch 2000.0 and their rates/year

ITRF Solution	T1 mm	T2 mm	T3 mm	D 10 ⁻⁹	R1 mas	R2 mas	R3 mas
ITRF2008	52.1	49.3	-58.5	1.34	0.891	5.390	-8.712
Rates	0.1	0.1	-1.8	0.08	0.081	0.490	-0.792
ITRF2005	54.1	50.2	-53.8	0.40	0.891	5.390	-8.712
Rates	-0.2	0.1	-1.8	0.08	0.081	0.490	-0.792
ITRF2000	54.0	51.0	-48.0	0.00	0.891	5.390	-8.712
Rates	0.0	0.0	0.0	0.00	0.081	0.490	-0.792
ITRF97	47.3	46.7	-25.3	-1.58	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF96	47.3	46.7	-25.3	-1.58	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF94	47.3	46.7	-25.3	-1.58	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF93	76.1	46.9	-19.9	-2.07	2.601	6.870	-8.412
Rates	2.9	0.2	0.6	-0.01	0.191	0.680	-0.862
ITRF92	39.3	44.7	-17.3	-0.87	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF91	27.3	30.7	-11.3	-2.27	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF90	29.3	34.7	4.7	-2.57	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF89	24.3	10.7	42.7	-5.97	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812

Parameters should be propagated at the central epoch of the observations

$$P(t_c) = P(2000.0) + \dot{P} \cdot (t_c - 2000.0)$$

How to realise the ETRS89 ?

- ITRF_y ==> ETRF2000

Straightforward: 14-parameter transformation formula

- GPS campaign, weekly solution, others...

All the problem is how to express first the solution in the ITRF ?

- ~~1. Fixing (constraining) some points to ITRF values~~
2. Using transformation parameters (3, 4, 7)
3. Using Minimum constraint approach

In all cases a reference set of stations is needed

Numerical Application

- 4 solutions (of GPS week 1631) provided by Bruno Garayt using IGS orbits, ERP, but **IGS05 and IGS08** Antex files,
 - Two European solutions
 - Two global solutions
 - Procedure to transform into ETRF2000:
 - Transform first into ITRF2008 (or use minimum constraints)
 - **Select RF stations from IGS08 list:**
 - 100 for the global solutions
 - 40 for the European solution
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- Transform into ETRF2000 using 14 parameters (Memo)
 - Extract France (RGP) points

Comparison btw pairs of solutions

Global

T1	T2	T3	D	R1	R2	R3
mm	mm	mm	10-9	mas	mas	mas
-7.0	-1.4	-2.0	-0.95	-0.091	0.076	0.050

European

-11.7	0.5	-14.4	-0.53	-0.031	0.010	-0.072
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-11.4	-0.2	-14.7	-0.53	0.000	0.000	0.000
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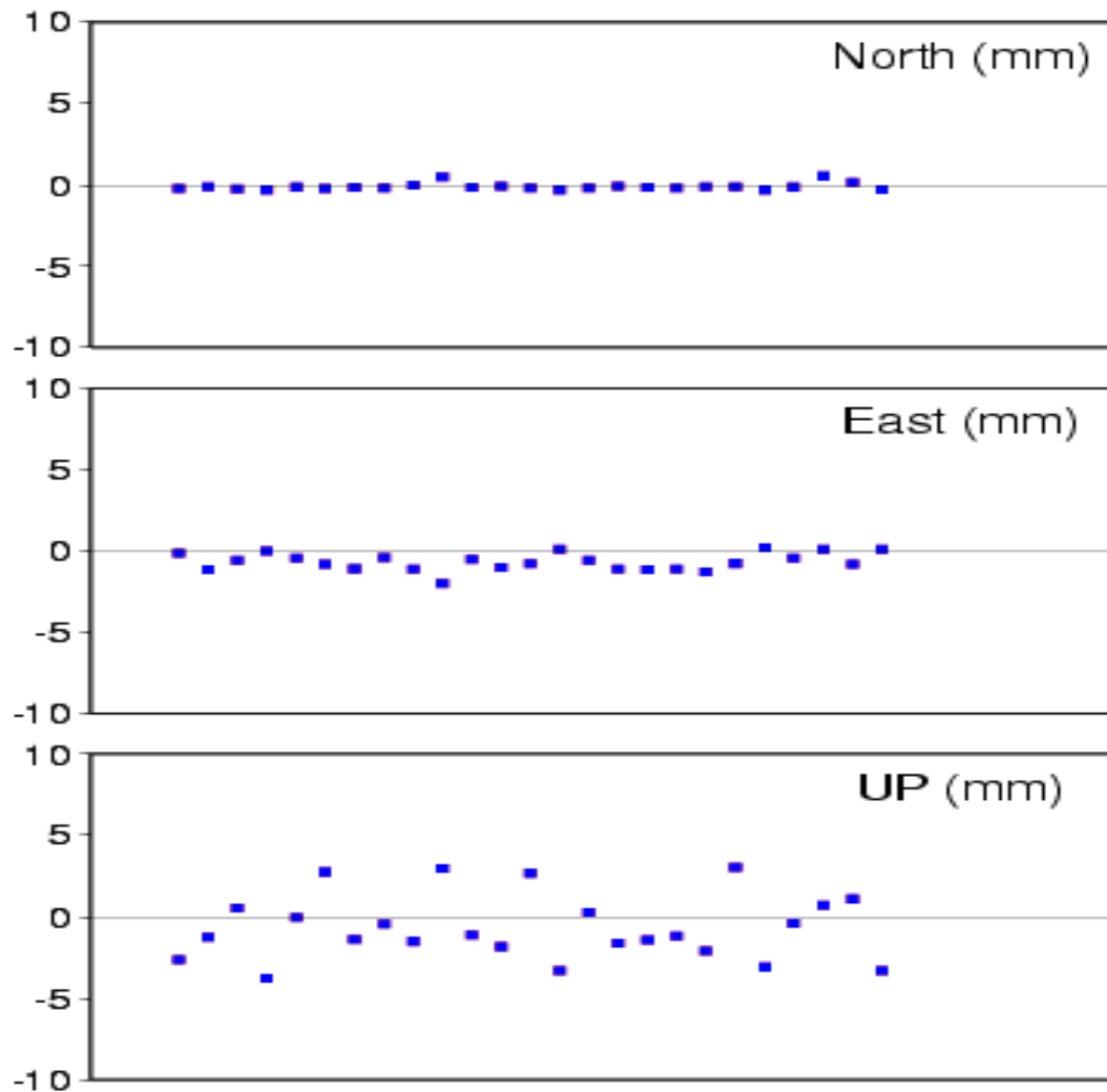
-13.5	-0.4	-17.1	0.00	0.000	0.000	0.000
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Impact of PCV correction differences (IGS08 – IGS05)

WRMS	East	North	Up
Global solutions	2.5	1.5	3.6
European Solutions	1.5	1.3	2.1

Differences btw the two transformed **European** solutions (IGS05, IGS08 Antex)

**France
points
only**



W-mean

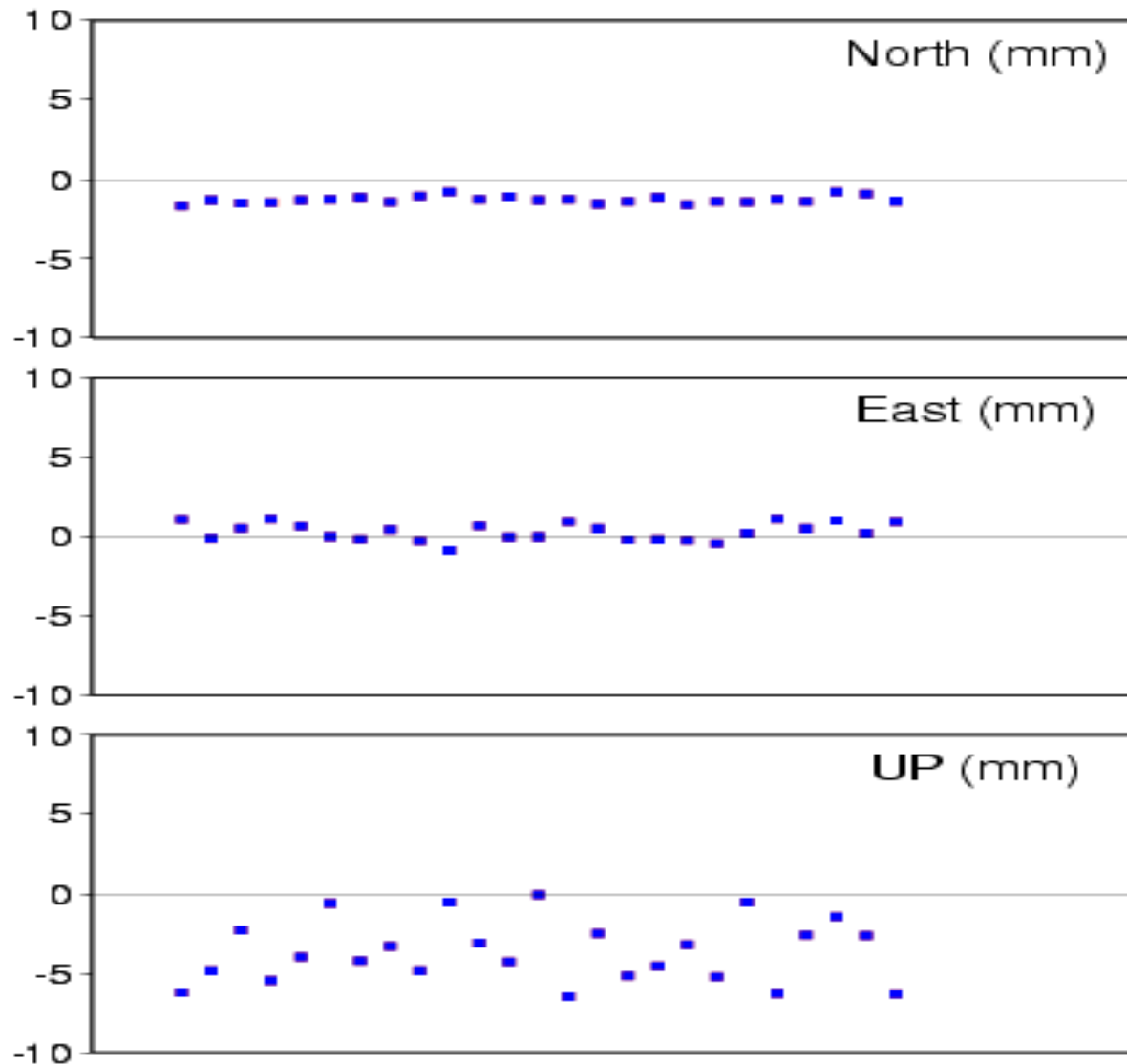
-0.07 mm

-0.15 mm

-0.40 mm

Differences btw the two transformed Global solutions (IGS05, IGS08 Antex)

France
points
only



W-mean

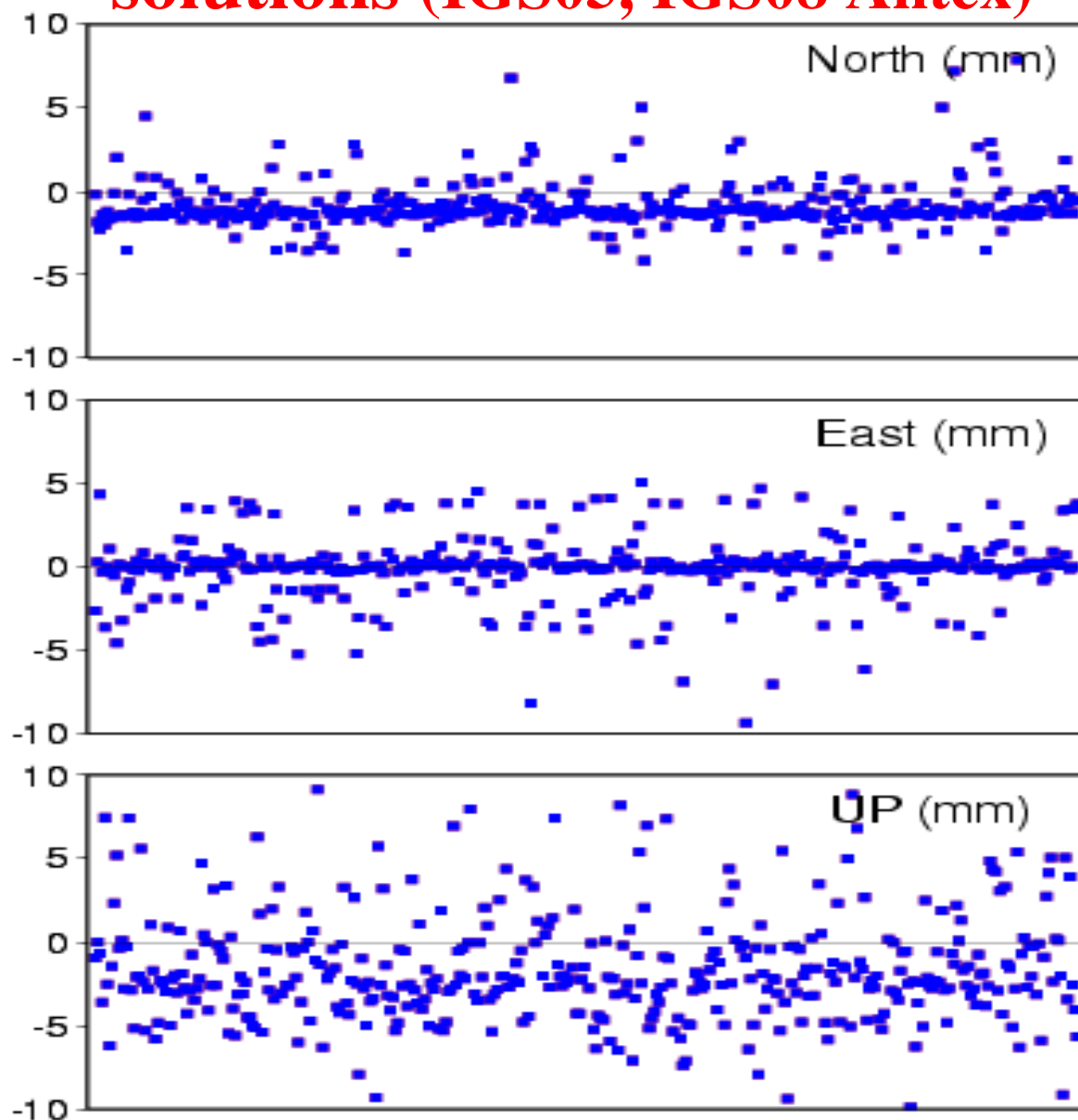
-1.97 mm

0.16 mm

-4.00 mm

Differences btw the two transformed **Global** solutions (IGS05, IGS08 Antex)

All ~400
points



W-mean

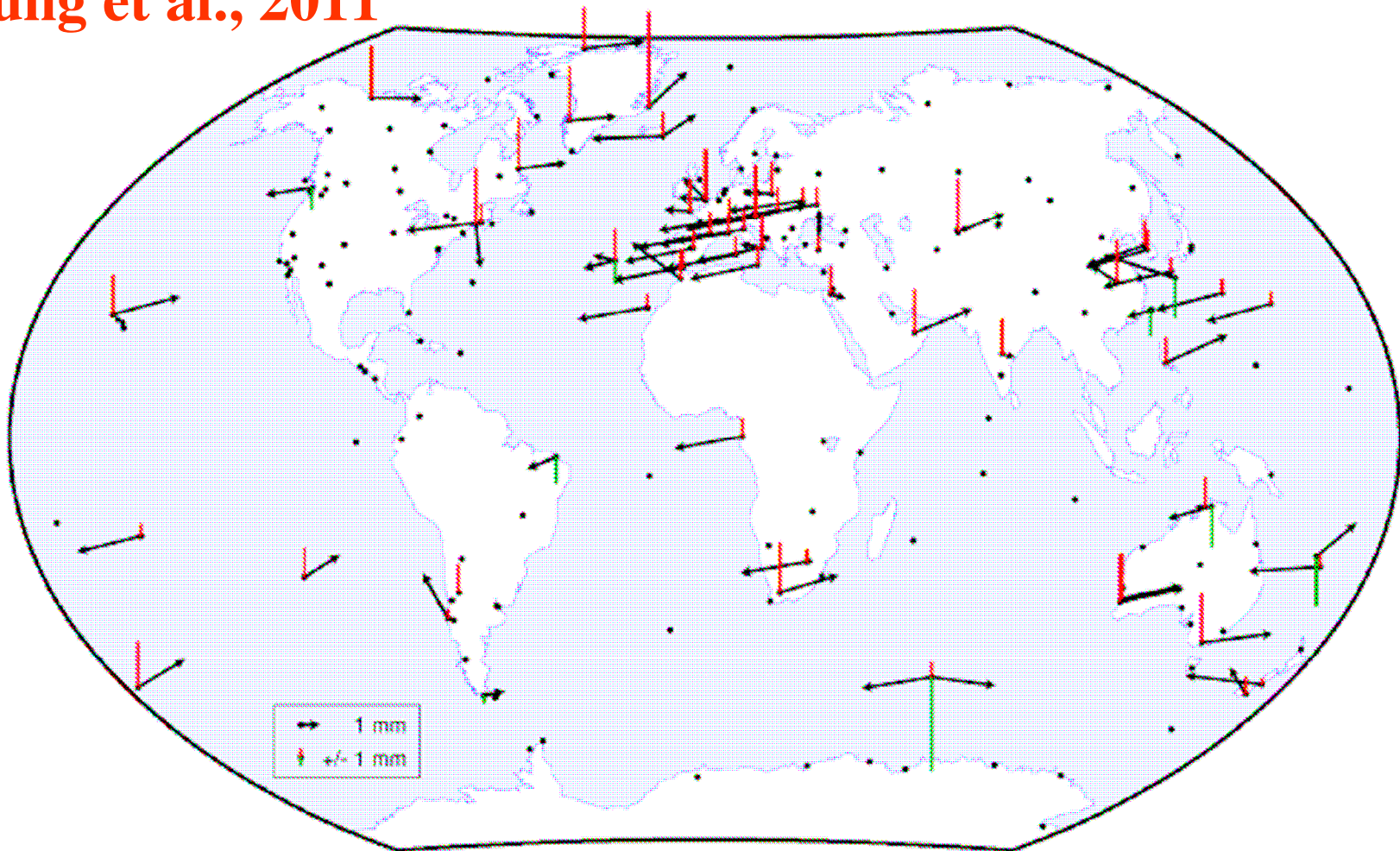
-0.85 mm

-0.01 mm

-1.35 mm

Corrections applied to ITRF2008 to derive IGS08

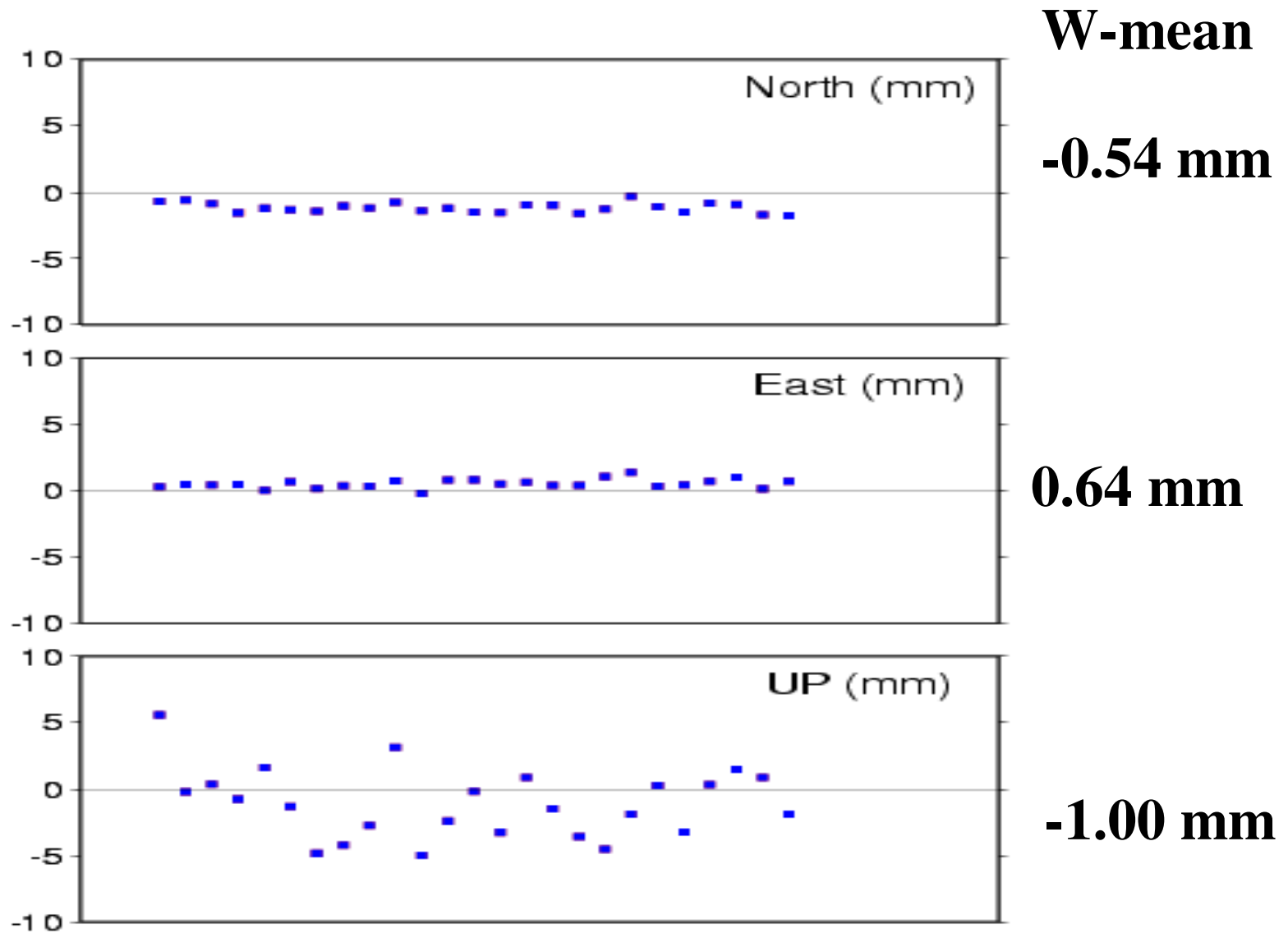
Rebischung et al., 2011



- Corrections derived from the IGN PPP tests were finally applied to the ITRF2008 coordinates of 65 stations (87 different time spans).
- IGS08 was **NOT** re-aligned to ITRF2008.

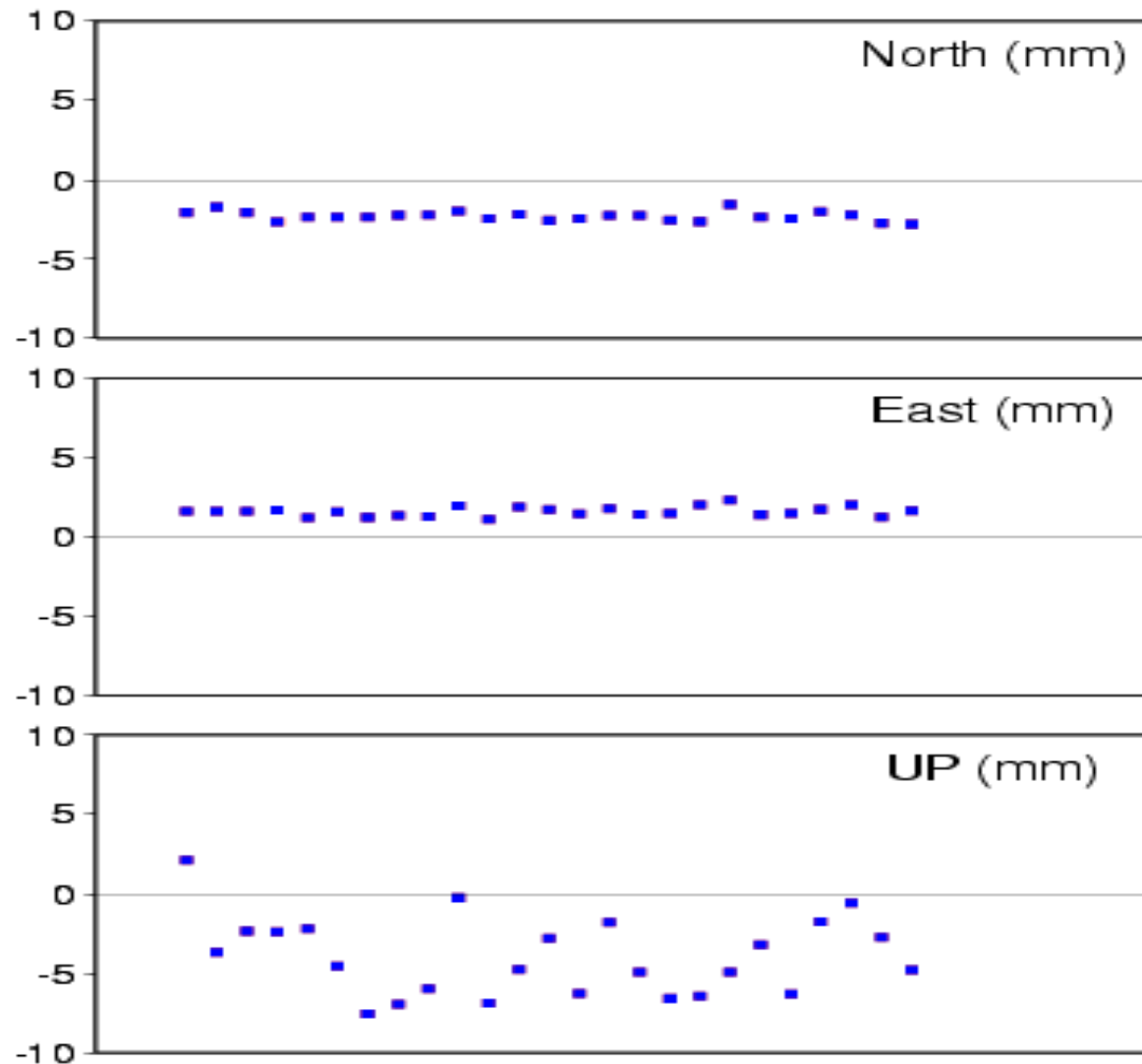
Differences btw using European and Global solutions (IGS05 Antex)

France
points
only



Differences btw using European and Global solutions (IGS08 Antex)

France
points
only



W-mean

-2.41 mm

1.46 mm

-4.36 mm

Conclusions

- **The European countries are encouraged to switch to ETRF2000**
- **Use the transformation parameters at the epoch of the observations**
- **Switch from IGS05 to IGS08 antex induces coords changes up to or larger than 1 cm.**
- **The accuracy of ETRS89/ETRF2000 realization using data of one week is about 1 cm.**