

ITRF2008 and transformation to ETRF2000

- Introduction to ITRF2008
- TWG recommendation on ETRS89/ETRF2000
- Transformation from ITRF2008 to ETRF2000
- Procedure
- Fundamental role of the EPN

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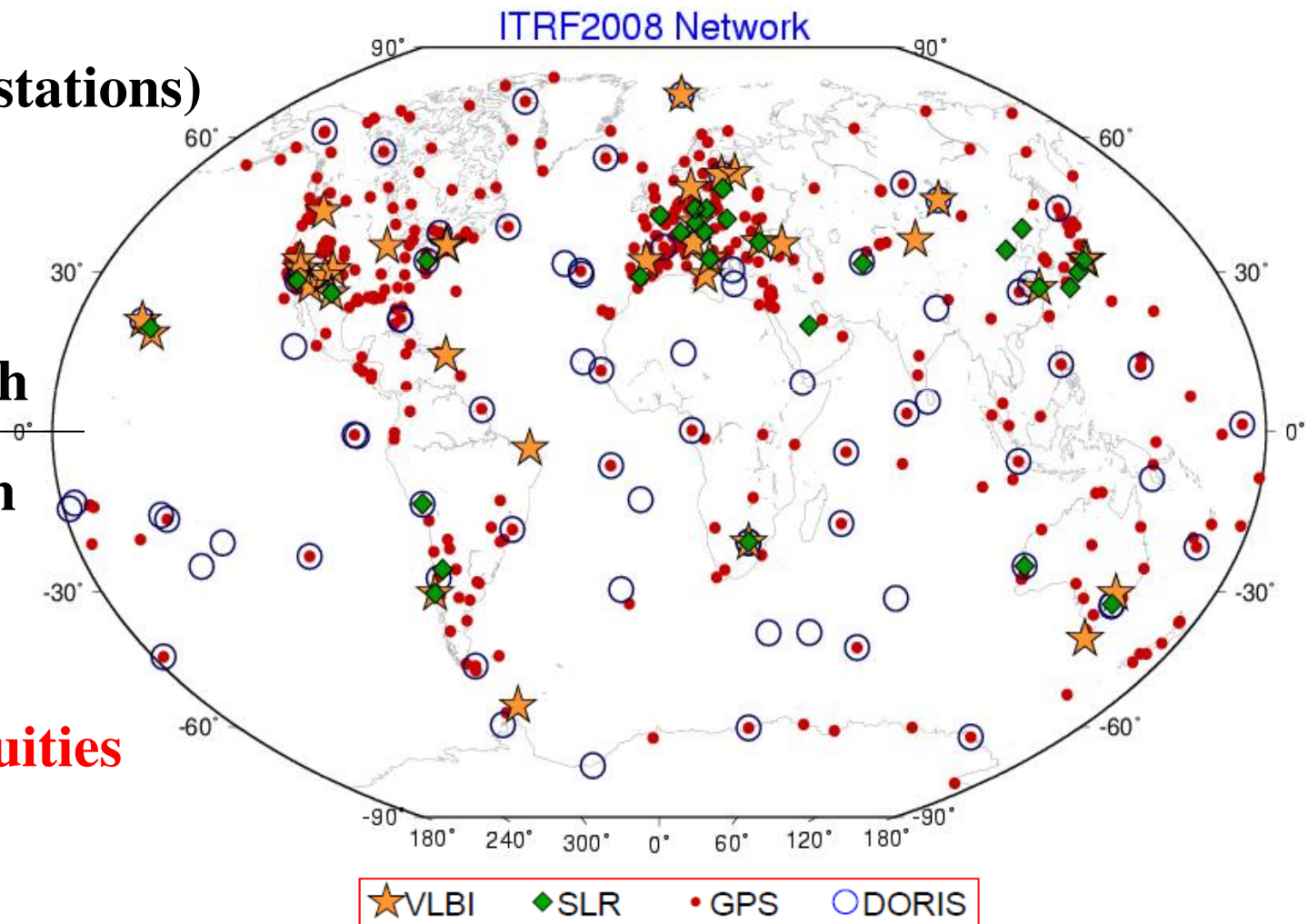
ITRF2008 Network

580 sites (934 stations)

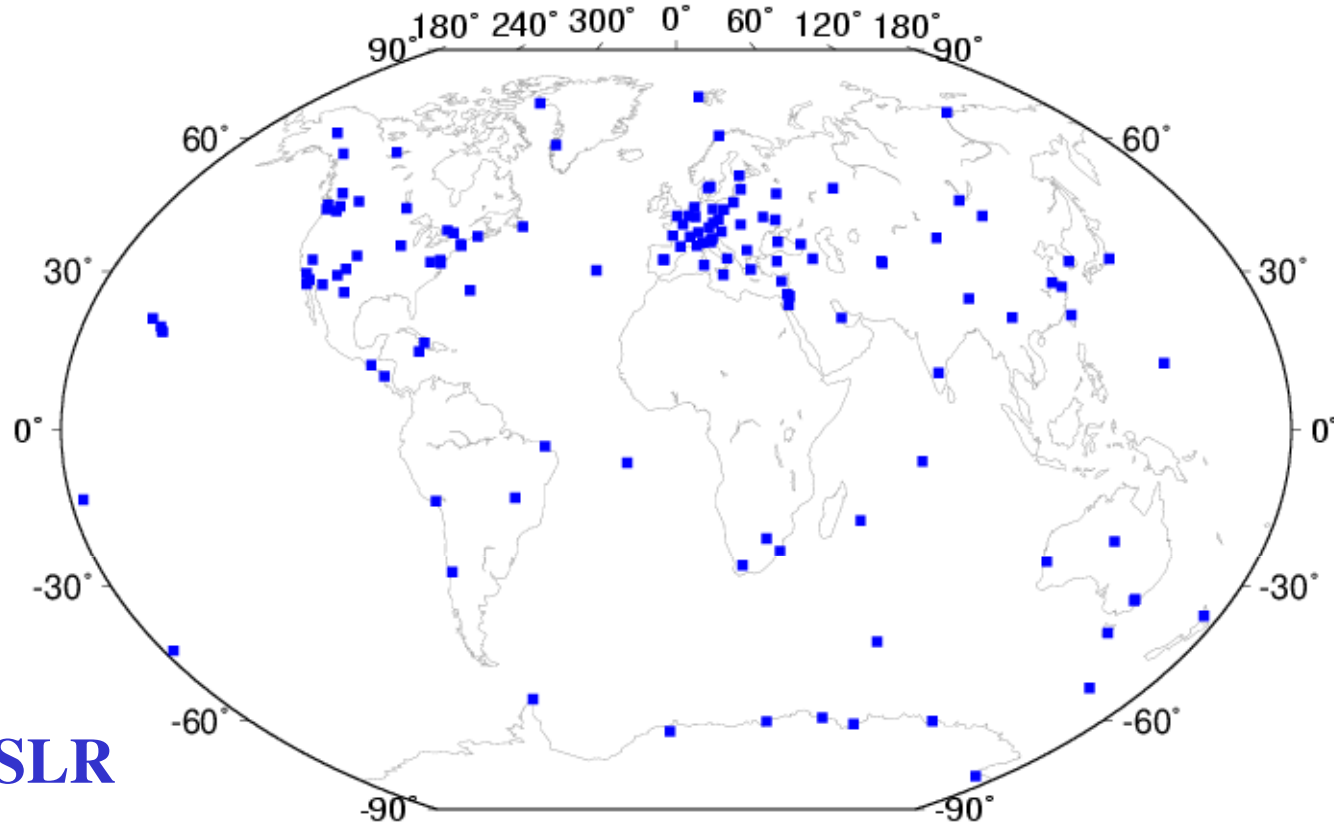
463 Sites North

117 Sites South

638 discontinuities

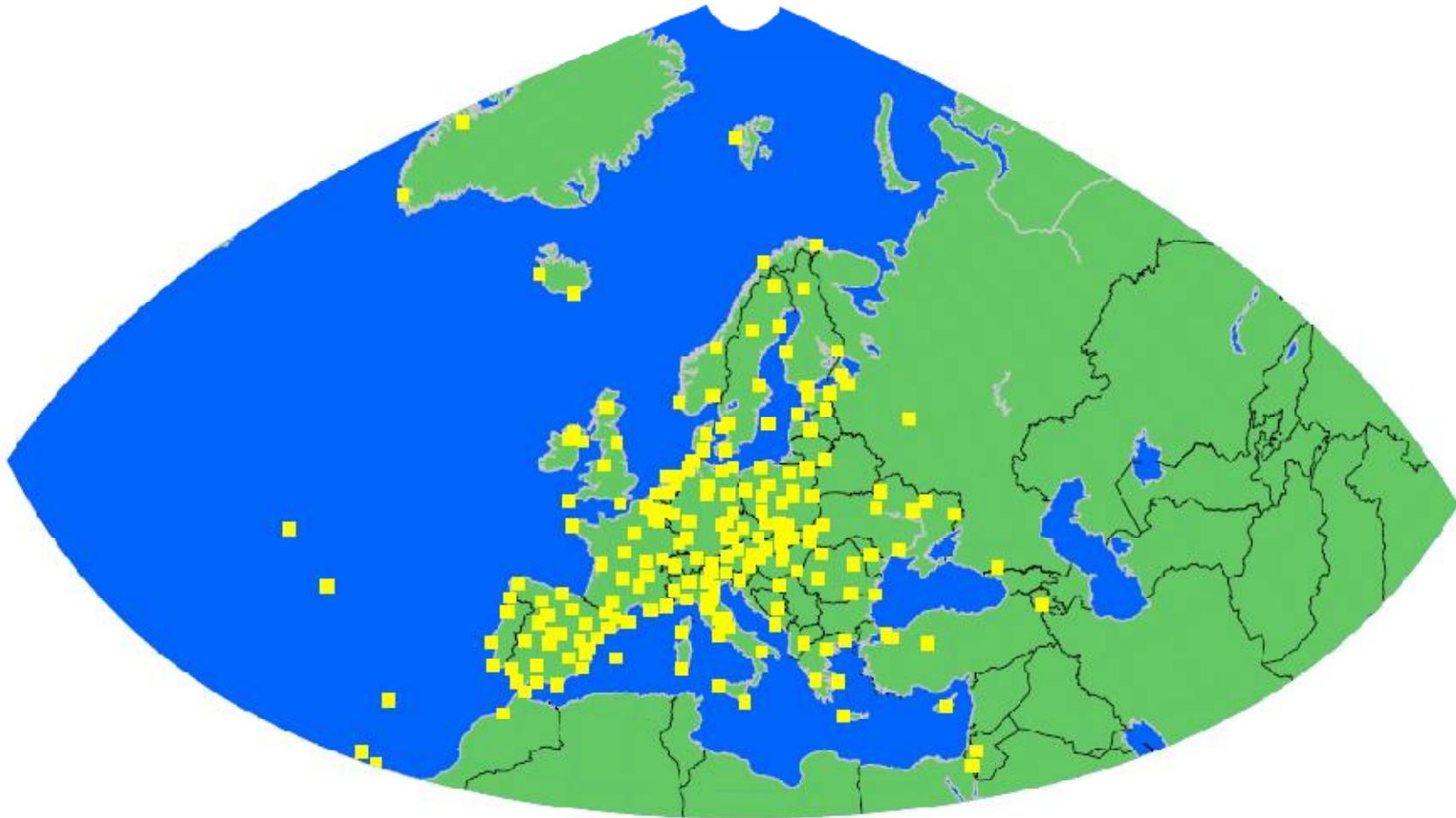


ITRF2008 Datum Specification



- **Origin: SLR**
 - **Scale : Mean of SLR & VLBI**
 - **Orientation: Aligned to ITRF2005**
- using 179 stations located at 131 sites:
104 at northern hemisphere and 27 at southern hemisphere
-

EPN Stations

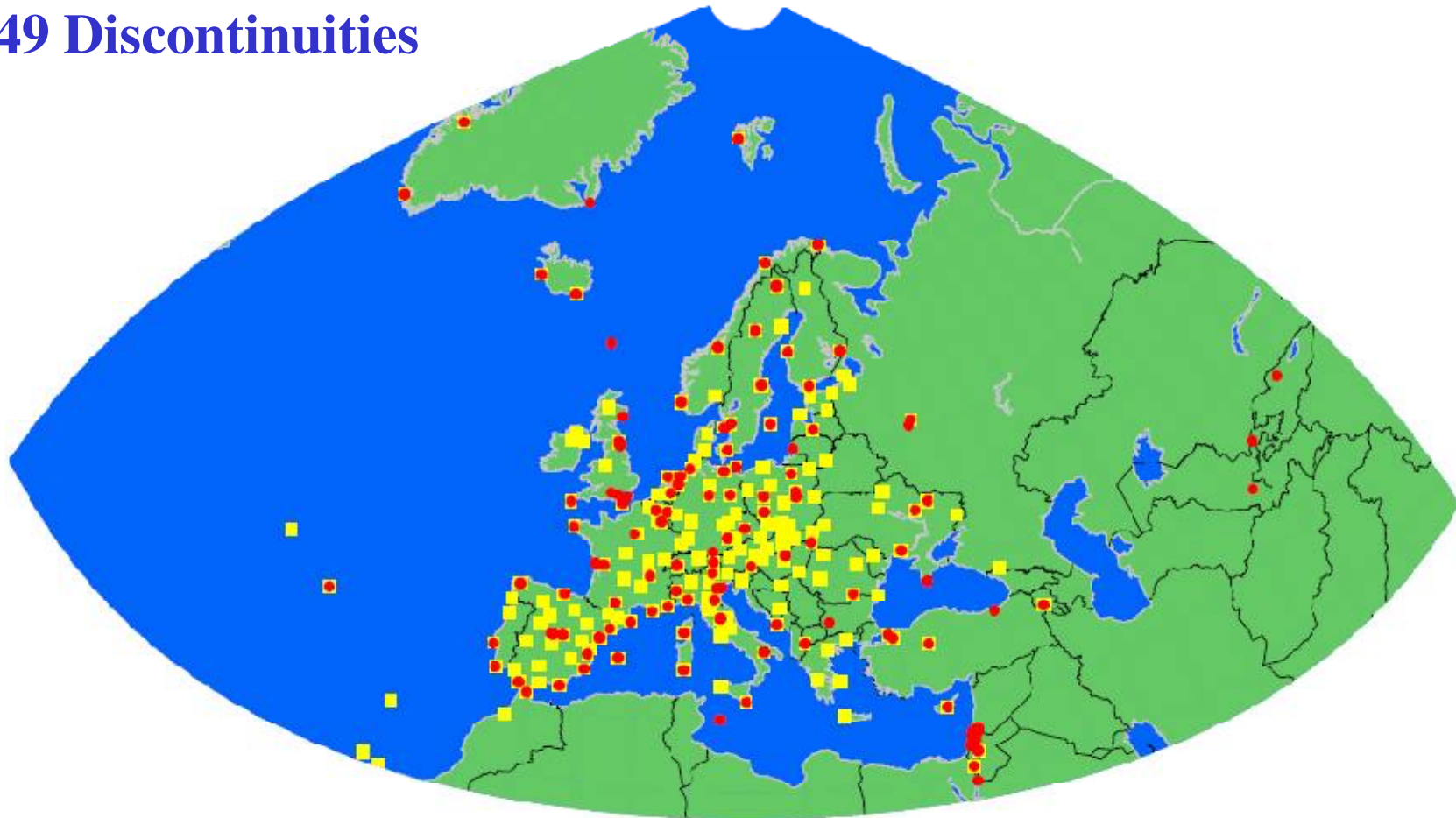


EPN Stations in ITRF2008

130 Sites

150 Stations

149 Discontinuities





ETRS89 Definition

- **Coincides with ITRS at epoch 1989.0:**
 - **Definition at a reference epoch (1989.0)**
 - **The 7 parameters between ITRS and ETRS89 are zero at 1989.0**
- **Fixed to the stable part of the Eurasian plate**
 - **Co-moving with the plate: law of time evolution**
 - **Time derivatives of the transformation parameters are zero except the 3 rotation rates**

ETRS89 Realization

- Expression in ITRF_{YY} at central epoch (t_c) of the implied observations
- Expression in ETRS89 using 14 transformation parameters some of them are zeros

Positions

$$X^E(t_c) = X_{YY}^I(t_c) + T_{YY} + \begin{pmatrix} 0 & -\dot{R}_{3YY} & \dot{R}_{2YY} \\ \dot{R}_{3YY} & 0 & -\dot{R}_{1YY} \\ -\dot{R}_{2YY} & \dot{R}_{1YY} & 0 \end{pmatrix} \times X_{YY}^I(t_c) \cdot (t_c - 1989.0)$$

Velocities

$$\begin{pmatrix} \dot{X}_{YY}^E \\ \dot{Y}_{YY}^E \\ \dot{Z}_{YY}^E \end{pmatrix} = \begin{pmatrix} \dot{X}_{YY}^I \\ \dot{Y}_{YY}^I \\ \dot{Z}_{YY}^I \end{pmatrix} + \begin{pmatrix} 0 & -\dot{R}_{3YY} & \dot{R}_{2YY} \\ \dot{R}_{3YY} & 0 & -\dot{R}_{1YY} \\ -\dot{R}_{2YY} & \dot{R}_{1YY} & 0 \end{pmatrix} \times \begin{pmatrix} X_{YY}^I \\ Y_{YY}^I \\ Z_{YY}^I \end{pmatrix}$$

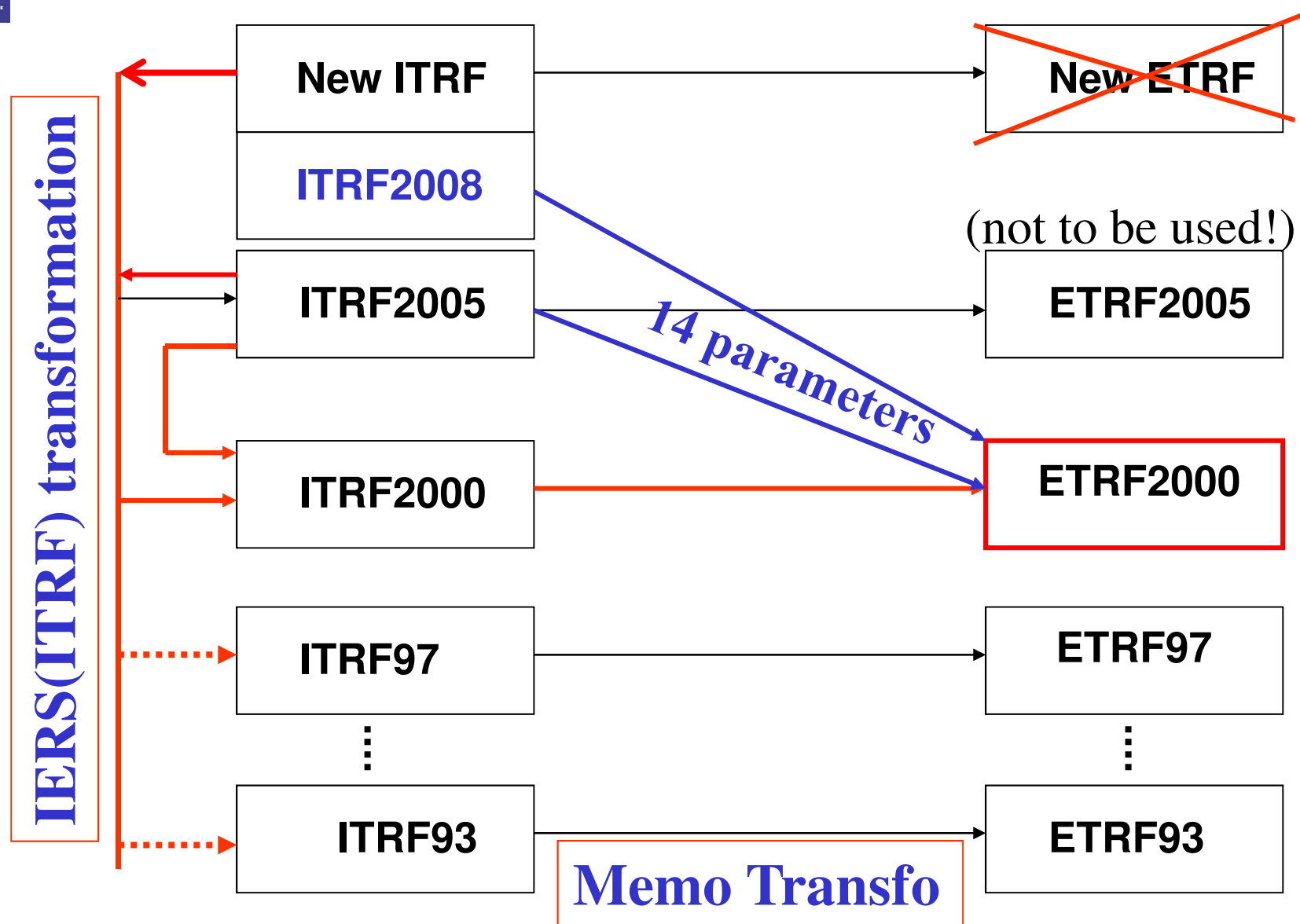
TWG Recommendation

- Adopte ETRF2000 as a conventional frame of the ETRS89 system
- Provide transformation parameters (14) from **ITRF2005 (and new ITRFyy) to ETRF2000**
- Goal:
 - harmonize the ETRS89 realization overall Europe
 - avoid coordinates jumps due to reference frame change

Procedures

- Transform from ITRF2005(8, 10) to ITRF2000 (97, ...,93)
- Use the ITRS-to-ETRS89 Transformation Formulae
- ==> 14 transformation parameters

ITRFyy to ETRFyy



Transformation Param Fm ITRF2008 To ITRF2005

T_x mm	T_y mm	T_z mm	Scale ppb
-0.5 ± 0.2	-0.9 ± 0.2	-4.7 ± 0.2	0.94 ± 0.03

**At epoch
2005.0**

T_x rate mm/yr	T_y rate mm/yr	T_z rate mm/yr	Scale rate ppb/yr
0.3 ± 0.2	0.0 ± 0.2	0.0 ± 0.2	0.00 ± 0.03

14-parameter transformation

From ITRF2005 To ETRF2000

	T1 mm	T2 mm	T3 mm	D 10 ⁻⁹	R1 mas	R2 mas	R3 mas	Epoch y
	54.1	50.2	-53.8	0.40	0.891	5.390	-8.712	00:001
Rates	-0.2	0.1	-1.8	0.08	0.081	0.490	-0.792	

From ITRF2008 To ITRF2005

	T1 mm	T2 mm	T3 mm	D 10 ⁻⁹	R1 mas	R2 mas	R3 mas	Epoch y
	-2.0	-0.9	-4.7	0.94	0.000	0.000	0.000	00:001
Rates	0.3	0.0	0.0	0.00	0.000	0.000	0.000	

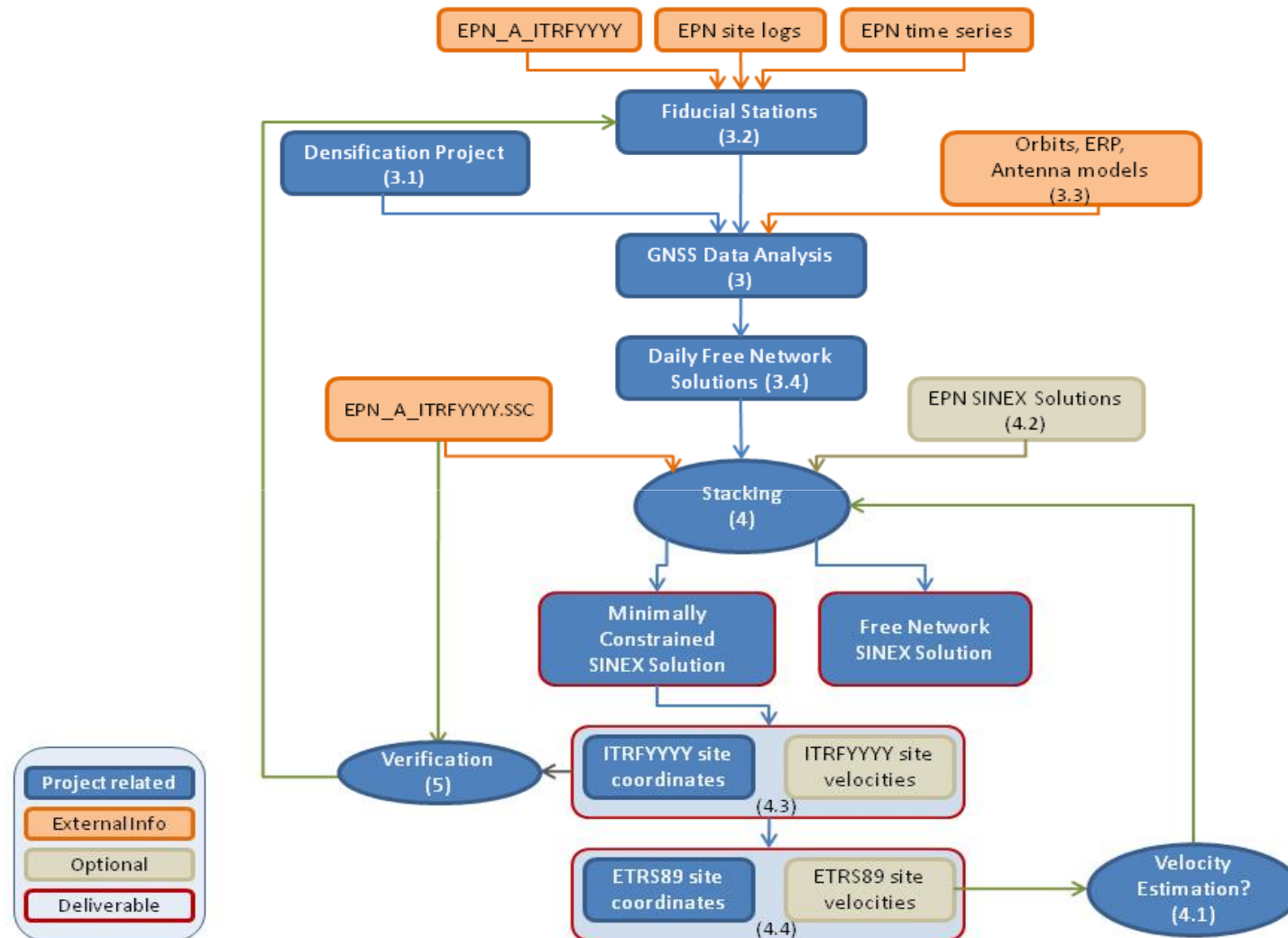
From ITRF2008 To ETRF2000

	T1 mm	T2 mm	T3 mm	D 10 ⁻⁹	R1 mas	R2 mas	R3 mas	Epoch y
	52.1	49.3	-58.5	1.34	0.891	5.390	-8.712	00:001
Rates	0.1	0.1	-1.8	0.08	0.081	0.490	-0.792	

Fundamental Role of the EPN

- ITRF densification within Europe
- Access to the ETRS89/ETRF2000 via
 - Minimum constraints wrt fiducial stations from EPN_A_ITRFYYYY (**at the central epoch of the obs**)
 - Use of transformation parameters ITRFyy to ETRF2000
 - Follow the guidelines for EUREF Densifications (Bruyninx et al., 2010)
 - Note that minimum constraints could be used wrt EPN_A_ETRFYYYY directly

Diagramme of Procedure



(Bruyninx et al., 2010)

Conclusion

- **Primary ETRS89 realization:**
 - EPN weekly time series
 - EPN cumulative solution **EPN_A_ETRFYYYY****==> both properly expressed in ETRF2000**
- **Secondary access: national and campaign-type access:**
 - ==> Follow the Guidelines (Bruyninx et al., 2010)**
- **The passage from ITRF2005 to ITRF2008 is transparent to the ETRS89 users**

Proposal to the TWG

- Update the famous memo by the 14 parameters from **ITRF2008** to **ETRF2000**
- Submit the updated memo to TWG members for comments, etc.
- An evaluation campaign by TWG members to test the transformation parameters
- Adoption of the updated memo