

Examination of ITRF2008 results



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To start ...:

- **Input data:**
 - Time series of station positions and EOP from Technique Services
 - Local ties in co-location sites (~86 sites) from different sources
- **Two-step strategy:**
 - Stacking and analysis of time series ==> long-term solutions (LT)
 - Combining LT solutions adding local ties in co-location sites
- **Reference frame definition**
 - Normal equation: 14 degrees of freedom
 - Origin (6 parameters): one technique only : SLR
 - Scale (2 parameters) : Mean of VLBI and SLR
 - Orientation (6 parameters): successive alignments between ITRFs
- **Weighting**
 - Variance components + empirical weighting
 - Local ties, weighed with lower bound uncertainty: 3 mm

Technique contributions

- **IVS: (1980.0 – 2009.0) : Full EOP set (91 sites)**
- **IGS: (1997.0 – 2009.5) : PM, PMrate, LOD (492 sites)**
- **ILRS: (1983.0 – 2009.0) : PM, LOD (89 sites)**
- **IDS: (1993.0 – 2009.0) : PM, LOD (67 sites)**

- **New local ties since ITRF2005:**
 - **Tahiti : GPS SLR DORIS**
 - **Tsukuba: GPS VLBI**
 - **Herstmonceaux: GPS SLR**
 - **Medicina & Noto : GPS VLBI**
 - **Greenbelt: VLBI SLR GPS DORIS**
 - **Maui/Haleakala**
 - **San Fernando : GPS SLR**

- **Parallel analysis by IGN and DGFI**

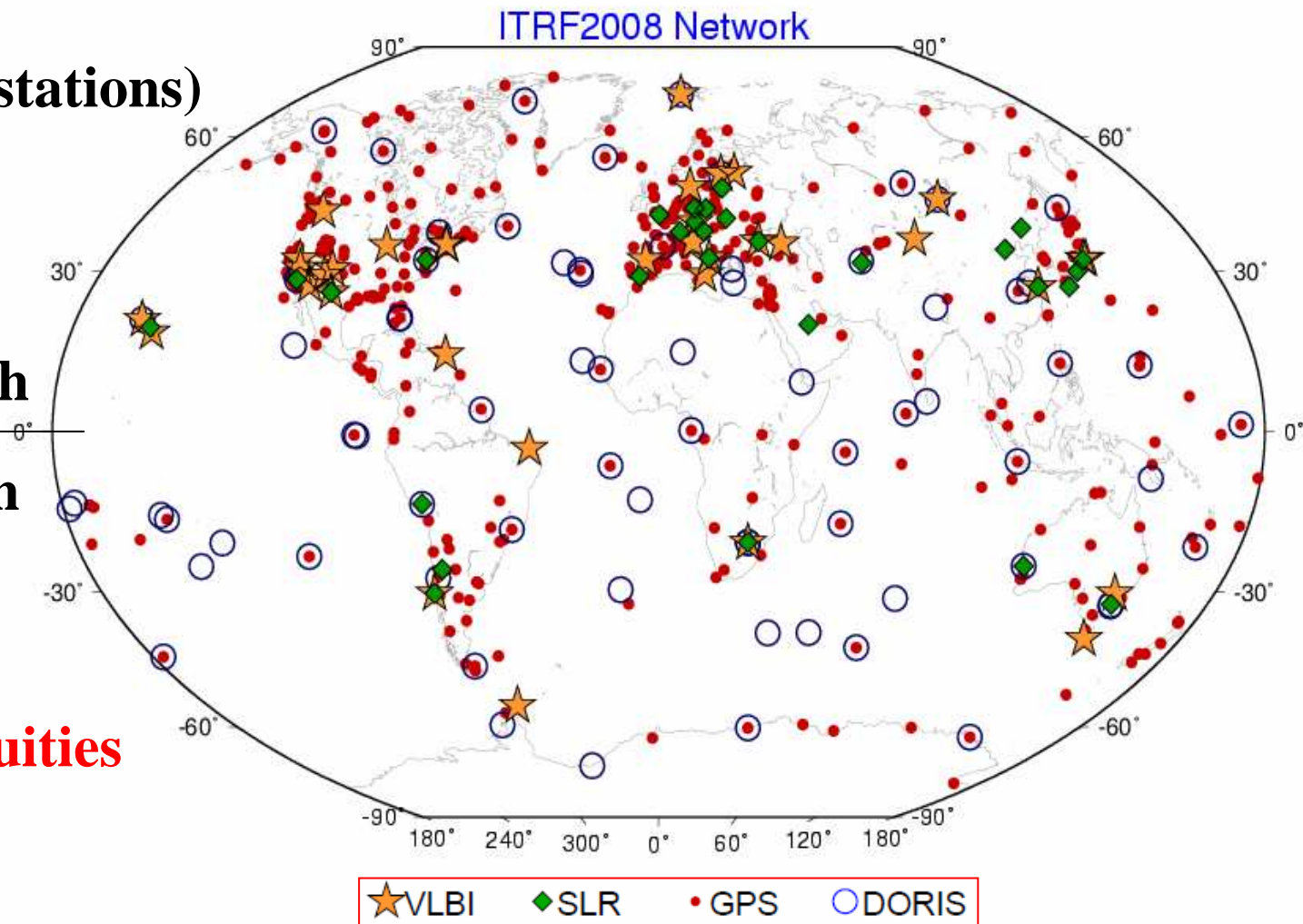
ITRF2008 Network

579 sites (920 stations)

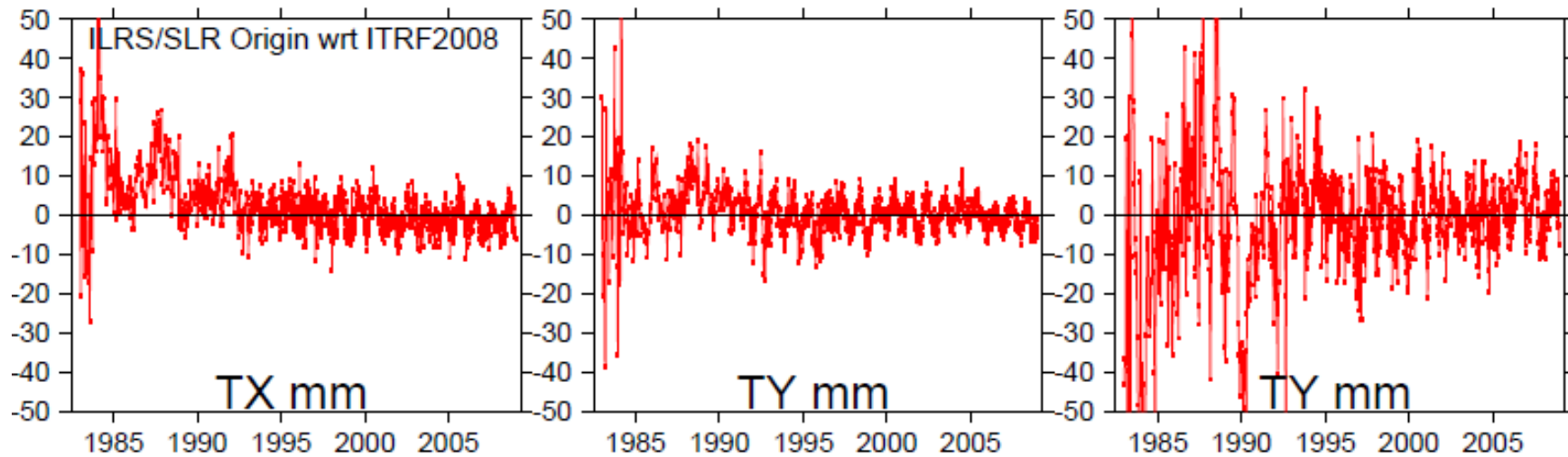
461 Sites North

118 Sites South

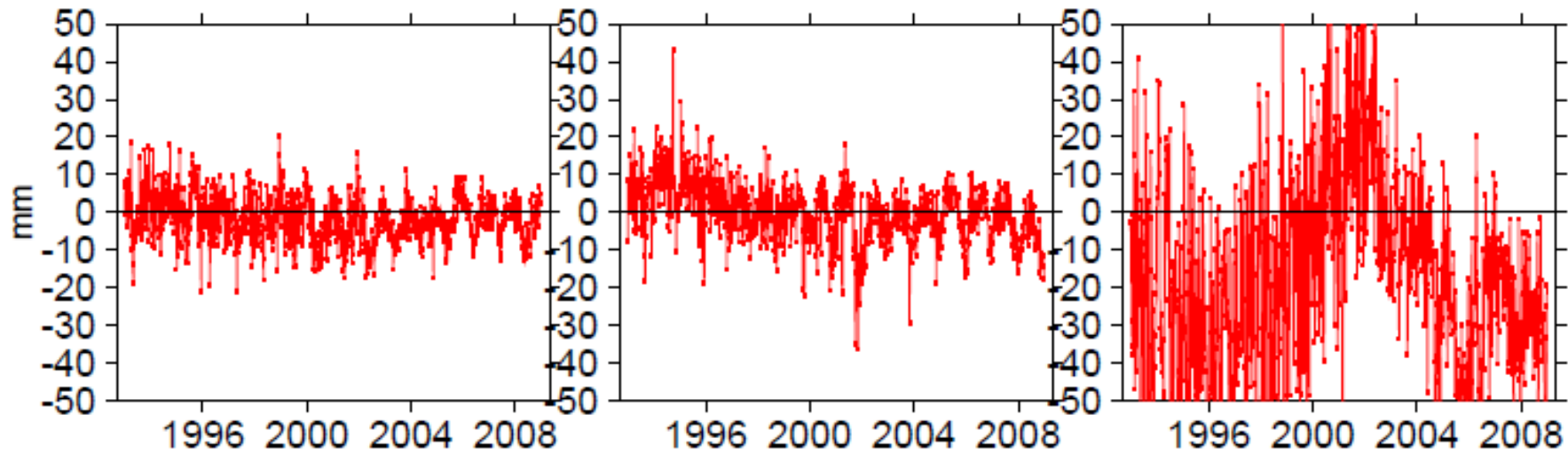
584 discontinuities



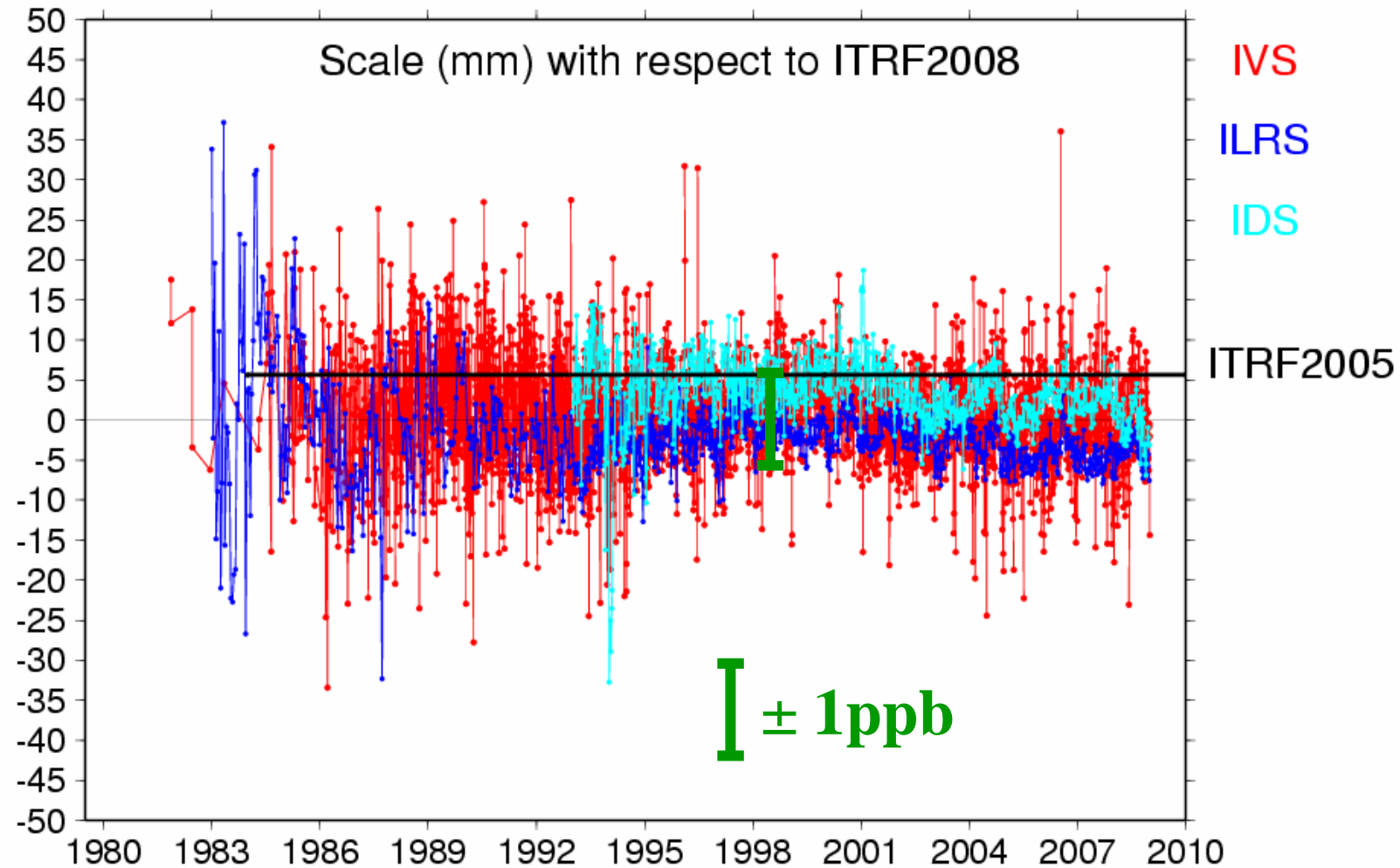
SLR-ILRSA Origin wrt ITRF2008



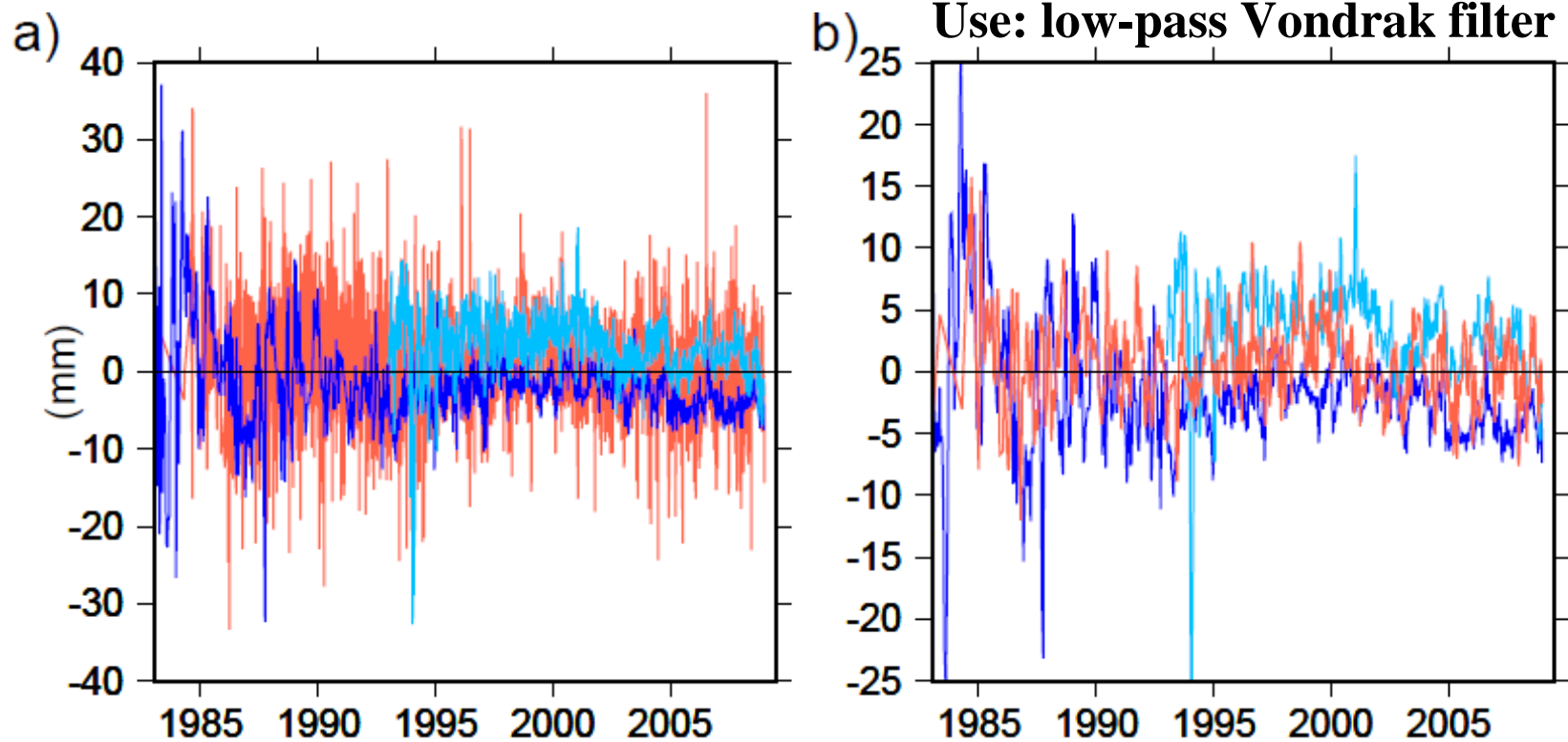
DORIS-IDS-3 Origin wrt ITRF2008



ITRF2008 Scale: mean of VLBI and SLR



ITRF2008 Scale: mean of VLBI and SLR



Scale FORMAL errors (1 σ) via ties to GPS

	Scale ppb	Scale rate ppb/yr
VLBI	± 0.10	± 0.01
SLR	± 0.12	± 0.01
DORIS	± 0.20	± 0.03

Local ties used in ITRF2008

- Ties are used as observations with proper weighting
- ~ 200 tie vectors from GPS to:
 - SLR (44) VLBI (43)
 - DORIS (68: in 38 co-location sites) + 15 DORIS-DORIS ties
- ==> **SLR, VLBI & DORIS are tied mainly via GPS**
- Tie uncertainty ~ 3 mm in best cases:
 - Tie errors due to instrument's reference point location measurement
 - Discrepancies btw local ties and SG estimates larger than 3 mm in most cases
 - Weighting the local ties is fundamental

Consistency btw local ties and space geodesy estimates

- GPS is playing a major role in ITRF combination
- Tie discrepancies < 6 mm for:
 - 47% GPS-VLBI
 - 52% GPS-SLR
 - 34% GPS-DORIS
- Tie discrepancies > 10 mm for:
 - 30% GPS-VLBI
 - 30% GPS-SLR
 - 54% GPS-DORIS

Scale and weighting of local ties

Scales with respect to VLBI (ppb) at 2005.0

Case	SLR	DORIS	GPS	VF ¹	Tie handling
ITRF2008	-1.05 ±0.13	0.18 ±0.20	0.67 ±0.10	0.90	All tie SINEX files, weighted

¹ Variance Factor

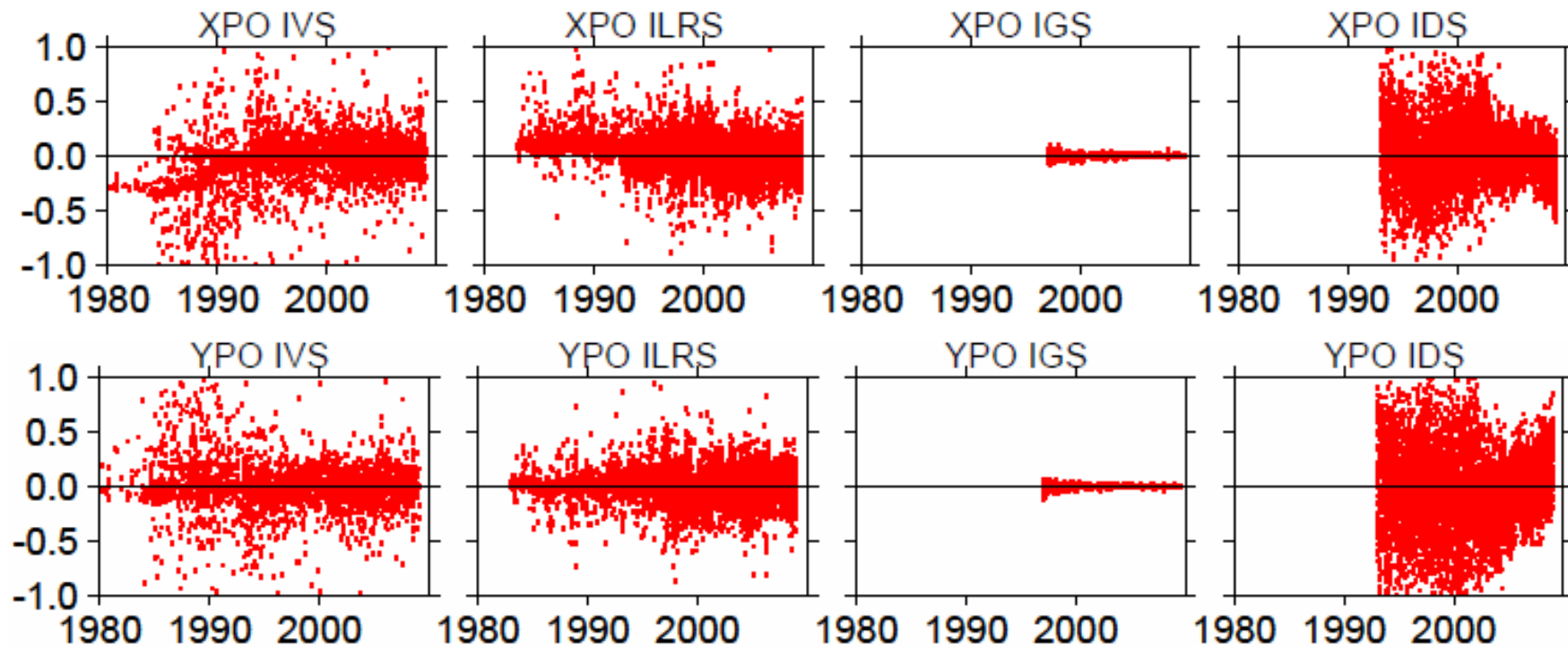
Transformation Param Fm ITRF2008 To ITRF2005

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

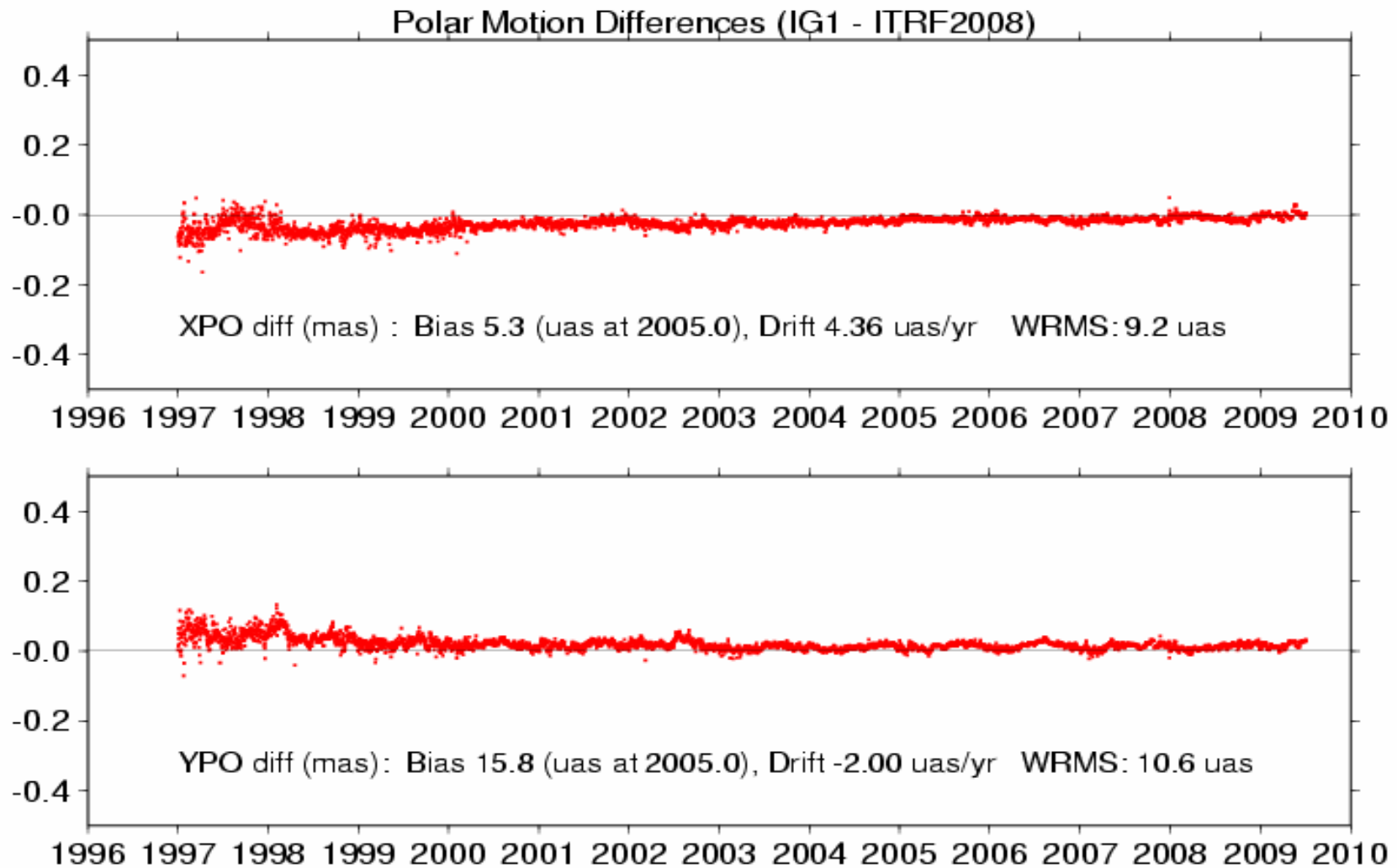
ITRF2008 PM residuals



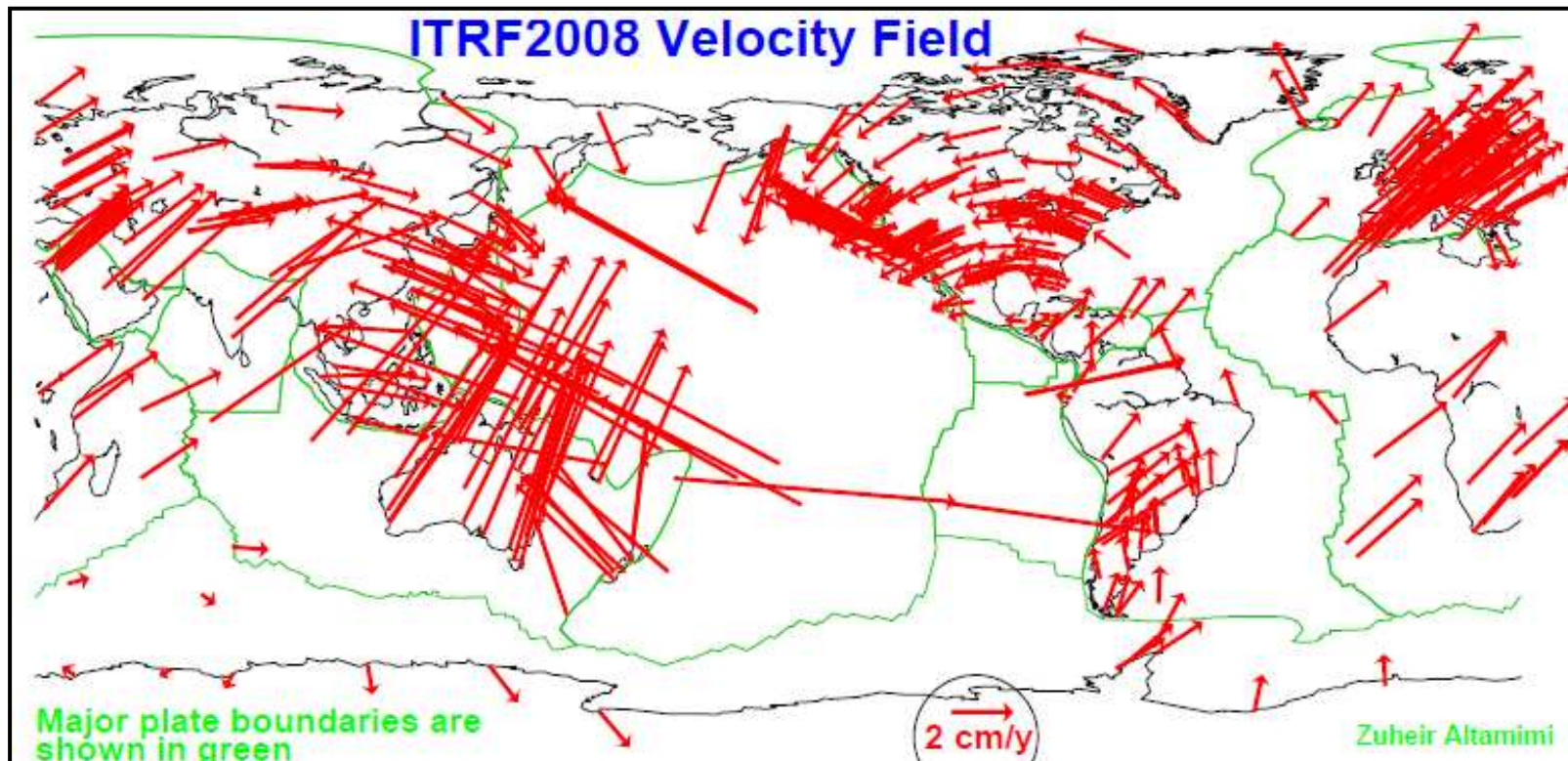
WRMS in μas

	X-pole	Y-pole		X-pole	Y-pole
GPS	10	10	VLBI	142	120
DORIS	239	353	SLR	144	128

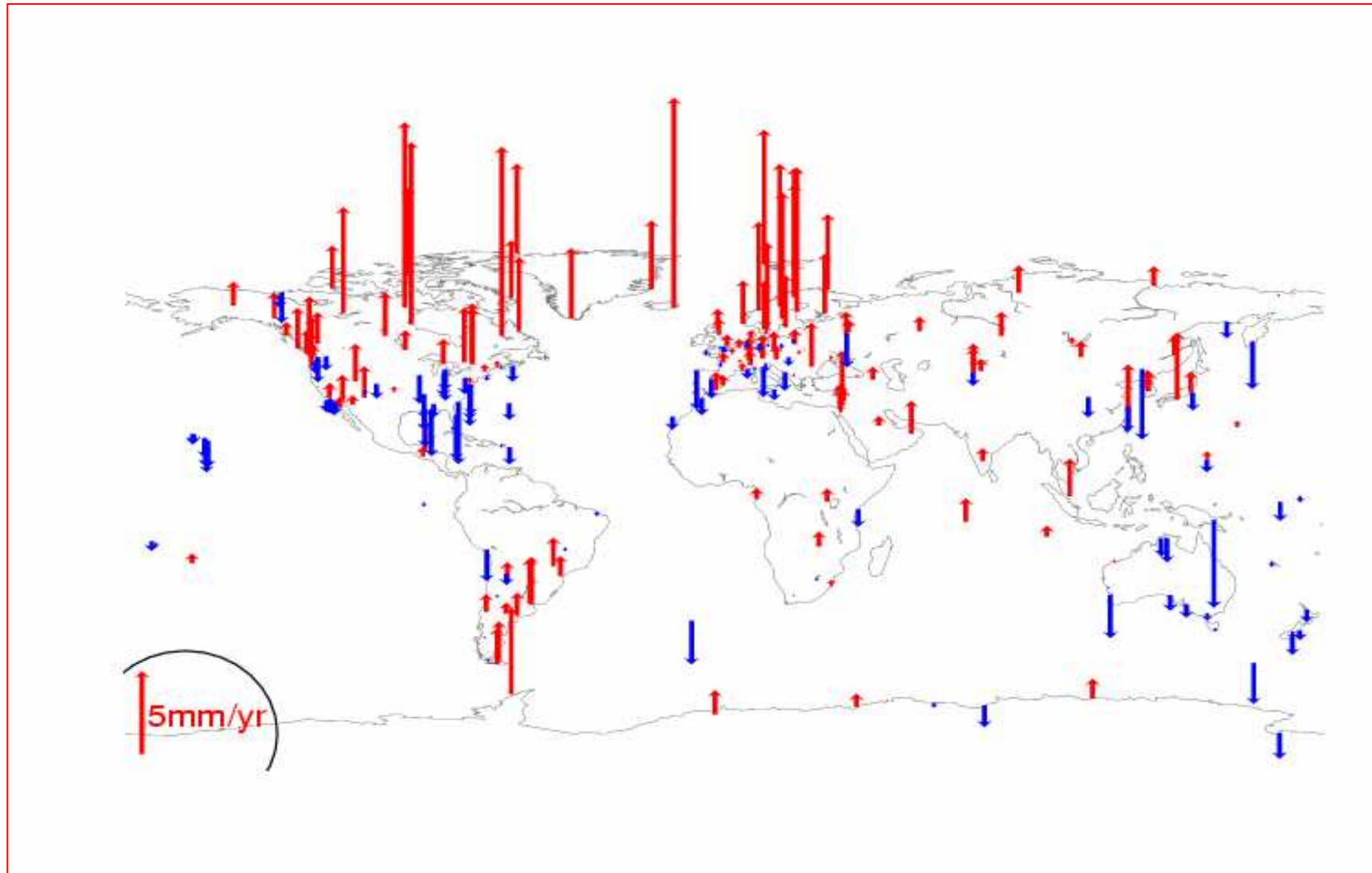
Polar motion diffs btw ITRF2008 and IGS repro1 (IG1)



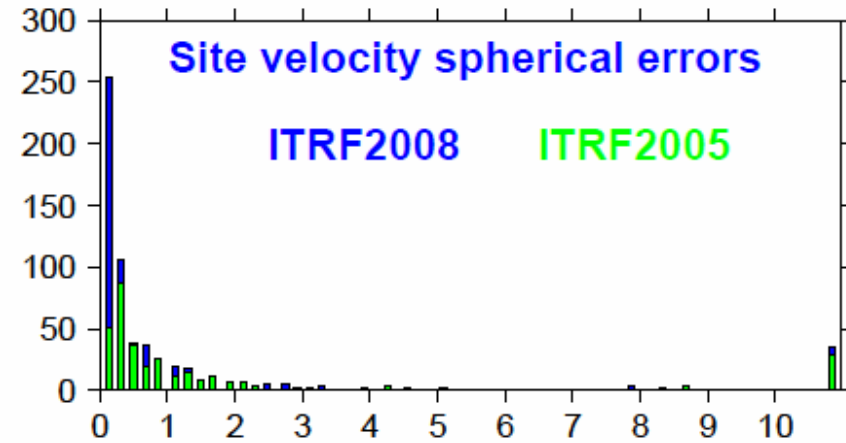
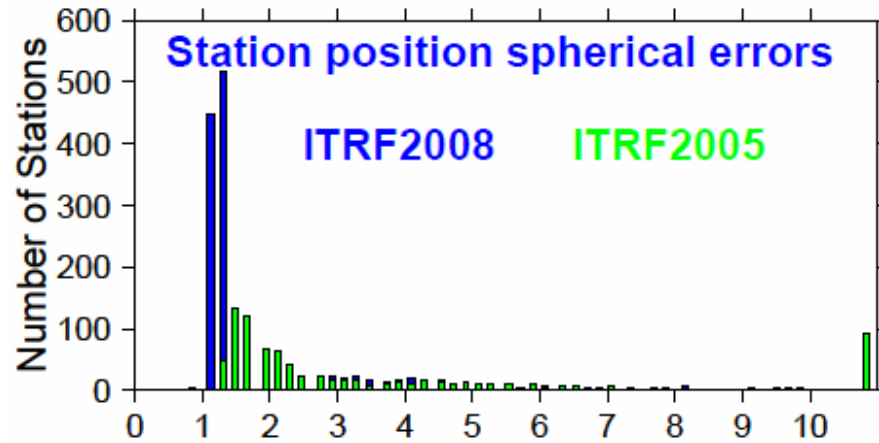
ITRF2008 Horizontal Velocity Field



ITRF2008 Vertical Velocity Field



ITRF2008 precision gain



And to finish ...:

- ITRF2008: an improved solution, compared to ITRF2005
- Local ties should be used as observations with appropriate weighting:
 - Full VAR-COVA information
 - Uncertainty: 3 mm in best cases
 - Agreement btw SG and Ties is roughly **4 mm WRMS**
- Overall ITRF2008 “accuracy” : **1 cm**
- Technique-specific systematic errors
 - GPS uncalibrated radome
 - VLBI antenna gravitational deformations
 - SLR range/timing biases
 - DORIS beacon reference point behavior ?