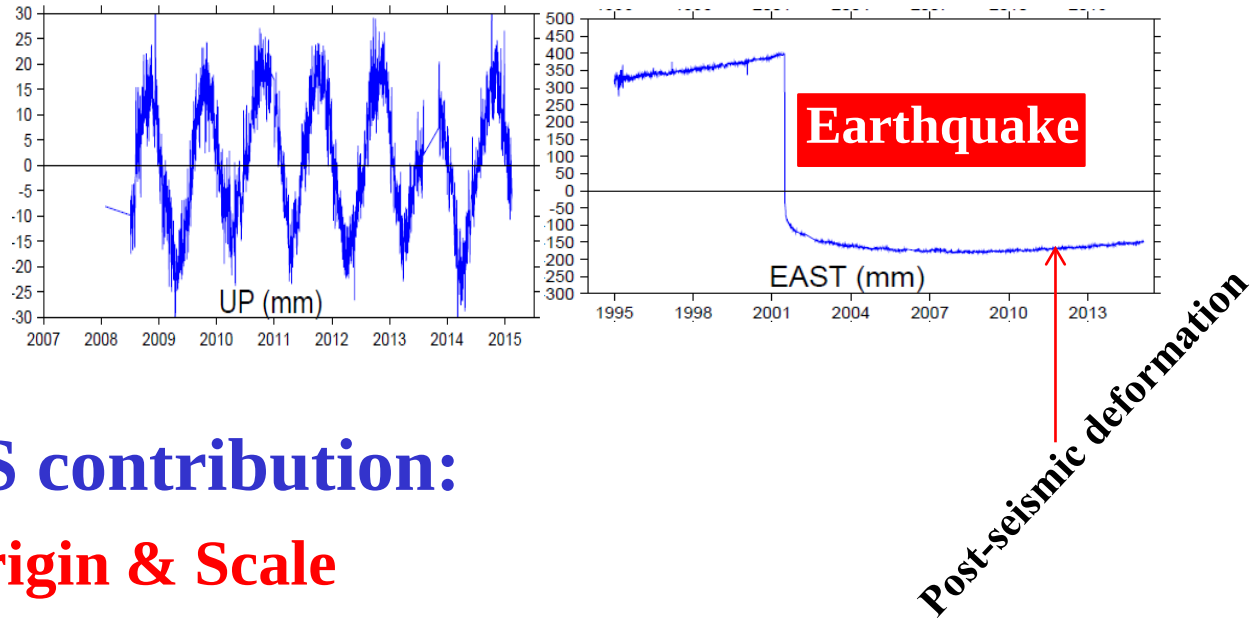
ITRF2014: Preliminary results and ILRS contribution

Zuheir Altamimi,
Paul Rebischung, Xavier Collilieux, Laurent Métivier

E-mail: zuheir.altamimi@ign.fr

Key Points

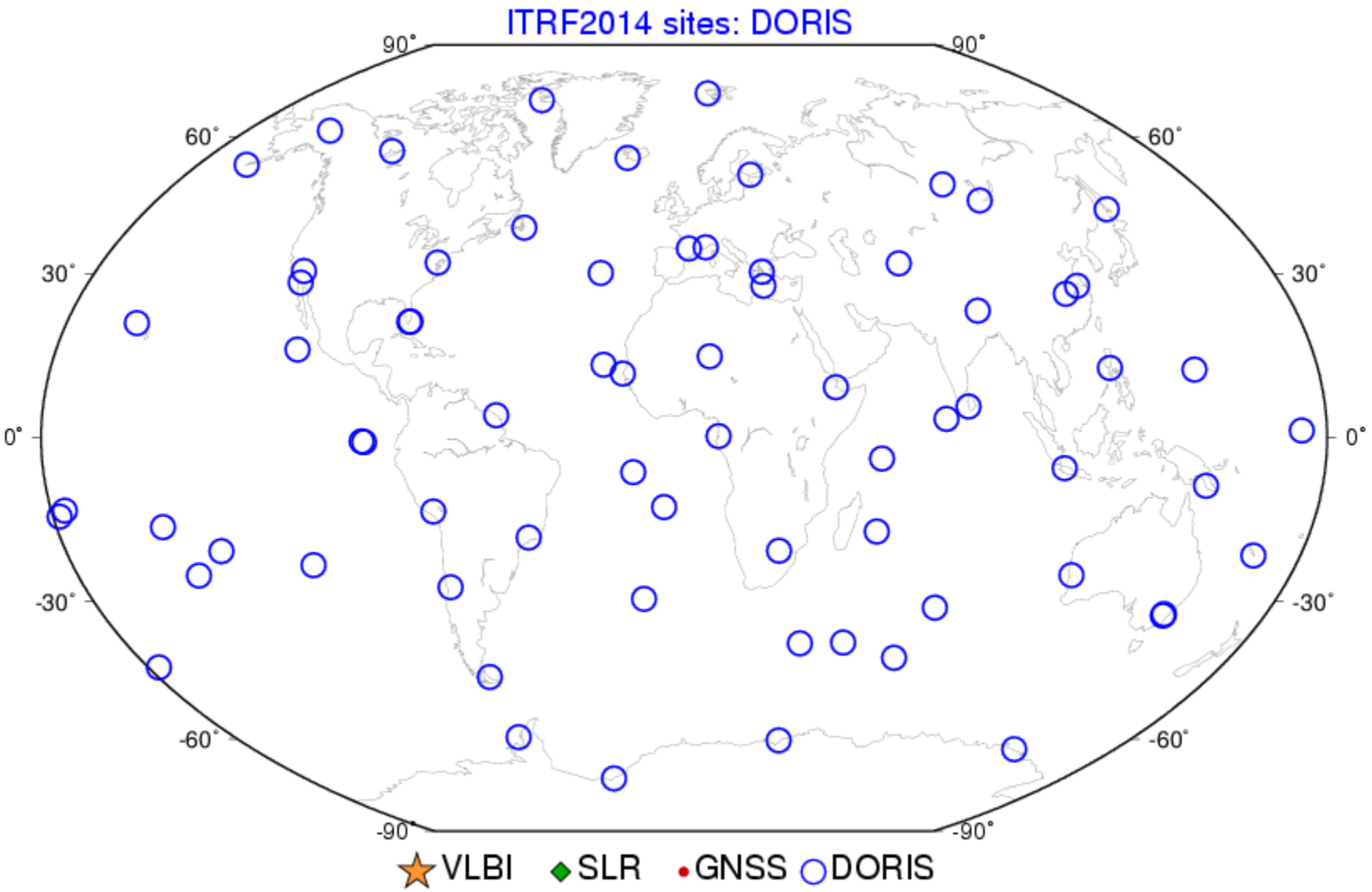
- **Linear & Non-linear motions**
  - **Periodic Signals : seasonal (e.g. annual, semi-annual)**
  - **Post-seismic deformation**



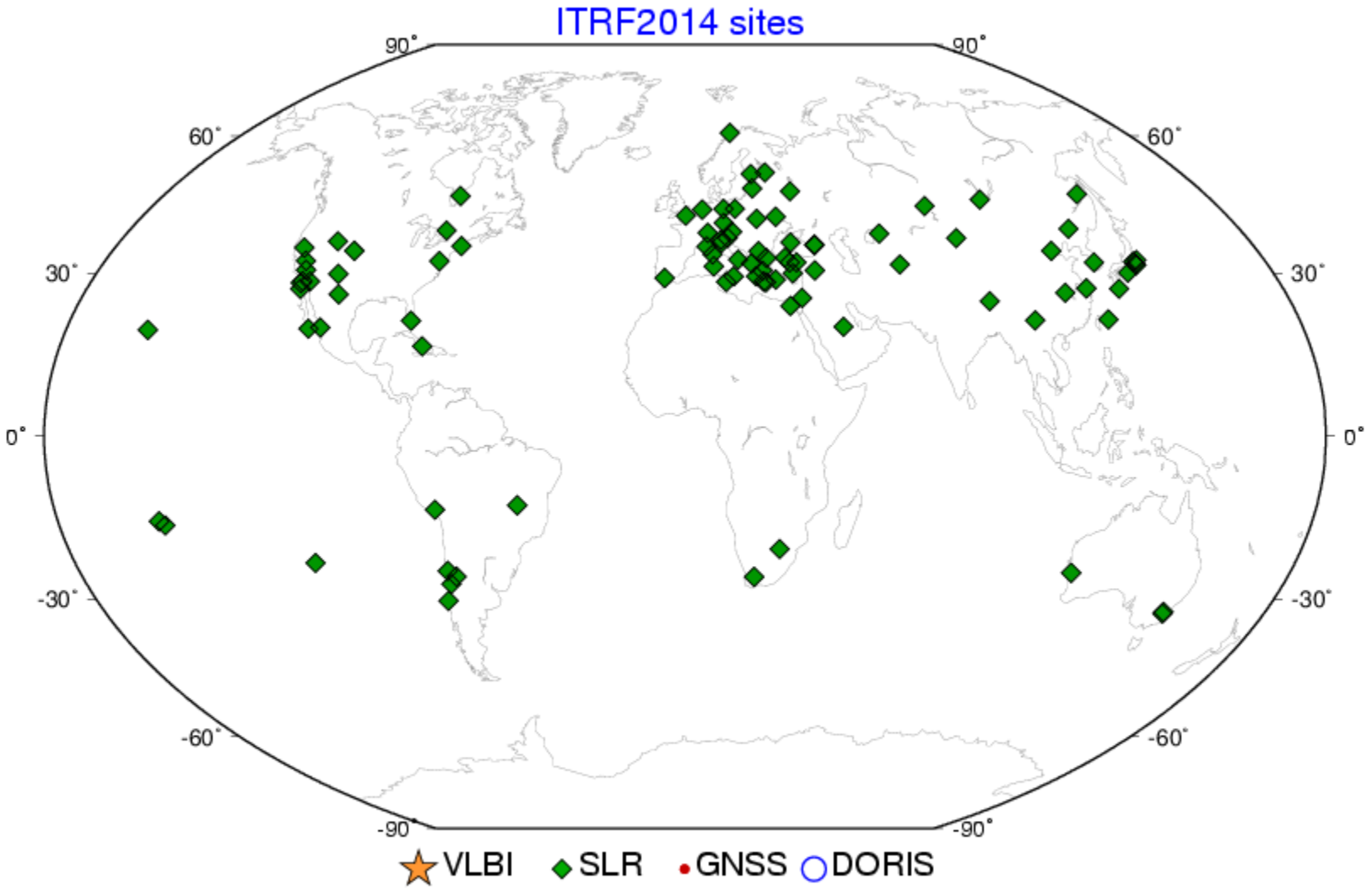
- **ILRS contribution:**
  - **Origin & Scale**
  - **Tie Agreements/discrepancies**

Preliminary results but close to final

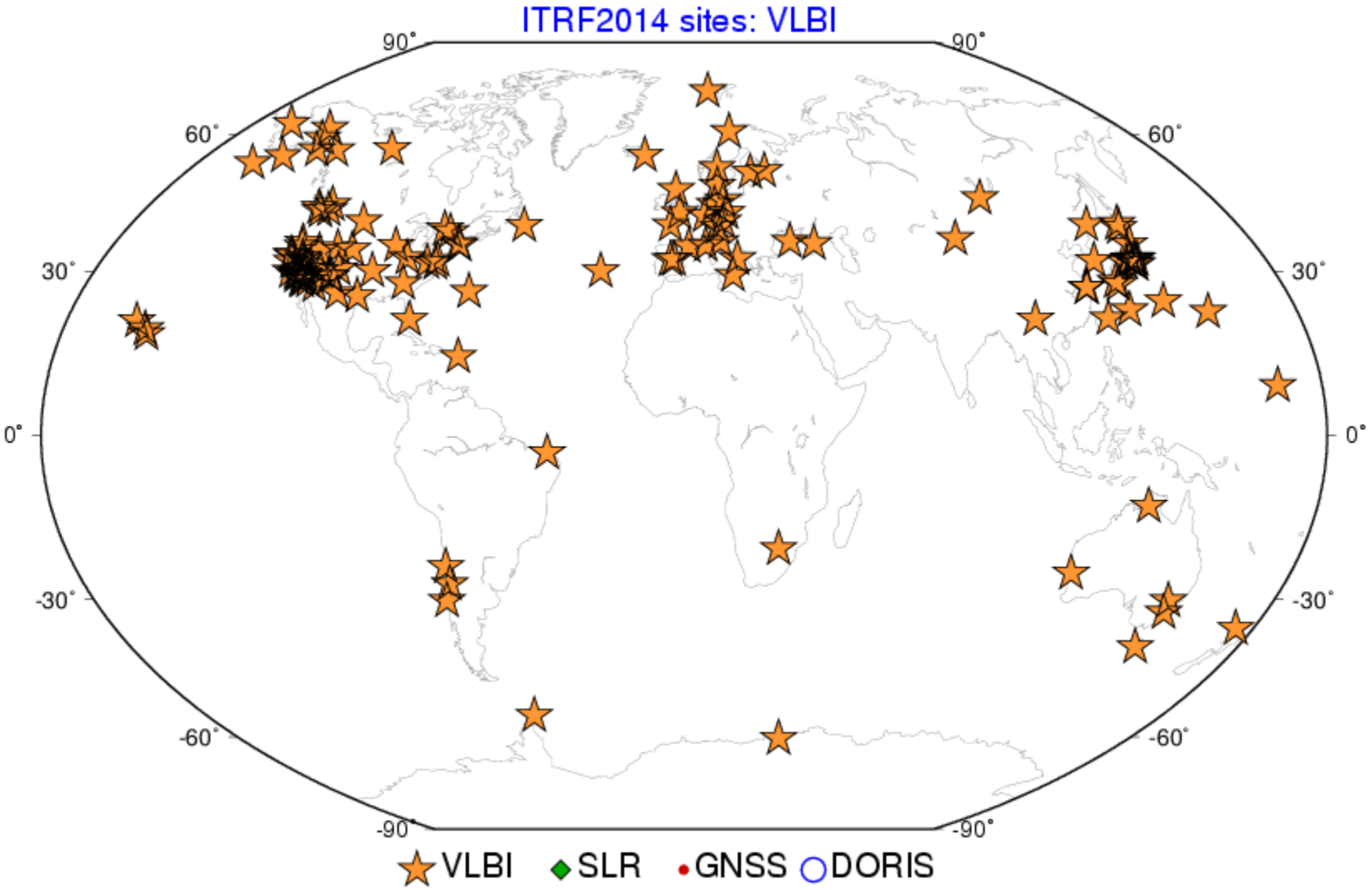
ITRF2014: DORIS



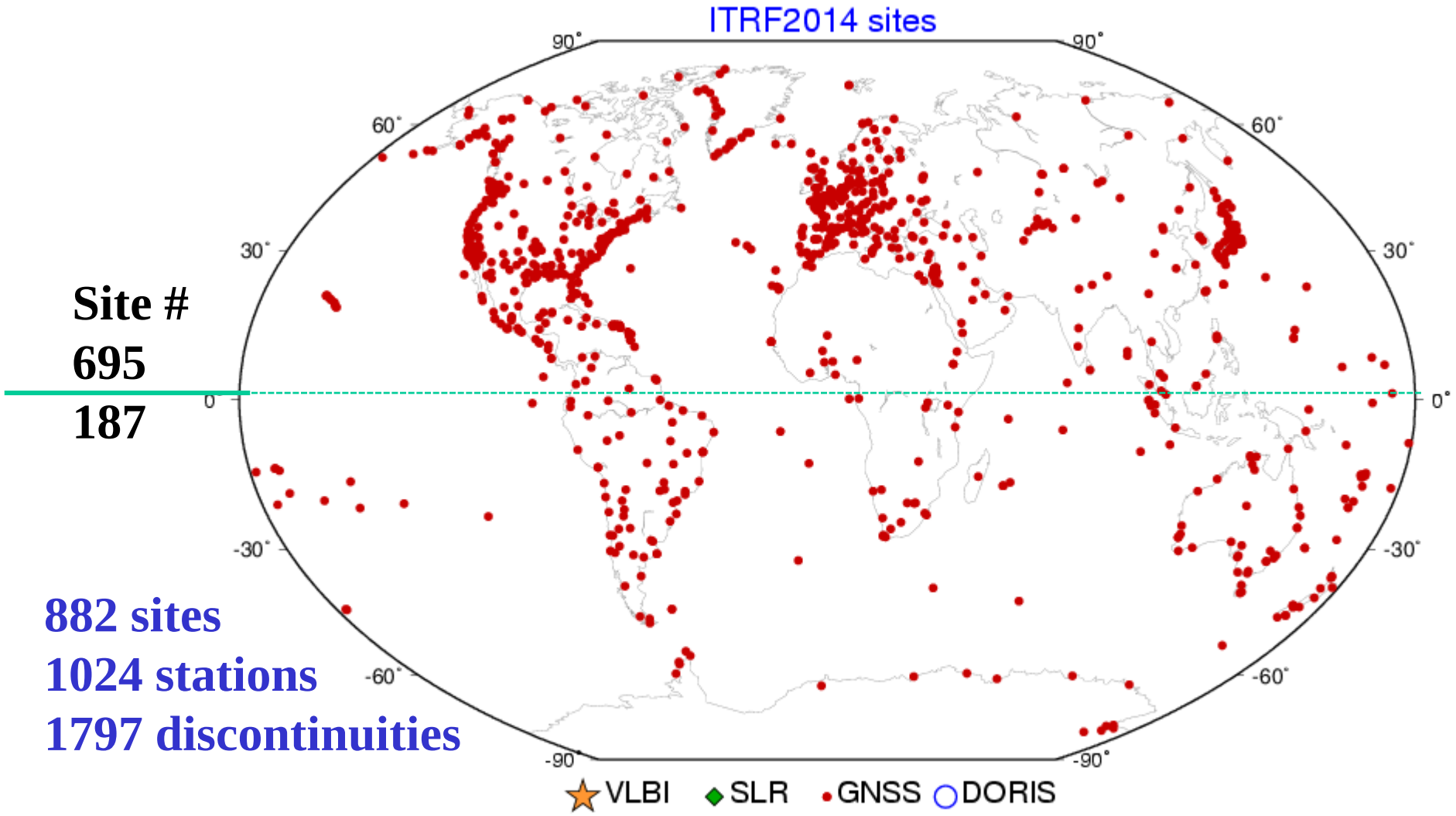
ITRF2014 : SLR



ITRF2014: VLBI



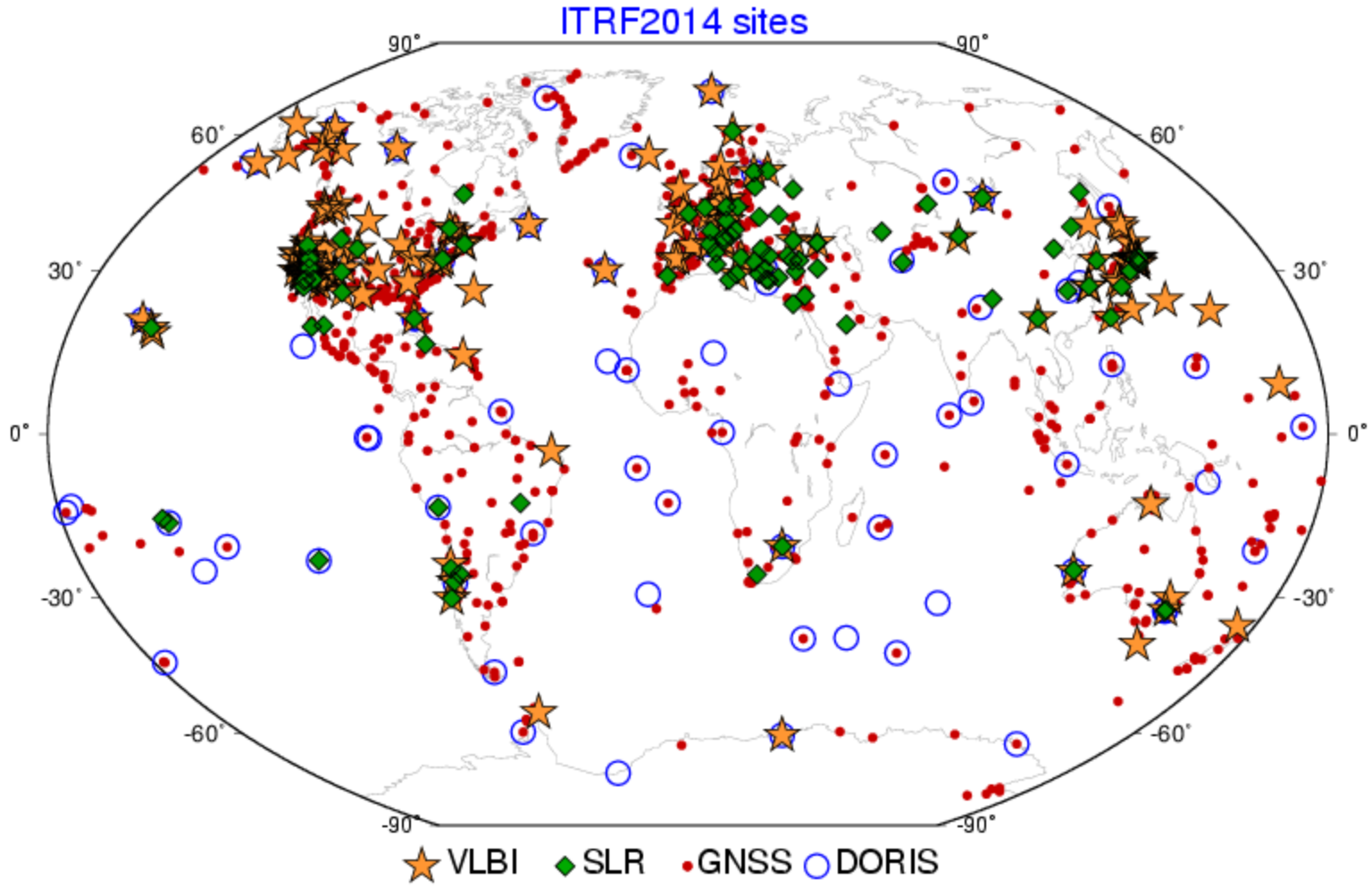
ITRF2014: GNSS



Site #
695
187

882 sites
1024 stations
1797 discontinuities

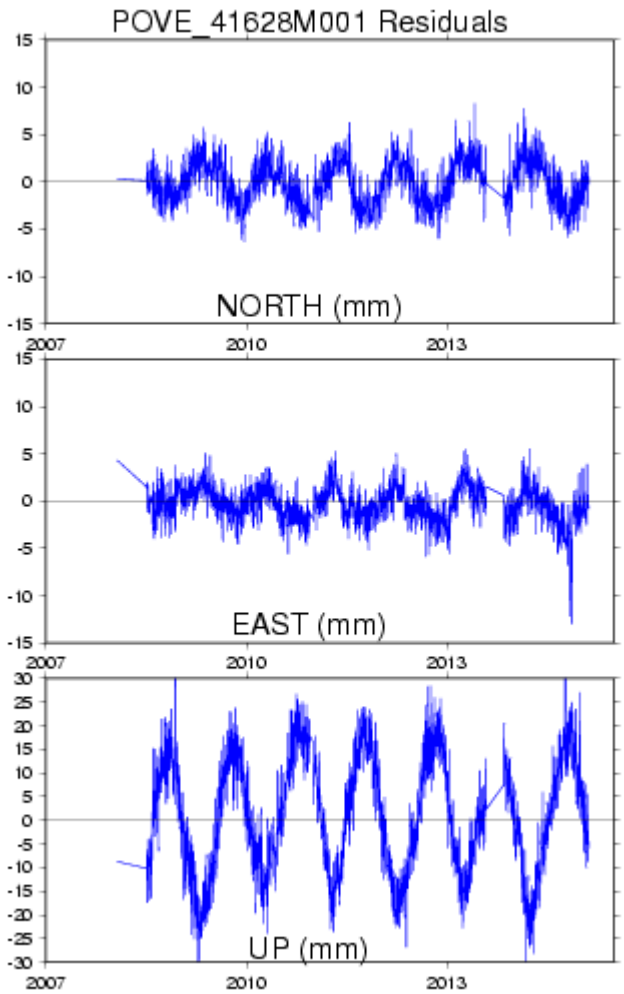
ITRF2014



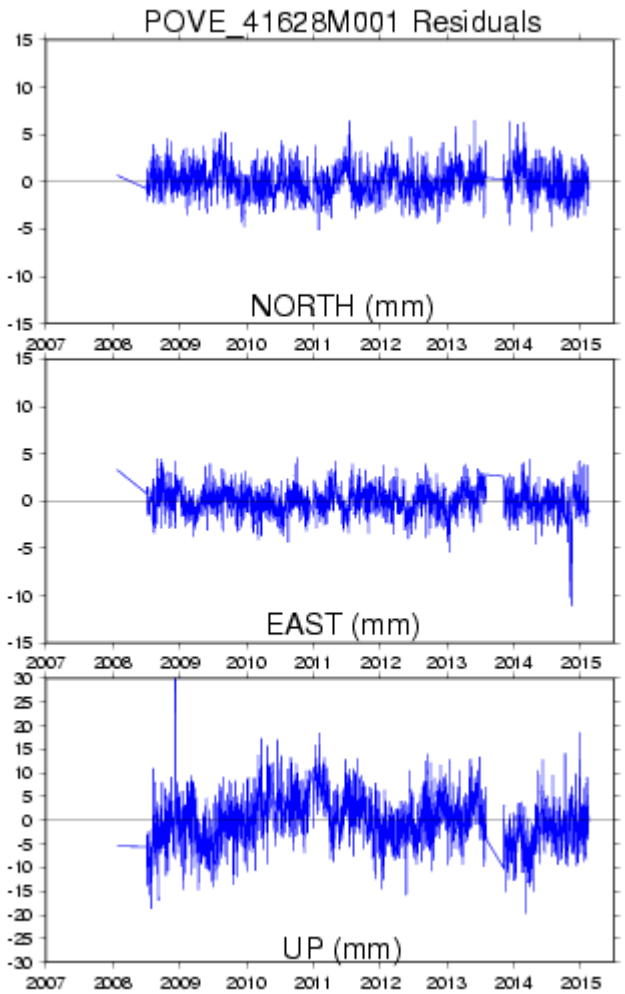
Periodic signals

POVE/ Brazil GNSS site

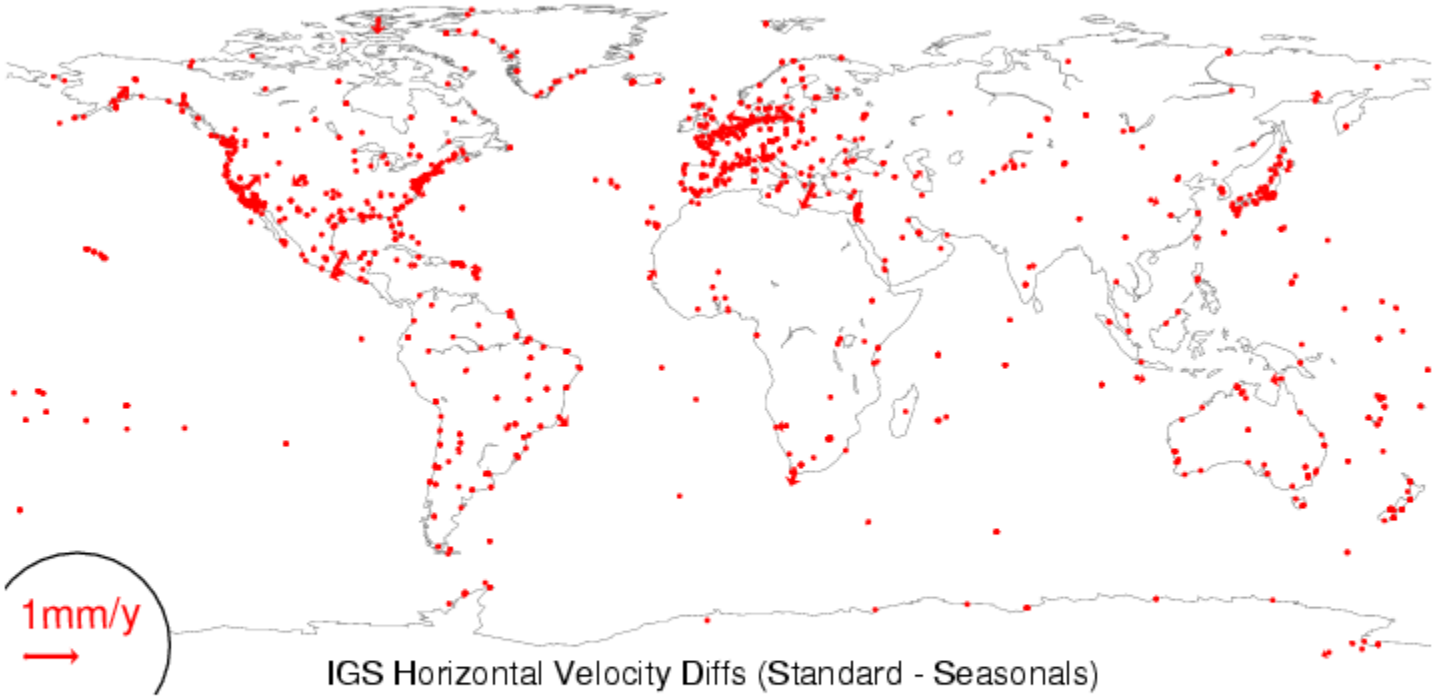
Standard residuals



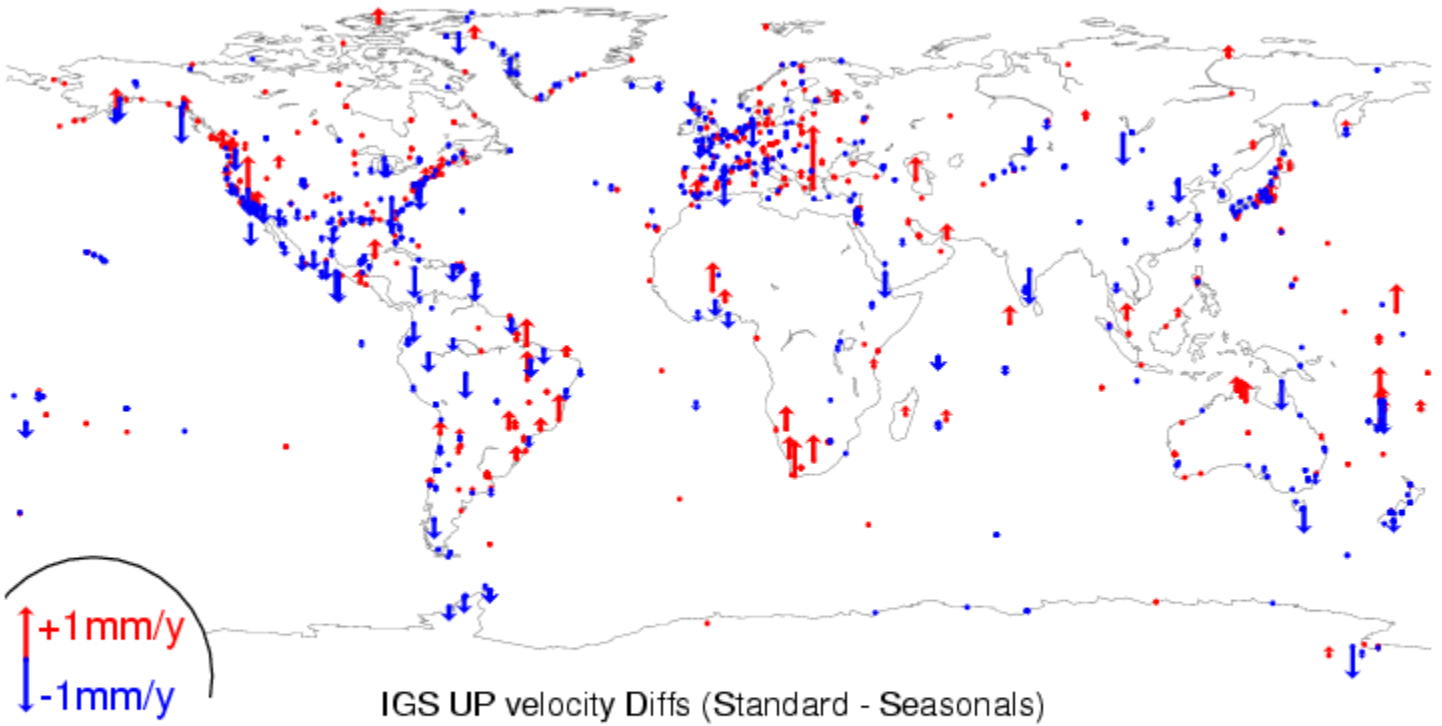
Annual & semi-annual estimated



IGS Horizontal Velocity Differences (Standard – Annual+Semi-Annual)



IGS Vertical Velocity Differences (Standard – Annual+Semi-Annual)

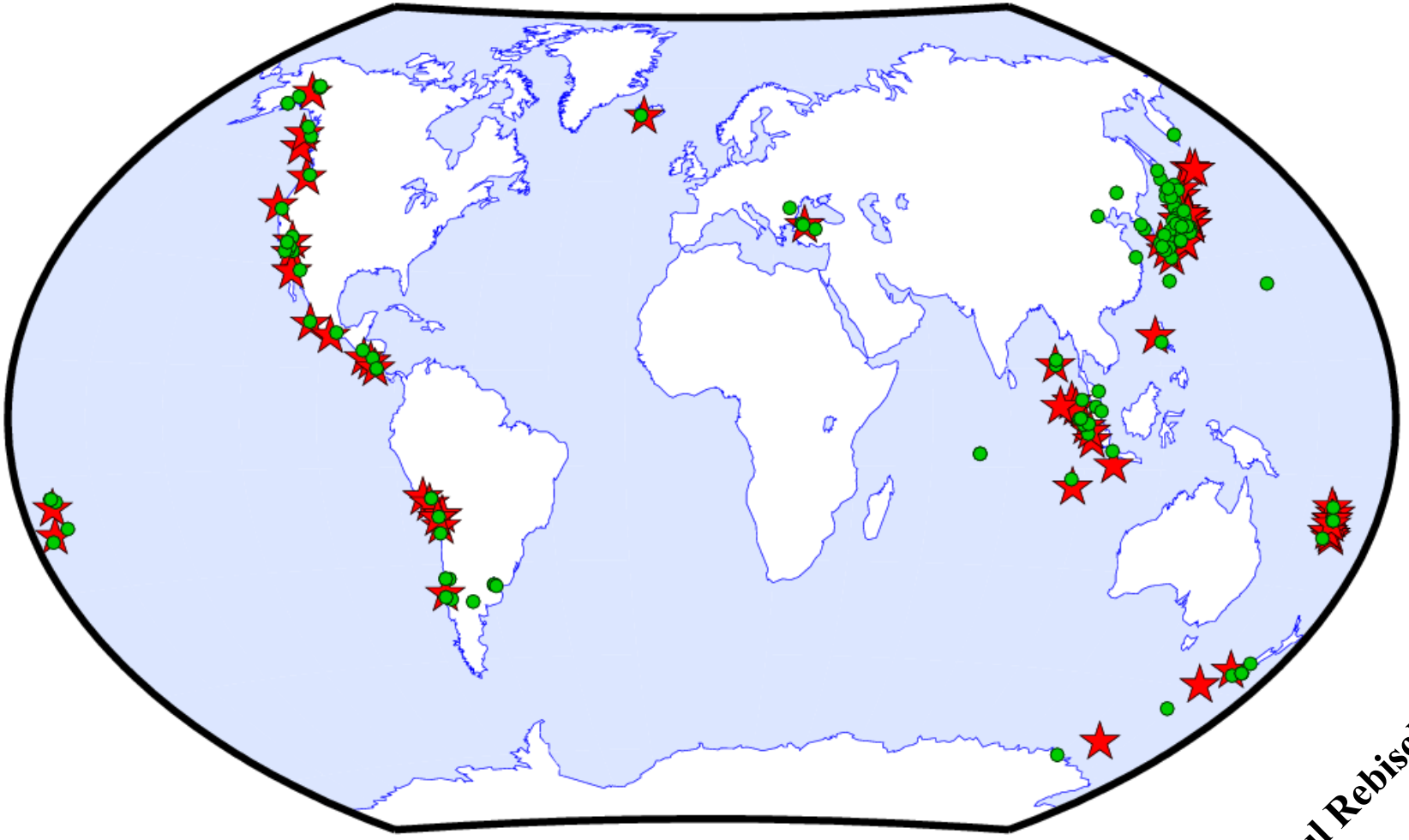


Post-Seismic Deformations

- **Fitting parametric models using GNSS/GPS data**
  - **at all GNSS/GPS Earthquake sites**
  - **Apply these models to the 3 other techniques at Co-location EQ sites**

- **Parametric models:**
  - **Logarithmic**
  - **Exponential**
  - **Log + EXP**
  - **Two EXP**

ITRF2014 Site affected by PSD



Red Stars: EQ Epicenters

Green circles: ITRF2014 sites

Artist: Paul Rebischung

Post seismic parametric models

$$X(t) = X(t_0) + \dot{X}(t - t_0) + \delta X_{psd}(t)$$

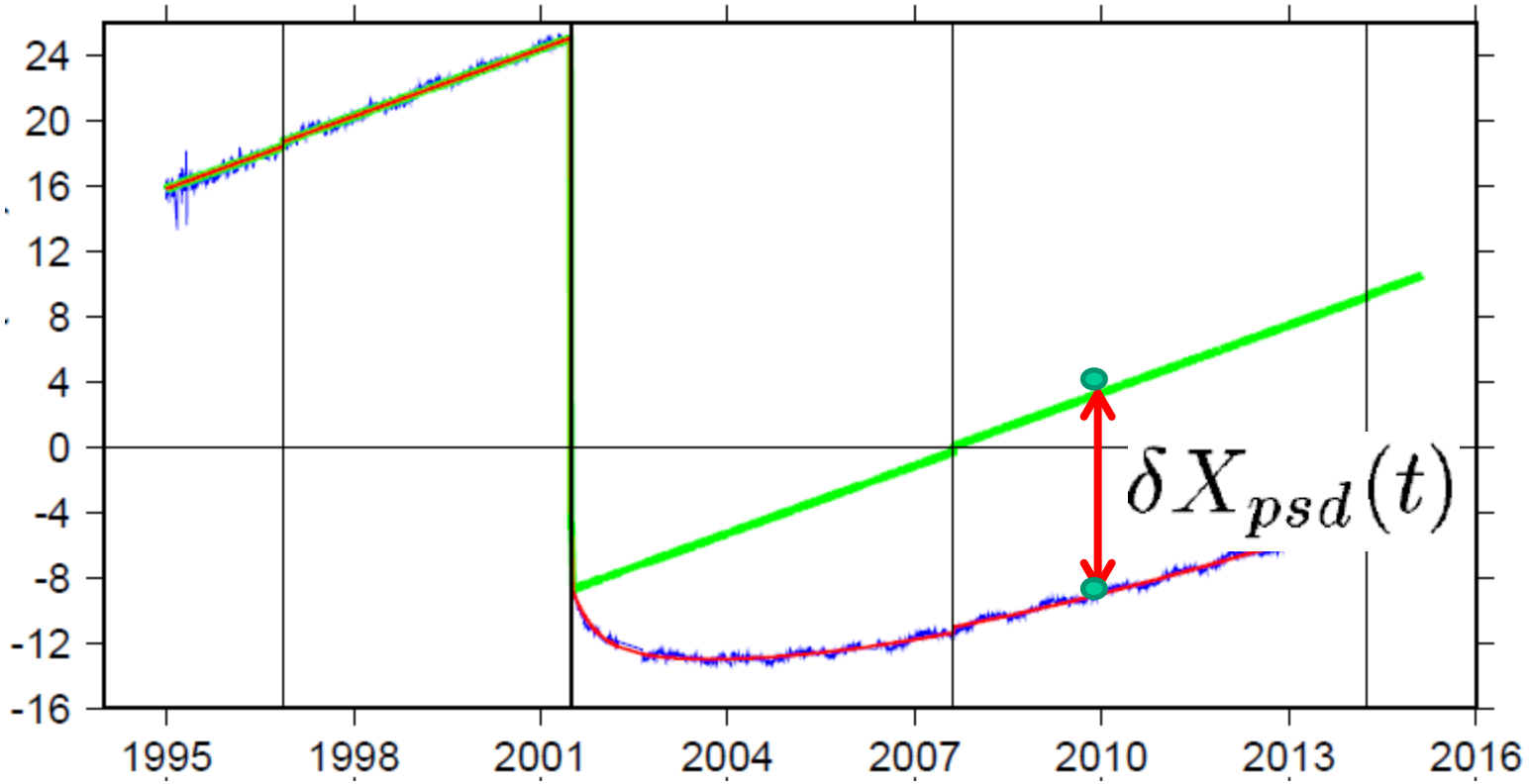
$$X_{instantaneous}(t) = X(t_0) + \dot{X}(t - t_0) + \delta X_{psd}(t)$$

$$\delta L(t) = \sum_{i=1}^{n^l} A_i^l \log(1 + \frac{t - t_i^l}{\tau_i^l}) + \sum_{i=1}^{n^e} A_i^e (1 - \mathrm{e}^{-\frac{t - t_i^e}{\tau_i^e}})$$

Applications:

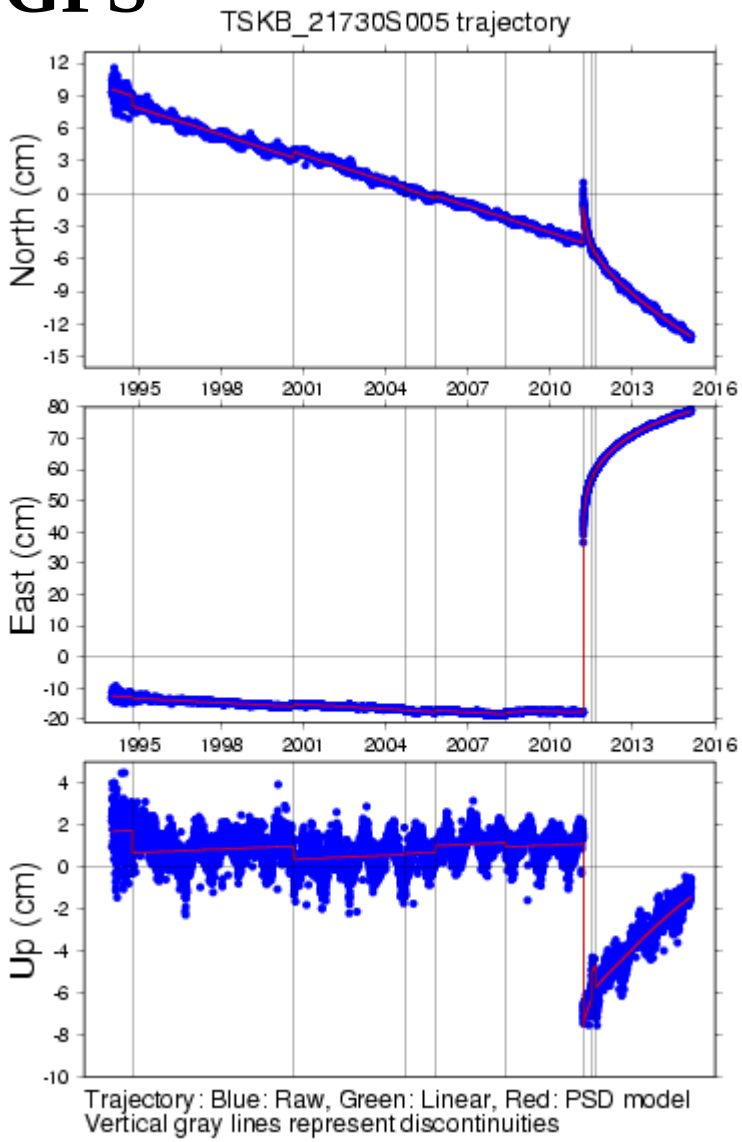
- Propagate ITRF2014 stations positions from $\mathbf{t_0}$ to **t**: Should **Add (+)** the correction
- Apply the correction to a time series before stacking: Should **Subtract (-)** the correction

PSD Correction

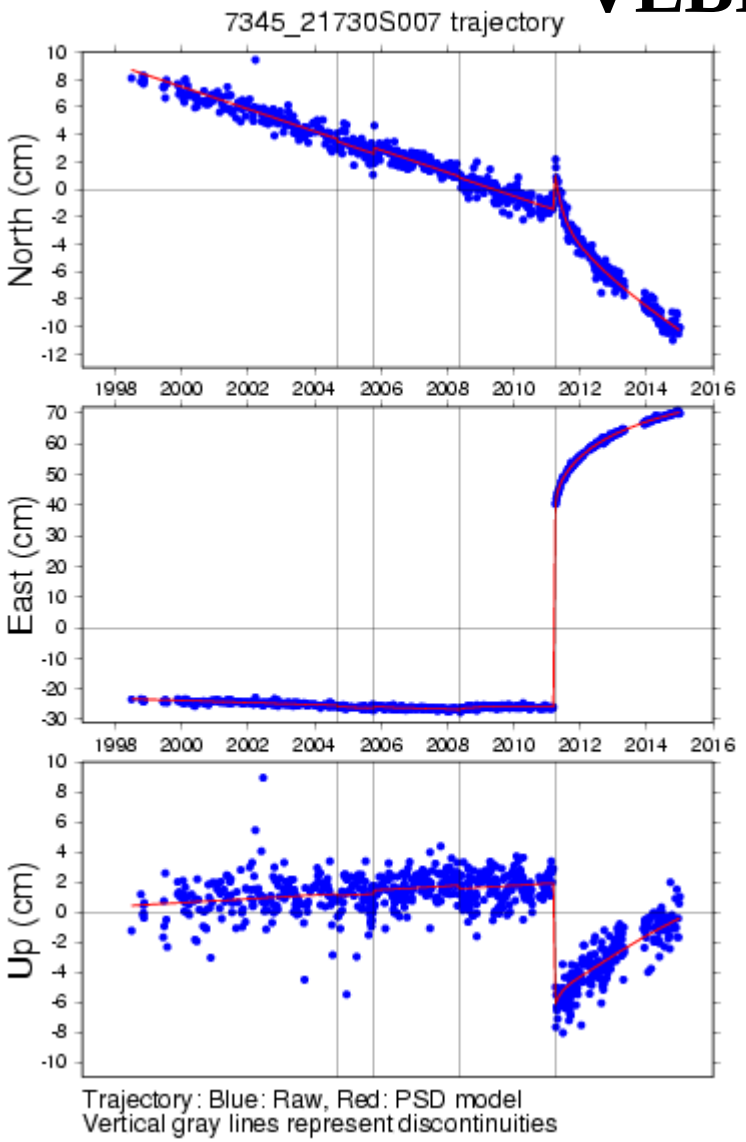


Tsukuba Trajectory

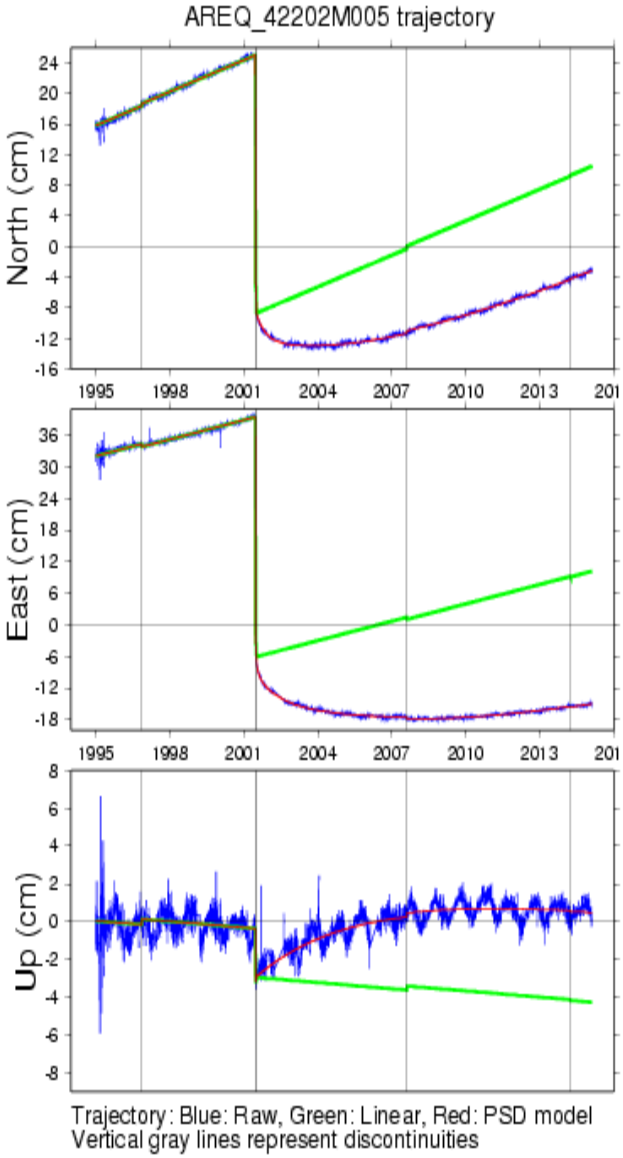
GPS

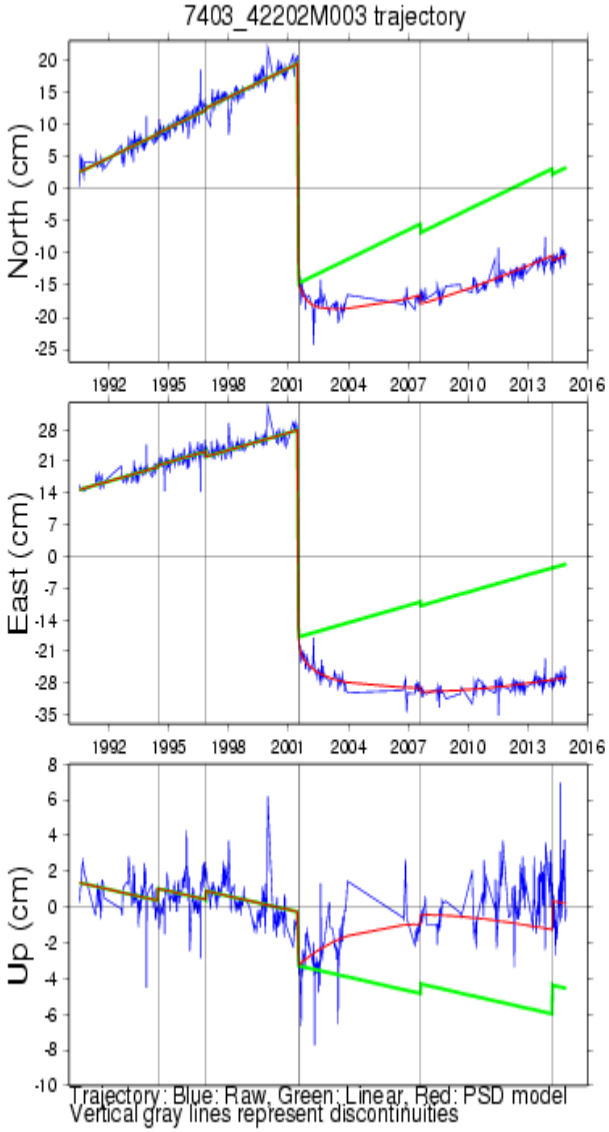


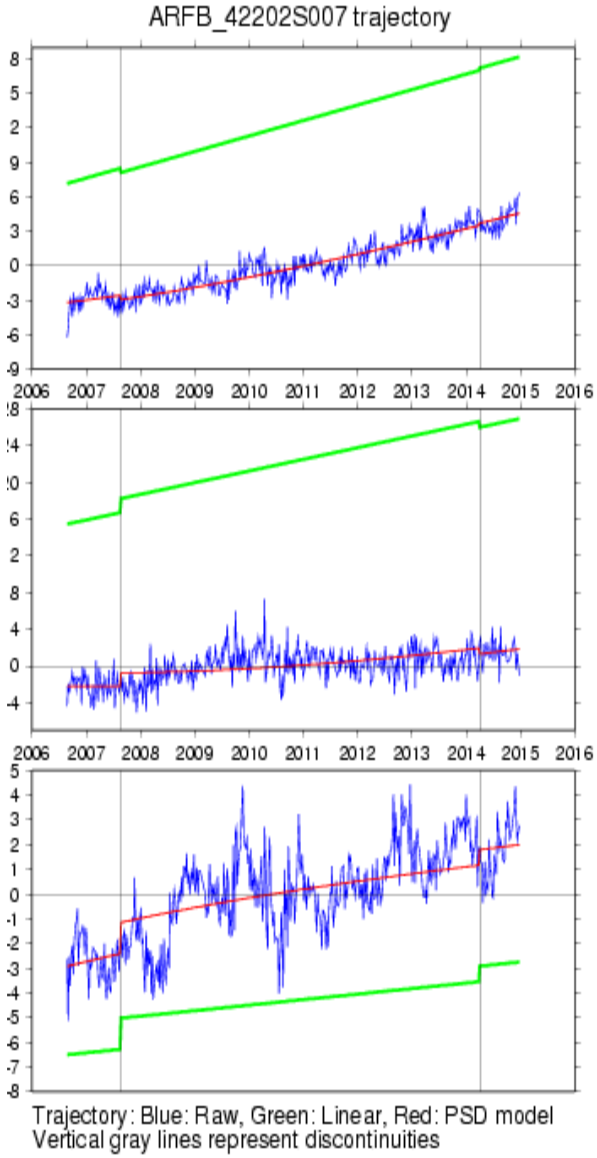
VLBI



Arequipa-GPS, SLR & DORIS

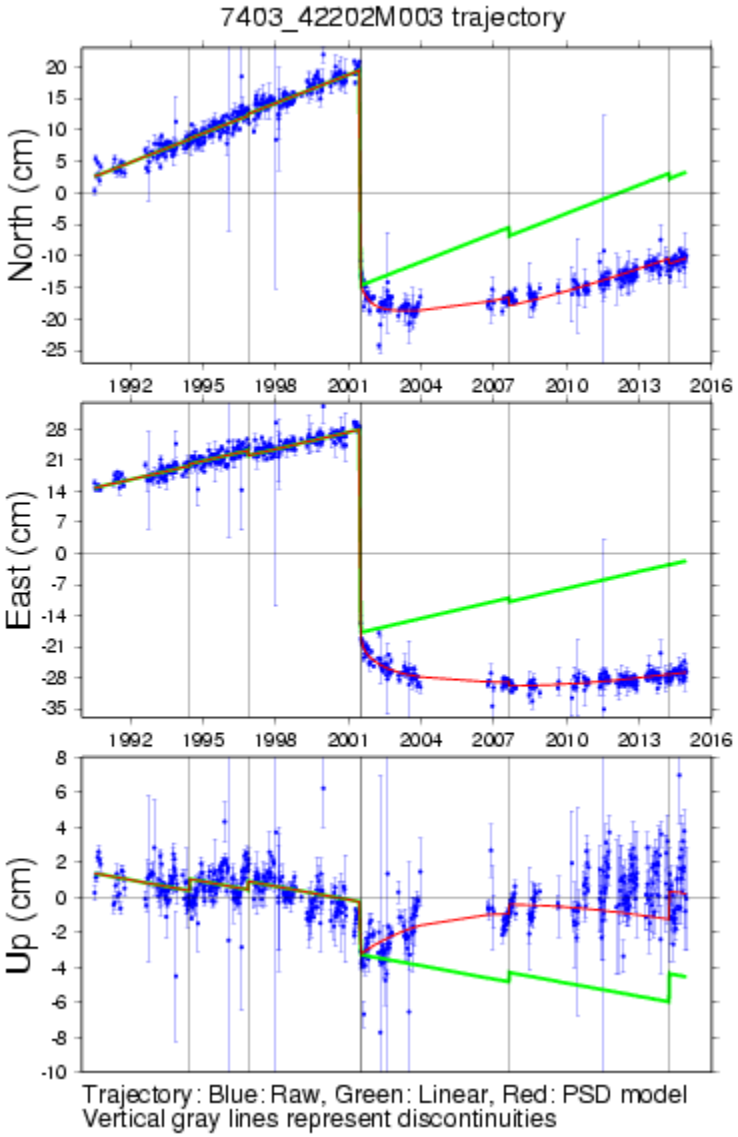




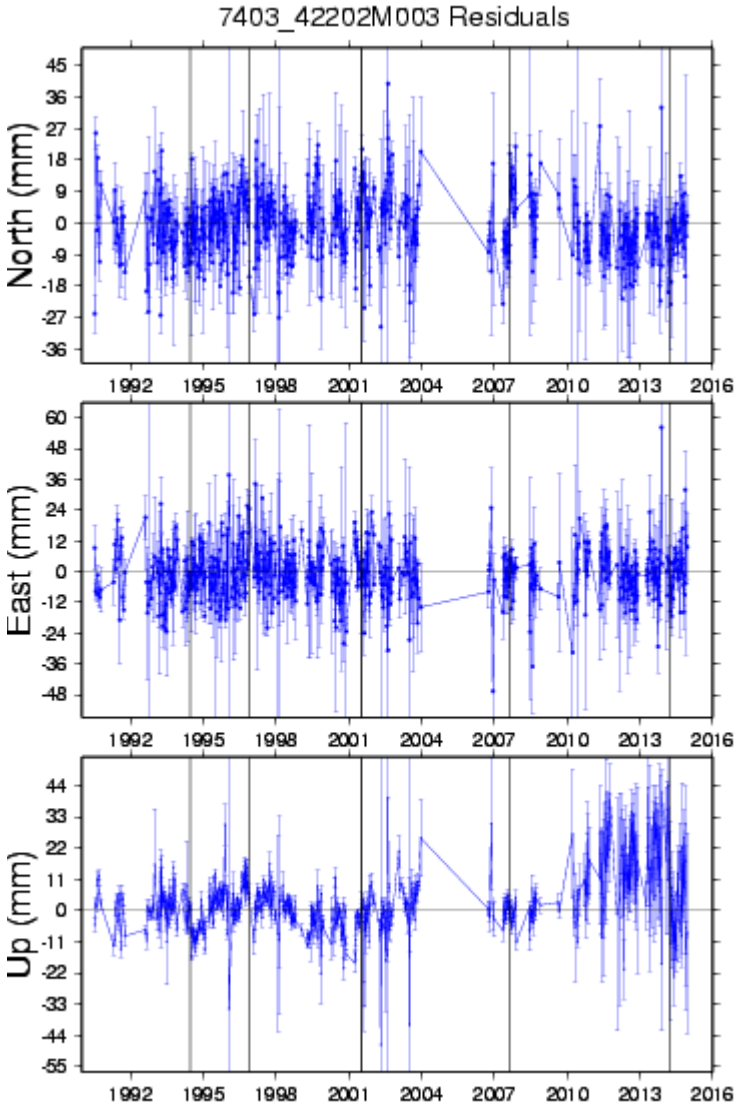


SLR station Arequipa

Trajectory

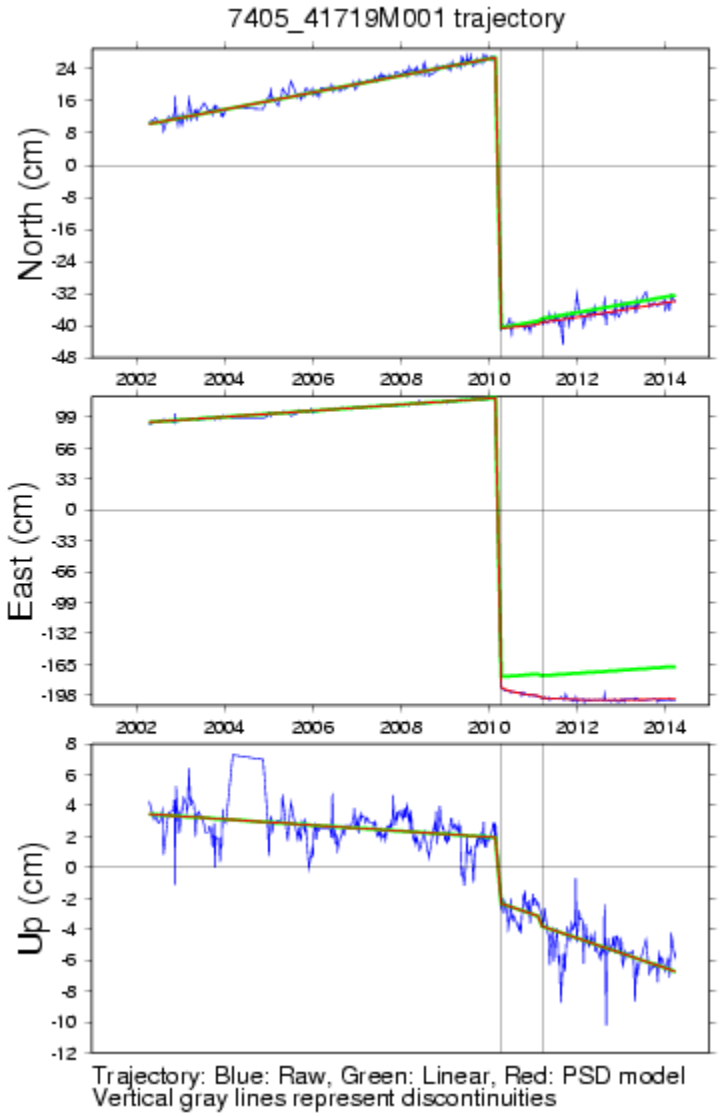


Residuals

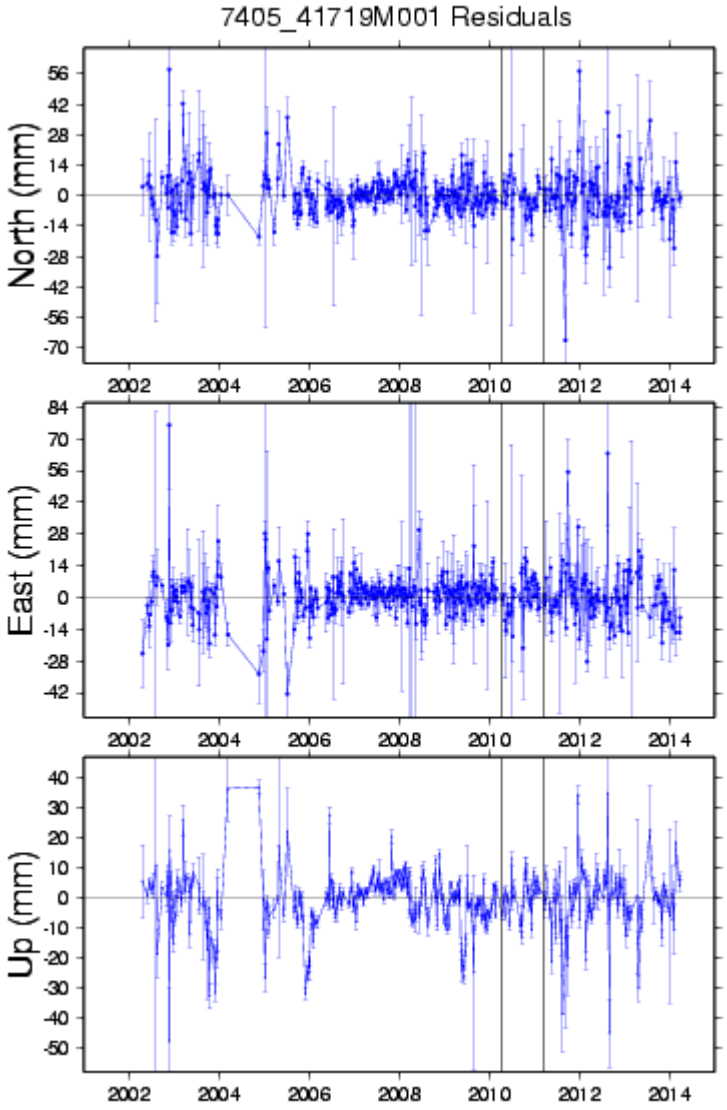


SLR station Concepcion

Trajectory

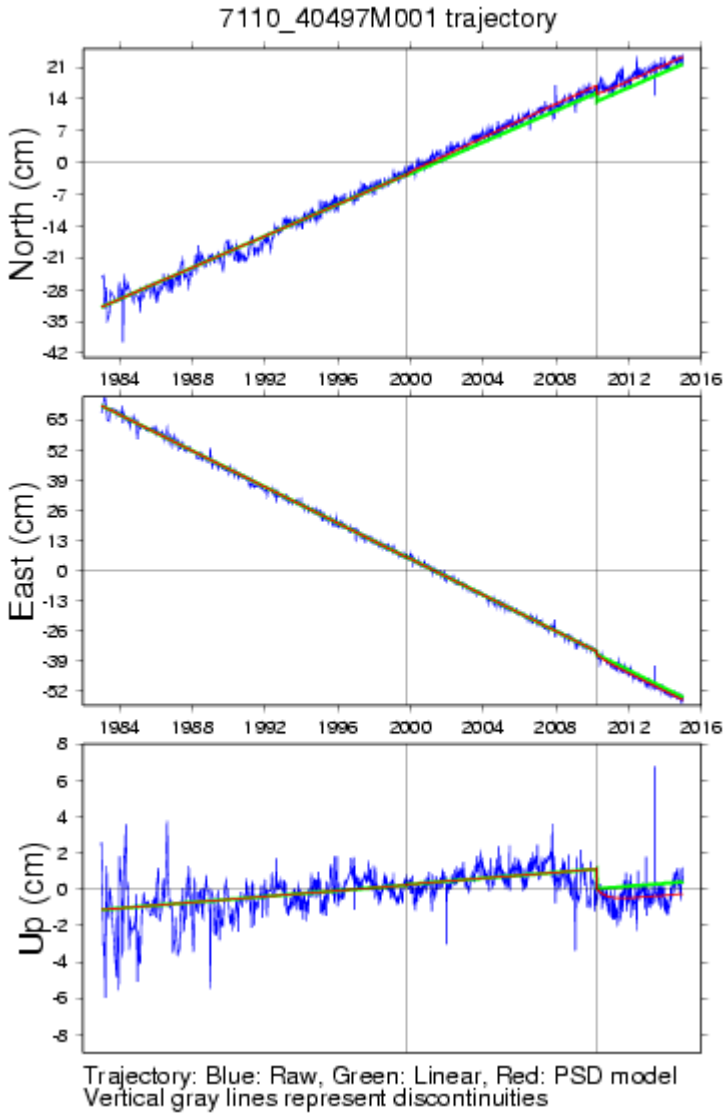


Residuals

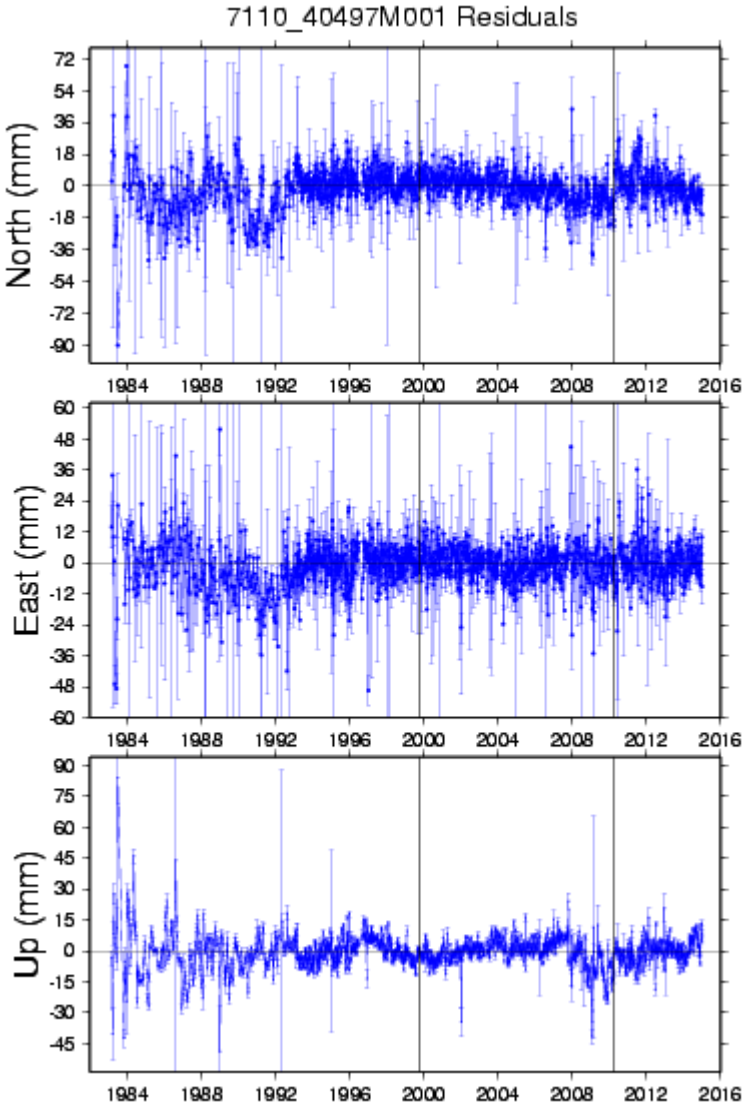


SLR station Monument Peak

Trajectory

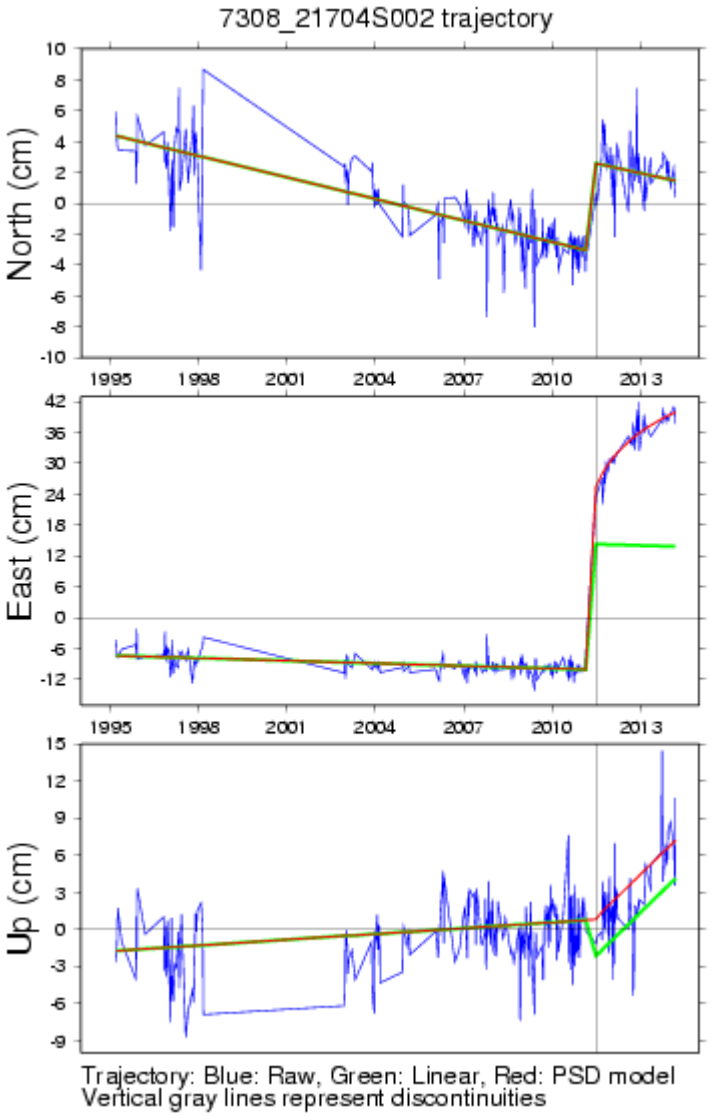


Residuals

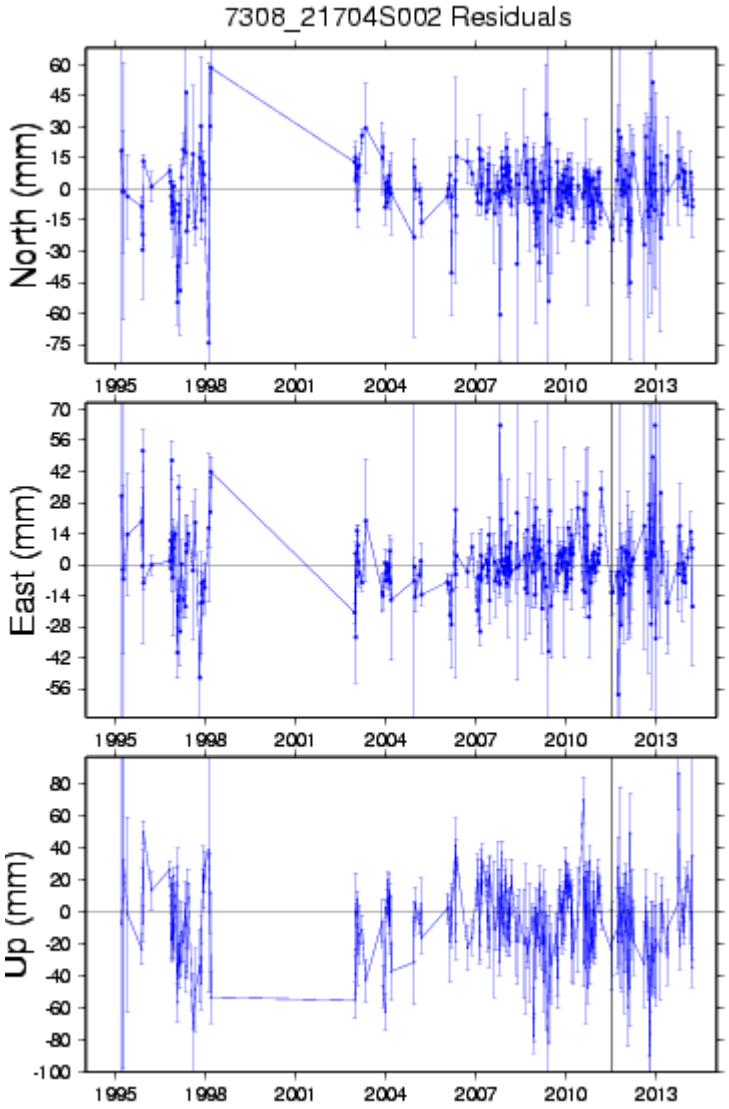


SLR station Koganei

Trajectory



Residuals



ITRF2014 Co-locations

- **GNSS/GPS is connecting the 3 other techniques. The number of tie vectors:**
  - **GPS-SLR : 44**
  - **GPS-VLBI: 50**
  - **GPS-DORIS: 80**
- **Level of agreement: discrepancies less than 5mm**

Pairs	#	Out of	%
GPS-SLR	14	44	32%
GPS-VLBI	21	50	42%
GPS-DORIS	20	80	20%

Consistency of ILRS SLR and ITRF2014P

Origin and Scale at epoch 2010.0 , and rates from ITRF2014P to ILRS Cumulative Solution

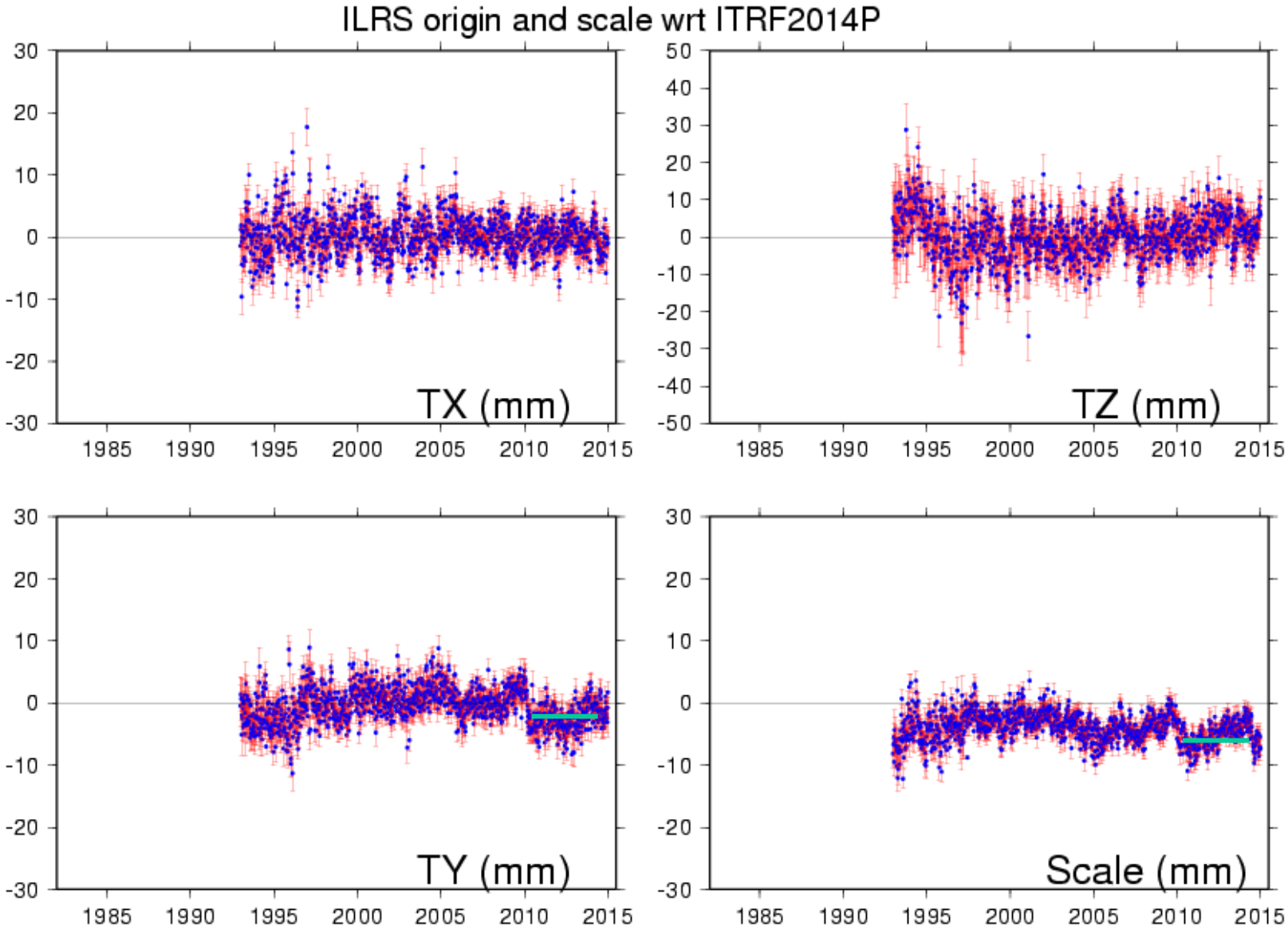
	Tx (mm)	Ty (mm)	Tz (mm)	Scale (ppb)
At 2010.0	**0.1** (±0.1)	**0.2** (±0.1)	**0.0** (±0.1)	**-0.72** (±0.02)
Rates (mm/yr)	**0.0** (±0.1)	**0.0** (±0.1)	**0.0** (±0.1)	**-0.01** (±0.01)

WRMS of fit

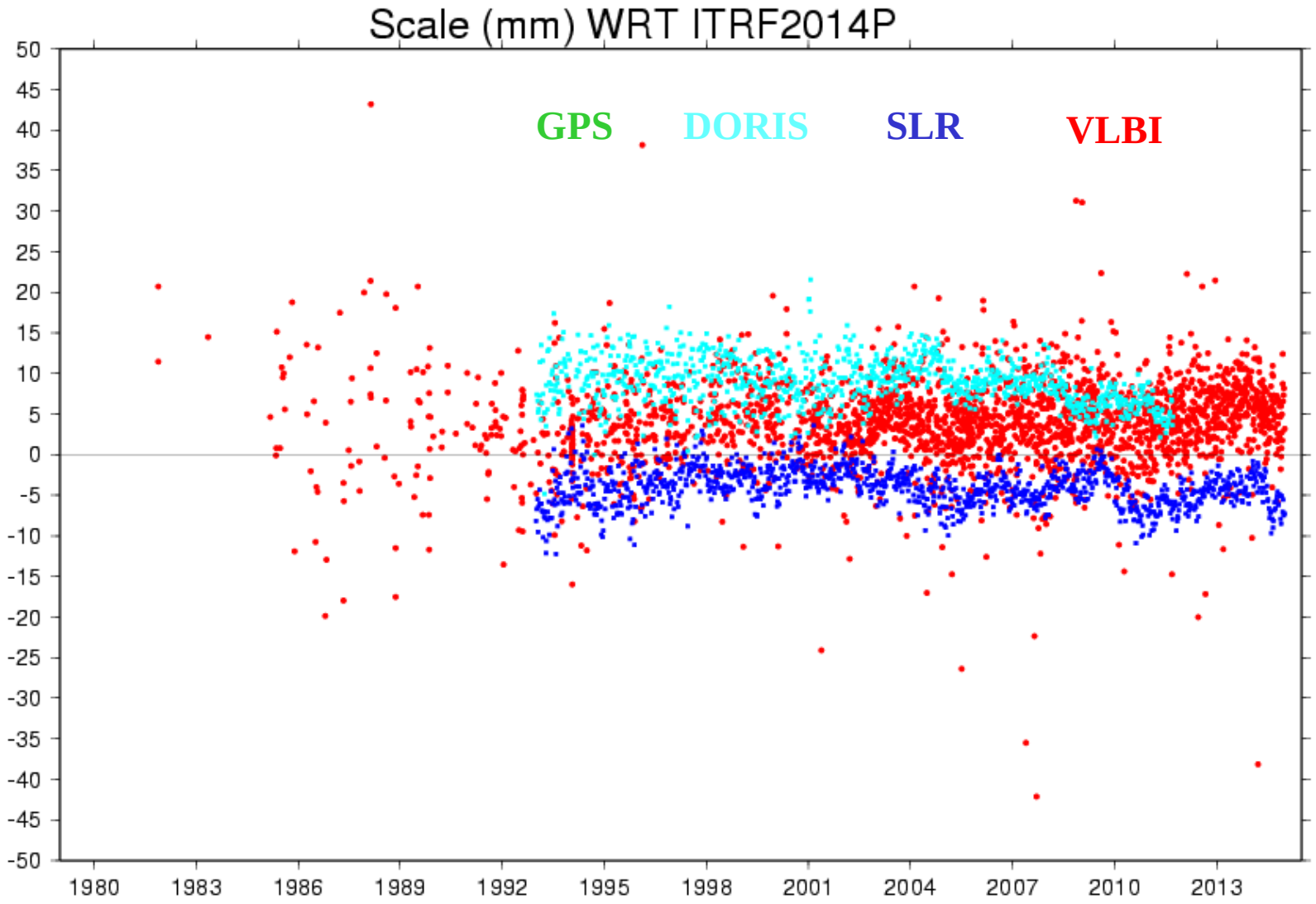
	East	North	Up
Positions (mm)	**0.7**	**0.9**	**0.4**
Velocities (mm/yr)	**0.4**	**0.4**	**0.2**

stations
133

SLR Origin & Scale WRT ITRF2014P



VLBI, SLR, DORIS & GPS Scales wrt ITRF2014P



Conclusion

- **ITRF2014: What is new?**
- **==> Modelling the non-linear motions**
  - **Seasonal terms**
  - **Application of parametric models for post-seismic deformation**

- **ITRF2014: When ?**
  - **Hopefully first half of November, 2015**