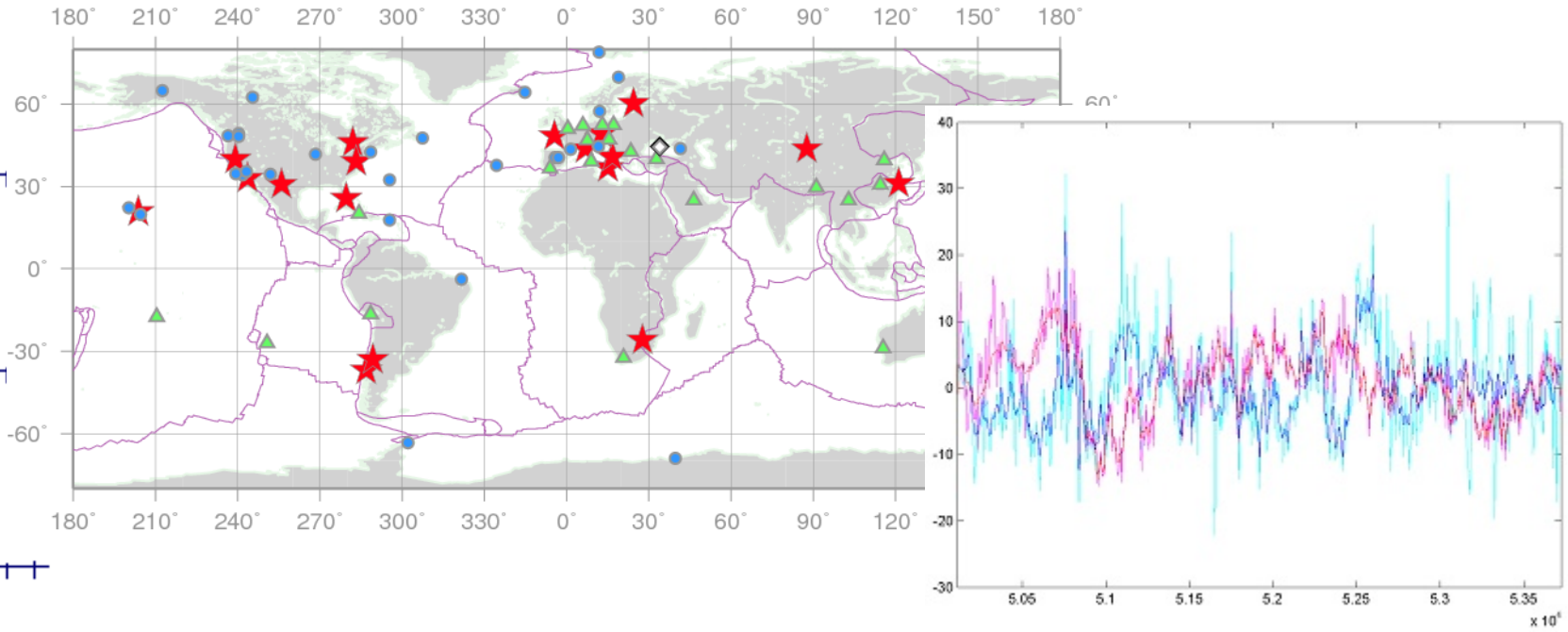
Coordinate time series comparison.
Application to ITRF2005 height residuals time series



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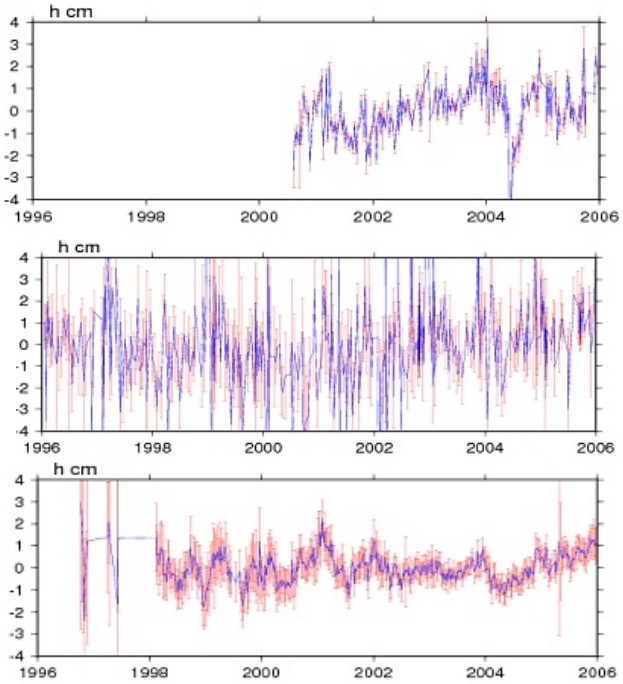
Acknowledgement : J. Ray,T. Van Dam, P. Sillard, I. Panet

Outline:

- ITRF2005 height residuals
- Annual signal
- Correlation
- Network effect, preliminary results



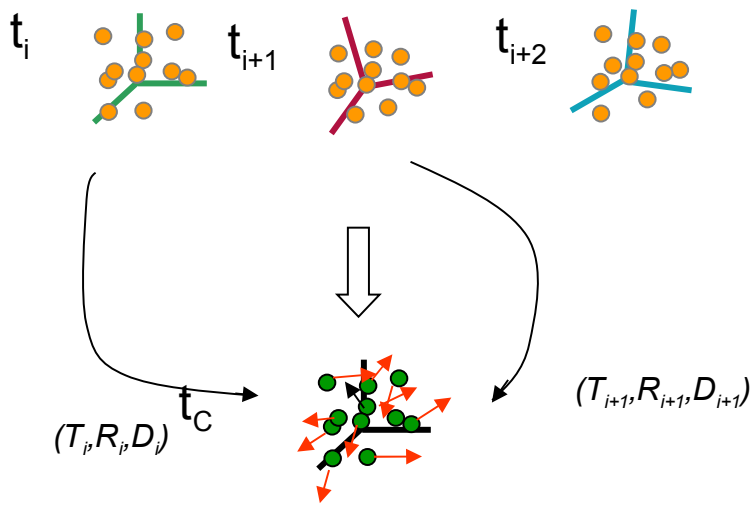
Data

Data :

	Epoch	Nb of files	CCs	Sampling
VLBI	**1980.0 – 2006.0**	> 3000 sessions	IVS	Daily and irregular
SLR	**1992.9 – 2005.9**	~ 650 weeks	ILRS	Weekly and regular
GPS	**1996.0 – 2006.0**	~ 500 weeks	IGS	Weekly and regular

Modeled	**Not modeled**
Solid earth tide	Atmospheric loading
Polar tide	Hydrology
Ocean tide loading	Non tidal ocean loading
	...

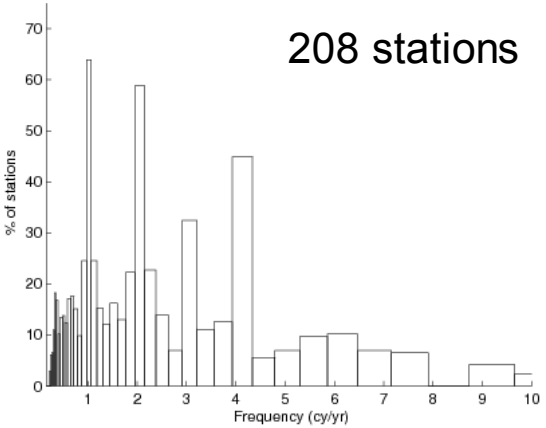
Time series stacking (CATREF model):

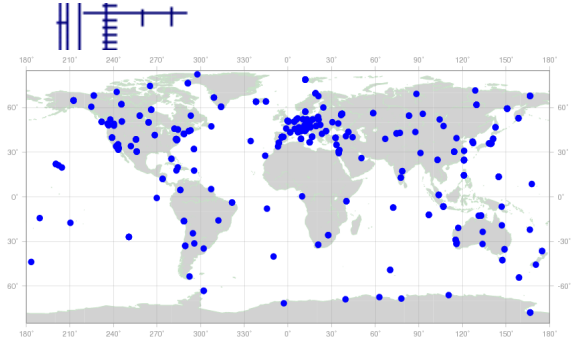


Spectral analysis Height component : GPS , VLBI, SLR

IGS (GPS)

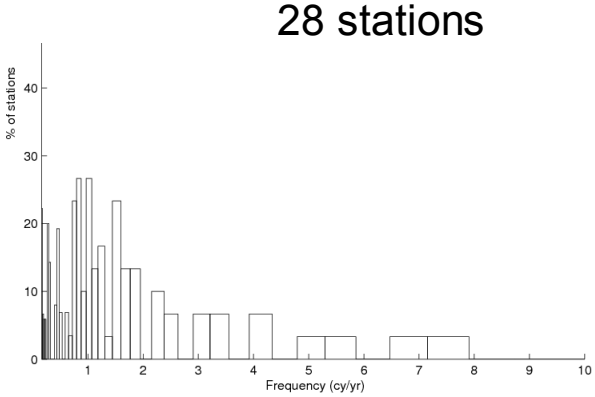
208 stations

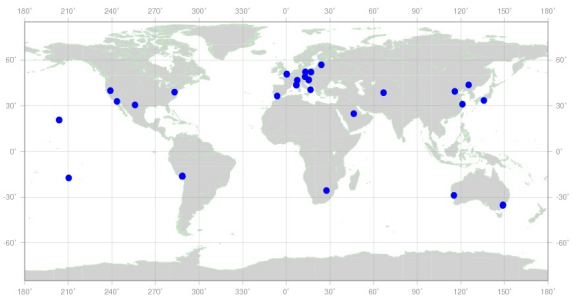




ILRS (SLR)

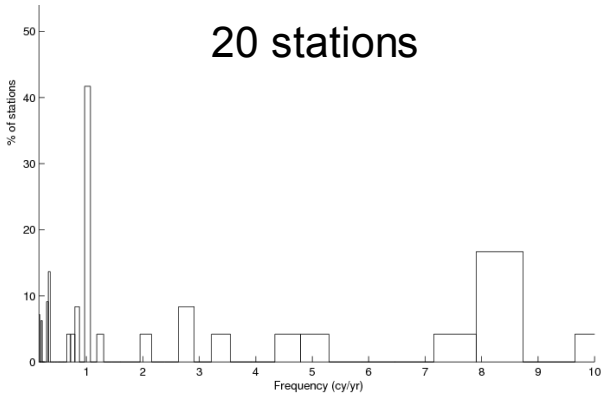
28 stations

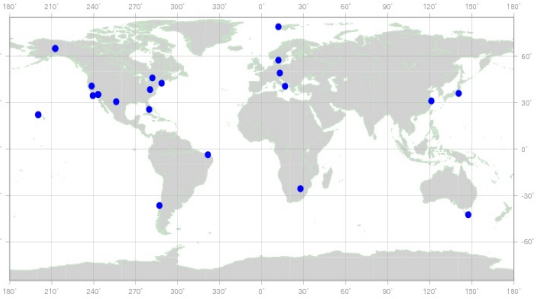




IVS (VLBI)

20 stations

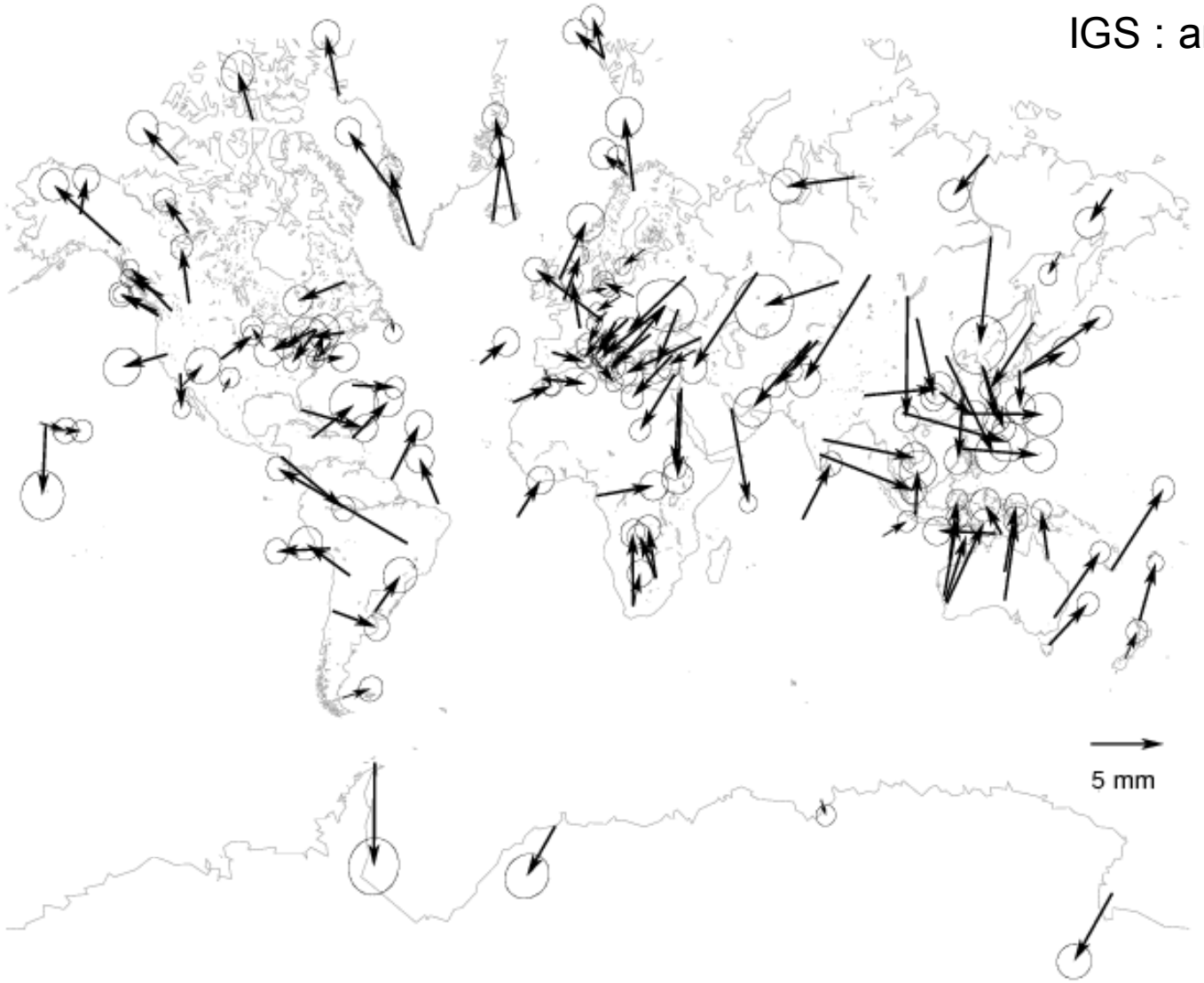




SNR > 3.5

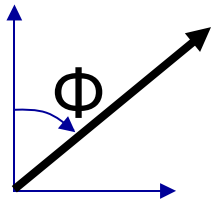
Annual signal in height residuals (1/3)

IGS : annual signal



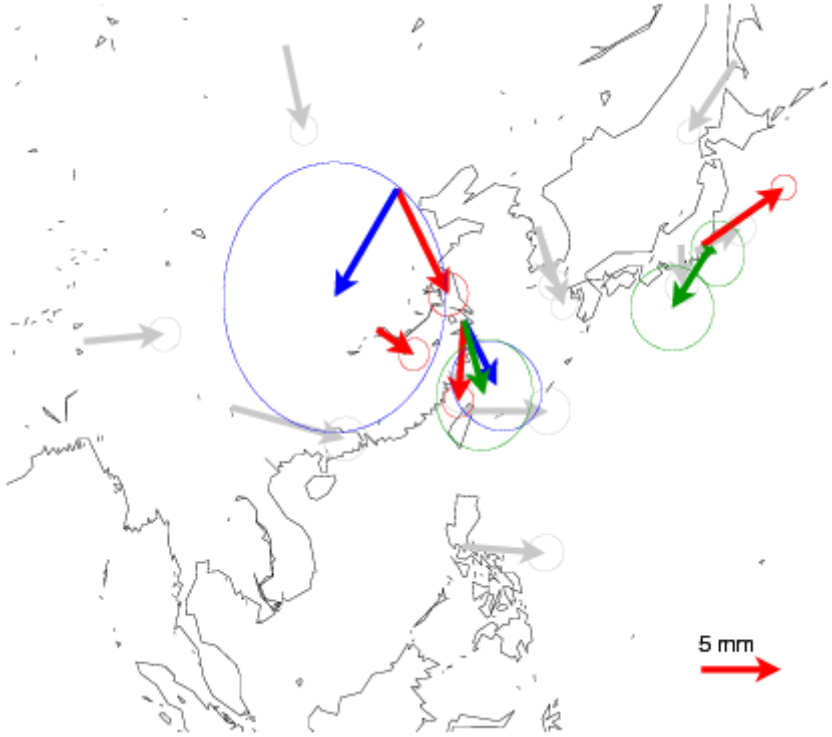
f = 1 cy/yr

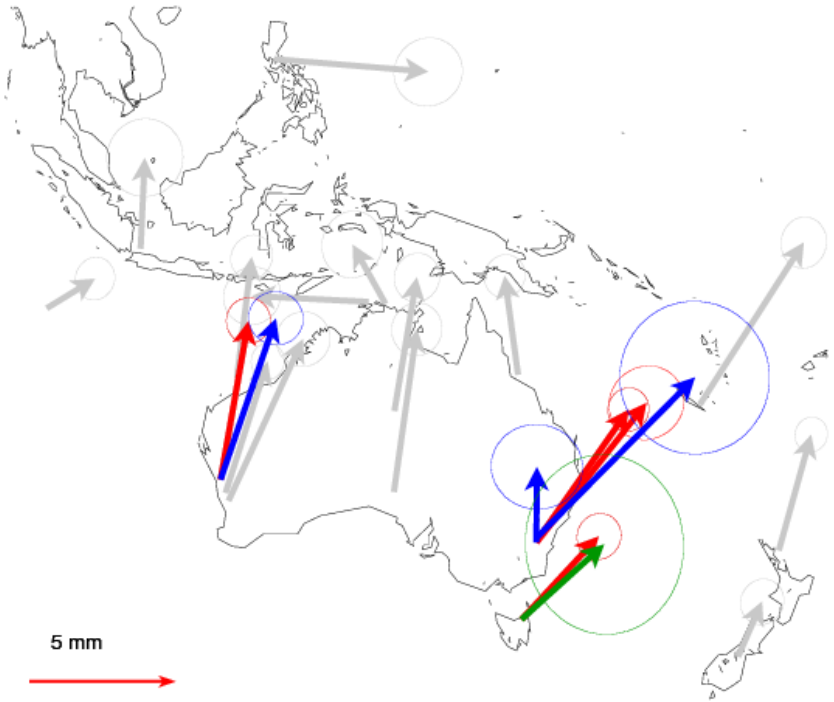
SNR > 3.5



$A \cdot cos(\omega \cdot T - \Phi)$

Annual signal in height residuals (2/3)





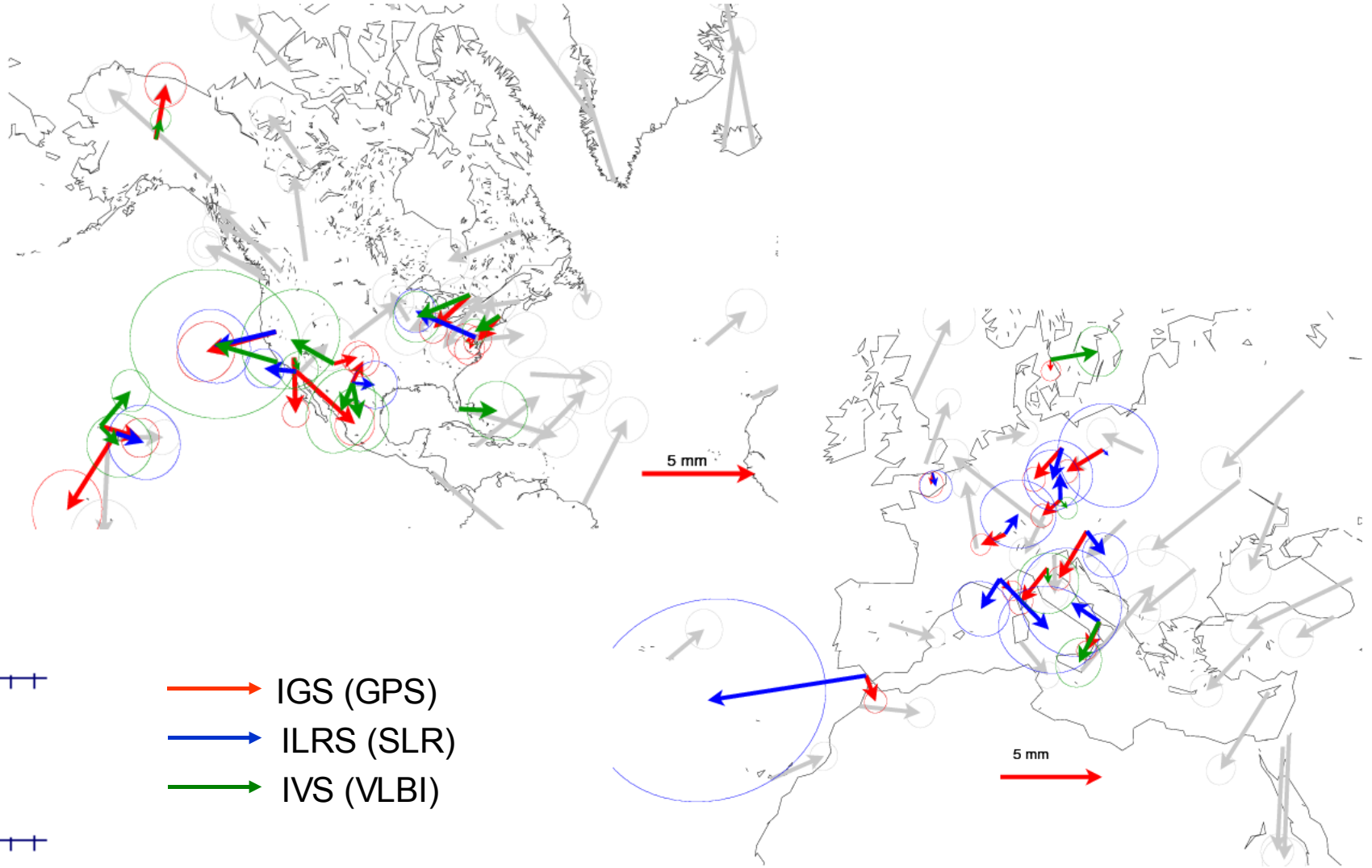
co-location site :

- IGS (GPS)
- ILRS (SLR)
- IVS (VLBI)

Not co-located :

- IGS (GPS)

Annual signal in height residuals (3/3)

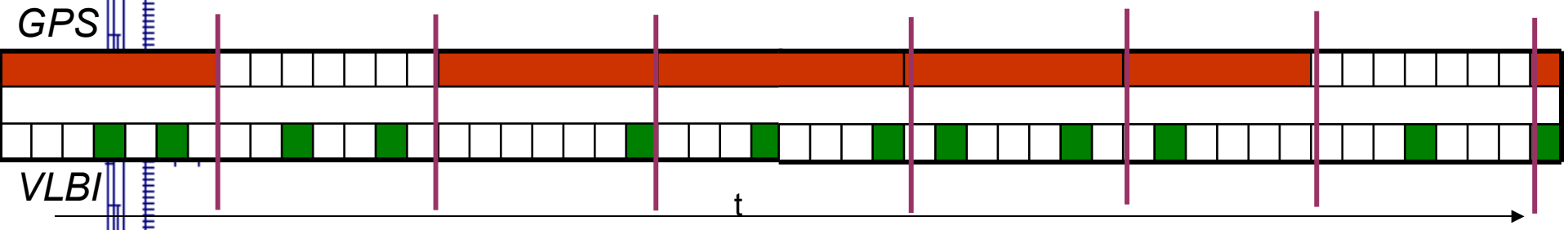


Correlation - Method

- Principle :

Data : Ex: VLBI and GPS data of a co-location site.

Problem : data gap, different sampling, displacements with uncertainties



- Hypothesis :

work at daily sampling. GPS and SLR measure a weekly mean of a daily process.

⇒ Add information about time evolution

$X_{t+1} = X_t + u_t$ with u_t white noise with unknown variance

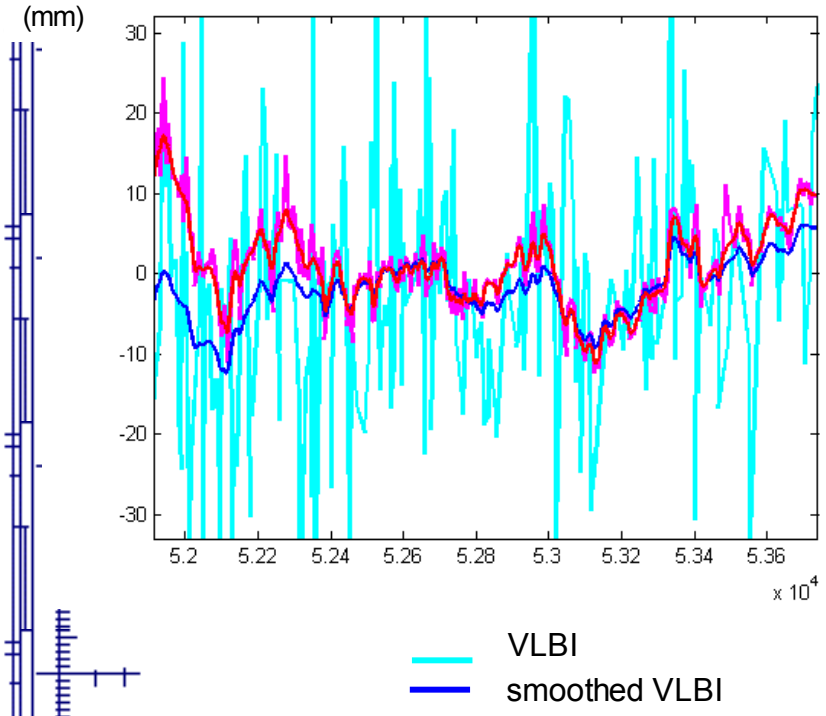
⇒ *the 2* White noises are correlated

⇒ additive decorrelated noise. data uncertainties are known with unknown scaling factor

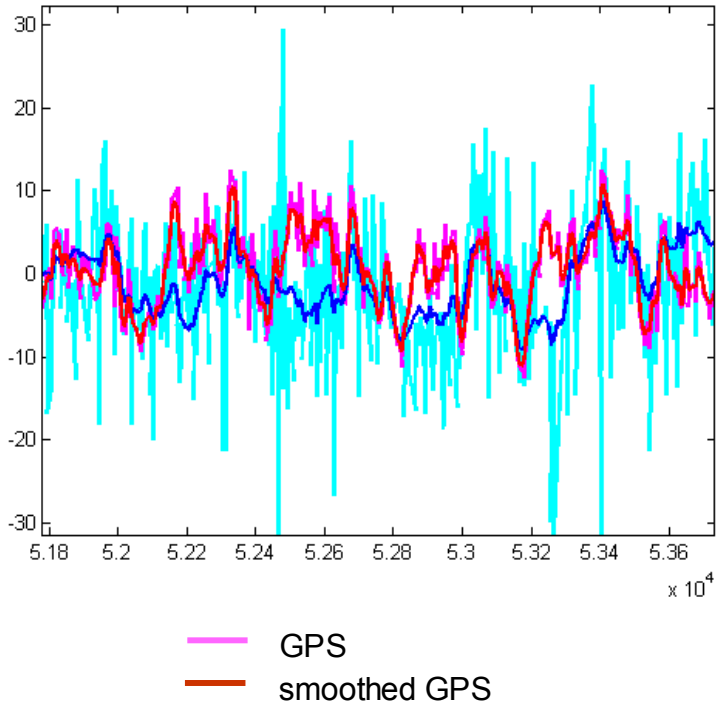
- 5 parameters to be estimated by maximum likelihood

Correlation – VLBI/GPS – Results (1/3)

Hartebeesthoek
Height residual time series



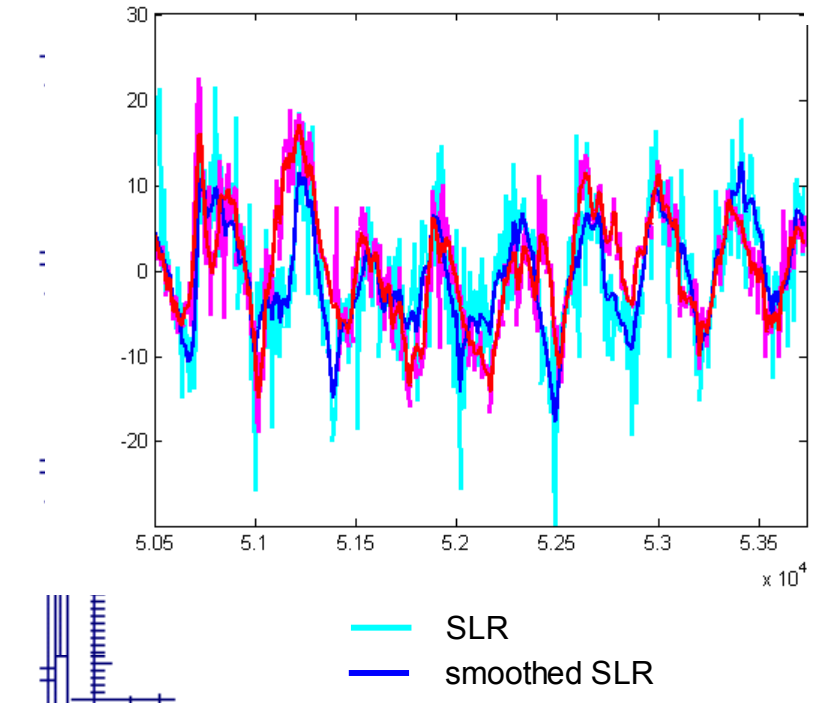
Ny-Alesund
Height residual time series



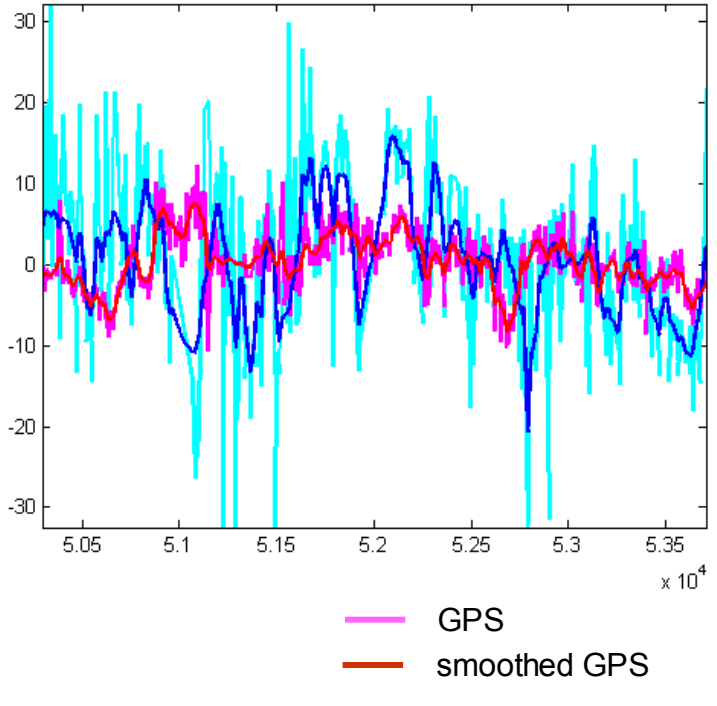
	VLBI Code	GPS Code	σ_{wnvlbi} (mm)	σ_{wngps} (mm)	σ_{0vlbi}	σ_{0gps}	ρ
Hartebeesthoek	7232 (386)	HRAO (413)	0.57 ± 0.14	0.79 ± 0.07	1.38 ± 0.05	0.43 ± 0.02	0.88 ± 0.09
Ny-Alesund	7331 (503)	NYA1 (394)	0.78 ± 0.15	1.03 ± 0.10	1.78 ± 0.07	0.39 ± 0.03	0.68 ± 0.13

Correlation – SLR/GPS - Results (2/3)

Yarragadee
Height residual time series



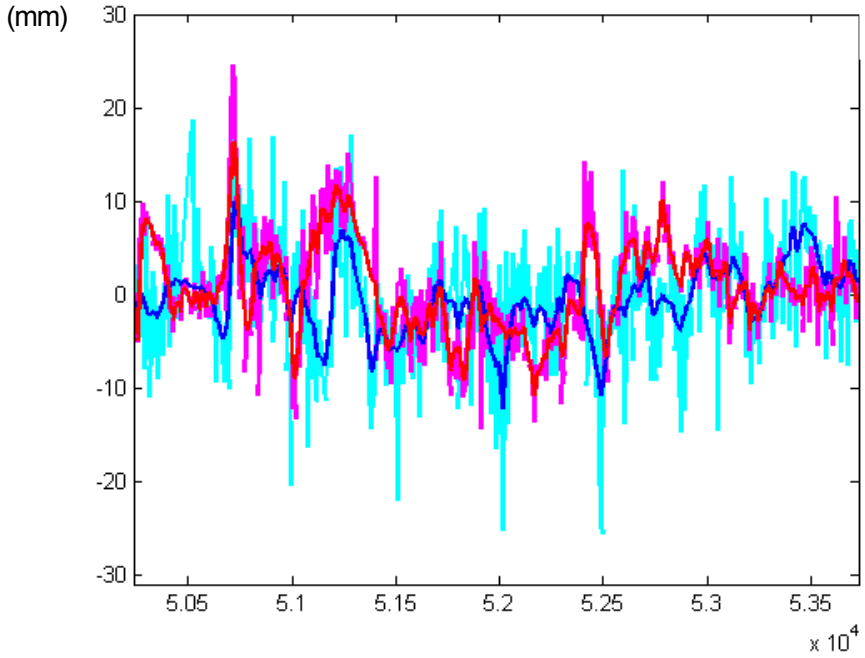
Wettzell
Height residual time series



	SLR code	GPS code	σ_{wnslr} *(mm)*	σ_{wngps} *(mm)*	σ_{0slr}	σ_{0gps}	ρ
Yaragadee	7090 (498)	YAR1 (497)	0.92 ± 0.09	0.84 ± 0.06	3.37 ± 0.15	0.38 ± 0.02	0.46 ± 0.10
Wettzell	8834 (417)	WTZR (500)	1.19 ± 0.15	0.42 ± 0.05	2.97 ± 0.15	0.54 ± 0.03	0.11 ± 0.17

Correlation – SLR/GPS - Results (3/3)

Yarragadee Height residual time series, Annual signal removed



Annual signal :
Amplitude : 5.5 ± 0.2 mm

SLR
smoothed SLR
GPS
smoothed GPS

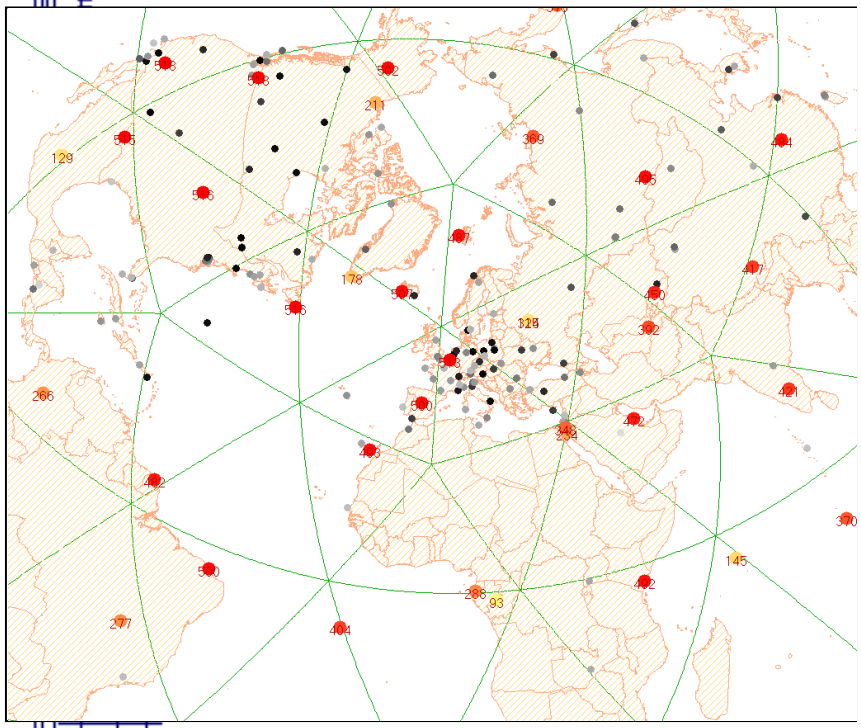
	SLR code	GPS code	σ_{wnslr} *(mm)*	σ_{wngps} *(mm)*	σ_{0slr}	σ_{0gps}	ρ
Yaragadee	7090 (`498´)	YAR1 (`497´)	0.69 ± 0.10	0.72 ± 0.06	3.49 ± 0.15	0.39 ± 0.02	0.23 ± 0.14

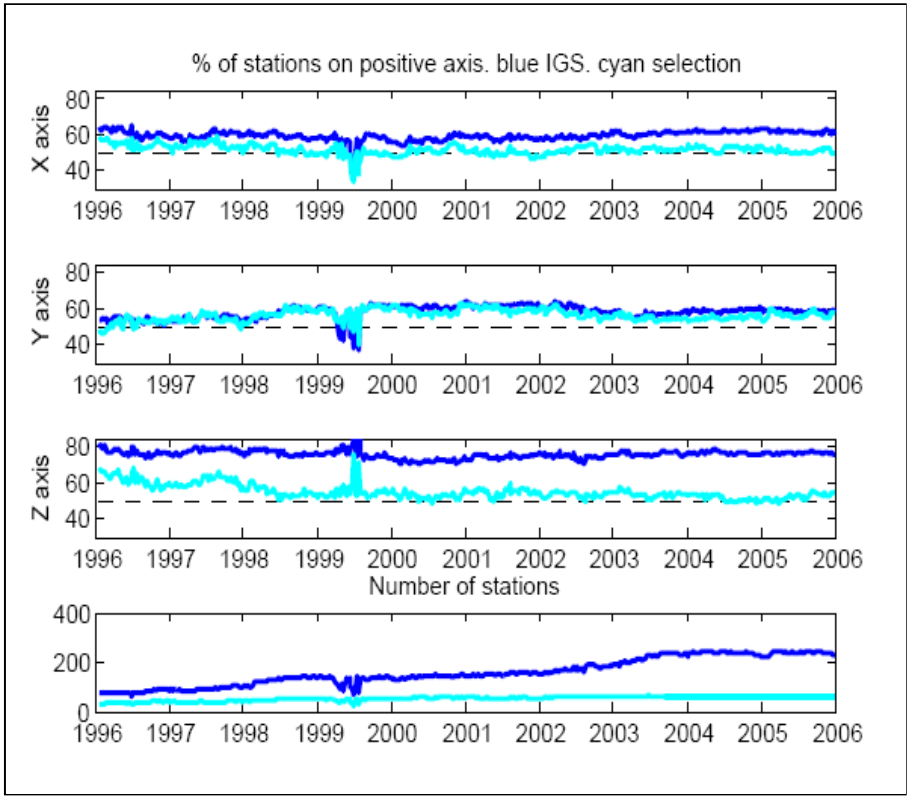
Network Effect (1/2)

Network effect:

- Propagation of some part of station individual motion into global parameters or conversely

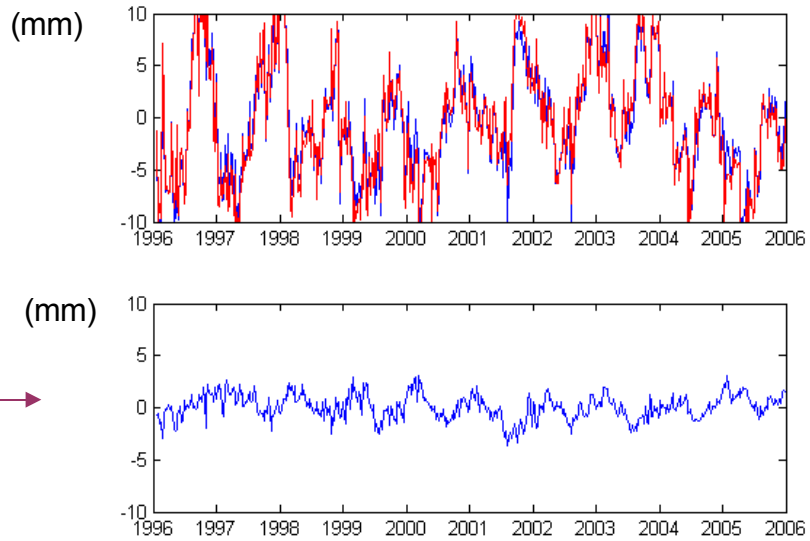
How can we quantify the network effect?





Network Effect (1/2)

Example : DRAO, height component



Scattering East (mm)	Annual ampl. East (mm)	Scattering North (mm)	Annual ampl. North (mm)	Scattering Up (mm)	Annual ampl. Up (mm)
0.40 ± 0.08	0.20 ± 0.14	0.40 ± 0.06	0.20 ± 0.11	1.20 ± 0.13	1.10 ± 0.20

* Computed from 2000.0

Conclusion

Spectral analysis :

Annual signal detected in the height residual time series of the three techniques

Significant regional correlation detected in the annual signal

→ Confirmed by SLR and VLBI in some areas: Australia, South of Africa…

Correlations :

Rather good consistency between VLBI and GPS in the height
Same conclusion for few SLR sites.

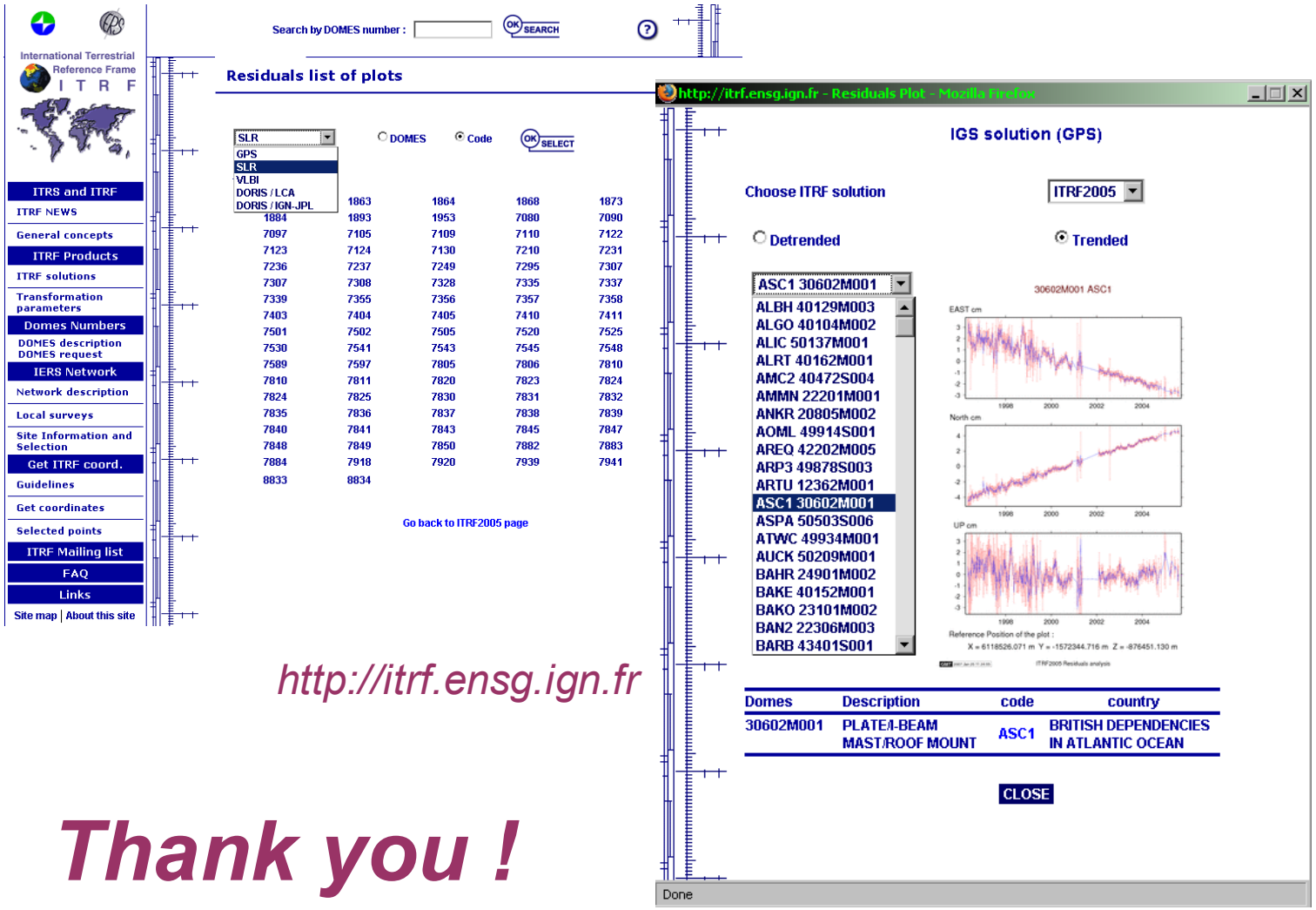
The network effect might contribute to the disagreement observed.
Need to be investigated

Artile submitted to JGR:

Spectral and correlation analyses of ITRF2005 VLBI, GPS and SLR height residuals: Howwell do space geodetic techniques agree? , Journal of Geophysical Research, submitted, X. Collilieux , Z. Altamimi , D. Coulot , J. Ray , P. Sillard

Web site

http://itrf.ensg.ign.fr



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Thank you !