ITRF2005 residuals and co-location tie issues

- Some features of ITRF2005 residuals
- ITRF2005 vs IGS05 in regional analysis ?
- Discontinuities
- Assessment of tie errors & impact on ITRF

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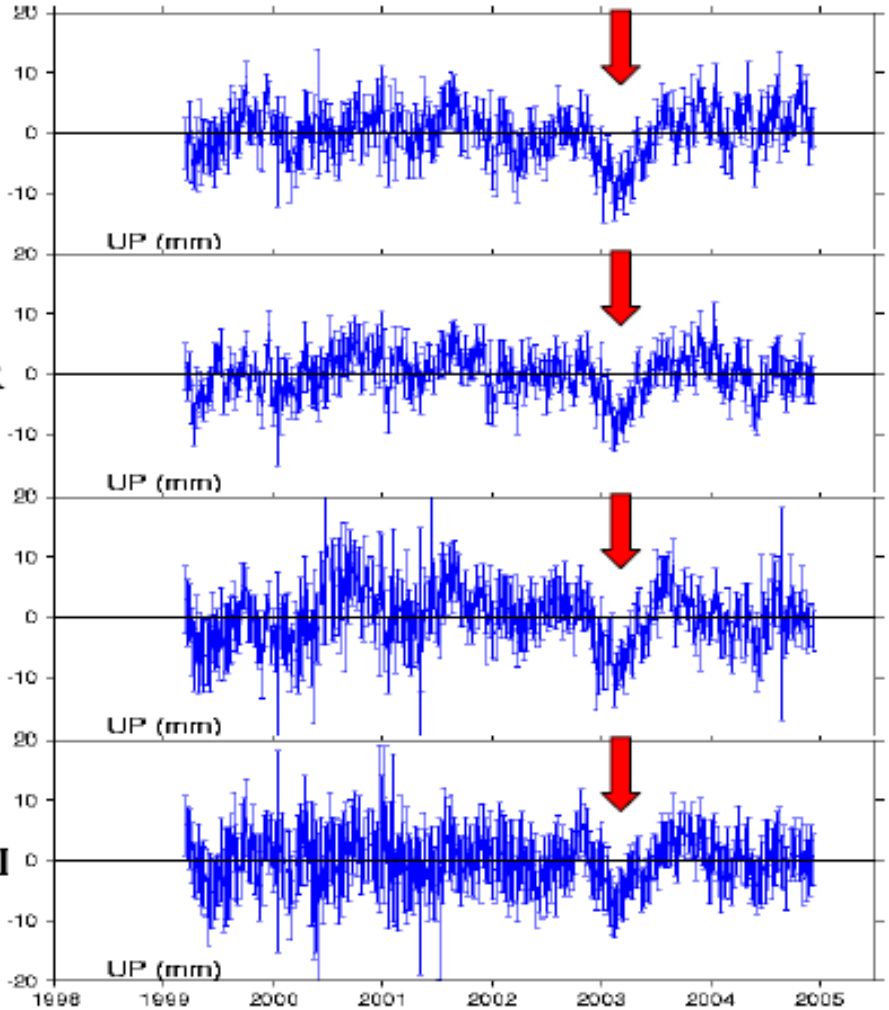
Some Geophysical Events May Also Occur

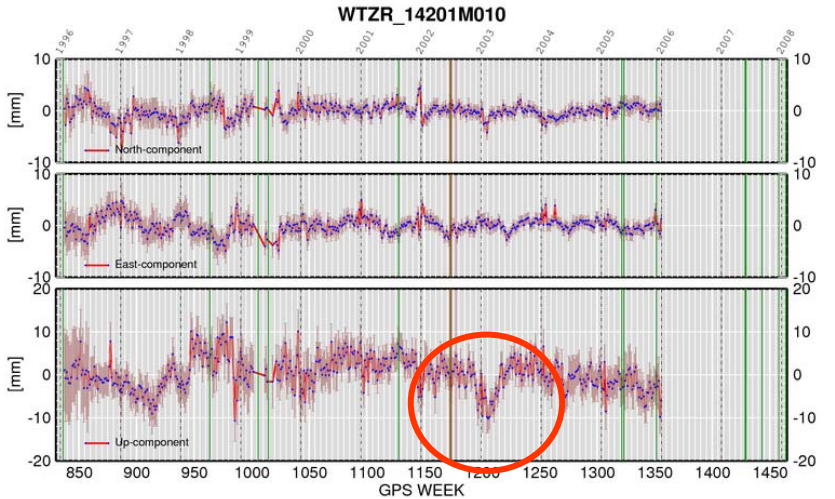
- e.g., central Europe in winter 2003
- might also occur at BOR1, MATE, others
- not at ONSA
- mount types are distinct
  - POTS, WZTR: antennas over pillars
  - GRAZ: 2-m steel pyramid
  - ZIMM: 9-m mast
- or a different technique error ?

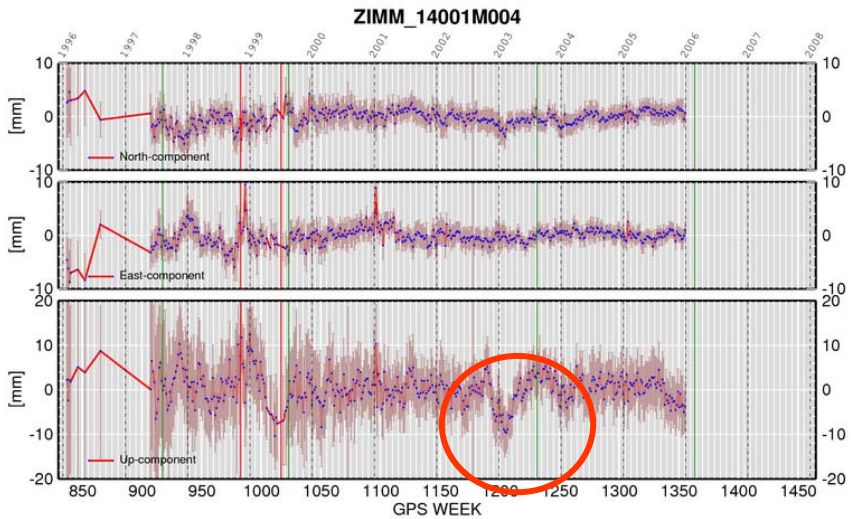


Ray et al., 2005

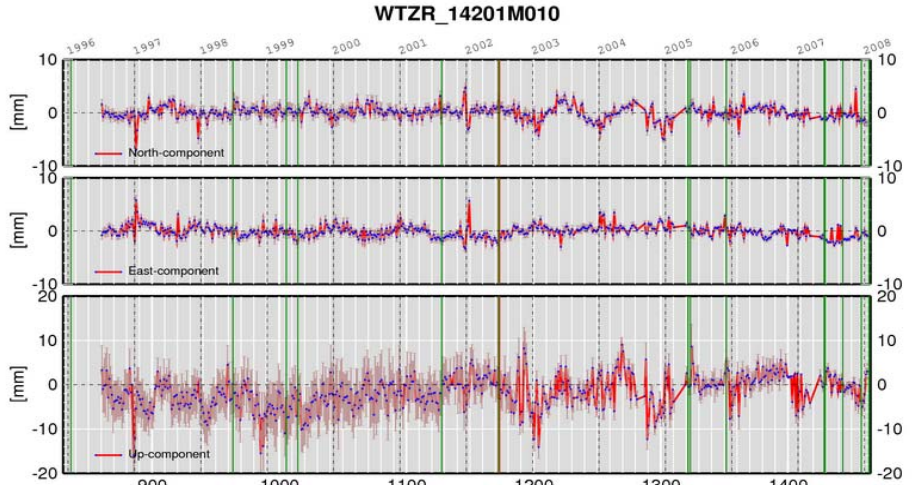
Residual behaviour IGS vs EPN

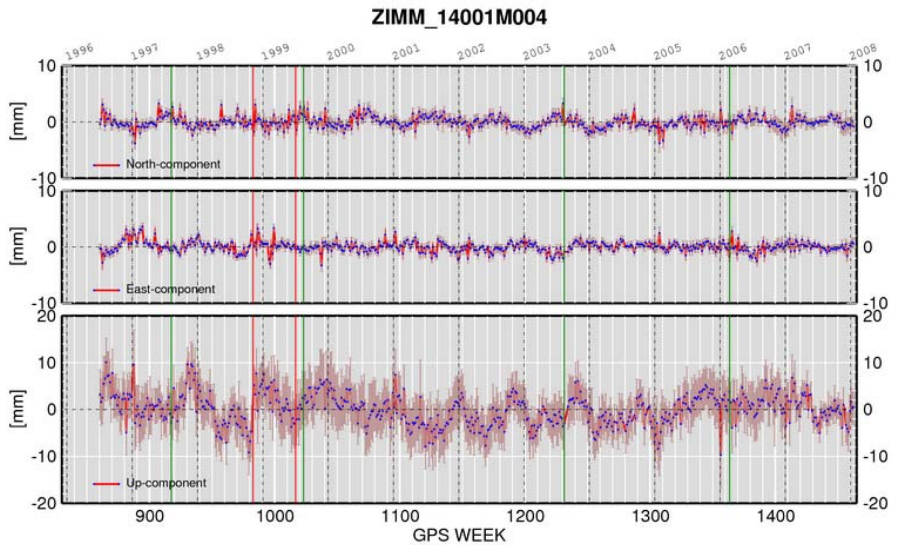
ITRF2005 results





EPN Analysis results





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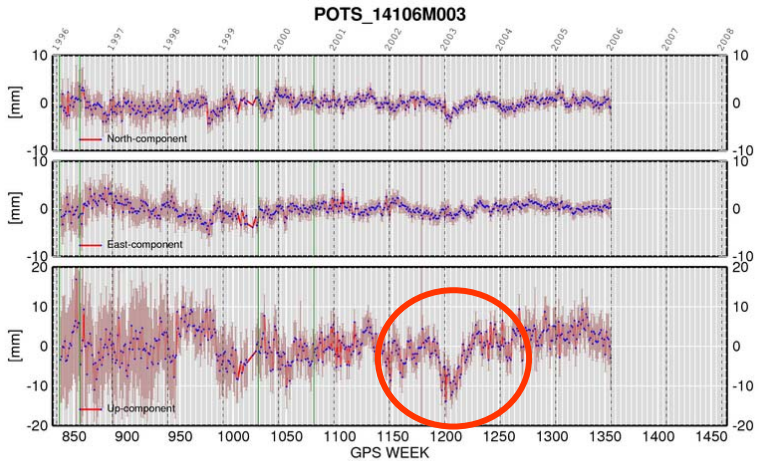
CATREF combins

Residual behaviour IGS vs EPN

ITRF2005 results



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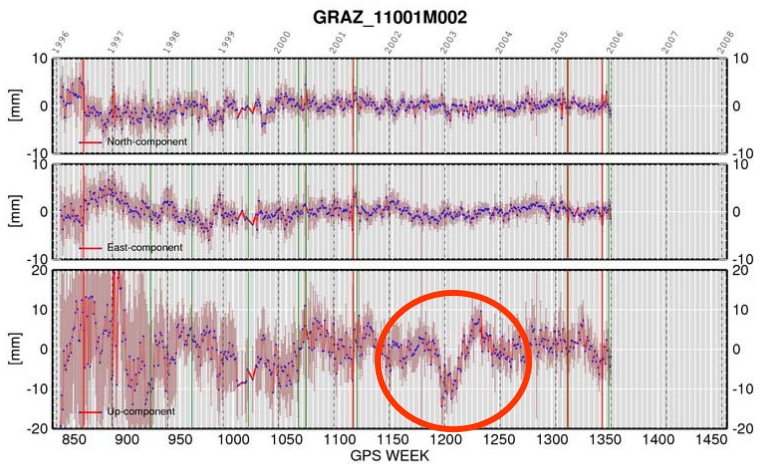

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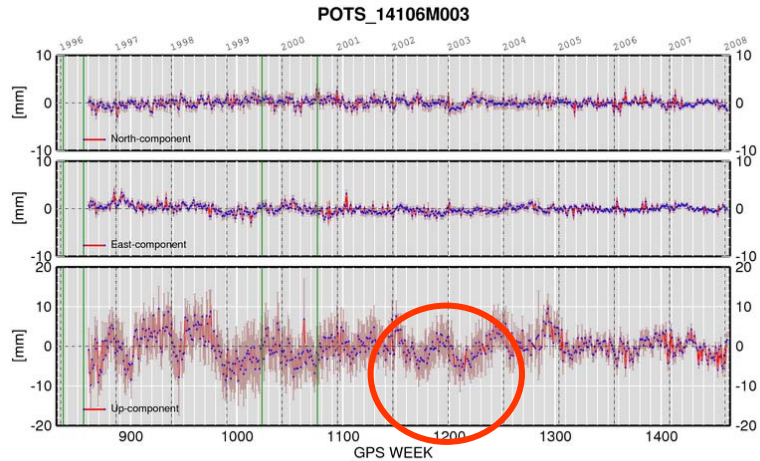
EPN Analysis results



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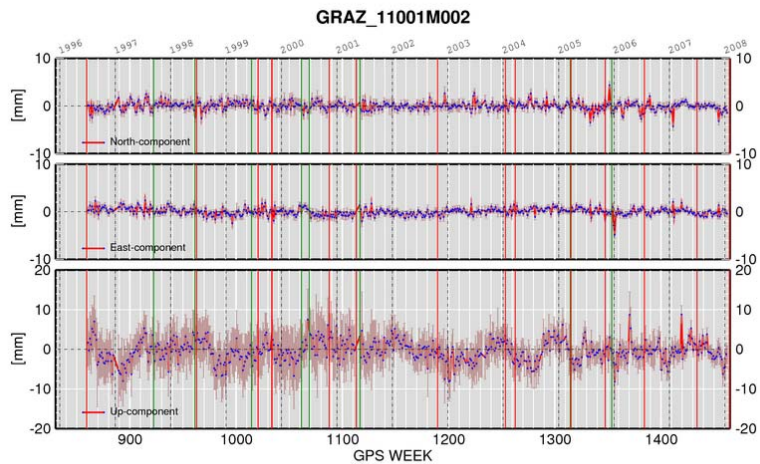
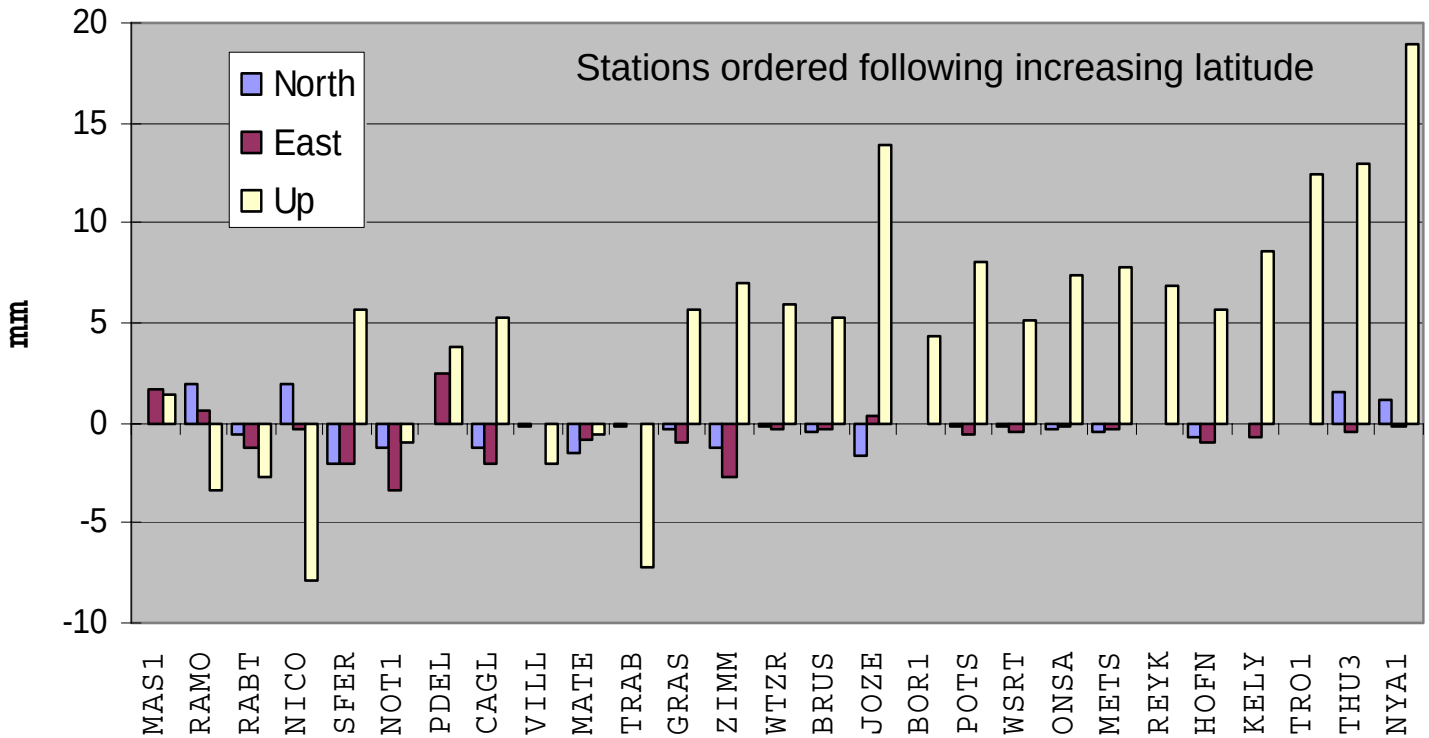


CATREF combins

Differences ITRF2005-IGS05

Extraction of EPN stations



Mean differences:

N= -0,2 mm ±1.0 mm E= -0,4 mm ± 1.4 mm U= 5.3 mm ± 6.5 mm

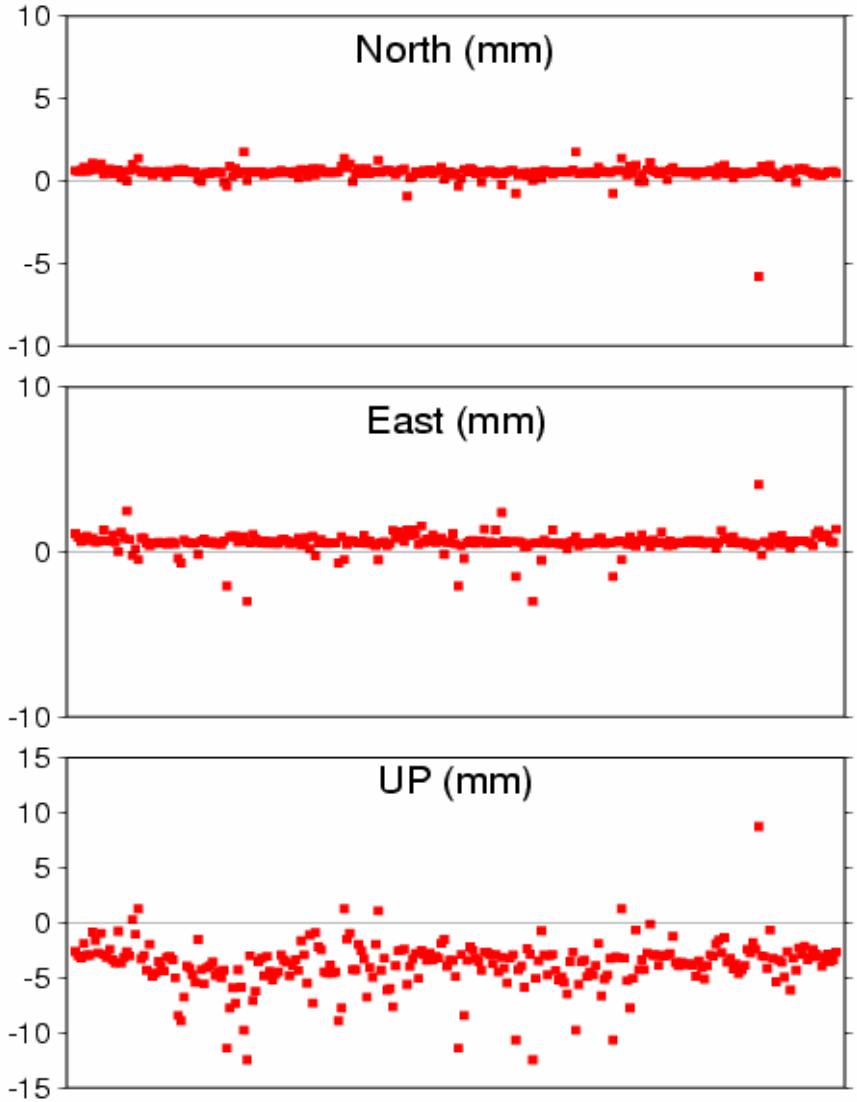
Bruyninx, 2006

Example of an EPN cumulative solution

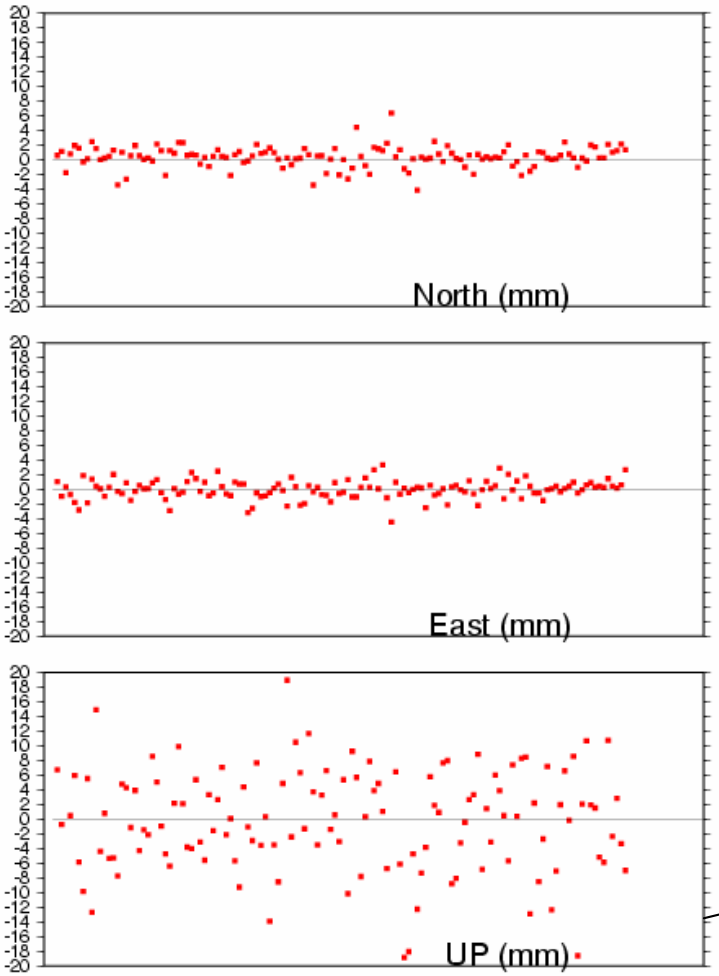
Differences when using IGS05 or ITRF2005 RF stations

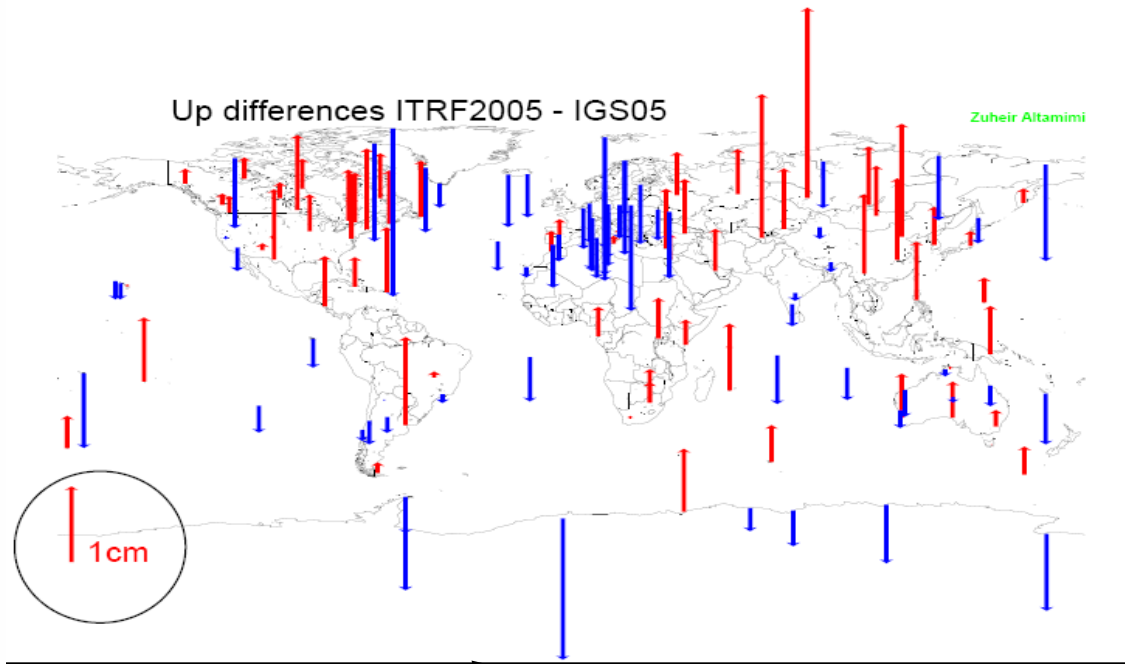
If relative PCV: Use ITRF2005

If absolute PCV: Use IGS05, but if a user wants to be in ITRF2005, what to do ?



ITRF2005-IGS05 differences

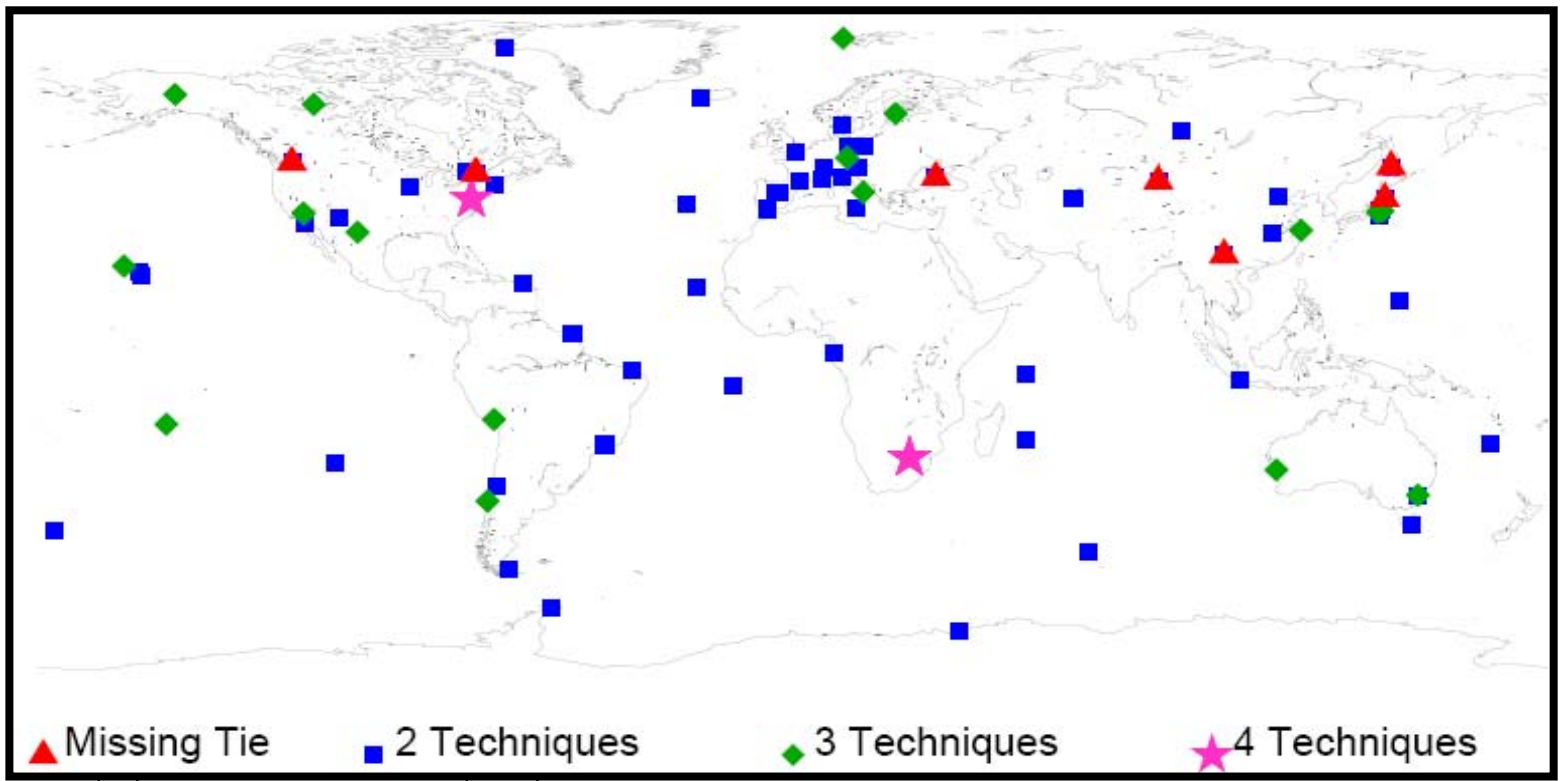




Local ties in co-location sites

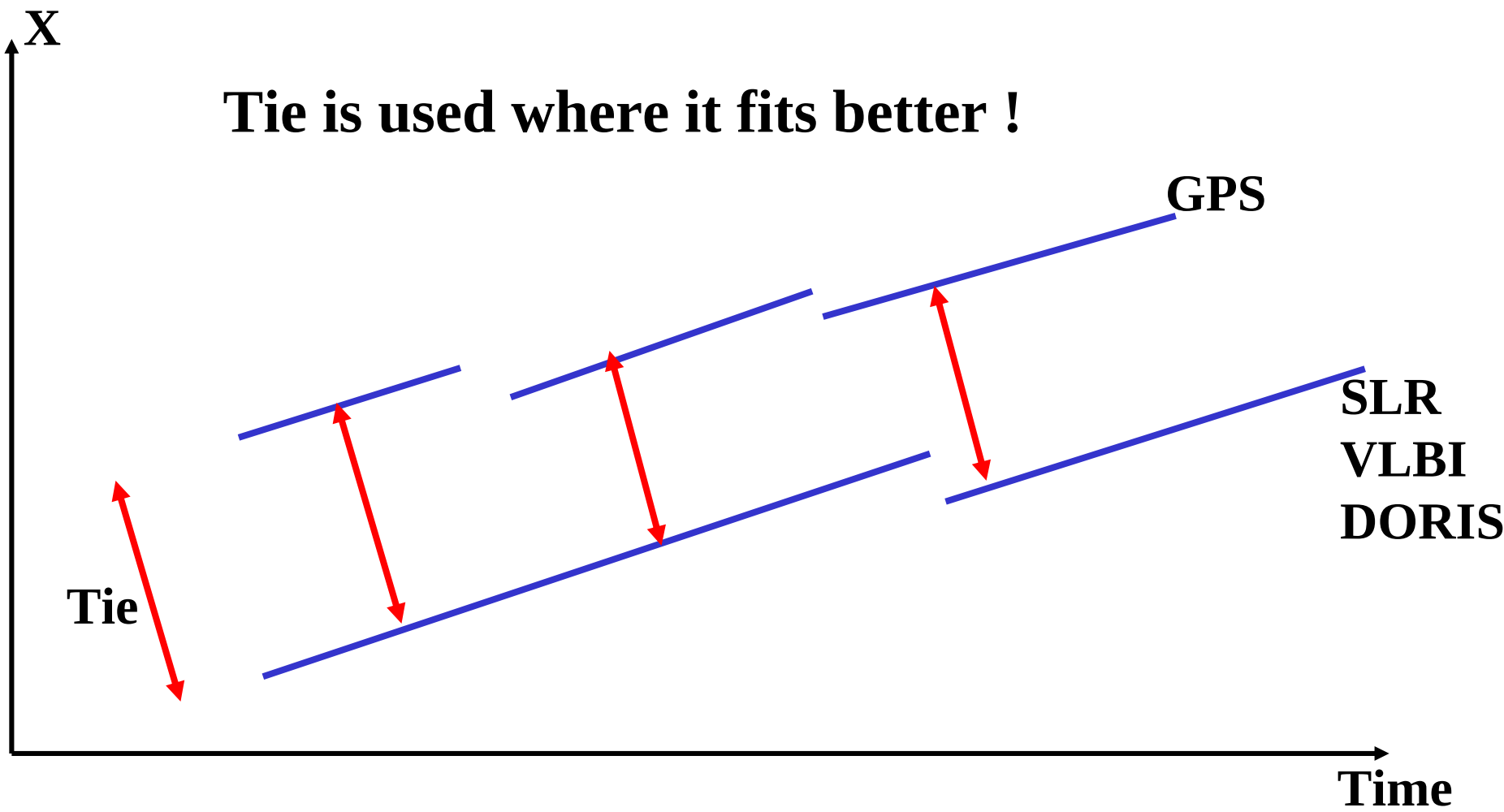
How to deal with GPS discontinuities in co-location sites ?

Threats: ITRF on “shaky ground”:
current co-locations



(7) (59) (16) (2)

A Co-location site with Discontinuities



Local ties at GPS co-location sites
Ex. GPS – VLBI ties

- **Tie = GPS-to-VLBI-external-ref-pts**
  + VLBI-internal-ecc + GPS-internal-ecc

- **Take into account**
  - **GPS discontinuities**
  - **VLBI & GPS phase centers to physical points**
  - **VLBI antenna deformation**
  - **GPS PCV**

- **Total tie error budget probably no better than 3-4 mm per component**

Statistics for discontinuities at IGS sites (ITRF2005)

Number of IGS sites: 258

Number of stations: 303

Number of breaks: 197

RMS over 74 sites where there should not be any position change

Stats over 74 sites	dX mm	dY mm	dZ mm
Means	3.0	3.3	3.95
Medians	2.1	2.2	3.35

Assuming total tie error = 4 mm

==> 16 minimum well distributed co-location sites are needed for 1mm global frame tie

==> ideally 32 sites for redundancy and reliability

ITRF2005-Like Combination: Datum Definition

Technique	Origin	Scale	Orientation
GPS	Free	Free	Fixed
SLR	Fixed	Free	Free
VLBI	Free	Fixed	Free

Local Ties Usage in ITRF Combinations

- **Local Ties in ITRF2005**
  - **~45% of ties are in SINEX with known measurement epoch**
  - **Others are with unknown variance**

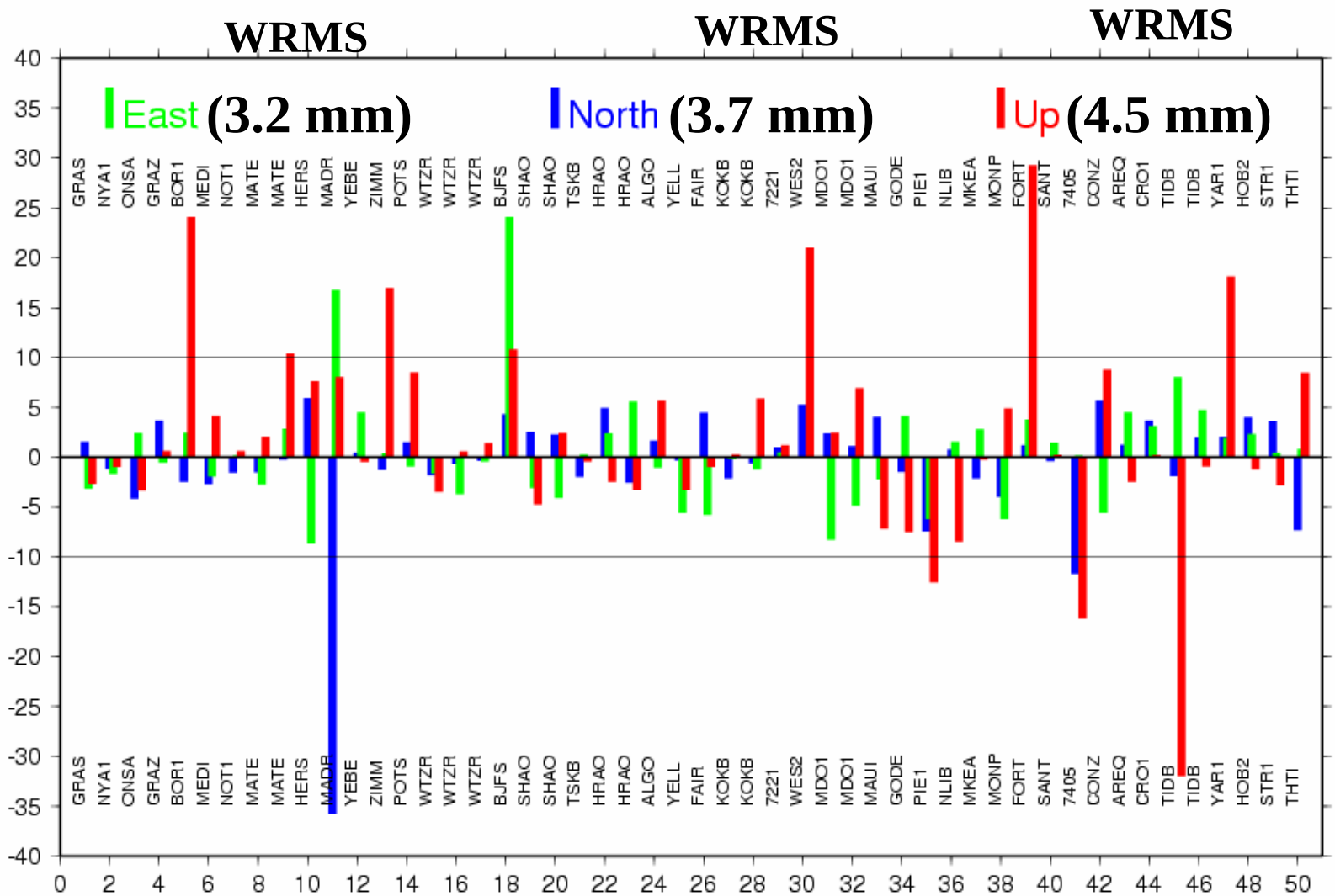
$$\sigma_{computed} = \sqrt{\sigma_1^2 + \sigma_2^2},$$

σ_1 = 3mm

$$\sigma_2 = 10^{-6} \times \sqrt{(\Delta x_s^{i,j})^2 + (\Delta y_s^{i,j})^2 + (\Delta z_s^{i,j})^2}$$

- **Local Ties used in this study**
  - **Tie vectors as observations with appropriate weighting**
  - **22 GPS-SLR vectors**
  - **29 GPS-VLBI vectors**
  - **==> SLR & VLBI are tied mainly via GPS**

Tie Residuals



Conclusions

- Significant differences when using IGS05 vs ITRF2005 in regional analysis, esp. in UP component
- The IGS05 is the best we can do for the interim period
- Should we recommend regional analysis to include global RF stations in their analysis ?
- Reprocessing is obviously needed

- Local tie errors on ITRF are mitigated via appropriate weighting
- Local tie typical error is about 4 mm per component
- For 1 mm global frame tie need minimum 16 well distributed co-locations, probably 32 for redundancy & reliability
- Current quality of local ties : 4 – 5 mm (RMS analysis), ignoring dubious ties.
- 15-20 % of available ties are dubious