DORIS antenna phase centers: Is there a bias between Alcatel and Starec reference points?

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SUMMARY

- Why do we ask such a question?
- Tests using DORIS/IGN results (GIPSY/OASIS)
- Tests using DORIS/IDS results (CATREF)
- Summary of results
- (Tentative) conclusions

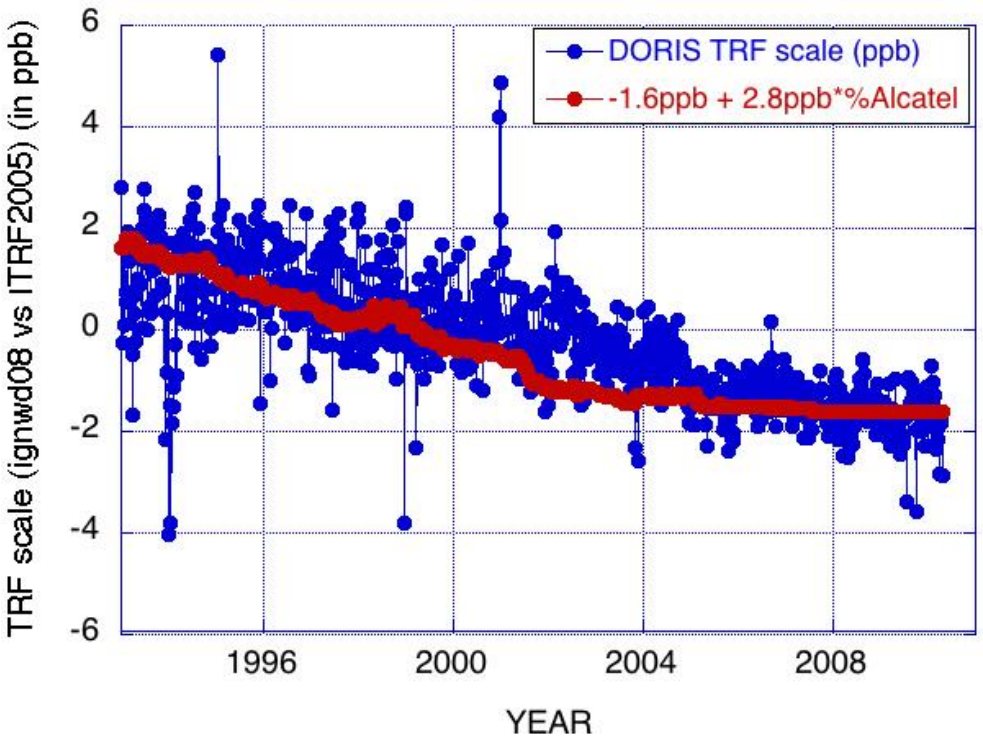
WHY DO WE ASK SUCH A QUESTION?

- Exact location of GPS antenna needs to be calibrated (especially in vertical). No current phase center correction (PCV) is currently applied for DORIS.
- DORIS/IGN TRF scale used to be at 3ppb (vs ITRFs) and now getting closer and closer to 0 (problem disappear when Alcatel beacons are not in use anymore?)
- Such an hypothesis was already proposed, while using tropospheric results:
  - Bock et al., ASR, 2010 "switch from Alcatel to Starec antenna at Toulouse is detected as an offset of 4 mm in the ZTD time series »
  - Snajdrova et al., J. Geod, 2006: "The worst agreements in terms of standard deviations are at Kokee Park (KOKA) … ». However, this problem disappears with recent results when using KOLB in Teke et al., J. Geod., in press

TESTS USING DORIS/IGN RESULTS (GIPSY/OASIS)

- 1) checking DORIS/IGN TRF scale
- 2) checking geodetic local ties at co-located Alcatel/Starec sites

Using DORIS/IGN TRF scale



As the percentage of Alcatel stations in the DORIS network, we should be able to see a slope in the derived TRF scale realized for DORIS

The change in TRF slope could be interpreted as an error in the vertical component of the Alcatel Stations

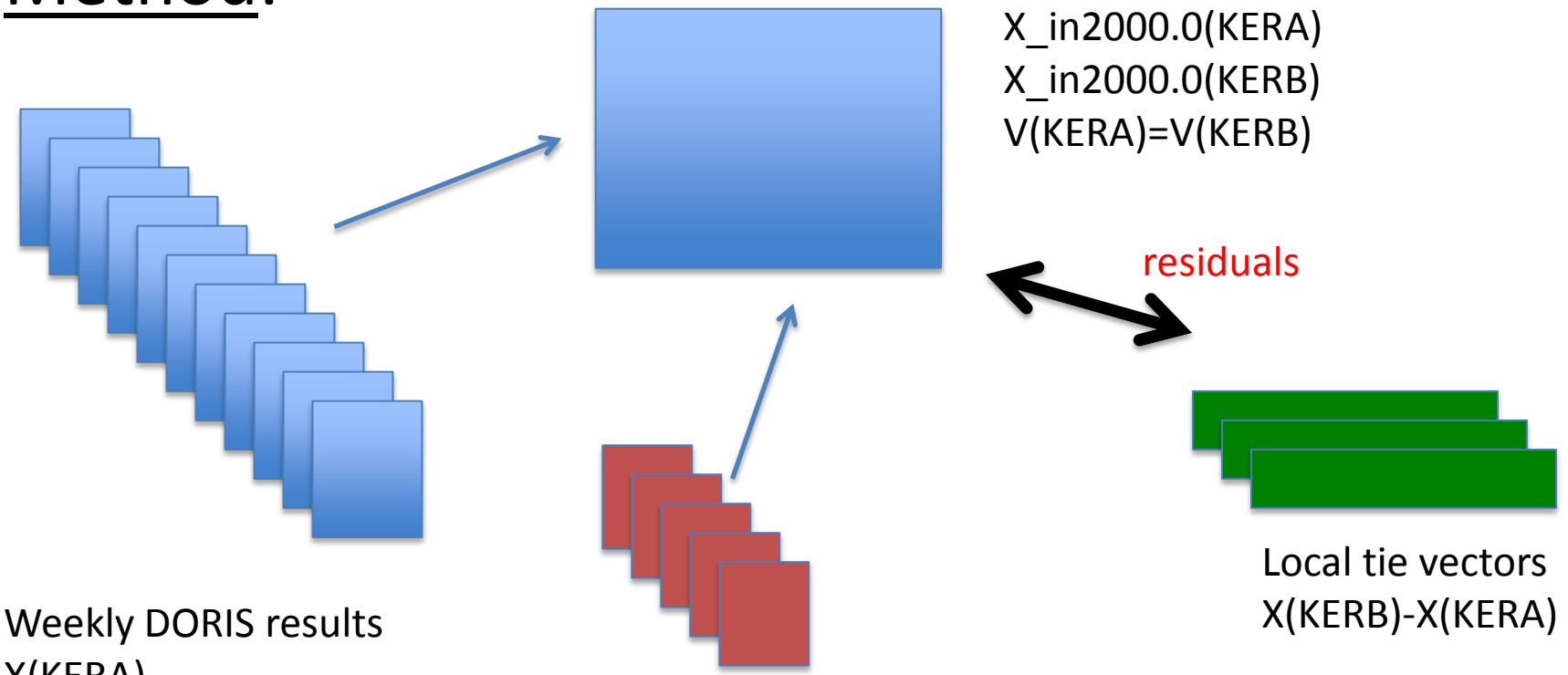
scale is 2.8 ppb = 18 mm (or less)

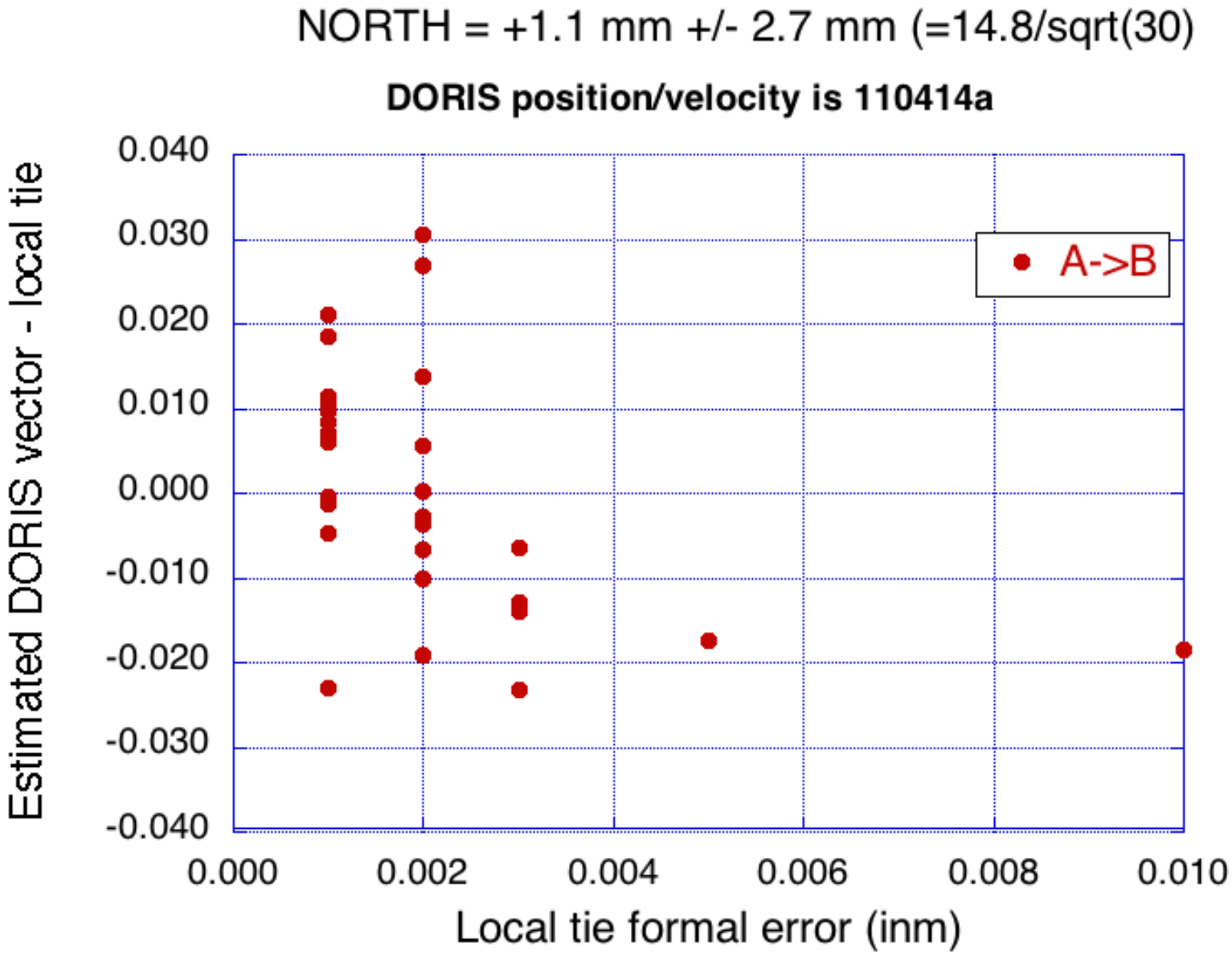
Estimated vertical component of the Alcatel antenna is too high

NB: This hypothesis does not fully answer the TRF scale factor (only part of the story?)

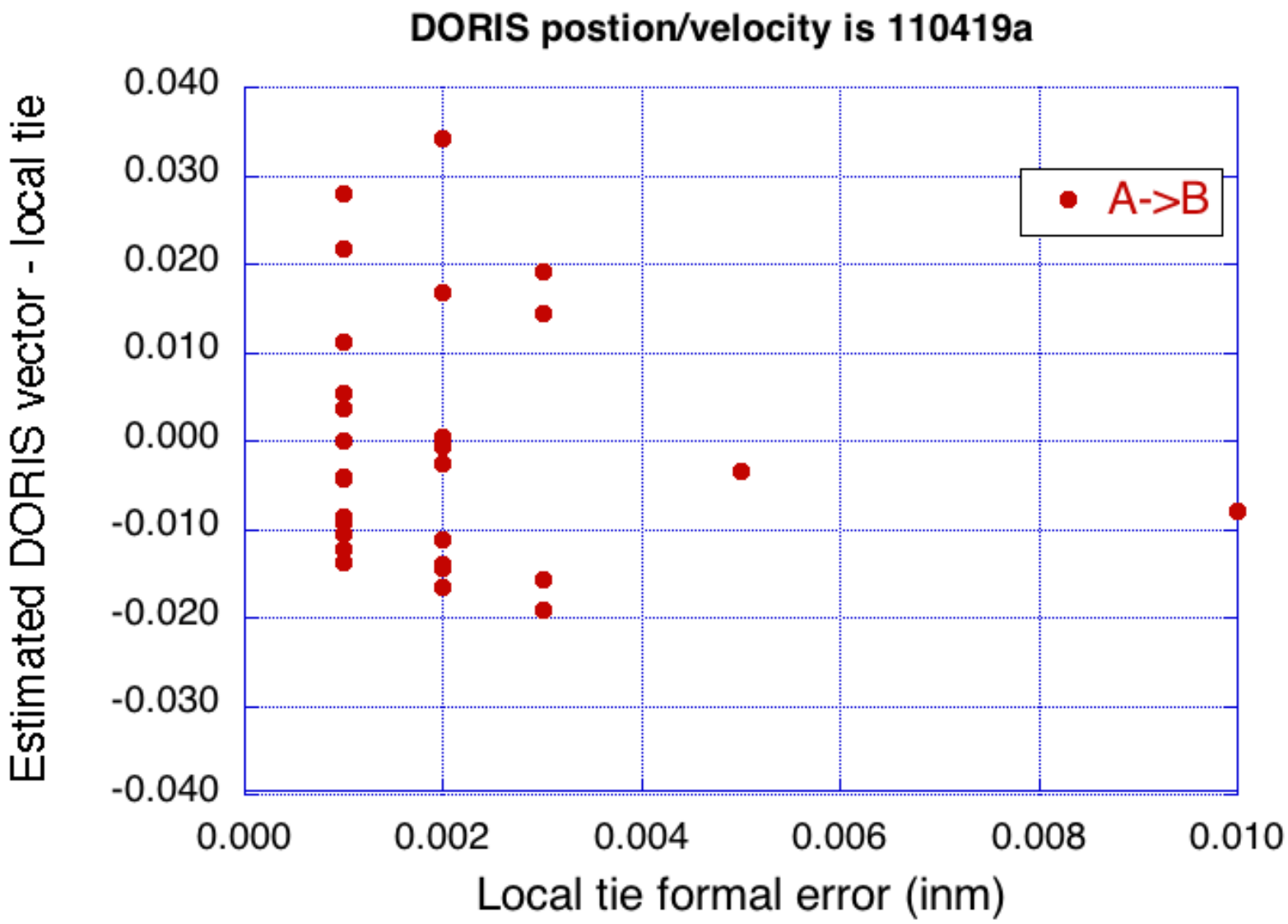
Using geodetic local ties at Alcatel/Starec co-located sites

- Method:

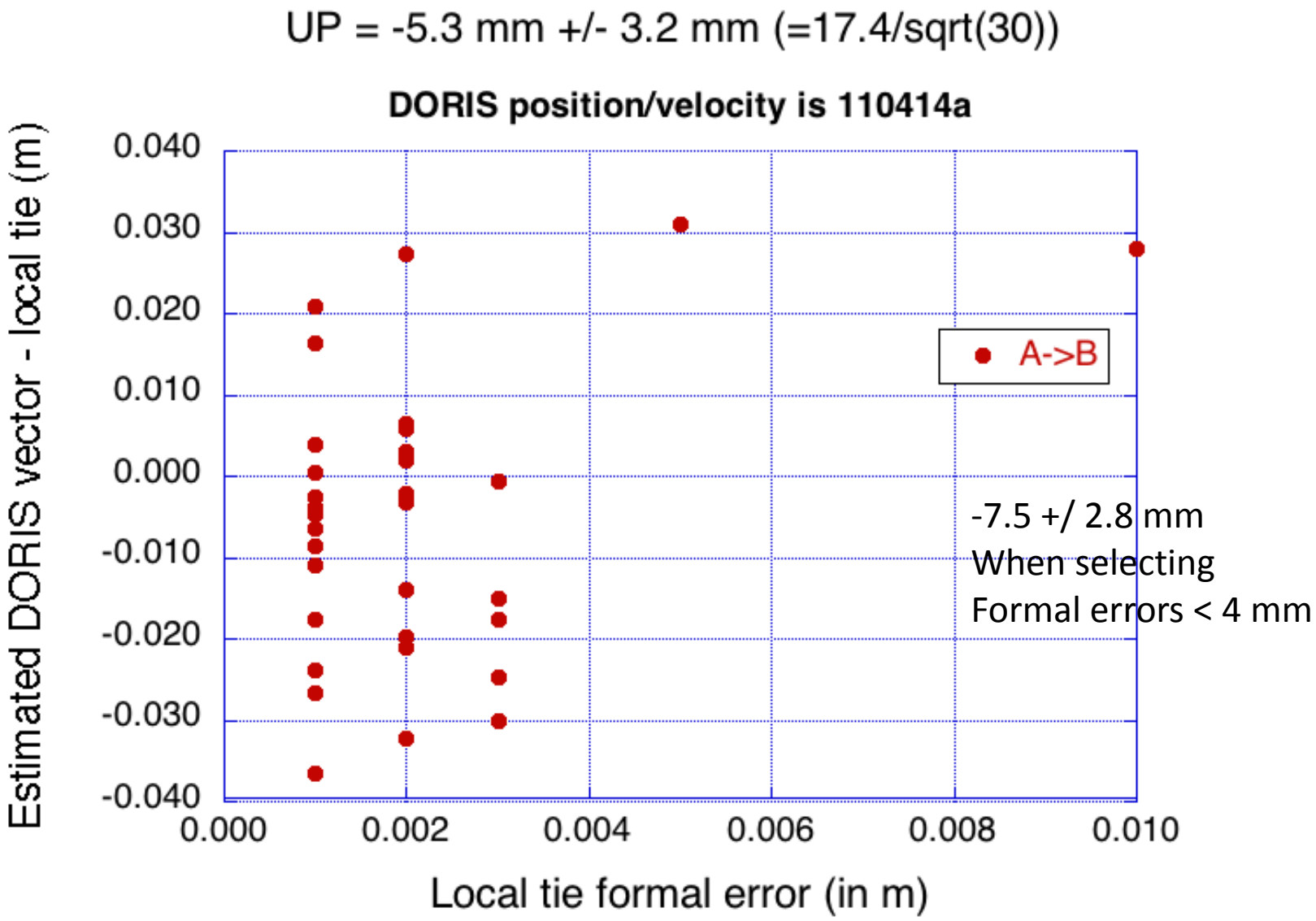



NORTH = +1.1 mm +/- 2.7 mm (=14.8/sqrt(30)
DORIS position/velocity is 110414a
Estimated DORIS vector - local tie
Local tie formal error (inm)
A->B
0.040
0.030
0.020
0.010
0.000
-0.010
-0.020
-0.030
-0.040
0.000
0.002
0.004
0.006
0.008
0.010

EAST = -0.8 mm +/- 2.6 mm (=14.1/sqrt(30)



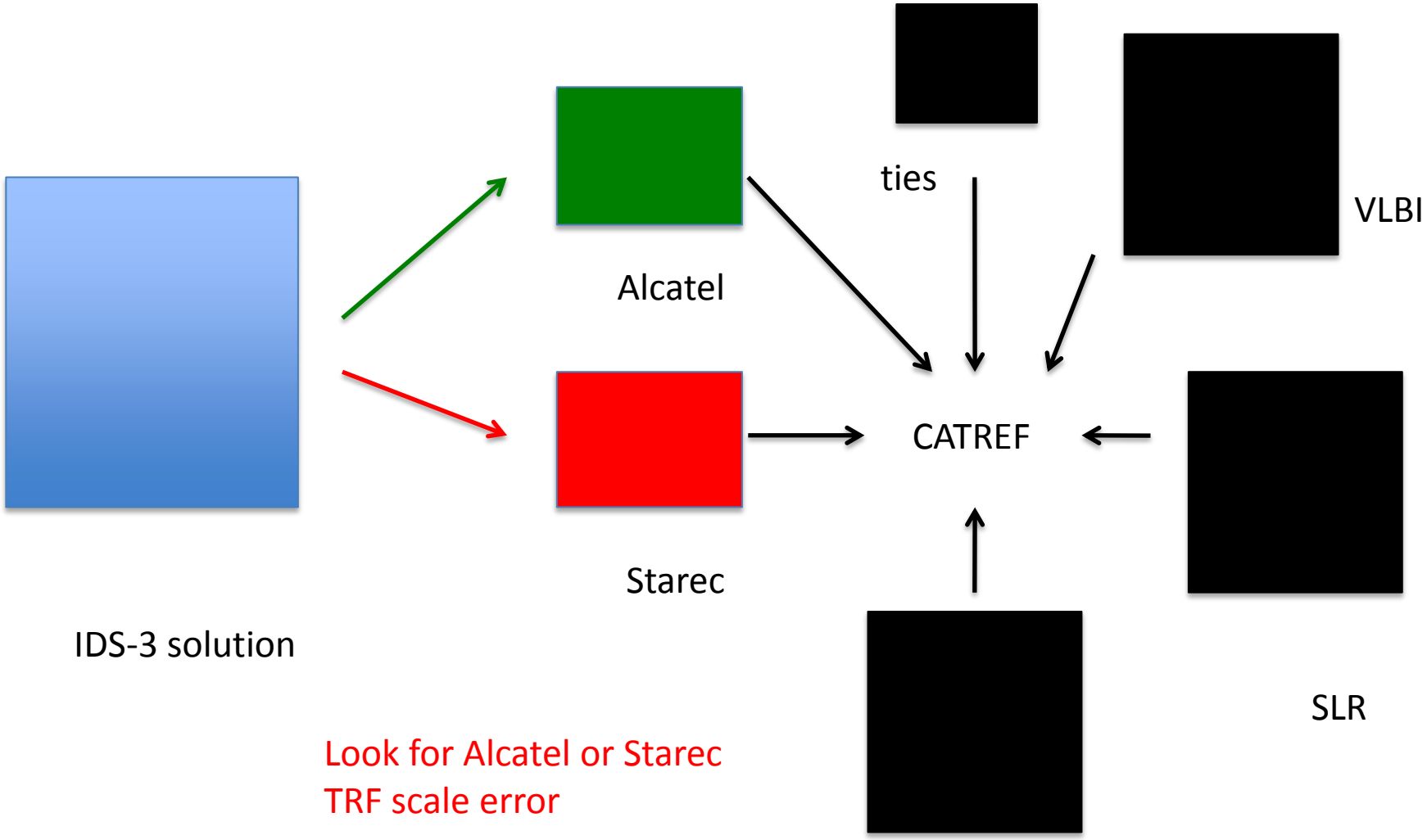
Summary : North = -0.8 mm, East = +1.1mm, Up = -5.3 mm



TESTS USING DORIS/IDS RESULTS (CATREF)

- 3) redo ITRF2008-type of computation using different SINEX for Alcatel and Starec (1 for each)
- 4) combine Alcatel corrected/SINEX + Starec/SINEX + GPS/SINEX + local ties

Splitting IDS solution into 2 solutions



Redo ITRF2008 using :
1 SINEX for Alcatel and 1 SINEX for Starec (IDS-3)

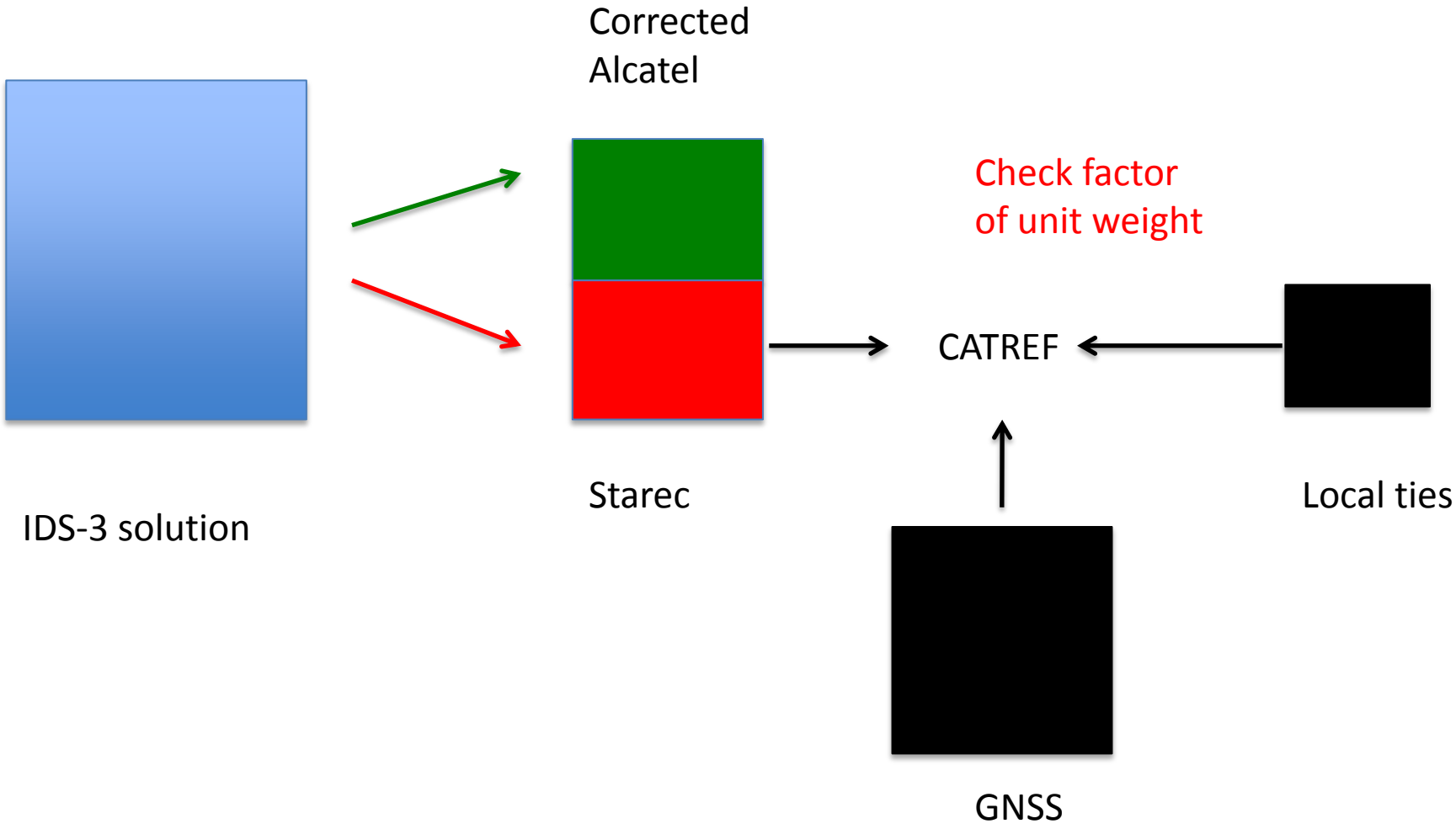
	TX mm	TY mm	TZ mm	Scale ppb	RX mas	RY mas	RZ mas	
IDS_alcatel	-5.4	-12.3	17.4	0.63	-0.167	0.156	0.000	5: 1
+/-	1.7	1.7	1.5	0.25	0.057	0.055	0.078	
IDS_starec	-6.9	-7.5	20.0	0.64	-0.020	0.154	0.039	5: 1
+/-	1.3	1.2	1.1	0.18	0.034	0.036	0.048	
Rates_alcate(/yr)	-0.4	-1.1	4.5	0.00	-0.028	0.044	-0.007	
+/-	0.0	0.0	0.0	0.00	0.000	0.000	0.000	fixed
Rates_starec(/yr)	-0.4	-1.1	4.5	0.00	-0.028	0.044	-0.007	
+/-	0.0	0.0	0.0	0.00	0.000	0.000	0.000	fixed

Scale factor is 0.0 ppb +/- 0.30 ppb

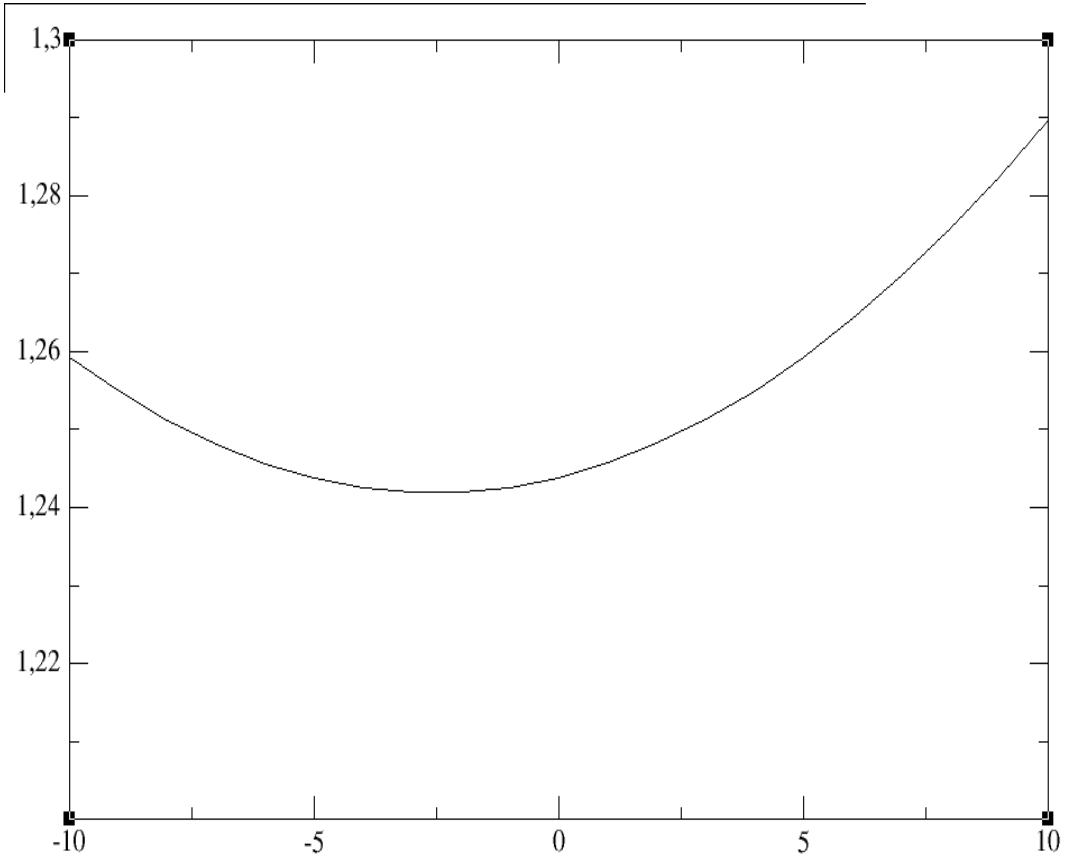
NB: not totally rigourous as the full covariance is not used

+ numbers strongly depends on how local ties are introduced

Correcting Alcatel heights in IDS solution



Change Alcatel heights and combine Alcatel SINEX + Starec SINEX + GPS SINEX



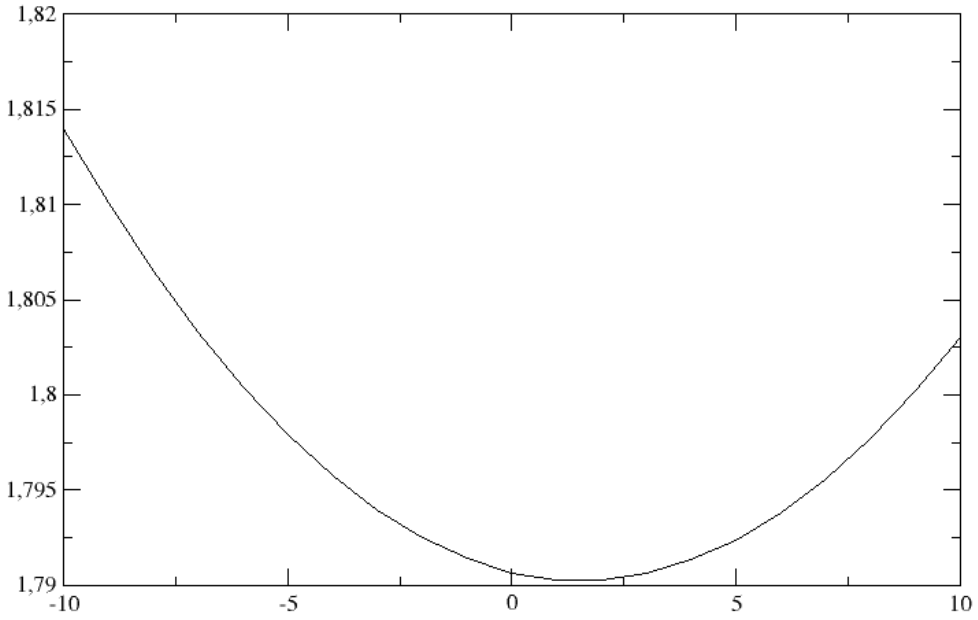
Using DORIS/IDS-3

Using 21 test values

Mininum of variance is obtained when bias is -3 mm

Estimated Alcatel positions in IDS solution seem to be lower than expected

Change Alcatel heights and combine Alcatel SINEX + Starec SINEX + GPS SINEX



Using DORIS/IGN

Using 21 test values

Mininum of variance is obtained when bias is +2 mm

Estimated Alcatel positions in IDS solution seem to be higher than expected

Preliminary test as IGN breaks were different

NB: IGN residuals are higher than IDS-3

SUMMARY OF RESULTS

Method	DORIS data	Alcatel bias	Formal error
Tropospheric results vs GPS (Bock)	IGN	+12 mm	3-5 mm (TBC)
TRF scale vs number of observing Alcatel antennas	IGN	+18 mm	TBD
Fixed velocity position/velocity vs geodetic local ties	IGN	+5.3 mm +7.5 mm	3.2 mm 2.9 mm
Redoing ITRF2008 using 1 SINEX for Alcatel and 1 SINEX for Starec	IDS	0.0 mm	0.3 mm
Correcting Alcatel heights and combining with GPS / factor of unit weight	IDS	-3 mm	TBD
Correcting Alcatel heights and combining with GPS / factor of unit weight	IGN	+3 mm	TBD

Basically 3-5 mm but sign differs (between IDS and IGN solution)

+ signs means that the estimated Alcatel position is higher than expected

(TENTATIVE) CONCLUSIONS

- If there is an currently unaccounted problem related to the center of phase/point of reference of the Alcatel antenna (vs Starec), it should be small (< 10 mm)
- All estimations agree in amplitude (3-5 mm) sign is different when DORIS/IDS-3 or DORIS/IGN solutions are considered
- Several possibilities:
  - Biais does not exist (estimation are barely significant)
  - Corrections using phase center from DORIS data file or recomputing it provide different Alcatel/Starec antenna heights (may depend on the AC software package and/or on the satellite used).
  - Others (any suggestion?) …