Analysis of DORIS map correction using phase measurements

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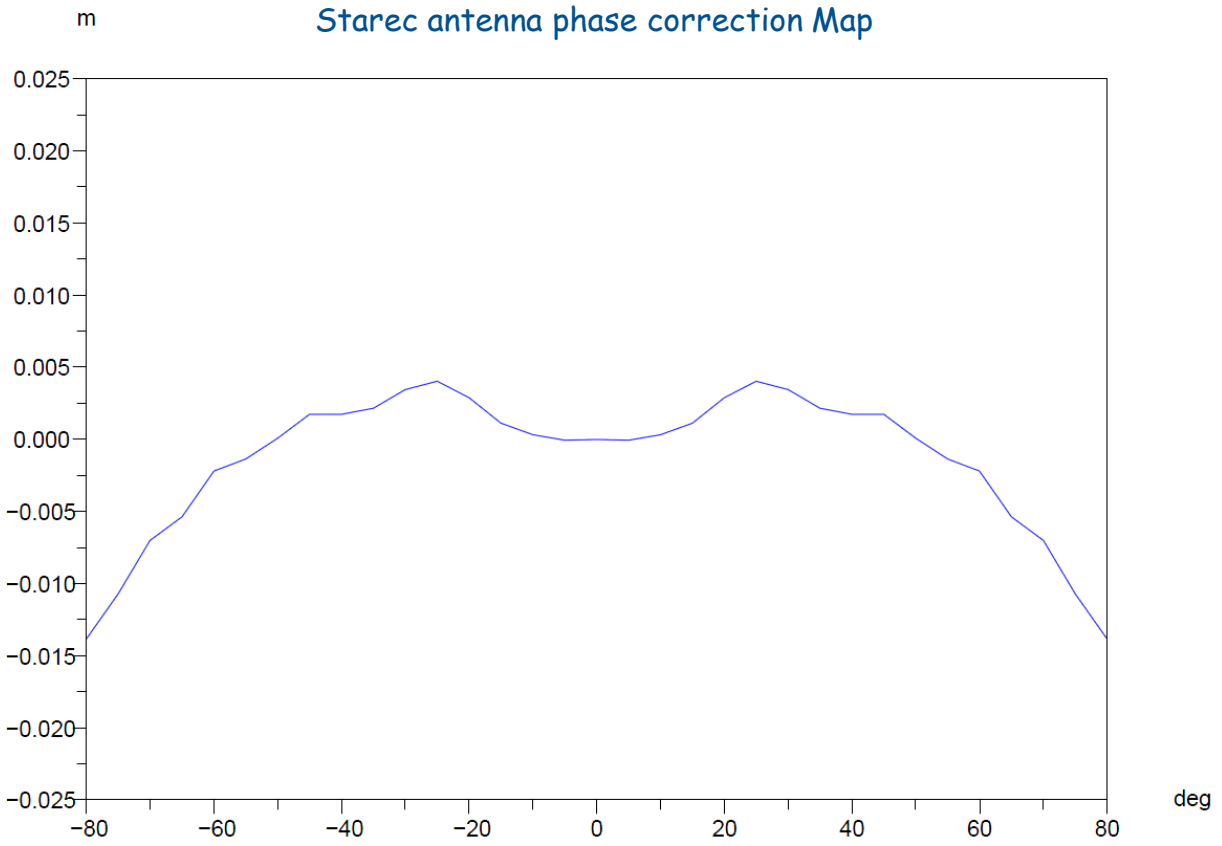
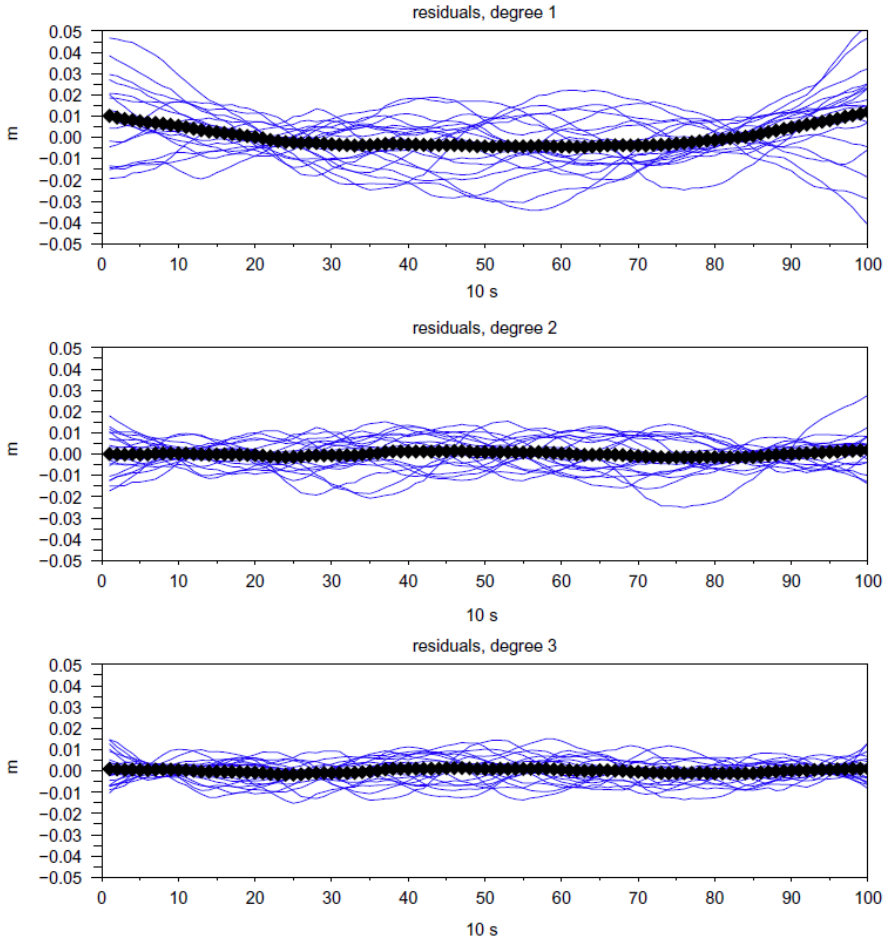
Doris ground Antenna phase map

Definition used : correction is added to the measurement model
(Antex file definition)



Phase residuals errors due to USO

Phase measurements errors due to USO : ground test results
20 samples with 1000 s duration



mean value for 20 cases
degree 1 removed
remaining parabolic error ~1 cm

degree 2 removed

Conclusion :

Even with 20 independent cases, a centimeter signature is possible

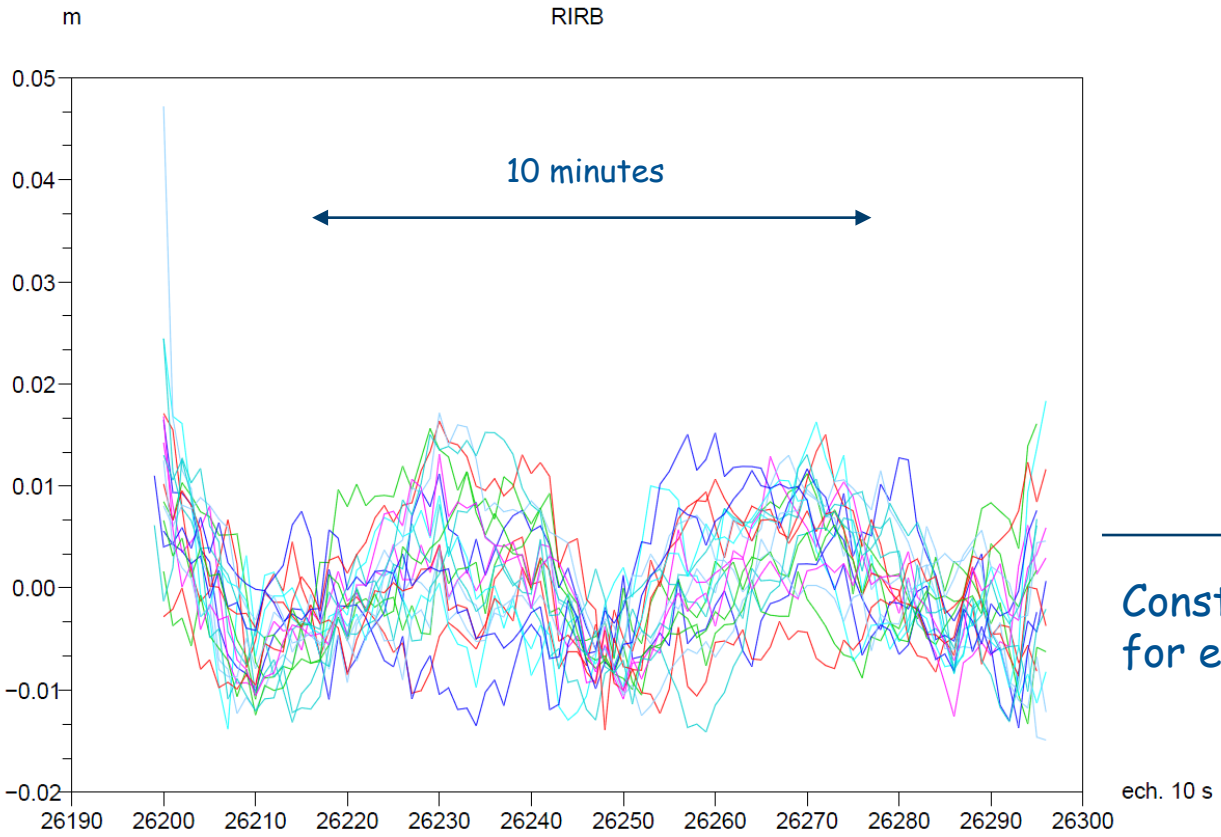
Complete map shape will not be observed correctly however, some local characteristics can be observed

JASR 10031 : Jason-2 DORIS phase measurement processing

Residuals obtained along a specific track

Observed residuals along a ground track (Jason 2, cycles 157 to 177)

adjusted parameters : bias, drift, wet tropospheric delay, for each measured pass
dispersions are at cm level (USO effect)
higher degree systematic signatures (symmetric)



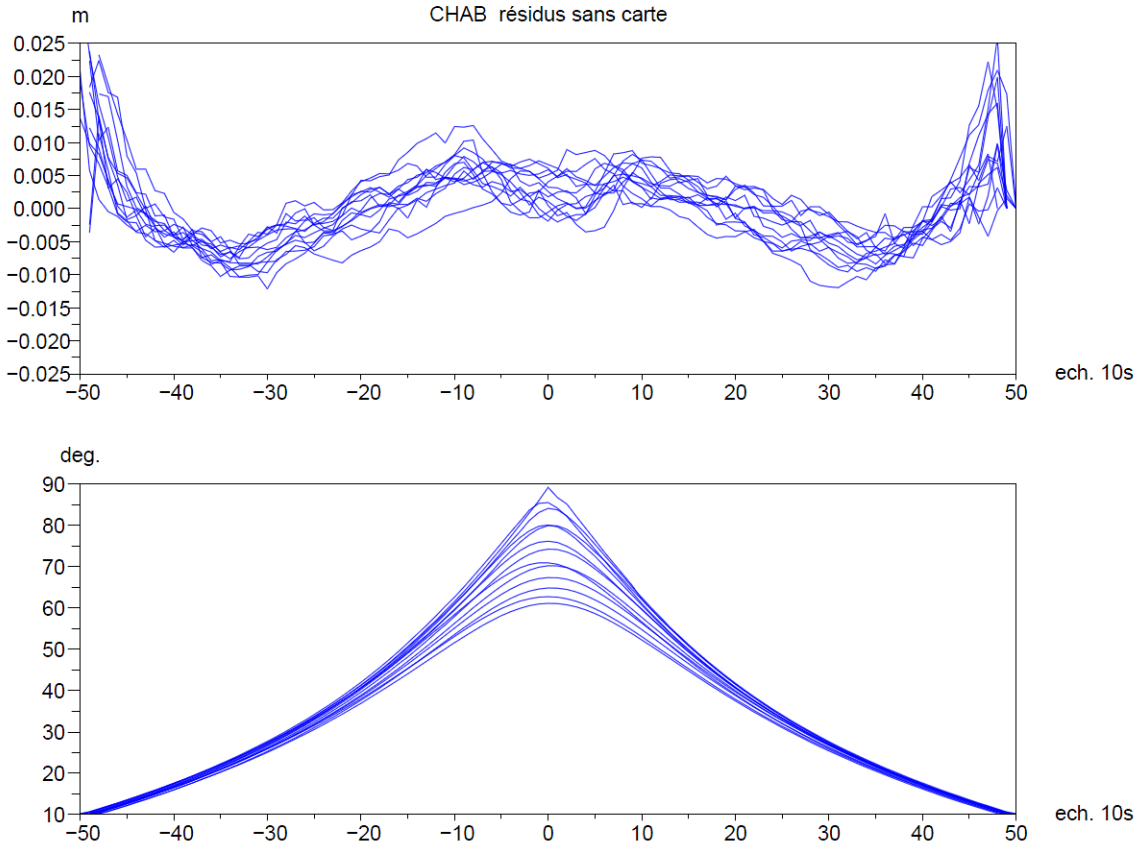
Construction of a mean signature for each reference track

Samples from beginning of reference cycle, for cycles 157 to 177

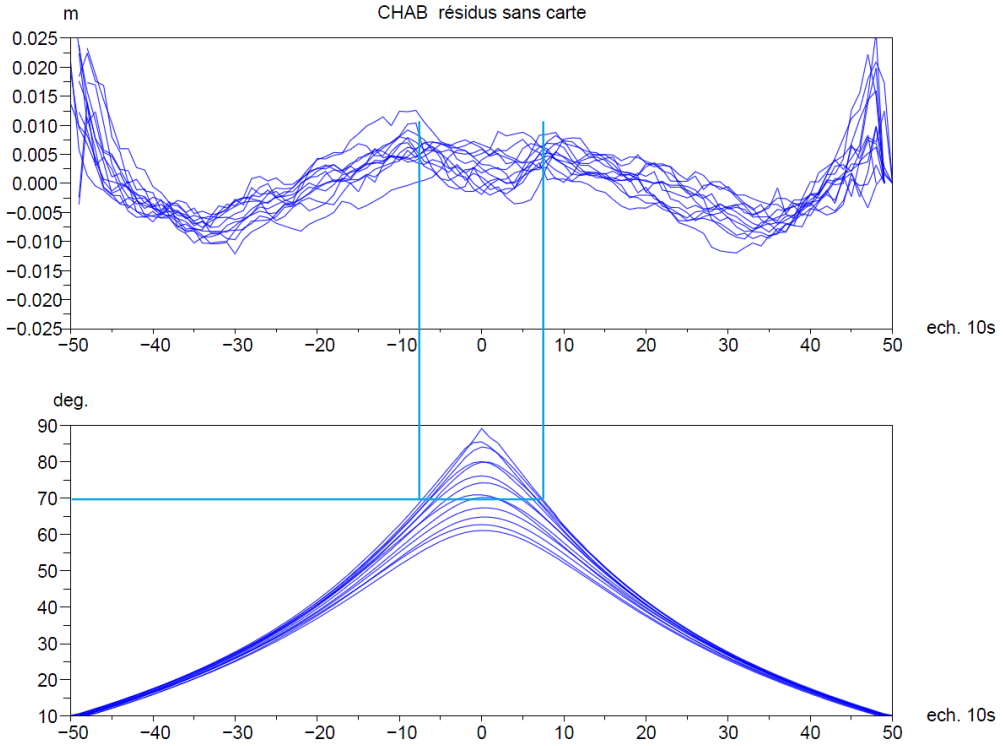
Analysis of the mean signatures for a beacon

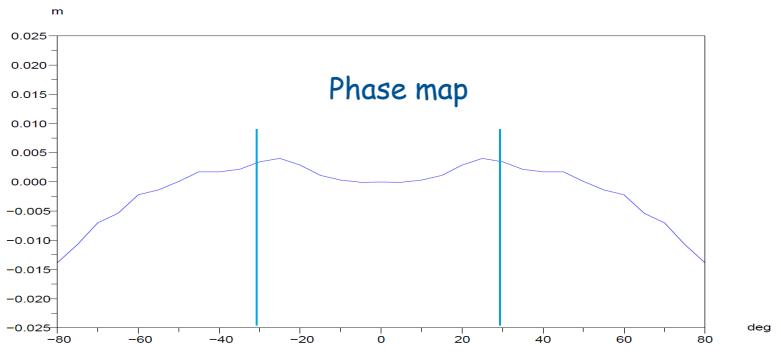
Mean signatures for each pass (21 cycles)
Passes with maximum elevation above 60 degrees only
Important observed common signature, for all passes, possible origins :

- USO (not completely removed by the averaging process ?)
- phase map
- tropospheric model performance
- coordinates



Analysis of the mean signatures for a beacon (some phase map characteristics observation)



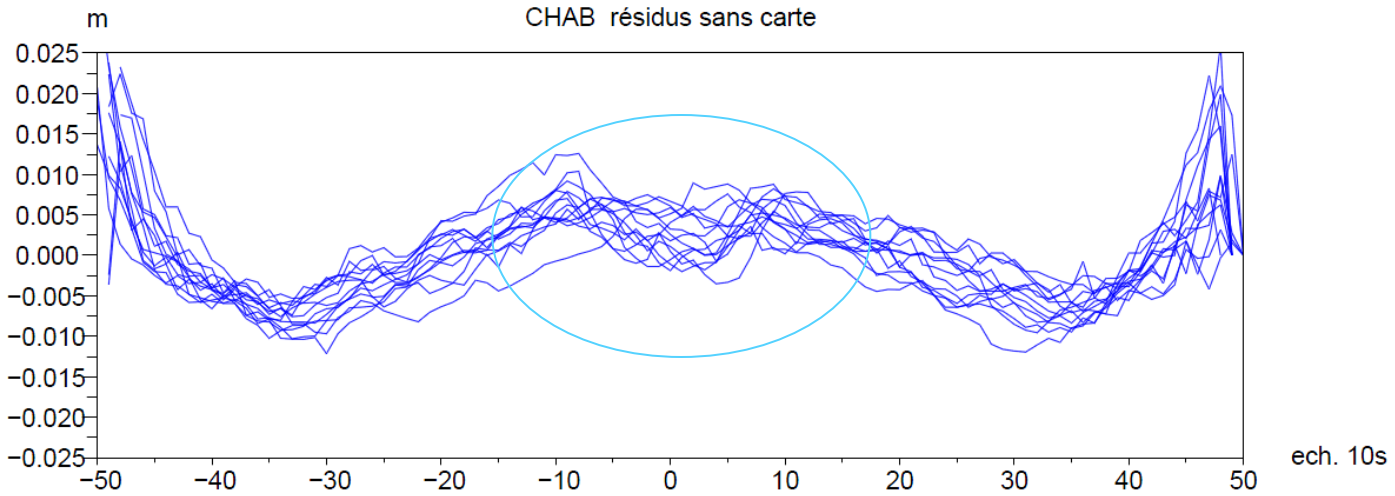


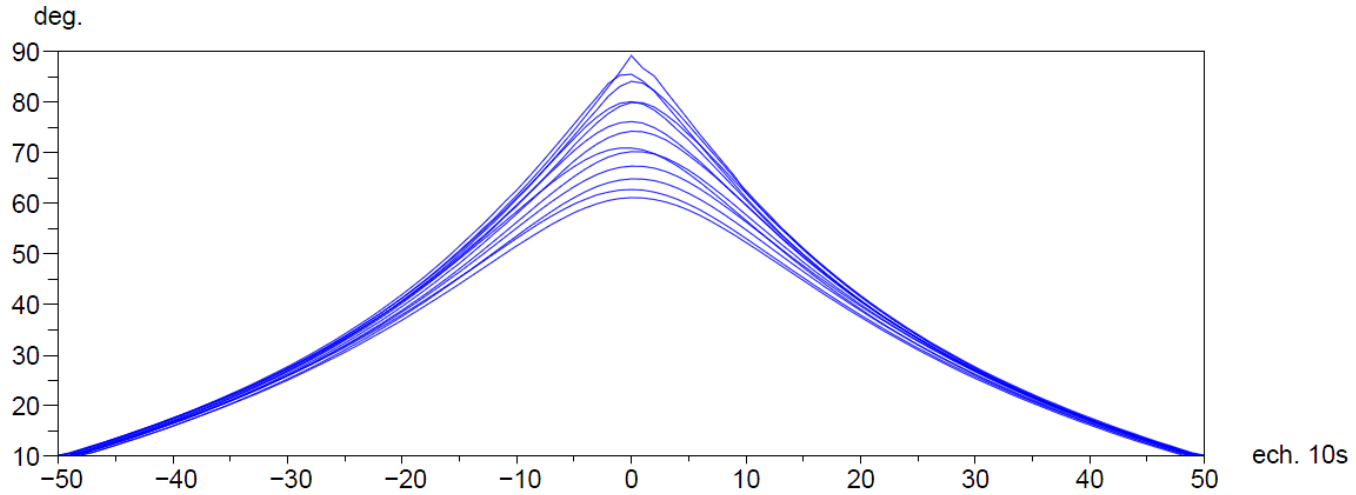
The phase map only is not sufficient to explain the residual signature

Coupling with wet zenith tropospheric delay (adjusted)

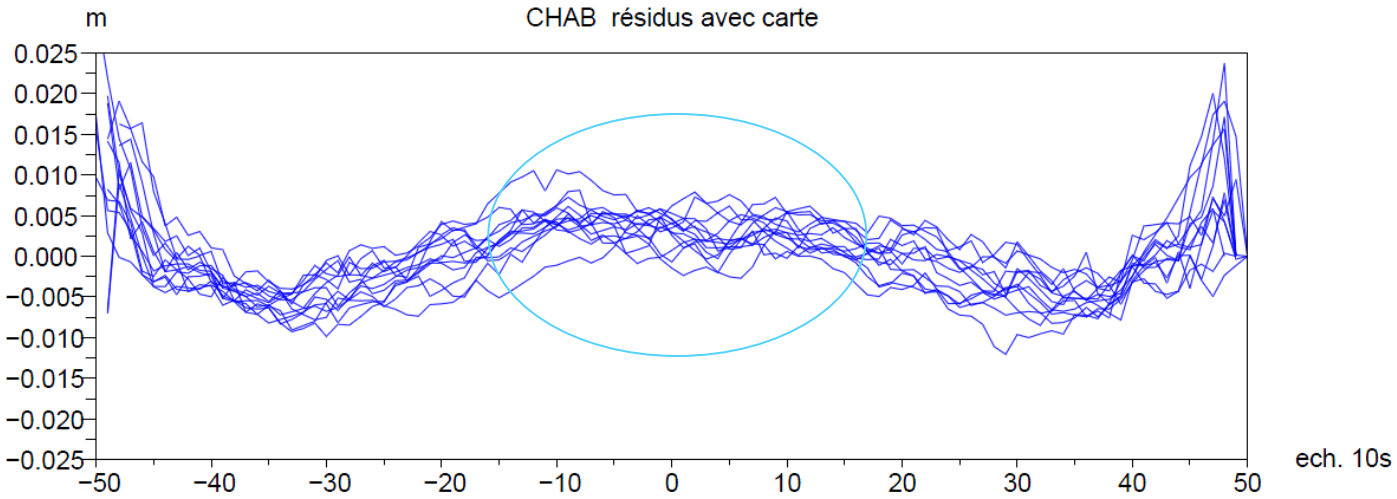
The 'valley' in the map for zenith angle > 70 degrees is very well observed

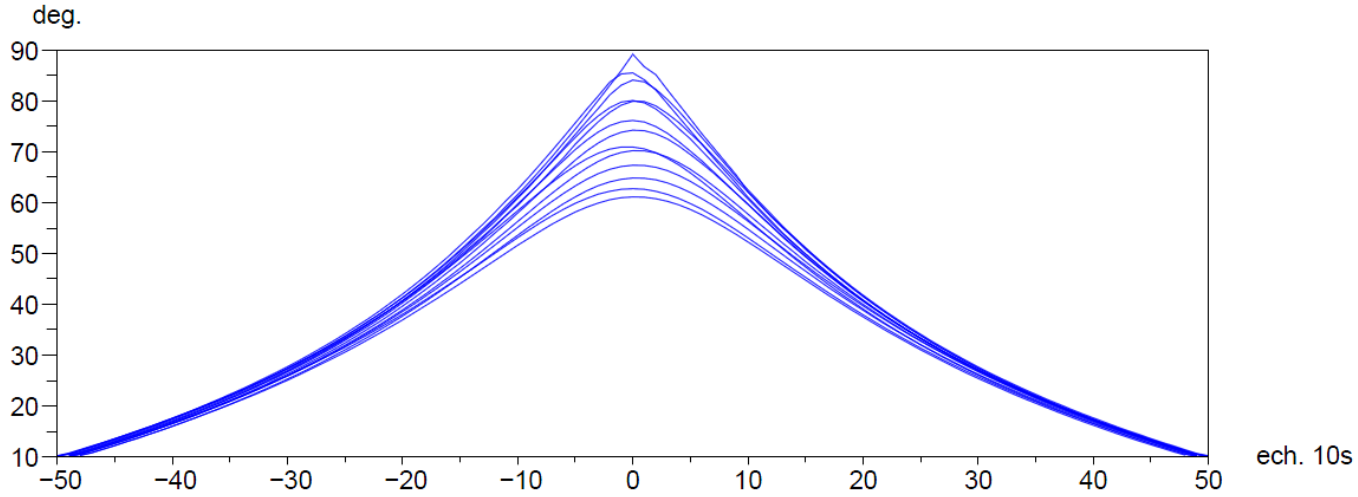
Residuals (no map)



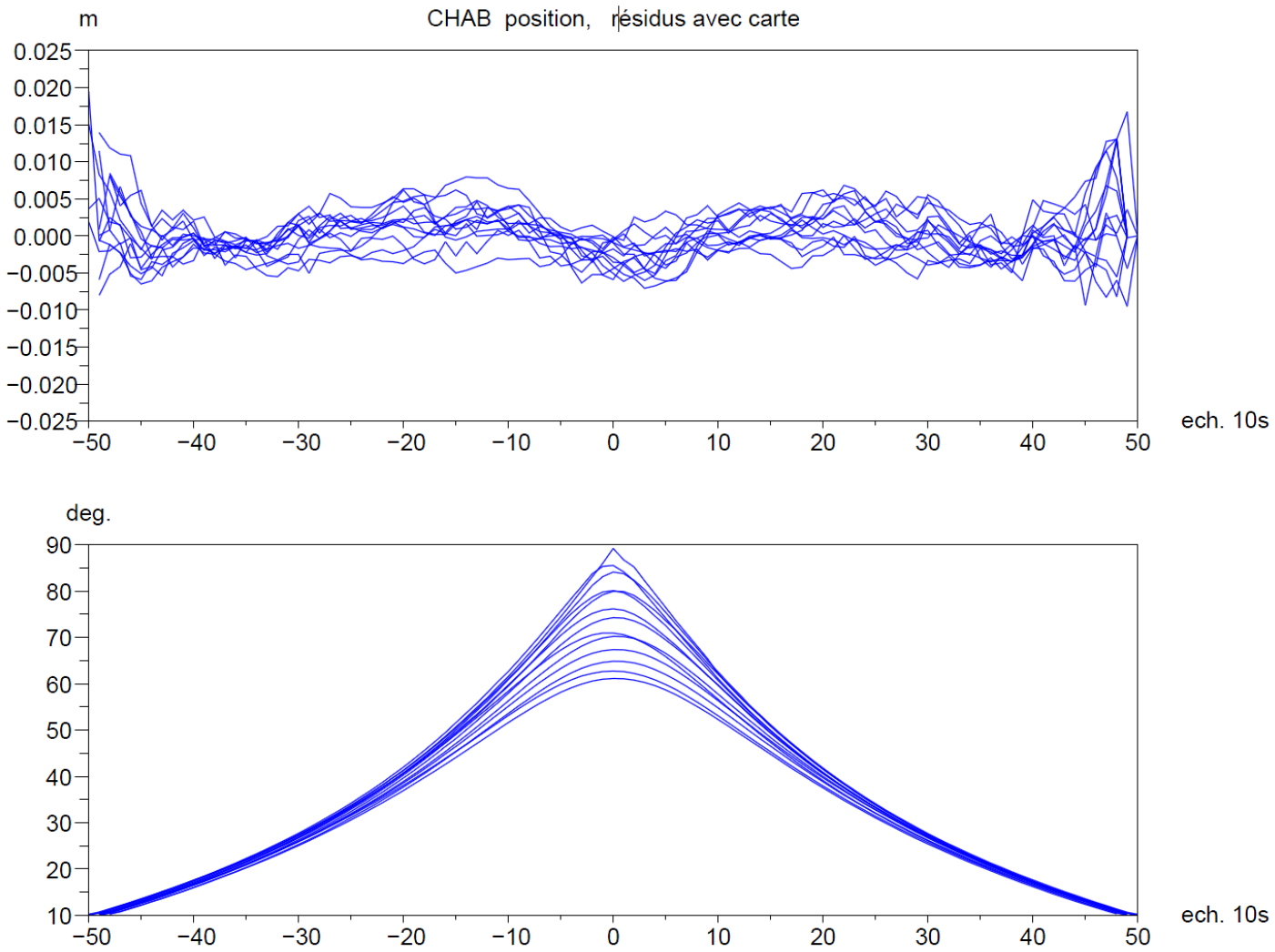


Residuals (map applied)





Residuals (map applied and vertical position adjusted)



Stations vertical positioning characteristics

Six stations, which have the best Doppler residuals in current IDS processing
- vertical positioning, orbit fixed, cycles 157 to 177
- adjusted parameters : bias, drift, wet tropospheric delay, for each measured pass
- effect of map and minimum elevation threshold

	sans carte		avec carte	
	10 degrés	20 degrés	10 degrés	20 degrés
YEMB	-7	0	21	16
ROVB	6	13	17	13
RIRB	-64	-57	-12	-15
MEUB	-32	-24	2	0
GRFB	6	14	16	13
CHAB	-45	-37	-8	-11

Vertical position may have many centimeters variation

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With the map, the results are more stable
when the minimum elevation is changed

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The positioning results are less scattered with the map

Position with Doppler or phase ?

If the models cannot represent the residuals then positioning using Doppler or phase (diagonal weighting) will change.

	10 degrés		20 degrés		cycles
	phase	Doppler	phase	Doppler	éliminés
YEMB	-1	-9	16	4	18
ROVB	22	22	23	23	5 et 18
RIRB	-49	-64	-11	-21	18
MEUB	-29	-40	-9	-11	18
GRFB	18	24	18	15	18
CHAB	-35	-43	-12	-19	18

ROVB, GRFB : little sensitivity to Doppler, phase and elevation limitation

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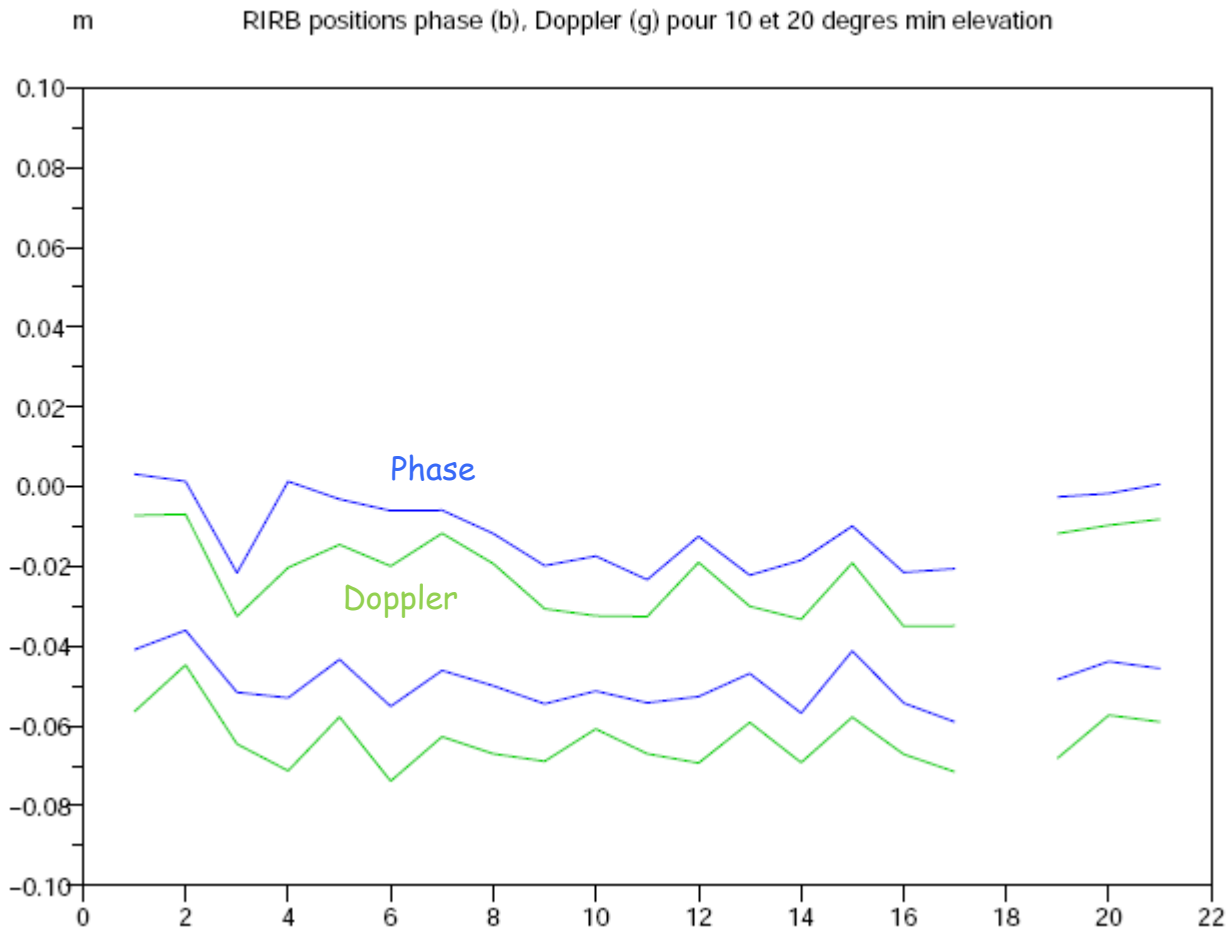
RIRB : sensitive to Doppler, phase and elevation limitation

RIRB positioning results (fixed orbits)

Comparison of phase and Doppler positioning for RIRB



20 degrees

10 degrees

Consequences on orbit determination (POD for altimetry)

Orbit determination (current GDR-D parameterizations, without or with map)

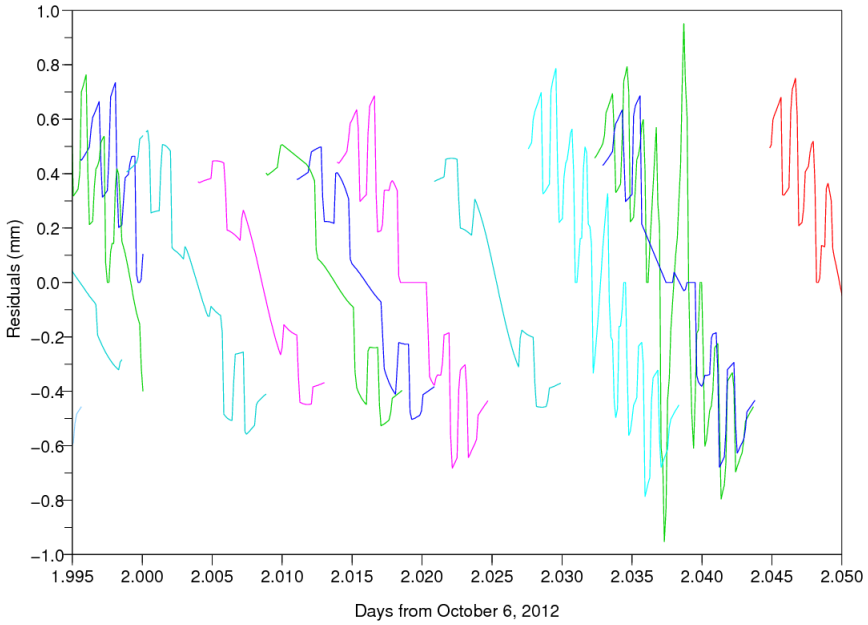
Effect of the minimal elevation (10 or 20 degrees)

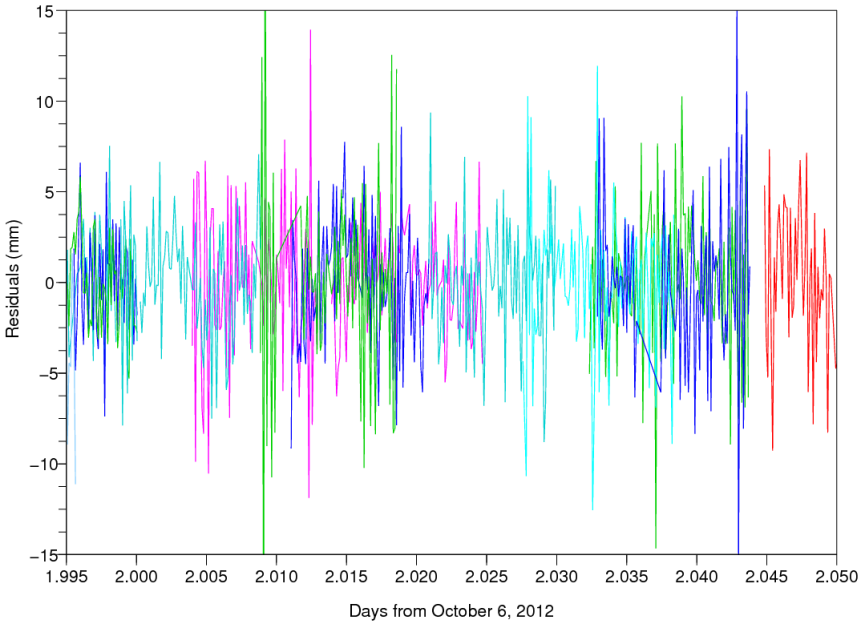
Orbits with vertical position adjusted

External validation with SLR residuals

Impact of Phase Law Non-Derivability on Doppler Residuals

Doppler residuals (with – without phase law) << Doppler residuals (observed – computed)

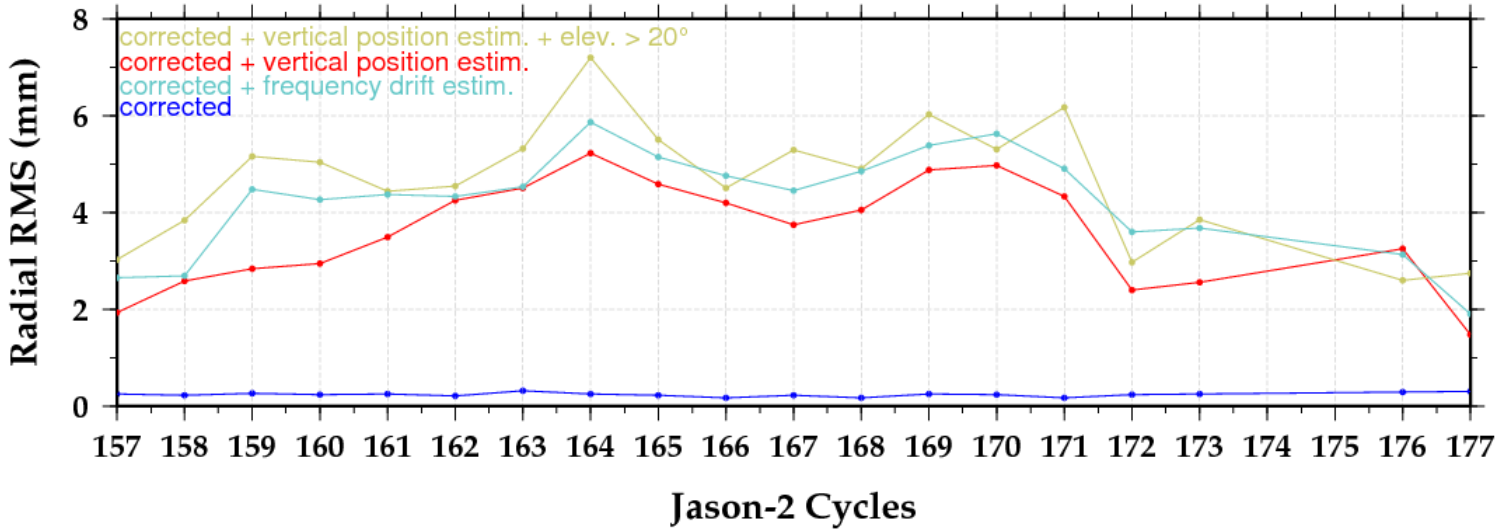




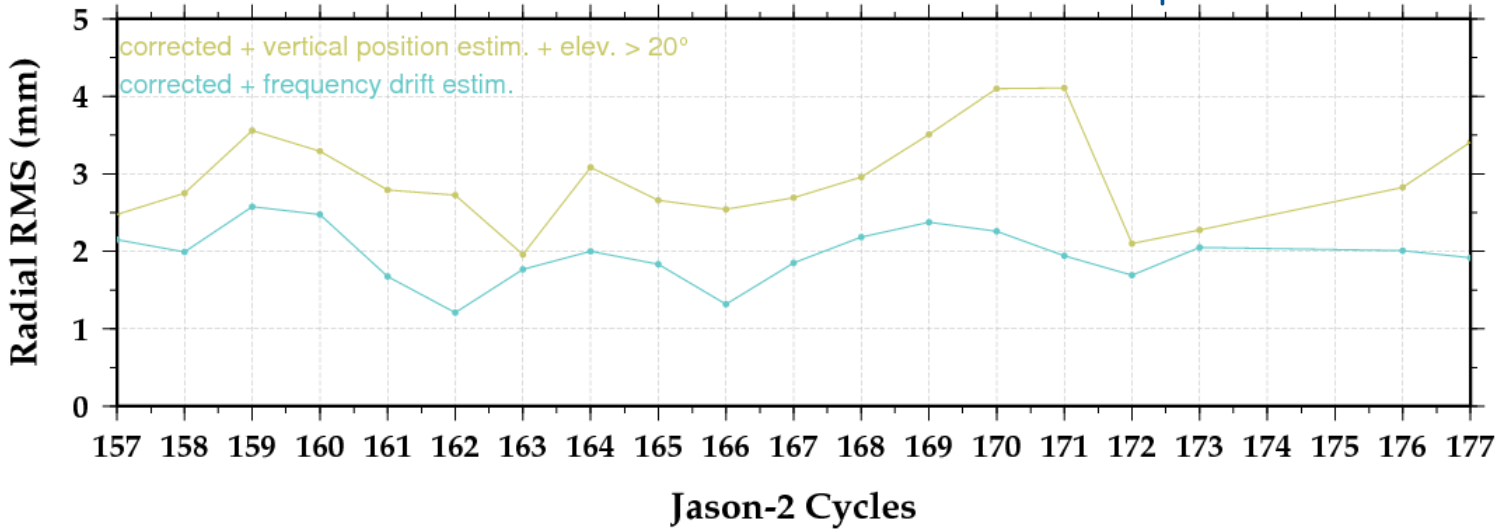
The Doppler phase noise due to the linear interpolation of the phase law should have negligible effect on the DORIS post-fit residuals (10-secondes phase increments)

DORIS-Only "Phase-Corrected" Orbits Comparisons

RMS of radial orbit differences relative to the GDR-D-like orbits

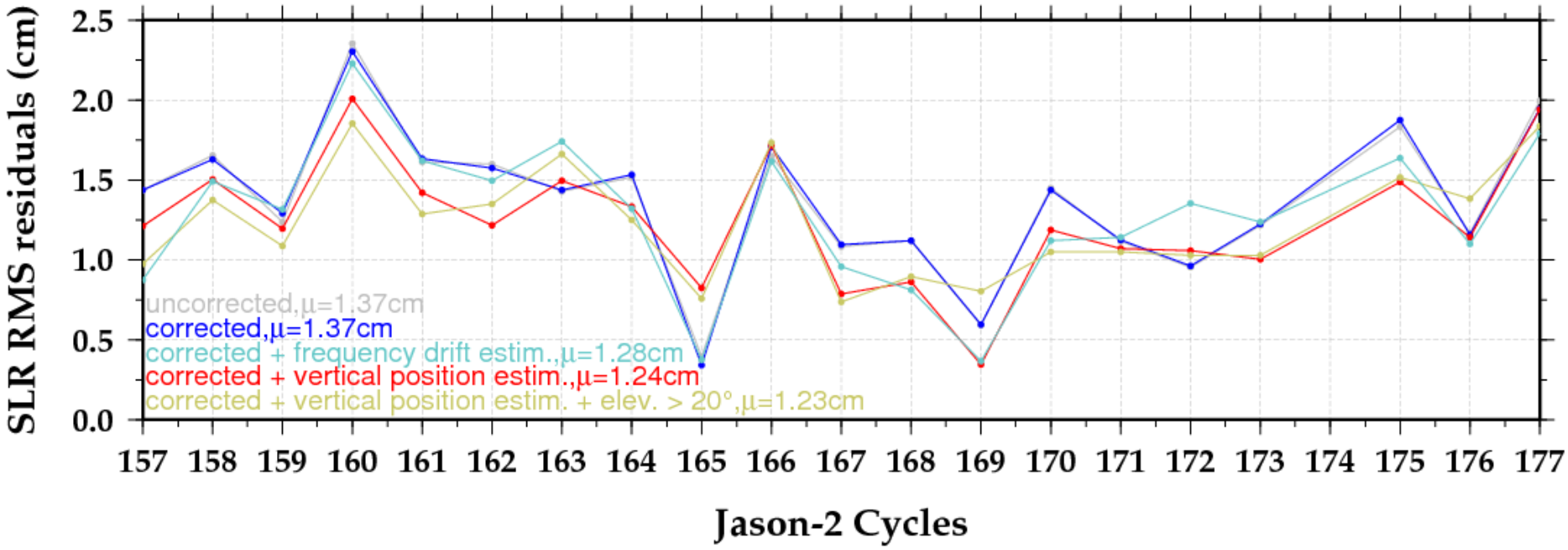


RMS of radial orbit differences relative to the corrected + vertical position estim. orbits



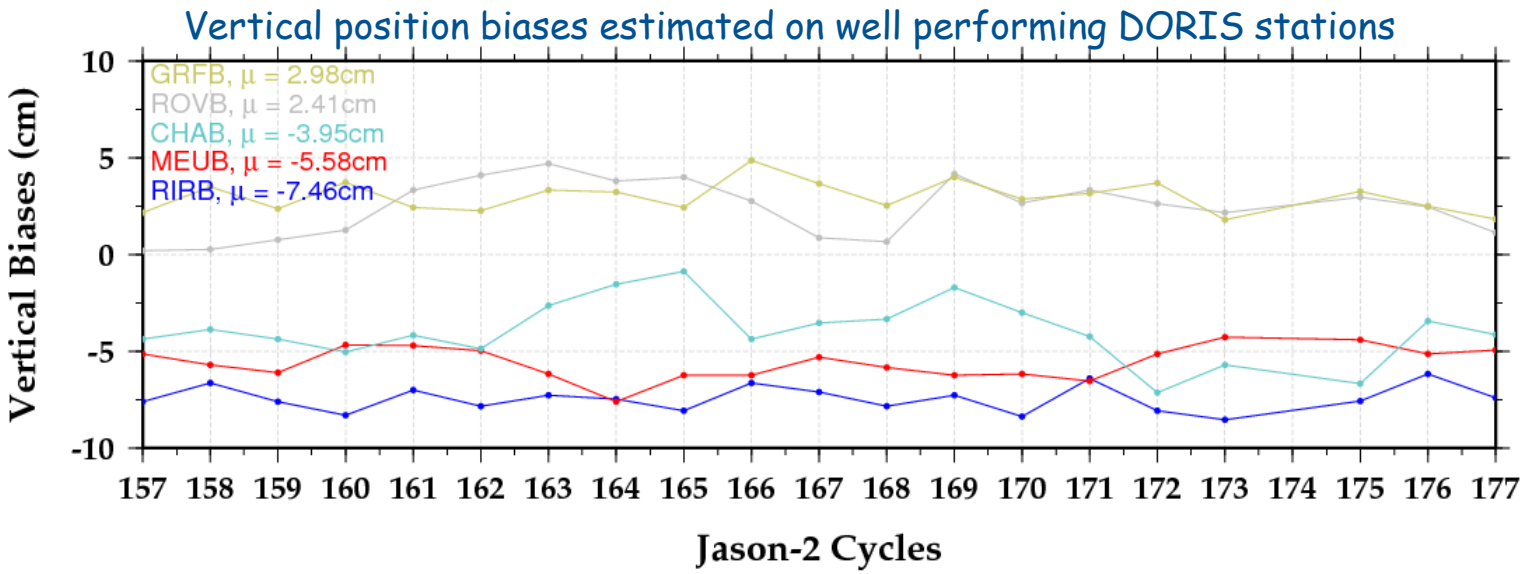
SLR Validation

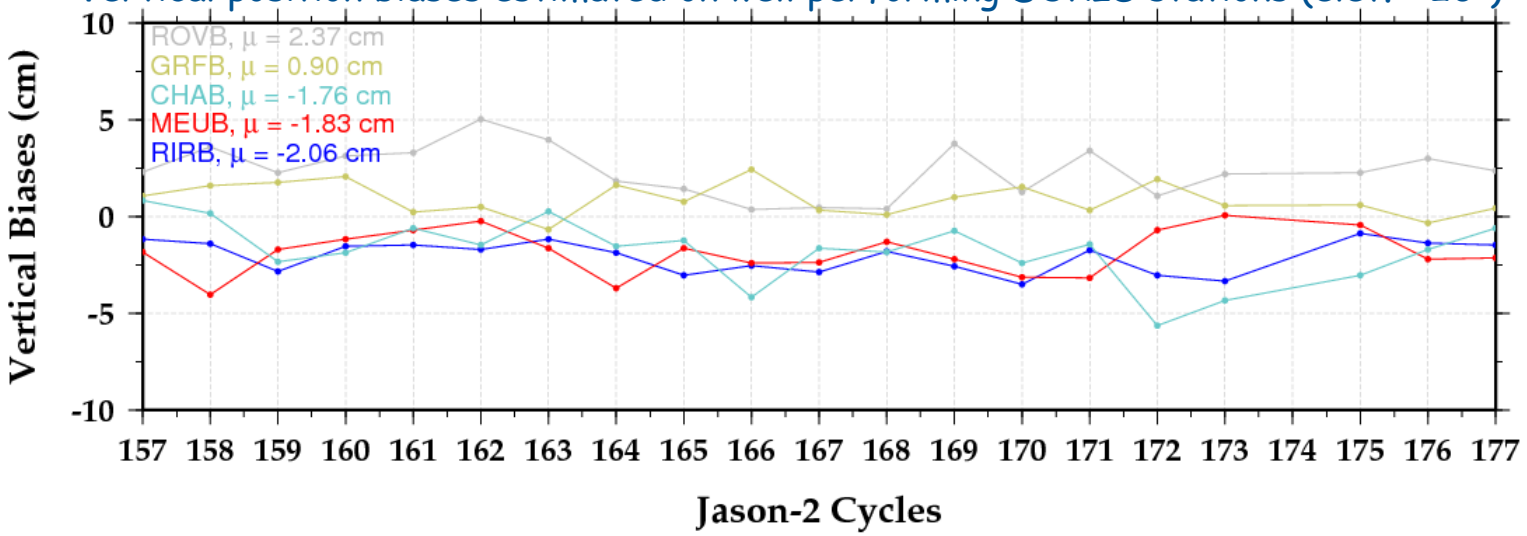
High elevation (above 70 degrees) SLR core network residuals on independent DORIS-only orbits



Solving for the vertical position of the DORIS beacons on average seems to reduce by ~2 mm RMS the radial component of the DORIS-only orbits

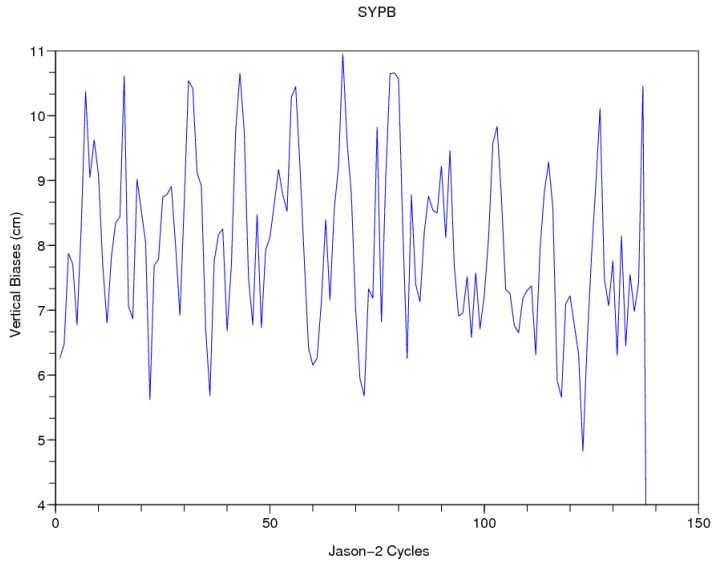
Adjusted Vertical Positions for the DORIS Beacons

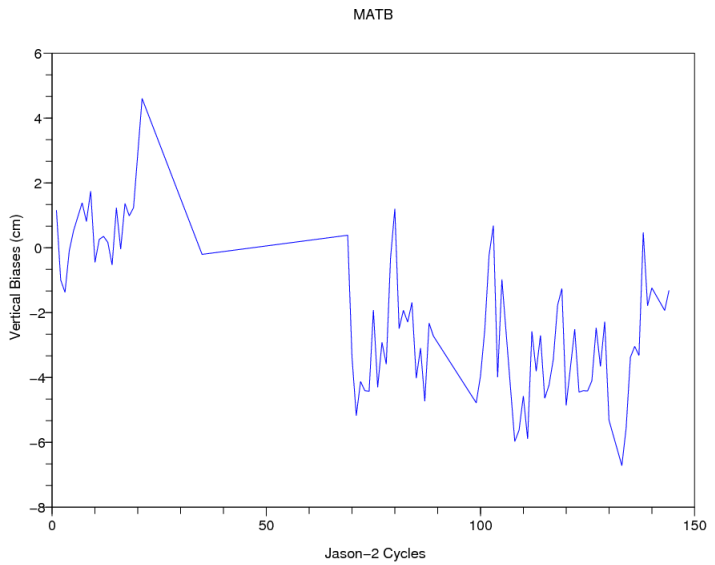


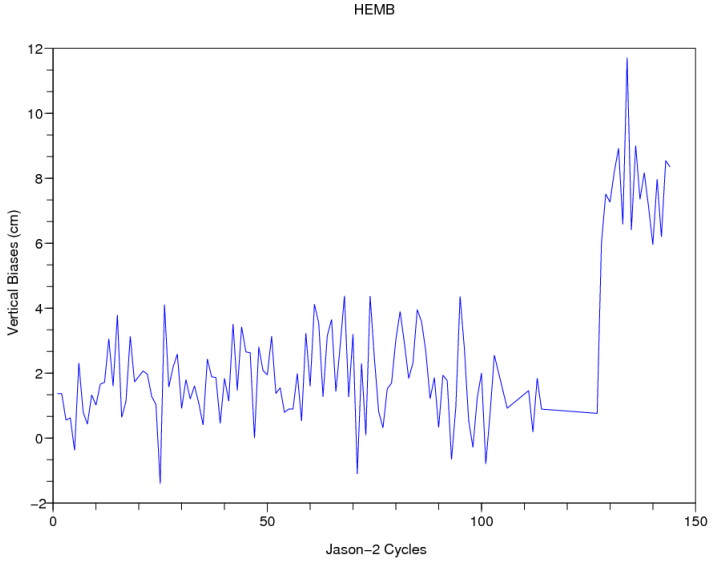


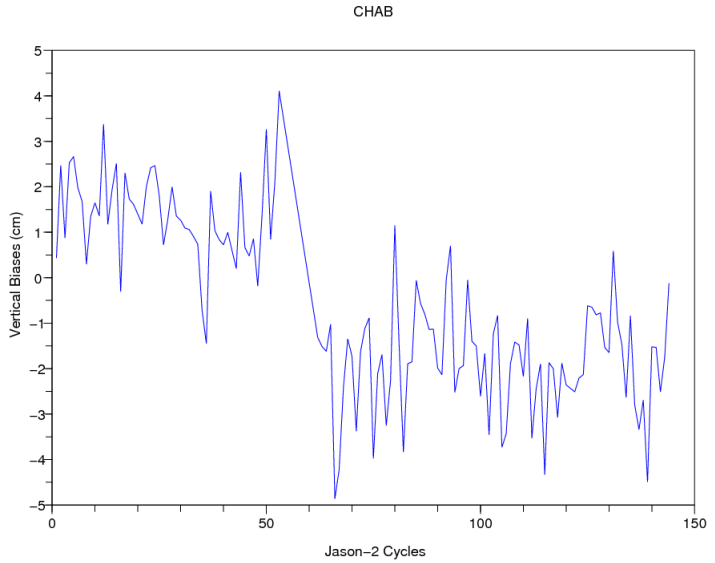
Odd Behaviors of Some Adjusted Vertical Positions (1/2)

Biases



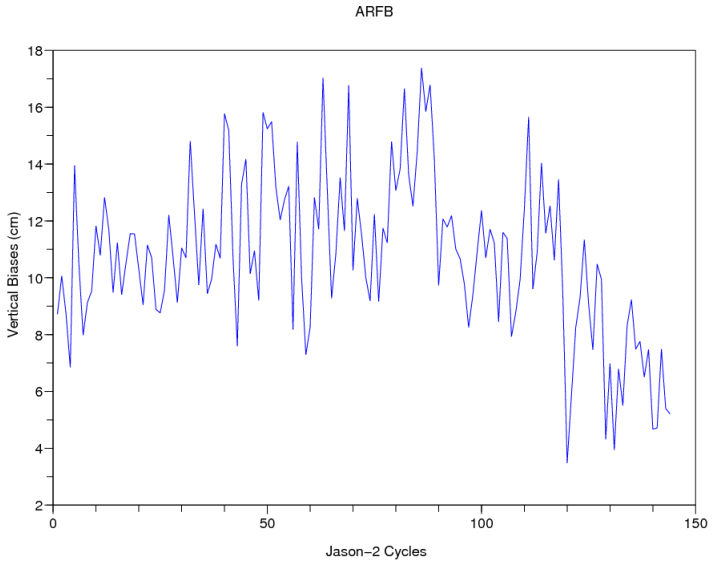


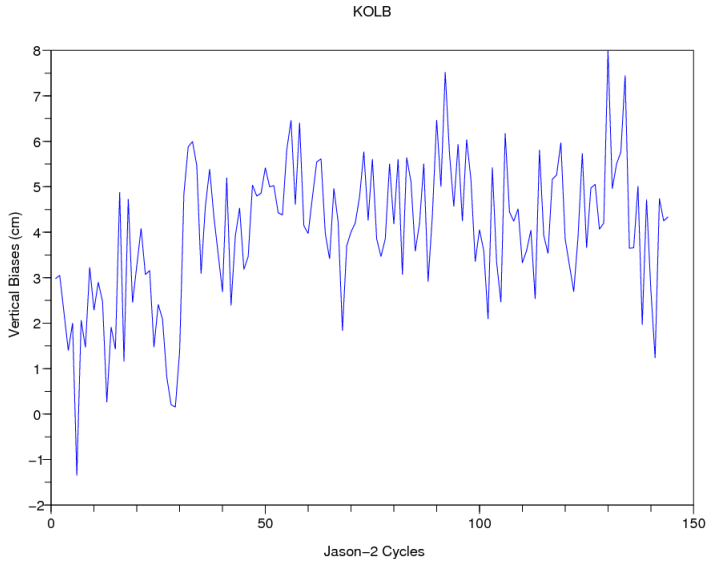


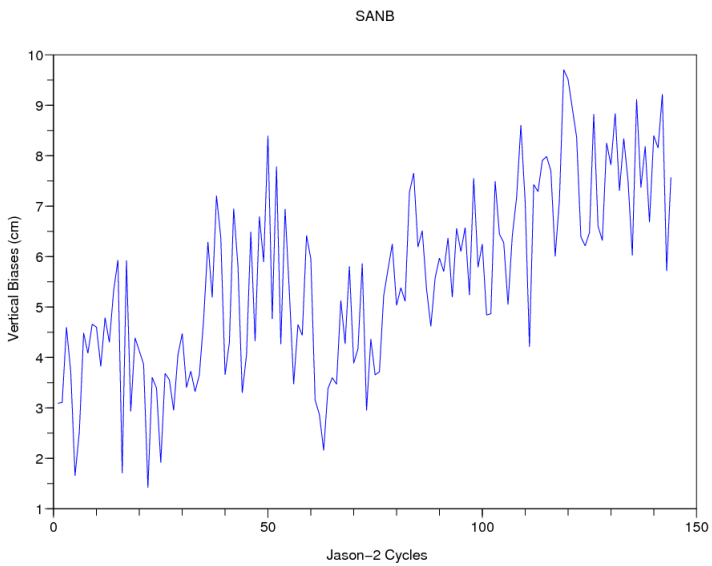


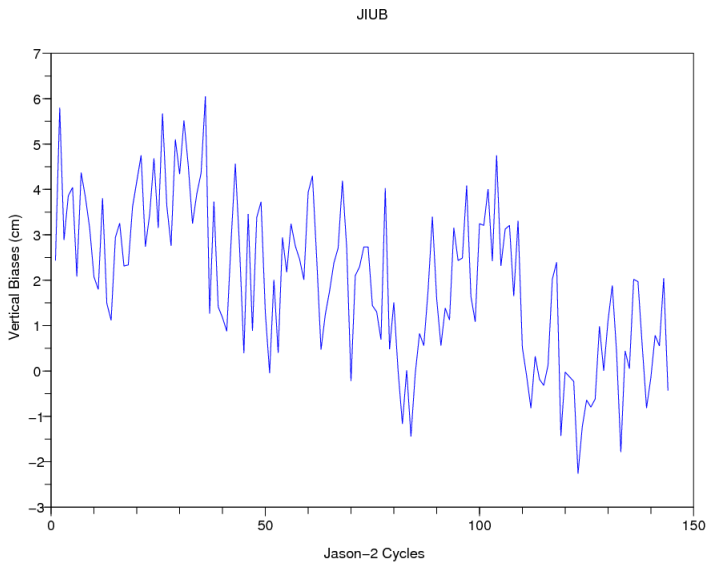
Odd Behaviors of Some Adjusted Vertical Positions (2/2)

Drifts









Conclusions

Validation of the map use in the current processing

Map effects on positioning

- adjusted vertical position is less sensitive to elevation limitations
  is less scattered between stations
- important remaining even signatures
  further studies are needed
- different values of the positions with phase or Doppler formulations

Map effects on orbit radial performances

- small effect with the standard POD configuration (< 1 mm rms)
- adjusted vertical positions, effect not negligible (up to 6 mm rms)
- this effect is an improvement, external validation with SLR for recent cycles
  (~2 mm improvement in the SLR rms of the tested cycles)
- differences between adjusted and ITRF-based vertical positions need to be understood

Thank you

Effect of second degree polynomial adjustment

	degré 1		degré 2	
	10 degrés	20 degrés	10 degrés	20 degrés
YEMB	21	16	14	19
ROVB	17	13	19	5
RIRB	-12	-15	2	16
MEUB	2	0	11	-7
GRFB	16	13	9	18
CHAB	-8	-11	-3	12

Less observability
No clear improvement