IDS workshop: Precise Orbit Modeling and Determination

New DORIS Doppler Parameterization Inferred from Phase Measurement Analyses

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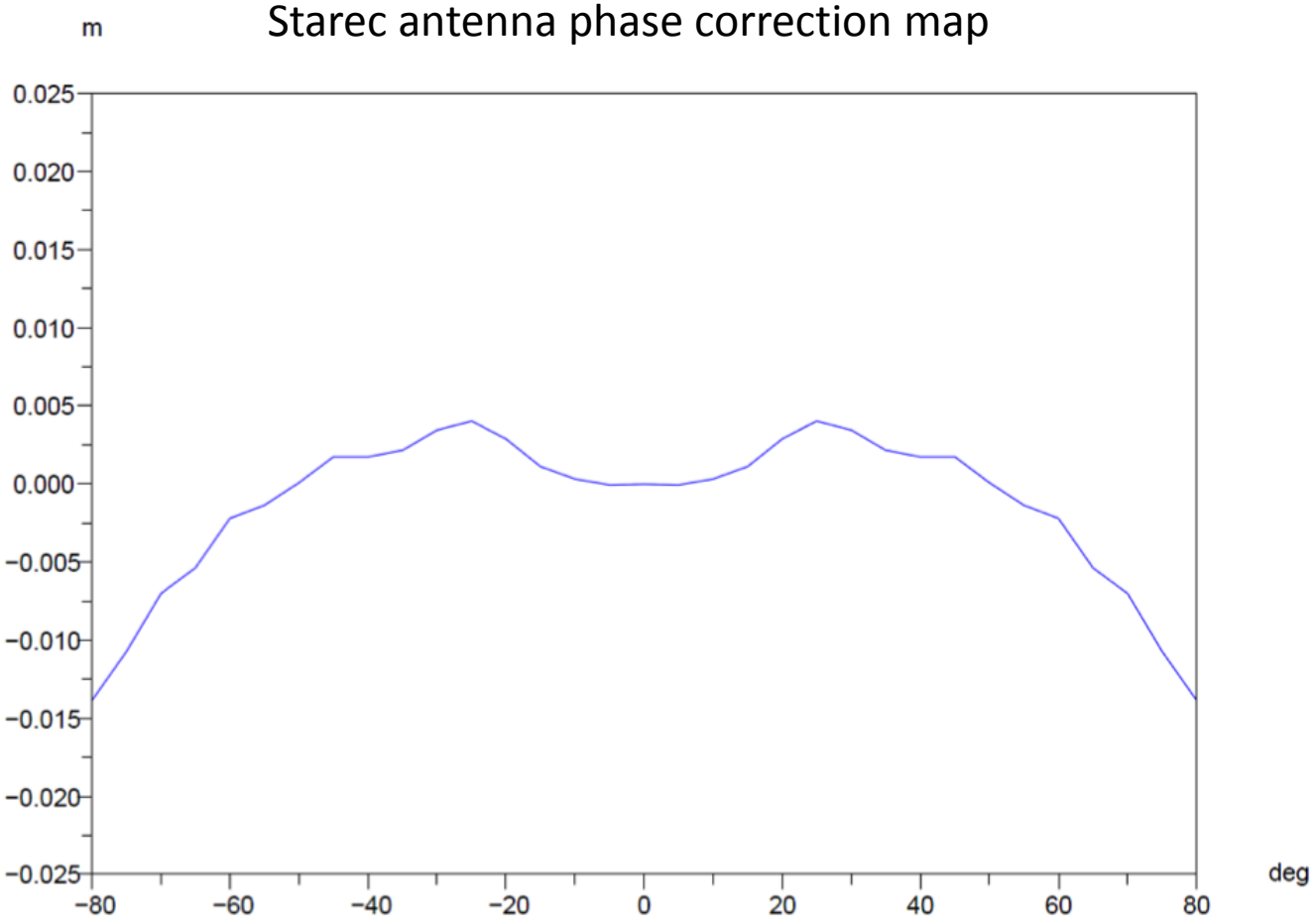
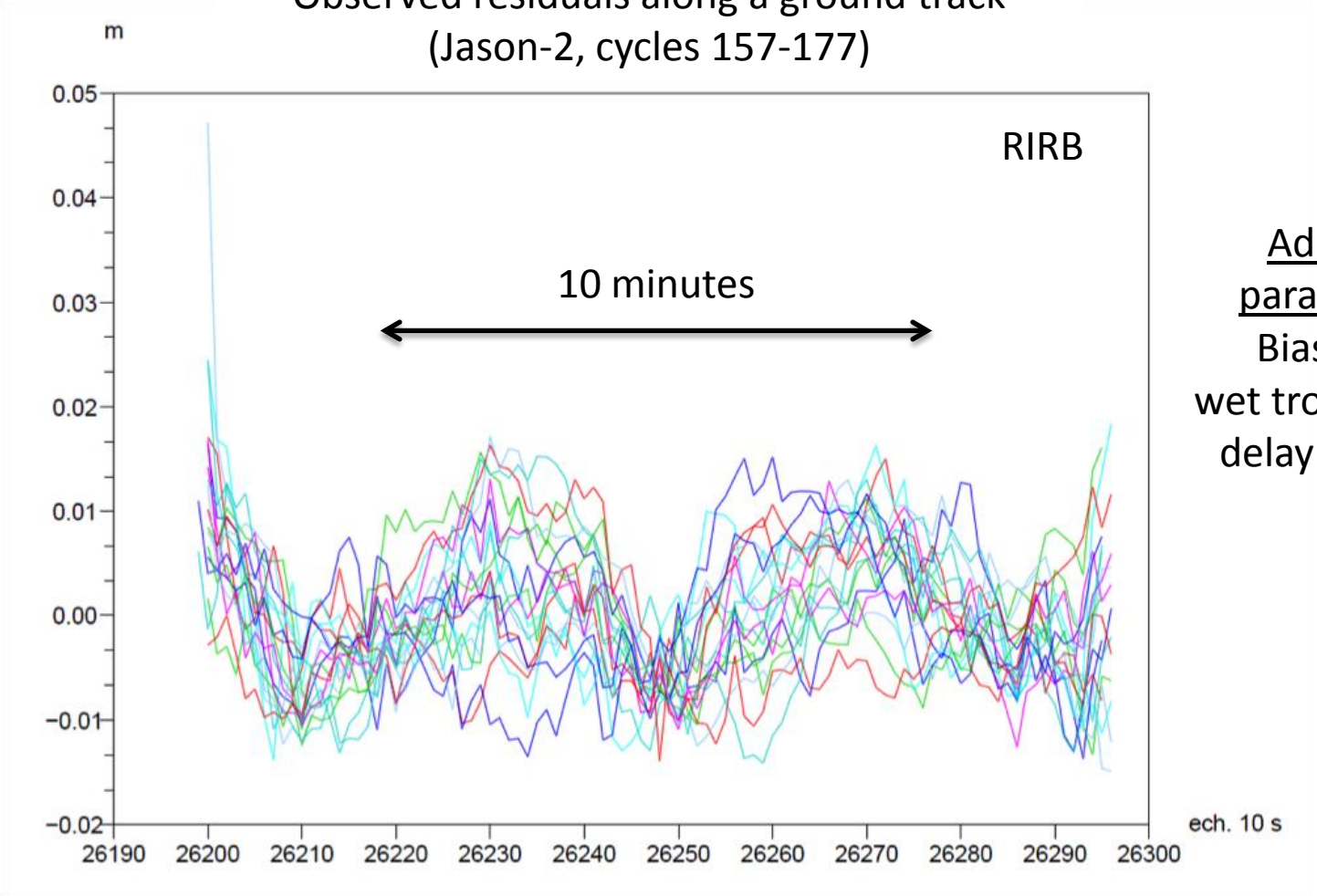
DORIS Ground Antenna Phase Map

Starec antenna phase correction map



Phase Residuals Obtained Along a Specific Track

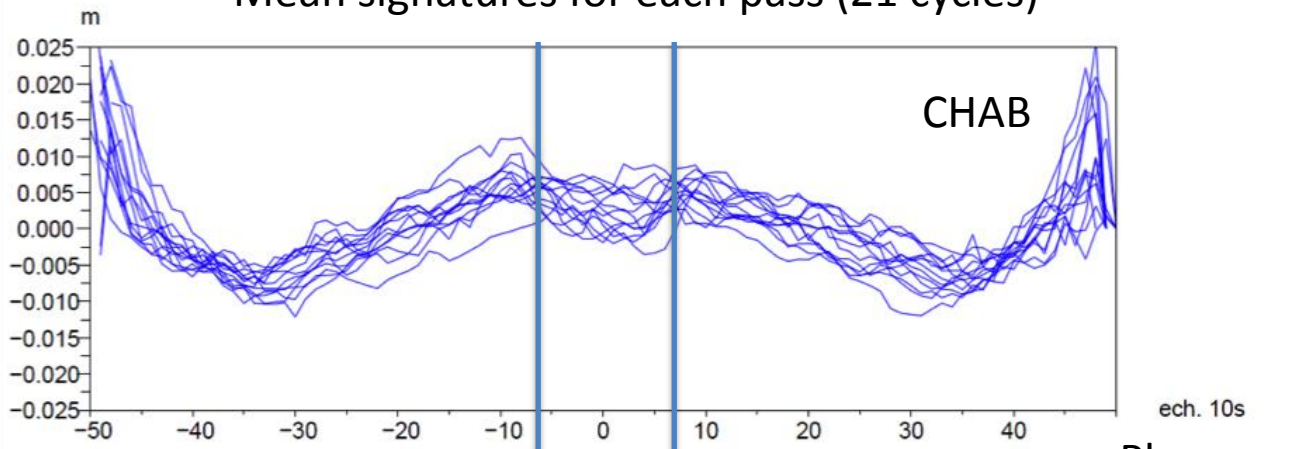
Observed residuals along a ground track
(Jason-2, cycles 157-177)

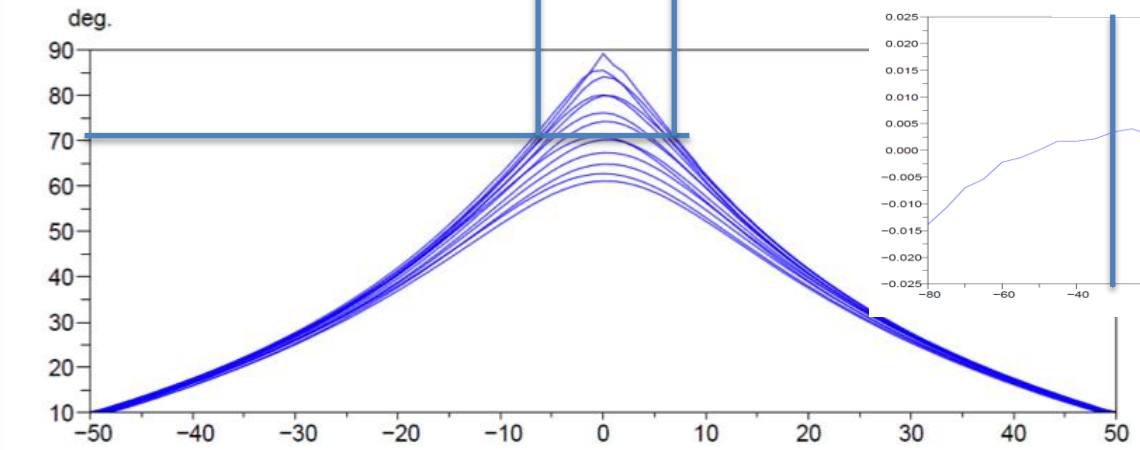


Adjusted parameters:
Bias, drift, wet tropospheric delay per pass

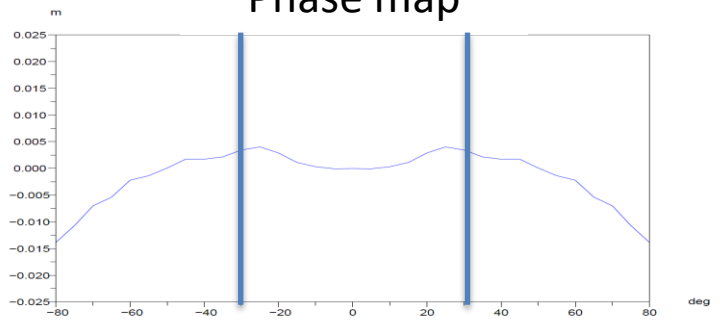
Analysis of the Mean Signatures for a Beacon

Mean signatures for each pass (21 cycles)



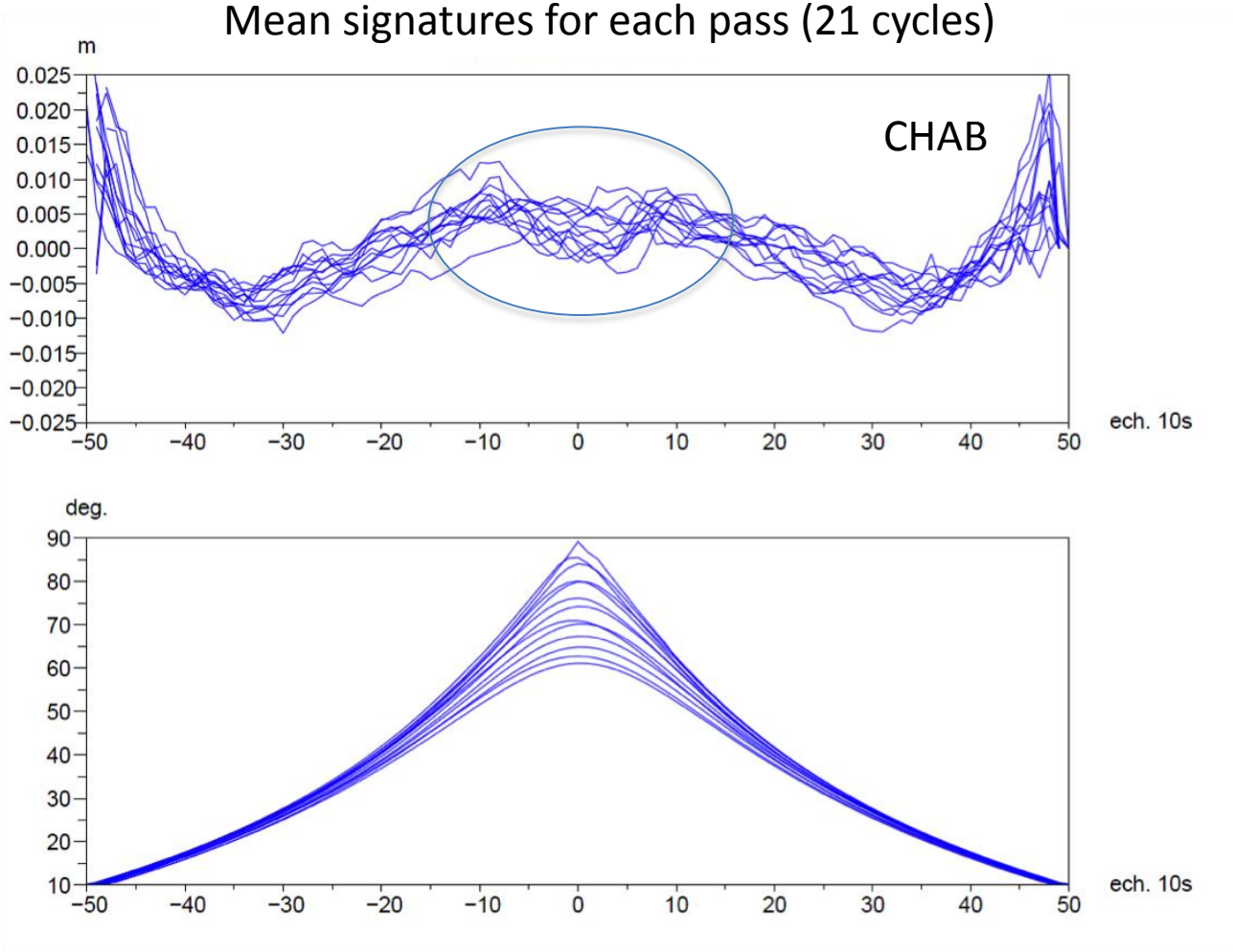


Phase map

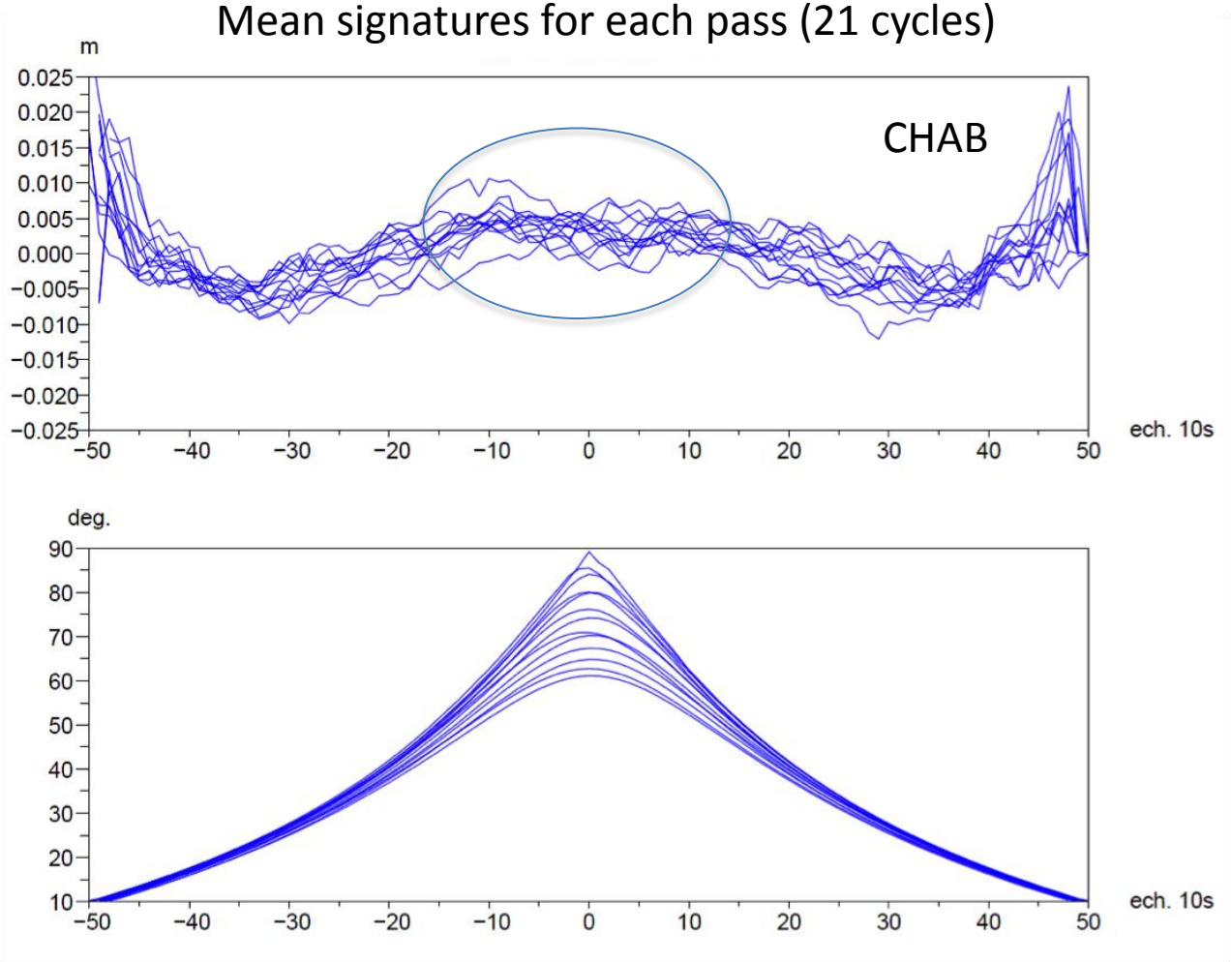


Possible origins for the common signature observed:
USO, phase map, tropospheric model, coordinates?

Phase Residuals (without map)

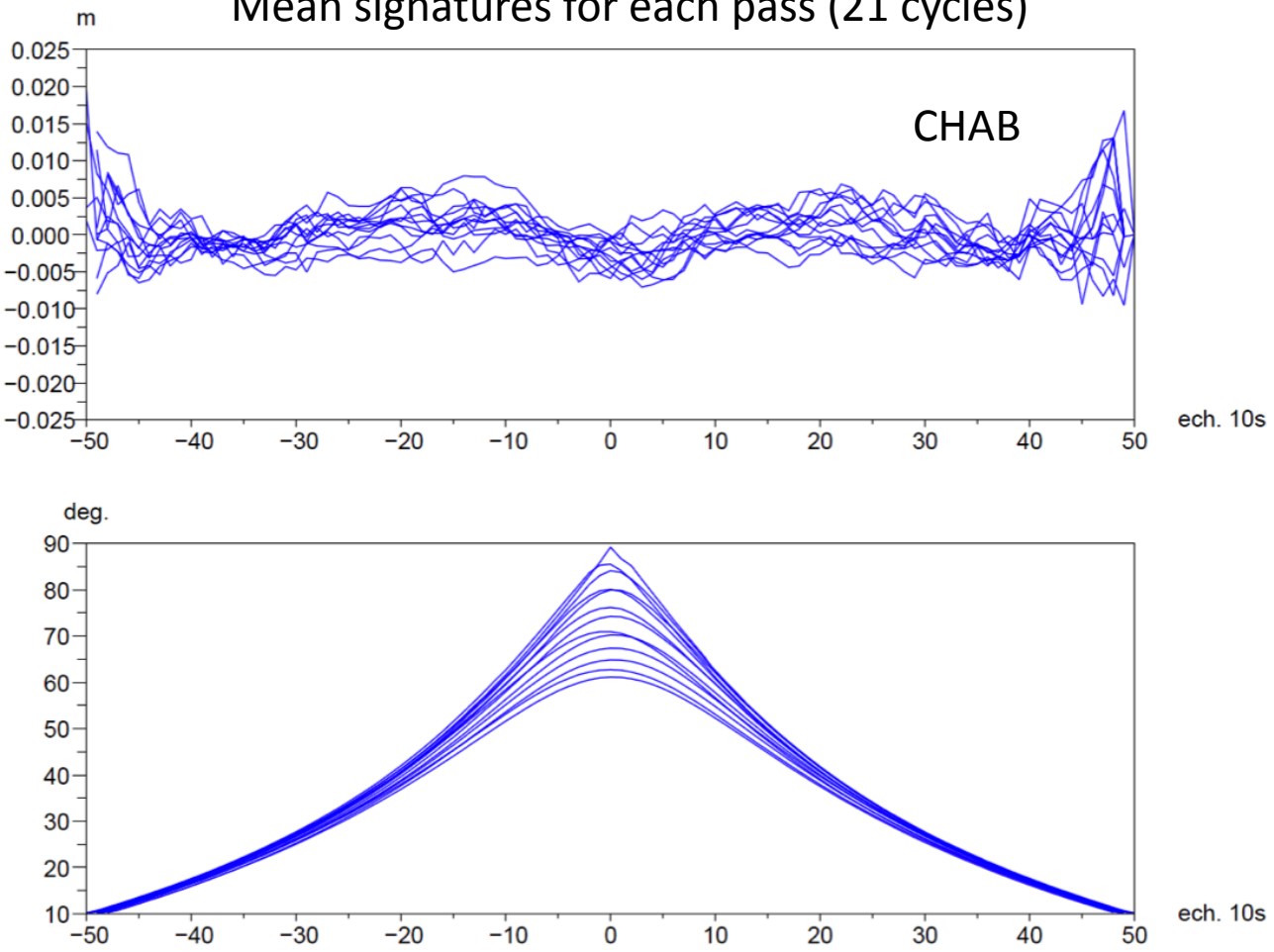


Phase Residuals (with map)



Phase Residuals
(with map and vertical position adjusted)

Mean signatures for each pass (21 cycles)



Stations Vertical Positioning Characteristics

6 stations which have the best Doppler residuals in the current IDS processing

	without map		with map	
	10 degree	20 degree	10 degree	20 degree
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

Estimated parameters: vertical position (orbit fixed), bias, drift, wet tropospheric delay per pass

The map as well as the elevation cut-off angle effects are clearly visible => several centimeter variations in the vertical positions, but the positioning results are more stable wit the map.

Position with Doppler or Phase?

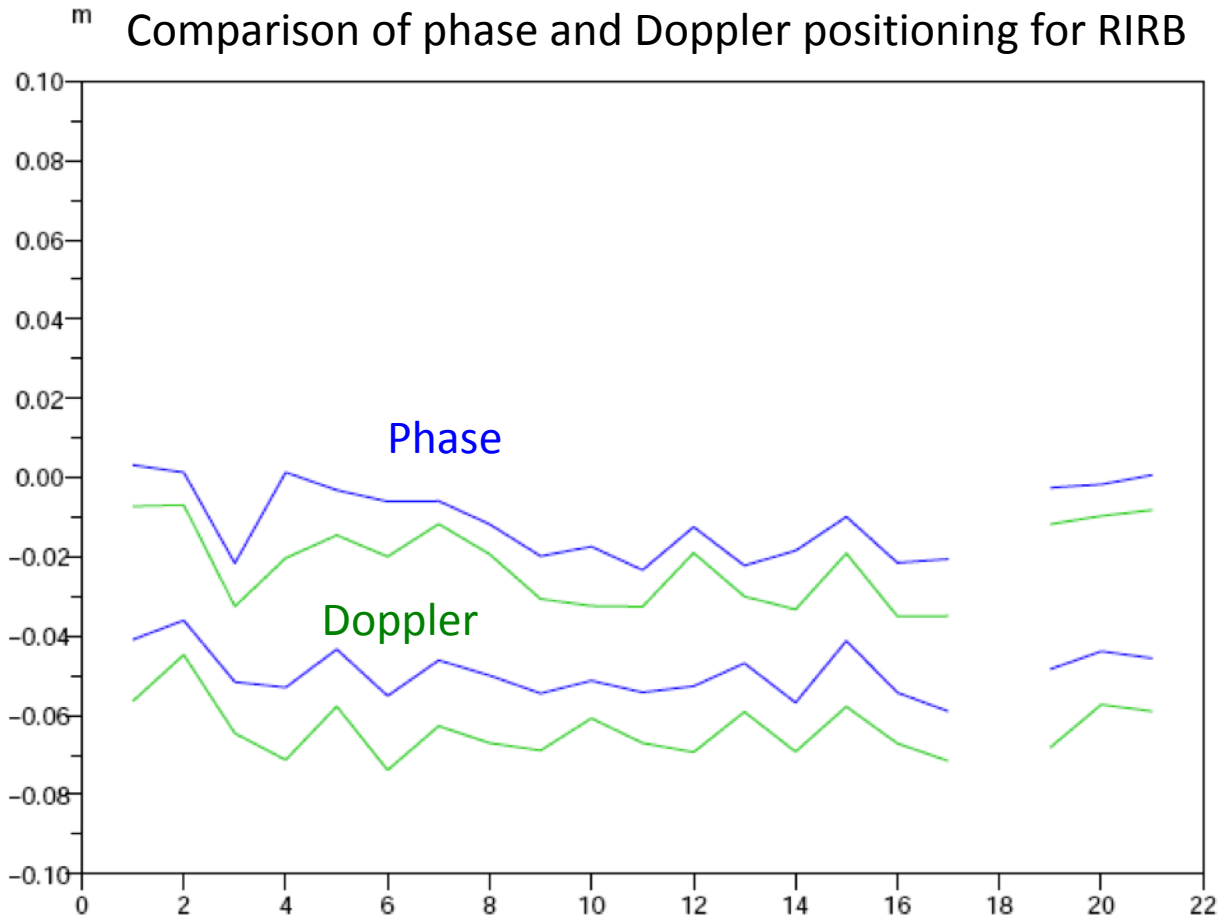
6 stations which have the best Doppler residuals in the current IDS processing

	10 degree		20 degree		Cycles removed
	phase	Doppler	phase	Doppler	
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

Estimated parameters: vertical position (orbit fixed), bias, drift, wet tropospheric delay per pass

ROVB and GRFB show little sensitivity to Doppler, phase and elevation cut-off angle, contrary to RIRB.

RIRB Positioning Results (fixed orbits)

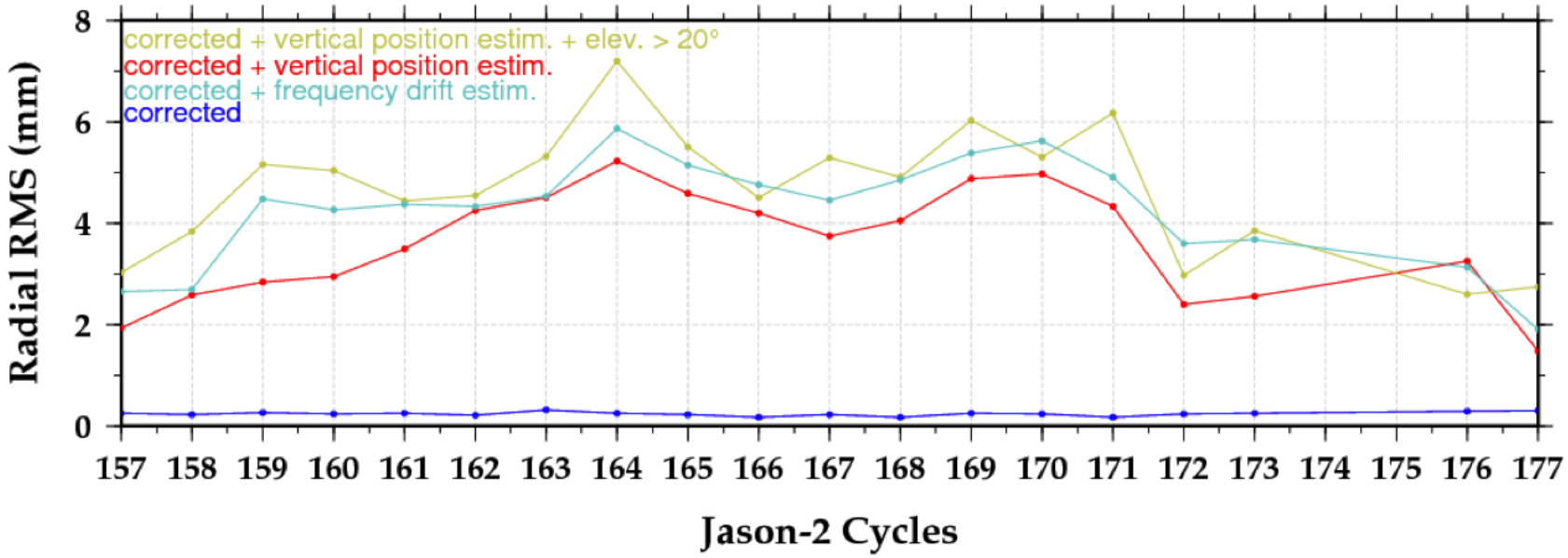


Consequences on Orbit Determination (POD for altimetry)

- Orbit determination (current GDR-D parameterization, with or without map)
- Effect of the cut-off elevation angle (10 or 20 degree)
- Orbits with vertical position adjusted for each station
- External validation with SLR residuals
- Investigation on the “geocenter estimate” as seen by DORIS

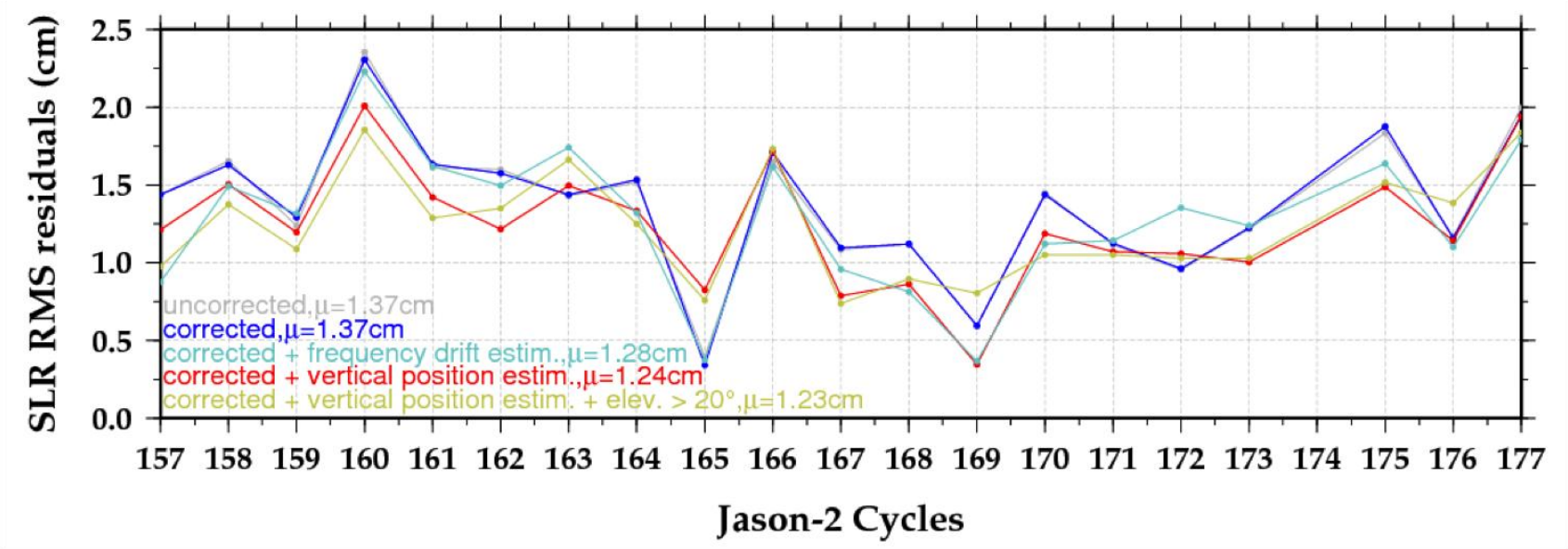
DORIS-only “Phase-Corrected” Orbit Comparisons

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



SLR Validation

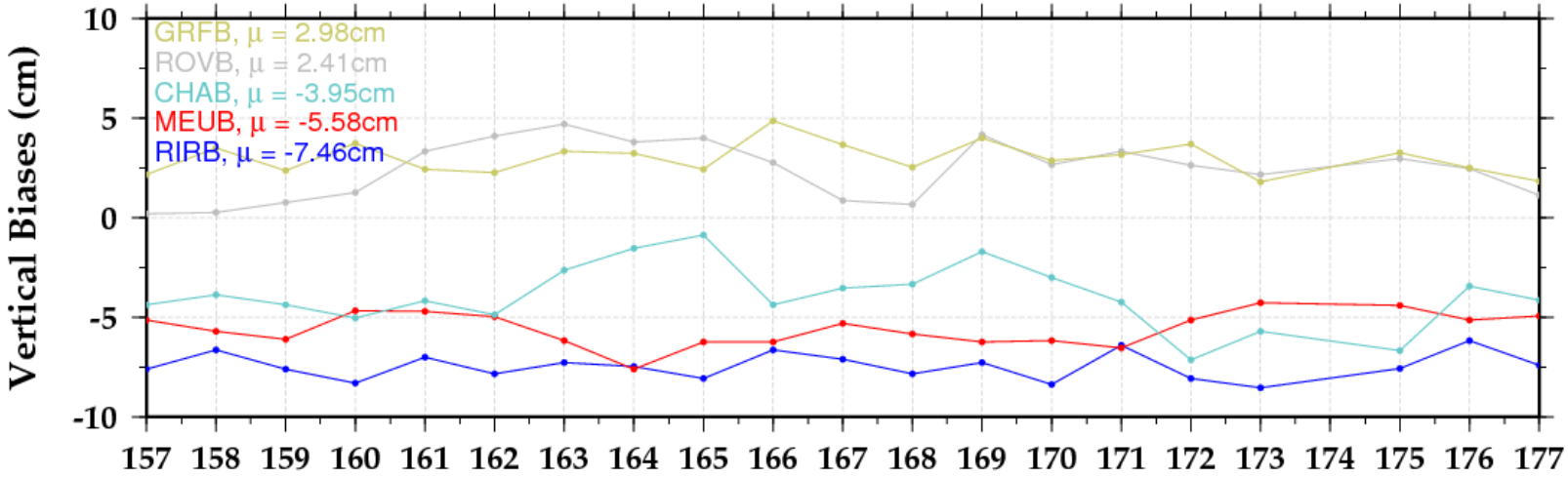
High elevation (above 70 degree) SLR core network residuals on independent DORIS-only orbits



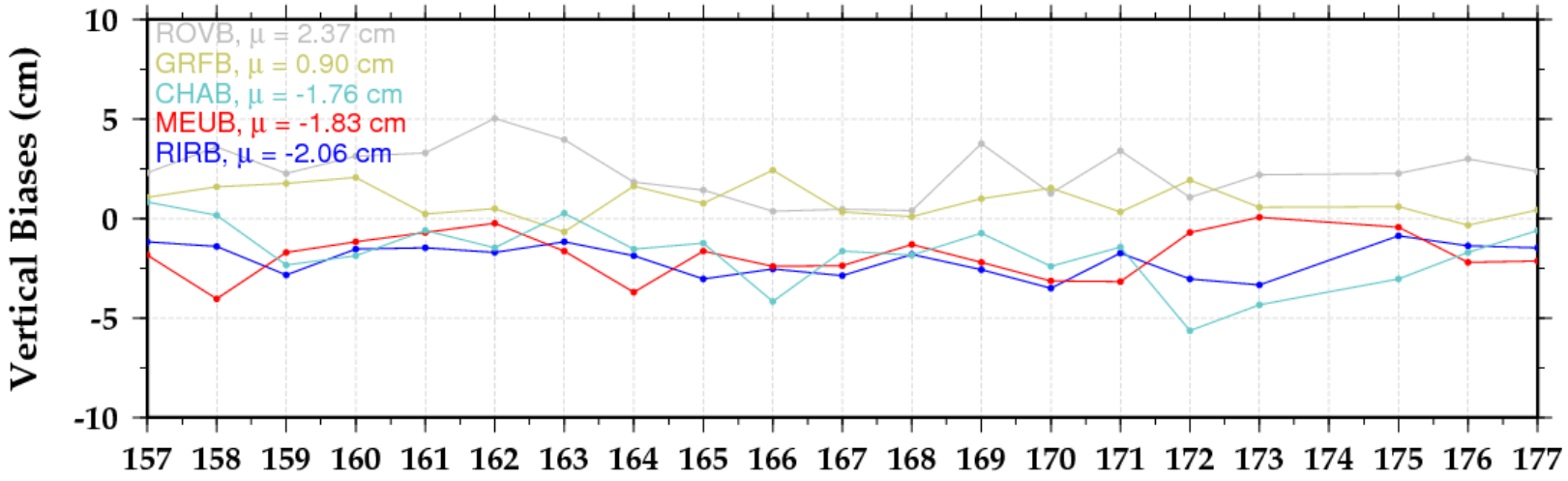
Solving for the vertical position of the DORIS beacons on average seems to reduce by ~2 mm RMS the radial component of the DORIS-only orbits.

Adjusted Vertical Positions for the DORIS Beacons

Vertical position biases estimated on well performing DORIS stations



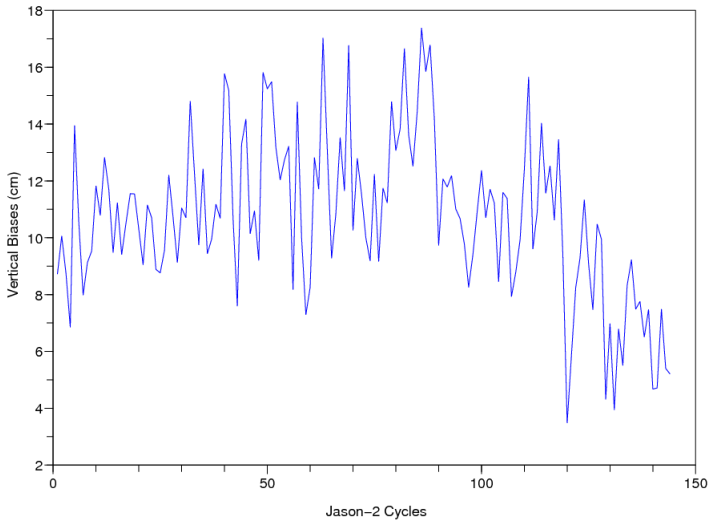
Vertical position biases estimated on well performing DORIS stations (elev. > 20 degree)



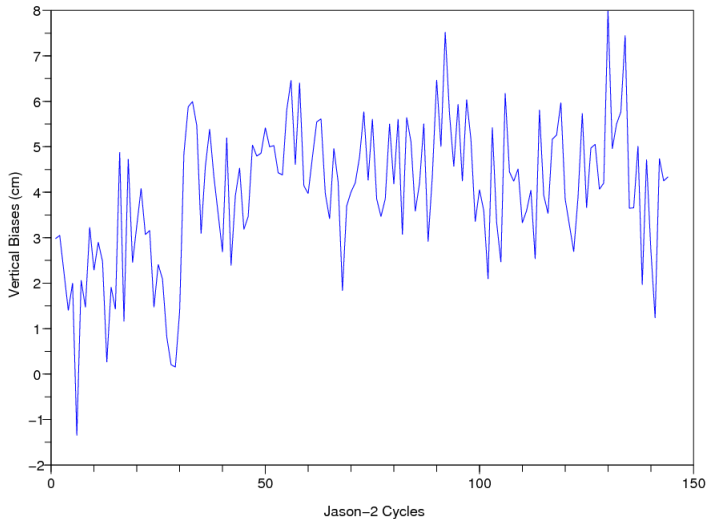
Odd Behaviors of Some Adjusted Vertical Positions

Some drifts and annual signatures seem to be visible?

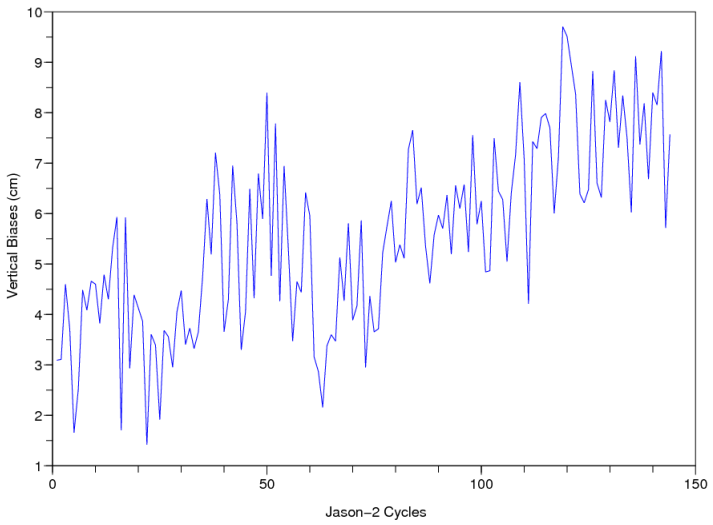
ARFB



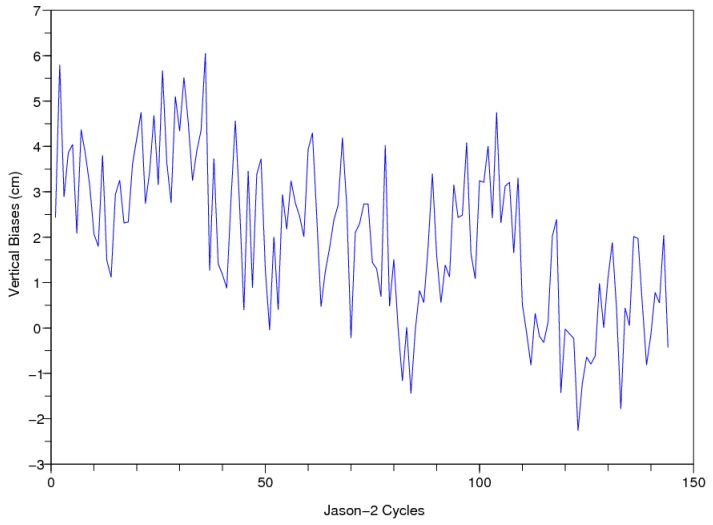
KOLB



SANB



JIUB

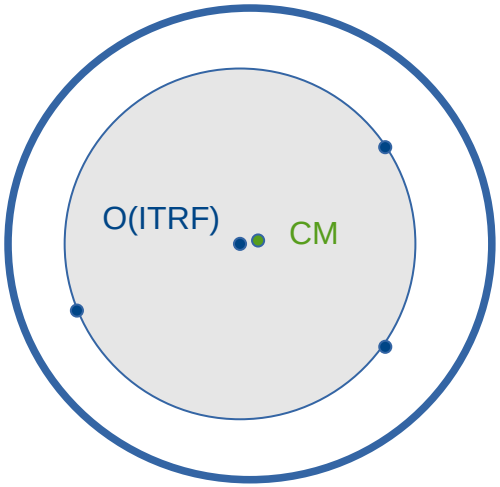


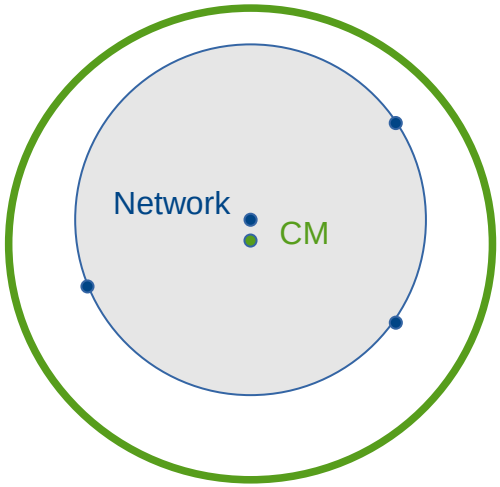
Estimation of the “Geocenter Motion” as Seen by DORIS

« Dynamical » approach

- A global translation vector for the network is determined simultaneously with the Jason-2 orbit (one per 10-day cycle).

Constrained network



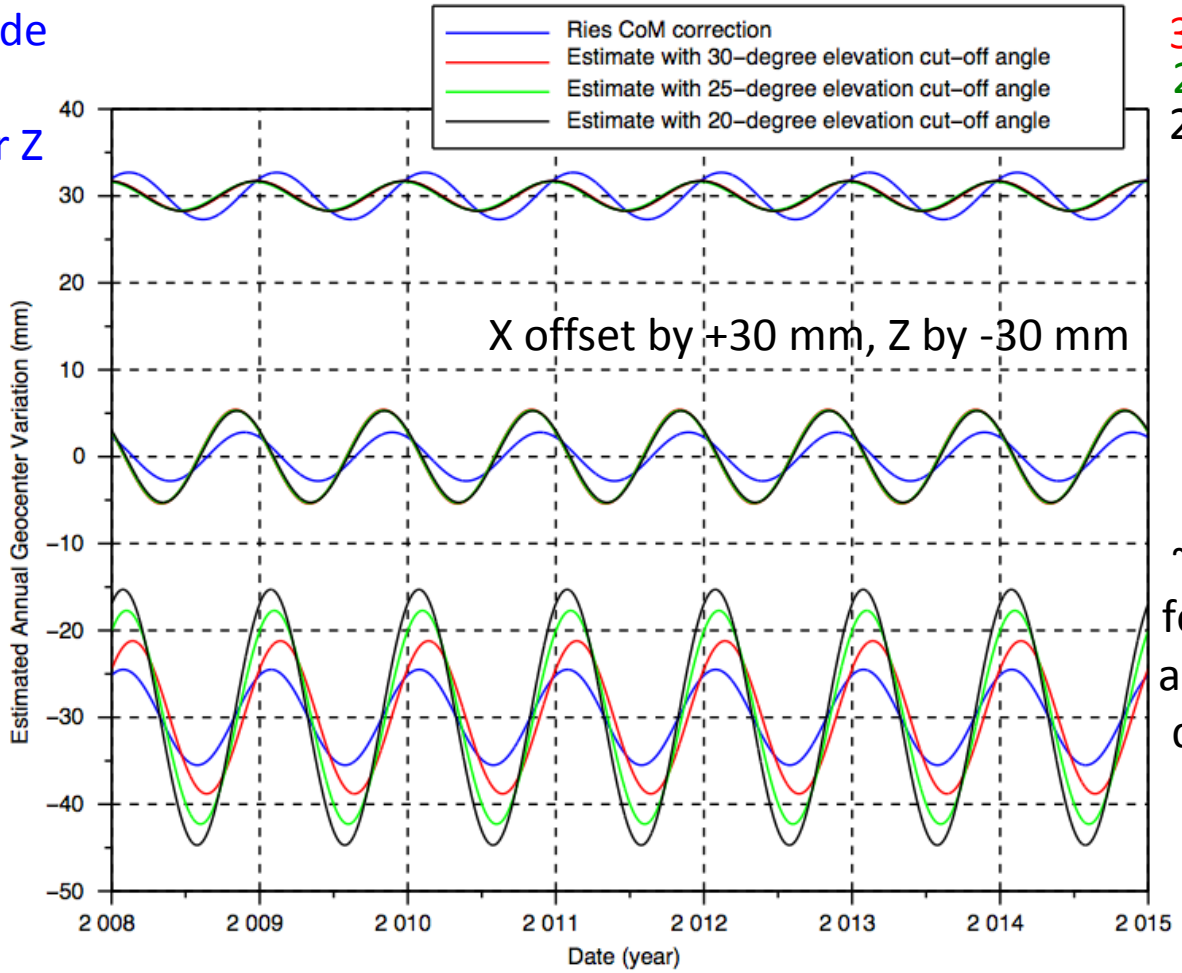


Free network translation

- The time evolution of the estimated translation vector is well characterized by a simple annual sinusoid.

Estimation of the "Geocenter Motion" as Seen by DORIS

Ries CoM correction:
~3 mm amplitude
for X and Y,
and 5-6 mm for Z



30 deg. Elev.
25 deg. Elev.
20 deg. Elev.

DORIS estimate:
~2 mm amplitude
for X, ~3 mm for Y,
and 9-15 mm for Z,
depending on the
elevation cut-off
angle

Stable and consistent X and Y components but Z is affected by the elevation cut-off angle (tropospheric delay modeling error?)

Conclusions

- Map effects on positioning
  - Adjusted vertical position is more stable.
  - Dependency on cut-off elevation angle and phase or Doppler measurements needs to be understood.
- Map effects on orbit radial performances (small < 1 mm RMS)
  - Effect of adjusting vertical positions or frequency drift not negligible (~6 mm RMS)
  - Estimated positions can differ significantly depending on the elevation limitation.
- Global translation network motion estimate
  - The reason for the odd behavior of the Z component estimates remains to be determined.
    - » Test if any improvement with other altimeter satellites (Saral, CryoSat-2, HY-2A).
  - Inclusion of SLR stations with DORIS+SLR orbits may reduce this instability.
  - Apply the same process with the GPS constellation (instead of the DORIS stations) and see if the gap in the North/South centering between DORIS-only and GPS-based orbits can be reduced.