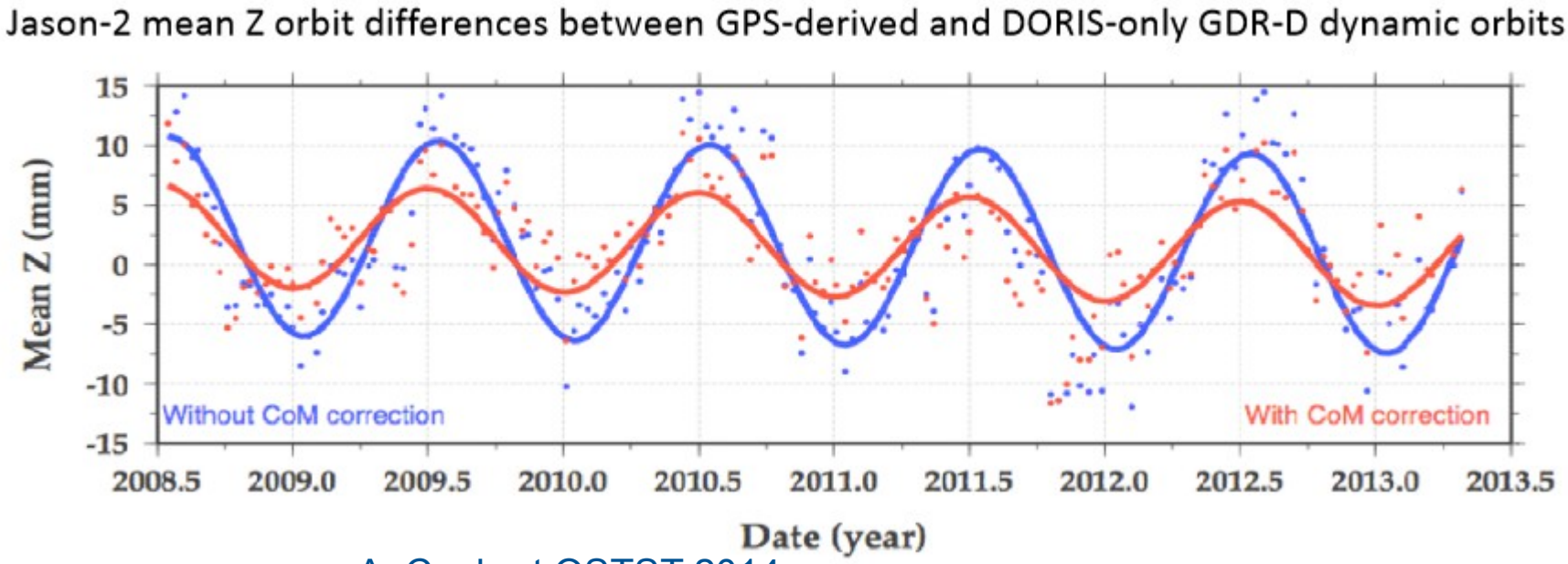
Improved orbit centering parameterization for mean sea level applications

A. Couhert, F. Mercier

CNES DCT/SB/OR

Comparison of N/S centering of the orbits



A. Couhert OSTST 2014

Long-term Analysis of Possible Remaining Sources of Orbit Error

Is it possible to improve this situation ?

(4 mm annual N/S between GPS and Doris orbits with CoM correction)

- one possible way is to add SLR (cf N. Zelensky OSTST 2014)

- or improve the Doris only processing : sensitivity of the Doris solutions in N/S direction

Network translations global adjustment, Jason 2

Centering analysis using global network solution (3 translations)

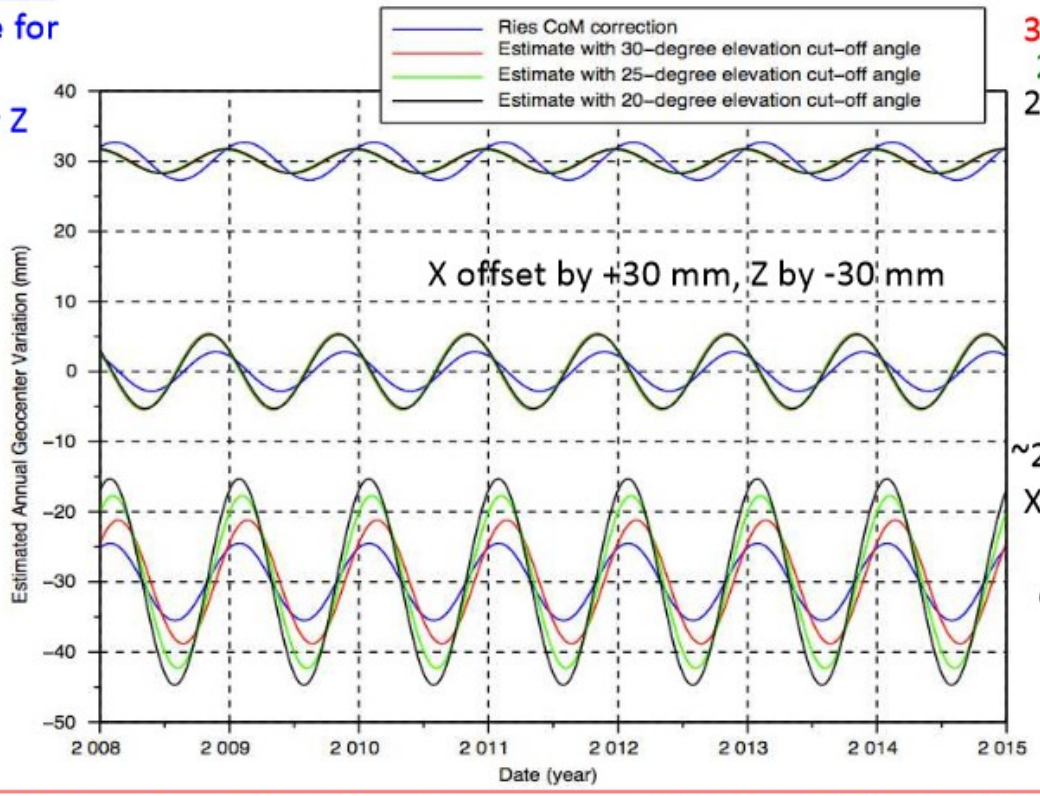
very important amplitudes in Z (N/S) direction, not realistic
the results are very sensitive to elevation cutoff (> 20 degrees)

(Systematic biases in DORIS-derived geocenter time series
related to solar radiation pressure mis-modeling; M.L. Gobinddas J Geod 2009)
(OSTST 2014 presentation A. Couhert)

X and Y (equatorial plane) consistent with SLR results (J. Ries)

OSTST 2014, results for geocentre motion estimation

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

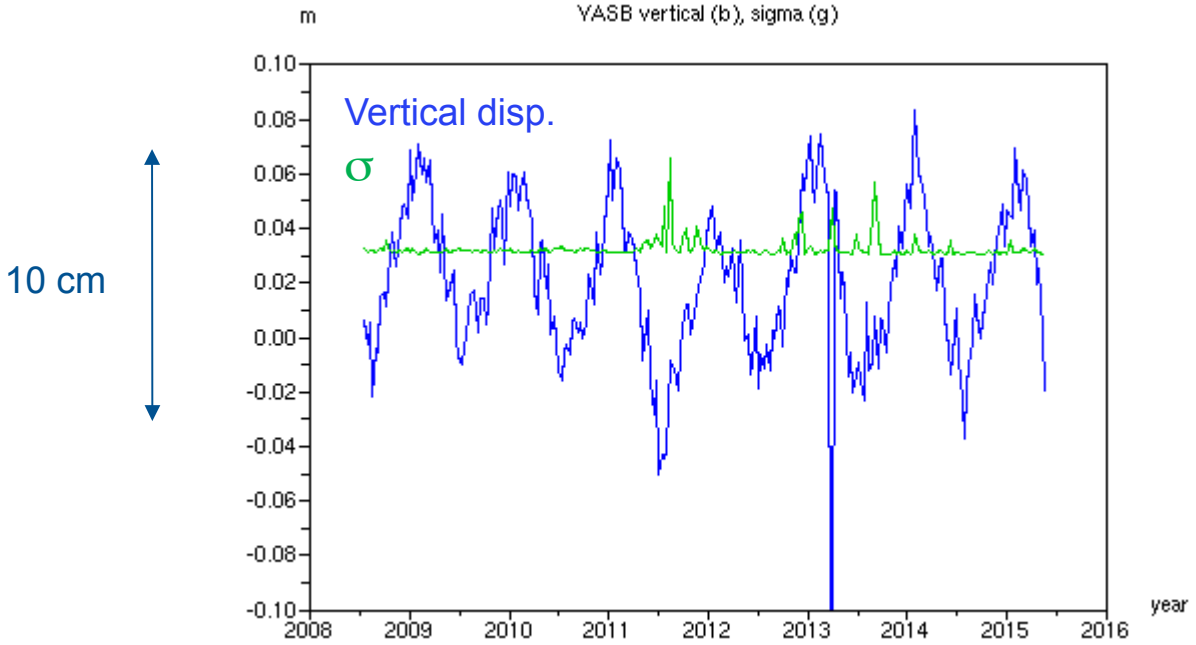
Stable and consistent X and Y components but Z is affected by the elevation cut-off angle (tropospheric delay modeling error?)

Analysis of station positioning

Fixed orbits, stations positioning, CF adjusted :

Station positioning is more sensitive to measurement model errors than the orbit

Example :



Yarragadee vertical position estimation, fixed Jason 2 orbit

Network global adjustment, Jason 2

The vertical modeling errors are probably an important error source

How to minimize the vertical errors (troposphere…) for the N/S global motion?

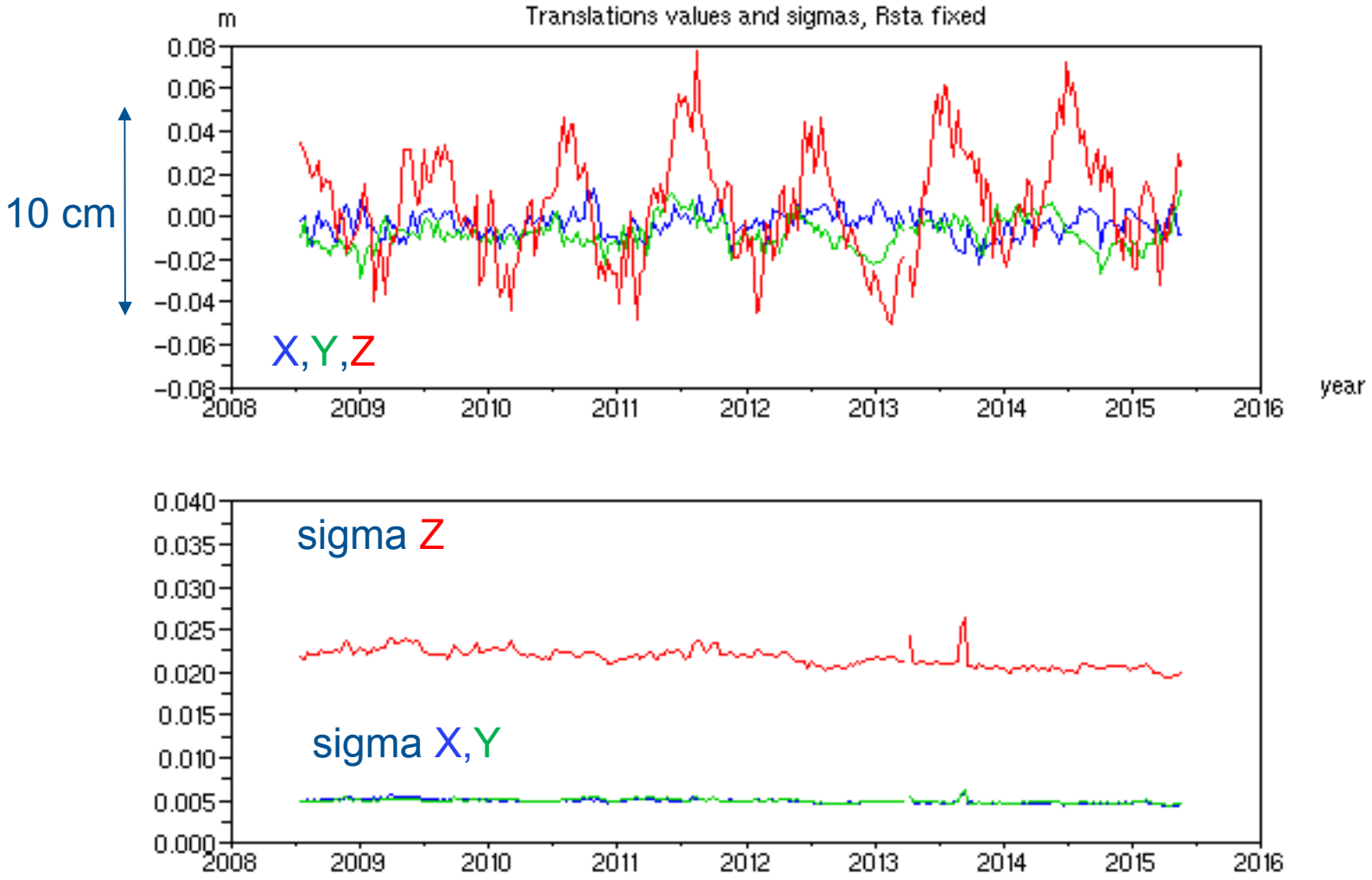
Jason 2 Doris dynamic solution, 10 days arcs

stations positions adjustment, wet ztd, frequency, loose constraints (10 m)
cutoff 10 degrees

construction of network normal equations, for each arc

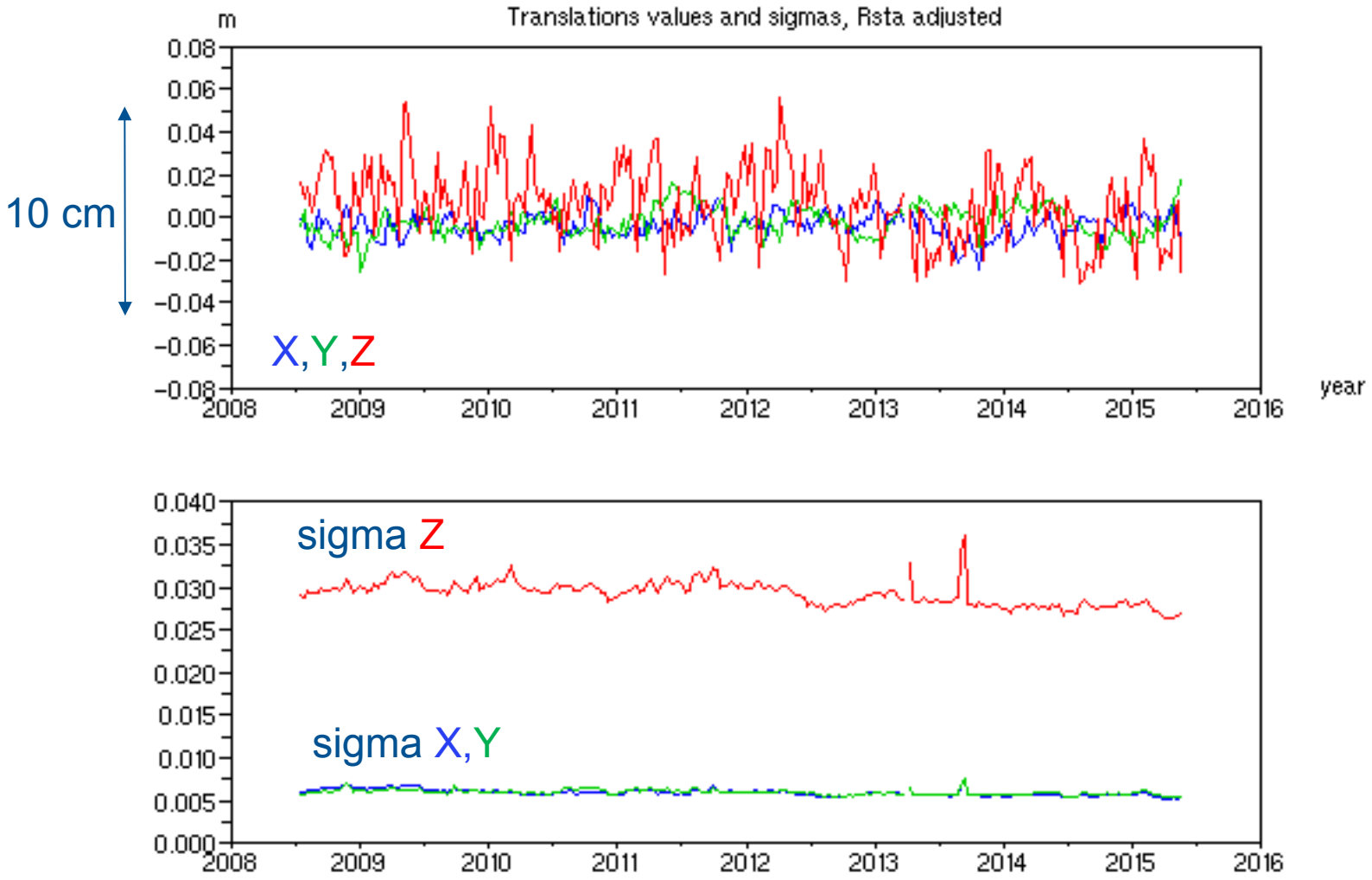
parameters
- 3 translations, 3 rotations
- 3 translations, 3 rotations, stations vertical displacement

Global results : 6 parameters model



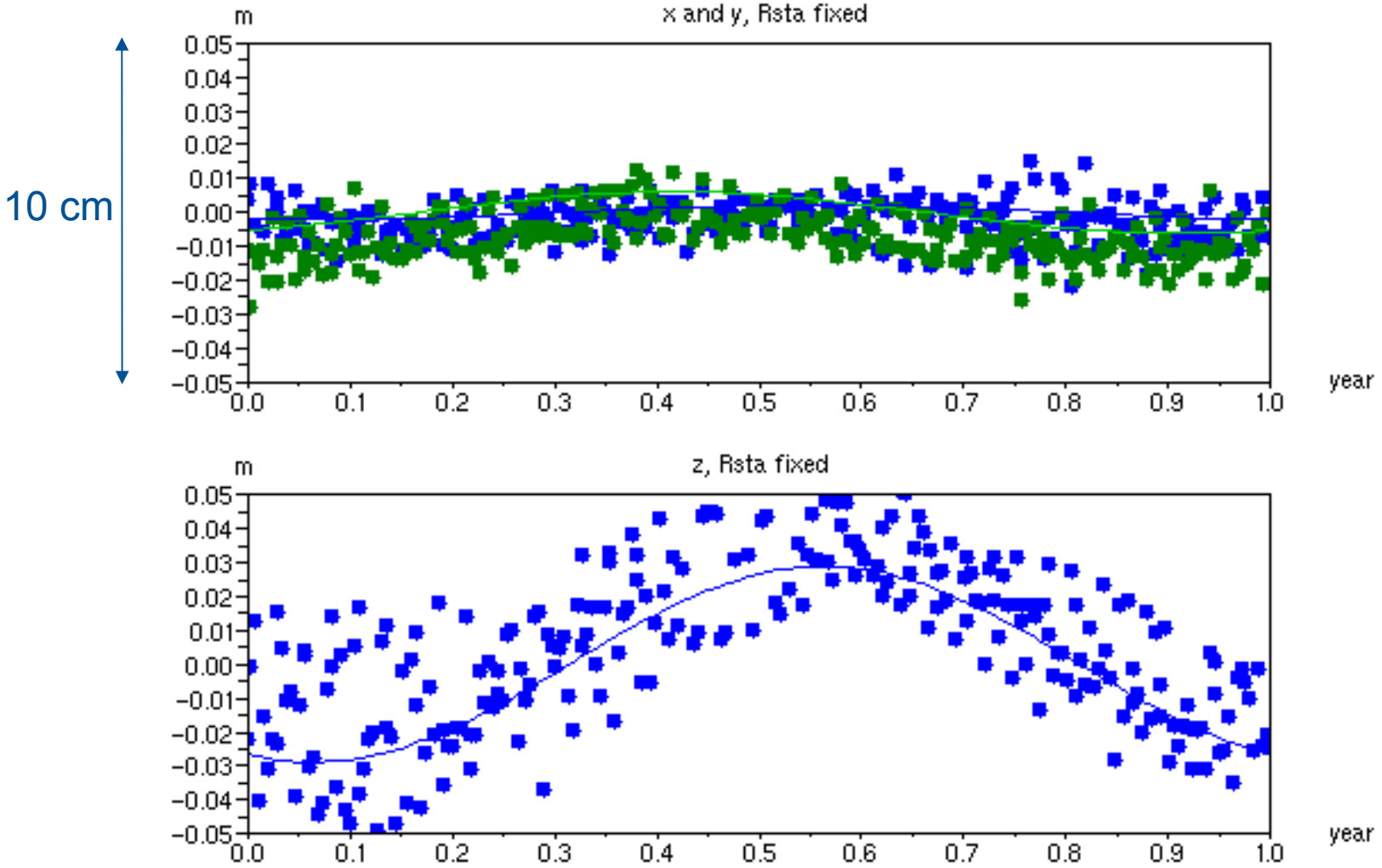
Z motion is not realistic, similar to OSTST 2014 results (10 ° min elevation)

Global results : 6 parameters model and stations vertical displacement



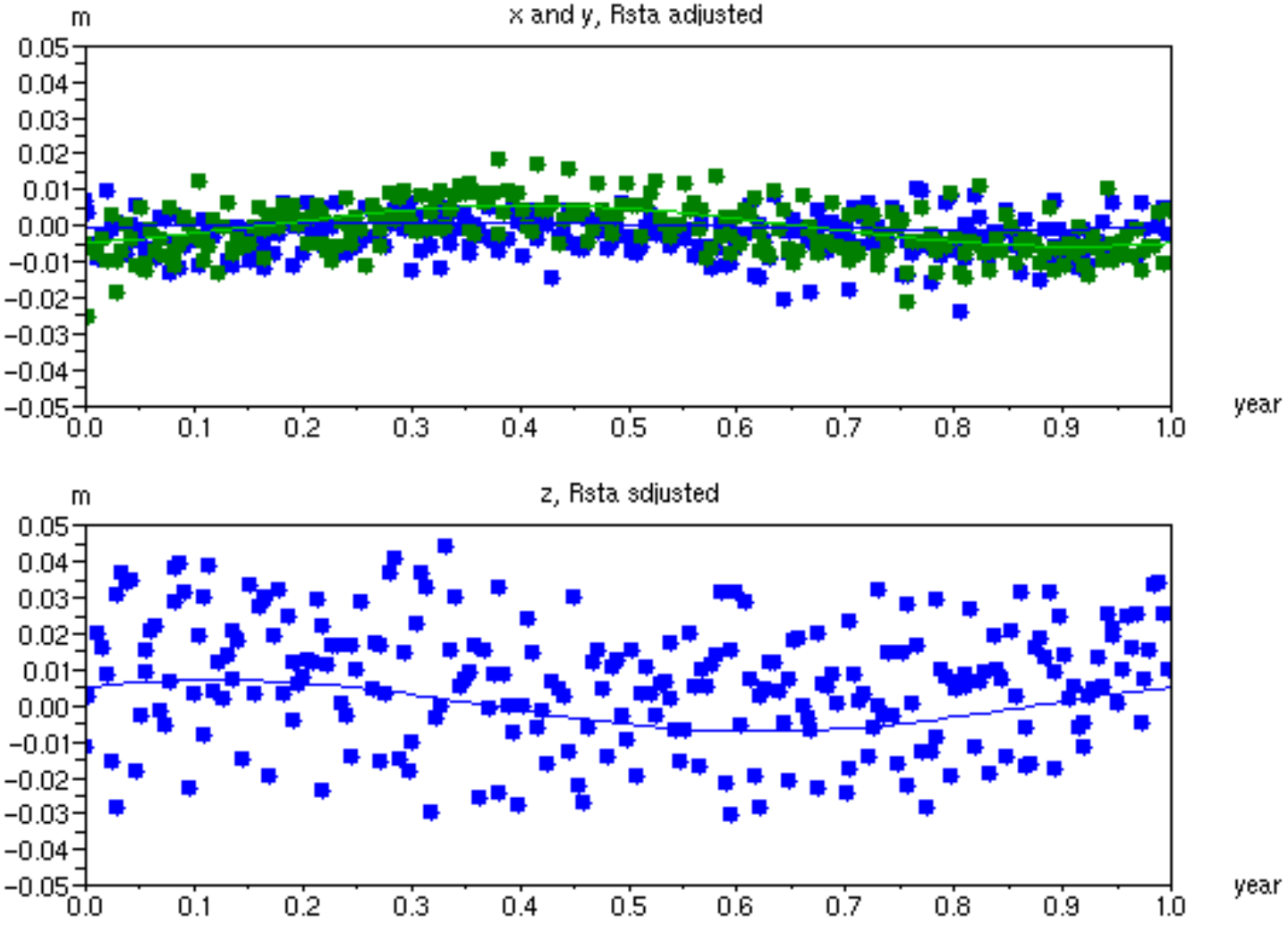
Z motion is noiser but less annual effects, similar observability in X and Y

Annual periodic term, 6 parameters

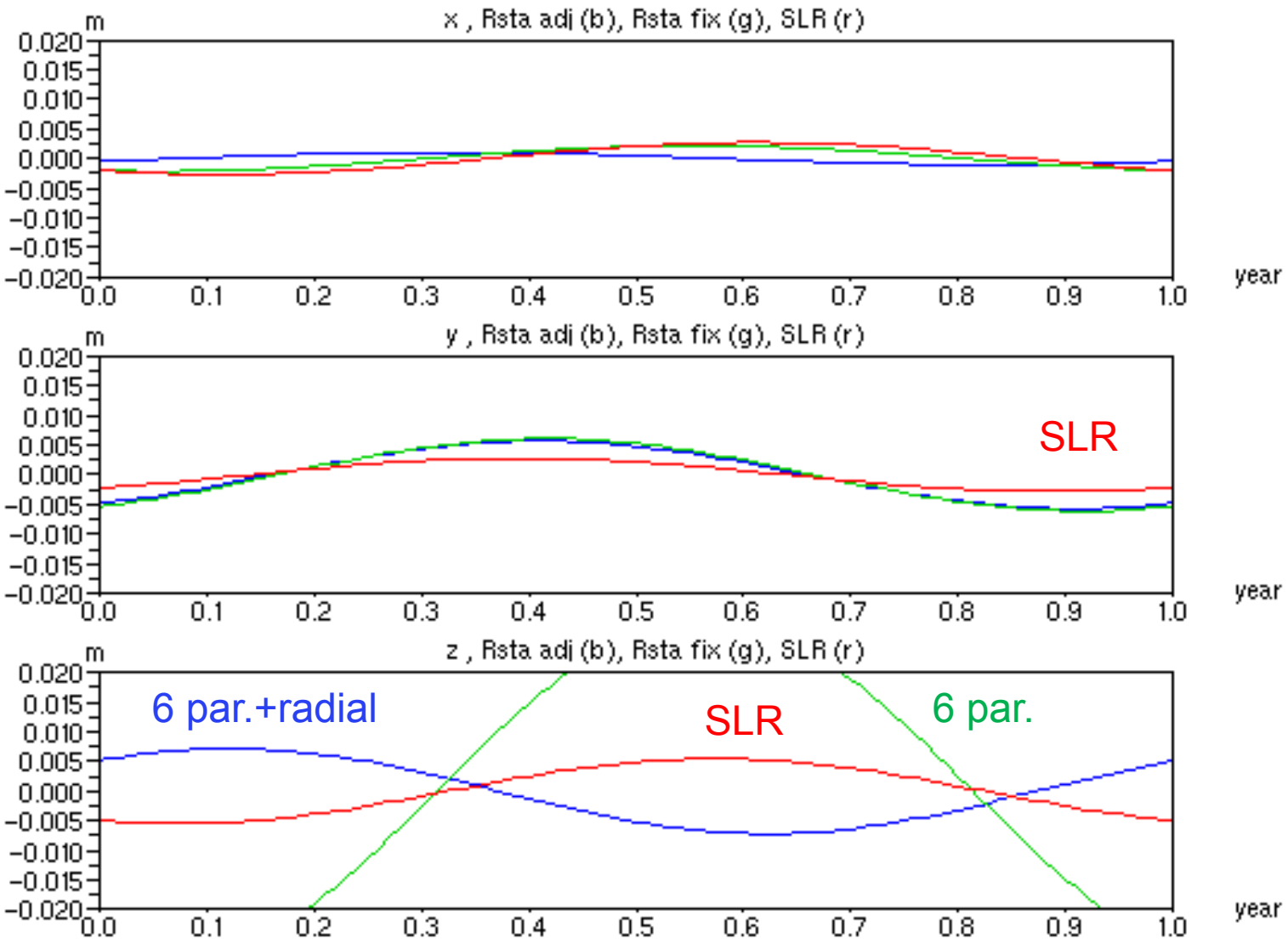


Annual periodic term, 6 parameters, radial displacements

10 cm



Comparaison with slr geocentre motion (J. Ries estimation)



Network centering results

Vertical information (station position+tropo) may be erroneous

- error in the current model used in POD ?
- troposphere correction, coupling with vertical displacement

Model with 6 global parameters only : not sufficient

Model with 6 global parameters and station radial displacement : better results

- correct observation of X and Y
- N/S motion is still not well observed, but the error is realistic

Orbits comparison

Doris orbits comparison

Doris dynamic arcs, with added parameters

3 mm rms in radial

- 3 translations on each station
  this orbit is not perturbed by station positions errors
  but a transverse alignment must be added

- 3 global translations and one vertical displacement for each station
  no network global rotation, the orbits are directly obtained without rotations alignment

Comparison with other solutions

- no geocentre model
- SLR geocentre model
- 3 global translations only
- 3 global translations and vertical displacements

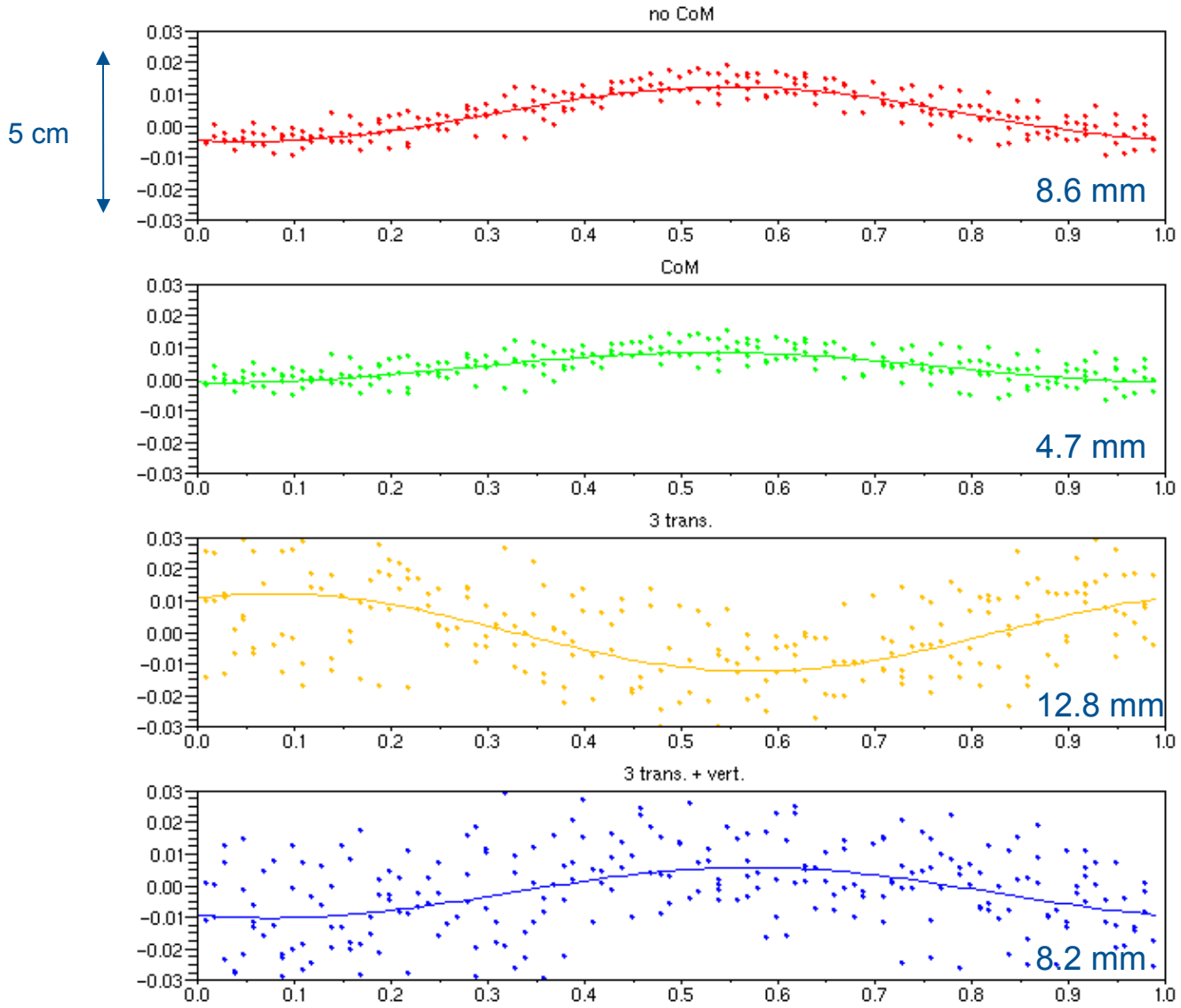
comparison with JPL GPS orbits or GDR-E GPS/Doris red. dyn.

Global results

	SLR (cm)		Crossover	
	high el.	All	mm	mm^2
No CoM	1.09	1.99	5.1	-0.2
COM	**1.07**	1.95	5.2	0.
3 trans.	1.11	2.06	5.8	1.5
3 trans. + vert.	**1.09**	**1.91**	5.6	1.8
GPS red. Dyn.	0.75	0.90	0.6	

The (3 trans. + vert.) model has good results however…

Orbits N/S translations compared with GPS red. dyn.



No CoM model

CoM model

3 trans.

3 trans. + vert.

Effect of stations choice

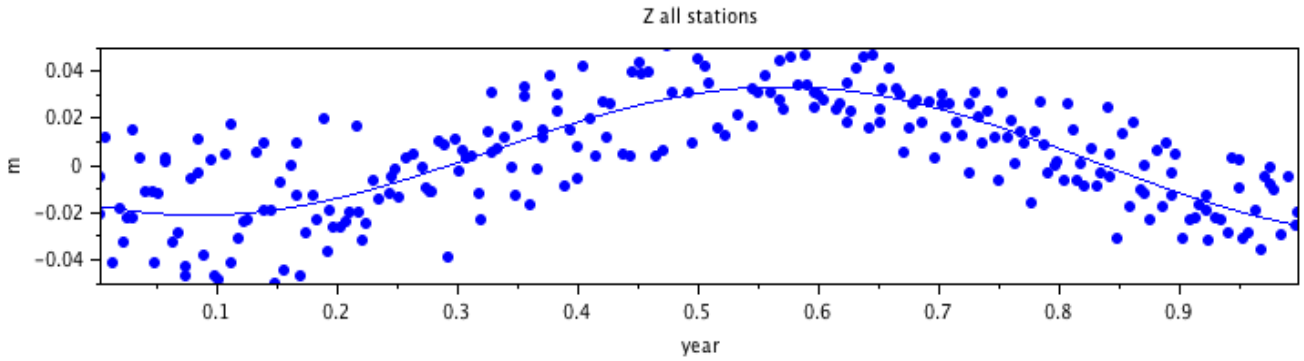
Effect of stations choice on network centering
(some stations may be more sensitive to these model errors)

Choice of stations with 'correct' positioning time history for 2008-2015
(no jumps, small annual effects)

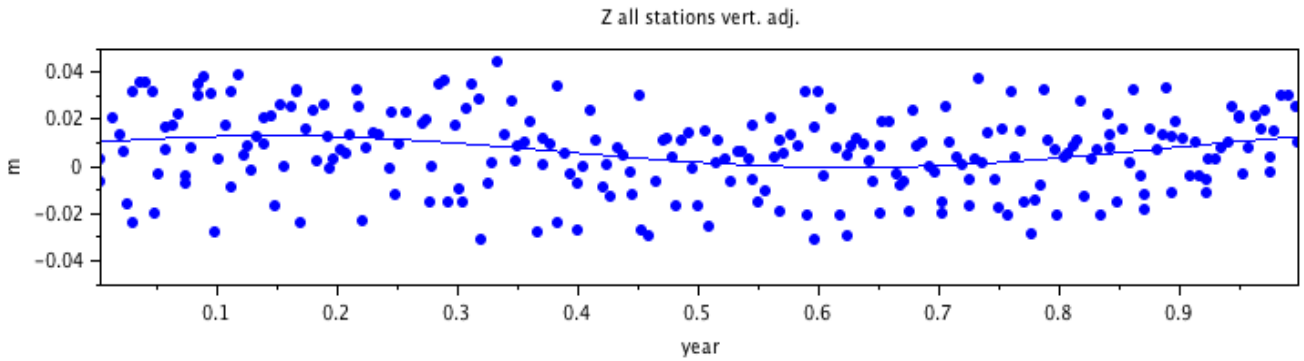
New solution with reduced network (17 stations), global x,y,z adjusted

Effect of stations choice

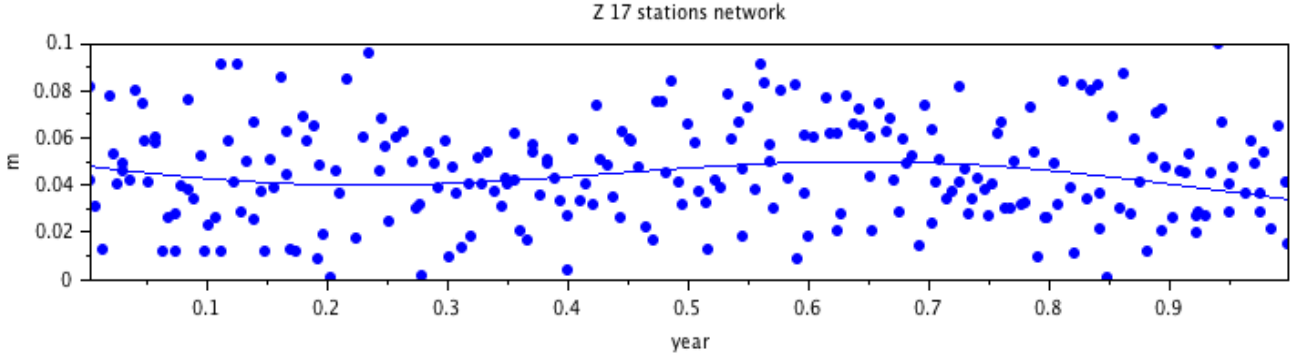
x,y,z
all stations



x,y,z
vert. transl.



x,y,z
17 stations



Conclusion

Network N/S centering is very sensitive to vertical modeling errors

Vertical modeling must be improved (troposphere model errors…)

3 trans. (+ 3 rot.) : noise OK but annual periods not realistic

3 trans. + vert disp.
3 trans., 17 stations, → Increased noise, better annual amplitudes, biases ?

Orbits Orbits with adjusted x,y,z for all stations have a good radial performance

- small sensitivity to stations positioning
- CoM referenced

N/S centering of Doris orbits, comparison with GPS red. dyn. :

- with CoM modelling (4.7 mm annual)

- adjusted 3 trans. not satisfactory (12.8 mm)

- adjusted 3 trans. + vert. disp. better (8.2 mm)

Thank you