IDS AWG 2016

PREPROCESSING CONSIDERATIONS AND USE OF LOW-ELEVATION DORIS MEASUREMENTS

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CONTENTS

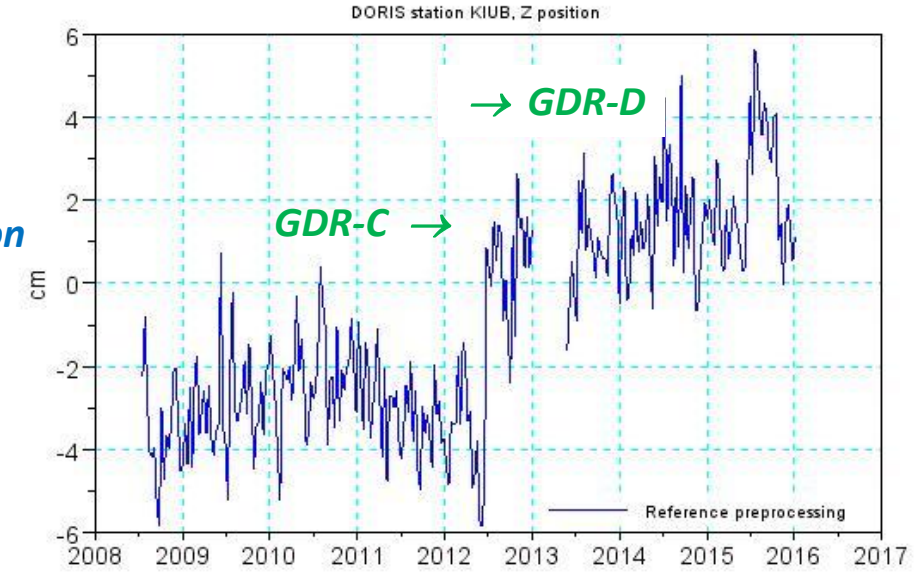
CONTEXT OF STUDY

OBSERVATION OF A GAP…

Adjust Z position of DORIS stations during orbit determination

The evolution of adjusted Z position for some stations shows an important gap at the same period (mid 2012) :

KIUB station



Analysis of this observation gives the following conclusions :

→ The gap has a direct link with the Geophysical Data Record standard version, i.e. change GDR-C to GDR-D, in regard of the tropospheric model correction

→ The preprocessing using adjusted CNET tropospheric correction invalidates more measurements than preprocessing including GMPF tropospheric correction

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NEW PREPROCESSING

MAIN OBJECTIVES

Present preprocessing in operational process needs refinement steps and invalidates measurements with low elevation (<10°)

→ ***New preprocessing should be done in one step without parameter adjustment done in orbit determination***

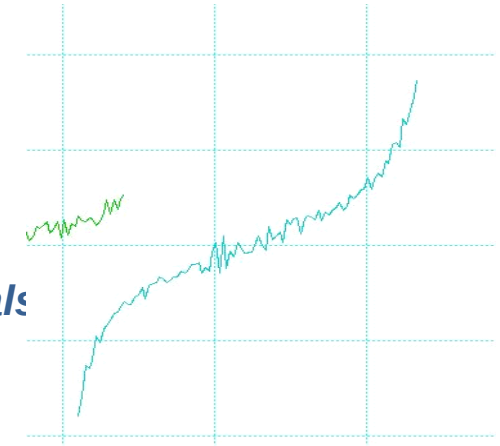
→ ***New preprocessing should deal with measurement at low elevation***

New preprocessing will be used in reprocessing of DORIS measurement files of the data base associated to GDR standard.

→***Obtain homogeneity in measurement editing***

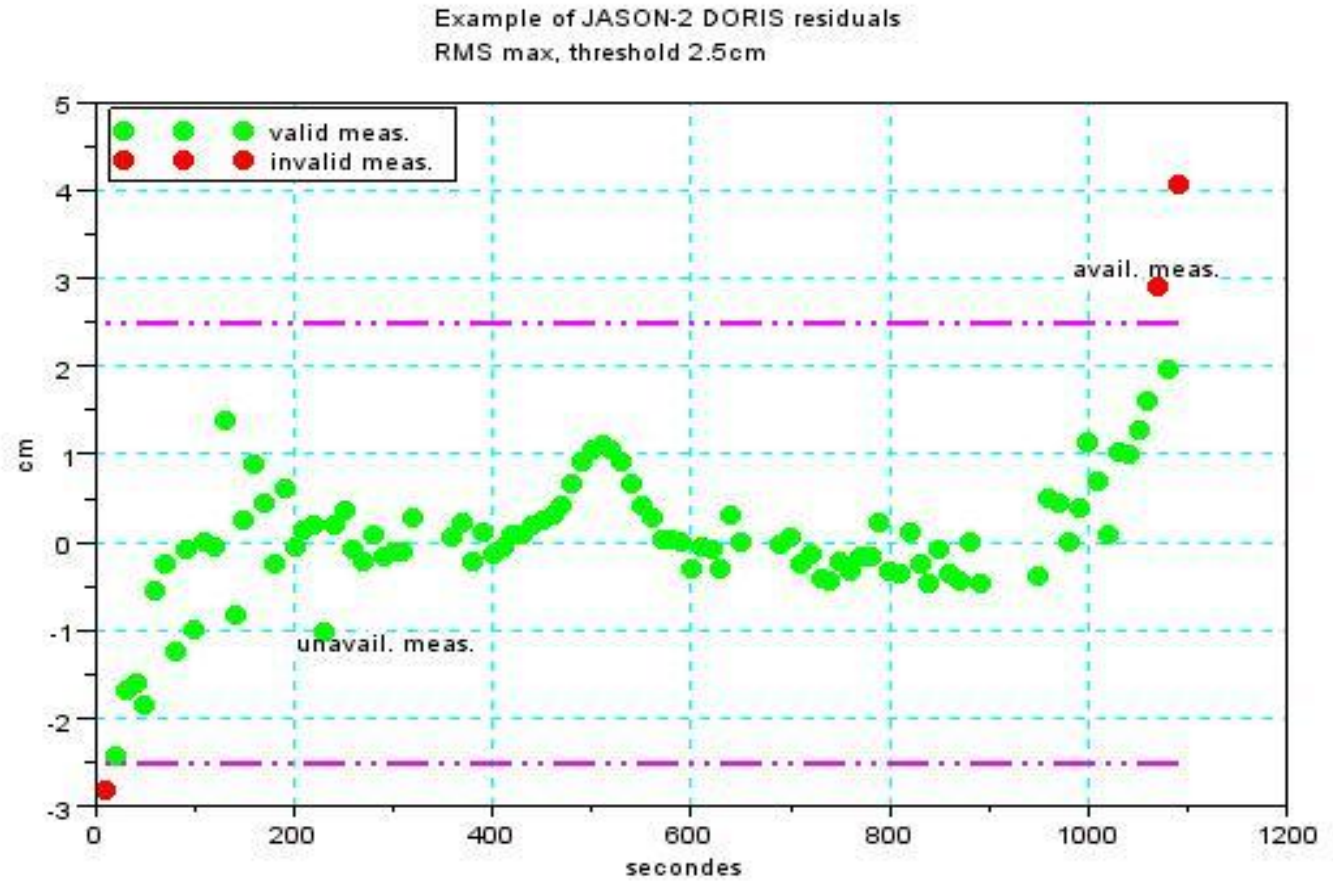
Example of DORIS residuals without adjustment of the wet tropospheric model component

→ ***New preprocessing should integrate the DORIS residuals adjustment on mapping tropospheric model correction***



NEW PREPROCESSING

CONSIDERATIONS

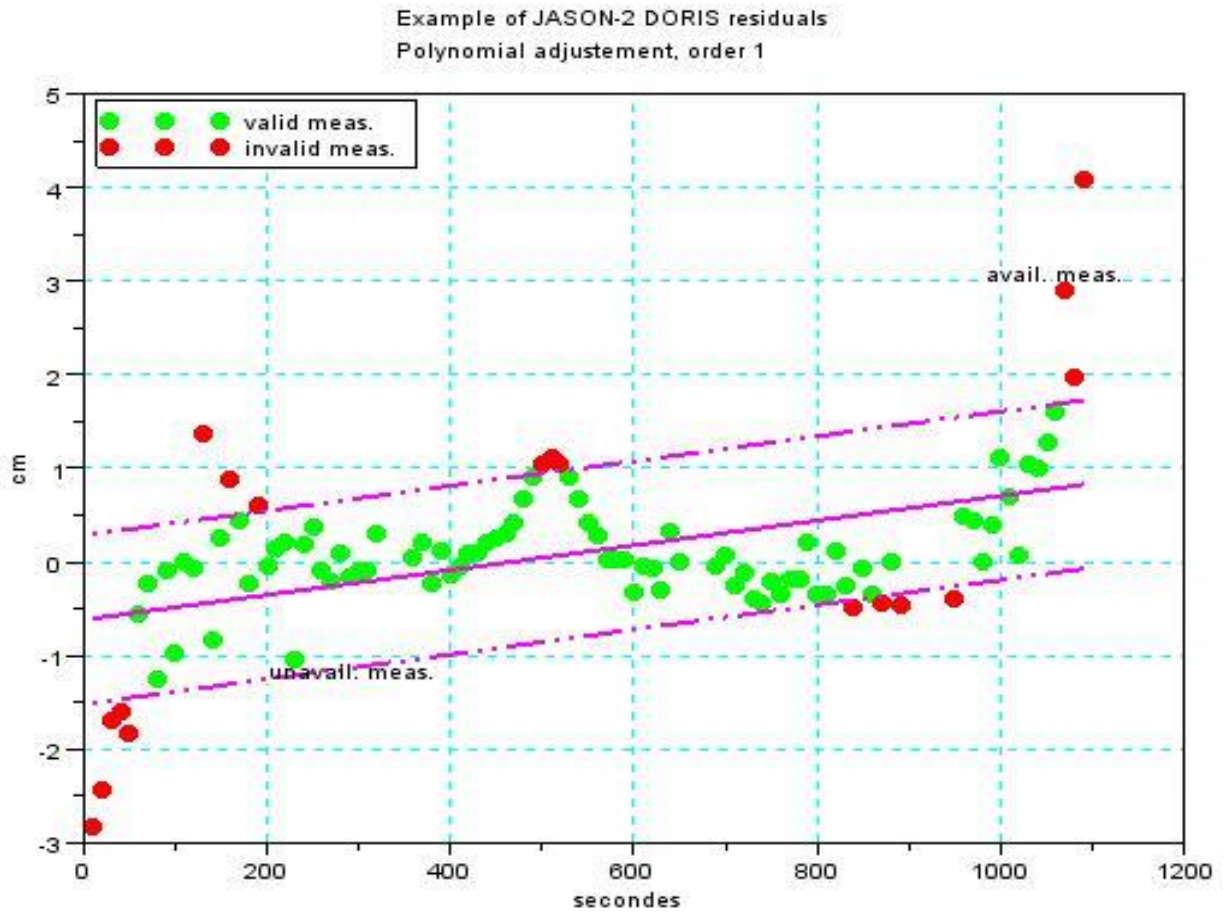


Preprocessing using a threshold, first used to invalidate unrealistic measurement with high threshold

Too small threshold involves too many invalidations

NEW PREPROCESSING

CONSIDERATIONS

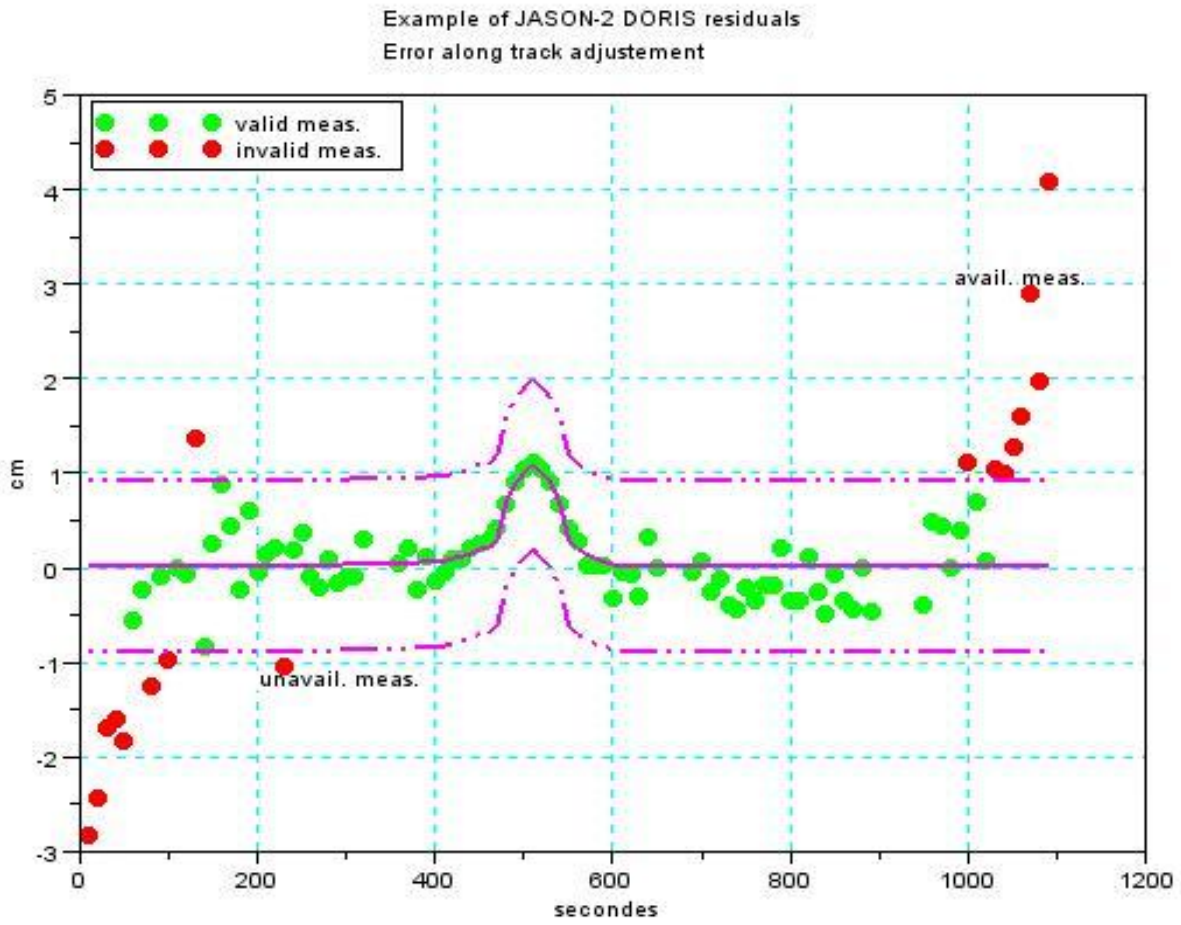


Polynomial adjustment, order 1, not suitable in that case

Invalidates too many correct measurements (low elevation, error along track)

NEW PREPROCESSING

CONSIDERATIONS

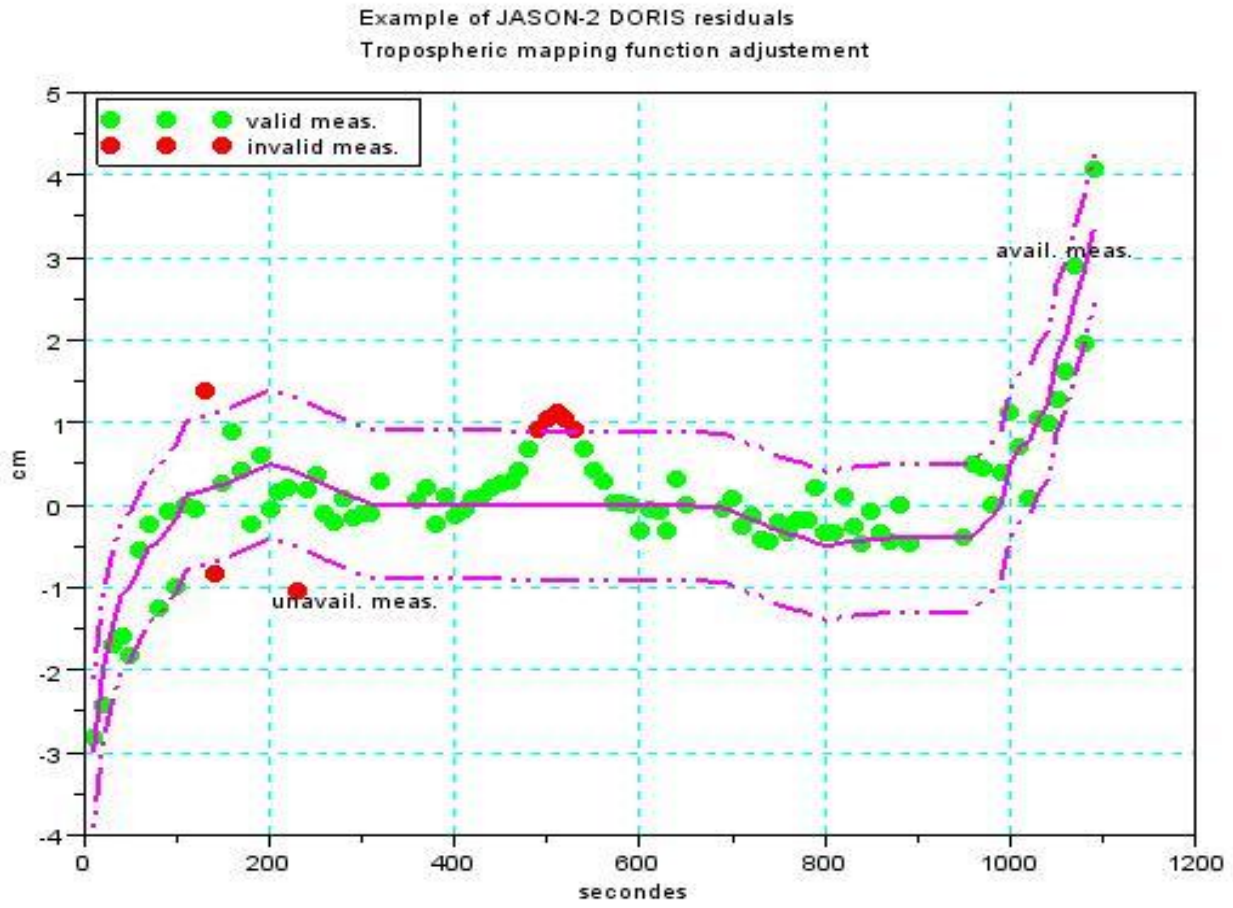


Along track error adjustment, invalidate measurements at low elevation

Frequent case?

NEW PREPROCESSING

CONSIDERATIONS



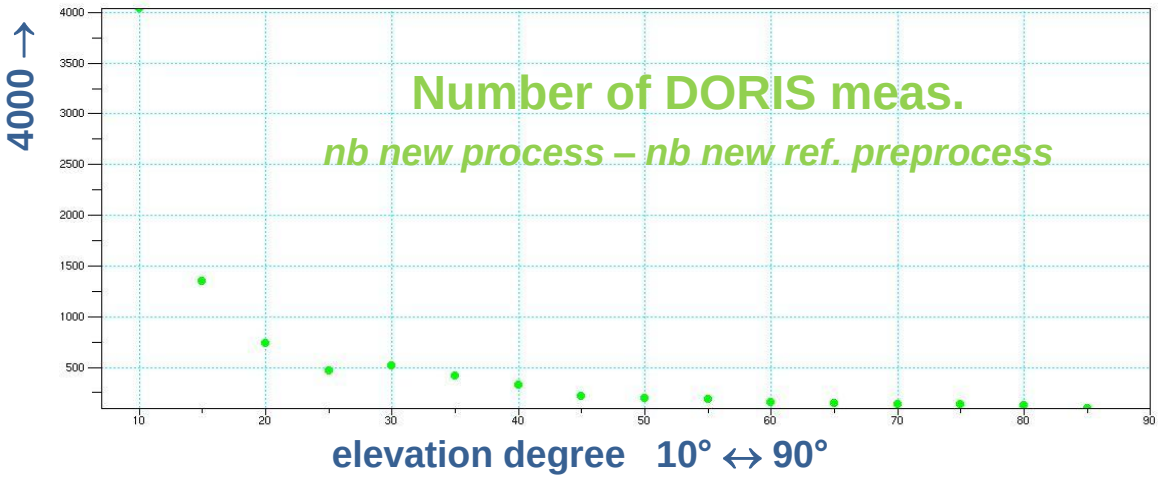
Tropospheric elevation function adjustment, the most suitable to keep available measurements at low elevation

NEW PREPROCESSING

RESULTS

Statistical point of view, example of JASON-2 cycle 274 DORIS measurements :

	Ref. Prepro. (>=10°)	New Prepro. (>=10°)	New Prepro. (>=5°)
Nb total meas.	314 981	314 981	314 981
Nb invalid meas.	104 421	95 158	45 242
% invalid meas.	33.15%	30.22%	14.36%
Nb total pass	3 754	3 754	3 754
Nb invalid pass	779	812	520

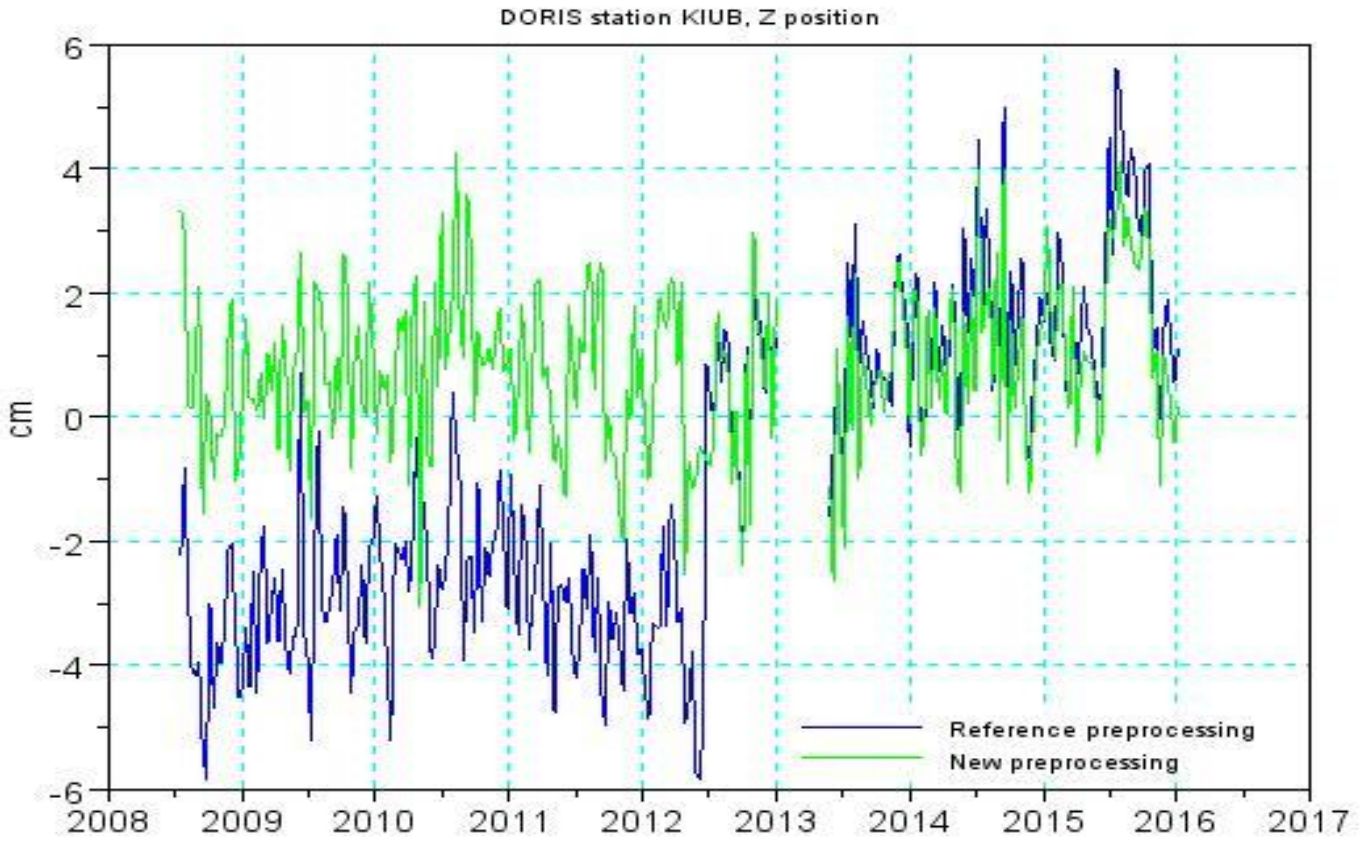


~50 000 measurements with elevation [5°,10[validated by new processing

NEW PREPROCESSING

RESULTS

Impact in Z position estimation, KIUB station example :



→ *no more gap !*

WEIGHTING FUNCTION

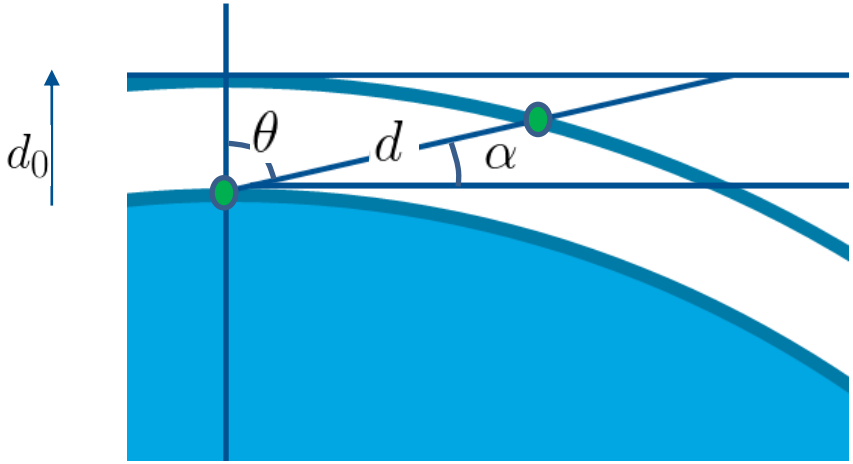
FORMULAS

Theorical measurement noise : (antenna gain not taken into account)

$$\sigma^2 = \sigma_a^2 + \sigma_b^2 \frac{d^2}{d_0^2}$$

USO contribution

propagation contribution



'flat earth' model $d(\alpha) = \frac{d_0}{\sin \alpha}$

improved model $d(\alpha) = \frac{d_0(1+k)}{\sin \alpha + k}$

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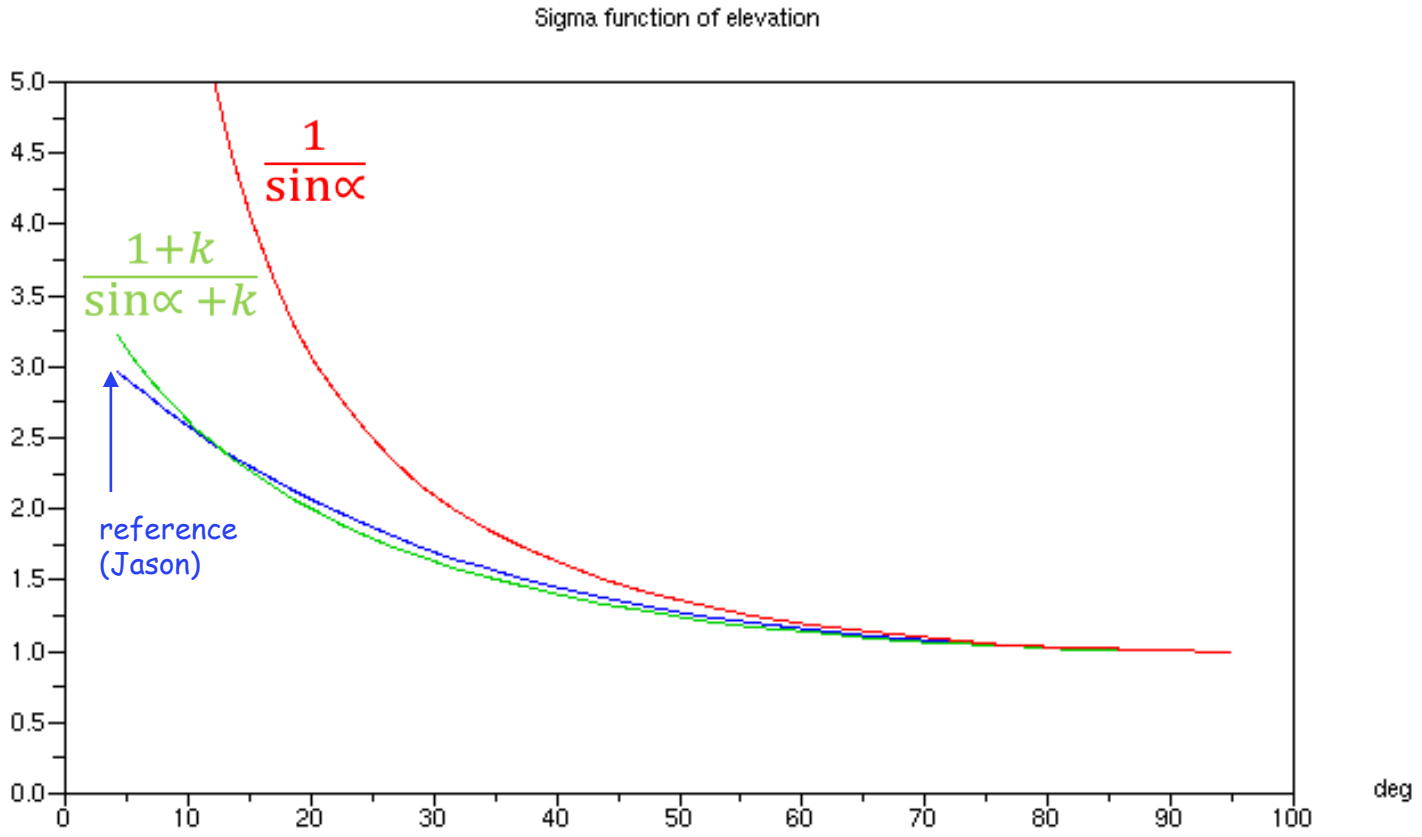
WEIGHTING FUNCTION

FORMULAS

Models comparison, for propagation : sigma proportional to d (k=0.35)



The propagation contribution only is probably not sufficient at low elevation (other effects, multipath, atmospheric attenuation…)

WEIGHTING FUNCTION

ADJUSTED FUNCTION

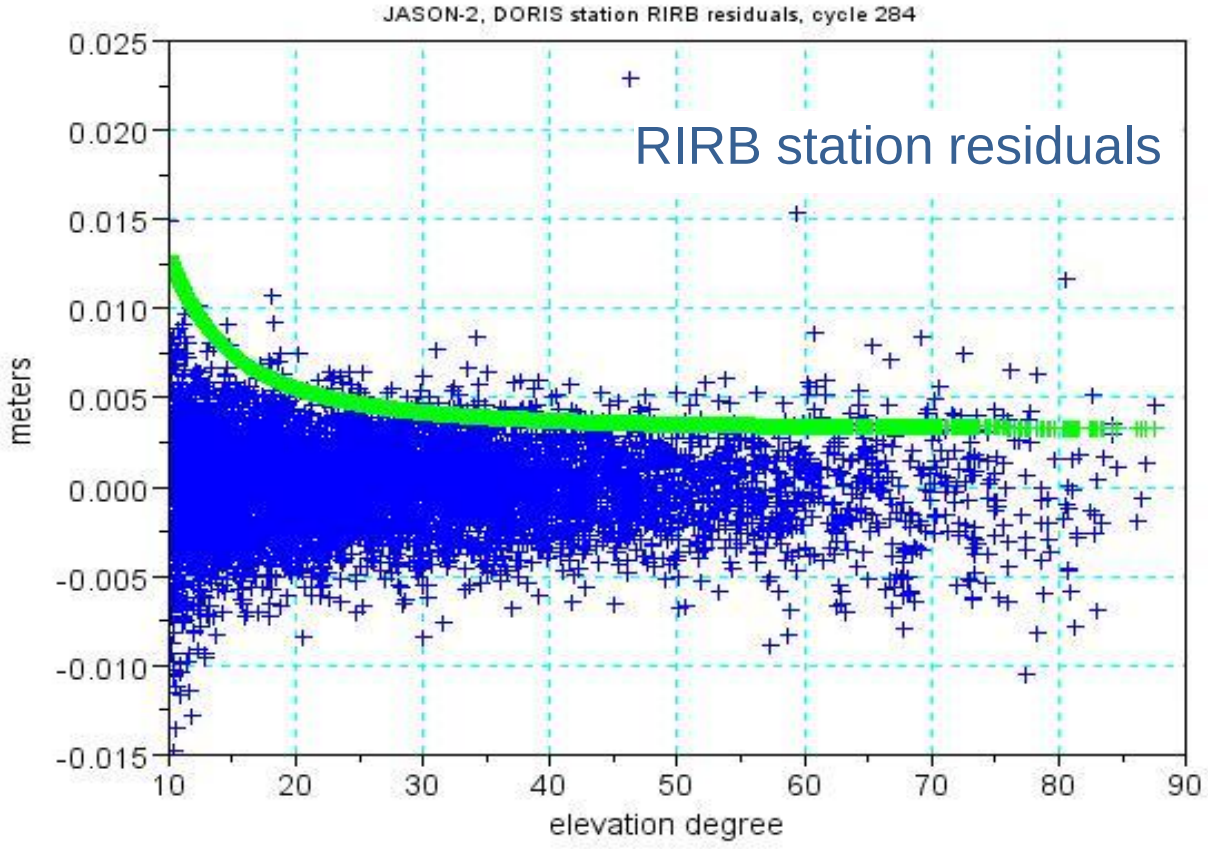
Implemented weighting function :

(theoretical structure with flat earth model, first order expansion)

$$\sigma = \sigma_0(1+\frac{0.1}{\sin^2\alpha})$$

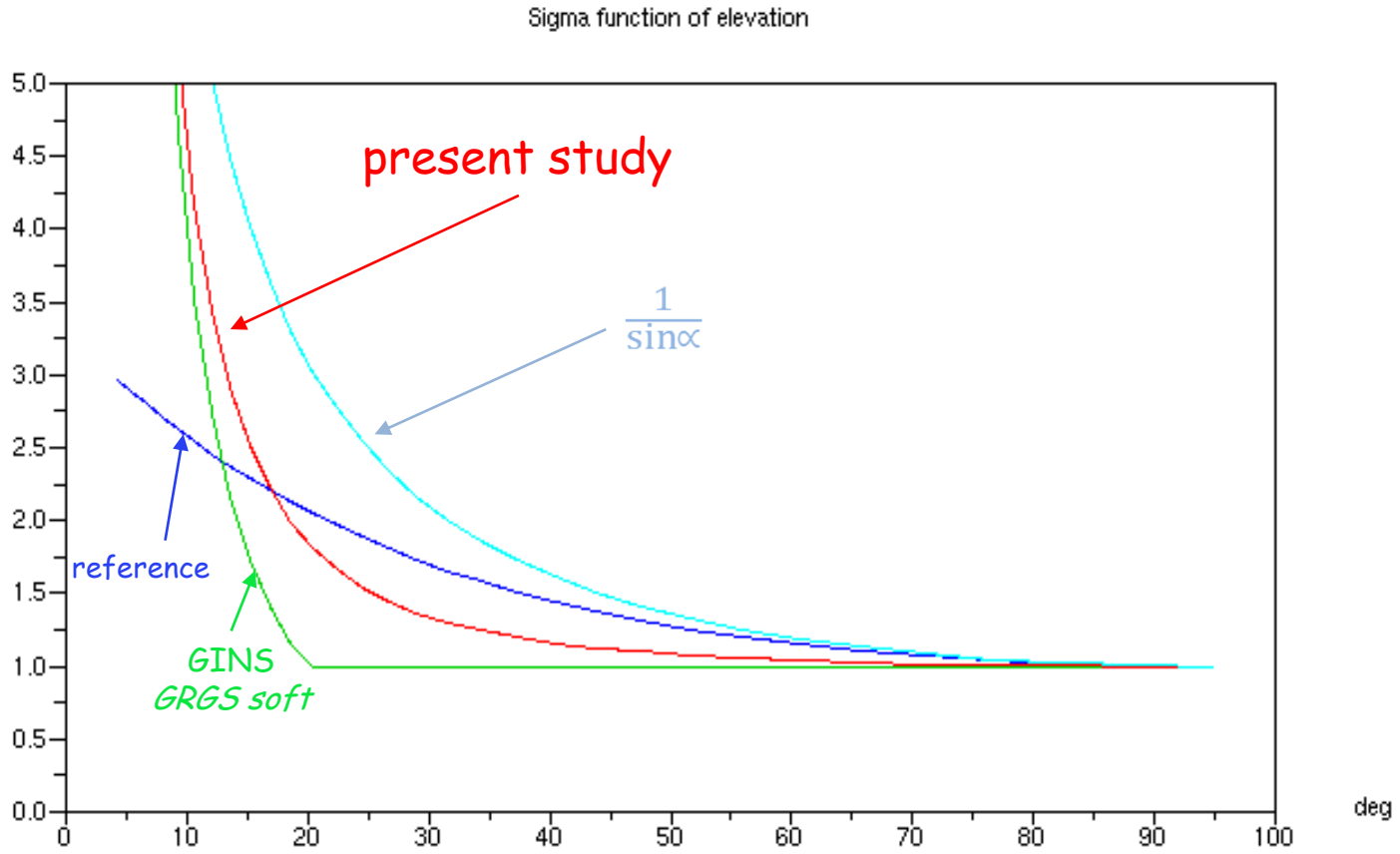
The coefficients are determined empirically on the residuals

(probably too important below 10 degrees)



WEIGHTING FUNCTION

COMPARISONS



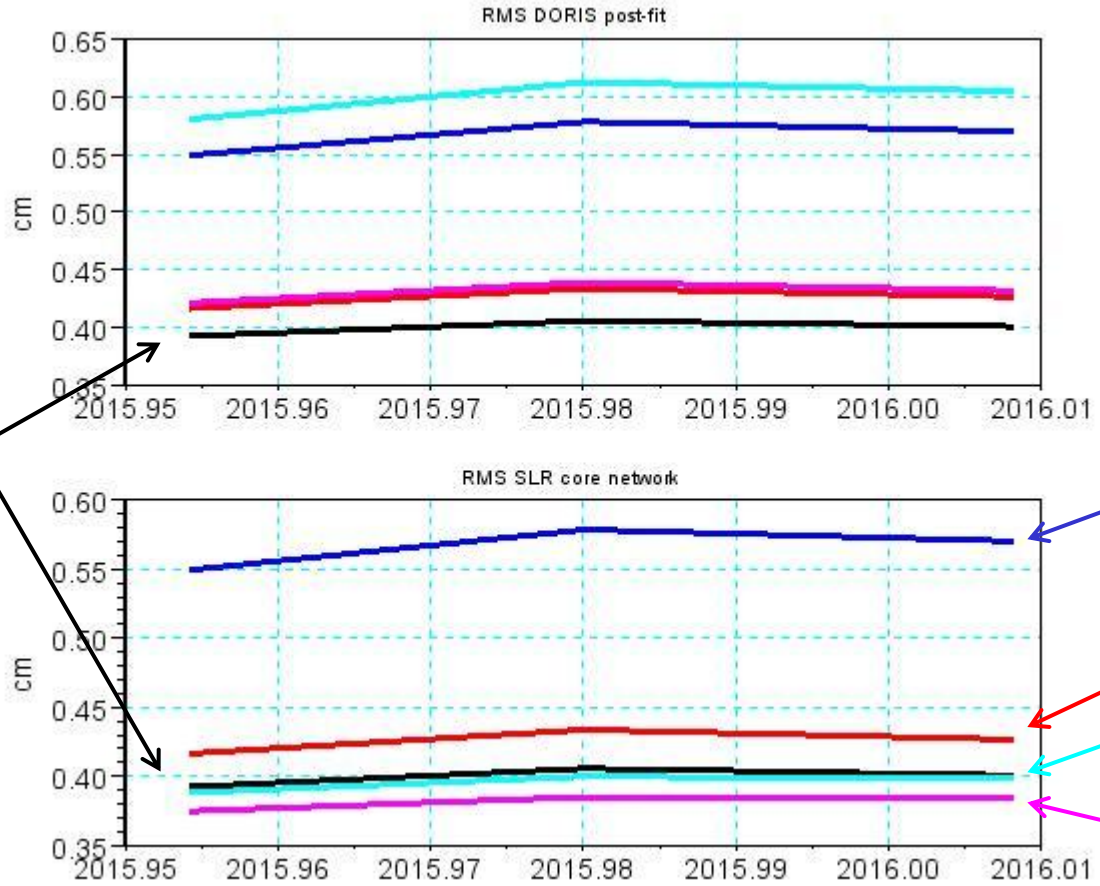
The elevation functions are probably too important at low elevations

However, this allows to minimize other effects (multipath …)

WEIGHTING FUNCTION

RESULTS

JASON-2 DORIS dynamic cycles 274 → 276, test of new preprocessing + weighting fonction with available measurements at 10° and 5°



reference

elevation 5°

elevation 10°

weighting function with elevation 5°

weighting function with elevation 10°

→ ***As expected, measurements at low elevation increases RMS DORIS***

→ ***The weighting function improves RMS SLR***

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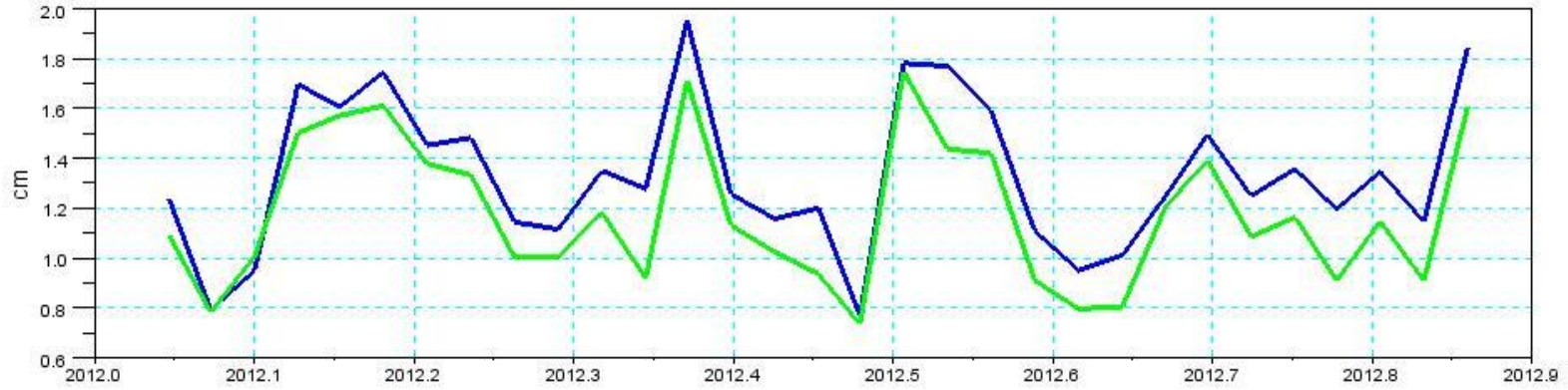
WEIGHTING FUNCTION

RESULTS

JASON-2 DORIS dynamic cycles 130 → 160, measurements with elevation > 5°

RMS SLR core network

RMS SLR core network + elevation >70°



→ Behaviour of weighting function on thirty cycles JASON-2 is stable, more tests should be done on other missions (HY2A, CRYOSAT-2,…)

CONCLUSION

First results on new DORIS preprocessing show interesting results, but need to be further tested on all missions (mainly tested on reference JASON-2 mission)

Same conclusion for weighting function

Weighting function : compare & test functions more ‘suitable’ at low elevations

New preprocessing : test and improve following features ?

- Mix all type of adjustments in way to obtain more efficient elimination, i.e. error along track and tropospheric mapping function
- Integrate new adjustment function, like the one on tropospheric gradient
- Integrate weighting function in preprocessing step

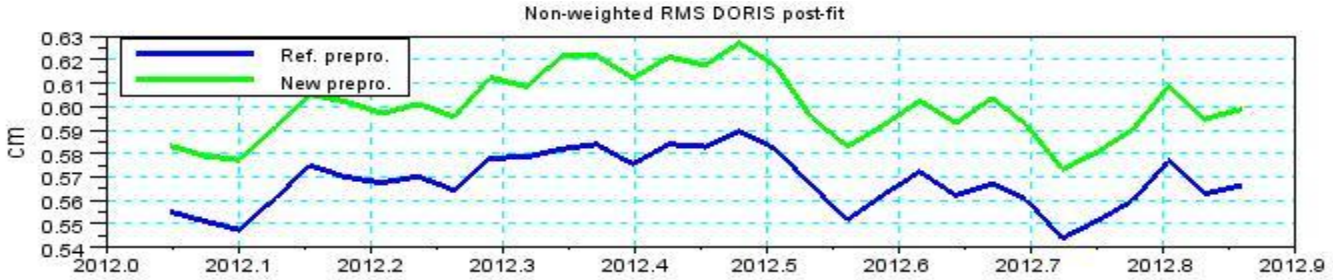
Mix new processing with weighting function is necessary when low elevation measurements are taken into account in orbit determination process, or study like geocenter motion ? …

BACKUPS

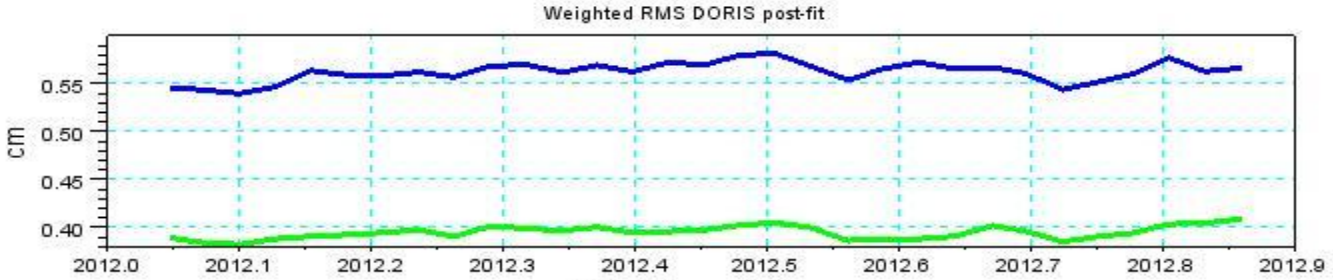
WEIGHTING FUNCTION

MORE DETAILS RESULTS

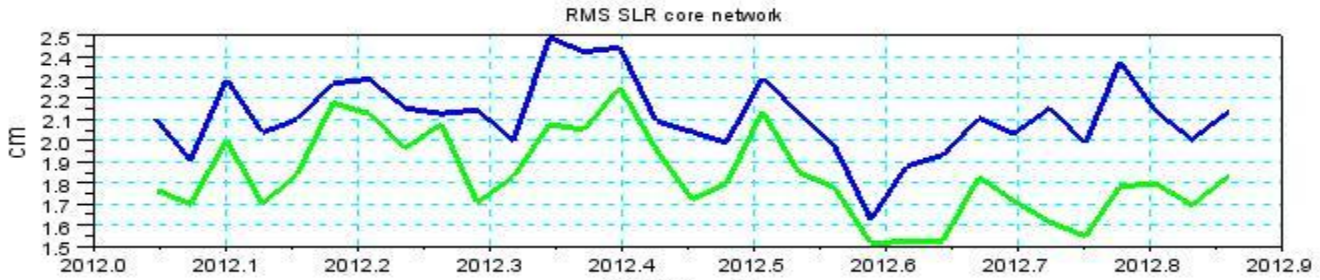
Unweighted RMS DORIS



Weighted RMS DORIS



RMS SLR core network



RMS SLR core network + elevation >70°