

DORIS PREPROCESSING AND WEIGHTING FUNCTION FOR JASON-1 AND OSTM/JASON-2

J. Moyard, F. Mercier, A. Couhert, E. Jalabert, S. Houry⁽¹⁾

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La Rochelle,
FRANCE

(1) CNES POD Team, Toulouse, France

CONTEXT OF STUDY

METHODOLOGY

RESULTS

CONCLUSION

A vertical grey line with circular dots at both ends is positioned on the right side of the slide, framing the 'CONTENTS' text.

CONTENTS

CONTEXT OF STUDY

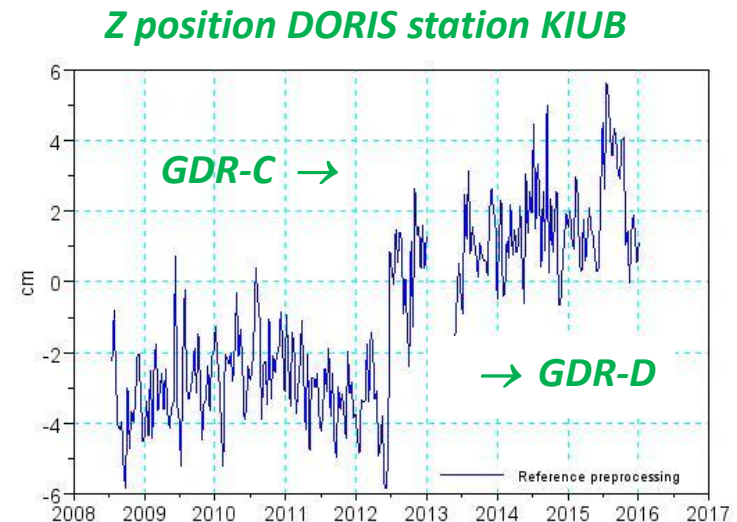
SEVERAL APPLICATIONS...

Consistent preprocessing of DORIS data below 10 degrees and associated weighting function for the low elevation measurements could be helpful for studies dealing with :

geocenter motion

reference frame scale factor

station positioning, with KIUB example
and the change of tropospheric model
between 2 GDR standards



In general, these elements should be used when solving for the DORIS
network station positions and a bit more...

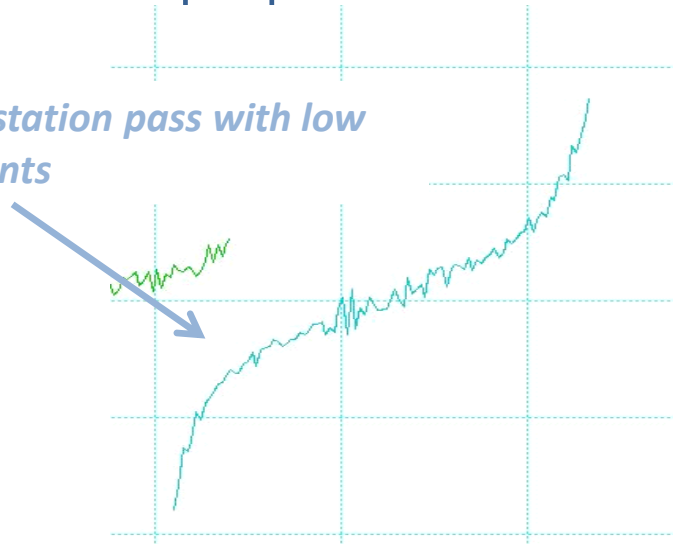
CONTEXT OF STUDY

SEVERAL APPLICATIONS...

Obtain homogeneity in measurement editing for global reprocessing

Take into account possible errors in tropospheric correction during measurements elimination

Residuals of a DORIS station pass with low elevation measurements



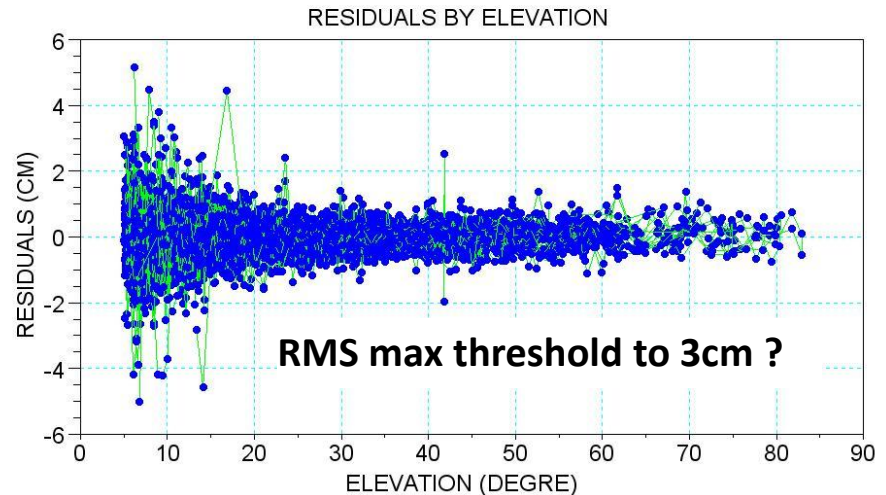
The “old” missions like JASON-1 don’t have the same important number of measurements at low elevation, this new preprocessing is more suitable for recent missions.

METHODOLOGY

NEW PREPROCESSING, INPUTS

Orbit issued from GDRE DORIS dynamic determination and the associated theoretic measurements

Adapted thresholds in regards of analysis on some post-fit residuals characteristics



Re-editing most of measurements, except those associated to too low elevation, i.e. below 5° or below 10° , depending on missions a restart beacon period a low signal strength received on board ?

METHODOLOGY

NEW PREPROCESSING, VALIDATION

'Specific preprocessing criterions'

Comparison number of non edited measurements, should decrease with low elevation re-editing

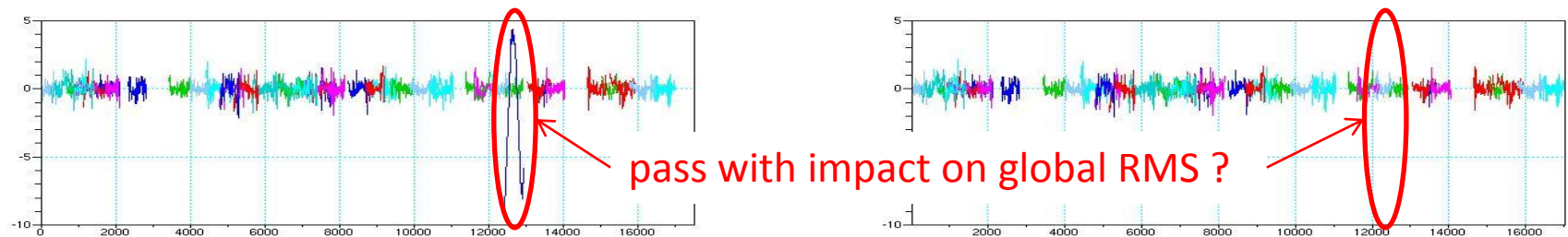
Global % non edited measurement associated to each input thresholds

DORIS RMS of each pass > 10 x DORIS RMS cycle

Local % non edited measurement compared to global % one?

'Usual criterions' for orbit determination validation

Comparison of DORIS RMS post-fit residuals, but significant ? or graphic comparison on cycles with most important difference between RMS



Comparison of SLR RMS residuals on DORIS dynamic orbits

Orbits comparisons with respect to the GDR-E solution

METHODOLOGY

WEIGHTING FUNCTION

Theoretical measurement noise with three contributions

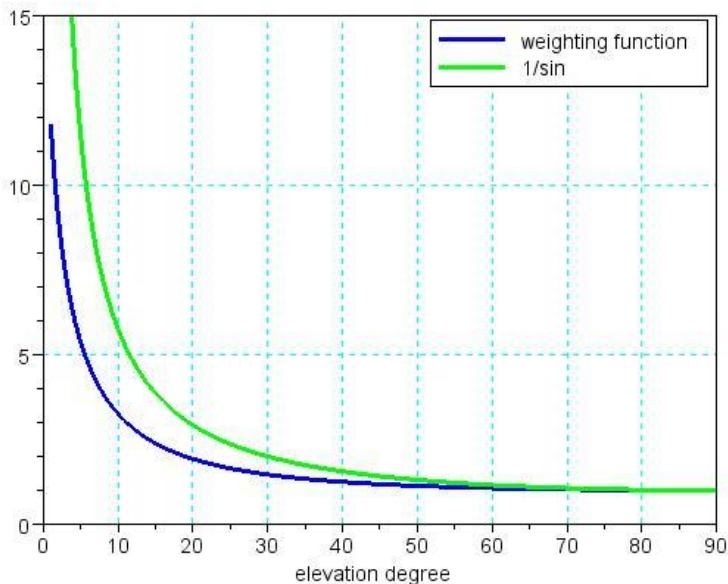
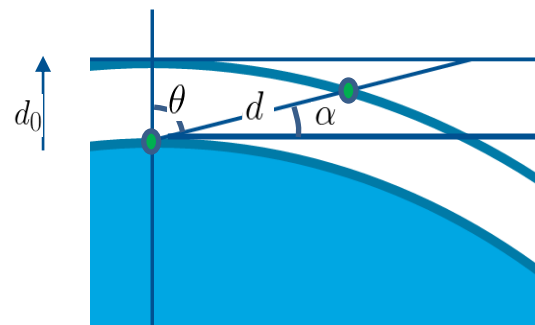
USO

Antenna gain, so should have a better behavior at low elevation

Propagation with following hypothesis

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

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



weighting function formula:

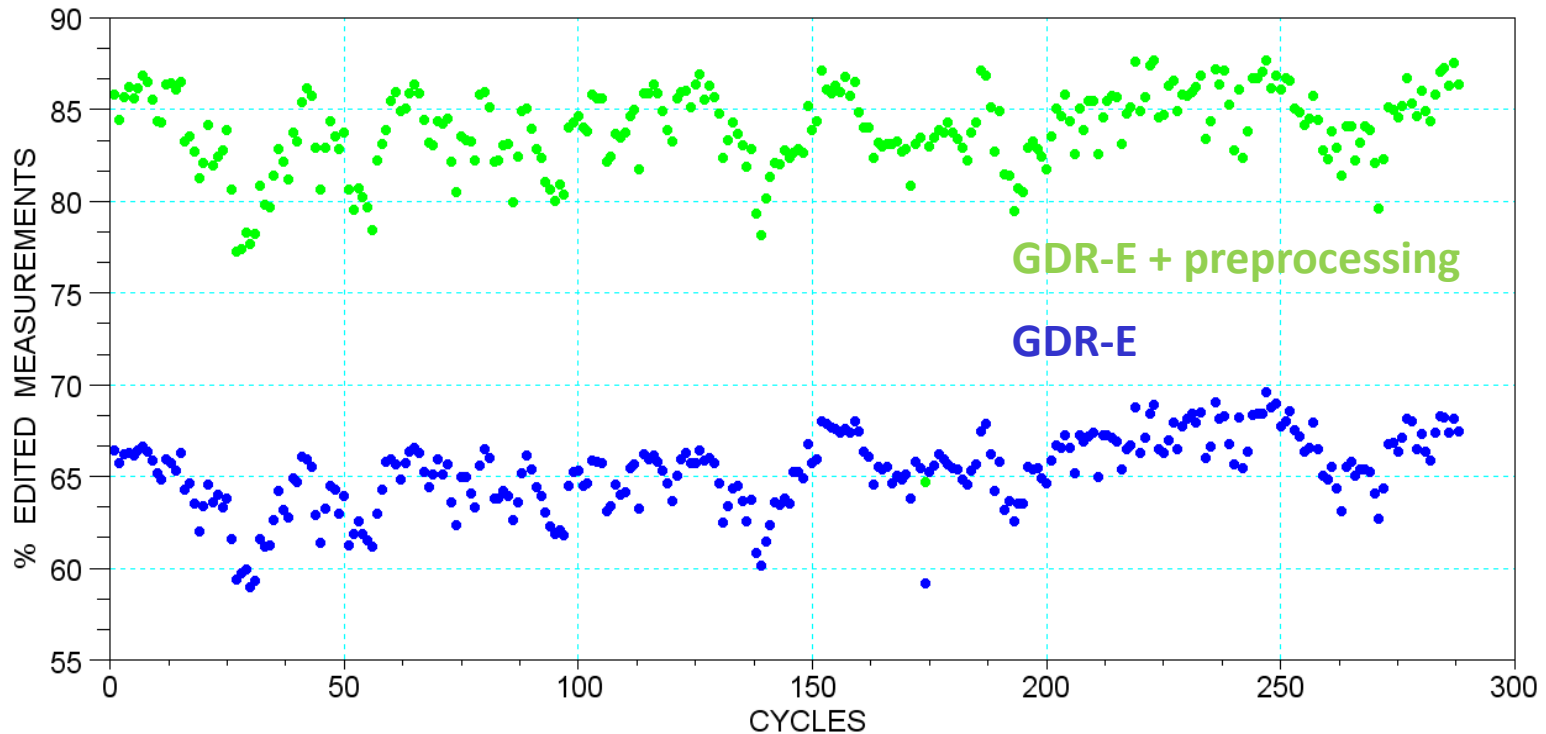
$$\sqrt{Ka + (1 - Ka) * \left(\frac{(1 + Kb)}{(\sin \alpha + Kb)} \right)^2}$$

with $Ka = 0.57647$

$Kb = 0.04$

RESULTS

OSTM/JASON-2, EDITED MEASUREMENTS



Average statistics by cycle

total of 270 000 measurement

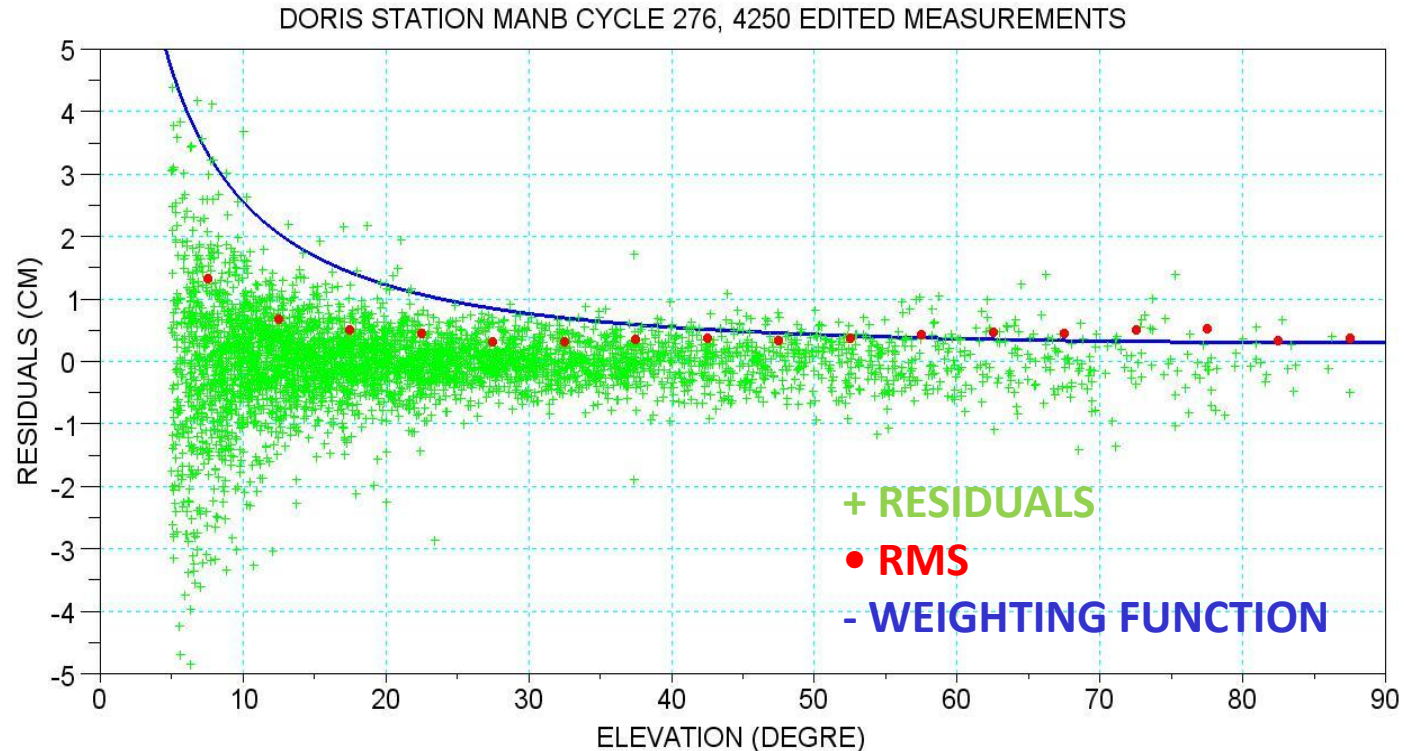
180 000 measurements edited in GDR-E standard

+ 50 000 measures edited with new preprocessing , 42 600 at low elevation ($<10^\circ$)

Stable behavior

RESULTS

OSTM/JASON-2, WEIGHTING FUNCTION

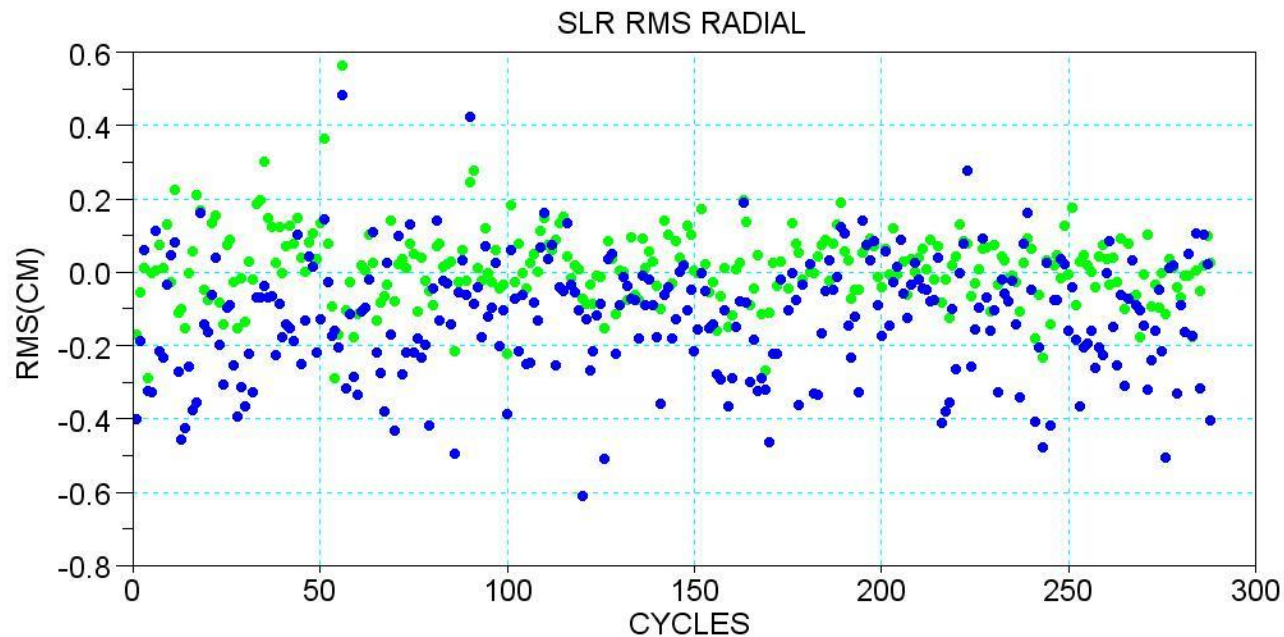


Weighting function quite in adequacy with RMS residuals calculated by 5° step

Weighting function should be able to deal with measurements associated to the “worst residuals” at low elevation

RESULTS

OSTM/JASON-2, SLR RMS



GDR-E – (GDR-E with preprocessing), mean -0.12cm

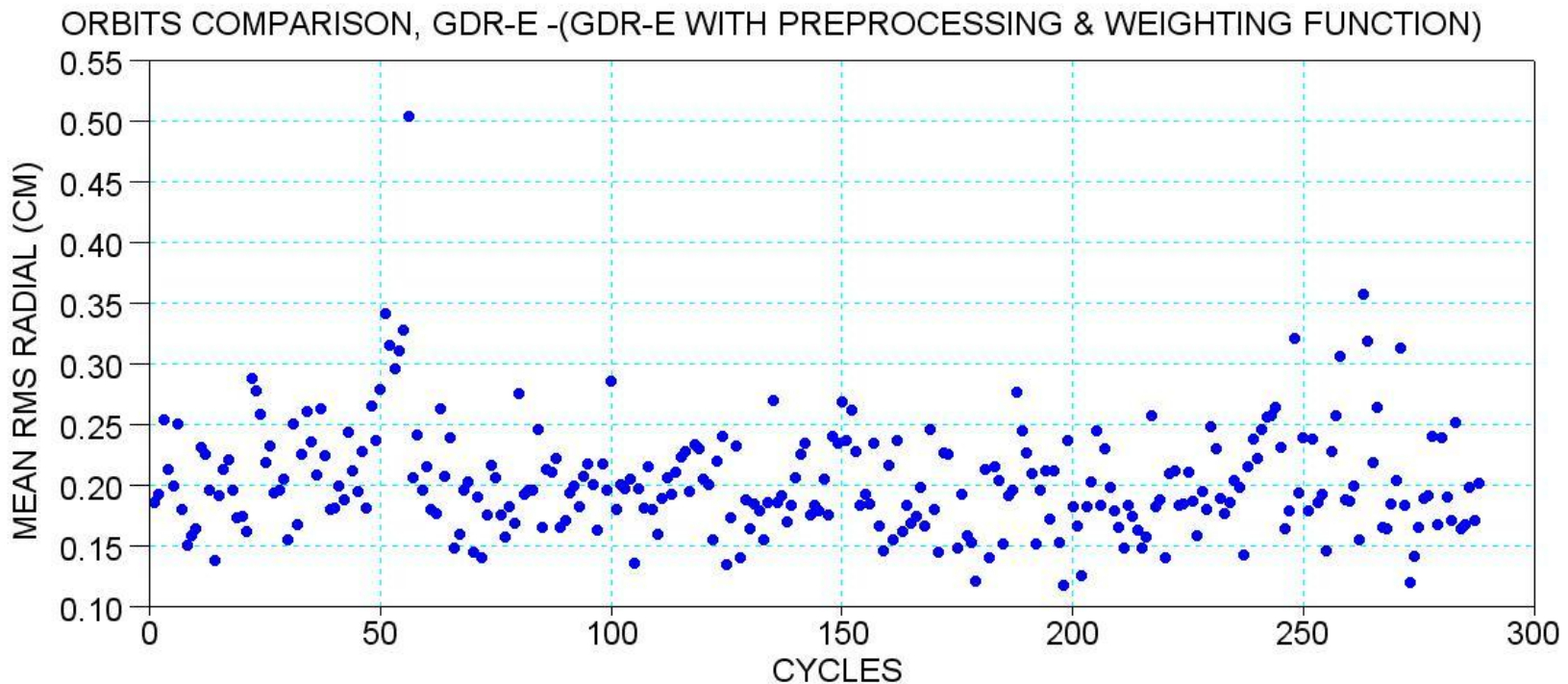
GDR-E – (GDR-E with preprocessing & weighting function), mean 0.012cm

Using only the preprocessing increases high-elevation SLR RMS, impact of low elevation measurements, more scattering of the residuals towards degradation

Using a weighting function has a good impact on high-elevation SLR RMS residuals, quite equivalent performance as GDR-E DORIS dynamic orbit

RESULTS

OSTM/JASON-2, ORBITS COMPARISON

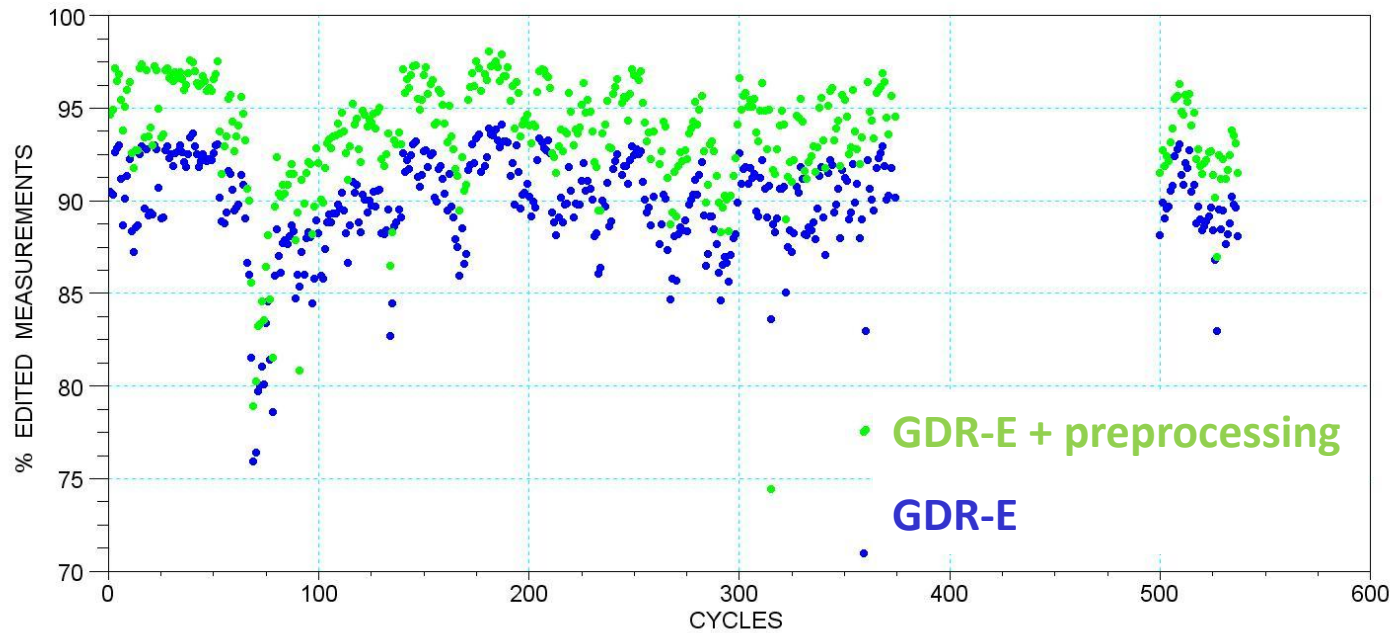


Impact of $\sim 0.2\text{cm}$ mean RMS radial but global criterion, i.e. local analysis could be done

Stable behavior , except for cycle 174 known as a specific one with two safe hold modes out of graphics (mean RMS radial 0.8cm)

RESULTS

JASON-1, EDITED MEASUREMENTS



<10°

Average statistics by cycle

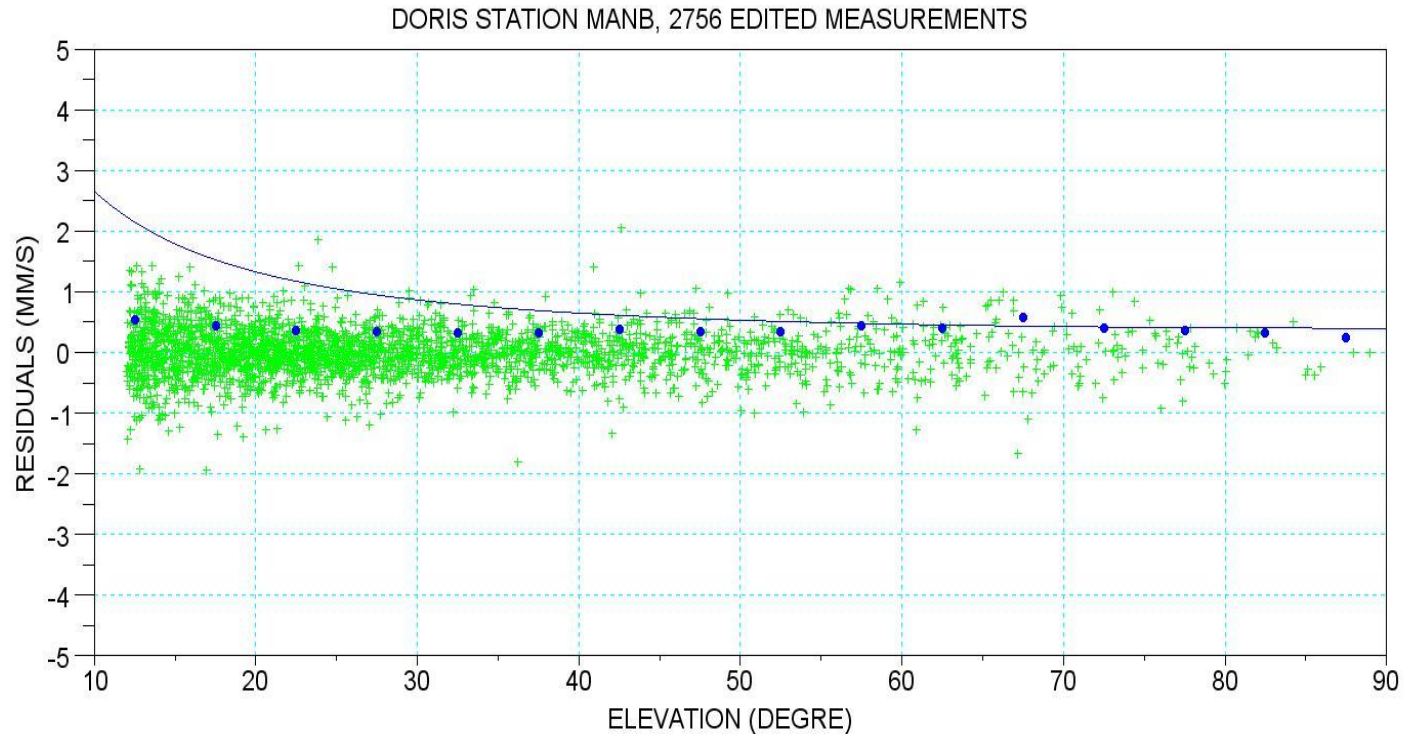
total of 131 500 measurements

118 100 measurements edited in GDR-E standard

+ 4 900 measurement edited with new preprocessing (elevation >10°)

RESULTS

JASON-1, WEIGHTING FUNCTION

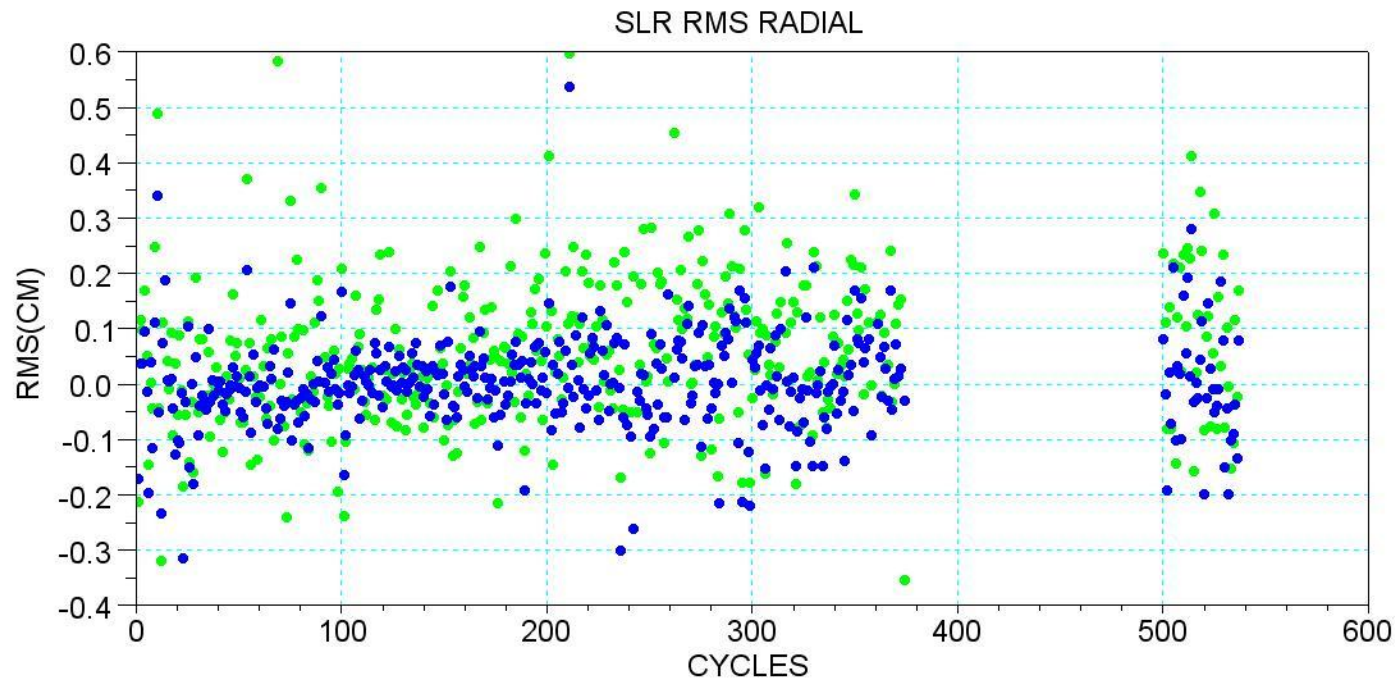


Residuals are stable, low increase at low elevation

Weighting function does not fit as we can observe on JASON-2, but the next slide justifies its use

RESULTS

JASON-1, SLR RMS



GDR-E – (GDR-E with preprocessing), mean 0.004cm

GDR-E – (GDR-E with preprocessing & weighting function), mean 0.058cm

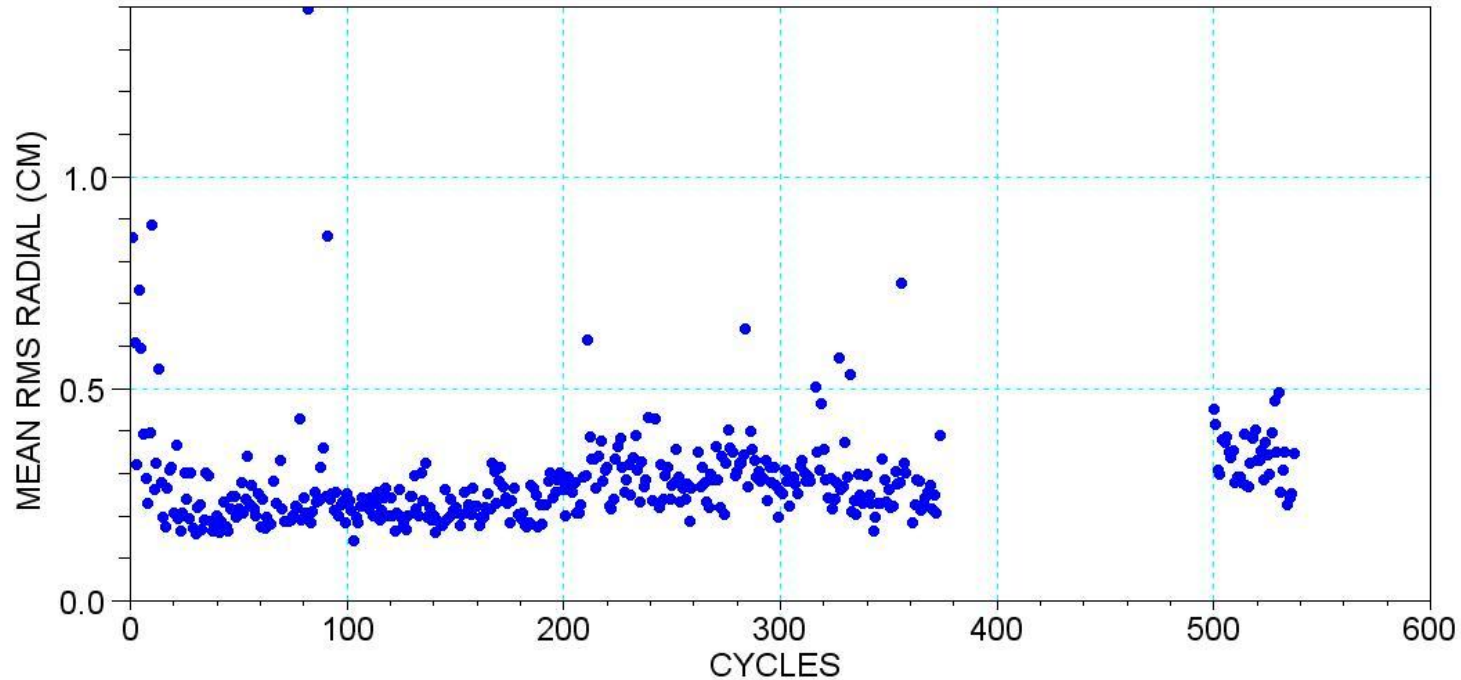
High elevation RMS SLR residuals of new reprocessing is quite equivalent to the GDR-E DORIS dynamic orbits, low elevation measurements $<10^\circ$ not edited

Using weighting function has a good impact on high elevation RMS SLR residuals, small improvement

RESULTS

JASON-1, ORBITS COMPARISON

ORBITS COMPARISON, GDR-E -(GDR-E WITH PREPROCESSING & WEIGHTING FUNCTION)



Average impact ~ 0.28 cm in mean RMS radial but behavior not stable as seen with JASON-2.

Some cycles show differences : lack of measurements, maneuvers, solar activity etc... And three mean RMS radial are out of this graphic, for cycle 068 (lack of measurements) and cycles 315 360 (several maneuvers).

RESULTS

OTHERS ALTIMETRY MISSIONS, SOME STATISTICS...

General statistics, average values by cycle

| | CRYOSAT-2 | HY2A | ENVISAT-1 |
|--|-----------|---------|-----------|
| Total measurements | 122 300 | 141 740 | 68 510 |
| Edited measurements GDR-E | 55% | 61% | 88% |
| Edited measurements GDR-E with preprocessing | 75% | 78% | 88% |
| Low elevation measurements edited ($5^{\circ} < \dots < 10^{\circ}$) | 18% | 15% | 8% |

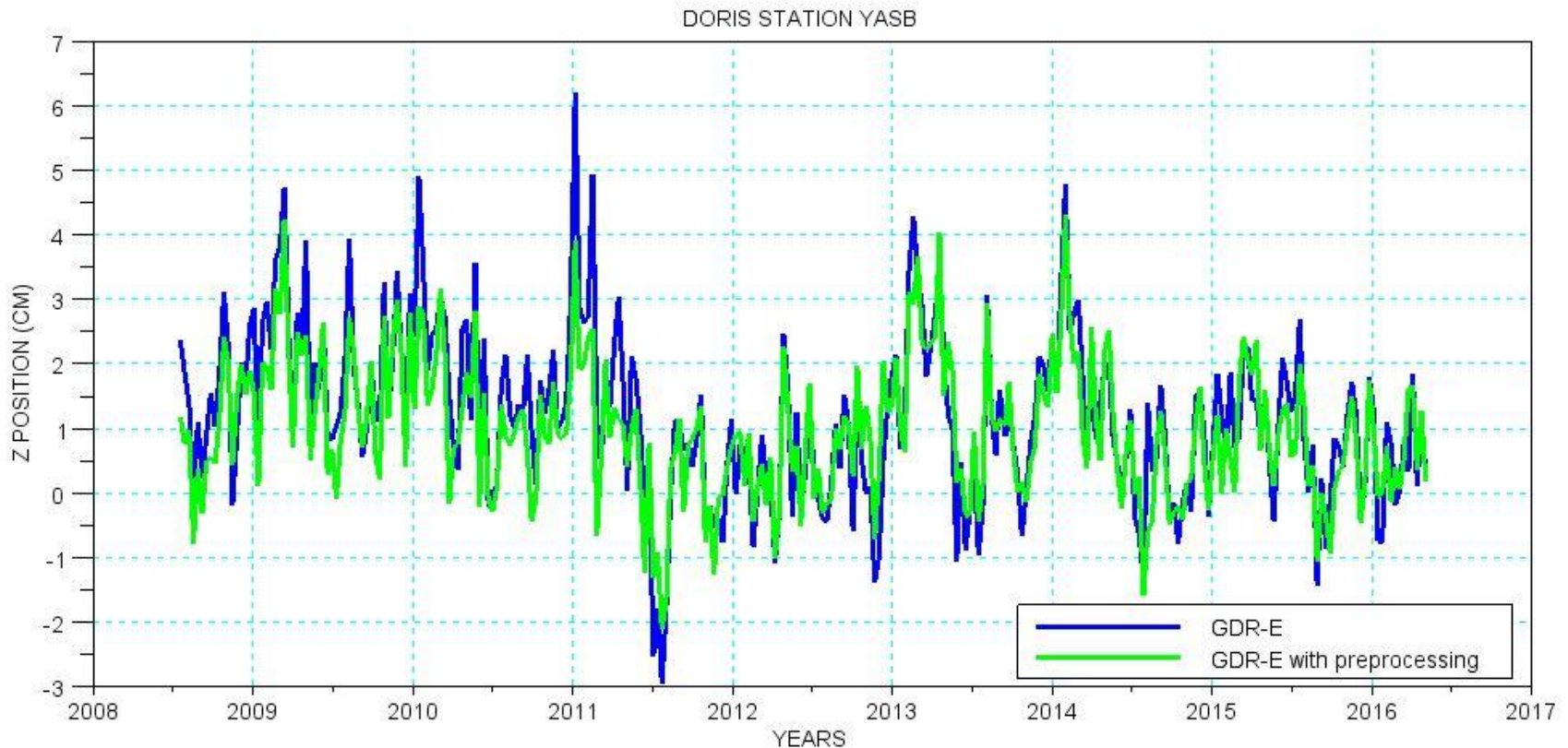
ENVISAT-1, lot of restart beacon periods at the beginning of the mission, lot of lack of measurements, quite difficult to validate.

Preprocessing edits less measurements on beginning of the mission, i.e. on 121 first cycles.

Adjustment on mapping tropospheric model correction not yet implemented for “old” missions.

RESULTS

IMPACT ON STATION POSITIONING



Difference in positioning could have some millimeters / centimeters impact

Include new preprocessing and low elevation measurements give lower scatter in results

CONCLUSION

Input parameters of new preprocessing are identified and seems to give good results in regards of analysis done so far.

Weighting function is available for all DORIS missions. No evolution or modification are needed in regards of analysis done so far.

Tests has been done on JASON-1, OSTM/JASON-2 but on ENVISAT-1 CRYOSAT-2 HY2A SENTINEL-3A too. New reprocessing needs to be more validated on the last missions.

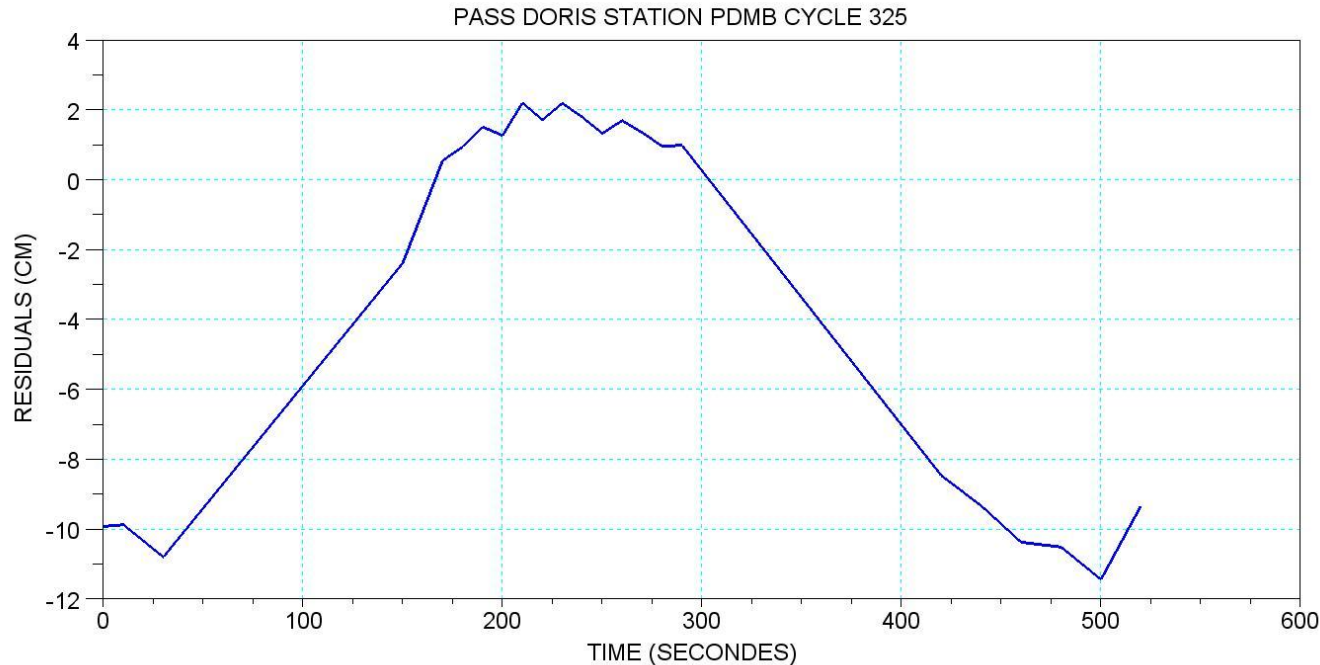
Improvement could be done in this new preprocessing : threshold used in input could depend on the measurement elevation

THANK YOU FOR YOUR ATTENTION, ANY QUESTIONS ?

BACKUP

CASES STUDY

ADJUSTMENT ALONG TRACK, ENVISAT-1 CYCLE 325



Example of a pass having high residuals that is not detected with the new preprocessing.

This pass is identified with validation criterion

'DORIS RMS of each pass > 10 x DORIS RMS cycle'

If adjustment along track is switched off during preprocessing, this pass is correctly eliminated, but ...

CASES STUDY

SOLAR ACTIVITY, ENVISAT-1 CYCLE 072

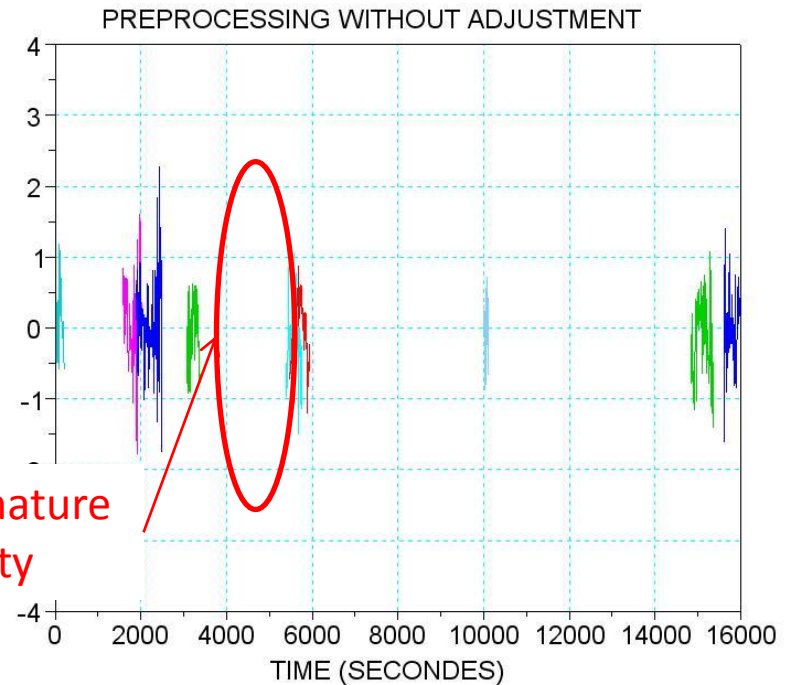
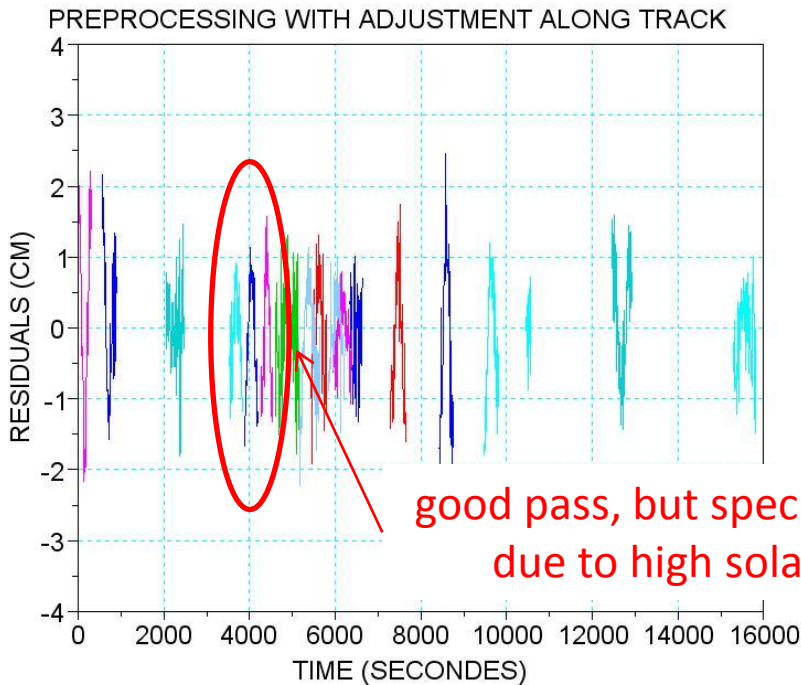


Illustration of the impact to switch off the adjustment for error along track. Some pass with \vee or \wedge signature are non-edited. But they are good ones. Seems to be a dynamic model problem link to a high solar activity. Indices of solar activity on this period

A = 230 AP=300 important values!