Characterization and Impact of DORIS scale variations

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DORIS scale jump in 2012

❑ Processing context

- **We analyzed DORIS data with 3.5-day arcs and a cut-off angle of 12°**

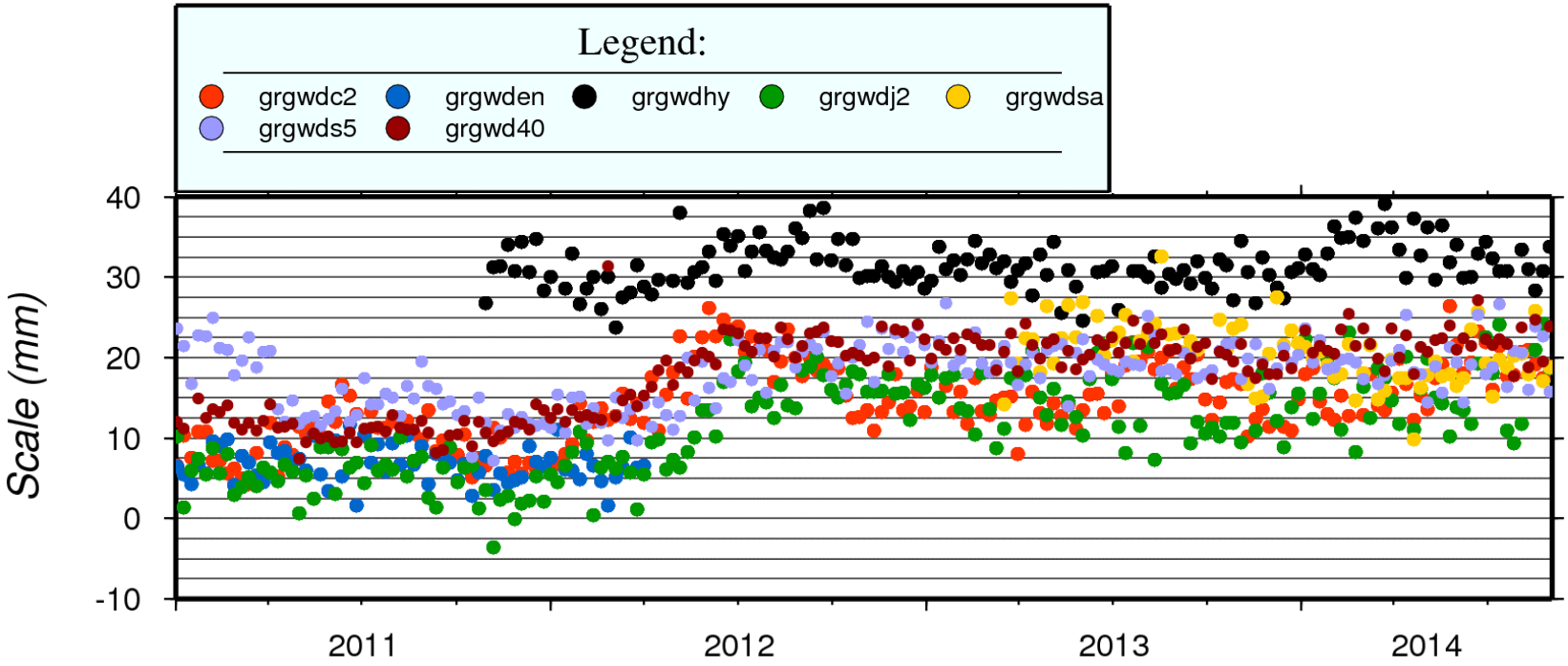
ITRF2014 configuration

All DORIS Satellites

- **Single satellite and multi-satellite solutions compared to DPOD2008**

(computed by CATREF)

❑ GRG scale from single satellite and multi-satellite solutions



Some DORIS Analysis Centers observe a jump in the scale factor. Then, the IDS combined solution has also the scale jump.

DORIS scale jump in 2012

❑ DORIS data format available

• Doris2.2

Format no longer available after Jason-2

Provide by the CNES POD team after their preliminary orbit determination:

Doppler measurement

- take into account the best estimate of the actual satellite frequency (long term on-board frequency drift)

- time tagging done

In this file the following corrections are also available and can be or not used by IDS ACs:

- ionospheric delay rate

- tropospheric delay rate

- phase center correction rate

- data pre-processing (data marked as rejected in the file)

• RINEX:

Format available for all current missions and only available since Jason-3

RINEX/DORIS 3.0 is a format derived from the RINEX/GPS format and adapted for the phase and pseudo-range measurements of the DGXX instruments

Phase measurement converted to Doppler

To use the RINEX file data IDS ACs have:

- to implement the ground antenna geometries in order to be able to position the 400 MHz, 2 GHz and iono-free phase centers with respect to the reference point of the antenna

- to implement the attitude law for each satellite in their software in order to be able to compute the phase-center-to-center-of-mass vector for each measurement

- to use a tropospheric model

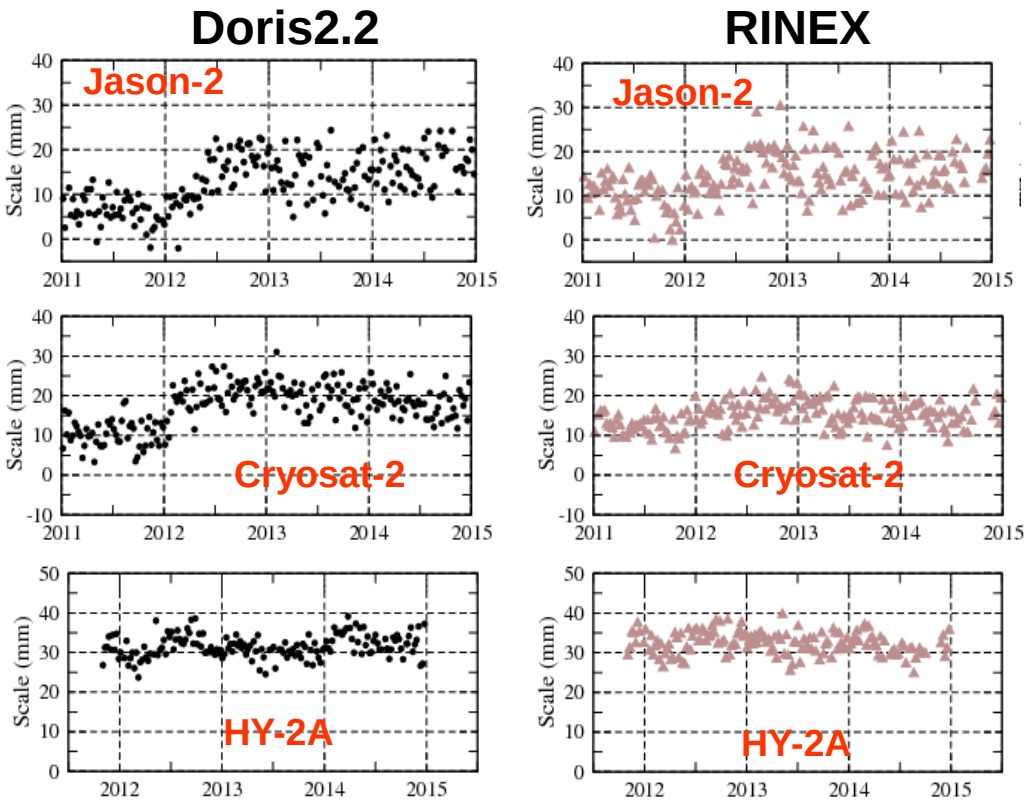
- to apply the ionospheric correction by the use of the iono-free combination

- to estimate a long term on-board frequency drift

- to do their own pre-processing

DORIS scale jump in 2012

GRG Scale factor for Jason-2, Cryosat-2, HY-2A single satellite solutions from Doris2.2 data and RINEX data

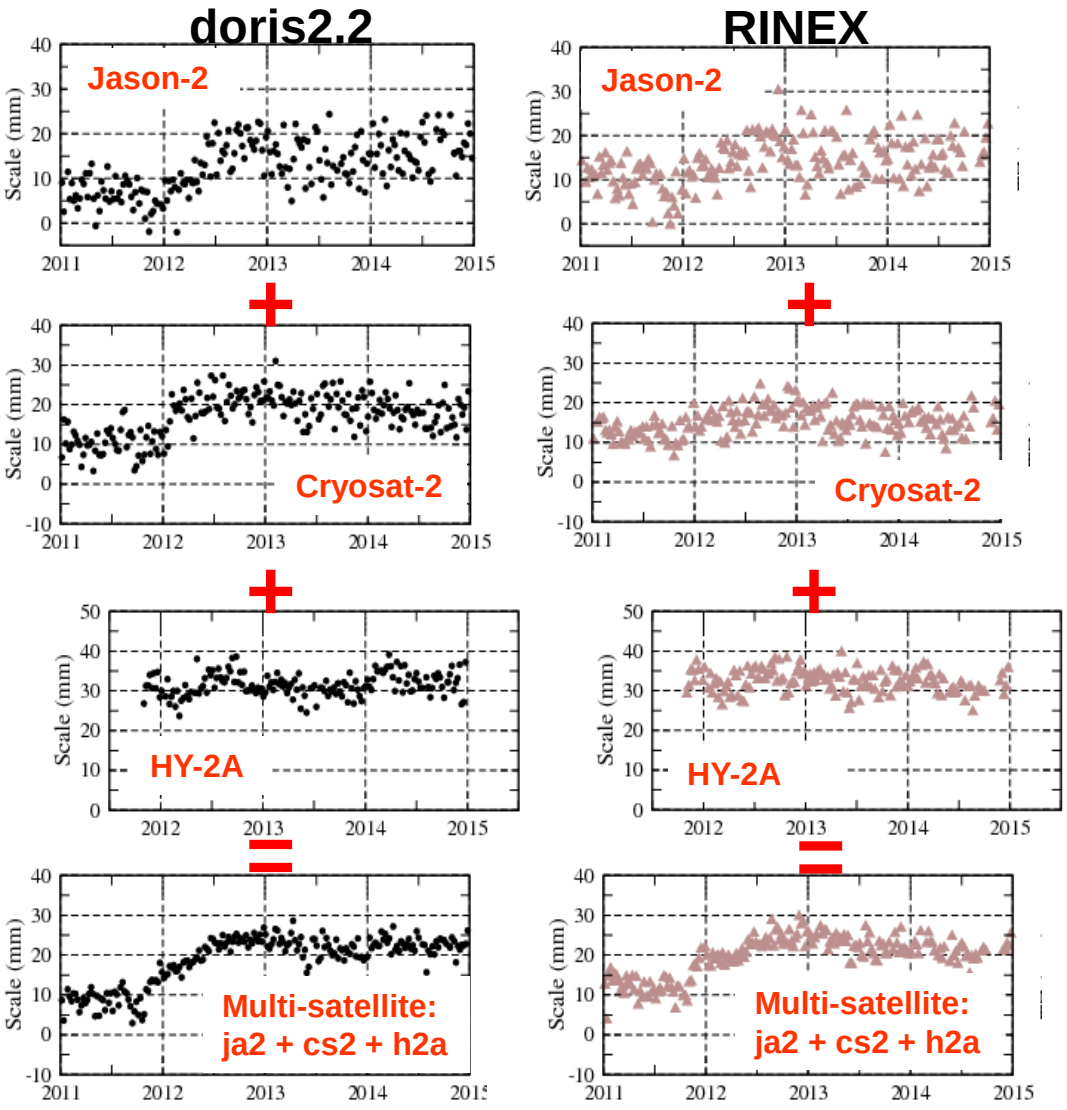


- **Doris2.2**
  Scale increase for Jason-2 and Cryosat-2.
  Stable and higher scale for HY-2A.

- **RINEX**
  No more scale increase for Jason-2 and Cryosat-2.
  HY-2A scale is still high.

DORIS scale jump in 2012

GRG Scale factor for Jason-2, Cryosat-2, HY-2A and the multi-satellite solutions from doris2.2 data and RINEX data



❑ **Doris2.2**

the scale increase of the multi-satellite solution is due to the jump not at the same time of the Jason-2 and Cryosat-2 solutions but also of the HY-2A high scale

❑ **RINEX**

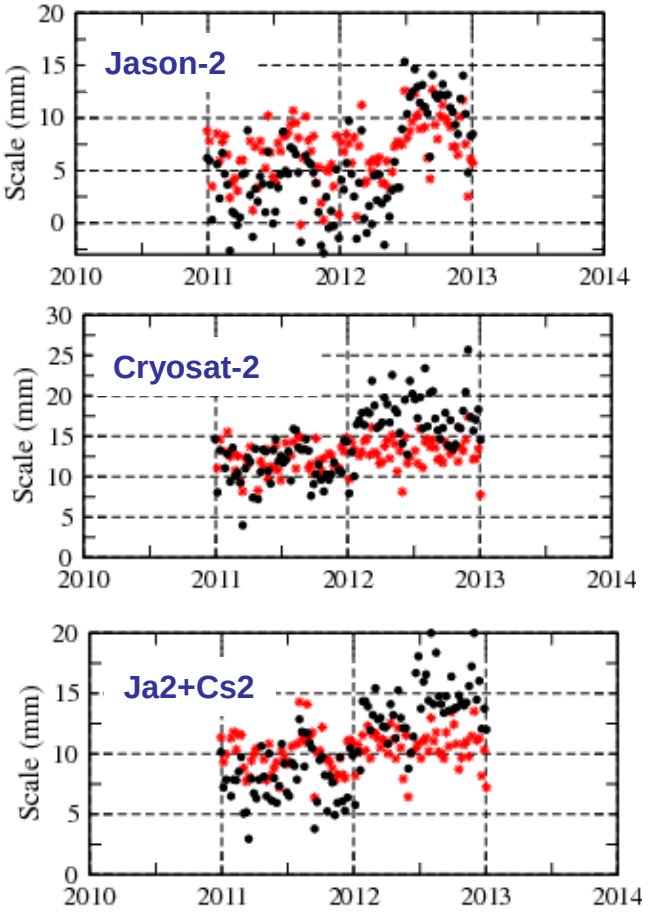
the jump observed is only due to the contribution of HY-2A adding

→Explanation of the scale factor increase:

for Jason-2 and Cryosat-2 that could be linked to the change of tropospheric model used by CNES in its POD processing

DORIS scale jump in 2012

GRG Scale factor for Jason-2, Cryosat-2 and the multi-satellite solutions from Doris2.2 data with pre-processing of CNES POD (in black) and GRG (in red)



❑ **CNES POD pre-processing (in black):**
Scale jump for Jason-2 and Cryosat-2.

❑ **GRG pre-processing (in red)**:
The scale jump is removed.

→ **The increase of the scale factor for Jason-2 and Cryosat-2 is linked to the change of the tropospheric model used by CNES in its POD processing (GDR standards): from CNET (GDR-C) to GPT/GMF (GRD-D).**
Date of change is mission dependent.
Reduction of the amount of data marked as rejected in the doris2.2 file. Then, an increase of the data used in GRG analysis considered to be good in CNES pre-processing.
The larger number of data, especially at low elevation, can be the cause of the change we observe in the scale factor.

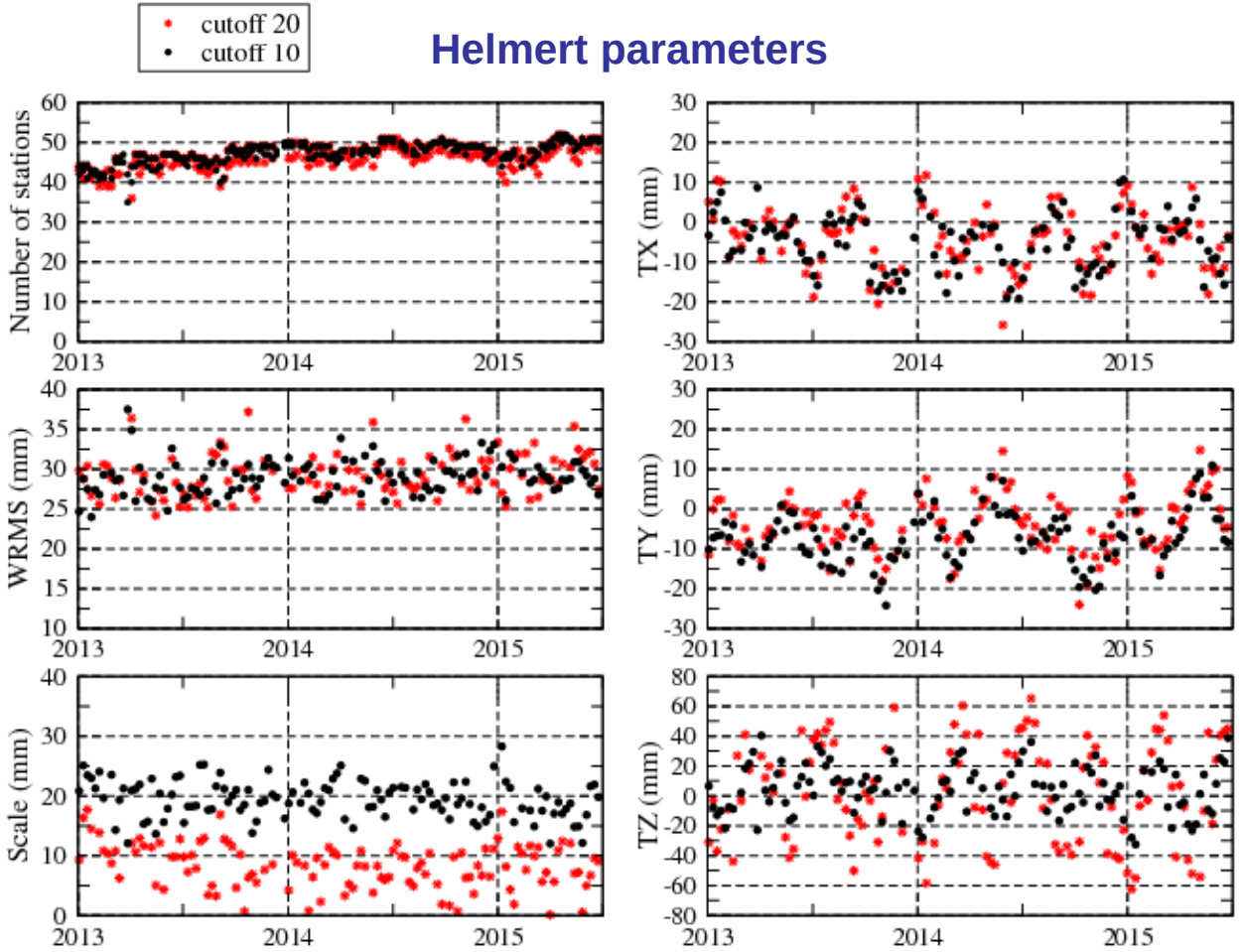
IDS ACs need to do their own pre-processing when using doris2.2 data

Impact of the cutoff angle on the DORIS scale factor

Jason-2 Single satellite Solution compared to DPOD2008 computed by CATREF

(from Jan. 2013 to Jun. 2015)

- with GMF/GPT Tropospheric model
- with cutoff angle of 10° and 20° (without downweighting)



The cutoff angle has an impact on the scale factor due to the difference number of data at low elevation.

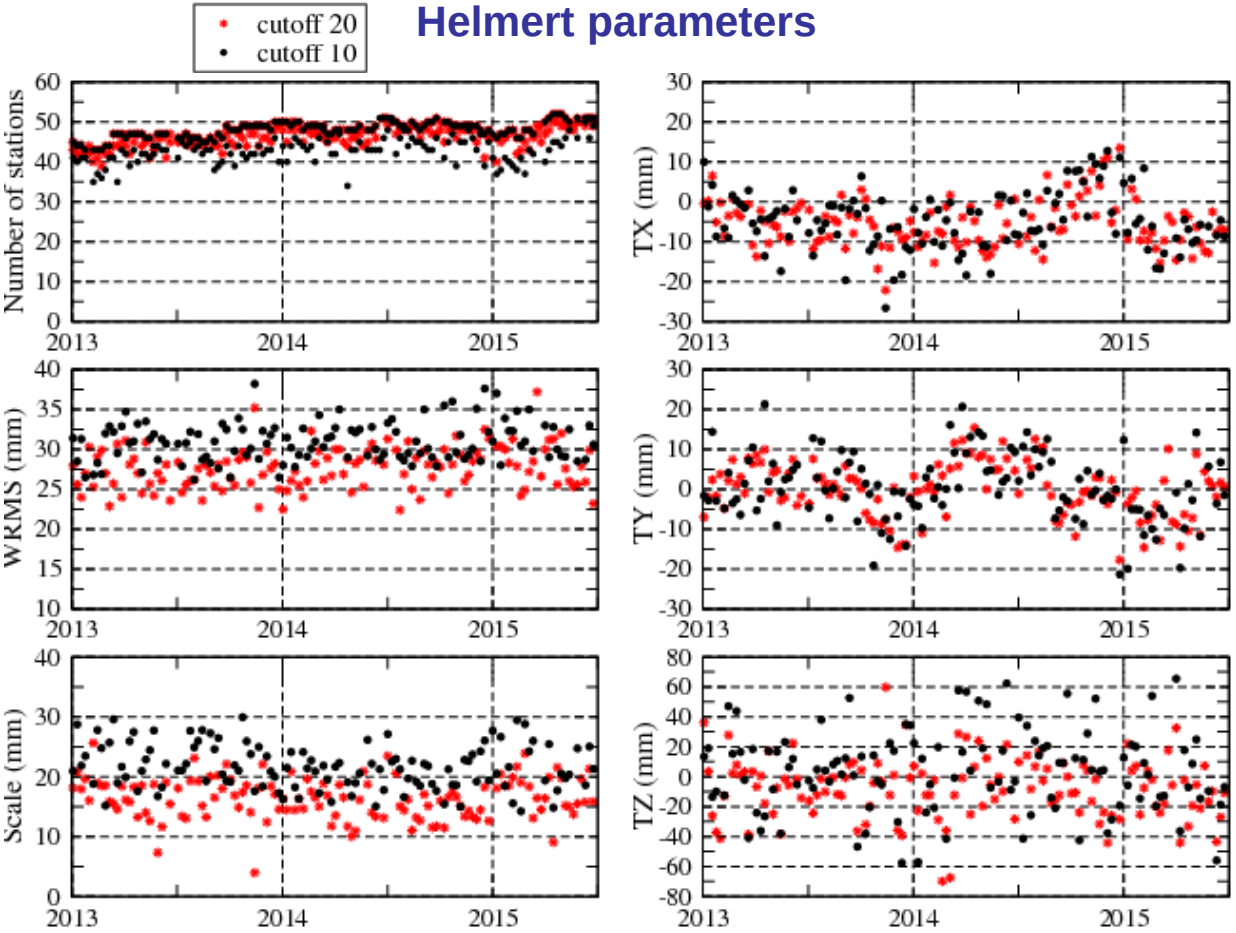
Impact of the cutoff angle on the DORIS scale factor

Cryosat-2 Single satellite Solution compared to DPOD2008 computed by CATREF

(from Jan. 2013 to Jun. 2015)

- with GMF/GPT Tropospheric model
- with cutoff angle of 10° and 20° (without downweighting)

Helmert parameters



The cutoff angle has an impact on the scale factor due to the difference number of data at low elevation.

DORIS scale variations: conclusions and perspective

❑ HY-2A high scale

The high scale level of HY-2A increases the scale of the DORIS solution

→ IDS AWG proposed to not use the HY2A scale in the multisatellite solution

❑ Scale variations due to the use of Doris2.2 data

Impact of using only the data considered to be good in CNES pre-processing:

The increase of the scale factor for Jason-2 and Cryosat-2 is fully explained by the change of tropospheric model used by CNES in its POD processing (GDR standards): from CNET (GDR-C) to GPT/GMF (GRD-D).
The larger number of data, especially at low elevation, is the cause of the change we observe in the scale factor.

→ IDS ACs need to do their own pre-processing when using doris2.2 data

***Impact of using in the doris2.2 data file of the corrections of CoP-CoM*:**

Some ACs using these correction have some scale jump in their solutions.

→These ACs can implement in their software the attitude law for each satellite

→ When ACs will use the RINEX data format these problems will be resolved

❑ Impact of the cutoff angle on the DORIS scale factor

The elevation cutoff has an impact on the scale factor due to the difference number of data at low elevation

DORIS scale variations: conclusions and perspective

❑ **Scale variations - Impact on the scale factor :**

- **data editing (pre-processing)**

- **data downweighting law**

- **elevation cutoff**

- **tropospheric model + elevation function**

- **choice of the CoM-CoP vector of satellites**

→Need to be Consistency of individual AC solutions?
and proposal to define IDS standards?

These can concern other space geodesy techniques.