

# Analyze of the DORIS Scale Factor and Geocenter from single satellite solutions

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## Introduction

The DORIS scale factor and geocenter is the combination of each single DORIS satellite solutions. We propose here to analyze the scale factor and geocenter of these single satellite solutions in order to improve the combined solution. Indeed, previous studies showed that single satellite solutions can have some large scale or geocenter values, such as the HY-2A scale. We have already identified a high value for Tz translation for several satellites. The objective of this study is to analyze each single satellite solutions in terms of scale and geocenter, to try to understand and resolve the potential problem. We started the analyses with Envisat and Sentinel-3A which have a significantly bias in Tz translation.

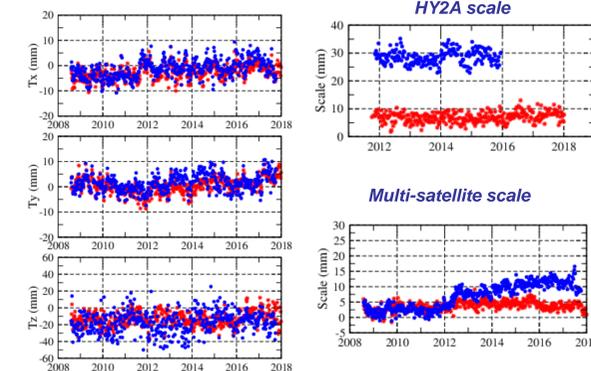
## POD modelling and Processing context

<b>Software</b>	GINS/DYNAMO
<b>DORIS data</b>	DOPPLER data (DORIS2.2 format) or phase measurement converted to DOPPLER (RINEX 3.0 format)
<b>Station Coordinates</b>	ITRF2014 (DPOD2014)
<b>Gravity Field</b>	EIGEN-GRGS.RL03-v2.MEAN-FIELD with mean slope extrapolation
<b>DORIS Troposphere</b>	VMF1 + one gradient per station in North & East directions
<b>Attitude Model</b>	Nominal law
<b>Surfaces Forces &amp; Estimated Parameters</b>	Box-wing model for solar radiation, drag, Albedo and IR Macromodel available at : <a href="ftp://ftp.ids-doris.org/pub/ids/satellites/DORISatelliteModels.pdf">ftp://ftp.ids-doris.org/pub/ids/satellites/DORISatelliteModels.pdf</a> Radiation pressure scale coefficient : 1 coef/day but strongly constrained 1/rev empiricals: 2 sets in along-track and cross-track directions (sin/cos) Drag coefficients adjusted: 1 coef per 4 hours except for Jason2&3 1 per half day
<b>Time span processing</b>	From July 2008 to December 2017 3.5-day arcs with a cut-off angle of 12° Data from satellites: Spot2&4&5, Jason2&3, Cryosat-2, HY-2A, Saral and Sentinel-3A

## Scale Factor and Geocenter from GRG combined solution

GRG (CNES/CLS) solution compared to DPOD2014 (computed by CATREF)

### GRG Scale factor and Geocenter



### Correction of the DORIS scale factor jump in 2012

**Correction of the HY-2A high scale**  
 The high scale level of HY-2A increased the scale of the DORIS solution.  
 We used the new position of the CoM given by the Chinese Project and the HY2A scale is significantly reduced.

**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 was 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, was the cause of the change we observe in the scale factor.

We did our own pre-processing when using doris2.2 data and the scale jump is removed

## Conclusions

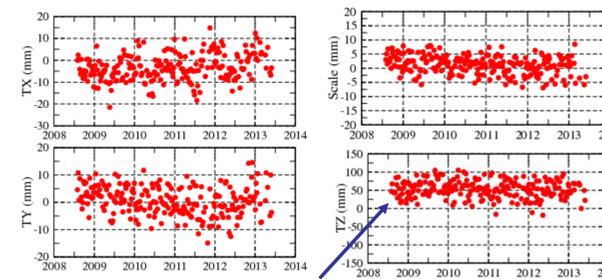
- We corrected the DORIS scale factor jump in 2012 due to the HY-2A high scale value and to the use of DORIS2.2 data pre-processing for the Jason-2 and Cryosat-2 satellites. We used the new position of the HY-2A CoM given by the Chinese Project and the HY2A scale was significantly reduced. We did our own pre-processing when using doris2.2 data and the scale jump was removed.
- We analyzed each single satellite solutions and identified a high bias in Tz translation for Envisat, HY-2A and Sentinel-3A. These 3 satellites have a similar attitude law and their solar panel are tilted from the rotation axis. We are working to take into account this last point.
- A study of the different signatures in geocenter, in particular at draconitic period, is also in progress by spectral analysis.

## REFERENCES

Lemoine, J.-M., Capdeville, H., 2006. A corrective model for Jason-1 DORIS Doppler data in relation to the South Atlantic Anomaly. J. Geod. 80 (8–11), 507–523. <http://dx.doi.org/10.1007/s00190-006-0068-2> (DORIS Special Issue).  
 Capdeville, H., Stepanek, P., Hecker, L., Lemoine, J.-M. Update of the corrective model for Jason-1 DORIS data in relation to the South Atlantic Anomaly and a corrective model for SPOT-5. Adv. Space Res. <http://dx.doi.org/10.1016/j.asr.2016.02.009>  
 Lemoine, J.-M., Capdeville, H., Soudarin, L. Precise orbit determination and station position estimation using DORIS RINEX data. Adv. Space Res. <http://dx.doi.org/10.1016/j.asr.2016.06.024>  
 Soudarin, L., Capdeville, H., Lemoine, J.M. Activity of the CNES/CLS analysis center for the IDS contribution to ITRF2014. Adv. Space Res. <http://dx.doi.org/10.1016/j.asr.2016.08.006>

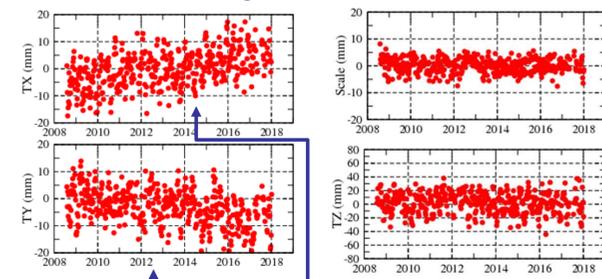
## Scale Factor and Geocenter from single satellite solutions

### Spot-4 Scale and geocenter



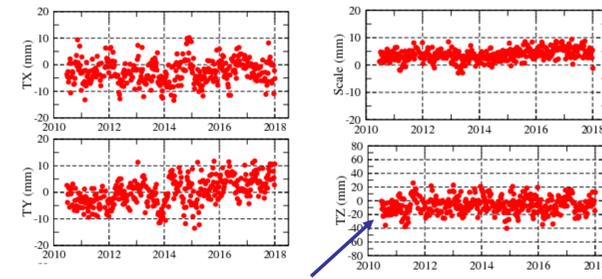
Tz bias ~5 cm (not yet explained)

### Jason-2 Scale and geocenter



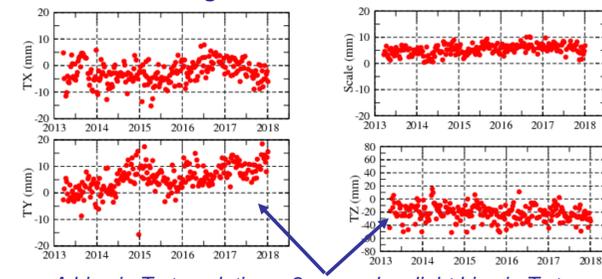
Drift in Tx and Ty translations (not yet explained)

### Cryosat-2 Scale and geocenter



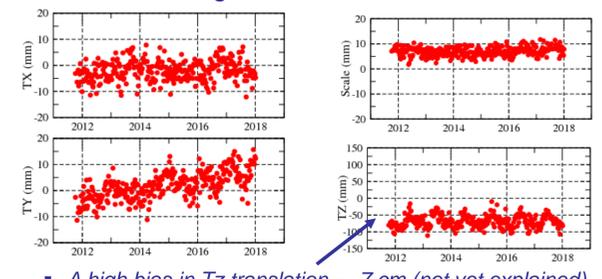
Signal at draconitic period in Tz translation

### Saral Scale and geocenter



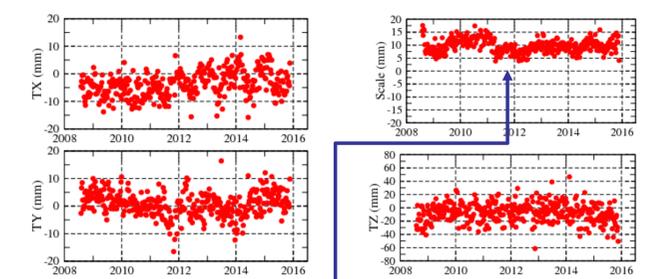
A bias in Tz translation ~ 2 cm and a slight bias in Ty translation

### HY-2A Scale and geocenter



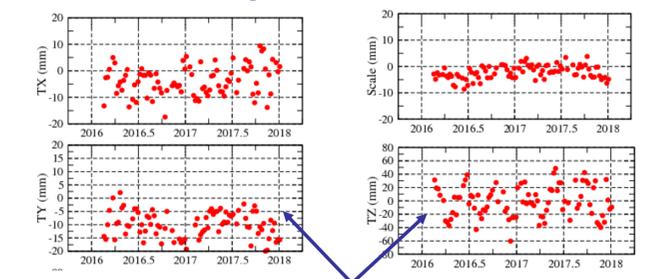
A high bias in Tz translation ~ -7 cm (not yet explained)

### Spot-5 Scale and geocenter



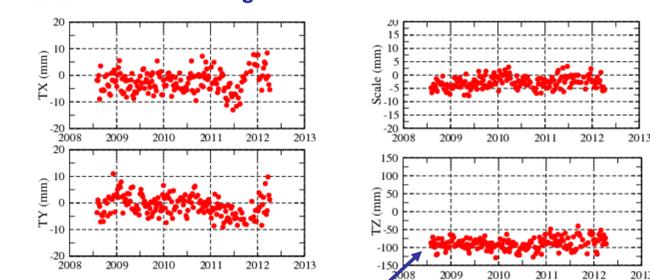
The SPOT-5-only scale clearly showed a sawtooth pattern with breaks. The discontinuities are of the order of -20 mm, so they are significant. Although no obvious cause has been found, efforts to understand these variations should continue, in particular to understand if something intrinsic to the SPOT-5 DORIS USO might be the cause.

### Jason-3 Scale and geocenter



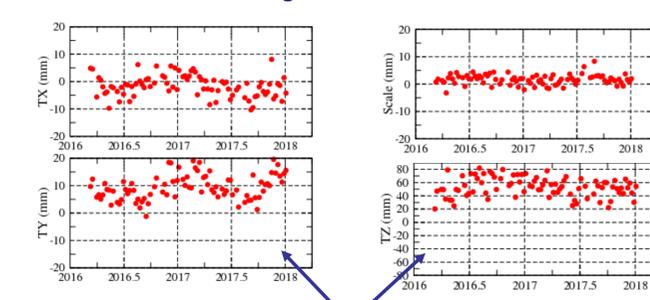
Signal at draconitic period in Tz translation and a slight bias in Ty translation

### Envisat Scale and geocenter



A high bias in Tz translation ~ -10 cm (not yet explained)

### Sentinel-3A Scale and geocenter



A high bias in Tz translation ~ 5 cm and a slight bias in Ty translation (under investigation)