GRG (CNES/CLS) AC SATUS

Hugues Capdeville, Jean-Michel Lemoine,
Adrien Mezerette

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GRG (CNES/CLS) AC STATUS

❑ Status of the routine DORIS data processing

- **We processed DORIS2.2 and RINEX data until end September 2018**
- **Serie grgwd41**

ITRF2014 configuration

List of last additions:

• Introduction of Jason-3 and Sentinel-3A&B (RINEX data) in the GRG DORIS processing
• Switch to the ITRF/DPOD2014
• DORIS-only orbits processing and evaluation by SLR processing
• Strategy to mitigate the SAA impact for Jason-2 and Jason-3
  on the orbit (adjusting of frequency Polynomial on SAA station per pass)
  on the positioning (renaming of SAA stations)
• Remove the DORIS scale jump in 2012
  use the new position of the HY-2A CoM given by the Chinese Project
  make our own pre-processing when using Doris2.2 data

- **We provided Sentinel3-A&B orbits to CPOD QWG until end January 2019**

❑ Preparation to the next ITRF2020

- **We update the new serie grgwd41**
  - We now use body and solar array quaternions for Jason-2 and Jason-3 satellites
  - …
- **We processed DORIS2.2 and RINEX data from July 2017 to January 2019**

Status of POD

❑ POD Processing overview

(we take the IERS conventions and the IDS recommendations)

Software	GINS/DYNAMO
DORIS data	RINEX 3.0 phase measurement converted to DOPPLER for Jason-3 and Sentinel-3 DORIS.2.2 for others satellites
Terrestrial Reference Frame	ITRF2014 (DPOD2014)
Gravity Field	EIGEN-GRGS.RL04-MEAN-FIELD with mean slope extrapolation C21/S21 coherent with the new linear mean pole model Ocean tides: FES2014
Displacement of reference Point	Pole tide: solid earth pole tides and ocean pole tides (Desai, 2002), new linear mean pole model
Attitude Model	for Jason: quaternions for BUS and solar panels and/or nominal law likeTopex for Sentinel-3: nominal law like Envisat for all other DORIS satellites: nominal law
Surfaces Forces **&** **Estimated Parameters**	Box-wing model for solar radiation,drag, Albedo and IR Macromodel available at : *ftp://ftp.ids-doris.org/pub/ids/satellites/DORISSatelliteModels.pdf* Radiation pressure scale coefficient : 1 coef/day but strongly constrained to: 0.99 for Jason and 1.0 for Sentinel-3 OPR empiricals: 2 coeff cos-sin /orbital period in normal direction and 2 coeff cos-sin /orbital period in tangential direction (per arc) Drag coefficients adjusted: 1 coef/4 hour except for Jason: 1 coef/half day
SAA compensation	Estimation of the beacon frequency Polynomial on SAA station per pass (for Jason-2 and Jason-3)
Time span processing	From July 2017 to January 2019 3.5-day arcs with a cut-off angle of 12°

Status of POD

❑ POD Summary

DORIS RMS of fit and SLR external validation

OPR Acceleration Amplitude Along-track and Cross-track / Radiation pressure coefficient

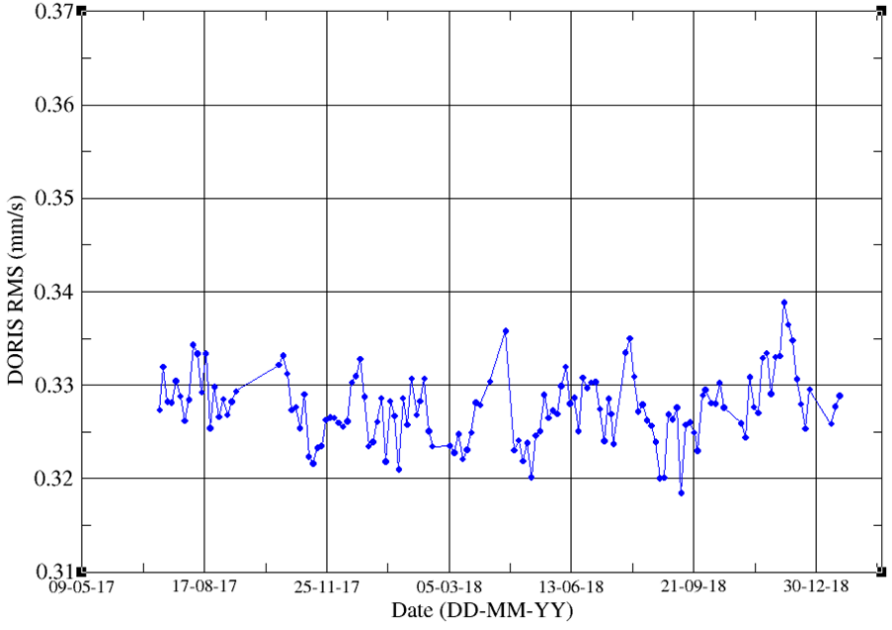
SATELLITE	DORIS RMS (mm/s)	SLR RMS (cm)	OPR amplitude average (10^{-9} m/s^2)		Solar radiation coefficient
			Along-track	Cross-track	
Jason-2	0.328	1.9	3.2	2.8	0.97
Jason-3	0.352	2.0	0.9	2.3	0.99
Sentinel-3A	0.361	1.4	2.5	1.6	1.00
Sentinel-3B	0.378	1.4	1.5	1.9	1.00
Cryosat-2	0.347	1.5	2.6	2.4	1.00
HY-2A	0.338	1.8	0.6	2.5	0.86
Saral	0.330	1.4	1.4	2.0	1.00

- *For the two directions, Along-track and Cross-track, the mean amplitudes are lower than $4x10^{-9}$ m/s^2, reflecting a satisfying level in the modeling of the satellite macromodels and the attitude law.*
- *The DORIS-only orbits have also been evaluated by an independent SLR measurements processing. SLR residuals on DORIS-only orbits are of a good level.*

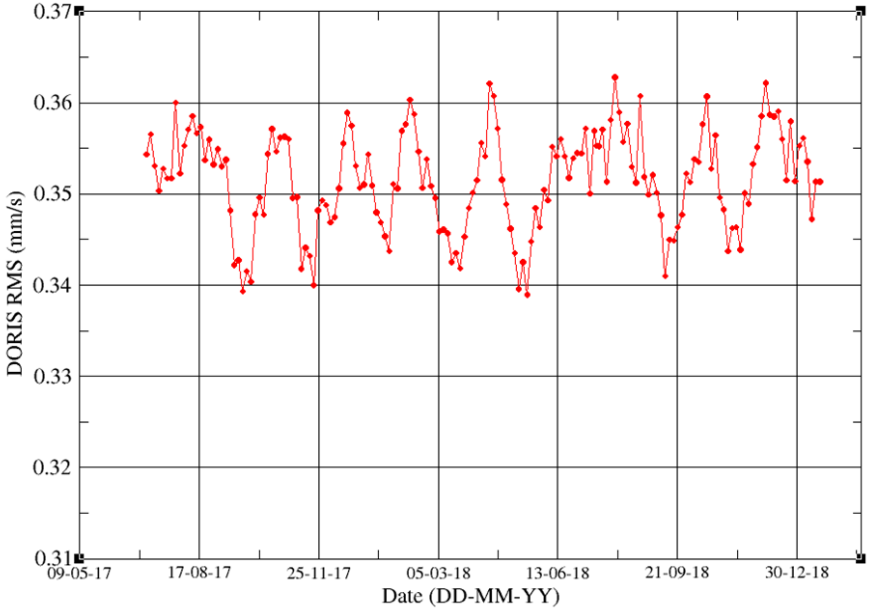
Status of POD for Jason-2 and Jason-3 satellites

❑ DORIS RMS of fit

Jason-2



Jason-3



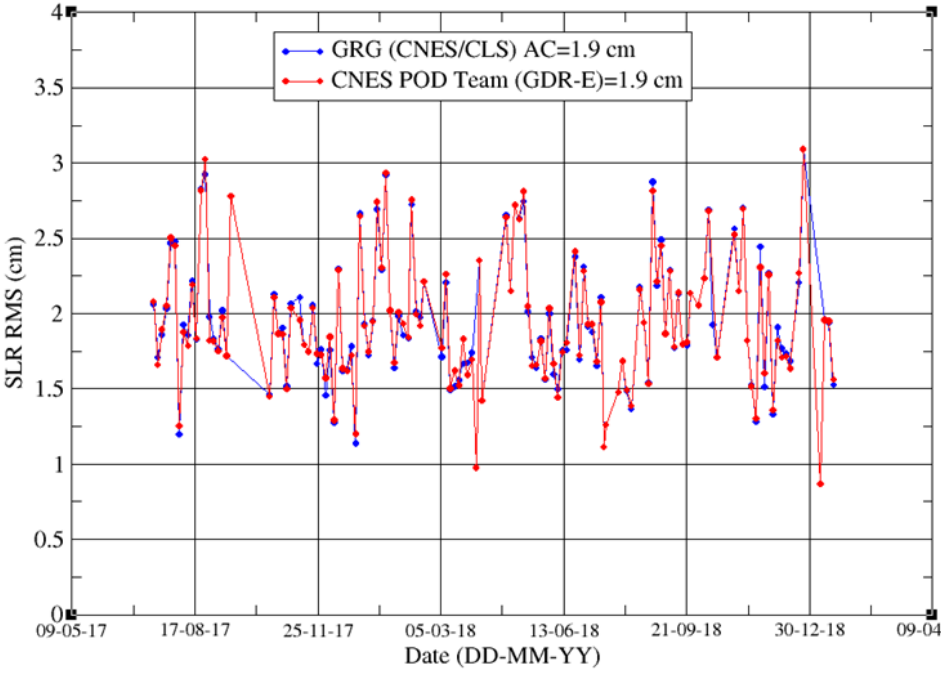
- *For Jason-3, the level of DORIS RMS residuals is slightly higher compared to Jason-2, explained by its higher sensitivity to the SAA.*
- *There is a ~59 days periodic signal for both satellites, even when we use quaternions for attitude satellite.*

Status of POD for Jason-2 and Jason-3 satellites

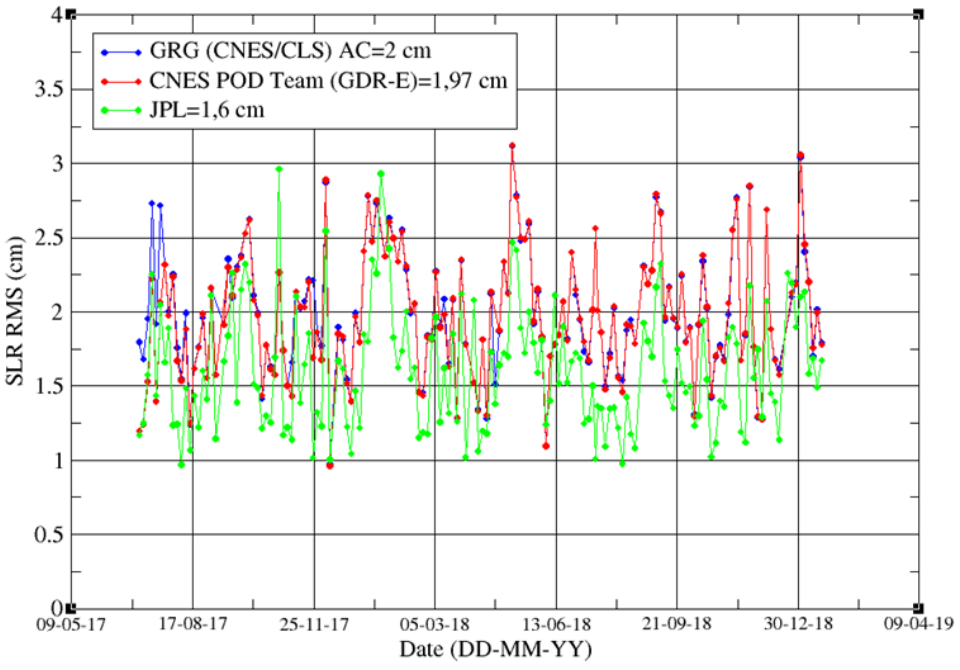
❑ Comparison to CNES POD team (GDR-E) and JPL orbits

Independent SLR RMS of fit

Jason-2



Jason-3



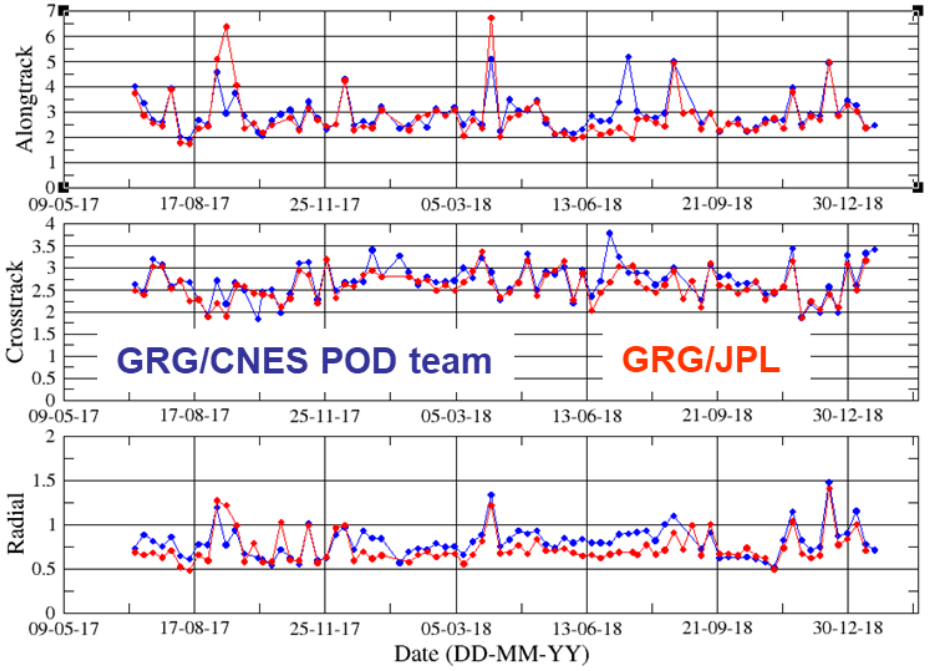
- *The level is comparable to the other orbits evaluated, precise orbit DORIS+GPS of CNES POD team, GPS-only orbit of JPL (for Jason-3).*

Status of POD for Jason-3 satellites

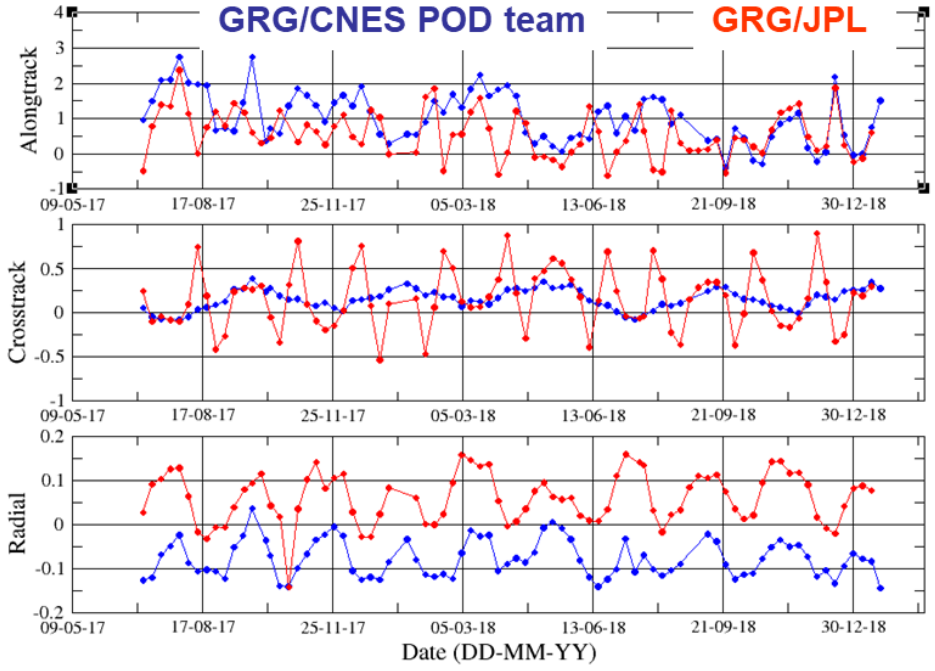
❑ Comparison to CNES POD team (GDR-E) and JPL orbits

Jason-3 orbit differences *(from July 2017 to January 2019)*

RMS of orbit differences (in cm)



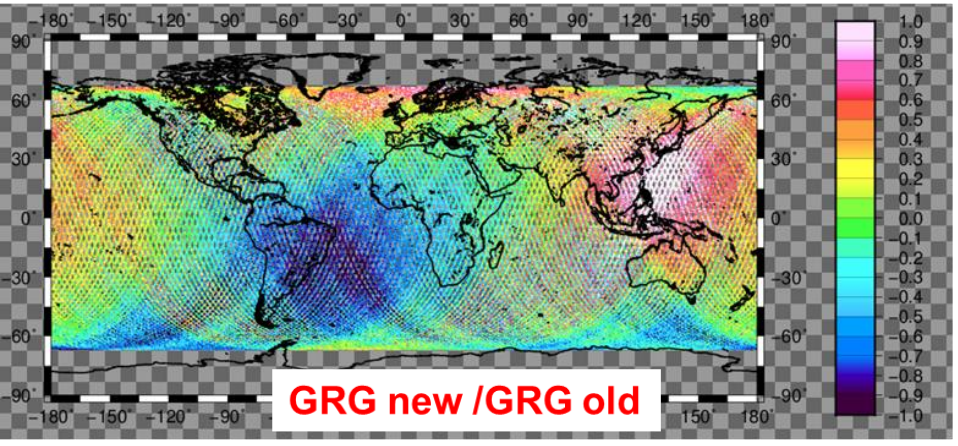
Mean of orbit differences (in cm)

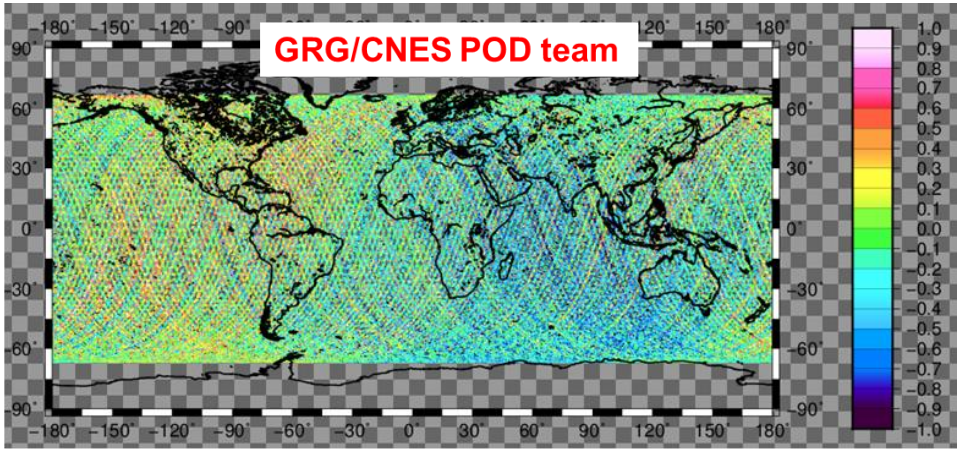


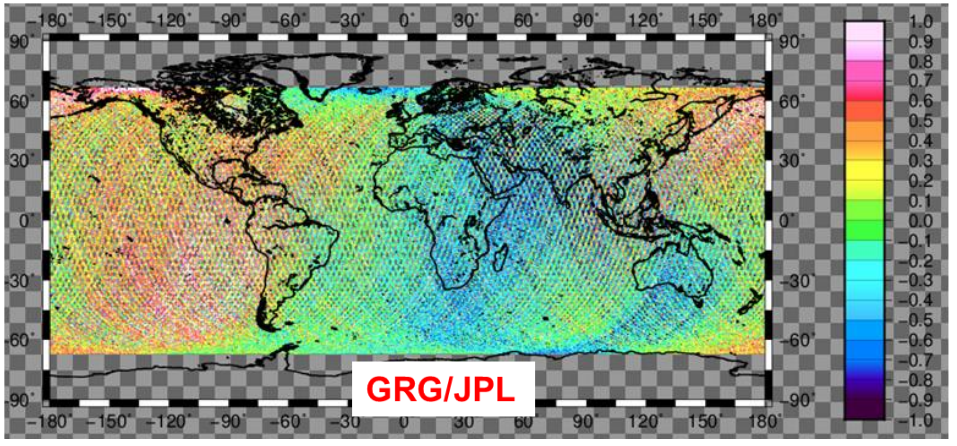
- *There is a good agreement between our orbits and the others but there is a tangential bias ~1 cm which could be explained by a difference in the time tagging of the DORIS and GPS measurements. This bias is present for all GPS orbit comparisons. There is also a signal at ~59 days in the average of the radial component, still present even when we use measured quaternions BUS + solar panels angles.*

Status of POD for Jason-3 satellites

❑ **Radial Orbit differences *(geographically correlated errors, 2° by 2° grids)* Jason-3 orbits** *(from July 2017 to January 2019)*







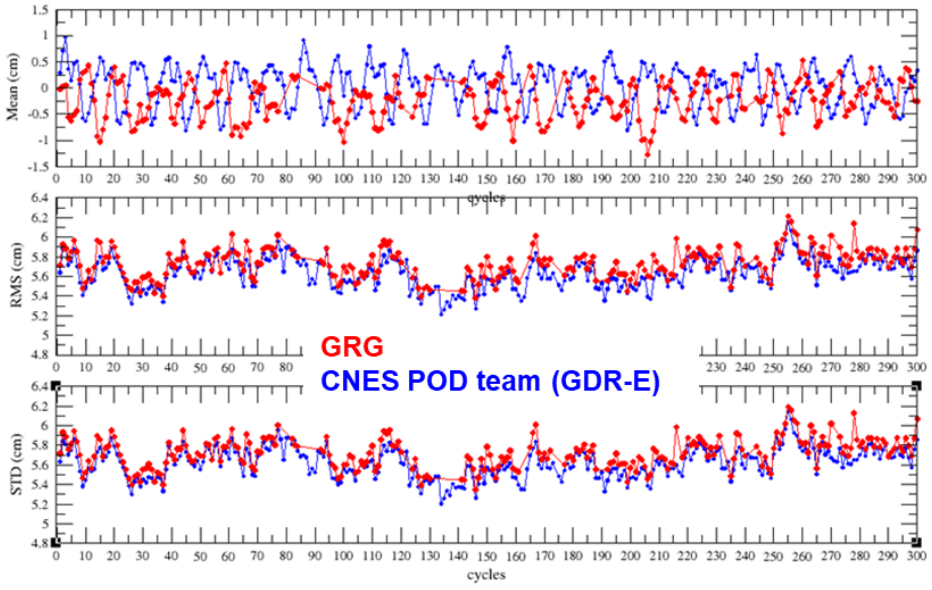
- *Impact of new gravity field and new Ocean tide models*
- *The agreement is better between GRG orbit and CNES POD team orbit than JPL orbit.*

Status of POD for Jason-2 and Jason-3 satellites

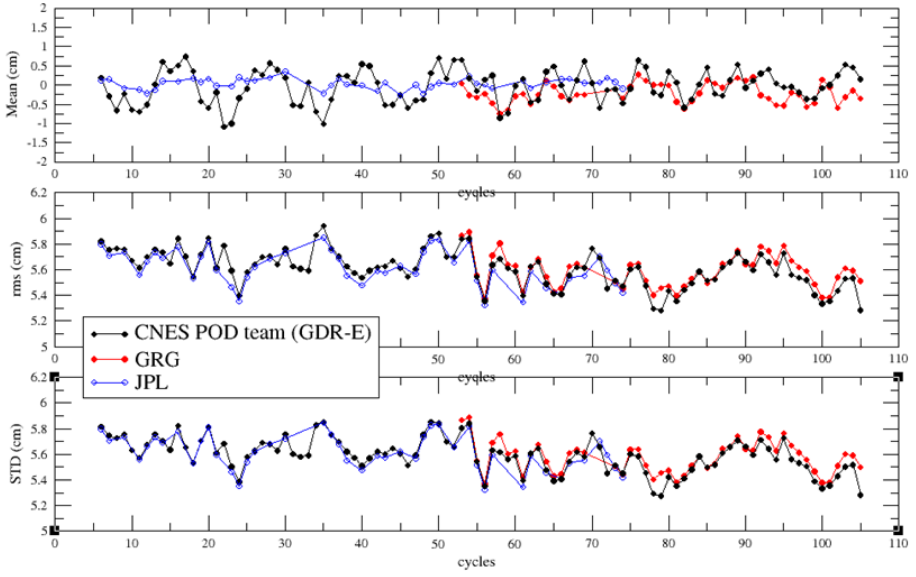
❑ Sea Surface Height differences at crossover per cycle

(from July 2017 to January 2019)

Jason-2



Jason-3



- *For Jason-2, the STD and RMS of the SSH differences are at the same level for the CNES POD team orbit and GRG orbit. For Jason-3, the statistical results are also very similar to the external orbits (from CNES POD team and JPL)*

Sentinel-3A&B - GRG DORIS-only orbits

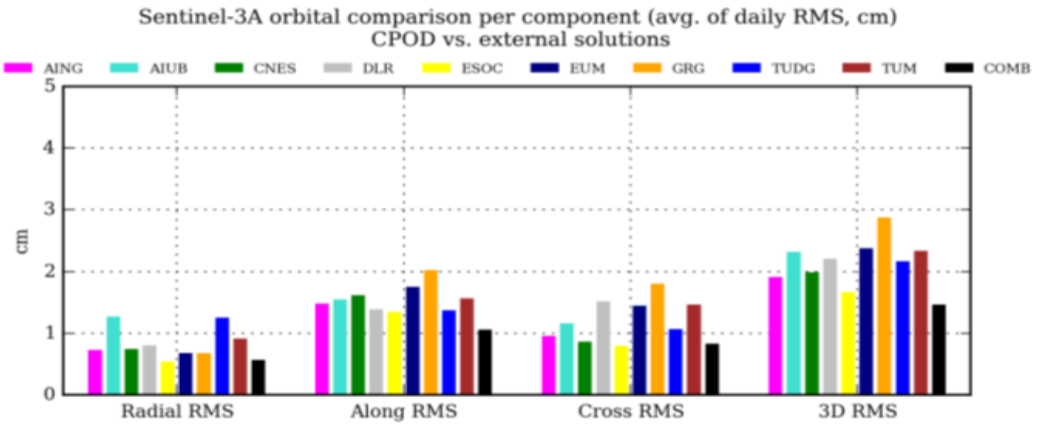
❑ Comparison to CPOD QWG GPS-only orbits

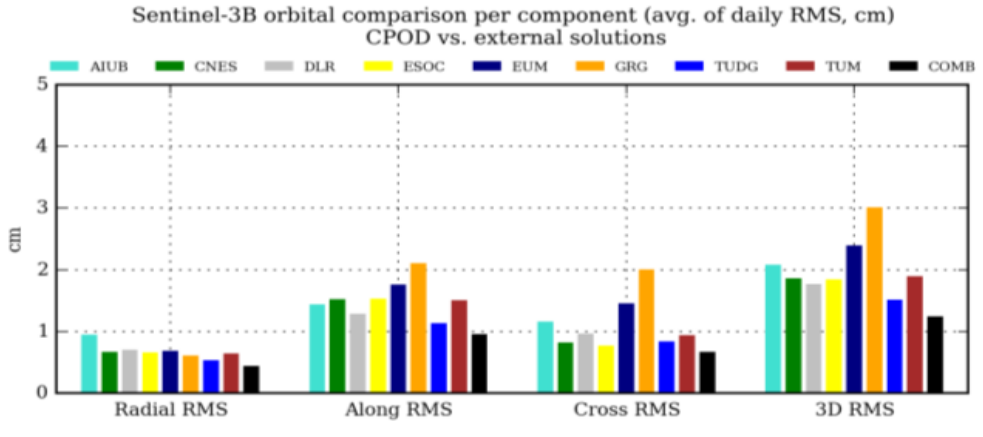
Results from GMV (J. Fernandez)

Sentinel-3A&B orbit differences

RMS of orbit differences (in cm)

Reference orbit: CPOD





- *The GRG DORIS-only orbit calculated with GINS is at the same level for radial component. The other orbits are all determined from GPS measurements.*

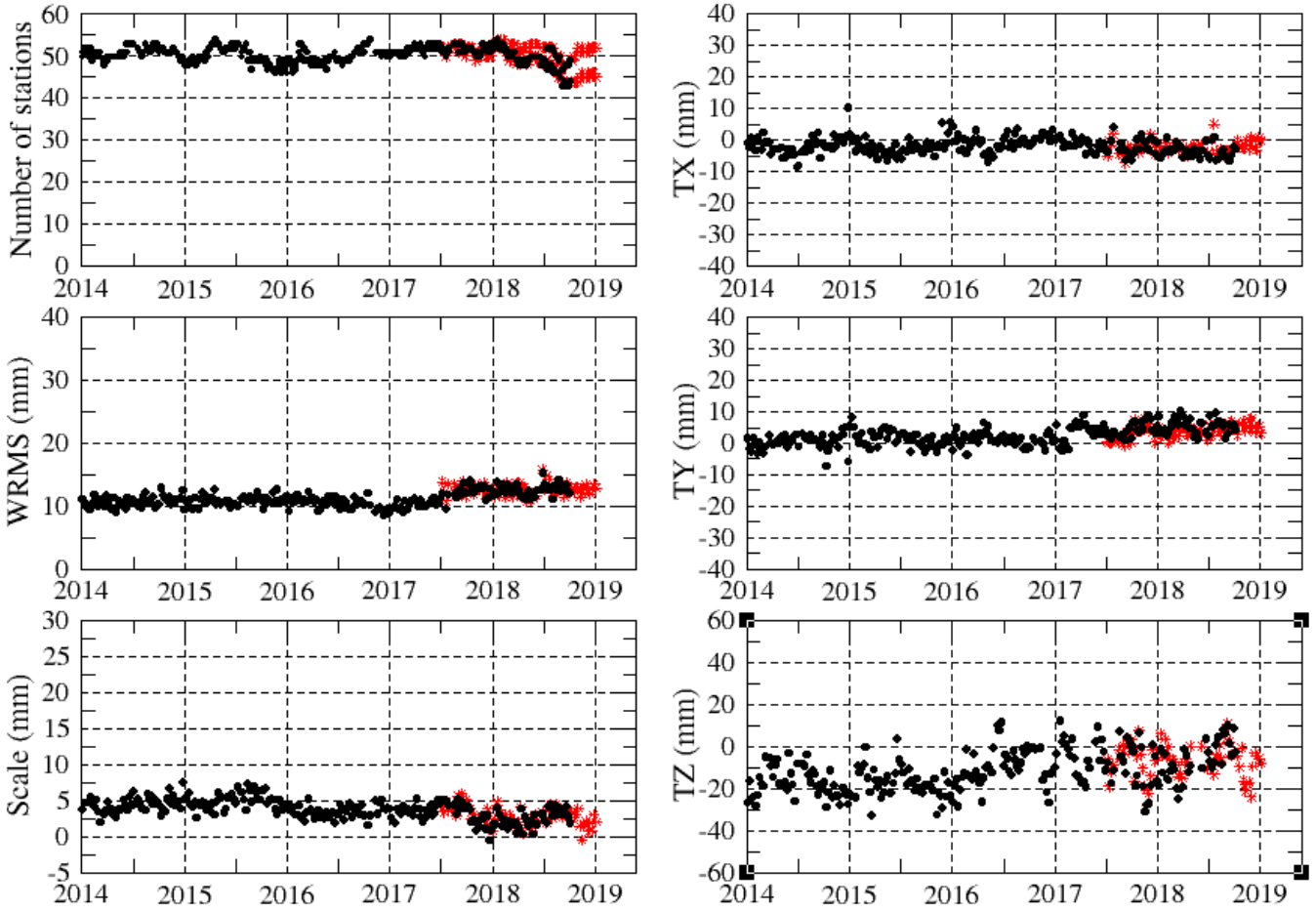
Improvement of the CNES/CLS IDS Analysis Center solution

❑ Impact on the positioning

Multi-satellite satellite Solution compared to DPOD2014 (computed by CATREF)

Differences between the solution with OLD and NEW configuration

(In red NEW multi-satellite solution)



CONCLUSIONS AND PERSPECTIVES

- For Jason and Sentinel satellites, there is a good agreement between the GRG orbits and other orbits (DORIS+GPS from CNES POD team and GPS-only orbits from JPL and CPOD).
- For Jason satellites, there is a ~59 days periodic signal visible in DORIS RMS and in the radial differences with other orbits for both satellites, even when we use quaternions.

- We plan to make a reduced dynamic orbit for Jason-3 satellite.
- We will continue our preparation to the next ITRF:
  implementation and tests of models recommended by IERS and IDS as *HF EOP model, …*
- Improvement of the GRG IDS AC solution
  - Analyze Geocenter and Scale factor from single satellite solutions (in progress)

Estimation of the distance between the satellite CoG and DORIS CoP (done for Sentinel satellites and Envisat).

Same analysis to be done for the other DORIS satellites

- GRG orbits evaluation by orbit comparison and by external validations as SLR measurements processing as well as through the use of altimeter crossovers.