Jason-3 mission performance towards GDR-F

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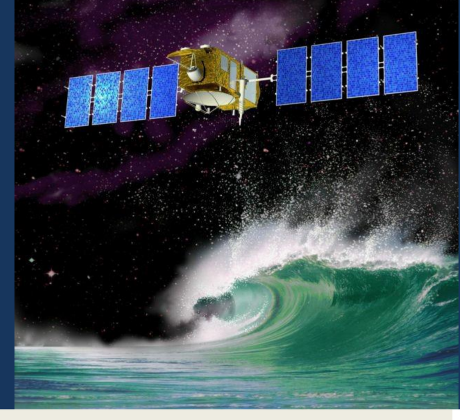

TOPEX/Poseidon, Jason-1, Jason-2, and then Jason-3 have allowed to build a high-precision ocean altimetry data record on historical ground track and will be followed in few years by Jason-CS/Sentinel-6.
A precise knowledge of Jason-3 data quality and errors is a key activity to ensure a reliable service to scientists involved in climate change studies as well as operational oceanography. As Jason-3 is the reference mission used in operational applications or for delayed time studies and especially for monitoring of the Global Mean Sea Level, the assessment of Jason-3 data quality is particularly important and we pay special attention to the long-term stability of Jason Global Mean Sea Level (GMSL).
Long-term monitoring of the Jason altimetric system is routinely performed at CLS, as part of the CNES SALP (Système d'Altimétrie et Localisation Précise) project. The main objective of this activity is to provide an estimation of the mission performances for oceanic applications such as mesoscale or climate studies.

The monitoring of all altimeter and radiometer parameters is also routinely performed in order to detect jumps or drifts. After three years in orbit as a precise altimeter mission, two successive Jason-3 Safe Hold Modes occurred at the beginning of 2019. In this presentation we will give an overview of Jason-3 data coverage and data quality concerning altimeter and radiometer parameters, but also the performance of delayed and real time products (GDR, IGDR, OGDR/OSDR) at mono-mission crossovers and along-track.
Finally, in order to prepare Jason-CS/Sentinel-6 launch, reprocessing of Jason-3 GDR in standard F will begin in few months. We aim at presenting the overall performance of Jason-3 through different metrics highlighting the high-level accuracy of this mission and we will also focus on the way the future reprocessing would impact Jason-3 dataset.

Data used	GDR-D	GDR-F
Orbit	c001 -> c094 : POE-E c095 onwards : POE-F	**POE-F**
Range	MLE4	MLE4
MSS	2001 (ref. over 7 years)	**CNES/CLS 2015**
Wet Tropo	JMR	JMR
Dry Tropo	ECMWF OPE	ECMWF OPE
Pole Tide	WAHR85 MPL legacy	**DESAI2015/ mpl2017**
Solid Earth Tide	Cartwright and Edden [1973]	Cartwright and Edden [1973]
Ocean Tide	GOT4.8	**FES14B (34 waves)**
InternalTide	N/A	**ZARON (M2,K1,S2,O1)**
IB/DAC	ECMWF + LEGOS/CLS/CNES	ECMWF + LEGOS/CLS/CNES
SSB	NonParametric fitted on J2 data	**NonParametric Tran2018 fitted on J3**
Ionospheric correction	Dual Frequency	Filtered solution

POE-F orbit versus POE-E solution

[*Note that POE-F orbit has been included in GDR product since cycle 095*]

Cyclic mean of the differences between the two orbit solutions is stable in time (variations <+/- 1mm).
POE-E and POE-F are differently computed out of yaw fix period. From mid-2017 onwards, yaw fix periods are longer, so that the impact on the orbit differences is lower (the standard deviation of the difference between the two solutions is slightly lower from mid-2017 onwards).

The map of the differences between the two orbit solutions, computed over 85 cycles shows no global bias (mean < 0.01cm). This is coherent with Fig.1. Geographically correlated patterns can reach +/-0.6cm, but are not stable in time (not shown here)

Variance of SSH differences at crossovers are compared using different solutions as a key performance indicator.
In our cases, a global gain >0.2cm² using POE-Fin SSH computation compared to SSH POE-E indicates an improvement.

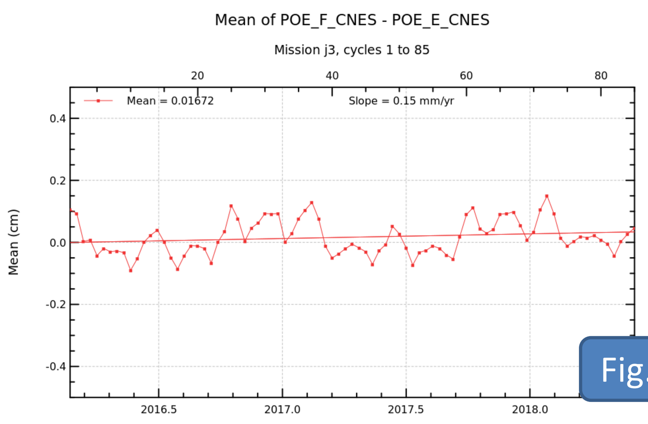

Fig.1

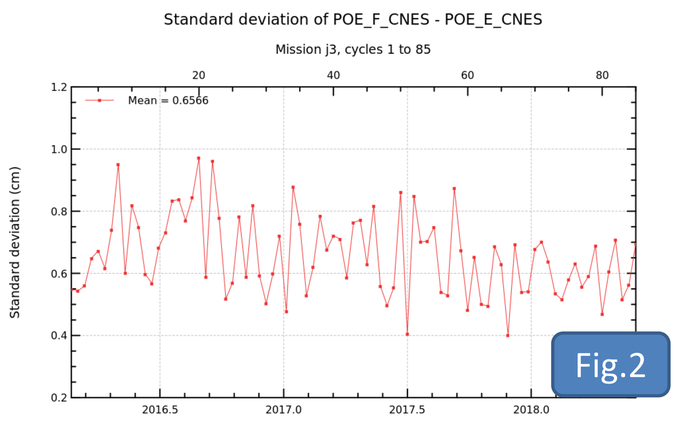

Fig.2

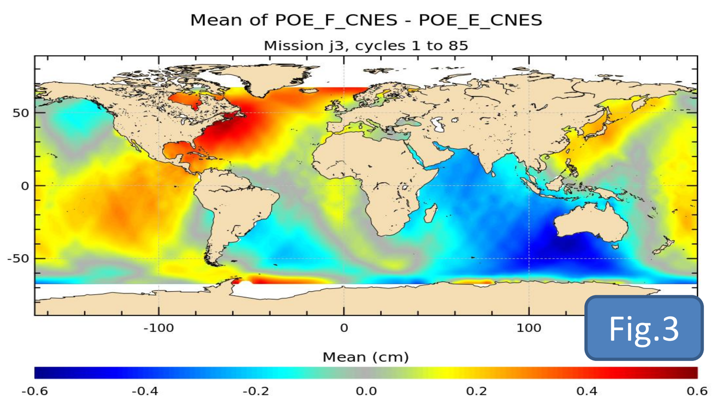

Fig.3

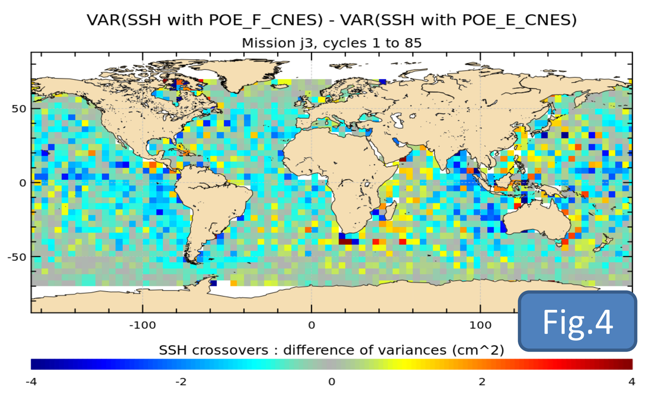

Fig.4

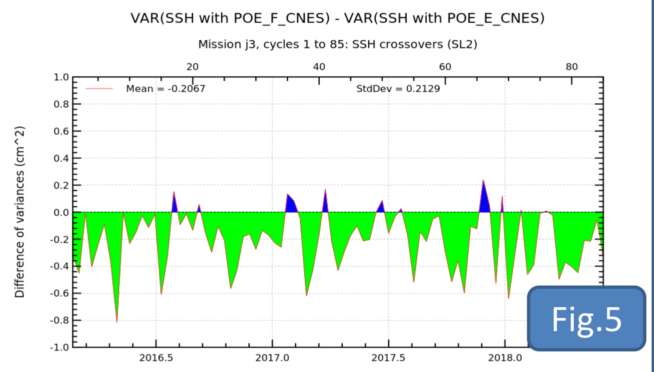

Fig.5

Pole tide

The pole tide altimeter correction is used to correct the response of the solid Earth and Oceans to the polar motion. The Wahr (1985) model has been used for all missions since TOPEX and another model is now available (Desai 2015). Legeais et al. [in 2015] showed the last model has a significant positive impact on the regional mean sea level trends and the comparison with independent in-situ data (Argo profiles) has demonstrated that the use of this model reduces the amplitude of the annual signal of the global mean sea level. A new recommendation for Mean Pole Location equation was done in 2017. This equation has been applied to both Wahr (1985) and Desai (2015) models. The model for the linear mean pole is recommended based on a linear fit to the IERS C01 time series spanning 1900 to 2015: in milliarcsec, Xp = 55.0+1.677*dt and Yp = 320.5+3.460*dt where dt=(t-t0), t0=2000.0 and assuming a year=365.25 days. The new mean pole location equation has a significant impact on the regional mean sea level trends thanks to the remove of the long term mean pole drift in pole tide computation.
The impact on performance indicators and
Global Mean Sea Level is negligible (not shown here).

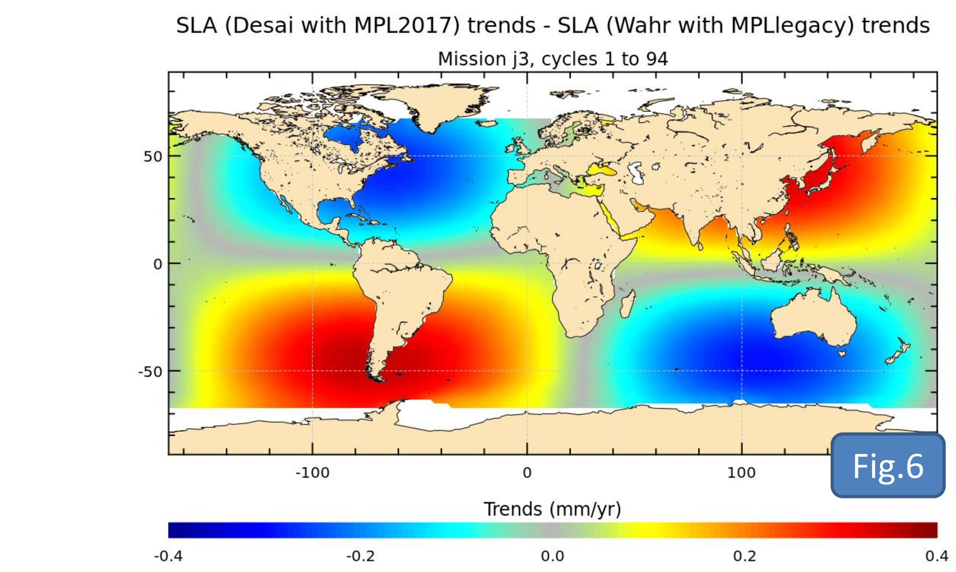

Fig.6

Impact of MPL on Wahr solution :

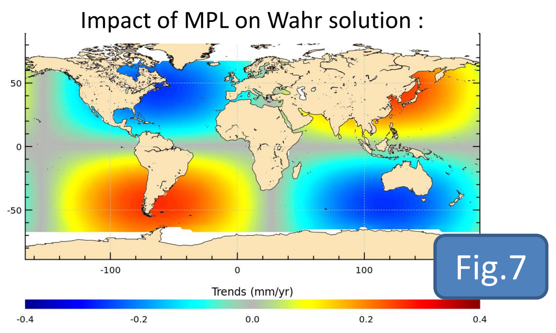

Fig.7

Differences between Desai 2015 and Wahr85 with both MPL2017 :

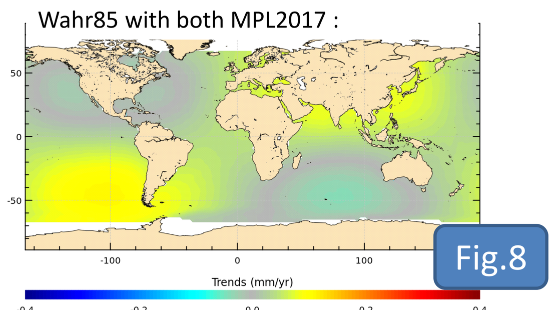

Fig.8

Internal tide

To take into account internal tide corrections improves SSHA performance indicators on along-track Sea Level Anomaly and error at crossover: altimeter performance indicators are computed with or without considering internal tide model as a correction of range. The results presented are computed with Zaron model for M2, K1, O1 and S2 waves. Over Jason-3 period, there is no significant impact on SSH difference at crossover points or on Global Mean Sea Level trend estimation taking into account internal tides or not (not shown here). Variance of SSH differences at crossovers are compared using different solutions as a key performance indicator. In our cases, a global gain close to 0.5cm² using internal tides compared to SSH without this correction indicates an improvement, with significant geographically correlated patterns where internal tides areas are defined. In the same way, a reduction is visible in case of global along-track SLA variance (>0.2cm²), with geographical patterns.

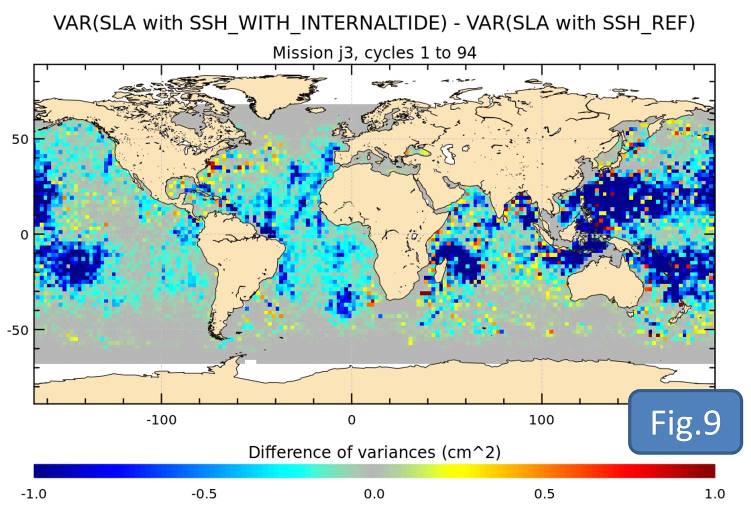

Fig.9

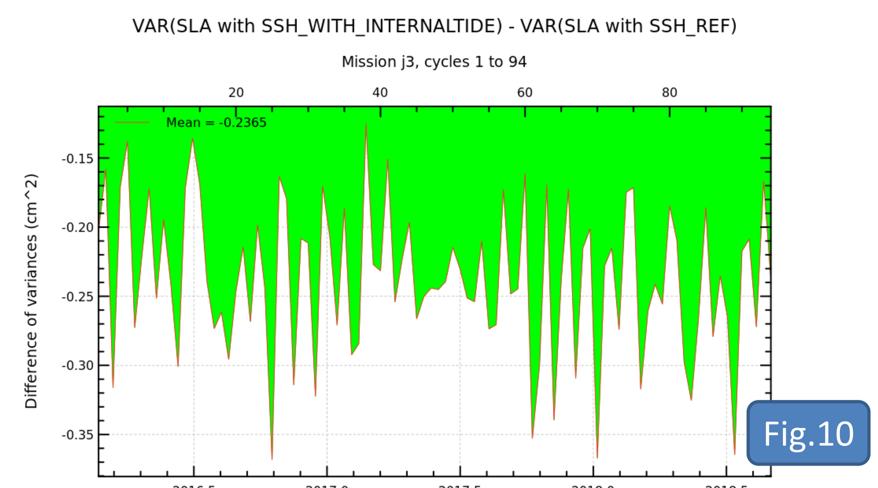

Fig.10

Ocean tide

Using the latest global tide models (GOT4.10 or FES2014b) instead of GOT4.8 or FES2012 improves the coherence between ascending and descending passes. The global variance reduction of SSH crossover variance when using FES2014b instead of GOT4.8 has a value of about 0.5 cm² (Fig.11) . Results are improved in many places, in deep ocean, in shallow waters, and at latitudes>50°. Nevertheless, variance at SSH crossovers is slightly lower with GOT4.8 on the western coast of South America. Standard deviation of SLA is slightly lower using FES2014b than with GOT4.8 (Fig.13): the differences are mainly located near coasts.
Global Mean Sea Level is equivalent with both solutions (GOT4.10 and FES2014, not shown here).Regional differences between SLA using FES2014 or GOT4.10 is not significant.

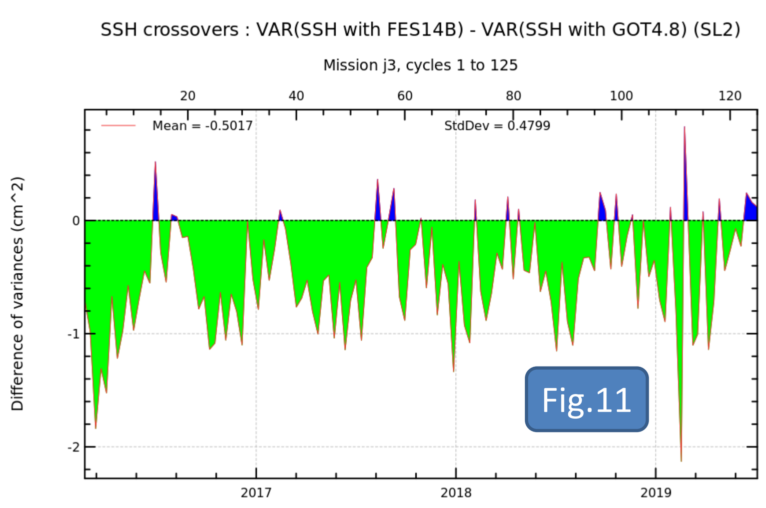

Fig.11

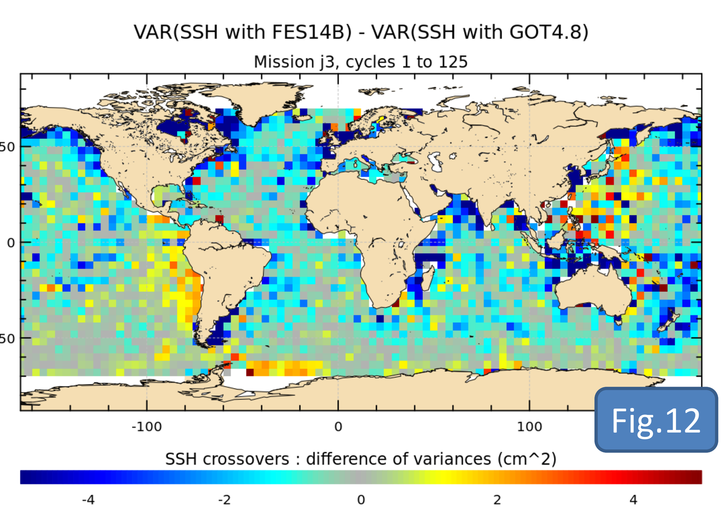

Fig.12

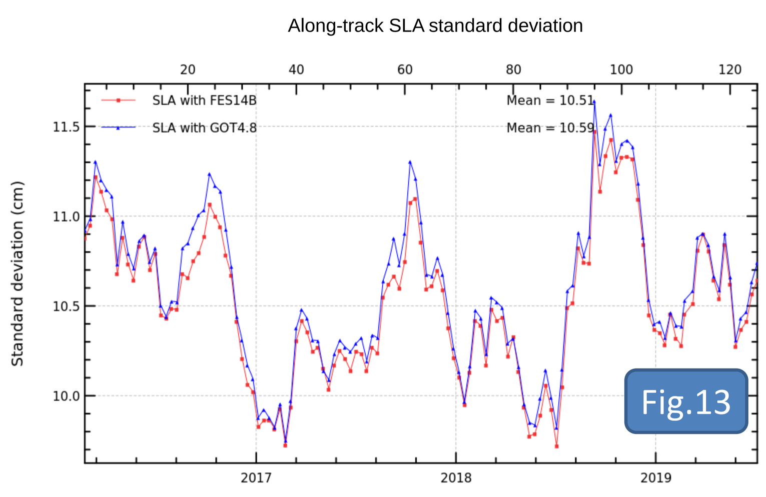

Fig.13

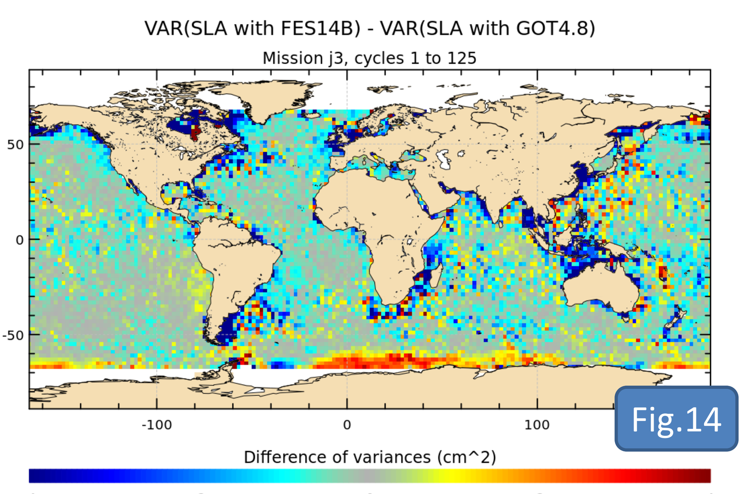

Fig.14

CONCLUSIONS
Total impact on SSH differences at crossover points and along-track SLA

Global improvements due to combined evolutions are:

- ✓ Mean of SSH differences at crossover points is nearest 0 using GDR-F. In addition, 120 days signal is reduced thanks to new orbit solution.
- ✓ Error from crossovers analysis is reduced from 3.7cm to 3.4cm (variance gain of 4.2cm², mainly due to filtering of ionosphere correction (3cm²), internal tide (0.5cm²), ocean tide (0.5cm²) and orbite (0.2cm²)).
- ✓ Along-track SLA standard deviation is also reduced from 11.2cm to less than 10.6cm.

The impact on Global MSL is negligible (<0.1mm/yr) but impact at regional scales)

Additional improvements could be available on radiometer solutions, Dynamical Atmospheric Correction or Mean Sea Surface for example.
Alternative solutions as adaptive retracking or 3D ssb will also be available in GDR-F products.

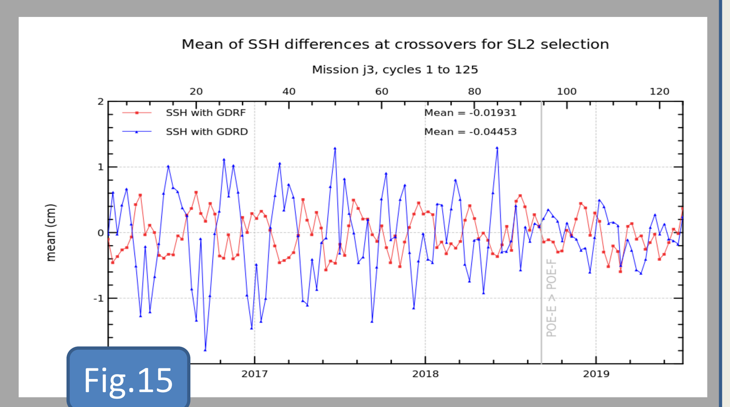

Fig.15

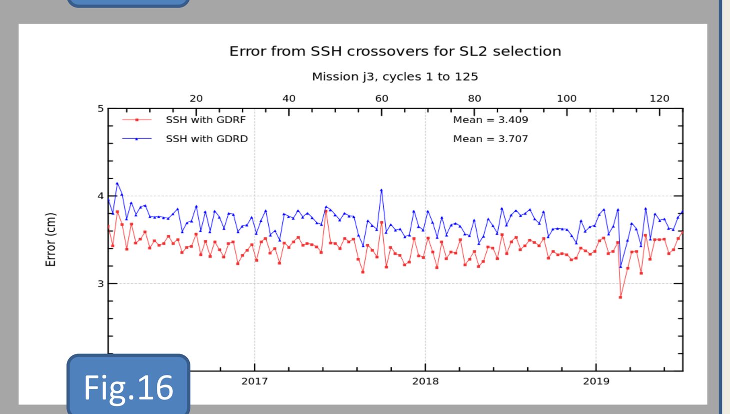

Fig.16

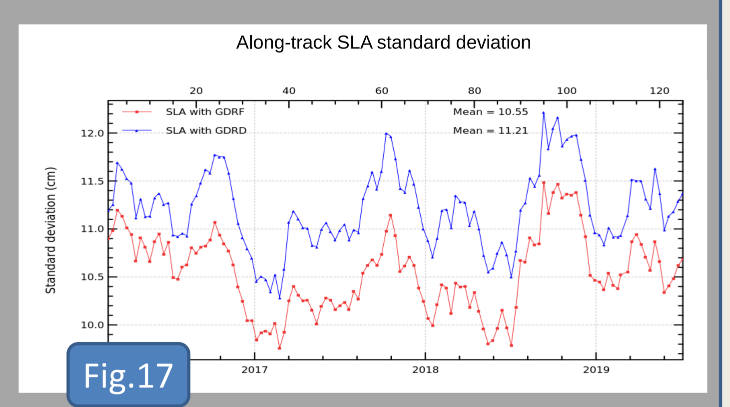

Fig.17

[**see also** Poster_OSTST19_CVL_005: « Improving Conventional Altimetry, Innovative LRM retracking »].

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