

# The first 3 years of Sentinel-3 altimetry (Marine Centre)

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# Outline

- Product Portfolio and Mission dataset
  - Past and Future
- Analysis of Reprocessing 2018 + NTC dataset
  - Radiometer Wet Tropo Correction
  - Altimeter Wind Speed
  - SWH
  - SLA
- Conclusions and Outlook

# Marine Product Portfolio (ALT)

| Status   | Product                                 | EUMETCast<br>(NRT/STC) | ODA<br>CODA | Data<br>Centre | AVISO+ | CMEMS | Timeliness    |
|--|---|------------------------|-------------|----------------|--------|-------|---------------|
| <b>S3A:<br/>operational</b><br><br><b>S3B:<br/>operational<br/>(since December<br/>2018)</b> | SRAL L1A                                |                        | ✓           | ✓              |        |       | STC, NTC      |
|  | SRAL L1B                                | ✓                      | ✓           | ✓              |        |       | NRT, STC, NTC |
|  | SRAL L1BS                               |                        | ✓           | ✓              |        |       | STC, NTC      |
|  | SRAL L2 WAT                             | ✓                      | ✓           | ✓              |        |       | NRT, STC, NTC |
|  | SRAL L2P SLA<br>(produced by CNES/CLS)  | ✓                      |             |                | ✓      |       | NRT, STC, NTC |
|  | SRAL L3 SLA<br>(produced by CNES/CLS)   |                        |             |                |        | ✓     | NRT/STC, NTC  |
| <b>New<br/>Products<br/>(Operational<br/>since Mid-2019)</b>                                 | SRAL L2P WAVE<br>(produced by CNES/CLS) | ✓                      |             |                | ✓      |       | NRT           |
|  | SRAL L3 WAVE<br>(produced by CNES/CLS)  |                        |             |                |        | ✓     | NRT           |
|  | SRAL L2 BUFR<br>(NRT only)              | ✓                      |             |                |        |       | NRT           |

# Information to the users

## Details on the Evolutions, Anomalies and notices about each PB can be found in the Product Notices:

<https://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Sentinel3/AltimetryServices/index.html>



### Sentinel-3 Product Notice – STM L2 Marine

|                   |  |
|-------------------|--|
| Mission           | S3A & S3B  |
| Sensor            | SRAL/MWR   |
| Product           | L2 NRT, STC and NTC (Marine Products)  |
| Product Notice ID | EUM/OPS-SEN3/DOC/16/893228   |
| Issue Date        | 6 February 2019  |
| Version           | v11 e-signed   |
| Preparation       | This Product Notice was prepared by EUMETSAT with the support of the ESA and S3 Mission Performance Centre experts |
| Approval          | EUMETSAT Mission Management  |

### Summary

This document is the Product Notice for the public release of Sentinel-3A & 3B Surface Topography Mission (STM) Level-2 Near Real Time (NRT), Short Time Critical (STC) and Non-Time Critical (NTC) products generated at the Marine Centre, EUMETSAT.

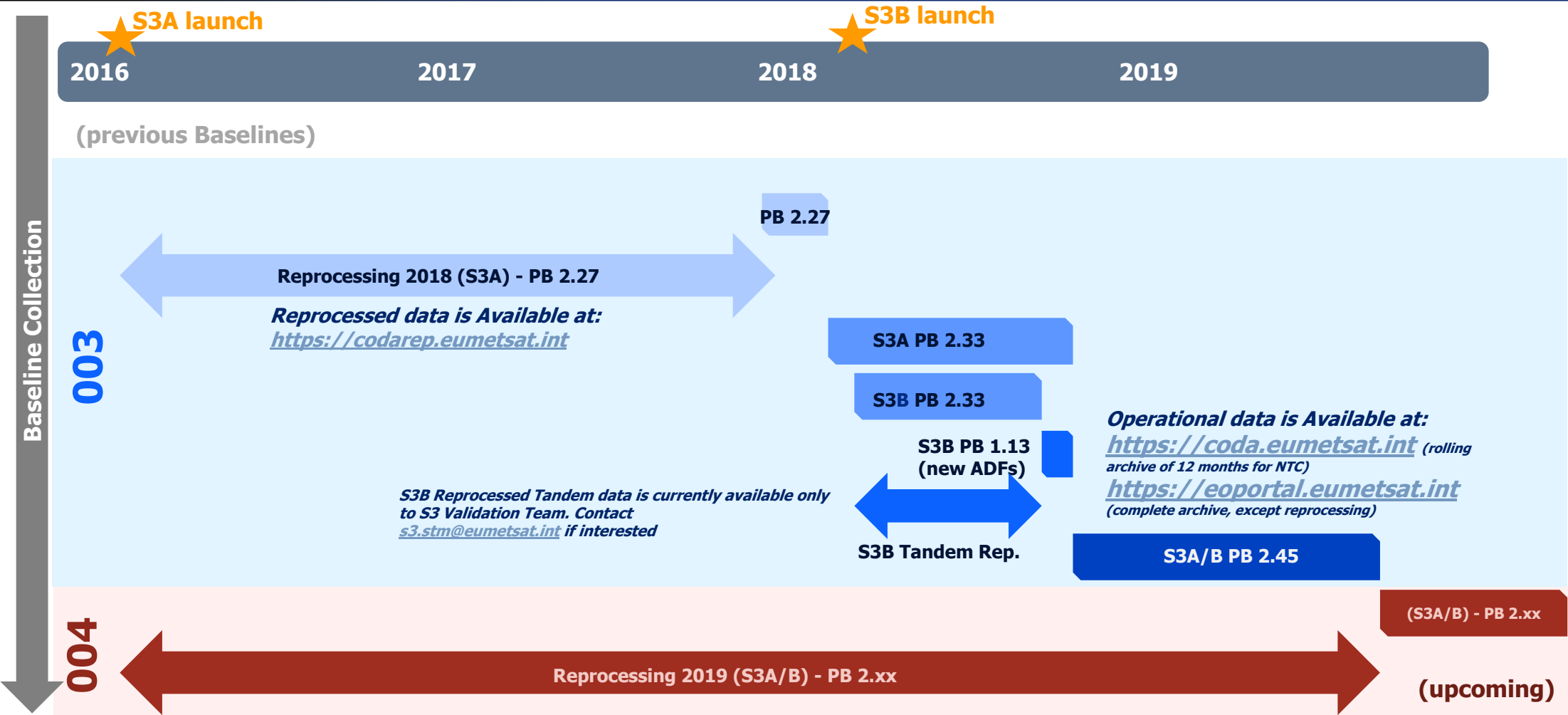
This Product Notice describes the STM current status, processing baseline, product quality and limitations, and product availability status.

## Timeline and Overview of the SRAL/MWR Processing Baselines of Sentinel-3 is available on the web:

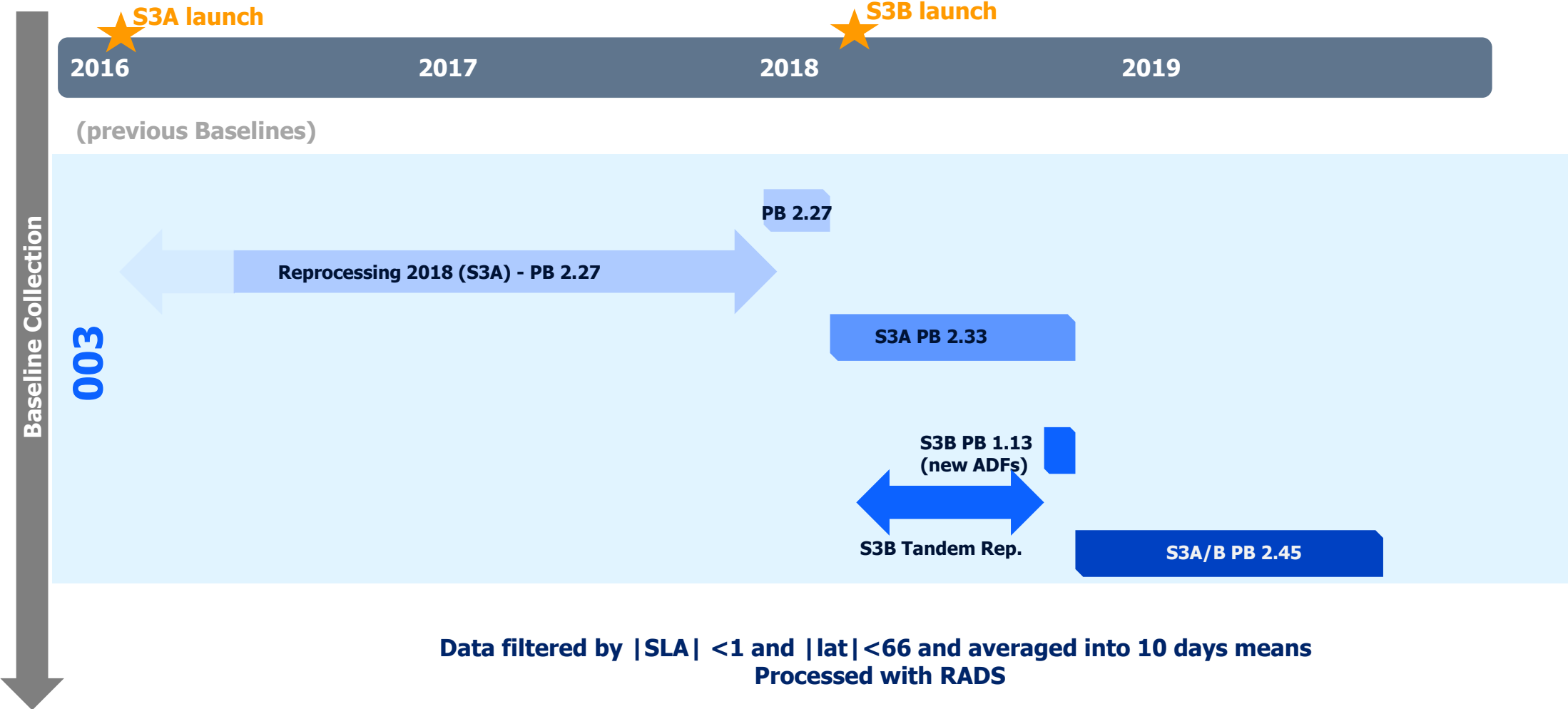
<https://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Sentinel3/AltimetryServices/Processingbaselines/index.html>

Contact: [ops@eumetsat.int](mailto:ops@eumetsat.int) or [s3.stm@eumetsat.int](mailto:s3.stm@eumetsat.int)

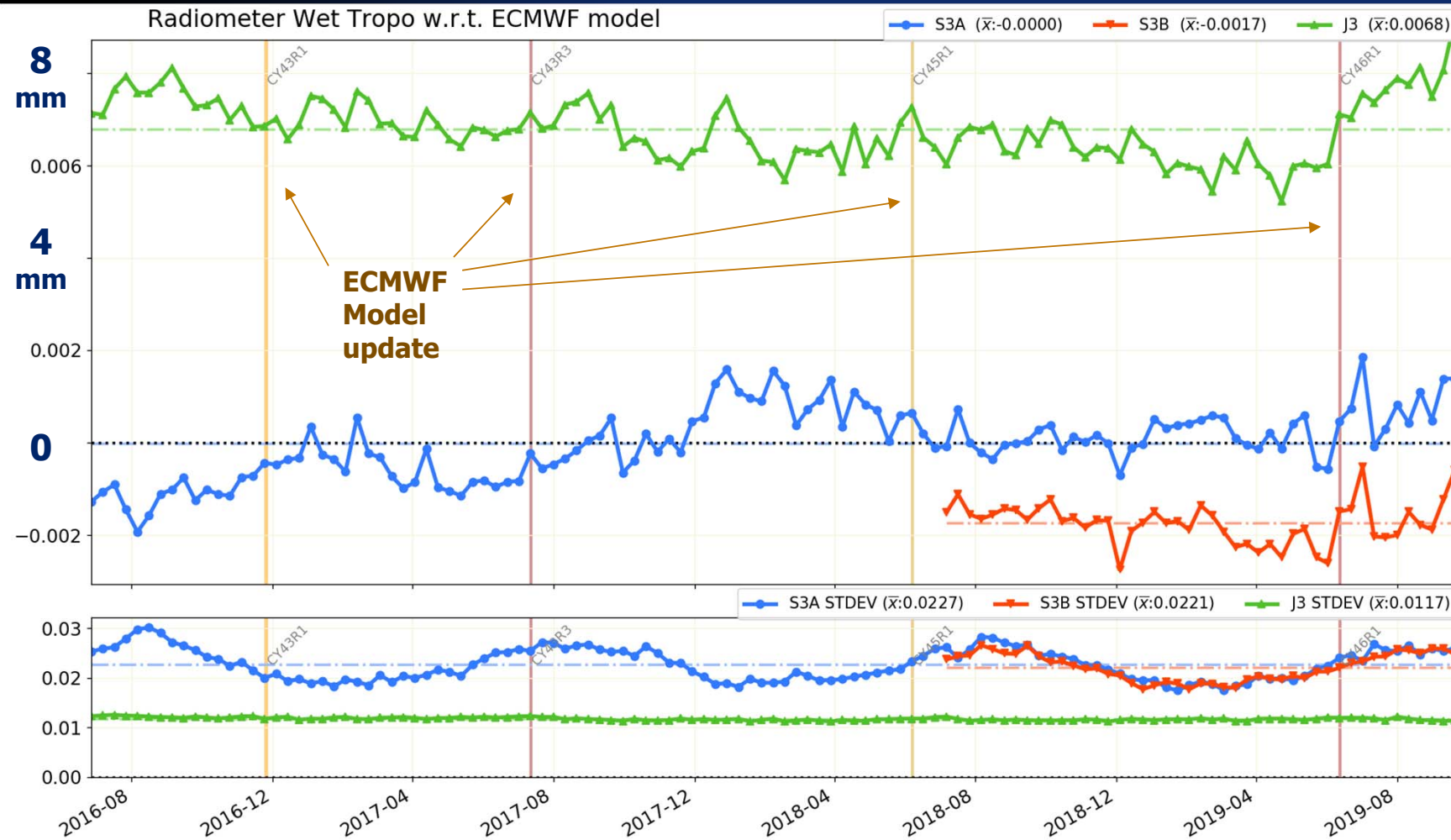
# Mission Dataset (current and future)



# Mission Dataset - analysed in the next slides



# Wet tropo correction X ECMWF Model



**Jason3**  
**Sentinel-3A**  
**Sentinel-3B**

**Good agreement of S3A and S3B with ECMWF's model, lower mean difference.**

**Better std dev. in J3.**

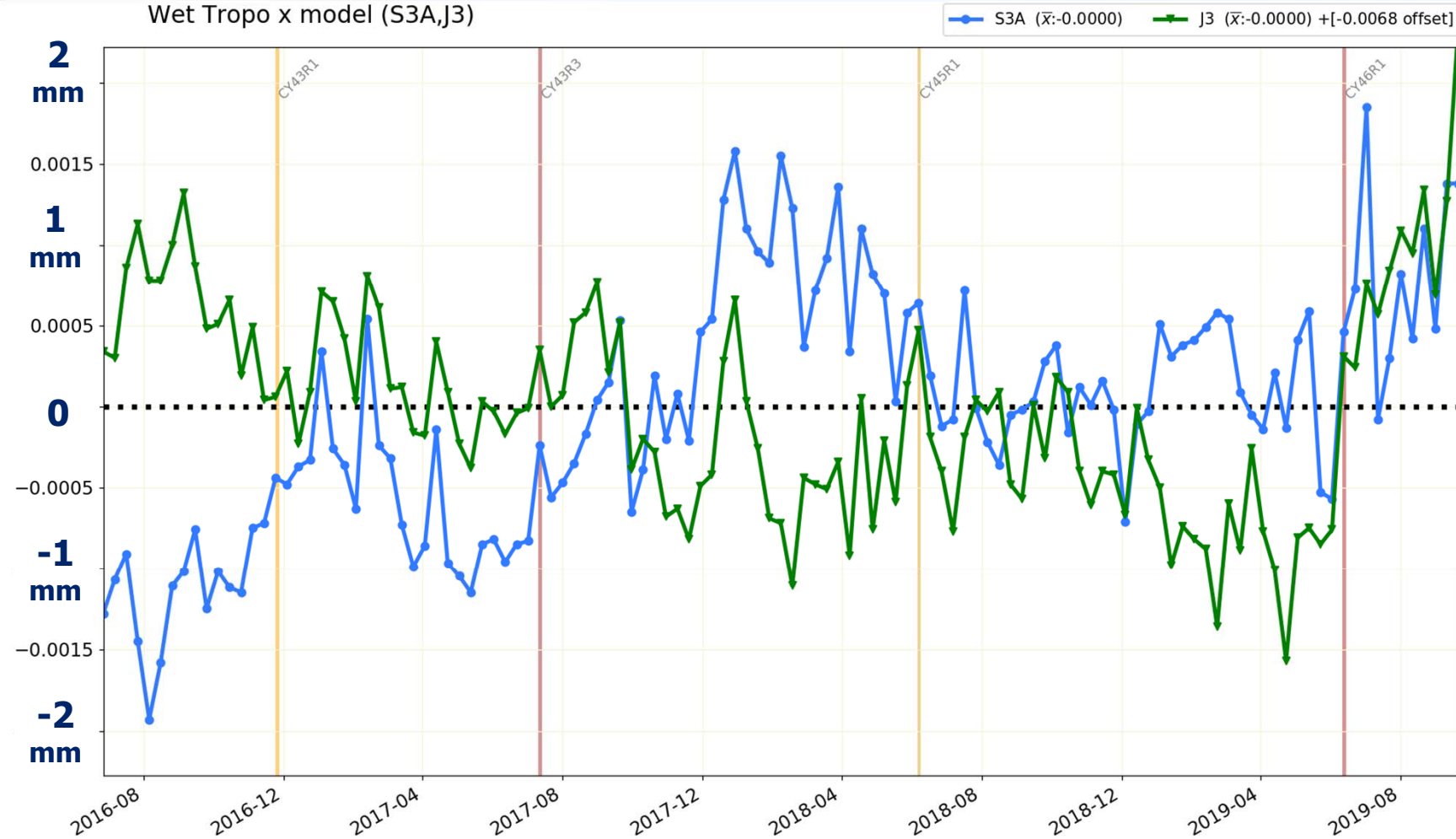
**No apparent trends visible.**



# Wet tropo correction X ECMWF Model



Wet Tropo x model (S3A,J3)



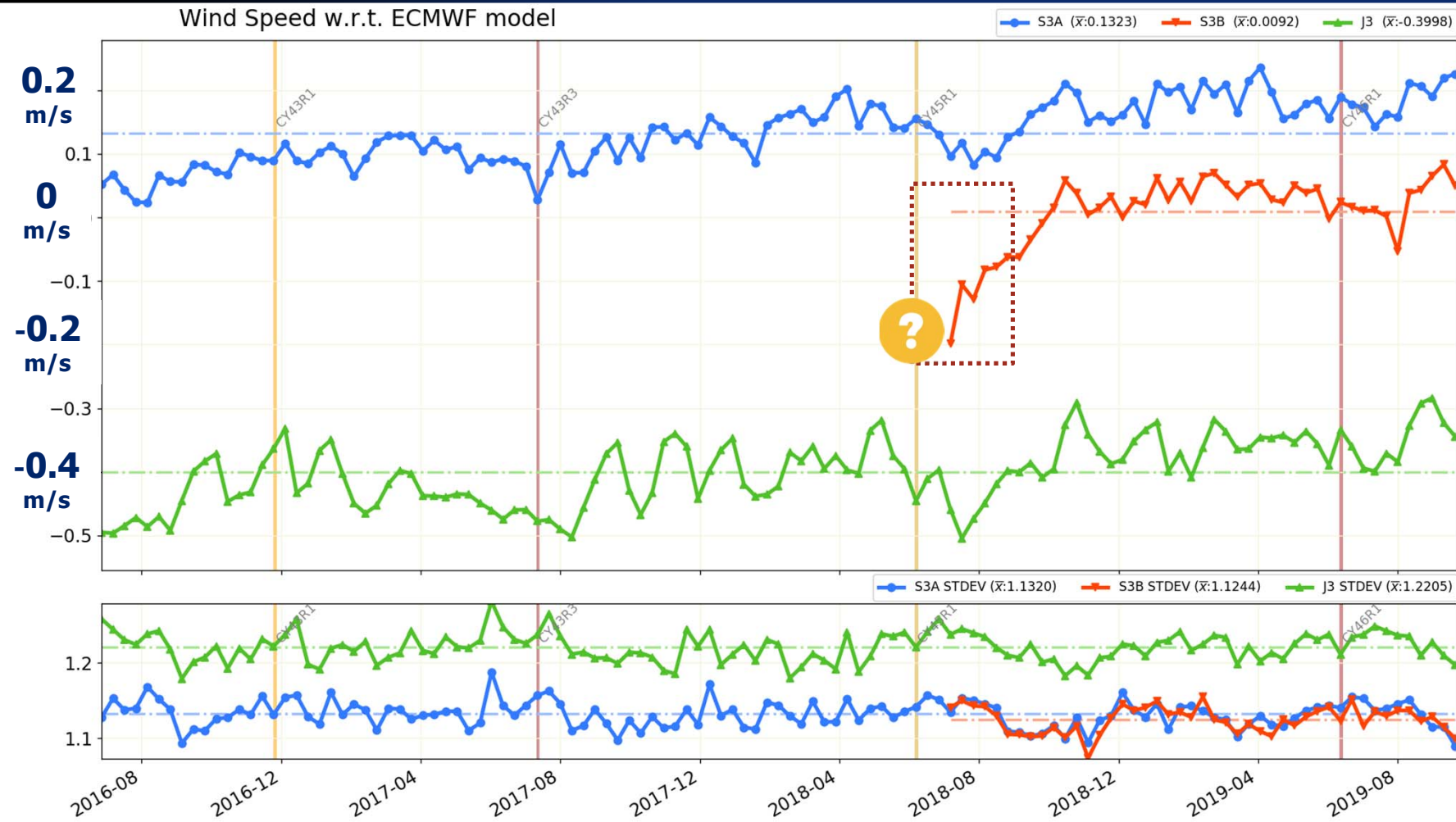
**S3A SAR**  
**Jason 3**  
**(-6.8 mm offset)**

**No long term trends.**

**Seasonal cycles and model changes are visible.**



# Alt Wind speed X Model



**Sentinel-3A**  
**Sentinel-3B**  
**Jason3**

**Good agreement of S3A and S3B with ECMWF's model, lower mean difference and lower std dev than J3.**

**No major trend visible.**

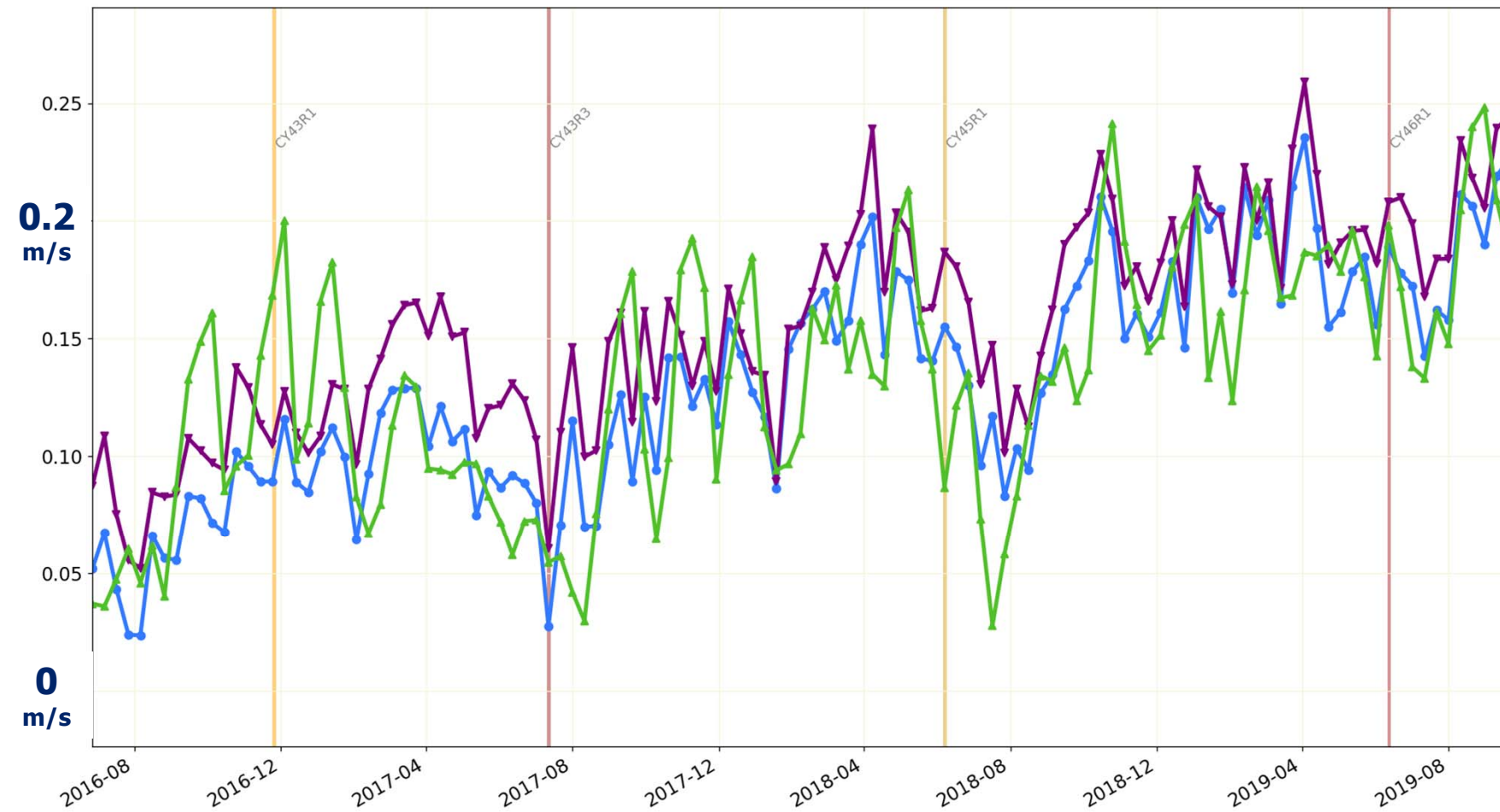
**Initial period of S3B to be understood**

# Alt Wind Speed - Model



Wind Speed x ECMWF

SAR ( $\bar{x}$ :0.1323) PLRM ( $\bar{x}$ :0.1556) J3 ( $\bar{x}$ :0.1323) +[0.5321 offset]



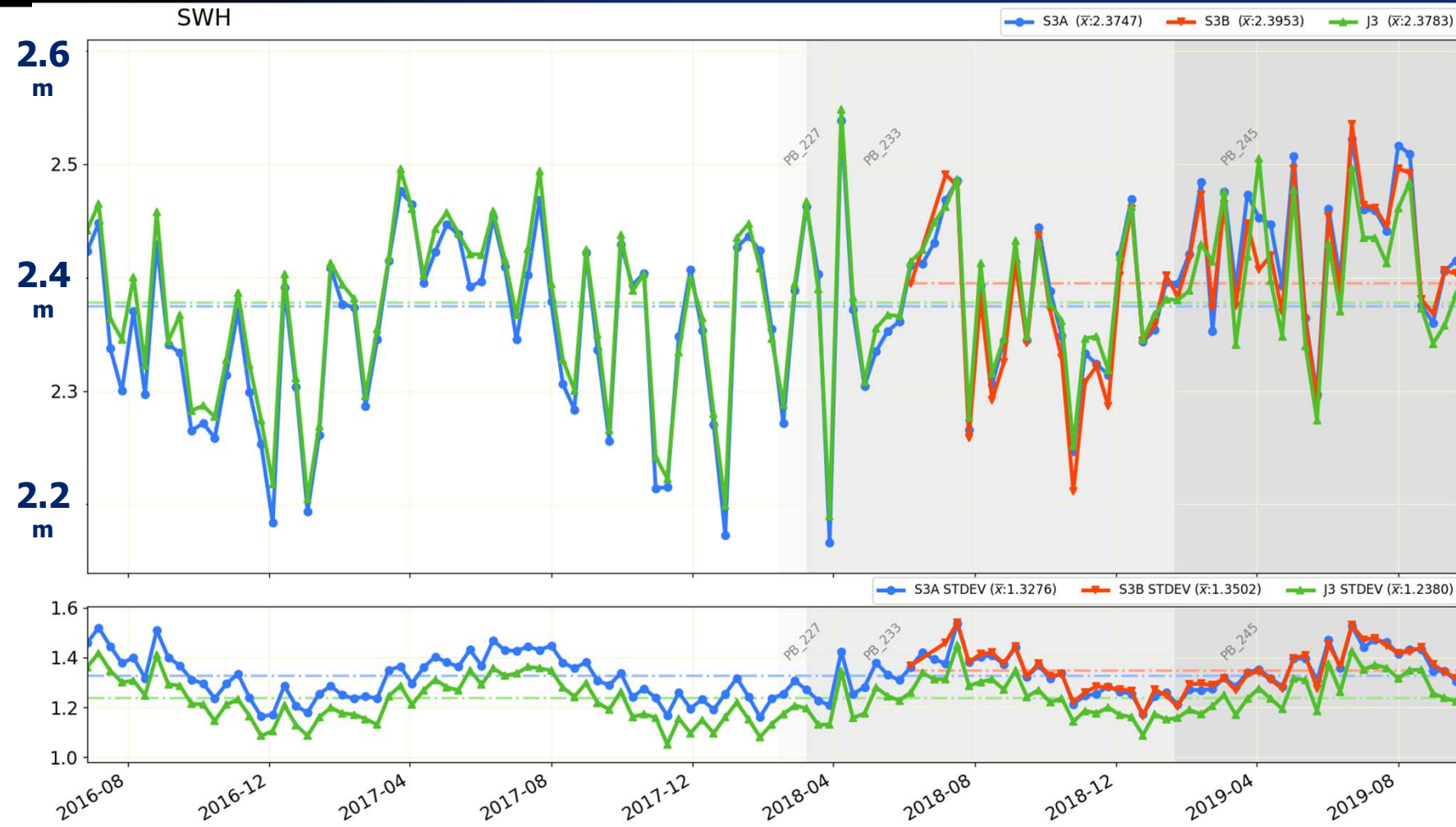
**Sentinel-3A SAR**  
**Sentinel-3A PLRM**  
**Jason 3**  
**(+0.5321 offset)**

**All altimeters have the same behaviour.**

**Season signal and model changes are visible**

**Crossover analysis between J3 and S3 does not show any trend**

# SWH



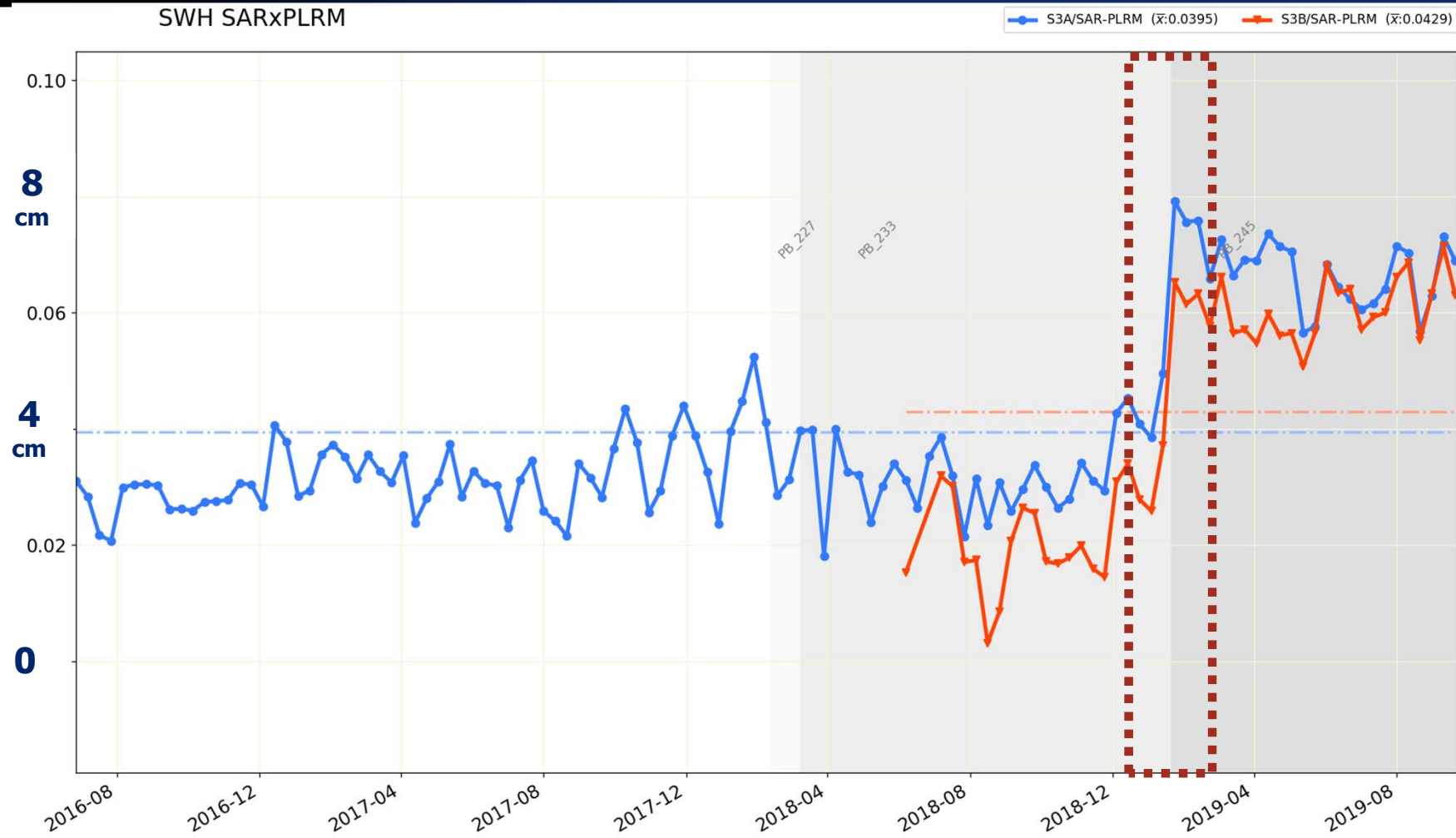
**Jason3**  
**Sentinel-3A**  
**Sentinel-3B**

**Good High level agreement of S3A/S3B/J3.**

**Lower std of J3**

**[Background colour indicates S3 Processing Baseline]**

# SWH – S3 SAR x S3 PLRM



**Sentinel-3A  
SAR-PLRM**  
**Sentinel-3B  
SAR-PLRM**

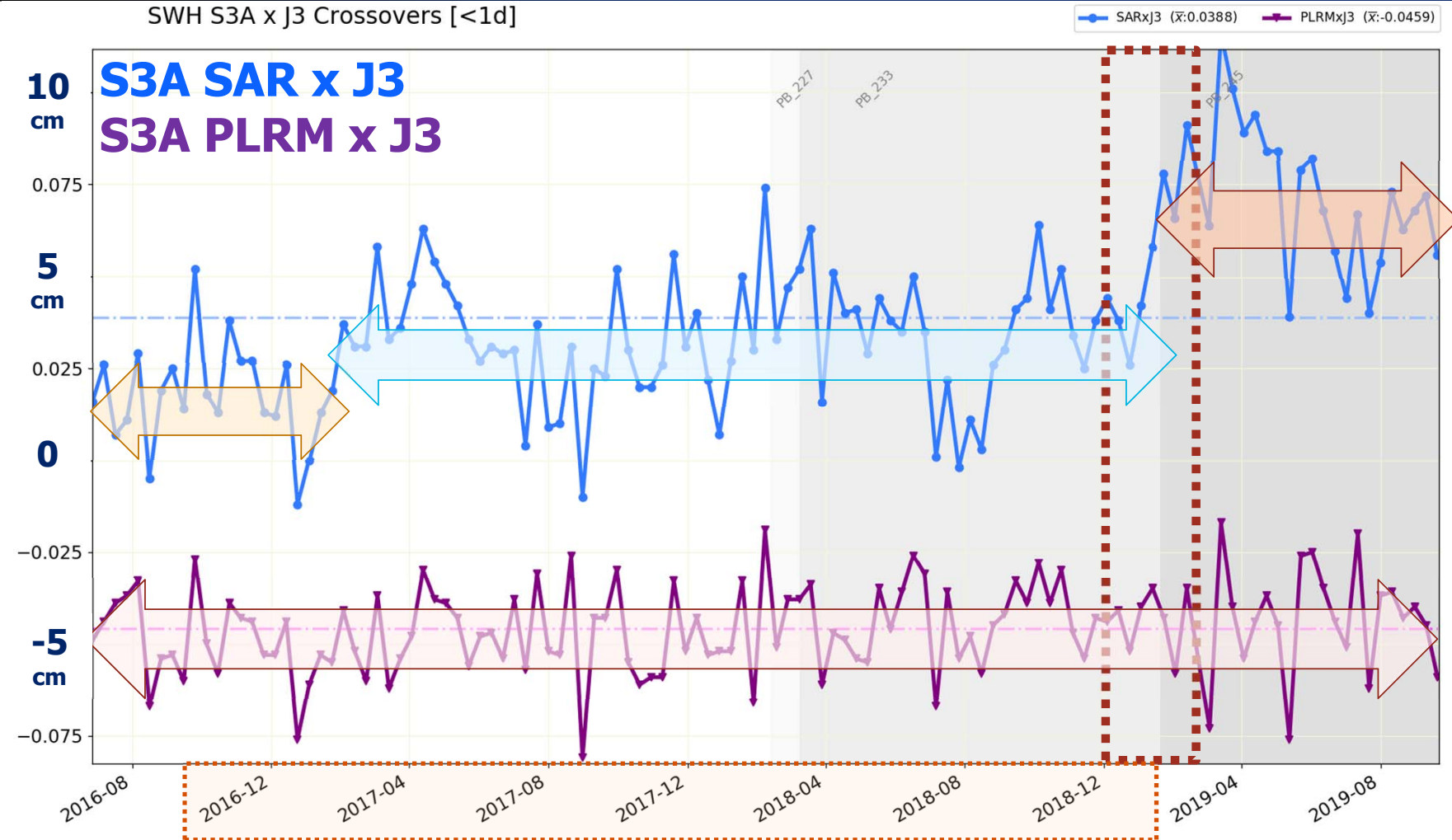
**Jump related to  
update of the  
SWH SAR  
processing  
(update bias).  
Same std before  
and after the  
update.**

**No apparent trend  
between SAR-  
PLRM SWH**



# SWH – Crossovers [S3A x J3]

SWH S3A x J3 Crossovers [<1d]



**Mean diff at crossovers:**

**+3.8 cm [SAR]**

**- 4.6 cm [PLRM]**

**SAR Jump** related to update of the SWH SAR processing (update bias). [Background colour indicates S3 Processing Baseline]

**Reprocessing with BC004** will bring all to this level

**No apparent drift between PLRM and J3 for the all period**

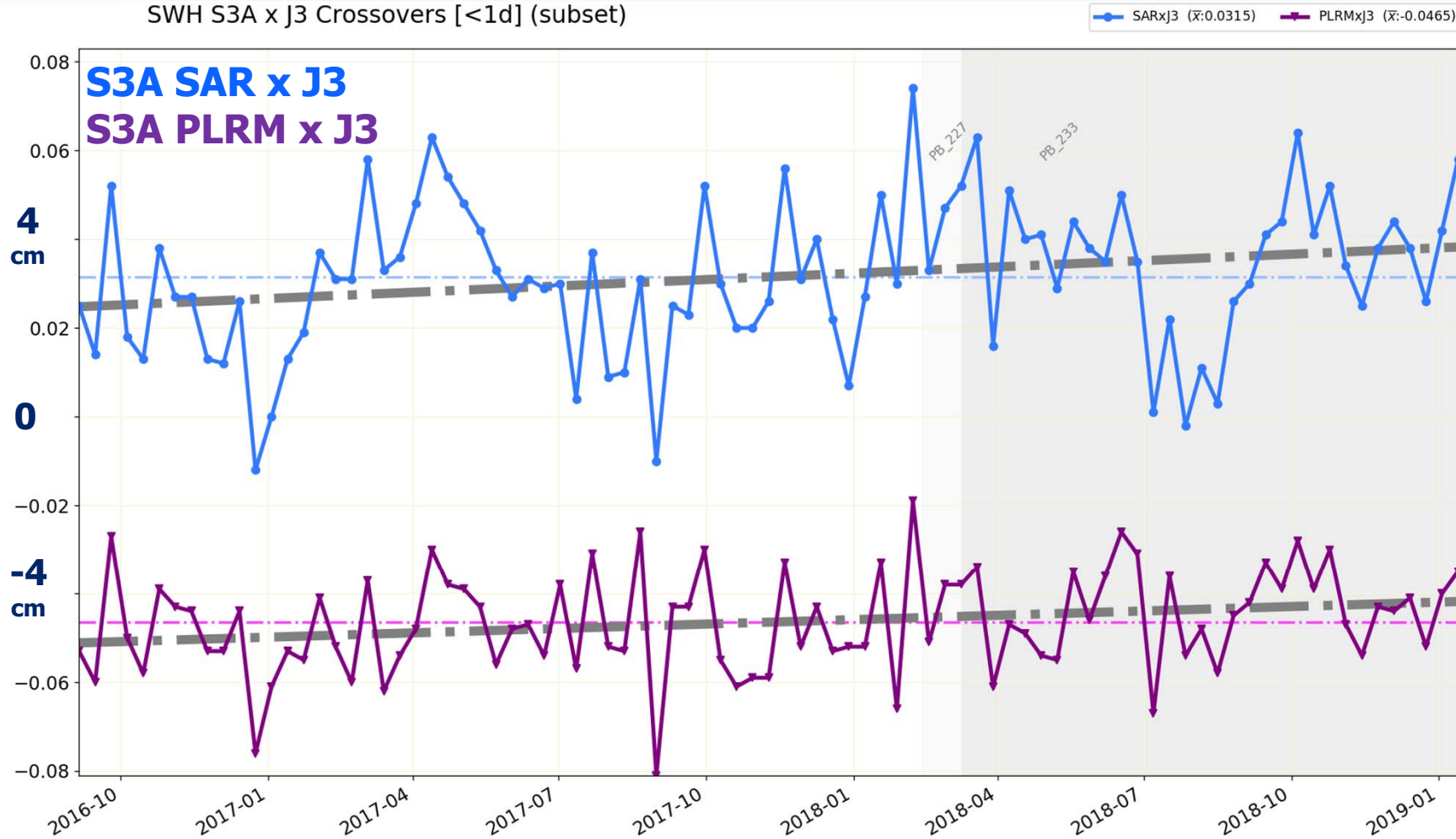
**Long stable period between S3 SAR-J3 SWH**

**Initial period of S3A/J3 to be further understood**

# SWH – Crossover [S3A x J3] (subset)



SWH S3A x J3 Crossovers [<1d] (subset)



**Period between  
2016-09-01 and  
2019-02-14**

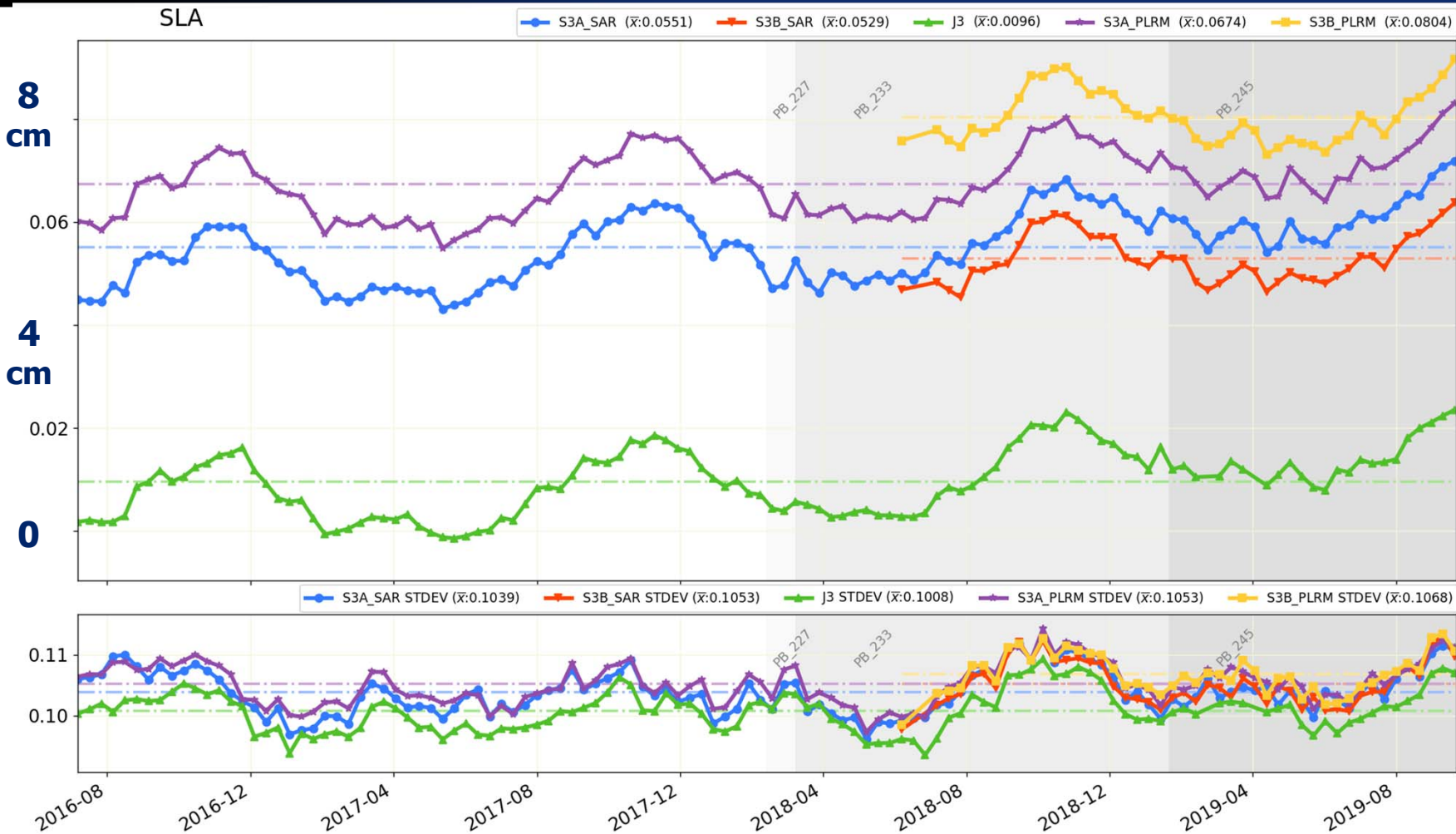
**Mean diff at  
crossovers:  
+3.2 cm [SAR]  
- 4.7 cm [PLRM]**

**Small drift  
between PLRM  
versus J3 SWH  
(3.9 mm/y)**

**Slightly larger  
drift in SAR  
versus J3 SWH  
(5.7 mm/y)**

# Sea Level Anomaly

SLAs with Rad Wet tropo



**S3B PLRM**  
**S3A PLRM**  
**S3A SAR**  
**S3B SAR**  
**Jason3**

Same MSS, Tides, etc.

No offset

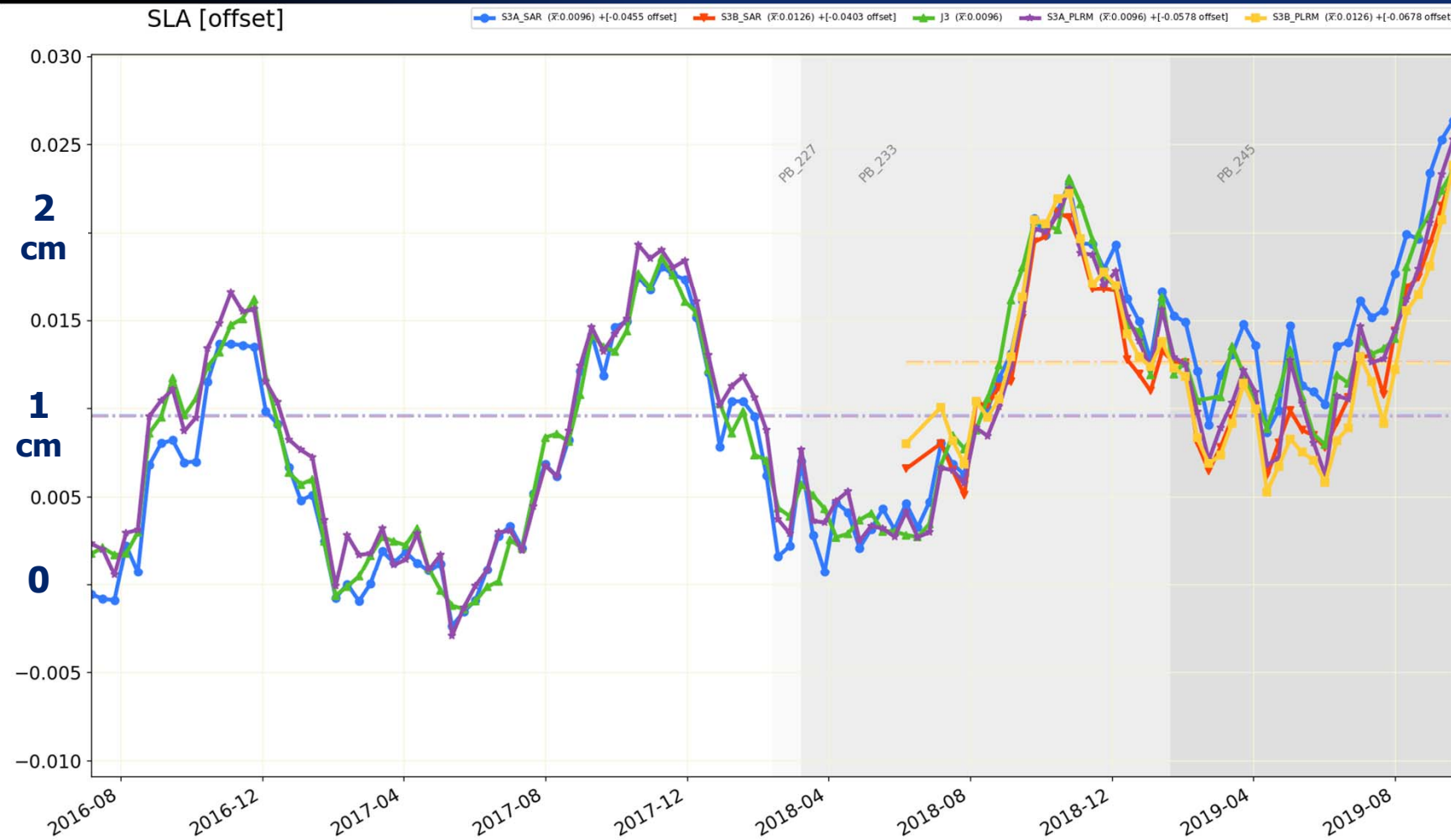
Similar patterns.

STD

J3 < S3 SAR < S3 PLRM



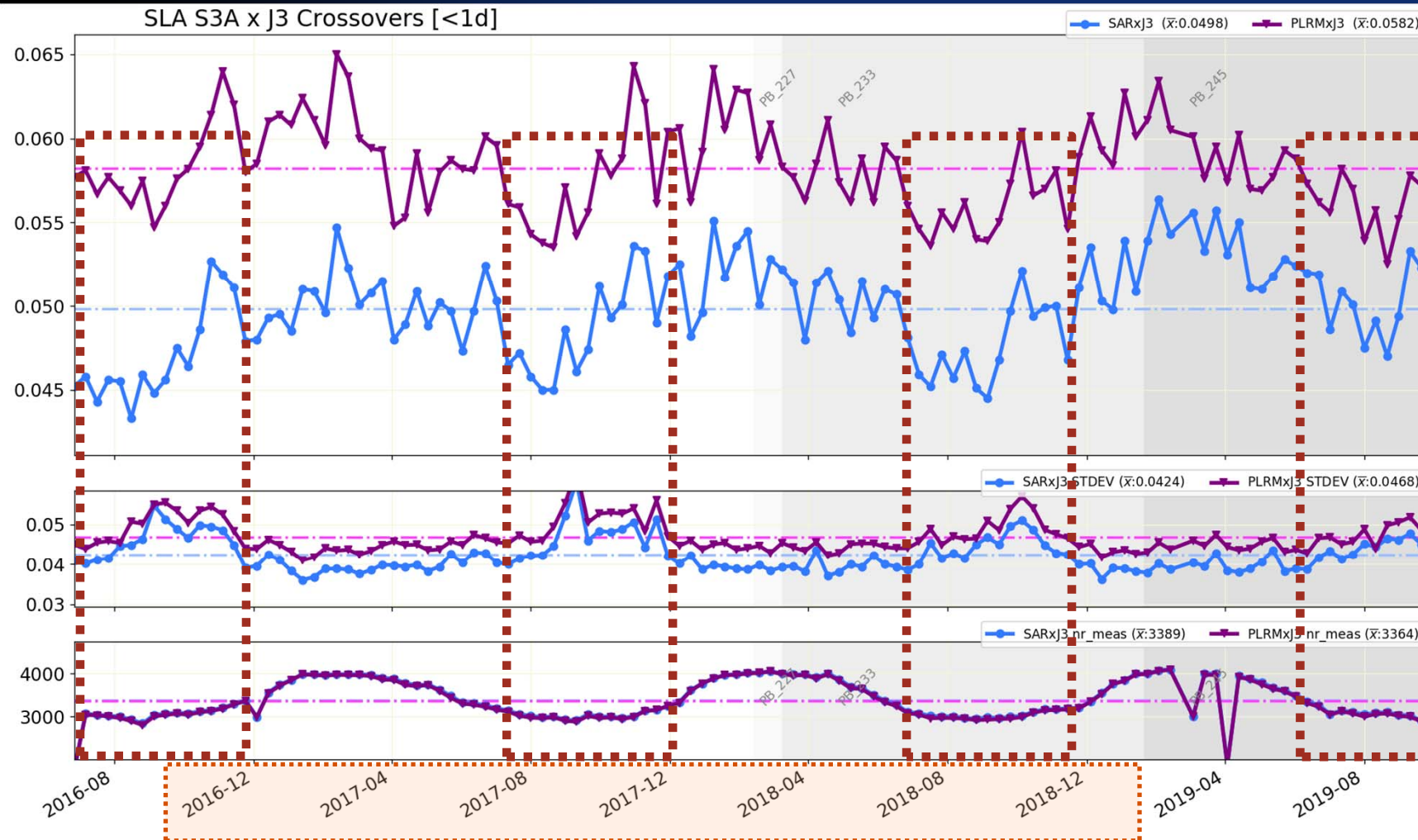
# Sea Level Anomaly – Offset timeline



**Jason3**  
**S3A SAR**  
(-4.55 cm)  
**S3B SAR**  
(-4.03 cm)  
**S3A PLRM**  
(-5.78 cm)  
**S3B PLRM**  
(-6.78 cm)

**At a macro level all looks fine ...**

# SLA – Crossovers [S3A x J3]



**S3A PLRM x J3**  
**S3A SAR x J3**

**Seasonal Cycle**  
**present, affects:**

**Abs Difference**

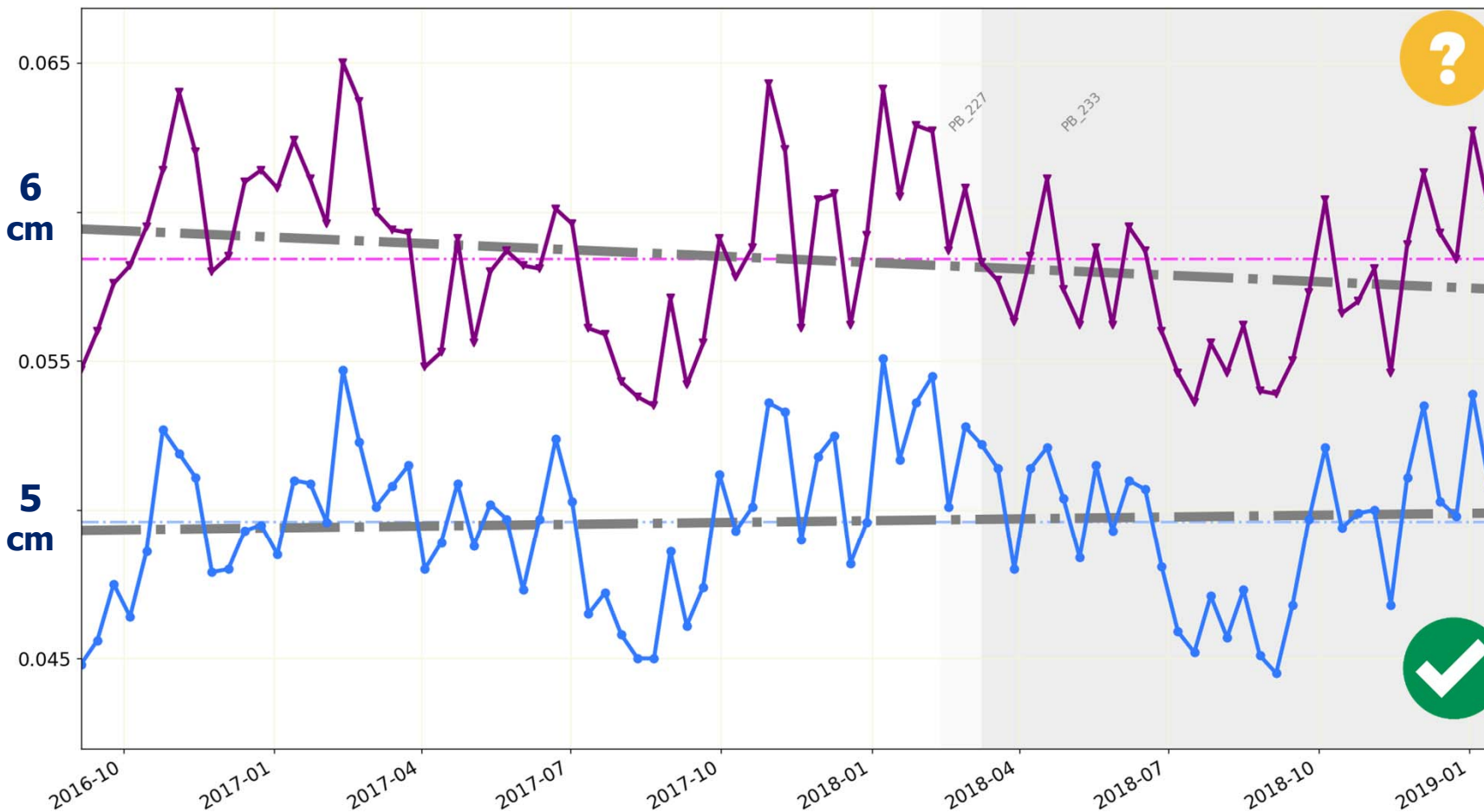
**Std Dev**

**Number of**  
**measurements**

# SLA S3 x J3 Crossovers [SAR & PLRM subset]

SLA S3A x J3 Crossovers [ $<1d$ ] (subset)

SARxJ3 ( $\bar{x}$ :0.0496) PLRMxJ3 ( $\bar{x}$ :0.0584)



**S3A PLRM x J3**  
**S3A SAR x J3**

**Period between  
2016-09-01 and  
2019-02-14**

**Mean diff at  
crossovers:**

**5.0 cm [SAR]**

**5.8 cm [PLRM]**

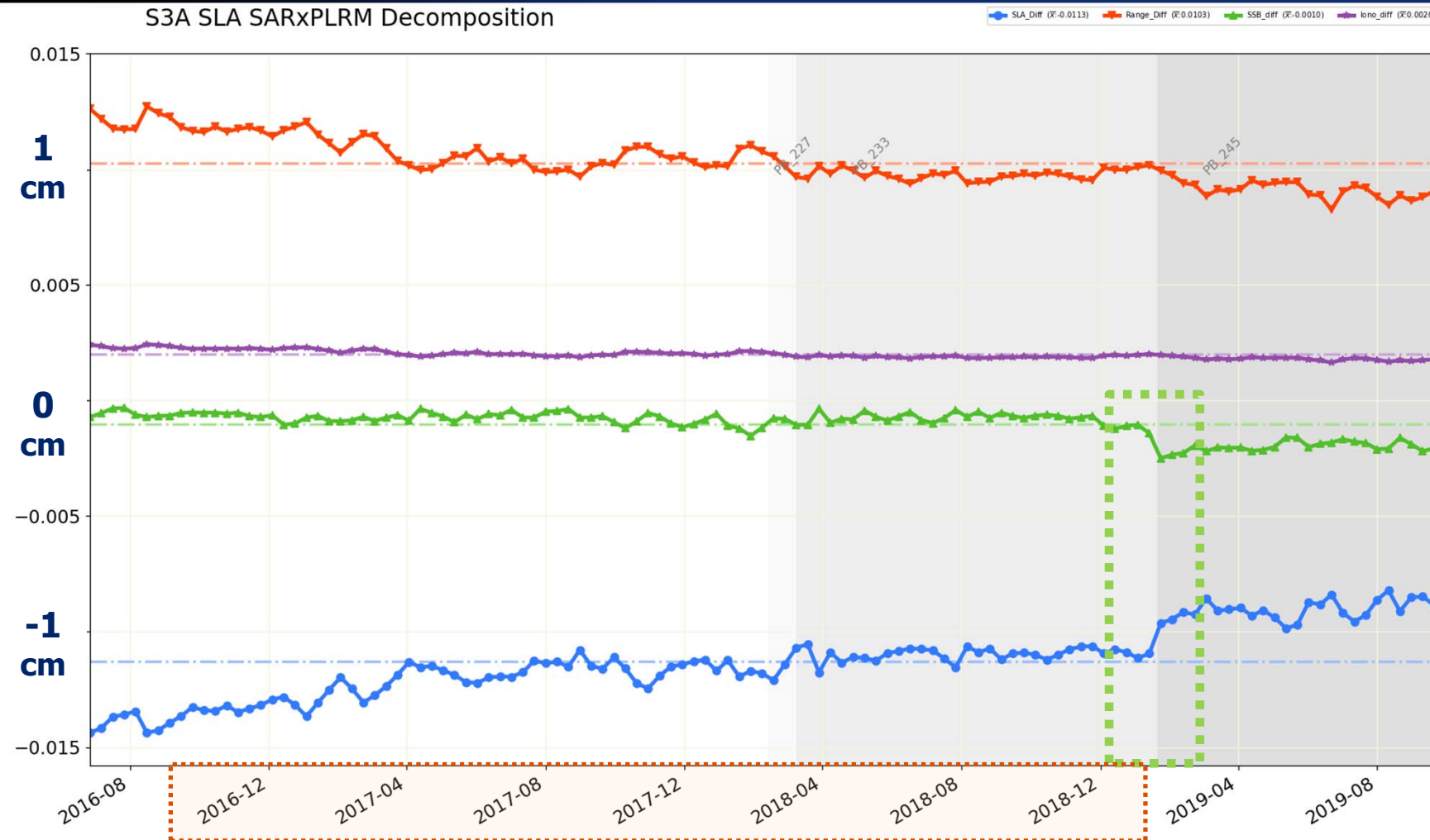
**Visible drift between  
PLRM versus J3 SLA  
(-0.9 mm/y)**

**Very small/No drift  
in SAR versus J3 SLA  
(+0.2 mm/y)**

# S3 – SLA [SAR-PLRM]



S3A SLA SARxPLRM Decomposition



## Mean differences:

**Range Ku diff**  
(1 cm)

**Iono diff**  
(0.2 cm)

**SSB diff**  
(0.1 cm)

**SLA diff**  
(1.0 cm)

Wet tropo not shown,  
but not drifting

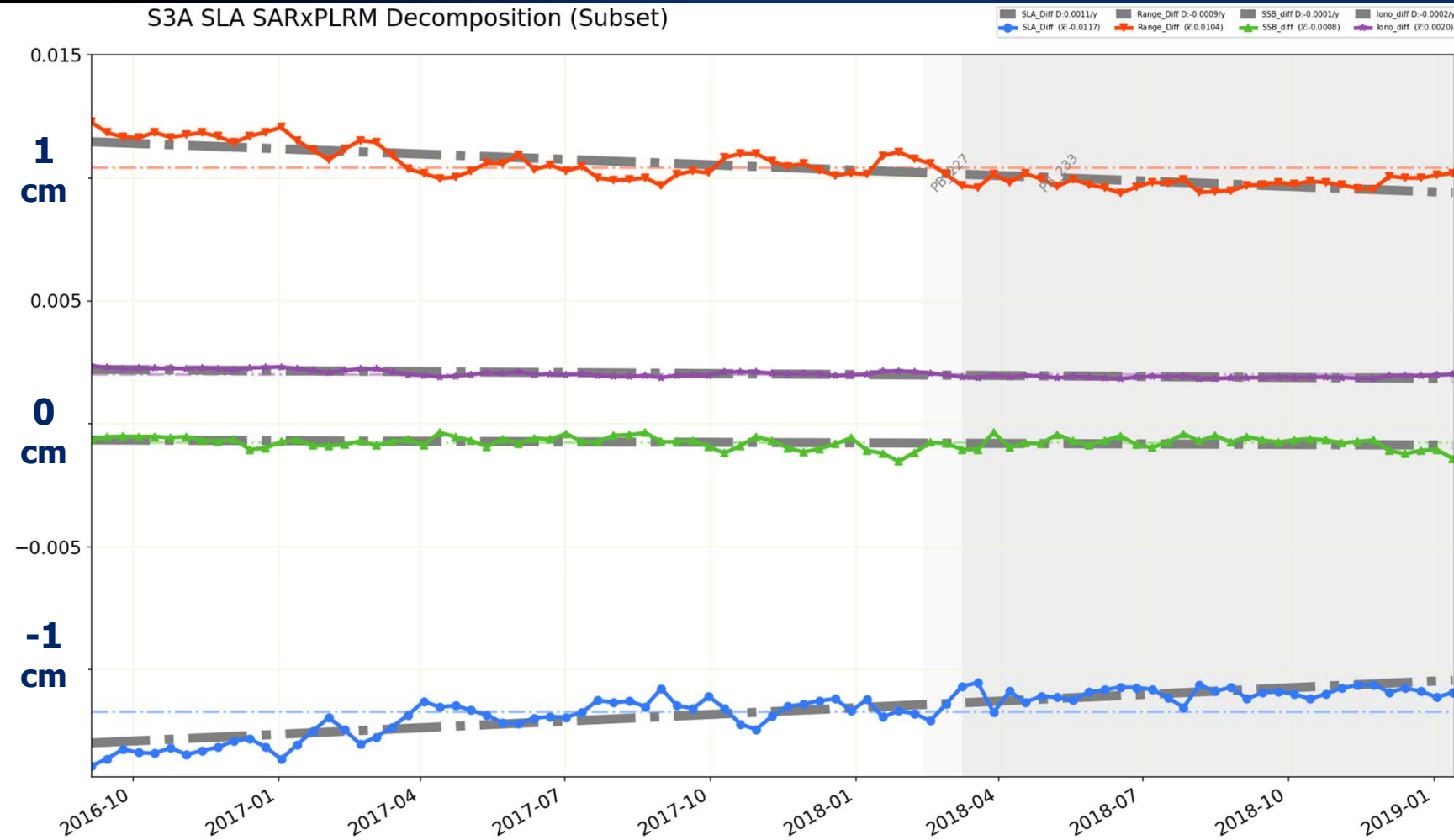
SSB/SWH appears  
stable, jump due to  
updated processing.  
[Background colour indicates  
S3 Processing Baseline]  
Reprocessing with BC004 will  
bring all to this level



# S3 – SLA [SAR-PLRM] (subset)



S3A SLA SARxPLRM Decomposition (Subset)



## Drifts:

**Range Ku**  
(-0.9mm/y)



**Iono**  
(-0.2mm/y)

**SSB**  
(-0.1mm/y)

**SLA**  
(1.1mm/y)

Drift in ranges  
Ku/C affect **Range**  
and **Iono**:  
Under study (PTR,  
thermal effects,  
etc.)

# Conclusions

- Very good data quality and availability for operational oceanography and NWP 
- Some improvements still needed for full climate usage of SAR and PLRM (not original requirement) 
  - First months of S3A show strange behaviour
    - Under study: PTR drift, Thermal effects on antenna impacting SAR/PLRM, etc.
  - Mission is stable afterwards
  - For Climate studies “Reprocessing” and not NTC should be used

# Outlook

- By end of 2019 (expected):
  - Baseline 004/PB2.xx:
    - Improved of SWH due to new fitting library
    - Improved SSHA:
      - Filtered Iono Correction
      - DTU 18 MSS
    - And more...
  - ... and full mission reprocessing of S3A/B
- By end 2020 expected that some of the drifts can be corrected (PTR drift with CoG approach)

**User survey on S3 data usage:**  
[http://tiny.cc/s3\\_alt\\_survey](http://tiny.cc/s3_alt_survey)  
**or**  
[https://www.surveymonkey.de/r/EUMETSAT\\_S-3\\_Altimetry\\_Survey](https://www.surveymonkey.de/r/EUMETSAT_S-3_Altimetry_Survey)