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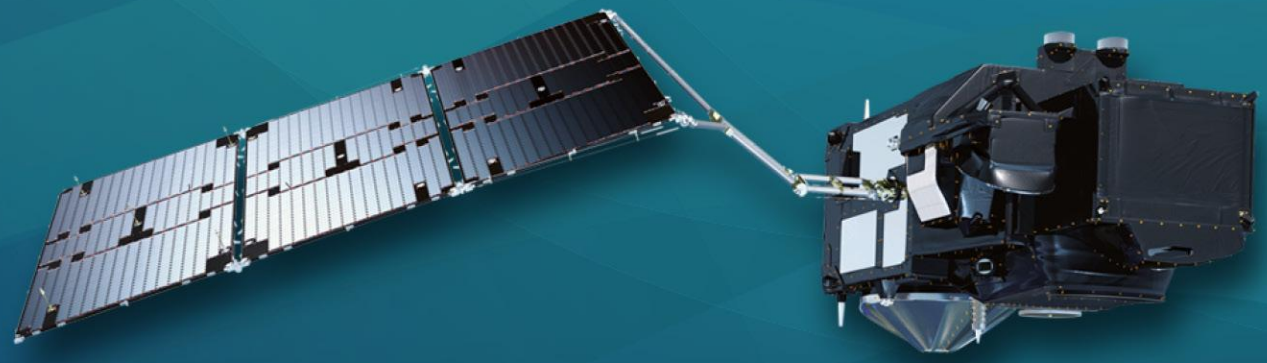


9th Sentinel-3 Validation Team meeting 2026

30 March–01 April 2026 | ESA–ESRIN | Frascati (Rome), Italy

Assessment of the new Sentinel-3 BC006.02: Part 1: open-ocean performance

F. Nencioli[1], L. Rinchiuso[1], C. Durand[1], B. Lucas[2], S. Dinardo[2] and C. Nogueira-Loddo[2]
[1]Collecte Localisation Satellites
[2]EUMETSAT

The COPAS project

- **COP**ernicus **ALT**imetry **S**ervice for the Sentinel-3 mission

- Started on May 2022
- Regular monitoring of Sentinel-3 Surface Topography Mission (STM) performance over the oceans

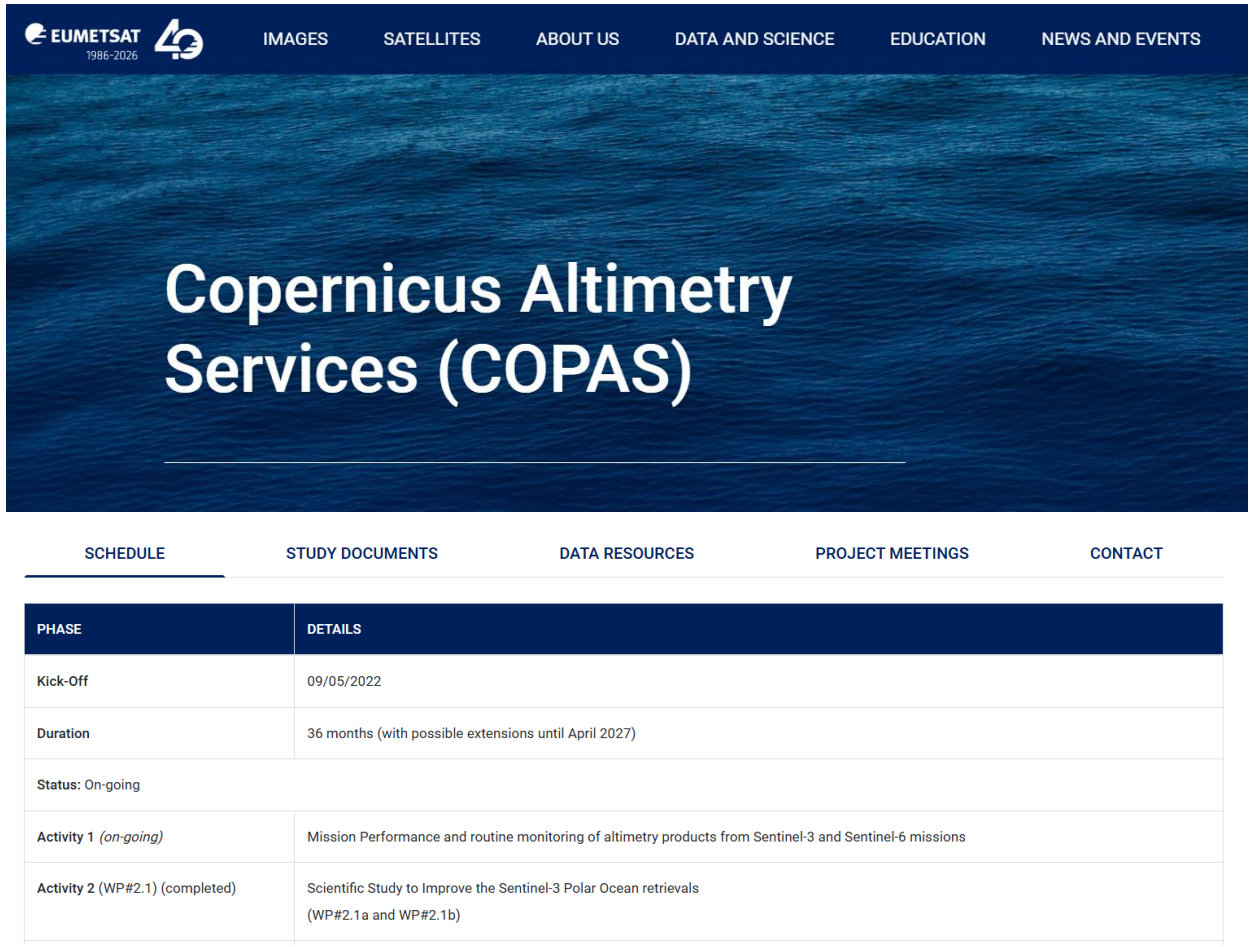
1. **Monitoring activities** :
   - Validation of the ground processing and final products
   - Assessment of the overall mission performance
   - Support for the continuous improvement of the S-3 STM performance

2. **Scientific studies** (via dedicated WP)

➢ WP#2.11: Assess improvements of S3 BC006 in polar ocean (implemented following CMEMS needs)

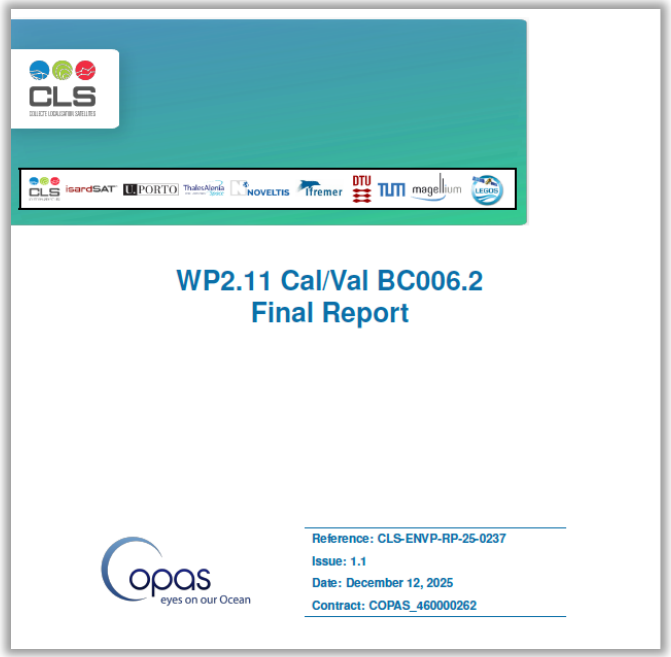
The COPAS project

https://www.eumetsat.int/copernicus-altimetry-services-copas
https://user.eumetsat.int/resources/service-statuses/sentinel-3-altimetry-reports



PHASE	DETAILS
Kick-Off	09/05/2022
Duration	36 months (with possible extensions until April 2027)
Status: On-going	
Activity 1 *(on-going)*	Mission Performance and routine monitoring of altimetry products from Sentinel-3 and Sentinel-6 missions
Activity 2 (WP#2.1) (completed)	Scientific Study to Improve the Sentinel-3 Polar Ocean retrievals (WP#2.1a and WP#2.1b)

- Routine reports (cyclic, quarterly, annual)
- WorkPackage reports



https://www.eumetsat.int/media/53153

Changes from BC005 to PB006.2
(other than GDR-G standards)

Two main goals for BC006.02 (G62)

1. Improvemets in polar region (as requested by CMEMS) => **open/leads continuty**
2. Non-regression in open-ocean

L1 processing changes

- Range Walk CZT
- New Spectral Weighting Window
- Zero Padding
- Fast Time Complex Calibration
- Dynamic Auto Cal
- L1B masking
- New CHD --> implied update of sig0 bias

L2 processing changes

- SAMOSA+ Waveform retracker
- Waveform Classification
- SWH correction for vertical wave motion
- SAR based wave period and std of vertical wave velocity (for VWM LUT)
- New Sea State Bias Solution
- Upper threshold for SWH to 25 m

➢ More info on BC006.02 CalVal report => **https://www.eumetsat.int/media/53153**

Overview of CalVal Analysis and Diagnostics

CalVal Analysis

- ❑ BC006.2 dataset from mid 2020 to mid 2022
- ❑ 1 Hz for open ocean – 20 Hz for polar regions
- ❑ Focus on key variables (**Range, Sigma0, SWH and SSHA**)
- ❑ **Comparison with Jason-3**

Diagnostics

- Data availability (missing observations) and validity (editing based of various thresholds)
- Time series
  - of BC006-BC005, for SARM and PLRM
  - of SARM-PLRM, for BC005 and BC006
- Geobox maps
  - for the same diagnostics
- Xover analysis (time series and geobox maps)
  - Monomission (S3A vs S3A) and Multimission (S3A vs J3)
- Spectral analysis

Important

- Only the subset of most relevant diagnostics presented here
- More results can be provided if required

➢ More info on BC006.02 CalVal report => **https://www.eumetsat.int/media/53153**

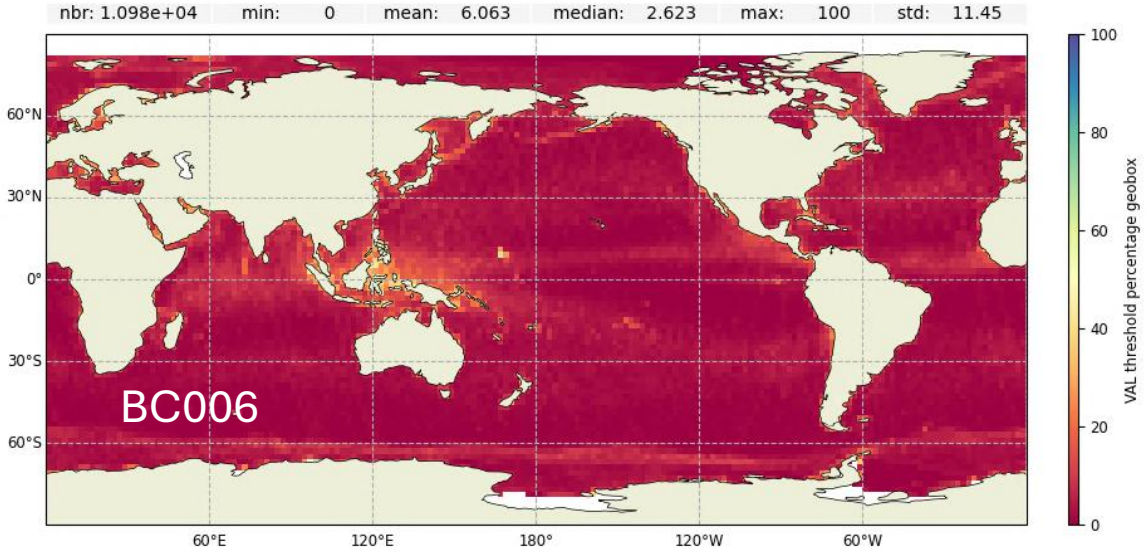
Data availbility and validity

Available measurements

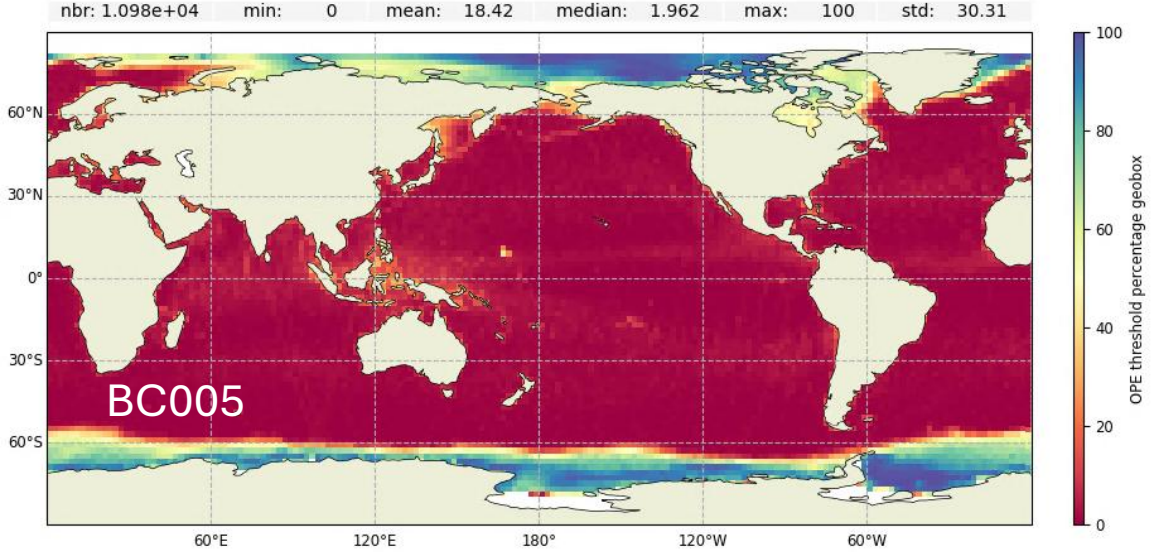
All nominal in terms of data avialability (no big differences between BC005 and BC006.02 from Jun 2020 to Jun 2022)

Edited measurements

BC_006 % of edited ocean measurements



BC_005 % of edited ocean measurements



Lower % of points edited in BC006 at high latitudes:

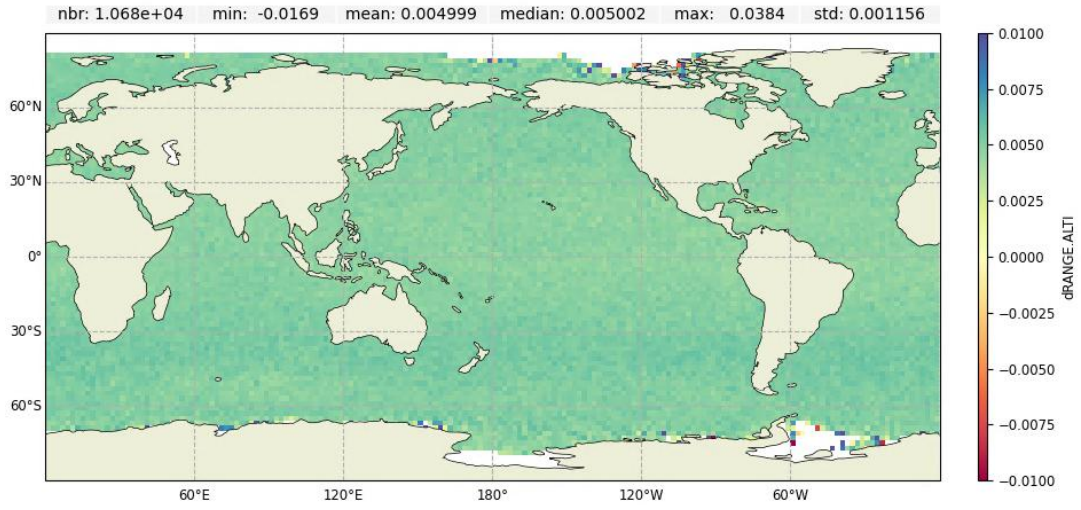
- Due to fixed open sea ice flag in BC006.02 (fixed in BC005.02)

1. Range

Range BC006 - BC005

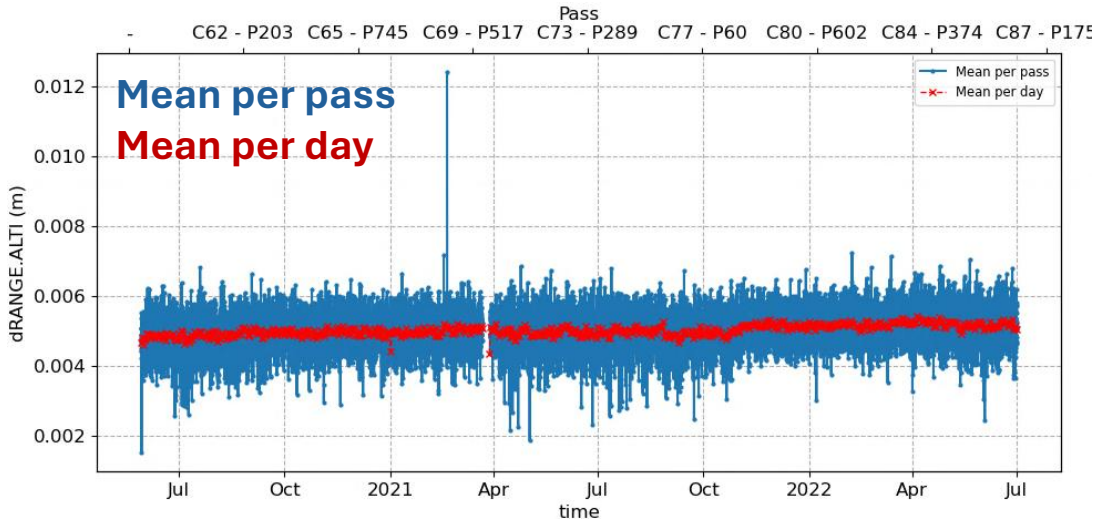
- SARM average map homogeneous and time series stable

SARM BC_006 - BC_005



SARM BC_006 - BC_005

	nbr	min	mean	median	max	std
Mean per pass	2.146e+04	0.001532	0.005029	0.005041	0.0124	0.0004686
Mean per day	759	0.004336	0.005019	0.005009	0.005436	0.0001486

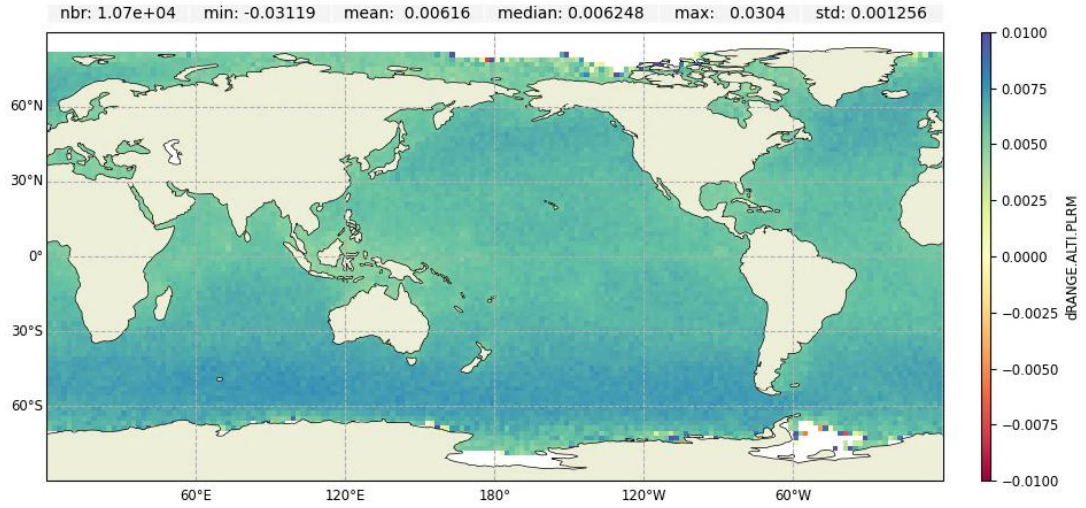


1. Range

Range BC006 - BC005

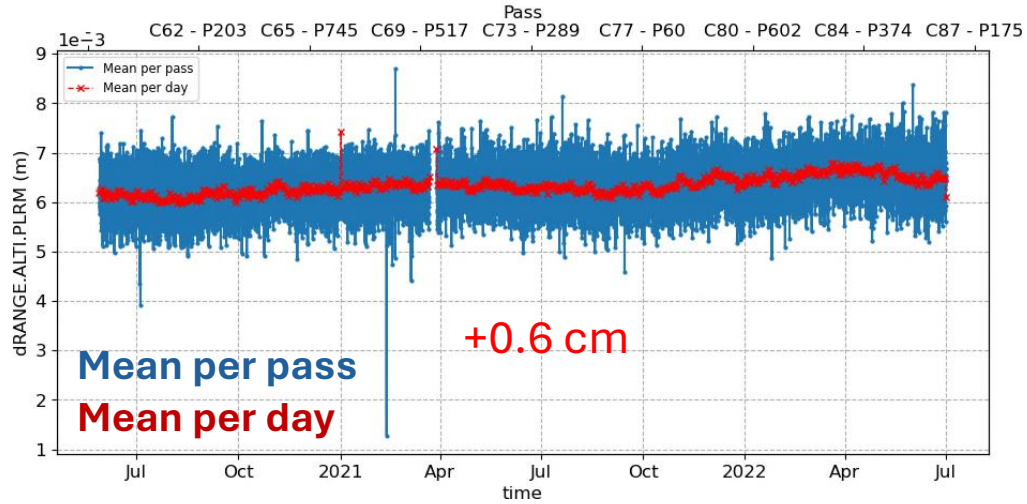
- SARM average map homogeneous and time series stable
- PLRM time series shows some sort of small positive trend and oscillation

PLRM BC_006 - BC_005



PLRM BC_006 - BC_005

	nbr	min	mean	median	max	std
Mean per pass	2.146e+04	0.00128	0.006329	0.006329	0.0087	0.0004044
Mean per day	759	0.005973	0.006338	0.006317	0.007432	0.0001779

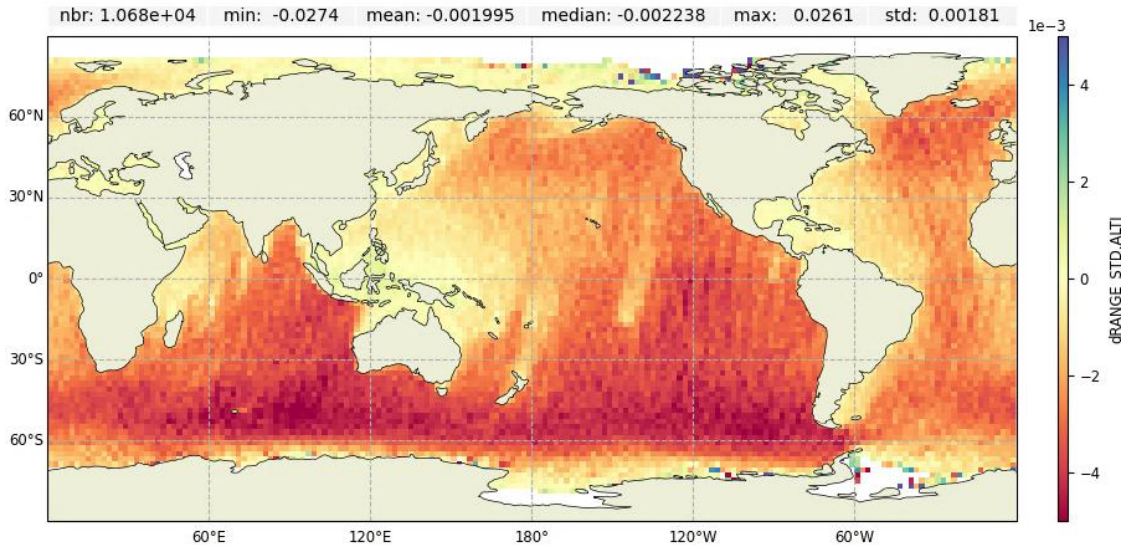


1. Range

Range BC006 - BC005

- SARM average map homogeneous and time series stable
- PLRM time series shows some sort of small positive trend and oscillation
- SARM box-stat map of range std shows reduced values with some geographical patterns
  (results confirmed by spectral analysis – not shown here)

SARM BC_006 - BC_005 (std)



Likely combination of two effects:

1. 0-padding
   - ❑ Reduced variance at low sea-state
2. New weghiting window
   - ❑ Increased variance at low sea state
   - ❑ Reduced variance at high sea state

➢ **Yellow regions** (low sea state => no variance difference): 0-padding counterbalance weighting window

➢ **Red regions** (high sea state => variance reduction): positive effect of weighting window

1. Range

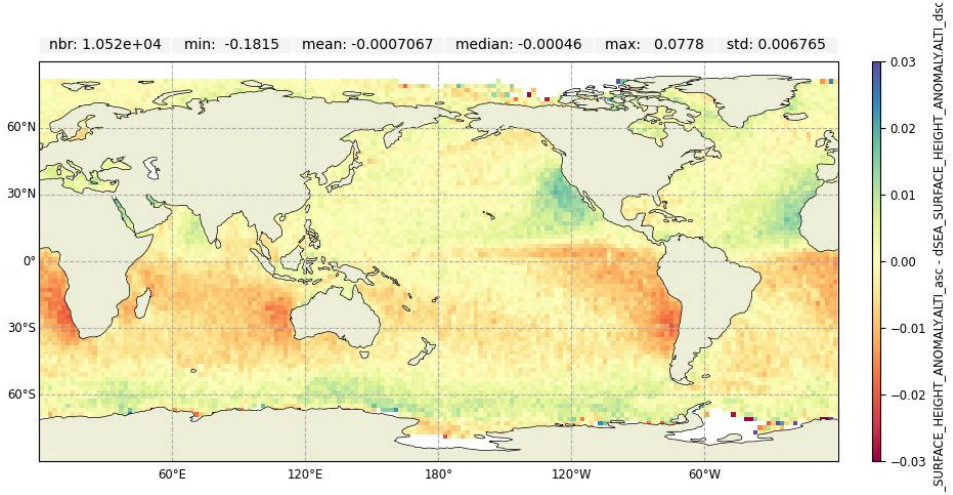
Range BC006 - BC005

- SARM average map homogeneous and time series stable
- PLRM time series shows some sort of small positive trend and oscillation
- SARM box-stat map of range std shows some geographical patterns

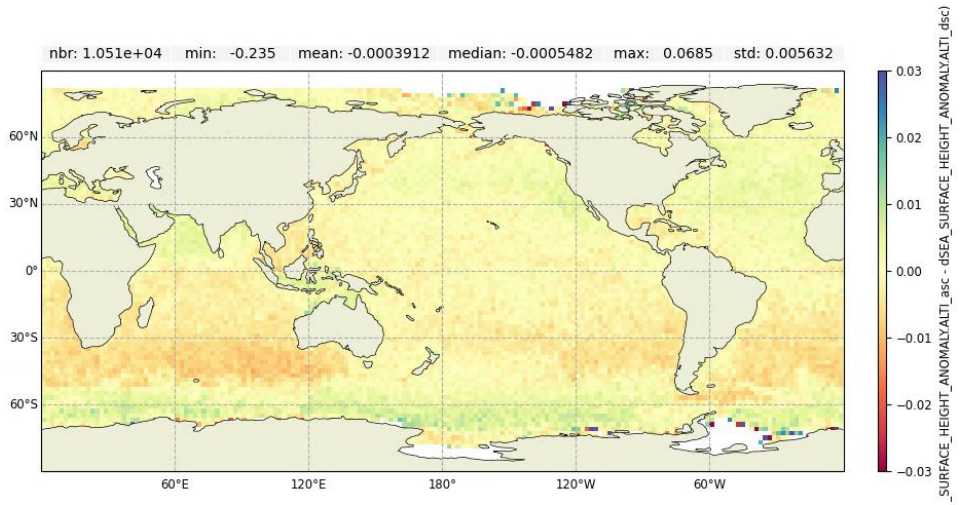
SARM-PLRM

- asc-dsc maps show that the previously observed **correlation with along-track wind is corrected in BC006** **(**Some residual patterns to be further investigated and corrected)

BC_005 SARM – PLRM asc - dsc



BC_006 SARM – PLRM asc - dsc

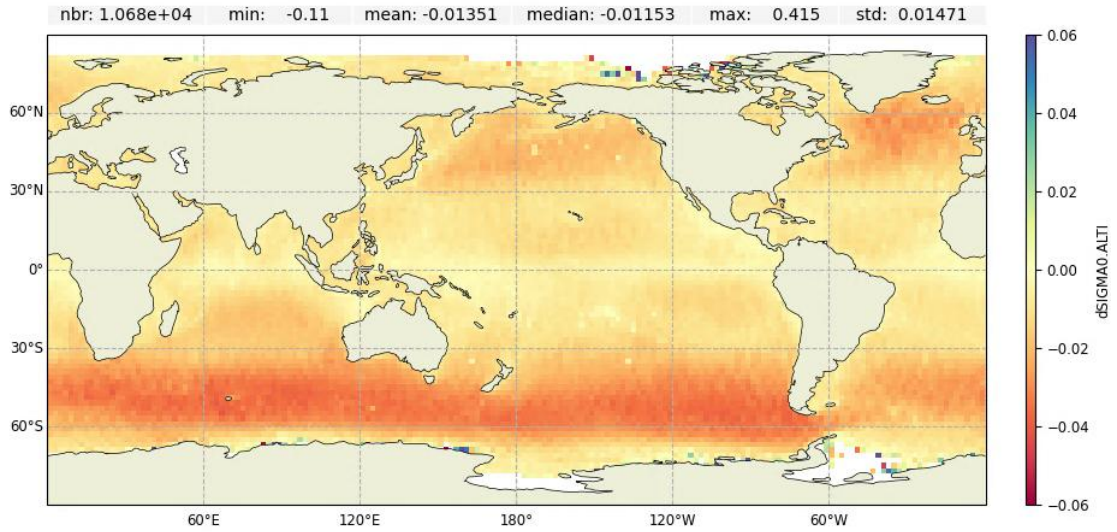


2. Sigma0

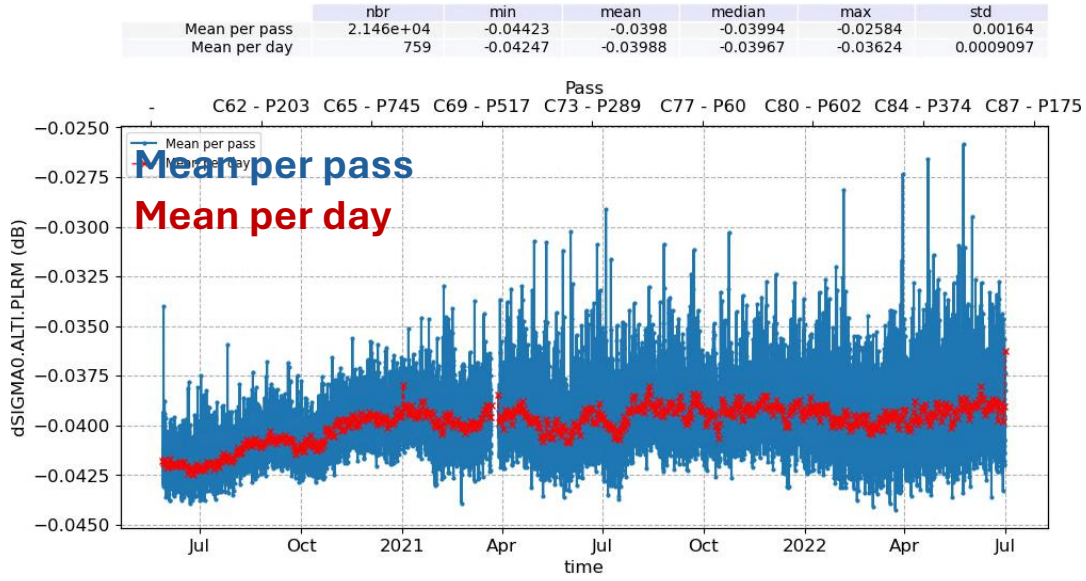
Sigma0 BC006 – BC005 :

- SARM: Stronger difference in high wave areas (stable time-series – not shown)
- PLRM: Slight increase of difference over time

SARM BC_006 - BC_005



PLRM BC_006 - BC_005



2. Sigma0

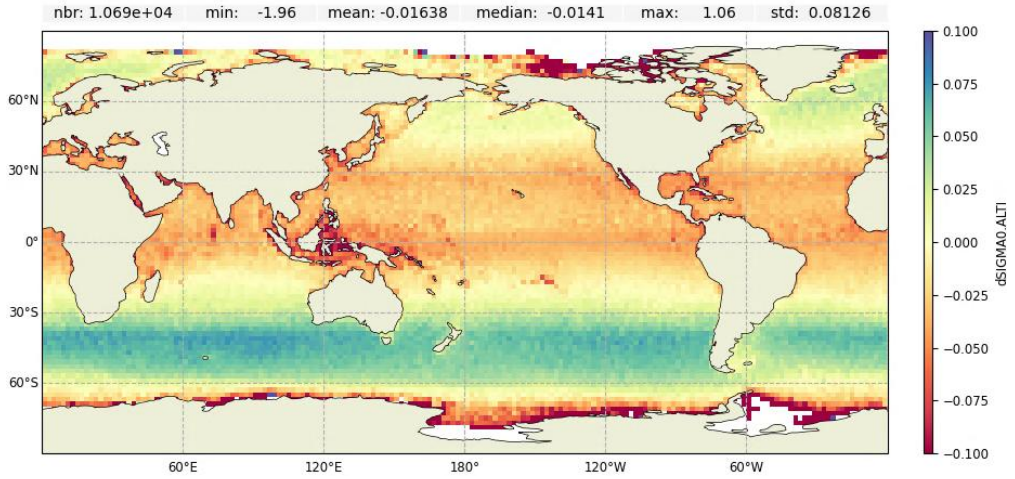
Sigma0 BC006 – BC005 :

- SARM: Stronger difference in high wave areas (stable time-series – not shown)
- PLRM: Slight increase of difference over time

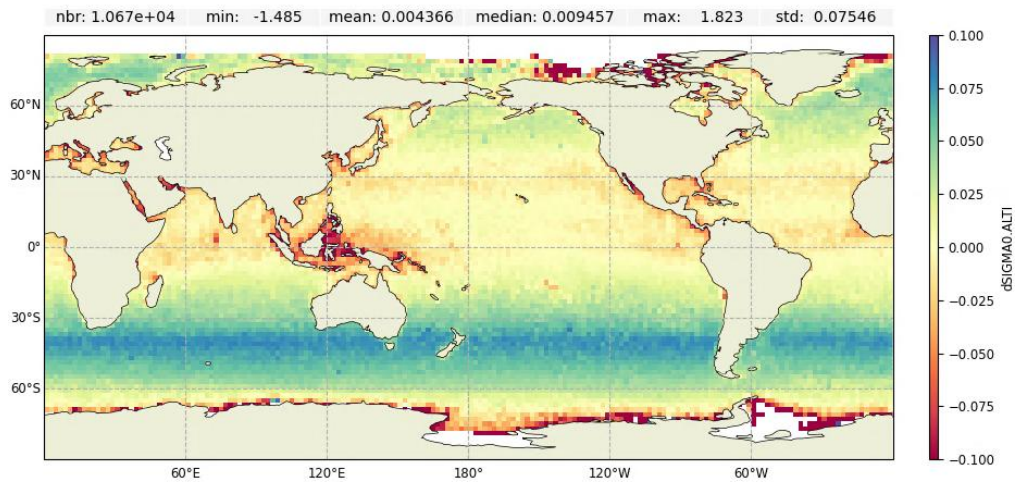
SARM – PLRM

- **The patterns correlated to orbital speed decrease near Equator**
  (but slight increase at high latitudes for BC006)

BC_005 SARM - PLRM



BC_006 SARM - PLRM



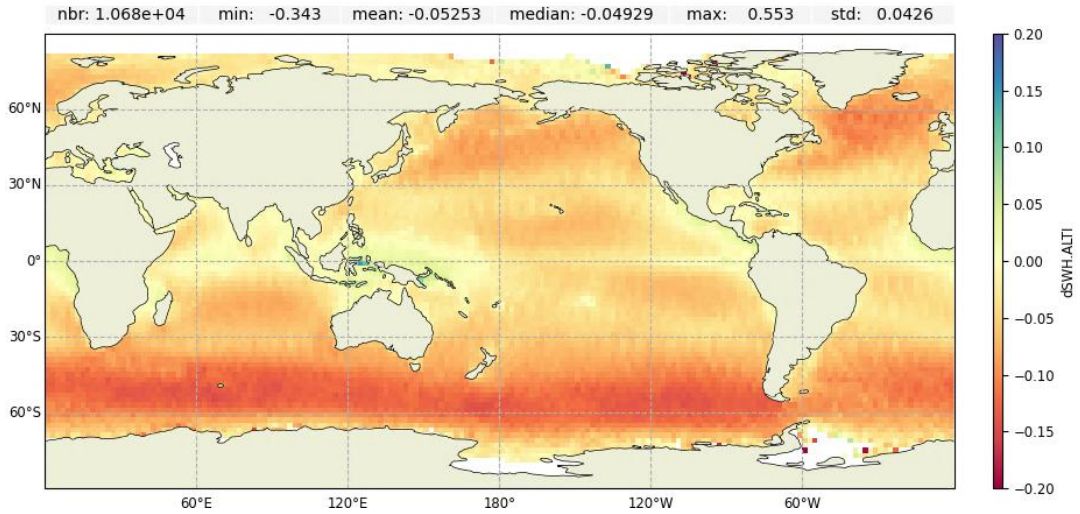
3. SWH

SWH BC006 - BC005

- SARM stronger differences related to wind and high waves
- PLRM time series shows an unexpected jump (not seen in SARM; associated with PTR discontinuity)

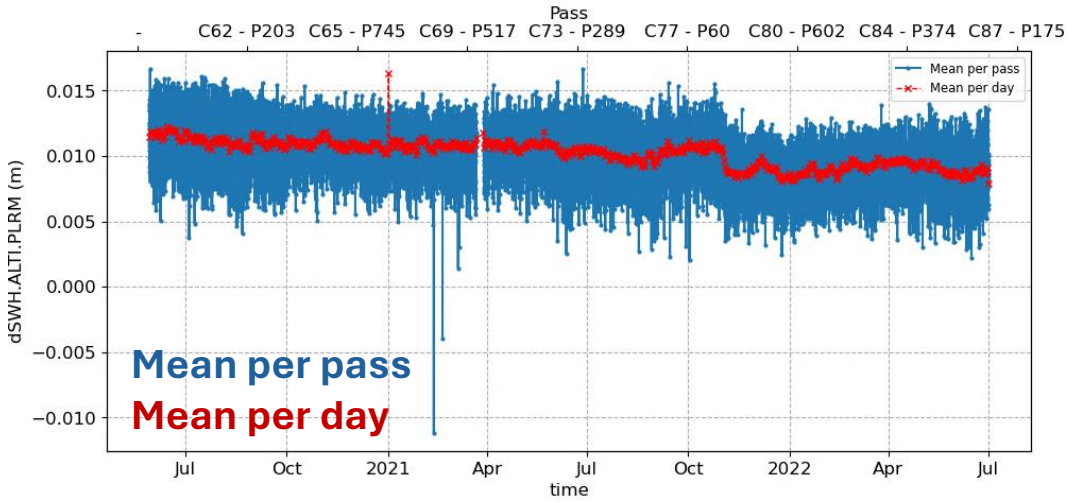
Such instrumental effects uncalibrated in BC005.02 but accounted for in BC006.02 by the new calibration scheme

SARM BC_006 - BC_005



PLRM BC_006 - BC_005

	nbr	min	mean	median	max	std
Mean per pass	2.146e+04	-0.01117	0.01014	0.01023	0.01666	0.00197
Mean per day	759	0.007856	0.01022	0.0105	0.01637	0.0009974



3. SWH

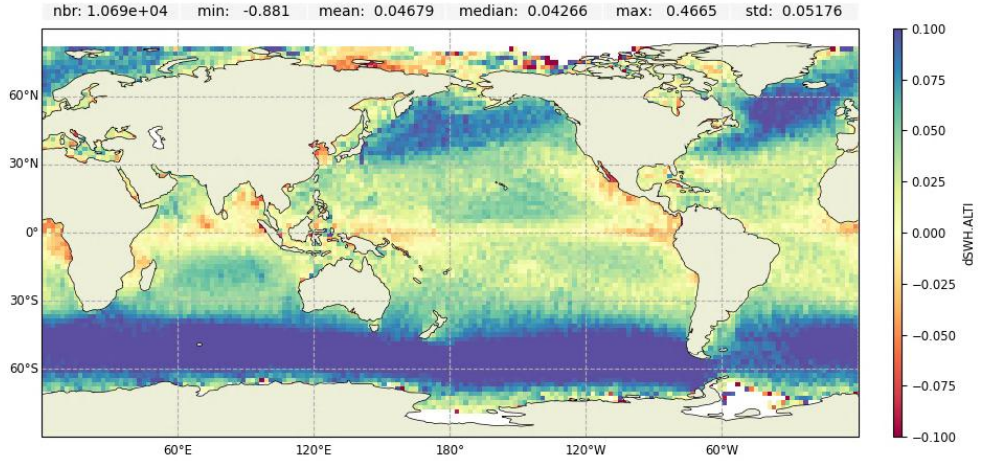
SWH BC006 - BC005

- SARM stronger differences related to wind and high waves
- PLRM time series shows an unexpected jump (not seen in SARM; associated with PTR discontinuity)

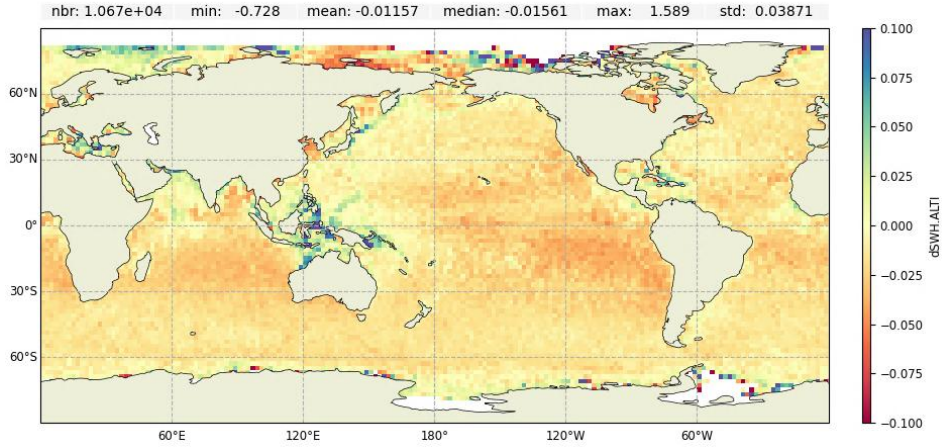
SARM - PLRM

- The strong differences correlated to alogn-track-wind- and high-wave- are **strongly mitigated in BC006**

BC_005 SARM – PLRM

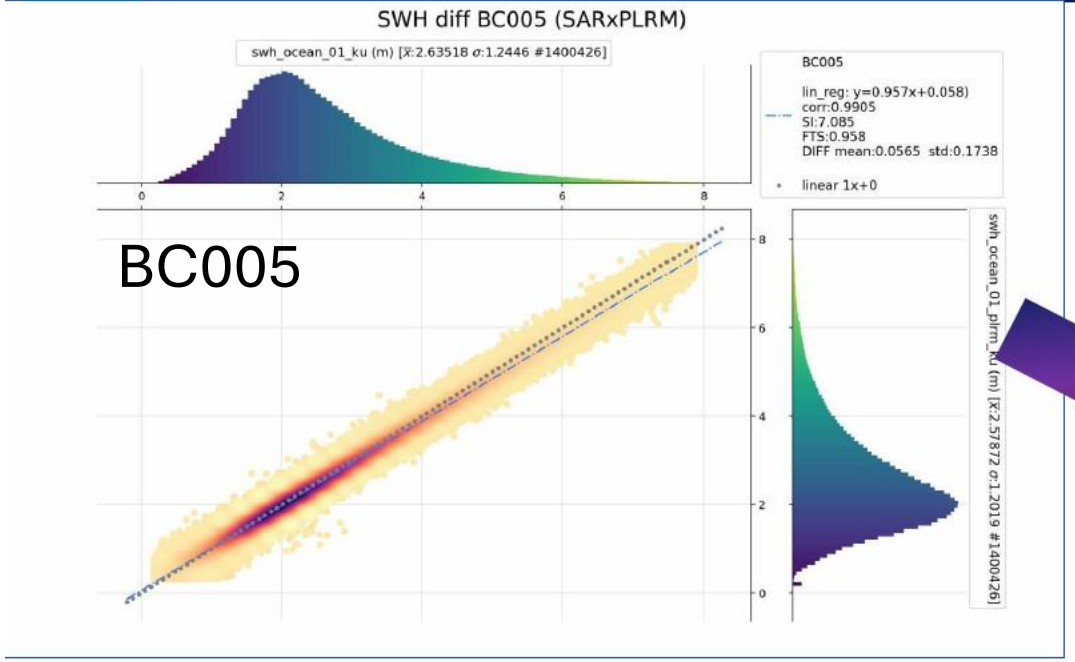


BC_006 SARM – PLRM



3. SWH

SWH SAR x PLRM



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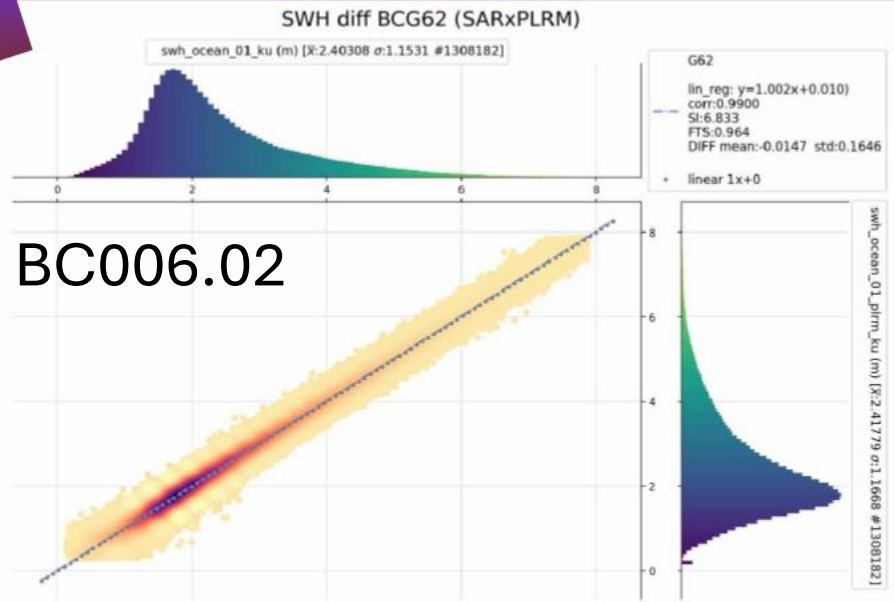
Improved SWH relationship for SAR x PLRM

- Improved calibration
- Vertical wave motioned applied to SAR @20Hz



Extra: there is now a 20Hz SWH quality flag present in the product:
`quality_swh_ocean_20_ku` (SAR only)

Slide courtesy of Bruno Lucas

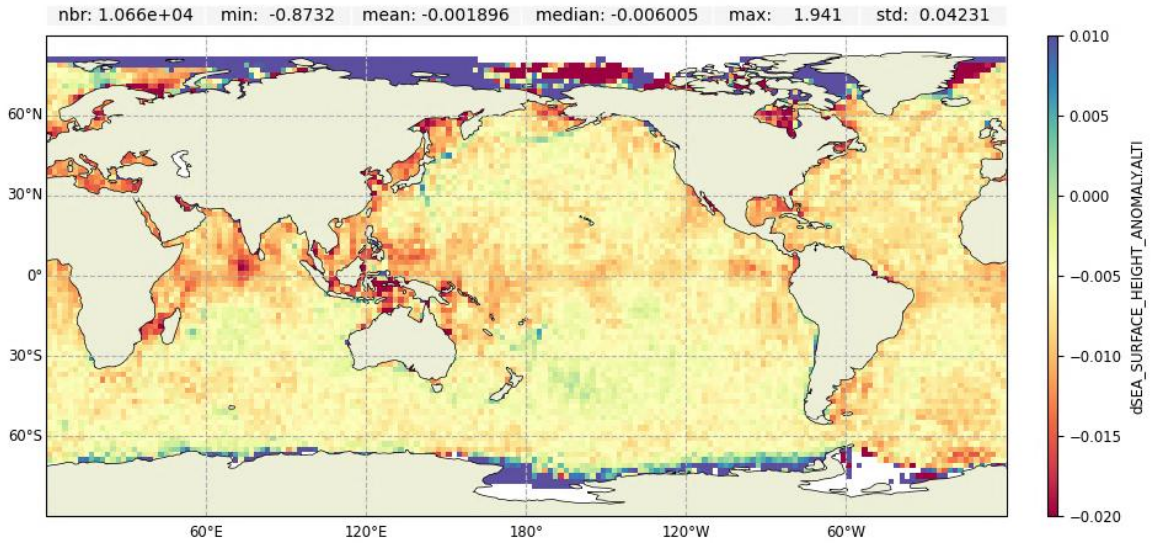
4. SSHA

SSHA BC006 - BC005

- SARM map shows some patterns in Equatorial area (small differences)
- SARM time series shows small oscillations (higher values in autumn)

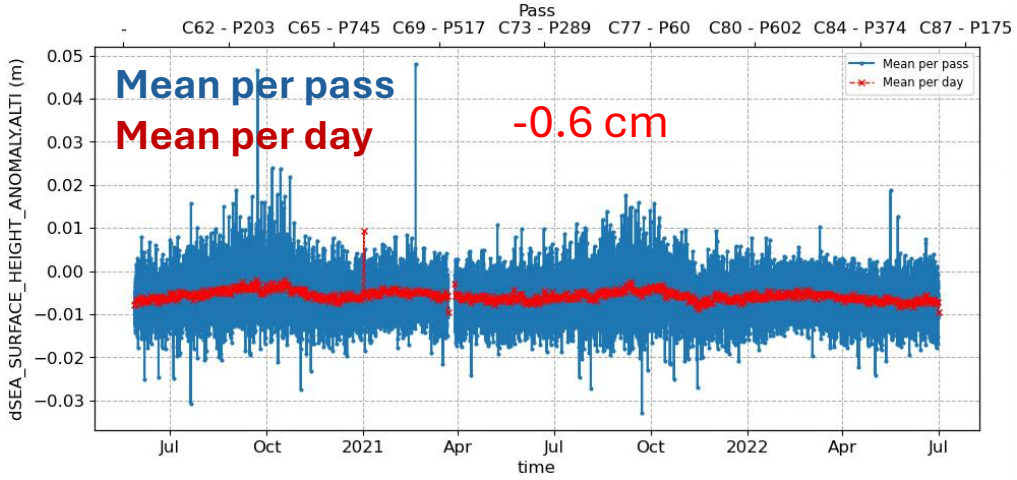
Changes in polar areas will be addressed later !

SARM BC_006 - BC_005



SARM BC_006 – BC_005

	nbr	min	mean	median	max	std
Mean per pass	2.146e+04	-0.03277	-0.005742	-0.005873	0.048	0.004491
Mean per day	759	-0.009556	-0.005658	-0.005751	0.009333	0.001258



4. SSHA

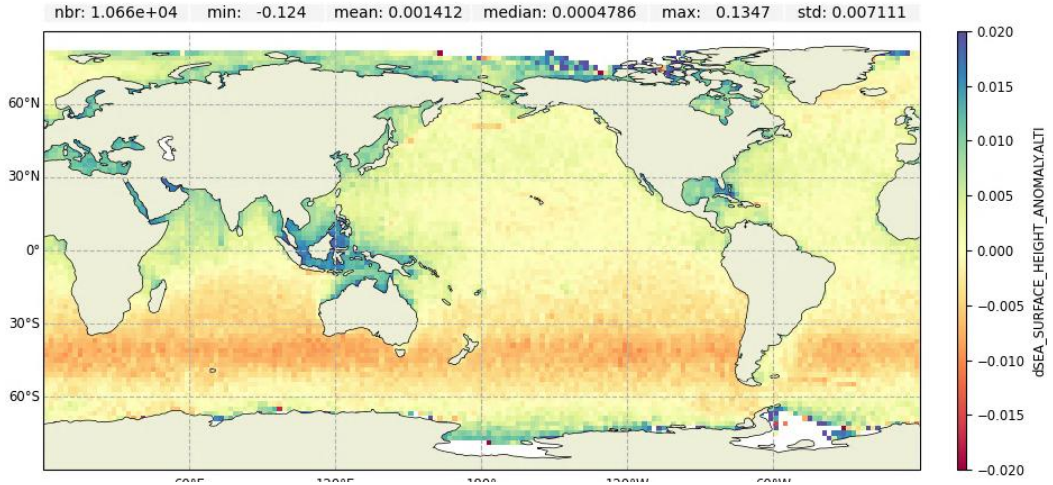
SSHA BC006 - BC005

- SARM map shows some patterns in Equatorial area (small differences)
- SARM time series shows small oscillations (higher values in autumn)

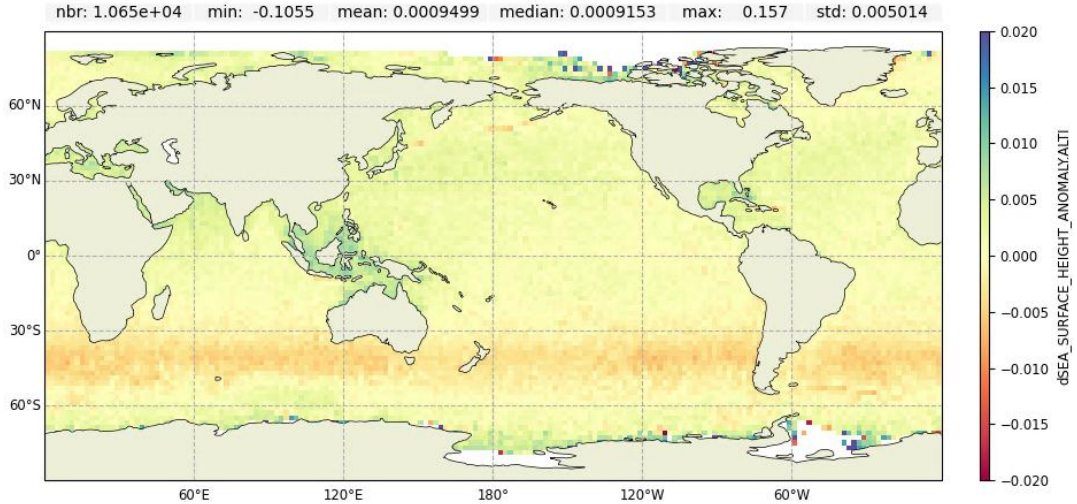
SARM-PLRM

- **Reduced differences in BC006**

BC_005 SARM – PLRM



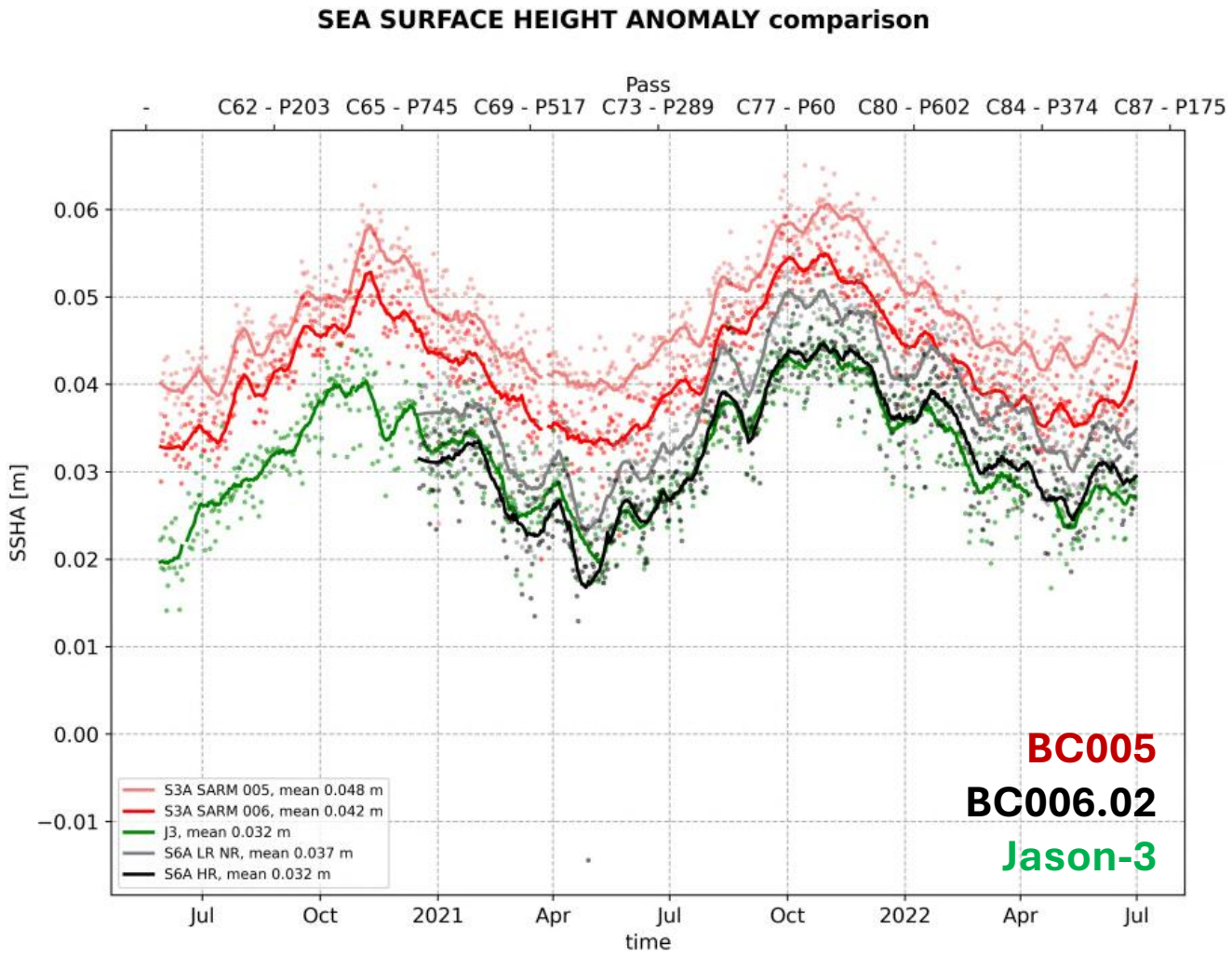
BC_006 SARM – PLRM



4. SSHA

SSHA time series:

- **Averages closer to the reference missions for BC006**
- The trends are not shown because the time series are too short



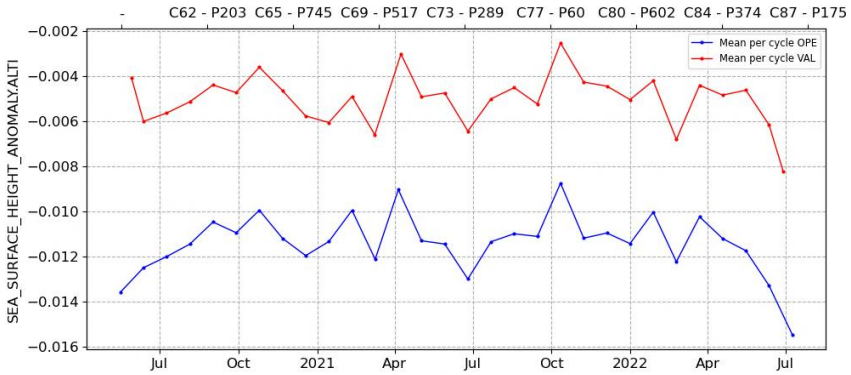
S3A PLRM curves not shown because very close to SARM, and make the plot difficult to read

4. SSHA

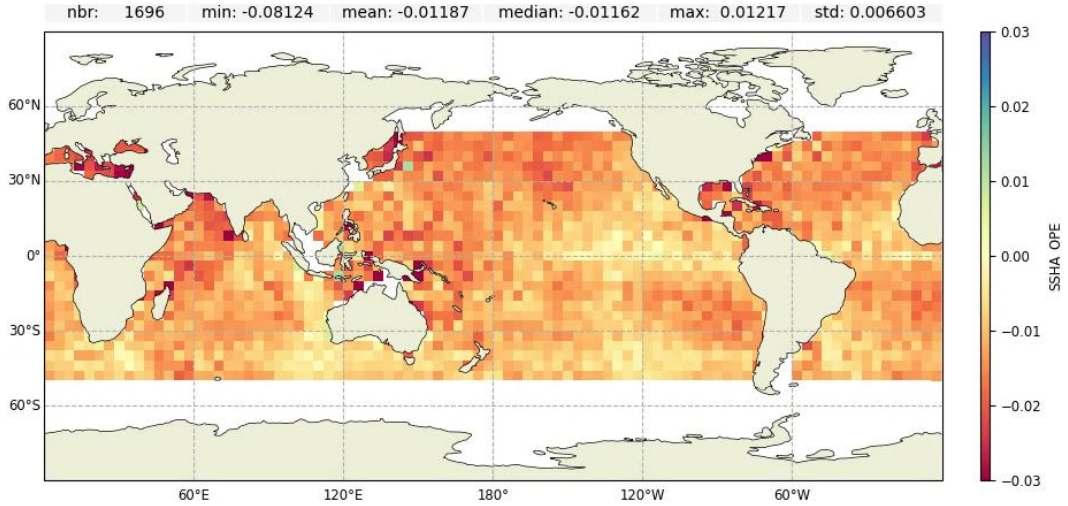
Sentinel-3A Jason-3 Crossovers:

- **Significantly lower mean** on time series
- Slightly lower std on time series
- Geographical patterns remain similar but weaker than BC005

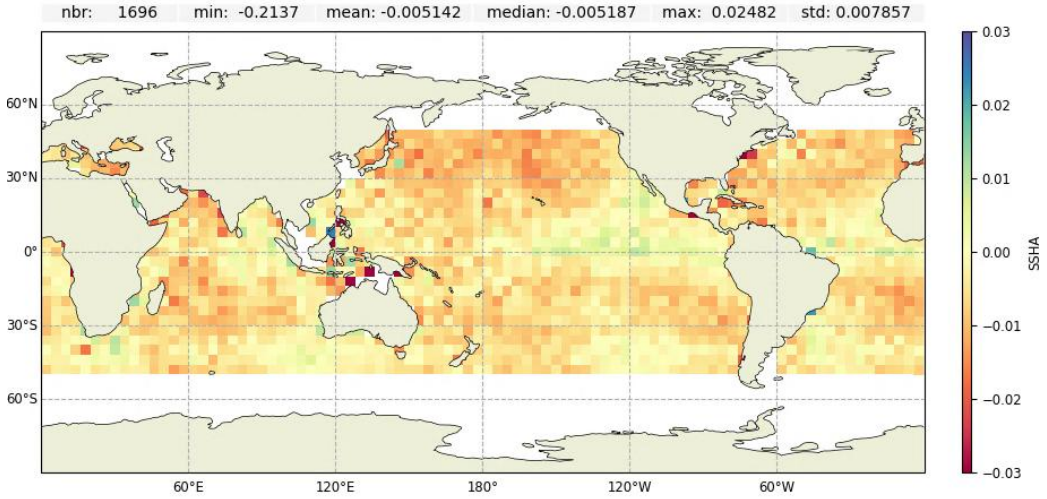
S3AJ3 Xovers tseries
(**BC005** and **BC006**)



BC_005 S3AJ3 Xovers



BC_ 006 S3AJ3 Xovers



Conclusions: Open Ocean

- No regression from BC005
- Significant improvements in mitigating the patterns correlated to along-track wind
- Reduced range noise over high sea conditions
- SSHA shows overall improvement
  - Better consistency SAR PLRM
  - Better better consistency with Jason-3 (time series and xovers)

Some points to be further clarified

- Spatial behavior of range std BC006 - BC005
- Slight trend in range PLRM BC006 - BC05