

PREPARATION AND OPERATIONS OF THE MISSION PERFORMANCE  
CENTRE (MPC) FOR THE COPERNICUS SENTINEL-3 MISSION

**S3 OLCI Cyclic Performance Report**

**S3-A**

Cycle No. 067

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End date: 28/01/2021

**S3-B**

Cycle No. 048

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## Changes Log

Version	Date	Changes
1.0	12/02/2021	First Version

## List of Changes

Version	Section	Answers to RID	Changes

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## 1 Processing Baseline Version

### 1.1 Sentinel3-A

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IPF	IPF / Processing Baseline version	Date of deployment
OL1	06.09 / 2.74	NRT: 10/12/2020 09:00 UTC NTC: 10/12/2020 09:00 UTC
OL2 LAND	06.14 / 2.66	NRT: 23/06/2020 08:00 UTC NTC: 23/06/2020 08:00 UTC
OL2 MAR	06.13 / 2.43	NRT: 12/12/2018 10:15 UTC NTC: 12/12/2018 10:15 UTC
SY2	06.20 / 2.66	NTC: 23/06/2020 08:00 UTC
SY2_VGS	06.08 / 2.56	NTC: 15/01/2020 11:00 UTC

### 1.2 Sentinel3-B

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IPF	IPF / Processing Baseline version	Date of deployment
OL1	06.09 / 1.52	NRT: 10/12/2020 09:00 UTC NTC: 10/12/2020 09:00 UTC
OL2 LAND	06.14 / 1.40	NRT: 23/06/2020 08:00 UTC NTC: 23/06/2020 08:00 UTC
OL2 MAR	06.13 / 1.15	NRT: 12/12/2018 10:15 UTC NTC: 12/12/2018 10:15 UTC
SY2	06.20 / 1.40	NTC: 23/06/2020 08:00 UTC
SY2_VGS	06.08 / 1.28	NTC: 15/01/2020 11:00 UTC

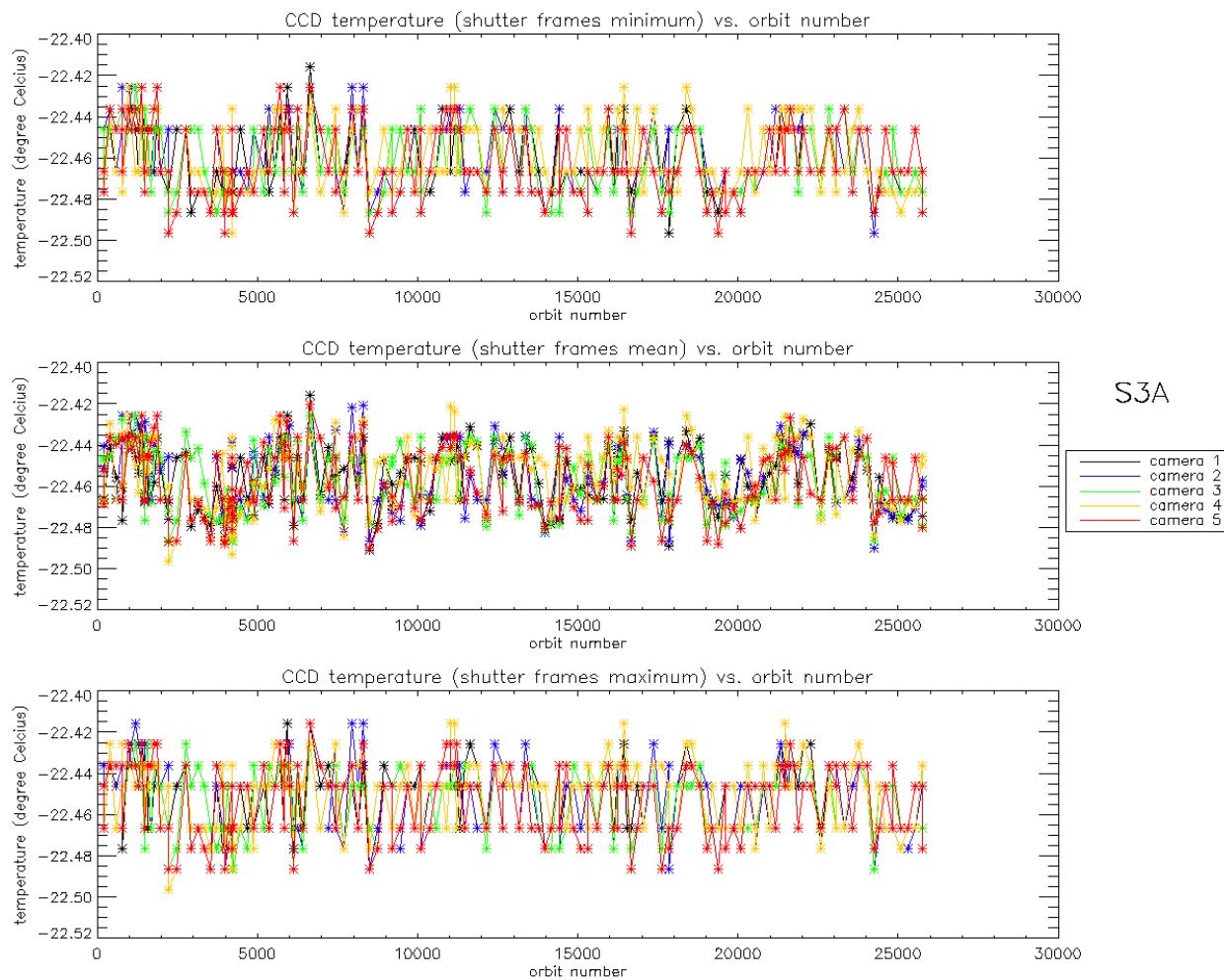
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## 2 Instrument monitoring

### 2.1 CCD temperatures

#### 2.1.1 OLCI-A

The monitoring of the CCD temperatures is based on MPMF data extractions not yet operational. In the meantime, we monitor the CCD temperatures on the long-term using Radiometric Calibration Annotations (see Figure 1). Variations are very small (0.09 C peak-to-peak) and no trend can be identified. Data from current cycle (rightmost data points) do not show any specificity.



**Figure 1:** long term monitoring of OLCI-A CCD temperatures using minimum value (top), time averaged values (middle), and maximum value (bottom) provided in the annotations of the Radiometric Calibration Level 1 products, for the Shutter frames, all radiometric calibrations so far except the first one (absolute orbit 183) for which the instrument was not yet thermally stable.



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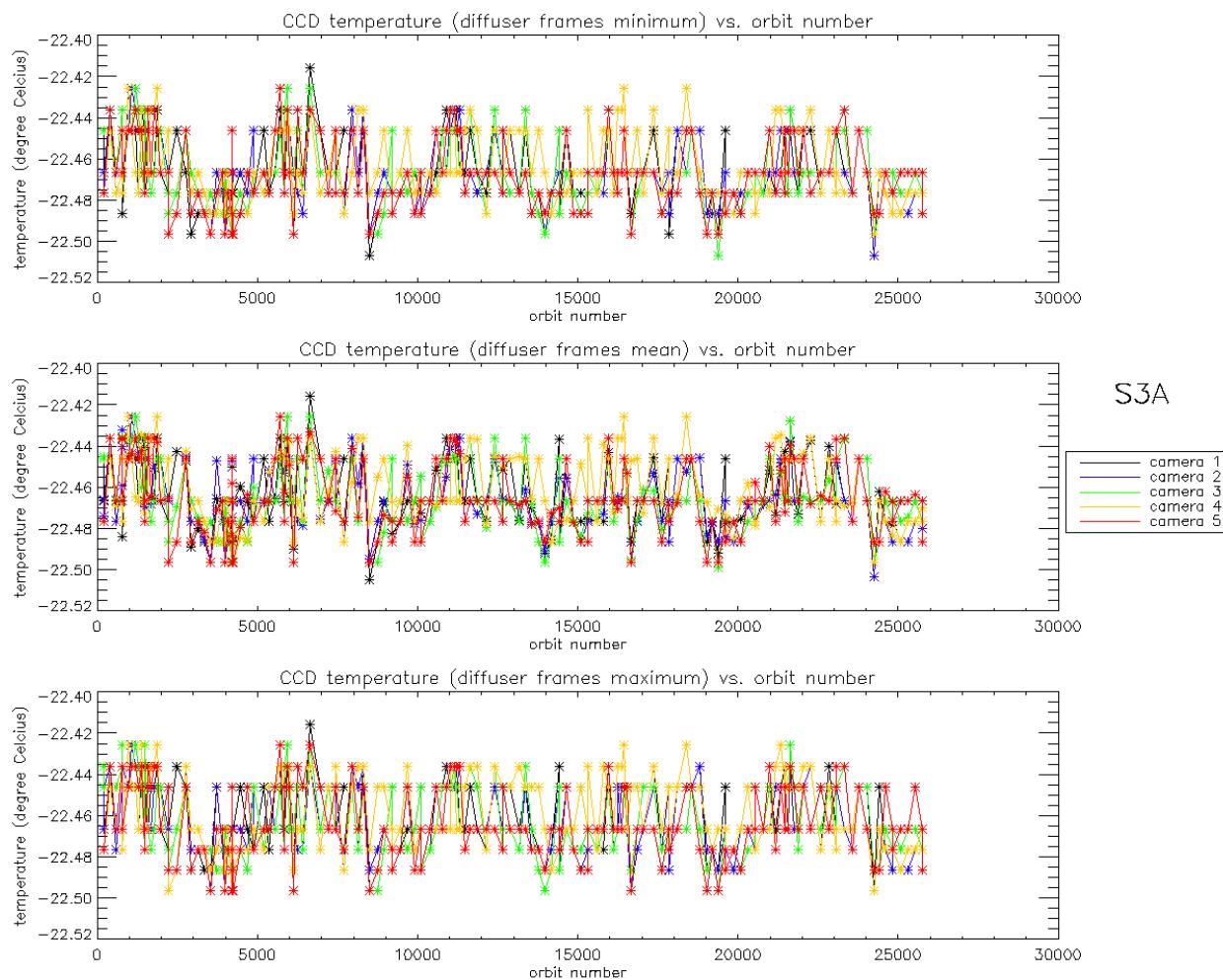


Figure 2: Same as Figure 1 for diffuser frames.

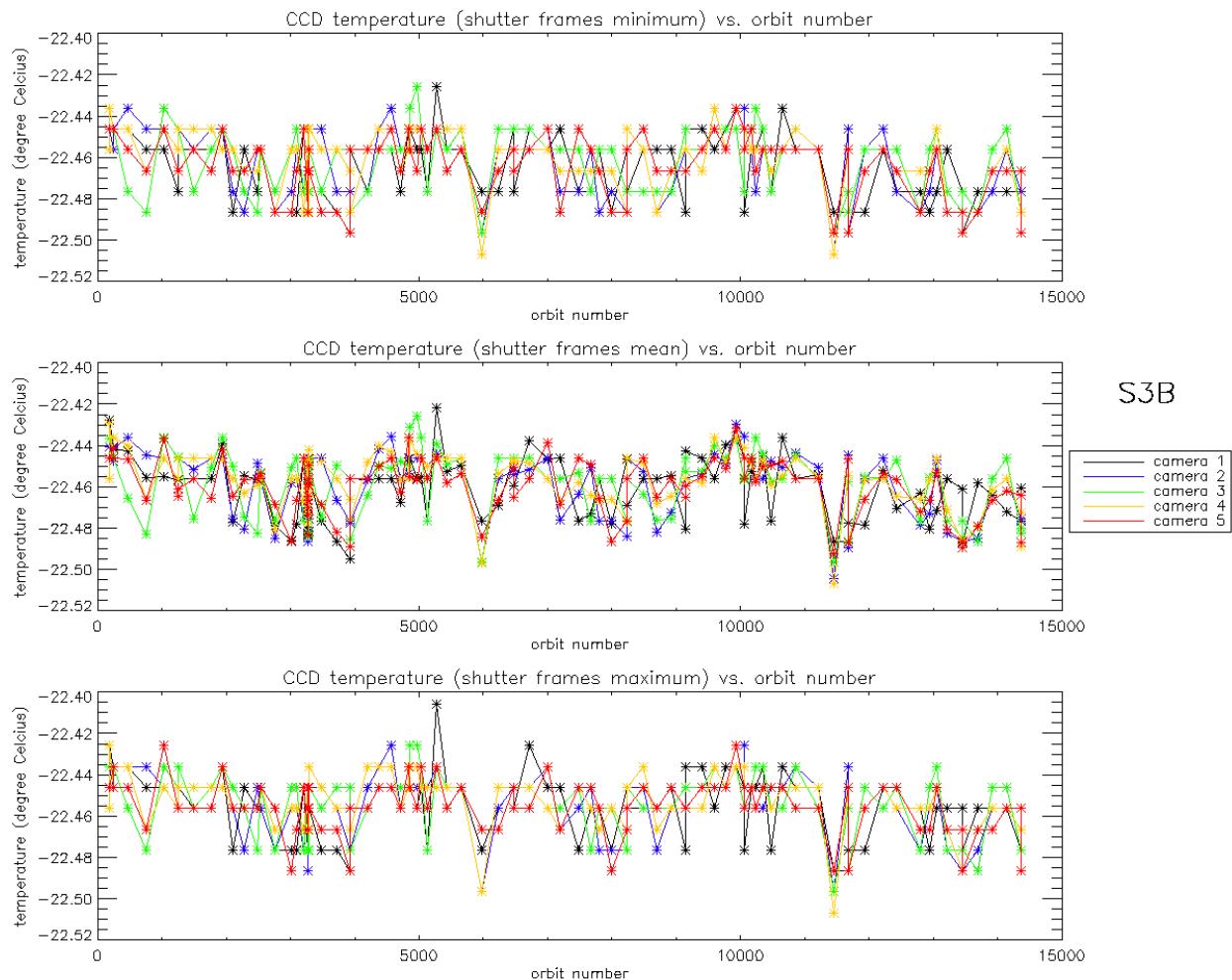


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## 2.1.2 OLCI-B

As for OLCI-A, the variations of CCD temperature are very small (0.08 C peak-to-peak) and no trend can be identified. Data from current cycle (rightmost data points) do not show any specificity.



**Figure 3: long term monitoring of OLCI-B CCD temperatures using minimum value (top), time averaged values (middle), and maximum value (bottom) provided in the annotations of the Radiometric Calibration Level 1 products, for the Shutter frames, all radiometric calibrations so far except the first one (absolute orbit 167) for which the instrument was not yet thermally stable.**



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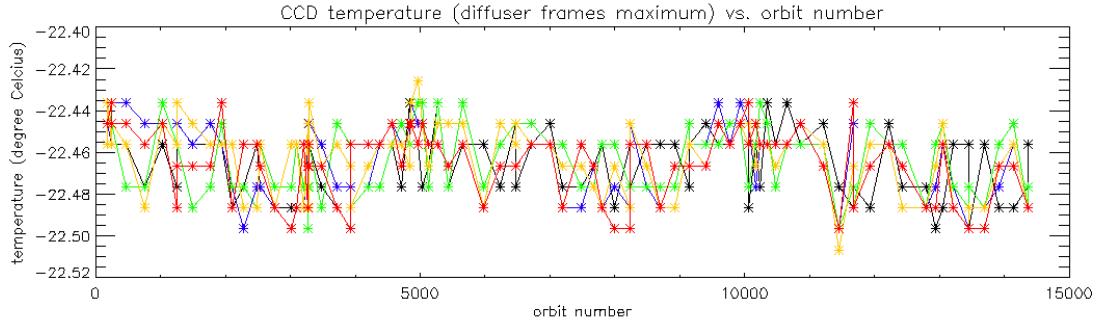
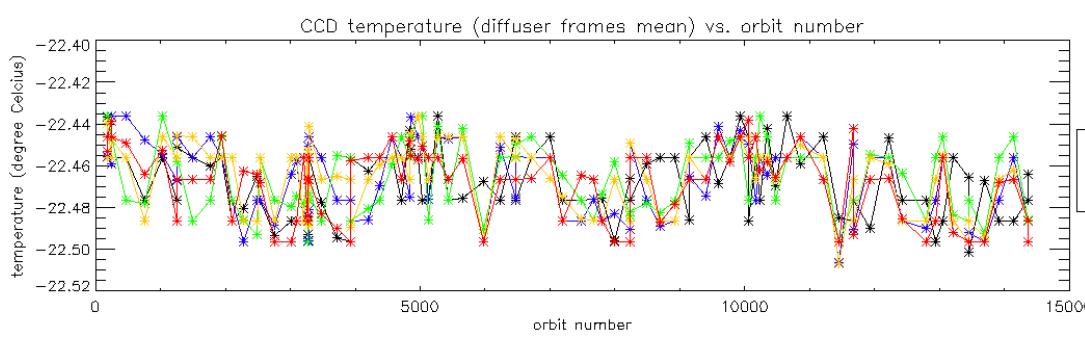
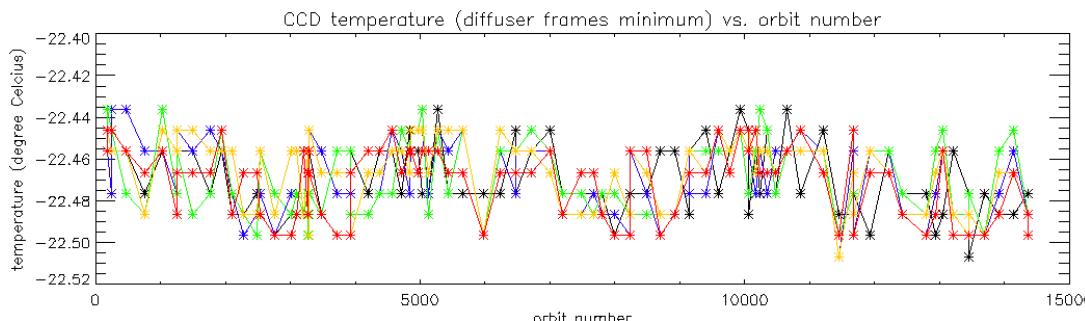
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**Figure 4: same as Figure 3 for diffuser frames.**

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## 2.2 Radiometric Calibration

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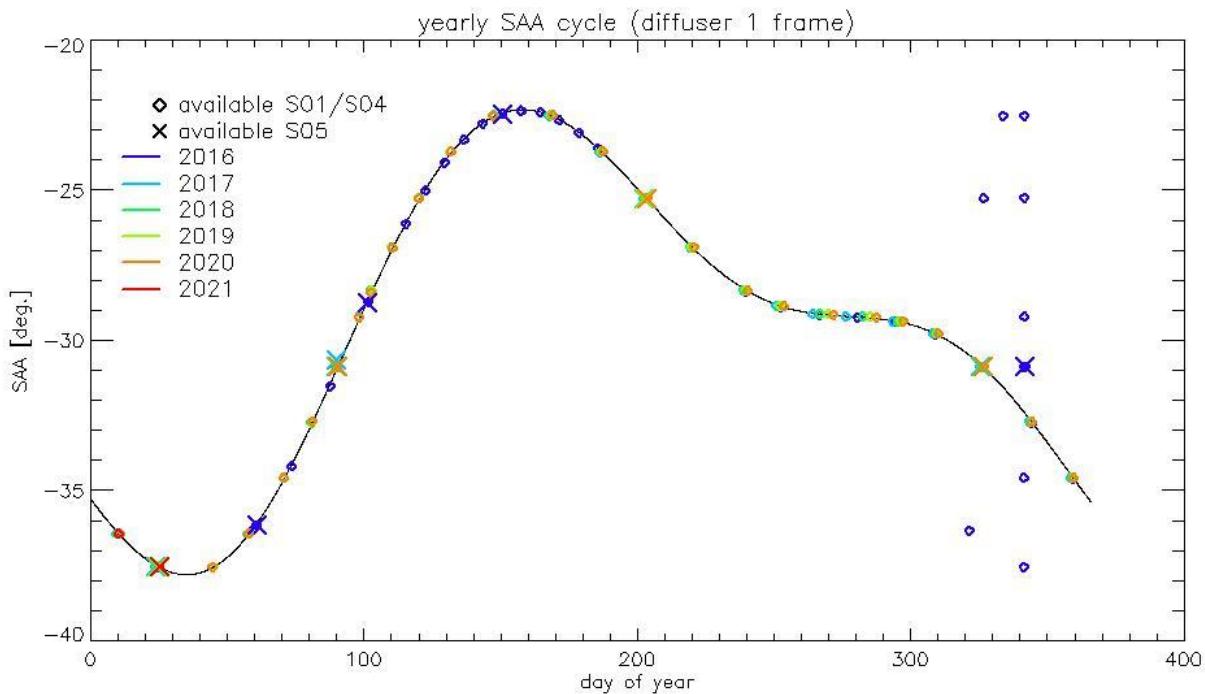
For OLCI-A, three Radiometric Calibration Sequences have been acquired during Cycle 067:

- ❖ S01 sequence (diffuser 1) on 10/01/2021 23:57 to 23:59 (absolute orbit 25527)
- ❖ S01 sequence (diffuser 1) on 25/01/2021 22:27 to 22:29 (absolute orbit 25740)
- ❖ S05 sequence (diffuser 2) on 26/01/2021 00:08 to 00:10 (absolute orbit 25741)

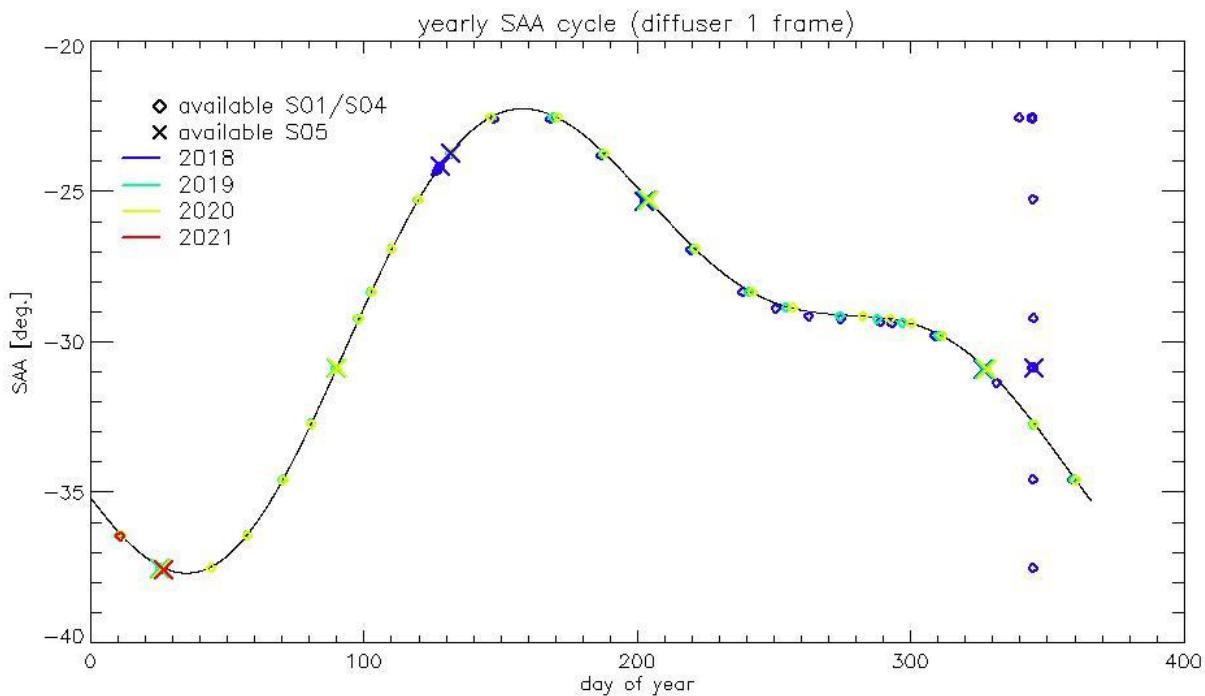
For OLCI-B, three Radiometric Calibration Sequence have been acquired during Cycle 048:

- ❖ S01 sequence (diffuser 1) on 11/01/2021 19:30 to 19:32 (absolute orbit 14145)
- ❖ S01 sequence (diffuser 1) on 27/01/2021 09:08 to 09:10 (absolute orbit 14367)
- ❖ S05 sequence (diffuser 2) on 27/01/2021 10:49 to 10:51 (absolute orbit 14368)

The acquired Sun azimuth angles are presented on Figure 5 for OLCI-A and Figure 6 for OLCI-B, on top of the nominal values without Yaw Manoeuvre (i.e. with nominal Yaw Steering control of the satellite).



**Figure 5:** Sun azimuth angles during acquired OLCI-A Radiometric Calibrations (diffuser frame) on top of nominal yearly cycle (black curve). Diffuser 1 with diamonds, diffuser 2 with crosses, 2016 acquisitions in dark blue, 2017 in clear blue, 2018 in green, 2019 in light green, 2020 in orange and 2021 in red.



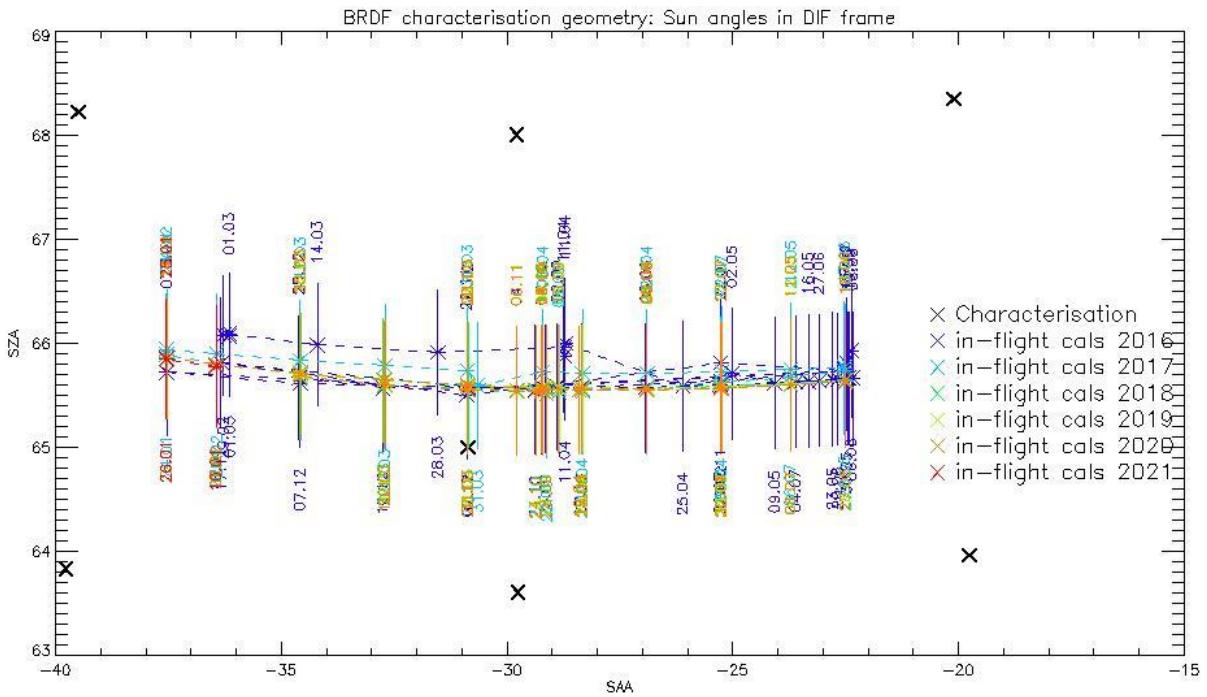
**Figure 6:** same as Figure 5 for OLCI-B (2018 in blue, 2019 in green, 2020 in yellow and 2021 in red).



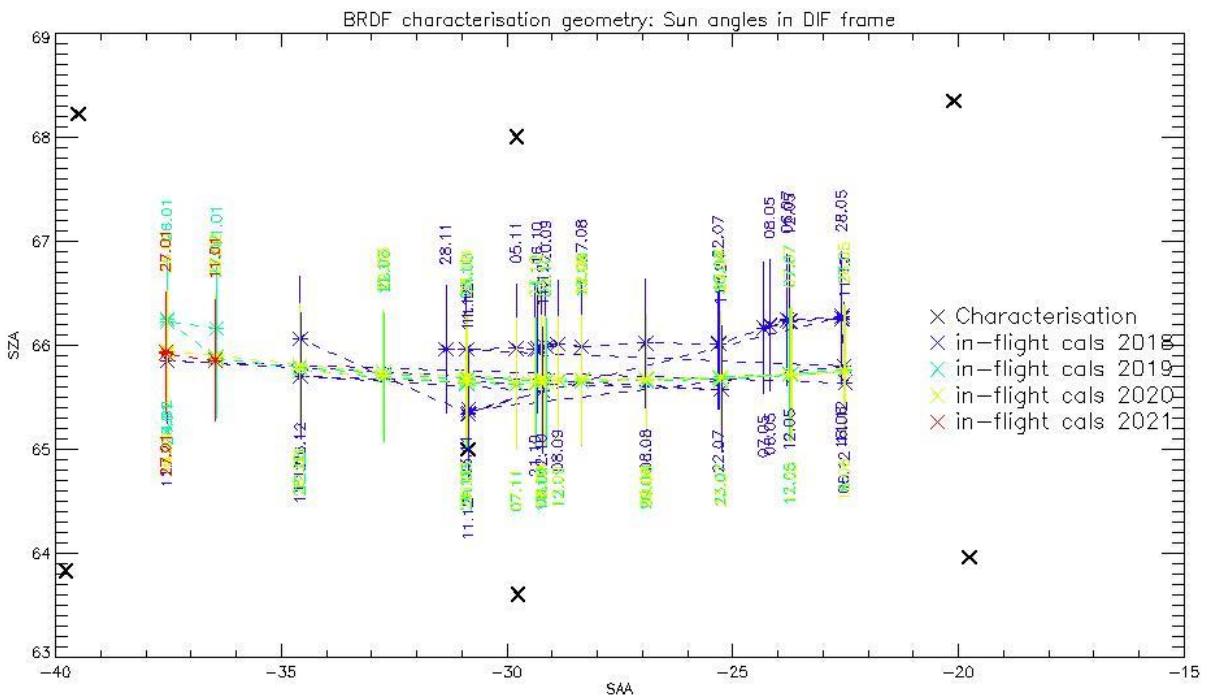
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Sun Azimuth Angles as a function of solar zenith Angles are presented in Figure 7 for OLCI-A and Figure 8 for OLCI-B.



**Figure 7: OLCI-A Sun geometry during radiometric Calibrations on top of characterization ones (diffuser frame)**



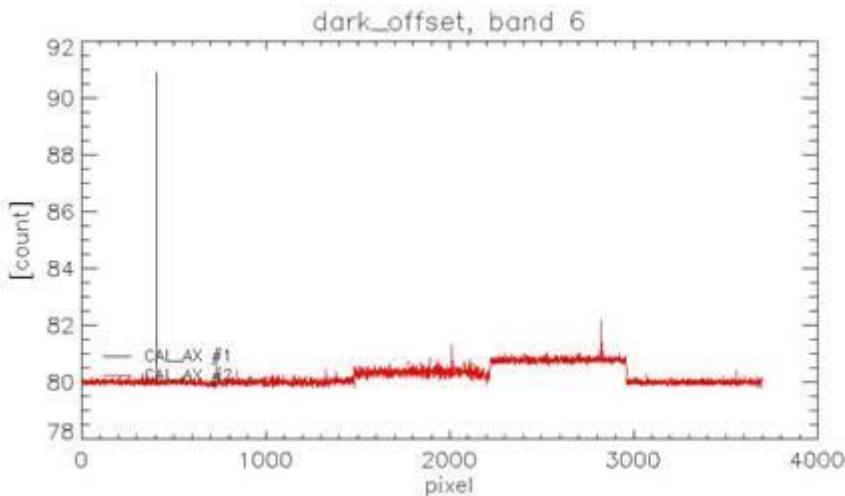
**Figure 8: same as Figure 7 for OLCI-B**

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## 2.2.1 Dark Offsets [OLCI-L1B-CV-230]

### Note about the High Energy Particles:

The filtering of High Energy Particle (HEP) events from radiometric calibration data has been implemented (for shutter frames only) in a post processor, allowing generating Dark Offset and Dark Current tables computed on filtered data. The post-processor starts from IPF intermediate data (corrected counts), applies the HEP detection and filtering and finally computes the Dark Offset and Dark Current tables the same way as IPF. An example of the impact of HEP filtering is given in Figure 9.



**Figure 9: Dark Offset table for band Oa06 with (red) and without (black) HEP filtering (Radiometric Calibration of 22 July 2017). The strong HEP event near pixel 400 has been detected and removed by the HEP filtering.**

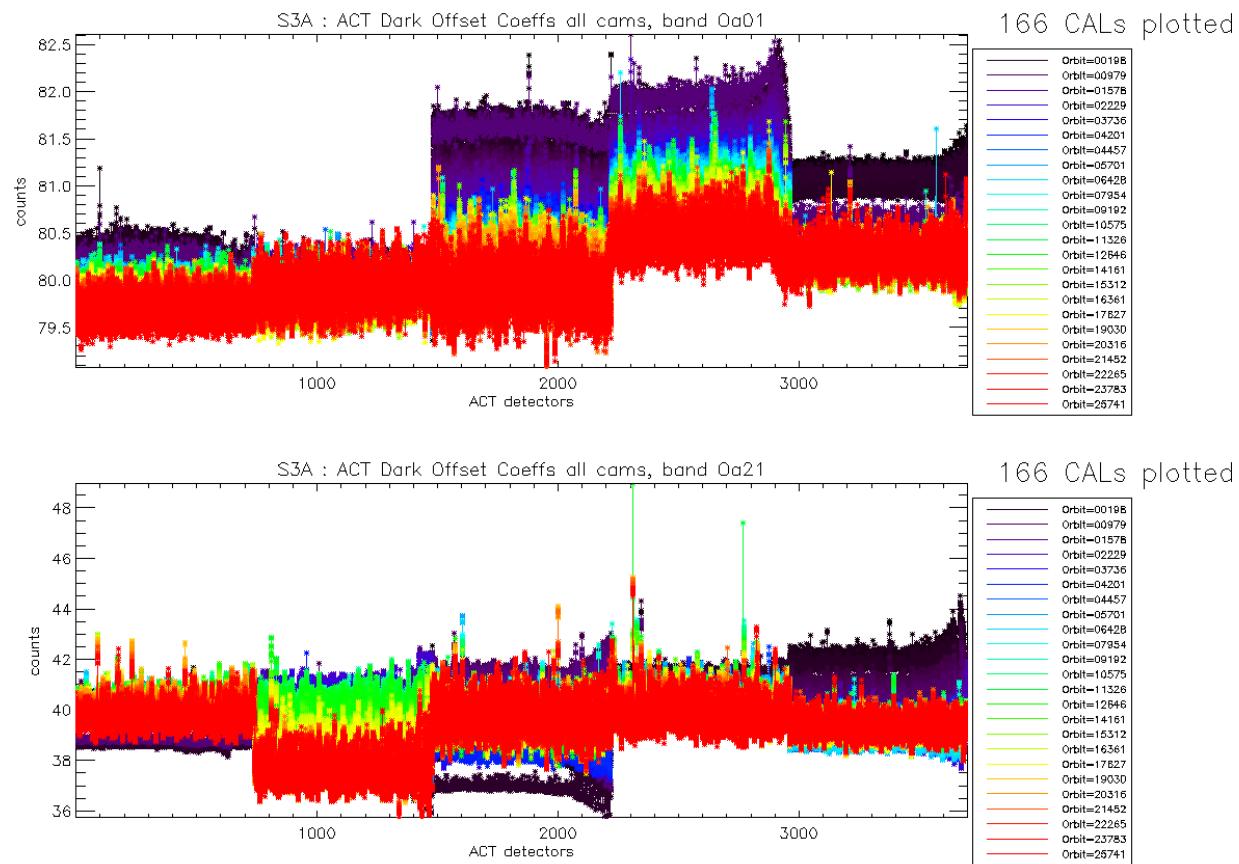
All results presented below in this section have been obtained using the HEP filtered Dark Offset and Dark Current tables.

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### 2.2.1.2 OLCI-A

#### Dark offsets

Dark offsets are continuously affected by the global offset induced by the Periodic Noise on the OCL convergence. Current Cycle calibrations are affected the same way as others. The amplitude of the shift varies with band and camera from virtually nothing (e.g. camera 2, band Oa01) to up to 5 counts (Oa21, camera 3). The Periodic Noise itself comes on top of the global shift with its known signature: high frequency oscillations with a rapid damp. This effect remains more or less stable with time in terms of amplitude, frequency and decay length, but its phase varies with time, introducing the global offset mentioned above.



**Figure 10:** OLCI-A Dark Offset for band Oa1 (top) and Oa21 (bottom), all radiometric calibrations so far except the first one (orbit 183) for which the instrument was not thermally stable yet.



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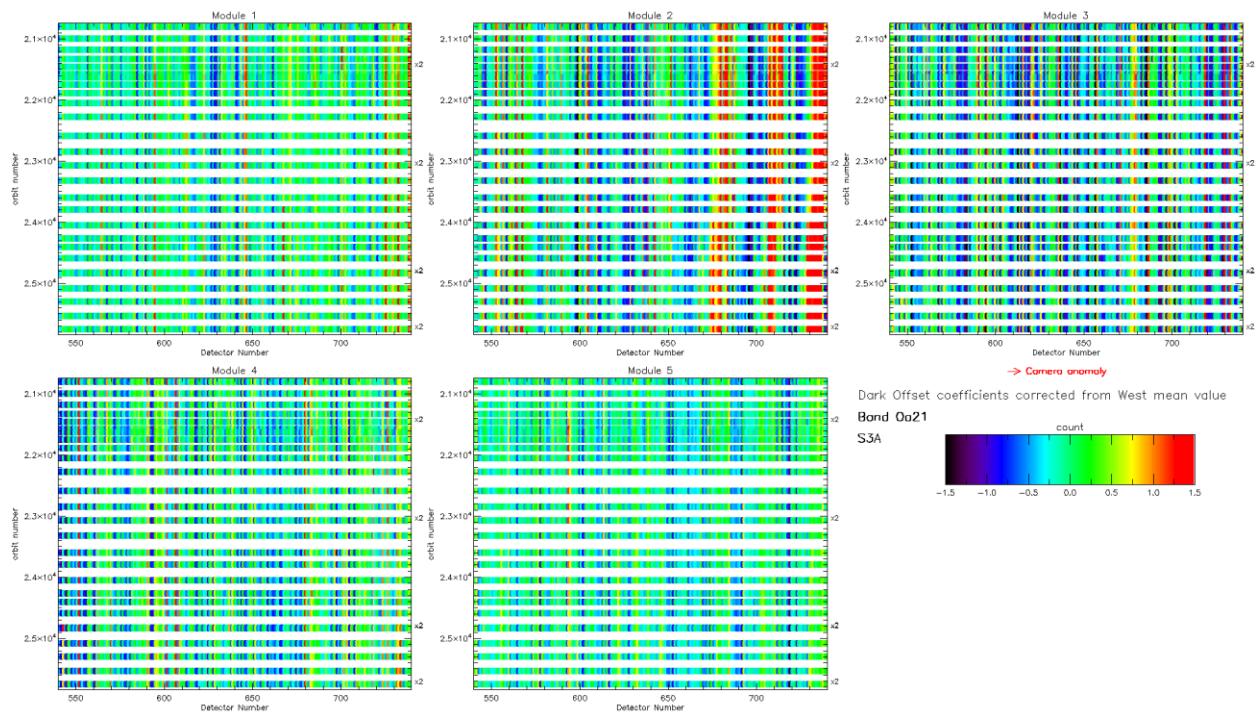
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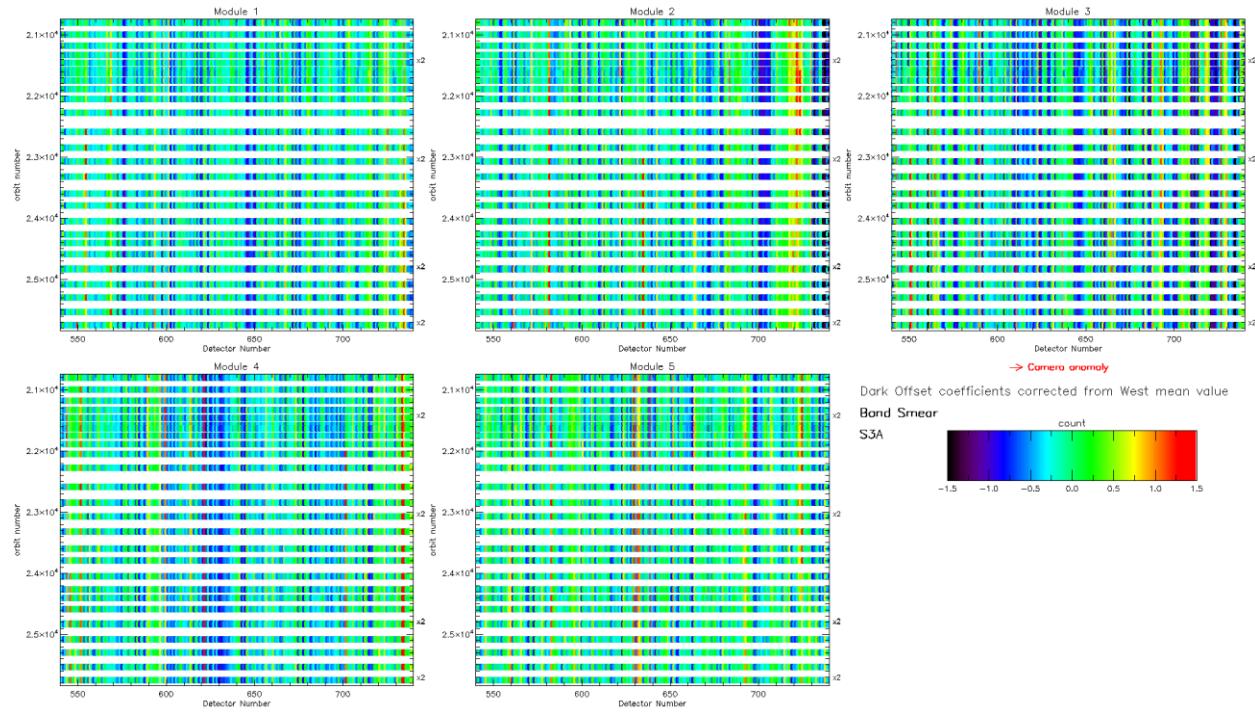
**Figure 11: map of OLCI-A periodic noise for the 5 cameras, for band Oa21. X-axis is detector number (East part, from 540 to 740, where the periodic noise occurs), Y-axis is the orbit number. Y-axis range is focused on the most recent 5000 orbits. The counts have been corrected from the West detectors mean value (not affected by periodic noise) in order to remove mean level gaps and consequently to have a better visualisation of the long term evolution of the periodic noise structure. At the beginning of the mission the periodic noise for band Oa21 had strong amplitude in camera 2, 3 and 5 compared to camera 1 and 4. However PN evolved through the**



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*mission and these discrepancies between cameras have been reduced. At the time of this Cyclic Report Camera 2 still shows a slightly higher PN than other cameras.*



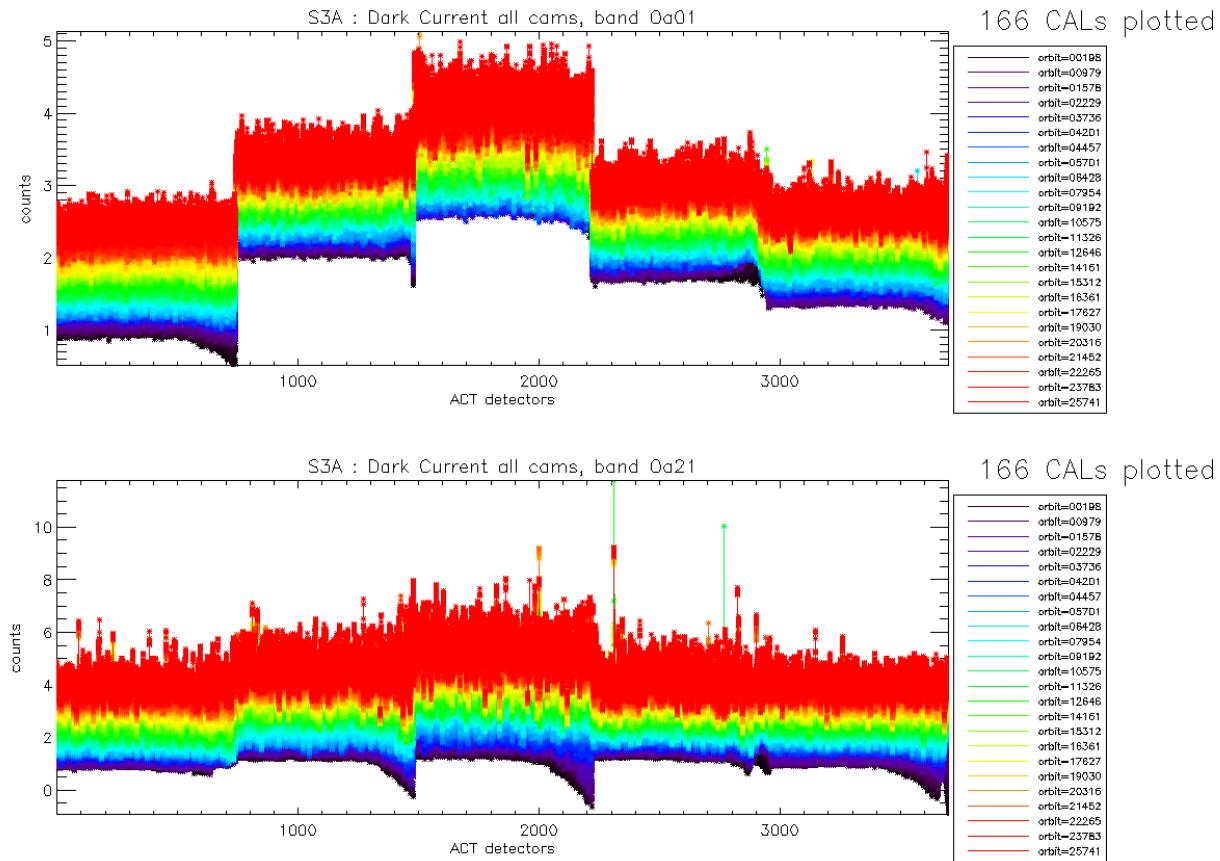
**Figure 12: same as Figure 11 for smear band.**

Figure 11 and Figure 12 show the so-called ‘map of periodic noise’ in the 5 cameras, for respectively band 21 and smear band. These maps have been computed from the dark offsets after removal of the mean level of the WEST detectors (not impacted by PN) in order to remove mean level gaps from one CAL to the other and consequently to highlight the shape of the PN. Maps are focused on the last 200 EAST detectors where PN occurs and on a time range covering only the last 5000 orbits in order to better visualize the CALs of the current cycle.

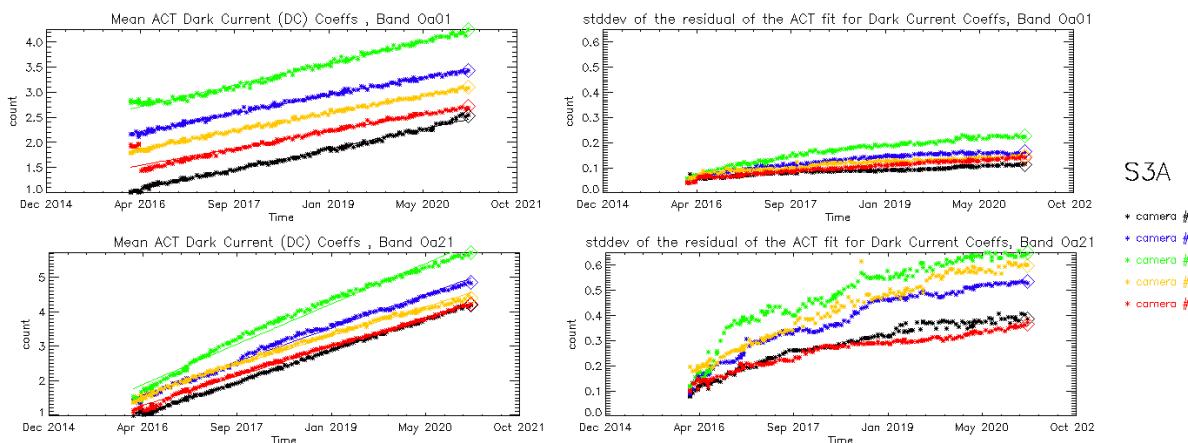
As there was no camera anomaly during the current cycle, there is no sudden change of periodic noise to report during the current cycle. the small drift in camera 2 Oa21 (Figure 11 upper middle plot) near orbit 24000 for the last 100 pixels is now pretty stabilized . This kind of drift had already been encountered for the same camera/band/pixels, for example between orbit 13500 and 14500 and between orbit 18000 and 19500 (see previous CR reports).

### Dark Currents

Dark Currents (Figure 13) are not affected by the global offset of the Dark Offsets, thanks to the clamping to the average blind pixels value. However, the oscillations of Periodic Noise remain visible. There is no significant evolution of this parameter during the current cycle except the small regular increase (almost linear), for all detectors, since the beginning of the mission (see Figure 14).



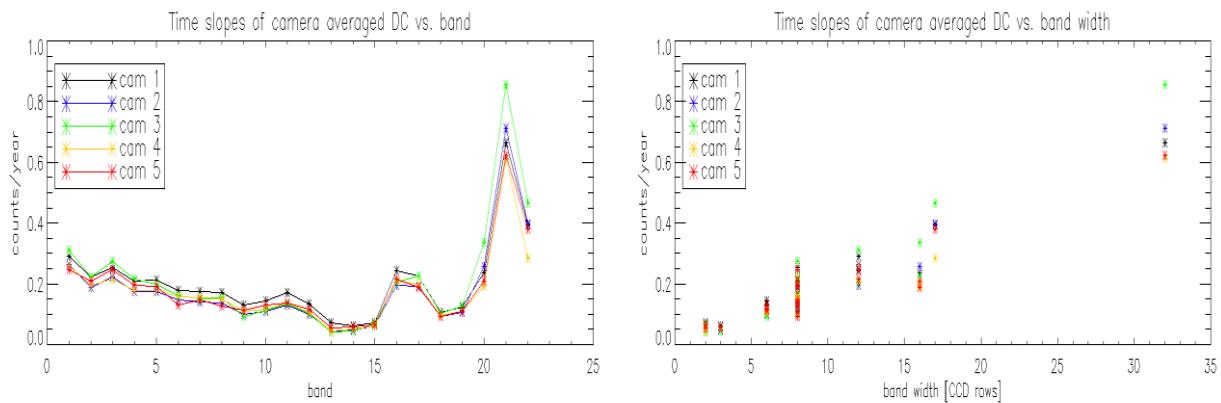
**Figure 13: OLCI-A Dark Current for band Oa1 (top) and Oa21 (bottom), all radiometric calibrations so far except the first one (orbit 183) for which the instrument was not thermally stable yet.**



**Figure 14: left column: ACT mean on 400 first detectors of OLCI-A Dark Current coefficients for spectral band Oa01 (top) and Oa21 (bottom). Right column: same as left column but for Standard deviation instead of mean. We see an increase of the DC level as a function of time especially for band Oa21.**

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A possible explanation of the regular increase of DC could be the increase of the number of hot pixels which is more important in Oa21 because this band is made of more CCD lines than band Oa01 and thus receives more cosmic rays impacts. It is known that cosmic rays degrade the structure of the CCD, generating more and more hot pixels at long term scales. Indeed, when computing the time slopes of the spatially averaged Dark Current as a function of band, i.e. the slopes of curves in left plots of Figure 14, one can see that Oa21 is by far the most affected, followed by the smear band (Figure 15, left); when plotting these slopes against total band width (in CCD rows, regardless of the number of micro-bands), the correlation between the slope values and the width becomes clear (Figure 15, right).



**Figure 15: OLCI-A Dark current increase rates with time (in counts per year) vs. band (left) and vs. band width (right)**

### 2.2.1.3 OLCI-B

#### Dark Offsets

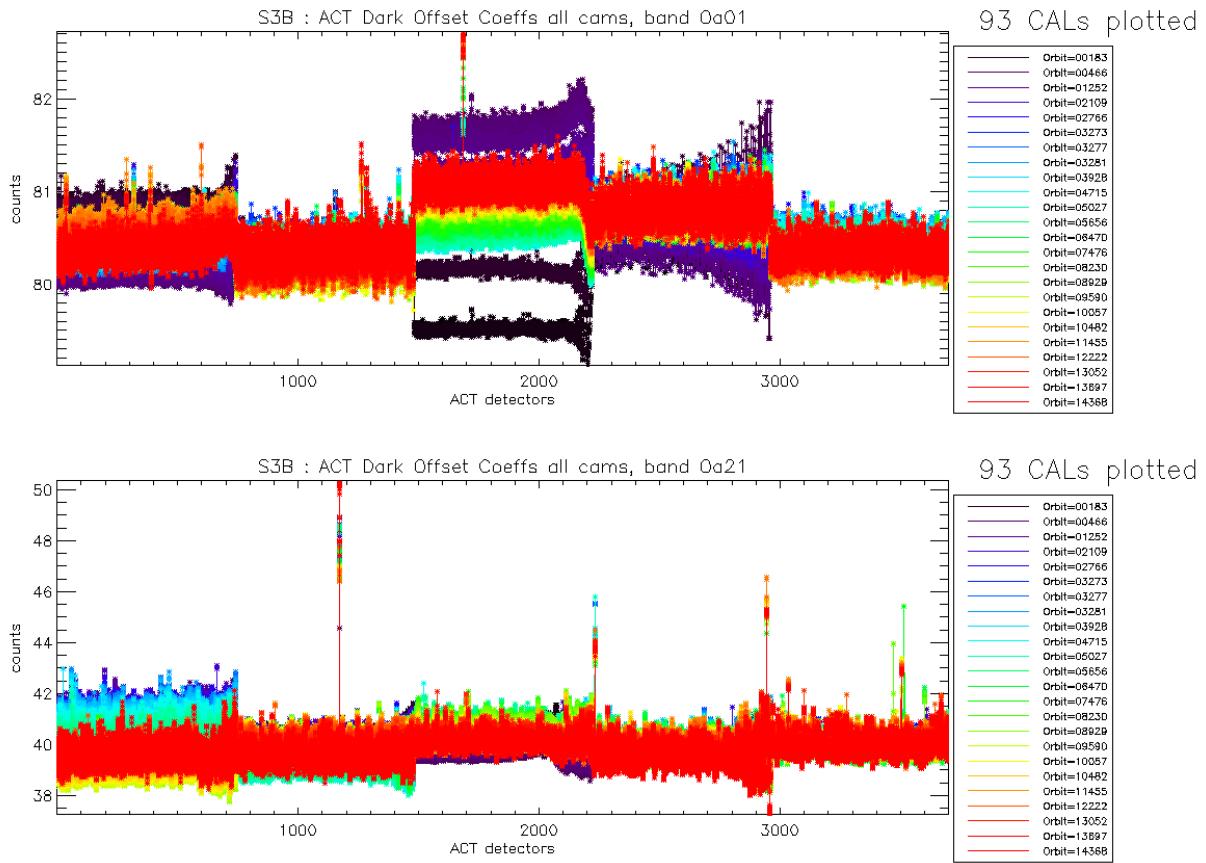
Dark offsets for OLCI-B show a similar behaviour than for OLCI-A: mean level gaps between different orbits, induced by the presence of a pseudo periodic noise on the east edge of the cameras with a drifting phase.

Evolution of OLCI-B Dark Offset coefficients for band Oa01 and Oa21 are represented in Figure 16.

The periodic noise maps are shown for band Oa21 and smear band respectively in Figure 17 and Figure 18. As it happened for OLCI-A after a few thousands of orbits, the strong periodic noise phase and amplitude drift, present at the very beginning of the mission is now showing a clear stabilization.

Despite this overall stabilization, small evolutions are still noticeable in some bands/camera, like for example pixels at the east edge of camera 1 in band Oa21 since orbit 10000 (upper left map in Figure 17) or in camera 4 band Oa21 since orbit 13000 (lower left map in Figure 17).

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**Figure 16: OLCI-B Dark Offset for band Oa1 (top) and Oa21 (bottom), all radiometric calibrations so far except the first one (orbit 167) for which the instrument was not thermally stable yet.**



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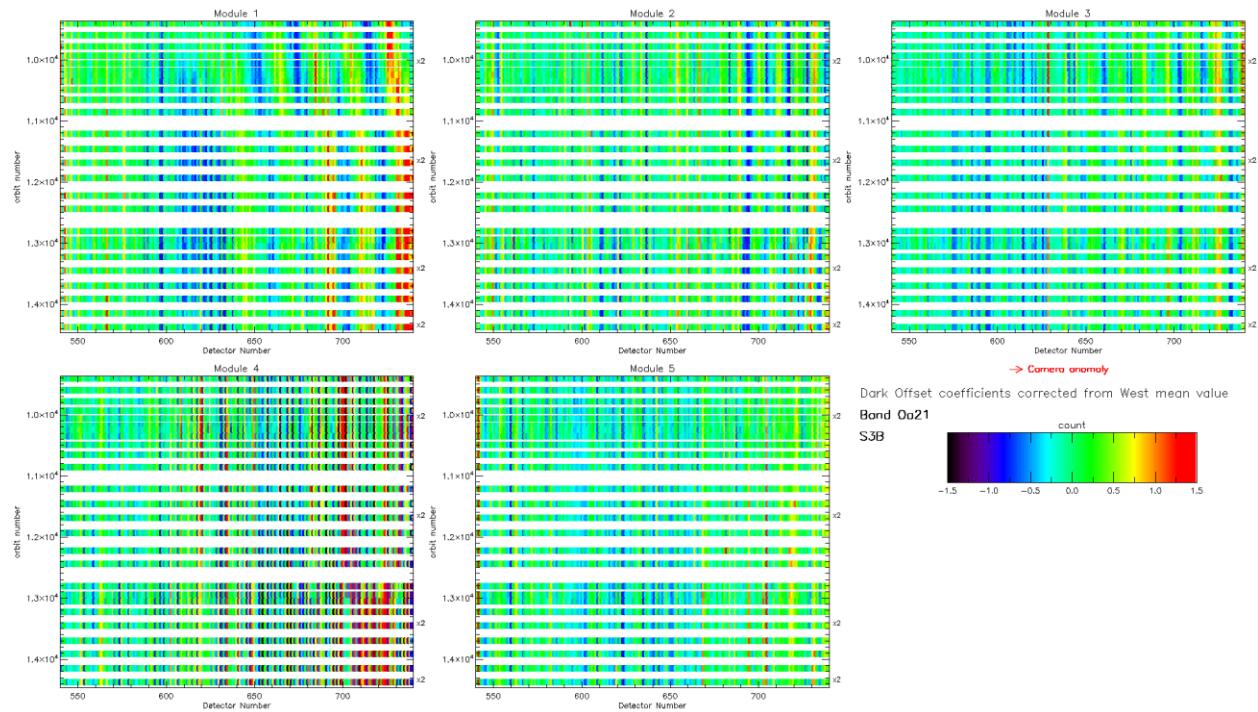
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**Figure 17: OLCI-B map of periodic noise for the 5 cameras, for band Oa21. X-axis is detector number (East part, from 540 to 740, where the periodic noise occurs), Y-axis is the orbit number. The counts have been corrected from the West detectors mean value (not affected by periodic noise) in order to remove mean level gaps and consequently to have a better visualisation of the long term evolution of the periodic noise structure.**



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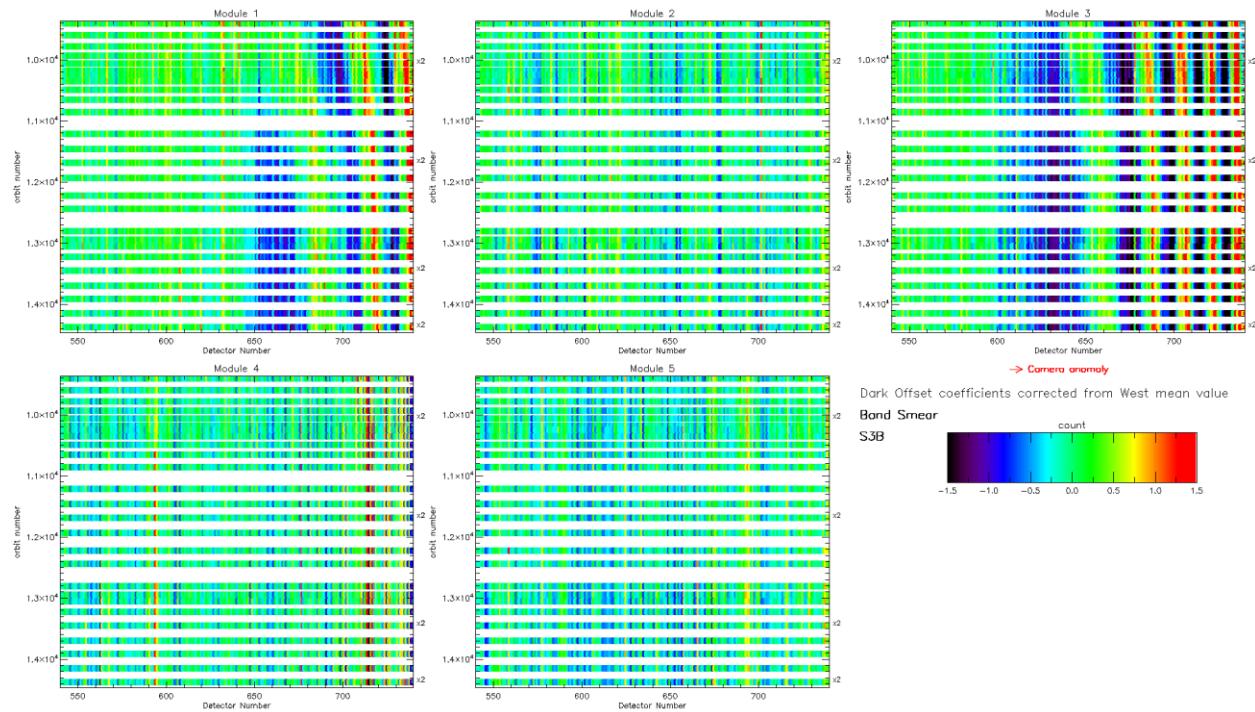
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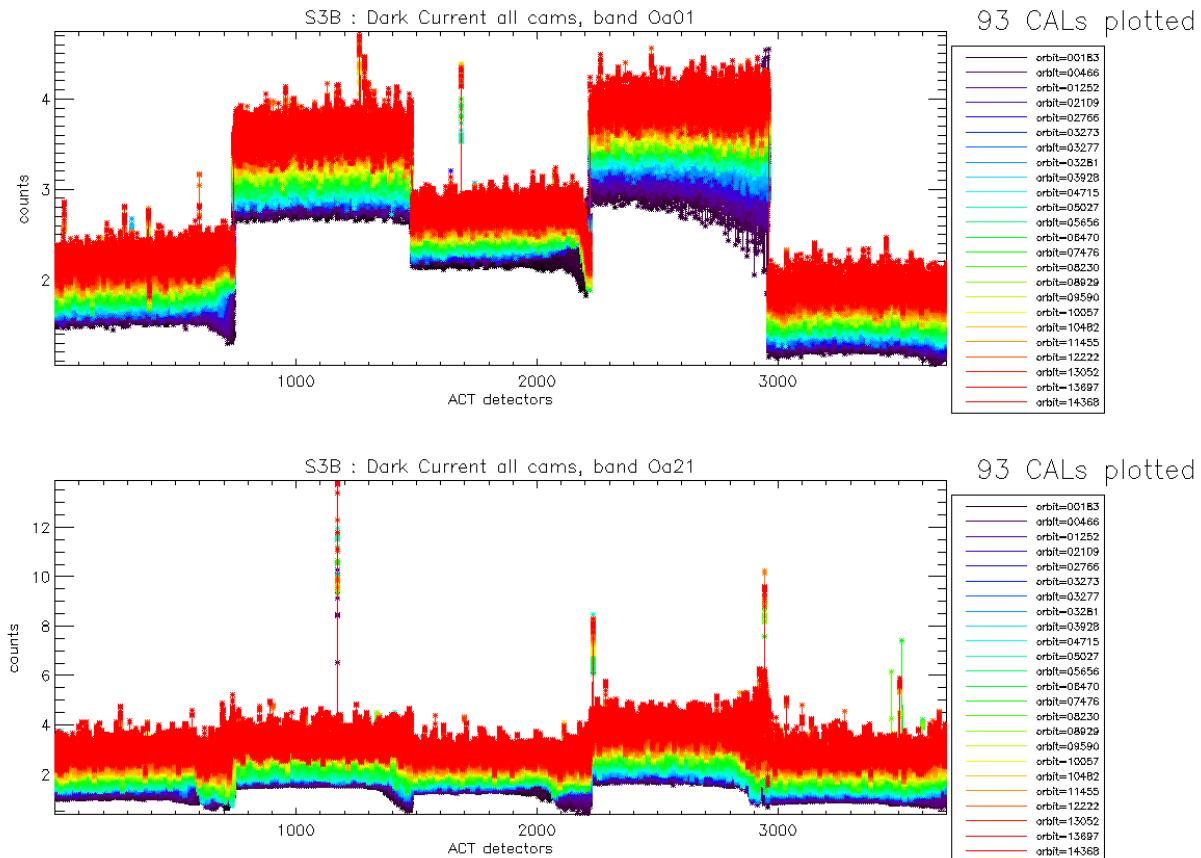
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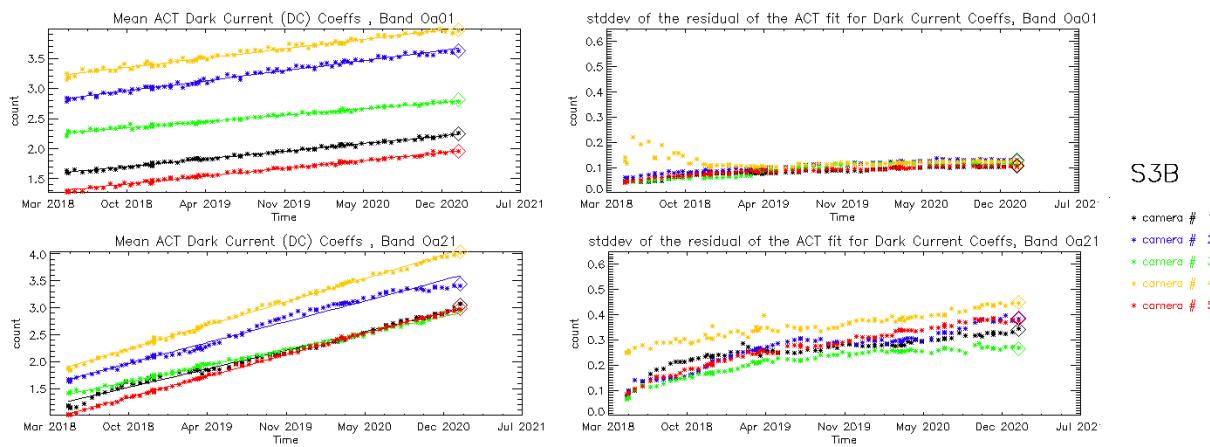
**Figure 18: same as Figure 17 for smear band.**

### Dark Currents

As for OLCI-A there is no significant evolution of the Dark Current coefficients (Figure 19) during the current cycle except the small regular increase (almost linear), for all detectors, since the beginning of the mission (see Figure 20) probably due to an increase of hot pixels (see Figure 21).



**Figure 19: OLCI-B Dark Current for band Oa1 (top) and Oa21 (bottom), all radiometric calibrations so far except the first one (orbit 167) for which the instrument was not thermally stable yet.**

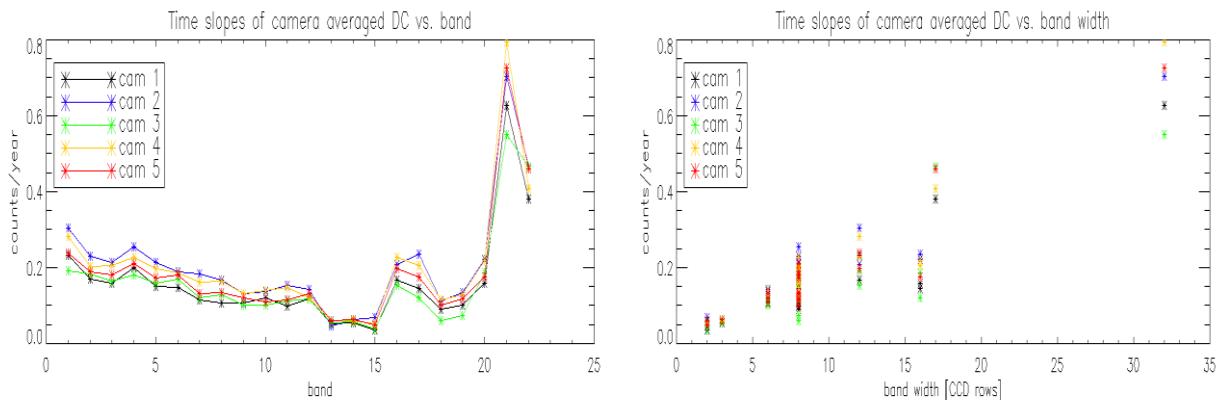


**Figure 20: left column: ACT mean on 400 first detectors of OLCI-B Dark Current coefficients for spectral band Oa01 (top) and Oa21 (bottom). Right column: same as left column but for Standard deviation instead of mean. We see an increase of the DC level as a function of time especially for band Oa21.**



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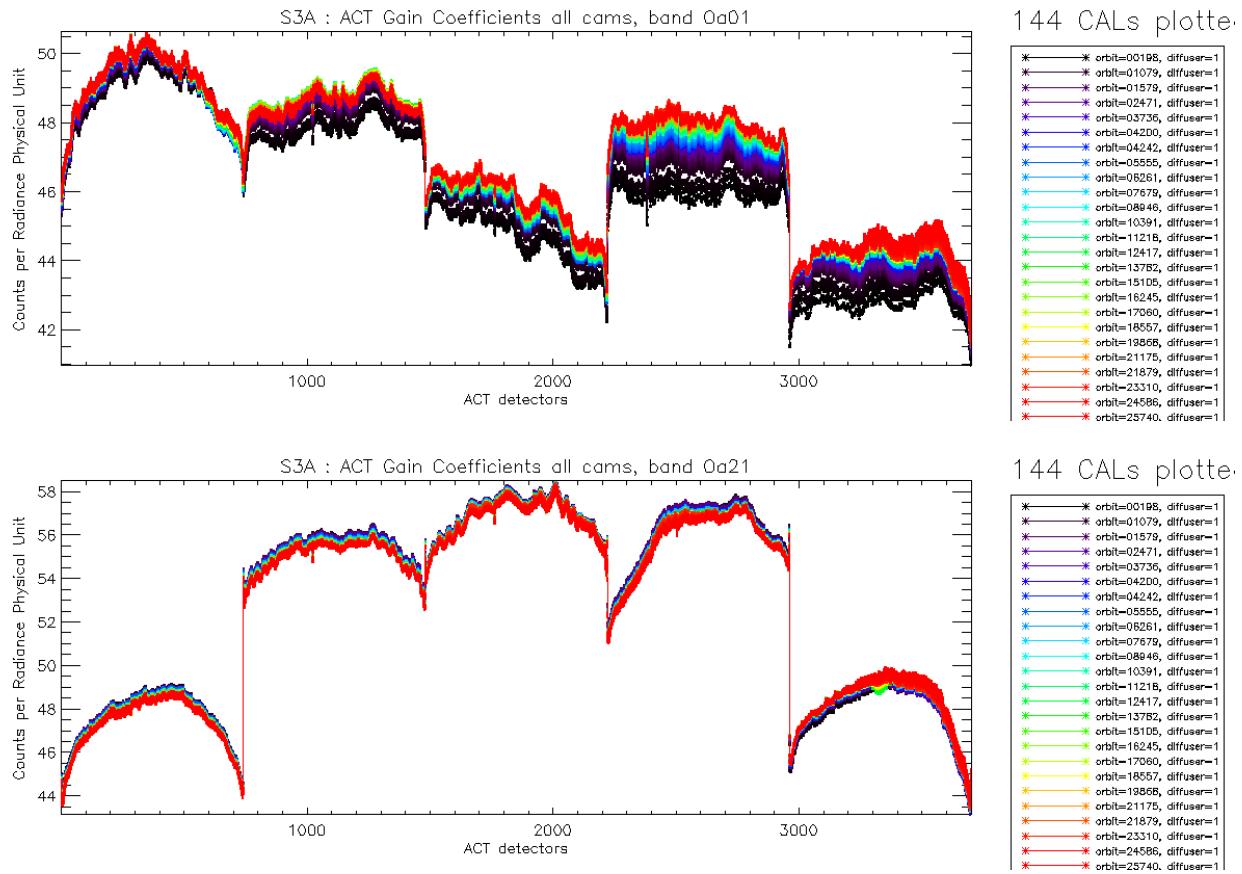
**Figure 21: OLCI-B Dark Current increase rates with time (in counts per year) vs. band (left) and vs. band width (right)**

## 2.2.2 Instrument response and degradation modelling [OLCI-L1B-CV-250]

### 2.2.2.1 Instrument response monitoring

#### 2.2.2.1.1 OLCI-A

Figure 22 shows the gain coefficients of every pixel for two OLCI-A channels, Oa1 (400 nm) and Oa21 (1020 nm), highlighting the significant evolution of the instrument response since early mission.



**Figure 22: OLCI-A Gain Coefficients for band Oa1 (top) and Oa21 (bottom), all diffuser 1 radiometric calibrations so far except the first one (orbit 183) for which the instrument was not thermally stable yet.**

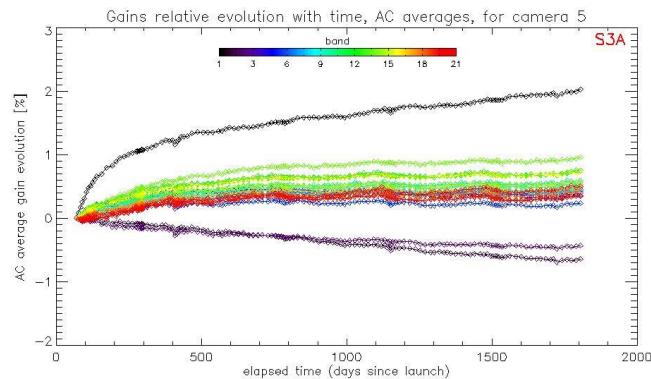
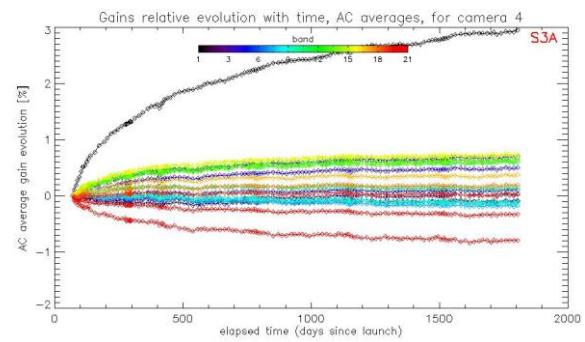
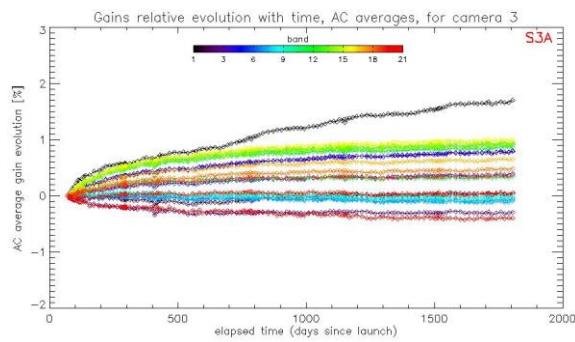
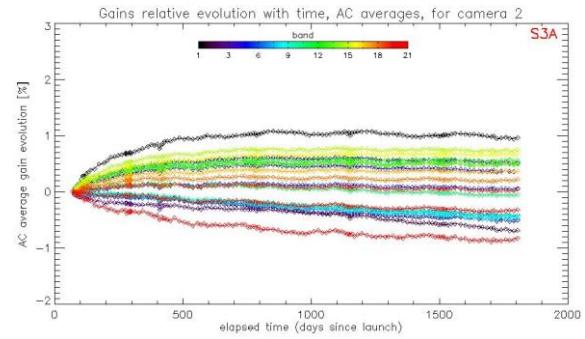
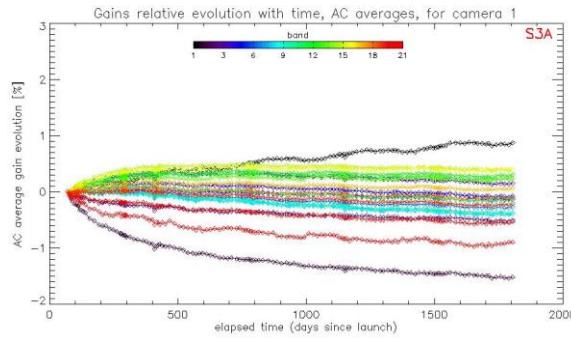
The gains plotted in Figure 22, however are derived using the ground BRDF model which is known to suffer from illumination geometry dependent residual errors (see previous Cyclic Reports for more details). Consequently they are post-processed to replace the ground BRDF model by the in-flight version, based on Yaw Manoeuvres data, prior to determine the radiometric evolution.

Figure 23 displays a summary of the time evolution derived from post-processed gains: the cross-track average of the BRDF corrected gains (taking into account the diffuser ageing) is plotted as a function of time, for each module, relative to a given reference calibration (the 25/04/2016, change of OLCI channel settings). It shows that, if a significant evolution occurred during the early mission, the trends tend in general to stabilize, with some exceptions (e.g. band 1 of camera 1 and 4, bands 2 & 3 of camera 5).



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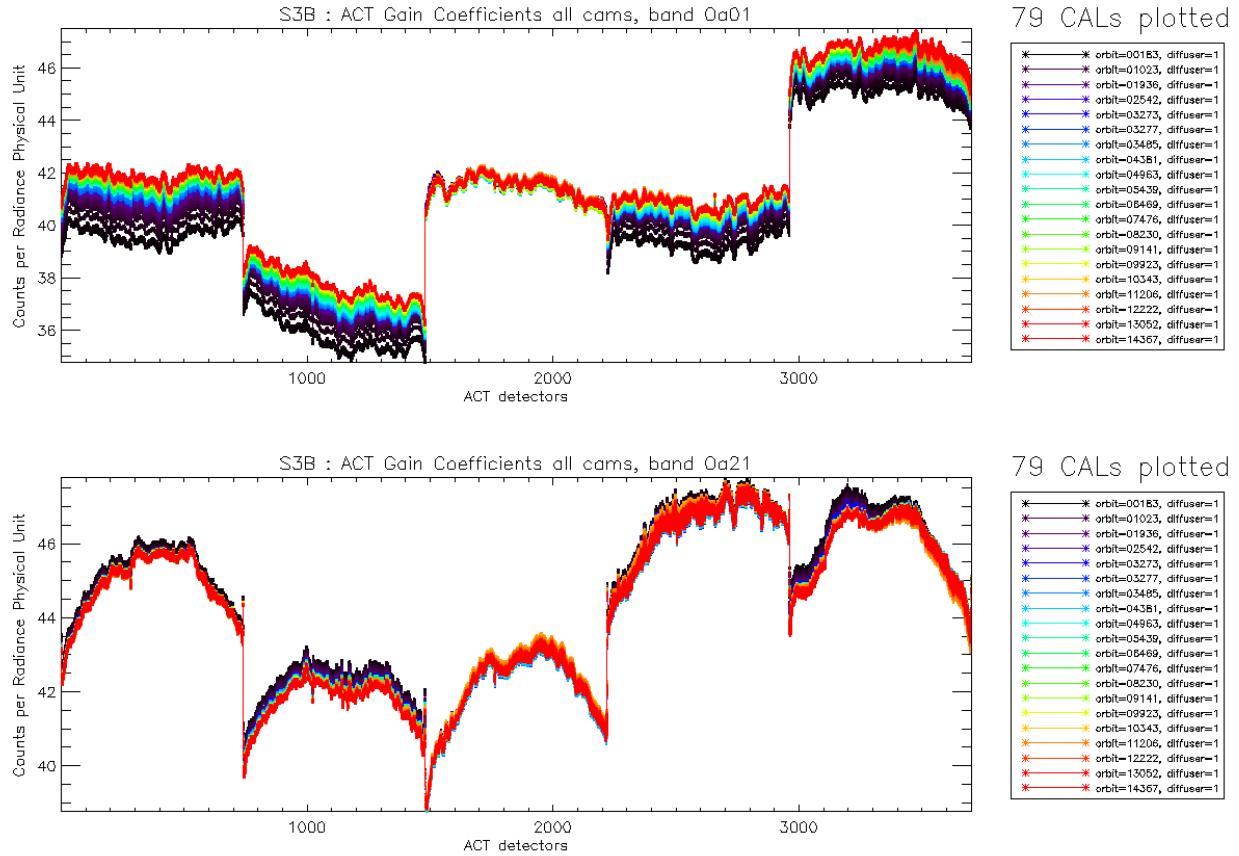


**Figure 23:** camera averaged gain relative evolution with respect to calibration of 25/04/2016 (change of OLCI channel settings), as a function of elapsed time since the beginning of the mission; one curve for each band (see colour code on plots), one plot for each module. The diffuser ageing has been taken into account.

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### 2.2.2.1.2 OLCI-B

Figure 24 shows the gain coefficients of every pixel for two OLCI-B channels, Oa1 (400 nm) and Oa21 (1020 nm), highlighting the significant evolution of the instrument response since early mission.



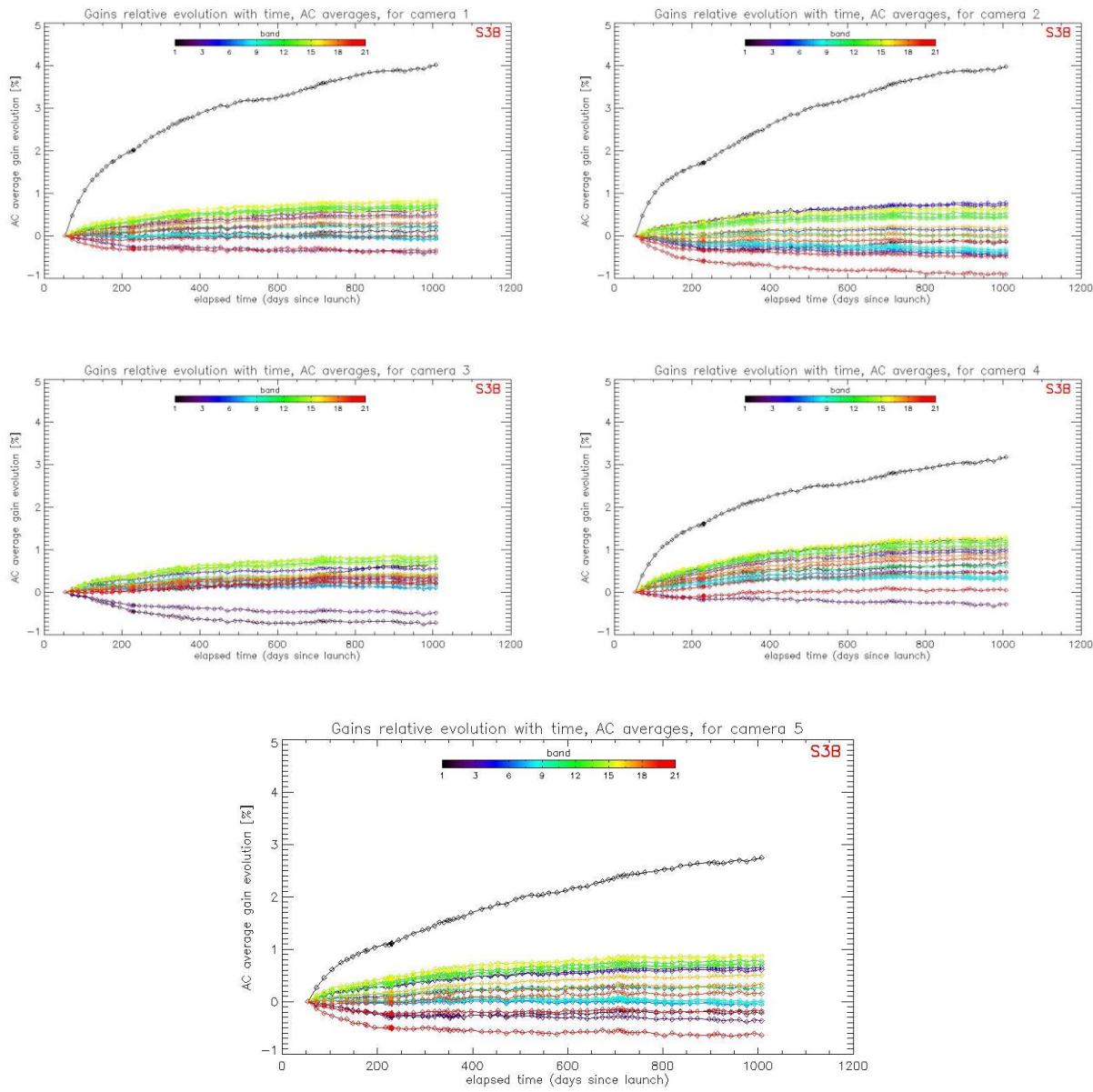
**Figure 24: OLCI-B Gain Coefficients for band Oa1 (top) and Oa21 (bottom), all diffuser 1 radiometric calibrations so far except the first one (orbit 167) for which the instrument was not thermally stable yet.**

Figure 25 displays a summary of the time evolution derived from post-processed gains: the cross-track average of the BRDF corrected gains is plotted as a function of time, for each module, relative to a given reference calibration (first calibration after channel programming change: 18/06/2018). It shows that, if a significant evolution occurred during the early mission, the trends tend to stabilize. The large amount of points near elapsed time = 220 days is due to the yaw manoeuvre campaign.



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**Figure 25: OLCI-B camera averaged gain relative evolution with respect to first calibration after channel programming change (18/06/2018), as a function of elapsed time since the beginning of the mission; one curve for each band (see colour code on plots), one plot for each module. The diffuser ageing has been taken into account.**

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## 2.2.2.2 Instrument evolution modelling

### 2.2.2.2.1 OLCI-A

The OLCI-A Radiometric Model has been refreshed and put in operations at PDGS the 15/10/2020 (Processing Baseline 2.71). The model has been derived on the basis of an extended Radiometric Calibration dataset (from 08/08/2016 to 08/08/2020). It includes the correction of the diffuser ageing for the six bluest bands (Oa1 to Oa6) for which it is clearly measurable. The model performance over the complete dataset (including the 11 calibrations in extrapolation over about 6 months) remains better than 0.09% when averaged over the whole field of view (Figure 26). The previous model, trained on a Radiometric Dataset limited to 28/08/2019, shows clearly a drift of the model with respect to most recent data (Figure 27). Comparison of the two figures shows the improvement brought by the updated Model over almost all the mission. Performance shown on Figure 26 adopts, as for OLCI-B, the dual model approach, i.e. two different models are used to cover the whole mission (red dashed line on Figure 26), each model being fitted on a partial dataset (green dashed line on Figure 26) whose coverage is optimised to provide best performance.

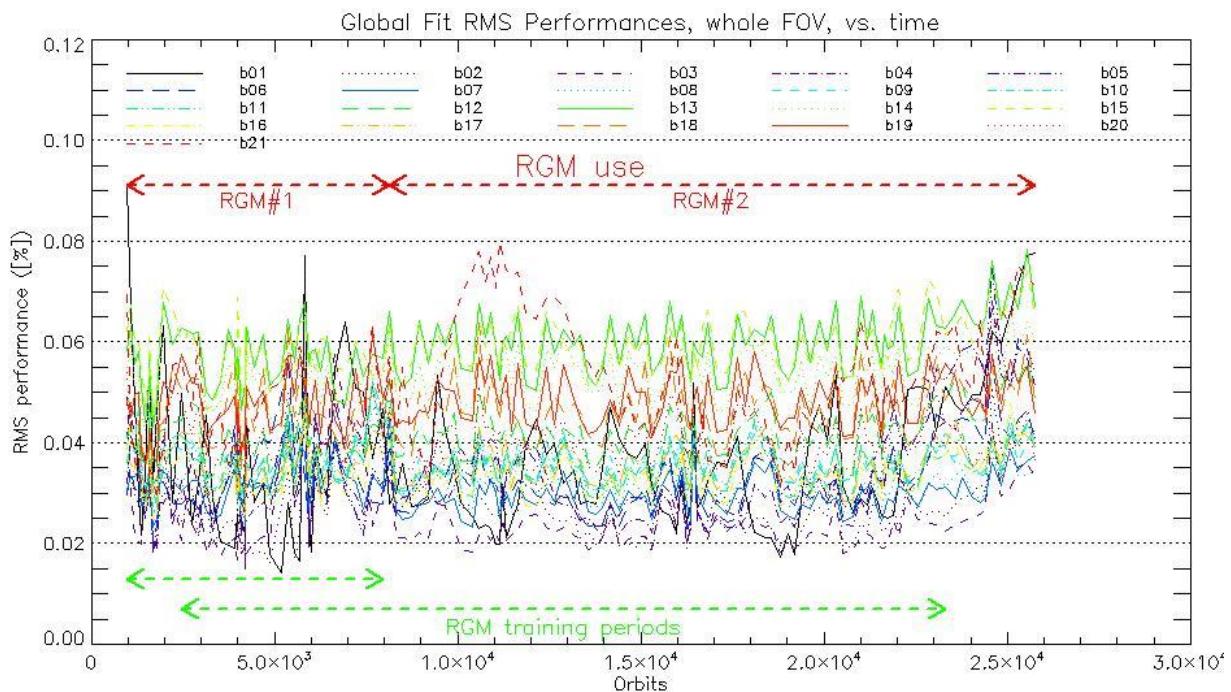
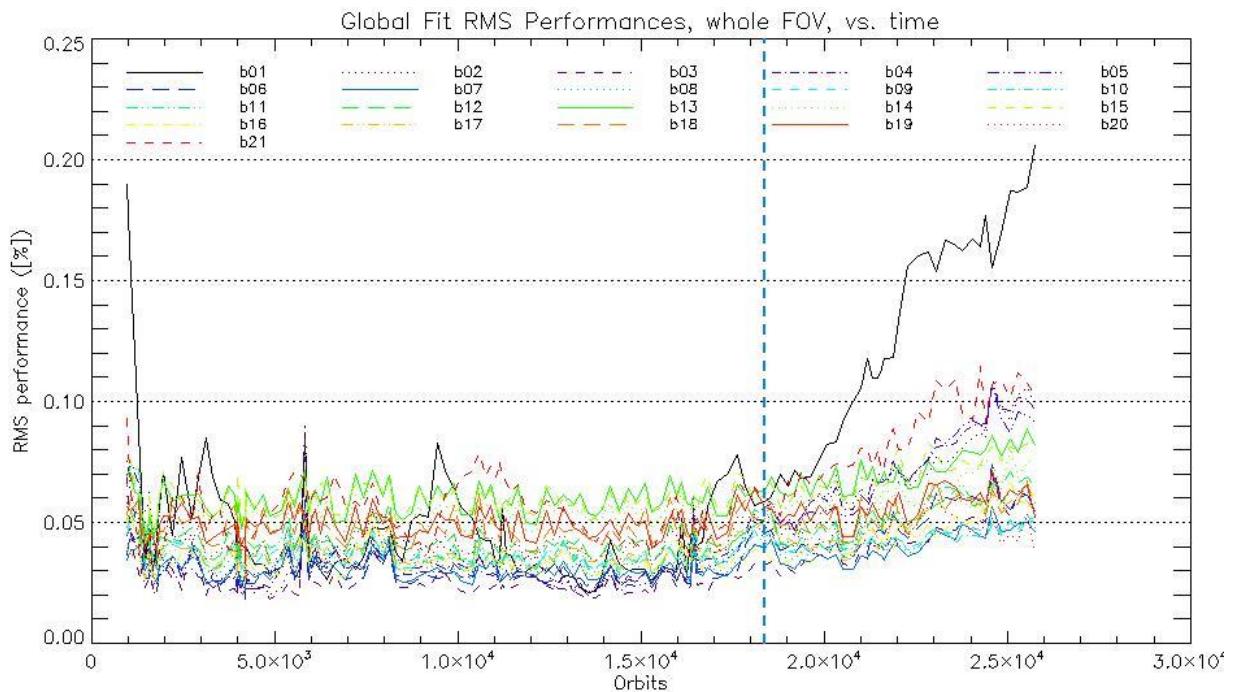


Figure 26: RMS performance of the OLCI-A Gain Model of the current processing baseline as a function of orbit.

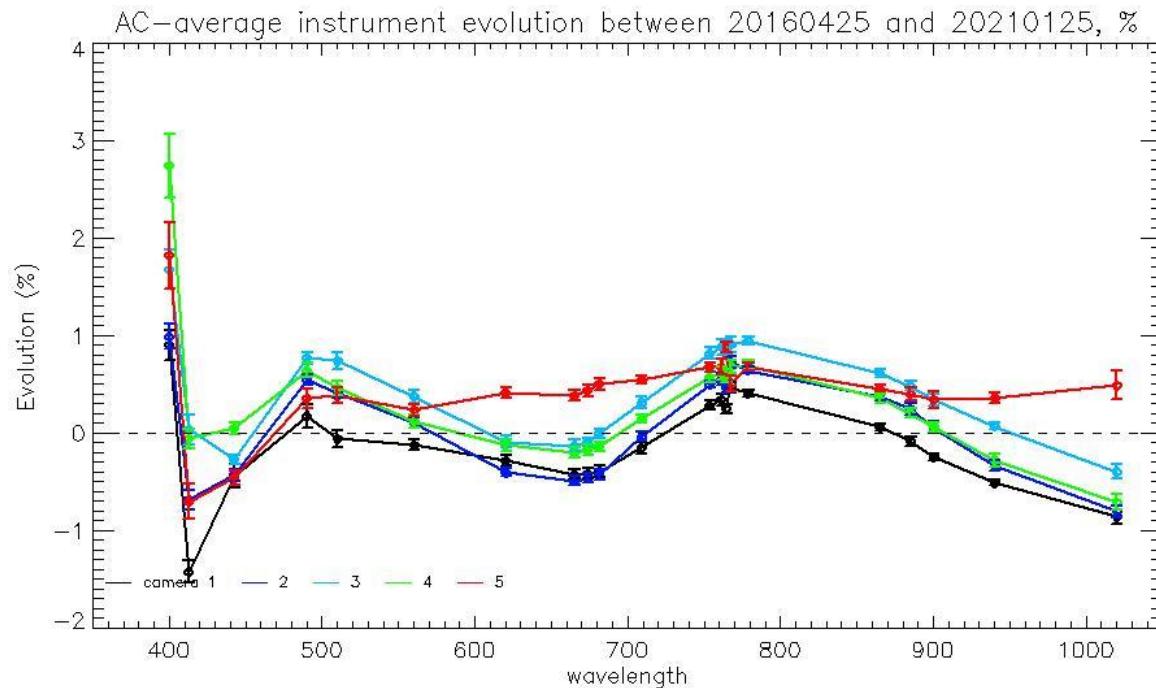
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**Figure 27: RMS performance of the OLCI-A Gain Model of the previous Processing Baseline as a function of orbit.**  
**The blue vertical dotted line defines the limit from which the gain model starts to be extrapolated (i.e. it corresponds to the most recent CAL of the dataset used to build the model).**

The overall instrument evolution since channel programming change (25/04/2016) is shown on Figure 28.

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**Figure 28: OLCI-A Camera-averaged instrument evolution since channel programming change (25/04/2016) and up to the most recent calibration (25/01/2021) versus wavelength.**

The overall per camera performance, as a function of wavelength, and at each orbit is shown on Figure 29 as the average and standard deviation of the model over data ratio.

Finally, Figure 30 to Figure 32 show the detail of the model performance, with across-track plots of the model over data ratios at each orbit, one plot for each channel.

Comparisons of Figure 30 to Figure 32 with their counterparts in Report of Cycle 62 clearly demonstrate the improvement brought by the new model whatever the level of detail.



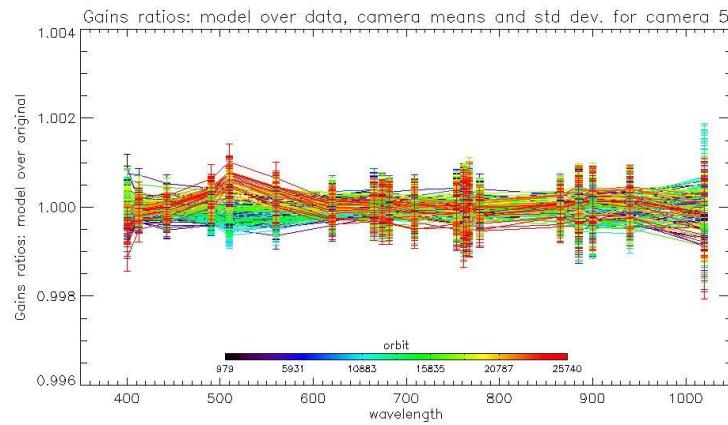
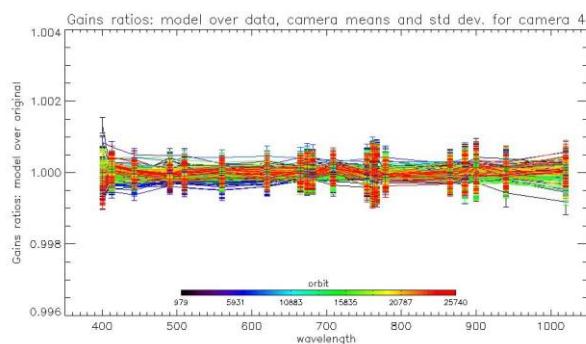
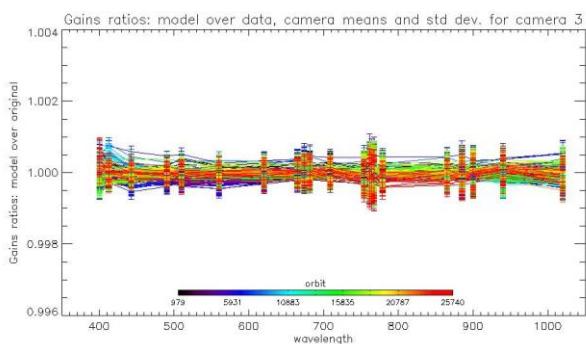
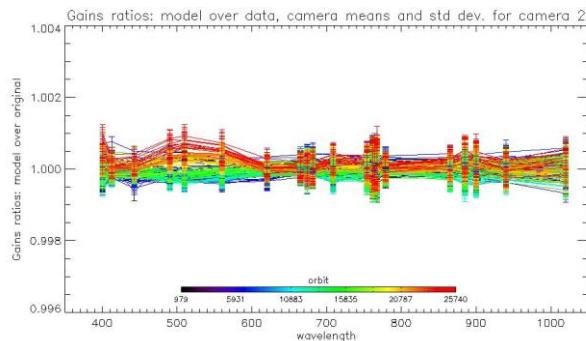
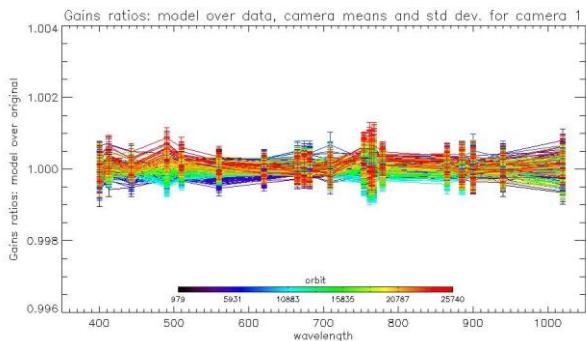
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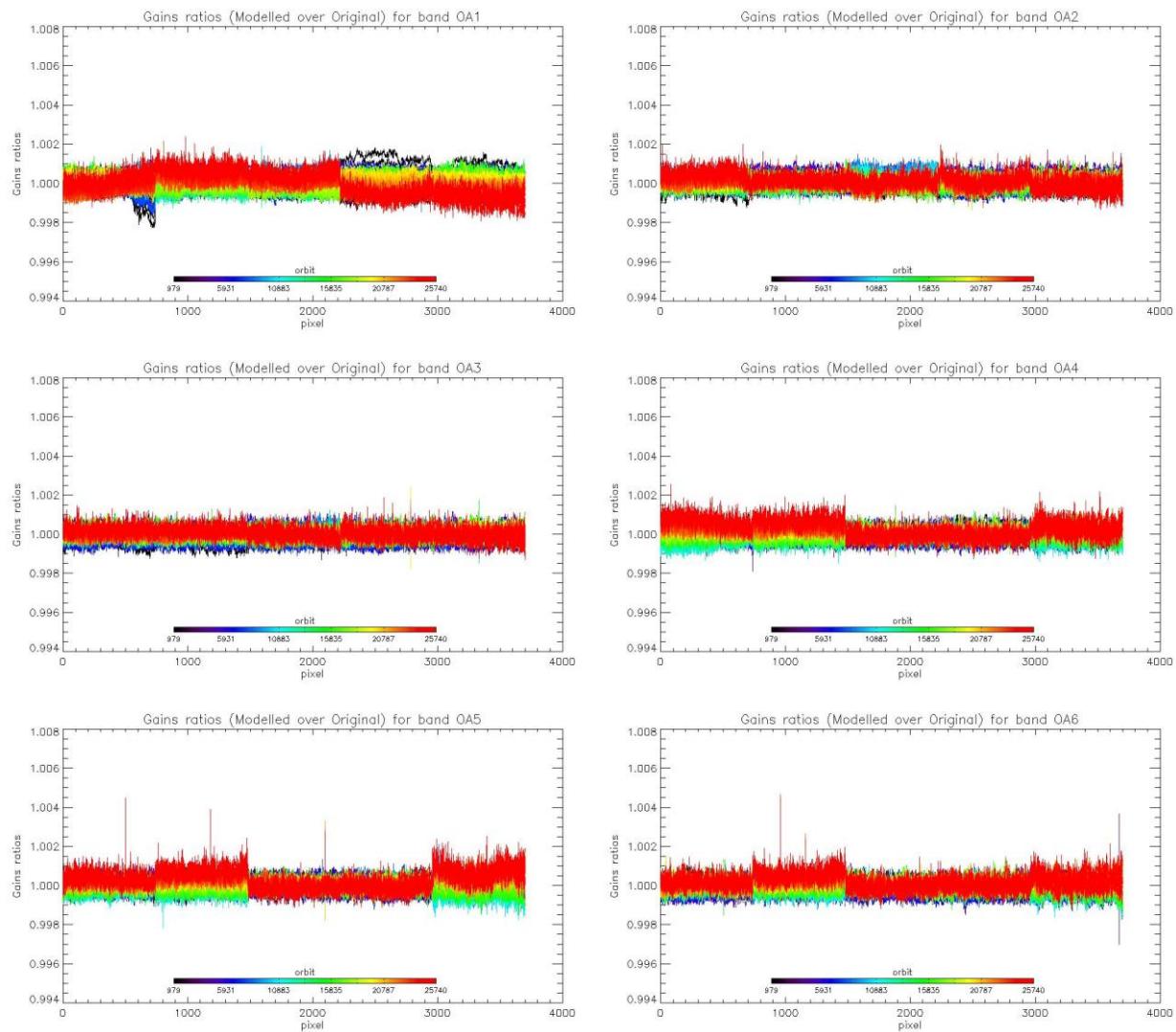


**Figure 29: For the 5 cameras: OLCI-A Evolution model performance, as camera-average and standard deviation of ratio of Model over Data vs. wavelength, for each orbit of the test dataset, including 11 calibrations in extrapolation, with a colour code for each calibration from blue (oldest) to red (most recent).**



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**Figure 30: OLCI-A evolution model performance, as ratio of Model over Data vs. pixels, all cameras side by side, over the whole current calibration dataset (since instrument programing update), including 11 calibrations in extrapolation, channels Oa1 to Oa6.**



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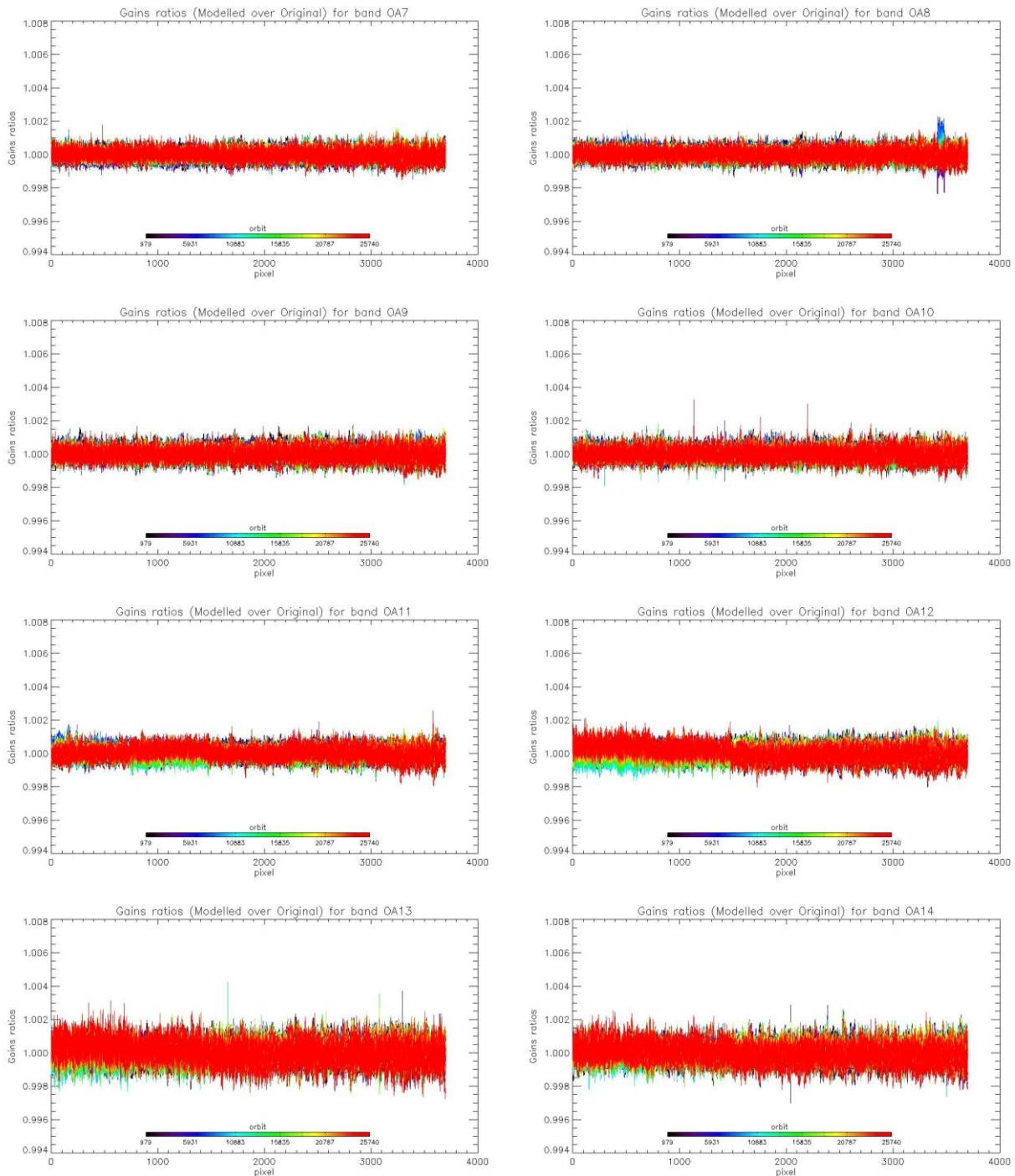


Figure 31: same as Figure 30 for channels Oa7 to Oa14.



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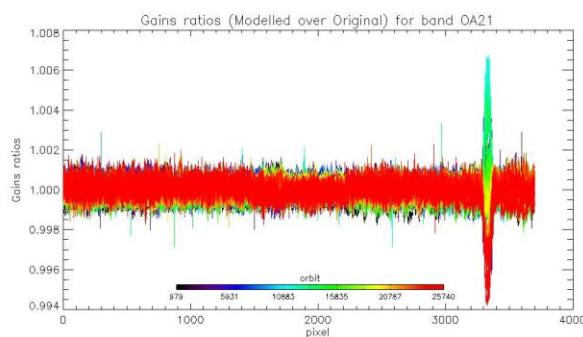
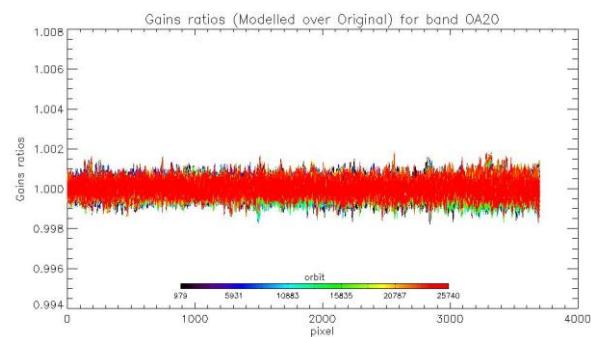
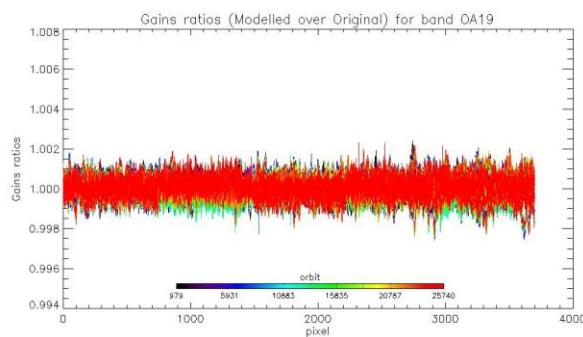
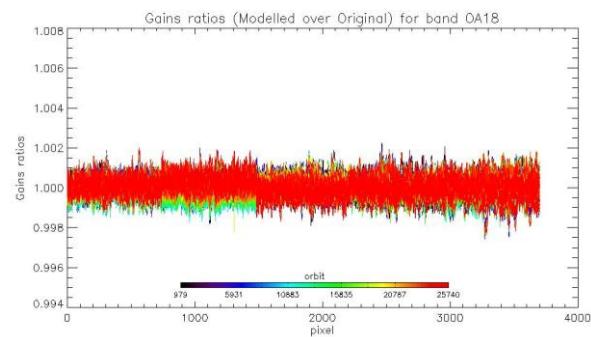
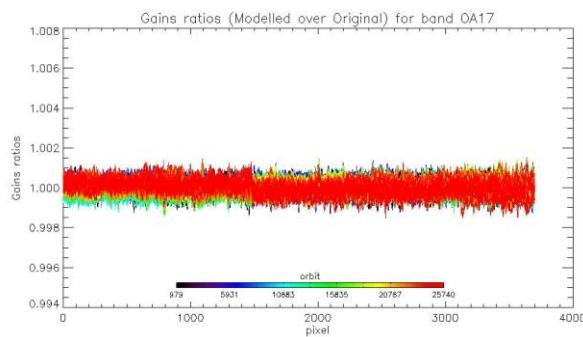
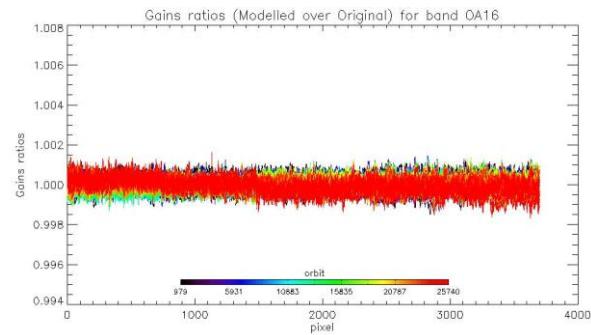
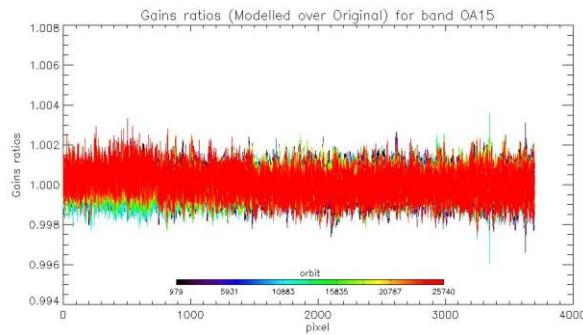


Figure 32: same as Figure 30 for channels OA15 to OA21.

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#### 2.2.2.2.2 OLCI-B

Instrument response and degradation modelling for OLCI-B, including the use of the in-flight BRDF model (based on 11<sup>th</sup> December 2018 Yaw Manoeuvres), has been refreshed and deployed at PDGS on 15<sup>th</sup> October 2020 (Processing Baseline 1.48). The model has been derived on the basis of an extended Radiometric Calibration dataset (from 05/11/2018 to 09/08/2020). It includes the correction of the diffuser ageing for the five bluest bands (Oa1 to Oa5) for which it is clearly measurable. The model performance over the complete dataset (including the 11 calibrations in extrapolation over about 6 months) is illustrated in Figure 33. It remains better than 0.07% when averaged over the whole field of view for all band except Oa01 (< 0.13%) which starts to show a significant drift compared to the other bands. The previous model, trained on a Radiometric Dataset limited to 02/10/2019, shows a strong drift of the model with respect to most recent data, especially for band Oa01 (Figure 34). Comparison of the two figures shows the improvement brought by the updated Model over all the mission.

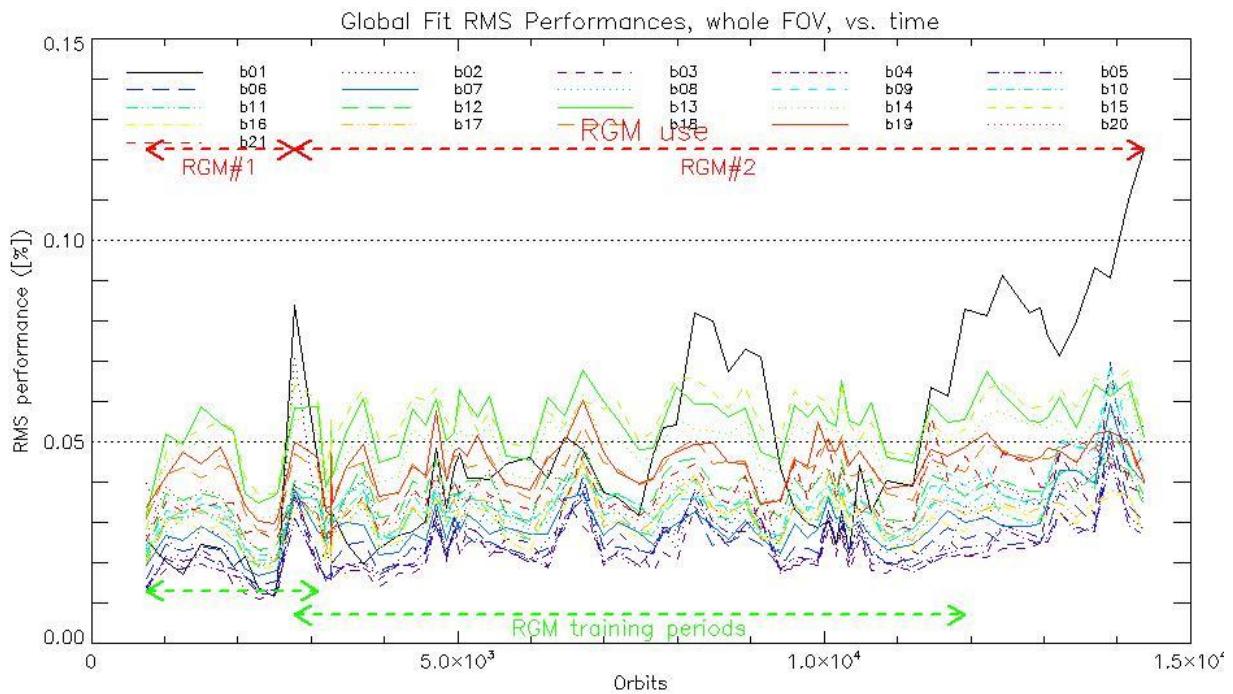
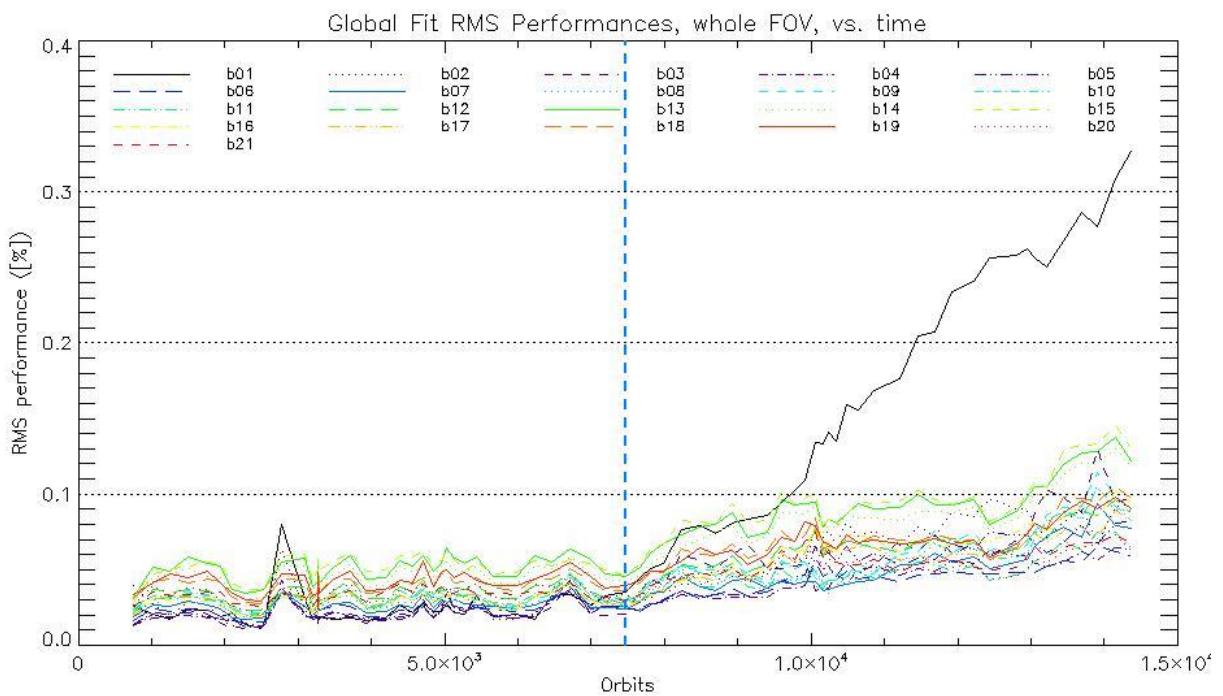


Figure 33: RMS performance of the OLCI-B Gain Model of the current processing baseline as a function of orbit.



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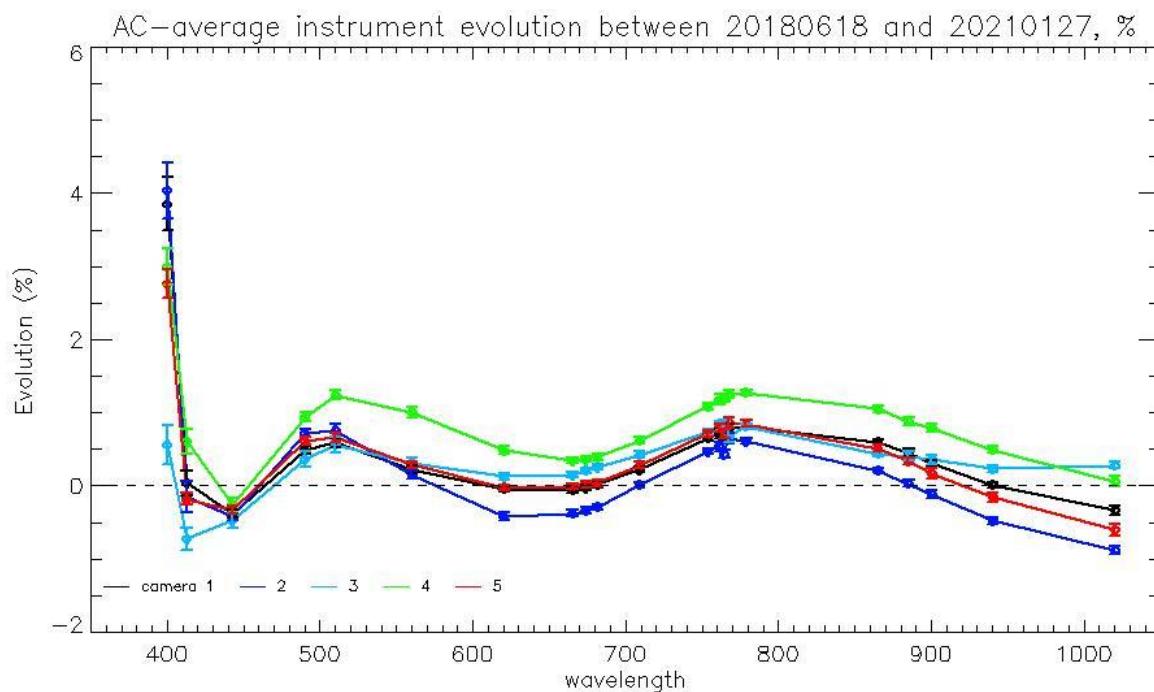
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**Figure 34: RMS performance of the OLCI-B Gain Model of the previous processing baseline as a function of orbit (please note the different vertical scale with respect to Figure 33).**

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The overall instrument evolution since channel programming change (18/06/2018) is shown on Figure 35.



**Figure 35: OLCI-B Camera-averaged instrument evolution since channel programming change (18/06/2018) and up to most recent calibration (27/01/2021) versus wavelength.**

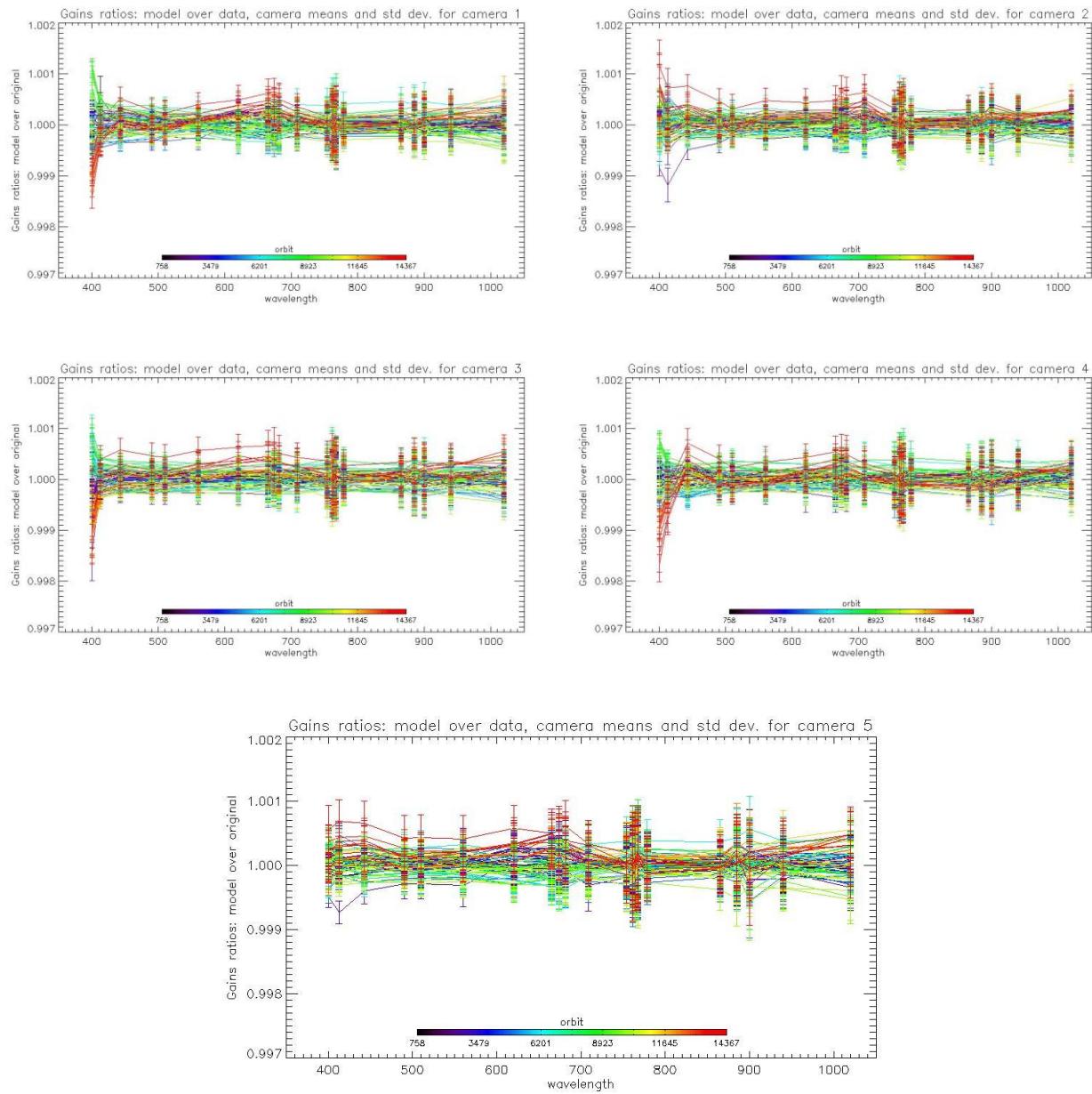
The overall per camera performance, as a function of wavelength, and at each orbit is shown on Figure 36 as the average and standard deviation of the model over data ratio.

Finally, Figure 37 to Figure 39 show the detail of the model performance, with across-track plots of the model over data ratios at each orbit, one plot for each channel.



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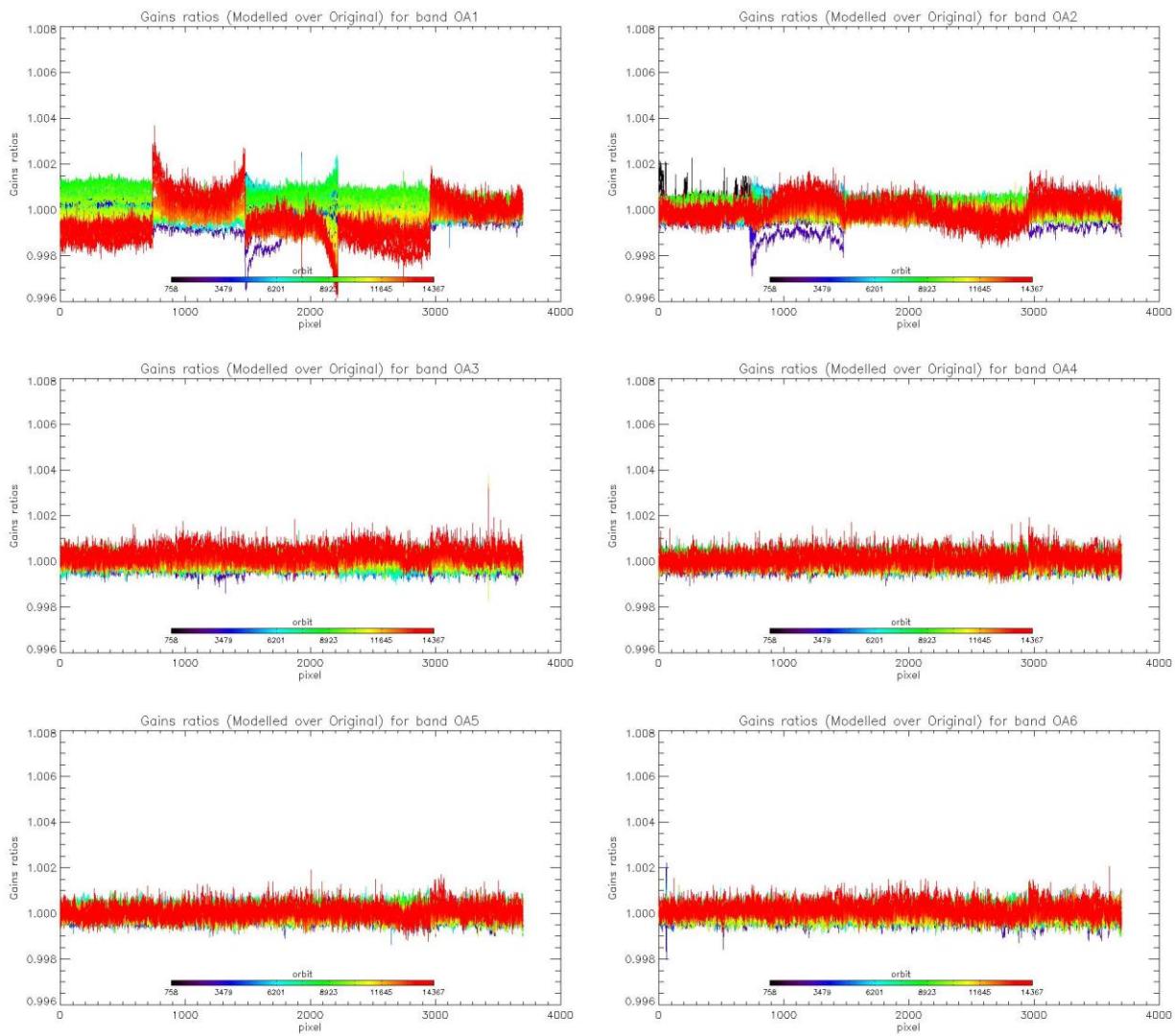


**Figure 36:** For the 5 cameras: OLCI-B Evolution model performance, as camera-average and standard deviation of ratio of Model over Data vs. wavelength, for each orbit of the test dataset, including 11 calibrations in extrapolation, with a colour code for each calibration from blue (oldest) to red (most recent).



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**Figure 37: OLCI-B evolution model performance, as ratio of Model over Data vs. pixels, all cameras side by side, over the whole current calibration dataset (since instrument programming update), including 11 calibrations in extrapolation, channels Oa1 to Oa6.**



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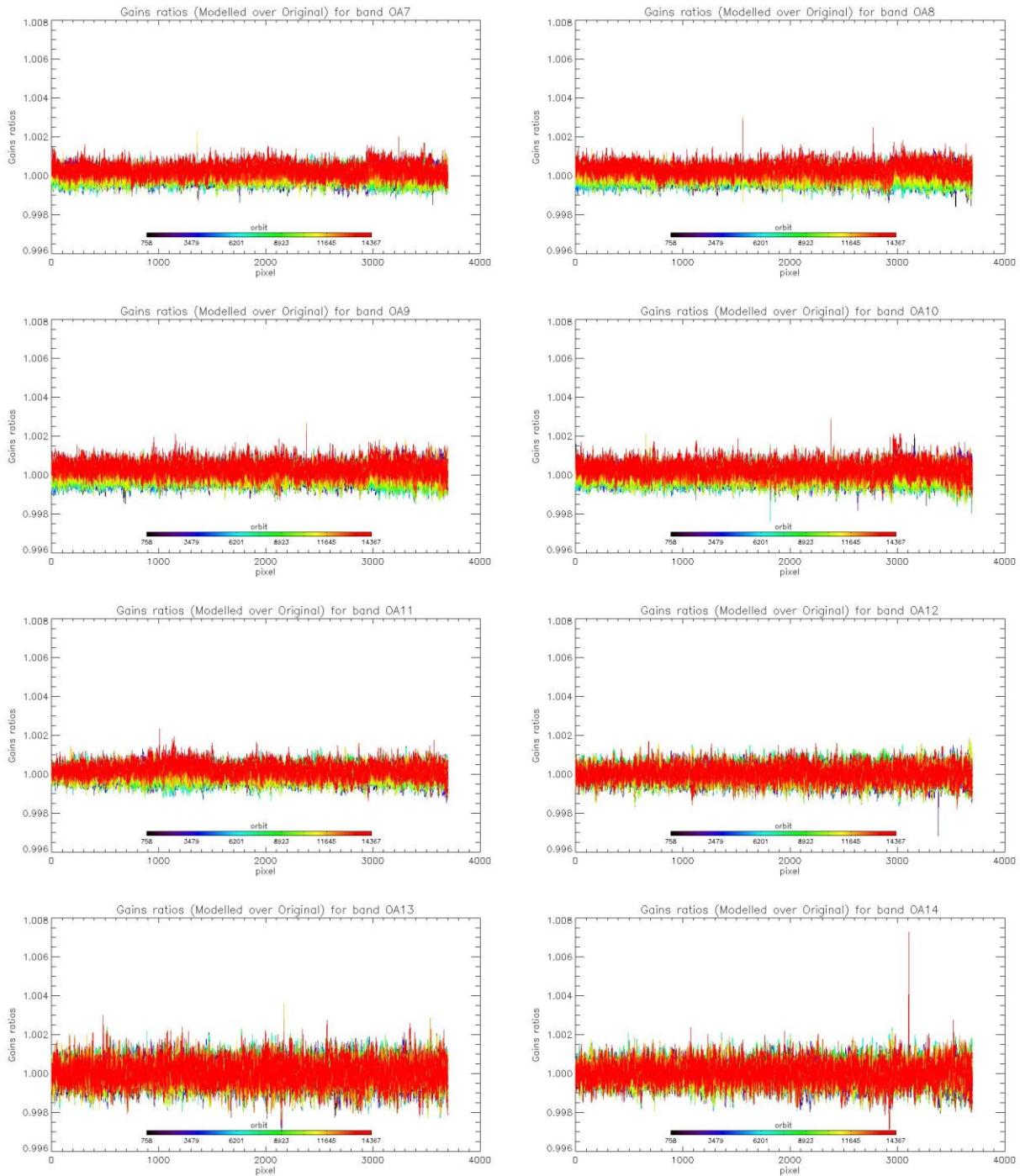


Figure 38: same as Figure 37 for channels Oa7 to Oa14.



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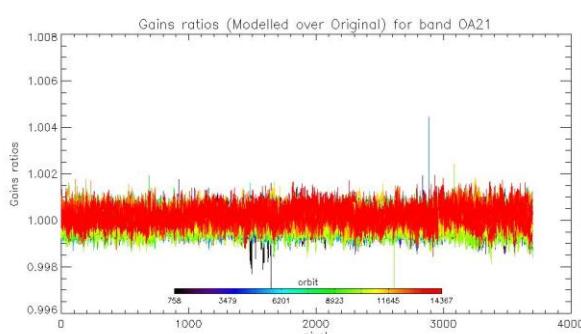
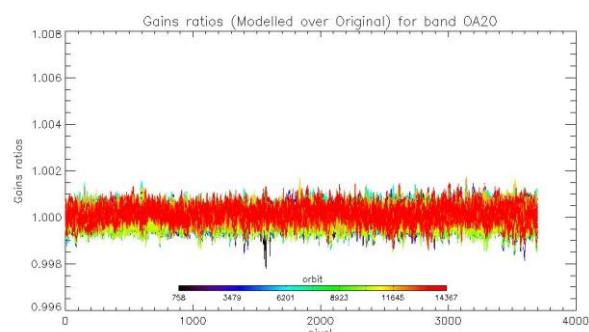
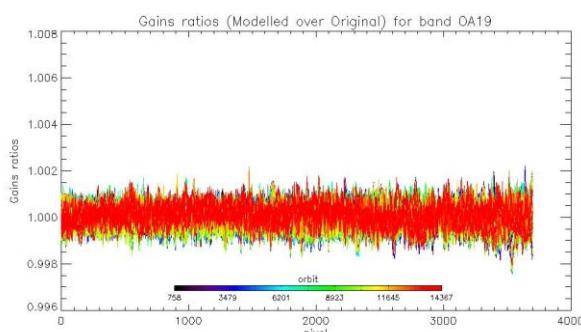
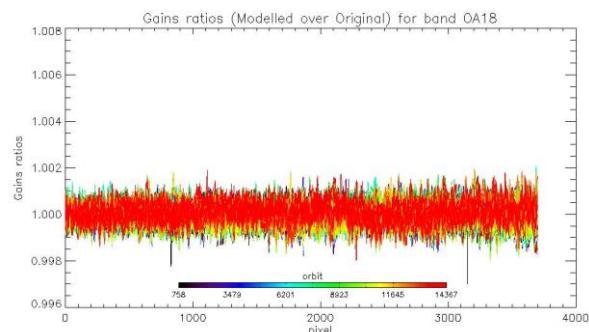
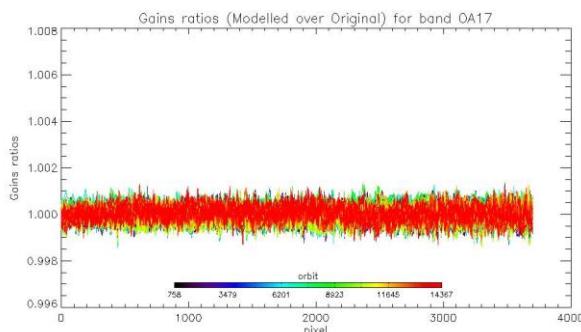
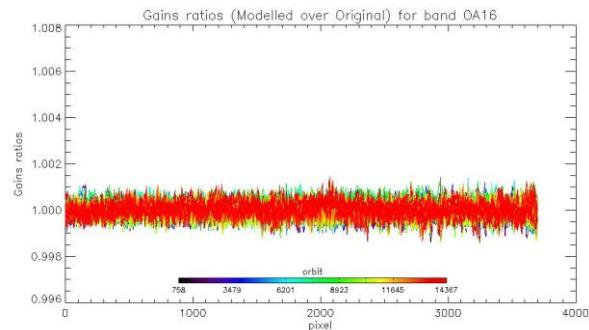
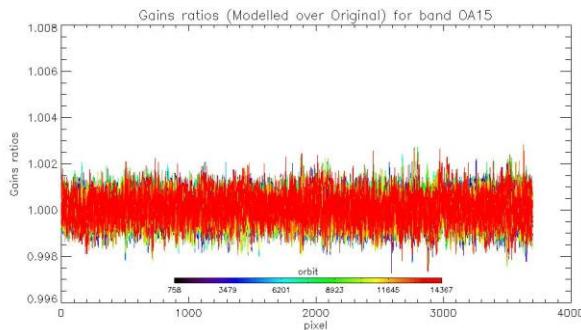


Figure 39: same as Figure 37 for channels OA15 to OA21.

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## 2.2.3 Ageing of nominal diffuser [OLCI-L1B-CV-240]

### 2.2.3.1 OLCI-A

There has been one calibration sequence S05 (reference diffuser) for OLCI-A during acquisition cycle 067:

- ❖ S05 sequence (diffuser 2) on 26/01/2021 00:08 to 00:10 (absolute orbit 25741)

With the associated S01 sequence (nominal diffuser) in order to compute ageing:

- ❖ S01 sequence (diffuser 1) on 25/01/2021 22:27 to 22:29 (absolute orbit 25740)

The diffuser 1 Ageing is computed for each 3700 detector and each spectral band by formula:

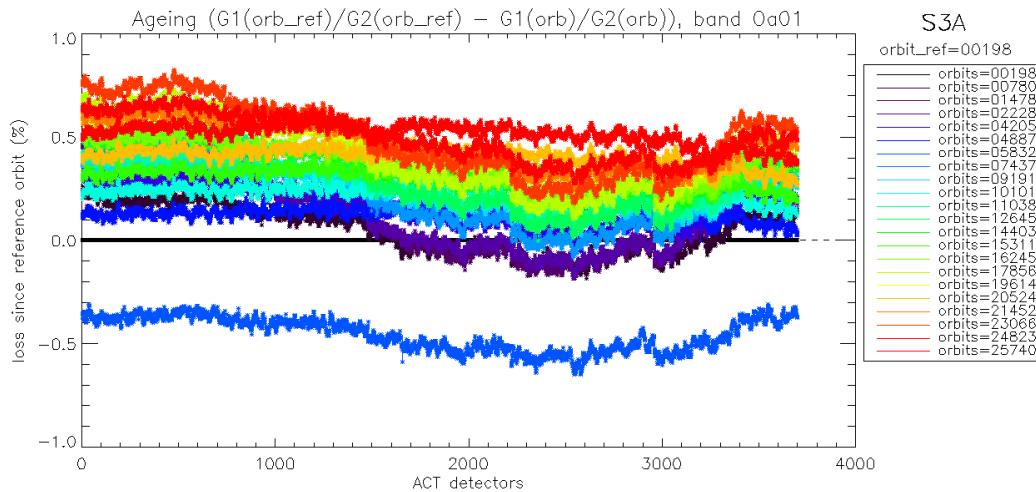
$$\text{Ageing(orb)} = G1(\text{orb})/G2(\text{orb}) - G1(\text{orb\_ref})/G2(\text{orb\_ref})$$

Where:

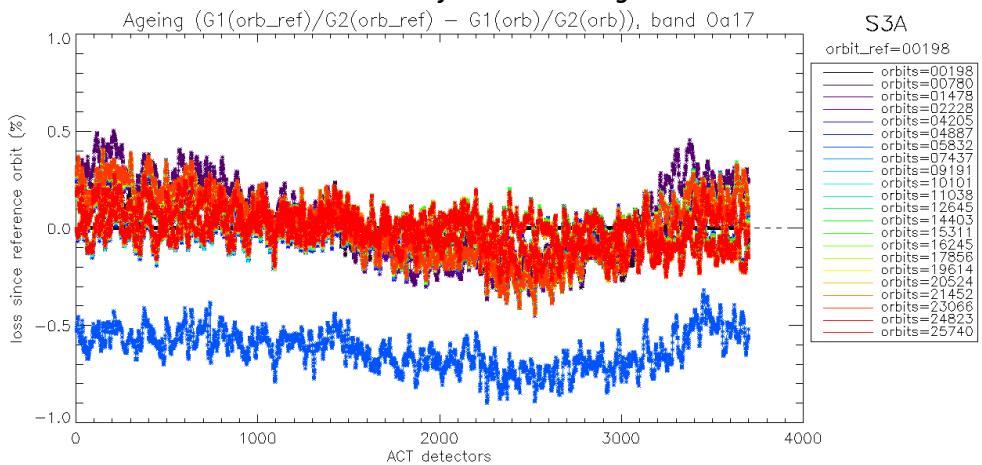
- ❖ G1 is the diffuser 1 (= nominal diffuser) Gain coefficients
- ❖ G2 is the diffuser 2 (= reference diffuser) Gain coefficients
- ❖ orb\_ref is a reference orbit chosen at the beginning of the mission

Ageing is represented in Figure 40 for band Oa01 and in Figure 41 for band Oa17. The negative shift of the sequence at orbit 5832 (for which a slight increase would be expected instead) is not explained so far and still under investigation. It should be noted that the corresponding orbit of diffuser 1 (nominal) has also been detected as an outlier in the modelling of the radiometric long-term trend with an unexpected excess of brightness.

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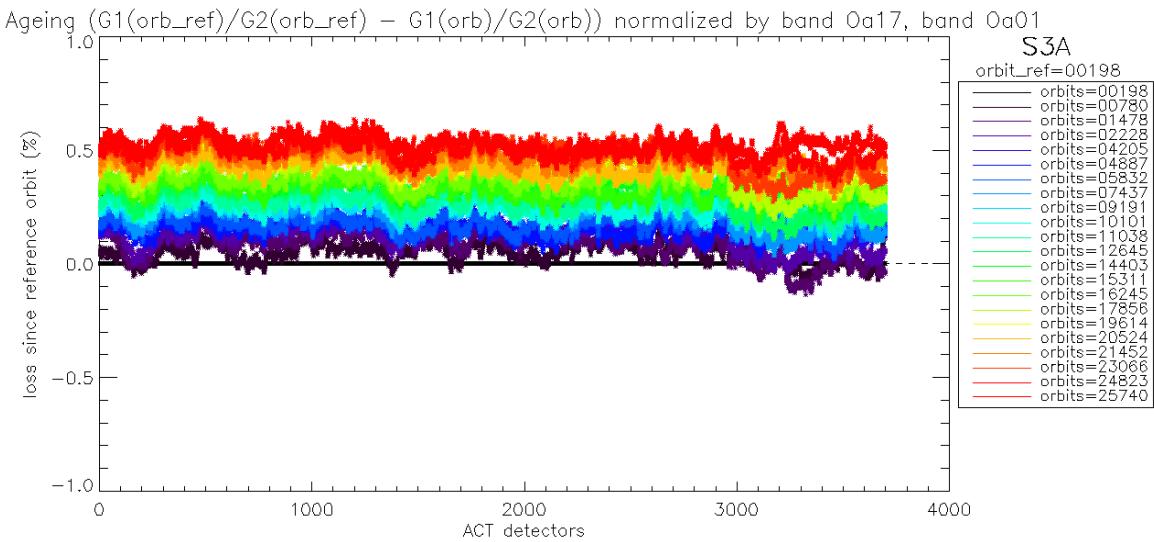
**Figure 40: diffuser 1 ageing for spectral band Oa01. We see strong ACT low frequency structures that are due to residual of BRDF modelling.**



**Figure 41: same as Figure 40 for spectral band Oa17. We use this band in order to normalize other bands and remove the ACT structures due to residual of BRDF modelling. Normalized curve for spectral band Oa01 is presented in Figure 42.**

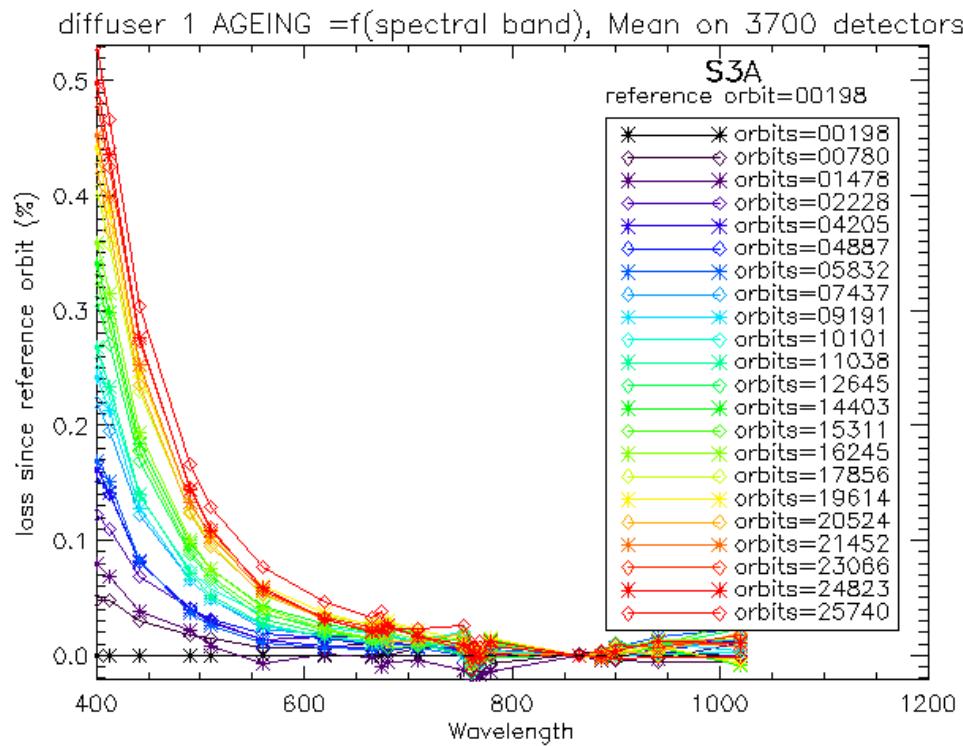
Figure 40 and Figure 41 show that the Ageing curves are impacted by a strong ACT pattern which is due to residuals of the bad modelling (on-ground) of the diffuser BRDF. This pattern is dependant of the azimuth angle. It is a ‘white’ pattern which means it is the same for all spectral bands. As such, we can remove this pattern by normalizing the ageing of all bands by the curve of band Oa17 which is expected not to be impacted by ageing because in the red part of the spectrum. We use an ACT smoothed version (window of 100 detectors) of band Oa17 in order to reduce the high frequency noise. Normalized ageing for spectral band Oa01 is represented in Figure 42 where we can see that this band is impacted by ageing of the diffuser.

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**Figure 42:** same as Figure 40 after normalization by band Oa17. Ageing of the diffuser 1 is now visible in the 5 cameras.

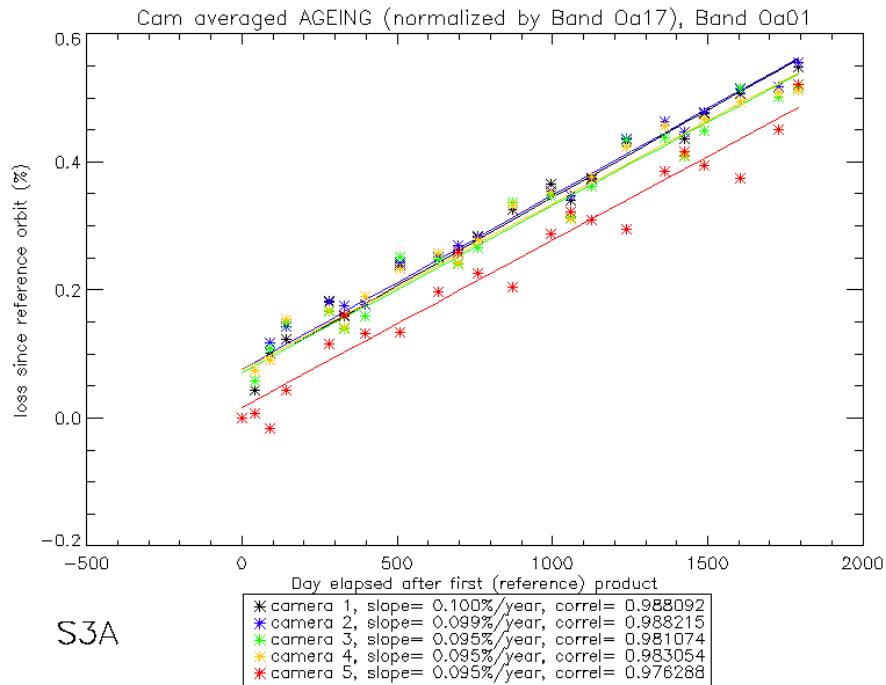
Camera averaged ageing (normalized by band Oa17) as a function of wavelength is represented in Figure 43 where we can see that ageing is stronger in the ‘bluest’ spectral bands (short wavelengths). Ageing is clearly visible only for the 6 first spectral bands so far in the OLCI mission life.



**Figure 43:** Diffuser 1 ageing as a function of wavelength (or spectral band). Ageing is clearly visible in spectral band #1 to #5.

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Figure 44 shows the evolution, for spectral band Oa01, of the 5 cameras averaged ageing as a function of time.

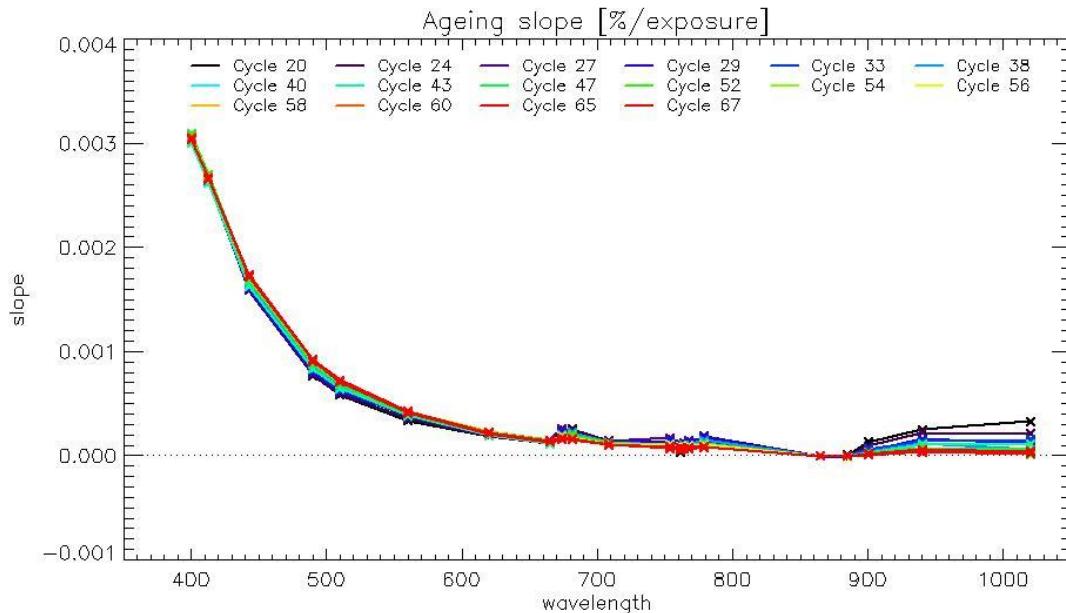


**Figure 44: Camera averaged ageing for band Oa01 (normalized by band Oa17) as a function of elapsed time. Linear fit for each camera is plotted. The slope (% loss per year) and the correlation coefficient.**

A model of diffuser ageing as a function of cumulated exposure time (i.e. number of acquisition sequence on nominal diffuser, regardless of the band setting) has been built and is described in Cyclic #23 Report. The results of this model confirm the need to model ageing against cumulated exposure rather than elapsed time, as it provides a more linear trend, even if not perfect (see Figure 21 of Cyclic #23 Report).

The slope of this ageing model (% of loss per exposure) as a function of wavelength is presented in Figure 45).

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**Figure 45: Slope of ageing fit (% of loss per exposure) vs wavelengths, using all the available ageing sequence at the time of the current cycle (red curve) and at the time of previous cycle for which an ageing sequence was measured (see legend within the figure).**

In Figure 45, we see that the Ageing slopes have not significantly changed between the current Cycle and the last 15 cycles with a S05 sequence (cycles #65, #60, #56, #58, #54, #52, #47, #43, #40, #38, #33, #29, #27, #24 and #20). Cycle #47 has been used to derive the Ageing Correction model used for the currently operational Gain Model. The exposure time dependent ageing model is used to derive the Gain Model, the most recent version of which has been put in operations in PDGS on 15<sup>th</sup> October 2020 (Processing Baseline 2.71).

### 2.2.3.2 OLCI-B

There has been one calibration sequence S05 (reference diffuser) for OLCI-B during acquisition Cycle 048:

- ❖ S05 sequence (diffuser 2) on 27/01/2021 10:49 to 10:51 (absolute orbit 14368)

With the associated S01 sequence (nominal diffuser) in order to compute ageing:

- ❖ S01 sequence (diffuser 1) on 27/01/2021 09:08 to 09:10 (absolute orbit 14367)

The diffuser 1 Ageing is computed for each 3700 detector and each spectral band by formula:

$$\text{Ageing(orb)} = \frac{\text{G1(orb)}}{\text{G2(orb)}} - \frac{\text{G1(orb\_ref)}}{\text{G2(orb\_ref)}}$$

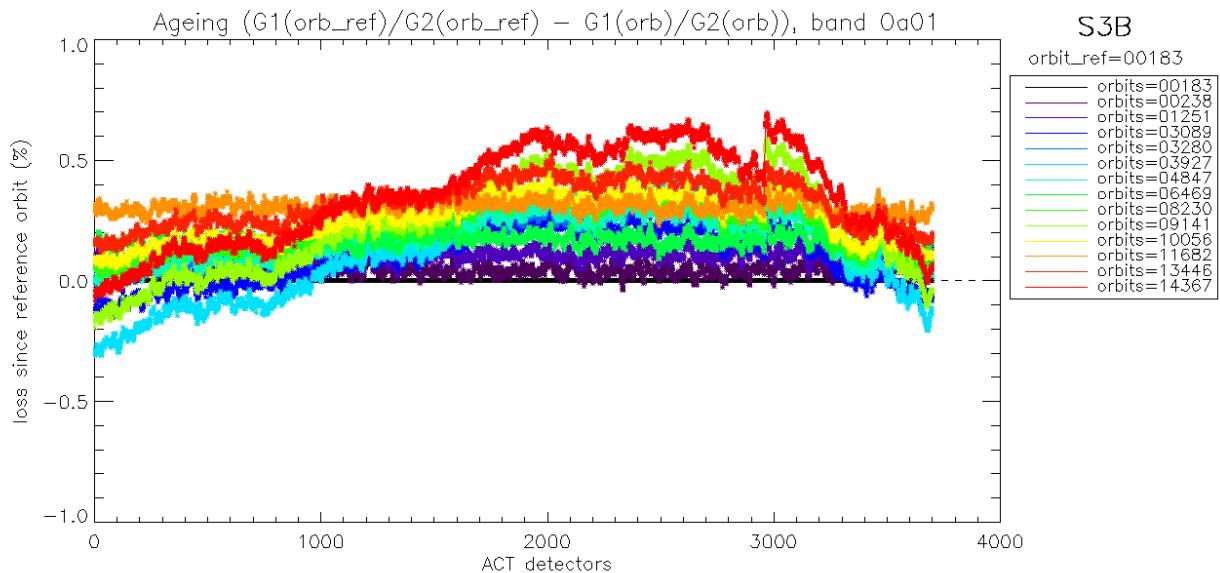
Where:

- ❖ G1 is the diffuser 1 (= nominal diffuser) Gain coefficients
- ❖ G2 is the diffuser 2 (= reference diffuser) Gain coefficients

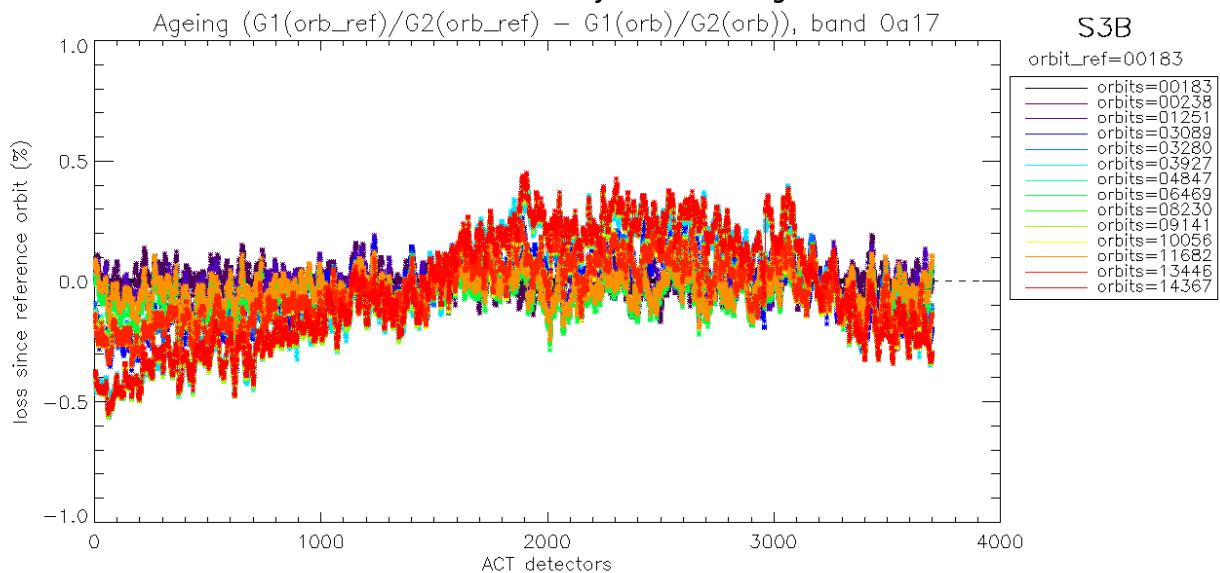
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- ❖ `orb_ref` is a reference orbit chosen at the beginning of the mission

Ageing is represented in Figure 46 for band Oa01 and in Figure 47 for band Oa17.



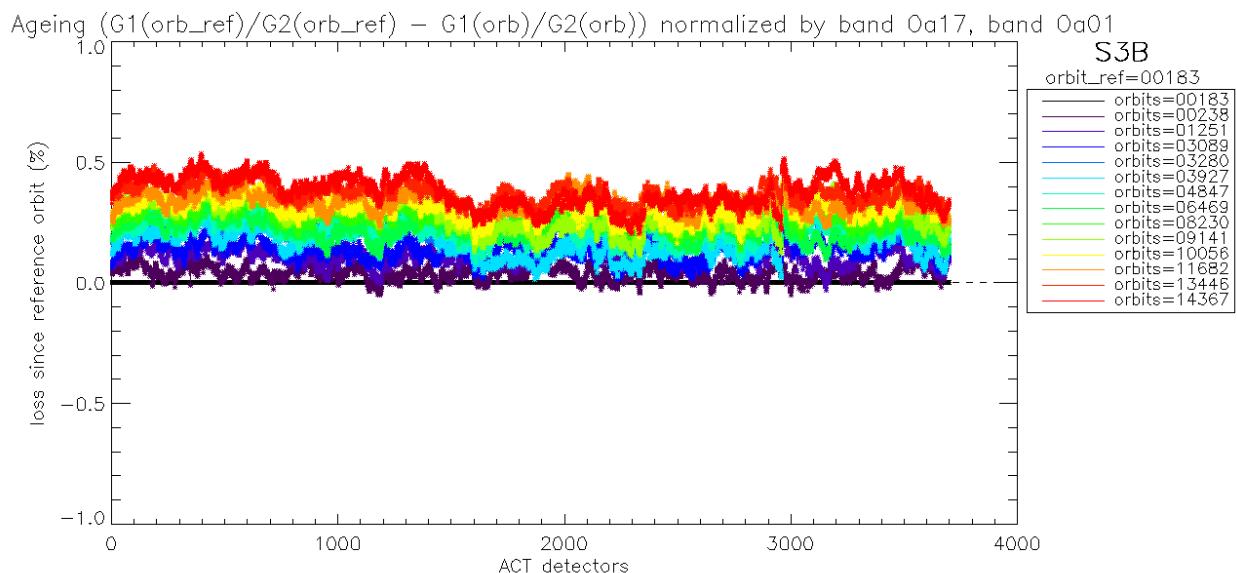
**Figure 46: OLCI-B diffuser 1 ageing for spectral band Oa01. We see strong ACT low frequency structures that are due to residual of BRDF modelling.**



**Figure 47: same as Figure 46 for spectral band Oa17. We use this band in order to normalize other bands and remove the ACT structures due to residual of BRDF modelling. Normalized curve for spectral band Oa01 is presented in Figure 48.**

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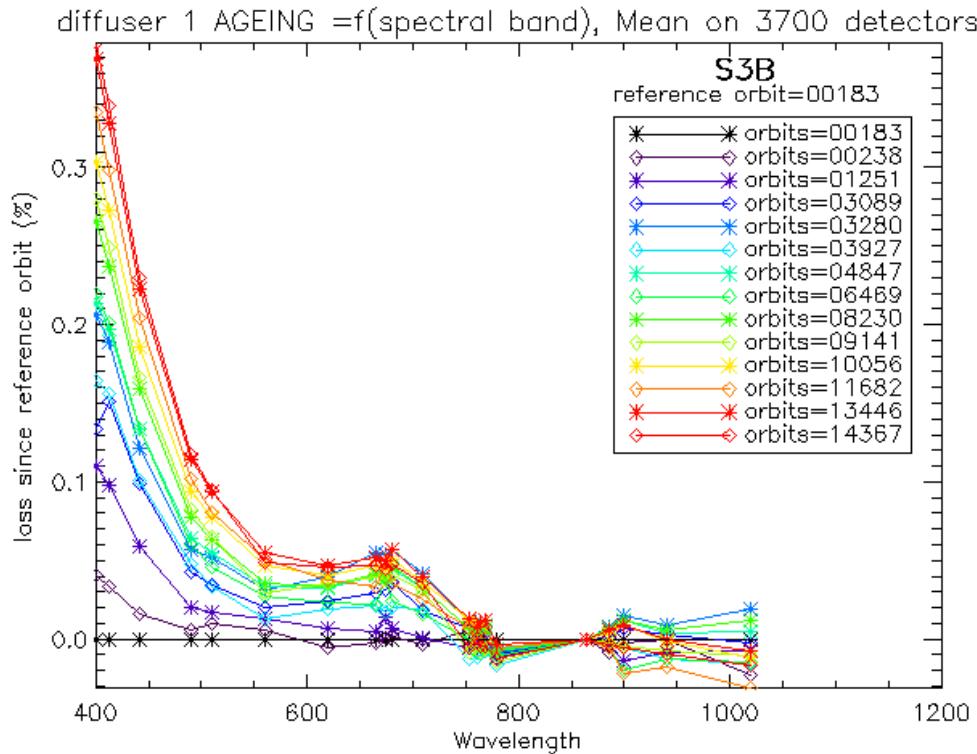
Figure 46 and Figure 47 show that the Ageing curves are impacted by a strong ACT pattern which is due to residuals of the bad modelling (on-ground) of the diffuser BRDF. This pattern is dependant of the azimuth angle. It is a ‘white’ pattern which means it is the same for all spectral bands. As such, we can remove this pattern by normalizing the ageing of all bands by the curve of band Oa17 which is expected not to be impacted by ageing because in the red part of the spectrum. We use an ACT smoothed version (window of 100 detectors) of band Oa17 in order to reduce the high frequency noise. Normalized ageing for spectral band Oa01 is represented in Figure 48 where we can see that this band is impacted by ageing of the diffuser.



**Figure 48:** same as Figure 46 after normalization by band Oa17. Ageing of the diffuser 1 is now visible in the 5 cameras.

Camera averaged ageing (normalized by band Oa17) as a function of wavelength is represented in Figure 49 where we can see that ageing is stronger in the ‘bluest’ spectral bands (short wavelengths). Ageing is clearly visible only for the 5 first spectral bands so far in the OLCI mission life. We see a bump around 680 nm which is probably due to characterisation errors that are strongly geometry dependant and affect differently the various camera. This behaviour is under investigation.

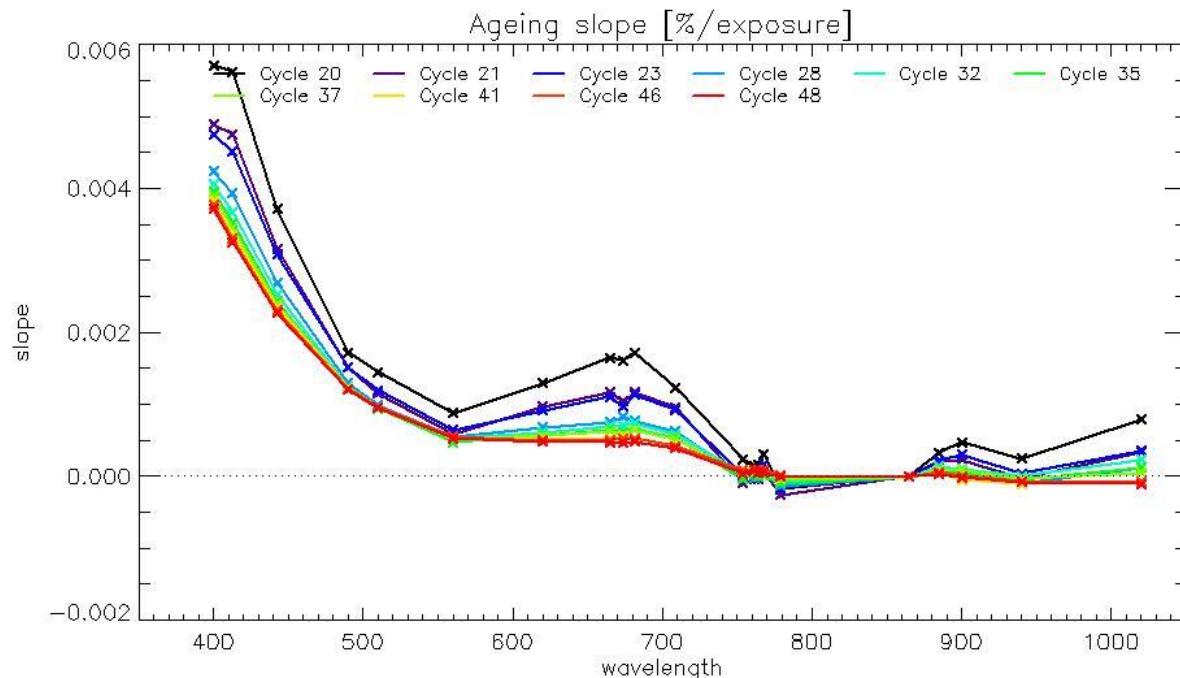
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**Figure 49: OLCI-B Diffuser 1 ageing as a function of wavelength (or spectral band). Ageing is clearly visible in spectral band #1 to #5.**

As for OLCI-A, the OLCI-B Diffuser Ageing has been modelled as a function of cumulated exposure time (i.e. number of acquisition sequence on nominal diffuser, regardless of the band setting). The OLCI-A modelling methodology has been applied to OLCI-B. The results of this modelling, iterated at each new Ageing Sequence acquisition, expressed as the rate of ageing (% of loss per exposure) as a function of wavelength is presented in Figure 50.

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**Figure 50: Slope of ageing fit (% of loss per exposure) vs wavelengths, using all the available ageing sequence at the time of the current cycle (red curve) and at the time of previous cycle for which an ageing sequence was measured (see legend within the figure).**

In Figure 50, we see that the Ageing slopes have significantly changed between the current Cycle and the last nine cycles with a S05 sequence (cycles #46, #41, #37, #35, #32, #28, #23, #21, #20). However, the behaviour tends to stabilize. The slope in the high wavelengths bands (red, NIR) is close to 0 in the three last cycles which is the expected behaviour (No Ageing expected at high wavelength). A workaround has been used instead of the nominal Ageing Assessment and modelling to allow accounting for Diffuser Ageing in the Radiometric Gain Model. Ageing was assessed by direct comparisons of two nominal diffuser observations, acquired under the same geometry (i.e. directly comparable) and the same day (i.e. with no significant instrument sensitivity evolution) but separated by 7 more exposures to light (during the Yaw Manoeuvres dedicated to the in-flight BRDF modelling). This exposure time dependent ageing model is used to derive the Gain Model, the most recent version of which has been put in operations in PDGS on 15<sup>th</sup> October 2020 (Processing Baseline 1.48).

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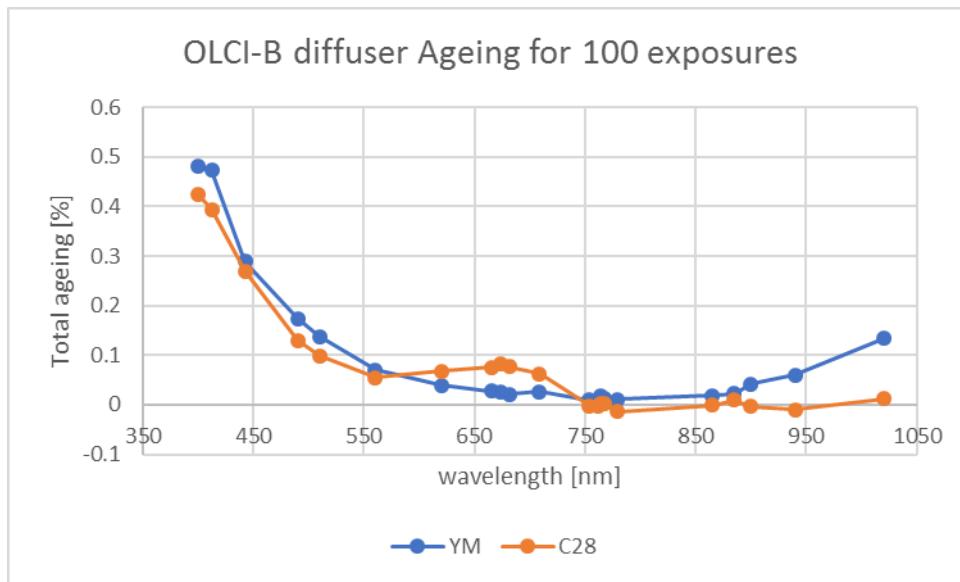


Figure 51: OLCI-B diffuser ageing (after 100 exposures, i.e. about two years) according to direct assessment from Yaw Manoeuvres (blue) and nominal method at Cycle 28 (orange).

## 2.2.4 Updating of calibration ADF [OLCI-L1B-CV-260]

### 2.2.4.1.1 OLCI-A

No CAL\_AX ADF has been delivered to PDGS during the report period for OLCI-A.

### 2.2.4.1.2 OLCI-B

No CAL\_AX ADF has been delivered to PDGS during the report period for OLCI-B.

## 2.2.5 Radiometric Calibrations for sun azimuth angle dependency and Yaw Manoeuvres for Solar Diffuser on-orbit re-characterization [OLCI-L1B-CV-270 and OLCI-L1B-CV-280]

### 2.2.5.1.1 OLCI-A

This activity has not evolved during cycle 067 and results presented in Cycle 15 report are still valid.

### 2.2.5.1.2 OLCI-B

Activity has started for S3B-OLCI. The SAA domain explored is now increased by the acquisitions from the Yaw Manoeuvres and analysis becomes meaningful. Analysis is on-going.

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## 2.3 Spectral Calibration [OLCI-L1B-CV-400]

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### 2.3.1 OLCI-A

There has been no S02+S03 nor S09 Spectral Calibration for OLCI-A in the reporting period.

Consequently the last results, presented in Cyclic Performance Report #66/#47 (OLCI-A/OLCI-B), stay valid.

### 2.3.2 OLCI-B

There has been no S02+S03 nor S09 Spectral Calibration for OLCI-B in the reporting period.

Consequently the last results, presented in Cyclic Performance Report #66/#47 (OLCI-A/OLCI-B), stay valid.

## 2.4 Signal to Noise assessment [OLCI-L1B-CV-620]

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### 2.4.1 SNR from Radiometric calibration data

#### 2.4.1.1 OLCI-A

SNR computed for all calibration data (S01, S04 and S05 sequences) as a function of band number is presented in Figure 52.

SNR computed for all calibration data as a function of orbit number for band Oa01 (the less stable band) is presented in Figure 53.

There is no significant evolution of this parameter during the current cycle and the ESA requirement is fulfilled for all bands.



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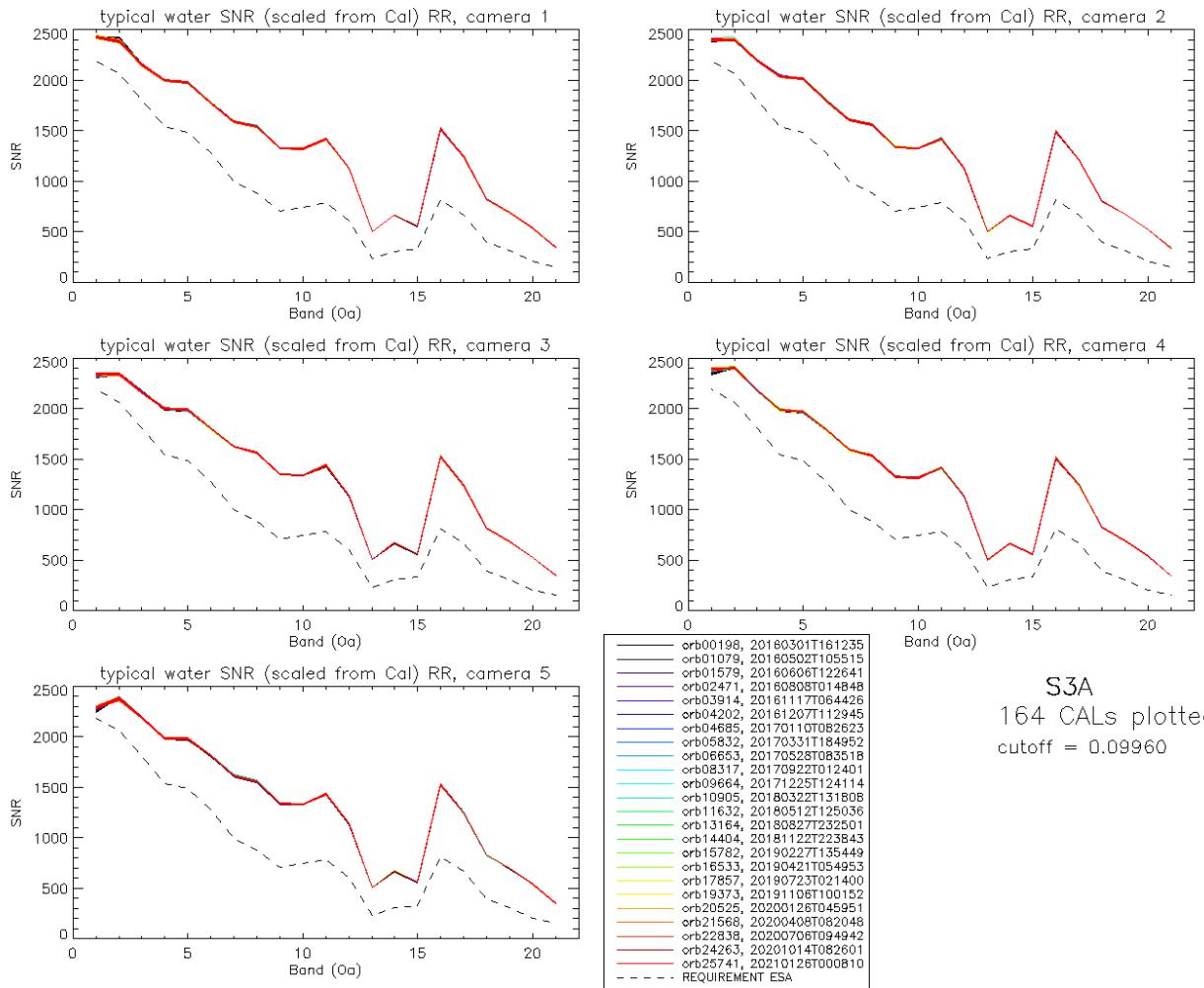
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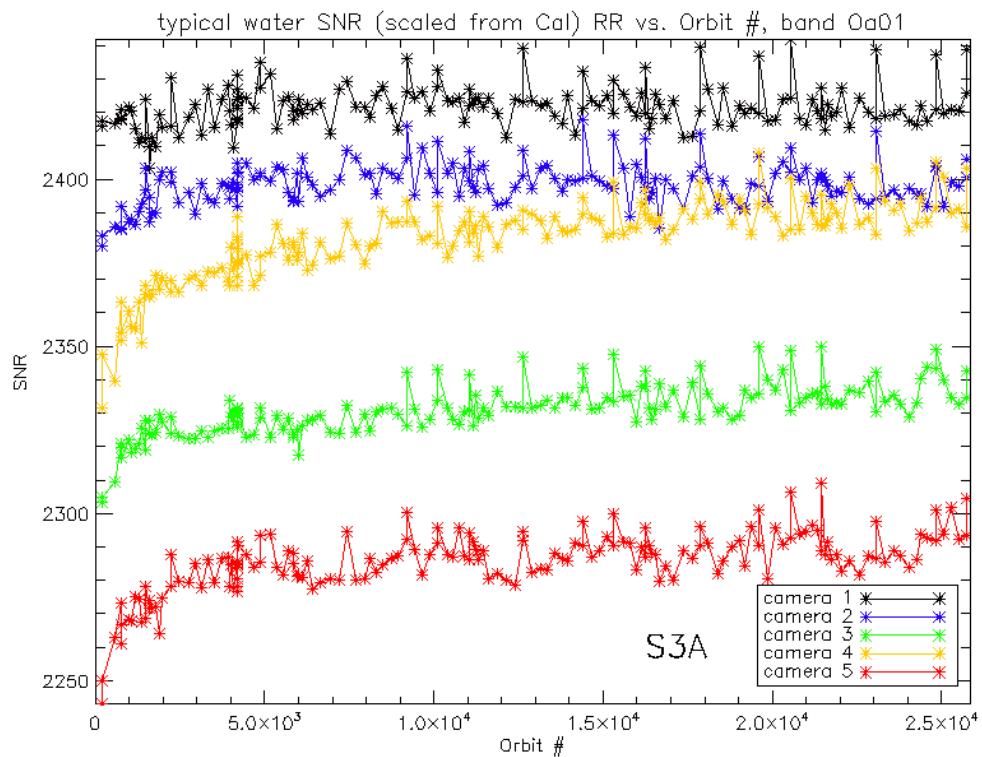


**Figure 52: OLCI-A Signal to Noise ratio as a function of the spectral band for the 5 cameras. These results have been computed from radiometric calibration data. All calibrations except first one (orbit 183) are presents with the colours corresponding to the orbit number (see legend). The SNR is very stable with time: the curves for all orbits are almost superimposed. The dashed curve is the ESA requirement.**



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**Figure 53: long-term stability of the SNR estimates from Calibration data, example of channel Oa1.**

The mission averaged SNR figures are provided in Table 1 below, together with their radiance reference level. According to the OLCI SNR requirements, these figures are valid at these radiance levels and at Reduced Resolution (RR, 1.2 km). They can be scaled to other radiance levels assuming shot noise (CCD sensor noise) is the dominating term, i.e. radiometric noise can be considered Gaussian with its standard deviation varying as the square root of the signal; in other words:  $SNR(L) = SNR(L_{ref}) \cdot \sqrt{\frac{L}{L_{ref}}}$ .

Following the same assumption, values at Full Resolution (300m) can be derived from RR ones as 4 times smaller.

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**Table 1: OLCI-A SNR figures as derived from Radiometric Calibration data. Figures are given for each camera (time average and standard deviation), and for the whole instrument. The requirement and its reference radiance level are recalled (in  $mW.sr^{-1}.m^{-2}.nm^{-1}$ ).**

nm	L <sub>ref</sub>	SNR	C1		C2		C3		C4		C5		All	
			LU	RQT	avg	std	avg	std	avg	std	avg	std	avg	std
400.000	63.0	2188	2421	6.3	2398	6.3	2331	7.6	2381	12.1	2285	9.3	2363	7.0
412.000	74.1	2061	2389	9.0	2405	6.3	2339	4.8	2401	5.0	2381	8.8	2383	5.2
442.000	65.6	1811	2159	5.6	2197	5.9	2164	4.9	2185	4.1	2194	5.5	2180	3.9
490.000	51.2	1541	2000	4.6	2036	5.0	1997	4.2	1984	4.4	1988	4.7	2001	3.3
510.000	44.4	1488	1979	5.3	2014	4.8	1985	4.6	1967	4.5	1985	4.4	1986	3.6
560.000	31.5	1280	1776	4.5	1802	4.1	1803	4.8	1794	3.9	1819	3.4	1799	3.0
620.000	21.1	997	1591	4.0	1609	4.2	1624	3.2	1593	3.2	1615	3.5	1606	2.6
665.000	16.4	883	1546	4.2	1557	4.4	1567	3.8	1533	3.6	1561	3.8	1553	3.1
674.000	15.7	707	1328	3.4	1337	3.6	1350	2.8	1323	3.2	1342	3.6	1336	2.5
681.000	15.1	745	1319	3.7	1326	3.1	1338	2.7	1314	2.5	1333	3.5	1326	2.2
709.000	12.7	785	1420	4.2	1420	4.0	1435	3.4	1414	3.4	1431	3.1	1424	2.8
754.000	10.3	605	1127	3.1	1121	2.9	1135	3.3	1125	2.5	1139	2.8	1129	2.3
761.000	6.1	232	502	1.1	498	1.1	505	1.2	500	1.1	508	1.4	503	0.9
764.000	7.1	305	663	1.6	658	1.6	668	2.1	661	1.5	670	2.1	664	1.4
768.000	7.6	330	558	1.5	554	1.3	562	1.3	557	1.4	564	1.3	559	1.0
779.000	9.2	812	1516	4.8	1498	4.7	1526	5.2	1511	5.0	1526	5.1	1515	4.2
865.000	6.2	666	1244	3.5	1213	3.5	1239	4.0	1246	3.5	1250	2.8	1238	2.8
885.000	6.0	395	823	1.7	801	1.6	814	1.9	824	1.5	831	1.7	819	1.1
900.000	4.7	308	691	1.6	673	1.3	683	1.6	693	1.5	698	1.5	688	1.0
940.000	2.4	203	534	1.2	522	1.1	525	0.9	539	1.1	542	1.3	532	0.7
1020.000	3.9	152	345	0.9	337	0.8	348	0.7	345	0.8	351	0.8	345	0.5



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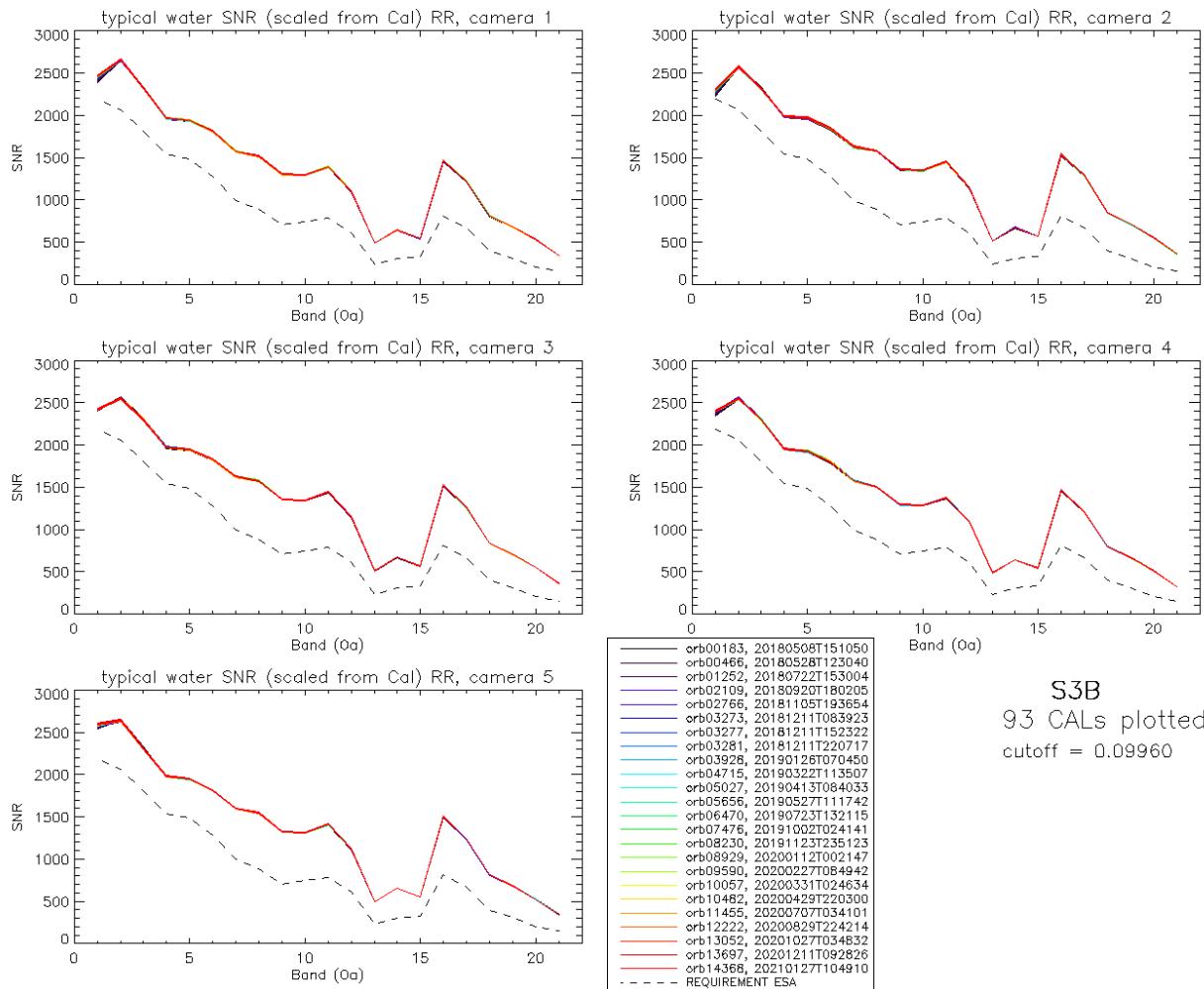
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#### 2.4.1.2 OLCI-B

SNR computed for all OLCI-B calibration data (S01, S04 (but not the dark-only S04) and S05 sequences) as a function of band number is presented in Figure 54.

SNR computed for all OLCI-B calibration data as a function of orbit number for band Oa01 (the less stable band) is presented in Figure 55.

As for OLCI-A the SNR is very stable in time. There is no significant evolution of this parameter during the current cycle and the ESA requirement is fulfilled for all bands.

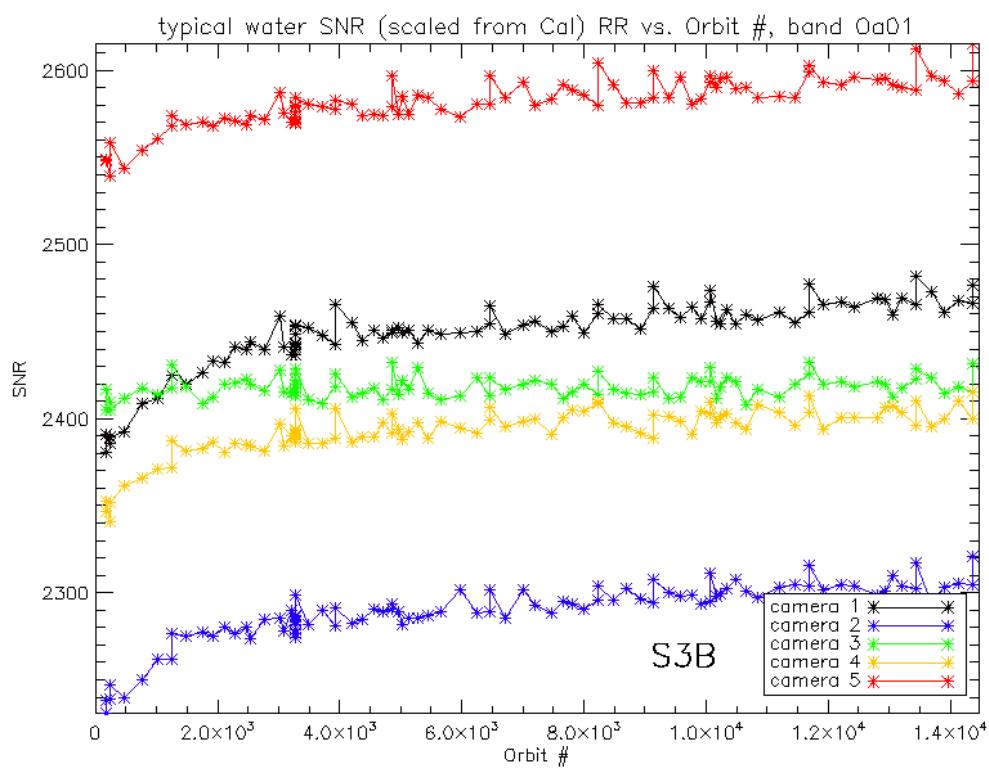


**Figure 54: OLCI-B Signal to Noise ratio as a function of the spectral band for the 5 cameras. These results have been computed from radiometric calibration data. All calibrations except first one (orbit 167) are presents with the colours corresponding to the orbit number (see legend). The SNR is very stable with time: the curves for all orbits are almost superimposed. The dashed curve is the ESA requirement.**



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**Figure 55: long-term stability of the OLCI-B SNR estimates from Calibration data, example of channel Oa1.**

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**Table 2: OLCI-B SNR figures as derived from Radiometric Calibration data. Figures are given for each camera (time average and standard deviation), and for the whole instrument. The requirement and its reference radiance level are recalled (in  $\text{mW} \cdot \text{sr}^{-1} \cdot \text{m}^{-2} \cdot \text{nm}^{-1}$ ).**

nm	L <sub>ref</sub>	SNR	C1		C2		C3		C4		C5		All	
			avg	std	avg	std	avg	std	avg	std	avg	std	avg	std
400.000	63.0	2188	2449	20.0	2289	17.1	2418	6.0	2392	13.7	2581	13.6	2426	13.0
412.000	74.1	2061	2655	6.6	2570	6.0	2546	8.4	2550	6.0	2639	7.0	2592	5.0
442.000	65.6	1811	2325	6.3	2318	5.8	2301	6.3	2304	6.2	2310	6.1	2312	5.1
490.000	51.2	1541	1966	4.6	1989	5.6	1972	4.8	1952	4.7	1979	4.8	1971	3.8
510.000	44.4	1488	1938	4.9	1967	5.8	1943	4.9	1923	5.1	1952	4.8	1944	4.1
560.000	31.5	1280	1813	5.0	1847	5.4	1829	4.7	1804	5.1	1817	4.3	1822	3.9
620.000	21.1	997	1573	4.2	1626	4.7	1625	3.9	1576	3.8	1601	3.3	1600	2.9
665.000	16.4	883	1513	4.2	1579	3.8	1574	4.0	1501	3.2	1546	4.0	1543	2.9
674.000	15.7	707	1301	3.8	1358	3.8	1353	3.4	1292	2.7	1328	3.1	1327	2.4
681.000	15.1	745	1293	3.7	1347	3.3	1343	3.0	1285	2.8	1316	2.8	1317	2.2
709.000	12.7	785	1390	4.2	1447	4.3	1443	4.3	1373	3.0	1412	4.0	1413	3.2
754.000	10.3	605	1096	4.0	1142	3.9	1142	3.8	1089	2.9	1116	3.5	1117	3.2
761.000	6.1	232	487	1.3	509	1.3	508	1.4	485	1.2	497	1.5	497	1.1
764.000	7.1	305	643	1.7	672	2.0	672	1.9	641	1.6	657	1.9	657	1.5
768.000	7.6	330	541	1.6	567	1.5	564	1.4	541	1.4	554	1.7	553	1.2
779.000	9.2	812	1467	4.5	1534	4.9	1526	5.7	1466	4.1	1506	4.7	1500	4.1
865.000	6.2	666	1221	3.7	1287	3.8	1258	3.8	1205	3.8	1238	3.0	1242	3.0
885.000	6.0	395	808	2.4	847	1.9	834	2.0	799	1.8	814	2.2	820	1.6
900.000	4.7	308	679	1.5	714	2.0	704	1.7	669	1.5	683	1.5	690	1.2
940.000	2.4	203	527	1.3	549	1.6	551	1.3	510	1.2	522	1.3	532	0.9
1020.000	3.9	152	336	0.8	358	1.1	358	0.8	318	0.8	339	1.0	342	0.6

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## 2.4.2 SNR from EO data

### 2.4.2.1 OLCI-A

There has been no update on SNR assessment from EO data during the cycle. Last figures (cycle 9) are considered valid.

### 2.4.2.2 OLCI-B

The SNR assessment from EO data has not been applied to OLCI-B considering a) that SNR estimates from RC data have been proved more reliable for OLCI-A and b) that it requires a significant amount of human and machine resources that can be more efficiently used for other tasks.

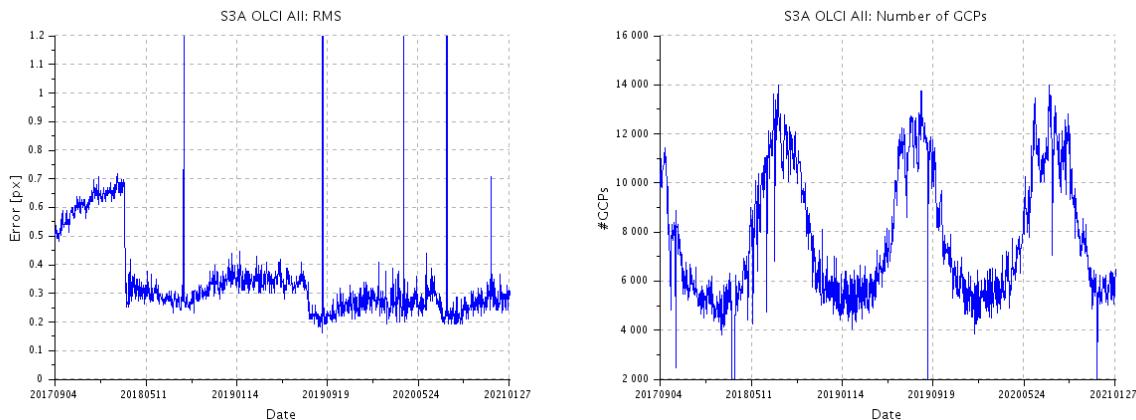
## 2.5 Geometric Calibration/Validation

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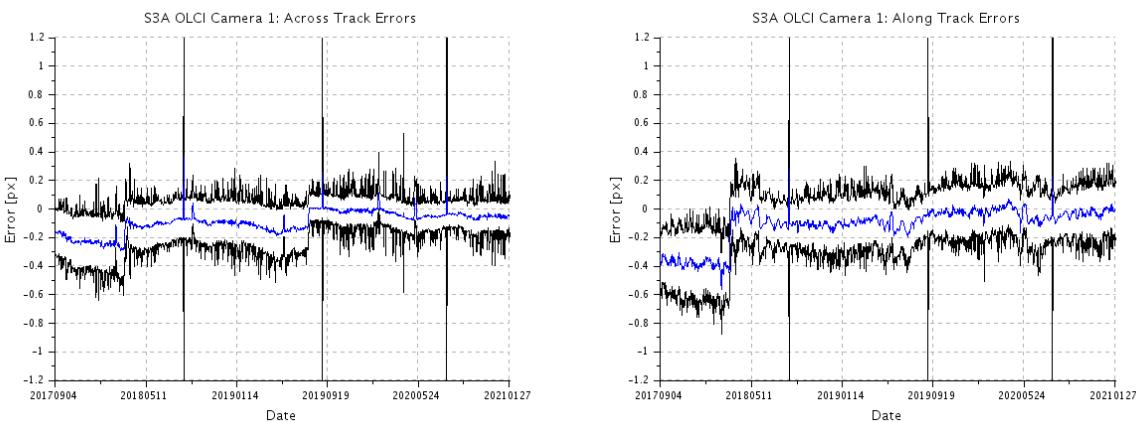
### 2.5.1 OLCI-A

OLCI-A georeferencing performance is compliant since the introduction of MPC Geometric Calibration, put in production on the 14<sup>th</sup> of March 2018. It has however significantly improved after its last full revision of GCMs (Geometric Calibration Models, or platform to instrument alignment quaternions) and IPPVMs (Instrument Pixels Pointing Vectors) both derived using the GeoCal Tool and put in production on 30/07/2019.

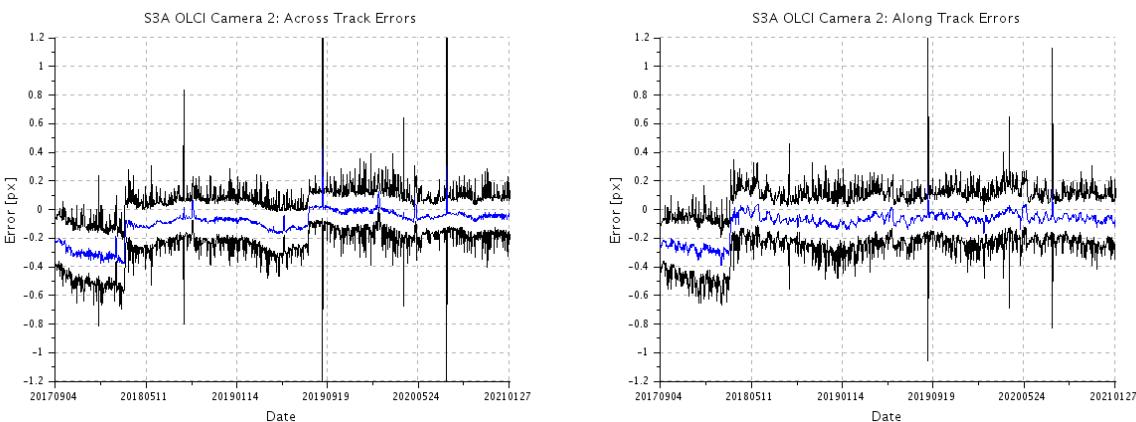
The following figures (Figure 56 to Figure 61) show time series of the overall RMS performance (requirement criterion) and of the across-track and along-track biases for each camera. New plots (Figure 62 and Figure 63) introduce monitoring of the performance homogeneity within the field of view: georeferencing errors in each direction at camera transitions (difference between last pixel of camera N and first pixel of camera N+1) and within a given camera (maximum bias minus minimum inside each camera). The performance improvement since the 30/07/2019 is significant on most figures: the global RMS value decreases from around 0.35 to about 0.2 (Figure 56), the across-track biases decrease significantly for all cameras (Figure 57 to Figure 61), the along-track bias reduces for at least camera 3 (Figure 59) and the field of view homogeneity improves drastically (Figure 62 and Figure 63, but also reduction of the dispersion – distance between the ± 1 sigma lines – in Figure 57 to Figure 61).



**Figure 56:** overall OLCI-A georeferencing RMS performance time series (left) and number of validated control points corresponding to the performance time series (right) over the whole monitoring period



**Figure 57:** across-track (left) and along-track (right) OLCI-A georeferencing biases time series for Camera 1. Blue line is the average, black lines are average plus and minus 1 sigma.

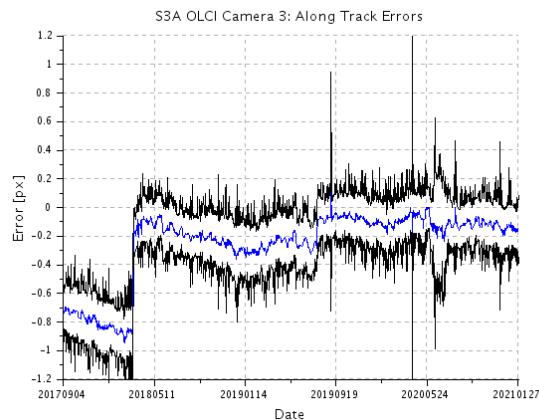
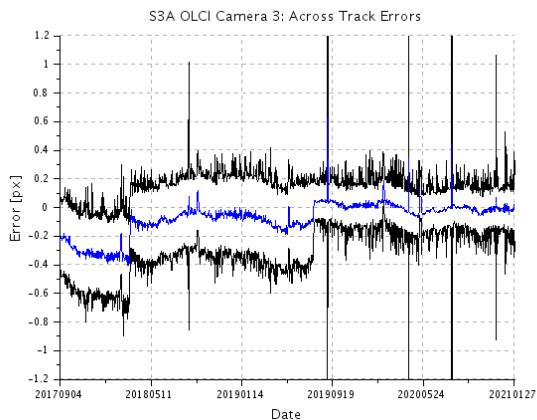


**Figure 58:** same as Figure 57 for Camera 2.

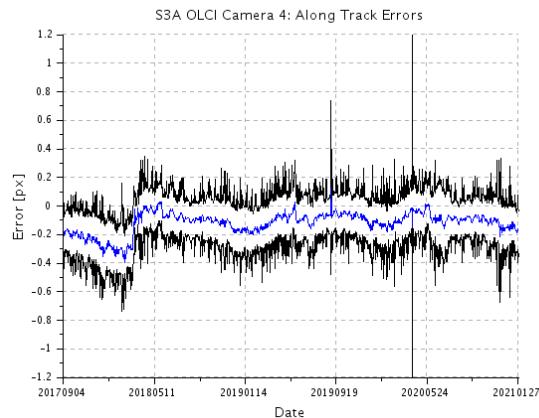
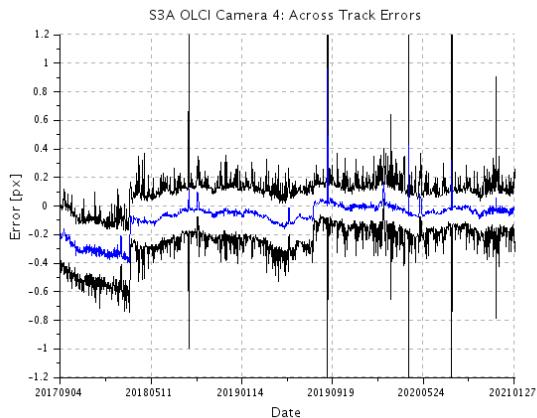


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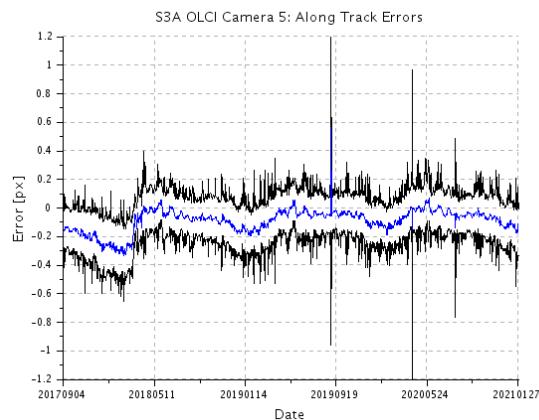
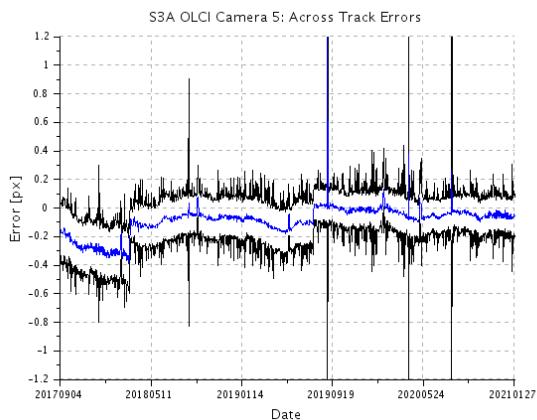
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**Figure 59:** same as Figure 57 for Camera 3.

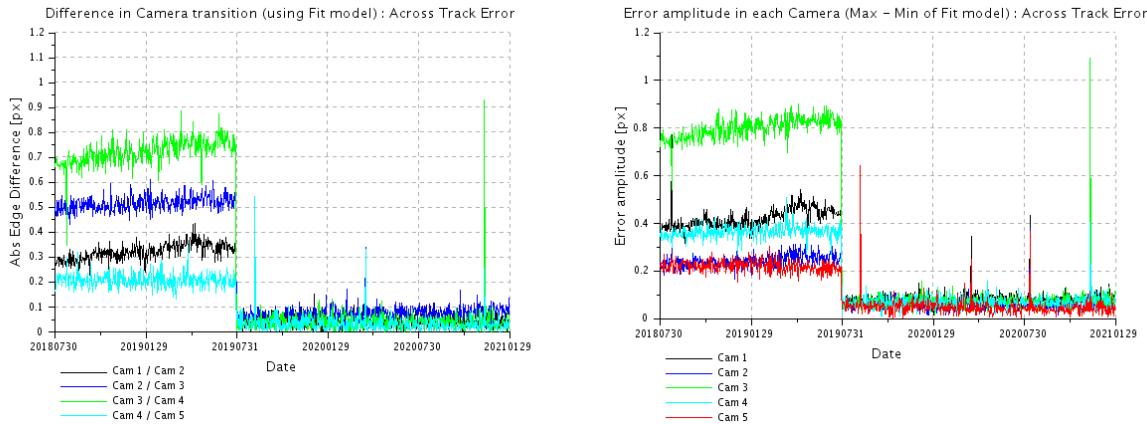


**Figure 60:** same as Figure 57 for Camera 4.

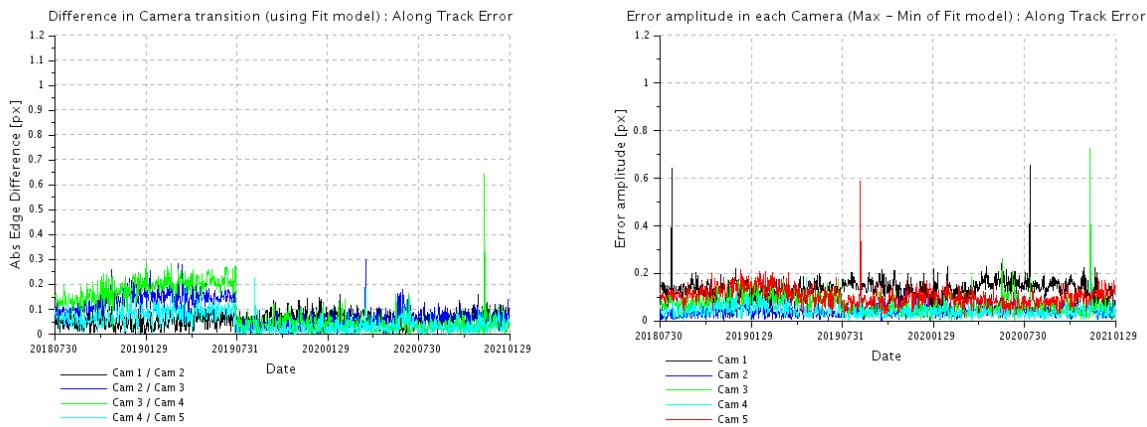


**Figure 61:** same as Figure 57 for Camera 5.

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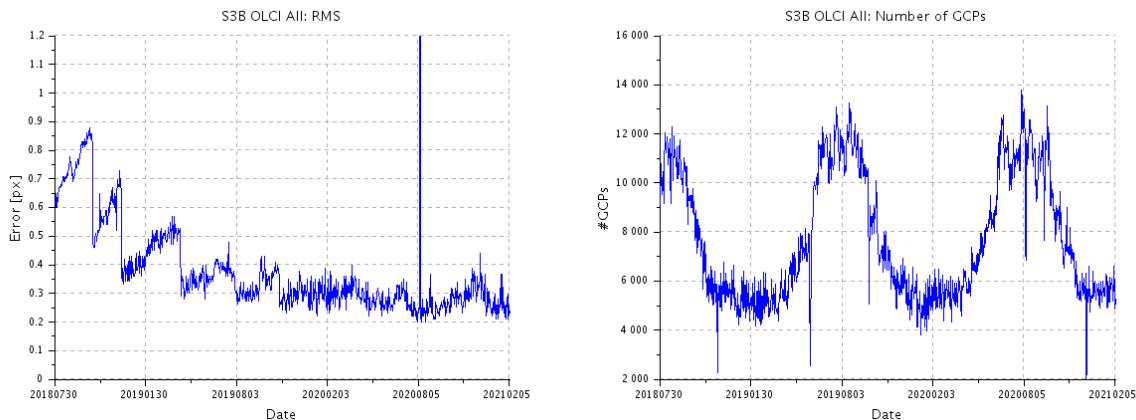
**Figure 62: OLCI-A spatial across-track misregistration at each camera transition (left) and maximum amplitude of the across-track error within each camera (left).**



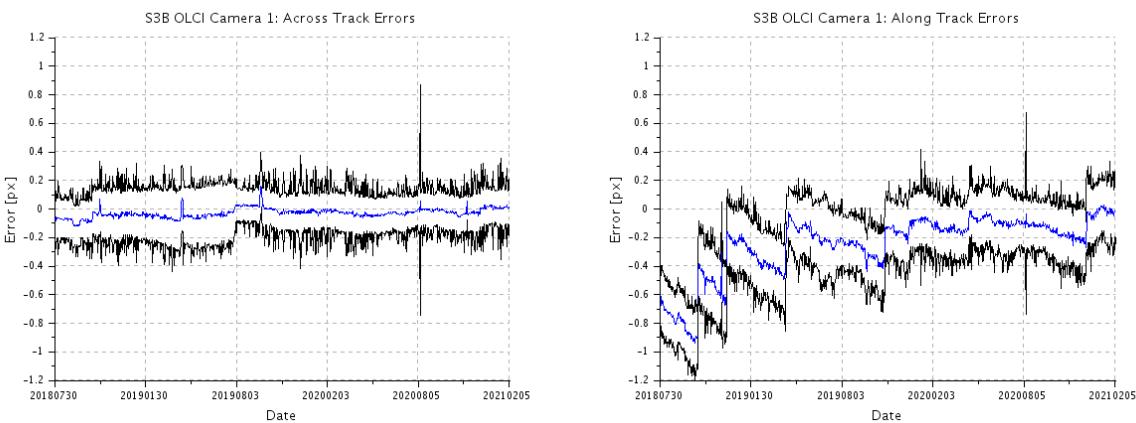
**Figure 63: OLCI-A spatial along-track misregistration at each camera transition (left) and maximum amplitude of the along-track error within each camera (left).**

## 2.5.2 OLCI-B

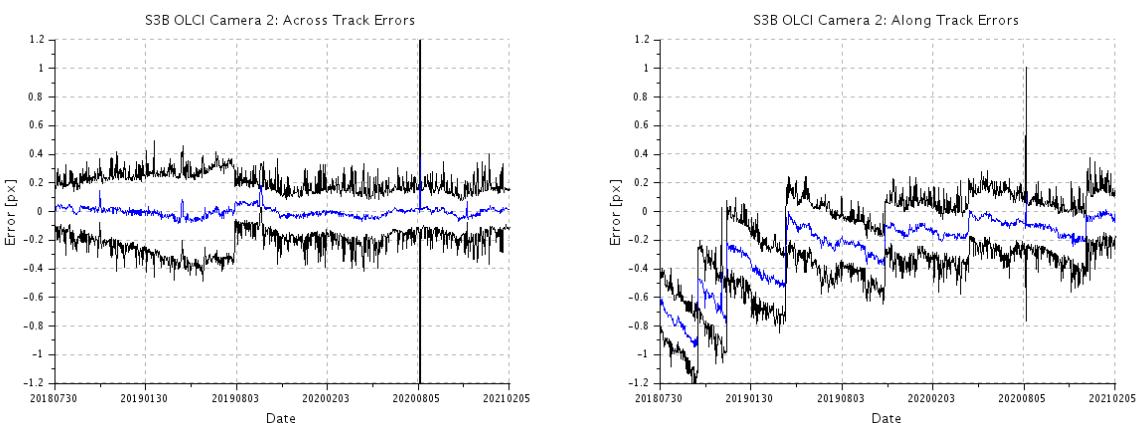
Georeferencing performance of OLCI-B improved significantly with the fourth geometric calibration introduced the 30/07/2019. However, the instrument pointing is still evolving, in particular for camera 2 (Figure 70) and a new geometric calibration has been done and introduced in the processing chain on the 16<sup>th</sup> of April 2020. Its impact is significant on the along-track biases of all cameras (Figure 65 to Figure 69), but also on the continuity at camera interfaces (Figure 70, left) and on intra-camera homogeneity (Figure 70, right). Since then, further adjustments to the geometric calibration have been introduced, mainly to correct the along-track drifts. The most recent was put in production on 10/12/2020 and its effect can be seen e.g. on left graphs of Figure 65 and Figure 66 (along-track biases of cameras 1 & 2).



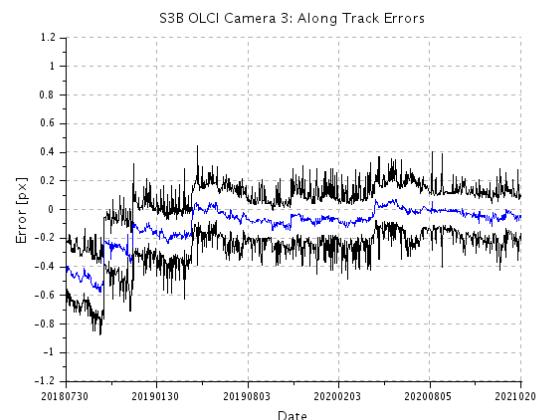
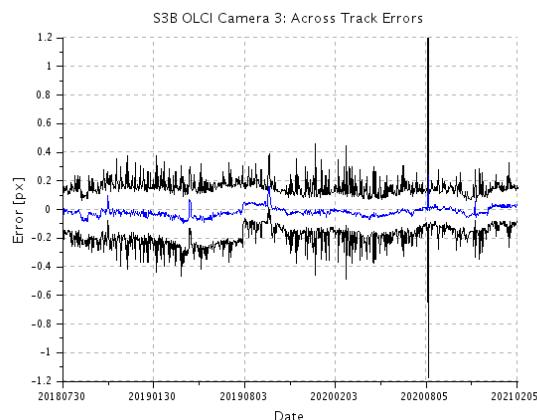
**Figure 64: overall OLCI-B georeferencing RMS performance time series over the whole monitoring period (left) and corresponding number of validated control points (right)**



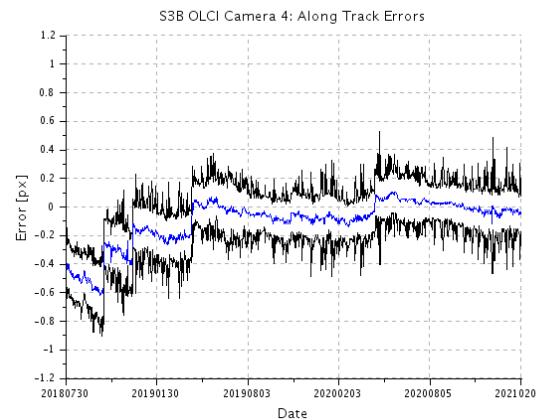
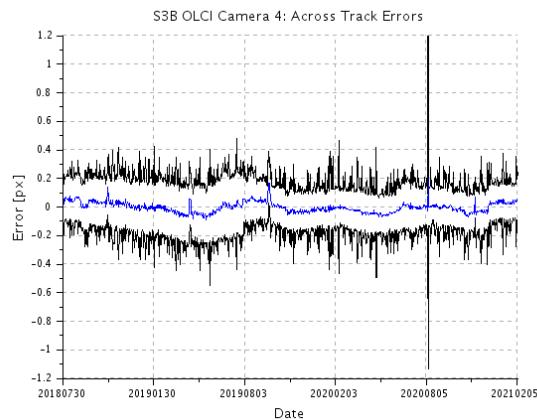
**Figure 65: across-track (left) and along-track (right) OLCI-B georeferencing biases time series for Camera 1.**



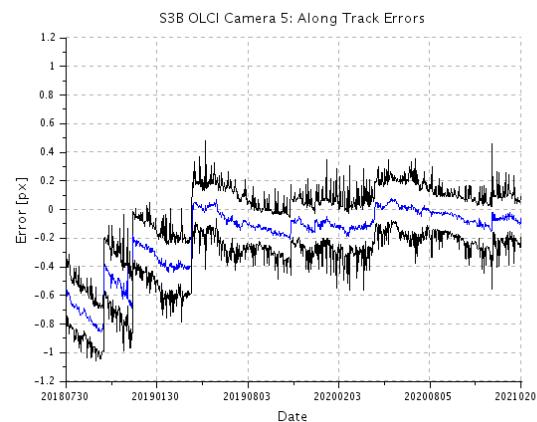
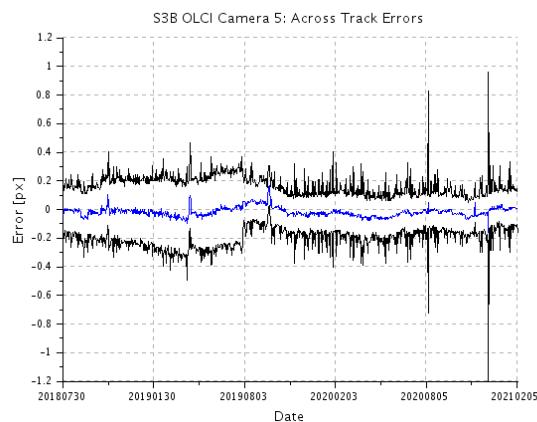
**Figure 66: same as Figure 65 for Camera 2.**



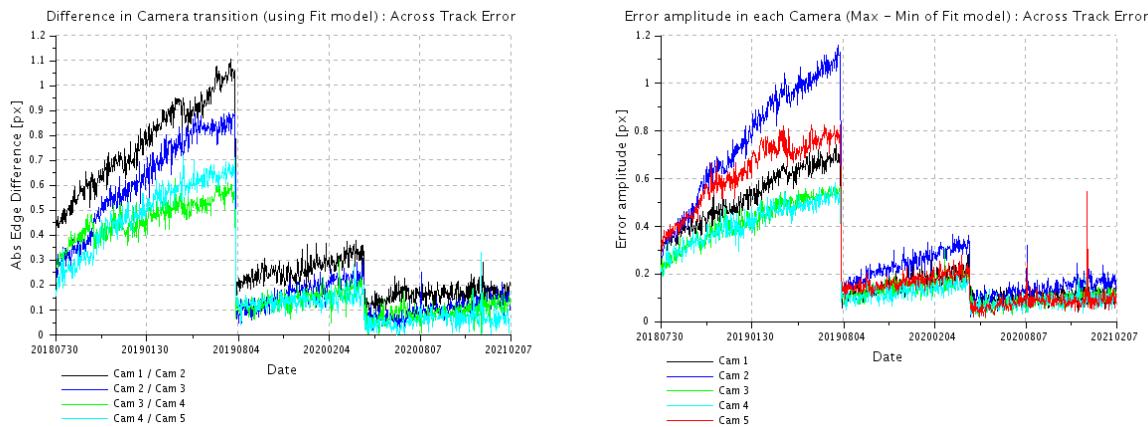
**Figure 67:** same as Figure 65 for Camera 3.



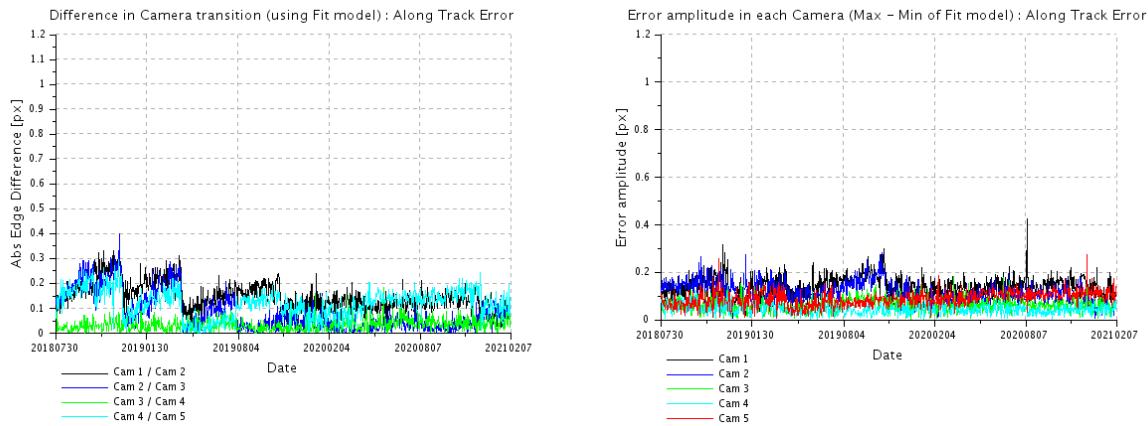
**Figure 68:** same as Figure 65 for Camera 4.



**Figure 69:** same as Figure 65 for Camera 5.



**Figure 70: OLCI-B spatial across-track misregistration at each camera transition (left) and maximum amplitude of the across-track error within each camera (left).**



**Figure 71: OLCI-B spatial along-track misregistration at each camera transition (left) and maximum amplitude of the along-track error within each camera (left).**

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## 3 OLCI Level 1 Product validation

### **3.1 [OLCI-L1B-CV-300], [OLCI-L1B-CV-310] – Radiometric Validation**

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#### **3.1.1 S3ETRAC Service**

##### **Activities done**

The S3ETRAC service extracts OLCI L1 RR and SLSTR L1 RBT data and computes associated statistics over 49 sites corresponding to different surface types (desert, snow, ocean maximizing Rayleigh signal, ocean maximizing sunglint scattering and deep convective clouds). The S3ETRAC products are used for the assessment and monitoring of the L1 radiometry (optical channels) by the ESLs.

All details about the S3ETRAC/OLCI and S3ETRAC/SLSTR statistics are provided on the S3ETRAC website  
<http://s3etrap.acri.fr/index.php?action=generalstatistics>

- ❖ Number of OLCI products processed by the S3ETRAC service
- ❖ Statistics per type of target (DESERT, SNOW, RAYLEIGH, SUNGLINT and DCC)
- ❖ Statistics per sites
- ❖ Statistics on the number of records

For illustration, we provide below statistics on the number of S3ETRAC/OLCI records generated per type of targets (DESERT, SNOW, RAYLEIGH, SUNGLINT and DCC) for both OLCI-A (Figure 72) and OLCI-B (Figure 73).



## Sentinel-3 MPC

### S3 OLCI Cyclic Performance Report

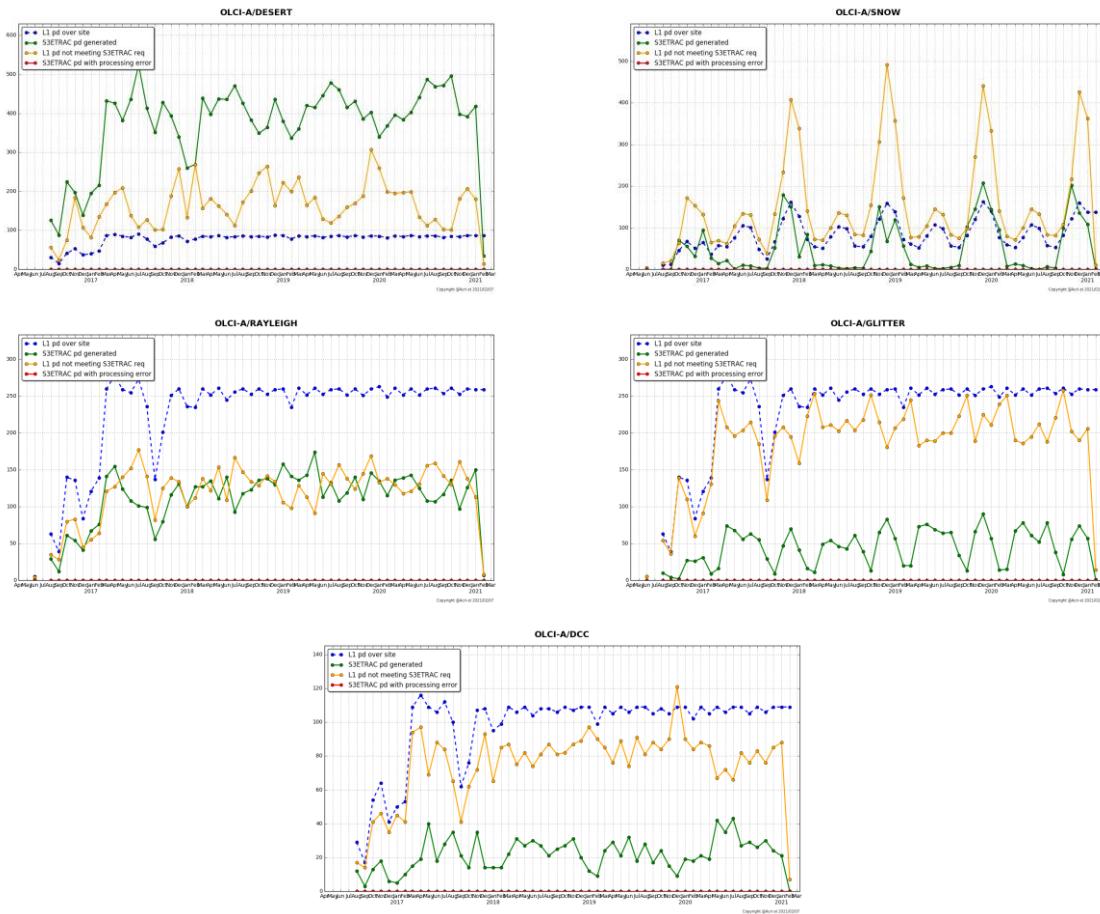
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**Figure 72: summary of S3ETRAC products generation for OLCI-A**  
**(number of OLCI-A L1 products Ingested, blue – number of S3ETRAC extracted products generated, green – number of S3ETRAC runs without generation of output product (data not meeting selection requirements), yellow – number of runs ending in error, red, one plot per site type).**



## Sentinel-3 MPC

### S3 OLCI Cyclic Performance Report

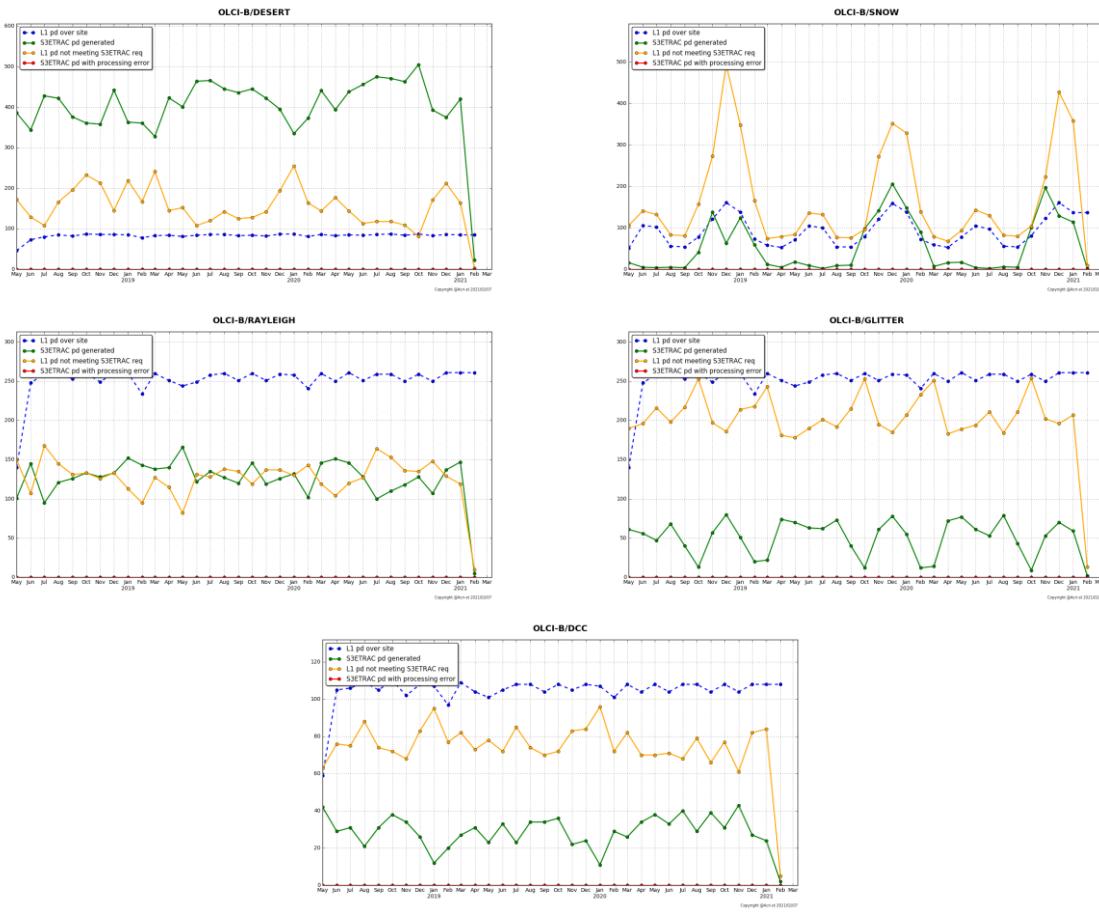
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**Figure 73: summary of S3ETRAC products generation for OLCI-B**  
**(number of OLCI-B L1 products Ingested, yellow – number of S3ETRAC extracted products generated, blue –**  
**number of S3ETRAC runs without generation of output product (data not meeting selection requirements), green**  
**– number of runs ending in error, red, one plot per site type).**

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### 3.1.2 Radiometric validation with DIMITRI

#### Highlights

OLCI-A and OLCI-B L1B radiometry verification as follow:

- ❖ The verification is performed over Desert and Ocean-sites **until the 10<sup>th</sup> of February 2021** .
- ❖ All results from OLCI-A and OLCI-B over Rayleigh, Glint and PICS are consistent with the previous cycle over the used CalVal sites.
- ❖ Good stability of both sensors OLCI-A and OLCI-B could be observed, nevertheless the time-series average shows higher reflectance from OLCI-A.
- ❖ Bands with high gaseous absorption are excluded.

#### Verification and Validation over PICS

1. The ingestion of all the available L1B-LN1-NT products from OLCI-A and OLCI-B over the 6 desert calval-sites (Algeria3 & 5, Libya 1 & 4 and Mauritania 1 & 2) has been performed until the **10<sup>th</sup> of February 2021** .
2. The results are consistent overall the six used PICS sites (Figure 74 and Figure 75). Both sensors show a good stability over the analysed period.
3. The temporal average over the period **January 2020 - Present** of the elementary ratios (observed reflectance to the simulated one) for **OLCI-A** shows gain values between 2-4% over all the VNIR bands (Figure 76). Unlike, the temporal average over the same period of the elementary ratios for **OLCI-B** shows gain values within 2% (mission requirements) over the VNIR spectral range (Figure 76). The spectral bands with significant absorption from water vapor and O<sub>2</sub> (Oa11, Oa13, Oa14, Oa15 and Oa20) are excluded.



Sentinel-3 MPC

## S3 OLCI Cyclic Performance Report

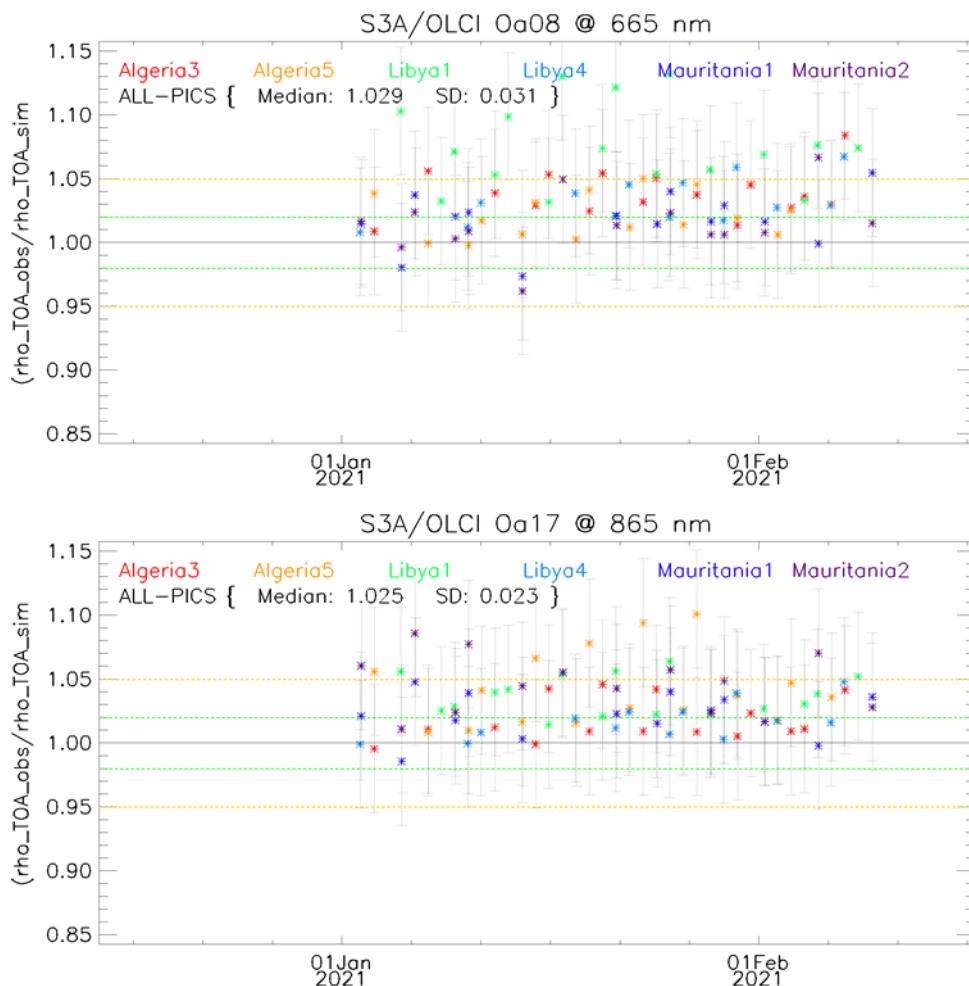
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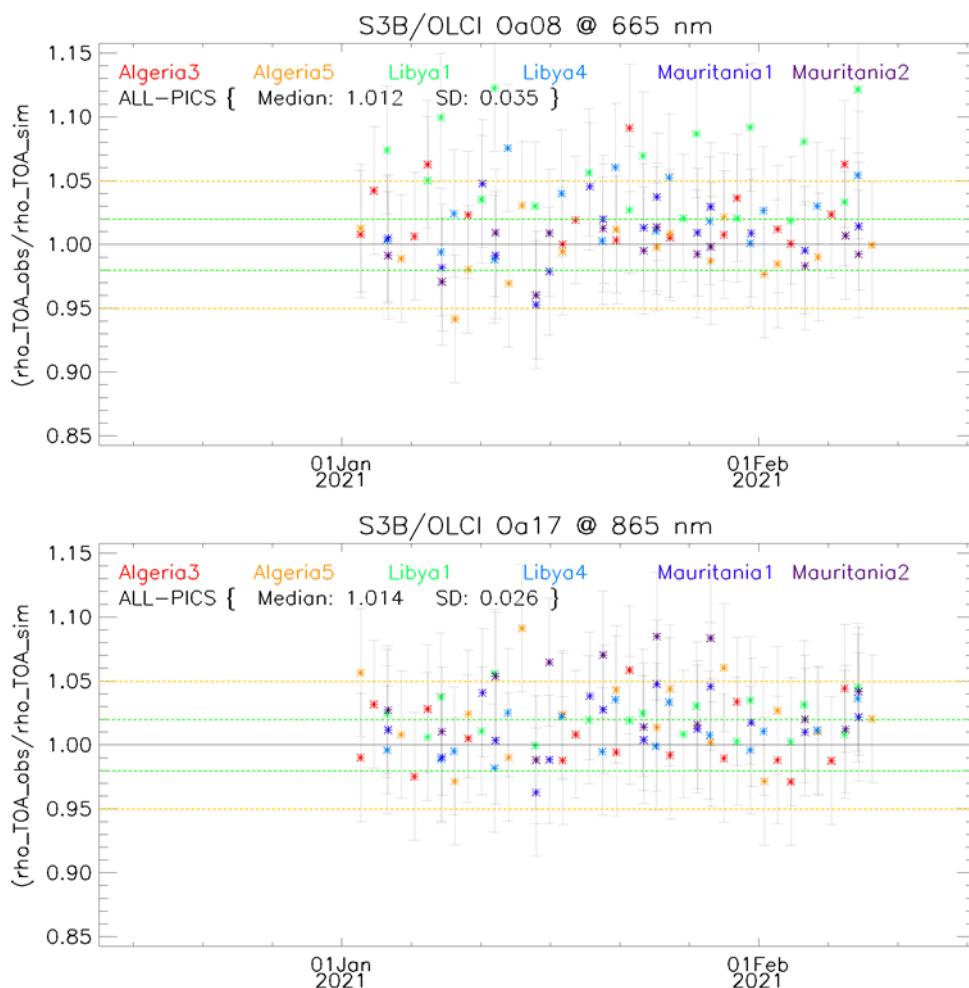


**Figure 74: Time-series of the elementary ratios (observed/simulated) signal from OLCI-A for (top to bottom) bands Oa08 and Oa17 respectively over January 2021-Present from the six PICS Cal/Val sites. Dashed-green and orange lines indicate the 2% and 5% respectively. Error bars indicate the desert methodology uncertainty.**



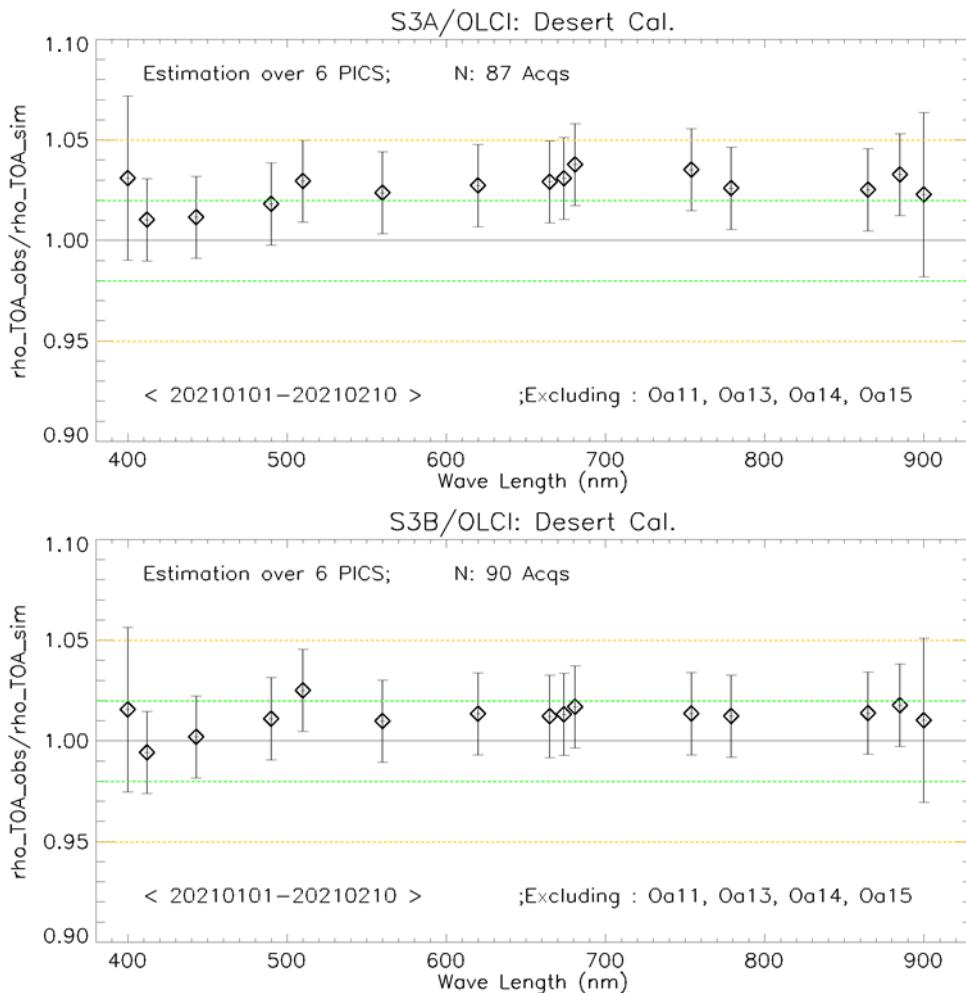
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**Figure 75:** Time-series of the elementary ratios (observed/simulated) signal from OLCI-B for (top to bottom) bands Oa08 and Oa17 respectively over January 2021-Present from the six PICS Cal/Val sites. Dashed-green and orange lines indicate the 2% and 5% respectively. Error bars indicate the desert methodology uncertainty.

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**Figure 76:** The estimated gain values for OLCI-A and OLCI-B over the 6 PICs sites identified by CEOS over the period January 2021-Present as a function of wavelength. Dashed-green and orange lines indicate the 2% and 5% respectively. Error bars indicate the desert methodology uncertainty.

#### Cross-mission Intercomparison over PICs:

X-mission Intercomparison with MODIS-A and MSI-A has been performed until February 2019 and November 2020 respectively. Figure 77 shows time-series of the elementary ratios from S2A/MSI, Aqua/MODIS, S3A/OLCI and S3B/OLCI over the LYBIA4 site for the period April 2016 until February 2019 and November 2020, respectively.

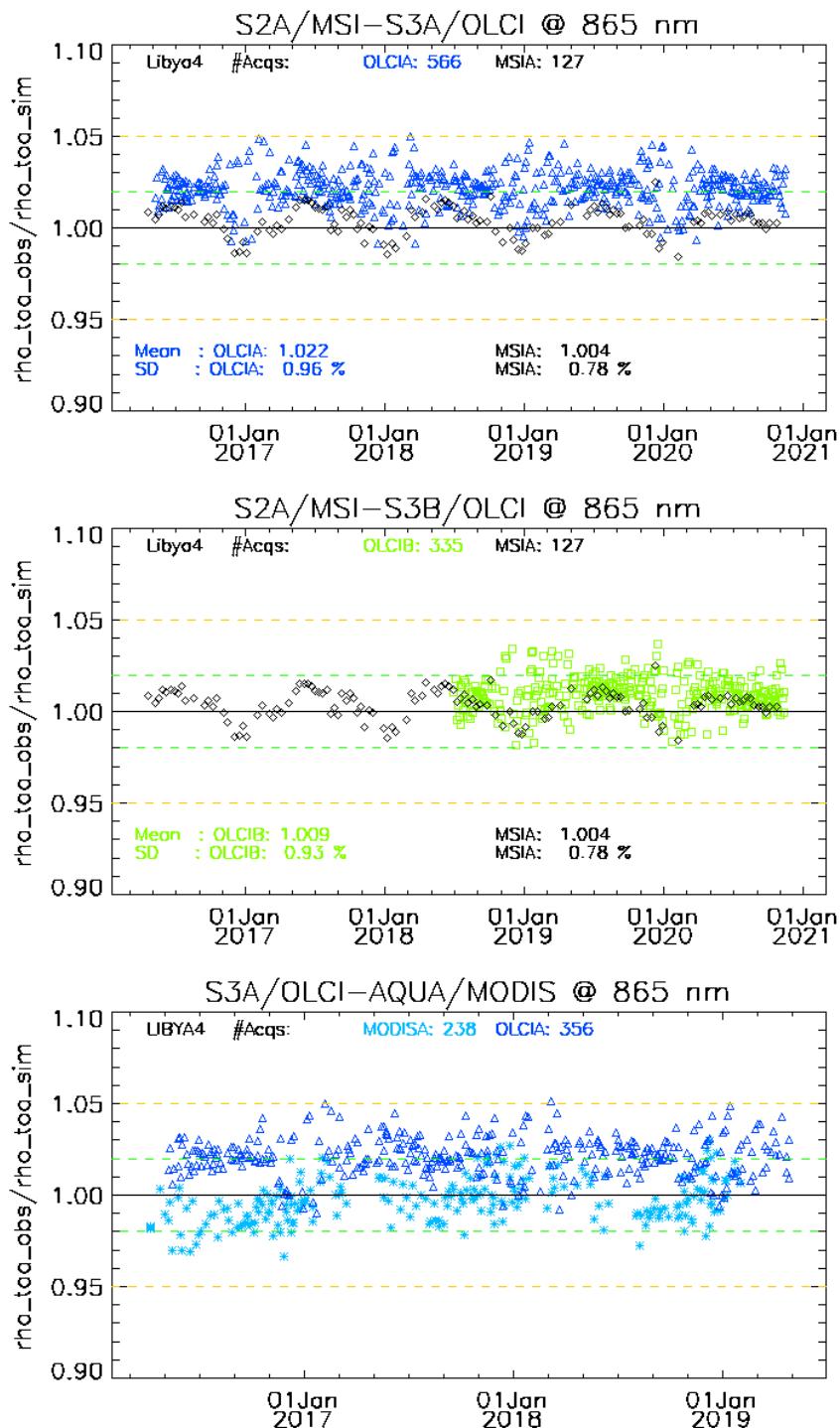
We observe a clear stability over the three sensors, associated with higher reflectance from OLCI-A wrt to MSI-A and MODISA. MODISA shows higher fluctuation wrt to MSI-A and OLCI-A/B ones.

Figure 78 shows the estimated gain over different time-series for different sensors (MSI-A, OLCI-A, OLCI-B and MODIS-A) over PICs. The spectral bands with significant absorption from water vapour and O2 are excluded. OLCI-A seems to have higher gain wrt the other sensors, which means that OLCI-A has brighter reflectance than its simulated one by PICs method.

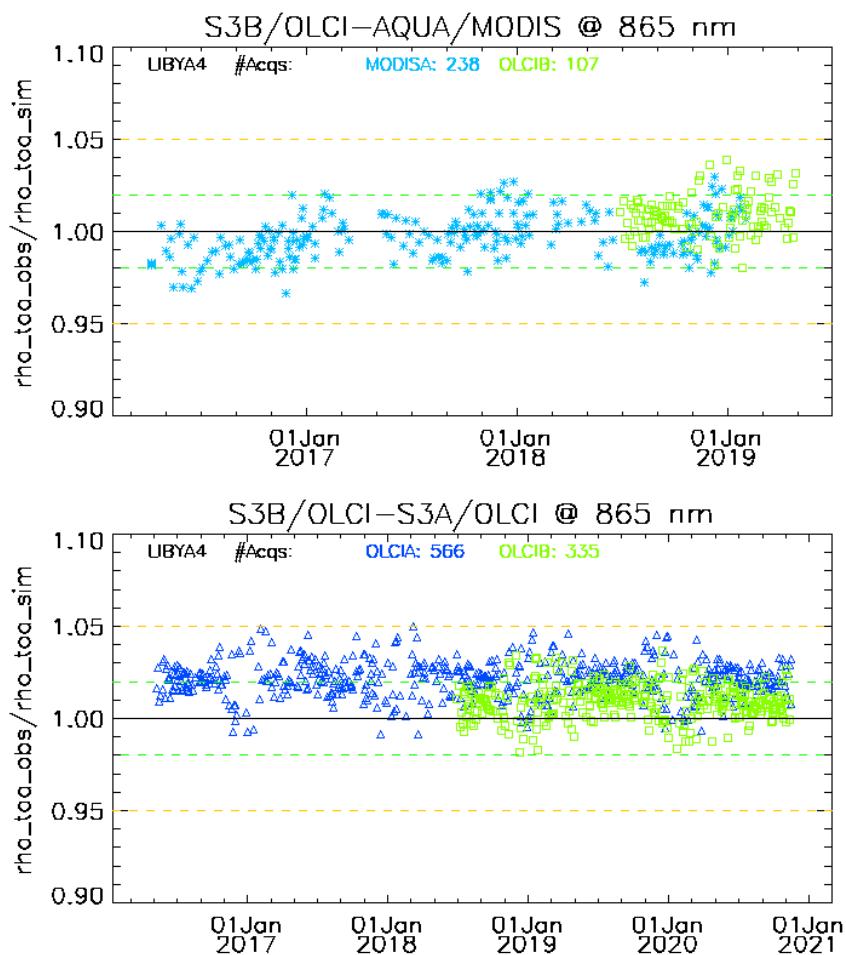


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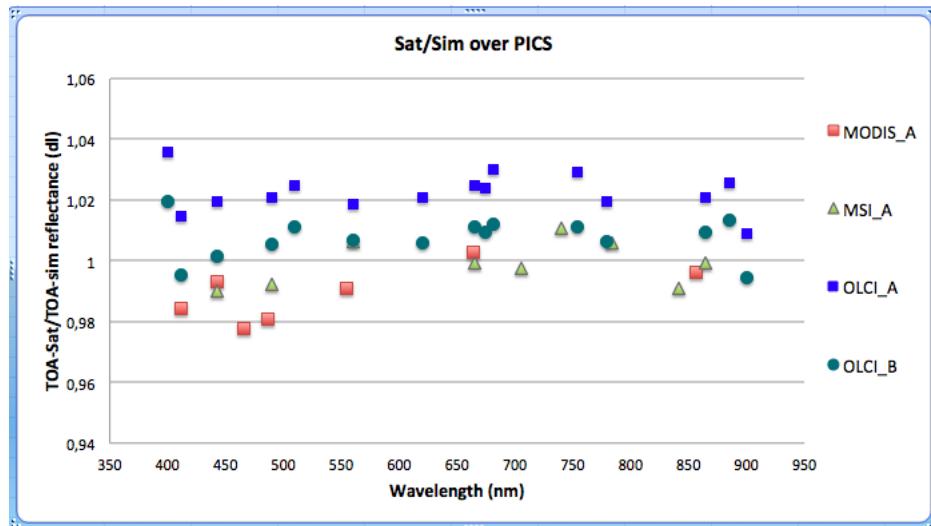


 <b>Sentinel-3 MPC</b> <b>S3 OLCI Cyclic Performance Report</b> <b>S3A Cycle No. 067 – S3B Cycle No. 048</b>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 70
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**Figure 77:** Time-series of the elementary ratios (observed/simulated) signal from (black) S2A/MSI, (blue) S3A/OLCI, (green) S3B/OLCI and (Cyan) Aqua/MODIS for NIR band 865nm over LIBYA4 site. Dashed-green and orange lines indicate the 2% and 5% respectively. The systematic and total uncertainties of the desert methodology are 1% and 5% respectively.

 <b>Sentinel-3 MPC</b> <b>S3 OLCI Cyclic Performance Report</b> <b>S3A Cycle No. 067 – S3B Cycle No. 048</b>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 71
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**Figure 78: Ratio of observed TOA reflectance to simulated one for (green-yellow) S2A/MSI, (red) Aqua/MODIS, (blue) S3A/OLCI and (green) S3B/OLCI averaged over the six PICS test sites as a function of wavelength.**

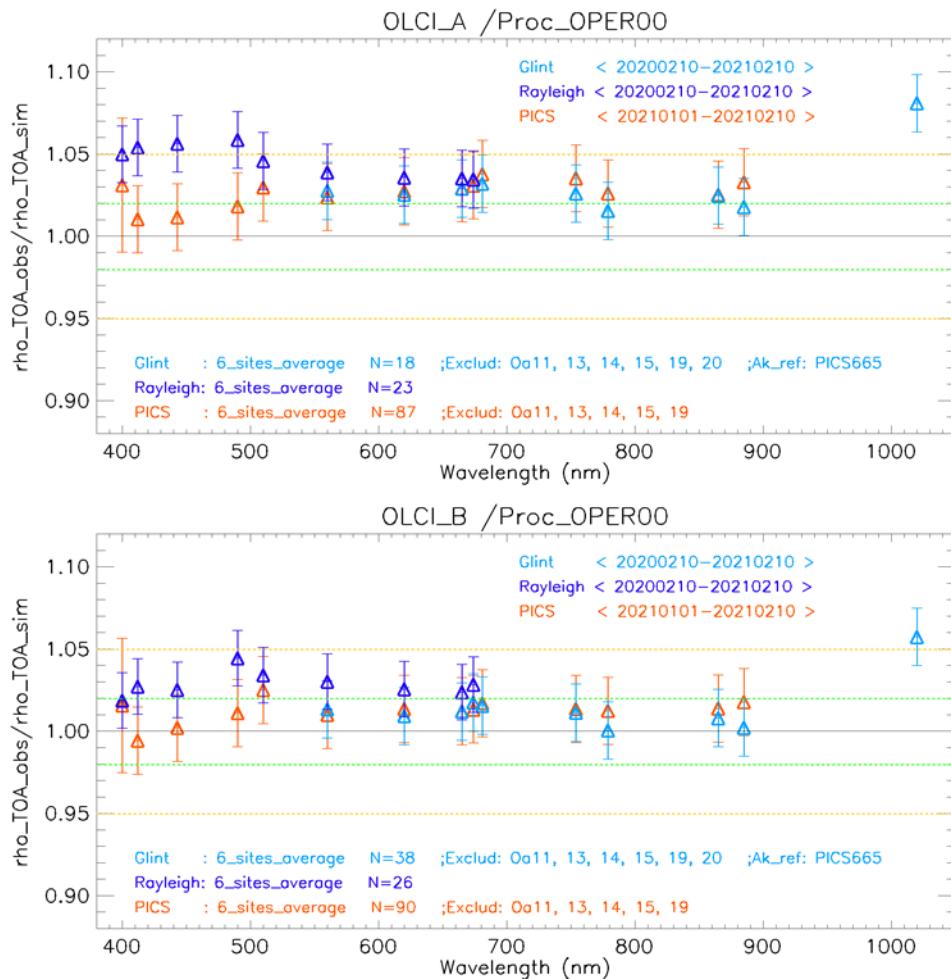
### Validation over Rayleigh

Rayleigh method has been performed from the available mini-files over the **last 12 months** for OLCI-A and OLCI-B. The results were produced with the configuration (ROI-AVERAGE). The gain coefficients of OLCI-A are consistent with the previous results. Bands Oa01-Oa05 display biases values between 5%-7% while bands Oa06-Oa09 exhibit biases between 2%-3% higher than the 2% mission requirements (Figure 79). The gain coefficients of OLCI-B are lower than OLCI-A ones, where bands Oa01-Oa05 display biases values about 3-5%, when bands Oa6-Oa9 exhibit biases better than 2% mission requirements (Figure 79).

### Validation over Glint and synthesis

Glint calibration method with the configuration (ROI-PIXEL) has been performed over the **last 12 months** for OLCI-A and OLCI-B. The outcome of this analysis shows a good consistency with the desert and Rayleigh outputs over the NIR spectral range Oa06-Oa09 for both sensors. Glint results from OLCI-A show that the NIR bands are within the 2% (mission requirements), except Oa21 which shows higher biases more than ~5% for both sensors (see Figure 79). Again, the glint gain from OLCI-B looks slightly lower than OLCI-A one.

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**Figure 79: The estimated gain values for OLCI-A and OLCI-B from Glint, Rayleigh and PICS methods over the past twelve months as a function of wavelength. We use the gain value of Oa8 from PICS-Desert method as reference gain for Glint method. Dashed-green and orange lines indicate the 2% and 5% respectively. Error bars indicate the method uncertainties.**

### 3.1.3 Radiometric validation with OSCAR

There has been no new result during the cycle. Last figures (cycle 66-47) are considered valid.



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## **3.2 [OLCI-L1B-CV-320] – Radiometric Validation with Level 3 products**

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### **3.2.1 OLCI-A**

There has been no new result during the cycle. Last figures (cycle 20) are considered valid.

### **3.2.2 OLCI-B**

This activity has not started for OLCI-B.

 <p><b>Sentinel-3 MPC</b>  <b>S3 OLCI Cyclic Performance Report</b>  <b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 74
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## 4 Level 2 Land products validation

### 4.1 [OLCI-L2LRF-CV-300]

#### 4.1.1 Routine extractions

##### 4.1.1.1 OLCI-A

- ❖ The focus for this time period has been on the rolling archive Non Time Critical (NT) data until the 1<sup>st</sup> of February 2021. More data available for statistical analysis as a concatenation procedure for all available data in the MERMAID processing has been implemented.
- ❖ Concatenated time series of OLCI Global Vegetation Index and OLCI Terrestrial Chlorophyll Index have been regenerated on the current rolling archive availability including previous extractions since June 2016 and April 2018 for S3A and S3B respectively.

Figure 80 to Figure 89 below present the Core Land Sites OLCI-A time series over the current period.

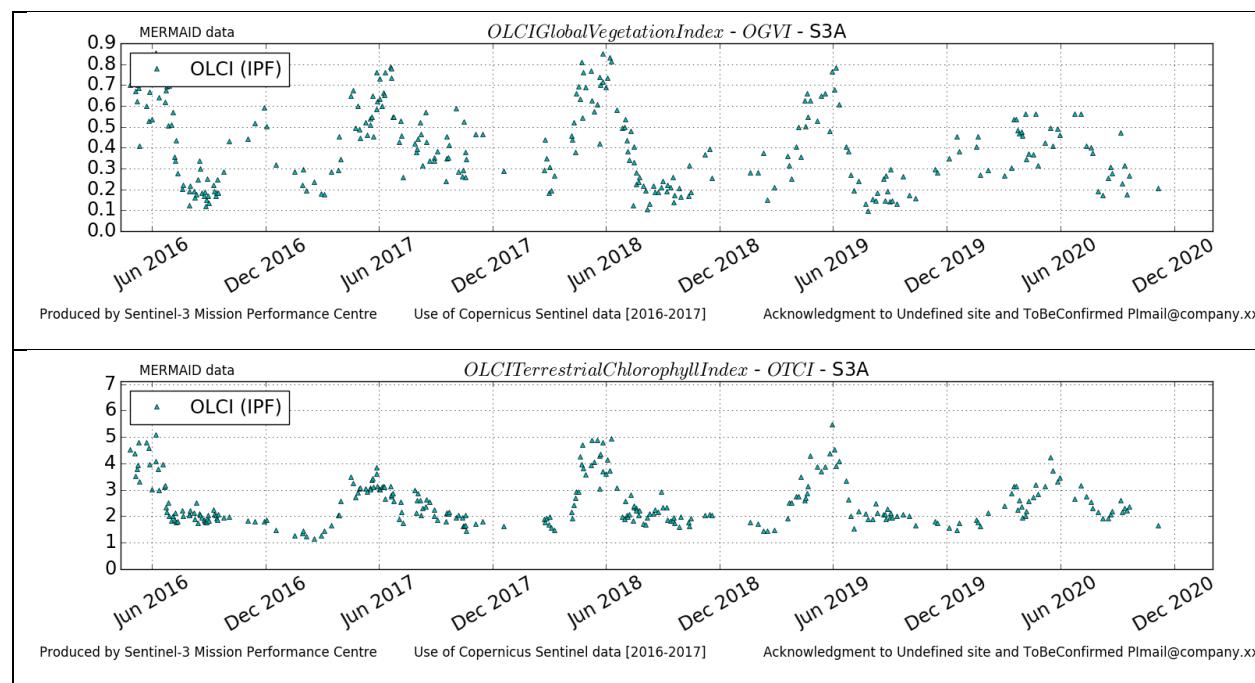
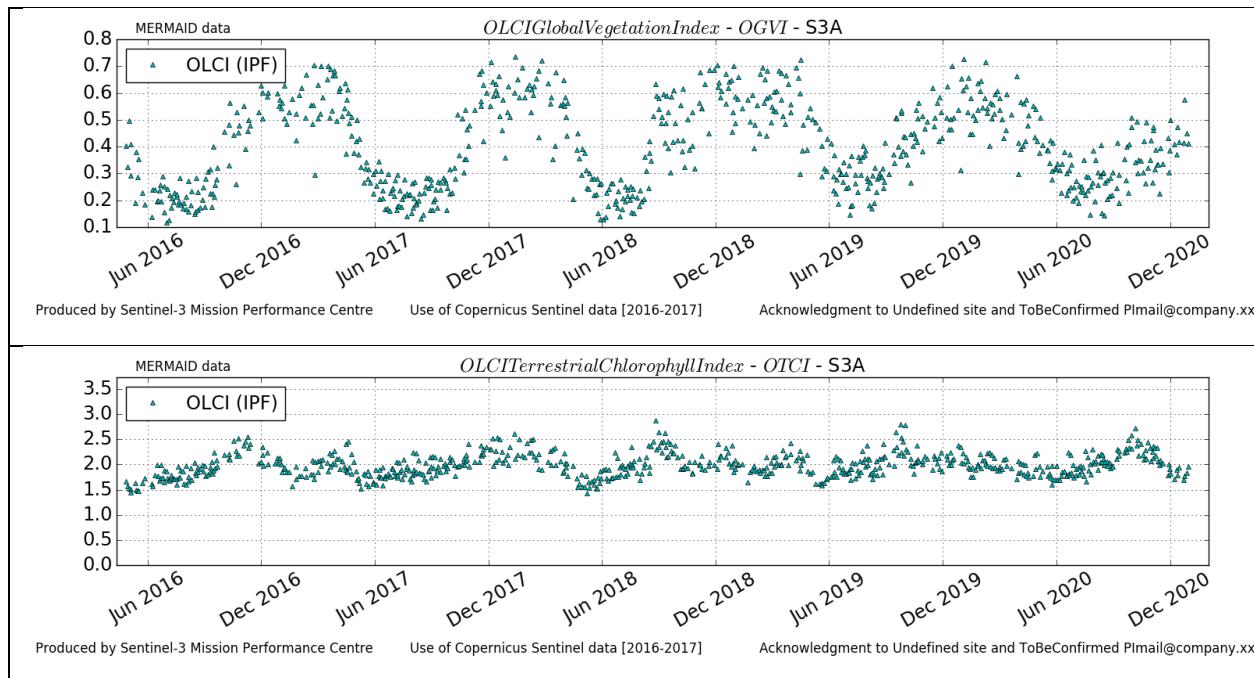
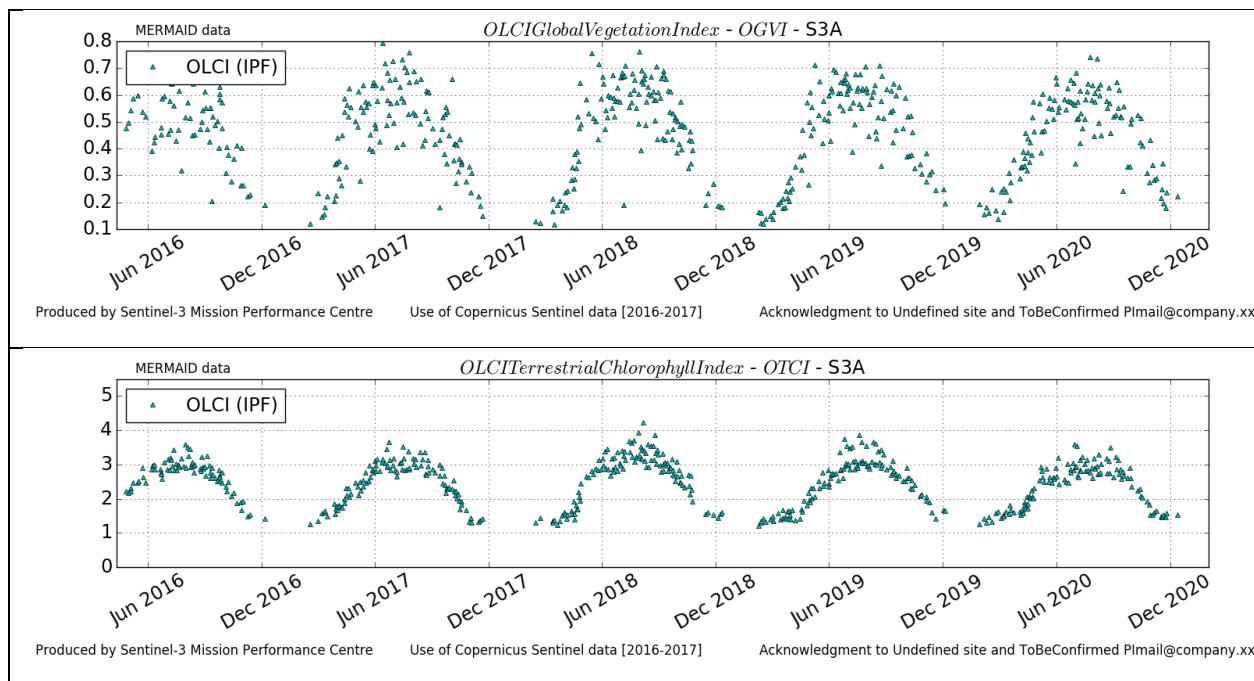


Figure 80: DeGeb time series over current report period

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 75
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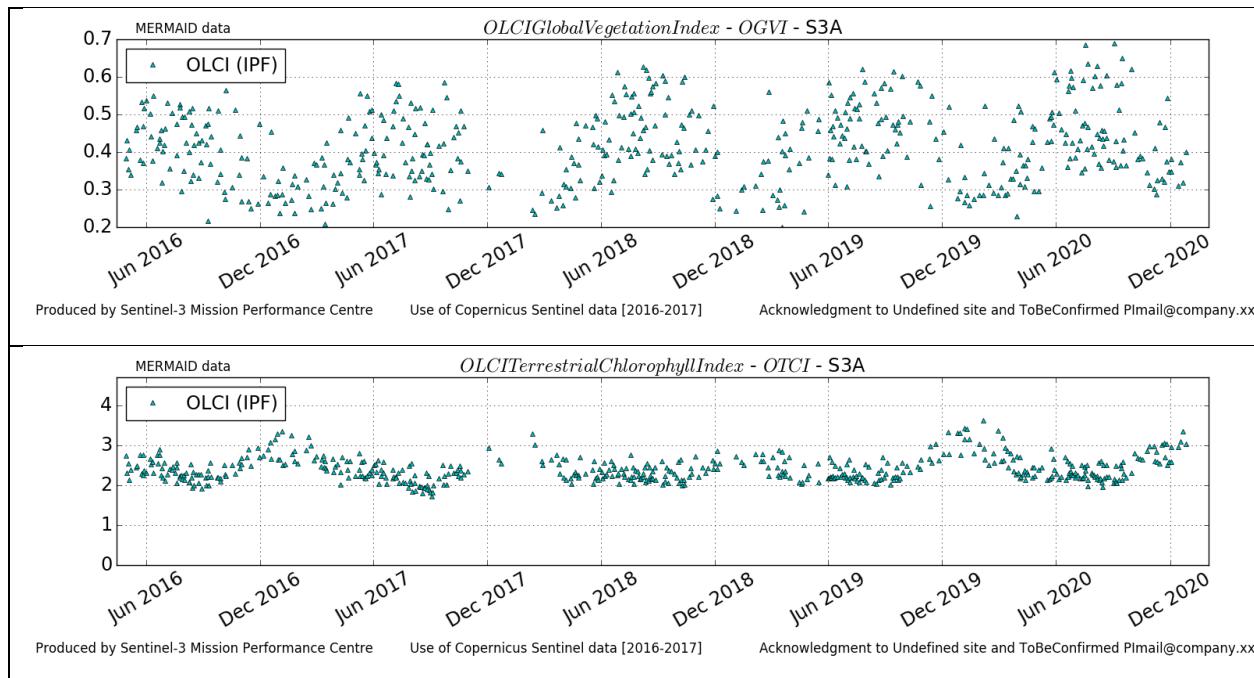


**Figure 81: ITCat time series over current report period**

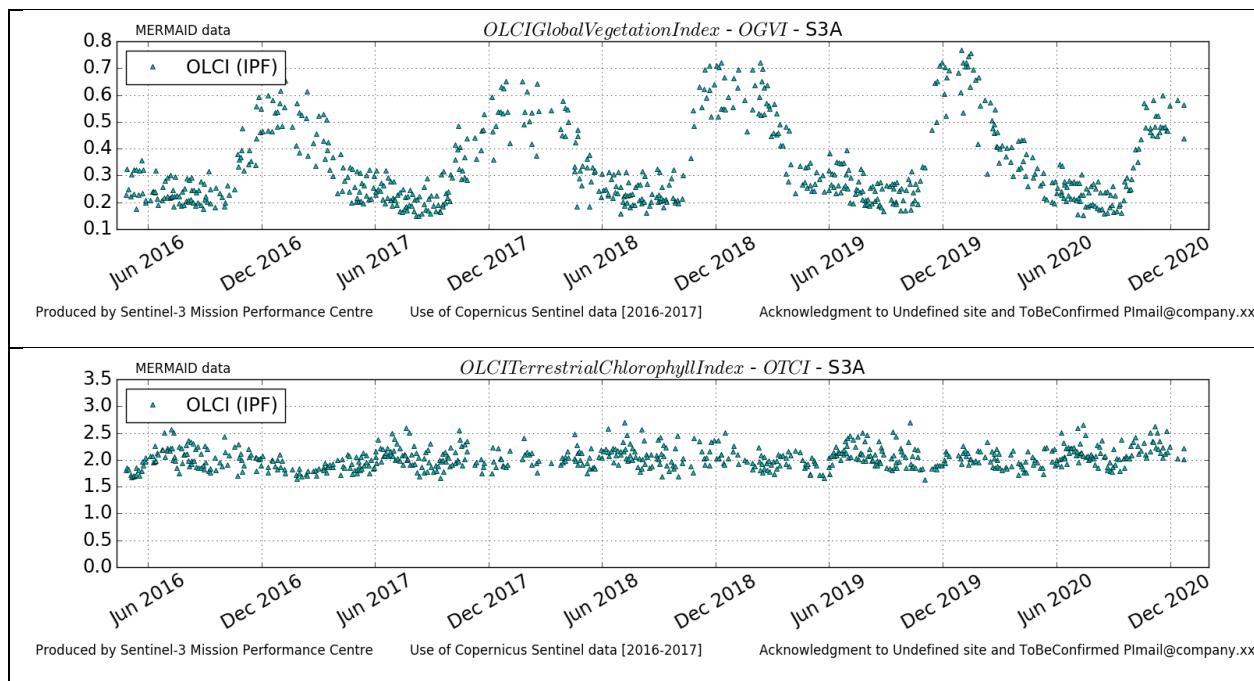


**Figure 82: ITisp time series over current report period**

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 76
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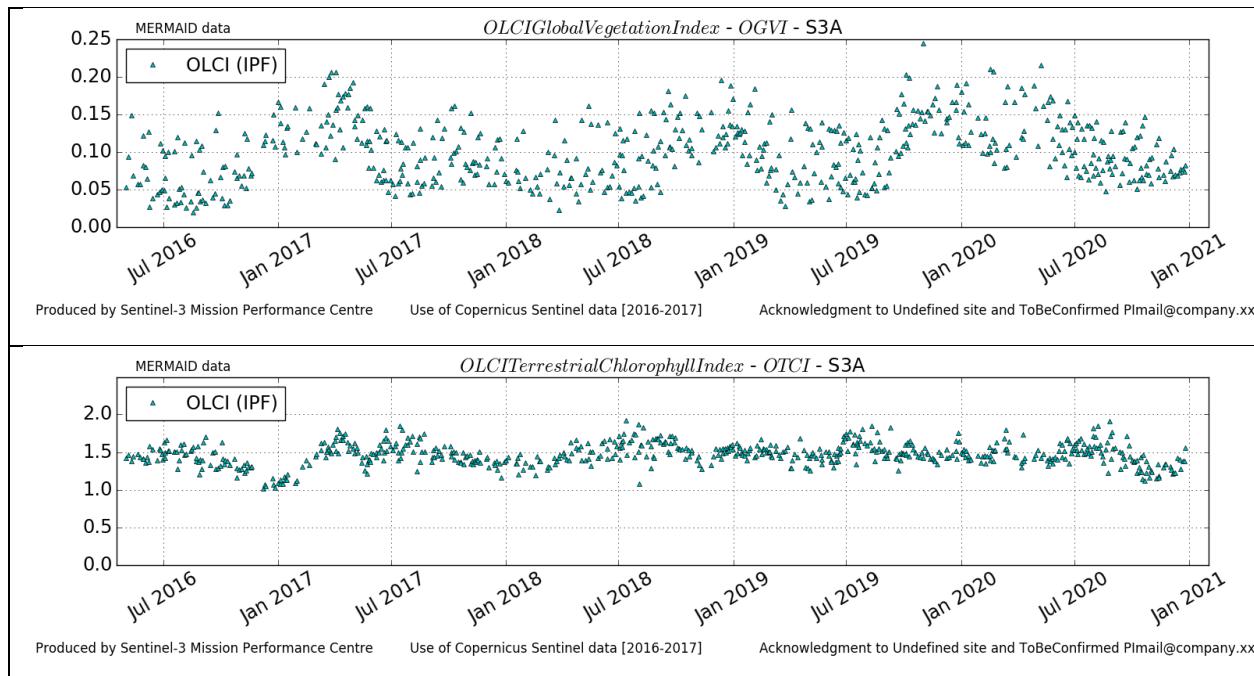


**Figure 83: ITro time series over current report period**

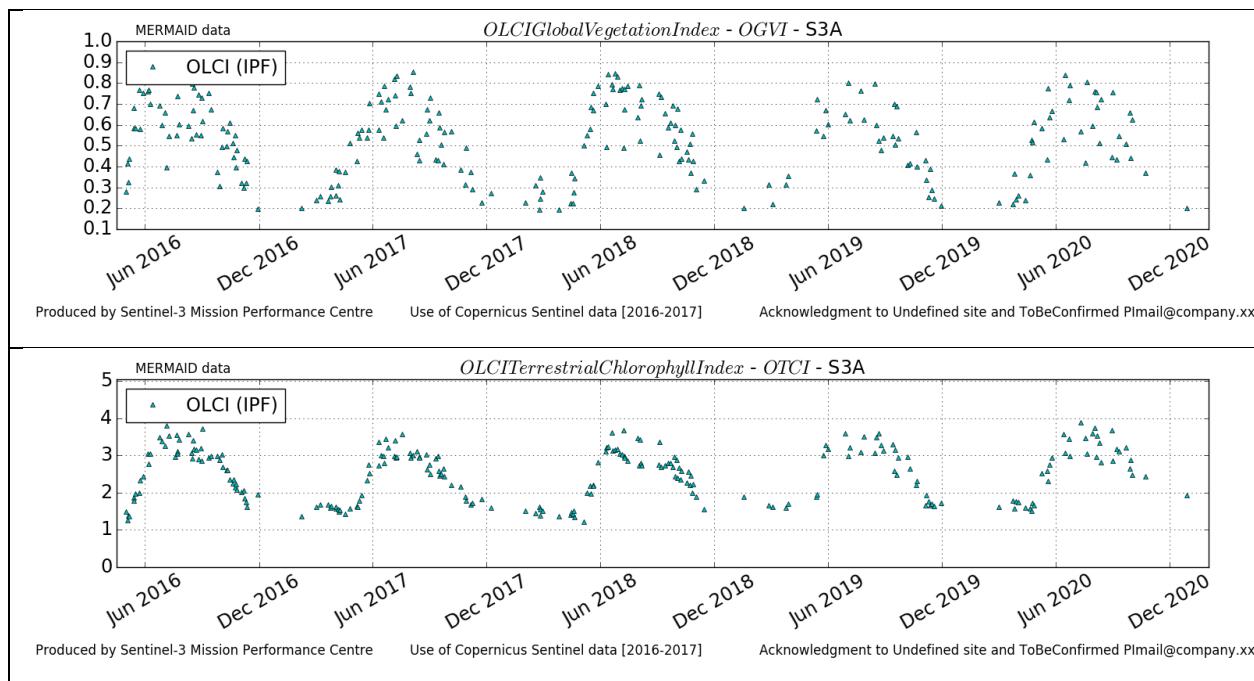


**Figure 84: ITra time series over current report period**

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 77
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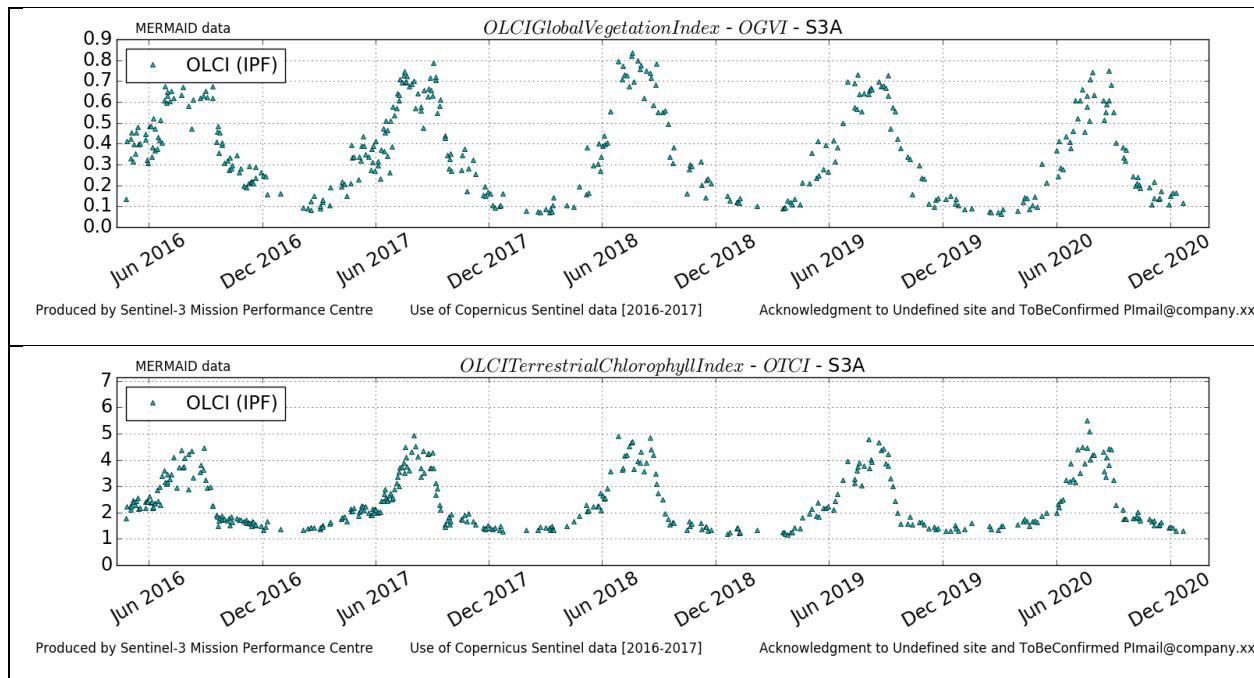


**Figure 85: SPAli time series over current report period**

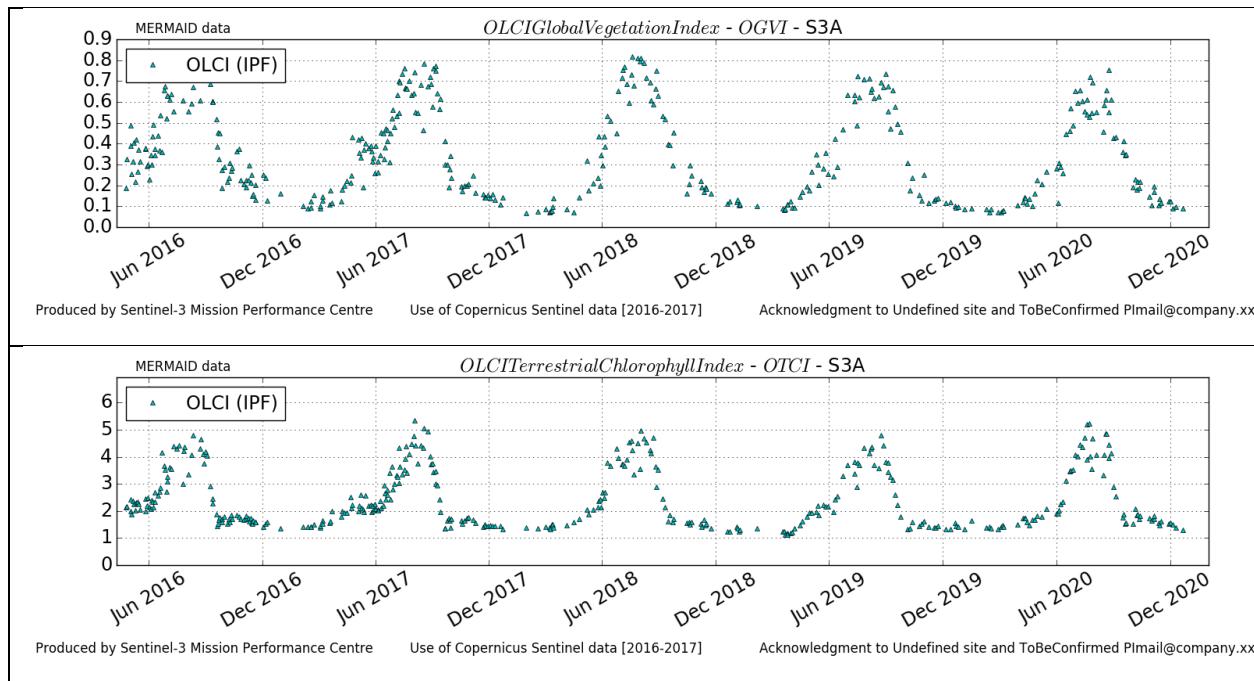


**Figure 86: UKNFO time series over current report period**

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 78
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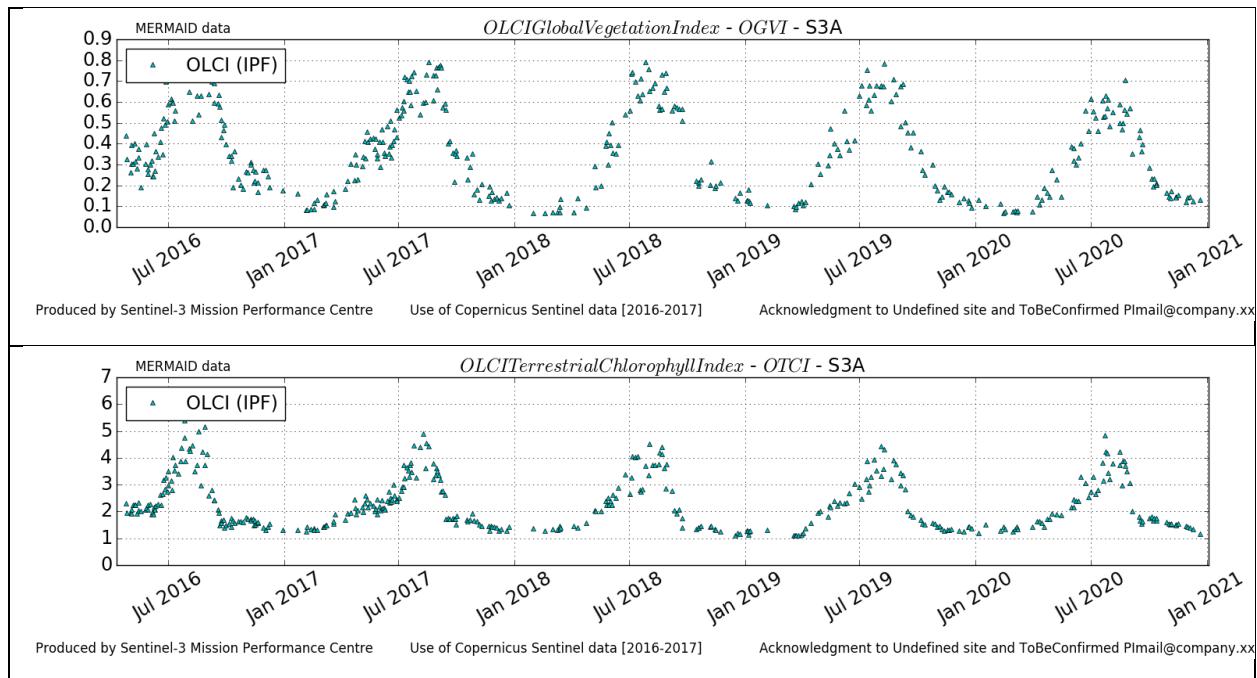


**Figure 87: USNe1 time series over current report period**



**Figure 88: USNe2 time series over current report period**

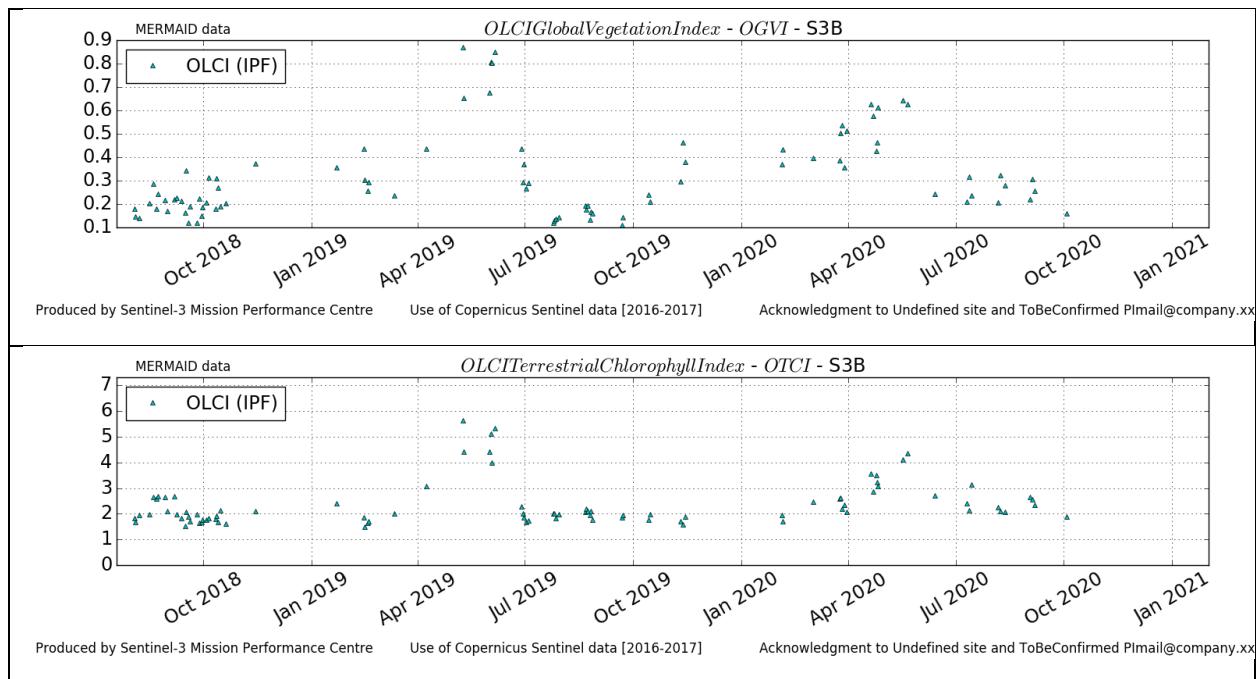
 <b>Sentinel-3 MPC</b> <b>S3 OLCI Cyclic Performance Report</b> <b>S3A Cycle No. 067 – S3B Cycle No. 048</b>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 79
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**Figure 89: USNe3 time series over current report period**

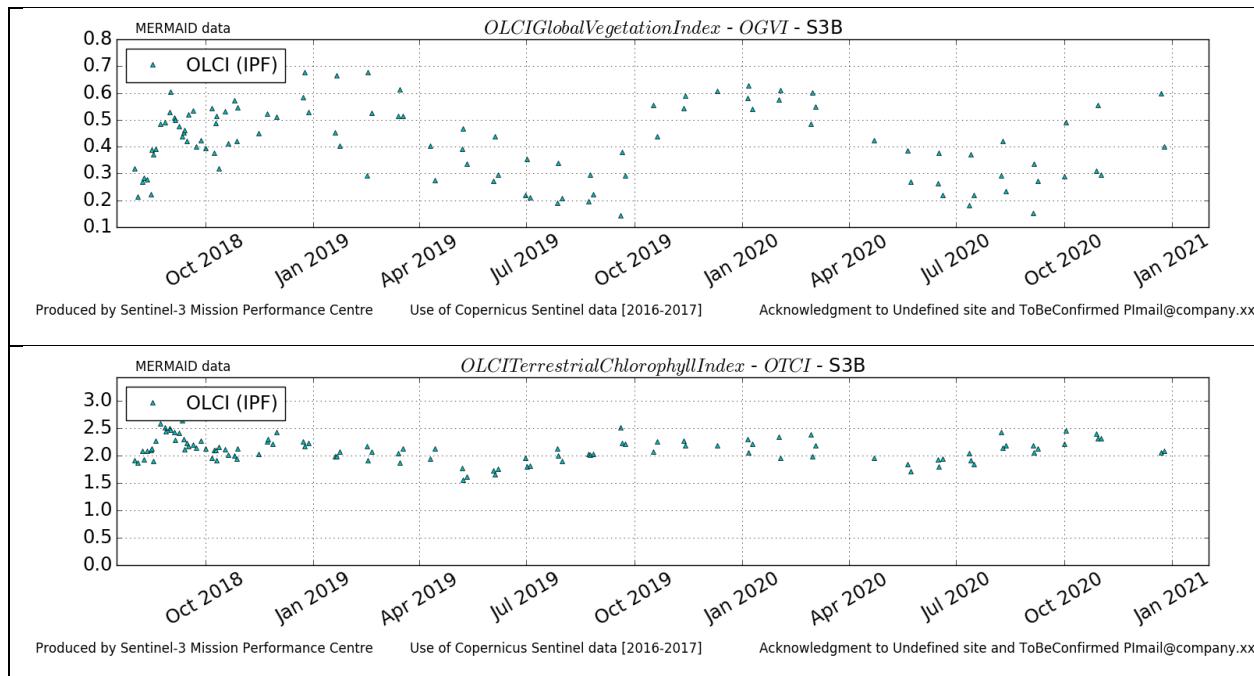
#### 4.1.1.2 OLCI-B

Figure 90 to Figure 99 below present the Core Land Sites OLCI-B time series over the current period.

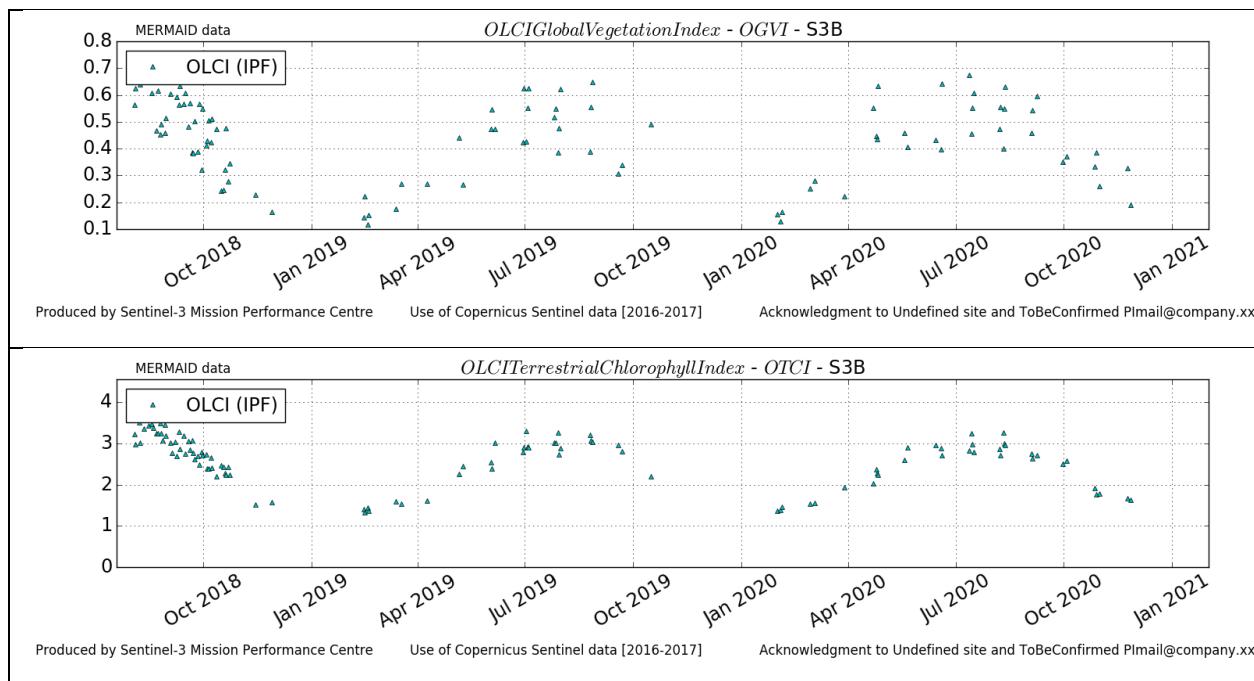


**Figure 90: DeGeb time series over current report period**

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 80
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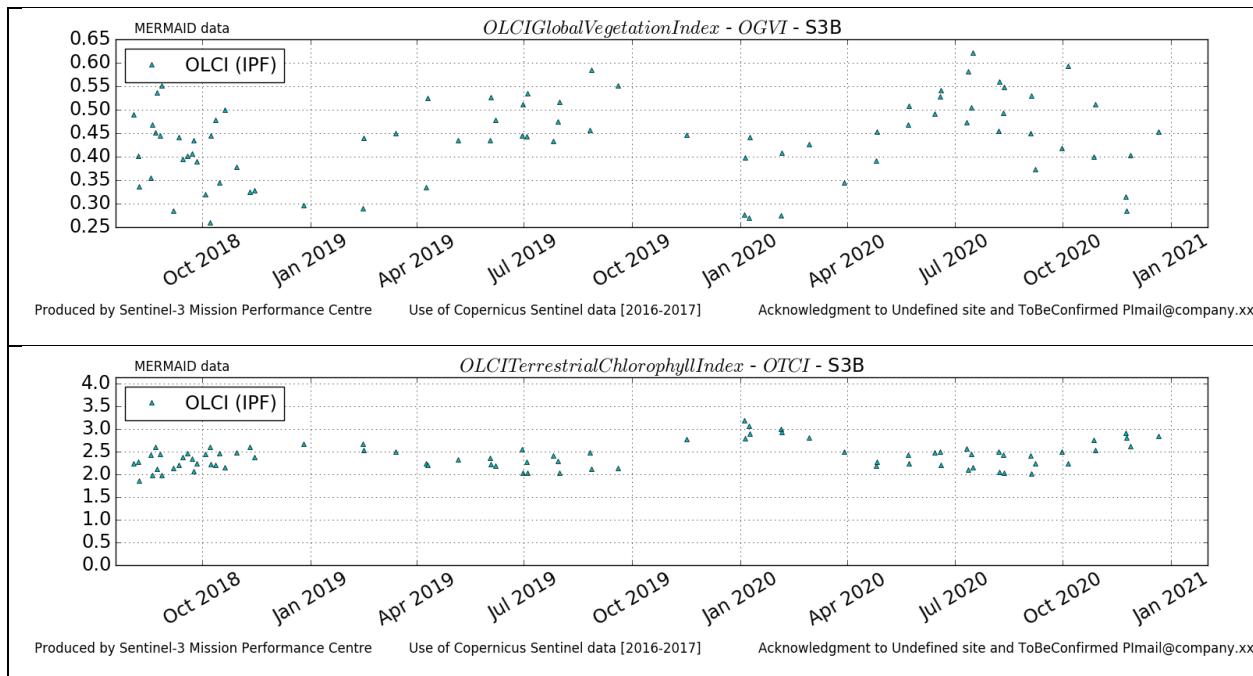


**Figure 91: ITCat time series over current report period**

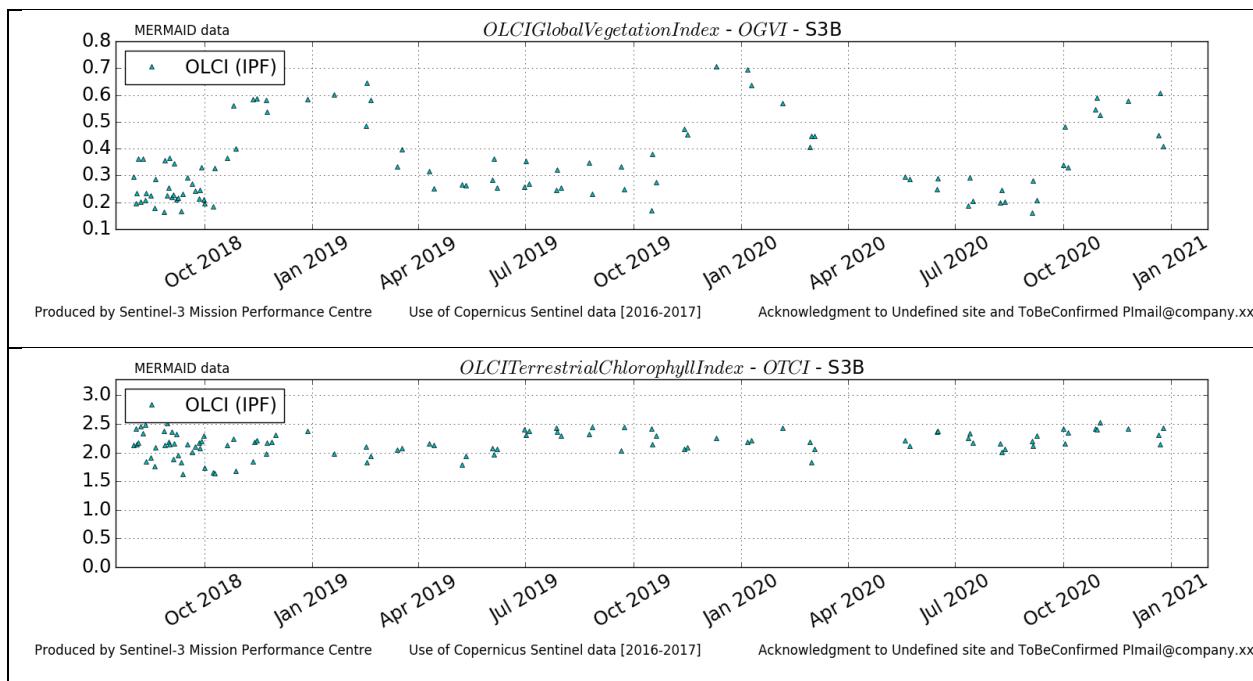


**Figure 92: ITisp time series over current report period**

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 81
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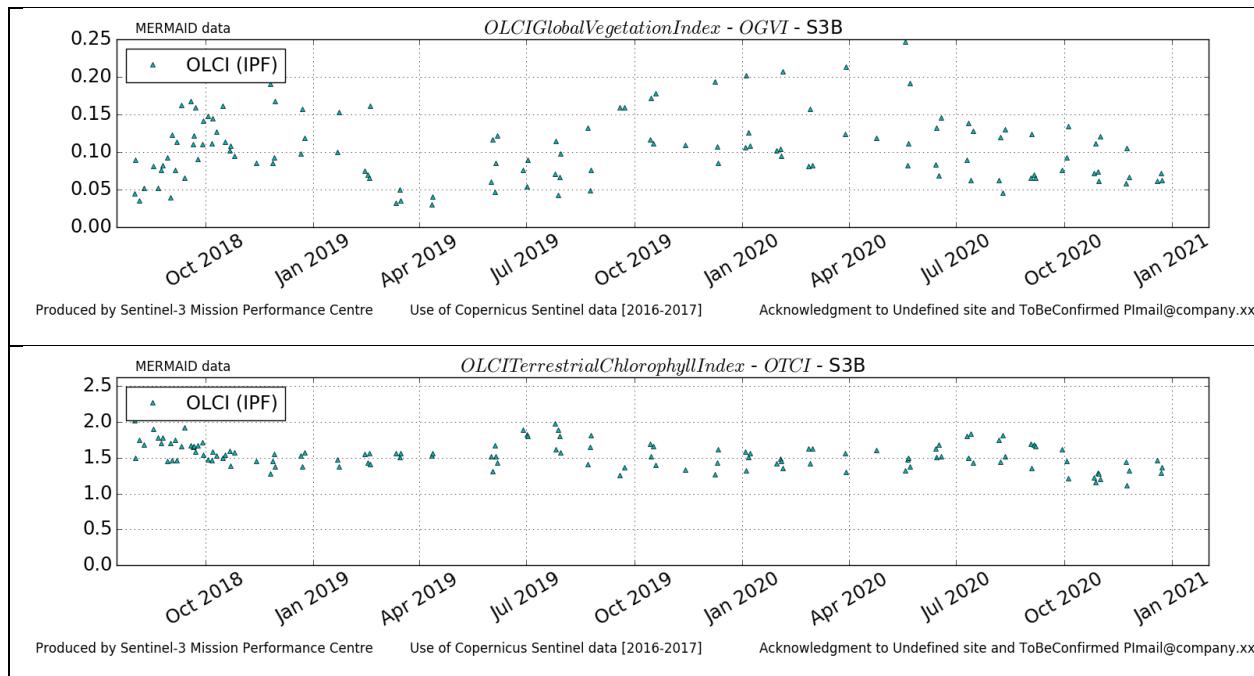


**Figure 93: ITSro time series over current report period**

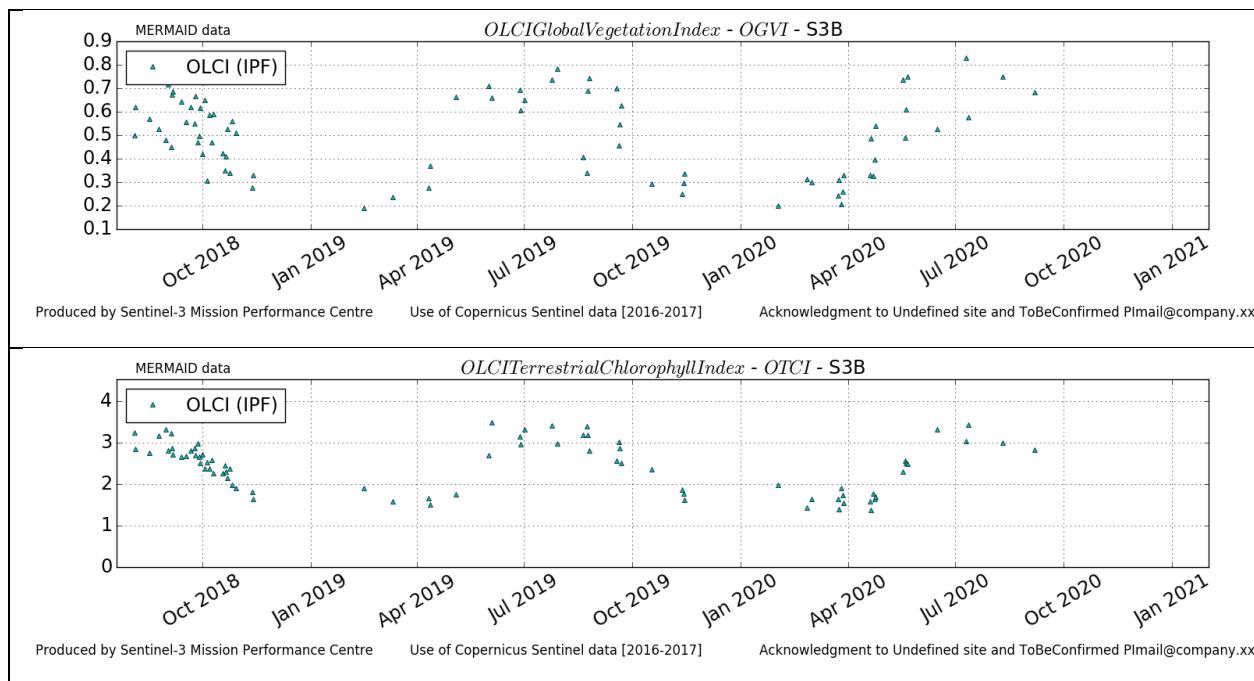


**Figure 94: ITTra time series over current report period**

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 82
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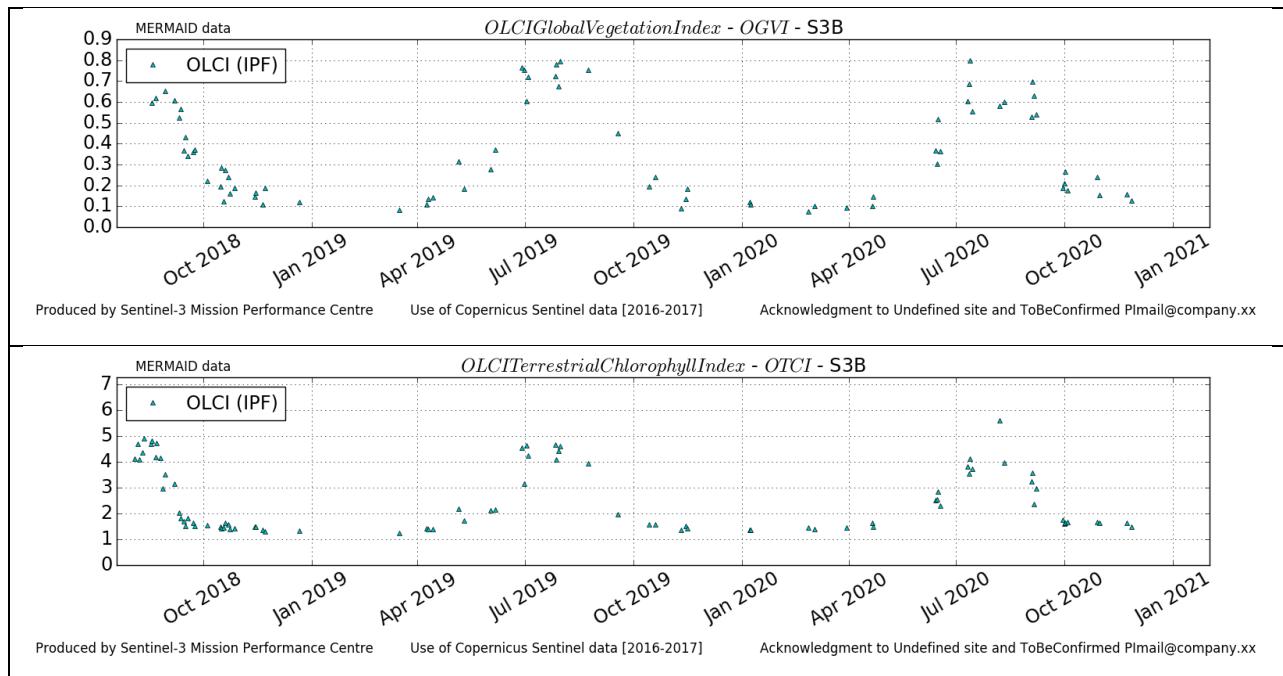


**Figure 95: SPAli time series over current report period**

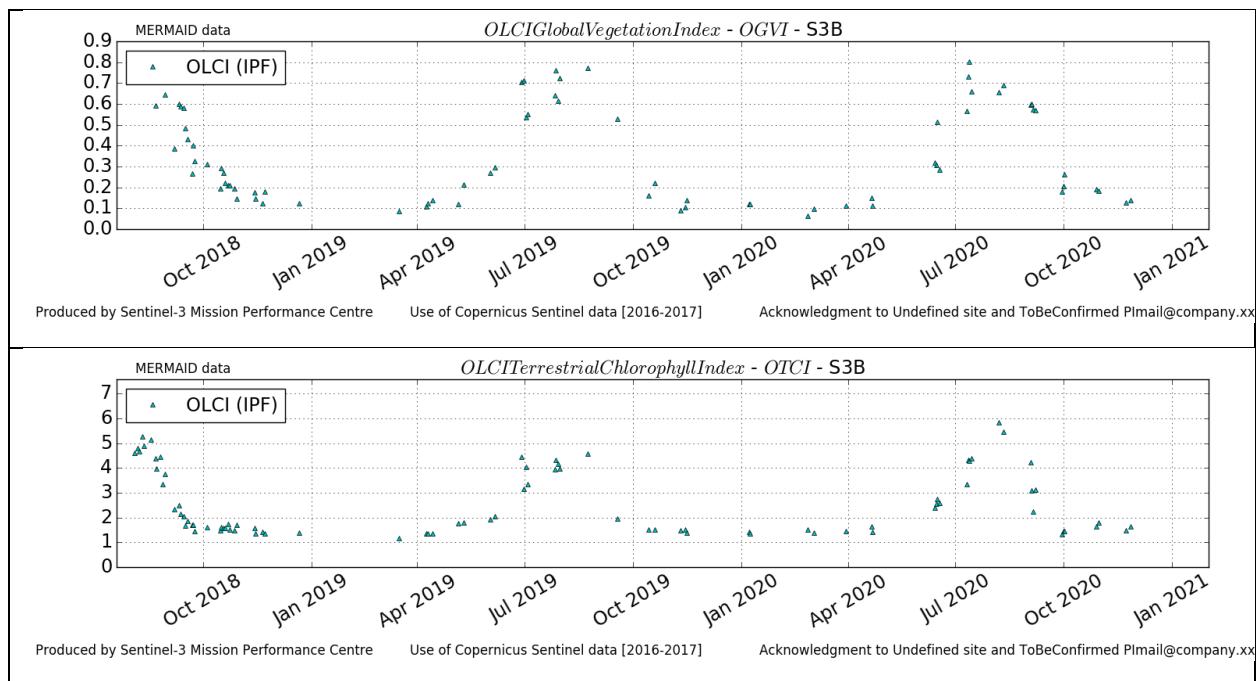


**Figure 96: UKNFO time series over current report period**

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 83
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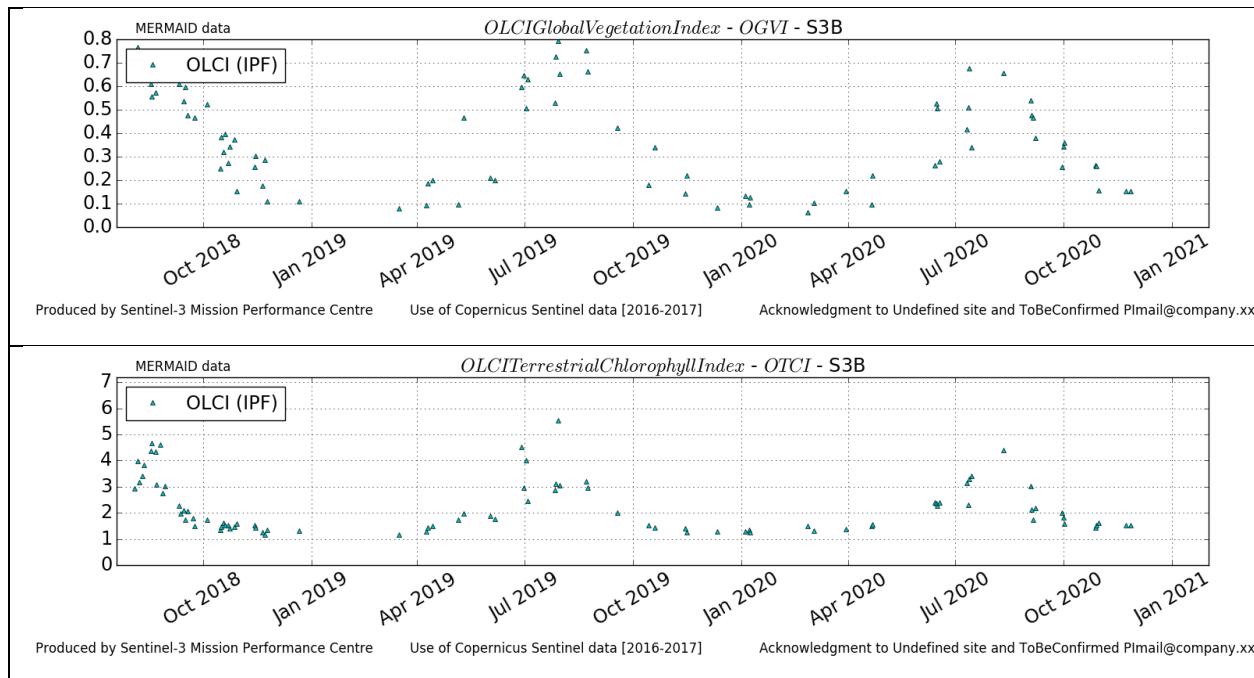


**Figure 97: USNe1 time series over current report period**



**Figure 98: USNe2 time series over current report period**

 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 84
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**Figure 99: USNe3 time series over current report period**

#### 4.1.2 Comparisons with MERIS MGVI and MTCI climatology

This report presents the comparison between MERIS and OLCI land products between 11<sup>th</sup> January 2021 and 9<sup>th</sup> February 2021. The comparison is conducted using 3x3 pixel extractions over 42 established validation sites. The sites are distributed across a range of latitudes and include representative land cover types (Table 4). Statistical measures of the comparison between MERIS and OLCI products are presented in Table 2. In general, there is good agreement between the land products with strong  $R^2$  values and biases around 0. For BE-Brasschaat and FR-EstreesMons the OTCI extractions are higher than recorded in the MTCI archive. There are similar seasonal trajectories and timings shown in the extractions from both products at the following sites reviewed in this monthly report: BE-Brasschaat, DE-Haininch and FR-Estrees-Mons. The monthly mean extractions from all sites are shown in Figure 103. OTCI from S3B shows a strong agreement with the MERIS archive,  $R^2 = 0.89$ ,  $NRMSD < 0.11$  with very low bias, -0.01. OGVI similarly shows a strong agreement with the MERIS archive,  $R^2 = 0.89$ ,  $NRMSD < 0.22$  with a slightly higher bias of 0.06. The performance results are available in the MPC web app ([https://s3mpc-soton.shinyapps.io/s3mpc\\_gui/](https://s3mpc-soton.shinyapps.io/s3mpc_gui/)).

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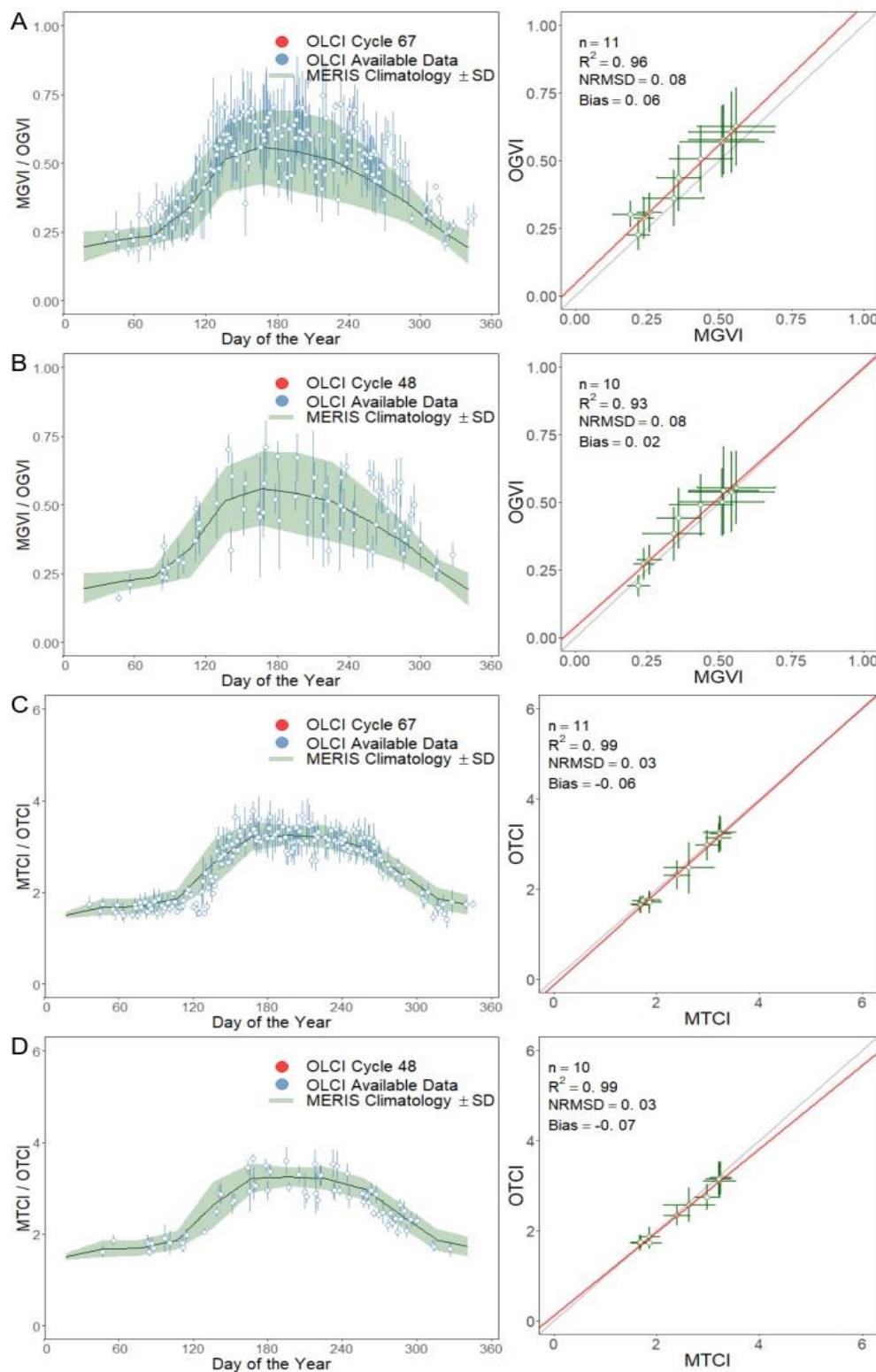
**Table 3: Validation sites analysed in report S3A 65/S3B 46. Land cover data from GLC2000 grouped according to the International Geosphere-Biosphere Programme (IGBP) designations.**

Acronym	Country	Network	Lat	Lon	Land cover
AU-Cape-Tribulation	Australia	TERN-SuperSites, OzFlux	-16.106	145.378 EBF	
AU-Cumberland	Australia	TERN-SuperSites, AusCover/OzFlux	-33.615	150.723 EBF	
AU-Great-Western	Australia	TERN-SuperSites, AusCover/OzFlux	-30.192	120.654 DBF	
AU-Litchfield	Australia	TERN-SuperSites, AusCover/OzFlux	-13.18	130.79 EBF	
AU-Robson-Creek	Australia	TERN-SuperSites, AusCover/OzFlux	-17.117	145.63 EBF	
AU-Rushworth	Australia	TERN-AusCover	-36.753	144.966 DBF	
AU-Tumbarumba	Australia	TERN-SuperSites, AusCover/OzFlux	-35.657	148.152 EBF	
AU-Warra-Tall	Australia	TERN-SuperSites, AusCover/OzFlux	-43.095	146.654 EBF	
AU-Watts-Creek	Australia	TERN-AusCover	-37.689	145.685 EBF	
AU-Wombat	Australia	TERN-SuperSites, AusCover/OzFlux	-37.422	144.094 EBF	
BE-Brasschaat	Belgium	ICOS	51.308	4.52 ENF	
BE-Vielsalm	Belgium	ICOS	50.305	5.998 ENF	
BR-Mata-Seca	Brazil	ENVIRONET	-14.88	-43.973 non-forest	
CA-Mer-Bleue	Canada	National Capitol Comission	45.4	-75.493 non-forest	
CR-Santa-Rosa	Costa Rica	ENVIRONET	10.842	-85.616 EBF	
CZ-Bili-Kriz	Czechia	ICOS	49.502	18.537 ENF	
DE-Haininch	Deutschland	ICOS Associated	51.079	10.453 DBF	
DE-Hones-Holz	Deutschland	ICOS	52.085	11.222 DBF	
DE-Selhausen	Deutschland	ICOS	50.866	6.447 cultivated	
DE-Tharandt	Deutschland	ICOS	50.964	13.567 ENF	
FR-Aurade	France	ICOS	43.55	1.106 cultivated	
FR-Estrees-Mons	France	ICOS Associated	49.872	3.021 cultivated	
FR-Guayaflux	France	ICOS Associated	5.279	-52.925 EBF	
FR-Hesse	France	ICOS	48.674	7.065 DBF	
FR-Montiers	France	ICOS	48.538	5.312 DBF	
FR-Puechabon	France	ICOS	43.741	3.596 ENF	
IT-Casterporziano2	Italy	ICOS	41.704267	12.357293 DBF	
IT-Collelongo	Italy	EFDC	41.849	13.588 DBF	
IT-Lison	Italy	ICOS	45.74	12.75 cultivated	
NE-Loobos	Netherlands	ICOS Associated	52.166	5.744 ENF	
SE-Dahra	Senegal	KIT / UC	15.4	-15.43 cultivated	
UK-Wytham-Woods	United Kingdom	ForestGeo - NPL	51.774	-1.338 DBF	
US-Bartlett	United States	NEON, AERONET	44.064	-71.287 DBF	
US-Central-Plains	United States	NEON, AERONET	40.816	-104.746 non-forest	
US-Harvard	United States	NEON, AERONET	42.537	-72.173 DBF	
US-Moab-Site	United States	NEON, AERONET	38.248	-109.388 non-forest	
US-Mountain-Lake	United States	NEON, AERONET	37.378	-80.525 DBF	
US-Oak-Rige	United States	NEON, AERONET	35.964	-84.283 DBF	
US-Ordway-Swisher	United States	NEON, AERONET	29.689	-81.993 ENF	
US-Smithsonian	United States	NEON, AERONET	38.893	-78.14 DBF	
US-Steigerwaldt	United States	NEON	45.509	-89.586 DBF	
US-Talladega	United States	NEON, AERONET	32.95	-87.393 ENF	

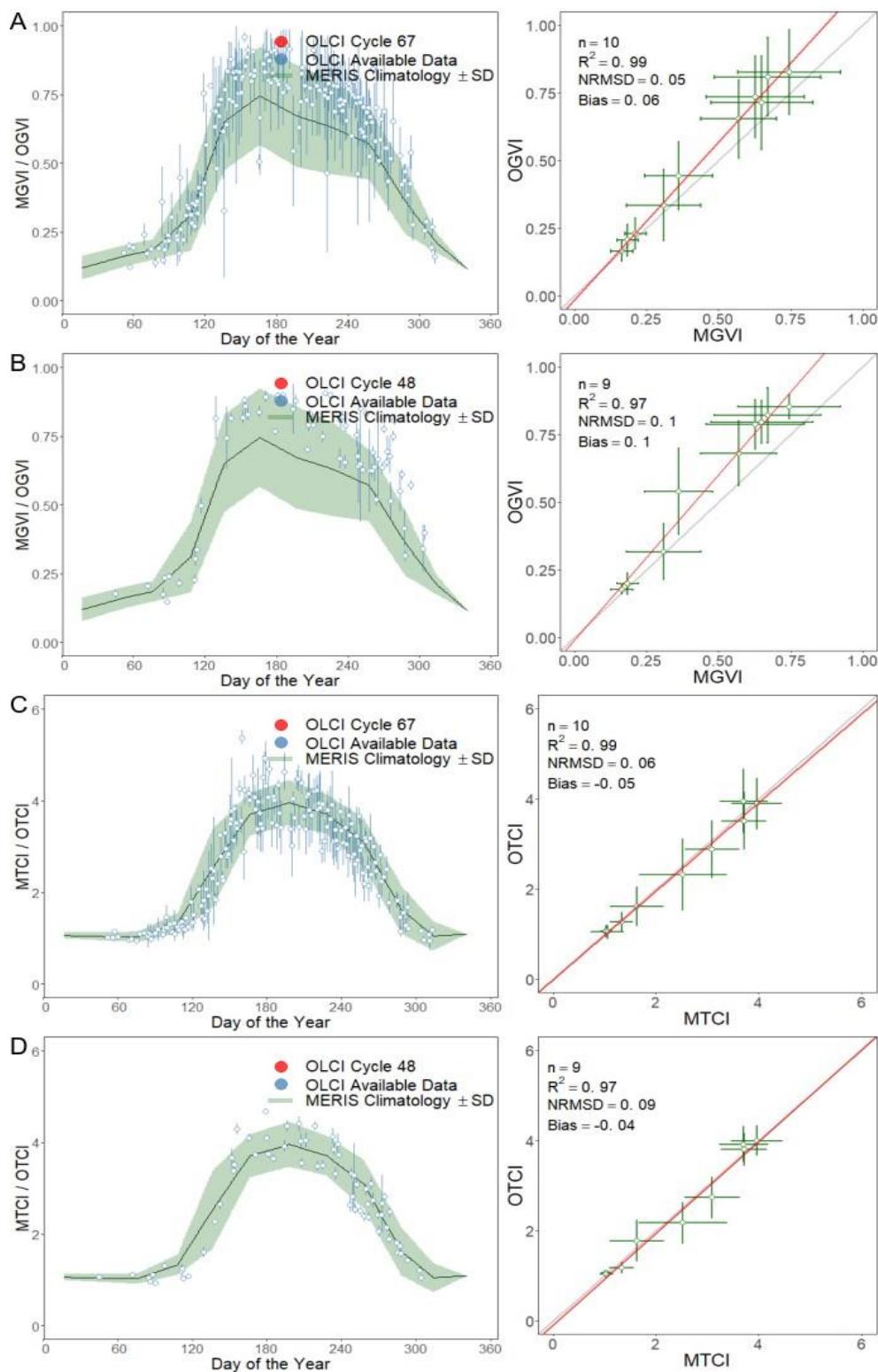
 <p><b>Sentinel-3 MPC</b></p> <p><b>S3 OLCI Cyclic Performance Report</b></p> <p><b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 86
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**Table 4: Comparison statistics between monthly S3A/B OLCI land products and MERIS archive data.**

Site Acronym	S3A									S3B										
	OTCI vs MTCI			OGVI vs MGVI			OTCI vs MTCI			OGVI vs MGVI										
	n	R2	NRMSD	Bias	n	R2	NRMSD	Bias	n	R2	NRMSD	Bias	n	R2	NRMSD	Bias	n	R2	NRMSD	Bias
AU-Cape-Tribulation	12	0.8	0.04	-0.11	12	0.27	0.06	0.15	11	0.75	0.04	-0.2	11	0.25	0.19	0.1	11	0.45	0.13	0.09
AU-Cumberland	12	0.9	0.02	0.01	12	0.46	0.07	0.08	12	0.46	0.05	0.02	12	0.75	0.1	0.03	12	0.91	0.06	0.02
AU-Great-Western	12	0.97	0.02	0.13	12	0.96	0	0.04	12	0.96	0.02	0.13	12	0.61	0.08	0.01	12	0.65	0.13	0.12
AU-Litchfield	12	0.93	0.02	-0.01	12	0.96	0.06	0.04	12	0.61	0.08	0.01	12	0.31	0.06	-0.14	12	0.33	0.08	0.04
AU-Robson-Creek	12	0.93	0.03	-0.05	12	0.87	0.04	0.11	12	0.81	0.05	-0.17	12	0.52	0.08	0.16	12	0.2	0.1	0.03
AU-Rushworth	12	0.82	0.04	0.13	12	0.2	0.08	0.09	12	0.35	0.1	-0.33	9	0.22	0.35	0.01	12	0.05	0.2	0.08
AU-Tumbarumba	12	0.83	0.06	0.33	12	0.47	0.1	0.11	12	0.68	0.06	0.02	12	0.79	0.03	-0.1	12	0.04	0.11	0.04
AU-Warra-Tall	12	0.64	0.07	-0.04	12	0.25	0.14	0.05	10	0.99	0.03	-0.07	10	0.77	0.07	0.03	10	0.83	0.17	0.1
AU-Watts-Creek	12	0.63	0.05	0.03	12	0.5	0.06	0.1	12	0.89	0.07	-0.04	10	0.92	0.08	0.02	12	0.98	0.07	0.04
AU-Wombat	12	0.9	0.03	0.13	12	0.34	0.08	0.08	12	0.93	0.08	-0.03	12	0.42	0.27	0.06	12	0.22	0.3	0.02
BE-Brasschaat	11	0.99	0.03	-0.06	11	0.96	0.08	0.06	8	0.92	0.04	-0.09	8	0.86	0.1	0.07	9	0.97	0.1	0.1
BE-Vielsalm	11	0.95	0.03	0.08	11	0.98	0.06	0.1	10	0.97	0.09	-0.04	10	0.94	0.12	0.01	10	0.97	0.09	0.11
BR-Mata-Seca	12	0.98	0.04	-0.01	12	0.99	0.05	0.02	12	0.77	0.11	-0.18	12	0.22	0.3	0.02	10	0.97	0.09	0.11
CA-Mer-Bleue	10	0.95	0.06	-0.01	10	0.98	0.06	0.03	10	0.99	0.02	-0.19	10	0.86	0.16	0.08	10	0.96	0.08	0
CR-Santa-Rosa	12	0.98	0.04	0.1	12	0.59	0.21	0.12	12	0.93	0.08	-0.03	12	0.42	0.27	0.06	12	0.22	0.3	0.02
CZ-Bili-Kriz	10	0.85	0.04	0.04	10	0.96	0.07	0.07	8	0.92	0.04	-0.09	8	0.86	0.1	0.07	9	0.97	0.1	0.1
DE-Haininch	10	0.99	0.06	-0.05	10	0.99	0.05	0.06	9	0.97	0.09	-0.04	9	0.97	0.12	0.01	10	0.94	0.12	0.01
DE-Hones-Holz	10	0.99	0.03	0.06	10	0.99	0.05	0.05	10	0.97	0.08	-0.11	10	0.94	0.12	0.01	10	0.97	0.09	0.11
DE-Selhausen	12	0.88	0.09	-0.03	12	0.52	0.18	0.06	12	0.77	0.11	-0.18	12	0.22	0.3	0.02	12	0.97	0.09	0.11
DE-Tharandt	11	0.95	0.05	-0.04	11	0.96	0.09	0.09	10	0.99	0.02	-0.19	10	0.86	0.16	0.08	11	0.9	0.11	0.05
FR-Aurade	12	0.81	0.11	0.09	12	0.85	0.16	0.14	11	0.88	0.08	0.03	11	0.86	0.16	0.08	11	0.88	0.1	0.05
FR-Estrees-Mons	12	0.94	0.07	0.06	12	0.9	0.11	0.06	11	0.84	0.13	0.15	11	0.9	0.11	0.05	11	0.88	0.19	0.08
FR-Guayaflux	12	0.74	0.03	-0.17	12	0.11	0.1	0.17	11	0.72	0.03	-0.24	11	0	0.2	0.24	11	0.83	0.19	0.08
FR-Hesse	12	0.99	0.03	0.07	12	0.98	0.04	0.07	11	0.96	0.07	0.1	11	0.83	0.19	0.08	11	0.9	0.17	0.09
FR-Montiers	12	0.99	0.03	-0.12	12	0.98	0.06	0.04	11	0.95	0.09	-0.09	11	0.88	0.09	0.06	12	0.88	0.09	0.06
FR-Puechabon	12	0.84	0.03	-0.05	12	0.89	0.06	0.09	12	0.93	0.03	0.05	12	0.54	0.1	0.05	12	0.97	0.11	0.03
IT-Casterporziano2	12	0.97	0.02	-0.1	12	0.87	0.03	0.07	12	0.88	0.04	-0.07	12	0.54	0.1	0.05	12	0.97	0.11	0.03
IT-Collelongo	12	0.98	0.05	0	12	0.99	0.05	0.02	12	0.92	0.13	0.05	12	0.97	0.11	0.03	12	0.94	0.1	0.08
IT-Lison	12	0.98	0.03	-0.04	12	0.98	0.07	0.09	12	0.93	0.06	-0.05	12	0.94	0.1	0.08	12	0.88	0.1	0.03
NE-Loobos	12	0.71	0.07	0.06	12	0.89	0.1	0.04	12	0.57	0.07	0.04	12	0.97	0.11	0.03	12	0.95	0.14	0.02
SE-Dahra	12	0.76	0.04	-0.04	12	0.9	0.43	0.01	11	0.26	0.1	-0.07	11	0.88	0.52	0.02	12	0.95	0.12	0.04
US-Bartlett	12	0.97	0.04	-0.02	12	0.97	0.1	0.06	12	0.89	0.08	-0.05	12	0.95	0.12	0.04	12	0.76	0.21	0
US-Central-Plains	11	0.72	0.03	-0.05	11	0.89	0.21	0.01	10	0.47	0.05	-0.06	10	0.76	0.21	0	11	0.95	0.14	0.02
US-Harvard	12	0.99	0.03	-0.16	12	0.97	0.09	0.05	11	0.98	0.05	-0.22	11	0.95	0.14	0.02	12	0.99	0.05	0.05
US-Moab-Site	12	0.75	0.02	0.05	12	0.09	0.22	0.02	11	0.86	0.02	0.02	11	0.05	0.22	0.03	12	0.05	0.22	0.03
US-Mountain-Lake	12	0.99	0.04	-0.23	12	1	0.05	0.03	11	0.96	0.07	-0.41	11	0.99	0.05	0	12	0.99	0.05	0
US-Oak-Rige	12	0.99	0.03	-0.05	12	0.98	0.07	0.05	12	0.98	0.05	-0.07	12	0.99	0.05	0.05	12	0.99	0.05	0.05
US-Ordway-Swisher	12	0.51	0.03	0.02	12	0.94	0.03	0.09	12	0.12	0.04	0	12	0.7	0.07	0.06	12	0.97	0.09	0.01
US-Smithsonian	11	0.99	0.04	-0.2	11	0.99	0.07	0.04	9	0.99	0.06	-0.22	9	0.97	0.09	0.01	8	0.99	0.05	0
US-Steigerwaldt	12	0.99	0.03	0.03	12	0.99	0.08	0	8	0.95	0.07	-0.03	8	0.99	0.05	0	12	0.96	0.1	0.06
US-Talladega	12	0.98	0.02	-0.12	12	0.98	0.05	0.07	12	0.92	0.04	-0.18	12	0.96	0.1	0.06	12	0.97	0.09	0.01



**Figure 100** Time-series OGVI and OTCI and corresponding scatterplot of monthly mean for site BE-Brasschaat, Belgium, land cover Needle-leaved, evergreen. A and C represent S3A; B and D represent S3B.

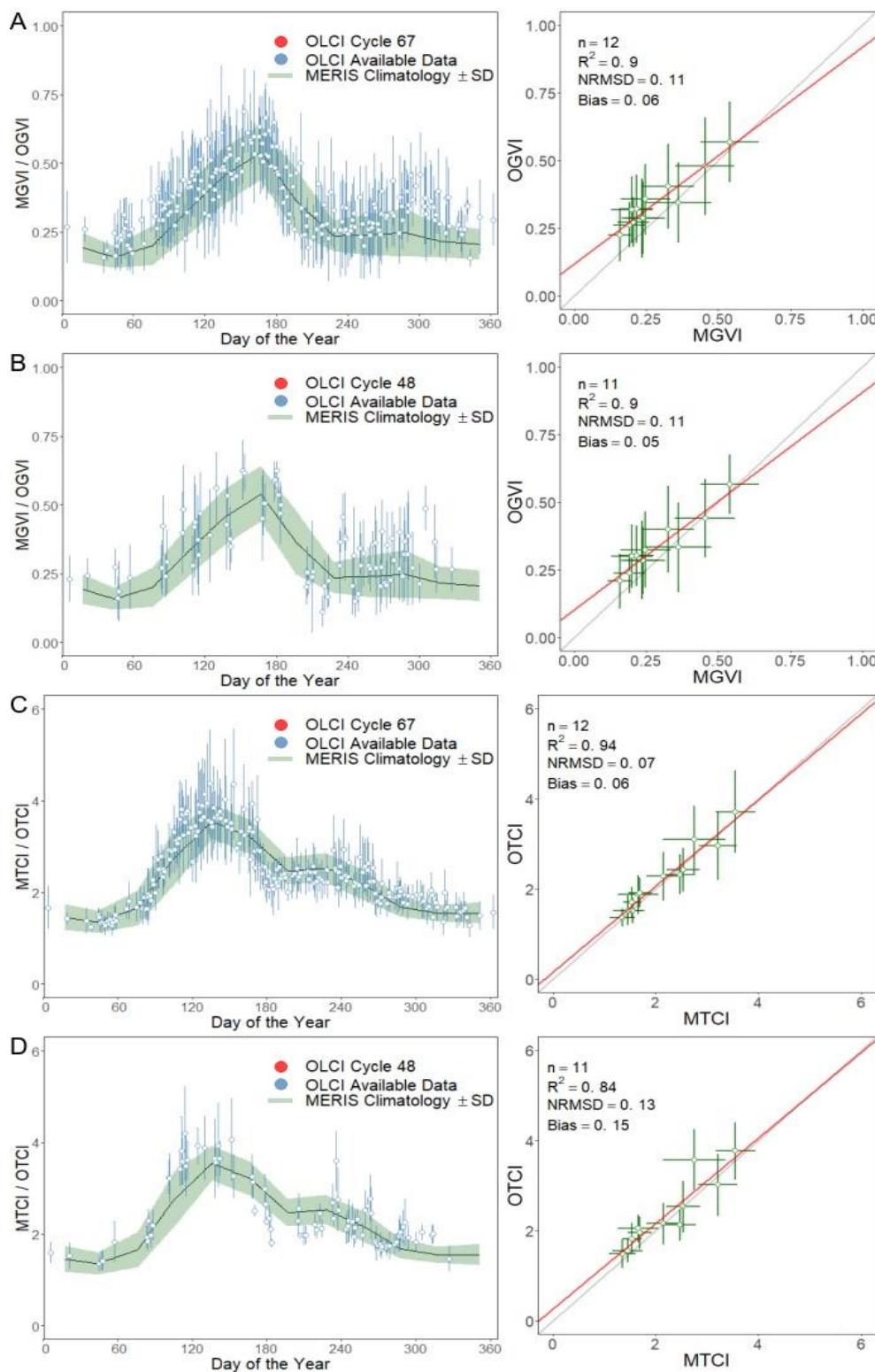


**Figure 101: Time-series OGVI and OTCI and corresponding scatterplot of monthly mean for site DE-Haininch, Deutschland, land cover Broadleaved, deciduous, closed. A and C represent S3A; B and D represent S3B.**



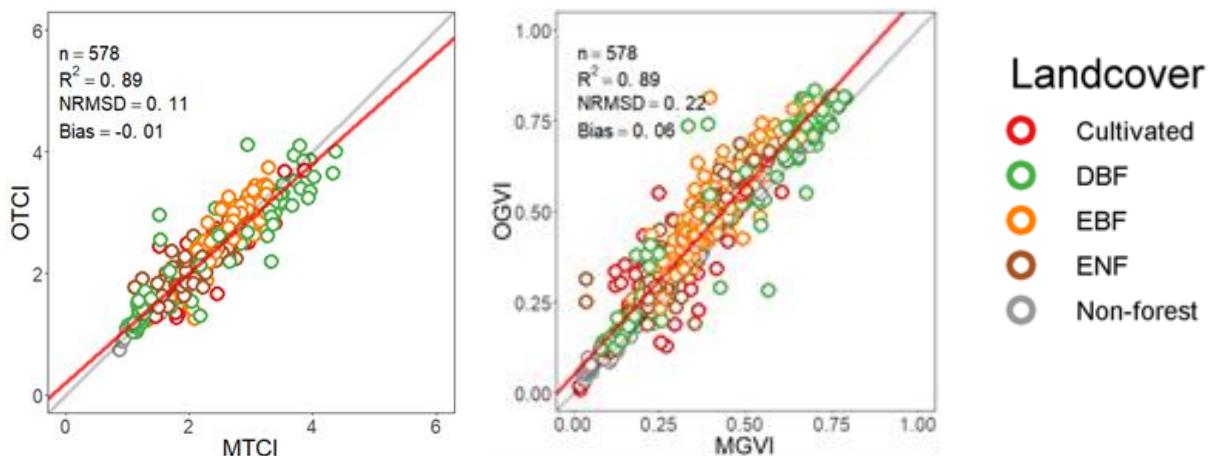
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**S3 OLCI Cyclic Performance Report**  
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**Figure 102:** Time-series OGVI and OTCI and corresponding scatterplot of monthly mean for site FR-Estrees-Mons, France, land cover Cultivated and managed areas. A and C represent S3A; B and D represent S3B.

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**Figure 103: Comparison of OTCI-MTCI (a) and OGVI-MGVI (b).** Points in the scatterplot represent the monthly mean of all available S3A and MERIS archive over 55 validation sites. Red and grey lines represent the modelled and 1:1 lines respectively. The scatterplots are updated to include extractions from cycle S3A 66.

## 4.2 [OLCI-L2LRF-CV-410 & OLCI-L2LRF-CV-420] – Cloud Masking & Surface Classification for Land Products

There has been no new result during the cycle. Last figures (cycle 065/046) are considered valid.

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## 5 Level 2 Water products validation

### 5.1 [OLCI-L2-CV-210, OLCI-L2-CV-220] – Vicarious calibration of the NIR and VIS bands

Results are not further discussed here as SVC is now implemented directly by EUMETSAT.

### 5.2 [OLCI-L2WLR-CV-300, OLCI-L2WLR-CV-310, OLCI-L2WLR-CV-32, OLCI-L2WLR-CV-330, OLCI-L2WLR-CV-340, OLCI-L2WLR-CV-350, OLCI-L2WLR-CV-360 and OLCI-L2WLR-CV-370] – Level 2 Water-leaving Reflectance product validation.

#### 5.2.1 Acknowledgements

S3-MPC acknowledges all PIs mentioned below and their respective institutions for their valuable contribution to the validation of OLCI L2 water products with a special emphasis on AERONET-OC PIs for their unique contribution to NRT data validation and a special mention to Giuseppe Zibordi maintaining and providing data over 5 ground stations. AERONET-OC is indeed from far the largest contributor of Fiducial Reference Measurements for routine quantitative data validation.

❖ AERONET-OC

- **AAOT, Galata, Gloria, GDT, HLH, Irbe Lighthouse:** Giuseppe Zibordi, Joint Research Centre of the European Commission
- **Ieodo, Socheongcho:** Young-Je Park & Hak-Yeol You, Korean Institute of Ocean Science and Technology & Korea Hydrographic and Oceanographic Administration
- **LISCO:** Sam Ahmed, Alex Gilerson, City College of New York
- **MVCO:** Hui Feng and Heidi Sosik, Ocean Process Analysis Laboratory (OPAL), Woods Hole Oceanographic Institution
- **Thornton:** Dimitry Van der Zande, RBINS/OD Nature
- **Lucinda:** Thomas Schroeder, Integrated Marine Observing System, IMOS
- **USC\_SEAPRISM:** Burton Jones and Curtiss Davis, University Southern California | USC, Oregon State University
- **WaveCIS:** Alan Weidemann, Bill Gibson, Robert Arnone, University of Southern MS, Coastal Studies Inst – LSU, Naval Research Laboratory
- **Ariake tower:** Joji Ishizaka, Kohei Arai, Nagoya University & Saga University
- **Blyth NOAH:** Rodney Forster, University of Hull, UK
- **Casablanca platform:** Giuseppe Zibordi, Marco Malone, Joint Research Centre of the European Commission

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- Grizzly bay, Lake Okeechobee, South Greenbay: NimaPahlevan, NASA
- **Lake Erie:** Tim Moore, Steve Ruberg, Menghua Wang, University of New Hampshire & NOAA
- ❖ BOUSSOLE
  - David Antoine, Enzo Vellucci (Curtin University, Perth & Laboratoire d'Oceanographie de Villefranche, CNRS)
- ❖ MOBY
  - Kenneth Voss & Carol Johnson (University of Miami & NIST)
- ❖ SLGO
  - Simon Belanger, Thomas Jaegler & Peter Galbraith (Arctus, Inc & Department of fisheries and Ocean Canada)
- ❖ AWI
  - Astrid Bracher (Alfred-Wegener-Institut)
- ❖ IMOS
  - Thomas Schroeder (Integrated Marine Observing System, IMOS)
- ❖ BSH
  - Holger Klein (Bundesamt für Seeschifffahrt und Hydrographie, BSH)
- ❖ Proval
  - Edouard Leymarie (Laboratoire d'Oceanographie de Villefranche, CNRS)

## 5.2.2 OLCI-A

### Activities done

- ❖ The focus for this time period has been on the rolling archive Non Time Critical (NT) data until the 8<sup>th</sup> of February 2021 .
- ❖ Current reporting period is hereafter compared to the reprocessed archive covering the April 2016 to November 2017 period. No issues are reported neither in the extraction process nor in OLCI data.
- ❖ All extractions and statistics have been regenerated on the current rolling archive availability including all the extraction since July 2017. The available matchups therefore represent over almost three years of operation.
- ❖ At best 481 and 487 matchups at 490 and 560nm respectively are useful for this time period. OLCI's performances remain nominal.

	<p style="text-align: center;"><b>Sentinel-3 MPC</b>  <b>S3 OLCI Cyclic Performance Report</b>  <b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 93
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## Overall Water-leaving Reflectance performance

### Scatter plots and Performance Statistics

Figure 104 to Figure 106 below present the scatterplots and statistics of OLCI FR versus in situ reflectance. Two time periods are considered:

- ❖ The reprocessed archive covering the April 2016 to November 2017 time period
- ❖ The current reporting period computed on the NT dataset.

The current reporting period statistics are in line with the reprocessed dataset.

Table 5 below summarises the statistics over the reprocessing period while Table 6 provides the same figures for the NT rolling Archive over July 2017 – present. The latter statistics are almost within the requirements (5% accuracy in the blue/green bands) – as demonstrated by the RPD values between 2 and 4.8%, with the noticeable exception of 400 and 412 nm with 9-10%. Performances over the current period appear a bit lower than for the calibration period (except at 412 nm), but of the same order of magnitude.



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### S3 OLCI Cyclic Performance Report S3A Cycle No. 067 – S3B Cycle No. 048

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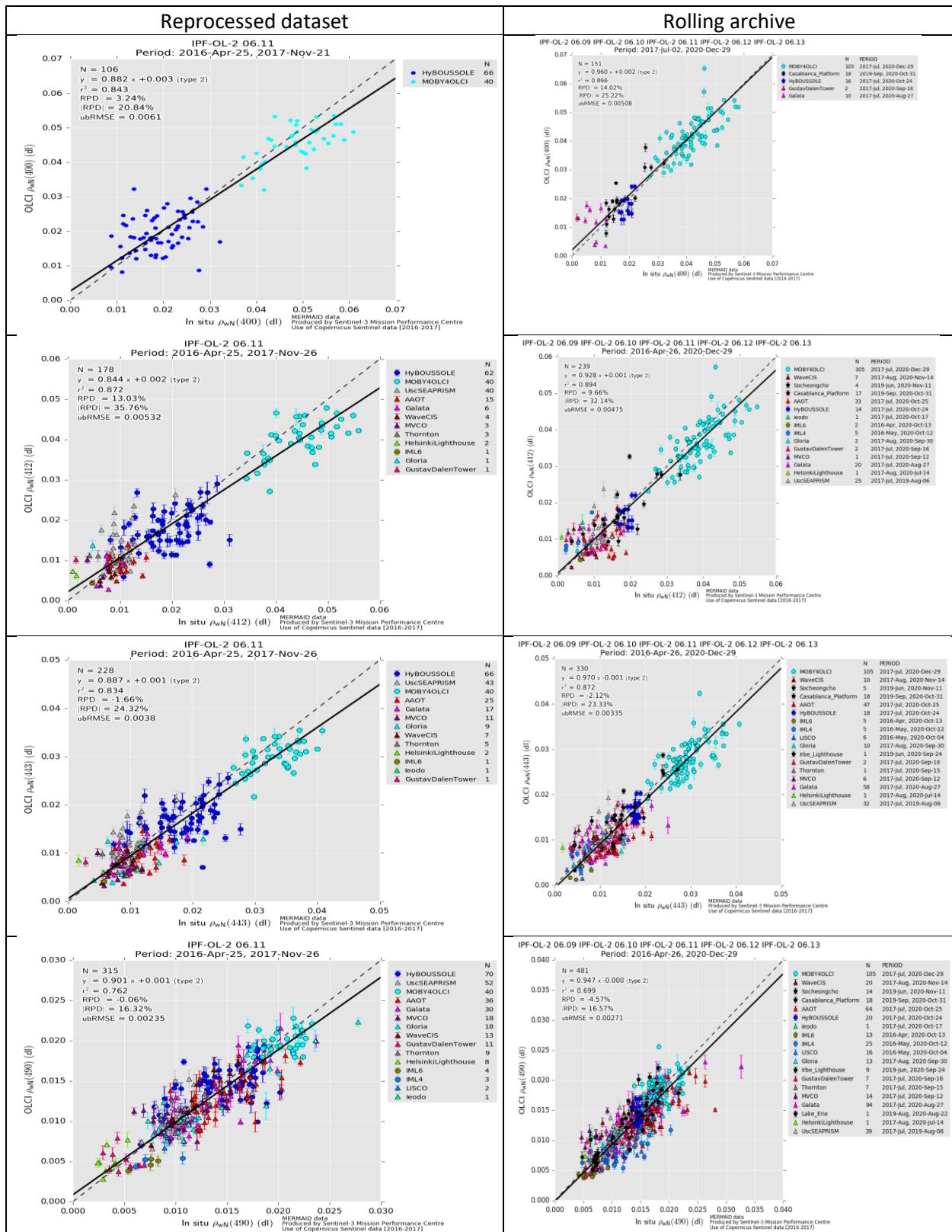


Figure 104: Scatter plots of OLCI-A versus in situ radiometry (FR data). Reprocessed dataset (left), all available data for the current time period (right), Oa1 to Oa4 (400 to 490 nm)



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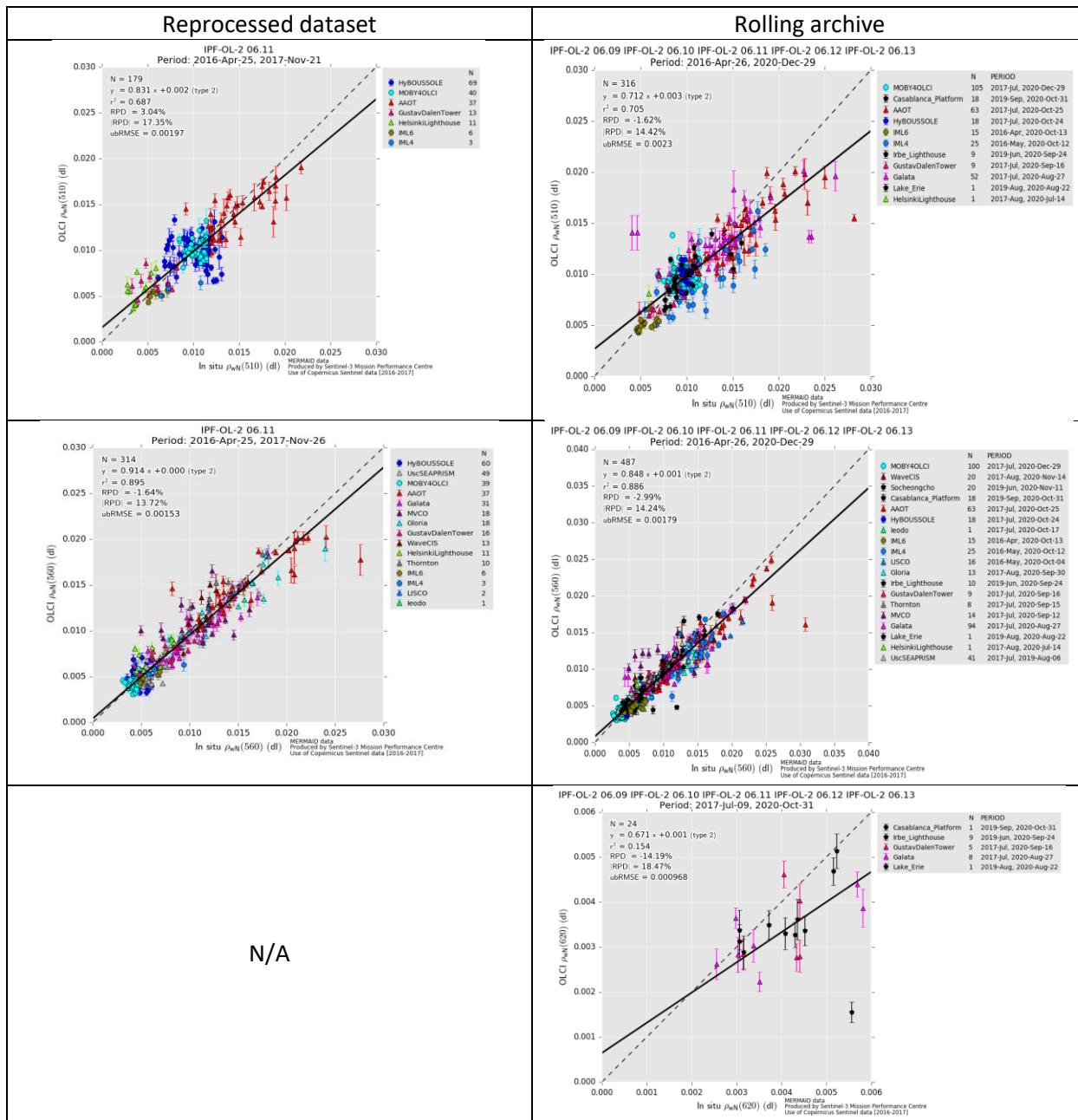
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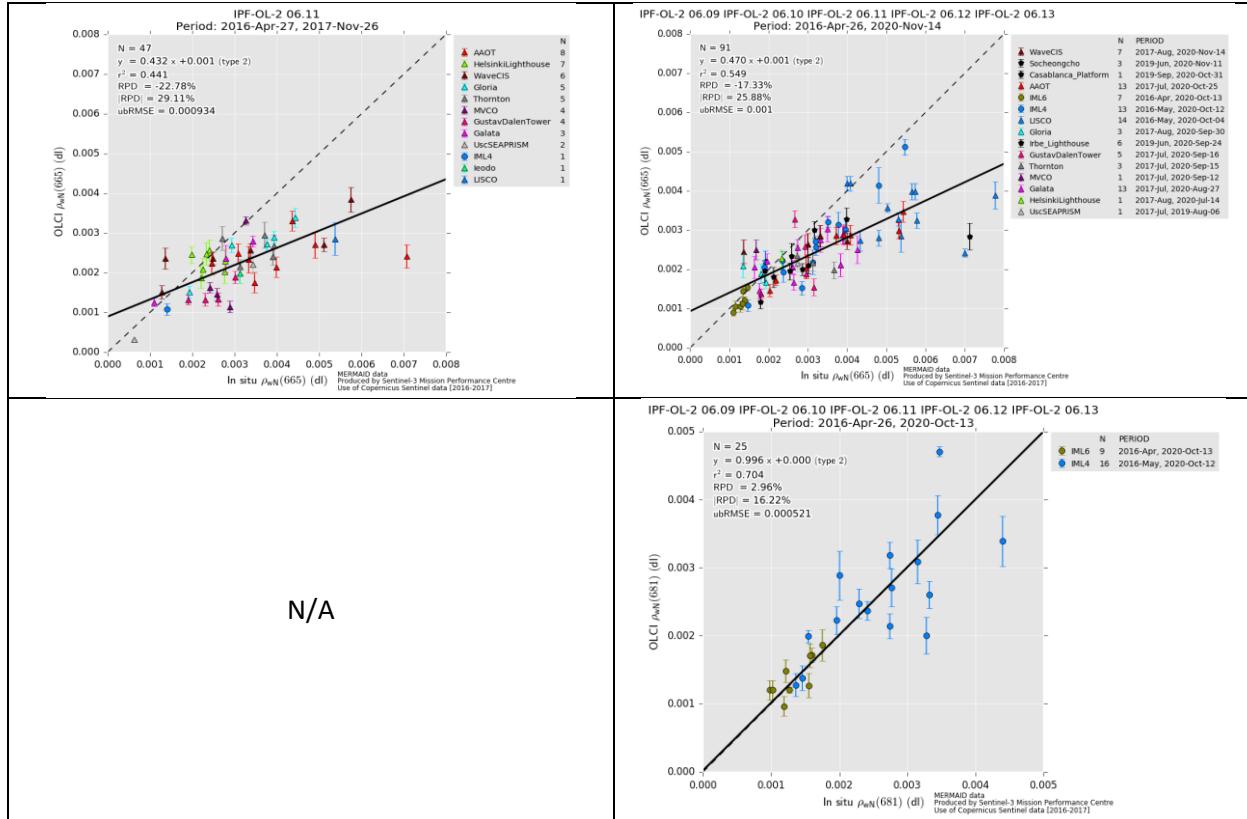
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**Figure 105: Scatter plots of OLCI-A versus in situ radiometry (FR data). Reprocessed dataset (left), all available data for the current time period (right), Oa5 Oa6 and Oa07 (510, 560 and 620 nm).**



**Figure 106:** Scatter plots of OLCI-A versus in situ radiometry (FR data). Reprocessed dataset (left), all available data for the current time period (right), Oa8 and Oa10 (665 and 681 nm).

**Table 5: OLCI-A FR statistics over REP\_006 period; FR data.**

lambda	N	RPD	RPD	MAD	RMSE	slope	intercept	r2
400	105	3.52%	20.74%	-0.0009	0.0062	0.8774	0.0029	0.8435
412	178	13.03%	35.76%	-0.0011	0.0054	0.8444	0.0021	0.8721
443	228	-1.66%	24.32%	-0.0013	0.0040	0.8874	0.0006	0.8336
490	315	-0.06%	16.32%	-0.0004	0.0024	0.9009	0.0009	0.7618
510	179	3.04%	17.35%	-0.0002	0.0020	0.8314	0.0015	0.6869
560	314	-1.64%	13.72%	-0.0003	0.0016	0.9139	0.0004	0.8946
665	47	-22.78%	29.11%	-0.0009	0.0013	0.4325	0.0009	0.4406

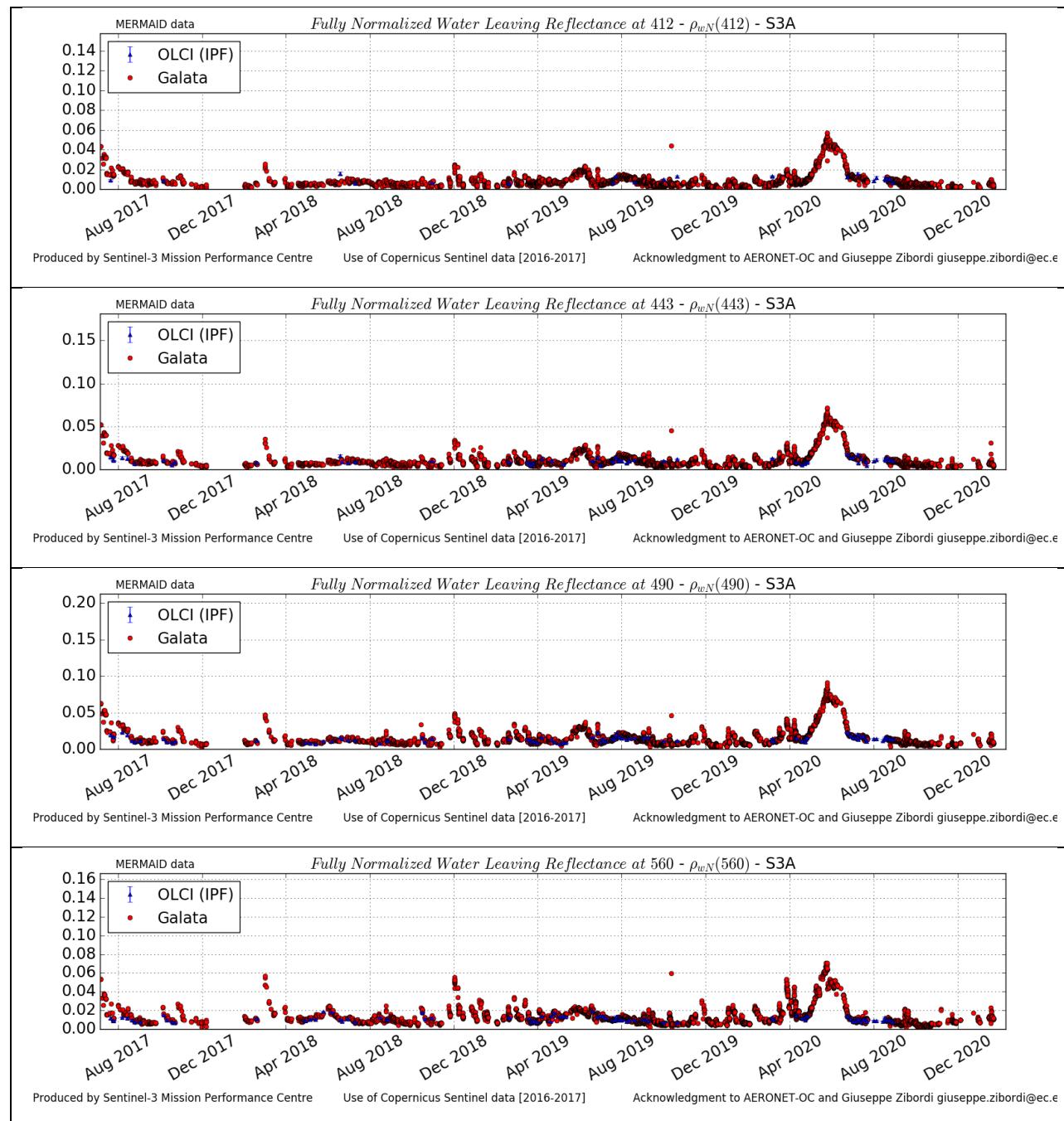
**Table 6: OLCI-A FR statistics over July 2017-present.**

lambda	N	RPD	RPD	MAD	RMSE	slope	intercept	r2
400	151	14.02%	25.22%	0.0007	0.0051	0.9598	0.0020	0.87
412	239	9.66%	32.14%	-0.0010	0.0049	0.9285	0.0007	0.89
443	330	-2.12%	23.33%	-0.0011	0.0035	0.9699	-0.0006	0.87
490	481	-4.57%	16.57%	-0.0009	0.0029	0.9467	-0.0002	0.70
510	316	-1.62%	14.42%	-0.0006	0.0024	0.7118	0.0027	0.70
560	487	-2.99%	14.24%	-0.0006	0.0019	0.8480	0.0008	0.89
620	24	-14.19%	18.47%	-0.0007	0.0012	0.6712	0.0006	0.15
665	91	-17.33%	25.88%	-0.0008	0.0013	0.4696	0.0009	0.55
681	25	2.96%	16.22%	0.0000	0.0005	0.9958	0.0000	0.70

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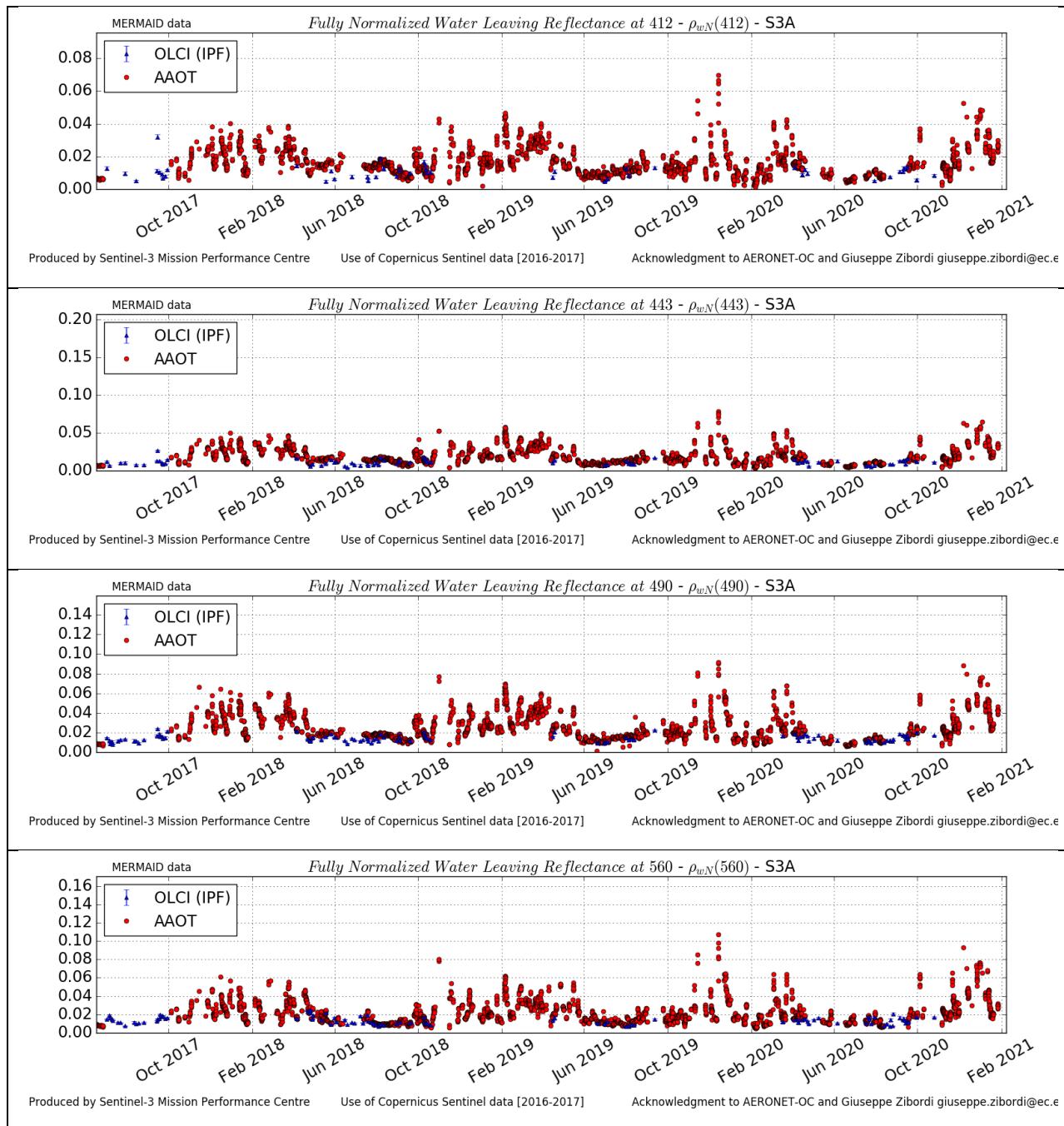
## Time series

Figure 107 and Figure 108 below present Galata and AAOT in situ and OLCI time series over the June 2017-present period, for the same IPF configuration (from a scientific point of view).



**Figure 107: Galata time series over current report period**

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**Figure 108: AAOT time series over current report period**

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### 5.2.3 OLCI-B

#### Activities done

- ❖ The focus for this time period has been on the rolling archive Non Time Critical (NT) data until the 8<sup>th</sup> of February 2021.
- ❖ All extractions and statistics have been regenerated on the current rolling archive availability including all the extraction since February 2019.
- ❖ At best 310 and 336 matchups at 490 and 560nm respectively are useful for this time period.

**It must be noted that OLCI-B has no SVC adjustment and as such cannot be expected to provide performances of the same level of quality than OLCI-A.**

#### Overall Water-leaving Reflectance performance

#### Scatter plots and Performance Statistics

- ❖ Figure 109 below presents the scatterplots and statistics of OLCI-B FR versus in situ reflectance.
- ❖ Table 7 below summarises the statistics over the current reporting period.



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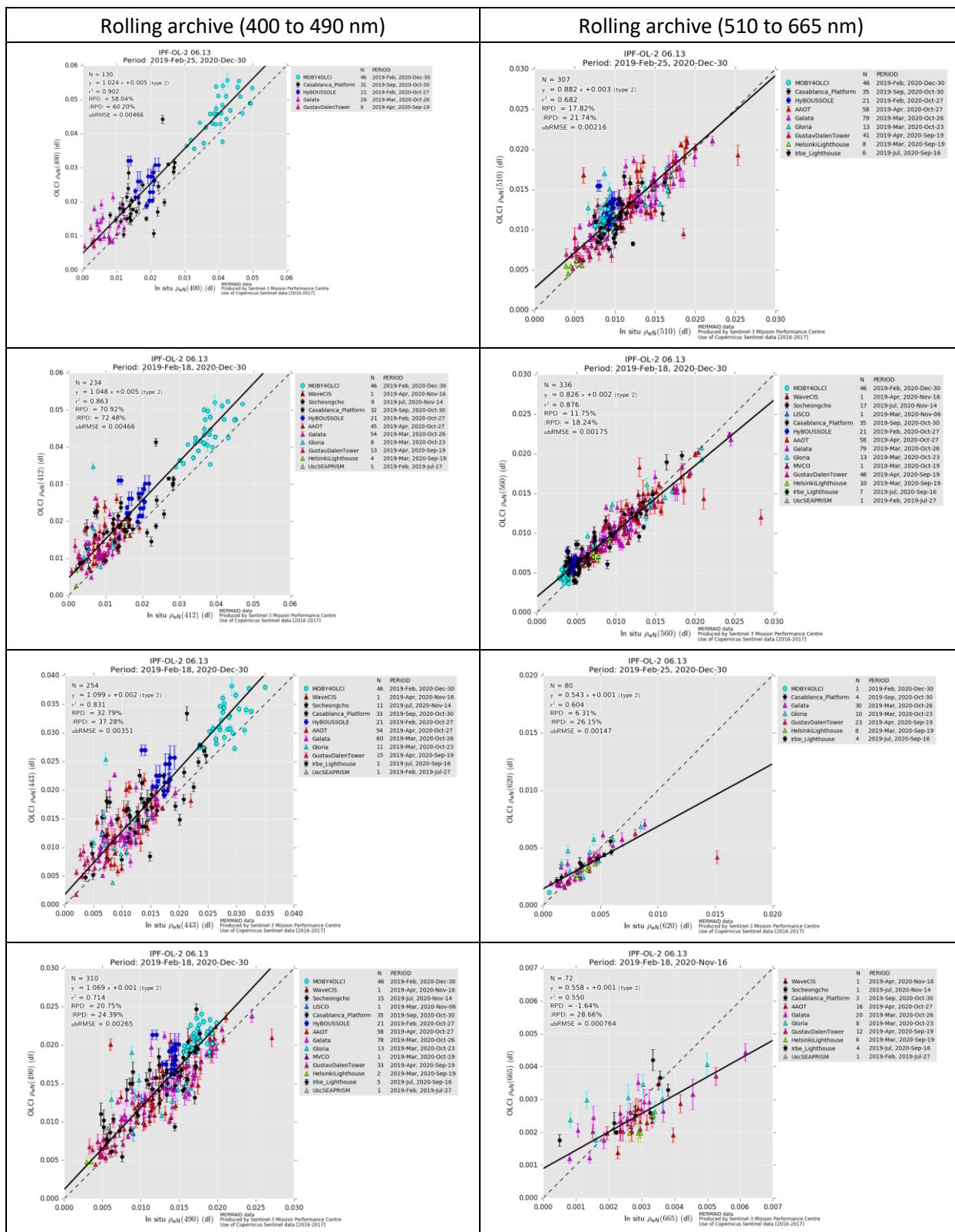


Figure 109: Scatter plots of OLCI-B versus in situ radiometry (FR data). All available data for the current time period.

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**Table 7: OLCI-B FR statistics over February to August 2020 reporting period.**

lambda	N	RPD	RPD	MAD	RMSE	slope	intercept	r2
400	130	58.04%	60.20%	0.0054	0.0072	1.0242	0.0049	0.90
412	234	70.92%	72.48%	0.0055	0.0072	1.0477	0.0047	0.86
443	254	32.79%	37.28%	0.0032	0.0048	1.0988	0.0018	0.83
490	310	20.75%	24.39%	0.0021	0.0034	1.0689	0.0012	0.71
510	307	17.82%	21.74%	0.0014	0.0026	0.8817	0.0027	0.68
560	336	11.75%	18.24%	0.0004	0.0018	0.8262	0.0020	0.88
620	80	6.31%	26.15%	-0.0003	0.0015	0.5430	0.0014	0.60
665	72	-1.64%	28.66%	-0.0004	0.0008	0.5577	0.0009	0.55

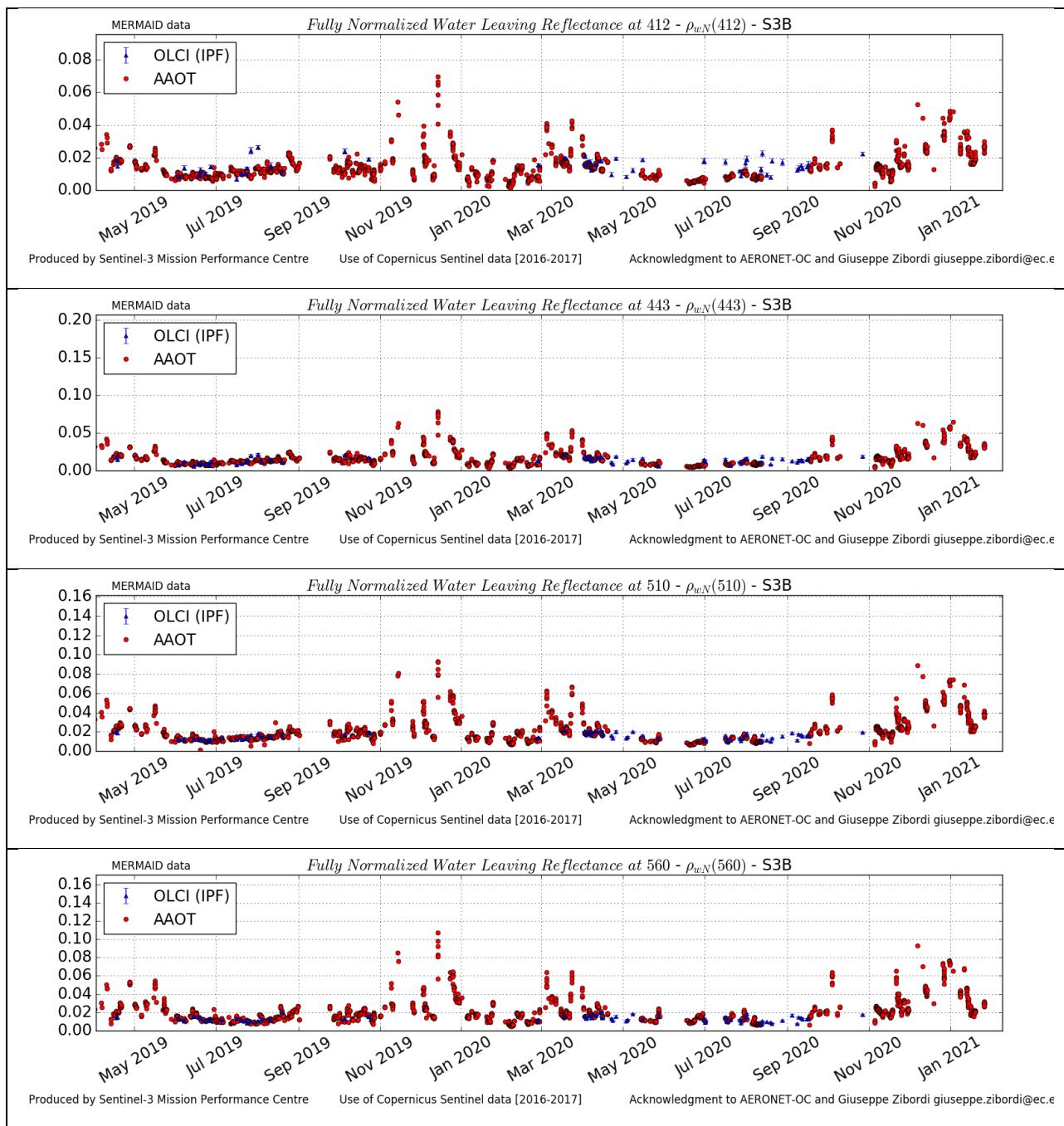
## Time series

Figure 110 and Figure 111 below present AAOT and GALATA in situ and OLCI-B time series over the current period.



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**Figure 110: AAOT time series over current report period**



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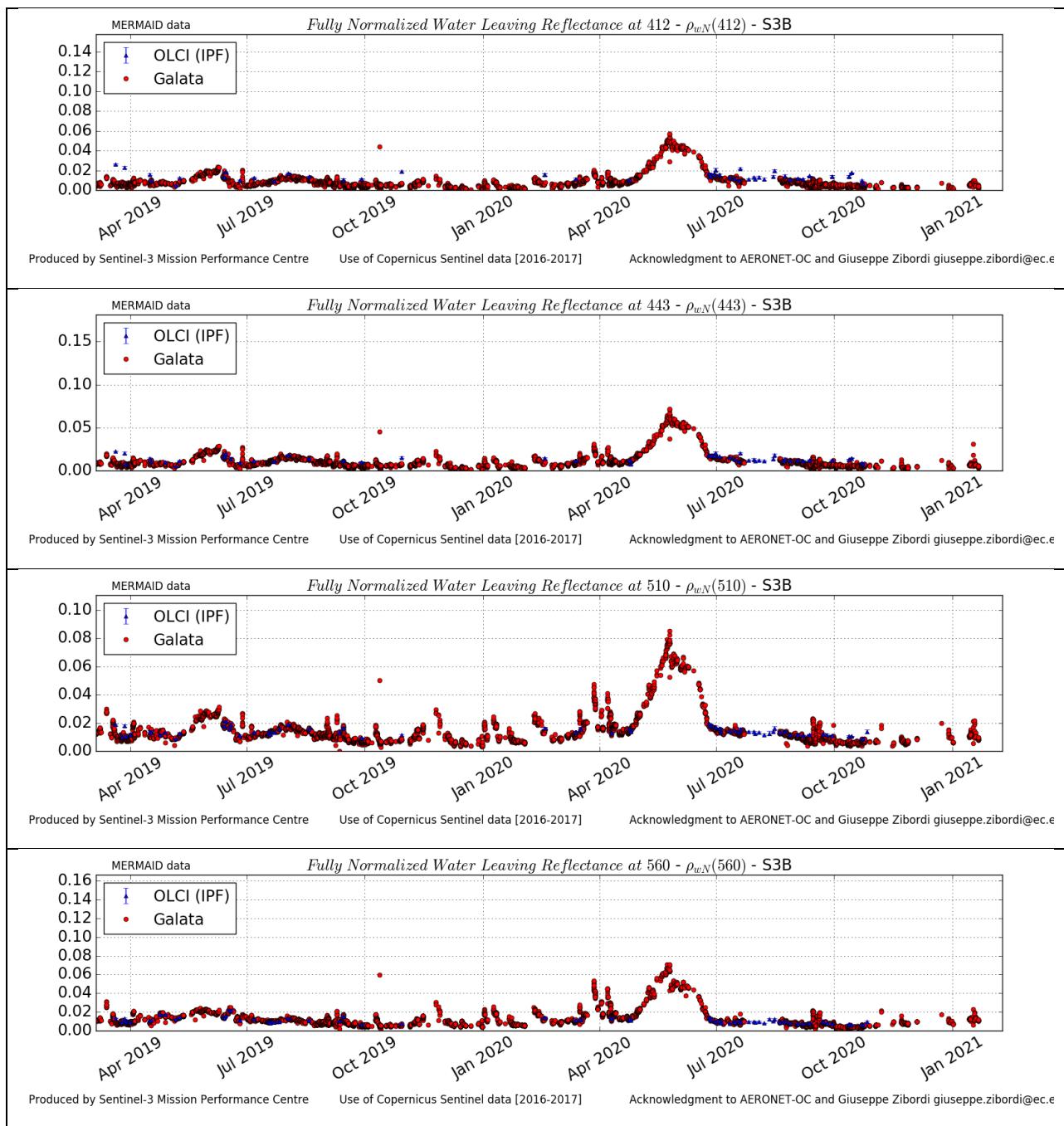


Figure 111: GALATA time series over current report period

 <p><b>SENTINEL-3</b> Mission Performance Centre</p>	<p><b>Sentinel-3 MPC</b> <b>S3 OLCI Cyclic Performance Report</b> <b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	<p>Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 104</p>
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## 5.3 [OLCI-L2WLR-CV-430] – Algorithm performance over spatial and temporal domains

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There has been no new result during the cycle. Last figures (cycle 27) are considered valid.

## 5.4 [OLCI-L2WLR-CV-510 & 520] – Cloud Masking & Surface Classification for Water Products

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There has been no new result during the cycle. Last figures (cycle 065/046) are considered valid.

## 5.5 [OLCI-L2WLR-CV530] Validation of Aerosol Product

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There has been no new result during the cycle. Last figures (cycle 065/046) are considered valid.

## 5.6 [OLCI-L2WLR-CV-380] Development of calibration, product and science algorithms

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There has been no new development on calibration, product and science algorithms during the cycle.

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## 6 Validation of Integrated Water Vapour over Land & Water

There has been no new result during the cycle. Last figures (cycle 065/046) are considered valid.

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## 7 Level 2 SYN products validation

There has been no new result during the cycle. Most recent performance figures can be found in the S3MPC OPT Annual Performance Report - Year 2019 (S3MPC.ACR.APR.005, issue 1.2, 25/06/2020), available on-line at:

<https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-3-olci/document-library>.

	<p style="text-align: center;"><b>Sentinel-3 MPC</b>  <b>S3 OLCI Cyclic Performance Report</b>  <b>S3A Cycle No. 067 – S3B Cycle No. 048</b></p>	Ref.: S3MPC.ACR.PR.01-067-048 Issue: 1.0 Date: 12/02/2021 Page: 107
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## 8 Events

For OLCI-A, three Radiometric Calibration Sequences have been acquired during Cycle 067:

- ❖ S01 sequence (diffuser 1) on 10/01/2021 23:57 to 23:59 (absolute orbit 25527)
- ❖ S01 sequence (diffuser 1) on 25/01/2021 22:27 to 22:29 (absolute orbit 25740)
- ❖ S05 sequence (diffuser 2) on 26/01/2021 00:08 to 00:10 (absolute orbit 25741)

For OLCI-B, three Radiometric Calibration Sequence have been acquired during Cycle 048:

- ❖ S01 sequence (diffuser 1) on 11/01/2021 19:30 to 19:32 (absolute orbit 14145)
- ❖ S01 sequence (diffuser 1) on 27/01/2021 09:08 to 09:10 (absolute orbit 14367)
- ❖ S05 sequence (diffuser 2) on 27/01/2021 10:49 to 10:51 (absolute orbit 14368)

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## 9 Appendix A

Other reports related to the Optical mission are:

- ❖ S3 SLSTR Cyclic Performance Report, S3A Cycle No. 067, S3B Cycle No. 048 (ref. S3MPC.RAL.PR.02-067-048)

All Cyclic Performance Reports are available on MPC pages in Sentinel Online website, at:  
<https://sentinel.esa.int>

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