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

**S3-A OLCI Cyclic Performance Report** 

Cycle No. 016

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#### Disclaimer

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# **Changes Log**

Version	Date	Changes
1.0	28/04/2017	First Version

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# 1 Instrument monitoring

## **1.1 CCD temperatures**

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 (0.08 C peak-to-peak) and no trend can be identified. Data from current cycle (rightmost data points) do not show any specificity.

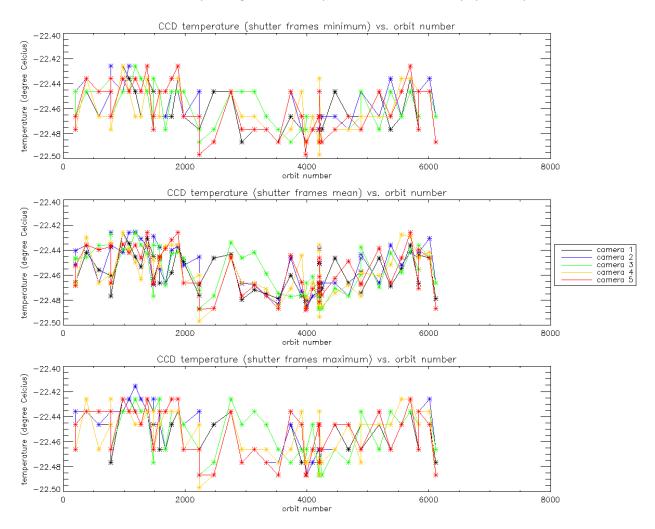


Figure 1: long term monitoring of CCD temperatures using minimum value (top), time averaged values (middle), and maximum value (bottom) provided in the annotations of the Radiometric Calibration Level 1 products, for the Shutter frames, all radiometric calibrations so far.



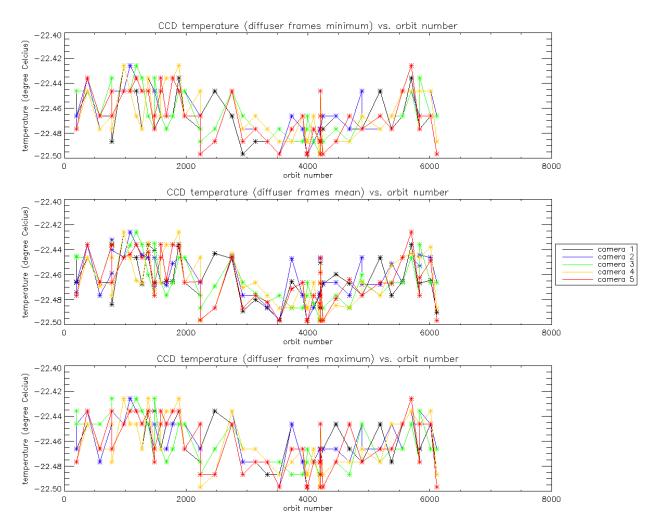


Figure 2: Same as Figure 1 for diffuser frames.

## **1.2 Radiometric Calibration**

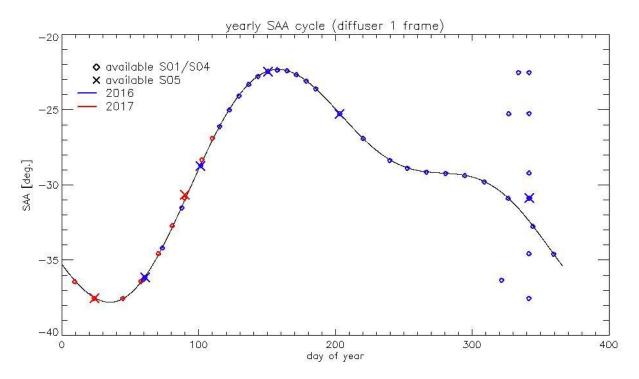
Five OLCI Radiometric Calibration Sequence have been acquired during Cycle 016:

- S04 sequence on 31/03/201718:49 to 18:51 (absolute orbit 5832)
- S05 sequence on 31/03/2017 20:30 to 20:32 (absolute orbit 5833)
- S01 sequence on 08/04/2017 23:44 to 23:46 (absolute orbit 5949)\*
- S01 sequence on 13/04/2017 09:46 to 09:48 (absolute orbit 6012)
- S01 sequence on 20/04/2017 13:31 to 23:33 (absolute orbit 6120)

\* The Level 0 product (S3A\_OL\_0\_CR0) of the S01 sequence on 08/04/2017 is corrupted (md5sum differences) due certainly to Svalbard hardware troubles that occurred on 08/04/2017. Consequently, this sequence could not be processed to Level-1 and we did not analyze it.



The acquired Sun azimuth angles are presented on below, on top of the nominal values without Yaw Manoeuvre (i.e. with nominal Yaw Steering control of the satellite).



*Figure 3: Sun azimuth angles during acquired Radiometric Calibrations (diffuser frame) on top of nominal yearly cycle (black curve). Diffuser 1 with diamonds, diffuser 2 with crosses, 2016 acquisitions in blue, 2017 in red.* 

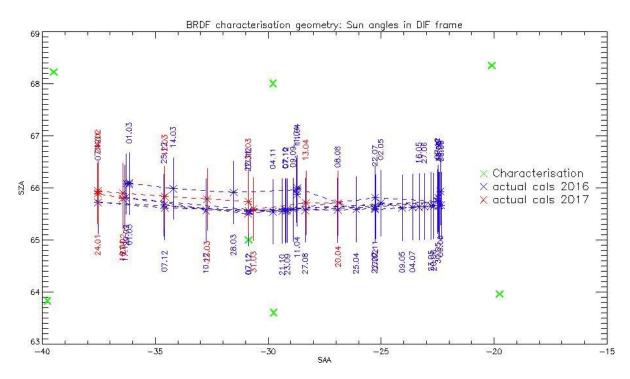


Figure 4: Sun geometry during radiometric Calibrations on top of characterization ones (diffuser frame)



This section presents the overall monitoring of the parameters derived from radiometric calibration data and highlights, if present, specificity of current cycle data.

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

### Dark offsets

Dark offsets are continuously affected by the global offset induced by the Periodic Noise on the OCL convergence. Current Cycle calibrations (orbits 4685, 4887 & 4888) 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 0a1) 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.

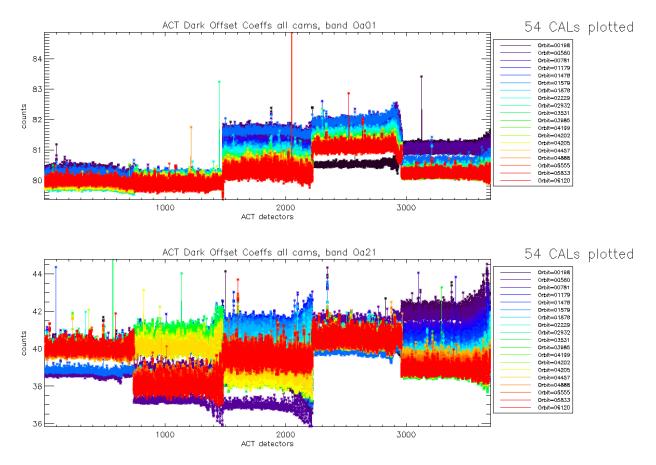


Figure 5: Dark Offset for band Oa1 (top) and Oa21 (bottom), all radiometric calibrations so far except the first one (orbit 183) for which the instrument was not thermally stable yet.

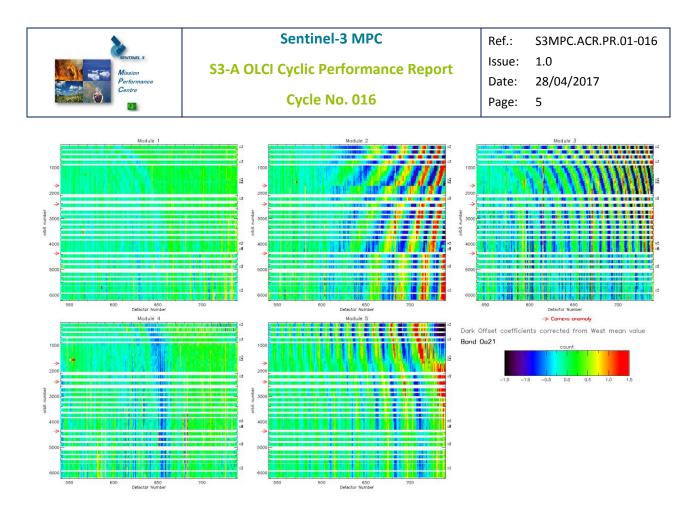


Figure 6: map of periodic noise for the 5 cameras, for band Oa21. X-axis is detector number (East part, from 540 to 740, where the periodic noise occurs), Y-axis is the orbit number. The counts have been corrected from the west detectors mean value (not affected by periodic noise). Periodic noise amplitude is high in camera 2, 3 and 4. It is lower in camera 4 and small in camera 1.

Looking at Figure 5 shows no significant evolution of this parameter during the current cycle. Figure 6 shows that since the last sudden PN change (phase and amplitude) caused by the camera-2 anomaly at orbit 4364 (18 December 2016), PN is nearly stabilized again. (See in particular cameras 2, 3 & 5).

### **Dark Currents**

Dark Currents 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.

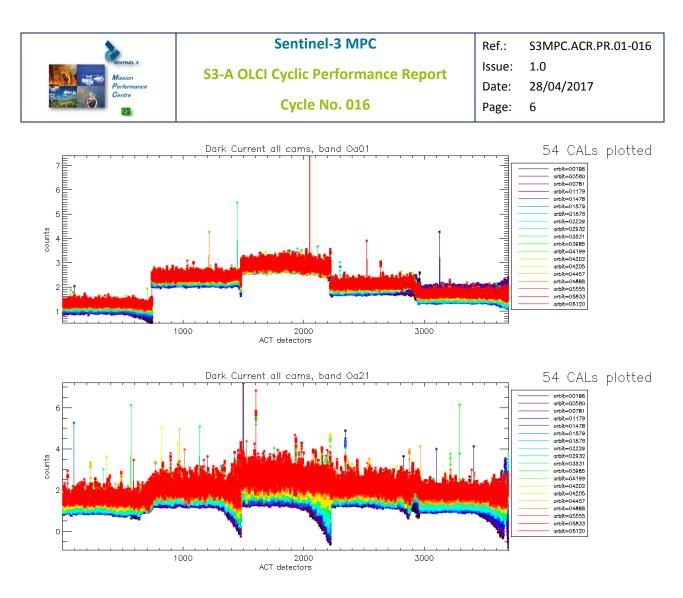


Figure 7: Dark Current for band Oa1 (top) and Oa21 (bottom), all radiometric calibrations so far except the first one (orbit 183) for which the instrument was not thermally stable yet.

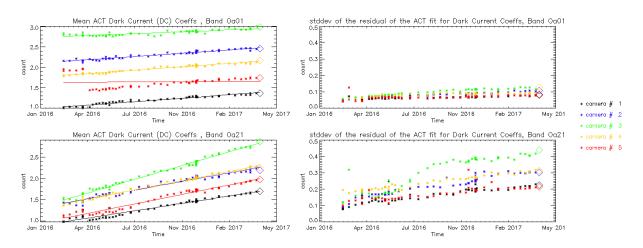


Figure 8: left column: ACT mean on 400 first detectors of Dark Current coefficients for spectral band Oa01 (top) and Oa21 (bottom). Right column: same as left column but for Standard deviation instead of mean. We see an increase of the DC level as a function of time especially for band Oa21. A possible explanation 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.



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

### 1.2.2.1 Instrument response monitoring

Figure 9 below shows the gain coefficients of every pixel for two OLCI channels, Oa1 (400 nm) and Oa21 (1020 nm), highlighting the significant evolution of the instrument response since early mission.

Figure 10 on the other hand displays the time evolution of the cross-track averaged gain, for each module, as a function of time. It shows that if a significant evolution occurred during the early mission, the trends tend to stabilize, with a noticeable exception during the Yaw Manoeuvres (YM) and after, pointing at the dependency of the BRDF model performance with Sun azimuth (on purpose large variations during YM, due to the shape of the seasonal cycle since then). In particular all calibrations between beginning of August and early December (YM) provide very stable results, within 0.5% for all bands. This is further illustrated on Figure 11. The latter shows that radiometric gains are becoming very stable over this period but starts to vary again when the first Yaw Manoeuvre tests come into play, illustrating the influence of geometry. Calibrations acquired during the current cycle, acquired with nominal Yaw Steering, confirm these findings.

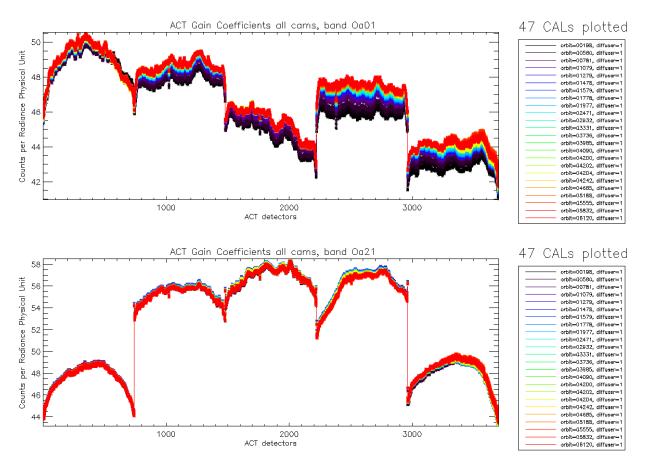


Figure 9: Gain Coefficients for band Oa1 (top) and Oa21 (bottom), all diffuser 1 radiometric calibrations so far except the first one (orbit 183) for which the instrument was not thermally stable yet.

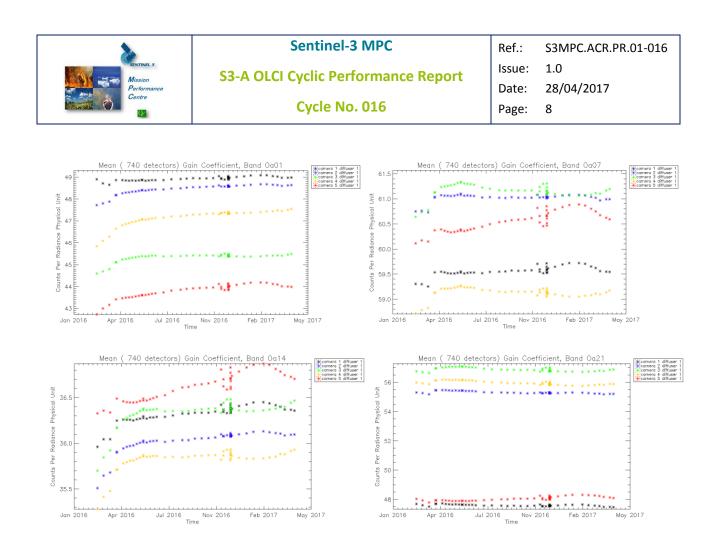
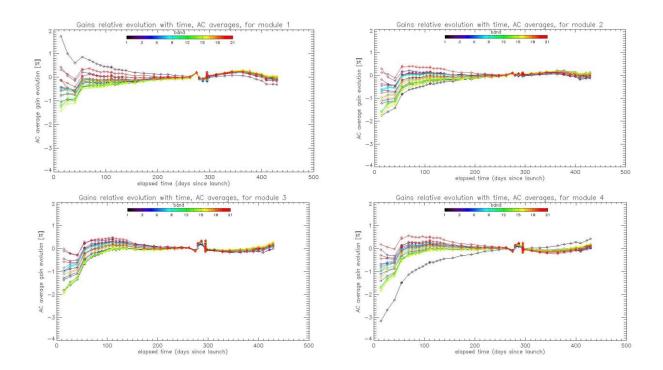


Figure 10: time evolution of the camera-averaged Absolute gain coefficients for bands Oa1, Oa7, Oa14 and Oa21 (from left to right and top to bottom).



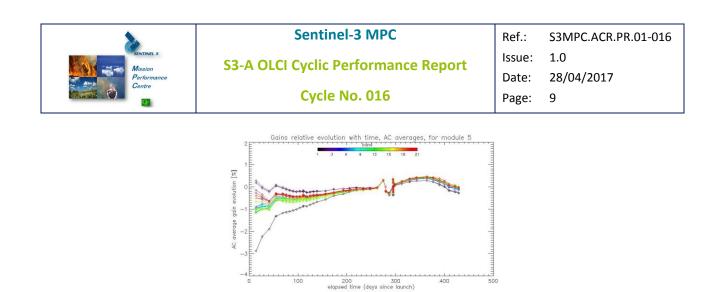


Figure 11: camera averaged gain relative evolution with respect to "best geometry" calibration (22/11), as a function of elapsed time since first calibration acquired after the fix of the Start Trackers issue; one curve for each band (see colour code on plots), one plot for each module.

Figure 12 further explore the geometry dependency at short and large time distances, selecting as reference the geometry that best match that of the BRDF modelling lowest residuals. Last two S01 calibrations (current cycle) as well past ones with about the opposite SAA differences are compared against the chosen reference (22/11). The impact is clearly seen, with a significant SAA dependent evolution that can be seen globally as a "white" curvature of the AC profile, increasing with azimuth difference, and with opposite curvature according to the sign of the azimuth difference. On the other hand, the instrument evolution is also clearly visible comparing ratios at symmetrical SAA differences but time lags with opposite signs (top-left with bottom right, top right with bottom left and to a lesser extent top right with centre left panes).



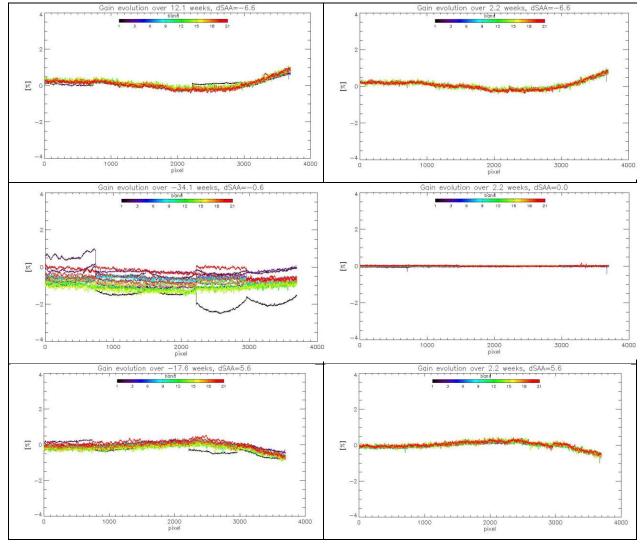


Figure 12: Across-track profiles of Gains relative evolution with respect to "best geometry" calibration over a relatively large time distance (from -34 to +12 weeks) and for varying geometries, more or less symmetrical with respect to reference one: on the right column time distance remains almost constant around 2 weeks, as calibrations compared to reference are selected within the Yaw Manoeuvres with SAA differences of -6.6, 0 and 5.6 degrees from top to bottom, the left column show the comparisons at equal or close &SAA, but as large as possible time distance.(from top to bottom time differences are respectively +12,-34 and -18 weeks). Influence of geometry and time are both clearly visible and can be distinguished from each other.

In order to get rid of the white variability (not spectrally dependant) caused by the BRDF model, all bands are normalized by band Oa18. Oa18 was chosen because NIR degrades slowest and because Oa20 and Oa21 are subject to Periodic Noise, e- leaks, etc ... Results are presented Figure 13.

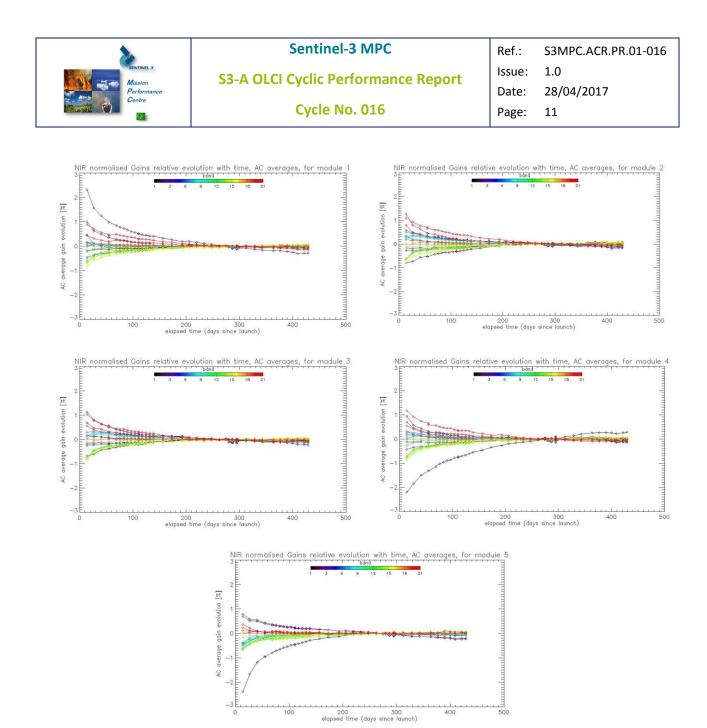


Figure 13: same as Figure 11 after normalization by band Oa18.

In Figure 13, we see that the ugly oscillations of Figure 11 have disappeared. However it is still surprising that some bands show an increase of sensitivity with time, while a decrease is expected since we are monitoring a 'degradation' of the instrument. Using the diffuser 2 results, we can say that this sensitivity increase cannot be explained by the ageing of diffuser 1. Moreover, we have checked that the spectral assignment drift cannot explain either this increase of sensitivity. Figure 14, compared to Figure 12, allows verifying the performance of the BRDF error correction on AC profiles.

Thus there is still something that remains unexplained concerning the evolution of the sensitivity of the instrument. Investigations are on-going.



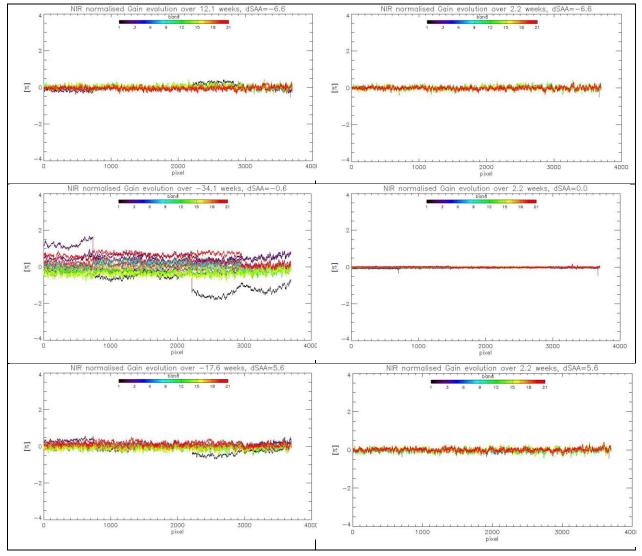


Figure 14: same as Figure 12 after normalization by band Oa18.

#### 1.2.2.2 Instrument evolution modelling

The time elapsed until the beginning of the mission is still too small to be able derive a degradation model, but Yaw Manoeuvres allow a direct quantification of the instrument sensitivity evolution between pairs of calibration with identical or close to identical geometries. This work is still on-going and will be presented in a future Cyclic Report.

Thanks to the work done on the Yaw Manoeuvers Calibration acquisitions (see section 1.2.5) an upgraded diffuser BRDF model has been derived, allowing to get rid of the operational model dependency with Sun azimuth discussed above. This in turn allowed, first to justify a posteriori the NIR normalization approach, as the evolution of band Oa18 – assumed negligible in the normalization process – could be assessed independently as relatively small (<0.2%), but overall to build a global gain



database corrected for BRDF error residuals. This database was used as the basis for the derivation of a long-term radiometric drift model.

This required a number of adaptations of the dedicated software for several reasons:

- The upgraded BRDF model is not implemented in the Calibration processing software (IPF OL1-RC), thus the derived gains have to be corrected for BRDF in a post-processing step, on the (justified) assumption that the BRDF changes have a second order impact on the stray-light computation.
- 2) The observed instrument evolution does not follow the expected behaviour: a slow and smooth instrument sensitivity decrease, but on the contrary can show increase as well (see Figure 15))
- 3) The time period is not long enough to correctly model the evolution for cameras/channels for which it is very small: in this case the signal to noise ratio (e. g. due to diffuser speckle) is not high enough and the fit parameters that provide the best match are not physical. As a consequence, it may happen that, despite the model matches very well to the data, its use in extrapolation generates huge drifts that are very unlikely to occur. A post-processing is thus necessary to identify and update those cases.

In order to have at least some rough estimate of the model performance in extrapolation, it has been derived over the dataset ranging from 26/04/2016 to 12/03/2017, leaving aside 3 calibrations in March and April 2017 (and a 4<sup>th</sup> that could not be processed due to corrupted Level 0 product) for performance estimation.

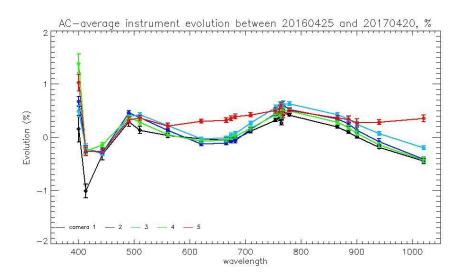


Figure 15: Camera-averaged instrument evolution since channel programming change (25/04/2016) and up to most recent calibration (20/04/2017) versus wavelength.

Once these steps are completed, the model performance over the complete dataset (including 3 calibrations in extrapolation over up to 5 weeks) is better than 0.2% except at very specific cases: few isolated pixels in about half of the bands, and two specific features in camera 5 for channels Oa8 and Oa21 that cannot be fitted with a bounded exponential model. The overall performance at each orbit is

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shown on Figure 16 as the average and standard deviation of the model over data ratio as a function of wavelength, for each orbit in order to highlight a possible extrapolation issue. If the figure shows an outlying orbit, it must be stressed that it is NOT the most recent, excluding a systematic drift in extrapolation, as proved by Figure 17.

Finally, Figure 18 to Figure 20 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.

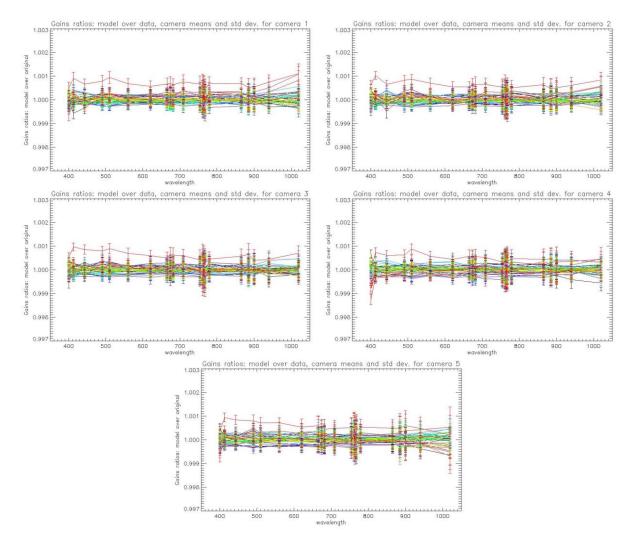


Figure 16: Evolution model performance, as camera-average and standard deviation of ratio of Model over Data vs. wavelength, for each orbit of the test dataset, including 3 calibration in extrapolation, with a colour code for each calibration from blue (oldest) to red (most recent).



Model performance: model/data, band 4

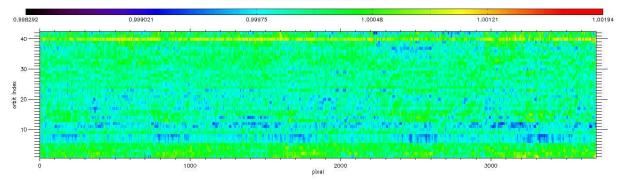


Figure 17: model performance: ratio of model over data for all pixels (x axis) of all orbits (y axis), for channel Oa4. The outlying orbit #40 is that of 31/03/2017.

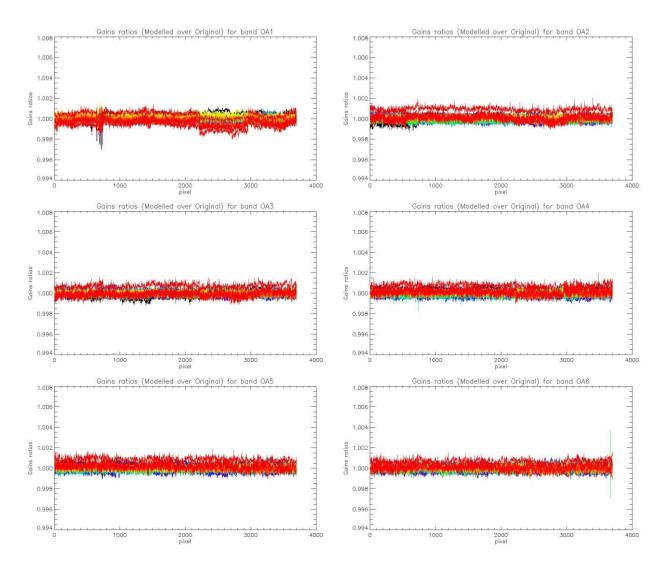


Figure 18: Evolution model performance, as ratio of Model over Data vs. pixels, all cameras side by side, over the whole current calibration dataset (since instrument programing update), including 3 calibration in extrapolation, channels Oa1 to Oa6.



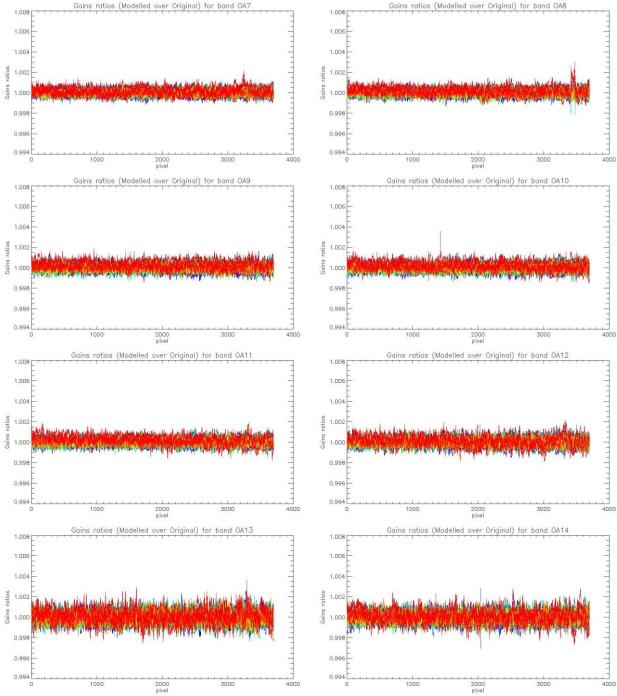


Figure 19: same as Figure 18 for channels Oa7 to Oa14.



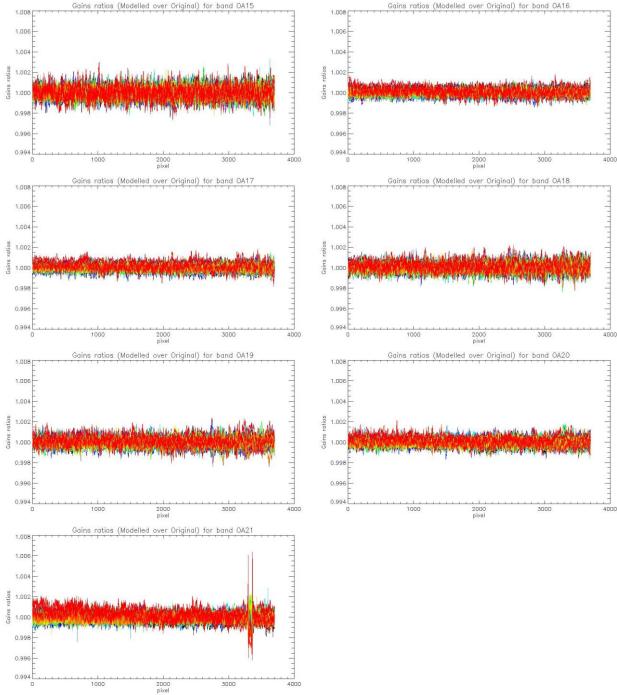


Figure 20: same as Figure 18 for channels Oa15 to Oa21.

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

There has been one calibration sequence S05 (reference diffuser) acquisition during cycle 016:

S05 sequence on 31/03/2017 20:30 to 20:32 (absolute orbit 5833)



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

Ageing(orb)=G1(orb)/G2(orb)-G1(orb\_ref)/G2(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 21 for band Oa1 and in Figure 22 for band Oa16. The negative shift of the latest sequence (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 (see section 1.2.2.2) with an unexpected excess of brightness.

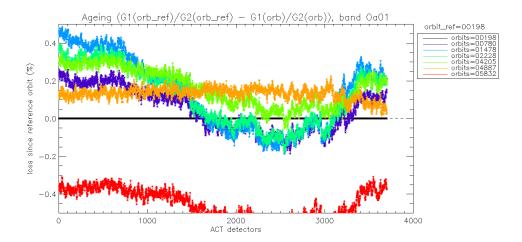


Figure 21: diffuser 1 ageing for spectral band Oa01. We see strong ACT low frequency structures that are due to residual of BRDF modelling.



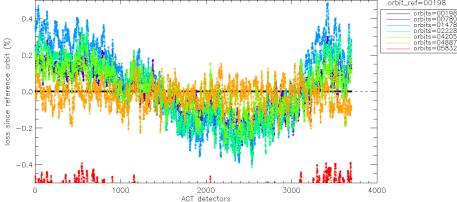


Figure 22: same as Figure 21 for spectral band Oa16. We use this band in order to normalize other bands and remove the ACT structures due to residual of BRDF modelling. Normalized curve for spectral band Oa01 is presented in Figure 23.

Figure 21 and Figure 22 show that the Ageing curves are impacted by a strong ACT pattern which is due to residuals of the bad modelling 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 Oa16 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 Oa16 in order to reduce the high frequency noise. Normalized ageing for spectral band Oa01 is represented in Figure 23 where we can see that this band is impacted by ageing of the diffuser.

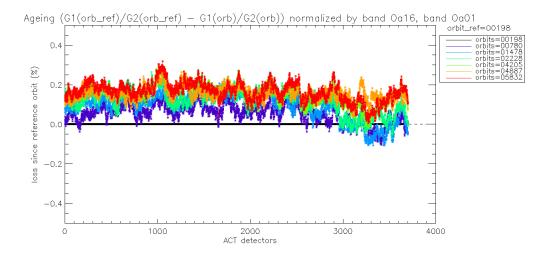
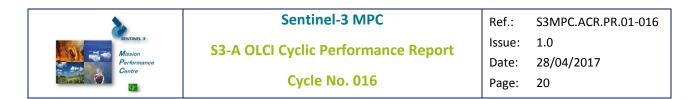


Figure 23: same as Figure 21 after normalization by band Oa16. Ageing of the diffuser 1 is now visible in the 5 cameras.



Camera averaged ageing (normalized by band Oa16) as a function of wavelength is represented in Figure 24 where we can see that ageing is stronger in the 'blue' (short wavelengths). Ageing is visible only for the 5 first spectral bands so far in the OLCI mission life.

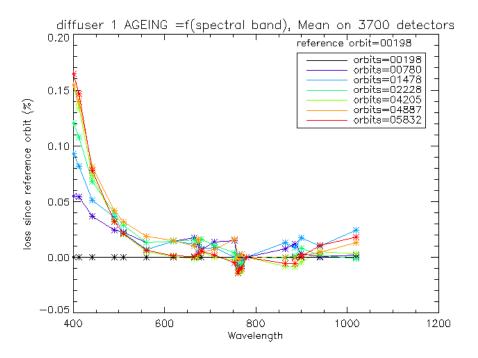


Figure 24: Diffuser 1 ageing as a function of wavelength (or spectral band). Ageing is visible in spectral band #1 to #5.

Figure 25 shows the evolution of the 5 camera averaged ageing as a function of time.

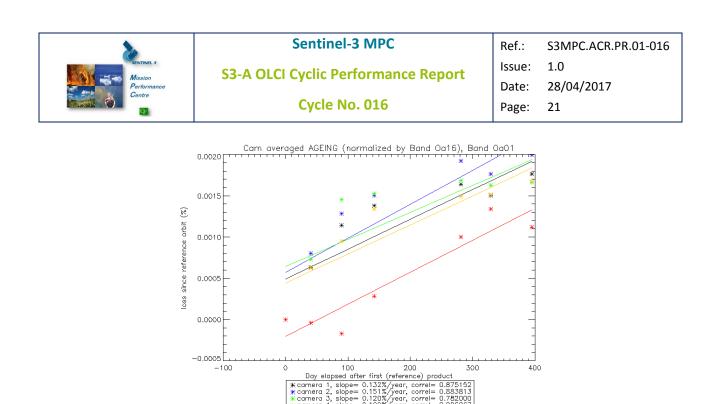


Figure 25: Camera averaged ageing (normalized by band Oa16) as a function of time. Linear fit for each camera is plotted. The slope (% loss per year) and the correlation coefficient of the linear fits are written in the legend at the bottom.

\* camera 1, slape= \* camera 2, slope= \* camera 3, slape= \* camera 4, slope= \* camera 5, slape=

#### Updating of calibration ADF [OLCI-L1B-CV-260] 1.2.4

A number of OL\_1\_CAL\_AX have been generated during cycle 016, to host the recently defined Radiometric Gain model (including long-term drift, see section 1.2.2.2) as well as frequently refreshed Dark Correction LUTs, covering the 25/04/2016 to present period. It includes the following evolution:

- 1. A common radiometric gain model for all, based on the long-term drift modelling described in section 1.2.2.2, and a reference gain derived from the average of all calibrations within [25/04/2016, 12/03/2017] once corrected for the drift,
- 2. Frequent update of the Dark Offset and Dark Current LUTs to minimise the impact of Periodic Noise: all calibrations with OCL ON have been selected, except those too close to their immediate predecessor (in practice this eliminates mostly the S05 of ageing sequences, 1 orbit later than S04 or S01). Validity dates have been set starting from the used calibration sequence and ending at next selected one, i.e. without any overlap.

S3A_OL_1_CAL_AX_20160425T103700_20160502T105515_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160502T105515_20160509T111321_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160509T111321_20160516T113134_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160516T113134_20160523T100851_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160523T100851_20160530T102711_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160530T102711_20160606T104537_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160606T104537_20160613T110409_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160613T110409_20160620T112246_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160620T112246_20160627T114128_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160627T114128_20160704T101917_20170426T171557_	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160704T101917_20160722T004742_20170426T171557_	MPC_O_AL_R02.SEN3

The list of generated ADFs is:

	Sentinel-3 MPC	Ref.:	S3MPC.ACR.PR.01-016
SENTINEL 3	S3-A OLCI Cyclic Performance Report		1.0
Mission Performance Centre	55 A Oler Cyclic I chormanice Report	Date:	28/04/2017
	Cycle No. 016	Page:	22

S3A_OL_1_CAL_AX_20160722T004742_20160808T014848_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160808T014848_20160827T170709_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160827T170709_20160909T094722_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160909T094722_20160923T102636_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20160923T102636_20161007T092447_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161007T092447_20161021T100350_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161021T100350_20161104T190739_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161104T190739_20161117T064426_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161117T064426_20161122T061449_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161122T061449_20161129T145852_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161129T145852_20161207T062647_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161207T062647_20161210T064921_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161210T064921_20161225T084146_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20161225T084146_20170110T082623_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170110T082623_20170124T122451_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170124T122451_20170214T145948_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170214T145948_20170227T123949_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170227T123949_20170312T083848_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170312T083848_20170322T142139_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170322T142139_20170331T184952_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170331T184952_20170413T094608_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170413T094608_20170420T233158_20170426T171557	MPC_O_AL_R02.SEN3
S3A_OL_1_CAL_AX_20170420T233158_20991231T235959_20170426T171557	MPC_O_AL_R02.SEN3
This set of ADEs is intended to be used first (and further validate	ad) in a coming partial reprocessing

This set of ADFs is intended to be used first (and further validated) in a coming partial reprocessing dedicated to the validation of Level 2 processing evolutions. If validated it would be ready for use for a global reprocessing and the last one could be used for NRT processing, with a different referencing (yet to be defined).

# **1.2.5** 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]

This activity has not evolved during cycle 016 and results presented in previous report are still valid.

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

There has been no Spectral Calibration acquisition during cycle 016.

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

### **1.4.1** SNR from Radiometric calibration data.

SNR computed for all calibration data as a function of band number is presented in Figure 26.

SNR computed for all calibration data as a function of orbit number for band Oa01 (the less stable band) is presented in Figure 27.



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

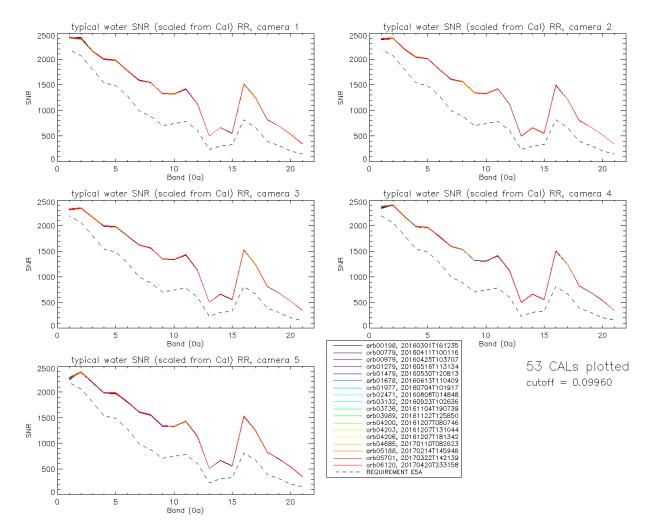


Figure 26: Signal to Noise ratio as a function of the spectral band for the 5 cameras. These results have been computed from radiometric calibration data. All calibrations except first one (orbit 183) are presents with the colours corresponding to the orbit number (see legend). The SNR is very stable with time: the curves for all orbits are almost superimposed. The dashed curve is the ESA requirement.



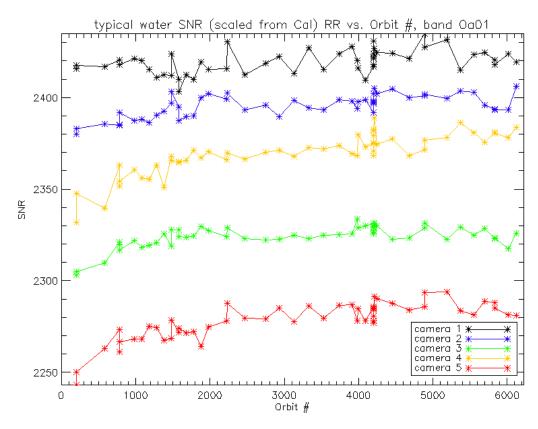


Figure 27: long-term stability of the SNR estimates from Calibration data, example of channel Oa1.

### **1.4.2** SNR from EO data.

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

## **1.5 Geometric Calibration/Validation**

- There has been no update on Geometric Calibration quantitative assessment during the cycle. Last figures (cycle 10) are considered valid.
- Qualitative assessment by product inspection showed no detectable performance evolution.



# 2 OLCI Level 1 Product validation

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

#### **S3ETRAC Service**

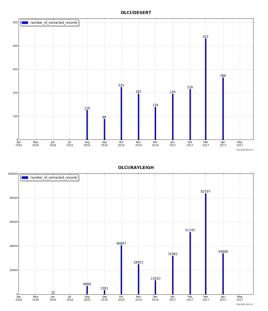
#### Activities done

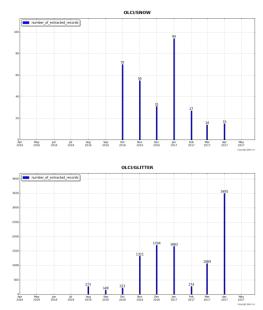
The S3ETRAC service extracts OLCI L1 RR and SLSTR L1 RBT data and computes associated statistics over 49 sites corresponding to different surface types (desert, snow, ocean maximizing Rayleigh signal, ocean maximizing sunglint scattering and deep convective clouds). The S3ETRAC products are used for 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 <u>http://s3etrac.acri.fr/index.php?action=generalstatistics</u>

- 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).

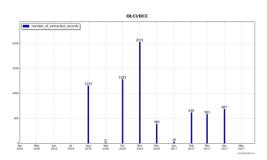






Ref.: S3MPC.ACR.PR.01-016 1.0 Issue: 28/04/2017 Date: 26 Page:

## Cycle No. 016



## Figure 28: summary of S3ETRAC data extraction for OLCI (number of generated records for each month, one plot per site type).

### **Radiometric validation with DIMITRI**

### **I-Validation over PICS**

- 1. Downloading and ingestion all the available L1B-LN1-NT products in the S3A-Opt database over the 6 desert calval-sites (Algeria 3 & 5, Libya 1 & 4 and Mauritania 1 & 2). Where the ingested time-series has been extended until 16<sup>th</sup> April 2017.
- 2. The results are consistent overall the six used PICS sites (Figure 29). OLCI reflectance shows strong fluctuation in the beginning of the commissioning phase (about ±8% amplitude) between March and July 2016. The temporal average over the period September 2016 – April 2017 of the elementary ratios (observed reflectance to the simulated one) shows values within 2% (mission requirements) over all the VNIR bands (Figure 30). The spectral bands with significant absorption from water vapor and O<sub>2</sub> (Oa11, Oa13 and Oa14) show an outlier ratio.

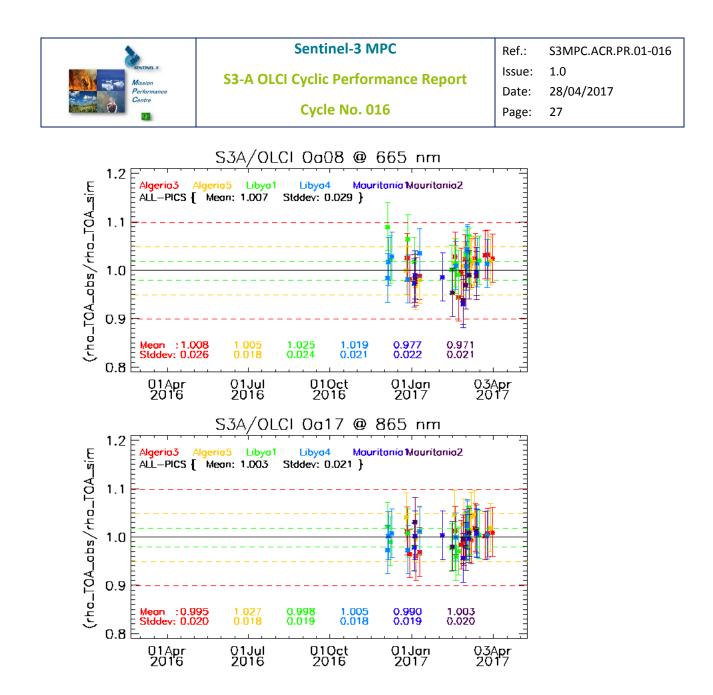
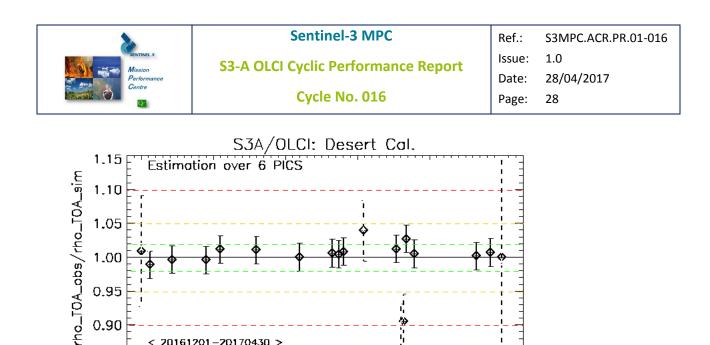


Figure 29: Time-series of the elementary ratios (observed/simulated) signal from S3A/OLCI for (top) band Oa8 and (bottom) band Oa17 over Six PICS Cal/Val sites. Dashed-green, orange and red lines indicate the 2%, 5% and 10% respectively. Error bars indicate the desert methodology uncertainty.



倁

800

900

Figure 30: The estimated gain values for S3A/OLCI over the 6 PICS sites identified by CEOS over the period December 2016 – April 2017 as a function of wavelength. Dashed-green, orange and red lines indicate the 2%, 5% and 10% respectively. Error bars indicate the desert methodology uncertainty.

Wave Length (nm)

700

# II-Intercomparison S3A/OLCI, S2A/MSI and LANDSAT/OLI over PICS

20170430

600

No new results.

0.90

0.85 b

400

20161201-

500

## **III-Validation over Rayleigh**

The investigations of the discrepancy between the results from ARGANS and ESTEC, when both use the same CFI (DIMITRI), are done. Following to several email-exchange with Marc Bouvet (ESTEC) then personal meeting during the RadCalNet workshop, we found that ARGANS and ESTEC have used different thresholds over Rayleigh in DIMITRI. ARGANS's ESL has performed Rayleigh using ESTECthresholds over the period September 2016-March 2017. We found slightly different results due to the different period. The outcome of this analysis will be provided to the S3MPC in a separate TN soon.

No new results yet in on this task

## **IV-Validation over Glint**

Glint calibration method (DIMITRI; PIXEL-Option) has been performed over two periods: The more recent period Dec 2016 – April 2017 and the reprocessing one April-August 2016. The outcome of this analysis shows a good consistency with the desert outputs (see Figure 31). In addition it attests the improvement of the radiometry quality of OLCI after November 2016 (compare Figure 31 and Figure 32).

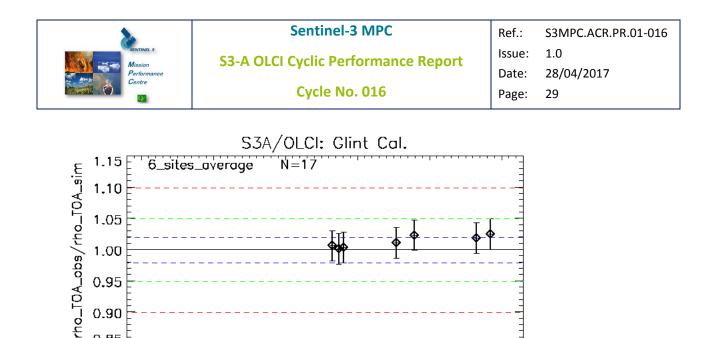


Figure 31: The estimated gain values for S3A/OLCI over the 6 Ocean calval-sites (Atl-NW\_Optimum, Atl-SW\_Optimum, Pac-NE\_Optimum , Pac-NW\_Optimum, SPG\_Optimum and SIO\_Optimum) over the period December 2016 – April 2017 as a function of wavelength. We use the gain value of Oa8 from Desert method as reference gain. Dashed-blue, green, and red lines indicate the 2%, 5% and 10% respectively. Error bars indicate the Oa8-Band uncertainty from Desert Calibration.

700

Wave Length (nm)

800

900

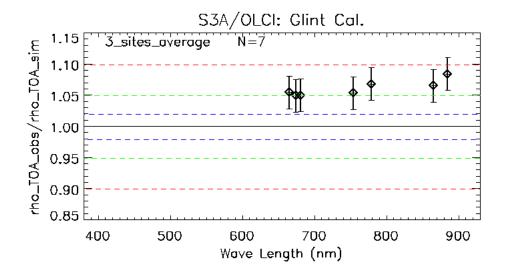


Figure 32: The estimated gain values for S3A/OLCI reprocessed products over the 6 Ocean calval-sites (Atl-NW\_Optimum, Atl-SW\_Optimum, Pac-NE\_Optimum , Pac-NW\_Optimum, SPG\_Optimum and SIO\_Optimum) over the period March 2016 – Augudt 2016 as a function of wavelength. We use the gain value of Oa8 from Desert method as reference gain. Dashed-blue, green, and red lines indicate the 2%, 5% and 10% respectively. Error bars indicate the Oa8-Band uncertainty from Desert Calibration.

**Radiometric validation with OSCAR** 

1.00

0.95

0.90 0.85

400

500

600

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	33-A Oler cyclic i enormance Report		28/04/2017	
	Cycle No. 016	Page:	30	

The S3ETRAC Rayleigh scenes of February 2017 over 4 sites (AtlN, IndS, PacN and PacSE) have been processed, processing of other sites and of March scenes is on-going. Corresponding results are shown on Figure 33.

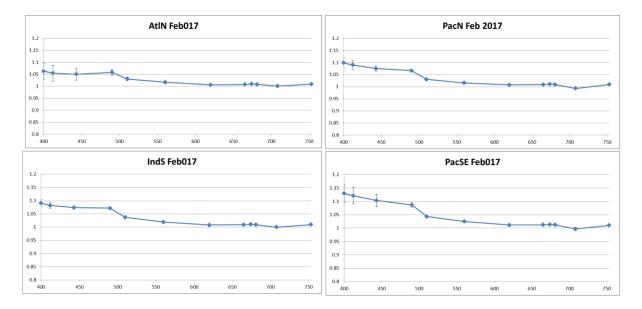


Figure 33 Oscar Rayleigh results for February 2017 for AtlN, IndS, PacN and PacSE sites.



# 3 Level 2 Land products validation

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

There has been no update on Land products validation quantitative assessment during the cycle. Last figures (cycle 14) are considered valid.

Qualitative assessment by product inspection showed no detectable performance evolution.

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

There has been no update on Land Cloud Masking & Surface Classification validation quantitative assessment during the cycle. Last figures (cycle 10) are considered valid.

Qualitative assessment by product inspection showed no detectable performance evolution.

#### Validation of Integrated Water Vapour over Land

There has been no update on Integrated Water Vapour over Land validation quantitative assessment during the cycle. Last figures (cycle 15) are considered valid.

Qualitative assessment by product inspection showed no detectable performance evolution.



## 4 Level 2 Water products validation

[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

### **Activities done**

- The focus for this time period has been on the Near Real Time data.
- All extractions and statistics have been regenerated for the last three months (February 1<sup>st</sup> 2017 onward; rolling archive limitation). The available matchups therefore cover the winter to spring transition as most of the stations are in the northern hemisphere. Time range available for last processing period covered December 1<sup>st</sup> to March 30<sup>th</sup>.
- Only AERONET-OC in-situ data are available for this time period. Update BOUSSOLE data have been received but not yet processed.
- Vicarious calibration activities is in stand-by, waiting for the complementary dataset covering the August 2016 to April 2017

### **Overall Water-leaving Reflectance performance**

Figure 34 below presents the scatter plots with statistics of OLCI versus in situ reflectances computed for the NRT dataset covering the period from February 1<sup>st</sup> 2016 to April 27<sup>th</sup> 2017 dataset. As stated in previous reports a positive bias is visible particularly on 412 and 443 nm confirming the need for vicarious calibration. Table 1 below summaries the statistics over the previous period, confirming the important bias at 412 and 443nm, 70% and 43% respectively, going done to about 10% toward the green bands. The satistics of the current NRT period are presented in Table 2. Figures remain similar between the two periods.

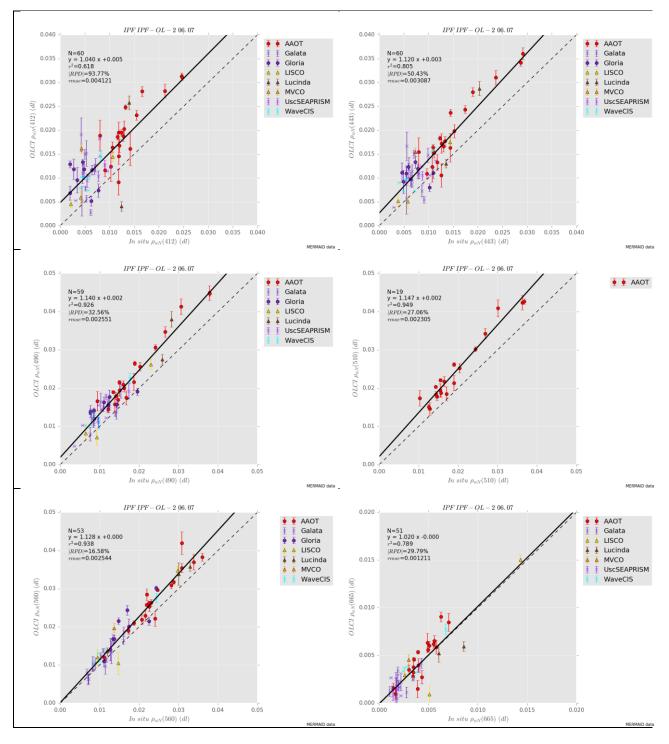
lambda	Ν	RPD	RPD	MAD	RMSE	slope	int.	r2
412	25	70,55%	77,47%	0,0055	0,0071	0,9486	0,0061	0,6787
443	25	43,34%	44,27%	0,0045	0,0056	1,1251	0,0028	0,9037
490	24	28,53%	28,53%	0,0048	0,0059	1,1634	0,0016	0,9611
510	2	31,69%	31,69%	0,0091	0,0093	2,0459	-0,0207	1,0000
560	17	15,44%	16,95%	0,0037	0,0052	1,1350	0,0003	0,9655
665	25	10,56%	34,24%	0,0010	0,0032	1,3661	-0,0013	0,9236

Table 1: statistics over the previous NRT period (December 2016-March 2017)

Table 2: statistics over the current NRT period (February 2017-April 2017)

lambda	Ν	RPD	RPD	MAD	RMSE	slope	int.	r2
412	60	88.15%	93.77%	0.0052	0.0066	1.0404	0.0048	0.6176
443	60	46.70%	50.43%	0.0038	0.0049	1.1195	0.0026	0.8046
490	59	31.38%	32.56%	0.0039	0.0046	1.1397	0.0019	0.9263
510	19	27.06%	27.06%	0.0050	0.0055	1.1474	0.0021	0.9486
560	53	13.42%	16.58%	0.0024	0.0035	1.1281	0.0001	0.9379
665	51	1.02%	29.79%	0.0000	0.0012	1.0202	-0.0001	0.7892

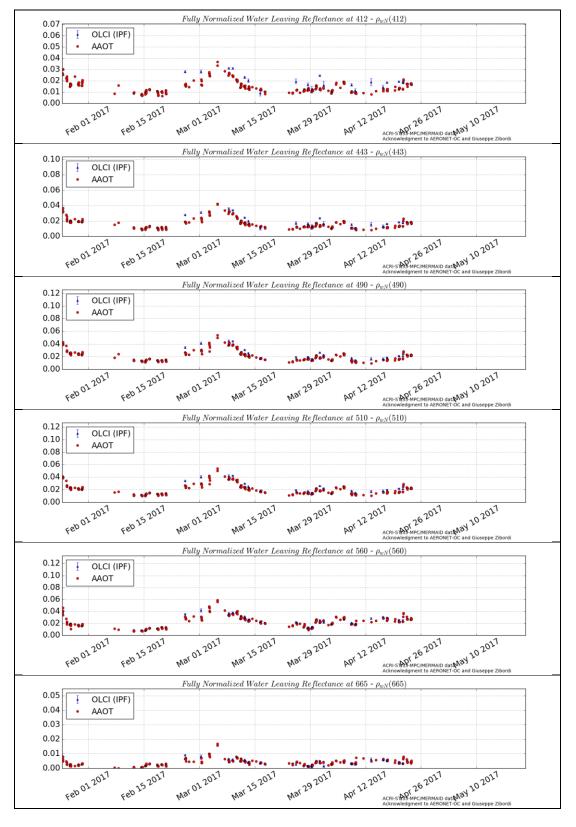




#### Figure 34: Scatter plots of OLCI versus in situ radiometry

Figure 35 below shows the AAOT time series derived over the current NRT period. The general cycle on in situ data is well reproduced but these time series confirm the positive bias at 412 and 443nm.









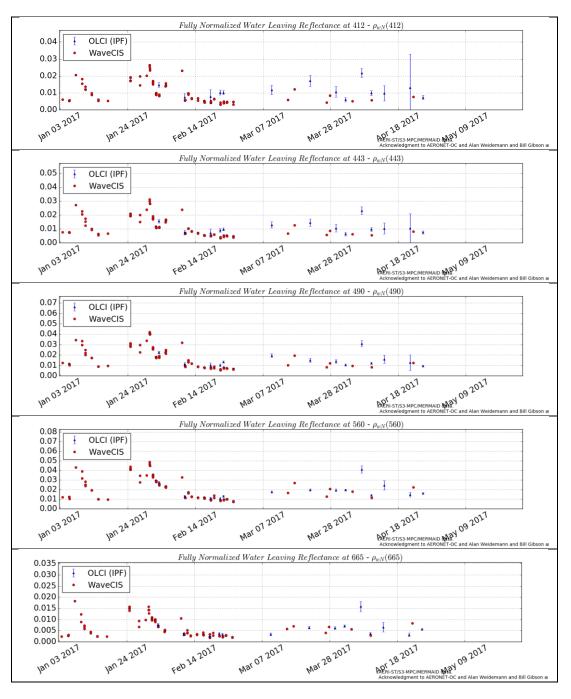


Figure 36: OLCI and AERONET-OC radiometric time series Wave-CIS station.

Figure 36 above shows the WaveCIS AERONET-OC station time series (Gulf of Mexico). After a fairly dynamic period during December to March, winter to Spring transition seems to stabilize the water body. However, standard deviation other the 5x5 macropixels seems to increase within the March April period. Figure 37 provides some elements of interpretation for 20170421's extraction. On this particular date, WaveCIS is located in an area of small patchy clouds. With the current baseline, cloud margin and cloud ambiguous flags are not implemented. A more refined filtration is therefore not possible. This advocates in favour of the operational implementation of these flags.



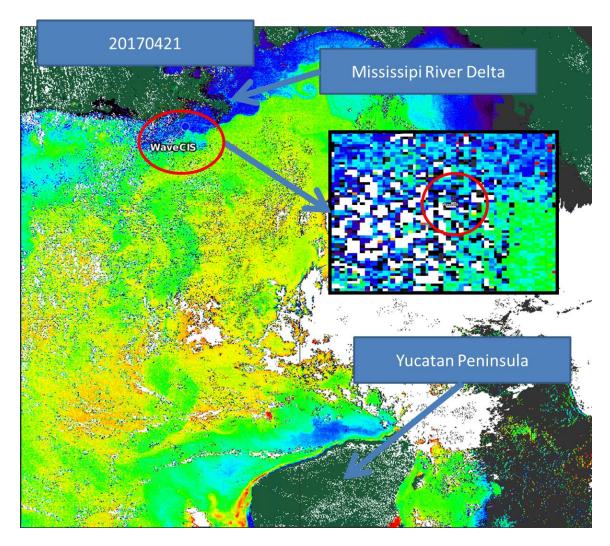


Figure 37: Matching scene over WaveCIS on 2017 04 21. Inspection of large macropixel standard deviation (band 02, 412.5nm)

Figure 38 provides a second example of visual inspection on 20170413 where high standard deviations are observed. On this date, WaveCIS is located within a patch of atmosphere with high aerosol optical thickness resulting in low and noisy reflectance retrieval.



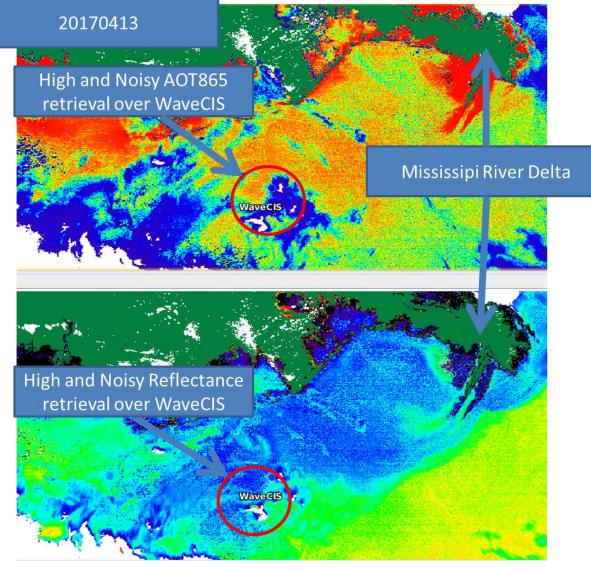
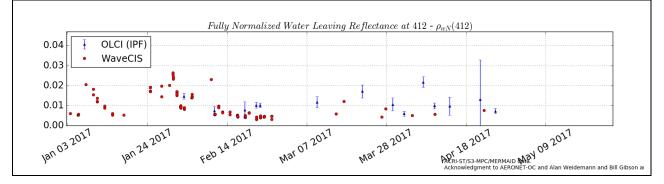
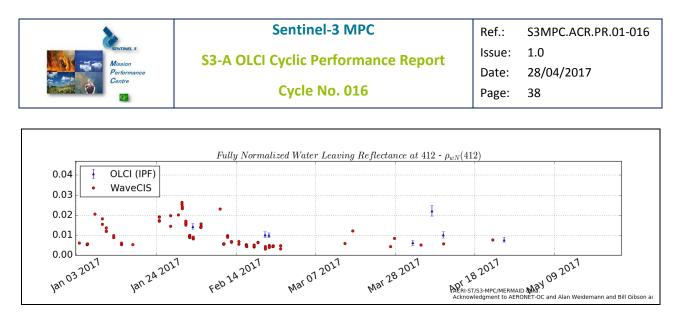


Figure 38: Matching scene over WaveCIS on 2017 04 13. Inspection of large macropixel standard deviation (AOT865 top; band 02, 412.5nm bottom)

Figure 39 illustrates that more stringent filtering criteria can be applied on macro-pixels to reduce dispersion. Top figure is a copy from Figure 38, bottom one make use of two statistical filters based on the means and standard deviation of the macropixels. Dispersion is indeed reduced but at the cost of a significant drop in the number of macropixels.





*Figure 39: Effect of filtering procedures on the number and quality of the matchups.* 



# 5 Level 2 SYN products validation

### [SYN-L2-CV-100]

There has been no update on SYN products validation quantitative assessment during the cycle. Last figures (cycle 10) are considered valid.

Qualitative assessment by product inspection showed no detectable performance evolution.



Cycle No. 016

### 6 Events

Three OLCI Radiometric Calibration Sequences have been acquired during Cycle 016:

- So1 sequence on 27/02/2017 12:39 to 12:41 (absolute orbit 5372)
- \$01 sequence on 12/03/2017 08:38 to 08:40 (absolute orbit 5555)
- So1 sequence on 22/03/2017 14:21 to 14:23 (absolute orbit 5701)



Cycle No. 016

# 7 Appendix A

Other reports related to the Optical mission are:

S3-A SLSTR Cyclic Performance Report, Cycle No. 016 (ref. S3MPC.RAL.PR.02-016)

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

End of document