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

S3 OLCI Cyclic Performance Report		
S3-A	S3-B	
Cycle No. 048	Cycle No. 029	
Start date: 06/08/2019	Start date: 16/08/2019	
End date: 02/09/2019	End date: 12/09/2019	





Mission Performance Centre



Ref.: S3MPC.ACR.PR.01-048-029

Issue: 1.0

Date: 20/09/2019

Contract: 4000111836/14/I-LG

Customer:	ESA	Document Ref.:	S3MPC.ACR.PR.01-048-029
Contract No.:	4000111836/14/I-LG	Date:	20/09/2019
		lssue:	1.0

Project:	PREPARATION AND OPERATIONS OF THE MISSION PERFORMANCE CENTRE (MPC) FOR THE COPERNICUS SENTINEL-3 MISSION		
Title:	S3 OLCI Cyclic Performance Report		
Author(s):	OLCI ESLs		
Approved by:	L. Bourg, OLCI ESL Coordinator	Authorized by	Frédéric Rouffi, OPT Technical Performance Manager
Distribution:	ESA, EUMETSAT, S3MPC conso	rtium	
Accepted by ESA	S. Dransfeld, MPC Deputy TO for OPT P. Féménias, MPC TO		
Filename	S3MPC.ACR.PR.01-048-029 - i1r0 - OLCI Cyclic Report 048-029_corrected.docx		

Disclaimer		
The work performed in the frame of this contract is carried out with funding by the European Union. The views expressed herein can in no way be taken to reflect the official opinion of either the European Union or the European Space Agency.		
Cesa Eumetsat		



Sentinel-3 MPC

S3 OLCI Cyclic Performance Report

S3A Cycle No. 048 – S3B Cycle No. 029

Changes Log

Version	Date	Changes
1.0	20/09/2019	First Version

List of Changes

Version	Section	Answers to RID	Changes



 Ref.:
 S3MPC.ACR.PR.01-048-029

 Issue:
 1.0

 Date:
 20/09/2019

 Page:
 iv

S3A Cycle No. 048 – S3B Cycle No. 029

Table of content

1	PROC	ESSING BASELINE VERSION	1
	1.1	Sentinel3-A	1
	1.2	Sentinel3-B	1
2	INST	RUMENT MONITORING	2
	2.1	CCD temperatures	2
	2.1.1	OLCI-A	2
	2.1.2	OLCI-B	4
	2.2	Radiometric Calibration	6
	2.2.1	Dark Offsets [OLCI-L1B-CV-230]	8
	2.2.2	Instrument response and degradation modelling [OLCI-L1B-CV-250]	. 19
	2.2.3	Ageing of nominal diffuser [OLCI-L1B-CV-240]	35
	2.2.4	Updating of calibration ADF [OLCI-L1B-CV-260]	35
	2.2.5 Diffu	Radiometric Calibrations for sun azimuth angle dependency and Yaw Manoeuvres for Sola ser on-orbit re-characterization [OLCI-L1B-CV-270 and OLCI-L1B-CV-280]	ar . 35
	2.3	Spectral Calibration [OLCI-L1B-CV-400]	35
	2.3.1	OLCI-A	35
	2.3.2	OLCI-B	36
	2.4	Signal to Noise assessment [OLCI-L1B-CV-620]	36
	2.4.1	SNR from Radiometric calibration data	36
	2.4.2	SNR from EO data	43
	2.5	Geometric Calibration/Validation	43
	2.5.1	OLCI-A	43
	2.5.2	OLCI-B	47
3	OLCI	LEVEL 1 PRODUCT VALIDATION	52
	3.1	[OLCI-L1B-CV-300], [OLCI-L1B-CV-310] – Radiometric Validation	52
	3.1.1	S3ETRAC Service	52
	3.1.2	Radiometric validation with DIMITRI	55
	3.1.3	Radiometric validation with OSCAR	55
	3.2	[OLCI-L1B-CV-320] – Radiometric Validation with Level 3 products	55
	3.2.1	OLCI-A	55
	3.2.2	OLCI-B	55



Sentinel-3 MPC

S3A Cycle No. 048 – S3B Cycle No. 029

4	LE\	VEL 2 LAND PRODUCTS VALIDATION	56
	4.1	[OLCI-L2LRF-CV-300]	. 56
	4.2	[OLCI-L2LRF-CV-410 & OLCI-L2LRF-CV-420] – Cloud Masking & Surface Classification for Land	d
	Produ	ucts	. 56
5	LE\	VEL 2 WATER PRODUCTS VALIDATION	57
	5.1	[OLCI-L2-CV-210, OLCI-L2-CV-220] – Vicarious calibration of the NIR and VIS bands	. 57
	5.1	I.1 OLCI-A	. 57
	5.1	I.2 OLCI-B	. 57
	5.2	[OLCI-L2WLR-CV-300, OLCI-L2WLR-CV-310, OLCI-L2WLR-CV-32, OLCI-L2WLR-CV-330, OLCI-	
	L2WL	R-CV-340, OLCI-L2WLR-CV-350, OLCI-L2WLR-CV-360 and OLCI-L2WLR-CV-370] – Level 2 Wate	r-
	leavir	ng Reflectance product validation	. 57
	5.2	2.1 Acknowledgements	. 57
	5.2	2.2 OLCI-A	. 58
	5.2	2.3 OLCI-B	. 58
	5.3	[OLCI-L2WLR-CV-430] – Algorithm performance over spatial and temporal domains	. 58
	5.4	[OLCI-L2WLR-CV-510 & 520] – Cloud Masking & Surface Classification for Water Products	. 58
	5.5	[OLCI-L2WLR-CV530] Validation of Aerosol Product	. 59
	5.6	[OLCI-L2WLR-CV-380] Development of calibration, product and science algorithms	. 59
6	VA	LIDATION OF INTEGRATED WATER VAPOUR OVER LAND & WATER	60
7	LE\	VEL 2 SYN PRODUCTS VALIDATION	61
8	EV	ENTS	62
9	AP	PENDIX A	63



S3 OLCI Cyclic Performance Report

 Ref.:
 S3MPC.ACR.PR.01-048-029

 Issue:
 1.0

 Date:
 20/09/2019

 Page:
 vi

S3A Cycle No. 048 – S3B Cycle No. 029

List of Figures

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 2
Figure 2: Same as Figure 1 for diffuser frames 3
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 stable4
Figure 4: same as Figure 3 for diffuser frames5
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 blue, 2017 in green, 2018 in yellow and 2019 in red6
Figure 6: same as Figure 5 for OLCI-B (2018 in blue, 2019 in red)7
Figure 7: OLCI-A Sun geometry during radiometric Calibrations on top of characterization ones (diffuser frame)7
Figure 8: same as Figure 7 for OLCI-B8
Figure 9: Dark Offset table for band OaO6 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 filtering9
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 10
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 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 12
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 13
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 13
Figure 15: OLCI-A Dark current increase rates with time (in counts per year) vs. band (left) and vs. band width (right) 14



S3A Cycle No. 048 – S3B Cycle No. 029

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. ------ 15

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. ------ 16 Figure 18: same as Figure 17 for smear band. ----- 16 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. ------ 17 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.----- 18 Figure 21: OLCI-B Dark Current increase rates with time (in counts per year) vs. band (left) and vs. band width (right)------ 18 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. ------ 19 Figure 23: camera averaged gain relative evolution with respect to "best geometry" calibration (07/12/2016), as a function of elapsed time since the change in OLCI channels settings (25/04/16); one curve for each band (see colour code on plots), one plot for each module. The diffuser ageing has been taken into account.------ 20 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. ------21 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 is not taken into account (too early to model it yet). ----- 22 Figure 26: RMS performance of the OLCI-A Gain Model of the current processing baseline as a function of orbit.----- 23 Figure 27: RMS performance of the OLCI-A Gain Model of the previous Processing Baseline as a function of orbit.------24 Figure 28: OLCI-A Camera-averaged instrument evolution since channel programming change (25/04/2016) and up to most recent calibration (28/08/2019) versus wavelength.------ 24 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 16 calibrations in extrapolation, with a colour code for each calibration from blue (oldest) to red (most recent).-----25 Figure 30: 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 16 calibrations in extrapolation, channels Oa1 to Oa6. ------ 26 Figure 31: same as Figure 30 for channels Oa7 to Oa14. ----- 27



S3A Cycle No. 048 – S3B Cycle No. 029

Figure 32: same as Figure 30 for channels Oa15 to Oa21.----- 28 Figure 33: RMS performance of the OLCI-B Gain Model of the current processing baseline as a function of orbit ------ 29 Figure 34: OLCI-B Camera-averaged instrument evolution since channel programming change (18/06/2018) and up to most recent calibration (12/09/2019) versus wavelength.------ 30 Figure 35: 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 15 calibrations in extrapolation, with a colour code for each calibration from blue (oldest) to red (most recent). ------ 31 Figure 36: 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 15 calibrations in extrapolation, channels Oa1 to Oa6. ----- 32 Figure 37: same as Figure 36 for channels Oa7 to Oa14. ----- 33 Figure 38: same as Figure 36 for channels Oa15 to Oa21.----- 34 Figure 39: 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. ---- 37 Figure 40: long-term stability of the SNR estimates from Calibration data, example of channel Oa1.---- 38 Figure 41: 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. ---- 40 Figure 42: long-term stability of the OLCI-B SNR estimates from Calibration data, example of channel Oa1. ------ 41 Figure 43: 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 44 Figure 44: across-track (left) and along-track (right) georeferencing biases time series for Camera 1.--- 44 Figure 45: same as Figure 44 for Camera 2.----- 44 Figure 46: : same as Figure 44 for Camera 3. ----- 45 Figure 47: : same as Figure 44 for Camera 4. ----- 45 Figure 48: : same as Figure 44 for Camera 5. ----- 45 Figure 49: OLCI-A across-track georeferencing error (pixels) as a function of instrument spatial pixel for each camera (1 to 5 from left to right and top to bottom), example of 5/5/2019. ------ 46 Figure 50: OLCI-A spatial across-track misregistration at each camera transition (left) and maximum amplitude of the across-track error within each camera (left). ------ 47 Figure 51: overall OLCI-B georeferencing RMS performance time series (left) and number of validated control points corresponding to the performance time series (right) over the whole monitoring period 48 Figure 52: across-track (left) and along-track (right) georeferencing biases time series for Camera 1.--- 48 Figure 53: same as Figure 52 for Camera 2.----- 48 Figure 54: same as Figure 52 for Camera 3.----- 49



S3A Cycle No. 048 – S3B Cycle No. 029

 Figure 55: same as Figure 52 for Camera 4.
 49

 Figure 56: same as Figure 52 for Camera 5.
 49

 Figure 57: OLCI-B across-track georeferencing error (pixels) as a function of instrument spatial pixel for each camera (1 to 5 from left to right and top to bottom), example of 5/5/2019.
 50

 Figure 58: OLCI-B spatial across-track misregistration at each camera transition (left) and maximum amplitude of the across-track error within each camera (left).
 51

 Figure 59: summary of S3ETRAC products generation for OLCI-A (number of OLCI-A 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).
 53

 Figure 60: summary of S3ETRAC products generation for OLCI-B (number of OLCI-B L1 products Ingested, yellow – number of S3ETRAC products generation for OLCI-B (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).
 53

 Figure 60: summary of S3ETRAC extracted products generated, blue – number of S3ETRAC runs without generation of output product (data not meeting selection requirements), green – 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).

List of Tables



S3 OLCI Cyclic Performance Report

Issue: 1.0 Date: 20/09/2019

Ref.: S3MPC.ACR.PR.01-048-029

S3A Cycle No. 048 – S3B Cycle No. 029

1 Processing Baseline Version

1.1 Sentinel3-A

IPF	IPF / Processing Baseline version	Date of deployment
OL1	06.08 / 2.55	NRT: 30/07/2019 10:17 UTC NTC 30/07/2019 10:17 UTC
OL2	06.12 / 2.38	NRT: 29/08/2018 09:24 UTC NTC: 29/08/2018 09:33 UTC
SY2	06.17 / 2.51	NTC: 30/05/2019 11:00 UTC
SY2_VGS	06.07 / 2.44	NTC: 21/01/2019 10:06 UTC

1.2 Sentinel3-B

IPF	IPF / Processing Baseline version	Date of deployment
OL1	06.08 / 1.27	NRT: 30/07/2019 09:37 UTC NTC: 30/07/2019 09:37 UTC
OL2	06.12 / 1.09	NRT: 29/08/2018 09:24 UTC NTC: 29/08/2018 09:33 UTC
SY2	06.17 / 1.23	NTC: 30/05/2019 11:00 UTC
SY2_VGS	06.07 / 1.16	NTC: 21/01/2019 10:06 UTC



S3 OLCI Cyclic Performance Report

S3A Cycle No. 048 – S3B Cycle No. 029

Ref.: S3MPC.ACR.PR.01-048-029 Issue: 1.0 Date: 20/09/2019 Page: 2

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.





Figure 2: Same as Figure 1 for diffuser frames.



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.





Figure 4: same as Figure 3 for diffuser frames.



2.2 Radiometric Calibration

For OLCI-A, two Radiometric Calibration Sequences have been acquired during Cycle 048:

- So1 sequence (diffuser 1) on 08/08/2019 23:53 to 23:54 (absolute orbit 18098)
- S01 sequence (diffuser 1) on 28/08/2019 15:11 to 15:13 (absolute orbit 18378)

For OLCI-B, two Radiometric Calibration Sequences have been acquired during Cycle 029:

- S01 sequence (diffuser 1) on 29/08/2019 17:27 to 17:29 (absolute orbit 7000)
- S01 sequence (diffuser 1) on 12/09/2019 08:00 to 08:02 (absolute orbit 7194)

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 blue, 2017 in green, 2018 in yellow and 2019 in red.





Figure 6: same as Figure 5 for OLCI-B (2018 in blue, 2019 in red).

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)



Sentinel-3 MPC

S3 OLCI Cyclic Performance Report

Ref.: S3MPC.ACR.PR.01-048-029 Issue: 1.0 Date: 20/09/2019

S3A Cycle No. 048 – S3B Cycle No. 029

Date: 20/09/2 Page: 8



Figure 8: same as Figure 7 for OLCI-B

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.

2.2.1.1 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 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 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.



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 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. For camera 2 band Oa21 a slight PN phase drift occurred between orbit 13500 and 14500 but is now stabilized.

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.



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)

2.2.1.2 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.

An instrument anomaly occurred on OLCI-B on 29 May 2019 (reported in document "S3MPC.ACR.MEM.061") followed by a reset of the instrument on 31 May 2019. This reset is probably responsible of the slight change of PN shape visible in camera 3 band Oa21 (see Figure 17) and of the slight change of PN phase in camera 3 smear band (see Figure 18).

There is no specific behaviour of the PN to report in the current cycle.







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.



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.



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.



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 07/12/2016). It shows that, if a



significant evolution occurred during the early mission, the trends tend to stabilize, with the exception of band 1 of camera 1 and 4.



Figure 23: camera averaged gain relative evolution with respect to "best geometry" calibration (07/12/2016), as a function of elapsed time since the change in OLCI channels settings (25/04/16); one curve for each band (see colour code on plots), one plot for each module. The diffuser ageing has been taken into account.



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.



600

0

500

500

100



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 is not taken into account (too early to model it yet).



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 the 11/04/2019 (Processing Baseline 2.48). The model has been derived on the basis of an extended Radiometric Calibration dataset (from 25/04/2016 to 25/01/2019). 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 16 calibrations in extrapolation over about 8 months) remains better than 0.1% (at the exception of band Oa01) when averaged over the whole field of view (Figure 26) while the previous model, trained on a Radiometric Dataset limited to 27/08/2017, shows a strong 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: only Oa01 show a lower performance for the very first calibration with the new model.



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





Figure 27: RMS performance of the OLCI-A Gain Model of the previous Processing Baseline as a function of orbit.

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



Figure 28: OLCI-A Camera-averaged instrument evolution since channel programming change (25/04/2016) and up to most recent calibration (28/08/2019) 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 42 clearly demonstrate the improvement brought by the new model whatever the level of detail.



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 16 calibrations in extrapolation, with a colour code for each calibration from blue (oldest) to red (most recent).



Sentinel-3 MPC

S3 OLCI Cyclic Performance Report

S3A Cycle No. 048 – S3B Cycle No. 029

Date: 20/09/ Page: 26



Figure 30: 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 16 calibrations in extrapolation, channels Oa1 to Oa6.





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






Figure 32: same as Figure 30 for channels Oa15 to Oa21.



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 11th December 2018 Yaw Manoeuvres), has been deployed at PDGS on 11th April 2019 (Processing Baseline 1.20). The model performance over the complete dataset (including the 15 calibrations in extrapolation over about 7 months) is illustrated in Figure 33. It remains better than 0.19% when averaged over the whole field of view except for Oa01 which already shows a strong drift (0.57%).



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

The overall instrument evolution since channel programming change (18/06/2018) is shown on Figure 34.





Figure 34: OLCI-B Camera-averaged instrument evolution since channel programming change (18/06/2018) and up to most recent calibration (12/09/2019) versus wavelength.

The overall per camera performance, as a function of wavelength, and at each orbit is shown on Figure 35 as the average and standard deviation of the model over data ratio.

Finally, Figure 36 to Figure 38 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 35: 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 15 calibrations in extrapolation, with a colour code for each calibration from blue (oldest) to red (most recent).





Figure 36: 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 15 calibrations in extrapolation, channels Oa1 to Oa6.



Sentinel-3 MPC

S3 OLCI Cyclic Performance Report

S3A Cycle No. 048 - S3B Cycle No. 029

 Ref.:
 S3MPC.ACR.PR.01-048-029

 Issue:
 1.0

 Date:
 20/09/2019

 Page:
 33



Figure 37: same as Figure 36 for channels Oa7 to Oa14.





Figure 38: same as Figure 36 for channels Oa15 to Oa21.



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

2.2.3.1 OLCI-A

There has been no calibration sequence S05 (reference diffuser) for OLCI-A during acquisition cycle 048.

Consequently, the last results presented in Cycle Report #47/#28 (S3A/S3B) stay valid.

2.2.3.2 OLCI-B

There has been no calibration sequence S05 (reference diffuser) for OLCI-B during acquisition cycle **029.**

Consequently, the last results presented in Cycle Report #47/#28 (S3A/S3B) stay valid.

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

2.2.4.1.1 OLCI-A

No CAL_AX was delivered to PDGS during the reported period for OLCI-A.

2.2.4.1.2 OLCI-B

No CAL_AX was delivered to PDGS during the reported 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 048 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.

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

2.3.1 OLCI-A

There has been no Spectral Calibration (S02 + S03) acquisition and no Spectral Calibration S09 for OLCI-A during the reporting period.

Consequently, the last results presented in Cyclic Report #46/#47 (S3A/S3B) remain valid.



2.3.2 OLCI-B

There has been no Spectral Calibration (S02 + S03) acquisition and no Spectral Calibration S09 for OLCI-B during the reporting period.

Consequently, the last results presented in Cyclic Report #46/#47 (S3A/S3B) remain valid.

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

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 39.

SNR computed for all calibration data as a function of orbit number for band Oa01 (the less stable band) is presented in Figure 40.

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





Figure 39: 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.





Figure 40: 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.



Sentinel-3 MPC

S3 OLCI Cyclic Performance Report

S3A Cycle No. 048 – S3B Cycle No. 029

 Ref.:
 S3MPC.ACR.PR.01-048-029

 Issue:
 1.0

 Date:
 20/09/2019

 Page:
 39

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).														
	L_{ref}	SNR	C1		C2		C3		C4		C5		All	
nm	LU	RQT	avg	std	avg	std	avg	std	avg	std	avg	std	avg	std
400.000	63.0	2188	2421	6.2	2398	6.7	2328	7.1	2378	11.8	2283	9.1	2362	7.0
412.000	74.1	2061	2391	8.6	2407	5.8	2340	4.8	2401	5.0	2383	8.1	2384	4.8
442.000	65.6	1811	2160	5.2	2198	5.7	2165	4.8	2185	4.1	2196	5.3	2181	3.6
490.000	51.2	1541	2001	4.7	2036	5.1	1997	4.1	1983	4.4	1988	4.8	2001	3.5
510.000	44.4	1488	1979	5.4	2014	4.8	1984	4.7	1966	4.5	1985	4.6	1986	3.7
560.000	31.5	1280	1776	4.6	1802	4.1	1802	4.9	1794	3.9	1818	3.4	1798	3.1
620.000	21.1	997	1591	4.1	1609	4.2	1624	3.3	1593	3.4	1615	3.6	1607	2.7
665.000	16.4	883	1546	4.2	1558	4.4	1566	3.9	1533	3.7	1561	4.0	1553	3.2
674.000	15.7	707	1329	3.5	1338	3.8	1350	2.8	1323	3.3	1342	3.6	1336	2.5
681.000	15.1	745	1319	3.7	1326	3.2	1338	2.7	1314	2.4	1333	3.6	1326	2.2
709.000	12.7	785	1420	4.5	1420	4.2	1435	3.4	1414	3.6	1430	3.1	1424	2.9
754.000	10.3	605	1127	3.2	1120	3.0	1135	3.5	1124	2.5	1139	3.0	1129	2.5
761.000	6.1	232	502	1.2	498	1.2	505	1.2	500	1.1	507	1.5	503	0.9
764.000	7.1	305	663	1.6	658	1.5	667	2.1	661	1.6	670	2.2	664	1.4
768.000	7.6	330	558	1.6	554	1.3	562	1.3	556	1.5	564	1.3	559	1.1
779.000	9.2	812	1515	5.0	1498	5.0	1525	5.3	1511	5.1	1526	5.1	1515	4.4
865.000	6.2	666	1244	3.6	1213	3.8	1238	4.0	1246	3.7	1250	2.9	1238	3.1
885.000	6.0	395	823	1.7	801	1.7	814	2.0	824	1.5	831	1.8	819	1.2
900.000	4.7	308	691	1.7	673	1.3	683	1.7	693	1.4	698	1.6	688	1.0
940.000	2.4	203	534	1.1	522	1.1	525	1.0	539	1.1	542	1.4	532	0.8
1020.000	3.9	152	345	0.9	337	0.9	348	0.7	345	0.9	351	0.8	345	0.5



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 41.

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 42.

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 41: 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.





Figure 42: long-term stability of the OLCI-B SNR estimates from Calibration data, example of channel Oa1.



Sentinel-3 MPC

S3 OLCI Cyclic Performance Report

 Ref.:
 S3MPC.ACR.PR.01-048-029

 Issue:
 1.0

 Date:
 20/09/2019

 Page:
 42

S3A Cycle No. 048 – S3B Cycle No. 029

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 mW.sr⁻¹.m⁻².nm⁻¹).

	L_{ref}	SNR	C1		C2		C3		C4		C5		All	
nm	LU	RQT	avg	std	avg	std	avg	std	avg	std	avg	std	avg	std
400.000	63.0	2188	2438	20.2	2279	16.4	2417	6.2	2386	14.3	2573	11.7	2419	12.8
412.000	74.1	2061	2655	6.5	2570	6.0	2550	8.1	2549	5.9	2640	7.1	2593	4.9
442.000	65.6	1811	2327	6.3	2318	6.2	2303	6.2	2307	6.2	2311	6.3	2313	5.3
490.000	51.2	1541	1965	4.8	1987	5.9	1971	5.3	1951	5.1	1978	4.9	1970	4.1
510.000	44.4	1488	1937	5.6	1965	5.3	1942	5.0	1921	4.5	1950	4.4	1943	3.9
560.000	31.5	1280	1812	5.0	1846	5.8	1828	4.7	1802	5.1	1816	4.8	1821	4.1
620.000	21.1	997	1572	4.5	1626	5.0	1625	3.7	1576	4.1	1601	3.4	1600	3.2
665.000	16.4	883	1513	4.2	1579	4.0	1573	4.1	1501	3.2	1546	4.1	1542	3.0
674.000	15.7	707	1301	3.9	1358	4.3	1353	3.6	1292	2.9	1328	3.2	1326	2.8
681.000	15.1	745	1292	3.5	1347	3.5	1343	3.1	1285	2.8	1316	3.0	1317	2.2
709.000	12.7	785	1389	4.4	1447	4.3	1442	4.7	1372	3.3	1412	4.1	1412	3.4
754.000	10.3	605	1094	4.2	1141	3.9	1141	4.0	1088	3.0	1114	3.9	1115	3.4
761.000	6.1	232	487	1.4	509	1.2	508	1.4	485	1.2	497	1.4	497	1.1
764.000	7.1	305	643	1.6	671	2.1	671	2.1	640	1.8	657	2.0	656	1.6
768.000	7.6	330	541	1.5	567	1.4	564	1.5	540	1.4	554	1.7	553	1.1
779.000	9.2	812	1465	4.6	1533	5.0	1524	6.3	1465	4.1	1504	4.9	1498	4.3
865.000	6.2	666	1220	4.0	1286	4.1	1257	4.2	1203	3.4	1237	3.3	1240	3.2
885.000	6.0	395	807	2.7	847	1.9	833	2.2	798	1.8	814	2.0	820	1.7
900.000	4.7	308	679	1.4	714	2.0	704	1.6	669	1.5	682	1.5	690	1.2
940.000	2.4	203	527	1.3	549	1.6	550	1.4	509	1.2	522	1.4	532	1.0
1020.000	3.9	152	336	0.8	359	1.2	358	0.9	318	0.8	339	1.2	342	0.8



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

2.5.1 OLCI-A

2.5.1.1 Global performance

The good performance of OLCI-A georeferencing since the introduction of the upgraded Geometric Calibration on 14/03/2018 is confirmed. The following figures show time series of the overall RMS performance (requirement criterion) and of the across-track and along-track biases for each camera. The performance improvement on the 14/03/2018 is obvious on each figure, the most dramatic improvements affecting along-track bias of Camera 3 (Figure 46) and across-track biases of Cameras 4 and 5 (Figure 47 & Figure 48, respectively). Compliance is comfortably met since then (Figure 43): RMS values remain around 0.3 pixel and all biases below 0.2 pixel from 14/03 on, except for the along-track bias of camera 3 for which a small drift can be noticed, implying a performance slightly below -0.2 pixel since a few weeks (Figure 46, right).

It can be seen that peak RMS values are associated to a very low numbers of GCPs (out of scale on Figure 43) and can be considered as outliers. The same remark applies to the AC and AL biases displayed in Figure 44 to Figure 48.



Figure 43: 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

Date

Date



Figure 44: across-track (left) and along-track (right) georeferencing biases time series for Camera 1.



Figure 45: same as Figure 44 for Camera 2.













Figure 48: : same as Figure 44 for Camera 5.



2.5.1.2 Cross-FOV analysis

An update of the geometric monitoring tools and procedures now allows to analyse the performance at a more detailed level and in particular with respect to the across-track position (in instrument grid).

This allowed to identify optical distortion implying a variation of the georeferencing performance across the field-of view. An example is provided below for the 5th of May 2019 (Figure 49). It shows that the performance remains generally correct for all pixels, except at the edge of camera 2 where it exceeds 0.5 pixel in absolute value. It also shows that the variation of the biases are in the same direction for all cameras, implying a maximum misregistration at the cameras interface.

Re-calibration of the instrument pixels pointing vectors (IPPVM) to correct this issue has been done and put in production since 30/07/2019, improvement on the coregistration performance at camera interfaces can be seen at the very end of the time series of Figure 50.



Figure 49: OLCI-A across-track georeferencing error (pixels) as a function of instrument spatial pixel for each camera (1 to 5 from left to right and top to bottom), example of 5/5/2019.

A long-term monitoring has been put in place and, considering the behaviour highlighted above, puts emphasis, on the one hand on the differences at the camera interfaces, and on the other hand on the maximum misregistration within each camera. Values are roughly stable with time.



Figure 50: OLCI-A spatial across-track misregistration at each camera transition (left) and maximum amplitude of the across-track error within each camera (left).

2.5.2 OLCI-B

2.5.2.1 Global performance

The performance of OLCI-B georeferencing is within requirements since the introduction of the 3rd Geometric Calibration on 12/12/2018 (instrument to platform alignment correction terms). In addition, a new Geometric Calibration has been put in production on the 30/07/2019, this time addressing the pixels pointing vectors (IPPVMs, see section 2.5.2.2) further improving the pointing performance. The following figures show time series of the overall RMS performance (requirement criterion) and of the across-track and along-track biases for each camera. The performance of across-track pointing is excellent over the whole mission. The along-track performance, showing initially significant drifts for all cameras is well corrected with the latest instrument/platform Calibration (12/12/18). Since the recent upgrade of the IPPVMs the georeferencing performance is further improved for all indicators (global RMS or per camera across-track and along-track biases), together with a significant reduction of their variability, as the upgrade of the pixels pointing vectors provides a more homogeneous performance across the instrument field of view.





12 000

0.9

0.8

Figure 51: overall OLCI-B 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 52: across-track (left) and along-track (right) georeferencing biases time series for Camera 1.



Figure 53: same as Figure 52 for Camera 2.













Figure 56: same as Figure 52 for Camera 5.



2.5.2.2 Cross-FOV analysis

The same cross-FOV performance analysis as described for OLCI-A has been applied to OLCI-B. It highlighted even larger optical distortion implying a variation of the georeferencing performance across the field-of view. The same example (5th of May 2019) is shown on Figure 57. It shows higher variations that for OLCI-A, with biases exceed 0.5 pixel at edges of cameras 1 2 and 3, and a significantly non-linear cross-FOV variation inside camera 1. As for OLCI-A the general trends of the biases variations are in the same direction for all cameras, implying a maximum misregistration at the cameras interface.

Re-calibration of the instrument pixels pointing vectors (IPPVM) to correct this issue has been done and put in production since 30/07/2019, improvement on the coregistration performance at camera interfaces can be seen at the very end of the time series of Figure 58.



Figure 57: OLCI-B across-track georeferencing error (pixels) as a function of instrument spatial pixel for each camera (1 to 5 from left to right and top to bottom), example of 5/5/2019.



The same long-term monitoring has been put in place and, considering the behaviour highlighted above, puts emphasis, on the one hand on the differences at the camera interfaces, and on the other hand on the maximum misregistration within each camera (Figure 58). Misregistration before the IPPVM correction reached up to 1 pixel, both at transitions and within a given camera while the performance wince the introduction of the upgraded Pointing Vectors is around 0.1 pixel (0.2 at transition between cameras 1 and 2). In the OLCI-B case, the values are not stable in time: the performance is not independent of the platform to instrument alignment correction recalibrated more frequently.



Figure 58: OLCI-B spatial across-track misregistration at each camera transition (left) and maximum amplitude of the across-track error within each camera (left).



S3A Cycle No. 048 – S3B Cycle No. 029

3 OLCI Level 1 Product validation

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

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 <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) for both OLCI-A (Figure 59) and OLCI-B (Figure 60).



Figure 59: summary of S3ETRAC products generation for OLCI-A

(number of OLCI-A 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).





Figure 60: 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).



3.1.2 Radiometric validation with DIMITRI

There has been no new result during the cycle. Last figures (cycle 047/029) are considered valid.

3.1.3 Radiometric validation with OSCAR

There has been no new result during the cycle. Last figures (cycle 047/029) are considered valid.

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

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.



4 Level 2 Land products validation

4.1 [OLCI-L2LRF-CV-300]

There has been no new result during the cycle. Last figures (cycle 047/029) are considered valid.

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 27) are considered valid.



S3A Cycle No. 048 – S3B Cycle No. 029

5 Level 2 Water products validation

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

5.1.1 OLCI-A

There has been no update of the SVC (System Vicarious Calibration) during Cycle 048. Last figures (cycle 17) are considered valid.

5.1.2 OLCI-B

There has been no update of the SVC (System Vicarious Calibration) during Cycle 029. Last figures (cycle 023) are considered state of the art.

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: Giuseppe Zibordi, Joint Research Centre of the European Commission
 - **leodo**: 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
 - **WaveCIS**: Alan Weidemann, Bill Gibson, Robert Arnone, University of Southern MS, Coastal Studies Inst LSU, Naval Research Laboratory



S3A Cycle No. 048 – S3B Cycle No. 029

- 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

There has been no new result during the cycle. Last figures (cycle 047/029) are considered valid.

5.2.3 OLCI-B

There has been no new result during the cycle. Last figures (cycle 047/029) are considered valid.

5.3 [OLCI-L2WLR-CV-430] – Algorithm performance over spatial and temporal domains

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

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



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

There has been no new result during the cycle. Last figures (cycle 047/029) are considered valid.

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

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



6 Validation of Integrated Water Vapour over Land & Water

There has been no new result during the cycle. Last figures (cycle 047/029) are considered valid.

The OLCI IWV above land surface product is continuously validated using various sources of ground truth data. In contrast to the previous results, the data base has been extended to OLCI B.



7 Level 2 SYN products validation

There has been no new result during the cycle. Last figures (cycle 43/24) are considered valid.



8 Events

For OLCI-A, two Radiometric Calibration Sequences have been acquired during Cycle 048:

- So1 sequence (diffuser 1) on 08/08/2019 23:53 to 23:54 (absolute orbit 18098)
- S01 sequence (diffuser 1) on 28/08/2019 15:11 to 15:13 (absolute orbit 18378)

For OLCI-B, two Radiometric Calibration Sequences have been acquired during Cycle 029:

- S01 sequence (diffuser 1) on 29/08/2019 17:27 to 17:29 (absolute orbit 7000)
- S01 sequence (diffuser 1) on 12/09/2019 08:00 to 08:02 (absolute orbit 7194)



S3A Cycle No. 048 – S3B Cycle No. 029

9 Appendix A

Other reports related to the Optical mission are:

 S3 SLSTR Cyclic Performance Report, S3A Cycle No. 048, S3B Cycle No. 029 (ref. S3MPC.RAL.PR.02-048-029)

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

End of document