QUARTERLY IMAGE QUALITY REPORT

IQR#019

Reporting period from 16/06/2018 to 15/09/2018

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DOCUMENT CONTROL

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Change record

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1.0	20/09/2018	All	Initial version	

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1. Radiometric Image Quality

1.1. Summary

An over-correction of the degradation is visible in the SWIR calibration results. It is therefore now decided to no longer apply the degradation model for the SWIR strips. This change will be implemented starting from the next ICP file update on the October 1, 2018. Investigation for the implementation of a non-linear degradation model to take better into account the asymptotic degradation trend is on-going.

The DDC blue band calibration results show a decreasing trend. This trend is probably caused by two effects : 1) an increase in the response of the RED reference band as seen in desert and lunar calibration results and 2) a decrease in response of the BLUE band itself that is not fully compensated for by the application of the blue band degradation model. More investigation is needed to decide on the proper actions.

The three yaw maneuver campaigns (on July 9,18 and 27) were successfully performed over the Niger1 site for the three different cameras and will be analyzed in the coming period and compared to the results retrieved on the basis of the yaw maneuvers performed last year.

During Q3 of 2018 one new bad pixel (i.e. center SWIR1 PixelID 819 0-based) was identified.

1.2. Assessment of the radiometric accuracy

1.2.1. Absolute radiometric accuracy

The absolute radiometric calibration requirement for PROBA-V specifies a 5 % absolute accuracy. This requirement is assessed through vicarious calibration over Libya-4 desert site and Rayleigh calibration zones.

1.2.1.1. Libya-4 desert calibration

Methodology

The nominal approach for assessing the absolute radiometric accuracy relies on the comparison between cloud-free TOA reflectance as measured over the Libya-4 desert site by PROBA-V and the modelled TOA reflectance values, following the approach described in [LIT1]. Validation of the approach using various satellite data (i.e. AQUA-MODIS, MERIS, AATSR, PARASOL, SPOT-VGT) has shown that absolute calibration over the Libya-4 desert is achievable with this approach with an accuracy of 3% [LIT1, LIT2].

Results

In Figure1, Figure3 and Figure 5 the monthly averaged results ($avg(\rho_{TOA}^{k,ProbaV(Acom)}/\rho_{TOA}^{k,model})$) and its standard deviation are given for respectively LEFT, CENTER and RIGHT camera.
The individual area-averaged results are given in Figure2, Figure4 and Figure 6 with a 3 % error bar (as expected uncertainty for an individual result) for respectively VNIR and SWIR strips.

Results are obtained based on the **Collection 1** ICP files.

It should be noted that since 2018 a degradation model is no longer in use for the RIGHT SWIR strips, while for LEFT and CENTER strips a linear degradation is still being applied. The Libya-4 calibration results do show a slight overcorrection of the degradation. It is therefore now decided to no longer apply the degradation model for the SWIR strips. This change will be implemented starting from the next ICP file update on the October 1, 2018. Investigation for the implementation of a non-linear degradation model to take better into account the asymptotic degradation trend is on-going.

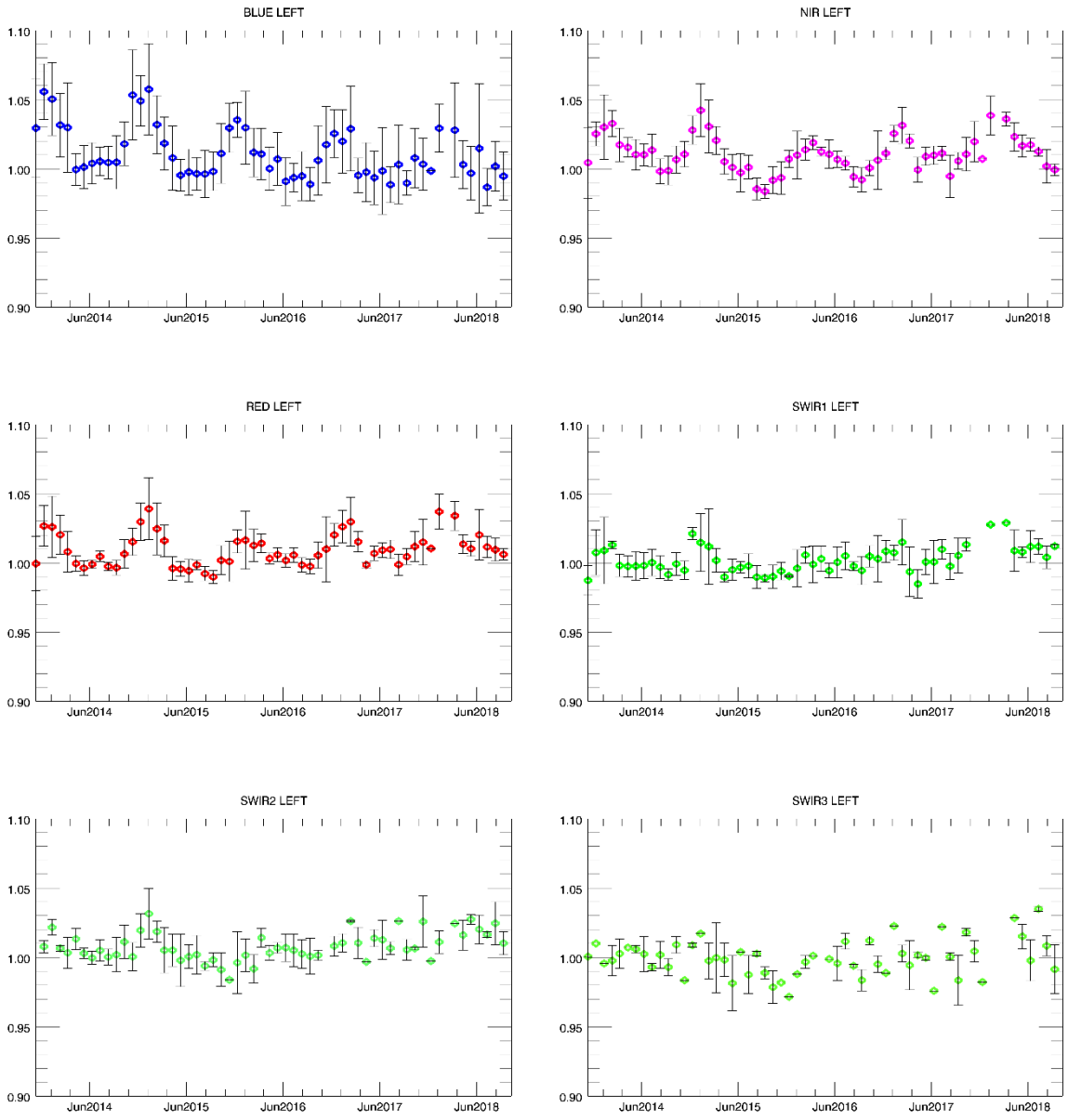


Figure 1. Libya-4 desert calibration results: LEFT monthly averaged results (Collection 1)

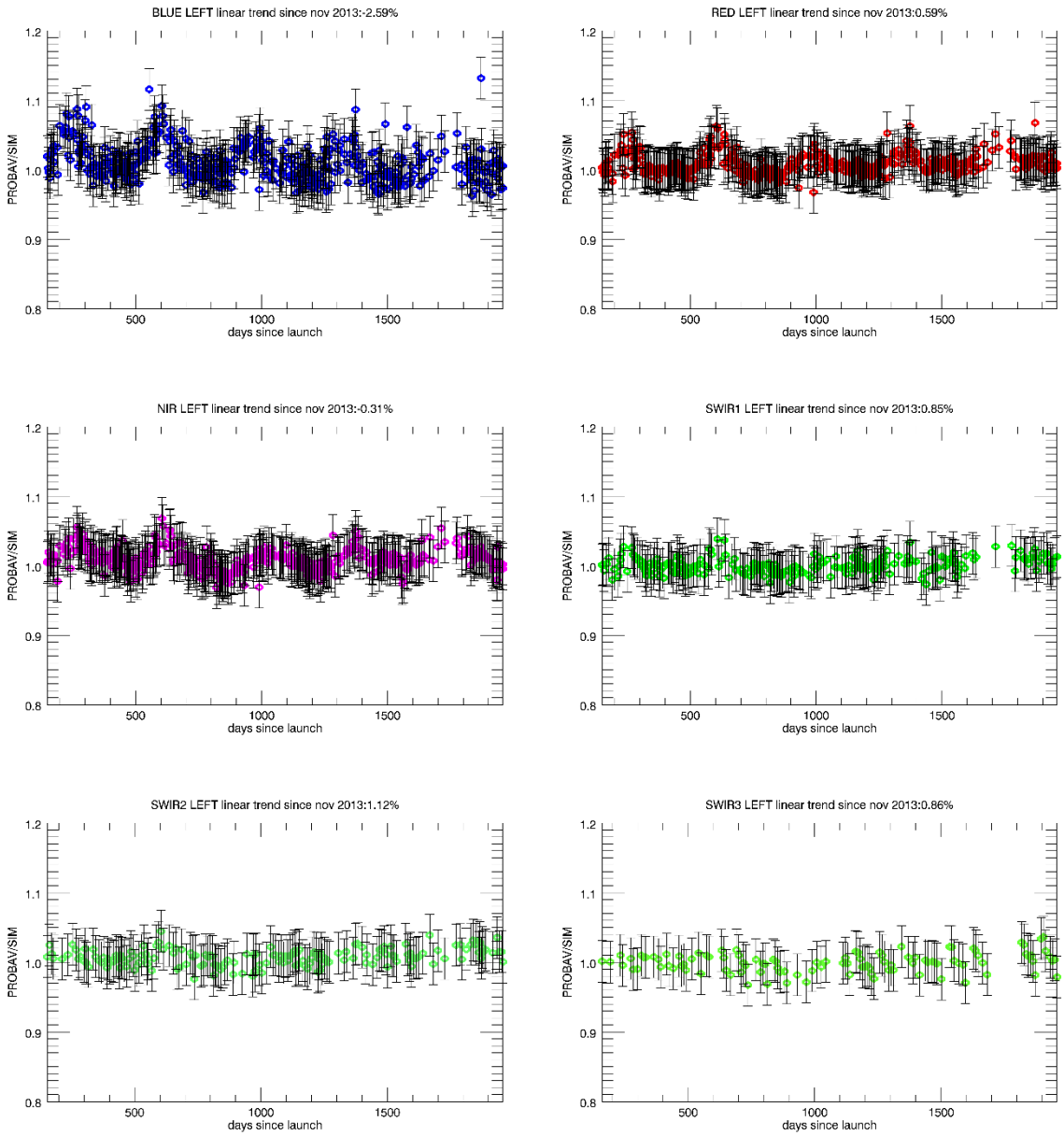


Figure 2. Libya-4 desert calibration results: LEFT individual results (Collection 1)

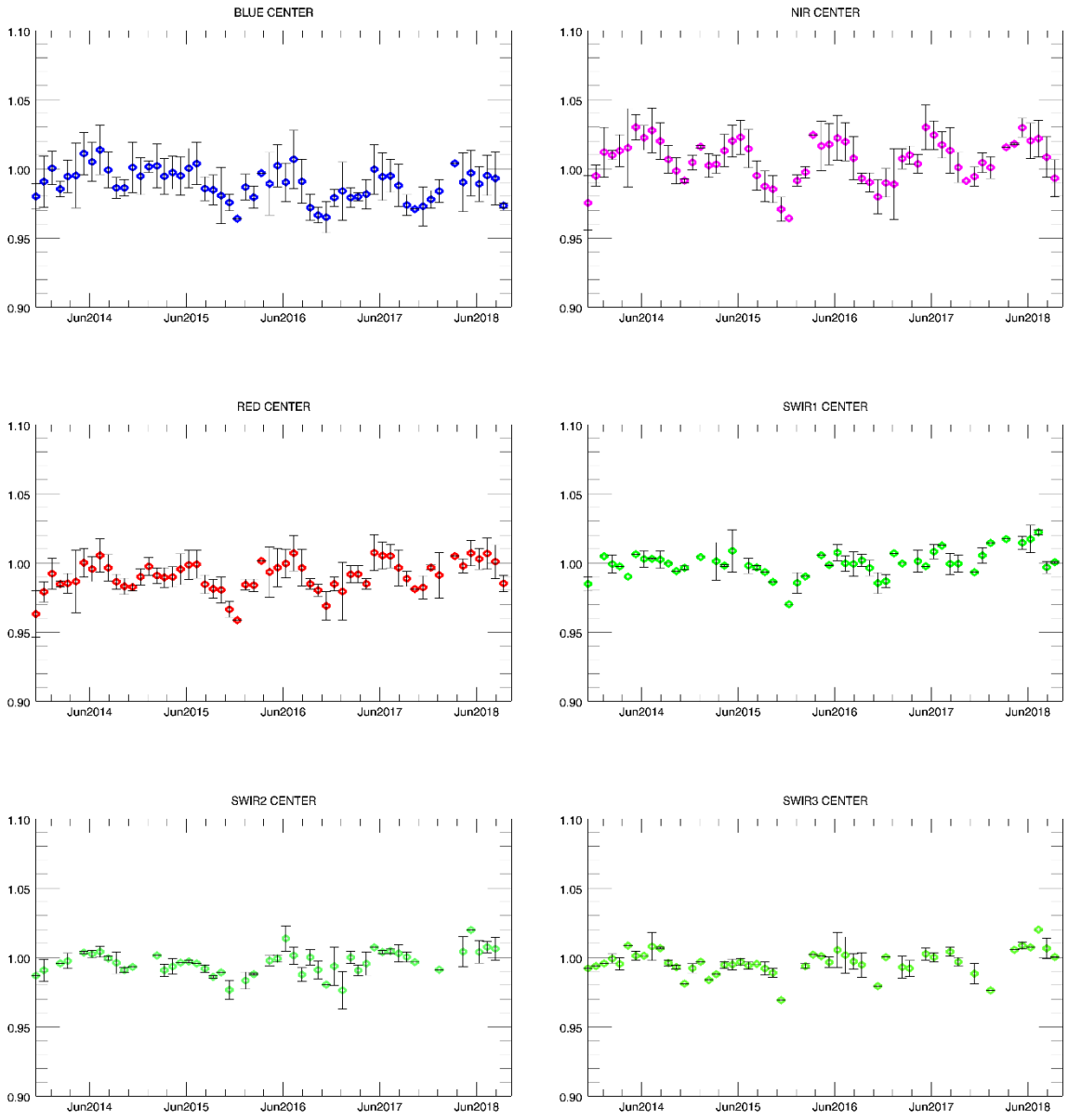


Figure 3. Libya-4 desert calibration results: CENTER monthly averaged results (Collection 1)

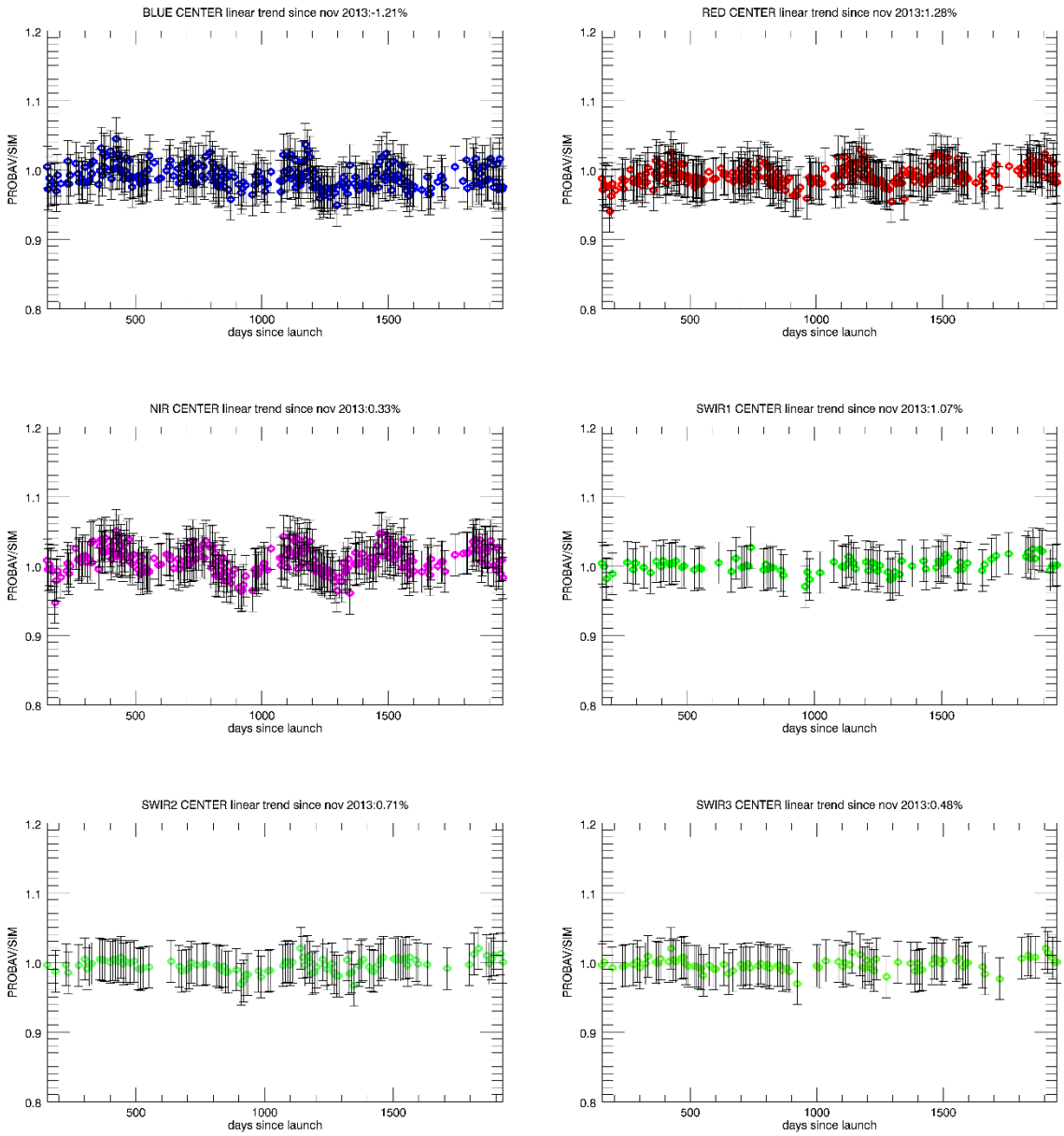


Figure 4. Libya-4 desert calibration results: CENTER individual results (Collection 1)

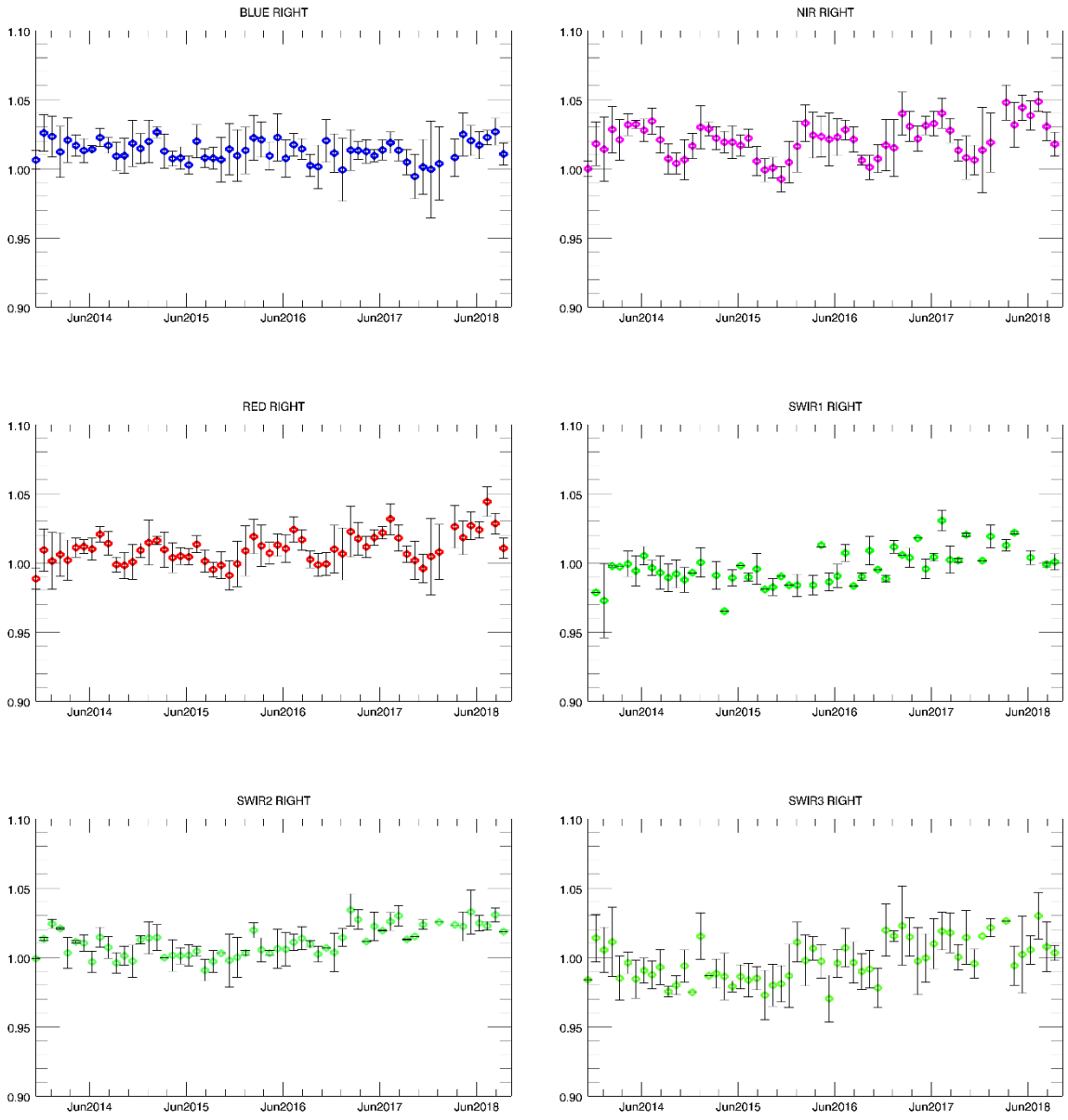


Figure 5. Libya-4 desert calibration results: RIGHT monthly averaged results (Collection 1)

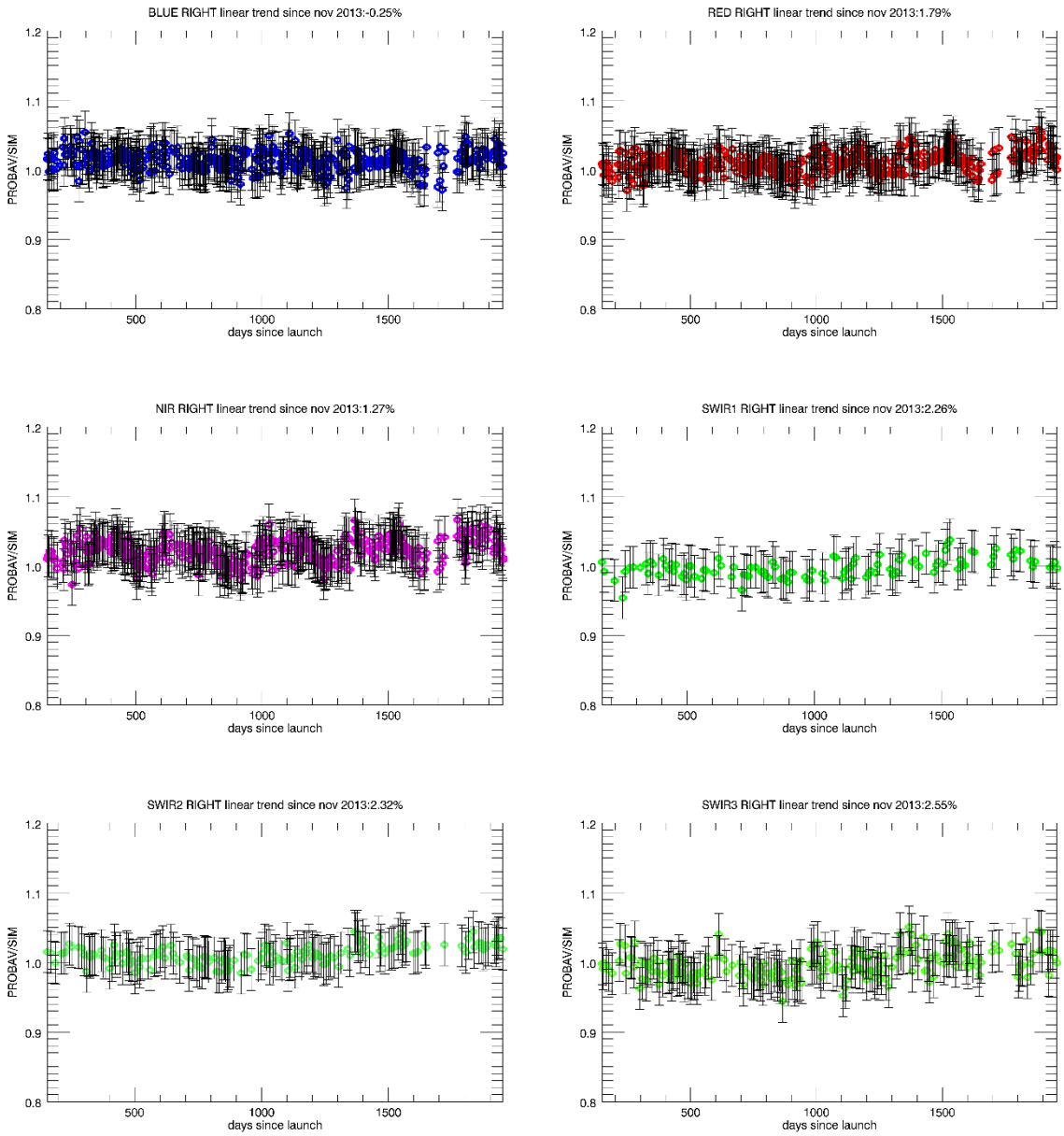


Figure 6. Libya-4 desert calibration results: RIGHT individual results (Collection 1)

1.2.1.2. Rayleigh calibration

Methodology

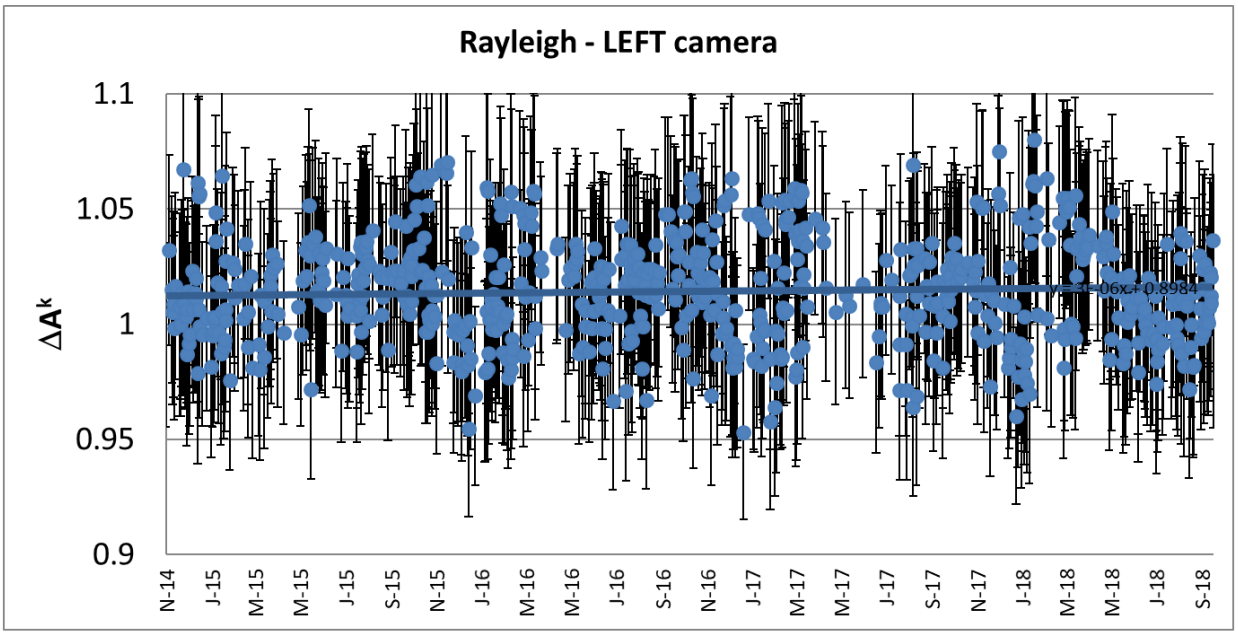
The Rayleigh calibration approach is an absolute calibration method for BLUE and RED bands. The primary assumption of the approach is that the ocean does not contribute to the Top-Of-Atmosphere (TOA) signal in the NIR. The contribution of aerosol scattering is derived from the ***NIR reference band*** where molecular scattering is negligible. The aerosol content estimated from the NIR band is then transferred to the BLUE and RED band to model the TOA radiance with a radiative transfer code. The simulated radiance values are then compared with the measured values.

Results

The scene averaged Rayleigh results ($(\rho_{TOA}^{k,ProbaV(Acom)}/\rho_{TOA}^{k,model})$) (with a 4 % error bar as rough indication of uncertainty of one individual result) obtained since January 2014 for LEFT, CENTER and RIGHT camera are given in respectively Figure 7, Figure 8 and Figure 9.

Results are obtained using the **Collection 1 ICP** files.

No significant trend is visible in the Rayleigh calibration results.



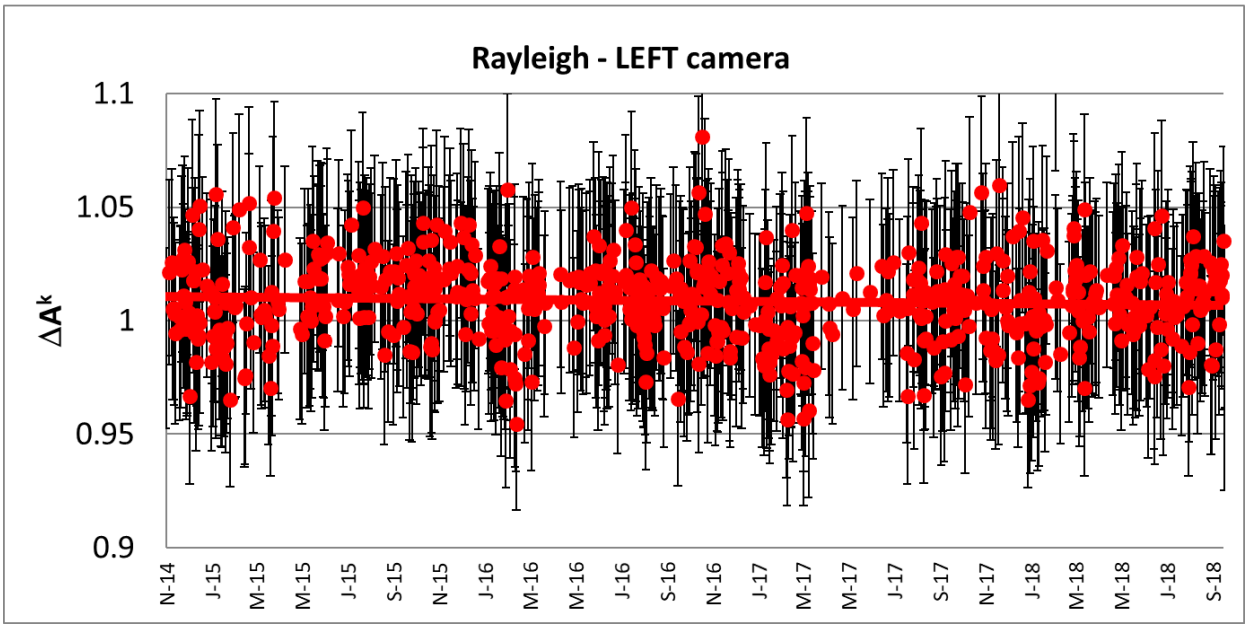


Figure 7. Rayleigh absolute calibration results: LEFT camera (Collection 1)

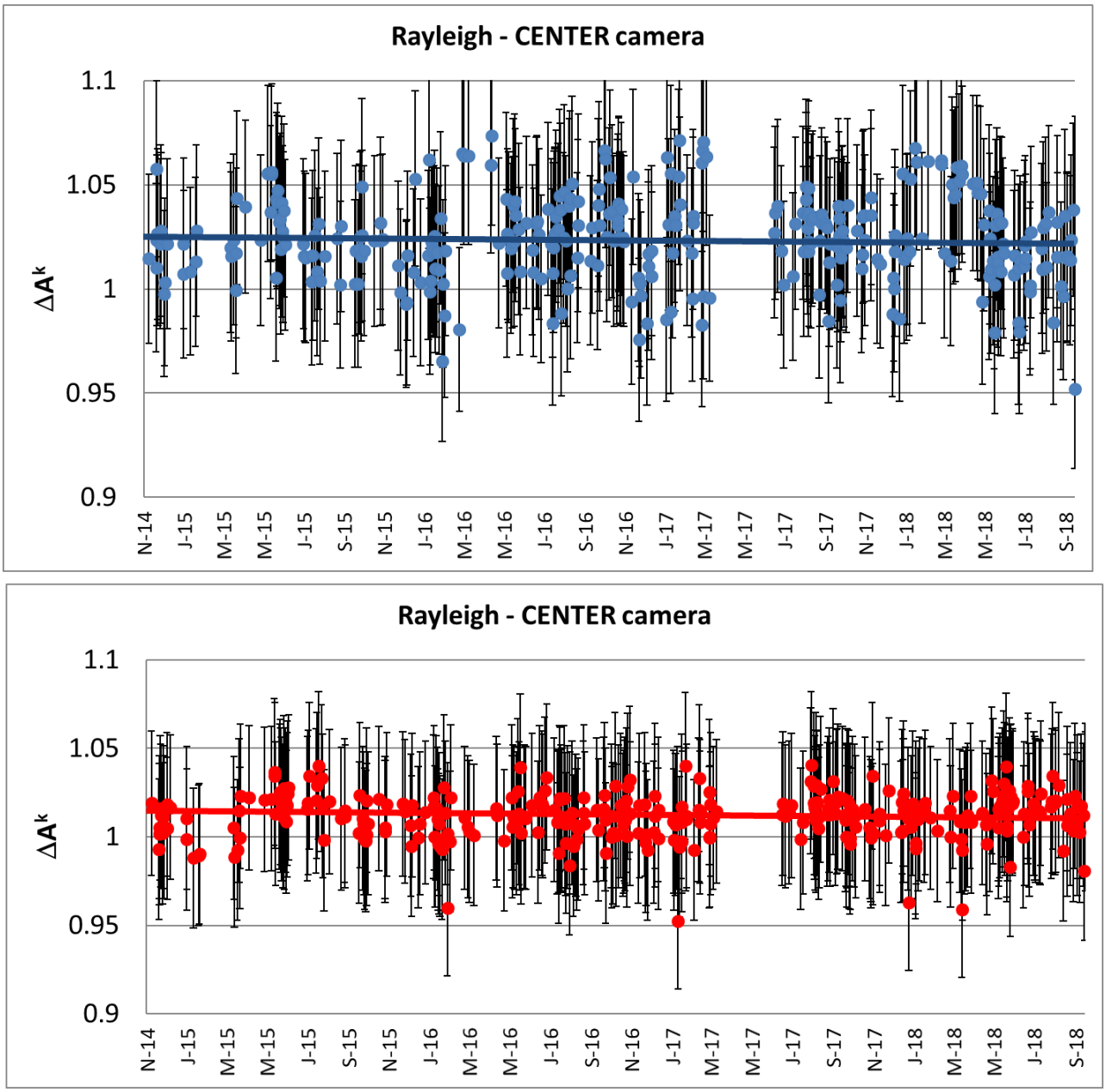


Figure 8. Rayleigh absolute calibration results: CENTER camera (Collection 1)

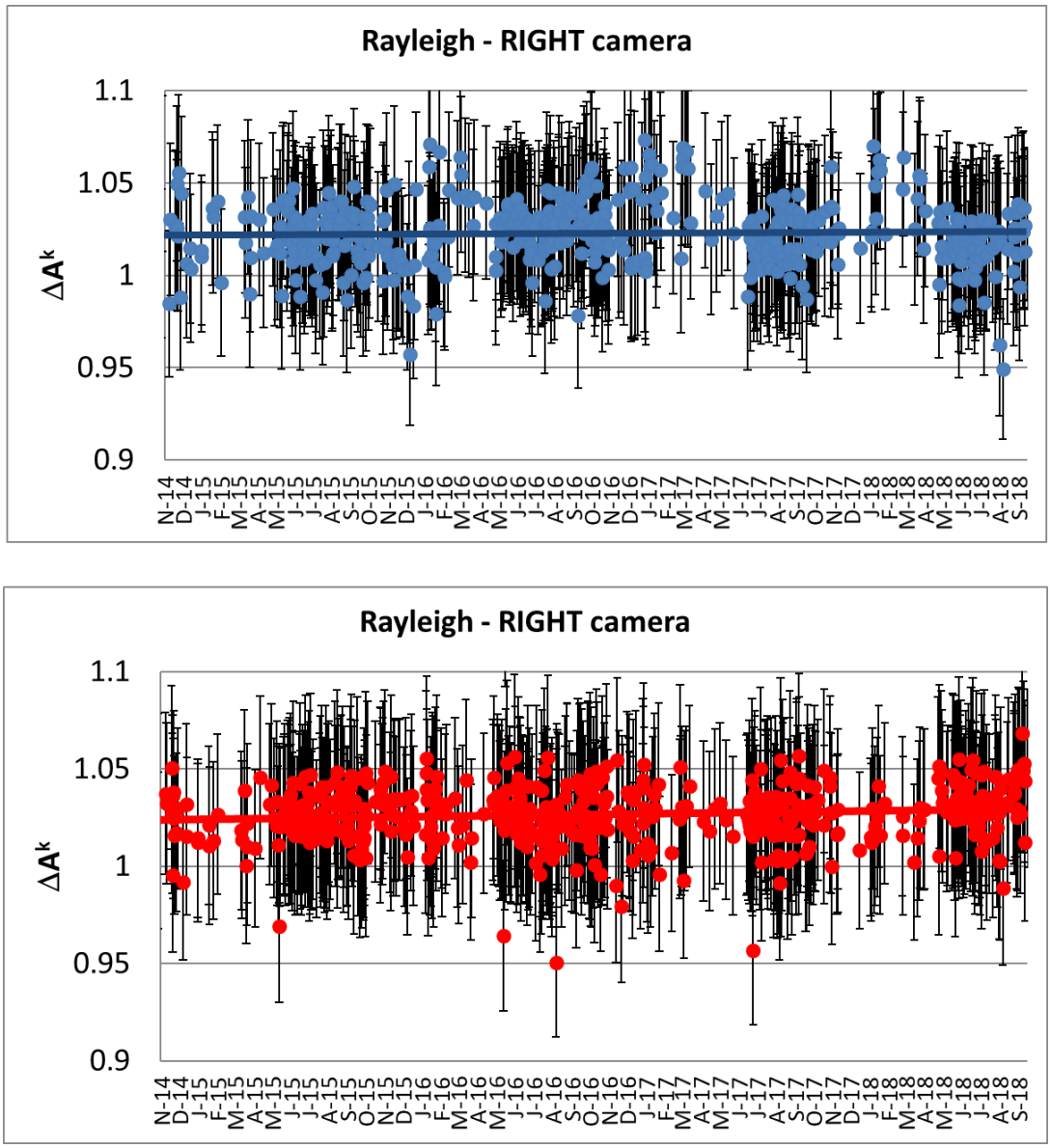


Figure 9. Rayleigh absolute calibration results: RIGHT camera (Collection 1)

1.2.2. Inter-band radiometric accuracy

The inter-band radiometric calibration requirement for PROBA-V specifies a 3 % inter-band accuracy. This requirement is assessed through vicarious calibration over deep convective clouds.

1.2.2.1. Calibration over deep convective clouds (DCC)

Methodology

The DCC approach is an inter-band calibration method. It makes use of bright, thick, high altitude, convective clouds over oceanic sites. Their reflective properties are spectrally flat in visible and near-infrared and the only contributions to the observed signal are from the cloud reflectance, molecular scattering and ozone absorption which can be modelled with a radiative transfer code.
The cloud reflectance in the non-absorbing VNIR bands is mainly sensitive to the cloud optical thickness. The DCC method uses the TOA reflectance in the 'reference' RED band to estimate cloud optical thickness assuming a fixed ice particle model. The derived cloud optical thickness is then used to model using a radiative transfer code the TOA reflectance for the BLUE and NIR band.

The method is not suited for the SWIR band as clouds are no longer spectrally uniform in this spectral region.

Results

The DCC inter-band calibration is defined by reference to the used RED reference band. The average DCC inter-band calibration result per month (from March 2015 to September 2018) is given in Figure 10 for all cameras using the **collection 1 ICP files**.

The DDC blue band calibration results show a decreasing trend. This trend is probably caused by two effects : 1) an increase in the response of the RED reference band as seen in desert and lunar calibration results and 2) a decrease in response of the BLUE band itself that is not fully compensated for by the application of the blue band degradation model. More investigation is needed to decide on the proper actions.

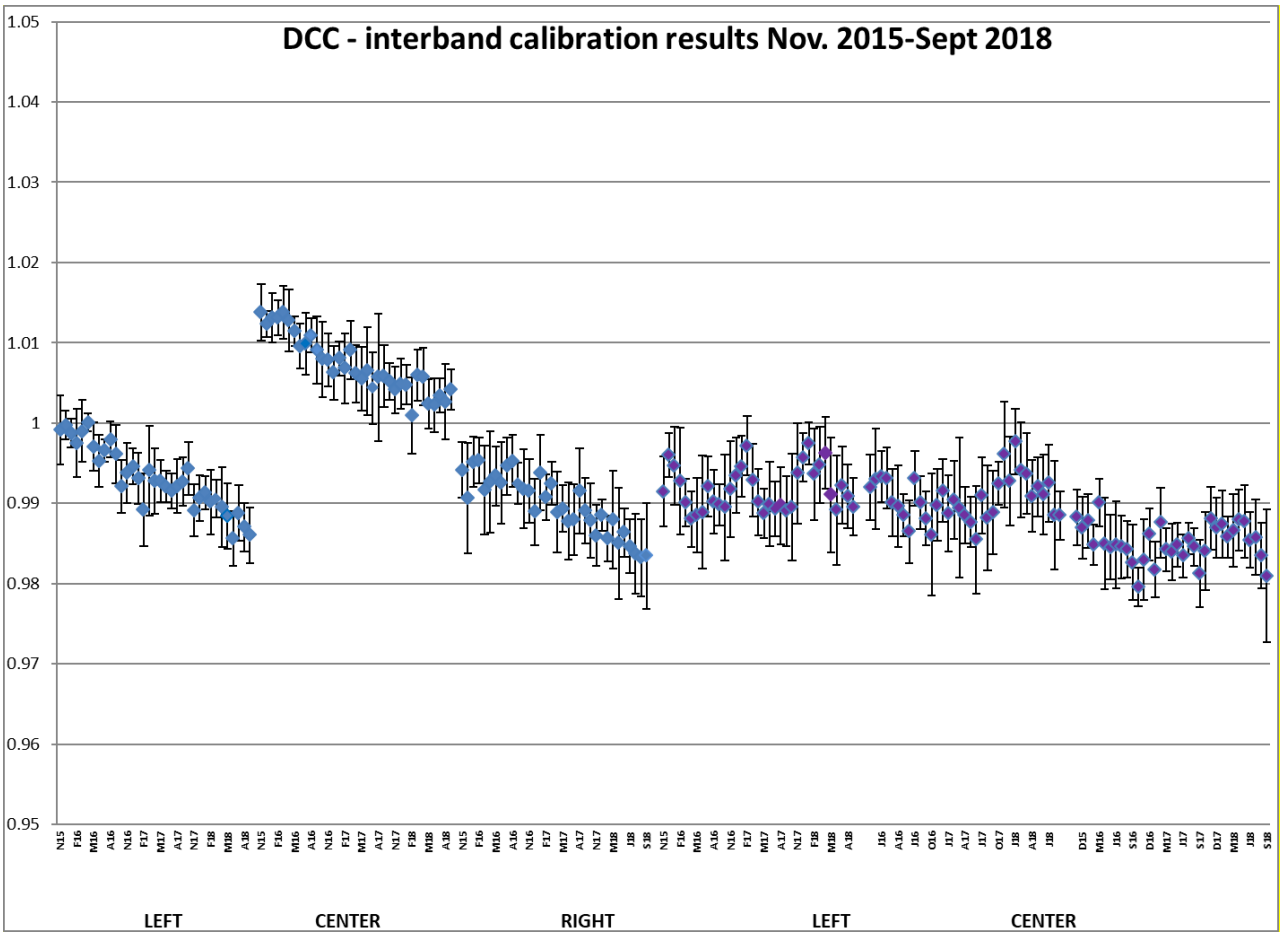


Figure 10. DCC inter-band calibration results: LEFT, CENTER and RIGHT camera

1.2.3. PROBA-V Multi-temporal radiometric accuracy

1.2.3.1. Degradation model

No changes have been made to the degradation models in this reporting period.

As the Libya-4 calibration results do show a slight overcorrection of the degradation, it is now decided to no longer apply the degradation model for the SWIR strips. This change will be implemented starting from the next ICP file update on the October 1, 2018. Investigation for the implementation of a non-linear degradation model to take better into account the asymptotic degradation trend is on-going.

In Table 1 the applied degradation model correction is given. This linear degration model is being applied for collection 1 since start of the operational phase (i.e. October 2013). A re-evaluation of the coefficients of the SWIR degradation model was performed in summer 2017. Since Jan 2018 a degradation model is no longer applied to the RIGHT SWIR strips. From October 2018 onwards this will the case for the other SWIR strips.

Table 1 SWIR degradation model: applied linear trend/month

	Degradation model ICP			
	Start- aug 2017	Sept 2017-Dec 2018	Jan 2018-Sept 2018	Oct 2018-..
SWIR1 LEFT	-0.087	-0.087	-0.087	NA
SWIR2 LEFT	-0.104	-0.104	-0.104	NA
SWIR3 LEFT	-0.097	-0.097	-0.097	NA
SWIR1 CENTER	-0.093	-0.093	-0.093	NA
SWIR2 CENTER	-0.092	-0.092	-0.092	NA
SWIR3 CENTER	-0.086	-0.086	-0.086	NA
SWIR1 RIGHT	-0.106	-0.077	NA	NA
SWIR2 RIGHT	-0.143	-0.122	NA	NA
SWIR3 RIGHT	-0.122	-0.078	NA	NA

A degradation model is used to update the absolute calibration coefficients of the LEFT and RIGHT BLUE since May 2017. A re-evaluation of the coefficients of the degradation model was performed in summer 2017. Since then no changes have been made to the model. In Table 2 the coefficients are given.

As mentioned in previous sections the DDC blue band calibration results show a decreasing trend. This trend is probably caused by two effects : 1) an increase in the response of the RED reference band as seen in desert and lunar calibration results and 2) a decrease in response of the BLUE band itself that is not fully compensated for by the application of the blue band degradation model. More investigation is needed to decide on the proper actions related to the degradation model.

Table 2 Degradation model BLUE LEFT and CENTER camera: applied linear trend/month

	Linear trend/month (%)	
	Degradation model ICP	Degradation model ICP
STRIP	may 2017-aug 2017	since sept 2017
BLUE LEFT	-0.028	-0.036
BLUE RIGHT	-0.011	-0.034

1.2.3.2. Lunar calibration

The Lunar calibration results for the VNIR CENTER camera bands, normalised to June 2013, are given in Figure 11. The results are given based on the **collection 1 ICP** files.

Similarly as in the Libya-4 CENTER RED results an increase in responsivity is observed in the lunar CENTER RED results and a degradation in the BLUE calibration results, whereas the results of the NIR strip seems to stable over time.

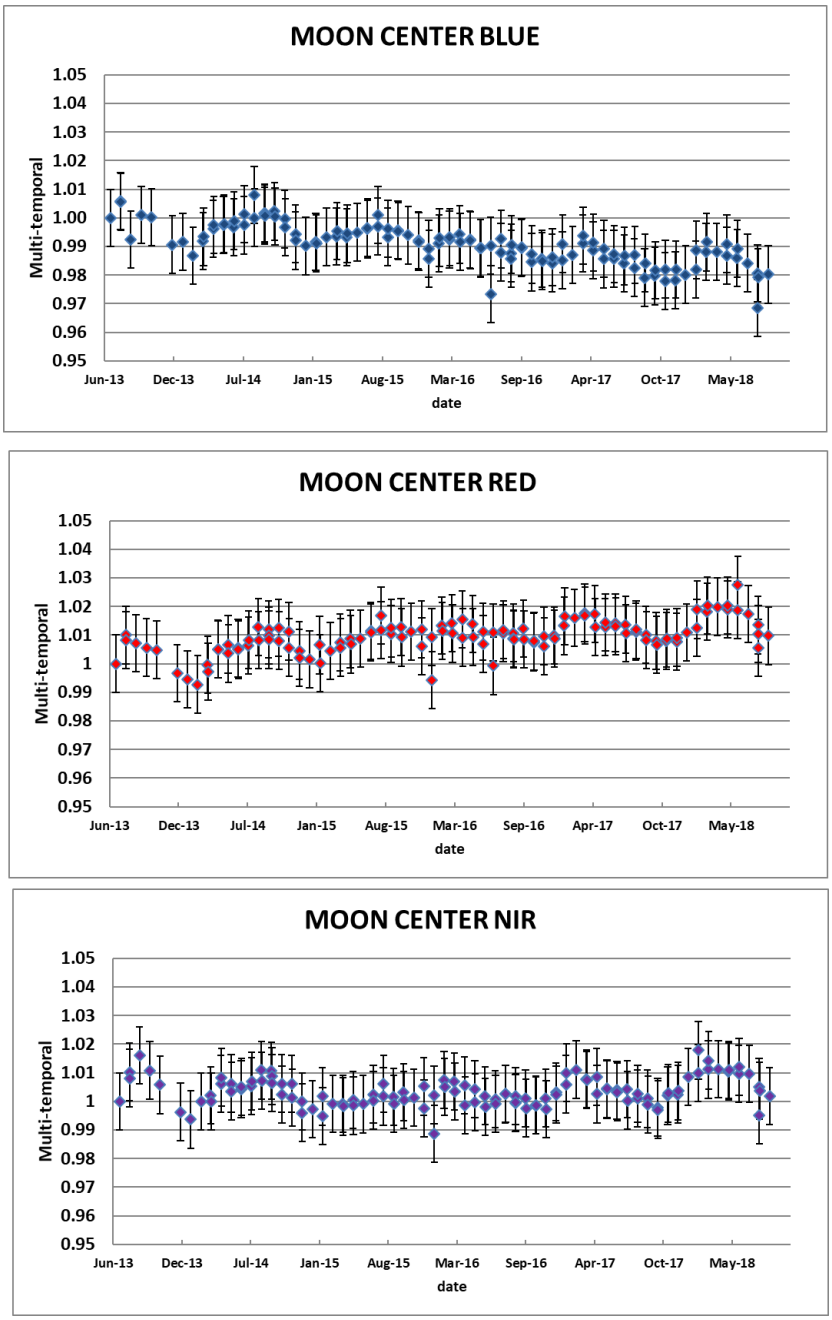


Figure 11. Lunar Calibration results CENTER camera normalised to June 2013 (collection 1 ICP files)

1.2.3.3. Libya-4 VS Moon

As mentioned in previous report degradation trends observed in the Lunar calibration results for the center SWIR2 strip are less significant than these observed in the desert calibration results.

In the frame of the ESA's 'Lunar Irradiance Measurements of the Moon' project VITO is working on an improved lunar model. A reprocessing of the PROBA-V lunar calibration results based on the

improved model is foreseen for the near future. It is expected that this will give us a better insight in the actual degradation trend.

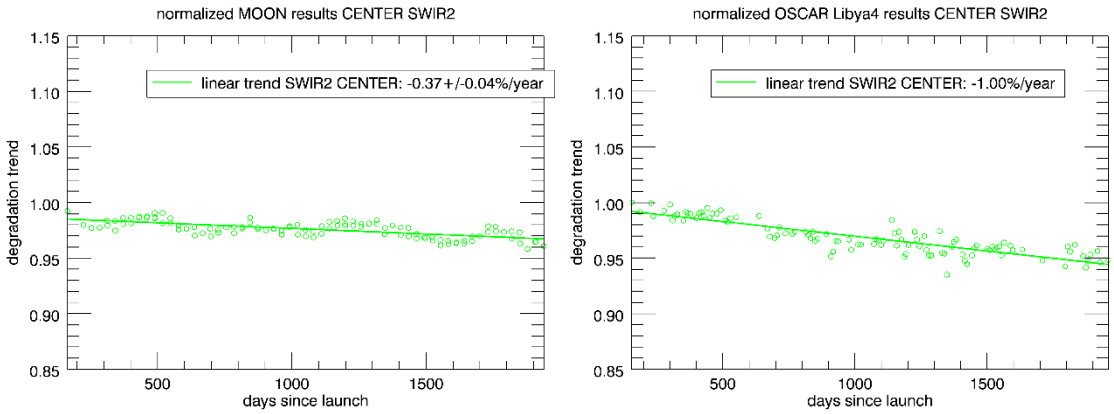


Figure 12. Comparison of degradation monitoring of CENTER SWIR2 strip on the basis of the lunar and Libya-4 calibration results

1.3. Dark current

1.3.1. Methodology

- Monthly difference plots :
  - All dark current results obtained during a period of one month for observations performed with a long integration time are averaged per pixel. This gives for each pixel the monthly averaged dark current, expressed **in LSB/s**, and its standard deviation.
  - The dark current results and its standard deviation expressed in LSB/s are converted to **LSB** using a maximum Integration Time for nominal acquisitions. For VNIR strips **0.006s** is used. For SWIR strips **0.02s.**
  - The differences between months (i.e. Month3-Month2, Month2-Month1) are calculated. This is done for both the dark current and the stdev. Differences are visualized in plots in blue the dark current difference in LSB is plotted, in red the standard deviation difference. This latter is an indicator of changes in the dark current noise between months.

As mentioned in the previous quarterly report (IQR#005) the integration time used for the SWIR dark current acquisitions has been decreased from 3s to 0.2 s since 2015.

1.3.2. VNIR results

Monthly difference plots for VNIR dark currents are given in Figure 13, Figure 14 and Figure 15 for respectively LEFT, CENTER and RIGHT camera.

Dark current differences for the VNIR bands are well below 1 DN.

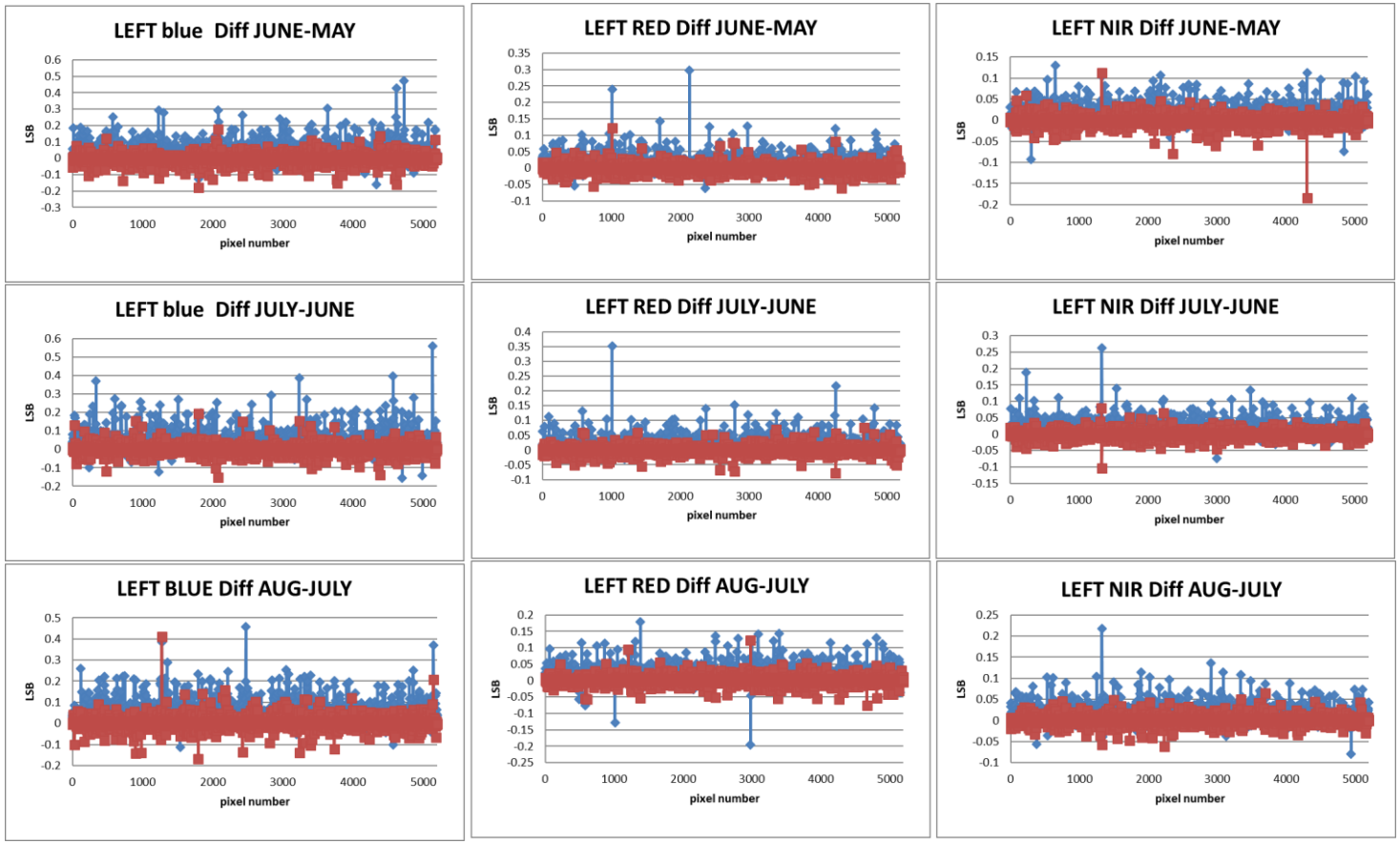


Figure 13. LEFT camera VNIR: Monthly difference (MAY AUG2018) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.

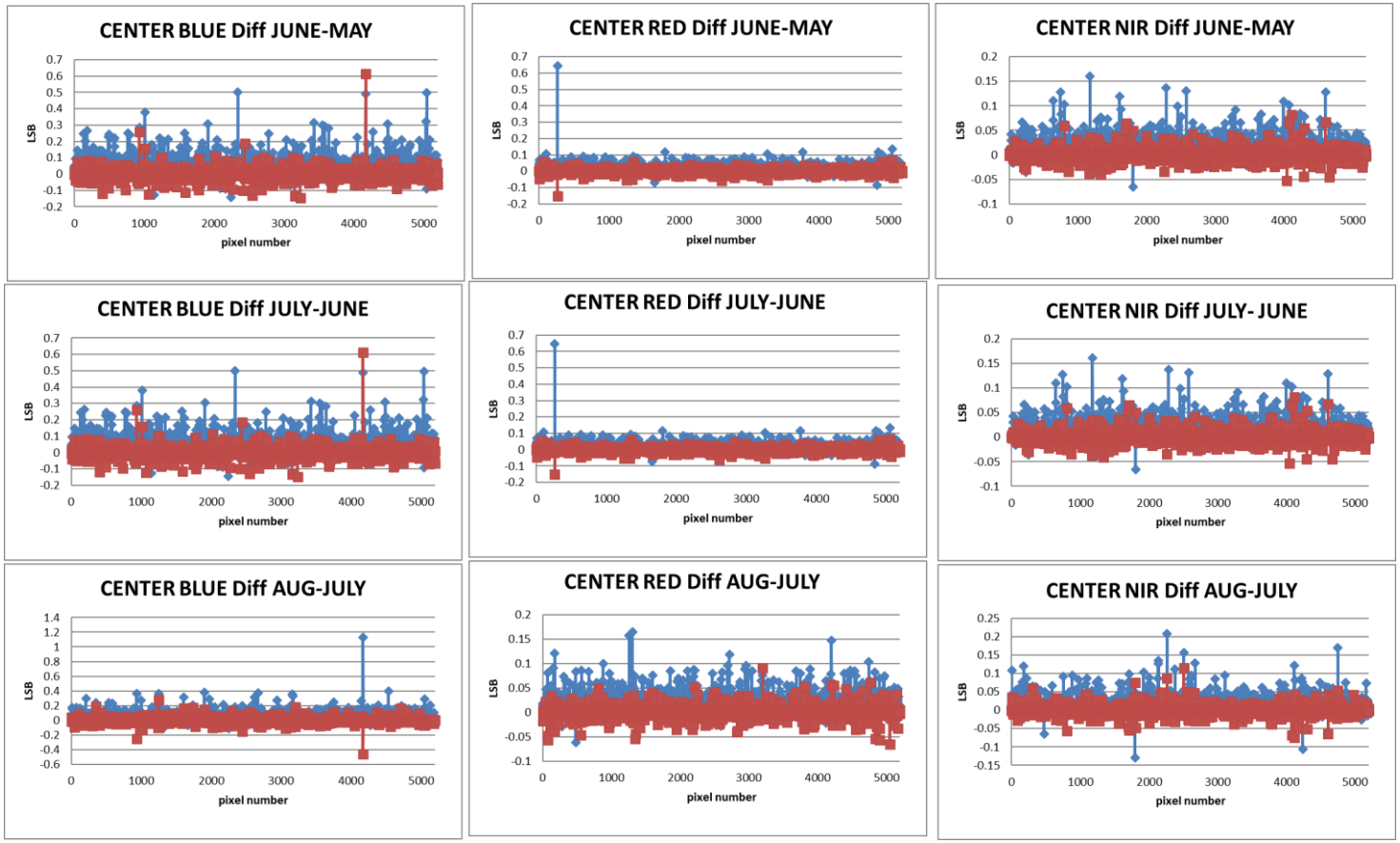


Figure 14. CENTER camera VNIR: Monthly difference (-MAY AUG2018*) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.*

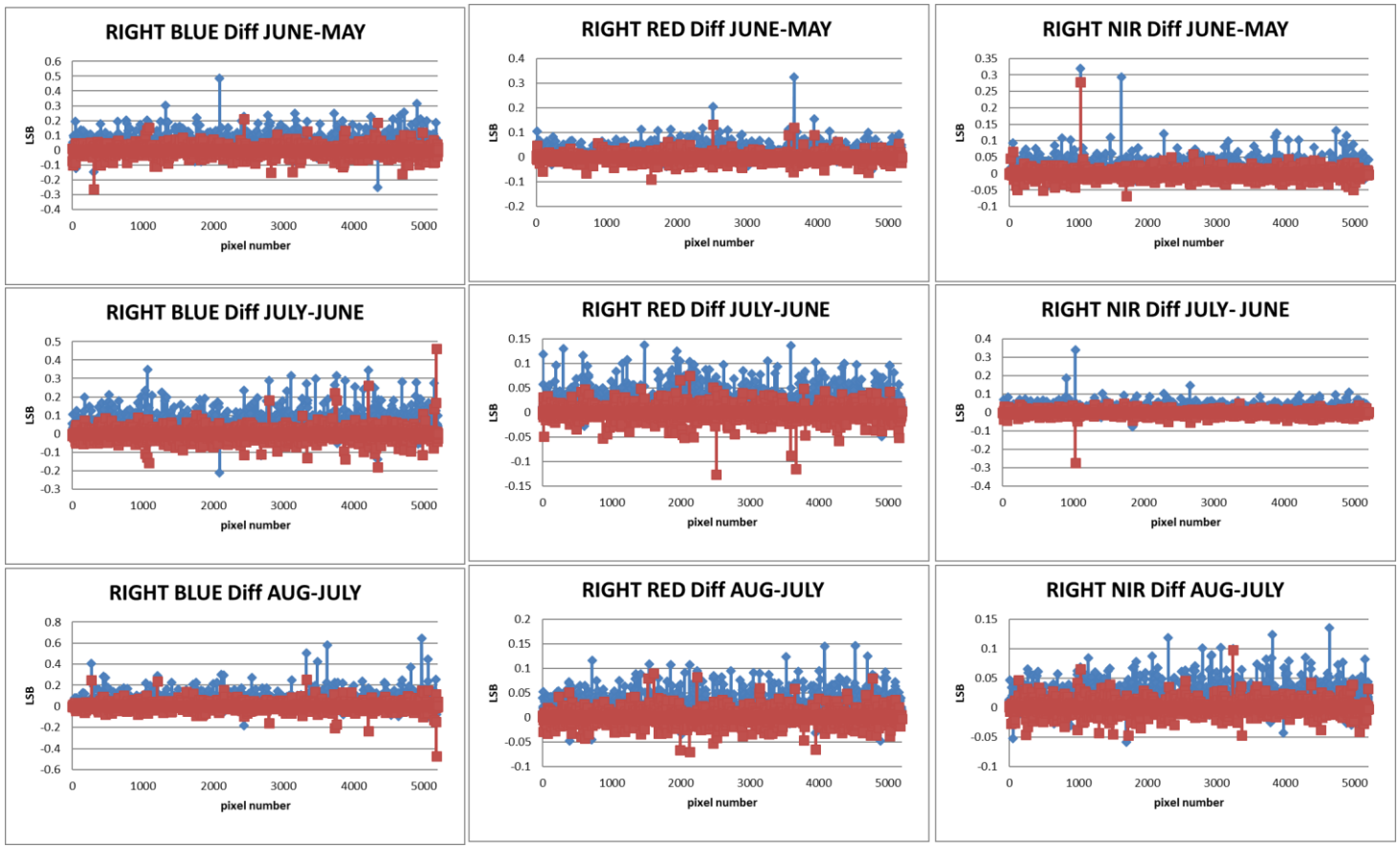


*Figure 15. RIGHT camera VNIR: Monthly difference (*MAY AUG2018*) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.*

1.3.3. SWIR results

Monthly difference plots for SWIR dark currents are given in Figure 16, Figure 17 and

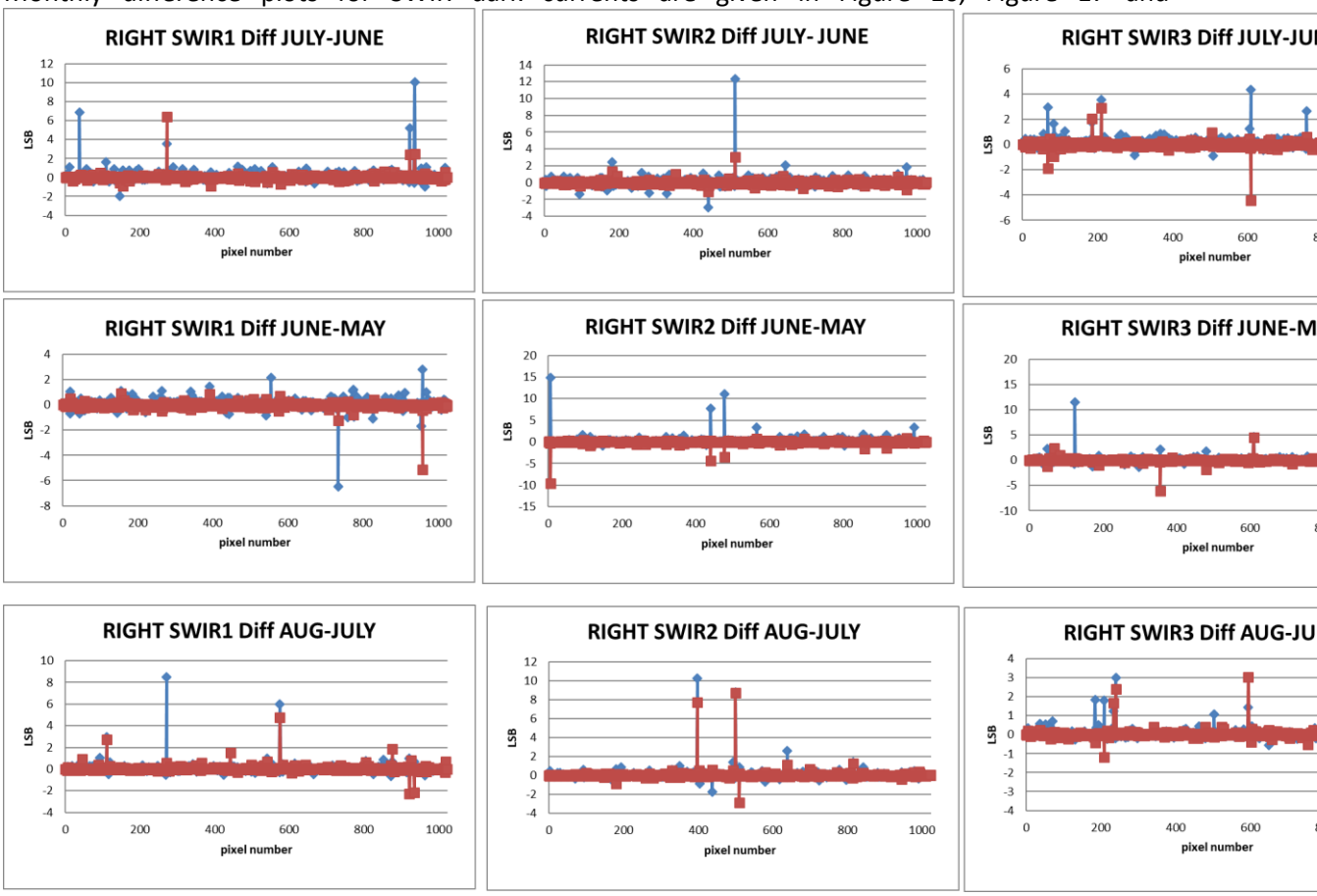


Figure 18 for respectively LEFT, CENTER and RIGHT camera.

A dark current outlier analysis is performed for pixels having for at least one month a dark current expressed in LSB larger than the DC THRESHOLD. This DC THRESHOLD is set to 4 LSB. For those pixels the following dark current pixel statuses are given:

- Both monthly differences > 4 LSB ? **Quality is "H DC BAD"**
- One monthly difference > 4 LSB ? **Quality is "H DC NOK"**.
- Both monthly differences < 4 LSB ? **Quality is "H DC OK"**

In Table 3,

APR-MAY-JUN						MAY-JUN-JUL						JUN-JUL-AUG					
SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3	
651	H DC NOK	419	H DC BAD	354	H DC NOK	545	H DC NOK	419	H DC NOK	354	H DC NOK	819	H DC BAD	208	H DC NOK	504	H DC BAD
940	H DC NOK	112	H DC NOK	448	H DC NOK	819	H DC NOK	648	H DC NOK	504	H DC NOK	916	H DC BAD	648	H DC NOK	729	H DC BAD
987	H DC NOK	266	H DC NOK	509	H DC NOK	916	H DC NOK	273pixels	H DC OK	509	H DC NOK	109	H DC NOK	279pixels	H DC OK	162pixels	H DC OK
222pixels	H DC OK	648	H DC NOK	564	H DC NOK	940	H DC NOK			729	H DC NOK	545	H DC NOK				
		262pixels	H DC OK	147pixels	H DC OK	222pixels	H DC OK			156pixels	H DC OK	908	H DC NOK				
												235pixels	H DC OK				

Table 4 and *Table 5* the resulting SWIR dark current status during the last 3 months is reported for respectively LEFT, CENTER and RIGHT camera.

Similarly as in previous reporting periods jumps in the dark current values of a few SWIR pixels is observed, requiring regular updates of ICP dark current values.

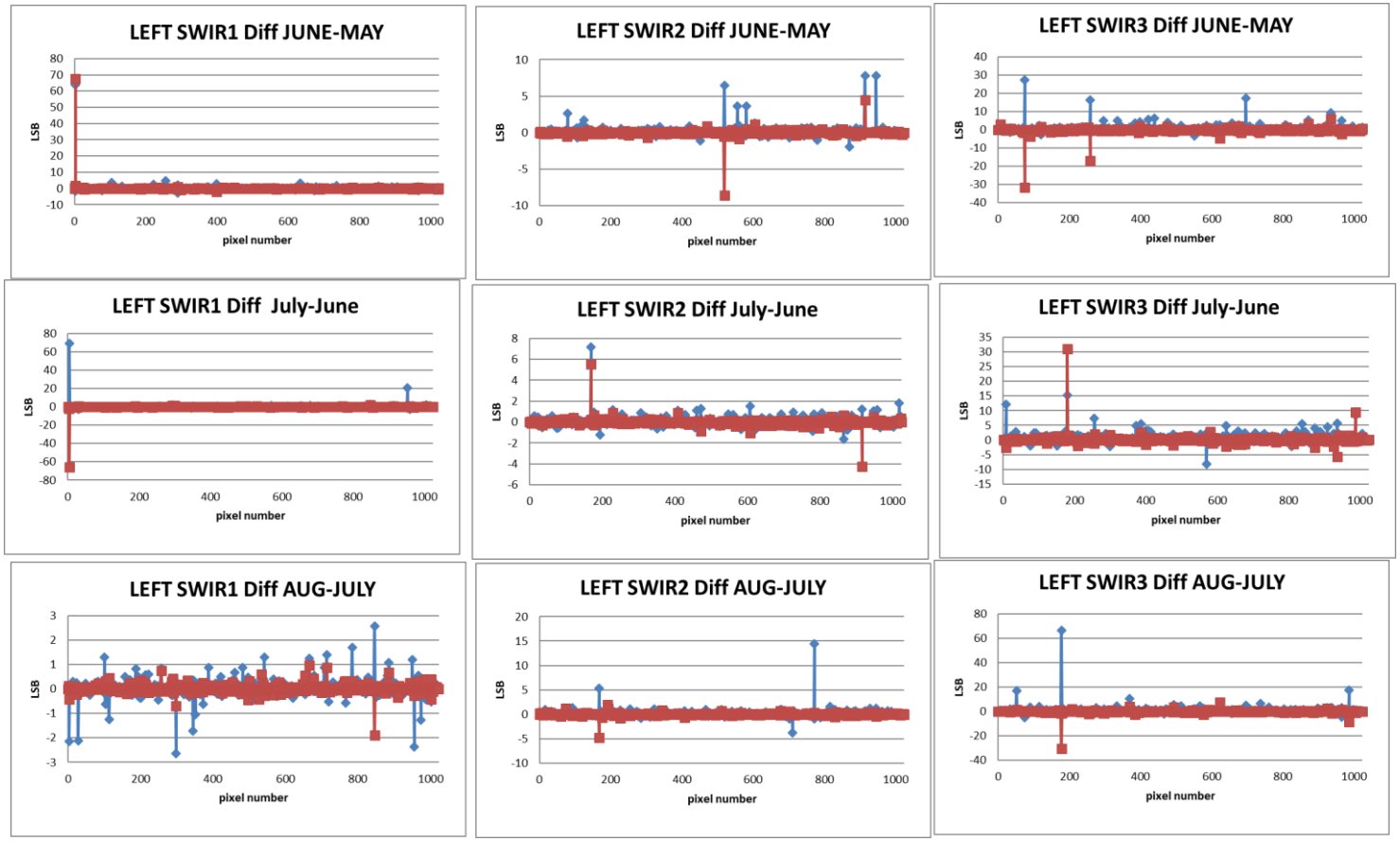


Figure 16. LEFT camera SWIR: Monthly difference (MAY AUG 2018) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.

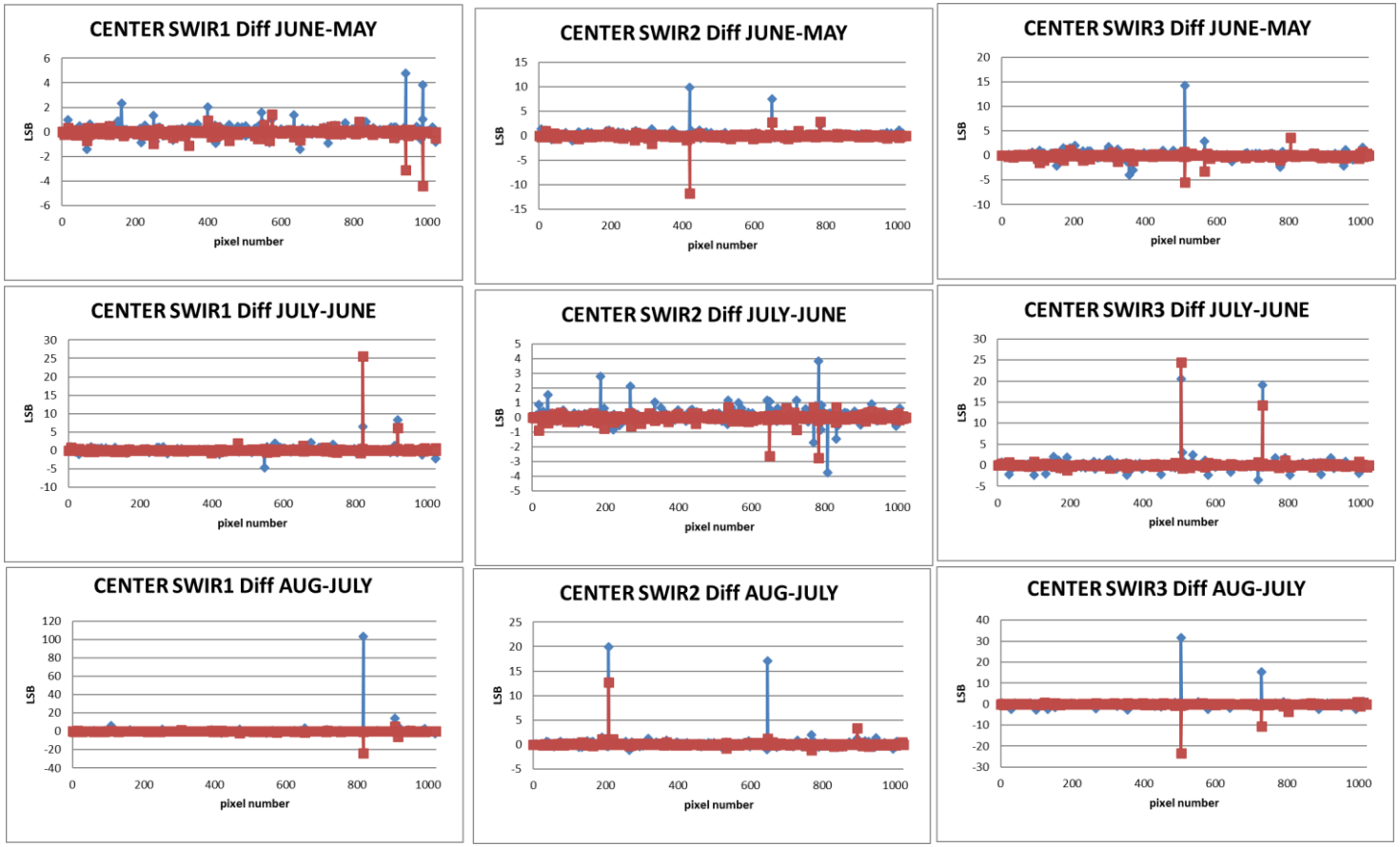


Figure 17. CENTER camera SWIR: Monthly difference (MAY - AUG2018) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.

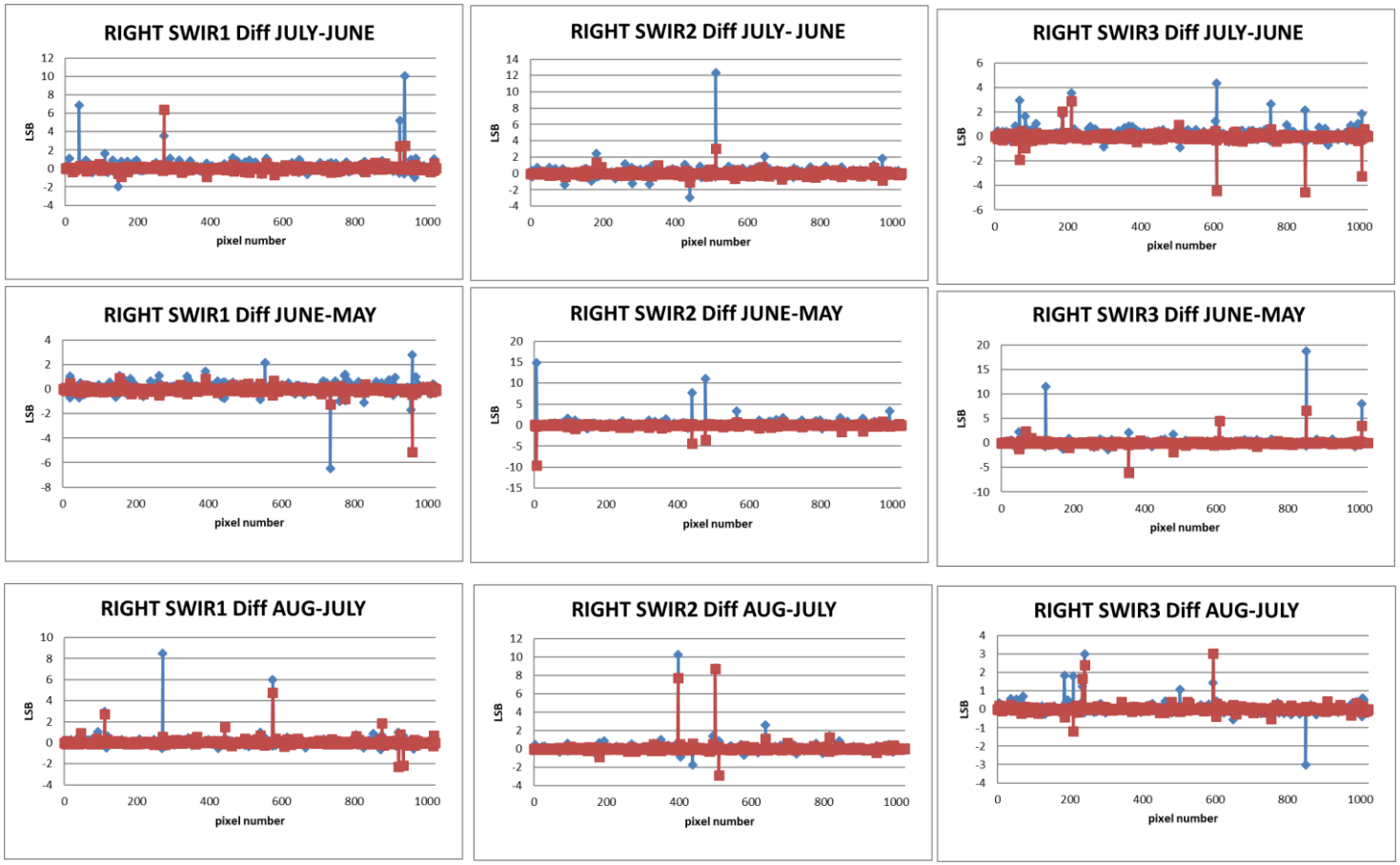


Figure 18. RIGHT camera SWIR: Monthly difference (MAY- AUG2018) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.

APR-MAY-JUNE						MAY-JUNE-JULY						JUNE-JULY-AUG					
SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3	
3	H DC NOK	519	H DC BAD	75	H DC BAD	3	H DC BAD	168	H DC NOK	871	H DC BAD	3	H DC NOK	168	H DC BAD	178	H DC BAD
104	H DC NOK	914	H DC NOK	259	H DC BAD	257	H DC NOK	519	H DC NOK	934	H DC BAD	950	H DC NOK	772	H DC NOK	370	H DC BAD
257	H DC NOK	945	H DC NOK	90	H DC NOK	950	H DC NOK	914	H DC NOK	7	H DC NOK	211pixels	H DC OK	33pixels	H DC OK	623	H DC BAD
567	H DC NOK	313pixels	H DC OK	297	H DC NOK	211pixels	H DC OK	945	H DC NOK	75	H DC NOK					986	H DC BAD
614	H DC NOK			336	H DC NOK			317pixels	H DC OK	178	H DC NOK					7	H DC NOK
892	H DC NOK			398	H DC NOK					254	H DC NOK					52	H DC NOK
207pixels	H DC OK			423	H DC NOK					259	H DC NOK					75	H DC NOK
				440	H DC NOK					297	H DC NOK					115	H DC NOK
				696	H DC NOK					336	H DC NOK					254	H DC NOK
				871	H DC NOK					370	H DC NOK					333	H DC NOK
				934	H DC NOK					385	H DC NOK					385	H DC NOK
				966	H DC NOK					398	H DC NOK					494	H DC NOK
				802pixels	H DC OK					423	H DC NOK					515	H DC NOK
										440	H DC NOK					567	H DC NOK
										568	H DC NOK					568	H DC NOK
										623	H DC NOK					696	H DC NOK
										696	H DC NOK					737	H DC NOK
										836	H DC NOK					836	H DC NOK
										907	H DC NOK					871	H DC NOK
										966	H DC NOK					907	H DC NOK
										986	H DC NOK					934	H DC NOK
										807pixels	H DC OK					966	H DC NOK
																821pixels	H DC OK

Table 3. LEFT SWIR dark current pixel outliers (ID L1A).

APR-MAY-JUN						MAY-JUN-JUL						JUN-JUL-AUG					
SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3	
651	H DC NOK	419	H DC BAD	354	H DC NOK	545	H DC NOK	419	H DC NOK	354	H DC NOK	819	H DC BAD	208	H DC NOK	504	H DC BAD
940	H DC NOK	112	H DC NOK	448	H DC NOK	819	H DC NOK	648	H DC NOK	504	H DC NOK	916	H DC BAD	648	H DC NOK	729	H DC BAD
987	H DC NOK	266	H DC NOK	509	H DC NOK	916	H DC NOK	273pixels	H DC OK	509	H DC NOK	109	H DC NOK	279pixels	H DC OK	162pixels	H DC OK
222pixels	H DC OK	648	H DC NOK	564	H DC NOK	940	H DC NOK			729	H DC NOK	545	H DC NOK				
		262pixels	H DC OK	147pixels	H DC OK	222pixels	H DC OK			156pixels	H DC OK	908	H DC NOK				
												235pixels	H DC OK				

Table 4. CENTER SWIR dark current pixel outliers (ID L1A)

APR-MAY-JUNE						MAY-JUNE-JULY						JUNE-JULY-AUG					
732	H DC BAD	4	H DC BAD	122	H DC NOK	36	H DC NOK	4	H DC NOK	607	H DC BAD	36	H DC NOK	398	H DC NOK	607	H DC NOK
957	H DC NOK	438	H DC BAD	354	H DC NOK	732	H DC NOK	438	H DC NOK	122	H DC NOK	271	H DC NOK	500	H DC NOK	341pixels	H DC OK
376pixels	H DC OK	476	H DC NOK	607	H DC NOK	922	H DC NOK	476	H DC NOK	850	H DC NOK	575	H DC NOK	510	H DC NOK		
		433pixels	H DC OK	677	H DC NOK	935	H DC NOK	510	H DC NOK	1005	H DC NOK	922	H DC NOK	459pixels	H DC OK		
				850	H DC NOK	391pixels	H DC OK	455pixels	H DC OK	334pixels	H DC OK	935	H DC NOK				
				1005	H DC NOK							389pixels	H DC OK				
				323pixels	H DC OK												

Table 5. RIGHT SWIR dark current pixel outliers (ID L1A)

1.4. Yaw manoeuvre: Low Frequency Equalisation

The three yaw maneuver campaigns (on July 9,18 and 27) were successfully performed over the Niger1 site for the three different cameras and will be analyzed in the coming period and compared to the results retrieved on the basis of the yaw maneuvers performed last year.

1.5. Bad pixels

One new bad pixel was identified in this reporting period.

Reporting period Mid-June 2018- Mid-Sept 2018																	
CAMERA	STRIP	pixel numbers (ID L1 A)															
		NEW BAD	BAD (from previous periods)														
left	swir1		3*	28	104	298	345	352	644	956							
left	swir2		711	863													
left	swir3		90	172	250	370	419	438	568	759	761						
center	swir1	819	1021														
center	swir2		57	295	769	831	900										
center	swir3		29	30	99	131	448	476	579	640	763	804	889	890	917	938	994
right	swir1																
right	swir2		14	438	470												
right	swir3																

Note :*wrong ID number assigned was assigned to the bad pixel, has been solved.

Table 6: Overview Bad pixels

1.6. Radiometric ICP file

The updates to the radiometric ICP file used within the user segment for the processing of the nominal PROBA-V data by PF are listed in the Table 9 for collection 1.

PROBAV_X_R_000_YEARMN01_**101**.xml*	Update dark currents Update of SWIR absolute following linear degradation model**
PROBAV_X_R_000_20161201_01.xml	Update dark currents Update of SWIR absolute following linear degradation model**
PROBAV_X_R_000_20161201_01.xml	Update dark currents Update of SWIR absolute following linear degradation model**
PROBAV_X_R_000_20161201_01.xml	Update dark currents Update of SWIR absolute following linear degradation model**
PROBAV_X_R_000_20161201_01.xml	Update dark currents Update of SWIR absolute following linear degradation model**
PROBAV_X_R_000_20170101_01.xml	Update dark currents Update of SWIR absolute following linear degradation model**
PROBAV_X_R_000_20170120_01.xml	SWIR status map updated : 1 bad pixel added
PROBAV_X_R_000_20170201_01.xml	Update dark currents Update of SWIR absolute following linear degradation model**
PROBAV_X_R_000_20170220_01.xml	SWIR status map updated : 1 bad pixel added

PROBAV_X_R_000_20170301_01.xml	Update dark currents Update of SWIR absolute following linear degradation model**
PROBAV_X_R_000_20170401_01.xml	Update dark currents Update of SWIR absolute following linear degradation model** SWIR status map updated : 1 bad pixel added
PROBAV_X_R_000_2017051_01.xml	Update dark currents Update of SWIR absolute following linear degradation model** Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model***
PROBAV_X_R_000_20170601_01.xml	Update dark currents Update of SWIR absolute following linear degradation model** Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model***
PROBAV_X_R_000_20170701_01.xml	Update dark currents Update of SWIR absolute following linear degradation model** Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model*** SWIR status map updated : 1 bad pixel added
PROBAV_X_R_000_20170801_01.xml	Update dark currents Update of SWIR absolute following linear degradation model** Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model*** SWIR status map updated : 2 bad pixel added
PROBAV_X_R_000_20170901_01.xml	Update dark currents Update of SWIR absolute following linear degradation model***, new coef applied for RIGHT SWIR strips***** Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** **** SWIR status map updated : 2 bad pixel added

PROBAV_X_R_000_20171001_01.xml	Update dark currents Update of SWIR absolute following linear degradation model***, new coef applied for RIGHT SWIR strips***** Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20171101_01.xml	Update dark currents Update of SWIR absolute following linear degradation model***, new coef applied for RIGHT SWIR strips***** Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20171201_01.xml	Update dark currents Update of SWIR absolute following linear degradation model***, new coef applied for RIGHT SWIR strips***** Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20180101_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20180201_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20180301_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients

	following linear degradation model **with new coef** ****
PROBAV_X_R_000_20180401_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20180501_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20180601_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20180701_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****
PROBAV_X_R_000_20180801_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****

PROBAV_X_R_000_20180821_01.xml	SWIR status map updated : 1 bad pixel added for SWIR2 center camera + correction for assignment of bad pixel status to wrong pixel ID
PROBAV_X_R_000_20180901_01.xml	Update dark currents Update of LEFT and CENTER SWIR absolute following linear degradation model***; **No update of RIGHT SWIR absolute cal**.. Update of LEFT BLUE and CENTER BLUE absolute calibration coefficients following linear degradation model **with new coef** ****

Table 7: Radiometric ICP-file updates Collection 1

2. Geometric Image Quality

2.1. Summary

The quarterly average location error (ALE) over the period 16/6/2018 – 15/9/2018 was 72 m (1σ = 79 m) for all spectral bands (combined cameras). Compared to the previous reporting period the ALE has increased by 6%.

The total number of chips per day and per spectral band used for the geometric accuracy analysis decreased by 3% on average compared to the previous reporting period.

The daily average location error compliance (ALE < 300m) was 99.23%, which is 0.11% higher than in the previous reporting period. The inter-band geometric accuracy was 32 m – 50 m (σ = 7 – 15 m), which is 0.09 – 0.15 of a pixel (333 m), a result that is similar to the previous reporting period.

The multi-temporal geometric accuracy was 83.16% (0.66% lower compared to previous quarter) for the VNIR and 95.10% (0.12% higher compared to previous quarter) for the combined VNIR/SWIR. The multi-temporal accuracies over the last full year are 82.78% and 94.86% for VNIR and VNIR/SWIR, respectively.

The geometric ICP file generated on 8/9/2016, valid from 1/9/2016 has remained valid throughout the reporting period.

2.2. Assessment of the geometric accuracy on L1C data

The absolute location error (ALE) and accompanying standard deviation of the Level1C data is presented in the tables below for each camera, spectral band/strip and reporting month.

CAMERA 1 Mean and standard deviation ALE [m]			
Strip\Period	**16/6/2018 - 15/7/2018**	**16/7/2018 - 15/8/2018**	**16/8/2018 - 15/9/2018**
BLUE	48.81, σ = 29.26	49.52, σ = 28.09	48.44, σ = 28.84
RED	50.03, σ = 30.39	50.07, σ = 28.95	49.55, σ = 30.01
NIR	50.34, σ = 29.72	51.00, σ = 28.85	50.30, σ = 29.93
SWIR1	74.48, σ = 47.26	74.65, σ = 46.92	73.57, σ = 46.31
SWIR2	52.62, σ = 29.54	51.91, σ = 28.32	51.81, σ = 29.06
SWIR3	48.81, σ = 28.48	45.98, σ = 25.52	46.21, σ = 26.29

Table 8: Mean absolute location error and standard deviation (σ) for camera 1.

CAMERA 2 Mean and standard deviation ALE [m]			
Strip\Period	**16/6/2018 - 15/7/2018**	**16/7/2018 - 15/8/2018**	**16/8/2018 - 15/9/2018**
BLUE	57.23, σ = 33.97	49.05, σ = 29.55	50.61, σ = 29.96
RED	58.47, σ = 34.24	49.96, σ = 29.73	51.98, σ = 30.45
NIR	55.26, σ = 32.89	47.30, σ = 27.99	48.89, σ = 28.86
SWIR1	57.68, σ = 33.89	49.73, σ = 29.21	52.70, σ = 30.45
SWIR2	57.49, σ = 34.44	49.43, σ = 29.47	52.54, σ = 31.25
SWIR3	57.78, σ = 34.68	50.01, σ = 29.56	52.42, σ = 31.09

Table 9: Mean absolute location error and standard deviation (σ) for camera 2.

CAMERA 3 Mean and standard deviation ALE [m]			
Strip\Period	**16/6/2018 - 15/7/2018**	**16/7/2018 - 15/8/2018**	**16/8/2018 - 15/9/2018**
BLUE	69.63, σ = 35.78	74.04, σ = 37.59	71.02, σ = 36.68
RED	71.23, σ = 38.75	78.55, σ = 41.39	75.81, σ = 41.70
NIR	63.12, σ = 35.13	65.97, σ = 36.64	65.68, σ = 37.60
SWIR1	61.48, σ = 34.01	61.34, σ = 33.41	59.32, σ = 33.14
SWIR2	65.16, σ = 37.07	67.80, σ = 37.66	65.78, σ = 37.49
SWIR3	83.59, σ = 47.95	90.60, σ = 52.72	86.48, σ = 51.53

Table 10: Mean absolute location error and standard deviation (σ) for camera 3.

In the reporting period the average location error of the Level 1C data was 59.2 m, which is 5.6 m (8.7%) lower than in the previous quarter.

2.3. Assessment of the geometric accuracy on L2 data

2.3.1. Absolute geometric accuracy

The daily summary of the L2 data absolute location error for all spectral bands is presented in the tables and figures below for the three reporting months:

- from 16/6/2018 – 15/7/2018
- from 16/7/2018 – 15/8/2018
- from 16/8/2018 – 15/9/2018

The tables list:

- The day of the measurement in format dd-mm-yy
- The daily achieved compliance (%B) for the BLUE band (% of GCP where ALE <=300m)
- The daily achieved compliance (%R) for the RED band (% of GCP where ALE <=300m)
- The daily achieved compliance (%N) for the NIR band (% of GCP where ALE <=300m)
- The daily achieved compliance (%S) for the SWIR band (% of GCP where ALE <=450m)

- The number of GCP per day (NB-B) used to derive the absolute location error ALE for the BLUE band
- The daily average ALE (in m) for the BLUE band (MU-B)
- The daily ALE standard deviation (in m) for the BLUE band (STD-B)

- The number of GCP per day (NB-R) used to derive the absolute location error ALE for the RED band
- The daily average ALE (in m) for the RED band (MU-R)
- The daily ALE standard deviation (in m) for the RED band (STD-R)

- The number of GCP per day (NB-N) used to derive the absolute location error ALE for the NIR band
- The daily average ALE (in m) for the NIR band (MU-N)
- The daily ALE standard deviation (in m) for the NIR band (STD-N)

- The number of GCP per day (NB-S) used to derive the absolute location error ALE for the SWIR band
- The daily average ALE (in m) for the SWIR band (MU-S)
- The daily ALE standard deviation (in m) for the SWIR band (STD-S)

Day	%B	%R	%N	%S	NB-B	MU-B	STD-B	NB-R	MU-R	STD-R	NB-N	MU-N	STD-N	NB-S	MU-S	STD-S
16/06/2018	99.07	99.49	99.50	99.77	41566	65.56	85.65	52346	58.24	74.07	55706	57.13	71.22	55397	61.20	73.78
17/06/2018	98.96	99.36	99.45	99.75	38308	69.53	88.18	48264	63.40	85.99	52161	58.03	70.48	51078	62.80	72.14
18/06/2018	98.80	99.22	99.38	99.71	35528	73.12	90.40	45005	66.23	71.17	47270	61.52	66.74	45563	67.11	78.18
19/06/2018	98.81	99.15	99.35	99.75	40187	72.45	100.72	50880	67.20	80.43	56881	60.95	71.16	55177	64.58	77.63
20/06/2018	98.77	99.14	99.24	99.72	40937	76.08	92.77	51289	70.63	75.69	56600	63.63	72.44	57642	66.35	77.79
21/06/2018	98.78	99.10	99.25	99.78	36356	76.94	92.87	46367	72.35	74.27	53229	68.32	74.36	53410	69.02	73.65
22/06/2018	98.58	98.85	99.07	99.68	36007	80.80	106.14	43840	76.90	85.37	46065	71.73	80.21	46597	72.91	80.40
23/06/2018	98.74	99.05	99.24	99.70	41217	80.89	92.84	50489	77.78	79.10	51148	74.41	73.08	51210	75.58	81.83
24/06/2018	98.91	99.12	99.29	99.77	42970	76.98	89.48	53045	74.21	73.25	56539	72.42	72.34	56364	71.88	75.64
25/06/2018	98.86	99.23	99.41	99.76	41511	77.64	91.55	51214	73.41	75.97	55065	70.12	78.20	55087	70.53	70.88
26/06/2018	98.91	99.09	99.24	99.74	39415	73.11	83.55	47978	71.21	74.59	52613	67.95	78.59	51385	69.45	72.12
27/06/2018	98.95	99.11	98.87	99.75	4939	88.22	93.77	4745	90.35	78.96	4264	92.41	79.87	2399	92.21	64.40
28/06/2018	NoData	NoData	NoData	NoData	0	NoData	NoData	0	NoData	NoData	0	NoData	NoData	0	NoData	NoData
29/06/2018	98.46	98.69	98.86	99.64	36783	88.81	103.08	45643	85.70	87.13	46667	83.27	77.98	46991	80.61	82.08
30/06/2018	98.23	98.38	98.82	99.72	34831	100.36	94.08	43314	99.02	87.30	46387	92.25	83.39	46078	89.81	79.30
01/07/2018	98.32	98.52	98.83	99.63	37216	100.40	104.64	45696	97.54	95.19	48731	88.86	95.44	47328	88.02	87.78
02/07/2018	98.35	98.61	98.87	99.62	39129	95.93	103.15	48551	92.52	95.63	52476	82.99	83.47	50297	83.40	89.30
03/07/2018	98.81	99.08	99.21	99.73	40074	77.40	87.49	49944	73.01	78.34	54658	67.07	75.79	51830	68.62	76.73
04/07/2018	99.02	99.34	99.46	99.78	41097	73.19	82.38	51748	69.13	76.46	58093	63.52	74.72	58795	65.49	78.41
05/07/2018	98.84	99.18	99.39	99.79	36411	74.34	88.61	46435	68.94	75.62	54100	60.74	78.01	53502	63.32	70.52
06/07/2018	98.63	98.90	99.22	99.61	34735	81.83	95.05	42102	78.02	84.82	46508	70.60	74.51	44320	73.91	82.73
07/07/2018	98.79	99.07	99.30	99.74	42565	76.77	98.66	45680	72.76	77.76	51788	66.29	75.08	49320	69.45	76.49
08/07/2018	98.76	98.88	99.17	99.74	21188	80.57	96.16	23155	76.16	85.86	27680	70.43	82.48	26718	71.78	78.13
09/07/2018	99.02	99.39	97.48	100.00	307	72.84	188.32	327	58.82	43.20	119	91.60	155.05	420	55.74	32.70
10/07/2018	98.53	99.03	99.32	99.75	22194	72.25	102.00	28638	64.78	79.14	34121	58.54	71.52	27234	59.10	69.71
11/07/2018	99.19	99.74	99.82	99.93	4458	69.35	106.91	6796	57.97	73.42	11550	48.87	43.79	10685	51.45	41.71
12/07/2018	98.94	99.17	99.26	99.74	41387	65.78	87.54	49821	61.39	77.92	51654	57.93	72.44	49642	61.04	74.94
13/07/2018	98.98	99.40	99.73	99.85	14827	63.79	93.59	19316	57.78	67.51	23074	52.96	55.39	20944	56.37	62.00
14/07/2018	98.70	99.09	99.23	99.72	31744	65.93	89.43	39700	62.36	86.58	42857	56.36	81.55	39026	60.16	81.07
15/07/2018	98.58	99.07	99.30	99.74	28994	69.59	97.77	36952	63.60	84.86	42084	55.26	68.70	34998	60.43	74.94
Averages	**98.77**	**99.08**	**99.19**	**99.75**	**31562**	**77.26**	**97.48**	**38976**	**72.47**	**78.81**	**42677**	**68.49**	**77.19**	**41320**	**69.05**	**73.74**

Table 11: Daily achieved compliance and the daily average location error (in m) for all spectral bands in the period 16/6/2018 to 15/7/2018.

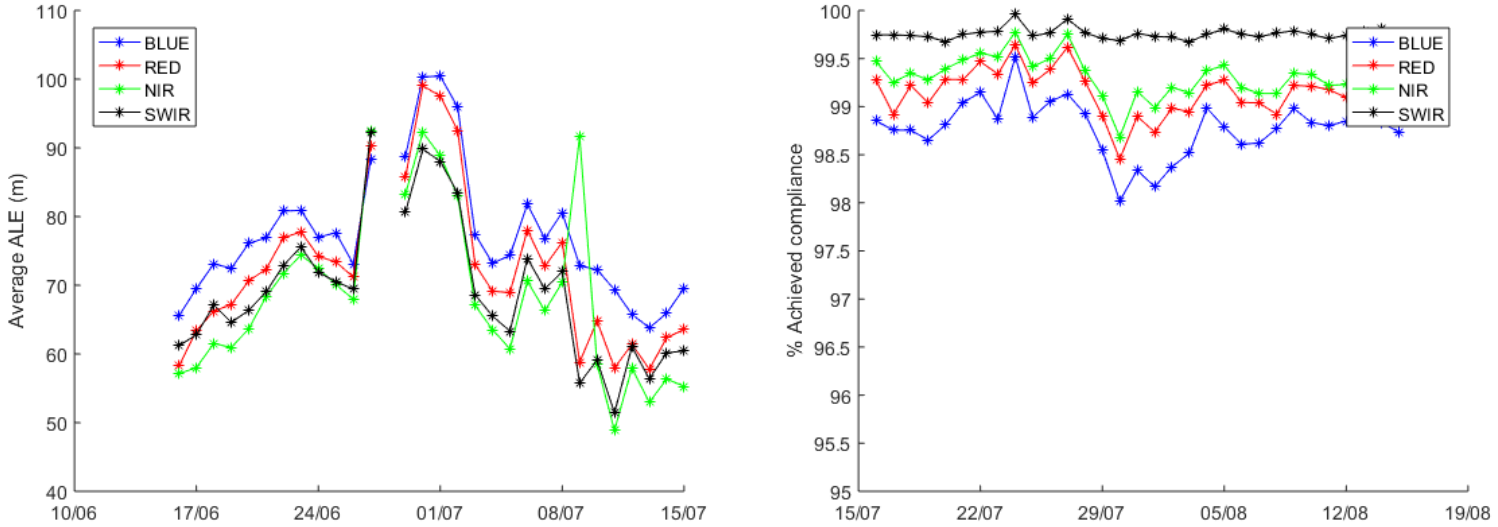


Figure 19: Daily average location error in the period from 16/6/2018 – 15/7/2018 (left) and the average daily compliance of the spectral bands (right).

Day	%B	%R	%N	%S	NB-B	MU-B	STD-B	NB-R	MU-R	STD-R	NB-N	MU-N	STD-N	NB-S	MU-S	STD-S
16/07/2018	98.85	99.27	99.47	99.75	43658	71.66	91.13	57023	66.00	72.68	65306	59.76	64.27	59873	65.38	78.39
17/07/2018	98.76	98.92	99.25	99.75	18812	75.50	91.27	24080	73.17	86.69	28764	65.89	69.52	27997	71.23	74.09
18/07/2018	98.76	99.22	99.35	99.74	27554	78.26	97.06	34334	72.47	85.54	38102	67.97	71.48	36804	70.21	76.19
19/07/2018	98.65	99.04	99.28	99.73	38731	77.41	103.74	44905	73.91	87.19	52480	65.90	72.08	48966	69.70	74.73
20/07/2018	98.81	99.28	99.39	99.68	35482	71.71	87.43	43862	66.72	78.59	47310	61.41	72.30	44185	66.69	83.37
21/07/2018	99.04	99.28	99.48	99.75	45147	67.41	83.88	55309	62.51	73.80	61654	58.31	71.39	55813	63.60	79.12
22/07/2018	99.15	99.47	99.56	99.77	47100	62.57	82.68	59586	56.97	69.50	60420	53.51	67.31	60734	56.51	66.73
23/07/2018	98.87	99.34	99.52	99.78	25962	64.62	95.73	29740	58.69	74.39	34085	55.50	72.47	33996	57.27	79.61
24/07/2018	99.52	99.64	99.77	99.96	8961	60.97	67.21	11501	58.13	61.73	15076	51.01	52.93	17634	53.81	47.35
25/07/2018	98.89	99.24	99.42	99.73	39829	69.24	84.79	51244	64.89	68.35	49307	59.80	67.41	46706	61.02	69.47
26/07/2018	99.05	99.39	99.50	99.77	41140	63.87	89.53	48051	60.07	73.89	50902	56.26	69.02	51521	58.64	67.22
27/07/2018	99.13	99.62	99.75	99.91	13817	65.39	92.66	19841	59.92	70.47	26599	54.86	61.66	29348	54.53	54.22
28/07/2018	98.93	99.26	99.38	99.77	39217	71.95	93.52	49512	67.92	82.89	54784	61.46	74.64	54260	64.21	66.54
29/07/2018	98.55	98.91	99.11	99.71	35439	86.41	99.41	46590	82.77	82.07	52193	74.04	74.36	47840	77.46	82.52
30/07/2018	98.02	98.45	98.68	99.69	33015	103.42	104.37	41611	99.06	88.26	42688	89.42	78.76	42345	90.31	77.41
31/07/2018	98.34	98.90	99.16	99.76	26664	93.44	88.98	34309	89.08	79.85	40067	76.85	68.05	36028	81.92	79.04
01/08/2018	98.17	98.74	98.99	99.73	33326	97.12	100.67	39559	90.12	89.96	46373	76.52	83.84	46224	80.53	78.47
02/08/2018	98.37	98.98	99.20	99.72	30634	84.54	104.46	40391	77.50	81.30	44780	67.62	79.54	44681	70.26	77.24
03/08/2018	98.52	98.95	99.14	99.68	32153	87.56	93.57	42233	83.39	91.29	44748	73.14	82.37	45236	75.51	79.96
04/08/2018	98.98	99.22	99.37	99.75	34219	80.07	95.30	43696	75.94	77.18	48767	68.59	75.71	49701	71.12	72.43
05/08/2018	98.79	99.27	99.43	99.81	34628	81.41	92.96	43703	75.83	74.96	49822	67.84	68.45	50867	69.34	73.41
06/08/2018	98.61	99.04	99.20	99.75	34460	82.71	98.09	42147	77.46	83.83	46013	70.94	77.09	47268	71.77	75.54
07/08/2018	98.62	99.04	99.14	99.73	36245	83.47	93.39	44302	79.57	80.57	48223	73.89	76.57	48675	75.19	78.42
08/08/2018	98.77	98.92	99.14	99.76	36413	84.90	101.23	45230	82.77	80.41	49950	77.64	77.33	49958	79.05	77.66

09/08/2018	98.98	99.22	99.35	99.79	23779	83.97	96.74	30613	79.36	77.01	35936	73.91	67.73	37588	75.74	70.94
10/08/2018	98.84	99.21	99.34	99.75	32746	81.94	102.06	42192	75.85	82.53	50149	68.03	76.55	51153	70.56	71.09
11/08/2018	98.80	99.18	99.22	99.71	34555	87.35	94.62	44317	81.87	87.40	49337	75.06	75.09	51334	76.15	82.10
12/08/2018	98.85	99.09	99.23	99.74	35578	87.30	96.73	44506	83.03	81.90	47126	75.95	71.73	49687	76.94	73.64
13/08/2018	98.88	99.34	99.44	99.78	37116	83.88	92.36	46564	77.68	80.67	50496	71.02	70.38	53793	72.60	69.19
14/08/2018	98.83	99.21	99.28	99.81	24461	81.12	94.12	30170	75.16	78.84	31187	68.81	70.56	32478	71.94	69.98
15/08/2018	98.74	99.08	99.22	99.74	28772	81.65	94.85	34624	76.38	81.74	36266	68.21	77.11	36283	70.17	74.52
Averages	**98.80**	**99.17**	**99.34**	**99.76**	**24680**	**77.38**	**92.72**	**30923**	**72.69**	**78.75**	**34172**	**65.98**	**71.18**	**33597**	**68.76**	**73.12**

Table 12: Daily achieved compliance and the daily average location error (in m) for all spectral bands in the period 16/7/2018 – 15/8/2018.

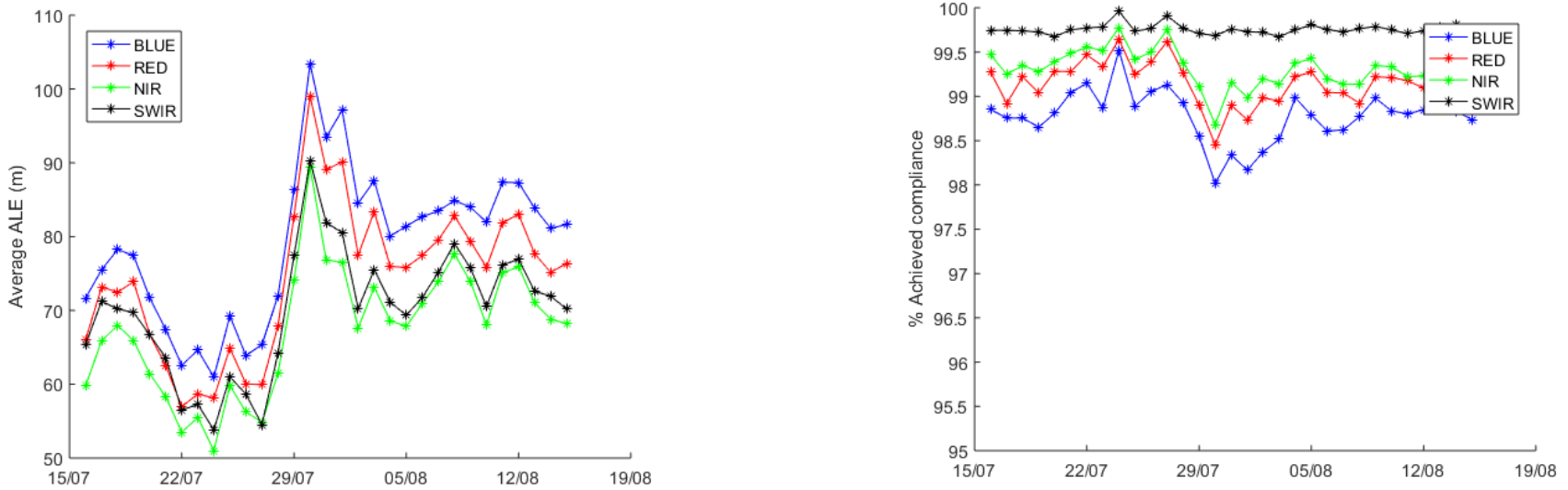


Figure 20: Daily average location error in the period from 16/7/2018 – 15/8/2018 (left) and the average daily compliance of all spectral bands (right).

Day	%B	%R	%N	%S	NB-B	MU-B	STD-B	NB-R	MU-R	STD-R	NB-N	MU-N	STD-N	NB-S	MU-S	STD-S
16/08/2018	98.59	99.03	99.32	99.75	28988	82.99	96.64	36500	76.96	84.87	42635	67.29	72.30	40408	69.37	77.30
17/08/2018	98.69	98.84	99.01	99.73	13600	81.40	91.67	16012	76.95	77.75	17802	70.01	73.69	17573	70.99	76.57
18/08/2018	98.84	99.26	99.42	99.77	24455	82.88	84.94	25397	80.45	74.04	25712	76.45	65.26	23819	76.42	72.46
19/08/2018	98.61	98.85	99.07	99.82	13356	90.10	102.19	15874	86.51	77.90	18686	85.34	77.46	20580	82.87	66.22
20/08/2018	98.18	98.43	98.98	99.74	8937	89.02	97.62	11626	87.20	81.43	14038	82.47	72.98	12770	83.70	69.33
21/08/2018	98.06	98.76	98.75	99.60	12404	79.95	93.70	15444	78.29	77.37	15232	80.19	119.20	11347	80.14	136.35
22/08/2018	98.50	98.72	98.85	99.59	18073	79.55	89.21	19335	78.02	80.78	18885	75.35	81.12	16598	76.19	92.61
23/08/2018	99.28	99.43	99.52	99.81	15377	65.74	81.27	19901	60.64	76.08	20864	59.68	67.20	23142	56.84	63.27
24/08/2018	98.60	99.15	99.30	99.59	24307	69.03	102.90	29322	62.70	86.88	30859	58.61	75.00	30214	60.04	83.39
25/08/2018	99.01	99.29	99.19	100.00	1623	74.60	74.12	1689	81.16	105.65	1116	81.12	104.74	375	66.97	43.53
26/08/2018	98.79	99.23	99.33	99.76	40462	69.15	96.52	49159	62.93	73.21	52541	58.47	72.00	53501	59.83	72.42
27/08/2018	99.14	99.42	99.48	99.80	42625	67.49	82.12	51226	63.37	72.99	53541	59.32	64.73	57199	59.97	65.24
28/08/2018	98.93	99.24	99.35	99.78	39137	66.32	87.80	47003	62.47	80.38	49181	57.62	69.40	53144	58.53	74.02
29/08/2018	99.00	99.42	99.53	99.80	33115	63.62	93.63	40346	57.41	77.67	43044	52.17	65.37	46782	53.94	67.69
30/08/2018	98.87	99.28	99.39	99.75	37951	70.15	87.12	46892	64.37	73.31	48504	58.48	69.11	50747	59.52	68.60
31/08/2018	98.82	99.19	99.28	99.80	28172	75.38	88.44	34800	69.72	79.14	40526	62.28	73.87	40835	61.59	65.21
01/09/2018	98.85	99.24	99.39	99.79	32916	80.52	87.49	40466	74.85	81.20	43263	66.79	72.45	44333	66.41	70.60
02/09/2018	98.82	99.28	99.36	99.74	37157	71.56	94.54	42490	64.45	71.00	44259	59.73	75.07	43023	61.89	75.11
03/09/2018	99.00	99.43	99.50	99.75	38709	67.53	95.67	46860	59.84	70.82	48929	55.57	70.87	49182	58.52	72.74
04/09/2018	99.00	99.34	99.46	99.75	41631	67.25	88.31	50228	61.87	72.61	51498	55.93	66.97	52529	59.30	72.19
05/09/2018	99.18	99.44	99.53	99.81	42350	65.31	81.36	52213	59.57	71.91	57231	54.02	60.78	59426	57.51	62.09
06/09/2018	98.93	99.29	99.36	99.77	37512	73.93	98.46	46260	67.28	80.70	50276	61.55	71.15	51426	63.84	69.05
07/09/2018	98.93	99.36	99.38	99.74	40563	74.73	91.44	50930	68.89	72.70	55567	63.24	67.94	57452	65.06	76.20
08/09/2018	98.43	98.83	99.03	99.69	37975	95.20	99.02	44953	92.08	88.83	46604	84.44	80.71	49975	84.11	81.54
09/09/2018	98.22	98.50	98.71	99.66	31329	103.44	96.39	36844	101.09	86.68	36049	96.74	82.31	38360	91.33	84.54
10/09/2018	98.24	98.55	98.60	99.66	35043	108.50	99.07	41827	104.34	84.39	44759	98.25	85.03	48646	96.54	82.76
11/09/2018	98.23	98.51	98.46	99.67	27420	103.33	102.58	32367	99.62	90.32	30303	95.51	91.46	33505	91.98	83.84
12/09/2018	98.71	99.04	98.99	99.73	27067	90.77	92.78	28820	87.89	83.05	26543	85.02	88.98	30458	80.43	87.37
13/09/2018	98.95	99.18	99.27	99.77	20574	80.58	82.14	24466	78.23	81.16	23041	74.31	73.18	24885	72.77	69.49
14/09/2018	99.08	99.38	99.42	99.71	19074	67.22	89.90	23091	64.27	70.38	25193	62.16	74.57	25563	63.54	76.12
15/09/2018	99.08	99.30	99.38	99.76	24346	63.03	90.96	26849	60.68	79.58	26837	57.49	71.02	28660	57.07	70.72
Averages	**98.79**	**99.14**	**99.25**	**99.74**	**35377**	**78.29**	**91.76**	**42563**	**73.57**	**78.91**	**45007**	**68.73**	**73.82**	**46704**	**68.86**	**74.60**

Table 13: Daily achieved compliance and the daily average location error (in m) for all spectral bands in the period 16/8/2018 – 15/9/2018.

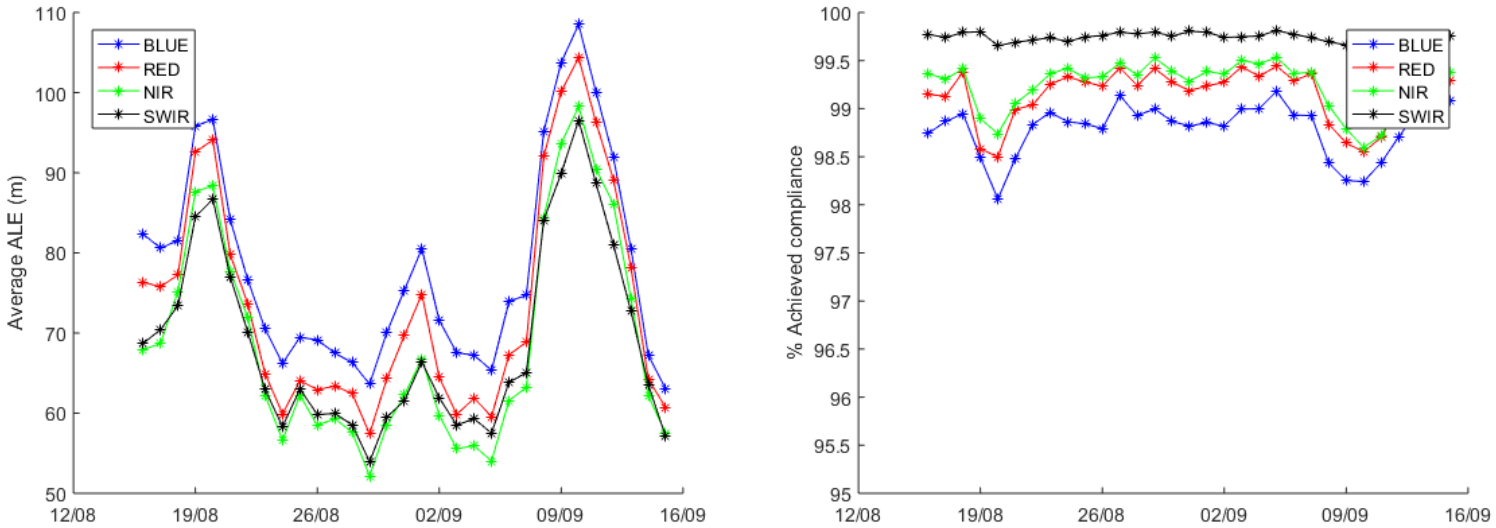


Figure 21: Daily average location error in the period from 16/8/2018 – 15/9/2018 (left) and the average daily compliance of all spectral bands (right).

2.3.2. Inter-band geometric accuracy

The monthly average inter-band geolocation error for all spectral band combinations was as follows:

Band pair	Inter-band error [m]
BLUE-RED	32.82, σ = 10.18
BLUE-NIR	47.99, σ = 14.06
BLUE-SWIR	50.44, σ = 13.97
RED-NIR	32.75, σ = 10.30
RED-SWIR	42.02, σ = 8.87
NIR-SWIR	40.35, σ = 7.22

Table 14: Inter-band geolocation accuracy for period 16/6/2018 to 15/7/2018 for the combined cameras, at 95% confidence level.

Band pair	Inter-band error [m]
BLUE-RED	33.14, σ = 9.71
BLUE-NIR	49.45, σ = 15.29
BLUE-SWIR	50.38, σ = 12.59
RED-NIR	34.96, σ = 12.31
RED-SWIR	42.24, σ = 8.91
NIR-SWIR	40.18, σ = 7.49

Table 15: Inter-band geolocation accuracy for period 16/7/2018 to 15/8/2018 for the combined cameras, at 95% confidence level.

Band pair	Inter-band error [m]
BLUE-RED	32.34, σ = 9.03
BLUE-NIR	49.00, σ = 15.01
BLUE-SWIR	49.01, σ = 12.89
RED-NIR	35.64, σ = 13.79
RED-SWIR	40.30, σ = 9.10
NIR-SWIR	38.47, σ = 7.17

Table 16: Inter-band geolocation accuracy for period 16/8/2018 to 15/9/2018 for the combined cameras, at 95% confidence level.

For the combined cameras, the inter-band geometric accuracy ranged from 32 – 50 m (standard deviation range is 7 – 15 m), which is 0.09 – 0.15 of a pixel (333 m). This result is slightly better at the high end of the range compared to the previous reporting period. The average inter-band RED-NIR registration accuracy was 34 m, which is similar to previous reporting period.

2.3.3. Multi-temporal geometric accuracy

During this reporting period the multi-temporal compliance of the geometric accuracy was:

- 83.16% for the VNIR sensor (196065 GCPs used),
- 95.10% for the VNIR/SWIR combined (217172 GCPs used).

The multi-temporal sensor compliance has decreased by 0.66% for the VNIR sensor and increased by 0.12% for the combined VNIR/SWIR sensors, compared to the previous reporting period (in which values were 83.82% and 94.98%, respectively).

For the VNIR the multi-temporal geometric accuracy is below the requirements. A map of regions with decreased multi-temporal geometric accuracy is presented in

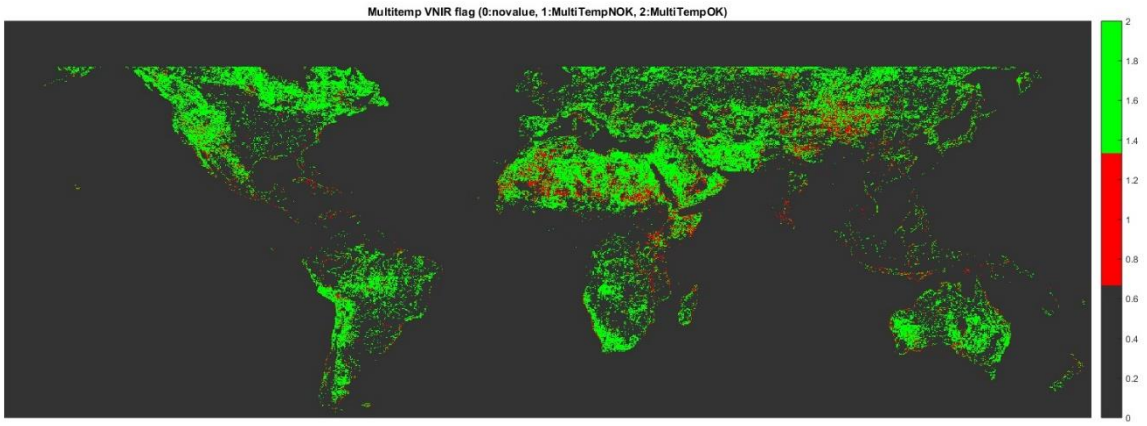


Figure 22.

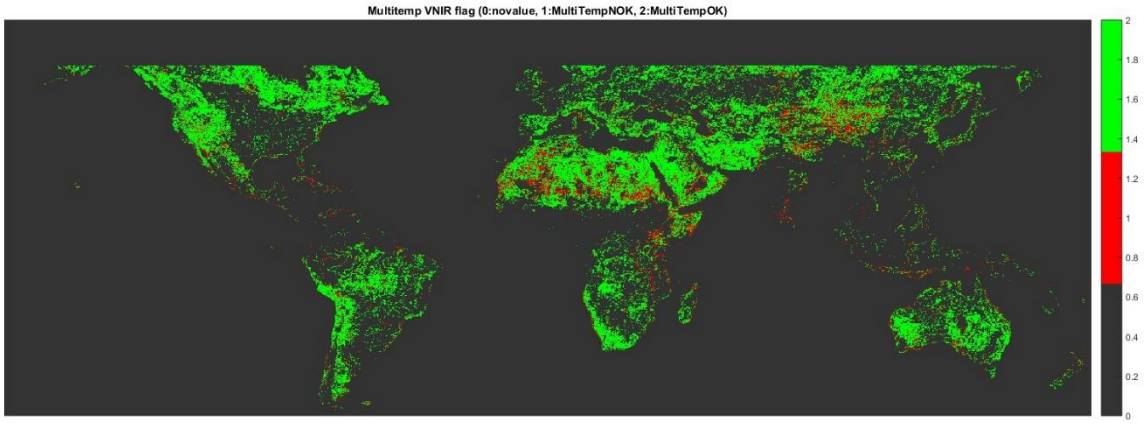


Figure 22: Multi-temporal geometric accuracy for the VNIR sensor. Compliant areas are marked in green; areas with accuracy below 95% are marked in red. Grey areas represent no data.

For the combined VNIR/SWIR the multi-temporal geometric accuracy is compliant with the requirements. A map of regions with decreased multi-temporal geometric accuracy is presented in

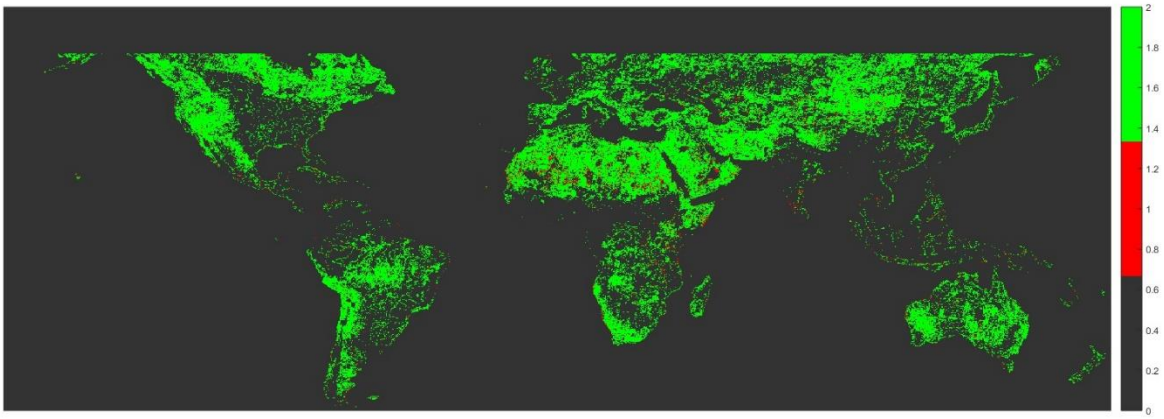


Figure 23.

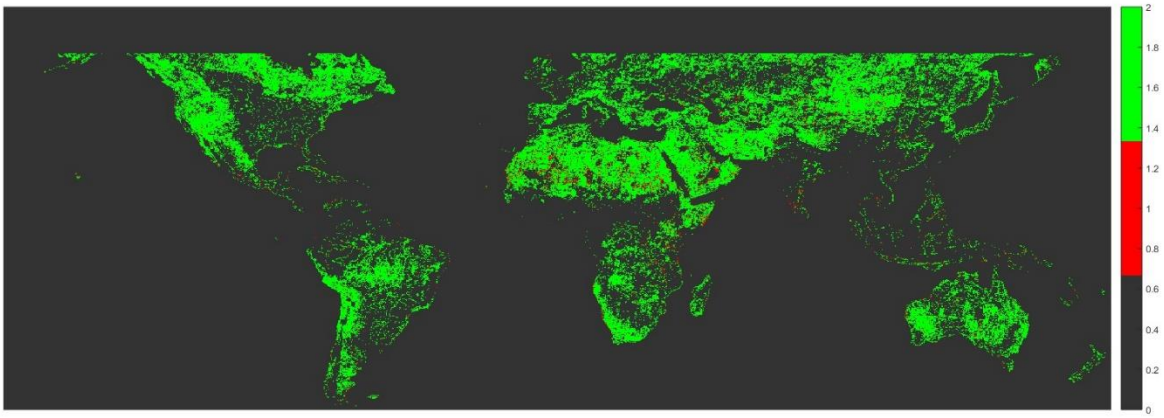


Figure 23: Multi-temporal geometric accuracy for the VNIR/SWIR combined. Compliant areas are marked in green; areas with accuracy below 95% are marked in red. Grey areas represent no data.

Over the last full year, the multi-temporal accuracy for VNIR and VNIR/SWIR is 82.78% and 94.86%, respectively.

2.4. Geometric ICP file

On 08.09.2016 a new file with validity date set to 01.09.2016 was created.

ICP filename	Description
PROBAV_ICP_GEOMETRIC#LEFT_20160901_V01 PROBAV_ICP_GEOMETRIC#CENTER_20160901_V01 PROBAV_ICP_GEOMETRIC#RIGHT_20160901_V01	Correction for the gradual degradation observed in the last week of August and first week of September 2016.

3. Reference documents

RD-1	PROBA-V Commissioning Report Annex 1-Radiometric Calibration Results [N77D7-PV02-US-20-CRPT-Annex1-RadiometricCalibartion-v1_3]
RD-2	PROBA-V Commissioning Report Annex 2-Geometric Calibration Results [N77D7-PV02-US-20-CRPT-Annex2-GeometricCalibartion-v1_3]
LIT1	Govaerts Y., Sterckx S. and Adriaensen S. (2013) "Use of simulated reflectances over bright desert target as an absolute calibration reference" Remote Sensing Letters, Vol. 4, Iss. 6, 2013.
LIT2	S. Adriaensen, K. Barker, L. Bourg , M. Bouvet, B. Fougnie, Y. Govaerts, P. Henry, C. Kent, D. Smith, S. Sterckx. "CEOS IVOS Working Group 4: Intercomparison of vicarious calibration methodologies and radiometric comparison methodologies over pseudo-invariant calibration sites A Report to the CEOS/IVOS Working Group", 2012
LIT3	Sterckx S., Adriaensen S., Livens, L., "Rayleigh, Deep Convective Clouds and Cross Sensor Desert vicarious calibration validation for the PROBA-V mission." IEEE Transactions on Geoscience and Remote Sensing. Inter-Calibration of Satellite Instruments Special Issue. Vol.51:3, 1437 – 1452.

Table 18: Reference Documents