QUARTERLY IMAGE QUALITY REPORT

IQR#011

Reporting period from 16/06/2016 to 15/09/2016

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Change record

Release	Date	Pages	Description	Editor(s)/Reviewer(s)
1.0	20/09/2016	All	Initial version	

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1. Radiometric Image Quality

1.1. Summary

The calibration results for the VNIR and SWIR strips remain relatively stable. A slight decreasing trend is observed in the DCC center BLUE results and right NIR results and in the moon calibration results of the center BLUE band. However as these trends are yet significant, it is decided to not yet update the absolute calibration parameters for these strips.

For the SWIR strips the linear degradation model is used, since May 2016, to update monthly the absolute calibration coefficients of the different SWIR strips which explains the stable trend observed over the last months in the desert calibration results.

Similarly as in previous reporting period, the dark current of a few SWIR pixels has suddenly increased, which might cause the presence of a few stripes. For one pixels, i.e.Center SWIR3 pixel 579, the increase in dark current is extremely high and/or unstable, therefore this pixel will be assigned the status BAD.

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 Figure 1, Figure 4 and Figure 7 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 Figure 2, Figure 5, Figure 8 and Figure 3, Figure 6, Figure 9 with a 3 % error bar (as expected uncertainty for an individual result) for respectively VNIR and SWIR strips.

Results are obtained with the absolute calibration parameters valid for the day of acquisition i.e. no reprocessing is done. Images acquired after an update are processed with the updated calibration coefficient.

The Libya-4 calibration results for the VNIR and SWIR strips remain relatively stable. For the SWIR strips the linear degradation model is used to update monthly the absolute calibration coefficients of the different SWIR strips which explains the stable trend observed over the last months.

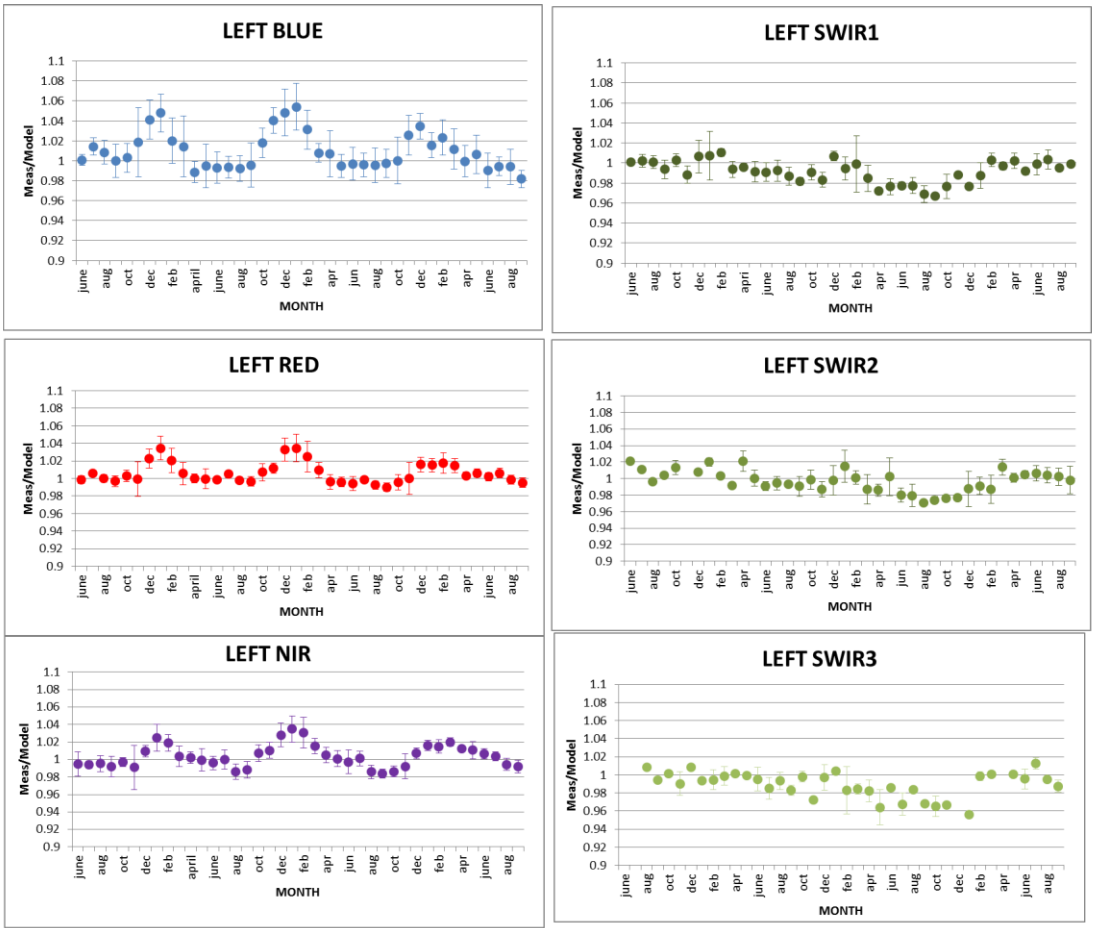
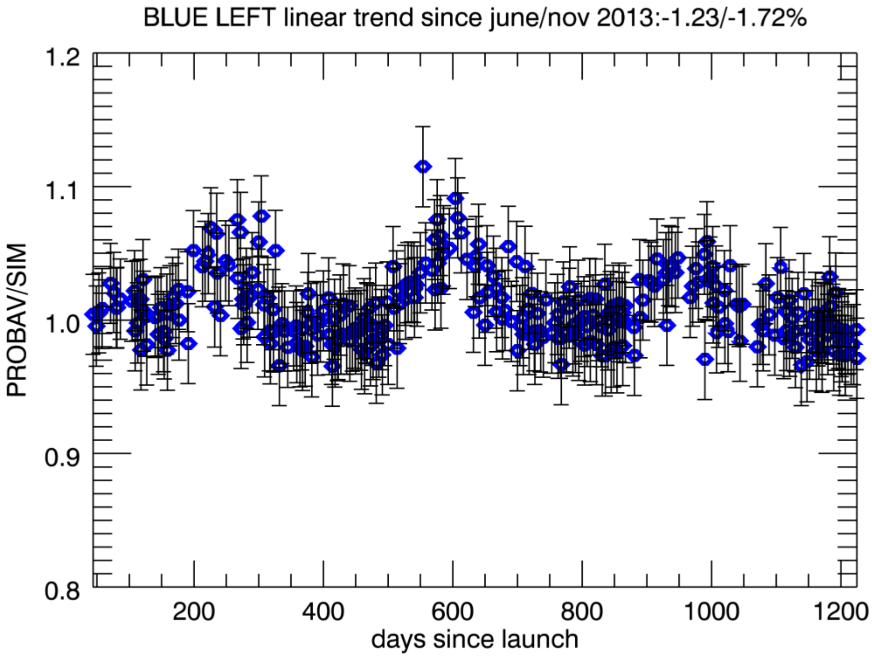
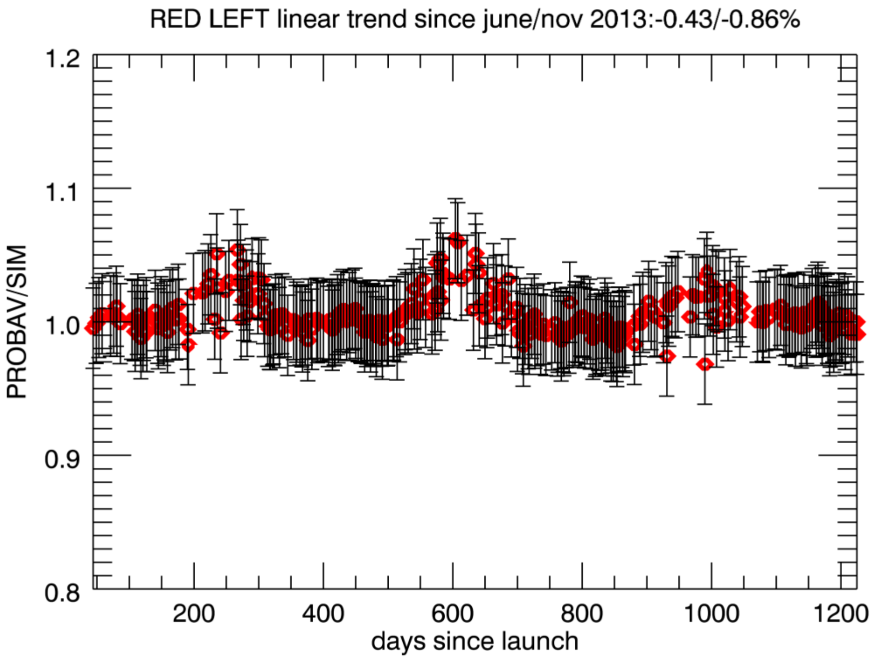


Figure 1. Libya-4 desert calibration results: LEFT monthly averaged results


BLUE LEFT linear trend since june/nov 2013:-1.23/-1.72%
PROBAV/SIM
1.2
1.1
1.0
0.9
0.8
200
400
600
800
1000
1200
days since launch


RED LEFT linear trend since june/nov 2013:-0.43/-0.86%
PROBAV/SIM
1.2
1.1
1.0
0.9
0.8
200
400
600
800
1000
1200
days since launch

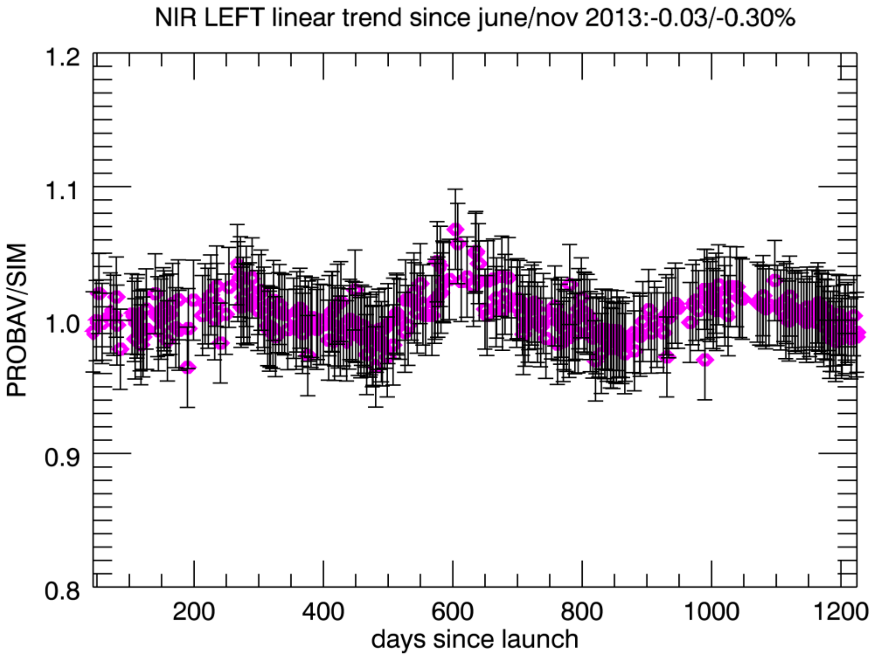
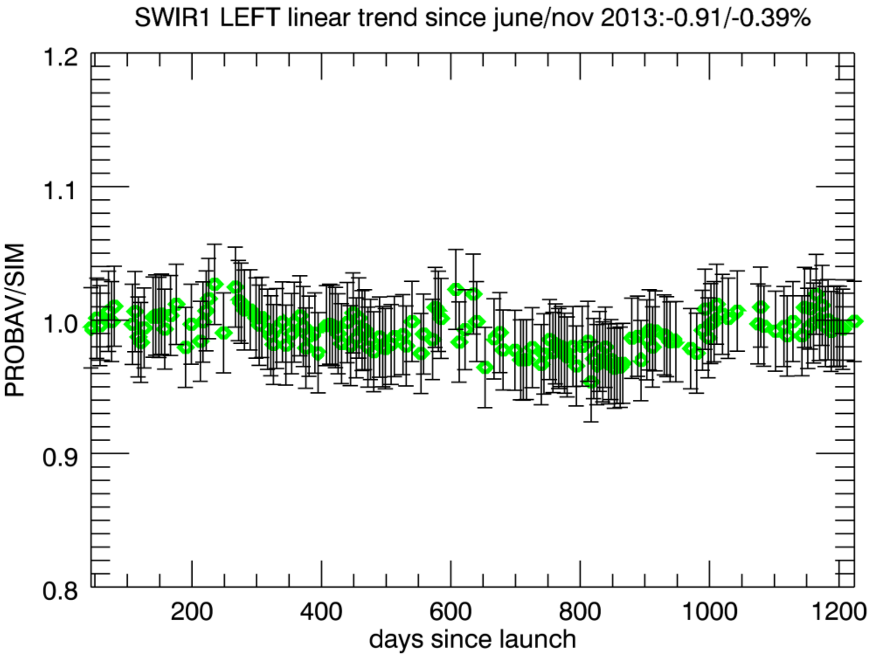
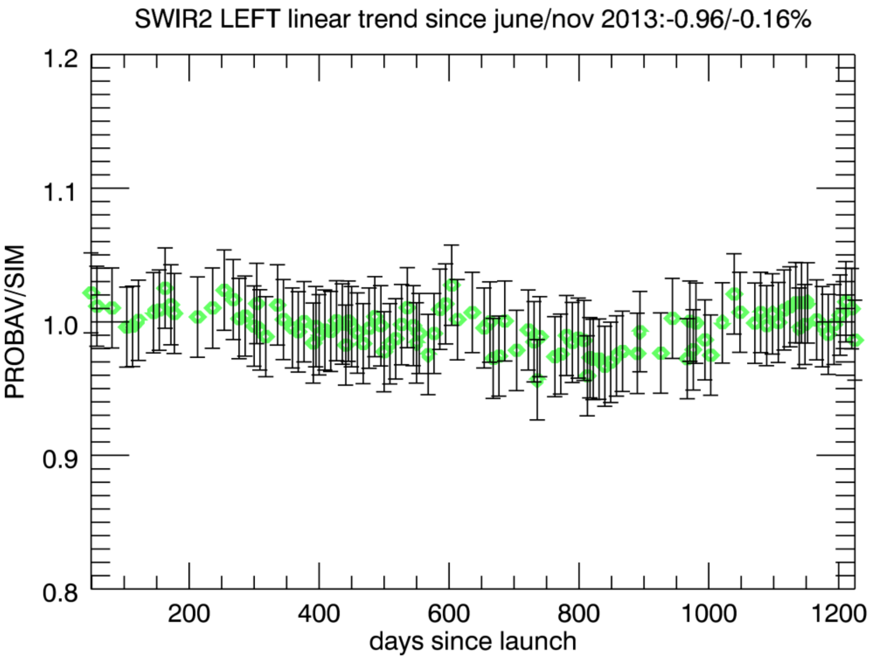


Figure 2. Libya-4 desert calibration results: LEFT VNIR- individual results


SWIR1 LEFT linear trend since june/nov 2013:-0.91/-0.39%
PROBAV/SIM
1.2
1.1
1.0
0.9
0.8
200
400
600
800
1000
1200
days since launch


SWIR2 LEFT linear trend since june/nov 2013:-0.96/-0.16%
PROBAV/SIM
1.2
1.1
1.0
0.9
0.8
200
400
600
800
1000
1200
days since launch

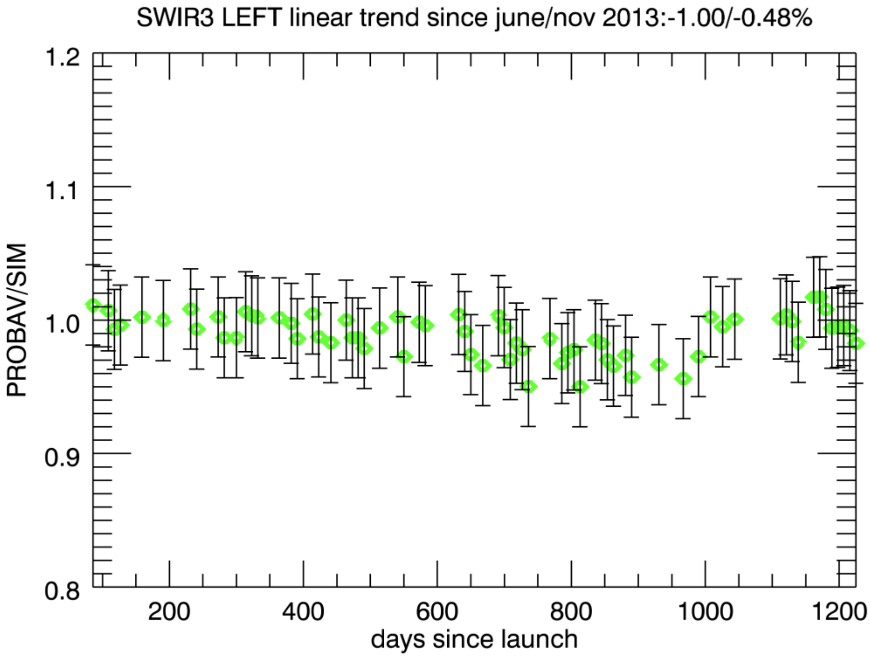


Figure 3. Libya-4 desert calibration results: LEFT SWIR – individual results

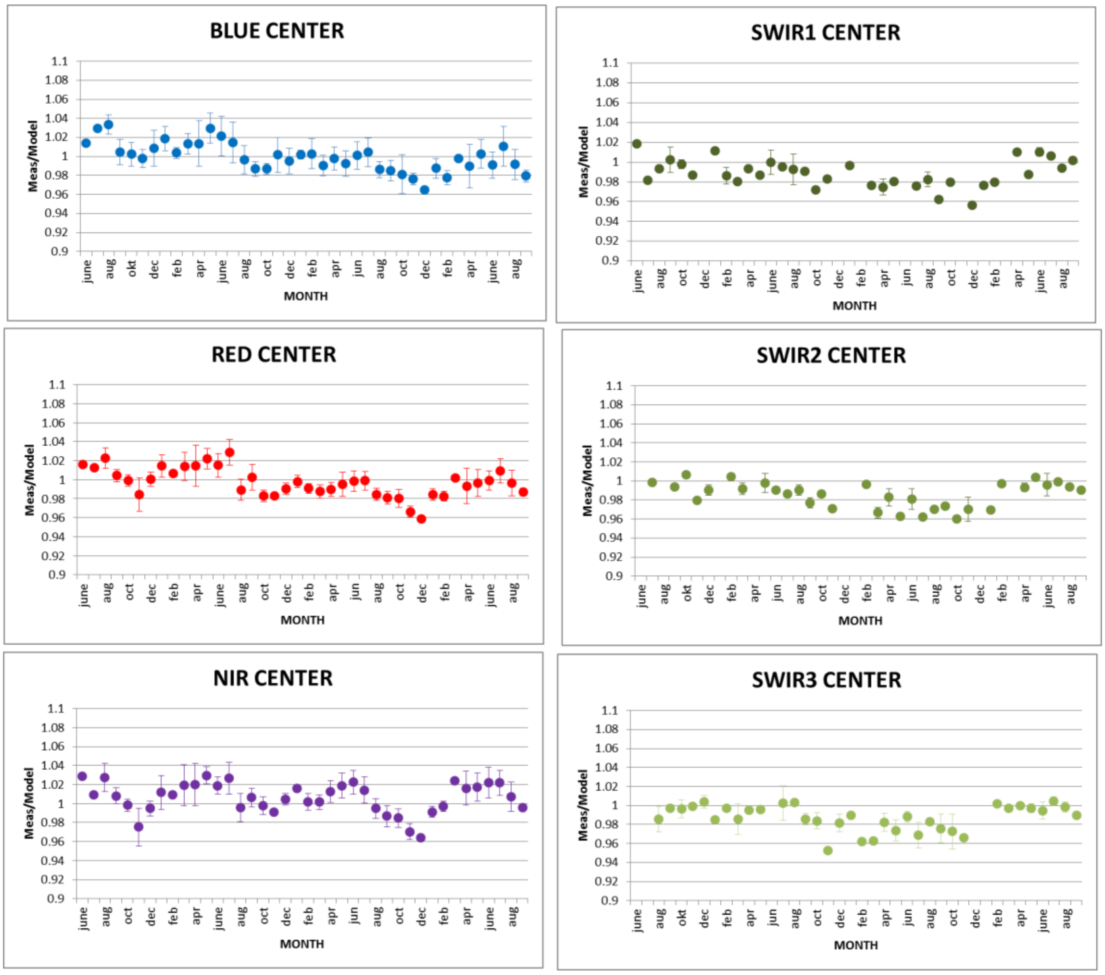
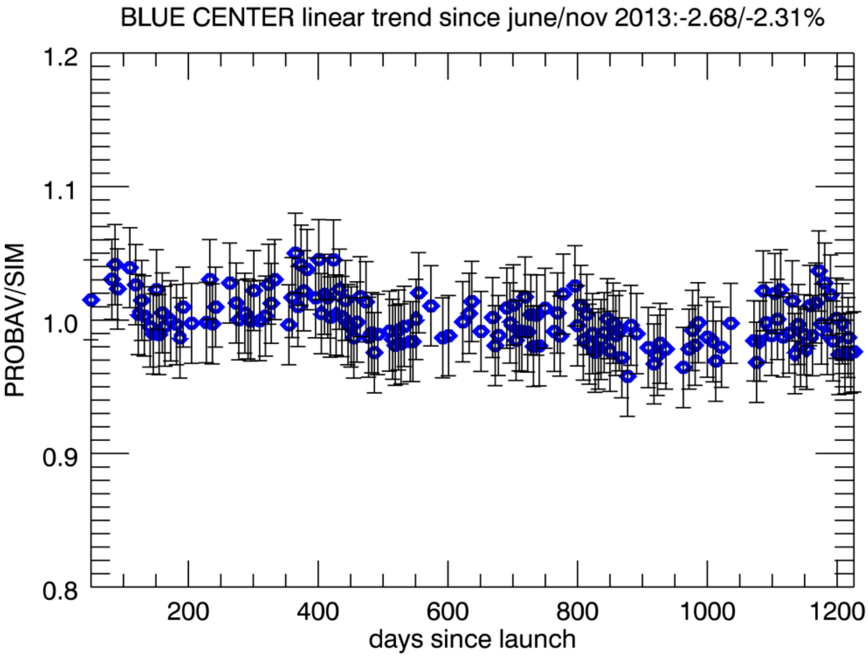
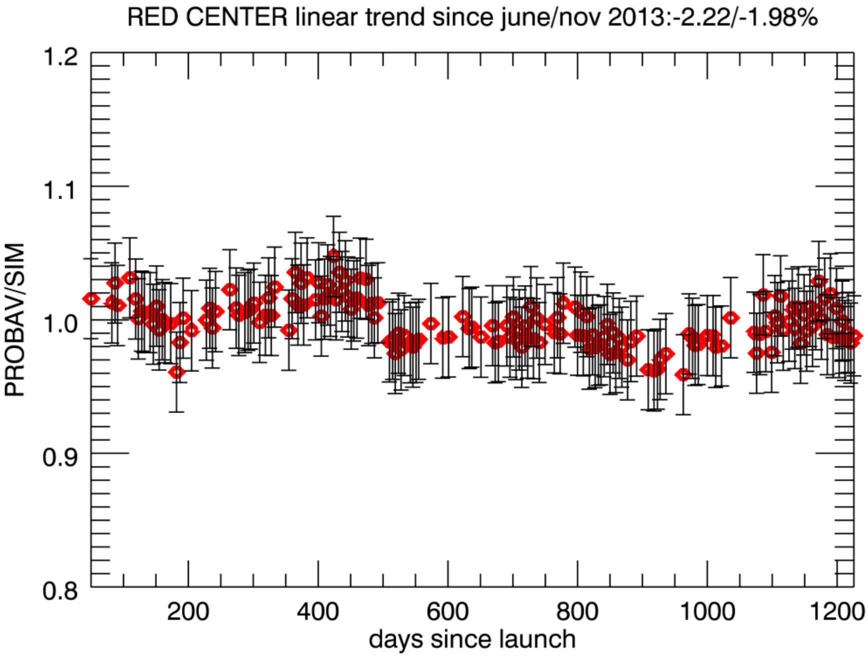


Figure 4. Libya-4 desert calibration results: CENTER monthly averaged results


BLUE CENTER linear trend since june/nov 2013:-2.68/-2.31%
1.2
1.1
1.0
0.9
0.8
PROBAV/SIM
200
400
600
800
1000
1200
days since launch


RED CENTER linear trend since june/nov 2013:-2.22/-1.98%
1.2
1.1
1.0
0.9
0.8
PROBAV/SIM
200
400
600
800
1000
1200
days since launch

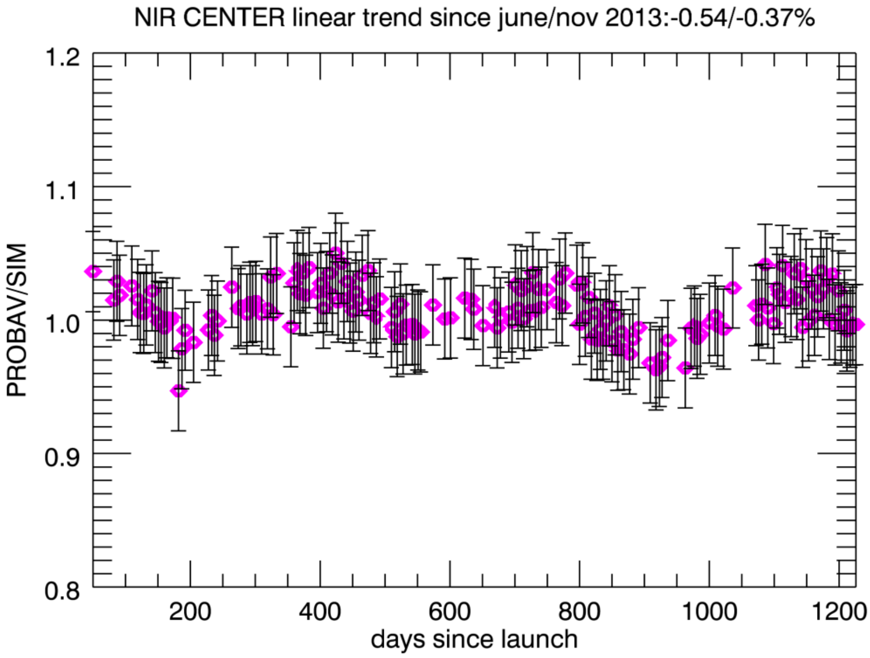
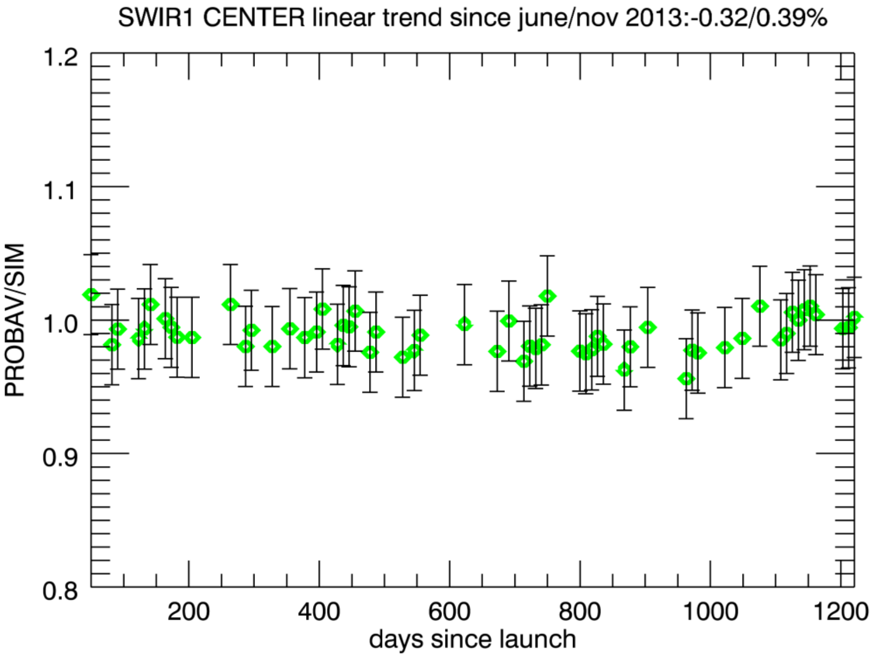
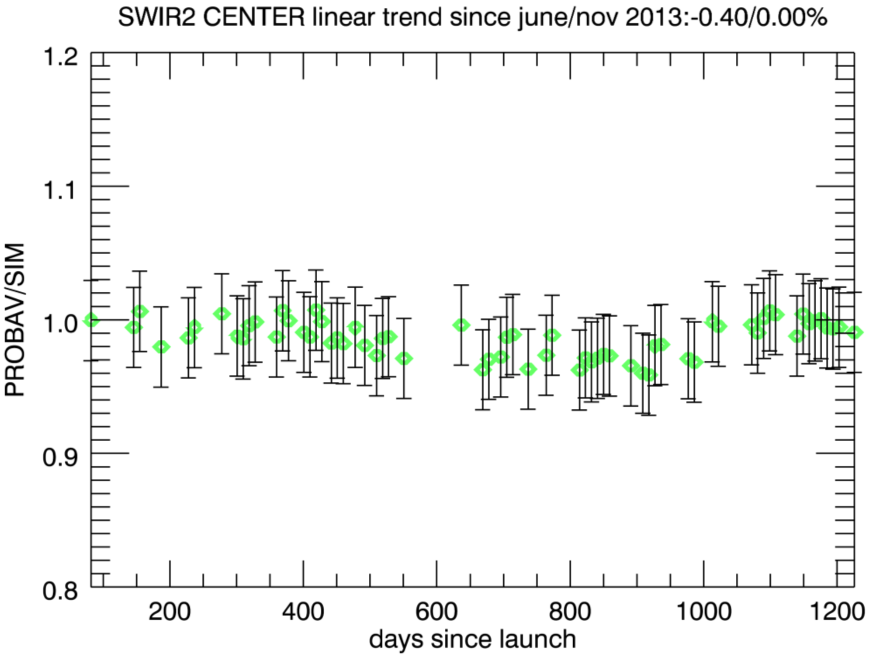


Figure 5. Libya-4 desert calibration results: CENTER VNIR-individual results


SWIR1 CENTER linear trend since june/nov 2013:-0.32/0.39%
PROBAV/SIM
days since launch


SWIR2 CENTER linear trend since june/nov 2013:-0.40/0.00%
PROBAV/SIM
days since launch

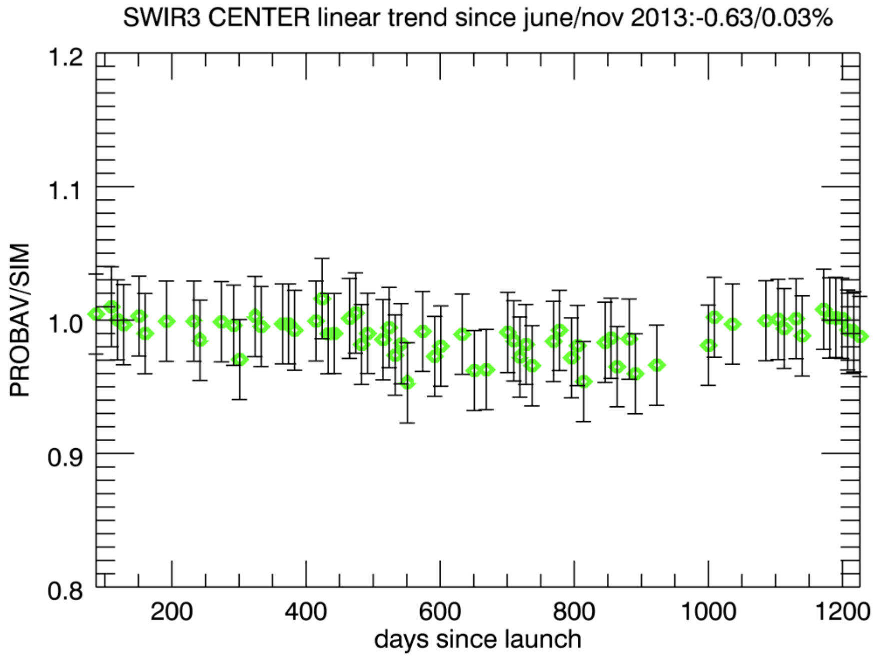


Figure 6. Libya-4 desert calibration results: CENTER SWIR-individual results

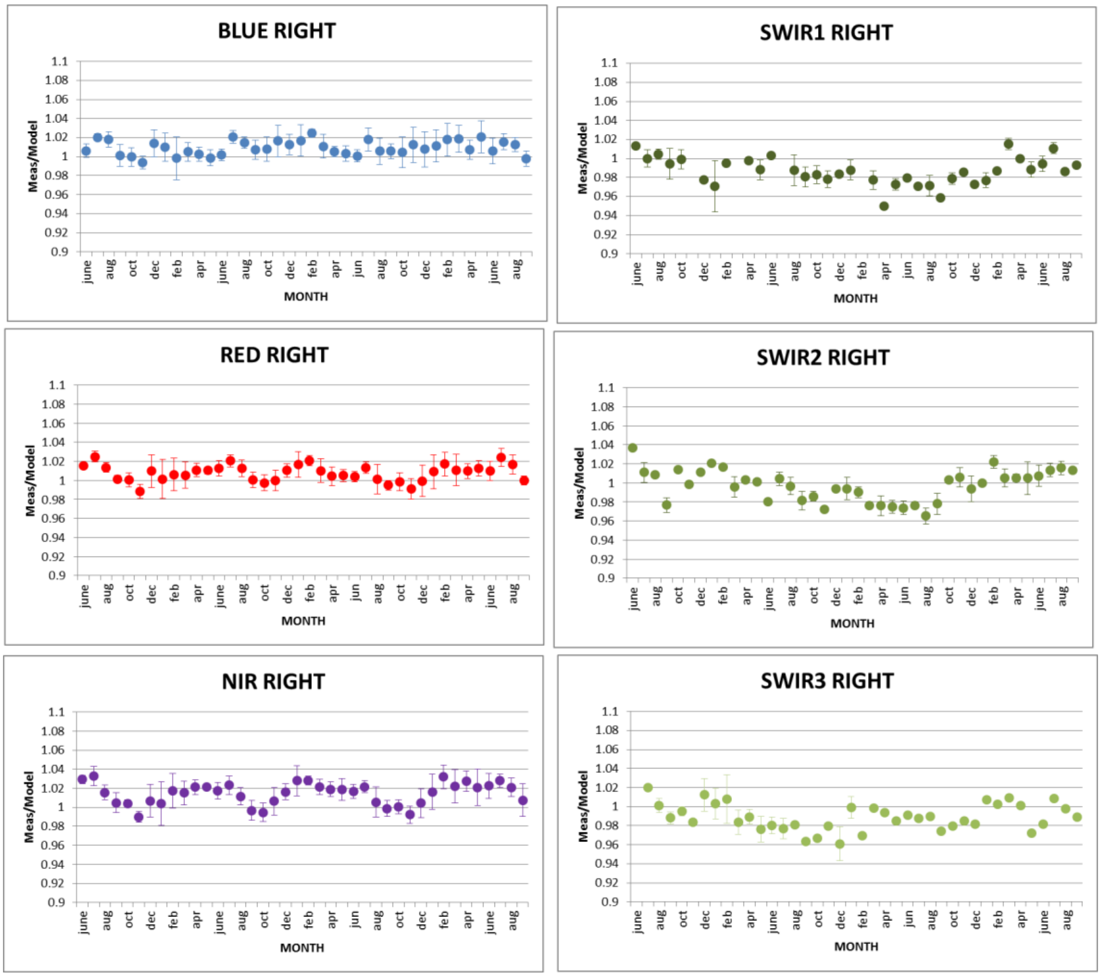
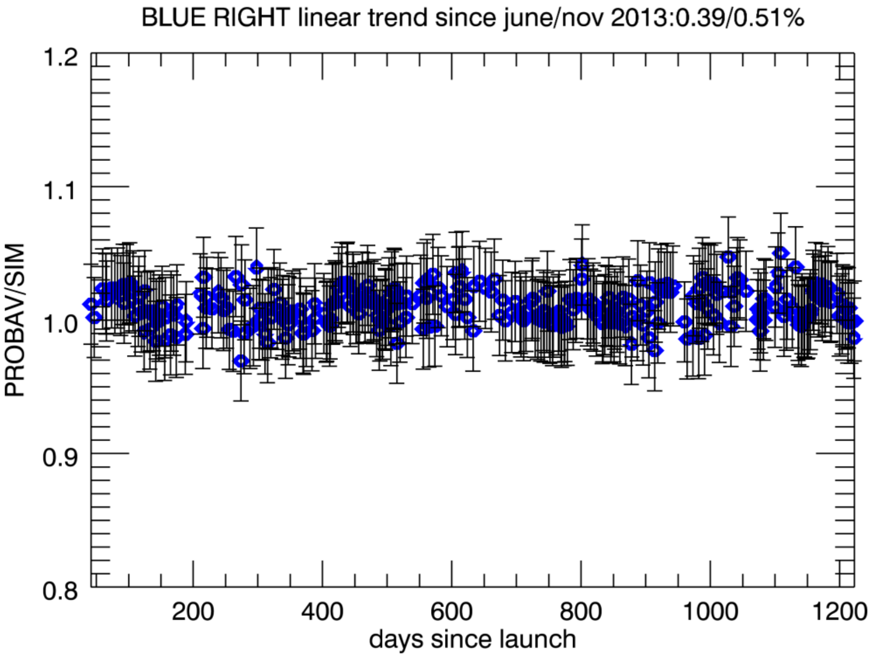
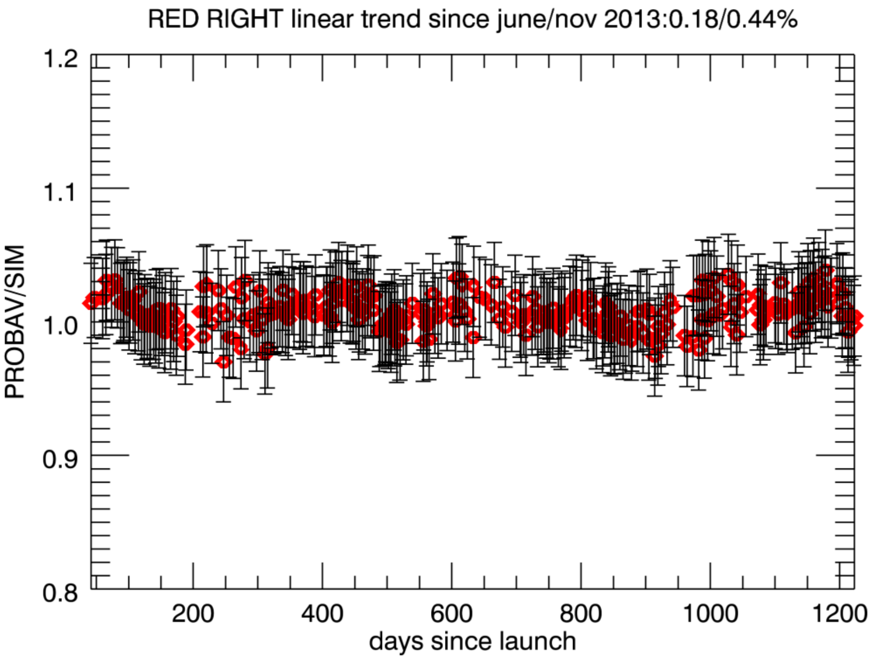


Figure 7. Libya-4 desert calibration results: RIGHT monthly averaged results


BLUE RIGHT linear trend since june/nov 2013:0.39/0.51%
1.2
1.1
1.0
0.9
0.8
PROBAV/SIM
200
400
600
800
1000
1200
days since launch


RED RIGHT linear trend since june/nov 2013:0.18/0.44%
1.2
1.1
1.0
0.9
0.8
PROBAV/SIM
200
400
600
800
1000
1200
days since launch

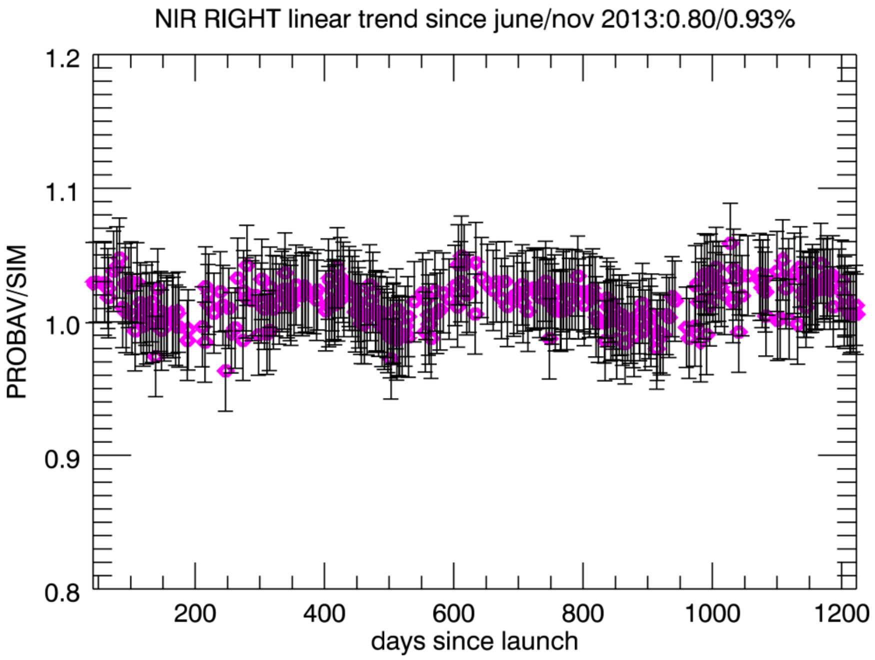
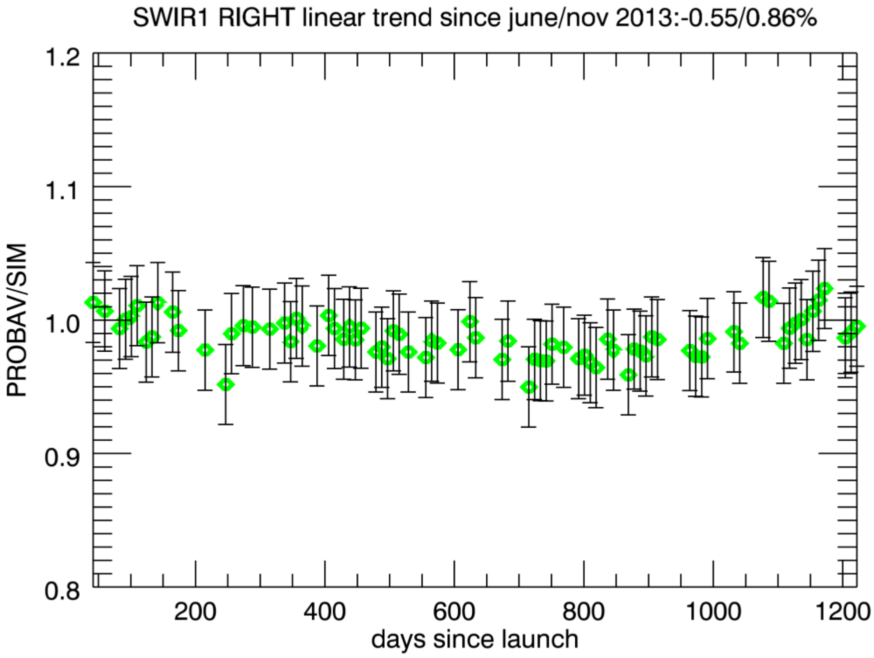
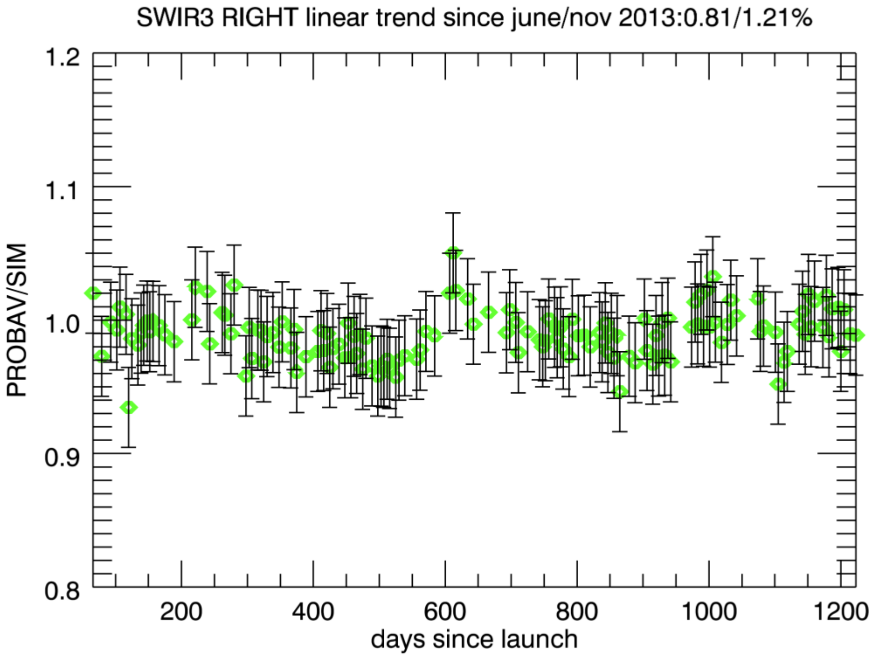


Figure 8. Libya-4 desert calibration results: RIGHT VNIR-individual results


SWIR1 RIGHT linear trend since june/nov 2013:-0.55/0.86%
PROBAV/SIM
days since launch
1.2
1.1
1.0
0.9
0.8
200
400
600
800
1000
1200



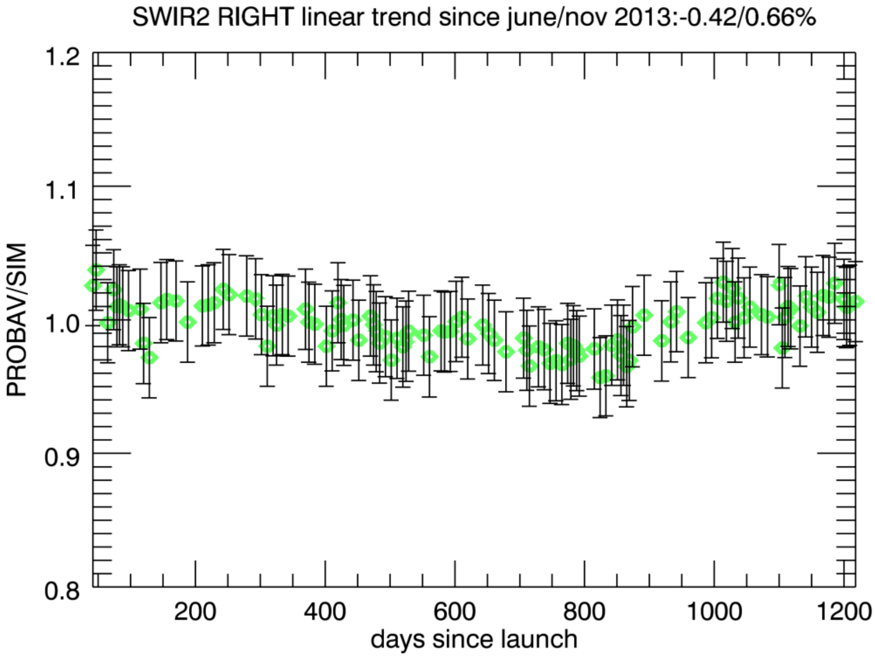


Figure 9. Libya-4 desert calibration results: RIGHT SWIR- individual results

1.2.1.2. Rayleigh calibration

Methodology

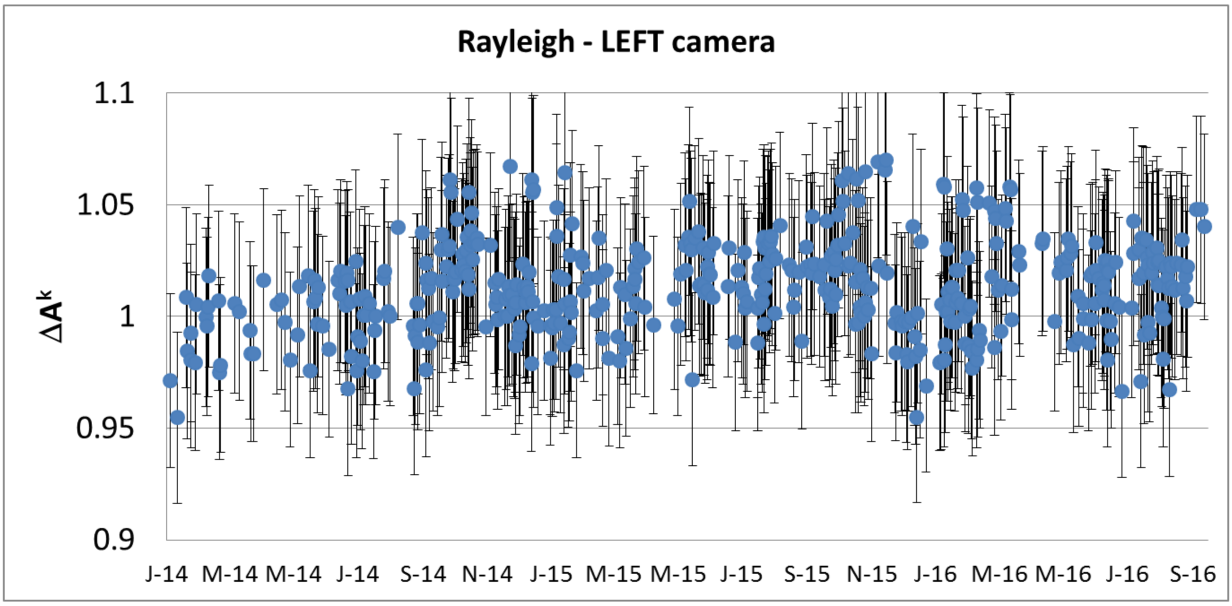
The Rayleigh calibration approach is an absolute calibration method for BLUE and RED bands. The primary assumption of the approach is that the ocean does not contribute to the Top-Of-Atmosphere (TOA) signal in the NIR. The contribution of aerosol scattering is derived from the ***NIR reference band*** 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 10, Figure 11 and Figure 12.

Results are obtained with the absolute calibration parameters valid for the day of acquisition i.e. no reprocessing is done on the results. Images acquired after an update are processed with the updated calibration coefficient.

No significant trend is visible in the Rayleigh calibration results.



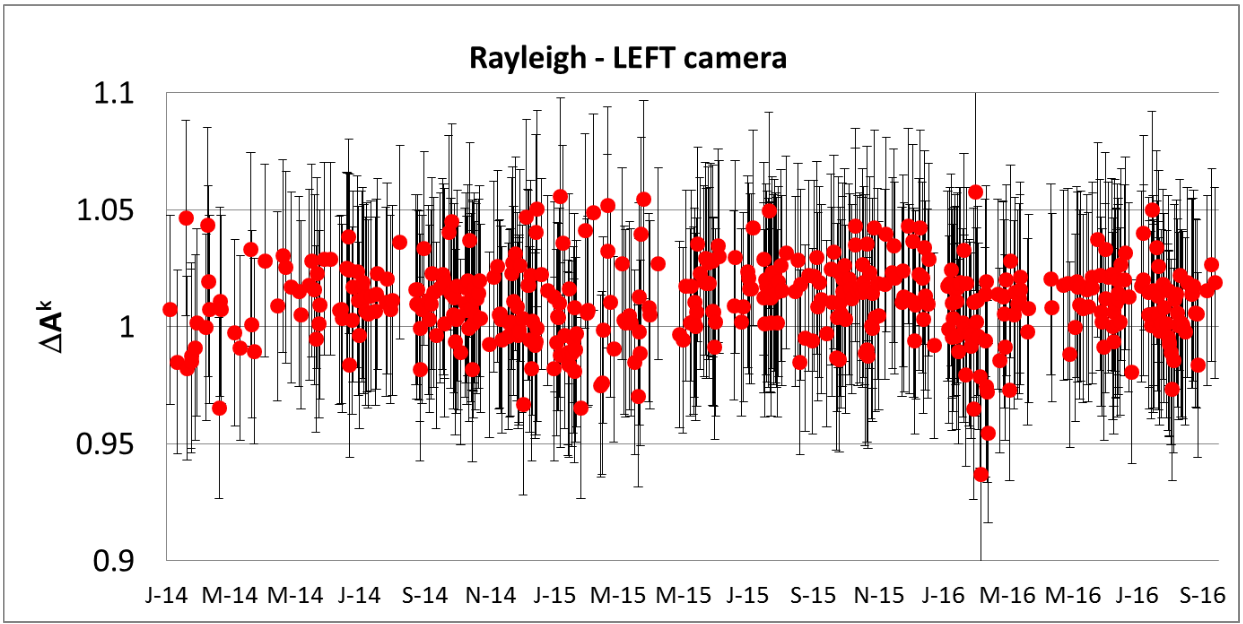
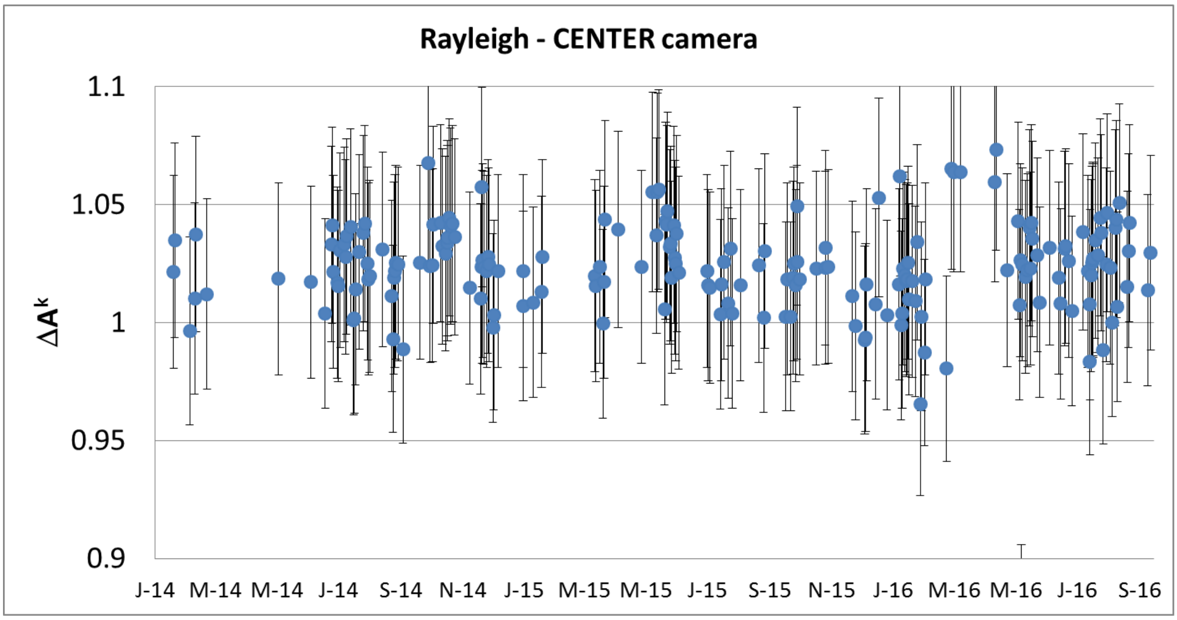


Figure 10. Rayleigh absolute calibration results: LEFT camera



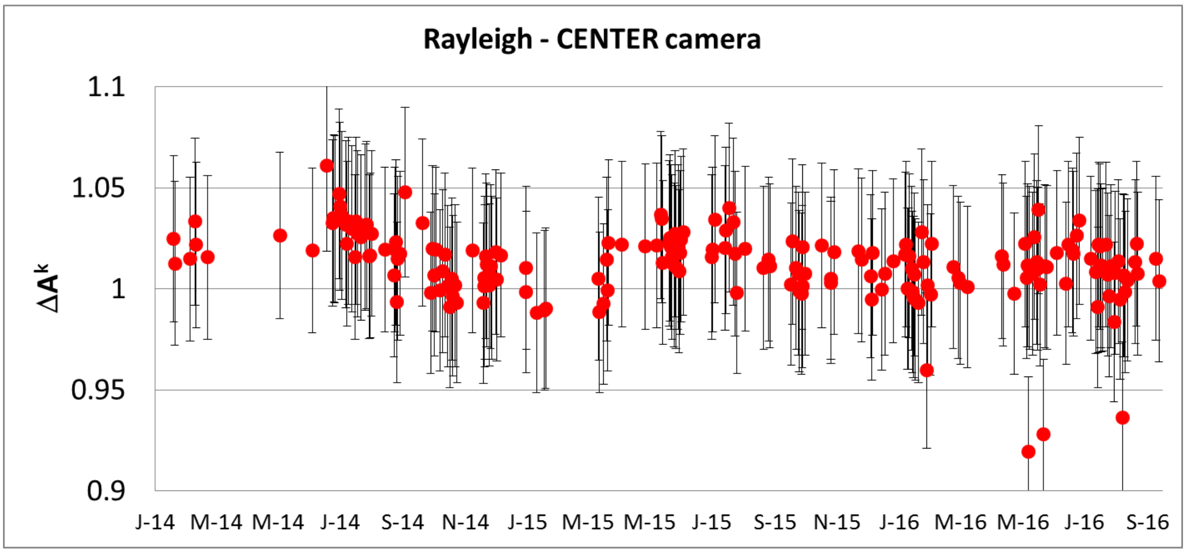


Figure 11. Rayleigh absolute calibration results: CENTER camera

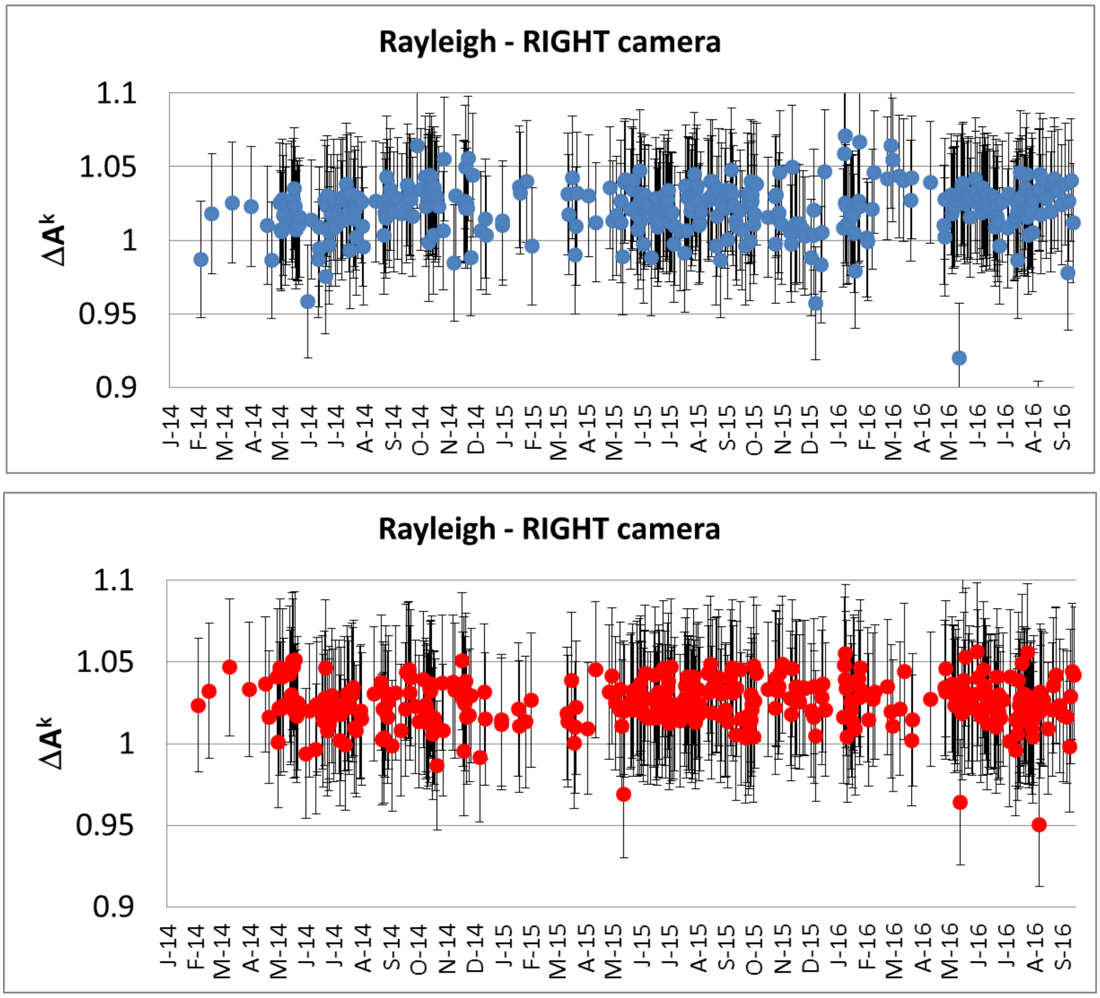


Figure 12. Rayleigh absolute calibration results: RIGHT camera

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 January 2015) is given in Figure 13 for all cameras. Results are obtained with the absolute calibration parameters valid for the day of acquisition i.e. no reprocessing is done on the results. Images acquired after an update are processed with the updated calibration coefficient.

A slight decreasing trend is observed in the DCC center BLUE results and right NIR results .

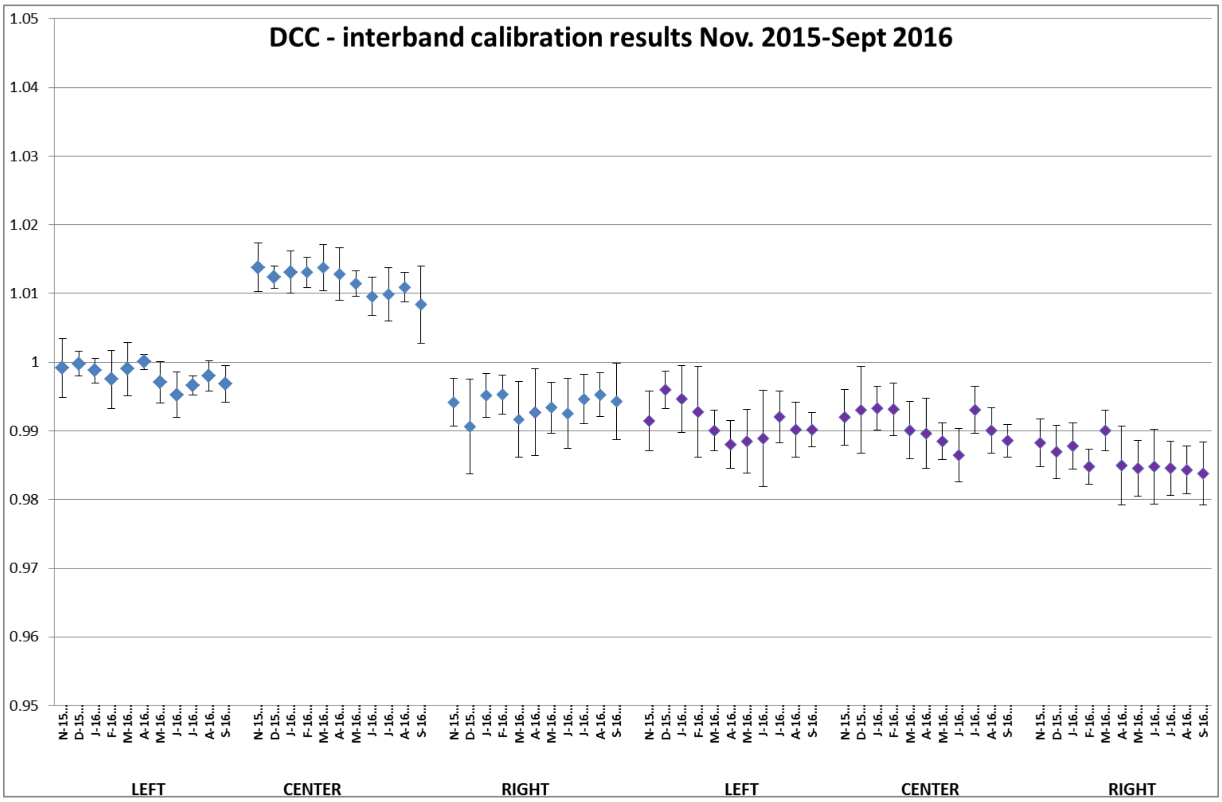


Figure 13. DCC inter-band calibration results: LEFT, CENTER and RIGHT camera

1.2.3. Multi-temporal radiometric accuracy

1.2.3.1. Desert calibration

As discussed in previous quarterly report a degredation model is used to update the absolute calibration coefficients of the different SWIR strips in the ICP files. In Table 1 the applied correction is given .

Table 1. Linear trend/month over different desert sites

STRIP	linear trend/month (%)
SWIR1 LEFT	-0.087
SWIR2 LEFT	-0.104
SWIR3 LEFT	-0.097
SWIR 1 CENTER	-0.093
SWIR2 CENTER	-0.092
SWIR3 CENTER	-0.086
SWIR 1 RIGHT	-0.106
SWIR 2 RIGHT	-0.143
SWIR 3 RIGHT	-0.122

1.2.3.2. Lunar calibration

The Lunar calibration results for the VNIR and SWIR2 CENTER camera bands, normalised to June 2013, are given in Figure 14. The results showed in this figure are obtained with the absolute calibration parameters valid for the day of acquisition i.e. no reprocessing is done on the results. Images acquired after an update are processed with the updated calibration coefficient. On the other hand we have given in Figure 15 the results for a constant calibration coefficient in order to monitor the stability of the instrument.

A slight long-term decreasing trend is observed in the moon calibration results of the center BLUE band in Figure 15, while for the RED and NIR bands no clear trend can be observed.

For the SWIR2 strip we see the impact of the different updates to the absolute calibration coefficients causing a slight overcorrection. In contrast to the deserts calibration results, no degradation trend was observed on in the lunar results. This might be due to the higher uncertainty in SWIR lunar calibration results, caused by the difficulty in delineating the on-Moon pixels correctly and consistently over time.

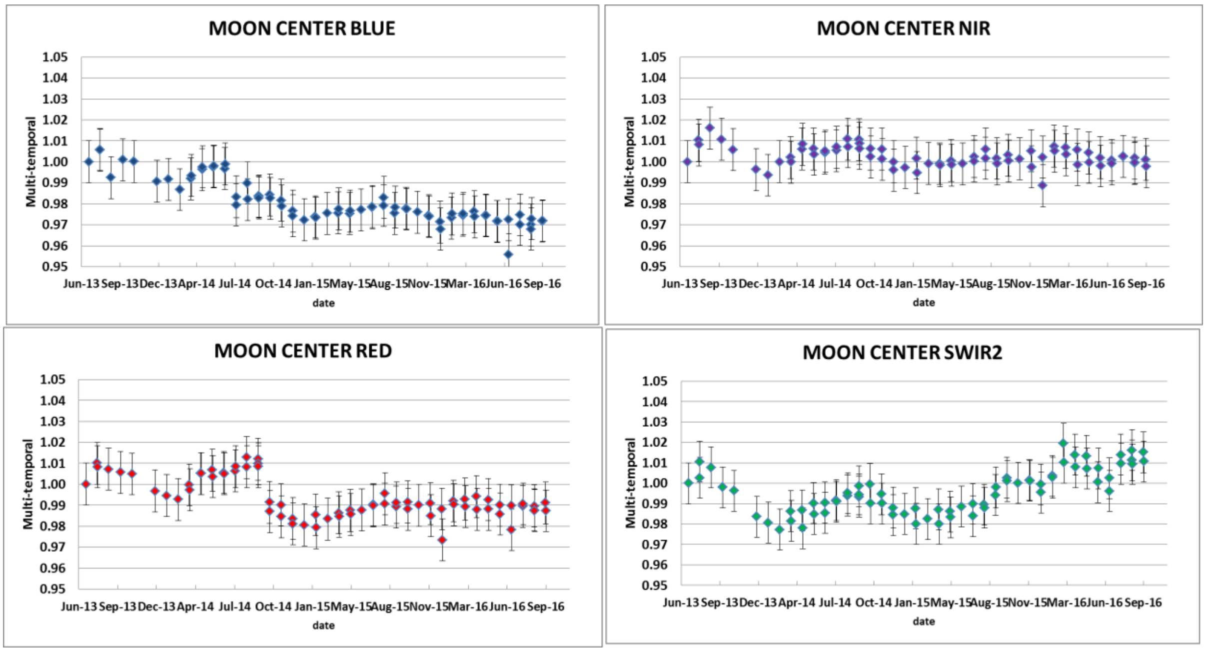


Figure 14. Lunar Calibration results CENTER camera normalised <u>to June taking into account calibration coefficient updates during operational phase.</u>

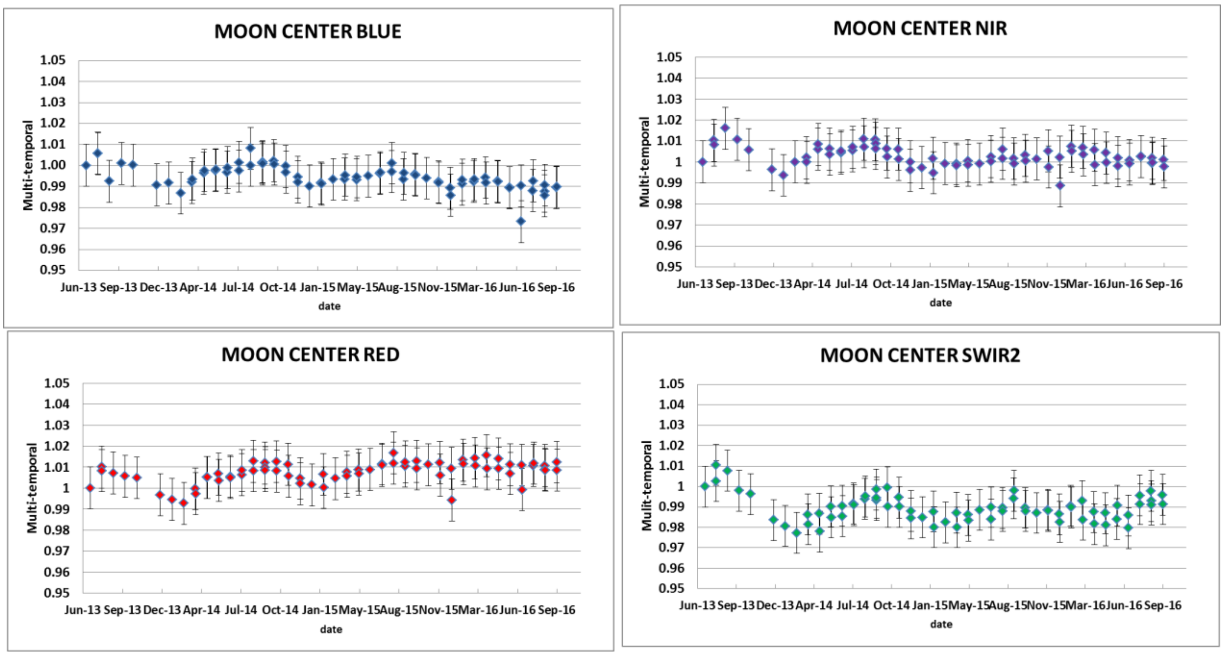


Figure 15. Lunar Calibration results CENTER camera normalised <u>to June considering constant Absolute calibration coefficients.</u>

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 16, Figure 17 and Figure 18 for respectively LEFT, CENTER and RIGHT camera.

Dark current differences for the VNIR bands are well below 1 DN, except for one pixel in the BLUE center strip.

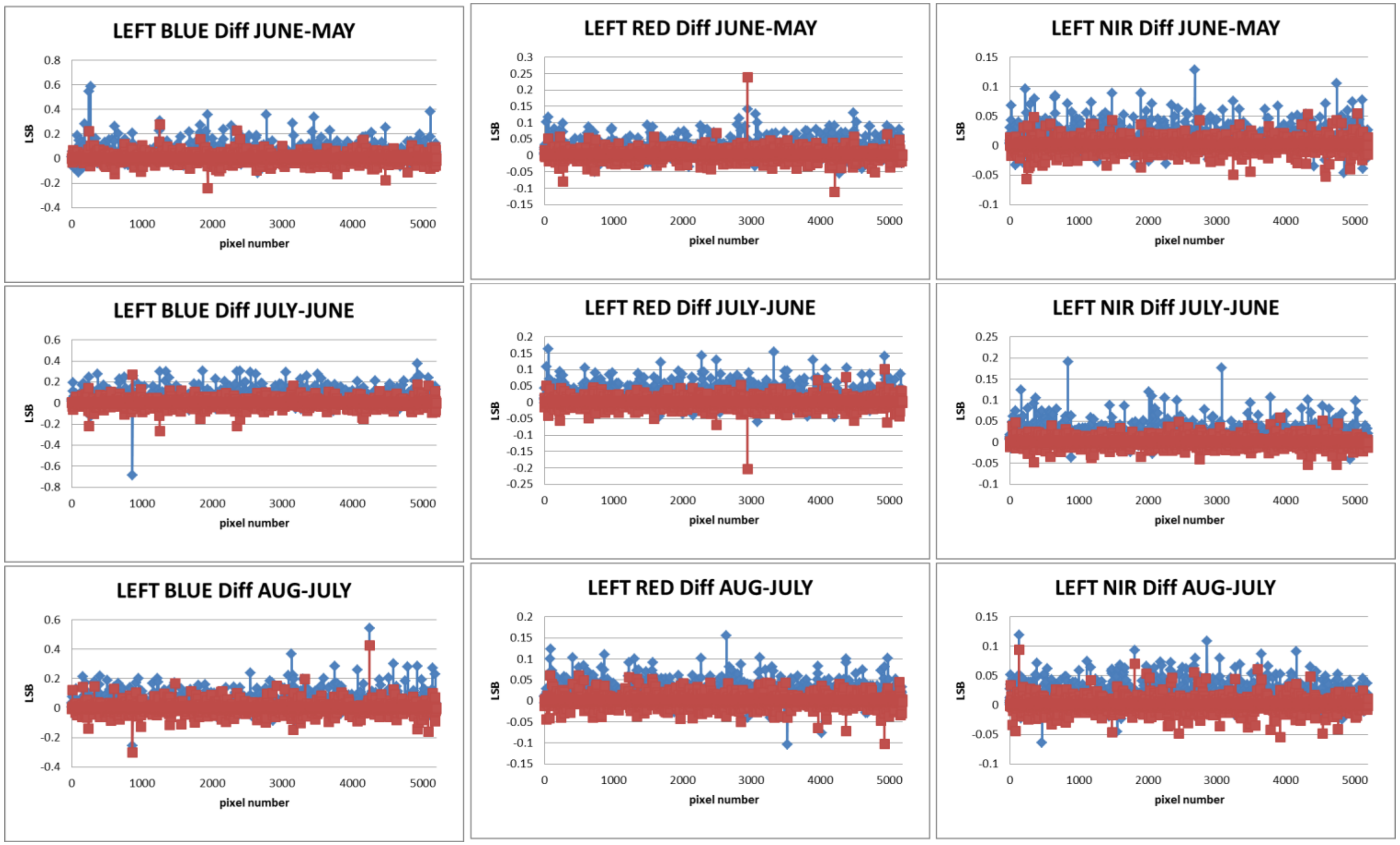


Figure 16. LEFT camera VNIR: Monthly difference (MAY 2016 to AUG 2016) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.

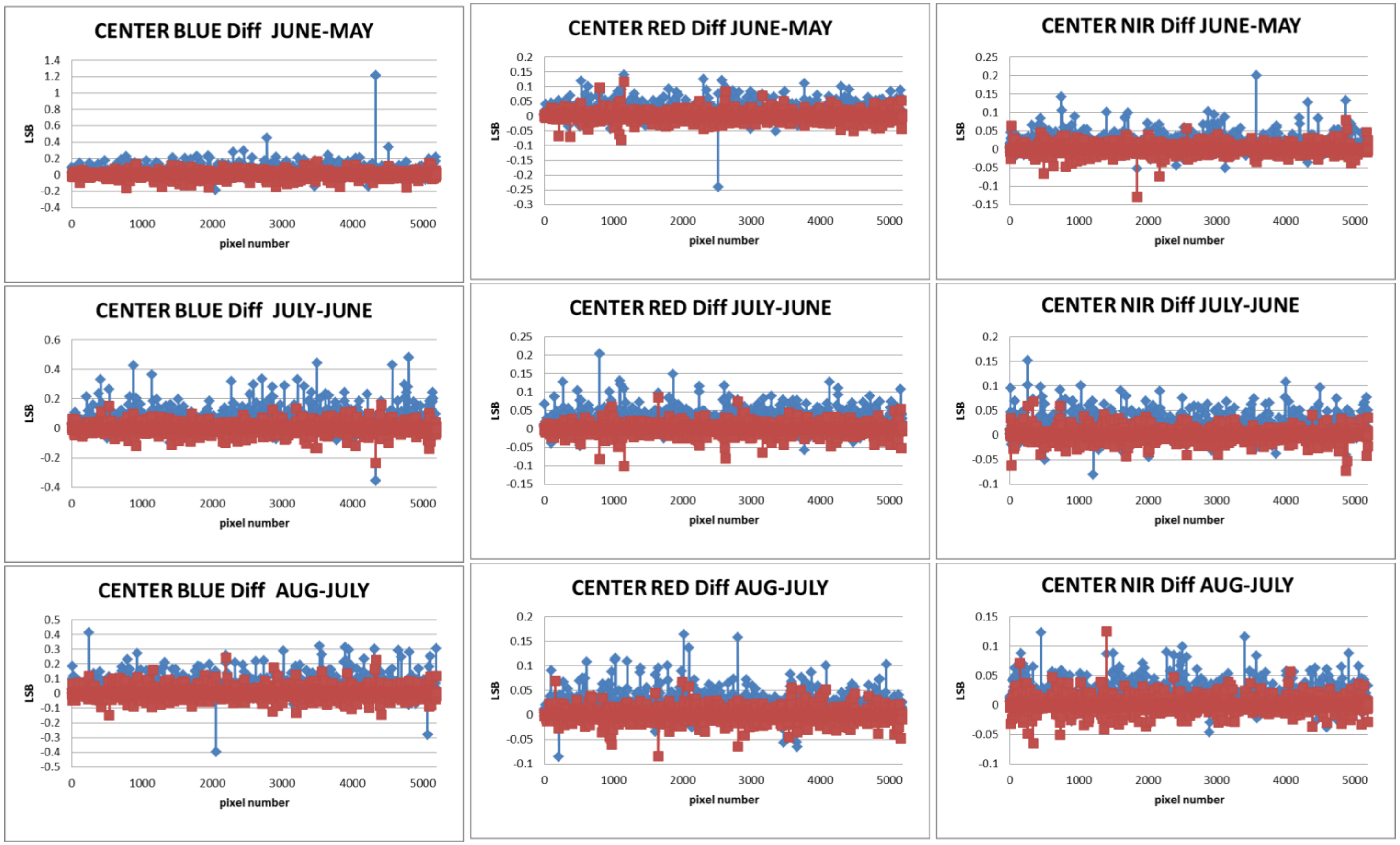


*Figure 17. CENTER camera VNIR: Monthly difference (*MAY 2016 to AUG 2016*) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.*

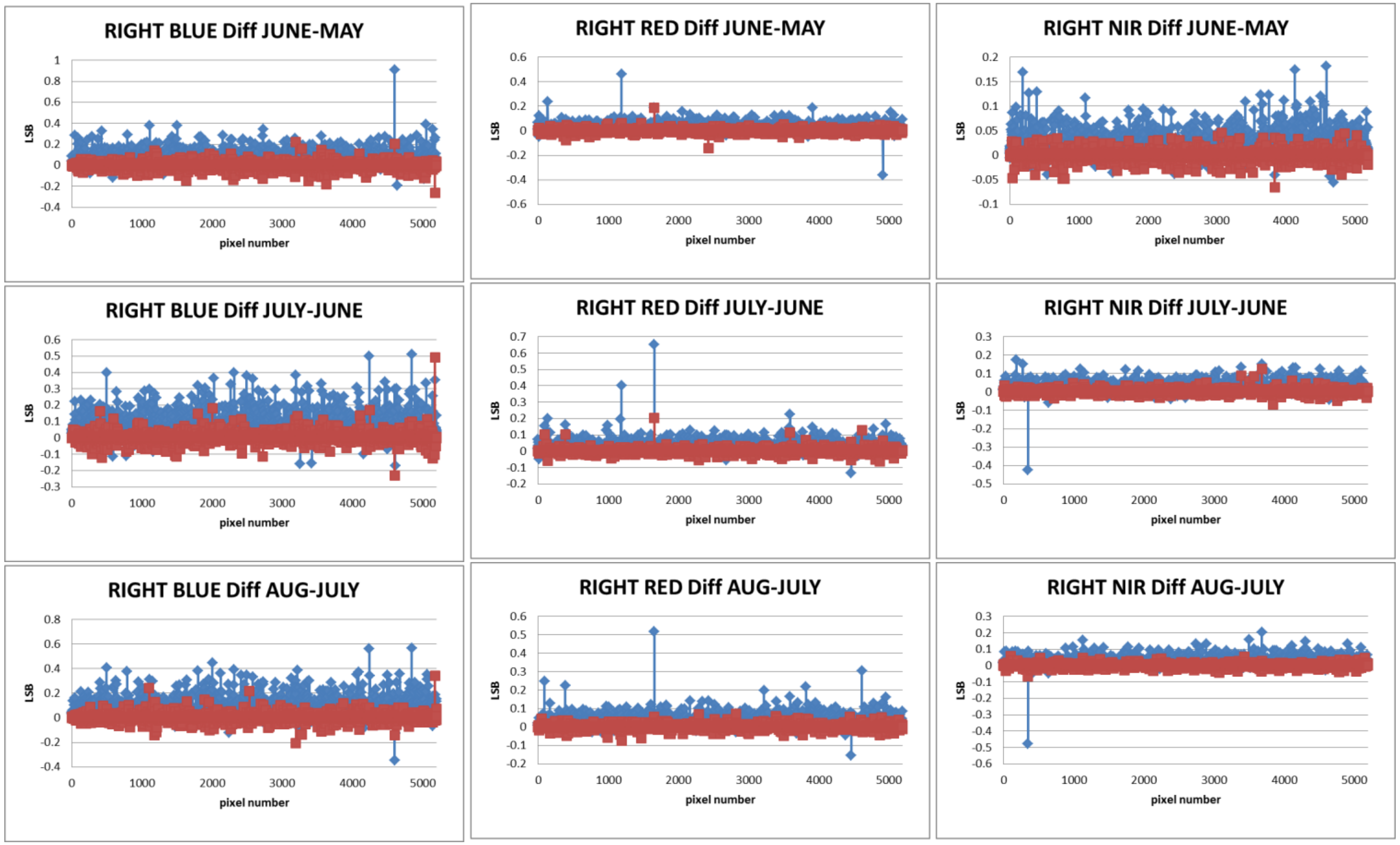


Figure 18. RIGHT camera VNIR: Monthly difference (MAY 2016 to AUG 2016) *in dark current (Blue) and standard deviation (Red) of the monthly averaged results*.

1.3.3. SWIR results

Monthly difference plots for SWIR dark currents are given in Figure 19. LEFT camera SWIR: Monthly difference (MAR 2016 to MAY 2016) in dark current (Blue) and standard deviation (Red) of the monthly averaged results. ,Figure 20 and Figure 21 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 status 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 2,Table 3 and Table 4 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.

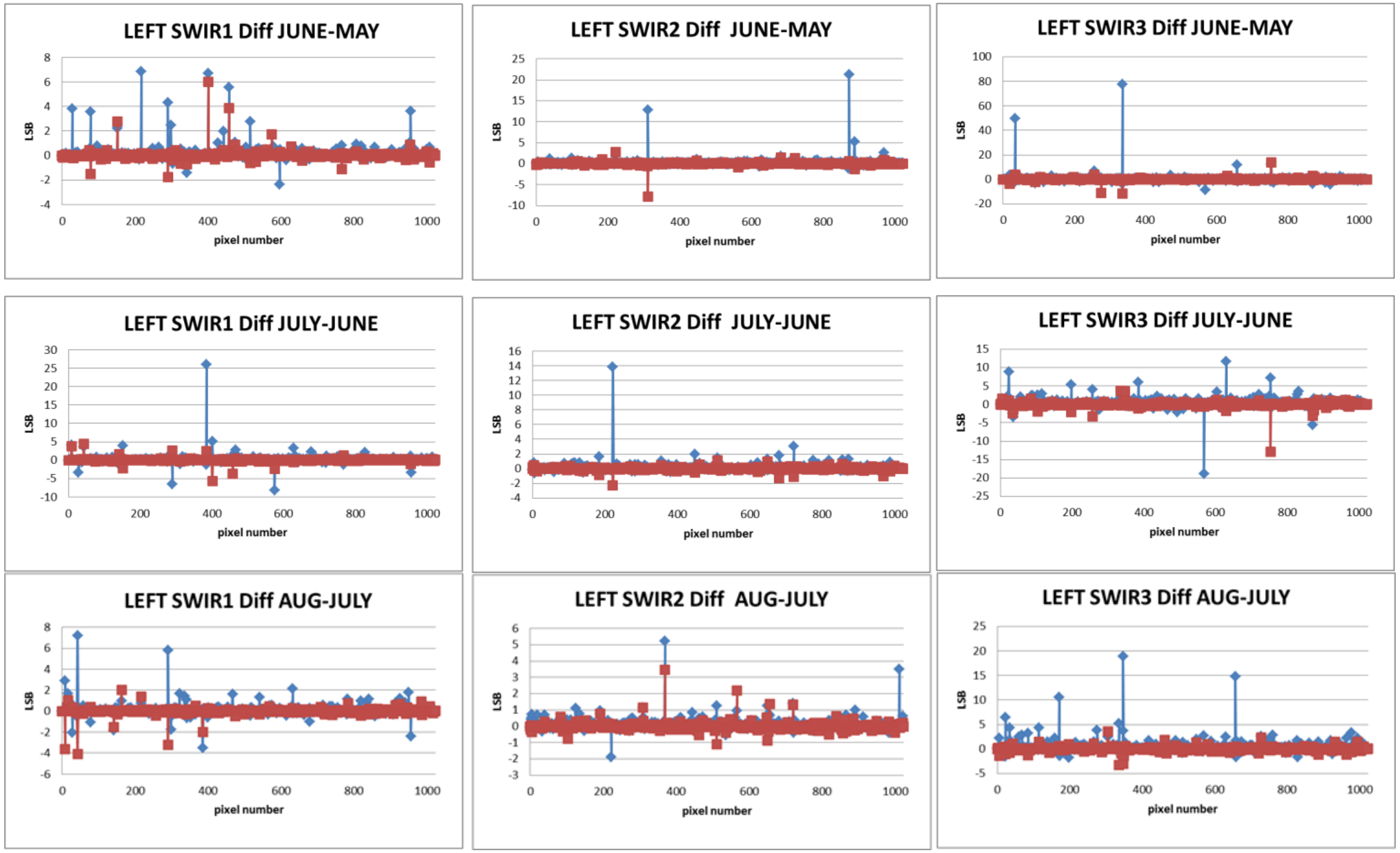


Figure 19. LEFT camera SWIR: Monthly difference (MAR 2016 to MAY 2016) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.

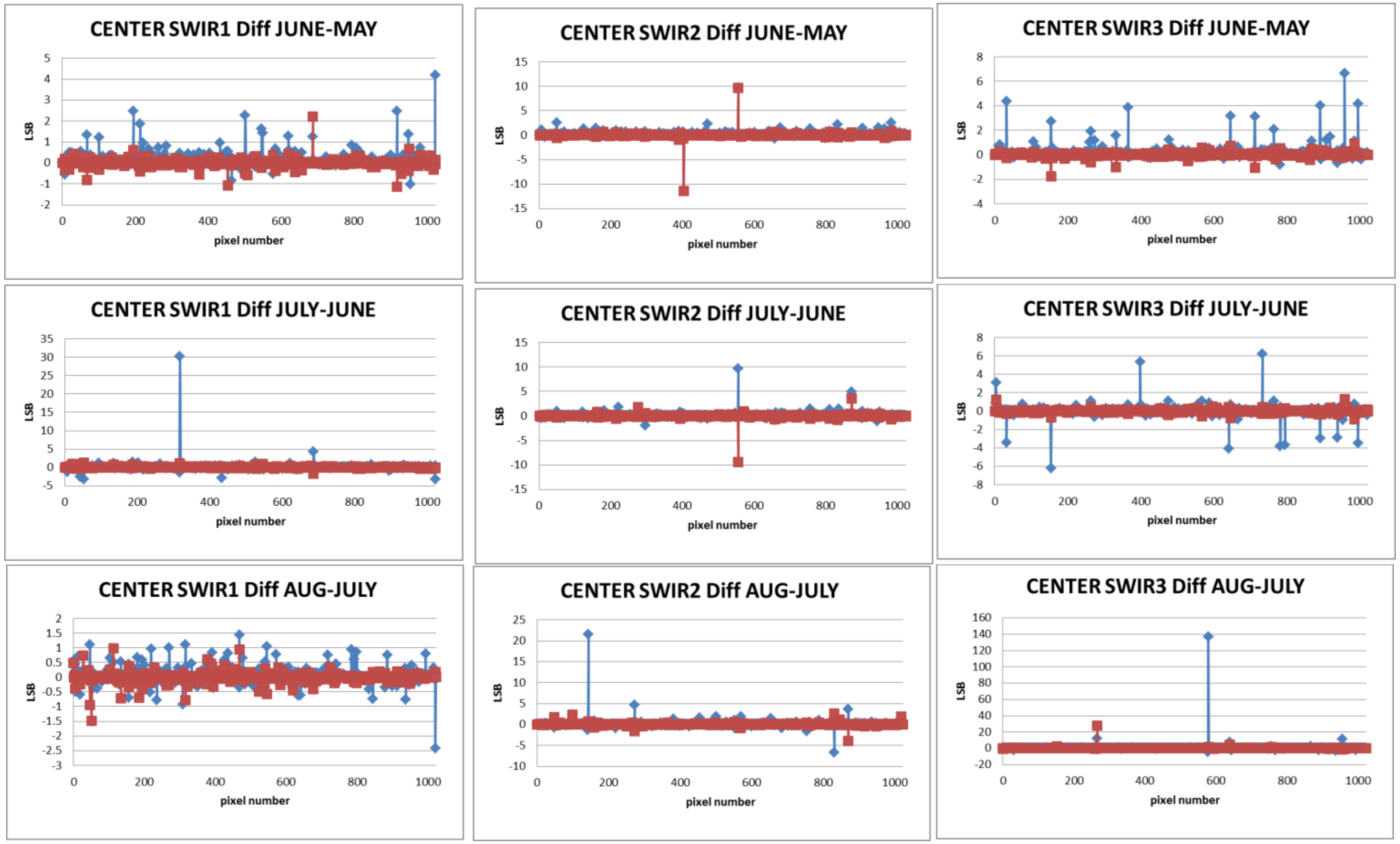


Figure 20. CENTER camera SWIR: Monthly difference (MAR 2016 to MAY 2016) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.

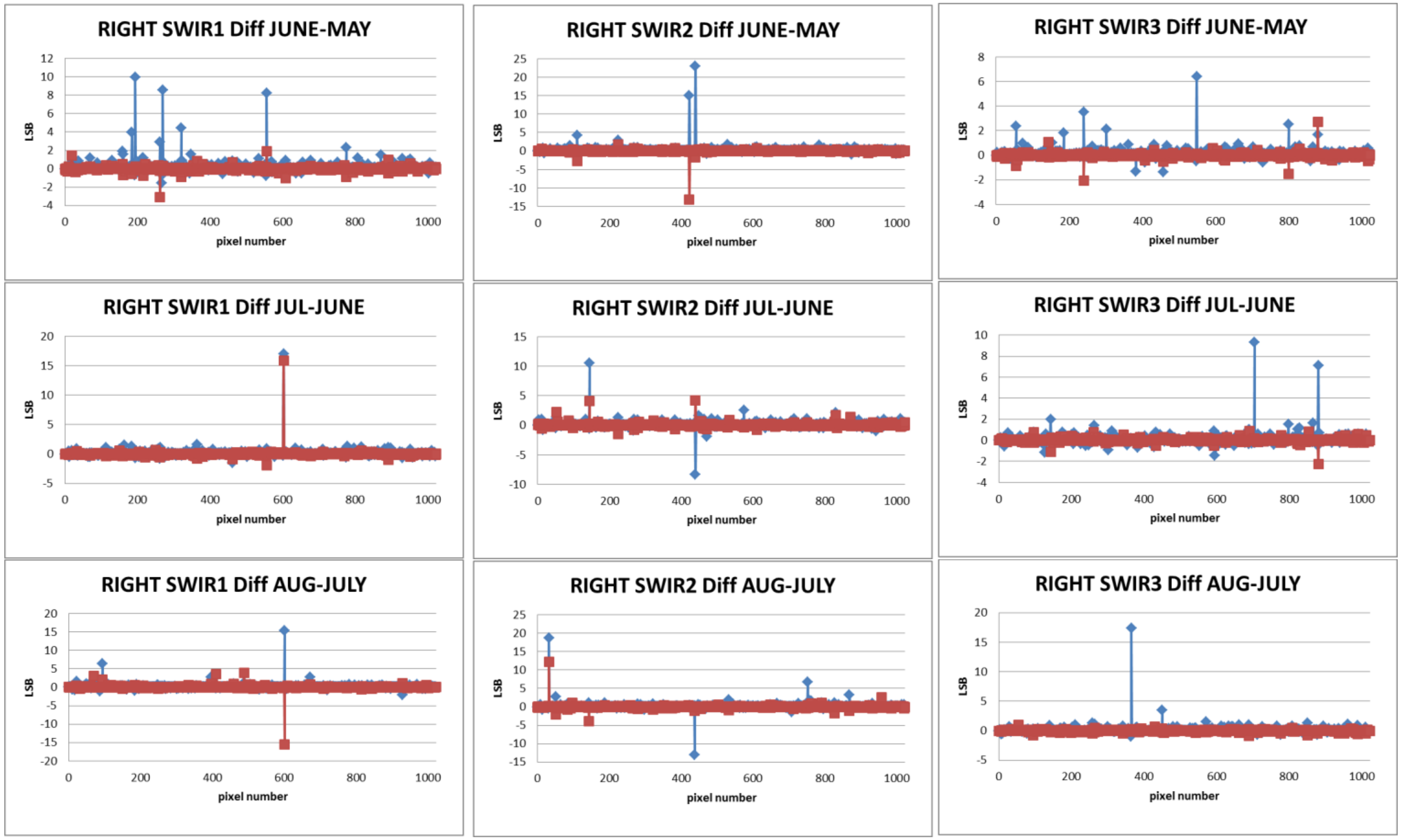


Figure 21. RIGHT camera SWIR: Monthly difference (MAR 2016 to MAY 2016) in dark current (Blue) and standard deviation (Red) of the monthly averaged results.

LEFT																	
Apr-May-June						May-June-July						June-July-Aug					
SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3	
120	H DC NOK	311	H DC BAD	336	H DC BAD	290	H DC BAD	222	H DC NOK	568	H DC BAD	290	H DC BAD	222	H DC NOK	23	H DC BAD
217	H DC NOK	5	H DC NOK	568	H DC BAD	401	H DC BAD	311	H DC NOK	754	H DC BAD	8	H DC NOK	369	H DC NOK	34	H DC NOK
290	H DC NOK	148	H DC NOK	921	H DC BAD	8	H DC NOK	873	H DC NOK	23	H DC NOK	42	H DC NOK	163pixels	H DC OK	115	H DC NOK
342	H DC NOK	580	H DC NOK	19	H DC NOK	217	H DC NOK	888	H DC NOK	34	H DC NOK	385	H DC NOK			171	H DC NOK
401	H DC NOK	873	H DC NOK	34	H DC NOK	385	H DC NOK	151pixels	H DC OK	35	H DC NOK	401	H DC NOK			198	H DC NOK
458	H DC NOK	888	H DC NOK	35	H DC NOK	458	H DC NOK			198	H DC NOK	575	H DC NOK			336	H DC NOK
95pixels	H DC OK	143pixels	H DC OK	56	H DC NOK	575	H DC NOK			257	H DC NOK	105pixels	H DC OK			347	H DC NOK
				90	H DC NOK	101pixels	H DC OK			336	H DC NOK					385	H DC NOK
				257	H DC NOK					385	H DC NOK					568	H DC NOK
				276	H DC NOK					630	H DC NOK					630	H DC NOK
				658	H DC NOK					658	H DC NOK					657	H DC NOK
				740	H DC NOK					871	H DC NOK					754	H DC NOK
				754	H DC NOK					921	H DC NOK					871	H DC NOK
				764	H DC NOK					445 pixels	H DC OK					470 pixels	H DC OK
				871	H DC NOK												
				427 pixels	H DC OK												

Table 2. LEFT SWIR dark current pixel outliers (ID L1A).

APR-MAY-JUNE						MAY-JUNE-JULY						JUNE-JULY-AUG					
SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3		SWIR1		SWIR2		SWIR3	
5	H DC NOK	401	H DC NOK	30	H DC NOK	316	H DC NOK	553	H DC BAD	30	H DC NOK	316	H DC NOK	143	H DC NOK	640	H DC BAD
740	H DC NOK	553	H DC NOK	364	H DC NOK	685	H DC NOK	401	H DC NOK	152	H DC NOK	685	H DC NOK	273	H DC NOK	152	H DC NOK
1021	H DC NOK	831	H DC NOK	644	H DC NOK	1021	H DC NOK	870	H DC NOK	397	H DC NOK	129 pixels	H DC OK	553	H DC NOK	266	H DC NOK
740	H DC NOK	132 pixels	H DC OK	890	H DC NOK	124 pixels	H DC OK	135 pixels	H DC OK	640	H DC NOK			831	H DC NOK	397	H DC NOK
118 pixels	H DC OK			957	H DC NOK					732	H DC NOK			870	H DC NOK	579	H DC NOK
				994	H DC NOK					890	H DC NOK			139 pixels	H DC OK	732	H DC NOK
				78 pixels	H DC OK					957	H DC NOK					957	H DC NOK
										994	H DC NOK					87 pixels	H DC OK
										82 pixels	H DC OK						

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

RIGHT																	
APR-MAY-JUNE						MAY-JUNE-JULY						JUNE-JULY-AUG					
183	H DC NOK	421	H DC BAD	300	H DC NOK	192	H DC NOK	438	H DC BAD	547	H DC NOK	601	H DC BAD	438	H DC BAD	366	H DC NOK
192	H DC NOK	438	H DC BAD	381	H DC NOK	268	H DC NOK	108	H DC NOK	703	H DC NOK	94	H DC NOK	32	H DC NOK	703	H DC NOK
268	H DC NOK	108	H DC NOK	455	H DC NOK	319	H DC NOK	143	H DC NOK	879	H DC NOK	191pixels	H DC OK	143	H DC NOK	879	H DC NOK
302	H DC NOK	648	H DC NOK	547	H DC NOK	554	H DC NOK	421	H DC NOK	147 pixels	H DC OK			753	H DC NOK	157 pixels	H DC OK
319	H DC NOK	893	H DC NOK	143 pixels	H DC OK	601	H DC NOK	171 pixels	H DC OK					171 pixels	H DC OK		
554	H DC NOK	170 pixels	H DC OK			181 pixels	H DC OK										
929	H DC NOK																
171 pixels	H DC OK																

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

1.4. High Frequency Equalisation/Striping

Methodology

The high frequency interpixel variation or equalization differences are estimated on radiometrically corrected images i.e. the radiometric model is applied including the equalization coefficients (gi). If they are correct, they remove all the pixel to pixel non-uniformity. In principle the multi-angular method then detects no non-uniformities, only noise if systematic non-uniformities are detected, they can be viewed as corrections to the existing equalization coefficients ($\Delta gi, high$). Working like this is in fact an advantage as it focuses entirely on the changes from the existing coefficients. The coefficients can be updated by multiplying the new estimates ("correction coefficients") with the old ones:

$$gi, new = gi\ x \Delta gi, high$$

The $\Delta gi, high$ are estimated as follows:

- An input image is taken, containing as little variation in the scene as possible. Image containing uniform snow areas over Antarctica or Greenland during local summer are ideal for VNIR bands. For SWIR bands images over homogeneous desert sites (e.g. Libya4) are used.
- Low pass image: is obtained by calculating an averaging filter in the along track direction.
- HFRR (high frequency relative response) image is the ratio between the original and the low pass image. It contains only the high frequency information.
- In the HFRR image, the trimmed mean is calculated in the along track direction (using all pixel values of a column).
- The average and standard deviation over the considered time period is calculated.

Results

No multi-angular calibration acquisitions have been performed for the VNIR strips due to unsuitable solar conditions over the Antarctica or Greenland calibration zones .
High Frequency/striping analyses for the SWIR strips over desert sites has been performed mid-August 2016 taken into account the acquisitions since the last dark current updates in the ICP file (ie 23 August 2016).Please note that no HF equalisation updates have been done during the reporting period. The SWIR High Frequency/striping results for LEFT, CENTER and RIGHT camera are given in respectively Figure 22, Figure 23 and Figure 24
Observed stripes in the equalisation profiles can directly be linked to a sudden significant jump in the DC values of that pixel as illustrated in *Figure 25*.

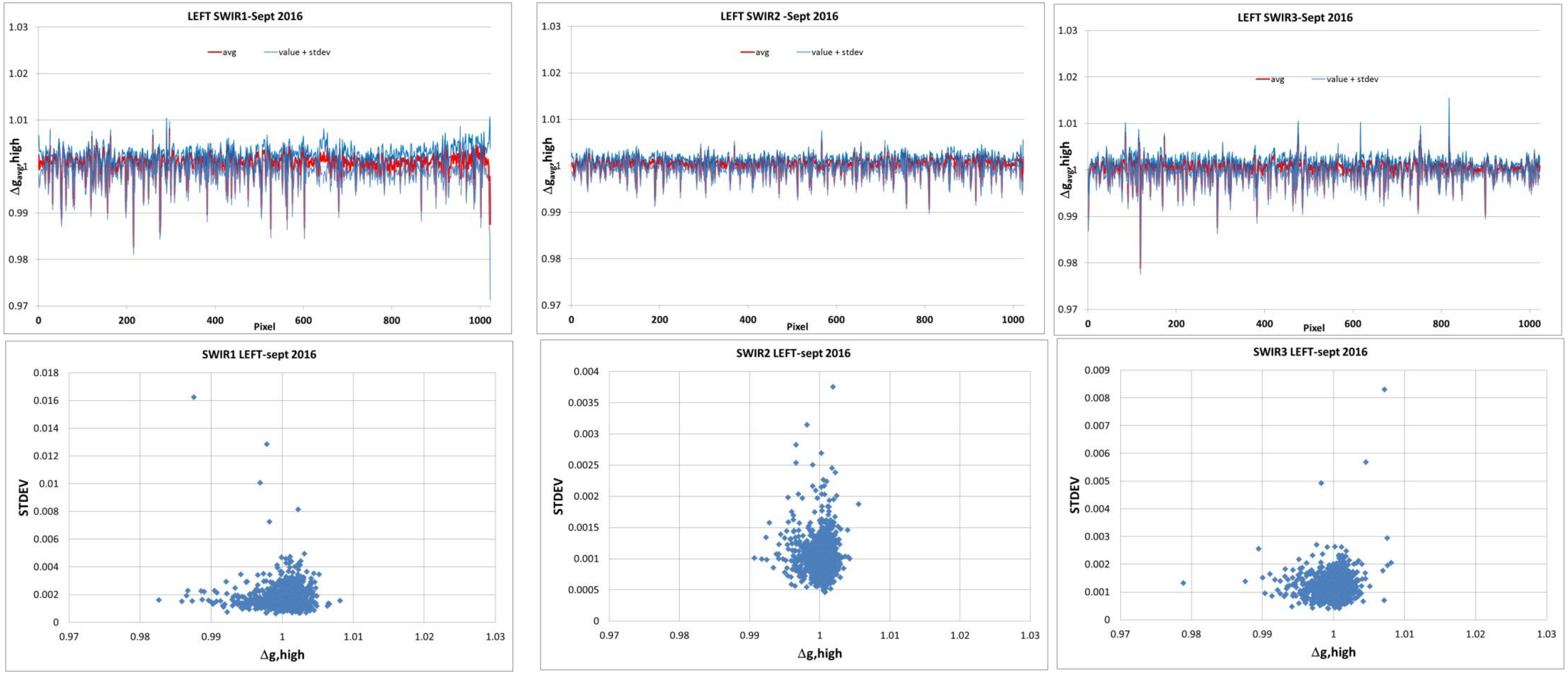


Figure 22. HF SWIR equalisation results SWIR LEFT: mid-Sept 2016

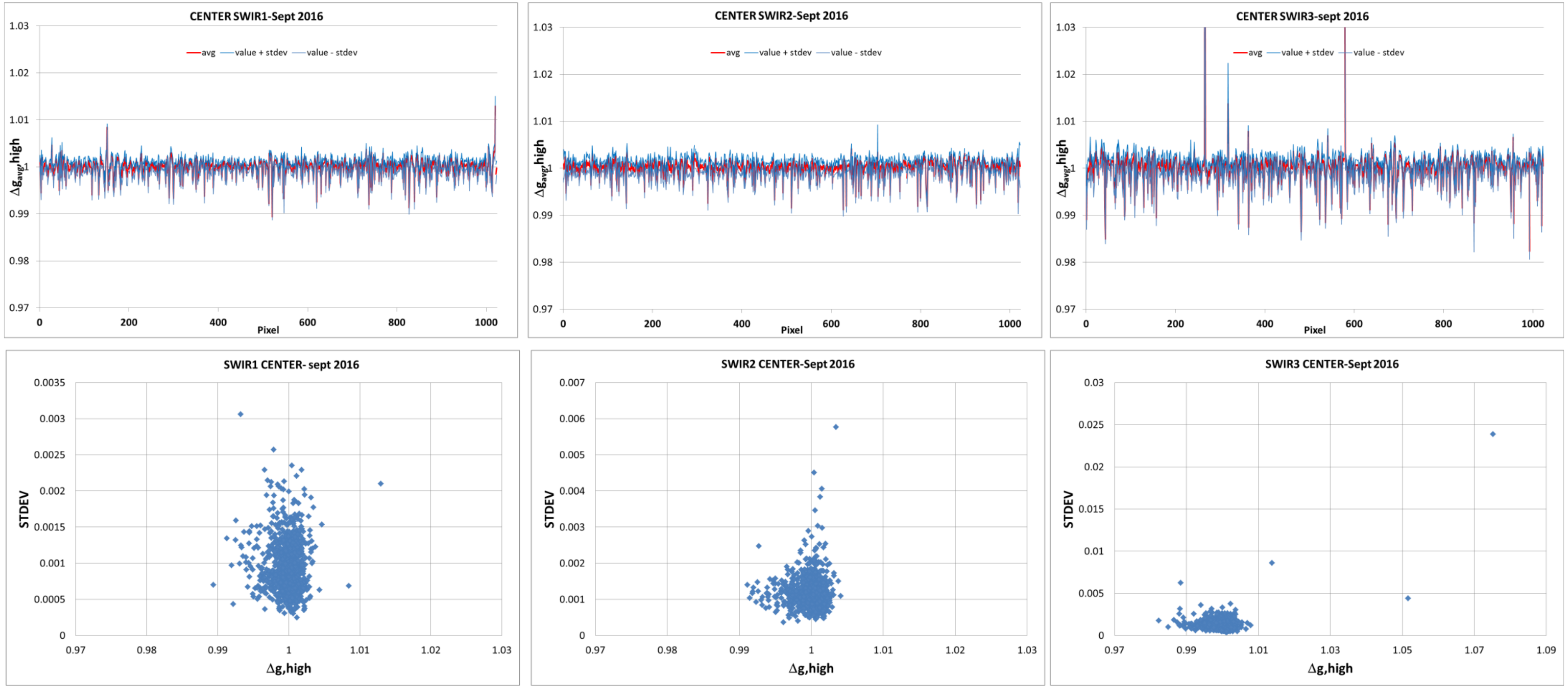


Figure 23. HF SWIR equalisation results SWIR CENTER mid-Sept 2016

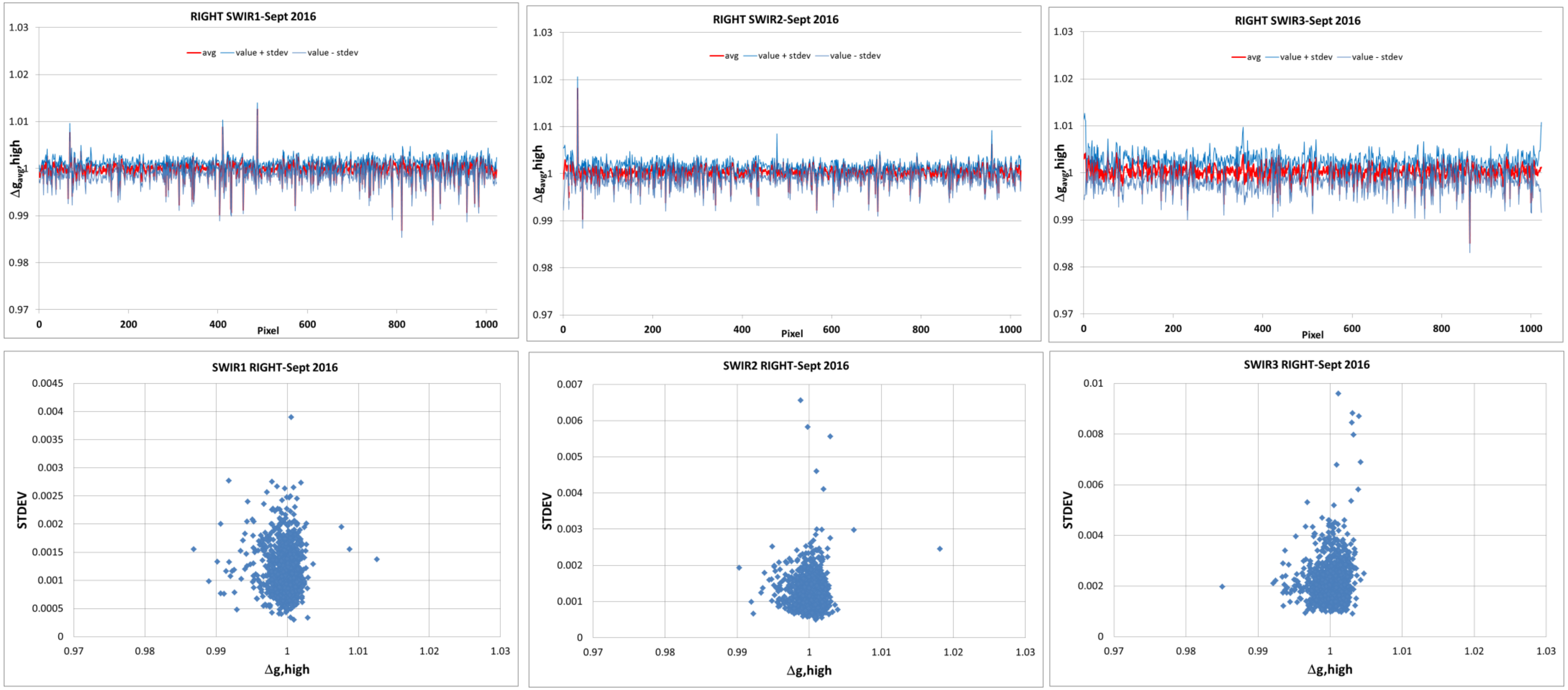
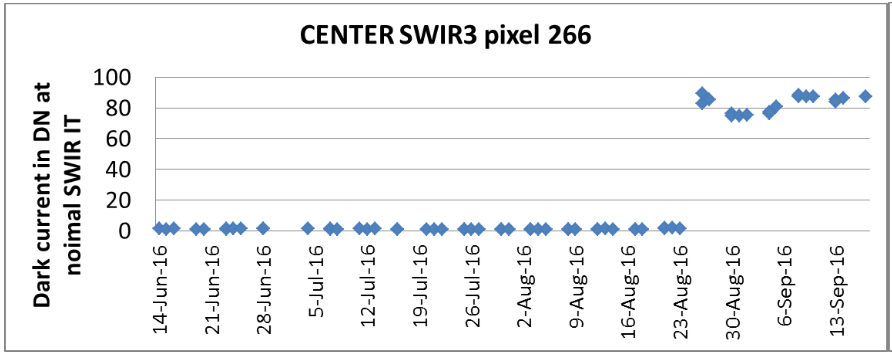
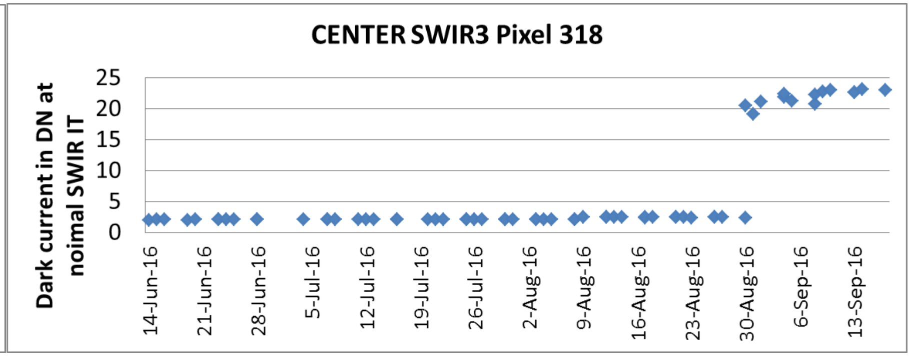


Figure 24. HF SWIR equalisation results SWIR RIGHT mid-Sept 2016





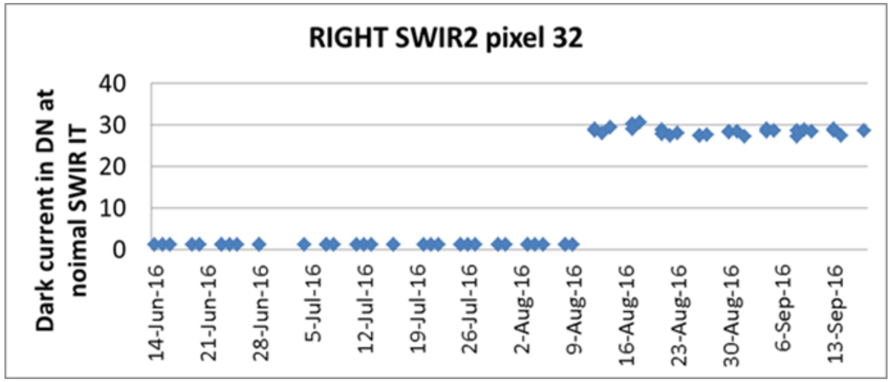


Figure 25 Illustration of sudden jump in DC values which impact the SWIR equalisation profiles

1.5. Bad pixels

CENTER SWIR3 pixel 579 is given the status bad in this reporting period. The status BAD is given because of the sudden extreme increase in DC (Figure 26) which causes a distinct stripe in the PROBA-V TOA data.

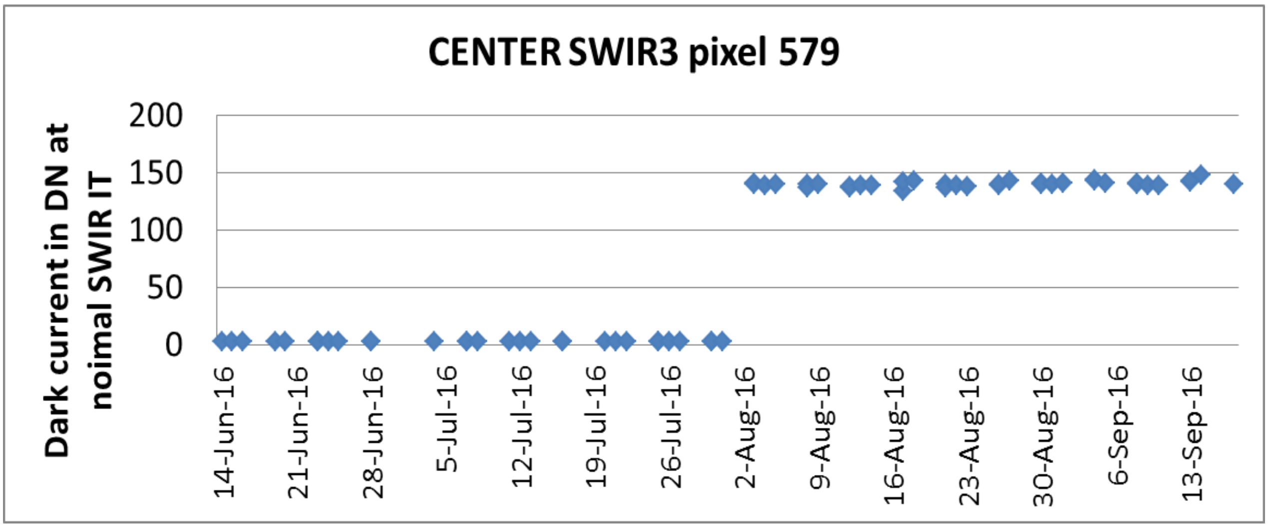


Figure 26 Sudden extreme increase in DC values

Reporting period Mid-DEC 2015 - Mid-Sept 2016													
CAMERA	STRIP	pixel numbers (ID L1 A)											
		NEW BAD	BAD (from previous periods)										
left	swir1		28	298	352	644	956						
left	swir2		711	863									
left	swir3	90	172	419	438	568	759	761					
center	swir1		1021										
center	swir2		57	295	769	831	900						
center	swir3		29	30	476	579	640	763	889	890	917	938	994
right	swir1												
right	swir2		14	438	470								
right	swir3												

Table 5: 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 below

ICP filename	Description
PROBAV_X_R_000_20140116_01.xml	Update of offset and NL values provided by OIP at end of the commissioning phase
PROBAV_X_R_000_20140215_01.xml	Update of VNIR and SWIR dark currents
PROBAV_X_R_000_20140219_01.xml	Update of SWIR equalizations
PROBAV_X_R_000_20140322_01.xml	Update of VNIR and SWIR dark currents , SWIR status map update : one bad pixel added
PROBAV_X_R_000_20140419_01.xml	Update of VNIR and SWIR dark currents , SWIR status map update : five bad pixel added
PROBAV_X_R_000_20140529_01.xml	Update of VNIR and SWIR dark currents , Update of SWIR equalizations
PROBAV_X_R_000_20140626_01.xml	Update of VNIR and SWIR dark currents ,update of absolute blue **CENTER and RIGHT**
PROBAV_X_R_000_20140718_01.xml	Update of VNIR and SWIR dark currents , Update of SWIR equalizations
PROBAV_X_R_000_20140826_01.xml	Update of VNIR and SWIR dark currents , Update of SWIR equalizations, SWIR status map update : two bad pixels added
PROBAV_X_R_000_20140923_01.xml	Update of absolute calibration coefficient **BLUE LEFT, NIR LEFT, RED CENTER**, Update of VNIR and SWIR dark currents, Update of SWIR equalizations, SWIR status map updated: one bad pixel added.
PROBAV_X_R_000_20141025_01.xml	Update of absolute calibration coefficient **NIR RIGHT.** Update of VNIR and SWIR dark currents , Update of SWIR equalizations, SWIR status map updated : one bad pixel added.
PROBAV_X_R_000_20141108_01.xml	Update of SWIR equalizations, SWIR status map updated : three bad pixels added.
PROBAV_X_R_000_20141129_01.xml	Update of VNIR and SWIR dark currents , Update of SWIR equalizations.
PROBAV_X_R_000_20141220_01.xml	Update of VNIR and SWIR dark currents (using for SWIR DC acquisitions with IT of 3 s) , Update of SWIR equalizations.

PROBAV_X_R_000_20141220_02.xml*	Update of SWIR dark currents (using DC acquisitions with IT **of 0.6s**). Update SWIR equalization coefficients.
PROBAV_X_R_000_20141220_03.xml**	Update of SWIR dark currents (using DC acquisitions with IT **of 0.2s**). Update of absolute calibration coefficient of **RIGHT SWIR3**. SWIR status map updated : four bad pixels added. Update SWIR equalization coefficients.
PROBAV_X_R_000_20150311_01.xml	Update of SWIR dark currents (using DC acquisitions with IT of 0.2s)
PROBAV_X_R_000_20150409_01.xml	Update of SWIR dark currents (using DC acquisitions with IT of 0.2s)
PROBAV_X_R_000_20150422_01.xml	Update of SWIR dark currents (using DC acquisitions with IT of 0.2s)
PROBAV_X_R_000_20150527_01.xml	Update of SWIR dark currents (using DC acquisitions with IT of 0.2s)
PROBAV_X_R_000_20150630_01.xml	Update of VNIR and SWIR dark currents
PROBAV_X_R_000_20150724_01.xml	Update of SWIR dark currents
PROBAV_X_R_000_20150826_01.xml	Update of SWIR dark currents. Update of absolute calibration parameter of **RIGHT SWIR2** strip.
PROBAV_X_R_000_20150926_01.xml	Update of SWIR dark currents, **and absolute calibration coefficients SWIR strips** (except Right SWIR3)
PROBAV_X_R_000_20151031_01.xml	Update of SWIR dark currents

PROBAV_X_R_000_20151119_01.xml	Update of SWIR dark currents SWIR status map updated : 1 bad pixel added.
PROBAV_X_R_000_20151218_01.xml	Update of SWIR dark currents SWIR status map updated : 1 bad pixel added.
PROBAV_X_R_000_20160122_01.xml	Update of SWIR dark currents
PROBAV_X_R_000_20160206_01.xml	Update of SWIR dark currents Update of absolute calibration coefficient of **SWIR:** • LEFT SWIR1 : increase radiance with 0.84 % • LEFT SWIR2 : increase radiance with 1.04 % • LEFT SWIR3 : increase radiance with 1.83 % • CENTER SWIR1: increase radiance with 1.19% • CENTER SWIR2: increase radiance with 1.29% • CENTER SWIR3: increase radiance with 1.16% • RIGHT SWIR1 : increase radiance with 1.28 % • RIGHT SWIR2: increase radiance with 0.78 % • RIGHT SWIR3: increase radiance with 0.90 %
PROBAV_X_R_000_20160225_01.xml	Update dark currents
PROBAV_X_R_000_20160319_01.xml	Update dark currents SWIR status map updated : 1 bad pixel added
PROBAV_X_R_000_20160423_01.xml	Update dark currents SWIR status map updated : 2 bad pixels added
PROBAV_X_R_000_20160521_01.xml	Update dark currents Update of SWIR absolute following linear degradation model *** Correction for 0-based versus 1-based pixel numbering error in previous status map update: Left SWIR3 pixel 568 and Center SWIR2 pixel 831 correctly added

PROBAV_X_R_000_20160622_01.xml	Update dark currents Update of SWIR absolute following linear degradation model***
PROBAV_X_R_000_20160719_01.xml	Update dark currents Update of SWIR absolute following linear degradation model***
PROBAV_X_R_000_20160823_01.xml	Update dark currents Update of SWIR absolute following linear degradation model***
PROBAV_X_R_000_201609*_01.xml	Update dark currents Update of SWIR absolute following linear degradation model*** One bad pixel added

* created on January 23 with a validity date in the past, ** created on February 13 with a validity date in the past, *** Applied Linear trend (in%)/month : SWIR1 LEFT: -0.087;SWIR2 LEFT:-0.104;SWIR3 LEFT:-0.097;SWIR1 CENTER:-0.093;SWIR2 CENTER:-0.092;SWIR3 CENTER:-0.086;SWIR1 RIGHT:-0.106;SWIR2 RIGHT:-0.143;SWIR3 RIGHT:-0.122.

Table 6: Radiometric ICP-file updates

2. Geometric Image Quality

2.1. Summary

The daily average location error compliance (ALE<300m) was at the level of 99.3%.

The quarterly average location error decreased to the level of 70m (1б<76m) for all spectral bands (combined cameras). When comparing to the previous reporting period a 17% decrease of the average location error was observed. The largest decrease of the absolute location error was observed for the NIR sensors (20%). The variation of the average location error decreased by 12%.

The inter-band geometric accuracy remained stable and ranged from 0.09 to 0.14 of a pixel (333m).

In this reporting period the multi-temporal geometric accuracy was at the level of 86.0% for the VNIR sensor and 97.2% for the VNIR/SWIR combined. This multi-temporal VNIR sensor compliance level has increased when comparing to the previous reporting period (82.6% for the VNIR sensor and 96.5% for the VNIR/SWIR).

The overall multi-temporal geometric accuracy (last 12 months) is at the level of 77.2% for the VNIR sensor (requirements not met) and 95.9% for the VNIR/SWIR combined.
The overall multi-temporal VNIR sensor compliance level has further decreased when comparing to the previous reporting period (78.4% for the VNIR sensor and 96.1% for the VNIR/SWIR).

On the 8.09.2016 a new geometric ICP file was created, with validity date set to 01.09.2016.

2.2. Assessment of the geometric accuracy on L1C data

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

CAMERA 1 Mean ALE (m)			
Strip\Period	16/06/2016 - 15/07/2016	16/07/2016 - 15/08/2016	16/08/2016 - 15/09/2016
BLUE	79.7, std = 97.6	71.2, std = 83.3	74.1, std = 77.9
RED	83.0, std = 100.5	77.2, std = 91.4	85.3, std = 91.1
NIR	62.9, std = 56.5	62.0, std = 54.6	69.1, std = 60.6
SWIR1	77.3, std = 70.0	73.1, std = 62.3	79.6, std = 70.7
SWIR2	45.4, std = 19.4	47.4, std = 20.7	51.8, std = 20.0
SWIR3	57.3, std = 19.9	49.4, std = 19.0	58.0, std = 18.9

Table 7: Mean absolute location error for camera 1.

CAMERA 2 Mean ALE (m)			
Strip\Period	16/06/2016 - 15/07/2016	16/07/2016 - 15/08/2016	16/08/2016 - 15/09/2016
BLUE	71.9, std = 79.8	64.8, std = 70.1	72.7, std = 77.3
RED	60.5, std = 63.2	55.2, std = 56.8	62.6, std = 62.0
NIR	48.2, std = 31.2	45.2, std = 28.6	50.4, std = 30.2
SWIR1	70.9, std = 73.0	63.5, std = 60.6	66.4, std = 52.3
SWIR2	52.1, std = 27.0	48.6, std = 25.5	53.0, std = 24.7
SWIR3	71.4, std = 60.4	61.9, std = 49.2	70.0, std = 42.5

Table 8: Mean absolute location error for camera 2.

CAMERA 3 Mean ALE (m)			
Strip\Period	16/06/2016 - 15/07/2016	16/07/2016 - 15/08/2016	16/08/2016 - 15/09/2016
BLUE	67.7, std = 70.8	63.1, std = 67.6	67.7, std = 66.5
RED	62.5, std = 59.6	57.6, std = 54.1	62.9, std = 54.3
NIR	53.0, std = 33.0	50.6, std = 32.0	56.3, std = 33.1
SWIR1	45.5, std = 21.2	64.3, std = 68.7	44.0, std = 19.0
SWIR2	42.8, std = 19.0	49.5, std = 26.0	43.0, std = 17.7
SWIR3	98.6, std = 83.9	93.0, std = 104.9	100.8, std = 94.9

Table 9: Mean absolute location error for camera 3.

In the reporting period the average location error of the Level 1C data was at the level of 63m on average. That result is 13% better than the results stated in the previous report.
Due to technical problems the above statistics do not include the period of 1.07-12.07.2016 for all cameras.

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 16/06/2016 to 15/07/2016
- from 16/07/2016 to 15/08/2016
- from 16/08/2016 to 15/09/2016

The tables list:

- The day of the measurement in format dd/mm/yyyy

- 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
16/06/2016	98.6	98.9	99.0	99.7	47690	78.3	96.6	60597	75.7	81.9	72519	68.5	77.7	69286	74.1	79.1
17/06/2016	98.8	99.3	99.3	99.8	49390	71.5	85.4	63421	68.6	75.0	74526	63.8	65.1	72625	68.1	75.5
18/06/2016	99.0	99.3	99.4	99.8	49963	72.5	85.0	63802	70.4	77.4	66266	65.5	69.5	62616	69.9	73.6
19/06/2016	98.7	99.1	99.2	99.7	50193	79.6	92.5	62965	76.9	79.8	67933	68.9	73.0	64151	72.4	79.0
20/06/2016	98.8	99.1	99.2	99.8	46219	76.7	97.4	59512	74.8	81.3	66626	67.2	72.4	62393	71.6	71.4
21/06/2016	98.6	99.1	99.2	99.7	42616	73.9	93.6	52371	70.3	82.6	63338	64.7	71.2	61757	68.3	71.6
22/06/2016	98.8	99.3	99.3	99.8	45405	69.5	92.0	58645	65.6	81.3	64504	62.3	73.6	63726	66.2	76.3
23/06/2016	99.0	99.2	99.4	99.8	43704	70.1	90.9	57388	64.3	74.9	67870	61.7	64.7	65162	66.5	69.5
24/06/2016	98.9	99.2	99.3	99.8	44369	73.1	89.0	50949	67.3	75.0	61013	64.7	73.7	58908	68.2	76.6
25/06/2016	98.9	99.1	99.3	99.8	37681	71.3	90.6	43274	67.8	72.5	47430	65.7	72.1	47033	69.0	72.4
26/06/2016	98.8	99.2	99.3	99.8	42202	69.6	79.7	54632	69.1	80.4	64372	65.9	67.8	62111	70.7	76.3
27/06/2016	98.8	99.0	99.3	99.7	32674	74.6	85.8	41955	75.5	85.0	49867	68.9	71.4	49855	73.3	76.3
28/06/2016	98.8	99.2	99.4	99.8	48250	76.1	95.1	55419	71.9	77.9	67828	68.1	67.2	62533	72.3	71.7
29/06/2016	98.8	99.3	99.5	99.8	50223	78.8	91.6	57455	74.1	75.6	73767	67.2	63.5	67631	72.8	68.9
30/06/2016	98.7	99.1	99.3	99.7	43187	77.7	88.5	51261	74.9	75.9	60706	66.4	73.5	57076	74.5	74.3
01/07/2016	98.6	99.1	99.2	99.8	48512	82.6	87.8	58139	82.2	83.5	73248	73.4	72.6	69153	79.7	80.0
02/07/2016	98.4	98.9	99.2	99.8	45696	88.9	100.9	50224	86.0	83.4	64655	77.4	70.6	61340	81.1	80.2
03/07/2016	98.5	99.0	99.2	99.8	48921	87.7	95.6	57345	84.5	80.7	72275	79.8	72.2	66015	81.3	74.6
04/07/2016	98.9	99.4	99.5	99.8	48235	74.8	93.5	58647	70.0	76.4	75455	65.8	64.2	69448	68.8	67.3
05/07/2016	98.9	99.3	99.4	99.8	43587	66.7	86.1	52283	62.8	76.6	64997	58.8	68.7	62802	62.9	69.5
06/07/2016	99.1	99.4	99.5	99.8	48077	63.1	86.5	58379	61.0	77.9	70698	58.0	65.3	68361	62.3	75.1
07/07/2016	99.2	99.4	99.5	99.8	28467	63.3	80.3	38558	60.5	67.6	49410	59.7	64.0	50037	61.8	63.9
08/07/2016	99.1	99.4	99.5	99.8	49971	67.9	86.9	57669	62.1	69.5	66635	61.8	67.3	64461	64.7	67.8
09/07/2016	99.0	99.3	99.5	99.8	49985	66.0	88.5	60384	60.2	70.7	70664	58.8	63.0	68281	62.2	70.4
10/07/2016	98.9	99.4	99.4	99.8	47565	70.9	82.4	60341	67.6	70.4	71791	64.7	67.7	68902	67.2	74.2
11/07/2016	98.5	99.1	99.2	99.8	44980	84.2	90.7	48484	80.5	84.6	60197	75.0	75.6	54382	77.4	74.9
12/07/2016	97.3	98.1	98.5	99.7	46665	106.7	100.1	56452	105.9	90.3	66174	97.6	86.5	61869	95.6	92.1
13/07/2016	97.3	98.2	98.4	99.7	47617	105.5	101.4	55676	103.2	88.1	66124	95.1	82.2	63173	91.8	81.5
14/07/2016	97.0	97.5	98.1	99.7	33109	102.0	103.4	38868	99.8	90.0	48873	90.9	79.3	47204	91.4	89.0
15/07/2016	97.7	98.4	98.8	99.7	47961	105.5	96.6	50368	104.6	90.3	63754	91.2	78.6	59770	92.1	79.6
Averages	**98.6**	**99.0**	**99.2**	**99.8**	**45104**	**78.3**	**91.2**	**54515**	**75.3**	**79.2**	**65117**	**69.9**	**71.1**	**62069**	**73.3**	**75.1**

Table 10: Daily achieved compliance and the daily average location error (in m) for all spectral bands in the period 16/06/2016 to 15/07/2016.

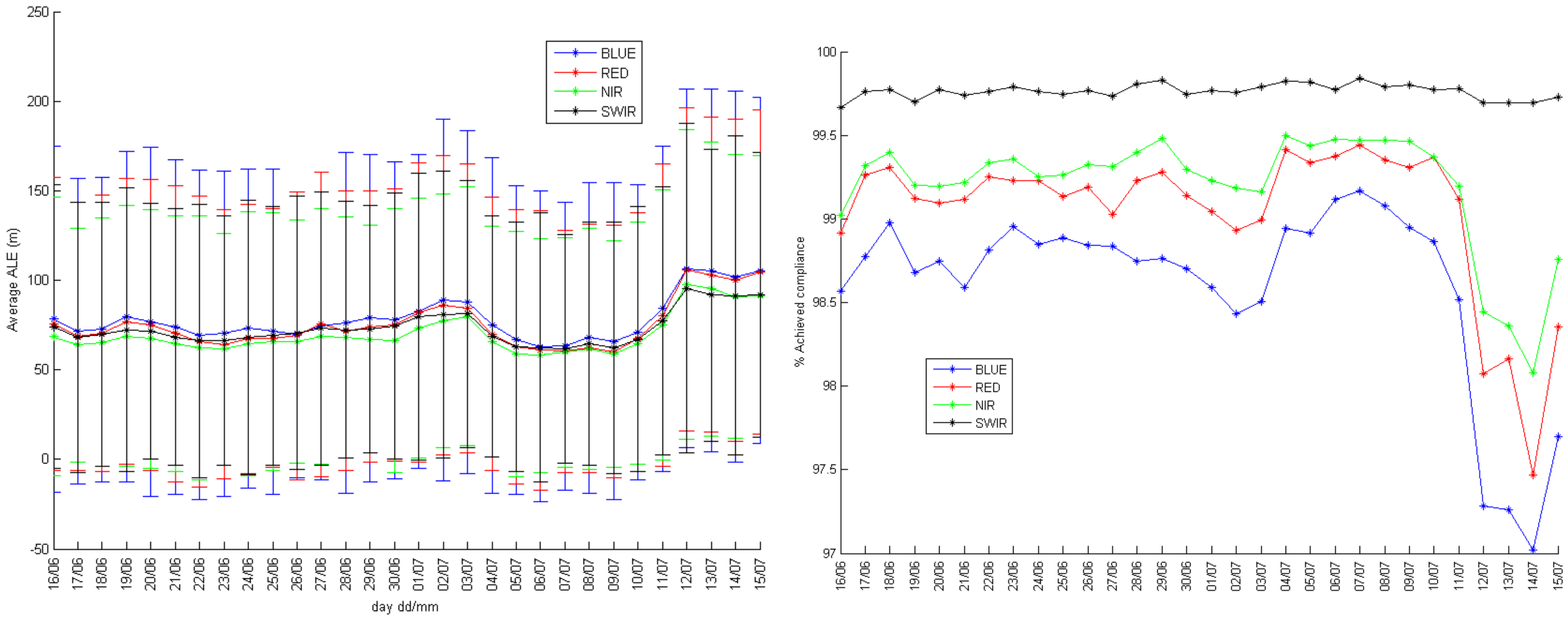


Figure 27: Daily average location error in the period from 16/06/2016 to 15/07/2016 (left). The average daily compliance of the spectral bands (right).

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
16/07/2016	98.4	98.9	99.1	99.8	44623	84.8	90.9	45582	83.3	80.8	58614	73.2	74.8	53950	76.1	76.2
17/07/2016	98.7	99.1	99.3	99.8	47531	81.1	91.6	53592	77.9	79.7	67970	67.7	71.4	62331	72.3	70.8
18/07/2016	98.9	99.2	99.4	99.8	46117	77.3	91.2	55738	74.2	77.2	72927	63.2	68.6	67688	71.1	74.2
19/07/2016	98.8	99.1	99.2	99.8	41156	73.0	85.0	48445	72.0	77.6	63521	62.7	71.0	57746	69.0	75.1
20/07/2016	99.1	99.4	99.5	99.8	44244	69.8	87.2	47792	69.1	76.3	64238	60.1	66.0	58341	66.8	71.4
21/07/2016	99.1	99.4	99.5	99.8	47512	65.6	80.7	50842	64.5	75.1	62218	58.8	62.6	57724	65.7	72.5
22/07/2016	98.9	99.4	99.4	99.8	44808	65.2	87.9	52156	59.4	63.8	65918	55.3	63.0	60480	62.1	68.4
23/07/2016	98.7	99.0	99.3	99.8	46149	61.3	84.3	53493	57.0	73.7	65059	55.0	63.2	59230	62.2	75.8
24/07/2016	99.2	99.6	99.6	99.8	46542	60.2	77.3	61055	55.8	65.1	70538	55.1	63.1	69102	60.1	70.4
25/07/2016	99.0	99.5	99.5	99.8	48170	68.7	84.1	57120	64.3	67.6	68722	62.2	61.3	65392	65.6	66.9
26/07/2016	98.7	99.2	99.4	99.8	51646	75.0	89.0	61535	70.4	76.1	74720	67.3	67.1	69534	69.1	71.7
27/07/2016	98.7	99.2	99.3	99.8	47154	75.5	92.1	53630	71.5	72.7	66339	67.1	67.5	63142	69.0	69.5
28/07/2016	97.9	98.8	98.8	99.7	45293	87.9	97.1	53178	89.0	80.9	62198	85.5	75.3	58042	85.6	82.1
29/07/2016	98.5	99.2	99.3	99.8	44453	80.5	95.2	50135	78.8	83.0	60367	72.4	72.3	57494	75.9	75.0
30/07/2016	98.6	99.2	99.3	99.8	46457	76.8	87.9	51700	73.7	76.9	61224	67.9	71.8	58618	69.7	70.1
31/07/2016	98.6	99.3	99.4	99.8	46394	76.2	91.6	54058	70.2	72.4	61959	65.3	63.2	59644	68.1	71.5
01/08/2016	98.4	99.1	99.2	99.8	43608	82.6	90.7	50351	77.2	82.5	60230	72.2	67.0	58972	73.1	77.8
02/08/2016	99.2	99.5	99.5	99.8	52983	71.2	83.5	59399	67.2	70.6	70449	62.3	62.9	69202	66.7	73.3
03/08/2016	99.1	99.4	99.5	99.8	49108	69.4	83.6	55305	63.2	70.2	66647	59.2	61.1	63487	63.6	66.4
04/08/2016	98.8	99.4	99.5	99.8	50542	70.5	88.7	59913	63.0	69.2	68388	59.3	60.9	66100	63.7	68.3
05/08/2016	98.9	99.4	99.4	99.8	51234	68.2	86.5	57592	61.6	67.5	66742	59.5	64.3	64889	62.7	66.0
06/08/2016	99.1	99.4	99.5	99.8	50040	62.9	78.6	60659	59.2	64.6	71468	57.9	61.4	70222	62.5	68.4
07/08/2016	99.1	99.5	99.5	99.9	51359	61.3	82.7	55562	56.3	71.1	67098	54.1	59.2	63867	59.2	66.1
08/08/2016	99.1	99.5	99.6	99.9	55373	61.3	78.9	61277	57.4	63.9	72001	54.1	59.7	69417	59.2	61.4
09/08/2016	99.2	99.4	99.5	99.8	50110	62.8	79.7	61845	60.2	73.1	74572	53.8	56.9	70527	60.4	66.1
10/08/2016	99.2	99.4	99.6	99.8	50424	60.7	74.1	58750	58.2	65.4	71968	54.2	58.0	67901	61.2	67.3
11/08/2016	99.3	99.6	99.6	99.8	55156	60.6	77.8	60314	56.8	64.8	70679	55.6	59.7	67006	62.1	72.8
12/08/2016	99.2	99.6	99.6	99.9	50014	61.6	84.1	54512	55.2	64.7	63245	55.3	56.2	61097	60.0	57.2
13/08/2016	99.2	99.6	99.6	99.9	53847	63.5	81.8	60116	58.8	65.7	70605	56.4	61.1	66912	61.1	63.4
14/08/2016	99.2	99.5	99.6	99.8	53650	62.6	78.4	62685	58.0	63.7	71807	54.9	59.8	68045	59.4	64.4
15/08/2016	99.0	99.4	99.5	99.8	51060	65.1	81.5	57105	62.7	65.7	70608	59.5	58.9	67574	62.3	70.8
Averages	**98.9**	**99.3**	**99.4**	**99.8**	**48605**	**69.8**	**85.3**	**55659**	**66.0**	**71.7**	**67195**	**61.5**	**64.2**	**63667**	**66.0**	**70.0**

Table 11: Daily achieved compliance and the daily average location error (in m) for all spectral bands in the period 16/07/2016 to 15/08/2016.

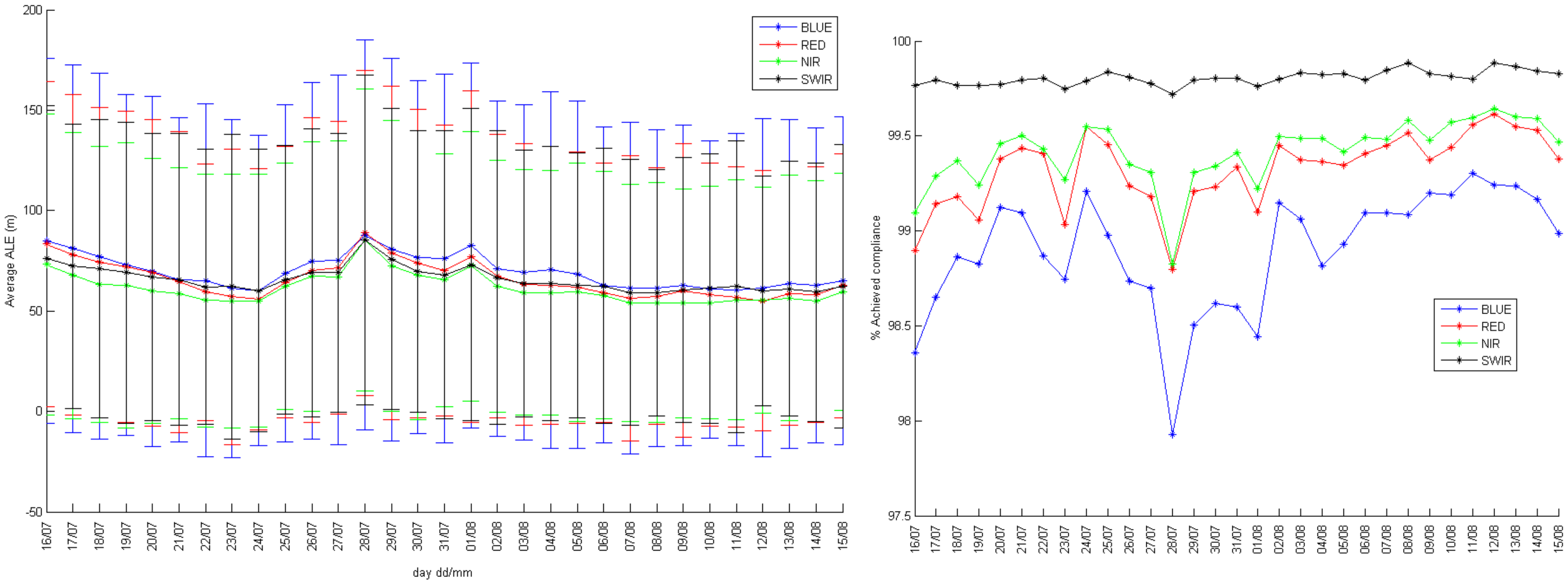


Figure 28: Daily average location error for all spectral bands in the period from 16/07/2016 to 15/08/2016 (left). The average daily compliance of the spectral bands (right).

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
16/08/2016	99.1	99.5	99.5	99.8	50923	66.2	83.8	64532	61.1	65.8	77550	57.7	59.2	73838.0	60.7	62.3
17/08/2016	99.1	99.4	99.4	99.8	47711	66.4	89.2	61455	62.3	70.9	70826	60.4	70.5	68057.0	62.8	69.7
18/08/2016	99.1	99.4	99.4	99.8	49681	63.8	86.6	63671	60.5	67.0	75213	60.0	61.7	71993.0	64.4	70.4
19/08/2016	99.3	99.4	99.5	99.9	46337	61.8	79.9	53812	60.4	69.0	67052	60.5	64.5	62814.0	62.7	73.8
20/08/2016	99.3	99.6	99.6	99.8	56429	61.9	74.7	69485	61.8	67.5	79722	61.7	66.3	76380.0	64.2	69.7
21/08/2016	98.9	99.2	99.3	99.8	50767	78.4	91.2	62020	78.4	78.1	71494	76.8	70.9	68718.0	78.6	75.7
22/08/2016	98.5	98.9	99.1	99.7	49445	83.5	93.1	60829	84.9	83.8	68290	80.6	71.5	66331.0	83.8	78.6
23/08/2016	98.9	99.1	99.2	99.7	49059	69.9	83.7	60610	72.0	79.4	69555	69.1	73.4	68389.0	72.1	76.0
24/08/2016	99.0	99.3	99.4	99.8	51646	63.8	74.5	62162	64.1	69.7	71018	63.8	70.4	69614.0	67.0	74.7
25/08/2016	98.9	99.2	99.3	99.8	49031	69.9	89.6	58999	70.6	79.6	65191	68.1	74.5	65251.0	70.7	74.7
26/08/2016	98.8	99.2	99.2	99.8	47463	76.9	86.5	57464	76.6	79.7	63231	75.3	80.4	63167.0	75.7	76.0
27/08/2016	98.8	99.3	99.3	99.8	52891	77.0	88.8	63163	75.9	76.5	70050	72.5	72.5	72418.0	72.5	74.8
28/08/2016	98.8	99.3	99.4	99.8	46958	69.4	91.5	54606	65.1	71.2	58385	61.0	62.7	61404.0	63.2	68.1
29/08/2016	99.3	99.5	99.4	99.8	47734	57.7	75.0	59790	54.4	65.0	64620	53.3	66.9	67815.0	56.8	67.9
30/08/2016	99.3	99.5	99.5	99.8	50277	61.1	80.5	57429	55.8	66.4	64394	56.5	63.1	63839.0	60.3	66.0
31/08/2016	99.1	99.4	99.5	99.8	44010	67.0	77.7	48465	60.8	66.3	57190	60.3	59.4	56954.0	65.2	69.8
01/09/2016	99.1	99.3	99.5	99.8	47634	63.5	81.5	53745	58.6	70.7	66074	56.7	60.4	65198.0	62.3	63.7
02/09/2016	99.1	99.4	99.5	99.8	47320	57.4	79.9	52190	53.4	68.4	67157	53.3	60.2	65367.0	57.3	65.2
03/09/2016	98.7	99.3	99.6	99.9	12414	67.5	91.8	16021	63.1	66.6	29236	54.3	53.7	26877.0	57.8	58.8
04/09/2016	99.0	99.3	99.5	99.8	50567	72.7	88.7	52926	70.2	77.5	67291	62.3	66.7	62795.0	65.8	70.3
05/09/2016	98.6	99.2	99.3	99.8	42995	83.9	92.2	47915	80.8	75.2	54472	71.8	71.1	50661.0	75.2	72.3
06/09/2016	98.4	99.0	99.3	99.8	47505	89.1	88.1	54215	91.3	81.4	67670	79.9	70.8	64698.0	83.3	72.7
07/09/2016	98.1	98.7	99.1	99.8	43865	98.1	93.7	45451	102.6	85.7	56089	88.4	70.0	57800.0	91.2	80.5
08/09/2016	98.6	98.8	99.1	99.8	47923	82.6	97.5	53150	79.8	83.1	61783	73.5	74.9	64276.0	77.9	81.9
09/09/2016	99.0	99.0	99.1	99.8	46203	78.5	98.6	51902	79.0	86.1	60152	74.3	72.0	60704.0	79.4	79.2
10/09/2016	99.2	99.3	99.4	99.8	54444	66.8	83.9	60487	64.3	73.0	69825	61.6	67.7	72189.0	64.7	70.6
11/09/2016	99.2	99.4	99.5	99.8	45464	66.0	80.3	52581	63.9	68.8	62629	62.0	61.1	67956.0	64.9	66.5
12/09/2016	99.2	99.4	99.4	99.8	47870	67.8	82.2	52191	67.6	75.1	64459	63.7	65.3	68071.0	67.1	73.0
13/09/2016	98.8	99.1	99.3	99.8	43028	73.9	93.2	41793	71.7	76.1	51874	68.8	69.7	52997.0	66.9	65.9
14/09/2016	99.1	99.4	99.5	99.8	40880	72.8	89.1	44193	68.0	68.9	52136	63.7	67.6	51123.0	67.5	79.1
15/09/2016	99.2	99.3	99.4	99.8	45874	67.1	75.2	45168	65.0	68.0	53181	61.0	61.8	56233.0	62.4	66.6
Averages	**99.0**	**99.3**	**99.4**	**99.8**	**46914**	**71.0**	**85.9**	**54272**	**69.2**	**73.6**	**63800**	**65.6**	**67.1**	**63352.5**	**68.5**	**71.4**

Table 7: Daily achieved compliance and the daily average location error (in m) for all spectral bands in the period 16/08/2016 to 15/09/2016.

Figure 29: Daily average location error for all spectral bands in the period from 16/08/2016 to 15/09/2016 (left). The average daily compliance of the spectral bands (right).

The total number of chips per day and per spectral band used for the geometric accuracy analysis insreased by 32% on average when comparing to the previous reporting period.

The daily average location error compliance (ALE<300m) was at the level of 99.3%. This result is comparable (0.35% higher) to the values stated in the previous reporting period.

The quarterly average location error decreased to the level of 70m (16<76m) for all spectral bands (combined cameras). When comparing to the previous reporting period a 17% decrease of the average location error was observed. The largest decrease of the absolute location error was observed for the NIR sensors (20%). The variation of the average location error decreased by 12%.

On the 8.09.2016 a new geometric ICP file was created, with validity date set to 01.09.2016.

2.3.2. Inter-band geometric accuracy

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

Band pair	Inter-band error [m]
BLUE-RED	30.9, std=10.6
BLUE-NIR	45.3, std=13.6
BLUE-SWIR	47.9, std=14.2
RED-NIR	31.9, std=10.2
RED-SWIR	40.9, std=9.4
NIR-SWIR	44.1, std=10.4

Table 13: Inter-band geolocation accuracy for period 16/06/2016 to 15/07/2016 stated for combined cameras, at 95% confidence level.

Band pair	Inter-band error [m]
BLUE-RED	29.0, std=9.8
BLUE-NIR	43.3, std=13.2
BLUE-SWIR	45.6, std=13.3
RED-NIR	33.2, std=13.0
RED-SWIR	40.2, std=10.9
NIR-SWIR	42.1, std=9.7

Table 14: Inter-band geolocation accuracy for period 16/07/2016 to 15/08/2016 stated for combined cameras, at 95% confidence level.

Band pair	Inter-band error [m]
BLUE-RED	29.9,std=10.2
BLUE-NIR	44.3,std=13.2
BLUE-SWIR	45.1,std=12.9
RED-NIR	32.3,std=10.7
RED-SWIR	38.2,std=9.2

NIR-SWIR	41.6,std=10.0

Table 15: Inter-band geolocation accuracy for period 16/08/2016 to 15/09/2016 stated for combined cameras, at 95% confidence level.

For combined cameras the inter-band geometric accuracy ranged from 29 m to 48 m (std ~= 11 m), that is 0.09 – 0.14 of a pixel (333m). This result is on average 9% better comparing to the result reported in the previous reporting period.
The inter-band NIR-SWIR registration accuracy is at the level of 43 m (10% better than in the previous report).

2.3.3. Multi-temporal geometric accuracy

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

- 86.0% for the VNIR sensor (115472 GCPs used),
- 97.2% for the VNIR/SWIR combined (127936 GCPs used).

This multi-temporal VNIR sensor compliance level has increased when comparing to the previous reporting period (82.6% for the VNIR sensor and 96.5% for the VNIR/SWIR).
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.

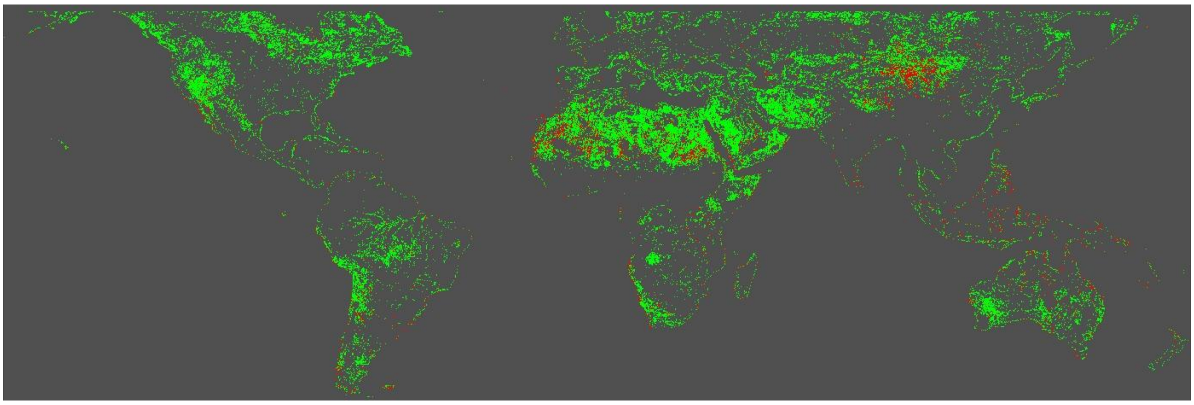


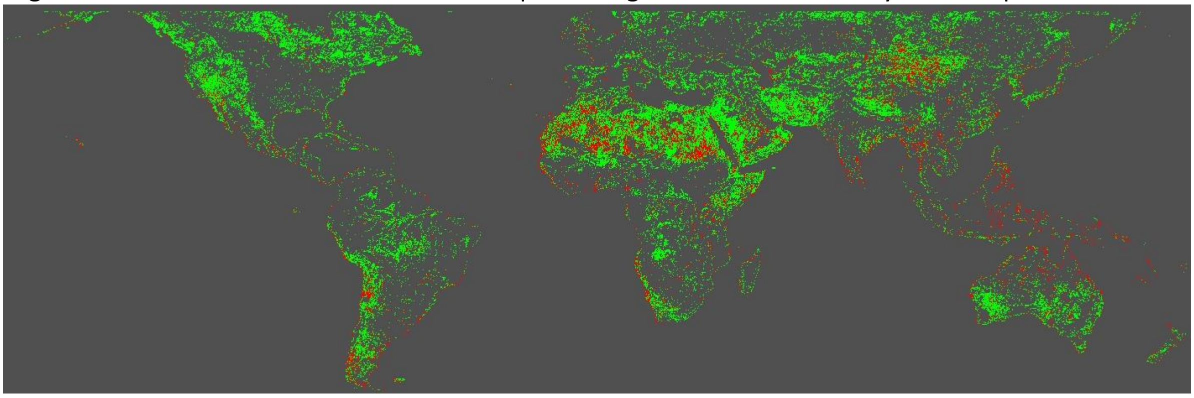
Figure 30: Multi-temporal geometric accuracy for the VNIR sensor. Compliant areas are marked in green; areas with accuracy below 95% are marked in red. Grey areas represent no data.

The overall (last year) multi-temporal geometric accuracy is as follows:

- 77.2% for the VNIR sensor (146769 GCPs used),
- 95.9% for the VNIR/SWIR combined (162543 GCPs used).

The overall multi-temporal VNIR sensor compliance level has further decreased when comparing to the previous reporting period (78.4% for the VNIR sensor and 96.1% for the VNIR/SWIR).

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



FigureFigure.

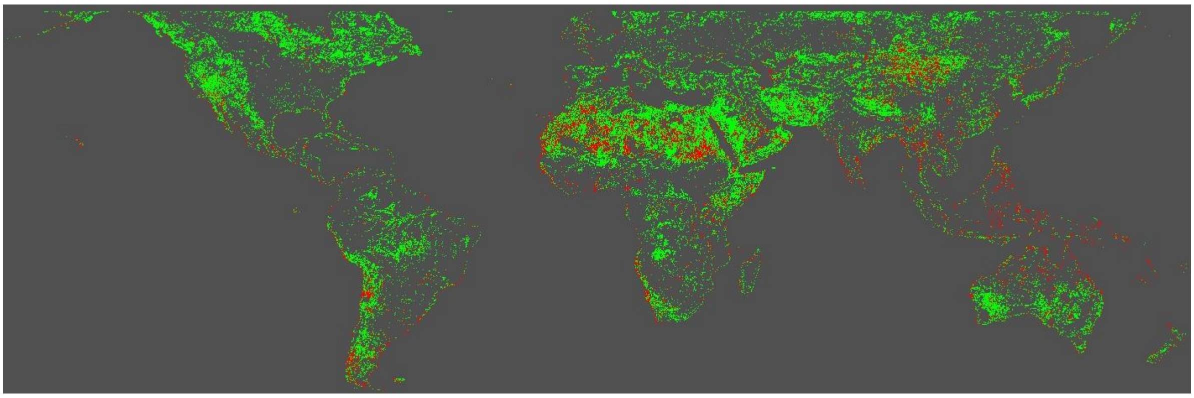


Figure 31: Overall multi-temporal geometric accuracy for the VNIR sensor. Compliant areas are marked in green; areas with accuracy below 95% are marked in red. Grey areas represent no data.

2.4. Geometric ICP file

The geometric ICP file created on the 16/02/2016 was valid from 08.02.2016 until 31.08.2016. On the 8.09.2016 a new file was created, with validity date set to 01.09.2016.

ICP filename	Description
PROBAV_ICP_GEOMETRIC#LEFT_20160208_V01 PROBAV_ICP_GEOMETRIC#CENTER_20160208_V01 PROBAV_ICP_GEOMETRIC#RIGHT_20160208_V01	Correct for the degradation observed in beginning of February 2016.
PROBAV_ICP_GEOMETRIC#LEFT_20160901_V01 PROBAV_ICP_GEOMETRIC#CENTER_20160901_V01 PROBAV_ICP_GEOMETRIC#RIGHT_20160901_V01	Correct for the gradual degradation observed in the last week of August and first week of September 2016.

Table 16: Geometric ICP-file updates

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 17: Reference Documents