

Proba – V 13th Quality Working Group (QWG): Summary Report

The 13th Proba-V QWG took place via WebEx on 21th - 22th Apr 2021

Participants:			
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E. Swinnen – VITO	S. Sterckx – VITO	C. Tote –VITO	S. Adriaensen –VITO
J.L. Tavares - VITO	X. Collaud - ASL	G. Gracas - ASL	L. Gomez-Chova – Uni Valencia
C. Henocq – ACRI	Y. Govaerts– Rayference	E. De Grandis – SERCO	D. Ramon – HYGEOs
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Objectives of the meeting

The status of the mission was recalled: Experimental Phase is running since July 2020 with the perspective to prepare the ground for the launch and exploitation of PV-CC mission. The latest delay in the schedule of the PV-CC launch (currently Q1/Q2 2022) changed the approach for exploitation, notably owing to the degrading Proba-V illumination conditions at the time of the launch. On the processing side, the main priority is to finalize the verification phase for the C2 and start the full mission reprocessing. The main objectives of the meeting were illustrated: the first one is to review the status of C2 verification, in particular of the AC module and agree on the go-ahead for C2 reprocessing, the second goal is to review the current development status of the PV-CC and its ground segment and brainstorm on the potential exploitation of PV-CC in combination with Sentinel-2/3. Besides that, the usual QWG topics will be presented and discussed, namely the status of the FS/GS, the calibration, the continuity with S3.

Flight and Ground Segment Status

The overall performances of the platform and sensor are excellent and very stable with platform availability between 98,1% and 99.9% for the last 9 months. All performance parameters are well within the requirements, the system is very stable with no sign of degradation.

- *LTDN predictions*: 08:50 AM are reached on 20 April 2021, as expected
- *Platform Status*: during this period, the platform status was very nominal.
- *AOCS*: pointing performance is far better than the requirements
- *Power Budget*: largely positive and stable, no apparent degradation of the solar arrays, battery, nor power distribution system
- *Thermal performances*: the optical bench thermal variation is $\sim 1.5^{\circ}\text{C}$ per day, confirming the excellent thermal performances of radiator and optical bench.
- *Decompression errors*: the number of decompression errors is currently low, VITO has implemented a better classification of errors that contains a split between the impact of geometric and decompression errors on the daily products. The catalogue should be updated to consider the experimental phase with reduced LSM.
- The **key activities on the platform** performed during this period are summarized:
 - since 01/07/2020 the focus is on systematic acquisitions with emphasis on 100m over Europe and Africa and on-request acquisitions for Cal/Val and science purposes.
 - Two super-resolution experiments performed on 22/10/2020 and 1/11/2020
 - monthly *Moon-imaging campaigns* since October 2020, some improvements on the SW were applied to automate the planning of Moon calibrations above 30 degree after the full Moon
 - the measurement campaigns of the *Energetic Particle Telescope*(EPT) are still on-going and high interest was expressed in completing a solar cycle (+3 years). Actually, the different mission objectives with respect to Proba-V and the fact that the acquisition is not impacted by the orbital drift introduce the possibility to continue the acquisition campaign beyond the end of VGT mission. This should be discussed and agreed between BELSPO and ESA with the technical support from VITO, identifying the people interested and evaluating the relative cost associated.

The satellite and ground segment operations are running nominally and the mission operations center is fully operational.

Radiometric and Geometric calibration

The **absolute location error** is presented starting from January 2020 and shows good stability for all spectral bands with an average ALE within ~70 m. The long-term analysis of the inter-band accuracy is very good and within the requirements. The inter-band errors per spectral bands are always below 70m for the three cameras. A decrease of inter-band error for Red-NIR is observed from half of 2020: this behaviour, not associated to the new ICP files because implemented in March 2021, should be investigated.

The **multitemporal accuracy** for the period from 1st January 2021 is well within the specifications with about 85% of compliance to the requirement for the VNIR bands and 94% for the SWIR, despite of the low multitemporal statistic. This good multitemporal accuracy is essential for the geometry CARD4L requirements. The compliance to the CARD4L requirement of 0.5 pixels multi-temporal geometric accuracy is discussed for Proba-V data. This requirement is largely met for 1km and 333m dataset, while for 100m data we are slightly above (70 m) to the threshold requirement.

An overview of the **updates** implemented in the **ICP files for C2** is given:

- *SWIR degradation model*: the linear degradation model implemented in C1 starting from October 2018 resulted in an overcorrection and needed to be improved using a higher order polynomial fitting. The Lybia-4 calibration results have been used to this end, whereas the Niger-2 results were used as verification dataset, a good consistency was observed with differences < 1% between the two models.
- *VNIR degradation model*: the second degree polynomial model determined based on Lybia-4 was applied to all VNIR strips to correct the deviations in BLUE left/center camera and also the increase in responsivity for other strips.
- *Small bias correction for BLUE LEFT*: the difference between LEFT BLUE and CENTER BLUE observed by Rayference and probably associated to potential polarization sensitivity highlighted by a on azimuthal configuration in the polar plots, was estimated by the VITO analysis as a smaller difference of ~0.7% in the overlap region. The bias correction of 1% to left blue is applied in the ICP files accordingly.
- *Bias correction SWIR RIGHT*: a bias for the SWIR RIGHT strips is still observed after the implementation of C2 degradation model and required additional bias correction to mitigate the observed spread.
- *Equalization coefficients*: the equalization correction based on yaw manoeuvre is applied from Oct 2013 in the CENTER SWIR strips for Low and High Frequency whereas in the LEFT/RIGHT SWIR strips is applied from Oct 2013 for Low Frequency and from Jan 2017 for High Frequency because of high instability observed in HF at the beginning of mission. A question was raised on the potential impact of the adjusted radiometry on the C2 cloud mask. This question will be addressed during the presentation of the C2 verification results, where the cloud mask before and after the new ICP radiometric files are compared and assessed. It is anticipated that the new radiometry has negligible impact on the new cloud mask.

Algorithm Baseline Definition for C2

No major issues have been identified for C2, the cloud masking module is performing extremely well, and the calibration and Atmospheric Correction showed significant improvements as compared to C1. As such, the new C2 baseline is endorsed by the QWG for further continuing the reprocessing and verification activities.

The preliminary **C2 verification** confirmed these results: the analysis shows a good consistency between C1 and C2 and highlights, in the pixel-flagging inspections, large differences between C1 and C2 in clear and cloudy pixels. The radiometric quality check and the impact analysis of the new ICP files in the AC were performed just for one date, the remaining four dates have to be re-processed. For the considered date, large areas of pixels with bad radiometry (black pixels) are observed in C2 probably associated with an AOT > threshold fixed in the AC algorithm (0.6). This information should be made available to the end-users. In addition, in C2 the NDVI saturation observed in C1 is corrected, as a consequence, a better consistency with S3 is foreseen, whereas it will likely decrease the consistency with the SPOT-VGT NDVI archive. These results will be consolidated finalizing the analysis for all selected dates. This partial verification showed in any case very major improvements and **good consistency for C2 and it is then recommended to start the reprocessing and conclude in parallel the validation of phase 1**. The results of the verification will be continuously reviewed in the future TCs organized among VITO/ESA and HYGEOs.

Mission Experimental Phase

The **launch schedule of the PV-CC is currently delayed** and the foreseen launch window is now in Q1/Q2 2022. The new schedule strongly impacts the main objective of PV-CC mission, which was to verify the synergistic exploitation in combination with Proba-V, since by Q2 2022 the Proba-V sensor will have very limited observation capabilities owing to the drifting orbit. **Exploitation of PV-CC in combination with Sentinels** is therefore the way forward and initial ideas on how to pursue this objective were presented and discussed during the meeting. The continuation of Proba-V acquisitions beyond October 2021 will need to be discussed at ESA level and agreed with BELSPO.

The **Lunar campaign** was successful and the validation of the LIME model shows good results, two other campaigns are recommended to cover the full lunar cycle, ESA will follow the planning activities and communicate to VITO the scheduled dates as soon as fixed and agreed with QINETIQ and REDU

Continuity and Consistency

The LAI/FAPAR/FCOVER, NDVI and Dry Matter Productivity S3 biophysical products are available on data portal from July 2020 whereas the Burnt Areas V1 & V3 are still produced with Proba-V over Europe and Africa only, but their transfer in operation is foreseen in the next days. Their assessment was successfully performed by validating the TOC reflectances and following the ACIX methodology. Several updates were applied to the SYN-VGT products to correct the issues raised in the previous analysis, such as the modification of compositing time or the NDVI calculation correctly computed at TOC instead of TOA. The possibility to reprocess 1-2 months of SYN-VGT data overlapping the Proba-V operational phase was discussed, this will allow proper consistency assessment at VITO side.