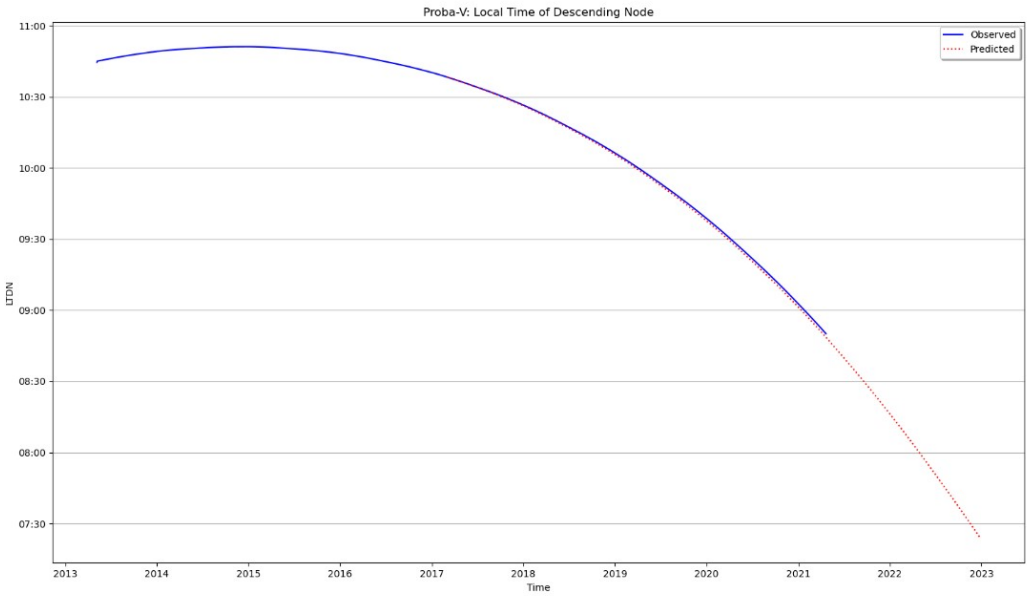
esa

Platform Status

Since QWG#12: 27/28 October 2020

Orbit Status – Predicted & Measured LTDN



7 May 2013: 10:44:30
1 Dec. 2014: 10:51:08
26 Apr. 2017: 10:36:26
1 Oct. 2017: 10:30:28
1 May 2018: 10:20:29
1 June 2018: 10:18:54
1 Nov. 2018: 10:10:06
15 Apr. 2019: 09:59:07
15 Oct. 2019: 09:45:14
31 Dec. 2019: 09:38:47
16 Jun. 2020: 09:23:15
15 Oct. 2020: 09:11:05
20 Apr. 2021: 08:50:13

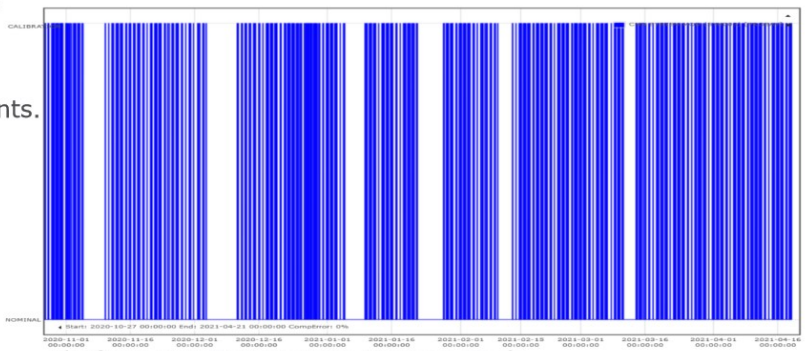
Platform Key Parameters

Satellite System mode: Nominal Observation with automatic transition to Calibration mode.

AOCS mode: Geodetic with all the units available. Primary lane selected with the use of associated units (AOCS IF 1, GPS 1, MM 1, XTX 3) and of the wheels 1, 3 and 4. Sun bathing mode enabled (with GPS ON).

During this period the system was very stable:

- Monthly platform availability between 98.8% and 99.9% over the last 3 months based on QS reporting.
- Pointing performances well within requirements.
- Power budget largely positive and stable.
- Thermal subsystem stable.
- No on-board failure, both primary and redundant chains available.

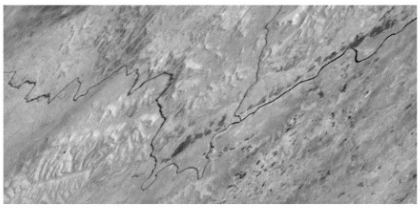


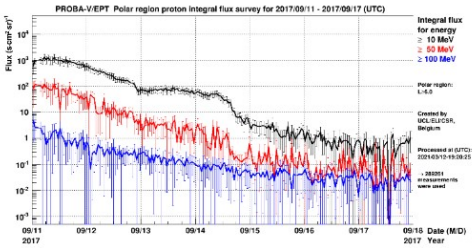
Platform Key Parameters: System Mode

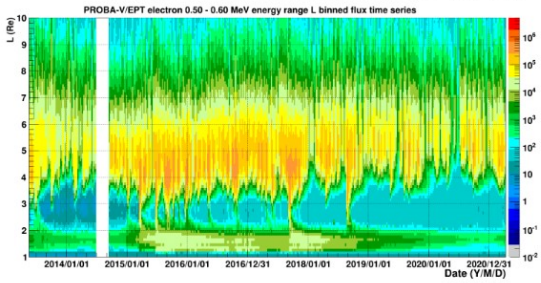
Platform Key Activities

Proba-V Experimental Phase (since 01/07/2021)

- Until the launch of PV-CC (planned for December 2021) focus on Europe and Africa data acquisitions with emphasis on 100m data and cal/val activities sensing of the moon, super-resolution experiments.
- 3 X-band contacts per day.
- 2 super-resolution experiments performed on 22/10/2020 and 01/11/2020.
- Monthly (partial) Moon-imaging campaigns since October 2020.
  - Modification of the MCT required by QS to automate the calculation of moon calibrations above 30deg after the full moon.
- **Continued high interest in EPT data (explicit interest in completing at least the current Solar Cycle +3 years).**







Close Approach Notifications

- None

Status AOCS: Pointing Performance

	Imaging APE at 95% confidence [arcsec]	3-axis APE at 95% confidence [arcsec]
Q4 2020	30.9	30.0

- Imaging APE: Only imaging periods considered.
- 3-axis APE: Includes imaging and momentum offload periods but not large-angle-rotations related to sun-bathing.

→ **The AOCS pointing performance is far better than the requirements (360 arcsec).**

Status AOCS: Units

Unit	Status	Remark
Star Tracker	nominal	Nominal head temp.: <0°C • Maximum: -1.64°C & -3.48°C • Average: -5.31°C & -10.05°C
GPS receiver	nominal	99.9% fix availability in Q4 2020 (ADS-B known interference on the GPS)
Magnetometer	nominal	
Reaction Wheels	nominal	No wear detected so far
Magneto-torquers	nominal	
AOCS IF	nominal	

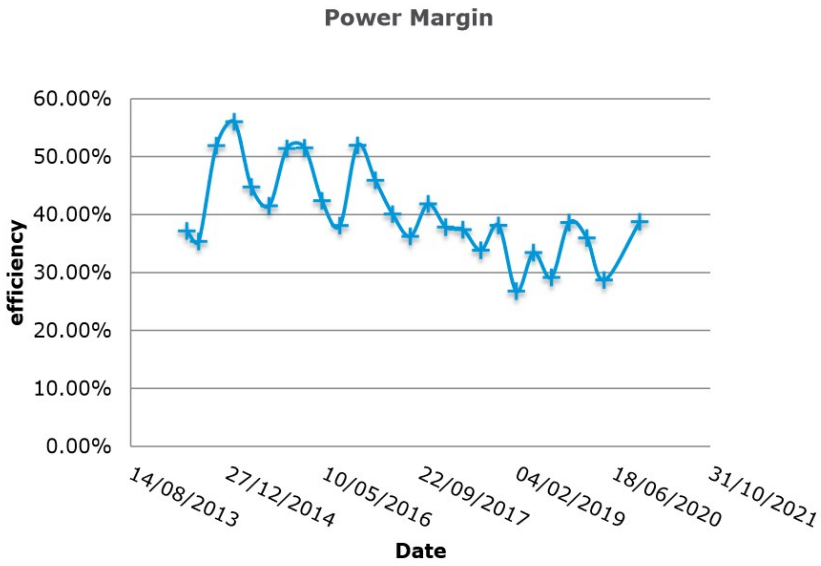
→ **AOCS overall status: all is nominal and performances met by far**

Status Power

Power summary (Q4 2020):

- Mode: nominal mode
- Bus average consumption: 67.18W
- S/A average generation: 95.71W
- Energy budget margin: 26.71W (38.74%)
- Minimum battery voltage: 27.91V
- Maximum battery voltage: 29.2V

→ **Power budget largely positive**



Status Power Units

Unit	In-orbit Status	Remark
Battery	nominal	Battery voltage nominal. Temperature nominal. • Average 19.04°C • Minimum 16.01°C • When >6°C no heater required
Solar Arrays	nominal	No degradation of the solar cells can be observed.
Power Conditioning (ADPMS)	nominal	Power conditioning (efficiencies) as expected

All units within power budget

The power situation is very stable, showing no apparent degradation of the solar arrays, battery, nor power distribution system

Data Handling Status

Unit	In-orbit Status	Remark
ADPMS	nominal	Single MPM SDRAM EDAC errors (trap 0x11) automatically corrected since launch: • Primary lane: 70 • Secondary lane: 9 Full flash dump monthly execution for bit-by-bit comparison purpose.
Mass Memory	nominal with work-around	• Latch-up behaviour detected in orbit. • On-board S/W work around in place. • Sectors 5, 1351 & 3302 (primary) show an increased amount of bitflips. • 64 bad blocks replaced by the MMM FPGA on the primary lane. • 4 bad blocks on the redundant ADPMS lane. • Function fully autonomous within the MMM.

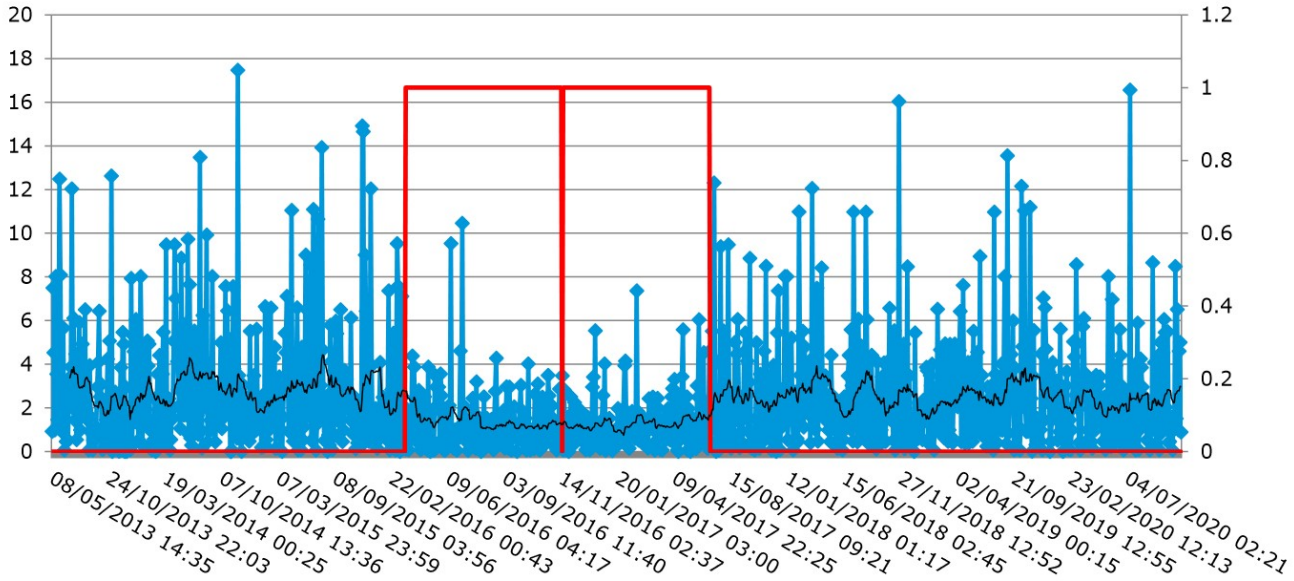
Data Handling: Mass Memory Anomaly

Mass memory anomaly statistics

- Location: Generally SAA
- Occurrences on average once per
  - 48:41 hours for 06/2020 for lane 1
  - Average over entire mission 54:58h
- Potential data gap: 3 minutes per occurrence (when over land)

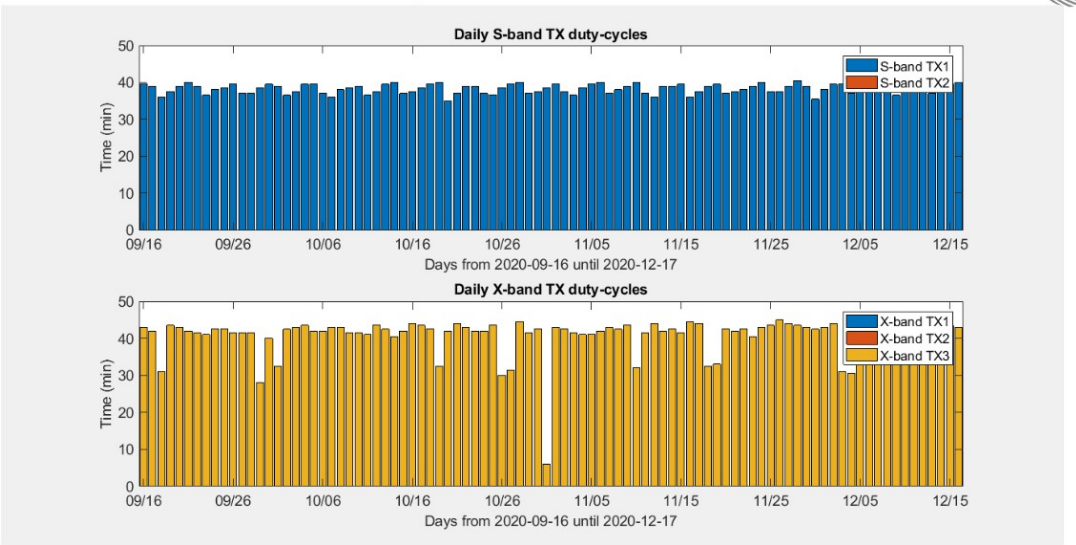
N.B.: The statistics & graph were not updated due to missing Quarterly Reports.

Data Handling: Mass Memory Anomaly



MMM SRAM latchup event interval + moving average over last 20 occurrences [days].
The red line shows the ADPMS lane (0 is primary, 1 is redundant).

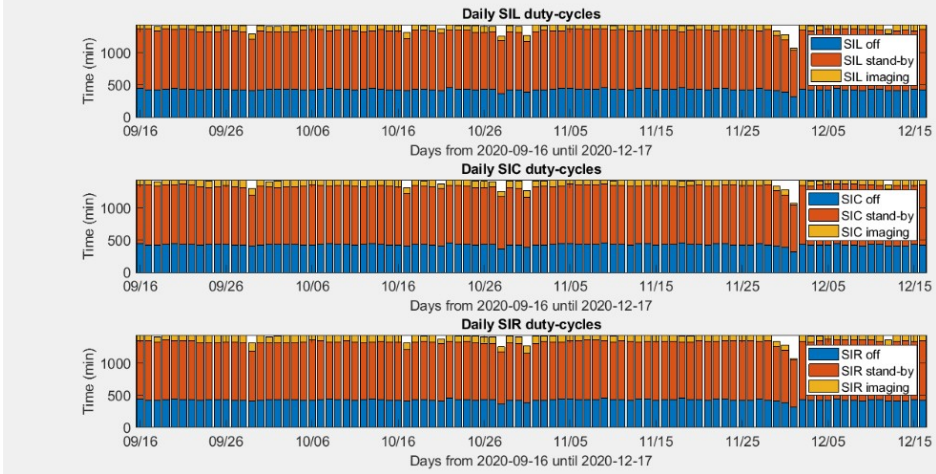
RF S- and X-band Duty Cycle



At request of Project, since March 15 2017, only the experimental GaN X-band transmitter is used for the X-band passes.

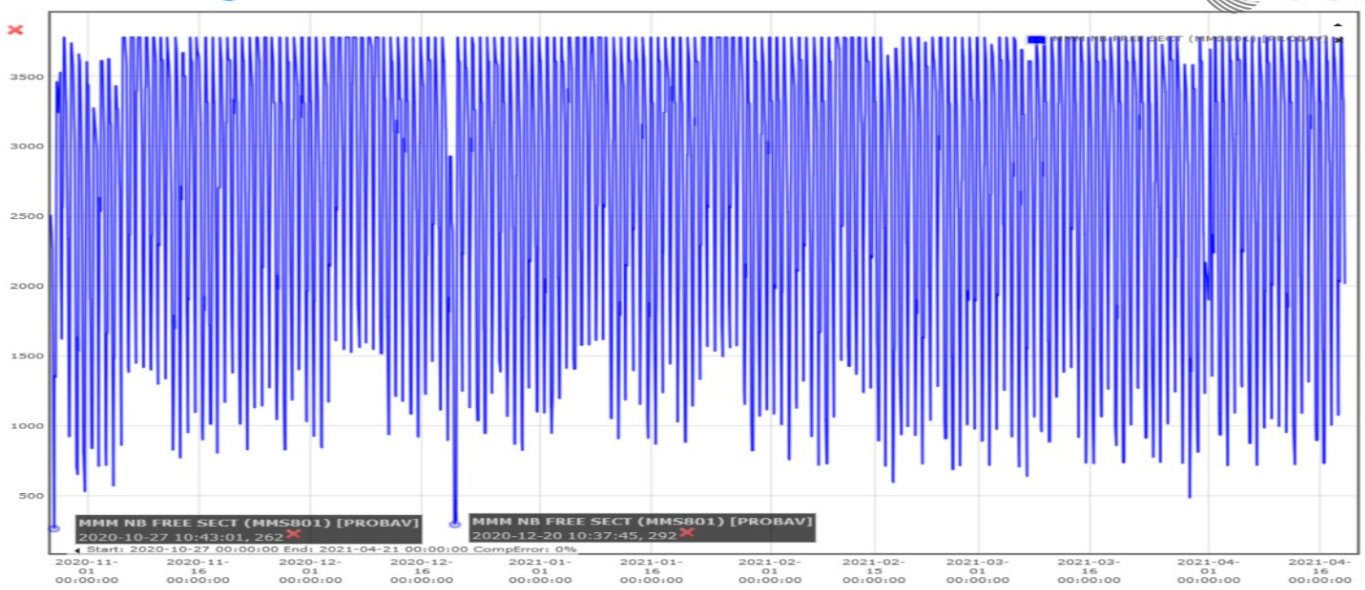
Instrument Status

Instrument Status



- Fully functional
- All calibration requests were executed correctly.

MMM usage



MMM NB FREE SECT (overwriting can occur below 238)

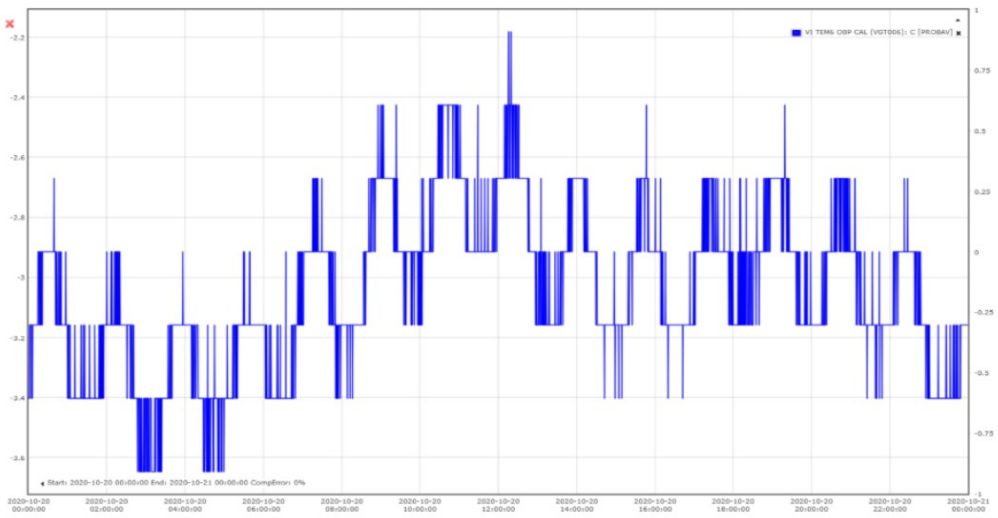
Instrument Thermal

Optical bench thermal variation

~ 1°C variation per orbit

~ 1.5°C variation per day

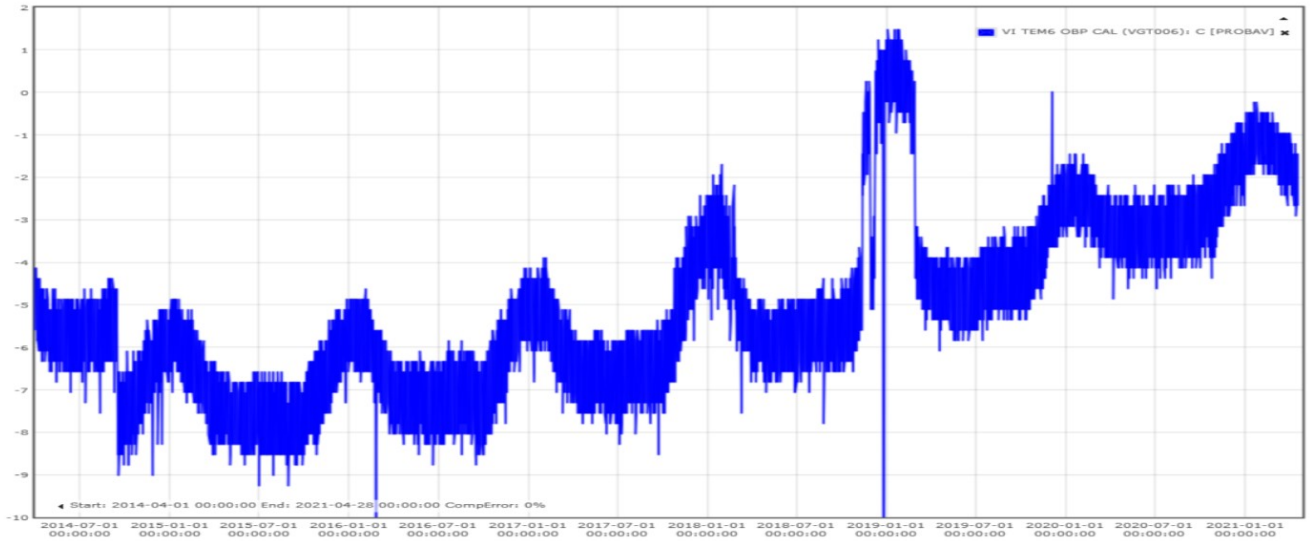
→ **Confirming excellent thermal performances of radiator and bench**



Optical bench thermal variation 17 April 2021

Instrument Thermal

Optical bench thermal variation since beginning of exploitation phase



S/C Anomalies

S/C Anomalies

Overview:

- 5 anomaly reports with status not closed (2 open, 3 pending)
- 1 new anomaly reports

➢ ARB (Project, QS, Redu, ESRIN) held on 02/12/2020 → QWG AI12.01 to be closed.

New Anomalies:

- SAT_AR28/20210207: Wrong GPS data leading to automatic selection of TLE's.

Closed Anomalies:

- SAT_AR23/20181224: Event 315 MMM_DUMP_WITHOUT_TRANSMITTER repeated every minute.
- SAT_AR24/20190628: Event 316 triggered every minute after S/C autonomous reconfiguration
- SAT_AR25/20200329: Wrong GPS data leading to automatic selection of TLEs

S/C Anomalies

Decompression errors

- The number of decompression errors is currently low.
- VITO has put in place a better classification of errors that now contains a split between the impact of geometric and decompression errors on the daily products. The missing % of pixels contains the other categories.

- The page https://www.vito-eodata.be/missingpixels/ is not yet updated to take into account the experimental phase with reduced LSM; therefore, the reported numbers are too high (~65%).

S/C Anomalies: SAT_AR23/20181224

Title: Event 315 MMM_DUMP_WITHOUT_TRANSMITTER repeated every minute.

Status: Closed.

QS opinion is that the rate of occurrence does not justify the development of a S/W patch/ upload.

S/C Anomalies: SAT_AR24/20190628

Title: Event 316 triggered every minute after S/C autonomous reconfiguration

Status: Closed

- On 28/06/2019 after an autonomous S/C reconfiguration which occurred at 10:57:05z, the Event 316 (EVT_MMM_STATUS_ERROR with parameters: Flash bad block table reconstruction error) was triggered every minute.
- This error is raised when there is a jump in the bad block replacement.
- On 17/09/2019 a small patch was uploaded to mask this bit of the MMM error register and made permanent via the StartUp TC 108 on 23/09/2019.

QS analysis: Correct solution is technically possible but requires ~2000 TCs and several days of loss of operations. **No operational impact with current mission length** (255 spare blocks present, 64/255 blocks are marked as bad. At present rate + margin ~8 years remaining before all spare blocks used).

S/C Anomalies: SAT_AR25/20200329

Title: Wrong GPS data leading to automatic selection of TLEs

Status: Closed

- On 2020-03-29 from 01:36:26z onwards on-board orbit propagator by TLE.
- At 03:11:28z return to use of GPS data due to autonomous on-board reconfiguration.
- DLR suspects a radiation-induced memory corruption in the "sprintf" routine.

➢ QS state that DLR support would be required. However for PV there is not much gain in doing this (only if future missions would use the same GPS receiver).

➢ **Action (done):** RW (ESA) to check the output of the orbital filter TM to see if the corrupt GPS data was used by the orbital filter. → No, orbital filter used TLE.

S/C Anomalies: SAT_AR26/20200407

Title: Event 254 and SAFE mode caused by orbital filter fdi flag

Status: Open

- On 2020-04-07 from 00:11:34z onwards many ephemerides parameters computed by the on-board software showed abnormal values and were followed by EKF orbital filter FDI errors.
- At 00:21:19z the event 254 EVT_AOCS_NO_ CONTROL triggered Bdot mode.
- At 08:54:19z return to nominal observation mode by ground TC.

➢ Further analysis by Industry is required to understand the cause of the observed on-board Orbital Filter behaviour.

➢ **Action (open):** JN (QS) due 31 Jan 21. → STATUS?

S/C Anomalies: SAT_AR27/20200505

Title: GPS corrupted data leading to GPS restart forced by cold reboot (Almanac corruption)

Status: Pending

- On 2020-05-05 at 16:49z the GPS started to deliver corrupted data while the GPS NAVIGATION STATUS remained equal to 2 (3D fix).
- From 16:54z onwards the TLE were selected by the ACNS.
- During morning passes of 2020-05-06, activation of the GPS units 1 and 2 in "assisted boot" mode (default) and a complete satellite reconfiguration w/o success.
- At 11:38z restart of GPS unit 1 in "cold boot" mode (no almanac assistance).
- At 11:47z the GPS starts to deliver good data.

➢ Problem could not be reproduced by DLR.

➢ **Action (open):** Redu to implement a ground-based procedure to verify the correctness of the almanac.

This is the first occurrence of this type of problem and the period with the selection of the TLE due to invalid GPS data had an impact on the Vegetation data products.

S/C Anomalies: SAT_AR28/20210207

Title: Wrong GPS data leading to automatic selection of TLE's

Status: Open

- On 2021-02-07 from 11:19:58z to 23:47:44z, the on-board orbit propagator used the TLE; several anomalies in the TM data related to the GPS were observed, similar to SAT_AR25.
- On 2021-02-07 at 23:46:42z, an autonomous S/C recovery rebooted the GPS and solved the issue.

➢ Further analysis by Industry is required to understand the cause of the observed on-board Orbital Filter behaviour.

Ground Segment Status

Ground Segment & Operations Status

- Overall status: Nominal
  - COVID-19 Business continuity plan: Presence of Proba operations personnel on site strictly following the sanitary rules.

- The satellite and ground segment operations, including its Vegetation Instrument acquisition and calibration requests, are running nominally.
- The Mission Operations Centre is fully operational. ESA/Redu centre supports all planned passes (3 S-band passes per day).
- The data downlink is shared between the SSC stations located in Kiruna, Alaska and Inuvik; due to Redu's downlink strategy Kiruna is the most used station.

X-band Status

	Total	Successful	Failed	Signal Degradation / Data Delay	Cancelled
October	94	91	0	3	0
November	90	89	1	0	0
December	93	92	0	1	0
January	93	93	0	0	0
February	84	81	0	3	0
March	91	86	0	5	0

Failed passes:
- 20201-11-13, pass #33743: Pass failed due to DEU freeze (see SSC AR#6557).

(Degraded & failed passes reported in the Weekly Reports; degradation usually due to R/F interference or strong winds.)

Ground Segment Anomalies

4 new REDU GS AR were opened; all without impact on operations.

- 17/02/2021 AR1051 AR1051_PROBA COMMON_GS_GSC PC SPARE_Power outage in the T03/SCC. Closed.
- 01/03/2021 AR1055_PROBA COMMON_GS_BBE UNIT10_LOW LEVEL RF OUTPUT. Closed.
- 03/03/2021 AR1056_PROBA COMMON_GS_BBE UNIT11_LOW LEVEL RF OUTPUT. Open.
- 31/03/2021 AR1068_PROBA COMMON_GS_ISP_Delivery_Failure_Report. Open.

(Managed via Redu Anomaly/Ticketing system (TANOR) and reported in the Weekly Reports)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Thank you!
proba-v
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VEGETATION
European Space Agency