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5 Years of in flight Operations

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Overview

- Flight Operations LEOP
- Flight Operations Commissioning Phase
- Flight Operations Routine
- FOS Status: Anomaly Reports, CAMs, Hydrazine consumption
- Ground Track Evolution
- S5p – SNPP Loose Formation
- Outlook

Flight Operations - LEOP

- Launch took place nominally on 13th October 2017 at 09:27:30 UTC and separation took place at 10:46:35 UTC. First AOS was observed at 11:01:00 over the Kiruna ground station.
- LEOP was executed with 24/7 support using a network of 4 ground stations (KIR, SVA, INU and TR) and completed in 33 hours without any spacecraft anomalies.

Time	Event	Comments
286.10.46.35	Separation	
286.10.48.18	SA Deployment End	
286.13.03.37	ASH Convergence	
287.04.04.14	TM Mode 2 - HBR	
287.09.16.12	Normal Mode	Sun Pointing (SUP)
287.14.41.25	CAP Entry	

Flight Operations – Comm 1/2

- Platform In-Orbit Testing was successfully carried out in 8 days from 16th to 24th October 2017.
  - All platform sub-system check-out activities were carried-out as planned as well as the first in-plane and out-of-plane manoeuvres.
  - X-band chain check-out was also performed at the start of the commission phase in order to fully validate the space to ground interface
- Payload In-Orbit Validation spanned over 21 working days from the 25th October to the 17th November 2017.
  - All payload check-out activities were executed as planned and the payload Radiant Cooler door was successfully deployed on 07/11/2017.
  - At the end of this phase, the first reference orbit (5mn +/- 1.5mn along track separation with Suomi-NPP) was successfully reached.

Flight Operations – Comm 2/2

- Payload Calibration and Validation: 18th November 2017 to 29th April 2018.
  - Payload operations were carried-out in order to validate the end to end mission planning process, to validate the payload behaviour and to refine the payload configuration for phase E2.
  - 1st TROPOMI E2 cycle started on 30th April 2018
- All foreseen activities have been performed as planned.
- At the end of this phase, the final reference orbit (3.5mn +/- 1.5mn along track separation with Suomi-NPP) was reached.
- Anomaly Reports: 20 Raised, 16 Closed, 4 Pending Closure

ID	Observation	Occurrence Date	Criticality	Urgency	Subsystem
GS5p_SC-8	[COM]: Heater line 24 thermistors reporting very low temperature	2017-11-07	Low	Low	TCS
GS5p_SC-11	[COM]: PDHU Memory Correctable Errors	2017-11-10	Low	Low	PDHT
GS5p_SC-14	[COM] RCS Off-modulation and impact in performance	2017-10-17	Low	Low	RCS
GS5p_SC-24	[COM]: PM-A corrected errors counter continuous increase	2018-04-06	High	Low	DHS

Routine Operations – Overview

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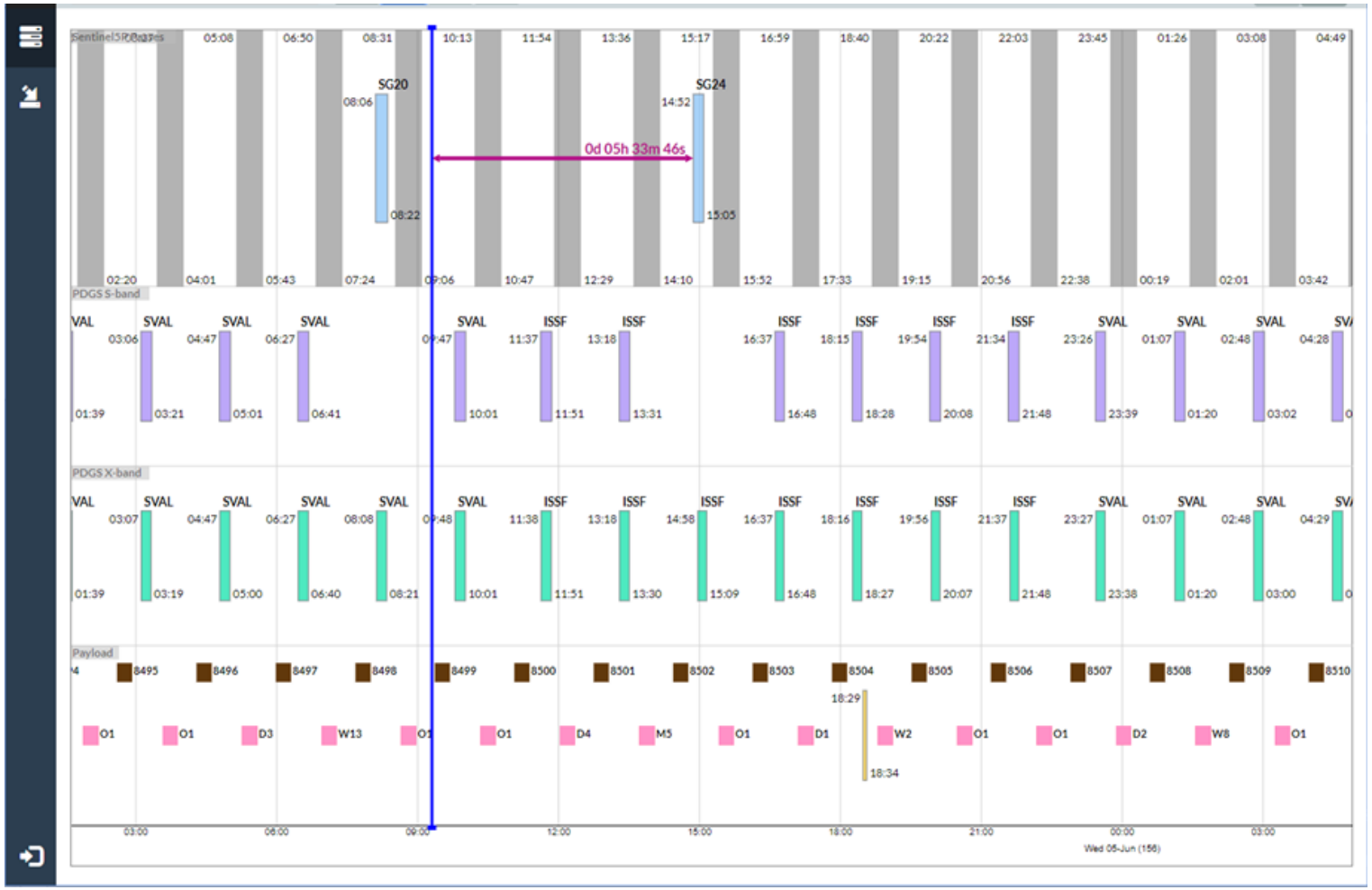
❑Current

- S-band dumps performed over PDGS stations for every orbit except those scheduled by FOS

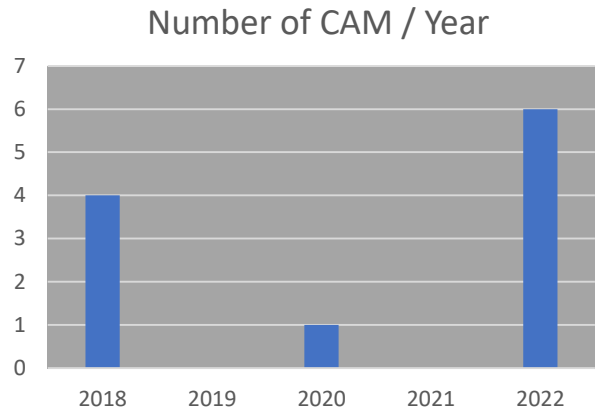
❑Evolution (Dates TBC)

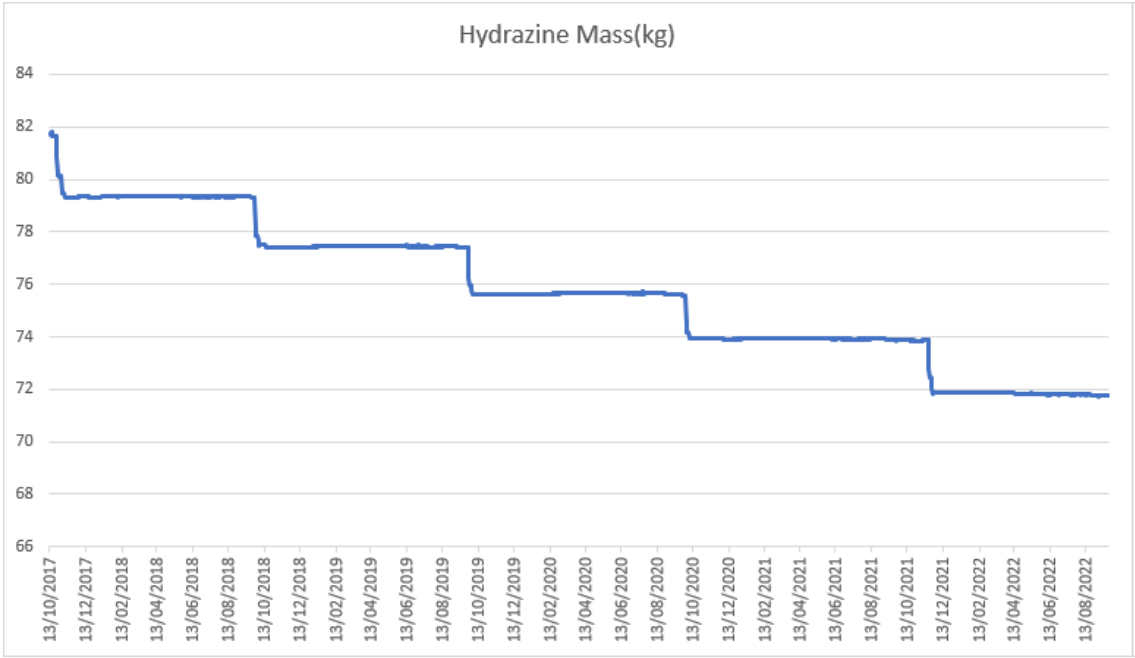
- Additional Kiruna pass during the night Q4 2022
- Automated routine pass operation Q1 2023
- Troll and Esrange operational
- Inuvik pending ITU filing

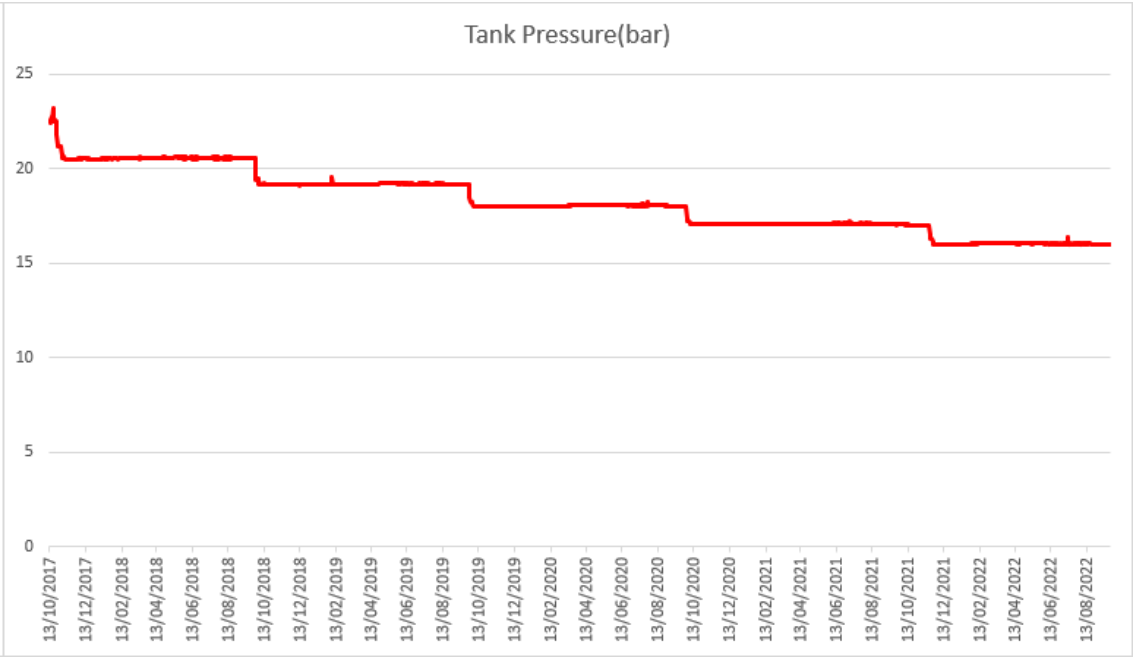


Flight Operations - Routine

- Since Start of Phase E2
  - MPS Cycles: 232
  - Orbit Control Manoeuvres: 48 (13 OOP)
  - Collision Avoidance Manoeuvres: 11
  - After 5 years in orbit 10.3 kg of hydrazine have been used.
  - Next inclination correction will take place in March 2024.

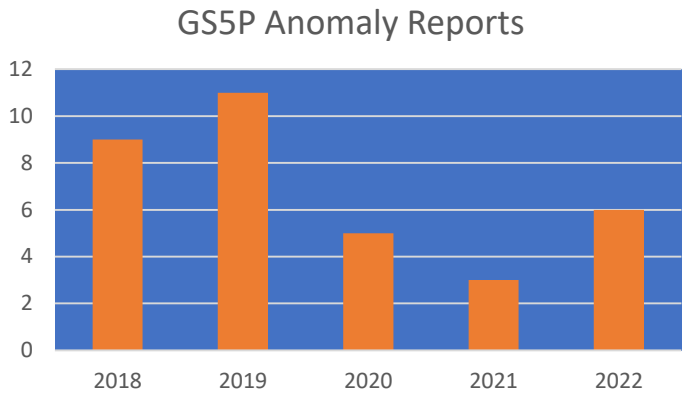


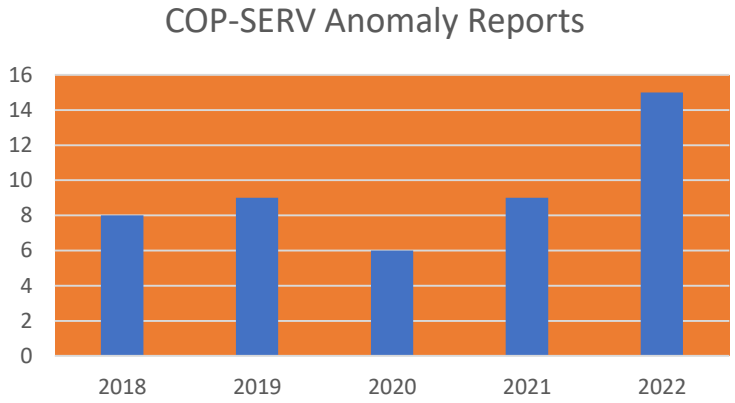




Ground Segment Issues – GS5P

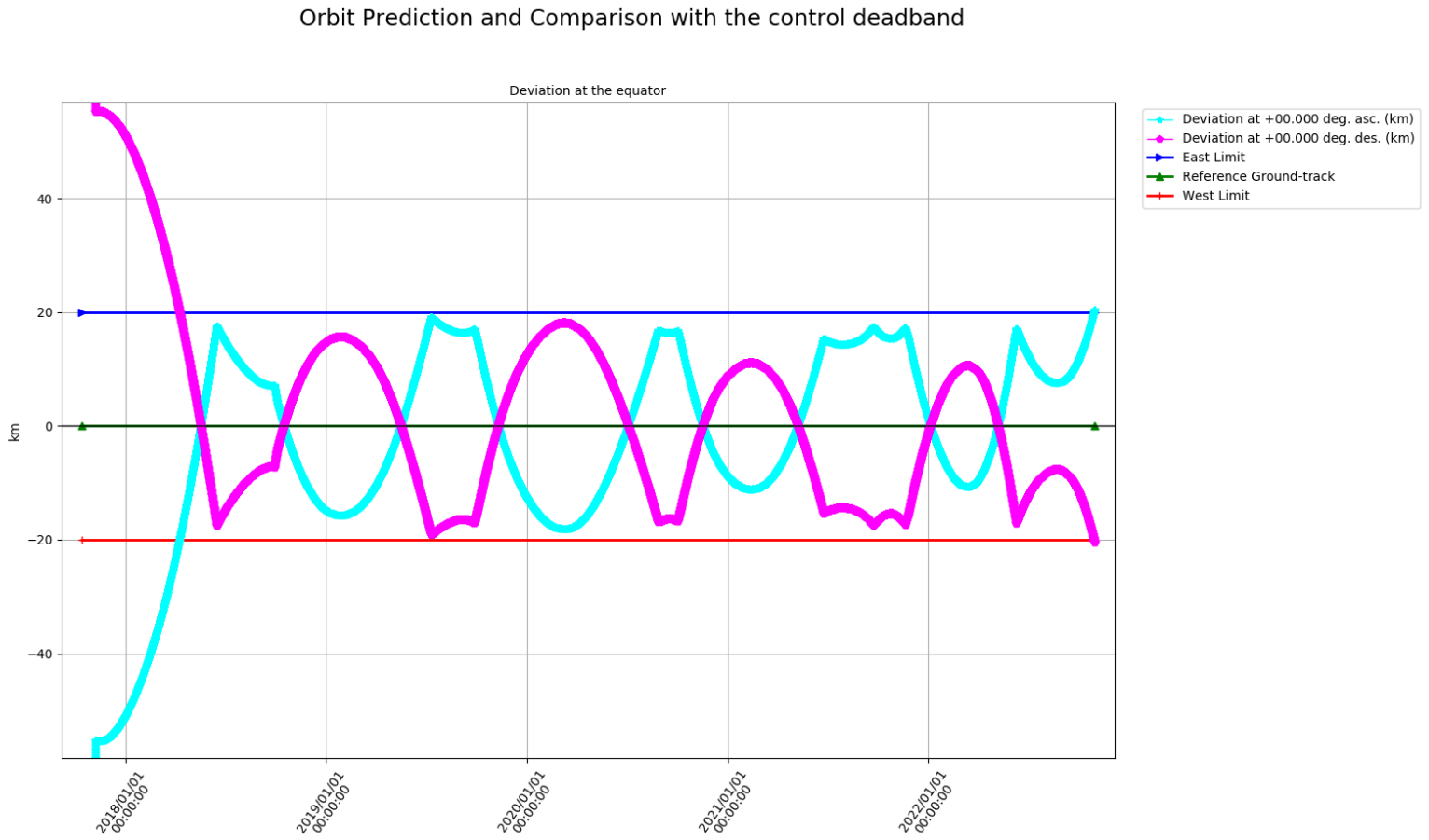
- Ground Segment ARs:
  - Problems with TT&C support affect 1% of passes.
  - In 2022 more issues raised due to problems with ESRANGE support.
  - 34 ARs raised, 4 Pending.





ID	Occurrence Date	Observation	SSystem	Criticality	Urgent	State	Actions
GS5P-166	2022-09-10	Not possible to log in to VCSEND59 from Console DTU E02-02	MCS	Low	Low	Pending	
GS5P-165	2022-07-10	[S5P] KIR1 Antenna Wrong Configuration	STATIONS	Low	Low	Pending	
GS5P-164	2022-06-23	S5P PDGS SAF duplicate file transfer issues	PDGS	Low	Low	Pending	RM
GS5P-163	2022-06-08	Duplicate S-Band HKTM files received from Svalbard Cortex	PDGS	Low	Low	Pending	RM

Ground Track evolution



- A small in-plane manoeuvre needed every year.
- In 2021 NOAA delayed the IAM. An extra small in-plane manoeuvre was executed to cover the delay
- the long cycle in 2022 was shorter than in previous years, this is due to the increasing solar activity. This will become shorter in the years to come.

S5p – SNPP Loose Formation

- Along track separation (orange line) was controlled only indirectly via standard independent ground track control. It worked well, as expected, but in 2021 NOAA “violated” their ground track deadband leading to a separation very close to the security minimum of 2 min. Eventually they corrected it by performing combined in-plane/out-of-plane manoeuvre and no action was required by us.
- LTAN separation (blue line) was maintained between 04:49 and 05:00. the oscillations at beginning of the mission are due to less accurate input from NOAA (TLE vs. OEM).

Outlook

❑Ground Segment

- Updates to the FOS External server in Q4 2022: New IP address.
- Evolution to ‘lights out’ routine pass operations, ie. fully automated.

❑Spacecraft

- Loose formation with S-NPP: Orbit inclination corrections to take place in March from 2023 onwards.
- Refresh of the TROPOMI EEPROM: predicted Unavailability of 2 days (EEPROM 0 and 1 in ICU A)

- Looking forward to the next 5 years…