GRACE Follow-On Project

Mission Operations Status



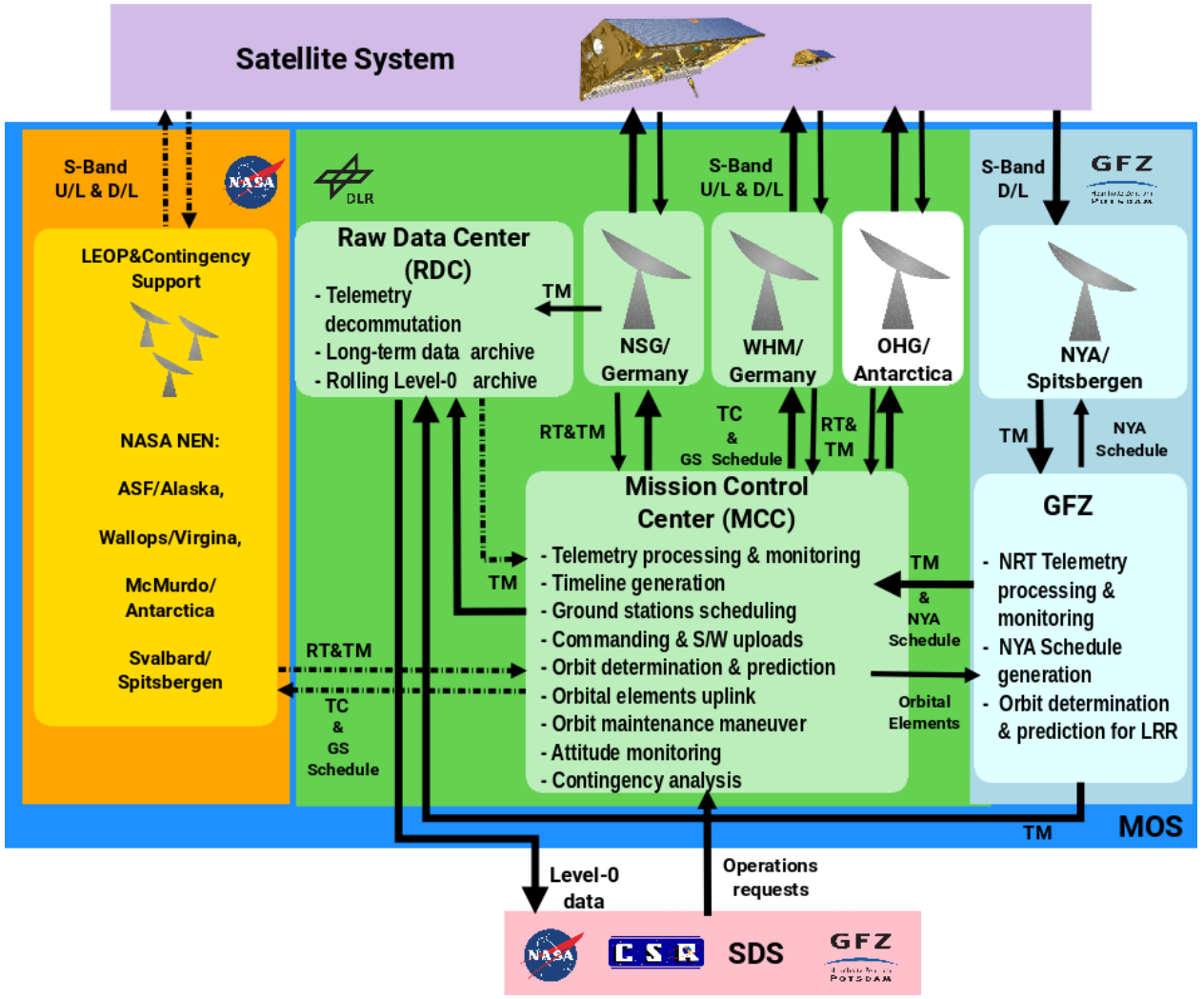
Krzysztof Snopek (GFZ)

Mona Witkowski (JPL), Sebastian Loew (DLR)

GRACE-FO Science Team Meeting, October 26, 2020

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MOS Design & Ops Concept



Primary data downlink at Ny-Ålesund (NYA) (about 6-8 times per day per satellite). Data processed at GFZ in Potsdam/Oberpfaffenhofen and provided to RDC and MCC.

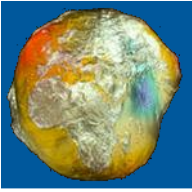
Uplink via Weilheim (WHM), Neustrelitz (NSG) and O'Higgins (OHG) plus evtl. data download (1-2 contacts per day per satellite)

NEN stations for contingency support and software uploads.

Mission Control Centre (MCC) in Oberpfaffenhofen (Routine ops tasks & special ops requests).

Raw Data Centre (RDC) in Neustrelitz is pickup point for SDS.

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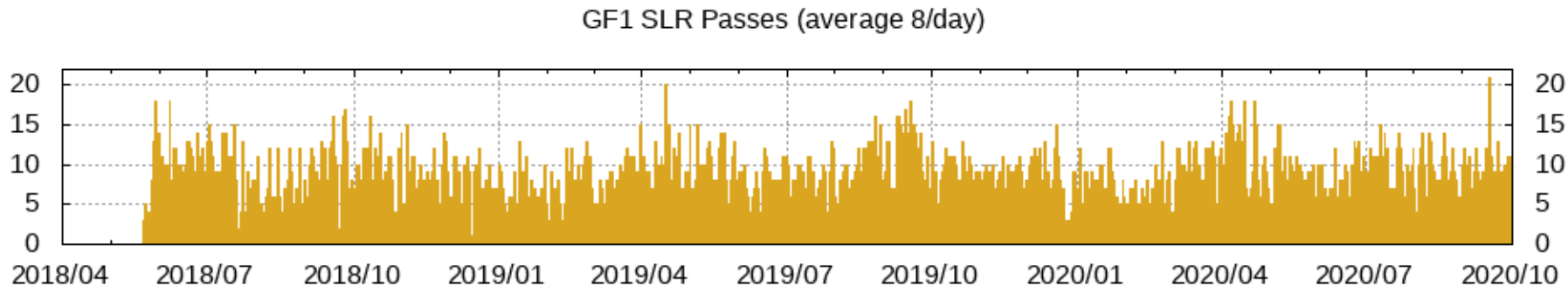


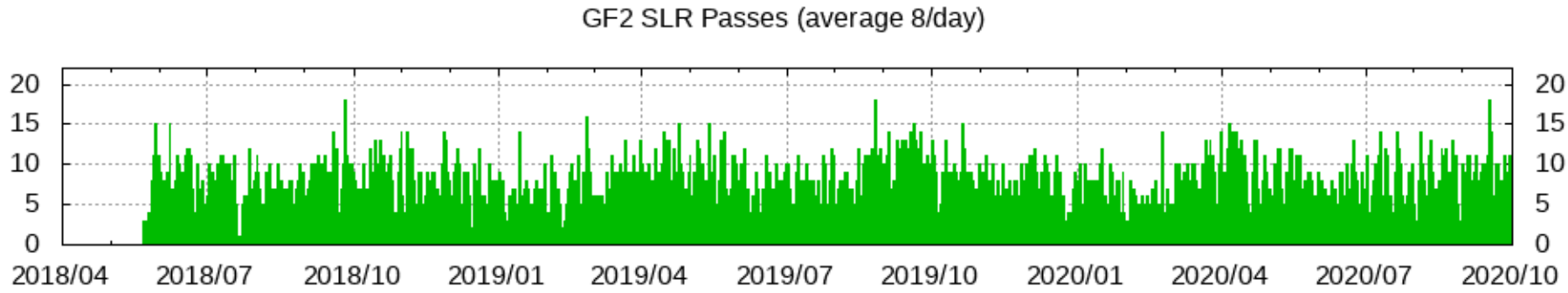
Satellite Status

H/W	GF1	GF2
Bus		
- OBC	A - nominal	A – PM-A/1553 MilBus anomaly B - nominal
- PCDU	A - nominal	A - nominal
- SCA	STRE A,3 heads – nominal	STRE A,3 heads - nominal
- TX	A - nominal	A - nominal
- Battery	Nominal	Nominal
- CGPS	A & B – nominal	A & B - nominal
- IMU	3 units (IMU-4 Off)	3 units (IMU-4 Off)
Payload		
- MWI	B – nominal (OCC On) **IPU S/W v4.3**	IPU-B failed A – nominal (OCC Off), IPU S/W v4.2
- ACC	A per design (NRM)	A per design (**NRM**)
- LRI	On (Master Role)	On (Slave Role)

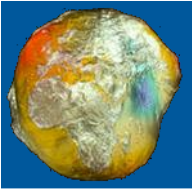
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SLR Observations





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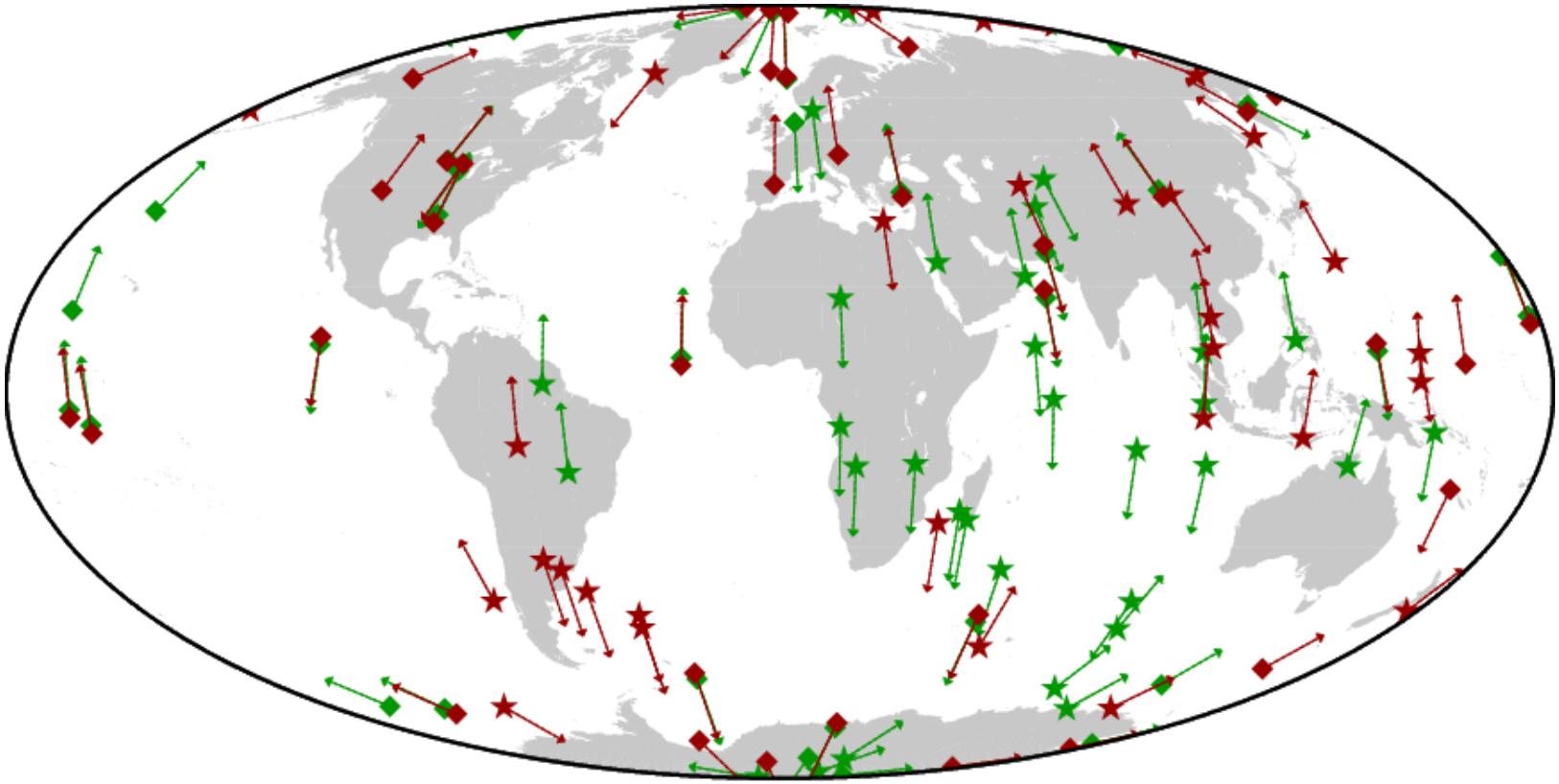
Major Events Since Last GSTM

Date	Event
18-Nov-2019	GF2 ACC relay test
18-Jan-2020	**GF2 time jump (drop ASM and science interruption for few days)**
27-Jan/14-Feb-2020	GF2 ACC relay test daily for 1sec
01-Feb/14-Feb-2020	GF1 CMCal – CM Trim in x – CMCal
07-Feb-2020	**GF1 time jump (drop SM and science interruption for few days)**
02/04-Mar-2020	GF1 IPU S/W Upload (mode drop AOCS-ASM)
03/04-Mar-2020	Drop to ASM (ground mistake) and recovery within 24h
08-May/15-May-2020	GF1 CMCal – CM Trim in y – CMCal
26-May/02-Jun	GF2 ACC in BMV2 and transition to NRM*
24-Jun-2020	GF1 Wiggle test
18/19-Aug-2020	GF1&2 OBCP 12,26,55 Upload
26-Aug-2020	GF2 Wiggle test
09-Sep-2020	GF2 Drift correction maneuver
17-Sep-2020	GF1 KBR calibration
28-Sep-2020	GF2 KBR calibration

* GF2 ACC still in anomaly and not used for gravity recovery

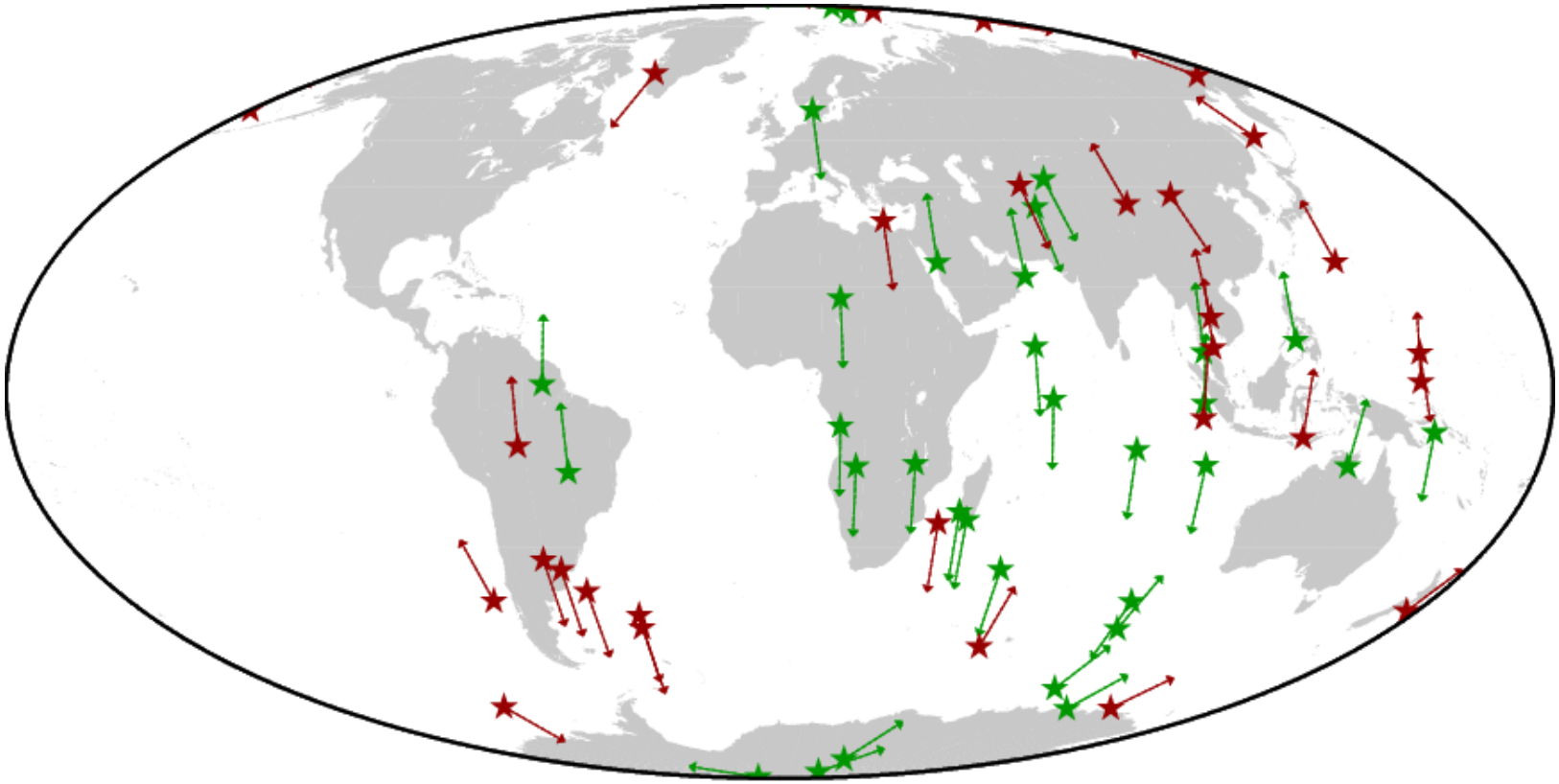
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Last year IPU Reboots (all)



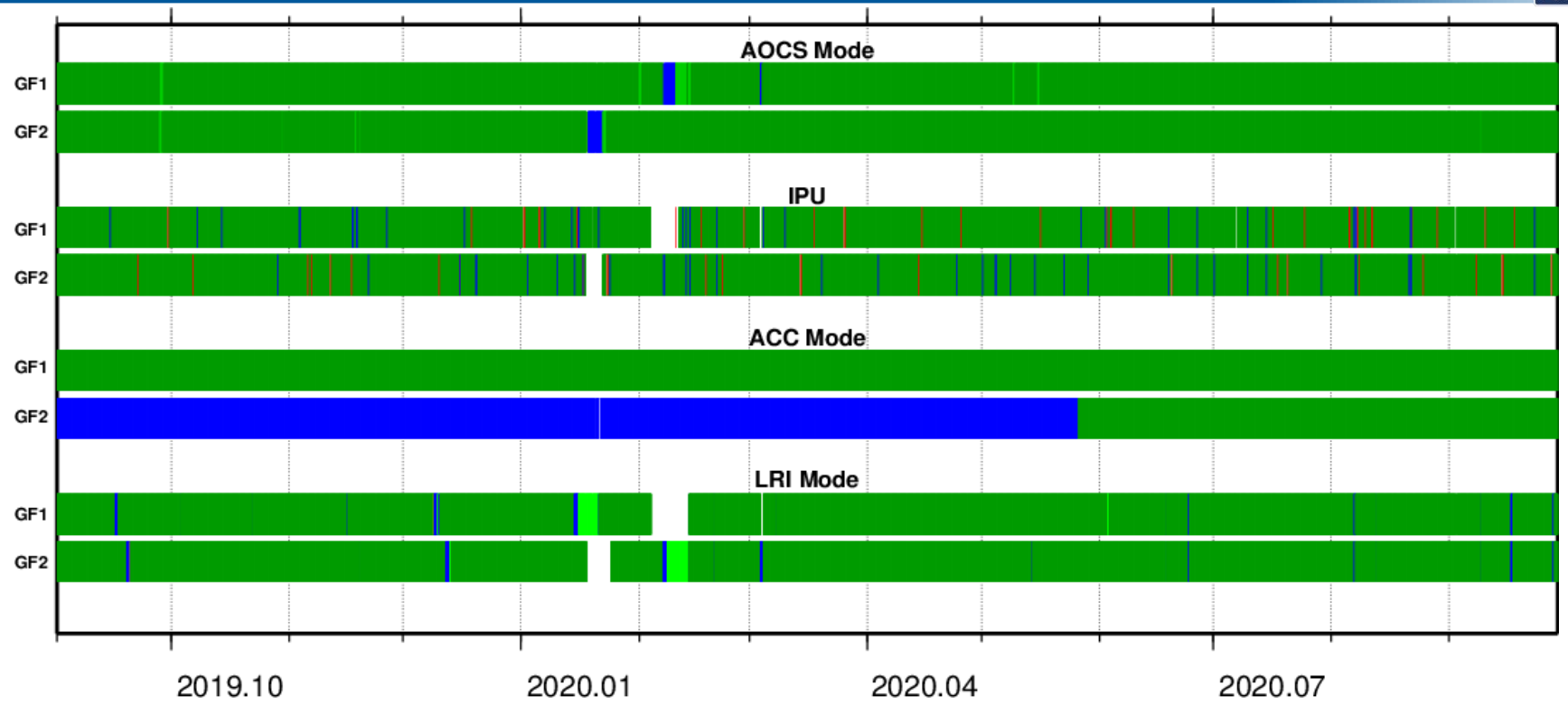
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Last year IPU Reboots (spontaneous)



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AOCS & Payload Status



AOCS Mode:
- ASM
- NOM_ACQ
- NOM_AH
- NOM_FP

IPU:
- On
- Reboot
- Soft Restart

ACC Mode:
- LRM
- NRM

LRI Mode:
- ReAcq
- InitialAcq
- Science
- Diagnostic
- Other

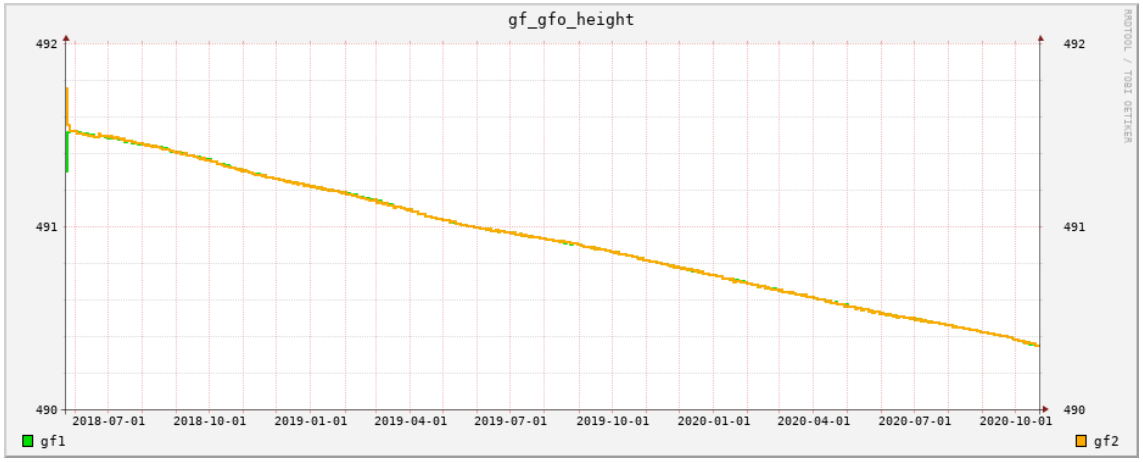
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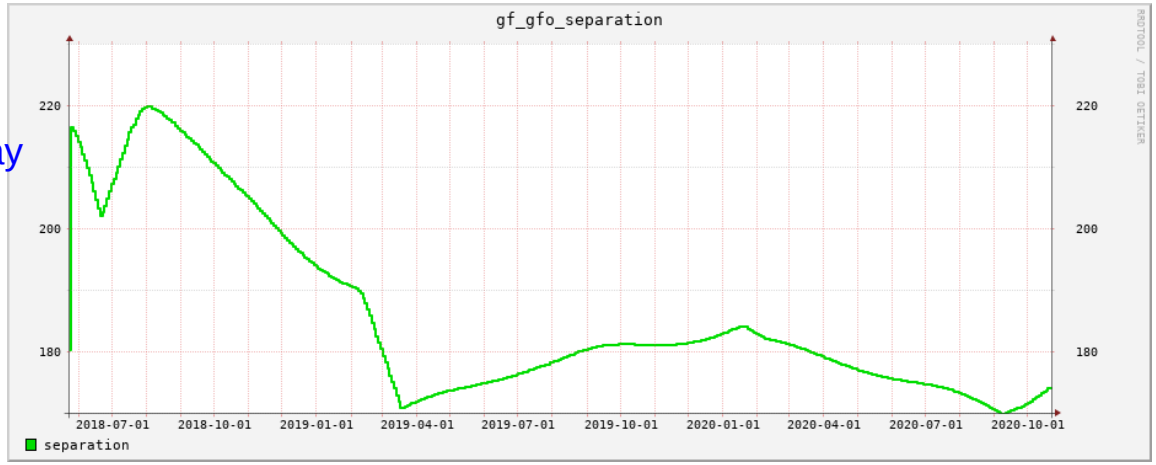
Orbit Status on 22-Oct-2020

- ~2.5 Years in Orbit
  - 883 days in orbit
  - 13460 revolutions completed
  - GF1 Leading / GF2 Trailing

- Orbital Height
  - 490.4 km (491.5 after launch)
  - Altitude decrease: 1.3 m/d

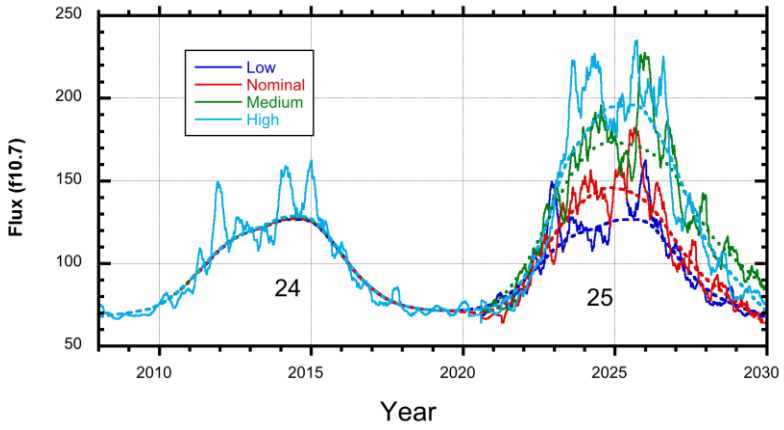
- Inter-satellite Distance
  (nominal range 220 km ± 50 km)
  - 174 km increasing with 0.14 km/day

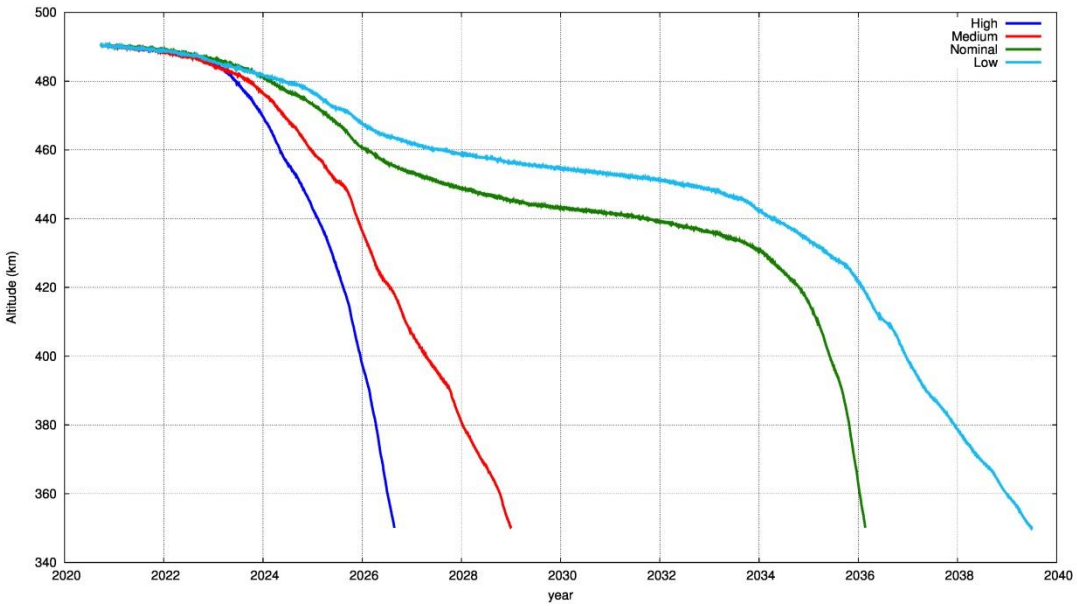




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Orbital decay prediction



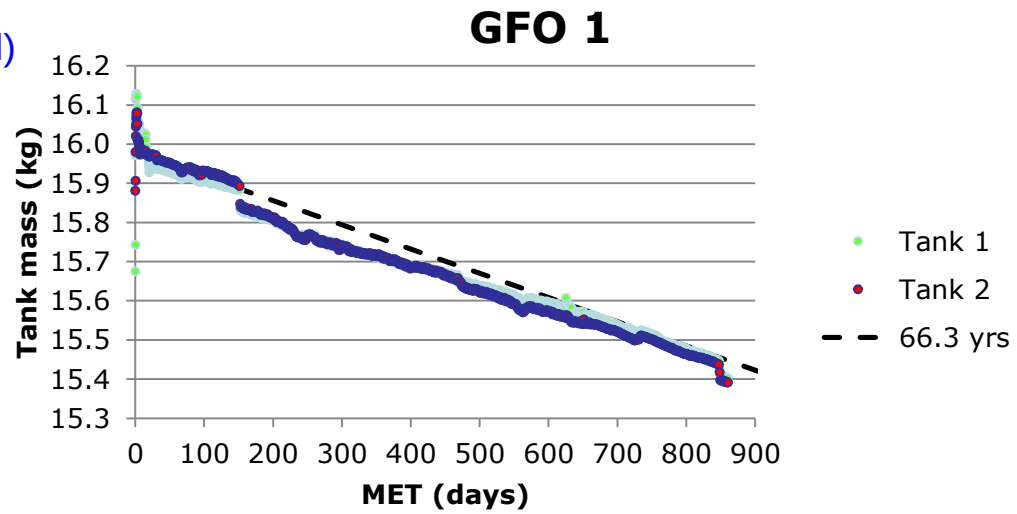


- Solar cycle #25 has started
- Slow decay in case of nominal or low solar activity (which is expected)
- Orbit raise maneuver(s) may be necessary to escape altitudes with bad repeat cycles and to ensure good quality of ACC transplants.

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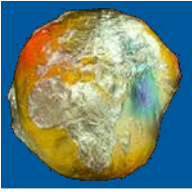
Lifetime Limiting Resources

- Propellant
  - Very low propellant consumption (< 1g/d)
  - Launched with 32 kg
  - Used 1 kg on both satellites



- Battery
  - Nominal
  - End of Charge Voltage: 32.8V

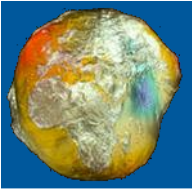
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Planned Activities

Event	Satellite	Date
Thruster calibration test	GF1 & GF2	2020
IPU S/W upload	GF1 & GF2	2021
Start OCC (GF1 is enabled)	GF2	After S/W upload
Swap maneuvers	GF1 & GF2	Jun-2020
Orbit raise maneuvers	GF1 & GF2	(tbd)

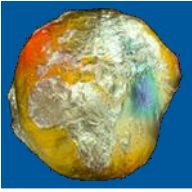
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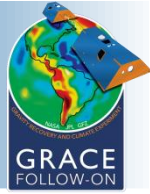


Summary

- GFO mission operations proceeding nominally
- Major failures and anomalies (no change since last year)
  - GF2 IPU-B Failure
  - GF2 OBC-A Anomaly (PM-A/1553 Milbus) -> operating with OBC-B
  - GF2 ACC Degraded Performance
- Other anomalies last year:
  - Time jumps on GF1/GF2 and drop to ASM resulted in science interruption for several days
  - Frequent IPU reboots
- Plans for the next year:
  - IPU S/W upload
  - Satellite swap
  - Orbit raise (tbd)
- The Joint German/US Mission Operations Team continues to work well together

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Thank you !

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