CloudSat Mission Status & Plans

4 December 2019

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Jet Propulsion Laboratory, California
Institute of Technology

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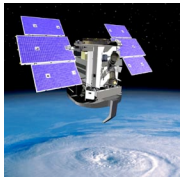
Mission Status



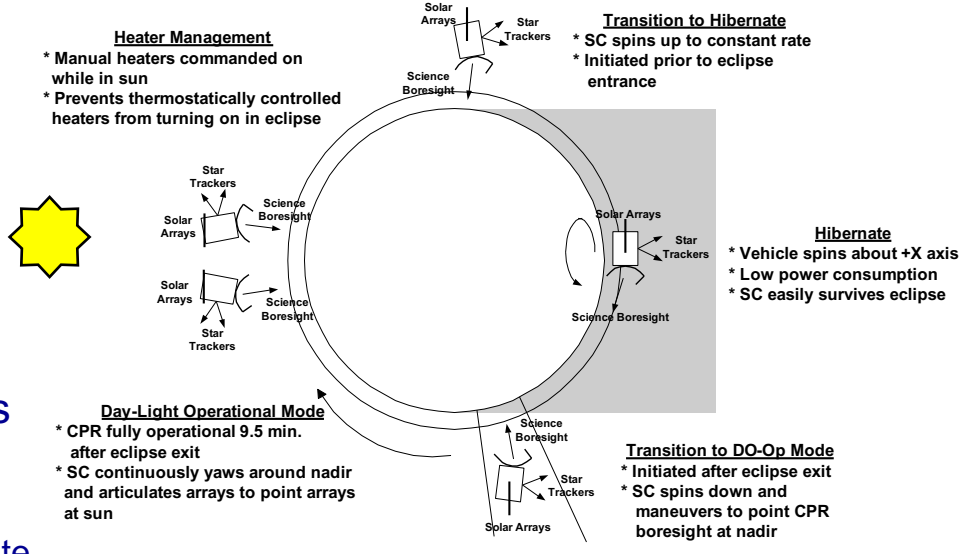
CloudSat celebrated 13 years in Orbit on 28 April!

Daylight Only Operations (DO-Op)

- Due to power restrictions

S/C Health/Redundancy Status

- CPR is fully redundant
- April 2011 Battery Anomaly
  - June 2011 Left A-Train
  - May 2012 Rejoined A-Train
- May 2011 Receiver #1 Probable Loss
  - Locked up at an off-nominal frequency
  - May be recoverable, however recovery attempts have been unsuccessful to date
- Loss of redundancy on catbed heater mats (no impact to operations)
  - Thruster #1 (2011) & Thruster #2 (2014)
  - Thruster #3 (2018)
- June 2017 Reaction Wheel #1 Failure
  - Triggered CloudSat A-Train Exit Criteria
  - February 2018 Left A-Train



C-Train Formation

- Flying ~45 sec behind CALIPSO

Consumables

- Battery - Gentle Charging Techniques
- Fuel – Sufficient for several more years

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CloudSat Overflight of Typhoon BUALAOI

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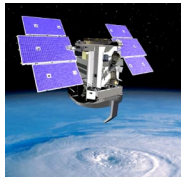
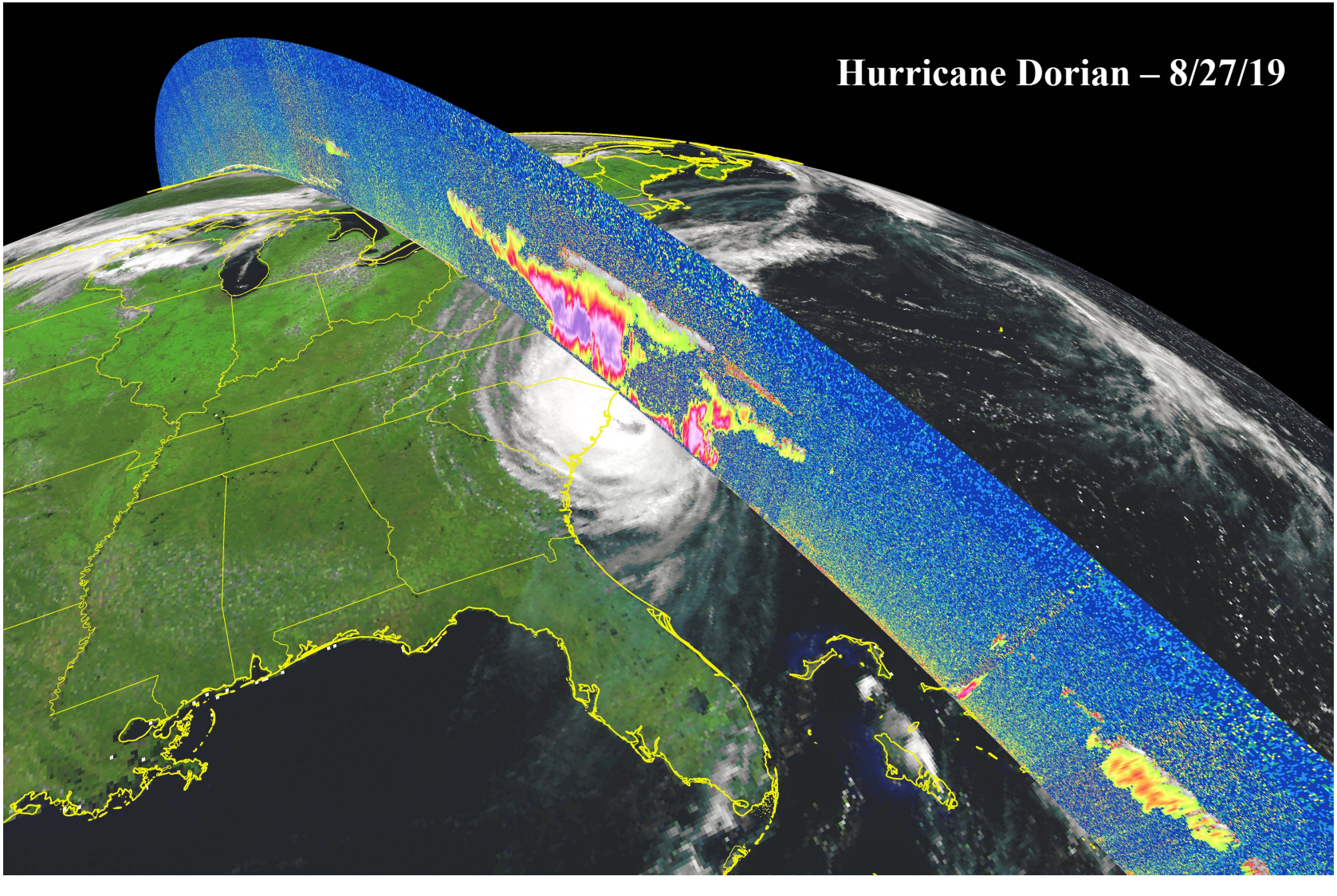
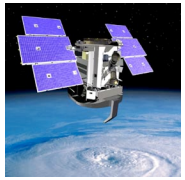
CloudSat/CALIPSO Combined Overflight





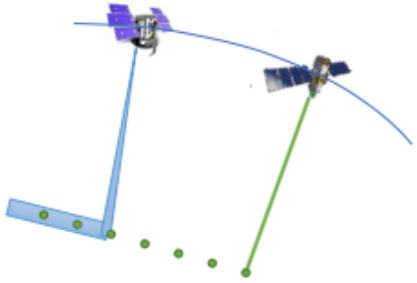
Operations History

(Since the last MOWG)



Maneuver History

- 1 Orbit Raise
- 1 Orbit Lower



Maneuver History – Un-planned Maneuvers

- None
- 2 COLA Maneuvers were planned but not executed

Data Outages

- Solar Eclipse: 2 July 19 - 13 Orbits of CPR data lost
- S/C Computer Reset: 11 July 19 - 208 Orbits of CPR data lost

Flight School was conducted in October 2019

- To raise command awareness and share procedural best practices

Battery Charging

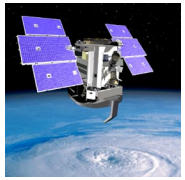
- Refined KI Boost durations
- Reduced VT Level in October (seasonal load reduction)

Other

- Star Catalog Rotation: 5 June 2019

Anomalies

(Since the last MOWG)

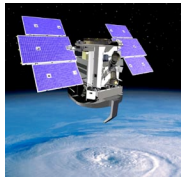


Spacecraft Computer (SCC) Reset– 11 July 2019

- SCC Reset occurred just prior to a planned formation-flying Orbit Raise
  - ✓ Fault protection transitioned the spacecraft into Recovery Mode
  - ✓ The maneuver was not executed
  - ✓ This reset is similar to the one that occurred in 2014, which was due to an SEU
- The computer was restarted and placed into Sun-Point-Spin (SPS) Mode
  - ✓ Requisite tables were re-loaded and onboard sequence memory was re-enabled
  - ✓ Failure analysis and recovery efforts continued over the next week
- The spacecraft was successfully transitioned through the various operations modes and resumed DO-Op on 24 July 2019
- CloudSat has been successfully operating in DO-Op since the reset

Risks & Concerns

(Since the last MOWG)



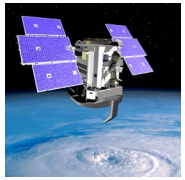
Communication Outages With Kirtland Air Force Base

- Automated Data Distribution System (DDS) outages to the Constellation Control System (CCS) have plagued the team since May 2019

  ✓ Mitigation: Back-up file delivery capabilities developed via Colorado State

  ✓ Status: Outage Continues
  - IP Addresses "White Listed" by DISA in September 2019
  - Configuration change identified by CCS at GSFC (resolution in work)

Summary



CloudSat has been flying with CALIPSO in the C-Train since October 2018

- CloudSat is flying ~45 seconds behind CALIPSO
- 5432 Granules have been successfully acquired & processed
  - ✓ 603 granules missed due to anomalies and maneuvers

The spacecraft is healthy and is operating nominally in DO-Op

- Gentle charging techniques are maintaining the health of the battery
- Fuel is sufficient to support several more years of operations

Preparations are underway for the 2020 Senior Review Proposal

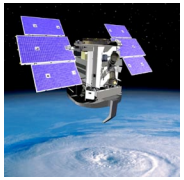
- Kick off is 8 December 2019 prior to the AGU Meeting

2020 Joint CloudSat / CALIPSO Science Team Meeting

- Scheduled for 3-5 March 2020 in Boulder, CO

Mission risks are being monitored and managed

- Reaction wheels – The remaining 3 reaction wheels are aging, but continue to operate nominally. There is no increased friction observed to-date.
- Battery capacity – The battery continues to perform nominally. Gentle charging has improved battery performance.



Back-Up

CLOUDSAT

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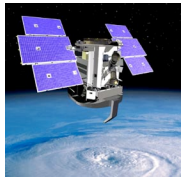
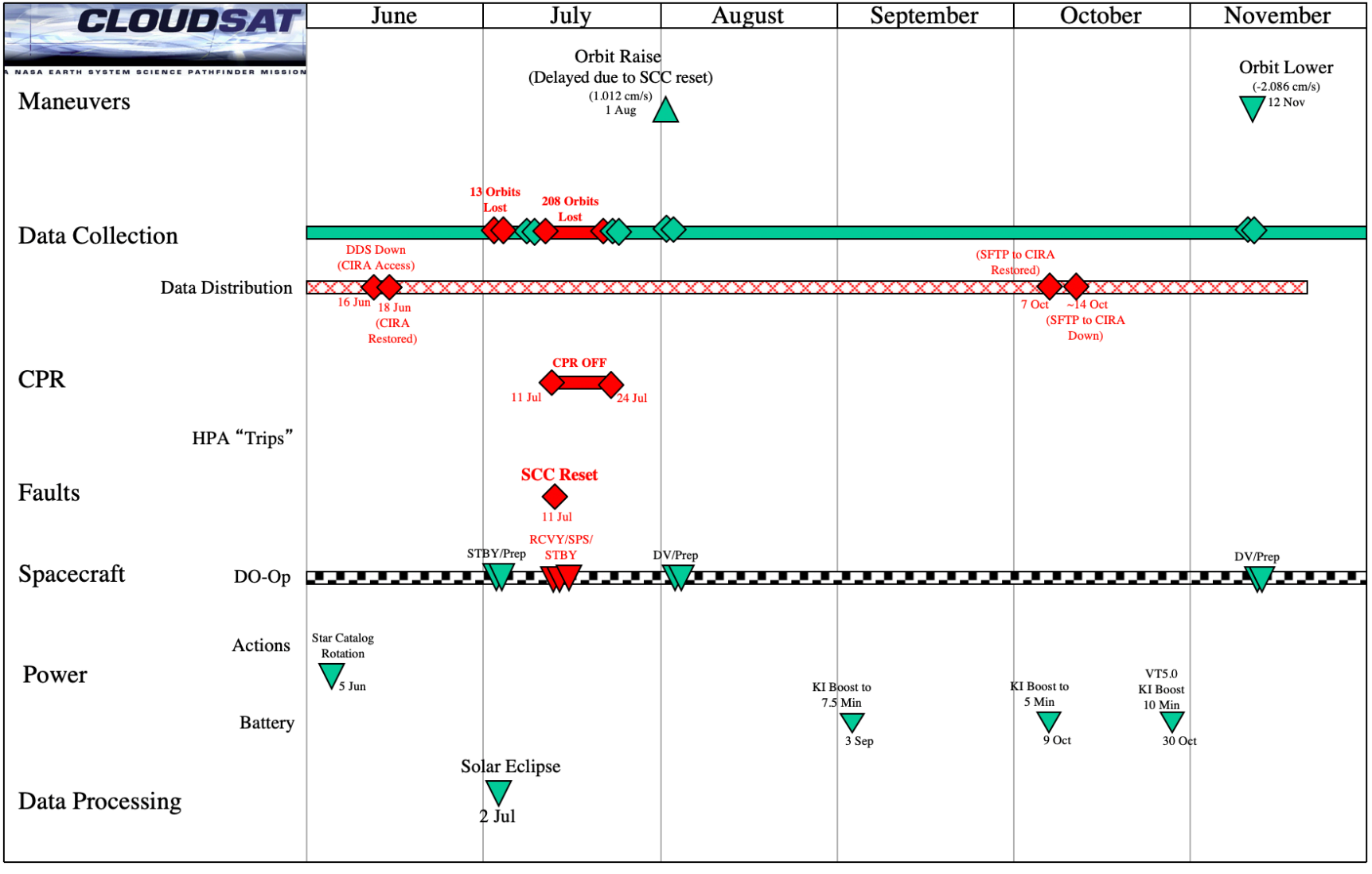
Ship's Log

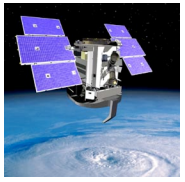
(Since the last MOWG)





Risks & Concerns

(Ongoing)

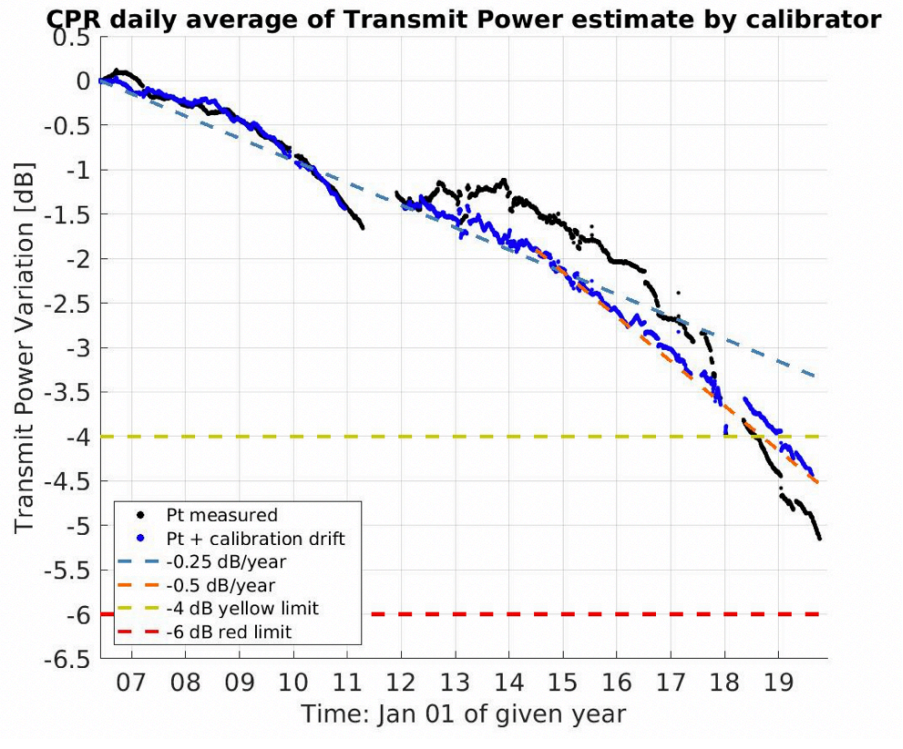


CPR EIK Degradation Risk

- As the CPR ages, we will eventually reach the-24dBZ sensitivity threshold
  - ✓ Mitigation: Switch to the backup CPR HPA (EIK & HVPS)

CPR Continues to Operate with Full Redundancy

- Yellow Limit is at -26dBZ / Red Limit is at -24dBZ



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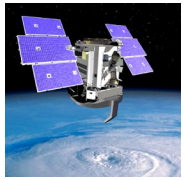

Reaction Wheel Failure Risk

- An additional reaction wheel failure could threaten/end science mission
  - ✓ Mitigation: Working on 2-Wheel science observation capability
  - ✓ Mitigation: Use thrusters-only to lower CloudSat to graveyard orbit

Spacecraft Battery Degradation Risk

- Additional battery degradation threatens/ends science mission
  - ✓ Mitigation: Continue to evaluate and implement gentle charging techniques (VT Stepping, MMKI with KI Boost options have proven beneficial)
  - ✓ Mitigation: Switch to Standby-Mode for 2 month in the summer if CPR stability heater on time increases
  - ✓ Mitigation: Use exit burns to lower CloudSat to the graveyard orbit (can be executed from the lower-power Sun-Point-Spin Mode)
  - ✓ Mitigation: Orbit will naturally begin drifting toward shorter eclipses now

Spacecraft Computer (SCC-1) Failure

- Failure of SCC-1 would necessitate the switch to the redundant side
  - ✓ Mitigation: Switch to backup SCC-2