EXPERIENCED MIRAS ANOMALIES AND MISSION IMPACT

This note describes briefly the anomalies experienced so far by MIRAS In Flight, and aims to describe the impact they may have both over the data production (i.e. data gaps) and on the possible degradation of the data itself. It is intended for the Data Users to understand references to anomalies in the weekly reports.

For further information on the anomalies, please consult the MoM of the Anomaly Review Boards regularly held.

CMN Unlock with wrong relocking.

Description

This anomaly was impacting shortly after launch the A2 CMN of the redundant Arm, known before launch to be a lazy one. It consisted in the CMN local oscillator moving away from the common frequency, and not regaining after the event a common frequency to the rest of the instrument CMN's. It has not been seen since January 2010, once the arm was moved to the nominal branch.

Geolocation

The anomaly tends to occur at high or low latitudes, or over the South Atlantic Anomaly.

Likelihood

Before arm swap to nominal, on the 11th of January 2010, the event happened 5 times in 40 days, thus making it quite likely. It has not been seen again in any other CMN. It is believed that there is a correlation among the CMN unlocks and the eclipse season, for SMOS in the period November to January.

Data generation

The anomaly does not create data gaps.

Data degradation

The anomaly degrades heavily SMOS data, making all the baselines from the affected segments unusable.

Recovery impact

The recovery found before arm swapping was to power off and on the arm. This is now procedurally handled by FOS/CNES, with less than 1 minute data gap created.

CMN Unlock with proper relocking

Description

The CMN's of MIRAS may loose temporarily lock in their Local Oscillator, but regaining again the required frequency.

Geolocation

The anomaly tends to occur at high or low latitudes, or over the South Atlantic Anomaly.

Likelihood

This has happened 72 times so far in the mission (up to Feb 2013), including also the A2 unlocks into wrong frequency. There is no definite conclusion on the date likelihood of these events, however it seems like the period from early February (i.e. end of eclipse season) to end of April (SMOS Spring equinox) seems to be regularly free of them..

Data generation

The anomaly does not create data gaps.

Data degradation

The anomaly creates direct degraded data for a short period (typically less than 10 seconds), but should occur during one of the calibrations (long, NIR Ext, FTR) it would spoil it and force to repeat it. However, it is agreed that since the processor is calculating the spline using consecutive samples, and the current LO Calibration taking place every 10 minutes, a degradation of 10 minutes is assigned upon each event case.

Recovery impact

No recovery is required.

False Temperature Acquisitions by CMN-6 (B1)

Description

The CMN-6 (segment B1) has shown to acquire false temperature from the different channels (Licef, Reference Temperatures, NS, PD, others), first noticed end of May 2010. The reoccurrence of the event in January 2011 was deemed as permanent, after several days, leading to a reconfiguration of Arm B to the Nominal side.

Geolocation

No clear geolocation correlation has been identified for this anomaly.

Likelihood

This anomaly has been found happening at the end of May 2010, reoccurring at least 4 times in a period of 10 days. Later on, in the last day of December 2010 and beginning of January 2011, it reoccurred on the same segment, staying this time permanent after several glitches. However, such an event was not seen in any other CMN, and after the event in Jan 2011, the complete arm B was changed to Nominal side, thus selecting different CMN unit.
Pending further assessment, it can be derived that the anomaly was linked to B1 redundant, and should not happen in other units.

Data generation

It does not create data gaps.

Data degradation

The data affected is seriously degraded, since the temperatures are used in the data processing, but furthermore, since at least in two of the cases the physical temperature of the segment has deviated significantly from the other segments.

Recovery impact

The January event imply a Power Off/On of the instrument, with some data loss. However, should this anomaly ever reoccur on other segments, the recovery has to be assessed by an ARB and is not quantifiable here.

Mass Memory Partition Latchup

Description

The instrument Mass Memory is implemented as a collection of 12 partitions (each composed of 8 SDRAM chips). Each partition is protected against current peaks by means of a latchup mechanism, that powers it off in case of over current.
A failure in the Application SW of MIRAS is causing that a latched up partition is not properly recognised, thus leading to a blocked situation that could stop both data writing and reading from the mass memory once the end of the “logical” MM is reached, not matching this “logical” pointer values with available “physical” ones.

Geolocation

The anomaly tends to occur at high or low latitudes, or over the South Atlantic Anomaly.

Likelihood

76 suspected latchups have occurred so far (14/02/13). There does not seem to be a grouping effect, the latchups are more or less spread in time, and also affect different partitions on board. All of them have been impacted at least twice on the mission.

Data generation

A latchup may or may not have impact on the data generation, creating a gap sometimes. This depends on the pointers (write and read) position at the time of the latchup. The worse situation could be the loss of the data sensed On Board since the last X Band Dump, that is around 100 minutes, in the case of latchup on the partition being written and not having been read.

Data degradation

No data degradation is caused by the latchup. However, the L0 DPGS processor may find some anomalous cases of data disordering that could delay the data production.

Recovery impact

Since January 2011, a recovery mechanism is in place for the Latchups that does not require a CCU reset. In cases of partitions latched other than 0, no data is lost through this process. In the case of P0 around 10 minutes of data will be lost, due to pointer reconfiguration and the need to execute the recovery after an X Band dump, thus losing data acquired over it.
Also, a volunteered reduction in the MM used size (wrapping around after 9 partitions instead of 12) prevents the data generation blocked situation, allowing a maximum of 3 latchups in non working days.

Autonomous CCU resets

Description

The MIRAS central processor, CCU, may suffer from autonomous resets. This causes that the instrument looses the routine configuration, among other impacts.

Geolocation

All the resets seem to be linked to the end of an X Band dump or to the end of the MM during one dump Therefore they are geolocated around the SVAL and VILS visibilities, on the northern hemisphere.

Likelihood

31 CCU resets have happened in the mission (14/02/13). The proportion of cases over ESAC or SVAL matches quite well the split of daily passes among both ground stations.

Data generation

The CCU reset generates gaps since the write and read pointers of the Mass Memory are reset to 0. Therefore, data sensed since last X Band dump may be lost (up to 110 minutes in the worst case).

Data degradation

A new On Board SW is used since Oct 2011, such that the instrument default after a CCU reset is now Full Pol and Local Oscillator calibration performed every 6 minutes. However, the downlink is in Auto mode, with only dumps over ESAC. Therefore, no data degradation is expected but the NRT timeliness is impacted until the service is resumed at the first available working hours in working days by MIRAS reprogramming.
A CCU reset could also impact the foreseen calibrations (External NIR, Long or PMS Offset) in the sense that they are lost in the programming and cannot be re-scheduled with the reprogramming in case its execution was foreseen from CCU reset time to reprogramming slot. The agreement is that they will be performed on the following week.

Recovery impact

The recovery of the CCU reset involves also disabling of chip 6 in MM partition 3. The current operational agreement with CNES is that this will be done at working times 7 days per week. Therefore, if this is done after this chip has been written (i.e. around 11 hours from CCU reset) but before its data has been dumped, this may cause another 20 minutes of data gap belonging to that chip.

Platform Manoeuvres

Description

Under certain circumstances, the platform will have to performed either planned (i.e. orbit maintenance, gyro calibration) or unplanned (collision avoidance) manoeuvres, that will cause MIRAS to be out of its nominal pointing.

Geolocation

Not applicable.

Likelihood

The orbit maintenance manoeuvres are planned a maximum of twice or 3 times per year. It is estimated that the Collision Avoidance should happen once per year (so far 6 in the mission at 14/02/13). The Gyro Calibration, lasting 1 full orbit, has been executed twice so far.

Data generation

No gaps should take place in data generation, since part of the procedure for such manoeuvres is to stop the on board queue and therefore do not transmit data to ground out of pointing. However, the NRT service could be briefly affected.

Data degradation

The data acquired during the manoeuvre will be flagged in external attitude. The LO will still be the routine 10 minutes one, currently using the same sequence as the LO in nominal pointing mode, and the instrument mode will be set to Full Pol.

Recovery impact

The OCM’s and collision avoidances last typically around 30 minutes. The Gyro Calibration lasts one orbit (around 100 minutes).

Mass Memory data gaps

Description

In the early mission it was found that a faulty portion of the Mass Memory (P3 chip 6) was creating small gaps (of less than 1 epoch) in the TM downloaded. Once this has been sorted out, it has been noted that the MM wrap around (around every day in Full Pol mode) also generates data gaps of the same extent, keeping some packets from the last write on the upper portion of the MM.

Geolocation

Not applicable

Likelihood

Around once every day, in the case of the MM wrap around gap.

Data generation

Impact is missing 1 epoch (i.e. 1.2 seconds) every day of current data, with old data transmitted instead.

Data degradation

No data degradation.

Recovery impact

No applicable recovery.

Mass Memory Double Bit Errors

Description

The mass memory data storage may suffer bit flips. The single flips are corrected by on board scrubbing, however the double (i.e. 2 bits wrong in the same 16 bit word) are not corrected.

Geolocation

No correlation to geolocation

Likelihood

Only 8 cases detected in the mission.

Data generation

No impact.

Data degradation

At least one word of data is wrong. Depending on the position, it may have an impact ranging from undetectable to creating a false packet, possible trapped by the DPGS processing or SPQC.

Recovery impact

No recovery foreseen, event is reported to CEC by FOS.