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# Swarm Alpha on-board anomaly registered on 18 October 2020

# Analysis of impact on data products

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| **Prepared by** | **Enkelejda Qamili, Filomena Catapano, Christian Siemes** |
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# 1    INTRODUCTION

## 1.1    Scope

This document describes the impact assessment on the Level-1 (L1B) and Level-2 PDGS (L2-Cat2) data products, as well as Level-2 acceleration, density and orbit data products, due to the on-board anomaly registered on Swarm Alpha on 18 October 2020 at 11:48 UTC. The first symptom of such anomaly was found due to corrupted Science packets received on ground. After in-depth investigations, the ESA Swarm Flight Operations team confirmed that the issue was caused by a malfunctioning of the on-board telemetry module. On 29 October 2020 the Swarm Alpha instruments have been switched on and a work-around has been put in place in order to receive uncorrupted science data by merging them into the house keeping data file. Presently, the Swarm ground segment team is working to adapt the Swarm data processing software in order to properly handle the modification introduced in the data file structure.

In summary, due this anomaly we have registered:
-   around 10 days of permanent gap in Swarm Alpha L1B data (from 18 to 28 October 2020).
-   a delay for generating and distributing the Swarm Alpha L1B from 29/10/2020.

In the following, it is provided an analysis of impact on Swarm L1b science products.

# 2    ACCELEROMETER

Accelerometer data products (ACCxCAL, DNSxACC) are <u>not affected</u> since we only process Swarm C data. The Swarm A accelerometer measures practically the same acceleration signal than Swarm C (since they fly so close to each other), but gives twice as noisy measurements that are much more contaminated by artefacts such as spikes and cross-axes couplings.

# 3    GPSR

GPS receiver products have a <u>small impact</u>:
-   Precise orbits (SP3xKIN, SP3xCOM) are used for gravity field model estimation (EGF_SHA). All satellite measure the same gravity field, so this should work like simple a reduction of the number of the measurements.
-   GPS tracking data is also used for observing mass density along the orbit. (ACCxPOD, DNSxPOD). Since Swarm A and C are so close to each other, they measure practically the same signal. Since we still have Swarm C, the impact here should be negligible.
-   Also for TEC (TECxTMS) we have the situation that Swarm A and C see the same GPS satellites. Here, however, one could probably use the common measurements to study the spatial extent of plasma irregularities.

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- For the optimization of the L2 PLL tracking loop bandwidth, since the solar activity is still very low, we do not expect a significant difference in the measurements between Swarm A and C. This is not expected to change in the next half year at least.

# 4    STAR TRACKER

Star Tracker products have <u>no impact</u>

# 5    MAGNET

ASM data will have a <u>negligible impact</u> on:
- Mapping of ASM measurements from Swarm Alpha to Swarm Charlie location: the ~10 days permanent gap will not affect the calibration of VFM data of Swarm Charlie.

ASM and VFM missing data will have a <u>small impact</u>:
- L2 Cat-2 data production: IBI (IBIxTMS) and FAC (FACxTMS and FAC_TMS). These two processors use MAGNET L1B data as input. Therefore, a failure of IBI and TEC during the affected time window is expected. Nevertheless, since A and C fly close together, they measure almost same geophysical phenomena. Thus, during the anomaly we will rely on warm Charlie data.
- The data gap is not expected to impact significantly the Swarm L2 magnetic field models. Nevertheless, each L2 product partner, has been required to do an complete assessment on the impact such Swarm Alpha data gap will have in their data production chain.

# 6    PLASMA

LP data gaps will have a <u>small impact</u>:

- IBI L2Cat2 data production. The IBI processor uses the EFIx_LP_1B data as inputs. Thus we expect a failure of the IBI production due to Swarm A data gaps

TII operation on Swarm Alpha will be coordinated between University of Calgary and FOS. Currently the TII sensors are in ready state on Swarm A. This will generate data gaps in the related TII products delivered as external dataset under the "/Advanced/Plasma_Data" folder in the ESA dissemination server. Also the Faceplate density will not be computed as long as the TII will be in ready state.

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