Summary

Swarm's Absolute Scalar Magnetometers (ASM) provide absolute scalar measurements of the magnetic field with high accuracy and stability on the three satellites of the mission. These ASMs nominally run at 1 Hz. But they can also run at 250 Hz frequency using a so-called "burst" mode. This possibility has been taken advantage of during commissioning, the burst mode having been run simultaneously on all three satellites over several days. These burst mode sessions were driven by the engineering need to explore the high frequency spectral content of the signal measured by the ASMs, to identify issues that could affect not only the nominal 1 Hz scalar data but also the 1 Hz vector data that the ASM simultaneously deliver on an experimental basis (see Poster EGU2014-8749). In the near future, these burst mode data will also be used to look for meaningful high frequency geomagnetic signals.

Instruments within operating temperature range (panel 3). Fortunately, none of the issues affected the nominal 1 Hz scalar data of the mission.

Impact of the piezo-electric motor activation

Identification of the issue

- An outlier (large value of dB/dt) may occur in Burst data each time the ASM piezo-electric motor is activated.
- Most of them (98.4 %) occur at most 3 s after the motor activation.

Correction in the Burst mode

- The Burst data can easily be cleaned of the piezo-electric motor effect using a linear interpolation.

Impact on the nominal 1 Hz data

- When running in nominal 1 Hz mode, the piezo-electric motor may also be expected to perturb the data.
- However, a differential test done with two RMN magnetometers and the EQM ASM model available on ground has shown the impact to be less than 10 pT on the nominal scalar data.
- In contrast, unfortunately, a significant impact is found in the experimental 1 Hz vector data that the ASM simultaneously delivers (on an experimental basis, see panel 5 in Poster EGU2014-8749).

Impact of heaters activation

Identification of the issue

- The ASM heaters are powered by a 58 kHz square signal that may interfere with the radiofrequency used to detect the resonance frequency f (recall panel 1). This can be expected to happen every time the magnetic field to be measured is close to:
  \[ B = B_0 \ast (1 + 2 k) \]  \( k \in \mathbb{N}, B_0 = 2069.5 \text{nT} \)

- Indeed, characteristic anomalies signals are detected:
  - Those signals occur only when interferences are expected (note however that interferences do not always lead to a detectable signal).
  - Those anomaly trains can last significant amount of time (most often a few seconds but sometimes 3 minutes).
  - For the time being, we simply replaced them by a linear interpolation (replacing the signal by "silence").

Impact on the nominal 1 Hz data

- When running in nominal 1 Hz mode, these interferences may also be expected to possibly perturb the data.
- However, implementing the filter of the 1 Hz mode to the Burst mode data shows the impact to be within the range of a few 10 pT at most.
- Note that such interferences also have little impact on the experimental 1 Hz vector data.

Checking the remaining noise level at the frequencies used to produce the experimental 1 Hz ASM vector data

- The experimental 1 Hz ASM vector data are produced with the help of 3 sets of coils that generate periodic magnetic fields with known amplitudes at the three known frequencies, 7.92 Hz, 10.98 Hz and 12.97 Hz (see panel 1 in Poster EGU2014-8749).
- This requires the natural geomagnetic noise to be within the 1-pT/Hz range at these frequencies.
- This can be seen to essentially be the case, at least on this day.

Conclusion & Prospects

- Analyzing the Burst mode data revealed perturbations produced by the piezo-electric motor and the heaters.
- None of these perturbations affect the nominal 1 Hz scalar data.
- Only the piezo-electric motor produces a significant perturbation in the experimental 1 Hz vector data (see Poster EGU2014-8749).
- The background geomagnetic noise level is compatible with experimental 1 Hz ASM vector measurements.
- Corrected Burst mode data can now be used to look for meaningful high frequency geomagnetic signals.