

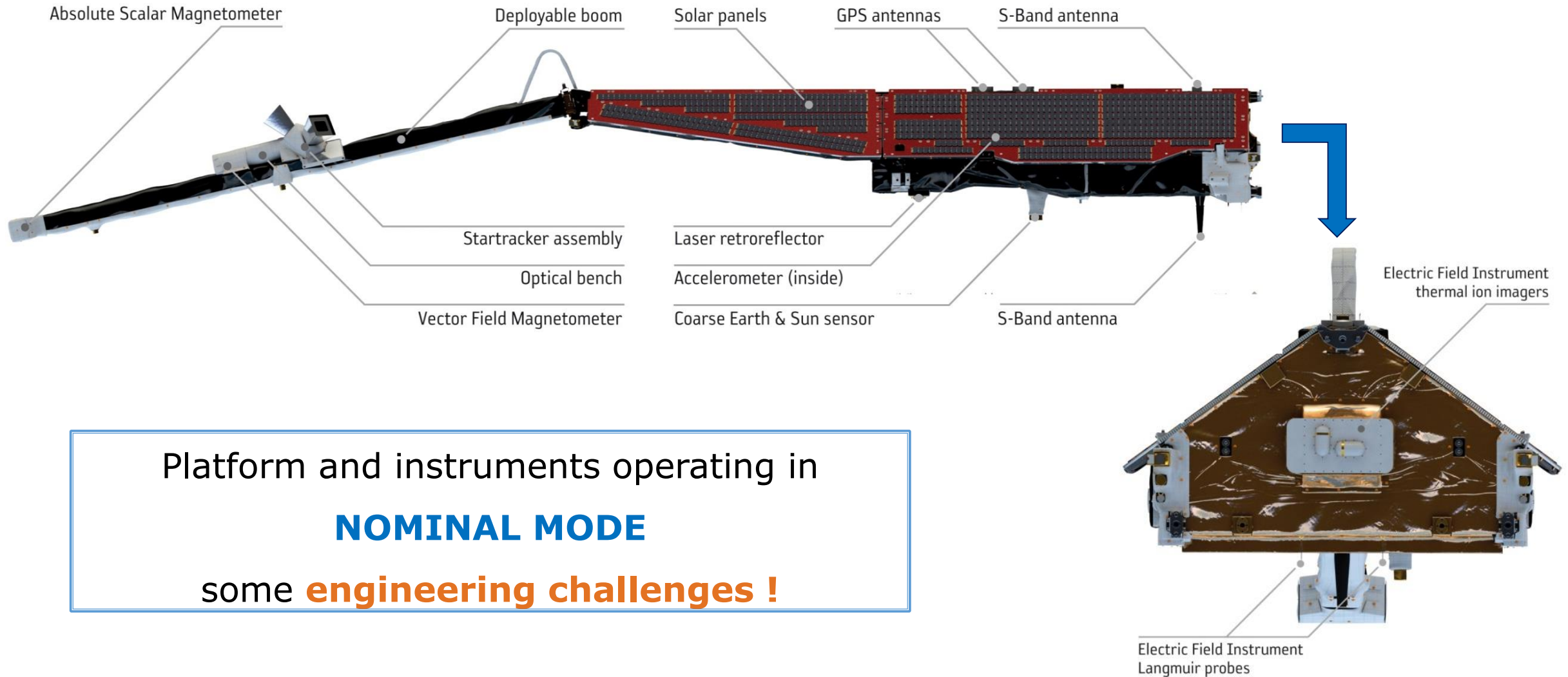
Six years of Swarm: instruments status and data quality

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The Star Tracker (STR) instruments on-board the three Swarm spacecraft operate nominally, delivering high-quality pointing data at 1 or 2 Hz rate.

Recent achievements:

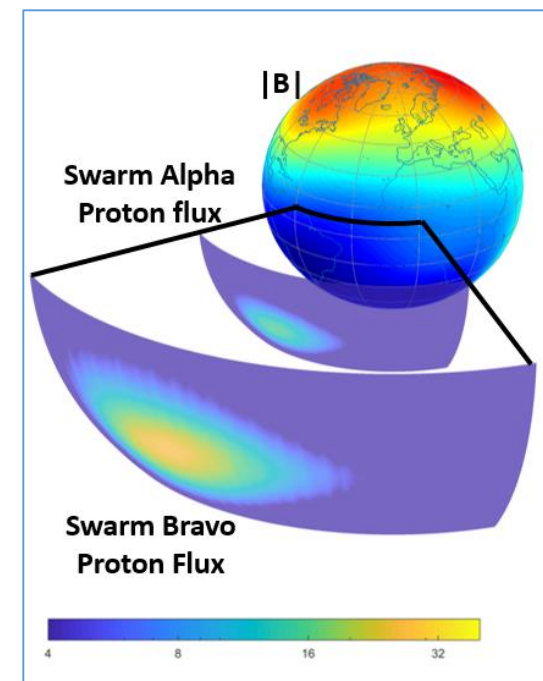
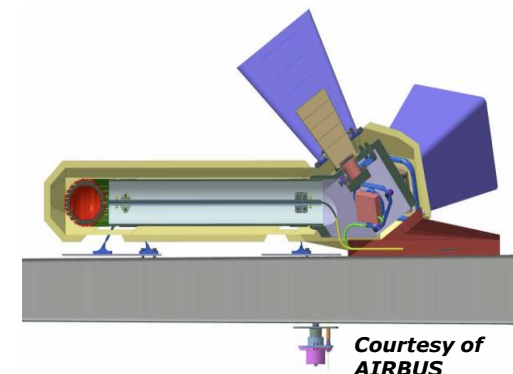
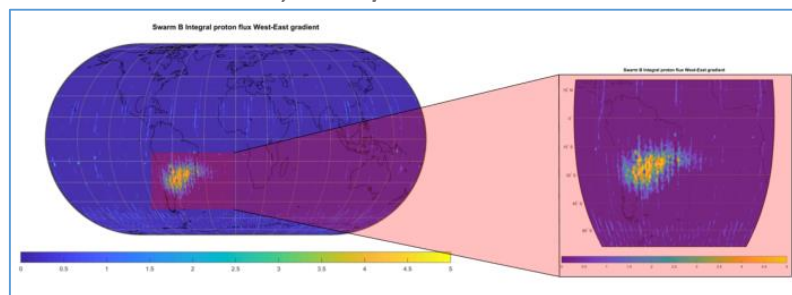
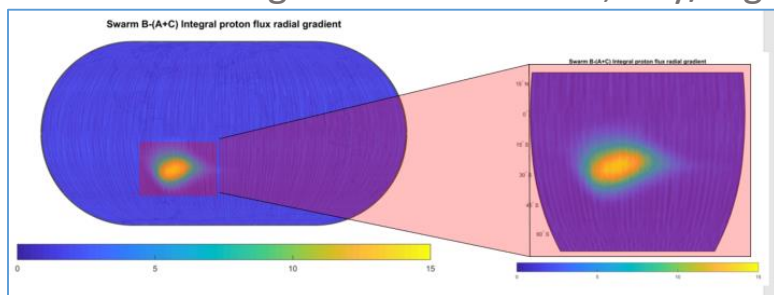
- Increasing of STR Frequency from 1 Hz to 2 Hz in all three spacecraft in end-2018
- STR used as particle detector, by counting the number of hotspots, since March 2018.
- Improve the combination of the three STR attitude quaternions into the combined attitude solution

Future prospective:

- The processing of Swarm radiation data will be soon performed in the operational L1B data processing chain.

Example of STR measurements:

- The first results of the radiation monitoring performed by STR instruments are very encouraging, i.e., clear vertical gradient of the SAA; Day/Night side flux differences; East/West flux differences.



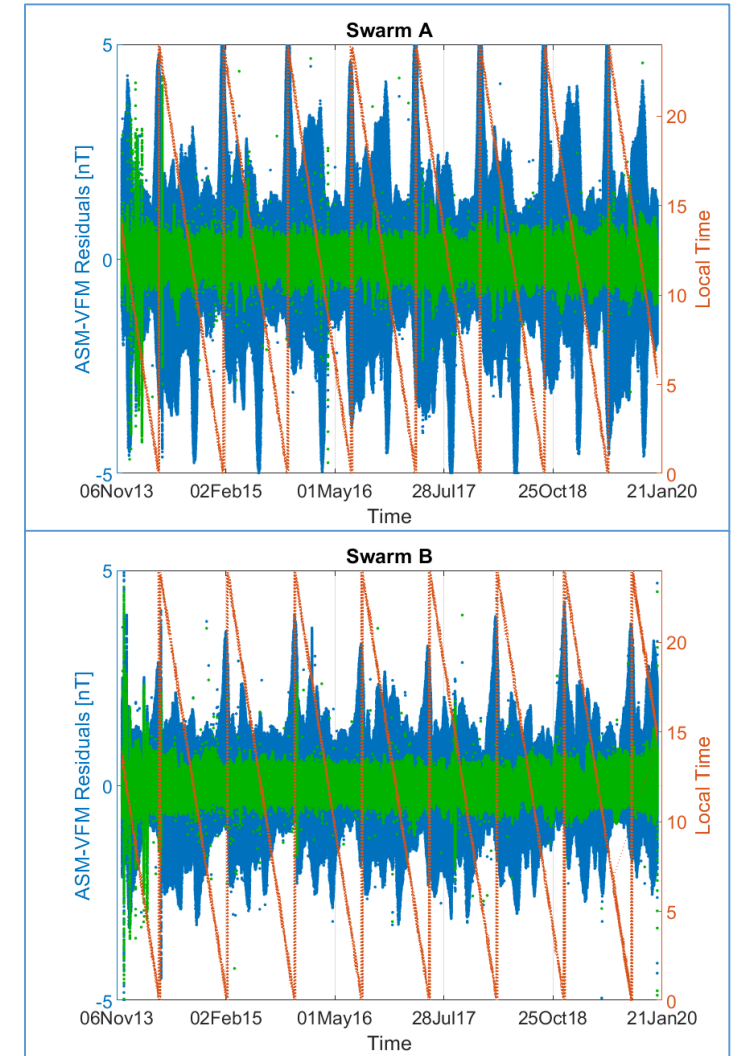
The Vector Field Magnetometer (VFM) instruments on-board the three Swarm spacecraft operate nominally, delivering high-quality vector magnetic measurements at 50Hz rate.

Recent achievements:

- The improved SH model (dB_Sun), deployed in operations in Sept. 2018, continuous to perform very well!
- Introduction of in-flight calibration parameters independent from pre-flight calibration parameters
- For Swarm Alpha and Charlie, the VFM scaling that changes with time, i.e., s_t , has been slightly adjusted from 2018-01-01 onwards.

Example of dB_Sun correction model performance:

- The introduction of the dB_Sun correction model decreased the differences between ASM and VFM data significantly for the whole mission period. Figures on the right show the scalar residuals of uncorrected (blue) and corrected (green) measurements as a function of time. Local time of the ascending node is shown in red (right axis).





Absolute Scalar Magnetometer



The Absolute Scalar Magnetometer (ASM) instruments on-board Alpha & Bravo operate nominally in Vector mode, delivering high-quality scalar magnetic measurements

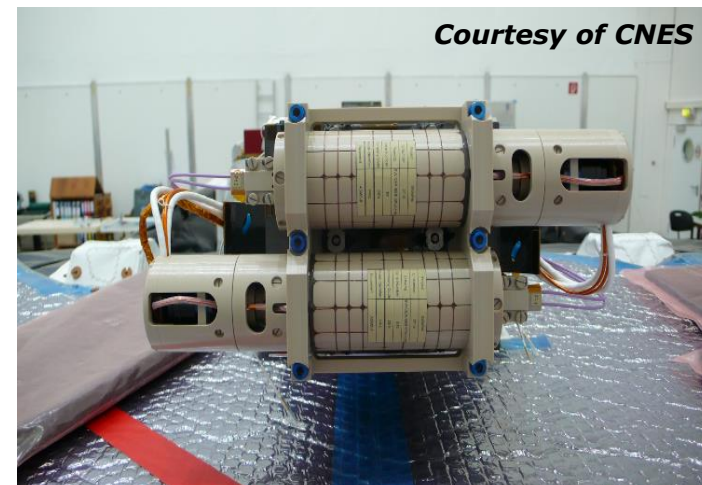
No ASM operating anymore on Charlie (since 5th November 2014)

Recent achievements:

- ASM instruments on-board Swarm spacecraft set in Burst mode more frequently, i.e., scalar measurements at 250 Hz frequency rate. Continuous 1-week / month of ASM Burst sessions are being performed.
- The Swarm L1B ASM algorithm is adapted to read also the L0 ASMxBUR_0_ file, and produces the 1Hz magnetic field intensity derived from the ASM and stored in in MAGx_LR_1B and MAGx_CA_1B.

Future prospective:

- ASM 250 Hz science data have been processed and soon will be distributed through ESA ftp server to all the Swarm users.
- Since the beginning of the mission, the ASM instruments have simultaneously produced vector data (ASM-V) that are independent from the core L1B VFM data. Soon, an improved ASM-V dataset will be distributed through ESA ftp server to all the Swarm users.



Early in the Swarm mission it was recognised that the measurements from the two magnetometer instruments (ASM and VFM) on-board each spacecraft measure slightly different absolute magnetic field values. This effect is highly correlated with the Sun incident angle with respect to the spacecraft [Tøffner-Clausen et al., 2016].

Recent achievements:

- On-ground magnetic survey focused on the analysis of thermoelectric currents was performed.
- The observed perturbation is likely due to a thermoelectric current flowing in the thermal blanket of both VFM and ASM instruments.

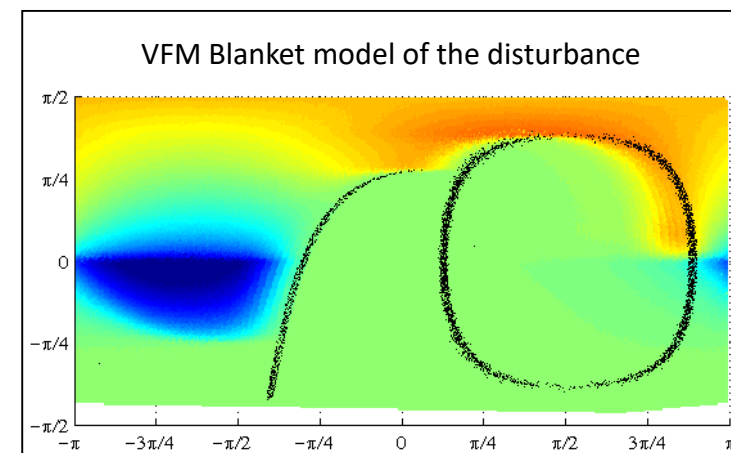
Future prospective:

- The Expert Group is working to build a physical based ΔB_{Sun} correction model considering all the outcomes from tests performed on-ground.
- The new physics-based correction model will consist in two different models:
 - One for the VFM instrument (disturbed in all the three directions, X, Y and Z)
 - One for the ASM instrument (disturbed almost exclusively in the Y direction).

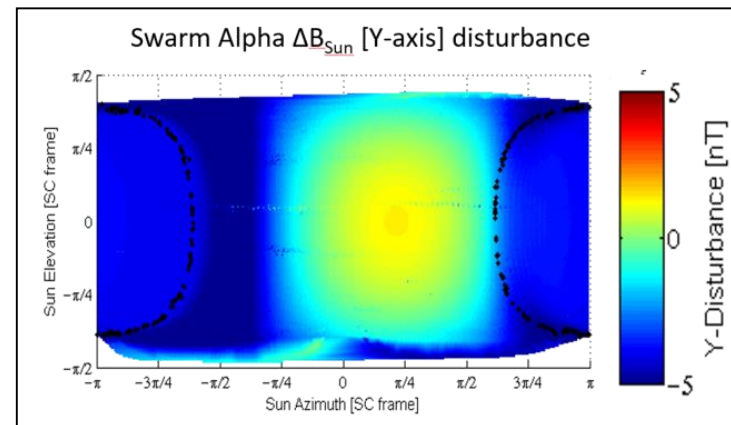
Example of new correction models measurements:

- Some progress done in building a physics-based compensation model for the ASM and VFM instruments.

Swarm Alpha ΔB_{Sun} [X-axis] disturbance



Swarm Alpha ΔB_{Sun} [Y-axis] disturbance



The two Langmuir Probes (LPs) on-board the three Swarm spacecraft, operate nominally, providing nearly continuous measurements from beginning of mission till present.

Recent achievements:

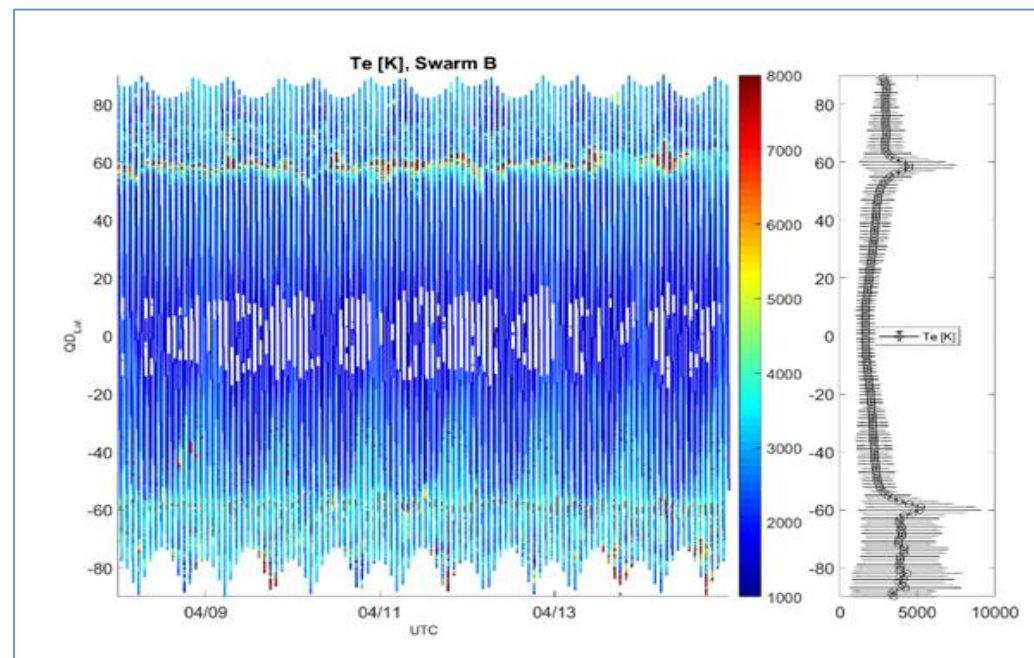
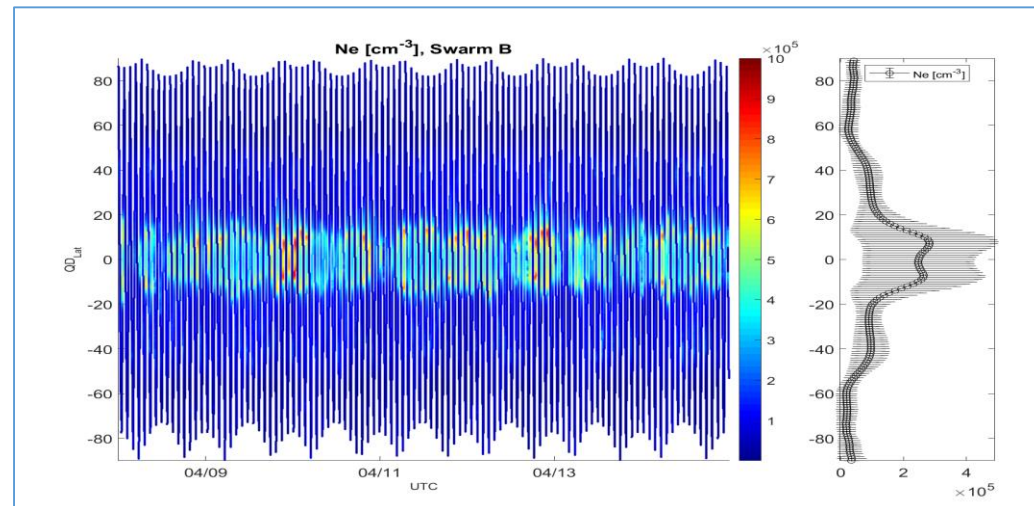
- Currently, the Plasma processor does not use magnetic field data as an input. Decoupling plasma and magnet processors allowed to have plasma data, even when magnetic field data are not available. Thus, it was possible to recover the data gaps registered in the past.

Future prospective:

- The computation of the error variables will be introduced by using the results presented in Lomidze et al., 2018
- The Flag tables will be reviewed in order to simplify the point-by-point data quality information

Example of LP measurements:

- Plasma density and electron temperature measured by Swarm B between 8-15/04/2018, as a function QD-Lat and time. Vertical lateral panels show the average and standard deviation for each degree in latitude.



Scientific data are obtained by the Thermal Ion Imager (TII) only during specific orbit per day. In particular, 8 orbits/day for Alpha and Bravo, and 2 orbits/day for Charlie. This is due to an instrumental anomaly that the Team is investigating with the scope to continuously improve the TII data quality. Indeed, more than 83 dedicated meetings took place to date.

Recent achievements:

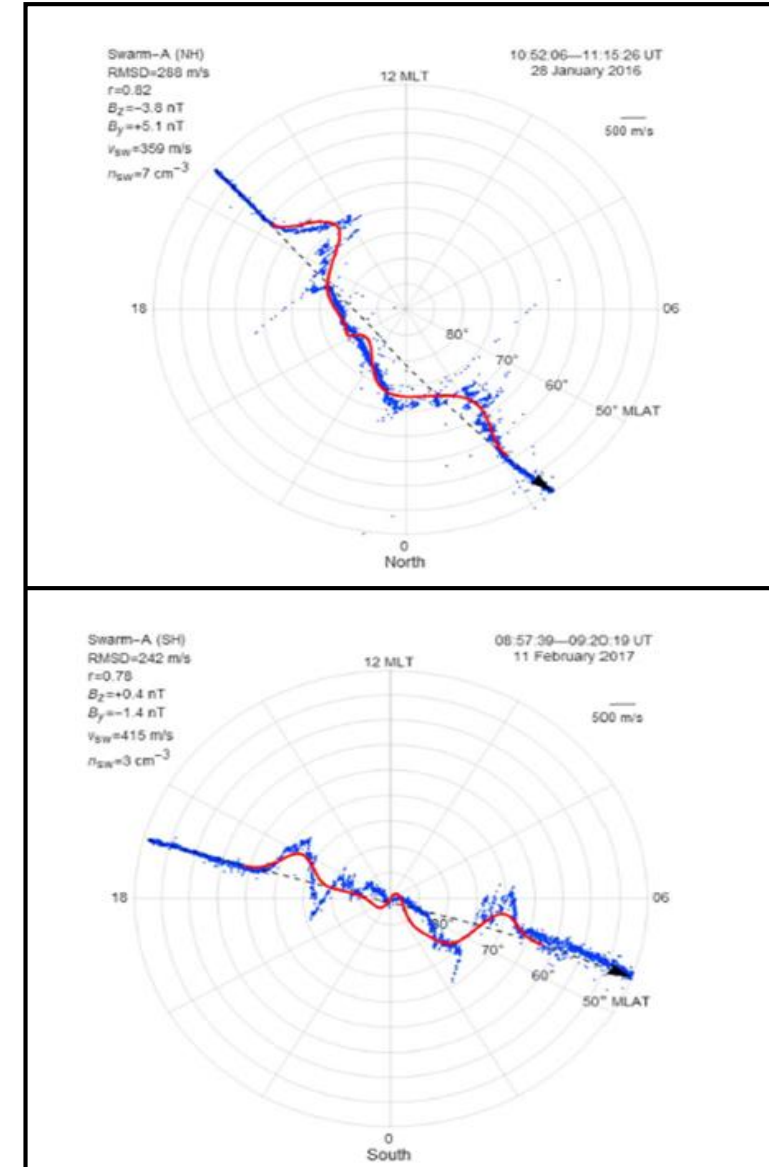
- New TII cross-track dataset (TIICT 0201) has been delivered for all the Swarm spacecraft. The dataset covers from Dec 2013 to Dec 2019.

Future prospective:

- To increase the data coverage by improving the scrubbing technique to be tested on a ground equipment.
- To improve the algorithm for the vertical ion drift component.

Example of TII measurements:

- Swarm-A horizontal cross-track ion flow velocities (blue points) and corresponding results from the Weimer 2005 model (red solid lines) for the NH and SH. The path and direction of the satellite's motion is indicated with the dashed arrow. The IMF condition are reported on the top left.



The Accelerometer (ACC) instruments on-board the three Swarm spacecraft continue to be affected by various perturbations.

Recent achievements:

- The following artefacts with the largest negative impact on ACC data quality are corrected in the L2 ACC data processing

Steps

Temperature-induced bias fluctuations

Spikes

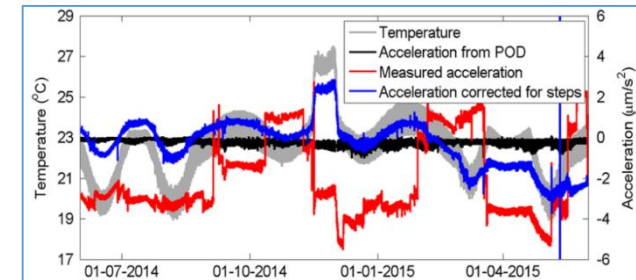
Future prospective:

- The correction of the following artefacts is under implementation in the ACC L2 data processing chain

Coupling between accelerometer axes

Harmonic aliasing artefacts

- Yet another artefact affecting the ACC data, i.e., polarization voltage jitter, not yet corrected in L2 data.



Calibrated Swarm C along-track acceleration and thermosphere density data available for Feb 2014 - Nov 2019

- Extension of Swarm C time series is highest priority
- Experimental dataset of calibrated Swarm C cross-track accelerations released (ESA ftp → /Advanced/Accelerometer/...)
- Processing of Swarm A along-track accelerations and thermosphere density in preparation
 - Since Swarm A and C are flying close by, the acceleration signal is practically identical → joint Swarm A and C interpretation helps to distinguish between geophysical signals and instrumental artifacts

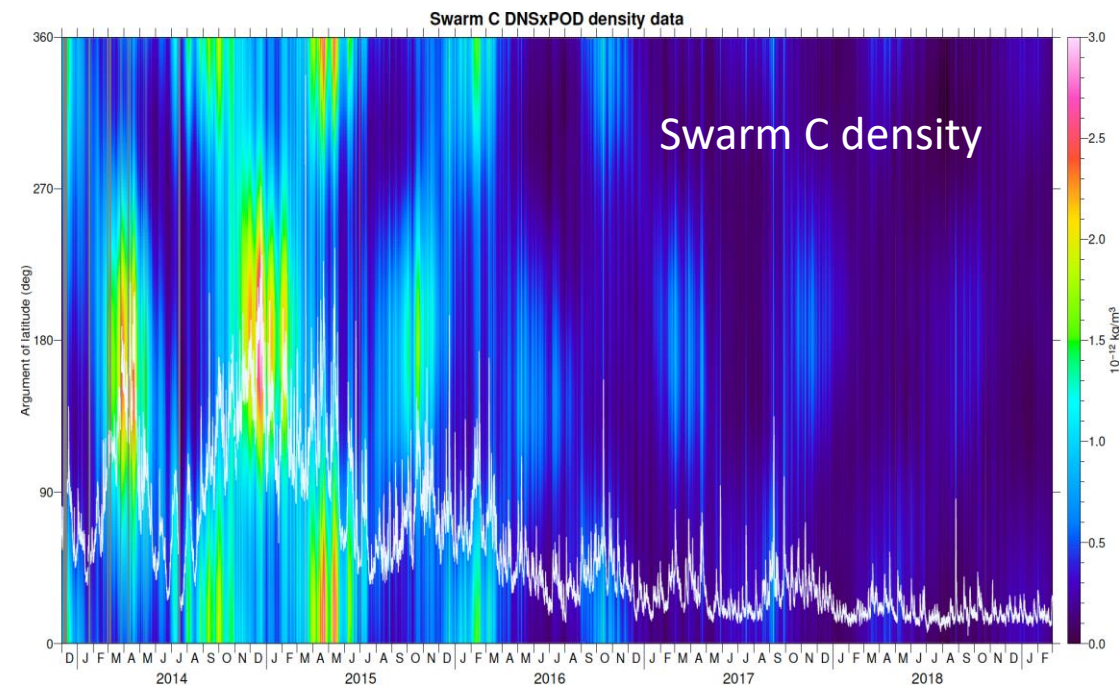
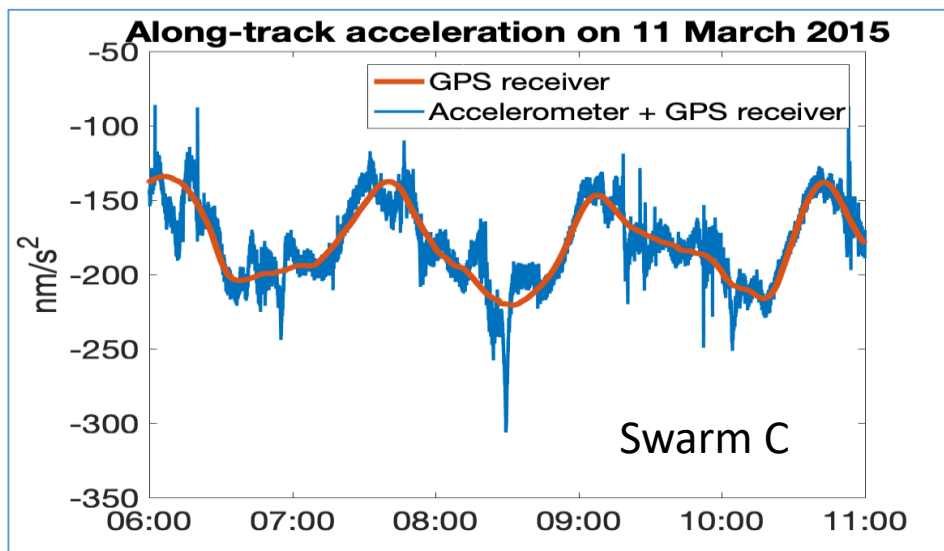
The GPS Receiver (GPSR) instruments on-board the three Swarm spacecraft continue to operate very well, delivering high-quality data.

Achievements:

- The Swarm POD data are at cm-level accuracy, e.g., Swarm POD data used in project “Swarm as a gravity field mission”

Example of GPSR measurements:

- The good quality of Swarm GPSR data allowed the derivation of non-gravitational acceleration (= lifeline for accelerometer) and thermosphere density as an independent product with resolution of 15 minutes along the orbit.





Swarm Data Access



In accordance with ESA Earth Observation Data Policy, all Swarm Level 1b and Level 2 products are freely accessible to all users via anonymous access.

All Swarm data can be downloaded :

- via HTTP browser at:
<http://swarm-diss.eo.esa.int>
- via an ftp client at:
<ftp://swarm-diss.eo.esa.int>

More info:

<https://earth.esa.int/web/guest/swarm/data-access>


European Space Agency



Swarm Data Access

The access and use of Swarm products are regulated by the [ESA's Data Policy](#) and subject to the acceptance of the specific [Terms & Conditions](#).
Users accessing Swarm products are intrinsically acknowledging and accepting the above.

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Name	Modified	Size
 Advanced	Apr 21, 2020 12:24 PM	--
 #CASSIOPE_e-POP	Apr 26, 2020 6:00 AM	--
 #CryoSat-2	Dec 4, 2019 3:00 PM	--
 Level1b	Jun 5, 2019 1:53 PM	--
 Level2daily	Jun 5, 2019 2:23 PM	--
 Level2longterm	Jun 13, 2019 12:28 PM	--

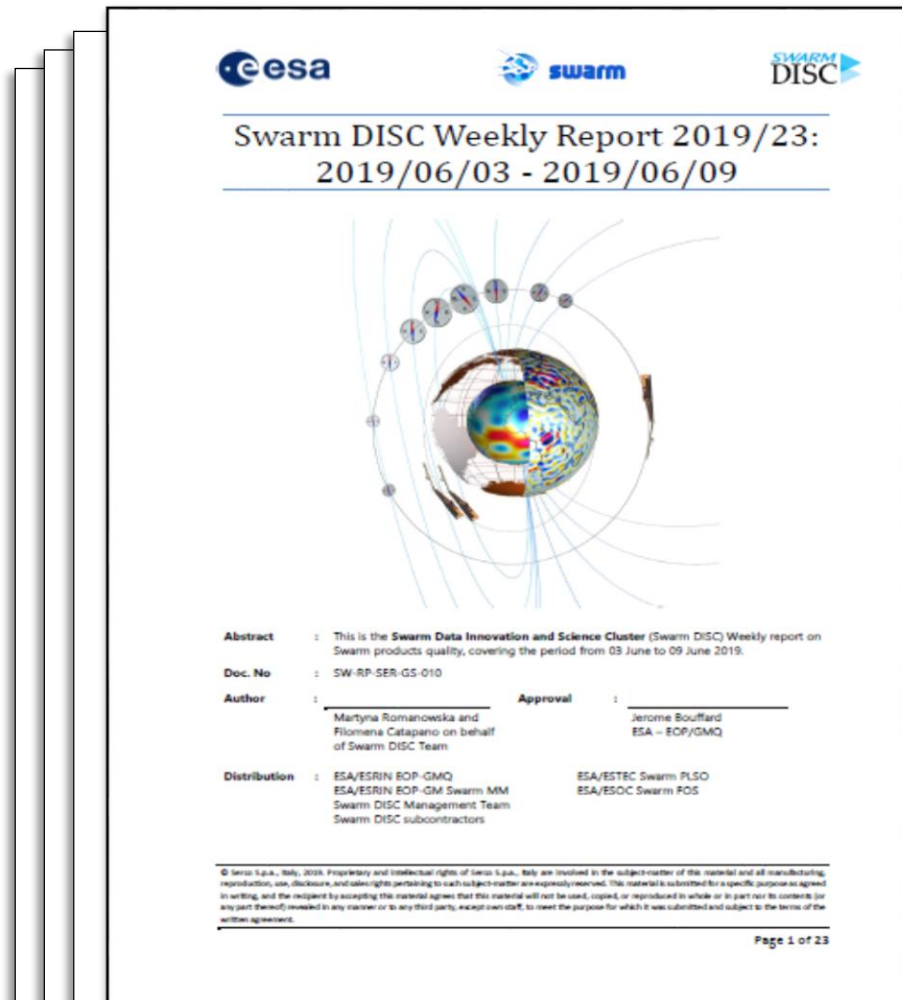
ESA European Space Agency



Swarm L1B data quality information

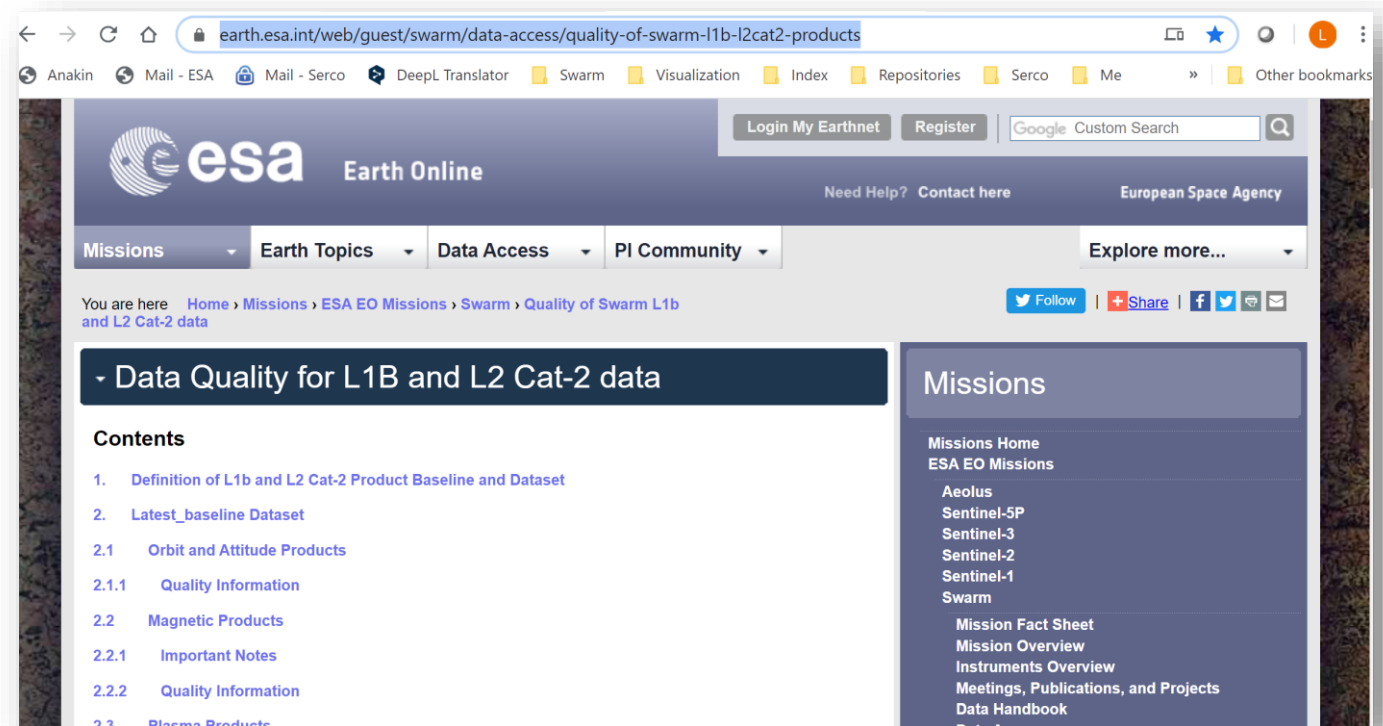


Swarm Data Quality Report



<https://earth.esa.int/web/sppa/mission-performance/esa-missions/swarm/weekly-quality-reports>

Quality for L1B and L2 Cat-2 data



<https://earth.esa.int/web/guest/swarm/data-access/quality-of-swarm-l1b-l2cat2-products>

Six years of Swarm: instruments status and data quality

Hello everyone

This presentations provides an overview on the Swarm instruments status and data quality:

Overall, the Swarm Platform and most of instruments operate in nominal mode. Still some engineering challenges.

Most of the instruments deliver high-quality measurements at different frequency rate.

On Data Quality: Few minor improvements introduced recently in the Swarm L1B processing chain, but overall, the quality of Swarm data remains excellent.

Some recent achievements: STR operating as