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The 13th Swarm Data Quality Workshop

Summary and Recommendations Report

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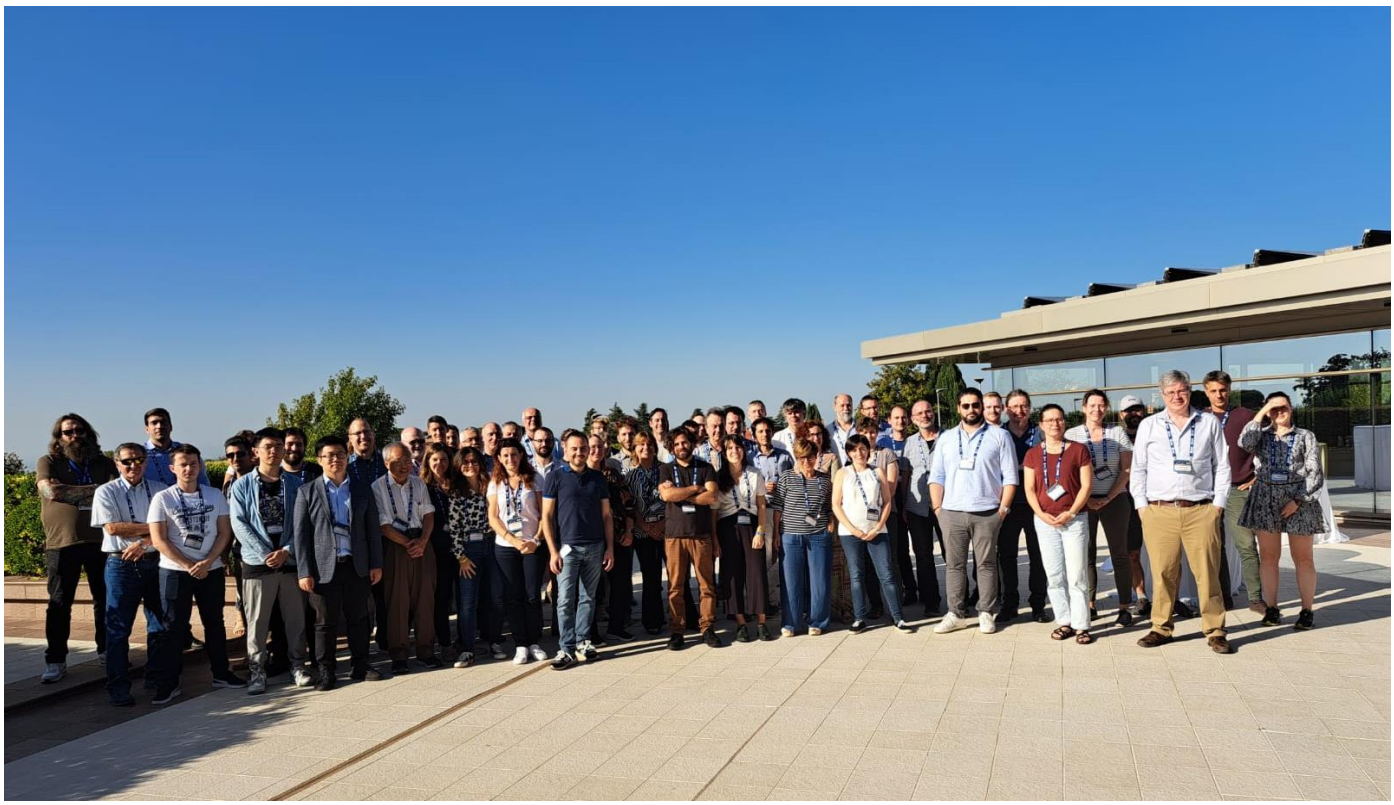

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1 CONTEXT AND MEETING SCOPE

The Swarm Data Quality Workshop (SDQW) is a yearly event organized by ESA and the Swarm data quality team with the participation of multidisciplinary scientists and instruments' experts. It focuses on innovative ideas for future Swarm-based activities and products, targeting new processing algorithms, correction improvements, emerging applications, and multi-mission synergies. The 13th edition was held in ESA-ESRIN Frascati, Italy, from 10 to 12 October 2023. The event reached the participation of more than 120 scientists (with about 85 of them joining in person) from different institutions in Europe, America and Asia.

The scope of this document - based on contributions from SDQW#13 sessions chairs- is to summarize the main points discussed during this workshop and compile key user recommendations and feedback, which should be translated into future Swarm-based product evolutions, services, and scientific activities.

This year's SDQW focused mainly on Swarm Data Cal/Val (Calibration and Validation) topics, while most of the other Swarm-based science and applications aspects will be more extensively discussed during the upcoming Swarm 10th Anniversary and Science Meeting, that will be held from 8 to 12 April 2024 at DTU Space (Copenhagen, Denmark, https://www.swarm-anniversary-and-science.org/).

During the 13th SDQW the community had the opportunity to further discuss on key technical challenges, on new Swarm products and science topics related to Internal/external field variations and applications in the areas of Near-Earth Space Sciences and Space Weather.

A key objective of the workshop, based on these interactions, is to compile recommendations (see **Section 3** of this report) in view of reshaping the content of the Swarm data product portfolio, identifying new data products and services based on Swarm enhanced synergy with other satellite missions and ground-based observations. The workshop is also instrumental in demonstrating the growing importance of Swarm-based virtual research environment used to support and innovate data processing approaches, as well as in collecting inputs for the optimization of the orbital constellation. To achieve these goals, the SDQW#13 was structured in 7 sessions including large time slots for discussions and brainstorming (see detailed agenda in **Appendix I**):

- Session 1: Mission overview
- Session 2: Magnetic field measurements
- Session 3: New products and Services
- Session 4: Swarm FAST L1B data status
- Session 5: Electric field and plasma measurements
- Session 6: GPSR and accelerometer
- Session 7: Swarm-based L2 data products and services/1
- Session 8: Swarm-based L2 data products and services/2

2 SESSION SUMMARY

2.1 Introduction

Session 1 presented an overview of the Swarm mission illustrating the mission status, summarizing Swarm data quality and characteristics, and introducing the meeting objectives. After almost 10 years in space, the three satellites are in excellent shape, being able to address new scientific challenges and operational applications and they are ready for collecting data for several more years. The status of the mission remains green for what regards all Platforms, Payload systems, data quality and PDGS infrastructures. To enable full exploitation of the Swarm constellation, the processing algorithms, as well as the ground and flight operating segments, are constantly improved, taking advantage of experience gained by ESA and Swarm users' community in the past years. Thanks to these joint efforts, the Swarm mission has already achieved remarkable scientific results, also opening the door for many innovative applications beyond its original scope. This is particularly true in the area of Near- Earth Space physics where Swarm-based science can now benefit of new opportunities of synergies with other ESA science missions. The combination of Swarm with complementary satellites is indeed promising as it increases the scientific value of the mission, enhancing both temporal and spatial coverage.

2.2 Magnetic Field Measurements

Session 2 was focused on data quality, algorithm improvements and applications of L1B magnetic measurements from Swarm constellation.

After nearly 10 years from the launch, the remarkable performances of Magnetic package instruments, consisting of the Vector Field Magnetometer (VFM), the Absolute Scalar Magnetometer (ASM) and the Star Tracker (STR) assembly, were reported. During the last year these instruments suffered only minor anomalies with very low impact on L1B data quality and magnetic field data time coverage remains excellent.

For what concerns the L1B Operational Processor status, a degradation of attitude and magnetic field measures with respect to the North-East-Centre (NEC) reference frame has been detected in the period from October/December 2018 to August 2023 causing errors in the B_NEC field stored inside MAGx_LR and MAGx_HR products up to ~3 nT. In addition, due to a processing library update, a further degradation up to ~150 nT in B_NEC has been registered between June and August 2023. The root causes of these issues were immediately identified, the nominal quality of magnetic L1B data was restored since 25 August 2023 and a reprocessing campaign to recover all the affected data during the above-mentioned time frame will be performed soon. In addition, a preliminary MAGx_LR dataset covering the impacted period has been made available to provide a reliable dataset for the whole Swarm Community.

An assessment of the full Swarm L1B MAGx_LR dataset (making use of the preliminary set) performed through field modelling has been presented. The most updated Swarm magnetic low-resolution products have been used to generate CHAOS-7.16 model which extends the previous model up to August 2023 confirming the very good quality of L1B production and anticipating few improvements that will be implemented for the next major CHAOS update.

During this Session the main future evolutions for the ORBATT and MAGNET processors were presented: i) a new L1B product taking advantage of the capability of Camera Head Units (CHUs) constituting the STR instrument to count the high energy (>100 MeV) incoming protons and ii) an improved dB_Sun model for ASM magnetic measures taking into account of Earth eclipses effects. The new dB_Sun model will replace the previous static model which parametrized the magnetic disturbance in terms of the

direction of the Sun with respect to the spacecraft, becoming a fully physical model based on P. Brauer's analysis.

The IPGP team presented an overview of the status of ASM Burst Mode (BM) 250 Hz science dataset and the ASM-V vector data processing. The processing algorithm of ASM BM data has been further improved, increasing the speed and efficiency of data generation now distributed with version 0302. This latest version as well as the most recent version of ASM-V data 060X, are aligned with the MAGNET official L1B dataset, therefore including the dB_Sun correction applied to ASM data along the Y-axis of the instrument. In terms of data quality, the effect of the above-mentioned anomaly in B_NEC magnetic measures on ASM-V and VFM global field models has been investigated and it was confirmed that the issue had a small impact (few nT in the East component) in the period from May to October 2019. Nevertheless, the comparison between ASM-V and VFM global field models suggests that a small calibration issue between ASM and VFM along the Y axis is present and that an improvement in calibration parameters would be beneficial for both instruments measurements.

Finally, the results of an analysis of 7 years of ASM BM data has been presented, highlighting how useful this dataset can be to investigate high frequency signals allowing to discriminate between artefacts and geophysical sources, ultimately being beneficial for the whole Swarm community.

2.3 New products and Services

Session 3 was dedicated to new Swarm product and services. The session started with the presentation of new Swarm products that make use of high and low resolution magnetic data (MAGx_HR and MAGx_LR) to characterize Ultra Low Frequency (ULF) waves events and features. The ULF waves product is in the final implementation phase: the algorithms are under finalization, and all available data have been processed. Next step will be implementation of fast-track data processing chain.

A correlation study between Swarm-derived Sheet Field Align Current (SFAC) prototype product and Auroral/Polar Electrojet (AE, PEJ) current systems using both Swarm and ground-based observations was presented. The next steps will be a further development of the Swarm SFAC prototype into a full space weather product. The implementation of fast-track data is coming soon.

FAC density derived from dual satellite Local Least-Squares method (FAC_LLS) product has been extensively validated and is now routinely produced. A fast-track implementation of such product will be done next year.

Swarm-E mission is still alive, providing mainly GPS based data products. The final report is in preparation. The data is available on https://epop-data.phys.ucalgary.ca and https://edex.phys.ucalgary.ca. A 'Payload Quicklook' is available on https://payloadquicklook.phys.ucalgary.ca.

SwarmPAL is an on-demand processing tool that provides a data interface to VirES and HAPI. Analysis and plots are reproducible, handling of changes in input data is quite challenging. It is open to implement more toolboxes. The full links to documentation and the repository can be found on https://swarmdisc.org/lab/.

2.4 Swarm FAST L1B data status

Session 4 was dedicated to Swarm FAST L1B data production status and quality.

The first presentation was given by Ingo Michaelis on verification and validation of Swarm L1B FAST MAGNET products. It was reported that the Swarm L1B FAST MAGNET data agree well with OPER version, though some positions differ, up to 10 metres. Some small issues were fixed. The CHAOS model implementation in VirES needs documentation (limited reproducibility due to changes in input

configuration for CHAOS not documented). It has been suggested that FAST MAGNET data should be usable for dual-FAC processing with a latency up to 12 hours.

Lauren Orr's presentation was about hazard variation index for Swarm FAST data: BGS team is developing a hazard variation index from FAST MAGNET data which identifies localised risk from highly varying magnetic field. It can quantify hazards on a shorter basis than one orbit, as soon as data are available, which means as close to real-time as currently feasible.

Ciaran Began's presentation showed that BGS team is continuing to deliver Swarm AUX_OBS, GVO, OPER_MMA (2F) products, and can implement the delivery of FAST_MMA product if requested (already tested).

Constantinos Papadimitriou presented Time-Frequency Analysis of the FAST L1B data, exploring derivation of radiation belt DLL radial diffusion coefficient from FAST data, that could be useful for operational predictive models.

Yaqi Jin presented IPIR FAST Update on FAST_IPDxIRR production: the algorithm is built and ready for routine operation after an internal review. The production delay is ~5 minutes. It has been noted that the dependency on the operational L2 TECx, IBIx, and AOBx is removed in the FAST version.

Guram Kervalishvili's presentation regarded first results of GFZ Swarm FAST data products: AEJxLPL_2F, AEJxPBL_2F, and AOBxFAC_2F. GFZ team stated that they ready for FAST production of AEJxLPL & AEJxPBL, while he production of AOBxFAC and PRISM products is subject to the production of FACxTMS.

Martin Pačes presented the evolution of VirES and VRE Service, showing that magnetic models are produced much faster with the exploitation of Swarm FAST data products. It has been recommended that current FAST products are ready for public release, depending on PDGS actions. Includes HAPI support.

Eelco Doornbos presented Swarm-SWITCH & Space weather timeline viewer, now accessible at https://spaceweather.knmi.nl/viewer/ and development at https://gitlab.com/KNMI-OSS/spaceweather/knmi-hapi-timeline-viewer.

2.5 Electric Field and plasma measurements

Session 5 was dedicated to the Swarm Electric Field and Plasma measurements. The presentations and final discussions carried on during the session showed that Swarm Plasma data quality is in continuous improvement, with new studies, calibration analysis and possible future evolutions.

The performance status Electric Field Instruments (EFI), composed by the Thermal Ion Imager (TII) and the Langmuir Probes (LPs), is good, and it is continuously monitored and reviewed.

In particular the TII instrument performances are continuously improving, with a consistent reduction of peripheral anomalies in the last year. Daily operations continue to be monitored and updated. A new version of TII Raw And Corrected Imagery and Spectra data (TRACIS), with good quality, is available for Swarm users, while a new version of TII cross-track flow data (TIICT) is under development.

LP instruments are performing very well, providing data with good time coverage, and including electron density and temperature "partially" calibrated via ISRs (Incoherent Scatter Radars) measurements. The next release of the L1B processor will also include the diversification of ion and electron density estimation: differences in estimation of these two parameters and preliminary analysis have been presented and discussed during this session.

The upcoming release of the L1BOP will also include flagging of artificial spikes in electron temperature, as defined by the "SPETTRALE" project.

The results of analysis on spacecraft potential data quality have been presented during this session, highlighting possible artefacts, which were discussed during the session and ascribed to the change in LPs gain mode configuration performed in December 2018. Also, the results of analysis on artificial fluctuations in electron density data were presented, opening the discussion to the possibility of flagging also artificial spikes in density as much as in temperature.

Methods to improve the calibration of LPs data have been presented and discussed during the session, using FP measurements as a reference, which show a better agreement with ISRs, and calibrating data via statistical approach or via Neural Networks methods.

2.6 GPSR and Accelerometer

Session 6 was dedicated to Swarm GPSR and accelerometer instruments status and their data quality. This session had 5 different presentations where several topics have been discussed and presented. The more relevant one is that for the first time the whole constellation (Swarm A, B and C) has ACCxCAL L2 data available for a certain span of time (March 2015). This is a very interesting period from the scientific point of view because it corresponds to the period when the famous St. Patrick's day storm took place, and the data can be exploited for different purposes. The scientific community is strongly advised to make use of the calibrated accelerometer dataset available.

Since the last DQW, the nominal accelerometer data processing chain has been revised and two parallel chains (nominal and validation) give comparable quality of data. A comparison between accelerometer scale factors has been presented and it shows to be stable over time.

An important message to deliver is that, having now the availability of both Swarm A and Swarm C data for different periods along the mission, when interpreting anomalies in the accelerometer data, one needs to compare both satellites information in order to distinguish between geophysical signals and artefacts.

2.7 Swarm-based L2 data products and services/1

Session 7 covered a wide spectrum of geophysical topics directly linking data products derived from the Swarm, CSES and GRACE mission as well as ground-based observations. Research interest can be divided into the following aspects:

- forward modelling and prediction of ionospheric irregularities (Miloch, Rausch, Fu);
- systematic study of the ionospheric electrodynamics (Papini, Alken);
- case study of ionospheric plasma parameters and magnetic field fluctuations originating from natural hazard events (Slominska, Coisson).
- Extended capabilities of the Swarm mission and its gravity field timeseries (Encarnação).

Advanced computational methods and deep learning framework were presented for the purpose of Swarm/Cluster data analysis, as well as mission planning and simulations of instrument performance with estimates of inferences and potential products (Balasis, Marchand, Brochu).
Latest version of the Time-Frequency Analysis (TFA) toolbox allows for analysis of Swarm FAST products and is a reliable tool for studies focusing on detection of certain patterns in Swarm time-series such as pulsations or other types of ULF/ELF wave activity.

Ionospheric variability and capability of accurate prediction of severe space weather effects were addressed during three talks. Since ionospheric irregularities can lead to degradation of trans-ionospheric radio waves, and in consequence impact communication or positioning with the Global Navigation Satellite Systems (GNSS), it is highly important to properly mitigate the effects of increasing solar and geomagnetic activity. Such solutions are provided by the Swarm-VIP model or the IBP_CLI model. The first

one determines the probability of occurrence of different scales in ionospheric plasma with respect to geomagnetic conditions and the magnetosphere-ionosphere coupling. While the second one, is an ionospheric bubble probability statistical model, which relies on the Swarm L2 product. The model is representative for the altitude range 350 - 500 km and low geographic latitudes of +/- 45 degree. The output from the model is the floating-point index ranging 0-1 and it characterises the percentage probability of low latitude bubble occurrence at the specified time, location and solar flux.

Topics related to ionospheric electrodynamics, were discussed from two perspectives: a novel approach in modelling of the EEJ and as well as analysis of auroral electric field, with many potential applications in the framework of space weather and ionosphere–magnetosphere–solar wind couplings.
Presentations dedicated to case study analysis, distinguished two particular areas of interest: low and mid-latitude regions in which Swarm detects strong magnetic field fluctuations originating from lightning activity, high latitude regions for which monitoring of auroral activity is discussed.
Finally, since 2016 the Swarm mission showed its full capabilities to fill the gap when no dedicated gravity mission is in-orbit. Swarm provides a gravity field model with stable quality, although increasing solar activity slightly breaks down agreement between Swarm products and high-resolution GRACE/GRACE-FO data.

2.8 Swarm-based L2 products and services /2

This Session included talks related to three satellite missions (GDC, CSES, and Swarm), and covered operational considerations as well as current research endeavours.

Amy Rager presented the current status of the GDC mission, for which funding is currently paused. She presented the GDC website which has a lot of current information on the instruments and mission. The audience was highly interested in the magnetometry instruments (vector, scalar, star cameras). While an absolute magnetometer is not currently included in the design, Amy understood the community's desire for this instrument and will bring this back for discussion with the instrument team. Inclusion of star cameras is also currently unclear, but Amy will discuss this also with the instrument team.

X. Shen presented an overview of the CSES mission, including all instruments, operational status, and research highlights. The satellite payloads appear to be operating nominally, and the data is being used in a number of scientific studies, including IGRF modelling, as well as an upcoming EISCAT collaboration to investigate ionospheric heating.

Y. Yang presented the CSES magnetic field measurements, with a focus on calibrations of the fluxgate magnetometer, as well as an upcoming lithospheric field model built from CSES magnetic field data.

D. Marchetti gave a talk on earthquake detection, using Swarm magnetic field measurements to identify magnetic anomaly precursors, which could potentially be used to predict earthquake events.

3. Recommendations

Topics	RECOMMENDATIONS	STATUS	MAIN UPDATES AT DQW#13
Magnetic Field	[DQW8_Rec 1.] Adapt the L1BOP in order to be able to process L1B MAG data with ASMxBUR_0_ data as input	Closed	
	[DQW8_Rec 2.] Run ASM on Swarm Alpha and Swarm Bravo in Burst mode more frequently (two weeks sessions).	Closed	
	[DQW8_Rec 3.] Generate new Swarm Product from ASM 250 Hz Burst mode science data.	Closed	
	[DQW8_Rec 4.] Produce a new Swarm STR L1B "particle flux" product	Ongoing	Implementation currently on going. Evolution will be included in the next release of Swarm L1B operational processor (L1BOP v03.25).
	[DQW8_Rec 5.] Implement a Time-jitter correction in the MAGNET processor to remove systematic spikes in ASM power spectrum	On-hold	Same status as DQW#12
	[DQW8_Rec 6.] Test the improvement that can be obtained by the use of POD rather than MODx_SC_1B as input positions for MAGx_.._1B	Closed	
	[DQW8_Rec 7.] Use the ASM correction model to investigate impacts on field modelling (external fields).	Closed	
	[DQW9_Rec 1.] In case of reprocessing POD data to be used as input for magnetic data processing	Closed	
	[DQW9_Rec 2.] Move MGF comparison model to CHAOS	Closed	
	[DQW9_Rec 3.] Create a Level 1b product of Cassiope spacecraft house -keeping data to aid with MGF calibration	Closed	
	[DQW9_Rec 4.] MGF output products to be in a CDF format similar to Swarm A/B/C products. Consider having daily files for both 1 Hz and 160 Hz products.	Closed	
	[DQW10_Rec1.] IPGP to validate the dB_Sun_ASM correction model proposed by DTU	Closed	
	[DQW10_Rec2.] DTU to consolidate the new dB_Sun correction model and transfer it into operations.	Closed	
	[DQW11_Rec1.] Transfer To Operations the new L1b product baseline	Closed	
	[DQW11_Rec2.] Release Swarm-Echo MGF dataset to the whole Swarm community	Closed	
	[DQW11_Rec3.] IPGP to generate and distribute ASM-V data version 06	Ongoing	Activity discussed during MAGNET session. Still on-going.

	[DQW11_Rec4.] IPGP to process and release future burst data version 0301	**Closed**	
	[DQW12_Rec1.] Continue the investigation aimed at improving the ASM and VFM dB_Sun correction models	**Ongoing**	Continuously on-going. This activity was discussed during the MAGNET session and a new more specific recommendation, i.e., [DQW13_Rec3], was opened.
	[DQW12_Rec2.] Process and release new e-POP MGF TDS after removing the reaction wheel and solar panel current noise.	**Open**	This topic was not discussed during DQW#13. Status to be updated next year.
	[DQW13_Rec1.] Distribute ASM BM 250 Hz data to the whole community	**Done**	*Post DQW#13 update: Full dataset made available to all the user community in Jan.2024.*
	[DQW13_Rec2.] Investigate the possibility to generate ASM BM data in a FAST chain	**Open**	
	[DQW13_Rec3.] Check calibration of Y component in both ASM and VFM instruments	**Open**	
Swarm FAST data	[DQW12_Rec3.] Go-ahead with the implementation of the FAST data processing and transfer it into operation	**Done**	Implementation and TTO performed although data currently accessed by Cal/Val only. Release of data to end users to be agreed during dedicated session. *Post DQW#13 update: data released on Nov. 2nd, 2023.*
	[DQW12_Rec4.] Set up a direct distribution from the Swarm PDGS to VirES for the FAST products in order to minimise the latency	**Done**	Same as above. Implemented in a testing environment. Data to be released soon. *Post DQW#13 update: data released on Nov. 2nd, 2023 both via Swarm dissemination server and via VirES.*
	[DQW12_Rec5.] Use VirES for ingesting and distributing Swarm L1b FAST data	**Done**	Same as above.
	[DQW13_Rec4.] Release the current FAST L1B products to the public	**Done**	*Post DQW#13 update: data released on Nov. 2nd, 2023.*
	[DQW13_Rec5.] Faster orbit counter files (ORBCNT) are required for several services. Explore the possibility of delivering 3-5 days into the future from TLE data.	**Done**	*Post DQW#13 update: FAST ORBCNT with stop validity to D+2 days tested and transferred into operations.*
	[DQW13_Rec6.] Prioritise FACx, TECx, and IBIx. These are required for several L2 products	**Open**	
	[DQW13_Rec7.] Identify & prioritise next FAST data products (or new services) relevant for space weather	**Open**	
	[DQW13_Rec8.] File server: Reorganise into yearly directories (because of file listing issue). Deliver directly as CDF (remove ZIP) but MUST still include checksum somehow.	**Open**	

	[DQW13_Rec9.] Documentation: Provide a clear distinction between OPER and FAST data. Make users aware of differences, when to use each, and detail reproducibility issues.	**Open**	
Electric Field	[DQW8_Rec 8.] To implement a new firmware to adopt an updated version of the TII automatic gain control, and to download TII images at higher frequencies (16 Hz). During such high frequency TII acquisitions, the number of pixels can be reduced to 32, instead of 64, in order to limit telemetry problems.	**Ongoing**	Additional testing was carried out showing that revision X runs on the EQM, but there is an issue receiving science telemetry from the EQM over one of the UART channels, which does not appear to be related to the Revision X software update. UoCalgary is collaborating with Honeywell on a way forward to release the VCD (version control document). Updates continuously provided via the ARBs
	[DQW8_Rec 9.] To implement new tests for LP bias, with higher voltages (+5V).	**Closed**	
	[DQW8_Rec 10.] To define a new e-POP science mode in order to collect data during conjunctions with Swarm that would allow cross-calibration of cross track plasma velocity between the two spacecraft.	**Closed**	
	[DQW9_Rec 5.] To release new cross-track velocity dataset TIICT 0201 with latest improved calibration	**Closed**	
	[DQW9_Rec 6.] Release of the new dataset TIIVI 0101 (3D flows) with quality info in the Flags.	**Closed**	
	[DQW9_Rec 7.] To improve the computation of the electron density.	**Ongoing**	A new computation for Ne will be introduced in the new version of Plasma processor (L1BOP v3.25) and it is under implementation. Further improvements for the Ne computation can be discussed in the future. The new N_elec computation is expected to have advantages mainly in an extremely low density environment, such as the mid-latitude trough/STEVE aurora, otherwise the existing density estimate, now labelled N_ion, is preferable for scientific studies. Improvements for the N_elec calibration/error calculation are being tried and are hoped to make the estimates of N_elec and N_ion more consistent between each other. LP investigations meeting should be resumed to discuss strategies.
	[DQW9_Rec 8.] To make a complete statistical analysis from BOM to characterize the evolution of the EFI L1B data quality and related anomalies to identify possible improvements.	**Closed**	
	[DQW10_Rec3.] To include the TIICT dataset in the ViRes platform	**Closed**	

		[DQW10_Rec4.] To analyse the data as outcome of the LP bias setting tests for the sweep mode	**Ongoing**	Investigation on the existing limited sweep data with bias range [-5V, +5V], useful also to learn about the LP performance. *Post DQW#13 update: sweep data could be used for further studies on machine learning inference models for Vs and Te.*
		[DQW11_Rec5.] Define a new quality flag for artificial Te spikes observed in LP data	**Done**	The new flag for artificial Te spikes events will be included in the next version of Plasma processor (L1BOP v3.25) and the implementation has been already started.
		[DQW11_Rec6.] Open discussion on how to operate between TII science acquisition vs Faceplate science acquisition	Done	
		[DQW12_Rec6.] The acquisition of as many FP measurements as possible, to obtain Ni data at 16 Hz to be compared with LP measurements.	**Ongoing**	The 16Hz FP acquisitions are continuously encouraged and periodically performed. Recommendation reaffirmed during DQW#13.
		[DQW12_Rec7.] The definition of a release note for final users regarding the future introduction of Ni parameter	**Ongoing**	Description of the new Ni will be included in Plasma Algorithms documents.
		[DQW13_Rec10.] Introduce in the future a flag based on discrepancies between electron and ion densities	**Open**	
		[DQW13_Rec11.] Provide VirES team with a test dataset consistent with new plasma variables included in the new version of the processor	**Open**	
		[DQW13_Rec12.] Perform further analysis on artificial T_elec spikes to verify possible correlation with plasma density for possible s/c-plasma interaction; and consider publishing analysis reports to allow future missions to consider possible artefacts related to solar panels	**Open**	
		[DQW13_Rec13.] Consider the possibility of flagging artificial spikes in density and spacecraft potential with the same method of flagging spikes in temperature	**Ongoing**	*Post DQW#13 update: flag for artificial spikes in ion density will be introduced in the upcoming new processor version (L1BOP v3.25).*
GPS and ACC	**ACC data**	[DQW8_Rec 11.] Release to users the Swarm C along-track accelerations covering the period from May to November 2016	**Closed**	
		[DQW8_Rec 12.] Continue to correct Swarm C along-track accelerometer data. Focus next on Swarm C cross-track accelerometer data of the second half of 2014 (motivations: large signals at beginning of mission; no large manoeuvres; Swarm C at lower altitude; 1 Hz GPS receiver data available).	**Closed**	

		[DQW8_Rec 13.] Improve the flagging and daily quality index of the ACCxCAL data products.	**Closed**	
		[DQW8_Rec 14.] Implement geophysical meaningful sanity checks based on presence of gravity waves (statistics with respect to latitude, local time, solar and geomagnetic activity, season, plasma bubbles, day/night side, etc.) that help to assess the quality of ACCxCAL data products before release.	**Closed**	
		[DQW9_Rec 9.] Release as much calibrated Swarm accelerometer data as possible, i.e., also fractions of days when part of the day is judged to be not usable.	**Closed**	
		[DQW10_Rec5.] Check cut-off in mass density variations.	**Closed**	
		[DQW10_Rec6.] Investigate dependency of density observations on errors in the concentration of Helium in thermosphere models.	**Ongoing**	Some progress was made as Delft University of Technology developed an error propagation software that can be used to address this recommendation. The research is yet to be carried out.
		[DQW11_Rec7.] Investigate Swarm B data (early mission phase) for possible dissemination.	**Done**	Swarm B data were investigated and disseminated for the full month of March 2015, when the famous St. Patricks' day storm took place. Also Swarm A dissemination has been extended to March 2015. For this month we have now the calibrated accelerometer datasets available for the full constellation. This message should be addressed to the community, who can now analyse the data and exploit this feature in the mission (for the first time).
		[DQW12_Rec8.] To write a paper on the Swarm accelerometer data processing as a proper reference for data users	**Ongoing**	The paper on the Swarm ACC processing aims to be ready as a draft, right before the science meeting in April 2024.
	A/B/C GPS	[DQW8_Rec 15.] Exploit integer ambiguity fixing when determining the non-gravitational acceleration from GPS receiver data.	**Closed**	
		[DQW8_Rec 16.] Maximize the duty cycle of the GAP-A instrument; noting that one receiver at a 0.1 Hz data rate is sufficient.	**Closed**	
		[DQW8_Rec 17.] Make star tracker data available and try to collect star tracker data when GAP data is collected, noting accurate spacecraft attitude data is needed for macro models (radiation pressure modelling, etc.).	**Closed**	
		[DQW8_Rec 18.] Collect GAP-A data once per orbit, preferably at low altitudes (high drag signal) and also some at apogee (constrains orbit)	**Closed**	

		[DQW8_Rec 19.] Avoid too much segmentation of GAP-A data (ambiguity fixing, etc.) and data gaps longer than one orbit (accuracy gets much worse for long interpolations).	**Closed**	
		[DQW8_Rec 20.] Determine the GPS antenna phase centre location with respect to the spacecraft CoM (from documentation, verify with inflight data), which should be used conventionally by all groups performing precise orbit determination for Swarm E.	**Closed**	
		[DQW8_Rec 21.] Determine GPS antenna phase centre variations with respect to the antenna phase centre location for Swarm E, potentially supported by dedicated campaigns GPS antenna calibration.	**Closed**	
		[DQW8_Rec 22.] Focus first on precise orbit determination for Swarm E and assess the feasibility of the determination of neutral density at a later stage.	**Closed**	
		[DQW9_Rec 10.] Make the new CASSIOPE orbit and attitude data available on Swarm dissemination server	**Closed**	
		[DQW9_Rec 11.] Place technical note on CASSIOPE attitude determination on Swarm webpage	**Closed**	
		[DQW9_Rec 12.] Extension of [DQW8_Rec 23.] and [DQW8_Rec 24.] towards the use of platform magnetometer data.	**Closed**	
		[DQW10_Rec7.] Make RINEX observation and precise orbit (SP3) files of AIUB with an empirical correction for L2 phase observations available in a dedicated folder on the Swarm ftp.	**Open**	No updates
		[DQW10_Rec8.] Distribute all files needed for generating mass density observations in near real-time and develop a near real-time mass density observations product, to be distributed also in near real-time.	**Ongoing**	The Swarm FAST processor is now operational, which means that all Swarm products required for a FAST GPS-derived neutral mass density product are now available. The development and operation of a FAST density processing chain requires a substantial effort, for which currently no sufficient resources are available (manpower for development and operation, and funding).
		[DQW12_Rec9.] 5 GPS block III satellites are not tracked by the Swarm GPS receivers. Recommended to implement asap onboard the satellites the available patch.	**Done**	Beyond Gravity (company that provided the GPSR instrument) prepared a patch that was implemented onboard by FOS.

		[DQW13_Rec14.] Change the L2 PLL setting from 0.5 Hz to 0.75 H. The expected effect is that the L2 carrier phase observations are less sensitive to ionospheric effects, leading to lower carrier phase residuals in the orbit determination.	**Open**	
Internal Fields		[DQW8_Rec 23.] Generate and distribute Swarm-based VO products.	**Closed**	
		[DQW8_Rec 24.] Develop new data processing/ modelling approaches using Swarm data to get better mantle conductivity models and understanding of core dynamics on sub-decadal timescale.	**Ongoing**	Different from previous DQWs, the focus of DQW#13 was entirely on data product quality, not on scientific results - that will be the focus of the 10th Swarm anniversary in April 2024. Consequently, there is no update on high-level scientific requirements / recommendations at DQW#13. An ITT about several scientific themes has recently been published and is presently in review by ESA.
		[DQW8_Rec 25.] Justify rationale for 3D Earth approach using Swarm data.	**Closed**	
		[DQW9_Rec 12.] Extension of [DQW8_Rec 23.] and [DQW8_Rec 24.] towards the use of platform magnetometer data.	**Closed**	
		[DQW10_Rec9.] Investigate annual signals in GVO series	**Open**	Same answer as for [DQW8_Rec 24]
		[DQW10_Rec10.] Explore more realistic prior information for external fields, to be used in field modelling for example in the MCM model of Lesur and co-workers	**Open**	Same answer as for [DQW8_Rec 24]
		[DQW10_Rec11.] Further studies of merging satellite and near-surface data, exploring band-limiting of near-surface data, in the extended dedicated crustal field product	**Open**	Same answer as for [DQW8_Rec 24]
		[DQW10_Rec12.] Clarify difference between ground and satellite Q-matrix in induction studies for mantle conductivity	**Open**	Same answer as for [DQW8_Rec 24]
		[DQW10_Rec13.] Continue efforts to calibrate platform magnetometers, using house-keeping data, if possible (e.g., GRACE), to aid induction studies	**Ongoing**	Same answer as for [DQW8_Rec 24]
		[DQW10_Rec14.] VRE-based dashboards for exploring ground observatory data and magnetic field models	**Ongoing**	On-going - VRE has now access to HAPI data servers from e.g., INTERMAGNET, providing magnetic ground data
External Fields		[DQW8_Rec 26.] Update the Swarm cross-track velocity data archive with a quality flag characterizing the intensity of along-track velocities.	**Closed**	
		[DQW8_Rec 27.] Improve the description on the linkage of electron density and TEC fluctuation rates to GNSS phase and amplitude scintillations to further enhance	**Closed**	

	the use of Swarm for space weather applications.		
	[DQW8_Rec 28.] Develop a well-documented toolbox to facilitate wider usage of innovative methods for Swarm-based FAC determinations.	**Ongoing**	Same answer as for [DQW8_Rec 24]
	[DQW10_Rec15.] Expand the number of products for space science and space weather e.g., by combination of different parameters (B, Ne, E, TEC, …) and multi-mission approach	**Ongoing**	Several space-weather related activities have been initiated as part of Swarm DISC session #5
Swarm-based L2 data products and services	[DQW12_Rec10.] A wider angular separation of Swarm A/C would be beneficial to the DSECS product (up to 3°)	**Open**	No update. For the time being a longitudinal separation between Alpha and Charlie of 1.4 degrees has been accepted, maximizing most Swarm Science objectives.
	[DQW12_Rec11.] Use Swarm ASM Burst Mode data to investigate signals associated with natural hazards (e.g., earthquakes, tsunamis, volcanos)	**Open**	Same answer as for [DQW8_Rec 24]
	[DQW12_Rec12.] Innovative tools and techniques for Swarm analyses based on Artificial Intelligence and, in particular, Machine Learning show promise in many cases, and could be further explored for Swarm studies, considering the large amount of available data from the mission.	**Open**	Same answer as for [DQW8_Rec 24]
	[DQW12_Rec13.] Swarm community could take advantage of the newly developed SwarmPAL package within VirES. There is scope for creating tools for new research communities to access Swarm data too (e.g., heliosphere studies, ecological animal movement).	**Ongoing**	SwarmPAL is further populated with additional tools
	[DQW13_Rec15.] With growing number of in-situ observations from such missions as Swarm, systematically develop and improve models, which allow to proper deal with: i) prediction of ionospheric and magnetic disturbances, ii) the complex nature of ionospheric electrodynamics.	**Open**	
Space physics and weather applications	[DQW9_Rec 13.] Further analyse and investigate LP based Te and Ne features potentially impacted by instrumental issues.	**Closed**	
	[DQW9_Rec 14.] Investigate the potential use of vertical velocity measured by EISCAT radars for the calibration of Swarm TII data.	**Closed**	
	[DQW10_Rec16.] Investigate the potential of Swarm for Space Weather research and application	**Ongoing**	See answer to [DQW10_Rec15.]
	[DQW10_Rec17.] Evaluate the potential of fast access of Swarm data with respect to reduced processing time and/or more frequent download	**Closed**	

	[DQW11_Rec8.] Implement a Swarm Fast processing chain (extension of [DWQ10_Rec17.])	**Done**	See answer to [DQW12_Rec3.]
	[DQW11_Rec9.] Process and distribute “Fast-track” L1b data (magnetics, plasma, GPS …) with latency as short as possible (< 3 hrs ?), accept “data gaps”	**Done**	See answer to [DQW12_Rec3.]. The latency of the data has not been described, so far, as proposed here.
	[DQW11_Rec10.] Process and distribute “Fast-track” L2 data (where it makes sense)	**Ongoing**	After the transfer to operations of the L1B FAST data production chain, the discussion has started to select the most relevant L2 data products to be released as FAST version.
	[DQW11_Rec11.] Identify new “Space-weather–related” higher level data products	**Open**	See answer to [DQW11_Rec10.]
	[DQW11_Rec12.] More long-term: Investigate possibility of more frequent data downlink ideally using stations in N and S hemisphere to achieve data latency of shorter than ½ hour, although Northern hemisphere probably more interesting for European Space Weather applications	**Open**	See answer to [DQW10_Rec16.]
	[DQW11_Rec13.] Take advantage of Swarm measurements and available models to understand the solar cycle	**Ongoing**	Swarm mission data do not yet cover one complete solar cycle
Swarm - CSES Synergies	[DQW8_Rec 29.] Foster collaboration between CSES and Swarm experts’ team for cross-calibration and validation activities.	**Closed**	
	[DQW8_Rec 30.] Make available appropriate level of CSES data to Swarm experts for starting such activities to as soon as possible.	**Closed**	
	[DQW9_Rec 15.] Organise a joint CSES-Swarm Data Quality or Science workshop	**Ongoing**	A workshop on a similar Chinese satellite mission, MSS-1, was held at RAS in London in October 2023, with strong participation from the Swarm science team.
	[DQW10_Rec18.] CSES-Swarm collaboration: Coordinate activities of Swarm DISC, ISSI-BJ science team and proposal included in the Dragon-5 project (also clarifying what can be funded by the Dragon-5 program), to ensure full advantage is taken of both tools (also ensuring possibility of mixed "physical" and "remote" attendance). Collaborate further on improving data CAL/VAL. Ensure the possibility of long-enough cross-visits for spending significant joint working time in same location, for allowing quick exchange of practical (hence critical) information.	**Ongoing**	See answer to previous recommendation

	[DQW10_Rec19.] CSES data: Streamline CSES data access to make all of them (not only HPM FGM2 data, but data from all payloads) accessible from outside China, including auxiliary data, by e.g., using ESA ftp site (as is currently done for HPM data). Provide relevant documentation (file format, data content, etc...) in English.	**Closed**	
	[DQW10_Rec20.] CSES data: Produce and provide high-latitude (above 65° latitudes) HPM scalar data (at least).	**Closed**	
	[DQW12_Rec14.] To continue and strengthen the Swarm/CSES collaboration in order to: - maintain and improve the quality of the data provided by CSES - ensure CSES data is kept available in a suitable format and in a timely manner for scientific investigations by the international scientific community	**Ongoing**	Continuous data exchange on-going. CSES L2 MGF scalar data shared via Swarm dissemination server.
Swarm - Echo	[DQW8_Rec 31.] Update data format of new MAG and GAP Swarm Echo products to better match with Swarm L1b and L2 data product formats	**Closed**	
	[DQW8_Rec 32.] Coordinate Swarm Echo and Swarm A/B/C activities regarding data cross-calibration and scientific validation	**Closed**	
	[DQW9_Rec 16.] e-POP related data quality status should be now reported into Swarm L1B data sessions	**Closed**	
	[DQW11_Rec 14.] Release Swarm-Echo MGF dataset to the whole Swarm community	**Closed**	
warm and Multi-mission Synergies	[DQW8_Rec 33.] Structure a Magnetometer calibration expert group" and organise a workshop on "Multimission data calibration and application" (about 6 months after the SDQW#8) for identification and coordination of the multi-mission potential and corresponding formulation of needs and procedures.	**Closed**	
	[DQW8_Rec 34.] Foster cooperation and exchange experience between ACC data processing experts from GRACEFO & Swarm missions	**Closed**	
	[DQW8_Rec 35.] Develop multi-mission, consistent, reliable, and well-calibrate multi-mission datasets to address key scientific challenges related to upper atmosphere "climate" trend analysis, studies of longer-term secular variation vs solar cycle effects, quantification of energy transports by waves and other phenomena.	**Ongoing**	Same answer as for [DQW8_Rec 24]

	[DQW9_Rec 17.] The Swarm DQW#8 Rec.34 to Rec.39 have been replaced by the new Rec i.e., [DQW9_Rec 18.] - [DQW9_Rec 23.], here below.	Closed	
	[DQW9_Rec 18.] Exploit needs and new research opportunities from multi-mission approaches in the areas of core field evolution, mantle conductivity, ionosphere-atmosphere, ionosphere-magnetosphere, and thermosphere-atmosphere coupling, climate trends, geodesy, and gravity, among others.	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW9_Rec 19.] Prepare and provide calibrated data of (platform) satellite magnetometers in support for Swarm. These data may include those from ESA missions (Aeolus, Cryosat-2, GOCE, e-POP, Sentinels, …), new missions (Daedalus, SMILE, Macao, NanoMagSat, …), none-ESA scientific missions (DMSP, GRACE, GRACE-FO, …), and commercial missions (AMPERE, SPIRE, …). It is aimed that these data are provided in daily CDF files (time, position, calibrated B_FGM, STR data, B_NEC, flags, …) and available to the scientific community.	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW9_Rec 20.] Continue effort in expert group for “Multi-mission data calibration and application”: Compile a peer-review publication describing data products and calibration process, and several publications on the multi-mission potential and applications in a special issue.	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW9_Rec 21.] Further investigate new data sources (e.g., platform magnetometers) to fill the gap between CHAMP and Swarm	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW9_Rec 22.] Enhance the potential synergy of thermosphere – ionosphere data of Swarm and other satellite missions, such as GRACE(-FO), Sentinels, e-POP, SPIRE, …).	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW9_Rec 23.] Investigate new funding schemes enabling consistent calibrations of multimission data.	Open	Same answer as for [DQW8_Rec 24]
	[DQW10_Rec21.] Combine magnetic observations from LEO satellites (dedicated and platform) distributed at different local times to characterise the asymmetry of the magnetospheric ring current signal, and for induction studies.	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW#10_Rec22.] Express strong support for exciting contribution Daedalus mission can make to lithospheric studies	Open	Same answer as for [DQW8_Rec 24]

Science projects and applications	[DQW12_Rec15.] Statistical models of ionospheric plasma have the potential to be operationalised can complement, and have the potential to improve upon, physical models such as TIE-GCM. Swarm observations of the thermospheric density can be used within statistical models to increase the understanding of the physical system. ITTs in these areas are recommended.	**Ongoing**	ITT "4D Ionosphere" in the context of ESA Science 4 Society opened in Q3 2023 on 6 different themes: -Theme 1: "Quiet" ionosphere -Theme 2: Dynamic Ionosphere: Irregularities, dynamics, and predictive capabilities – space weather -Theme 3: Ionosphere – Upper Atmosphere/Thermosphere coupling -Theme 4: Ionosphere – Magnetosphere Coupling In addition, two extra Themes were included in this ITT enlarging its scope beyond ionosphere research: - Theme 5: Swarm for Ocean - Theme 6: Open Innovative Theme. From this call, 5 new projects were selected, and they are launched in Q1 2024. One of the projects aims at working on the topic mentioned in [DQW12_Rec15]
	[DQW12_Rec16.] The unique configuration of Swarm A and C enable studies of the 2D horizontal structures in both the ionospheric plasma and the magnetic field. The high temporal resolution of both the plasma and magnetic field observations is enabling novel studies. ITTs in these areas are recommended.	**Ongoing**	Same answer as for [DQW12_Rec 15]
	[DQW12_Rec17.] There is in general a lack of understanding of Joule heating which was also stressed during the COSPAR 2022 conference as a topic with research priority. An ITT in this area is recommended.	**Ongoing**	Same answer as for [DQW12_Rec 15]
	[DQW12_Rec18.] Ocean applications from Swarm shall distinguish between ocean circulation and ocean tide electrical conductivity. It is recommended to have separate ITT's addressing these two Swarm applications.	**Ongoing**	Same answer as for [DQW12_Rec 15]
	[DQW12_Rec19.] Regarding core field studies, specific long-term vision for advancing our understanding of core dynamics and the origin of changes in Earth's magnetic field shall be to determine a physically consistent, time-dependent, model of core dynamics and Earth's magnetic field based on Swarm long-term observations.	**Ongoing**	Long-term vision includes progressing on the mapping of the base state (magnetic, velocity and buoyancy fields) within Earth's outer core (Swarm+ 4D Deep Earth: Core study) and its contribution to the knowledge of the mantle conductivity at the Core-Mantle Boundary (CMB) (synergies with 4D Dynamic Earth study)
	[DQW12_Rec20.] Foster synergies between other EO missions by including related activities in future science ITTs.	**Ongoing**	Same answer as for [DQW12_Rec 15]

	[DQW12_Rec21.] The lengthy, and growing, temporal extent of the Swarm data set is enabling excellent, novel scientific results. The continuation of this mission as solar activity increases in the coming years will further add to the value of this dataset. ITTs are recommended which exploit this dataset by building on current or previous projects are recommended.	Ongoing	Same answer as for [DQW12_Rec 15]
Swarm SPACE4.0I, Data Visualization and Analysis	[DQW8_Rec 36.] Provide lessons learned from the Swarm community to the Daedalus MAG	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW8_Rec 37.] Investigate whether the science objectives of Daedalus could be broadened to Swarm areas of science	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW8_Rec 38.] Enhance the use of Machine Learning / AI methods applied to emerging Swarm Data applications	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW8_Rec 39.] Make easier the access / manipulation of Swarm data and facilitate collaborations via the development of VRE	Closed	
	[DQW8_Rec 40.] Redesign and improve the content of the Swarm website to make it fully align with the scientific community expectations	Done	New Swarm website released and now fully consolidated. Rec to be considered as completed although the webpage is in continuous evolution.
Future Missions	[DQW11_Rec 15.] Consider the possibility to align orbits of future satellites or constellations with Swarm satellites	Open	Same answer as for [DQW8_Rec 24]
	[DQW11_Rec 16.] Define cross-mission objectives	Open	Same answer as for [DQW8_Rec 24]
	[DQW11_Rec 17.] Start generating and elaborating post-Swarm mission ideas	Open	Same answer as for [DQW8_Rec 24]
	[DQW11_Rec 18.] Ensure that data from complementary missions are open and free	Ongoing	Same answer as for [DQW8_Rec 24]
	[DQW11_Rec 19.] Explore the possibility for a workshop to align existing and future missions	Open	Same answer as for [DQW8_Rec 24]
	[DQW11_Rec 20.] Swarm and beyond: Swarm is the backbone of “Geomagnetism and Geospace Satellite Fleet” … synergy with other existing and future satellite missions	Open	Same answer as for [DQW8_Rec 24]
	[DQW11_Rec 21.] Ensure a Swarm mission extension for the future, in order to allow the scientific community to rely on long time series data, for Space "climatology" applications	Open	Same answer as for [DQW8_Rec 24]
	[DQW11_Rec 22.] Create a series of “Swarms ideas workshop"	Open	Same answer as for [DQW8_Rec 24]

Appendix I: SDQW#13 AGENDA

Swarm 13th DQW Agenda

10 - 12 October 2023, Esrin (Frascati), Italy

Webex link		https://esait.webex.com/esait/j.php?MTID=m21f658c9bd45d62533262c105fe4b9fd	
Day 1	**Tuesday 10/10/2023**		
	Magellan Conference Room		
09:00	09:45	**Registration**	
09:45	10:00	**Welcome**	
		Session 1: Mission overview	**Chair: Anja Stromme**
10:00	10:15	Swarm mission status	Anja Stromme
10:15	10:30	A Decade with Swarm	Nils Olsen
10:30	10:45	Flight Operations Segment Status	Giuseppe Albini
10:45	11:00	Constellation status of the Swarm mission	Francesco Petrucciani
11:00	11:15	Swarm Data quality status	Enkelejda Qamili
11:15	**11:30**	**Open Discussion**	
11:30	12:00	Coffee break	
		Session 2: Magnetic field measurements	**Chairs: Leda Qamili / Nicola Comparetti**
12:00	12:15	MAGNET processor status	Nicola Comparetti
12:15	12:30	The VFM status	Jose Merayo*
12:30	12:45	An assessment of recent L1b Mag-L data from field modelling	Chris Finlay
12:45	13:00	Future Improvements of the dB_Sun Corrections	Lars Toffner-Clausen
13:00	**14:30**	**Lunch**	
14:30	14:45	Status of ASM Burst data	Louis Chauvet
14:45	15:00	Unusual signals in the Swarm ASM 250 Hz data	Ciaran Beggan
15:00	15:15	Status of Swarm ASM-V data	Gauthier Hulot
15:15	15:30	Noise removal from the Swarm-Echo magnetic field data	David Miles
15:30	**15:45**	**Discussion and Recommendations**	
15:45	16:00	Coffee break	
		Session 3: New product and services	**Chairs: Ingo Michaelis / Pierdavide Coisson**
16:00	16:15	New Swarm products to characterize ULF waves	Balázs Heilig
16:15	16:30	A new product for Space Weather monitoring by Swarm magnetic field observations: The SFAC index	Octav Marghitu
16:30	16:45	A new Swarm L2 product: the FAC density estimated with the dual-satellite local least squares method	Adrian Blagau
16:45	17:00	New data products, services, and data quality improvements for Swarm-Echo	Andrew Howarth
17:00	17:15	On-demand processing of data with SwarmPAL & VRE	Ashley Smith
17:15	**17:30**	**Discussion and Recommendations**	
17:30	**19:30**	**Ice Breaker**	

*remote participant

Webex Link		https://esait.webex.com/esait/j.php?MTID=m1b545faf943288e733b9f8af2f391f6d	
Day 2	**Wednesday 11/10/2023**		
	Magellan Conference Room		
		Session 4: Swarm FAST L1B data status	**Chairs: Ashley Smith/ Guram Kervalishvili**
09:00	09:15	Verification and validation of SwarmL1b FAST MAG products.	Ingo Michaelis
09:15	09:30	A Regional Swarm FAST Data Hazard Variation Index	Lauen Orr
09:30	09:45	Update on BGS work with Swarm FAST data	Ciaran Beggan
09:45	10:00	Time-Frequency Analysis of the FAST L1B data	Constantinos Papadimitriou
10:00	10:15	Status of FAST-IPIR (FAST-Ionospheric Plasma IRregularities) and IPIR L2 data products.	Wojciech Miloch*
10:15	10:30	First results of GFZ Swarm FAST data products: AEJxLPL_2F, AEJxPBL_2F, and AOBxFAC_2F	Guram Kervalishvili
10:30	11:00	Coffee break	
11:00	11:15	Evolution of VirES and VRE Services - Swarm FAST products and faster magnetic models	Martin Paces
11:15	11:30	Swarm-SWITCH timeline viewer tool - Demo	Eelco Doornbos*
11:30	**11:45**	**Discussion and Recommendations**	
		Session 5: Electric field and plasma measurements	**Chairs: Roberta Forte / Lorenzo Trenchi**
11:45	12:00	Swarm Electric Field Instrument and Processor: status and updates	Roberta Forte
12:00	12:15	LP, Status and Outlook	Stephan Buchert
12:15	12:30	Artificial Te spikes: implementation of the new quality flag	Lorenzo Trenchi
12:30	12:45	What can we learn from the spacecraft potential of Swarm	Chao Xiong
12:45	**14:30**	**Lunch**	
14:30	14:45	An artificial signal in the electron density data of the Swarm Langmuir probe	Chao Xiong
14:45	15:00	Calibration of the Langmuir Probe and Faceplate plasma densities using neural networks	Artem Smirnov*
15:00	15:15	Calibration of Swarm LP plasma density through FP observations, preliminary results	Alessio Pignalberi
15:15	15:30	Swarm Thermal Ion Imager performance and processing update	Johnathan Burchill
15:30	**15:45**	**Discussion and Recommendations**	
15:45	16:15	Coffee break	
		Session 6: GPSR and accelerometer	**Chairs: Elisabetta Iorfida / Christian Siemes***
16:15	16:30	Comparing Swarm A, B, and C accelerometer data	Elisabetta Iorfida
16:30	16:45	Current status of Swarm ACC Level 2 data processing	Sergiy Svitlov
16:45	17:00	Status of Swarm accelerometer data processing at LUH	Igor Koch/Jakob Flury*
17:00	17:15	Comparison of possible pre-earthquake magnetic anomalies with acceleration data (ACC) product.	Dedalo Marchetti
17:15	17:30	Status of Swarm L2 orbit and thermospheric density products	Jose van den Ijssel
17:30	**18:00**	**Discussion and Recommendations**	

*remote participant

Dinner at Cantina Simonetti at 19:00

Webex Link		https://esait.webex.com/esait/j.php?MTID=m1ca68528922c9c7bdad81c325f400144	
Day 3	**Thursday 12/10/2023**		
	Magellan Conference Room		
		Session 7: Swarm-based L2 data products and services/1	**Chairs: Ewa Slominska/ Constantinos Papadimitriou**
09:00	09:15	Detecting the Auroral Oval through Swarm ionospheric magnetic field measurements and CSES-01 electric field observations.	Emanuele Papini
09:15	09:30	The Swarm-Aurora Event Database	Eric Donovan
09:30	09:45	An update on the Variability of Ionospheric Plasma (Swarm-VIP) model.	Wojciech Miloch*
09:45	10:00	The Time-Frequency Analysis (TFA) Toolbox: Recent Developments	Georgios Balasis
10:00	10:15	Quality test and visualisation tools for the ionospheric irregularity model IBI_CLI	Ina Rusch
10:15	10:30	A new tool for modeling ionospheric electrojets	Patrick Alken
10:30	11:00	Coffee break	
11:00	11:15	Analysis of magnetic field fluctuations in regions of active volcanoes	Ewa Slominska
11:15	11:30	Status of Swarm L2 whistler product	Pierdavide Coisson
11:30	11:45	Inference of space plasma state parameters from combined multiple particle sensor measurements with a machine learning approach.	Richard Marchand*
11:45	12:00	Novel machine learning and quantum vector magnetometer data collection and compensation developed through the MagQuest program	Mathieu Brochu
12:00	12:15	Nearly a decade of Swarm monthly gravity field models	Joao Encarnação (Aleš Bezděk)
12:15	12:30	Ionospheric Perturbance Analysis Using Gradient Ionospheric Index (GIX) over China Region	Zhihao Fu
12:30	**13:00**	**Discussion and Recommendations**	
13:00	**14:30**	**Lunch**	
		Session 7: Swarm-based L2 data products and services/2	**Chairs: Patrick Alken / Yanyan Yang***
14:30	14:45	The Future of the Geospace Dynamics Constellation: Harnessing the Power of Enhanced Instruments, Architecture, and Ground-Based Observations	Amy Rager
14:45	15:00	The main Achievements and current situation of CSES mission	Xuhui Shen
15:00	15:15	Recent Progress on CSES Magnetic Field Calibration and Geomagnetic Field Modeling	Yanyan Yang*
15:15	15:30	Ten years of Swarm observations of earthquakes: from single case study to large statistics as a function of focal mechanism and sea/land location of seismic events.	Dedalo Marchetti
15:30	15:45	Characteristics of the same ionospheric parameters detected by ZH-1 and Swarm satellites pre-and post-earthquakes with magnitude Ms≥6.0 in West China	Yang Muping
15:45	**16:00**	**Discussion and Recommendations**	
16:00	**16:45**	**General discussion and conclusions**	

*remote participant