

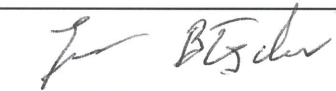
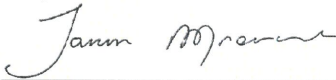
**Minutes of Meeting - Milestone Meeting #2**

**21.10.2019 - ESRIN, ESA, Frascati**

**CCN2 - Swarm4Anom**

**Attendees:**

[AS] - Anja Stromme (ESA)  
[RH] - Roger Haagmans (ESA)  
[FC] - Filomena Catapano (ESA)  
[EQ] - Enkelejda Qamili (ESA)  
[LT] - Lorenzo Trenchi (ESA)  
[JB] - Jan Błęcki (CBK)  
[JM] - Janusz Młynarczyk (AGH)  
[ES] - Ewa Słomińska (OBSEE)  
[MS] - Marek Strumik (CBK)

<b>Prepared by:</b>	<b>E. Slominska</b>
<b>Approved by:</b>	
<b>Jan Błęcki (CBK)</b>	
<b>Janusz Młynarczyk (AGH)</b>	
<b>Roger Haagmans (ESA)</b>	

*Agenda:*

*Part I - Swarm4Anom - Swarm I\_NDD product for Ionospheric Anomalies*  
*Ewa Slominska, OBSEE*

*Normalized density difference index - from the concept to main findings*  
*- Status of the product,*  
*- main scientific results*  
*- applicability of the index to the equatorial ionosphere*  
*Marek Strumik, CBK*

*TIEGCM modeling and 3D visualizations as tools for interpretation of Swarm (and other satellite) measurements*

*Discussion*

*Part II - Swarm for TLEs (Transient Luminous Events)*

*11:30- 12:15 (Ewa Slominska, OBSEE)*

*Capabilities of the Swarm magnetometers to detect events related to lightning activity:*

- Approach to the problem, main goals and review of selected results*
- Synergies with other satellite mission.*

*12:15 - 12:50 (Marek Strumik, CBK)*

*Swarm measurements and lightning activity: minimum variance and inter-satellite cross-correlation analysis*

*Lunch*

*14:00 - 14:45 (Janusz Mlynarczyk, AGH)*

*Searching for correlations between magnetic field variation on Swarm and atmospheric discharges observed by ELF ground stations*

*14:45 - 15:15 (Jan Blecki, CBK)*

*Remarks on the "whistler" type waves registered in space.*

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**Report #1:** ES reviewed the main concept of the Swarm index product. ES reported that the data product stored on the CBK servers is upgraded on a regular basis, since the beginning of the mission.

The link to the product is:

<http://swarm4anom.cbk.waw.pl/s4a/prodcdf/>

**Report #2:** ES reported that results obtained from the modeling studies focused on the impact of the geomagnetic field secular variation and its impact on the spatial pattern of the Weddell Sea Anomaly has been submitted to Journal of Geophysical Research - Space Physics. The manuscript "Analysis of the impact of long-term changes in the geomagnetic field on the spatial pattern of the Weddell Sea Anomaly" has been assigned the manuscript #2019JA027528 and is under revision. Draft of the manuscript is attached as one of MS deliverables.

**Report #3:** ES reported that detailed analysis of Swarm response to the decreasing phase of the solar cycle is still under preparation. RH pointed out, that analysis should also include the seasonal dependence of the index.

**Report #4:** MS presented vast range of results from numerical simulations based on the NCAR TIEGCM model. Presentations included discussion of key mechanisms responsible for the formation of the WSA. MS reported that in order to give a more accurate representation of

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physical conditions, in future simulations, TIEGCM should be fed with real data reflecting solar and magnetic conditions, instead of stand-alone runs based on fixed parameters.

**Report #5:** AS suggested to start closer cooperation with the TIEGCM NCAR team, for potential further improvements of physical description of the WSA anomaly, and other linked phenomena.

**Report #6:** AS, RH, LT agreed that simulation presented by MS, should be used presentations promoting the Swarm mission and its capabilities.

**Report #7:** ES presented improved approach to analysis of fluctuations in Swarm MAG VFM 50 Hz data possibly triggered by strong lightning discharges. Several examples of cross-analysis with GLM data from the GEOS-R satellite were presented. Selected cases provide a critical set of examples showing the response of Swarm's magnetometers to strong discharges.

**Action #1:** RH stated that, for publication purposes, synchronization between Swarm and GLM time-series has to be improved in order to assess more convincing representation of results.

**Report #8:** LT pointed that VFM data is very noisy, thus it is recommended to expand analysis with ASM burst data, when available. ES showed that such attempt has been made and obtained results suggest that despite lower resolution 50 Hz MAG VFM data show very good agreement with 250 Hz ASM readings.

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**Report #9:** EQ reported that full set of the 250 Hz ASM data should be available in two weeks time.

**Report #10:** MS presented detailed analysis of wave properties for selected cases in the American sector using minimum variance approach. Applied method suggests that due to emissions triggered by TLEs, two main classes of effects can be observed by Swarm - waves propagating directly from the ground to the satellite, and those which were reflected and amplified in the IAR.

**Report #11:** LT suggested that maybe it is worth to supplement analysis with the 16 Hz TII ion outflows gathered by the TII instrument, and see if additional information can be derived from other data provided by Swarm.

**Action #2:** Based on informal communication with the ASIM team, AS informed that data from ASIM should be available by November. AS and RH pointed out that additional work on cross-correlation between ASIM and Swarm is of interest for the project and both missions.

**Report #12:** JM provided confirmation with ground-based data from the WERA system, showing that for a series of selected cases there is agreement between Swarm and ULF data proving that Swarm is able to detect signatures of TLEs.

**Report #13:** JB gave the review of types of plasma waves and stated that observed on Swarm whistler-type emissions, should be properly called ion cyclotron waves.

***Deliverables scheduled for the MS2:***

1. Draft of publication submitted to JGR:  
"Analysis of the impact of long-term changes in the geomagnetic field on the spatial pattern of the Weddell Sea Anomaly" - manuscript #2019JA027528

2. *Database of Swarm and TLEs used for verification with ground-based observations*  
<http://swarm4anom.cbk.waw.pl/gauss/YYYYMM/>

Selection of cases is stored in a QuickLook form of images showing following types:

- Synthetic gauss function, fit to data samples: "\*\_f.png"- file ending: extended name of the file (after the Mod- prefix ) denotes time and location of detected spikes, and amplitudes: T0 = 153416, lon0 = 74.6, lat0 = 34.1

SW\_OPER\_MAGA\_HR\_1B\_????????T000000\_????????T235959\_0505\_20181101\_000000\_20181101\_235959\_Mod6.012\_153416\_74.6\_34.1\_-0.16\_0.21\_f.png

- Global distribution of detected spikes: in "ascending" and "descending" passes. Files with ending "a.png" denote all detected spikes, while with "g.png" limit cases to those meeting criteria of lightning occurrence.

Selected piece of data with detected event, with time-series representing magnetic field spectrum and plasma properties in the time frame around observed peak.

SpectrumPlasma-SwA-????-F-????????T??????\_????????T??????\_011636w.png

Presentations and materials from the MS meeting are stored in the directory:  
<http://swarm4anom.cbk.waw.pl/CCN2/MS2/>

**Conclusions:** All deliverables which were due to MS2 were provided. They are acceptable in the current state. Study team accepts that revision to the document may be done at the request by ESA at a later stage. MS2 review was successfully completed and the corresponding invoices can be submitted