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IDEAS+ Swarm Weekly Report : 10/11/2014 – 16/11/2014

Abstract : This is the **Instrument Data quality Evaluation and Analysis Service Plus** (IDEAS+) Swarm Weekly report on Swarm products quality, covering the period from 10 to 16 November, 2014.

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AMENDMENT POLICY

This document shall be amended by releasing a new edition of the document in its entirety. The Amendment Record Sheet below records the history and issue status of this document.

AMENDMENT RECORD SHEET

ISSUE	DATE	REASON
1.0	21 Nov 2014	First issue

1. INTRODUCTION

This document refers to the activities carried out in the framework of the Sensor Performance, Products and Algorithms (SPPA) Office [RD.1], and as such it reports on work related to:

- Algorithms and Processors Development, Maintenance and Evolution: these include all algorithm and software evolution and maintenance aspects for the different components, for both the Operational processors (OP) and Prototypes processors (PP) of L1 and L2 chains.
- Performance Assessment: these include all Quality Control activities (on-line and offline, systematic or on-demand), for the applicable product levels.
- System Calibration: these include the activities related to calibration, from sensor to system level. They also include aspects like cross calibration and handling of external calibration sources.
- Product validation: these include definition and maintenance of product validation plans.
- End-to-end Sensor Dataset Performance: these include activities related to the organisation and coordination of Quality Working Groups and all aspects of the Experimental platform. It also covers the product baseline, coordination and handling of external communities, and all aspects of ADF handling (both for the operational processors and for the prototypes).

This weekly report constitutes a work in progress throughout the mission life time, and new parts and complements will be added while the consolidation of knowledge on Swarm data and instruments will progress.

Section 2.1 always gives an overview of the general quality status of the mission instruments and products, while the main observations of the week are summarized in Section 2.4.

The document also includes information on data quality for the three Swarm spacecraft, inferred from automated HTML quality reports which are produced on daily basis for each product. Please contact the IDEAS+ Swarm team if interested in accessing the reports via web or FTP (all details about interfaces and folder structure available on [RD.2]). Such quality reports represent the core of the Routine Quality Control (Chapter 3). A description of the implemented quality checks is given in [RD.3], and references therein.

Basing on specific findings of the routine quality control, or on-demand from other entities (i.e. Swarm PDGS, FOS, Mission Management, Post-Launch Support Office, Expert Support Laboratories, Quality Working Groups, user community), anomalies can be triggered and preliminary characterisations and investigations of such anomalies are given in Chapter 4.The anomalies documented in the Weekly Reports are tracked in the following way:

1. If triggered by ESA Eohelp or within the Service: IDEAS+ action and ticketing system (http://requests-sppa.serco.it/RT3/index.html).

2. If triggered by IDEAS+ Swarm team or other entities:

    2a. If the observation/analysis leads to an anomaly to be addressed to the processor provider (GMV): SPR on EO ARTS (https://arts.eo.esa.int), **SWL1L2DB** project.

2.b. If the observation/analysis does not lead to an anomaly or the investigation shall be escalated to other entities (PLSO/industry, ESL, PDGS): Action tracked on EO ARTS, **SW-IDEAS** project, then addressed to the proper tracking system if needed (e.g. JIRA for ESLs, SW-CP-AR project on EO ARTS for PDGS)

Information on Level 1B Swarm products can be found in [RD.4].

1.1 Current Operational configuration of monitored data:

- Processors Version: L1BOP 3.11p3, L2-Cat2 1.12
- L0 input products baseline: 02
- L1B baseline: 03 (for definitions and description of the data baseline concept see https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/swarm/data-access/product-baseline-definition)
- Level 2 – Cat 2 baseline: 01
- Input auxiliary files baseline: CCDB 0009, ADF 0101
- MPPF-CVQ v.2.11p2

1.2 Reference documents

The following is a list of documents with a direct bearing on the content of this report. Where referenced in the text, these are identified as RD.n, where 'n' is the number in the list below:

[RD.1] Sensor Performance, Products and Algorithms (SPPA), PGSI-GSOP-EOPG-TN-05-0025. Version 2.3.

[RD.2] Swarm PDGS External DMC Interface Control Document, SW-ID-DS-GS-0001, Issue 3.2.

[RD.3] Swarm MPPF-CVQ Monitoring Baseline Document, ST-ESA-SWARM-MBD-0001, Issue 1.7.

[RD.4] Swarm Level 1B Product Definition, SW-RS-DSC-SY-0007, Issue 5.13.

[RD.5] Swarm IDEAS Configuration Management Plan, IDEAS-SER-MGT-PLN-1081 v0.14.

[RD.6] Swarm Quality Control Project Plan, IDEAS-SER-MGT-PLN-1071

[RD.7] SW_L1BOP_status_20141114_MoM

[RD.8] Planned Updates for Level 1b, SW-PL-DTU-GS-008, Rev: 1dC.

[RD.9] IDEAS+ Swarm Weekly Report: 25/08/2014 – 31/08/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20140825_20140831.pdf

[RD.10] IDEAS+ Swarm Weekly Report: 29/09/2014 – 05/10/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20140929_20141005.pdf

[RD.11] IDEAS+ Swarm Weekly Report: 20/10/2014 – 26/10/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20141020_20141026.pdf

[RD.12] IDEAS+ Swarm Weekly Report: 22/09/2014 – 28/09/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20140922_20140928.pdf

2. SUMMARY OF THE OBSERVATIONS

2.1 General status of Swarm instruments and Level 1B products quality

With respect to the previous reporting period, the following updates have to be reported:

The Absolute Scalar Magnetometer on Swarm C. Several attempts have been done in order to switch up again the ASM on C. We are also trying to switch up the redundant unit which was declared lost during the commissioning phase. Up to now the attempts are unfruitful. The instrument receives the switch-on command and correctly goes in "ready" state, but it does not start the vector mode sequence and therefore does not take any data. The current strategy is to try to heat up a bit the electronics (up to 40 deg. or so), for favouring the correct initialisation of some states in the controller that perhaps got stuck at the time of the switch-off.

The burn-in procedure applied to TII on S/C C goes to the end of its first phase. The MCP "scrubbing" is considered very effective and Univ. of Calgary reports about dramatic improvements in the gain profiles and in the 2nd y moments, especially for the horizontal sensor. During week 48 (24-28/11), the combined MCP-phosphor scrubbing will commence, ramping the phosphor voltage up to 5000 V, keeping the MCP voltage to -1900 V and spanning Vg through a series of values: the aim of this procedure is to "blur" the phosphors for eliminating possible residual gas. The recommendation from the manufacturer would be to operate the phosphors with a voltage at least 20% higher than the nominal operations, i.e. 6000 V in our case. As we still lack clear information about the full qualification of the instrument above 5000 V, we will first run the instruments at 5000 V for a cycle then, if the results are not very satisfactory, we will re-discuss on the opportunity to push a bit beyond. At the same time, the MCP burn-in already done on C, will start also on B and A during week 48 (first on B, then on A, because a constellation manoeuvre is foreseen on A for that week that could be possibly cause the EFI switch off).

2.2 Plan for operational processor updates

On the last L1B teleconference (14/11/2014, [RD.7]) it has been decided to post-pone the delivery to the 28th of November for the following reasons:

1. Some SPR scenario is hard to tackle, because the fixes risk to cause damage in other parts of the processing. Some more time is needed for handling this properly.

2. The recent ASM failure on C opens quite dramatic needs on the processing: we cannot loose all the magnetic data because of that, so the processor needs to handle the lack of ASM data. GMV says that this is not difficult to be done, in terms of code, but rather tricky and tedious, because the ASM data are used in many parts of the code and the work to be done should be very careful.

Other information: the plasma cross-verification further advanced, and now all the issues related to the Langmuir Probes have been spotted and fixed; J. Burchill from Univ. of Calgary provided evidences of the fact that cross-verification between the OP and the "sandbox" works much better with respect to the EFI Matlab prototype. As a final step of the cross-verification process before the delivery, GMV is going to compare the fitting libraries used in OP with the ones in the sandbox.

2.3 Quality Working Group and Cal/Val Coordination

The third QWG – Cal/Val meeting is being planned for the 2-5 December 2014 at GFZ premises in Potsdam, Germany.

A number of Task forces, each dedicated to an instrument group, continuously co-ordinates the investigation of the various anomalies.

2.4 Summary of observations for Week 46 (10-16/11/2014)

During the monitored week the following events have been found and investigated:

1. **Strange features observed again in the MOD-GPSNAV solution difference:** again we often notice a marked "spiky" behaviour, with deviations from the average which are not normal spikes but lasts for several seconds if not minutes (**SW-IDEAS-34**, [RD.10]); we also report again about two evidences of **SWL1L2DB-9** ([RD.9]): the MOD-NAV solution difference starts to diverge from the average value up to the end of the day.

2. **14 cases of GPS loss of sync occurred during the week.** The phenomenon involves all the S/C. This causes rejection of the corresponding Level 0 packets in the Level 1B processing and consequent data gaps in STR and magnetic products (**SW-IDEAS-40**, [RD.11]).

3. **Several rejected attitudes to be reported in S/C B and C,** because of the simultaneous occurrence of either BBOs and invalid measurements (Flags_q = 255). This issue is traced through SW-IDEAS-43 and SW-IDEAS-44

4. **Magnetic production lost on S/C C for the whole week**, because of the ASM switch off mentioned above.

3. ROUTINE QUALITY CONTROL

3.1 Gaps analysis

SW-IDEAS-40:

The GPS sync losses already mentioned in Sect. 2.4 affect all the Level 0 products. The Sync Status is = 32 for all the intervals specified in Sect. 3.2.1.2, 3.2.2.2 and 3.2.3.2, also for the ASMxVEC_0_ and VFMxNOM_0_ product types of Swarm A, B and C affected by such sync loss, and this causes the corresponding records to be rejected and not processed further.

In the MAGx_HR_1B product types a gap is left corresponding to the a GPS sync loss interval, while in the MAGx_LR_1B product types, in the same intervals, all the magnetic values are set to exactly zero (but properly flagged as not good).

3.2 Orbit and Attitude Products

The following events have to be reported:

Observation ID	Description	Affected parameter	Sect. of Obs. Description	Sect. of Obs. analysis
SW-IDEAS-34	OBS_ROUTINE: large number of spiky features observed in the NAV-MOD difference	Orbits (position and velocity)	3.2.1.1	[RD.10]
SWL1L2DB-9	OBS_ROUTINE: deviations of MOD-NAV solution apparently correlated with GPS clock deterioration	Orbits (position and velocity)	3.2.3.1	[RD.9]
SW-IDEAS-40	OBS_ROUTINE: STR out of range - ANOMALOUS CASES	STRCATT_1B STRCSCI_1A	3.2.1.2, 3.2.2.2 3.2.3.2	[RD.11]
SW-IDEAS-43	OBS_ROUTINE: week 10-16/11 STR S/C B out of range.	STRCATT_1B STRCSCI_1A	3.2.2.2	3.2.2.2
SW-IDEAS-44	OBS_ROUTINE: week 10-16/11 STR S/C C out of range.	STRCATT_1B STRCSCI_1A	3.2.3.2	3.2.3.2

Table 1: list of events related to attitude and orbit products to be reported in the monitoring for Week 46: 10 - 16/11/2014

The relevant parameters that have been monitored are:

- Position difference between calculated Medium Accuracy orbits (**MODx_SC_1B**) and on-board solution (**GPSxNAV_0**). Threshold values for such differences have not been assessed yet: we have just monitored the average values and maximum variations around the week, and reported in tables in the sections below, along with some example from the HTML daily reports. For the time being we evaluated an anomaly should be raised if one (or more) of the following conditions occurs:
    - The **average difference** on a given day exceeds the position accuracy requirement for the mission (1.5 m),
    - The variability around the average is quite high: **standard deviation** threshold has been arbitrarily chosen to be twice the position accuracy requirement for the mission (2-sigma = 3 m).
    - At least 4-5 spikes are observed on a given day, exceeding +/- 50 m.
- Visual inspection of Star Tracker characterisation flags (**STRxATT_1B**)
- Deviation of the quaternion norm from unity (deviation threshold = +/- 10^{-9})
- Visual inspection of Euler Angles derived from quaternions.

3.2.1 Swarm A

3.2.1.1 Position statistics

In Table 2 one can see the statistics of the differences between MOD and on-board solution positions. In the third column the maximum differences (maximum negative and maximum positive) are reported with, in parentheses, the ITRF component affected by such difference. The maximum standard deviation is in the fourth column: it usually refers to the Z component which is always the most disturbed; in case another component is most affected, it will be specified in parentheses.

Swarm A, 10-16/11/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard deviation (m)**	**Notes**
10/11	0.06	-9 (Z), 17 (X)	1.5	Big spikes corresponding to GPS sync losses
11/11	0.2	-7.6, 6.6 (Z)	1.3	
12/11	0.17	+/- 9 (Z)	1.6	
13/11	0.11	-9.6, 19 (Z)	1.7	Big spikes corresponding to GPS sync losses
14/11	0.13	-13, 8.6 (Z)	1.4	
15/11	0.11	-12, 11 (Z)	1.7	
16/11	0.11	-10 (Z), 10 (Y)	1.5	SW-IDEAS-34

Swarm A, 10-16/11/2014, Position difference				
				[RD.10]

Table 2: Swarm A, difference between MOD and on-board solution positions.

Below some plot example follows of such differences taken at the beginning of the week (10/11, Figure 1), in the middle (13/11, Figure 2) and at the end (16/11, Figure 3). From top to bottom the plots show: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two. The values are given in Km.

In Figure 3 one can see a couple of example (red-circles areas) of intervals affected by **SW-IDEAS-34** anomaly ([RD.10]): spiky features are observed in the MOD-NAV solutions difference, which are not mere spikes but departures from the average value that last for several minutes.

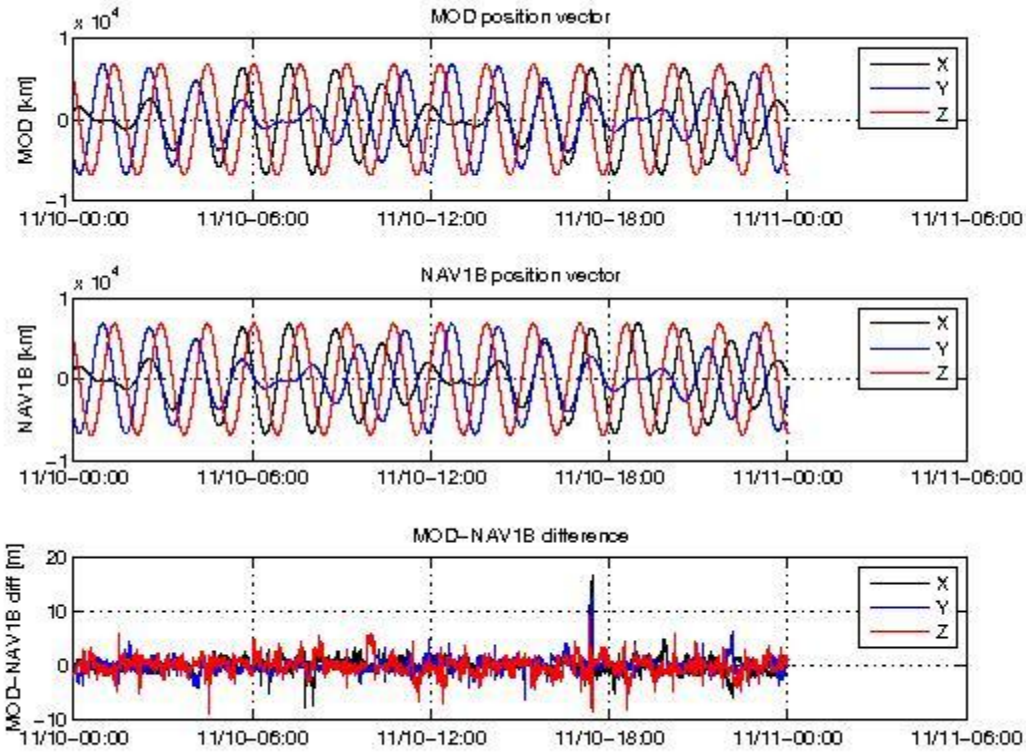

Figure 1: Difference MOD-GPSNAV, sc A, 10/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

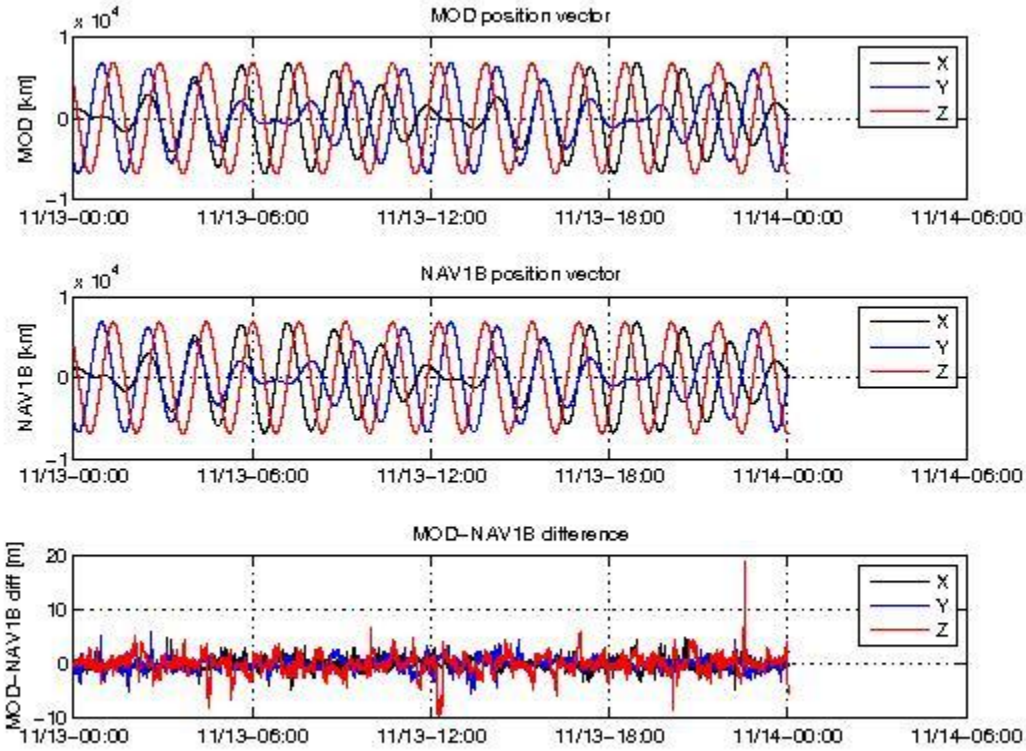

Figure 2: Difference MOD-GPSNAV, sc A, 13/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

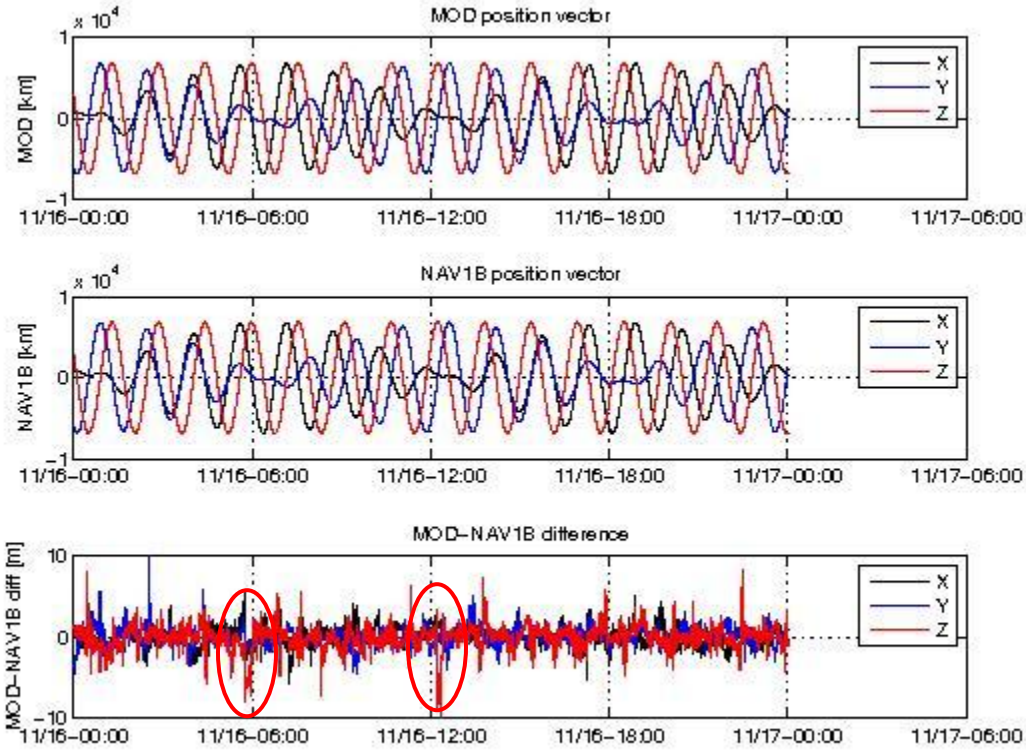

Figure 3: Difference MOD-GPSNAV, sc A, 16/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two. The red-circled areas highlight intervals affected by SW-IDEAS-34 ([RD.10]).

3.2.1.2 Attitude observations

- **SW-IDEAS-40**

  During week 46 several GPS out-of-Sync were detected. As explained in [RD.11], this affects the STR data, causing rejection of packets in the Level 1A products and filling gaps with zero quaternions and Flags_q = 255 in the Level 1B products. In Table 3 below, the list of such events for S/C A is given.

Start Out-of-range	Stop Out-of-range	Duration (s)
10NOV2014 17:19:55	10NOV2014 17:20:08	13
10NOV2014 17:23:58	10NOV2014 17:24:49	51
12NOV2014 17:34:32	12NOV2014 17:42:08	40*
12NOV2014 20:57:45	12NOV2014 20:58:08	23

Table 3: Attitudes out-of-range due to GPS out-of-sync, S/C A, 10 – 16/11/2014.

*40 seconds out-of-sync in the interval, summed up over six sub-intervals.

3.2.2 Swarm B

3.2.2.1 Position Statistics

In Table 4 one can see the statistics of the differences between MOD and on-board solution positions. In the third column the maximum differences (maximum negative and maximum positive) are reported with, in parentheses, the ITRF component affected by such difference. The maximum standard deviation is in the fourth column: it usually refers to the Z component which is always the most disturbed; in case another component is most affected, it will be specified in parentheses.

Swarm B, 10-16/11/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard Deviation (m)**	**Notes**
10/11	0.1	-13.7 (Y), 12 (Z)	1.6	
11/11	0.07	+/- 7.5 (Z)	1.2	
12/11	0.11	-101 (Y), 21 (X)	2 (Y)	Huge spikes corresponding to a GPS out-of-Sync
13/11	0.11	-10.6 (Y), 15.5 (X)	1.5	
14/11	0.17	-9.2, 8.2 (Z)	1.3	SW-IDEAS-34 [RD.10]
15/11	0.19	-19.5 (Y), 20.5 (X)	1.5	Big spikes corresponding to a GPS sync loss
16/11	0.03	-12 (Y), 10 (Z)	1.7	SWL1L2DB-9 [RD.9]

Table 4: Swarm B, difference between MOD and on-board solution positions.

Below some plot example follows of such differences taken at the beginning of the week (10/11, Figure 4), in the middle (13/11, Figure 5), and at end of the week (16/11, Figure 6). From top to bottom the plots show: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two. The values are given in Km.

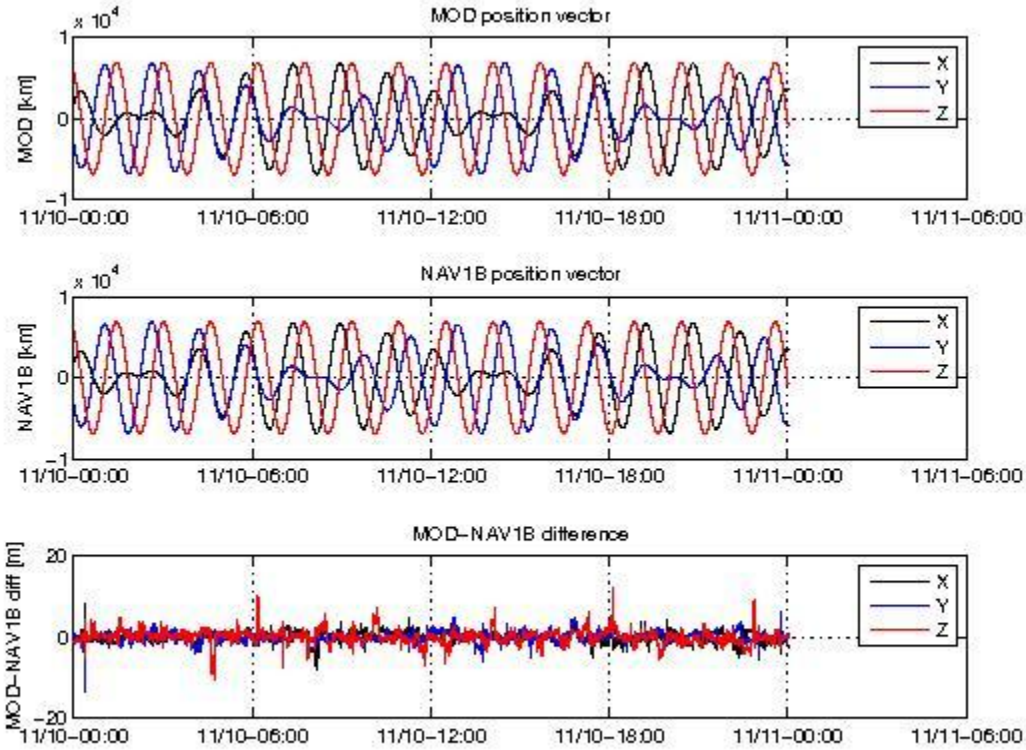

Figure 4: Difference MOD-GPSNAV, sc B, 10/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

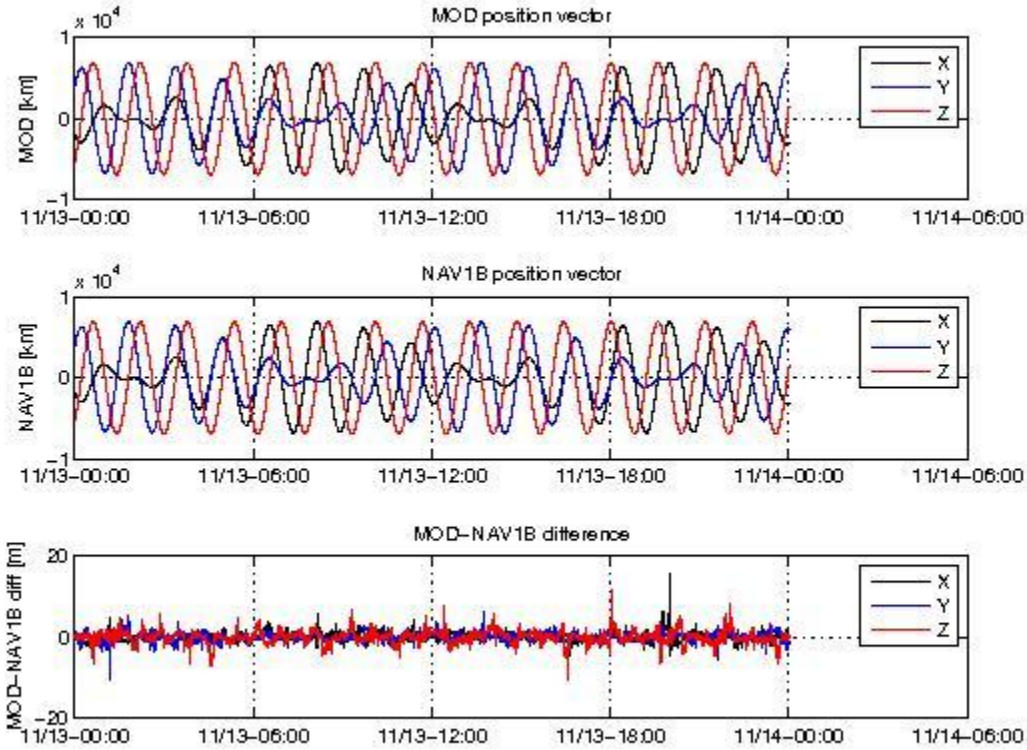

Figure 5: Difference MOD-GPSNAV, sc B, 13/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

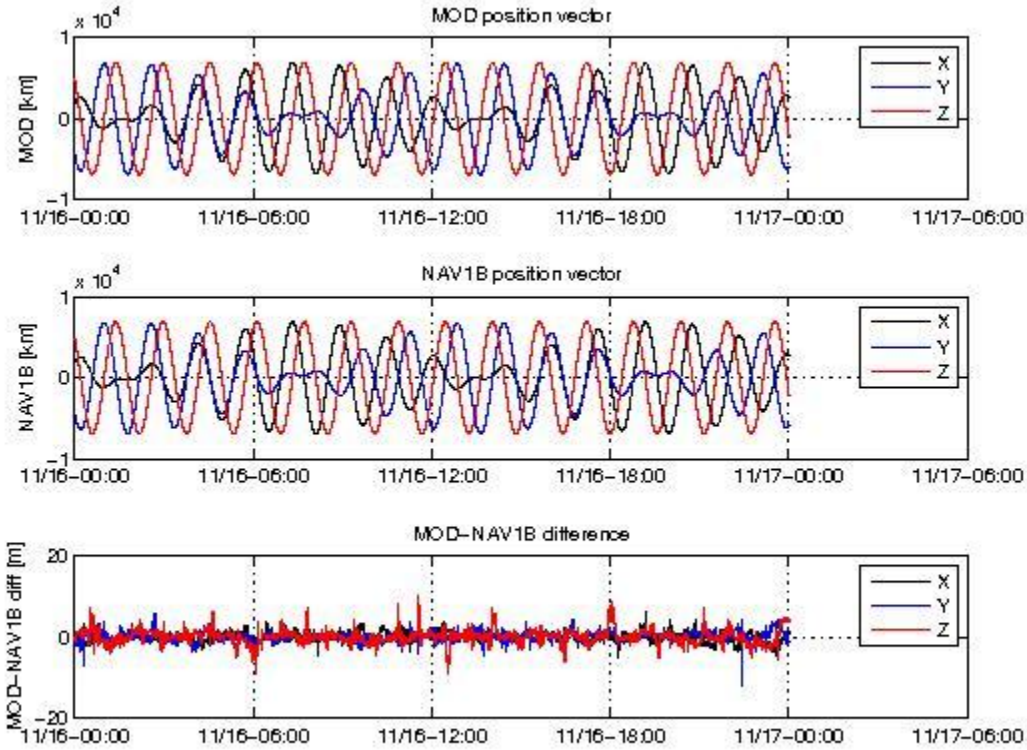

Figure 6: Difference MOD-GPSNAV, sc B, 16/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

3.2.2.2 Attitude observations

- **SW-IDEAS-40**

  During week 46 several GPS out-of-Sync were detected. As explained in [RD.11], this affects the STR data, causing rejection of packets in the Level 1A products and filling gaps with zero quaternions and Flags_q = 255 in the Level 1B products. In Table 5 below, the list of such events for S/C B is given.

Start Out-of-range	Stop Out-of-range	Duration (s)
10NOV2014 00:21:49	10NOV2014 00:22:38	50
12NOV2014 23:32:36	12NOV2014 23:32:40	4
13NOV2014 01:09:18	13NOV2014 01:09:38	20
15NOV2014 22:42:03	15NOV2014 22:42:38	35

Table 5: Attitudes out-of-range due to GPS out-of-sync, S/C B, 10 – 16/11/2014.

- **SW-IDEAS-43**

Affected products:

SW_OPER_STRBATT_1B_20141111T000000_20141111T235959_0302

SW_OPER_STRBATT_1B_20141113T000000_20141113T235959_0302

SW_OPER_STRBATT_1B_20141114T000000_20141114T235959_0302

SW_OPER_STRBATT_1B_20141116T000000_20141116T235959_0302

87 seconds out of range (Flags_q=255, no attitude available).

See Table 6 for details.

Start Out-of-range	Stop Out-of-range	Duration (s)	Value
11NOV2014 22:27:25	11NOV2014 22:27:33	9	255
13NOV2014 01:19:18	13NOV2014 01:19:38	20	255
13NOV2014 01:42:07	13NOV2014 01:42:14	7	255
13NOV2014 11:06:15	13NOV2014 11:06:19	4	255
13NOV2014 17:25:58	13NOV2014 17:26:22	24	255
14NOV2014 01:22:43	14NOV2014 01:22:50	8	255
16NOV2014 12:55:00	16NOV2014 12:55:15	15	255

Table 6: Attitudes out-of-range, S/C B, 10-16/11/2014

The cause of such rejected attitudes is the simultaneous occurrence of BBOs, invalid measurements and invalid sequence on the three cameras for the specified interval.

3.2.3 Swarm C

3.2.3.1 Position Statistics

In Table 7 one can see the statistics of the differences between MOD and on-board solution positions. In the third column the maximum differences (maximum negative and maximum positive) are reported with, in parentheses, the ITRF component affected by such difference. The maximum standard deviation is in the fourth column: it usually refers to the Z component which is always the most disturbed; in case another component is most affected, it will be specified in parentheses.

Swarm C, 10-16/11/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard Deviation (m)**	**Notes**
10/11	0.06	-9.3, 13.7 (X)	1.5	
11/11	0.13	-9.7 (Z), 11 (X)	1.3	
12/11	0.16	-9.2 (Z), 8.6 (Y)	1.6	
13/11	0.09	-10, 17 (Z)	1.7	Big spikes corresponding to GPS sync loss
14/11	0.15	-9.6 (Z), 8.6 (X)	1.5	SWL1L2DB-9 [RD.9]
15/11	0.1	+/- 12 (Z)	1.7	
16/11	0.2	-9, 10.4 (Z)	1.5	SW-IDEAS-34 [RD.10]

Table 7: Swarm C, difference between MOD and on-board solution positions.

Below some plot example of such differences follows, taken at the beginning of the week (10/11, Figure 7), in the middle (14/11, Figure 8) and at the end (16/11, Figure 9). From top to bottom the plots show: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two. The values are given in Km.

In Figure 8, the red-circled area highlights an interval affected by **SWL1L2DB-9** anomaly ([RD.9]): the MOD-NAV solution difference departs from the average value starting at about 18 UT and diverging until the end of the day.

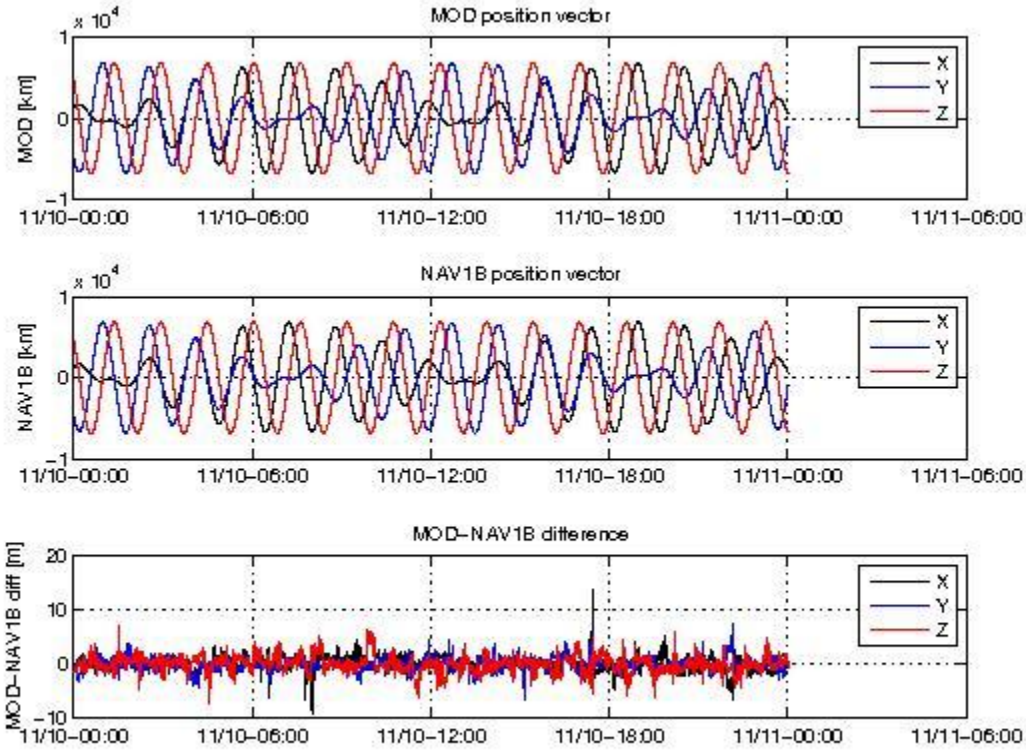

Figure 7: Difference MOD-GPSNAV, sc C, 10/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

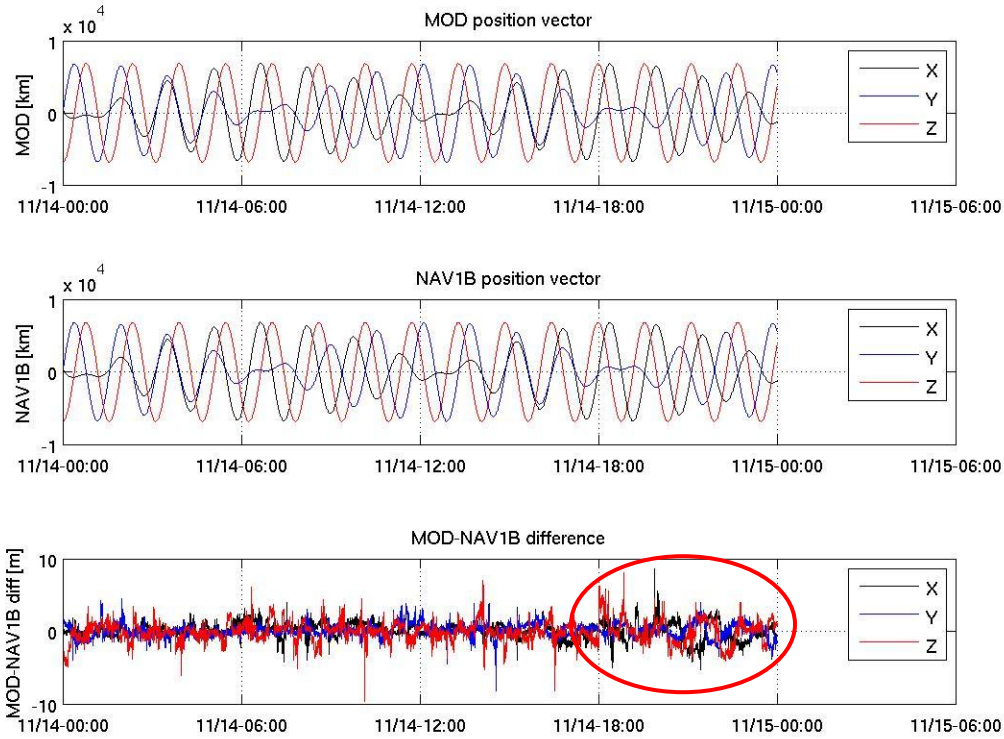

Figure 8: Difference MOD-GPSNAV, sc C, 14/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two. The red-circled area evidences an interval affected by SWL1L2DB-9 anomaly ([RD.9]).

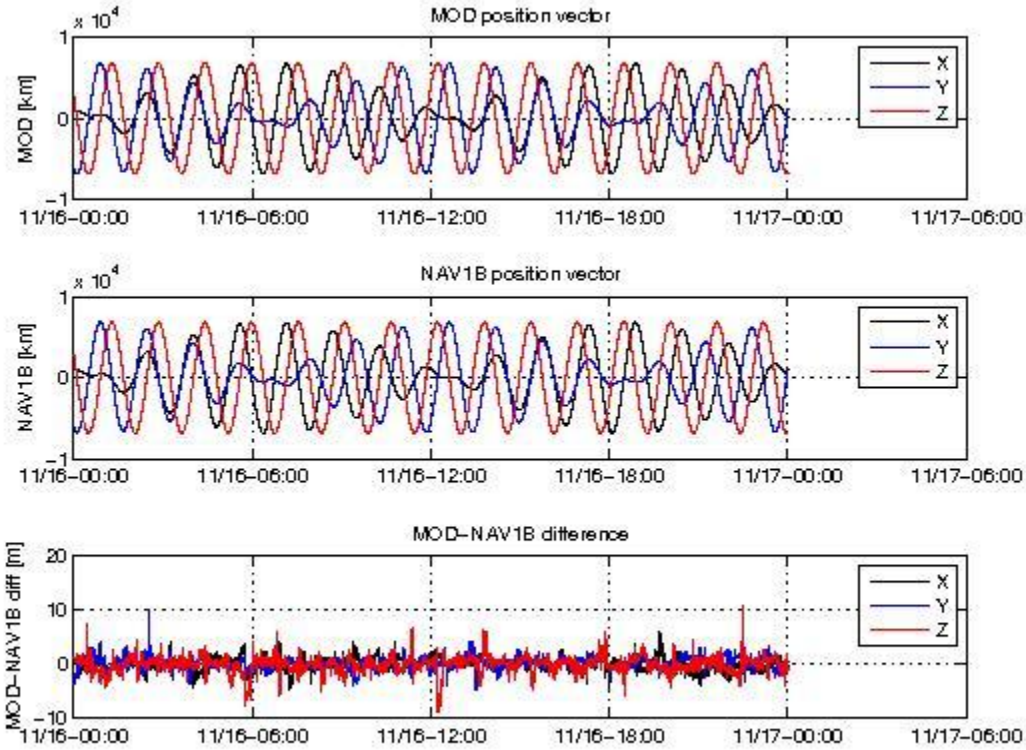

Figure 9: Difference MOD-GPSNAV, sc C, 16/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

3.2.3.2 Attitude observations

- **SW-IDEAS-40**

During week 46 several GPS out-of-Sync were detected. As explained in [RD.11], this affects the STR data, causing rejection of packets in the Level 1A products and filling gaps with zero quaternions and Flags_q = 255 in the Level 1B products. In Table 8 below, the list of such events for S/C C is given.

Start Out-of-range	Stop Out-of-range	Duration (s)
10NOV2014 17:20:56	10NOV2014 17:21:08	12
10NOV2014 17:25:12	10NOV2014 17:25:39	27
11NOV2014 21:30:33	11NOV2014 21:30:38	5
11NOV2014 23:05:51	11NOV2014 23:07:08	78
12NOV2014 20:57:41	12NOV2014 20:58:08	27

13NOV2014 22:09:24	13NOV2014 22:09:38	14

Table 8: Attitudes out-of-range due to GPS out-of-sync, S/C C, 10 – 16/11/2014.

- **SW-IDEAS-44**

Affected products:

SW_OPER_STRCATT_1B_20141111T000000_20141111T235959_0302

SW_OPER_STRCATT_1B_20141112T000000_20141112T235959_0302

57 seconds out of range (Flags_q=255, no attitude available).

See Table 9 for details.

Start Out-of-range	Stop Out-of-range	Duration (s)	Value
11NOV2014 19:26:46	11NOV2014 19:27:12	26	255
11NOV2014 23:43:07	11NOV2014 23:43:25	18	255
12NOV2014 09:06:26	12NOV2014 09:06:30	4	255
12NOV2014 13:47:49	12NOV2014 13:47:58	9	255

Table 9: Attitudes out-of-range, S/C C, 10-16/11/2014

The cause of such rejected attitudes is the simultaneous occurrence of BBOs, invalid measurements and invalid sequence on the three cameras for the specified interval.

3.3 Magnetic Products

For the magnetic products the weekly monitoring consists in:

- Visual inspection of daily time series of magnetic field intensity F, $\mathbf{B_{NEC}}$ and $\mathbf{B_{VFM}}$. Looking for gaps (or zero values in case of **MAGx_LR_1B** products), out-of-threshold values (i.e. exceeding +/- 60000 nT), and other strange features.

- Monitoring of the **VFM-ASM known anomaly**: visual inspection of $|B_{NEC}|$ - F and recording of daily maximum variations. If +/- 5 nT are exceed on a given day, an alert is raised.

- TCF.VFM parameters monitoring (VFM calibration parameters): series of biases, scales, non-orthogonality factors and RMS. **This check is performed on monthly basis.**

SW-IDEAS-27 (monitoring of the anomaly): During week 46 we do observe events of noise increase in the ASM-VFM residuals, especially at the beginning of the week. The

noise level in the spectral region [0.03 – 0.06] Hz often exceeds the average PSD usually observed for more “quiet” days almost every time.

3.3.1 Swarm A

3.3.1.1 Magnetic time series visual inspection

An example of representative magnetic field time series for S/C A can be seen in Figure 10 (16/11/2014).

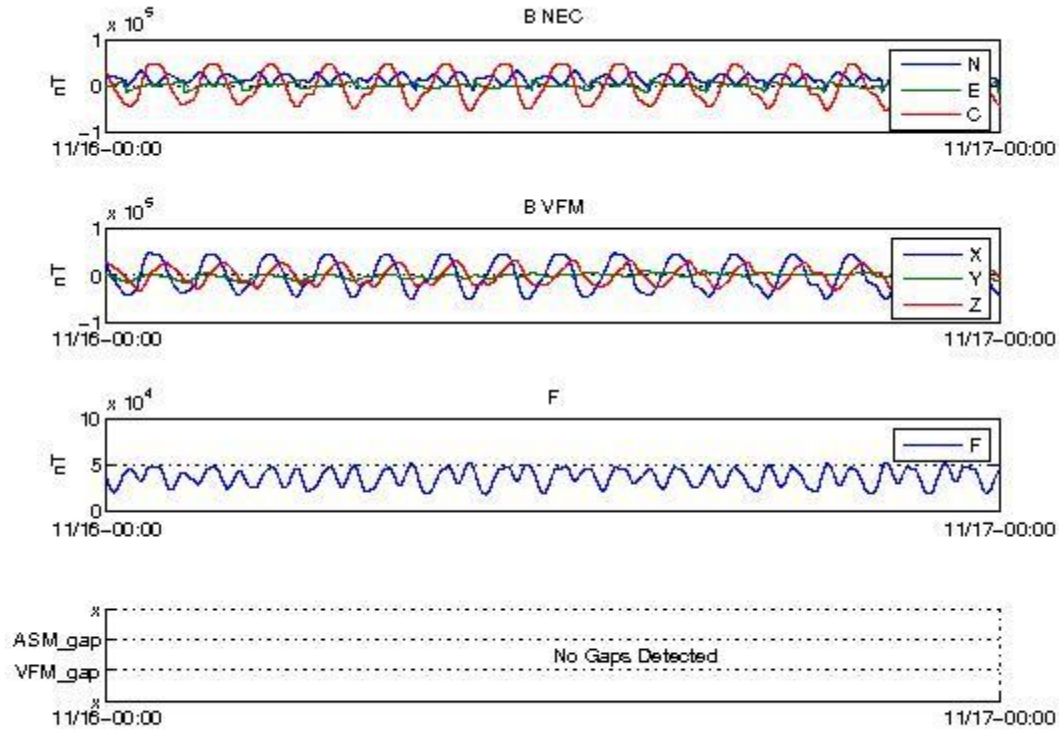

Figure 10: Time series of the geomagnetic field, for 16/11/2014, S/C A. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

3.3.1.2 VFM-ASM anomaly

The daily peak-to-peak difference around the week is, on average: [-2.5, 2] nT, with occasional spikes up to 15 nT.

Below some plot example of such differences follows, taken at the beginning of the week (11/11, Figure 11) and at the end (16/11, Figure 12). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

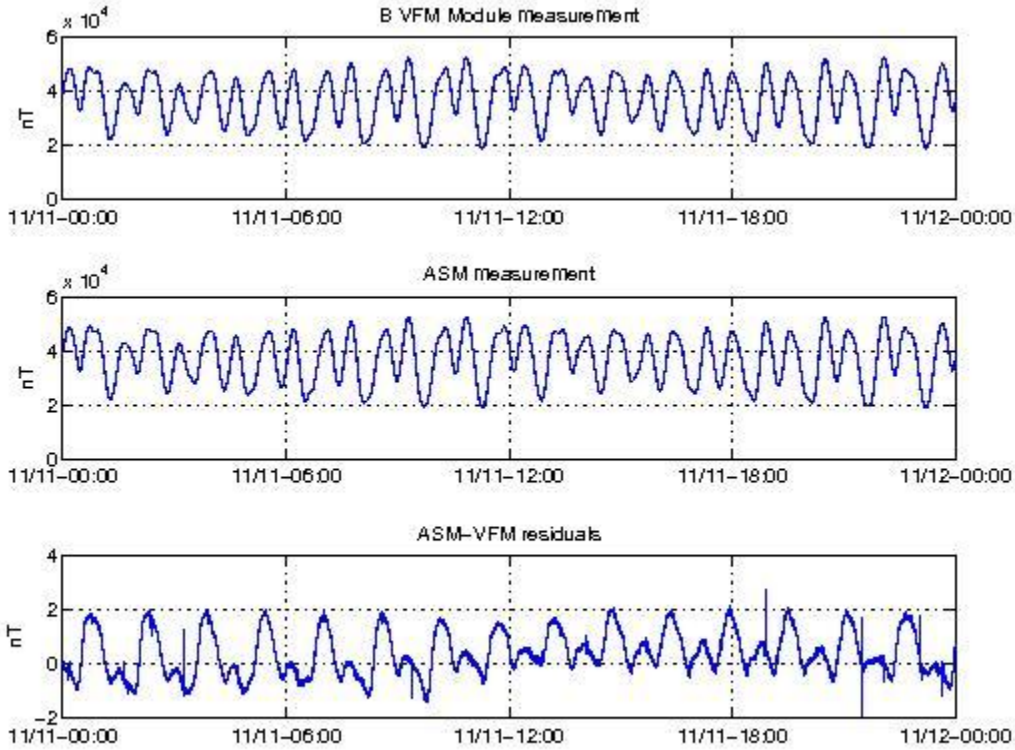

Figure 11: VFM module, ASM module and ASM-VFM residuals for S/C A, 11/11/2014.

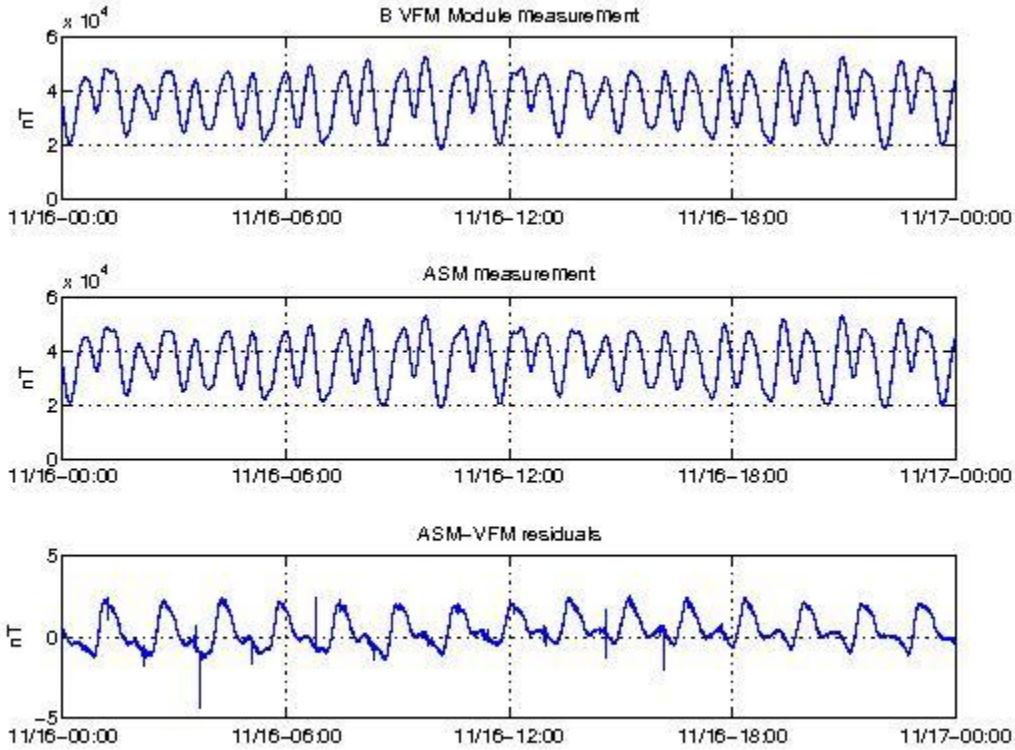

Figure 12: VFM module, ASM module and ASM-VFM residuals for S/C A, 16/11/2014.

3.3.1.3 TCF.VFM monitoring

The TCF.VFM analysis will be included in the last report of the month.

3.3.2 Swarm B

3.3.2.1 Magnetic time series visual inspection

Nothing relevant to report. An example of representative F time series for S/C B (16/11/2014) can be seen in Figure 13 below.

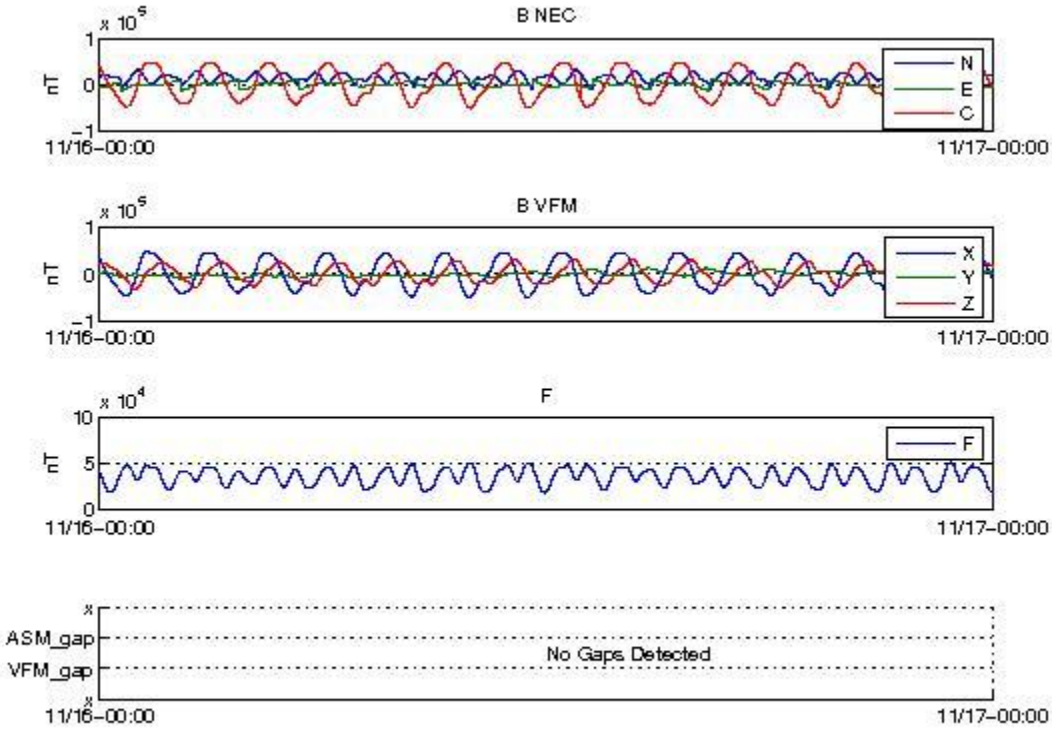

Figure 13: Time series of the geomagnetic field for 16/11/2014, S/C B. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

3.3.2.2 VFM-ASM anomaly

The daily peak-to-peak difference around the week is, on average: [-1.8, 2] nT, with isolated spikes (gradients) that reaches up to 7 nT.

Below some plot example follows of such differences taken at the beginning of the week (10/11, Figure 14), and at the end of the week (16/11, Figure 15). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

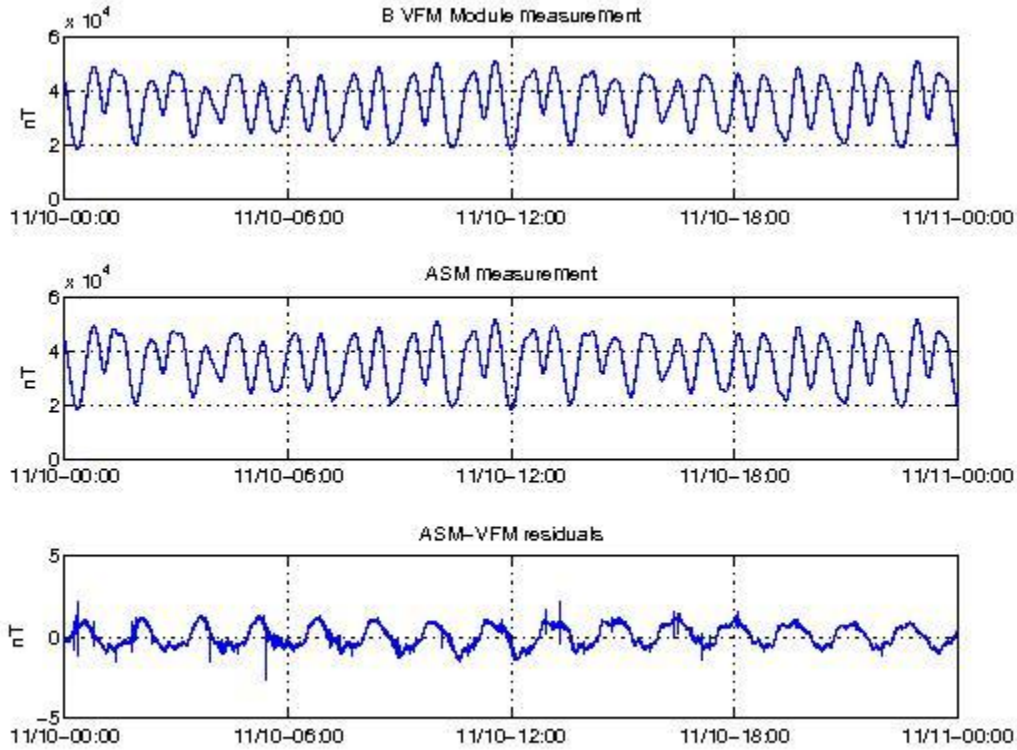

Figure 14: VFM module, ASM module and ASM-VFM residuals for S/C B, 10/11/2014

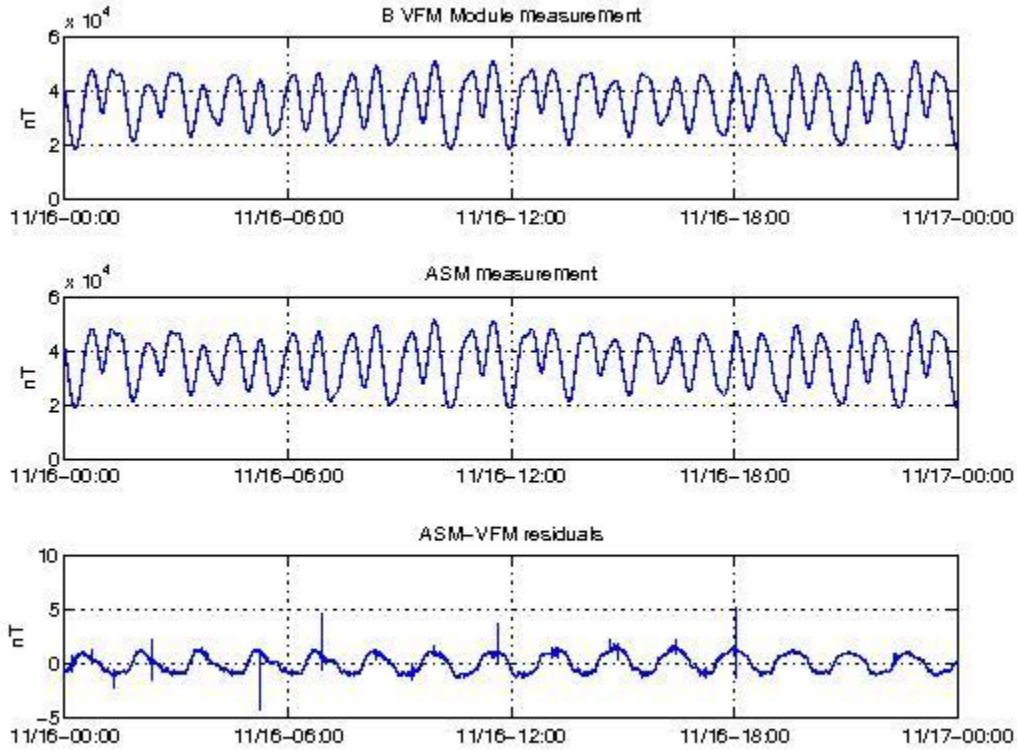

Figure 15: VFM module, ASM module and ASM-VFM residuals for S/C B, 16/11/2014.

3.3.2.3 TCF.VFM monitoring

The TCF.VFM analysis will be included in the last report of the month.

3.3.3 Swarm C

3.3.3.1 Magnetic time series visual inspection

No data because ASM is still switched off

3.3.3.2 VFM-ASM anomaly

No data because ASM is still switched off

3.3.3.3 TCF.VFM monitoring

The TCF.VFM analysis will be included in the last report of the month.

3.3.4 Summary of TCF behaviour for the three S/C

The TCF.VFM analysis will be included in the last report of the month.

4. ON-DEMAND ANALYSIS

Nothing to report.

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