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IDEAS+ Swarm Weekly Report : 27/10/2014 – 02/11/2014

Abstract : This is the **Instrument Data quality Evaluation and Analysis Service Plus** (IDEAS+) Swarm Weekly report on Swarm products quality, covering the period from 27 October to 02 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	07 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_20141027_MoM

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

[RD.9] IDEAS+ Swarm Weekly Report: 06/10/2014 – 12/10/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20141006_20141012.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:

Again several GPS out-of-sync events have been reported by FOS throughout week 44. This issue affects mainly S/C A and C (the low pair), but in one case we also see an out-of-sync on S/C B and the occurrence distribution seems to peak in proximity of the South Atlantic anomaly. A dedicated ARB is planned for 6/11/2014 in order to discuss the situation with Airbus and RUAG.

2.2 Plan for operational processor updates

Nothing to report from the past week.

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 44 (27/10-02/11/2014)

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]); at times, the NAV-MOD difference takes an oscillatory behaviour accompanied by an apparent loss of GPS clock calculation (**SW-IDEAS-36**, [RD.9])

2. **23 cases of GPS loss of sync occurred during the week.** The phenomenon involves mainly S/C A and C, but also one occurrence in S/C B is reported the 1st November. 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. **ASM-VFM residuals superimposed noise** observed at times (**SW-IDEAS-27**).

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 and 3.2.3.2, also for the ASMxVEC_0_ and VFMxNOM_0_ product types of Swarm A 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)	3.2.3.1	[RD.10]
SW-IDEAS-36	OBS_ROUTINE: deviations of MOD-NAV solution apparently correlated with GPS clock deterioration	Orbits (position and velocity)	3.2.1.1	[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]

Table 1: list of events related to attitude and orbit products to be reported in the monitoring for Week 44: 27/10 - 02/11/2014

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, 27/10-02/11/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard deviation (m)**	**Notes**
27/10	**0.5**	**-235.4 (Y), 1124.6 (X)**	**16.9**	**Huge spike corresponding to GPS loss of sync**
28/10	0.14	-11.5, 14 (Z)	1.8	SW-IDEAS-34 [RD.10]
29/10	0.2	-24.6 (Y), 9.6 (Z)	1.6	
30/10	0.15	-11 (X), 10 (Y)	1.5	SW-IDEAS-36 [RD.9]
31/10	0.08	-12, 10.8 (Y)	1.6	SW-IDEAS-36 [RD.9]
01/11	0.18	-23 (Y), 12.4 (X)	1.4	Spikes corresponding to GPS loss of sync
02/11	0.05	-16.5 (Y), 14.5 (Z)	1.4	

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 (28/10, Figure 1), in the middle (30/10, Figure 2) and at the end (02/11, 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 2, lower panel, one can see an example of **SW-IDEAS-36** observation (red-circled area): the MOD-NAV solution difference seems to show an oscillatory behaviour; during the same interval the GPS clock calculated in the MOD product has several gaps where interpolation occurs (not shown here, for an example see [RD.9])

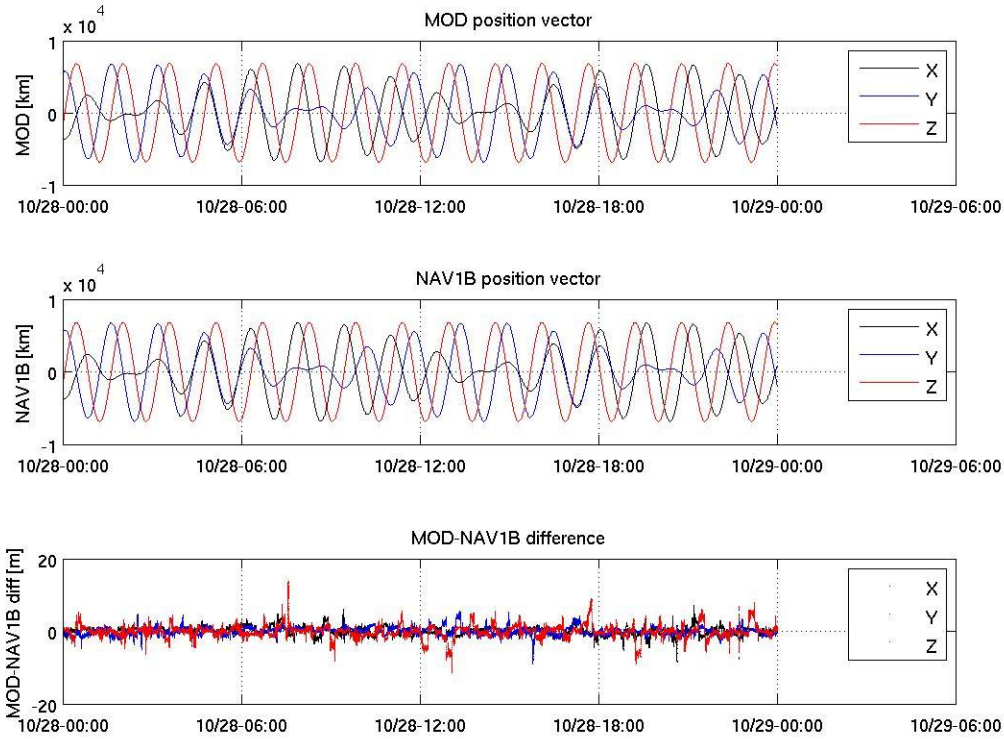

Figure 1: Difference MOD-GPSNAV, sc A, 28/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

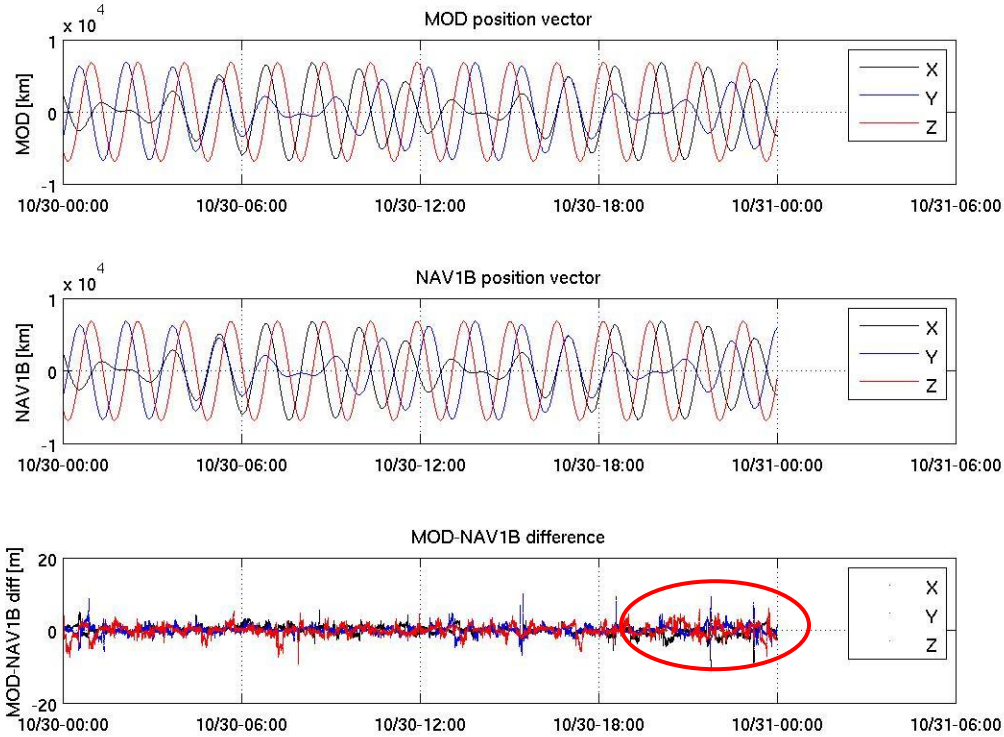

Figure 2: Difference MOD-GPSNAV, sc A, 30/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two. The red circled area in the lower panel shows an occurrence of SW-IDEAS-36 ([RD.9]).

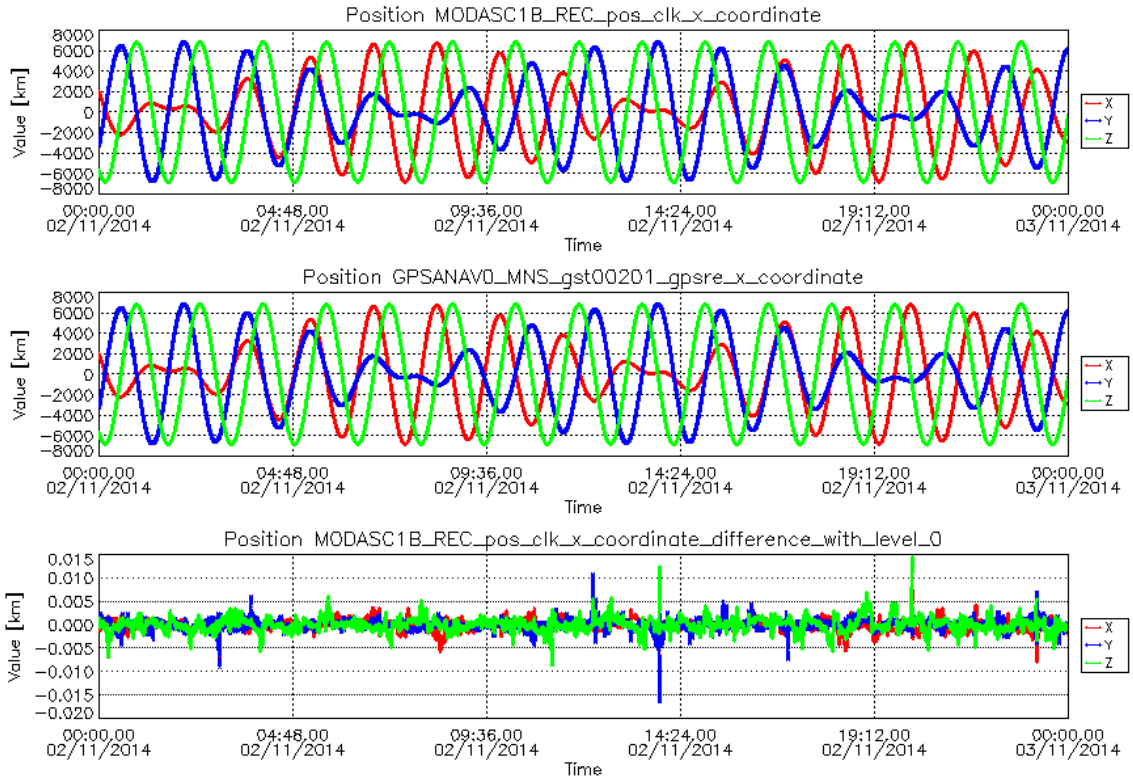

Figure 3: Difference MOD-GPSNAV, sc A, 02/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

3.2.1.2 Attitude observations

- **SW-IDEAS-40**

During week 44 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)
27OCT2014 21:45:47	27OCT2014 21:46:08	21
27OCT2014 23:13:53	27OCT2014 23:14:09	16
27OCT2014 23:15:07	27OCT2014 23:16:11	64
28OCT2014 22:43:29	28OCT2014 22:43:38	9
29OCT2014 22:15:36	29OCT2014 22:16:38	62
29OCT2014 23:46:17	29OCT2014 23:46:38	21
30OCT2014 21:46:44	30OCT2014 21:47:07	25

01NOV2014 22:14:42	01NOV2014 22:15:38	56
01NOV2014 23:44:00	01NOV2014 23:45:08	68
02NOV2014 13:53:27	02NOV2014 13:53:38	11
02NOV2014 20:07:48	02NOV2014 20:08:08	20

Table 3: Attitudes out-of-range due to GPS out-of-sync, S/C A, 27/10 – 02/11/2014.

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, 27/10-02/11/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard Deviation (m)**	**Notes**
27/10	0.3	-9.3 (X), 8 (Z)	1.5	SW-IDEAS-34 [RD.10]
28/10	0.14	-12.7, 10.3 (Z)	1.6	
29/10	0.18	-9.3, 11 (Z)	1.6	SW-IDEAS-34 [RD.10]
30/10	0.16	-11, 8.5 (Z)	1.5	SW-IDEAS-34 [RD.10]
31/10	0.1	+/- 10 (Z)	1.5	SW-IDEAS-34 [RD.10]
01/11	0.09	-10, 11 (Z)	1.5	SW-IDEAS-34 [RD.10]
02/11	0.03	+/- 7 (Z)	1.3	

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 (27/10, Figure 4), in the middle (30/10, Figure 5), and at end of the week (02/11, 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.

In Figure 4 one can see several occurrences of **SW-IDEAS-34** ([RD.10]): the difference between the MOD and NAV solutions shows several “spiky” features (red circled area in the lower panel).

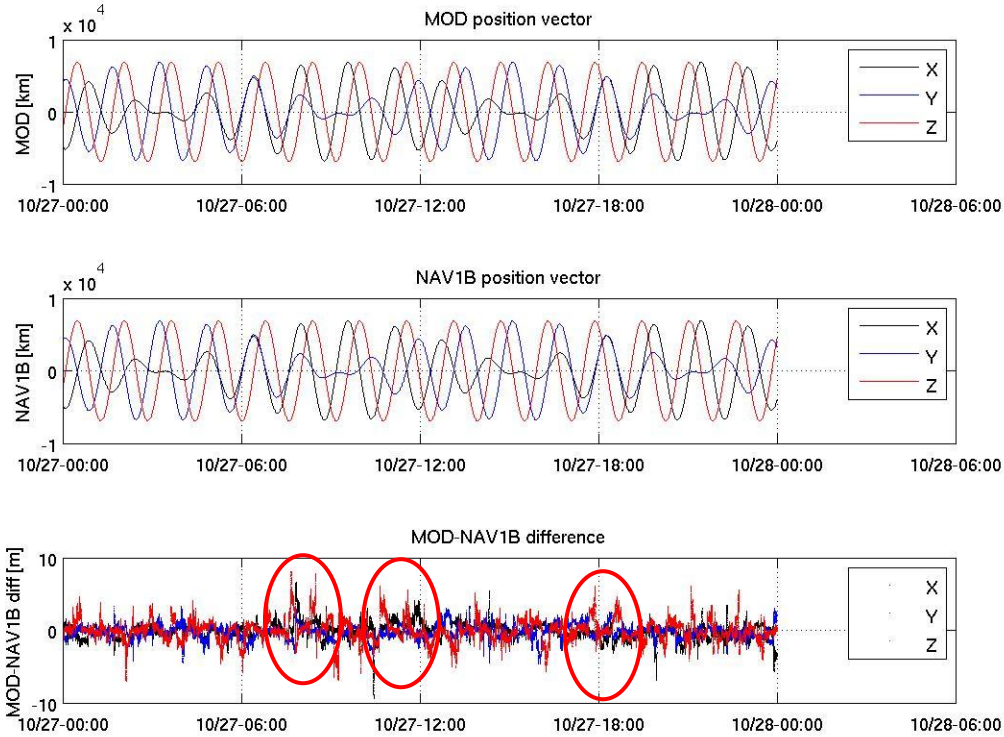

Figure 4: Difference MOD-GPSNAV, sc B, 27/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two. The red circled areas in the lower panel highlight occurrences of SW-IDEAS-34 ([RD.10]).

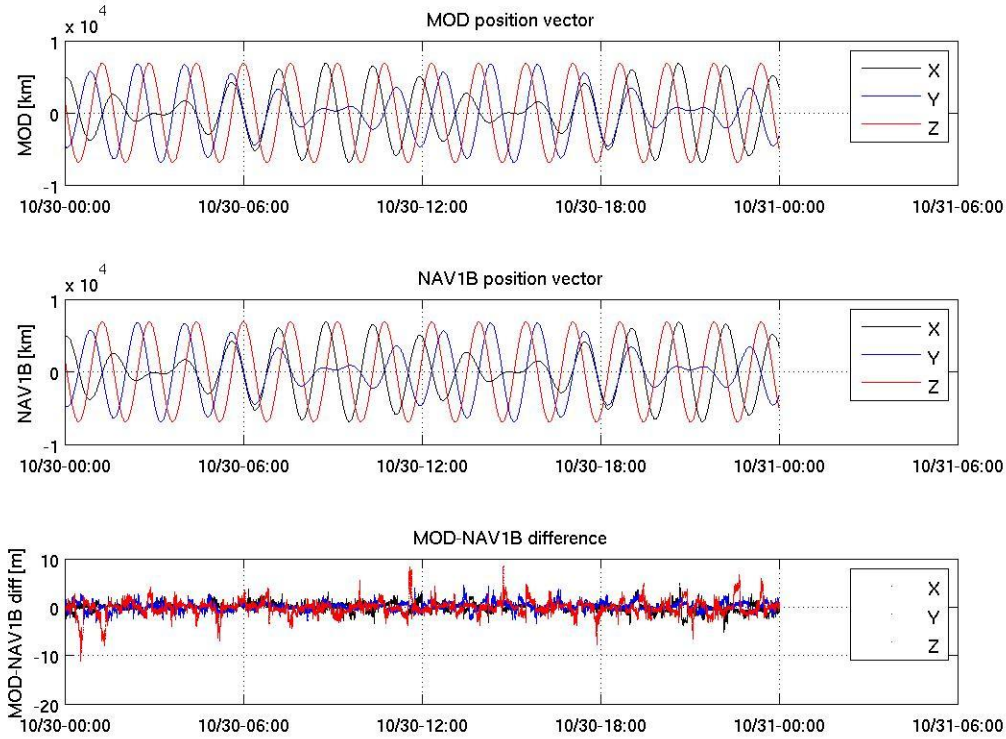

Figure 5: Difference MOD-GPSNAV, sc B, 30/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

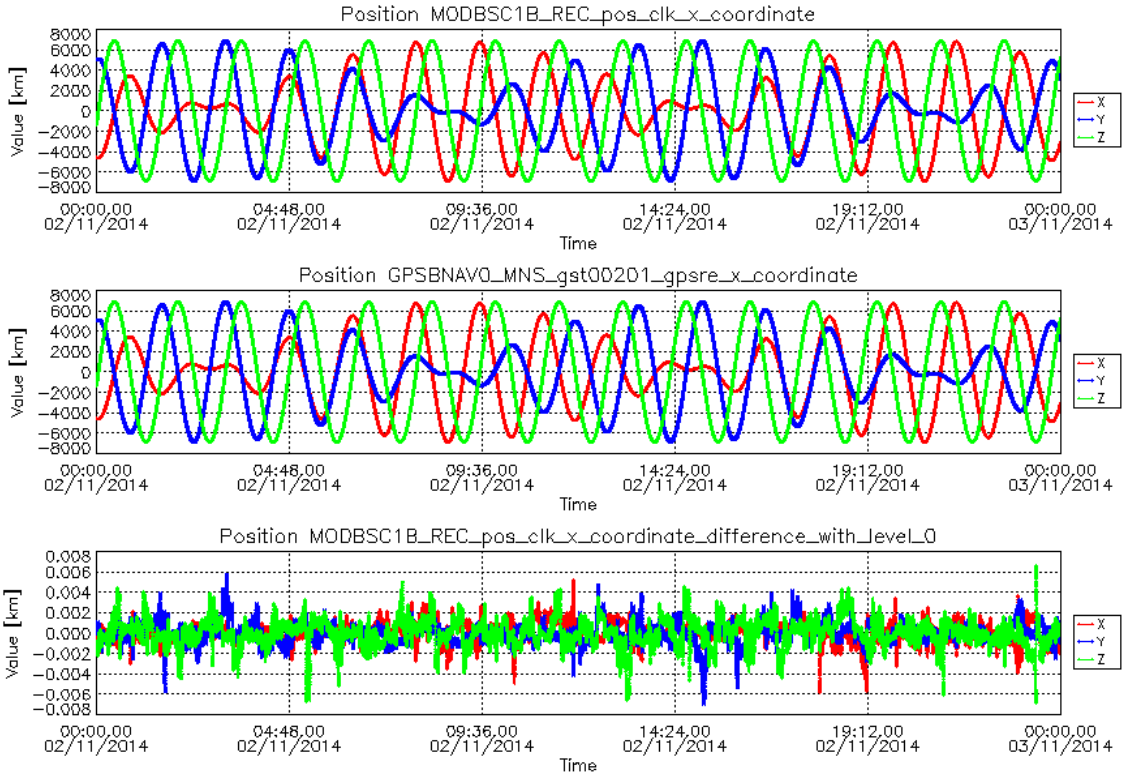

Figure 6: Difference MOD-GPSNAV, sc B, 02/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

3.2.2.2 Attitude observations

- **SW-IDEAS-40**

  During week 44 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)
01NOV2014 23:12:52	01NOV2014 23:13:08	16

Table 5: Attitudes out-of-range due to GPS out-of-sync, S/C B, 27/10 – 02/11/2014.

3.2.3 Swarm C

3.2.3.1 Position Statistics

In Table 6 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, 27/10-02/11/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard Deviation (m)**	**Notes**
27/10	0.3	-9.3 (X), 12.3 (Z)	1.5	SW-IDEAS-36
28/10	0.12	-18 (Y), 10.4 (Z)	1.8	SW-IDEAS-34 [RD.10]
29/10	0.17	-21.1 (X), 12 (Y)	1.6	Big spikes corresponding to GPS sync loss.
30/10	0.14	-110.4 (Y), 23.5 (Z)	1.6	Huge spikes corresponding to GPS sync loss.
31/10	0.06	-14.2 (Z), 13 (X)	1.6	SW-IDEAS-34 [RD.10]
01/11	0.15	-9.2 (Z), 8.2 (X)	1.35	
02/11	0.1	-21.6 (X), 19.2 (Y)	1.4	Big spikes corresponding to GPS sync loss.

Table 6: 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 (27/10, Figure 7), in the middle (29/10, Figure 8) and at the end (02/11, 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.

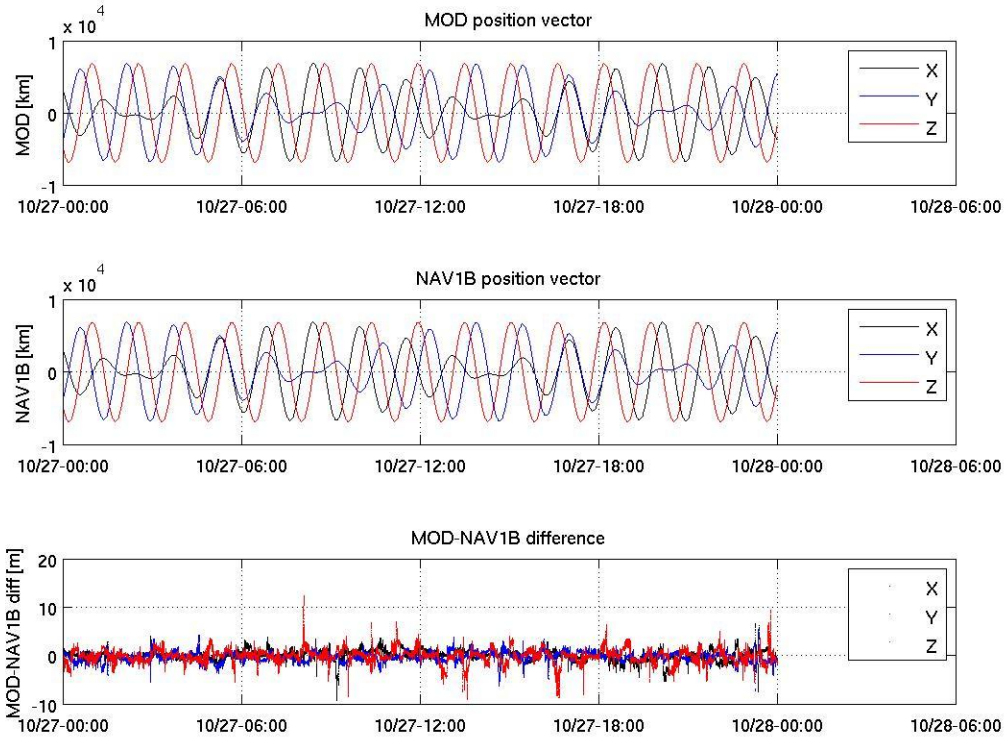

Figure 7: Difference MOD-GPSNAV, sc C, 27/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

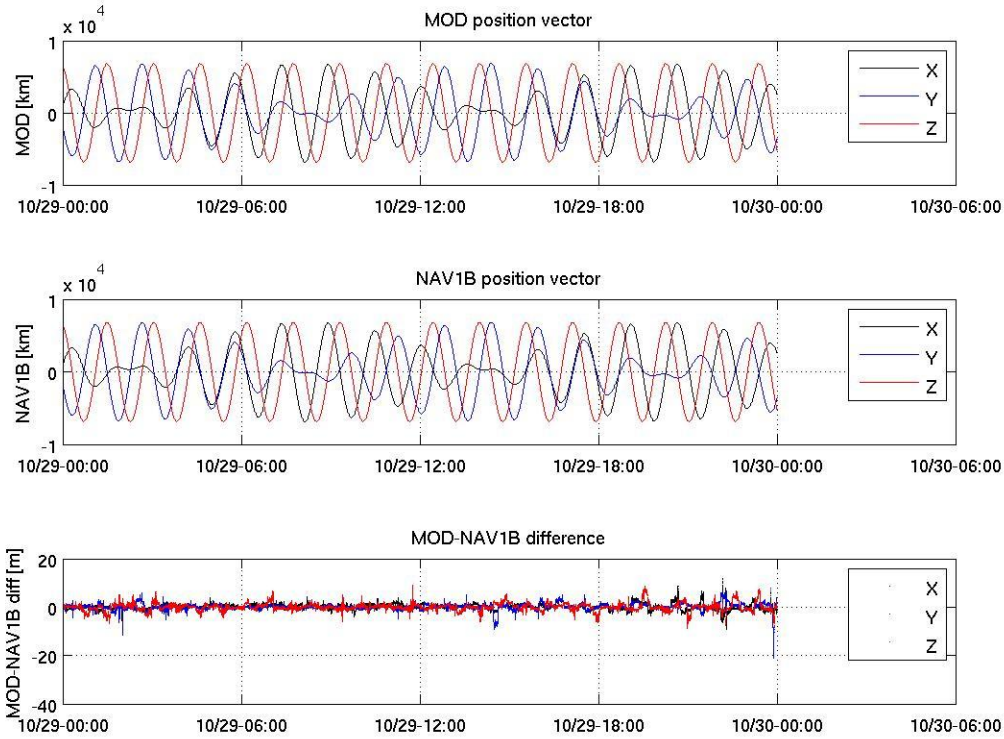

Figure 8: Difference MOD-GPSNAV, sc C, 29/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

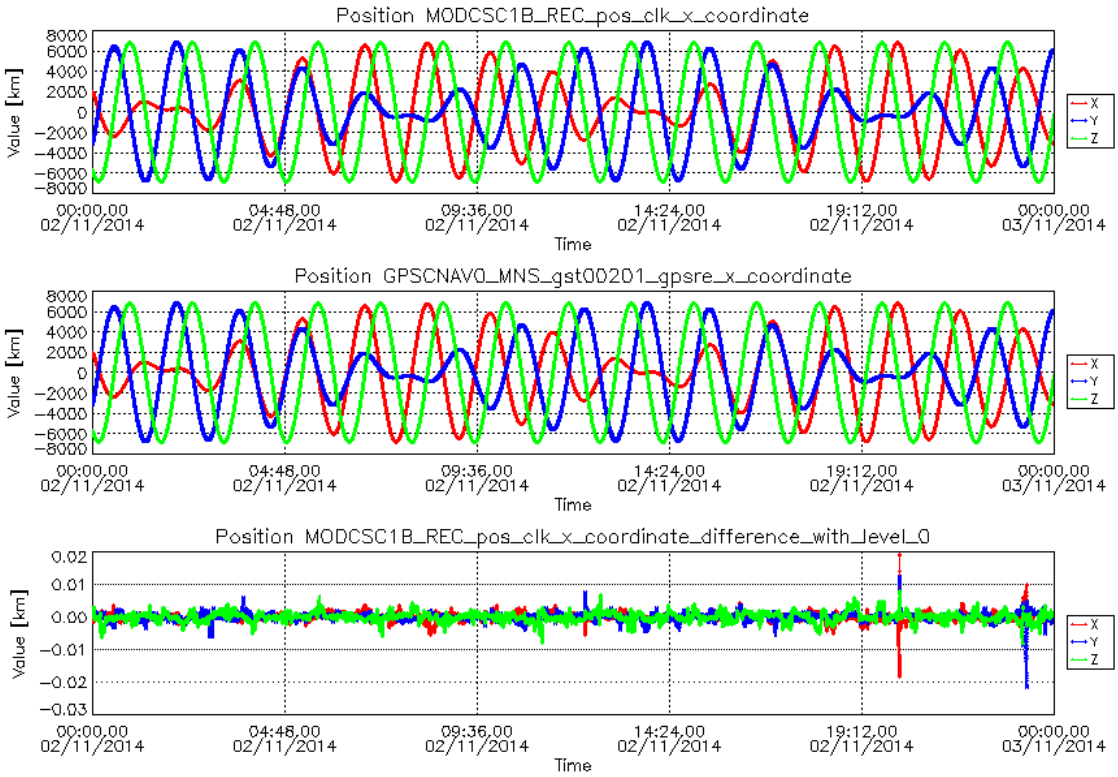

Figure 9: Difference MOD-GPSNAV, sc C, 02/11/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

3.2.3.2 Attitude observations

- **SW-IDEAS-40**

During week 44 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 7 below, the list of such events for S/C C is given.

Start Out-of-range	Stop Out-of-range	Duration (s)
27OCT2014 23:14:04	27OCT2014 23:15:38	95
27OCT2014 23:22:44	27OCT2014 23:24:08	85
29OCT2014 22:16:05	29OCT2014 22:16:38	34
29OCT2014 23:46:34	29OCT2014 23:47:08	35
29OCT2014 23:53:34	29OCT2014 23:54:07	34
30OCT2014 01:21:42	30OCT2014 01:22:07	26

30OCT2014 01:28:45	30OCT2014 01:29:37	53
30OCT2014 21:46:51	30OCT2014 21:47:07	18
01NOV2014 23:43:27	01NOV2014 23:45:08	101
02NOV2014 20:07:45	02NOV2014 20:08:37	53
02NOV2014 23:12:16	02NOV2014 23:12:37	23

Table 7: Attitudes out-of-range due to GPS out-of-sync, S/C C, 27/10 – 02/11/2014.

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 44 we do observe events of noise increase in the ASM-VFM residuals. Especially at the beginning of the week a moderate auroral activity is observed (AE index close to to 1000 nT) and the noise level in the spectral region [0.03 – 0.06] Hz exceeds at times the average PSD usually observed for more “quiet” days.

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 (02/11/2014). In the lower plot, the intervals characterized by GPS sync loss are evidenced as gaps in magnetic data.

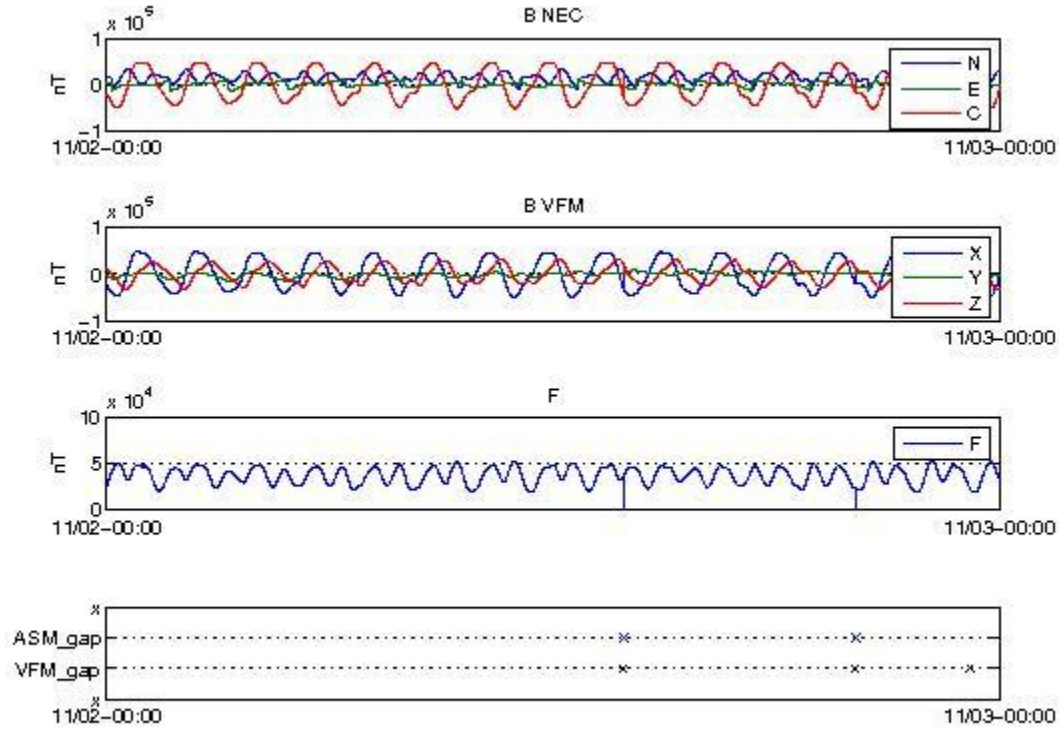

Figure 10: Time series of the geomagnetic field, for 02/11/2014, S/C A. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps.

3.3.1.2 VFM-ASM anomaly

The daily peak-to-peak difference around the week is, on average: [-2, 2.5] nT, with occasional spikes up to 8 nT.

Below some plot example of such differences follows, taken at the beginning of the week (27/10, Figure 11) and on the middle (31/10, Figure 12). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

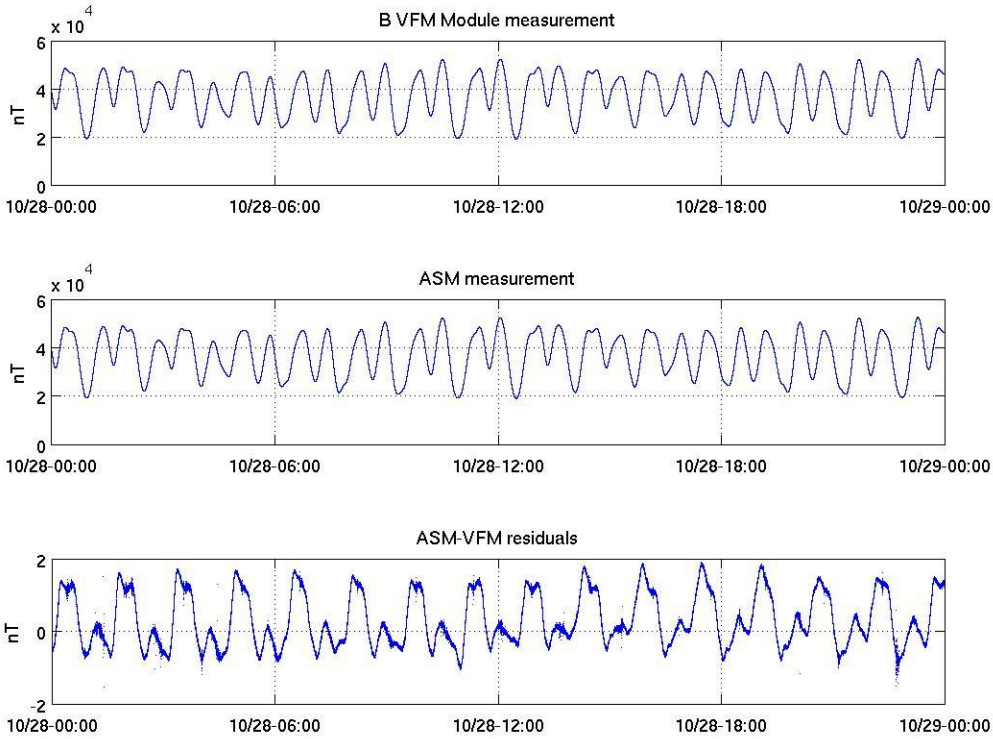

Figure 11: VFM module, ASM module and ASM-VFM residuals for S/C A, 28/10/2014.

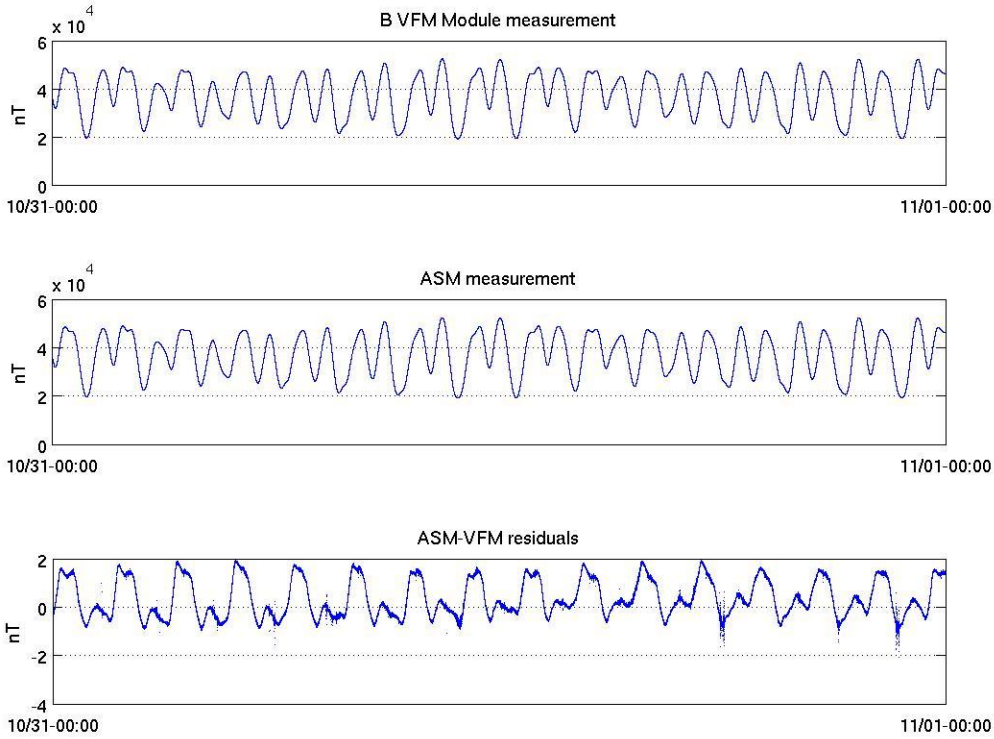

Figure 12: VFM module, ASM module and ASM-VFM residuals for S/C A, 31/10/2014.

3.3.1.3 TCF.VFM monitoring

In the following plots one can see the three groups of TCF VFM calibration parameters for Swarm A, for the whole month of October: Biases (Figure 13), Scales (Figure 14) and Non-orthogonalities (Figure 15). Each group is actually a three-component vector in the compact detector coil frame. All the parameters are rather constant and steady throughout the month.

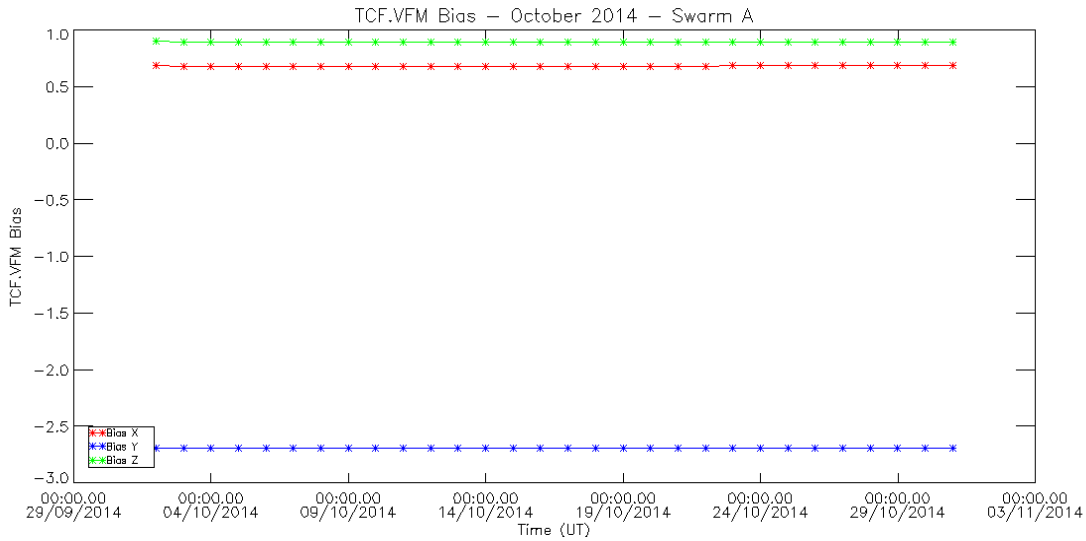

Figure 13: TCF.VFM Biases for S/C A, October 2014.

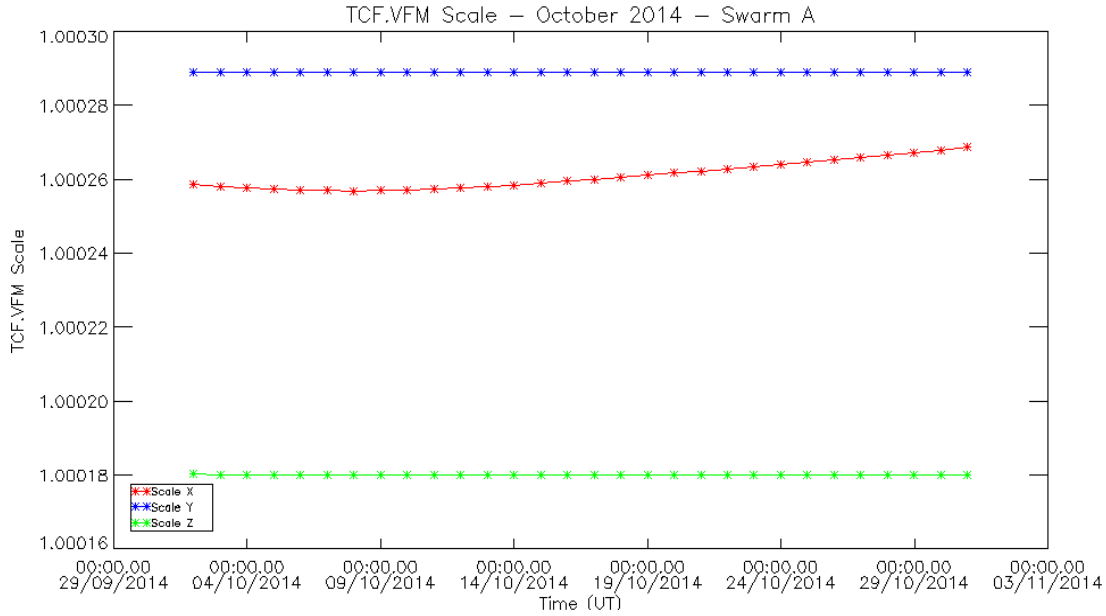

Figure 14: TCF.VFM Scales for S/C A, October 2014.

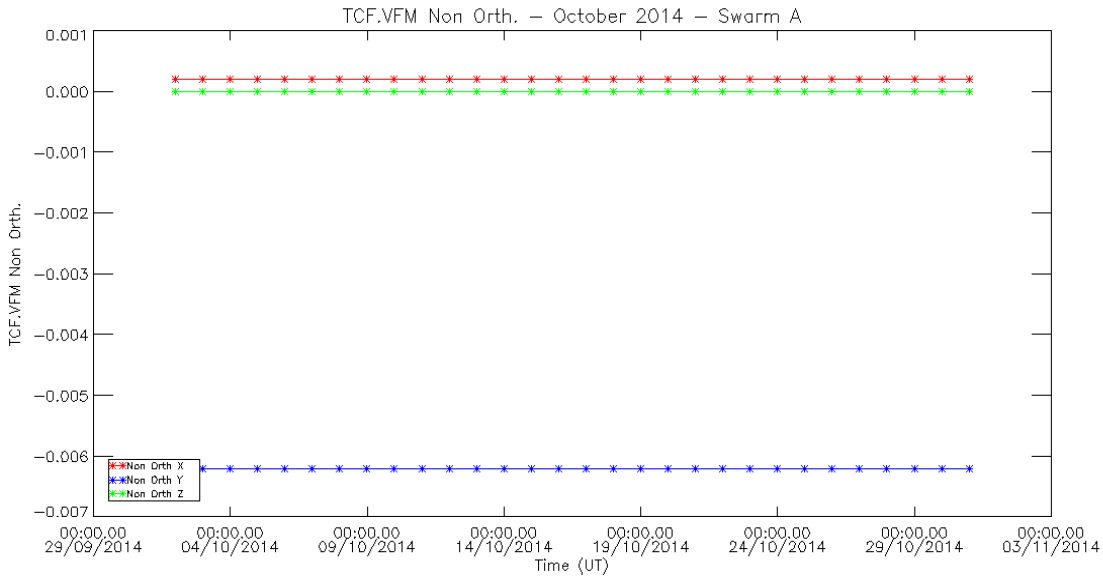

Figure 15: TCF.VFM Non-Orthogonalities for S/C A, October 2014.

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 (02/11/2014) can be seen in Figure 16 below.

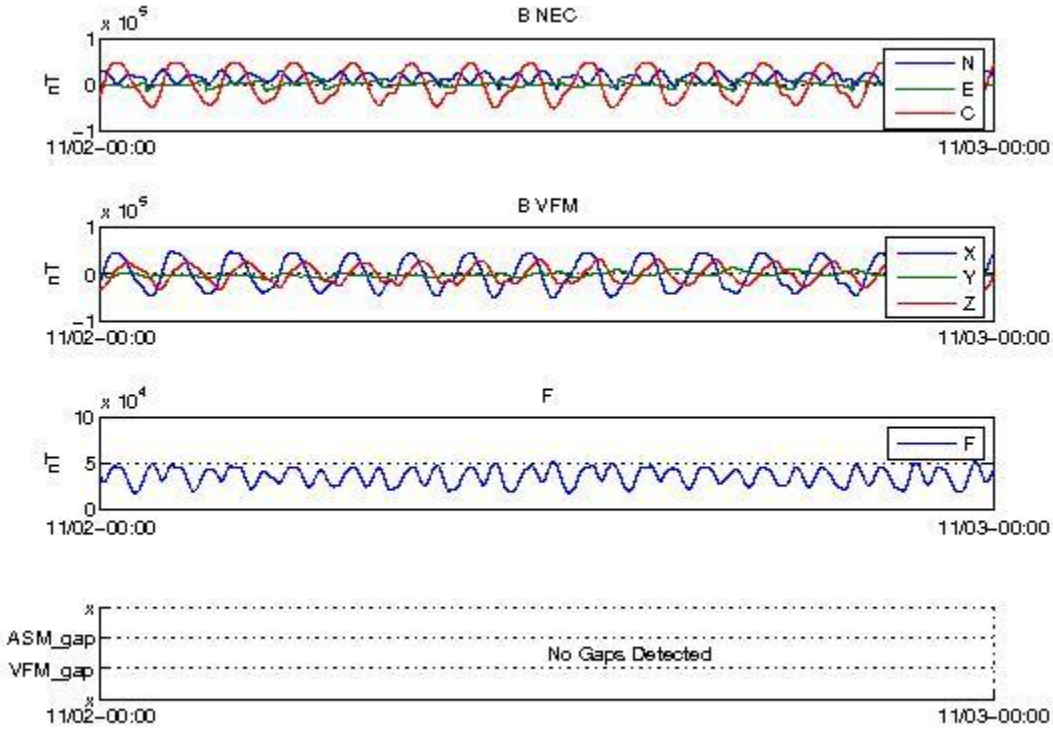

Figure 16: Time series of the geomagnetic field for 02/11/2014, S/C B. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

3.3.2.2 VFM-ASM anomaly

The daily peak-to-peak difference around the week is, on average: [-1.5, 1.5] nT, with isolated spikes (gradients) that reaches up to 5 nT.

Below some plot example follows of such differences taken at the beginning of the week (28/10, Figure 17), and on the middle of the week (31/10, Figure 18). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

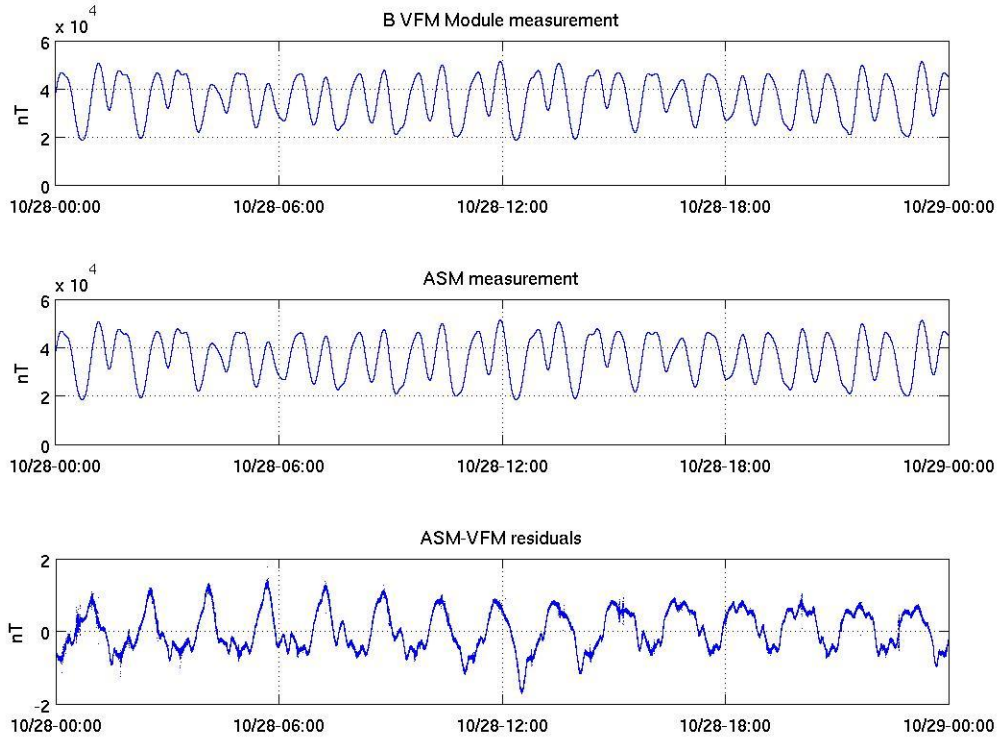

Figure 17: VFM module, ASM module and ASM-VFM residuals for S/C B, 28/10/2014

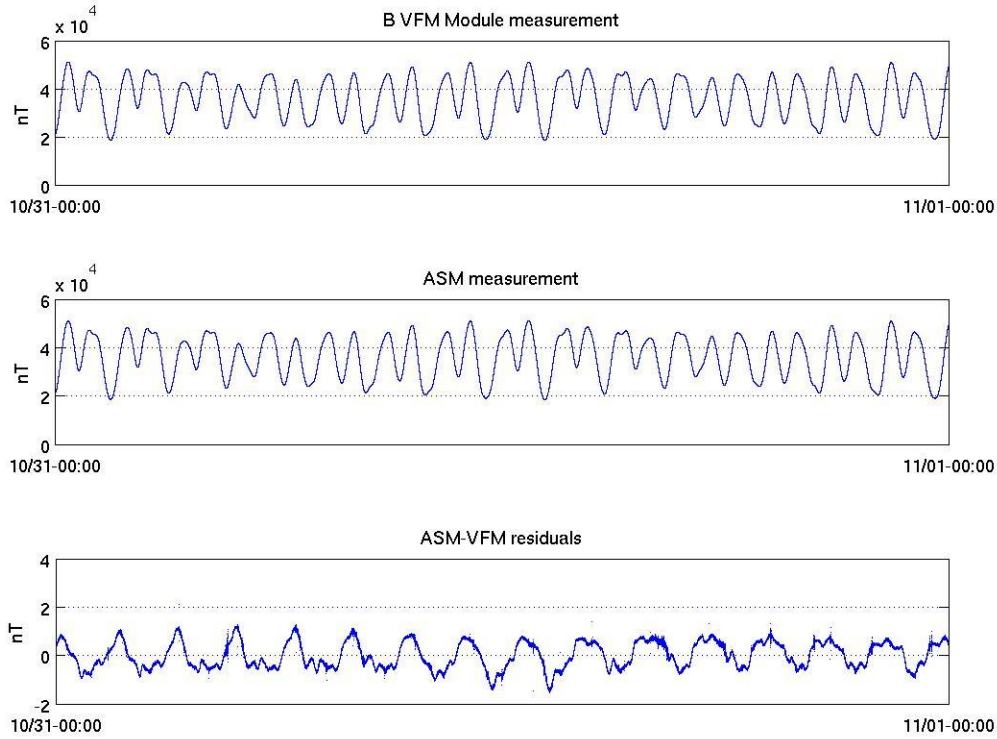

Figure 18: VFM module, ASM module and ASM-VFM residuals for S/C B, 31/10/2014.

3.3.2.3 TCF.VFM monitoring

In the following plots one can see the three groups of TCF VFM calibration parameters for Swarm B, for the whole month of October: Biases (Figure 19), Scales (Figure 20) and Non-orthogonalities (Figure 21). Each group is actually a three-component vector in the compact detector coil frame. All the parameters are rather constant and steady throughout the month, except for the Scale X component, which shows a slow rise of about 0.002%: it seems actually the trend is recovering the pre-September level (see Figure 22 in [RD.12]).

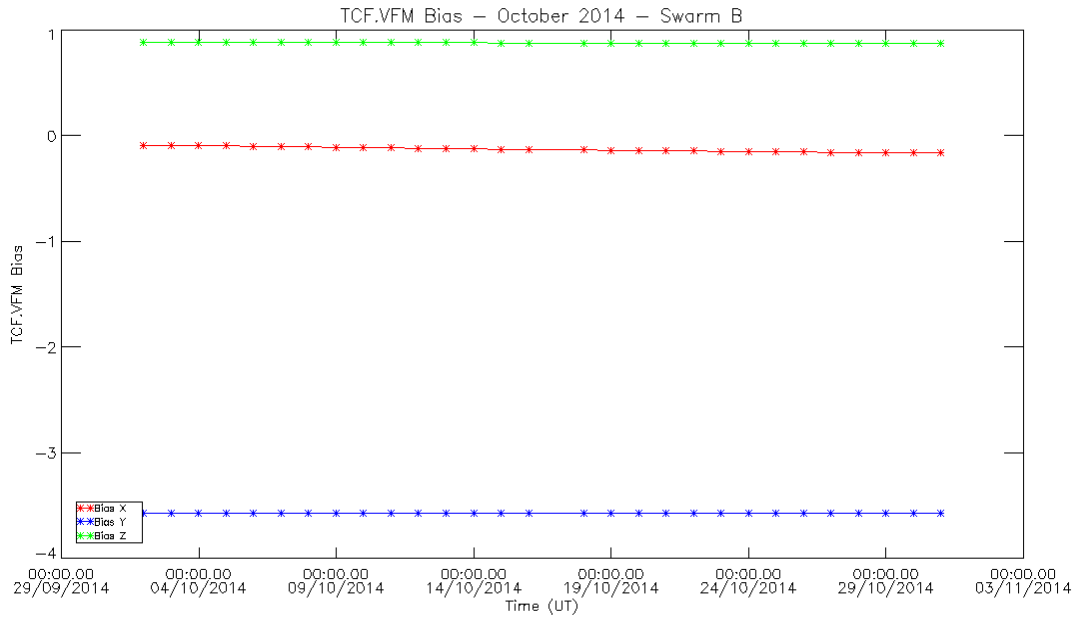

Figure 19: TCF.VFM Biases for S/C B, October 2014.

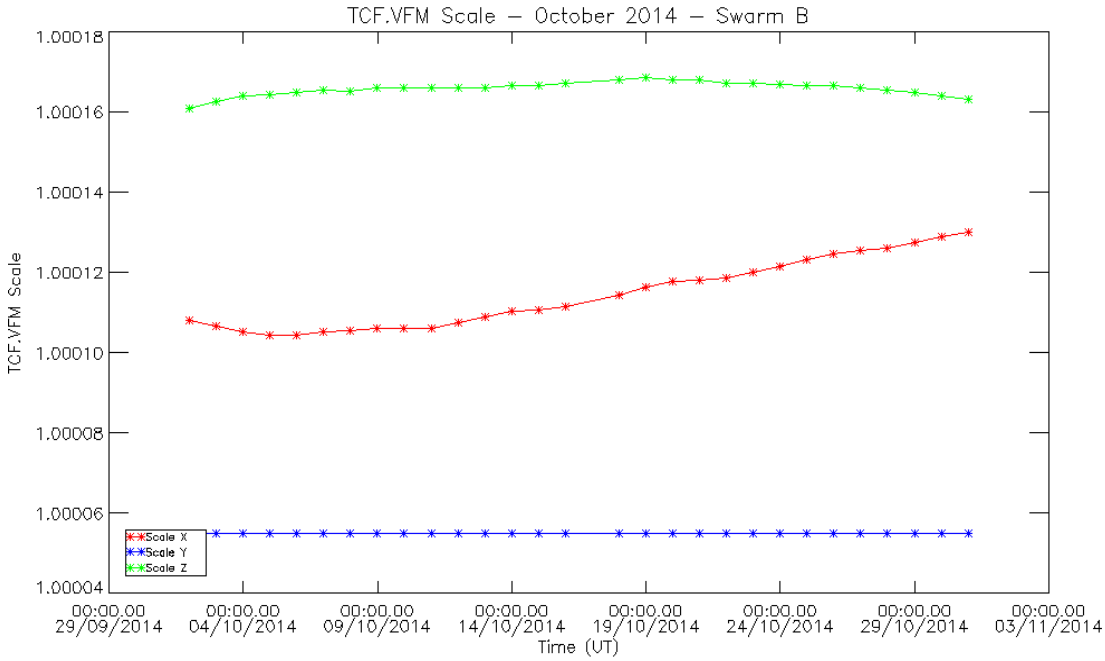

Figure 20: TCF.VFM Scales for S/C B, October 2014.

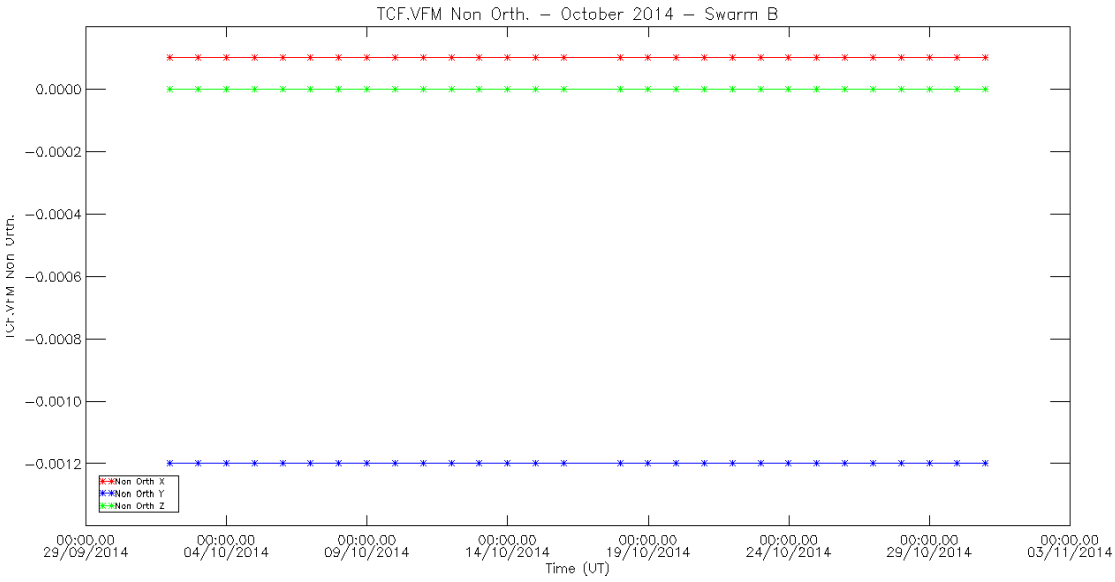

Figure 21: TCF.VFM Non-Orthogonalities for S/C B, October 2014.

3.3.3 Swarm C

3.3.3.1 Magnetic time series visual inspection

An example of representative F time series for S/C C (02/11/2014) can be seen in Figure 22 below. In the lower plot, the two intervals characterized by GPS sync loss are evidenced as gaps in magnetic data.

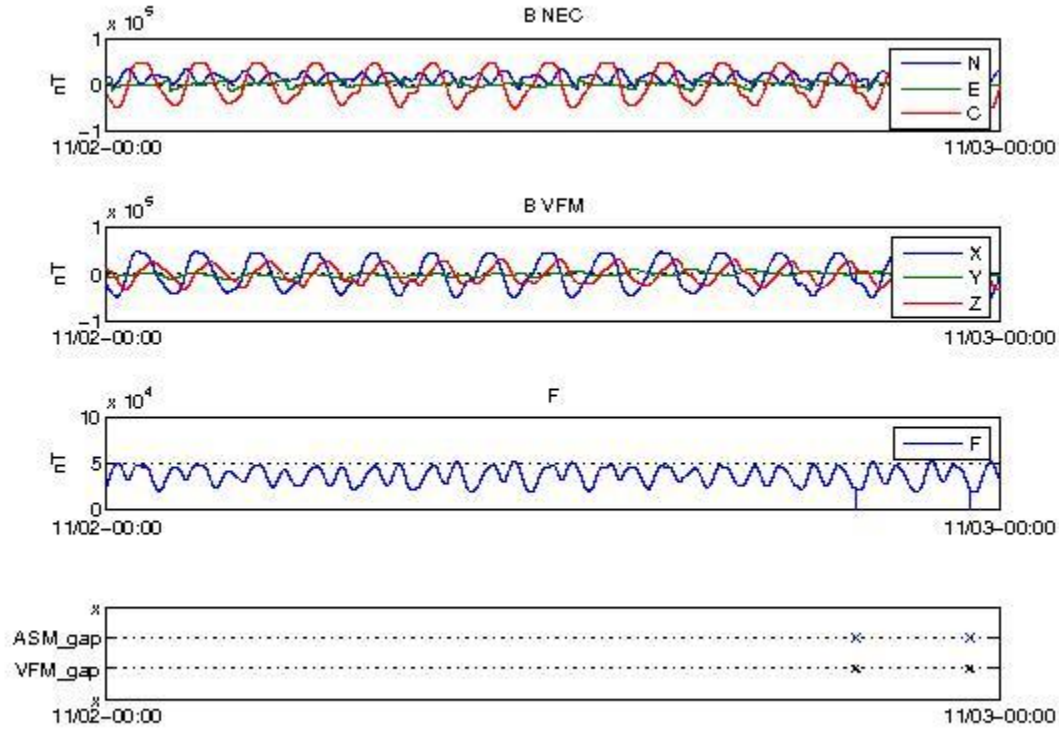

Figure 22: Time series of magnetic field intensity, F, for 02/11/2014, S/C C. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps.

3.3.3.2 VFM-ASM anomaly

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

Below some plot example follows of such differences taken at the beginning of the week (28/10, Figure 23) and on the middle of the week (30/10, Figure 24). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

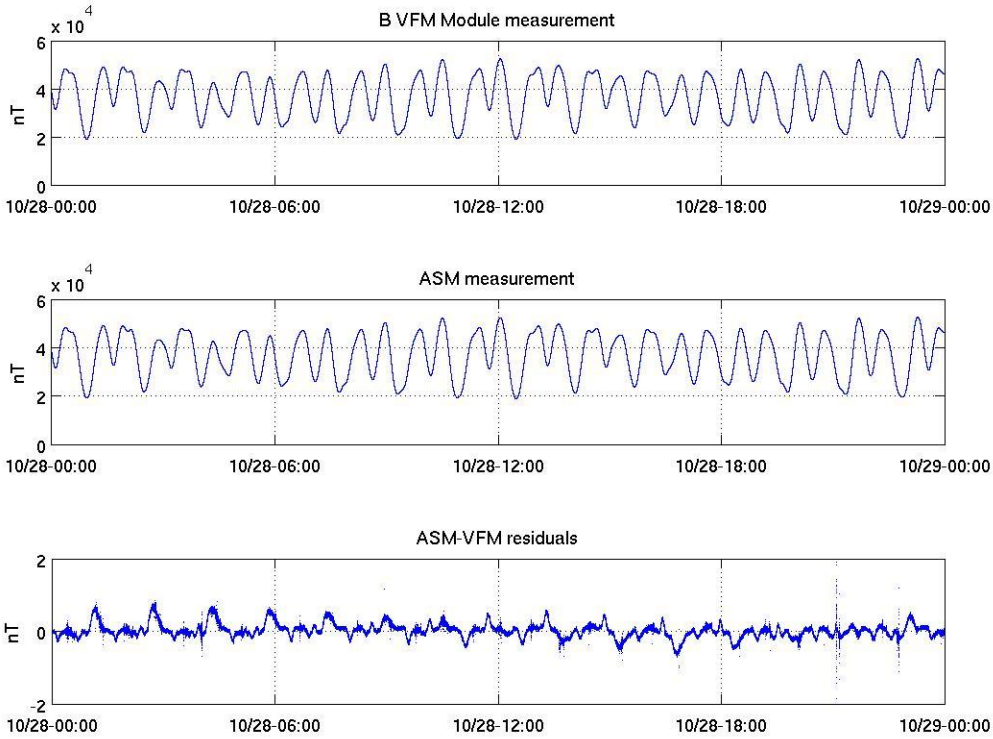

Figure 23: VFM module, ASM module and ASM-VFM residuals for S/C C, 28/10/2014.

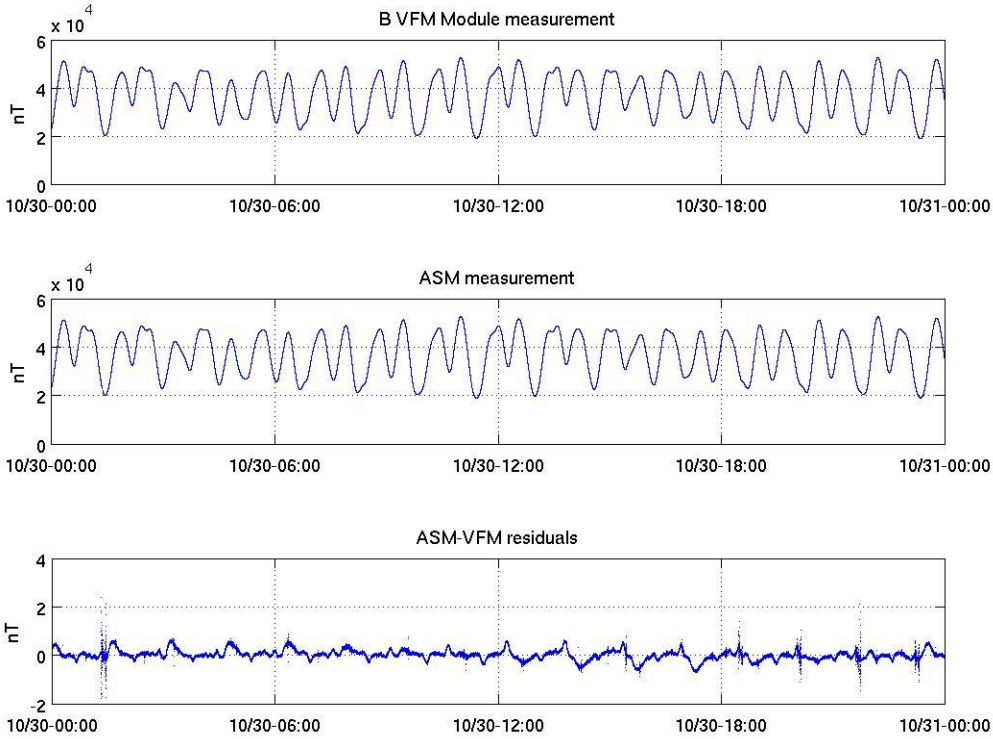

Figure 24: VFM module, ASM module and ASM-VFM residuals for S/C C, 30/10/2014.

3.3.3.3 TCF.VFM monitoring

In the following plots one can see the three groups of TCF VFM calibration parameters for Swarm C, for the whole month of October: Biases (Figure 25), Scales (Figure 26) and Non-orthogonalities (Figure 27). Each group is actually a three-component vector in the compact detector coil frame. All the parameters are rather constant and steady throughout the month, except for the Scale X component, which shows a slow rise of about 0.004%: it seems actually the trend is recovering the pre-September level (see Figure 22 in [RD.12]).

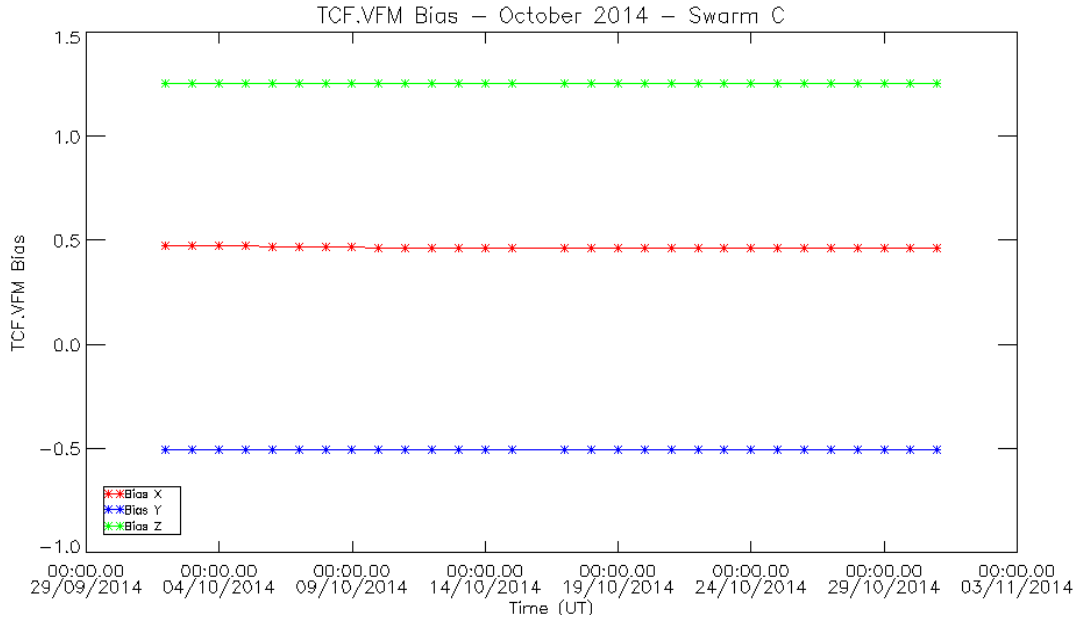

Figure 25: TCF.VFM Biases for S/C C, October 2014.

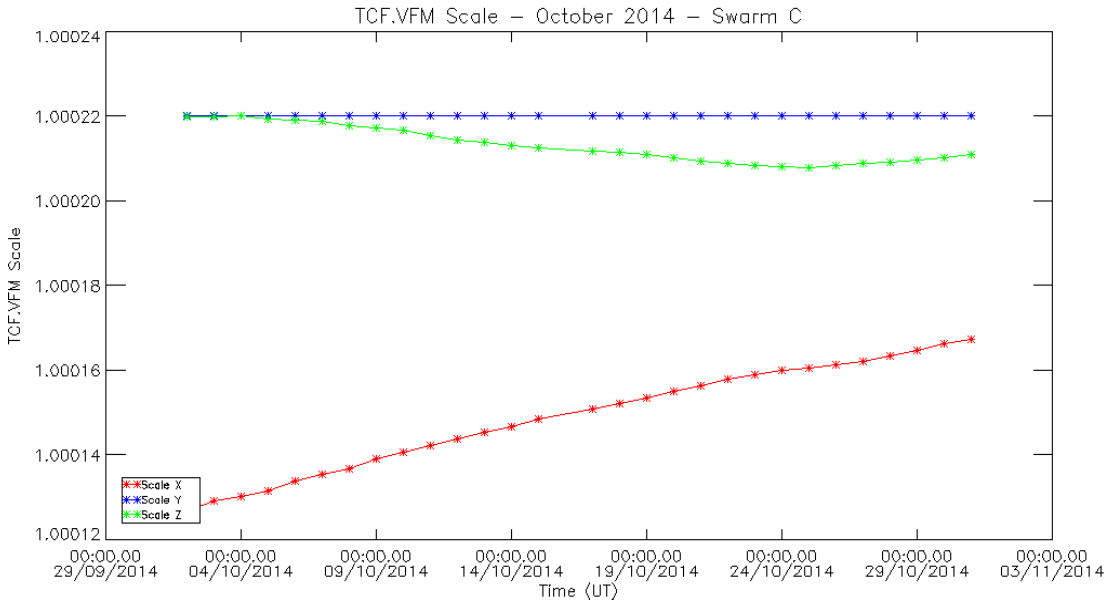

Figure 26: TCF.VFM Scales for S/C C, October 2014.

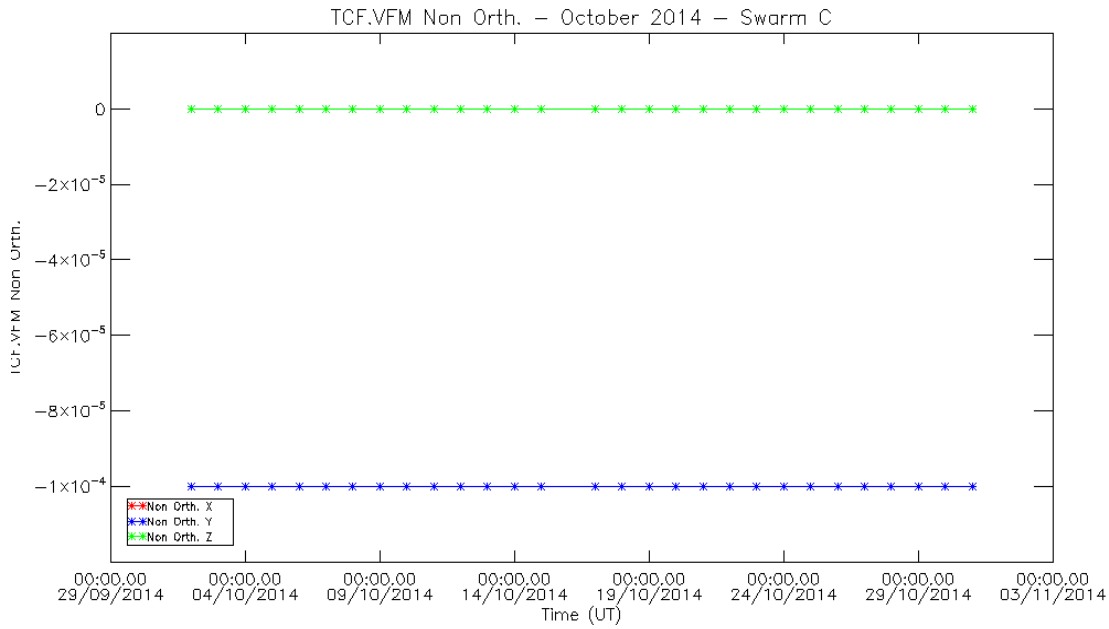

Figure 27: TCF.VFM Non-Orthogonalities for S/C C, October 2014.

3.3.4 Summary of TCF behaviour for the three S/C

An important parameter which characterizes the quality of the TCF calculation is the weighted Root Mean Square (RMS) value of the residuals after the estimation. Figure 28 summarizes the RMS behavior for all S/C during October 2014 (Red curve = S/C A, blue curve = S/C B, green curve = S/C C).

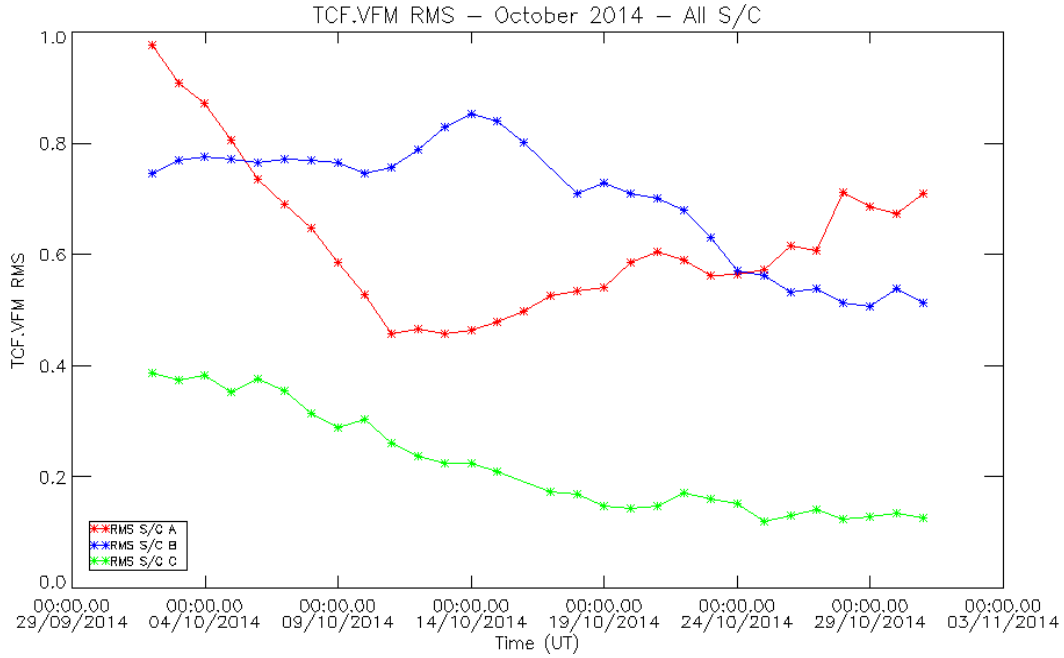

Figure 28: weighted RMS of the residuals after the TCF estimation, all S/C, October 2014.

4. ON-DEMAND ANALYSIS

Nothing to report.

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