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IDEAS+ Swarm Weekly Report : 29/09/2014 – 05/10/2014

Abstract : This is the **Instrument Data quality Evaluation and Analysis Service Plus** (IDEAS+) Swarm Weekly report on Swarm products quality, covering the period 29 September to 5 October, 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	10 Oct 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:

- Processor Version: L1BOP 3.11p2
- 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_20141001_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: 15/09/2014 – 21/09/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20140915_20140921_2.pdf

[RD.11] 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:

Status of EFI – TII recent operations. The 02/10 all the three TII have been switched in Ready state, following the recent analysis from Calgary which showed degradation starting again on Swarm A and B. In the meanwhile, Univ. of Calgary and ComDev had a very fruitful meeting with the Phosphor screen manufacturer (Torr Scientific): they strongly recommend a "scrubbing" of the phosphors, operating the MCP at high gain but keeping the phosphor voltage low (1 kV) for an extended period (days). Following this they recommend another period with both high MCP output and high phosphor voltage. The two procedures are intended to expel residual gas from the MCPs and phosphor screen, respectively. The Calgary team envisages to try this procedure on SC C first, which is the most affected, but before to do this, a further run in calibration mode is needed, in order to set the optimal VG.

2.2 Plan for operational processor updates

From the last L1B coordination teleconference the following updates shall be reported [RD.7]:

- After the OK from Univ. of Delft about the quality of the output dataset for SC A and B, the ORBATT patch for handling the raw RINEX will be delivered to ESA on Friday 10/10. Christian Siemes and R. Mecozzi will provide meanwhile the correct information for operatively change the CCDB. The patch will be first tested in the APDF operational platform using the same TDS GMV used for tests then, provided no issues are encountered, it will be deployed in operation mid week 41 (around 15/10), starting with the production of new RINEX from 4 days before.

- The cross-verification of MAGNET hectically progresses. Many small discrepancies have been found by GMV in the OP after a great and thorough work of comparison, concerning especially how the quality and platform flags are calculated and how some of the stray field is computed and subtracted. More details can be found in [RD.7].

- The PLASMA cross-verification work has been started. A good direct interaction has been established between GMV and the EFI team, and first outcomes have been already circulated. Quite large discrepancies have been found between OP and PP data, both TII side (larger) and LP side (more "reasonable"). GMV decided to concentrate first on the LP part, as the discrepancies seem to concentrate in particular regions around the orbit and, considering the last implementations, it should be easier to spot the origin of the problems, with some help from IRF.

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 40 (29/09-05/10/2014)

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

1. **ORBATT processor failure** on S/C A, 01/10/2014. No L1b data produced for that day. The reason of failure is known, and it is probably related to converge of the STR interpolation loops. This issue will be fixed in the next L1BOP delivery.

2. **Differences in the MOD-GPSNAV solutions reported again:** the observations are related to the already described **SWL1L2DB-9** ([RD.9]), but new “spiky” features are also observed.

3. **Increase in the time series noise of the ASM-VFM difference** already reported ([RD.10]). The observation occurred only on 5/10/2014 for all S/C, this time during a period of low/moderate geomagnetic activity.

4. **Spikes observed in the Sun pressure acceleration correction.** These seem to be related to discontinuities in the quaternions.

3. ROUTINE QUALITY CONTROL

3.1 Gaps analysis

SW-CP-AR-239: ORBATT processing failure: Segmentation fault

On day 01/10/2014 ORBATT on S/C A had a failure. The processor exited with a segmentation fault message. So no products has come out from day 01/10.

The issue already documented as internal PDGS anomaly (SW-CP-AR-239) is also reported to the processor manufacturer (SW-L1BOP-SPR-282): the problem will be fixed in the next L1BOP delivery at the end of October.

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 3.2.2.1 3.2.3.1	4.1
SWL1L2DB-9	L1B: MOD - NAV1B discrepancies [...]	Orbits (position and velocity)	3.2.1.1	[RD.9] and [RD.11]

Table 1: list of events related to attitude and orbit products to be reported in the monitoring for Week 40: 29/09 - 05/10/2014

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, 29/09-05/10/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard deviation (m)**	**Notes**
29/09	0.21	-15.5, 10.6 (Z)	1.8	
30/09	0.08	-8, 9.5 (Z)	1.5	
01/10	No Data	No Data	No Data	See Sect. 3.1
02/10	**0.1**	**-11, 13.3 (Z)**	**2**	**Anomaly SWL1L2DB-9**
03/10	**0.08**	**-15, 9.5 (Z)**	**2.1**	**SW-IDEAS-34, see Sect. 4.1**
04/10	0.07	-8 (Z), 13.5 (Y)	1.6	
05/10	0.2	-10.2 (X), 15.5 (Y)	1.8	

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 (29/09, Figure 1), in the middle (02/10, Figure 2) and at the end (05/10, 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 one can observe another occurrence of the anomaly described in SPR **SWL1L2DB-9** (02/10/2014): starting from about 22 UT the navigation solution and MOD calculation start to depart each other.

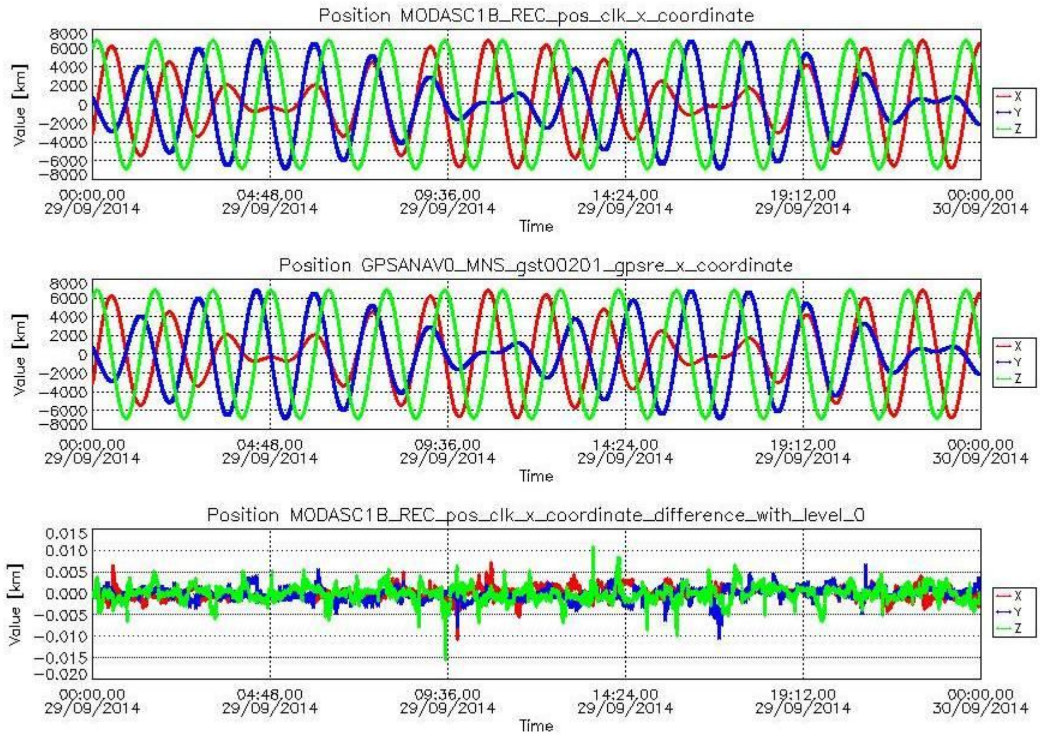

Figure 1: Difference MOD-GPSNAV, sc A, 29/09/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

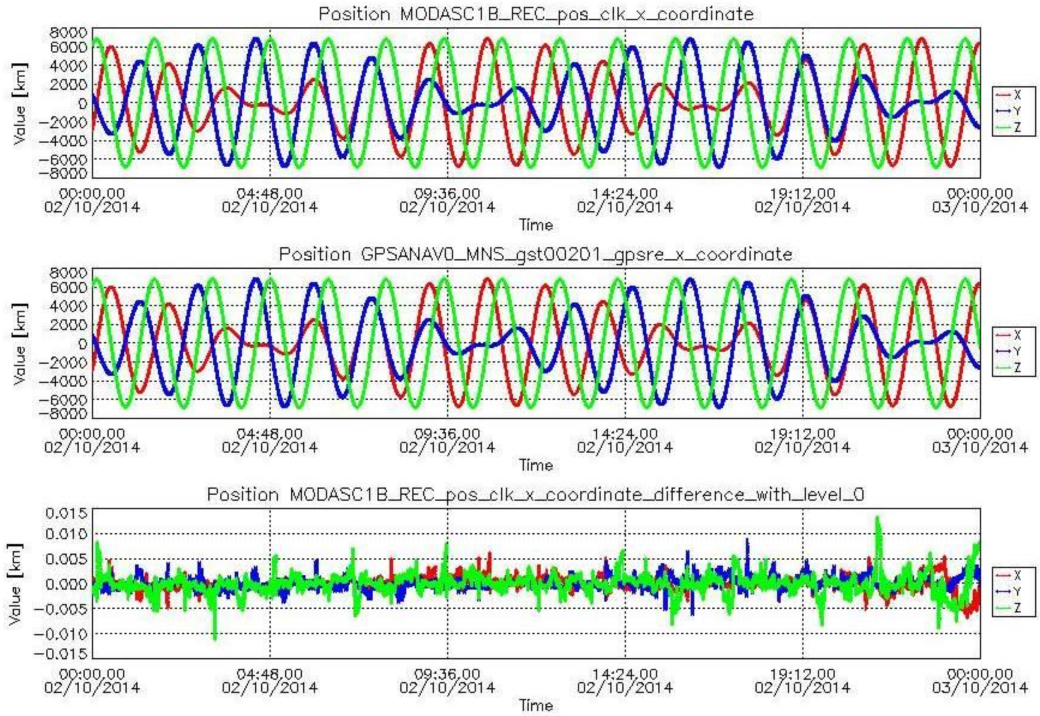

Figure 2: Difference MOD-GPSNAV, sc A, 02/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

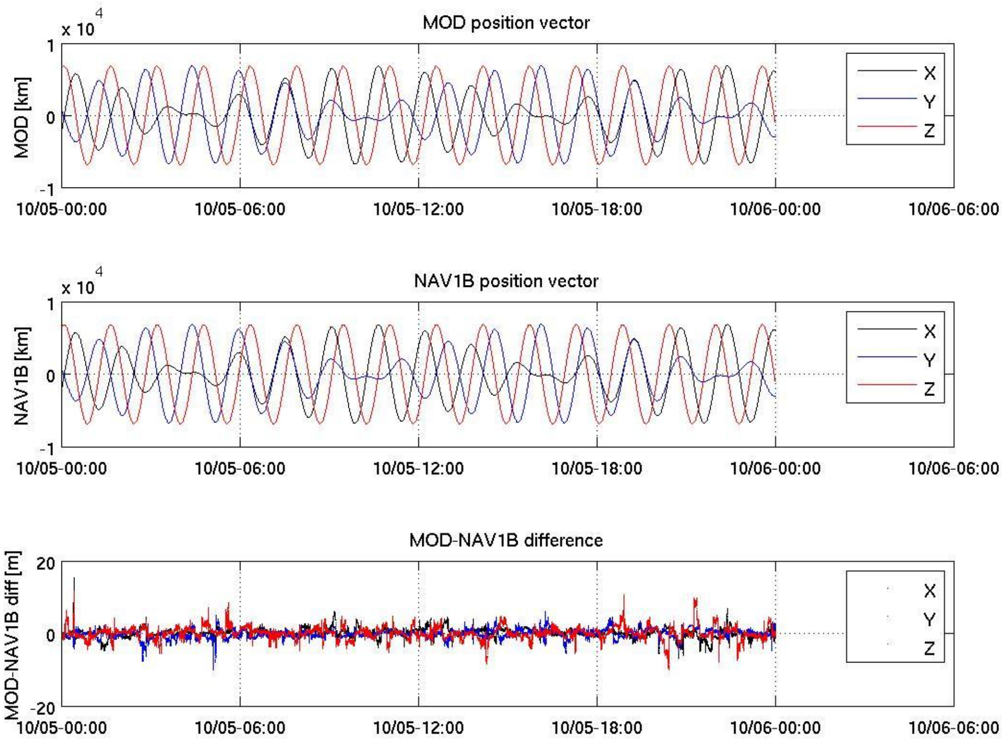

Figure 3: Difference MOD-GPSNAV, sc A, 05/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

3.2.1.2 Attitude observations

Nothing to report.

3.2.2 Swarm B

3.2.2.1 Position Statistics

In Table 3 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, 29/09-05/10/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard Deviation (m)**	**Notes**
29/09	0.2	-12.2, 7.2 (Z)	1.9	
30/09	0.14	-8, 9 (Z)	1.5	
01/10	0.13	-10 (Z), 7 (Y)	1.5	
02/10	0.05	-19, 9.6 (Z)	1.8	A single isolated spike is observed on Z
03/10	**0.18**	**-11.5, 9.5 (Z)**	**2.1**	**SW-IDEAS-34, see Sect. 4.1**
04/10	0.07	-7.2 (Z), 8.6 (Y)	1.6	
05/10	0.14	-11 (Y), 9.4 (Z)	1.8	

Table 3: 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 (29/09, Figure 4), in the middle (02/10, Figure 5), and at end of the week (05/10, 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.

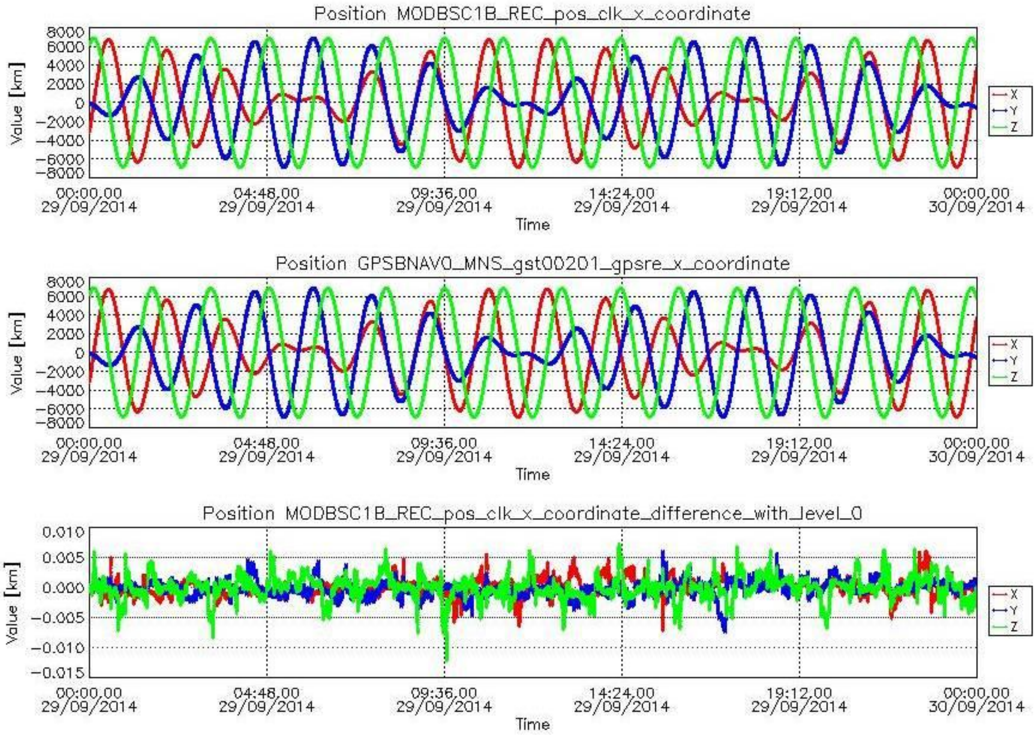

Figure 4: Difference MOD-GPSNAV, sc B, 29/09/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

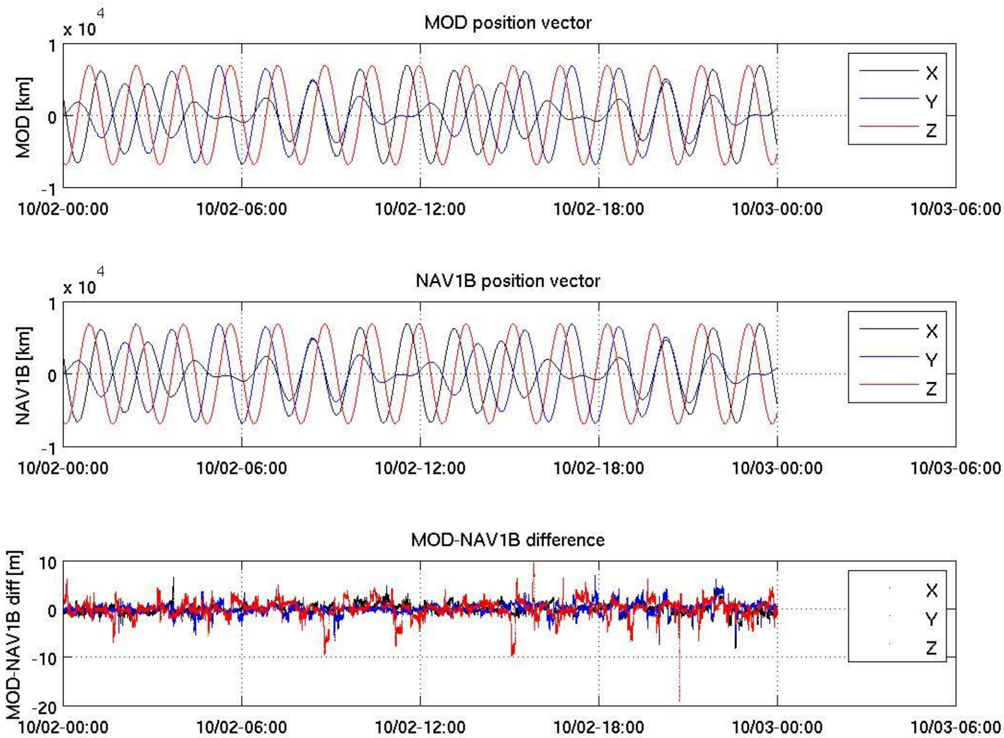

Figure 5: Difference MOD-GPSNAV, sc B, 02/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

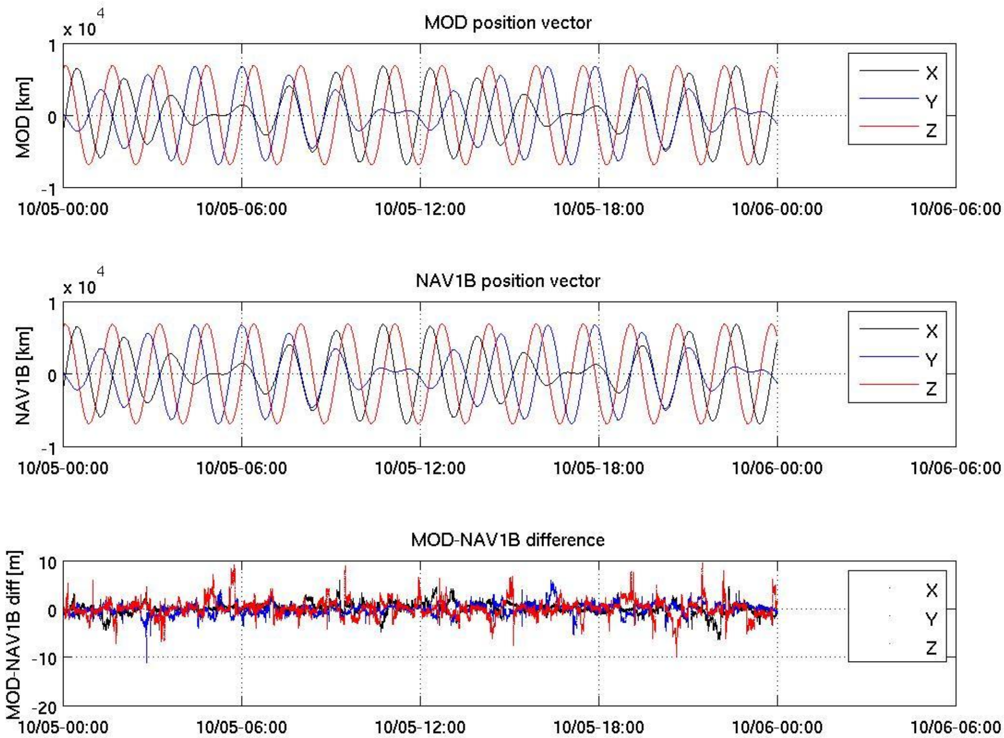

Figure 6: Difference MOD-GPSNAV, sc B, 05/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

3.2.2.2 Attitude observations

Nothing to report.

3.2.3 Swarm C

3.2.3.1 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 C, 29/09-05/10/2014, Position difference				
Day	**Average Difference (m)**	**Maximum difference (m)**	**Standard Deviation (m)**	**Notes**
29/09	0.23	-16, 10 (Z)	1.8	

Swarm C, 29/09-05/10/2014, Position difference				
30/09	0.03	-7, 9 (Z)	1.5	
01/10	0.15	-6.6 (Y), 8 (Z)	1.5	
02/10	0.06	-9, 13 (Z)	1.9	
03/10	**0.08**	**-14, 10 (Z)**	**2.1**	**SW-IDEAS-34, see Sect. 4.1**
04/10	0.12	-7, 8 (Z)	1.5	
05/10	0.2	-13.5 (Y), 11 (Z)	1.8	

Table 4: 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 (29/09, Figure 7), in the middle (02/10, Figure 8) and at the end (05/10, 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.

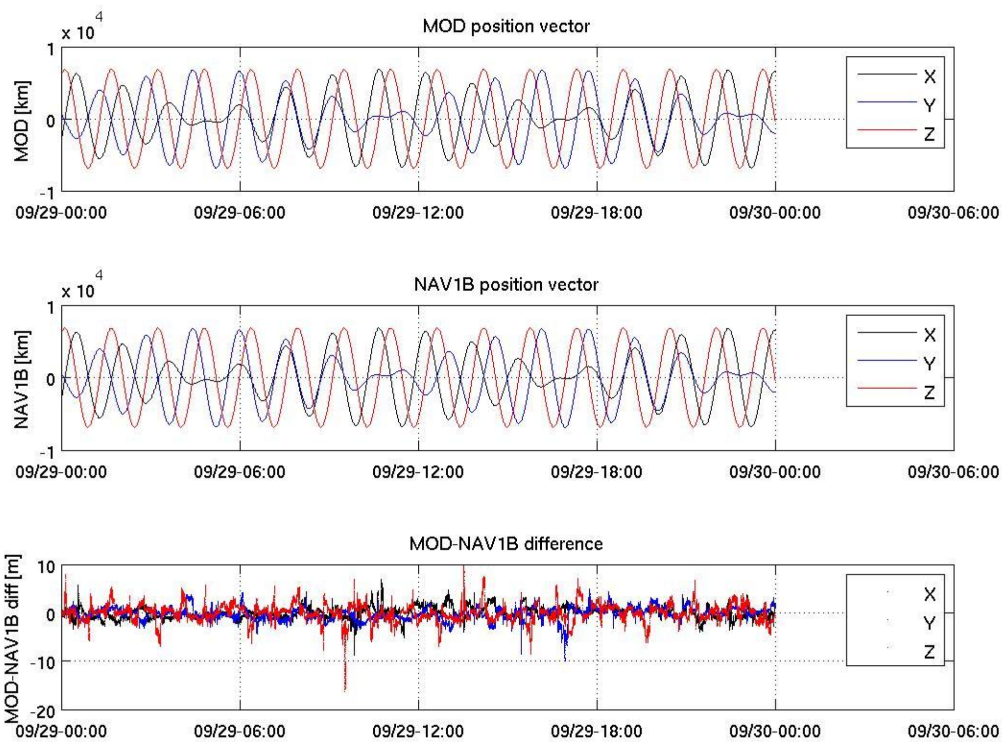

Figure 7: Difference MOD-GPSNAV, sc C, 29/09/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

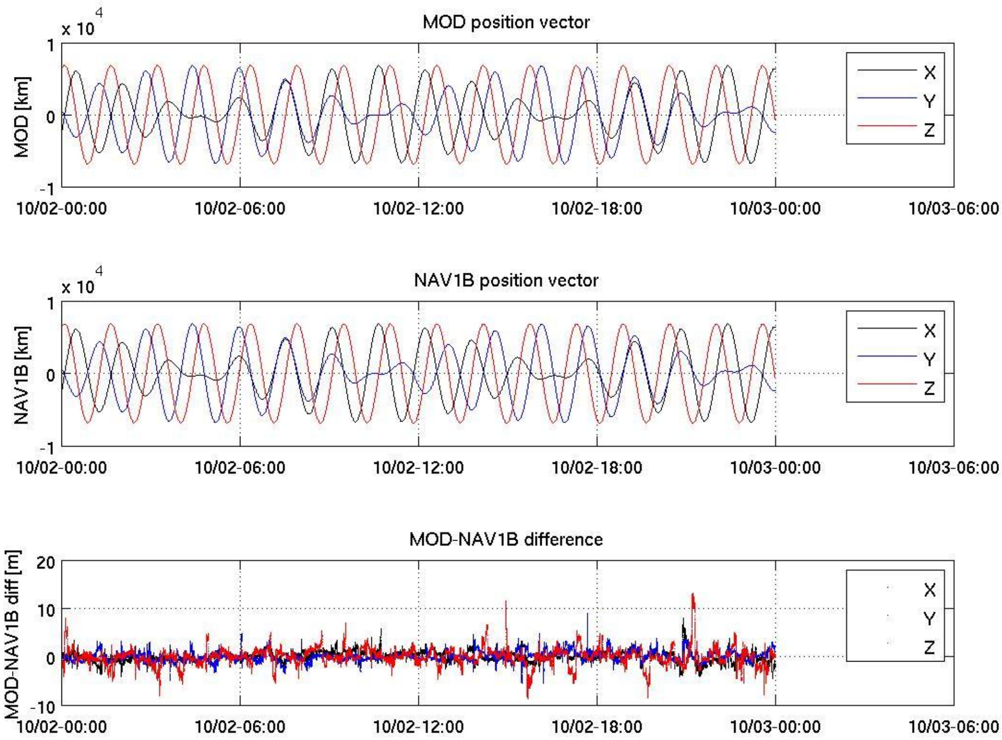

Figure 8: Difference MOD-GPSNAV, sc C, 02/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

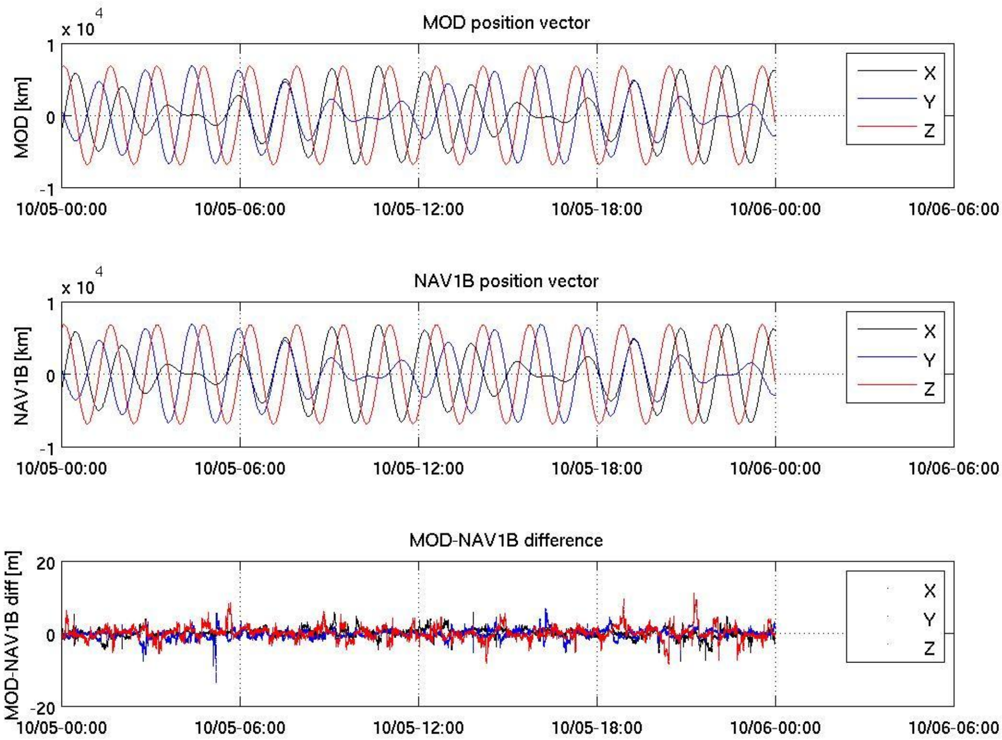

Figure 9: Difference MOD-GPSNAV, sc C, 05/10/2014. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, the difference between the two.

3.2.3.2 Attitude observations

Nothing to report.

3.3 Magnetic Products

The following events have to be reported:

Observation ID	Description	Affected parameter	Sect. of Obs. Description	Sect. of Obs. analysis
SW-IDEAS-27	OBS_ROUTINE: increase of noise in VFM-ASM diff	B_{VFM}, F, B_{NEC}	3.3.1.2, 3.3.2.2, 3.3.3.2	Sect. 4.2; [RD.10], Sect. 4.1

Table 5: list of events related to magnetic products to be reported in the monitoring for Week 40: 29/09/2014 - 05/10/2014.

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.**

3.3.1 Swarm A

3.3.1.1 Magnetic time series visual inspection

Nothing relevant to report. An example of representative magnetic field time series for S/C A can be seen in Figure 10 (05/10/2014):

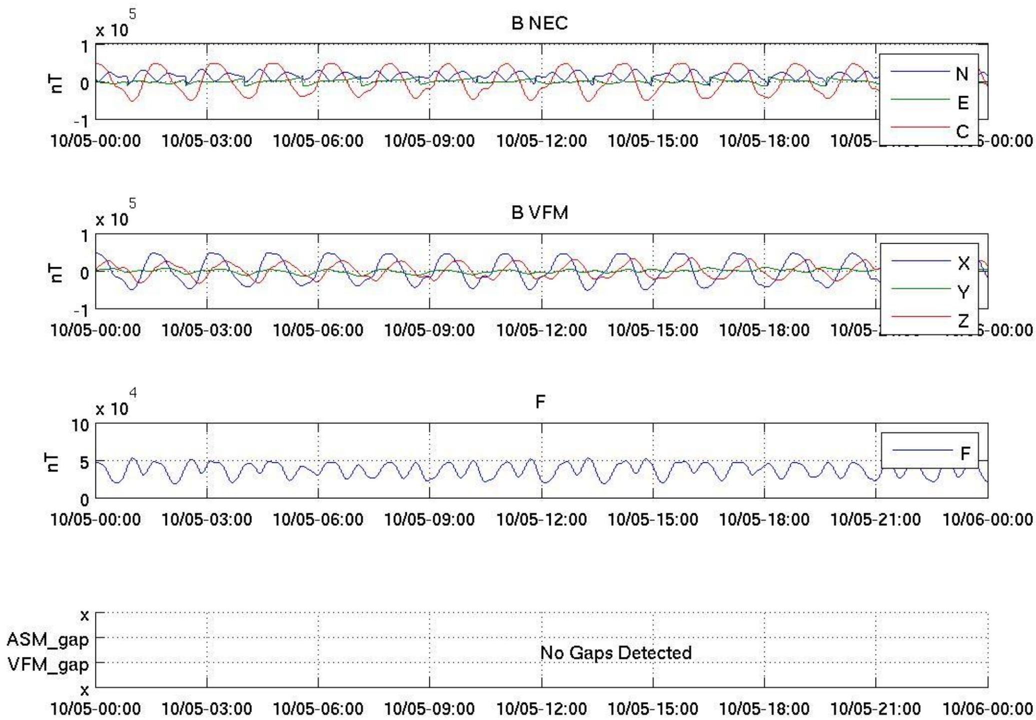

Figure 10: Time series of the geomagnetic field, for 05/10/2014, S/C A. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

3.3.1.2 VFM-ASM anomaly

- **SW-IDEAS-27:** During week 40 the noise superimposed to the ASM-VFM residuals seldom showed up, except during day 05/10 (see Figure 13, red-circled areas). In this period the geomagnetic activity is very moderate. In Sect. 4.2 further details will be given about this issue.

The daily peak-to-peak difference around the week is, on average: [-2.5, 2.5] nT, with some isolated spike which reaches up to 10 nT.

Below some plot example of such differences follows, taken at the beginning of the week (29/9, Figure 11) middle of week (02/10, Figure 12), and end of the week (05/10, Figure 13). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

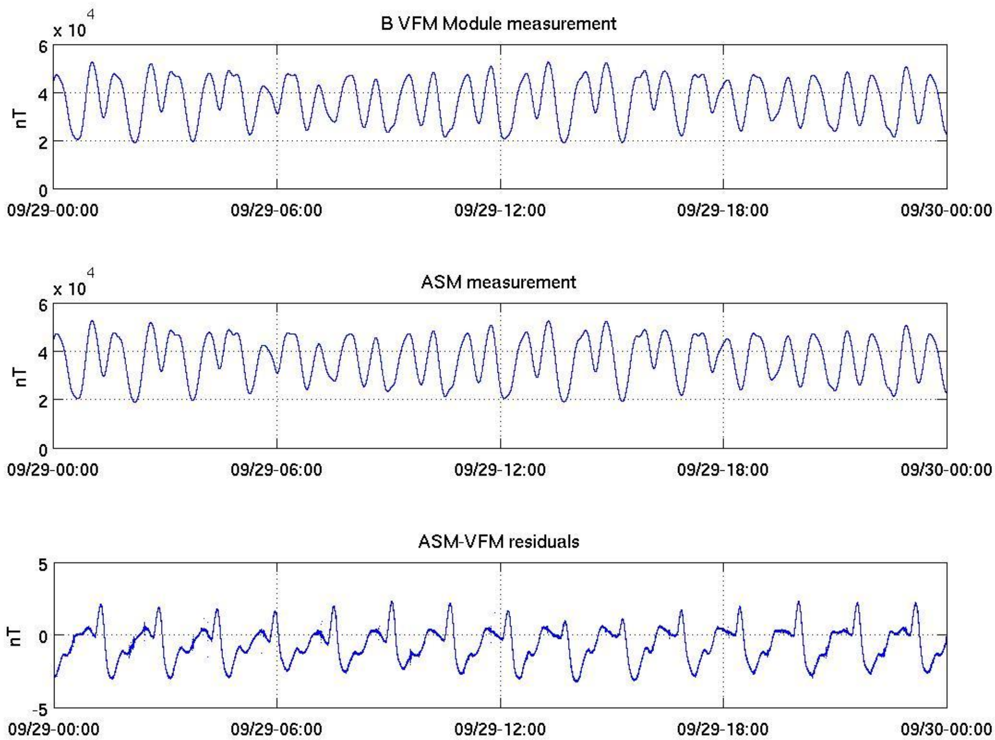

Figure 11: VFM module, ASM module and ASM-VFM residuals for S/C A, 29/09/2014.

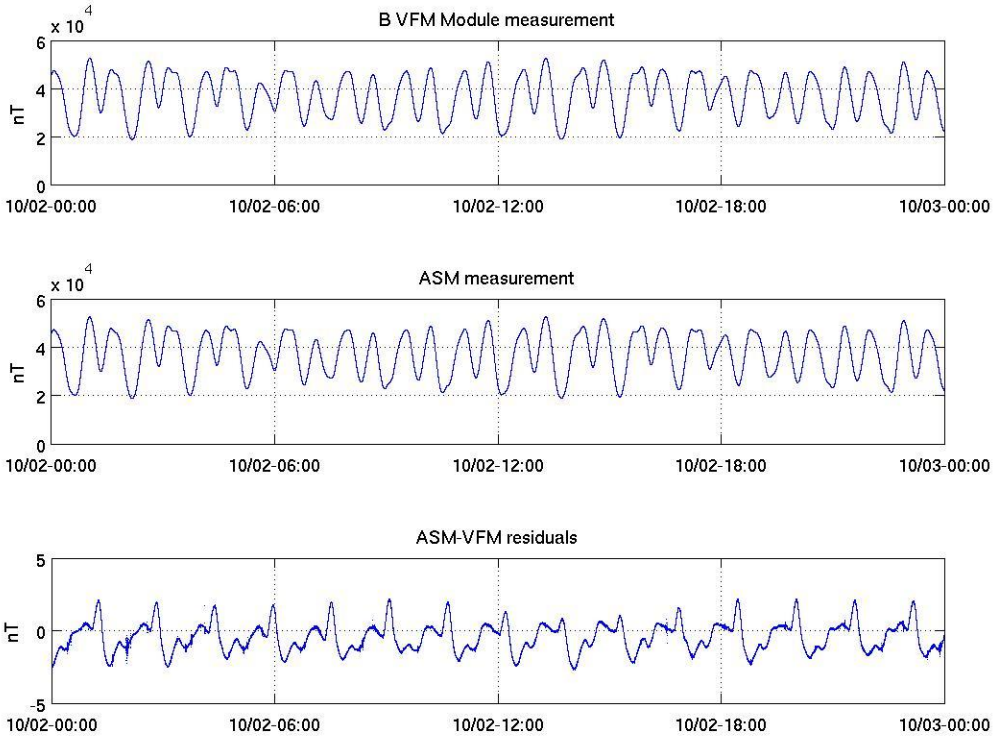

Figure 12: VFM module, ASM module and ASM-VFM residuals for S/C A, 02/10/2014.

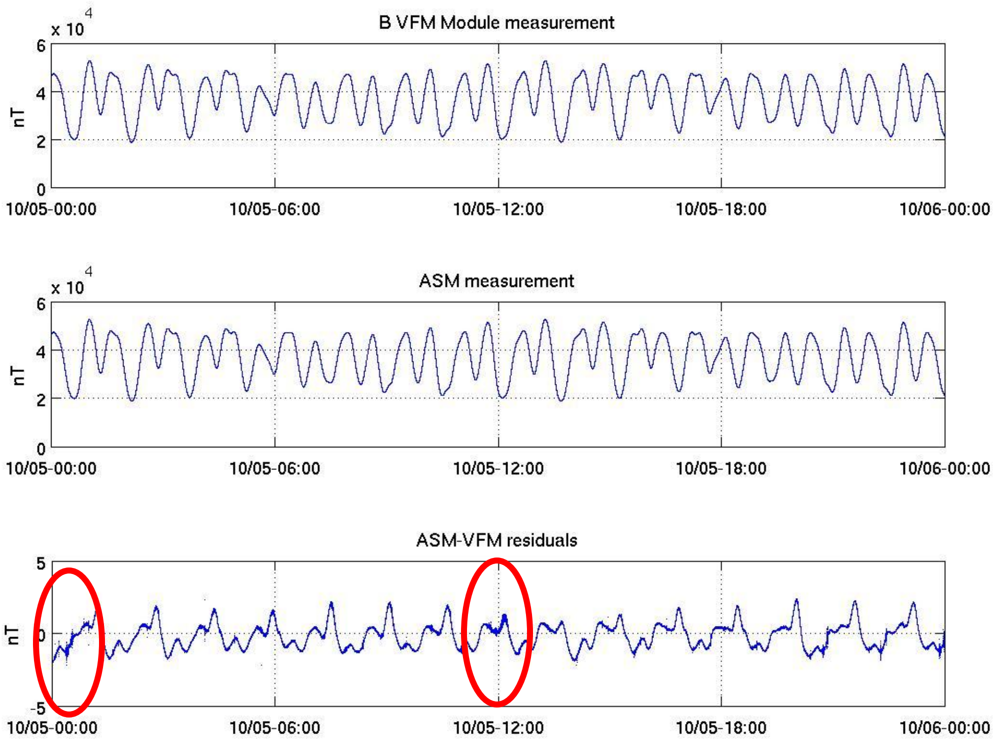

Figure 13: VFM module, ASM module and ASM-VFM residuals for S/C A, 05/10/2014. Red ovals highlight areas where noise is superimposed on the ASM-VFM time series.

3.3.1.3 TCF.VFM monitoring

Output will be provided 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 (05/10/2014) can be seen in Figure 14 below.

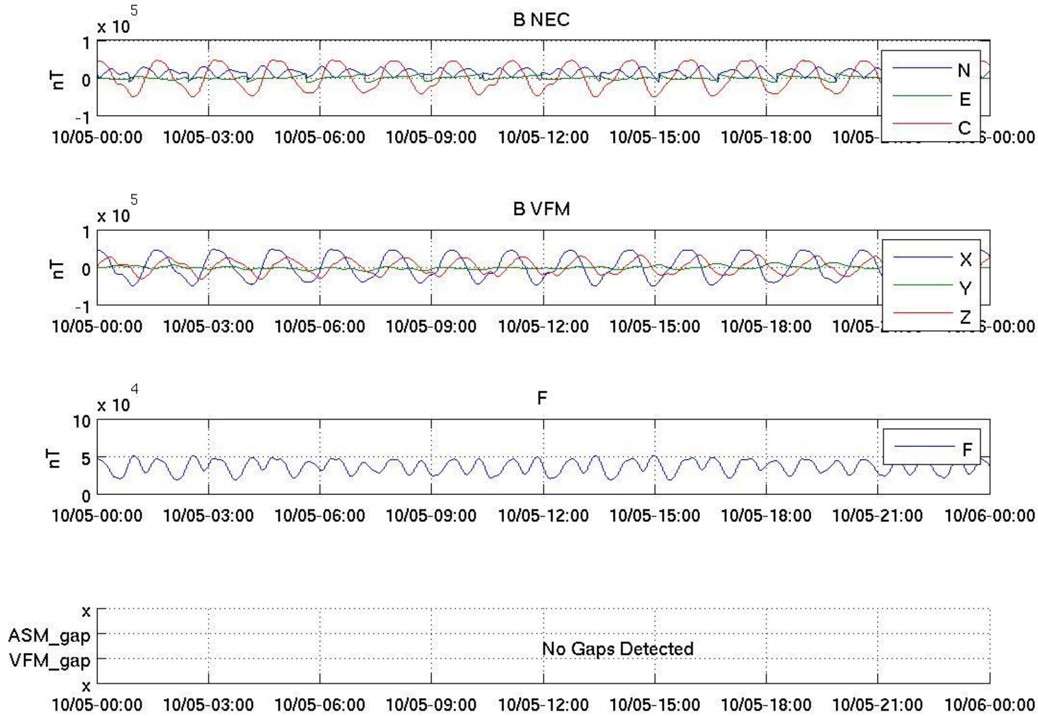

Figure 14: Time series of the geomagnetic field for 05/10/2014, S/C B. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

3.3.2.2 VFM-ASM anomaly

- **SW-IDEAS-27:** See Sect. 3.3.1.2

The daily peak-to-peak difference around the week is, on average: [-2.3, 2] nT, with some small isolated spike which reaches up to 6 nT.

Below some plot example follows of such differences taken at the beginning of the week (29/09, Figure 15), middle of the week (02/10, Figure 16) and at the end of the week (05/10, Figure 17). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

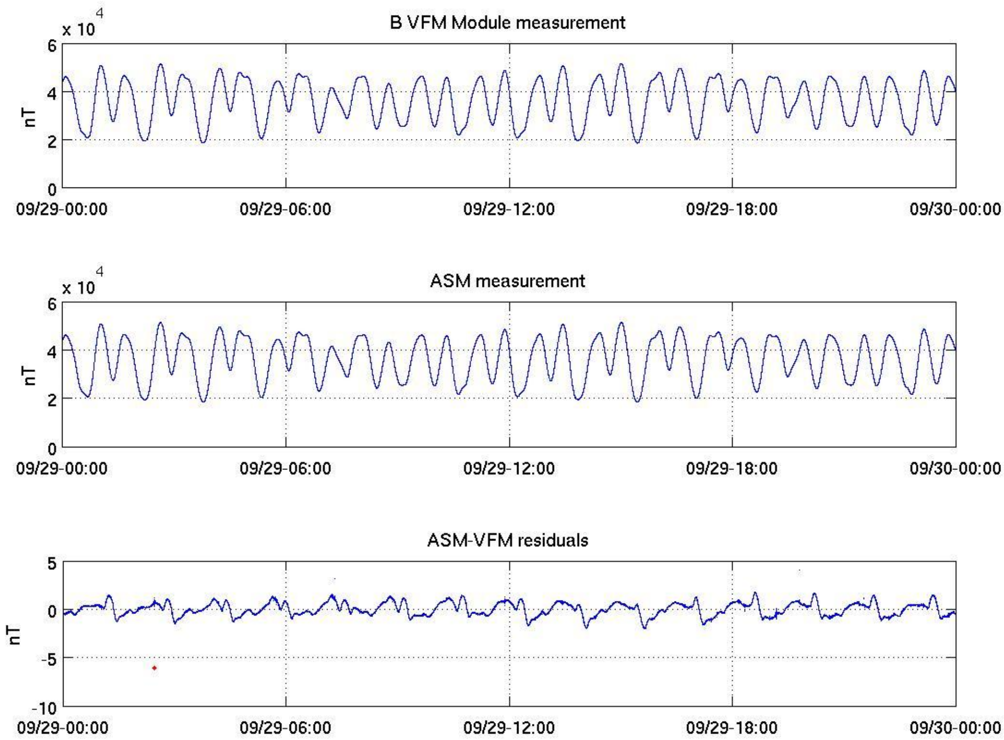

Figure 15: VFM module, ASM module and ASM-VFM residuals for S/C B, 29/09/2014

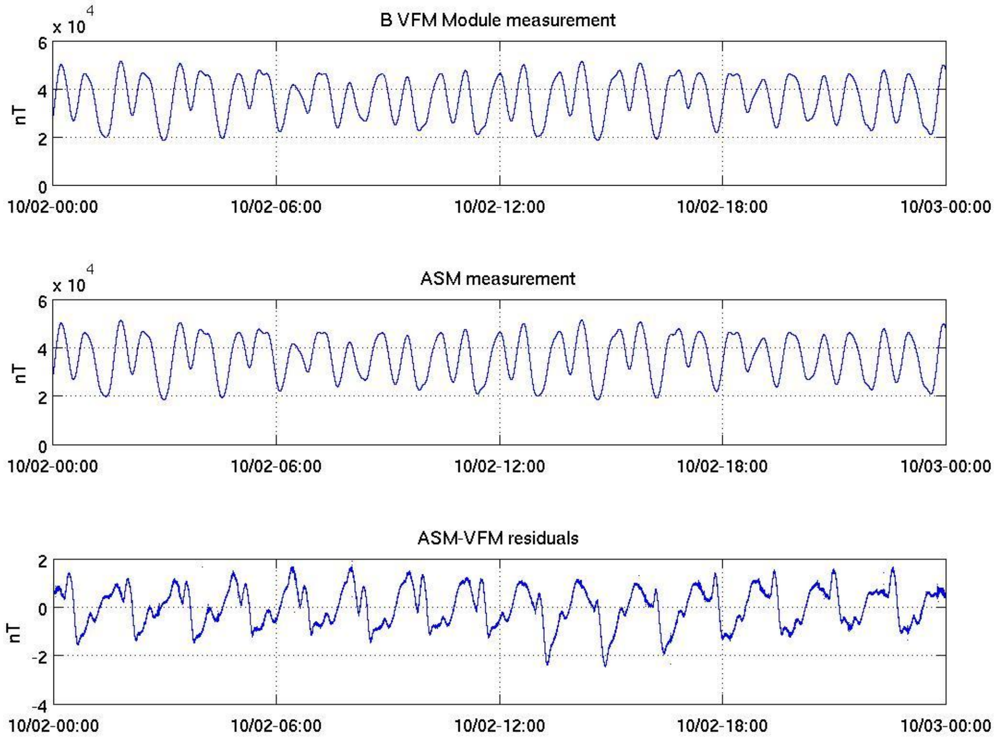

Figure 16: VFM module, ASM module and ASM-VFM residuals for S/C B, 02/10/2014.

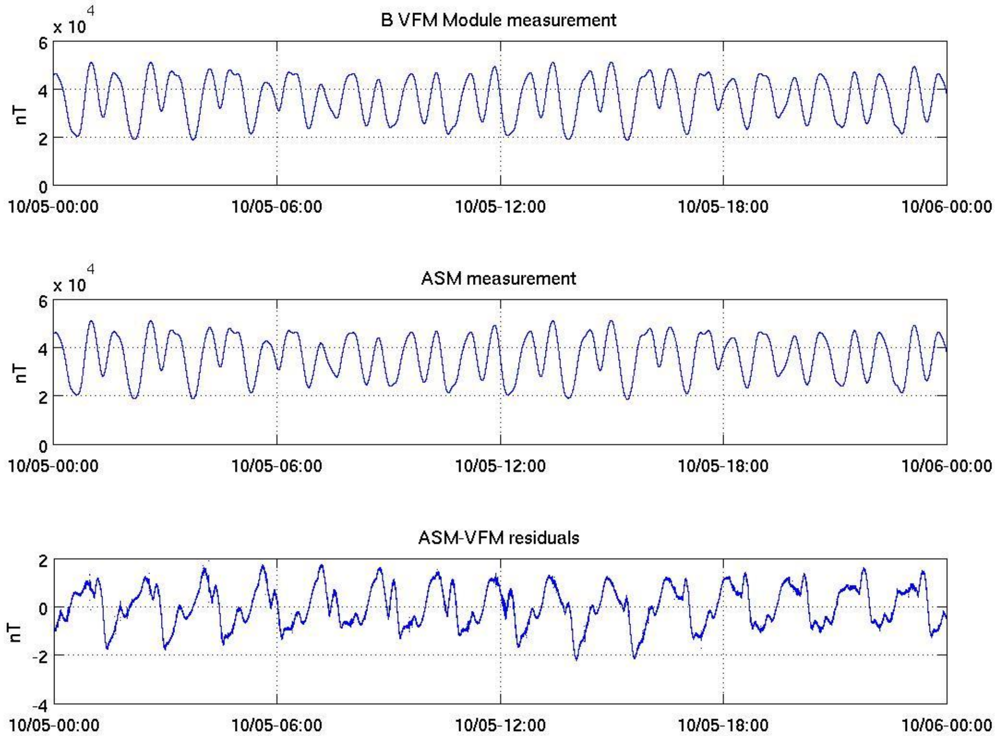

Figure 17: VFM module, ASM module and ASM-VFM residuals for S/C B, 05/10/2014.

3.3.2.3 TCF.VFM monitoring

Output will be provided in the last report of the month.

3.3.3 Swarm C

3.3.3.1 Magnetic time series visual inspection

Nothing relevant to report. An example of representative F time series for S/C C (05/10/2014) can be seen in Figure 18 below.

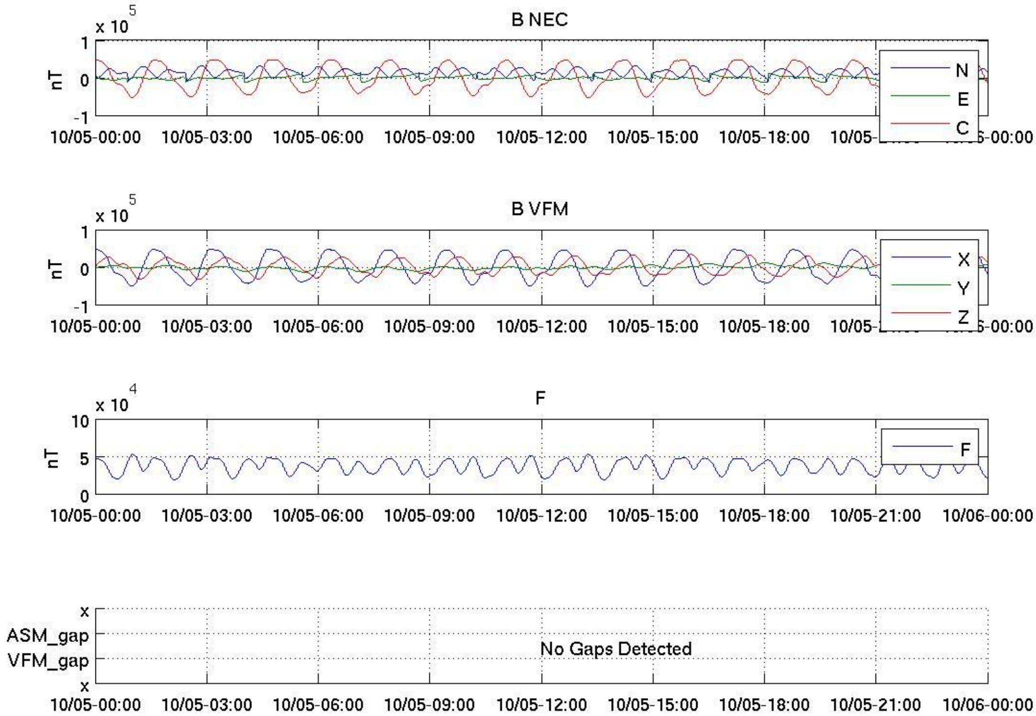

Figure 18: Time series of magnetic field intensity, F, for 05/10/2014, S/C C. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

3.3.3.2 VFM-ASM anomaly

- **SW-IDEAS-27:** see Sect. 3.3.1.2.

The daily peak-to-peak difference around the week is, on average: [-2, 2] nT, with isolated spikes which reaches up to 5 nT.

Below some plot example follows of such differences taken at the beginning of the week (29/09, Figure 19), at the middle of the week (02/10, Figure 20), and at the end of the week (05/10, Figure 21). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

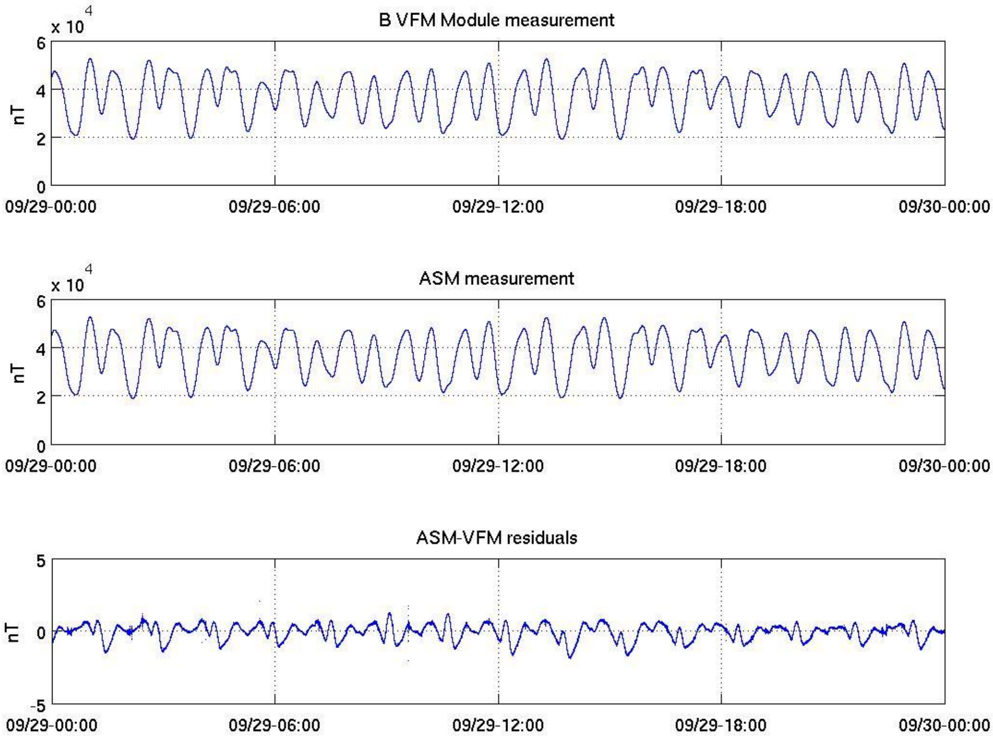

Figure 19: VFM module, ASM module and ASM-VFM residuals for S/C C, 29/09/2014.

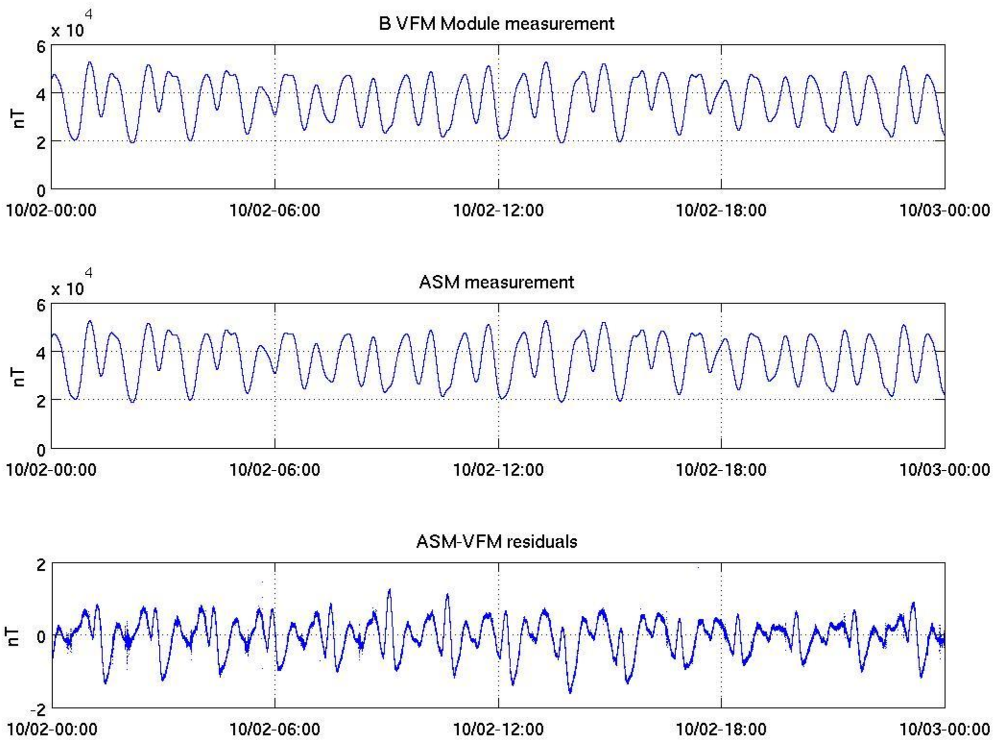

Figure 20: VFM module, ASM module and ASM-VFM residuals for S/C C, 02/10/2014.

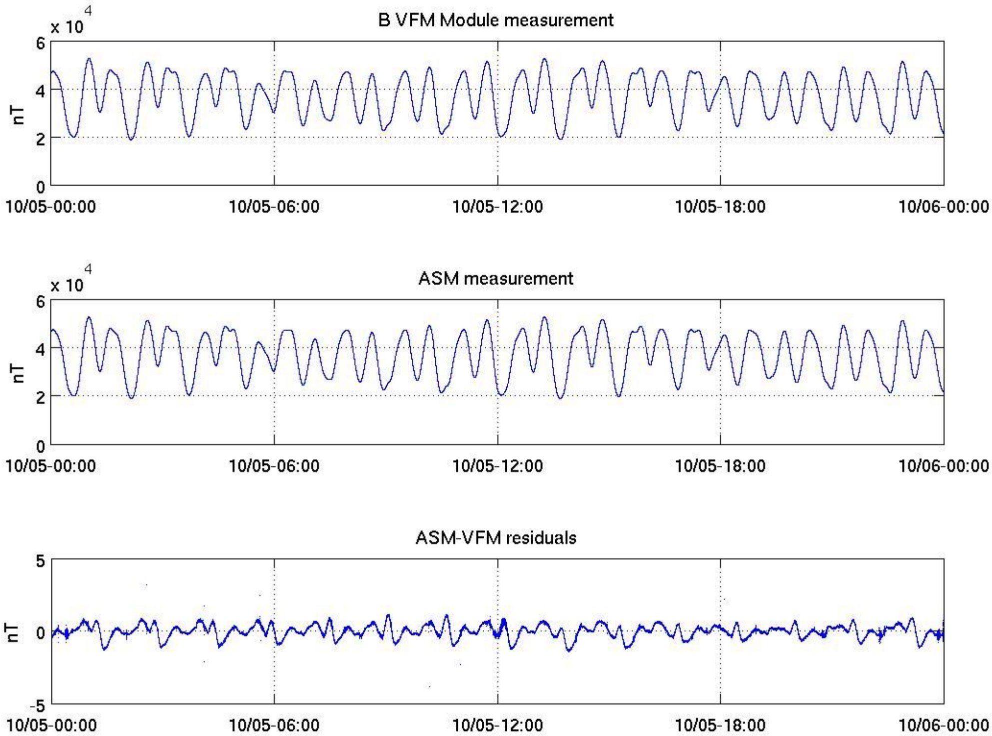

Figure 21: VFM module, ASM module and ASM-VFM residuals for S/C C, 05/10/2014.

3.3.3.3 TCF.VFM monitoring

Output will be provided in the last report of the month.

3.3.4 Summary of TCF behaviour for the three S/C

Output will be provided in the last report of the month.

4. ON-DEMAND ANALYSIS

4.1 SW-IDEAS-34: MOD-GPSNAV spiky features frequently observed.

We think this issue is closely connected with SPR SWL1L2DB-9 (see Sect. 4.1 of [RD.9]). See for example, in Figure 22, the behaviour of the MOD-GPSNAV difference for S/C A, 04/10/2014. This is a representative “worst case” of a quite common situation, that we observe almost every day on all S/C: the time series show a high number of deviations from a belt that we can define as average +/- standard deviation (roughly +/- 2m, see Figure 23, where only the deviations are evidenced); these are not simple spikes, but it looks like the two solutions depart each other for long intervals, from tens of seconds up to 15-20 minutes. In Figure 24 a zoom into one of such “spiky” features is shown: as one can see the increase in the difference of solutions appears as an abrupt jump of few meters (between 3 and 5 on average, above 5 meters we rather observe “true” short duration spikes), followed by plateaus often characterized by different time extensions depending on the component.

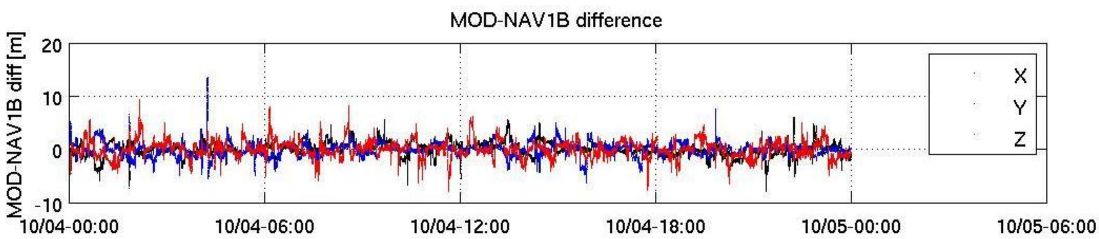

Figure 22: MOD-NAV difference for S/C A, 04/10/2014.

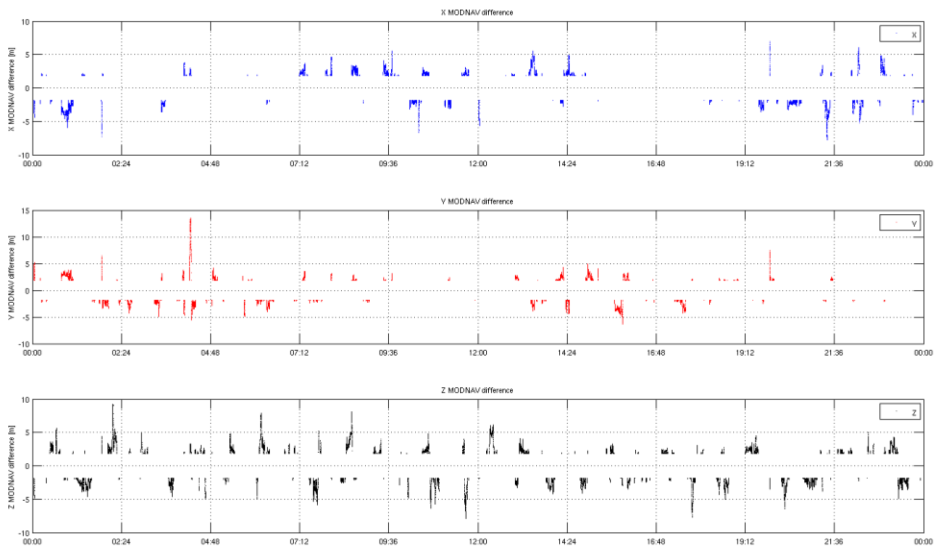

Figure 23: cut of the time series in Figure 22, above +/- 2 m.

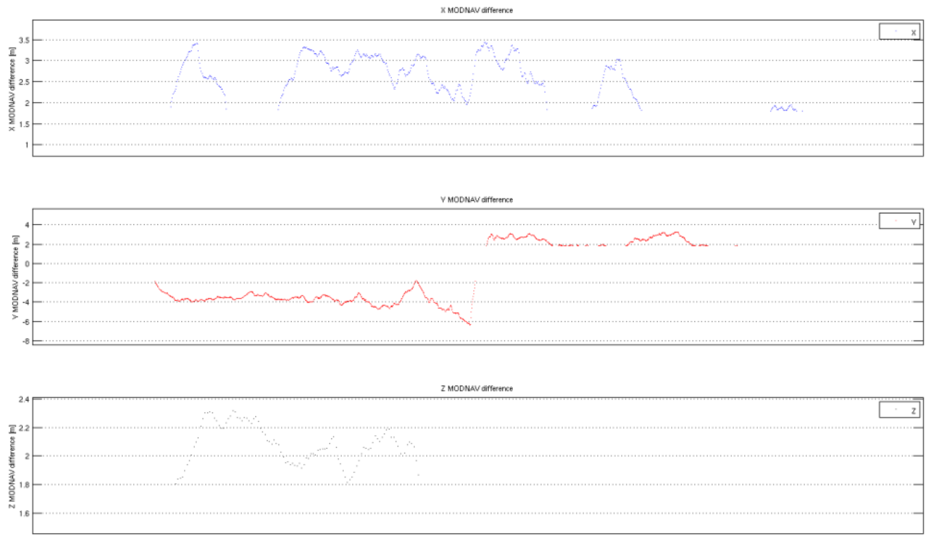

Figure 24: detail of one of the "spiky" behaviour described above in the text.

4.2 SW-IDEAS-27: Further analysis on noise superimposed on the ASM-VFM residuals

After a deep study into the MAGNET algorithms, we understood something more about the ASM-VFM residual noise described in the past reports. In fact the main result we obtained is a final confirmation that such noise is observed by the VFM and not by the ASM. The ASM data are pre-filtered at 0.04 Hz, i.e. every signal feature occurring on time scales shorter than 25 seconds is drastically smoothed. A cross-check of this effect can be done by comparing the ASM-VFM difference as calculated starting from MAG_LR or MAG_CA datasets. These are the differences between these two datasets:

a. in Mag_CA, the F_{VFM} is ASM-filtered and is linearly interpolated at t_{ASM} so that it can be compared directly with $F_{ASM.}$

b. while in Mag_LR the B values are not ASM-filtered and they are interpolated from $t_{out, VFM}$ to the exact UTC. And the F_{ASM} is interpolated from $t_{out, ASM}$ (i.e. corrected for filter group delay) to the exact UTC.

So, in the MAG_LR there are basically two sources of additional "noise" with respect to the MAG_CA: 1) the "time interpolation" noise and 2) the effect of filter removal on VFM data.

In the two figures below basically the same quantities are plotted. From top to bottom: the over-plot of the ASM-VFM differences calculated using MAG_LR inputs (blue) and MAG_CA inputs (red); the difference of the two time series; a zoom of such differences over a more sensitive y-axis scale (+/- 200 pT).

Figure 25 refers to a quiet day from a geomagnetic point of view (07/09/2014: low Dst index, Kp below 3); Figure 26 refers to an "active" day from a geomagnetic point of view (12/09/2014: a moderate geomagnetic storm begins at about 16 UT).

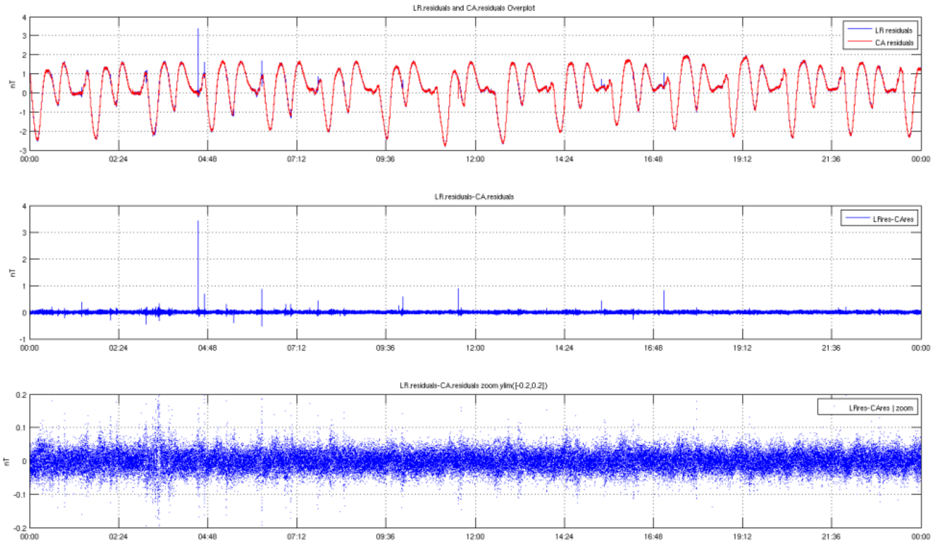

Figure 25: ASM-VFM differences calculated using MAG_LR and MAG_CA datasets for a "quiet" day (07/09/2014)

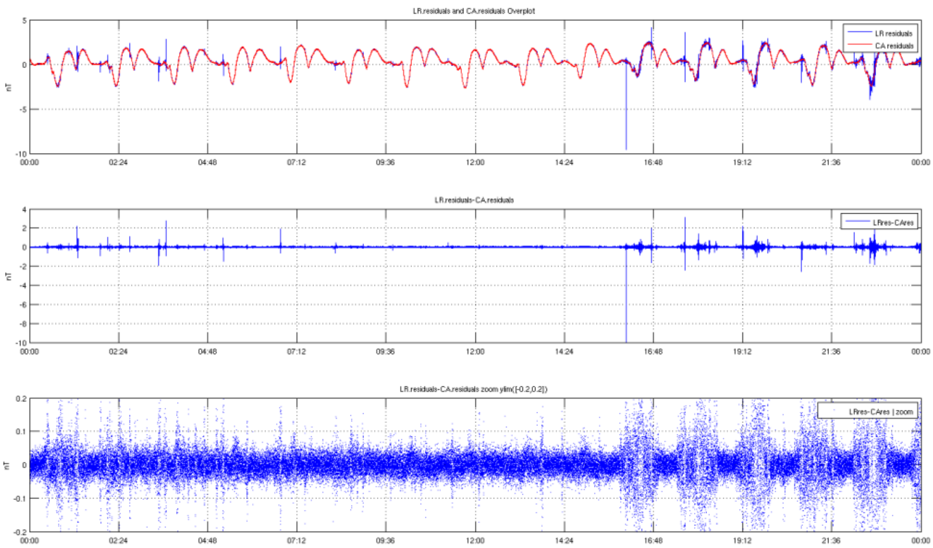

Figure 26: ASM-VFM differences calculated using MAG_LR and MAG_CA datasets for a geomagnetically active day (12/09/2014).

Comparing the two figures, one can immediately see that, when the geomagnetic storm begins on day 12/09, the increase of the noise affects only the MAG_LR. This effect is even clearer when we go to the time series power spectra. Figure 27 shows such spectra of the ASM-VFM difference of day 12/09, calculated with MAG_LR (upper panel) and MAG_CA (lower panel): the noise band between 0.04 and 0.1 Hz is clearly visible in the LR data and almost absent in CA data.

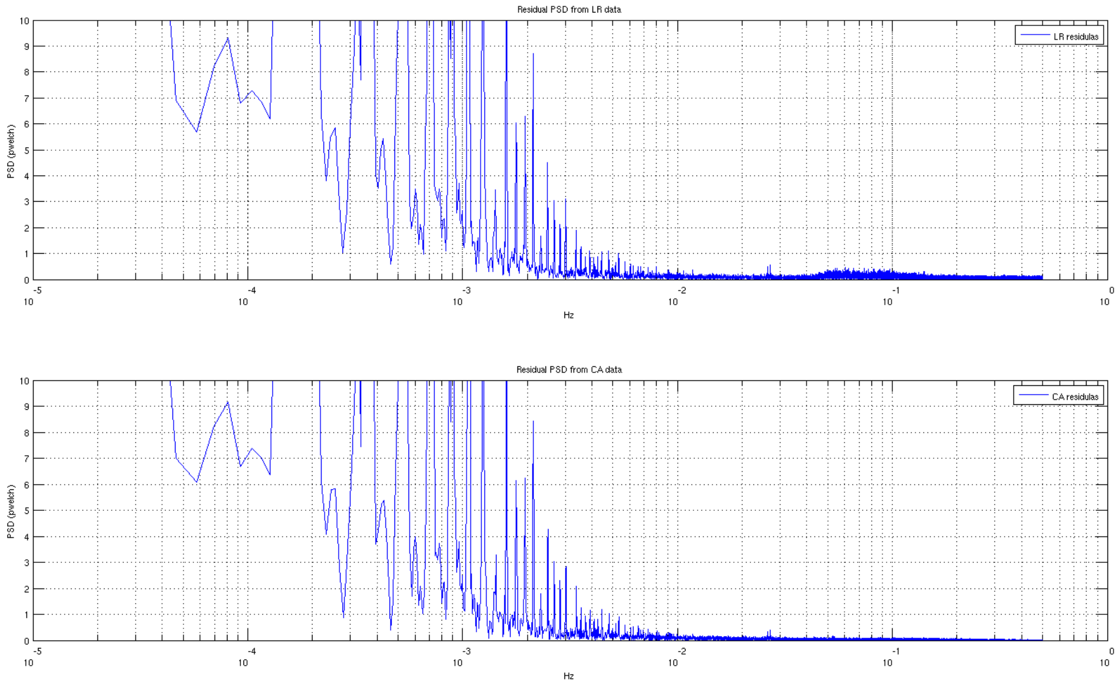

Figure 27: power spectra of the ASM-VFM difference of day 12/09, calculated with MAG_LR (upper panel) and MAG_CA (lower panel).

4.3 SW-IDEAS-35: Spikes observed in the Sun pressure radiation correction of the acceleration.

During an analysis which required the identification of satellites position with respect to the Sun (information available in the ACC_PR_1B data), we stepped into a strange feature that can be observed in the Sun pressure correction to the acceleration.

In Figure 28, data from 04/10/2014, SC A are reported. From top to bottom: module of the linear acceleration; module of the $a_{\_SUN}$ correction; differential value of the S/C Mass; MOD position in ITRF; Accelerometer flags; Platform flags; quaternions from STRAATT_1B product. The red ovals in the figure evidence a spike in the $a_{\_SUN}$ correction, which seems to be related to a discontinuity in the quaternions. This could be an algorithm anomaly and it has been reported to the processor provider (not yet as an SPR).

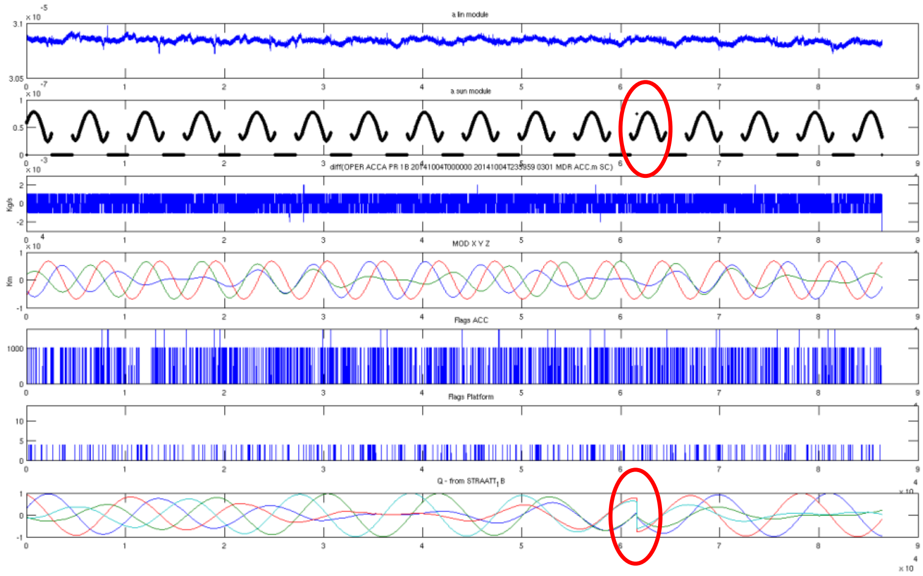

Figure 28: data from 04/10/2014, S/C A. From top to bottom: module of the linear acceleration; module of the a_$_{SUN}$ correction; differential value of the S/C Mass; MOD position in ITRF; Accelerometer flags; Platform flags; quaternions from STRAATT_1B product.

End of Document