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# IDEAS+ Swarm Weekly Report 2015/14: 2015/03/30 - 2015/04/05

**Abstract** : This is the **Instrument Data quality Evaluation and Analysis Service Plus** (IDEAS+) Swarm Weekly report on Swarm products quality, covering the period from 30 March to 05 April 2015.

**Author** : Igino Coco and Jan Miedzik on behalf of Swarm IDEAS+ Team

**Approval** : Lidia Saavedra de Miguel
IDEAS+ Science and Ops. Coordinator

**Distribution** : ESA/ESRIN EOP-GMQ
ESA/ESRIN EOP-GM Swarm MM
IDEAS+ Leadership Team
IDEAS+ subcontractors
ESA/ESTEC Swarm PLSO
ESA/ESOC Swarm FOS



**Serco Italia Spa**
**Via Sciadonna 24/26, 00040, Frascati, Italy**
**Tel: +39 06 98354400 Fax: +39 06 9419426**
**www.serco.com**

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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 | 13 Apr 2015 | 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 3.14.01, 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.2.12p1

## 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_20141124_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 (ref. for SWL1L2DB-9)

[RD.10] IDEAS+ Swarm Weekly Report: 29/09/2014 – 05/10/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20140929_20141005.pdf (ref. for SW-IDEAS-34)

[RD.11] IDEAS+ Swarm Weekly Report: 06/10/2014 – 12/10/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20141006_20141012.pdf (ref. for SW-IDEAS-36)

[RD.12] IDEAS+ Swarm Weekly Report: 20/10/2014 – 26/10/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20141020_20141026.pdf (ref. for SW-IDEAS-40, GPS sync loss)

[RD.13] IDEAS+ Swarm Weekly Report: 15/09/2014 – 21/09/2014, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_20140915_20140921.pdf (ref. for SW-IDEAS-27)

# 2. SUMMARY OF THE OBSERVATIONS

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

Nothing new to report.

## 2.2 Plan for operational processor updates

L1BOP 3.15 has been put into operation on March 23th. The data quality with the new processor has been quickly assessed and it is satisfactory (**Error! Reference source not ound.**).

The PDGS team has concluded the recovery of the failed production due to the bug in L1BOP 3.14, and the generation of the Swarm C magnetic production lost from 6th November (when ASM has fallen down).

## 2.3 Quality Working Group and Cal/Val Coordination

Coordination is in place for organizing the 6th Swarm Data Quality Workshop in Paris (hosted by IPGP) in late September 2015.

Following the QWG recommendations in Potsdam and the scientists need in view of the IUGG conference in June, the preliminary plasma dataset has been released early February 2015.

According to the last coordination meeting within the MAGNET QWG (22/01/2015) the following decisions have been taken:

- With the data provided by DTU/ESL, further analysis can be performed by industry (ADS, DTU-MI), other scientific groups (e.g. Richard Marchand and Stephan Buchert on plasma induced fields), and of course by ESA. The agreement is - as always - that results will be shared with all others on the Task Force.

- DTU/ESL will further refine the Lesur-Tøffner-Clausen model parametrisation and share a final description of the process (input data, model description, output results and tests) (by mid-February).

- In parallel, GFZ will distribute the Lühr-Michaelis results, and a number of people (e.g. Malcolm Dunlop, Yulia Bogdanova, Arnaud Chulliat, and Patrick Alken) will further support the analysis of these datasets (by mid-February).

- The PDGS will generate the currently VFM missing data on Charlie due to the ASM failure (by end February).

- DTU/ESL will share the final set of corrected data by early March. These corrected data will also contain the dBsun correction, providing the users the possibility to access to uncorrected data.

- The corrected data will be distributed by ESA to all Swarm users (by early April and no later than 20th April). The correction will also be implemented in the OP. Until this is fully validated, it is agreed that the operational processing will continue as nominal without the correction.

- Next Task Force meeting: **9-10 April**. The meeting will be held in ESTEC.

## 2.4 Summary of observations for 2015, Week 14 (30/03 - 05/04)

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

- **Two GPS loss of sync** observed on S/C A and S/C B during week 14.

- **Several features observed in the MOD-NAV difference:** we often observe deviations from the average values lasting several minutes (**SW-IDEAS-34**).

- **Artefact jump in some of the TCF parameters** due to processing issues (see Sect. 3.3.1.3 and 3.3.2.3).

# 3. ROUTINE QUALITY CONTROL

## 3.1 Gaps analysis

- **GPS sync loss events.** Two GPS out-of-sync occurred on S/C B on 03/04 and one on S/C A on 01/04. Such events cause the related timestamps to be rejected by the Level 1B processor and cause gaps to be present in all the Level 1A products.

## 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] |
| **SW-IDEAS-40** | OBS_ROUTINE: STR out of range - ANOMALOUS CASES | All level 1A and level 1B products | 3.2.2.2 | [RD.12] |

**Table 1**: List of events related to attitude and orbit products to be reported in the monitoring for 2015, Week 14: 30/03 - 05/04.

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. The maximum standard deviation is in the fourth

column. Maxima, minima and standard deviations usually refer to the Z component which is often the most disturbed; in case another component is most affected, it will be specified in parentheses.

| Swarm A, 30/03 - 05/04, Position difference | | | | | |
|---|---|---|---|---|---|
| **Day** | **Average difference (m)** | **Maximum difference (m)** | | **Maximum standard deviation (m)** | **Notes** |
| 30/03 | 0.13 | -10.8 | 9 | 1.7 | SW-IDEAS-34 [RD.10] |
| 31/03 | 0.11 | -9.1 (Y) | 9.3 | 1.3 | SW-IDEAS-34 [RD.10] |
| 01/04 | 0.17 | -5.8 | 12 | 1.3 | Spike on Z comp. |
| 02/04 | 0.11 | -9.7 | 8.3 (Y) | 1.5 | SW-IDEAS-34 [RD.10] |
| 03/04 | 0.06 | -11 | 12.9 | 2.1 | SW-IDEAS-34 [RD.10] |
| 04/04 | 0.09 | -12.1 | 10.2 | 1.7 | SW-IDEAS-34 [RD.10] |
| 05/04 | 0.13 | -10.4 | 8.3 | 1.4 | |

**Table 2:** Swarm A, difference between MOD and on-board solution positions. If not specified maximum difference and maximum standard deviation refers to the Z axis.

Below some plot example follows of such differences taken at the beginning of the week (30/03, Figure 1) in the middle (02/04, Figure 2) and at the end (05/04, 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, and the difference between the two. The values of position are given in [km] and the difference between both solutions is given in [m].

In Figure 2 the red-circled areas show examples of SW-IDEAS-34 ([RD.10]) occurrences: the MOD-NAV difference departs from the average value and keeps higher/lower levels for several minutes.

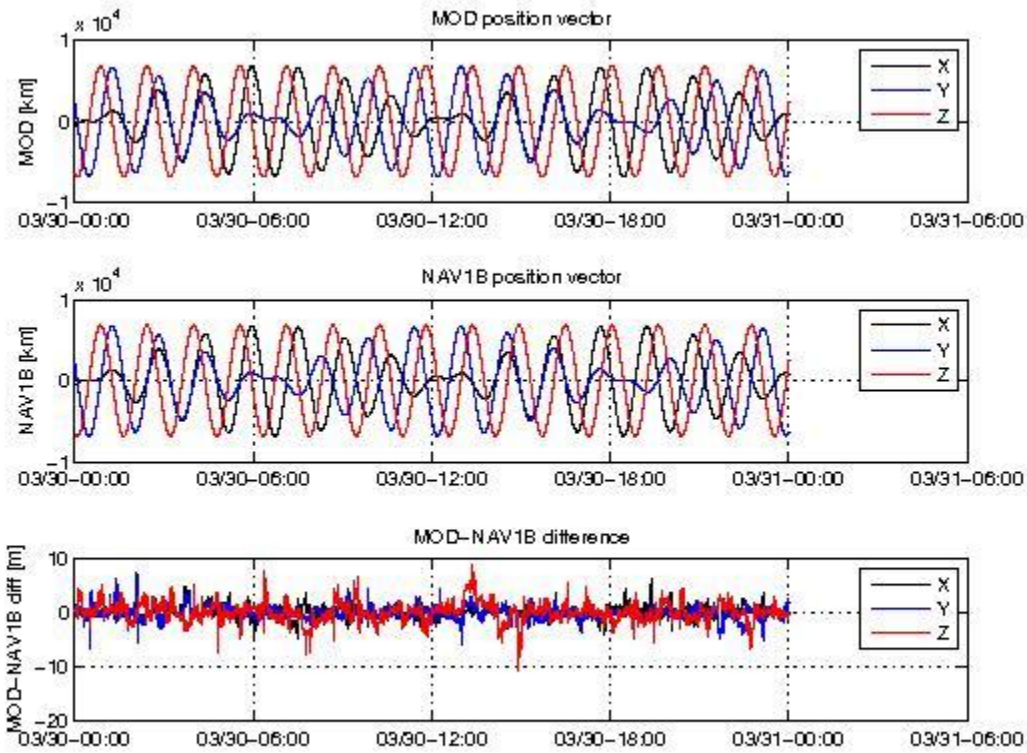


**Figure 1:** Difference MOD-GPSNAV, S/C A, 30/03. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two.

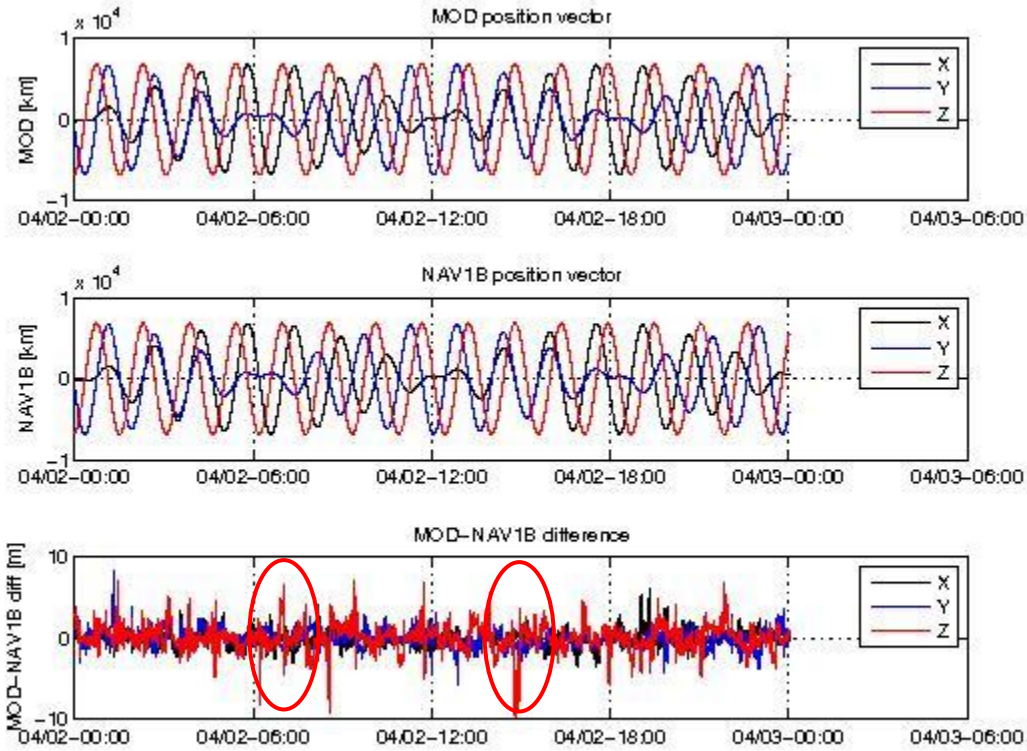


**Figure 2:** Difference MOD-GPSNAV, S/C A, 02/04. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two. The red circled areas show occurrences of SW-IDEAS-34 [RD.10].

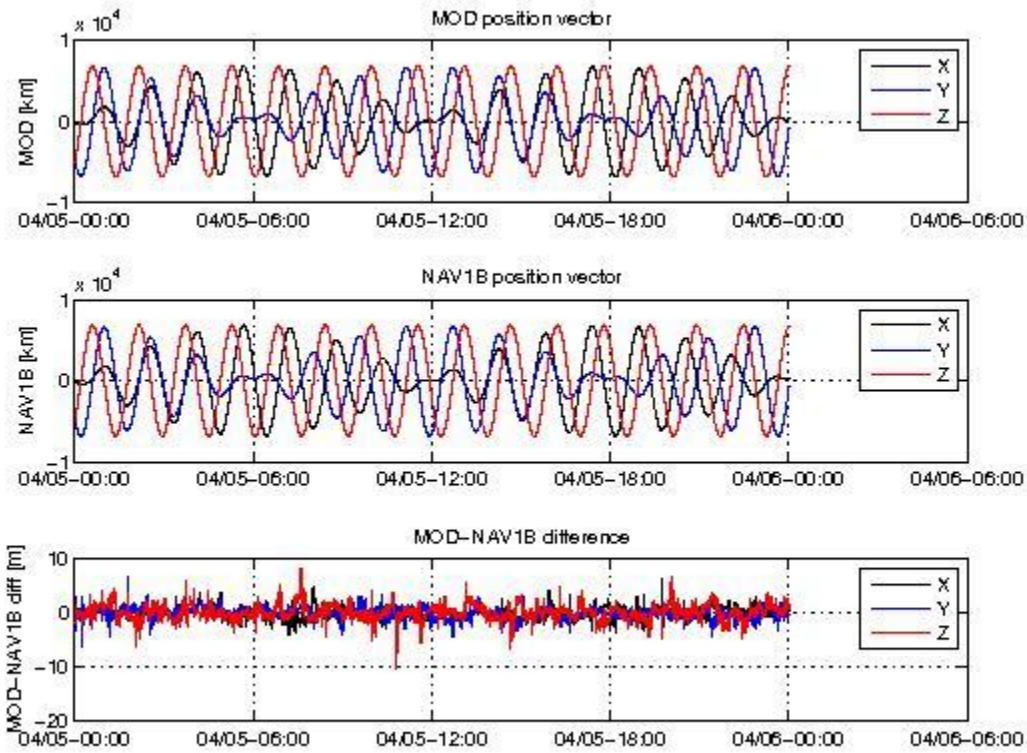


**Figure 3:** Difference MOD-GPSNAV, S/C A, 05/04. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two. The red circled area shows a big spike in the Y and Z components.

#### 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. The maximum standard deviation is in the fourth column. Maxima, minima and standard deviations usually refer to the Z component which is often the most disturbed; in case another component is most affected, it will be specified in parentheses.

| **Swarm B, 30/03 - 05/04, Position difference** | | | | | |
|---|---|---|---|---|---|
| **Day** | **Average Difference (m)** | **Maximum difference (m)** | | **Standard Deviation (m)** | **Notes** |
| 30/03 | 0.09 | -9.5 | **23** | 1.9 | Big spike on Z comp. |

| Swarm B, 30/03 - 05/04, Position difference | | | | | |
|---|---|---|---|---|---|
| 31/03 | 0.07 | -9.7 | 6.3 | 1.3 | SW-IDEAS-34 [RD.10] |
| 01/04 | 0.15 | -7.5 | 12.6 | 1.3 | |
| 02/04 | 0.17 | -13.3 | 13.8 (Y) | 1.4 | |
| 03/04 | 0.09 | -12.6 | 12 | 1.9 | SW-IDEAS-34 [RD.10] |
| 04/04 | 0.03 | -7.8 | 9.5 (Y) | 1.5 | SW-IDEAS-34 [RD.10] |
| 05/04 | 0.1 | -7.5 | 11.3 | 1.6 | SW-IDEAS-34 [RD.10] |

**Table 3:** Swarm B, difference between MOD and on-board solution positions. If not specified maximum difference and maximum standard deviation refers to the Z axis.

Below some plot example follows of such differences taken at the beginning of the week (30/03, Figure 4), in the middle (02/04, Figure 5), and at end of the week (05/04, 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, and the difference between the two. . The values of position are given in [km] and the difference between both solutions is given in [m].

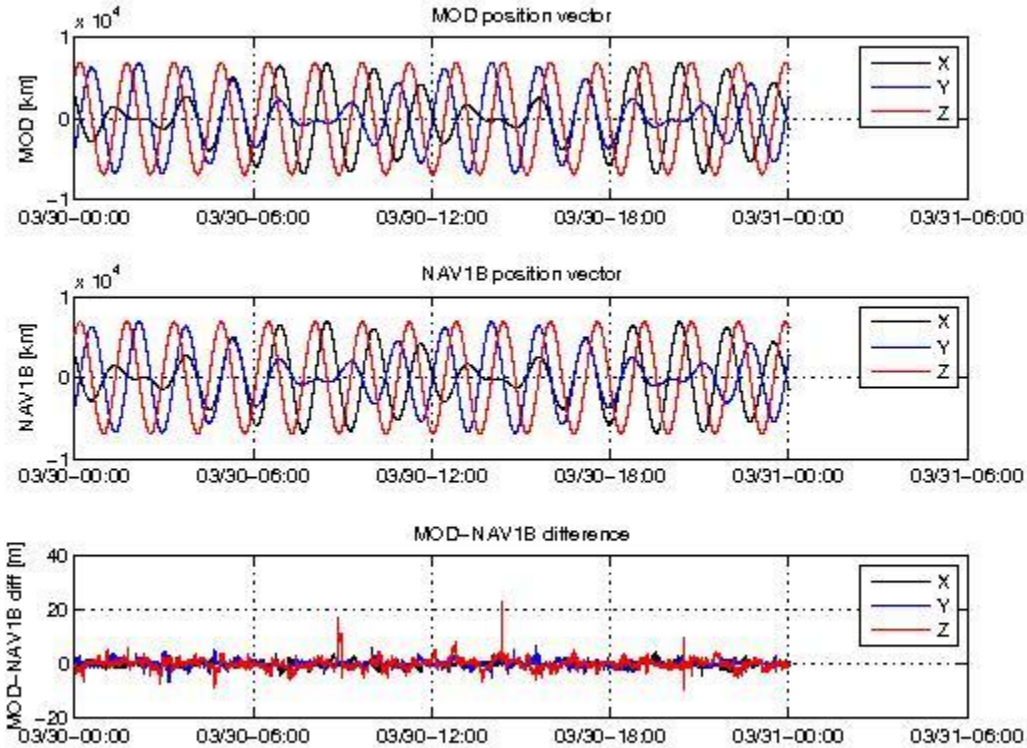


**Figure 4:** Difference MOD-GPSNAV, S/C B, 30/03. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two.

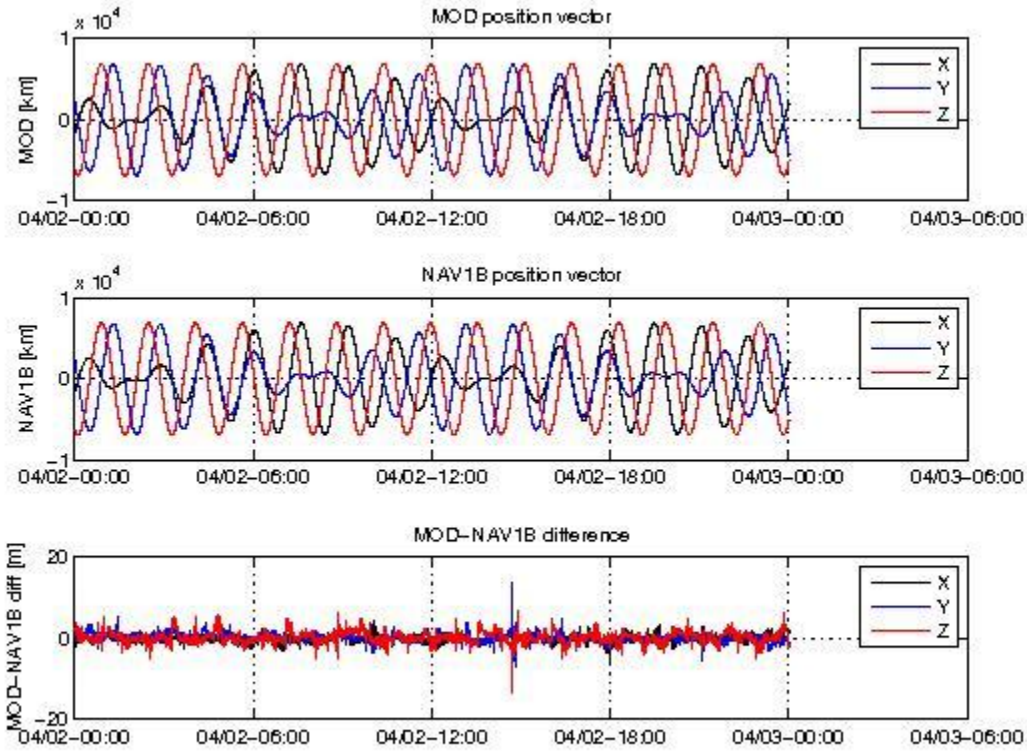


**Figure 5:** Difference MOD-GPSNAV, S/C B, 02/04. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two.

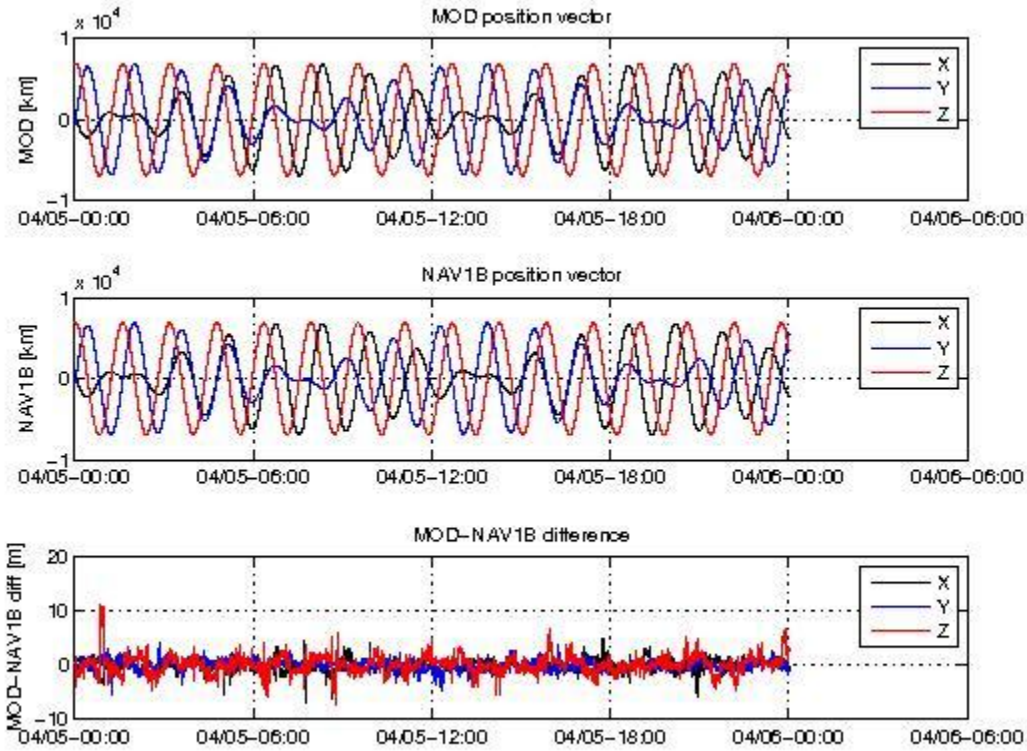


**Figure 6:** Difference MOD-GPSNAV, S/C B, 05/04. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two.

#### 3.2.2.2 Attitude observations

- **SW-IDEAS-40**

During week 14 one GPS out-of-Sync was detected. As explained in [RD.12], 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 below, the list of such events for S/C B is given.

| Start time | Stop time | Length (s) |
|---|---|---|
| 03/04/2015 20:52:32 | 03/04/2015 20:52:38 | 6 |

**Table 4** Attitudes out-of-range, S/C B, week 14.

### 3.2.3 Swarm C

#### 3.2.3.1 Position Statistics

In Table 5 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. The maximum standard deviation is in the fourth column. Maxima, minima and standard deviations usually refer to the Z component which is often the most disturbed; in case another component is most affected, it will be specified in parentheses.

| Swarm C, 30/03 - 05/04, Position difference | | | | | |
|---|---|---|---|---|---|
| **Day** | **Average Difference (m)** | **Maximum difference (m)** | | **Standard Deviation (m)** | **Notes** |
| 30/03 | 0.09 | -8.2 | 9.4 | 1.5 | SW-IDEAS-34 [RD.10] |
| 31/03 | 0.03 | -6.5 (X) | 8.6 | 1.3 | SW-IDEAS-34 [RD.10] |
| 01/04 | 0.16 | -9.2 (X) | 4.7 (X) | 1.2 | SW-IDEAS-34 [RD.10] |
| 02/04 | 0.05 | -12 | 7.5 | 1.2 | |
| 03/04 | 0.02 | -9 | 7.7 (Y) | 1.7 | |
| 04/04 | 0.04 | -6.4 | 6.6 | 1.4 | |
| 05/04 | 0.18 | -8.3 | 6.7 | 1.3 | SW-IDEAS-34 [RD.10] |

**Table 5:** Swarm C, difference between MOD and on-board solution positions. If not specified maximum difference and maximum standard deviation refers to the Z axis.

Below some plot example of such differences follows, taken at the beginning of the week (30/03, Figure 7), in the middle (02/04, Figure 8) and at the end (05/04, 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, and the difference between the two. The values of position are given in [km] and the difference between both solutions is given in [m]

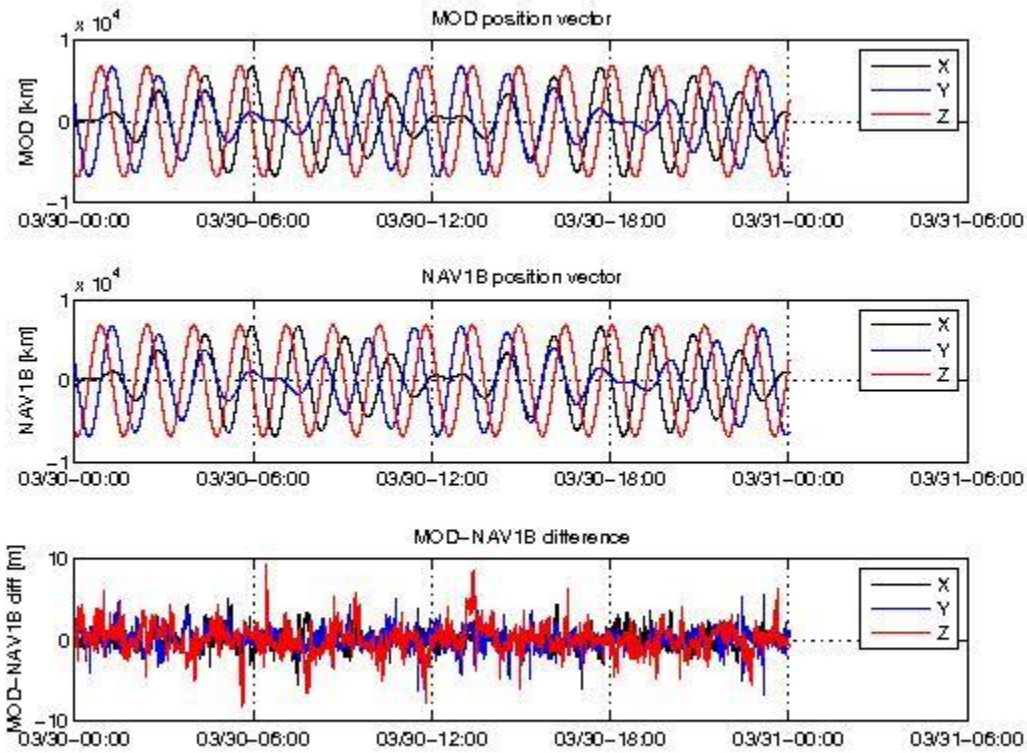


**Figure 7:** Difference MOD-GPSNAV, S/C C, 30/03. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two.

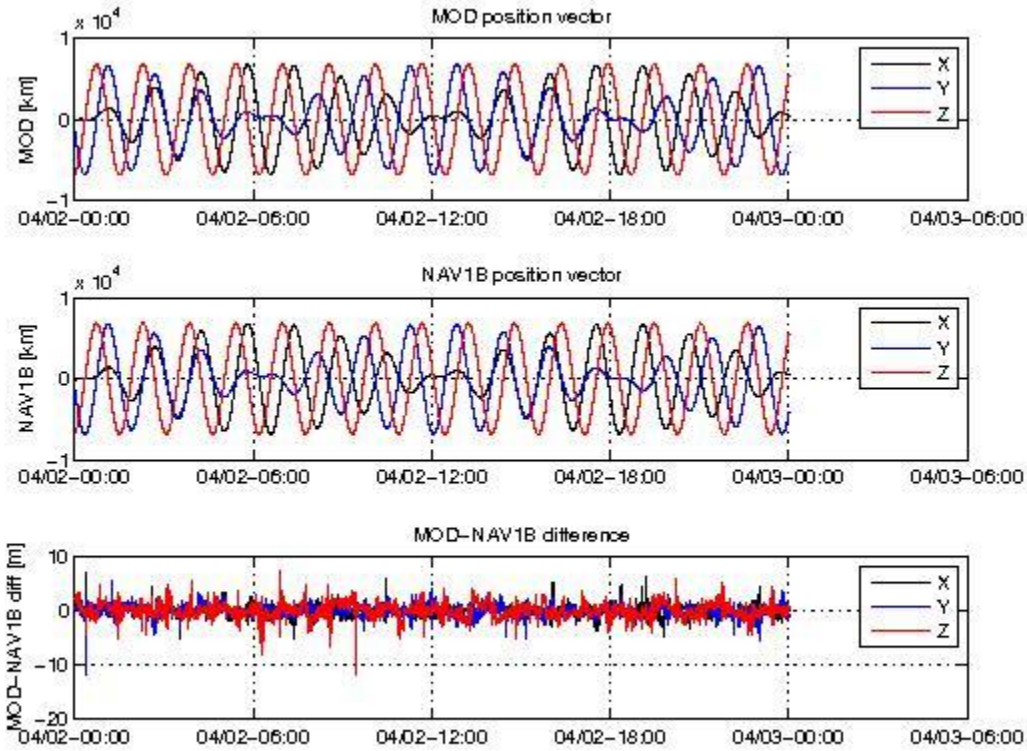


**Figure 8:** Difference MOD-GPSNAV, S/C C, 02/04. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two.

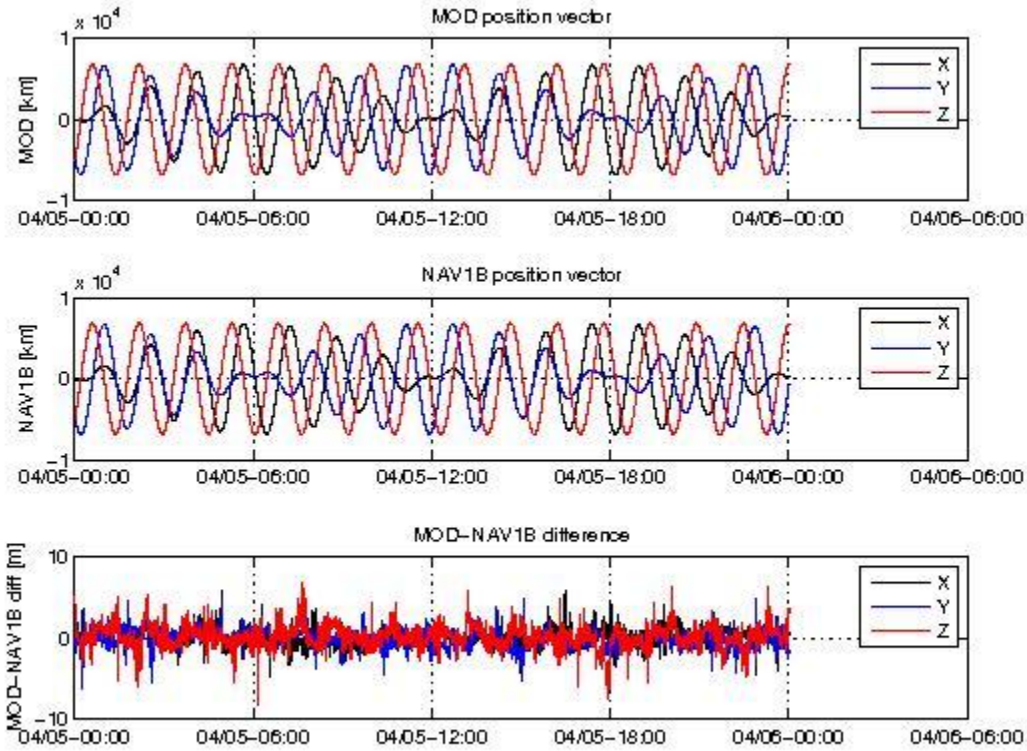


**Figure 9:** Difference MOD-GPSNAV, S/C C, 05/04. From top to bottom: the S/C position determined from the MOD calculation, the S/C position determined on-board, and the difference between the two.

#### 3.2.3.2 Attitude observations

Nothing to report.

## 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.**

### 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 B (05/04) can be seen in Figure 10 below.

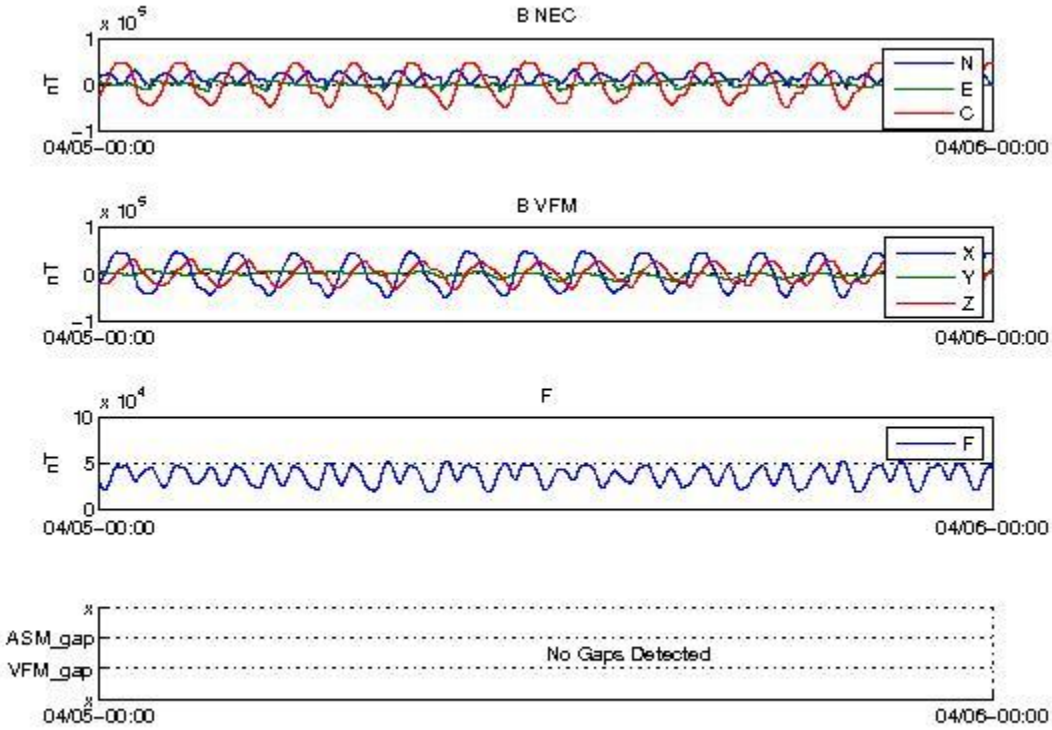


**Figure 10:** Time series of the geomagnetic field, for 05/04, S/C A. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

### 3.3.1.2 VFM-ASM anomaly

The daily peak-to-peak difference for the only available day during current week stays within [-3.6, +1.6] nT with sporadic spikes exceeding 7nT.

Below two example plots follows of such differences: 30/03 (Figure 11), and 05/04 (Figure 12). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM

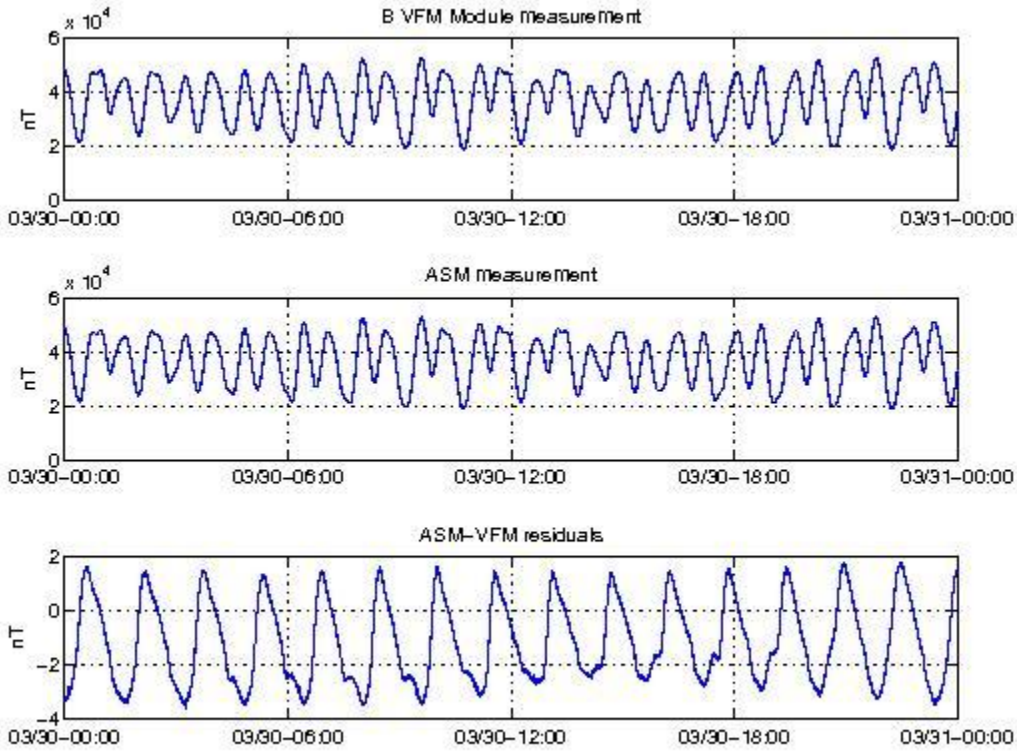


**Figure 11:** VFM module, ASM module and ASM-VFM residuals for S/C A, 30/03.

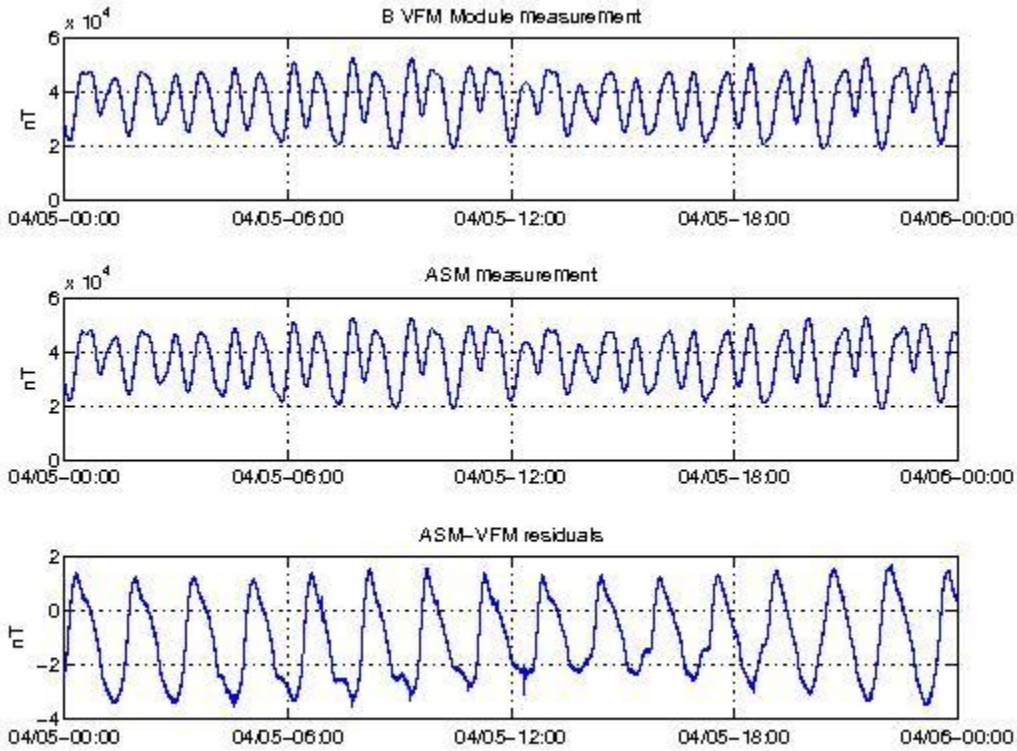


**Figure 12:** VFM module, ASM module and ASM-VFM residuals for S/C A, 05/04.

### 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, March 2015: 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.

Most parameters show a jump on the 10th of March, that resembles a kind of return towards pre-flight levels: this is an artefact due to the processing. With version 3.14, installed in February, we experienced a lot of MAGNET failures due to a bug in the electrically induced stray fields computation (SPR **SWL1L2DB-53**); each time a gap in the telemetry occurred, the processor failed, and this condition happened very often, because of several GPS sync losses in that period, that led the processor to discard the out-of-sync timestamps and leave gaps in all the Level 1A products. The 10th of March came without sync losses after more than 7 days, during which no magnetic data were produced for S/C A: therefore, the selection policies could not select the TCFs from previous days for initializing the calculation, but went directly to the TCF.AUX in the CCDB, i.e. the pre-flight values. The 30th of March, L1BOP 3.15 was deployed in operations, and the failed production was soon recovered, allowing a continuity in the TCF computation, except for the very day 10, that was not re-generated as already existed.

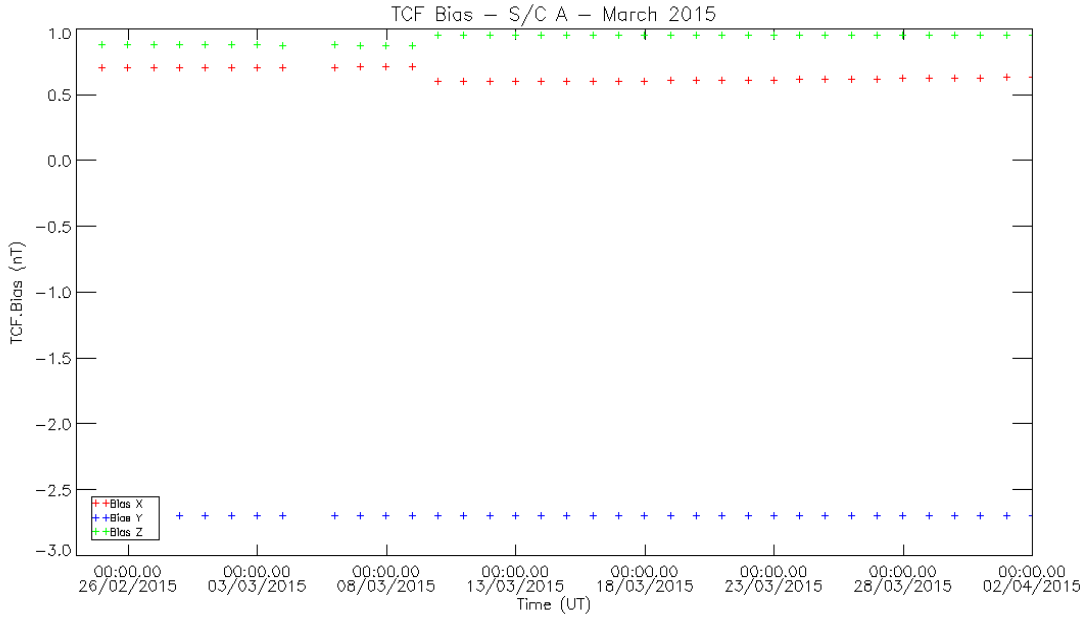


**Figure 13:** TCF.VFM Biases for S/C A, March 2015.

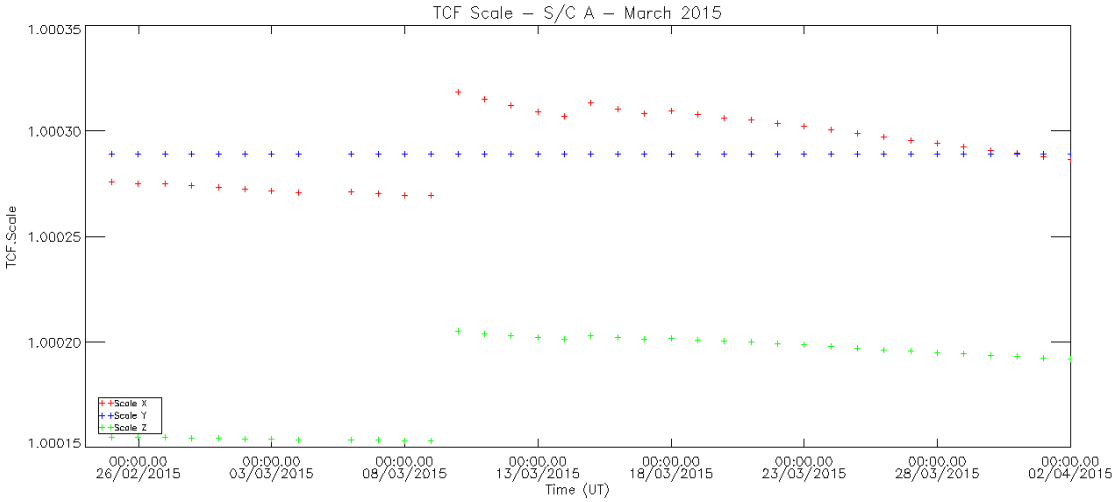


**Figure 14:** TCF.VFM Scales for S/C A, March 2015.

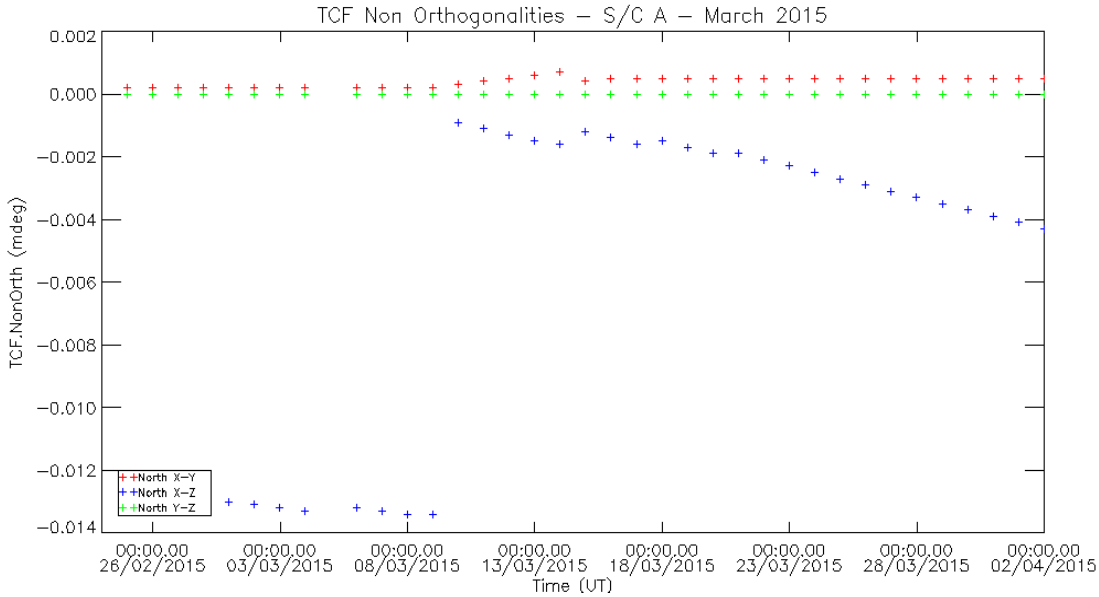


**Figure 15:** TCF.VFM Non Orthogonalities for S/C A, March 2015.

## 3.3.2 Swarm B

### 3.3.2.1 Magnetic time series visual inspection

An example of representative magnetic field time series for S/C B (05/04) can be seen in Figure 16 below.

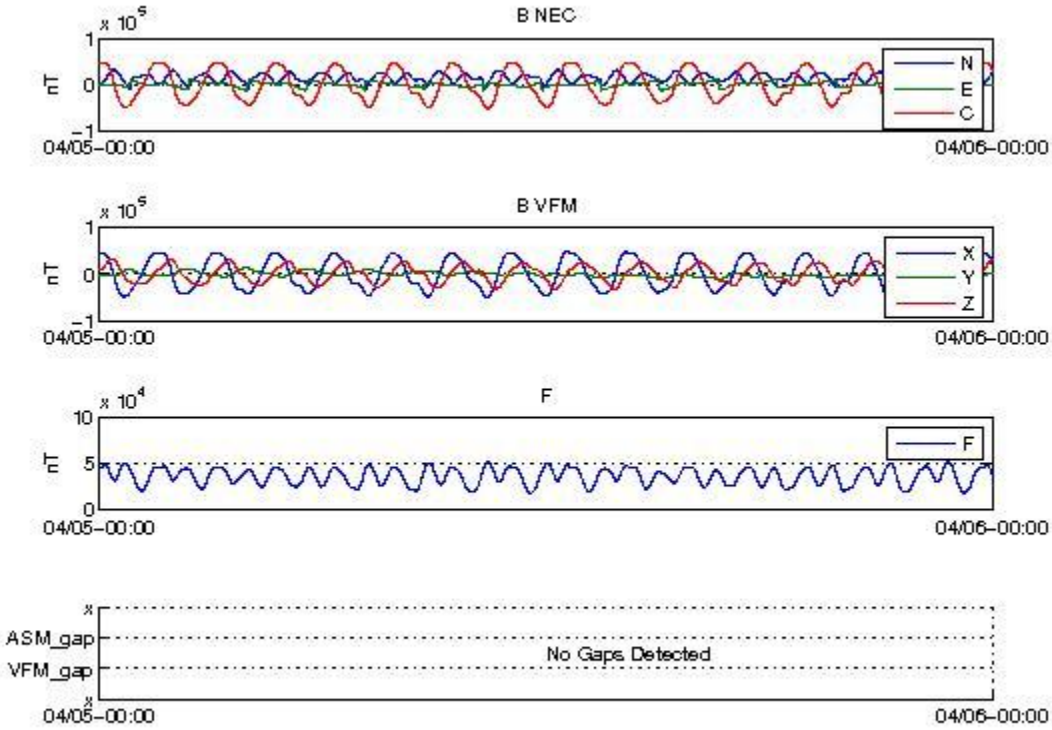


**Figure 16:** Time series of the geomagnetic field for 05/04, S/C B. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

### 3.3.2.2 VFM-ASM anomaly

The daily peak-to-peak difference around the week is, on average: [-2.5, 2] nT, with a few peaks of about 5 nT.

Below two example plots follows of such differences: 30/03 (Figure 17), and 05/04 (Figure 18). From top to bottom the plots show: The VFM module, the ASM module, the difference ASM-VFM.

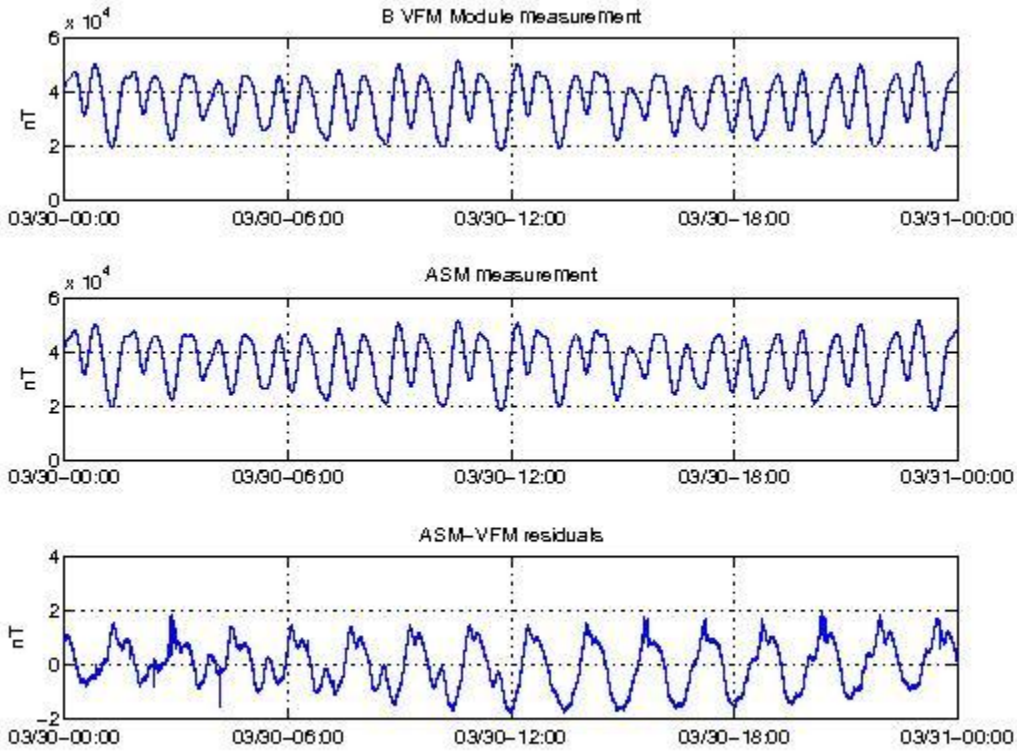


**Figure 17:** VFM module, ASM module and ASM-VFM residuals for S/C B, 30/03.

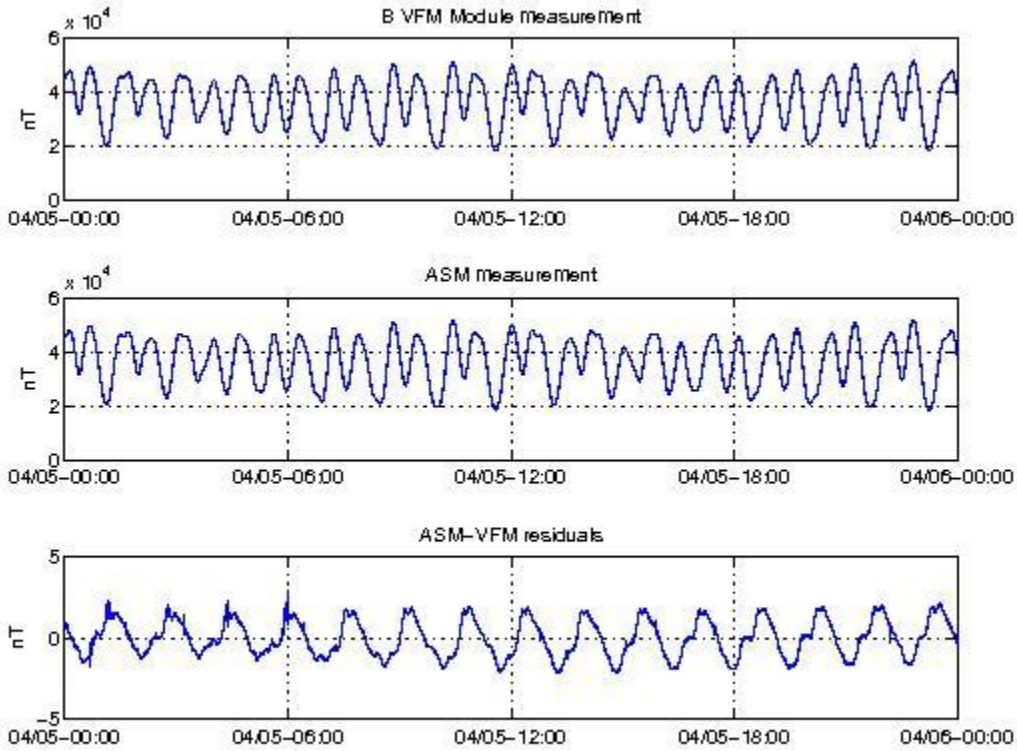


**Figure 18:** VFM module, ASM module and ASM-VFM residuals for S/C B, 05/04.

### 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 February 2015: 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 X-Z Non-orthogonality angle (Figure 21) which decreases of about 0.0001 mDeg throughout the month.

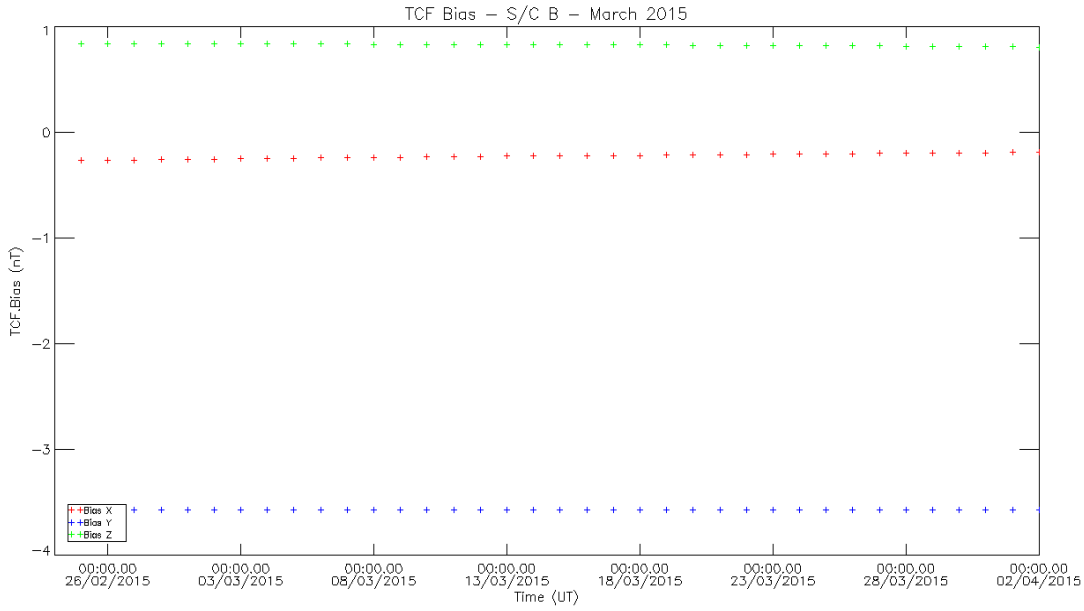


**Figure 19:** TCF.VFM Biases for S/C B, March 2015.

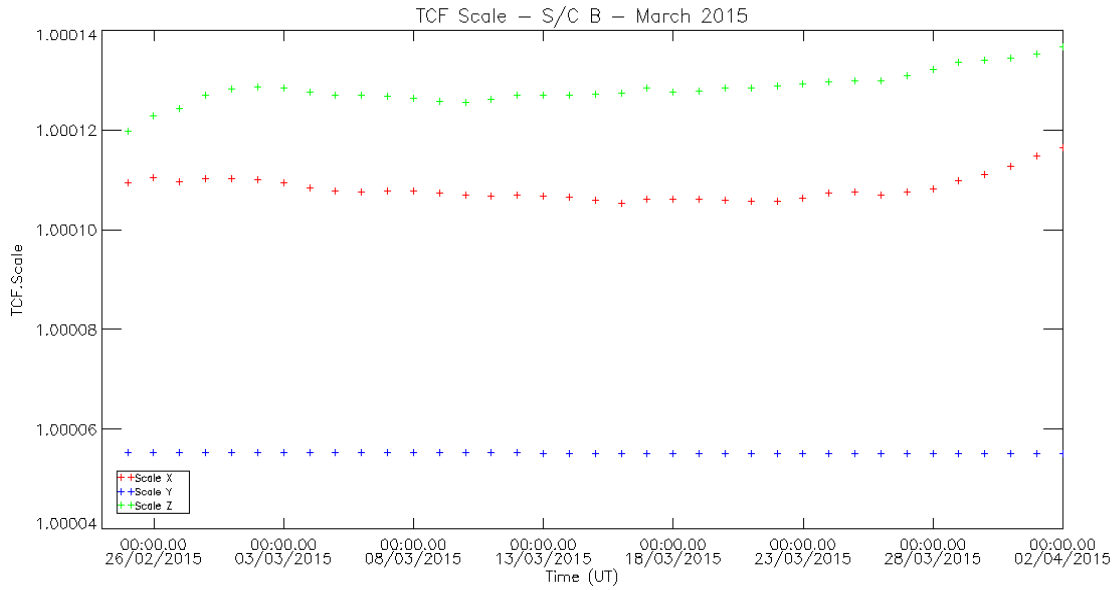


**Figure 20:** TCF.VFM Scales for S/C B, March 2015.

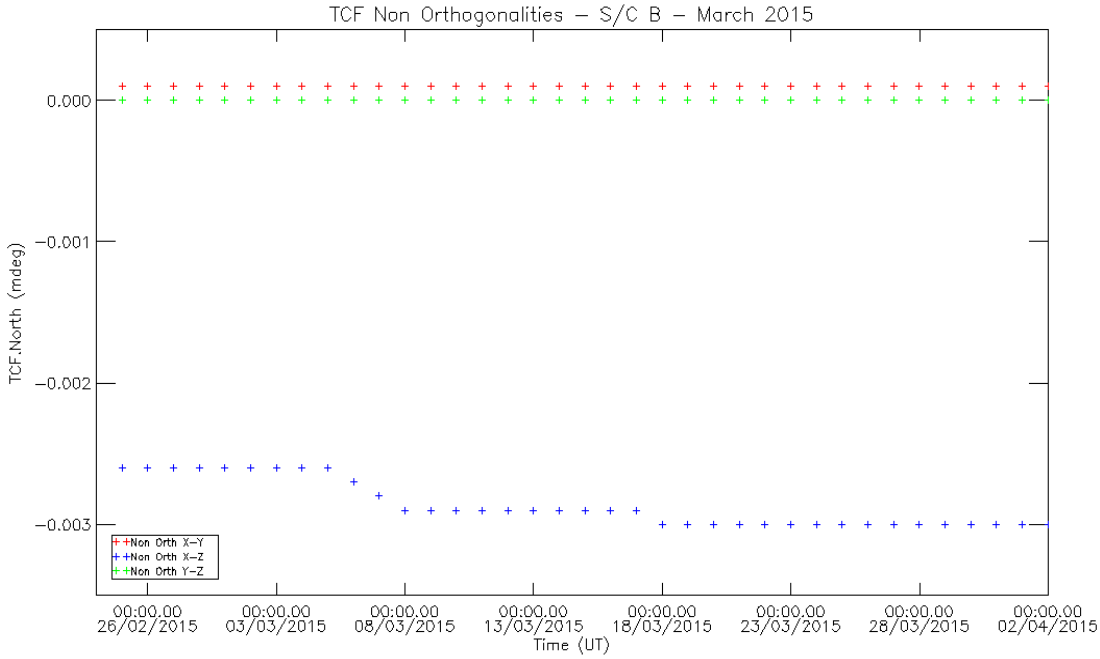


**Figure 21:** TCF.VFM Non Orthogonalities for S/C B, March 2015.

## 3.3.3 Swarm C

### 3.3.3.1 Magnetic time series visual inspection

An example of magnetic field time series for S/C C (05/04) can be seen in Figure 22.

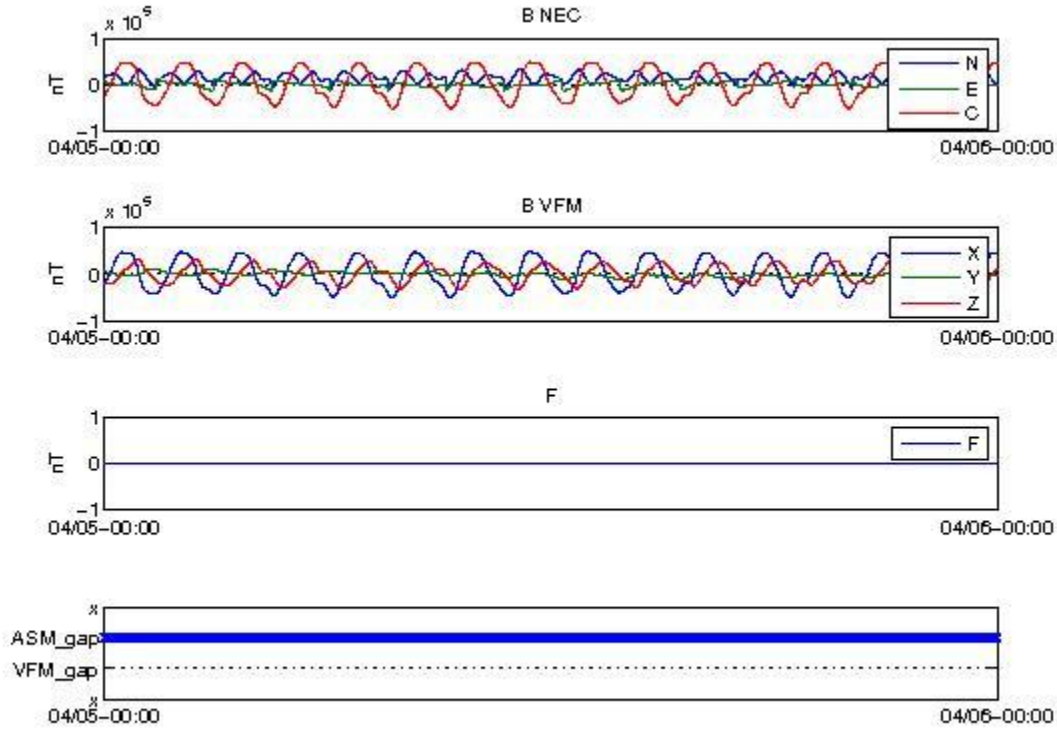

**Figure 22:** Time series of the geomagnetic field for 05/04, S/C C. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM (no data here because ASM it is off) and location of gaps.

#### 3.3.3.2 VFM-ASM anomaly

No data because ASM is switched off.

#### 3.3.3.3 TCF.VFM monitoring

No data because ASM is still switched off

### 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 23 summarizes the RMS behavior for all S/C during March 2015 (Red curve = S/C A, blue curve = S/C B). The jump of 2 nT observed the 10$^{th}$ of March for S/C A is due to an artifact of the processing as described in Sect. 3.3.1.3.

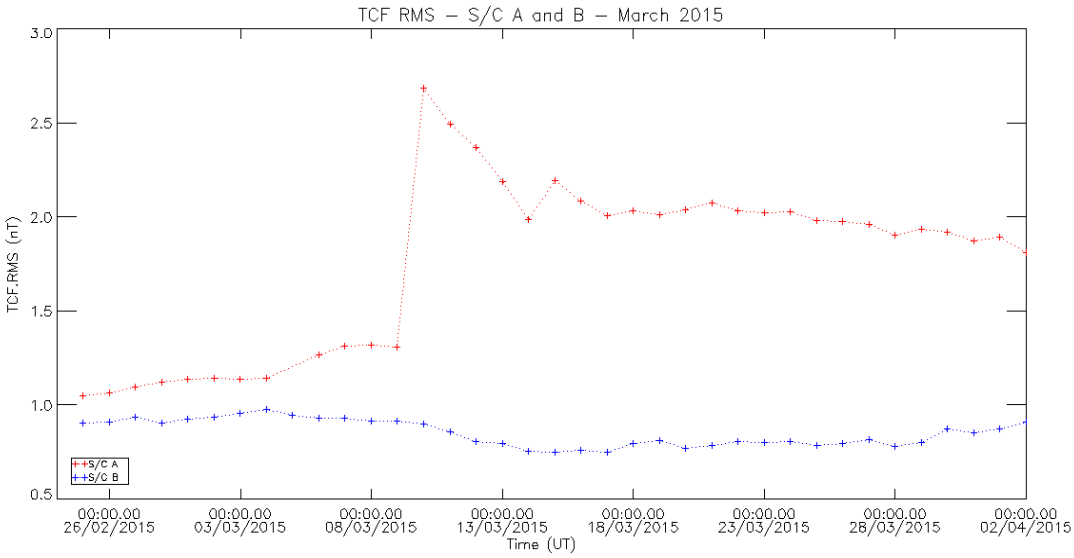


**Figure 23:** weighted RMS of the residuals after the TCF estimation, all S/C, March 2015.

# 4. ON-DEMAND ANALYSIS

Nothing to report.

***End of Document***