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IDEAS+ Swarm Weekly Report 2015/26: 2015/06/22 - 2015/06/28

Abstract : This is the **Instrument Data quality Evaluation and Analysis Service Plus** (IDEAS+) Swarm Weekly report on Swarm products quality, covering the period from 22 June to 28 June 2015.

Author :
Igino Coco, Jan Miedzik and Enkelejda Qamili 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

Telespazio VEGA UK Ltd
350 Capability Green, Luton, Bedfordshire, LU1 3LU, United Kingdom
Tel: +44 (0) 1582 399 000 Fax: +44 (0) 1582 728 686
www.telespazio-vega.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	06 Jul 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 2.2.

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 3.15, 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.2.14.00

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)

[RD.14] Swarm L1B 03.15 Validation Report, OSMV-OPMT-SRCO-RP-15-3385, Issue 1.3.

[RD.15] IDEAS+ Swarm Weekly Report: 23/03/2015 – 29/03/2015, IDEAS+-SER-OQC-REP-2071_SPPA_SwarmWeeklyReport_201513_20150323_20150329.pdf.

[RD.16] , SWARM Weekly Operations Report #83, SW-RP-ESC-FS-6172.

[RD.17] Olsen, N., H. Luhr, C.C. Finlay, T.J. Sabaka, I. Michaelis, J. Rauberg and L. Tøffner-Clausen, The CHAOS-4 geomagnetic field model, Geophys. J. Int. 197, 815–827, 2014

[RD.18] IDEAS+-SER-IPF-PLN-2272, Swarm Level 1B Operational Processor Verification Plan, IDEAS+-SER-IPF-PLN-2272_L1BOP_316_v1.5_final.pdf

2. SUMMARY OF THE OBSERVATIONS

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

ACC: thermal tests on-going for better characterizing the correlation of the non-gravitational acceleration with the environment temperature. The heaters surrounding the instrument are commanded through a series of on/off cycles.

EFI-TII: one orbit operations tests still on going on A and B. Operations extended to one orbit per day also for C, considering the promising results of the first loop of tests. Discussions are on-going on how to deal with such one orbit operations in the future and on the need to put in place a mission planning procedure for that.

EFI-LP: A sweep cycle test has been performed, varying the sweep voltage on Swarm A from -5 to +5 V for one orbit after a period of rest of the TII. The aim is to investigate the effects on the S/C potential of the sweep voltage settings.

2.2 Plan for operational processor updates

Nothing new to report about L1BOP: PDGS and IDEAS+ team verification is on-going.

The L2-Cat2 EEF processor has been delivered and will be soon integrated in operations.

2.3 Quality Working Group and Cal/Val Coordination

Coordination is 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.

DTU/ESL shared the final set of corrected data on early April. These corrected data also contain the dB_sun correction, providing the users the possibility to access to uncorrected data.

The Task Force meeting was held on 9-10 April in ESTEC. During this meeting the following decisions have been taken:

- ESA and CNES have to be prepared for potential further ASM failures scenarios.
- The corrected data provided by Lesur-Tøffner-Clausen (DTU) will be distributed by ESA to all Swarm users[1]. Soon, the correction will also be implemented in the OP. Meanwhile, the team agreed that the following investigation should be done:
  i. Clarifications of coordinate systems used (and left out) in models. To confirm overall dynamics and time constants / phase shifts.
  ii. Splinter group with Airbus, DTU-MI, and ESA to further coordinate investigations of “secondary” contributions.

[1] *The corrected Swarm magnetic data have been distributed to all Swarm users on 13/04 (https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/swarm/news/-/article/corrected-swarm-magnetic-data-now-available).*

iii. (v x B) further investigations during: 1) the 4-step-360 rotation data, 2) the Alpha-Charlie rotations.

iv. Test with same sun attitude conditions (excluding manoeuvres) but different plasma conditions or magnetic longitude.

v. To better quantify (from models) potential plasma-related effects. Link to MAGx_HR.

vi. Involvement of EFI-TII team.

The next task force meeting is scheduled for **2-3 July 2015**.

2.4 Summary of observations for 2015, Week 26 (22/06 - 28/06)

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

- **Some features observed in the MOD-NAV difference:** we observe at times deviations from the average values lasting several minutes (SW-IDEAS-34).
- **Two events of attitude rejection** are observed for S/C B (22/06), and S/C C (24/06), due to simultaneous occurrence of BBOs and invalid measurement and not Sequential measurement (SW-IDEAS-78).
- **Several few seconds gaps in MAGx_CA_1B products** throughout the week (SW-IDEAS-63).
- **Increase of the B-Bchaos residuals** on day 22/06, associated to a geomagnetic storm.

3. ROUTINE QUALITY CONTROL

3.1 Gaps analysis

- Gap in magnetic product MAG_HR_1B on S/C A on 24/06 at 11:51:59 2 seconds and 24/06 at 12:20:59 2 seconds; the gaps are related to GPS sync loss events, as reported by the FOS weekly report #83 [RD.16].

- MAG_CA_1B gaps throughout the week (SW-IDEAS-63), due at times to gaps in the HK telemetry required to compute magnetic stray fields; this is expected from the MAGNET algorithms, nevertheless only a portion of such gaps can be explained by a telemetry rejection, so analyses are still on-going for understanding the reason of the unexplained gaps.

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: spiky features observed in the NAV-MOD difference	Orbits (position and velocity)	3.2.1.1, 3.2.1.2, 3.2.1.3	[RD.10]
SW-IDEAS-63	OBS_ROUTINE: MAGx_CA_1B gaps	MAGx_CA_1B	3.1	3.1
SW-IDEAS-78	OBS_ROUTINE: 2015, week 26 22/06 - 28/06), STR S/C B and C out of range.	STRBATT_1B STRBSCI_1A STRCATT_1B STRCSCI_1A	3.2.2.2; 3.2.2.3	3.2.2.2; 3.2.2.3

Table 1: List of events related to attitude and orbit products to be reported in the monitoring for 2015, Week 26: 22/06 - 28/06.

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 Position Statistics

In Table 2 one can see the statistics of the differences between MOD and on-board solution positions for S/C A, B and C respectively. 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.

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

Swarm A, 22/06 - 28/06, Position difference					
Day	**Average difference (m)**	**Maximum difference (m)**		**Maximum standard deviation (m)**	**Notes**
22/06	0.12	-7	10.2	1.3	
23/06	0.07	-7.7	6.3	1.3	
24/06	0.19	-6 (X)	8.2	1.48	
25/06	0.14	-7.2	6.7	1.26	
26/06	0.08	-6	8.5	1.39	
27/06	0.17	-8.4	6.4	1.4	
28/06	0.09	-5.8	5.9 (X)	1.28	
Swarm B, 22/06 - 28/06, Position difference					
Day	**Average difference (m)**	**Maximum difference (m)**		**Maximum standard deviation (m)**	**Notes**
22/06	0.16	-8.2 (X)	9.3	1.3	
23/06	0.08	-6.2	7.8	1.21	
24/06	0.2	-6.8	10.2	1.52	SW-IDEAS-34 [RD.10]
25/06	0.04	-6.4	6.2 (Y)	1.19	
26/06	0.15	-10	7.7	1.48	SW-IDEAS-34 [RD.10]
27/06	0.21	-8.3	6.4	1.36	
28/06	0.06	-7.1	9.4 (Y)	1.36	
Swarm C, 22/06 - 28/06, Position difference					
Day	**Average difference (m)**	**Maximum difference (m)**		**Maximum standard deviation (m)**	**Notes**
22/06	0.19	-6.5	9.8	1.2	
23/06	0.06	-6.8	5.7	1.28	
24/06	0.18	-7.9 (Y)	8.6	1.37	SW-IDEAS-34 [RD.10]
25/06	0.16	-6.4	6.7	1.25	
26/06	0.1	-7.8	7.5	1.34	
27/06	0.2	-7.1	6.2	1.31	
28/06	0.07	-6.4	5.6 (Y)	1.24	

3.2.1.1 Swarm A

Below some plot example follows of MOD-NAV differences, S/C A, taken at the beginning of the week (22/06, Figure 1) in the middle (25/06, Figure 2) and at the end (28/06, Figure

3). From top to bottom the plots show of MOD-NAV differences in ITFR reference frame: on X, Y and Z axis respectively. The difference between both solutions is given in [m].

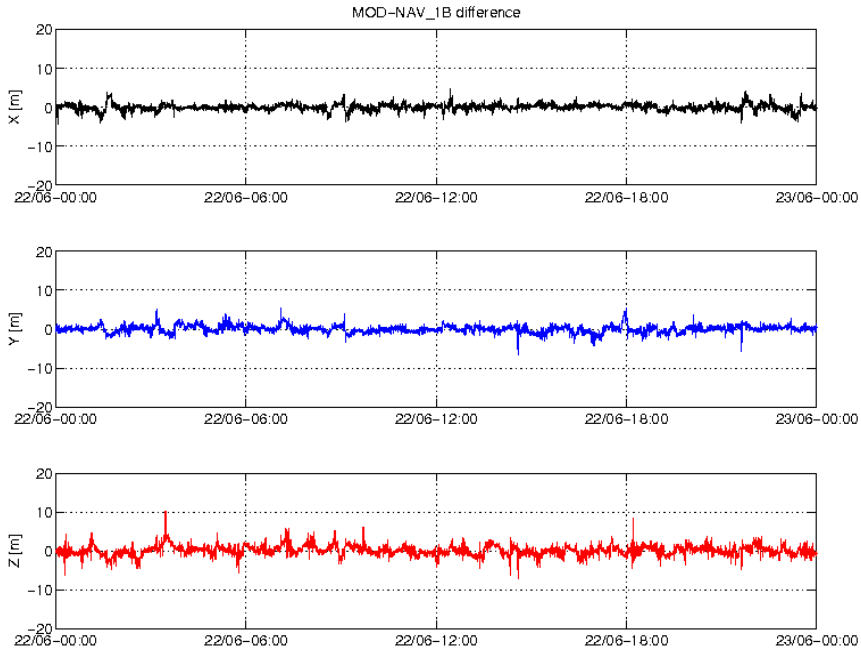

Figure 1: Difference MOD-GPSNAV, S/C A, 22/06. From top to bottom: X, Y and Z axis

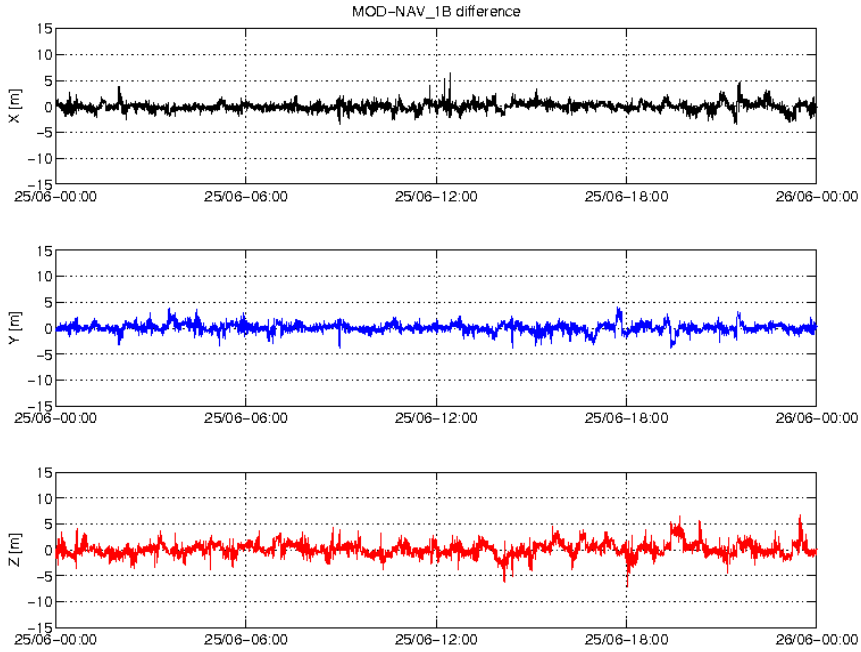

Figure 2: Difference MOD-GPSNAV, S/C A, 25/06. From top to bottom: X, Y and Z axis

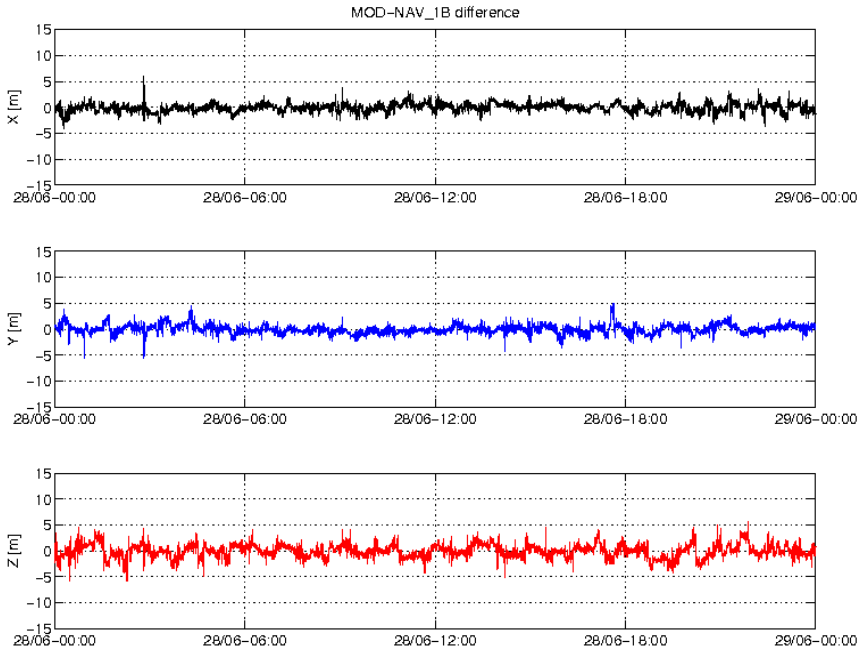

Figure 3: Difference MOD-GPSNAV, S/C A, 28/06. From top to bottom: X, Y and Z axis

3.2.1.2 Swarm B

Below some plot example follows of MOD-NAV differences, S/C B, taken at the beginning of the week (22/06, Figure 4), in the middle (25/06, Figure 5), and at end of the week (28/06, Figure 6). From top to bottom the plots show of MOD-NAV differences in ITFR reference frame: on X, Y and Z axis respectively. The difference between both solutions is given in [m].

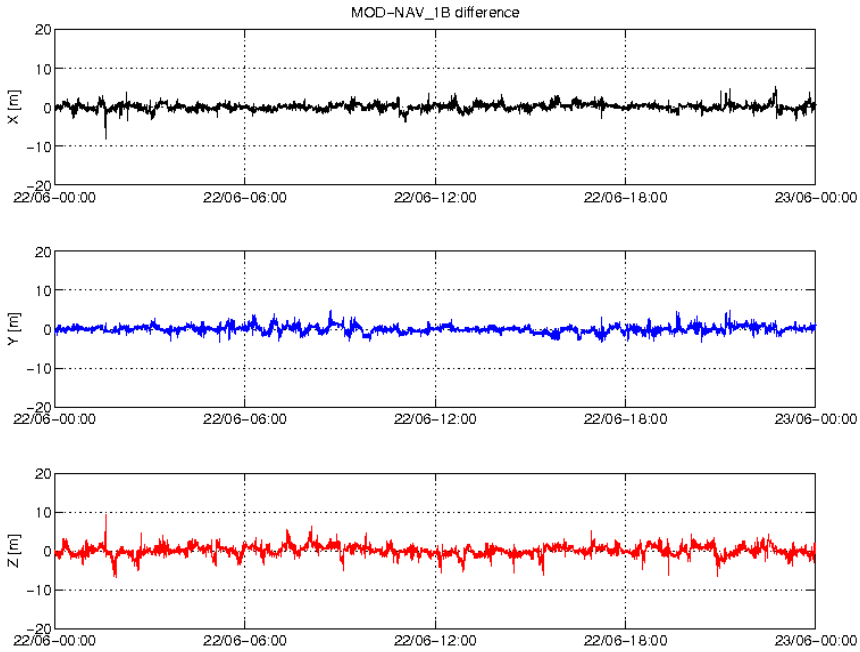

Figure 4: Difference MOD-GPSNAV, S/C B, 22/06. From top to bottom: X, Y and Z axis

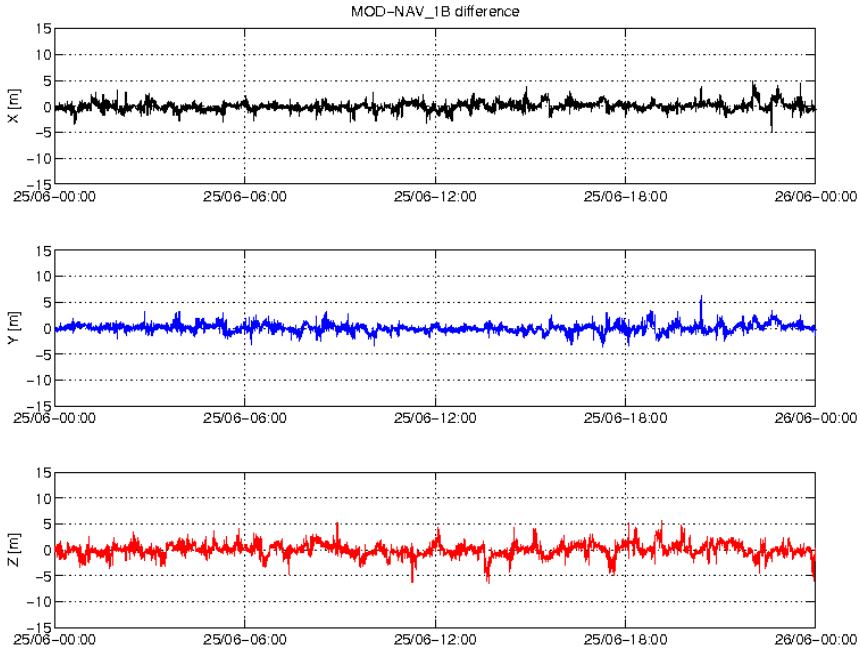

Figure 5: Difference MOD-GPSNAV, S/C B, 25/06. From top to bottom: X, Y and Z axis

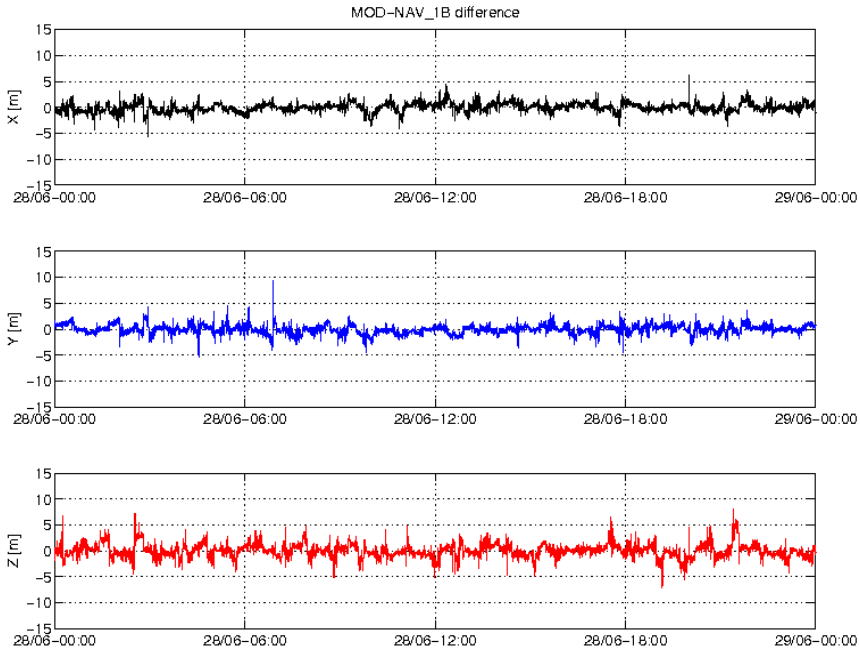

Figure 6: Difference MOD-GPSNAV, S/C B, 28/06. From top to bottom: X, Y and Z axis

3.2.1.3 Swarm C

Below some plot example of MOD-NAV differences, S/C C, follows, taken at the beginning of the week (22/06, Figure 7), in the middle (25/06, Figure 8) and at the end (28/06, Figure 9). From top to bottom the plots show of MOD-NAV differences in ITFR reference frame: on X, Y and Z axis respectively. The difference between both solutions is given in [m].

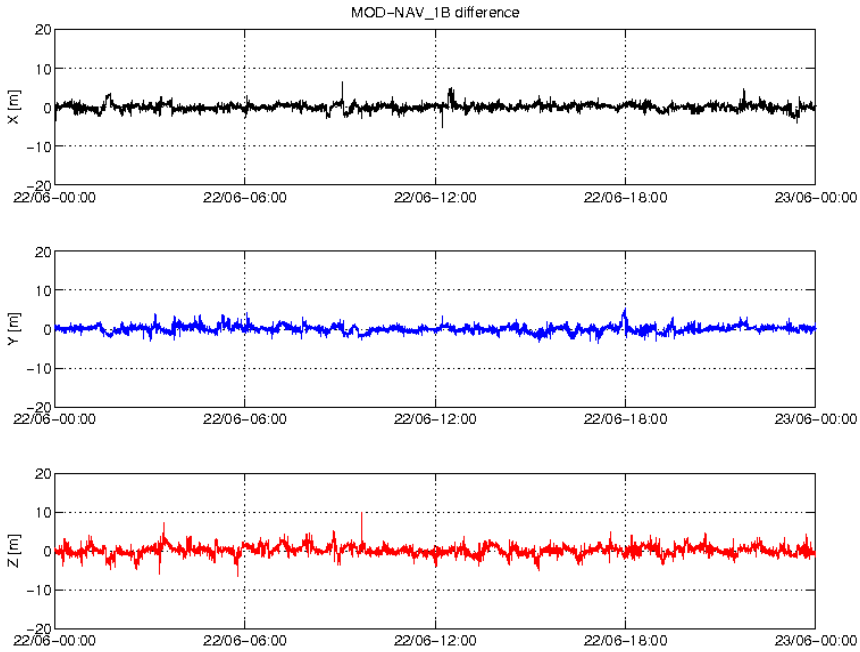

Figure 7: Difference MOD-GPSNAV, S/C C, 22/06. From top to bottom: X, Y and Z axis

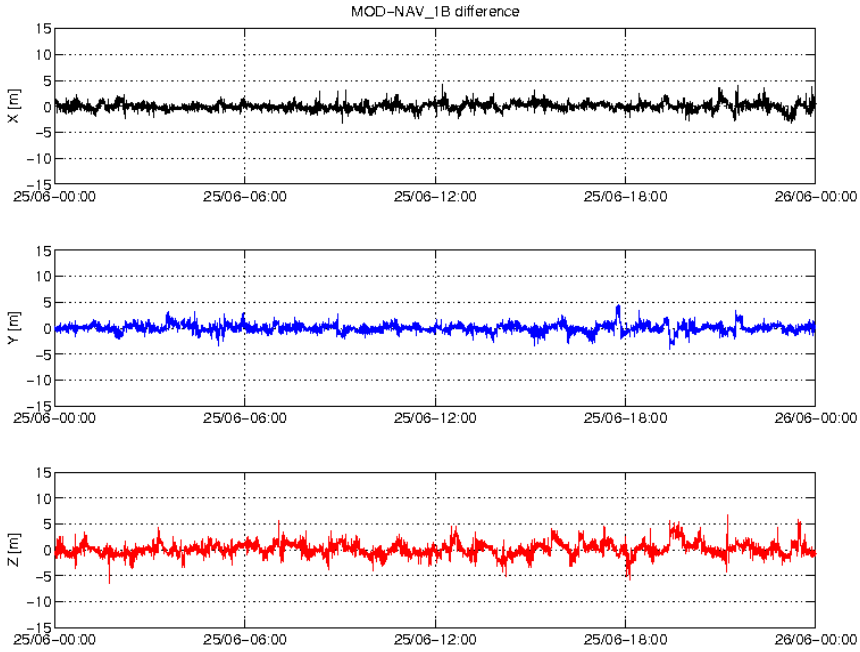

Figure 8: Difference MOD-GPSNAV, S/C C, 25/06. From top to bottom: X, Y and Z axis

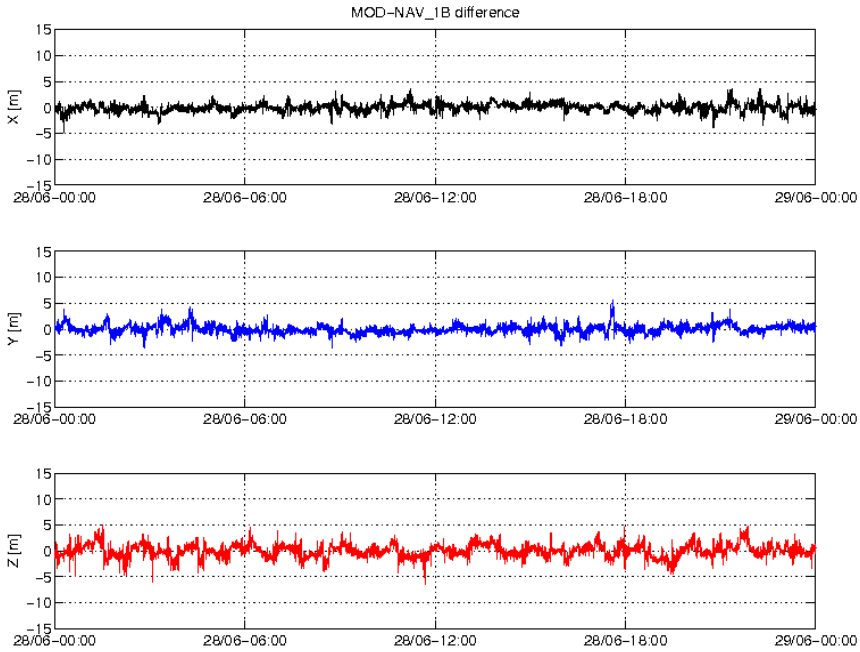

Figure 9: Difference MOD-GPSNAV, S/C C, 28/06. From top to bottom: X, Y and Z axis

3.2.2 Attitude observations

3.2.2.1 Swarm A

Nothing to report.

3.2.2.2 Swarm B

- **SW-IDEAS-78:**

  We observe an an interval of rejected attitudes for S/C B on 22/06 (Flags_q=255). The reason for such rejection is the simultaneous occurrence of BBO Not Valid, not Sequential on two CHU. See Table 3 below for details.

Table 3 Attitudes out-of-range on S/C B, due to BBO, Not Sequential and not Valid, week 26.

Start time	Stop time	Value	Length
22/06/2015 00:30:12	22/06/2015 00:30:15	255	2

3.2.2.3 Swarm C

- **SW-IDEAS-78:**

  We observe an an interval of rejected attitudes for S/C C on 24/06 (Flags_q=255). The reason for such rejection is the simultaneous occurrence of BBO Not Valid, not Sequential on two CHU. See Table 4 below for details.

Table 4 Attitudes out-of-range on S/C C, due to BBO, Not Sequential and Not Valid, week 26.

Start time	Stop time	Value	Length
24/06/2015 08:42:00	24/06/2015 08:42:03	255	2

3.3 Magnetic Products

For the magnetic products the weekly monitoring consists in:

- TCF.VFM parameters monitoring (VFM calibration parameters): series of biases, scales, non-orthogonality factors and RMS. **This check is performed on monthly basis.**
- ASM instrument monitoring: quartz frequency and ASM temperature
- VFM instrument monitoring: temperatures
- 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.
- Comparison of magnetic data (BNEC) with a model (Chaos4plus);

3.3.1 ASM Instrument parameters: quartz frequency and ASM temperature

For S/C Alpha and Bravo the temperature and quartz frequency behaved as expected.

3.3.2 VFM Instrument parameters: VFM temperatures

The VFM instrument parameters important for monitoring the instrument health are the VFM sensor temperatures: T_CDC, T_CSC and T_EU.

For S/C Alpha and Bravo for reported period the temperatures behaved as expected.

3.3.3 Magnetic time series visual inspection

3.3.3.1 Swarm A

An example of representative magnetic field time series for S/C A (28/06) can be seen in Figure 10 below.

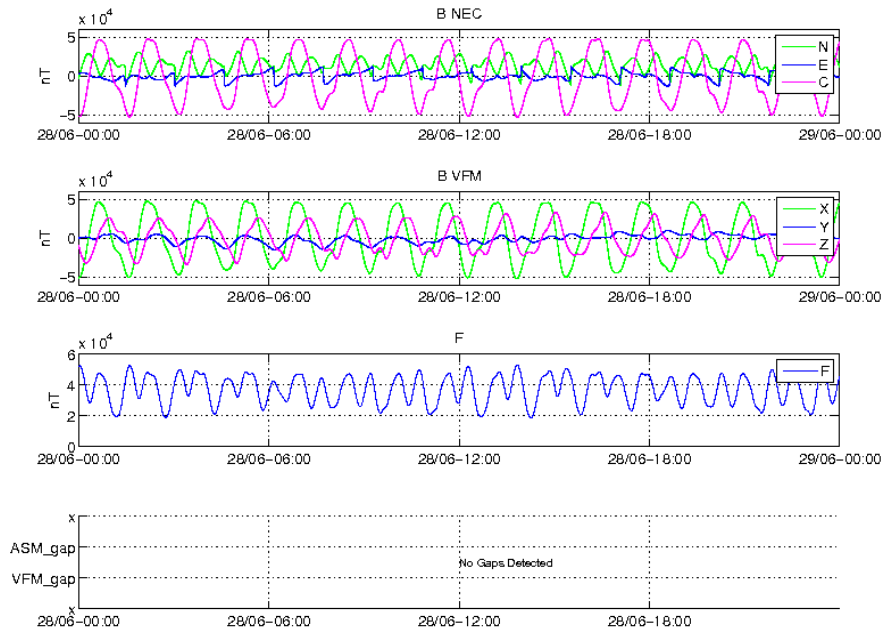

Figure 10: Time series of the geomagnetic field, for 28/06, S/C A. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM, and location of gaps (if any).

3.3.3.2 Swarm B

An example of representative magnetic field time series for S/C B (28/06) can be seen in Figure 11 below.

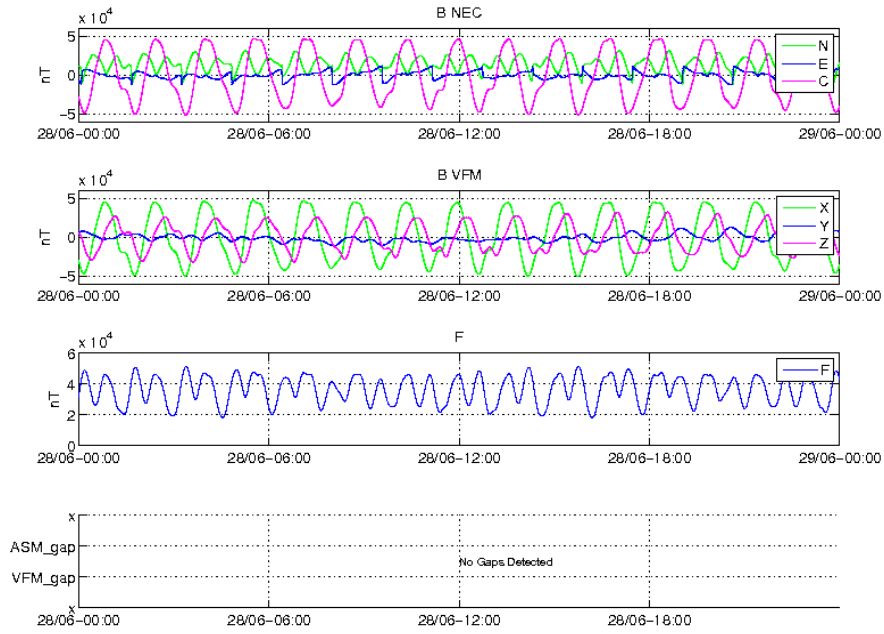

Figure 11: Time series of the geomagnetic field for 28/06, S/C B. From top to bottom:

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).

3.3.3.3 Swarm C

An example of magnetic field time series for S/C C (28/06) can be seen in Figure 12.

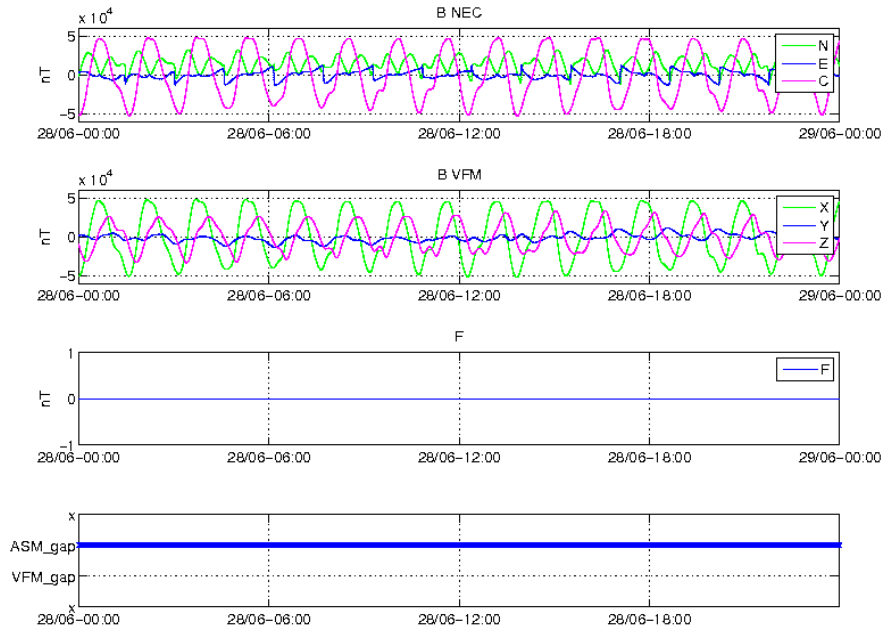

Figure 12: Time series of the geomagnetic field for 28/06, S/C C. From top to bottom: magnetic field components in NEC reference frame, magnetic field components in the VFM reference frame, magnetic field intensity (F) from ASM (no data here because ASM it is off) and location of gaps.

3.3.4 VFM-ASM anomaly

General observation: on day 22/06, on both Swarm A and B, we observe a particularly noisy and spiky behaviour starting from about 19 UT. This is a natural effect due to an intense geomagnetic storm which occurred that very day. Some detail has been already given in the weekly report for past week, and some more will be added in Sect. 3.3.5.

3.3.4.1 ASM-VFM difference statistics

In Table 5 one can see the statistics of the differences between magnetic field absolute value measured by ASM and by VFM. In the second and third column are reported the maximum differences, maximum negative and maximum positive respectively. The maximum standard deviation is in the fourth column.

Table 5 Swarm A and B, difference between magnetic field absolute value measured by ASM and by VFM.

Swarm A, 22/06 - 28/06, ASM-VFM difference				
Day	**Max (nT)**	**Min (nT)**	**Standard deviation (m)**	**Notes**
22/06	6.6E+00	-6.5E+00	1.4E+00	
23/06	3.3E+00	-1.2E+01	1.3E+00	
24/06	3.2E+00	-4.6E+04	2.4E+02	Gap corresponding to a gap in the MAG_HR product.
25/06	5.7E+00	-3.2E+00	1.2E+00	
26/06	1.6E+00	-2.6E+00	1.1E+00	
27/06	1.6E+00	-2.3E+00	1.1E+00	
28/06	2.3E+00	-2.6E+00	9.9E-01	
Swarm B, 22/06 - 28/06, ASM-VFM difference				
Day	**Max (nT)**	**Min (nT)**	**Standard deviation (m)**	**Notes**
22/06	4.1E+04	-5.3E+01	2.4E+02	GAP
23/06	2.5E+00	-2.3E+00	4.6E-01	
24/06	2.6E+00	-1.3E+00	4.5E-01	
25/06	4.0E+00	-3.0E+00	4.3E-01	
26/06	1.5E+00	-1.4E+00	4.2E-01	
27/06	1.2E+00	-1.6E+00	4.0E-01	
28/06	1.2E+00	-1.5E+00	3.9E-01	

3.3.4.2 Swarm A

The daily peak-to-peak difference for the only available day during current week stays within [-3; 2] nT with many spikes on 22/06 some of them reaching 6nT, other days less spiky. Below two example plots follows of such differences: 22/06 (Figure 13), and 28/06 (Figure 14).

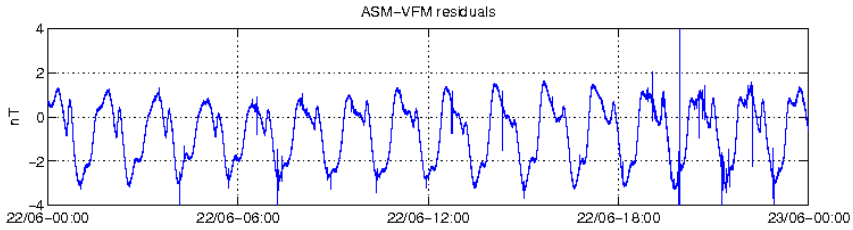

Figure 13: ASM-VFM residuals for S/C A, 22/06.

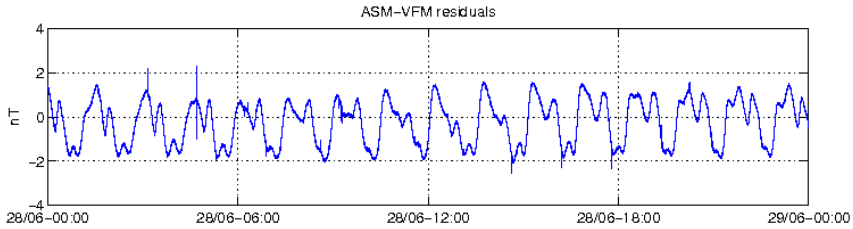

Figure 14: ASM-VFM residuals for S/C A, 28/06.

3.3.4.3 Swarm B

The daily peak-to-peak difference around the week is, on average: [-1.5; 1.5] nT, with many spikes on 22/06 some of them reaching 5nT. On 25/06 also many spikes but not exceeding 4nT. Other days were less spiky. Below two example plots follows of such differences: 22/06 (Figure 15), and 28/06 (Figure 16).

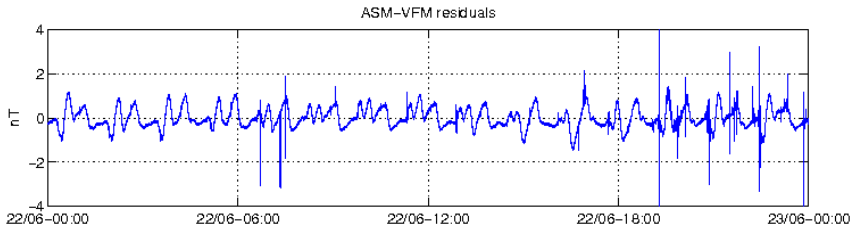

Figure 15: ASM-VFM residuals for S/C B, 22/06.

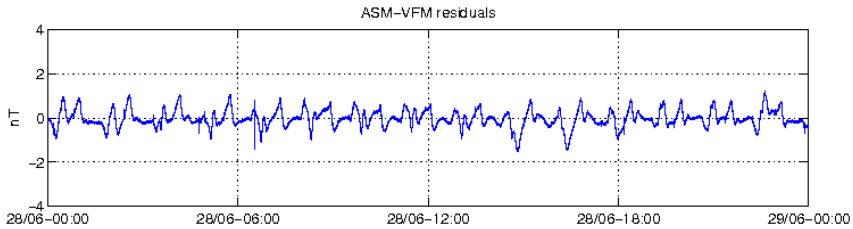

Figure 16: ASM-VFM residuals for S/C B, 28/06.

3.3.4.4 Swarm C

No data because ASM is switched off.

3.3.5 B_{NEC} vs Chaos4plus model residuals

Figure 17, Figure 19 and Figure 21 show field residuals $dB=B_{NEC} - B_{Chaos}$ (all versus co-latitude in degrees), on 22/06. From top to bottom: 1) Br, 2) Bθ and 3) Bφ.

The field residuals of Br and Bθ show a large variability also at low latitude, especially Bθ that exceeds 200 nT for some orbital pass. Usually the low and mid-latitude residuals

are steady and below 50 nT; then the residual increases at high latitudes because the Chaos model does not take into account the contribution from the external field ([RD.17]). The reason for such anomalous deviation from the model is an intense magnetic storm occurring on 22/06, which starts its main phase at about 19-20 UT, and reaches a peak of -150 nT few hours later (see past week report): the CHAOS model has not the necessary accuracy to track the ring current variations associated to a storm, therefore an increase of the residuals is expected.

Figure 18, Figure 20 and Figure 22 shows, from top to bottom, the time series on 22/06 of: (1-2-3) residuals of B_{NEC}-B_{CHAOS} by components, related to Swarm Alpha, Bravo and Charlie respectively,

The component most affected by residual spikes and variations is Bθ_NEC, i.e. the component which shows the variations of the field wrt to co-latitude. At high latitudes, the order of magnitude of the variability is about +/- 200 nT.

It is very clear from the time series the effect of the magnetic storm described above: around 19 UT a peak to peak variation that can reach 2000 nT for the theta component marks the start of the storm effects.

3.3.5.1 Swarm A

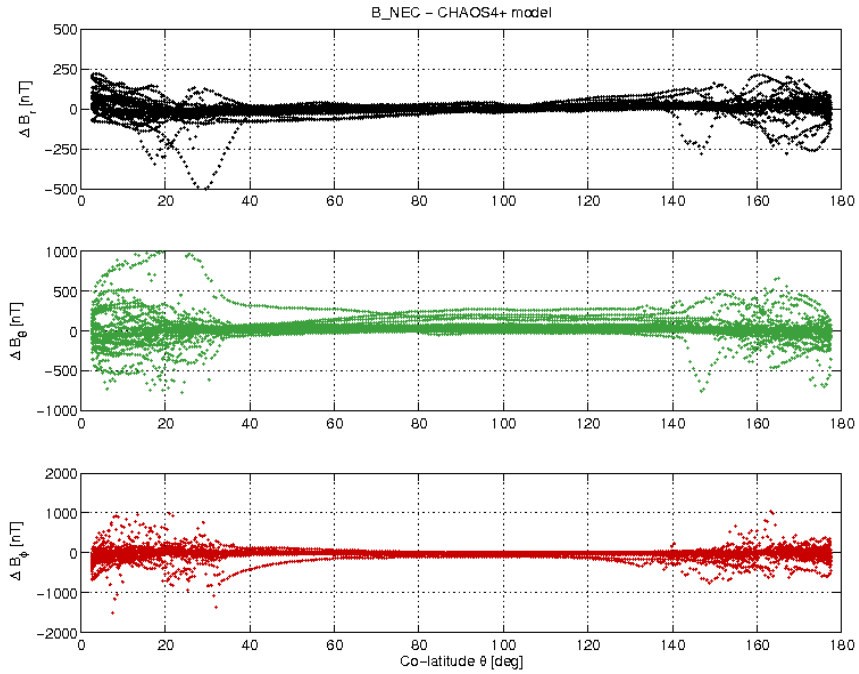

Figure 17 Swarm A day 22/06 B_NEC - B_Chaos vs colatitude.

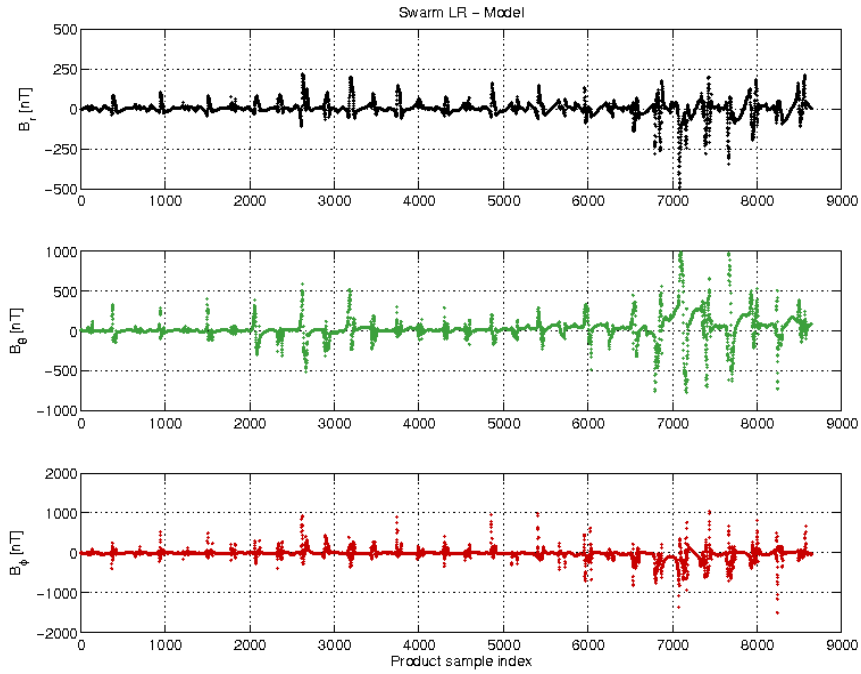

Figure 18 Swarm A day 22/06: time series of B_NEC – B_Chaos residuals.

3.3.5.2 Swarm B

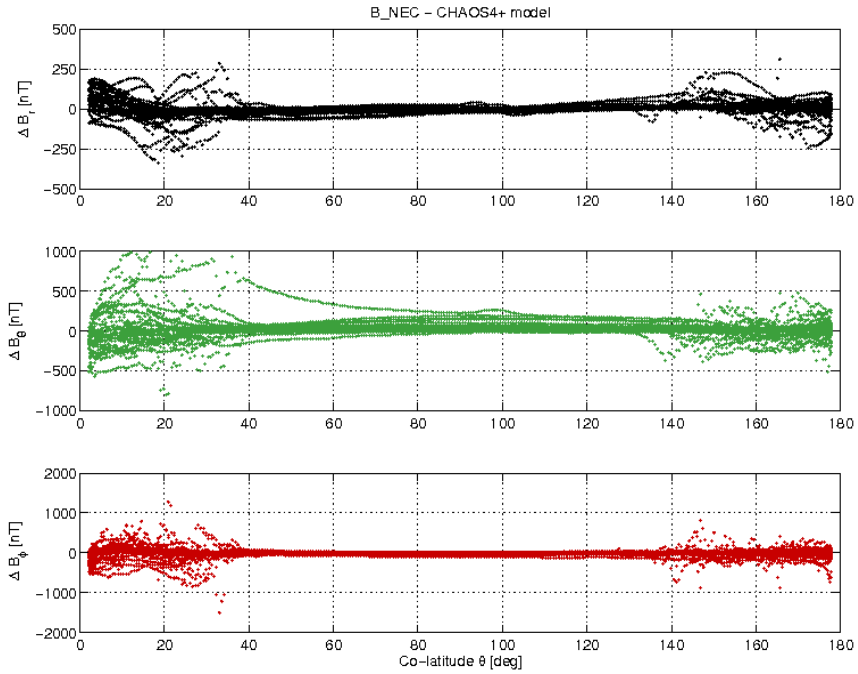

Figure 19 Swarm B day 22/06 B_NEC - B_Chaos difference vs colatitude.

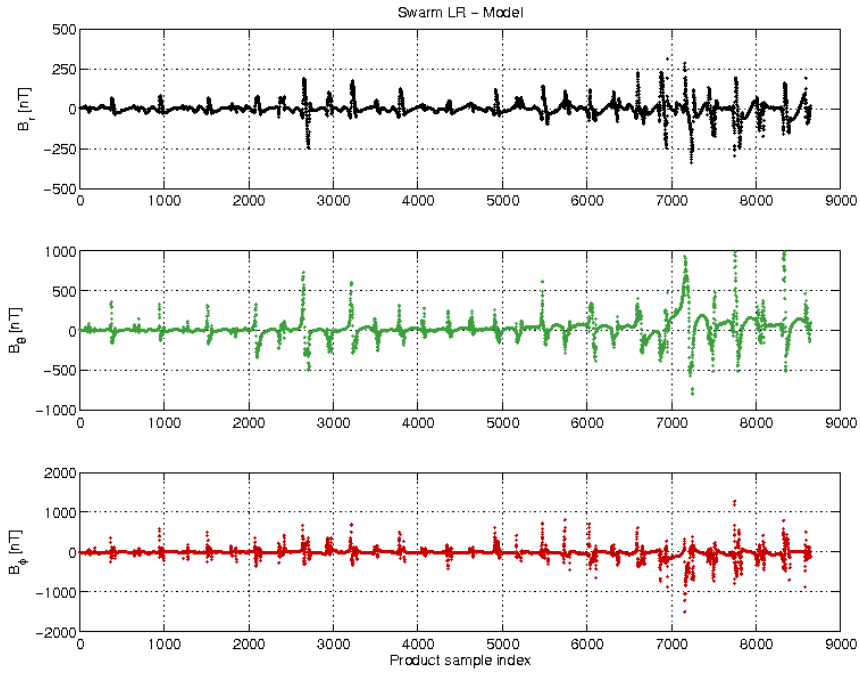

Figure 20 Swarm B day 22/06 time series of B_NEC – B_Chaos residuals.

3.3.5.3 Swarm C

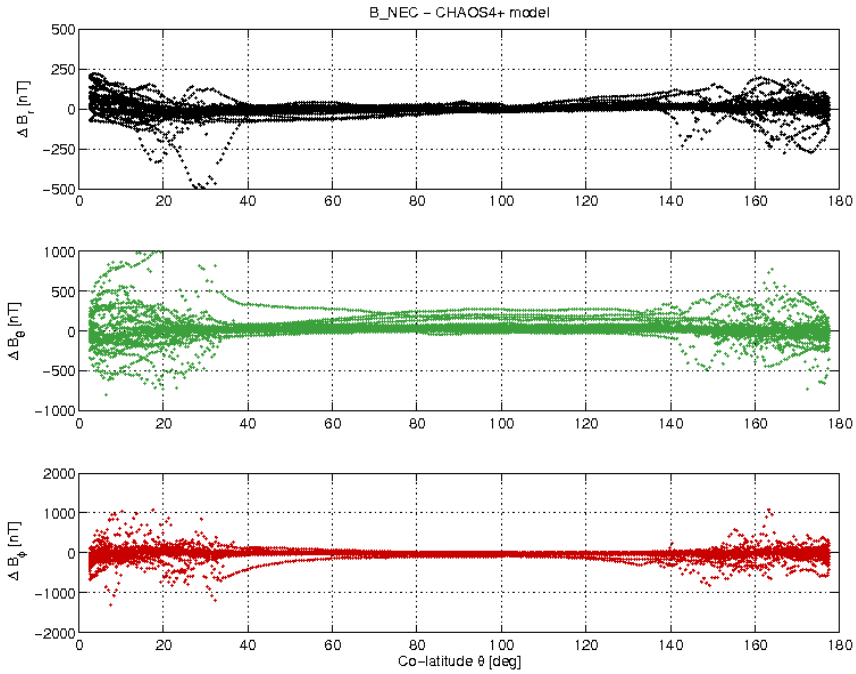

Figure 21 Swarm C day 22/06 B_NEC - B_Chaos difference vs colatitude.

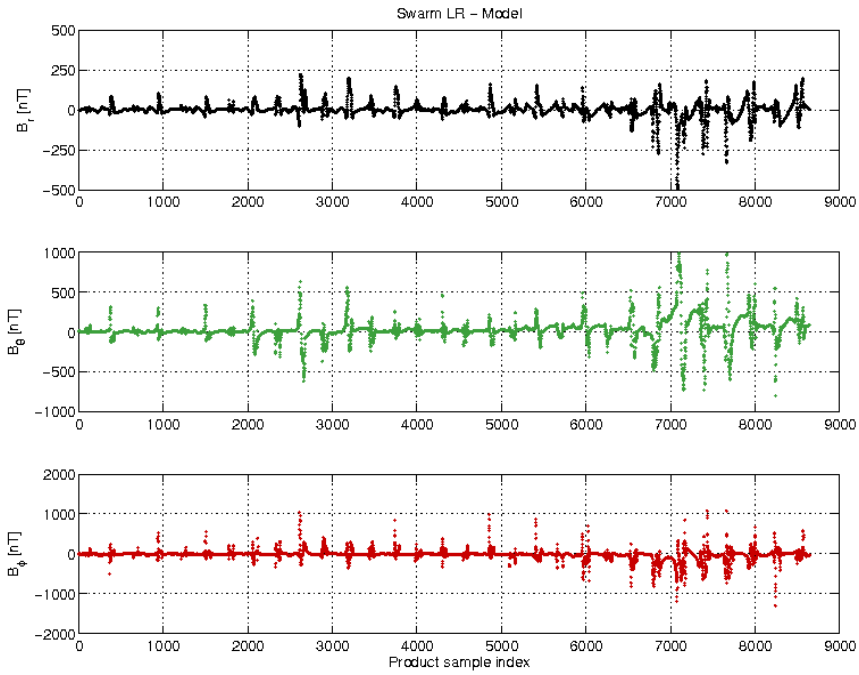

Figure 22 Swarm C day 22/06 time series of B_NEC – B_Chaos residuals.

4. ON-DEMAND ANALYSIS

Nothing to report.

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