Status of the ASM-V and ASM Burst mode data

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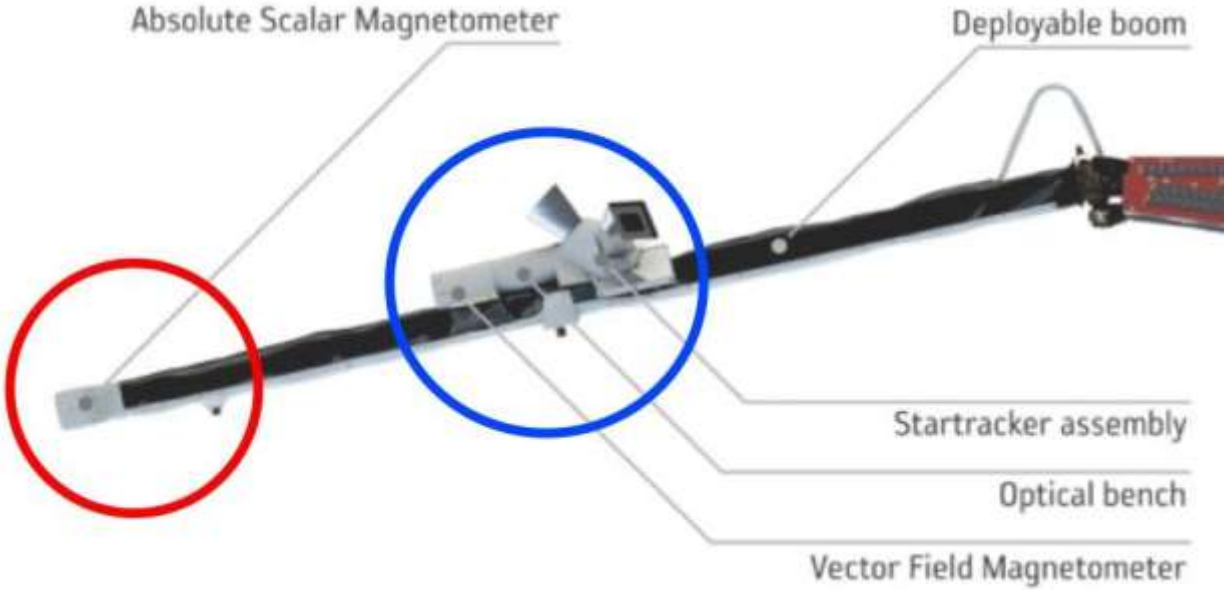
The Absolute Scalar Magnetometer



The ASM nominal mode has 2 purposes:

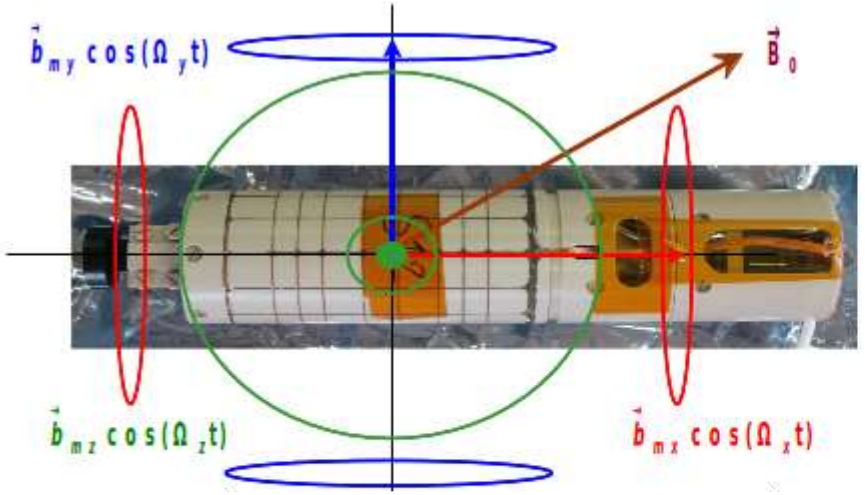
1) Produce **absolute scalar measurements** of the Earth's magnetic field
→ Official scalar data at 1 Hz from MAGxLR_1B

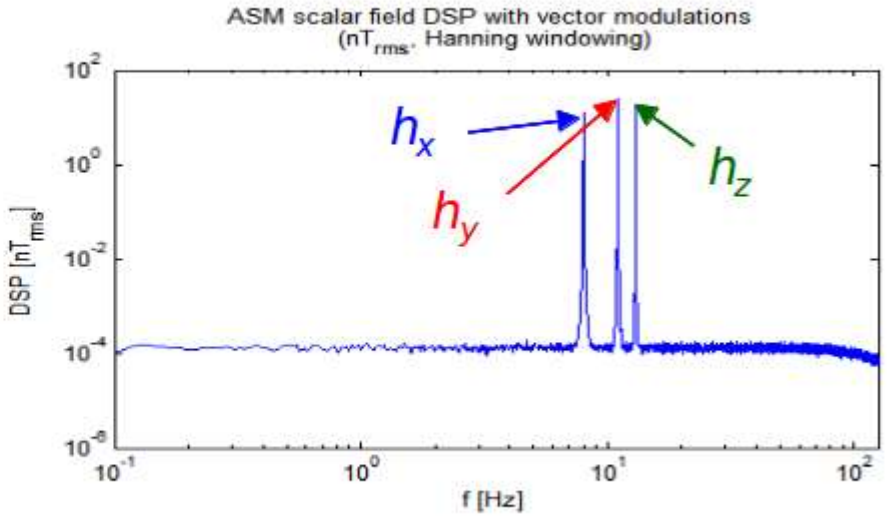
2) Provide **an absolute reference for calibrating L1B vector data** measured by the Vector Field Magnetometer
→ Vector data at 50 Hz from MAGxHR_1B and at 1 Hz from MAGxLR_1B

In addition to the nominal mode, the ASM can be used in:

Burst mode (Scalar mode) **OR** **ASM-V** mode (Vector mode)

ASM additional modes





$$\|B_{tot}\| = \left\|B_0 + \sum_{i=x,y,z} b_{mi}\cos(\Omega_i t)\right\|$$

The internal sampling of the scalar sensors at 1 kHz, allows the ASM to be used in**:**

1) Conjunctions with 3 sets of coils to provide **vector components at 1 Hz** : **ASM-V** mode
→ The 3 perpendicular coils generate periodic magnetic fields with known frequencies and amplitudes
→ Vector data are **self-calibrated**

2) **Burst** mode to provide **scalar measurements at 250 Hz**

Either: Nominal mode (scalar at 1 Hz) + ASM-V mode (vector components at 1 Hz)
Or: Nominal mode (scalar at 1 Hz) + Burst mode (scalar at 250 Hz)

ASM-V and Burst data availability

Default mode is the **ASM-V** mode:

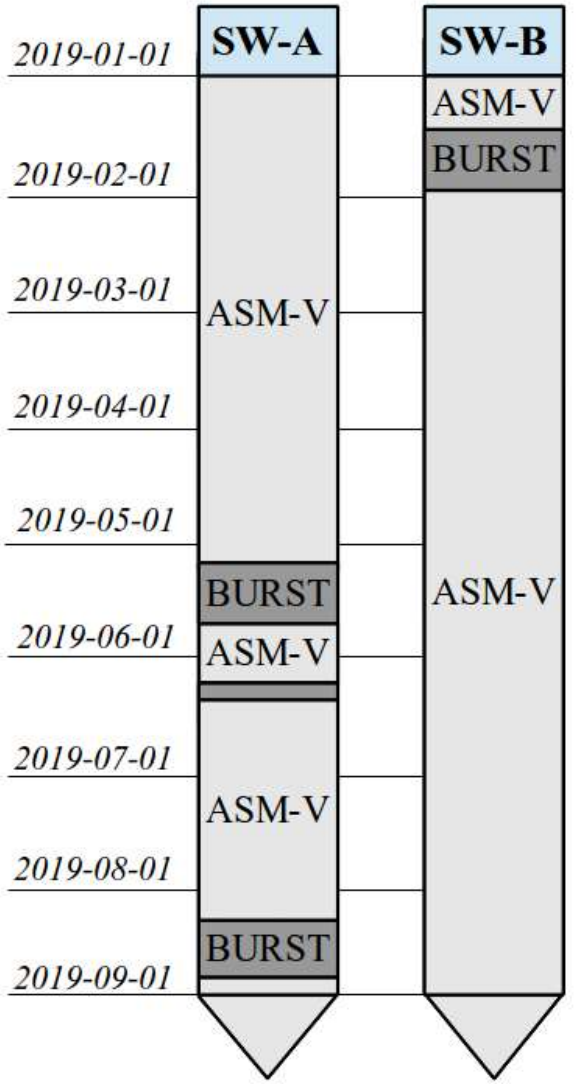
→ ASM-V data are available since the launch of the mission

→ ASM-V data production is still **experimental**

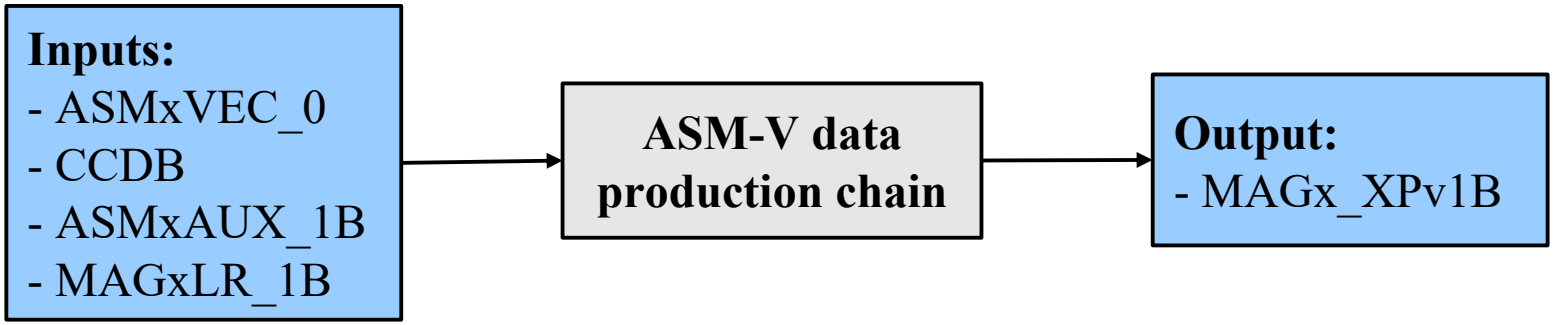
Burst mode was validated during commissioning phase: 2013-2014

→ A production chain was developed in 2018-2019 to provide burst data on a regular basis (~ 1 week/month)

→ Burst data production is now **official**



ASM-V data production



Main steps:

1) Conversion of the ASMxVEC_0 raw data to physical units and ASM time building

2) Correction of intrinsic disturbances using CCDB
→ Such as geometric and distortion effects

3) Stray fields correction using ASMxAUX_1B
→ Same kind of corrections made on official product: battery, thrust etc.

4) Position retrieving and alignment solving using MAGxLR_1B
→ Conversion from ASM time to UTC time and frame rotation

ASM-V product file

ASM-V data are saved into a **CDF file**:

Field Name	Type	Dim	Units	Decription
Timestamp	CDF_DOUBLE	N	MJD-2000	Time of measurements (t_UTC)
Latitude	CDF_DOUBLE	N	°	Position in ITRF – Latitude (equal to the one stored in official MAGx_LR_1B file)
Longitude	CDF_DOUBLE	N	°	Position in ITRF – Longitude (equal to the one stored in official MAGx_LR_1B file)
Radius	CDF_DOUBLE	N	km	Position in ITRF – Radius (equal to the one stored in official MAGx_LR_1B file)
F_Ref	CDF_DOUBLE	N	nT	Reference scalar magnetic field at t_UTC time (equal to the one stored in official MAGx_LR_1B file)
F_ASMV	CDF_DOUBLE	N	nT	Scalar magnetic field estimated alongside the ASMV vector estimates at t_UTC time. It is analogous to F_Ref except for the fact that this is now an output of the present chain; it is not computed from the modulus of the vector estimate

ASM-V product file

B_VFM_VFM	CDF_DOUBLE	N*3	nT	Official vector magnetic field estimated from VFM data at t_UTC time, in the VFM frame (equal to the one stored in official MAGx_LR_1B file)
B_VFM_NEC	CDF_DOUBLE	N*3	nT	Official vector magnetic field estimated from VFM data at t_UTC time, in the NEC frame (equal to the one stored in official MAGx_LR_1B file)
B_ASMV_ASM	CDF_DOUBLE	N*3	nT	Experimental vector magnetic field estimated from ASM data at t_UTC time, in the ASM frame
B_ASMV_VFM	CDF_DOUBLE	N*3	nT	Experimental vector magnetic field estimated from ASM data at t_UTC time, in the VFM frame
q_VFM_ASM	CDF_DOUBLE	N*4	-	Rotation of ASM frame to VFM sensor frame
q_NEC_CRF	CDF_DOUBLE	N*4	-	Rotation of CRF to NEC frames (equal to the one stored in official MAGx_LR_1B file)

→ **No flag stored:** it is recommended to compute scalar residuals
→ Data might be affected by the **Sun-related thermoelectric effect (dBSun)**

ASM-V data provision

Data released so far (beware: all before re-calibration):

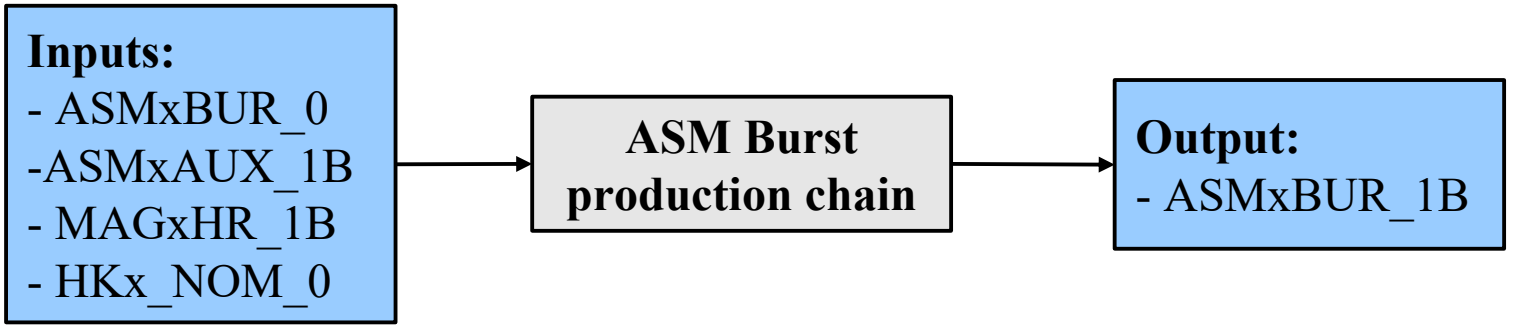
Satellite	First day of data	Last day of data	Release
A	2013-12-22	2013-12-28	1
A	2013-11-29	2015-02-28	2
A	2016-05-29	2016-06-05	4
B	2013-12-22	2013-12-28	1
B	2013-11-29	2015-02-28	2
C	2014-01-20	2014-01-27	3

Documents :
→ SW-ASMV-DD-IPGP-0002_Experimental_L1B_Product_Definition_For_**First**_Release_of_Data.pdf
→ SW-ASMV-DD-IPGP-0003_Experimental_L1B_Product_Definition_For_**Second**_Release_of_Data.pdf
→ SW-ASMV-DD-IPGP-0004_Experimental_L1B_Product_Definition_For_**Third**_Release_of_Data.pdf
→ SW-ASMV-DD-IPGP-0006_Experimental_L1B_Product_Definition_For_**Fourth**_Release_of_Data.pdf

More data have been produced since and all data have been re-calibrated, and will be made available

ASM-V data are currently used to build geomagnetic field models
→ Presentation by Vigneron et al. on Wednesday:
"Core field modelling using ASM-V data"

ASM Burst data production



Main steps:

1) Conversion of the ASMxBUR_0 raw data to physical units and UTC Time building

2) Dynamic steps correction due to data encoding and outliers detection: **Flagged**

3) Correction of intrinsic disturbances such as the Bloch-Siegert effect

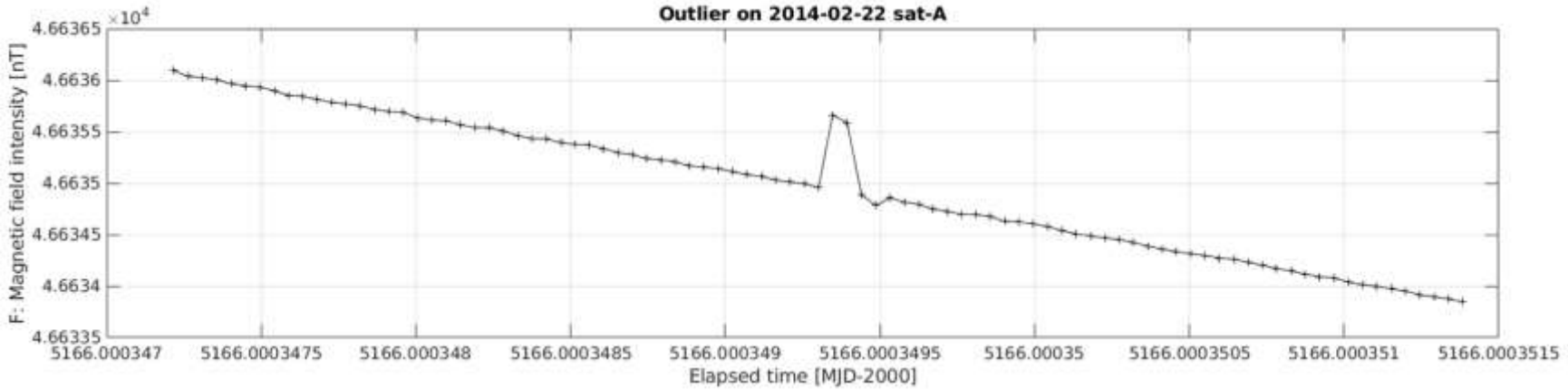
4) Stray fields correction using ASMxAUX_1B
   → Same kind of corrections made on official product: battery, thrust etc.

5) Position retrieving using MAGxHR_1B

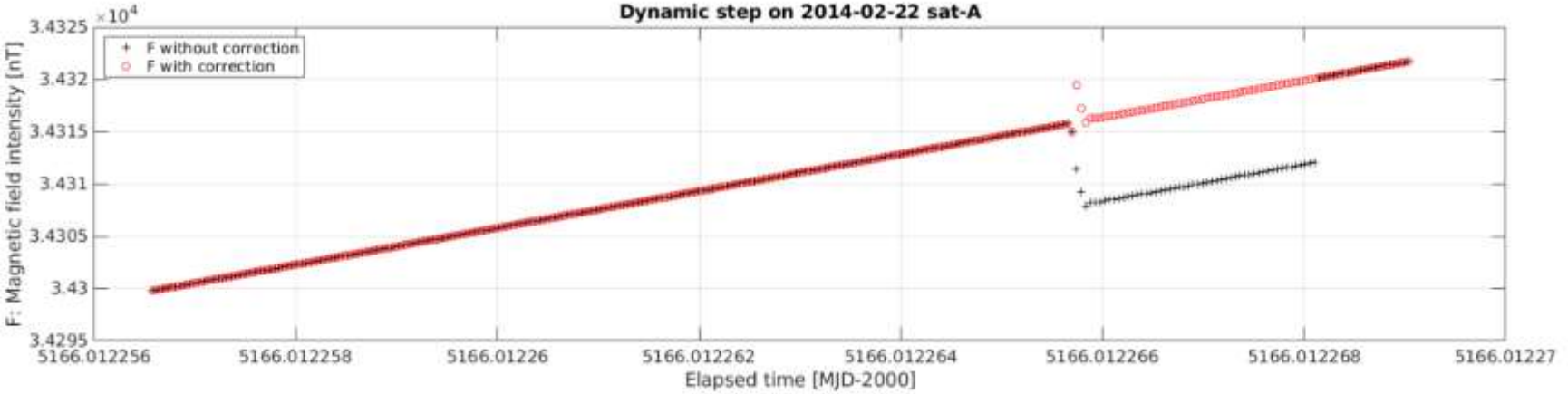
6) Magnetic condition identification and heater activation detection using HKx_NOM_0: **Flagged**

ASM Burst data flags

Outlier: **flagged**

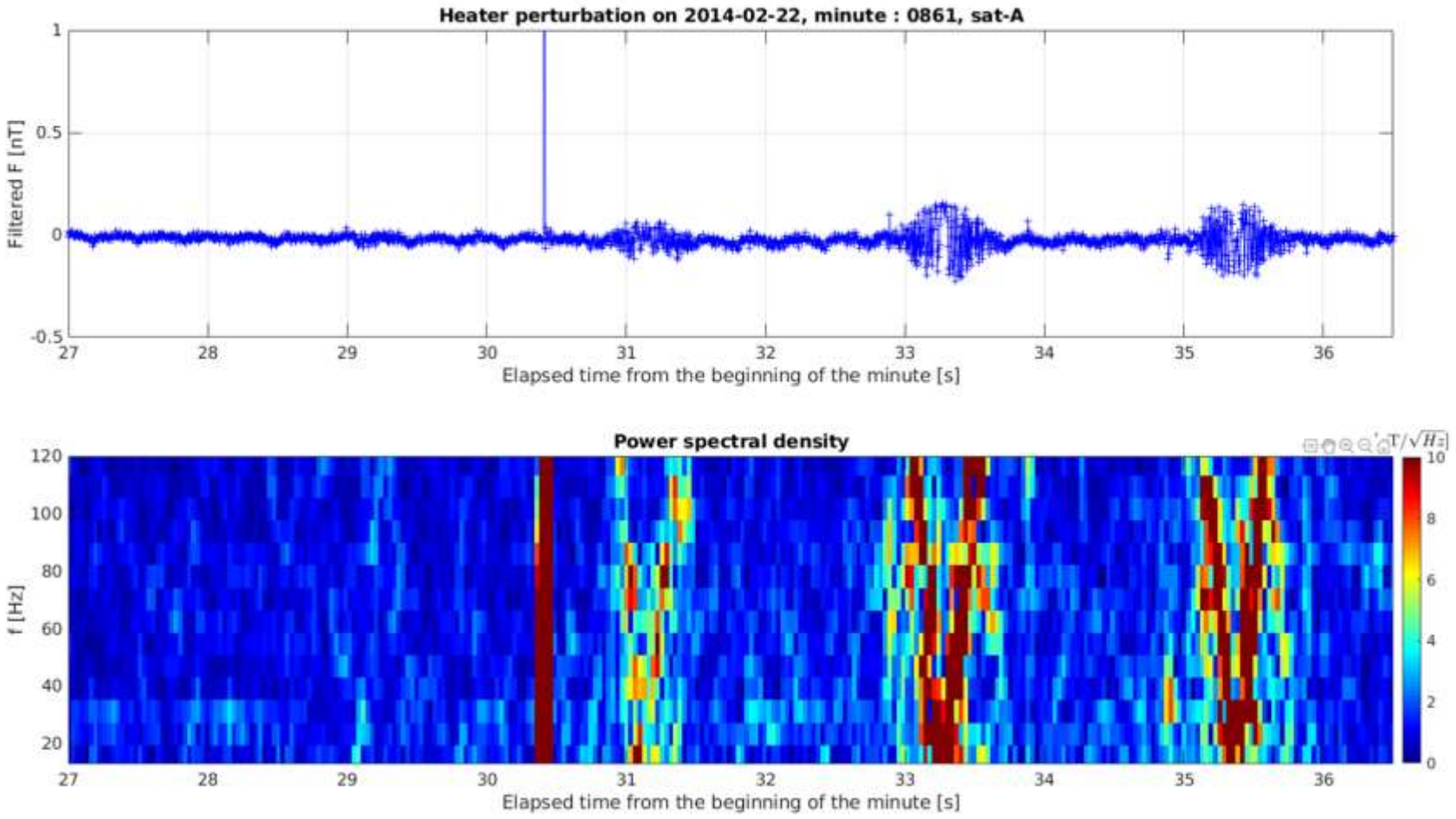


Dynamic step: **flagged** and **corrected**



ASM Burst data flags

Magnetic condition and heater activation are **flagged independently**. If both flags are equal to 1, a heater perturbation may be observed:



ASM Burst product file

ASM Burst data are saved into a **CDF file**:

Field Name	Type	Dim	Units	Scope	Decription
Timestamp	CDF_EPOCH	N	Epoch	V	Time of measurements (UTC)
TimeFrac	CDF_UINT4	N	ns	V	Fractional time of observation: ns within second
Latitude	CDF_DOUBLE	N	Degree	V	Position in ITRF - Geocentric latitude
Longitude	CDF_DOUBLE	N	Degree	V	Position in ITRF - Geocentric longitude
Radius	CDF_DOUBLE	N	m	V	Position in ITRF – Geocentric Radius
F	CDF_DOUBLE	N	nT	V	Magnetic field intensity
dF_Stray	CDF_DOUBLE	N	nT	V	Magnetic stray fields correction
dF_BlochSiegert	CDF_DOUBLE	N	nT	V	Bloch-Siegert correction
Flags	CDF_UINT1	N	-	V	Binary combination of the values taken by Flag_outlier, Flag_magnetic_condition, Flag_heater, Flag_step
Time_piezo	CDF_EPOCH	Nm	Epoch	V	Timestamp of ASM motor activations

ASM Burst data provision

ASM Burst sessions:

Sessions		Satellite		
2014-01	From 07 to 08	A	B	C
2014-01	19	A	B	C
2014-01	28	A	B	C
2014-02	From 22 to 23	A	B	C
2018-07	From 24 to 26	A	-	-
2019-01	From 21 to 28	-	B	-
2019-05	From 13 to 20	A	-	-
2019-06	11	A	-	-
2019-08	From 11 to 19	A	-	-

+ Few hours in 2013-11 and 2013-12

Released data:

→ 2018-07-25 SW-A
Doc: SW-ASMV-DD-IPGP-0008_ASM_Burst_Product_Definition.pdf

Use of data:

Burst data are currently used to study lightning-generated ELF whistlers

→ Presentation by Coïsson et al. on Wednesday :
"ELF whistlers analysis for ionospheric modelling: Initial results of the ILGEW project"

Current state

ASM-V mode:
→ Vector data at 1 Hz
→ Continuous production except during Burst mode
→ Status: Experimental

ASM Burst mode:
→ Scalar data at 250 Hz
→ Production on a regular basis: ~ 1 week/month
→ Status: Official (All produced data are released aiming at less than 2 to 4 weeks of latency)