

Cluster Science Archive: Interface Control Document for STAFF

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Table of Contents

Purpose	8
Points of Contact	8
1. Instrument Description.....	9
1.1 Science Objectives.....	9
1.2 Hardware Overview.....	9
1.2.1 The search coil sensors and the preamplifier	10
1.2.2 The magnetic waveform unit.....	12
1.2.3 The spectrum analyser	13
1.2.4 In flight calibration.....	13
1.2.5 Operational modes	14
1.2.6 Status word.....	18
1.2.7 Data compression.....	22
1.3 Data Processing Chain.....	23
1.3.1 On board data processing	23
1.3.2 Ground processing	24
1.3.3 Science processing.....	26
2. Data Provision – General Conventions.....	28
2.1 Formats.....	28
2.2 Standards.....	28
2.2.1 Time standards	28
2.2.2 Coordinate systems	28
2.2.3 Units.....	29
2.3 Production Procedures.....	30
2.3.1 STAFF-SC.....	30
2.3.2 STAFF-SA.....	30
2.4 Quality Control Procedures	30
2.4.1 STAFF-SC.....	30
2.4.2 STAFF-SA.....	31
2.5 Delivery Procedures	31
3. Data Provision – Specific Descriptions.....	32
3.1 Level 1 Data – SC - Decommutated Wave Form (DWF).....	32
3.1.1 Format: CEF.....	32
3.1.2 Standard: cf 2.2.....	32
3.1.3 Production Procedure: cf 2.3.1.....	32
3.1.4 Quality Control Procedure: cf 2.4.1	32
3.1.5 Delivery Procedure.....	32
3.1.6 Product Specification	32
3.1.7 Dataset metadata description.....	32
3.1.8 File Metadata Specification	41
3.1.9 Dataset header example	42
3.1.10 Dataset file example.....	49
3.2 Level 2 data – SC – Calibrated WaveForm (CWF).....	53
3.2.1 Format: CEF.....	53
3.2.2 Standard: cf 2.2.....	53

3.2.3	Production Procedure: cf 2.3.1.....	53
3.2.4	Quality Control Procedure: cf 2.4.1	53
3.2.5	Delivery Procedure.....	53
3.2.6	Product Specification	53
3.2.7	Dataset metadata description.....	53
3.2.8	File Metadata Specification	61
3.2.9	Dataset header example	62
3.2.10	Dataset file example.....	68
3.3	Level 2 data - SC - Complex Spectra (CS).....	71
3.3.1	Format: CEF.....	71
3.3.2	Standard: cf 2.2.....	71
3.3.3	Production Procedure: cf 2.3.1.....	71
3.3.4	Quality Control Procedure: cf 2.4.1.	71
3.3.5	Delivery Procedure.....	71
3.3.6	Product Specification	71
3.3.7	Dataset metadata description.....	72
3.3.8	File Metadata Specification	78
3.3.9	Dataset header example	80
3.3.10	Dataset file example.....	92
3.4	Level 2 data – SA- Automatic Gain Control (AGC).....	95
3.4.1	Format: CEF.....	95
3.4.2	Standard: cf 2.2.....	95
3.4.3	Production Procedure: cf 2.3.1.....	95
3.4.4	Quality Control Procedure: cf 2.4.1.	95
3.4.5	Delivery Procedure.....	95
3.4.6	Product Specification	95
3.4.7	Dataset metadata description.....	96
3.4.8	File Metadata Specification	99
3.4.9	Dataset header example	100
3.4.10	Dataset file example.....	103
3.5	Level 2 data - SA - Power Spectral Density Files (PSD)	105
3.5.1	Format: CEF.....	105
3.5.2	Standard: cf 2.2.....	105
3.5.3	Production Procedure: cf 2.3.2.....	105
3.5.4	Quality Control Procedure: cf 2.4.2.	105
3.5.5	Delivery Procedure.....	105
3.5.6	Product Specification	105
3.5.7	Dataset metadata description.....	106
3.5.8	File Metadata Specification	111
3.5.9	Dataset header example	112
3.5.10	Dataset file example.....	115
3.6	Level 2 data – SA - Spectral Matrices Files (SM).....	117
3.6.1	Format: CEF.....	117
3.6.2	Standard: cf 2.2.....	117
3.6.3	Production Procedure: cf 2.3.2.....	117
3.6.4	Quality Control Procedure: cf 2.4.2.	117

3.6.5	Delivery Procedure.....	117
3.6.6	Product Specification	117
3.6.7	Dataset metadata description.....	118
3.6.8	File Metadata Specification	123
3.6.9	Dataset header example	123
3.6.10	Dataset file example.....	128
3.7	Level 3 data - Graphical Data (Plots)	130
3.7.1	Format: binary	130
3.7.2	Standard: N.A.....	130
3.7.3	Production Procedure: N.A.....	130
3.7.4	Quality Control Procedure: N.A.....	130
3.7.5	Delivery Procedure.....	130
3.7.6	Product Specification	130
3.7.7	Dataset metadata description.....	133
3.7.8	Metadata Specification.....	134
3.7.9	Dataset header example	134
3.7.10	Dataset file example.....	136
3.8	Level 3 data - SA – Polarization and Propagation Parameters (PPP).....	136
3.8.1	Format: CEF.....	136
3.8.2	Standard: cf 2.2.....	136
3.8.3	Production Procedure: cf 2.3.2.....	136
3.8.4	Quality Control Procedure: cf 2.4.2.	136
3.8.5	Delivery Procedure.....	136
3.8.6	Product Specification	136
3.8.7	Dataset metadata description.....	137
3.8.8	File Metadata Specification	144
3.8.9	Dataset header example	144
3.8.10	Dataset file example.....	149
3.9	Auxilliary data –CAVEAT file for SM/PPP STAFF-SA – PSDNEG	151
3.9.1	Format: CEF.....	151
3.9.2	Standard: cf 2.2.....	151
3.9.3	Production Procedure: cf 2.3.2.....	151
3.9.4	Quality Control Procedure: cf 2.4.2.	151
3.9.5	Delivery Procedure.....	151
3.9.6	Product Specification	151
3.9.7	Dataset metadata description.....	151
3.9.8	File Metadata Specification	153
3.9.9	Dataset header example	154
3.9.10	Dataset file example.....	156
3.10	Auxilliary data –CAVEAT file for PPP STAFF-SA – UNDEF_MFA.....	157
3.10.1	Format: CEF.....	157
3.10.2	Standard: cf 2.2.....	157
3.10.3	Production Procedure: cf 2.3.2.....	157
3.10.4	Quality Control Procedure: cf 2.4.2.	157
3.10.5	Delivery Procedure.....	157
3.10.6	Product Specification	157

3.10.7	File Metadata Specification	159
3.10.8	Dataset header example	159
3.10.9	Dataset file example.....	161
3.11	Auxilliary data –CAVEAT file for PSD/SM/PPP STAFF-SA – NOTSRP	162
3.11.1	Format: CEF.....	162
3.11.2	Standard: cf 2.2.....	162
3.11.3	Production Procedure: cf 2.3.2.....	162
3.11.4	Quality Control Procedure: cf 2.4.2.	162
3.11.5	Delivery Procedure.....	162
3.11.6	Product Specification	162
3.11.7	Dataset metadata description.....	163
3.11.8	File Metadata Specification	164
3.11.9	Dataset header example	164
3.11.10	Dataset file example	166
3.12	Auxilliary data –CAVEAT file for STAFF data – CALIBRATION.....	167
3.12.1	Format: CEF.....	167
3.12.2	Standard: cf 2.2.....	167
3.12.3	Production Procedure: cf 2.3.2.....	167
3.12.4	Quality Control Procedure: cf 2.4.2.	167
3.12.5	Delivery Procedure.....	167
3.12.6	Product Specification	167
3.12.7	Dataset metadata description.....	167
3.12.8	File Metadata Specification	169
3.12.9	Dataset header example	169
3.12.10	Dataset file example	171
3.13	Auxilliary data – IFCReport for STAFF-SC data.....	172
3.13.1	Format: txt.....	172
3.13.2	Standard: cf 2.2.....	172
3.13.3	Production Procedure: cf 2.3.2.....	172
3.13.4	Quality Control Procedure: cf 2.4.2.	172
3.13.5	Delivery Procedure.....	172
3.13.6	Product Specification	172
3.13.7	Dataset metadata description.....	172
3.13.8	File Metadata Specification	173
3.13.9	Dataset header example	173
3.14	Software (executables).....	175
3.15	Calibration files.....	175
APPENDIX A - References for STAFF description.....		176
APPENDIX B – List of acronyms.....		177

PURPOSE

The purpose of this document is to provide a broad outline of the archiving of the data from the STAFF instrument on Cluster in the ESA Cluster Science Archive (CSA) and to define the agreement of the CSA and PI of STAFF on this broad outline.

The scientific rationale underpinning the CSA activities is as follows:

Maximise the scientific return from the mission by making all Cluster data available to the worldwide scientific community.

Ensure that the unique data set returned by the Cluster mission is preserved in a stable, long-term archive for scientific analysis beyond the end of the mission.

Provide this archive as a major contribution by ESA and the Cluster science community to the International Living With a Star programme.

In the case of STAFF the main responsibilities will be:

Deliver to CSA high resolution STAFF data in an agreed format at the best possible quality level, as far as possible in physical units (Level 2 data). When not in physical units (possible case of the waveform data) the calibration files and the relevant software to calibrate the data will be delivered with the adequate documentation. Additional value-added products will be delivered too, on the best effort basis, as well as graphical displays. All needed caveat regarding data quality and necessary documentation will be delivered

POINTS OF CONTACT

For the operation of archiving the high-resolution data from STAFF the following contacts have been agreed:

- as scientific correspondents, C. P. Escoubet for the CSA and P. Canu and O. Le Contel for STAFF-SC and STAFF-SA.
- as technical correspondents, C. Perry for the CSA and R. Piberne for STAFF-SC and STAFF-SA.
- as managerial correspondents, P. Escoubet for the CSA and P. Canu for STAFF.

1. INSTRUMENT DESCRIPTION

1.1 Science Objectives

The Cluster mission has been designed to study the thin layers of the interaction regions between the solar wind and the Earth's magnetosphere. The very existence of these regions, with their different plasma bulk properties, is largely due to wave-particle interactions which, in a collisionless plasma, provide the only means of modifying the bulk properties of plasma crossing the frontier. Within these regions, waves again provide the only effective coupling between particles of the same and of different species, and give rise to anomalous transport effects; the basic physics of these regions requires an understanding of the wave-particle interactions present.

Thus, it is important to characterise the waves and turbulence: this is the objective of the Cluster STAFF measurements. Four-point measurements will allow, for the first time, a clear separation of spatial and temporal effects. A major consideration for wave observations in a fast-flowing medium is the Doppler effect. Waveform data from four spacecraft in a tetrahedral configuration allow correction for this effect when the wavelength is comparable with the inter-spacecraft separation. On the other hand, when the wavelength is small compared to the inter-spacecraft separation, the determination of the wave normals on the four separate spacecraft may yield information about the source location. To understand turbulence, it is important to measure over a frequency range wide enough to determine any cut-off frequency; instrumentation has sometimes been inadequate for this purpose on earlier missions. Earlier missions have been even less adapted to investigate spatial wavenumber spectra. Furthermore, some geophysically important regions have been rather neglected: for example, the high-altitude cusp has been visited only by the HEOS spacecraft.

1.2 Hardware Overview

The STAFF experiment comprises a boom-mounted three-axis search coil magnetometer to measure magnetic fluctuations in the frequency range 0.1 Hz - 4 kHz, a preamplifier and an electronics box that houses the two complementary data-analysis packages: a digital Spectrum Analyser, and an on-board waveform unit.

STAFF is one of the five experiments of the Wave Experiment Consortium (WEC). The STAFF team includes scientific and hardware contributions from a number of institutes, as shown in Table 1.

LPP (previously CETP)	STAFF co-ordination (PI + technical manager) manufacturing and testing of: search coil, magnetic waveform unit, calibration check-out software support to integration and testing data analysis
LESIA- Meudon	manufacturing and testing of the spectrum analyser check-out software support to integration and testing data analysis
LPCE-Orléans	design, calibration and tests of the filters data analysis, development of dedicated scientific tools
SSD-ESTEC	manufacturing of the filters
Charles University, Prague, Czech Republic	Development of dedicated scientific tools (PRASSADCO), data analysis
LPG-Grenoble	theoretical support for data analysis relationship with ground-based measurements
Co-Is from other institutes: LPCE, Orléans, France Sussex University, UK University of Iowa, USA IRF, Uppsala, Sweden Sheffield University, UK	link between STAFF and the other WEC experiments P.M.E. Décréau M.P. Gough D.A. Gurnett, J. Pickett G. Gustafsson, M. André H.St.C. Alleyne

Table 1: Share of tasks

1.2.1 The search coil sensors and the preamplifier

Three orthogonal sensors are mounted on a rigid boom away from the spacecraft body. Two sensors, B_y and B_z , are in the spin plane, while the third one, B_x , is parallel to the spacecraft spin axis (note that the science data products have different definition for axes). Each sensor consists of a high permeability core embedded inside two solenoids. The main winding has a very large number of turns, its resonant frequency is within the expected 3 dB bandwidth. The frequency response of the main winding is flattened by a secondary winding through a flux feedback effect, in the frequency range 40-4000 Hz. Furthermore, the secondary winding is used as a calibration loop on which an external AC signal is applied through a calibration network included in the pre-amplifiers. Example of the transfer function and the experiment sensitivity are given in figure 1 below.

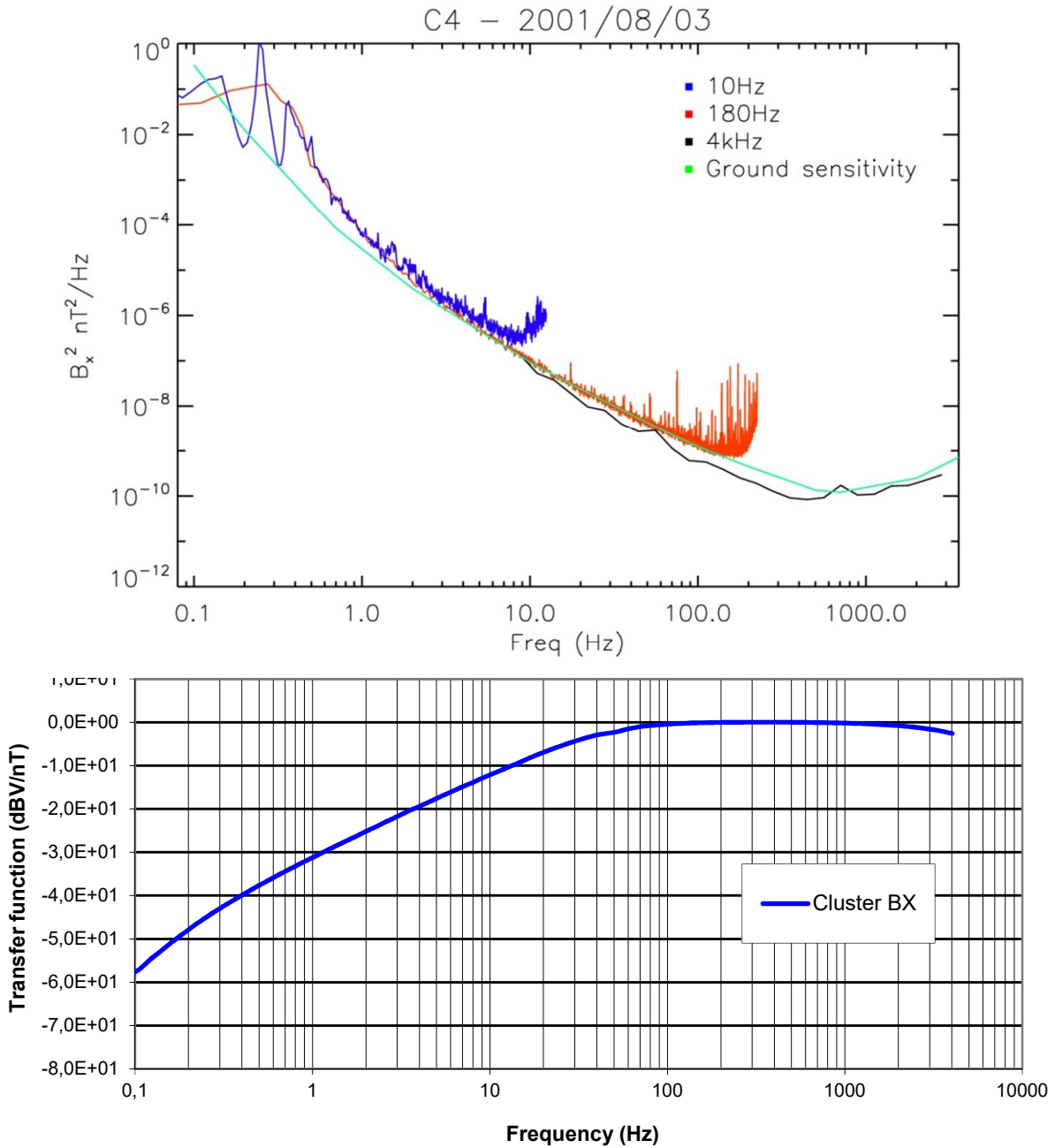


Figure 1: Top: STAFF sensitivity: comparison between ground measurements in a quiet site (green) and in-flight measurements (blue/red), when no natural signal was detected

Bottom: STAFF transfer function for one component.

The 3 channels pre-amplifier unit is located on the spacecraft deck. The low-power-consumption pre-amplifiers have a low-noise input stage and high input impedance since they are connected to the magnetic sensors which are characterised by a low DC resistance and a very high impedance in the vicinity of the resonant frequency. The dynamic range of the pre-amplifiers is about 100 dB, which allows to withstand the large voltage signals induced by the rotation of the spacecraft in the DC magnetic field, as well as the weak signals to be measured. A new pre-amplifier using hybrid technology has been developed that has been flown successfully for the first time on CASSINI (first launched on Cluster I). This technique has the advantages to include protection against radiation, together with the possibility of a thermal control of the pre-amplifier (when located outside the spacecraft body, which is not the case of Cluster II). Moreover, these pre-amplifiers are lighter than the traditional ones.

The output signals of the magnetic preamplifiers are sent to:

- the magnetic waveform unit for analysis up to either 10 or 180 Hz,
- the spectrum analyser up to 4 kHz,
- the Wide Band Data unit, also up to 4 kHz,
- the EFW experiment for use in one of the EFW internal burst memory modes,
- the Electron Drift Experiment (EDI).

1.2.2 The magnetic waveform unit

The magnetic waveform unit consists of three sections to fulfil different filtering and wave form digitalisation, data output interface and on-board calibration.

The three magnetic components B_x, B_y, B_z, at the output of the search coil pre-amplifier are filtered simultaneously either in 0-10 Hz or in 0-180 Hz bandwidth.

The low-pass filters are seventh order. They are specified with an accuracy of 1% in amplitude and 1° in absolute phase. The sampling frequency is 2.5 times the 3dB point frequency of the filters. So, the rejection of the aliasing components is at least 40 dB. The filters are the same as those used in the E-field experiment to optimise the E/B waveforms correlation.

The filtered signals are applied, after the selection of the bandwidth, to three sampling and hold devices synchronised by DWP, then digitized and sent to the DWP experiment. The same synchronisation signal is sent to EFW. The selection between the two bandwidths is made by the DWP DPU according to the telemetry rate. The filtered signals are simultaneously sampled in a large dynamic range within a very short sampling time of about 10 μs in order to guarantee a relative error of less than one degree at 180 Hz between the three components. The sampling signal, provided by DWP, is common between STAFF and EFW experiments to allow the best simultaneous analysis of the five available components of the electromagnetic waves.

Then the samples are digitized by a real 16-bit analogue-to-digital converter and transmitted to the DWP experiment through one parallel interface.

The 16-bits digitization advantage is a simultaneous analysis of natural waves of a few $\text{pT}\cdot\text{Hz}^{1/2}$ and the large signal induced by the rotation of the spacecraft in the environmental DC field, up to 100 nT at 0.25 Hz. With such a dynamic range, there is no trouble shoot to expect at the inversion of the DC magnetic field at the magnetopause.

Due to the telemetry limitation, a reduction of the dynamic data range from 16 to 12 bits is performed inside DWP (see §1.3).

1.2.3 The spectrum analyser

The spectrum analyser is designed to perform the complete auto and cross correlation matrix of 5 sensor channels over a frequency range of 8-4000 Hz at a high rate.

The "front-end" of the analyser is analogue. It consists of 15 variable-gain amplifiers and 15 anti-aliasing filters. The analysis band of 8-4000 Hz is divided into three logarithmically distributed frequency sub-bands, each with a maximum frequency eight times the minimum frequency. Distinct band pass filters are applied to each 3 sub-bands and each 5 sensor channels. For each sub-band there are 3 controlled-gain amplifiers (AGC): one for Bx channel (parallel to the spin axis) and one for each couple of spinning components (By, Bz and Ey, Ez respectively). The AGC amplifiers normalise the output signals to an optimum level for digitization. For spin-plane sensors (Ey, Ez, By, Bz) the total power from the 2 sensors is used for the normalisation because the sensor outputs will have to be "de-spun" later (see below).

The dynamic range of the normalisation is 80 dB, which, combined with the 45-50 dB dynamic range of the digital processing, gives a total instrument dynamic range order of 120 dB. Separate high-pass and low-pass filters ensure that the gain normalisation is only performed for signal components with frequencies within the sub-band. It will be further analysed digitally, and more important, will prevent "aliasing", i.e. unwanted contribution from frequency components above the Nyquist frequency (sample frequency/2).

The 15 amplifier outputs are multiplexed together to a single 8-bit flash A/D converter. They are digitized in a rapid-fire mode by groups of 5 or 10, as needed at a 16 kHz rate. The 9 AGC gain-control signals are digitized separately to be included in the telemetry packets, as a multiplicative factor for the results of the subsequent digital filtering.

1.2.4 In flight calibration

One sequence of calibration can be commanded by the DWP to calibrate in flight the STAFF experiment (the magnetic wave sensors, the waveform unit and the spectrum analyser), either at normal bit rate or at high bit rate.

STAFF calibrations take place, once per orbit close to a so called BM3 period (dump of experiments internal burst memories).

The calibration sequence duration is about 6 minutes at normal bit rate and 2 minutes at high bit rate.

Two kinds of calibration signals are generated in the magnetic waveform unit: either two simultaneous sinusoidal signals at around 7 Hz and 100 Hz, or a pseudo-random noise signal covering 4 kHz bandwidth. Eight different steps in amplitude are available to cover an 80-dB dynamic range. The calibration signal called REF is transmitted in the telemetry packets, together with the signals coming from the output of the STAFF analysers. It is used as a reference signal for the phase measurements between the different channels. It allows to identify the origin of an anomaly and thus to recalibrate the experiment. The Calibration mode is indicated by a status CAL ON (see 1.2.6).

1.2.5 Operational modes

Different operational modes are applied, mainly depending on the bit rate. A short description of these modes, for both the waveform and the spectrum analyser is given below. The STAFF modes are part of the WEC modes that are commanded and monitored by DWP.

Modes

The principle is to cover the full STAFF frequency range in all modes, but the methods are different depending on the bit rate. In Normal bit rate, the waveform data covers the 0.1 - 10 Hz frequency range, whereas the Spectrum Analyser covers the frequency range 8 Hz - 4 kHz, working in its 3 frequency bands. In High bit rate, the waveform data covers the 0.1 - 180 Hz frequency range, then in order to spare telemetry, the Spectrum Analyser only operates in its two upper frequency bands, from 64 Hz to 4 kHz.

For the waveform data, two combinations of commands can be sent, one is the sampling frequency rate which is a STAFF command, the other is whether a data compression is applied or not. This is an application software in the DWP experiment. The sampling frequency is either 25 Hz, with the 10 Hz low pass filter, in normal bit rate, or, 450 Hz, with the 180 Hz filter in high bit rate. One constraint is that STAFF and EFW must use the same sampling frequency as they are synchronised by DWP. The sampling rate is a sub multiple of the DWP clock the frequency of which is ~900 Hz, but slightly different. Its value is constant with time, but S/C dependant.

Cluster WEC (DWP) exact sampling frequency (Hz) derived from the DWP clock:

NBR:

(SC1)	25.0005833
(SC2)	25.0003611
(SC3)	25.0001667
(SC4)	25.0001667

HBR :

(SC1)	450.0105
(SC2)	450.0065
(SC3)	450.0030
(SC4)	450.0030

The STAFF waveform words are 16 bits. Normally, due to telemetry limitations, DWP applies a compression algorithm to get 12 bits words (giving 912 bits per second). In emergency mode, the 16-bit words are telemetered (see tables above), The principle is the same in high bit rate; with compression the needed telemetry is then 16320 bps.

Mode	Bit rate	Low pass filter	Compression	b/s
NM	Normal	10 Hz	Yes (12 bits)	928
BM	High Bit Rate	180 Hz	Yes (12 bits)	16480
EM NBR	Normal	10 Hz	No (16 bits)	1216
EMHBR	High Bit Rate	180 Hz	No (16 bits)	21760

Table 2 - STAFF Wave Form data Modes

For the Spectrum Analyser, the different modes are the combination of three parameters: the time resolution, the number of frequencies computed, and the number of wave components considered. Then each mode is a combination of these different parameters. The modes are defined to fulfil different scientific objectives, in the framework of two constraints, first the telemetry limitation, second the total WEC power limitation.

The "Normal Mode 1" is the basic mode in normal bit rate. The auto-spectra are averaged over 1s and the complete matrix over 4s for five components (25 coefficients). The other modes are variations of this.

In Normal Mode 1', the calculation is performed for only three components, either 3 x B (NM1'b) or Bx and 2x E (NM1'e). Only nine elements of the spectral matrix are computed (instead of 25). The mode NM1'b is used in time-sharing with NM1, during active Whisper modes. It allows saving telemetry.

In the Normal Modes 2, three of the five wave components are selected. The time resolution is 0.5 or 1s for the auto spectra and 1s for the cross spectra. Modes NM2b and NM2e are used in time-sharing.

In the Special Mode the time resolution is improved.

In the Emergency Mode, the five components are considered, with a lower time resolution, 2 and 4 seconds for the auto- and cross- spectra respectively. This reduction in time resolution, and thus in telemetry is intended to compensate for the increase due to the non-compression of the wave form data.

In high bit rate, only the two highest frequency bands are analysed. In the Fast Modes the time resolution is 1s for the cross spectra and either 0.125 s or 0.25s for the auto-spectra. Here again

five or three components can be considered. The different constraints, telemetry, Whisper active and low power are considered in the choice of the modes.

The STAFF SA modes are given in the tables below:

NORMAL MODE 1: NM1 (3 x B + 2 x E), secondary power = 1.75 W

Band	AUTO resolution	b/s	CROSS resolution	b/s	AGC resolution	b/s
A: 8-64 Hz	1.s	360	4.s	180	1.s	24
B: 64-512 Hz	1.s	360	4.s	180	1.s	24
C: 512-4096 Hz	1.s	360	4.s	180	1.s	24

Table 3.1 Total: 1696 bps (including status)

NORMAL MODES 1': NM1'b (3 x B) or NM1'e (2 x E + Bx)

Band	AUTO resolution	b/s	CROSS resolution	b/s	AGC resolution	b/s
A: 8-64 Hz	1.s	216	4.s	54	1.s	16
B: 64-512 Hz	1.s	216	4.s	54	1.s	16
C: 512-4096 Hz	1.s	216	4.s	54	1.s	16

Table 3.2 Total: 864 bps (including status)

NORMAL MODES 2: NM2 b (3 x B) or NM2 e (2 x E + Bx)

Band	AUTO resolution	b/s	CROSS resolution	b/s	AGC resolution	b/s
A: 8-64 Hz	1.s	216	1.s	216	1.s	16
B: 64-512 Hz	0.5s	432	1.s	216	0.5s	32
C: 512-4096 Hz	0.5s	432	1.s	216	0.5s	32

Table 3.3 In NM1 the Total data rate is always 1840 bps (including status)

SPECIAL MODE: SM (3 x B + 2 x E)

Band	AUTO resolution	b/s	CROSS resolution	b/s	AGC resolution	b/s
A: 8-64 Hz	1.s	360	2.s	360	1.s	24
B: 64-512 Hz	0.5s	720	2.s	360	0.5s	48
C: 512-4096 Hz	0.5s	720	2.s	360	0.5s	48

Table 3.4 Total: 3032 bps (including status)

EMERGENCY MODE: EM (3 x B + 2 x E)

Band	AUTO resolution	b/s	CROSS resolution	b/s	AGC resolution	b/s
A: 8-64 Hz	2.s	180	4.s	180	2.s	12
B: 64-512 Hz	2.s	180	4.s	180	2.s	12
C: 512-4096 Hz	2.s	180	4.s	180	2.s	12

Table 3.5 Total: 1120 bps (including status)

FAST MODE 1: FM1 (3 x B + 2 x E)

Band	AUTO resolution	b/s	CROSS resolution	b/s	AGC resolution	b/s
B: 64-512 Hz	0.125s	2880	1.s	720	0.125s	192
C: 512-4096 Hz	0.125s	2880	1.s	720	0.125s	192

Table 3.6 Total: 7600 bps (including status)

FAST MODE 2: FM2 (3 x B + 2 x E)

Band	AUTO resolution	b/s	CROSS resolution	b/s	AGC resolution	b/s
B: 64-512 Hz	0.25s	1440	1.s	720	0.25s	96
C: 512-4096 Hz	0.25s	1440	1.s	720	0.25s	96

Table 3.7 Total: 4528 bps (including status)

FAST MODES 3: FM3 b (3 x B) or FM3 e (2 x E + Bx)

Band	AUTO resolution	b/s	CROSS resolution	b/s	AGC resolution	b/s
B: 64-512 Hz	0.125s	1728	1.s	216	0.125s	128
C: 512-4096 Hz	0.125s	1728	1.s	216	0.125s	128

Table 3.8 Total: 4160 bps (including status) - STAFF Spectrum Analyser Normal Bit Rate Operation

In flight, the most often used modes are:

in Normal Bit Rate, NM1 alternatively with NM'1b when Whisper is active.

in Burst mode: FM1 or FM2, depending on the priority given to STAFF within WEC (one BM over 3 in average), again alternated with FM3b when Whisper is active.

The calibration mode calibrates both parts of the experiment. The different SA modes are tested during this sequence. The calibration mode operation is operated by remote control once per orbit and preferentially at the beginning of a data acquisition sequence, in connection with the S/C Burst Mode 3.

WHISPER MODE	STAFF-SA components	STAFF SA Mode Names
active	3 x B	NM1; FM1; FM3
passive	3 x B + 2 x E	NM1'b; FM3b

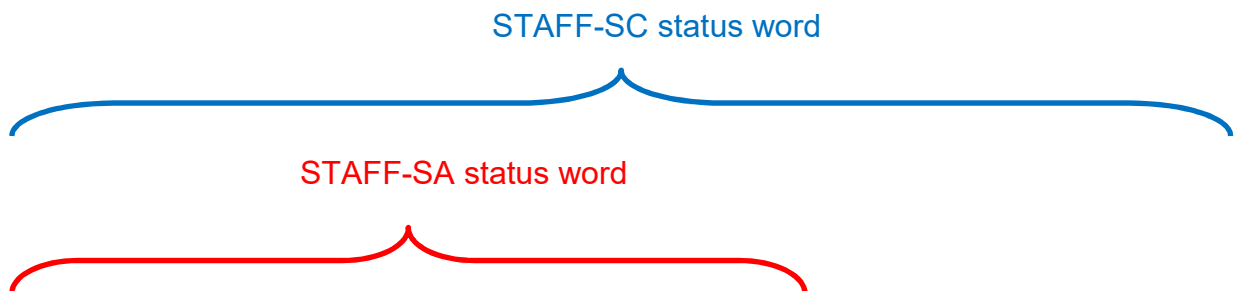
Table 4: Main STAFF SA modes as a function of Whisper experiment mode, active or passive.

1.2.6 Status word

The Status word provides information about the onboard operations and some key parameters needed in the STAFF ground data processing. There is in fact two status word in STAFF data:

- STAFF-SA status word: 1 to 9 characters described below.
- STAFF-SC status word: 1 to 14 characters described below.

STAFF-SC status word is present in DWF and CWF data files. CS files have a reduced one. STAFF-SA status word is present in AGS, SM, PSD and PPP data.



The status word is composed as follows:

Step in cal	EFW Y	EFW Z	Mode SA	Mode SC	Despin SA	WHISPER	Calibration	EFW sweep	Compression	Phase	Tcor	Time Quality	Compression Quality
-------------	-------	-------	---------	---------	-----------	---------	-------------	-----------	-------------	-------	------	--------------	---------------------

The value of each character is explained in the following table:

Description	Values																																																																										
	Min-max	Meanings																																																																									
Step in cal	0-0	0: science mode <table border="1"> <thead> <tr> <th>Step</th> <th>Mode</th> <th>Attenuation (dB)</th> </tr> </thead> <tbody> <tr><td>1</td><td>CAL4</td><td>0</td></tr> <tr><td>2</td><td>CAL4</td><td>0</td></tr> <tr><td>3</td><td>CAL4</td><td>0</td></tr> <tr><td>4</td><td>CAL4</td><td>0</td></tr> <tr><td>5</td><td>CAL4</td><td>-13</td></tr> <tr><td>6</td><td>CAL4</td><td>-26</td></tr> <tr><td>7</td><td>CAL4</td><td>-39</td></tr> <tr><td>8</td><td>CAL4</td><td>-52</td></tr> <tr><td>9</td><td>CAL4</td><td>-65</td></tr> <tr><td>a</td><td>CAL4</td><td>-78</td></tr> <tr><td>b</td><td>CAL4</td><td>Gnd</td></tr> <tr><td>c</td><td>CAL3</td><td>0</td></tr> <tr><td>d</td><td>CAL3</td><td>-26</td></tr> <tr><td>e</td><td>CAL1</td><td>0</td></tr> <tr><td>f</td><td>CAL2</td><td>0</td></tr> <tr><td>g</td><td>CAL1</td><td>-26</td></tr> <tr><td>h</td><td>CAL2</td><td>-26</td></tr> <tr><td>i</td><td>CAL1</td><td>-52</td></tr> <tr><td>j</td><td>CAL2</td><td>-52</td></tr> <tr><td>k</td><td>CAL2</td><td>Gnd</td></tr> <tr><td>l</td><td>CAL OFF redundant</td><td></td></tr> <tr><td>m</td><td>CAL2</td><td>-26</td></tr> <tr><td>n</td><td>CAL Off/On satellite</td><td></td></tr> </tbody> </table> o: after calibration, till reset or new calibration		Step	Mode	Attenuation (dB)	1	CAL4	0	2	CAL4	0	3	CAL4	0	4	CAL4	0	5	CAL4	-13	6	CAL4	-26	7	CAL4	-39	8	CAL4	-52	9	CAL4	-65	a	CAL4	-78	b	CAL4	Gnd	c	CAL3	0	d	CAL3	-26	e	CAL1	0	f	CAL2	0	g	CAL1	-26	h	CAL2	-26	i	CAL1	-52	j	CAL2	-52	k	CAL2	Gnd	l	CAL OFF redundant		m	CAL2	-26	n	CAL Off/On satellite	
Step	Mode	Attenuation (dB)																																																																									
1	CAL4	0																																																																									
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9	CAL4	-65																																																																									
a	CAL4	-78																																																																									
b	CAL4	Gnd																																																																									
c	CAL3	0																																																																									
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l	CAL OFF redundant																																																																										
m	CAL2	-26																																																																									
n	CAL Off/On satellite																																																																										
EFW Y boom pair	0-1	0: density mode off 1: density mode on																																																																									
EFW Z boom pair	0-1	0: density mode off 1: density mode on																																																																									

STAFF-SA description	mode	0-f	Value	Mode
			0	NM1
			1	NM2e
			2	NM2b
			3	Illegal
			4	Emergency
			5	Special
			6	NM1'e
			7	NM1'b
			8	FM1
			9	FM3e
			a	FM3b
			b	Illegal
			c	FM2
			d	Illegal
			e	Illegal
			f	Passive
STAFF-SC mode		0-1	0: SC bandwidth 10 Hz 1: SC bandwidth 180 Hz	
On-board (STAFF-SA) despin		0-1	0: despin off 1: despin on	
WHISPER transmitter		0-1	0: off 1: active	
Calibration		0-1	0: off 1: active	
EFW sweep progress		0-2	0: no scanning 1: scanning 2: non synchronised block	
Compression		0-2	0: nominal 1: backup 2: no compression	
Phase		0-3	0: Phase calculation OK/Right Sun Pulse 1: Phase calculation OK/Sun Pulse interpolated 2: Phase=-500 / No Sun Pulse 3: Phase=-500 / No reference phase in SATT	
Tcor		0-1	0:no (no Tcor correction) 1:yes (Tcor correction)	
Time Quality		0-1	0: interpolated time 1: block time	
Compression Error			0 = no compression error 1 – 7 = error on 1 to 3 components in instrument frame 1 error in BX 2 error in By 3 error in Bx an in By 4 error in Bz 5 error in Bx an Bz 6 Error in By and Bz Error in the 3 components	

Table 5: Status word description

E.g. A status values of 000f0100020100, means: science mode, density mode off for EFW Y and Z, SA mode = Passive, SC bandwidth = 10 Hz, SA despun off, Whisper transmitter off, Cal off, EFW not scanning, Sc compression = no compression, Phase calculation OK/Right Sun Pulse, Tcor is applied, the time is interpolated and no compression error.

1.2.7 Data compression

Data are sampled into 16bits for the first record of each block, but for other records only the difference is kept, coded in 12bits. If the difference between two records is too big, we may encounter compression errors. Fortunately, we know on which bit the error occurs, which allows us to maximise it.

Three compression modes are available (see Status word character #10), and may lead to one or another bit to be wrong. The maximum error is then known, see the following table (where Delta is the difference between the current record and the previous one):

	Delta (16 bits)	Maximum Compression Error (TM counts)	Maximum Error (mV)
No Compression	0-65535	0	0
Normal Compression	0-2015	0	0
	2016-65535	1024	150
Backup compression	0-511	0	0
	512-1535	1	0.15
	1536-3587	2	0.3
	3588-7447	4	0.6
	7448-65535	1024	150

Table 6: Data compression

The normal and backup compression are used respectively when we expect to measure “low” and “high” amplitude signals including large spin signals.

1.3 Data Processing Chain

1.3.1 On board data processing

1.3.1.1 STAFF wave form data processing (STAFF-SC)

DWP has an internal clock running at a fixed 900 Hz frequency. Pulses of this clock are counted by software which derives either a 25 Hz or a 450 Hz signal known as the WEC Sample Sync (WECSS). This controls STAFF Magnetic Waveform Analyser (SC) and EFW electric field sampling and ensures that sample taking is synchronised to this clock in order to facilitate further STAFF/EFW comparison.

DWP also performs the waveform compression for STAFF-SC from 16 bits to 12 bits words, in order to reduce the telemetry rate. The principle is to transmit at the beginning of each telemetry packet (1 packet = 1 second or 25 samples in NBR, 0.1 s or 45 samples in HBR) the full 16 bits word, and then the difference between the successive samples, coded on 12 bits in such a way that the dynamic of the experiment should be preserved even at boundary crossings. There are three possible modes selected by remote control: no compression, normal compression and backup compression. (see § 5.1.7 for modes and possible compression errors)

1.3.1.2 STAFF Spectrum Analyser data processing (STAFF-SA)

The digital processing of the sampled inputs is performed in three distinct steps:

- 1/ de-spin of the spin-plane sensor outputs,
- 2/ determination of the complex Fourier coefficients,
- 3/ calculation of the correlation matrices (see Fig. 6 in [1]).

Despin system:

The de-spinning operation involves processing of the two signals received by a pair of spinning dipole or search coils to make them appear as signals received by non-rotating sensors. This transformation is necessary because the spacecraft spin period is generally not long compared to the measurement times.

Each time samples are taken of the spinning sensor outputs; they will undergo the following calculations:

$$V_a = V_y \cdot \cos(m) + V_z \cdot \sin(m)$$

$$V_b = V_z \cdot \cos(m) - V_y \cdot \sin(m)$$

where V_y and V_z are the spinning outputs, m the instantaneous angular position of the V_y sensor, and V_a and V_b the expected outputs for non-spinning antennas at $m=0^\circ$ and $m=90^\circ$. It is foreseen that the reference for m will be the sun pulse and that m will be derived from the spin rate signals, both spacecraft-supplied on board.

Fourier Coefficients:

The Fourier coefficients are determined using appropriate algorithms which are extensions of the Remez exchange algorithm. Each of the three-octave bands is divided into 9 logarithmically-spaced channels. The relative (3 dB) bandwidth is 26 % of its central frequency.

The required analysis times are variable, depending on the frequency sub-bands, ranging from 0.016 to 1.0 s.

Correlation matrices:

The auto- and cross-spectra are calculated by complex multiplication of the complex Fourier coefficients and accumulation of the products. The analyser stores all of the results during one measurement cycle of 4 s (in normal operating mode). 540 auto-spectral coefficients are stored. This corresponds to 5 real sensor amplitudes per frequency, 27 frequencies, and 4 sub-cycles of 1s each. The number of stored cross-spectral coefficients is 540, i.e., 20 off-diagonal matrix elements and 27 frequencies. Only one set of cross-correlation components are transmitted each 4 s in the normal mode.

All of these numbers are stored in the analyser as 40-bit numbers, representing power. Out of these 40 bits, 24 are significant in the final results of the auto-spectrum calculations. They represent a dynamic range of $10 \cdot \log_{10}(2^{24}) = 72\text{dB}$. To optimise use of allocated telemetry and to simplify interfaces with the DWP, the 24-bit amplitudes N are logarithmically compressed in the wave analyser before the transfer to the DWP. The result of this compression for an amplitude N_{in} is:

$$N_{in} = 2^{(E-3)}(8+M)$$

where 5 bits are used to represent the exponent E and 3 bits for the mantissa M . The total possible dynamic range for this data presentation is 96 dB, while the average relative amplitude resolution is 0.38 dB.

The cross-spectral coefficients are sent to the DWP with the same compression technique. But only 4 bits will be put into the telemetry bit stream.

1.3.2 Ground processing

TED software produced by DWP team is applied to WEC raw data provided by ESOC in order to get level 0 files. At this level, STAFF science data are extracted in two separated datasets (STAFF-SC and STAFF-SA) and time tagged thanks to the WEC House Keeping data and TED.

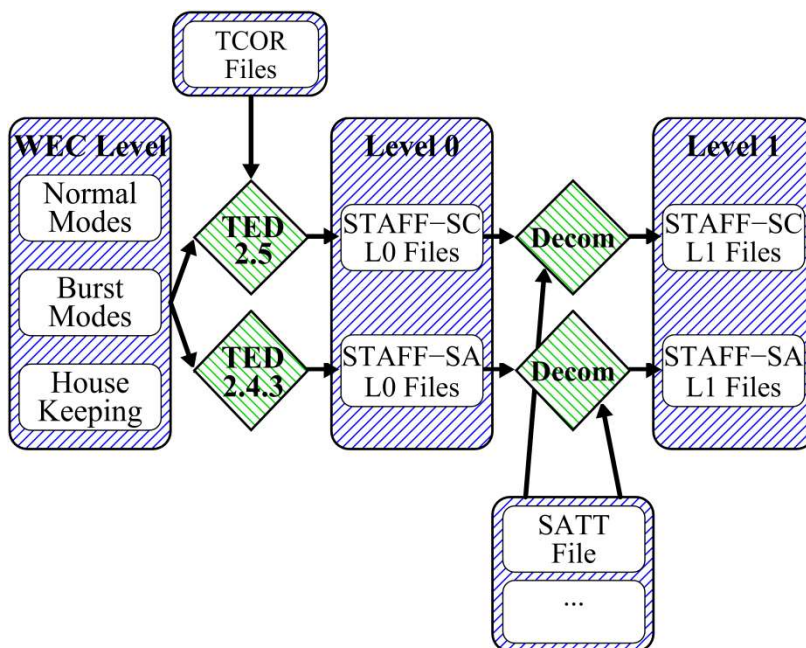
The TED version 2.5 is run to extract STAFF SC data files, in order to get the best time accuracy by activating the option that uses TCOR files in order to reach a time

accuracy of the order of some microseconds, which is important mainly for wave data in high bit rate for inter spacecraft comparisons.

The comments which follow only concern a future utilisation of STAFF waveform data: In the case of simultaneous utilisation of EFW waveform, the user should verify that the same option has been chosen for those concerned data set production by EFW team. As there are some gaps in TCOR files, all data are not time-corrected. The twelfth character of the STAFF status word indicates if TCOR files are applied or not.

For STAFF SA one uses TED version 2.4.3 (an accuracy of some μ s is not needed as the best time resolution of STAFF SA in HBR is 125 ms).

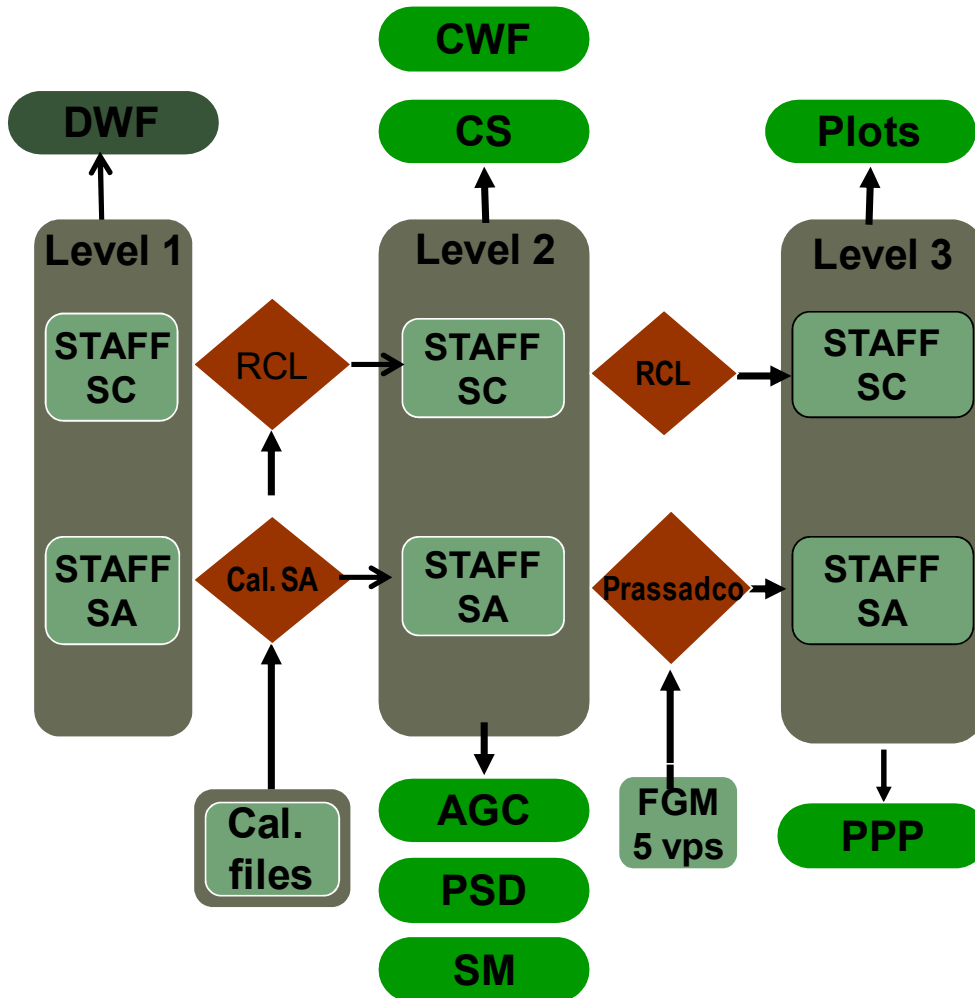
The decommutation, to go from level 0 to level 1, is done by software written in LPP, previously CETP. Data are transcribed to files of 16 bits words with regard to the compression. See documents [2] and [3] for details.



For STAFF-SC data, the spin phase is computed from the Sun Reference Pulse (seeAnnexe 1 document [4]) and added in the Level 1 file.

The spin phase is the rotation angle of the half-plane defined by the $+Z_{SR}$ and $+X_{SR}$ Spin Reference System axes around the maximum principal axis of inertia ($+Z_{SR}$) from the time when the Sun direction was contained in this plane.

1.3.3 Science processing



The data processing routines and the related science data products (those delivered to the CSA are indicated in red).

1.3.3.1 STAFF-SC

STAFF-SC data are calibrated with the FORTRAN code developed by Patrick Robert. These routines are part of the Roproc Command Language (RCL) (See [5]) that calibrates, computes and plots different types of products. The output data are formatted into a proprietary format called Roproc File Format (RFF) and graphical products are formatted into Postscript, that can be further transformed into png format.

RCL takes L1 files and converts them into RFF files. These files are self-documented files which include metadata. From this step, it is possible with RCL to perform

calibration, filtering, coordinate system transformations, time checking and other processing operations whose results (L2 files) can be translated into CEF.

Value added products are computed from L2 files: spectrograms and polarisation files (L3 files) which are displayed in Postscript files and accessible via a web interface (<http://cluster.lpp.polytechnique.fr/accueil/framepa.html>).

1.3.3.2 STAFF-SA

The calibration procedure for the STAFF-SA is fully described in [6]. This procedure is performed by the C-code `n1toN2sa`, version 2002-01-25, developed by Y. de Conchy and L. Sitruk at LESIA. The calibrated STAFF-SA data are then processed by the IDL code PRASSADCO (PPropagation Analysis of STAFF-SA Data with COherency tests) developed by O.Santolik (see [7]), in order to get the polarisation parameters.

2. DATA PROVISION – GENERAL CONVENTIONS

2.1 Formats

There are two types of products:

ASCII data files are delivered in CEF-2.0 format as described in the CEF document [8].

Binary graphical products are delivered as PNG files.

2.2 Standards

2.2.1 Time standards

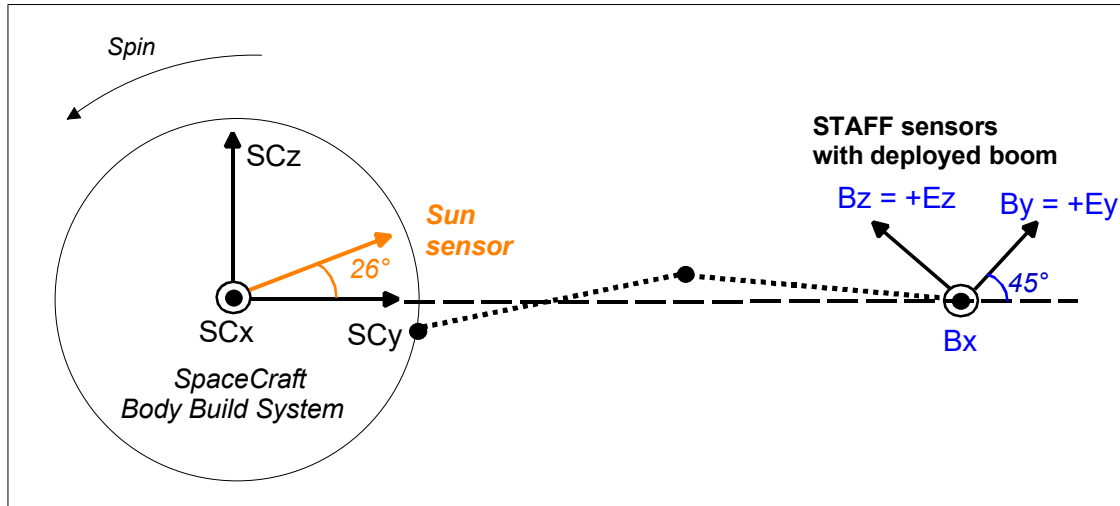
Both STAFF-SC and STAFF-SA products are time series data, every event is tagged by a time given in ISO format i.e. CCSDS ASCII time standard tag (yyyy-mm-ddThh:mm:ss.mmmZ).

2.2.2 Coordinate systems

The STAFF-SC level 1 waveform (DWF) data are given in the instrument reference frame, in order to keep all available information. This reference frame is the Data Sensor System (DSS), a variant of the Spin Reference System (SRS), and has been chosen to be the same as EFW instrument coordinate system in the spin plane (at 45° of the satellite body built reference frame); the third component, orthogonal to the 2 others, is parallel to the spacecraft spin axis, at the first order of precision. There is ~0.5° difference between spacecraft spin axis and the axial component which is small enough that no correction is needed. This small angle is seen as a weak spin modulation on Bz component when the B field is very strong (e.g. close to perigee). The three sensors are so close to orthogonality that no correction is needed.

STAFF level 2 (calibrated data) and level 3 (value added products) products are given in de-spun coordinate systems, as detailed below.

STAFF antenna reference frames are represented on figure below:



2.2.3 Units

Level 1 STAFF-SC DWF waveform is given in telemetry counts.

STAFF-SC CWF (calibrated waveform) are given in nT.

STAFF-SC CS (calibrated complex spectra) are given in nT.

STAFF-SA PSD (Power Spectral Density) parameters are given in $\text{nT}^2\text{Hz}^{-1}$ for the magnetic components (B_x^2 , B_y^2 and B_z^2) and in $\text{mV}^2\text{m}^{-2}\text{Hz}^{-1}$ for the electric components (E_x^2 and E_y^2).

STAFF-SA SM (Spectral Matrix) parameters are given in $\text{mV}^2\text{m}^{-2}\text{Hz}^{-1}$ units.

STAFF-SA AGC (Automatic Gain Control) parameters are given in $\text{nT}^2\text{Hz}^{-1}$ for the magnetic AGC (B_z , B_{xy}) and in $\text{mV}^2\text{m}^{-2}\text{Hz}^{-1}$ the Electric AGC (E_{xy}).

In addition, the factor of conversion for all components in SI units is given.

7 parameters are given for STAFF-SA PPP (Polarization and Propagation Parameters). Polar and azimuthal angle of the direction of propagation are given in degrees. Ellipticity of the polarization and the degree of polarization in the polarization plane are unitless (indeed it's a percentage). The sum of the three magnetic auto-power spectra is given in $\text{nT}^2\cdot\text{Hz}^{-1}$. The parallel component of the Poynting vector normalized by its standard deviation is unitless. Finally, the sum of the two electric auto-power spectra is given in $\text{mV}^2\text{m}^{-2}\text{Hz}^{-1}$.

2.3 Production Procedures

2.3.1 STAFF-SC

The STAFF-SC products (waveform, calibrated complex spectra and plots) are created from the L1 database (see 3.3) which is updated every time WEC data are provided by ESA. A filter is applied that converts level 1 and level 2 products to CEF.

2.3.2 STAFF-SA

SM and PSD data are extracted from the L2 database which is updated every time WEC data are provided by ESA. These data are calibrated into physical units once by our calibration software and stored in an IDL database by PRASSADCO.

IDL stored data are then formatted into CEF.

PRASSADCO transfers the SM data into MFA coordinate system with help of attitude and FGM 5VPS data extracted from CSA database. Then PRASSADCO calculates the polarization and propagation parameters and stores them in an IDL database. IDL stored data are then formatted into CEF.

2.4 Quality Control Procedures

Every CEF file produced is checked by the CSA tool CEF MDD (Cluster Exchange Format Meta Data Dictionary, CEFpass before 2020) to satisfy the CEF requirements. The filters to generate products in CEF include the check by CEFMDD.

The procedure to generate CEF produces a matrix that indicates, for a month of processed data, the number of files generated. It is compared with the input data files. In case of problem, a visual investigation is performed.

The procedure permits also to create empty files.

Before any version update, the amount of data produced by the new version is compared to the latest version. It should correspond at last to the same set of data.

2.4.1 STAFF-SC

With regard to the quality of data calibration, we started a comparison work between STAFF-SC data and FGM data. This will continue and is part of the cross-calibration activities.

With regard to the quality of data calibration, we started a comparison work between STAFF-SC data and FGM data. This will continue and is part of the cross-calibration activities

2.4.2 STAFF-SA

We intend to develop an IDL code which will read both the original STAFF-SA data and the CEF STAFF-SA data (the routines to read the CEF STAFF-SA data are being developed by CSA) and compare them. Then, using the appropriate CEF routines, we will also compare the STAFF-SA data with the STAFF-SC, EFW and WHISPER data, in the frequency ranges where those experiments overlap. This is the purpose of cross-calibration activities.

2.5 Delivery Procedures

For both STAFF-SC and STAFF-SA products, a dedicated Linux PC has been installed. This machine runs routinely the described processing chain and opens a secured connection to ESTEC each time a set of products is ready. Data are transferred to ESTEC via secured FTP (SFTP) to the dedicated machine.

3. DATA PROVISION – SPECIFIC DESCRIPTIONS

3.1 Level 1 Data – SC - Decommutated Wave Form (DWF)

3.1.1 Format: CEF

3.1.2 Standard: cf 2.2.

3.1.3 Production Procedure: cf 2.3.1.

3.1.4 Quality Control Procedure: cf 2.4.1

3.1.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.1.6 Product Specification

One CEF file per day, per satellite and per mode (NBR or HBR) is produced. This CEF file contains the Decommutated Wave Form of the Magnetic Field (level 1) and other variables or constant data (constant for one given file) described below. Data are given in the instrument coordinate frame.

3.1.7 Dataset metadata description

3.1.7.1 NBR mode

The detached dataset header is called: **C1/C2/C3/C4_CH_STA_DWF_NBR.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

Example of the **global metadata** keywords for C1_CP_STA_DWF_NBR are:

```
DATASET_ID= C1_CP_STA_DWF_NBR
DATA_TYPE= "CP"
DATASET_TITLE = "Magnetic Field Waveform – uncalibrated (25 Hz sampling)"
CONTACT_COORDINATES =
    "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
```

"Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"

"Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"

DATASET_DESCRIPTION =

"This dataset contains 3.99990667E-02s resolution measurements of the magnetic field Decommutated WaveForm (DWF) from the STAFF-SC instrument in NBR mode on the Cluster C1 spacecraft. This product is given in the STAFF Data Coordinate System ."

DATASET_TYPE=

"Raw_Data"

"Waveform"

"Magnetic_Field"

PROCESSING_LEVEL = "Uncalibrated"

ACKNOWLEDGEMENT

ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."

ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyjm"

TIME_RESOLUTION = "3.99990667E-02"

MIN_TIME_RESOLUTION, same as TIME_RESOLUTION.

MAX_TIME_RESOLUTION, same as TIME_RESOLUTION.

Note: The time resolution values given in the headers are more precise and satellite dependent.

DATASET_CAVEATS =

"DATASET VERSION HISTORY"

"All versions:"

"Use the TED software, provided by the Sheffield DWP group, with TCOR option used for a maximum UT time precision every second. S/C HK used to calculate the phase are not corrected by TCOR. The maximum error induced is 0.2 degree, including time around the leap second."

"Version 03 : All the headers have been updated (laboratory name and email). Introduction of a new header file (Dataset). For each data point time inside a one-second data block, each sample has been interpolated to insure a continuous sampling rate. The phase has been re-calculated for each point inside each one-second block."

"Version 04 : Addition of data necessary for CWF data. Correction of the time interpolation and of the backward time problem. The Maximum Compression Error information has been removed from the variables (MaxCompError_xyz_Instrument__C[n]_CP_STA_DWF_NBR) and added to the status (cf. User Guide).

"Version 05 : Some support data fields were moved to the FILE_CAVEATS section."

"Version 06 : Technical deliveries"

"Version 07 : Improved timing due to new TCOR files"

Then, the metadata for the **Support variables** are

- **Time** which is the time index. Its properties are:
CATDESC = "Time tag"
DELTA_MINUS = "1.9999533E-02"
DELTA_PLUS = "1.9999533E-02"
FIELDNAM = "UT Time"
FILLVAL = 9999-12-31T23:59:59.999999Z
LABLAXIS = "UT"
PARAMETER_TYPE = "Support Data"
SI_CONVERSION = "1.0>s"
SIGNIFICANT_DIGITS = 27
SIZES = "1"
UNITS = "s"
VALUE_TYPE = ISO_TIME

Originally, the Waveform data are separated in blocks or windows. Each block composed of several measurements (25 in Normal Bit Rate) covers 1s of measurement. The block is time tagged by TED and then split into individual measurements.

- **Status** which is a word of ASCII characters, each depending on one different factor
CATDESC = "STAFF-SC Status"
DEPEND_0 = Time__C1_CP_STA_DWF_NBR
FIELDNAM = "STAFF-SC Status"
FILLVAL = ZZZZZZZZZZZZZZ
LABEL_1 = "Status"
LABLAXIS = "Status"
PARAMETER_TYPE = "Support_Data"
PARAMETER_CAVEATS = "We cannot certify the 9th character (EFW)"
QUALITY = 1
SIGNIFICANT_DIGITS = 14
SIZES = 1
UNITS = "unitless"
VALUE_TYPE = CHAR
- **Phase_Angle:**
CATDESC = "Phase Angle"
COORDINATE_SYSTEM = "SC"
DEPEND_0 = Time__C1_CP_STA_DWF_NBR
FIELDNAM = "Phase Angle"

FILLVAL = -500.00
LABEL_1 = "Phase Angle"
LABLAXIS = "Phase Angle"
PARAMETER_TYPE = "Support_Data"
PARAMETER_CAVEATS = "Phase derived from Sun Pulse measurement: can be interpolated, see STATUS"
QUALITY = 3
SI_CONVERSION = "0.01745>rad"
SIGNIFICANT_DIGITS = 6
SIZES = 1
UNITS = "degree"
VALUE_TYPE = FLOAT

- **Misalignment_Matrix:**

CATDESC = "C1 transformation from STAFF real instrument frame to the theoretic orthogonal frame linked to the instrument."
COORDINATE_SYSTEM = "Instrument"
DATA = 1.0000, 0.0000, 0.0000, 0.0000, 1.0000, 0.0000, 0.0000, 0.0000, 1.0000
ENTITY = "Transformation"
FIELDNAM = "Misalignment_Matrix"
FILLVAL = 1.E30
FRAME = "Instrument"
LABEL_1 = "L*_C1","L*_C2","L*_C3"
PARAMETER_TYPE = "Support_Data"
PROPERTY = "Coordinate_Rotation"
QUALITY = 0
REPRESENTATION_1 = "x","y","z"
REPRESENTATION_2 = "x","y","z"
SI_CONVERSION = "1>unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3, 3
TENSOR_ORDER = 2
UNITS = "unitless"
VALUE_TYPE = FLOAT

- **Minimum_volt_range:**

CATDESC = "Minimum Volt range"
DATA = -5.00
FIELDNAM = "Minimum_volt_range"
FILLVAL = -9.99
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1>V"
SIGNIFICANT_DIGITS = 3
UNITS = "V"
VALUE_TYPE = FLOAT

-
- **Maximum_volt_range:**
CATDESC = "Maximum Volt range"
DATA = 5.00
FIELDNAM = "Maximum_volt_range"
FILLVAL = -9.99
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1>V"
SIGNIFICANT_DIGITS = 3
UNITS = "V"
VALUE_TYPE = FLOAT
 - **TM_range_min_C1_CP_STA_DWF_NBR**
CATDESC = "Minimum telemetry range in TM counts"
DATA = 0
FIELDNAM = "TM_range_min"
FILLVAL = -1
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.52590218967E-4>V"
SIGNIFICANT_DIGITS = 1
UNITS = "TM counts"
VALUE_TYPE = INT
 - **TM_range_max_C1_CP_STA_DWF_NBR**
CATDESC = "Maximum telemetry range in TM counts"
DATA = 65535
FIELDNAM = "TM_range_max"
FILLVAL = -99999
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.52590218967E-4>V"
SIGNIFICANT_DIGITS = 5
UNITS = "TM counts"
VALUE_TYPE = INT

Data themselves:

- **The Magnetic Field Decommutated WaveForm:**
B_vec_xyz_Instrument__C1_CP_STA_DWF_NBR:
CATDESC = "Cluster C1, NBR Magnetic Field Decommutated WaveForm"
COORDINATE_SYSTEM = "Instrument"
DEPEND_0 = Time__C1_CP_STA_DWF_NBR
ENTITY = "Magnetic_Field"
FIELDNAM = "Cluster C1, NBR Magnetic Field Decommutated WaveForm"
FILLVAL = -999
FLUCTUATIONS = "Waveform"
LABEL_1 = "Bx","By","Bz"

```
LABLAXIS = "Decommutated Magnetic Field Waveform"  
PARAMETER_TYPE = "Data"  
PROPERTY = "Vector"  
QUALITY = 3  
REPRESENTATION_1 = "x","y","z"  
SI_CONVERSION = "1>(counts) unitless"  
SIGNIFICANT_DIGITS = 5  
SIZES = 3  
TENSOR_ORDER = "1"  
UNITS = "TM counts"  
VALUE_TYPE = INT
```

3.1.7.2 HBR mode

The detached dataset header is called: **C1/C2/C3/C4_CH_STA_DWF_HBR.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

Example of the **global metadata** keywords for C1_CP_STA_DWF_HBR are:

```
DATASET_ID= C1_CP_STA_DWF_HBR  
DATA_TYPE= "CP"  
DATASET_TITLE = "Magnetic Field Waveform – uncalibrated (burst; 450 Hz  
sampling)"
```

```
CONTACT_COORDINATES =  
  "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"  
  "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"  
  "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
```

```
DATASET_DESCRIPTION = "This dataset contains 0.22221704E-02s resolution  
measurements of the magnetic field Decommutated WaveForm (DWF) from the  
STAFF-SC instrument in HBR mode on the Cluster C1 spacecraft. This product is  
given in the STAFF Sensor Coordinate System."
```

```
DATASET_TYPE =  
  "Raw_Data"  
  "Waveform"  
  "Magnetic_Field"
```

```
PROCESSING_LEVEL = "Uncalibrated"
```

```
ACKNOWLEDGEMENT
```

"Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."

"Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"

TIME_RESOLUTION = "0.22221704E-02s"

MIN_TIME_RESOLUTION, same as TIME_RESOLUTION.

MAX_TIME_RESOLUTION, same as TIME_RESOLUTION.

Note: The time resolution values given in the headers are more precise and satellite dependent

.
DATASET_CAVEATS =

"DATASET VERSION HISTORY. "All versions:"

"Use the TED software, provided by the Sheffield DWP group,"

"with TCOR option used for a maximum UT time precision every second."

"S/C HK used to calculate the phase are not corrected by TCOR."

"The maximum error induced is 0.2 degree, including time around the leap second."

"Version 03: All the headers have been updated (laboratory name and email). Introduction of a new header file (Dataset). For each data point time inside a 0.1s data block, each sample has been interpolated to insure a continuous sampling rate. The phase has been re-calculated for each point inside each 0.1s block."

"Version 04: Addition of data necessary for CWF data."

"Correction of the time interpolation and of the backward time problem."

"The Maximum Compression Error information has been removed from the variables (MaxCompError_xyz_Instrument__C[n]_CP_STA_DWF_HBR) and added to the status (cf. User Guide)."

"Version 05: Some support data fields were moved to the FILE_CAVEATS section."

Then, the metadata for the **Support variables** are

- **Time** which is the time index. Its properties are:
CATDESC = "Interval centred time tag"
DELTA_MINUS = "0.1111085E-02"
DELTA_PLUS = "0.1111085E-02"
FIELDNAM = "UT Time"
FILLVAL = 9999-12-31T23:59:59.999999Z
LABLAXIS = "UT"
PARAMETER_TYPE = "Support Data"
SI_CONVERSION = "1.0>s"
SIGNIFICANT_DIGITS = 27
SIZES = "1"
UNITS = "s"
VALUE_TYPE = ISO_TIME

Originally, the Waveform data are separated in blocks or windows. Each block composed of several measurements (45 in High Bit Rate) covers 100ms of measurement. The block is time tagged by TED and then split into individual measurements.

- **Status** which is a word of ASCII characters, each depending on one different factor
CATDESC = "STAFF-SC Status"
DEPEND_0 = Time__C1_CP_STA_DWF_HBR
FIELDNAM = "STAFF-SC Status"
FILLVAL = ZZZZZZZZZZZZZZ
LABEL_1 = "Status"
LABLAXIS = "Status"
PARAMETER_TYPE = "Support_Data"
PARAMETER_CAVEATS = "We cannot certify the 9th character (EFW)"
QUALITY = 1
SIGNIFICANT_DIGITS = 14
SIZES = 1
UNITS = "unitless"
VALUE_TYPE = CHAR
- **Phase Angle:**
CATDESC = "Phase Angle"
COORDINATE_SYSTEM = "SC"
DEPEND_0 = Time__C1_CP_STA_DWF_HBR
FIELDNAM = "Phase Angle"
FILLVAL = -500.00
LABEL_1 = "Phase Angle"
LABLAXIS = "Phase Angle"
PARAMETER_TYPE = "Support_Data"
PARAMETER_CAVEATS = "Phase derived from Sun Pulse measurement: can be interpolated, see STATUS"
QUALITY = 3
SI_CONVERSION = "0.01745>rad"
SIGNIFICANT_DIGITS = 6
SIZES = 1
UNITS = "degree"
VALUE_TYPE = FLOAT
- **Misalignment Matrix:**
CATDESC = "C1 transformation from STAFF real instrument frame to the theoretic orthogonal frame linked to the instrument."
COORDINATE_SYSTEM = "Instrument"
DATA = 1.0000, 0.0000, 0.0000, 0.0000, 1.0000, 0.0000, 0.0000, 0.0000, 1.0000
ENTITY = "Transformation"
FIELDNAM = "Misalignment_Matrix"
FILLVAL = 1.E30

FRAME = "Instrument"
LABEL_1 = "L*_C1","L*_C2","L*_C3"
PARAMETER_TYPE = "Support_Data"
PROPERTY = "Coordinate_Rotation"
QUALITY = 0
REPRESENTATION_1 = "x","y","z"
REPRESENTATION_2 = "x","y","z"
SI_CONVERSION = "1>unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3, 3
TENSOR_ORDER = 2
UNITS = "unitless"
VALUE_TYPE = FLOAT

- **Minimum_volt_range:**

CATDESC = "Minimum Volt range"
DATA = -5.00
FIELDNAM = "Minimum_volt_range"
FILLVAL = -9.99
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1>V"
SIGNIFICANT_DIGITS = 3
UNITS = "V"
VALUE_TYPE = FLOAT

- **Maximum_volt_range:**

CATDESC = "Maximum Volt range"
DATA = 5.00
FIELDNAM = "Maximum_volt_range"
FILLVAL = -9.99
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1>V"
SIGNIFICANT_DIGITS = 3
UNITS = "V"
VALUE_TYPE = FLOAT

- **TM_range_min:**

CATDESC = "Minimum telemetry range in TM counts"
DATA = 0
FIELDNAM = "TM_range_min"
FILLVAL = -1
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.52590218967E-4>V"
SIGNIFICANT_DIGITS = 1
UNITS = "TM counts"
VALUE_TYPE = INT

- **TM_range_max:**
CATDESC = "Maximum telemetry range in TM counts"
DATA = 65535
FIELDNAM = "TM_range_max"
FILLVAL = -99999
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.52590218967E-4>V"
SIGNIFICANT_DIGITS = 5
UNITS = "TM counts"
VALUE_TYPE = INT

Data themselves:

- **The Magnetic Field Decommutated WaveForm:**
CATDESC = "Cluster C1, HBR Magnetic Field Decommutated WaveForm"
COORDINATE_SYSTEM = "Instrument"
DEPEND_0 = Time_C1_CP_STA_DWF_HBR
ENTITY = "Magnetic_Field"
FIELDNAM = "Cluster C1, HBR Magnetic Field Decommutated WaveForm"
FILLVAL = -999
FLUCTUATIONS = "Waveform"
LABEL_1 = "Bx","By","Bz"
LABLAXIS = "Decommutated Magnetic Field Waveform"
PARAMETER_TYPE = "Data"
PROPERTY = "Vector"
QUALITY = 3
REPRESENTATION_1 = "x","y","z"
SI_CONVERSION = "1>(counts) unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3
TENSOR_ORDER = "1"
UNITS = "TM counts"
VALUE_TYPE = INT

3.1.8 File Metadata Specification

3.1.8.1 NBR Mode

Each file contains the following **file metadata** keywords (example is shown for a full day file on 1 October 2001):

```
FILE_NAME = C1_CP_STA_DWF_NBR__20011001_V05.cef  
FILE_FORMAT_VERSION = "CEF-2.0"  
FILE_TYPE = "cef"  
DATASET_VERSION = "05"
```

```
LOGICAL_FILE_ID = "C1_CP_STA_DWF_NBR__20011001_V05"  
VERSION_NUMBER = "05"  
METADATA_TYPE = "CAA"  
METADATA_VERSION = "2.0"  
FILE_TIME_SPAN      =      "2001-10-01T00:00:00.000000Z/2001-10-01T23:59:59.999999Z"  
  • GENERATION_DATE = "2014-04-25T17:44:21.000Z"  
  • FILE_CAVEATS= "Produced using software RCL V2.1"  
                  "TED version 2.5.0.109"  
                  "TCOR option yes"  
                  "Measurement time : 2001-10-01T21:45:38Z"  
                  "Spin axis direction in GEI : 1.0, -67.09, 74.54"  
                  "Spin period : 4.0234250"  
                  "Mass center : 0.0001, 0.7609, -0.0001"  
                  "Euler angles (degree): 0.00, 0.06"
```

3.1.8.2 HBR Mode

Each file contains the following **file metadata** keywords (example is shown for a full day file on 1 October 2001):

```
FILE_NAME = C1_CP_STA_DWF_HBR__20011001_V05.cef  
FILE_FORMAT_VERSION = "CEF-2.0"  
FILE_TYPE = "cef"  
DATASET_VERSION = "05"  
LOGICAL_FILE_ID = "C1_CP_STA_DWF_HBR__20011001_V03"  
VERSION_NUMBER = "05"  
METADATA_TYPE = "CAA"  
METADATA_VERSION = "2.0"  
FILE_TIME_SPAN      =      "2001-10-01T00:00:00.000000Z/2001-10-01T23:59:59.999999Z"  
GENERATION_DATE = "2014-04-25T17:48:30.000Z"  
FILE_CAVEATS = "Produced using software RCL V2.1"  
              "TED version 2.5.0.109"  
              "TCOR option yes"  
              "Measurement time : 2000-12-25T17:00:03Z"  
              "Spin axis direction in GEI : 1.0, -60.88, 94.57"  
              "Spin period : 4.0013290"  
              "Mass center : 0.0001, 0.7613, -0.0001"  
              "Euler angles (degree): 0.00, 0.03"
```

3.1.9 Dataset header example

3.1.9.1 NBR mode

Ex: C1_CH_STA_DWF_NBR.keh

```
! CEH VALIDATION 03 Dec 2019 by LPP, header V08 (RK)
!
START_META = DATASET_ID
  ENTRY = "C1_CP_STA_DWF_NBR"
END_META = DATASET_ID
!
START_META = DATA_TYPE
  ENTRY = "CP"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
  ENTRY = "Magnetic Field Waveform - uncalibrated (25 Hz sampling)"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
  ENTRY = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
  ENTRY = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
  ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
  ENTRY = "This dataset contains 3.99990667E-02s resolution measurements"
  ENTRY = "of the magnetic field Decommutated WaveForm (DWF)"
  ENTRY = "from the STAFF-SC instrument in NBR mode on the"
  ENTRY = "Cluster C1 spacecraft. This product is given in the STAFF"
  ENTRY = "Sensor Coordinate System."
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
  ENTRY = "Raw_Data"
  ENTRY = "Waveform"
  ENTRY = "Magnetic_Field"
END_META = DATASET_TYPE
!
START_META = PROCESSING_LEVEL
  ENTRY = "Uncalibrated"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
  ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication
based upon use of this data."
  ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
END_META = ACKNOWLEDGEMENT
!
START_META = TIME_RESOLUTION
  VALUE_TYPE = FLOAT
  ENTRY = 3.99990667E-02
END_META = TIME_RESOLUTION
!
START_META = MIN_TIME_RESOLUTION
  VALUE_TYPE = FLOAT
  ENTRY = 3.99990667E-02
END_META = MIN_TIME_RESOLUTION
!
START_META = MAX_TIME_RESOLUTION
  VALUE_TYPE = FLOAT
  ENTRY = 3.99990667E-02
END_META = MAX_TIME_RESOLUTION
!
START_META = DATASET_CAVEATS
  ENTRY = "DATASET VERSION HISTORY"
  ENTRY = "All versions:"
  ENTRY = "Use the TED software, provided by the Sheffield DWP group,"
  ENTRY = "with TCOR option used for a maximum UT time precision every second."
  ENTRY = "S/C HK used to calculate the phase are not corrected by TCOR."
  ENTRY = "The maximum error induced is 0.2 degree, including time around the leap second."
  ENTRY = "Version 03 : All the headers have been updated (laboratory name"
```

```
ENTRY = "and email). Introduction of a new header file (Dataset)."  
ENTRY = "For each data point time inside a one-second data block,"  
ENTRY = "each sample has been interpolated to insure a continuous sampling rate."  
ENTRY = "The phase has been re-calculated for each point inside each one-second block."  
ENTRY = "Version 04 : Addition of data necessary for CWF data."  
ENTRY = "Correction of the time interpolation and of the backward time problem."  
ENTRY = "The Maximum Compression Error information has been removed from the"  
ENTRY = "variables (MaxCompError_xyz_Instrument__C[n]_CP_STA_DWF_NBR) and added "  
ENTRY = "to the status (cf. User Guide)."  
ENTRY = "Version 05 : Some support data fields were moved to the FILE_CAVEATS section."  
ENTRY = "Version 06 : Technical deliveries"  
ENTRY = "Version 07 : Improved timing due to new TCOR files"  
END_META = DATASET_CAVEATS  
!  
!  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!                                                                                               Variables !  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!  
START_VARIABLE = Time__C1_CP_STA_DWF_NBR  
CATDESC          = "Interval centred time tag"  
DELTA_MINUS     = 1.9999533E-02  
DELTA_PLUS      = 1.9999533E-02  
FIELDNAM        = "UT Time"  
FILLVAL         = 9999-12-31T23:59:59.999999Z  
LABLAXIS        = "UT"  
PARAMETER_TYPE  = "Support_Data"  
SI_CONVERSION   = "1.0>s"  
SIGNIFICANT_DIGITS = 27  
SIZES           = 1  
UNITS           = "s"  
VALUE_TYPE      = ISO TIME  
END_VARIABLE = Time__C1_CP_STA_DWF_NBR  
!  
START_VARIABLE = Status__C1_CP_STA_DWF_NBR  
CATDESC          = "STAFF-SC Status"  
DEPEND_0         = Time__C1_CP_STA_DWF_NBR  
FIELDNAM         = "STAFF-SC Status"  
FILLVAL          = "ZZZZZZZZZZZZZZ"  
LABEL_1          = "Status"  
LABLAXIS         = "Status"  
PARAMETER_CAVEATS = "We cannot certify the 9th character (EFW)"  
PARAMETER_TYPE   = "Support_Data"  
QUALITY          = 1  
SIGNIFICANT_DIGITS = 14  
SIZES            = 1  
UNITS            = "unitless"  
VALUE_TYPE       = CHAR  
END_VARIABLE = Status__C1_CP_STA_DWF_NBR  
!  
START_VARIABLE = Phase_Angle__C1_CP_STA_DWF_NBR  
CATDESC          = "Phase Angle"  
COORDINATE_SYSTEM = "SC"  
DEPEND_0         = Time__C1_CP_STA_DWF_NBR  
FIELDNAM         = "Phase Angle"  
FILLVAL          = -500.00  
LABEL_1          = "Phase Angle"  
LABLAXIS         = "Phase Angle"  
PARAMETER_CAVEATS = "Phase derived from Sun Pulse measurement: can be interpolated, see  
STATUS"  
PARAMETER_TYPE   = "Support_Data"  
QUALITY          = 3  
SI_CONVERSION    = "0.01745>rad"  
SIGNIFICANT_DIGITS = 6  
SIZES            = 1  
UNITS            = "degree"  
VALUE_TYPE       = FLOAT  
END_VARIABLE = Phase_Angle__C1_CP_STA_DWF_NBR  
!  
START_VARIABLE = B_vec_xyz_Instrument__C1_CP_STA_DWF_NBR
```

```

CATDESC = "Cluster C1, NBR Magnetic Field Decommutated WaveForm"
COORDINATE_SYSTEM = "Instrument"
DEPEND_0 = Time_C1_CP_STA_DWF_NBR
ENTITY = "Magnetic_Field"
FIELDNAM = "Cluster C1, NBR Magnetic Field Decommutated WaveForm"
FILLVAL = -999
FLUCTUATIONS = "Waveform"
LABEL_1 = "Bx","By","Bz"
LABLAXIS = "Decommutated Magnetic Field Waveform"
PARAMETER_TYPE = "Data"
PROPERTY = "Vector"
QUALITY = 3
REPRESENTATION_1 = "x","y","z"
SI_CONVERSION = "1>(counts) unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3
TENSOR_ORDER = 1
UNITS = "TM counts"
VALUE_TYPE = INT
END_VARIABLE = B_vec_xyz_Instrument_C1_CP_STA_DWF_NBR
!
START_VARIABLE = Misalignment_Matrix_C1_CP_STA_DWF_NBR
CATDESC = "C1 transformation from STAFF real instrument frame to the theoretic
orthogonal frame linked to the instrument."
COORDINATE_SYSTEM = "Instrument"
DATA = 1.0000, 0.0000, 0.0000, 0.0000, 1.0000, 0.0000, 0.0000, 0.0000, 1.0000
ENTITY = "Transformation"
FIELDNAM = "Misalignment_Matrix"
FILLVAL = 1.E30
FRAME = "Instrument"
LABEL_1 = "L*_C1","L*_C2","L*_C3"
PARAMETER_TYPE = "Support_Data"
PROPERTY = "Coordinate_Rotation"
QUALITY = 0
REPRESENTATION_1 = "x","y","z"
REPRESENTATION_2 = "x","y","z"
SI_CONVERSION = "1>unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3, 3
TENSOR_ORDER = 2
UNITS = "unitless"
VALUE_TYPE = FLOAT
END_VARIABLE = Misalignment_Matrix_C1_CP_STA_DWF_NBR
!
START_VARIABLE = Minimum_volt_range_C1_CP_STA_DWF_NBR
CATDESC = "Minimum Volt range"
DATA = -5.00
FIELDNAM = "Minimum_volt_range"
FILLVAL = -9.99
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1>v"
SIGNIFICANT_DIGITS = 3
UNITS = "v"
VALUE_TYPE = FLOAT
END_VARIABLE = Minimum_volt_range_C1_CP_STA_DWF_NBR
!
START_VARIABLE = Maximum_volt_range_C1_CP_STA_DWF_NBR
CATDESC = "Maximum Volt range"
DATA = 5.00
FIELDNAM = "Maximum_volt_range"
FILLVAL = -9.99
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1>v"
SIGNIFICANT_DIGITS = 3
UNITS = "v"
VALUE_TYPE = FLOAT
END_VARIABLE = Maximum_volt_range_C1_CP_STA_DWF_NBR
!
START_VARIABLE = TM_range_min_C1_CP_STA_DWF_NBR
CATDESC = "Minimum telemetry range in TM counts"

```

```
DATA = 0
FIELDNAM = "TM_range_min"
FILLVAL = -1
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.52590218967E-4>v"
SIGNIFICANT_DIGITS = 1
UNITS = "TM counts"
VALUE_TYPE = INT
END_VARIABLE = TM_range_min_C1_CP_STA_DWF_NBR
!
START_VARIABLE = TM_range_max_C1_CP_STA_DWF_NBR
CATDESC = "Maximum telemetry range in TM counts"
DATA = 65535
FIELDNAM = "TM_range_max"
FILLVAL = -99999
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.52590218967E-4>v"
SIGNIFICANT_DIGITS = 5
UNITS = "TM counts"
VALUE_TYPE = INT
END_VARIABLE = TM_range_max_C1_CP_STA_DWF_NBR
!
```

3.1.9.2 NBR Mode

Ex: C1_CH_STA_DWF_HBR.ceh

```
!
! CEH VALIDATION 03 Dec 2019 by LPP, header V08 (RK)
!
START_META = DATASET_ID
ENTRY = "C1 CP STA DWF HBR"
END_META = DATASET_ID
!
START_META = DATA_TYPE
ENTRY = "CP"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
ENTRY = "Magnetic Field Waveform - uncalibrated (burst; 450 Hz sampling)"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
ENTRY = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
ENTRY = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
ENTRY = "This dataset contains 0.22221704E-02s resolution measurements"
ENTRY = "of the magnetic field Decommutated WaveForm (DWF)"
ENTRY = "from the STAFF-SC instrument in HBR mode on the"
ENTRY = "Cluster C1 spacecraft. This product is given in the STAFF"
ENTRY = " Sensor Coordinate System"
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
ENTRY = "Raw_Data"
ENTRY = "Waveform"
ENTRY = "Magnetic_Field"
END_META = DATASET_TYPE
!
START_META = PROCESSING_LEVEL
ENTRY = "Uncalibrated"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
```



```

SIGNIFICANT_DIGITS = 14
SIZES = 1
UNITS = "unitless"
VALUE_TYPE = CHAR
END_VARIABLE = Status__C1_CP_STA_DWF_HBR
!
START_VARIABLE = Phase_Angle__C1_CP_STA_DWF_HBR
CATDESC = "Phase Angle"
COORDINATE_SYSTEM = "SC"
DEPEND_0 = Time__C1_CP_STA_DWF_HBR
FIELDNAM = "Phase Angle"
FILLVAL = -500.00
LABEL_1 = "Phase Angle"
LABLAXIS = "Phase Angle"
PARAMETER_CAVEATS = "Phase derived from Sun Pulse measurement: can be interpolated, see
STATUS"
PARAMETER_TYPE = "Support Data"
QUALITY = 3
SI_CONVERSION = "0.01745>rad"
SIGNIFICANT_DIGITS = 6
SIZES = 1
UNITS = "degree"
VALUE_TYPE = FLOAT
END_VARIABLE = Phase_Angle__C1_CP_STA_DWF_HBR
!
START_VARIABLE = B_vec_xyz_Instrument__C1_CP_STA_DWF_HBR
CATDESC = "Cluster C1, HBR Magnetic Field Decommutated WaveForm"
COORDINATE_SYSTEM = "Instrument"
DEPEND_0 = Time__C1_CP_STA_DWF_HBR
ENTITY = "Magnetic Field"
FIELDNAM = "Cluster C1, HBR Magnetic Field Decommutated WaveForm"
FILLVAL = -999
FLUCTUATIONS = "Waveform"
LABEL_1 = "Bx", "By", "Bz"
LABLAXIS = "Decommutated Magnetic Field Waveform"
PARAMETER_TYPE = "Data"
PROPERTY = "Vector"
QUALITY = 3
REPRESENTATION_1 = "x", "y", "z"
SI_CONVERSION = "1>(counts) unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3
TENSOR_ORDER = 1
UNITS = "TM counts"
VALUE_TYPE = INT
END_VARIABLE = B_vec_xyz_Instrument__C1_CP_STA_DWF_HBR
!
START_VARIABLE = Misalignment_Matrix__C1_CP_STA_DWF_HBR
CATDESC = "C1 transformation from STAFF real instrument frame to the theoretic
orthogonal frame linked to the instrument."
COORDINATE_SYSTEM = "Instrument"
DATA = 1.0000, 0.0000, 0.0000, 0.0000, 1.0000, 0.0000, 0.0000, 0.0000, 1.0000
ENTITY = "Transformation"
FIELDNAM = "Misalignment_Matrix"
FILLVAL = 1.E30
FRAME = "Instrument"
LABEL_1 = "L*_C1", "L*_C2", "L*_C3"
PARAMETER_TYPE = "Support_Data"
PROPERTY = "Coordinate_Rotation"
QUALITY = 0
REPRESENTATION_1 = "x", "y", "z"
REPRESENTATION_2 = "x", "y", "z"
SI_CONVERSION = "1>unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3, 3
TENSOR_ORDER = 2
UNITS = "unitless"
VALUE_TYPE = FLOAT
END_VARIABLE = Misalignment_Matrix__C1_CP_STA_DWF_HBR
!

```

```
START_VARIABLE = Minimum_volt_range_C1_CP_STA_DWF_HBR
CATDESC        = "Minimum Volt range"
DATA           = -5.00
FIELDNAM      = "Minimum_volt_range"
FILLVAL       = -9.99
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION  = "1>v"
SIGNIFICANT_DIGITS = 3
UNITS         = "v"
VALUE_TYPE    = FLOAT
END_VARIABLE = Minimum_volt_range_C1_CP_STA_DWF_HBR
!
START_VARIABLE = Maximum_volt_range_C1_CP_STA_DWF_HBR
CATDESC        = "Maximum Volt range"
DATA           = 5.00
FIELDNAM      = "Maximum_volt_range"
FILLVAL       = -9.99
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION  = "1>v"
SIGNIFICANT_DIGITS = 3
UNITS         = "v"
VALUE_TYPE    = FLOAT
END_VARIABLE = Maximum_volt_range_C1_CP_STA_DWF_HBR
!
START_VARIABLE = TM_range_min_C1_CP_STA_DWF_HBR
CATDESC        = "Minimum telemetry range in TM counts"
DATA           = 0
FIELDNAM      = "TM_range_min"
FILLVAL       = -1
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION  = "1.52590218967E-4>v"
SIGNIFICANT_DIGITS = 1
UNITS         = "TM counts"
VALUE_TYPE    = INT
END_VARIABLE = TM_range_min_C1_CP_STA_DWF_HBR
!
START_VARIABLE = TM_range_max_C1_CP_STA_DWF_HBR
CATDESC        = "Maximum telemetry range in TM counts"
DATA           = 65535
FIELDNAM      = "TM_range_max"
FILLVAL       = -99999
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION  = "1.52590218967E-4>v"
SIGNIFICANT_DIGITS = 5
UNITS         = "TM counts"
VALUE_TYPE    = INT
END_VARIABLE = TM_range_max_C1_CP_STA_DWF_HBR
!
```

3.1.10 Dataset file example

3.1.10.1 NBR mode

Ex : C1_CP_STA_DWF_NBR__20070106_V05.cef

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                 File Metadata !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
FILE_NAME = "C1_CP_STA_DWF_NBR__20070106_V05.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                 Global Metadata !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

```
!
INCLUDE= CL_CH_MISSION.keh ! Mission level metadata.
!
INCLUDE= C1_CH_OBS.keh ! Observatory level metadata.
!
INCLUDE= CL_CH_STA.keh ! Experiment level metadata.
!
INCLUDE= C1_CH_STA_SC.keh ! Instrument level metadata.
!
INCLUDE= C1_CH_STA_DWF_NBR.keh ! Dataset level metadata.
!
START_META = FILE_TYPE
ENTRY = "cef"
END_META = FILE_TYPE
!
START_META = DATASET_VERSION
ENTRY = "05"
END_META = DATASET_VERSION
!
START_META = LOGICAL_FILE_ID
ENTRY = "C1_CP_STA_DWF_NBR__20070106_V05"
END_META = LOGICAL_FILE_ID
!
START_META = VERSION_NUMBER
ENTRY = "05"
END_META = VERSION_NUMBER
!
START_META = METADATA_TYPE
ENTRY = "CAA"
END_META = METADATA_TYPE
!
START_META = METADATA_VERSION
ENTRY = "2.0"
END_META = METADATA_VERSION
!
START_META = FILE_TIME_SPAN
VALUE_TYPE = ISO_TIME_RANGE
ENTRY = "2007-01-06T00:00:00.000000Z/2007-01-06T23:59:59.999999Z"
END_META = FILE_TIME_SPAN
!
START_META = GENERATION_DATE
VALUE_TYPE = ISO_TIME
ENTRY = "2014-04-25T21:28:29.000Z"
END_META = GENERATION_DATE
!
START_META = FILE_CAVEATS
ENTRY = "Produced using software RCL V2.1"
ENTRY = "TED version 2.5.0.109"
ENTRY = "TCOR option yes"
ENTRY = "Measurement time : 2007-01-01T20:24:53Z"
ENTRY = "Spin axis direction in GEI : 1.0, -61.27, 86.22"
ENTRY = "Spin period : 4.1464550"
ENTRY = "Mass center : 0.0001, 0.7535, -0.0001"
ENTRY = "Euler angles (degree): -0.02, 0.07"
END_META = FILE_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
DATA_UNTIL = "END_OF_FILE"
2007-01-06T00:00:00.014824Z,00100000000100, 210.00,33056,33124,32861
2007-01-06T00:00:00.054823Z,00100000000100, 213.47,33010,32959,32686
2007-01-06T00:00:00.094822Z,00100000000100, 216.94,32909,32871,32560
2007-01-06T00:00:00.134821Z,00100000000100, 220.42,32817,32847,32551
2007-01-06T00:00:00.174820Z,00100000000100, 223.89,32779,32774,32588
2007-01-06T00:00:00.214819Z,00100000000100, 227.36,32825,32897,32703
2007-01-06T00:00:00.254818Z,00100000000100, 230.83,33018,32914,32818
2007-01-06T00:00:00.294817Z,00100000000100, 234.31,33033,32880,32837
```

3.1.10.2 HBR mode

Ex : C1_CP_STA_DWF_HBR__20070106_V05.cef

```

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                               File Metadata !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
FILE_NAME = "C1_CP_STA_DWF_HBR__20070106_V05.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                               Global Metadata !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
INCLUDE= CL_CH_MISSION.cef ! Mission level metadata.
!
INCLUDE= C1_CH_OBS.cef ! Observatory level metadata.
!
INCLUDE= CL_CH_STA.cef ! Experiment level metadata.
!
INCLUDE= C1_CH_STA_SC.cef ! Instrument level metadata.
!
INCLUDE= C1_CH_STA_DWF_HBR.cef ! Dataset level metadata.
!
START_META = FILE_TYPE
ENTRY = "cef"
END_META = FILE_TYPE
!
START_META = DATASET_VERSION
ENTRY = "05"
END_META = DATASET_VERSION
!
START_META = LOGICAL_FILE_ID
ENTRY = "C1_CP_STA_DWF_HBR__20070106_V05"
END_META = LOGICAL_FILE_ID
!
START_META = VERSION_NUMBER
ENTRY = "05"
END_META = VERSION_NUMBER
!
START_META = METADATA_TYPE
ENTRY = "CAA"
END_META = METADATA_TYPE
!
START_META = METADATA_VERSION
ENTRY = "2.0"
END_META = METADATA_VERSION
!
START_META = FILE_TIME_SPAN
VALUE_TYPE = ISO_TIME_RANGE
ENTRY = "2007-01-06T00:00:00.000000Z/2007-01-06T23:59:59.999999Z"
END_META = FILE_TIME_SPAN
!
START_META = GENERATION_DATE
VALUE_TYPE = ISO_TIME
ENTRY = "2014-04-25T21:59:12.000Z"
END_META = GENERATION_DATE
!
START_META = FILE_CAVEATS
ENTRY = "Produced using software RCL V2.1"
ENTRY = "TED version 2.5.0.109"
ENTRY = "TCOR option yes"
ENTRY = "Measurement time : 2007-01-01T20:24:53Z"
ENTRY = "Spin axis direction in GEI : 1.0, -61.27, 86.22"
ENTRY = "Spin period : 4.1464550"
ENTRY = "Mass center : 0.0001, 0.7535, -0.0001"
  
```

```
ENTRY = "Euler angles (degree): -0.02, 0.07"
END_META = FILE_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                               Data      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
DATA_UNTIL = "END_OF_FILE"
2007-01-06T19:49:56.918400Z,001f1000000110, 306.30,32764,33082,32727
2007-01-06T19:49:56.920622Z,001f1000000100, 306.49,32768,33077,32721
2007-01-06T19:49:56.922844Z,001f1000000100, 306.69,32772,33079,32724
2007-01-06T19:49:56.925066Z,001f1000000100, 306.88,32769,33081,32726
...
```

3.2 Level 2 data – SC – Calibrated WaveForm (CWF)

These data are given in two different frames: GSE and ISR2.

3.2.1 Format: CEF

3.2.2 Standard: cf 2.2.

3.2.3 Production Procedure: cf 2.3.1.

3.2.4 Quality Control Procedure: cf 2.4.1

3.2.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.2.6 Product Specification

One CEF file per day, per satellite is produced. This CEF file contains the Calibrated Wave Form of the Magnetic Field (level 2) and other variables or constant data (constant for one given file) described below. Data are given in either in GSE or in ISR2.

3.2.7 Dataset metadata description

3.2.7.1 GSE

The detached dataset header is called: **C1/C2/C3/C4_CH_STA_CWF_GSE.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

Example of the **global metadata** keywords for C1_CP_STA_CWF_GSE are:

```
DATASET_ID= C1_CP_STA_CWF_GSE
DATA_TYPE= "CP"
DATASET_TITLE = "Magnetic Field Waveform – calibrated"
CONTACT_COORDINATES =
    "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
    "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
```

"Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"

DATASET_DESCRIPTION = "This dataset contains measurements of the magnetic field Calibrated WaveForm (CWF) from the STAFF-SC instrument in NBR mode (filtered from 0.6Hz to 10Hz and sampled at 25Hz) and HBR mode (filtered from 0.6Hz to 180Hz and sampled at 450Hz) on the Cluster C1 spacecraft. This product is given in the GSE frame. Data calibration is performed using a moving window of 1024 points in NBR mode and 4096 points in HBR mode. These values were chosen as the best compromise for routine production. For further details, please refer to the STAFF Calibration Report."

DATASET_TYPE = "Waveform"
"Magnetic_Field"

PROCESSING_LEVEL = "Calibrated"

ACKNOWLEDGEMENT = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."

"Digital Object Identifier for the STAFF archive:
doi.org/10.5270/esa-yrzyijm"

TIME_RESOLUTION = 3.99990667E-02

MIN_TIME_RESOLUTION = 3.99990667E-02

MAX_TIME_RESOLUTION = 0.22221704E-02

Note: The time resolution values given in the headers are satellite dependent.

DATASET_CAVEATS = "*C1_CQ_STA_CALIB_YTR_CAVEATS"
"*C1_CQ_STA_NOTSRP_MTR_CAVEATS"
"DATASET VERSION HISTORY"
"Version 01: First version of dataset."
"Version 02: Few corrected re-deliveries."
"Version 03: Removal of on-board calibration records is now based on the calibration bit (instead of the step-in-cal character)."

Then, the metadata for the **Support variables** are:

- **Time** which is the time index. Its properties are:
CATDESC = "Time tag"
DELTA_MINUS = "0"
DELTA_PLUS = "Interval__C1_CP_STA_CWF_GSE"
FIELDNAM = "UT Time"
FILLVAL = 9999-12-31T23:59:59.999999Z
LABLAXIS = "UT"
PARAMETER_TYPE = "Support Data"
SI_CONVERSION = "1.0>s"
SIGNIFICANT_DIGITS = 27

SIZES = "1"
UNITS = "s"
VALUE_TYPE = ISO_TIME

Originally, the Waveform data are separated in blocks or windows. Each block composed of several measurements (25 in Normal Bit Rate) covers 1s of measurement. The block is time tagged by TED and then split into individual measurements.

- **Half interval** which is half time interval between two samples. Its properties are:
CATDESC = "Sampling interval length"
FIELDNAM = "Sampling interval length"
FILLVAL = 9.999999
LABLAXIS = "s"
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.0>s"
SIGNIFICANT_DIGITS = 7
UNITS = "s"
VALUE_TYPE = FLOAT
DEPEND_0 = Time__C1_CP_STA_CWF_GSE
- **Status** which is a word of ASCII characters, each depending on one different factor
CATDESC = "STAFF-SC Status"
DEPEND_0 = Time__C1_CP_STA_CWF_GSE
FIELDNAM = "STAFF-SC Status"
FILLVAL = ZZZZZZZZZZZZZZ
LABEL_1 = "Status"
LABLAXIS = "Status"
PARAMETER_TYPE = "Support_Data"
PARAMETER_CAVEATS = "See UG, Appendix C. We cannot certify the 9th character (EFW)"
QUALITY = 1
SIGNIFICANT_DIGITS = 14
SIZES = 1
UNITS = "unitless"
VALUE_TYPE = CHAR
- **Phase Angle:**
CATDESC = "Phase Angle"
COORDINATE_SYSTEM = "SC"
DEPEND_0 = Time__C1_CP_STA_CWF_GSE
FIELDNAM = "Phase Angle"
FILLVAL = -500.00
LABEL_1 = "Phase Angle"
LABLAXIS = "Phase Angle"
PARAMETER_TYPE = "Support_Data"

PARAMETER_CAVEATS = "Phase derived from Sun Pulse measurement: can be interpolated, see STATUS"

QUALITY = 3

SI_CONVERSION = "0.01745>rad"

SIGNIFICANT_DIGITS = 6

SIZES = 1

UNITS = "degree"

VALUE_TYPE = FLOAT

- **Misalignment_Matrix:**

CATDESC = "C1 transformation from STAFF real instrument frame to the theoretic orthogonal frame linked to the instrument."

COORDINATE_SYSTEM = "Instrument"

DATA = 1.0000, 0.0000, 0.0000, 0.0000, 1.0000, 0.0000, 0.0000, 0.0000, 1.0000

ENTITY = "Transformation"

FIELDNAM = "Misalignment_Matrix"

FILLVAL = 1e30

FRAME = "Instrument"

LABEL_1 = "M1","M2","M3"

PARAMETER_TYPE = "Support_Data"

PROPERTY = "Coordinate_rotation"

REPRESENTATION_1 = "x","y","z"

REPRESENTATION_2 = "x","y","z"

QUALITY = 0

SI_CONVERSION = "1>unitless"

SIGNIFICANT_DIGITS = 5

SIZES = 3,3

UNITS = "unitless"

VALUE_TYPE = FLOAT

Data themselves:

- **The Magnetic Field Calibrated WaveForm:**

CATDESC = "Cluster C1, NBR Calibrated Magnetic Field WaveForm"

COORDINATE_SYSTEM = "GSE"

DEPEND_0 = Time__C1_CP_STA_CWF_GSE

ENTITY = "Magnetic_Field"

FIELDNAM = "Cluster C1, Calibrated Magnetic Field WaveForm "

FILLVAL = -0.1000E+31

FLUCTUATIONS = "Waveform"

LABEL_1 = "Bx","By","Bz"

LABLAXIS = "Calibrated Magnetic Field Waveform"

PARAMETER_TYPE = "Data"

PROPERTY = "Vector"

QUALITY = 3

REPRESENTATION_1 = "x","y","z"

```
SI_CONVERSION = "1E-9>T"  
SIGNIFICANT_DIGITS = 7  
SIZES = 3  
TENSOR_ORDER = "1"  
UNITS = "nT"  
VALUE_TYPE = FLOAT
```

3.2.7.2 ISR2

The detached dataset header is called: **C1/C2/C3/C4_CH_STA_CWF_ISR2.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

Example of the **global metadata** keywords for C1_CP_STA_CWF_ISR2 are:

```
DATASET_ID= C1_CP_STA_CWF_ISR2  
DATA_TYPE= "CP"  
DATASET_TITLE = "Magnetic Field Waveform – calibrated"  
CONTACT_COORDINATES =  
    "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"  
    "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"  
    "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
```

```
DATASET_DESCRIPTION = "This dataset contains measurements of the magnetic field Calibrated WaveForm (CWF) from the STAFF-SC instrument in NBR mode (filtered from 0.1Hz to 10Hz and sampled to 12.5Hz) and in HBR mode (filtered from 0.1Hz to 180Hz and sampled to 225Hz) and DC magnetic field components in the spin plane Dx, Dy, on the Cluster C1 spacecraft. This product is given in the ISR2 frame.
```

```
DATASET_TYPE = "Waveform"  
              "Magnetic_Field"
```

```
PROCESSING_LEVEL = "Calibrated"  
ACKNOWLEDGEMENT = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."  
                  "Digital Object Identifier for the STAFF archive:  
doi.org/10.5270/esa-yrzyijm"
```

```
TIME_RESOLUTION = 3.99990667E-02  
MIN_TIME_RESOLUTION = 3.99990667E-02  
MAX_TIME_RESOLUTION = 0.22221704E-02
```

Note: The time resolution values given in the headers are more precise and satellite dependent.

```
DATASET_CAVEATS =  "*C1_CQ_STA_CALIB_YTR_CAVEATS"  
                  "*C1_CQ_STA_NOTSRP_MTR_CAVEATS"  
                  "DATASET VERSION HISTORY"  
                  "Version 01: First version of dataset."  
                  "Version 02: Few corrected re-deliveries."  
                  "Version 03: Removal of on-board calibration records is  
                  now based on"  
                  "the calibration bit (instead of the step-in-cal character)."
```

Then, the metadata for the **Support variables** are:

- **Time** which is the time index. Its properties are:

```
CATDESC = "Time tag"  
DELTA_MINUS = "0"  
DELTA_PLUS = "Interval__C1_CP_STA_CWF_ISR2"  
FIELDNAM = "UT Time"  
FILLVAL = 9999-12-31T23:59:59.999999Z  
LABLAXIS = "UT"  
PARAMETER_TYPE = "Support Data"  
SI_CONVERSION = "1.0>s"  
SIGNIFICANT_DIGITS = 27  
SIZES = "1"  
UNITS = "s"  
VALUE_TYPE = ISO_TIME
```

Originally, the Waveform data are separated in blocks or windows. Each block composed of several measurements (25 in Normal Bit Rate) covers 1s of measurement. The block is time tagged by TED and then split into individual measurements.

- **Half interval** which is half time interval between two samples. Its properties are:

```
CATDESC = "Sampling interval length"  
FIELDNAM = "Sampling interval length"  
FILLVAL = 9.999999  
LABLAXIS = "s"  
PARAMETER_TYPE = "Support_Data"  
SI_CONVERSION = "1.0>s"  
SIGNIFICANT_DIGITS = 7  
UNITS = "s"  
VALUE_TYPE = FLOAT
```

- **Status** which is a word of ASCII characters, each depending on one different factor

```
CATDESC = "STAFF-SC Status"  
DEPEND_0 = Time__C1_CP_STA_CWF_ISR2
```

FIELDNAM = "STAFF-SC Status"
FILLVAL = ZZZZZZZZZZ
LABEL_1 = "Status"
LABLAXIS = "Status"
PARAMETER_TYPE = "Support_Data"
PARAMETER_CAVEATS = "See UG, Appendix C. We cannot certify the 9th character (EFW)"
QUALITY = 1
SIGNIFICANT_DIGITS = 14
SIZES = 1
UNITS = "unitless"
VALUE_TYPE = CHAR

- **Phase_Angle:**

CATDESC = "Phase Angle"
COORDINATE_SYSTEM = "SC"
DEPEND_0 = Time__C1_CP_STA_CWF_ISR2
FIELDNAM = "Phase Angle"
FILLVAL = -500.00
LABEL_1 = "Phase Angle"
LABLAXIS = "Phase Angle"
PARAMETER_TYPE = "Support_Data"
PARAMETER_CAVEATS = "Phase derived from Sun Pulse measurement: can be interpolated, see STATUS"
PARAMETER_TYPE = "Support_Data"
QUALITY = 3
SI_CONVERSION = "0.01745>rad"
SIGNIFICANT_DIGITS = 6
SIZES = 1
UNITS = "degree"
VALUE_TYPE = FLOAT

- **Misalignment_Matrix:**

CATDESC = "C1 transformation from STAFF real instrument frame to the theoretic orthogonal frame linked to the instrument."
COORDINATE_SYSTEM = "Instrument"
DATA = 1.0000, 0.0000, 0.0000, 0.0000, 1.0000, 0.0000, 0.0000, 0.0000, 1.0000
ENTITY = "Transformation"
FIELDNAM = "Misalignment_Matrix"
FILLVAL = 1e30
FRAME = "Instrument"
LABEL_1 = "M1","M2","M3"
PARAMETER_TYPE = "Support_Data"
PROPERTY = "Coordinate_Rotation"
REPRESENTATION_1 = "x","y","z"
REPRESENTATION_2 = "x","y","z"

QUALITY = 0
SI_CONVERSION = "1>unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3,3
TENSOR_ORDER = 2
UNITS = "unitless"
VALUE_TYPE = FLOAT

Data themselves:

- **The Magnetic Field Calibrated WaveForm:**

CATDESC = "Cluster C1, Calibrated Magnetic Field WaveForm"
COORDINATE_SYSTEM = "ISR2"
DEPEND_0 = Time__C1_CP_STA_CWF_ISR2
ENTITY = "Magnetic_Field"
FIELDNAM = "Cluster C1, Calibrated Magnetic Field WaveForm "
FILLVAL = -0.1000E+31
FLUCTUATIONS = "Waveform"
LABEL_1 = "Bx","By","Bz"
LABLAXIS = "Decommutated Magnetic Field Waveform"
PARAMETER_TYPE = "Data"
PROPERTY = "Vector"
QUALITY = 3
REPRESENTATION_1 = "x","y","z"
SI_CONVERSION = "1E9>T"
SIGNIFICANT_DIGITS = 7
SIZES = 3
TENSOR_ORDER = "1"
UNITS = "nT"
VALUE_TYPE = FLOAT

- **BDC_vec_xy_Instrument:**

CATDESC = "Cluster C1, DC Magnetic Field in the spin plane"
COORDINATE_SYSTEM = "ISR2"
DEPEND_0 = Time__C1_CP_STA_CWF_ISR2
ENTITY = "Magnetic_Field"
FIELDNAM = "Cluster C1, DC Magnetic Field"
FILLVAL = -0.1000E+31
FLUCTUATIONS = "Waveform"
LABEL_1 = "BDCx","BDCy"
LABLAXIS = "Calibrated Magnetic Field Waveform"
PARAMETER_TYPE = "Data"
PROPERTY = "Vector"
QUALITY = 3
REPRESENTATION_1 = "x","y"
SI_CONVERSION = "1E9>T"

SIGNIFICANT_DIGITS = 7
SIZES = 2
TENSOR_ORDER = 1
UNITS = "nT"
VALUE_TYPE = FLOAT

3.2.8 File Metadata Specification

Each file contains the following **file metadata** keywords (example is shown for a full day file on 1 October 2001):

3.2.8.1 GSE

FILE_NAME = C1_CP_STA_CWF_GSE__20011001_V01.cef
FILE_FORMAT_VERSION = "CEF-2.0"
FILE_TYPE = "cef"
DATASET_VERSION = "01"
LOGICAL_FILE_ID = "C1_CP_STA_CWF_GSE__20011001_V01"
VERSION_NUMBER = "01"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
FILE_TIME_SPAN="2001-10-01T00:00:00.000000Z/2001-10-01T23:59:59.999999Z"
GENERATION_DATE = "2013-05-21T18:57:32.000Z"
FILE_CAVEATS = "Produced from DWF"
"TED version 2.5.0.109"
"TCOR option yes"
"Produced using software RCL V1.8"
"Calibration tables: feb 2013"
"Kernel size :4096 for HBR and 1024 for NBR"
"Shift size : 2 for HBR and 2 for NBR"
"Cutoff frequency : 0.60"
"Measurement time : 2001-10-01T21:45:38Z"
"Spin axis direction in GEI : 1.0, -67.09, 74.54"
"Spin period : 4.0234250"
"Mass center : 0.0001, 0.7609, -0.0001"
"Euler angles (degree): 0.00, 0.06"

3.2.8.2 ISR2

FILE_NAME = C1_CP_STA_CWF_ISR2__20011001_V01.cef
FILE_FORMAT_VERSION = "CEF-2.0"
FILE_TYPE = "cef"

```
DATASET_VERSION = "01"
LOGICAL_FILE_ID = "C1_CP_STA_CWF_ISR2__20011001_V01"
VERSION_NUMBER = "01"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
FILE_TIME_SPAN      =          "2001-10-01T00:00:00.000000Z/2001-10-01T23:59:59.999999Z"
GENERATION_DATE = "2014-02-12T19:42:11.000Z"
FILE_CAVEATS = "Produced from DWF"
                "TED version 2.5.0.109"
                "TCOR option yes"
                "Produced using software RCL V2.0"
                "Calibration tables: feb 2013"
                "Kernel size :4096 for HBR and 1024 for NBR"
                "Shift size : 2 for HBR and 2 for NBR"
                "Cutoff frequency : 0.10"
                "Measurement time : 2001-10-01T21:45:38Z"
                "Spin axis direction in GEI : 1.0, -67.09, 74.54"
                "Spin period : 4.0234250"
                "Mass center : 0.0001, 0.7609, -0.0001"
                "Euler angles (degree): 0.00, 0.06"
```

3.2.9 Dataset header example

3.2.9.1 GSE

Ex : C1_CH_STA_CWF_GSE.ceh

```
! CEH VALIDATION 03 Dec 2019 by LPP, header V11 (RK)
!
START_META = DATASET_ID
  ENTRY = "C1_CP_STA_CWF_GSE"
END_META = DATASET_ID
!
START_META = DATA_TYPE
  ENTRY = "CP"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
  ENTRY = "Magnetic Field Waveform - calibrated"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
  ENTRY = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
  ENTRY = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
  ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
  ENTRY = "This dataset contains measurements of the magnetic field"
  ENTRY = "Calibrated WaveForm (CWF) from the STAFF-SC instrument"
  ENTRY = "in NBR mode (filtered from 0.6Hz to 10Hz and sampled at 25Hz) and"
  ENTRY = "in HBR mode (filtered from 0.6Hz to 180Hz and sampled at 450Hz)"
  ENTRY = "on the Cluster C1 spacecraft. This product is given in the GSE frame."
```



```
LABLAXIS = "s"
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.0>s"
SIGNIFICANT_DIGITS = 7
UNITS = "s"
VALUE_TYPE = FLOAT
DEPEND_0 = Time__C1_CP_STA_CWF_GSE
END_VARIABLE = Interval__C1_CP_STA_CWF_GSE
!
START_VARIABLE = Status__C1_CP_STA_CWF_GSE
CATDESC = "STAFF-SC Status"
DEPEND_0 = Time__C1_CP_STA_CWF_GSE
FIELDNAM = "STAFF-SC Status"
FILLVAL = "ZZZZZZZZZZZZZZ"
LABEL_1 = "Status"
LABLAXIS = "Status"
PARAMETER_CAVEATS = "See UG, Appendix C. We cannot certify the 9th character (EFW)"
PARAMETER_TYPE = "Support_Data"
QUALITY = 1
SIGNIFICANT_DIGITS = 14
SIZES = 1
UNITS = "unitless"
VALUE_TYPE = CHAR
END_VARIABLE = Status__C1_CP_STA_CWF_GSE
!
START_VARIABLE = Phase_Angle__C1_CP_STA_CWF_GSE
CATDESC = "Phase Angle"
COORDINATE_SYSTEM = "SC"
DEPEND_0 = Time__C1_CP_STA_CWF_GSE
FIELDNAM = "Phase Angle"
FILLVAL = -500.00
LABEL_1 = "Phase Angle"
LABLAXIS = "Phase Angle"
PARAMETER_CAVEATS = "Phase derived from Sun Pulse measurement: can be interpolated, see
STATUS"
PARAMETER_TYPE = "Support_Data"
QUALITY = 3
SI_CONVERSION = "0.01745>rad"
SIGNIFICANT_DIGITS = 6
SIZES = 1
UNITS = "degree"
VALUE_TYPE = FLOAT
END_VARIABLE = Phase_Angle__C1_CP_STA_CWF_GSE
!
START_VARIABLE = B_vec_xyz_Instrument__C1_CP_STA_CWF_GSE
CATDESC = "Cluster C1, Calibrated Magnetic Field WaveForm"
COORDINATE_SYSTEM = "GSE"
DEPEND_0 = Time__C1_CP_STA_CWF_GSE
ENTITY = "Magnetic_Field"
FIELDNAM = "Cluster C1, Calibrated Magnetic Field WaveForm"
FILLVAL = -0.1000E+31
FLUCTUATIONS = "Waveform"
LABEL_1 = "Bx", "By", "Bz"
LABLAXIS = "Calibrated Magnetic Field Waveform"
PARAMETER_TYPE = "Data"
PROPERTY = "Vector"
QUALITY = 3
REPRESENTATION_1 = "x", "y", "z"
SI_CONVERSION = "1E-9>T"
SIGNIFICANT_DIGITS = 7
SIZES = 3
TENSOR_ORDER = 1
UNITS = "nT"
VALUE_TYPE = FLOAT
END_VARIABLE = B_vec_xyz_Instrument__C1_CP_STA_CWF_GSE
!
START_VARIABLE = Misalignment_Matrix__C1_CP_STA_CWF_GSE
CATDESC = "C1 transformation from STAFF real instrument frame to the theoretic
orthogonal frame linked to the instrument."
COORDINATE_SYSTEM = "Instrument"
```

```
DATA = 1.0000, 0.0000, 0.0000, 0.0000, 1.0000, 0.0000, 0.0000, 0.0000, 1.0000
ENTITY = "Transformation"
FIELDNAM = "Misalignment_Matrix"
FILLVAL = 1.E30
FRAME = "Instrument"
LABEL_1 = "M1", "M2", "M3"
PARAMETER_TYPE = "Support_Data"
PROPERTY = "Coordinate_Rotation"
QUALITY = 0
REPRESENTATION_1 = "x", "y", "z"
REPRESENTATION_2 = "x", "y", "z"
SI_CONVERSION = "1>unitless"
SIGNIFICANT_DIGITS = 5
SIZES = 3, 3
TENSOR_ORDER = 2
UNITS = "unitless"
VALUE TYPE = FLOAT
END_VARIABLE = Misalignment_Matrix_C1_CP_STA_CWF_GSE
!
```

3.2.9.2 ISR2

Ex : C1_CP_STA_CWF_ISR2.ceh

```
! CEH VALIDATION 03 Dec 2019 by LPP, header V11 (RK)
!
START_META = DATASET_ID
ENTRY = "C1_CP_STA_CWF_ISR2"
END_META = DATASET_ID
!
START_META = DATA_TYPE
ENTRY = "CP"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
ENTRY = "Magnetic Field Waveform - calibrated"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
ENTRY = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
ENTRY = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
ENTRY = "This dataset contains measurements of the magnetic field"
ENTRY = "Calibrated WaveForm (CWF) from the STAFF-SC instrument"
ENTRY = "in NBR mode (filtered from 0.1Hz to 10Hz and sampled at 25Hz) and"
ENTRY = "in HBR mode (filtered from 0.1Hz to 180Hz and sampled at 450Hz) and"
ENTRY = "DC magnetic field components in the spin plane BDCx, BDCy, on the"
ENTRY = "Cluster C1 spacecraft. This product is given in the ISR2 frame."
ENTRY = "Data calibration is performed using a moving window of 1024 points in NBR mode"
ENTRY = "and 4096 points in HBR mode."
ENTRY = "These values were chosen as the best compromise for routine production."
ENTRY = "For further details, please refer to the STAFF Calibration Report."
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
ENTRY = "Waveform"
ENTRY = "Magnetic_Field"
END_META = DATASET_TYPE
!
START_META = PROCESSING_LEVEL
ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL
```



```
LABEL_1 = "Status"
LABLAXIS = "Status"
PARAMETER_CAVEATS = "See UG, Appendix C. We cannot certify the 9th character (EFW)"
PARAMETER_TYPE = "Support_Data"
QUALITY = 1
SIGNIFICANT_DIGITS = 14
SIZES = 1
UNITS = "unitless"
VALUE_TYPE = CHAR
END_VARIABLE = Status__C1_CP_STA_CWF_ISR2
!
START_VARIABLE = Phase_Angle__C1_CP_STA_CWF_ISR2
CATDESC = "Phase Angle"
COORDINATE_SYSTEM = "SC"
DEPEND_0 = Time__C1_CP_STA_CWF_ISR2
FIELDNAM = "Phase Angle"
FILLVAL = -500.00
LABEL_1 = "Phase Angle"
LABLAXIS = "Phase Angle"
PARAMETER_CAVEATS = "Phase derived from Sun Pulse measurement: can be interpolated, see
STATUS"
PARAMETER_TYPE = "Support_Data"
QUALITY = 3
SI_CONVERSION = "0.01745>rad"
SIGNIFICANT_DIGITS = 6
SIZES = 1
UNITS = "degree"
VALUE_TYPE = FLOAT
END_VARIABLE = Phase_Angle__C1_CP_STA_CWF_ISR2
!
START_VARIABLE = B_vec_xyz_Instrument__C1_CP_STA_CWF_ISR2
CATDESC = "Cluster C1, Calibrated Magnetic Field WaveForm"
COORDINATE_SYSTEM = "ISR2"
DEPEND_0 = Time__C1_CP_STA_CWF_ISR2
ENTITY = "Magnetic_Field"
FIELDNAM = "Cluster C1, Calibrated Magnetic Field WaveForm"
FILLVAL = -0.1000E+31
FLUCTUATIONS = "Waveform"
LABEL_1 = "Bx","By","Bz"
LABLAXIS = "Calibrated Magnetic Field Waveform"
PARAMETER_TYPE = "Data"
PROPERTY = "Vector"
QUALITY = 3
REPRESENTATION_1 = "x","y","z"
SI_CONVERSION = "1E-9>T"
SIGNIFICANT_DIGITS = 7
SIZES = 3
TENSOR_ORDER = 1
UNITS = "nT"
VALUE_TYPE = FLOAT
END_VARIABLE = B_vec_xyz_Instrument__C1_CP_STA_CWF_ISR2
!
START_VARIABLE = BDC_vec_xy_Instrument__C1_CP_STA_CWF_ISR2
CATDESC = "Cluster C1, DC Magnetic Field in the spin plane"
COORDINATE_SYSTEM = "ISR2"
DEPEND_0 = Time__C1_CP_STA_CWF_ISR2
ENTITY = "Magnetic_Field"
FIELDNAM = "Cluster C1, DC Magnetic Field"
FILLVAL = -0.1000E+31
FLUCTUATIONS = "Waveform"
LABEL_1 = "BDCx","BDCy"
LABLAXIS = "Calibrated Magnetic Field Waveform"
PARAMETER_TYPE = "Data"
PROPERTY = "Vector"
QUALITY = 3
REPRESENTATION_1 = "x","y"
SI_CONVERSION = "1E-9>T"
SIGNIFICANT_DIGITS = 7
SIZES = 2
TENSOR_ORDER = 1
```




```

END_META = LOGICAL_FILE_ID
!
START_META = VERSION_NUMBER
  ENTRY = "01"
END_META = VERSION_NUMBER
!
START_META = METADATA_TYPE
  ENTRY = "CAA"
END_META = METADATA_TYPE
!
START_META = METADATA_VERSION
  ENTRY = "2.0"
END_META = METADATA_VERSION
!
START_META = FILE_TIME_SPAN
  VALUE_TYPE = ISO_TIME_RANGE
  ENTRY = "2001-01-04T00:00:00.000000Z/2001-01-04T23:59:59.999999Z"
END_META = FILE_TIME_SPAN
!
START_META = GENERATION_DATE
  VALUE_TYPE = ISO_TIME
  ENTRY = "2013-05-21T16:14:40.000Z"
END_META = GENERATION_DATE
!
START_META = FILE_CAVEATS
  ENTRY = "Produced from DWF"
  ENTRY = "TED version 2.5.0.109"
  ENTRY = "TCOR option yes"
  ENTRY = "Produced using software RCL V1.8"
  ENTRY = "Calibration tables: feb 2013"
  ENTRY = "Kernel size :4096 for HBR and 1024 for NBR"
  ENTRY = "Shift size : 2 for HBR and 2 for NBR"
  ENTRY = "Cutoff frequency : 0.60"
  ENTRY = "Measurement time : 2001-01-04T08:40:03Z"
  ENTRY = "Spin axis direction in GEI : 1.0, -60.89, 94.55"
  ENTRY = "Spin period : 4.0016010"
  ENTRY = "Mass center : 0.0001, 0.7613, -0.0001"
  ENTRY = "Euler angles (degree): 0.00, 0.03"
END_META = FILE_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
!                                     Data      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
DATA_UNTIL = "END_OF_FILE"
2001-01-04T07:20:31.193286Z,0.040000,0000000000000000, 132.42, 0.427755E+00, 0.173744E+00,
0.372376E+00
2001-01-04T07:20:31.233285Z,0.040000,0000000000000000, 136.02, 0.491170E+00, 0.284578E+00,
0.411116E+00
2001-01-04T07:20:31.273284Z,0.040000,0000000000000000, 139.62, 0.467615E+00, 0.336600E+00,
0.483392E+00
2001-01-04T07:20:31.313283Z,0.040000,0000000000000000, 143.22, 0.476545E+00, 0.403262E+00,
0.457924E+00
2001-01-04T07:20:31.353283Z,0.040000,0000000000000000, 146.82, 0.487804E+00, 0.432446E+00,
0.347283E+00
2001-01-04T07:20:31.393282Z,0.040000,0000000000000000, 150.42, 0.373381E+00, 0.387527E+00,
0.331519E+00
2001-01-04T07:20:31.433281Z,0.040000,0000000000000000, 154.01, 0.180476E+00, 0.294348E+00,
0.323333E+00

```



```
ENTRY = "Cutoff frequency : 0.10"
ENTRY = "Measurement time : 2001-01-04T08:40:03Z"
ENTRY = "Spin axis direction in GEI : 1.0, -60.89, 94.55"
ENTRY = "Spin period : 4.0016010"
ENTRY = "Mass center : 0.0001, 0.7613, -0.0001"
ENTRY = "Euler angles (degree): 0.00, 0.03"
END_META = FILE_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
! Data !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
DATA_UNTIL = "END_OF_FILE"
2001-01-04T07:20:31.193286Z,0.040000,0000000000000000, 132.42,-0.173573E+01, 0.190039E+01,
0.435648E+01,-0.348259E+01, 0.308837E+02
2001-01-04T07:20:31.233285Z,0.040000,0000000000000000, 136.02,-0.169945E+01, 0.186909E+01,
0.429633E+01,-0.348259E+01, 0.308837E+02
2001-01-04T07:20:31.273284Z,0.040000,0000000000000000, 139.62,-0.171817E+01, 0.175526E+01,
0.426840E+01,-0.348494E+01, 0.308941E+02
2001-01-04T07:20:31.313283Z,0.040000,0000000000000000, 143.22,-0.170524E+01, 0.163077E+01,
0.412183E+01,-0.348494E+01, 0.308941E+02
```

3.3 Level 2 data - SC - Complex Spectra (CS)

3.3.1 Format: CEF

3.3.2 Standard: cf 2.2.

3.3.3 Production Procedure: cf 2.3.1.

3.3.4 Quality Control Procedure: cf 2.4.1.

3.3.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.3.6 Product Specification

One CEF file per day, per satellite and per mode (HBR or NBR) is produced. This CEF file contains calibrated Complex Spectra (CS) of the magnetic field measured by STAFF-SC from 0.00Hz to 12.40Hz (0.00Hz to 224.90Hz) with a frequency/time resolution of 0.097658Hz x 10.24s (0.109866Hz x 9.10s), in NBR mode (in HBR mode) and filtered at 0.6Hz for GSE data.

Complex_Spectrum__C1_CP_STA_CS_NBR/HBR is a complex variable defined for x, y and z components (where C1 stands for satellite 1 in this example); they are given in nT units.

This variable is sampled for 128/2048 (NBR/HBR mode) frequencies described in Frequency__C1_CP_STA_CS_NBR/HBR (given in Hz).

DATA are given in GSE coordinate system.

3.3.7 Dataset metadata description

3.3.7.1 NBR mode

The detached dataset header is called: **C1/C2/C3/C4_CH_STA_CS_NBR.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

Example of the **global metadata** keywords for C1_CP_STA_CS_NBR are:

```
DATASET_ID="C1_CP_STA_CS_NBR"
```

```
DATA_TYPE = "CP"
```

```
DATASET_TITLE = "Magnetic Field Spectra in GSE (up to 12.5 Hz"
```

```
CONTACT_COORDINATES =
```

```
  "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
```

```
  "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
```

```
  "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
```

```
DATASET_DESCRIPTION = "This dataset contains calibrated Complex Spectra (CS) of the magnetic field measured by STAFF-SC from 0.1Hz to 12.5Hz with a resolution of 0.097659Hz x 10.24s, in NBR mode on the Cluster C1 spacecraft. This product is given in Geocentric Solar Ecliptic (GSE) coordinate system. Data calibration is performed using a moving window of 256 points in NBR mode. This value was chosen as the best compromise for routine production. For further details, please refer to the STAFF Calibration Report."
```

```
DATASET_TYPE = "Spectra"
```

```
  "Magnetic_Field"
```

```
PROCESSING_LEVEL = "Calibrated"
```

```
ACKNOWLEDGEMENT = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."
```

```
  "Digital Object Identifier for the STAFF archive:  
doi.org/10.5270/esa-yrzyijm"
```

```
TIME_RESOLUTION = 0.1024E+02
```

```
MIN_TIME_RESOLUTION, same as time resolution
```

MAX_TIME_RESOLUTION, same as time resolution

DATASET_CAVEATS =

"*C1_CQ_STA_CALIB_YTR_CAVEATS"

"*C1_CQ_STA_NOTSRP_MTR_CAVEATS"

"Data are filtered at 0.6Hz. "

"All data below this value are not relevant and must not be used."

"DATASET VERSION HISTORY"

"Version 07 : Removal of on-board calibration records is now based on the calibration bit (instead of the step-in-cal character)."

"Version 06 : Rare corrected re-deliveries."

"Version 05 : Minor corrections."

"Version 04 : The 10% error is corrected (new transfer function - Nov 2011)."

"Onboard calibration data are removed. When there is no Sun pulse, there is now a fill value in the data."

"All versions inferior to 4: the transfer function of S/C #1 has 10% of error with all the other spacecraft up to 7Hz."

"Version 03 : All the headers have been updated (laboratory name and email). Introduction of a new header file (Dataset). "

"The data were time tagged using TED version 2.5.0 with option TCOR active(provided by the Sheffield DWP Group)."

"Complex_Spectrum__C1_CP_STA_CS_NBR SI_CONVERSION has been corrected."

"Version 02 : "

"Complex_Spectrum__C1_CP_STA_CS_NBR unit has been corrected."

"Warning: the corresponding SI_CONVERSION was set to 1.E9 instead of 1.E-9."

"Older versions should not be used !"

"Version 01 : Obsolete. Should not be used !"

Then, the metadata for the **Support variables** are:

- **Time_tags_C1_CP_STA_CS_NBR** which the ISO time of data acquisition (Universal Time):

PARAMETER_TYPE = "Support_Data"

CATDESC = "Time tag"

UNITS = "s"

SI_CONVERSION = "1.0>s"

SIZES = 1

DELTA_PLUS = 0.1024E+02

DELTA_MINUS = 0.0000E+00

VALUE_TYPE = ISO_TIME

SIGNIFICANT_DIGITS = 27

FILLVAL = 9999-12-31T23:59:59.999999Z

FIELDNAM = "UT Time"

LABLAXIS = "UT"

- **Frequency** represents the 128 frequency bin centres regularly spaces expressed in Hz. The zero frequency is not significant. The frequency resolution is $0.1024E+02$:

PARAMETER_TYPE = "Support_Data"

CATDESC = "Frequency Bin"

UNITS = "Hz"

SI_CONVERSION = "1.0>Hz"

SIZES = 128

DELTA_PLUS = $0.4883E-01$

DELTA_MINUS = $0.4883E-01$

VALUE_TYPE = FLOAT

SIGNIFICANT_DIGITS = 4

FILLVAL = $-0.1000E+31$

FIELDNAM = "Frequency"

LABLAXIS = "F"

SCALETYP = "Linear"

DATA = $0.0000E+00$, $0.9766E-01$, $0.1953E+00$, $0.2930E+00$,
 $0.3906E+00$, $0.4883E+00$, $0.5860E+00$, $0.6836E+00$,
 $0.7813E+00$, $0.8789E+00$, $0.9766E+00$, $0.1074E+01$,
 $0.1172E+01$, $0.1270E+01$, $0.1367E+01$, $0.1465E+01$,
 $0.1563E+01$, $0.1660E+01$, $0.1758E+01$, $0.1856E+01$,
 $0.1953E+01$, $0.2051E+01$, $0.2148E+01$, $0.2246E+01$,
 $0.2344E+01$, $0.2441E+01$, $0.2539E+01$, $0.2637E+01$,
 $0.2734E+01$, $0.2832E+01$, $0.2930E+01$, $0.3027E+01$,
 $0.3125E+01$, $0.3223E+01$, $0.3320E+01$, $0.3418E+01$,
 $0.3516E+01$, $0.3613E+01$, $0.3711E+01$, $0.3809E+01$,
 $0.3906E+01$, $0.4004E+01$, $0.4102E+01$, $0.4199E+01$,
 $0.4297E+01$, $0.4395E+01$, $0.4492E+01$, $0.4590E+01$,
 $0.4688E+01$, $0.4785E+01$, $0.4883E+01$, $0.4981E+01$,
 $0.5078E+01$, $0.5176E+01$, $0.5274E+01$, $0.5371E+01$,
 $0.5469E+01$, $0.5567E+01$, $0.5664E+01$, $0.5762E+01$,
 $0.5860E+01$, $0.5957E+01$, $0.6055E+01$, $0.6152E+01$,
 $0.6250E+01$, $0.6348E+01$, $0.6445E+01$, $0.6543E+01$,
 $0.6641E+01$, $0.6738E+01$, $0.6836E+01$, $0.6934E+01$,
 $0.7031E+01$, $0.7129E+01$, $0.7227E+01$, $0.7324E+01$,
 $0.7422E+01$, $0.7520E+01$, $0.7617E+01$, $0.7715E+01$,
 $0.7813E+01$, $0.7910E+01$, $0.8008E+01$, $0.8106E+01$,
 $0.8203E+01$, $0.8301E+01$, $0.8399E+01$, $0.8496E+01$,
 $0.8594E+01$, $0.8692E+01$, $0.8789E+01$, $0.8887E+01$,
 $0.8985E+01$, $0.9082E+01$, $0.9180E+01$, $0.9278E+01$,
 $0.9375E+01$, $0.9473E+01$, $0.9571E+01$, $0.9668E+01$,
 $0.9766E+01$, $0.9863E+01$, $0.9961E+01$, $0.1006E+02$,
 $0.1016E+02$, $0.1025E+02$, $0.1035E+02$, $0.1045E+02$,
 $0.1055E+02$, $0.1064E+02$, $0.1074E+02$, $0.1084E+02$,
 $0.1094E+02$, $0.1104E+02$, $0.1113E+02$, $0.1123E+02$,

0.1133E+02, 0.1143E+02, 0.1152E+02, 0.1162E+02,
0.1172E+02, 0.1182E+02, 0.1191E+02, 0.1201E+02,
0.1211E+02, 0.1221E+02, 0.1230E+02, 0.1240E+02

Data themselves:

- **Complex_spectrum_C1_CP_STA_CS_NBR** variable stores the components of the Magnetic Field Complex Spectrum.

PARENT_DATASET_ID = "C1_CP_STA_CS_NBR"

PARAMETER_TYPE = "Data"

CATDESK = "Components of the Magnetic Field Complex Spectrum"

ENTITY = "Magnetic_Field"

PROPERTY = "Vector"

UNITS = "nT"

SI_CONVERSION = "1.E-9>T"

TENSOR_ORDER = 1

COORDINATE_SYSTEM = "GSE"

FRAME = "GSE>xyz"

TENSOR_FRAME = "GSE"

SIZES = 128,2,3 ! 128 frequency bins x 2 (Re.+Im.) parts

DEPEND_0 = Time__C1_CP_STA_CS_NBR

DEPEND_1 = Frequency__C1_CP_STA_CS_NBR

REPRESENTATION_2 = "x","y","z"

LABEL_2 = "x","y","z"

LABEL_3 = "Re","Im"

VALUE_TYPE = FLOAT

SIGNIFICANT_DIGITS = 4

FILLVAL = -0.1000E+31

QUALITY = 0

FIELDNAM = "Magnetic Field Complex Spectrum"

LABLAXIS = "Magnetic Field Complex Spectrum"

3.3.7.2 HBR mode

The detached dataset header is called: **C1/C2/C3/C4_CH_STA_CS_HBR.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

Example of the **global metadata** keywords for C1_CP_STA_CS_HBR are:

DATASET_ID="C1_CP_STA_CS_HBR"

DATA_TYPE = "CP"

DATASET_TITLE = "Magnetic Field Spectra in GSE (burst; up to 225 Hz)"

CONTACT_COORDINATES =

"Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"

"Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"

"Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"

DATASET_DESCRIPTION = "This dataset contains calibrated Complex Spectra (CS) of the magnetic field measured by STAFF-SC from 0.1Hz to 225Hz with a resolution of 0.109866Hz x 9.10s, in HBR mode on the Cluster C1 spacecraft. This product is given in Geocentric Solar Ecliptic (GSE) coordinate system. Data calibration is performed using a moving window of 4096 points in HBR mode. This value was chosen as the best compromise for routine production. For further details, please refer to the STAFF Calibration Report."

DATASET_TYPE = "Spectra"
 "Magnetic_Field"

PROCESSING_LEVEL = "Calibrated"

TIME_RESOLUTION = 0.9102E+01

MIN_TIME_RESOLUTION, same as time resolution

MAX_TIME_RESOLUTION, same as time resolution

DATASET_CAVEATS =

 "*C1_CQ_STA_CALIB_YTR_CAVEATS"

 "*C1_CQ_STA_NOTSRP_MTR_CAVEATS"

 "Data are filtered at 0.6Hz. "

 "All data below this value are not relevant and must not be used."

 "DATASET VERSION HISTORY"

 "Version 07 : Removal of on-board calibration records is now based on the calibration bit (instead of the step-in-cal character)."

 "Version 06 : Rare corrected re-deliveries."

 "Version 05 : Minor corrections."

 "Version 04 : The 10% error is corrected (new transfer function - Nov 2011)."

 "Onboard calibration data are removed. When there is no Sun pulse, there is now a fill value in the data."

 "All versions inferior to 4: the transfer function of S/C #1 has 10% of error with all the other spacecraft up to 7Hz."

 "Version 03 : All the headers have been updated (laboratory name and email). Introduction of a new header file (Dataset). "

 "The data were time tagged using TED version 2.5.0 with option TCOR active (provided by the Sheffield DWP Group)."

 "Complex_Spectrum__C1_CP_STA_CS_HBR_SI_CONVERSION has been corrected."

 "Version 02 : "

 "Complex_Spectrum__C1_CP_STA_CS_HBR unit has been corrected."

 "Warning: the corresponding SI_CONVERSION was set to 1.E9 instead of 1.E-9."

 "Older versions should not be used !"

 "Version 01 : Obsolete. Should not be used !"

Then, the metadata for the **Support variables** are:

- **Time_tags_C1/C2/C3/C4_CP_STA_CS_HBR** which the ISO time of data acquisition (Universal Time):
PARAMETER_TYPE = "Support_Data"
CATDESC = "Time tag"
UNITS = "s"
SI_CONVERSION = "1.0>s"
SIZES = 1
DELTA_PLUS = 0.9102E+01
DELTA_MINUS = 0.0000E+00
VALUE_TYPE = ISO_TIME
SIGNIFICANT_DIGITS = 27
FILLVAL = 9999-12-31T23:59:59.999999Z
FIELDNAM = "UT Time"
LABLAXIS = "UT"
- **Frequency** represents the 128 frequency bin centres regularly spaces expressed in Hz. The zero frequency is not significant. The frequency resolution is 0.1024E+02:
PARENT_DATASET_ID = "C1_CP_STA_CS_HBR"
PARAMETER_TYPE = "Support_Data"
CATDESC = "Frequency Bin"
UNITS = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES = 2048
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 4
FILLVAL = -0.1000E+31
FIELDNAM = "Frequency"
LABLAXIS = "F"
SCALETYP = "Linear"
DATA = 0.0000E+00, 0.1099E+00, 0.2197E+00, 0.3296E+00, \
0.4395E+00, 0.5493E+00, 0.6592E+00, 0.7691E+00, \
0.8789E+00, 0.9888E+00, 0.1099E+01, 0.1209E+01, \
0.1318E+01, 0.1428E+01, 0.1538E+01, 0.1648E+01, \
0.1758E+01, 0.1868E+01, 0.1978E+01, 0.2087E+01, \
0.2197E+01, 0.2307E+01, 0.2417E+01, 0.2527E+01, \
0.2637E+01, 0.2747E+01, 0.2857E+01, 0.2966E+01, \
0.3076E+01, 0.3186E+01, 0.3296E+01, 0.3406E+01, \
0.3516E+01, 0.3626E+01, 0.3735E+01, 0.3845E+01, \
0.3955E+01, 0.4065E+01, 0.4175E+01, 0.4285E+01, \
0.4395E+01, 0.4505E+01, 0.4614E+01, 0.4724E+01, \
0.4834E+01, 0.4944E+01, 0.5054E+01, 0.5164E+01, \
0.5274E+01, 0.5383E+01, 0.5493E+01, 0.5603E+01, \

```
0.5713E+01, 0.5823E+01, 0.5933E+01, 0.6043E+01, \  
0.6152E+01, 0.6262E+01, 0.6372E+01, 0.6482E+01, \  
0.6592E+01, 0.6702E+01, 0.6812E+01, 0.6922E+01, \  
0.7031E+01, 0.7141E+01, 0.7251E+01, 0.7361E+01, \  
0.7471E+01, 0.7581E+01, 0.7691E+01, 0.7800E+01, \  
0.7910E+01, 0.8020E+01, 0.8130E+01, 0.8240E+01, \  
0.8350E+01, 0.8460E+01, 0.8570E+01, 0.8679E+01, \  
0.8789E+01, 0.8899E+01, 0.9009E+01, 0.9119E+01, \  
0.9229E+01, 0.9339E+01, 0.9448E+01, 0.9558E+01, \  
...
```

Data themselves:

- **Complex_spectrum_C1_CP_STA_CS_HBR** variable stores the components of the Magnetic Field Complex Spectrum.

PARENT_DATASET_ID = "C1_CP_STA_CS_HBR"

PARAMETER_TYPE = "Data"

CATDESK = "Components of the Magnetic Field Complex Spectrum"

ENTITY = "Magnetic_Field"

PROPERTY = "Vector"

UNITS = "nT"

SI_CONVERSION = "1.E-9>T"

TENSOR_ORDER = 1

COORDINATE_SYSTEM = "GSE"

FRAME = "GSE>xyz"

TENSOR_FRAME = "GSE"

SIZES = 2048,2,3 ! 128 frequency bins x 2 (Re.+Im.) parts

DEPEND_0 = Time__C1_CP_STA_CS_HBR

DEPEND_1 = Frequency__C1_CP_STA_CS_HBR

REPRESENTATION_2 = "x","y","z"

LABEL_2 = "x","y","z"

LABEL_3 = "Re","Im"

VALUE_TYPE = FLOAT

SIGNIFICANT_DIGITS = 4

FILLVAL = -0.1000E+31

QUALITY = 0

FIELDNAM = "Magnetic Field Complex Spectrum"

LABLAXIS = "Magnetic Field Complex Spectrum"

3.3.8 File Metadata Specification

3.3.8.1 NBR mode

Each file contains the following **file metadata** keywords (example is shown for a full day file on 1 October 2001):

```
FILE_NAME = C1_CP_STA_CS_NBR__20011001_V05.cef
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
FILE_TYPE = "cef"
DATASET_VERSION = "05"
LOGICAL_FILE_ID = "C1_CP_STA_CS_NBR__20011001_V05"
VERSION_NUMBER = "05"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
GENERATION_DATE = "2013-10-21T18:53:37.000Z"
FILE_TIME_SPAN = 2001-10-01T00:00:00.000Z/2001-04-15T23:59:59.999Z
FILE_CAVEATS = "Produced using software RCL V2.0"
                "TED version 2.5.0.109"
                "TCOR option yes"
                "Calibration tables: 14 nov 2011"
                "Kernel size :256"
                "Shift size :256"
"Cutoff frequency : 0.60"
```

3.3.8.2 HBR mode

Each file contains the following **file metadata** keywords (example is shown for a full day file on 1 October 2001):

```
FILE_NAME = C1_CP_STA_CS_HBR__20011001_V05.cef
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
FILE_TYPE = "cef"
DATASET_VERSION = "05"
LOGICAL_FILE_ID = "C1_CP_STA_CS_HBR__20011001_V05"
VERSION_NUMBER = "05"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
GENERATION_DATE = "2013-10-21T13:39:39.000Z"
FILE_TIME_SPAN = 2001-10-01T00:00:00.000Z/2001-04-15T23:59:59.999Z
FILE_CAVEATS = "Produced using software RCL V2.0"
                "TED version 2.5.0.109"
                "TCOR option yes"
                "Calibration tables: 14 nov 2011"
                "Kernel size :4096"
                "Shift size :4096"
                "Cutoff frequency : 0.60"
```

3.3.9 Dataset header example

3.3.9.1 NBR mode

Ex : C1_CH_STA_CS_NBR.ceh

```
! CEH VALIDATION 13 May 2019 by LPP, V08 (RK)
!
START_META = DATASET_ID
  ENTRY = "C1_CP_STA_CS_NBR"
END_META = DATASET_ID
!
START_META = DATA_TYPE
  ENTRY = "CP"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
  ENTRY = "Magnetic Field Spectra in GSE (up to 12.5 Hz)"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
  ENTRY = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
  ENTRY = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
  ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
  ENTRY = "This dataset contains calibrated Complex Spectra (CS) of the magnetic field"
  ENTRY = "measured by STAFF-SC from 0.1Hz to 12.5Hz with a resolution of"
  ENTRY = "0.097659Hz x 10.24s, in NBR mode on the Cluster C1 spacecraft."
  ENTRY = "This product is given in Geocentric Solar Ecliptic (GSE) coordinate system."
  ENTRY = "Data calibration is performed using a moving window of 256 points in NBR mode."
  ENTRY = "This value was chosen as the best compromise for routine production."
  ENTRY = "For further details, please refer to the STAFF Calibration Report."
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
  ENTRY = "Spectra"
  ENTRY = "Magnetic Field"
END_META = DATASET_TYPE
!
START_META = PROCESSING_LEVEL
  ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
  ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication"
  ENTRY = "based upon use of this data."
  ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
END_META = ACKNOWLEDGEMENT
!
START_META = TIME_RESOLUTION
  VALUE_TYPE = FLOAT
  ENTRY = 0.1024E+02
END_META = TIME_RESOLUTION
!
START_META = MIN_TIME_RESOLUTION
  VALUE_TYPE = FLOAT
  ENTRY = 0.1024E+02
END_META = MIN_TIME_RESOLUTION
!
START_META = MAX_TIME_RESOLUTION
  VALUE_TYPE = FLOAT
  ENTRY = 0.1024E+02
END_META = MAX_TIME_RESOLUTION
!
```

```

START_META = DATASET_CAVEATS
ENTRY = "*C1_CO_STA_CALIB_YTR_CAVEATS"
ENTRY = "*C1_CO_STA_NOTSRP_MTR_CAVEATS"
ENTRY = "Data are filtered at 0.6Hz. "
ENTRY = "All data below this value are not relevant and must not be used."
ENTRY = "DATASET VERSION HISTORY"
ENTRY = "Version 07 : Removal of on-board calibration records is now based on"
ENTRY = "the calibration bit (instead of the step-in-cal character)."
```

... (omitted entries) ...

```

END_META = DATASET_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                 Variables !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!

START_VARIABLE = Time_C1_CP_STA_CS_NBR
PARENT_DATASET_ID = "C1_CP_STA_CS_NBR"
PARAMETER_TYPE = "Support Data"
CATDESC = "Time tag"
UNITS = "s"
SI_CONVERSION = "1.0>s"
SIZES = 1
DELTA_PLUS = 0.1024E+02
DELTA_MINUS = 0.0000E+00
VALUE_TYPE = ISO_TIME
SIGNIFICANT_DIGITS = 27
FILLVAL = 9999-12-31T23:59:59.999999Z
FIELDNAM = "UT Time"
LABLAXIS = "UT"
END_VARIABLE = Time_C1_CP_STA_CS_NBR
!

START_VARIABLE = Frequency_C1_CP_STA_CS_NBR
PARENT_DATASET_ID = "C1_CP_STA_CS_NBR"
PARAMETER_TYPE = "Support Data"
CATDESC = "Frequency Bin"
UNITS = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES = 128
DELTA_PLUS = 0.4883E-01
DELTA_MINUS = 0.4883E-01
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 4
FILLVAL = -0.1000E+31
FIELDNAM = "Frequency"
LABLAXIS = "F"
SCALETYP = "Linear"
DATA = 0.0000E+00, 0.9766E-01, 0.1953E+00, 0.2930E+00, \
0.3906E+00, 0.4883E+00, 0.5860E+00, 0.6836E+00, \
0.7813E+00, 0.8789E+00, 0.9766E+00, 0.1074E+01, \
0.1172E+01, 0.1270E+01, 0.1367E+01, 0.1465E+01, \
0.1563E+01, 0.1660E+01, 0.1758E+01, 0.1856E+01, \
0.1953E+01, 0.2051E+01, 0.2148E+01, 0.2246E+01, \
0.2344E+01, 0.2441E+01, 0.2539E+01, 0.2637E+01, \
0.2734E+01, 0.2832E+01, 0.2930E+01, 0.3027E+01, \

```

```

0.3125E+01, 0.3223E+01, 0.3320E+01, 0.3418E+01, \
0.3516E+01, 0.3613E+01, 0.3711E+01, 0.3809E+01, \
0.3906E+01, 0.4004E+01, 0.4102E+01, 0.4199E+01, \
0.4297E+01, 0.4395E+01, 0.4492E+01, 0.4590E+01, \
0.4688E+01, 0.4785E+01, 0.4883E+01, 0.4981E+01, \
0.5078E+01, 0.5176E+01, 0.5274E+01, 0.5371E+01, \
0.5469E+01, 0.5567E+01, 0.5664E+01, 0.5762E+01, \
0.5860E+01, 0.5957E+01, 0.6055E+01, 0.6152E+01, \
0.6250E+01, 0.6348E+01, 0.6445E+01, 0.6543E+01, \
0.6641E+01, 0.6738E+01, 0.6836E+01, 0.6934E+01, \
0.7031E+01, 0.7129E+01, 0.7227E+01, 0.7324E+01, \
0.7422E+01, 0.7520E+01, 0.7617E+01, 0.7715E+01, \
0.7813E+01, 0.7910E+01, 0.8008E+01, 0.8106E+01, \
0.8203E+01, 0.8301E+01, 0.8399E+01, 0.8496E+01, \
0.8594E+01, 0.8692E+01, 0.8789E+01, 0.8887E+01, \
0.8985E+01, 0.9082E+01, 0.9180E+01, 0.9278E+01, \
0.9375E+01, 0.9473E+01, 0.9571E+01, 0.9668E+01, \
0.9766E+01, 0.9864E+01, 0.9961E+01, 0.1006E+02, \
0.1016E+02, 0.1025E+02, 0.1035E+02, 0.1045E+02, \
0.1055E+02, 0.1064E+02, 0.1074E+02, 0.1084E+02, \
0.1094E+02, 0.1104E+02, 0.1113E+02, 0.1123E+02, \
0.1133E+02, 0.1143E+02, 0.1152E+02, 0.1162E+02, \
0.1172E+02, 0.1182E+02, 0.1191E+02, 0.1201E+02, \
0.1211E+02, 0.1221E+02, 0.1230E+02, 0.1240E+02
END_VARIABLE = Frequency_C1_CP_STA_CS_NBR
!
START_VARIABLE = Complex_Spectrum_C1_CP_STA_CS_NBR
PARENT_DATASET_ID = "C1_CP_STA_CS_NBR"
PARAMETER_TYPE = "Data"
CATDESC = "Components of the Magnetic Field Complex Spectrum"
ENTITY = "Magnetic_Field"
PROPERTY = "Vector"
UNITS = "nT"
SI_CONVERSION = "1.E-9>T"
TENSOR_ORDER = 1
COORDINATE_SYSTEM = "GSE"
FRAME = "GSE>xyz"
TENSOR_FRAME = "GSE"
SIZES = 128,3,2 ! 128 frequencies x 2 (Re.+Im.) parts vector
DEPEND_0 = Time_C1_CP_STA_CS_NBR
DEPEND_1 = Frequency_C1_CP_STA_CS_NBR
REPRESENTATION_2 = "x","y","z"
LABEL_2 = "x","y","z"
LABEL_3 = "Re","Im"
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 4
FILLVAL = -0.1000E+31
QUALITY = 0
FIELDNAM = "Magnetic Field Complex Spectrum"
LABLAXIS = "Magnetic Field Complex Spectrum"
END_VARIABLE = Complex_Spectrum_C1_CP_STA_CS_NBR

```

3.3.9.2 HBR mode

Ex : C1_CH_STA_CS_HBR.keh

```

! CEH VALIDATION 13 May 2019 by LPP, V08 (RK)
!
START_META = DATASET_ID
ENTRY = "C1_CP_STA_CS_HBR"
END_META = DATASET_ID
!
START_META = DATA_TYPE
ENTRY = "CP"

```

```
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
ENTRY = "Magnetic Field Spectra in GSE (burst; up to 225 Hz)"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
ENTRY = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
ENTRY = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
ENTRY = "This dataset contains calibrated Complex Spectra (CS) of the magnetic field"
ENTRY = "measured by STAFF-SC from 0.1Hz to 225Hz with a resolution of"
ENTRY = "0.109866Hz x 9.10s, in HBR mode on the Cluster C1 spacecraft."
ENTRY = "This product is given in Geocentric Solar Ecliptic (GSE) coordinate system."
ENTRY = "Data calibration is performed using a moving window of 4096 points in HBR mode."
ENTRY = "This value was chosen as the best compromise for routine production."
ENTRY = "For further details, please refer to the STAFF Calibration Report."
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
ENTRY = "Spectra"
ENTRY = "Magnetic_Field"
END_META = DATASET_TYPE
!
START_META = PROCESSING_LEVEL
ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication
based upon use of this data."
ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
END_META = ACKNOWLEDGEMENT
!
START_META = TIME_RESOLUTION
VALUE_TYPE = FLOAT
ENTRY = 0.9102E+01
END_META = TIME_RESOLUTION
!
START_META = MIN_TIME_RESOLUTION
VALUE_TYPE = FLOAT
ENTRY = 0.9102E+01
END_META = MIN_TIME_RESOLUTION
!
START_META = MAX_TIME_RESOLUTION
VALUE_TYPE = FLOAT
ENTRY = 0.9102E+01
END_META = MAX_TIME_RESOLUTION
!
START_META = DATASET_CAVEATS
ENTRY = "*C1_CQ_STA_CALIB_YTR_CAVEATS"
ENTRY = "*C1_CQ_STA_NOTSRP_MTR_CAVEATS"
ENTRY = "Data are filtered at 0.6Hz. "
ENTRY = "All data below this value are not relevant and must not be used."
ENTRY = "DATASET VERSION HISTORY"
ENTRY = "Version 07 : Removal of on-board calibration records is now based on"
ENTRY = "the calibration bit (instead of the step-in-cal character)."
ENTRY = "Version 06 : Rare corrected re-deliveries."
ENTRY = "Version 05 : Minor corrections."
ENTRY = "Version 04 : The 10% error is corrected (new transfer function - Nov 2011)."
ENTRY = "Onboard calibration data are removed. When there is no Sun pulse, there is"
ENTRY = "now a fill value in the data."
ENTRY = "All versions inferior to 4: the transfer function of S/C #1 has 10% of error"
ENTRY = "with all the other spacecraft up to 7Hz."
ENTRY = "Version 03 : All the headers have been updated (laboratory name "
ENTRY = "and email). Introduction of a new header file (Dataset). "
ENTRY = "The data were time tagged using TED version 2.5.0 with"
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ENTRY = "option TCOR active(provided by the Sheffield DWP Group)."  
ENTRY = "Complex_Spectrum_C1_CP_STA_CS_HBR SI_CONVERSION has been corrected."  
ENTRY = "Version 02 : "  
ENTRY = "Complex_Spectrum_C1_CP_STA_CS_HBR unit has been corrected."  
ENTRY = "Warning: the corresponding SI_CONVERSION was set to 1.E9 instead of 1.E-9."  
ENTRY= "Older versions should not be used !"  
ENTRY = "Version 01 : Obsolete. Should not be used !"  
END_META = DATASET_CAVEATS  
!  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!  
START_VARIABLE = Time_C1_CP_STA_CS_HBR  
PARENT_DATASET_ID = "C1_CP_STA_CS_HBR"  
PARAMETER_TYPE = "Support_Data"  
CATDESC = "Time tag"  
UNITS = "s"  
SI_CONVERSION = "1.0>s"  
SIZES = 1  
DELTA_PLUS = 0.9102E+01  
DELTA_MINUS = 0.0000E+00  
VALUE_TYPE = ISO TIME  
SIGNIFICANT_DIGITS = 27  
FILLVAL = 9999-12-31T23:59:59.999999Z  
FIELDNAM = "UT Time"  
LABLAXIS = "UT"  
END_VARIABLE = Time_C1_CP_STA_CS_HBR  
!  
START_VARIABLE = Frequency_C1_CP_STA_CS_HBR  
PARENT_DATASET_ID = "C1_CP_STA_CS_HBR"  
PARAMETER_TYPE = "Support_Data"  
CATDESC = "Frequency Bin"  
UNITS = "Hz"  
SI_CONVERSION = "1.0>Hz"  
SIZES = 2048  
DELTA_PLUS = 0.5493E-01  
DELTA_MINUS = 0.5493E-01  
VALUE_TYPE = FLOAT  
SIGNIFICANT_DIGITS = 4  
FILLVAL = -0.1000E+31  
FIELDNAM = "Frequency"  
LABLAXIS = "F"  
SCALETYP = "Linear"  
DATA = 0.0000E+00, 0.1099E+00, 0.2197E+00, 0.3296E+00, \  
0.4395E+00, 0.5493E+00, 0.6592E+00, 0.7691E+00, \  
0.8789E+00, 0.9888E+00, 0.1099E+01, 0.1209E+01, \  
0.1318E+01, 0.1428E+01, 0.1538E+01, 0.1648E+01, \  
0.1758E+01, 0.1868E+01, 0.1978E+01, 0.2087E+01, \  
0.2197E+01, 0.2307E+01, 0.2417E+01, 0.2527E+01, \  
0.2637E+01, 0.2747E+01, 0.2857E+01, 0.2966E+01, \  
0.3076E+01, 0.3186E+01, 0.3296E+01, 0.3406E+01, \  
0.3516E+01, 0.3626E+01, 0.3735E+01, 0.3845E+01, \  
0.3955E+01, 0.4065E+01, 0.4175E+01, 0.4285E+01, \  
0.4395E+01, 0.4505E+01, 0.4614E+01, 0.4724E+01, \  
0.4834E+01, 0.4944E+01, 0.5054E+01, 0.5164E+01, \  
0.5274E+01, 0.5383E+01, 0.5493E+01, 0.5603E+01, \  
0.5713E+01, 0.5823E+01, 0.5933E+01, 0.6043E+01, \  
0.6152E+01, 0.6262E+01, 0.6372E+01, 0.6482E+01, \  
0.6592E+01, 0.6702E+01, 0.6812E+01, 0.6922E+01, \  
0.7031E+01, 0.7141E+01, 0.7251E+01, 0.7361E+01, \  
0.7471E+01, 0.7581E+01, 0.7691E+01, 0.7800E+01, \  
0.7910E+01, 0.8020E+01, 0.8130E+01, 0.8240E+01, \  
0.8350E+01, 0.8460E+01, 0.8570E+01, 0.8679E+01, \  
0.8789E+01, 0.8899E+01, 0.9009E+01, 0.9119E+01, \  
0.9229E+01, 0.9339E+01, 0.9448E+01, 0.9558E+01, \  
0.9668E+01, 0.9778E+01, 0.9888E+01, 0.9998E+01, \  
0.1011E+02, 0.1022E+02, 0.1033E+02, 0.1044E+02, \  
0.1055E+02, 0.1066E+02, 0.1077E+02, 0.1088E+02, \  
0.1099E+02, 0.1110E+02, 0.1121E+02, 0.1132E+02, \  

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0.1143E+02, 0.1154E+02, 0.1165E+02, 0.1176E+02, \
0.1187E+02, 0.1198E+02, 0.1209E+02, 0.1220E+02, \
0.1230E+02, 0.1241E+02, 0.1252E+02, 0.1263E+02, \
0.1274E+02, 0.1285E+02, 0.1296E+02, 0.1307E+02, \
0.1318E+02, 0.1329E+02, 0.1340E+02, 0.1351E+02, \
0.1362E+02, 0.1373E+02, 0.1384E+02, 0.1395E+02, \
0.1406E+02, 0.1417E+02, 0.1428E+02, 0.1439E+02, \
0.1450E+02, 0.1461E+02, 0.1472E+02, 0.1483E+02, \
0.1494E+02, 0.1505E+02, 0.1516E+02, 0.1527E+02, \
0.1538E+02, 0.1549E+02, 0.1560E+02, 0.1571E+02, \
0.1582E+02, 0.1593E+02, 0.1604E+02, 0.1615E+02, \
0.1626E+02, 0.1637E+02, 0.1648E+02, 0.1659E+02, \
0.1670E+02, 0.1681E+02, 0.1692E+02, 0.1703E+02, \
0.1714E+02, 0.1725E+02, 0.1736E+02, 0.1747E+02, \
0.1758E+02, 0.1769E+02, 0.1780E+02, 0.1791E+02, \
0.1802E+02, 0.1813E+02, 0.1824E+02, 0.1835E+02, \
0.1846E+02, 0.1857E+02, 0.1868E+02, 0.1879E+02, \
0.1890E+02, 0.1901E+02, 0.1912E+02, 0.1923E+02, \
0.1934E+02, 0.1945E+02, 0.1956E+02, 0.1967E+02, \
0.1978E+02, 0.1989E+02, 0.2000E+02, 0.2011E+02, \
0.2022E+02, 0.2033E+02, 0.2044E+02, 0.2054E+02, \
0.2065E+02, 0.2076E+02, 0.2087E+02, 0.2098E+02, \
0.2109E+02, 0.2120E+02, 0.2131E+02, 0.2142E+02, \
0.2153E+02, 0.2164E+02, 0.2175E+02, 0.2186E+02, \
0.2197E+02, 0.2208E+02, 0.2219E+02, 0.2230E+02, \
0.2241E+02, 0.2252E+02, 0.2263E+02, 0.2274E+02, \
0.2285E+02, 0.2296E+02, 0.2307E+02, 0.2318E+02, \
0.2329E+02, 0.2340E+02, 0.2351E+02, 0.2362E+02, \
0.2373E+02, 0.2384E+02, 0.2395E+02, 0.2406E+02, \
0.2417E+02, 0.2428E+02, 0.2439E+02, 0.2450E+02, \
0.2461E+02, 0.2472E+02, 0.2483E+02, 0.2494E+02, \
0.2505E+02, 0.2516E+02, 0.2527E+02, 0.2538E+02, \
0.2549E+02, 0.2560E+02, 0.2571E+02, 0.2582E+02, \
0.2593E+02, 0.2604E+02, 0.2615E+02, 0.2626E+02, \
0.2637E+02, 0.2648E+02, 0.2659E+02, 0.2670E+02, \
0.2681E+02, 0.2692E+02, 0.2703E+02, 0.2714E+02, \
0.2725E+02, 0.2736E+02, 0.2747E+02, 0.2758E+02, \
0.2769E+02, 0.2780E+02, 0.2791E+02, 0.2802E+02, \
0.2813E+02, 0.2824E+02, 0.2835E+02, 0.2846E+02, \
0.2857E+02, 0.2867E+02, 0.2878E+02, 0.2889E+02, \
0.2900E+02, 0.2911E+02, 0.2922E+02, 0.2933E+02, \
0.2944E+02, 0.2955E+02, 0.2966E+02, 0.2977E+02, \
0.2988E+02, 0.2999E+02, 0.3010E+02, 0.3021E+02, \
0.3032E+02, 0.3043E+02, 0.3054E+02, 0.3065E+02, \
0.3076E+02, 0.3087E+02, 0.3098E+02, 0.3109E+02, \
0.3120E+02, 0.3131E+02, 0.3142E+02, 0.3153E+02, \
0.3164E+02, 0.3175E+02, 0.3186E+02, 0.3197E+02, \
0.3208E+02, 0.3219E+02, 0.3230E+02, 0.3241E+02, \
0.3252E+02, 0.3263E+02, 0.3274E+02, 0.3285E+02, \
0.3296E+02, 0.3307E+02, 0.3318E+02, 0.3329E+02, \
0.3340E+02, 0.3351E+02, 0.3362E+02, 0.3373E+02, \
0.3384E+02, 0.3395E+02, 0.3406E+02, 0.3417E+02, \
0.3428E+02, 0.3439E+02, 0.3450E+02, 0.3461E+02, \
0.3472E+02, 0.3483E+02, 0.3494E+02, 0.3505E+02, \
0.3516E+02, 0.3527E+02, 0.3538E+02, 0.3549E+02, \
0.3560E+02, 0.3571E+02, 0.3582E+02, 0.3593E+02, \
0.3604E+02, 0.3615E+02, 0.3626E+02, 0.3637E+02, \
0.3648E+02, 0.3659E+02, 0.3670E+02, 0.3681E+02, \
0.3691E+02, 0.3702E+02, 0.3713E+02, 0.3724E+02, \
0.3735E+02, 0.3746E+02, 0.3757E+02, 0.3768E+02, \
0.3779E+02, 0.3790E+02, 0.3801E+02, 0.3812E+02, \
0.3823E+02, 0.3834E+02, 0.3845E+02, 0.3856E+02, \
0.3867E+02, 0.3878E+02, 0.3889E+02, 0.3900E+02, \
0.3911E+02, 0.3922E+02, 0.3933E+02, 0.3944E+02, \
0.3955E+02, 0.3966E+02, 0.3977E+02, 0.3988E+02, \
0.3999E+02, 0.4010E+02, 0.4021E+02, 0.4032E+02, \
0.4043E+02, 0.4054E+02, 0.4065E+02, 0.4076E+02, \
0.4087E+02, 0.4098E+02, 0.4109E+02, 0.4120E+02, \
0.4131E+02, 0.4142E+02, 0.4153E+02, 0.4164E+02, \
0.4175E+02, 0.4186E+02, 0.4197E+02, 0.4208E+02, \

0.4219E+02,	0.4230E+02,	0.4241E+02,	0.4252E+02,	\
0.4263E+02,	0.4274E+02,	0.4285E+02,	0.4296E+02,	\
0.4307E+02,	0.4318E+02,	0.4329E+02,	0.4340E+02,	\
0.4351E+02,	0.4362E+02,	0.4373E+02,	0.4384E+02,	\
0.4395E+02,	0.4406E+02,	0.4417E+02,	0.4428E+02,	\
0.4439E+02,	0.4450E+02,	0.4461E+02,	0.4472E+02,	\
0.4483E+02,	0.4494E+02,	0.4505E+02,	0.4515E+02,	\
0.4526E+02,	0.4537E+02,	0.4548E+02,	0.4559E+02,	\
0.4570E+02,	0.4581E+02,	0.4592E+02,	0.4603E+02,	\
0.4614E+02,	0.4625E+02,	0.4636E+02,	0.4647E+02,	\
0.4658E+02,	0.4669E+02,	0.4680E+02,	0.4691E+02,	\
0.4702E+02,	0.4713E+02,	0.4724E+02,	0.4735E+02,	\
0.4746E+02,	0.4757E+02,	0.4768E+02,	0.4779E+02,	\
0.4790E+02,	0.4801E+02,	0.4812E+02,	0.4823E+02,	\
0.4834E+02,	0.4845E+02,	0.4856E+02,	0.4867E+02,	\
0.4878E+02,	0.4889E+02,	0.4900E+02,	0.4911E+02,	\
0.4922E+02,	0.4933E+02,	0.4944E+02,	0.4955E+02,	\
0.4966E+02,	0.4977E+02,	0.4988E+02,	0.4999E+02,	\
0.5010E+02,	0.5021E+02,	0.5032E+02,	0.5043E+02,	\
0.5054E+02,	0.5065E+02,	0.5076E+02,	0.5087E+02,	\
0.5098E+02,	0.5109E+02,	0.5120E+02,	0.5131E+02,	\
0.5142E+02,	0.5153E+02,	0.5164E+02,	0.5175E+02,	\
0.5186E+02,	0.5197E+02,	0.5208E+02,	0.5219E+02,	\
0.5230E+02,	0.5241E+02,	0.5252E+02,	0.5263E+02,	\
0.5274E+02,	0.5285E+02,	0.5296E+02,	0.5307E+02,	\
0.5318E+02,	0.5328E+02,	0.5339E+02,	0.5350E+02,	\
0.5361E+02,	0.5372E+02,	0.5383E+02,	0.5394E+02,	\
0.5405E+02,	0.5416E+02,	0.5427E+02,	0.5438E+02,	\
0.5449E+02,	0.5460E+02,	0.5471E+02,	0.5482E+02,	\
0.5493E+02,	0.5504E+02,	0.5515E+02,	0.5526E+02,	\
0.5537E+02,	0.5548E+02,	0.5559E+02,	0.5570E+02,	\
0.5581E+02,	0.5592E+02,	0.5603E+02,	0.5614E+02,	\
0.5625E+02,	0.5636E+02,	0.5647E+02,	0.5658E+02,	\
0.5669E+02,	0.5680E+02,	0.5691E+02,	0.5702E+02,	\
0.5713E+02,	0.5724E+02,	0.5735E+02,	0.5746E+02,	\
0.5757E+02,	0.5768E+02,	0.5779E+02,	0.5790E+02,	\
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0.5845E+02,	0.5856E+02,	0.5867E+02,	0.5878E+02,	\
0.5889E+02,	0.5900E+02,	0.5911E+02,	0.5922E+02,	\
0.5933E+02,	0.5944E+02,	0.5955E+02,	0.5966E+02,	\
0.5977E+02,	0.5988E+02,	0.5999E+02,	0.6010E+02,	\
0.6021E+02,	0.6032E+02,	0.6043E+02,	0.6054E+02,	\
0.6065E+02,	0.6076E+02,	0.6087E+02,	0.6098E+02,	\
0.6109E+02,	0.6120E+02,	0.6131E+02,	0.6142E+02,	\
0.6152E+02,	0.6163E+02,	0.6174E+02,	0.6185E+02,	\
0.6196E+02,	0.6207E+02,	0.6218E+02,	0.6229E+02,	\
0.6240E+02,	0.6251E+02,	0.6262E+02,	0.6273E+02,	\
0.6284E+02,	0.6295E+02,	0.6306E+02,	0.6317E+02,	\
0.6328E+02,	0.6339E+02,	0.6350E+02,	0.6361E+02,	\
0.6372E+02,	0.6383E+02,	0.6394E+02,	0.6405E+02,	\
0.6416E+02,	0.6427E+02,	0.6438E+02,	0.6449E+02,	\
0.6460E+02,	0.6471E+02,	0.6482E+02,	0.6493E+02,	\
0.6504E+02,	0.6515E+02,	0.6526E+02,	0.6537E+02,	\
0.6548E+02,	0.6559E+02,	0.6570E+02,	0.6581E+02,	\
0.6592E+02,	0.6603E+02,	0.6614E+02,	0.6625E+02,	\
0.6636E+02,	0.6647E+02,	0.6658E+02,	0.6669E+02,	\
0.6680E+02,	0.6691E+02,	0.6702E+02,	0.6713E+02,	\
0.6724E+02,	0.6735E+02,	0.6746E+02,	0.6757E+02,	\
0.6768E+02,	0.6779E+02,	0.6790E+02,	0.6801E+02,	\
0.6812E+02,	0.6823E+02,	0.6834E+02,	0.6845E+02,	\
0.6856E+02,	0.6867E+02,	0.6878E+02,	0.6889E+02,	\
0.6900E+02,	0.6911E+02,	0.6922E+02,	0.6933E+02,	\
0.6944E+02,	0.6955E+02,	0.6965E+02,	0.6976E+02,	\
0.6987E+02,	0.6998E+02,	0.7009E+02,	0.7020E+02,	\
0.7031E+02,	0.7042E+02,	0.7053E+02,	0.7064E+02,	\
0.7075E+02,	0.7086E+02,	0.7097E+02,	0.7108E+02,	\
0.7119E+02,	0.7130E+02,	0.7141E+02,	0.7152E+02,	\
0.7163E+02,	0.7174E+02,	0.7185E+02,	0.7196E+02,	\
0.7207E+02,	0.7218E+02,	0.7229E+02,	0.7240E+02,	\
0.7251E+02,	0.7262E+02,	0.7273E+02,	0.7284E+02,	\

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0.7691E+02, 0.7702E+02, 0.7713E+02, 0.7724E+02, \
0.7735E+02, 0.7746E+02, 0.7757E+02, 0.7768E+02, \
0.7779E+02, 0.7789E+02, 0.7800E+02, 0.7811E+02, \
0.7822E+02, 0.7833E+02, 0.7844E+02, 0.7855E+02, \
0.7866E+02, 0.7877E+02, 0.7888E+02, 0.7899E+02, \
0.7910E+02, 0.7921E+02, 0.7932E+02, 0.7943E+02, \
0.7954E+02, 0.7965E+02, 0.7976E+02, 0.7987E+02, \
0.7998E+02, 0.8009E+02, 0.8020E+02, 0.8031E+02, \
0.8042E+02, 0.8053E+02, 0.8064E+02, 0.8075E+02, \
0.8086E+02, 0.8097E+02, 0.8108E+02, 0.8119E+02, \
0.8130E+02, 0.8141E+02, 0.8152E+02, 0.8163E+02, \
0.8174E+02, 0.8185E+02, 0.8196E+02, 0.8207E+02, \
0.8218E+02, 0.8229E+02, 0.8240E+02, 0.8251E+02, \
0.8262E+02, 0.8273E+02, 0.8284E+02, 0.8295E+02, \
0.8306E+02, 0.8317E+02, 0.8328E+02, 0.8339E+02, \
0.8350E+02, 0.8361E+02, 0.8372E+02, 0.8383E+02, \
0.8394E+02, 0.8405E+02, 0.8416E+02, 0.8427E+02, \
0.8438E+02, 0.8449E+02, 0.8460E+02, 0.8471E+02, \
0.8482E+02, 0.8493E+02, 0.8504E+02, 0.8515E+02, \
0.8526E+02, 0.8537E+02, 0.8548E+02, 0.8559E+02, \
0.8570E+02, 0.8581E+02, 0.8592E+02, 0.8602E+02, \
0.8613E+02, 0.8624E+02, 0.8635E+02, 0.8646E+02, \
0.8657E+02, 0.8668E+02, 0.8679E+02, 0.8690E+02, \
0.8701E+02, 0.8712E+02, 0.8723E+02, 0.8734E+02, \
0.8745E+02, 0.8756E+02, 0.8767E+02, 0.8778E+02, \
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0.1890E+03, 0.1891E+03, 0.1892E+03, 0.1893E+03, \
0.1894E+03, 0.1895E+03, 0.1896E+03, 0.1897E+03, \
0.1898E+03, 0.1900E+03, 0.1901E+03, 0.1902E+03, \
0.1903E+03, 0.1904E+03, 0.1905E+03, 0.1906E+03, \
0.1907E+03, 0.1908E+03, 0.1909E+03, 0.1911E+03, \
0.1912E+03, 0.1913E+03, 0.1914E+03, 0.1915E+03, \
0.1916E+03, 0.1917E+03, 0.1918E+03, 0.1919E+03, \
0.1920E+03, 0.1922E+03, 0.1923E+03, 0.1924E+03, \
0.1925E+03, 0.1926E+03, 0.1927E+03, 0.1928E+03, \
0.1929E+03, 0.1930E+03, 0.1931E+03, 0.1933E+03, \
0.1934E+03, 0.1935E+03, 0.1936E+03, 0.1937E+03, \
0.1938E+03, 0.1939E+03, 0.1940E+03, 0.1941E+03, \
0.1942E+03, 0.1944E+03, 0.1945E+03, 0.1946E+03, \
0.1947E+03, 0.1948E+03, 0.1949E+03, 0.1950E+03, \
0.1951E+03, 0.1952E+03, 0.1953E+03, 0.1955E+03, \
0.1956E+03, 0.1957E+03, 0.1958E+03, 0.1959E+03, \

```
0.1960E+03, 0.1961E+03, 0.1962E+03, 0.1963E+03, \  
0.1964E+03, 0.1966E+03, 0.1967E+03, 0.1968E+03, \  
0.1969E+03, 0.1970E+03, 0.1971E+03, 0.1972E+03, \  
0.1973E+03, 0.1974E+03, 0.1975E+03, 0.1976E+03, \  
0.1978E+03, 0.1979E+03, 0.1980E+03, 0.1981E+03, \  
0.1982E+03, 0.1983E+03, 0.1984E+03, 0.1985E+03, \  
0.1986E+03, 0.1987E+03, 0.1989E+03, 0.1990E+03, \  
0.1991E+03, 0.1992E+03, 0.1993E+03, 0.1994E+03, \  
0.1995E+03, 0.1996E+03, 0.1997E+03, 0.1998E+03, \  
0.2000E+03, 0.2001E+03, 0.2002E+03, 0.2003E+03, \  
0.2004E+03, 0.2005E+03, 0.2006E+03, 0.2007E+03, \  
0.2008E+03, 0.2009E+03, 0.2011E+03, 0.2012E+03, \  
0.2013E+03, 0.2014E+03, 0.2015E+03, 0.2016E+03, \  
0.2017E+03, 0.2018E+03, 0.2019E+03, 0.2020E+03, \  
0.2022E+03, 0.2023E+03, 0.2024E+03, 0.2025E+03, \  
0.2026E+03, 0.2027E+03, 0.2028E+03, 0.2029E+03, \  
0.2030E+03, 0.2031E+03, 0.2033E+03, 0.2034E+03, \  
0.2035E+03, 0.2036E+03, 0.2037E+03, 0.2038E+03, \  
0.2039E+03, 0.2040E+03, 0.2041E+03, 0.2042E+03, \  
0.2044E+03, 0.2045E+03, 0.2046E+03, 0.2047E+03, \  
0.2048E+03, 0.2049E+03, 0.2050E+03, 0.2051E+03, \  
0.2052E+03, 0.2053E+03, 0.2054E+03, 0.2056E+03, \  
0.2057E+03, 0.2058E+03, 0.2059E+03, 0.2060E+03, \  
0.2061E+03, 0.2062E+03, 0.2063E+03, 0.2064E+03, \  
0.2065E+03, 0.2067E+03, 0.2068E+03, 0.2069E+03, \  
0.2070E+03, 0.2071E+03, 0.2072E+03, 0.2073E+03, \  
0.2074E+03, 0.2075E+03, 0.2076E+03, 0.2078E+03, \  
0.2079E+03, 0.2080E+03, 0.2081E+03, 0.2082E+03, \  
0.2083E+03, 0.2084E+03, 0.2085E+03, 0.2086E+03, \  
0.2087E+03, 0.2089E+03, 0.2090E+03, 0.2091E+03, \  
0.2092E+03, 0.2093E+03, 0.2094E+03, 0.2095E+03, \  
0.2096E+03, 0.2097E+03, 0.2098E+03, 0.2100E+03, \  
0.2101E+03, 0.2102E+03, 0.2103E+03, 0.2104E+03, \  
0.2105E+03, 0.2106E+03, 0.2107E+03, 0.2108E+03, \  
0.2109E+03, 0.2111E+03, 0.2112E+03, 0.2113E+03, \  
0.2114E+03, 0.2115E+03, 0.2116E+03, 0.2117E+03, \  
0.2118E+03, 0.2119E+03, 0.2120E+03, 0.2122E+03, \  
0.2123E+03, 0.2124E+03, 0.2125E+03, 0.2126E+03, \  
0.2127E+03, 0.2128E+03, 0.2129E+03, 0.2130E+03, \  
0.2131E+03, 0.2132E+03, 0.2134E+03, 0.2135E+03, \  
0.2136E+03, 0.2137E+03, 0.2138E+03, 0.2139E+03, \  
0.2140E+03, 0.2141E+03, 0.2142E+03, 0.2143E+03, \  
0.2145E+03, 0.2146E+03, 0.2147E+03, 0.2148E+03, \  
0.2149E+03, 0.2150E+03, 0.2151E+03, 0.2152E+03, \  
0.2153E+03, 0.2154E+03, 0.2156E+03, 0.2157E+03, \  
0.2158E+03, 0.2159E+03, 0.2160E+03, 0.2161E+03, \  
0.2162E+03, 0.2163E+03, 0.2164E+03, 0.2165E+03, \  
0.2167E+03, 0.2168E+03, 0.2169E+03, 0.2170E+03, \  
0.2171E+03, 0.2172E+03, 0.2173E+03, 0.2174E+03, \  
0.2175E+03, 0.2176E+03, 0.2178E+03, 0.2179E+03, \  
0.2180E+03, 0.2181E+03, 0.2182E+03, 0.2183E+03, \  
0.2184E+03, 0.2185E+03, 0.2186E+03, 0.2187E+03, \  
0.2189E+03, 0.2190E+03, 0.2191E+03, 0.2192E+03, \  
0.2193E+03, 0.2194E+03, 0.2195E+03, 0.2196E+03, \  
0.2197E+03, 0.2198E+03, 0.2200E+03, 0.2201E+03, \  
0.2202E+03, 0.2203E+03, 0.2204E+03, 0.2205E+03, \  
0.2206E+03, 0.2207E+03, 0.2208E+03, 0.2209E+03, \  
0.2211E+03, 0.2212E+03, 0.2213E+03, 0.2214E+03, \  
0.2215E+03, 0.2216E+03, 0.2217E+03, 0.2218E+03, \  
0.2219E+03, 0.2220E+03, 0.2221E+03, 0.2223E+03, \  
0.2224E+03, 0.2225E+03, 0.2226E+03, 0.2227E+03, \  
0.2228E+03, 0.2229E+03, 0.2230E+03, 0.2231E+03, \  
0.2232E+03, 0.2234E+03, 0.2235E+03, 0.2236E+03, \  
0.2237E+03, 0.2238E+03, 0.2239E+03, 0.2240E+03, \  
0.2241E+03, 0.2242E+03, 0.2243E+03, 0.2245E+03, \  
0.2246E+03, 0.2247E+03, 0.2248E+03, 0.2249E+03
```

```
END_VARIABLE = Frequency_C1_CP_STA_CS_HBR
```

```
!
```

```
START_VARIABLE = Complex_Spectrum_C1_CP_STA_CS_HBR
```

```
PARENT_DATASET_ID = "C1_CP_STA_CS_HBR"
```



```

START_META = VERSION_NUMBER
ENTRY = "05"
END_META = VERSION_NUMBER
!
START_META = METADATA_TYPE
ENTRY = "CAA"
END_META = METADATA_TYPE
!
START_META = METADATA_VERSION
ENTRY = "2.0"
END_META = METADATA_VERSION
!
START_META = FILE_TIME_SPAN
VALUE_TYPE = ISO_TIME_RANGE
ENTRY = "2006-01-01T00:00:00.000000Z/2006-01-01T23:59:59.999999Z"
END_META = FILE_TIME_SPAN
!
START_META = GENERATION_DATE
VALUE_TYPE = ISO_TIME
ENTRY = "2013-10-21T15:34:20.000Z"
END_META = GENERATION_DATE
!
START_META = FILE_CAVEATS
ENTRY = "Produced using software RCL V2.0"
ENTRY = "TED version 2.5.0.109"
ENTRY = "TCOR option yes"
ENTRY = "Calibration tables: 14 nov 2011"
ENTRY = "Kernel size : 256"
ENTRY = "Shift size : 256"
ENTRY = "Cutoff frequency : 0.60"
END_META = FILE_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                       Data      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
DATA_UNTIL = "END_OF_FILE"
2006-01-01T00:00:00.003685Z,
 0.3994E-02,  0.0000E+00,  0.5841E-01,  0.0000E+00,  0.6689E-02,  0.0000E+00,
 0.1713E-02, -0.1601E-01,  0.7592E-01,  0.1580E-02,  0.4741E-02,  0.1481E-02,
 0.8677E-02, -0.8333E-01,  0.1768E+00,  0.7312E-02,  0.1038E-01,  0.7769E-02,
-0.1621E-01,  0.1129E+00, -0.9751E-01, -0.4729E-02, -0.4436E-02, -0.1040E-01,
-0.2906E-01,  0.7865E-01,  0.3026E-01,  0.1344E-01,  0.4631E-02, -0.6257E-02,
 0.7862E-01,  0.2672E-01, -0.6578E-02, -0.5775E-01, -0.7200E-02, -0.6091E-02,
-0.4769E-02, -0.4101E-01, -0.8810E-01, -0.4814E-03, -0.4874E-02,  0.3457E-02,
-0.4249E-01,  0.4978E-03, -0.1436E-01,  0.2521E-01, -0.1781E-02,  0.5145E-02,
 0.1542E-01,  0.3466E-02,  0.2320E-02, -0.1429E-01,  0.3214E-03, -0.5954E-02,
-0.8812E-02, -0.3526E-01, -0.3139E-01, -0.1289E-01, -0.2174E-02,  0.6825E-02,
 0.1304E-01,  0.8806E-02, -0.3910E-01,  0.4244E-01, -0.4653E-03,  0.2310E-02,
 0.1563E-01, -0.1371E-01,  0.3280E-01,  0.3134E-02,  0.3524E-03,  0.1113E-03,
...

```



```
ENTRY = "Cutoff frequency : 0.60"
END_META = FILE_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                   Data      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
DATA_UNTIL = "END_OF_FILE"
2006-01-03T07:15:57.246581Z,
-0.2317E-02,  0.0000E+00,  0.4781E-02,  0.0000E+00,  0.5336E-02,  0.0000E+00,
-0.3998E-02, -0.4961E-03,  0.7211E-02, -0.9338E-03,  0.1123E-02,  0.4974E-05,
-0.1836E-01, -0.1099E-01,  0.2467E-01, -0.1028E-01,  0.3502E-02,  0.3145E-03,
 0.7827E-03,  0.8602E-02,  0.2172E-02,  0.5626E-02,  0.3643E-03, -0.2975E-03,
 0.2388E-01, -0.6849E-02, -0.1526E-01, -0.1331E-01, -0.2782E-02, -0.1946E-03,
-0.8702E-02, -0.7702E-02, -0.1524E-01,  0.7892E-02,  0.1658E-05,  0.1297E-02,
 0.2182E-02,  0.3200E-03, -0.1974E-02, -0.2306E-03, -0.7407E-02,  0.3572E-06,
-0.8398E-03, -0.3883E-02, -0.8041E-02,  0.2021E-02, -0.1395E-02,  0.1500E-02,
 0.1526E-02,  0.7467E-03, -0.5062E-02,  0.1487E-02,  0.4917E-02, -0.9546E-03,
 0.5463E-02, -0.8190E-02,  0.1174E-01,  0.6754E-02,  0.3200E-02,  0.1531E-02,
...
```

3.4 Level 2 data – SA- Automatic Gain Control (AGC)

3.4.1 Format: CEF

3.4.2 Standard: cf 2.2.

3.4.3 Production Procedure: cf 2.3.1.

3.4.4 Quality Control Procedure: cf 2.4.1.

3.4.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.4.6 Product Specification

One CEF file per day and per satellite is produced.

The CEF file contains the average power spectral density in the passband of the analogue receivers derived from the Automatic Gain Control signal. This is measured in the three large passbands with 1s time resolution, for the axial component of the magnetic field, and the sums of the spins plane components of the magnetic and of the electric field.

Data are separated in two variables, one for the magnetic AGC, one for the electric AGC.

B__C1/C2/C3/C4_CP_STA_AGC. They are given in $\text{nT}^2 \text{Hz}^{-1}$ units.

E__C1/C2/C3/C4_CP_STA_AGC. They are given in $\text{mV}^2 \text{m}^{-2} \text{Hz}^{-1}$ units.

3.4.7 Dataset metadata description

The CEF file version 04 includes a detached dataset header called: **C1/C2/C3/C4_CH_STA_AGC.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

First, the following **global metadata** keywords:

DATASET_ID = "C1/C2/C3/C4_CP_STA_AGC"

DATA_TYPE = "CP"

DATASET_TITLE = "Automatic Gain Control"

CONTACT_COORDINATES =

 "Olga Alexandrova>PI>olga.alexandrova@obspm.fr"

 "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"

DATASET_DESCRIPTION = "Average power spectral density in the passband of the analogue receivers derived from the Automatic Gain Control signal. This is measured in three large passbands for the axial component of the magnetic field, and the sums of the spin plane components of the magnetic and of the electric field. The time resolution can vary between 0.125 and 0.250s in High Bit Rate and usually 1s (exceptionally 0.5 and 2s) in Normal Bit Rate telemetry mode."

DATASET_TYPE = "Raw_Data"

PROCESSING_LEVEL = "Calibrated"

TIME_RESOLUTION = 1.0

MIN_TIME_RESOLUTION = 2.0

MAX_TIME_RESOLUTION = 0.125

ACKNOWLEDGEMENT = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data. Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"

DATASETS_CAVEATS = "*C1_CQ_STA_CALIB_YTR_CAVEATS"

 "Version 07 : New calibration tables plus addition of the interval duration and status. Removal of onboard calibration data."

 "Warning to the users of versions lower than 07:"

 "Delta_plus of Time__C1_CP_STA_AGC variables is set to a fixed value "instead of a value varying with the mode. This chosen fixed value is the usual minimum time resolution (1s) which is correct in most of the time (Normal Bit Rate)."

 "The time resolution is better in High Bit Rate. Note that the data themselves are correct."

 "Version 04 : All the headers have been updated (laboratory name and email). Introduction of a new header file (Dataset). "

 "Version 03 : The data were time tagged using TED version 2.4.3"

"(TED Library 4.4.3 User Patch 1), provided by the Sheffield DWP Group."

"Version 02 : Obsolete. Should not be used !"

"Version 01 : Obsolete. Should not be used !"

Then, the following **Support data**:

Data are indexed by the following variables:

- **Time** which is the time tag. Its properties are:

PARAMETER_TYPE = "Support_Data"

CATDESC = " Interval Start time tag"

UNITS = "s"

SI_CONVERSION = "1.0>s"

SIZES = 1

VALUE_TYPE = ISO_TIME

SIGNIFICANT_DIGITS = 24

FILLVAL = 9999-12-31T23:59:59.999Z

FIELDNAM = "UT Time"

LABLAXIS = "UT"

DELTA_MINUS = 0.0

DELTA_PLUS = Duration__C1_CP_STA_AGC

- **Duration:**

CATDESC = "Interval duration"

FIELDNAM = "Interval duration"

DEPEND_0 = Time__C1_CP_STA_AGC

FILLVAL = 9.999

LABLAXIS = "s"

PARAMETER_TYPE = "Support_Data"

SI_CONVERSION = "1.0>s"

SIGNIFICANT_DIGITS = 4

UNITS = "s"

VALUE_TYPE = FLOAT

SIZES = 1

- **Status:**

CATDESC = "STAFF-SA Status"

DEPEND_0 = Time__C1_CP_STA_AGC

FIELDNAM = "STAFF-SA Status"

FILLVAL = "ZZZZZZZZZ"

LABEL_1 = "Status"

LABLAXIS = "Status"

PARAMETER_CAVEATS = "First nine characters of STAFF Status. See UG, Appendix C. We cannot certify the 9th character (EFW Sweep)"

PARAMETER_TYPE = "Support_Data"

QUALITY = 1

SIGNIFICANT_DIGITS = 9
SIZES= 1
UNITS= "unitless"
VALUE_TYPE = CHAR

- **Frequency** defining the centres of the 3 frequency bands:

PARAMETER_TYPE = "Support_Data"
CATDESC = "Interval centred frequency tag"
UNITS = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES = 3
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 4
FILLVAL = -999.99
FIELDNAM = "Frequency bin centres"
LABLAXIS = "F"
LABEL_1 = "A","B","C" ! 3 bands
DELTA_PLUS = Frequency_BHW__C1/C2/C3/C4_CP_STA_AGC
DELTA_MINUS = Frequency_BHW__C1/C2/C3/C4_CP_STA_AGC
SCALETYP = Log
DATA = 34.9226,279.3811,2235.0488

- **Frequency_BHW** which is the half width of the 3 frequency bands:

PARAMETER_TYPE = "Support_Data"
CATDESC = "Frequency bin half widths"
UNITS = "Hz"
SI_CONVERSION= "1.0>Hz"
SIZES = 3
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL= -999.99
FIELDNAM= "Frequency bin half widths"
LABLAXIS = "F_bhw"
LABEL_1 = "A_bhw","B_bhw","C_bhw"
SCALETYP= Log
DATA= 27.1618,217.2948,1738.3584

Data themselves

- **The magnetic AGC B:**

PARAMETER_TYPE = "Data"
ENTITY= "Magnetic_Field"
PROPERTY = "Component"
FLUCTUATIONS = "Mean_Square_Level"
CATDESC = "Magnetic AGC"
UNITS = "nT^2 Hz^-1"

```
SI_CONVERSION = "1.0e-18>T^2 Hz^-1"  
TENSOR_ORDER = 0  
TENSOR_FRAME = "ISR2"  
FRAME = "ISR2>xyz"  
COORDINATE_SYSTEM= "ISR2"  
SIZES = 3,2    ! 3 frequency bins x 2 components  
VALUE_TYPE = FLOAT  
SIGNIFICANT_DIGITS = 3  
FILLVAL= -1.00E+31  
FIELDNAM = "Magnetic AGC"  
LABLAXIS = "Magnetic AGC"  
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_AGC  
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_AGC  
LABEL_2 = "Bz","Bxy"  
QUALITY = 0
```

- **The Electric AGC E:**

```
PARAMETER_TYPE = "Data"  
ENTITY = "Electric_Field"  
PROPERTY = "Component"  
FLUCTUATIONS = "Mean_Square_Level"  
CATDESC = "Electric AGC"  
UNITS = "mV^2 m^-2 Hz^-1"  
SI_CONVERSION = "1.0E-6> V^2 m^-2 Hz^-1"  
TENSOR_ORDER = 0  
TENSOR_FRAME = "ISR2"  
FRAME = "ISR2>xyz"  
COORDINATE_SYSTEM = "ISR2"  
SIZES = 3    ! 3 frequency bins x 1 components  
VALUE_TYPE = FLOAT  
SIGNIFICANT_DIGITS = 3  
FILLVAL = -1.00E+31  
FIELDNAM = "Electric AGC"  
LABLAXIS = "Electric AGC"  
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_AGC  
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_AGC  
LABEL_2 = "Exy"  
QUALITY = 0
```

3.4.8 File Metadata Specification

The version 07 CEF file includes a detached dataset header called: **C1/C2/C3/C4_CH_STA_AGC.ceh** described above.

For the version 07, the CEF file header contains only the static parameters (file and global metadata):

- The following **file metadata** keywords:

```
FILE_NAME = C1/C2/C3/C4_CP_STA_AGC __20070101_V07.cef
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
```

- And the following **global metadata** keywords:

```
FILE_TYPE = "cef"
DATASET_VERSION = "07"
LOGICAL_FILE_ID = "C1/C2/C3/C4_CP_STA_AGC __20070101_V04"
VERSION_NUMBER = "07"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
FILE_TIME_SPAN = 2007-01-01T00:00:00.000Z/2007-01-01T23:59:59.999Z
GENERATION_DATE = ex. 2014-02-26T11:51:23.000Z
FILE_CAVEATS =
    "Release V07 of STAFF-SA CAA Data"
    "Ted version 2.4.3 with lib 4.4.3 User patch 1"
    "STAFF-SA Processing software with C1_CT_STASA_20130124_V001.cal"
    "Prassadco software: Module Read_N2SA (2002Dec16)"
    "Caa software version 2.4 of January 2014"
```

3.4.9 Dataset header example

Ex : C1_CH_STA_AGC.ceh

```
!CEH VALIDATION 02 Feb 2019 by LPP, header V12, (RK, RP, PC, NCW)
!
START_META = DATASET_ID
    ENTRY = "C1_CP_STA_AGC"
END_META = DATASET_ID
!
START_META = DATA_TYPE
    ENTRY = "CP"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
    ENTRY = "Automatic Gain Control"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
    ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
    ENTRY = "Olga Alexandrova>Co-I>olga.alexandrova@obspm.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
```

```

ENTRY = "Average power spectral density in the passband of the analogue"
ENTRY = "receivers derived from the Automatic Gain Control signal."
ENTRY = "This is measured in three large passbands"
ENTRY = "for the axial component of the magnetic field, and the sums"
ENTRY = "of the spin plane components of the magnetic and of the electric field."
ENTRY = "The time resolution"
ENTRY = "can vary between 0.125 and 0.250s in"
ENTRY = "High Bit Rate and usually 1s (exceptionally"
ENTRY = "0.5 and 2s) in Normal Bit Rate telemetry mode."
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
ENTRY = "Raw_Data"
END_META = DATASET_TYPE
!
START_META = TIME_RESOLUTION
ENTRY = 1.0
END_META = TIME_RESOLUTION
!
START_META = MIN_TIME_RESOLUTION
ENTRY = 2.0
END_META = MIN_TIME_RESOLUTION
!
START_META = MAX_TIME_RESOLUTION
ENTRY = 0.125
END_META = MAX_TIME_RESOLUTION
!
START_META = PROCESSING_LEVEL
ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication
based upon use of this data."
ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
END_META = ACKNOWLEDGEMENT
!
START_META = DATASET_CAVEATS
ENTRY = "*C1_CQ_STA_CALIB_YTR_CAVEATS"
ENTRY = "Version 07 : New calibration tables plus addition of the interval "
ENTRY = "duration and status. Removal of onboard calibration data."
ENTRY = "Warning to the users of versions lower than 07:"
ENTRY = "Delta plus of Time_C1_CP_STA_AGC variables is set to a fixed value"
ENTRY = "instead of a value varying with the mode."
ENTRY = "This chosen fixed value is the usual minimum time resolution (1s)"
ENTRY = "which is correct in most of the time (Normal Bit Rate)."
ENTRY = "The time resolution is better in High Bit Rate."
ENTRY = "Note that the data themselves are correct."
ENTRY = "Version 04 : All the headers have been updated (laboratory name "
ENTRY = "and email). Introduction of a new header file (Dataset). "
ENTRY = "Version 03 : The data were time tagged using TED version 2.4.3"
ENTRY = "(TED Library 4.4.3 User Patch 1), provided by the Sheffield DWP Group."
ENTRY = "Version 02 : Obsolete. Should not be used !"
ENTRY = "Version 01 : Obsolete. Should not be used !"
END_META = DATASET_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
!                                                                                               Variables      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
START_VARIABLE = Time_C1_CP_STA_AGC
PARAMETER_TYPE = "Support_Data"
CATDESC       = "Interval Start time tag"
UNITS        = "s"
SI_CONVERSION = "1.0>s"
SIZES       = 1
VALUE_TYPE  = ISO_TIME
SIGNIFICANT_DIGITS = 24
FILLVAL    = 9999-12-31T23:59:59.999Z
FIELDNAM   = "UT Time"

```

```
LABLAXIS      = "UT"
DELTA_MINUS  = 0.0
DELTA_PLUS   = Duration__C1_CP_STA_AGC
END_VARIABLE = Time__C1_CP_STA_AGC
!
START_VARIABLE = Duration__C1_CP_STA_AGC
CATDESC      = "Interval duration"
FIELDNAM     = "Interval duration"
DEPEND_0     = Time__C1_CP_STA_AGC
FILLVAL      = 9.999
LABLAXIS     = "s"
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.0>s"
SIGNIFICANT_DIGITS = 4
UNITS        = "s"
VALUE_TYPE   = FLOAT
SIZES        = 1
END_VARIABLE = Duration__C1_CP_STA_AGC
!
START_VARIABLE = Status__C1_CP_STA_AGC
CATDESC      = "STAFF-SA Status"
DEPEND_0     = Time__C1_CP_STA_AGC
FIELDNAM     = "STAFF-SA Status"
FILLVAL      = "ZZZZZZZZZ"
LABEL_1     = "Status"
LABLAXIS     = "Status"
PARAMETER_CAVEATS = "First nine characters of STAFF Status. See UG, Appendix C. We cannot
certify the 9th character (EFW Sweep)"
PARAMETER_TYPE = "Support_Data"
QUALITY      = 1
SIGNIFICANT_DIGITS = 9
SIZES        = 1
UNITS        = "unitless"
VALUE_TYPE   = CHAR
END_VARIABLE = Status__C1_CP_STA_AGC
!
START_VARIABLE = Frequency__C1_CP_STA_AGC
PARAMETER_TYPE = "Support_Data"
CATDESC      = "Interval centred frequency tag"
UNITS        = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES        = 3
VALUE_TYPE   = FLOAT
SIGNIFICANT_DIGITS = 4
FILLVAL      = -999.99
FIELDNAM     = "Frequency bin centres"
LABLAXIS     = "F"
LABEL_1     = "A", "B", "C"
DELTA_PLUS   = Frequency_BHW__C1_CP_STA_AGC
DELTA_MINUS  = Frequency_BHW__C1_CP_STA_AGC
SCALETYP     = Log
DATA         = 34.9226,279.3811,2235.0488
END_VARIABLE = Frequency__C1_CP_STA_AGC
!
START_VARIABLE = Frequency_BHW__C1_CP_STA_AGC
PARAMETER_TYPE = "Support_Data"
CATDESC      = "Frequency bin half widths"
UNITS        = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES        = 3
VALUE_TYPE   = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL      = -999.99
FIELDNAM     = "Frequency bin half widths"
LABLAXIS     = "F_bhw"
LABEL_1     = "A_bhw", "B_bhw", "C_bhw"
SCALETYP     = Log
DATA         = 27.1618,217.2948,1738.3584
END_VARIABLE = Frequency_BHW__C1_CP_STA_AGC
!
```



```

DATA_UNTIL = EOF
!
2007-01-01T00:00:01.886Z,1.000,001700100,
 3.76E-02, 4.15E-02,
 3.22E-03, 1.35E-03,
 2.01E-04, 9.18E-05,
-1.00E+31,
-1.00E+31,
-1.00E+31$
!
2007-01-01T00:00:02.886Z,1.000,001700100,
 3.76E-02, 4.44E-02,
 3.22E-03, 1.35E-03,
 2.01E-04, 9.18E-05,
-1.00E+31,
-1.00E+31,
-1.00E+31$
!
...

```

3.5 Level 2 data - SA - Power Spectral Density Files (PSD)

3.5.1 Format: CEF

3.5.2 Standard: cf 2.2.

3.5.3 Production Procedure: cf 2.3.2.

3.5.4 Quality Control Procedure: cf 2.4.2.

3.5.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.5.6 Product Specification

One CEF file per day and per satellite is produced.

This CEF file contains the Power Spectral Densities values for the magnetic and the electric field.

$$\begin{pmatrix}
 B_x^2 & B_x \cdot B_y^* & B_x \cdot B_z^* & B_x \cdot E_x^* & B_x \cdot E_y^* \\
 B_y \cdot B_x^* & B_y^2 & B_y \cdot B_z^* & B_y \cdot E_x^* & B_y \cdot E_y^* \\
 B_z \cdot B_x^* & B_z \cdot B_y^* & B_z^2 & B_z \cdot E_x^* & B_z \cdot E_y^* \\
 E_x \cdot B_x^* & E_x \cdot B_y^* & E_x \cdot B_z^* & E_x^2 & E_x \cdot E_y^* \\
 E_y \cdot B_x^* & E_y \cdot B_y^* & E_y \cdot B_z^* & E_y \cdot E_x^* & E_y^2
 \end{pmatrix}$$

Data are separated into two variables, one for the magnetic components and another for the electric ones:

BB_C1_CP_STA_PSD is the float variable defined for the B_x^2 , B_y^2 and B_z^2 values (where C1 stands for satellite 1 in this example), they are given in $\text{nT}^2\text{Hz}^{-1}$ units.

EE_C1_CP_STA_PSD is the float variable defined for the E_x^2 and E_y^2 values they are given in $\text{mV}^2\text{m}^{-2}\text{Hz}^{-1}$ units.

Each variable is sampled for 27 ranges of frequencies described in the Dimension_F_C1_CP_STA_PSD variable which summarizes the 27 bin centres (given in Hz).

This variable is linked to the Dimension_F_bin_half_width_C1_CP_STA_PSD variable which gives the half width of each bin.

Data are given in SR2 coordinate system. Note that coordinate transformation is not allowed since the information that is mandatory for such an operation is unknown.

3.5.7 Dataset metadata description

The CEF file version 04 includes a detached dataset header called: **C1/C2/C3/C4_CH_STA_PSD.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

First, the following **global metadata** keywords:

```
DATASET_ID = C1/C2/C3/C4_CP_STA_PSD
DATA_TYPE = "CP>CAA_Parameter"
DATASET_TITLE = "Power Spectral Density (8 Hz - 4 kHz)"
CONTACT_COORDINATES =
    "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
    "Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"
    "Olga Alexandrova>Co-I>olga.alexandrova@obsrpm.fr"
```

```
DATASET_DESCRIPTION = "Power Spectral Density measurements of three"
"components of the magnetic field and two components of the electric field in SR2"
"reference frame, at 27 frequencies logarithmically distributed between 8 Hz and 4 kHz."
"The time resolution can vary between 0.125 and 0.250s in High Bit Rate and usually"
"1s (exceptionally 0.5 and 2s) in Normal Bit Rate telemetry mode."
```

```
PROCESSING_LEVEL = "Calibrated"
TIME_RESOLUTION = 1.0
MIN_TIME_RESOLUTION = 2.0
MAX_TIME_RESOLUTION = 0.125
```

```
ACKNOWLEDGEMENT = "Please acknowledge the STAFF team and the ESA Cluster"
"Archive in any publication based upon use of this data."
```

"Digital Object Identifier for the STAFF archive:
doi.org/10.5270/esa-yrzyijm"

DATASET_CAVEATS =

"*C1_CQ_STA_SA_PSD_NEG_CAVEATS"

"*C1_CQ_STA_NOTSRP_MTR_CAVEATS"

"*C1_CQ_STA_CALIB_YTR_CAVEATS"

"Version 07 : New calibration tables plus addition of the interval duration and status.
Removal of onboard calibration data."

"Warning to the users of versions lower than 07:"

"Delta_plus of Time__C1_CP_STA_PSD variables is set to a fixed value instead of a
value varying with the mode."

"This chosen fixed value is the usual minimum time resolution (1s) which is correct in
most of the time (Normal Bit Rate)."

"The time resolution is better in High Bit Rate."

"Note that the data themselves are correct."

"Version 04 : All the headers have been updated (laboratory name and email).
Introduction of a new header file (Dataset)."

"The PSD negative values in the version 03 have been replaced by the fillvalue (-
1.00E+31)."

"Version 03:"

"The data were time tagged using TED version 2.4.3"

"(TED Library 4.4.3 User Patch 1), provided by the Sheffield DWP Group."

"Phase rotation corrected + exhaustive data. Older versions are obsolete and should
not be used ! The negative values must not be taken into account by the users."

"Version 02 : Obsolete. This version may be used if Version 03 is not "

"available, as long as only total B and total E power are used !"

"Version 01 : Obsolete. Should not be used !"

Then, the following **Support data**:

Data are indexed by the following variables:

- **Time** which the ISO time of data acquisition (Universal Time). Its properties are:

PARAMETER_TYPE = "Support_Data"

CATDESC = "Interval time tag"

UNITS = "s"

SI_CONVERSION = "1.0>s"

SIZES = 1

VALUE_TYPE = ISO_TIME

SIGNIFICANT_DIGITS = 24

FILLVAL = 9999-99-99T99:99:99.999Z

FIELDNAM = "UT Time"

LABLAXIS = "UT"

DELTA_MINUS = 0.5

DELTA_PLUS = 0.5

DELTA_PLUS = Frequency_BHW__C1/C2/C3/C4_CP_STA_PSD
DELTA_MINUS = Frequency_BHW__C1/C2/C3/C4_CP_STA_PSD
SCALETYP = Log
DATA = 8.7692, 11.0485, 13.9203, 17.5385, 22.0971, 27.8406, 35.0769, 44.1942,
55.6812, 70.1539, 88.3883, 111.3623, 140.3078, 176.7767, 222.7247, 280.6155,
353.5534, 445.4493, 561.2310, 707.1068, 890.8987, 1122.4620, 1414.2135,
1781.7975, 2244.9243, 2828.4270, 3563.5945

- **Frequency_BHW** represents the Frequency bin half widths expressed in Hz. Its values correspond to the 27 frequency bin centres (Frequency_C?_CP_STA_PSD) :

PARAMETER_TYPE = "Support_Data"

CATDESC = "Frequency bin half widths"

UNITS = "Hz"

SI_CONVERSION = "1.0>Hz"

SIZES = 27

VALUE_TYPE = FLOAT

SIGNIFICANT_DIGITS = 3

FILLVAL = -999.99

FIELDNAM = "Frequency bin half widths"

LABLAXIS = "F_bhw"

LABEL_1 = "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",
"F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",
"F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",
"F_bhw", "F_bhw", "F_bhw", "F_bhw"

SCALETYP = Log

DATA = 1.0085, 1.2706, 1.6008, 2.0169, 2.5412, 3.2017, 4.0338, 5.0823, 6.4033,
8.0677, 10.1647, 12.8067, 16.1354, 20.3293, 25.6133, 32.2708, 40.6586, 51.2267,
64.5416, 81.3173, 102.4534, 129.0831, 162.6346, 204.9067, 258.1663, 325.2691,
409.8134

Data themselves:

- **BB_xxyyzz_SR2_C1/C2/C3/C4_CP_STA_PSD** variable stores the magnetic components of the power spectral density is an incomplete tensor of order 2. Since only B_x^2 , B_y^2 and B_z^2 are present, its representation in SR2 coordinate system ('COORDINATE_SYSTEM = "SR2") is limited to "xx", "yy" and "zz" ('REPRESENTATION = xx" "yy" "zz"):

PARAMETER_TYPE = "Data"

ENTITY = "Magnetic Field"

PROPERTY = "Vector"

FLUCTUATIONS = "Wavelet_Power-spectrum"

CATDESC = "Power spectrum 8-4000 Hz of the B-field components along the SR2 coordinate axes"

UNITS = "nT^2Hz^-1"

SI_CONVERSION = "1.0E-18>T^2Hz^-1"

```
TENSOR_ORDER = 2
TENSOR_FRAME = SR2
FRAME = SR2
COORDINATE_SYSTEM = SR2
SIZES = 27,3 ! 27 frequency bins x 3 components
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E+31
FIELDNAM = "Magnetic Power Spectral Density"
LABLAXIS = "Magnetic Power Spectral Density"
REPRESENTATION_2 = "xx","yy","zz"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PSD
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PSD
LABEL_2 = "Bx^2","By^2","Bz^2"
QUALITY = 3
```

- **EE_xxyy_SR2_C1/C2/C3/C4_CP_STA_PSD** variable stores the electric components of the power spectral density is an incomplete tensor of order 2. Since only E_x^2 and E_y^2 are present, its representation in SR2 coordinate system is limited to "xx" and "yy":

```
PARAMETER_TYPE = "Data"
ENTITY = "Electric Field"
PROPERTY = "Vector"
FLUCTUATIONS = "Wavelet_Power-spectrum"
CATDESC = "Power spectrum 8-4000 Hz of the E-field components along the ISR coordinate axes"
UNITS = "mV^2 m^-2 Hz^-1"
SI_CONVERSION = "1.0E-6>V^2 m^-2 Hz^-1"
TENSOR_ORDER = 2
TENSOR_FRAME = "SR2"
FRAME = "SR2 >xyz"
COORDINATE_SYSTEM = "SR2"
SIZES = 27,2 ! 27 frequency bins x 2 components
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E+31
FIELDNAM = "Electrical Power Spectral Density"
LABLAXIS = "Electrical Power Spectral Density"
REPRESENTATION_2 = "xx","yy"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PSD
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PSD
LABEL_2 = "Ex^2","Ey^2"
QUALITY = 3
```

3.5.8 File Metadata Specification

The version 7 CEF file includes a detached dataset header called: **C1/C2/C3/C4_CH_STA_PSD.ceh** described above.

For the version 04, the CEF contains now only the static parameters (file and global metadata).

The following file **metadata** keywords:

```
FILE_NAME = C1/C2/C3/C4_CP_STA_PSD__20010419_V07.cef
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
```

And the following **global metadata** keywords:

```
FILE_TYPE = "cef"
LOGICAL_FILE_ID = "C1/C2/C3/C4_CP_STA_PSD__20070101_V07"
DATASET_VERSION = "07"
VERSION_NUMBER = "07"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
FILE_TIME_SPAN = ex. 2007-01-01T00:00:00.000Z/2007-01-01T23:59:59.999Z
GENERATION_DATE = ex. 2014-01-24T21:12:11.000Z
FILE_CAVEATS = "Release V07 of STAFF-SA CAA Data
                "Ted version 2.4.3 with lib 4.4.3 User patch 1"
                "STAFF-SA Processing software with
C1_CT_STASA_20130124_V001.cal"
                "Prasadco software: Module Read_N2SA (2002Dec16)"
                "Caa software version 2.4 of January 2014"
```

3.5.9 Dataset header example

Ex : C1_CH_STA_PSD.ceh

```
!CEH VALIDATION 13 May 2019 by LPP, header V15, (RK)
!
START_META = DATASET_ID
  ENTRY = "C1_CP_STA_PSD"
END_META = DATASET_ID
!
START_META = DATA_TYPE
  ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
  ENTRY = "Power Spectral Density (8 Hz - 4 kHz)"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
  ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
  ENTRY = "Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"
  ENTRY = "Olga Alexandrova>Co-I>olga.alexandrova@obspm.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
  ENTRY = "Power Spectral Density measurements of three"
  ENTRY = "components of the magnetic field and two components"
  ENTRY = "of the electric field in SR2 reference frame,"
  ENTRY = "at 27 frequencies logarithmically distributed"
  ENTRY = "between 8 Hz and 4 kHz. The time resolution"
  ENTRY = "can vary between 0.125 and 0.250s in"
  ENTRY = "High Bit Rate and usually 1s (exceptionally"
  ENTRY = "0.5 and 2s) in Normal Bit Rate telemetry mode."
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
  ENTRY = "Spectra"
  ENTRY = "Electric_Field"
  ENTRY = "Magnetic_Field"
END_META = DATASET_TYPE
!
START_META = TIME_RESOLUTION
  ENTRY = 1.0
END_META = TIME_RESOLUTION
!
START_META = MIN_TIME_RESOLUTION
  ENTRY = 2.0
END_META = MIN_TIME_RESOLUTION
!
START_META = MAX_TIME_RESOLUTION
  ENTRY = 0.125
END_META = MAX_TIME_RESOLUTION
!
START_META = PROCESSING_LEVEL
  ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
  ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication
based upon use of this data."
  ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
END_META = ACKNOWLEDGEMENT
!
START_META = DATASET_CAVEATS
  ENTRY = "*C1_CQ_STA_SA_PSD_NEG_CAVEATS"
  ENTRY = "*C1_CQ_STA_NOTSRP_MTR_CAVEATS"
  ENTRY = "*C1_CQ_STA_CALIB_YTR_CAVEATS"
  ENTRY = "Version 07 : New calibration tables plus addition of the interval "
```

```
ENTRY = "duration and status. Removal of onboard calibration data."
ENTRY = "Warning to the users of versions lower than 07:"
ENTRY = "Delta plus of Time_C1_CP_STA_PSD variables is set to a fixed value"
ENTRY = "instead of a value varying with the mode."
ENTRY = "This chosen fixed value is the usual minimum time resolution (1s)"
ENTRY = "which is correct in most of the time (Normal Bit Rate)."
ENTRY = "The time resolution is better in High Bit Rate."
ENTRY = "Note that the data themselves are correct."
ENTRY = "Version 04 : All the headers have been updated (laboratory name "
ENTRY = "and email). Introduction of a new header file (Dataset). "
ENTRY = "The PSD negative values in the version 03 have been replaced "
ENTRY = "by the fillvalue (-1.00E+31)."
ENTRY = "Version 03:"
ENTRY = "The data were time tagged using TED version 2.4.3"
ENTRY = "(TED Library 4.4.3 User Patch 1), provided by the Sheffield DWP Group."
ENTRY = "Phase rotation corrected + exhaustive data. Older versions "
ENTRY = "are obsolete and should not be used ! The negative values must not be"
ENTRY = "taken into account by the users."
ENTRY = "Version 02 : Obsolete. This version may be used if Version 03 is not "
ENTRY = "available, as long as only total B and total E power are used !"
ENTRY = "Version 01 : Obsolete. Should not be used !"
END_META = DATASET_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                 Variables !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
START_VARIABLE = Time_C1_CP_STA_PSD
PARAMETER_TYPE = "Support_Data"
CATDESC = "Interval start time tag"
UNITS = "s"
SI_CONVERSION = "1.0>s"
SIZES = 1
VALUE_TYPE = ISO TIME
SIGNIFICANT_DIGITS = 24
FILLVAL = 9999-12-31T23:59:59.999Z
FIELDNAM = "UT Time"
LABLAXIS = "UT"
DELTA_MINUS = 0.
DELTA_PLUS = Duration_C1_CP_STA_PSD
END_VARIABLE = Time_C1_CP_STA_PSD
!
START_VARIABLE = Duration_C1_CP_STA_PSD
CATDESC = "Interval duration"
FIELDNAM = "Sampling interval duration"
DEPEND_0 = Time_C1_CP_STA_PSD
FILLVAL = 9.999
LABLAXIS = "s"
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION = "1.0>s"
SIGNIFICANT_DIGITS = 4
UNITS = "s"
VALUE_TYPE = FLOAT
SIZES = 1
END_VARIABLE = Duration_C1_CP_STA_PSD
!
START_VARIABLE = Status_C1_CP_STA_PSD
CATDESC = "STAFF-SA Status"
DEPEND_0 = Time_C1_CP_STA_PSD
FIELDNAM = "STAFF-SA Status"
FILLVAL = "ZZZZZZZZZ"
LABEL_1 = "Status"
LABLAXIS = "Status"
PARAMETER_CAVEATS = "First nine characters of STAFF Status. See UG, Appendix C. We cannot
certify the 9th character (EFW Sweep)"
PARAMETER_TYPE = "Support_Data"
QUALITY = 1
SIGNIFICANT_DIGITS = 9
SIZES = 1
UNITS = "unitless"
```

```

VALUE_TYPE = CHAR
END_VARIABLE = Status__C1_CP_STA_PSD
!
START_VARIABLE = Frequency__C1_CP_STA_PSD
PARAMETER_TYPE = "Support_Data"
CATDESC = "Interval centred frequency tag"
UNITS = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES = 27
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 8
FILLVAL = -999.99
FIELDNAM = "Frequency bin centres"
LABLAXIS = "F"
LABEL_1 =
"F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F"
",","F","F","F"
DELTA_PLUS = Frequency_BHW__C1_CP_STA_PSD
DELTA_MINUS = Frequency_BHW__C1_CP_STA_PSD
SCALETYP = Log
DATA = 8.7692,11.0485,13.9203,17.5385,22.0971,27.8406,35.0769, \
44.1942,55.6812,70.1539,88.3883,111.3623,140.3078, \
176.7767,222.7247,280.6155,353.5534,445.4493,561.2310, \
707.1068,890.8987,1122.4620,1414.2135,1781.7975, \
2244.9243,2828.4270,3563.5945
END_VARIABLE = Frequency__C1_CP_STA_PSD
!
START_VARIABLE = Frequency_BHW__C1_CP_STA_PSD
PARAMETER_TYPE = "Support_Data"
CATDESC = "Frequency bin half widths"
UNITS = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES = 27
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 7
FILLVAL = -999.99
FIELDNAM = "Frequency bin half widths"
LABLAXIS = "F_bhw"
LABEL_1 =
"F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw"
",","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw"
hw","F_bhw","F_bhw","F_bhw"
SCALETYP = Log
DATA = 1.0085,1.2706,1.6008,2.0169,2.5412,3.2017,4.0338, \
5.0823,6.4033,8.0677,10.1647,12.8067,16.1354,20.3293, \
25.6133,32.2708,40.6586,51.2267,64.5416,81.3173, \
102.4534,129.0831,162.6346,204.9067,258.1663,325.2691, \
409.8134
END_VARIABLE = Frequency_BHW__C1_CP_STA_PSD
!
START_VARIABLE = BB_xxyyzz_sr2__C1_CP_STA_PSD
PARAMETER_TYPE = "Data"
ENTITY = "Magnetic_Field"
PROPERTY = "Vector"
FLUCTUATIONS = "Wavelet_Power_Spectrum"
CATDESC = "Power spectrum 8-4000 Hz of the B-field components along the SR2
coordinate axes"
UNITS = "nT^2 Hz^-1"
SI_CONVERSION = "1.0E-18>T^2 Hz^-1"
TENSOR_ORDER = 2
TENSOR_FRAME = "SR2"
FRAME = "SR2>xyz"
COORDINATE_SYSTEM = "SR2"
SIZES = 27,3 ! 27 frequency bins x 3 components
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E+31
FIELDNAM = "Magnetic Power Spectral Density"
LABLAXIS = "Magnetic Power Spectral Density"
REPRESENTATION_2 = "xx","yy","zz"

```

```
DEPEND_0      = Time_C1_CP_STA_PSD
DEPEND_1      = Frequency_C1_CP_STA_PSD
LABEL_2       = "Bx^2","By^2","Bz^2"
QUALITY       = 3
END_VARIABLE = BB_xxyyzz_sr2_C1_CP_STA_PSD
!
START_VARIABLE = EE_xxyy_sr2_C1_CP_STA_PSD
PARAMETER_TYPE = "Data"
ENTITY         = "Electric_Field"
PROPERTY       = "Vector"
FLUCTUATIONS  = "Wavelet Power Spectrum"
CATDESC       = "Power spectrum 8-4000 Hz of the E-field components along the SR2
coordinate axes"
UNITS         = "mV^2 m^-2 Hz^-1"
SI_CONVERSION = "1.0E-6>V^2 m^-2 Hz^-1"
TENSOR_ORDER  = 2
TENSOR_FRAME  = "SR2"
FRAME         = "SR2>xyz"
COORDINATE_SYSTEM = "SR2"
SIZES         = 27,2      ! 27 frequency bins x 2 components
VALUE_TYPE    = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL       = -1.00E+31
FIELDNAM      = "Electrical Power Spectral Density"
LABLAXIS      = "Electrical Power Spectral Density"
REPRESENTATION_2 = "xx","yy"
DEPEND_0      = Time_C1_CP_STA_PSD
DEPEND_1      = Frequency_C1_CP_STA_PSD
LABEL_2       = "Ex^2","Ey^2"
QUALITY       = 3
END_VARIABLE = EE_xxyy_sr2_C1_CP_STA_PSD
```

3.5.10 Dataset file example

Ex : C1_CP_STA_PSD__20010701_V07.cef

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                   File Metadata      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
FILE_NAME = "C1_CP_STA_PSD_20010701_V07.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                   Global Metadata      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
INCLUDE= CL_CH_MISSION.ceh                ! Mission level metadata.
!
INCLUDE= C1_CH_OBS.ceh                    ! Observatory level metadata.
!
INCLUDE= CL_CH_STA.ceh                    ! Experiment level metadata.
!
INCLUDE= C1_CH_STA_SA.ceh                 ! Instrument level metadata.
!
INCLUDE= C1_CH_STA_PSD.ceh               ! Dataset level metadata.
!
START_META = FILE_TYPE
ENTRY = "cef"
END_META = FILE_TYPE
!
START_META = LOGICAL_FILE_ID
ENTRY = "C1_CP_STA_PSD__20010701_V07"
END_META = LOGICAL_FILE_ID
!
```


3.6 Level 2 data – SA - Spectral Matrices Files (SM)

3.6.1 Format: CEF

3.6.2 Standard: cf 2.2.

3.6.3 Production Procedure: cf 2.3.2.

3.6.4 Quality Control Procedure: cf 2.4.2.

3.6.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.6.6 Product Specification

One CEF file per day and per satellite is produced.

This CEF file contains the Spectral Matrix values for the magnetic electric cross-products.

$$\begin{pmatrix} B_x^2 & B_x \cdot B_y^* & B_x \cdot B_z^* & B_x \cdot E_x^* & B_x \cdot E_y^* \\ B_y \cdot B_x^* & B_y^2 & B_y \cdot B_z^* & B_y \cdot E_x^* & B_y \cdot E_y^* \\ B_z \cdot B_x^* & B_z \cdot B_y^* & B_z^2 & B_z \cdot E_x^* & B_z \cdot E_y^* \\ E_x \cdot B_x^* & E_x \cdot B_y^* & E_x \cdot B_z^* & E_x^2 & E_x \cdot E_y^* \\ E_y \cdot B_x^* & E_y \cdot B_y^* & E_y \cdot B_z^* & E_y \cdot E_x^* & E_y^2 \end{pmatrix}$$

Data are separated into three variables, one for the magnetic components BB, one for the electric components EE, and one for the BE cross-products:

For sake of homogeneity, all components are given in $\text{mV}^2\text{m}^{-2}\text{Hz}^{-1}$ units.

Each variable is sampled for 27 ranges of frequencies described in the Dimension_F_C1_CP_STA_PSD variable which summarizes the 27 bin centres (given in Hz). This variable is linked to the Dimension_F_bin_half_width_C1_CP_STA_PSD variable which gives the half width of each bin.

Data are given in SR2 coordinate system.

3.6.7 Dataset metadata description

The version 04 CEF file includes a detached dataset header called: **C1/C2/C3/C4_CH_STA_SM.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

First, the following **global metadata** keywords:

```
DATASET_ID = "C1/C2/C3/C4_CP_STA_SM"
DATA_TYPE = "CP"
DATASET_TITLE = "Spectral Matrix (8 Hz - 4 kHz)"
CONTACT_COORDINATES =
    "Rodrigue Piberne>Archive Manager>rodrigue.piberne@jpp.polytechnique.fr"
    "Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"
    "Olga Alexandrova>Co-I>olga.alexandrova@obspm.fr"
```

```
DATASET_DESCRIPTION = "Cross spectral matrices formed from 3 components of
the magnetic field and 2 components of the electric field determined with 4s time
resolution at 27 logarithmically distributed frequencies between 8 Hz and 4 kHz."
```

```
DATASET_TYPE = "Spectra"
    "Electric_Field"
    "Magnetic_Field"
```

```
PROCESSING_LEVEL = "Calibrated"
```

```
ACKNOWLEDGEMENT= "Please acknowledge the STAFF team and the ESA Cluster
Archive in any publication based upon use of this data."
```

```
    Digital Object Identifier for the STAFF archive:
    doi.org/10.5270/esa-yrzyijm"
```

```
TIME_RESOLUTION = 4.0
```

```
MIN_TIME_RESOLUTION = 4.0
```

```
MAX_TIME_RESOLUTION = 1.0
```

```
DATASET_CAVEATS =
```

```
    "*C1_CQ_STA_NOTSRP_MTR_CAVEATS"
```

```
    "*C1_CQ_STA_CALIB_YTR_CAVEATS"
```

```
    "Version 07 : New calibration tables plus addition of the interval duration and status.
    Removal of onboard calibration data."
```

```
    "Warning to the users of versions lower than 07:"
```

```
    "Delta_plus of Time__C1_CP_STA_SM variables is set to a fixed value instead of a
    value varying with the mode."
```

```
    "This chosen fixed value is the minimum time resolution (4s) which is correct in most
    of the cases (Normal Bit Rate)"
```

```
    "Note that the data themselves are correct."
```

"Version 04 : All the headers have been updated (laboratory name and email).
Introduction of a new header file (Dataset). "

"Units and Si Conversion of the variables BB and BE have been corrected."

"Version 03 : Phase rotation corrected + exhaustive data. "

"The data were time tagged using TED version 2.4.3"

"(TED Library 4.4.3 User Patch 1), provided by the Sheffield DWP Group."

"Older versions are obsolete and should not be used ! "

"Version 02 : Obsolete. Should not be used !"

"Version 01 : Obsolete. Should not be used !"

Then, the following **Support Data**:

- **Time_C1/C2/C3/C4_CP_STA_SM** which the ISO time of data acquisition (Universal Time):

PARAMETER_TYPE = "Support_Data"

CATDESC = "Interval start time tag"

UNITS = "s"

SI_CONVERSION = "1.0>s"

SIZES = 1

VALUE_TYPE = ISO_TIME

SIGNIFICANT_DIGITS = 24

FILLVAL = 9999-12-31T23:59:59.999Z

FIELDNAM = "UT Time"

LABLAXIS = "UT"

DELTA_MINUS = 0.0

DELTA_PLUS = Duration__C1_CP_STA_SM

- **Duration_C1_CP_STA_SM** :

CATDESC= "Interval duration"

FIELDNAM = "Interval duration"

DEPEND_0 = Time__C1_CP_STA_SM

FILLVAL= 9

LABLAXIS = "s"

PARAMETER_TYPE = "Support_Data"

SI_CONVERSION= "1.0>s"

SIGNIFICANT_DIGITS = 1

UNITS = "s"

VALUE_TYPE= INT

SIZES = 1

END_VARIABLE = Duration__C1_CP_STA_SM

- **Status_C1_CP_STA_SM** :

CATDESC = "STAFF-SA Status"

DEPEND_0 = Time__C1_CP_STA_SM

FIELDNAM = "STAFF-SA Status"

```
LABLAXIS = "F_bhw"  
LABEL_1 = "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",  
"F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",  
"F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",  
"F_bhw", "F_bhw", "F_bhw", "F_bhw"  
SCALETYP = Log  
DATA = 1.0085, 1.2706, 1.6008, 2.0169, 2.5412, 3.2017, 4.0338, 5.0823, 6.4033,  
8.0677, 10.1647, 12.8067, 16.1354, 20.3293, 25.6133, 32.2708, 40.6586, 51.2267,  
64.5416, 81.3173, 102.4534, 129.0831, 162.6346, 204.9067, 258.1663, 325.2691,  
409.8134
```

Data themselves:

- **BB_xyz_xyz_sr2** variable stores the magnetic components of the Spectral Matrix is a complex tensor of order 2:

```
PARAMETER_TYPE = "Data"  
ENTITY = "Magnetic_Field"  
PROPERTY = "Vector"  
FLUCTUATIONS = "Wavelet_Cross-power-spectrum"  
CATDESC = "Cross-spectral matrix of the magnetic field at 27 frequencies form  
8HZ to 4 kHz."  
UNITS = "mV^2 m^-2 Hz^-1"  
SI_CONVERSION = "1.1E-23>T^2 Hz^-1"  
TENSOR_ORDER = 2  
TENSOR_FRAME = SR2  
FRAME = SR2>xyz  
COORDINATE_SYSTEM = SR2  
SIZES = 27,2,3,3 ! 27 frequency bins x 2 (Re.+Im.) parts (3x3)matrix  
VALUE_TYPE = FLOAT  
SIGNIFICANT_DIGITS = 6  
FILLVAL = -1.00000E+31  
FIELDNAM = "Spectral Matrix, BB components "  
LABLAXIS = "Spectral Matrix, BB components"  
REPRESENTATION_3 = "x","y","z"  
REPRESENTATION_4 = "x","y","z"  
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_SM  
DEPEND_1 = Frequency__C1C1/C2/C3/C4_CP_STA_SM  
LABEL_2 = "Re","Im"  
LABEL_3 = "Bx","By","Bz"  
LABEL_4 = "Bx","By","Bz"  
QUALITY = 3
```

- **EE_xy_xy_sr2** variable stores the electric components of the spectral matrix is a complex tensor of order 2:

```
PARAMETER_TYPE = "Data"  
ENTITY = "Electric_Field"
```

```
PROPERTY = "Vector"  
FLUCTUATIONS = "Wavelet_Cross-power-spectrum"  
CATDESC = "Cross-spectral matrix of the electric field at 27 frequencies from 8 Hz  
to 4 kHz"  
UNITS = "mV^2m^-2Hz^-1"  
SI_CONVERSION = "1.0E-6>V^2m^-2Hz^-1"  
TENSOR_ORDER = 2  
TENSOR_FRAME = "SR2"  
FRAME = "SR2>xyz" SIZES = 27,2,2,2 ! 27 frequency bins x 2 (Re.+Im.) parts x  
(2x2)matrix  
VALUE_TYPE = FLOAT  
SIGNIFICANT_DIGITS = 6  
FILLVAL = -1.00000E+31  
FIELDNAM = "Spectral Matrix, EE components"  
LABLAXIS = "Spectral Matrix, EE components"  
REPRESENTATION_3 = "x","y"  
REPRESENTATION_4 = "x","y"  
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_SM  
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_SM  
LABEL_2 = "Re","Im"  
LABEL_3 = "Ex","Ey"  
LABEL_4 = "Ex","Ey"  
QUALITY = 3
```

- **BE_xyz_xy_sr2** variable stores the BE cross-product components of the spectral matrix is a complex tensor of order 2:

```
PARAMETER_TYPE = "Data"  
ENTITY = "Compound"  
PROPERTY = "Vector"  
FLUCTUATIONS = "Wavelet_Cross-spectrum"  
CATDESC = "Electromagnetic cross-spectral ExB products at 27 frequencies from  
8 Hz to 4 KHz"  
UNITS = "mV^2 m^-2 Hz^-1"  
SI_CONVERSION = "3.3E-15>T V m^-1 Hz^-1"  
TENSOR_ORDER = 2  
TENSOR_FRAME = "SR2"  
FRAME = "SR2 >xyz"  
COORDINATE_SYSTEM = "SR2"  
SIZES = 27,2,3,2 ! 27 frequency bins x 2 (Re.+Im.) parts (3x2)matrix  
VALUE_TYPE = FLOAT  
SIGNIFICANT_DIGITS = 6  
FILLVAL = -1.00000E+31  
FIELDNAM = "Spectral Matrix, BE components"  
LABLAXIS = "Spectral Matrix, BE components"  
REPRESENTATION_3 = "x","y","z"  
REPRESENTATION_4 = "x","y"
```

```
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_SM
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_SM
LABEL_2 = "Re","Im"
LABEL_3 = "Bx","By","Bz"
LABEL_4 = "Ex","Ey"
QUALITY = 3
```

3.6.8 File Metadata Specification

The version 07 CEF file includes a detached dataset header called: **C1/C2/C3/C4_CH_STA_SM.ceh** described above.

For the version 04, the CEF header contains now only the static parameters (file and global metadata):

The following **file metadata** keywords:

```
FILE_NAME = C1/C2/C3/C4_CP_STA_SM__20070101_V04.cef
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
```

And the following **global metadata** keywords:

```
FILE_TYPE = "cef"
DATASET_VERSION = "07"
LOGICAL_FILE_ID = ex. "C1/C2/C3/C4_CP_STA_SM__20070101_V07"
VERSION_NUMBER = "07"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
FILE_TIME_SPAN = ex. 2007-01-01T00:00:00.000Z/2007-01-01T23:59:59.999Z
GENERATION_DATE = ex. 2014-03-11T11:15:39.000Z
FILE_CAVEATS = "Release V07 of STAFF-SA CAA Data"
               "Ted version 2.4.3 with lib 4.4.3 User patch 1"
               "STAFF-SA           Processing           software           with
C1_CT_STASA_20130124_V001.cal"
               "Prasadco software: Module Read_N2SA (2002Dec16)"
               "Caa software version 2.4 of January 2014"
```

3.6.9 Dataset header example

Ex : C1_CH_STA_SM.ceh

```
!CEH VALIDATION 13 May 2019 by LPP, header V15, (RK)
!
START_META = DATASET_ID
ENTRY = "C1_CP_STA_SM"
```

```
END_META = DATASET_ID
!
START_META = DATA_TYPE
  ENTRY = "CP>CAA_Parameter"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
  ENTRY = "Spectral Matrix (8 Hz - 4 kHz)"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
  ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
  ENTRY = "Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"
  ENTRY = "Olga Alexandrova>Co-I>olga.alexandrova@obspm.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
  ENTRY = "Cross spectral matrices formed from"
  ENTRY = "3 components of the magnetic field"
  ENTRY = "and 2 components of the electric field determined"
  ENTRY = "with either 1 or 4s time resolution at 27 logarithmically"
  ENTRY = "distributed frequencies between 8 Hz and 4 kHz."
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
  ENTRY = "Spectra"
  ENTRY = "Electric_Field"
  ENTRY = "Magnetic_Field"
END_META = DATASET_TYPE
!
START_META = TIME_RESOLUTION
  ENTRY = 4.0
END_META = TIME_RESOLUTION
!
START_META = MIN_TIME_RESOLUTION
  ENTRY = 4.0
END_META = MIN_TIME_RESOLUTION
!
START_META = MAX_TIME_RESOLUTION
  ENTRY = 1.0
END_META = MAX_TIME_RESOLUTION
!
START_META = PROCESSING_LEVEL
  ENTRY = "Calibrated"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
  ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication
based upon use of this data."
  ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
END_META = ACKNOWLEDGEMENT
!
START_META = DATASET_CAVEATS
  ENTRY = "*C1_CQ_STA_NOTSRP_MTR_CAVEATS"
  ENTRY = "*C1_CQ_STA_CALIB_YTR_CAVEATS"
  ENTRY = "Version 07 : New calibration tables plus addition of the interval "
  ENTRY = "duration and status. Removal of onboard calibration data."
  ENTRY = "Warning to the users of versions lower than 07:"
  ENTRY = "Delta_plus of Time_C1_CP_STA_SM variables is set to a fixed value"
  ENTRY = "instead of a value varying with the mode."
  ENTRY = "This chosen fixed value is the minimum time resolution (4s)"
  ENTRY = "which is correct in most of the cases (Normal Bit Rate)"
  ENTRY = "Note that the data themselves are correct."
  ENTRY = "Version 04 : All the headers have been updated (laboratory name "
  ENTRY = "and email). Introduction of a new header file (Dataset). "
  ENTRY = "Units and Si Conversion of the variables BB and BE have been corrected."
  ENTRY = "Version 03 : Phase rotation corrected + exhaustive data. "
  ENTRY = "The data were time tagged using TED version 2.4.3"
  ENTRY = "(TED Library 4.4.3 User Patch 1), provided by the Sheffield DWP Group."
  ENTRY = "Older versions are obsolete and should not be used ! "
```



```

SCALETYP      = Log
DATA          = 8.7692,11.0485,13.9203,17.5385,22.0971,27.8406,35.0769, \
              44.1942,55.6812,70.1539,88.3883,111.3623,140.3078, \
              176.7767,222.7247,280.6155,353.5534,445.4493,561.2310, \
              707.1068,890.8987,1122.4620,1414.2135,1781.7975, \
              2244.9243,2828.4270,3563.5945
END_VARIABLE = Frequency_C1_CP_STA_SM
!
START_VARIABLE = Frequency_BHW_C1_CP_STA_SM
PARAMETER_TYPE = "Support_Data"
CATDESC       = "Frequency bin half widths"
UNITS         = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES        = 27
VALUE_TYPE    = FLOAT
SIGNIFICANT_DIGITS = 7
FILLVAL      = -999.99
FIELDNAM     = "Frequency bin half widths"
LABLAXIS     = "F_bhw"
LABEL_1      = "F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw"
              =
              "F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw","F_bhw"
              "F_bhw","F_bhw","F_bhw"
SCALETYP      = Log
DATA          = 1.0085,1.2706,1.6008,2.0169,2.5412,3.2017,4.0338, \
              5.0823,6.4033,8.0677,10.1647,12.8067,16.1354,20.3293, \
              25.6133,32.2708,40.6586,51.2267,64.5416,81.3173, \
              102.4534,129.0831,162.6346,204.9067,258.1663,325.2691, \
              409.8134
END_VARIABLE = Frequency_BHW_C1_CP_STA_SM
!
START_VARIABLE = BB_xyz_xyz_sr2_C1_CP_STA_SM
PARAMETER_TYPE = "Data"
ENTITY         = "Magnetic Field"
PROPERTY       = "Vector"
FLUCTUATIONS  = "Wavelet_Cross_Power_Spectrum"
CATDESC       = "Cross-spectral matrix of the magnetic field at 27 frequencies from 8
Hz to 4 kHz"
UNITS         = "mV^2 m^-2 Hz^-1"
SI_CONVERSION = "1.1E-23>T^2 Hz^-1"
TENSOR_ORDER  = 2
TENSOR_FRAME  = "SR2"
FRAME         = "SR2>xyz"
COORDINATE_SYSTEM = "SR2"
SIZES        = 27,2,3,3      ! 27 frequency bins x 2 (Re.+Im.) parts x (3x3)matrix
VALUE_TYPE    = FLOAT
SIGNIFICANT_DIGITS = 6
FILLVAL      = -1.00000E+31
FIELDNAM     = "Spectral Matrix, BB components"
LABLAXIS     = "Spectral Matrix, BB components"
REPRESENTATION_3 = "x","y","z"
REPRESENTATION_4 = "x","y","z"
DEPEND_0     = Time_C1_CP_STA_SM
DEPEND_1     = Frequency_C1_CP_STA_SM
LABEL_2      = "Re","Im"
LABEL_3      = "Bx","By","Bz"
LABEL_4      = "Bx","By","Bz"
QUALITY      = 3
END_VARIABLE = BB_xyz_xyz_sr2_C1_CP_STA_SM
!
START_VARIABLE = EE_xy_xy_sr2_C1_CP_STA_SM
PARAMETER_TYPE = "Data"
ENTITY         = "Electric Field"
PROPERTY       = "Vector"
FLUCTUATIONS  = "Wavelet_Cross_Power_Spectrum"
CATDESC       = "Cross-spectral matrix of the electric field at 27 frequencies from 8
Hz to 4 kHz"
UNITS         = "mV^2 m^-2 Hz^-1"
SI_CONVERSION = "1.0E-6>V^2 m^-2 Hz^-1"
TENSOR_ORDER  = 2

```

```
TENSOR_FRAME = "SR2"
FRAME = "SR2>xyz"
COORDINATE_SYSTEM = "SR2"
SIZES = 27,2,2,2 ! 27 frequency bins x 2 (Re.+Im.) parts x (2x2)matrix
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 6
FILLVAL = -1.00000E+31
FIELDNAM = "Spectral Matrix, EE components"
LABLAXIS = "Spectral Matrix, EE components"
REPRESENTATION_3 = "x","y"
REPRESENTATION_4 = "x","y"
DEPEND_0 = Time_C1_CP_STA_SM
DEPEND_1 = Frequency_C1_CP_STA_SM
LABEL_2 = "Re","Im"
LABEL_3 = "Ex","Ey"
LABEL_4 = "Ex","Ey"
QUALITY = 3
END_VARIABLE = EE_xy_xy_sr2_C1_CP_STA_SM
!
START_VARIABLE = BE_xyz_xy_sr2_C1_CP_STA_SM
PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Vector"
FLUCTUATIONS = "Wavelet Cross Spectrum"
CATDESC = "Electromagnetic cross-spectral ExB products at 27 frequencies from 8
Hz to 4 kHz"
UNITS = "mV^2 m^-2 Hz^-1"
SI_CONVERSION = "3.3E-15>T V m^-1 Hz^-1"
TENSOR_ORDER = 2
TENSOR_FRAME = "SR2"
FRAME = "SR2>xyz"
COORDINATE_SYSTEM = "SR2"
SIZES = 27,2,3,2 ! 27 frequency bins x 2 (Re.+Im.) parts x (3x2)matrix
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 6
FILLVAL = -1.00000E+31
FIELDNAM = "Spectral Matrix, BE components"
LABLAXIS = "Spectral Matrix, BE components"
REPRESENTATION_3 = "x","y","z"
REPRESENTATION_4 = "x","y"
DEPEND_0 = Time_C1_CP_STA_SM
DEPEND_1 = Frequency_C1_CP_STA_SM
LABEL_2 = "Re","Im"
LABEL_3 = "Bx","By","Bz"
LABEL_4 = "Ex","Ey"
QUALITY = 3
END_VARIABLE = BE_xyz_xy_sr2_C1_CP_STA_SM
```

3.7 Level 3 data - Graphical Data (Plots)

3.7.1 Format: binary

Graphical products are delivered in PNG formats.

3.7.2 Standard: N.A.

3.7.3 Production Procedure: N.A.

3.7.4 Quality Control Procedure: N.A.

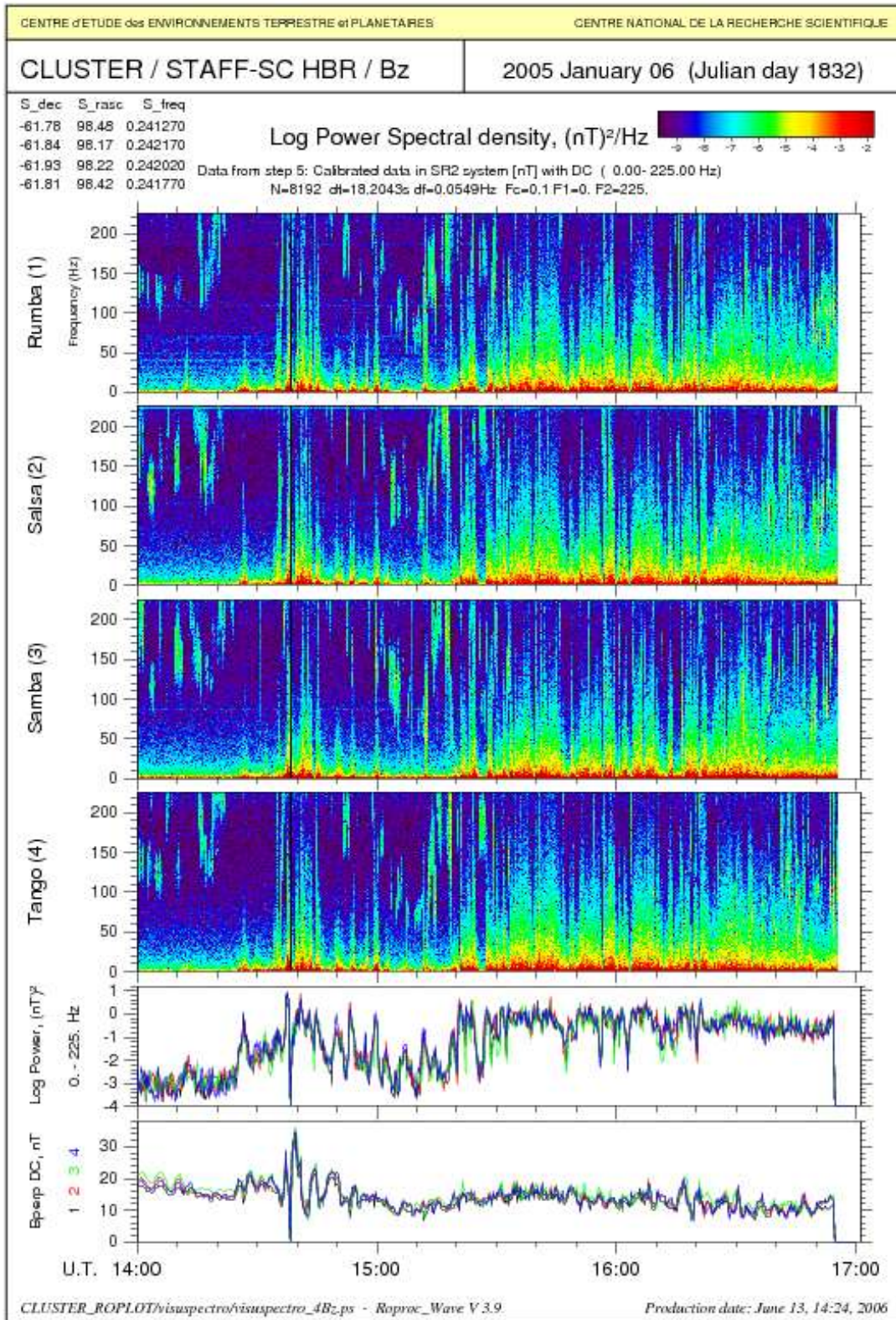
3.7.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.7.6 Product Specification

3.7.6.1 STAFF-SC spectrograms

Plots are separated in time series of 3 hours, in other words we have 8 files per day (this is a maximum number, because if data don't exist files are not created). NBR and HBR plots are separated (2x8). They show the B_z (spin axis aligned) component of the magnetic field expressed as the Log Power Spectral Density (nT^2Hz^{-1}) for the 4 satellites. The range of covered frequencies is 0-12.5 Hz in Normal Bit Rate (NBR) and 0-225 Hz in High Bit Rate (HBR). Below these 4 plots (one per satellite) one finds the integrated power curves for the 4 satellites in the range 0.2-12.5Hz (NBR) or 0.2-225Hz (HBR). At the very bottom the DC field in the plan perpendicular to the spin axis for the four spacecraft is given. An example of HBR plot is given next page.



3.7.6.2 STAFF house keeping plots

These plots show a summary of housekeeping data extracted from WEC HK telemetry. There is one plot per S/C, of 3 hours duration each. HK time resolution is 5.15 seconds.

The plotted parameters allow verifying the mode of operation and the health of STAFF experiment, in the context of WEC and satellite mode of operation.

It permits in particular to understand data gaps.

The 10 plots, from top to bottom describe:

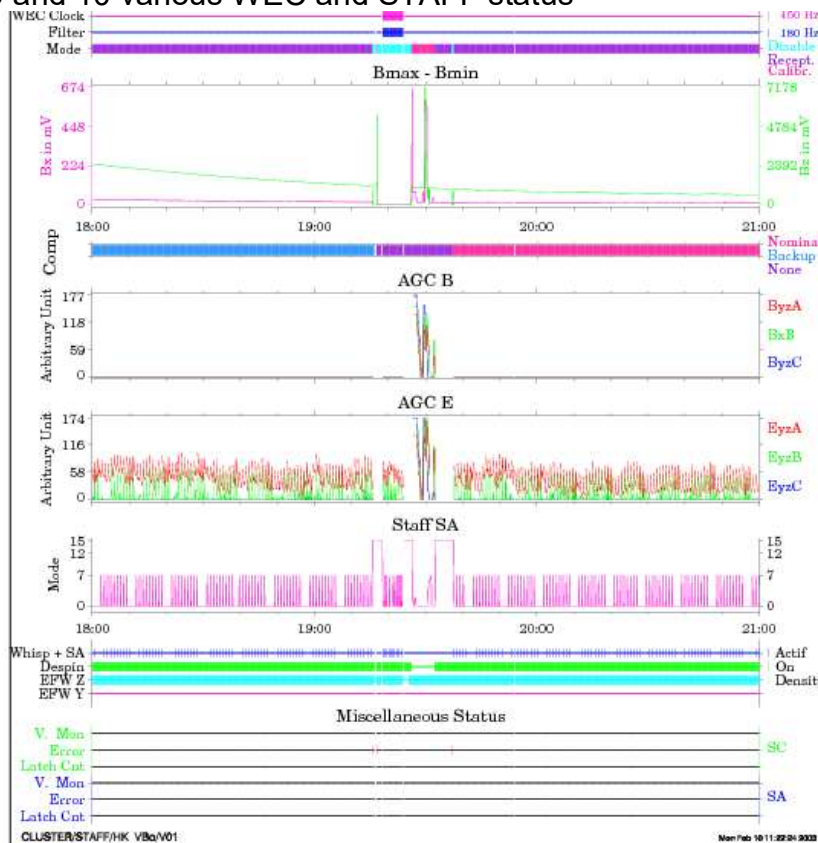
1-The S/C telemetry mode

2- STAFF relevant DWP status (as Application or TM overflow)

3-4-5 STAFF SC (3- mode; 4- maximum amplitude of the waveform; 5- compression mode)

6-7-8 STAFF SA (6 and 7- AGC level; 8-mode)

9 and 10 various WEC and STAFF status



Example of HK plot. There is a calibration mode in operation in the middle of the 3 hours.

3.7.7 Dataset metadata description

3.7.7.1 STAFF-SC spectrograms

N/A

3.7.7.2 STAFF house keeping plots

All the png files include a detached dataset header called: **C1/C2/C3/C4_CG_STA_HK_OVERVIEW**.

In this header, only the static parameters (global metadata) are included.

The following **global metadata** keywords:

```
DATASET_ID = "C1_CG_STA_HK_OVERVIEW"  
DATA_TYPE = "CG>CAA_Graphic"  
CONTACT_COORDINATES =  
    "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"  
    "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"  
    "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
```

```
DATASET_TITLE = "STAFF HK overview plots"
```

```
DATASET_DESCRIPTION = These plots show a summary of housekeeping data  
extracted from WEC HK telemetry. There is one plot per S/C, of 3 hours duration each.  
HK time resolution is 5.15 seconds. The plotted parameters allow verifying the mode  
of operation and the health of STAFF experiment, in the context of WEC and satellite  
mode of operation. It permits in particular to understand data gaps. The 10 plots, from  
top to bottom describe:"
```

```
    "1-The S/C telemetry mode"
```

```
    "2- STAFF relevant DWP status (as Application or TM overflow)"
```

```
    "3-4-5 STAFF SC (3- mode; 4- maximum amplitude of the waveform; 5-  
compression mode)"
```

```
    "6-7-8 STAFF SA (6 and 7- AGC level; 8-mode)"
```

```
    "9 and 10 various WEC and STAFF status"
```

```
PROCESSING_LEVEL = "Auxiliary"
```

```
ACKNOWLEDGEMENT = "Please acknowledge the STAFF team and the ESA Cluster  
Archive in any publication based upon use of this data. Digital Object Identifier for the  
STAFF archive: doi.org/10.5270/esa-yrzyijm"
```

```
! Mandatory except for CAVEATS datasets
```

```
!-----  
TIME_RESOLUTION = 10800
```

```
MIN_TIME_RESOLUTION = 10800
MAX_TIME_RESOLUTION = 10800
FILE_TYPE = "png"
DATASET_VERSION = "V01"
METADATA_VERSION = "2.0"
METADATA_TYPE = "CAA"
```

! Optional metadata

!-----

```
DATASET_CAVEATS = ""
```

3.7.8 Metadata Specification

N/A

3.7.9 Dataset header example

3.7.9.1 STAFF-SC spectrograms

N/A

3.7.9.2 STAFF house keeping plots

Ex : C1_CG_STA_HK_OVERVIEW.ceh

```
! CEH VALIDATION 13 March 2019 by LPP, V02 (VB, RK)
!
! Include mission header
! This header is provided by the CAA
!-----
INCLUDE = "CL_CH_MISSION.ceh"

! Include observatory header
! This header is provided by the CAA
!-----
INCLUDE = "C1_CH_OBS.ceh"

! Include experiment header
!-----
INCLUDE = "CL_CH_STA.ceh"

! Include instrument header
!-----
INCLUDE = "C1_CH_STA.ceh"

!=====
! Dataset Level Metadata
!=====

! Mandatory metadata
!-----
START_META      = DATASET_ID
ENTRY           = "C1_CG_STA_HK_OVERVIEW"
END_META        = DATASET_ID
```

```
START_META = DATA_TYPE
ENTRY = "CG>CAA_Graphic"
END_META = DATA_TYPE

START_META = CONTACT_COORDINATES
ENTRY = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
ENTRY = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES

START_META = DATASET_TITLE
ENTRY = "STAFF HK overview plots"
END_META = DATASET_TITLE

START_META = DATASET_DESCRIPTION
ENTRY = "These plots show a summary of housekeeping data extracted from WEC HK
telemetry."
ENTRY = "There is one plot per S/C, of 3 hours duration each. HK time resolution is
5.15 seconds."
ENTRY = "The plotted parameters allow verifying the mode of operation and the health
of STAFF"
ENTRY = "experiment, in the context of WEC and satellite mode of operation."
ENTRY = "It permits in particular to understand data gaps."
ENTRY = "The 10 plots, from top to bottom describe:"
ENTRY = "1-The S/C telemetry mode"
ENTRY = "2- STAFF relevant DWP status (as Application or TM overflow)"
ENTRY = "3-4-5 STAFF SC (3- mode; 4- maximum amplitude of the waveform; 5- compression
mode)"
ENTRY = "6-7-8 STAFF SA (6 and 7- AGC level; 8-mode)"
ENTRY = "9 and 10 various WEC and STAFF status"
END_META = DATASET_DESCRIPTION
!
START_META = PROCESSING_LEVEL
ENTRY = "Auxiliary"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication
based upon use of this data."
ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyjm"
END_META = ACKNOWLEDGEMENT
!

! Mandatory except for CAVEATS datasets
!-----
START_META = TIME_RESOLUTION
ENTRY = 10800
END_META = TIME_RESOLUTION

START_META = MIN_TIME_RESOLUTION
ENTRY = 10800
END_META = MIN_TIME_RESOLUTION

START_META = MAX_TIME_RESOLUTION
ENTRY = 10800
END_META = MAX_TIME_RESOLUTION

START_META = FILE_TYPE
ENTRY = "png"
END_META = FILE_TYPE

START_META = DATASET_VERSION
ENTRY = "V01"
END_META = DATASET_VERSION

START_META = METADATA_VERSION
ENTRY = "2.0"
END_META = METADATA_VERSION
```

```
START_META      = METADATA_TYPE
ENTRY           = "CAA"
END_META        = METADATA_TYPE

! Optional metadata
!-----
START_META      = DATASET_CAVEATS
ENTRY           = ""
END_META        = DATASET_CAVEATS
```

3.7.10 Dataset file example

N/A

3.8 Level 3 data - SA – Polarization and Propagation Parameters (PPP)

3.8.1 Format: CEF

3.8.2 Standard: cf 2.2.

3.8.3 Production Procedure: cf 2.3.2.

3.8.4 Quality Control Procedure: cf 2.4.2.

3.8.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.8.6 Product Specification

One CEF file per day and per satellite is produced.

This CEF file contains the Polarization and Propagation Parameters for the magnetic and the electric field.

Data are separated into seven variables:

The parameters calculated from the three magnetic components are:

THSVD_mfa__C1_STA_PPP is the float variable defined for the polar angle value of the wave vector (where C1 stands for satellite 1 in this example), they are given in degree units.

PHSVD_mfa__C1_STA_PPP is the float variable defined for the azimuthal angle value of the wave vector (where C1 stands for satellite 1 in this example), they are given in degree units.

ELLSVD__C1_CP_STA_PPP is the float variable defined for the ellipticity of the polarization (unitless)

POLSVD__C1_CP_STA_PPP is the float variable defined for the degree of polarization in the polarization plane.

BSUM__C1_CP_STA_PPP is the float variable defined for the sum of the three auto-power spectra of the three magnetic antennae given in $\text{nT}^2\text{Hz}^{-1}$ units.

PVSIGN__C1_CP_STA_PPP is the float variables defined for the direction of the Poynting vector component parallel to the magnetic field. Positive (negative) values correspond to a parallel (anti-parallel) Z-component of the Poynting vector.

ESUM__C1_CP_STA_PPP is the float variable defined for the sum of the two auto-power spectra of the two electric antennae given in $\text{mV}^2\text{m}^{-2}\text{Hz}^{-1}$ units.

Each variable is sampled for 27 ranges of frequencies described in the Dimension_F__C1_CP_STA_PPP variable which summarizes the 27 bin centres (given in Hz).

This variable is linked to the Dimension_F_bin_half_width__C1_CP_STA_PPP variable which gives the half width of each bin.

Data are given in MFA coordinate system. Note that coordinate transformation is not allowed since the information that is mandatory for such an operation is unknown.

3.8.7 Dataset metadata description:

The detached dataset header is called: **C1/C2/C3/C4_CH_STA_PPP.ceh**.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

First, the following **global metadata** keywords:

```
DATASET_ID = C1/C2/C3/C4_CP_STA_PPP
```

```
DATA_TYPE = "CP"
```

```
DATASET_TITLE = "Polarization and Propagation Parameter"
```

```
CONTACT_COORDINATES =
```

```
    "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
```

```
    "Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"
```

```
    "Olga Alexandrova>Co-I>olga.alexandrova@obspm.fr"
```

```
DATASET_DESCRIPTION = "Polarization and propagation parameters derived from singular value decomposition (SVD) method of the cross-spectral matrix (sm) using the PRASSADCO program with 4s (or 1s) time resolution at 27 (or 18) logarithmically distributed frequencies between either 8 (or 64) Hz to 4 kHz. The SVD method is described in Santolik et al (2003). The parameters calculated from the three magnetic components are THSVD, PHSVD, ELLSVD,POLSVD and BSUM. BSUM is the sum of the three magnetic auto-power spectra. When BSUM is inferior to  $1.0\text{E}-09 \text{ nT}^2/\text{Hz}$ , the calculation of the other magnetic dependant parameters is meaningless. The theta
```

and phi variables are respectively the wave vector polar and azimuthal angles in MFA coordinate system. PVSIGN is the direction of the Poynting vector component parallel to the magnetic field. It is given only when E component is valid. Positive (negative) values correspond to a parallel (anti-parallel) Z-component of the Poynting vector. ESUM is the the sum of auto-power spectra of the two electric antennae. The calculation of PVSIGN is meaningless when BSUM is inferior to 1.0E-09 nT²/Hz, and ESUM to 3.0E-09mV²m²/Hz. The change of coordinate system has been done using FGM 5VPS data. “

DATASET_TYPE = "Electric_Field"
 = "Magnetic_Field"

PROCESSING_LEVEL = "Derived"

ACKNOWLEDGEMENT = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."

 "Digital Object Identifier for the STAFF archive:
 doi.org/10.5270/esa-yrzyijm"

TIME_RESOLUTION = 4.0

MIN_TIME_RESOLUTION = 4.0

MAX_TIME_RESOLUTION = 1.0

DATASET_CAVEATS =

"*C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS"

"*C1_CQ_STA_NOTSRP_MTR_CAVEATS"

"*C1_CQ_STA_CALIB_YTR_CAVEATS"

"DATASET VERSION HISTORY:"

 "Version 09 : Reprocessed due to FGM and/or SPD-AUX files re-deliveries."

 "Version 08 : FGM induced gaps revised and completed."

 "Version 07 : New calibration tables plus addition of the half-interval duration and status. Removal of onboard calibration data."

 "Now with FGM induced gaps. FGM file used described in the FILE_CAVEATS

 "

 "metadata section. "

 "Warning to the users of versions lower than 07:"

 "Delta_plus of Time__C1_CP_STA_PPP variables was set to a fixed value instead of a value varying with the mode."

 "This chosen fixed value is the minimum time resolution (4s)"

 "which is correct in most of the cases (Normal Bit Rate)."

 "Note that the data themselves are correct."

 "The data were time tagged using TED version 2.4.3"

 "(TED Library 4.4.3 User Patch 1), provided by the Sheffield DWP Group."

 "Version 05: used the new calibration tables (feb 2013)."

 "Version 03: AUX files in CDF format used are 26 hours."

 "Same data than version02 but less missing values."

 "Version 02: Data format corrected."

FIELDNAM = "Half-interval duration"
DEPEND_0 = Time__C1_CP_STA_PPP
FILLVAL= 9.999
LABLAXIS = "s"
PARAMETER_TYPE = "Support_Data"
SI_CONVERSION= "1.0>s"
SIGNIFICANT_DIGITS = 4
UNITS = "s"
VALUE_TYPE= FLOAT
SIZES = 1

- **Status_C1/C2/C3/C4_CP_STA_PPP:**

CATDESC = "STAFF-SA Status"
DEPEND_0 = Time__C1_CP_STA_PPP
FIELDNAM = "STAFF-SA Status"
FILLVAL= "ZZZZZZZZZ"
LABEL_1= "Status"
LABLAXIS = "Status"
PARAMETER_CAVEATS = "First nine characters of STAFF Status. See UG, Appendix C. We cannot certify the 9th character (EFW Sweep)"
PARAMETER_TYPE = "Support_Data"
QUALITY= 1
SIGNIFICANT_DIGITS = 9
SIZES = 1
UNITS = "unitless"
VALUE_TYPE= CHAR

- **Frequency_BHW** represents the Frequency bin half widths expressed in Hz. Its values correspond to the 27 frequency bin centres (Frequency_C?_CP_STA_PPP) :

PARAMETER_TYPE = "Support_Data"
CATDESC = "Frequency bin half widths"
UNITS = "Hz"
SI_CONVERSION = "1.0>Hz"
SIZES = 27
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 7
FILLVAL = -999.99
FIELDNAM = "Frequency bin half widths"
LABLAXIS = "F_bhw"
LABEL_1 = "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",
"F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",
"F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw", "F_bhw",
"F_bhw", "F_bhw", "F_bhw", "F_bhw"
SCALETYP = Log
DATA = 1.0085, 1.2706, 1.6008, 2.0169, 2.5412, 3.2017, 4.0338, 5.0823, 6.4033,
8.0677, 10.1647, 12.8067, 16.1354, 20.3293, 25.6133, 32.2708, 40.6586, 51.2267,

64.5416, 81.3173, 102.4534, 129.0831, 162.6346, 204.9067, 258.1663, 325.2691,
409.8134

Data themselves:

- **THSVD_mfa_C1/C2/C3/C4_CP_STA_PPP** variable stores the polar angle of the direction of propagation in MFA coordinate system (SVD).
PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Direction"
CATDESC = "Polar angle of the direction of propagation in MFA coordinate system (SVD)."
UNITS = "deg"
SI_CONVERSION = "0.01745>rad"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -999.
FIELDNAM = "Polar angle (SVD) in MFA coordinate system."
LABLAXIS = "THSVD"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PPP
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PPP
QUALITY = 3
- **PHSVD_mfa_C1/C2/C3/C4_CP_STA_PPP** variable stores the azimuthal angle of the direction of propagation in MFA coordinate system (SVD).
PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Direction"
CATDESC = "Azimuthal angle of the direction of propagation in MFA coordinate system (SVD)."
UNITS = "deg"
SI_CONVERSION = "0.01745>rad"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -999.
FIELDNAM = "Azimuthal angle (SVD) in MFA coordinate system."
LABLAXIS = "PHSVD"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PPP
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PPP
QUALITY = 3
- **ELLSVD_C1/C2/C3/C4_CP_STA_PPP** variable stores the ellipticity of the polarization (SVD).

PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Magnitude"
CATDESC = "Ellipticity of the polarization (SVD)."
UNITS = "Unitless"
SI_CONVERSION = "1>unitless"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 2
FILLVAL = -9.9
FIELDNAM = "Ellipticity of the polarization (SVD)."
LABLAXIS = "ELLSVD"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PPP
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PPP
QUALITY = 3

- **POLSVD_C1/C2/C3/C4_CP_STA_PPP** variable stores the degree of polarization in the polarization plane (SVD).

PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Magnitude"
CATDESC = "Degree of polarization in the polarization plane (SVD)."
UNITS = "Unitless"
SI_CONVERSION = "1>unitless"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 2
FILLVAL = -9.9
FIELDNAM = "Degree of polarization in the polarization plane (SVD)."
LABLAXIS = "POLSVD"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PPP
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PPP
QUALITY = 3

- **BSUM_C1/C2/C3/C4_CP_STA_PPP** variable stores the sum of the three magnetic auto-power spectra.

PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Magnitude"
CATDESC = "Sum of the three magnetic auto-power spectra."
UNITS = "nT² Hz⁻¹"
SI_CONVERSION = "1.0E-18>T² Hz⁻¹"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E-31

FIELDNAM = "Sum of the three magnetic auto-power spectra."
LABLAXIS = "BSUM"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PPP
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PPP
QUALITY = 3

- **PVSIGN_C1/C2/C3/C4_CP_STA_PPP** variable stores the parallel component of the Poynting vector normalized by its standard deviation.

PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Component"
CATDESC = "Parallel component of the Poynting vector normalized by its standard deviation."
UNITS = "Unitless"
SI_CONVERSION = "1>Unitless"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E-31
FIELDNAM = "Normalized Z-component of the Poynting vector."
LABLAXIS = "PVSIGN"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PPP
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PPP
QUALITY = 3

- **ESUM_C1/C2/C3/C4_CP_STA_PPP** variable stores the sum of the two electric auto-power spectra.

PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Magnitude"
CATDESC = "Sum of the two electric auto-power spectra."
UNITS = "mV² m⁻² Hz⁻¹"
SI_CONVERSION = "1.0E-6>V² m⁻² Hz⁻¹"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E-31
FIELDNAM = "Sum of the two electric auto-power spectra."
LABLAXIS = "ESUM"
DEPEND_0 = Time__C1/C2/C3/C4_CP_STA_PPP
DEPEND_1 = Frequency__C1/C2/C3/C4_CP_STA_PPP
QUALITY = 3

3.8.8 File Metadata Specification

The version 4 CEF file includes a detached dataset header called: **C1/C2/C3/C4_CH_STA_PPP.ceh** described above.

For the version 08, the CEF contains now only the static parameters (file and global metadata).

The following file **metadata** keywords:

```
FILE_NAME = C1/C2/C3/C4_CP_STA_PPP__20010201_V08.cef
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
```

And the following **global metadata** keywords:

```
FILE_TYPE = "cef"
LOGICAL_FILE_ID = "C1/C2/C3/C4_CP_STA_PPP__20070101_V08"
DATASET_VERSION = "08"
VERSION_NUMBER = "08"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
FILE_TIME_SPAN = ex. 2001-02-01T00:00:00.000Z/2001-02-01T23:59:59.999Z
GENERATION_DATE = ex. 2016-03-04T18:56:43.758Z
```

```
FILE_CAVEATS = "Release V07 of STAFF-SA CAA Data"
               "TED version 2.4.3 with lib 4.4.3 User Patch 1"
               "STAFF-SA Processing software with C1_CT_STASA_20130124_V001.cal"
               "Prasadco software:"
               "Module read_N2SA(2011Sep30) and module PRASSADCO(2010Nov15)"
               "Caa software version 2.0 of July 2009"
               "FGM file used:"
               "C1_CP_FGM_5VPS__20010201_000000_20010202_000000_V140304.cdf"
               "FGM file's MD5 checksum: 1f13ee9fbb5c70f2b479020bb67fcc68"
```

3.8.9 Dataset header example

Ex : C1_CH_STA_PPP.ceh

```
!CEH VALIDATION 03 Dec 2019 by LPP, header V15, (RK)
!
START_META = DATASET_ID
  ENTRY = "C1_CP_STA_PPP"
END_META = DATASET_ID
!
START_META = DATA_TYPE
  ENTRY = "CP>CAA_Parameter"
```

```
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
  ENTRY = "Polarization and Propagation Parameters"
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
  ENTRY = "Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"
  ENTRY = "Olga Alexandrova>Co-I>olga.alexandrova@obspm.fr"
  ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
  ENTRY = "Polarization and propagation parameters"
  ENTRY = "derived from singular value decomposition (SVD) method"
  ENTRY = "of the cross-spectral matrix (sm) using the PRASSADCO program"
  ENTRY = "with 4s (or 1s) time resolution at 27 (or 18) logarithmically"
  ENTRY = "distributed frequencies between either 8 (or 64) Hz to 4 kHz."
  ENTRY = "The SVD method is described in Santolik et al (2003)."
```

```
ENTRY = "Version 07 : New calibration tables plus addition of the half-interval "  
ENTRY = "duration and status. Removal of onboard calibration data."  
ENTRY = "Now with FGM induced gaps. FGM file used described in the FILE_CAVEATS "  
ENTRY = "metadata section. "  
ENTRY = "Warning to the users of versions lower than 07:"  
ENTRY = "Delta_plus of Time_C1_CP_STA_PPP variables was set to a fixed value"  
ENTRY = "instead of a value varying with the mode."  
ENTRY = "This chosen fixed value is the minimum time resolution (4s)"  
ENTRY = "which is correct in most of the cases (Normal Bit Rate)."  
ENTRY = "Note that the data themselves are correct."  
ENTRY = "The data were time tagged using TED version 2.4.3"  
ENTRY = "(TED Library 4.4.3 User Patch 1), provided by the Sheffield DWP Group."  
ENTRY = "Version 05: used the new calibration tables (feb 2013)."  
ENTRY = "Version 03: AUX files in CDF format used are 26 hours."  
ENTRY = "Same data than version02 but less missing values."  
ENTRY = "Version 02: Data format corrected."  
ENTRY = "Version 01: Obsolete. Should not be used !"  
END_META = DATASET_CAVEATS  
!  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!                                     Variables      !  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!  
START_VARIABLE = Time_C1_CP_STA_PPP  
PARAMETER_TYPE = "Support_Data"  
CATDESC       = "Interval time tag"  
UNITS         = "s"  
SI_CONVERSION = "1.0>s"  
SIZES         = 1  
VALUE_TYPE    = ISO_TIME  
SIGNIFICANT_DIGITS = 24  
FILLVAL       = 9999-12-31T23:59:59.999Z  
FIELDNAM      = "UT Time"  
LABLAXIS      = "UT"  
DELTA_MINUS   = Duration_C1_CP_STA_PPP  
DELTA_PLUS    = Duration_C1_CP_STA_PPP  
END_VARIABLE = Time_C1_CP_STA_PPP  
!  
START_VARIABLE = Frequency_C1_CP_STA_PPP  
PARAMETER_TYPE = "Support_Data"  
CATDESC       = "Interval centred frequency tag"  
UNITS         = "Hz"  
SI_CONVERSION = "1.0>Hz"  
SIZES         = 27  
VALUE_TYPE    = FLOAT  
SIGNIFICANT_DIGITS = 8  
FILLVAL       = -999.99  
FIELDNAM      = "Frequency bin centres"  
LABLAXIS      = "F"  
LABEL_1      = "  
"F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F","F"  
", "F", "F", "F"  
DELTA_PLUS    = Frequency_BHW_C1_CP_STA_PPP  
DELTA_MINUS   = Frequency_BHW_C1_CP_STA_PPP  
SCALETYP      = Log  
DATA          = 8.7692,11.0485,13.9203,17.5385,22.0971,27.8406,35.0769, \  
44.1942,55.6812,70.1539,88.3883,111.3623,140.3078, \  
176.7767,222.7247,280.6155,353.5534,445.4493,561.2310, \  
707.1068,890.8987,1122.4620,1414.2135,1781.7975, \  
2244.9243,2828.4270,3563.5945  
END_VARIABLE = Frequency_C1_CP_STA_PPP  
!  
START_VARIABLE = Duration_C1_CP_STA_PPP  
CATDESC       = "Half-interval duration"  
FIELDNAM      = "Half-interval duration"  
DEPEND_0      = Time_C1_CP_STA_PPP  
FILLVAL       = 9.999  
LABLAXIS      = "s"  
PARAMETER_TYPE = "Support_Data"  
SI_CONVERSION = "1.0>s"
```



```
CATDESC = "Azimuthal Angle of the direction of propagation in MFA coordinate
system (SVD)."
```

```
UNITS = "deg"
SI_CONVERSION = "0.01745>rad"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -999.
FIELDNAM = "Azimuthal angle (SVD) in MFA coordinate system"
LABLAXIS = "PHSVD"
DEPEND_0 = Time C1 CP STA PPP
DEPEND_1 = Frequency_C1_CP_STA_PPP
QUALITY = 3
END_VARIABLE = PHSVD_mfa_C1_CP_STA_PPP
!
```

```
START_VARIABLE = ELLSVD_C1_CP_STA_PPP
PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Magnitude"
CATDESC = "Ellipticity of the polarization (SVD)."
```

```
UNITS = "Unitless"
SI_CONVERSION = "1.0>unitless"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 2
FILLVAL = -9.9
FIELDNAM = "Ellipticity of the polarization (SVD)."
```

```
LABLAXIS = "ELLSVD"
DEPEND_0 = Time_C1_CP_STA_PPP
DEPEND_1 = Frequency_C1_CP_STA_PPP
QUALITY = 3
END_VARIABLE = ELLSVD_C1_CP_STA_PPP
!
```

```
START_VARIABLE = POLSVD C1 CP STA PPP
PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Magnitude"
CATDESC = "Degree of polarization in the polarization plane (SVD)."
```

```
UNITS = "Unitless"
SI_CONVERSION = "1.0>unitless"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 2
FILLVAL = -9.9
FIELDNAM = "Degree of polarization in the polarization plane (SVD)."
```

```
LABLAXIS = "POLSV"
DEPEND_0 = Time_C1_CP_STA_PPP
DEPEND_1 = Frequency_C1_CP_STA_PPP
QUALITY = 3
END_VARIABLE = POLSVD_C1_CP_STA_PPP
!
```

```
START_VARIABLE = BSUM_C1_CP_STA_PPP
PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Magnitude"
CATDESC = "Sum of the three magnetic auto-power spectra."
```

```
UNITS = "nT^2 Hz^-1"
SI_CONVERSION = "1.0E-18>T^2 Hz^-1"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E+31
FIELDNAM = "Sum of the three magnetic auto-power spectra."
```

```
LABLAXIS = "BSUM"
DEPEND_0 = Time_C1_CP_STA_PPP
DEPEND_1 = Frequency_C1_CP_STA_PPP
QUALITY = 3
END_VARIABLE = BSUM_C1_CP_STA_PPP
!
```

```
START_VARIABLE = PVSIGN_C1_CP_STA_PPP
```

```
PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Component"
CATDESC = "Parallel component of the Poynting vector normalized by its standard
deviation."
UNITS = "Unitless"
SI_CONVERSION = "1.0>unitless"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E+31
FIELDNAM = "Normalized Z-component of the Poynting vector"
LABLAXIS = "PVSIGN"
DEPEND_0 = Time__C1_CP_STA_PPP
DEPEND_1 = Frequency__C1_CP_STA_PPP
QUALITY = 3
END VARIABLE = PVSIGN C1 CP STA PPP
!
START VARIABLE = ESUM__C1_CP_STA_PPP
PARAMETER_TYPE = "Data"
ENTITY = "Compound"
PROPERTY = "Magnitude"
CATDESC = "Sum of the two electric auto-power spectra."
UNITS = "mV^2 m^-2 Hz^-1"
SI_CONVERSION = "1.0E-6>V^2 m^-2 Hz^-1"
SIZES = 27 ! 27 frequency bins
VALUE_TYPE = FLOAT
SIGNIFICANT_DIGITS = 3
FILLVAL = -1.00E+31
FIELDNAM = "Sum of the two electric auto-power spectra."
LABLAXIS = "ESUM"
DEPEND_0 = Time__C1_CP_STA_PPP
DEPEND_1 = Frequency__C1_CP_STA_PPP
QUALITY = 3
END VARIABLE = ESUM__C1_CP_STA_PPP
!
```

3.8.10 Dataset file example

Ex : C1_CP_STA_PPP__20010201_V01.cef

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                   File Metadata      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
FILE_NAME = "C1_CP_STA_PPP__20010201_V08.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                   Global Metadata      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
INCLUDE= CL_CH_MISSION.ceh                ! Mission level metadata.
!
INCLUDE= C1_CH_OBS.ceh                    ! Observatory level metadata.
!
INCLUDE= CL_CH_STA.ceh                    ! Experiment level metadata.
!
INCLUDE= C1_CH_STA_SA.ceh                 ! Instrument level metadata.
!
INCLUDE= C1_CH_STA_PPP.ceh                ! Dataset level metadata.
!
START_META = DATASET_VERSION
ENTRY = "08"
END_META = DATASET_VERSION
```



```
-0.9,-0.9,-1.0,-0.6, 0.9, 0.7,-0.7,-0.4,-0.8,-0.5, 0.6, 0.4, 0.6,-0.6,-0.7,-0.9,-0.9, 0.8,-  
9.9,-9.9,-0.8,-9.9,-9.9, 0.9,-1.0,-0.8,-0.9,  
0.4, 0.6, 0.6, 0.3, 0.0, 0.2, 0.2, 0.5, 0.1, 0.3, 0.2, 0.4, 0.2, 0.2, 0.2, 0.0, 0.0, 0.1,-9.9,-  
9.9, 0.1,-9.9,-9.9, 0.1, 0.0, 0.1, 0.1,  
1.91E-06, 1.08E-06, 7.09E-07, 4.16E-07, 1.21E-07, 9.22E-08, 7.02E-08, 3.31E-08, 1.75E-08,  
1.24E-08, 5.55E-09, 4.87E-09, 4.04E-09, 2.63E-09, 1.82E-09, 1.25E-09, 8.07E-10, 4.96E-10, 2.77E-  
10, 2.97E-10, 5.60E-10, 3.47E-10, 3.59E-10, 6.21E-10, 6.53E-10, 8.87E-10, 1.19E-09,  
7.50E-04, 2.02E-01,-2.59E-02,-2.96E-03, 4.72E-01,-3.00E-01, 1.71E-01,-5.59E-02, 1.11E-01,  
7.99E-03, 7.17E-02,-8.92E-02,-1.05E-01,-1.61E-01,-6.57E-02, 5.16E-02, 1.12E-01,-2.19E-02,-  
1.00E+31,-1.00E+31,-1.00E+31,-1.00E+31,-1.00E+31, 1.37E-01, 4.43E-02,-1.00E+31, 9.76E-03,  
1.64E-05, 1.14E-06, 5.29E-07, 1.08E-06, 3.13E-07, 6.25E-07, 4.16E-07, 1.52E-07, 9.35E-08,  
4.01E-07, 1.46E-07, 4.00E-08, 5.64E-08, 1.98E-08, 1.48E-08, 1.61E-08, 5.79E-09, 4.50E-09, 2.10E-  
09, 1.89E-09, 1.20E-09, 1.04E-09, 9.14E-10, 3.82E-09, 3.36E-09, 8.90E-10, 1.99E-09 $  
2001-02-01T00:00:18.587Z,2.000,000000000,  
...
```

3.9 Auxilliary data –CAVEAT file for SM/PPP STAFF-SA – PSDNEG

3.9.1 Format: CEF

3.9.2 Standard: cf 2.2.

3.9.3 Production Procedure: cf 2.3.2.

3.9.4 Quality Control Procedure: cf 2.4.2.

3.9.5 Delivery Procedure

Secured ftp from LPP to ESTEC

3.9.6 Product Specification

One CEF file per day and per satellite is produced where
This CEF file contains the caveats for the SM/PPP datasets from the STAFF-SA instrument. For a given time and frequency are given the PSD negative values that have been replaced in the PSD data product by a fillvalue.

3.9.7 Dataset metadata description

The detached dataset header is called: **C1/C2/C3/C4_CH_STA_SA_PSDNEG.keh.**

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

First, the following **global metadata** keywords:

```
DATASET_ID = C1/C2/C3/C4_CP_STA_SA_PSDNEG
DATA_TYPE = "CQ"
DATASET_TITLE = "PSD negative value"
CONTACT_COORDINATES =
  "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
  "Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"
  "Olga Alexandrova>Co-I>olga.alexandrova@obsmpm.fr"
```

```
DATASET_DESCRIPTION = "This dataset contains caveats for the PSD dataset from the STAFF-SA instrument. It gives the time, frequency bin, component and amplitude of PSD negative values that have been replaced by fill-values in the PSD product."
```

```
PROCESSING_LEVEL = "Auxilliary"
DATASET_TYPE = "Caveats"
ACKNOWLEDGEMENT = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data. Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
```

Then, the following **Support data**:

Data are indexed by the following variables:

- **Time** which the ISO time of data acquisition (Universal Time). Its properties are:

```
PARAMETER_TYPE = "Support_Data"
CATDESC = "Time tag"
VALUE_TYPE = ISO_TIME
UNITS = "s"
SI_CONVERSION = "1.0>s"
DELTA_MINUS = 0
DELTA_PLUS = 0
SIGNIFICANT_DIGITS = 24
FILLVAL = 9999-12-31T23:59:99.999Z
FIELDNAM = "UT Time"
LABLAXIS = "UT"
```

- **Frequency_C1_CQ_STA_SA_PSD_NEG_CAVEATS:**

```
PARAMETER_TYPE = "Support_Data"
CATDESC = "Frequency of the PSD negative value."
FIELDNAM = "Frequency bin centres"
VALUE_TYPE = FLOAT
FILLVAL = -999.99
UNITS = "Hz"
SI_CONVERSION = "1.0>Hz"
SIGNIFICANT_DIGITS = 8
```

DEPEND_0 = Time__C1_CQ_STA_SA_PSD_NEG_CAVEATS

- **Component_Id_C1_CQ_STA_SA_PSD_NEG_CAVEATS:**

PARAMETER_TYPE = "Support_Data"

CATDESC = "Identifier of the component of the PSD negative value."

FIELDNAM = "Component identifier"

VALUE_TYPE = INT

FILLVAL = 0

UNITS = "unitless"

SI_CONVERSION = "1>unitless"

SIGNIFICANT_DIGITS = 1

DEPEND_0 = Time__C1_CQ_STA_SA_PSD_NEG_CAVEATS

- **Amplitude_C1/C2/C3/C4_CP_STA_SA_PSDNEG:**

PARAMETER_TYPE = "Support_Data"

CATDESC = "Amplitude of the PSD negative value (see PARAMETER_CAVEATS for units)."

FIELDNAM = "Amplitude"

VALUE_TYPE = FLOAT

FILLVAL = -1.00E+31

UNITS = "unitless"

SI_CONVERSION = "1>unitless"

PARAMETER_CAVEATS = "If Component_Id is 1, 2 or 3 then units are nT² Hz⁻¹, else units are mV² m⁻² Hz⁻¹."

SIGNIFICANT_DIGITS = 3

DEPEND_0 = Time__C2_CQ_STA_SA_PSD_NEG_CAVEATS

DEPEND_1 = Component_Id__C2_CQ_STA_SA_PSD_NEG_CAVEATS

3.9.8 File Metadata Specification

The version 4 CEF file includes a detached dataset header called: **C1/C2/C3/C4_CH_STA_PSDNEG.ceh** described above.

For the version 01, the CEF contains now only the static parameters (file and global metadata).

The following file **metadata** keywords:

FILE_NAME = C1/C2/C3/C4_CP_STA_PSDNEG__20010402_V01.cef

FILE_FORMAT_VERSION = "CEF-2.0"

END_OF_RECORD_MARKER = "\$"

And the following **global metadata** keywords:

FILE_TYPE = "cef"

```
LOGICAL_FILE_ID = "C1/C2/C3/C4_CP_STA_SA_PSDNEG__20040102_V01"  
DATASET_VERSION = "01"  
VERSION_NUMBER = "01"  
METADATA_TYPE = "CAA"  
METADATA_VERSION = "2.0"  
FILE_TIME_SPAN = ex. 2001-04-02T00:00:00.000Z/2001-04-02T23:59:59.999Z  
GENERATION_DATE = ex. 2017-07-07T16:01:14.257Z  
DATASET_CAVEATS  
  ENTRY = "Produced using CAA software version 2.2 of September 2011"  
  ENTRY = "and convert_file_PSDNEG_to_PSD_NEG.py v1.0."
```

3.9.9 Dataset header example

Ex : C1_CH_STA_SA_PSDNEG.ceh

```
!CEH VALIDATION 25 Jan. 2018 by LPP, header V01, (NC,VB,RK,RP)  
!  
START_META = DATASET_ID  
  ENTRY = "C1_CQ_STA_SA_PSD_NEG_CAVEATS"  
END_META = DATASET_ID  
!  
START_META = DATA_TYPE  
  ENTRY = "CQ"  
END_META = DATA_TYPE  
!  
START_META = DATASET_TITLE  
  ENTRY = "PSD negative values"  
END_META = DATASET_TITLE  
!  
START_META = CONTACT_COORDINATES  
  ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"  
  ENTRY = "Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"  
  ENTRY = "Olga Alexandrova>Co-I>olga.alexandrova@obspm.fr"  
END_META = CONTACT_COORDINATES  
!  
START_META = DATASET_DESCRIPTION  
  ENTRY = "This dataset contains caveats for the PSD dataset from the STAFF-SA "  
  ENTRY = "instrument. It gives the time, frequency bin, component and amplitude "  
  ENTRY = "of PSD negative values that have been replaced by fill-values in the "  
  ENTRY = "PSD product."  
END_META = DATASET_DESCRIPTION  
!  
START_META = DATASET_TYPE  
  ENTRY = "Caveats"  
END_META = DATASET_TYPE  
!  
START_META = PROCESSING_LEVEL  
  ENTRY = "Auxiliary"  
END_META = PROCESSING_LEVEL  
!  
START_META = ACKNOWLEDGEMENT  
  ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication  
based upon use of this data."  
  ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"  
END_META = ACKNOWLEDGEMENT  
!  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!                                                                                   Variables  !  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!  
START_VARIABLE = Time_C1_CQ_STA_SA_PSD_NEG_CAVEATS
```

```
PARAMETER_TYPE = "Support_Data"
CATDESC        = "Time tag"
VALUE_TYPE     = ISO_TIME
UNITS          = "s"
SI_CONVERSION  = "1.0>s"
DELTA_MINUS    = 0.0
DELTA_PLUS     = 0.0
SIGNIFICANT_DIGITS = 24
FILLVAL        = 9999-12-31T23:59:59.999Z
FIELDNAM       = "UT Time"
LABLAXIS       = "UT"
END_VARIABLE = Time_C1_CQ_STA_SA_PSD_NEG_CAVEATS
!
START_VARIABLE = Frequency_C1_CQ_STA_SA_PSD_NEG_CAVEATS
PARAMETER_TYPE = "Support_Data"
CATDESC        = "Frequency of the PSD negative value."
FIELDNAM       = "Frequency bin centres"
VALUE_TYPE     = FLOAT
FILLVAL        = -999.99
UNITS          = "Hz"
SI_CONVERSION  = "1.0>Hz"
SIGNIFICANT_DIGITS = 8
DEPEND_0       = Time_C1_CQ_STA_SA_PSD_NEG_CAVEATS
END_VARIABLE = Frequency_C1_CQ_STA_SA_PSD_NEG_CAVEATS
!
START_VARIABLE = Component_Id_C1_CQ_STA_SA_PSD_NEG_CAVEATS
PARAMETER_TYPE = "Support_Data"
CATDESC        = "Identifier of the component of the PSD negative value."
FIELDNAM       = "Component identifier"
VALUE_TYPE     = INT
FILLVAL        = 0
UNITS          = "unitless"
SI_CONVERSION  = "1>unitless"
SIGNIFICANT_DIGITS = 1
DEPEND_0       = Time_C1_CQ_STA_SA_PSD_NEG_CAVEATS
END_VARIABLE = Component_Id_C1_CQ_STA_SA_PSD_NEG_CAVEATS
!
START_VARIABLE = Amplitude_C1_CQ_STA_SA_PSD_NEG_CAVEATS
PARAMETER_TYPE = "Support_Data"
CATDESC        = "Amplitude of the PSD negative value (see PARAMETER_CAVEATS for units)."
```



```
!
! Component and frequency of PSD negative values replaced by fill-values.
!
! Each block of data is organized this way:
!
! ISO-TIME, frequency, component's identifier, amplitude$
!
! Exemple:
! 2016-09-02T02:25:09.240Z, 13.9203, 5, -7.28E-04$
!
! Component/identifier correspondence chart:
! -----
! 1      PSD_Bxx
! 2      PSD_Byy
! 3      PSD_Bzz
! 4      PSD_Exx
! 5      PSD_Eyy
!
! DATA_UNTIL = EOF
!
2004-01-02T02:11:09.767Z, 44.1942, 4, -2.43E-10$
2004-01-02T02:11:17.766Z, 27.8406, 4, -3.01E-10$
2004-01-02T05:14:18.515Z, 445.4493, 5, -2.56E-06$
...
```

3.10 Auxilliary data –CAVEAT file for PPP STAFF-SA – UNDEF_MFA

3.10.1 Format: CEF

3.10.2 Standard: cf 2.2.

3.10.3 Production Procedure: cf 2.3.2.

3.10.4 Quality Control Procedure: cf 2.4.2.

3.10.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.10.6 Product Specification

One CEF file per day and per satellite is produced.

This CEF file contains the caveats for the PPP datasets from the STAFF-SA instrument.

These caveats give the time-ranges and the reason when the SM data could not be transformed to MFA coordinates. It can be due to a lack of FGM data or a lack of attitude data (from the auxiliary data).

The detached dataset header is called:
C1/C2/C3/C4_CH_STA_SA_UNDEF_MFA_TR_CAVEATS.ceh.

In this header, only the static parameters (global metadata, support data and data themselves) are included.

First, the following **global metadata** keywords:

```
DATASET_ID = C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS
DATA_TYPE = "CQ"
DATASET_TITLE = " Reason of undefined MFA coordinate system"
```

CONTACT_COORDINATES

```
"Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
"Ondrej Santolik>Co-I>ondrej.santolik@mff.cuni.cz"
"Olga Alexandrova>Co-I>olga.alexandrova@obspm.fr"
```

```
DATASET_DESCRIPTION = "This dataset contains caveats for the PPP (L3) datasets from the STAFF-SA instrument. It gives the time-ranges and the reason when the SM data could not be transformed to MFA coordinates. It can be due to a lack of FGM data or a lack of attitude data (from the auxiliary data)."
```

```
DATASET_TYPE = "Caveats"
PROCESSING_LEVEL = "Auxilliary"
```

```
DATASET_CAVEATS = "VERSION HISTORY:"
"V02 : Reprocessed due to FGM and/or SPD-AUX files re-deliveries."
"V01 : First versions."
```

ACKNOWLEDGEMENT =

```
"Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."
```

```
"Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
```

Then, the following **Support data**:

- **Time_Range_C1/C2/C3/C4_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS:**
PARAMETER_TYPE = "Support_Data"
CATDESC = "Time span"
VALUE_TYPE = ISO_TIME_RANGE
UNITS = "s"
SI_CONVERSION = "1.0>s"
DELTA_MINUS = 0.0
DELTA_PLUS = 0.0
SIGNIFICANT_DIGITS = 49

```
FILLVAL = 9999-12-31T23:59:59.999Z/9999-12-31T23:59:59.999Z
FIELDNAM = " UT Time"
LABLAXIS = "UT"
```

3.10.7 File Metadata Specification

The version 1 CEF file includes a detached dataset header called: **C1/C2/C3/C4_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS.ceh** described above.

For the version 01, the CEF contains now only the static parameters (file and global metadata).

The following file **metadata** keywords:

```
FILE_NAME =
"C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS__20240801_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
```

And the following **global metadata** keywords:

```
FILE_TYPE = "cef"
LOGICAL_FILE_ID = "
C1/C2/C3/C4_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS__20240801_V01 "
DATASET_VERSION = "01"
VERSION_NUMBER = "01"
METADATA_TYPE = "CAA"
METADATA_VERSION = "2.0"
FILE_TIME_SPAN = ex. 2024-08-01T00:00:00.000Z/2024-08-01T23:59:59.999Z
GENERATION_DATE = ex. "2025-09-17T19:36:09.079Z "
FILE_CAVEATS =
  "This file has been produced using : "
  "- Prassadco software, module read_N2SA(2011Sep30)"
  "- Caa software version 2.0 of July 2009"
  "- FGM_GAPS_CORRECTION patch of July 2016"
  "- convert_file_UNDEFINED_MFA_to_UNDEF_MFA_TR.py v1.0"
```

3.10.8 Dataset header example

Ex : C1_CH_STA_SA_UNDEF_MFA_TR_CAVEATS.ceh

```
!CEH VALIDATION 26 June 2019 by LPP, header V03, (RK)
!
START_META = DATASET_ID
  ENTRY = "C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS"
END_META = DATASET_ID
```



```
FIELDNAM      = "Caveats"
FILLVAL       = "NA"
DEPEND_0      = Time_Range__C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS
QUALITY       = 0
END_VARIABLE = Text__C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS
!
```

3.10.9 Dataset file example

Ex : C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS__20240801_V01.cef

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                 File Metadata   !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
FILE_NAME = "C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS__20240801_V01.cef"
FILE_FORMAT_VERSION = "CEF-2.0"
END_OF_RECORD_MARKER = "$"
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                 Global Metadata !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
INCLUDE= CL_CH_MISSION.cef           ! Mission level metadata.
!
INCLUDE= C1_CH_OBS.cef               ! Observatory level metadata.
!
INCLUDE= CL_CH_STA.cef               ! Experiment level metadata.
!
INCLUDE= C1_CH_STA_SA.cef            ! Instrument level metadata.
!
INCLUDE= C1_CH_STA_SA_UNDEF_MFA_TR_CAVEATS.cef ! Dataset level metadata.
!
START_META = DATASET_VERSION
ENTRY = "01"
END_META = DATASET_VERSION
!
START_META = LOGICAL_FILE_ID
ENTRY = "C1_CQ_STA_SA_UNDEF_MFA_TR_CAVEATS__20240801_V01"
END_META = LOGICAL_FILE_ID
!
START_META = FILE_TYPE
ENTRY = "cef"
END_META = FILE_TYPE
!
START_META = VERSION_NUMBER
ENTRY = 01
END_META = VERSION_NUMBER
!
START_META = METADATA_TYPE
ENTRY = "CAA"
END_META = METADATA_TYPE
!
START_META = METADATA_VERSION
ENTRY = "2.0"
END_META = METADATA_VERSION
!
START_META = FILE_TIME_SPAN
VALUE_TYPE = ISO_TIME_RANGE
ENTRY = 2024-08-01T00:00:00.000Z/2024-08-01T23:59:59.999Z
END_META = FILE_TIME_SPAN
!
START_META = GENERATION_DATE
VALUE_TYPE = ISO_TIME
ENTRY = 2025-09-17T19:36:09.079Z
END_META = GENERATION_DATE
```

```
!
START_META = FILE_CAVEATS
ENTRY = "This file has been produced using :"
ENTRY = "- Prassadco software, module read_N2SA(2011Sep30)"
ENTRY = "- Caa software version 2.0 of July 2009"
ENTRY = "- FGM_GAPS_CORRECTION patch of July 2016"
ENTRY = "- convert_file_UNDEFINED_MFA_to_UNDEF_MFA_TR.py v1.0"
END_META = FILE_CAVEATS
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
! Data !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
! Undefined MFA for a given time-range.
! Each block of data is organized this way:
!
! ISO-TIME START/ISO-TIME END, "Reason for undefined MFA" $
!
! Reason for undefined MFA can be one of the two following strings:
! - "Lack of FGM data"
! or
! - "Lack of attitude data"
!
! For further details, please refer to the dataset metadata,
! the STAFF User Guide (UG) and the Interface Control Document (ICD).
!
DATA_UNTIL = EOF
!
2024-08-01T05:32:47.039Z/2024-08-01T05:32:47.039Z, "Lack of FGM data" $
2024-08-01T05:33:43.037Z/2024-08-01T05:33:43.037Z, "Lack of FGM data" $
2024-08-01T05:34:55.035Z/2024-08-01T05:34:55.035Z, "Lack of FGM data" $
...
```

3.11 Auxilliary data –CAVEAT file for PSD/SM/PPP STAFF-SA – NOTSRP

3.11.1 Format: CEF

3.11.2 Standard: cf 2.2.

3.11.3 Production Procedure: cf 2.3.2.

3.11.4 Quality Control Procedure: cf 2.4.2.

3.11.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.11.6 Product Specification

One CEF file per month and per satellite is produced.

This CEF file contains the caveats for the PSD/SM/PPP datasets from the STAFF-SA instrument.

This caveats dataset provides the users time interval when no Sun pulse (TSRP) was recorded in the S/C housekeeping data. Note that it can be in eclipse period but not especially.

3.11.7 Dataset metadata description

The detached dataset header is called:
C1/C2/C3/C4_CH_STA_NOTSRP_MTR_CAVEATS.ceh.

In this header, only the static parameters (global metadata, support data and data themselves description) are included.

First, the following **global metadata** keywords:

DATASET_ID = C1_CQ_STA_NOTSRP_MTR_CAVEATS

DATA_TYPE = "CQ"

DATASET_TITLE = "Time Interval with no TSRP"

CONTACT_COORDINATES

"Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"

"Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"

"Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"

DATASET_DESCRIPTION = "This dataset contains caveats for some of the STAFF datasets It provides the users time intervals when no Sun pulse (TSRP) was recorded in the S/C housekeeping data. Some periods can corresponds to eclipse."

DATASET_TYPE = "Caveats"

PROCESSING_LEVEL = "Auxilliary"

ACKNOWLEDGEMENT =

"Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."

"Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzjijm"

Then, the following **Support data**:

- **Time** which the ISO time of data acquisition (Universal Time). Its properties are:

PARAMETER_TYPE = "Support_Data"

CATDESC = "Time tag"

VALUE_TYPE = ISO_TIME_RANGE

UNITS = "s"

SI_CONVERSION = "1.0>s"

SIZES = 1


```
INCLUDE= C1_CH_OBS.ceh                ! Observatory level metadata.
!
INCLUDE= CL_CH_STA.ceh                ! Experiment level metadata.
!
INCLUDE= C1_CH_STA.ceh                ! Instrument level metadata.
!
START_META = DATASET_ID
  ENTRY = "C1_CQ_STA_NOTSRP_MTR_CAVEATS"
END_META = DATASET_ID
!
START_META = DATA_TYPE
  ENTRY = "CQ"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
  ENTRY = "Time Intervals with no TSRP."
END_META = DATASET TITLE
!
START_META      = CONTACT_COORDINATES
  ENTRY         = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
  ENTRY         = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
  ENTRY         = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META       = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
  ENTRY = "This dataset contains caveats for some of the STAFF datasets."
  ENTRY = "It provides the users time intervals when"
  ENTRY = "no Sun pulse (TSRP) was recorded in the S/C housekeeping data."
  ENTRY = "Some periods can corresponds to eclipse."
END_META = DATASET_DESCRIPTION
!
START_META = DATASET_TYPE
  ENTRY = "Caveats"
END_META = DATASET TYPE
!
START_META = PROCESSING_LEVEL
  ENTRY = "Auxiliary"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
  ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication
based upon use of this data."
  ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
END_META = ACKNOWLEDGEMENT
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                               Variables      !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
START_VARIABLE = Time_range_C1_CQ_STA_NOTSRP_MTR_CAVEATS
  VALUE_TYPE      = ISO_TIME_RANGE
  PARAMETER_TYPE  = "Support_Data"
  CATDESC         = "Time interval with no TSRP in the S/C housekeeping."
  UNITS           = "s"
  SI_CONVERSION   = "1.0>s"
  SIZES           = 1
  SIGNIFICANT_DIGITS = 49
  FILLVAL         = 9999-12-31T23:59:59.999Z/9999-12-31T23:59:59.999Z
  FIELDNAM        = "Universal Time Range"
  LABLAXIS        = "UT"
END_VARIABLE = Time_range_C1_CQ_STA_NOTSRP_MTR_CAVEATS
!
```

3.12 Auxilliary data –CAVEAT file for STAFF data – CALIBRATION

3.12.1 Format: CEF

3.12.2 Standard: cf 2.2.

3.12.3 Production Procedure: cf 2.3.2.

3.12.4 Quality Control Procedure: cf 2.4.2.

3.12.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.12.6 Product Specification

One CEF file per year and per satellite is produced.
This CEF file contains the caveats for the STAFF datasets.
This caveats dataset provides the users time where there is an onboard calibration.

3.12.7 Dataset metadata description

The detached dataset header is called:
C1/C2/C3/C4_CH_STA_CALIB_YTR_CAVEATS.ceh.

In this header, only the static parameters (global metadata, support data and data) are included.

First, the following **global metadata** keywords:

```
DATASET_ID = C1/C2/C3/C4_CQ_STA_CALIB_YTR_CAVEATS  
DATA_TYPE = "CQ"  
DATASET_TITLE = "On-board calibrations times and modes."
```

```
CONTACT_COORDINATES
```

```
"Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
```

```
"Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
```

```
"Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
```

DATASET_DESCRIPTION = "This dataset contains time spans and bitrate modes when the STAFF instruments are in calibration mode."

PROCESSING_LEVEL = "Auxilliary"

ACKNOWLEDGEMENT =

"Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."

"Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"

DATASET_CAVEATS =

"DATASET VERSION HISTORY"

"Version 02: Same data. Uses new instrument-level header C?_CH_STA.ceh"

"Version 01: First version, based on the calibration bit."

DATASET_TYPE = "Caveats"

"Calibration_Data"

Then, the following **Support data**:

- **Time_Range_C1/C2/C3/C4_CQ_STA_CALIB_YTR_CAVEATS:**

PARAMETER_TYPE = "Support_Data"

CATDESC = "Time span"

VALUE_TYPE = ISO_TIME_RANGE

UNITS = "s"

SI_CONVERSION = "1.0>s"

DELTA_MINUS = 0.0

DELTA_PLUS = 0.0

SIGNIFICANT_DIGITS = 49

FILLVAL = 9999-12-31T23:59:59.999Z/9999-12-31T23:59:59.999Z

FIELDNAM = "UT Time"

LABLAXIS = "UT"

And the **Data**:

- **Text** to show that it is an onboard calibration

PARAMETER_TYPE = "Data"

ENTITY = "Instrument"

VALUE_TYPE = CHAR

PROPERTY = "Status"

CATDESC = " Bitrate mode."

UNITS = "unitless"

SI_CONVERSION = "1>unitless"

SIGNIFICANT_DIGITS = 3

FIELDNAM = "Caveats"

```
INCLUDE= C1_CH_STA.ceh                                ! Instrument level metadata.
!
START_META = DATASET_ID
  ENTRY = "C1_CQ_STA_CALIB_YTR_CAVEATS"
END_META = DATASET_ID
!
START_META = DATA_TYPE
  ENTRY = "CQ"
END_META = DATA_TYPE
!
START_META = DATASET_TITLE
  ENTRY = "On-board calibrations times and modes."
END_META = DATASET_TITLE
!
START_META = CONTACT_COORDINATES
  ENTRY = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
  ENTRY = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
  ENTRY = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META = CONTACT_COORDINATES
!
START_META = DATASET_DESCRIPTION
  ENTRY = "This dataset contains time spans and bitrate modes "
  ENTRY = "when the STAFF instruments are in calibration mode."
END_META = DATASET_DESCRIPTION
!
START_META = PROCESSING_LEVEL
  ENTRY = "Auxiliary"
END_META = PROCESSING_LEVEL
!
START_META = ACKNOWLEDGEMENT
  ENTRY = "Please acknowledge the STAFF team and the ESA Cluster Archive in any publication
based upon use of this data."
  ENTRY = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyjm"
END_META = ACKNOWLEDGEMENT
!
START_META = DATASET_CAVEATS
  ENTRY = "DATASET VERSION HISTORY"
  ENTRY = "Version 02: Same data. Uses new instrument-level header C?_CH_STA.ceh"
  ENTRY = "Version 01: First version, based on the calibration bit."
END_META = DATASET_CAVEATS
!
START_META = DATASET_TYPE
  ENTRY = "Caveats"
  ENTRY = "Calibration_Data"
END_META = DATASET_TYPE
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!                                                                                               Variables          !
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
START_VARIABLE = Time_Range_C1_CQ_STA_CALIB_YTR_CAVEATS
  PARAMETER_TYPE = "Support_Data"
  CATDESC = "Time span"
  VALUE_TYPE = ISO_TIME_RANGE
  UNITS = "s"
  SI_CONVERSION = "1.0>s"
  DELTA_MINUS = 0.0
  DELTA_PLUS = 0.0
  SIGNIFICANT_DIGITS = 49
  FILLVAL = 9999-12-31T23:59:59.999Z/9999-12-31T23:59:59.999Z
  FIELDNAM = "UT Time"
  LABLAXIS = "UT"
END_VARIABLE = Time_Range_C1_CQ_STA_CALIB_YTR_CAVEATS
!
START_VARIABLE = Text_C1_CQ_STA_CALIB_YTR_CAVEATS
  PARAMETER_TYPE = "Data"
  ENTITY = "Instrument"
  VALUE_TYPE = CHAR
  PROPERTY = "Status"
  CATDESC = "Bitrate mode."
```


3.13 Auxilliary data – IFCReport for STAFF-SC data

3.13.1 Format: txt

3.13.2 Standard: cf 2.2.

3.13.3 Production Procedure: cf 2.3.2.

3.13.4 Quality Control Procedure: cf 2.4.2.

3.13.5 Delivery Procedure

Secured ftp from LPP to ESTEC.

3.13.6 Product Specification

One CEF file per calibration period and per satellite is produced.
This IFCReport file contains a brief analysis of a STAFF-SC in-flight calibration sequence.

3.13.7 Dataset metadata description

The detached dataset header is called: C1/C2/C3/C4_CE_STA_IFCReport.ceh.

In this header, only the static parameters (global metadata) are included.

```
DATASET_ID = C1_CE_STA_IFCReport  
DATA_TYPE = " CE>CAA Non-CEF (external) Product"  
DATASET_TITLE = " STAFF-SC In flight calibration report from Cluster-1"
```

CONTACT_COORDINATES

```
"Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"  
"Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"  
"Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
```

```
DATASET_DESCRIPTION = "This file contains a brief analysis of a STAFF-SC in-flight calibration sequence. In operation, the calibration mode is performed at least once per orbit and depending on telemetry cadence. Normal mode (NBR) is most often used. It consists of sending a known current into the sensor loops of each axis. The
```

sequence consists of 23 steps described in the Staff Status file. Step duration depends on NBR or HBR mode. The comparison between the most significant step measurements and the ground reference values is listed here. An anomaly message is generated each time a measurement step has values that differ by 50% of the reference value for magnetic component and 30 degrees for phase between magnetic sensors. The files are stored in a non-standard ASCII format. The filename indicates the span of the calibration sequence."

"START and END of CALIBRATION SEQUENCE as
YYYYMMDD_HHMMSS_YYYYMMDD_HHMMSS"

"Each IFCReport file has an introductory comment line that starts with a semicolon (;). The comment line contains the parameters that have been used when running the calibration program. "

"See Staff CR/UG for a complete description. "

PROCESSING_LEVEL = "Auxilliary"

ACKNOWLEDGEMENT =

"Please acknowledge the STAFF team and the ESA Cluster Archive in any publication based upon use of this data."

"Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"

DATASET_CAVEATS =

"This is a non-CEF product. You will need your own software to open/manipulate these data.

"DATASET VERSION HISTORY"

"VERSION 01: The first version of this dataset to be ingested by the CAA"

DATASET_TYPE = "Support_Data"

FILE_TYPE = "txt"

3.13.8 File Metadata Specification

N/A

3.13.9 Dataset header example

Ex : C1_CE_STA_IFCReport.keh

```
! CEH VALIDATION 31 March 2025 by LPP, V01 (VB)
!
!
INCLUDE= CL_CH_MISSION.keh ! Mission level metadata.
!
INCLUDE= C1_CH_OBS.keh ! Observatory level metadata.
!
INCLUDE= CL_CH_STA.keh ! Experiment level metadata.
```

```
!
INCLUDE= C1_CH_STA_SC.ceh ! Instrument level metadata.
!
START_META = DATASET_ID
ENTRY      = "C1_CE_STA_IFCReport"
END_META   = DATASET_ID
!
START_META = DATA_TYPE
ENTRY      = "CE>CAA Non-CEF (external) Product"
END_META   = DATA_TYPE
!
START_META = CONTACT_COORDINATES
ENTRY      = "Olivier Le Contel>PI>olivier.lecontel@lpp.polytechnique.fr"
ENTRY      = "Patrick Canu>Deputy PI>patrick.canu@lpp.polytechnique.fr"
ENTRY      = "Rodrigue Piberne>Archive Manager>rodrigue.piberne@lpp.polytechnique.fr"
END_META   = CONTACT_COORDINATES
!
START_META = ACKNOWLEDGEMENT
ENTRY      = "Please acknowledge the STAFF team and the ESA Cluster Archive in any
publication based upon use of this data."
ENTRY      = "Digital Object Identifier for the STAFF archive: doi.org/10.5270/esa-yrzyijm"
END_META   = ACKNOWLEDGEMENT
!
START_META = DATASET_CAVEATS
ENTRY      = "This is a non-CEF product. You will need your own software to open/manipulate
these data."
ENTRY      = "DATASET VERSION HISTORY"
ENTRY      = "VERSION 01: The first version of this dataset to be ingested by the CAA"
END_META   = DATASET_CAVEATS
!
START_META = DATASET_VERSION
ENTRY      = "01"
END_META   = DATASET_VERSION
!
START_META = METADATA_TYPE
ENTRY      = "CAA"
END_META   = METADATA_TYPE
!
START_META = METADATA_VERSION
ENTRY      = "2.0"
END_META   = METADATA_VERSION
!
START_META = DATASET_TITLE
ENTRY      = "STAFF-SC In flight calibration report from Cluster-1"
END_META   = DATASET_TITLE
!
START_META = DATASET_TYPE
ENTRY      = "Support_Data"
END_META   = DATASET_TYPE
!
START_META = DATASET_DESCRIPTION
ENTRY      = "This file contains a brief analysis of a STAFF-SC in-flight calibration
sequence."
ENTRY      = "In operation, the calibration mode is performed at least once per orbit and
"
ENTRY      = "depending on telemetry cadence. Normal mode (NBR) is most often used."
ENTRY      = "It consists of sending a known current into the sensor loops of each axis."
ENTRY      = "The sequence consists of 23 steps described in the Staff Status file."
ENTRY      = "Step duration depends on NBR or HBR mode."
ENTRY      = "The comparison between the most significant step measurements and the ground
reference values"
ENTRY      = "is listed here. An anomaly message is generated each time a measurement
step"
ENTRY      = "has values that differ by 50% of the reference value for magnetic component"
ENTRY      = "and 30 degrees for phase between magnetic sensors."
ENTRY      = "The files are stored in a non-standard ASCII format."
ENTRY      = "The filename indicates the span of the calibration sequence."
ENTRY      = "START and END of CALIBRATION SEQUENCE as YYYYMMDD_HHMMSS_YYYYMMDD_HHMMSS"
ENTRY      = "Each IFCReport file has an introductory comment line that starts with "
ENTRY      = "a semicolon (;). The comment line contains the parameters that have "
```

```
ENTRY      = "been used when running the calibration program. "  
ENTRY      = "See Staff CR/UG for a complete description. "  
END_META   = DATASET_DESCRIPTION  
!  
START_META = PROCESSING_LEVEL  
ENTRY      = "Auxiliary"  
END_META   = PROCESSING_LEVEL  
!  
START_META = FILE_TYPE  
ENTRY      = "txt"  
END_META   = FILE_TYPE
```

3.14 Software (executables)

Software are mainly composed of the RCL (P. Robert) and Prasadco (O. Santolic). Additional softwares were developed by V. Bouzid, R. Piberne and R. Katra.

3.15 Calibration files

Calibration files are not archived at CSA.

APPENDIX A - REFERENCES FOR STAFF DESCRIPTION

ESA-SP1159

CLU-CP-122-2021-CET "DECOMMUTATION STAFF-SC"

CLU-CP-122-2021-CET "DECOMMUTATION STAFF-SA"

DDID – CL-ESC-ID-2001." Data Delivery Interface document".

RCL (Patrick Robert, Rodrigue Piberne), <https://hal.science/hal-05444782v1>

Santolik, O.: PPropagation Analysis of STAFF-SA Data with COherency tests (PRASSADCO),

http://aurora2.troja.mff.cuni.cz/~santolik/PRASSADCO/staff_sa/guide.pdf (2003)

DS-QMW-TN-0010 "Cluster Exchange Format – Data File Syntax"

APPENDIX B – LIST OF ACRONYMS

AGC	Automated Gain Control
ASCII	American Standard Code for Information Interchange
CAA	Cluster Active Archive
CCSDS	Consultative Committee on Space Data System
CEF	Cluster Exchange Format
CSA	Cluster Science Archive
CS	ComplexSpectra
CETP	Centre d'étude des Environnements Terrestre et Planétaires
Co-I	Co-Investigator
DWF	Decommutated Wave Form
DWP	Digital Wave Processing
EFW	Electric Field and Wave
ESA	European Space Agency
ESTEC	European Space Research and Technology Centre
FGM	Flux Gate Magnetometer
FTP	File Transfer Protocol
GEI	Geocentric Equatorial Inertial reference frame
GSE	Geocentric Solar Ecliptic reference frame
HBR	High Bit rate
IDL	Interactive Data Language
ISR2	Inverted SR2
LESIA	Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique
LPP	Laboratoire de Physique des Plasmas
MFA	Magnetic Field Aligned reference frame
NBR	Normal Bit Rate
PI	Principal Investigator
PDF	Portable Document Format
PNG	Portable Network Graphics
PPP	Polarization and Propagation Parameters
PRASSADCO	Propagation Analysis of STAFF-SA data with Coherency tests
PSD	Power Spectral Density
RCL	Roproc Command Language
RFF	Roproc FileFormat
Roproc	Robert's procedures
SFTP	Secured-FTP
SM	Spectral Matrix
SR2	Spin Reference frame 2
STAFF	Spatio-Temporal Analysis of Field Fluctuations
STAFF-SA	STAFF digital Spectrum Analyser
STAFF-SC	STAFF on-board waveform unit (SC stands for Search Coil)
SVD	Singular Value Decomposition
TED	Telemetry Extraction and Decommutation package
WEC	Wave Experiment Consortium



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Page: 178 of 178

WECSS WEC Sample Sync
WHISPER Waves of High frequency and Sounder for Probing the Electron
density by Relaxation