DEMETER Microsatellite

SCIENCE MISSION CENTER

DATA PRODUCT DESCRIPTION

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REFERENCES

REFERENCE DOCUMENTS

[DR1] D. Lagoutte, M. Parrot, B. Poirier, J.Y. Brochot, F. Colin, F. Elie, C. Legendre et P. Zamora, Description des données en Télémesure et Télécommande, DMT-SP-7-CS-6035-LPC-3.1, LPCE, Orléans, Septembre 2002.

ACRONYMS

APID	Application Process IDentifier
CCC	Centre de Commande Contrôle
CCSDS	Consultative Committee for Space Data Systems
CDPP	Centre de Données en Physique des Plasmas
CESR	Centre d'Etudes Spatiales des Rayonnements
CETP	Centre d'Etudes des Environnements Terrestre et Planétaires
CMS	Centre de Mission Scientifique DEMETER
CNES	Centre National d'Etudes Spatiales
CNRS	Centre National de la Recherche Scientifique
DEMETER	Detection of Electro-Magnetic Emissions Transmitted from Earthquake Regions
ESTEC	European Space Technical Centre
FTP	File Transfer Protocol
ICE	Instrument Capteur Electrique
IMSC	Instrument Magnétomètre Search-Coil
IPGP	Institut de Physique du Globe de Paris
LPCE	Laboratoire de Physique et Chimie de l'Environnement
NA	Non Applicable
PNG	Portable Network Graphics
PS	PostScript
QL	QuickLook
QV	QuickView
TBC	To Be Confirmed
TBD	To Be Defined

MODIFICATIONS

Edition	Revision	Date	Comments
0	0	06/06/2001	Draft1 version
0	0	12/06/2001	Draft2 version (comments M. Parrot)
0	1	24/10/2001	Draft3 version following ALCATEL software specifications draft document
1	0	30/01/2002	Comments on data formats from CDPP integrated; Comments on orbit and attitude parameters from J.C. Kosik (CNES) integrated; User-defined quicklook suppressed; Modifications of data blocks; Modifications of data formats;
1	1	22/03/2002	Comments from IAP experimenters; Comments from RNF experimenters;
1	2	22/05/2002	All the filenames are in capital letters; Image format is PostScript instead of PNG; At level 1, all the data experiments have included the block 3 (orbit parameters) and block 4 (attitude) ; The CCSDS date format has been added in the experiment level 1 data, orbit and attitude archive files; All the data formats at level 1 have been modified; The orbit and attitude data formats have been modified;
1	3	19/07/2002	HF Electric field power spectrum format : field number 10 is now field 8. ORBIT_EPHEMERIS format : solar position is now in field 15 and geomagnetic parameters from field 16 to 28. P_ORBIT_NUMBERS format : new ASCII format.
2	0	18/12/2002	Modification of attitude parameters of the common block 3 in paragraph 3.4.3 (matrices from satellite to Veis and from

			satellite to local geomagnetic suppressed). Sun position in the geocentric coordinate system (instead of Veis). Modification of the contents of the ATTITUDE_<startdate>_<enddate> file in paragraph 5.2.3 (orbit number added, quaternions in J2000 added, matrice from satellite to Veis suppressed). Modification of the contents of the P_ORBIT_NUMBERS file in paragraph 5.3.2 (Mission event added, event number 11 added). Examples QV and QL added. Description of coordinate systems added.

PLAN

INTRODUCTION

This document describes the data products available at the DEMETER Science Mission Center (CMS) located at LPCE (Orléans, France).

Data level processing

The data are classified according to the processing level :

- Level 0 (N0) processing converts telemetry raw data into experiment raw data,
- Level 0' (N0') processing allows a quick diagnosis of the experiment behavior,
- Level 1 (N1) processing transforms the experiment raw data into physical value data,
- Level 2 (N2) processing presents high resolution views.

CMS product summary

The DEMETER CMS products are :

- data at level 0
  - decommutation report,
  - error data files,
  - experiment raw data,
  - technological raw data;
- data at level 0'
  - Good Health report,
  - QuickView image,
  - QuickLook image;
- data at level 1
  - Physical value science data;
- data at level 2
  - Science high resolution plots;
- Ancillary data
  - Orbit parameters,
  - Attitude,
  - Orbit number description,
  - Seismic events;

All these products can be downloaded on the data server, according to the user type. The rights are summarized in Table 1.

The experiment data files are organized per data identifier (APID) and per half orbit since DEMETER science payload performs measurements in the invariant latitude interval [-65°, +65°].

Rights to data access

To access to the data server, *Login* and *Password* will be required for the user types 'Experimenter', 'Co-Investigator' and 'Guest-Investigator'. The user rights are summarized in Table 1.

	Experimenter	Co-Investigator	Guest-Investigator	All users
Level 0 decommutation report	x			
Level 0 error data files	x			
Level 0 raw data	x	x		
Level 0' good health report	x			
Level 0' QuickView	x	x		
Level 0' Quicklook	x	x	x	x
Level 1 physical value data	x	x	x	
Level 2 high resolution plots	x	x	x	
Ancillary data	x	x	x	
Orbit information	x	x	x	x

Table 1. Summary of user rights.

Data convention

- Convention applied to binary files
  The encoding of integer is Big Endian (most significant byte, least significant byte, 2-complement);
  The encoding of real numbers corresponds to the IEEE format;
  The type I*1 means Byte 8 bits;
  The type I*2 means Integer 16 bits;
  The type I*4 means Long Integer 32 bits;
  The type R*4 means Float 32 bits;
  The type A*n* means ASCII chain of *n* characters;

- Convention for character chains
  The ASCII character chains are left-aligned. For example, a type A3 for the text "HF" will be stored as "HF ".

1. LEVEL 0 DATA FILES

1.1. Level 0 data definition

Level 0 data are raw data generated from the DEMETER general decommutation software.
The CCSDS format applied to the data packets for the transmission to ground has been removed by the decommutation software. So, the DEMETER data at level 0 are identical to the ones at the output of the experiment onboard.

1.2. Level 0 experiment raw data

All the science experiments of the DEMETER payload plus the BANT electronic module produce data at level 0. There is one data file per data identifier (APID) and per half orbit.

The onboard data identifier (APID) list is given in Table N0-1.

APID	Experiment	Data type	Data description	Mode
1124	BANT	'Init'	Onboard computers (DSP and µC) tests	
1125	BANT	'Echo TC'	Command echoed by µC	
1126	BANT	'Event'	Onboard events and anomalies report	
1127	BANT	'Dump'	E2PROM and/or RAM DSP memory dump	
1128	BANT	'Trace DSP'	DSP software trace	
1129	ICE	ULFe "WF"	Waveforms of four electric field probes in the ULF range	Burst and Survey
1130	ICE	ELFe "WF"	Waveforms of three electric field components in the ELF range	Burst
1131	ICE	VLFe "WF"	Waveform of one electric field component in the VLF range	Burst
1132	ICE	VLFe "SP"	Spectra of one electric field component in the VLF range	Burst and Survey
1133	ICE	HFe "WF"	Waveform of one electric field component in the HF range	Burst
1134	ICE	HFe "SP"	Spectra of one electric field component in the HF range	Burst and Survey
1135	IMSC	ELFb "WF"	Waveforms of three magnetic field components in the ELF range	Burst
1136	IMSC	VLFb "WF"	Waveform of one magnetic field component in the VLF range	Burst
1137	IMSC	VLFb "SP"	Spectra of one magnetic field component in the VLF range	Burst and Survey
1138	RNF		Detection results of the neural network	Burst and Survey
1139	IAP		Data of IAP experiment	Burst
1140	IAP		Data of IAP experiment	Survey
1141	IDP		Data of IDP experiment	Burst
1142	IDP		Data of IDP experiment	Survey

1143	ISL		Data of ISL experiment	Burst
1144	ISL		Data of ISL experiment	Survey
1145	ISL		ISL control surface mode	

Table N0-1. List of onboard data identifiers.

The N0 data files are named as :

DMT_N0_<apid>_<nnnnns>_<start_date>_<end_date>.DAT

- <apid> : data identifier;
- <nnnnns> : half-orbit number, "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards);
- <start_date> : date of the first data sample as "yyyymmdd_hhmnss";
- <end_date> : date of the last data sample as "yyyymmdd_hhmnss".

The data formats, same as at the onboard experiment output, are described in DR1.

1.2.1. Science raw data

The science raw data have the identifiers from 1129 to 1144.

1.2.2. Technological raw data

The technological raw data have the identifiers from 1124 to 1128 and 1145.

1.3. Decommutation report

The decommutation software generates a report file (text format) containing the details of the decommutation results as number of data packets, errors found, statistics, ….

The name of the report file is :

DMT_N0_<start_nnnnns>_<end_ nnnnns >.REP

- <start_ nnnnns > : half-orbit number as "nnnnns" with "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards) of the first orbit processed;
- <end_ nnnnns > : half-orbit number as "nnnnns" with "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards) of the last orbit processed.

An example of decommutation file is given in Annex A.

1.4. Error data files

All the data on which the decommutation software has detected errors (missing packets, identifier unknown, …) are stored into global error files.

The name of the error data file produced by decommutation software is :

DMT_N0_<start_ nnnnns >_<end_ nnnnns >.ERR

- <start_nnnnns> : half-orbit number as "nnnnns" with "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards) of the first orbit processed;
- <end_ nnnnns > : half-orbit number as "nnnnns" with "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards) of the last orbit processed.

After decommutation, tests of time coherence are performed. The packets with incoherent time (time not increasing for example) are stored, per half orbit, into an error file with the name :

DMT_SEG_<start_ nnnnns >_<end_ nnnnns >.ERR

- <start_nnnnns> : half-orbit number as "nnnnns" with "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards) of the first orbit processed;
- <end_ nnnnns > : half-orbit number as "nnnnns" with "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards) of the last orbit processed.

2. LEVEL 0' DATA FILES

2.1. Level 0' definition

Level 0' processing has two main goals :

- to allow the experimenter to rapidly know the behavior of the science payload and thus to react on the next telecommand plan; two files are produced to that effect, the 'Good Health' report and the QuickView image;
- to have an overview of the science DEMETER payload results;
- to help for the data selection with the QuickLook that gives a quick presentation over one half orbit data.

The difference between QuickView and QuickLook is that, for QuickView, no orbit and earthquake information is given.

2.2. 'Good Health' report

The 'Good Health' software component generates a report file (text format) containing the results of a set of elementary tests. The reports are organized by half orbit number.

The name of the 'Good Health' report file is :

DMT_BS_<nnnnns>.REP

- <nnnnns> : half-orbit number, "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards);

An example of 'Good Health' report is given in Annex B.

2.3. QuickView image

The QuickView gives a quick presentation of the data. All the science experiments are presented in a portrait image (format PostScript). One QV image represents half-orbit data with a low time resolution of several seconds, resolution depending on the experiments. The QV image is only available during about 24 hours (temporary storage) since it is then replaced by the standard Quicklook image.

The QV image is composed of the 13 elementary images :

(i) Presentation images :

- image 1 : title frame (date, orbit number, involved institutes);
- image 2 : mode frame (Survey or Burst);
- image 3 : abscissa label frame (time);

(ii) Experiment images :

- image 4 : ICE HF spectrogram
  - Spectrogram of one component of the HF electric field,

  - Frequency resolution : 52 kHz,
  - Time resolution : 2.048 s;
- image 5 : ICE VLF spectrogram
  - Spectrogram of one component of the VLF electric field,
  - Frequency resolution : 78 Hz from 0 and 1.7 kHz and 312 Hz from 1.7 to 18 kHz,
  - Time resolution : 2.048 s;
- image 6 : ICE ULF waveforms
  - Waveforms of the four electrode potentials,
  - Sampling frequency : 39.0625 Hz;
- image 7 : IMSC VLF spectrogram
  - Spectrogram of one component of the VLF magnetic field,
  - Frequency resolution : see ICE VLF spectrogram,
  - Time resolution : 2.048 s;
- image 8 : RNF activity
  - Results of the neural network,
  - Time resolution : 13.107 s;
- image 9 : IDP electron counter
  - Time resolution : 2 s, TBD;
- image 10 : IAP APR detector
  - Averaged ion density, averaged ion temperature and ion velocity;
  - Time resolution : 2s, TBD;
- image 11 : IAP ADV detector
  - Total current, angles of the velocity respect to satellite frame,
  - Time resolution : 2 s, TBD;
- image 12 : ISL sweep spectrogram
  - Spectrogram of the Langmuir probe sweeps,
  - Voltage resolution : TBD,
  - Time resolution : TBD;
- image 13 : ISL curves
  - Floating potential,
  - Satellite potential,
  - Electron current,
  - Ion current,
  - Time resolution : TBD;

The QuickView is only available for experimenters.

The QuickView name is :

DMT_QV_<nnnnns>.PS

- <nnnnns> : half-orbit number, "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards);

An example of QuickView image is given in Annex C.

2.4. QuickLook image

The standard QuickLook image is made from the QV experiment images plus a 14th image containing information about earthquakes. More, the image 3 gets information on the orbit parameters.

The 14 elementary images that composes the QL images are :

(i) Presentation images :

- image 1 : title frame (date, orbit number, involved institutes);
- image 2 : mode frame (Survey or Burst);
- image 3 : abscissa label frame (time and determinated orbit parameters);

(ii) Experiment images :

- image 4 : ICE HF spectrogram
  - Spectrogram of one component of the HF electric field,
  - Frequency resolution : 52 kHz,
  - Time resolution : 2.048 s;
- image 5 : ICE VLF spectrogram
  - Spectrogram of one component of the VLF electric field,
  - Frequency resolution : 78 Hz from 0 and 1.7 kHz and 312 Hz from 1.7 to 18 kHz,
  - Time resolution : 2.048 s;
- image 6 : ICE ULF waveforms
  - Waveforms of the four electrode potentials,
  - Sampling frequency : 39.0625 Hz;
- image 7 : IMSC VLF spectrogram
  - Spectrogram of one component of the VLF magnetic field,
  - Frequency resolution : see ICE VLF spectrogram,
  - Time resolution : 2.048 s;
- image 8 : RNF activity
  - Results of the neural network,
  - Time resolution : 13.107 s;
- image 9 : IDP electron counter
  - Time resolution : 2 s, TBD;
- image 10 : IAP APR detector
  - Averaged ion density, averaged ion temperature and ion velocity;
  - Time resolution : 2s, TBD;
- image 11 : IAP ADV detector
  - Total current, angles of the velocity respect to satellite frame,
  - Time resolution : 2 s, TBD;
- image 12 : ISL sweep spectrogram
  - Spectrogram of the Langmuir probe sweeps,
  - Voltage resolution : TBD,
  - Time resolution : TBD;
- image 13 : ISL curves

  - Time resolution : TBD;
- image 14 : Earthquake information
  - Magnitude (> 5),
  - Distance between orbit and epicenter;

The QuickLook is available for all users.

The QuickLook name is :

DMT_QL_<nnnnns>.PS

- <nnnnns> : half-orbit number, "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards);

An example of standard QuickLook image is given in Annex D.

3. LEVEL 1 SCIENCE DATA

3.1. Level 1 definition

Level 1 science data correspond to physical values data. Ancillary information have been added to make the data files consistent and to facilitate the higher level processing.

3.2. Level 1 experiment data

There is one data file per data identifier and per half orbit. The data identifier are given in Table 2.

The data files are named as :

DMT_N1_<apid>_<nnnnns>_<start_date>_<end_date>.DAT

- <apid> : data identifier;
- <nnnnns> : half-orbit number, "nnnnn" the orbit number and "s" the sub-orbit type ("0" downwards and "1" upwards);
- <start_date> : date of the first data sample as "yyyymmdd_hhmnss";
- <end_date> : date of the last data sample as "yyyymmdd_hhmnss".

The data identifier list is given in Table N1-1.

APID	Experiment	Data type	Data description	Mode
1129	ICE	ULFe "WF"	Waveforms of three electric field components in the ULF range	Burst and Survey
1130	ICE	ELFe "WF"	Waveforms of three electric field components in the ELF range	Burst
1131	ICE	VLFe "WF"	Waveform of one electric field component in the VLF range	Burst
1132	ICE	VLFe "SP"	Spectra of one electric field component in the VLF range	Burst and Survey
1133	ICE	HFe "WF"	Waveform of one electric field component in the HF range	Burst
1134	ICE	HFe "SP"	Spectra of one electric field component in the HF range	Burst and Survey
1135	IMSC	ELFb "WF"	Waveforms of three magnetic field components in the ELF range	Burst
1136	IMSC	VLFb "WF"	Waveform of one magnetic field component in the VLF range	Burst
1137	IMSC	VLFb "SP"	Spectra of one magnetic field component in the VLF range	Burst and Survey
1138	RNF		Detection results of the neural network	Burst and Survey
1139	IAP		Data of IAP experiment	Burst
1140	IAP		Data of IAP experiment	Survey
1141	IDP		Data of IDP experiment	Burst

1142	IDP		Data of IDP experiment	Survey
1143	ISL		Data of ISL experiment	Burst
1144	ISL		Data of ISL experiment	Survey

Table N1-1. List of level 1 data identifiers.

3.3. Level 1 data file structure

The level 1 data files are organized with a constant time structure as presented in Table N1-2. It is composed of successive data blocks, each block containing parameters useful to make science. The size of each block is constant per data type.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-2. General structure of level 1 data files.

Four different blocks are defined, the first one and the last one are mandatory and the other two optional (Table N1-3).

Block number	**Type**	**Description**
1	Mandatory	General header
2	Optional	Orbit and geomagnetic parameters
3	Optional	Attitude parameters
4	Mandatory	Experiment data

Table N1-3. Level 1 data block types.

According to the data type, the data files at level 1 will be constituted of several consecutive blocks; the minimum structure has two mandatory blocks (blocks 1 + 4), the maximum has four blocks.

The first three blocks are common to all the data types, only the last block is data-dependent.

3.4. Common block descriptions

3.4.1. Common block 1 : General header

Block 1 : General Header					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Standard CCSDS date
1	I*1	1	1		P field (decimal value = 76)
2	I*3	1	3		Number of days from 01/01/1950
3	I*4	1	4		Number of milliseconds in the day
					Time and orbit information
4	I*2	7	14		UT time of the first point of the data array as : year, month, day, hour, minute, second, millisecond (year as 20xx)
5	I*2	1	2		Orbit number
6	I*2	1	2		Sub-orbit type : 0 : downwards, 1 : upwards
7	A8	1	8		Telemetry station : "TOULOUSE"
					Code and calibration versions
8	I*1	1	1		Version (edition number) of the processing software : from 0 to 9
9	I*1	1	1		Sub-version (revision number) of the processing software : from 0 to 9
10	I*1	1	1		Version (edition number) of the calibration file : from 0 to 9
11	I*1	1	1		Sub-version (revision number) of the calibration file : from 0 to 63

Table N1-4. Common block 1 : general header.

3.4.2. Common block 2 : Orbit and Geomagnetic Parameters

Block 2 : Orbit and Geomagnetic Parameters					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Orbit parameters
1	R*4	1	4	degree	Geocentric latitude (-90°, +90°)
2	R*4	1	4	degree	Geocentric longitude (0°, 360°)
3	R*4	1	4	km	Altitude
4	R*4	1	4	hour	Local time of the first point of the data array (0, 24h)
					Geomagnetic parameters
5	R*4	1	4	degree	Geomagnetic latitude (-90°, +90°)
6	R*4	1	4	degree	Geomagnetic longitude (0°, +360°)

7	R*4	1	4	hour	Magnetic local time of the first point
8	R*4	1	4	degree	Invariant latitude (-90°, +90°)
9	R*4	1	4		Mc Ilwain parameter L (0, 999)
10	R*4	1	4	degree	Geocentric latitude of the conjugate point at the satellite altitude (-90°, +90°)
11	R*4	1	4	degree	Geocentric longitude of the conjugate point at the satellite altitude (0°, +360°)
12	R*4	1	4	degree	Geocentric latitude of North conjugate point at altitude 100 km (-90°, +90°)
13	R*4	1	4	degree	Geocentric longitude of North conjugate point at altitude 100 km (0°, +360°)
14	R*4	1	4	degree	Geocentric latitude of South conjugate point at altitude 100 km (-90°, +90°)
15	R*4	1	4	degree	Geocentric longitude of South conjugate point at altitude 100 km (0°, +360°)
16	R*4	3	12	nT	Components of the magnetic field model at the satellite point (satellite coordinate system)
17	R*4	1	4	Hz	Proton gyrofrequency at satellite point
					Solar parameters
18	R*4	3	12		Solar position, Xs, Ys, Zs in the geocentric coordinate system
					Code version
19	I*1	1	1		Version (edition number) of the software component : from 0 to 9
20	I*1	1	1		Sub-version (revision number) of the software component : from 0 to 9

Table N1-5. Common block 2 : orbit and geomagnetic parameters.

3.4.3. Common block 3 : Attitude Parameters

Block 3 : Attitude Parameters					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Attitude parameters
1	R*4	9	36		$M_{satgeog}$: Matrix from satellite coordinate system to inertial geographic coordinate system
2	R*4	9	36		$M_{geoggeom}$: Matrix from geographic coordinate system to local geomagnetic coordinate system
3	I*2	1	2		Quality index of attitude parameters
					Code version
4	I*1	1	1		Version (edition number) of the software component : from 0 to 9
5	I*1	1	1		Sub-version (revision number) of the software

					component : from 0 to 9

Table N1-6. Common block 3 : attitude parameters.

Note : The elements of the matrix $\begin{matrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{matrix}$ are stored as a_{11}, a_{12}, a_{13}, a_{21}, a_{22}, a_{23}, a_{31}, a_{32}, a_{33} where i is the raw index and j the column index of the element a_{ij}.

The different coordinate systems are detailed in Annex E.

3.5. Level 1 science data description

3.5.1. Waveform of the ULF Electric Field (APID 1129)

Experiment : ***ICE***.
Data type : ***Waveform of the 3 components of the electric field in the ULF range***.

The level 1 file structure of "ULF Electric Waveforms" is given in Table N1-7.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-7. Structure of the "ULF electric waveform" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-8.

Waveform of 3 components of the electric field in the ULF range					
Filename : ***DMT_N1_1129_<nnnnns>_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "ULF ELECTRIC WAVEFORM"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor ", "Satellite" or "B0field "
4	R*4	9	36		M_{sensat} : Matrix from sensor coordinate system to satellite coordinate system (dependent of the sensor configuration)
5	A16	1	16		Data unit : "mV/m "
6	R*4	1	4	Hz	Sampling frequency : 39.0625
7	I*2	1	2		Sample data number per component : 256
8	R*4	1	4	s	Time duration of one data array : 256 / 39.0625
					First component waveform
9	A3	1	3		First component name : "E12" in sensor coordinate system "Ex " in the other coordinate systems
10	R*4	256	1024	mV/m	Waveform sample array of the first component
					Second component waveform
11	A3	1	3		Second component name : "Eij", i, j are the sensor numbers "Eij" in sensor coordinate system, i, j are the sensor numbers "Ey " in the other coordinate systems
12	R*4	256	1024	mV/m	Waveform sample array of the second component

					Third component waveform
13	A3	1	3		Third component name : "E34" in sensor coordinate system "Ez " in the other coordinate systems
14	R*4	256	1024	mV/m	Waveform sample array of the third component
					Probe E1 waveform 'sensor'
15	A3	1	3		Probe 1 name : "E1 "
16	R*4	256	1024	mV	Waveform sample array of the E1 probe
					Probe E2 waveform 'sensor'
17	A3	1	3		Probe 2 name : "E2 "
18	R*4	256	1024	mV	Waveform sample array of the E2 probe
					Probe E3 waveform 'sensor'
19	A3	1	3		Probe 3 name : "E3 "
20	R*4	256	1024	mV	Waveform sample array of the E3 probe
					Probe E4 waveform 'sensor'
21	A3	1	3		Probe 4 name : "E4 "
22	R*4	256	1024	mV	Waveform sample array of the E4 probe

Table N1-8. Block 4 : ULF electric waveform.

3.5.2. Waveform of the ELF Electric Field (APID 1130)

Experiment : ***ICE***.
Data type : ***Waveform of the 3 components of the electric field in the ELF range***.

The level 1 file structure of "ELF Electric Waveform" is given in Table N1-9.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-9. Structure of the "ELF electric waveform" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-10.

Waveform of 3 components of the electric field in the ELF range					
Filename : ***DMT_N1_1130_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "ELF ELECTRIC WAVEFORM"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor ", "Satellite" or "B0field "
4	R*4	9	36		M_{sensat} : Matrix from sensor coordinate system to satellite coordinate system (dependent of the sensor configuration)
5	A16	1	16		Data unit : "mV/m "
6	R*4	1	4	Hz	Sampling frequency : 2500.
7	I*2	1	2		Sample data number per component : 4096
8	R*4	1	4	s	Time duration of one data array : 4096 / 2500
					First component data waveform
9	A3	1	3		First component name : "E12" in sensor coordinate system "Ex " in the other coordinate systems
10	R*4	4096	16384	mV/m	Waveform sample array of the first component
					Second component data waveform
11	A3	1	3		Second component name : "Eij" in sensor coordinate system, i, j are the sensor numbers "Ey " in the other coordinate systems
12	R*4	4096	16384	mV/m	Waveform sample array of the second component
					Third component data waveform
13	A3	1	3		Third component name : "E34" in sensor coordinate system "Ez " in the other coordinate systems
14	R*4	4096	16384	mV/m	Waveform sample array of the third component

Table N1-10. Block 4 : ELF electric waveform.

3.5.3. Waveform of the VLF Electric Field (APID 1131)

Experiment : ***ICE***.
Data type : ***Waveform of 1 component of the electric field in the VLF range***.

The level 1 file structure of "VLF Electric Waveform" is given in Table N1-11.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-11. Structure of the "VLF electric waveform" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-12.

Waveform of 1 component of the electric field in the VLF range					
Filename : ***DMT_N1_1131_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "VLF ELECTRIC WAVEFORM"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor "
4	A16	1	16		Data unit : "mV/m "
5	R*4	1	4	Hz	Sampling frequency : 40000.
6	I*2	1	2		Sample data number per component : 8192
7	R*4	1	4	s	Time duration of one data array : 8192 / 40000
					Waveform data
8	A3	1	3		Component name : "Eij", i, j are the sensor numbers
9	R*4	8192	32768	mV/m	Waveform sample array

Table N1-12. Block 4 : VLF electric spectrum.

3.5.4. Power spectrum of the VLF Electric Field (APID 1132)

Experiment : ***ICE***.
Data type : ***Power spectrum of 1 component of the electric field in the VLF range***.

The level 1 file structure of "VLF Electric Spectrum" is given in Table N1-13.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-13. Structure of the "VLF electric spectrum" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-14.

Power spectrum of 1 component of the electric field in the VLF range					
Filename : ***DMT_N1_1132_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "VLF ELECTRIC SPECTRUM"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor "
4	A3	1	3		Component name : "Eij", i, j are the sensor numbers
5	A16	1	16		Data unit : "log(mV^2/m^2/Hz)"
6	I*1	1	1		Number of consecutive spectra (Nb) : 2 or 8 (1)
7	I*2	1	2		Number of spectrum frequencies (Nbf) : 1024 or 256
8	R*4	1	4	s	Total time duration of Nb spectra : 16.384, 4.096 or 1.024 s
9	R*4	1	4	Hz	Frequency resolution : 19.53125 or 78.125
10	R*4	2	8	Hz	Frequency range : [19.53125 or 78.125 - 20000].
11	I*2	7	14		UT time of the first spectrum as : year, month, day, hour, minute, second, millisecond (2)
					Power spectrum data
12	R*4	Nbf	Nbf*4	log(mV^2/ m^2/Hz)	Power array of the first spectrum
…	…	…	…	…	….
12 + (Nb-1)	R*4	Nbf	Nbf*4	log(mV^2/ m^2/Hz)	Power array of the Nb^{th} spectrum

Table N1-14. Block 4 : VLF electric spectrum.

(1) The parameters of the 3 different spectrum types are summarized below :

Spectrum type	*Spectrum number in the data format (Nb)*	*Frequency number per spectrum (Nbf)*	*Total time duration*	*Duration of one spectrum*	*Number of averaged spectra (onboard)*	*Number of averaged frequencies (onboard)*
Type 0	2	1024	4.096 s	2.048 s	40	1
Type 1	2	1024	1.024 s	0.512 s	10	1
Type 2	8	256	16.384 s	2.048 s	40	4

(2) Only the time of the first spectrum is given in the data format (field 11). The UT time of each spectrum can be computed by adding the time of the first one plus the spectrum duration. The elementary spectrum duration is obtained from the division of the total duration (field 8) by the spectrum number (field 6).

3.5.5. Waveform of the HF Electric Field (APID 1133)

Experiment : ***ICE***.
Data type : ***Waveform of 1 component of the electric field in the HF range***.

The level 1 file structure of "HF Electric Waveform" is given in Table N1-15.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-15. Structure of the "HF electric waveform" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-16.

Waveform of 1 component of the electric field in the HF range					
Filename : ***DMT_N1_1133_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "HF ELECTRIC WAVEFORM "
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor "
4	A16	1	16		Data unit : "mV/m "
5	R*4	1	4	kHz	Sampling frequency : 6666.6667
6	I*2	1	2		Sample data number per component : 4096
7	R*4	1	4	ms	Time duration of one data array : 4096 / 6666.6667
					Waveform data
8	A3	1	3		Component name : "Eij", i, j are the sensor numbers
9	R*4	4096	16384	mV/m	Waveform sample array

Table N1-16. Block 4 : HF electric waveform.

3.5.6. Power spectrum of the HF Electric Field (APID 1134)

Experiment : ***ICE***.
Data type : ***Power spectrum of 1 component of the electric field in the HF range***.

The level 1 file structure of "HF Electric Spectrum" is given in Table N1-17.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-17. Structure of the "HF electric spectrum" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-18.

Power spectrum of 1 component of the electric field in the HF range					
Filename : ***DMT_N1_1134_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "HF ELECTRIC SPECTRUM"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor "
4	A3	1	3		Component name : "Eij", i, j are the sensor numbers
5	A16	1	16		Data unit : "log(mV^2/m^2/Hz)"
6	I*1	1	1		Number of consecutive spectra (Nb) : 2 or 8 (1)
7	I*2	1	2		Number of spectrum frequencies (Nbf) : 1024 or 256
8	R*4	1	4	s	Total time duration of Nb spectra : 16.384, 4.096 or 1.024
9	R*4	1	4	kHz	Frequency resolution : 3.255 or 13.021
10	R*4	2	8	kHz	Frequency range : [3.255 or 13.021 - 3333.3333]
11	I*2	7	14		UT time of the first spectrum as : year, month, day, hour, minute, second, millisecond (2)
					Power spectrum data
12	R*4	Nbf	Nbf*4	log(mV^2/ m^2/Hz)	Power array of the first spectrum
…	…	…	…	…	….
12 + (Nb-1)	R*4	Nbf	Nbf*4	log(mV^2/ m^2/Hz)	Power array of the Nbth spectrum

Table N1-18. Block 4 : HF electric spectrum.

(1) The parameters of the 3 different spectrum types are summarized below :

Spectrum type	*Spectrum number in the data format (Nb)*	*Frequency number per spectrum (Nbf)*	*Total time duration*	*Duration of one spectrum*	*Number of averaged spectra (onboard)*	*Number of averaged frequencies (onboard)*
Type 0	2	1024	4.096 s	2.048 s	40	1
Type 1	2	1024	1.024 s	0.512 s	10	1
Type 2	8	256	16.384 s	2.048 s	40	4

(2) Only the time of the first spectrum is given in the data format (field 11). The UT time of each spectrum can be computed by adding the time of the first one plus the spectrum duration. The elementary spectrum duration is obtained from the division of the total duration (field 8) by the spectrum number (field 6).

3.5.7. Waveform of the ELF Magnetic Field (APID 1135)

Experiment : ***IMSC***.
Data type : ***Waveform of 3 components of the magnetic field in the ELF range***.

The level 1 file structure of "ELF Magnetic Waveform" is given in Table N1-19.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-19. Structure of the "ELF magnetic waveform" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-20.

Waveform of 3 components of the magnetic field in the ELF range					
Filename : ***DMT_N1_1135_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "ELF MAGNETIC WAVEFORM"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor ", "Satellite" or "B0field "
4	R*4	9	36		$M_{senssat}$: Matrix from sensor coordinate system to satellite coordinate system
5	A16	1	16		Data unit : "nT "
6	R*4	1	4	Hz	Sampling frequency : "2500."
7	I*2	1	2		Sample data number per component : 4096
8	R*4	1	4	s	Time duration of one data array : 4096 / 2500
					First component waveform
9	A3	1	3		First component name : "B1 " in sensor coordinate system "Bx " in the other coordinate systems
10	R*4	4096	16384	nT	Waveform sample array of the first component
					Second component waveform
11	A3	1	3		Second component name : "B2 " in sensor coordinate system "By " in the other coordinate systems
12	R*4	4096	16384	nT	Waveform sample array of the second component
					Third component waveform
13	A3	1	3		Third component name :

					"B3 " in sensor coordinate system "Bz " in the other coordinate systems
14	R*4	4096	16384	nT	Waveform sample array of the third component

Table N1-20. Block 4 : ELF magnetic waveform.

3.5.8. Waveform of the VLF Magnetic Field (APID 1136)

Experiment : ***IMSC***.
Data type : ***Waveform of 1 component of the magnetic field in the VLF range***.

The level 1 file structure of "VLF Magnetic Waveform" is given in Table N1-21.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-21. Structure of the "VLF magnetic waveform" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-22.

Waveform of 1 component of the magnetic field in the VLF range					
Filename : ***DMT_N1_1136_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "VLF MAGNETIC WAVEFORM"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor "
4	A16	1	16		Data unit : "nT "
5	R*4	1	4	Hz	Sampling frequency : 40000.
6	I*2	1	2		Sample data number per component : 8192
7	R*4	1	4	s	Time duration of one data array : 8192 / 40000
					Waveform data
8	A3	1	3		Component name : "Bi ", i is the sensor number
9	R*4	8192	32768	nT	Waveform sample array

Table N1-22. Block 4 : VLF magnetic waveform.

3.5.9. Power spectrum of the VLF Magnetic Field (APID 1137)

Experiment : ***IMSC***.
Data type : ***Power spectrum of 1 component of the magnetic field in the VLF range***.

The level 1 file structure of "VLF Magnetic Spectrum" is given in Table N1-23.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-23. Structure of the "VLF magnetic spectrum" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-24.

Power spectrum of 1 component of the magnetic field in the VLF range					
Filename : ***DMT_N1_1137_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "VLF MAGNETIC SPECTRUM"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	A9	1	9		Data coordinate system : "Sensor "
4	A3	1	3		Component name : "Bi ", i is the sensor number
5	A16	1	16		Data unit : "log(nT^2/Hz) "
6	I*1	1	1		Number of consecutive spectra (Nb) : 2 or 8 (1)
7	I*2	1	2		Number of spectrum frequencies (Nbf) : 1024 or 256
8	R*4	1	4	s	Total time duration of Nb spectra : 16.384, 4.096 or 1.024
9	R*4	1	4	Hz	Frequency resolution : 19.53125 or 78.125
10	R*4	2	8	Hz	Frequency range : [19.53125 or 78.125 - 20000]
11	I*2	7	14		UT time of the first spectrum as : year, month, day, hour, minute, second, millisecond (2)
					Power spectrum data
12	R*4	Nbf	Nbf*4	log(nT^2/Hz)	Power array of the first spectrum
…	…	…	…	…	….
12 + (Nb-1)	R*4	Nbf	Nbf*4	log(nT^2/Hz)	Power array of the Nb^{th} spectrum

Table N1-24. Block 4 : VLF magnetic spectrum.

(1) The parameters of the 3 different spectrum types are summarized below :

Spectrum type	*Spectrum number in the data format (Nb)*	*Frequency number per spectrum (Nbf)*	*Total time duration*	*Duration of one spectrum*	*Number of averaged spectra (onboard)*	*Number of averaged frequencies (onboard)*
Type 0	2	1024	4.096 s	2.048 s	40	1
Type 1	2	1024	1.024 s	0.512 s	10	1
Type 2	8	256	16.384 s	2.048 s	40	4

(2) Only the time of the first spectrum is given in the data format (field 11). The UT time of each spectrum can be computed by adding the time of the first one plus the spectrum duration. The elementary spectrum duration is obtained from the division of the total duration (field 8) by the spectrum number (field 6).

3.5.10. Neural network results (APID 1138)

Experiment : ***RNF***.
Data type : ***Results of event detection from the neural network***.

The level 1 file structure of "RNF detection results" is given in Table N1-25.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-25. Structure of the "RNF results" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-26.

RNF results					
Filename : ***DMT_N1_1138_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A21	1	21		Data type : "Neural Network "
2	I*1	32	32		House-Keepings and Status (see DR1)
3	I*1	1	1		Data sub-type : 0 or 1 (0 : 3D spectrogram, 1 : 2D curves)
4	A20	1	20		Study title : "WHISTLER "
5	A3	1	3		Component name : "Eij" or "Bi "
6	R*4	1	4	s	Time resolution (*dt*)
7	I*1	1	1		Class number (*Nbclasses*) : from 1 to 20
8	I*1	1	1		Number of spectra (*Nbs*)when '3D spectrogram' sub-type Number of plot points (*Nbp*) when '2D curves' sub-type Value from 1 to 128
9	I*1	1	1		0 when '3D spectrogram' sub-type Number of curves *Nbc* when '2D curves' sub-type, from 0 to 5
					Class description
10	A10	1	10		Unit name for the class ranges
11	R*4	20	80		Minimum ranges for the classes Di (filled by 0 when *Nbclasses* < 20)
12	R*4	20	80		Maximum ranges for the classes Di (filled by 0 when *Nbclasses* < 20)
					Spectrogram intensity
13	I*1	128*20	2560		*Nbs* vectors of *Nbclasses* elements when '3D spectrogram' sub-type; the vectors are set in the order V_0, V_1, …, V_{Nbs-1} *Nbc* vectors of *Nbp* elements when '2D curves' sub-type; the vectors are set in the order C_0, C_1, …, C_{Nbc-1} The field is completed by 0.

					Spectrogram uncertainty (time resolution)
14	I*1	128*20	2560		*Nbs* vectors of *Nbclasses* elements when '3D spectrogram' sub-type; the vectors are set in the order V_0, V_1, …, V_{Nbs-1} *Nbc* vectors of *Nbp* elements when '2D curves' sub-type; the vectors are set in the order C_0, C_1, …, C_{Nbc-1} The field is completed by 0.

Table N1-26. Block 4 : RNF detection results.

3.5.11. Ion characteristics (APID 1139)

Experiment : ***IAP***.
Data type : ***Ion density, temperature and velocity***.

The level 1 file structure of "Ion characteristics" is in Table N1-27.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-27. Structure of the "IAP Burst" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-28.

Density, temperature and velocity of low energy ions					
Filename : ***DMT_N1_1139_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A10	1	10		Data type : "IAP BURST "
2	I*1	32	32		House-Keepings and Status (see DR1)
3	R*4	1	4	s	Time resolution
4	A6	1	6		Density unit : "m^-3 "
5	A6	1	6		Temperature unit : "eV "
6	A6	1	6		Velocity unit : "m/s "
7	A6	1	6		Potential unit : "V "
8	A6	1	6		Angle unit : "degree"
					Density and temperature
9	R*4	1	4	m^-3	H+ density
10	R*4	1	4	m^-3	He+ density
11	R*4	1	4	m^-3	O+ density
12	R*4	1	4	eV	Ions temperature
					Plasma velocity
13	R*4	1	4	ms^-1	Ions velocity along the satellite Oz axis
14	R*4	1	4	degree	Angle between the ion velocity and –Oz axis of satellite
15	R*4	1	4	degree	Angle between projection of the ions velocity on the plane xOy and axis Ox of satellite
					Satellite potential
16	R*4	1	4	V	Satellite potential

Table N1-28. Block 4 : IAP Burst results.

3.5.12. Ion characteristics (APID 1140)

Experiment : ***IAP***.
Data type : ***Ion density, temperature and velocity***.

The level 1 file structure of "Ion characteristics" is given in Table N1-29.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-29. Structure of the "IAP Survey" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-30.

Density, temperature and velocity of low energy ions					
Filename : ***DMT_N1_1139_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A10	1	10		Data type : "IAP BURST "
2	I*1	32	32		House-Keepings and Status (see DR1)
3	R*4	1	4	s	Time resolution
4	A6	1	6		Density unit : "m^-3 "
5	A6	1	6		Temperature unit : "eV "
6	A6	1	6		Velocity unit : "m/s "
7	A6	1	6		Potential unit : "V "
8	A6	1	6		Angle unit : "degree"
					Density and temperature
9	R*4	1	4	m^-3	H+ density
10	R*4	1	4	m^-3	He+ density
11	R*4	1	4	m^-3	O+ density
12	R*4	1	4	eV	Ions temperature
					Plasma velocity
13	R*4	1	4	ms^-1	Ions velocity along the satellite Oz axis
14	R*4	1	4	degree	Angle between the ion velocity and –Oz axis of satellite
15	R*4	1	4	degree	Angle between projection of the ions velocity on the plane xOy and axis Ox of satellite
					Satellite potential
16	R*4	1	4	V	Satellite potential

Table N1-30. Block 4 : IAP Survey results.

3.5.13. Energetic electron flux (APID 1141)

Experiment : ***IDP***.
Data type : ***Energetic electron spectrum***.

The level 1 file structure of "Energetic Electron Spectrum" is given in Table N1-31.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-31. Structure of the "IDP Burst" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-32.

Spectrum of energetic electrons					
Filename : ***DMT_N1_1141_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A10	1	10		Data type : "IDP BURST "
2	I*1	32	32		House-Keepings and Status (see DR1)
3	R*4	1	4	s	Time resolution (one spectrum / second)
4	R*4	1	4	V	Polarisation voltage
5	R*4	1	4	keV	Discrimination level
6	A20	1	20		Spectrum data unit : "elec/cm^2/s/ster/keV"
7	A6	1	6		Pitch angle unit : "degree"
					Electron spectra
8	R*4	256	1024	elec/cm^2/s/ster/keV	Data array of spectrum n°1
9	R*4	256	1024	elec/cm^2/s/ster/keV	Data array of spectrum n°2
10	R*4	256	1024	elec/cm^2/s/ster/keV	Data array of spectrum n°3
11	R*4	256	1024	elec/cm^2/s/ster/keV	Data array of spectrum n°4
					Energy table
12	R*4	256	1024	keV	Energy table
					Pitch angle data
13	R*4	1	4	degree	Pitch angle (from 0 to 180°)

Table N1-32. Block 4 : IDP Burst results.

3.5.14. Energetic electron counters (APID 1142)

Experiment : ***IDP***.
Data type : ***Energetic electron counter and spectrum***.

The level 1 file structure of "Energetic Electron Counters" is given in Table N1-33.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-33. Structure of the "IDP Survey" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-34.

Counters of energetic electrons					
Filename : ***DMT_N1_1142_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A10	1	10		Data type : "IDP SURVEY"
2	I*1	32	32		House-Keepings and Status (see DR1)
3	R*4	1	4	s	Spectrum time resolution
4	R*4	1	4	s	Counters time resolution
5	R*4	1	4	V	Polarisation voltage
6	R*4	1	4	keV	Discrimination level
7	R*4	1	4	keV	Threshold low interval 1
8	R*4	1	4	keV	Threshold low interval 2
9	R*4	1	4	keV	Threshold low interval 3
10	R*4	1	4	keV	Threshold high interval 3
11	A20	1	20		Spectrum data unit : "elec/cm^2/s/ster/keV"
12	A6	1	6		Pitch angle unit : "degree"
					Counters and spectrum data
13	I*4	12	48		4 x [counter #1 value counter #2 value counter #3 value]
14	R*4	128	512	elec/cm^2/s/ster/keV	Data array of spectrum #1
15	I*4	12	48		4 x [counter #1 value counter #2 value counter #3 value]
16	R*4	128	512	elec/cm^2/s/ster/keV	Data array of spectrum #2
17	I*4	12	48		4 x [counter #1 value counter #2 value counter #3 value]

18	R*4	128	512	elec/cm^2/s/ster/keV	Data array of spectrum #3
19	I*4	12	48		4 x [counter #1 value counter #2 value counter #3 value]
20	R*4	128	512	elec/cm^2/s/ster/keV	Data array of spectrum #4
21	I*4	12	48		4 x [counter #1 value counter #2 value counter #3 value]
22	R*4	128	512	elec/cm^2/s/ster/keV	Data array of spectrum #5
23	I*4	12	48		4 x [counter #1 value counter #2 value counter #3 value]
24	R*4	128	512	elec/cm^2/s/ster/keV	Data array of spectrum #6
25	I*4	12	48		4 x [counter #1 value counter #2 value counter #3 value]
26	R*4	128	512	elec/cm^2/s/ster/keV	Data array of spectrum #7
					Energy table
27	R*4	128	512	keV	Energy table
					Pitch angle data
28	R*4	1	4	degree	Pitch angle (from 0 to 180°)

Table N1-34. Block 4 : IDP Survey results.

3.5.15. Langmuir probe data (APID 1143)

Experiment : ***ISL***.
Data type : ***Electron and ion densities, electron temperature and potentials***.

The level 1 file structure of "Langmuir probe data" is given in Table N1-35.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-35. Structure of the "ISL Burst" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-36.

Langmuir probe results					
Filename : ***DMT_N1_1143_< nnnnns >_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A10	1	10		Data type : "ISL BURST "
2	I*1	32	32		House-Keepings and Status (see DR1)
3	R*4	1	4	s	Time resolution
4	A5	1	5		Density unit : "cm^-3"
5	A5	1	5		Temperature unit : "K "
6	A5	1	5		Potential unit : "V "
					Plasma parameters
7	R*4	1	4	cm^-3	Electron density
8	R*4	1	4	cm^-3	Ion density
9	R*4	1	4	K	Electron temperature
10	R*4	1	4	V	Floating potential
11	R*4	1	4	V	Potential for I=0 in the I-V characteristics
12	R*4	1	4	V	Satellite potential

Table N1-36. Block 4 : ISL Burst results.

3.5.16. Langmuir probe data (APID 1144)

Experiment : ***ISL***.
Data type : ***Electron and ion densities, electron temperature and potentials***.

The level 1 file structure of "Langmuir probe data" is given in Table N1-37.

Time T_1				*Time T_2*				
block 1	block 2	block 3	block 4	block 1	block 2	block 3	block 4	…

Table N1-37. Structure of the "ISL Survey" data file.

The structures of the data blocks from 1 to 3 are detailed in section 3.4.

The data block 4 is detailed in Table N1-38.

Langmuir probe results					
Filename : ***DMT_N1_1144_<nnnnns>_<start_date>_<end_date>.DAT***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Data header
1	A10	1	10		Data type : "ISL SURVEY "
2	I*1	32	32		House-Keepings and Status (see DR1)
3	R*4	1	4	s	Time resolution
4	A5	1	5		Density unit : "cm^-3"
5	A5	1	5		Temperature unit : "K "
6	A5	1	5		Potential unit : "V "
					Plasma parameters
7	R*4	1	4	cm^-3	Electron density
8	R*4	1	4	cm^-3	Ion density
9	R*4	1	4	K	Electron temperature
10	R*4	1	4	V	Floating potential
11	R*4	1	4	V	Potential for I=0 in the I-V characteristics
12	R*4	1	4	V	Satellite potential

Table N1-38. Block 4 : ISL Survey results.

4. LEVEL 2 SCIENCE DATA

4.1. Level 2 definition

Level 2 data processing corresponds to high resolution plots of the physical values data. The level 2 image is created by the user itself on the data server which gives facilities to personalize the output image.

4.2. Level 2 experiment image

The level 2 image name is :

DMT_N2_<start_date>_<end_date>.PS

- <start_date> : date of the first data sample as "yyyymmdd_hhmnss";
- <end_date> : date of the last data sample as "yyyymmdd_hhmnss".

Note that the image is not stored in the Mission Center since created on request. The name of the image is only used for image transfer.

5. ANCILLARY DATA

5.1. Orbit and geomagnetic parameters

5.1.1. Contents

The orbit and geomagnetic parameters are

- the position and velocity of the satellite versus the time in the geographic coordinate system,
- the geocentric latitude, geocentric longitude and local time,
- the geomagnetic latitude, geomagnetic longitude, magnetic local time, invariant latitude, Mc Ilwain parameter,
- the position of the Sun.

The time resolution is 30 seconds.

Note that the given latitude is named geocentric latitude to make difference with the geodetic latitude; the geodetic latitude takes into account that the shape of the Earth that is an oblate spheroid and not a sphere.

5.1.2. Orbit ephemeris file

The orbit ephemeris files are named as :

ORBIT_EPHEMERIS_<start_date>_<end_date>

- <start_date> : date of the first orbit parameter as "yyyymmdd_hhmnss",
- <end_date> : date of the last orbit parameter as "yyyymmdd_hhmnss".

5.1.3. Orbit parameter description

Orbit ephemeris					
Filename : ***ORBIT_EPHEMERIS_<start_date>_<end_date>***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Standard CCSDS date
1	I*1	1	1		P field (decimal value = 76)
2	I*3	1	3		Number of days from 01/01/1950
3	I*4	1	4		Number of milliseconds in the day
					Time and orbit information
4	I*2	7	14		UT time of the orbit parameters as : year, month, day, hour, minute, second, millisecond
5	I*2	1	2		Orbit number
6	I*2	1	2		Orbit sub-number (0 : downwards, 1 : upwards)
					Satellite position and velocity

7	R*4	3	12	m	Position in the geographic coordinate system
8	R*4	3	12	m/s	Velocity in the geographic coordinate system
9	R*4	3	12	m	Position in the VEIS coordinate system
10	R*4	3	12	m/s	Velocity in the VEIS coordinate system
					Orbit parameters
11	R*4	1	4	degree	Geocentric latitude (from -90° to +90°)
12	R*4	1	4	degree	Geocentric longitude (from 0° to +360°)
13	R*4	1	4	km	Altitude
14	R*4	1	4	hour	Local time of the first point of the data array (0, 24h)
					Solar position
15	R*4	3	12		Solar position, Xs, Ys, Zs in the geocentric coordinate system
					Geomagnetic parameters
16	R*4	1	4	degree	Geomagnetic latitude (-90°, +90°)
17	R*4	1	4	degree	Geomagnetic longitude (0°, +360°)
18	R*4	1	4	hour	Magnetic local time of the first point
19	R*4	1	4	degree	Invariant latitude (-90°, +90°)
20	R*4	1	4		Mc Ilwain parameter L (0, 999)
21	R*4	1	4	degree	Geocentric latitude of the conjugate point at the satellite altitude (-90°, +90°)
22	R*4	1	4	degree	Geocentric longitude of the conjugate point at the satellite altitude (0°, +360°)
23	R*4	1	4	degree	Geocentric latitude of North conjugate point at altitude 100 km (-90°, +90°)
24	R*4	1	4	degree	Geocentric longitude of North conjugate point at altitude 100 km (0°, +360°)
25	R*4	1	4	degree	Geocentric latitude of South conjugate point at altitude 100 km (-90°, +90°)
26	R*4	1	4	degree	Geocentric longitude of South conjugate point at altitude 100 km (0°, +360°)
27	R*4	3	12	nT	Components of the magnetic field model at the satellite point (satellite coordinate system)
28	R*4	1	4	Hz	Proton gyrofrequency at satellite point

Table AUX-1. Description of the 'ORBIT_EPHEMERIS' file.

For the 2 years DEMETER mission, the total volume for the orbit parameters is about 340 Mbytes; thus, 12 'ORBIT_EPHEMERIS' files will be necessary to store these parameters (file size limited to 30 Mbytes). The size is 162 bytes per time.

When the geomagnetic latitude is upper than +66° or lower than -66° (North and South pole regions), the geomagnetic parameters are set to 99999.00

5.2. Attitude

5.2.1. Contents

The attitude file contains the elements of the matrices that allows the transformation satellite coordinate to geographic coordinate system or local geomagnetic coordinate system.
The time resolution is 250 milliseconds.

5.2.2. Attitude file

The attitude files are named as :

ATTITUDE_<start_date>_<end_date>

- <start_date> : date of the first attitude parameters as "yyyymmdd_hhmnss",
- <end_date> : date of the last attitude parameters as "yyyymmdd_hhmnss".

5.2.3. Attitude data description

Attitude					
Filename : ***ATTITUDE_<start_date>_<end_date>***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Standard CCSDS date
1	I*1	1	1		P field (decimal value = 76)
2	I*3	1	3		Number of days from 01/01/1950
3	I*4	1	4		Number of milliseconds in the day
					Time and quality information
4	I*2	7	14		UT time of the attitude parameters as : year, month, day, hour, minute, second, millisecond
5	I*2	1	2		Orbit number
6	I*2	1	2		Orbit sub-number (0 : downwards, 1 : upwards)
7	I*2	1	2		Data quality : 0 : NOK 1 : OK 2 : interpolation
					Quaternions
8	R*4	4	16		Attitude quaternions in the J2000 coordinate system
					Coordinate change matrices
9	R*4	9	36		$M_{satgeog}$: Matrix from satellite coordinate system to geographic system
10	R*4	9	36		$M_{geoggeom}$: Matrix from geographic coordinate system to local geomagnetic coordinate system

Table AUX-2. Description of the 'ATTITUDE' file.

For the 2 years DEMETER mission, the total volume for the attitude parameters is about 30000 Mbytes; thus, 700 'ATTITUDE' files will be necessary to store these parameters (file size limited to 42 Mbytes). The size is 116 bytes per time value (every 250 ms).

5.3. Orbit numbers

5.3.1. Contents

The orbit number file contains the times of the beginning and of the end of one half orbit; this file has been created with predicted orbit parameters (about 1 m maximum difference with determinated parameters).

5.3.2. Orbit number file

The orbit number file is named as :

P_ORBIT_NUMBERS

5.3.3. Orbit number file description

All the values are separated by a tabulation character.

Field number	Type	Array dim.	Size (bytes)	Description
				Information type
1	ASCII	1	5	EVENT for the orbit events ORBIT for the orbit and sub-orbit numbers SPROG for the programmation days
				Date of the event
1	ASCII	1	23	STRING Format is YYYY/MM/DD/ HH:MN:SS.MS
				Class of event
1	ASCII	1	1	M : mission event O : orbital event S : satellite event
				Event number
1	ASCII (I2)	1	2	For EVENT, ORBIT and SPROG information : - For mission event class (M) : 15 : Beginning of programmation day - For orbital event class (O) : 3 : Light → penombra transition time 4 : Penombra → shadow transition time 5 : Shadow → penombra transition time 6 : Penombra → light transition time 7 : Day → night transition time 8 : Night → day transition time

				9 : Time of shifting into quadrature position (satellite – Sun – Earth) 10 : Time of shifting into subsolary position 11 : Time of shifting into anti-subsolary position 12 : Time of Sun eclipse by moon 13 : +90° orbit position pass time 14 : - 90° orbit position pass time - For satellite event class (S) : 15 : Maneuver beginning (start of turn attitude maneuver for the µsat) 16 : Maneuver end (stop of turn attitude maneuver for the µsat) 33 : Start of MTB activation period 34 : End of MTB activation period
				Orbit number
1	ASCII (I5)	1	5	orbit number
1	ASCII (I1)	1	1	orbit sub-number
				Event description
1	ASCII	1	<40	Event description text

Table AUX-3. Description of the 'P_ORBIT_NUMBERS' file.

For the 2 years DEMETER mission, the estimated total volume for the 'P_ORBIT_NUMBERS' file is about a few tens of Mb.

Example of P_ORBIT_NUMBERS file is given in Annex F.

5.4. Seismic events

5.4.1. Contents

The seismic events file contains all the earthquake information relative to the DEMETER orbit parameters.

5.4.2. Filename

The seismic events files are named as :

SEISMIC_EVENTS_<start_date>_<end_date>

- <start_date> : date of the first earthquake as "yyyymmdd_hhmnss",
- <end_date> : date of the last earthquake as "yyyymmdd_hhmnss".

5.4.3. Seismic events file structure

The seismic events file is organized by earthquake (magnitude greater than 5) and time.
The structure is given in Table AUX-4.

Earthquake time T_1						*Earthquake time T_2*						
block 1	block 2	block 3	block 4_1	block 4_2	…	block 1	block 2	block 3	block 4_1	block 4_2	…	…

Table AUX-4. Structure of the 'SEISMIC EVENTS' file.

Four different blocks are defined (Table AUX-5)

Block number	**Data description**
1	Earthquake coordinates for magnitude (mag) greater than 5.
2	Geomagnetic parameters at time of the earthquakes; The model of Earth magnetic field used to compute the geomagnetic parameters is IGRF2000.
3	DEMETER orbits according to the earthquakes, direct distances between epicenter and orbit.
4	Pre- and post-seismic information; The minimum distances are computed for every earthquake within the following parameters : - direct distance between epicenter and orbit lower than 2000 km, - time interval [-6, +2] months for earthquake with mag ≥ 7, - time interval [-3, +2] months for earthquake with 6 ≤ mag < 7, - time interval [-1, +2] months for earthquake with 5 ≤ mag < 6.

Table AUX-5. Block type description of the 'SEISMIC EVENTS' file.

5.4.4. Seismic events file description

Seismic events : Earthquake geomagnetic parameters					
Filename : ***SEISMIC_EVENTS_<start_date>_<end_date>***					
Field number	Type	Array dim.	Size (bytes)	Unit	Description
					Block 1 : Earthquake coordinates
1	I*2	1	2		Earthquake number
2	I*2	6	12		Time of the earthquake processing update as : year, month, day, hour, minute, second
3	I*2	6	12		UT time of the earthquake as : year, month, day, hour, minute, second
4	R*4	1	4	degree	Geocentric latitude of the epicenter (from -90° to +90°)
5	R*4	1	4	degree	Geocentric longitude of the epicenter (from 0° to 360°)
6	R*4	1	4		Magnitude
7	R*4	1	4	km	Depth
8	A1	1	1		Determination quality index (a letter, "X" if not defined)
9	A1	1	1		Determination origin (a letter)
					Block 2 : Geomagnetic parameters at time of the earthquakes
10	R*4	1	4	degree	Geomagnetic latitude (from -90° to +90°)
11	R*4	1	4	degree	Geomagnetic longitude (from 0° to 360°)
12	R*4	1	4	hour	Magnetic local time
13	R*4	1	4		Mc Ilwain parameter L
14	R*4	1	4	degree	Geocentric latitude of conjugate point (from -90° to +90°)
15	R*4	1	4	degree	Geocentric longitude of conjugate point (from 0° to 360°)
16	R*4	1	4	degree	Geocentric latitude of North conjugate point at the satellite altitude (from -90° to +90°)
17	R*4	1	4	degree	Geocentric longitude of North conjugate point at the satellite altitude (from 0° to 360°)
18	R*4	1	4	degree	Geocentric latitude of South conjugate point at the satellite altitude (from -90° to +90°)
19	R*4	1	4	degree	Geocentric longitude of South conjugate point at the satellite altitude (from 0° to 360°)
					Block 3 : DEMETER orbits according to the earthquakes
20	I*2	1	2		Orbit number at the earthquake time
21	I*2	1	2		Orbit sub-number (0 : downwards, 1 : upwards)
22	R*4	1	4	km	Distance d_1 between the epicenter and the satellite at the earthquake time
23	R*4	1	4	km	Distance d_2 between the conjugate point of the epicenter and the satellite at the earthquake time
24	R*4	1	4	km	Distance d_3 between the North conjugate point at the satellite altitude (800 km) and the satellite at the earthquake time
25	R*4	1	4	km	Distance d_4 between the South conjugate point at the satellite altitude (800 km) and the satellite at the

					earthquake time
26	I*2	1	2		Number of blocks 4
					Block 4 : Pre- and post-seismic information
27	I*2	1	2		Orbit number at the time t_m
28	I*2	1	2		Orbit sub-number (0 : downwards, 1 : upwards)
29	R*4	1	4	km	Distance minimum d_m between the epicenter and the satellite (< 2000 km)
30	I*2	6	12		Time t_m (UT) when the satellite is at the distance d_m as year, month, day, hour, minute, second
31	R*4	1	4	km	Distance minimum d_{mc} between the conjugate point of the epicenter and the satellite (< 2000 km)
32	I*2	6	12		Time t_{mc} (UT) when the satellite is at the distance d_{mc} as year, month, day, hour, minute, second
33	R*4	1	4	km	Distance minimum d_{mcN} between North conjugate point at the satellite altitude (750 km) and the satellite
34	I*2	6	12		Time t_{mcN} (UT) when the satellite is at the distance d_{mcN} as year, month, day, hour, minute, second
35	R*4	1	4	km	Distance minimum d_{mcS} between South conjugate point at the satellite altitude (750 km) and the satellite
36	I*2	6	12		Time t_{mcS} (UT) when the satellite is at the distance d_{mcS} as year, month, day, hour, minute, second

Table AUX-6. Block description of the 'SEISMIC EVENTS' file.

Note : the distances are validated and stored only when the distances d_m or d_{mc} are lower than 2000 km.

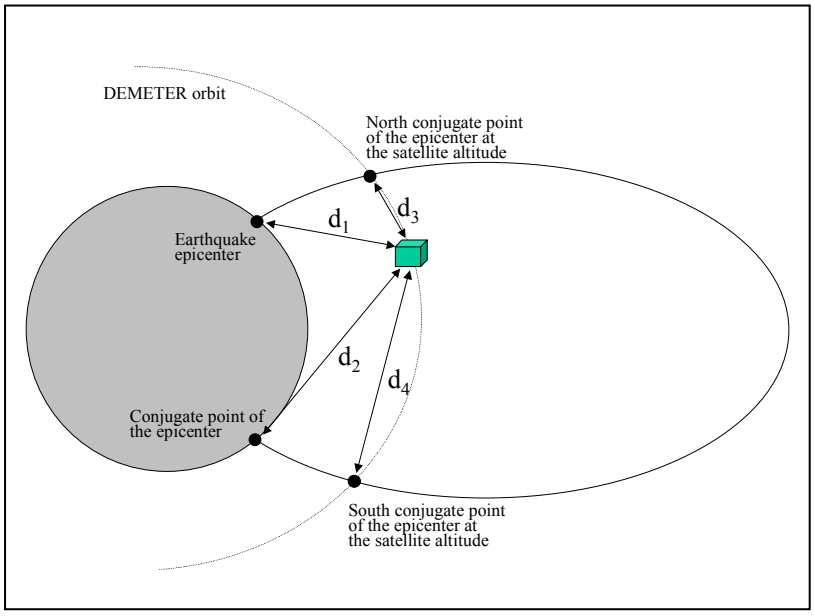


Figure AUX-1. Distance and conjugate point definitions.

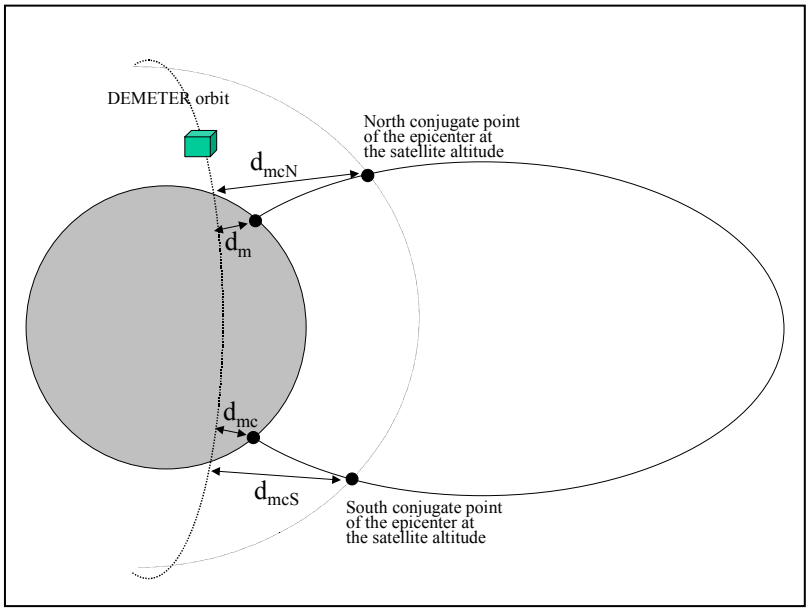


Figure AUX-2. Minimum distance definitions.

For 2-year mission, the estimation of total file volume is :

- *Earthquakes : 8085 events (USGS 5-year data) → 4.43 events / day*
- *Blocks 1 to 3 : 106 bytes*
- *Block 4 : 68 bytes*
  4 orbits with encounter a day
  during 240 days, 960 times
- *Per event : 65386 bytes*
- *For 2-year mission, about 208 Mbytes → 7 'SEISMIC-_EVENTS' files will be necessary to store these parameters (file size limited to 30 Mo).*

ANNEX A. EXAMPLE OF DECOMMUTATION REPORT

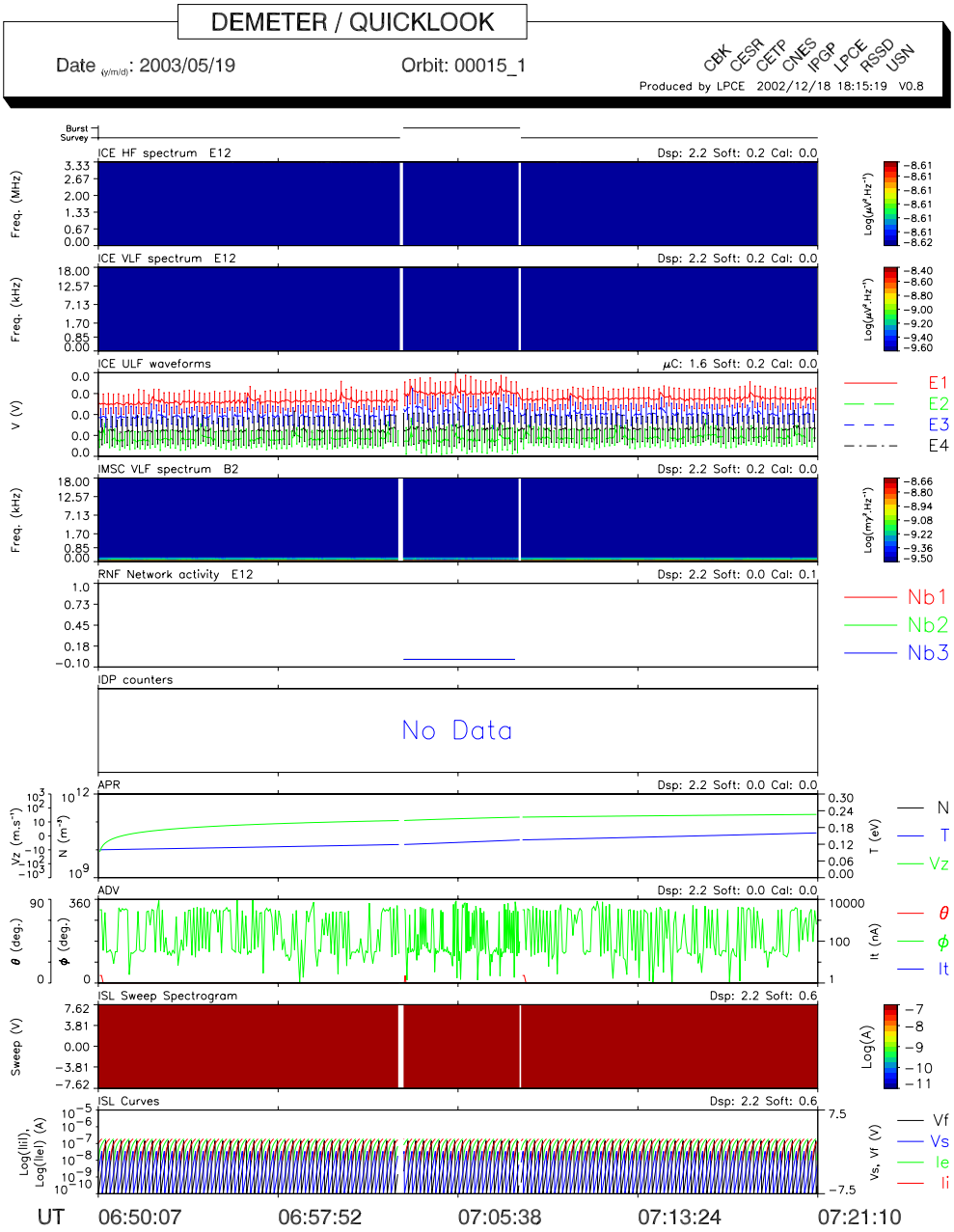
```
Raw Telemetry : ...ement/data/Burst/in=UBF-E12_5Vsqr1Hz.dem   27349056  bytes

Decommutation version : 1.2

First orbit     :  150301     20020417_11_3607
Last  orbit     :  150301     20020417_11_3826

Lost of synchronization      : 1
Number of wrong APID         : 0
#CCSDS pack. with null orbit : 0
```

APID	CCSDS read	CCSDS missing	CCSDS to err	DEMETER output
1124	27	0	0	3
1125	9	0	0	1
1126	18	0	0	2
1127	0	0	0	0
1128	1197	0	0	133
1129	180	0	0	20
1130	8730	0	0	970
1131	46548	0	0	5172
1132	288	0	0	32
1133	1152	0	0	128
1134	288	0	0	32
1135	8730	0	0	970
1136	46548	0	0	5172
1137	288	0	0	32
1138	90	0	0	10
1139	0	0	0	0
1140	0	0	0	0
1141	0	0	0	0
1142	0	0	0	0
1143	288	0	0	32
1144	0	0	0	0
1145	0	0	0	0
total	114381	0	0	12709

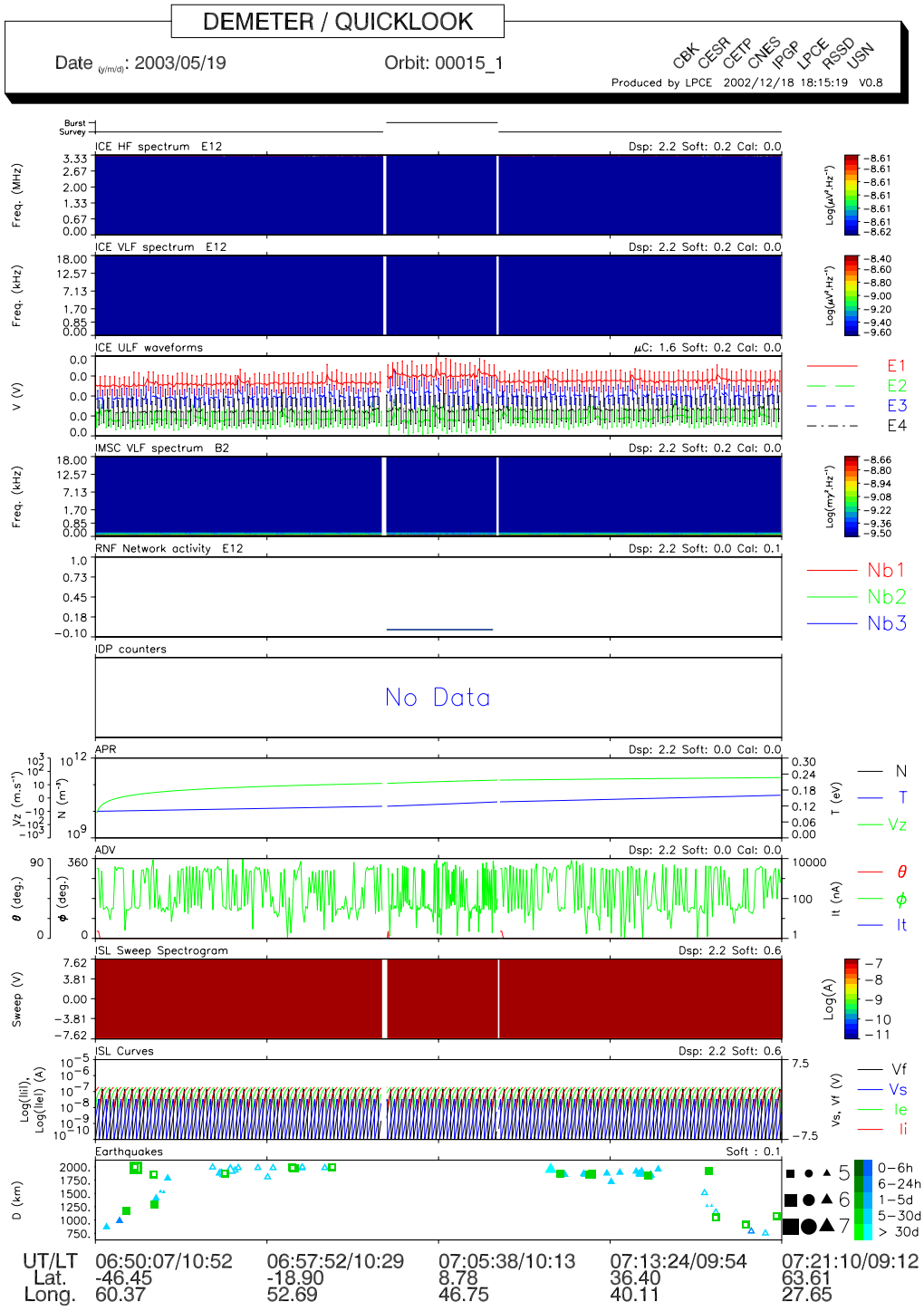
ANNEX B. EXAMPLE OF GOOD HEALTH REPORT

```
Programme de bonne sante de DEMETER V0.3

Orbit 150301 :
--------------
PAQUETS DEMARRAGE : ..................................................... OK
     Echo TC : ..................................................... OK
     DMT_n0_1125_150301_20020417_113607_20020417_113607.dat
     Init Micro-C : ..................................................... OK
     Init Systeme DSP : ..................................................... OK
     DMT_n0_1124_150301_20020417_113607_20020417_113613.dat
VERIF DATE : ..................................................... OK
     DMT_n0_1124_150301_20020417_113607_20020417_113613.dat (3 enrs  0 erreur)
TEST HK : ..................................................... NOK
     DMT_n0_1138_150301_20020417_113614_20020417_113811.dat (10 enrs  10 erreurs)
     #enr : 0  TU : 2002/04/17 11:36:14.026  hk(3) = -273.00 V
VERIF TENSION IFCU : ..................................................... OK
     DMT_n0_1124_150301_20020417_113607_20020417_113613.dat (3 enrs  0 erreur)
TEST RAM micro-C : ..................................................... OK
     DMT_n0_1124_150301_20020417_113607_20020417_113613.dat (3 enrs  0 erreur)
INIT SYSTEME DSP : ..................................................... OK
     EEPROM : ..................................................... OK
     RAM : ..................................................... OK
     DMT_n0_1124_150301_20020417_113607_20020417_113613.dat (3 enrs  0 erreur)
INIT TRAITEMENT DSP : ..................................................... OK
     SINUS : ..................................................... OK
     FEN : ..................................................... OK
     FFT : ..................................................... OK
     DMT_n0_1124_150301_20020417_113607_20020417_113613.dat (3 enrs  0 erreur)
TEST EVENEMENTS DE BORD : ..................................................... NOK
     DMT_n0_1126_150301_20020417_113614_20020417_113826.dat (2 enrs  15 erreurs)
     #enr : 0  TU : 2002/04/17 11:36:14.008  Proc : 0x99  1er ev. inattendu (ev1) :
Mauvaise configuration du traitement ou de l'instrument IDP (0x4C)
TEST DUMP : ..................................................... NA
     NUM PAQUETS : ..................................................... NA
     NB PAQUETS : ..................................................... NA
     VERSION DSP : ..................................................... NA
Pas de fichier N0
TEST PATCH : ..................................................... NA
     DMT_n0_1125_150301_20020417_113607_20020417_113607.dat
     DMT_n0_1126_150301_20020417_113614_20020417_113826.dat

TEST 1/2 ORBITE : ..................................................... NOK
```

ANNEX C. EXAMPLE OF QUICKVIEW IMAGE



ANNEX D. EXAMPLE OF QUICKLOOK IMAGE



ANNEX E. COORDINATE SYSTEMS

E.1. Introduction

The wave data (ICE and IMSC) are measured in the sensor systems (sensor 'electric' for ICE, sensor 'magnetic' for IMSC).
When only one component is available (TBF or HF bandwidth), no transformation is possible; the data will remain into the sensor frame.
When three components are available (UBF or EBF bandwidth), data can be transformed in an other coordinate system; the proposed choice is :

satellite,
geographic (geocentric),
geomagnetic.

But if one antenna component failed, the transformation will be no more possible and the data will be kept in the sensor system.

For the wave instruments, the choice of the final data coordinate system must be indicated into the instrument calibration file which is required for the ground data processing.

DEMETER orbit and attitude data from control centre are available in the geocentric equatorial inertial system for epoch known as J2000.0, which is 12:00 UT1 on 1 January 2000.

E.2. Coordinate systems for DEMETER

All the coordinate systems are right-handed and all except the electric sensor coordinate system are orthogonal.

The different coordinate systems necessary for DEMETER are given in Figure AN-1.

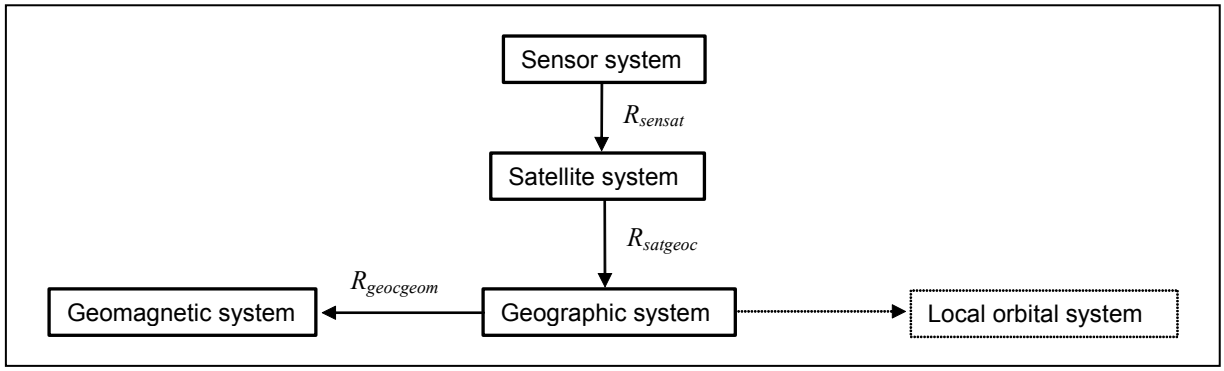


Figure AN-1. Coordinate transformations.

The transformation from satellite coordinate system to geographic coordinate system is computed as "Satellite" → "Inertial J2000" → "Inertial Veis" → "Geographic".

The definitions of the coordinate systems used for DEMETER are :

- ***Sensor coordinate system***
  The sensor coordinate system is defined by the main axes of the instrument. Electric and magnetic instruments have their own axes. The matrix M_{sensat} is given in bock4 when transformation is possible.

- ***Satellite coordinate system***
  The satellite coordinate system is defined with the main inertia satellite axes. They are :
  +Xs Nadir (Earth direction),
  +Ys along the normal to the orbit,
  -Zs along the velocity vector.

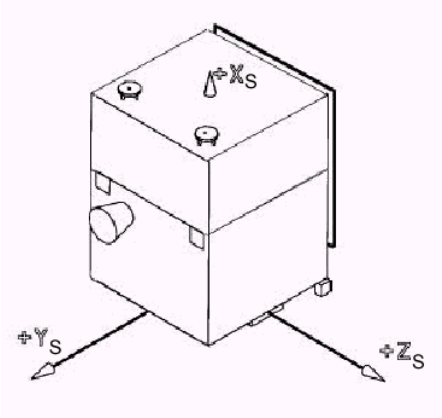


Figure AN-2. Satellite coordinate system.

- ***J2000 coordinate system***
  The geocentric equatorial inertial J2000 coordinate system is defined by :
  - origin O at the centre of the Earth,
  - X is the intersection of the equator plane and the ecliptic plane and is pointing towards the Sun position at the vernal equinox,
  - Z is parallel to the rotation axis of the Earth,
  - Y makes the trihedron.

- ***Geographic (geocentric) coordinate system***
  This system is convenient for specifying the location of ground stations and ground-based experiments. It is defined by :
  - X axis towards the intersection of the Equator and the Greenwich meridian,
  - Z axis parallel to the Earth's rotation axis (positive to the North),
  - Y makes the trihedron.

➢ ***Geomagnetic coordinate system***

The geomagnetic coordinate system (Figure AN-3.) is defined by :

- origin O at the centre of the satellite,
- Oz is parallel to the $\vec{B}_0$ field vector and is directed upwards,
- Ox is located in the plane $[\vec{T}, \vec{B}_0]$, perpendicular to $\vec{B}_0$, with $\vec{x} . \vec{T} > 0$, $\vec{T}$ being the upwards geocentric,
- Oy terminates the trihedron (oriented Eastwards).

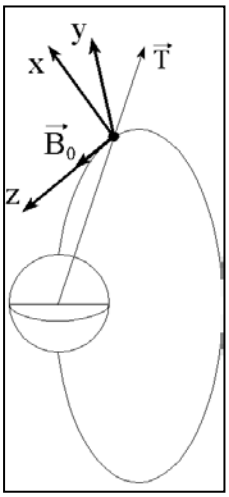


Figure AN-3. B_0 field coordinate system.

➢ ***Local orbital system***

The local orbital system (Figure AN-4) is defined by:

- origin O at the centre of the satellite,
- OZ_{ol} is the downwards geocentric,
- OX_{ol} is perpendicular to Z_{ol} in the orbit plane and directed to the same sense of the velocity vector,
- Y_{ol} terminates the trihedron.

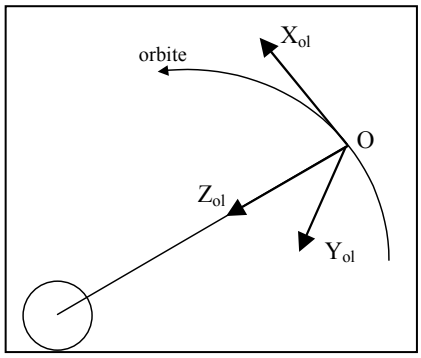


Figure AN-4. Local orbital coordinate system.

E.3. Coordinate transformations

From satellite to geographic :

$$\begin{pmatrix} X_{GEO} \\ Y_{GEO} \\ Z_{GEO} \end{pmatrix} = \left[R_{satgeog}\right] \begin{pmatrix} X_{SAT} \\ Y_{SAT} \\ Z_{SAT} \end{pmatrix}$$

From geographic to local geomagnetic :

$$\begin{pmatrix} X_{MAG} \\ Y_{MAG} \\ Z_{MAG} \end{pmatrix} = \left[R_{geoggeom}\right] \begin{pmatrix} X_{GEO} \\ Y_{GEO} \\ Z_{GEO} \end{pmatrix}$$

From satellite to local geomagnetic :

$$\begin{pmatrix} X_{MAG} \\ Y_{MAG} \\ Z_{MAG} \end{pmatrix} = \left[R_{geoggeom}\right]\left[R_{satgeog}\right]\begin{pmatrix} X_{SAT} \\ Y_{SAT} \\ Z_{SAT} \end{pmatrix}$$

ANNEX F. EXAMPLE OF 'P_ORBIT_NUMBERS' FILE

```
ORBIT  2003/05/18 06:28:07.000   O      13         1  0      Start downwards half-
orbit, position +90
ORBIT  2003/05/18 07:18:07.000   O      14         1  1      Start upwards half-
orbit, position -90
EVENT  2003/05/18 07:22:49.067   O      11     Shifting into antisubsolary position
EVENT  2003/05/18 07:39:07.826   O       5     Transition Shadow-->Penombra
EVENT  2003/05/18 07:39:18.469   O       6     Transition Penombra-->Light
EVENT  2003/05/18 07:48:01.903   O       9     Shifting into quadrature position
EVENT  2003/05/18 07:48:03.753   O       8     Transition Night-->Day
ORBIT  2003/05/18 08:08:07.000   O      13         2  0      Start downwards half-
orbit, position +90
EVENT  2003/05/18 08:13:15.825   O      10     Shifting into subsolary position
EVENT  2003/05/18 08:38:34.065   O       9     Shifting into quadrature position
EVENT  2003/05/18 08:38:36.025   O       7     Transition Day-->Night
EVENT  2003/05/18 08:43:07.000   S      15     Start attitude maneuver
EVENT  2003/05/18 08:47:24.165   O       3     Transition Light-->Penombra
EVENT  2003/05/18 08:47:34.830   O       4     Transition Penombra-->Shadow
EVENT  2003/05/18 08:53:31.000   S      16     End attitude maneuver
ORBIT  2003/05/18 08:58:07.000   O      14         2  1      Start upwards half-
orbit, position -90
EVENT  2003/05/18 09:03:51.169   O      11     Shifting into antisubsolary position
EVENT  2003/05/18 09:20:09.904   O       5     Transition Shadow-->Penombra
EVENT  2003/05/18 09:20:20.546   O       6     Transition Penombra-->Light
EVENT  2003/05/18 09:29:04.059   O       9     Shifting into quadrature position
EVENT  2003/05/18 09:29:05.907   O       8     Transition Night-->Day
ORBIT  2003/05/18 09:48:07.000   O      13         3  0      Start downwards half-
orbit, position +90
EVENT  2003/05/18 09:54:18.035   O      10     Shifting into subsolary position
SPROG  2003/05/18 10:00:00.000   M       1     Beginning of programmation day
EVENT  2003/05/18 10:19:36.237   O       9     Shifting into quadrature position
EVENT  2003/05/18 10:19:38.194   O       7     Transition Day-->Night
EVENT  2003/05/18 10:28:26.298   O       3     Transition Light-->Penombra
EVENT  2003/05/18 10:28:36.963   O       4     Transition Penombra-->Shadow
ORBIT  2003/05/18 10:38:07.000   O      14         3  1      Start upwards half-
orbit, position -90
EVENT  2003/05/18 10:44:07.000   S      33     Start of MTB activation period
EVENT  2003/05/18 10:44:53.302   O      11     Shifting into antisubsolary position
EVENT  2003/05/18 10:48:07.000   S      34     End of MTB activation period
EVENT  2003/05/18 11:01:12.021   O       5     Transition Shadow-->Penombra
EVENT  2003/05/18 11:01:22.664   O       6     Transition Penombra-->Light
EVENT  2003/05/18 11:10:06.184   O       9     Shifting into quadrature position
EVENT  2003/05/18 11:10:08.031   O       8     Transition Night-->Day
ORBIT  2003/05/18 11:28:07.000   O      13         4  0      Start downwards half-
orbit, position +90
EVENT  2003/05/18 11:35:20.209   O      10     Shifting into subsolary position
…
```