CRYOSAT Ground Segment

Instrument Processing Facility L1B

CryoSat Ice netCDF L1b Product Format Specification

[PFS-I-L1B]

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Document Change Record

Issue/Rev.	Class (R=Review /A=Approval)	Date	Reason for Change	Changed Pages/Paragraphs
1.0draft	R	02/05/2016	First Issue	All
1.0	R	04/08/2016	First Official Issue	All
1.1	R	15/09/2016	Implementation of ESA comments The following variables names have been introduced: ant_bench_pitch_20_ku (time_20_ku) ant_bench_roll_20_ku(time_20_ku) ant_bench_yaw_20_ku(time_20_ku) dop_angle_start _20_ku(time_20_ku) dop_angle_stop _20_ku(time_20_ku) echo_scale_pwr_20_ku (time_20_ku) instr_ext_ph_cor_20_k u(time_20_ku) flag_cor_err_01(time_c or_01) flag_cor_status_01(tim e_cor_01) flag_echo_01(time_avg _01) flag_instr_conf_rx_bwd t_20_ku(time_20_ku) flag_instr_conf_rx_flags _20_ku(time_20_ku) flag_instr_conf_rx_in_u se_20_ku(time_20_ku) flag_instr_conf_rx_str_i n_use_20_ku(time_20_ ku) flag_instr_conf_rx_trk_ mode_20_ku(time_20_ ku) flag_instr_mode_att_ctr l_20_ku(time_20_ku) flag_instr_mode_flags_ 20_ku(time_20_ku) flag_instr_mode_op_20 _ku(time_20_ku) instr_cor_gain_rx_20_k u(time_20_ku) instr_cor_gain_tx_rx_2 0_ku(time_20_ku)	Section 3, appendix A

			instr_cor_range_rx_20_ku(time_20_ku) instr_cor_range_tx_rx_20_ku(time_20_ku) instr_seq_count_20_ku (time_20_ku) instr_int_ph_cor_20_ku (time_20_ku lat_01(time_avg_01) lon_avg_01_ku(time_avg_01_ku) ph_diff_waveform_20_ku(time_20_ku, ns_20_ku) pole_tide_01 pwr_waveform_01(time_avg_ku, ns_avg_01_ku) pwr_waveform_20_ku(time_20_ku, ns_20_ku) flag_surf_type_01(time_cor_01) time_avg_01(time_avg_01) flag_trk_cycle_20_ku(time_20_ku) window_del_01(time_avg_01) Unused variable types have been removed attribute comment added to eachCDL dump Appendix B and C have been added, former appendix B is now appendix D CDL dump of FBR variables added	Section 2.3 Section 3.3 Appendices B,C and D Section 3.3
1.2	R	19/09/2016	Harmonisation of variable names The following variables have been renamed: lon_01_ku(time_avg_01_ku) -> lon_avg_01_ku(time_avg_01_ku) pwr_waveform_01(time_avg_ku, ns_01_ku)->	Section 2.3, 3.1, 3.2, 3.3. and Appendix A and B

			pwr_waveform_01(time_avg_ku, ns_avg_01_ku) time_20_ku -> time_tai_20_ku time_21_ku-> time_tai_21_ku time_85_ku-> time_tai_85_ku time_avg_01_ku->time_tai_avg_01_ku time_cor_01_ku->time_tai_cor_01_ku The following dimension has been renamed: ns_01_ku-> ns_avg_01_ku Use of coordinate variables deleted Corrected table to give evidence of the unlimited variables used in the product Attributes "source" and "institution" added to geophysical correction variables when available	Section 2.3, 3.1, 3.2, 3.3. and Appendix A and B Section 2.2 Section 2.3 Section 3.3
1.3	R	03/10/2016	Appendix title added into description of the document structure Use of coordinate variables reintroduced Missing descriptions of global attributes have been added The following variables have been renamed: time_tai_20_ku-> time_20_ku	Section 1.2 Section 2.2 Section 2.3 Section 3.1, 3.2, 3.3.153->3.3.157 and Appendix A and B

			time_tai_21_ku -> time_21_ku time_tai_85_ku -> time_85_ku time_tai_avg_01_ku -> time_avg_01_ku time_tai_cor_01_ku-> time_cor_01_ku trasmit_pwr_XX_ku-> transmit_pwr_XX_ku The dimension space_3d_ku has been renamed to space_3d. Type of cplx_waveforms changed from int to byte Attribute comment of variables flag_instr_mode_op_XX has been corrected Attributes "source", "institution" and "comment" of the variable flag_surf_type have been modified type (f) removed from values of add_offset and scale_factor	Section 2.3, 3.1, 3.2, 3.3.153->3.3.157 and Appendix A and B Section 3.3.21->3.3.26 and appendix B Section 3.3.67->3.3.69 Section 3.3.73 Section 3.3
1.4	R	10/10/2016	incorrect meas_noise_pwr replaced by noise_power in tables Explanation how to link 20Hz records to 1-Hz ones added Implementation of ESA's comments	Section 3.1.2 and 3.2.2 Section 3.1 Section 1.4, 3.3.8, 3.3.11->13, 3.3.21->26, 3.3.29->31, 3.3.47->53, 3.3.55->63, 3.3.78->84,3.3.91->96, 3.3.99, 3.3.104, 3.3.110->113, 3.3.115->118, 3.3.120, 3.3.121, 3.3.144, 3.3.145, 3.3.147, 3.3.148, 3.3.152,

				3.3.154, 3.3.155, 3.3.170, 3.3.173
1.5	R	27/01/2017	The variable: seq_count_20_ku is put in every L1b product CDL dumps reviewed to assure homogeneity among products	Appendix A Section 3
1.6	R	25/05/2017	Type error commment corrected in comment Reference to CoG or Centre of Mass replaced with CoM Variables: agc_1_21_ku and agc_2_21_ku added Variables: agc_ch1_85_ku and agc_ch2_85_ku changed in agc_1_85_ku and agc_2_85_ku Variables "long_name" modified Variables "comment" modified	Sections 3.3.21 ->3.3.35 Section 3.3.38 Sections 3.3.42 ->3.3.44 Section 3.3.46 ->3.3.54 Section 3.3.74 Sections 3.3.119 ->3.3.123 Section 3.3.133 Section 3.3.135 Sections 3.3.144 ->3.3.152 Sections 3.1.1, 3.1.4, 3.2.1, 3.3.7->3.3.10, 3.3.90->3.3.92, 3.3.125, 3.3.126, 3.3.171 abd 3.3.172 Sections 3.3.1 and 3.3.3 added Sections 3.3.2 and 3.3.4 Sections 3.3.22, 3.3.30 -> 3.3.32, 3.3.40, 3.3.43, 3.3.100, 3.3.102, 3.3.107, 3.3.114, 3.3.119, 3.3.120, 3.3.124 -> 3.3.126, 3.3.130, 3.3.133 -> 3.3.135, 3.3.142 and 3.3.170 -> 3.3.173 3.3.5 -> 3.3.13, 3.3.15 -> 3.3.17, 3.3.29, 3.3.32, 3.3.37, 3.3.40, 3.3.41, 3.3.43 -> 3.3.51, 3.3.55 -> 3.3.69, 3.3.80 -> 3.3.89, 3.3.95 -> 3.3.111, 3.3.114 -> 3.3.120, 3.3.124 -> 3.3.126, 3.3.130, 3.3.133 -> 3.3.139, 3.3.142, 3.3.147, 3.3.153 -> 3.3.157 and 3.3.168 -> 3.3.173,
1.7	R	06/06/2017	Variables "comment" modified	Sections 3.3.24, 3.3.25, 3.3.87 -> 3.3.89, 3.3.112 and 3.3.113

1.8	R	21/06/2018	Release for Baseline D implementation Global Attributes nomenclature aligned to COP Processor specification New fields added to track measumerement index: ind_first_meas_20hz_01 and ind_meas_1hz_20_ku	CCN#5 implementation Section 3.4 Section 3

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1 INTRODUCTION

This document specifies the netCDF format of the Level-1b products generated by the CryoSat ice processing chains. This new specification is called CONFORM: CryOsat Netcdf FORMat.

1.1 PURPOSE AND SCOPE

The purpose of the document is to specify the netCDF product structure and content of the Level-1b products generated by the CryoSat ice processing.

Since the beginning of the mission (2010), all CryoSat products had been generated in EE (Earth Explorer) a bespoke format devised for the Cryosat products at the time of the Cryosat-1 mission and derived from the ENVISAT products format with the purpose to maximise the reuse of decoding/analysis tools developed for this mission.

In 2015 the Agency decided to migrate from this Earth Explorer format to the more flexible and up-to-date netCDF model for those products that are intended to be distributed to the users.

This new format is called CONFORM (CryOsat Netcdf FORMat) and is applicable to the following ice products:

- LRM Level 1B
- FDM Level 1B
- SAR Level 1B
- SARIn Level 1B
- SAR FBR
- SARIn FBR

The first product baseline available in netCDF for all users is baseline D.

However the migration is prototyped on the baseline C even though this production is intended to be distributed only to selected users with the purpose of receiving feedbacks to be implemented in baseline D.

This document specifies the CryoSat baseline C netCDF ice products.

1.2 DOCUMENT STRUCTURE

The document includes the following sections:

Section 1 – Introduction	Introduction to the whole document
Section 2 - General Overview	This section gives an overview of the Cryosat IPF1 ice production as well as a short introduction to the netCDF.
Section 3 - Product Format Specification	This section contains the specification of the FBR and L1b ice CONFORM products. In particular: • section 3.1 lists the variables of the L1b products and links each of them to the relevant CDL dump • section 3.2 lists the variables of the products and links each of them to the relevant CDL dump • section 3.3 contains the CDL dump of each variable • section 3.4 specifies the global attributes of each product
Section 4- Cryosat Level-1b Conform Products	Here is the list of the L1b CONFORM ice products
Appendix A – Variables to Products Mapping	In this section there is the variable name list alphabetically ordered and for each variable it is shows in which product types it can be used
Appendix B: Default Setting of the Attribute: _FillValue	In this section the list of _FillValues for each variable type is listed
Appendic C: Timestamps Data Type	In this section it is demonstrated that the timestamps used in the CONFORM products are reliable till January 2034
Appendix D - EE to netCDF Migration	This section contains a short description of the general rules followed to migrate from the EE format to CONFORM

1.3 APPLICABLE & REFERENCE DOCUMENTS

1.3.1 Applicable Documents

Document Title	Identifier	Reference
CCN #3: CONFORM [IPF1-CCN3] Issue 1.0	C2-CN-ACS-GS-5343	[CCN3-TN]
Minute of CCN#3 and CCN#4 KO meeting	C2-MN-ACS-GS-5248	[CCN3-KO]

1.3.2 Reference Documents

Document Title	Identifier	Reference
IPF1 Detailed Processing Model Issue 4.2, April 2015	CS-TN-ACS-GS-5105	[IPF1-DPM]
Level 0 Products Specification Format Issue 3.1, November 2007	CS-ID-ACS-GS-0119	[L0-FMT]
IEEE Standard for Binary Floating-Point Arithmetic. ANSI/IEEE Std 754-1985 Institute of Electrical and Electronics Engineers Issued 1985	IEEE-754	[IEEE]
CCSDS Recommendation Time Code Formats Blue Book Issue 2.0, April 1990	CCSDS 301.0-B-2	[CCSDS-TIMEGUIDE]
CCSDS Recommendation Advanced Orbiting System, Networks and Data Links Architectural Specification Blue Book Issue 3.0, June 2001	CCSDS 701.0-B-3	[CCSDS-AOS]

1.4 ACRONYMS AND ABBREVIATIONS

ACS	Advanced Computer Systems S.p.A.
ADC	Analogue to Digital Converter
AGC	Automatic Gain Control
AIR	Azimuth Impulse Response
AISP	Annotated Instrument Source Packet
APID	Application Process IDentifier
BER	Bit Error Rate
BLOB	Binary Large Object
CADU	Channel Access Data Unit
CAL	Calibration
CCSDS	Consultative Committee for Space Data Systems
CFR	Cryosat Reference Frame
CID	Content IDentifier
CVCDU	Coded Virtual Channel Data Unit
DFCB	Data Format Control Book
DSR	Data Set Record
EE	Earth Explorer
EO	Earth Observation
ESA	European Space Agency
FOS	Flight Operations Segment
FBR	Full Bit Rate
GS	Ground Segment
HK/TM	Housekeeping/Telemetry data
ID	IDentifier
I/O	Input/Output
ISP	Instrument Source Packet
L1B	Level 1B
LRM	Low Rate Mode
MDS	Measurement Data Set
MDSR	Measurement Data Set Record
MJD	Modified Julian Day
MON	Monitoring
MPH	Main Product Header
NPM	Noise Power Measurement
PDS	Payload Data System
PSLR	Peak to Side Lobe Ratio
PSS-05	ESA Software Engineering Standard
PTR	Point Target Response
RC	Radar Cycle
RIR	Range Impulse Response
SIRAL	Synthetic Interferometric Radar ALtimeter
SOW	Statement Of Work
SPH	Specific Product Header
TAI	International Atomic Time Reference
TBC	To Be Clarified
TBD	To Be Defined
TRK	TRaKing
TT&C	Tracking, Telemetry and Command
UTC	Universal Time Co-ordinates
VCID	Virtual Channel IDentifier
VCDU	Virtual Channel Data Unit
WGS84	World Geodetic System 1984

2 GENERAL OVERVIEW

2.1 OVERVIEW OF THE IPF1 ICE PRODUCTION

The Level-1 products are generated from the SIRAL instrument Level 0 data by applying the IPF1 processing algorithms defined in the IPF1 system of PDS.

The IPF1 processing chains provide four types of Level1 products:

❒ **Level 1B**

The L1B data is the main product output from the IPF1. In the case of SAR and SARIN modes of SIRAL, the L1B data are strongly compressed in size following the application of SAR/SARIN algorithms and multilook for speckle reduction.

❒ **Level 1B CAL products**

CAL1 and CAL2 products also belong to the L1B class. CAL1 data are available for LRM/SAR/SARIN modes, while CAL2 data are available only for SAR/SARIN modes.

❒ **FBR**

The Full Bit Rate (FBR) product is output at an intermediate stage before the L1B processing is complete. This is the highest processing stage reached before information compression occurs. In particular the FBR data for SAR and SARin modes still contain the echo data as complex numbers.

❒ **Monitoring**

Monitoring data is a systematic product aimed to provide timely information on the health of the instrument. It consists of a set of instrument parameters which may be produced rapidly and routinely starting from LRM/TRK SIRAL data, SAR or SARIN data.

The IPF1 has as output the following products:

- **Level 1B Science Data**
  - LRM Level 1B generated and distributed in CONFORM
  - FDM Level 1B generated and distributed in CONFORM
  - SAR Level 1B generated and distributed in CONFORM
  - SARIn Level 1B generated and distributed in CONFORM
- **FBR Science Data**
  - LRM FBR generated and distributed in Earth Explorer format
  - FDM FBR generated and distributed in Earth Explorer format

- SAR FBR generated and distributed in CONFORM
- SARIn FBR generated and distributed in CONFORM

- **Auxiliary Calibration Data**
  - CAL1 LRM generated and distributed in Earth Explorer format
  - CAL1 SAR generated and distributed in Earth Explorer format
  - CAL1 SARIn generated and distributed in Earth Explorer format
  - CAL2 SAR generated and distributed in Earth Explorer format
  - CAL2 SARIn generated and distributed in Earth Explorer format
  - CCAL1 SARIn generated and distributed in Earth Explorer format
- **Monitoring Products**
  - MON LRM/TRK generated and distributed in Earth Explorer format
  - MON SAR generated and distributed in Earth Explorer format
  - MON SARin generated and distributed in Earth Explorer format

The Earth Explorer format of the products is specified in [PROD-FMT].

2.2 OVERVIEW OF THE NETCDF

NetCDF (Network Common Data Form) is a set of software libraries and self-describing, machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data.

The version of the netCDF libraries used for the Cryosat ice production is **NetCDF-4 CF compliant** and consists of the following elements:

- DIMENSIONS:
  A dimension is used to represent a real physical dimension (for example, time, latitude, longitude, and height) or to index other quantities (for example number of records or waveforms or samples). A dimension can also be used to index other quantities (waveforms index for example).
  A netCDF dimension has both a name and a length and can be limited or unlimited (i.e. a dimension that can be appended to).

- VARIABLES:
  Variables are used to store the bulk of the data in a netCDF dataset. A variable represents an array of values of the same type. A scalar value is treated as a 0-dimensional array. A variable has a name, a data type, and a shape described by its list of dimensions specified when the variable is created. A variable may also have associated attributes, which may be added, deleted or changed after the variable is created.

- COORDINATE VARIABLES:
  A variable can have the same name as a dimension and in this case the variable is called a coordinate variable. It typically defines a physical coordinate corresponding to that dimension. If a dimension has a corresponding coordinate variable, then this provides an alternative, and often more convenient, means of specifying position along it. Current application packages that make use of coordinate variables commonly assume they are numeric vectors and strictly monotonic (all values are different and either increasing or decreasing).

- ATTRIBUTES:
  Attributes are used to store information about the data (ancillary data or metadata). Most attributes provide information about a specific variable. These are identified by the name (or ID) of that variable, together with the name of the attribute.

- GLOBAL ATTRIBUTES:
  Some attributes provide information about the dataset as a whole and are called global attributes. In particular, the global attributes used in the Cryosat products contains the information that were present in the EE header (see [PROD-FMT])

2.3 NETCDF PRIMITIVES

The following **dimensions** are used in the Cryosat ice Level1b CONFORM products:

Dimensions					
Name	Description	Size	Units	Type	Limited/ Unlimited
time_20_ku	Timestamps of 20 Hz power waveforms in the L1b product file (L1b only)	Number of 20 Hz power waveforms in the product file	seconds since 2000-01-01 00:00:00.0	double	Unlimited
time_21_ku	Timestamps of 21 Hz Complex echo waveforms in the SARin FBR product file (FBR ony)	Number of 21 Hz Complex echo waveforms in the SARin FBR product file	seconds since 2000-01-01 00:00:00.0	double	Unlimited
time_85_ku	Timestamps of 85 Hz Complex echo waveforms in the SAR FBR product file (FBR ony)	Number of 85 Hz Complex echo waveforms in the SAR FBR product file	seconds since 2000-01-01 00:00:00.0	double	Unlimited
time_avg_01_ku	Timestamps of 1 Hz power waveforms in the L1b product file (L1b only)	Number of 1 Hz power waveforms in the product file	seconds since 2000-01-01 00:00:00.0	double	Unlimited
time_cor_01	Timestamps of 1 Hz Geophysical corrections in the product file	Number of 1 Hz Geophysical corrections in the product file	seconds since 2000-01-01 00:00:00.0	double	Unlimited
np_ku	Number of pulses in 1 burst of complex echo waveforms (FBR only)	Number of pulses in 1 burst of complex echo waveforms	count	short	Limited
ns_ku	Number of samples in 1 complex echo waveform (FBR only)	Number of samples in 1 complex echo waveform	count	short	Limited
ns_20_ku	Number of samples in a 20Hz waveform (L1b only)	Number of samples in a 20Hz waveform	count	short	Limited

Dimensions					
Name	Description	Size	Units	Type	Limited/ Unlimited
ns_avg_01_ku	Number of samples in a 1Hz averaged waveform (L1b only)	Number of samples in a 1Hz averaged waveform	count	short	Limited
space_3d	3 dimensions of space (x,y,z)	3	count	short	Limited

The following **variables** are used in the Cryosat ice Level1b CONFORM products:

Variables	
Name	Description
byte	8-bit data signed
short	16-bit signed integer
ushort	16-bit unsigned integer
int	32-bit signed integer
int64	64-bit signed integer
double	IEEE double precision floating point (64 bits)

The following **attributes** are used in the Cryosat ice Level1b CONFORM products:

Variable Attributes	
Name	Description
add_offset scale_factor	According to the netCDF standard, the value in the specified unit is computed as: value_unit = (value_product * scale_factor) + add_offset
Calendar	Reference time calendar
Comment	The "comment" attribute allows for miscellaneous information about the dataset.
_FillValue	A value used to represent missing or undefined data add_offset If present, this number is to be added to the date
flag_meanings	Use in conjunction with flag_values to provide descriptive words or phrase for each flag value.

Variable Attributes	
Name	Description
flag_values	Provide a list of the flag values. Use in conjunction with flag_meanings.
institution	Institution which provides the data
long_name	A long descriptive name for the variable (not necessarily from a controlled vocabulary).
source	Data source (model features, or observation)
standard_name	A long descriptive name for the variable taken from a controlled vocabulary of variable names. (when applicable)
units	The units of the variables data values. This attributes value should be a valid units string.

3 PRODUCT FORMAT SPECIFICATION

3.1 L1B PRODUCT SPECIFICATION –LIST OF VARIABLES

The contents of the Cryosat science products can be logically grouped in:

1. Time and Orbit Information
2. Measurements
3. External Corrections
4. Average Waveforms
5. Waveforms

This logical classification could be implemented in the netCDF 4.0 model by means of a specific structure called **group**, however this feature is not used in the Cryosat products because users could be forced to update their existing analysis/visualisation tools in order to keep up with these new netCDF features.

Nevertheless the logic behind this grouping is kept in the definition of the products and the remaining of this section will follow this hierarchy for the format specification.

Another difference to the EE format that is worth being pointed out is that the Cryosat netCDF products – quite obviously- won't contain blank records that are needed in the EE format to keep the binary structure consistent.

This means that there are no longer exactly 20 20 Hz records for every 1Hz record and therefore the only way to associate 1Hz to 20 Hz quantity is by means of the time stamps: the record whose 20 Hz time stamp holds the same as the 1Hz time stamp is the first record in a group of up to 20 20Hz records.

Before entering the details of the Product Format Definition please bear in mind that::

- Only signed types are used unless strictly required otherwise.
- The long-name has been kept from the field description in [PROD-FMT]

3.1.1 Time and Orbit Group

Time and Orbit Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
T0	time_20_ku(time_20_ku) *(time in TAI: seconds since 1 Jan 2000)*	s	time	Data Record Time (MDSR Time Stamp)
T2	uso_cor_20_ku(time_20_ku) *uso correction (2-way)*			USO correction factor
T4	flag_instr_mode_op_20_ku(time_20_ku) *mode id - identifies the siral instrument measurement mode*	FLAG		Mode ID – ID 1
T6	flag_instr_mode_att_ctr_20_ku(time_20_ku) *mode id - identifies the Platform Attitude Control*	FLAG		Mode ID – ID 5
T8	flag_instr_mode_flags_20_ku(time_20_ku) *mode id - identifies the sarin degraded case and the CAL4 flag*	FLAG		Mode ID – ID 2, ID 4
T10 LRM only	seq_count_20_ku(time_20_ku) *Source Sequence Counter only for LRM (FillValue in SAR and SARIN cases)*	count		Source Sequence Counter
T12	flag_instr_conf_rx_in_use_20_ku(time_20_ku) *instrument configuration flags*	FLAG		Instrument Configuration
T14	flag_instr_conf_rx_bwdt_20_ku(time_20_ku) *instrument configuration flags*	FLAG		Instrument Configuration
T16	flag_instr_conf_rx_trk_mode_20_ku(time_20_ku)	FLAG		Instrument Configuration

Time and Orbit Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	instrument configuration flags			
T18	flag_instr_conf_rx_str_in_use_20_ku(time_20_ku) *instrument configuration flags*	FLAG		Instrument Configuration
T20	flag_instr_conf_rx_flags_20_ku(time_20_ku) *instrument configuration flags*	FLAG		Instrument Configuration
T22	rec_count_20_ku(time_20_ku) *sample counter*	count		Burst counter
T24	lat_20_ku(time_20_ku) *latitude of measurement*	deg_north	latitude	Latitude of measurement
T26	lon_20_ku(time_20_ku) *longitude of measurement*	deg_east	longitude	Longitude of measurement
T28	alt_20_ku(time_20_ku) *center of mass altitude above reference ellipsoid*	m	height_above_reference_ellipsoid	Altitude of CoMG above reference ellipsoid
T30	orb_alt_rate_20_ku(time_20_ku) *centre of mass altitude rate with respect to the reference ellipsoid*	m/s		Instantaneous altitude rate derived from orbit Satellite velocity vector
T32	sat_vel_vec_20_ku(time_20_ku,space_3d) *velocity vector in itrf*	m/s		Satellite velocity vector[3] (in ITRF)
T34	beam_dir_vec_20_ku(time_20_ku,space_3d	m		Real beam

Time and Orbit Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	) *real beam direction vector in crf*			direction vector[3] (in CRF)
T36	inter_base_vec_20_ku(time_20_ku,space_3 d) *interferometric baseline direction vector in crf*	m		Interferometer baseline vector[3] (in CRF)
T38	off_nadir_roll_angle_str_20_ku (time_20_ku) *antenna bench roll angle corresponding to the mdsr time stamp*	deg		Antenna Bench Roll Angle
T40	off_nadir_pitch_angle_str_20_ku (time_20_ku) *antenna bench pitch angle corresponding to the mdsr time stamp*	deg		Antenna Bench Pitch Angle
T42	off_nadir_yaw_angle_str_20_ku (time_20_ku) *antenna bench yaw angle corresponding to the mdsr time stamp*	deg		Antenna Bench Yaw Angle
T44	flag_mcd_20_ku (time_20_ku) *measurement confidence flags*	FLAG		Level 1b Measurement Confidence Data (flag word)
T45	ind_first_meas_20hz_01(time_cor_01) *index of the first 20Hz measurement: 1 Hz*	count		

Time and Orbit Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
T46	ind_meas_1hz_20_ku(time_20_ku) *index of the 1Hz measurement: 20 Hz ku band*	count		

Table 3.2.1-1 – Time and Orbit Group Variables

3.1.2 Measurements Group

Measurements Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
M0	window_del_20_ku(time_20_ku) *window delay (2way) corrected for instrument delays*	s		Window Delay (2way) corrected for instrument delays
M2	h0_applied_20_ku(time_20_ku) *h0 initial height word*	s		H0 Initial Height Word
M4	cor2_applied_20_ku(time_20_ku) *cor2 height rate*	s		COR2 Height Rate
M6	h0_lai_word_20_ku(time_20_ku) *coarse range word lai*	s		Coarse Range word LAI
M8	h0_fai_word_20_ku(time_20_ku) *fine word fai*	s		Fine Range word FAI
M10	agc_ch1_20_ku(time_20_ku) *agc gain applied on rx channel 1. gain calibration corrections are applied*	dB		AGC Channel 1 (corrected)
M12	agc_ch2_20_ku(time_20_ku) *agc gain applied on rx channel 2. gain calibration corrections are applied*	dB		AGC Channel 2 (corrected)
M14	tot_gain_ch1_20_ku(time_20_ku) *total fixed gain on channel 1*	dB		Total Fixed Gain Rx 1
M16	tot_gain_ch2_20_ku(time_20_ku) *total fixed gain on channel 2*	dB		Total Fixed Gain Rx 2
M18	transmit_pwr_20_ku(time_20_ku) *transmitted power*	Watt		Transmit Power
M20	dop_cor_20_ku(time_20_ku)	m		Doppler range

Measurements Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	doppler range correction			correction (Radial component)
M22	instr_cor_range_tx_rx_20_ku(time_20_ku) *instrument range correction (tx-rx chain)*	m		Instrument Range Correction tx-rx antenna
M24	instr_cor_range_rx_20_ku(time_20_ku) *instrument range correction (rx only chain)*	m		Instrument Range Correction rx only antenna
M26	instr_cor_gain_tx_rx_20_ku(time_20_ku) *instrument gain correction (tx-rx chain)*	dB		Instrument Gain Correction tx-rx antenna
M28	instr_cor_gain_rx_20_ku(time_20_ku) *instrument gain correction (rx only chain)*	dB		Instrument Gain Correction rx only antenna
M30 SARin only	instr_int_ph_cor_20_ku(time_20_ku) *internal phase correction computed from the cal-4* *(FillValue in LRM and SAR cases)*	rad		Internal Phase Correction
M32 SARin only	instr_ext_ph_cor_20_ku(time_20_ku) *external phase correction taken from the ipfdb file* *(FillValue in LRM and SAR cases)*	rad		External Phase Correction
M34	noise_power_20_ku(time_20_ku) *noise power measurement*	dB		Noise power measurement
M36 SARin only	ph_slope_cor_20_ku(time_20_ku) *phase slope correction* *(FillValue in LRM and SAR cases)*	rad		Phase Slope Correction

3.1.3 External Corrections Group

Corrections Group				
ID	**Variable Name(dim1,..,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
C0	time_cor_01(time_cor_01) *(time in TAI: seconds since 1 Jan 2000)*	s	time	
C2	mod_dry_tropo_cor_01(time_cor_01) *dry tropospheric correction*	m	altimeter_range_correction_due_to_dry_troposphere	Dry Tropospheric Correction
C4	mod_wet_tropo_cor_01(time_cor_01) *wet tropospheric correction*	m	altimeter_range_correction_due_to_wet_troposphere	Wet Tropospheric Correction
C6	inv_bar_cor_01(time_cor_01) *inverse barometric correction*	m	sea_surface_height_correction_due_to_air_pressure_at_low_frequency	Inverse Barometric Correction
C8	hf_fluct_total_cor_01(time_cor_01) *dynamic atmospheric correction*	m	sea_surface_height_correction_due_to_air_pressure_and_wind_at_high_frequency	Dynamic Atmospheric Correction
C10	iono_cor_gim_01(time_cor_01) *gim ionospheric correction*	m	altimeter_range_correction_due_to_ionosphere	GIM Ionospheric Correction
C12	iono_cor_01(time_cor_01) *model ionospheric correction*	m	altimeter_range_correction_due_to_ionosphere	Model Ionospheric Correction
C14	ocean_tide_01 (time_cor_01) *elastic ocean tide*	m	sea_surface_height_amplitude_due_to_geocentric_oc	Elastic Ocean Tide

Corrections Group				
ID	**Variable Name(dim1,..,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
			ean_tide	
C16	ocean_tide_eq_01(time_cor_01) *long period ocean tide*	m	sea_surface_height_amplitude_due_to_equilibrium_ocean_tide	Long Period Ocean Tide
C18	load_tide_01(time_cor_01) *ocean loading tide*	m		Ocean Loading Tide
C20	solid_earth_tide_01(time_cor_01) *solid earth tide*	m	sea_surface_height_amplitude_due_to_earth_tide	Solid Earth Tide
C22	pole_tide_01(time_cor_01) *geocentric polar tide*	m	sea_surface_height_amplitude_due_to_pole_tide	Geocentric Polar Tide
C24	surf_type_01(time_cor_01) *surface type flag*	count		Surface type flag
C26	flag_cor_status(time_cor_01) *correction status flags*	FLAG		Correction status flags
C28	flag_cor_error(time_cor_01) *correction error flags*	FLAG		Correction error flags

3.1.4 Average Waveforms Group

Average Waveform group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
A0	time_avg_01_ku(time_avg_01_ku) *time in TAI: seconds since 1 Jan 2000)*	s	time	Data Record Time (MDSR Time Stamp)
	uso_cor_avg_01_ku *uso correction applied to window delay (2-way)*	s		
A2	lat_avg_01_ku(time_avg_01_ku) *latitude of measurement*	degrees_north	latitude	Latitude of measurement
A4	lon_avg_01_ku(time_avg_01_ku) *longitude of measurement*	degrees_east	longitude	Longitude of measurement
A6	alt_avg_01_ku(time_avg_01_ku) *center of mass altitude above reference ellipsoid*	m	height_above_reference_ellipsoid	Altitude of CoM above reference ellipsoid (interpolated value)
A8	window_del_avg_01_ku(time_avg_01_ku) *window delay (2way) corrected for instrument delays*	s		Window Delay (2way) corrected for Ainstrument delays
A10	pwr_waveform_avg_01_ku(time_avg_01_ku,ns_avg_01_ku) *1hz l1b power waveform scaled 0-65535*	count		1 Hz Averaged Power Echo Waveform
A12	echo_scale_factor_avg_01_ku(time_avg_01_ku)	count		Echo Scale Factor (to scale echo to

Average Waveform group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	echo scale factor (to scale echo to watts)			watts)
A14	echo_scale_pwr_avg_01_ku(time_avg_01_ku) *echo scale power (a power of 2)*	count		Echo Scale Power (a power of 2)
A16	echo_numval_avg_01_ku(time_avg_01_ku) *number of echoes averaged*	count		Number of echoes averaged
A18	flag_echo_avg_01_ku(time_avg_01_ku) *flags for errors or information about 1Hz average power waveform*	FLAG		Flags

3.1.5 Waveforms Group

Waveform group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
W0	pwr_waveform_20_ku(time_20_ku,ns_20_ku) *l1b power waveform scaled 0-65535*	count		Averaged Power Echo Waveform [128]
W2	echo_scale_factor_20_ku(time_20_ku) *echo scale factor (to scale echo to watts)*	count		Echo Scale Factor (to scale echo to watts)
W4	echo_scale_pwr_20_ku(time_20_ku) *echo scale power (a power of 2)*	count		Echo Scale Power (a power of 2)
W6	echo_numval_20_ku(time_20_ku) *number of single-look echoes averaged*	count		Number of echoes averaged
W8	flag_echo_20_ku(time_20_ku) *flags for errors or information about L1b 20Hz power waveform*	FLAG		Flags
W10 LRM only	flag_trk_cycle_20_ku(time_20_ku)	count		TRK Report
W12 SAR/ SARin only	stack_std_20_ku (time_20_ku) *Gaussian power fitting: std wrt beam number* *(FillValue in LRM case)*	count		Beam behaviour parameter
W14 SAR/ SARin only	stack_centre_20_ku (time_20_ku) *gaussian power fitting: center wrt beam number* *(FillValue in LRM case)*	count		
W16	stack_scaled_amplitude_20_ku(time_20_ku	dB		

Waveform group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
SAR/ SARin only	) *gaussian power fitting: amplitude* *(FillValue in LRM case)*			
W18 SAR/ SARin only	Stack_skewness_20_ku(time_20_ku) *gaussian power fitting: skewness wrt beam number* *(FillValue in LRM case)*	count		
W20 SAR/ SARin only	stack_kurtosis_20_ku(time_20_ku) *gaussian power fitting: kurtosis wrt beam number* *(FillValue in LRM case)*	count		
W22 SAR/ SARin only	stack_std_angle_20_ku(time_20_ku) *gaussian power fitting: std wrt boresight angle* *(FillValue in LRM case)*	rad		
W24 SAR/ SARin only	stack_centre_angle_20_ku(time_20_ku) *gaussian power fitting: center wrt boresight angle number* *(FillValue in LRM case)*	rad		
SAR/ SARin only	stack_centre_look_angle_20_ku *gaussian power fitting: center wrt look angle*	rad		
SAR/ SARin only	stack_gaussian_fitting_residuals_20_ku *gaussian power fitting: residuals fitting*	rad		
W26 SAR/ SARin	dop_angle_start_20_ku(time_20_ku) *doppler angle start*	Rad		

Waveform group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
only	*(FillValue in LRM case)*			
W28 SAR/ SARin only	dop_angle_stop_20_ku(time_20_ku) *doppler angle stop* *(FillValue in LRM case)*	rad		
W30 SAR/ SARin only	look_angle_start_20_ku(time_20_ku) *look angle start* *(FillValue in LRM case)*	rad		
W32 SAR/ SARin only	look_angle_stop_20_ku(time_20_ku) *look angle stop* *(FillValue in LRM case)*	rad		
W34 SAR/ SARin only	stack_number_after_weighting_20_ku(time_20_ku) *number of contributing beams in the stack after weighting* *(FillValue in LRM case)*	count		Beam behaviour parameter
W36 SAR/ SARin only	stack_number_before_weighting_20_ku(time_20_ku) *number of contributing beams in the stack after weighting* *(FillValue in LRM case)*	count		Beam behaviour parameter
SAR/ SARin only	stack_peakiness_20_ku *gaussian power fitting: peakiness wrt beam number*	count		
W38 SARin only	coherence_waveform_20_ku(time_20_ku,ns_20_ku) *l1b Coherence waveform*	Count		Coherence [1024]

Waveform group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	(FillValue in LRM and SAR cases)			
W40 SARin only	ph_diff_waveform_20_ku(time_20_ku,ns_20_ku) *l1b Phase Difference waveform* *(FillValue in LRM and SAR cases)*	rad		Phase difference [1024]

3.2 FBR PRODUCT SPECIFICATION –LIST OF VARIABLES

The contents of the Cryosat FBR products can be logically grouped in:

1. Time and Orbit Information
2. Measurements
3. External Corrections
4. Waveforms

This logical classification could be implemented in the netCDF 4.0 model by means of a specific structure called **group**, however this feature is not used in the Cryosat products in order to assure the back compatibility with previous versions of the netCDF models.

Nevertheless the logic behind this grouping is kept in the definition of the products and the remaining of this section will follow this hierarchy for the format specification.

Note: all the FBR variables are written in lowercase and have the suffix ***_x*** where ***_x*** indicates the frequency and it is set to ***21*** for SARin (01 for corrections) and ***85*** for SAR (04 for corrections)

3.2.1 Time and Orbit Group

Time and Orbit Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
T0	time_x_ku(time_x_ku) *(time in TAI: seconds since 1 Jan 2000)*	s		Data Record Time (MDSR Time Stamp)
T2	uso_cor_x_ku(time_x_ku) *(uso correction (2-way)*			USO correction factor
T4	flag_instr_mode_op_x_ku(time_x_ku) *mode id - identifies the siral instrument measurement mode*	FLAG		Mode ID – ID 1
T6	flag_instr_mode_att_ctr_x_ku(time_x_ku) *mode id - identifies the Platform Attitude Control*	FLAG		Mode ID – ID 5
T8	flag_instr_mode_flags_x_ku(time_x_ku) *mode id - identifies the sarin degraded case and the CAL4 flag*	FLAG		Mode ID – ID 2, ID 4
T10	instr_seq_count_x_ku(time_x_ku) *Source Sequence Counter*	count		Source Sequence Counter
T12	flag_instr_conf_rx_in_use_x_ku (time_x_ku) *instrument configuration flags*	FLAG		Instrument Configuration
T14	flag_instr_conf_rx_bwdt_x_ku (time_x_ku) *instrument configuration flags*	FLAG		Instrument Configuration
T16	flag_instr_conf_rx_trk_mode_x_ku (time_x_ku)	FLAG		Instrument Configuration

Time and Orbit Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	instrument configuration flags			
T18	flag_instr_conf_rx_str_in_use_x_ku(time_x_ku) *instrument configuration flags*	FLAG		Instrument Configuration
T20	flag_instr_conf_rx_flags_x_ku(time_x_ku) *instrument configuration flags*	FLAG		Instrument Configuration
T22	rec_count_x_ku (ns_x_ku) *sample counter*	count		Burst counter
T24	lat_x_ku (time_x_ku) *latitude of measurement*	deg	latitude	Latitude of measurement
T26	lon_x_ku (time_x_ku) *longitude of measurement*	deg	longitude	Longitude of measurement
T28	alt_x_ku (time_x_ku) *center of mass altitude above reference ellipsoid*	m	height_above_reference_ellipsoid	Altitude of CoM above reference ellipsoid
T30	orb_alt_rate_x_ku (time_x_ku) *centre of mass altitude rate with respect to the reference ellipsoid*	m/s		Instantaneous altitude rate derived from orbit Satellite velocity vector
T32	sat_vel_vec_x_ku(time_x_ku,space_3d) *velocity vector in itrf*	m/s		Satellite velocity vector[3] (in ITRF)
T34	beam_dir_vec_20_x_ku(time_x_ku,space_3d)	m		Real beam direction

Time and Orbit Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	real beam direction vector in crf			vector[3] (in CRF)
T36	inter_base_vec_x_ku(time_x_ku,space_3d) *interferometric baseline direction vector in crf*	m		Interferometer baseline vector[3] (in CRF)
T38	flag_mcd_x_ku(time_x_ku) *measurement confidence flags*	FLAG		FBR Measurement Confidence Data (flag word)

3.2.2 Measurements Group

Measurements Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
M0	window_del_x_ku(time_x_ku) *window delay (2way) corrected for instrument delays*	s		Window Delay (2way) corrected for instrument delays
M2	h0_applied_x_ku (time_x_ku) *h0 initial height word*	s		H0 Initial Height Word
M4	cor2_applied_x_ku (time_x_ku) *cor2 height rate*	s		COR2 Height Rate
M6	h0_lai_word_x_ku (time_x_ku) *coarse range word lai*	s		Coarse Range word LAI
M8	h0_fai_word_x_ku (time_x_ku) *fine word fai*	s		Fine Range word FAI
M10	agc_ch1_x_ku (time_x_ku) *agc gain applied on rx channel 1. gain calibration corrections are applied*	dB		AGC Channel 1 (corrected)
M12	agc_ch2_x_ku (time_x_ku) *agc gain applied on rx channel 2. gain calibration corrections are applied*	dB		AGC Channel 2 (corrected)
M14	tot_gain_ch1_x_ku (time_x_ku) *total fixed gain on channel 1*	dB		Total Fixed Gain Rx 1
M16	tot_gain_ch2_x_ku (time_x_ku) *total fixed gain on channel 2*	dB		Total Fixed Gain Rx 2
M18	transmit_pwr_x_ku (time_x_ku) *transmitted power*	Watt		Transmit Power
M20	dop_cor_x_ku (time_x_ku)	m		Doppler range

Measurements Group				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	doppler range correction			correction (Radial component)
M22	instr_cor_range_tx_rx_x_ku(time_x_ku) *instrument range correction (tx-rx chain)*	m		Instrument Range Correction tx-rx antenna
M24	instr_cor_range_rx_x_ku (time_x_ku) *instrument range correction (rx only chain)*	m		Instrument Range Correction rx only antenna
M26	instr_cor_gain_tx_rx_x_ku (time_x_ku) *instrument gain correction (tx-rx chain)*	dB		Instrument Gain Correction tx-rx antenna
M28	instr_cor_gain_rx_x_ku (time_x_ku) *instrument gain correction (rx only chain)*	dB		Instrument Gain Correction rx only antenna
M30 SARin only	instr_int_ph_cor_x_ku (time_x_ku) *internal phase correction computed from the cal-4* *(FillValue in SAR case)*	rad		Internal Phase Correction
M32 SARin only	instr_ext_ph_cor_x_ku(time_x_ku) *external phase correction taken from the ipfdb file* *(FillValue in SAR case)*	rad		External Phase Correction
M34	noise_power_x_ku(time_x_ku) *noise power measurement*	dB		Noise power measurement
M36 SARin only	ph_slope_cor_x_ku(time_x_ku) *phase slope correction* *(FillValue in SAR case)*	rad		Phase Slope Correction

3.2.3 External Corrections Group

Corrections Group				
ID	**Variable Name(dim1,..,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
C0	time_cor_01(time_x_cor) *time in TAI: seconds since 1 Jan 2000)*	s	time	Data Record Time (MDSR Time Stamp)
C2	mod_dry_tropo_cor_01(time_x_cor) *dry tropospheric correction*	m	altimeter_range_correction_due_to_dry_troposphere	Dry Tropospheric Correction
C4	mod_wet_tropo_cor_01(time_x_cor) *wet tropospheric correction*	m	altimeter_range_correction_due_to_wet_troposphere	Wet Tropospheric Correction
C6	inv_bar_cor_01(time_x_cor) *inverse barometric correction*	m		Inverse Barometric Correction
C8	hf_fluct_total_cor_01(time_x_cor) *dynamic atmospheric correction*	m		Dynamic Atmospheric Correction
C10	iono_cor_gim_01_ku(time_x_cor) *gim ionospheric correction*	m	altimeter_range_correction_due_to_ionosphere	GIM Ionospheric Correction
C12	iono_cor_01_ku(time_x_cor) *model ionospheric correction*	m	altimeter_range_correction_due_to_ionosphere	Model Ionospheric Correction
C14	ocean_tide_01(time_x_cor) *elastic ocean tide*	m		Elastic Ocean Tide
C16	ocean_tide_eq_01(time_x_cor) *long period ocean tide*	m		Long Period Ocean Tide
C18	load_tide_01(time_x_cor)	m		Ocean Loading Tide

Corrections Group				
ID	**Variable Name(dim1,..,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
	ocean loading tide			
C20	solid_earth_tide_01(time_x_cor) *solid earth tide*	m		Solid Earth Tide
C22	pole_tide_01(time_x_cor) *geocentric polar tide*	m		Geocentric Polar Tide
C24	surf_type_x(time_x_cor) *surface type flag*	count		Surface type flag
C26	flag_cor_status_01(time_x_cor) *correction status flags*	m		Correction status flags
C28	flag_cor_err_01(time_x_cor) *correction error flags*	m		Correction error flags

3.2.4 Waveforms Group

Waveform group – SAR case				
ID	**Variable Name (dim1,…,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
W0	cplx_waveform_ch1_i_85_ku(time_85_ku ,np_ku,ns_ku) *power waveforms i samples*	count		Complex Echo Waveform [64,128]
W2	cplx_waveform_ch1_q_85_ku(time_85_ku, np_ku,ns_ku) *power waveforms q samples*	count		Complex Echo Waveform [64,128]
W4	echo_numval_85_ku(time_85_ku) *number of pulses in burst*	count		Number of pulses in burst
W6	flag_echo_85_ku(time_85_ku) *flags for errors or information about FBR 20Hz power waveform*	FLAG		Flags

Waveform group – SARin case				
ID	**Variable Name (dim1,...,dim N)** ***long_name***	**units**	**Standard_name**	**EE Field**
W0	cplx_waveform_ch1_i_21_ku(time_21_ku,np_ku,ns_ku) *power waveforms ch1 i samples*	count		Complex Echo Waveform [64,128] antenna 1 (Tx-Rx)
W2	cplx_waveform_ch1_q_21_ku(time_21_ku, np_ku,ns_ku) *power waveforms ch1 q samples*	count		Complex Echo Waveform [64,128] antenna 1 (Tx-Rx)
W4	cplx_waveform_ch2_i_21_ku(time_21_ku,np_ku,ns_ku) *power waveforms ch2 i samples*	count		Complex Echo Waveform [64,128] antenna 2 (Rx only)
W6	cplx_waveform_ch2_q_21_ku(time_21_ku, np_ku,ns_ku) *power waveforms ch2 q samples*	count		Complex Echo Waveform [64,128] antenna 2 (Rx only)
W8	echo_numval_21_ku(time_21_ku) *number of pulses in burst*	count		Number of pulses in burst
W10	flag_echo 21_ku(time_21_ku) *flags for errors or information about FBR 20Hz power waveform*	FLAG		Flags

3.3 L1B / FBR PRODUCT SPECIFICATION – CDL DUMP

3.3.1 agc_1_21_ku(time_21_ku)

```
int agc_1_21_ku(time_21_ku) ;
    agc_1_21_ku:_FillValue = -2147483648 ;
    agc_1_21_ku:units = "dB" ;
    agc_1_21_ku:long_name = "uncorrected agc command value for stage 1" ;
    agc_1_21_ku:comment = "Gain command for the AGC stage 1 for both the Rx
                           channels. It does not include the
                           calibration correction that are specific
                           for each Rx channel" ;
    agc_1_21_ku:add_offset = 0.0 ;
    agc_1_21_ku:scale_factor = 0.01 ;
```

3.3.2 agc_1_85_ku(time_85_ku)

```
int agc_1_85_ku(time_85_ku) ;
    agc_1_85_ku:_FillValue = -2147483648 ;
    agc_1_85_ku:units = "dB" ;
    agc_1_85_ku:long_name = "uncorrected agc command value for stage 1" ;
    agc_1_85_ku:comment = "Gain command for the AGC stage 1 for both the Rx
                           channels. It does not include the
                           calibration correction that are specific
                           for each Rx channel." ;
    agc_1_85_ku:add_offset = 0.0 ;
    agc_1_85_ku:scale_factor = 0.01 ;
```

3.3.3 agc_2_21_ku(time_21_ku)

```
int agc_2_21_ku(time_21_ku) ;
    agc_2_21_ku:_FillValue = -2147483648 ;
    agc_2_21_ku:units = "dB" ;
    agc_2_21_ku:long_name = "uncorrected agc command value for stage 2" ;
    agc_2_21_ku:comment = "Gain command for the AGC stage 2 for both the Rx
                          channels. It does not include the
                          calibration correction that are specific for
                          each Rx channel." ;
    agc_2_21_ku:add_offset = 0.0 ;
    agc_2_21_ku:scale_factor = 0.01 ;
```

3.3.4 agc_2_85_ku(time_85_ku)

```
int agc_2_85_ku(time_85_ku) ;
    agc_2_85_ku:_FillValue = -2147483648 ;
    agc_2_85_ku:units = "dB" ;
    agc_2_85_ku:long_name = "uncorrected agc command value for stage 2" ;
    agc_2_85_ku:comment = "Gain command for the AGC stage 2 for both the Rx
                          channels. It does not include the
                          calibration correction that are specific for
                          each Rx channel." ;
    agc_2_85_ku:add_offset = 0.0 ;
    agc_2_85_ku:scale_factor = 0.01 ;
```

3.3.5 agc_ch1_20_ku(time_20_ku)

```
int agc_ch1_20_ku(time_20_ku) ;
    agc_ch1_20_ku:_FillValue = -2147483648;
    agc_ch1_20_ku:units = "dB" ;
    agc_ch1_20_ku:long_name = "agc gain applied on rx channel 1. Gain
                              calibration corrections are applied" ;
    agc_ch1_20_ku:comment = "Calibrated AGC gain applied on Rx channel 1.
                              This is the sum of AGC stages 1 and 2
                              plus the corresponding AGC calibration
                              corrections" ;
    agc_ch1_20_ku:add_offset = 0.0 ;
    agc_ch1_20_ku:scale_factor = 0.01 ;
```

3.3.6 agc_ch2_20_ku(time_20_ku)

```
int agc_ch2_20_ku(time_20_ku) ;
    agc_ch2_20_ku:_FillValue = -2147483648 ;
    agc_ch2_20_ku:units = "dB" ;
    agc_ch2_20_ku:long_name = "agc gain applied on rx channel 2. gain
                              calibration corrections are applied" ;
agc_ch1_20_ku:comment = " Calibrated AGC gain applied on Rx channel 2. This
is the sum of AGC stages 1 and 2 plus the corresponding AGC calibration
corrections" ;
    agc_ch2_20_ku:add_offset = 0.0 ;
    agc_ch2_20_ku:scale_factor = 0.01 ;
```

3.3.7 alt_20_ku(time_20_ku)

```
int alt_20_ku(time_20_ku) ;
    alt_20_ku:_FillValue = -2147483648 ;
    alt_20_ku:units = "m" ;
    alt_20_ku:long_name = "altitude of CoM above reference ellipsoid" ;
    alt_20_ku:standard_name = "height_above_reference_ellipsoid" ;
    alt_20_ku:comment = "Altitude of the Satellite CoM above reference
                        ellipsoid [WGS84]." ;
    alt_20_ku:add_offset = 0.0 ;
    alt_20_ku:scale_factor = 0.001 ;
```

3.3.8 alt_21_ku(time_21_ku)

```
int alt_21_ku(time_21_ku) ;
    alt_21_ku:_FillValue = -2147483648 ;
    alt_21_ku:units = "m" ;
    alt_21_ku:long_name = "altitude of CoM above reference ellipsoid" ;
    alt_21_ku:standard_name = "height_above_reference_ellipsoid" ;
    alt_21_ku:comment = "Altitude of the Satellite CoM above reference
                        ellipsoid [WGS84]corresponding to the MDSR Time
                        Stamp - FBR SARin." ;
    alt_21_ku:add_offset = 0. ;
    alt_21_ku:scale_factor = 0.001 ;
```

3.3.9 alt_85_ku(time_85_ku)

```
int alt_85_ku(time_85_ku) ;
    alt_85_ku:_FillValue = -2147483648 ;
    alt_85_ku:units = "m" ;
    alt_85_ku:long_name = "altitude of CoM above reference ellipsoid" ;
    alt_85_ku:standard_name = "height_above_reference_ellipsoid" ;
    alt_85_ku:comment = "Altitude of the Satellite CoM above reference
                        ellipsoid [WGS84]corresponding to the MDSR Time
                        Stamp - FBR SAR." ;
    alt_85_ku:add_offset = 0.0 ;
    alt_85_ku:scale_factor = 0.001 ;
```

3.3.10 alt_avg_01_ku(time_avg_01_ku)

```
int alt_avg_01_ku(time_avg_01_ku) ;
    alt_avg_01_ku:_FillValue = -2147483648 ;
    alt_avg_01_ku:units = "m" ;
    alt_avg_01_ku:long_name = "altitude of CoM above reference ellipsoid" ;
    alt_avg_01_ku:comment = "Altitude of the Satellite CoM above reference
ellipsoid [WGS84] corresponding to the MDSR Time Stamp for L1B 1Hz average
power waveform." ;
    alt_avg_01_ku:add_offset = 0.0 ;
    alt_avg_01_ku:scale_factor = 0.001 ;
```

3.3.11 beam_dir_vec_20_ku(time_20_ku,space_3d)

```
int  beam_dir_vec_20_ku(time_20_ku, space_3d) ;
    beam_dir_vec_20_ku:_FillValue = -2147483648 ;
    beam_dir_vec_20_ku:units = "m" ;
    beam_dir_vec_20_ku:long_name = "real beam direction vector in CRF" ;
    beam_dir_vec_20_ku:comment = "Real beam direction vector described in
                        the CryoSat Reference Frame. The 3 components are
                        given according to the 'space_3d' dimension: [1]
                        x, [2] y, [3] z." ;
    beam_dir_vec_20_ku:add_offset = 0.0 ;
    beam_dir_vec_20_ku:scale_factor = 1.e-06 ;
```

3.3.12 beam_dir_vec_21_ku(time_1_ku,space_3d)

```
int  beam_dir_vec_21_ku(time_21_ku, space_3d) ;
    beam_dir_vec_21_ku:_FillValue = -2147483648 ;
    beam_dir_vec_21_ku:units = "m" ;
    beam_dir_vec_21_ku:long_name = "real beam direction vector in CRF" ;
    beam_dir_vec_21_ku:comment = "Real beam direction vector described in
                        the CryoSat Reference Frame. The 3 components are
                        given according to the 'space_3d' dimension: [1]
                        x, [2] y, [3] z - FBR SARin Mode." ;
    beam_dir_vec_21_ku:add_offset = 0.0 ;
    beam_dir_vec_21_ku:scale_factor = 1.e-06 ;
```

3.3.13 beam_dir_vec_85_ku(time_85_ku,space_3d)

```
int  beam_dir_vec_85_ku(time_85_ku, space_3d) ;
    beam_dir_vec_85_ku:_FillValue = -2147483648 ;
    beam_dir_vec_85_ku:units = "m" ;
    beam_dir_vec_85_ku:long_name = "real beam direction vector in CRF" ;
    beam_dir_vec_85_ku:comment = "Real beam direction vector described in
                        the CryoSat Reference Frame. The 3 components are
                        given according to the 'space_3d' dimension: [1]
                        x, [2] y, [3] z - FBR SAR Mode." ;
    beam_dir_vec_85_ku:add_offset = 0.0 ;
    beam_dir_vec_85_ku:scale_factor = 1.e-06 ;
```

3.3.14 coherence_waveform_20_ku(time_20_ku, ns_20_ku)

```
short coherence_waveform_20_ku(time_20_ku, ns_20_ku) ;
    coherence_waveform_20_ku:_FillValue = -32768s ;
    coherence_waveform_20_ku:units = "count" ;
    coherence_waveform_20_ku:long_name = "l1b coherence waveform" ;
    coherence_waveform_20_ku:comment = "The L1b 20Hz coherence waveform is
                    a fully-calibrated, high resolution, multilooked
                    coherence computed from the complex echoes on the
                    two receiving channels (SARin only)." ;
    coherence_waveform_20_ku:add_offset = 0.0 ;
    coherence_waveform_20_ku:scale_factor = 0.001 ;
```

3.3.15 cor2_applied_20_ku(time_20_ku)

```
int cor2_applied_20_ku(time_20_ku) ;
    cor2_applied_20_ku:_FillValue = -2147483648 ;
    cor2_applied_20_ku:units = "seconds/rc" ;
    cor2_applied_20_ku:long_name = "cor2 height rate" ;
    cor2_applied_20_ku:comment = "COR2 is the 2-way on-board tracker height
                    rate over the radar cycle, forwarded from
                    telemetry." ;
    cor2_applied_20_ku:add_offset = 0.0 ;
    cor2_applied_20_ku:scale_factor = 3.05e-12 ;
```

3.3.16 cor2_applied_21_ku(time_21_ku)

```
int cor2_applied_21_ku(time_21_ku) ;
    cor2_applied_21_ku:_FillValue = -2147483648 ;
    cor2_applied_21_ku:units = "seconds/rc" ;
    cor2_applied_21_ku:long_name = "cor2 height rate" ;
    cor2_applied_21_ku:comment = "COR2 is the 2-way on-board tracker height
                    rate over the radar cycle, forwarded from telemetry
                    - FBR SARin." ;
    cor2_applied_21_ku:add_offset = 0.0 ;
    cor2_applied_21_ku:scale_factor = 3.05e-12 ;
```

3.3.17 cor2_applied_85_ku(time_85_ku)

```
int cor2_applied_85_ku(time_85_ku) ;
    cor2_applied_85_ku:_FillValue = -2147483648 ;
    cor2_applied_85_ku:units = "seconds/rc" ;
    cor2_applied_85_ku:long_name = "cor2 height rate" ;
    cor2_applied_85_ku:comment = "COR2 is the 2-way on-board tracker height
                    rate over the radar cycle, forwarded from telemetry
                    - FBR SAR." ;
    cor2_applied_85_ku:add_offset = 0.0 ;
    cor2_applied_85_ku:scale_factor = 3.05e-12 ;
```

3.3.18 cplx_waveform_ch1_i_21_ku(time_21_ku,np_ku,ns_ku)

```
byte cplx_waveform_ch1_i_21_ku(time_21_ku, np_ku,ns_ku) ;
    cplx_waveform_ch1_i_21_ku:units = "count" ;
    cplx_waveform_ch1_i_21_ku:long_name = "fbr sarin rx1 complex waveforms
i samples" ;
    cplx_waveform_ch1_i_21_ku:add_offset = 0b ;
    cplx_waveform_ch1_i_21_ku:scale_factor = 1b ;
    cplx_waveform_ch1_i_21_ku:comment = "The in-phase component of each
complex echo waveforms in the burst received by antenna 1 (Tx-Rx). Instrument
calibrations not applied." ;
```

3.3.19 cplx_waveform_ch1_i_85_ku(time_85_ku,np_ku, ns_ku)

```
byte cplx_waveform_ch1_i_85_ku(time_85_ku, np_ku, ns_ku) ;
    cplx_waveform_ch1_i_85_ku:units = "count" ;
    cplx_waveform_ch1_i_85_ku:long_name = " fbr sar complex waveforms i
samples" ;
    cplx_waveform_ch1_i_85_ku:add_offset = 0b ;
    cplx_waveform_ch1_i_85_ku:scale_factor = 1b ;
    cplx_waveform_ch1_i_85_ku:comment = "The in-phase component of each
complex echo waveforms in the burst received by antenna 1 (Tx-Rx). Instrument
calibrations not applied." ;
```

3.3.20 cplx_waveform_ch1_q_21_ku(time_21_ku,np_ku, ns_ku)

```
byte cplx_waveform_ch1_q_21_ku(time_21_ku, np_ku, ns_ku) ;
    cplx_waveform_ch1_q_21_ku:units = "count" ;
    cplx_waveform_ch1_q_21_ku:long_name = "fbr sarin rx1 complex waveforms q samples" ;
    cplx_waveform_ch1_q_21_ku:add_offset = 0b ;
    cplx_waveform_ch1_q_21_ku:scale_factor = 1b ;
    cplx_waveform_ch1_q_21_ku:comment = "The quadrature component of each complex echo waveforms in the burst received by antenna 1 (Tx-Rx). Instrument calibrations not applied." ;
```

3.3.21 cplx_waveform_ch1_q_85_ku(time_85_ku,np_ku, ns_ku)

```
byte cplx_waveform_ch1_q_85_ku(time_85_ku, np_ku, ns_ku) ;
    cplx_waveform_ch1_q_85_ku:units = "count" ;
    cplx_waveform_ch1_q_85_ku:long_name = "fbr sar complex waveforms q samples" ;
    cplx_waveform_ch1_q_85_ku:add_offset = 0b ;
    cplx_waveform_ch1_q_85_ku:scale_factor = 1b ;
    cplx_waveform_ch1_q_85_ku:comment = "The quadrature component of each complex echo waveforms in the burst received by antenna 1 (Tx-Rx). Instrument calibrations not applied." ;
```

3.3.22 cplx_waveform_ch2_i_21_ku(time_21_ku,np_ku, ns_ku)

```
byte cplx_waveform_ch2_i_21_ku(time_21_ku, np_ku, ns_ku) ;
    cplx_waveform_ch2_i_21_ku:units = "count" ;
    cplx_waveform_ch2_i_21_ku:long_name = "fbr sarin complex waveforms i samples" ;
    cplx_waveform_ch2_i_21_ku:add_offset = 0b ;
    cplx_waveform_ch2_i_21_ku:scale_factor = 1b ;
    cplx_waveform_ch2_i_21_ku:comment = "The in-phase component of each complex echo waveforms in the burst received by antenna 2 (Rx only). Instrument calibrations not applied." ;
```

3.3.23 cplx_waveform_ch2_q_21_ku(time_21_ku,np_ku, ns_ku)

```
byte cplx_waveform_ch2_q_21_ku(time_21_ku, np_ku, ns_ku) ;
    cplx_waveform_ch2_q_21_ku:units = "count" ;
    cplx_waveform_ch2_q_21_ku:long_name = "fbr sarin rx2 complex waveforms
q samples" ;
    cplx_waveform_ch2_q_21_ku:add_offset = 0b ;
    cplx_waveform_ch2_q_21_ku:scale_factor = 1b ;
    cplx_waveform_ch2_q_21_ku:comment = "The quadrature component of each
complex echo waveforms in the burst received by antenna 2 (Rx only). Instrument
calibrations not applied." ;
```

3.3.24 dop_angle_start_20_ku(time_20_ku)

```
int dop_angle_start_20_ku(time_20_ku) ;
    dop_angle_start_20_ku:_FillValue = -2147483648 ;
    dop_angle_start_20_ku:units = "rad" ;
    dop_angle_start_20_ku:long_name = "doppler angle start" ;
    dop_angle_start_20_ku:add_offset = 0.0 ;
    dop_angle_start_20_ku:scale_factor = 1.e-07 ;
    dop_angle_start_20_ku:comment = "Value of Doppler Angle for the first
                single look echo in the stack. It is the angle
                between: (a) direction perpendicular to the
                velocity vector, (b) direction satellite -
                surface location. The Doppler angle depends on
                velocity vector and on geometry." ;
```

3.3.25 dop_angle_stop_20_ku(time_20_ku)

```
int dop_angle_stop_20_ku(time_20_ku) ;
    dop_angle_stop_20_ku:_FillValue = -2147483648 ;
    dop_angle_stop_20_ku:units = "rad" ;
    dop_angle_stop_20_ku:long_name = "doppler angle stop" ;
    dop_angle_stop_20_ku:add_offset = 0.0;
    dop_angle_stop_20_ku:scale_factor = 1.e-07 ;
    dop_angle_stop_20_ku:comment = "Value of Doppler Angle for the last
                        single look echo in the stack. It is the angle
                        between: (a) direction perpendicular to the
                        velocity vector, (b) direction satellite -
                        surface location. The Doppler angle depends on
                        velocity vector and on geometry." ;
```

3.3.26 dop_cor_20_ku(time_20_ku)

```
int  dop_cor_20_ku(time_20_ku) ;
    dop_cor_20_ku:_FillValue = -2147483648 ;
    dop_cor_20_ku:units = "m" ;
    dop_cor_20_ku:long_name = "doppler range correction" ;
    dop_cor_20_ku:comment = "This is the Doppler range correction due to
                        the satellite altitude rate. It is computed for the
                        component of satellite velocity in the nadir
                        direction. Correction applied to L1B LRM waveforms
                        only." ;
    dop_cor_20_ku:add_offset = 0.0 ;
    dop_cor_20_ku:scale_factor = 0.001 ;
```

3.3.27 dop_cor_21_ku(time_21_ku)

```
int  dop_cor_21_ku(time_21_ku) ;
    dop_cor_21_ku:_FillValue = -2147483648 ;
    dop_cor_21_ku:units = "m" ;
    dop_cor_21_ku:long_name = "doppler range correction" ;
    dop_cor_21_ku:comment = "This is the Doppler range correction due to
                    the satellite altitude rate. It is computed for the
                    component of satellite velocity in the nadir
                    direction. Not used by the SAR processor - FBR
                    SARin.";
    dop_cor_21_ku:add_offset = 0. ;
    dop_cor_21_ku:scale_factor = 0.001 ;
```

3.3.28 dop_cor_85_ku(time_85_ku)

```
int  dop_cor_85_ku(time_85_ku) ;
    dop_cor_85_ku:_FillValue = -2147483648 ;
    dop_cor_85_ku:units = "m" ;
    dop_cor_85_ku:long_name = "doppler range correction" ;
    dop_cor_85_ku:comment = "This is the Doppler range correction due to
                    the satellite altitude rate. It is computed for the
                    component of satellite velocity in the nadir
                    direction. Not used by the SAR processor - FBR
                    SAR.";
    dop_cor_85_ku:add_offset = 0. ;
    dop_cor_85_ku:scale_factor = 0.001 ;
```

3.3.29 echo_numval_20_ku(time_20_ku)

```
short echo_numval_20_ku(time_20_ku) ;
    echo_numval_20_ku:_FillValue = -32768s ;
    echo_numval_20_ku:units = "count" ;
    echo_numval_20_ku:long_name = "number of echoes averaged" ;
    echo_numval_20_ku:add_offset = 0s ;
    echo_numval_20_ku:scale_factor = 1s ;
    echo_numval_20_ku:comment = "For LRM is the number of echoes averaged
                    to compute the corresponding L1B 20Hz power
                    waveform. For SAR/SARin is the number of single look
                    echoes in the Surface Sample Stack that have been
                    multilooked to compute the corresponding L1B 20Hz
                    power waveform. This variable includes only one
                    receiving channel however, in SARin, single looks
                    from both channels are averaged in order to reduce
                    the SNR.";
```

3.3.30 echo_numval_21_ku(time_21_ku)

```
short echo_numval_21_ku(time_21_ku) ;
    echo_numval_21_ku:_FillValue = -32768s ;
    echo_numval_21_ku:units = "count" ;
    echo_numval_21_ku:long_name = "number of echoes in a burst" ;
    echo_numval_21_ku:add_offset = 0s ;
    echo_numval_21_ku:scale_factor = 1s ;
    echo_numval_21_ku:comment = "Number of echoes in a burst. It is
                    expected to be equal to 64: if lower some of the
                    echoes the corresponding burst are filled with
                    zeroes." ;
```

3.3.31 echo_numval_85_ku(time_85_ku)

```
short echo_numval_85_ku(time_85_ku) ;
    echo_numval_85_ku:_FillValue = -32768s ;
    echo_numval_85_ku:units = "count" ;
    echo_numval_85_ku:long_name = "number of echoes in a burst" ;
    echo_numval_85_ku:add_offset = 0s ;
    echo_numval_85_ku:scale_factor = 1s ;
    echo_numval_85_ku:comment = "Number of echoes in a burst. It is
                    expected to be equal to 64: if lower some of the
                    echoes the corresponding burst are filled with
                    zeroes." ;
```

3.3.32 echo_numval_avg_01_ku(time_avg_01_ku)

```
short echo_numval_avg_01_ku(time_avg_01_ku) ;
    echo_numval_avg_01_ku:_FillValue = -32768s ;
    echo_numval_avg_01_ku:units = "count" ;
    echo_numval_avg_01_ku:long_name = "number of echoes averaged" ;
    echo_numval_avg_01_ku:add_offset = 0s ;
    echo_numval_avg_01_ku:scale_factor = 1s ;
    echo_numval_avg_01_ku:comment = "Number of echoes averaged to obtain
                the corresponding L1B 1Hz average power
                waveform. In SARin it accounts for the two Rx
                channels" ;
```

3.3.33 echo_scale_factor_20_ku(time_20_ku)

```
int  echo_scale_factor_20_ku(time_20_ku) ;
        echo_scale_factor_20_ku:_FillValue = -2147483648;
        echo_scale_factor_20_ku:units = "count" ;
        echo_scale_factor_20_ku:long_name = "echo scale factor (to scale
        echo to watts)" ;
        echo_scale_factor_20_ku:add_offset = 0.0 ;
        echo_scale_factor_20_ku:scale_factor = 1.e-09;
        echo_scale_factor_20_ku:comment = "The 20Hz power waveform
                scaling factor, computed in order to best fit
                each waveform within 2 bytes. The scaling,
                needed to convert the L1B 1Hz average power
                waveform into Watt, is applied as follows:
                pwr_waveform_20_ku(time_20_ku,ns_20_ku)
                *echo_scale_factor_20_ku(time_20_ku)*2^echo_s
                cale_pwr_20_ku(time_20_ku)." ;
```

3.3.34 echo_scale_factor_avg_01_ku(time_avg_01_ku)

```
int echo_scale_factor_avg_01_ku(time_avg_01_ku) ;
    echo_scale_factor_avg_01_ku:_FillValue = -2147483648;
    echo_scale_factor_avg_01_ku:units = "count" ;
    echo_scale_factor_avg_01_ku:long_name = "echo scale factor (to scale
                                    echo to watts)" ;
    echo_scale_factor_avg_01_ku:add_offset = 0. ;
    echo_scale_factor_avg_01_ku:scale_factor = 1.e-09 ;
    echo_scale_factor_avg_01_ku:comment = "The 1Hz average power waveform
                scaling factor, computed in order to best fit each
                waveform within 2 bytes. The scaling, needed to
                convert the L1B 1Hz average power waveform into
                Watt, is applied as follows:
                pwr_waveform_avg_01_ku(time_avg_01_ku,ns_avg_01_ku)
                *echo_scale_factor_avg_01_ku(time_avg_01_ku)*2^echo_
                scale_pwr_avg_01_ku(time_avg_01_ku)." ;
```

3.3.35 echo_scale_pwr_20_ku(time_20_ku)

```
int echo_scale_pwr_20_ku(time_20_ku) ;
    echo_scale_pwr_20_ku:_FillValue = -2147483648 ;
    echo_scale_pwr_20_ku:units = "count" ;
    echo_scale_pwr_20_ku:long_name = "echo scale power (a power of 2)" ;
    echo_scale_pwr_20_ku:add_offset = 0 ;
    echo_scale_pwr_20_ku:scale_factor = 1 ;
    echo_scale_pwr_20_ku:comment = "The 20Hz power waveform power scaling
                            factor, computed in order to best fit each
                            waveform within 2 bytes. The scaling, needed
                            to convert the L1B 1Hz average power waveform
                            into Watt, is applied as follows:
                            pwr_waveform_20_ku(time_20_ku,ns_20_ku)
                            *echo_scale_factor_20_ku(time_20_ku)*2^echo_s
                            cale_pwr_20_ku(time_20_ku)." ;
```

3.3.36 echo_scale_pwr_avg_01_ku(time_avg_01_ku)

```
int echo_scale_pwr_avg_01_ku(time_avg_01_ku) ;
    echo_scale_pwr_avg_01_ku:_FillValue = -2147483648 ;
    echo_scale_pwr_avg_01_ku:units = "count" ;
    echo_scale_pwr_avg_01_ku:long_name = "echo scale power (a power of 2)";
    echo_scale_pwr_avg_01_ku:add_offset = 0 ;
    echo_scale_pwr_avg_01_ku:scale_factor = 1 ;
    echo_scale_pwr_avg_01_ku:comment = "The 1Hz average power waveform
                power scaling factor, computed in order to best fit each
                waveform within 2 bytes. The scaling, needed to convert the
                L1B 1Hz average power waveform into Watt, is applied as
                follows:
                pwr_waveform_avg_01_ku(time_avg_01_ku,ns_avg_01_ku)
                *echo_scale_factor_avg_01_ku(time_avg_01_ku)*2^echo_scale_p
                wr_avg_01_ku(time_avg_01_ku)." ;
```

3.3.37 flag_cor_err_01(time_cor_01)

```
int flag_cor_err_01(time_cor_01) ;
    flag_cor_err_01:_FillValue = -1 ;
    flag_cor_err_01:long_name = "correction error flags" ;
    flag_cor_err_01:flag_masks = 2048, 1024, 512, 256, 128, 64, 32, 16, 8,
                                 4, 2, 1;
    flag_cor_err_01:flag_meanings = "model_dry_error model_wet_error
                                     inv_bar_error
                                     hf_fluctuations_error
                                     iono_gim_error
                                     iono_model_error
                                     ocean_tide_equil_error
                                     long_tide_error
                                     load_tide_error
                                     solid_earth_error
                                     pole_tide_error
                                     surface_type_error" ;
    flag_cor_err_01:comment = "Correction error flags. This flag shows
                               whether the correction models
                               returned an error." ;
```

3.3.38 ind_first_meas_20hz_01 (time_cor_01)

int ind_first_meas_20hz_01(time_cor_01) ;

ind_first_meas_20hz_01:_FillValue = -2147483648 ;

ind_first_meas_20hz_01:comment = "Index of the first 20Hz measurement of the 1Hz packet." ;

ind_first_meas_20hz_01:long_name = "index of the first 20Hz measurement: 1 Hz" ;

ind_first_meas_20hz_01:units = "count" ;

3.3.39 ind_ meas_1hz_20_ku (time_20_ku)

short ind_meas_1hz_20_ku(time_20_ku) ;

ind_meas_1hz_20_ku:_FillValue = -32768s ;

ind_meas_1hz_20_ku:comment = "Index of the 1Hz measurement to which belongs the 20Hz measurement." ;

ind_meas_1hz_20_ku:long_name = "index of the 1Hz measurement: 20 Hz ku band" ;

ind_meas_1hz_20_ku:units = "count" ;

3.3.40 flag_cor_status_01(time_cor_01)

```
int flag_cor_status_01(time_cor_01) ;
    flag_cor_status_01:_FillValue = –1
    flag_cor_status_01:long_name = "correction status flags" ;
    flag_cor_status_01:flag_masks = 2048, 1024, 512, 256, 128, 64, 32, 16,
                                    8, 4, 2, 1;
    flag_cor_status_01:flag_meanings = "model_dry_called model_wet_called
                                        inv_bar_called
                                        hf_fluctuations_called
                                        iono_gim_called
                                        iono_model_called
                                        ocean_tide_called
                                        ocean_tide_equil_called
                                        load_tide_called
                                        solid_earth_called
                                        pole_tide_called
                                        surface_type_called" ;
    flag_cor_status_01:comment = "Correction status flags- showing which
                                correction algorithms have been called." ;
```

3.3.41 flag_echo_20_ku(time_20_ku)

```
short flag_echo_20_ku(time_20_ku) ;
    flag_echo_20_ku:_FillValue = -1s;
    flag_echo_20_ku:long_name = "flags for errors or information about L1b
                                20Hz power waveform" ;
    flag_echo_20_ku:flag_masks = -32768s, 16384s, 8192s, 4096s, 2048s,
                                 1024s, 512s, 256s;
    flag_echo_20_ku:flag_meanings = "approx_beam_steering
                                     exact_beam_steering
                                     doppler_weighting_computed
                                     doppler_weighting_applied
                                     multi_look_incomplete
                                     beam_angle_steering_error
                                     anti_aliased_power_echoes
                                     auto_beam_steering" ;
    flag_echo_20_ku:comment = "Flags for errors or information about L1b
                              20Hz power waveform." ;
```

3.3.42 flag_echo_21_ku(time_21_ku)

```
short flag_echo_21_ku(time_21_ku) ;
    flag_echo_21_ku:_FillValue = -1s;
    flag_echo_21_ku:long_name = "flags for errors or information about fbr
                                 complex waveforms" ;
    flag_echo_21_ku:comment = "Flags for errors or information about FBR
                               SARin 21Hz complex echo waveforms. Currently
                               not used. Reserved for future use" ;
```

3.3.43 flag_echo_85_ku(time_85_ku)

```
short flag_echo_85_ku(time_85_ku) ;
    flag_echo_85_ku:_FillValue = -1s;
    flag_echo_85_ku:long_name = "flags for errors or information about L1b
                                 20Hz power waveform" ;
    flag_echo_85_ku:comment = "Flags for errors or information about fbr
                               complex waveforms. Currently not used.
                               Reserved for future use " ;
```

3.3.44 flag_echo_avg_01_ku(time_avg_01_ku)

```
short flag_echo_avg_01_ku(time_avg_01_ku) ;
    flag_echo_avg_01_ku:_FillValue = -1s;
    flag_echo_avg_01_ku:long_name = "flags for errors or information about
                                     1Hz average power waveform" ;
    flag_echo_avg_01_ku:flag_masks = -32768s, 1s;
    flag_echo_avg_01_ku:flag_meanings = "1_hz_echo_error_not_computed
                                         mispointing_bad_angles" ;
    flag_echo_avg_01_ku:comment = "Flags for errors or information about
                                   L1B 1Hz average power waveform."
                                   ;
```

3.3.45 flag_instr_conf_rx_bwdt_20_ku(time_20_ku)

```
byte flag_instr_conf_rx_bwdt_20_ku(time_20_ku) ;
    flag_instr_conf_rx_bwdt_20_ku:_FillValue = -128b;
    flag_instr_conf_rx_bwdt_20_ku:long_name = "instrument configuration:
                                              acquisition band" ;
    flag_instr_conf_rx_bwdt_20_ku:flag_values = 0b, 1b, 2b ;
    flag_instr_conf_rx_bwdt_20_ku:flag_meanings = "unknown 320_mhz 40_mhz"
;
    flag_instr_conf_rx_bwdt_20_ku:comment = "This flag contains the
                                  acquisition band of the SIRAL instrument." ;
```

3.3.46 flag_instr_conf_rx_bwdt_21_ku(time_21_ku)

```
byte flag_instr_conf_rx_bwdt_21_ku(time_21_ku) ;
    flag_instr_conf_rx_bwdt_21_ku:_FillValue = -128b;
    flag_instr_conf_rx_bwdt_21_ku:long_name = "instrument configuration :
                                              tracking bandwidth" ;
    flag_instr_conf_rx_bwdt_21_ku:flag_values = 0b, 1b, 2b ;
    flag_instr_conf_rx_bwdt_21_ku:flag_meanings = "unknown 320_mhz 40_mhz"
;
    flag_instr_conf_rx_bwdt_21_ku:comment = "This flag contains the
                                  tracking bandwidth of the SIRAL instrument -
                                  FBR SARin." ;
```

3.3.47 flag_instr_conf_rx_bwdt_85_ku(time_85_ku)

```
byte flag_instr_conf_rx_bwdt_85_ku(time_85_ku) ;
    flag_instr_conf_rx_bwdt_85_ku:_FillValue = -128b;
    flag_instr_conf_rx_bwdt_85_ku:long_name = "instrument configuration:
                                              tracking bandwidth" ;
    flag_instr_conf_rx_bwdt_85_ku:flag_values = 0b, 1b, 2b ;
    flag_instr_conf_rx_bwdt_85_ku:flag_meanings = "unknown 320_mhz 40_mhz"
;
    flag_instr_conf_rx_bwdt_85_ku:comment = "This flag contains the
                                  tracking bandwidth of the SIRAL instrument -
                                  FBR SAR." ;
```

3.3.48 flag_instr_conf_rx_flags_20_ku(time_20_ku)

```
byte flag_instr_conf_rx_flags_20_ku(time_20_ku) ;
    flag_instr_conf_rx_flags_20_ku:long_name = "instrument configuration
                                               flags" ;
    flag_instr_conf_rx_flags_20_ku:flag_masks = -128b, 64b, 32b, 16b, 8b,
                                               4b, 2b, 1b ;
    flag_instr_conf_rx_flags_20_ku:flag_meanings = "siral_redundant
                                               external_cal open_loop
                                               loss_of_echo real_time_error
                                               echo_saturation
                                               rx_band_attenuated
                                               cycle_report_error" ;
    flag_instr_conf_rx_flags_20_ku:comment = "This flag contains the status
                                of the SIRAL instrument acquisition." ;
```

3.3.49 flag_instr_conf_rx_flags_21_ku(time_21_ku)

```
byte flag_instr_conf_rx_flags_21_ku(time_21_ku) ;
    flag_instr_conf_rx_flags_21_ku:long_name = "instrument configuration
                                               flags" ;
    flag_instr_conf_rx_flags_21_ku:flag_masks = -128b, 64b, 32b, 16b, 8b,
                                               4b, 2b, 1b ;
    flag_instr_conf_rx_flags_21_ku:flag_meanings = "siral_redundant
                                               external_cal open_loop
                                               loss_of_echo real_time_error
                                               echo_saturation
                                               rx_band_attenuated
                                               cycle_report_error" ;
    flag_instr_conf_rx_flags_21_ku:comment = "This flag contains the status
                                of the SIRAL instrument tracking - FBR
                                SARin." ;
```

3.3.50 flag_instr_conf_rx_flags_85_ku(time_85_ku)

```
byte flag_instr_conf_rx_flags_85_ku(time_85_ku) ;
    flag_instr_conf_rx_flags_85_ku:long_name = "instrument configuration
                                               flags" ;
    flag_instr_conf_rx_flags_85_ku:flag_masks = -128b, 64b, 32b, 16b, 8b,
                                              4b, 2b, 1b ;
    flag_instr_conf_rx_flags_85_ku:flag_meanings = "siral_redundant
                                              external_cal open_loop
                                              loss_of_echo real_time_error
                                              echo_saturation
                                              rx_band_attenuated
                                              cycle_report_error" ;
    flag_instr_conf_rx_flags_85_ku:comment = "This flag contains the status
                                of the SIRAL instrument tracking - FBR SAR."
                                ;
```

3.3.51 flag_instr_conf_rx_in_use_20_ku(time_20_ku)

```
byte flag_instr_conf_rx_in_use_20_ku(time_20_ku) ;
    flag_instr_conf_rx_in_use_20_ku:_FillValue = -128b ;
    flag_instr_conf_rx_in_use_20_ku:long_name = "instrument configuration :
                                              rx chain in use" ;
    flag_instr_conf_rx_in_use_20_ku:flag_values = 0b, 1b, 2b, 3b ;
    flag_instr_conf_rx_in_use_20_ku:flag_meanings = "unknown rx1 rx2 both"
;
    flag_instr_conf_rx_in_use_20_ku:comment = "This flag contains the
                                instrument chain in use in SIRAL
                                instrument." ;
```

3.3.52 flag_instr_conf_rx_in_use_21_ku(time_21_ku)

```
byte   flag_instr_conf_rx_in_use_21_ku(time_20_ku) ;
       flag_instr_conf_rx_in_use_21_ku:_FillValue      = -128b ;
       flag_instr_conf_rx_in_use_21_ku:long_name       = "instrument configuration:
                                                       rx chain in use" ;
       flag_instr_conf_rx_in_use_21_ku:flag_values     = 0b, 1b, 2b, 3b ;
       flag_instr_conf_rx_in_use_21_ku:flag_meanings   = "unknown rx1 rx2 both" ;

       flag_instr_conf_rx_in_use_21_ku:comment         = "This flag contains the
                                                       SIRAL instrument chain in use
                                                       in FBR SARin" ;
```

3.3.53 flag_instr_conf_rx_in_use_85_ku(time_85_ku)

```
      byte flag_instr_conf_rx_in_use_85_ku(time_85_ku) ;
          flag_instr_conf_rx_in_use_85_ku:_FillValue = -128b;
          flag_instr_conf_rx_in_use_85_ku:long_name  =  "instrument  configuration
                                                        flags" ;
          flag_instr_conf_rx_in_use_85_ku:flag_values = 0b, 1b, 2b, 3b ;
          flag_instr_conf_rx_in_use_85_ku:flag_meanings = "unknown  rx1  rx2  both"
    ;
          flag_instr_conf_rx_in_use_85_ku:comment = "This flag contains the SIRAL
                                        instrument channel in use in FBR SAR." ;
```

3.3.54 flag_instr_conf_rx_str_in_use_20_ku(time_20_ku)

```
byte flag_instr_conf_rx_str_in_use_20_ku(time_20_ku) ;
    flag_instr_conf_rx_str_in_use_20_ku:_FillValue = -128b ;
    flag_instr_conf_rx_str_in_use_20_ku:long_name = "instrument
                                                    configuration: str in
                                                    use" ;
    flag_instr_conf_rx_str_in_use_20_ku:flag_values = 0b, 1b, 2b, 3b, 4b ;
    flag_instr_conf_rx_str_in_use_20_ku:flag_meanings = "no_str_tracker
                                                        tracker_1 tracker_2
                                                        tracker_3
                                                        attref_file" ;
    flag_instr_conf_rx_str_in_use_20_ku:comment = "Star tracker
                                        identification flag showing the
                                        source of the platform pointing. 0:
                                        No Star Tracker data used. 1: Data
                                        from Star Tracker 1 used. 2: Data
                                        from Star Tracker 2 used. 3: Data
                                        from Star Tracker 3 used. 4: Data
                                        from the Star Tracker selected on
                                        board by AOCS used." ;
```

3.3.55 flag_instr_conf_rx_str_in_use_21_ku(time_21_ku)

```
byte flag_instr_conf_rx_str_in_use_21_ku(time_21_ku) ;
    flag_instr_conf_rx_str_in_use_21_ku:_FillValue = -128b ;
    flag_instr_conf_rx_str_in_use_21_ku:long_name       =       "instrument
                                                        configuration: str in
                                                        use" ;
    flag_instr_conf_rx_str_in_use_21_ku:flag_values = 0b, 1b, 2b, 3b, 4b ;
    flag_instr_conf_rx_str_in_use_21_ku:flag_meanings    =    "no_str_tracker
                                                          tracker_1 tracker_2
                                                          tracker_3
                                                          attref_file" ;
    flag_instr_conf_rx_str_in_use_21_ku:comment     =     "Star     tracker
                                        identification flag showing which
                                        the source of the platform pointing.
                                        0: No Star Tracker data used. 1:
                                        Data from Star Tracker 1 used. 2:
                                        Data from Star Tracker 2 used. 3:
                                        Data from Star Tracker 3 used. 4:
                                        Data from the Star Tracker selected
                                        on board by AOCS used - FBR SARin."
                                        ;
```

3.3.56 flag_instr_conf_rx_str_in_use_85_ku(time_85_ku)

```
byte flag_instr_conf_rx_str_in_use_85_ku(time_85_ku) ;
    flag_instr_conf_rx_str_in_use_85_ku:_FillValue = -128b ;
    flag_instr_conf_rx_str_in_use_85_ku:long_name = "instrument
                                                    configuration: str in
                                                    use" ;
    flag_instr_conf_rx_str_in_use_85_ku:flag_values = 0b, 1b, 2b, 3b, 4b ;
    flag_instr_conf_rx_str_in_use_85_ku:flag_meanings = "no_str_tracker
                                                        tracker_1 tracker_2
                                                        tracker_3
                                                        attref_file" ;
    flag_instr_conf_rx_str_in_use_85_ku:comment = "Star tracker
                                        identification flag showing which
                                        the source of the platform pointing.
                                        0: No Star Tracker data used. 1:
                                        Data from Star Tracker 1 used. 2:
                                        Data from Star Tracker 2 used. 3:
                                        Data from Star Tracker 3 used. 4:
                                        Data from the Star Tracker selected
                                        on board by AOCS used - FBR SAR." ;
```

3.3.57 flag_instr_conf_rx_trk_mode_20_ku(time_20_ku)

```
byte flag_instr_conf_rx_trk_mode_20_ku(time_20_ku) ;
    flag_instr_conf_rx_trk_mode_20_ku:_FillValue = -128b ;
    flag_instr_conf_rx_trk_mode_20_ku:long_name = "instrument
                                                  configuration: tracking
                                                  mode" ;
    flag_instr_conf_rx_trk_mode_20_ku:flag_values = 0b, 1b, 2b, 3b ;
    flag_instr_conf_rx_trk_mode_20_ku:flag_meanings = "unknown lrm sar
                                                      sarin" ;
    flag_instr_conf_rx_trk_mode_20_ku:comment = "This flag indicates the
tracking mode of the SIRAL instrument." ;
```

3.3.58 flag_instr_conf_rx_trk_mode_21_ku(time_21_ku)

```
byte flag_instr_conf_rx_trk_mode_21_ku(time_21_ku) ;
    flag_instr_conf_rx_trk_mode_21_ku:_FillValue = -128b ;
    flag_instr_conf_rx_trk_mode_21_ku:long_name = "instrument
                                        configuration: tracking
                                        mode" ;
    flag_instr_conf_rx_trk_mode_21_ku:flag_values = 0b, 1b, 2b, 3b ;
    flag_instr_conf_rx_trk_mode_21_ku:flag_meanings = "unknown lrm sar
                                        sarin" ;
    flag_instr_conf_rx_trk_mode_21_ku:comment = "This flag indicates the
tracking mode of the SIRAL instrument - FBR SARin." ;
```

3.3.59 flag_instr_conf_rx_trk_mode_85_ku(time_85_ku)

```
byte flag_instr_conf_rx_trk_mode_85_ku(time_85_ku) ;
    flag_instr_conf_rx_trk_mode_85_ku:_FillValue = -128b ;
    flag_instr_conf_rx_trk_mode_85_ku:long_name = "instrument
                                        configuration: tracking
                                        mode" ;
    flag_instr_conf_rx_trk_mode_85_ku:flag_values = 0b, 1b, 2b, 3b ;
    flag_instr_conf_rx_trk_mode_85_ku:flag_meanings = "unknown lrm sar
                                        sarin" ;
    flag_instr_conf_rx_trk_mode_85_ku:comment = "This flag indicates the
tracking mode of the SIRAL instrument - FBR SAR." ;
```

3.3.60 flag_instr_mode_att_ctrl_20_ku(time_20_ku)

```
byte flag_instr_mode_att_ctrl_20_ku (time_20_ku) ;
    flag_instr_mode_att_ctrl_20_ku:_FillValue = -128b ;
    flag_instr_mode_att_ctrl_20_ku:long_name = "mode id: platform attitude
                                        control" ;
    flag_instr_mode_att_ctrl_20_ku:flag_values = 0b, 1b, 2b ;
    flag_instr_mode_att_ctrl_20_ku:flag_meanings = "unknown
                                        local_normal_pointing
                                        yaw_steering";
```

```
        flag_instr_mode_att_ctrl_20_ku:comment = "Platform attitude control
                                                 mode from instrument
                                                 configuration bits in L0." ;
```

3.3.61 flag_instr_mode_att_ctrl_21_ku(time_21_ku)

```
    byte flag_instr_mode_att_ctrl_21_ku (time_21_ku) ;
        flag_instr_mode_att_ctrl_21_ku:_FillValue = -128b ;
        flag_instr_mode_att_ctrl_21_ku:long_name = "mode id: platform attitude
                                                 control" ;
        flag_instr_mode_att_ctrl_21_ku:flag_values = 0b, 1b, 2b ;
        flag_instr_mode_att_ctrl_21_ku:flag_meanings = "unknown
                                                 local_normal_pointing
                                                 yaw_steering";
        flag_instr_mode_att_ctrl_21_ku:comment = "Platform attitude control
                                                 mode from instrument
                                                 configuration bits in L0." ;
```

3.3.62 flag_instr_mode_att_ctrl_85_ku(time_85_ku)

```
    byte flag_instr_mode_att_ctrl_85_ku (time_85_ku) ;
        flag_instr_mode_att_ctrl_85_ku:_FillValue = -128b ;
        flag_instr_mode_att_ctrl_85_ku:long_name = "mode id: platform attitude
                                                 control" ;
        flag_instr_mode_att_ctrl_85_ku:flag_values = 0b, 1b, 2b ;
        flag_instr_mode_att_ctrl_85_ku:flag_meanings = "unknown
                                                 local_normal_pointing
                                                 yaw_steering" ;
        flag_instr_mode_att_ctrl_85_ku:comment = "Platform attitude control
                                                 mode from instrument
                                                 configuration bits in L0." ;
```

3.3.63 flag_instr_mode_flags_20_ku(time_20_ku)

```
byte flag_instr_mode_flags_20_ku(time_20_ku) ;
    flag_instr_mode_flags_20_ku:_FillValue = -128b ;
    flag_instr_mode_flags_20_ku:long_name = "mode id - identifies the siral
                                            instrument measurement mode" ;
    flag_instr_mode_flags_20_ku:flag_masks =  2b, 1b ;
    flag_instr_mode_flags_20_ku:flag_meanings     =     "sarin_degraded_case
                                                   cal4_packet_detection";
    flag_instr_mode_flags_20_ku:comment  =  "Flags  related  to  sub-modes  of
                                          SARin    mode    from    instrument
                                          configuration bits in L0." ;
```

3.3.64 flag_instr_mode_flags_21_ku(time_21_ku)

```
byte flag_instr_mode_flags_21_ku(time_21_ku) ;
    flag_instr_mode_flags_21_ku:_FillValue = -128b ;
    flag_instr_mode_flags_21_ku:long_name = "mode id - identifies the siral
                                            instrument measurement mode" ;
    flag_instr_mode_flags_21_ku:flag_masks =  2b, 1b ;
    flag_instr_mode_flags_21_ku:flag_meanings     =     "sarin_degraded_case
                                                   cal4_packet_detection" ;
    flag_instr_mode_flags_21_ku:comment  =  "Flags  related  to  sub-modes  of
                                          SARin    mode    from    instrument
                                          configuration  bits  in  L0  -  FBR
                                          SARin." ;
```

3.3.65 flag_instr_mode_flags_85_ku(time_85_ku)

```
byte flag_instr_mode_flags_85_ku(time_85_ku) ;
    flag_instr_mode_flags_85_ku:_FillValue = -128b ;
    flag_instr_mode_flags_85_ku:long_name = "mode id - identifies the siral
                                            instrument measurement mode" ;
    flag_instr_mode_flags_85_ku:flag_masks =  2b, 1b ;
    flag_instr_mode_flags_85_ku:flag_meanings     =     "sarin_degraded_case
                                                 cal4_packet_detection";
    flag_instr_mode_flags_85_ku:comment  =  "Flags  related  to  sub-modes  of
                                          SARin    mode    from    instrument
                                          configuration  bits  in  L0  -  FBR
                                          SAR." ;
```

3.3.66 flag_instr_mode_op_20_ku(time_20_ku)

```
byte flag_instr_mode_op_20_ku(time_20_ku) ;
    flag_instr_mode_op_20_ku:_FillValue = -128b ;
    flag_instr_mode_op_20_ku:long_name  =  "mode  id  -  identifies  the  siral
                                        instrument measurement mode" ;
    flag_instr_mode_op_20_ku:flag_values = 1b, 2b, 3b ;
    flag_instr_mode_op_20_ku:flag_meanings = "lrm sar sarin" ;
    flag_instr_mode_op_20_ku:comment = "Instrument measurement mode derived
                                       from configuration bits in L0." ;
```

3.3.67 flag_instr_mode_op_21_ku(time_21_ku)

```
byte flag_instr_mode_op_21_ku(time_21_ku) ;
    flag_instr_mode_op_21_ku:_FillValue = -128b ;
    flag_instr_mode_op_21_ku:long_name  =  "mode  id  -  identifies  the  siral
                                        instrument measurement mode" ;
    flag_instr_mode_op_21_ku:flag_values = 1b, 2b, 3b ;
    flag_instr_mode_op_21_ku:flag_meanings = "lrm sar sarin" ;
    flag_instr_mode_op_21_ku:comment = "Instrument measurement mode derived
                                       from  configuration  bits  in  L0  -  FBR
                                       SARin." ;
```

3.3.68 flag_instr_mode_op_85_ku(time_85_ku)

```
byte flag_instr_mode_op_85_ku(time_85_ku) ;
    flag_instr_mode_op_85_ku:_FillValue = -128b ;
    flag_instr_mode_op_85_ku:long_name = "mode id - identifies the siral
                                         instrument measurement mode" ;
    flag_instr_mode_op_85_ku:flag_values = 1b, 2b, 3b ;
    flag_instr_mode_op_85_ku:flag_meanings = "lrm sar sarin" ;
    flag_instr_mode_op_85_ku:comment = "Instrument measurement mode derived
                                       from configuration bits in L0 - FBR
                                       SAR." ;
```

3.3.69 flag_mcd_20_ku(time_20_ku)

```
int flag_mcd_20_ku(time_20_ku) ;
    flag_mcd_20_ku:_FillValue = -1 ;
    flag_mcd_20_ku:long_name = "measurement confidence flags" ;
    flag_mcd_20_ku:flag_masks = -2147483648, 1073741824, 536870912,
                                268435456, 134217728, 67108864, 33554432,
                                16777216, 8388608, 4194304, 2097152,
                                1048576, 524288, 262144, 131072, 65536,
                                32768, 16384, 8192, 4096, 2048, 128, 64,
                                32, 16, 8, 1 ;
    flag_mcd_20_ku:flag_meanings = "block_degraded blank_block
                                datation_degraded orbit_prop_error
                                orbit_file_change orbit_gap echo_saturated
                                other_echo_error sarin_rx1_error
                                sarin_rx2_error window_delay_error
                                agc_error cal1_missing cal1_default
                                doris_uso_missing ccal1_default
                                trk_echo_error echo_rx1_error
                                echo_rx2_error npm_error cal1_pwr_corr_type
                                phase_pert_cor_missing cal2_missing
                                cal2_default power_scale_error
                                attitude_cor_missing
                                phase_pert_cor_default" ;
    flag_mcd_20_ku:comment = "Measurement confidence flags. Generally the
                            MCD flags indicate problems when set. If the
                            whole MCD is 0 then no problems or non-nominal
                            conditions were detected. Serious errors are
                            indicated by setting the most significant bit,
                            i.e. block_degraded, in which case the block
                            must not be processed. Other error settings can
                            be regarded as warnings." ;
```

3.3.70 flag_mcd_21_ku(time_21_ku)

```
int flag_mcd_21_ku(time_21_ku) ;
    flag_mcd_21_ku:_FillValue = -1 ;
    flag_mcd_21_ku:long_name = "measurement confidence flags" ;
    flag_mcd_21_ku:flag_masks = -2147483648, 1073741824, 536870912,
                                268435456, 134217728, 67108864, 33554432,
                                16777216, 8388608, 4194304, 2097152,
                                1048576, 524288, 262144, 131072, 65536,
                                32768, 16384, 8192, 4096, 2048, 128, 64,
                                32, 16, 8, 1 ;
    flag_mcd_21_ku:flag_meanings = "block_degraded blank_block
                                datation_degraded orbit_prop_error
                                orbit_file_change orbit_gap echo_saturated
                                other_echo_error sarin_rx1_error
                                sarin_rx2_error window_delay_error
                                agc_error cal1_missing cal1_default
                                doris_uso_missing ccal1_default
                                trk_echo_error echo_rx1_error
                                echo_rx2_error npm_error
                                azimuth_cal_missing phase_pert_cor_missing
                                cal2_missing cal2_default power_scale_error
                                attitude_cor_missing
                                phase_pert_cor_default" ;
    flag_mcd_21_ku:comment = "Measurement confidence flags. Generally the
                            MCD flags indicate problems when set. If the
                            whole MCD is 0 then no problems or non-nominal
                            conditions were detected. Serious errors are
                            indicated by setting the most significant bit,
                            i.e. block_degraded, in which case the block
                            must not be processed. Other error settings can
                            be regarded as warnings - FBR SARin." ;
```

3.3.71 flag_mcd_85_ku(time_85_ku)

```
int flag_mcd_85_ku(time_85_ku) ;
    flag_mcd_85_ku:_FillValue = -1 ;
    flag_mcd_85_ku:long_name = "measurement confidence flags" ;
    flag_mcd_85_ku:flag_masks = -2147483648, 1073741824, 536870912,
                                268435456, 134217728, 67108864, 33554432,
                                16777216, 8388608, 4194304, 2097152,
                                1048576, 524288, 262144, 131072, 65536,
                                32768, 16384, 8192, 4096, 2048, 128, 64,
                                32, 16, 8, 1 ;
    flag_mcd_85_ku:flag_meanings = "block_degraded blank_block
                                datation_degraded orbit_prop_error
                                orbit_file_change orbit_gap echo_saturated
                                other_echo_error sarin_rx1_error
                                sarin_rx2_error window_delay_error
                                agc_error cal1_missing cal1_default
                                doris_uso_missing ccal1_default
                                trk_echo_error echo_rx1_error
                                echo_rx2_error npm_error
                                azimuth_cal_missing phase_pert_cor_missing
                                cal2_missing cal2_default power_scale_error
                                attitude_cor_missing
                                phase_pert_cor_default" ;
    flag_mcd_85_ku:comment = "Measurement confidence flags. Generally the
                            MCD flags indicate problems when set. If the
                            whole MCD is 0 then no problems or non-nominal
                            conditions were detected. Serious errors are
                            indicated by setting the most significant bit,
                            i.e. block_degraded, in which case the block
                            must not be processed. Other error settings can
                            be regarded as warnings - FBR SAR." ;
```

3.3.72 flag_trk_cycle_20_ku(time_20_ku)

```
short flag_trk_cycle_20_ku(time_20_ku) ;
    flag_trk_cycle_20_ku:long_name = "trk cycle report (as extracted from
                                the L0)" ;
    flag_trk_cycle_20_ku:_FillValue =  -32768 ;
    flag_trk_cycle_20_ku: flag_values = 0s, 1s, 2s, 3s, 7s ;
    flag_trk_cycle_20_ku:flag_meanings     =     "no_errors     loss_of_echo
                           run_time_error            echo_saturation_error
                           unknown_error" ;
    flag_trk_cycle_20_ku:comment = "Flags for errors or information about
                             L1b 20Hz power waveform for LRM/FDM case." ;
```

3.3.73 h0_applied_20_ku(time_20_ku)

```
int h0_applied_20_ku(time_20_ku) ;
    h0_applied_20_ku:_FillValue = -2147483648 ;
    h0_applied_20_ku:units = "seconds" ;
    h0_applied_20_ku:long_name = "h0 initial height word" ;
    h0_applied_20_ku:add_offset = 0. ;
    h0_applied_20_ku:scale_factor = 4.88e-11 ;
    h0_applied_20_ku:comment  =  "The  H0  (initial  altitude  instruction)
            forwarded from telemetry." ;
```

3.3.74 h0_applied_21_ku(time_21_ku)

```
int h0_applied_21_ku(time_21_ku) ;
    h0_applied_21_ku:_FillValue = -2147483648 ;
    h0_applied_21_ku:units = "seconds" ;
    h0_applied_21_ku:long_name = "h0 initial height word" ;
    h0_applied_21_ku:add_offset = 0. ;
    h0_applied_21_ku:scale_factor = 4.88e-11 ;
    h0_applied_21_ku:comment  =  "The  H0  (initial  altitude  instruction)
            forwarded from telemetry - FBR SARin." ;
```

3.3.75 h0_applied_85_ku(time_85_ku)

```
int h0_applied_85_ku(time_85_ku) ;
    h0_applied_85_ku:_FillValue = -2147483648 ;
    h0_applied_85_ku:units = "seconds" ;
    h0_applied_85_ku:long_name = "h0 initial height word" ;
    h0_applied_85_ku:add_offset = 0. ;
    h0_applied_85_ku:scale_factor = 4.88e-11 ;
    h0_applied_85_ku:comment = "The H0 (initial altitude instruction)
            forwarded from telemetry - FBR SAR." ;
```

3.3.76 h0_fai_word_20_ku(time_20_ku)

```
int  h0_fai_word_20_ku(time_20_ku) ;
    h0_fai_word_20_ku:_FillValue = -2147483648 ;
    h0_fai_word_20_ku:units = "seconds" ;
    h0_fai_word_20_ku:long_name = "fine word fai" ;
    h0_fai_word_20_ku:add_offset = 0. ;
    h0_fai_word_20_ku:scale_factor = 4.88e-11 ;
    h0_fai_word_20_ku:comment = "This is the Fine Altitude Instruction
            (FAI), computed from H0 and COR2." ;
```

3.3.77 h0_fai_word_21_ku(time_21_ku)

```
int  h0_fai_word_21_ku(time_21_ku) ;
    h0_fai_word_21_ku:_FillValue = -2147483648 ;
    h0_fai_word_21_ku:units = "seconds" ;
    h0_fai_word_21_ku:long_name = "fine word fai" ;
    h0_fai_word_21_ku:add_offset = 0. ;
    h0_fai_word_21_ku:scale_factor = 4.88e-11 ;
    h0_fai_word_21_ku:comment = "This is the Fine Altitude Instruction
            (FAI), computed from H0 and COR2 - FBR SARin." ;
```

3.3.78 h0_fai_word_85_ku(time_85_ku)

```
int  h0_fai_word_85_ku(time_85_ku) ;
    h0_fai_word_85_ku:_FillValue = -2147483648 ;
    h0_fai_word_85_ku:units = "seconds" ;
    h0_fai_word_85_ku:long_name = "fine word fai" ;
    h0_fai_word_85_ku:add_offset = 0. ;
    h0_fai_word_85_ku:scale_factor = 4.88e-11 ;
    h0_fai_word_85_ku:comment = "This is the Fine Altitude Instruction
            (FAI), computed from H0 and COR2 - FBR SAR." ;
```

3.3.79 h0_lai_word_20_ku(time_20_ku)

```
int h0_lai_word_20_ku(time_20_ku) ;
    h0_lai_word_20_ku:_FillValue = -2147483648 ;
    h0_lai_word_20_ku:units = "seconds" ;
    h0_lai_word_20_ku:long_name = "coarse range word lai" ;
    h0_lai_word_20_ku:add_offset = 0. ;
    h0_lai_word_20_ku:scale_factor = 1.25e-08 ;
    h0_lai_word_20_ku:comment = "This is the Coarse Altitude Instruction
            (LAI), computed from H0 and COR2." ;
```

3.3.80 h0_lai_word_21_ku(time_21_ku)

```
int h0_lai_word_21_ku(time_21_ku) ;
    h0_lai_word_21_ku:_FillValue = -2147483648 ;
    h0_lai_word_21_ku:units = "seconds" ;
    h0_lai_word_21_ku:long_name = "coarse range word lai" ;
    h0_lai_word_21_ku:add_offset = 0. ;
    h0_lai_word_21_ku:scale_factor = 1.25e-08 ;
    h0_lai_word_21_ku:comment = "This is the Coarse Altitude Instruction
            (LAI), computed from H0 and COR2 - FBR SARin." ;
```

3.3.81 h0_lai_word_85_ku(time_85_ku)

```
int h0_lai_word_85_ku(time_85_ku) ;
    h0_lai_word_85_ku:_FillValue = -2147483648 ;
    h0_lai_word_85_ku:units = "seconds" ;
    h0_lai_word_85_ku:long_name = "coarse range word lai" ;
    h0_lai_word_85_ku:add_offset = 0. ;
    h0_lai_word_85_ku:scale_factor = 1.25e-08 ;
    h0_lai_word_85_ku:comment = "This is the Coarse Altitude Instruction
            (LAI), computed from H0 and COR2 - FBR SAR." ;
```

3.3.82 hf_fluct_total_cor_01(time_cor_01)

```
int hf_fluct_total_cor_01(time_cor_01) ;
    hf_fluct_total_cor_01:_FillValue = -2147483648 ;
    hf_fluct_total_cor_01:units = "m" ;
    hf_fluct_total_cor_01:long_name = "1-way dynamic atmospheric
correction" ;
    hf_fluct_total_cor_01:standard_name =
"sea_surface_height_correction_due_to_air_pressure_and_wind_at_high_frequency" ;
    hf_fluct_total_cor_01:add_offset = 0. ;
    hf_fluct_total_cor_01:scale_factor = 0.001 ;
    hf_fluct_total_cor_01:comment = "High frequency fluctuations of the sea
                    surface topography due to high frequency air
                    pressure and wind effects. Also known as DAC
                    (Dynamical Atmospheric Correction). This 1-way
                    correction is computed at the altimeter
                    [time_cor_01] time-tag from the interpolation of 2
                    meteorological fields that surround the altimeter
                    time-tag. The inverse barometric correction
                    [inv_bar_cor_01] is included in this field. This
                    correction has been accounted for during the
                    computation of height (see [flag_height_20_ku] to
                    determine if it was applied) in order to account
                    for both the depression of the ocean surface caused
                    by the local barometric pressure and the high-
                    frequency effects caused by wind forcing. This
                    correction is an alternative to [inv_bar_cor_01]
                    and therefore only one should be used." ;
    hf_fluct_total_cor_01:source = "2.1.0" ;
    hf_fluct_total_cor_01:institution = "LEGOS/CLS/CNES" ;
```

3.3.83 instr_cor_gain_rx_20_ku(time_20_ku)

```
int instr_cor_gain_rx_20_ku(time_20_ku) ;
    instr_cor_gain_rx_20_ku:_FillValue = -2147483648 ;
    instr_cor_gain_rx_20_ku:units = "dB" ;
    instr_cor_gain_rx_20_ku:long_name = "instrument gain correction (rx
                                        only chain)" ;
    instr_cor_gain_rx_20_ku:add_offset = 0. ;
    instr_cor_gain_rx_20_ku:scale_factor = 0.01 ;
    instr_cor_gain_rx_20_ku:comment = "Instrument Gain Correction (Rx only
              chain). It includes the power variation from CAL1 and the
              AGC calibration values." ;
```

3.3.84 instr_cor_gain_rx_21_ku(time_21_ku)

```
int instr_cor_gain_rx_21_ku(time_21_ku) ;
    instr_cor_gain_rx_21_ku:_FillValue = -2147483648 ;
    instr_cor_gain_rx_21_ku:units = "dB" ;
    instr_cor_gain_rx_21_ku:long_name = "instrument gain correction (rx
                                        only chain)" ;
    instr_cor_gain_rx_21_ku:add_offset = 0. ;
    instr_cor_gain_rx_21_ku:scale_factor = 0.01 ;
    instr_cor_gain_rx_21_ku:comment = "Instrument Gain Correction (Rx only
              chain). It includes the power variation from CAL1 and the
              AGC calibration values - FBR SARin." ;
```

3.3.85 instr_cor_gain_rx_85_ku(time_85_ku)

```
int instr_cor_gain_rx_85_ku(time_85_ku) ;
    instr_cor_gain_rx_85_ku:_FillValue = -2147483648;
    instr_cor_gain_rx_85_ku:units = "dB" ;
    instr_cor_gain_rx_85_ku:long_name = "instrument gain correction (rx
                                        only chain)" ;
    instr_cor_gain_rx_85_ku:add_offset = 0. ;
    instr_cor_gain_rx_85_ku:scale_factor = 0.01 ;
    instr_cor_gain_rx_85_ku:comment = "Instrument Gain Correction (Rx only
              chain). It includes the power variation from CAL1 and the
              AGC calibration values - FBR SAR." ;
```

3.3.86 instr_cor_gain_tx_rx_20_ku(time_20_ku)

```
int instr_cor_gain_tx_rx_20_ku(time_20_ku) ;
    instr_cor_gain_tx_rx_20_ku:_FillValue = -2147483648 ;
    instr_cor_gain_tx_rx_20_ku:units = "dB" ;
    instr_cor_gain_tx_rx_20_ku:long_name = "instrument gain correction (tx-
                                          rx chain)" ;
    instr_cor_gain_tx_rx_20_ku:add_offset = 0. ;
    instr_cor_gain_tx_rx_20_ku:scale_factor = 0.01 ;
    instr_cor_gain_tx_rx_20_ku:comment = "Instrument Gain Correction (Tx-Rx
              chain. It includes the power variation from CAL1 and the AGC
              calibration values." ;
```

3.3.87 instr_cor_gain_tx_rx_21_ku(time_21_ku)

```
int instr_cor_gain_tx_rx_21_ku(time_21_ku) ;
    instr_cor_gain_tx_rx_21_ku:_FillValue = -2147483648 ;
    instr_cor_gain_tx_rx_21_ku:units = "dB" ;
    instr_cor_gain_tx_rx_21_ku:long_name = "instrument gain correction (tx-
                                        rx chain)" ;
    instr_cor_gain_tx_rx_21_ku:add_offset = 0. ;
    instr_cor_gain_tx_rx_21_ku:scale_factor = 0.01 ;
    instr_cor_gain_tx_rx_21_ku:comment = "Instrument Gain Correction (Tx-Rx
            chain). It includes the power variation from CAL1 and the
            AGC calibration values - FBR SARin." ;
```

3.3.88 instr_cor_gain_tx_rx_85_ku(time_85_ku)

```
int instr_cor_gain_tx_rx_85_ku(time_85_ku) ;
    instr_cor_gain_tx_rx_85_ku:_FillValue = -2147483648 ;
    instr_cor_gain_tx_rx_85_ku:units = "dB" ;
    instr_cor_gain_tx_rx_85_ku:long_name = "instrument gain correction (tx-
                                        rx chain)" ;
    instr_cor_gain_tx_rx_85_ku:add_offset = 0. ;
    instr_cor_gain_tx_rx_85_ku:scale_factor = 0.01 ;
    instr_cor_gain_tx_rx_85_ku:comment = "Instrument Gain Correction (Tx-Rx
            chain). It includes the power variation from CAL1 and the
            AGC calibration values - FBR SAR." ;
```

3.3.89 instr_cor_range_rx_20_ku(time_20_ku)

```
int instr_cor_range_rx_20_ku(time_20_ku) ;
    instr_cor_range_rx_20_ku:_FillValue = -2147483648 ;
    instr_cor_range_rx_20_ku:units = "m" ;
    instr_cor_range_rx_20_ku:long_name = "2-way instrument range correction
                                        (rx only chain)" ;
    instr_cor_range_rx_20_ku:add_offset = 0. ;
    instr_cor_range_rx_20_ku:scale_factor = 0.001 ;
    instr_cor_range_rx_20_ku:comment = "2-way instrument Range Correction
               (Rx only chain). It includes: the internal path delay from
               CAL1, the external group delay from ground characterisation
               and  the vertical component of CoM – Antenna distance." ;
```

3.3.90 instr_cor_range_rx_21_ku(time_21_ku)

```
int instr_cor_range_rx_21_ku(time_21_ku) ;
    instr_cor_range_rx_21_ku:_FillValue = -2147483648 ;
    instr_cor_range_rx_21_ku:units = "m" ;
    instr_cor_range_rx_21_ku:long_name = "2-way instrument range correction
                                        (rx only chain)" ;
    instr_cor_range_rx_21_ku:add_offset = 0. ;
    instr_cor_range_rx_21_ku:scale_factor = 0.001 ;
    instr_cor_range_rx_21_ku:comment = "2-way instrument Range Correction
               (Rx only chain). It includes: the internal path delay from
               CAL1, the external group delay from ground characterisation
               and the vertical component of the CoM – Antenna distance -
               FBR SARin." ;
```

3.3.91 instr_cor_range_rx_85_ku(time_85_ku)

```
int instr_cor_range_rx_85_ku(time_85_ku) ;
    instr_cor_range_rx_85_ku:_FillValue = -2147483648 ;
    instr_cor_range_rx_85_ku:units = "m" ;
    instr_cor_range_rx_85_ku:long_name = "2-way instrument range correction
                                        (rx only chain)" ;
    instr_cor_range_rx_85_ku:add_offset = 0. ;
    instr_cor_range_rx_85_ku:scale_factor = 0.001 ;
    instr_cor_range_rx_85_ku:comment = "2-way instrument Range Correction
               (Rx only chain). It includes: the internal path delay from
               CAL1, the external group delay from ground characterisation
               and the vertical component of the CoM – Antenna distance -
               FBR SAR." ;
```

3.3.92 instr_cor_range_tx_rx_20_ku(time_20_ku)

```
int instr_cor_range_tx_rx_20_ku(time_20_ku) ;
    instr_cor_range_tx_rx_20_ku:_FillValue = -2147483648 ;
    instr_cor_range_tx_rx_20_ku:units = "m" ;
    instr_cor_range_tx_rx_20_ku:long_name = "2-way instrument range
                                        correction (tx-rx chain)" ;
    instr_cor_range_tx_rx_20_ku:add_offset = 0. ;
    instr_cor_range_tx_rx_20_ku:scale_factor = 0.001 ;
    instr_cor_range_tx_rx_20_ku:comment = "Instrument Range Correction (Tx-
               Rx chain) - Calibration correction to range on channel 1
               applied at L1B. It includes the internal path delay from
               CAL1, the external group delay from ground characterisation
               and the CoM – Antenna distance." ;
```

3.3.93 instr_cor_range_tx_rx_21_ku(time_21_ku)

```
int instr_cor_range_tx_rx_21_ku(time_21_ku) ;
    instr_cor_range_tx_rx_21_ku:_FillValue = -2147483648 ;
    instr_cor_range_tx_rx_21_ku:units = "m" ;
    instr_cor_range_tx_rx_21_ku:long_name = "2-way instrument range
                                           correction (tx-rx chain)" ;
    instr_cor_range_tx_rx_21_ku:add_offset = 0. ;
    instr_cor_range_tx_rx_21_ku:scale_factor = 0.001 ;
    instr_cor_range_tx_rx_21_ku:comment = "Instrument Range Correction (Tx-
              Rx chain) - Calibration correction to range on channel 1
              applied at L1B. It includes the internal path delay from
              CAL1, the external group delay from ground characterisation
              and the CoM – Antenna distance - FBR SARin." ;
```

3.3.94 instr_cor_range_tx_rx_85_ku(time_85_ku)

```
int instr_cor_range_tx_rx_85_ku(time_85_ku) ;
    instr_cor_range_tx_rx_85_ku:_FillValue = -2147483648 ;
    instr_cor_range_tx_rx_85_ku:units = "m" ;
    instr_cor_range_tx_rx_85_ku:long_name = "2-way instrument range
                                           correction (tx-rx chain)" ;
    instr_cor_range_tx_rx_85_ku:add_offset = 0. ;
    instr_cor_range_tx_rx_85_ku:scale_factor = 0.001 ;
    instr_cor_range_tx_rx_85_ku:comment = "Instrument Range Correction (Tx-
              Rx chain) - Calibration correction to range on channel 1
              applied at L1B. It includes the internal path delay from
              CAL1, the external group delay from ground characterisation
              and the CoM – Antenna distance - FBR SAR." ;
```

3.3.95 instr_ext_ph_cor_20_ku(time_20_ku)

```
int instr_ext_ph_cor_20_ku(time_20_ku) ;
    instr_ext_ph_cor_20_ku:_FillValue = -2147483648 ;
    instr_ext_ph_cor_20_ku:units = "rad" ;
    instr_ext_ph_cor_20_ku:long_name = "external phase correction taken from
                                the ipfdb file" ;
    instr_ext_ph_cor_20_ku:add_offset = 0. ;
    instr_ext_ph_cor_20_ku:scale_factor = 1.e-06 ;
    instr_ext_ph_cor_20_ku:comment = "External phase correction taken from
                                the IPFDB file (SARin only) to be added
                                to the internal phase correction term.
                                The external phase correction is the
                                temperature-averaged component of
                                external inter-channel phase difference
                                derived from phase difference sensitive
                                antenna subsystem, waveguides and
                                instrument waveguide switches. The
                                external phase correction doesn't
                                contain internal instrument effects of
                                calibration coupler and duplexer which
                                are included in the internal phase
                                difference correction." ;
```

3.3.96 instr_ext_ph_cor_21_ku(time_21_ku)

```
int instr_ext_ph_cor_21_ku(time_21_ku) ;
    instr_ext_ph_cor_21_ku:_FillValue = -2147483648 ;
    instr_ext_ph_cor_21_ku:units = "rad" ;
    instr_ext_ph_cor_21_ku:long_name = "external phase correction taken from
                                the ipfdb file" ;
    instr_ext_ph_cor_21_ku:add_offset = 0. ;
    instr_ext_ph_cor_21_ku:scale_factor = 1.e-06 ;
    instr_ext_ph_cor_21_ku:comment = "External phase correction taken from
                                the IPFDB file (SARin only) to be added
                                to the internal phase correction term.
                                The external phase correction is the
                                temperature-averaged component of
                                external inter-channel phase difference
                                derived from phase difference sensitive
                                antenna subsystem, waveguides and
                                instrument waveguide switches. The
                                external phase correction doesn't
                                contain internal instrument effects of
                                calibration coupler and duplexer which
                                are included in the internal phase
                                difference correction - FBR SARin." ;
```

3.3.97 instr_int_ph_cor_20_ku(time_20_ku)

```
int instr_int_ph_cor_20_ku(time_20_ku) ;
    instr_int_ph_cor_20_ku:_FillValue = -2147483648 ;
    instr_int_ph_cor_20_ku:units = "rad" ;
    instr_int_ph_cor_20_ku:long_name = "internal phase correction computed
                                from the cal-4" ;
    instr_int_ph_cor_20_ku:add_offset = 0. ;
    instr_int_ph_cor_20_ku:scale_factor = 1.e-06 ;
    instr_int_ph_cor_20_ku:comment = "Internal phase correction computed
                                from the CAL-4 packets during the
                                azimuth impulse response amplitude
                                (SARin only). It is set from the latest
                                available CAL-4 packet." ;
```

3.3.98 instr_int_ph_cor_21_ku(time_21_ku)

```
int instr_int_ph_cor_21_ku(time_21_ku) ;
    instr_int_ph_cor_21_ku:_FillValue = -2147483648 ;
    instr_int_ph_cor_21_ku:units = "rad" ;
    instr_int_ph_cor_21_ku:long_name = "internal phase correction computed
                                from the cal-4" ;
    instr_int_ph_cor_21_ku:add_offset = 0. ;
    instr_int_ph_cor_21_ku:scale_factor = 1.e-06 ;
    instr_int_ph_cor_21_ku:comment = "Internal phase correction computed
                                from the CAL-4 packets during the
                                azimuth impulse response amplitude
                                (SARin only). It is set from the latest
                                available CAL-4 packet - FBR SARin." ;
```

3.3.99 inter_base_vec_20_ku(time_20_ku,space_3d)

```
int inter_base_vec_20_ku(time_20_ku, space_3d) ;
    inter_base_vec_20_ku:_FillValue = -2147483648 ;
    inter_base_vec_20_ku:units = "m" ;
    inter_base_vec_20_ku:long_name = "interferometric baseline direction
                                      vector in crf" ;
    inter_base_vec_20_ku:add_offset = 0. ;
    inter_base_vec_20_ku:scale_factor = 1.e-06 ;
    inter_base_vec_20_ku:comment = "Interferometer baseline direction
                                   vector. This is the direction vector
                                   from Tx-Rx antenna reference point to
                                   Rx only antenna reference point
                                   described in the CryoSat Reference
                                   Frame. The 3 components are given
                                   according to the 'space_3d' dimension:
                                   [1] x, [2] y, [3] z." ;
```

3.3.100 inter_base_vec_21_ku(time_21_ku,space_3d)

```
int inter_base_vec_21_ku(time_21_ku, space_3d) ;
    inter_base_vec_21_ku:_FillValue = -2147483648 ;
    inter_base_vec_21_ku:units = "m" ;
    inter_base_vec_21_ku:long_name = "interferometric baseline direction
                                      vector in crf" ;
    inter_base_vec_21_ku:add_offset = 0. ;
    inter_base_vec_21_ku:scale_factor = 1.e-06 ;
    inter_base_vec_21_ku:comment = "Interferometric Baseline direction
                                   vector. This is the direction vector
                                   from Tx-Rx antenna reference point to
                                   Rx only antenna reference point
                                   described in the CryoSat Reference
                                   Frame. The 3 components are given
                                   according to the 'space_3d' dimension:
                                   [1] x, [2] y, [3] z - FBR SARin." ;
```

3.3.101 inter_base_vec_85_ku(time_85_ku,space_3d)

```
int inter_base_vec_85_ku(time_85_ku, space_3d) ;
    inter_base_vec_85_ku:_FillValue = -2147483648 ;
    inter_base_vec_85_ku:units = "m" ;
    inter_base_vec_85_ku:long_name = "interferometric baseline direction
                                      vector in crf" ;
    inter_base_vec_85_ku:add_offset = 0. ;
    inter_base_vec_85_ku:scale_factor = 1.e-06 ;
    inter_base_vec_85_ku:comment = "Interferometric Baseline direction
                                   vector. This is the direction vector
                                   from Tx-Rx antenna reference point to
                                   Rx only antenna reference point
                                   described in the CryoSat Reference
                                   Frame. The 3 components are given
                                   according to the 'space_3d' dimension:
                                   [1] x, [2] y, [3] z - FBR SAR." ;
```

3.3.102 inv_bar_cor_01(time_cor_01)

```
int inv_bar_cor_01(time_cor_01) ;
    inv_bar_cor_01:_FillValue = -2147483648;
    inv_bar_cor_01:units = "m" ;
    inv_bar_cor_01:long_name = "inverse barometric correction (1-way)";
    inv_bar_cor_01:standard_name =
"sea_surface_height_correction_due_to_air_pressure_at_low_frequency" ;
    inv_bar_cor_01:add_offset = 0. ;
    inv_bar_cor_01:scale_factor = 0.001 ;
    inv_bar_cor_01:comment = "Inverse Barometric Correction. This 1-way
                             correction is computed at the altimeter
                             [time_cor_01] time-tag from the
                             interpolation of 2 meteorological
                             fields that surround the altimeter
                             time-tag. This correction has been
                             accounted for during the computation of
                             height (see [flag_height_20_ku] to
                             determine if it was applied) in order
                             to correct this range measurement for
                             the depression of the ocean surface
                             caused by the local barometric
                             pressure. This correction is an
                             alternative to [hf_fluct_total_cor_01]
                             and only one should be used. (1-way
                             correction)." ;
    inv_bar_cor_01:source = "European Center for Medium Range Weather
                             Forecasting" ;
    inv_bar_cor_01:institution = "ECMWF" ;
```

3.3.103 iono_cor_01(time_cor_01)

```
int iono_cor_01(time_cor_01) ;
    iono_cor_01:_FillValue = -2147483648 ;
    iono_cor_01:units = "m" ;
    iono_cor_01:long_name = "model ionospheric correction (1-way)" ;
    iono_cor_01:standard_name                                          =
"altimeter_range_correction_due_to_ionosphere" ;
    iono_cor_01:add_offset = 0. ;
    iono_cor_01:scale_factor = 0.001 ;
    iono_cor_01:comment = "Model Ionospheric Correction. This 1-way
                correction has been accounted for during the computation
                of height (see [flag_height_20_ku] to determine if it was
                applied) in order to correct this range measurement for
                ionospheric range delays of the radar pulse. This
                correction is an alternative to [iono_cor_gim_01_ku] and
                only one should be used. See S. K. Llewellyn, R. B. Bent,
                A. S. C. I. H. B. FL, U. S. N. T. I. Service, Space and
                Missile Systems Organization (U.S.), Documentation and
                Description of the Bent Ionospheric Model. U.S.
                Department of Commerce, National Technical Information
                Service, 1973." ;
    iono_cor_01:source = "Bent" ;
    iono_cor_01:institution = "Bent" ;
```

3.3.104 iono_cor_gim_01(time_cor_01)

```
int iono_cor_gim_01(time_cor_01) ;
    iono_cor_gim_01:_FillValue = -2147483648 ;
    iono_cor_gim_01:units = "m" ;
    iono_cor_gim_01:long_name = "gim ionospheric correction (1-way)" ;
    iono_cor_gim_01:standard_name                                    =
"altimeter_range_correction_due_to_ionosphere" ;
    iono_cor_gim_01:add_offset = 0. ;
    iono_cor_gim_01:scale_factor = 0.001 ;
    iono_cor_gim_01:comment  =  "GIM  Ionospheric  Correction.  This  1-way
                                 correction has been accounted for during
                                 the  computation  of  height  (see
                                 [flag_height_20_ku]  to  determine  if  it
                                 was  applied)  in  order  to  correct  this
                                 range  measurement  for  ionospheric  range
                                 delays  of  the  radar  pulse.  This
                                 correction  is  an  alternative  to
                                 [iono_cor_01_ku] and only one should be
                                 used." ;
    iono_cor_gim_01:source = "[TBD GIM version]" ;
    iono_cor_gim_01:institution = "NASA/JPL" ;
```

3.3.105 lat_20_ku(time_20_ku)

```
int lat_20_ku(time_20_ku) ;
    lat_20_ku:units = "degrees_north" ;
    lat_20_ku:_FillValue = -2147483648 ;
    lat_20_ku:long_name = "20 Hz latitude" ;
    lat_20_ku:standard_name = "latitude" ;
    lat_20_ku:scale_factor = 1.e-07 ;
    lat_20_ku:add_offset = 0. ;
    lat_20_ku:comment = "Latitude of nadir location [-90,+90]. Positive
                        latitude is North latitude, negative latitude is
                        South latitude. Note the scale factor." ;
```

3.3.106 lat_21_ku(time_21_ku)

```
int lat_21_ku(time_21_ku) ;
    lat_21_ku:units = "degrees_north" ;
    lat_21_ku:_FillValue = -2147483648 ;
    lat_21_ku:long_name = "20 Hz latitude" ;
    lat_21_ku:standard_name = "latitude" ;
    lat_21_ku:scale_factor = 1.e-07 ;
    lat_21_ku:add_offset = 0. ;
    lat_21_ku:comment = "Latitude of nadir location [-90,+90]. Positive
                        latitude is North latitude, negative latitude is
                        South latitude. Note the scale factor - FBR
                        SARin." ;
```

3.3.107 lat_85_ku(time_85_ku)

```
int lat_85_ku(time_85_ku) ;
    lat_85_ku:units = "degrees_north" ;
    lat_85_ku:_FillValue = -2147483648 ;
    lat_85_ku:long_name = "20 Hz latitude" ;
    lat_85_ku:standard_name = "latitude" ;
    lat_85_ku:scale_factor = 1.e-07 ;
    lat_85_ku:add_offset = 0. ;
    lat_85_ku:comment = "Latitude of nadir location [-90,+90]. Positive
                        latitude is North latitude, negative latitude is
                        South latitude. Note the scale factor - FBR
                        SAR." ;
```

3.3.108 lat_avg_01_ku(time_avg_01_ku)

```
int lat_avg_01_ku(time_avg_01_ku) ;
    lat_avg_01_ku:_FillValue = -2147483648 ;
    lat_avg_01_ku:units = "degrees_north" ;
    lat_avg_01_ku:long_name = "latitude of measurement" ;
    lat_avg_01_ku:standard_name = "latitude" ;
    lat_avg_01_ku:add_offset = 0. ;
    lat_avg_01_ku:scale_factor = 1.e-07 ;
    lat_avg_01_ku:comment = "Latitude of nadir location [-90,+90]. Positive
                latitude is North latitude, negative latitude is South
                latitude. Note the scale factor." ;
```

3.3.109 load_tide_01(time_cor_01)

```
int load_tide_01(time_cor_01) ;
    load_tide_01:_FillValue = -2147483648 ;
    load_tide_01:units = "m" ;
    load_tide_01:long_name = "ocean loading tide (1-way)" ;
    load_tide_01:add_offset = 0. ;
    load_tide_01:scale_factor = 0.001 ;
    load_tide_01:comment = "Ocean loading tide. This 1-way correction has
           been accounted for during the computation of height (see
           [flag_height_20_ku] to determine if it was applied) to remove
           the effect of local tidal distortion to the Earth's crust,
           caused by increasing weight of ocean as local water tide rises."
           ;
    load_tide_01:source = "FES2004" ;
    load_tide_01:institution = "GSFC" ;
```

3.3.110 lon_20_ku(time_20_ku)

```
int lon_20_ku (time_20_ku) ;
    lon_20_ku:units = "degrees_east" ;
    lon_20_ku:_FillValue = -2147483648 ;
    lon_20_ku:long_name = "20 Hz longitude" ;
    lon_20_ku:standard_name = "longitude" ;
    lon_20_ku:scale_factor = 1.e-07 ;
    lon_20_ku:add_offset = 0. ;
    lon_20_ku:comment = "Longitude of nadir location [-180,+180]. Positive
                         at East. East longitude relative to Greenwich
                         meridian. Note the scale factor." ;
```

3.3.111 lon_21_ku(time_21_ku)

```
int lon_21_ku (time_21_ku) ;
    lon_21_ku:units = "degrees_east" ;
    lon_21_ku:_FillValue = -2147483648 ;
    lon_21_ku:long_name = "20 Hz longitude" ;
    lon_21_ku:standard_name = "longitude" ;
    lon_21_ku:scale_factor = 1.e-07 ;
    lon_21_ku:add_offset = 0. ;
    lon_21_ku:comment = " Longitude of nadir location [-180,+180]. Positive
                        at East East longitude relative to Greenwich
                        meridian. Note the scale factor - FBR SARin." ;
```

3.3.112 lon_85_ku(time_85_ku)

```
int lon_85_ku (time_85_ku) ;
    lon_85_ku:units = "degrees_east" ;
    lon_85_ku:_FillValue = -2147483648 ;
    lon_85_ku:long_name = "20 Hz longitude" ;
    lon_85_ku:standard_name = "longitude" ;
    lon_85_ku:scale_factor = 1.e-07 ;
    lon_85_ku:add_offset = 0. ;
    lon_85_ku:comment = " Longitude of nadir location [-180,+180]. Positive
                        at East East longitude relative to Greenwich
                        meridian. Note the scale factor - FBR SAR." ;
```

3.3.113 lon_avg_01_ku(time_avg_01_ku)

```
int lon_avg_01_ku(time_avg_01_ku) ;
    lon_avg_01_ku:_FillValue = -2147483648 ;
    lon_avg_01_ku:units = "degrees_east" ;
    lon_avg_01_ku:long_name = "longitude of measurement" ;
    lon_avg_01_ku:standard_name = "longitude" ;
    lon_avg_01_ku:add_offset = 0. ;
    lon_avg_01_ku:scale_factor = 1.e-07 ;
    lon_avg_01_ku:comment = "Longitude of nadir location [-180,+180].
            Positive at East. East longitude relative to Greenwich
            meridian. Note the scale factor." ;
```

3.3.114 look_angle_start_20_ku(time_20_ku)

```
int look_angle_start_20_ku(time_20_ku) ;
    look_angle_start_20_ku:_FillValue = -2147483648 ;
    look_angle_start_20_ku:units = "rad" ;
    look_angle_start_20_ku:long_name = "look angle start" ;
    look_angle_start_20_ku:add_offset = 0. ;
    look_angle_start_20_ku:scale_factor = 1.e-07 ;
    look_angle_start_20_ku:comment = "Value of Look Angle for the first
            single look echo in the stack. It is the angle between: (a)
            nadir direction from the satellite CoM to the surface, (b)
            direction satellite - surface location. The look angle depends
            purely on geometry." ;
```

3.3.115 look_angle_stop_20_ku(time_20_ku)

```
int look_angle_stop_20_ku(time_20_ku) ;
    look_angle_stop_20_ku:_FillValue = -2147483648 ;
    look_angle_stop_20_ku:units = "rad" ;
    look_angle_stop_20_ku:long_name = " look angle stop" ;
    look_angle_stop_20_ku:add_offset = 0. ;
    look_angle_stop_20_ku:scale_factor = 1.e-07 ;
    look_angle_stop_20_ku:comment = "Value of Look Angle for the last
              single look echo in the stack.  It is the angle between: (a)
              nadir direction from the satellite CoM to the surface, (b)
              direction satellite - surface location. The look angle
              depends purely on geometry." ;
```

3.3.116 mod_dry_tropo_cor_01(time_cor_01)

```
int mod_dry_tropo_cor_01(time_cor_01) ;
    mod_dry_tropo_cor_01:_FillValue = -2147483648 ;
    mod_dry_tropo_cor_01:units = "m" ;
    mod_dry_tropo_cor_01:long_name = "dry tropospheric correction (1-way)"
;
    mod_dry_tropo_cor_01:standard_name                                    =
"altimeter_range_correction_due_to_dry_troposphere" ;
    mod_dry_tropo_cor_01:add_offset = 0. ;
    mod_dry_tropo_cor_01:scale_factor = 0.001 ;
    mod_dry_tropo_cor_01:comment = "Dry Tropospheric Correction. This 1-way
                                   correction is computed at the
                                   [time_cor_01] altimeter time-tag from the
                                   interpolation of 2 meteorological fields
                                   that surround the altimeter time-tag.
                                   This correction has been accounted for
                                   during the computation of height (see
                                   [flag_height_20_ku] to determine if it
                                   was applied) in order to correct for the
                                   propagation delay to the radar pulse,
                                   caused by the dry-gas component of the
                                   Earth's atmosphere." ;
    mod_dry_tropo_cor_01:source = "European Center for Medium Range Weather
                                   Forecasting" ;
    mod_dry_tropo_cor_01:institution = "ECMWF" ;
```

3.3.117 mod_wet_tropo_cor_01(time_cor_01)

```
int mod_wet_tropo_cor_01(time_cor_01) ;
    mod_wet_tropo_cor_01:_FillValue = -2147483648 ;
    mod_wet_tropo_cor_01:units = "m" ;
    mod_wet_tropo_cor_01:long_name = "wet tropospheric correction (1-way)"
;
    mod_wet_tropo_cor_01:standard_name =
"altimeter_range_correction_due_to_wet_troposphere" ;
    mod_wet_tropo_cor_01:add_offset = 0.0 ;
    mod_wet_tropo_cor_01:scale_factor = 0.001 ;
    mod_wet_tropo_cor_01:comment = "Wet Tropospheric Correction. This 1-way
                                   correction is computed at the time_cor_01
                                   altimeter time-tag from the interpolation
                                   of 2 meteorological fields that surround
                                   the altimeter time-tag. This correction has
                                   been accounted for during the computation
                                   of height (see [flag_height_20_ku] to
                                   determine if it was applied) in order to
                                   correct for the propagation delay to the
                                   radar pulse, caused by the H~2~O component
                                   of the Earth's atmosphere." ;
    mod_wet_tropo_cor_01:source = "European Center for Medium Range Weather
                                   Forecasting" ;
    mod_wet_tropo_cor_01:institution = "ECMWF" ;
```

3.3.118 noise_power_20_ku(time_20_ku)

```
int noise_power_20_ku(time_20_ku) ;
    noise_power_20_ku:_FillValue = -2147483648 ;
    noise_power_20_ku:units = "dB" ;
    noise_power_20_ku:long_name = "noise power measurement" ;
    noise_power_20_ku:add_offset = 0.0 ;
    noise_power_20_ku:scale_factor = 0.01 ;
    noise_power_20_ku:comment = "Noise power measurement to be the noise
            floor of measurement echoes. In SAR/SARin it is estimated on
            the L1b 20Hz multilooked power waveform. In LRM it is
            converted from telemetry units and scaled according to the
            proper AGC value. This field is set to the default value
            equal to -9999.99 when the telemetry contains zero." ;
```

3.3.119 noise_power_21_ku(time_21_ku)

```
int noise_power_21_ku(time_21_ku) ;
    noise_power_21_ku:_FillValue = -2147483648 ;
    noise_power_21_ku:units = "dB" ;
    noise_power_21_ku:long_name = "noise power measurement" ;
    noise_power_21_ku:add_offset = 0.0 ;
    noise_power_21_ku:scale_factor = 0.01 ;
    noise_power_21_ku:comment = "Noise power measurement to be the noise
            floor of FBR measurement echoes. In SARin it is estimated on
            the L1b 20Hz multilooked power waveform. This field is set to
            the default value equal to -9999.99 when the telemetry
            contains zero - FBR SARin." ;
```

3.3.120 noise_power_85_ku(time_85_ku)

```
int noise_power_85_ku(time_85_ku) ;
    noise_power_85_ku:_FillValue = -2147483648 ;
    noise_power_85_ku:units = "dB" ;
    noise_power_85_ku:long_name = "noise power measurement" ;
    noise_power_85_ku:add_offset =  0.0 ;
    noise_power_85_ku:scale_factor = 0.01 ;
    noise_power_85_ku:comment = "Noise power to be the noise floor of FBR
            measurement echoes. In SAR it is estimated on the L1b 20Hz
            multilooked power waveform. This field is set to the default
            value equal to -9999.99 when the telemetry contains zero -
            FBR SAR." ;
```

3.3.121 ocean_tide_01(time_cor_01)

```
int ocean_tide_01(time_cor_01) ;
    ocean_tide_01:_FillValue = -2147483648 ;
    ocean_tide_01:units = "m" ;
    ocean_tide_01:long_name = "elastic ocean tide (1-way)" ;
    ocean_tide_01:standard_name                                    =
"sea_surface_height_amplitude_due_to_geocentric_ocean_tide" ;
    ocean_tide_01:add_offset = 0. ;
    ocean_tide_01:scale_factor = 0.001 ;
    ocean_tide_01:comment = "Ocean Tide. This 1-way correction has been
                accounted for during the computation of height (see
                [flag_height_20_ku] to determine if it was applied) to
                remove the effect of local tide and adjust the measurement
                to the mean sea surface. This is the pure ocean tide, not
                including the corresponding loading tide [load_tide_01] or
                the equilibrium long-period ocean tide height
                [ocean_tide_eq_01]. The permanent tide (zero frequency) is
                not included in this parameter because it is included in
                the geoid [geoid_01] and mean sea surface
                [mean_sea_surf_sea_ice_01]." ;
    ocean_tide_01:source = "FES2004" ;
    ocean_tide_01:institution = "LEGOS/CNES" ;
```

3.3.122 ocean_tide_eq_01(time_cor_01)

```
int ocean_tide_eq_01(time_cor_01) ;
    ocean_tide_eq_01:_FillValue = -2147483648 ;
    ocean_tide_eq_01:units = "m" ;
    ocean_tide_eq_01:long_name = "long period ocean tide (1-way)" ;
    ocean_tide_eq_01:standard_name                                    =
"sea_surface_height_amplitude_due_to_equilibrium_ocean_tide" ;
    ocean_tide_eq_01:add_offset = 0. ;
    ocean_tide_eq_01:scale_factor = 0.001 ;
    ocean_tide_eq_01:comment = "Equilibrium Ocean Tide. This 1-way
            correction has been accounted for during the computation of
            height (see [flag_height_20_ku] to determine if it was
            applied) to remove the effect of the oceanic response to
            the single tidal forcing." ;
    ocean_tide_eq_01:source = "FES2004" ;
    ocean_tide_eq_01:institution = "LEGOS/CNES" ;
```

3.3.123 off_nadir_pitch_angle_str_20_ku(time_20_ku)

```
int off_nadir_pitch_angle_str_20_ku(time_20_ku) ;
    off_nadir_pitch_angle_str_20_ku:_FillValue = -2147483648 ;
    off_nadir_pitch_angle_str_20_ku:units = "degrees" ;
    off_nadir_pitch_angle_str_20_ku:long_name = "antenna bench pitch
                                    angle";
    off_nadir_pitch_angle_str_20_ku:comment = "Pitch angle with respect to
                        the nadir pointing, measured by the STRs and
                        post-processed by ground facility." ;
    off_nadir_pitch_angle_str_20_ku:add_offset = 0.0 ;
    off_nadir_pitch_angle_str_20_ku:scale_factor = 1.e-07;
```

3.3.124 off_nadir_roll_angle_str_20_ku(time_20_ku)

```
int off_nadir_roll_angle_str_20_ku(time_20_ku) ;
    off_nadir_roll_angle_str_20_ku:_FillValue = -2147483648 ;
    off_nadir_roll_angle_str_20_ku:units = "degrees" ;
    off_nadir_roll_angle_str_20_ku:long_name = "antenna bench roll angle";
    off_nadir_roll_angle_str_20_ku:comment = "Roll angle with respect to
                        the nadir pointing, measured by the STRs and
                        post-processed by ground facility." ;
    off_nadir_roll_angle_str_20_ku:add_offset = 0.0 ;
    off_nadir_roll_angle_str_20_ku:scale_factor = 1.e-07 ;
```

3.3.125 off_nadir_yaw_angle_str_20_ku(time_20_ku)

```
int off_nadir_yaw_angle_str_20_ku(time_20_ku) ;
    off_nadir_yaw_angle_str_20_ku:_FillValue = -2147483648 ;
    off_nadir_yaw_angle_str_20_ku:units = "degrees" ;
    off_nadir_yaw_angle_str_20_ku:long_name = "antenna bench yaw angle";
    off_nadir_yaw_angle_str_20_ku:comment = "Yaw angle with respect to the
                        nadir pointing, measured by the STRs and post-
                        processed by ground facility." ;
    off_nadir_yaw_angle_str_20_ku:add_offset = 0.0 ;
    off_nadir_yaw_angle_str_20_ku:scale_factor = 1.e-07 ;
```

3.3.126 orb_alt_rate_20_ku(time_20_ku)

```
int orb_alt_rate_20_ku(time_20_ku) ;
    orb_alt_rate_20_ku:_FillValue = -2147483648 ;
    orb_alt_rate_20_ku:units = "m/s" ;
    orb_alt_rate_20_ku:long_name = "altitude rate of CoM with respect to
                                    the reference ellipsoid" ;
    orb_alt_rate_20_ku:add_offset = 0. ;
    orb_alt_rate_20_ku:scale_factor = 0.001 ;
    orb_alt_rate_20_ku:comment = "Instantaneous altitude rate at the
                satellite CoM with respect to the reference ellipsoid
                [WGS84]." ;
```

3.3.127 orb_alt_rate_21_ku(time_21_ku)

```
int orb_alt_rate_21_ku(time_21_ku) ;
    orb_alt_rate_21_ku:_FillValue = -2147483648 ;
    orb_alt_rate_21_ku:units = "m/s" ;
    orb_alt_rate_21_ku:long_name = "altitude rate of CoM with respect to
                                    the reference ellipsoid" ;
    orb_alt_rate_21_ku:add_offset = 0. ;
    orb_alt_rate_21_ku:scale_factor = 0.001 ;
    orb_alt_rate_21_ku:comment = "Instantaneous altitude rate of the
                satellite CoM with respect to the reference ellipsoid
                [WGS84] - FBR SARin." ;
```

3.3.128 orb_alt_rate_85_ku(time_85_ku)

```
int orb_alt_rate_85_ku(time_85_ku) ;
    orb_alt_rate_85_ku:_FillValue = -2147483648 ;
    orb_alt_rate_85_ku:units = "m/s" ;
    orb_alt_rate_85_ku:long_name = "altitude rate of CoM with respect to
                                    the reference ellipsoid" ;
    orb_alt_rate_85_ku:add_offset = 0. ;
    orb_alt_rate_85_ku:scale_factor = 0.001 ;
    orb_alt_rate_85_ku:comment = "Instantaneous altitude rate of the
                satellite CoM with respect to the reference ellipsoid
                [WGS84] - FBR SAR." ;
```

3.3.129 ph_diff_waveform_20_ku(time_20_ku, ns_20_ku)

```
int ph_diff_waveform_20_ku(time_20_ku, ns_20_ku) ;
    ph_diff_waveform_20_ku:_FillValue = -2147483648 ;
    ph_diff_waveform_20_ku:units = "rad" ;
    ph_diff_waveform_20_ku:long_name = "l1b Phase Difference waveform" ;
    ph_diff_waveform_20_ku:add_offset = 0. ;
    ph_diff_waveform_20_ku:scale_factor = 1.e-06 ;
    ph_diff_waveform_20_ku:comment = "The L1b 20Hz phase difference
                                      waveform is a fully-
                                      calibrated, high
                                      resolution, multilooked
                                      phase difference computed
                                      from the complex echoes on
                                      the two receiving channels
                                      (SARin only)." ;
```

3.3.130 ph_slope_cor_20_ku(time_20_ku)

```
int ph_slope_cor_20_ku(time_20_ku) ;
    ph_slope_cor_20_ku:_FillValue = -2147483648 ;
    ph_slope_cor_20_ku:units = "rad" ;
    ph_slope_cor_20_ku:long_name = "phase slope correction" ;
    ph_slope_cor_20_ku:add_offset = 0. ;
    ph_slope_cor_20_ku:scale_factor = 1.e-06 ;
    ph_slope_cor_20_ku:comment = "Differential group delay phase difference
                slope correction across the whole bandwidth (SARin only).
                It is composed by fixed contributions from IPFDB and by
                variable contributions covering differences between the
                CAL-1 and CAL-4 paths. Applied in L1B SARin products." ;
```

3.3.131 ph_slope_cor_21_ku(time_21_ku)

```
int ph_slope_cor_21_ku(time_21_ku) ;
    ph_slope_cor_21_ku:_FillValue = -2147483648 ;
    ph_slope_cor_21_ku:units = "rad" ;
    ph_slope_cor_21_ku:long_name = "phase slope correction" ;
    ph_slope_cor_21_ku:add_offset = 0. ;
    ph_slope_cor_21_ku:scale_factor = 1.e-06 ;
    ph_slope_cor_21_ku:comment = "Differential group delay phase difference
                slope correction across the whole bandwidth (SARin only).
                It is composed by fixed contributions from IPFDB and by
                variable contributions covering differences between the
                CAL-1 and CAL-4 paths - FBR SARin" ;
```

3.3.132 pole_tide_01(time_cor_01)

```
int pole_tide_01(time_cor_01) ;
    pole_tide_01:_FillValue = -2147483648 ;
    pole_tide_01:units = "m" ;
    pole_tide_01:long_name = "geocentric polar tide (1-way)" ;
    pole_tide_01:add_offset = 0. ;
    pole_tide_01:scale_factor = 0.001 ;
    pole_tide_01:comment = "Geocentric polar tide. This 1-way correction
                has been accounted for during the computation of height (see
                [flag_height_20_ku] to determine if it was applied) to
                remove a long-period distortion of the Earth's crust.
                Although called a 'tide' this is in fact caused by
                variations in centrifugal force as the Earth's rotational
                axis moves its geographic location." ;
    pole_tide_01:source = "Wahr [1985] Deformation of the Earth induced by
                polar motion - J. Geophys. Res. (Solid Earth), 90, 9363-
                9368." ;
    pole_tide_01:institution = "IERS/CNES" ;
```

3.3.133 pwr_waveform_20_ku(time_20_ku, ns_20_ku)

```
ushort pwr_waveform_20_ku(time_20_ku, ns_20_ku) ;
    pwr_waveform_20_ku:units = "count" ;
    pwr_waveform_20_ku:long_name = "l1b power waveform scaled 0-65535" ;
    pwr_waveform_20_ku:add_offset = 0us ;
    pwr_waveform_20_ku:scale_factor = 1us ;
    pwr_waveform_20_ku:comment = "The L1b 20Hz power waveform is a fully-
                calibrated waveform. For LRM it is a low resolution pulse
                limited waveform. For SAR/SARin it is a high resolution
                multilooked waveform. Units are counts scaled to fit in
                the range 0-65535." ;
```

3.3.134 pwr_waveform_avg_01_ku(time_avg_01_ku, ns_avg_01_ku)

```
ushort pwr_waveform_avg_01_ku(time_avg_01_ku, ns_avg_01_ku) ;
    pwr_waveform_avg_01_ku:units = "count" ;
    pwr_waveform_avg_01_ku:long_name = "1hz l1b power waveform scaled 0-
                                       65535" ;
    pwr_waveform_avg_01_ku:add_offset = 0us ;
    pwr_waveform_avg_01_ku:scale_factor = 1us ;
    pwr_waveform_avg_01_ku:comment = "The L1b 1Hz averaged power waveform is
              a fully-calibrated low resolution pulse limited power
              waveform. For SAR/SARin it is a Pseudo-LRM power waveform
              obtained by averaging all individual L0 echoes covering
              approx 1 second after range compression. Units are counts
              scaled to fit in the range 0-65535." ;
```

3.3.135 rec_count_20_ku(time_20_ku)

```
int rec_count_20_ku(time_20_ku) ;
    rec_count_20_ku:units = "count" ;
    rec_count_20_ku:long_name = "record counter" ;
    rec_count_20_ku:comment = "Record counter - progressive counter
                              incremented by 1 for each record.
                              Surface Sample counter for SAR/SARin
                              L1B products. See [seq_count_20_ku]
                              for LRM." ;
```

3.3.136 rec_count_21_ku(time_21_ku)

```
int rec_count_21_ku(time_21_ku) ;
    rec_count_21_ku:units = "count" ;
    rec_count_21_ku:long_name = "record counter" ;
    rec_count_21_ku:comment = "Record counter - progressive counter
                              incremented by 1 for each record.
                              Burst counter for FBR SARin products."
                              ;
```

3.3.137 rec_count_85_ku(time_85_ku)

```
int rec_count_85_ku(time_85_ku) ;
    rec_count_85_ku:units = "count" ;
    rec_count_85_ku:long_name = "record counter" ;
    rec_count_85_ku:comment = "Record counter - progressive counter
                               incremented by 1 for each record.
                               Burst counter for FBR SAR products." ;
```

3.3.138 sat_vel_vec_20_ku(time_20_ku,space_3d)

```
int sat_vel_vec_20_ku(time_20_ku, space_3d) ;
    sat_vel_vec_20_ku:_FillValue = -2147483648 ;
    sat_vel_vec_20_ku:units = "m/s" ;
    sat_vel_vec_20_ku:long_name = "velocity vector in itrf" ;
    sat_vel_vec_20_ku:add_offset = 0. ;
    sat_vel_vec_20_ku:scale_factor = 0.001 ;
    sat_vel_vec_20_ku:comment = "Satellite velocity vector, described in
                               the International Terrestrial
                               Reference Frame in the International
                               Earth Fixed System. This is not a unit
                               vector as the velocity magnitude is
                               also required. The 3 components are
                               given according to the 'space_3d'
                               dimension: [1] x, [2] y, [3] z.";
```

3.3.139 sat_vel_vec_21_ku(time_21_ku,space_3d)

```
int sat_vel_vec_21_ku(time_21_ku, space_3d) ;
    sat_vel_vec_21_ku:_FillValue = -2147483648 ;
    sat_vel_vec_21_ku:units = "m/s" ;
    sat_vel_vec_21_ku:long_name = "velocity vector in itrf" ;
    sat_vel_vec_21_ku:add_offset = 0. ;
    sat_vel_vec_21_ku:scale_factor = 0.001 ;
    sat_vel_vec_21_ku:comment = "Satellite velocity vector, described in
                                the International Terrestrial
                                Reference Frame in the International
                                Earth Fixed System. This is not a unit
                                vector as the velocity magnitude is
                                also required. The 3 components are
                                given according to the 'space_3d'
                                dimension: [1] x, [2] y, [3] z - FBR
                                SARin." ;
```

3.3.140 sat_vel_vec_85_ku(time_85_ku,space_3d)

```
int sat_vel_vec_85_ku(time_85_ku, space_3d) ;
    sat_vel_vec_85_ku:_FillValue = -2147483648 ;
    sat_vel_vec_85_ku:units = "m/s" ;
    sat_vel_vec_85_ku:long_name = "velocity vector in itrf" ;
    sat_vel_vec_85_ku:add_offset = 0. ;
    sat_vel_vec_85_ku:scale_factor = 0.001 ;
    sat_vel_vec_85_ku:comment = "Satellite velocity, described in the
                                International Terrestrial Reference
                                Frame in the International Earth Fixed
                                System. This is not a unit vector as
                                the velocity magnitude is also
                                required. The 3 components are given
                                according to the 'space_3d' dimension:
                                [1] x, [2] y, [3] z - FBR SAR." ;
```

3.3.141 seq_count_20_ku(time_20_ku)

```
short seq_count_20_ku(time_20_ku) ;
    seq_count_20_ku:units = "count" ;
    seq_count_20_ku:long_name = "Source Sequence Counter" ;
    seq_count_20_ku:add_offset = 0s ;
    seq_count_20_ku:scale_factor = 1s ;
    seq_count_20_ku:comment = "Source Sequence Counter read from the L0
                              echo telemetry packet (LRM only). See
                              [rec_count_20_ku] for SAR/SARin." ;
```

3.3.142 seq_count_21_ku(time_21_ku)

```
short seq_count_21_ku(time_21_ku) ;
    seq_count_21_ku:units = "count" ;
    seq_count_21_ku:long_name = "Source Sequence Counter" ;
    seq_count_21_ku:add_offset = 0s ;
    seq_count_21_ku:scale_factor = 1s ;
    seq_count_21_ku:comment = "Source Sequence Counter read from the L0
                              echo telemetry packet - FBR SARin." ;
```

3.3.143 seq_count_85_ku(time_85_ku)

```
short seq_count_85_ku(time_85_ku) ;
    seq_count_85_ku:units = "count" ;
    seq_count_85_ku:long_name = "Source Sequence Counter" ;
    seq_count_85_ku:add_offset = 0s ;
    seq_count_85_ku:scale_factor = 1s ;
    seq_count_85_ku:comment = "Source Sequence Counter read from the L0
                              echo telemetry packet - FBR SAR." ;
```

3.3.144 solid_earth_tide_01(time_cor_01)

```
int solid_earth_tide_01(time_cor_01) ;
    solid_earth_tide_01:_FillValue = -2147483648 ;
    solid_earth_tide_01:units = "m" ;
    solid_earth_tide_01:long_name = "solid earth tide (1-way)" ;
    solid_earth_tide_01:standars_name="sea_surface_height_amplitude_due_to_
earth_tide" ;
    solid_earth_tide_01:add_offset = 0. ;
    solid_earth_tide_01:scale_factor = 0.001 ;
    solid_earth_tide_01:comment = "Solid Earth. This 1-way correction has
                been accounted for during the computation of height (see
                [flag_cor_applied_20_ku] to determine if it was applied) to
                remove the effect of local tidal distortion to the Earth's
                crust, in particular by the sun and moon." ;
    solid_earth_tide_01:source = "Cartwright and Edden [1973] Corrected
                tables of tidal harmonics - J. Geophys. J. R. Astr. Soc.,
                33, 253-264." ;
```

3.3.145 stack_centre_20_ku(time_20_ku)

```
short stack_centre_20_ku(time_20_ku) ;
    stack_centre_20_ku:units = "count" ;
    stack_centre_20_ku:_FillValue = -32768s ;
    stack_centre_20_ku:long_name = "gaussian power fitting: center wrt beam
                                   number" ;
    stack_centre_20_ku:add_offset = 0. ;
    stack_centre_20_ku:scale_factor = 0.01 ;
    stack_centre_20_ku:comment = "Position of the centre of Gaussian that
                                 fits the range integrated power of the
                                 single look echoes within a stack. Stack
                                 centre as function of stack beam number."
                                 ;
```

3.3.146 stack_centre_angle_20_ku(time_20_ku)

```
short stack_centre_angle_20_ku(time_20_ku) ;
    stack_centre_angle_20_ku:_FillValue = -32768s ;
    stack_centre_angle_20_ku:units = "rad" ;
    stack_centre_angle_20_ku:long_name = "gaussian power fitting: center
                                         wrt boresight angle" ;
    stack_centre_angle_20_ku:add_offset = 0. ;
    stack_centre_angle_20_ku:scale_factor = 1.e-06 ;
    stack_centre_angle_20_ku:comment = "Position of the centre of Gaussian
                                       that fits the range integrated
                                       power of the single look echoes
                                       within a stack. Centre as function
                                       of the boresight angle, that is the
                                       angle between: (a) antenna
                                       boresight direction, (b) direction
                                       satellite - surface location. The
                                       pointing angle depends on geometry
                                       and attitude (roll and pitch)." ;
```

3.3.147 stack_centre_look_angle_20_ku(time_20_ku)

```
short stack_centre_look_angle_20_ku(time_20_ku) ;
    stack_centre_look_angle_20_ku:_FillValue = -32768s ;
    stack_centre_look_angle_20_ku:add_offset = 0. ;
    string stack_centre_look_angle_20_ku:comment = "Position of the centre
                                                   of Gaussian that fits the range
                                                   integrated power of the single look
                                                   echoes within a stack. Centre as
                                                   function of the look angle, that is
                                                   the angle between: (a) nadir
                                                   direction from the satellite CoM to
                                                   the surface, (b) direction
                                                   satellite - surface location. Read
                                                   \'Pitch Estimation for CryoSat by
                                                   Analysis of Stacks of Single-Look
                                                   Echoes\' - M. Scagliola, M. Fornari
                                                   and N. Tagliani - IEEE Geoscience
                                                   and Remote Sensing Letters, vol.
```

12, no. 7, pp. 1561-1565, July 2015. doi: 10.1109/LGRS.2015.2413135" ;

string stack_centre_look_angle_20_ku:long_name = "gaussian power fitting: center wrt look angle" ;

stack_centre_look_angle_20_ku:scale_factor = 1.e-06 ;

string stack_centre_look_angle_20_ku:units = "rad" ;

3.3.148 stack_gaussian_fitting_residuals_20_ku(time_20_ku)

short stack_gaussian_fitting_residuals_20_ku(time_20_ku) ;

stack_gaussian_fitting_residuals_20_ku:_FillValue = -32768s ;

stack_gaussian_fitting_residuals_20_ku:add_offset = 0. ;

string stack_gaussian_fitting_residuals_20_ku:comment = "Residuals of Gaussian that fits the range integrated power of the single look echoes within a stack. It is the root mean squared error between the Gaussian fitting and the range integrated power of the single look echoes within a stack." ;

string stack_gaussian_fitting_residuals_20_ku:long_name = "gaussian power fitting: residuals fitting" ;

stack_gaussian_fitting_residuals_20_ku:scale_factor = 0.01 ;

string stack_gaussian_fitting_residuals_20_ku:units = "dbW" ;

3.3.149 stack_kurtosis_20_ku(time_20_ku)

short stack_kurtosis_20_ku(time_20_ku) ;

stack_kurtosis_20_ku:_FillValue = -999s ;

stack_kurtosis_20_ku:units = "count" ;

stack_kurtosis_20_ku:long_name = "gaussian power fitting: kurtosis wrt beam number" ;

stack_kurtosis_20_ku:add_offset = 0. ;

stack_kurtosis_20_ku:scale_factor = 0.01 ;

stack_kurtosis_20_ku:comment = "4th central moment computed on the range integrated power of the single

look echoes within a stack. Kurtosis as function of stack beam number." ;

3.3.150 stack_number_after_weighting_20_ku(time_20_ku)

```
short stack_number_after_weighting_20_ku(time_20_ku) ;
    stack_number_after_weighting_20_ku:_FillValue = -32768s ;
    stack_number_after_weighting_20_ku:units = "count" ;
    stack_number_after_weighting_20_ku:long_name = "number of contributing
                                beams in the stack after weighting" ;
    stack_number_after_weighting_20_ku:add_offset = 0s ;
    stack_number_after_weighting_20_ku:scale_factor = 1s ;
    stack_number_after_weighting_20_ku:comment = "Number of contributing
                                beams in the stack after weighting:
                                number of single look echoes in the
                                stack after the Surface Sample Stack
                                weighting is applied." ;
```

3.3.151 stack_number_before_weighting_20_ku(time_20_ku)

```
short stack_number_before_weighting_20_ku(time_20_ku) ;
    stack_number_before_weighting_20_ku:_FillValue = -32768s ;
    stack_number_before_weighting_20_ku:units = "count" ;
    stack_number_before_weighting_20_ku:long_name = "number of contributing
                                 beams in the stack before weighting" ;
    stack_number_before_weighting_20_ku:add_offset = 0s ;
    stack_number_before_weighting_20_ku:scale_factor = 1s ;
    stack_number_before_weighting_20_ku:comment = "Number of contributing
                                beams in the stack before
                                weighting: number of single look
                                echoes in the stack before the
                                Surface Sample Stack weighting is
                                applied." ;
```

3.3.152 stack_peakiness_20_ku (time_20_ku)

```
    short stack_peakiness_20_ku(time_20_ku) ;
    stack_peakiness_20_ku:_FillValue = -32768s ;
    stack_peakiness_20_ku:add_offset = 0. ;
    string stack_peakiness_20_ku:comment = "TBC" ;
```

```
string stack_peakiness_20_ku:long_name = "gaussian power fitting:
                                        peakiness wrt beam number" ;
stack_peakiness_20_ku:scale_factor = 0.01 ;
string stack_peakiness_20_ku:units = "count" ;
```

3.3.153 stack_scaled_amplitude_20_ku(time_20_ku)

```
short stack_scaled_amplitude_20_ku(time_20_ku) ;
    stack_scaled_amplitude_20_ku:_FillValue = -32768s ;
    stack_scaled_amplitude_20_ku:units = "dB" ;
    stack_scaled_amplitude_20_ku:long_name = "gaussian power fitting:
                                            amplitude" ;
    stack_scaled_amplitude_20_ku:add_offset = 0. ;
    stack_scaled_amplitude_20_ku:scale_factor = 0.01 ;
    stack_scaled_amplitude_20_ku:comment = "Amplitude of Gaussian that fits
                                        the range integrated power of the
                                        single look echoes within a stack." ;
```

3.3.154 stack_skewness_20_ku(time_20_ku)

```
short stack_skewness_20_ku(time_20_ku) ;
    stack_skewness_20_ku:_FillValue = -999s ;
    stack_skewness_20_ku:units = "count" ;
    stack_skewness_20_ku:long_name = "gaussian power fitting: skewness wrt
                                        beam number" ;
    stack_skewness_20_ku:add_offset = 0.0 ;
    stack_skewness_20_ku:scale_factor = 0.01 ;
    stack_skewness_20_ku:comment = "3rd central moment computed on the
                                    range integrated power of the single
                                    look echoes within a stack. Skewness
                                    as function of stack beam number." ;
```

3.3.155 stack_std_20_ku(time_20_ku)

```
short stack_std_20_ku(time_20_ku) ;
    stack_std_20_ku:units = "count" ;
    stack_std_20_ku:_FillValue = -32768s ;
    stack_std_20_ku:long_name = "Gaussian power fitting: std wrt beam
                                number" ;
    stack_std_20_ku:add_offset = 0. ;
    stack_std_20_ku:scale_factor = 0.01 ;
    stack_std_20_ku:comment = "Standard deviation of Gaussian that fits the
                              range integrated power of the single look
                              echoes within a stack. Standard deviation as
                              function of stack beam number." ;
```

3.3.156 stack_std_angle_20_ku(time_20_ku)

```
short stack_std_angle_20_ku(time_20_ku) ;
    stack_std_angle_20_ku:_FillValue = -32768s ;
    stack_std_angle_20_ku:units = "rad" ;
    stack_std_angle_20_ku:long_name = "gaussian power fitting: std wrt
                                      boresight angle" ;
    stack_std_angle_20_ku:add_offset = 0. ;
    stack_std_angle_20_ku:scale_factor = 1.e-06 ;
    stack_std_angle_20_ku:comment = "Standard deviation of Gaussian that
                        fits the range integrated power of the single
                        look echoes within a stack. Standard deviation as
                        function of the boresight angle, that is the
                        angle between: (a) antenna boresight direction,
                        (b) direction satellite - surface location. The
                        boresight angle depends on geometry and attitude
                        (roll and pitch)." ;
```

3.3.157 surf_type_01(time_cor_01)

```
byte surf_type_01(time_cor_01) ;
    surf_type_01:_FillValue = -128b ;
    surf_type_01:long_name = "surface type flag" ;
    surf_type_01:flag_values = 0b, 1b, 2b, 3b ;
    surf_type_01:flag_meanings = "ocean lake_enclosed_sea ice land" ;
    surf_type_01:source = "TERRAINBASE 1.0";
    surf_type_01:institution = "NOAA National Geophysical Data Center, Boulder, Colorado." ;
    surf_type_01:comment = "A surface type mask for the surface type at the nadir location. Computed using the TERRAINBASE model: 0= open oceans or semi-enclosed seas; 1= enclosed seas or lakes; 2= continental ice; 3= land. See Row, L.W., and D.A. Hastings, 1994. TerrainBase Worldwide Digital Terrain Data on CD-ROM, Release 1.0. NOAA National Geophysical Data Center, Boulder, Colorado." ;
```

3.3.158 time_20_ku(time_20_ku)

```
double time_20_ku(time_20_ku) ;
    time_20_ku:units = "seconds since 2000-01-01 00:00:00.0" ;
    time_20_ku:long_name = "time in TAI: seconds since 1 Jan 2000" ;
    time_20_ku:standard_name = "time" ;
    time_20_ku:calendar = "gregorian" ;
    time_20_ku:comment = "TAI time counted in seconds since 2000-01-01
                          00:00:00. Time refers to the instant the L1B
                          20Hz power waveform touches the surface." ;
```

3.3.159 time_21_ku(time_21_ku)

```
double time_21_ku(time_21_ku) ;
    time_21_ku:units = "seconds since 2000-01-01 00:00:00.0" ;
    time_21_ku:long_name = "time in TAI: seconds since 1 Jan 2000" ;
    time_21_ku:standard_name = "time" ;
    time_21_ku:calendar = "gregorian" ;
    time_21_ku:comment = "TAI time counted in seconds since 2000-01-01
                          00:00:00. Time corresponding to ground bounce
```

time of the middle of the burst - FBR SARin."
;

3.3.160 time_85_ku(time_85_ku)

double time_85_ku(time_85_ku)) ;
time_85_ku:units = "seconds since 2000-01-01 00:00:00.0" ;
time_85_ku:long_name = "time in TAI: seconds since 1 Jan 2000" ;
time_85_ku:standard_name = "time" ;
time_85_ku:calendar = "gregorian" ;
time_85_ku:comment = "TAI time counted in seconds since 2000-01-01 00:00:00. Time corresponding to ground bounce time of the middle of the burst - FBR SAR." ;

3.3.161 time_avg_01_ku(time_avg_01_ku)

double time_avg_01_ku(time_avg_01_ku) ;
time_avg_01_ku:units = "seconds since 2000-01-01 00:00:00.0" ;
time_avg_01_ku:calendar = "gregorian" ;
time_avg_01_ku:long_name = "time in TAI: seconds since 1 Jan 2000" ;
time_avg_01_ku:standard_name = "time" ;
time_avg_01_ku:comment = "TAI time counted in seconds since 2000-01-01 00:00:00. Time refers to the instant the L1B 1Hz average power waveform touches the surface." ;

3.3.162 time_cor_01(time_cor_01)

double time_cor_01(time_cor_01)) ;
time_cor_01:units = "seconds since 2000-01-01 00:00:00.0" ;
time_cor_01:long_name = "time in TAI: seconds since 1 Jan 2000" ;
time_cor_01:standard_name = "time" ;
time_cor_01:calendar = "gregorian" ;
time_cor_01:comment = "TAI time counted in seconds since 2000-01-01 00:00:00. Time refers to the instant which the corrections are referred to." ;

3.3.163 tot_gain_ch1_20_ku(time_20_ku)

```
int tot_gain_ch1_20_ku(time_20_ku) ;
    tot_gain_ch1_20_ku:_FillValue = -2147483648 ;
    tot_gain_ch1_20_ku:units = "dB" ;
    tot_gain_ch1_20_ku:long_name = "total fixed gain on channel 1" ;
    tot_gain_ch1_20_ku:add_offset = 0. ;
    tot_gain_ch1_20_ku:scale_factor = 0.01 ;
    tot_gain_ch1_20_ku:comment = "Total Fixed Gain On Channel 1 - total
                                 fixed instrument gain applied on chain 1,
                                 this is the gain applied by the RF unit.
                                 Applied in L1B." ;
```

3.3.164 tot_gain_ch1_21_ku(time_21_ku)

```
int tot_gain_ch1_21_ku(time_21_ku) ;
    tot_gain_ch1_21_ku:_FillValue = -2147483648 ;
    tot_gain_ch1_21_ku:units = "dB" ;
    tot_gain_ch1_21_ku:long_name = "total fixed gain on channel 1" ;
    tot_gain_ch1_21_ku:add_offset = 0. ;
    tot_gain_ch1_21_ku:scale_factor = 0.01 ;
    tot_gain_ch1_21_ku:comment = "Total Fixed Gain On Channel 1 - total
                                 fixed instrument gain to be applied on chain
                                 1, this is the gain applied by the RF unit-
                                 FBR SARin." ;
```

3.3.165 tot_gain_ch1_85_ku(time_85_ku)

```
int tot_gain_ch1_85_ku(time_85_ku) ;
    tot_gain_ch1_85_ku:_FillValue = -2147483648 ;
    tot_gain_ch1_85_ku:units = "dB" ;
    tot_gain_ch1_85_ku:long_name = "total fixed gain on channel 1" ;
    tot_gain_ch1_85_ku:add_offset = 0. ;
    tot_gain_ch1_85_ku:scale_factor = 0.01 ;
    tot_gain_ch1_85_ku:comment = "Total Fixed Gain On Channel 1 - total
                                 fixed instrument gain to be applied on chain
                                 1, this is the gain applied by the RF unit -
                                 FBR SAR." ;
```

3.3.166 tot_gain_ch2_20_ku(time_20_ku)

```
int  tot_gain_ch2_20_ku(time_20_ku) ;
    tot_gain_ch2_20_ku:_FillValue = -2147483648 ;
    tot_gain_ch2_20_ku:units = "dB" ;
    tot_gain_ch2_20_ku:long_name = "total fixed gain on channel 2" ;
    tot_gain_ch2_20_ku:add_offset = 0. ;
    tot_gain_ch2_20_ku:scale_factor = 0.01 ;
    tot_gain_ch2_20_ku:comment = "Total Fixed Gain On Channel 2 - total
                                 fixed instrument gain applied on chain 2,
                                 this is the gain applied by the RF unit.
                                 Applied in L1B." ;
```

3.3.167 tot_gain_ch2_21_ku(time_21_ku)

```
int tot_gain_ch2_21_ku(time_21_ku) ;
    tot_gain_ch2_21_ku:_FillValue = -2147483648 ;
    tot_gain_ch2_21_ku:units = "dB" ;
    tot_gain_ch2_21_ku:long_name = "total fixed gain on channel 2" ;
    tot_gain_ch2_21_ku:add_offset = 0. ;
    tot_gain_ch2_21_ku:scale_factor = 0.01 ;
    tot_gain_ch2_21_ku:comment = "Total Fixed Gain On Channel 2 - total
                                 fixed instrument gain to be applied on chain
                                 2, this is the gain applied by the RF unit -
                                 FBR SARin." ;
```

3.3.168 tot_gain_ch2_85_ku(time_85_ku)

```
int tot_gain_ch2_85_ku(time_85_ku) ;
    tot_gain_ch2_85_ku:_FillValue = -2147483648 ;
    tot_gain_ch2_85_ku:units = "dB" ;
    tot_gain_ch2_85_ku:long_name = "total fixed gain on channel 2" ;
    tot_gain_ch2_85_ku:add_offset = 0. ;
    tot_gain_ch2_85_ku:scale_factor = 0.01 ;
    tot_gain_ch2_85_ku:comment = "Total Fixed Gain On Channel 2 - total
                                 fixed instrument gain to be applied on chain
                                 2, this is the gain applied by the RF unit -
                                 FBR SAR." ;
```

3.3.169 transmit_pwr_20_ku(time_20_ku)

```
int  transmit_pwr_20_ku(time_20_ku) ;
    transmit_pwr_20_ku:_FillValue = -2147483648 ;
    transmit_pwr_20_ku:units = "Watt" ;
    transmit_pwr_20_ku:long_name = "transmitted power" ;
    transmit_pwr_20_ku:add_offset = 0. ;
    transmit_pwr_20_ku:scale_factor = 1.e-06 ;
    transmit_pwr_20_ku:comment = "The altimeter transmit power." ;
```

3.3.170 transmit_pwr_21_ku(time_21_ku)

```
int  transmit_pwr_21_ku(time_21_ku) ;
    transmit_pwr_21_ku:_FillValue = -2147483648 ;
    transmit_pwr_21_ku:units = "Watt" ;
    transmit_pwr_21_ku:long_name = "transmitted power" ;
    transmit_pwr_21_ku:add_offset = 0. ;
    transmit_pwr_21_ku:scale_factor = 1.e-06 ;
    transmit_pwr_21_ku:comment = "The altimeter transmit power - FBR
                                 SARin."
```

3.3.171 transmit_pwr_85_ku(time_85_ku)

```
int  transmit_pwr_85_ku(time_85_ku) ;
    transmit_pwr_85_ku:_FillValue = -2147483648 ;
    transmit_pwr_85_ku:units = "Watt" ;
    transmit_pwr_85_ku:long_name = "transmitted power" ;
    transmit_pwr_85_ku:add_offset = 0. ;
    transmit_pwr_85_ku:scale_factor = 1.e-06 ;
    transmit_pwr_85_ku:comment = "The altimeter transmit power - FBR SAR."
                                 ;
```

3.3.172 uso_cor_20_ku(time_20_ku)

```
int uso_cor_20_ku(time_20_ku) ;
uso_cor_20_ku:_FillValue = 2147483647 ;
uso_cor_20_ku:add_offset = 0. ;
string uso_cor_20_ku:comment = "USO correction defined as the additive
correction to window delay referred to L1B 20Hz average waveform. This correction
has been applied. This correction accounts for the difference between the nominal
frequency provided in the IPFDB and the modelled frequency deviation provided by
the DORIS USO drift file." ;
string uso_cor_20_ku:long_name = "uso correction applied to window delay (2-
way)" ;
uso_cor_20_ku:scale_factor = 1.e-12 ;
    string uso_cor_20_ku:units = "seconds" ;
```

3.3.173 uso_cor_avg_01_ku(time_avg_01_ku)

```
int uso_cor_avg_01_ku(time_avg_01_ku) ;
uso_cor_avg_01_ku:_FillValue = 2147483647 ;
uso_cor_avg_01_ku:add_offset = 0. ;
string uso_cor_avg_01_ku:comment = "USO correction defined as the
                          additive correction to window delay referred
                          to L1B 1Hz average power waveform. This
                          correction has been applied. This correction
                          accounts for the difference between the
                          nominal frequency provided in the IPFDB and
                          the modelled frequency deviation provided by
                          the DORIS USO drift file." ;
string uso_cor_avg_01_ku:long_name = "uso correction applied to window
                          delay (2-way)" ;
uso_cor_avg_01_ku:scale_factor = 1.e-12 ;
string uso_cor_avg_01_ku:units = "seconds" ;
```

3.3.174 uso_cor_21_ku(time_21_ku)

```
int  uso_cor_21_ku(time_21_ku) ;
    uso_cor_21_ku:_FillValue = 2147483647 ;
    uso_cor_21_ku:long_name = "uso correction (2-way)" ;
    uso_cor_21_ku:add_offset = 0. ;
    uso_cor_21_ku:scale_factor = 1.e-15 ;
    uso_cor_21_ku:comment = "USO correction factor defined as the ratio
                            between the nominal and the modelled value.
                            This correction accounts for the different
                            between the nominal frequency provided in
                            the IPFDB and the modelled frequency
                            deviation provided by the DORIS USO drift
                            file. Correction to be applied by the user -
                            FBR SARin." ;
```

3.3.175 uso_cor_85_ku(time_85_ku)

```
int  uso_cor_85_ku(time_85_ku) ;
    uso_cor_85_ku:_FillValue = 2147483647 ;
    uso_cor_85_ku:long_name = "uso correction (2-way)" ;
    uso_cor_85_ku:add_offset = 0. ;
    uso_cor_85_ku:scale_factor = 1.e-15 ;
    uso_cor_85_ku:comment = "USO correction factor defined as the ratio
                            between the nominal and the modelled value.
                            This correction accounts for the different
                            between the nominal frequency provided in
                            the IPFDB and the modelled frequency
                            deviation provided by the DORIS USO drift
                            file. Correction to be applied by the user -
                            FBR SAR." ;
```

3.3.176 window_del_20_ku(time_20_ku)

```
int64 window_del_20_ku(time_20_ku) ;
    window_del_20_ku:_FillValue = -9223372036854775808L ;
    window_del_20_ku:units = "seconds" ;
    window_del_20_ku:long_name = "calibrated window delay (2-way)" ;
    window_del_20_ku:add_offset = 0.0 ;
    window_del_20_ku:scale_factor = 1.e-12 ;
    window_del_20_ku:comment = "Calibrated 2-way window delay: distance
            from CoM to middle range window (at sample ns/2 from 0). It
            includes all the range corrections given in the variable
            instr_cor_range. This is a 2-way time and 2-way corrections
            are applied." ;
```

3.3.177 window_del_21_ku(time_21_ku)

```
int64 window_del_21_ku(time_21_ku) ;
    window_del_21_ku:_FillValue = -9223372036854775808L ;
    window_del_21_ku:units = "seconds" ;
    window_del_21_ku:long_name = "window delay (2-way)" ;
    window_del_21_ku:add_offset = 0.0 ;
    window_del_21_ku:scale_factor = 1.e-12 ;
    window_del_21_ku:comment = "2-way window: distance from CoM to middle
            range window (at sample ns/2 from 0. It does not include
            range corrections, which are given in the variable
            instr_cor_range - FBR SARin." ;
```

3.3.178 window_del_85_ku(time_85_ku)

```
int64 window_del_85_ku(time_85_ku) ;
    window_del_85_ku:_FillValue = -9223372036854775808L ;
    window_del_85_ku:units = "seconds" ;
    window_del_85_ku:long_name = "window delay (2-way)" ;
    window_del_85_ku:add_offset = 0.0 ;
    window_del_85_ku:scale_factor = 1.e-12 ;
    window_del_85_ku:comment = "2-way window delay: distance from CoM to
                               middle range window (at sample ns/2 from 0).
                               It does not include range corrections, which
                               are given in the variable instr_cor_range -
                               FBR SAR." ;
```

3.3.179 window_del_avg_01_ku(time_avg_01_ku)

```
int64 window_del_avg_01_ku(time_avg_01_ku) ;
    window_del_avg_01_ku:_FillValue = -9223372036854775808L ;
    window_del_avg_01_ku:units = "seconds" ;
    window_del_avg_01_ku:long_name = "window delay (2-way)" ;
    window_del_avg_01_ku:add_offset = 0.d ;
    window_del_avg_01_ku:scale_factor = 1.e-12d ;
    string window_del_avg_01_ku:comment = "Calibrated 2-way window delay:
                               distance from CoM to middle range window (at
                               sample ns/2 from 0). It includes all range
                               corrections given in the variable
                               instr_cor_range. This is a 2-way time and 2-
                               way corrections are applied." ;
```

3.4 GLOBAL ATTRIBUTES

The global attributes contains general information about the product and are listed in this section.

The classification of each attribute is adopted for the sake of clarity and to trace each attribute back to the EE Header field where the attribute comes from.

In any real product the attributes are not grouped but simply listed inside the CONFORM product.

Product Identification Information		
Attribute Name	**Description**	**Values**
product_name	Product File Name	any string
processing_stage	Processing stage code identifier.	RPRO = Reprocessing OFFL = Routine Operation NRT_ = Near Real Time TEST = Test LTA_ = Long Term Archive
reference_document	Reference DFCB Document describing the product	any string
acquisition_station	Acquisition Station	any string
mission	Mission Name	Cryosat
processing_centre	Processing Facility	PDS

Data Processing Information	
Attribute Name	**Description**
creation_time	Processing Time (Product Generation Time)
sensing_start	sensing start time
sensing_stop	sensing stop time
software_version	Processor Name and software version number

Orbit Information	
Attribute Name	**Description**
phase	Phase Code (set to X if not used)
cycle_number	Cycle Number (set to +000 if not used)
rel_orbit_number	Relative Orbit Number at sensing start time (set to +00000 if not used)
abs_orbit_number	Absolute Orbit Number at sensing start time (set to +00000 if not used)
state_vector_time	UTC state vector time
delta_ut1	Universal Time Correction: DUT1 = UT1 – UTC
x_position	X position in Earth Fixed Reference If not used set to +0000000.000
y_position	Y position in Earth Fixed Reference If not used set to +0000000.000
z_position	Z position in Earth Fixed Reference If not used set to +0000000.000
x_velocity	X velocity in Earth Fixed Reference If not used set to +0000.000000
y_velocity	Y velocity in Earth Fixed Reference If not used set to +0000.000000
z_velocity	Z velocity in Earth Fixed Reference If not used set to +0000.000000
vector_source	Source of Orbit State Vector Record: fos predicted doris_navigator doris_precise fos_restituted

Orbit Information	
Attribute Name	**Description**
	doris_preliminary

Leap Second Information	
Attribute Name	**Description**
leap_utc	UTC Time of the occurrence of the leap second. If a leap second occurred in the product window the field is set by a devoted function in the CFI EXPLORER_ORBIT library (see [EXPL_ORB-SUM] for details), otherwise it is not set. It corresponds to the time after the Leap Second occurrence (i.e. midnight of the day after the leap second)
leap_sign	If a leap second occurred in the product window the field is set to the expected value by a devoted function in the CFI EXPLORER_ORBIT library (see [EXPL_ORB-SUM] for details), otherwise it is not set
leap_err	This field is always not set considering that CRYOSAT products have true UTC times

Product Confidence Data Information	
Attribute Name	**Description**
product_err	Product Error Flag: 1 errors have been reported in the Product 0 no errors

Product Time Information	
Attribute Name	**Description**
first_record_time	TAI of the first record in the Main MDS of this product
last_record_time	TAI of the last record in the Main MDS of this product

Product Orbit Information	
Attribute Name	**Description**
abs_orbit_start	Absolute Orbit Number at sensing start time.
rel_time_asc_node_start	Relative time since crossing ascending node time relative to start time of data sensing.
abs_orbit_stop	Absolute Orbit Number at sensing stop time.
rel_time_asc_node_stop	Relative time since crossing ascending node time relative to stop time of data sensing.
equator_cross_time	Time of equator crossing at the ascending node relative to the sensing start time.
equator_cross_long	Longitude of equator crossing at the ascending node relative to the sensing start time (positive East, 0 = Greenwich) referred to WGS84.
ascending_flag	Orbit Orientation at the sensing start time: A=Ascending D=Descending

Product Location Information	
Attribute Name	**Description**
first_record_lat	WGS84 latitude of the first record in the Main MDS (positive north)
first_record_lon	WGS84 longitude of the first record in the Main MDS (positive East, 0 = Greenwich)
last_record_lat	WGS84 latitude of the last record in the Main MDS (positive north
last_record_lon	WGS84 longitude of the last record in the Main MDS (positive East, 0 = Greenwich)

SIRAL Level 0 Quality information	
Attribute Name	**Description**
l0_proc_flag	Processing errors significance flag : 1 errors (percentage of errors greater than threshold) 0 no errors
l0_processing_quality	Percentage of quality checks successfully passed during ISP processing : max allowed +10000
l0_proc_thresh	Minimum acceptable percentage of quality threshold that must be passed during ISP processing: max allowed +10000
l0_gaps_flag	Flag to indicate gaps in input data: 1 gaps 0 no gaps
l0_gaps_num	Number of gaps detected during ISP processing

SIRAL Instrument Configuration	
Attribute Name	**Description**
instr_id	Instrument_Identifier : A = SIRAL Nominal B = SIRAL Redundnant
sir_op_mode	SIRAL Operative Mode: lrm sar sarin
sir_configuration	SIRAL Rx Configuration : rx_1 rx_2 both unknown

Level 1 Surface Statistics	
Attribute Name	**Description**
open_ocean_percent	Percentage of output L1B records detected on open ocean or semi-enclosed seas
close_sea_percent	Percentage of output L1B records detected on close seas or lakes
continent_ice_percent	Percentage of output L1B records detected on continental ice
land_percent	Percentage of output L1B records detected on land

SIRAL Level 1 Processing information	
Attribute Name	**Description**
l1b_prod_status	Complete/Incomplete Product Completion Flag (0 or 1). 1 if the product has a duration shorter than the input Level 0
l1b_proc_flag	Processing errors significance flag 1 errors (percentage of errors greater than threshold) 0 no errors
l1b_processing_quality	Percentage of quality checks successfully passed during Level 1B processing (max allowed +10000)
l1b_proc_thresh	Minimum acceptable percentage of quality threshold that must be passed during Level 1B processing (max allowed +10000)

Reference DSD	
Attribute Name	**Description**
xref_bending_cor	Auxiliary file used to remove the time-varying bias of the mispointing angles
xref_cal1	L1B CAL1 file name
xref_cal1_sarin	L1B CAL1 SARIN file name
xref_cal2	L1B CAL2 file name
xref_constants	Constants File
xref_dip_map	Modified Dip Map File used for Bent Ionospheric Correction
xref_earth_tide	CartWright File
xref_fos	FOS Platform Data File
xref_fos_hktm	FOS Sorted HouseKeeping Telemetries File
xref_gim	GPS Ionospheric Map Data generated by using either analysis or forecast data

Reference DSD	
Attribute Name	**Description**
xref_iono_cor	Ionospheric Coefficients file used for Bent Ionospheric Correction
xref_mean_pressure	Mean Pressure File for Meteo Correction generated by using either analysis or forecast data
xref_meteo	Meteo file name(s)
xref_mog2d	2D Gravity Wave model for Dynamic Atmospheric Correction (DAC) generated by using either analysis or forecast data
xref_ocean_tide	File for Ocean Tide
xref_orbit	Orbit file name(s)
xref_orbit_scenario	Orbit scenario file name
xref_pconf	Processor Configuration Parameters File
xref_pole_location	Pole location file name
xref_s1_tide_amplitude	S1 tide grid of monthly mean of global amplitude
xref_s1_tide_phase	S1 tide grid of monthly mean of global phase
xref_s1s2_pressure_00h	Climatology Pressure Grids for each month at 00 h.
xref_s1s2_pressure_06h	Climatology Pressure Grids for each month at 06 h.
xref_s1s2_pressure_12h	Climatology Pressure Grids for each month at 12 h.
xref_s1s2_pressure_18h	Climatology Pressure Grids for each month at 18 h.
xref_s2_tide_amplitude	S2 tide grid of monthly mean of global amplitude
xref_s2_tide_phase	S2 tide grid of monthly mean of global phase
xref_sai	Solar Activity Index File used for Bent Ionospheric Correction
xref_siral_characterisation	SIRAL IPFDB file name
xref_siral_l0	SIRAL L0 file name(s)
xref_star_tracker_0	Star Tracker Level 1b File
xref_star_tracker_attref	Star Tracker Level 1b File

Reference DSD	
Attribute Name	**Description**
xref_surf_pressure	Surface Pressure File for Meteo Correction generated by using either analysis or forecast data
xref_surf_type	Surface Type Map File
xref_tidal_load	File for Tidal Loading
xref_u_wind	U Wind component File for Meteo Correction generated by using either analysis or forecast data
xref_uso	USO file name
xref_v_wind	V Wind component File for Meteo Correction generated by using either analysis or forecast data
xref_wet_trop	Wet Troposphere File for Meteo Correction generated by using either analysis or forecast data

4 CRYOSAT LEVEL-1B CONFORM PRODUCTS

The following table provides the Product Identification for each CONFORM product generated by the IPF1.

CONFORM Products	
Product Identification	**Description**
SIR1SAR_FR	Level 1 FBR SAR Mode (Rx1 Channel)
SIR2SAR_FR	Level 1 FBR SAR Mode (Rx2 Channel)
SIR_SIN_FR	Level 1 FBR SARin Mode
SIR_LRM_1B	Level-1 Product Low Rate Mode
SIR_FDM_1B	Level-1 Product Fast Delivery Marine Mode
SIR_SAR_1B	Level-1 SAR Mode
SIR_SIN_1B	Level-1 SARin Mode

Table 3-1: Level-1b CONFORM products list

4.1 FILE NAMES

The file name of each Level-1 product abides to the following conventions (in italics the variable parts).:

***MM_CCCC_TTTTTTTTT_yyyymmddThhmmss_YYYYMMDDTHHMMSS_bvvv*.nc**

where

MM is the mission identifier **CS** for CryoSat

CCCC is the file class (i.e.: OPER for routine operation, NRT_ for Near Real Time, RPRO for Reprocessing, TEST for Testing or TIxx for stand alone IPF1 testing associated to Test Data Sets tagged as Tixx, LTA_ for products generated in the Long Term Archive).

TTTTTTTTT is the file type and corresponds to the Product ID of the Table 3-1

yyyymmddThhmmss is the validity start time and correspond to the time of the first valid record stored in the Interim FBR.

YYYYMMDDTHHMMSS is the validity stop time and correspond to time of the last valid record stored in the Interim FBR.

b is the baseline identifier as read-in from the PCONF

vvv is the version number

For example in case of an operational Level-1 product of the SIRAL instrument in Low Rate Mode in baseline number A and version 1 the name could be:

CS_OPER_ SIR_LRM1B_20030624T075728_20030624T080231_A001.nc

Appendix A: Variables to Products

	FBR		L1b		
	SAR	SARin	LRM	SAR	SARin
agc_ch1_20_ku(time_20_ku)			x	x	x
agc_ch1_21_ku(time_21_ku)		x			
agc_ch1_85_ku(time_85_ku)	x				
agc_ch2_20_ku(time_20_ku)			x	x	x
agc_ch2_21_ku(time_21_ku)		x			
agc_ch2_85_ku(time_85_ku)	x				
alt_avg_01_ku(time_avg_01_ku)			x	x	x
alt_20_ku(time_20_ku)			x	x	x
alt_21_ku(time_21_ku)		x			
alt_85_ku(time_x85ku)	x				
off_nadir_pitch_angle_str_20_ku(time_20_ku)			x	x	x
off_nadir_roll_angle_str_20_ku(time_20_ku)			x	x	x
off_nadir_yaw_angle_str_20_ku(time_20_ku)			x	x	x
beam_dir_vec_20_ku(time_20_ku,space_3d)			x	x	x
beam_dir_vec_21_ku(time_21_ku,space_3d)		x			
beam_dir_vec_85_ku(time_95_ku,space_3d)	x				
coherence_waveform_20_ku(time_20_ku, ns_20_ku)					x
cor2_applied_20_ku(time_20_ku)			x	x	x
cor2_applied_21_ku(time_21_ku)		x			
cor2_applied_85_ku(time_85_ku)	x				
cplx_waveform_ch1_i_21_ku(time_21_ku,np_ku)		x			
cplx_waveform_ch1_i_85_ku(time_85_ku,np_ku)	x				
cplx_waveform_ch1_q_21_ku(time_21_ku,np_ku)		x			
cplx_waveform_ch1_q_85_ku(time_85_ku,np_ku)	x				
cplx_waveform_ch2_i_21_ku(time_21_ku,np_ku)		x			
cplx_waveform_ch2_q_21_ku(time_21_ku,np_ku)		x			
dop_angle_start _20_ku(time_20_ku)				x	x
dop_angle_stop _20_ku(time_20_ku)				x	x
dop_cor_20_ku(time_20_ku)			x	x	x
dop_cor_21_ku(time_21_ku)		x			
dop_cor_85_ku(time_85_ku)	x				
echo_numval_avg_01_ku(time_avg_01_ku)			x	x	x
echo_numval_20_ku(time_20_ku)			x	x	x
echo_numval_21_ku(time_21_ku)		x			
echo_numval_85_ku(time_85_ku)	x				

	FBR		L1b		
	SAR	SARin	LRM	SAR	SARin
echo_scale_factor_avg_01_ku(time_avg_01_ku)			x	x	x
echo_scale_factor_20_ku(time_20_ku)			x	x	x
echo_scale_pwr_20_ku(time_20_ku)			x	x	x
echo_scale_pwr_avg_01_ku(time_avg_01_ku)			x	x	x
flag_cor_err_01(time_01_ku)		x	x	x	x
flag_cor_status_01(time_01_ku)		x	x	x	x
flag_echo_20_ku(time_20_ku)			x	x	x
flag_echo_21_ku(time_21_ku)		x			
flag_echo_85_ku(time_85_ku)	x				
flag_echo_avg_01_ku(time_avg_01_ku)			x	x	x
flag_instr_conf_rx_bwdt_20_ku(time_20_ku)			x	x	x
flag_instr_conf_rx_bwdt_21_ku(time_21_ku)		x			
flag_instr_conf_rx_bwdt_85_ku(time_85_ku)	x				
flag_instr_conf_rx_flags_20_ku(time_20_ku)			x	x	x
flag_instr_conf_rx_flags_21_ku(time_21_ku)		x			
flag_instr_conf_rx_flags_85_ku(time_85_ku)	x				
flag_instr_conf_rx_in_use_20_ku(time_20_ku)			x	x	x
flag_instr_conf_rx_in_use_21_ku(time_21_ku)		x			
flag_instr_conf_rx_in_use_85_ku(time_85_ku)	x				
flag_instr_conf_rx_str_in_use_20_ku(time_20_ku)			x	x	x
flag_instr_conf_rx_str_in_use_21_ku(time_21_ku)		x			
flag_instr_conf_rx_str_in_use_85_ku(time_85_ku)	x				
flag_instr_conf_rx_trk_mode_20_ku(time_20_ku)			x	x	x
flag_instr_conf_rx_trk_mode_21_ku(time_21_ku)		x			
flag_instr_conf_rx_trk_mode_85_ku(time_85_ku)	x				
flag_instr_mode_att_ctrl_20_ku(time_20_ku)			x	x	x
flag_instr_mode_att_ctrl_21_ku(time_21_ku)		x			
flag_instr_mode_att_ctrl_85_ku(time_85_ku)	x				
flag_instr_mode_flags_20_ku(time_20_ku)			x	x	x
flag_instr_mode_flags_21_ku(time_21_ku)		x			
flag_instr_mode_flags_85_ku(time_85_ku)	x				
flag_instr_mode_op_20_ku(time_20_ku)			x	x	x
flag_instr_mode_op_21_ku(time_21_ku)		x			
flag_instr_mode_op_85_ku(time_85_ku)	x				
flag_mcd_20_ku(time_20_ku)			x	x	x
flag_mcd_21_ku(time_21_ku)		x			
flag_mcd_85_ku(time_85_ku)	x				
surf_type_01(time_cor_01)	x	x	x	x	x

	FBR		L1b		
	SAR	SARin	LRM	SAR	SARin
flag_trk_cycle_20_ku(time_20_ku)			x		
h0_applied_20_ku(time_20_ku)			x	x	x
h0_applied_21_ku(time_21_ku)		x			
h0_applied_85_ku(time_85_ku)	x				
h0_fai_word_20_ku(time_20_ku)			x	x	x
h0_fai_word_21_ku(time_21_ku)		x			
h0_fai_word_85_ku(time_85_ku)	x				
h0_lai_word_20_ku(time_20_ku)			x	x	x
h0_lai_word_21_ku(time_21_ku)		x			
h0_lai_word_85_ku(time_85_ku)	x				
hf_fluct_total_cor_01(time_cor_01)	x	x	x	x	x
instr_cor_gain_rx_20_ku(time_20_ku)			x	x	x
instr_cor_gain_rx_21_ku(time_21_ku)		x			
instr_cor_gain_rx_85_ku(time_85_ku)	x				
instr_cor_gain_tx_rx_20_ku(time_20_ku)			x	x	x
instr_cor_gain_tx_rx_21_ku(time_21_ku)		x			
instr_cor_gain_tx_rx_85_ku(time_85_ku)	x				
instr_cor_range_rx_20_ku(time_20_ku)			x	x	x
instr_cor_range_rx_21_ku(time_21_ku)		x			
instr_cor_range_rx_85_ku(time_85_ku)	x				
instr_cor_range_tx_rx_20_ku(time_20_ku)			x	x	x
instr_cor_range_tx_rx_21_ku(time_21_ku)		x			
instr_cor_range_tx_rx_85_ku(time_85_ku)	x				
instr_ext_ph_cor_20_ku(time_20_ku)					x
instr_ext_ph_cor_21_ku(time_21_ku)		x			
instr_int_ph_cor_20_ku(time_20_ku)					x
instr_int_ph_cor_21_ku(time_21_ku)		x			
seq_count_20_ku(time_20_ku)	x	x	x	x	x
seq_count_21_ku(time_21_ku)					x
seq_count_85_ku(time_85_ku)				x	
inter_base_vec_20_ku(time_20_ku,space_3d)			x	x	x
inter_base_vec_21_ku(time_21_ku,space_3d)		x			
inter_base_vec_85_ku(time_85_ku,space_3d)	x				
inv_bar_cor_01(time_cor_01)	x	x	x	x	x
iono_cor_01(time_cor_01)	x	x	x	x	x
iono_cor_gim_01(time_cor_01)	x	x	x	x	x
lat_20_ku(time_20_ku)			x	x	x
lat_21_ku(time_21_ku)		x			

	FBR		L1b		
	SAR	SARin	LRM	SAR	SARin
lat_85_ku(time_85_ku)	x				
lat_avg_01_ku(time_avg_01_ku)			x	x	x
load_tide_01(time_cor_01)	x	x	x	x	x
lon_20_ku(time_20_ku)			x	x	x
lon_21_ku(time_21_ku)		x			
lon_85_ku(time_85_ku)	x				
lon_avg_01_ku(time_avg_01_ku)			x	x	x
look_angle_start _20_ku(time_20_ku)				x	x
look_angle_stop _20_ku(time_20_ku)				x	x
noise_power_20_ku(time_20_ku)			x	x	x
noise_power_21_ku(time_21_ku)		x			
noise_power_85_ku(time_85_ku)	x				
mod_dry_tropo_cor_01(time_cor_01)	x	x	x	x	x
mod_wet_tropo_cor_01(time_cor_01)	x	x	x	x	x
ocean_tide_01(time_cor_01)	x	x	x	x	x
ocean_tide_eq_01(time_cor_01)	x	x	x	x	x
orb_alt_rate_20_ku(time_20_ku)			x	x	x
orb_alt_rate_21_ku(time_21_ku)		x			
orb_alt_rate_85_ku(time_85_ku)	x				
ph_slope_cor_20_ku(time_20_ku)					x
ph_slope_cor_21_ku(time_21_ku)		x			
ph_diff_waveform_20_ku(time_20_ku, ns_20_ku)					x
pole_tide_01(time_cor_01)	x	x	x	x	x
pwr_waveform_20_ku(time_20_ku, ns_20_ku)			x	x	x
pwr_waveform_avg_01_ku(time_avg_01_ku, ns_avg_01_ku)			x	x	x
rec_count_20_ku(ns_20_ku)			x	x	x
rec_count_21_ku(ns_21_ku)		x			
rec_count_85_ku(ns_85_ku)	x				
sat_vel_vec_20_ku(time_20_ku,space_3d)			x	x	x
sat_vel_vec_21_ku(time_21_ku,space_3d)		x			
sat_vel_vec_85_ku(time_85_ku,space_3d)	x				
solid_earth_tide_01(time_cor_01)	x	x	x	x	x
stack_centre_20_ku(time_20_ku)				x	x
stack_centre_angle_20_ku(time_20_ku)				x	x
stack_kurtosis_20_ku(time_20_ku)				x	x
stack_number_after_weighting_20_ku(time_20_ku)				x	x
stack_number_before_weighting_20_ku(time_20_ku)				x	x

	FBR		L1b		
	SAR	SARin	LRM	SAR	SARin
stack_scaled_amplitude_20_ku(time_20_ku)				x	x
stack_skewness_20_ku(time_20_ku)				x	x
stack_std_20_ku(time_20_ku)				x	x
stack_std_angle_20_ku(time_20_ku)				x	x
time_20_ku(time_20_ku)			x	x	x
time_21_ku(time_21_ku)		x			
time_85_ku(time_85_ku)	x				
time_avg_01_ku(time_avg_01_ku)			x	x	x
time_cor_01(time_cor_01)		x	x	x	x
time_cor_01(time_cor_01)	x	x	x	x	x
tot_gain_ch1_20_ku(time_20_ku)			x	x	x
tot_gain_ch1_21_ku(time_21_ku)		x			
tot_gain_ch1_85_ku(time_85_ku)	x				
tot_gain_ch2_20_ku(time_20_ku)			x	x	x
tot_gain_ch2_21_ku(time_21_ku)		x			
tot_gain_ch2_85_ku(time_85_ku)	x				
transmit_pwr_20_ku(time_20_ku)			x	x	x
transmit_pwr_21_ku(time_21_ku)		x			
transmit_pwr_85_ku(time_85_ku)	x				
uso_cor_20_ku(time_20_ku)			x	x	x
uso_cor_21_ku(time_21_ku)		x			
uso_cor_85_ku(time_85_ku)	x				
window_del_20_ku(time_20_ku)			x	x	x
window_del_21_ku(time_21_ku)		x			
window_del_85_ku(time_85_ku)	x				
window_del_avg_01_ku(time_avg_01_ku)			x	x	x

Appendix B: Default Setting of the Attribute: _FillValue

By design, each variable of the CONFORM products has got a _FillValue attribute, which contains the default value of that variable, i.e. the value the variable holds when its content hasn't been changed by the Cryosat processing.

The only exceptions to this rule are the variables that use the whole validity range of their types and these are:

Variables with no _FillValue			
name	**type**	**units**	**comment**
cplx_waveform_ch1_i_x_ku(time_x_ku,np_ku)	byte	count	power waveforms i samples (ch1)
cplx_waveform_ch1_q_x_ku(time_x_ku,np_ku)	byte	count	power waveforms q samples (ch1)
cplx_waveform_ch2_i_x_ku(time_x_ku,np_ku)	byte	count	power waveforms i samples (ch2)
cplx_waveform_ch2_q_x_ku(time_x_ku,np_ku)	byte	count	power waveforms q samples (ch2)
seq_count_20_ku(time_20_ku)	short	count	Source Sequence Counter read from the L0 echo telemetry packet
pwr_waveform_avg_01_ku(time_avg_01_ku, ns_avg_01_ku)	ushort	count	1Hz averaged fully-calibrated power waveform. Obtained by averaging all individual L0 echoes covering approx 1 second after range compressopon. Units are counts scaled to fit in the range 0-65535.
pwr_waveform_20_ku(time_20_ku, ns_20_ku)	ushort	count	The L1b 20Hz power waveform is a fully-calibrated, high resolution multilooked waveform. Units are counts scaled to fit in the range 0-65535.
rec_count_20_ku(time_20_ku)	int	count	Record counter - progressive counter incremented by 1 for each data block.

For the above variables, the _FillValue is missing but it is possible to figure out whether the variables are meaningful or not by checking the status of some flags.

In particular, as to the counters (i.e. rec_count_20_ku and seq_count_20_ku) there is no way to know whether they are meaningful so the only case when their contents shouldn't be used (as any other variables) is when the whole block containing the conters are flagged as invalid (i.e. the following bitfields are set in flag_mcd_20_ku: `block_degraded blank_block datation_`)

Likewise specific bitfields in the same flag are devoted to flag the validity or the errors in the wavefomrs.

For all the remaining variables (with a few exceptions, see later) the default _FillValue for each type is as follows:

_FillValue Specific Settings	
variable type	**_FillValue**
byte	-128b
double	NaN
int	-2147483648
int64	–9223372036854775808LL
short	-32768
ushort	32767US

The above convention is not used in the following cases:

_FillValue Default Settings			
Variable Name	**Variable Type**	**_FillValue**	**Note**
flag_cor_error_01(time_cor_01)	int	-1	
flag_cor_status_01(time_cor_01)	int	-1	
flag_echo_01(time_avg_01)	short	-1s	
flag_echo_20_ku(time_20_ku)	short	-1s	
flag_instr_conf_rx_bwdt_20_ku(time_20_ku)	int	-1	
flag_mcd_20_ku(time_20_ku)	int	-1	
stack_ kurtosis _20_ku(time_20_ku)	short	-999	This is the default value used in the EE product
stack_ skewness _20_ku(time_20_ku)	short	-999	This is the default value used in the EE product
uso_cor_20_ku(time_20_ku)	int	2147483647	It has been observed a negative drift in time of the uso correction, then choosing the max positive value as _ FillValue seems to be the safest choice.

Appendix C: Timestamps Data Type

All the timestamps used in the CONFORM products represent the number of seconds since 1/1/2000 in double precision.
In this appendix it is shown that the current choice allows the represent timestamps with a precision of 1 microsecond till January 2034.

As the timestamps are typically added to or subtracted from each other, in order to preserve the precision of these operations down to the microsecond, we need to keep the exact representation of the number till the 10^{-7}, whose binary representation is around 2^{-23}, i.e. 23 bits are needed to represent the decimal part of the timestamps with a precision till 0,1 microseconds
The IEEE 754 standard representation for double precision type reserves 54 bits for the representation of the mantissa (53 bits plus 1 implicitely set), which means that the number of bits left to be used to represent the integer part of the number of seconds is : 53-23 = 30 bits, which means that we have at disposal 2^{30} -1 = 1,073,741,823 sec, i.e. 34 years.

Accordingly, the current representation allows to represent and manage timestamps in the CONFORM without issues in arithmetic operations till January 2034, a date compatible with the mission lifetime.

Appendix D: EE to netCDF migration

The purpose of this section is to give the Cryosat users some insight into the criteria adopted to implement the migration from EE to CONFORM hoping that this can ease the analysis of the products in the new format.

The logic driving the migration is that this operation has to be implemented in two steps:

1. A version of the IPF1 software has to be released that generates baseline C CONFROM products. This IPF1 version as well as the baseline C CONFORM products are hidden versions, i.e. the software is not installed in the operational platform and the products are not distributed but to a selected groups of users to receive their feedback and suggestions for improvements.
2. The first official version of the IPF1 CONFORM software has to be the baseline D that has to generate CONFORM products containing some evolution from baseline C.

Accordingly the contents of this section are applicable to the step one only, i.e. they explain how the baseline C CONFORM products have been designed.

As of baseline D, the format will evolve without any relation to the EE format.

The Earth Explorer Cryosat Product consists of two files (figure 6-1):

- The XML Header File
- The Product File.

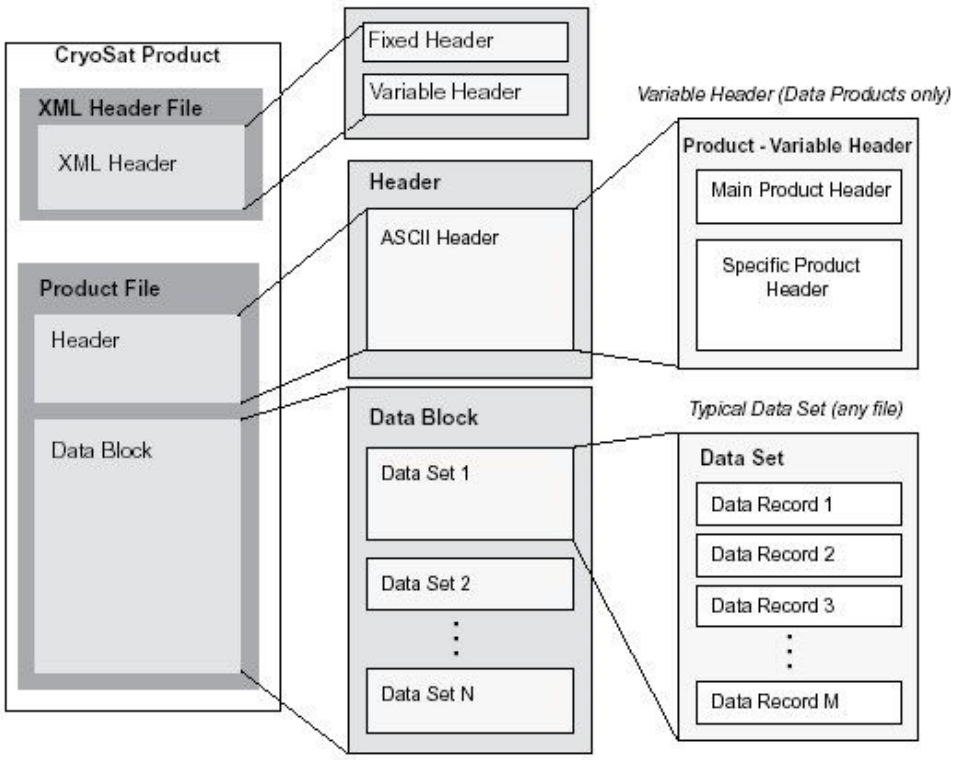

Figure 6-1: EE Product Structure

The CONFORM products consists of one file that contains the same information as the EE Product File whilst the XML Header File doesn't exist anymore in CONFORM and will no longer referred to in this section.

The EE Product File is defined taking the ENVISAT level-0 products as template and consists of:

- Main Product Header (MPH)
- Specific Product Header (SPH)
- Data Sets

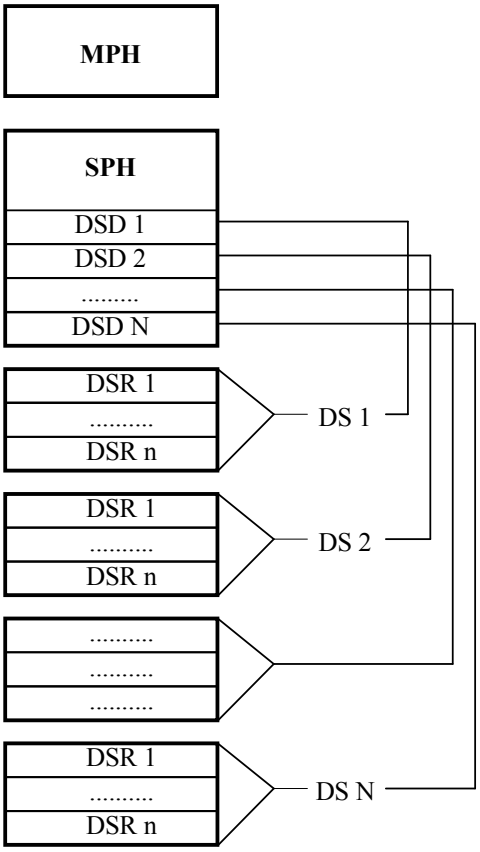

Figure 6-2: EE Product File Structure

The MPH and SPH blocks are ASCII whereas the Data Sets are completely binary and each of them contains one or more Data Set Records.
All the EE CryoSat Products that have migrated to the netCDF format contain one DS.

The general rules driving the migration are:

- The contents of the MPH and SPH have to be converted into netCDF global attributes
- each DS fields has been converted into a netCDF variable
- Grouping within the product is only logical (i.e. the group feature of the netCDF 4.0 is not used but the rationale is kept in the variable naming)
- Three time dimensions are used:
    - One time stamp for each 1Hz measurement.
    - One time stamp for each 20Hz measurement.

- One time stamp to tag the time when the correction is applied.

- 20 Hz measurements are linked to the corresponding 1 Hz measurement by means of one index.
- _FillValue attribute is always filled with limited exceptions.
- Coding of binary flags:
  - For flags coded in a single bit the same convention as S6 GPP is used
  - For flags coded on more than one bit, a variable will be created

END OF DOCUMENT