ENVISAT RA-2/MWR
Level 2 User Manual

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1.0	05/01/2006	QWG review
1.1	20/06/2006	Spelling correction
1.3	20/01/2010	Review version in line with Linux IPF 6.02L04 and for BoM reprocessing

1 RA-2/MWR PRODUCT USER GUIDE

1.1 Introduction

EnviSat is the follow-on altimetry mission to ERS1 and ERS2. This new mission supports ten different onboard instruments dedicated to the global observation of our environment. Our interest relates to ocean and ice observation using the RA-2 radar altimeter and the MWR microwave radiometer.

A complete description of the new RA-2 and MWR instruments can be found in the RA-2/MWR Product handbook, at http://envisat.esa.int/dataproducts/ [RD 1].

In this document, the NRT (Near Real Time) product term is used for FDGDR and/or FDMAR data processed with the IPF processing chain, whereas the OFL (Offline) product term is used for IGDR, IMAR, GDR and SGDR data processed with the CMA processing chain.

The only data that are considered as valid for altimetry are the ones from 25 September 2002 onwards.

1.2 Handbook Purpose and Overview

This user manual is an extract from the complete Product Handbook [RD 1] which describes all the data from Level 0 to Level 2 including Level 1B. The aim of this user manual is to provide the user with information that is limited to the formats and content of the Level 2 Geophysical Data Record (GDR) product.

Section 1 gives an overview of the Altimetric system's health

Section 2 provides general information about the convention used to build the product

Section 3 gives an historical version of the processing chains and provides information on re-processing chains

Section 4 describes the PDS structure of the overall products

Section 5 provides a description of each product's field

Section 6 gives the differences between all the Level 2 products

Section 7 gives some altimetry applications

Section 8 describes some software and tools developed for EnviSat

Section 9 gives some general information

Section 10 is the glossary

Section 11 includes the references

Annex 1 gives the Level 2 products table from near real time (NRT), to offline (OFL)

Annex 2 provides a table that includes the cycle number and its start and end date for the first hundred cycles

1.3 Altimetric system health overview

1.3.1 USO

The Ultra Stable Oscillator (USO), inside the FGCU, is the frequency reference of the instrument. It is used by the instrument to conduct the range measurements. It is well known that altimetry measurements are extremely accurate. This is the reason why the altimeter needs an ultra stable clock, which is provided in the RA-2 L0 product with 40 bits.

Since the USO is the RA-2 frequency reference used to conduct the range measurements, or in other words to position the range window, the range window computation inside the level 1b processor will need to use that USO frequency (or clock period).

The USO, as its name indicates, is supposed to be very stable. However, they usually have a drift, which shall be accurately monitored. The real USO frequency (or period) is nominally provided in the USO auxiliary file for its use in the range window computation.

Since February 2006 the RA-2 USO period has increased by a significant fraction of about 7 ppm. Compared to the nominal period of 12500 ps, about 0.088 ps (88 femtoseconds) has been added, along with a variation around the orbit with a peak-to-peak amplitude of about 5 fs [RD 21]. When the anomaly occurs, the USO period increases rapidly during several hours to reach about 12500.090 picoseconds and from then starts to oscillate with a 0.005 ps amplitude [RD 22]. This has induced a range bias which is characterised by a relatively constant offset of about 5.6 meters, and an additional 1-cpr non harmonic variation around the orbit with an amplitude of about 10-20 cm [RD 21].

The USO period can be characterised by two components:

- a linear behaviour (non harmonic), that models the USO drifts with its ageing;
- a harmonic components that varies around the satellite orbit.

The USO clock period is calculated in this section, to be used later in the following sections to calculate the calibrated AGC and the Window Time Reference Extraction.

1.3.1.1 USO anomaly

The Ultra Stable Oscilator (USO) onboard ENVISAT has gone through different behaviors since the beginning of the mission. Figure 1-1 synthesizes the periods when it was affected by the USO anomaly.

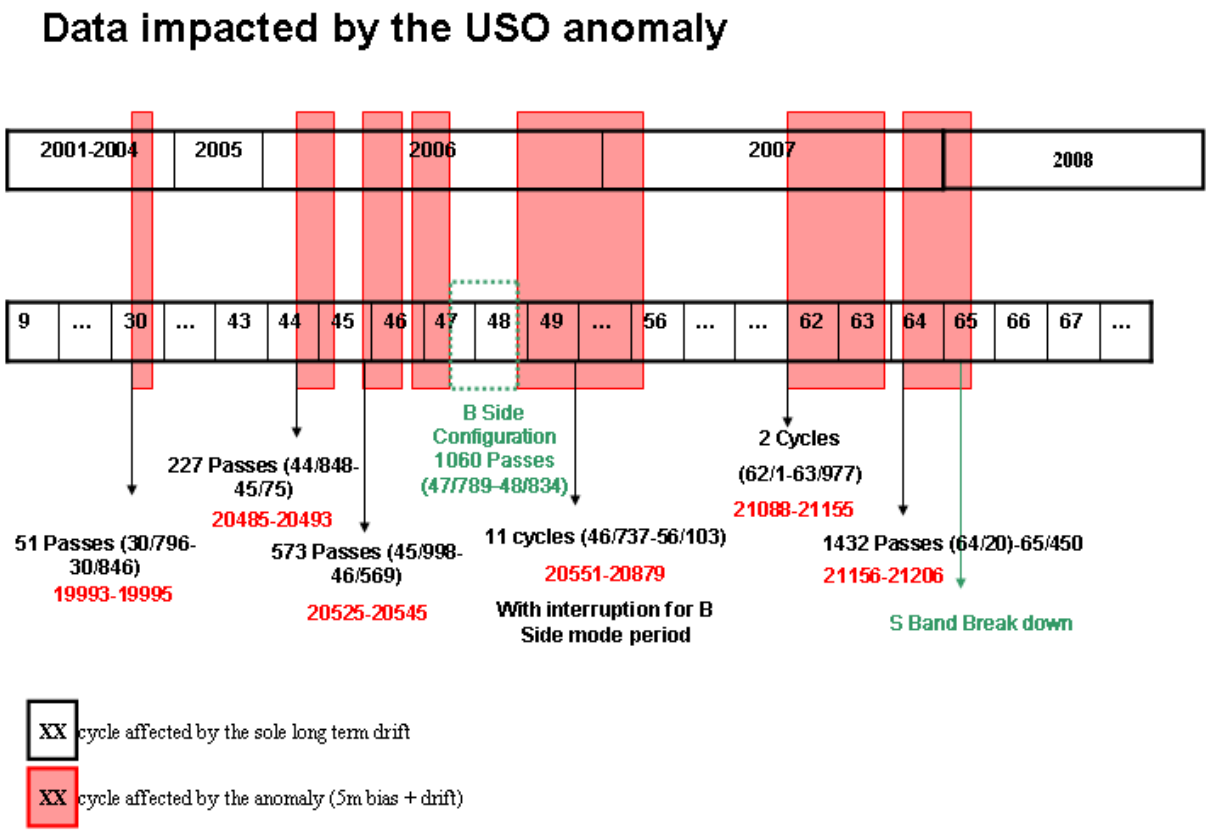


Figure 1-1: USO anomalies chronology

The USO Clock Period anomaly was almost permanently present during 2006 and 2007. It started in cycle 44, on date 1 Feb 2006 12:04:30, Orbit = 205181. It directly happened after the recovery of the RA-2 on-board anomaly which occurred on the 2006/02/01 at 05:17:56. During the anomalous period, the altimetric range jumped by several meters (about 5.6m) w.r.t. the Mean Sea Surface due to an anomaly in the USO clock period. Moreover, oscillations at the orbital period with an amplitude of 20-30 cm affect the Sea Level Anomaly making the range unusable for both Ku and S Band. The anomaly persisted intermittently until the 15th of May 2006 14:21:50, Orbit = 21994, when the instrument was configured to its RFSS B-side. It appeared again when the instrument was reconfigured to its nominal RFSS A-side on date 21 June 2006 13:20:15, Orbit = 22523. The anomaly reappeared after the instrument recovery on date 27th of September 2007 11:13:30 and disappeared again for an unknown reason on date 3rd of December 2007 03:00:00. The anomaly was back again on the 4th of December 2007 13:50:00 and it lasted until the 23rd January 2008 14:11:35, orbit nb 30840. Note that the correction comes back to its nominal value in several steps, causing small uncertainties on the associated correction.

1.3.1.2 Description of the agreed solution to correct the data from USO

The method that has been used since the beginning of the EnviSat mission, in order to correct for the long term USO drifts, is based on the comparison between the USO clock and an

external clock (the platform clock). The USO clock period is calculated for each time t [RD23] as follows:

$$\text{USO\_clock}(t) = \frac{\text{Datation\_OBDH}(t - step/2) - \text{Datation\_OBDH}(t + step/2)}{\text{USO\_dat}(t - step/2) - \text{USO\_dat}(t + step/2)} \qquad \text{Eq.1}$$

where OBDH is the On-Board Datation Handling, the time given by the platform clock (actually this parameter is referenced to the UTC through the UTC_SBT_Time parameter).

Fundamentally the method proposed now for the USO anomaly correction is the one currently used to correct by the long term USO drift. The difference lies in the choice of the step value. Currently the value of the step in the function that determines the USO drift is set to 86400 seconds, which is equivalent to 1 day. This value was chosen during the EnviSat Commissioning phase when we observed that any smaller value would not provide us with the required USO period accuracy. With this value of step we will not be able to determine any orbital variation of the USO period. The DPQC team performed a study where they determined that the adequate value in order to see the orbital fluctuations the USO period was showing, was 100 seconds. The choice of a step=100 s seemed to be a good compromise between a good restitution of the short wave length, and a low noise level [RD23]. However, this noise level needs to be carefully assessed.

Applying a noisy correction to the altimetric range would decrease the range performance. Therefore, this USO period has to be filtered before is used to compute the Window Delay [RD 20, Section 5.1.7] and the calibrated AGC [RD 20, Section 5.1.8]. The filter to be used is a **Spline Regression Filter**: it removes the high frequency, fills in the gaps and reduces the side effects.

A compromise shall be found between smoothing the signal and keeping all the useful information. The filtering needs to be performed product by product.

Implementation Steps:

The high-level implementation steps shall be:

1. use the above equation [Eq.1] to determine the preliminary USO period, data block per data block, until the product is finished.
2. Collect all the preliminary USO periods.
3. Calculate the USO period by applying a filtering to them, to smooth the values.
4. Use these new USO smoothed period‘s as input (USO_clock) of function 5.1.7 “Window Time Reference Extraction” that calculates the Window Delay [RD 20, eq. 5.1.7.3-1], for both Ku and S bands; and the “AGC Calibration” function 5.1.8, that calculates the middle AGC applied to the average waveform [RD 20, eq. 5.1.8.3-1 and eq. 5.1.8.3-2] for Ku and S bands respectively.

1.3.2 S-Band power drop

The RA2 S-Band transmission power dropped on 17 January 2008. This occurred in the South Atlantic Anomaly, showing similar characteristics as for the RA-2 RFSS Side B S-

Band power drop anomaly occurred in May 2006. Consequently, all the S-Band parameters, as well as the parameters that depend on the S-Band are not relevant anymore, and MUST NOT be used from the following date: **17 January 2008, 23:23:40, UTC, orbit nb 30759**. The parameters that depend on the S-Band are the:

- Dual ionospheric correction in both band which are not more relevant. Users are advised to use the Ionospheric correction from Bent model, which is available in FGDR data products, and GIM ionospheric correction which is available for IGDR and GDR products.
- Rain flag which is no longer relevant.

Investigations have been conducted and the failure of the S-Band power stage is considered to be permanent since **17 January 2008, 23:23:40, UTC, orbit nb 30759**.

1.3.3 RA2 into B-Side and particular Chirp bandwidth

Due to the USO anomaly it has been decided to switch the RA2 instrument to its B-Side.

Before the switch, on 12th-13th May, a special operation was executed to limit RA-2 Chirp Bandwidth to:

- 80MHz, starting from 12 May at.15.51.37,
- 20 MHz, starting from 13 May at.03.57.57,
- 320MHz, starting from 13 May at.15.10.17.

During cycle 47 the instrument sub-system Radio Frequency Module (RFM) was switched to its B-side on **15 May 2006 at 14:21:50, Orbit = 21994**. After a few days of promising operations with the RFM B-side, its S-band transmission power dropped on 20 May 2006 at 13:24:57, Orbit=22065, making all the S Band related parameters meaningless.

Due to the lost of the S-Band, the Envisat RA-2 sensor has been successfully reconfigured on its nominal side (RFSS A-side) and was commanded back into Measurement Mode on **June 21, 2006 at 13.20.15.000 UTC time, Orbit = 22523**. The analysis of the RA-2 data shows an expected behaviour of the RA-2 parameters but also confirmed the persistence of the abnormal RA-2 Ultra-Stable Oscillator (USO) behaviour affecting the Altimetric Range by few meters.

1.3.4 TB36 drift

Since the beginning of the mission, all MWR instrumental parameters (sky horn counts, hot load counts, gain, residual temperature) measured at 36.5 GHz are drifting with time

An in depth analysis of the instrument behaviour was performed. The conclusion was that the gain drift was the same, whatever the observed brightness temperature. This observation shows that the problem does not come from the detector, as suspected, but probably is inside the amplifier part of the system.

2 CONVENTIONS

2.1 Vocabulary

The radar altimetry user community has developed a vocabulary of common terms which have a specific meaning. While these are (mostly) clear to experienced users the terms can be confusing to newcomers. This section explains the common terms and conventions used within this User Manual.

AGC (automatic gain control) is the setting of the onboard receiver attenuator as transmitted by telemetry.

Altitude is the distance of a satellite's centre of mass above a reference point on the earth. The reference point will usually be on a geodetic reference frame or at the centre of the Earth. The altitude is given by the orbit computation.

Default value: when a physically meaningful value cannot be computed, a default value is provided. It is in most cases the maximum value of the field. There may be exceptions, in which case a particular description of the default value is provided.

Elementary measurements are the twenty measurements in the source packet.

Flags are used to convey quality information or operating modes. They are usually set to zero to mean ‘OK’ and 1 for ‘not OK’. Any spare flags are set to zero. There may be exceptions, in which case a particular description of the flag's use is provided.

Footprint is the area on the Earth's surface illuminated by the radar pulse. The altimeter boresight is pointed at nadir and the antenna half-power beamwidth is 1.3 degrees. At a height of 800 km this corresponds to a circular area 18 km across. However the short duration of the radar pulse normally means that a much smaller area of illumination is seen by the instrument. This is often referred to as the Pulse Limited Footprint.

Geophysical corrections are used to adjust the measurement for environmental effects (e.g. tropospheric, ionospheric) or to remove a geophysical signal of no (or even detrimental) interest to the application pursued (e.g. tides). These corrections are external to the measurement and come from other sources of data and models.

Height is the elevation of the mean surface observed at nadir above the reference ellipsoid. As a first approximation it is calculated from range and altitude (height = altitude - range).

Instrument source packet is a group of twenty elementary measurements packaged onboard and downlinked by telemetry. It holds the basic science data.

Individual echoes, or individual waveforms, are the 1800 Hz un-averaged waveforms. No other radar altimeter provided individual echoes prior to RA-2.

Orbit is one revolution around the Earth, when referring to the amount of data. Otherwise it refers to the positioning of the satellite; its orbital altitude. The Level 2 NRT products are organised by data flow, generally covering one orbit.

Pass is a half orbit going from pole to pole, ascending or descending. There are 1002 passes per cycle. The Level 2 OFL products are organised by pass.

Range is the one-way distance from the satellite to the mean surface below. It is referenced to the satellite's centre of gravity. It is the principal measurement of the radar altimeter. Range is estimated from the echo waveforms as part of the process called retracking.

Reference Ellipsoid is the WGS 84, defined by: Equatorial radius = 6378.137 km and Flattening coefficient = 1/298.2572236.

Sea level is synonymous with sea surface height (SSH).

Sea surface height = Satellite Altitude – (Measured Range + Corrections).

Sea surface topography, or dynamic topography, is the departure of the sea surface from an equipotential surface, the marine geoid.

Sigma0 is the backscatter estimate calculated from the AGC and the power level of the radar echo. The signal path attenuation, as calculated from the in-flight calibration records, is applied. To compute an accurate Sigma0, geophysical corrections such as liquid water and water vapour attenuation must be applied.

Slope refers to the gradient of the leading edge of the radar echo, so called the leading-edge slope.

Significant **W**ave **H**eight **(SWH)** is a measure of the sea state approximately equal to the average of the highest one-third of ocean waves in a given area or period of time and is calculated from the radar echo leading edge slope.

Time delay is the basic onboard instrument measurement converted to standard physical units. It is the two-way travel time of the radar pulse from the satellite to the surface and back. It is uncalibrated. The measurement is referenced to the centre of the range window: that is bin 63 (in the range 0 - 127) for the Ku-band window, and bin 31 (in the range 0 - 63) for the S-band window.

2.2 Filenaming conventions

The naming convention for products is described in "ENVISAT-1 Product Specifications Volume A: Product Data Conventions" [RD 2].

filename = <product_ID> <processing_stage_flag><originator_ID><start_day> <"_"> <start_time> <"_"> <duration> <phase>

<cycle> <"_"> <relative_orbit> <"_"> <absolute_orbit> <"_"><counter><"."> <satellite_ID> <.extension>

For Level 2 the product ID, WWW_XXX_YZ could be:

RA2_FGD_2P

for fast delivery geophysical data records from RA-2 and MWR available three hours after data acquisition

RA2_IGD_2P

for intermediate geophysical data records from RA-2 and MWR, processed off-line and available three to five days after acquisition

RA2_GDR_2P

For geophysical data records from RA-2 and MWR processed off-line and available 50 days after acquisition

RA2_WWV_2P

For wind/wave products for NRT dissemination to Meteo users

RA2_MWS_2P

For sensor data records from RA-2 and MWR, as well as Individual Uncalibrated Waveforms from RA-2

2.3 Correction Conventions

The geophysical correction given in the Level 2 products already has the appropriate sign and is to be added to the range.

The correction that has to be added to the measured range is usually as follows:

Geophysical Corrections = Inverse Barometer + Sea State Bias + Ionospheric Correction + Ocean Tide + Polar Tide + Earth Tide + Wet Tropospheric Correction + Dry Tropospheric Correction.

The instrumental range correction has already been added to the range. This correction is based on Doppler correction, time delay flight calibration and time delay ground calibration:

Instrumental Range Correction = Doppler correction + Time Delay Flight Correction + Time Delay Ground Correction

2.4 Time Convention

The convention for the EnviSat mission is to use a Modified Julian Day which is referenced to Universal Time from a datum of 1st January 2000.

2.5 Flagging and Editing

The L1b processed data are the ones with:

- operating mode set to RA-2 nominal tracking,
- waveform quality flags set to OK (= 0) meaning that the waveform samples are not set to 0.

Over the ocean, users are advised to edit the data according to:

Min. Value	Parameters	Max. Value	Unit (SI)
-2	SSH – mean sea surface height	2	m
10	Number of 18 Hz valid points for Ku-band	20	/
0	Range Standard deviation	0.25	m
-0.2	Off-Nadir angle square of the satellite from waveforms	0.16	deg^2
-2.5	Dry tropospheric correction	-1.9	m
-2	Inverse barometer correction or MOG2D correction	2	m
-0.5	MWR Wet tropospheric correction	-0.001	m
-0.4	Ionospheric correction (Bent or GIM)	-0.04	m
0	Significant wave height	11	m
-0.5	Sea State Bias	0	m
7	Backscatter coefficient	30	db
-5	Ocean tide correction	5	m
-0.5	Long period equilibrium	0.5	m
-1	Earth tide correction	1	m
5	Polar tide correction	5	m
0	Wind speed	30	m/s

Table 2-1: Proposed criteria for editing data over Ocean

2.6 Default Values

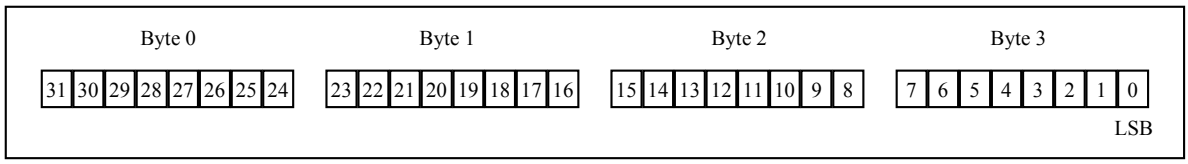
Any field of the Level 2 output product which cannot be computed or determined during processing will be set to its default value.

- For an MCD indicator (one bit of a bit field) the default value is “1”, except for ‘spare’ bits which must be set to “0”.
- For an ASCII field, the default value is the corresponding string of blank characters.
- For any other field, the default value is the maximal value of the corresponding field (e.g. 65535 for an unsigned 2-byte integer).

2.7 Bit Fields order

The N-bits of a bit field are numbered from 0 to N-1, 0 being the LSB. Byte 0 consists of bits N-8 to N-1, byte 1 consists of bits N-16 to N-9, and so on.

This convention is illustrated below in the case of a 32-bit bit field:



Unused bits of a bit field (‘spare’) must be set to "0".

3 SOFTWARE VERSIONS

The Level 1B (L1B) and near real time Level 2 (L2 NRT) data are produced by the IPF processing chain, while the Level 2 offline data are produced with the CMA. The tables below show for each version of the processing chain, the algorithms and auxiliary data files upgrade.

3.1 L1B IPF upgrades

L1B IPF version

IPF Version	Date of issue PDHS-K&E, LRAC	L1B Algorithms upgrades	L1B ADF updates	ADF filename
V4.53	Nov. 27, 2002			
V4.54	Apr. 7, 2003	*Wrong sign in AGC calibration estimate *Missing integrity check for the Data Block number read from the Level 0 Data Blocks *The altitude above CoG and the altitude rate have to be included in the records also in case of dummy records *1Hz data should be referenced to data block 9.5 not block 10	Correction of the Tx-Rx gain of Ku and S band parameters (3.5 dB)	RA2_CHD_AX
V4.56	Nov. 26, 2003	1- Extrapolation of AGC value to the Waveform centre (49.5) for both Ku- and S-band. 2 - Correction for an error found in the evaluation of S band AGC.	RA2 IF Mask	RA2_IFF_AX
V4.57	PDHS-K: 29-04-2004 PDHS-E: 28-04-2004			
V4.58	Aug. 9, 2004			
V5.0.2	Oct. 24, 2005	MWR Side Lobe correction upgrade	- side lobe table and Config param	MWR_SLT_AX MWR_CON_AX
		USO clock period units correction	New ADF format - clock period unit	RA2_USO_AX RA2_CHD_AX RA2_CON_AX
		RA-2 alignment: OBDH & USO datation, IE flags correction		

L1B IPF version

IPF Version	Date of issue PDHS-K&E, LRAC	L1B Algorithms upgrades	L1B ADF updates	ADF filename
		Rain Flag tuning to compensate for the increase of the S band Sigma0	New table in SOI file	RA2_SOI_AX
		Monthly IF estimation		RA2_IFF_AX
		Level 1B S-Band anomaly flag	New format	RA2_CON_AX
		DORIS Navigator CFI upgrade (RA-2 & MWR) Orbit Flag not well implemented: when a DORIS product is used for the processing, the Orbit flag is set to 1 for the whole length of the RA2 L1b product file while it should be set to 1 only for the part of the RA2 product overlapping with the DORIS one. Problem has been traced on OAR 1938 to be solved on next IPF delivery.		
		Correction of the Rx_dist_fine from the Level 0 product, leading to an error in the calculation of the Window_delay (SPR- 058).		
V5.03	Sep. 19, 2006	* Level 1B S-Band anomaly flag well implemented. * Orbit Flag well implemented * Correction of the Rx_dist_fine (for 80 and 20 MHz) from the Level 0 product, leading to an error when applying the IF mask correction on to the waveforms (SPR- 059).		
V 5.06	Jun. 20, 2007	DORIS Navigator threshold update to 900 seconds coverage RA2/DORIS Alignment of Chain B to Prod Spec 3/N.		
V 6.02L04	Feb 15, 2010	• New S-Band Waveform Reconstruction algorithm • New USO correction algorithm • New parameters in the following ADF after Linux IPF validation: - RA2_CON_AX	• Zero Padding Factor, • Minimum and Maximum value of length of the	RA2_CON_AX

L1B IPF version

IPF Version	Date of issue PDHS-K&E, LRAC	L1B Algorithms upgrades	L1B ADF updates	ADF filename
			stack used for averaging the in-flight time dalay calibration factor, • *max_time_lag_sp_Ku_ptr* and *max_time_lag_sp_S_ptr* values.	
		- RA2_CHD_AX	*sigmap* parameter	RA2_CHD_AX
		- MWR_CHD_AX	deactivated the 36.5GHz drift correction	MWR_CHD_AX
		- MWR_SLT_AX	*eta_sky* and *eta_refl* parameters	MWR_SLT_AX

Table 3-1: L1B IPF version

3.2 L2 IPF upgrades

L2 IPF version

IPF Version	Date of issue PDHS-K&E, LRAC	L2 Algorithms upgrades	L2 ADF updates	ADF filename
V4.53	Nov. 27, 2002			
V4.54	Apr. 7, 2003	No update	No update	
V4.56	Nov. 26, 2003	SPR 26 Tuning of the Ice2 retracking	MSS CLS01	RA2_MSS_AX
		New MWR NN algorithms	Rain flag	RA2_SOI_AX
			Updated OCOG retracker thresholds Ice1/Sea Ice Conf file	RA2_ICT_AX
			Sea State Bias Table file	RA2_SSB_AX
			GOT00.2 Ocean Tide Sol 1	RA2_OT1_AX

L2 IPF version

IPF Version	Date of issue PDHS-K&E, LRAC	L2 Algorithms upgrades	L2 ADF updates	ADF filename
			Map file	
			FES 2002 Ocean Tide Sol 2 Map file	RA2_OT2_AX
			FES 2002 Tidal Loading Coeff Map file	RA2_TLD_AX
V4.57	PDHS-K: 29-04-2004 PDHS-E: 28-04-2004	ECMWF meteo files handling		
V4.58	Aug. 9, 2004	Addition of a Pass Number Field in FD Level 2 SPH product		
V5.0.2	Oct. 24, 2005	Handling of the new RA2_CHD_AX ADF format		RA2_CHD_AX
		Rain Flag tuning to compensate for the increase of the S band Sigma0	New table in SOI file	RA2_SOI_AX
		Improving the mispointing estimation	Two needed parameters in SOI file	RA2_SOI_AX
		Export of the Level 1B S-band flag into the Level 2 data product	New format	RA2_SOI_AX
		Export of the Level 1B NRT orbit quality flag into the Level 2 data product		
		Addition of a Pass Number Field in FD Level 2 SPH product		
		Addition of peakiness in Ku and S band in FDMAR		
		Addition of square of the SWH in Ku and S band		
		Correction of MCD flag		
		SPH pass number (field 8) set to 0 in SPH NRT Level 2 data products		
			Addition of GOT2000.2 TLD	RA2_TLG_AX
			New DEM AUX file (MACESS) merge of ACE land elevation data and Smith and	AUX_DEM_AX

L2 IPF version

IPF Version	Date of issue PDHS-K&E, LRAC	L2 Algorithms upgrades	L2 ADF updates	ADF filename
			Sandwell ocean bathymetry	
V 5.03	Sep. 19, 2006	./.Correction for an error found in the Channel 2 brightness temperature	./.	./.
		USO Clock period units correction		
		Rain flag tuning to compensate for the increase in S-Band sigma0		
		Monthly IF mask taken into account		
		DORIS Navigator CFI upgrade		
		S-band anomaly flag		
V5.06	Jun. 20, 2007			
V6.02L04	Feb, 15, 2010	Updated Rain flag algorithm Updated wind table according to ECMWF requirement New Sea_Ice flag algorithm New Ocean Tide and TLD for FES 2004 + additional changes (inc sea state bias)	 Updated values in SOI Add new parameters in SOI file New ADF for OT2 and TLD for FES2004 and updated SOI	RA2_SOI_AX RA2_SOI_AX RA2_SOI_AX RA2_OT2_AX RA2_TLD_AX RA2_SSB_AX

Table 3-2: L2 IPF version

3.3 CMA upgrades

L2 CMA version

CMA Vsn.	Date of issue	IPF Version	Algorithm upgrades	ADF updates	ADF filename
V6.1	Aug. 4, 2003	V4.54 or V4.56	Tuning of the Ice2 retracking New MWR NN algorithms	MSS CLS01	RA2_MSS_AX

L2 CMA version

CMA Vsn.	Date of issue	IPF Version	Algorithm upgrades	ADF updates	ADF filename
				Rain flag	RA2_SOI_AX
				Updated OCOG retracker thresholds Ice1/Sea Ice Conf file	RA2_ICT_AX
				Sea State Bias Table file	RA2_SSB_AX
				GOT00.2 Ocean Tide Sol 1 Map file	RA2_OT1_AX
				FES 2002 Ocean Tide Sol 2 Map file	RA2_OT2_AX
				FES 2002 Tidal Loading Coeff Map file	RA2_TLD_AX
V7.1	Oct. 26, 2005	V5.0.2	Rain Flag tuning to compensate for the increase of the S band Sigma0	New table in SOI file	RA2_SOI_AX
			Handling of the new RA2_CHD_AX ADF format		RA2_CHD_AX
			Improvement of the mispointing estimation	Two parameters needed in SOI file	RA2_SOI_AX
			Export of the Level 1B S-band flag into the Level 2 data product	New format	RA2_SOI_AX
			Addition of square of the SWH in Ku and S band		
			Dry tropospheric correction estimated through the Meteorological Pressure corrected from a climatological value and from S1 and S2 waves.		
			MOG2-D estimation		
			GIM correction		
			Estimation of 20Hz Latitude and longitude parameters		
			IPF L1b version inside the Level 2 product		
			Contribution of S1 and M4 for GOT00.2		

L2 CMA version

CMA Vsn.	Date of issue	IPF Version	Algorithm upgrades	ADF updates	ADF filename
			MWR Land Ocean flag set to Default value (instead 1 which mean Land) if the estimation has not succeed		
			MWR to RA2 interpolation quality flag set to 3 if equal to default value instead of 0, which means "good"		
			Addition of peakiness in Ku and S band in IMAR		
				New DEM MACESS	AUX_DEM_AX
				New Ocean tide and Tidal loading FES2004	
				Addition of GOT2000.2 TLD	RA2_TLG_AX
v8.1	Nov, 30, 2006	Processing integrated in CMA	IBM nodes		
			Correction of S-IGDR anomaly		
9.0	Nov. 27, 2007	BIBLI-ALTI v1.0	Correction of an anomaly in the relative orbit field in product header		
			More robust acquisition and processing chain		
				MOG2D barotropic correction is added in ENVISAT IGDR products	
			ENVISAT IGDR products are generated in 2 days instead of 3 days		
9.1	Jan. 29, 2008	BIBLI-ALTI v2.1	New Sun HW and OS (Solaris 9), no scientific evolutions but this version allows to perform scientific evolutions on one mission without impacting the others		
9.2	June 19, 2008		New POD orbit configuration New Dynamic Atmosphere configuration		

L2 CMA version

CMA Vsn.	Date of issue	IPF Version	Algorithm upgrades	ADF updates	ADF filename
			(DAC/MOG2D High Resolution)		
9.3	February 15, 2010	BIBLI-ALTI v3.1	Update of Rain Flag Inclusion of Ice/Sea-ice Flag FES2004 evolution for loading tide, K2 and S1 coefficient CMA handling of the Altimetry level 1B data product as a result of the implementation of the RA-2 USO correction in the level 1B processing chain Sigma0 to Windspeed table extension (ECMWF model) Removal of the BURST mode from the Envisat S-GDR data product		

Table 3-3: L2 CMA version

3.4 Re-processing data

The data from cycles 9 to cycle 15 have been re-processed with IPF version V4.56 for L1B and CMA version V6.2.01 for Level 2.

Users are advised that the data from cycles 16 to 21 are produced with IPF version V4.54, meaning that the data for to this period do not use the IF mask of IPF version 4.56

Table 3-4 lists the versions of IPF and CMA used in processing the GDR records currently available from the F-PAC

Cycles	IPF Version	CMA Version
9 to 10	4.58	6.3
11 to 12	4.57	6.3
13 to 14	4.56	6.3
15 to 21	4.54	6.1
22 to 24	4.56	6.2

25 to 26	4.56	6.3
27 to 28	4.57	6.3
29 to 40	4.58	6.3
38 to 40	5.02	7.1
41 to 47 pass 790	5.02	7.1
47 to 48 pass 849	5.06	9.0
48 to 51 pass 7	5.02	7.1
51 to 58 pass 843	5.03	8.0
58 to 64	5.06	9.0
65 to 67	5.06	9.1
68 to 86	5.06	9.2
87 onwards	6.02L04	9.3

Table 3-4: versions of IPF and CMA used in processing the GDR

Note that some literature will refer to alphabetic lettering distinguishing between significantly different versions of the GDR, as follows

GDR-a	Cycles 9-40
GDR-b	Cycles 41-67 (IPF 5.02 -5.06, CMA 7-9
GDR-b + new POE	Cycles 68 onwards (IPF 5.06, CMA 9.2)

The reprocessing of the full ENVISAT RA2 mission is foreseen to start in March 2010, which will reprocess the entire mission from Cycle 5 (8th April 2002, start orbit 556).

The Beginning of Mission (BoM) reprocessing will be performed with Linux IPF V602L04 for Level 1b products and CMA 9.3 for Level 2 products.

4 RA-2/MWR LEVEL 2 PRODUCTS

4.1 Introduction

There are six RA-2/MWR Level 2 products: the near real time with the FDGDR and FDMAR products, the interim GDR with the IGDR and IMAR products, and the offline with the GDR and SGDR products.

The Fast Delivery GDR product, **FDGDR**, is processed at the receiving stations and is transmitted in less than three hours, for weather forecasting, sea-state and real-time ocean-circulation applications. An ocean-related parameter subset of the FDGDR called **FDMAR** (for Marine Abridged Record) is extracted to reduce the volume of on-line data transfers. FDMAR is converted into the BUFR format commonly used by meteorological offices.

Less than three days later, the so-called Interim GDR, **IGDR**, for ocean-circulation monitoring and forecasting applications is delivered, replacing the original meteorological predictions with more precise analyses, and the preliminary orbit with an improved orbit solution. An **IMAR** ocean-related parameter is extracted from the IGDR product.

The final **GDR** and **SGDR** products containing the most precise instrument calibrations and orbit solutions are delivered after 30 days (not more than 50 days).

The near real time products, FDGDR and FDMAR, are processed inside the Payload Data Handling Stations at PDHS-E (ESRIN) and PDHS-K (Kiruna).

The Interim Geophysical Data Record (IGDR and IMAR), the final precision Geophysical Data Record (GDR) and SGDR products are processed offline at F-PAC, the French Processing and Archiving Centre in Toulouse.

Figure 4-1 summarises the organisation, the inter-relationships and latency of the product generation. The terminology used to name products is based on the nomenclature traditionally used in altimetry, with the product names stored in the first field of the specific product header.

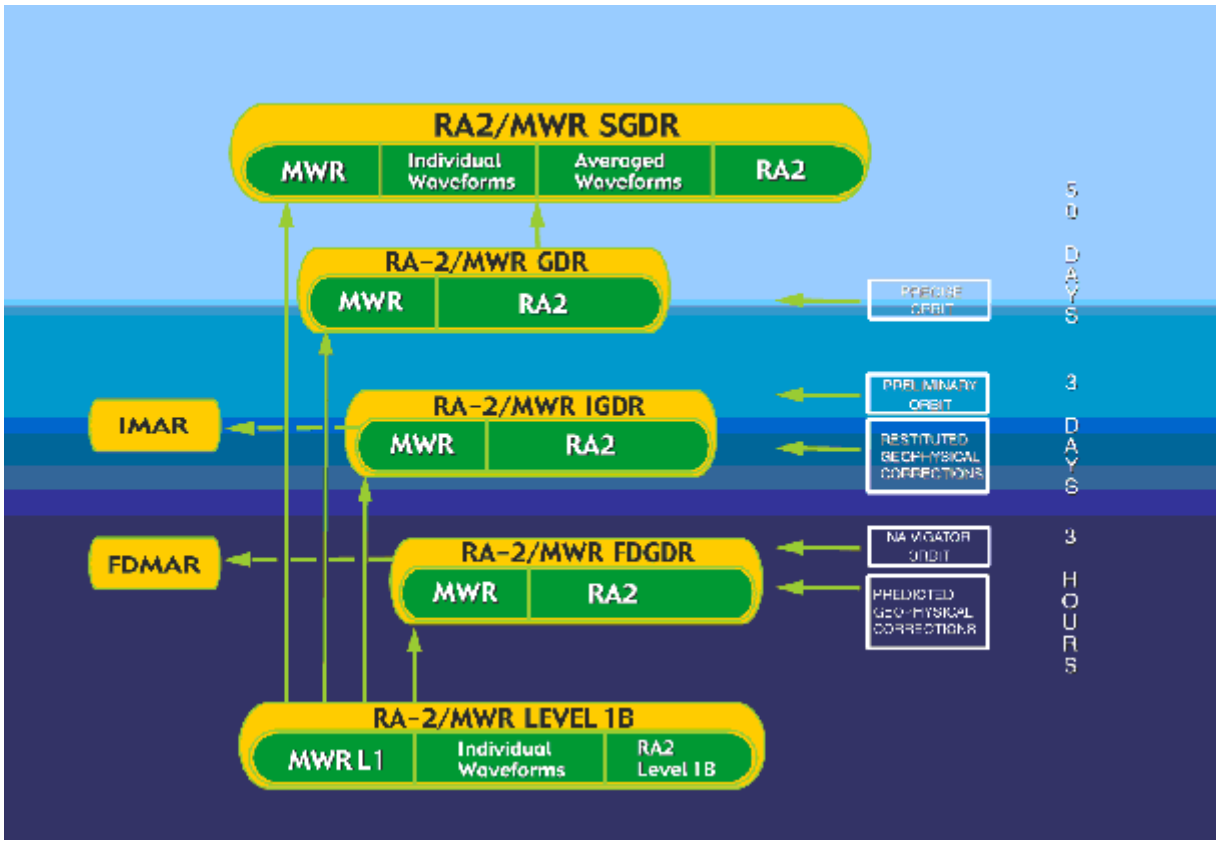


Figure 4-1: The RA-2/MWR Product Tree

The Level 2 geophysical data are converted to geophysical units (with retracking); the product mainly contains parameters for time tagging, geolocation, output from retrackers (range, wind speed, significant wave height, etc.) at 1 Hz, plus some 18 Hz parameters (range, orbital altitude). All geophysical products, including the near-real time products, are retracked (waveform data are fully processed by the ground-based processor to extract the geophysical parameters). In order to retrieve the geophysical parameters over all types of surface (ocean, ice, sea ice, etc.), four specialised retrackers are continuously run in parallel (over all surfaces):

- Ocean retracker: optimised for ocean surfaces and based on a modification of the Hayne model [Hayne, 1980].
- Ice-1 retracker: optimised for general continental ice sheets, a model-free retracker called the 'Offset Centre of Gravity Echo Model'; it is used for ERS and will ensure measurement continuity [Bamber, 1994].
- Ice-2 retracker: optimised for ocean-like echoes from the continental ice-sheet interior, it is a Brown-based model retracking algorithm [Legrésy, 1997].
- Sea-Ice retracker: optimised for specular returns from sea ice, it is a threshold retracking scheme for peaky waveforms [Laxon, 1994].

The usual necessary geophysical corrections are available in the Level-2 products. The ionospheric correction will come from the dual-frequency altimeter, backed-up by

measurements from DORIS, the Bent model and the GIM model. The wet tropospheric correction will come from the onboard microwave radiometer, backed-up by a value computed from ECMWF fields. Users requiring the altimeter waveforms will find them conveniently stored in the Level 2 SGDR product, along with the co-located geophysical corrections and the outputs of the four retrackers. In other words, the SGDR holds the GDR data augmented by averaged and individual waveforms.

4.2 Geophysical Data Record

The Level 2 products will consist of a series of records, each representing approximately one second of data. There shall be sufficient records to cover one pass (i.e., approximately 3,000) formatted from pole to pole when fully consolidated. Records are provided independently of the surface type at the sub-satellite point.

4.3 Product Structure

The high product structure consists of a Main Product Header (MPH), a Specific Product Header (SPH) and some Main Data Sets (MDS), such as the RA-2 MDS, the MWR MDS, the 18 Hz waveform MDS and the Burst waveform MDS.

The high-level product structure for the FD/I/GDR product is shown below.

MPH
Level 2 - SPH
RA-2 MDS
MWR MDS

Table 4-1: Level 2 FDGDR/IGDR/GDR Product Structure

The high-level product structure for the FD/I/MAR product is shown below.

MPH
Level 2 - SPH
RA-2 MDS

Table 4-2: Level 2 FD/I/MAR Product Structure

The high-level product structure for the SGDR product is shown below.

MPH
Level 2 SDR- SPH
RA-2 MDS (from the GDR product)
MWR MDS (from the GDR product)
18 Hz Waveform MDS
Burst Waveform MDS

Table 4-3: Level 2 SGDR Product Structure

5 FIELD DEFINITIONS

The aim of this section is to provide a definition for each product field, containing the following items:

- Mnemonic — Mnemonic of each field
- Field number — Element field number in the record for the GDR product
- Definition — Element definition
- Product Applicability — To which product(s) it belongs
- Comment — Brief definition and comments

The following items are already defined in the corresponding tables:

- Element type — Bitfield, integer, real or string
- Storage type — Signed or unsigned (integer)
  Bit (contiguous sequence of bits)
  Character (contiguous sequence of ASCII characters)
- Size — Element size in 8-bit bytes
- Unit — Element unit

Warning: all the S-Band parameters, as well as the parameters that depend on the S-Band are not relevant anymore, and MUST NOT be used from the following date:

17 January 2008, 23:23:40, UTC, orbit nb 30759

5.1 Level 2 RA-2 MDSR

- **alt_cog_ellip (Field number 09)**

  Altitude of CoG above reference ellipsoid

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  In NRT this is currently obtained by propagating an OSV from the DORIS Navigator orbit file.

  In OFL products, the 1 Hz altitude is obtained by interpolating the OSVs available in the DORIS intermediate (for IMAR and IGDR) and precise (for GDR and SGDR) orbit files.

- **altim_landocean_flag (Field number 144)**

  Altimeter surface type flag

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The flag is based on a land/sea mask file and has the following four meanings:

  – 0: oceans or semi-enclosed seas
  – 1: enclosed seas or lakes
  – 2: continental ice
  – 3: land

- **ave_ku_chirp (Field number 121)**

  Average Ku chirp band

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Ku chirp band value is associated with the minimum of the 20 elementary chirp band indexes in the source packet.

  Possible values:

  – 0 -> if there is at least one record at 320 MHz
  – 1 -> if there is at least one record at 80 MHz (and the others are at 20 MHz)
  – 2 -> if all input records are at 20 MHz

- **dib_hf (Field number 51)**

  DIB value has been coded as a difference from the IB value

  Unit: mm

  Product Applicability: GDR, SGDR
  Default value is set for IGDR/IMAR products
  Spare is set for FDGDR/FDMAR products

  Comment

  This parameter is the difference between the MOG2D estimate and the inverse barometer, where MOG2D is the sum of the high frequency variability of the sea surface height and the low frequency component of the inverse parameter [RD 5].

- **dsr_time (Field number 01)**

  MDSR Time stamp

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Time fields based on UTC are computed for each record. Time is expressed in Modified Julian Day (MJD), elapsed since 01/01/2000.

- **elev_echo_pt (Field number 61)**

  1 Hz Elevation of echoing point

  Unit: cm

  Product Applicability: FD/I/GDR, SGDR

  Comment

  This corresponds to the mean slope-corrected elevation of the echoing points in the geodetic coordinate frame. The 1 Hz value is obtained by averaging only valid elevation measurements (i.e. tracking records for which the Ice-1 leading edge was inside bounds). Where a slope correction is invalid, the elevation value used relates to the elevation at the orbit nadir position corrected for tracker range offset.

- **error_flag_chirp_id_flags (Field number 123)**

  Error flag for chirp band id [20 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Unused bits are set to 1. Bit 0 applies to the first data block.

- **fault_id_flags (Field number 125)**

  Fault identifier [20 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Unused bits are set to 1. Bit 0 applies to the first data block.

- **geocen_pole_tide_ht (Field number 106)**

  Geocentric pole tide height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the geocentric tide height due to polar motion. The predicted and restored (for NRT and OFL processing) polar coordinates are obtained from the IERS centre (International Earth Rotation and Reference Systems Service), that updates the position of the pole approximately twice a week.

  In NRT, the algorithm for the calculation of the polar tide uses the same Love numbers for all surface types, whereas in OFL, different Love numbers are used over ocean and over land.

- **geoid_ht (Field number 99)**

  Geoid height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The geoid model used is EGM96 (Lemoine et al., 1998 [RD 6])

- **hz18_1st_edge_ice2_ku (Field number 93)**

  18 Hz Ku-band slope of the first part of the trailing edge from the Ice-2 retracker [20]

  Unit: 1/s

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Default values (maximum value allowed for that data type) are output whenever the Ku waveform leading edge is not found or the maximum amplitude-thermal noise ratio is too low, as when coming from the Ice-2 retracker.

- **hz18_1st_edge_ice2_s (Field number 94)**

  18 Hz S-band slope of the first part of the trailing edge from the Ice-2 retracker [20]

  Unit: 1/s

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Default values (maximum value allowed for that data type) are output whenever the S waveform leading edge is not found or the maximum amplitude-thermal noise ratio is too low, as when coming from the Ice-2 retracker.

- **hz18_2nd_edge_ice2_ku (Field number 95)**

  18 Hz Ku-band slope of the second part of the trailing edge from the Ice-2 retracker [20]

  Unit: 1/s

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Default values (maximum value allowed for that data type) are output whenever the Ku waveform leading edge is not found or the maximum amplitude-thermal noise ratio is too low, as when coming from the Ice-2 retracker.

- **hz18_2nd_edge_ice2_s (Field number 96)**

  18 Hz S-band slope of the second part of the trailing edge from the Ice-2 retracker [20]

  Unit: 1/s

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Default values (maximum value allowed for that data type) are output whenever the S waveform leading edge is not found or the maximum amplitude-thermal noise ratio is too low, as when coming from the ice-2 retracker.

- **hz18_diff_1Hz_alt (Field number 10)**

  18 Hz altitude differences from 1 Hz altitude [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The altitude differences are computed from the elementary altitudes (extracted from the input L1b records) and the corresponding averaged altitude.

- **hz18_diff_1hz_lat (Field number 63)**

  18 Hz slope-corrected latitude differences from 1 Hz latitude [20]

  Unit: 10μ degree

  Product Applicability: FD/I/GDR, SGDR

  Comment

  The 18 Hz slope-corrected latitude differences are computed by subtracting the central 1 Hz latitude value (i.e. an average of the latitude locations for blocks 9 and 10) from the 18 Hz slope-corrected latitudes of the echoing point, calculated in the geodetic reference frame. Default values for the latitudes (i.e. input L1b latitude values) are used

to compute these differences in the event of non tracking records and where a slope correction is not available.

Note that field 32 contains non-slope corrected latitude differences for offline products.

- **hz18_diff_1hz_lon (Field number 64)**

  18 Hz slope-corrected longitude differences from 1 Hz longitude [20]

  Unit: 10μ degree

  Product Applicability: FD/I/GDR, SGDR

  Comment

  The 18 Hz slope-corrected longitude differences are computed by subtracting the central 1 Hz longitude value (i.e. an average of the longitude locations for blocks 9 and 10) from the 18 Hz slope-corrected longitudes of the echoing point, calculated in the geodetic reference frame. Default values for the longitudes (i.e. input L1b longitude values) are used to compute these differences in the event of non tracking records and where a slope correction is not available.

  Note that field 32bis contains non-slope corrected longitude differences for offline products.

- **hz18_diff_mean_ech_pt (Field number 62)**

  18 Hz Elevation differences of echoing point from mean [20]

  Unit: cm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The elevation differences are computed by subtracting the mean elevation from the elementary elevation values.

  Default values (set to 0) are output for non tracking records or for records where the Ice-1 leading edge is out of bounds.

- **hz18_ku_band_ocean (Field number 19)**

  18 Hz Ku-band ocean ranges [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  An ocean retracking algorithm is applied to the 18Hz waveform to retrieve the epoch, the slope of the waveform and the waveform amplitude (see the Product Handbook [RD 1] for more details) to retrieve more accurate physical parameters: range, significant wave height and backscatter coefficient.

- **hz18_ku_dop_corr (Field number 35)**

  18 Hz Ku-band Doppler correction [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The Doppler corrections are computed from the 20 Hz orbital altitude rates with respect to the reference ellipsoid.

- **hz18_ku_dop_slp_corr (Field number 37)**

  18 Hz Ku-band delta Doppler slope correction [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The delta-Doppler range correction is calculated for a sloping surface. It is obtained by subtracting the flat surface Doppler correction from the general slope corrected Doppler.

  The default value (0) is output if the elementary measurement is not Tracking/Preset Tracking/Preset Loop Output, if there is a data gap between adjacent orbit values, if the next record is invalid, or if this is the last record of a file.

  In OFL, the default value is currently set to the maximum value allowed for that data type.

- **hz18_ku_ice1 (Field number 27)**

  18 Hz Ku-band Ice-1 ranges [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the Ice-1 (Offset Centre of Gravity (OCoG)) retracked range derived from Ku-band waveforms. If retracking fails due to a bad waveform, the onboard range estimate is used. It is set to zero for non-tracking records.

- **hz18_ku_ice1_bscat (Field number 78)**

  18 Hz Ku-band Ice-1 backscatter coefficient [20]

  Unit: dB/100

  Product Applicability: FD/I/GDR, SGDR

Comment

This is the backscatter estimate obtained from the Ice-1 OCoG retracker Ku-band waveform amplitude and the instrument link budget.

- **hz18_ku_ice2 (Field number 29)**

  18 Hz Ku-band Ice-2 ranges [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  An Ice-2 retracking algorithm is applied to the 18 Hz waveform to retrieve the epoch, the leading edge, the leading edge width and the waveform amplitude (see the Product Handbook [RD 1] for more details).

- **hz18_ku_ice2_bscat (Field number 82)**

  18 Hz Ku-band Ice-2 backscatter coefficient [20]

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_ice2.

- **hz18_ku_ice2_edge_bscat (Field number 80)**

  18 Hz Ku-band Ice-2 leading edge backscatter coefficient [20]

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_ice2.

- **hz18_ku_ice2_edge_width (Field number 65)**

  18 Hz Ku-band Ice-2 leading edge width [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_ice2.

- **hz18_ku_instr_corr (Field number 33)**

  18 Hz Ku-band range instrumental correction [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  $$Range\_Instr\_Corr = Doppler\_Corr + TD\_Flight\_Cal + TD\_Ground\_Cal$$

  where

  Doppler_Corr is the Doppler correction, TD_flight_Cal is the time delay flight calibration and TD_Ground_Cal is the time delay ground calibration

- **hz18_ku_k_cal_ku (Field number 68)**

  18 Hz Ku-band calibration [20]

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Ku-band scaling factor for Sigma0 evaluation

- **hz18_ku_seaice (Field number 31)**

  18 Hz Ku-band sea ice ranges [20]

  Unit: mm

  Product Applicability: FD/I/GDR, SGDR

  Comment

  This is the sea ice retracked range derived from Ku-band waveforms. If retracking fails due to a bad waveform, the onboard range estimate is used. It is set to zero for non-tracking records.

- **hz18_ku_seaice_bscat (Field number 84)**

  18 Hz Ku-band sea ice backscatter coefficient [20]

  Unit: dB/100

  Product Applicability: FD/I/GDR, SGDR

  Comment

  This is the backscatter estimate obtained from the Sea-ice retracker Ku-band waveform amplitude and the instrument link budget.

- **hz18_ku_trk_cog (Field number 13)**

  18 Hz Ku tracker range referenced to the CoG (no Doppler correction)

Unit: mm

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

This represents the Ku-band onboard rough estimates of the altimeter range (distance between the satellite and the overflown surface), produced by the model-free tracker. Specific ground processing (retracking of the waveforms) is requested to retrieve accurate estimates of the altimeter range over ocean, ice and sea ice.

The elementary tracker range values are derived from the L1b Ku window delay values and then corrected for the distance between the satellite's CoG and the RA-2 antenna's phase centre, and adjusted for the Doppler effects.

Default values (maximum value allowed for that data type) are output if the corresponding elementary measurement is not Tracking/Preset Tracking/Preset Loop Output, if the input Ku and S waveform samples are all set to 0, or if the AGC_Ku or Ku Rx delay value is out of bounds.

- **hz18_lat_diff (Field number 32)**

  18 Hz latitude differences from 1 Hz

  Unit: 10μ degree

  Product Applicability: I/GDR, SGDR (products processed with CMA v7.1 or higher)

  Comment

  Full 18 Hz latitude is reconstructed by adding the 18 Hz latitude difference to the 1 Hz latitude value.

  Note that field 63 contains slope corrected latitude differences.

  Only for offline, next field is 32bis.

- **hz18_lon_diff (Field number 32bis)**

  18 Hz longitude differences from 1 Hz

  Unit: 10μ degree

  Product Applicability: I/GDR, SGDR (products processed with CMA v7.1 or higher)

  Comment

  Full 18 Hz longitude is reconstructed by adding the 18 Hz longitude difference to the 1 Hz longitude value.

  Note that field 64 contains slope corrected longitude differences. Only for offline, next field is 33.

- **hz18_s_band_ocean (Field number 20)**

  18 Hz S-band ocean ranges [20]

  Unit: mm

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

See hz18_ku_band_ocean.

- **hz18_s_dop_corr (Field number 36)**

  18 Hz S-band Doppler correction [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_dop_corr.

- **hz18_s_dop_slp_corr (Field number 38)**

  18 Hz S-band delta Doppler slope correction [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_dop_slp_corr.

- **hz18_s_ice1 (Field number 28)**

  18 Hz S-band ice1 ranges [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_ice1.

- **hz18_s_ice1_bscat (Field number 79)**

  18 Hz S-band Ice-1 backscatter coefficient [20]

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_ice1.

- **hz18_s_ice2 (Field number 30)**

  18 Hz S-band Ice-2 ranges [20]

  Unit: mm

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

See hz18_ku_ice2.

- **hz18_s_ice2_bscat (Field number 83)**

  18 Hz S-band Ice-2 backscatter coefficient [20]

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_ice2.

- **hz18_s_ice2_edge_bscat (Field number 81)**

  18 Hz S-band Ice-2 leading edge backscatter coefficient [20]

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_ice2.

- **hz18_s_ice2_edge_width (Field number 66)**

  18 Hz S-band Ice-2 leading edge width [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_ice2.

- **hz18_s_instr_corr (Field number 34)**

  18 Hz S-band range instrumental correction [20]

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_instr_corr.

- **hz18_s_k_cal_s** (Field number 69)

  18 Hz S-band calibration [20]

  Unit: dB/100

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

See hz18_ku_k_cal_ku.

- **hz18_s_trk_cog (Field number 14)**

  18 Hz S tracker range referenced to the CoG (no Doppler correction)

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See hz18_ku_trk_cog.

- **instant_alt_rate (Field number 11)**

  Instantaneous altitude rate

  Unit: mm/s

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  In NRT this is currently obtained by propagating an OSV from the DORIS Navigator orbit file.

  In OFL products, the 1 Hz altitude rate is obtained by interpolating the OSVs available in the DORIS intermediate (for IMAR and IGDR) and precise (for GDR and SGDR) orbit files.

- **instr_flags (Field number 124)**

  Instrument flag

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See Note 2 (Annex 1) : Definition of RA-2 Instrument Flag **Table 12.1.3-3**

- **instr_id_data_level_flags (Field number 128)**

  Instrument mode ID at data block level [80 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 80 least significant bits (bits 0-79) correspond to the 20 values (4 bits per data block) bits 0 to 3 apply to the first data block. Unused bits are set to 0.

Possible values:

0 => spare

1 => acquisition

2 => Tracking

3 => IF Cal

4 => BITE RF

5 => BITE DGT

6 => Preset Tracking

7 => Preset Loop Output

8 => Alignment failed

Default values (bits set to 1) are output in the event of non tracking records (records not in Tracking, Preset Tracking or Preset Loop Output), wherever the sum of all Ku and S waveform samples are set to 0, or if Ku AGC or Ku onboard Rx delay are out of bounds.

- **inst_mode_id_flags (Field number 07)**

  Instrument Mode ID

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 80 least significant bits (bits 0-79) correspond to the 20 values (4 bits per data block) bits 0 to 3 apply to the first data block. Unused bits are set to 0.

  Possible values:

  0 => spare

  1 => acquisition

  2 => Tracking

  3 => IF Cal

  4 => BITE RF

  5 => BITE DGT

  6 => Preset Tracking

  7 => Preset Loop Output

  8 => Alignment failed

  Default values (bits set to 1) are output in the event of non tracking records (records not in Tracking, Preset Tracking or Preset Loop Output), wherever the sum of all Ku and S waveform samples are set to 0, or if Ku AGC or Ku onboard Rx delay are out of bounds.

- **interpole_238_temp_mwr (Field number 116)**

  Interpolated 23.8 GHz brightness temperature from MWR

  Unit: K/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The brightness temperature is interpolated to the altimeter time tag.

- **interpole_365_temp_mwr (Field number 117)**

  Interpolated 36.5 GHz brightness temperature from MWR

  Unit: K/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The brightness temperature is interpolated to the altimeter time tag.

- **interpole_flag (Field number 148)**

  Interpolation flag

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See Note 3 (Annex 1): Definition of the interpolation flag **Table 12.1.3-4**

- **interpole_sd_238_temp_mwr (Field number 118)**

  Interpolated standard deviation of MWR 23.8 GHz brightness temperature

  Unit: K/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The standard deviation of the brightness temperature is interpolated to the altimeter time tag.

- **interpole_sd_365_temp_mwr (Field number 119)**

  Interpolated standard deviation of MWR 36.5 GHz brightness temperature

  Unit: K/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

The standard deviation of the brightness temperature is interpolated to the altimeter time tag.

- **inv_baro_corr (Field number 40)**

  Inverted barometer correction

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The inverted barometer height correction is computed (in mm) according to the following formula:

  H_Baro = - b [Psurf - Pbar]

  where b = 9.948 mm/hPa, Psurf is the surface atmospheric pressure at the location and time of the altimeter measurement, and Pbar is the mean atmospheric pressure over the global ocean. Psurf is corrected first from a climatological value and then corrected for S1 and S2 (diurnal and semi-diurnal) atmospheric tides (see the Product Handbook for more details [RD 1]).

- **ion_corr_doris_ku (Field number 45)**

  Ionospheric correction from DORIS on Ku-band

  Unit: mm

  Product Applicability: I/GDR, IMAR, SGDR

  Comment

  The ionospheric corrections are obtained (in mm) by using the DORIS daily TEC maps (Total Electron Content, in e-/m2).

- **ion_corr_doris_s (Field number 46)**

  Ionospheric correction from DORIS on S-band

  Unit: mm

  Product Applicability: I/GDR, IMAR, SGDR

  Comment

  See ion_corr_doris_ku.

- **ion_corr_mod_ku (Field number 47)**

  Ionospheric correction from model on Ku-band

  Unit: mm

  Product Applicability: I/GDR, IMAR, SGDR

Comment

In NRT, this correction is obtained from the Bent model. In OFL, this correction is obtained from the GIM model for products processed with CMA v7.1 or higher (see Product Handbook for more details [RD 1]).

- **ion_corr_mod_s (Field number 48)**

  Ionospheric correction from model on S-band

  Unit: mm

  Product Applicability: I/GDR, IMAR, SGDR

  Comment

  See ion_corr_mod_ku.

- **ku_atm_atten_corr (Field number 88)**

  Ku-band atmospheric attenuation correction

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This value is added to the Sigma0 in Ku-band.

  The Ku-band backscatter coefficient two-way MWR atmospheric attenuation (in dB) is computed with neural algorithms as a function of TB23_Int, TB36_Int and σ0_Ku (see Product Handbook for more details [RD 1]).

- **ku_band_ocean_range (Field number 17)**

  Ku-band Ocean Range

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the 1 Hz estimate from the 18 Hz output retracking estimates.

- **ku_chirp_id_flags (Field number 122)**

  Ku chirp band id [40 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 40 least significant bits (bits 0-39) correspond to the 20 values (2 bits per data block), bits 0 to 1 apply to the first data block. Unused bits are set to 0.

Possible values:

0 => 320 MHz (Ku)

1 => 80 MHz (Ku)

2 => 20 MHz (Ku)

Default values (bits set to 1) are output in the event of non tracking records (records not in Tracking, Preset Tracking or Preset Loop Output), wherever the sum of all Ku and S waveforms samples are set to 0, or if Ku AGC or Ku onboard Rx delay are out of bounds.

- **ku_ice1_retrk_qua_flags (Field number 137)**

  Ku-band Ice-1 retracking quality [20 bits].

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0=valid measurement, 1=invalid (i.e. non tracking record, sum of all Ku waveform filters set to 0, leading edge out of bounds or average power smaller than a multiple of the noise power). Bit 0 applies to the first data block. Unused bits are set to 0.

- **ku_ice2_retrk_qua_flags (Field number 139)**

  Ku-band ice2 retracking quality [20 bits].

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid (i.e. non tracking record, sum of all Ku and S waveform filters set to 0, Ku AGC or Ku onboard Rx delay out of bounds, leading edge out of bounds or average power smaller than a multiple of the noise power). Bit 0 applies to the first data block. Unused bits are set to 0.

- **ku_net_instr_corr_agc (Field number 86)**

  Ku-band net instrument correction for AGC

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This correction is computed as:

$$AGC\_Instr\_Corr = Sig0\_Flight\_Cal + Loss\_Ground\_Cal + AGC\_Corr$$

Where

Sig0_Flight_Cal is the Sigma0 flight calibration factor

Loss_Ground_Cal is the loss calibration factor

AGC_Corr is the AGC correction factor

- **ku_ocean_bscat_coeff (Field number 72)**

  Ku-band corrected Ocean backscatter coefficient

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the 1 Hz estimate from the 18 Hz output ocean retracking estimates.

- **ku_ocean_retrk_qua_flags (Field number 135)**

  Ku-band ocean retracking quality [20 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid (i.e. non tracking record, sum of all Ku and S waveform filters set to 0, Ku AGC or Ku onboard Rx delay out of bounds, leading edge out of bounds or average power smaller than a multiple of the noise power). Bit 0 applies to the first data block. Unused bits are set to 0.

- **ku_peak (Field number 142)**

  1 Hz Ku-band peakiness

  Unit: 1/1000

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the ratio of the maximum amplitude and the mean amplitude of the waveform, weighted by the ratio of the number of samples on the right of the tracking point and the total number of samples of the waveform (128). This independent waveform quality assessment parameter is computed irrespective of surface type.

  The 1 Hz peakiness value is obtained by arithmetic averaging of the 18 Hz peakiness values of the tracking records.

- **ku_rai_atten (Field number 90)**

  Ku-band rain attenuation

Unit: dB/100

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

The rain attenuation (dB) is calculated using the ocean backscatter coefficient for Ku-band, σ0_Ku (dB) [RD 7] by:

Rain_Att = Exp_Sigma0_Ku - σ0_Ku

where the expected Ku-band backscatter coefficient, Exp_Sigma0_Ku, is determined by linear interpolation from the input table, as a function of the S-band backscatter coefficient.

- **ku_seaice_retrk_qua_flags (Field number 141)**

  Ku-band sea ice retracking quality [20 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid (i.e. non tracking record, sum of all Ku waveform filters set to 0, leading edge out of bounds or average power smaller than a multiple of the noise power). Bit 0 applies to the first data block. Unused bits are set to 0.

- **ku_sig_wv_ht (Field number 54)**

  Ku-band significant wave height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the 1 Hz estimate from the 18 Hz output ocean retracking estimates.

- **lat (Field number 04)**

  Geodetic Latitude

  Unit: μdegree

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the 1 Hz latitude value defined as the latitude of the source packet centre (i.e. average of blocks 9 and 10). It is not corrected for surface slope and so represents the orbit track position. Positive north and negative south.

- **lon (Field number 05)**

  Longitude

  Unit: μdegree

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the 1 Hz longitude value defined as the longitude of the source packet centre (i.e. average of blocks 9 and 10). It is not corrected for surface slope and so represents the orbit track position. Positive East, 0 at Greenwich, and negative West.

- **long_period_ocn_tide_ht (Field number 103)**

  Long period tide height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This equilibrium tide is added to the total geocentric ocean tide.

- **m_sea_surf_ht (Field number 98)**

  Mean sea-surface height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The mean sea surface used is the one from CLS (*Collecte Localisation Satellite*), CLS01 [RD 8].

  The mean sea surface has been estimated on a 1/30 (2 minutes) of a degree grid using a local inverse method, which also provides an estimate and an associated error field.

- **map_18hz_k_cal_ku_flags (Field number 70)**

  Map of valid points for 18 Hz K-cal_Ku

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Unused bits are set to 0. Bit 0 applies to the first data block.

- **map_18hz_ku_ocean_flags (Field number 25)**

  Map of 18 Hz valid points for Ku-band ocean range

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits are set to 0.

- **map_18hz_ku_trk_flags (Field number 15)**

  Map of valid points for 18 Hz Ku-band tracker range

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits are set to 0.

- **map_18hz_s_ocean_flags (Field number 26)**

  Map of 18 Hz valid points for S-band ocean range

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits are set to 0.

- **meas_conf_data_flags (Field number 08)**

  Measurement Confidence Data (MCD)

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See Note 1 (Annex 1): Definition of Flags in the MCD Field for NRT and OFL products **Table 12.1.3-2**

- **membership 1 (Field number 150)**

  Membership value (in percentage) associated to the "Open Water" class used to compute the 3-state ocean/sea-ice flag.

  Unit: /

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See sea_ice_flag.

- **membership 2 (Field number 151)**

  Membership value (in percentage) associated to the "First-Year Ice" class used to compute the 3-state ocean/sea-ice flag.

  Unit: /

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See sea_ice_flag.

- **membership 3 (Field number 152)**

  Membership value (in percentage) associated to the "Wet Ice" class used to compute the 3-state ocean/sea-ice flag.

  Unit: /

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See sea_ice_flag.

- **membership 4 (Field number 153)**

  Membership value (in percentage) associated to the "Multi-Year Ice" class used to compute the 3-state ocean/sea-ice flag.

  Unit: /

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See sea_ice_flag.

- **mod_dry_tropo_corr (Field number 39)**

  Model dry tropospheric correction

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

The input ECMWF meteorological fields used to calculate these parameters are different for the near real time products (FDGDR and FDMAR) and for the offline products (IGDR, IMAR, GDR and SGDR).

For NRT, the meteorological fields used are the following: U and V components of the 10 metre wind vector, surface pressure, relative humidity profile, geopotential profile and temperature profile. These six parameters are provided on a regular 1 x 1 degree grid. From the relative humidity, pressure and temperature profiles, the wet tropospheric correction field is computed, and from the surface pressure the dry tropospheric correction is computed.

For OFL, the meteorological fields used are the following: U and V components of the 10 metre wind vector, dry tropospheric correction, wet tropospheric correction, surface pressure. These five parameters are provided on the so-called Gaussian grid (quasi regular in latitude, irregular in longitude). This grid is the computational grid of the ECMWF model used for the model run. The wet and dry tropospheric corrections are computed by the French met office from the ECMWF humidity and temperature profiles.

The SWT 2004 recommendation was to use the new FES2004 tide model, which already includes the S1 and S2 waves. Then, in the event of offline processing, the dry tropospheric correction is derived from the surface pressure filtered and corrected from the S1 and S2 waves and from a climatological value.

- **mod_surf_atm_pres (Field number 107)**

  Model surface atmospheric pressure

  Unit: 10Pa

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See mod_dry_tropo_corr.

- **mod_wet_tropo_corr (Field number 41)**

  Model wet tropospheric correction

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See mod_dry_tropo_corr.

- **mod_wind_sp_u (Field number 112)**

  U component of the model's 10-metre wind vector

  Unit: mm/s

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

See mod_dry_tropo_corr.

- **mod_wind_sp_v (Field number 113)**

  V component of the model 10-metre wind vector

  Unit: mm/s

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See mod_dry_tropo_corr.

- **mwr_instr_flags (Field number 131)**

  MWR instrument flag

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See Note 5 (Annex 1): MWR Instrument Flag **Table 12.1.4-2**

- **mwr_liq_water_cont (Field number 109)**

  MWR liquid water content

  Unit: $10^{-2}kg/m^2$

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is computed from the MWR 23.8 GHz and 36.5 GHz brightness temperatures (TB23 and TB36) and from the ocean backscatter coefficient for Ku-band σ0_Ku using a neural network algorithm.

  See mwr_wet_tropo_corr.

- **mwr_qua_interp_flag (Field number 146)**

  MWR Quality interpolation flag

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  0: if interpolation was OK with no gap between the two MWR measurements around the RA-2 time

1: if interpolation was OK but there was a gap between the two selected MWR measurements

2: if extrapolation was used

3: if neither interpolation nor extrapolation could be used

The default value ('3' in NRT, and '0' in OFL) is output when no MWR data is available.

- **mwr_wet_tropo_corr (Field number 42)**

  MWR derived wet tropospheric correction

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The MWR wet tropospheric correction is obtained with a neural algorithm. A global and representative database has been built using ECMWF analyses from surface and atmospheric parameters, and simulations of the brightness temperatures and backscattering coefficient in Ku-band. Then the architecture of the network (one layer of 8 hidden neurons) and the weights of each neuron are determined to produce the most accurate estimate of the wet tropospheric correction (in mm) from brightness temperatures (TB23_Int and TB36_Int) and σ0_Ku,

  where TB23_Int and TB36_Int are the 23.8 GHz and 36.5 GHz brightness temperatures (in K) interpolated to RA-2 time tag, and σ0_Ku is the ocean backscatter coefficient for Ku-band (dB), not corrected for atmospheric attenuation.

- **mwr_wvapour_cont (Field number 108)**

  MWR water vapour content which is also called "total column water vapour"

  Unit: $10^{-2}g/cm^2$

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  It is computed with a neural algorithm [RD 9] from the MWR 23.8 GHz and 36.5 GHz brightness temperatures (TB23 and TB36), and from σ0_Ku.

  See mwr_wet_tropo_corr.

- **num_18hrz_ku_ocean_bscat (Field number 76)**

  Number of 18 Hz valid points for Ku-band ocean backscatter coefficient

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

This is the number of elementary measurements effectively used for calculating the averaged ocean Ku Sigma0 value and standard deviation.

In NRT this number is set to default (maximum value allowed for that data type) when the number of valid elementary measurements is less than a threshold (currently set to 6).

In OFL the actual number of valid measurements (< 6) appears in this field instead.

Note that for both NRT and OFL, the averaged ocean Sigma0 value and its standard deviation are set to default if that number is below 6.

- **num_18hrz_s_ocean_bscat (Field number 77)**

  Number of 18 Hz valid points for S-band ocean backscatter coefficient

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See num_18hrz_ku_ocean_bscat**.**

- **num_18hz_ku_ocean (Field number 23)**

  Number of 18 Hz valid points for Ku-band ocean range

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the number of elementary measurements effectively used for calculating the averaged ocean range value and standard deviation.

  In NRT this number is set to default (maximum value allowed for that data type) when the number of valid elementary measurements is less than a threshold (currently set to 6).

  In OFL the actual value of valid measurements (< 6) appears in this field instead.

  Note that for both NRT and OFL, the averaged ocean value and its standard deviation are set to default if that number is below 6.

- **num_18hz_ku_ocean_swh (Field number 58)**

  Number of 18 Hz valid points for Ku-band ocean SWH

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

This is the number of elementary measurements effectively used to calculate the averaged ocean SWH value and standard deviation.

In NRT this number is set to default (maximum value allowed for that data type) when the number of valid elementary measurements is less than a threshold (currently set to 6).

In OFL the actual number of valid measurements (< 6) appears in this field instead.

Note that for both NRT and OFL, the averaged ocean SWH value and its standard deviation are set to default if that number is below 6.

- **num_18hz_s_ocean (Field number 24)**

  Number of 18 Hz valid points for Ku-band ocean range

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See num_18hz_ku_ocean.

- **num_18hz_s_ocean_swh (Field number 59)**

  Number of 18 Hz valid points for S-band ocean SWH

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See num_18hz_ku_ocean_swh.

- **num_meas_ku_calibr (Field number 129)**

  Number of measurements for Ku flight calibration factor evaluation

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the number of Ku flight calibration factors (currently from 0 to 5) used at L1b to obtain the smoothed Sigma0 and time delay PTR flight calibration factors.

  Default values (maximum value allowed for that data type) will appear in the event that none of the 20 elementary records are in Tracking/Preset Tracking/Preset Loop Output, where the sum of all Ku/S waveforms samples are different from 0, and where Ku AGC and Ku onboard Rx delay values are inside bounds.

- **num_meas_s_calibr (Field number 130)**

  Number of measures for S flight calibration factor evaluation

Unit: -

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

See num_meas_ku_calibr.

- **ocean_depland_elev (Field number 100)**

  Ocean depth/land elevation

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The new Global Digital Elevation Model, MACESS, has been developed at ESRIN by merging the ACE land elevation data and the Smith and Sandwell ocean bathymetry data [RD 10].

- **off_nad_ang_platf (Field number 91)**

  Off nadir angle of the satellite from platform data

  Unit: $deg^2/10^4$

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The squared off-nadir angle (in radians) from the platform is derived from the interpolated pitch and roll mispointing angles.

- **off_nad_ang_wvform (Field number 92)**

  Off nadir angle of the satellite from waveform data

  Unit: $deg^2/10^4$

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The squared off-nadir angle (in radians) from the waveform is derived from the slope of the trailing edge of the waveform. This slope is derived from the Ice-2 retracking algorithm. For more details see the Product Handbook [RD 1].

- **quality flag (Field number 02)**

  Quality Indicator (-1 for blank MDSR, otherwise 0).

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

Always set to 0.

- **ra2_elec_cont (Field number 110)**

  RA-2 total electron content.

  Unit: TECU/10

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The RA-2 total electron content (e^-/m^2) is given by

  $TEC\_RA\text{-}2 = RA\text{-}2\_ion\_corr\_ku * (f\_Ku)^2/(-40250)$

  Where f_Ku is the Ku-band radar wavelength.

- **ra2_ion_corr_ku (Field number 43)**

  RA-2 ionospheric correction on Ku-band

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The Ku-band and S-band sea state bias corrections are first added to the Ku-band and S-band altimeter ranges to correct them, because sea state bias may be different for the two frequencies. Let RKu and RS be the corresponding corrected values.

  The ionospheric corrections Iono_alt_Ku and Iono_alt_S (in mm) are given for the two frequencies by the following equations:

  $Iono\_RA2\_Ku = \delta f_{Ku} * (Rc\_Ku - Rc\_S)$

  $Iono\_RA2\_S = \delta f_S * (Rc\_Ku - Rc\_S)$

  with:

  $\delta f_{Ku} = (f\_S)^2 / [(f\_Ku)^2 - (f\_S)^2]$

  $\delta f_S = (f\_Ku)^2 / [(f\_Ku)^2 - (f\_S)^2]$

  where f_Ku and f_S are the transmitted frequencies (in Hz)

- **ra2_ion_corr_s (Field number 44)**

  RA-2 ionospheric correction on S-band

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See ra2_ion_corr_ku.

- **ra2_wind_sp (Field number 111)**

  RA-2 wind speed

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The wind speed is computed (in m/s), using a linear interpolation in the input wind table, according to the algorithm proposed by Abdalla [Level 2 FDMAR: SPH RD 17]. The algorithm is based on a fit between EnviSat Ku-band Sigma0 and the collocated ECMWF model wind speed. The result was then adjusted based on *in-situ* wind measurements.

- **radio_landocean_flag (Field number 145)**

  Radiometer land/ocean flag

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This flag has two states: 0 = Ocean and 1 = Land.

  In NRT, when MWR data are not available, this flag is set to its maximum value

  In OFL, when MWR data are not available, this flag is set to its default value which is 1 (land).

- **rain_flag (Field number 147)**

  Altimeter rain flag

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The rain flag is computed from main and auxiliary bands altimeter backscatter coefficients, and from the MWR liquid water content, interpolated to RA-2 time. It is a 6-state flag with the following meanings [**RD 19**]:

  0 = “no rain”

  1 = “rain”

  2 = “high rain probability from altimeter” (degraded case: no MWR LWC available)

  3 = “high probability of no rain from altimeter” (degraded case: no MWR LWC available)

  4 = “ambiguous situation” (i.e. possibility of ice)

  5 = “evaluation not possible” (i.e. data are missing or surface type is land or ice or $\sigma0\_Ku < 0$ or $\sigma0\_S < 0$)

States “0”, “1”, “4” and “5” correspond to the nominal use of the algorithm. State “4” is set to advice caution to the user because sea-ice affected data can be misinterpreted as rain affected data at high latitude (above 50°). State “5” indicates that the algorithm cannot be used because of missing or bad data (i.e. surface type is land or ice or $\sigma 0\_Ku < 0$ or $\sigma 0\_S < 0$). States “2” and “3” correspond to a degraded use of the algorithm because the MWR data is not available. The setting of the flag is based only on altimeter measurements.

This flag is calibrated only over ocean.

- **s_atm_atten_corr (Field number 89)**

  S-band atmospheric attenuation correction

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See ku_atm_atten_corr.

- **s_band_ocean_range (Field number 18)**

  S-band ocean range

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See ku_band_ocean_range.

- **s_ice1_retrk_qua_flags (Field number 138)**

  S-band Ice-1 retracking quality [20 bits].

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid, 1 = invalid. Unused bits are set to 0. Bit 0 applies to the first data block.

- **s_ice2_retrk_qua_flags (Field number 140)**

  S-band Ice-2 retracking quality [20 bits].

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid, 1 = Invalid. Unused bits are set to 0. Bit 0 applies to the first data block.

- **s_net_instr_corr_agc (Field number 87)**

  S-band net instrument correction for AGC

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See ku_net_instr_corr_agc.

- **s_ocean_bscat_coeff (Field number 73)**

  S-band corrected ocean backscatter coefficient

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See ku_ocean_bscat_coeff.

- **s_ocean_retrk_qua_flags (Field number 136)**

  S-band ocean retracking quality [20 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid, 1 = invalid. Unused bits are set to 0. Bit 0 applies to the first data block.

- **s_peak (Field number 143)**

  1 Hz S-band peakiness

  Unit: 10^{-3}

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See ku_peak.

- **s_sig_wv_ht (Field number 55)**

  S-band significant wave height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See ku_sig_wv_ht.

- **sd_18hrz_ku_ocean_bscat (Field number 74)**

  Standard deviation of 18 Hz Ku-band ocean backscatter coefficient

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the number of elementary measurements effectively used to calculate the averaged ocean Ku Sigma0 value and standard deviation.

  In NRT this number is set to default (maximum value allowed for that data type) when the number of valid elementary measurements is less than a threshold (currently set to 6).

  In OFL the actual number of valid measurements (< 6) appears in this field instead.

  Note that in both cases, NRT and OFL, the averaged ocean Sigma0 value and its standard deviation are set to default if that number is below 6.

- **Sea_ice_flag (Field number 149)**

  Sea Ice flag

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  It is a 3-state flag indicating open water or sea ice pixel along with an additional “not evaluated” state in case of failure. It is a simplified algorithm based on the 4 memberships values (fields 150 to 153) associated to the 4 classes (open water, first-year ice, multi-year ice, and wet ice). See **RD 18** for details on the algorithm. The meaning of the different states is the following:

  0 =“ocean”

  1 = "sea-ice"

  2 = “not evaluated”

- **sd_18hz_s_ocean_bscat (Field number 75)**

  Standard deviation of 18 Hz S-band ocean backscatter coefficient

Unit: dB/100

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

See sd_18hrz_ku_ocean_bscat.

- **sd_18hz_ku_ocean (Field number 21)**

  Standard deviation of 18 Hz Ku-band ocean range

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The default value (max value allowed for that data type) is output whenever the number of valid elementary Ku ocean range values used for the averaging is less than a minimum threshold (currently set to 6).

- **sd_18hz_ku_swh (Field number 56)**

  Standard deviation of 18 Hz Ku-band significant wave height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The default value (max value allowed for that data type) is output whenever the number of valid elementary Ku ocean SWH values used for the averaging is less than a minimum threshold (currently set to 6).

- **sd_18hz_s_ocean (Field number 22)**

  Standard deviation of 18 Hz S-band ocean range

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See sd_18hz_ku_ocean

- **sd_18hz_s_swh (Field number 57)**

  Standard deviation of 18 Hz S-band significant wave height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See sd_18hz_ku_swh.

- **sea_bias_ku (Field number 49)**

  Sea state bias correction on Ku-band

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Sea state bias is the difference between the apparent sea level as 'seen' by an altimeter and the actual mean sea level.

  The sea state biases for Ku-band and S-band are computed, in mm, by bilinear interpolation from a table given as function of Ku-band's significant wave height and the RA-2 wind speed, (SWH_Ku and W).

  The look-up table in Ku-band was derived from one year of EnviSat data (cycles 25 to 35), using crossover SSH differences and applying the non parametric estimation technique [RD 11].

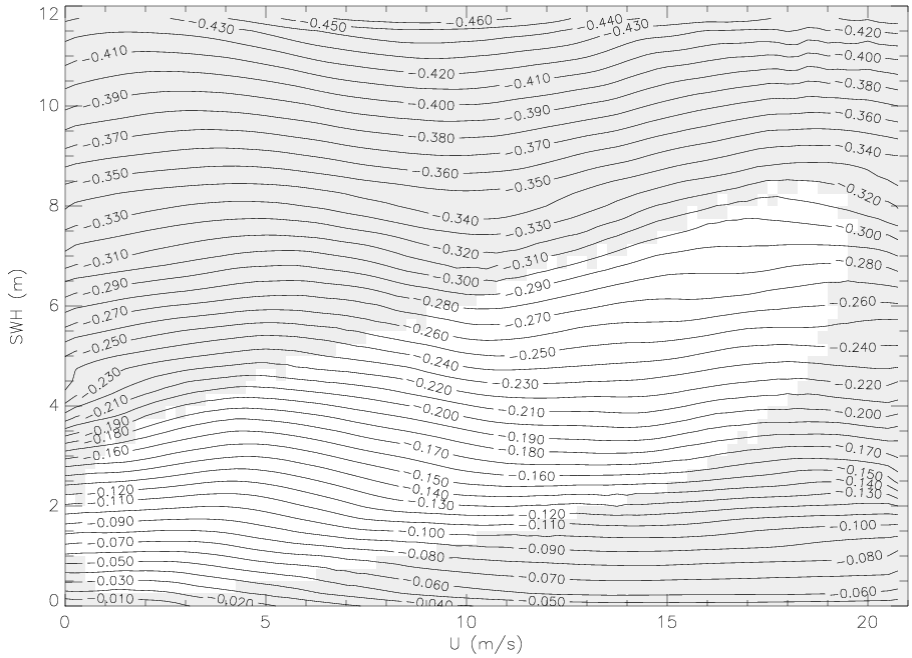


Figure 5-1: EnviSat SSB in Ku-band (m), the white area delineates the distribution of 95 % of the data

- **sea_bias_s (Field number 50)**

  Sea state bias correction on S-band

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See sea_bias_ku

- **slp_mod_flags (Field number 60)**

  Slope model present flags [20 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid (i.e. input data block not in Tracking/Preset Tracking/Preset Loop Output, or if the position of the input record is not within the models, currently only existing for Greenland and Antarctica). Bit 0 applies to the first data block. Unused bits are set to 0.

- **solid_earth_tide_ht (Field number 105)**

  Solid earth tide height

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The gravitational potential V induced by an astronomical body can be broken down into harmonic constituents, each characterised by amplitude, phase and frequency.

- **square_ku_ sig_wv_ht (Field number 52)**

  Square of Ku-band significant wave height

  Unit: mm^2

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  According to user requirements, the square of the significant wave height is estimated and filled in for all the products. The purpose is to keep all the values even when the square is negative. This occurs when the Sigmac parameter (estimated by the ocean retracking) is smaller than the response width of the target point, due to speckle.

- **square_s_sig_wv_ht (Field number 53)**

  Square of S-band significant wave height

  Unit: mm^2

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See square_ku_sig_wv_ht.

- **src_pack_cnt (Field number 06)**

  Source Packet Counter

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  /

- **tidal_load_ht_sol1 (Field number 101)**

  Tidal loading height solution 1

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The height of the tidal loading induced by the ocean tide is calculated from the GOT00.2 model [RD 12].

- **tidal_load_ht_sol2 (Field number 104)**

  Tidal loading height solution 2

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The height of the tidal loading induced by the ocean tide is calculated from the FES2004 model [RD 13 16].

- **tot_geocen_ocn_tide_ht_sol1 (Field number 101)**

  Total geocentric ocean tide height (solution 1)

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The ocean tide model, GOT00.2b, is essentially an update of the one (GOT99.2) described in detail in Ray [RD 14]. GOT00.2 is the latest solution in a series beginning with the work described in: E J O Schrama and R Ray, Journal of Geophysical Research, v.99, p 24799, 1994.

  GOT00.2b used 286 10-day cycles of Topex and Poseidon data, supplemented in shallow seas and polar seas (latitudes above 66 degrees) by 81 35-day cycles of ERS-1 and ERS-2 data. The solution consists of independent near-global estimates of eight components (Q1, O1, P1, K1, N2, M2, S2 and K2).

The total geocentric ocean tide is the sum of the ocean tide height, the tidal loading height and the long period tide height.

- **tot_geocen_ocn_tide_ht_sol2 (Field number 102)**

  Total geocentric ocean tide height (solution 2)

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  FES2004 version is generated at LEGOS. It is the latest update of the FES2002 solution [RD 15]. The altimeter data reprocessing consists of a new atmospheric forcing response correction (mog2D-G) applied to the data before the harmonic analysis.

  This new model includes two extra waves, S1 and M4, to add to the nine waves of the FES2002 model. Validation of the FES2004 solutions shows an overall improvement in FES2004 vs GOT00 compared with FES2002 vs GOT00, especially in mid and high latitudes. [RD 16]

- **wvform_fault_id_flags (Field number 127)**

  Waveform samples fault identifier [40 bits]

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The first 40 least significant bits (bits 0-39) correspond to the 20 values (2 bits per data block), bits 0 to 1 apply to the first data block. Unused bits are set to 0.

  Possible values:

  0 => no errors

  1 => Ku waveform samples set to 0

  2 => S waveform samples set to 0

  3 => Ku and S waveform samples set to 0

  Default values (bits set to 1) are output in the event of non tracking records (records not in Tracking, Preset Tracking or Preset Loop Output), whenever the sum of all Ku and S waveforms samples is set to 0, or if Ku AGC or Ku onboard Rx delay are out of bounds.

5.2 Level 2 MWR MDSR

- **brgt_temp_238 (Field number 11)**

  mean brightness temperature of the first channel

  Unit: K/100

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

The mean brightness temperature of the first channel is obtained by averaging the temperatures of the valid (<=8) channel 1 samples (i.e. samples for which a non null brightness temperature was obtained from the antenna temperature).

Default value (mean TB set to 0) is output if no single sample, out of the 8 samples, had a valid TB for the averaging process.

- **brgt_temp_365 (Field number 13)**

  mean brightness temperature of the second channel

  Unit: K/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The mean brightness temperature of the second channel is obtained by averaging the temperatures of the valid (<= 8) Channel 2 samples (i.e. samples for which a non null brightness temperature was obtained from the antenna temperature).

  Default value (mean TB set to 0) is output if no single sample, out of the 8 samples, had a valid TB for the averaging process.

- **brgt_temp_sd_238 (Field number 12)**

  Standard deviation of the first channel brightness temperature

  Unit: K/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Standard deviation of the first channel brightness temperature, obtained from the valid Channel 1 samples (i.e. samples for which a non null brightness temperature was obtained from the antenna temperature).

  Default value (standard deviation set to 0) is output in the event that only 0 or 1 valid Ch1 samples are available for the computation.

- **brgt_temp_sd_365 (Field number 14)**

  Standard deviation of the second channel brightness temperature

  Unit: K/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Standard deviation of the second channel brightness temperature, obtained from the valid Channel 2 samples (i.e. samples for which a non null brightness temperature was obtained from the antenna temperature).

Default value (standard deviation set to 0) is output in the event that only 0 or 1 valid Ch2 samples are available for the computation.

- **dsr_time (Field number 1)**

  Time fields

  Unit: mjd (Modified Julian Day)

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Time fields based on UTC are computed for each record.

- **interpole_ra2_ku_ocn_coeff (Field number 31)**

  Interpolated RA-2 Ku-band corrected ocean backscatter coefficient

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The RA-2 Ku backscattering coefficient is corrected for atmospheric attenuation and interpolated to MWR time.

- **interpole_ra2_ku_wv_ht (Field number 33)**

  RA-2 Ku SWH, interpolated to MWR time.

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  The RA-2 Ku SWH, is interpolated to MWR time, if two valid RA-2 ocean measurements are available which straddle the MWR measurement.

  Otherwise, if RA-2 measurements are only available either before or after the MWR time, but within a maximum time interval, the interpolated SWH is simply the one corresponding to the closest RA-2 measurement.

  No RA-2 SWH is output (default value output: maximum value allowed for that data type) if no RA-2 valid ocean measurements are available, either before or after the MWR time, within the permitted time interval.

- **interpole_ra2_s_ocn_coeff (Field number 32)**

  RA-2 backscattering coefficient in S-band

  Unit: dB/100

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

This is the RA-2 S backscattering coefficient of the echo, corrected for atmospheric attenuation, interpolated to MWR time, if two valid RA-2 ocean measurements are available which straddle the MWR measurement.

Otherwise, if RA-2 measurements are only available either before or after the MWR time, but within a maximum time interval, the interpolated Sigma0 is simply the one corresponding to the closest RA-2 measurement.

No RA-2 Sigma0 is output (default value output: maximum value allowed for that data type) if no RA-2 valid ocean measurements are available, either before or after the MWR time, within the permitted time interval.

- **interpole_ra2_wind_spd (Field number 30)**

  RA-2 wind speed

  Unit: mm/s

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the RA-2 wind speed interpolated to MWR time, if two valid RA-2 ocean measurements are available which straddle the MWR measurement.

  Otherwise, if RA-2 measurements are only available either before or after the MWR time, but within a maximum time interval, the interpolated wind speed is simply the one corresponding to the closest RA-2 measurement.

  No RA-2 wind speed is output (default value output: maximum value allowed for that data type) if no RA-2 valid ocean measurements are available, either before or after the MWR time, within the permitted time interval.

- **lat (Field number 4)**

  latitude

  Unit: 10^{-6}deg

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is currently obtained for L1b by propagating an OSV from the DORIS Navigator orbit file. In NRT, the L2 latitude values are just a copy of the L1b ones.

  In OFL, the L2 latitude value is obtained by interpolating the OSVs available in the DORIS intermediate (for IMAR and IGDR) and precise (for GDR and SGDR) orbit files.

- **liq_water_content (Field number 28)**

  liquid water content

  Unit: 10^{-2} Kg/ m^2

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

This parameter is currently obtained through neural network algorithms.

The default value (maximum value allowed for that data type) is output in the event that either of the two brightness temperatures is greater than 280 K.

Note that this parameter, although only meaningful over the ocean, is output for all surface types.

- **Lon (Field number 5)**

  longitude

  Unit: 10^{-6}deg

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is currently obtained for L1b by propagating an OSV from the DORIS Navigator orbit file. In NRT, the L2 longitude values are just a copy of the L1b ones.

  In OFL, the L2 longitude value is obtained by interpolating the OSVs available in the DORIS intermediate (for IMAR and IGDR) and precise (for GDR and SGDR) orbit files.

- **meas_conf_level_1b_flags (Field number 08)**

  Measurement Confidence Data

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See Note 1 (Annex 1): Definition of Flags in the MCD Field for NRT and OFL products

- **mwr_instr_flags (Field number 16)**

  Unit: flag

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  See Note 2 (Annex 1): The content of the MWR Instrument Flags field

- **mwr_proc_ave_238 (Field number 17)**

  MWR processing information, number of averaged samples (23.8 GHz channel)

  Unit: -

Product Applicability: FD/I/GDR, FD/IMAR, SGDR

Comment

This is the number of samples (<= 8) used effectively for calculating the mean Channel 1 brightness temperature.

- **mwr_proc_ave_365 (Field number 18)**

  MWR processing information, number of averaged samples (36.5 GHz channel)

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This is the number of samples (<= 8) used effectively for calculating the mean Ch2 brightness temperature.

- **mwr_proc_output_last (Field number 19)**

  MWR Processing information, number of outputs since last calibration period

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Number of telemetries (samples) which have occurred since the last calibration period. This value indicates the temporal distance of the current measurement from the moment when the Gain and Offset temperatures were computed.

- **mwr_proc_pack_id_238 (Field number 22)**

  MWR processing information, 23.8 GHz channel source packet id

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Sequence counter of the current MWR L0 source packet.

- **mwr_proc_pack_id_365 (Field number 23)**

  MWR processing information, 36.5 GHz channel source packet id

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Sequence counter of the current MWR L0 source packet.

- **mwr_proc_tele_238 (Field number 20)**

  MWR Processing information, packet telemetry counter for 23.8 GHz channel

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Telemetry counter of the fourth averaged sample for Channel 1 (in the range 0..., 159).

- **mwr_proc_tele_365 (Field number 21)**

  MWR processing information, packet telemetry counter for 36.5 GHz channel

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Telemetry counter of the fourth averaged sample for Channel 2 (in the range 0..., 159).

- **mwr_proc_win_size (Field number 24)**

  MWR processing information, moving window size

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Dimension of the calibration data array, containing the gain and offset temperatures that have to be smoothed for the computation of the antenna temperatures. This is a 'sliding window' such that the oldest calibration data in the array are removed before any new Gain/TE data are stored. Currently this array size is set to 6.

- **mwr_wet_tropo_corr (Field number 29)**

  MWR derived wet tropospheric correction

  Unit: mm

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This parameter is currently obtained through neural network algorithms.

  The default value (maximum value allowed for that data type) is output whenever either of the two brightness temperatures are greater than 280 K.

  Note that this parameter, although only meaningful over the ocean, is output for all surface types.

- **quality_flag (Field number 2)**

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  Always set to 0.

- **ra2_interpole_flag (Field number 25)**

  RA-2 quality interpolation flag

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  0: if interpolation was OK with no gap between the two valid RA-2 ocean measurements (i.e. RA-2 surface type flag set to 0 or 1) around the MWR time

  1: if interpolation was OK but there was a gap between the two selected RA-2 measurements

  2: if extrapolation was used

  3: if neither interpolation nor extrapolation could be used

- **rec_cnt (Field number 6)**

  Record counter

  Unit: -

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  /

- **wvapour_content (Field number 27)**

  Water vapour content

  Unit: 10^{-2} g/cm^2

  Product Applicability: FD/I/GDR, FD/IMAR, SGDR

  Comment

  This parameter is currently obtained through neural network algorithms.

  The default value (maximum value allowed for that data type) is output whenever either of the two brightness temperatures is greater than 280 K.

  Note that this parameter, although only meaningful over the ocean, is output for all surface types.

6 PRODUCT DIFFERENCES

The product differences between NRT (Near Real time) and OFL (Off-Line) products are due to:

- a more accurate estimate of the parameters after a few days,
- recommendations for applying some models instead of others,
- different strategies for the near real time processing chain and the offline processing chain.

6.1 Greater accuracy

Some OFL product parameters are more accurate, such as the:

- orbit,
- meteorological forecast and data,
- polar tide,
- Centre of Gravity files.

6.2 Recommended models and parameters

- The meteorological data derived from Meteo-France for OFL and ECMWF for NRT products (forecast for FDGDR and analysis for IGDR).
- The latitude and longitude differences are given for OFL products and set to 'spare' for NRT products.
- The difference from the inverse barometer is given for OFL products, set to 'spare' for NRT products and set to the default value for IGDR.
- The ionospheric model correction is the GIM model for OFL products and the Bent model for NRT products.

6.3 Different strategies

In the NRT processing chain, geophysical parameters depending on the range, SWH or Sigma0 values are only computed if these three parameters are declared as valid.

In the OFL processing chain, geophysical parameters are computed if all the necessary parameters are valid. For example, if SWH and Sigma0 are valid but the range is not, the EMB is not computed in NRT but is computed in off-line.

7 ALTIMETRY APPLICATIONS

7.1 Sea Level Anomaly (SLA)

The SLA is the difference between the observed sea surface height and the mean sea level. The SLA allows us to monitor ocean variability due to seasonal variations and climatic phenomena. The SLA formula is defined below:

$$SSH = Orbit - Altimeter\ Range - \sum Corrections - Mean\ Sea\ Surface$$

with

$$Altimeter\ Range = Range\ corrected\ \ for\ instrumental\ effects$$

and :

$$\sum Corrections = Dry\ troposphere\ correction +$$

$$+ MOG2D$$

$$+ Radiometer\ wet\ troposphere\ correction.$$

$$+ Dual\ \ frequency\ ionospheric\ correction\ (\ filter\ 300km)$$

$$+ Non\ Parametric\ SSB$$

$$+ GOT00\ ocean\ tide\ correction\ (including\ loading\ tide)$$

$$+ Earth\ tide\ correction$$

$$+ Polar\ tide\ correction$$

An example of an EnviSat SLA map is shown below.

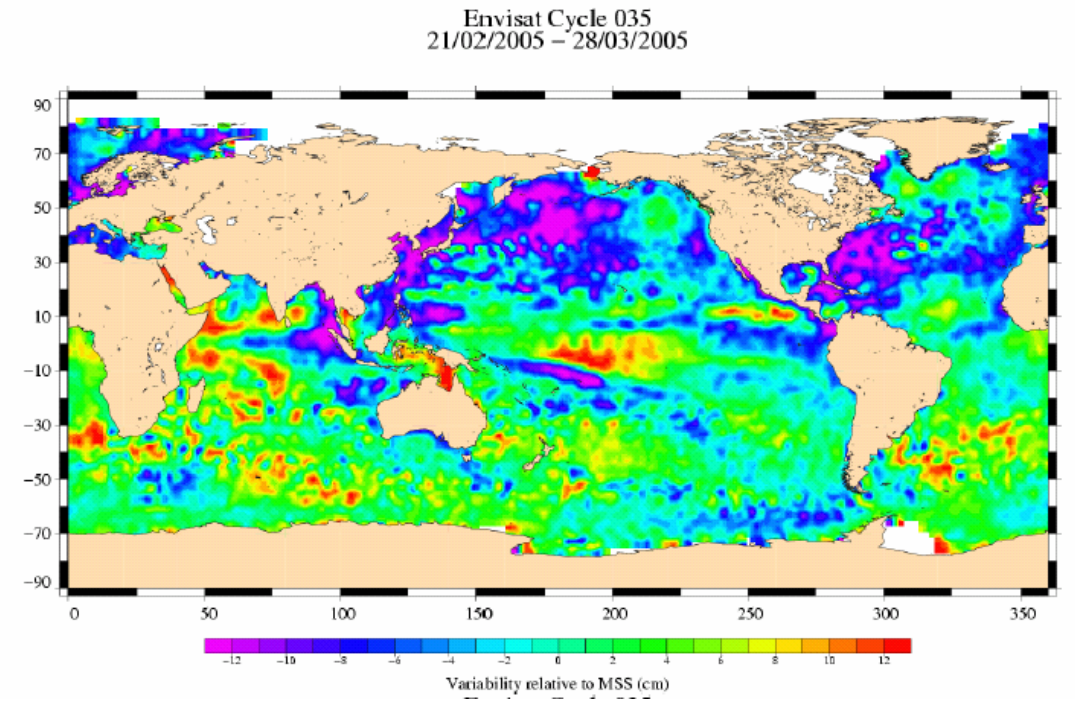


Figure 7-1: Variability relative to MSS (cm)

7.2 Monitoring trends in Mean Sea Level

A rise in Mean Sea Level could be a sign of global warming of the atmosphere. Monitoring this level is one application of altimetry, and one of the main challenges for Environmental sciences in the 21st century.

The Global Mean Sea Level as observed by EnviSat since mid-2003 is shown in the following graph. Close correlation can be observed over this period between EnviSat and the other flying altimeters Jason-1 and Topex.

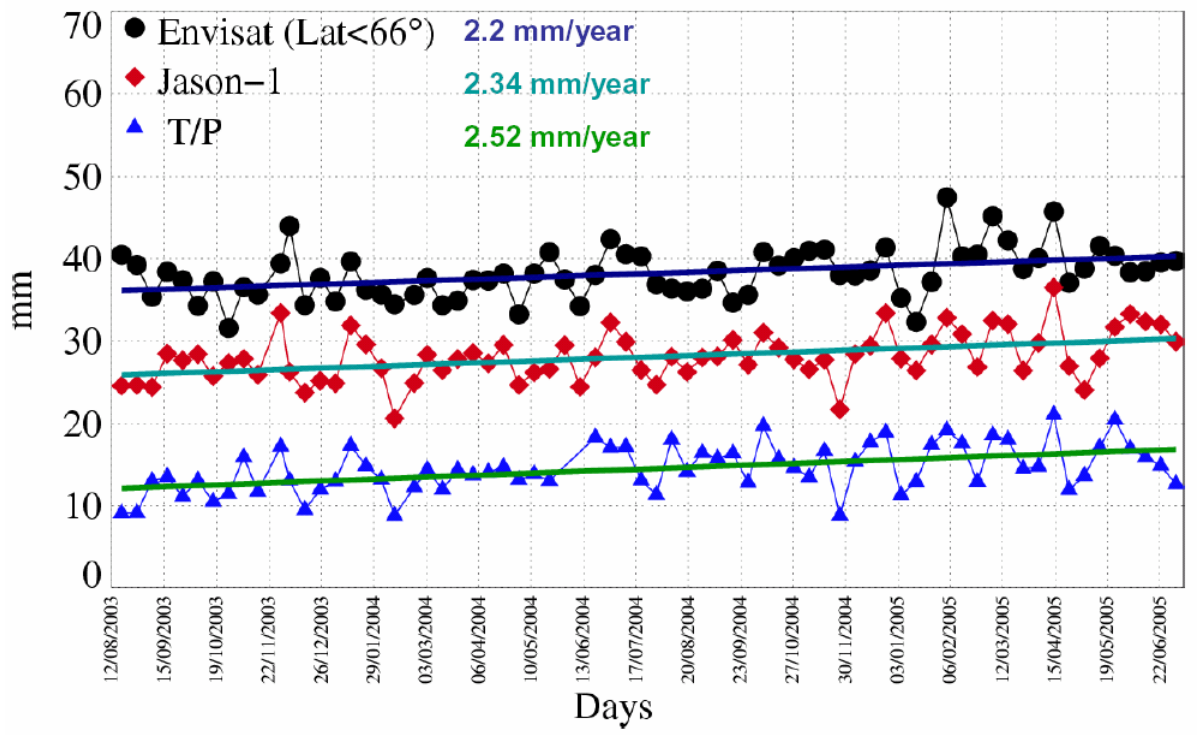


Figure 7-2: Global Mean Sea Level

7.3 Wind and waves

The significant wave height is obtained by analyzing the shape and intensity of the altimeter radar beam reflected from the sea surface (radar echo). A long time delay in the return signal indicates that waves are high, whereas conversely, a short delay indicates that the sea surface is calm.

A map of wave heights measured by EnviSat is shown below.

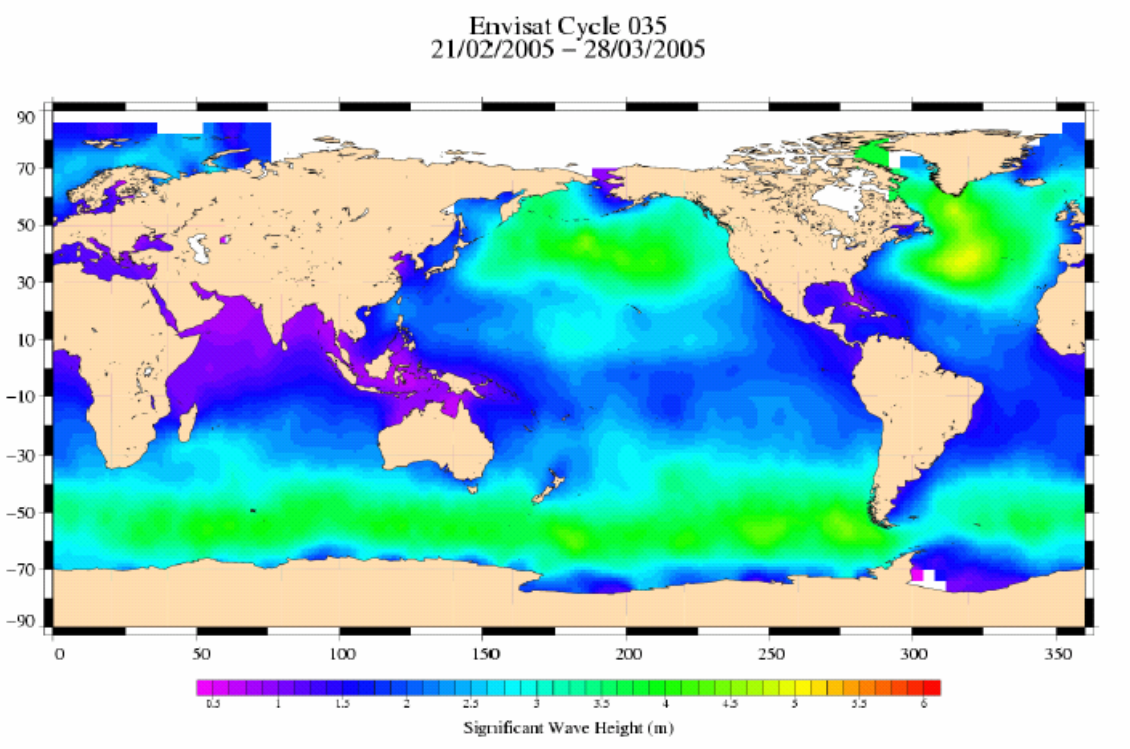


Figure 7-3: Significant wave height

A map of altimeter wind speed measured by EnviSat is shown below. These figures highlight the relationship between wind speed and significant wave height: the faster the wind, the higher the waves.

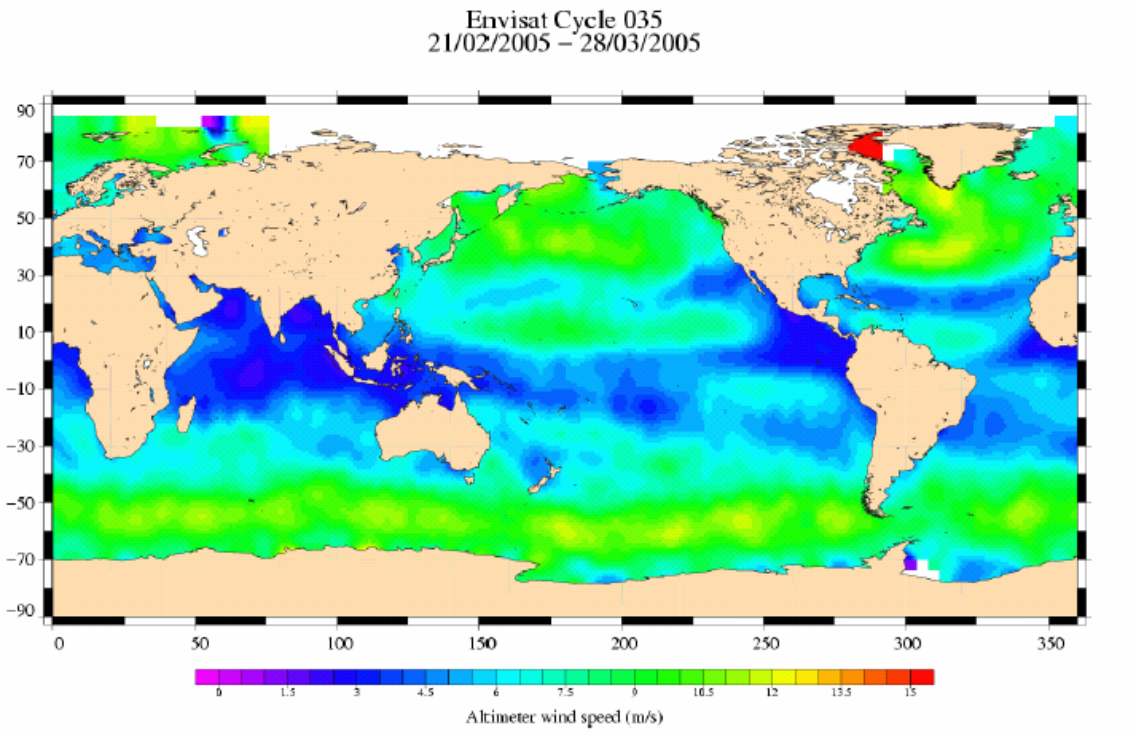


Figure 7-4: Altimeter wind speed

7.4 Links to altimetry applications

The various altimetry applications (Operational oceanography, Ocean circulation and its variations, Tides, Marine weather and atmospheric studies, Climate, El Niño, Level of oceans, enclosed seas and lakes, Hydrology, etc) are well described at the following link:

http://www.jason.oceanobs.com/html/applications/welcome_uk.html

In addition, numerous links on these topics can be found at the following address:

http://www.jason.oceanobs.com/html/kiosque/liens_uk.html#applications

8 SUPPORTING SOFTWARE AND TOOLS

Some software and tools are available on the ESA website. These include:

- GDR2MAR converter (ref http://earth.esa.int/pcs/envisat/ra2/events/)

  A description of the EnviSat GDR2MAR utility installed at F-PAC. The GDR2MAR utility is a program which converts the EnviSat GDR altimeter data files into Meteo products, i.e. IMAR or FDMAR-like products (RA-2 Wind/Wave products "RA2_WWV_2P" files)

- Envisat CFI

  The CFI software is a collection of multiplatform precompiled C libraries for timing, coordinate conversions, orbit propagation, satellite pointing calculations and target visibility calculations. This software is made available by the EnviSat project to any user involved in EnviSat mission preparation/exploitation. The only constraint on the user side is to fill in and send off a formal registration form. *NB: A username and password are required to get the CFI software. If you are not yet registered, please refer to the CFI Registration Instructions.*

- Reading tool

  To read and process satellite data, specific software tools are available online. A brief description of each tool, instructions to compile and execute them and a direct link to the FTP server to download the files can be found at http://envisat.esa.int/services/.

- EnviView

  This is a free application that allows EnviSat data users to open any EnviSat data file and examine its contents. It provides simple visualisation capabilities and allows data to be exported to HDF for use in other software packages.

9 GENERAL USER INFORMATION

More information can be found at http://earth.esa.int/pcs/envisat/ra2/ and http://earth.esa.int/pcs/envisat/mwr/ for the performance reports, or at http://envisat.esa.int/services/auxiliary_data/ra2mwr/ for all the RA-2 auxiliary data files.

For the product disclaimers please refer to the following web link:

http://envisat.esa.int/dataproducts/availability/.

For any questions, the ESA help desk is: eohelp@esa.int.

10 GLOSSARY

ANX	Ascending Node crossing
CCN	Contract Change Notice
CFI	Customer-Furnished Item
CI	Configuration Item
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
ECMWF	European Centre for Medium-Range Weather Forecasts
ESL	Expert Support Laboratory
FAT	Factory Acceptance Test
FEP	Front-End Processor
FOS	Flight Operations Segment
F-PAC	Processing and Archiving Centre in France
FTP	File Transfer Protocol
GDR	Geophysical Data Record
GUI	Graphical User Interface
I/F	Interface
IGDR	Interim Geophysical Data Record
IPF	Instrument Processing Facility
MCD	Measurement Confidence Data
MWR	Microwave Radiometer
NRT	Near Real Time
OFL	Off-Line
PAC	Processing and Archiving Centre
PDAS	Payload Data Acquisition Station (same as PDAS-F)
PDAS - F	Payload Data Acquisition Station at Fucino
PDCC	Payload Data Control Centre
PDHS - E	Payload Data Handling Station at ESRIN
PDHS - K	Payload Data Handling Station at Kiruna
PDS	Payload Data Segment
PF_HS	Processing Facility Host Structure
PNO	Public Network Operator
RA-2	Radar Altimeter
SLA	Sea Level Anomaly
S/W	Software

11 REFERENCES

RD 1

RA-2/MWR Product Handbook: http://envisat.esa.int/dataproducts/

RD 2

EnviSat-1 Product Specifications, ANNEX A: PRODUCT DATA CONVENTIONS

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RD 3

EnviSat-1 Product Specifications, Volume 5: RA-2 Product Structure

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RD 4

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12 ANNEXES

12.1 Annex 1

12.1.1 Level 2 FDGDR

12.1.1.1 Level 2 FDGDR: MPH

The Main Product Headers (MPH) below are described in the "ENVISAT-1 PRODUCT SPECIFICATIONS VOLUME 5: PRODUCT STRUCTURES" [RD 3].

Fld.	Contents	Units	Byte length	Data Type
	Product Identification Information			
1	**PRODUCT=**	keyword	8	8*uc
	quotation mark (“)		1	uc
	Product File name (Note 1) The following fields describe the product naming convention for products. For Auxiliary data files these fields will be different.		62	
	10 character Product ID (including underscoring)	-	10	10*uc
	Processing stage flag (see field 2 below)	-	1	uc
	Originator ID	-	3	3*uc
	start_day (YYYYMMDD UTC of first MDSR, or file creation date for auxiliary files)	-	8	8*uc
	underscore character	-	1	uc
	start_time (HHMMSS UTC of first MDSR, or file creation time for auxiliary files)	-	6	6*uc
	underscore character	-	1	uc
	duration (seconds of product coverage, or 00000000 if not relevant)	sec.	8	8*uc
	phase identifier	-	1	uc
	cycle number within the phase	-	3	3*uc
	underscore character	-	1	uc
	relative orbit # within the cycle (at start of product)	-	5	5*uc
	underscore character	-	1	uc
	absolute orbit # (at start of product)	-	5	5*uc
	underscore character	-	1	uc
	product type file counter (0000 to 9999, then wraps to 0000)	-	4	4*uc
	period	-	1	uc
	satellite ID (ENVISAT-1=N1, E1 = ERS1, E2 =ERS2)	-	2	2*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc

Table 12-1: Level 2 FDGDR: Main Product Header

2	**PROC_STAGE=**	keyword	11	11*uc
	Processing Stage Flag N = Near Real Time, T = test product, V= fully validated (fully consolidated) product, S = special product. Letters between N and V (with the exception of T and S) indicate steps in the consolidation process, with letters closer to V meaning higher levels of consolidation. If not used, set to X.	-	1	uc
	newline character	terminator	1	uc
3	**REF_DOC=**	keyword	8	8*uc
	quotation mark (")	-	1	uc
	Reference Document Describing Product (Note 2) AA-BB-CCC-DD-EEEE_V/IØØ (23 characters, including blank space characters) where AA-BB-CCC-DD-EEEE is the ESA standard document no. and V/I is the Version / Issue If not used, set to ØØØØØØØØØØØØØØØØØØØØØØØ	-	23	23*uc
	quotation mark (")	-	1	uc
	newline character	terminator	1	uc
4	**Spare (blank characters (Ø))**	-	40	40*uc
	newline character	terminator	1	uc
	Information with regard to Data Acquisition and Processing			
5	**ACQUISITION_STATION=**	keyword	20	20*uc
	quotation mark (")	-	1	uc
	Acquisition Station ID (up to 3 codes from:) Center Code PDHS-K = PDHS-K PDHS-E = PDHS-E LRAC = LRAC PDCC = PDCC FOS-ESOC = FOS-ES PDAS-Fucino = PDAS-F UK-PAC = UK-PAC D-PAC = D-PAC I-PAC = I-PAC F-PAC = F-PAC S-PAC = S-PAC E-PAC = E-PAC ECMWF = ECMWF others TBD. All codes TBC by ESA multiple entries are separated by commas. e.g. PDHS-K,D-PAC,LRACØØØ. String is left justified with blank space characters used for unused characters.	-	20	20*uc

Table 12-2: Level 2 FDGDR: Main Product Header

	If not used, set to ØØØØØØØØØØØØØØØØØØØØ.			
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
6	**PROC_CENTER=**	keyword	12	12*uc
	quotation mark (“)	-	1	uc
	Processing Center ID which generated current product (Note 3) (1 site code according to list in Field 5 above, left justified). If not used, set to ØØØØØØ	-	6	6*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
7	**PROC_TIME=**	keyword	10	10*uc
	quotation mark (“)	-	1	uc
	UTC Time of Processing (product generation time) UTC Time format. If not used, set to ØØØØØØØØØØØØØØØØØØØØØØØØØØØØ.	UTC	27	27*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
8	**SOFTWARE_VER=**	keyword	13	13*uc
	quotation mark (“)	-	1	uc
	Software Version number of processing software Format: Name of processor (up to 10 characters)/ version number (4 characters) -- left justified (any blanks added at end). If not used, set to ØØØØØØØØØØØØØØ. e.g. MIPAS/2.31ØØØØ	-	14	14*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
9	**Spare (blank characters (Ø))**	-	40	40*uc
	newline character	terminator	1	uc
	Information on Time of Data			

Table 12-3: Level 2 FDGDR: Main Product Header

10	**SENSING_START=**	keyword	14	14*uc
	quotation mark (“)	-	1	uc
	UTC start time of data sensing (Note 4) (first measurement in first data record) UTC Time format. If not used, set to ØØØØØØØØØØØØØØØØØØØØØØØØØØ.	UTC	27	27*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
11	**SENSING_STOP=**	keyword	13	13*uc
	quotation mark (“)	-	1	uc
	UTC stop time of data sensing (Note 4) (last measurements last data record) UTC Time format. If not used, set to ØØØØØØØØØØØØØØØØØØØØØØØØØØ.	UTC	27	27*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
12	**Spare (blank characters (Ø))**	-	40	40*uc
	newline character	terminator	1	uc
	Information on Envisat Orbit and Position			
13	**PHASE=**	keyword	6	6*uc
	Phase phase letter. If not used, set to X.	-	1	uc
	newline character	terminator	1	uc
14	**CYCLE=**	keyword	6	6*uc
	Cycle Cycle number. If not used, set to +000.	-	4	Ac
	newline character	terminator	1	uc
15	**REL_ORBIT=**	keyword	10	10*uc
	Start relative orbit number (Note 5). If not used, set to +00000	-	6	As
	newline character	terminator	1	uc

Table 12-4: Level 2 FDGDR: Main Product Header

16	**ABS_ORBIT=**	keyword	10	10*uc
	Start absolute orbit number (Note 5). If not used, set to +00000.	-	6	As
	newline character	terminator	1	uc
17	**STATE_VECTOR_TIME=**	keyword	18	18*uc
	quotation mark (“)	-	1	uc
	UTC of ENVISAT state vector (see Note 6) UTC time format. If not used, set to ØØØØØØØØØØØØØØØØØØØØØØØØØØ.	UTC	27	27*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
18	**DELTA_UT1=**	keyword	10	10*uc
	DUT1=UT1-UTC (see Note 6). If not used, set to +.000000.	s	8	Ado06
	<s>	units	3	3*uc
	newline character	terminator	1	uc
19	**X_POSITION=**	keyword	11	11*uc
	X Position in Earth-Fixed reference (see Note 6). If not used, set to +0000000.000.	m	12	Ado73
	<m>	units	3	3*uc
	newline character	terminator	1	uc
20	**Y_POSITION=**	keyword	11	11*uc
	Y Position in Earth-Fixed reference (see Note 6). If not used, set to +0000000.000.	m	12	Ado73
	<m>	units	3	3*uc
	newline character	terminator	1	uc
21	**Z_POSITION=**	keyword	11	11*uc
	Z Position in Earth-Fixed reference (see Note 6). If not used, set to +0000000.000.	m	12	Ado73
	<m>	units	3	3*uc
	newline character	terminator	1	uc

Table 12-5: Level 2 FDGDR: Main Product Header

22	**X_VELOCITY=**	keyword	11	11*uc
	X velocity in Earth fixed reference (see Note 6). If not used, set to +0000.000000.	m/s	12	Ado46
	<m/s>	units	5	5*uc
	newline character	terminator	1	uc
23	**Y_VELOCITY=**	keyword	11	11*uc
	Y velocity in Earth fixed reference (see Note 6). If not used, set to +0000.000000.	m/s	12	Ado46
	<m/s>	units	5	5*uc
	newline character	terminator	1	uc
24	**Z_VELOCITY=**	keyword	11	11*uc
	Z velocity in Earth fixed reference (see Note 6). If not used, set to +0000.000000.	m/s	12	Ado46
	<m/s>	units	5	5*uc
	newline character	terminator	1	uc
25	**VECTOR_SOURCE=**	keyword	14	14*uc
	quotation mark (“)	-	1	uc
	Source of Orbit Vectors (see Note 6) FP = FOS predicted orbit state vectors (NRT processing) DN = DORIS Level 0 navigator product acquired at PDHS (NRT) FR = FOS restituted orbit state vectors DI = DORIS initial (preliminary) orbit DP = DORIS precise orbit If not used, set to ØØ.	-	2	2*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
26	**Spare (blank characters (Ø))**	-	40	40*uc
	newline character	terminator	1	uc
	SBT to UTC Conversion Information			

Table 12-6: Level 2 FDGDR: Main Product Header

27	**UTC_SBT_TIME=**	keyword	13	13*uc
	quotation mark (“)	-	1	uc
	UTC time corresponding to SBT below (currently defined to be given at the time of the ascending node state vector). If not used, set to ØØØØØØØØØØØØØØØØØØØØØØØØØØ.	UTC	27	27*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
28	**SAT_BINARY_TIME=**	keyword	16	16*uc
	Satellite Binary Time (SBT) 32bit integer time of satellite clock. If not used, set to +0000000000. (This value is unsigned, i.e., to be interpreted ≥0)	-	11	Al
	newline character	terminator	1	uc
29	**CLOCK_STEP=**	keyword	11	11*uc
	Clock Step Size clock step in picoseconds. If not used, set to +0000000000. (This value is unsigned, i.e., to be interpreted ≥0)	psec.	11	Al
	<ps>	units	4	4*uc
	newline character	terminator	1	uc
30	**Spare (blank characters (Ø))**	-	32	32*uc
	newline character	terminator	1	uc
	Leap Second Information[a]			
31	**LEAP_UTC=**	keyword	9	9*uc
	quotation mark (“)	-	1	uc
	UTC time of the occurrence of the Leap Second Set to ØØØØØØØØØØØØØØØØØØØØØØØØØØ if not used.	UTC	27	27*uc
	quotation mark (“)	-	1	uc
	newline character	terminator	1	uc
32	**LEAP_SIGN=**	keyword	10	10*uc
	Leap second sign (+001 if positive Leap Second, -001 if negative) Set to +000 if not used.	s	4	Ac
	newline character	terminator	1	uc

Table 12-7: Level 2 FDGDR: Main Product Header

33	**LEAP_ERR=**	keyword	9	9*uc
	Leap second error if leap second occurs within processing segment = 1, otherwise = 0 If not used, set to 0. (see Note 7)	-	1	uc
	newline character	terminator	1	uc
34	**Spare (blank characters (Ø))**	-	40	40*uc
	newline character	terminator	1	uc
	Product Confidence Data Information			
35	**PRODUCT_ERR=**	keyword	12	12*uc
	1 or 0. If 1, errors have been reported in the product. User should then refer to the SPH or Summary Quality ADS of the product for details of the error condition. If not used, set to 0.		1	uc
	newline character	terminator	1	uc
	Product Size Information			
36	**TOT_SIZE=**	keyword	9	9*uc
	Total Size Of Product (# bytes DSR + SPH+ MPH)	bytes	21	Ad
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
37	**SPH_SIZE=**	keyword	9	9*uc
	Length Of SPH (# bytes in SPH)	bytes	11	Al
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
38	**NUM_DSD=**	keyword	8	8*uc
	Number of DSDs This number includes the Spare DSDs and all other types of DSDs.	-	11	Al
	newline character	terminator	1	uc
39	**DSD_SIZE=**	keyword	9	9*uc
	Length of Each DSD (# bytes for each DSD, all DSDs shall have the same length)	-	11	Al
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc

Table 12-8: Level 2 FDGDR: Main Product Header

40	**NUM_DATA_SETS=**	keyword	14	14*uc
	Number of DSs attached (not all DSDs have a DS attached)	-	11	A1
	newline character	terminator	1	uc
41	**Spare (blank characters (Ø))**	-	40	40*uc
	newline character	terminator	1	uc
TOTAL		-	**1247**	

Table 12-9: Level 2 FDGDR: Main Product Header

MPH Notes:

1. The product identifier is a unique string which may be used as a file name when storing a product. The format is described in detail in the product identification scheme section in Annex A [RD 2].

2. The reference document describing the product is updated with any changes to the processor software.

3. Since a product can be generated in a different centre to the receiving station, this field will identify the Production Centre ID.

4. This is the start time and stop time in UTC format when data sensing occurred onboard the satellite, as calculated from the Satellite Binary Time counter for the first and last MDSRs in the Level 0 product.

5. The satellite orbit number is specified in two ways: absolute number and relative to a specific orbit cycle. The orbit numbers given are those current at the Sensing Start Time of the product.

6. The Orbit State Vector (OSV) corresponds to the Ascending Node crossing if the OSV is generated from the DORIS Navigator Level 0 product (DOR_NAV_OP), or from the DORIS Navigator Orbit (AUX_FPO_AX). The OSV corresponds to sensing start time of the product if the OSV is generated from the DORIS preliminary product (DOR_POR_2P), DORIS precision product (DOR_VOR_2P), or from the FOS Restored Orbit (AUX_FRO_AX).

7. The processing segment is defined by the segment start and stop times. In stripline processing, the strips processed represent a subset of the segment data. As a result, the product coming from a strip may have the LEAP_ERR set to 1 with the LEAP_UTC after SENSING_STOP or before SENSING_START.

12.1.1.2 Level 2 FDGDR: SPH

The SPH is an ASCII header and as such follows the ASCII conventions described in Volume 5.

The content of the RA-2 Level 2 Specific Product Header shall be as follows:

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
1	**SPH_DESCRIPTOR=**	keyword	15	uc	15
	quotation mark (“)	-	1	uc	1
	SPH Descriptor, set to RA2_MWR_FDGDR or RA2_MWR_IGDR or RA2_MWR_GDR. (Note 1) ASCII string describing the product. Unused characters set to the ASCII blank space character.	-	28	uc	28
	quotation mark (“)	-	1	uc	1
	new line character	terminator	1	uc	1
	RA-2 Time Information				
2	**RA2_FIRST_RECORD_TIME=**	keyword	22	uc	22
	quotation mark (“)	-	1	uc	1
	UTC Time of first record in the RA-2 MDS for this product.	UTC	27	uc	27
	quotation mark (“)	-	1	uc	1
	new line character	terminator	1	uc	1
3	**RA2_LAST_RECORD_TIME=**	keyword	21	uc	21
	quotation mark (“)	-	1	uc	1
	UTC Time of last record in the RA-2 MDS for this product.	UTC	27	uc	27
	quotation mark (“)	-	1	uc	1
	new line character	terminator	1	uc	1
	RA-2 Positioning Information				
4	**RA2_FIRST_LAT=**	keyword	14	uc	14
	Geodetic Latitude of the first record in the RA-2 MDS A negative value denotes a South latitude, a positive value denotes a North latitude	10 -6 degrees	11	Al	1
	<10-6degN>	units	10	uc	10
	new line character	terminator	1	uc	1
5	**RA2_FIRST_LONG=**	keyword	15	uc	15
	Geodetic longitude of the first record in the RA-2 MDS. Positive values East of Greenwich, negative values West of Greenwich	10 -6 degrees	11	Al	1
	<10-6degE>	units	10	uc	10
	new line character	terminator	1	uc	1
6	**RA2_LAST_LAT=**	keyword	13	uc	13

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
	Geodetic Latitude of the last record in the RA-2 MDS A negative value denotes a South latitude, a positive value denotes a North latitude	10 -6 degrees	11	Al	1
	<10-6degN>	units	10	uc	10
	new line character	terminator	1	uc	1
7	**RA2_LAST_LONG=**	keyword	14	uc	14
	Geodetic longitude of the last record in the RA-2 MDS Positive values East of Greenwich, negative values West of Greenwich	10 -6 degrees	11	Al	1
	<10-6degE>	units	10	uc	10
	new line character	terminator	1	uc	1
7b	**PASS_NUMBER=**	keyword	12	uc	12
	Pass number from pole to pole (set to +00000 for NRT products)	-	6	As	1
	new line character	terminator	1	uc	1
8	**Spare (blank characters)**	-	31	uc	31
	new line character	terminator	1	uc	1
	RA-2 Quality Information				
9	**RA2_L2_PROC_FLAG=**	keyword	17	uc	17
	Processing errors significance flag 1 or 0. 1 if the percentage of DSRs free of processing errors during Level 2 processing is less than the acceptable threshold.	-	1	uc	1
	new line character	terminator	1	uc	1
10	**RA2_L1B_PROC_FLAG=**	keyword	18	uc	18
	Processing errors significance flag 1 or 0. 1 if the percentage of DSRs free of processing errors during Level 1B SP data block processing is less than the acceptable threshold.	-	1	uc	1
	new line character	terminator	1	uc	1
11	**RA2_L1B_HEADER_FLAG=**	keyword	20	uc	20
	Header errors significance flag 1 or 0. 1 if the percentage of DSRs free of processing errors during Level 1B SP Headers processing is less than the acceptable threshold.	-	1	uc	1
	new line character	terminator	1	uc	1
12	**RA2_L2_PROCESSING_QUALITY=**	keyword	26	uc	26
	Percentage of DSRs free of processing errors during Level 2 processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
13	**RA2_L1B_PROCESSING_QUALITY=**	keyword	27	uc	27
	Percentage of DSRs free of processing errors during Level IB SP data block processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
14	**RA2_L1B_HEADER_QUALITY=**	keyword	23	uc	23
	Percentage of DSRs free of processing errors during Level 1B SP Headers processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
15	**RA2_L2_PROC_THRESH=**	keyword	19	uc	19
	Minimum acceptable percentage of DSRs free of processing errors during Level 2 processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
16	**RA2_L1B_PROC_THRESH=**	keyword	20	uc	20
	Minimum acceptable percentage of DSRs free of processing errors during Level 1B SP data block processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
17	**RA2_L1B_HEADER_THRESH=**	keyword	22	uc	22
	Minimum acceptable percentage of DSRs free of processing errors during Level 1B SP Headers processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
18	**RA2_FLAG_MANOEUVER=**	keyword	19	uc	19
	Orbit manoeuvre indicator Not used for FD products (set to +00000 if not used)	-	6	As	1
	new line character	terminator	1	uc	1
19	**RA2_MANOEUVER_START_UTC=**	keyword	24	uc	24
	quotation mark (“)	-	1	uc	1
	UTC of start of manoeuvre. Not used for FD products (set to all blank space characters)	UTC	27	uc	27
	quotation mark (“)	-	1	uc	1
	new line character	terminator	1	uc	1
20	**RA2_MANOEUVER_STOP_UTC=**	keyword	23	uc	23
	quotation mark (“)	-	1	uc	1

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
	UTC of end of manoeuvre. Not used for FD products (set to all blank space characters)	UTC	27	uc	27
	quotation mark (“)	-	1	uc	1
	new line character	terminator	1	uc	1
21	**Spare (blank space characters)**	ASCII	50	uc	50
	new line character	terminator	1	uc	1
	RA-2 Subsystem Identification				
22	**RA2_RV_RFSS_DEF=**	keyword	16	uc	16
	Hardware configuration for RF subsystem (A or B)	-	1	uc	1
	new line character	terminator	1	uc	1
23	**RA2_RV_HPA_DEF=**	keyword	15	uc	15
	Hardware configuration for HPA subsystem (A or B)	-	1	uc	1
	new line character	terminator	1	uc	1
	RA-2 Processing Information				
24	**RA2_MEASUREMENT_PERCENT=**	keyword	24	uc	24
	Percentage of valid measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
25	**RA2_320_BAND_PERCENT=**	keyword	21	uc	21
	Percentage of the 320 MHz band processed	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
26	**RA2_80_BAND_PERCENT=**	keyword	20	uc	20
	Percentage of the 80 MHz band processed	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
27	**RA2_20_BAND_PERCENT=**	keyword	20	uc	20
	Percentage of the 20 MHz band processed	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
28	**RA2_OCEAN_KU_RETRACK_PERCENT=**	keyword	29	uc	29
	Percentage of valid Ku Ocean retracker measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
29	**RA2_OCEAN_S_RETRACK_PERCENT=**	keyword	28	uc	28
	Percentage of valid S Ocean retracker measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
30	**RA2_ICE1_KU_RETRACK_PERCENT=**	keyword	28	uc	28
	Percentage of valid Ku Ice-1 retracker measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
31	**RA2_ICE1_S_RETRACK_PERCENT=**	keyword	27	uc	27
	Percentage of valid S Ice-1 retracker measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
32	**RA2_ICE2_KU_RETRACK_PERCENT=**	keyword	28	uc	28
	Percentage of valid Ku Ice-2 retracker measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
33	**RA2_ICE2_S_RETRACK_PERCENT=**	keyword	27	uc	27
	Percentage of valid S Ice-2 retracker measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
34	**RA2_SEAICE_KU_RETRACK_PERCENT=**	keyword	30	uc	30
	Percentage of valid Ku Sea-ice retracker measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
35	**RA2_PEAKINESS_LOW_PERCENT=**	keyword	26	uc	26
	Percentage of low peakiness measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
36	**RA2_PEAKINESS_HIGH_PERCENT=**	keyword	27	uc	27
	Percentage of high peakiness measurements	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
37	**MWR_BT_OPTIMAL_INTERPOLATION_PERCENT=**	keyword	37	uc	37
	Percentage of optimal interpolation of MWR brightness temperatures	10-2%	6	As	1

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
38	**RA2_TIME_SHIFT_MIDFRAME=**	keyword	24	uc	24
	Offset to apply to time tag to derive datation of the first waveform in a source packet	10-6s	11	Al	1
	<10-6s>	units	7	uc	7
	new line character	terminator	1	uc	1
39	**RA2_TIME_INTERVAL=**	keyword	18	uc	18
	Time interval between two waveforms	10-6s	11	Al	1
	<10-6s>	units	7	uc	7
	new line character	terminator	1	uc	1
40	**RA2_IF_MASK_SEL=**	keyword	16	uc	16
	IF Mask selection flag	-	1	uc	1
	new line character	terminator	1	uc	1
41	**RA2_IF_MASK_PROC=**	keyword	17	uc	17
	IF shape compensation processing mode	-	1	uc	1
	new line character	terminator	1	uc	1
42	**RA2_USO_SEL=**	keyword	12	uc	12
	USO selection flag	-	1	uc	1
	new line character	terminator	1	uc	1
43	**RA2_USO_PROC=**	keyword	13	uc	13
	USO compensation processing mode	-	1	uc	1
	new line character	terminator	1	uc	1
44	**AVERAGE_GLOBAL_PRESSURE=**	keyword	24	uc	24
	Average of the global pressure over the ocean computed from the meteo field, the closest time to the first measurement. This field must be set to all zeros.	10Pa	11	Al	1
	<10Pa>	units	6	uc	6
	new line character	terminator	1	uc	1
45	**SOLAR_ACTIVITY_INDEX=**	keyword	21	uc	21
	Interpolated value for the solar activity index used for the first measurement	-	6	As	1
	new line character	terminator	1	uc	1
46	**METEO_MODEL_VERSION=**	keyword	20	uc	20
	quotation mark (“)	terminator	1	uc	1
	Version of the meteorological model	-	50	uc	50

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
	quotation mark (“)	terminator	1	uc	1
	new line character	terminator	1	uc	1
47	**DORIS_IONOSPHERIC_MODEL_VERSION=**	keyword	32	uc	32
	quotation mark (“)	terminator	1	uc	1
	Version of the ionospheric model	-	50	uc	50
	quotation mark (“)	terminator	1	uc	1
	new line character	terminator	1	uc	1
48	**Spare**	ASCII	50	uc	50
	new line character	terminator	1	uc	1
	MWR Time Information				
49	**MWR_FIRST_RECORD_TIME=**	keyword	22	uc	22
	quotation mark (“)	terminator	1	uc	1
	UTC of the first record in the MWR MDS	UTC	27	uc	27
	quotation mark (“)	terminator	1	uc	1
	new line character	terminator	1	uc	1
50	**MWR_LAST_RECORD_TIME=**	keyword	21	uc	21
	quotation mark (“)	terminator	1	uc	1
	UTC of the last record in the MWR MDS	UTC	27	uc	27
	quotation mark (“)	terminator	1	uc	1
	new line character	terminator	1	uc	1
	MWR Location Information				
51	**MWR_FIRST_LAT=**	keyword	14	uc	14
	Geodetic Latitude of the first record in the MWR MDS. A negative value denotes a South latitude, a positive value denotes a North latitude	10 -6 degrees	11	Al	1
	<10-6degN>	units	10	uc	10
	new line character	terminator	1	uc	1
52	**MWR_FIRST_LONG=**	keyword	15	uc	15
	Geodetic longitude of the first record in the MWR MDS. Positive values East of Greenwich, negative values West of Greenwich	10 -6 degrees	11	Al	1
	<10-6degE>	units	10	uc	10
	new line character	terminator	1	uc	1
53	**MWR_LAST_LAT=**	keyword	13	uc	13
	Geodetic Latitude of the last record in the MWR MDS A negative value denotes a South latitude, a positive value	10 -6 degrees	11	Al	1

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
	denotes a North latitude				
	<10-6degN>	units	10	uc	10
	new line character	terminator	1	uc	1
54	**MWR_LAST_LONG=**	keyword	14	uc	14
	Geodetic longitude of the last record in the MWR MDS Positive values East of Greenwich, negative values West of Greenwich	10 -6 degrees	11	Al	1
	<10-6degE>	units	10	uc	10
	new line character	terminator	1	uc	1
	MWR Quality Information				
55	**MWR_L2_PROC_FLAG=**	keyword	17	uc	17
	1 or 0. 1 if the percentage of DSRs free of processing errors during Level 2 processing is less than the acceptable threshold.	-	1	uc	1
	new line character	terminator	1	uc	1
56	**MWR_L1B_PROC_FLAG=**	keyword	18	uc	18
	1 or 0. 1 if the percentage of MWR MDSRs without errors is less than the acceptable threshold.	-	1	uc	1
	new line character	terminator	1	uc	1
57	**MWR_L1B_HEADER_FLAG=**	keyword	20	uc	20
	1 or 0. 1 if the number of MWR MDSRs without header reading errors is less than the acceptable threshold	-	1	uc	1
	new line character	terminator	1	uc	1
58	**MWR_L1B_TELEMETRY_FLAG=**	keyword	23	uc	23
	1 or 0. 1 if the number of MWR MDSRs without telemetry reading errors is less than the acceptable threshold	-	1	uc	1
	new line character	terminator	1	uc	1
59	**MWR_L2_PROC_QUALITY=**	keyword	20	uc	20
	Percentage of DSRs free of processing errors during MWR Level 2 processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
60	**MWR_L1B_PROC_QUALITY=**	keyword	21	uc	21
	Percentage of MWR MDSRs free of processing errors during Level 1B processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
61	**MWR_L1B_HEAD_QUALITY=**	keyword	21	uc	21
	Percentage of MWR MDSRs free of header errors.	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
62	**MWR_L1B_TELEM_QUALITY=**	keyword	22	uc	22
	Percentage of MWR MDSRs free of telemetry errors	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
63	**MWR_L2_PROC_THRESH=**	keyword	19	uc	19
	Minimum acceptable percentage of DSRs free of processing errors during MWR Level 2 processing	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
64	**MWR_L1B_PROC_THRESH=**	keyword	20	uc	20
	Minimum acceptable percentage of MWR MDSRs without processing errors	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
65	**MWR_L1B_HEAD_THRESH=**	keyword	20	uc	20
	Minimum acceptable percentage of MWR MDSRs without header reading errors	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
66	**MWR_L1B_TELEM_THRESH=**	keyword	21	uc	21
	Minimum acceptable percentage of MWR MDSRs without telemetry reading errors	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
67	**RA2_WS_OPTIMAL_INTERPOLATION_PERCENT=**	keyword	37	uc	37
	Percentage of optimal interpolation of the RA-2 altimeter wind speed with the MWR DSR time stamps	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
68	**MWR_LANDFLAG_PERCENT=**	keyword	21	uc	21
	land coverage percentage	10-2%	6	As	1
	<10-2%>	units	7	uc	7

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
	new line character	terminator	1	uc	1
69	**MWR_SEAFLAG_PERCENT=**	keyword	20	uc	20
	sea coverage percentage	10-2%	6	As	1
	<10-2%>	units	7	uc	7
	new line character	terminator	1	uc	1
70	**Spare (ASCII blank space characters)**	-	50	uc	50
	new line character	terminator	1	uc	1
	DSDs for included Data Sets				
71	**DSD (M) - for the RA-2 MDS**	-	280	dsd	1
72	**DSD (M) - for the MWR MDS**	-	280	dsd	1
73	**DSD (M) - for the 18 Hz Average Waveforms MDS (Note 2)**	-	280	dsd	1
74	**DSD (M) - for the Burst Waveforms MDS (Note 2)**	-	280	dsd	1
75	**DSD - Spare Reserved (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
76	**DSD - Spare Reserved (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
77	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
	DSDs for referenced files				
78	**DSD (R) - Level 1B product from which this product was created**	-	280	dsd	1
79	**DSD (R) - for Level-2 parent product (Note 2)**	-	280	dsd	1
80	**DSD (R) for Orbit Data File Used**	-	280	dsd	1
81	**DSD (R) - For DORIS Ionospheric correction file (Note 3)**	-	280	dsd	1
82	**DSD (R) - RA-2 Level 1B IF data file**	-	280	dsd	1
83	**DSD (R) - RA-2 Level 1B USO data file**	-	280	dsd	1
84	**DSD (R) - MWR Level 1B side lobe data file**	-	280	dsd	1
85	**DSD - spare (279 blanks followed by a new line)**	-	280	dsd_sp	1
86	**DSD (R) - referencing the ENVISAT-1 Attitude data file**	-	280	dsd	1
87	**DSD - spare (279 blanks followed by a new line)**	-	280	dsd_sp	1
88	**DSD (R) - Platform data file**	-	280	dsd	1
89	**DSD (R) - for first ECMWF file used**	-	280	dsd	1
90	**DSD (R) - for second ECMWF file used**	-	280	dsd	1
91	**DSD (R) - for third ECMWF file used**	-	280	dsd	1
92	**DSD (R) - Solar Activity Data File**	-	280	dsd	1

Level 2 RA-2 SPH

N	Description	Units	Byte Length	Data Type	Dim.
93	**DSD (R) - Pole Location Data File**	-	280	dsd	1
94	**DSD - spare (279 blanks followed by a new line)**	-	280	dsd_sp	1
95	**DSD - spare (279 blanks followed by a new line)**	-	280	dsd_sp	1
96	**DSD - spare (279 blanks followed by a new line)**	-	280	dsd_sp	1
97	**DSD (R) - RA-2 Level 1B Configuration File**	-	280	dsd	1
98	**DSD (R) - RA-2 Level 1B Characterization Data File**	-	280	dsd	1
99	**DSD (R) - MWR Level 1B Configuration File**	-	280	dsd	1
100	**DSD (R) - MWR Level 1B Characterization Data File**	-	280	dsd	1
101	**DSD (R) - MWR Land/Sea Flags Data File**	-	280	dsd	1
102	**DSD - spare (279 blanks followed by a new line)**	-	280	dsd_sp	1
103	**DSD - spare (279 blanks followed by a new line)**	-	280	dsd_sp	1
104	**DSD (R) - Altitude of Meteo Grid Points File**	-	280	dsd	1
105	**DSD (R) - RA-2 Constants File**	-	280	dsd	1
106	**DSD (R) - RA-2 Configuration (System) File for Ocean / Ice-2 Processing**	-	280	dsd	1
107	**DSD (R) -RA-2 Configuration (System) File for Ice-1 / Sea-Ice Processing**	-	280	dsd	1
108	**DSD (R) - Sea State Bias file**	-	280	dsd	1
109	**DSD (R) - Modified Dip Map File**	-	280	dsd	1
110	**DSD (R) - Ionospheric Coefficients File**	-	280	dsd	1
111	**DSD (R) - Cartwright Amplitudes File**	-	280	dsd	1
112	**DSD (R) - Ocean Tide Solution 1 Map File**	-	280	dsd	1
113	**DSD (R) - Loading Tide Solution 1 Map File**	-	280	dsd	1
114	**DSD (R) - Ocean Tide Solution 2 Map File**	-	280	dsd	1
115	**DSD (R) - Loading Tide Solution 2 Map File**	-	280	dsd	1
116	**DSD (R) - Geoid Height Map File**	-	280	dsd	1
117	**DSD (R) - Mean Sea Surface Heights file**	-	280	dsd	1
118	**DSD (R) - Ocean depth/land elevation file**	-	280	dsd	1
119	**DSD (R) - Slope model 1 (Map for Greenland)**	-	280	dsd	1
120	**DSD (R) - Slope model 2 (Map for Antarctica)**	-	280	dsd	1
121	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
122	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
	size (in bytes)		**17178**		

Table 12-10: Level 2 RA-2 SPH

Note 1: The SPH descriptor value will be set to RA2_MWR_FDGDR for Fast Delivery products, to RA2_MWR_IGDR for Intermediate delivery products and to RA2_MWR_GDR for fully consolidated products.

Note 2: The DSDs of fields 73, 74 and 79 above are always set to 'NOT USED' (see Volume 5, section 5.4.3.3).

Note 3: The DSD of field 81 above is set to 'NOT USED' for products generated in Near Real Time (FDGDR). It is only meaningful for off-line processing (IGDR and GDR).

12.1.1.3 Level 2 FDGDR: RA-2 MDS

The RA-2 MDS is composed of several MDSRs (1 MDSR every 1.114s). The MDSR format is described below.

Level 2 RA-2 MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**MDSR Time stamp** Time fields based on UTC are computed for each record and referred to the centre of the averaged waveform.	-	12	mjd	1
2	**Quality Indicator (-1 for blank MDSR, 0 otherwise)**	-	1	sc	1
3	**Spare (See Note 4, for differences in this field between NRT and OFL level2 products)**	-	3	uc	3
4	**Geodetic Latitude (positive N, negative S)**	1 x 10^{-6} deg	4	sl	1
5	**Longitude (positive E, 0 at Greenwich, negative W)**	1 x 10^{-6} deg	4	sl	1
6	**Source Packet Counter**	-	4	ul	1
7	**Instrument Mode ID**	flags	4	ul	1
8	**Measurement Confidence Data (See Note 1)**	flags	4	ul	1
	Orbit Information				
9	**Altitude of CoG above reference ellipsoid**	mm	4	ul	1
10	**18 Hz altitude differences from 1 Hz altitude [20]**	mm	40	ss	20
11	**Instantaneous altitude rate**	mm/s	2	ss	1
12	**Spare (see Note 4)**	-	50	uc	50
	Range Information				
13	**18 Hz Ku tracker range referenced to the COG (no Doppler correction) [20]**	mm	80	ul	20
14	**18 Hz S tracker range referenced to the COG (no Doppler correction) [20]**	mm	80	ul	20

Level 2 RA-2 MDSR

N	Description		Units	Byte Length	Data Type	Dim.
15	**Map of valid points for 18 Hz Ku-band tracker range** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0= valid measurement, 1= invalid. Bit 0 applies to the first data block. Unused bits set to 0.		flags	4	ul	1
16	**Spare (see Note 4)**		-	4	uc	4
17	**Ku-band ocean range**		mm	4	ul	1
18	**S-band ocean range**		mm	4	ul	1
19	**18 Hz Ku-band ocean ranges [20]**		mm	80	ul	20
20	**18 Hz S-band ocean ranges [20]**		mm	80	ul	20
21	**Standard deviation of 18 Hz Ku-band ocean range**		mm	2	us	1
22	**Standard deviation of 18 Hz S-band ocean range**		mm	2	us	1
23	**Number of 18 Hz valid points for Ku-band ocean range**		-	2	us	1
24	**Number of 18 Hz valid points for S-band ocean range**		-	2	us	1
25	**Map of 18 Hz valid points for Ku-band ocean range** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0= valid measurement, 1= invalid. Bit 0 applies to the first data block. Unused bits set to 0.		flags	4	ul	1
26	**Map of 18 Hz valid points for S-band ocean range** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0= valid measurement, 1= invalid. Bit 0 applies to the first data block. Unused bits set to 0.		flags	4	ul	1
27	**18 Hz Ku-band ice1 ranges [20]**		mm	80	ul	20
28	**18 Hz S-band ice1 ranges [20]**		mm	80	ul	20
29	**18 Hz Ku-band ice2 ranges [20]**		mm	80	ul	20
30	**18 Hz S-band ice2 ranges [20]**		mm	80	ul	20
31	**18 Hz Ku-band sea-ice ranges [20]**		mm	80	ul	20
32	***Only for NRT products:***	**Spare (See Note 4) .**		80	uc	80
	***ONLY for OFL products*:**	**18 Hz latitudes differences from 1Hz [20]**	$10x10^{-6}$ deg	40	ss	20
		18 Hz longitudes differences from 1Hz [20]	$10x10^{-6}$ deg	40	ss	20
	Range Corrections Information					
33	**18 Hz Ku-band range instrumental correction [20]**		mm	40	ss	20
34	**18 Hz S-band range instrumental correction [20]**		mm	40	ss	20
35	**18 Hz Ku-band Doppler correction [20]**		mm	40	ss	20

Level 2 RA-2 MDSR

N	Description		Units	Byte Length	Data Type	Dim.
36	**18 Hz S-band Doppler correction [20]**		mm	40	ss	20
37	**18 Hz Ku-band Delta Doppler Slope correction [20]**		mm	40	ss	20
38	**18 Hz S-band Delta Doppler Slope correction [20]**		mm	40	ss	20
39	**Model dry tropospheric correction**		mm	2	ss	1
40	**Inverted barometer correction**		mm	2	ss	1
41	**Model wet tropospheric correction**		mm	2	ss	1
42	**MWR derived wet tropospheric correction**		mm	2	ss	1
43	**RA2 ionospheric correction on Ku-band**		mm	2	ss	1
44	**RA2 ionospheric correction on S-band**		mm	2	ss	1
45	**Ionospheric correction from DORIS on Ku-band**		mm	2	ss	1
46	**Ionospheric correction from DORIS on S-band**		mm	2	ss	1
47	**Ionospheric correction from model on Ku-band**		mm	2	ss	1
48	**Ionospheric correction from model on S-band**		mm	2	ss	1
49	**Sea state bias correction on Ku-band**		mm	2	ss	1
50	**Sea state bias correction on S-band**		mm	2	ss	1
51	***Only for NRT products:***	**Spare (see Note 4).**	-	12	uc	1
	Only for OFL products:	**DIB_HF** for GDR/MWS. The DIB value has been coded as a difference from the IB value; default value is set for IGDR product**.**	mm	2	ss	1
		Spare (see Note 4)		10	uc	1
	Significant Wave Height Information					
52	**Square of Ku-band Significant wave height**		mm^2	4	sl	1
53	**Square of S-band Significant wave height**		mm^2	4	sl	1
54	**Ku-band Significant Wave Height**		mm	2	ss	1
55	**S-Band Significant Wave Height**		mm	2	ss	1
56	**Standard deviation of 18 Hz Ku-band SWH**		mm	2	ss	1
57	**Standard deviation of 18 Hz S-band SWH**		mm	2	ss	1
58	**Number of 18 Hz valid points for Ku-band ocean SWH**		-	2	us	1
59	**Number of 18 Hz valid points for S-band ocean SWH**		-	2	us	1
60	**Slope model present flags [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0= valid measurement, 1= invalid. Bit 0 applies to the first		flags	4	ul	1

Level 2 RA-2 MDSR

N	Description	Units	Byte Length	Data Type	Dim.
	data block. Unused bits set to 0.				
61	**1 Hz Elevation of echoing point**	cm	4	sl	1
62	**18 Hz Elevation differences of echoing point from mean[20]**	cm	40	ss	20
63	**18 Hz slope-corrected latitude differences from 1 Hz latitude [20]**	10 x 10^{-6} deg	40	ss	20
64	**18 Hz slope-corrected longitude differences from 1 Hz longitude [20]**	10 x 10^{-6} deg	40	ss	20
65	**18 Hz Ku-band Ice 2 leading edge width [20]**	mm	40	ss	20
66	**18 Hz S-band Ice 2 leading edge width [20]**	mm	40	ss	20
67	**Spare (see Note 4)**	-	40	uc	40
	Backscatter Information				
68	**18 Hz Ku-band K_cal_Ku [20]**	dB/100	40	ss	20
69	**18 Hz S-band K_cal_S [20]**	dB/100	40	ss	20
70	**Map of valid points for 18 Hz K_cal_Ku** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0= valid measurement, 1= invalid. Bit 0 applies to the first data block. Unused bits set to 0.	flags	4	ul	1
71	**Spare (see Note 4)**	-	4	uc	4
72	**Ku-band corrected Ocean backscatter coefficient**	dB/100	2	ss	1
73	**S-band corrected Ocean backscatter coefficient**	dB/100	2	ss	1
74	**Standard deviation of 18 Hz Ku-band ocean backscatter coefficient**	dB/100	2	ss	1
75	**Standard deviation of 18 Hz S-band ocean backscatter coefficient**	dB/100	2	ss	1
76	**Number of 18 Hz valid points for Ku-band ocean backscatter coefficient**	-	2	us	1
77	**Number of 18 Hz valid points for S-band ocean backscatter coefficient**	-	2	us	1
78	**18 Hz Ku-band Ice1 backscatter coefficient [20]**	dB/100	40	ss	20
79	**18 Hz S-band Ice1 backscatter coefficient [20]**	dB/100	40	ss	20
80	**18 Hz Ku-band Ice2 leading edge backscatter coefficient [20]**	dB/100	40	ss	20
81	**18 Hz S-band Ice2 leading edge backscatter coefficient [20]**	dB/100	40	ss	20
82	**18 Hz Ku-band Ice2 backscatter coefficient [20]**	dB/100	40	ss	20
83	**18 Hz S-band Ice2 backscatter coefficient [20]**	dB/100	40	ss	20
84	**18 Hz Ku-band sea-ice backscatter coefficient [20]**	dB/100	40	ss	20
85	**Spare (see Note 4)**	-	40	uc	40

Level 2 RA-2 MDSR

N	Description	Units	Byte Length	Data Type	Dim.
	Backscatter Corrections Information				
86	**Ku-band net instrumental correction for AGC**	dB/100	2	ss	1
87	**S-band net instrumental correction for AGC**	dB/100	2	ss	1
88	**Ku-band atmospheric attenuation correction**	dB/100	2	ss	1
89	**S-band atmospheric attenuation correction**	dB/100	2	ss	1
90	**Ku band rain attenuation**	dB/100	4	sl	1
	Off-nadir Angle Information				
91	**Square of the satellite off nadir angle from platform data**	$deg^2/10^4$	2	ss	1
92	**Square of the satellite off nadir angle from waveform data**	$deg^2/10^4$	2	ss	1
93	**18 Hz Ku-band slope of the first part of the trailing edge from ice-2 retracker [20]**	s^{-1}	80	sl	20
94	**18 Hz S-band slope of the first part of the trailing edge from ice-2 retracker [20]**	s^{-1}	80	sl	20
95	**18 Hz Ku-band slope of the second part of the trailing edge from ice-2 retracker [20]**	s^{-1}	80	sl	20
96	**18 Hz S-band slope of the second part of the trailing edge from ice-2 retracker [20]**	s^{-1}	80	sl	20
97	**Spare (see Note 4)**	-	40	uc	40
	Geophysical Information				
98	**Mean sea-surface height**	mm	4	sl	1
99	**Geoid height**	mm	4	sl	1
100	**Ocean depth/land elevation**	mm	4	sl	1
101	**Total geocentric ocean tide height (solution 1)**	mm	2	ss	1
102	**Total geocentric ocean tide height (solution 2)**	mm	2	ss	1
103	**Long period Tide height**	mm	2	ss	1
104	**Tidal loading height (solution 2)**	mm	2	ss	1
105	**Solid earth tide height**	mm	2	ss	1
106	**Geocentric pole tide height**	mm	2	ss	1
107	**Model surface atmospheric pressure**	10 Pa	2	ss	1
108	**MWR water vapour content**	10-^2 g/cm^2	2	ss	1
109	**MWR liquid water content**	10-^2 kg/m^2	2	ss	1
110	**RA2 Total electron content**	10^{-1} TECU	2	ss	1
111	**RA2 wind speed**	mm/s	2	ss	1
112	**U-component of the model wind vector**	mm/s	2	ss	1
113	**V-component of the model wind vector**	mm/s	2	ss	1

Level 2 RA-2 MDSR

N	Description	Units	Byte Length	Data Type	Dim.
114	**Tidal loading height (solution 1)**	mm	2	ss	1
115	**Spare (see Note 4)**	-	8	uc	1
	MWR Information				
116	**Interpolated 23.8 GHz brightness temperature from MWR**	K/100	2	ss	1
117	**Interpolated 36.5 GHz brightness temperature from MWR**	K/100	2	ss	1
118	**Interpolated standard deviation of MWR 23.8 GHz brightness temperature**	K/100	2	ss	1
119	**Interpolated standard deviation of MWR 36.5 GHz brightness temperature**	K/100	2	ss	1
120	**Spare (see Note 4)**	-	2	uc	1
	Flags and Other Quality Information				
121	**Average Ku chirp band:** Ku chirp band Id value associated to the minimum of the 20 elementary chirp band id indexes (i.e. 0 -> 320 MHz, 1 -> 80 MHz, 2 -> 20 MHz)	–	2	us	1
122	**Ku chirp band id [40 bits]** First 40 least significant bits (bits 0-39) correspond to the 20 values (2 bits per data block) - bits 0 and 1 apply to the first data block, Unused bits set to 0	flags	8	ul	2
123	**Error flag for chirp band id [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (1 per data block), bit 0 applies to the first data block. A bit is set to 0 for a valid measurement, 1 for an invalid measurement. Unused bits set to 0.	flags	4	ul	1
124	**Instrument flag (See Note 2)**	flags	4	ul	1
125	**Fault identifier [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (1 per data block), bit 0 applies to the first data block. A bit is set to 0 for a valid measurement, 1 for an invalid measurement. Unused bits set to 0.	flags	8	ul	2
126	**Spare (See note 4)**	-	8	uc	8
127	**Waveforms samples fault identifier [40 bits]** First 40 least significant bits (bits 0-39) correspond to the 20 values (2 bits per data block) - bits 0 and 1 apply to the first data block, Unused bits set to 0	flags	8	ul	2
128	**Instrument mode ID at data block level [80 bits]** First 80 least significant bits (bits 0-79) correspond to the 20 values (4 bits per data block), bits 0 to 3 apply to the first data block. Unused bits set to 0.	flags	12	ul	3
129	**No. of measures for Ku flight calibration factor evaluation**	-	2	us	1

Level 2 RA-2 MDSR

N	Description	Units	Byte Length	Data Type	Dim.
130	**No. of measures for S flight calibration factor evaluation**	-	2	us	1
131	**MWR instrument flag (as defined in Table 14.4.1.7.4-3)**	flags	2	us	1
132	**Spare (See note 4)**	-	6	uc	6
133	**Spare (See note 4)**	-	8	uc	8
134	**Spare (See note 4)**	-	8	uc	8
135	**Ku-band ocean retracking quality [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits set to 0.	flags	4	ul	1
136	**S-band ocean retracking quality [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits set to 0.	flags	4	ul	1
137	**Ku-band ice1 retracking quality [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits set to 0.	flags	4	ul	1
138	**S-band ice1 retracking quality [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits set to 0.	flags	4	ul	1
139	**Ku-band ice2 retracking quality [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits set to 0.	flags	4	ul	1
140	**S-band ice2 retracking quality [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits set to 0.	flags	4	ul	1
141	**Ku-band sea-ice retracking quality [20 bits]** First 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0 = valid measurement, 1 = invalid. Bit 0 applies to the first data block. Unused bits set to 0.	flags	4	ul	1
142	**1 Hz Ku-band peakiness**	10^{-3}	2	us	1
143	**1 Hz S-band peakiness**	10^{-3}	2	us	1
144	**Altimeter surface type flag**	flags	2	us	1
145	**Radiometer land/ocean flag**	flags	2	us	1

Level 2 RA-2 MDSR

N	Description	Units	Byte Length	Data Type	Dim.
146	**MWR Quality interpolation flag**	flags	2	us	1
147	**Altimeter rain flag (See Note 5)**	flags	2	us	1
148	**Interpolation Flag (See Note 3)**	flags	2	us	1
149	**Sea ice flag (see Note 6)**	flags	1	uc	1
150	**Membership 1**	flags	1	uc	1
151	**Membership 2**	flags	1	uc	1
152	**Membership 3**	flags	1	uc	1
153	**Membership 4**	flags	1	uc	1
154	**Spare (See note 4)**	-	1	uc	1
	size (in bytes)		**2492**		

Table 12-11: Level 2 RA-2 MDSR

Note 1: Definition of MCD Flags for NRT products

The following table defines the flags in the MCD field. The bit numbering convention is defined in Volume A.

Definition of Flags in the MCD Field for NRT products[a]			
	Bit position	**Description**	**Values**
ul integer	bits 31-30	Orbit propagator status flag for *initialisation* mode.	0: several errors, no result 1: no errors 2: warning detected
	bits 29-28	Orbit propagator status flag for *propagation* mode.	0: several errors, no result 1: no errors 2: warning detected
	bit 27	Orbit Quality Flag	0:Propagator used 1:Interpolator used
	bits 26-25	Meteo data state	0: 2 maps nominal 1: 2 maps degraded 2: 1 map 3: no map
	bit 24	Absence of processing error (arithmetic faults)	0: OK 1: error

Definition of Flags in the MCD Field for NRT products[a]			
	Bit position	**Description**	**Values**
	bit 23	Spare	0
	bit 22	Ku Sea-ice retracking OK	0: OK 1: error
	bit 21	S Ice-2 retracking OK	0: OK 1: error
	bit 20	Ku Ice-2 retracking OK	0: OK 1: error
	bit 19	S Ice-1 retracking OK	0: OK 1: error
	bit 18	Ku Ice-1 retracking OK	0: OK 1: error
	bit 17	S Ocean retracking OK	0: OK 1: error
	bit 16	Ku Ocean retracking OK	0: OK 1: error
	bits 15-13	Spare	0
	bit 12	Brightness Temperature Range check (channel 2)	0: within range 1: out of range
	bit 11	Brightness Temperature Range check (channel 1)	0: within range 1: out of range
	bits 10-8	Validity	-
	bit 7	S-Band anomaly flag	0: no errors 1: error
	bit 6	Wave form samples fault identifier	0: no errors 1: error
	bit 5	Rx delay Fault Identifier	0: no error 1: Rx distance out of range
	bit 4	AGC Fault Identifier	0: no error 1: AGC out of range
	bit 3	Fault Identifier	0: no errors detected 1: errors detected by onboard
	bit 2	USO validity flag	0: no errors detected 1: anomaly in USO value detected
	bit 1	OBDH validity flag	0: no errors detected 1: anomaly in OBDH value detected

Definition of Flags in the MCD Field for NRT products[a]			
Bit position		Description	Values
	bit 0	Packet Length Error flag	0: no error detected 1: error detected and attempt made to recover

Table 12-12: Definition of Flags in the MCD Field for NRT products[a]

a. bits 31-16 are generated by Level 2 processing,

b. bits 15-13: spare,

c. bit 12 comes from the MWR Level 1B MCD, bit 30,

d. bit 11 comes from the MWR Level 1B MCD , bit 31,

e. bits 10-8 come from the MWR Level 1B MCD, bits 24-22,

f. bit 6 comes from the RA-2 Level 1B MCD, summary of bits 21-20

g. bits 5-0 come from the RA-2 Level 1B MCD, bits 27-22.

Note 1[bis]: Definition of MCD Flags for OFL products

The following table defines the flags in the MCD field. The bit numbering convention is defined in Volume A.

Definition of Flags in the MCD Field for OFL products[a]			
	Bit position	Description	Values
ul integer	bits 28-31	Orbital processing status for OFL products	**0011**: Adjusted preliminary / precise DORIS orbit **0100**: Estimated preliminary/ precise DORIS orbit during manoeuvre **0101**: Estimated preliminary / precise DORIS orbit after interpolation (data gap) **0110**: Estimated preliminary / precise DORIS orbit extrapolated on a time interval <1 day **0111**: Estimated preliminary / precise DORIS orbit extrapolated on a time interval >1 day but <2 days **1000**: Estimated preliminary / precise DORIS orbit extrapolated on a time interval >2 days or after

Definition of Flags in the MCD Field for OFL products[a]			
	Bit position	**Description**	**Values**
			manoeuvre
	bit 27	spare	0
	bits 26-25	Meteo data state	0: 2 maps nominal 1: 2 maps degraded 2: 1 map 3: no map
	bit 24	Absence of processing error (arithmetic faults)	0: OK 1: error
	bit 23	Spare	0
	bit 22	Ku Sea-ice retracking OK	0: OK 1: error
	bit 21	S Ice-2 retracking OK	0: OK
			1: error
	bit 20	Ku Ice-2 retracking OK	0: OK 1: error
	bit 19	S Ice-1 retracking OK	0: OK 1: error
	bit 18	Ku Ice-1 retracking OK	0: OK 1: error
	bit 17	S Ocean retracking OK	0: OK 1: error
	bit 16	Ku Ocean retracking OK	0: OK 1: error
	bits 15-13	Spare	0
	bit 12	Brightness Temperature Range check (channel 2)	0: within range 1: out of range
	bit 11	Brightness Temperature Range check (channel 1)	0: within range 1: out of range
	bits 10-8	Validity	-
	bit 7	S-Band anomaly flag	0: no errors 1: error
	bit 6	Wave form samples fault	0: no errors

Definition of Flags in the MCD Field for OFL products[a]			
Bit position		Description	Values
		identifier	1: error
	bit 5	Rx delay Fault Identifier	0: no error 1: Rx distance out of range
	bit 4	AGC Fault Identifier	0: no error 1: AGC out of range
	bit 3	Fault Identifier	0: no errors detected 1: errors detected by onboard
	bit 2	USO validity flag	0: no errors detected 1: anomaly in USO value detected
	bit 1	OBDH validity flag	0: no errors detected 1: anomaly in OBDH value detected
	bit 0	Packet Length Error flag	0: no error detected 1: error detected and attempt made to recover

Table 12-13: Definition of Flags in the MCD Field for OFL products[a]

h. bits 31-16 are generated by Level 2 processing
i. bits 15-13: spare
j. bit 12 comes from the MWR Level 1B MCD, bit 30
k. bit 11 comes from the MWR Level 1B MCD, bit 31
l. bits 10-8 come from the MWR Level 1B MCD, bits 24-22
m. bit 7: spare
n. bit 6 comes from the RA-2 Level 1B MCD, summary of bits 21-20
o. bits 5-0 come from the RA-2 Level 1B MCD, bits 27-22.

Note 2: Definition of RA-2 Instrument Flag

The following table defines the flags in the field. The bit numbering convention is defined in Volume A.

Bit position		Description	Values
ul integer	bits 31-8	spare	0
	bit 7	Flag for S-band anomaly	
	bit 6	Flag for availability of S flight calibration corrections	-
	bit 5	Flag for availability of Ku flight calibration corrections	-
	bits 4-2	PTR calibration band identifier field	-
	bits 1-0	Error flag for decoded redundancy flags	-

Table 12-14: Definition of Flags in the RA-2 Instrument Flags

a. RA-2 Instrument Flags come from the RA-2 Level 1B MCD

Note 3: Definition of the Interpolation Flag

The following table defines the flags in the field. The bit numbering convention is defined in Volume A.

Bit position		Description	Values
us integer	bits 15-4	spare	0
	bit 3	Meteorological data interpolation flag	-
	bit 2	Ocean tide solution 2 interpolation flag	-
	bit 1	Ocean tide solution 1 interpolation flag	-
	bit 0	MSS Interpolation flag	-

Table 12-15: Definition of Flags in the Interpolation Flags

Note 4: The spare fields will always be set to zero, according to Annex A (Section A.2.3) of the Product Specifications.

Field 3: On level 2 products generated with the OFL CMA processor, this field will contain the software version of the RA-2 IPF used to process the input level 1 and is defined as "Level 1B software number" of three bytes. For example, if the IPF version used is 4.58, the "Level 1B software number" value will be set to 458.

Note 5: Definition of the Altimeter Rain Flag

The following table defines the flags in the field. The bit numbering convention is defined in Volume A.

	Bit position	Description	Values
us integer	bits 15-3	spare	0
	bits 2-0	Altimeter Rain flag	0 = "no rain" 1 = "rain" 2 = "high rain probability from altimeter" 3 = "high probability of no rain from altimeter" 4 = "ambiguous situation" i.e. possibility of ice 5 = "evaluation not possible" (i.e. data are missing or surface type is land or ice or s0_Ku < 0 or s0_S < 0)

Table 12-16: Definition of Rain Flag

Note 6: Definition of the Sea-Ice Flag

The following table defines the flags in the field. The bit numbering convention is defined in Volume A.

Bit position		Description	Values
Uc (1byte)	bits 7-1	spare	0
	bit 0	Sea-Ice Flag	0 = "ocean" 1 = "sea-ice" 2= "not evaluated"

Table 12-17: Definition of Flags in the Interpolation Flags

12.1.1.4 Level 2 FDGDR: MWR MDS

The MWR MDS contains data from the MWR sensor. The MDS is composed of several MDSRs. The fields that cannot be filled at Level 1B processing are set to zero. They are

updated by level 2 processing. There is one record every 1.2 seconds. The format of each MDSR is described below.

Level 1B/2 MWR MDSR

N	Description	Units	Byte Length	Data Type	Dim.
1	**UTC Time stamp of MDSR**	-	12	mjd	1
2	**Quality Indicator (-1 for blank MDSR, 0 otherwise)**	-	1	sc	1
3	**Spare (See Note 3, for differences in OFL Level2 products)**	-	3	uc	3
4	**Geodetic Latitude (positive N, negative S)**	10-6 deg	4	sl	1
5	**Longitude (positive E, 0 at Greenwich, negative W)**	10-6 deg	4	sl	1
6	**Record Counter**	-	2	us	1
7	**Spare (Note 3)**	-	2	uc	2
8	**Measurement Confidence Data Level 1B/2** See Note 1	flags	4	ul	1
9	**Spare (Note 3)**	-	4	uc	4
10	**Spare (Note 3)**	-	4	uc	4
11	**23.8 GHz brightness temperature**	10-2 K	2	us	1
12	**23.8 GHz brightness temperature standard deviation**	10-2 K	2	us	1
13	**36.5 GHz brightness temperature**	10-2 K	2	us	1
14	**36.5 GHz brightness temperature standard deviation**	10-2 K	2	us	1
15	**Spare (Note3)**	-	2	uc	2
16	**MWR instrument flags** See Note 2	flags	2	us	1
17	**MWR Processing Information, Number of averaged samples (23.8 GHz channel)**	-	2	us	1
18	**MWR Processing Information, Number of averaged samples (36.5 GHz channel)**	-	2	us	1
19	**MWR Processing Information, Number of outputs since last calibration period**	-	2	us	1
20	**MWR Processing Information, Packet Telemetry counter for 23.8 GHz channel**	-	2	us	1
21	**MWR Processing Information, Packet telemetry counter for 36.5 GHz channel**	-	2	us	1
22	**MWR Processing Information, 23.8 GHz channel**	-	2	us	1

Level 1B/2 MWR MDSR

N	Description	Units	Byte Length	Data Type	Dim.
	source packet ID				
23	**MWR Processing Information, 36.5 GHz channel source packet ID**	-	2	us	1
24	**MWR Processing Information, Moving window size**	-	2	us	1
25	**RA-2 quality interpolation flag**	flag	2	us	1
26	**Spare (Note 3)**	-	2	uc	2
27	**Water vapour content** (filled in Level 2 processing, set to zero for Level 1B)	10-2 g/cm^2	2	ss	1
28	**Liquid water content** (filled in Level 2 processing, set to zero for Level 1B)	10-2 Kg/m^2	2	ss	1
29	**MWR derived wet tropospheric correction** (filled in Level 2 processing, set to zero for Level 1B)	mm	2	ss	1
30	**Interpolated RA2 wind speed** (filled in Level 2 processing, set to zero for Level 1B)	mm/s	2	ss	1
31	**Interpolated RA2 Ku-band corrected ocean backscatter coefficient** (filled in Level 2 processing, set to zero for Level 1B)	dB/100	2	ss	1
32	**Interpolated RA2 S-band corrected ocean backscatter coefficient** (filled in Level 2 processing, set to zero for Level 1B)	dB/100	2	ss	1
33	**Interpolated RA2 Ku-band significant wave height** (filled in Level 2 processing, set to zero for Level 1B)	mm	2	ss	1
34	**Spare (Note 3)**	-	2	uc	2
	size (in bytes)		**88**		

Table 12-18: Level 1B/2 MWR MDSR

Note 1: The contents of the MWR Measurement Confidence Data are defined in the table below. The bit numbering convention is defined in Volume A.

Bit position		Description	Values
ul integer	bit 31	Brightness Temperature Range check (channel 1)	0: in range 1: out of range
	bit 30	Brightness Temperature Range check (channel 2)	0: in range 1: out of range
	bit 29	at L2: Land/Ocean flag at L1b: Unused, set to zero	0: ocean 1: land
	bit 28	CRC check flag	0: no error 1: error
	bit 27	Processing Flag	0: no error 1: error
	bit 26	Telemetry Flag	0: no error 1: error
	bit 25	Header Flag	0: no error 1: error
	bits 24-22	Validity: Indicates data set record validity (result of the weighted sequence of Temp_flg, OBDH_flg, and BP_flg)	min: 0 max: 7
	bit 21	Spare	set to zero
	bit 20-19	Orbit propagator status flag for *initialisation* mode at L1b/L2	0: several errors, no result 1: no error 2: warning detected
	bit 18-17	Orbit propagator status flag for *propagation* mode at L1b/L2	0: several errors, no result 1: no error 2: warning detected
	bit 16-2	Spare	set to zero
	bit 1	Orbit Accuracy Flag	0: Orbit Propagator used 1: Orbit Interpolator used
	bit 0	Level 2 processing error flag	0: no error 1: error

Table 12-19: 1 Definition of MWR Measurement Confidence Data Field

Note 2: The contents of the MWR Instrument Flags field are defined in the table below. The bit numbering convention is defined in Volume A.

Bit position		Description	Values
us integer	bit 15	Temp Flag (Tmp_flg) Indicates uniformity of CEU temperature	0: temperature consistency 1: temperature inconsistency
	bit 14	OBDH Flag (OBDH_flg) flag to indicate data is missing	0: no error 1: error
	bit 13	Red Flag: ICU channel redundancy indicator	0: normal channel 1: redundant channel
	bit 12	Power Bus Protection Flag (PBP_flg) Power Bus protection indicator	0: no protection 1: protection
	bit 11	Over Prot. flag Overvoltage/Overload protection indicator	0: no protection 1: protection
	bit 10	Spare	set to zero
	bits 9-0	Spare	set to zeros

Table 12-20: 2 Definition of MWR Instrument Flags Field

Note 3: The spare fields will always be set to zero, according to Annex A (Paragraph A.2.3) of Products Specifications.

FIELD 3: On level2 products produced with the OFL CMA processor this field will contain the software version of the RA2 IPF used to process the input level1 and is defined as “Level 1B software number” of three bytes. As an example, if the IPF version used is 4.58, the "Level 1B software number" value will be set to 458.

12.1.2 Level 2 FDMAR

The FDMAR product corresponds to a segment of the orbit. The content is given below.

12.1.2.1 BUFR Product Structure

You can find all WMO BUFR tables at:

http://www.wmo.ch/web/www/WMOCodes.html

12.1.2.2 PDS Product Structure

The overall product structure is described below:

MPH
SPH
MDS

Table 12-21: Level 2 Wind/Wave Product Structure

12.1.2.3 Level 2 FDMAR: MPH

The MPH is described in section 12.1.1.1.

12.1.2.4 Level 2 FDMAR: SPH

The format of the Specific Product Header (SPH) is shown in the table below.

Level 2 Wind/Wave - SPH

N	Description	Units	Byte Length	Data Type	Dim.
1-70	**Fields 1-70 of Table 14.5.1.6-1. Field 1 set to RA2_MWR_FDMAR or RA2_MWR_IMAR.** (Note 1)	-	2618	-	-
	DSDs for included Data Sets				
71	**DSD (M) - for the MDS**	-	280	dsd	1
72	**DSD (M) - for the MWR MDS** (Note 3)	-	280	dsd	1
73	**DSD (M) - for the 18 Hz Average Waveforms MDS** (Note 3)	-	280	dsd	1
74	**DSD (M) - for the Burst Waveforms MDS** (Note 3)	-	280	dsd	1
75	**DSD - Spare Reserved (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
76	**DSD - Spare Reserved (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
77	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
	DSDs for referenced files				
78	**DSD (R) - Level 1B product from which the Level 2 product was created**	-	280	dsd	1

Level 2 Wind/Wave - SPH

N	Description	Units	Byte Length	Data Type	Dim.
79	**DSD (R) - Level 2 product from which this product was extracted** (Note 2)	-	280	dsd	1
80	**DSD (R) for Orbit Data File Used**	-	280	dsd	1
81	**DSD (R) - For DORIS Ionospheric correction file** (Note 4)	-	280	dsd	1
82	**DSD (R) – RA-2 Level 1B IF data file**	-	280	dsd	1
83	**DSD(R) – RA-2 Level 1B USO data file**	-	280	dsd	1
84	**DSD (R) - MWR Level 1B side lobe data file**	-	280	dsd	1
85	**DSD- Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
86	**DSD (R) - referencing the ENVISAT-1 Attitude data file**	-	280	dsd	1
87	**DSD- Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
88	**DSD (R) - Platform data file**	-	280	dsd	1
89	**DSD (R) - for first ECMWF file used**	-	280	dsd	1
90	**DSD (R) - for second ECMWF file used**	-	280	dsd	1
91	**DSD (R) - for third ECMWF file used**	-	280	dsd	1
92	**DSD (R) - Solar Activity Data File**	-	280	dsd	1
93	**DSD (R) - Pole Location Data File**	-	280	dsd	1
94	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
95	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
96	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
97	**DSD (R) - RA-2 Level 1B Configuration File**	-	280	dsd	1
98	**DSD (R) - RA-2 Level 1B Characterization Data File**	-	280	dsd	1
99	**DSD (R) - MWR Level 1B Configuration File**	-	280	dsd	1
100	**DSD (R) - MWR Level 1B Characterization Data File**	-	280	dsd	1
101	**DSD (R) - MWR Land/Sea Flags Data File**	-	280	dsd	1
102	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
103	**DSD- Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1

Level 2 Wind/Wave - SPH

N	Description	Units	Byte Length	Data Type	Dim.
104	**DSD (R) - Altitude of Meteo Grid Points File**	-	280	dsd	1
105	**DSD (R) - RA-2 Constants File**	-	280	dsd	1
106	**DSD (R) - RA-2 Configuration (System) File for Ocean / Ice-2 Processing**	-	280	dsd	1
107	**DSD (R) -RA-2 Configuration (System) File for Ice-1/Sea-ice Processing**	-	280	dsd	1
108	**DSD (R) - Sea State Bias file**	-	280	dsd	1
109	**DSD (R) - Modified Dip Map File**	-	280	dsd	1
110	**DSD (R) - Ionospheric Coefficients File**	-	280	dsd	1
111	**DSD (R) - Cartwright Amplitudes File**	-	280	dsd	1
112	**DSD (R) - Ocean Tide Solution 1 Map File (orthotide)**	-	280	dsd	1
113	**DSD (R) - Loading Tide Solution 1 Map File**	-	280	dsd	1
114	**DSD (R) - Ocean Tide Solution 2 Map File (harmonic)**	-	280	dsd	1
115	**DSD (R) - Loading Tide Solution 2 Map File**	-	280	dsd	1
116	**DSD (R) - Geoid Height Map File**	-	280	dsd	1
117	**DSD (R) - Mean Sea Surface Heights file**	-	280	dsd	1
118	**DSD (R) - Ocean depth/land elevation file**	-	280	dsd	1
119	**DSD (R) - Slope model Map for Greenland**	-	280	dsd	1
120	**DSD (R) - Slope model Map for Antarctica**	-	280	dsd	1
121	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
122	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
	size (in bytes)		**17178**		

Table 12-22: Level 2 Wind/Wave - SPH

Note 1: The SPH descriptor value will be set to RA2_MWR_FDMAR if the meteocean product originates from the FDGDR product and to RA2_MWR_IMAR if it is from the IGDR.

Note 2: Field 79 is always used in RA2_WWV_2P products: this DSD refers to the parent product RA2_FGD_2P or RA2_IGD_2P. The DS_NAME in this DSD corresponds to the SPH_DESCRIPTOR of the parent product from which this product was extracted.

Note 3: The DSDs of fields 72, 73, 74 are always set to 'NOT USED' for FDMAR and IMAR.

Note 4: The DSD for field 81 shall be set to 'NOT USED' for the NRT product (FDMAR).

The DS_NAME fields in the DSDs are filled in as per Table 12-10, except for the following names used:

- field 71, DSD (M) for the MDS: RA2_OCEAN_DATA_FOR_LEVEL_2,
- field 79, DSD (R): set to the SPH descriptor of the level-2 product from which this product was extracted.

12.1.2.5 Level 2 FDMAR: RA-2 MDS

The contents of the Data Sets are described in the following sections. Data Sets are in mixed binary format. They may contain ASCII strings, but unlike the MPH/SPH, these ASCII strings are not contained within quotation marks.

The MDS is composed of several MDSRs (1 MDSR every 1.114s). The MDSR format is described below.

Meteo Product MDSR					
N	**Description**	**Units**	**Byte Length**	**Data Type**	**Dim.**
1	**MDSR Time stamp** Time fields based on UTC are computed for each record and refer to the centre of the averaged waveform.	-	12	mjd	1
2	**Quality Indicator (-1 for blank MDSR, 0 otherwise)**	-	1	sc	1
3	**Spare (Note 1 for differences between NRT and OFL products)**	-	3	uc	3
4	**Geodetic Latitude (positive North, negative South)**	1×10^{-6} deg	4	sl	1
5	**Longitude (positive E, 0 at Greenwich, negative W)**	1×10^{-6} deg	4	sl	1
6	**Source Packet Counter**	-	4	ul	1
7	**Instrument Mode ID**	flags	4	ul	1
8	**Measurement Confidence Data**	flags	4	ul	1
	Orbit Information				
9	**Altitude of CoG above reference ellipsoid**	mm	4	ul	1
10	**Instantaneous altitude rate**	mm/s	2	ss	1
11	**Spare (Note 1)**	-	6	uc	6
	Range Information				

Meteo Product MDSR					
N	**Description**	**Units**	**Byte Length**	**Data Type**	**Dim.**
12	**Ku-band ocean range**	mm	4	ul	1
13	**S-band ocean range**	mm	4	ul	1
14	**Standard deviation of 18 Hz Ku-band ocean range**	mm	2	us	1
15	**Standard deviation of 18 Hz S-band ocean range**	mm	2	us	1
16	**Number of 18 Hz valid points for Ku-band ocean range**	-	2	us	1
17	**Number of 18 Hz valid points for S-band ocean range**	-	2	us	1
18	**Spare (Note 1)**	-	8	uc	8
	Range Correction Information				
19	**Model dry tropospheric correction**	mm	2	ss	1
20	**Inverted barometer correction**	mm	2	ss	1
21	**Model wet tropospheric correction**	mm	2	ss	1
22	**MWR derived wet tropospheric correction**	mm	2	ss	1
23	**RA-2 ionospheric correction on Ku-band**	mm	2	ss	1
24	**RA-2 ionospheric correction on S-band**	mm	2	ss	1
25	**Ionospheric correction from DORIS on Ku-band**	mm	2	ss	1
26	**Ionospheric correction from DORIS on S-band**	mm	2	ss	1
27	**Ionospheric correction from model on Ku-band**	mm	2	ss	1
28	**Ionospheric correction from model on S-band**	mm	2	ss	1
29	**Sea state bias correction on Ku-band**	mm	2	ss	1
30	**Sea state bias correction on S-band**	mm	2	ss	1
31	**Spare (Note 1)**	-	12	uc	12
	Significant Wave Height Information				
32	**Square of Ku-band significant wave height**	mm^2	4	sl	1
33	**Square of S-band significant wave height**	mm^2	4	sl	1
34	**Ku-band significant wave height**	mm	2	ss	1
35	**S-band significant wave height**	mm	2	ss	1
36	**Standard deviation of 18 Hz Ku-band SWH**	mm	2	ss	1
37	**Standard deviation of 18 Hz S-band SWH**	mm	2	ss	1
38	**Number of 18 Hz valid points for Ku-band ocean SWH**	-	2	us	1
39	**Number of 18 Hz valid points for S-band ocean SWH**	-	2	us	1

Meteo Product MDSR					
N	**Description**	**Units**	**Byte Length**	**Data Type**	**Dim.**
	Backscatter Information				
40	**Ku-band corrected Ocean backscatter coefficient**	dB/100	2	ss	1
41	**S-band corrected Ocean backscatter coefficient**	dB/100	2	ss	1
42	**Standard deviation of 18 Hz Ku-band ocean backscatter coefficient**	dB/100	2	ss	1
43	**Standard deviation of 18 Hz S-band ocean backscatter coefficient**	dB/100	2	ss	1
44	**Number of 18 Hz valid points for Ku-band ocean backscatter coefficient**	-	2	us	1
45	**Number of 18 Hz valid points for S-band ocean backscatter coefficient**	-	2	us	1
46	**Spare (Note 1)**	-	40	uc	40
	Backscatter Correction Information				
47	**Ku-band net instrumental correction for AGC**	dB/100	2	ss	1
48	**S-band net instrumental correction for AGC**	dB/100	2	ss	1
49	**Ku-band atmospheric attenuation correction**	dB/100	2	ss	1
50	**S-band atmospheric attenuation correction**	dB/100	2	ss	1
51	**Ku-band rain attenuation**	dB/100	4	sl	1
	Off-nadir Angle Information				
52	**Squared off nadir angle of the satellite from platform data**	$deg^2/10^4$	2	ss	1
53	**Squared off nadir angle of the satellite from waveform data**	$deg^2/10^4$	2	ss	1
	Geophysical Information				
54	**Mean sea surface height**	mm	4	sl	1
55	**Geoid height**	mm	4	sl	1
56	**Ocean depth/land elevation**	mm	4	sl	1
57	**Total geocentric ocean tide height (solution 1)**	mm	2	ss	1
58	**Total geocentric ocean tide height (solution 2)**	mm	2	ss	1
59	**Long period tide height**	mm	2	ss	1
60	**Tidal loading height (Solution 2)**	mm	2	ss	1
61	**Solid earth tide height**	mm	2	ss	1
62	**Geocentric pole tide height**	mm	2	ss	1
63	**Model surface atmospheric pressure**	10 Pa	2	ss	1

Meteo Product MDSR					
N	**Description**	**Units**	**Byte Length**	**Data Type**	**Dim.**
64	**MWR water vapour content**	10^{-2} g/ cm^2	2	ss	1
65	**MWR liquid water content**	10^{-2} kg/ m^2	2	ss	1
66	**RA-2 Total electron content**	10^{-1} TECU	2	ss	1
67	**RA-2 wind speed**	mm/s	2	ss	1
68	**u component of the model wind vector**	mm/s	2	ss	1
69	**v component of the model wind vector**	mm/s	2	ss	1
70	**Tidal loading height (Solution 1)**	mm	2	ss	1
71	**Spare (Note 1)**	-	8	uc	8
	MWR Information				
72	**Interpolated 23.8 GHz brightness temperature from MWR**	K/100	2	ss	1
73	**Interpolated 36.5 GHz brightness temperature from MWR**	K/100	2	ss	1
74	**Interpolated standard deviation of MWR 23.8 GHz brightness temperature**	K/100	2	ss	1
75	**Interpolated standard deviation of MWR 36.5 GHz brightness temperature**	K/100	2	ss	1
76	**Spare (Note 1)**	-	2	uc	2
	Flags and Other Quality Information				
77	**Average Ku chirp band**	-	2	us	1
78	**Ku chirp band id [40 bits]** The first 40 least significant bits (bits 0-39) correspond to the 20 values (2 bits per data block) - bits 0 and 1 apply to the first data block, Unused bits are set to 0	flags	8	ul	2
79	**Error flag for chirp band id [20 bits]** The first 20 least significant bits (bits 0-19) correspond to the 20 values (1 per data block), bit 0 applies to the first data block. A bit is set to 0 for a valid measurement, 1 for an invalid measurement. Unused bits are set to 0.	flags	4	ul	1
80	**Instrument flag**	flags	4	ul	1
81	**Fault identifier [20 bits]** The first 20 least significant bits (bits 0-19) correspond to the 20 values (1 per data block), bit 0 applies to the first data block. A bit is set to 0 for a valid measurement, 1 for an invalid measurement. Unused bits are set to 0.	flags	8	ul	2
82	**Spare (Note 1)**	-	8	uc	8

Meteo Product MDSR					
N	**Description**	**Units**	**Byte Length**	**Data Type**	**Dim.**
83	**Waveform samples fault identifier [40 bits]** First 40 least significant bits (bits 0-39) correspond to the 20 values (2 bits per data block) - bits 0 and 1 apply to the first data block. Unused bits are set to 0	flags	8	ul	2
84	**Instrument mode ID at data block level [80 bits]** First 80 least significant bits (bits 0-79) correspond to the 20 values (4 bits per data block), bits 0 to 3 apply to the first data block. Unused bits are set to 0.	flags	12	ul	3
85	**Number of measurements for Ku flight calibration factor evaluation**	-	2	us	1
86	**Number of measurements for S flight calibration factor evaluation**	-	2	us	1
87	**MWR instrument flag (as defined in Table 14.4.1.7.4-3)**	flags	2	us	1
88	**Spare (Note 1)**	-	6	uc	1
89	**1 Hz Ku-Band Peakiness**	10^{-3}	2	us	2
90	**1 Hz S-Band Peakiness**	10^{-3}	2	us	2
91	**Spare (Note 1)**	-	12	uc	1
92	**Ku-band ocean retracking quality [20 bits]** The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0= valid measurement, 1= invalid. Bit 0 applies to the first data block. Unused bits are set to 0.	flags	4	ul	1
93	**S-band ocean retracking quality [20 bits]** The first 20 least significant bits (bits 0-19) correspond to the 20 values (one per data block) containing: 0= valid measurement, 1= invalid. Bit 0 applies to the first data block. Unused bits are set to 0.	flags	4	ul	1
94	**Altimeter surface type flag**	flag	2	us	1
95	**Radiometer land/ocean flag**	flag	2	us	1
96	**MWR quality interpolation flag**	flag	2	us	1
97	**Altimeter Rain flag**	flag	2	us	1
98	**Interpolation flag**	flag	2	us	1
99	**Spare (Note 1)**	-	2	uc	1
	size (in bytes)		**356**		

Table 12-23: Meteo Product MDSR

Note 1: The spare fields will always be set to zero, according to Annex A (Section A.2.3) of the Product Specifications.

Field 3: For level 2 products generated with the OFL CMA processor, this field will contain the software version of the RA-2 IPF used to process the input level 1 and is defined as "Level 1B software number" of three bytes. For example, if the IPF version used is 4.58, the "Level 1B software number" value will be set to 458.

12.1.3 Level 2 IGDR

The content of the IGDR product is identical to that of the FDGDR, apart from some differences that are pointed out where they exist.

12.1.3.1 Level 2 IGDR: MPH

The content of the MPH is identical to that of the FDGDR (see section 12.1.1.1).

12.1.3.2 Level 2 IGDR: SPH

The content of the SPH is identical to that of the FDGDR (see section 12.1.1.2).

In section 2.4.2, notes 1 and 3 have to be taken into account for the IGDR product.

12.1.3.3 Level 2 IGDR: RA-2 MDS

The content of the RA-2 MDS is generally identical to that of the FDGDR (see section 12.1.1.3) apart from some fields which are defined for the IGDR product:

- **Field 3**: On level 2 products generated with the OFL CMA processor, this field will contain the software version of the RA-2 IPF used to process the input level 1 and is defined as "Level 1B software number" of three bytes. For example, if the IPF version used is 4.58, the "Level 1B software number" value will be set to 458.
- **Field 8**: Concerns bits 27 to 30 of the MCD relative to the orbit information.
- **Field 32**:18 Hz latitude differences from 1 Hz.
- **Field 32bis**: 18 Hz longitude differences from 1 Hz.
- **Fields 47 and 48:** Filled in with the GIM model instead of Bent for NRT products.
- **Field 51**: Default value.
- **Field 51bis**: spare.

12.1.3.4 Level 2 IGDR: MWR MDS

The content of the MWR MDS is identical to that of the FDGDR (see section 12.1.1.4).

12.1.4 Level 2 IMAR

The contents of the IMAR product are identical to that of the FDMAR, apart from some differences that are pointed out where they exist.

12.1.4.1 Level 2 IMAR: MPH

The content of the MPH is identical to that of the FDGDR (see section 12.1.1.1)

12.1.4.2 Level 2 IMAR: SPH

The content of the SPH is identical to that of the FDMAR (see section 12.1.2.4).

12.1.4.3 Level 2 IMAR: RA-2 MDS

The content of the RA-2 MDS inside the IMAR product is generally identical to that of the FDMAR (see section 12.1.2.5) apart from some fields which are defined for the IMAR product:

- **Field 3**: On level 2 products generated with the OFL CMA processor, this field will contain the software version of the RA-2 IPF used to process the input level 1 and is defined as “Level 1B software number” of three bytes. For example, if the IPF version used is 4.58, the “Level 1B software number” value will be set to 458.
- **Field 8**: Concerns bits 27 to 30 of the MCD relative to the orbit information.
- **Fields 27 and 28:** Filled in with the GIM model instead of Bent for NRT products.
- **Field 51**: Set to default value instead of spare for NRT products.

12.1.5 Level 2 GDR

The content of the GDR product is identical to that of the FDGDR apart from some differences that are pointed out where they exist.

12.1.5.1 Level 2 GDR: MPH

The content of the MPH is identical to that of the FDGDR (see section 12.1.1.1).

12.1.5.2 Level 2 GDR: SPH

The content of the SPH is identical to that of the FDGDR (see section 12.1.1.2).

12.1.5.3 Level 2 GDR: RA-2 MDS

The content of the RA-2 MDS is generally identical to that of the FDGDR (see section 12.1.1.3) apart from some fields which are defined for the GDR product:

- **Field 3**: On level 2 products generated with the OFL CMA processor, this field will contain the software version of the RA-2 IPF used to process the input level 1 and is defined as "Level 1B software number" of three bytes. For example, if the IPF version used is 4.58, the "Level 1B software number" value will be set to 458.
- **Field 8**: Concerns bits 27 to 30 of the MCD relative to the orbit information.
- **Field 32**:18 Hz latitude differences from 1 Hz.
- **Field 32bis**: 18 Hz longitude differences from 1 Hz.
- **Fields 47 and 48:** Filled in with the GIM model instead of Bent for NRT products.
- **Field 51**: DIB_HF, difference from Inverse Barometer.
- **Field 51bis**: Spare.

12.1.5.4 Level 2 GDR: MWR MDS

The content of the MWR MDS is identical to that of the FDGDR (see section 12.1.1.4).

12.1.6 Level 2 SGDR

12.1.6.1 Level 2 SGDR: MPH

The content of the MPH is identical to that of the FDGDR (see section 12.1.1.1).

12.1.6.2 Level 2 SGDR: SPH

The format of the SPH is shown in the table below.

RA-2 Level 2 SDR - SPH					
N	**Description**	**Units**	**Byte Length**	**Data Type**	**Dim.**
1-70	**Fields 1-70 of Table 14.5.1.6-1. Field 1 set to RA2_MWR_SGDR.**	-	2618	-	-
	DSDs for included Data Sets				
71	**DSD (M) - for the RA-2 MDS**	-	280	dsd	1
72	**DSD (M) - for the MWR MDS**	-	280	dsd	1
73	**DSD (M) - for the 18 Hz Waveforms MDS**	-	280	dsd	1
74	**DSD (M) - for the Burst Waveforms MDS (if not included in product set this DSD is NOT USED as described in Volume 5)**	-	280	dsd	1
75	**DSD - Spare Reserved (each DSD-Spare is 279 blank**	-	280	dsd_sp	1

RA-2 Level 2 SDR - SPH					
N	**Description**	**Units**	**Byte Length**	**Data Type**	**Dim.**
	space characters followed by one new line character)				
76	**DSD - Spare Reserved (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
77	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
	DSDs for referenced files				
78	**DSD (R) - Level 1B product from which this product was created**	-	280	dsd	1
79	**DSD (R) - For Level 2 parent product** (Note 1)	-	280	dsd	1
80	**DSD (R) for Orbit Data File Used**	-	280	dsd	1
81	**DSD (R) - For DORIS Ionospheric correction file**	-	280	dsd	1
82	**DSD (R) - RA-2 Level 1B IF data file**	-	280	dsd	1
83	**DSD(R) - RA-2 Level 1B USO data file**	-	280	dsd	1
84	**DSD (R) - MWR Level 1B side lobe data file**	-	280	dsd	1
85	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
86	**DSD (R) - referencing the ENVISAT-1 Attitude data file**	-	280	dsd	1
87	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
88	**DSD (R) - Platform data file**	-	280	dsd	1
89	**DSD (R) - for first ECMWF file used**	-	280	dsd	1
90	**DSD (R) - for second ECMWF file used**	-	280	dsd	1
91	**DSD (R) - for third ECMWF file used**	-	280	dsd	1
92	**DSD (R) - Solar Activity Data File**	-	280	dsd	1
93	**DSD (R) - Pole Location Data File**	-	280	dsd	1
94	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
95	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
96	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
97	**DSD (R) - RA-2 Level 1B Configuration File**	-	280	dsd	1
98	**DSD (R) - RA-2 Level 1B Characterization Data File**	-	280	dsd	1
99	**DSD (R) - MWR Level 1B Configuration File**	-	280	dsd	1
100	**DSD (R) - MWR Level 1B Characterization Data**	-	280	dsd	1

RA-2 Level 2 SDR - SPH					
N	**Description**	**Units**	**Byte Length**	**Data Type**	**Dim.**
	File				
101	**DSD (R) - MWR Land/Sea Flags Data File**	-	280	dsd	1
102	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
103	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
104	**DSD (R) - Altitude of Meteo Grid Points File**	-	280	dsd	1
105	**DSD (R) - RA-2 Constants File**	-	280	dsd	1
106	**DSD (R) - RA-2 Configuration (System) File for Ocean / Ice-2 Processing**	-	280	dsd	1
107	**DSD (R) -RA-2 Configuration (System) File for Ice-1/Sea-ice Processing**	-	280	dsd	1
108	**DSD (R) - Sea State Bias file**	-	280	dsd	1
109	**DSD (R) - Modified Dip Map File**	-	280	dsd	1
110	**DSD (R) - Ionospheric Coefficients File**	-	280	dsd	1
111	**DSD (R) - Cartwright Amplitudes File**	-	280	dsd	1
112	**DSD (R) - Ocean Tide Solution 1 Map File (orthotide)**	-	280	dsd	1
113	**DSD (R) - Loading Tide Solution 1 Map File**	-	280	dsd	1
114	**DSD (R) - Ocean Tide Solution 2 Map File (harmonic)**	-	280	dsd	1
115	**DSD (R) - Loading Tide Solution 2 Map File**	-	280	dsd	1
116	**DSD (R) - Geoid Height Map File**	-	280	dsd	1
117	**DSD (R) - Mean Sea Surface Heights file**	-	280	dsd	1
118	**DSD (R) - Ocean depth/land elevation file**	-	280	dsd	1
119	**DSD (R) - Slope model Map for Greenland**	-	280	dsd	1
120	**DSD (R) - Slope model Map for Antarctica**	-	280	dsd	1
121	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
122	**DSD - Spare (each DSD-Spare is 279 blank space characters followed by one new line character)**	-	280	dsd_sp	1
	size (in bytes)		**17178**		

Table 12-24: RA-2 Level 2 SDR - SPH

Note 1: The DSD for field 79 will always be set to ‘NOT USED’ as described in Volume 5, section 5.4.3.3.

12.1.6.3 Level 2 SGDR: RA-2 MDS

The content of the RA-2 MDS is identical to that of the GDR (see section 12.1.5.3).

12.1.6.4 Level 2 SGDR: MWR MDS

The content of the MWR MDS is identical to that of the FDGDR (see section 12.1.5.4).

12.1.6.5 Level 2 SGDR: 18 Hz Waveforms MDS

N	Description	Units	Byte Size	Data Type	Dim.
1	**Time stamp**	-	12	mjd	1
2	**Quality Indicator (-1 for blank MDSR, 0 otherwise)**	-	1	sc	1
3	**Spare (Note 1)**	-	3	uc	3
4	**Source Packet Counter**	-	4	ul	1
5	**Spare (Note 1)**	-	8	ul	2
	Data Block Information				
6	**Data Block information (see structure definition below). The structure is repeated 20 times, once for each data block**	-	8560	block_info	20
TOTAL			**8588**		

Table 12-25: 18-Hz Waveforms MDSR

N	Description	Units	Byte Size	Data Type	Dim.
	Waveforms data				
1	**Average Ku-band waveforms corrected for IF transfer function (128 samples)**	1/2048	256	us	128
2	**Central Ku-band filters from DFT corrected for IF transfer function (2 samples)**	1/2048	4	us	2
3	**Average S-band waveforms corrected for IF transfer function (64 samples)**	1/8192	128	us	64
4	**Indexes of 2 DFT samples**	-	4	ss	2
5	**Δoffset in FFT filters units**	1/256	2	ss	1
6	**Spare (Note 1)**	-	18	us	9
	Power information				
7	**Noise power measurement**	1/2048	2	ss	1
8	**AGC of noise power measurement**	10-2	2	ss	1
9	**Reference power value**	dB/100	2	us	1
10	**Spare (Note 1)**	-	10	us	5
TOTAL			**428**		

Table 12-26: Format of block_info Structure

Note 1: The spare fields will always be set to zero, according to Annex A (Section A.2.3) of the Product Specifications.

12.1.6.6 Level 2 SGDR: Burst Waveforms MDS

N	Description	Units	Byte Length	Data Type	Dim.
1	**Data Record Time:** Time fields based on UTC are computed for each record and refer to the first data block of the source packet containing the individual echoes.	-	12	mjd	1
2	**Quality Indicator (-1 for blank MDSR, 0 otherwise)**	-	1	sc	1
3	**Spare (Note 1)**	-	3	uc	3
4	**OBDH datation word (43 bits)** The time tagging words are transcriptions of the words provided in the first source packet of the sequence, and do not change over the sequence.	1/524288 s	8	ud	1
5	**Spare (Note 1)**	-	12	uc	12
6	**Record Counter**	-	4	ul	1
7	**Source Sequence Count** Extracted from the header of the source packet		2	us	1
8	**Ku Individual Echoes (1600 I,Q pairs)**	-	3200	sc	1600*2
	size (in bytes)		**3242**		

Table 12-27: Level 1B Burst Waveforms MDSR

Note 1: The spare fields will always be set to zero, according to Annex A (Section A.2.3) of the Product Specifications.

12.2 Annex 2

DEFINITION OF CYCLES			
CYCLE	**FIRST ABSOLUTE ORBIT**	**LAST ABSOLUTE ORBIT**	**ANX UTC**
1	1	19	01 Mar 2002 02:53:55
2	20	369	02 Mar 2002 10:45:18
3	370	485	26 Mar 2002 21:59:53
4	486	555	04 Apr 2002 00:37:34
5	556	1056	08 Apr 2002 21:59:29
6	1057	1557	13 May 2002 21:59:29
7	1558	2058	17 Jun 2002 21:59:29
8	2059	2559	22 Jul 2002 21:59:29
9	2560	3060	26 Aug 2002 21:59:29
10	3061	3561	30 Sep 2002 21:59:29
11	3562	4062	04 Nov 2002 21:59:29
12	4063	4563	09 Dec 2002 21:59:29
13	4564	5064	13 Jan 2003 21:59:29
14	5065	5565	17 Feb 2003 21:59:29
15	5566	6066	24 Mar 2003 21:59:29
16	6067	6567	28 Apr 2003 21:59:29
17	6568	7068	02 Jun 2003 21:59:29
18	7069	7569	07 Jul 2003 21:59:29
19	7570	8070	11 Aug 2003 21:59:29
20	8071	8571	15 Sep 2003 21:59:29
21	8572	9072	20 Oct 2003 21:59:29
22	9073	9573	24 Nov 2003 21:59:29
23	9574	10074	29 Dec 2003 21:59:29
24	10075	10575	02 Feb 2004 21:59:29
25	10576	11076	08 Mar 2004 21:59:29
26	11077	11577	12 Apr 2004 21:59:29
27	11578	12078	17 May 2004 21:59:29
28	12079	12579	21 Jun 2004 21:59:29
29	12580	13080	26 Jul 2004 21:59:29

DEFINITION OF CYCLES			
CYCLE	**FIRST ABSOLUTE ORBIT**	**LAST ABSOLUTE ORBIT**	**ANX UTC**
30	13081	13581	30 Aug 2004 21:59:29
31	13582	14082	04 Oct 2004 21:59:29
32	14083	14583	08 Nov 2004 21:59:29
33	14584	15084	13 Dec 2004 21:59:29
34	15085	15585	17 Jan 2005 21:59:29
35	15586	16086	21 Feb 2005 21:59:29
36	16087	16587	28 Mar 2005 21:59:29
37	16588	17088	02 May 2005 21:59:29
38	17089	17589	06 Jun 2005 21:59:29
39	17590	18090	11 Jul 2005 21:59:29
40	18091	18591	15 Aug 2005 21:59:29
41	18592	19092	19 Sep 2005 21:59:29
42	19093	19593	24 Oct 2005 21:59:29
43	19594	20094	28 Nov 2005 21:59:29
44	20095	20595	02 Jan 2006 21:59:29
45	20596	21096	06 Feb 2006 21:59:29
46	21097	21597	13 Mar 2006 21:59:29
47	21598	22098	17 Apr 2006 21:59:29
48	22099	22599	22 May 2006 21:59:29
49	22600	23100	26 Jun 2006 21:59:29
50	23101	23601	31 Jul 2006 21:59:29
51	23602	24102	04 Sep 2006 21:59:29
52	24103	24603	09 Oct 2006 21:59:29
53	24604	25104	13 Nov 2006 21:59:29
54	25105	25605	18 Dec 2006 21:59:29
55	25606	26106	22 Jan 2007 21:59:29
56	26107	26607	26 Feb 2007 21:59:29
57	26608	27108	02 Apr 2007 21:59:29
58	27109	27609	07 May 2007 21:59:29
59	27610	28110	11 Jun 2007 21:59:29
60	28111	28611	16 Jul 2007 21:59:29
61	28612	29112	20 Aug 2007 21:59:29

DEFINITION OF CYCLES			
CYCLE	**FIRST ABSOLUTE ORBIT**	**LAST ABSOLUTE ORBIT**	**ANX UTC**
62	29113	29613	24 Sep 2007 21:59:29
63	29614	30114	29 Oct 2007 21:59:29
64	30115	30615	03 Dec 2007 21:59:29
65	30616	31116	07 Jan 2008 21:59:29
66	31117	31617	11 Feb 2008 21:59:29
67	31618	32118	17 Mar 2008 21:59:29
68	32119	32619	21 Apr 2008 21:59:29
69	32620	33120	26 May 2008 21:59:29
70	33121	33621	30 Jun 2008 21:59:29
71	33622	34122	04 Aug 2008 21:59:29
72	34123	34623	08 Sep 2008 21:59:29
73	34624	35124	13 Oct 2008 21:59:29
74	35125	35625	17 Nov 2008 21:59:29
75	35626	36126	22 Dec 2008 21:59:29
76	36127	36627	26 Jan 2009 21:59:29
77	36628	37128	02 Mar 2009 21:59:29
78	37129	37629	06 Apr 2009 21:59:29
79	37630	38130	11 May 2009 21:59:29
80	38131	38631	15 Jun 2009 21:59:29
81	38632	39132	20 Jul 2009 21:59:29
82	39133	39633	24 Aug 2009 21:59:29
83	39634	40134	28 Sep 2009 21:59:29
84	40135	40635	02 Nov 2009 21:59:29
85	40636	41136	07 Dec 2009 21:59:29
86	41137	41637	11 Jan 2010 21:59:29
…	…	…	…

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
1	0	21:59:29
2	1	23:40:04
3	1	01:20:40
4	1	03:01:16
5	1	04:41:52
6	1	06:22:28
7	1	08:03:04
8	1	09:43:40
9	1	11:24:16
10	1	13:04:52
11	1	14:45:28
12	1	16:26:04
13	1	18:06:40
14	1	19:47:16
15	1	21:27:51
16	2	23:08:27
17	2	00:49:03
18	2	02:29:39
19	2	04:10:15
20	2	05:50:51
21	2	07:31:27
22	2	09:12:03
23	2	10:52:39
24	2	12:33:15
25	2	14:13:51
26	2	15:54:27
27	2	17:35:03
28	2	19:15:39
29	2	20:56:14
30	3	22:36:50
31	3	00:17:26
32	3	01:58:02

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
33	3	03:38:38
34	3	05:19:14
35	3	06:59:50
36	3	08:40:26
37	3	10:21:02
38	3	12:01:38
39	3	13:42:14
40	3	15:22:50
41	3	17:03:26
42	3	18:44:02
43	3	20:24:37
44	4	22:05:13
45	4	23:45:49
46	4	01:26:25
47	4	03:07:01
48	4	04:47:37
49	4	06:28:13
50	4	08:08:49
51	4	09:49:25
52	4	11:30:01
53	4	13:10:37
54	4	14:51:13
55	4	16:31:49
56	4	18:12:25
57	4	19:53:00
58	4	21:33:36
59	5	23:14:12
60	5	00:54:48
61	5	02:35:24
62	5	04:16:00
63	5	05:56:36
64	5	07:37:12
65	5	09:17:48

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
66	5	10:58:24
67	5	12:39:00
68	5	14:19:36
69	5	16:00:12
70	5	17:40:48
71	5	19:21:23
72	5	21:01:59
73	6	22:42:35
74	6	00:23:11
75	6	02:03:47
76	6	03:44:23
77	6	05:24:59
78	6	07:05:35
79	6	08:46:11
80	6	10:26:47
81	6	12:07:23
82	6	13:47:59
83	6	15:28:35
84	6	17:09:11
85	6	18:49:46
86	6	20:30:22
87	7	22:10:58
88	7	23:51:34
89	7	01:32:10
90	7	03:12:46
91	7	04:53:22
92	7	06:33:58
93	7	08:14:34
94	7	09:55:10
95	7	11:35:46
96	7	13:16:22
97	7	14:56:58
98	7	16:37:34

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
99	7	18:18:09
100	7	19:58:45
101	7	21:39:21
102	8	23:19:57
103	8	01:00:33
104	8	02:41:09
105	8	04:21:45
106	8	06:02:21
107	8	07:42:57
108	8	09:23:33
109	8	11:04:09
110	8	12:44:45
111	8	14:25:21
112	8	16:05:57
113	8	17:46:32
114	8	19:27:08
115	8	21:07:44
116	9	22:48:20
117	9	00:28:56
118	9	02:09:32
119	9	03:50:08
120	9	05:30:44
121	9	07:11:20
122	9	08:51:56
123	9	10:32:32
124	9	12:13:08
125	9	13:53:44
126	9	15:34:20
127	9	17:14:55
128	9	18:55:31
129	9	20:36:07
130	10	22:16:43
131	10	23:57:19

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
132	10	01:37:55
133	10	03:18:31
134	10	04:59:07
135	10	06:39:43
136	10	08:20:19
137	10	10:00:55
138	10	11:41:31
139	10	13:22:07
140	10	15:02:43
141	10	16:43:18
142	10	18:23:54
143	10	20:04:30
144	10	21:45:06
145	11	23:25:42
146	11	01:06:18
147	11	02:46:54
148	11	04:27:30
149	11	06:08:06
150	11	07:48:42
151	11	09:29:18
152	11	11:09:54
153	11	12:50:30
154	11	14:31:06
155	11	16:11:41
156	11	17:52:17
157	11	19:32:53
158	11	21:13:29
159	12	22:54:05
160	12	00:34:41
161	12	02:15:17
162	12	03:55:53
163	12	05:36:29
164	12	07:17:05

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
165	12	08:57:41
166	12	10:38:17
167	12	12:18:53
168	12	13:59:29
169	12	15:40:04
170	12	17:20:40
171	12	19:01:16
172	12	20:41:52
173	13	22:22:28
174	13	00:03:04
175	13	01:43:40
176	13	03:24:16
177	13	05:04:52
178	13	06:45:28
179	13	08:26:04
180	13	10:06:40
181	13	11:47:16
182	13	13:27:51
183	13	15:08:27
184	13	16:49:03
185	13	18:29:39
186	13	20:10:15
187	13	21:50:51
188	14	23:31:27
189	14	01:12:03
190	14	02:52:39
191	14	04:33:15
192	14	06:13:51
193	14	07:54:27
194	14	09:35:03
195	14	11:15:39
196	14	12:56:14
197	14	14:36:50

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
198	14	16:17:26
199	14	17:58:02
200	14	19:38:38
201	14	21:19:14
202	15	22:59:50
203	15	00:40:26
204	15	02:21:02
205	15	04:01:38
206	15	05:42:14
207	15	07:22:50
208	15	09:03:26
209	15	10:44:02
210	15	12:24:37
211	15	14:05:13
212	15	15:45:49
213	15	17:26:25
214	15	19:07:01
215	15	20:47:37
216	16	22:28:13
217	16	00:08:49
218	16	01:49:25
219	16	03:30:01
220	16	05:10:37
221	16	06:51:13
222	16	08:31:49
223	16	10:12:25
224	16	11:53:00
225	16	13:33:36
226	16	15:14:12
227	16	16:54:48
228	16	18:35:24
229	16	20:16:00
230	16	21:56:36

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
231	17	23:37:12
232	17	01:17:48
233	17	02:58:24
234	17	04:39:00
235	17	06:19:36
236	17	08:00:12
237	17	09:40:48
238	17	11:21:23
239	17	13:01:59
240	17	14:42:35
241	17	16:23:11
242	17	18:03:47
243	17	19:44:23
244	17	21:24:59
245	18	23:05:35
246	18	00:46:11
247	18	02:26:47
248	18	04:07:23
249	18	05:47:59
250	18	07:28:35
251	18	09:09:11
252	18	10:49:46
253	18	12:30:22
254	18	14:10:58
255	18	15:51:34
256	18	17:32:10
257	18	19:12:46
258	18	20:53:22
259	19	22:33:58
260	19	00:14:34
261	19	01:55:10
262	19	03:35:46
263	19	05:16:22

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
264	19	06:56:58
265	19	08:37:34
266	19	10:18:09
267	19	11:58:45
268	19	13:39:21
269	19	15:19:57
270	19	17:00:33
271	19	18:41:09
272	19	20:21:45
273	20	22:02:21
274	20	23:42:57
275	20	01:23:33
276	20	03:04:09
277	20	04:44:45
278	20	06:25:21
279	20	08:05:57
280	20	09:46:32
281	20	11:27:08
282	20	13:07:44
283	20	14:48:20
284	20	16:28:56
285	20	18:09:32
286	20	19:50:08
287	20	21:30:44
288	21	23:11:20
289	21	00:51:56
290	21	02:32:32
291	21	04:13:08
292	21	05:53:44
293	21	07:34:20
294	21	09:14:55
295	21	10:55:31
296	21	12:36:07

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
297	21	14:16:43
298	21	15:57:19
299	21	17:37:55
300	21	19:18:31
301	21	20:59:07
302	22	22:39:43
303	22	00:20:19
304	22	02:00:55
305	22	03:41:31
306	22	05:22:07
307	22	07:02:43
308	22	08:43:18
309	22	10:23:54
310	22	12:04:30
311	22	13:45:06
312	22	15:25:42
313	22	17:06:18
314	22	18:46:54
315	22	20:27:30
316	23	22:08:06
317	23	23:48:42
318	23	01:29:18
319	23	03:09:54
320	23	04:50:30
321	23	06:31:06
322	23	08:11:41
323	23	09:52:17
324	23	11:32:53
325	23	13:13:29
326	23	14:54:05
327	23	16:34:41
328	23	18:15:17
329	23	19:55:53

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
330	23	21:36:29
331	24	23:17:05
332	24	00:57:41
333	24	02:38:17
334	24	04:18:53
335	24	05:59:29
336	24	07:40:04
337	24	09:20:40
338	24	11:01:16
339	24	12:41:52
340	24	14:22:28
341	24	16:03:04
342	24	17:43:40
343	24	19:24:16
344	24	21:04:52
345	25	22:45:28
346	25	00:26:04
347	25	02:06:40
348	25	03:47:16
349	25	05:27:51
350	25	07:08:27
351	25	08:49:03
352	25	10:29:39
353	25	12:10:15
354	25	13:50:51
355	25	15:31:27
356	25	17:12:03
357	25	18:52:39
358	25	20:33:15
359	26	22:13:51
360	26	23:54:27
361	26	01:35:03
362	26	03:15:39

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
363	26	04:56:14
364	26	06:36:50
365	26	08:17:26
366	26	09:58:02
367	26	11:38:38
368	26	13:19:14
369	26	14:59:50
370	26	16:40:26
371	26	18:21:02
372	26	20:01:38
373	26	21:42:14
374	27	23:22:50
375	27	01:03:26
376	27	02:44:02
377	27	04:24:37
378	27	06:05:13
379	27	07:45:49
380	27	09:26:25
381	27	11:07:01
382	27	12:47:37
383	27	14:28:13
384	27	16:08:49
385	27	17:49:25
386	27	19:30:01
387	27	21:10:37
388	28	22:51:13
389	28	00:31:49
390	28	02:12:25
391	28	03:53:00
392	28	05:33:36
393	28	07:14:12
394	28	08:54:48
395	28	10:35:24

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
396	28	12:16:00
397	28	13:56:36
398	28	15:37:12
399	28	17:17:48
400	28	18:58:24
401	28	20:39:00
402	29	22:19:36
403	29	00:00:12
404	29	01:40:48
405	29	03:21:23
406	29	05:01:59
407	29	06:42:35
408	29	08:23:11
409	29	10:03:47
410	29	11:44:23
411	29	13:24:59
412	29	15:05:35
413	29	16:46:11
414	29	18:26:47
415	29	20:07:23
416	29	21:47:59
417	30	23:28:35
418	30	01:09:11
419	30	02:49:46
420	30	04:30:22
421	30	06:10:58
422	30	07:51:34
423	30	09:32:10
424	30	11:12:46
425	30	12:53:22
426	30	14:33:58
427	30	16:14:34
428	30	17:55:10

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
429	30	19:35:46
430	30	21:16:22
431	31	22:56:58
432	31	00:37:34
433	31	02:18:09
434	31	03:58:45
435	31	05:39:21
436	31	07:19:57
437	31	09:00:33
438	31	10:41:09
439	31	12:21:45
440	31	14:02:21
441	31	15:42:57
442	31	17:23:33
443	31	19:04:09
444	31	20:44:45
445	32	22:25:21
446	32	00:05:57
447	32	01:46:32
448	32	03:27:08
449	32	05:07:44
450	32	06:48:20
451	32	08:28:56
452	32	10:09:32
453	32	11:50:08
454	32	13:30:44
455	32	15:11:20
456	32	16:51:56
457	32	18:32:32
458	32	20:13:08
459	32	21:53:44
460	33	23:34:20
461	33	01:14:55

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
462	33	02:55:31
463	33	04:36:07
464	33	06:16:43
465	33	07:57:19
466	33	09:37:55
467	33	11:18:31
468	33	12:59:07
469	33	14:39:43
470	33	16:20:19
471	33	18:00:55
472	33	19:41:31
473	33	21:22:07
474	34	23:02:43
475	34	00:43:18
476	34	02:23:54
477	34	04:04:30
478	34	05:45:06
479	34	07:25:42
480	34	09:06:18
481	34	10:46:54
482	34	12:27:30
483	34	14:08:06
484	34	15:48:42
485	34	17:29:18
486	34	19:09:54
487	34	20:50:30
488	35	22:31:06
489	35	00:11:41
490	35	01:52:17
491	35	03:32:53
492	35	05:13:29
493	35	06:54:05
494	35	08:34:41

ANX TIMES		
RELATIVE ORBIT	**DAY SHIFT**	**ANX UTC**
495	35	10:15:17
496	35	11:55:53
497	35	13:36:29
498	35	15:17:05
499	35	16:57:41
500	35	18:38:17
501	35	20:18:53