Infoterra Limited

ALTIMETER WAVEFORM PRODUCT
ALT.WAP
COMPACT USER GUIDE

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NOTICE

ALTIMETER WAVEFORM PRODUCT

ALT.WAP

COMPACT USER GUIDE

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	27	corrected description of source packets affected by HW1 - only ocean tracking source packets are affected		
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Amendments

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4.1	New issue for ALT.WAP Version 4.1 Internal Range Correction errors with the ALT WAP product fixed		Phil Capp	22/11/01

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1 INTRODUCTION

1.1 Introduction

This document is a user guide for the Altimeter Waveform Product (ALT.WAP) produced by the United Kingdom Processing and Archiving Facility (UK-PAF).

1.2 Scope of Document

This document provides information about the parameters which are contained in the Waveform Product, ALT.WAP and describes the product format in order to allow users to extract these parameters.

1.3 Intended Audience

This document is intended for use by scientists who are familiar with Altimeter data, though not necessarily with ERS-1/2 Altimeter data.

1.4 Document Structure

Following this section the document has three main sections and an Annex:

- 2 The ERS Missions & the Radar Altimeter
- 3 The ALT.WAP Product
- 4 Additional Information — The ALT.WAP Health Warning
- Annex A ALT.WAP CEOS Format Definition

1.5 Point of Contact

For further information on the UK-PAF and UK-PAF products please contact:

ERS Help Desk
EECF
ESA/Earthnet Programme Office
ESRIN
C.P. 64
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1.6 Abbreviations and Acronyms

The following is a list of the abbreviations and acronyms which are used in this document.

ACSW	Atmospheric Correction Status Word
ADLFH	Auxiliary Data Limit Flags Halfword
AGC	Automatic Gain Control
ALT	Altimeter
ALT.WAP	ALT.WAP, Altimeter Waveform Product
ALT.WDR	ALT.WDR, Altimeter Waveform Foundation Product
ATSR-M	Along Track Scanning Radiometer-Microwave Sounder
BITE	Built in Test Equipment
C	Count
CEOS	Committee on Earth Observation Satellites
DPAF	German Processing and Archiving Facility
ECMWF	European Centre for Medium-Range Weather Forecasting
EECF	Earthnet ERS Central Facility
EFC	Error Flag Count
EFCP	Error Flag Count Percentage
EFST	Error Flag Summation Threshold
ERS-1/2	First/Second European Remote Sensing Satellite
ESA	European Space Agency
ESF	Error Summary Flag
ESRIN	European Space Research Institute
FC	Flag Count
FCP	Flag Count Percentage
FD	Fast Delivery
FPDU	Filter Power Density Units
GFA	Global Forecast Analysis
HCEFB	Hs Corrections Error Flags Byte
HEFB	Hs Error Flags Byte
HTL	Height Tracking Loop
HW	Health Warning
LEFB	Location Error Flags Byte
LOT	Loss of Tracking
LSB	Least Significant Bit

MSB	Most Significant Bit
MSSL	Mullard Space Science Laboratory
OCOG	Offset Centre of Gravity
PACC	Precise Time Correlation File
PATC	Time Correlation File
PCD	Product Confidence Data
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
QC	Quality Check
RAL	Rutherford Appleton Laboratory
RCEFW	Range Corrections Error Flags Word
REFB	Range Error Flags Byte
RSS	Return Signal Simulator
RX	Receiver
SB	Science Block
SCEFB	Sigma0 Corrections Error Flags Byte
SEFB	Sigma0 Error Flags Byte
SF	Summary Flag
SP	Source Packet
SSM/I	Special Sensor Microwave/Imager
STL	Slope Tracking Loop
SWH	Significant Waveheight, H_s
TM	Transcribed Telemetry value
UK-PAF	United Kingdom Processing and Archiving Facility
UTC	Universal Time Coordinated
WEFB	Waveform Error Flags Byte
WSFB	Waveform Shape Flags Byte

2 THE ERS MISSIONS & THE RADAR ALTIMETER

2.1 The ERS Missions

The ERS-1 satellite was launched sucessfully on 17th July 1991 by flight V44 of the ARIANE launcher, from Kourou in French Guiana.

The satellite carries the following sensors;

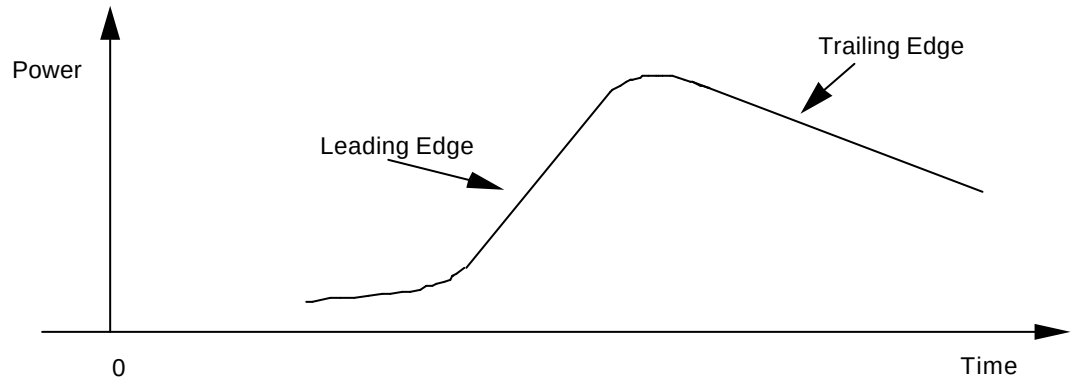
- Active Microwave Instrument
  - Synthetic Aperture Radar
  - Wave Scatterometer
  - Wind Scatterometer
- Radar Altimeter
- Along Track Scanning Radiometer
- Microwave Sounder
- Precise Range and Range Rate Equipment
- Laser Retroreflector.

The ERS-2 satellite was launched on 21st April 1995 and carries an identical Radar Altimeter to that on ERS-1.

2.2 The Radar Altimeter

The Radar Altimeter (RA) is a Ku band nadir pointing active microwave sensor. It provides high precision measurements of the distance from the satellite to the surface. Infomation on the 'imaged' surface characteristics such as surface roughness and reflectivity can also be determined by examining the shape of the return echo.

The following diagram shows the measurement principle of the altimeter.



The following parameters can be determined from this return pulse;

- the time delay between the transmitted and returned pulses, which provides an indication of the satellite altitude

- the slope of the leading edge of the echo, which is related to the width distribution of the heights of the surface reflectors, and thus to parameters such as significant waveheight

- the power level of the trailing edge of the echo pulse, which is used to provide an estimate of the backscatter coefficient and hence the small scale surface roughness characteristics such as wind speed.

The following table gives the main characteristics of the Radar Altimeter.

Frequency	13.8 GHz (Ku band)
Transmitted Pulse Length	20 microseconds
Bandwidth	330 MHz (ocean) 82.5 MHz (ice)
Transmitted Power	50 Watts
Pulse Repetition Frequency	1020 Hz
Antenna Diameter	1.2 m
Antenna Beamwidth	1.34 °
Compressed Pulse Length	3.03 nanoseconds (ocean) 12.12 nanoseconds (ice)

3 THE ALT.WAP PRODUCT

3.1 Description

The ALT.WAP product is a level 1.5 product and contains all the information telemetered in the altimeter source packets together with the corrections, calibration and orbit data required to further process the data into higher level geophysical products.

The product has the same general content as the Level 1.0 Waveform Foundation Product (ALT.WDR) and is produced from this product, with the following optional updates if the required data is available: the precision orbit-derived location data to replace the restituted orbit derived data; the improved calibration corrections to replace the coarse corrections; the improved wet tropospheric corrections to be inserted; and geoid and tidal information. In general, the corrections are not applied to the measurements (except where stated) and it is left to the user to apply the corrections which they require.

The following processing steps (algorithms) are performed to produce the Waveform Foundation Product, ALT.WDR, which is the input product for ALT.WAP. Calibration processing forms an integral part of this processing chain and is also described below.

A brief description of each algorithm and its major inputs is given below.

Raw Data Formatting and Quality Assessment
The ERS-1/2 altimeter raw data, ALT.RAW, form the input to this algorithm which primarily reformats these data. The algorithm then converts the SBC value to UTC, resequences the waveform data, identifies the source packet/science block type, mode and validity and performs quality assessment of the raw altimeter data.

Mode Identification
This algorithm identifies the type of input data (tracking, acquisition etc.) and the operating status (tracking type, calibration type, chirp type etc.). It identifies the data which are suitable for further processing and those which are degraded. It also extracts the calibration data for calibration processing.

Delay Correction and convert to Range
This algorithm converts the time delay measurement for each science block into a one way range value in metres. The internal and external range corrections are incorporated into the range measurement.

Slope Correction and convert to H_S
This algorithm calculates the corrected slope by incorporating the internal range correction and converts this value to significant waveheight, H_s.

Hs is related to slope via the following equation.

$$H_s = 4 \times \{(K_1/S')^2 - K_2\}^{1/2} + \Delta Se$$

where H_s = significant waveheight

K_2= instrument dependent constant

S' = corrected slope

K_1= c x FBS x P_{ref} / (2x v2 x T_z)

where FBS = filter bin spacing in seconds

P_{ref} = power reference value

Tz = instrumental constant

ΔSe = external H_s correction

Gain Correction and convert to Sigma0

This algorithm inserts corrections for the variations in the receiver chain gain characteristic and the relative biases in the waveform samples. It calculates the corrected backscatter coefficient, sigma0, using an AGC calibration correction value and externally derived sigma0 corrections (one for ocean and one for ice mode). A corrected waveform is also produced.

Merge Orbit and Attitude

This algorithm calculates values of latitude, longitude, altitude and attitude using the most accurate orbit information which is available at time of processing.

This algorithm uses a common algorithm, the Orbit, Attitude and Timing Algorithm, to calculate the above information. Within this algorithm is the ESA supplied ERSORB program which calculates the orbital parameters.

The PACC time correlation file is used giving an accuracy better than 0.5ms (ER-IS-EPO-GE-0102, EECF to PAF Interface Specification). Timing information is calculated as specified in ER-TN-ESA-GS-0017, Time Handling and Processing and full 36 bit precision is used giving a timing accuracy of 8µs.

Merge Surface Type

This algorithm produces surface flagging information, e.g. land/sea flag, terrain type flag, possible sea ice flag.

Doppler Range Correction and Range Sigma0 Correction

This algorithm provides a correction for the altimeter range measurement to correct for the Doppler shift of the echo and a correction for the backscatter coefficient (s^0) to allow for the change in altimeter footprint with altitude.

Blunder Point Check

This algorithm outputs flags which indicate the occurrence of anomalous values of onboard or derived parameters along with the means and standard deviations of the parameters calculated on a once per source packet basis.

Waveform Parameterisation

This algorithm calculates the waveform shape parameters (amplitude, width, retracked threshold positions and peakiness) and sets flags indicating anomalous waveform shapes (multi-peaked, strange shaped and peaky waveforms).

Waveform Foundation Product Output and QA
This algorithm assembles the data generated in the previous algorithms and outputs these data along with the reformatted raw data to the Waveform Foundation Product (in internal format). The algorithm assembles the quality and error flags into words and writes these to the product. The algorithm also produces and outputs quality information.

Calibration Data Output and QA
This algorithm controls the calibration processing and outputs the data to the Calibration Data and Trends product. This product is used in update processing for updating the calibration corrections.

Calibration Mode Identifier
This algorithm identifies the calibration mode and sets flags accordingly. It also calculates the waveform width and amplitude for open loop calibration (OLC) waveforms.

Process Open Loop Point Target Response
This algorithm processes the OLC Point Target Response Waveforms to give time indexed correction values for Time Delay and AGC.

Calibration Mode Tends Analysis
This algorithm analyses the on-board altimeter calibration data on a pass by pass basis and calculates statistical information for the calibration parameters calculated by the above algorithm.

The following processing steps (algorithms) are performed to produce the ALT.WAP product from the input product, ALT.WDR whose algorithms are described above. A brief description of each algorithm and its major inputs is given below.

Update Calibration Corrections
This algorithm inserts updated values of the Internal AGC and Internal Delay Corrections and ensures that the calibration corrections come from the correct mode of open-loop calibrations. The quality of the input data is controlled with a blunder point check ensuring that the incremental change between one correction and the next does not exceed a given threshold. The corrections are read from the Calibration Data and Trends product which is produced as part of routine processing.

Ionospheric Corrections
This algorithm appends a range correction for the altimeter path to compensate for the ionospheric group delay. The correction is predicted from an empirical electron

content model[1] based on a set of lookup tables. In addition a warning flag derived from the Kp Geomagnetic Index is output to indicate periods of excessive ionospheric activity which may invalidate the model assumptions producing an unrepresentative correction. The electron content is estimated using the sunspot number and a series of lookup tables containing monthly mean values of electron content. The electron content model data is supplied by the Department of Physics, University of Leicester, UK. The sunspot numbers are supplied by the World Data Centre, RAL. The Kp Index Warning data is supplied by the National Centre for Atmospheric Research.

The ionospheric delay correction, e, is calculated from the following equation:

$$e = 0.403 \times \frac{E}{f^2}$$

where E is the electron content ($m^{-2} \times 10^{16}$)
f is the altimeter frequency (GHz)

A refined value of electron content was to have been obtained from the PRARE but this improved correction is not now available due to the instrument's failure.

Dry Tropospheric Range Correction
This algorithm appends a correction for the additional path length caused by 'non-polar' gases in the troposphere, i.e. those molecules which do not have a permanent dipole moment. The dry tropospheric range correction is calculated using a measurement of surface pressure at the subsatellite point and the subsatellite point latitude. This data is supplied by the ECMWF Global Forecast Analysis.

The dry tropospheric range correction, ΔHd, is calculated from the following equation[2]:

$$\Delta H_d = 2.277 \times 10^{-3} \{1 + 0.0026 \cos(|2c|)\} P^0$$

where c is the subsatellite point latitude (microdegrees)
P^0 is the surface pressure at the source packet centre time (millibars)

Wet Tropospheric Range Correction
This algorithm appends a correction for the additional path length caused by 'polar' water vapour in the troposphere, i.e. those molecules which have a permanent

[1]Rawer, K. and Bilitza, D., 1985, 'Study of Ionospheric and Tropospheric models.' in ESA contract report ESA-CR(P)-2157.

[2]Tapley, B. D., Lundberg, J. B. and Born, G. H., 1982, 'The SEASAT altimeter wet tropospheric range correction' in The Journal of Geophysical Research, Vol. 87, No. C5, pp3212 - 3220.

dipole moment. The wet tropospheric range correction is calculated using an estimate of the total integrated water vapour and surface air temperature at the subsatellite point. This data is supplied by the ECMWF Global Forecast Analysis. The wet tropospheric range correction, ΔHw, is calculated from the following equation[3]:

$$\Delta Hw = -Q\{2.584 \times 10^{-5} + 5.324 \times 10^{-2} \log_e(1 - \frac{32.5}{T_o})\}$$

where Q is the total integrated water vapour at the source packet centre time (kgm^{-2})
T_o is the surface air temperature at the source packet centre time (kelvin)

Merge FD Products
This algorithm inserts the fast delivery source packet into the primary altimeter data stream.

From ALT.WAP Version 3.0 no FD data will be included within the product.

Merge Precise Orbit and Attitude
This algorithm calculates values of latitude, longitude, altitude and attitude using version 1.00 of the precise orbit which is supplied by the D-PAF.

This algorithm uses a common algorithm, the Orbit, Attitude and Timing Algorithm, to calculate the above information. Within this algorithm is the ESA supplied ERSORB program which calculates the orbital parameters.

The PACC time correlation file is used giving an accuracy better than 0.5ms (ER-IS-EPO-GE-0102, EECF to PAF Interface Specification). Timing information is calculated as specified in ER-TN-ESA-GS-0017, Time Handling and Processing and full 36 bit precision is used giving a timing accuracy of 8µs.

Merge Spacecraft Health
This algorithm merges the spacecraft health word which comprises a number of engineering quality flags held within a 32 bit word into the primary data stream. This data is supplied by ESA.

Improved Range Corrections
This algorithm calculates improved values of internal and external range corrections. The internal range correction is calculated from data provided by the update calibration corrections algorithm. The external range correction is calculated from ESA campaign data. These corrections are incorporated to the

[3]Smith, E. K. and Weintraub, S., 1953, 'The constants in the equation for atmospheric refractive index at radio frequencies' in Proceedings of the IRE, Vol. 41, pp 1035 - 1037

range measurement. If no update corrections are available then range is left unchanged (i.e. has only the original internal and external range corrections applied).

Improved Gain/Sigma0 Corrections
This algorithm calculates an improved backscatter coefficient, sigma0, using improved bin gain corrections (supplied by ESA/MSSL) and an improved internal AGC correction from the Update Calibration Corrections algorithm. These corrections are incorporated in the Sigma0 value. If no update corrections are available then sigma0 is left unchanged (i.e. has only the original AGC internal and sigma0 corrections applied).

Radiosonde Data Processing
This algorithm calculates values for integrated water vapour and the integral of water vapour with respect to temperature ($r_w(h)/T(h)$) for radiosonde ascents which are close in time and space to the source packet centre time and location.

From ALT.WAP Version 3.0 no radiosonde data will be included within the product.

QC and check values of Integrated Water Vapour
This algorithm firstly calculates values of integrated water vapour from SSM/I and ATSR-M measurements which correspond to the source packet centre time. It then compares these with values of integrated water vapour obtained from Radiosonde ascents and the GFA and flags those occasions when there are significant differences (discrepancies) between them. In the event that there are differences between the GFA and the other measurements a 'possible feature' flag is set to indicate that the difference may be due to a genuine meteorological feature such as a depression.

From ALT.WAP Version 3.0 no SSM/I or ATSR-M data will be included within the product.

Improved Wet Tropospheric Correction
This algorithm calculates wet tropospheric range corrections (using the same equation as the GFA wet tropospheric range correction) with values of total integrated water vapour obtained by the SSM/I, ATSR-M and Radiosonde ascents.

From ALT.WAP Version 3.0 no SSM/I, ATSR-M or Radiosonde data will be included within the product.

Liquid Water Correction
This algorithm calculates the altimeter range correction and altimeter pulse attenuation due to the liquid water in the troposphere. The liquid water content of the troposphere is calculated from measurements made by the ATSR-M.

The liquid water range correction, ΔH_L, is calculated using the following equation[4]:

$$\Delta H_L = (6.15 + 0.0675\{(T_0 - 13) - 273.16\} - 1)\frac{L}{999.7}$$

where L is the total liquid water (kgm^{-2})
T_0 is the subsatellite surface air temperature (kelvin)

The liquid water attenuation correction, a_L, is calculated using the following equation[5]:

$$a_L = 2 \times L \times n^{1.95} \times e^{-6.866\{1 + 0.0045(T_0 - 286)\}}$$

where L is the liquid water content (kgm-2)
n is the altimeter transmission frequency (13.8GHz)
T_0 is the subsatellite surface air temperature (kelvin)

From ALT.WAP Version 3.0 no ATSR-M data will be included within the product.

Waveform Product Output and QA
This algorithm outputs the Waveform Product and its associated quality information (in internal format) and calls the tidal corrections and geoid algorithms as required.

Tide Correction algorithm
This algorithm calculates the solid earth tide, ocean tide and ocean loading tide corrections using the following models:

Solid Earth Tide	Cartwright Edden Tayler[6]
Ocean Tide	Schwiderski[7]
Ocean Loading Tide	Ray and Sanchez[8]

[4]Gunn, K. L. S. and East, T. W. R., 1954, Quarterly Journal of the Meteorological Society, Vol. 80, p522

[5]Benoit, A., 1968, Microwave Journal, Vol. 11, No. 11 p 73

[6]Cartwright and Tayler, 1971, Geophysics Journal of the Royal Astronomical Society, No. 23, pp 45 - 74

Cartwright and Edden, 1973, Geophysics Journal of the Royal Astronomical Society, No. 33, pp 253 - 264

[7]Schwiderski, 1983, 'Atlas of tidal charts and maps. Part 1. The semi-diurnal principal lunar tide M2' in Marine Geodesy, No. 6,pp 219 - 265

Geoid Estimation algorithm
This algorithm calculates the geoid elevation corresponding to the subsatellite point using the GEM-T1 geoid model[9].

3.2 Product Content

The following tables give details of the parameters which are contained in the ALT.WAP Processed Data Record and ALT.WAP Product Quality Summary Record. Details of the other records of the CEOS format product can be found in the Annex to this document.

The ALT Processed Data Record contains the Altimeter parameters described in section 3.1 and the Product Quality Summary Record contains counts and summary flag information which can be used to indicate the quality of the product.

Table 1 lists the altimeter parameters with their units and minimum/maximum acceptable values. Table 2 lists certain of the parameters together with their related error flags and provides an explanation of their settings and how they should be used. The product consists of a mix of 1Hz and 20 Hz parameters, the latter are shown in Table 1 as bold entries.

Comprehensive data quality flagging is included, and the contents of the flag bytes, halfwords and words are defined in Table 3.

Table 4 gives an explanation of the derivation of the counts and flags in the product quality summary record. These counts and flags can be used to give an indication of the quality of the product. In general if the total summary flag is set to false then the product is of acceptable quality.

Data type is given in FORTRAN-style format descriptions. Flag bytes, halfwords and words are defined as L-type, or LOGICAL, which can alternatively be read as BYTE using A-type descriptors, where supported by compilers.

The data is written using the IBM byte ordering convention with words being addressed by the highest order byte when writing to the output media. The following IBM bit level conventions also apply:

- the most significant bit (MSB) of a word shall be the bit that is transferred first.

[8]Ray and Sanchez, 1989, 'Radial deformation of the Earth by oceanic tidal loading., NASA technical memorandum 100743

[9]Marsh, J. G. et al, 1988, 'A New gravitational Model for the Earth from Satellite Tracking Data: GEM-T1', Journal of Geophysical Research, No. 93, B6, pp 6169 - 6215

- the least significant bit (LSB) shall be the bit that is transferred last.
- the MSB of a word shall be numbered 0.
- the LSB of a word shall be numbered n (e.g. 7, 15, 31).
- when representing words and bytes diagrammatically the LSB shall be drawn on the right e.g. if bit 4 is set then the word would have a value of 8 in decimal notation or 00001000 in binary notation (see figure 3.1 below).

Figure 3.1 Bit and Byte Conventions

MSB							LSB	
0	1	2	3	4	5	6	7	Bit No.
128	64	32	16	8	4	2	1	Bit value

Table 1 — The ALT.WAP Parameters Units and Ranges

Parameter	Units	Minimum	Maximum
Source packet number	—	1	9999
Orbit number	—	1	50000
Source packet UTC, days since 1 Jan 1950	Days	14600	18250
Source packet UTC, milliseconds in day	ms	0	86400000
Source packet UTC, microseconds	µs	0	999
Packet length	dimensionless	0	3132
S/C binary counter	s/c clock units	0	2**35
alpha HTL filter coefficient	x E+6	49000000	200000000
beta HTL filter coefficient	x E+10	100000	350000
alpha STL filter coefficient	x E+5	20000000	95000000
beta STL filter coefficient	x E+6	30000000	90000000
alpha AGC filter coefficient	x E+5	650000	2500000
beta AGC filter coefficient	x E+8	2500000	35000000
Power reference value	FPDU*100	0	204800
Preset duration	base frames	0	65536
Preset time delay	12.5ns x 1000	0	48000000
Preset first derivative of time delay	12.5ns/PRI x E+6	-1330000	1330000
Preset AGC	dB x 100	0	6399
Preset slope	slope units x 100	0	204800
RX offset	12.5ns x 1000	-8000	8000
Noise floor estimation	FPDU x 100	0	204800
HTL discr. o/p (ocean/ice)	12.5ns x 10000	-1400000	1400000
STL discriminator o/p	slope units x 100	-204800	204800
AGC discriminator o/p	counts x 10	-10240	10240

HTL beta branch	—, x E+6	-1330000	1330000
Parameter	Units	Minimum	Maximum
64 waveform samples	counts	0	65536
Time delay	12.5ns x 1000	2000000	48000000
Slope	slope units x 100	0	204800
AGC	dB x 100	0	6399
Frame number	—	0	19
Range	mm	769500000	825000000
Hs	mm	0	21700
Sigma0	dB x 100	-2500	5600
Waveform amplitude	counts x 100	0	9900000
Waveform width	mm	0	115200
Low retrack point	bins x 100	0	6300
Medium retrack point	bins x 100	0	6300
High retrack point	bins x 100	0	6300
Waveform peakiness	—, x 1000	0	32000
Waveform latitude	µdegrees	-90000000	90000000
Waveform longitude	µdegrees	0	359999999
Altitude	mm	769500000	825000000
Range Constant	mm	769500000	825000000
Range std. dev., RSD	mm	0	200000
Range gradient	m/s x 100	-20000	20000
Range values used, n	—	0	20
Hs mean, Hmean	mm	0	21700
Hs values used, nh	—	0	20
Hs std. dev., HSD	mm	0	12000
Sigma0 mean, Smean	dB x 10	-2500	5600
Sigma0 std. dev., SSD	mm	0	30000

Sigma0 values used, ns	—	0	20
Parameter	Units	Minimum	Maximum
Mispointing	µdegrees	0	0
Yaw	µdegrees	0	0
Roll	µdegrees	0	0
Pitch	µdegrees	0	0
Radial Orbit Correction (for time of Source Packet Centre UTC)	—	-6000	6000
Internal range correction	mm	4500000	5000000
External range correction	mm	0	0
Pulse repetition frequency	$Hz*10^8$	102000000000	102000000000
Internal slope correction	FPDU/bin x 100	-1300	1300
External Hs correction	mm	-2000	2000
AGC internal correction	dB x 100	-200	200
Sigma0 correction	dB x 100	-2000	2000
64 bin gain corrections	dB x 1000	500	2000
Doppler range correction	mm	-500	500
Range sigma0 correction	dB x 100	-25	25
Ionospheric delay correction	mm	0	1060
PRARE delta correction	mm	-1000	1000
Electron content	electrons m^{-2} x 10**16 x 10	0	5000
Dry tropo. range correction	mm	1700	2500
Surface pressure	mbars x 10	7500	11000
Wet tropospheric range correction [GFA]	mm	0	370
Surface air temperature, T0	K x 10	2100	3200
Total integrated water vapour, Q [GFA]	kgm^{-2} x 10	0	550
Wet tropospheric range correction [ATSR-M]	mm	0	370
Wet tropospheric range correction [SSM/I]	mm	0	370
Wet tropospheric range correction [Rad Snd]	mm	0	370

Integral of function rw(h)/T(h)	$kgm^{-2}\ K^{-1} x\ 10$	0	200
Parameter	Units	Minimum	Maximum
Total integrated water vapour, Q [ATSR-M]	kgm^{-2} x 10	0	550
Total integrated water vapour, Q [SSM/I]	kgm^{-2} x 10	0	550
Total integrated water vapour, Q [Rad Snd	kgm^{-2} x 10	0	550
Liquid water range correction	mm	0	60
Liquid water attenuation correction	dB x 100	0	5000
Total liquid water, L	kgm^{-2} x 10	0	120
Terrain type flag	—	0	9
Spacecraft C-of-G offset	mm	0	1152
Geoid elevation	mm	-200000	200000
Earth Tide	mm	-1000	1000
Ocean Tide	mm	-10000	10000
Ocean Loading Tide	mm	-100	100
FD Data record number	—	0	65536
FD UTC time	D-M-Y h:m:s	01-AUG-1990 00:00:00.000	01-AUG-2000 00:00:00.000
FD Latitude	millidegrees	-90000	90000
FD Longitude	millidegrees	0	359999
FD wind speed, U10	$10^{-2}\ ms^{-1}$	40	2400
FD windspeed Std. dev.	$10^{-4}\ ms^{-1}$	0	32768
FD significant waveheight, Hs	10^{-2} m	100	2000
FD SWH Std. dev.	10^{-4} m	0	32768
FD altitude, H	10^{-2} m	76950000	82500000
FD Altitude Std. dev.	10^{-4} m	0	2147483600
FD Number of blocks	counts	0	20
FD Average peakiness	10^{-2}	-32768	32768

FD Attitude Correction, ionosphere	10^{-3}m	0	1100
FD Attitude Correction, dry tropospheric	10^{-3}m	1700	2500
FD Attitude Correction, wet tropospheric	10^{-3}m	0	350
Parameter	Units	Minimum	Maximum
FD Attitude Correction, cal. constant	10^{-3}m	-1000	1000
FD Open Loop HTL, cal. correction	10^{-3}m	-5000000	5000000
FD Open Loop AGC, cal. correction	10^{-3}dB	-2000	2000
Orbit type (corresp. to source packet centre UTC)	—	PRED/REST/PREL/PREC	PRED/REST/PREL/PREC
Source packet centre UTC - days	Days	14600	182500
Source packet centre UTC - millisecs	ms	0	86400000
Source packet centre - microsecs	microseconds	0	999
Number of valid waveforms/data blocks	—	0	20

Table 2 — Definition of ALT.WAP Parameters' Error Flagging

Parameter	Error Flag	Bit #	Usage	
alpha HTL filter coefficient	Auxiliary Data Limit Flags Word	1	0 : OK	1 : out of valid range
beta HTL filter coefficient	Auxiliary Data Limit Flags Word	2	0 : OK	1 : out of valid range
alpha STL filter coefficient	Auxiliary Data Limit Flags Word	3	0 : OK	1 : out of valid range
beta STL filter coefficient	Auxiliary Data Limit Flags Word	4	0 : OK	1 : out of valid range
alpha AGC filter coefficient	Auxiliary Data Limit Flags Word	5	0 : OK	1 : out of valid range
beta AGC filter coefficient	Auxiliary Data Limit Flags Word	6	0 : OK	1 : out of valid range
Power reference value	Auxiliary Data Limit Flags Word	7	0 : OK	1 : out of valid range
Preset duration	Auxiliary Data Limit Flags Word	8	0 : OK	1 : out of valid range
Preset time delay	Auxiliary Data Limit Flags Word	9	0 : OK	1 : out of valid range
Preset first derivative of time delay	Auxiliary Data Limit Flags Word	10	0 : OK	1 : out of valid range

Preset AGC	Auxiliary Data Limit Flags Word	11	0 : OK	1 : out of valid range
Preset slope	Auxiliary Data Limit Flags Word	12	0 : OK	1 : out of valid range
RX offset	Auxiliary Data Limit Flags Word	13	0 : OK	1 : out of valid range
Noise floor estimation	Sigma0 Error Flags Byte	4	0 : OK	1 : out of valid range
HTL discr. o/p (ocean/ice)	Range Error Flags Byte	2	0 : OK	1 : out of valid range
Parameter	Error Flag	Bit #		Usage
STL discriminator o/p	Hs Error Flags Byte	2	0 : OK	1 : out of valid range
AGC discriminator o/p	Sigma0 Error Flags Byte	2	0 : OK	1 : out of valid range
HTL beta branch	Range Error Flags Byte	3	0 : OK	1 : out of valid range
64 waveform samples	Waveform Error Flags Byte	0	0 : OK	1 : out of valid range
		2	0 : OK	1 : out of valid range
Time delay	Range Error Flags Byte	0	0 : OK	1 : out of valid range
Slope	Hs Error Flags Byte	0	0 : OK	1 : out of valid range
AGC	Sigma0 Error Flags Byte	0	0 : OK	1 : out of valid range
Range	Range Error Flags Byte	1	0 : OK	1 : out of valid range
		4	0 : OK	1 : blundered
Hs	Hs Error Flags Byte	1	0 : OK	1 : out of valid range
		3	0 : OK	1 : blundered
Sigma0	Sigma0 Error Flags Byte	1	0 : OK	1 : out of valid range
		3	0 : OK	1 : blundered
Waveform latitude	Location Error Flags Byte	3	0 : OK	1 : error
		7	0 : OK	1 : orbit manoeuvre
Waveform longitude	Location Error Flags Byte	4	0 : OK	1 : error
		7	0 : OK	1 : orbit manoeuvre
Altitude	Location Error Flags Byte	5	0 : OK	1 : error
		7	0 : OK	1 : orbit manoeuvre
Mispointing	Location Error Flags Byte	3	0 : OK	1 : error
Internal range correction	Range Corrections Error Flags Word	0	0 : OK	1 : out of valid range
	Update Status Word	17	0 : no update	1 : update present

External range correction	Range Corrections Error Flags Word	1	0 : OK	1 : out of valid range
	Update Status Word	18	0 : no update	1 : update present
Internal slope correction	Hs Correction Error Flags Byte	0	0 : OK	1 : out of valid range
External Hs correction	Hs Correction Error Flags Byte	1	0 : OK	1 : out of valid range
AGC internal correction	Sigma0 Correction Error Flags Byte	0	0 : OK	1 : out of valid range
	Update Status Word	19	0 : no update	1 : update present
Sigma0 correction	Sigma0 Correction Error Flags Byte	1	0 : OK	1 : out of valid range
	Update Status Word	20	0 : no update	1 : update present

Parameter	Error Flag	Bit #	Usage	
64 bin gain corrections	Waveform Error Flags Byte	1	0 : OK	1 : out of valid range
	Update Status Word	21	0 : no update	1 : update present
Doppler range correction	Range Corrections Error Flags Word	2	0 : OK	1 : out of valid range
Range sigma0 correction	Sigma0 Correction Error Flags Byte	2	0 : OK	1 : out of valid range
Ionospheric delay correction	Range Corrections Error Flags Word	3	0 : OK	1 : out of valid range
	Atmospheric Corrections Status Word	4	0 : no PRARE	1 : PRARE included
		5	0 : no Kp Warning	1 : Kp Warning present
		6	0 : correction OK	1 : correction suspect due to turbulent ionosphere
	Update Status Word	24	0 : no sunspot data hence no correction	1 : sunspot present
PRARE delta correction	Atmospheric Corrections Status Word	4	0 : no PRARE	1 : PRARE included
Dry tropo. range correction (DTRC)	Range Corrections Error Flags Word	4	0 : OK	1 : out of valid range
Surface pressure	Update Status Word	25	0 : data absent hence no DTRC	1 : data present
Wet tropospheric range correction [GFA] (WTRC)	Range Corrections Error Flags Word	5	0 : OK	1 : out of valid range

Surface air temperature, T0	Update Status Word	26	0 : data absent hence no WTRC	1 : data present
Total integrated water vapour, Q [GFA]	Update Status Word	27	0 : data absent hence no WTRC	1 : data present
Wet tropospheric range correction [ATSR-M]	Atmospheric Corrections Status Word	0	0 : correction absent	1 : correction present
	Range Corrections Error Flags Word	8	0 : OK	1 : out of valid range
Wet tropospheric range correction [SSM/I]	Atmospheric Corrections Status Word	1	0 : correction absent	1 : correction present
	Range Corrections Error Flags Word	9	0 : OK	1 : out of valid range
Wet tropospheric range correction [Rad Snd]	Atmospheric Corrections Status Word	2	0 : correction absent	1 : correction present
	Range Corrections Error Flags Word	10	0 : OK	1 : out of valid range
Liquid water range correction	Atmospheric Corrections Status Word	3	0 : correction absent	1 : correction present
	Range Corrections Error Flags Word	11	0 : OK	1 : out of valid range
Liquid water attenuation correction	Atmospheric Corrections Status Word	3	0 : correction absent	1 : correction present
	Sigma0 Correction Error Flags Byte	3	0 : OK	1 : out of valid range
Spacecraft Health word	Update Status Word	16	0 : no update	1 : update present
Geoid elevation	Update Status Word	22	0 : data absent	1 : data present
Earth Tide	Update Status Word	23	0 : correction absent	1 : correction present
Parameter	Error Flag	Bit #	Usage	
Ocean Tide	Update Status Word	23	0 : correction absent	1 : correction present
Ocean Loading Tide	Update Status Word	23	0 : correction absent	1 : correction present
FD Data	Update Status Word	28	0 : no FD Data	1 : FD Data present

Table 3 — Definition of Words/Halfwords/Bytes

Word	Bits	Explanation
Packet id		
Version number	0,1	
Spare	2,3	

Secondary header present flag	4	
Instrument identification	5,6,7	
Tracking on Ocean	8	0=No, 1=Yes
Tracking on Ice	9	0=No, 1=Yes
Acquisition on Ocean	10	0=No, 1=Yes
Acquisition on Ice	11	0=No, 1=Yes
BITE mode	12	0=No, 1=Yes
Closed-loop calibration	13	0=No, 1=Yes
RSS state on	14	0=No, 1=Yes
Ground calibration	15	0=No, 1=Yes
Mode identifier		
Tracking on ocean from acquisition	0	0=No, 1=Yes
Tracking on ice from acquisition	1	0=No, 1=Yes
Tracking on ocean from preset tracking	2	0=No, 1=Yes
Tracking on ice from preset tracking	3	0=No, 1=Yes
Tracking on ocean from tracking on ice	4	0=No, 1=Yes
Tracking on ice from tracking on ocean	5	0=No, 1=Yes
Closed loop calibration	6	0=No, 1=Yes
Open loop calibration	7	0=No, 1=Yes
Spare	8	
Test (RSS status)	9	0=No, 1=Yes
Transmitted chirp	10	0 = ocean, 1 = ice
Ground calibration	11	0=No, 1=Yes
Word	Bits	Explanation
Mode identifier ctd.		
Loss of tracking (LOT assertion)	12	0=OK, 1=Loss of tracking declared
Loss of tracking (Alarm bit)	13	0=OK, 1=Alarm set
Ice tracking point	14,15	00 : n/a 10 : 1/4 01 : 3/4 11 : default

PCD bytes		
Bytes	0,1	Acquisition PCD
Byte	2	Ingestion PCD
Byte	3	SP_reconstruction PCD, defined as follows:
FS Parity flag	0	
Frame checksum flag	1	0=OK, 1=Checksum error
Frame lock	2	
Spare	3 to 7	
Science block valid word(1Hz)	0 to 19 Unused bits set to zero.	Bits 0 to 19 correspond to science blocks 1 to 20. Valid=1, invalid=0.
Data degraded word(1Hz)	0 to 19 Unused bits set to zero.	Bits 0 to 19 correspond to science blocks 1 to 20. Not degraded=0, degraded=1.
Range error flags byte (20Hz)		
Time delay error flag	0	0-OK,1-parameter out of limits
Range error flag	1	0-OK,1-parameter out of limits
HTL discriminator output error flag	2	0-OK,1-parameter out of limits
HTL b Branch error flag	3	0-OK,1-parameter out of limits
Range blunder flag	4	0-OK,1-parameter out of limits
	Unused bits set to zero.	
Hs error flags byte (20Hz)		
Slope error flag	0	0-OK,1-parameter out of limits
Hs error flag	1	0-OK,1-parameter out of limits

STL discriminator output error flag	2	0-OK,1-parameter out of limits
Word	Bits	Explanation
Hs blunder flag	3 Unused bits set to zero.	0-OK,1-parameter out of limits
Sigma0 error flags byte (20Hz)		
AGC error flag	0	0-OK,1-parameter out of limits
Sigma0 error flag	1	0-OK,1-parameter out of limits
AGC discriminator output error flag	2	0-OK,1-parameter out of limits
Sigma0 blunder flag	3	0-OK,1-parameter out of limits
Noise floor estimate flag	4 Unused bits set to zero.	0-OK,1-parameter out of limits
Waveform error flags byte (20Hz)		
Waveform samples error flag	0	0-OK,1-parameter out of limits
Bin Gains error flag	1	0-OK,1-parameters out of limits
Waveform sum error flag	2 Unused bits set to zero.	0-OK,1-parameter out of limits
Waveform shape flags byte (20Hz)		
Peakiness flag	0	0-OK,1-non-ocean threshold exceeded
Multi-peaked flag	1	0-OK,1-waveform multipeaked
Strange-shape flag	2	0-OK,1-waveform has strange shape
Tracking error flag	3 Unused bits set to zero.	0-OK,1-tracking point out of limits
Location error flags byte(20Hz)		
Mispointing error flag	0	0-OK,1-parameter in error
Orbit degraded flag	1	0-OK,1-parameter in error
Waveform UT error flag	2	0-OK,1-parameter in error

Latitude error flag	3	0-OK,1-parameter in error
Longitude error flag	4	0-OK,1-parameter in error
Altitude error flag	5	0-OK,1-parameter in error
Attitude error flag	6	0-OK,1-parameter in error
	7	0-OK, 1-orbit data degraded due to orbit manoeuvre
	Unused bits set to zero.	

Word	Bits	Explanation
Range corrections error flags word (1Hz)		
Internal range correction error flag	0	0-OK,1-parameter out of limits
External range correction error flag	1	0-OK,1-parameter out of limits
Doppler range correction error flag	2	0-OK,1-parameter out of limits
Ionospheric correction error flag	3	0-OK,1-parameter out of limits
Dry tropo. range correction error flag	4	0-OK,1-parameter out of limits
Wet tropo. range corr. [GFA] error flag	5	0-OK,1-parameter out of limits
Spare bit	6	
Spare bit	7	
Wet tropo. range corr. [ATSR-M] error flag.	8	0-OK,1-parameter out of limits
Wet tropo. range corr. [SSM/I] error flag	9	0-OK,1-parameter out of limits
Wet tropo. range corr. [Rad Snd] error flag.	10	0-OK,1-parameter out of limits
Liquid water range correction error flag	11	0-OK,1-parameter out of limits
	Unused bits set to zero.	
Hs correction error flags byte (1Hz)		
Internal slope correction error flag	0	0-OK,1-parameter out of limits
External slope correction error flag	1	0-OK,1-parameter out of limits
	Unused bits set to zero.	
Sigma0 correction error flags byte (1Hz)		
AGC Internal correction error flag	0	0-OK,1-parameter out of limits
Sigma0 correction error flag	1	0-OK,1-parameter out of limits
Range so correction error flag	2	0-OK,1-parameter out of limits
Liquid water attenuation correction error flag	3	0-OK,1-parameter out of limits
	Unused bits set to zero.	

Word	Bits	Explanation
Auxiliary Data Limit Flags word (1Hz)		
Packet checksum error flag	0	0-OK,1-parameter out of limits
a HTL filter coefficient error flag	1	0-OK,1-parameter out of limits
b HTL filter coefficient error flag	2	0-OK,1-parameter out of limits
a STL filter coefficient error flag	3	0-OK,1-parameter out of limits
b STL filter coefficient error flag	4	0-OK,1-parameter out of limits
a AGC filter coefficient error flag	5	0-OK,1-parameter out of limits
b AGC filter coefficient error flag	6	0-OK,1-parameter out of limits
Power ref. value error flag	7	0-OK,1-parameter out of limits
Preset tracking duration error flag	8	0-OK,1-parameter out of limits
Preset time delay error flag	9	0-OK,1-parameter out of limits
Preset first derivative of time delay error flag	10	0-OK,1-parameter out of limits
Preset AGC error flag	11	0-OK,1-parameter out of limits
Preset slope error flag	12	0-OK,1-parameter out of limits
RX offset error flag	13	0-OK,1-parameter out of limits
	Unused bits set to zero.	
Atmospheric correction status word (1Hz)		
ATSR-M range correction present	0	0-no correction,1-correction present
SSM/I range correction present	1	0-no correction,1-correction present
Radio Sonde correction present	2	0-no correction,1-correction present
Liquid water correction present	3	0-no correction,1-correction present
PRARE present	4	0-no PRARE data 1-PRARE data used in ionospheric correction
Kp warning present	5	0-no Kp warning, 1-Kp warning present
Kp warning	6	0-Ionospheric delay correction ok 1-Iono. delay corr. probably incorrect due to turbulent ionosphere

Water Vapour Discrepancy Water Vapour 'possible feature'	7 8 Unused bits set to zero.	0= no discrepancy, 1= discrepancy 0= no feature, 1= feature present
Land/sea flags word(1Hz)	0 to 19 Unused bits set to zero.	Bits 0 to 19 correspond to science blocks 1 to 20. Sea=0, land=1.
Word	Bits	Explanation
Coastline flags word(1Hz)	0 to 19 Unused bits set to zero.	Bits 0 to 19 correspond to science blocks 1 to 20. Coastline=1, not coastline=0.
Possible sea-ice word(1Hz)	0 to 19 Unused bits set to zero.	Bits 0 to 19 correspond to science blocks 1 to 20. Possible sea ice=1 (Possible sea ice is defined as ocean data, as defined by land/sea word which is north of 50°N or south of 50°S.
Ocean/Ice mode flags word (1Hz)	0 to 19 Unused bits set to zero.	Bits 0 to 19 correspond to science blocks 1 to 20. Ocean mode = 1, Ice Mode = 0.
Update Status Word (1Hz)		
Merge precise orbit & attitude algorithm called	0	0=alg not called, 1=alg called
Merge spacecraft health algorithm called	1	0=alg not called, 1=alg called
Improved range correction algorithm called	2	0=alg not called, 1=alg called
Improved gain/sigma0 correction alg. called	3	0=alg not called, 1=alg called
Improved wet tropo. range correction alg. called	4	0=alg not called, 1=alg called
Liquid water correction algorithm called	5	0=alg not called, 1=alg called
Geoid algorithm called	6	0=alg not called, 1=alg called
Tide correction algorithm called	7	0=alg not called, 1=alg called
Ionospheric correction algorithm called	8	0=alg not called, 1=alg called

Dry Tropospheric Range correction alg. called	9	0=alg not called, 1=alg called
Wet Tropospheric Range correction alg. called	10	0=alg not called, 1=alg called
Merge FD Products algorithm called	11	0=alg not called, 1=alg called
Radiosonde Data Processing algorithm called	12	0=alg not called, 1=alg called
QC and compare values of int. water vap. alg called	13	0=alg not called, 1=alg called
Update Calibration Corrections algorithm called	14	0=alg not called, 1=alg called
	15	unset
Update spacecraft health data present	16	0=data absent,1=data present
Update internal range corrections data present	17	0=data absent,1=data present
Update external range corrections data present	18	0=data absent,1=data present
Update internal AGC corrections data present	19	0=data absent,1=data present
Update external sigma0 corrections data present	20	0=data absent,1=data present
Update bin gain corrections data present	21	0=data absent,1=data present
Update geoid data present	22	0=data absent,1=data present
Word	Bits	Explanation
Update tide data present	23	0=data absent,1=data present
Update Status Word ctd.		
Sunspot number data present	24	0=data absent,1=data present
Surface Pressure data present	25	0=data absent,1=data present
Surface Air Temperature data present	26	0=data absent,1=data present
GFA Integrated Water Vapour data present	27	0=data absent,1=data present
ALT FD Products data present	28	0=data absent,1=data present
	29-31	unset

Table 4 — Product Quality Summary Parameters

The following table provides an explanation of the parameters in the Product Quality Summary Record.

Counters	Incremented by 1 when condition below is satisfied
Source packet C	All source packets
Missing previous source packet C	Missing previous source packet flag set to true
Non-zero data degraded word source packet C	Any bit of Data Degraded word set to 1
Dummy source packet C	Bits 8 - 15 Packet ID set to 1
Source packet tracking on ocean C	Bit 8 Packet ID set to 1
Source packet tracking on ice C	Bit 9 Packet ID set to 1
Source packet acquisition ocean mode C	Bit 10 Packet ID set to 1
Source packet acquisition ice mode C	Bit 11 Packet ID set to 1
Source packet BITE mode C	Bit 12 Packet ID set to 1
Source packet closed-loop calibration C	Bit 13 Packet ID set to 1
Source packet RSS state on C	Bit 14 Packet ID set to 1
Source packet ground calibration C	Bit 15 Packet ID set to 1
Source packet with open loop ocean cal. C	Bit 8 Packet ID set to 1 and for 1st SB in the SP Bit 7 Mode identifier set to 1
Source packet with open loop ice cal. C	Tracking mode changes for next SP (i.e. Bit 8 Packet ID set to 1 for 1st SP and bit 9 Packet ID set to 1 for 2nd SP or vice versa)
Source packet with LOT assertion C	Bit 12 Mode identifier set to 1 for any SB in the SP
Source packet with LOT alarm C	Bit 13 Mode identifier set to 1 for any SB in the SP
Source packet preset tracking C	Bit 2 or 3 Mode identifier set to 1 for any SB in the SP
ATSR-M range correction present FC	Bit 0 of ACSW set to 1
Counters	Incremented by 1 when condition below is satisfied
SSM/I range correction present FC	Bit 1 of ACSW set to 1
Radio Sonde range correction present FC	Bit 2 of ACSW set to 1
Liquid water correction present FC	Bit 3 of ACSW set to 1
PRARE present FC	Bit 4 of ACSW set to 1
Kp warning present FC	Bit 5 of ACSW set to 1
PCD bytes EFC	Bit 0 or bit 1 of byte 3 PCD bytes set to 1
Alpha HTL filter EFC	Bit 1 ADLFH set to 1
Beta HTL filter EFC	Bit 2 ADLFH set to 1

Alpha STL filter EFC	Bit 3 ADLFH set to 1
Beta STL filter EFC	Bit 4 ADLFH set to 1
Alpha AGC filter EFC	Bit 5 ADLFH set to 1
Beta AGC filter EFC	Bit 6 ADLFH set to 1
Power reference EFC	Bit 7 ADLFH set to 1
Preset tracking duration EFC	Bit 8 ADLFH set to 1
Preset time delay EFC	Bit 9 ADLFH set to 1
Preset first deriv. of time delay EFC	Bit 10 ADLFH set to 1
Preset AGC EFC	Bit 11 ADLFH set to 1
Preset slope EFC	Bit 12 ADLFH set to 1
Rx offset EFC	Bit 13 ADLFH set to 1
Internal range correction EFC	Bit 0 RCEFW set to 1
External range correction EFC	Bit 1 RCEFW set to 1
Doppler range correction EFC	Bit 2 RCEFW set to 1
Ionospheric correction EFC	Bit 3 RCEFW set to 1
Kp warning FC	Bit 6 ACSH set to 1
Dry tropo. range correction EFC	Bit 4 RCEFW set to 1
Wet tropo. range corr. [GFA]EFC	Bit 5 RCEFW set to 1
Wet tropo. range corr. [ATSR-M] EFC	Bit 8 RCEFW set to 1
Wet tropo. range corr. [SSM/I] EFC	Bit 9 RCEFW set to 1
Wet tropo. range corr. Rad. Sond.] EFC	Bit 10 RCEFW set to 1
Liquid water range corr. EFC	Bit 11 RCEFW set to 1
Internal slope correction EFC	Bit 0 HCEFB set to 1
External Hs correction EFC	Bit 1 HCEFB set to 1
AGC Internal correction EFC	Bit 0 SCEFB set to 1
Sigma0 correction EFC	Bit 1 SCEFB set to 1
Range Sigma0 correction EFC	Bit 2 SCEFB set to 1
Liquid water attenuation correction EFC	Bit 3 SCEFB set to 1
Counters	Incremented by 1 when condition below is satisfied
Time delay EFC	Bit 0 REFB set to 1

Range EFC	Bit 1 REFB set to 1
HTL discr. EFC	Bit 2 REFB set to 1
HTL beta branch EFC	Bit 3 REFB set to 1
Range blunder point FC	Bit 4 REFB set to 1
Slope EFC	Bit 0 HEFB set to 1
Hs EFC	Bit 1 HEFB set to 1
STL discr. EFC	Bit 2 HEFB set to 1
Hs blunder point FC	Bit 3 HEFB set to 1
AGC EFC	Bit 0 SEFB set to 1
Sigma0 EFC	Bit 1 SEFB set to 1
AGC discr. EFC	Bit 2 SEFB set to 1
Sigma0 blunder point FC	Bit 3 SEFB set to 1
Waveform samples EFC	Bit 0 WEFB set to 1
Bin gains EFC	Bit 1 WEFB set to 1
Waveform sum EFC	Bit 2 WEFB set to 1
Mispointing EFC	Bit 0 LEFB set to 1
Orbit degraded FC	Bit 1 LEFB set to 1
Waveform UT EFC	Bit 2 LEFB set to 1
Latitude EFC	Bit 3 LEFB set to 1
Longitude EFC	Bit 4 LEFB set to 1
Altitude EFC	Bit 5 LEFB set to 1
Attitude EFC	Bit 6 LEFB set to 1
Peakiness FC	Bit 0 WSFB set to 1
Multi-peaked FC	Bit 1 WSFB set to 1
Strange-shape FC	Bit 2 WSFB set to 1
Tracking EFC	Bit 3 WSFB set to 1

Summary Flags	Set to TRUE when condition below is satisfied

Total SF	Any SF set to true
Packet checksum ESF	PCD bytes EFCP exceeds packet checksum EFST
Alpha HTL filter ESF	Alpha HTL filter EFCP exceeds alpha HTL filter EFST
Beta HTL filter ESF	Beta HTL filter EFCP exceeds beta HTL filter EFST
Alpha STL filter ESF	Alpha STL filter EFCP exceeds alpha STL filter EFST
Summary Flags	Set to TRUE when condition below is satisfied
Beta STL filter ESF	Beta STL filter EFCP exceeds beta STL filter EFST
alpha AGC filter ESF	alpha AGC filter EFCP exceeds alpha AGC filter EFST
beta AGC filter ESF	beta AGC filter EFCP exceeds beta AGC filter EFST
Power reference ESF	Power reference EFCP exceeds Power reference EFST
Preset tracking duration ESF	Preset tracking duration EFCP exceeds Preset tracking duration EFST
Preset time delay ESF	Preset time delay EFCP exceeds Preset time delay EFST
Preset first deriv. of time delay ESF	Preset first deriv. of time delay EFCP exceeds Preset SF first deriv. of time delay EFST
Preset AGC ESF	Preset AGC EFCP exceeds Preset AGC EFST
Preset slope ESF	Preset slope EFCP exceeds Preset slope EFST
Rx offset ESF	Rx offset EFCP exceeds Rx offset EFST
Internal range correction ESF	Internal range correction EFCP exceeds Internal range correction EFST
External range correction ESF	External range correction EFCP exceeds External range correction EFST
Doppler range correction ESF	Doppler range correction EFCP exceeds Doppler range correction EFST
Ionospheric correction ESF	Ionospheric correction EFCP exceeds Ionospheric range correction EFST
Kp warning SF	Kp warning FCP exceeds Kp warning FST
Dry tropo. range correction ESF	Dry tropo. range correction EFCP exceeds Dry tropo. range correction EFST
Wet tropo. range corr. [GFA] ESF	Wet tropo. range corr. [GFA] EFCP exceeds Wet SF tropo. range corr. [GFA] EFST
Wet tropo. range corr. [ATSR-M] ESF	Wet tropo. range corr. [ATSR-M] EFCP exceeds Wet SF tropo. range corr. [ATSR-M] EFST
Wet tropo. range corr. [SSM/I] ESF	Wet tropo. range corr. [SSM/I] EFCP exceeds Wet SF tropo. range corr. [SSM/I] EFST
Wet tropo. range corr. [Rad. Snd.] ESF	Wet tropo. range corr. [Rad. Snd.] EFCP exceeds Wet SF tropo. range corr. [Rad. Snd.] EFST
Liquid water range corr. ESF	Liquid water range corr. EFCP exceeds Liquid water SF range corr. EFST
Internal slope correction ESF	Internal slope correction EFCP exceeds Internal slope correction EFST
External Hs correction ESF	External Hs correction EFCP exceeds External Hs correction EFST
AGC Internal correction ESF	AGC Internal correction EFCP exceeds AGC Internal correction EFST

Sigma0 correction ESF	Sigma0 correction EFCP exceeds Sigma0 correction EFST
Range Sigma0 correction ESF	Range Sigma0 correction EFCP exceeds Range Sigma0 correction EFST
Liquid water attenuation corr. ESF	Liquid water att. correction EFCP exceeds Liquid SF water attenuation correction EFST
Time delay ESF	Time delay EFCP exceeds Time delay EFST
Range ESF	Range EFCP exceeds Range EFST
HTL discr. ESF	HTL discr. EFCP exceeds HTL discr. EFST
HTL beta branch ESF	HTL beta branch EFCP exceeds HTL beta branch EFST
Range blunder point SF	Range blunder point FCP exceeds Range blunder point FST
Slope ESF	Slope EFCP exceeds Slope EFST
Hs ESF	Hs EFCP exceeds Hs EFST
STL discr. ESF	STL discr. EFCP exceeds STL discr. EFST
Hs blunder point SF	Hs blunder point FCP exceeds Hs blunder point FST
Summary Flags	Set to TRUE when condition below is satisfied
AGC ESF	AGC EFCP exceeds AGC EFST
Sigma0 ESF	Sigma0 EFCP exceeds Sigma0 EFST
AGC discr. ESF	AGC discr. EFCP exceeds AGC discr. EFST
Sigma0 blunder point SF	Sigma0 blunder point FCP exceeds Sigma0 blunder point FST
Waveform samples ESF	Waveform samples EFCP exceeds Waveform samples EFST
Bin gains ESF	Bin gains EFCP exceeds Bin gains EFST
Waveform sum ESF	Waveform sum EFCP exceeds Waveform sum EFST
Mispointing ESF	Mispointing EFCP exceeds Mispointing EFST
Orbit degraded SF	Orbit degraded FCP exceeds Orbit degraded FST
Waveform UT ESF	Waveform UT EFCP exceeds Waveform UT EFST
Latitude ESF	Latitude EFCP exceeds Latitude EFST
Longitude ESF	Longitude EFCP exceeds Longitude EFST
Altitude ESF	Altitude EFCP exceeds Altitude EFST
Attitude ESF	Attitude EFCP exceeds Attitude EFST

N.B. where

parameter error flag count percentage = (parameter error flag count / source packet count) * 100
parameter flag count percentage = (parameter flag count / source packet count)* 100

4 Additional Information

This section contains the ALT.WAP Health Warning, DC-HW-NRL-SE-0001. Each warning has a code, HW#, and a revision number which can be updated to reflect a change of state of the warning. As these problems are fixed the health warning will be updated to reflect this.

The version numbers for the ALT.WAP products can be used to indicate which products are affected by which warnings.

4.1 ALT.WAP Health Warning DC-HW-NRL-SE-0001

Issue 6.0 - 18th May 1995

This Health Warning describes known faults and problems in UK-PAF ALT.WAP products processed to date. It is based on the UK-PAF documents PF-RP-PST-CV-0001, UK-PAF Product Verification Report, Altimeter Waveform Foundation Product and DC-RP-NRL-AW-0001, UK-PAF Verification Report, Altimeter Waveform Product. Copies of these reports can be obtained on application to ESRIN.

All known errors in the resultant ALT.WAP products are described below, along with procedures to correct them where possible.

HW1 rev 2.0 — WAP Version 1.0

Waveform sample sequence

Due to a software bug, the waveform samples in ocean tracking mode source packets are out of order, and sample 29 is invalid (N.B. ice mode tracking and ocean and ice mode open loop calibration source packets are not affected). Please be warned that this is in fact not the same problem as was reported for the initial batches of WDRs sent to Principal Investigators, i.e. the problem was the shift to the right of 4 waveform samples resulting in a wraparound of samples from the end to the beginning of the source packet.

Solution

Copy samples 0-28 to 1-29. Zero-fill or ignore sample 0, effectively resulting in a 63 bin waveform. (This sample forms part of the "wraparound" due to aliasing during on-board processing, and is not of primary importance.)

***** IMPORTANT *****

This problem has been fixed for the later products in this batch. All products manually labelled V1.1 do not exhibit this problem.

HW2 rev 2.2 — WAP Versions 1.0, 1.1 & 1.2

Doppler range correction

This is currently erroneously set to 0 in the WDR. This problem has been corrected in WAP version 2.0.

Solution

The Doppler correction, DH_d (m) can be easily derived by using the following equation:

$$DH_d = t \times T_p \times \frac{h_2 - h_1}{t_2 - t_1} \times f_0$$

where t = nominal compressed pulse length = 2.96ns (OCEAN) or 11.93ns (ICE)
T_p = chirp duration = 20.4 µs (OCEAN) or 20.39µs (ICE)
h_1 / h_2 = altitude of first (frame number = 0) and second (frame number = 1) science blocks respectively
t_1 / t_2 = UTCs of first and second science blocks respectively
f_0 = altimeter centre frequency = 13.7994 GHz

HW3 rev 1.2 — WAP Versions 1.0, 1.1 & 1.2

Yaw, Pitch & Roll

These parameters are currently calculated using a model and though they are non-zero the contents should effectively be treated as spares. ESA state that ERS-1 does not suffer from detectable mispointing, and that attitude figures remain within specification.

The roll, pitch and yaw are set to zero from WAP version 2.0.

HW4 rev 1.2 — WAP Versions 1.0, 1.1, 1.2 & 2.0

Product sequencing

Due to teething problems with the ESA data transcription facility at Fucino, and to the lack of large data sorting facilities at the UK-PAF, orbit products on Exabytes should not be assumed sequential or consecutive. Although this problem has been greatly reduced since generation of the prototype WDR distribution, users should not assume perfect time ordering.

HW5 rev 1.3 — WAP Versions 1.0, 1.1, 1.2, 2.0, 2.1 & 3.0

Data time ordering

Again, due to problems with raw data transcription, small jumps in both directions may be observed, and some data segments may be duplicated. This is not of great consequence to users, except where global or regional statistics are being calculated.

HW6 rev 1.2 — WAP Versions 1.0, 1.1 & 1.2

Data jitter

A jitter, or quantisation, of the order to a few milliseconds has been observed in the product UTC. It is believed that this is due to truncations in the handling of the raw satellite binary time words.

This problem has been corrected in WAP version 2.0.

HW7 rev 1.2 — WAP Versions 1.0, 1.1 & 1.2

Source Packet Centre UTC and Source Packet UTC

The Source Packet UTC is defined as the ground strike time of pulse 37 within the 50 averaged pulses making up waveform 0 in the source packet. The Source Packet Centre UTC corresponds to the same ground strike but for waveform 10. This specification is slightly incorrect, as the reference should be to pulse 34. In addition, the range value was erroneously subtracted from the correction rather than added to it.

This problem has been corrected in WAP version 2.0.

Solution

The Waveform UTCs, TW, should be calculated using the following equation:

$TW = TS + \{(N \times 50/PRF + 34/PRF) + range/c\} / 86400$

where TS = Source Packet UTC
PRF = Pulse Repetition Frequency = 1019.991843 Hz
range = range for science block
N = frame number
c = speed of light = 299792458.0 ms^{-1}

Therefore the Source Packet and Source Packet Centre UTCs can be corrected in the following manner:

Corrected UTC = Old UTC + {-3/PRF + 2*range/speed of light}/86400

HW8 rev 1.2 — WAP Versions 1.0, 1.1 & 1.2

Geoid Elevation

The geoid correction is seen to display a significant jitter, apparently as a consequence of inappropriate interpolation. The jitter is of the order of magnitude of 1m.

This problem has been corrected in WAP version 2.0.

Solution

Users requiring orthometric heights should apply independent geoid elevation corrections until this problem is fixed. The reference ellipsoid used for ALT.WAP products is WGS84.

HW9 rev 1.2 — WAP Versions 1.0, 1.1 & 1.2

Sigma0 correction flags

In WAP products used for verification, the Sigma0 error flag was seen to be set for the whole orbit, even when the parameter was in range.

This problem has been corrected in WAP version 2.0.

HW10 rev 1.2 — WAP Versions 1.0, 1.1 & 1.2

Atmospheric corrections at 180 degrees Longitude.

Atmospheric corrections derived from ECMWF models appear to be incorrect for cells bordering on 180^{o} longitude. It is believed that this is due to an error in interpolation which is being investigated.

This problem has been corrected in WAP version 2.0.

Solution

Either use corrections from other sources (Radiosonde, ATSR/M, SSMI) provided in the product, or use values from adjacent cells. Cell size is 1.5 x 1.5 degrees.

HW11 rev 1.2 — WAP Versions 1.0, 1.1 & 1.2

Internal calibration corrections

For a number of reasons internal calibration correction processing is under revision. For an interim period, corrections are only interpolated from calibrations using ocean mode chirps. Corrections given are only valid for ocean mode data.

This problem has been corrected in WAP version 2.0.

HW12 rev 1.0 — WAP Versions 1.0 & 1.1

Internal range correction Modifications 1

An error has been found in the range computed in the Improved Range Correction algorithm (ALT.1.A520).

Solution

The error can be corrected by applying the following equations:-

Correct range = uncorrected range -2 (RCI_N - RCI_O)

Where RCI_O and RCI_N refer to old and new internal range corrections respectively and RCI_O = 4676.76 metres.

The "new" internal range correction (RCI_N) is that given in the ALT.WAP product and averages about 4680.37 for ocean mode.

HW13 rev 1.2, WAP Versions 1.0, 1.1 & 1.2

Internal range correction Modifications 2

In current ALT.WAP products the Internal Range Correction (supplied in mm) is currently only valid for Ocean Mode.

The value contained in the WAP is calculated form Open Loop Calibration records using the Ocean Chirp. Ice Mode data requires an Internal Range Correction derived from Open Loop Calibration records using the Ice Chirp. An empirical study of the relationship between the two types of Open Loop calibration has identified how the Ice Mode corrections can be derived from the Ocean Mode corrections.

This problem has been corrected in WAP version 2.0.

Solution

The Internal Range Correction for Ice Mode data can be calculated using two methods. The second method, being more accurate, is recommended.

a) Add 118mm to the value contained in the WAP product, this is accurate to ±16mm.

$\text{Internal Range Correction}_{(ice)} = \text{Internal Range Correction}_{(ocean)} + 118$

b) Multiply the value contained in the WAP product value by 1.5414211 and subtract 2533937 (mm). This method is accurate to 7mm.

Internal Range Correction$_{(ice)}$ = (Internal Range Correction$_{(ocean)}$ * 1.5414211) -2533937.

HW14 rev 1.0, WAP Versions 1.0, 1.1 & 1.2

Significant Waveheight

Due to a problem with the correct definition of an altimeter constant the calculation of significant waveheight is in error to the order of 45cm.

Solution

The correct value of H_s can be calculated using the following equation:

$$H_s = 4 \times \{(K_1/S')^2 - K_2\}^{1/2} + \Delta Se$$

where H_s = significant waveheight
K_2= instrument dependent constant = 0.084
S' = corrected slope
ΔSe = external H_s correction
K_1= c x FBS x P_{ref} / (2x v2 x T_z)
where FBS = filter bin spacing in seconds = 3.024e-9
P_{ref} = power reference value
Tz = instrumental constant = 1.035

HW15 rev 1.0, WAP Versions 1.0, 1.1, 1.2, 2.0 & 2.1

Orbital Height/Altitude

The orbital height of the satellite (altitude) is currently referenced to an incorrect reference ellipsoid.

Solution

A constant offset of 7 metres should be **added** to the altitude value:

Corrected_altitude(metres) = WAP_Altitude(metres) + 7

HW16 rev 1.0, WAP Versions 1.0, 1.1, 1.2, 2.0 & 2.1

Tropospheric Corrections

The Dry Tropospheric Range Correction and Wet Tropospheric Range Correction GFA in the early versions of the product are erroneous and should not be used.

Solution

Replace the corrections with data from an alternative source.

HW17 rev 1.0, WAP Versions 1.0, 1.1, 1.2, 2.0, 2.1, 3.0, 3.1

OAT Handling Update

Altitude excursions found across Precise Orbit file boundaries have been found

Solution

Changes made to OAT routines to handle consecutive precise orbit files having identical end and start reference times.

HW18 rev 1.0 WAP Version 4.0

Linux Port

The Altimeter processing chain has now been ported from SUN Sparc architecture to intel based architecture running Redhat Linux. This was a straight porting and as such no changes have been made to the WAP product.

HW19 rev 1.0 WAP Version 4.1

Errors have been found in some of the Internal Range Correction values within the ALT WAP product.

An investigation of all associated code has been performed and the problem has been traced back to the Time Delay Correction (TDC) field in the interim P200 product used as input during WAP production. The investigation showed that the manifestation of the error was due to the way that the Intel platforms read and store floating point type variables. After Byte swapping the stored result of some values was found to no longer represent a valid floating point number, instead the variable was designated “Not a Number”, floating point operations on these stored values were causing exceptions to be raised.

Two types of errors required to be corrected. Firstly where values were swapped and output to a file and secondly where swapped values are read from file and used within the software.

Solution

To correct the output errors each instance of identified code was modified to byte swap calculated values directly into an output character array.

To correct the input errors, where swapped values are read from file and need to be swapped back into the correct byte order, the code was modified to read the value directly into a character array and then byte swapped into a floating point variable.

4.2 ALT.WAP Product Version Labelling

This section has been inserted to explain how the ALT.WAP Product Version can be deduced from information provided in the CEOS headers. There has been some confusion on this issue and so it is clarified here.

All version numbers which can be found in the CEOS headers apart from the one described below (field 47) relate only to the software which is used to convert the WAP products from the internal UK-PAF format into CEOS.

The exception to this is field 47, Processing Version code, of the Dataset Summary Record, this contains the ALT.WAP version number and takes the form VX.X., e.g. V3.0.

This information should be used in conjunction with the health warnings, all the corrections detailed in the health warnings which apply to the version given in this field should be applied to the data before they are used.

Only products from Phases A and B and cycle 91 onwards, i.e. ALT.WAP version 1.2 or higher have this field filled in this manner. ALT.WAP version 1.1 products are manually labelled with this information.

ANNEX A ALT.WAP CEOS FORMAT

Tape Structure

Volume Directory File	Volume Descriptor Record
	WAP Leader File Pointer Record
	WAP Data File Pointer Record
	Text Record
WAP Leader File	WAP Leader File Descriptor Record
	WAP Data Set Summary Record
	EODC Product Quality Summary Record
	Instrument Characteristics Record
WAP Data File	WAP Data File Descriptor Record
	WAP Processed Data Record
Null Volume Directory File	Volume Descriptor Record

Format	Meaning	Example
A	field contains ASCII characters	$$$ERS-1
B	field contains unformatted binary integer	Represented numerically e.g 256
D	Field contains formatted (ASCII) double precision floating point number	45.88888888888888888
F	Field contains formatted (ASCII) floating point number	27.678
I	Field contains formatted (ASCII) integer	256

The $ symbol indicates the presence of an ASCII character, or an ASCII blank.
The brackets <TBD>, or<nnnn> etc around a quantity indicate the entry is variable or likely to change (i.e. with product, time, processing etc).
The absence of the brackets indicate that the entered value is constant and unlikely to change.

Volume Directory File
Volume Descriptor Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		
1	1	4	B4	Record Sequence Number	1	M
2	5		B1	File Code (CEOS defn)	192	M
3	6		B1	Record Code (CEOS defn)	192	M
4	7		B1	Mission Code (CEOS defn)	18	M
5	8		B1	Origin Code (CEOS defn)	18	M
6	9	12	B4	Length of this record	360	M
7	13	14	A2	ASCII/EBCDIC Flag	A$	M
8	15	16	A2	Reserved	$$	M
	17	44		Volume Documentation Segment		
9	17	28	A12	Superstructure control document number	<volume.set.id>	M
10	29	30	A2	Superstructure control document revision number	$A	M
11	31	32	A2	Superstructure record format revision letter <XX> Initially '$A', next '$B' etc	$A	M
12	33	44	A12	Software release number	<software.id>	M
	45	360		Volume Identification Segment		
13	45	60	A16	Identifier of logical volume containing this volume descriptor	<physical.tape.id>	M
14	61	76	A16	Logical Volume ID	<logical.tape.id>	M
15	77	92	A16	Volume Set ID	<volume.set.id>	M

16	93	94	I2	Number of Physical Volumes in Set	$1	M
17	95	96	I2	Physical Volume No - Start of Logical Volume	$1	M
18	97	98	I2	Physical Volume No - End of Logical Volume	$1	M
19	99	100	I2	Physical Volume Sequence No (of current tape)	$1	M
20	101	104	I4	First Referenced File Number in this Physical Volume	$$$1	M
21	105	108	I4	Logical Volume Number within Volume Set	$$$1	M
22	109	112	I4	Logical Volume Number within Physical Volume	$$$1	M
23	113	120	A8	Logical Volume Creation Date <YYYYMMDD>	<YYYYMMDD>	M
24	121	128	A8	Logical Volume Creation Time <HHMMSSXX> XX = centi-seconds	<HHMMSSXX>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
25	129	140	A12	Logical Volume Generating Country	$$$$$$$$$$UK	M
26	141	148	A8	Logical Volume Generating Agency	$$$$$ESA	M
27	149	160	A12	Logical Volume Generating Facility	$$$$$$UK-PAF	M
28	161	164	I4	Number of Pointer Records in Volume Directory	$$$2	M
29	165	168	I4	Number of Records in Volume Directory	$$$4	M
30	169	172	I4	Number of Logical Volumes on this Physical Volume	<nnnn>	M
31	173	260	A88	Volume Descriptor Spare Segment	Blanks	M
32	261	360	A100	Local Use Segment	Blanks	M

Volume Directory File
WAP Leader File Pointer Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		
1	1	4	B4	Record Sequence Number	2	M
2	5		B1	File Code (CEOS defn)	219	M
3	6		B1	Record Code (CEOS defn)	192	M
4	7		B1	Mission Code (CEOS defn)	18	M
5	8		B1	Origin Code (CEOS defn)	18	M
6	9	12	B4	Length of this record	360	M
7	13	14	A2	ASCII/EBCDIC Flag	A$	M
8	15	16	A2	Reserved	$$	M
	17	360		File Identification Segment		
9	17	20	I4	Referenced File Number	$$$1	M
10	21	36	A16	Referenced File Name (where n is either 1 or 2)	ERSn.ALT.WAPALTL	M
11	37	64	A28	Referenced File Class	ALT$LEADER$FILE$...$	M
12	65	68	A4	Referenced File Class Code	ALTL	M
13	69	96	A28	Referenced File Data Type	MIXED$BINARY$AND$ASCII$...$	M
14	97	100	A4	Referenced File Data Type Code	MBAA	M
15	101	108	I8	Number of Records in Referenced File	<TBD>	M
16	109	116	I8	Referenced File - Descriptor Record Length	$$$$$512	M
17	117	124	I8	Referenced File Maximum Record Length	<nnnnnnnn>	M
18	125	136	A12	Referenced File Record Length Type	VARIABLE$LENGTH	M

19	137	140	A4	Referenced File Record Length Type Code	VARE	M
20	141	142	I2	Referenced File Physical Volume Number, Start of File	<nn>	M
21	143	144	I2	Referenced File Physical Volume Number, End of File	<nn>	M
22	145	152	I8	Referenced File Portion, 1st record number for this Physical Volume	<nnnnnnnn>	M
23	153	160	I8	Referenced File Portion, last record number for this Physical Volume	<nnnnnnnn>	M
24	161	260	A100	Pointer Record Spare Segment - Blanks	Blanks	M
25	261	360	A100	Local Use Segment - Blanks	Blanks	M

Volume Directory File
WAP Data File Pointer Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		
1	1	4	B4	Record Sequence Number	3	M
2	5		B1	File Code (CEOS defn)	219	M
3	6		B1	Record Code (CEOS defn)	192	M
4	7		B1	Mission Code (CEOS defn)	18	M
5	8		B1	Origin Code (CEOS defn)	18	M
6	9	12	B4	Length of this record	360	M
7	13	14	A2	ASCII/EBCDIC Flag	A$	M
8	15	16	A2	Reserved	$$	M
	17	360		File Identification Segment		
9	17	20	I4	Referenced File Number	$$$2	M
10	21	36	A16	Referenced File Name (where n is either 1 or 2)	ERSn.ALT.WAPDTOPM	
11	37	64	A28	Referenced File Class	DATA$OPTIONS$FILE$...$	M
12	65	68	A4	Referenced File Class Code	DTOP	M
13	69	96	A28	Referenced File Data Type	<TBD>	M
14	97	100	A4	Referenced File Data Type Code	<TBD>	M
15	101	108	I8	Number of Records in Referenced File	<TBD>	M
16	109	116	I8	Referenced File - Descriptor Record Length	<TBD>	M
17	117	124	I8	Referenced File Maximum Record Length	<TBD>	M
18	125	136	A12	Referenced File Record Length Type	FIXED$LENGTH	M

19	137	140	A4	Referenced File Record Length Type Code	FIXD	M
20	141	142	I2	Referenced File Physical Volume Number, Start of File	$1	M
21	143	144	I2	Referenced File Physical Volume Number, End of File	$1	M
22	145	152	I8	Referenced File Portion, 1st record number for this Physical Volume	$$$$$$$1	M
23	153	160	I8	Referenced File Portion, last record number for this Physical Volume	<nnnnnnnn>	M
24	161	260	A100	Pointer Record Spare Segment - Blanks	Blanks	M
25	261	360	A100	Local Use Segment - Blanks	Blanks	M

Volume Directory File
Text Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		
1	1	4	B4	Record Sequence Number	4	M
2	5		B1	File Code (CEOS defn)	18	M
3	6		B1	Record Code (CEOS defn)	63	M
4	7		B1	Mission Code (CEOS defn)	18	M
5	8		B1	Origin Code (CEOS defn)	18	M
6	9	12	B4	Length of this record	360	M
7	13	14	A2	ASCII/EBCDIC Flag	A$	M
8	15	16	A2	Continuation Flag	$$ unless continuation, then C$	M
	17	360		Product Identification Segment		
9	17	48	A32	Product Identification Segment	<PRODUCT:logical.set.id.UK-PAF$...$>	M

10	49	106	A58	Location, date and time of product generation		
					PROCESS.UK.ESA.UKPAF<YYYYMMDDHHMMSSDD>$...$	M
11	107	146	A40	Physical Volume Identification		
					TAPE$ID:xxxxxxxxxxxxxxxx,$TAPE$<nn>$OF$<nn>$	M
				where xxx... is the physical id - field 13 of volume descriptor record		
12	147	360		Reserved	Blanks	M

WAP Leader File
WAP Leader File Descriptor Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		
1	1	4	B4	Record Sequence Number	1	M
2	5		B1	File Code (CEOS defn)	63	M
3	6		B1	Record Code (CEOS defn)	192	M
4	7		B1	Mission Code (CEOS defn)	18	M
5	8		B1	Origin Code (CEOS defn)	18	M
6	9	12	B4	Length of this record	512	M
7	13	14	A2	ASCII/EBCDIC Flag	A$	M
8	15	16	A2	Reserved	$$	M
	17	180		File Descriptor Record Fixed Segment		
9	17	28	A12	Control Document Number for this Data File Format	<TBD>	M
10	29	30	A2	Control Document Revision Number	$A	M
11	31	32	A2	File Design Descriptor Revision Letter	$A	M
12	33	44	A12	Software Release Number	<software.id>	M
13	45	48	I4	File Number	$$$1	M
14	49	64	A16	File Name (where n is either 1 or 2)	ERSn.ALT.WAPALTL	M
15	65	68	A4	Record Sequence and Location Type Flag	FSEQ	M
16	69	76	I8	Sequence Number Location	$$$$$$$1	M
17	77	80	I4	Sequence Number Field Length	$$$4	M

18	81	84	A4	Record Code and Location Type Flag	FTYP	M
19	85	92	I8	Record Code Location	$$$$$$$5	M
20	93	96	I4	Record Code Field Length	$$$4	M
21	97	100	A4	Record Length and Location Type Flag	FLGT	M
22	101	108	I8	Record Length Location	$$$$$$$9	M
23	109	112	I4	Record Length Field Length	$$$4	M
24	113		A1	Reserved	Blanks	M
25	114		A1	Reserved	Blanks	M
26	115		A1	Reserved	Blanks	M

Field name	**Start byte**	**Last byte**	**Format**	**Description**	**Content**	**Compliancy**
27	116		A1	Reserved	Blanks	M
28	117	180	A64	Reserved Segment	Blanks	M
	181	512		File Descriptor Record Variable Segment		
29	181	360	A180	Reserved for use by F-PAF (Fields 29 to 47)	Blanks	M
48	361	366	I6	Number of ALT Data Set Summary Records	$$$$$1	M
49	367	372	I6	ALT Data Set Summary Record Length	$$1800	M
50	373	390	I18	Reserved	Blanks	M
51	391	396	I6	Reserved	$$$$$0	M
52	397	402	I6	Reserved	$$1800	M
53	403	408	I6	Reserved	$$$$$0	M
54	409	414	I6	Reserved	$$8000	M
55	415	426	I12	Reserved	Blanks	M
56	427	438	I12	Reserved	Blanks	M
57	439	450	I12	Reserved	Blanks	M

58	451	462	I12	Reserved	Blanks	M
59	463	474	I12	Reserved	Blanks	M
60	475	480	I6	Number of EODC Product Quality Summary Records	$$$$$1	M
61	481	486	I6	EODC Product Quality Summary Record Length	$$$406	M
62	487	492	I6	Number of Instrument Characteristics Records	$$$$$1	M
63	493	498	I6	Instrument Characteristics Record Length	$$$768	M
64	499	512	A14	Reserved	Blanks	M

WAP Leader File
WAP Data Set Summary Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	20		Record Identification Segment		
1	1	4	B4	Record Sequence Number	2	M
2	5		B1	File Code (CEOS defn)	10	M
3	6		B1	Record Code (CEOS defn)	20	M
4	7		B1	Mission Code (CEOS defn)	18	M
5	8		B1	Origin Code (CEOS defn)	18	M
6	9	12	B4	Length of this record	1800	M
7	13	16	I4	Data Set Summary Record Sequence Number	$$$1	M

8	17	20	I4	ALT Channel Indicator	$$$$	M
	21	372		Pass Parameters		
9	21	36	A16	Pass Identification	<TBD>	M
10	37	68	A32	Pass Designator	<TBD>	M
11	69	100	A32	Pass Start Time <YYYYMMDDHHMMSSmmm+15blanks>	<TBD>	M
12	101	132	A32	Pass End Time <YYYYMMDDHHMMSSmmm+15blanks>	<TBD>	M
13	133	148	F16.7	Pass Start Latitude in degrees	<TBD>	M
14	149	164	F16.7	Pass Start Longitude in degrees	<TBD>	M
15	165	180	F16.7	Pass End Latitude in degrees	<TBD>	M
16	181	196	F16.7	Pass End Longitude in degrees	<TBD>	M
17	197	212	A16	Ellipsoid Designator	<TBD>	M
18	213	228	F16.7	Ellipsoid Semi-Major Axis (Re)	$$$$6378.1440000	M
19	229	244	F16.7	Ellipsoid Semi-Minor Axis	$$$$6356.6200000	M
20	245	260	F16.7	Earth Mass (M)	Blanks	M
21	261	276	F16.7	Gravitational Constant (G)	Blanks	M
22	277	292	F16.7	Ellipsoid J2 Parameter	Blanks	M
23	293	308	F16.7	Ellipsoid J3 Parameter	Blanks	M
24	309	324	F16.7	Ellipsoid J4 Parameter	Blanks	M
25	325	332	A8	Reserved	Blanks	M
26	333	348	F16.7	Pass Length (Km)	<TBD>	M
27	349	372	A24	Reserved	Blanks	M

Field name	**Start byte**	**Last byte**	**Format**	**Description**	**Content**	**Compliancy**
	373	608		General Mission/Sensor Parameters		

28	373	376	I4	No. of ALT Channels	$$$1	M
29	377	392	A16	Sensor Platform Mission Identifier	ERS-N$$$$$$$$$$	M
30	393	416	A24	Sensor and Mode of Operation for this Channel <AAAAAABBCC$$…$$> with AAAAAA = Sensor ID (ERS-n ALT) BB = ALT band CC = resolution mode code	ERS-n$<etc>	M
31	417	424	A8	Orbit Number	<TBD>	M
32	425	440	A16	Spare	Blanks	M
33	441	456	F16.7	Radar Wavelength (metres)	0.0217400	M
34	457	472	A16	Motion Compensation Indicator 00 = no compensation 01 = on board compensation 0 = in processor compensation	$$$$$$$$$$$$$$00	M
35	473	488	A16	Transmitted pulse code specifier (e.g. Linear FM modulated chirp, etc)	LINEARFMCHIRP$	M
36	489	504	F16.7	Transmitted Pulse Coefficient 1 (Chirp = range chirp constant term (offset from DC) (Hz))	<TBD>	M
37	505	520	F16.7	Transmitted Pulse Coefficient 2 (Chirp = range chirp linear term (Hz/sec)	<TBD>	M
38	521	536	F16.7	Sampling Rate in Hz	<TBD>	M
39	537	552	F16.7	Transmitted Pulse Length (microseconds)	20.0000000	M
40	553	560	I8	Quantization in bits per channel	$$$$$$$5	M
41	561	572	A12	Quantizer descriptor (i.e. uniform, I,Q etc)	UNIFORM$$$$$	M
42	573	576	A4	Echo Tracker on/off designator ($$ON/$OFF)	<TBD>	M
43	577	592	F16.7	Nominal PRF (Hz)	1020.0000000	M
44	593	608	F16.7	Antenna 3dB Beamwidth (degrees)	1.3400000	M
	609	EOR		General Processing Parameters		
45	609	624	A16	Processing Facility Identifier	<TBD>	M
46	625	632	A8	Processing System Identifier	<TBD>	M

47	633	640	A8	Processing Version Codes (WAP Product Version)	<TBD>	M
48	641	656	A16	Processing Facility Process Code	<TBD>	M
49	657	672	A16	Product Level Code	<TBD>	M
50	673	704	A32	Product Type Specifier	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
51	705	736	A32	Processing Algorithm Identifier	<TBD>	M
52	737	740	I4	Data Averaging Factor	$$$$	M
53	741	772	A32	Retracking Pulse Model Designator	<TBD>	M
54	773	804	A32	Tracker Type	<TBD>	M
55	805	820	F16.7	Nominal Sampling Time Interval in nsec	<TBD>	M
56	821	828	I8	Number of Tracker Parameters	<TBD>	M
57	829	844	F16.7	First Tracker Parameter	<TBD>	M
58	845	860	F16.7	Rest of the Tracker Parameters	<TBD>	M
59	861	1800	A940	Spare	Blanks	M

WAP Data Leader File
EODC Product Quality Summary Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		
1	1	4	B4	Record Sequence Number	3	M
2	5		B1	File Code (CEOS defn)	10	M
3	6		B1	Record Code (CEOS defn)	22	M
4	7		B1	Mission Code (CEOS defn)	36	M
5	8		B1	Origin Code (CEOS defn)	50	M
6	9	12	B4	Length of this record	406	M
7	13	16	I4	Product Quality Summary Record Sequence Number	$$$1	M
	17	406		Quality Parameters		
8	17	20	B4	Orbit number	<TBD>	M
9	21	22	B2	Source packet count	<TBD>	M
10	23	24	B2	Missing previous source packet count	<TBD>	M
11	25	26	B2	Non-zero data degraded word source packet count	<TBD>	M
12	27	28	B2	Dummy source packet count	<TBD>	M
13	29	30	B2	Source packet tracking on ocean count	<TBD>	M
14	31	32	B2	Source packet tracking on ice count	<TBD>	M
15	33	34	B2	Source packet acquisition ocean mode count	<TBD>	M
16	35	36	B2	Source packet acquisition ice mode count	<TBD>	M
17	37	38	B2	Source packet BITE mode count	<TBD>	M
18	39	40	B2	Source packet closed-loop calibration count	<TBD>	M

19	41	42	B2	Source packet RSS state on count	<TBD>	M
20	43	44	B2	Source packet ground calibration count	<TBD>	M
21	45	46	B2	Source packet with open loop ocean cal. count	<TBD>	M
22	47	48	B2	Source packet with open loop ice cal. count	<TBD>	M
23	49	50	B2	Source packet mode change count	<TBD>	M
24	51	52	B2	Source packet with LOT assertion count	<TBD>	M
25	53	54	B2	Source packet with LOT alarm count	<TBD>	M
26	55	56	B2	Source packet preset tracking count	<TBD>	M
27	57	58	B2	ATSR-M range corr. present flag count	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
28	59	60	B2	SSM/I range corr. present flag count	<TBD>	M
29	61	62	B2	Rad. Snd. range corr. present flag count	<TBD>	M
30	63	64	B2	Liquid Water range corr. present flag count	<TBD>	M
31	65	66	B2	PRARE present flag count	<TBD>	M
32	67	68	B2	Kp warning present flag count	<TBD>	M

Error flag counts per source packet:

33	69	70	B2	PCD bytes error flag count	<TBD>	M
34	71	72	B2	alpha HTL filter error flag count	<TBD>	M
35	73	74	B2	beta HTL filter error flag count	<TBD>	M
36	75	76	B2	alpha STL filter error flag count	<TBD>	M
37	77	78	B2	beta STL filter error flag count	<TBD>	M
38	79	80	B2	alpha AGC filter error flag count	<TBD>	M
39	81	82	B2	beta AGC filter error flag count	<TBD>	M
40	83	84	B2	Power reference error flag count	<TBD>	M

41	85	86	B2	Preset tracking duration error flag count	<TBD>	M
42	87	88	B2	Preset time delay error flag count	<TBD>	M
43	89	90	B2	Preset first deriv. of time delay error flag count	<TBD>	M
44	91	92	B2	Preset AGC error flag count	<TBD>	M
45	93	94	B2	Preset slope error flag count	<TBD>	M
46	95	96	B2	Rx offset error flag count	<TBD>	M
47	97	98	B2	Internal range correction error flag count	<TBD>	M
48	99	100	B2	External range correction error flag count	<TBD>	M
49	101	102	B2	Doppler range correction error flag count	<TBD>	M
50	103	104	B2	Ionospheric correction error flag count	<TBD>	M
51	105	106	B2	Kp warning flag count	<TBD>	M
52	107	108	B2	Dry tropo. range correction error flag count	<TBD>	M
53	109	110	B2	Wet tropo. [GFA] range corr. error flag count	<TBD>	M
54	111	112	B2	Wet tropo. [ATSR-M] range corr. error flag count	<TBD>	M
55	113	114	B2	Wet tropo. [SSM/I] range corr. error flag count	<TBD>	M
56	115	116	B2	Wet tropo. [Rad. Snd.] range corr. error flag count	<TBD>	M
57	117	118	B2	Liquid Water range correction error flag count	<TBD>	M
58	119	120	B2	Internal slope correction error flag count	<TBD>	M
59	121	122	B2	External Hs correction error flag count	<TBD>	M
60	123	124	B2	AGC Internal correction error flag count	<TBD>	M

Field name	**Start byte**	**Last byte**	**Format**	**Description**	**Content**	**Compliancy**
61	125	126	B2	Sigma0 correction error flag count	<TBD>	M
62	127	128	B2	Range Sigma0 correction error flag count	<TBD>	M
63	129	130	B2	Liquid Water attenuation correction error flag count	<TBD>	M

Error flag counts per science block:

64	131	134	B4	Time delay error flag count	<TBD>	M
65	135	138	B4	Range error flag count	<TBD>	M
66	139	142	B4	HTL discr. error flag count	<TBD>	M
67	143	146	B4	HTL beta branch error flag count	<TBD>	M
68	147	150	B4	Range blunder point flag count	<TBD>	M
69	151	154	B4	Slope error flag count	<TBD>	M
70	155	158	B4	Hs error flag count	<TBD>	M
71	159	162	B4	STL discr. error flag count	<TBD>	M
72	163	166	B4	Hs blunder point flag count	<TBD>	M
73	167	170	B4	AGC error flag count	<TBD>	M
74	171	174	B4	Sigma0 error flag count	<TBD>	M
75	175	178	B4	AGC discr. error flag count	<TBD>	M
76	179	182	B4	Sigma0 blunder point flag count	<TBD>	M
77	183	186	B4	Waveform samples error flag count	<TBD>	M
78	187	190	B4	Bin gains error flag count	<TBD>	M
79	191	194	B4	Waveform sum error flag count	<TBD>	M
80	195	198	B4	Mispointing error flag count	<TBD>	M
81	199	202	B4	Orbit degraded flag count	<TBD>	M
82	203	206	B4	Waveform UT error flag count	<TBD>	M
83	207	210	B4	Latitude error flag count	<TBD>	M
84	211	214	B4	Longitude error flag count	<TBD>	M
85	215	218	B4	Altitude error flag count	<TBD>	M
86	219	222	B4	Attitude error flag count	<TBD>	M
87	223	226	B4	Peakiness flag count	<TBD>	M
88	227	230	B4	Multi-peaked flag count	<TBD>	M
89	231	234	B4	Strange-shape flag count	<TBD>	M
90	235	238	B4	Tracking error flag count	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
Thresholds for Summations of QA flags:						
91	239	240	B2	Packet checksum error flag summation threshold	<TBD>	M
92	241	242	B2	alpha HTL filter error flag summation threshold	<TBD>	M
93	243	244	B2	beta HTL filter error flag summation threshold	<TBD>	M
94	245	246	B2	alpha STL filter error flag summation threshold	<TBD>	M
95	247	248	B2	beta STL filter error flag summation threshold	<TBD>	M
96	249	250	B2	alpha AGC filter error flag summation threshold	<TBD>	M
97	251	252	B2	beta AGC filter error flag summation threshold	<TBD>	M
98	253	254	B2	Power reference error flag summation threshold	<TBD>	M
99	255	256	B2	Preset tracking duration error flag summ. threshold	<TBD>	M
100	257	258	B2	Preset time-delay error flag summation threshold	<TBD>	M
101	259	260	B2	Preset f.d. of t.d. error flag summation threshold	<TBD>	M
102	261	262	B2	Preset AGC error flag summation threshold	<TBD>	M
103	263	264	B2	Preset slope error flag summation threshold	<TBD>	M
104	265	266	B2	Rx offset error flag summation threshold	<TBD>	M
105	267	268	B2	Internal range correction summation threshold	<TBD>	M
106	269	270	B2	External range correction error flag summ. threshold	<TBD>	M
107	271	272	B2	Doppler range correction error flag summ. threshold	<TBD>	M
108	273	274	B2	Ionospheric range correction error flag summ. thresh.	<TBD>	M
109	275	276	B2	Kp index warning summation threshold	<TBD>	M
110	277	278	B2	Dry tropo. range correction error flag summ. thresh.	<TBD>	M
111	279	280	B2	Wet tropo. range corr. [GFA] error flag summ. thresh.	<TBD>	M
112	281	282	B2	Wet tropo. range corr. [ATSR-M] error flag summation threshold	<TBD>	M
113	283	284	B2	Wet tropo. range corr. [SSM/I] error flag summation threshold	<TBD>	M
114	285	286	B2	Wet tropo. range corr. [Rad Snd]. error flag summation threshold	<TBD>	M

115	287	288	B2	Liquid water range correction error flag summation threshold	<TBD>	M
116	289	290	B2	Internal slope correction error flag summation threshold	<TBD>	M
117	291	292	B2	External Hs correction error flag summation threshold	<TBD>	M
118	293	294	B2	AGC Internal correction error flag summation threshold	<TBD>	M
119	295	296	B2	Sigma0 correction error flag summation threshold	<TBD>	M
120	297	298	B2	Range sigma0 correction error flag summation threshold	<TBD>	M
121	299	300	B2	Liquid water attenuation correction error flag summation threshold	<TBD>	M
122	301	302	B2	Time delay error flag summation threshold	<TBD>	M
123	303	304	B2	Range error flag summation threshold	<TBD>	M
124	305	306	B2	HTL discr. error flag summation threshold	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
125	307	308	B2	HTL beta branch error flag flag summation threshold	<TBD>	M
126	309	310	B2	Range blunder point flag summation threshold	<TBD>	M
127	311	312	B2	Slope error flag summation threshold	<TBD>	M
128	313	314	B2	Hs error flag summation threshold	<TBD>	M
129	315	316	B2	STL discr. error flag summation threshold	<TBD>	M
130	317	318	B2	Hs blunder point flag summation threshold	<TBD>	M
131	319	320	B2	AGC error flag summation threshold	<TBD>	M
132	321	322	B2	Sigma0 error flag summation threshold	<TBD>	M
133	323	324	B2	AGC discr. error flag summation threshold	<TBD>	M
134	325	326	B2	Sigma0 blunder point flag summation threshold	<TBD>	M
135	327	328	B2	Waveform samples error flag summation threshold	<TBD>	M
136	329	330	B2	Bin Gains error flag summation threshold	<TBD>	M
137	331	332	B2	Waveform sum error flag summation threshold	<TBD>	M
138	333	334	B2	Mispointing error flag summation threshold	<TBD>	M
139	335	336	B2	Orbit degraded flag summation threshold	<TBD>	M

140	337	338	B2	Waveform UT error flag summation threshold	<TBD>	M
141	339	340	B2	Latitude error flag summation threshold	<TBD>	M
142	341	342	B2	Longitude error flag summation threshold	<TBD>	M
143	343	344	B2	Altitude error flag summation threshold	<TBD>	M
144	345	346	B2	Attitude error flag summation threshold	<TBD>	M

Summary QA flags:

145	347	350	B4	Orbit number	<TBD>	M
146	351		B1	Total summary flag	<TBD>	M
147	352		B1	Packet checksum error summary flag	<TBD>	M
148	353		B1	alpha HTL filter error summary flag	<TBD>	M
149	354		B1	b HTL filter error summary flag	<TBD>	M
150	355		B1	alpha STL filter error summary flag	<TBD>	M
151	356		B1	b STL filter error summary flag	<TBD>	M
152	357		B1	a AGC filter error summary flag	<TBD>	M
153	358		B1	b AGC filter error summary flag	<TBD>	M
154	359		B1	Power reference error summary flag	<TBD>	M
155	360		B1	Preset tracking duration error summary flag	<TBD>	M
156	361		B1	Preset time delay error summary flag	<TBD>	M
157	362		B1	Preset first deriv. of time delay error summary flag	<TBD>	M

Field name	**Start byte**	**Last byte**	**Format**	**Description**	**Content**	**Compliancy**
158	363		B1	Preset AGC error summary flag	<TBD>	M
159	364		B1	Preset slope error summary flag	<TBD>	M
160	365		B1	Rx offset error summary flag	<TBD>	M
161	366		B1	Internal range correction error summary flag	<TBD>	M
162	367		B1	External range correction error summary flag	<TBD>	M
163	368		B1	Doppler range correction error summary flag	<TBD>	M
164	369		B1	Ionospheric correction error summary flag	<TBD>	M
165	370		B1	Kp index warning summary flag	<TBD>	M
166	371		B1	Dry tropo. range correction error summary flag	<TBD>	M
167	372		B1	Wet tropo. range corr. [GFA] error summary flag	<TBD>	M

168	373		B1	Wet tropo. range corr. [ATSR-M] error summary flag	<TBD>	M
169	374		B1	Wet tropo. range corr. [SSM/I] error summary flag	<TBD>	M
170	375		B1	Wet tropo. range corr. [Rad. Snd.] error summary flag	<TBD>	M
171	376		B1	Liquid water. range corr. error summary flag	<TBD>	M
172	377		B1	Internal slope correction error summary flag	<TBD>	M
173	378		B1	External Hs correction error summary flag	<TBD>	M
174	379		B1	AGC Internal correction error summary flag	<TBD>	M
175	380		B1	Sigma0 correction error summary flag	<TBD>	M
176	381		B1	Range Sigma0 correction error summary flag	<TBD>	M
177	382		B1	Liquid water attenuation corr. error summary flag	<TBD>	M
178	383		B1	Time delay error summary flag	<TBD>	M
179	384		B1	Range error summary flag	<TBD>	M
180	385		B1	HTL discr. error summary flag	<TBD>	M
181	386		B1	HTL beta branch error summary flag	<TBD>	M
182	387		B1	Range blunder point summary flag	<TBD>	M
183	388		B1	Slope error summary flag	<TBD>	M
184	389		B1	Hs error summary flag	<TBD>	M
185	390		B1	STL discr. error summary flag	<TBD>	M
186	391		B1	Hs blunder point summary flag	<TBD>	M
187	392		B1	AGC error summary flag	<TBD>	M
188	393		B1	Sigma0 error summary flag	<TBD>	M
189	394		B1	AGC discr. error summary flag	<TBD>	M
190	395		B1	Sigma0 blunder point summary flag	<TBD>	M
191	396		B1	Waveform samples error summary flag	<TBD>	M
192	397		B1	Bin gains error summary flag	<TBD>	M
193	398		B1	Waveform sum error summary flag	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy

194	399	B1	Mispointing error summary flag	<TBD>	M
195	400	B1	Orbit degraded summary flag	<TBD>	M
196	401	B1	Waveform UT error summary flag	<TBD>	M
197	402	B1	Latitude error summary flag	<TBD>	M
198	403	B1	Longitude error summary flag	<TBD>	M
199	404	B1	Altitude error summary flag	<TBD>	M
200	405	B1	Attitude error summary flag	<TBD>	M
201	406	B1	Reserved	Blanks	M

WAP Data Leader File
Instrument Characteristics Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		
1	1	4	B4	Record Sequence Number	4	M
2	5		B1	File Code (CEOS defn)	10	M
3	6		B1	Record Code (CEOS defn)	23	M
4	7		B1	Mission Code (CEOS defn)	36	M
5	8		B1	Origin Code (CEOS defn)	50	M
6	9	12	B4	Length of this record	768	M
7	13	16	I4	Instrument Characteristics Record Sequence Number	$$$1	M
	17	EOR		Altimeter Characterisation Data		
Geophysical constants:						
8	17	20	UB4	Speed of light (c) (dm/s)	<TBD>	M
9	21	24	B4	Semi-major axis of Earth ellipse (a) (dm)	<TBD>	M
10	25	28	B4	Earth radius (dm)	<TBD>	M
11	29	32	B4	Flattening of the Earth ellipse (f) (X 106)	<TBD>	M
12	33	56	B24	Reserved	Blanks	M
Algorithm Constants:						
13	57	58	B2	Low retrack fraction (% X 10)	<TBD>	M

14	59	60	B2	Medium retrack fraction (% X 10)	<TBD>	M
15	61	62	B2	High retrack fraction (% X 10)	<TBD>	M
16	63	64	B2	Ocean peakiness threshold (X 1000)	<TBD>	M
17	65	66	B2	Ocean width threshold (X 100)	<TBD>	M
18	67	86	B20	Reserved	Blanks	M

Altimeter characterisation data:

19	87	90	B4	80 Mhz clock period (P80) (nsec X 104)	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
20	91	94	B4	Pulse repetition frequency (PRF) (Hz X 106)	<TBD>	M
21	95	98	B4	Nominal Pulse rep. frequency (Hz X 106)	<TBD>	M
22	99	102	B4	Altimeter frequency (fo) (GHz X 104)	<TBD>	M
23	103	104	B2	Ground calibration correction (Dg) (cm)	<TBD>	M
24	105	232	64B2	AGC to sigma0 ocean table (X 100)	<TBD>	M
25	233	360	64B2	AGC to sigma0 ice table (X 100)	<TBD>	M
26	361	364	B4	Significant waveheight constant K1 (cm)	<TBD>	M
27	365	366	B2	Significant waveheight constant K2 (m2 X 1000)	<TBD>	M
28	367	368	B2	Significant waveheight constant Tz (X 1000)	<TBD>	M
29	369	372	B4	Significant waveheight constant sp (X 104)	<TBD>	M
30	373	376	B4	Standard power reference value (Poref) (dB X 104)	<TBD>	M
31	377	504	64B2	64 pre-launch bin-gain corrections (X 100)	<TBD>	M
32	505	632	64B2	64 bin-gain corrections (X 100)	<TBD>	M
33	633	636	B4	Reference satellite altitiude (m)	<TBD>	M
34	637	640	B4	Chirp bandwidth ocean (mHz X 104)	<TBD>	M

35	641	644	B4	Chirp bandwidth ice (mHz X 104)	<TBD>	M
36	645	646	B2	Chirp duration ocean (µs X 100)	<TBD>	M
37	647	648	B2	Chirp duration ice (µs X 100)	<TBD>	M
38	649	650	B2	Nominal compressed pulse length ocean (tocean) (ns X 1000)	<TBD>	M
39	651	652	B2	Nominal compressed pulse length ice (tice) (ns X 1000)	<TBD>	M
40	653	656	B4	Bin to metres ocean (X 105)	<TBD>	M
41	657	660	B4	Bin to metres ice (X 105)	<TBD>	M
42	661	664	B4	Antenna beam width (millidegrees)	<TBD>	M
43	665	668	B4	Antenna aperture constant (X 107)	<TBD>	M
44	669	672	B4	Nominal Preset duration for calibration SPTR mode	<TBD>	M
45	673	674	I2	Range window alias lower limit ocean	<TBD>	M
46	675	676	I2	Range window alias upper limit ocean	<TBD>	M
47	677	678	I2	Range window alias lower limit ice	<TBD>	M
48	679	680	I2	Range window alias upper limit ice	<TBD>	M
49	681	682	I2	Window centre ocean	<TBD>	M
50	683	684	I2	Window centre ice 1/4	<TBD>	M
51	685	686	I2	Window centre ice 1/2	<TBD>	M
52	687	688	I2	Window centre ice 3/4	<TBD>	M
53	689	692	I4	RX init ocean	<TBD>	M
54	693	696	I4	RX init ice	<TBD>	M
55	697	700	I4	PTR nominal amplitude	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
56	701	702	I2	PTR window centre ocean	<TBD>	M
57	703	704	I2	PTR window centre ice	<TBD>	M
58	705	708	B4	Spacecraft Centre of Gravity Offset (m X 104)	<TBD>	M
59	709	712	B4	Antenna/platform roll offset (millidegrees)	<TBD>	M

60	713	716	B4	Antenna/platform pitch offset (millidegrees)	<TBD>	M
61	717	720	B4	Antenna/platform yaw offset (millidegrees)	<TBD>	M
62	721	724	B4	Datation bias (msec X 100)	<TBD>	M
63	725	728	B4	External calibration altitude correction (mm)	<TBD>	M
64	729	768	B40	Reserved	Blanks	M

WAP Data File
WAP Data File Descriptor Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		

1	1	4	B4	Record Sequence Number	1	M
2	5		B1	File Code (CEOS defn)	63	M
3	6		B1	Record Code (CEOS defn)	192	M
4	7		B1	Mission Code (CEOS defn)	18	M
5	8		B1	Origin Code (CEOS defn)	18	M
6	9	12	B4	Length of this record (depends on product)	<TBD>	M
7	13	14	A2	ASCII/EBCDIC flag	A$	M
8	15	16	A2	Reserved	$$	M
	17	180		File Descriptor Record Fixed Segment		
9	17	28	A12	Control Document Number for this Data File Format	<TBD>	M
10	29	30	A2	Control Document Revision Number	$A	M
11	31	32	A2	File Design Descriptor Revision Letter	$A	M
12	33	44	A12	Software Release Number	<software.id>	M
13	45	48	I4	File Number	$$$2	M
14	49	64	A16	File Name (where n is either 1 or 2)	ERSn.ALT.WAPDTOP	M
15	65	68	A4	Record Sequence and Location Type Flag	FSEQ	M
16	69	76	I8	Sequence Number Location	$$$$$$$1	M
17	77	80	I4	Sequence Number Field Length	$$$4	M
18	81	84	A4	Record Code and Location Type Flag	FTYP	M
19	85	92	I8	Record Code Location	$$$$$$$5	M
20	93	96	I4	Record Code Field Length	$$$4	M
21	97	100	A4	Record Length and Location Type Flag	FLGT	M
22	101	108	I8	Record Length Location	$$$$$$$9	M
23	109	112	I4	Record Length Field Length	$$$4	M
24	113		A1	Reserved	Blanks	M
25	114		A1	Reserved	Blanks	M
26	115		A1	Reserved	Blanks	M

27	116		A1	Reserved	Blanks	M
Field name	**Start byte**	**Last byte**	**Format**	**Description**	**Content**	**Compliancy**
28	117	180		Reserved Segment	Blanks	M
	181	EOR		Sample Group Parameters		

NB: these records changed to harmonise with F-PAF requirements

29	181	360	A180	Reserved for use by F - PAF (Fields 29 to 49)	Blanks	M
50	361	366	I6	Number of ALT Data Records	<TBD>	M
51	367	372	I6	ALT Data Record Length	<TBD>	M
52	373	378	I6	Number of Signal Data Records	$$$$$0	M
53	379	384	I6	Signal data record length	Blanks	M
54	385	388	I4	Number of Records in Product	<TBD>	M
55	389	396	I8	Length of Product	<TBD>	M
56	397	400	I4	Number of Bytes of Prefix Data per Record	<TBD>	M
57	401	408	I8	Number of Bytes of Data per Record	<TBD>	M
58	409	412	I4	Number of Bytes of Suffix Data per Record	<TBD>	M
59	413	416	A4	Prefix/Suffix Repeat Flag	<TBD>	M
60	417	EOR	A	Reserved	Blanks	M

WAP Data File
WAP Processed Data Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	20		Record Identification Segment		
1	1	4	B4	Record Sequence Number	<2 to N+1>	M
2	5		B1	File Code (CEOS defn)	70	M
3	6		B1	Record Code (CEOS defn)	21	M
4	7		B1	Mission Code (CEOS defn)	36	M
5	8		B1	Origin Code (CEOS defn)	50	M
6	9	12	B4	Length of this record	5156	M
7	13	16	A4	Reserved	$$$$	M
8	17	20	A4	Reserved	$$$$	M
	21	40		Prefix Data		
9	21	24	B4	Source packet No within product (1-n)	<TBD>	M
10	25	28	B4	Orbit Number	<TBD>	M
11	29	32	B4	Source Packet UTC - 4 most sig bytes (No of days MJD)	<TBD>	M
12	33	36	B4	Source Packet UTC - milliseconds of day	<TBD>	M
13	37	40	B4	Source Packet UTC - microseconds remaining	<TBD>	M
	41	5132		ALT Processed Data		
14	41	42	B2	Packet ID (status identifier)	<TBD>	M
15	43	44	B2	Packet Sequence Control	<TBD>	M

16	45	46	B2	Packet Length	<TBD>	M
17	47	51	B5	S/C Binary Counter	<TBD>	M
18	52	52	B1	Data Subset Counter	<TBD>	M
19	53	56	B4	a HTL Filter (X 1010)	<TBD>	M
20	57	60	B4	b HTL Filter (X 1010)	<TBD>	M
21	61	64	B4	a STL Filter (X 108)	<TBD>	M
22	65	68	B4	b STL Filter (X 1010)	<TBD>	M
23	69	72	B4	a AGC Filter (X 108)	<TBD>	M
24	73	76	B4	b AGC Filter (X 1010)	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
25	77	80	B4	Power Reference Value (FPDU X 100)	<TBD>	M
26	81	86	B6	Spares	<TBD>	M
27	87	90	B4	Preset Duration	<TBD>	M
28	91	94	B4	Preset Time Delay (12.5ns X 1000)	<TBD>	M
29	95	98	B4	Preset First Derivative of Time Delay (12.5ns/PRI X 106)	<TBD>	M
30	99	102	B4	Preset AGC (dB X 100)	<TBD>	M
31	103	106	B4	Preset Slope (slope units X 100)	<TBD>	M
32	107	110	B4	RX Offset (12.5ns X 1000)	<TBD>	M
33	111	144	B34	Spares	<TBD>	M

For each of 20 science blocks:
First science block

34	145	146	B2	Mode ID	<TBD>	M
35	147	150	B4	Noise Floor Estimation (FPDU X 100)	<TBD>	M
36	151	154	B4	HTL Discriminator o/p (12.5NS X 10000)	<TBD>	M

37	155	158	B4	STL Discriminator o/p (slope units X 100)	<TBD>	M
38	159	162	B4	AGC Discriminator o/p (counts X 10)	<TBD>	M
39	163	166	B4	HTL Beta Branch (X 106)	<TBD>	M
40	167	294	64B2	64 Waveform Samples	<TBD>	M
41	295	298	B4	Time Delay (12.5ns X 1000)	<TBD>	M
42	299	302	B4	Slope (slope units X 100)	<TBD>	M
43	303	306	B4	AGC (dB X 100)	<TBD>	M

44 to 233 - other 19 science blocks

end of 20 science blocks

234	3385	3388	B4	PCD bytes	<TBD>	M

The following (once per source packet):

235	3389	3392	B4	Science block valid word	<TBD>	M
236	3393	3394	B2	Spares	<TBD>	M
237	3395	3398	B4	Data degraded word	<TBD>	M
238	3399	3400	B2	Auxiliary Data Limit Flags Halfword	<TBD>	M

Field name	**Start byte**	**Last byte**	**Format**	**Description**	**Content**	**Compliancy**
239	3401	3404	B4	Ocean/Ice Mode Flags Word	<TBD>	M

The following repeated 20 times (once per science block):

240	3405	3406	B2	Frame number	<TBD>	M

241	3407	3410	B4	Range (mm)	<TBD>	M
242	3411	3414	B4	Hs (mm)	<TBD>	M
243	3415	3418	B4	Sigma0 (dB X 100)	<TBD>	M

Waveform parameters:

244	3419	3422	B4	Waveform amplitude (counts X 100)	<TBD>	M
245	3423	3426	B4	Waveform width (mm)	<TBD>	M
246	3427	3430	B4	Low retrack point (bins X 100)	<TBD>	M
247	3431	3434	B4	Medium retrack point (bins X 100)	<TBD>	M
248	3435	3438	B4	High retrack point (bins X 100)	<TBD>	M
249	3439	3442	B4	Waveform peakiness (X 1000)	<TBD>	M
250	3443	3446	B4	Waveform latitude	<TBD>	M
251	3447	3450	B4	Waveform longitude	<TBD>	M
252	3451	3454	B4	Altitude (mm)	<TBD>	M
253	3455	3455	B1	Range error flags byte	<TBD>	M
254	3456	3456	B1	Hs error flags byte	<TBD>	M
255	3457	3457	B1	Sigma0 error flags byte	<TBD>	M
256	3458	3458	B1	Waveform error flags byte	<TBD>	M
257	3459	3459	B1	Waveform shape flags byte	<TBD>	M
258	3460	3460	B1	Location error flags byte	<TBD>	M

259 to 619 - remaining 19 groups of waveform data

Then the following parameters, once per source packet:

620	4525	4528	B4	Range constant (mm)	<TBD>	M
621	4529	4532	B4	Range std. dev., RSD (mm)	<TBD>	M
622	4533	4536	B4	Range Gradient (ms-1 X 100)	<TBD>	M

623	4537	4540	B4	Spares	<TBD>	M
624	4541	4544	B4	Range values used, n	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
625	4545	4548	B4	Hs mean, Hmean (mm)	<TBD>	M
626	4549	4552	B4	Hs values used, nh	<TBD>	M
627	4553	4556	B4	Hs std. dev., HSD (mm)	<TBD>	M
628	4557	4560	B4	Sigma0 mean, Smean (dB X 10)	<TBD>	M
629	4561	4564	B4	Sigma0 std. dev., SSD (mm)	<TBD>	M
630	4565	4568	B4	Sigma0 values used, ns	<TBD>	M
631	4569	4570	B2	Range corrections error flags word	<TBD>	M
632	4571	4571	B1	Hs correction error flags byte	<TBD>	M
633	4572	4572	B1	Sigma0 corr.error flags byte	<TBD>	M
634	4573	4576	B4	Mispointing (microdegrees)	<TBD>	M
635	4577	4588	B12	Spares	<TBD>	M
636	4589	4592	B4	Yaw (microdegrees)	<TBD>	M
637	4593	4596	B4	Roll (microdegrees)	<TBD>	M
638	4597	4600	B4	Pitch (microdegrees)	<TBD>	M
639a	4601	4612	B4	Radial Orbit Correction (corresponding to the Source Packet Centre UTC) (mmX10)	<TBD>	M
639b	4601	4612	A8	Spares	<TBD>	M

The following corrections, once per source packet:

640	4613	4616	B4	Internal Range Correction (mm)	<TBD>	M
641	4617	4620	B4	External Range Correction (mm)	<TBD>	M
642	4621	4624	B4	Pulse Repetition Period (Hz X 108)	<TBD>	M
643	4625	4628	B4	Internal Slope Correction (FPDU/bin X 100)	<TBD>	M

644	4629	4632	B4	External Hs Correction (mm)	<TBD>	M
645	4633	4636	B4	AGC Correction (dB X 100)	<TBD>	M
646	4637	4640	B4	Sigma0 Correction (dB X 100)	<TBD>	M
647	4641	4896	64B4	64 Bin Gain Corrections (X 1000)	<TBD>	M
648	4897	4900	B4	Doppler Range Correction (mm)	<TBD>	M
649	4901	4904	B4	Range sigma0 Correction (dB X 100)	<TBD>	M
650	4905	4908	B4	Ionospheric Delay Correction (mm)	<TBD>	M
651	4909	4912	B4	PRARE Data Correction (mm)	<TBD>	M
652	4913	4916	B4	Electron Content (electrons m-2 X 1016 X 10)	<TBD>	M
653	4917	4920	B4	Dry tropo range correction (mm)	<TBD>	M
654	4921	4924	B4	Surface pressure (mbars X 10)	<TBD>	M
655	4925	4928	B4	Wet tropospheric range correction.[GFA] (mm)	<TBD>	M
656	4929	4932	B4	Surface air temperature, T0 (K X 10)	<TBD>	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
657	4933	4936	B4	Total integrated water vapour, Q [GFA] (kg m-2 X 10)	<TBD>	M
658	4937	4940	B4	Wet tropospheric range correction.[ATSR-M] (mm)	<TBD>	M
659	4941	4944	B4	Wet tropospheric range correction .[SSM/I] (mm)	<TBD>	M
660	4945	4948	B4	Wet tropospheric range correction.[Rad Snd] (mm)	<TBD>	M
661	4949	4952	B4	Integral of function rw(h)/T(h) (kg m-2 K-1 X 1000)	<TBD>	M
662	4953	4956	B4	Total integrated water vapour, Q [ATSR-M] (kg m-2 X 10)	<TBD>	M
663	4957	4960	B4	Total integrated water vapour, Q [SSM/I] (kg m-2 X 10)	<TBD>	M
664	4961	4964	B4	Total integrated water vapour, Q [Rad Snd] (kg m-2 X 10)	<TBD>	M
665	4965	4968	B4	Liquid water range correction (mm)	<TBD>	M
666	4969	4972	B4	Liquid water attenuation correction (dB X 106)	<TBD>	M
667	4973	4976	B4	Total liquid water, L ((kg m-2 X 1000)	<TBD>	M
668	4977	4980	B4	Atmos. Corrections Status Word	<TBD>	M

669	4981	4984	B4	Terrain type flag	<TBD>	M
670	4985	4988	B4	Land/sea flags word (20bits)	<TBD>	M
671	4989	4992	B4	Coastline flags word (20bits)	<TBD>	M
672	4993	4996	B4	Possible sea-ice word (20bits)	<TBD>	M
673	4997	5000	B4	Spacecraft health word	<TBD>	M
674	5001	5004	B4	Spacecraft C-of-G offset (mm)	<TBD>	M
675	5005	5008	B4	Geoid elevation (mm)	<TBD>	M
676	5009	5010	B2	Earth Tide	<TBD>	M
677	5011	5012	B2	Ocean Tide	<TBD>	M
678	5013	5014	B2	Ocean Loading Tide	<TBD>	M

Corresponding FD product (if available, otherwise zero filled):

679	5015	5018	B4	FD Data Record Number	<TBD>	M
680	5019	5042	A24	FD UTC Time	<TBD>	M
681	5043	5046	B4	FD Latitude	<TBD>	M
682	5047	5050	B4	FD Longitude	<TBD>	M
683	5051	5052	B2	FD wind speed, U10	<TBD>	M
684	5053	5054	B2	FD Windspeed Std. Dev.	<TBD>	M
685	5055	5056	B2	FD Significant Waveheight, Hs	<TBD>	M
686	5057	5058	B2	FD SWH Std. Dev	<TBD>	M
687	5059	5062	B4	FD Altitude, H	<TBD>	M
688	5063	5066	B4	FD Altitude Std. Dev.	<TBD>	M
689	5067	5068	B2	FD Number of Blocks Used for Averaging	<TBD>	M

Field name	**Start byte**	**Last byte**	**Format**	**Description**	**Content**	**Compliancy**
690	5069	5069	B1	FD Product Confidence Data	<TBD>	M

691	5070	5071	B2	FD Average Peakiness	<TBD>	M
692	5072	5075	B4	FD Spares	<TBD>	M
693	5076	5076	B1	FD Open Loop Calibration Status	<TBD>	M
694	5077	5077	B1	FD Instrument Mode Byte	<TBD>	M
695	5078	5078	B1	FD Spare	<TBD>	M
696	5079	5082	B4	FD Altitude Correction - ionosphere	<TBD>	M
697	5083	5086	B4	FD Altitude Correction - dry tropospheric	<TBD>	M
698	5087	5090	B4	FD Altitude Correction - wet tropospheric	<TBD>	M
699	5091	5094	B4	FD Altitude Correction - cal. constant	<TBD>	M
700	5095	5098	B4	FD Open Loop HTL - cal. correction	<TBD>	M
701	5099	5102	B4	FD Open Loop AGC - cal. correction	<TBD>	M
702	5103	5106	A4	Orbit type corresponding to Source Packet Centre UTC	<TBD>	M
703	5107	5110	B4	Update Status Word	<TBD>	M
704	5111	5120	B10	Spares	<TBD>	M
705	5121	5124	B4	Source Packet Centre UTC - 4 most sig bytes (No of days MJD)	<TBD>	M
706	5125	5128	B4	Source Packet Centre UTC - milliseconds of day	<TBD>	M
707	5129	5132	B4	Source Packet Centre UTC - microseconds remaining	<TBD>	M
				Suffix Data		
708	5133	5136	B4	Actual Number of Waveforms in this data record	20	M
				Quality Codes		
709	5137	EOR		Processing Specific Details (Facility Specific Including Quality Information)	<TBD>	M

Null Volume Directory File
Volume Descriptor Record

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
	1	16		Record Identification Segment		
1	1	4	B4	Record Sequence Number	1	M
2	5		B1	File Code (CEOS defn)	192	M
3	6		B1	Record Code (CEOS defn)	192	M
4	7		B1	Mission Code (CEOS defn)	63	M
5	8		B1	Origin Code (CEOS defn)	18	M
6	9	12	B4	Length of this record	360	M
7	13	14	A2	ASCII/EBCDIC Flag	A$	M
8	15	16	A2	Reserved	$$	M
	17	44		Volume Documentation Segment		
9	17	28	A12	Superstructure control document number	<volume.set.id>	M
10	29	30	A2	Superstructure control document revision number	$A	M
11	31	32	A2	Superstructure record format revision letter	$A	M
12	33	44	A12	Software release number	<software.id>	M
	45	360		Volume Identification Segment		
13	45	60	A16	Identifier of logical volume containing this volume descriptor	Blanks	M
14	61	76	A16	Logical Volume ID	Blanks	M
15	77	92	A16	Volume Set ID	Blanks	M

16	93	94	I2	Number of Physical Volumes in Set	Blanks	M
17	95	96	I2	Physical Volume No - Start of Logical Volume	Blanks	M
18	97	98	I2	Physical Volume No - End of Logical Volume	Blanks	M
19	99	100	I2	Physical Volume Sequence No (of current tape)	Blanks	M
20	101	104	I4	First Referenced File Number in this Physical Volume	Blanks	M
21	105	108	I4	Logical Volume Number within Volume Set	Blanks	M
22	109	112	I4	Logical Volume Number within Physical Volume	Blanks	M
23	113	120	A8	Logical Volume Creation Date <YYYYMMDD>	Blanks	M
24	121	128	A8	Logical Volume Creation Time <HHMMSSXX>	Blanks	M

Field name	Start byte	Last byte	Format	Description	Content	Compliancy
25	129	140	A12	Logical Volume Generating Country	Blanks	M
26	141	148	A8	Logical Volume Generating Agency	Blanks	M
27	149	160	A12	Logical Volume Generating Facility	Blanks	M
28	161	164	I4	Number of Pointer Records in Volume Directory	Blanks	M
29	165	168	I4	Number of Records in Volume Directory	Blanks	M
30	169	172	I4	Number of Logical Volumes on this Physical Volume	Blanks	M
31	173	260	A88	Volume Descriptor Spare Segment	Blanks	M
32	261	360	A100	Local Use Segment	Blanks	M