Ref: ER-IS-MDA-GS-2010
Issue/Revision: 1/3
Date: FEB. 20, 1996

GS16

ERS-2 Kiruna Station User Interface Specification

Prepared By:	N. Wright	11/26/96
Checked By:	M. Walsh	11/26/96
Quality Assurance:	R. Dale	11/27/96.
Project Manager:	R. Slim	Nov 26, 96.

(signature / date)

MACDONALD DETTWILER

13800 Commerce Parkway
Richmond, B.C., Canada V6V 2J3
Telephone (604) 278-3411
Fax (604) 278-2117

MACDONALD DETTWILER

THIS PAGE INTENTIONALLY LEFT BLANK

CHANGE RECORD

ISSUE	DATE	PAGE(S)	DESCRIPTION	RELEASE
1/0	05/04/94	All	SCR #62, CR #62 First Issue	
1/1	04/08/94		SCR #80, CR #80 First Issue - First Revision Reason for Change: Incorporate Ivan Petiteville's comments from the May 4, 1994 e-mail 'comments on GS-2010 (Issue 1/0, dated Apr. 5, 1994)'.	
		1-1, 1-2, 2-1, 3-1 to 3-4, 3-9, 4-3, 4-4, 4-13, 4-16, 4-24, 4-34, 4-40, 4-41, 4-78, 4-89, 4-93, 4-111, 4-113	Description of Change: Minor updates - mostly relating to product media and distribution.	
1/2	27/07/95		SCR #99, CR #99 First Issue - Second Revision Reason for Change: Addition of wave processing algorithm to the LRDPF. Description of Change: Addition of wave products being produced optionally on the SAR FDP or the LRDPF.	

MACDONALD DETTWILER

ISSUE	DATE	PAGE(S)	DESCRIPTION	RELEASE
1/3	20/02/96		SCR #103, CR #103 First Issue - Third Revision Problem #10 Reason for Change: Modification of wave processing algorithm for the LRDPF. Description of Change:	RELEASED BY CONFIGURATION CONTROL
		4-45-4-47 4-49-4-53 4-60-4-63	Update SPH fields description of IWA, UWA.	
		4-64 - 4-118	Repagination only.	

TABLE OF CONTENTS

1 INTRODUCTION 1-1
1.1 Intended Audience 1-1
1.2 Scope Of Applicability 1-2
1.3 Document Overview 1-2

2 DOCUMENTS 2-1
2.1 Applicable Documents 2-1
2.2 Reference Documents 2-1

3 OVERVIEW 3-1
3.1 ERS System 3-1
3.2 Ground Segment 3-1
3.3 Kiruna Station Overview 3-2
3.3.1 System Functions 3-2
3.4 Instrument Overview 3-3
3.4.1 AMI Image Mode 3-5
3.4.2 AMI Wave Mode 3-5
3.4.3 AMI Wind Mode 3-5
3.4.4 Radar Altimeter 3-9
3.4.5 Along-Track Scanning Radiometer 3-9
3.4.6 Global Ozone Monitoring Experiment 3-10
3.4.7 Microwave Radiometer 3-10
3.5 Satellite: X-Band Downlink 3-10
3.5.1 High Rate Data (LINK 1) 3-10
3.5.2 Low Rate Data (LINK 2) 3-11

4 PRODUCT DEFINITIONS 4-1
4.1 Introduction 4-1
4.1.1 Type of Products 4-1
4.1.2 Structure of Product Format 4-5
4.1.3 Product Generation 4-14
4.1.4 Product Quality Control 4-20
4.2 Raw Data Products 4-23
4.2.1 High Rate Data (RH) 4-24
4.2.2 Low Rate Data (RL) 4-34
4.2.3 ATSR-1 Data (RATSR) 4-36
4.2.4 ATSR-2 Data (EATC2) 4-38
4.3 Fast Delivery Products 4-40
4.3.1 AMI Image-16-bit (UI16) 4-40
4.3.2 AMI Image-8-bit (UI8) 4-53

4.3.3 AMI Image Noise Statistic and Drift Calibration (UIND) 4-54
4.3.4 AMI Image Chirp Replica (UIC) 4-55
4.3.5 AMI Wave (UWA) 4-56
4.3.6 AMI Wave Noise Statistic and Drift Calibration (UWAND).. 4-61
4.3.7 AMI Wave Chirp Replica (UWAC) 4-62
4.3.8 AMI Wind (UWI) 4-63
4.3.9 Radar Altimeter (URA) 4-80
4.4 Intermediate Products 4-88
4.4.1 AMI Wave Intermediate (IWA) 4-88
4.4.2 AMI Image Mode Intermediate (II16) 4-91
4.5 Extracted Data Products 4-93
4.5.1 AMI Image Calibration Data (EIC) 4-94
4.5.2 AMI Wave Calibration Data (EWAC) 4-95
4.5.3 AMI Wind Calibration Data (EWIC) 4-97
4.5.4 Radar Altimeter Calibration Data (ERAC) 4-99
4.5.5 GOME Calibration Data (EGOC) 4-101
4.5.6 Microwave Calibration Data (EMWC) 4-103
4.5.7 AMI Image Instrument Header (EII) 4-105
4.5.8 AMI Wave Instrument Header (EWAI) 4-108
4.5.9 AMI Wind Instrument Header (EWII) 4-108
4.5.10 Radar Altimeter Instrument Header (ERAI) 4-109
4.5.11 ATSR-1 Instrument Header (EATI1) 4-110
4.5.12 ATSR-2 Instrument Header (EATI2) 4-111
4.5.13 GOME Instrument Header (EGOI) 4-112
4.5.14 General Headers (EGH) 4-113
4.5.15 Ephemeris Data (EEP) 4-114
4.5.16 Text Product (TP) 4-115

A **COMPUTER-COMPATIBLE TAPE FORMAT** A-1

B **EXABYTE TAPE FORMAT** B-1
B1. DPMC Exabyte Format B-1
B2. Transcription Exabyte Format B-6
B3. Archive Exabyte Format B-10

LIST OF FIGURES

Figure 3-1 **Kiruna Station Block Diagram** 3-4
Figure 3-2 **Data Collection** 3-6
Figure 3-3 **Scatterometer Antenna Orientations** 3-7
Figure 3-4 **Scatterometer System Geometry** 3-8
Figure 4-1 **Wave Product Example** 4-60
Figure 4-2 **Wind Direction Definitions** 4-79
Figure 4-3 **Relation between Ambiguity Removal and Product Confidence Data** ... 4-80
Figure A-1 **Product-Type-Per-File Format of One Tape Reel** A-3
Figure A-2 **Product-Per-File Format of One Tape Reel** A-4
Figure A-3 **Product-Per-File Format Multireel Configuration** A-5
Figure B-1 **Exabyte Tape Format** B-2
Figure B-2 **Small Product Format** B-4
Figure B-3 **Large Product Format** B-5

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 4-1	**Product Sizes**	4-2
Table 4-2	**Data Volume**	4-3
Table 4-3	**MPH for All Products (Except HDDT Products)**	4-6
Table 4-4	**Product Distribution Media**	4-16
Table 4-5	**Organization of Information in a Time Code Frame ("Not Used" Bits shall be set to Zero)**	4-27
Table 4-6	**Product Confidence Data Definitions**	4-32
Table 4-7	**Specific Product Header Record for RATSR, EATC2, EWIC, ERAC**	4-38
Table 4-8	**Data Set Record for RATSR**	4-38
Table 4-9	**Data Set Record for EATC2**	4-39
Table 4-10	**Specific Product Header for UI16, UI8, UWA, IWA**	4-42
Table 4-11	**Data Set Record for UI16**	4-54
Table 4-12	**Data Set Record for UI18**	4-55
Table 4-13	**Specific Product Header for UIND, UWAND**	4-56
Table 4-14	**Data Set Record for UIND**	4-56
Table 4-15	**Data Set Record for UIC, UWAC**	4-57
Table 4-16	**Data Set Record for UWA**	4-61
Table 4-17	**Data Set Record for UWAND**	4-64
Table 4-18	**Specific Product Header for UWI**	4-67
Table 4-19	**Data Set Record for UWI**	4-73
Table 4-20	**Specific Product Header for URA**	4-82
Table 4-21	**Data Set Record for URA**	4-85
Table 4-22	**Data Set Record 1-16 for IWA**	4-91
Table 4-23	**Data Set Record 17 for IWA**	4-91
Table 4-24	**Specific Product Header for II16**	4-93
Table 4-25	**Data Set Record for EIC**	4-96
Table 4-26	**Specific Product Header Record for EWAC**	4-97
Table 4-27	**Data Set Record for EWAC (OBRC and OGRC)**	4-98
Table 4-28	**Data Set Record for EWIC**	4-100
Table 4-29	**Data Set Record for ERAC**	4-101
Table 4-30	**Specific Product Header Record for EGOC**	4-103
Table 4-31	**Data Set Record for EGOC**	4-104
Table 4-32	**Specific Product Header Record for EMWC**	4-105
Table 4-33	**Data Set Record for EMWC**	4-106
Table 4-34	**Specific Header for EII, EWAI, EWII, ERAI, EATI1, EATI2, EGOI**	4-107
Table 4-35	**Data Set Record for EII, EWAI, EWII, ERAI, EATI1, EATI2, EGOI**	4-108
Table 4-36	**Data Set Record for EGH**	4-115
Table 4-37	**Data Set Record for EEP**	4-116
Table 4-38	**Data Set Record for Text Product**	4-117
Table A-1	**Tape Header File Format**	A-1

MACDONALD DETTWILER

Table B-1 **MPH File Format** B-3
Table B-2 **Transcription Exabyte Contents** B-6
Table B-3 **Tape File Header Format** B-7
Table B-4 **Production Information File Format (Transcribed Exabyte)** B-7
Table B-5 **Product Files** B-8
Table B-6 **Directory File Format (Transcribed Exabyte)** B-9
Table B-7 **Archive Exabyte Contents** B-10
Table B-8 **Production Information File Format (Archived Exabyte)** B-11
Table B-9 **Directory File Format (Archived Exabyte)** B-12

1 INTRODUCTION

This document defines all ERS-1 and ERS-2 products generated and disseminated by the Kiruna Station (KS). Products are defined in terms of their structure, content, format and distribution media.

The document serves both as a requirements specification to which the Kiruna Station developers shall design and build, and as a specification for end users of the products.

In this document, the Low-Rate Data Processing Facility (LRDPF) refers to the re-hosted LRDPF for the ERS-2 upgrade as specified in Document R-1. Similarly, the term Mission Management Control Centre (MMCC) refers to the MMCC2 and the term Data Processing, Monitoring and Control (DPMC) refers to the DPMC6 resulting from the ERS-2 upgrade as outlined in Document R-2.

1.1 Intended Audience

The intended audience of this document is made up of the following:

- Customer (European Space Agency (ESA));
- end users of Kiruna Station products;
- developers involved in the ERS-2 upgrades of the Kiruna Station.

1.2 Scope Of Applicability

This document shall be treated as a high-level requirement specification for all products generated by the Kiruna Station. Hence, it shall take precedence over the respective subsystem specifications.

The following items are specifically excluded from this document:

- shipping of Computer-Compatible Tapes (CCTs), Exabyte tapes, and High-Density Digital Tapes (HDDTs);
- outputs transmitted to the MMCC specifically related to the monitoring and control of the Kiruna Station (see Document R-2);
- structure and format of products within Kiruna Station (e.g., as transmitted between subsystems);
- transmission of products over the Broad-band Data Distribution Network (BDDN).

1.3 Document Overview

This document is divided into four sections:

- Section 2 lists applicable documents.
- Section 3 provides a general description of the ERS System, the Ground Segment and the Kiruna Station.
- Section 4 gives definition, format and distribution media for all Kiruna Station Products.
- Appendix A provides the CCT tape layout.
- Appendix B provides the Exabyte tape layout.

2 DOCUMENTS

All documents listed below are issued by MacDonald Dettwiler unless otherwise noted.

2.1 Applicable Documents

A-1	ER-IS-MDA-GS-0010	ERS-1 Kiruna Station User Interface Specification. Issue 8/0. March 15, 1993.
A-2	ER-IS-ESA-GS-0002	ERS-2 Satellite to Ground Segment Interface Specification. European Space Agency. Issue 1/1. February 12, 1993.
A-3	ER-RS-MDA-GS-2004	System Requirements Definition for the ERS-2 Upgrade. Issue 2/2. March 31, 1994.

2.2 Reference Documents

R-1	RH-IC-SPT-SY-0001	LRDPF Re-host External Interface Specification. Spacetec. Issue 1/3. March 23, 1994.
R-2	ER-IS-MDA-GS-2020	ERS-2 Kiruna Station to Mission Management and Control Centre Interface Specification. Issue 3/0. March 9, 1994.

MACDONALD DETTWILER

R-3	ER-TN-MDA-GS-0400	Technical Note on the Upgrade of ERS-1 SAR FDP to Version 4. Issue 1/0. March 8, 1993.

3 OVERVIEW

The content of this section is for general information only.

3.1 ERS System

The ERS system is an end-to-end remote sensing system. Launched in July of 1991, ERS-1 has successfully performed microwave measurements of selected earth surface parameters from space, extracted from these measurements specific environmental and geophysical data, and disseminated the results to the commercial and scientific user communities. The ERS system comprises both a space segment, consisting of the satellite with its ground support equipment and an Ariane launcher, plus a ground segment, consisting of the control facilities and the data processing and dissemination facilities. ERS-2 launched in April of 1995, is very similar to the ERS-1 satellite; differing by one instrument with enhanced functionality and carrying one new instrument.

3.2 Ground Segment

The overall ground segment encompasses both facilities to be implemented and controlled by ESA, as well as a number of decentralized facilities to be implemented and operated by the data users.

ERS-1 and ERS-2 are oriented towards ice and ocean monitoring, combining objectives of both a scientific and economic nature in one mission. ERS-2 will also be used to monitor the ozone layer.

The principal application objectives are aimed towards improvements in short- and medium-term forecasts of sea ice, weather and ocean conditions of benefit to offshore activities such as the fishing and oil industries, and to ship routing. Furthermore, it is intended to perform, on an experimental basis, all-weather microwave imaging over land areas.

The overall ground segment for the ERS satellites is concerned with all aspects of the satellite operations and the instrument data acquisition and processing. It comprises all ground elements forming part of an end- to-end remote sensing system. The main elements of the ERS ground segment are:

- MMCC in Darmstadt;
- Kiruna Station;
- FDPC Ground Stations;
- Precision Processing Facilities;
- Product Archiving Facilities.

The MMCC is responsible for mission planning and coordination, and for control of the satellite and Kiruna Station.

The Kiruna Station is the dedicated ERS ground station for controlling the satellite (it is the Tracking, Telemetry and Command (TT&C) station), for receiving and processing instrument data, and for distributing data products to primary users of the system.

The ERS-2 ground segment is an upgrade of the ERS-1 ground segment so as to allow handling of both these satellites.

3.3 Kiruna Station Overview

3.3.1 System Functions

There are three primary functional requirements of the Kiruna Station:

- **Satellite Control and Monitoring:** The Kiruna Station provides a two-way S-Band communications link with the satellite.
- **Payload Data Acquisition:** The Kiruna Station receives and records payload data transmitted over the X-Band satellite downlink.
- **Payload Data Processing and Distribution:** The station includes the subsystems required to generate both fast delivery and intermediate products from

the raw payload data, and to make the products available for dissemination to the user.

The Kiruna Station is comprised of the following subsystems:

- Tracking, Telemetry, Command and Data Acquisition Facility (TTCDAF);
- Low-Rate Data Processing Facility (LRDPF);
- Data Processing Monitor and Control/Product Distribution Facility (DPMC);
- Synthetic Aperture Radar Fast-Delivery Processor (SAR FDP);
- Data Recording and Reproduction (DRR);
- BDDN.

The relationship between the various subsystems within the Kiruna Station is shown in Figure 3-1.

3.4 Instrument Overview

Data of the following instruments carried by the ERS satellites are processed in Kiruna:

- The C-Band Active Microwave Instrumentation (AMI) comprising side-looking radar systems with three in-flight selectable functional modes for high resolution imaging, and measurements relating to wave spectra and wind scatterometry over the ocean surface.

- The Ku-Band Radar Altimeter (RA), comprising a nadir-looking instrument for measurements over ocean and ice surface.

- The data from the Along-Track Scanning Radiometer (ATSR), are only extracted at Kiruna Station and sent to Rutherford Appleton Laboratories (RAL) for processing. The ATSR is a passive instrument consisting of an infrared radiometer, a microwave sounder, and an optical spectrometer. All three instruments can be operated at the same time. The third instrument, Global Ozone Monitoring Experiment (GOME), collects light arriving from the sun-illuminated atmosphere and decomposes it into its spectral components. The GOME data are sent to Deutsche Forschunsantalt Für Luft und Raumfahrt (DLR) for processing.

ERS-1 and ERS-2 instrumentation differ in only two ways:

- ERS-2 has a GOME instrument, ERS-1 does not;
- ERS-2 has an enhanced ATSR instrument operating in LR or HR.

Document A-2 contains a detailed description of the ERS-2 instruments.

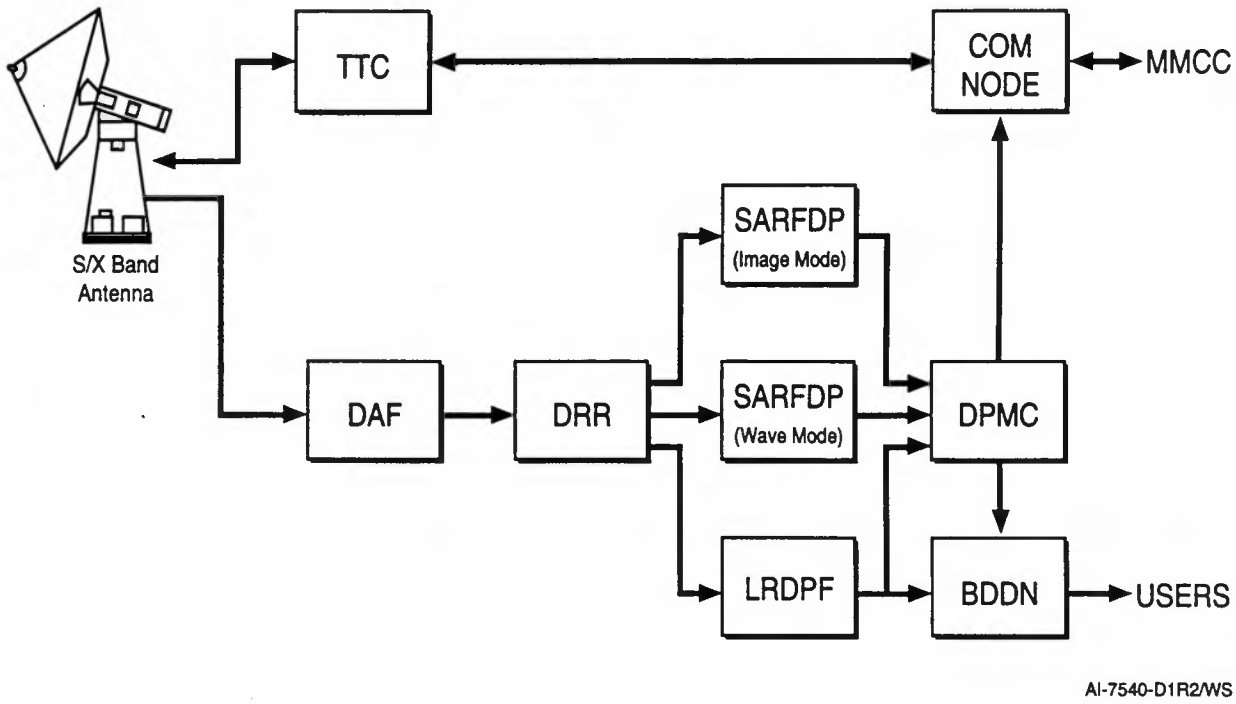


Figure 3-1 Kiruna Station Block Diagram

3.4.1 AMI Image Mode

The function of the Image Mode is to produce high-resolution radar images of the earth's surface. In this mode, the instrument operates as a Synthetic Aperture Radar (SAR). A swath of approximately 100 km is illuminated to the side of the satellite (see Figure 3-2).

The high-resolution image requiring both high RF power and a high data rate precludes on-board storage and prolonged measurement. Image mode operation is therefore performed only while in line-of-sight communication with the ground station.

3.4.2 AMI Wave Mode

The function of wave mode is to measure the change in radar reflectivity of the sea surface due to ocean waves. In this mode, the instrument operates as a SAR.

For wave mode, the input signals and the target area are reduced from that of the image mode in both the along-track and across-track directions, having the effect of reducing the output data rate to enable on-board storage of the wave data (see Figure 3-2).

The data acquired is first processed as in the SAR image mode, except that there is no Doppler Ambiguity Estimator. In a second step, the wave image is converted to a spectrum of the SAR image.

3.4.3 AMI Wind Mode

In the AMI wind mode (scatterometer) the sea surface is sequentially illuminated by RF pulses and the backscattered signal is measured to determine the sea surface radar reflectivity. From this, the wind characteristics are determined by using a model which relates wind speed and wind direction relative to the radar beam to sea surface reflectivity. Unambiguous wind measurements require that each ocean patch is illuminated under at least three different directions. This is achieved by using three antennas, one looking sideward (midbeam antenna), one looking 45° forward (forebeam antenna), and one looking 45° aftward (aftbeam antenna) with respect to the spacecraft flight direction (Figure 3-3). All three antennas form a fan beam with a narrow azimuth pattern and a relative wide elevation pattern in order to cover a wide swath (measurement area approximately 500 km) parallel to the subsatellite track (Figure 3-4).

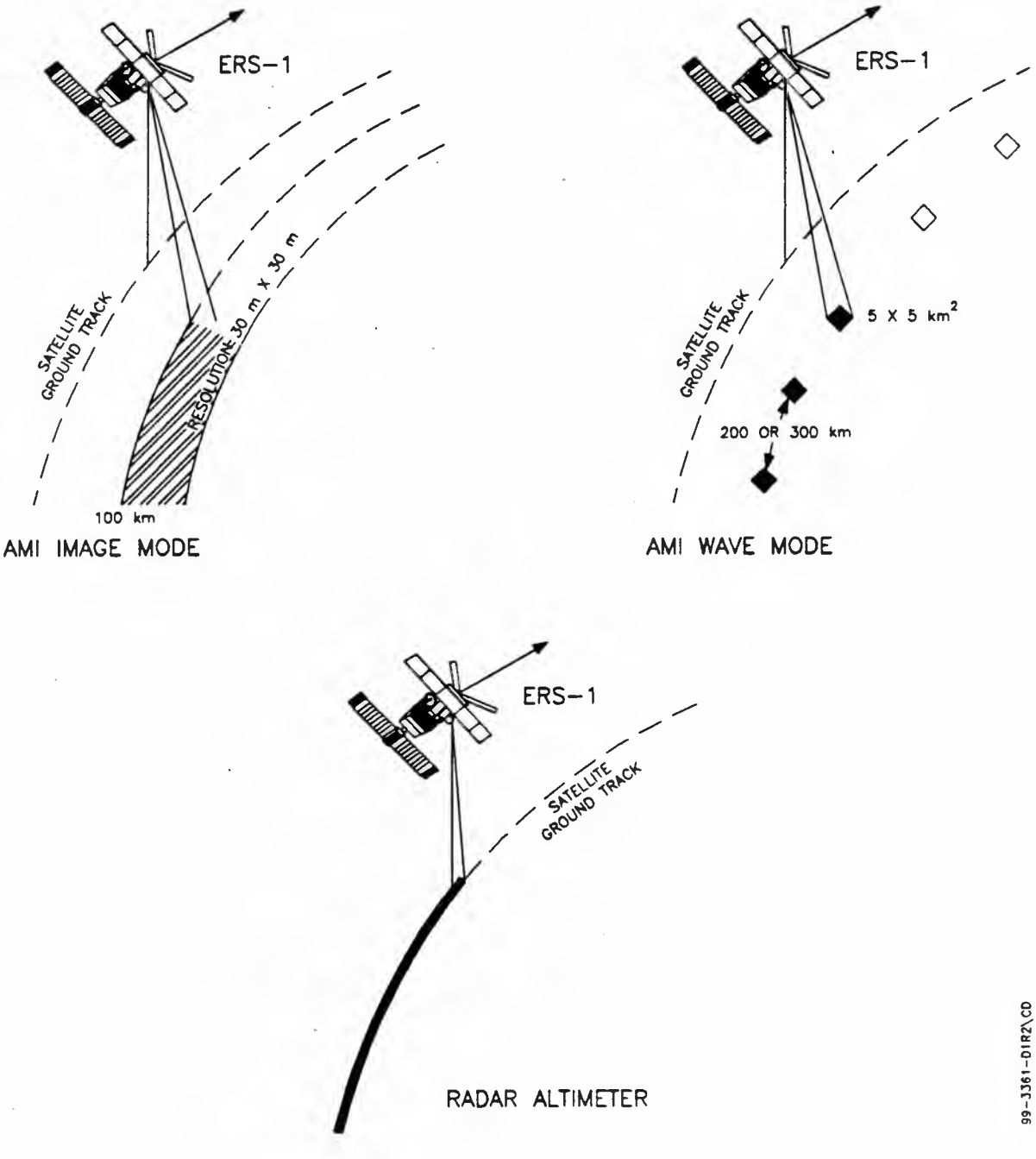


Figure 3-2 Data Collection

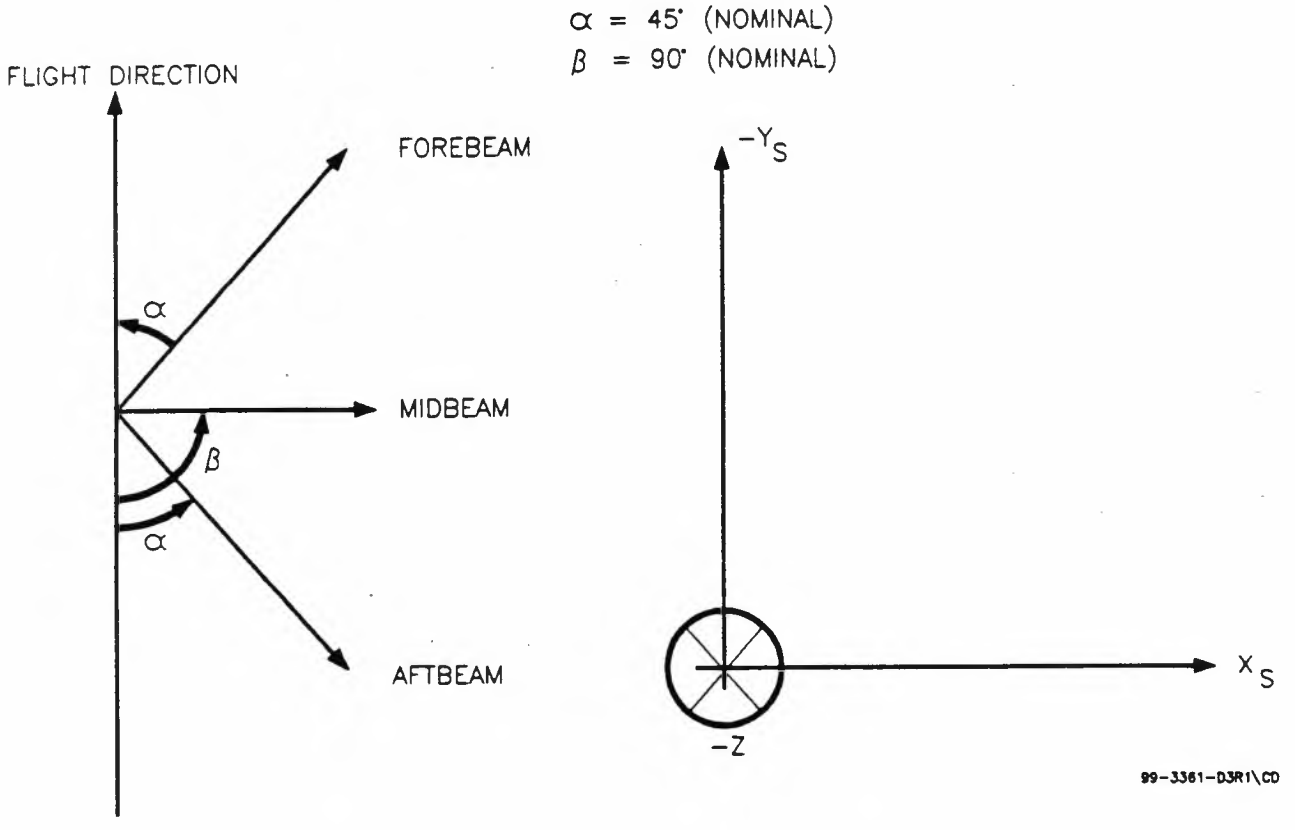


Figure 3-3 Scatterometer Antenna Orientations

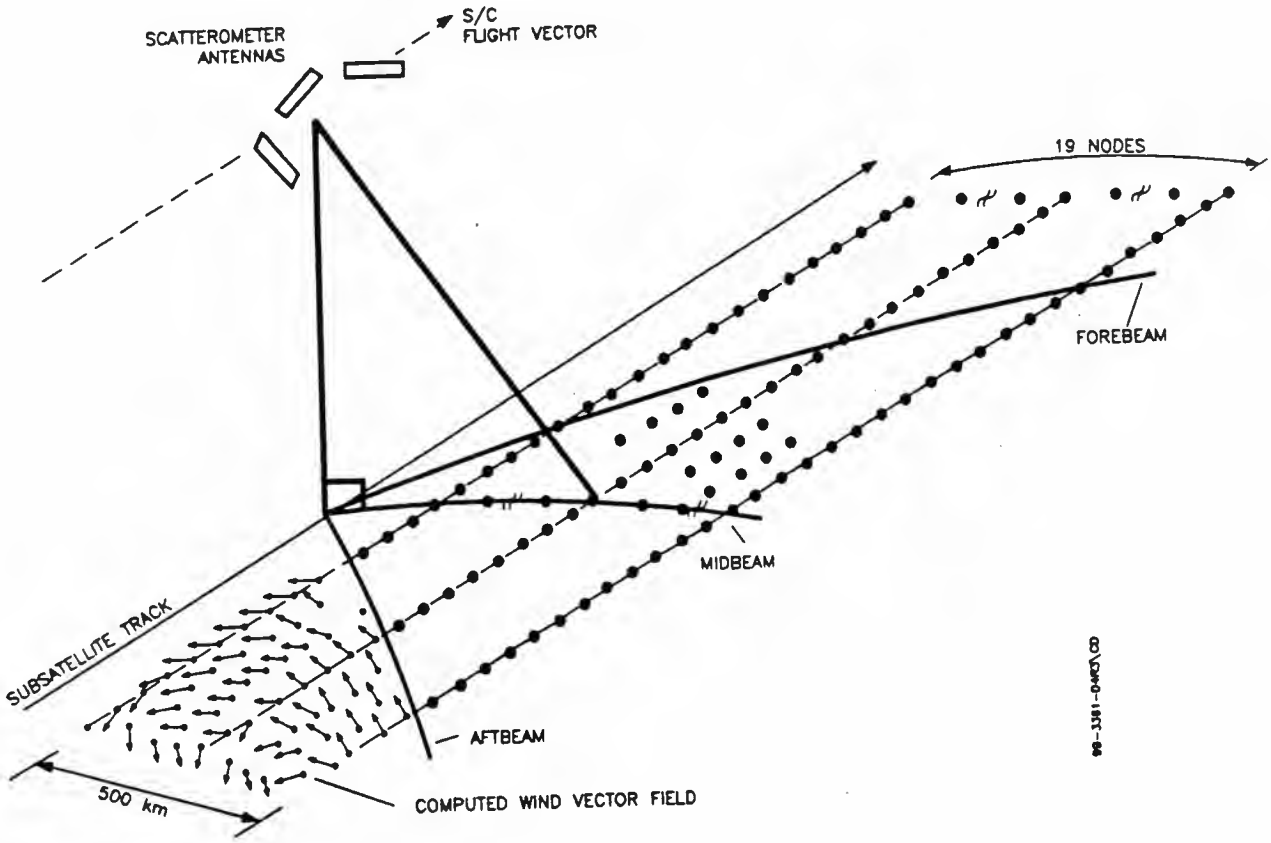


Figure 3-4 Scatterometer System Geometry

(For clarity, not all nodes and their surrounding areas are shown.)

Inside the swath a regular grid of points, called (measurement) nodes, is defined, the spacing of which is approximately 25 km.

Wind speed and direction can be calculated from either two or three beams. The number of beams used is indicated with each cell.

The conversion from sigma naught to wind speed and direction gives an ambiguous result. In a second step, an attempt is taken to remove the ambiguity. If that is not possible, it is indicated in the output product and the most likely solution is given.

3.4.4 Radar Altimeter

The RA of ERS-2 is a nadir-looking active microwave instrument, which operates over the ocean and over ice. Over ocean it is used to determine the significant wave height, the wind speed and the mesoscale topography. Over ice it is used to determine the ice surface topography and ice type.

The microwave measurements comprise the time delay between transmission and reception of a pulse, the slope of the leading edge of the return pulse, the amplitude of the return pulse and the echo waveforms.

These measurements are used as follows:

- The altitude is determined from the measured delay time after correction of propagation delays caused by ionosphere and troposphere.
- The significant ocean wave height (SWH) is calculated from the slope of the leading edge of the return echo.
- The wind speed over sea surfaces is estimated from the power level of the backscatter signal.

3.4.5 Along-Track Scanning Radiometer

The ATSR-2 instrument is purely passive. It consists of a rotating scan mirror, with a field of view of one kilometer by one kilometer at nadir, and several detectors tuned to specific thermal or visible wavelengths. The instrument was conceived and designed to provide the following main types of data and observations:

- Sea surface temperature with an absolute accuracy of better than 0.5°K with a spatial resolution of 50 km and in conditions of up to 80% cloud-over.

- Images of surface temperature with1 km resolution and 500 km swath with a relative accuracy of about 0.1°K.
- Observations of clouds, aerosols, and haze.

3.4.6 Global Ozone Monitoring Experiment

GOME is an across-track scanning optical spectrometer operating on four channels covering the wavelength range 240 to 790 nm. The instrument collects light arriving from the sun-illuminated atmosphere and decomposes it into its spectral components. From the spectrum the absorbing atmospheric constituents can be determined. The most prominent molecule in this range is ozone but other molecules are also detectable. From GOME data there is the possibility of deriving cloud coverage and properties, aerosol type and properties, and surface reflectance values. The GOME instrument is integrated into and controlled by the ATSR-2.

3.4.7 Microwave Radiometer

The instrument is a microwave sounder operating at either 23.8 GHz or 36.5 GHz. The field of view for the instrument is near nadir: the 23.8 GHz channel pointing slightly backward and the 36.5 GHz channel pointing slightly forward. The results from the two channels are co-registered at nadir to provide water vapor content measurements every 1.2 seconds (8 km). The microwave radiometer instrument is integrated into and controlled by the ATSR-2.

3.5 Satellite: X-Band Downlink

The instrument data transmitted by the satellite in the X-Band down link consists of two independent types: High Rate (HR) in Link 1 and Low Rate (LR) in Link 2. These are described below.

3.5.1 High Rate Data (LINK 1)

High Rate data consists of formatted AMI image mode SAR data plus Instrument Data Handling and Transmission (IDHT) General Header. The data is put into frames of 256 bytes each, of which the first 6 bytes are allocated to a frame header generated by the IDHT formatter. One complete SAR data set, corresponding to one pulse return (range line), is contained in a format of 29 frames.

The IDHT format generation rate is somewhat greater than the SAR data set generation rate, to avoid synchronization problems and to accommodate the variation in SAR pulse generation rate. The IDHT will generate a format or frame with Pseudorandom Noise (PRN)-fill data whenever a data set is not available from the AMI.

IDHT General Header packets are subcommutated in segments of 8 bytes per transmitted format, and are located in the first frame of each format.

3.5.2 Low Rate Data (LINK 2)

3.5.2.1 Low Rate Data Contents and Formatting

Low Rate data is generated by five different sources:

- AMI operating in wave-mode
- AMI operating wind-mode
- ATSR (including MW and GOME)
- Radar Altimeter
- IDHT General Header

This data is transmitted in 412-byte transfer frames. The first 10 bytes of each frame are used for the frame header, and the last two for frame checksum, with the remaining 400 bytes available for LR data.

The LR data sources are multiplexed on a frame-by-frame basis by the IDHT, using a round-robin polling sequence. The IDHT transmission rate is intentionally greater than the net data generation rate of the LR data sources, so the IDHT will generate frames of PRN-fill data when none of the LR sources has data available during a polling sequence.

Each of the LR data sources generates data organized as source packets, which contain packet header, auxiliary data, and measurement data. Source packets typically are larger than the transfer frame data field, so that several transfer frames are generally required to transmit a source packet. The size and organization of the source packets are different for each of the data sources.

3.5.2.2 Low Rate Real-Time and Playback Data

Two separate streams of LR data are transmitted to the Ground Station: real-time data and playback data.

Real-time data is that which is acquired by the satellite instruments and transmitted directly to the ground station during the period when the satellite is within view of the ground station.

Playback data is that which is acquired during the majority of each orbit, when the satellite is not within view of the ground station. This data is recorded on board the satellite in the downlink format and transmitted to the ground station at a higher rate during the time in which the satellite is within view of the ground station (once per orbit).

4 PRODUCT DEFINITIONS

4.1 Introduction

4.1.1 Type of Products

This section gives a description of all products generated in Kiruna. The products are listed in Table 4-1 and Table 4-2, and are grouped in four categories:

- Raw Data Products
- Fast-Delivery (FD) Products
- Intermediate Products
- Extracted Data Products

Each product is described in the following sections.

MACDONALD DETTWILER

Table 4-1 Product Sizes

	Data Set			
	SPH Size in Bytes	Record Size in Bytes	Number of Records	Product Size in Bytes
RAW-DATA PRODUCTS				
ATSR-1 (RATSR)	282	4,004	1	4,462
ATSR-2 (EATC2)	282	6,804	1 (for LR) 2 (for HR)	7,262 (for LR) 14,066 (for HR)
FAST DELIVERY PRODUCTS				
AMI Image 16-bit (UI16)	260	10,004	6,300	63,025,636
AMI Image 8-bit (UI8)	260	5,004	6,300	31,525,636
AMI Image Noise Statistics and Drift Calibration (UIND)	28	1,540	4	6,364
AMI Image Chirp Replica (UIC)	N/A	1,540	2	3,256
AMI Wave (UWA)	260	148	1	584
AMI Wave Noise Statistics and	28	1,540 (G)	4	6,364
Drift Calibration (UWAND)	28	124 (B)	4	700
AMI Wave Chirp Replica (UWAC)	N/A	1,540	1	1,716
AMI Wind (UWI)	166	46	361	16,948
Radar Altimeter (URA)	56	88	77	7,008
INTERMEDIATE PRODUCTS				
AMI Wave Intermediate Products (IWA)	260	16,004 (G)	17	272,504
	260	24,004 (B)	17	408,504
AMI Image Intermediate Products (II16)	600	10,004	6,300	63,025,976
EXTRACTED DATA PRODUCTS				
AMI Image Calibration Data (EIC)	N/A	11,466	1	11,642
AMI Image Calibration Data (EICM)	N/A	11,642	5,400	62,866,976
AMI Wave Calibration Data (EWAC)	4,480	4,332	299	1,299,924
AMI Wind Calibration Data (EWIC)	282	7,864	1	8,322
Radar Altimeter Calibration Data (ERAC)	282	3,136	1	3,594
GOME Calibration Data (EGOC)	303	8,004	1	8,483
Microwave Calibration Data (EMWC)	315	900	1	1,391
AMI Image Instrument Headers (EII)	40	234 (M)	(V)	1,500,000(MP)
AMI Wave Instrument Headers (EWAI)	40	108 (M)	299	32,508 (MP)
AMI Wind Instrument Headers (EWII)	40	72 (M)	(V)	1,500,000 (MP)
Radar Altimeter Instrument Headers (ERAI)	40	3,136 (M)	(V)	1,500,000 (MP)
ATSR-1 Instrument Headers (EATI1)	40	4,004 (M)	(V)	1,500,000 (MP)
ATSR-2 Instrument Headers (EATI2)	40	13,604 (M)	(V)	5,000,000 (MP)
GOME Instrument Headers (EGOI)	40	8,004 (M)	(V)	1,500,000 (MP)
General Headers (EGH)	N/A	260	16	4,336
Ephemeris Data (EEP)	N/A	388	1	564
Text Product (TP)	N/A	84	1	260

M = maximum number of bytes per record
V = variable number of records
MP = maximum product size

G = OGRC
B = OBRC

Table 4-2 Data Volume

	Storage Subsystem	Number of Products per Orbit	Maximum Amount of Data per Orbit in kBytes	KS On-Disk Storage Requirement	Amount of Data per Day in kBytes
***NOTE: The relevant data for the LRDPF is TBD. ***					
RAW-DATA PRODUCTS					
ATSR-1 (RATSR)	N/A	40,000	178,480	N/A	1,784,800
ATSR-2 (EATC2)	DPMC	100 (for LR) 50 (for HR)	726 (for LR) 703 (for HR)	2 orbits 2 orbits	726,000 703,000
FAST DELIVERY PRODUCTS					
AMI Image 16-bit (UI16) (1)	DPMC	3	189,078	2 orbits	1,890,780
AMI Image 8-bit (U18) (1)	DPMC	3	94,577	2 orbits	945,770
AMI Image Noise Statistics and Drift Calibration (UIND) (1)	DPMC	2	13	2 orbits	130
AMI Image Chirp Replica (UIC)	DPMC	3	10	2 orbits	100
AMI Wave (UWA) (1)	DPMC	200	117	2 orbits	1170
AMI Wave Noise Statistics and	DPMC	10	64(G)	2 orbits	640
Drift Calibration (UWAND) (1)	DPMC	13	9(B)	2 orbits	90
AMI Wave Chirp Replica (UWAC) (1)	DPMC	200	343	2 orbits	3,430
AMI Wind (UWI)	DPMC	88	1,491	2 orbits	14,910
Radar Altimeter (URA)	DPMC	84	589	2 orbits	5,890
INTERMEDIATE PRODUCTS					
AMI Wave Intermediate Products (IWA) (1)	DPMC	200	54,500(G)	2 orbits	545,000

MACDONALD DETTWILER

Table 4-2 Data Volume

	Storage Subsystem	Number of Products per Orbit	Maximum Amount of Data per Orbit in kBytes	KS On-Disk Storage Requirement	Amount of Data per Day in kBytes
	SAR FDP	200	54,500(G)	2 orbits	545,000
	DPMC	200	81,701(B)	2 orbits	817,010
	SAR FDP	200	81,701(B)	2 orbits	817,010
AMI Image Intermediate Products (II16) (2)	DPMC	3	189,101	2 orbits	1,891,010
EXTRACTED PRODUCTS					
AMI Image Calibration Data (EIC)	SAR FDP	28,000	325,976	1 orbit	325,976
	DPMC	750	8,732	1 orbit	8,732
AMI Wave Calibration Data (EWAC)	SAR FDP	200	259,985	1 orbit	259,985
	DPMC	11	14,299	2 orbits	28,598
AMI Wind Calibration Data (EWIC)	DPMC	1,450	12,067	2 orbits	24,134
Radar Altimeter Calibration Data (ERAC)	DPMC	564	2,027	2 orbits	4,054
GOME Calibration Data (EGOC)	DPMC	4,000	33,932	2 orbits	67,864
Microwave Calibration Data (EMWC)	DPMC	1,375	1,913	2 orbits	3,825
AMI Image Instrument Headers (EII)	DPMC	10	1,500	2 orbits	15,000
AMI Wave Instrument Headers (EWAI)	DPMC	150	1,500	2 orbits	15,000
AMI Wind Instrument Headers (EWII)	DPMC	10	1,500	2 orbits	15,000
Radar Altimeter Instrument Headers (ERAI)	DPMC	10	1,500	2 orbits	15,000
ATSR-1 Instrument Headers (EATI1)	DPMC	10	1,500	2 orbits	15,000
ATSR-2 Instrument Headers (EATI2)	DPMC	10	5,000	2 orbits	50,000
GOME Instrument Headers (EGOI)	DPMC	10	1,500	2 orbits	15,000
General Headers (EGH)	DPMC	375	1,626	2 orbits	16,260
Ephemeris Data (EEP)	DPMC	1	0.6	2 orbits	6
Text Product (TP)	DPMC	10	2.6	2 orbits	26

Note: For calibration data products, the table gives the maximum amount of data which can be accommodated over one day. This data can be stored for ten consecutive orbits.

1 = one SAR FDP in wave, one in image mode

2 = the Image intermediate products II16 may be generated as an alternative to the UI16, UI8 products (i.e., not in addition to the FD products)

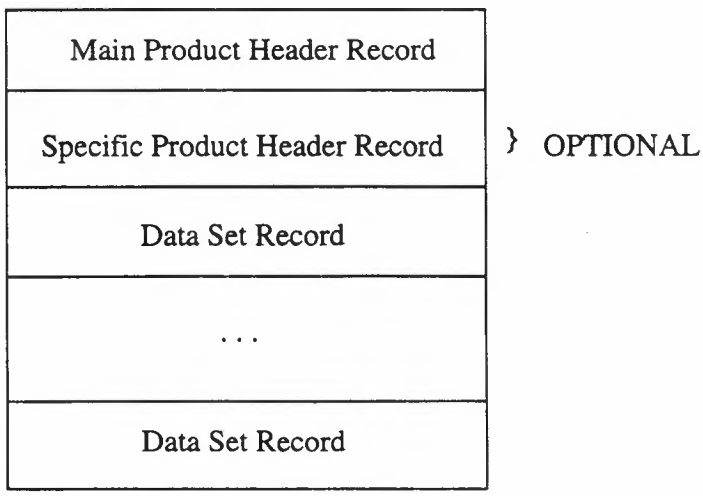
G =OGRC

B =OBRC

V =Variable Length

4.1.2 Structure of Product Format

Each product, with the exception of the raw data products stored on HDDT, has the same structure. This product structure consists of three parts.



The MPH has a single 176-byte record with an identical format for all products. The format of the Main Product Header record is given in Table 4-3. The Main Product Header contains information applicable to all processing chain products.

The specific product header is optional. The number and length of the record varies by product type.

All products have a product data set, consisting of one or more records. Length and number of records is determined by the product type and is given in the Main Product Header.

MACDONALD DETTWILER

Data Types

Data is stored in the following formats:

I1 = 1-byte unsigned integer
I2 = 2-byte integer in DEC format
I4 = 4-byte integer in DEC format

A = ASCII
B = 1 byte or bits (flags)
S = Special format, as defined in description field

Table 4-3 MPH for All Products (Except HDDT Products)

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	17	A/I	1-17	Product identifier (for internal operational use only); i.e., a set of characters and integers which form a unique identifier. The set is defined by MMCC and KS as follows: Byte 1 Originator of logical schedule "I" = MMCC - Immediate Command "M" = MMCC - Logical Schedule "J" = Local operator - Immediate Command "K" = Local operator - Logical Schedule Byte 2-5 Sequential Counter of Logical Schedule Byte 6-9 Unique Identification or Schedule Offset Byte 10-13 Not used, set to 0 Byte 14-17 Sequential Number of Currently Generated Product
2	1	I1	18	Type of Product:

Table 4-3 MPH for All Products (Except HDDT Products)

Field Number	Number of Bytes	Data Type	Byte Position	Description
				0 = ATSR Data (RATSR)
				1 = AMI Image-16-bit (UI16)
				2 = AMI Image-8-bit (UI8)
				3 = AMI Image Noise Statistics and Drift Calibration (UIND)
				4 = AMI Image Chirp Replica (UIC)
				5 = AMI Wave (UWA) (see also Field 12)
				6 = AMI Wave Noise Statistics and Drift Calibration (UWAND) (see also Field 12)
				7 = AMI Wave Chirp Replica (UWAC)
				8 = AMI Wind (UWI)
				9 = Radar Altimeter (URA)
				10 = AMI Wave Mode Intermediate (IWA) (see also Field 12)
				11 = AMI Image Mode Intermediate (II16)
				12 = AMI Image Calibration Data (EIC)
				13 = AMI Wave Calibration Data (EWAC)
				14 = AMI Wind Calibration Data (EWIC)
				15 = Radar Altimeter Calibration Data (ERAC)
				16 = AMI Image Instrument Headers (EII)

Table 4-3 MPH for All Products (Except HDDT Products)

Field Number	Number of Bytes	Data Type	Byte Position	Description
				17 = AMI Wave Instrument Headers (EWAI)
				18 = AMI Wind Instrument Headers (EWII)
				19 = Radar Altimeter Instrument Headers (ERAI)
				20 = General Headers (EGH)
				21 = Ephemeris Data (EEP)
				22 = Text Product (TP)
				30 = VI product (VMP)
				31 = VIC product (VMP)
				32 = VWA product (VMP)
				33 = VWAC product (VMP)
				34 = GOME Calibration Data (EGOC)
				35 = GOME Instrument Headers (EGOI)
				36 = ATSR-2 Instrument Headers (EATI2)
				37 = ATSR-1 Instrument Headers (EATI1)
				38 = ATSR-2 Calibration Data (EATC2)
				39 = Microwave Calibration Data (EMWC)
				40 = AMI Image Calibration Data (EICM)
3	1	I1	19	Spacecraft
				1 = ERS-1

Table 4-3 MPH for All Products (Except HDDT Products)

Field Number	Number of Bytes	Data Type	Byte Position	Description
				2 = ERS-2
4	24	A	20-43	UTC time of subsatellite point at beginning of product (see Note 2). Format in ASCII: "dd-mmm-yyyy hh:mm:ss.ttt" For example: "30-JAN-1987 14:30:27.123"
5	1	I1	44	Station ID, where data was processed 1 = Kiruna Station (KS) 2 = Fucino Station (FS) 3 = Gatineau Station (GS) 4 = Maspalomas Station (MS) 5 = EECF Station (ES) 6 = Prince Albert Station (PS)
6	2	B	45-46	Product Confidence Data (described in Subsection 4.1.4) 1. bit PCD Summary Flag 0 = product correctly generated 1 = some problem during acquisition or product generation. For more detail see below and SPH. 2.-3. bit SPARE 4.-5. bit Performance of Downlink and X-Band acquisition chain. This value summarizes the PCD snap shots related to the product.

Table 4-3 MPH for All Products (Except HDDT Products)

Field Number	Number of Bytes	Data Type	Byte Position	Description
				0 = performance better than MMCC-supplied minimum threshold 1 = performance equal to or worse than MMCC-supplied minimum threshold 2 = performance unknown 6.-7. bit HDDT. This value summarizes the PCD snap shots related to the product. 0 = performance better than MMCC-supplied minimum threshold 1 = performance equal to or worse than MMCC-supplied minimum threshold 2 = performance unknown 8.-9. bit Frame Synchronizer 0 = performance better than MMCC-supplied minimum threshold 1 = performance equal to or worse than MMCC-supplied minimum threshold 2 = performance unknown 10.-11. bit FS to Processor I/F 0 = no parity error detected 1 = parity error detected 2 = performance unknown 12.-13. bit Checksum Analysis on LR Frames 0 = better than MMCC-supplied minimum percentage threshold 1 = worse than MMCC-supplied minimum percentage threshold 2 = performance unknown

Table 4-3 MPH for All Products (Except HDDT Products)

Field Number	Number of Bytes	Data Type	Byte Position	Description
				14.-15. bit Quality of Downlinked Formats and Source Packets 0 = total of complete packets received were more than the MMCC-defined minimum percentage threshold 1 = total of complete packets received was less than or equal to the MMCC-defined minimum percentage threshold 2 = performance unknown 16. bit Quality of Auxiliary Data 0 = auxiliary data (and/or chirp) correctly extracted 1 = auxiliary data (and/or chirp) not extracted For UWI and URA products, this flag is always zero.
7	24	A	47-70	UTC time when MPH was generated; Format as in field 4.
8	4	I4	71-74	Size of Specific Product Header Record in Bytes
9	4	I4	75-78	Number of Product Data Set Records
10	4	I4	79-82	Size of each Product Data Set Record in Bytes
11	1	B	83	Subsystem that generated the product. 1.-2. bit 0 = SAR FDP 1 1 = SAR FDP 2 2 = LRDPF 3 = VMP

Table 4-3 MPH for All Products (Except HDDT Products)

Field Number	Number of Bytes	Data Type	Byte Position	Description
12	1	B	84	OBRC flag used for SAR products only 1.-2. bit 0 = not used 1 = OGRC data 2 = OBRC data
13	24	A	85-108	UTC reference time. Time relation used to convert from satellite to ground, used together with the next two fields.
14	4	I4	109-112	Reference binary time of satellite clock
15	4	I4	113-116	Step length of satellite clock in nanoseconds
16	8	I2	117-124	Processor software version used to generate product. 1. Byte : Revision Level 2. Byte : Issue Level 3. Byte : Reserved 4. Byte : Reserved
17	2	I2	125-126	Threshold table version number.
18	2	B	127-128	Spare
19	24	A	129-152	UTC time of ascending node state vector.
20-25	24	I4	153-176	Ascending node state vector in earth-fixed reference system (see Note 1).
20	4	I4	153-156	State vector; X 10^{-2} m
21	4	I4	157-160	State vector; Y 10^{-2} m
22	4	I4	161-164	State vector; Z 10^{-2} m
23	4	I4	165-168	State vector; X velocity 10^{-5} m/s
24	4	I4	169-172	State vector; Y velocity 10^{-5} m/s
25	4	I4	173-176	State vector; Z velocity 10^{-5} m/s

Note 1. WARNING. Product types which don't need valid orbit state vectors (e.g, UWAND and extracted products) for production, may contain invalid state vectors since these are not verified during production. The state vedor in the MPH will be that from the last C_ORBIT_PROP command received prior to the product being generated.

Note 2. For SAR, the UTC time at beginning of product is the time of the first processing range line (i.e., 0.4 to 0.48 seconds before the zero doppler time of the first line of the product). For UWI, it is the time of the first line of nodes. For URA, it is the time of the first data set record.

Nonvalid Fields

If the Kiruna Station does not have a value for a field, either because the field is not applicable or a value is unavailable the field is set to:

0	for integer numbers
space	for ASCII
0	for bit fields within a byte
0	for special format. Note that there may also exist a "non-value" definition by the special format itself.

If a value exceeds the range of a type, the positive or negative maximum is given.

Byte + Bit Order

Data which are stored in Digital Equipment Corporation (DEC) internal storage formats have the following layout:

- 16-bit or 32-bit integer numbers have the Least Significant Byte first; for example:

Byte		
1	Least significant byte	Integer 1 (32 bits)
2	.	
3	.	
4	Most significant byte	
5	Least significant byte	Integer 2 (32 bits)
6	.	
7	.	
8	Most significant byte	
9	Least significant byte	Integer 3 (32 bits)
10	.	
11	.	
12	Most significant byte	
.	.	
.	.	
.	.	

- data addressed on bit level; for example, Product Confidence Data (PCD), have the bit addresses start at the least significant bit of a byte and increase to the most significant bit in the byte; i.e., the data item with the following description:

1.- 3. bit	PCD_A
4.bit	PCD_B
5.- 7. bit	PCD_C
8.-10. bit	PCD_D
11.-16. bit	PCD_E

is stored:	1. byte	2. byte
bit position:	7 6 5 4 3 2 1 0	15 14 13 12 11 10 9 8
storage of PCD:	D C C C B A A A	E E E E E E D D

4.1.3 Product Generation

Products are generated and distributed according to a schedule which is defined by the MMCC. This schedule contains separate commands to generate and disseminate these

products. The parameters with which a product is generated, are product-dependent. Details are given for each product type under the heading "Product Generation", in the product description contained in Subsections 4.2 to 4.5.

Products are distributed through a product type-specific media. As backup they may be disseminated through an alternate media; Table 4-4 gives an overview of which product may use which distribution media.

Products are generated by the three Fast Delivery Processors (FDPs). Once completed, they can be output to the DPMC, which provides temporary storage on disk until the products are distributed. The length of time for which products are stored on disk is given under "On-line Storage Spec" in the product descriptions, in Subsections 4.2 to 4.5. Some products produced by the LRDPF can be sent to the BDDN for distribution without first being sent to the DPMC.

In addition to the nominal and alternative distribution media given in Table 4-4, any product type stored in the DPMC database (i.e., all product types except Raw Products) can be stored on CCT or Exabyte 8 mm tape cartridge.

In case there is a loss of data between products, null products may be generated. The interval of null products is determined by the PCD update rate (nominally 2.5 seconds) during ingestion. In terms of satellite time, the interval of null products will be:

- Low Rate Realtime data: 1.25 seconds
- Low Rate Playback data: 17.1 seconds
- High Rate data: 0.078 seconds

This variation is due to the difference between record speed and the speed of reproduction of data for ingestion.

MACDONALD DETTWILER

Table 4-4 Product Distribution Media

Product	Distribution Media				
	HDDT	Exabyte	CCT	BDDN	MMCC
* **NOTE:** The contents of this table are TBC.*					
Raw Data Products:					
High-Rate Data (RH)	N				
Low-Rate Data (RL)	N				
ATSR-1 (RATSR)		N			
ATSR-2 (EATC2)		N			
Fast Delivery Products:					
AMI Image 16-bit (UI16)		N		N	
AMI Image 8-bit (UI8)				N	
AMI Image Noise Statistic and Drift Calibration (UIND)				N	N
AMI Image Chirp Replica (UIC)					N
AMI Wave (UWA)				A	N
AMI Wave Noise Statistics and Drift Calibration (UWAND)				A	N
AMI Wave Chirp Replica (UWAC)				A	N
AMI Wind (UWI)				A	N
Radar Altimeter (URA)		N		A	N
Intermediate Products:					
AMI Wave Intermediate Product (IWA)		N		A	A
AMI Image Intermediate Product (II16)				N	
Extracted Data Products:					
AMI Image Calibration Data (EIC)			N	A	A
AMI Image Calibration Data (EICM)		N			
AMI Wave Calibration Data (EWAC)		N		A	A
AMI Wind Calibration Data (EWIC)		N		A	A
Radar Altimeter Calibration Data (ERAC)		N		A	A
GOME Calibration Data (EGOC)				N	
Microwave Calibration Data (EMWC)		N			
AMI Image Instrument Headers (EII)					N
AMI Wave Instrument Headers (EWAI)					N
AMI Wind Instrument Headers (EWII)					N
Radar Altimeter Instrument Headers (ERAI)					N
ATSR-1 Instrument Headers (EATI1)		A			A
ATSR-2 Instrument Headers (EATI2)		N			N
GOME Instrument Headers (EGOI)		N			N
General Headers (EGH)					N
Ephemeris Data (EEP)					N
Text Product				N	N

N = Nominal, A = Alternative (not to be considered for link sizing)

4.1.3.1 SAR FDP Input Data Error Handling

The SAR FDP has two basic schemes for minimizing the effects of bit errors in the high-rate and low-rate data:

- for extracted parameters which are relatively static (for example, PRF code, sampling window start time code, gain codes), the processor searches for the same value in two consecutive range lines or source packets;
- for dynamic extracted parameters (for example, range line number, satellite binary time code), the processor compares each value with previous and next values and thereby establishes the validity of each value based on acceptable ranges of change.

Missing or incomplete range lines of image mode data or source packets of wave mode data are replaced with zeroes. No parameters are extracted from the auxiliary data fields of these data sets. Missing data is indicated in the header of each affected product and summarized in the product confidence data field. Duplicate wave mode source packets are detected by the SAR FDP on the basis of the satellite binary time code and are discarded.

If data are not received for the generation of a product, then no product is generated and the SAR FDP indicates so in its status report to the DPMC.

4.1.3.2 LRDPF Input Data Error Handling

Error handling within the LRDPF is performed on a product-type basis. The following subsections describe the error handling strategy for each product type.

Note: The following subsections regarding error handling on the LRDPF are TBC. The LRDPF's error handling for GOME, MW and Wave data is TBD.

4.1.3.2.1 Radar Altimeter Error Handling

A URA Fast Delivery Product will always contain 77 data set records, equally spaced in time, by about one second.

Blank data records or, if necessary, blank products are generated, whenever no valid RA ocean tracking mode data are available at the beginning or between sets of valid data of the specified processing time interval. They are inserted as needed to ensure the above spacing as well as the right number of records per product.

A blank data record has the same structure as normal data record with only valid data for the UTC time, localization and the instrument mode identification byte. All other bytes of the blank data set record will be set to default values.

If a source packet is valid but not error-free, then calibration values contained in the auxiliary data of the packet will be ignored and the previous values, obtained from the last error-free source packet, will be used.

If at the end of a processing interval a product contains less than 77 data set records, then the whole product is discarded.

4.1.3.2.2 Wind Scatterometer Error Handling

Wind Scatterometer Fast Delivery Products will always be generated for the complete specified processing time interval with reference to the mid-beam.

Each product will correspond to an array of 19 nodes across-track by 19 nodes along-track with a node spacing of about 25 km.

For each node within the processing interval, the processor will attempt to find and process the corresponding satellite telemetered data of each beam (fore, mid and aft). For each beam and each node, the processor will calculate the corresponding sigma-nought value only if sufficient valid data are available for this node calculation.

The wind extraction algorithm will not be attempted for nodes having less than 2-beam sigma-nought calculated values. For each of the records of the products generated within the processing time interval, the appropriate data fields will be filled or flagged according to the number of processed beams and the possibility of wind vector extraction.

If a source packet is valid but not error-free, then calibration values contained in the auxiliary data of the packet will be ignored and the previous values, obtained from the last error-free source packet, will be used.

If at the end of the processing time interval, the last product is incomplete, it will be completed either by processed data or by blank records to make a complete product.

4.1.3.2.3 ATSR Products Error Handling

ATSR products shall be generated for a specified time interval.

The products shall start with the first data which can be extracted for that time interval: as long as no data are available, no products shall be generated.

In case there is a loss of data in gaps between products or at the end of a requested time period, then null products shall be generated with an update rate corresponding to the receipt of PCDs from the DPMC, normally every 2.5 seconds (see 4.1.3).

4.1.3.3 Extracted Data Products

Extracted data products may be generated by the SAR FDPs and the LRDPF. The general error handling strategy is independent of the processor involved.

4.1.3.3.1 General Header and Ephemeris Data Products

For EEP products, the input data are searched from the start time until a complete product is found, that is 16 contiguous frames forming a complete set of ephemeris data without error.

EGH products are generated within the time interval specified in the generation command. Products are generated within the interval corresponding to complete products; that is, sets of 16 contiguous error-free frames. Data which are not error-free are replaced by null data and flagged as erroneous. If no source packets are obtained in the interval then no product is generated.

4.1.3.3.2 Instrument Header and Calibration Data Product

Instrument Header products and Calibration Data products will be generated for a specified time interval.

The products will start with the first data which can be extracted for that time interval: as long as no data are available, no products will be generated.

In case there is a loss of data in gaps between products or at the end of a requested time period, then null products will be generated with an update rate corresponding to the receipt of PCDs from the DPMC, normally every 2.5 seconds (see 4.1.3) for the following products:

- EIC
- EWIC
- ERAC
- EWII
- ERAI
- EGOC (TBC)
- EATC2 (TBC)

- EMWC (TBC)

Note: Whether or not EGOI, EATI1 and EATI2 products will have null products is TBD.

For the Wave Instrument Headers (EWAI) and Wave Calibration Data Products (EWAC), products will be generated for all wave cells found within the specified time interval.

For the Image Instrument Headers (EII) products will be generated for all formats (one range line per format) found in a specified time interval, products will be generated within the specified interval.

In case of incomplete wave cells, the product EWAI or EWAC will be completed by null records to generate complete products.

4.1.4 Product Quality Control

All products disseminated from Kiruna contain information on the quality of the content. This data is referred to as Product Confidence Data (PCD). Six areas are covered:

- performance of downlink and X-Band acquisition chain;
- checksum analysis on LR frames;
- quality of downlinked formats and source packets;
- quality of auxiliary data;
- performance and status of processing chain equipment;
- quality assessment performed during product generation.

4.1.4.1 Location of Product Confidence Data in Product Format

Product confidence data are stored in several places throughout a product. As a general rule, acquisition-related information is stored in the MPH, processing information covering the entire product is given in the SPH, and information affecting the quality of individual cells is recorded on a cell basis together with the other cell contents. The location of the PCD in a product is as follows:

- Main Product Header:

  PCD summary flag;
  performance of downlinked and X-Band acquisition chain;
  performance and status of processing chain;
  checksum analysis on LR frames;
  quality of downlinked formats and source packets;
  quality of auxiliary data;

quality of auxiliary data;

- Specific Product Header (FD and intermediate products):

  product processor hardware equipment;

  quality of downlinked formats and source packets (image and wave products only);

  performance during product generation;

- Data Set Cell (RA and Wind products only):

  checksum analysis on LR frames;
  quality of downlinked formats and source packets;
  performance during product generation;
  quality assessment performed during product generation.

All PCD collected during acquisition and product generation are summarized in a single flag, product confidence factor. This flag is stored in the MPH of every product.

4.1.4.2 Performance of Downlink and X-Band Acquisition Chain

During acquisition, the following PCD is collected from the demodulator/bit synchronizer:

- Bit Error Rate (BER) estimate;
- downlink channel signal strength (through the automatic gain control);
- I and Q bit synch lock status;
- demodulator lock status.

These PCD, called PCD_DEMOD, are passed via the Time Code Generator (TCG) Interface to the TCG, to be embedded in the IRIG time code and passed on to the Data Path Switcher (DPS). The DPS outputs the downlinked data in parallel with the time code for recording on HDDT.

When data are read back from the HDDT for processing, the DPMC collects the PCD_DEMOD from the time code. It checks the PCD_DEMOD against limits, and passes the result as PCD flags (correct, incorrect, unknown) every 2.5 seconds on to the LRDPF and SAR FDP.

The LRDPF and the SAR FDPs attach the PCD flags to all products which are generated from the downlinked data associated with the PCD_DEMOD.

4.1.4.3 Checksum Analysis on Low Rate Frames

The LR transfer frame checksums are analyzed by the Frame Synchronizer. Any detected errors are flagged by the Frame Synchronizer. The LRDPF takes action by replacing the noise and calibration pulse data with defaults, and by flagging the event in the MPH.

In the SAR FDP, auxiliary data are checked for self consistency between consecutive source packets. A count of checksum errors is maintained and a flag in the MPH set if the ratio of erroneous frames to total frames exceeds a threshold.

4.1.4.4 Quality of Downlinked Formats and Source Packets

The performance of instrument formats and source packets is monitored by the SAR FDPs and the LRDPF through analysis of the data from the Frame Synchronizer.

If a source packet (LR) or format (HR) cannot be reassembled; that is, it is too short or too long, all data are either replaced by "0" (AMI image or wave products) before processing, or totally disregarded (AMI wind and RA products). In addition, a flag is set accordingly in the MPH, the SPH (image and wave products), and in the PCD of the cell (RA and wind products).

4.1.4.5 Quality of Auxiliary Data

Auxiliary data in the header of the downlinked data are checked by the processors against predefined limits. If a processor is unable to extract the auxiliary data needed for product generation, a flag is set accordingly in the MPH or in the PCD of the cell (RA and wind products).

4.1.4.6 Performance and Status of Processing Chain Equipment

The following equipment is monitored during product generation:

- High-Density Digital Recorders (HDDRs)
- Frame Synchronizers (FSs)
- Frame Synchronizer to product processor interfaces
- SAR FDP and LRDPF processor status

The HDDRs are monitored by the DPMC, which collects status information generated by the Tape Search Units (TSUs). The DPMC also collects Synch Lock status directly from the HDDR Master Formatters every 2.5 seconds, checks the parameters against

predefined limits, and passes the resulting flag (correct, incorrect, unknown) every 2.5 seconds on to the LRDPF and the SAR FDPs.

During the replay of the recorder, the Frame Synchronizers monitor the:

- BER, and
- lock status

of the downlinked data. The DPMC samples the Frame Synchronizer status every 2.5 seconds, checks the parameters against predefined limits, and passes the resulting flag (correct, incorrect, unknown) every 2.5 seconds on to the LRDPF and the SAR FDPs.

The Frame Synchronizers to processor interfaces are monitored in the SAR FDPs and the LRDPF. The processors check the parity bit in the incoming data from the Frame Synchronizer. Performance below a certain threshold is recorded in the MPH of the related products.

Generally, the processing hardware is checked out in the daily or in the prepass test. Each test usually produces a Pass or Fail result, which is reported to the MMCC in the relevant test report. In certain ambiguous cases, where processing is done with uncertain hardware conditions, a flag is set in the SPH of each product.

4.1.4.7 Performance During Product Generation

During product generation, algorithm-specific data for product confidence parameters are generated. Depending on whether a PCD applies to an entire product or a product cell, the PCD is stored in the SPH or in the cell PCD. Cell-dependent PCD exist for wind and RA products.

4.2 Raw Data Products

Raw data products contain data as received from the ERS-1 or ERS-2 satellite. No processing or reformatting of data has been performed. All raw data products are output on tape, either HDDT, CCT, or Exabyte. The raw data are annotated with the time of data reception at Kiruna and an indication of the quality of reception.

The following raw data products are described below:

- High Rate Data (RH)
- Low Rate Data (RL)
- ATSR-1 Data (RATSR)
- ATSR-2 Data (EATC2)

4.2.1 High Rate Data (RH)

Description: This data is an exact copy of all data downlinked from ERS-1 or ERS-2 on the X-Band High Rate Link.

Satellite Source: X-Band, Link 1; that is, the AMI image mode data (and scrambled zero frames) and IDHT General Header.

Originating Subsystem: DRR

Production Generation: all data received in Kiruna

Command: no specific product generation command

On-Line Storage Specification: recorded in parallel on two HDDTs, one HDDT is kept in Kiruna storage until the other HDDT has been accepted at the Product Archive Facility. Note that during the Commissioning Phase recording of ERS-2 data may take place on only one HDDR and hence there would be no redundant recording.

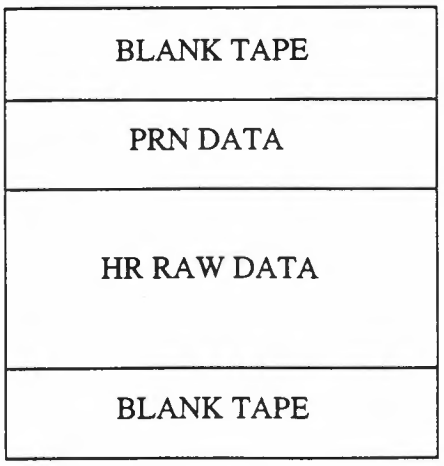
Throughput: all data of every pass

Format and Media:

The tapes recommended to record the HR (SAR image) downlinked data are 1-inch Sony V1-K compatible video tapes with a reel size of 14 inches, accommodating 9200 feet of tape.

To read these tapes, the same recorder used to generate them is required: Thorn EMI Datatech SE9000 Laboratory 28-Track Tape Recorder/Reproducer and the SE9500 3PM Digital Data Formatter configured for HR data. The units used at Kiruna have been modified by Thorn EMI to accept Sony V1-K compatible video tapes.

For HR data, each tape accommodates a single pass: approximately 11 minutes recording time. The layout of a tape is as follows:



At the beginning of each tape there is some blank space, followed by PRN data used to verify proper performance of the HDDRs prior to acquisition of data from the satellite. Next comes the downlinked X-Band data.

The data is recorded on 27 tracks (24 data plus 3 parity), at 120 ips, yielding a recording density of 39.06 kbps. Possible playback speeds range from 3-3/4 ips to 120 ips. The BER is 1 in 10^6 at any of these IRIG speeds.

On one track, an analogue time code in IRIG-A130 format (10 kHz carrier) is recorded (see Table 4-5). The time is Universal Time, Coordinated (UTC). Embedded in the IRIG format is product quality data.

The exact track allocation is as follows:

	Odd Headstack	**Even Headstack**
D R Channel (time code track)	1,	
Formatter 1	7, 13, 19, 25	4, 10, 16, 22, 28
Formatter 2	5, 11, 17, 23	2, 8, 14, 20, 26
Formatter 3	3, 9, 15, 21, 27	6, 12, 18, 24

Tape Label:

- MMCC-supplied information field
- satellite ID
- start time of pass
- stop time of pass
- station ID
- drive on which HDDT was generated

Comments on Product Confidence: Product confidence data from the demodulators are stored in the time track (see Table 4-4).

Table 4-5 Organization of Information in a Time Code Frame ("Not Used" Bits shall be set to Zero)

Bit Number	Meaning
0	**PR (Position Identifier - Reference)**
1	1 second
2	2 seconds
3	4 seconds
4	8 seconds
5	0 • not used
6	10 seconds
7	20 seconds
8	40 seconds
9	**P1 (Position Identifier)**
10	1 minute
11	2 minutes
12	4 minutes
13	8 minutes
14	0 • not used
15	10 minutes
16	20 minutes
17	40 minutes
18	0 • not used
19	**P2 (Position Identifier)**
20	1 hour
21	2 hours
22	4 hours
23	8 hours

MACDONALD DETTWILER

Table 4-5 Organization of Information in a Time Code Frame ("Not Used" Bits shall be set to Zero)

Bit Number	Meaning
24	0 • not used
25	10 hours
26	20 hours
27	0 • not used
28	0 • not used
29	**P3 (Position Identifier)**
30	1 day
31	2 days
32	4 days
33	8 days
34	0 • not used
35	10 days
36	20 days
37	40 days
38	80 days
39	**P4 (Position Identifier)**
40	100 days
41	200 days
42	0 • not used
43	0 • not used
44	0 • not used
45	0.1 second
46	0.2 second
47	0.4 second

Table 4-5 Organization of Information in a Time Code Frame ("Not Used" Bits shall be set to Zero)

Bit Number	Meaning	
48	0.8 second	
49	**P5 (Position Identifier)**	
50	PC0 1 HR BER estimate (LSB)	Product Confidence Bits (definitions given in Table 4-6)
51	PC1 2 HR BER estimate	
52	PC2 4 HR BER estimate	
53	PC3 8 HR BER estimate (MSB)	
54	PC4 1 HR AGC (LSB)	
55	PC5 2 HR AGC	
56	PC6 4 HR AGC	
57	PC7 8 HR AGC (MSB)	
58	PC8 HR carrier lock (1=TRUE)	
59	**P6 (Position Identifier)**	
60	PC10 1 LR BER estimate (PB) (LSB)	Product Confidence Bits (definitions given in Table 4-6)
61	PC11 2 LR BER estimate (PB)	
62	PC12 4 LR BER estimate (PB)	
63	PC13 8 LR BER estimate (PB) (MSB)	
64	PC14 HR I bit clock lock (1=TRUE)	
65	PC15 HR Q bit clock lock (1=TRUE)	
66	PC16 LR I bit clock lock (1=TRUE)	
67	PC17 LR Q bit clock lock (1=TRUE)	
68	PC18 PCD Source flag (1=chain 1, 0=chain 2)	See Note 1
69	**P7 (Position Identifier)**	

MACDONALD DETTWILER

Table 4-5 Organization of Information in a Time Code Frame ("Not Used" Bits shall be set to Zero)

Bit Number	Meaning	
70	PC20 1 LR BER (RT) (LSB)	Product Confidence Bits (definitions given in Table 4-6)
71	PC21 2 LR BER (RT)	
72	PC22 4 LR BER (RT)	
73	PC23 8 LR BER (RT) (MSB)	
74	PC24 1 LR AGC (LSB)	
75	PC25 2 LR AGC	
76	PC26 4 LR AGC	
77	PC27 8 LR AGC (MSB)	
78	PC28 LR carrier lock (1=TRUE)	
79	**P8 (Position Identifier)**	

Table 4-5 Organization of Information in a Time Code Frame ("Not Used" Bits shall be set to Zero)

Bit Number	Meaning	
80	SBS (LSB)	Straight Binary Seconds Time of Day
81	SBS	
82	SBS	
83	SBS	
84	SBS	
85	SBS	
86	SBS	
87	SBS	
88	SBS	
89	**P9 (Position Identifier)**	
90	SBS	
91	SBS	
92	SBS	
93	SBS	
94	SBS	
95	SBS	
96	SBS	
97	SBS	
98	SBS (MSB)	
99	**P0 (Position Identifier)**	

Note 1: Bit number 68 (PC18 PCD source flag) changes value every second while the data is being recorded.

Chain 1 indicates demodulators 0 and 2 (HR demod 1 and LR demod 1).

Chain 2 indicates demodulators 1 and 3 (HR demod 2 and LR demod 2).

MACDONALD DETTWILER

Table 4-6 Product Confidence Data Definitions

	PC3	PC2	PC1	PC0	QPSK											
	PC13	PC12	PC11	PC10	UQPSK PB (15 Mbps)											
	PC23	PC22	PC21	PC20							UQPSK RT (1.1 Mbps)					
	MSB			LSB	E/Nc db		BER TYP.		OUTPUT 0 + +10V		E/Nc db		BER TYP.		OUTPUT 0 + +10V	
					MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
15	1	1	1	1	0	2.77	8×10^{-2}	•	0	0.642	0	8.77	•	•	0	0.642
14	1	1	1	0	2.77	3.54	4×10^{-2}	•	0.642	1.283	8.77	9.54	•	•	0.642	1.283
13	1	1	0	1	3.54	4.30	2.5×10^{-2}	8×10^{-2}	1.283	1.916	9.54	10.30	•	•	1.283	1.916
12	1	1	0	0	4.30	5.07	1.5×10^{-2}	5×10^{-2}	1.916	2.558	10.30	11.07	1×10^{-5}	3×10^{-4}	1.916	2.558
11	1	0	1	1	5.07	5.84	8×10^{-3}	3×10^{-2}	2.558	3.199	11.07	11.84	4.5×10^{-6}	8×10^{-5}	2.558	3.199
10	1	0	1	0	5.84	6.60	3.5×10^{-3}	1.5×10^{-2}	3.199	3.833	11.84	12.60	4×10^{-7}	2×10^{-5}	3.199	3.833
9	1	0	0	1	6.60	7.38	1.5×10^{-2}	8×10^{-3}	3.833	4.483	12.60	13.38	$>1 \times 10^{-7}$	3×10^{-6}	3.833	4.483
8	1	0	0	0	7.38	8.14	5×10^{-4}	3.5×10^{-3}	4.483	5.116	13.38	14.14	$>1 \times 10^{-7}$	4×10^{-7}	4.483	5.116
7	0	1	1	1	8.14	8.91	1.5×10^{-4}	1.5×10^{-3}	5.116	5.758	14.14	14.91	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	5.116	5.758
6	0	1	1	0	8.91	9.68	4×10^{-5}	5×10^{-4}	5.758	6.399	14.91	15.68	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	5.758	6.399
5	0	1	0	1	9.68	10.45	1×10^{-5}	1.5×10^{-4}	6.399	7.041	15.68	16.45	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	6.399	7.041
4	0	1	0	0	10.45	11.22	2×10^{-6}	4×10^{-5}	7.041	7.683	16.45	17.22	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	7.041	7.683
3	0	0	1	1	11.22	11.98	$>1 \times 10^{-7}$	1.5×10^{-6}	7.683	8.316	17.22	17.98	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	7.683	8.316
2	0	0	1	0	11.98	12.75	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	8.316	8.957	17.98	18.75	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	8.316	8.957
1	0	0	0	1	12.75	13.52	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	8.957	9.607	18.75	19.52	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	8.957	9.607
0	0	0	0	0	13.52	•	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	9.607	10.0	19.52	•	$>1 \times 10^{-7}$	$>1 \times 10^{-7}$	9.607	10.0

Theoretical Limit: 4×10^{-5} for low-rate RT demodulator

* Out of range

The absolute accuracy of E/N_0 measurement is: ± 1.0 dB

The E/N_0 quantization step size is: 0.77 dB

Table 4-6 Product Confidence Data Definitions

	PC7	PC6	PC5	PC4	QPSK			
	PC27	PC26	PC25	PC24	UQPSK (PB) (RT)			
	MSB			LSB	Input Level (dBm)		Output (0 + +10V)	
					MIN	MAX	MIN	MAX
15	1	1	1	1	*	-47.44	0	0.624
14	1	1	1	0	-47.44	-44.88	0.625	1.28
13	1	1	0	1	-44.88	-42.32	1.28	1.925
12	1	1	0	0	-42.32	-39.76	1.925	2.562
11	1	0	1	1	-39.76	-37.20	2.562	3.200
10	1	0	1	0	-37.20	-34.64	3.200	3.837
9	1	0	0	1	-34.64	-32.08	3.837	4.475
8	1	0	0	0	-32.08	-29.52	4.475	5.125
7	0	1	1	1	-29.52	-26.96	5.125	5.762
6	0	1	1	0	-26.96	-24.40	5.762	6.400
5	0	1	0	1	-24.40	-21.84	6.400	7.050
4	0	1	0	0	-21.84	-19.28	7.050	7.675
3	0	0	1	1	-19.28	-16.72	7.675	8.325
2	0	0	1	0	-16.72	-14.16	8.385	8.962
1	0	0	0	1	-14.16	-11.6	8.962	9.600
0	0	0	0	0	-11.6	*	9.600	10V

Absolute accuracy of Input Level measurement is: ±1 dB

Input Level quantization step size is: 2.56 dB

4.2.2 Low Rate Data (RL)

Description: This data is an exact copy of all data downlinked from ERS-1 or ERS-2 on the X-Band Low Rate Link.

Satellite Source: X-Band, Link 2; that is, AMI wave mode, AMI wind mode, RA data (and scrambled zero data) and IDHT General Header.

Originating Subsystem: DRR

Product Generation: all data received in Kiruna

Command: no specific product generation command

On-Line Storage Specification: recorded in parallel on two HDDTs. One HDDT is kept in Kiruna storage until the other HDDT has been accepted at the Product Archive Facility. Note that during the Commissioning Phase recording of ERS-2 data may take place on only one HDDR and hence there would be no redundant recording.

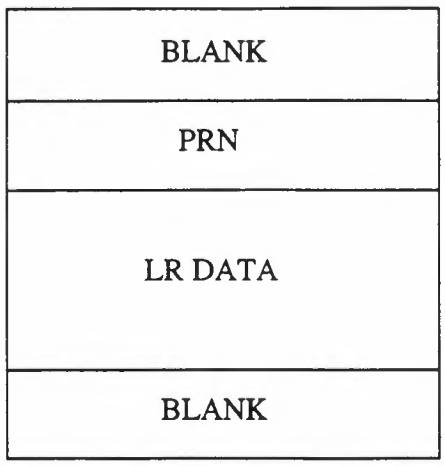
Throughput: all data of every pass

Format and Media:

The tapes recommended to record the LR downlinked data are 1-inch Sony V1-K compatible video tapes accommodating 6000 feet of tape.

To read these tapes, the same recorder used to generate them is required: Penny and Giles Datatech SE9000 Laboratory 14-Track Tape Recorder/Reproducer and the SE9500 3PM Digital Data Formatter configured for LR data. The units used at Kiruna have been modified by Penny and Giles to accept Sony V1-K compatible video tapes.

LOW RATE



Preceding each pass there is some blank space, followed by PRN data used to verify proper performance of the HDDRs prior to acquisition of data from the satellite. Next comes the downlinked X-Band data.

The data is recorded on 13 of the available 14 tracks: 9 tracks (8 data + 1 parity) for the 15 Mbps PB data and 4 tracks (3 data + 1 parity) for RT data. Data is recorded at 60 ips, yielding packing densities of 33.48 kbpi and 14.28 kbpi for PB and RT, respectively.

The PB data is recorded on the tape in reverse direction from the RT data. Possible playback speeds for the PB data range from 15 to 60 ips. For RT data the playback speed can be 60 or 120 ips.

The BER is 1 in 10^6 at any of these IRIG speeds.

On one track, an analogue time code in IRIG-A130 format (10-kHz carrier) is recorded (see Table 4-5). The time is UTC. Embedded in the IRIG format is product quality data.

The exact track allocation is as follows:

	Odd Headstack	Even Headstack
Formatter 1 (PB)	3, 5, 7, 11	2, 6, 8, 10, 12
Formatter 2 (RT)	9, 13	4
D R Channel (time code track)	1	

Tape Label:

- MMCC-supplied information field
- satellite ID
- start time of 1. pass
- stop time of 1. pass
- start time of 2. pass
- stop time of 2. pass
- start time of 3. pass
- stop time of 3. pass
- station ID
- drive on which HDDT was generated

Comments on Product Confidence: See High Rate Data.

4.2.3 ATSR-1 Data (RATSR)

Description: This product contains one ATSR-1 and one General Header source packet.

Satellite Source: ATSR-1 and General Header

Originating Subsystem: LRDPF

Product Generation: ATSR-1 products are generated for an MMCC-specified start and stop time.

Command: C_GEN_RATSR

On-Line Storage Specification: none

Throughput: All data collected in one orbit, approximately 40K products, per orbit.

Format: One product includes:

- **Main Product Header:** See Table 4-3.
- **Specific Product Header:** General Header information is stored in the SPH record as shown in Table 4-8.

  All ATSR-1 products have the same size. If there is no General Header available, the General Header portion of the SPH is padded with zeroes. Note that a General Header packets is received only for every 6th to 7th ATSR-1 package.

  The General Header packet is not available for the first RATSR product resulting from the C_GEN_RATSR command, unless the times of the General Header and RATSR packets are identical.
- **1 Product Data Set Record:** The product data set consists of one record with one ATSR-1 source packet as specified in Table 4-7.

Media: ATSR-1 products are stored on Exabyte. Products of one specified time frame are stored on one or several tapes. Each tape contains a maximum fixed number of products. More information on Exabyte storage is included in Appendix B.

Comments on Product Confidence: See Subsection 4.1.3.2.3.

Table 4-7 Specific Product Header Record for RATSR, EATC2, EWIC, ERAC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	256	S	1-256	PF Data. This field is identical to the first 256 bytes of the "Source Data Field" of the General IDHT Header Source Packet, see Document A-2.
2	1	S	257	Ephemeris ID. This field is identical to the Ephemeris ID byte field of the "Source Data Field" of the General IDHT Header Source Packet, see Document A-2.
3	1	B	258	Spare - not used.
4	24	S	259-282	Ephemeris data subcommutated. This field is identical to the subcommutated, 24 bytes of Ephemeris Data of the "Source Data Field" of the General IDHT Header Source Packet, see Document A-2.

Table 4-8 Data Set Record for RATSR

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, this number is always 1.
2	4000	S	5-4004	One source packet, identical to the down-linked format, see Document A-2.

4.2.4 ATSR-2 Data (EATC2)

Description: This product contains one LR or two HR ATSR-2 source packets and one General Header source packet.

Satellite Source: ATSR-2 and General Header

Originating Subsystem: LRDPF

Product Generation: ATSR-2 products are generated for an MMCC-specified start and stop time.

Command: C_GEN_EATC2

On-Line Storage Specification: none

Throughput: All data collected in one orbit, approximately 44,000 products, per orbit.

Format: One product includes:

- **Main Product Header:** See Table 4-3.
- **Specific Product Header:** See Table 4-8.
- **1 Product Data Set Record for LR, 2 Product Data Set Records for HR:** The product data set record consists of one ATSR-2 source packet as specified in Table 4-8.

Media: ATSR-2 products are stored on Exabyte. Products of one specified time frame are stored on one or several tapes. Each tape contains a maximum fixed number of products. More information on Exabyte storage is included in Appendix B.

Comments on Product Confidence: See Subsection 4.1.3.2.3.

Table 4-9 Data Set Record for EATC2

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number.
2	6800	S	5-6804	One source packet, identical to the down-linked format, see Document A-2.

4.3 Fast Delivery Products

Fast delivery products include all products which are disseminated over a high-speed or the MMCC link. This includes the following products:

- AMI Image-16-bit (UI16)
- AMI Image-8-bit (UI8)
- AMI Image Noise Statistic and Drift Calibration (UIND)
- AMI Image Chirp Replica (UIC)
- AMI Wave (UWA)
- AMI Wave Noise Statistic and Drift Calibration (UWAND)
- AMI Wave Chirp Replica (UWAC)
- AMI Wind (UWI)
- Radar Altimeter (URA)

4.3.1 AMI Image-16-bit (UI16)

Description: SAR processed image covering an area of about 100 x 100 km. This is equivalent to the full azimuth swath width (5000 pixels) and 6300 lines. Pixel size is 20 m (ground range) by approximately 16 m (azimuth). The pixel value, proportional to the square root of the image pixel power (magnitude), is represented by 16 bits. The image specification for the product is given in Document R-1.

Input for this product is On-Ground Range Compressed (OGRC) data. These are data which have been acquired and digitized on the spacecraft prior to range compression and which undergo range compression in the SAR FDP.

Satellite Source: AMI Image mode

Originating Subsystem: SAR FDP

Product Generation: The MMCC defines the start time for each product.

Command: C_GEN_UI

On-Line Storage Specification: 200 minutes

Throughput: Three AMI Image products, either 8- or 16-bit output pixels, per orbit and per SAR FDP. If both SAR FDPs are in image mode, only 8-bit images can be produced, if the On-line storage capacity specification is to be met.

The throughput requirements are not applicable if the SAR FDP must produce one or more of the following products:

- Extracted Data Product
- Instrument Header Product

Format: One product includes:

- **Main Product Header:** See Table 4-3.
- **Specific Product Header**: See Table 4-10.
- **6300 Product Data Set Records**: See Table 4-8. One record is one range line. Range lines are stored in ascending time order. Within each range line, pixels closer to the satellite track precede farther range pixels. The intensity of each pixel is represented by 16 bits.

Media: Exabyte; for tape format and label, see Appendix B.

Comments on Product Confidence:

- **Missing Lines**: Missing and corrupted lines are padded with zeroes before processing.

  The number of missing lines is given in the SPH.

- **Chirp Replica Quality**: The pulse width, first side lobes, and ISLR of the chirp cross-correlation function are checked against specification.
- **Input Data Statistic**: The mean and variance of the I and Q input data is computed, and compared against norms.
- **Doppler Centroid Confidence:** The goodness of fit of the expected and actual beam profile are computed and compared to norms.
- **Doppler Centroid Value:** The Doppler centroid offset from zero Doppler is compared to a norm.
- **Doppler Ambiguity Estimator Measures:** Statistics based on the correlation peak of two looks in range are used to derive a product confidence measure. UI16 and UI8 products only.
- **Output Data Statistic:** The mean and standard deviations of output data are computed, compared against norms.

MACDONALD DETTWILER

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
1	2	B	1-2	Product Confidence Data for Processing. These bits do not cause the MPH summary bit to be set. 1.-2. bit Processing equipment status 0 = equipment working 1 = some problems with equipment 2 = equipment failed during product generation 3. bit PRF code change flag 0 = same PRF code for entire image 1 = PRF code changed 4. bit Sampling window change flag 0 = same sampling window for entire image 1 = sampling window changed 5. bit Calibration system and receiver gain change flag	N/A

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = same calibration system and receiver gain for entire image 1 = calibration system or receiver gain changed	
			6. bit	Chirp replica quality flag 0 = cross-correlation (note 1) pulse width, first side lobe and ISLR all less than MMCC-specified values 1 = the correctly extracted chirp quality (pulse width, first side lobe and ISLR) exceeds the thresholds set by the MMCC.	
			7. bit	Input data statistic flag (see Note 4).	

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = mean of I and Q input values are both within MMCC-specified percentage of dynamic range centre, and standard deviation values of I and Q input values are both greater than MMCC-specified percentage of dynamic range 1 = otherwise	
			8. bit	Doppler centroid confidence measure flag 0 = confidence measure ≤MMCC-specified value 1 = confidence measure >MMCC-specified value	
			9. bit	Doppler centroid value flag 0 = centroid absolute value ≤PRF/2 1 = centroid absolute value >PRF/2	
			10. bit	Doppler ambiguity confidence measure flag	

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = confidence measure ≥MMCC-specified value 1 = confidence measure <MMCC-specified value	
				11. bit Output data mean flag (see Note 5). 0 = mean and standard deviation both greater than MMCC-specified percentage of dynamic range 1 = otherwise	
				12. bit Land/Sea Flag (wave mode only) 0 = Sea image 1 = Land image	
				13.-16.bit Spare	
2	4	I4	3-6	Subsatellite Track Heading at mid-azimuth position of product	10^{-3} deg
3	2	I2	7-8	Number of PRF code changes. No PRF changes are to be expected during an imaging sequence.	
4	2	I2	9-10	Number of sampling window time changes	
5	2	I2	11-12	Number of calibration system gain changes plus number of receiver gain changes	
6	2	I2	13-14	Number of missing lines	

MACDONALD DETTWILER

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
7	2	I2	15-16	Incidence angle at imagette centre (wave mode only)	10^{-3} deg
8	4	I4	17-20	3-dB pulse width of chirp replica cross-correlation function (see note 1.)	10^{-3} pixels
9	4	I4	21-24	First side lobe level of point chirp replica cross-correlation function (see note 1.)	10^{-3} dB
10	4	I4	25-28	ISLR of chirp replica cross-correlation function (see note 1.)	10^{-3} dB
11	4	I4	29-32	Doppler centroid confidence measure. This is the goodness of fit between the Doppler data and the beam replica. A value of zero results when there is a perfect match between the Doppler data and the replica. A value of one represents the worst possible fit.	10^{-3}
12	4	I4	33-36	Doppler ambiguity confidence measure. This is a measure of the peak of the matched filter output for the predicted Doppler ambiguity offset. This value is normalized such that it takes a value of one for the best case and a value of zero for the worst case. (Not used in wave mode products.)	10^{-3}
13	4	I4	37-40	Unbiased Mean of uncorrected I input data	10^{-3}
14	4	I4	41-44	Unbiased Mean of uncorrected Q input data	10^{-3}
15	4	I4	45-48	Standard Deviation of I input data	10^{-3}

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
16	4	I4	49-52	Standard Deviation of Q input data	10^{-3}
17-26	40	I4	53-92	Scene Latitudes and Longitudes (see Note 6)	
17	4	I4	53-56	Geodetic latitude of the first pixel of the first line of the scene product. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
18	4	I4	57-60	East longitude (i.e. 360° from Greenwich to east) of the first pixel of the first line of the scene product.	10^{-3} deg
19	4	I4	61-64	Geodetic latitude of the last pixel of the first line of the scene product.	10^{-3} deg
20	4	I4	65-68	East longitude of the last pixel of the first line of the scene product.	10^{-3} deg
21	4	I4	69-72	Geodetic latitude of the last pixel of the last line of the scene product.	10^{-3} deg
22	4	I4	73-76	East longitude of the last pixel of the last line of the scene product.	10^{-3} deg
23	4	I4	77-80	Geodetic latitude of the first pixel of the last line of the scene product.	10^{-3} deg
24	4	I4	81-84	East longitude of the first pixel of the last line of the scene product.	10^{-3} deg
25	4	I4	85-88	Geodetic latitude of the centre pixel of the scene product.	10^{-3} deg
26	4	I4	89-92	East longitude of the centre pixel of the scene product.	10^{-3} deg
27	1	B	93	Origin of used chirp (not applicable for OBRC)	
				1. bit	

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = chirp replica used 1 = Default chirp from MMCC has been used. Note: In case of requested chirp from telemetry and extraction fails, the default chirp from MMCC is used.	
28	2	I2	94-95	Chirp extraction index	samples
29	4	I4	96-99	Chirp amplitude coefficient-constant	10^{-5}
30	4	I4	100-103	Chirp amplitude coefficient-linear	sec^{-1}
31	4	I4	104-107	Chirp amplitude coefficient-quadratic	$10^{5} sec^{-2}$
32	4	I4	108-111	Chirp amplitude coefficient-cubic	$10^{10} sec^{-3}$
33	4	I4	112-115	Chirp amplitude coefficient-quartic	$10^{15} sec^{-4}$
34	4	I4	116-119	Chirp phase coefficient-constant	10^{-6} cycles
35	4	I4	120-123	Chirp phase coefficient-linear	Hz
36	4	I4	124-127	Chirp phase coefficient-quadratic	10^{6} Hz/sec
37	4	I4	128-131	Chirp phase coefficient-cubic	10^{12} Hz/sec^{2}
38	4	I4	132-135	I bias for raw data correction (See Note 3).	10^{-3}
39	4	I4	136-139	Q bias for raw data correction (See Note 3).	10^{-3}
40	4	I4	140-143	I/Q Standard Deviation Ratio for raw data correction	10^{-3}
41	4	I4	144-147	Output pixel bit length (8 or 16) applicable for UI16 and UI8 products only:	-

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = Wave mode products 8 = UI8 product 16 = UI16 and II16 product	
42	4	I4	148-151	For UI8: 16- to 8-bit conversion coefficient for output pixel - constant. (See Note 2).	10^{-3}
				For wave mode: Imagette size calculated as number of samples in range multiplied by 65536 plus the number of samples in azimuth. Interpreted as range (MSBs) and azimuth (LSBs).	
43	4	I4	152-155	For UI8: 16- to 8-bit conversion coefficient for output pixel - linear. (See Note 2).	10^{-6}
				For wave mode: Total energy above wavelengths of 731m.	10^{-3}
44	4	I4	156-159	For UI8: 16- to 8-bit conversion coefficient for output pixel - quadratic. (See Note 2).	10^{-9}
				For wave mode: Azimuth clutter cut-off.	10^{-3}
45	4	I4	160-163	Calibration System Gain (telemetry value)	
46	4	I4	164-167	Receiver Gain (telemetry value)	
47	4	I4	168-171	Normalized Clutter noise estimate (wave mode only). (See Note 7).	10^{3}
48	4	I4	172-175	For wave mode: Maximum of UWA spectrum components before normalization (see Note 7). For others: Reserved for ESA usage.	

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
49	4	I4	176-179	Range pixel spacing Slant range pixel spacing for II16. Ground range pixel spacing for UI16, UI8, and IWA.	10^{-3} m
50	4	I4	180-183	Azimuth pixel spacing	10^{-3} m
51	4	I4	184-187	Pulse Repetition Frequency	10^{-3} Hz
52	4	I4	188-191	Two-way slant range time of the first processed range cell	nsec
53	4	I4	192-195	Doppler centroid value at near range	10^{-3} Hz
54	4	I4	196-199	Slope of Doppler centroid in two-way slant range time	Hz/sec
55	4	I4	200-203	Azimuth FM rate at near range	10^{-3} Hz/sec
56	4	I4	204-207	Slope of azimuth FM rate in two-way slant range time	10^{-3} Hz/sec^2
57	2	I2	208-209	Doppler ambiguity number	
58	4	I4	210-213	For UI16, UI8: Calibration coefficient (antenna) constant term.	10^{-3}
				For wave mode: Mean wavelength for wavelengths above 731 m.	10^{-3} m
59	4	I4	214-217	For UI16, UI8: Calibration coefficient (antenna) linear term.	10^{-6}
				For wave mode: Wavelength spread for wavelengths above 731 m.	10^{-3} m
60	4	I4	218-221	For UI16, UI8: Calibration coefficient (antenna) quadratic term.	10^{-9}
				For wave mode: Mean direction for wavelengths above 731 m.	10^{-3} deg
61	4	I4	222-225	For UI16, UI8: Calibration coefficient (antenna) spare term.	

Table 4-10 Specific Product Header for UI16, UI8, UWA, IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				For wave mode: Directional spread for wavelengths above 731 m.	10^{-3} deg
62	4	I4	226-229	For UI16, UI8: Calibration coefficient (antenna) spare term.	
				For wave mode: Calibration constant for scaling image intensity.	10^{-3}
63	2	I2	230-231	EXT_SAR parameter table ID	
64	1	I1	232	Datation improvement (UI16, II16, UI8 only) 0 = successfully performed 1 = attempted but failed	
65	2	I2	233-234	SARFDP Static Transfer Function Table ID (wave mode only)	
66	2	I2	235-236	SARFDP Parameter Database ID	
67	4	I4	237-240	Output image mean (Only valid for UI16, UI8, II16, IWA). (See Note 8).	10^{-3}
68	4	I4	241-244	Output image standard deviation (Only valid for UI16, UI8, II16, IWA). (See Note 8).	10^{-3}
69	4	I4	245-248	Range compression scalar gain	10^{-5}
70	4	I4	249-252	Azimuth FFT scalar gain	10^{-5}
71	4	I4	253-256	Azimuth compression scalar gain	10^{-5}
72	4	I4	257-260	Overall processing gain Includes all the gains in fields 69, 70 and 71 and the scaling due to look summation and others. Only valid for 16 bit images.	10^{-3}

Note 1.

Fields 1 (bit 6), 8, 9 and 10 all refer to chirp cross-correlation. This means cross-correlation with an MMCC supplied nominal chirp. These fields are only valid if the chirp replica is successfully extracted. If the chirp replica is not extracted successfully, Fields 8, 9, and 10 will be set to 0. Also, if field 1 (bit 6) is set (i.e., chirp quality failed) then the values in Fields 8, 9 and 10 have no significance. The values given in Fields 8, 9 and 10 are calculated on the assumptions that the chirp baseband and the chirp extraction index are correct.

Note 2.

For UI8 these coefficients are used to convert from 16-bit pixels to 8-bit pixels.

Note 3.

The values given in Fields 38 and 39 are the same as the biases provided by MMCC (in the EXT_SAR table) and they include the nominal encoding bias (Image OGRC=16; Image OBRC=32; Wave OGRC=2; Wave OBRC=8).

Note 4.

The input data statistics flag (Field 1, bit 7) is set to 1 if:

For image mode:

(abs(in_mean_i-dynamic range/2) > (mean i threshold % of dynamic range)
.OR. (abs(in_mean_q-dynamic range/2) > (mean q threshold % of dynamic range)
.OR. (in_stdev_i > std dev i threshold % of dynamic range)
.OR. (in_stdev_q > std dev q threshold % of dynamic range)

For wave mode:

(abs(in_mean_i-dynamic range/2) > (mean i threshold % of dynamic range)/2)
.OR. (abs(in_mean_q-dynamic range/2) > (mean q threshold % of dynamic range)/2)
.OR. (in_stdev_i > std dev i threshold % of dynamic range)
.OR. (in_stdev_q > std dev q threshold % of dynamic range)

Where:

in_mean_i is SPH bytes 37-40 + ogrc/obrc i bias
in_mean_q is SPH bytes 41-44 + ogrc/obrc q bias
in_stdev_i is SPH bytes 45-48
in_stdev_q is SPH bytes 49-52

The dynamic range is: Image OBRC=63; Image OGRC=31;
Wave OBRC=15; Wave OGRC=3.

Note 5.

The output data statistics flag (Field 1, bit 11) is set to 1 if:

(output mean < mean threshold % of dynamic range)

.OR. (output std dev < std dev threshold % of dynamic range)

The output mean is given in SPH bytes 241-244 and the output standard deviation is given in bytes 245-248.

The dynamic range is 255 for UI8 and 65535 for UI16, II16 and IWA.

Note 6.

The latitudes and longitudes always refer to the image frame (6300 by 5000 pixels) independent of the size of the actual data contained within the frame.

Note 7.

The clutter noise is computed as the average level in a 50 by 50 pixel window centered in the Cartesian spectrum on the following wave numbers: 0.0 in range, 0.18638 in azimuth. The clutter noise is normalized by multiplying by 255 and dividing by the value reported in Field 48. The UWA spectrum components are also normalized by multiplying by 255 and dividing by the value reported in Field 48.

Note 8.

Some variation may exist in the output image mean and output standard deviation for an ERS-1 product processed using a SAR FDP software version prior to 4.0 when compared with processing using Version 4.0 or higher. The cause and magnitude of these differences are explained in Document R-3.

Table 4-11 Data Set Record for UI16

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, starting with 1.
2	10,000	I2	5-10,004	Processed image mode data samples. There are 5000 samples per record. A sample is represented as a 16-bit integer. The most significant bit is not used and set to zero.

4.3.2 AMI Image-8-bit (UI8)

Description: SAR processed image covering an area of about 100 x 100 km. This is equivalent to the full azimuth swath width (5000 pixel) and 6300 lines. Pixel size is 20 m (ground range) by approximately 16 m (azimuth). The pixel value, proportional to the square root of the image pixel power (magnitude), is represented by 8 bits. The data are processed with 16 bits per pixel and are reduced to 8 bits for dissemination. The reduction from 16 to 8 bits is done using coefficients defined by MMCC. Whether an image is to be produced in 8 or 16 bits is determined by the generation command prior to processing.

Input for this product is OGRC data.

All product parameters are the same as for AMI Image (16-bit) FD Product, except that one pixel is represented by 8 bits.

Format:

- **Product Data Set**: See Table 4-8. One record is one range line. Range lines are stored in ascending time order. Within each range line, pixels closer to the satellite track precede farther range pixels. The intensity of each pixel is represented by 8 bits.

Table 4-12 Data Set Record for UI18

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, starting with 1.
2	5000	I1	5-5004	Processed image mode data samples. There are 5000 samples per record. A sample is represented as an 8-bit integer.

4.3.3 AMI Image Noise Statistic and Drift Calibration (UIND)

Description: The data for one single product can be extracted either at the beginning or at the end of a measurement sequence. The product contains mean magnitude and standard deviation of the extracted noise data, and four calibration pulses.

Satellite Source: AMI Image mode

Originating Subsystem: SAR FDP

Product Generation: Generated upon MMCC commands, which must specify from where the data shall be extracted. The UIND product can be generated either as a stand-alone command or together with a UI16 or UI8 command. In the latter case, the UIND product is done during azimuth processing of the image product.

Command: C_GEN_UIND,
C_GEN_UI

On-Line Storage Specification: 200 minutes

Throughput: maximum two products per orbit

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: Contains the noise data statistics. See Table 4-13.
- **4 Product Data Set Records**: One data set record contains one complete pulse and is described in Table 4-14. The records are stored in ascending time order.

If a complete pulse cannot be extracted, zeroes are placed in the data set record.

Media: BDDN to user community and MMCC Link

Comments on Product Confidence: Not Applicable

Table 4-13 Specific Product Header for UIND, UWAND

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
1	4	I4	1-4	Mean of uncorrected I noise data	10^{-3}
2	4	I4	5-8	Mean of uncorrected Q noise data	10^{-3}
3	4	I4	9-12	Standard deviation of I noise data	10^{-3}
4	4	I4	13-16	Standard deviation of Q noise data	10^{-3}
5	4	I4	17-20	Number of noise lines extracted	-
6	4	I4	21-24	Calibration System Gain (telemetry value)	-
7	4	I4	25-28	Receiver Gain (telemetry value)	-

Table 4-14 Data Set Record for UIND

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, starting with 1.
2	1536	I1	5-1540	768 Calibration pulse samples. Each sample is represented as 8-bit I, 8-bit Q. Values are unsigned integers.

4.3.4 AMI Image Chirp Replica (UIC)

Description: This product contains two chirps, i.e. two sets of samples of the transmitted pulse. For each image scene, one chirp is extracted from the beginning, and one at the end, of the auxiliary data to be processed.

Satellite Source: AMI Image mode

Originating Subsystem: SAR FDP

Product Generation: Automatically generated for every requested AMI Image User FD product; i.e. up to 3 per orbit.

Command: C_GEN_UI

On-Line Storage Specification: 200 minutes

Throughput: same as AMI Image User FD products

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **2 Product Data Set Records**: One record contains one chirp. The first record is from the beginning and the second from the end of the image scene. The records are described in Table 4-15.

Media: MMCC Link

Comment on Product Confidence: Not Applicable.

Table 4-15 Data Set Record for UIC, UWAC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, starting with 1.
2	1536	I1	5-1540	Chirp replica samples. There are 768 samples. Each sample is represented as 8-bit I, 8-bit Q. Values are unsigned integers.

4.3.5 AMI Wave (UWA)

Description: Power spectrum in polar coordinates. The power spectrum is based on a sample of data covering an area of at least 5 x 5 km. The instrument on the satellite collects data at intervals of approximately 200 to 300 km. The sample patch may be anywhere in the 100-km wide swath in the order of 2 km steps.

Input for this product can be OBRC or OGRC data.

Satellite Source: AMI Wave mode

Originating Subsystem: SAR FDP (LRDPF alternatively)

Product Generation: Products are generated for MMCC defined start and stop times.

Command: C_GEN_WA

On-Line Storage Specification: 200 minutes

Throughput: 200 products per orbit

The throughput requirements are not applicable if the SAR FDP must also produce one or more of the following products:

- Extracted Data Product
- Instrument Header Product
- General Header Product

Format: One product includes:

- **Main Product Header:** See Table 4-3.
- **Specific Product Header**: See Table 4-10.
- **1 Product Data Set Record**: For format see Table 4-16. The data set contains the mean square value of the intensity of all pixels in one sector. A sector is defined in Figure 4-1.

Media: MMCC Link.

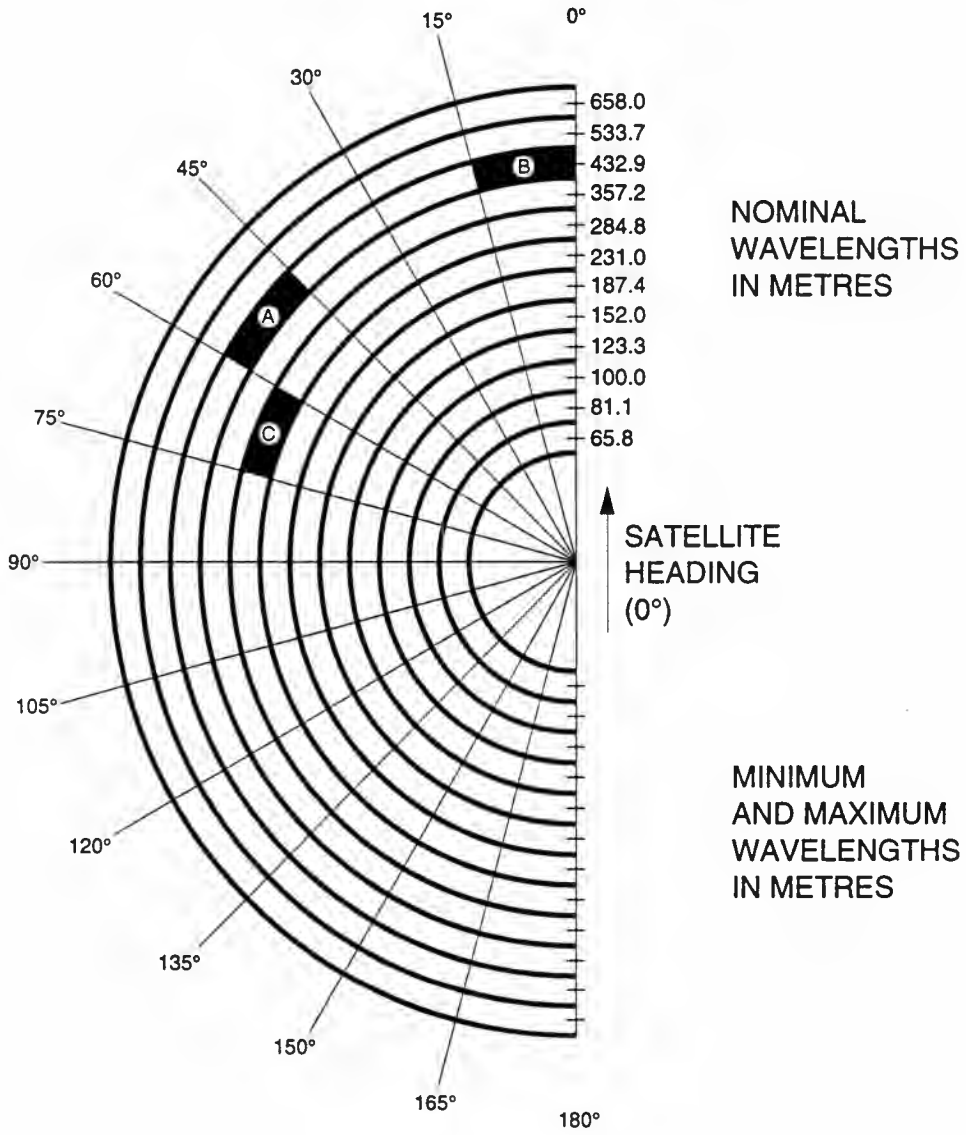
Comment on Product Confidence:

- **Missing Lines**: Missing and corrupted lines are padded with zeroes before processing. The occurrence of this is flagged in the MPH.

  The number of missing lines is given in the SPH.

- **Chirp Replica Quality**: The pulse width, first side lobes, and Integrated Side Lobe Ratio (ISLR) of the chirp cross-correlation function are checked against specification.

- **Input Data Statistic**: The mean and variance of the I and Q input data is computed and compared against norms.
- **Doppler Centroid Offset:** The Doppler centroid offset from zero Doppler is compared to a norm.
- **Output Data Statistic:** The mean and standard deviations of output data are computed and compared against norms.



SECTOR A HAS A NOMINAL WAVELENGTH OF 432 M AND AN ANGLE OF 45° TO 60°
SECTOR B HAS A NOMINAL WAVELENGTH OF 432 M AND AN ANGLE OF 0° TO 15°
SECTOR C HAS A NOMINAL WAVELENGTH OF 284 M AND AN ANGLE OF 60° TO 75°

AI-8260-D1/EM

Figure 4-1 Wave Product Example

Table 4-16 Data Set Record for UWA

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, this number is always 1.
2-13	12	I1	5-16	Log scaled spectrum intensity of sector 1. Nominal heading 7.5°.
2	1	I1	5	Nominal wavelength 65.8 m Wavelength range 59 m-<73 m
3	1	I1	6	Nominal wavelength 81.1 m Wavelength range 73 m-<90 m
4	1	I1	7	Nominal wavelength 100 m Wavelength range 90 m-<111 m
5	1	I1	8	Nominal wavelength 123.3 m Wavelength range 111 m-<137 m
6	1	I1	9	Nominal wavelength 152.0 m Wavelength range 137 m-<169 m
7	1	I1	10	Nominal wavelength 187.4 m Wavelength range 169 m-<208 m
8	1	I1	11	Nominal wavelength 231.0 m Wavelength range 208 m-<257 m
9	1	I1	12	Nominal wavelength 284.8 m Wavelength range 257 m-<316 m
10	1	I1	13	Nominal wavelength 351.2 m Wavelength range 316 m-<390 m
11	1	I1	14	Nominal wavelength 432.9 m Wavelength range 390 m-<481 m
12	1	I1	15	Nominal wavelength 533.7 m Wavelength range 481 m-<593 m
13	1	I1	16	Nominal wavelength 658.0 m Wavelength range 593 m-<731 m

Table 4-16 Data Set Record for UWA

Field Number	Number of Bytes	Data Type	Byte Position	Description
14-25	12	I1	17-28	Log scaled spectrum intensity of sector 2. Nominal heading 22.5°. Wavelengths as for sector 1.
26-37	12	I1	29-40	Log scaled spectrum intensity of sector 3. Nominal heading 37.5°. Wavelengths as for sector 1.
38-49	12	I1	41-52	Log scaled spectrum intensity of sector 4. Nominal heading 52.5°. Wavelengths as for sector 1.
50-61	12	I1	53-64	Log scaled spectrum intensity of sector 5. Nominal heading 67.5°. Wavelengths as for sector 1.
62-73	12	I1	65-76	Log scaled spectrum intensity of sector 6. Nominal heading 82.5°. Wavelengths as for sector 1.
74-85	12	I1	77-88	Log scaled spectrum intensity of sector 7. Nominal heading 97.5°. Wavelengths as for sector 1.
86-97	12	I1	89-100	Log scaled spectrum intensity of sector 8. Nominal heading 112.5°. Wavelengths as for sector 1.
98-109	12	I1	101-112	Log scaled spectrum intensity of sector 9. Nominal heading 127.5°. Wavelengths as for sector 1.
110-121	12	I1	113-124	Log scaled spectrum intensity of sector 10. Nominal heading 142.5°. Wavelengths as for sector 1.
122-133	12	I1	125-136	Log scaled spectrum intensity of sector 11. Nominal heading 157.5°. Wavelengths as for sector 1.

Table 4-16 Data Set Record for UWA

Field Number	Number of Bytes	Data Type	Byte Position	Description
134-145	12	I1	137-148	Log scaled spectrum intensity of sector 12. Nominal heading 172.5°. Wavelengths as for sector 1.

4.3.6 AMI Wave Noise Statistic and Drift Calibration (UWAND)

Description: Mean magnitude and standard deviation of the noise data, as well as four calibration pulses, extracted at the beginning of a measurement sequence (= scene).

Satellite Source: AMI Wave mode

Originating Subsystem: SARFDP (LRDPF alternatively)

Product Generation: Generated from data of every 15th scene, within each specified processing interval for AMI Wave FD Product generation, starting with the first scene of every processing interval.

Command: C_GEN_WA

On-Line Storage Specification: 200 minutes

Throughput: thirteen products per orbit

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: Contains the noise data statistics. See Table 4-13.
- **4 Product Data Set Records**: One data set record contains one complete pulse and is described in Table 4-17.

  If a complete pulse cannot be extracted, zeroes are placed in the data set record.

Media: MMCC Link

Comment on Product Confidence: Not Applicable

Table 4-17 Data Set Record for UWAND

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, starting with 1.
2				Calibration pulse samples. Each sample is represented as 8-bit I, 8-bit Q. Values are unsigned integers:
	OGRC:			
	1536	I1	5-1540	768 samples
	OBRC:			
	120	I1	5-124	60 samples

4.3.7 AMI Wave Chirp Replica (UWAC)

Description: This product contains one chirp as extracted from the auxiliary data at the beginning of the data to be processed.

Satellite Source: AMI Wave Mode

Originating Subsystem: SAR FDP (LRDPF alternatively)

Product Generation: Automatically generated for every AMI Wave FD Product

Command: C_GEN_WA

On-Line Storage Specification: 200 minutes

Throughput: 200 products per orbit

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Product Data Set Record**: The single data set record is described in Table 4-15.

Media: MMCC Link

Comment on Product Confidence: Not Applicable

4.3.8 AMI Wind (UWI)

Description: This product includes the intermediate and final results of the wind product generation. It consists of an array of wind vectors expressed in wind speed and direction. The product corresponds to a 500 x 500-km area. This area is represented by a 19 x 19 array of cells, with nominal 25-km spacing. The produced wind field corresponds to an equivalent neutral stability wind field, referenced to a height of 10 m. For each cell a wind vector is given together with latitude and longitude. The sigma nought and other information needed to convert these to wind fields are also provided for each cell.

Satellite Source: AMI wind mode

Originating Subsystem: LRDPF

Product Generation: Products are generated for MMCC-defined start and stop times with reference to the midbeam.

Command: C_GEN_WI

On-Line Storage Specification: 200 minutes

Throughput: 88 products per orbit

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-18.
- **361 Product Data Set Records**: One cell is stored in one record. See Table 4-19.

Cells are stored in ascending time order within each cell line across-track; cells closer to the satellite track precede farther cells.

Media: MMCC Link.

Comment on Product Confidence:

Product confidence is monitored on a product-wide and cell basis. Factors which apply to the entire product, are included in the SPH:

- Doppler Compensation accuracy (power spectrum monitoring) for each beam
- Mean power on I and Q Channel for each beam

- Internal Calibration level for each beam

Factors which are related to an individual cell are included in the PCD of each cell:

- **Checksum Errors in downlinked data** are flagged. If a checksum error happens, the calibration and noise data are replaced with defaults.
- **Source Packet level errors.** If a source packet is incomplete or too long, it is disregarded. Note that wind vectors can be generated from two input beams only. The occurrence of that is flagged in the PCD.
- **Beam Flag,** i.e. a flag indicating per beam if the number of valid source packets contributing to node is above or below an MMCC-provided threshold. In the latter case, the corresponding beam is not considered for the wind extraction. Wind speed and direction can be calculated from either two or three beams.
- **Limit of K_p values**
- **Land-Sea Flag.** Land coverage above a certain percentage is flagged.
- **Ambiguity Removal Confidence.** A value for ambiguity removal confidence is given. If the ambiguity cannot be removed, then the rank 1 solution is given, and the corresponding flag is set.

Wind speed (field 4) may lie in the range 0 to 50.8 m/s. The value of 51.0 m/s (field value of 255) is reserved to indicate an invalid wind speed was determined.

For the UWI specific product headers (Table 4-18), the following values shall be used in the event of estimates not being available:

- Averaged power spectrum centre of gravity (fields 6,8,10) : 999
- Averaged power spectrum Standard Deviation" (fields 7,9,11) : -1
- I/Q Mean Noise Power (fields 12-17) : -1
- Internal Calibration level (fields 18-20) : -1

Table 4-18 Specific Product Header for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
1	2	B	1-2	Product Confidence Data for Processing 1.-2. bit Processing equipment status 0 = equipment working 1 = some problems with equipment 2 = equipment failed during product generation 3. bit Spare 4. bit I/Q imbalance flag 0 = all beams better than MMCC-defined threshold 1 = any beam above or equal to MMCC-defined threshold 5. bit Internal Calibration level flag 0 = all beams within MMCC-defined level window 1 = any beam out of MMCC-defined level window 6. bit Blank Product Flag 0 = data available 1 = no data available 7. bit Doppler Compensation: Centre of Gravity flag	N/A

Table 4-18 Specific Product Header for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = all beams below MMCC defined threshold 1 = any beam above or equal to MMCC-defined threshold	
				8. bit Doppler Compensation: Standard Deviation flags 0 = all beams within MMCC defined interval 1 = any beam outside MMCC defined interval	
				9.-16. bit Spare	
2	4	I4	3-6	Geodetic latitude of Product Centre. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
3	4	I4	7-10	East longitude (i.e. 0-360° from Greenwich to East)	10^{-3} deg
4	4	I4	11-14	Subsatellite Track Heading at Product Centre (clockwise with respect to north)	10^{-3} deg
5	2	I2	15-16	Mean distance between two successive along track nodes at product centre	metre
6	2	I2	17-18	Centre of Gravity of averaged power spectrum (forebeam)	2.344 Hz Note 1.
7	2	I2	19-20	"Standard Deviation" of averaged power spectrum (forebeam)	2.344 Hz Note 1.
8	2	I2	21-22	Centre of Gravity of averaged power spectrum (midbeam)	2.344 Hz Note 1.

Table 4-18 Specific Product Header for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
9	2	I2	23-24	"Standard Deviation" of averaged power spectrum (midbeam)	2.344 Hz Note 1.
10	2	I2	25-26	Centre of Gravity of averaged power spectrum (aftbeam)	2.344 Hz Note 1.
11	2	I2	27-28	"Standard Deviation" of averaged power spectrum (aftbeam)	2.344 Hz Note 1.
12	4	I4	29-32	I Mean Noise Power, forebeam	10^{-3}*ADC unit
13	4	I4	33-36	Q Mean Noise Power, forebeam	10^{-3}*ADC unit
14	4	I4	37-40	I Mean Noise Power, midbeam	10^{-3}*ADC unit
15	4	I4	41-44	Q Mean Noise Power, midbeam	10^{-3}*ADC unit
16	4	I4	45-48	I Mean Noise Power, aftbeam	10^{-3}*ADC unit
17	4	I4	49-52	Q Mean Noise Power, aftbeam	10^{-3}*ADC unit
18	4	I4	53-56	Internal Calibration level monitoring factor, forebeam	10^{-3}*ADC unit
19	4	I4	57-60	Internal Calibration level monitoring factor, midbeam	10^{-3}*ADC unit
20	4	I4	61-64	Internal Calibration level monitoring factor, aftbeam	10^{-3}*ADC unit
21	2	B	65-66	Mode of operation - set by the first midbeam source packet contributing to spatial filtering for the first node (near swath) in the centre row of a product. 1.-2. bit	

MACDONALD DETTWILER

Table 4-18 Specific Product Header for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = wind mode 1 = wind/wave mode 2 = no data found to identify mode	
22-71	100	I2	67-166	Parameter Table ID. Details as follows:	
22	2	I2	67-68	Global threshold Parameter Table ID	
23	2	I2	69-70	Static parameter Parameter Table ID	
24	2	I2	71-72	Dynamic parameter Parameter Table ID	
25	2	I2	73-74	$FR_b(n)$ Parameter Table ID	
26	2	I2	75-76	$T_{orbit,ref,D}$ Parameter Table ID	
27	2	I2	77-78	ϕ_F Parameter Table ID	
28	2	I2	79-80	ϕ_M Parameter Table ID	
29	2	I2	81-82	ϕ_A Parameter Table ID	
30	2	I2	83-84	FT_b (n) Parameter Table ID	
31	2	I2	85-86	$C_{ADC,b}$ (n) Parameter Table ID	
32	2	I2	87-88	$T_{orbit,ref,N}$ Parameter Table ID	
33	2	I2	89-90	$F_{N,F}$ Parameter Table ID	
34	2	I2	91-92	$F_{N,M}$ Parameter Table ID	
35	2	I2	93-94	$F_{N,A}$ Parameter Table ID	
36	2	I2	95-96	$\hat{\theta}_{N,b}$ (j,k) Parameter Table ID	
37	2	I2	97-98	$\hat{\phi}_{N,b}$ (j,k) Parameter Table ID	

Table 4-18 Specific Product Header for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
38	2	I2	99-100	$M_{eff,b}$ (j,k) Parameter Table ID	
39	2	I2	101-102	$\overline{N}$ (j,k) Parameter Table ID	
40	2	I2	103-104	Wind extraction software configuration Table ID	
41	2	I2	105-106	LA_b (i_r, i_c) Parameter Table ID	
42	2	I2	107-108	LZ_b (i_r, i_c) Parameter Table ID	
43	2	I2	109-110	LN_b Parameter Table ID	
44	2	I2	111-112	MA_b Parameter Table ID	
45	2	I2	113-114	MS_b Parameter Table ID	
46	2	I2	115-116	NA_F (ν, ic) fore Parameter Table ID	
47	2	I2	117-118	NA_M (ν, ic) mid Parameter Table ID	
48	2	I2	119-120	NA_A (ν, ic) aft Parameter Table ID	
49	2	I2	121-122	NS_F (ν, ic) fore Parameter Table ID	
50	2	I2	123-124	NS_M (ν, ic) mid Parameter Table ID	
51	2	I2	125-126	NS_A (ν, ic) aft Parameter Table ID	
52	2	I2	127-128	NN_F (ν, ic) fore Parameter Table ID	
53	2	I2	129-130	NN_M (ν, ic) mid Parameter Table ID	
54	2	I2	131-132	NN_A (ν, ic) aft Parameter Table ID	
55	2	I2	133-134	l_{ref} Parameter Table ID	
56	2	I2	135-136	a_F (μ, i_c) fore Parameter Table ID	

Table 4-18 Specific Product Header for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
57	2	I2	137-138	a_M (μ, i_c) mid Parameter Table ID	
58	2	I2	139-140	a_A (μ, i_c) aft Parameter Table ID	
59	2	I2	141-142	av_F (k, i_r, i_c) fore Parameter Table ID	
60	2	I2	143-144	av_M (k, i_r, i_c) mid Parameter Table ID	
61	2	I2	145-146	av_A (k, i_r, i_c) aft Parameter Table ID	
62	2	I2	147-148	i_b Parameter Table ID	
63	2	I2	149-150	Spare	
64	2	I2	151-152	Spare	
65	2	I2	153-154	Meteo Table ID (table type 83, Forecast F18)	
66	2	I2	155-156	Meteo Table ID (table type 84, Forecast F24)	
67	2	I2	157-158	Meteo Table ID (table type 85, Forecast F30)	
68	2	I2	159-160	Meteo Table ID (table type 86, Forecast F36)	
69	2	I2	161-162	Spare	
70	2	I2	163-164	Spare	
71	2	I2	165-166	Spare	

Note 1.

Fields 6 through 11 have units of 2.344 Hz. This value is derived from 10^{-2}*234.4 Hz and 234.4 Hz is the unit of frequency spectrum discretisation.

Table 4-19 Data Set Record for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
1	4	I4	1-4	Data record number, starting with 1.	
2	4	I4	5-8	Geodetic latitude of Node. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
3	4	I4	9-12	East longitude (i.e. 0-360° from Greenwich to east)	10^{-3} deg
4	4	I4	13-16	σ° of forebeam (set to -999 999 999 if the calculation is not possible) (See Note 3).	10^{-7} dB
5	2	I2	17-18	Incidence Angle for forebeam	10^{-1} deg
6	2	I2	19-20	Look Angle of forebeam with respect to North at grid point (see Note 2.)	10^{-1} deg
7	1	I1	21	Kp Value of forebeam (set to 255 if the calculation is not possible).	%
8	1	I1	22	Counter of forebeam corrupted or missing source packets (see Note 1)	
9	4	I4	23-26	σ° of midbeam (set to -999 999 999 if the calculation is not possible) (See Note 3).	10^{-7} dB
10	2	I2	27-28	Incidence Angle of midbeam	10^{-1} deg
11	2	I2	29-30	Look Angle of midbeam with respect to North at grid point (see Note 2.)	10^{-1} deg
12	1	I1	31	Kp Value of midbeam (set to 255 if the calculation is not possible)	%
13	1	I1	32	Counter of midbeam corrupted or missing source packets (see Note 1)	

Table 4-19 Data Set Record for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
14	4	I4	33-36	σ° of aftbeam (set to -999 999 999 if the calculation is not possible) (See Note 3).	10^{-7} dB
15	2	I2	37-38	Incidence Angle of aftbeam	10^{-1} deg
16	2	I2	39-40	Look Angle of aftbeam with respect to North at grid point (see Note 2.)	10^{-1} deg
17	1	I1	41	Kp Value of aftbeam (set to 255 if the calculation is not possible)	%
18	1	I1	42	Counter of aftbeam corrupted or missing source packets (see Note 1)	
19	1	I1	43	Wind speed (set to 255 if wind extraction is not possible)	2×10^{-1} m/s
20	1	I1	44	Wind direction with respect to North at grid point counting clock-wise (set to 255 if wind extraction is not possible). (See Note 4).	2 deg
21	2	B	45-46	Product Confidence Data 1. bit Summary PC factor 0 = processing of cell according to full specification 1 = result to be viewed with limitation, i.e. one of the PCD flags listed below (except bits 11-13) is not 0. 2. bit Forebeam Flag 0 = beam OK 1 = no forebeam calculation 3. bit Midbeam Flag	N/A

Table 4-19 Data Set Record for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = beam OK 1 = no midbeam calculation 4. bit Aftbeam Flag 0 = beam OK 1 = no aftbeam calculation 5. bit Forebeam Arcing Flag 0 = no arcing detected on forebeam 1 = arcing detected on fore-beam 6. bit Midbeam Arcing Flag 0 = no arcing detected on midbeam 1 = arcing detected on mid-beam 7. bit Aftbeam Arcing Flag 0 = no arcing detected on aft-beam 1 = arcing detected on aft-beam 8. bit Limit of Kp value 0 = all beams below MMCC-supplied threshold 1 = any beam above or equal to MMCC-supplied threshold 9. bit Land-Sea Flag 0 = Sea 1 = Land	

MACDONALD DETTWILER

Table 4-19 Data Set Record for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				10. bit Rank one solution flag (see Note 5) 0 = ambiguity removed 1 = no ambiguity removal performed or ambiguity removal not successful (See Note 6). 11.-12. bit Ambiguity Removal Method (See Note 5 and 7). 0 = ambiguity removed autonomously 1 = use of meteor tables after failure of autonomous ambiguity removal method 2 = ambiguity removed by using only meteor data. 3 = no ambiguity removal attempted. 13. bit Maximum Likelihood Distance Flag (See Note 5). 0 = maximum likelihood distance of the rank one solution is less than or equal to a threshold. 1 = maximum likelihood distance of the rank one solution (i.e., solution of minimum residual) is greater than a threshold. 14. bit Frame Checksum Flag	

Table 4-19 Data Set Record for UWI

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = Checksum correct 1 = Checksum error detected, noise and calibration replaced with default	
				15.-16. bit Spare	

Note 1: (Field numbers 8, 13, and 18)

The counter of corrupted or missing source packets is multiplied by -1 when in wind/wave mode to indicate wind/wave mode operation. The absolute value of the counter, in wind/wave mode, is always greater than two because the wind/wave mode operation causes two FMA sequences to be lost.

Note 2: (Field numbers 6, 11, and 16)

The beam look angle is defined as the angle between the unit vector tangential to the local meridian and pointing North and the projection of the vector from the centre of cell node to satellite onto the local tangential plane, counting clockwise.

Note 3: (Field numbers 4, 9, 14)

The sigma_0 values given in these fields are derived from the linear values by using: $10\log_{10}$ (linearvalue).

Note 4: (Field number 20)

For version 2.502 and onward the wind direction is given in the meteorological sense. The definitions of the wind direction used for version 2.502 and onward and used for versions before 2.502 are shown in Figure 4-2.

Note 5: (Field number 21: bits 10 to 13)

Figure 4-3, corresponding to one run of the ambiguity removal, demonstrates how these flags are set. Note that the case where bit 10=0, bit 11-12=3, and bit 13=0, with the given wind speed solution chosen by the ambiguity removal, may happen. This is because the ambiguity removal is attempted over six consecutive products with a displacement of two products such that when the ambiguity removal is run, it has already been run for two products out of six and these results

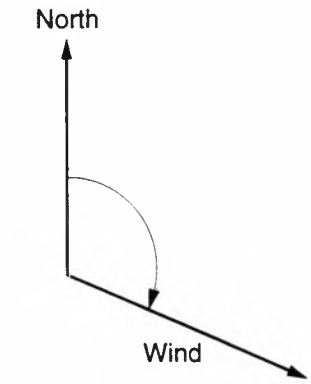
are kept. In the case of non-successful ambiguity removal, the old results (after ambiguity removal) are used but the indicator of the method used is last.

Note 6: (Field number 21: bit 10)

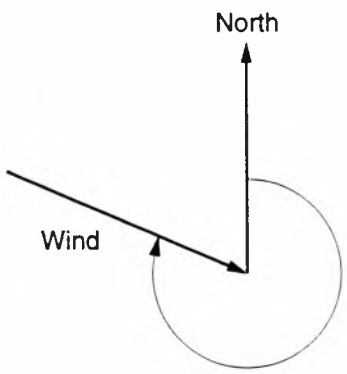
When no ambiguity removal is performed or when the ambiguity removal is not successful, the solution with the highest probability (rank one) is given.

Note 7: (Field number 21: bits 11-12)

The ambiguity removal method is set independently of the ambiguity removal as given in bit 10 of Field 21.



Wind Direction Definition before version 2.502



Wind Direction Definition for version 2.502 and on

AI-7550-D1R1/CD

Figure 4-2 Wind Direction Definitions

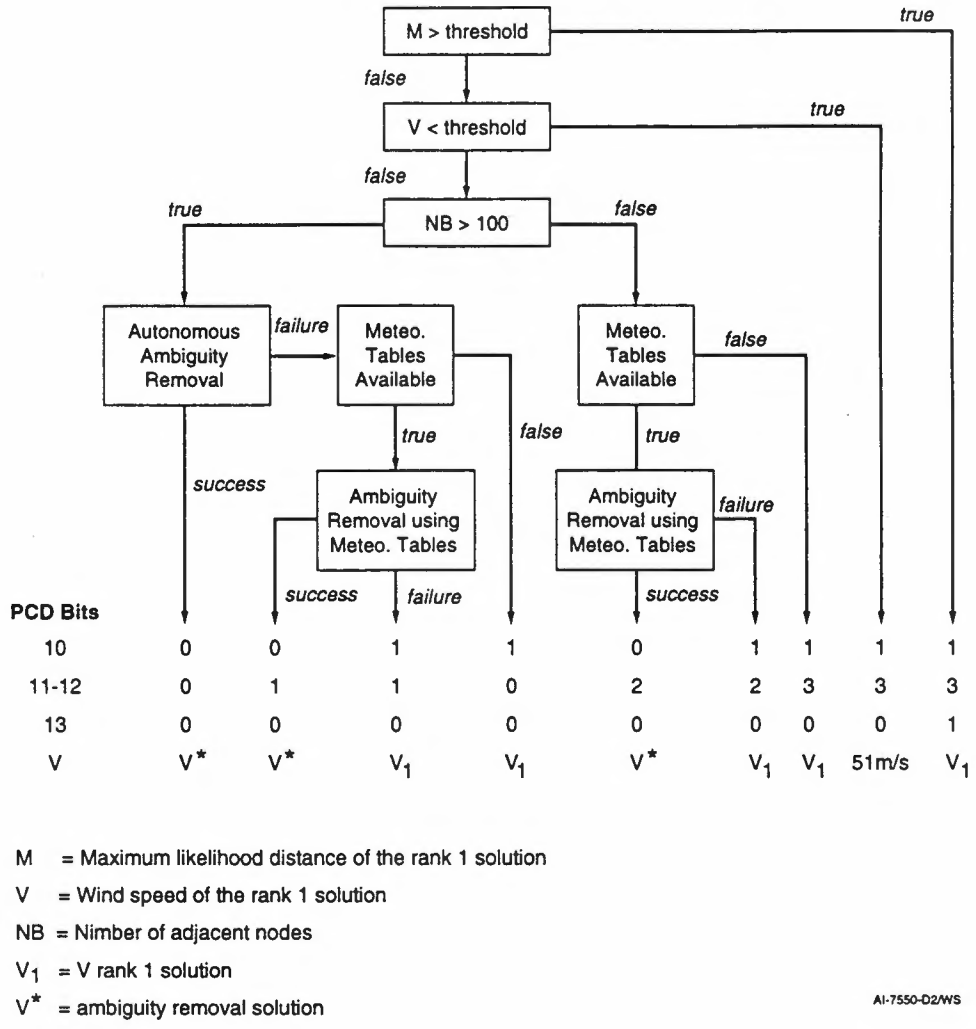


Figure 4-3 Relation between Ambiguity Removal and Product Confidence Data

4.3.9 Radar Altimeter (URA)

Description: The product contains an averaged wind speed, wave height, and satellite altitude together with the standard deviations (one per quantity) for single cells along the satellite track. One cell is sampled every 6.725 km and there is a maximum of 20 values measured during 1 second. Seventy seven cells are combined in one product and represent an area of approximately 500 km.

Satellite Source: Radar Altimeter

Originating Subsystem: LRDPF

Product Generation: Products are generated for MMCC-defined start and stop times.

Command: C_GEN_URA

On-Line Storage Specification: 200 minutes

Throughput: 84 products per orbit

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-20.
- **77 Product Data Set Records**: See Table 4-21.

Media: MMCC Link. This product is also stored on Exabyte. For tape format and tape label annotation see Appendix B.

Comment on Product Confidence:

Product confidence is monitored on a cell-by-cell basis and covers:

- Source Packet level errors:

  Only ocean mode valid source packets are processed.

  Too long or incomplete source packets are discarded.

  Non-Ocean mode valid source packets are reported in a blank record (cell time longitude and latitude are calculated).

  Time gaps, due to unavailability or nonvalid satellite source packets, are filled with blank records at one-second intervals.

Checksum errors on valid source packet are reported.

- Lack of data, if there are not enough measurements as input in the averaging process, a flag is raised. The contents of the wind speed, wave height and altitude fields are to be discarded.
- Peakiness of return echo to detect sea ice is added to output data. Mean peakiness is calculated.
- Check of standard deviation or SWH, altitude and wind speed with respect to MMCC-supplied threshold.
- Auxiliary data provides:

  mispointing estimate (not calculated at present)
  noise floor estimate

- A summary of the cell-based PCDs is given in the SPH.

Table 4-20 Specific Product Header for URA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
1	2	B	1-2	Product Confidence Data 1.-2. bit Processing Equipment Status 0 = equipment working 1 = some problems with equipment 2 = equipment failed during product generation 3. bit Product type 0 = ocean mode 1 = non-ocean mode or blank product 4. bit Corrupt Data 0 = all processing nominal 1 = details of data corruption in Data Set Record	

Table 4-20 Specific Product Header for URA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				5. bit Arithmetic fault 0 = no fault 1 = at least one dsr has an arthritic fault flagged in byte 62.	
				6.-16. bit Spare	
2	4	I4	3-6	Geodetic latitude of 1. data set record. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
3	4	I4	7-10	East longitude (i.e. 0-360° from Greenwich to east) of 1. data set record.	10^{-3} deg
4	4	I4	11-14	Subsatellite Track Heading at 1. Data set record.	
5	4	I4	15-18	USO offset frequency with respect to 5 MHz	10^{-3} Hz
6-23	36	I2	19-54	Identifier of external tables. Details as follows:	
6	2	I2	19-20	Global Threshold Parameter Table ID	
7	2	I2	21-22	Static Parameters Parameter Table ID	
8	2	I2	23-24	Dynamic Parameter Parameter Table ID	
9	2	I2	25-26	$\overset{G}{\tau}_{REF}$ Parameter Table ID	
10	2	I2	27-28	$TAB_{\tau 1}$ Parameter Table ID	
11	2	I2	29-30	$TAB_{\tau 2}$ Parameter Table ID	
12	2	I2	31-32	Reserved	
13	2	I2	33-34	$\overset{G}{\sigma}_{S,REF}$ Parameter Table ID	
14	2	I2	35-36	TAB_S Parameter Table ID	

MACDONALD DETTWILER

Table 4-20 Specific Product Header for URA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
15	2	I2	37-38	Reserved	
16	2	I2	39-40	A^{G}_{REF} Parameter Table ID	
17	2	I2	41-42	Reserved	
18	2	I2	43-44	TAB_{A2} Parameter Table ID	
19	2	I2	45-46	TAB_{LOC} Parameter Table ID	
20	2	I2	47-48	Spare	
21	2	I2	49-50	Pressure table ID (table type 83, Forecast F18)	
22	2	I2	51-52	Pressure table ID (table type 84, Forecast F24)	
23	2	I2	53-54	Pressure table ID (table type 85, Forecast F30)	
24	2	I2	55-56	Pressure Table ID (table type 86, Forecast F36)	

Table 4-21 Data Set Record for URA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
1	4	I4	1-4	Data record number, starting with 1.	
2	24	A	5-28	UTC Time at middle of the source packet ($T_{H,LOC}$) in ASCII: "dd-mmm-yyyy hh:mm:ss.ttt" For example: "30-JAN-1987 14:30:27.123"	
3	4	I4	29-32	Geodetic latitude. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
4	4	I4	33-36	East longitude (i.e. 0-360° from Greenwich to east)	10^{-3} deg
5	2	I2	37-38	Average Wind Speed	10^{-2} m/s
6	2	I2	39-40	Standard Deviation of Wind Speed	10^{-4} m/s
7	2	I2	41-42	Average Significant Wave Height	10^{-2} m
8	2	I2	43-44	Standard Deviation of Significant Wave Height	10^{-4} m
9	4	I4	45-48	Average Altitude (Corrected)	10^{-2} m
10	4	I4	49-52	Standard Deviation of Altitude	10^{-4} m
11	2	I2	53-54	Number of blocks used for averaging	
12	1	B	55	Product Confidence Data 1. bit Summary PC factor	

MACDONALD DETTWILER

Table 4-21 Data Set Record for URA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = processing of all according to specification 1 = result to be viewed with limitation (details in following bits). 2. bit Standard Deviation Wind Speed 0 = Standard Deviation Wind Speed within MMCC-supplied limits 1 = Standard Deviation Wind Speed outside MMCC-supplied limits 3. bit Standard Deviation SWH Limit 0 = Standard Deviation SWH within MMCC-supplied limits 1 = Standard Deviation SWH outside MMCC-supplied limits 4. bit Standard Deviation Altitude Limit 0 = Standard Deviation Altitude within MMCC-supplied limits 1 = Standard Deviation Altitude outside MMCC-supplied limits 5. bit Mean Peakiness Limit	

Table 4-21 Data Set Record for URA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = Mean peakiness within limits 1 = Mean peakiness outside limits 6. bit Frame Checksum Flag 0 = Checksum correct 1 = Checksum error detected, no action taken 7. bit HTL time constant correction (on product localization) 0 = correction performed 1 = correction not performed 8. bit Enough Measurements 0 = enough measurements to process data 1 = not enough measurements to process data	
13	2	I2	56-57	Average Peakiness	10^{-2}
14	2	I2	58-59	Average Sigma_0	10^{-2} dB
15	2	I2	60-61	Integrated electron density	$10^{\text{value}/1000}$ electrons/ m^2
16	1	B	62	Open Loop Calibration Status: 1. bit Height Error Correction 0 = from open loop calibration 1 = default 2. bit Reserved 3. bit AGC output correction	

MACDONALD DETTWILER

Table 4-21 Data Set Record for URA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
				0 = from open loop calibration 1 = default 5. bit Real Arithmetic Error 0 = No error 1 = Overflow or underflow encountered during processing 6. bit Integer Arithmetic Error 0 = No error 1 = Overflow encountered during processing 7. bit Division by Zero Error 0 = No error 1 = Division by zero encountered during processing	
17	1	B	63	Instrument Mode, i.e. 2. byte of packet ID in Primary Header (see Document A-2)[1] 1. bit Blank data record 2. bit Test 3. bit Calibration (closed loop) 4. bit BITE 5. bit Acquisition on Ice 6. bit Acquisition on Ocean 7. bit Tracking on Ice 8. bit Tracking on Ocean	
18	1	B	64	Reserved for later use	
19	4	I4	65-68	Altitude Correction, ionosphere	10^{-3}m
20	4	I4	69-72	Altitude Correction, wet troposphere	10^{-3}m

Table 4-21 Data Set Record for URA

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
21	4	I4	73-76	Altitude Correction, dry tropo-sphere	10^{-3}m
22	4	I4	77-80	Altitude Correction, calibration constant	10^{-3}m
23	4	I4	81-84	Smoothed open Loop HTL calibra-tion correction	10^{-3}m
24	4	I4	85-88	Smoothed open Loop AGC calibra-tion correction	10^{-3}dB

1. 0=no, 1=yes.

Fields 5-15 of this record are only valid if bit 8 of Field 17 is set to "1".

4.4 Intermediate Products

Intermediate products are derived during AMI wave FD product generation or as an alternative to the UI16, UI8 product generation. Upon request, products are either put on CCT, Exabyte, or sent to MMCC or user over the BDDN.

The intermediate products generated at Kiruna Station are:

- AMI Wave Mode Intermediate (IWA)
- AMI Image Mode Intermediate (II16)

Note that the RA FD products can also be stored on CCT or Exabyte and can be used like intermediate products.

4.4.1 AMI Wave Intermediate (IWA)

Description: This product consists of an intermediate wave image generated prior to conversion to a power spectrum, and the power spectrum, see UWA product. The image contains 320 x 400 pixels for OGRC and 320 in azimuth by 600 in range pixels for OBRC. The intensity of each pixel is represented by 16 bits.

Satellite Source: AMI Wave Mode

Originating Subsystem: SAR FDP (LRDPF alternatively)

Product Generation: Products are automatically generated, when AMI Wave FD products are generated.

Command: C_GEN_WA

On-line Storage Spec: 200 minutes

Throughput: Same as AMI Wave FD Product

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-10.
- **17 Product Data Set Records**: The data set records of this product are of two different types. The first 16 records contain 20 range lines each of the intermediate image (see Table 4-22). Within each range line, pixels closer to the satellite track precede farther range pixels. The 17. data set record contains the power spectrum (see Table 4-23).

Media: Exabyte; for tape format and tape label annotation see Appendix B.

Comment on Product Confidence: See AMI Wave FD Product

Table 4-24 Specific Product Header for II16

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
1-72	260		1-260	As for UI16, UI8 Specific Product Header. See Table 4-10.	
73	4	I4	261-264	Zero Doppler range time of the first range pixel	nsec
74	4	I4	265-268	Zero Doppler range time of the centre range pixel	nsec
75	4	I4	269-272	Zero Doppler range time of the last range pixel	nsec
76	24	A	273-296	Zero Doppler azimuth time of the first azimuth pixel. ASCII format: "dd-mmm-yyyy hh:mm:ss.ttt"	
77	24	A	297-320	Zero Doppler azimuth time of the centre azimuth pixel. Format as for field 76.	
78	24	A	321-344	Zero Doppler azimuth time of the last azimuth pixel. Format as for field 76.	
79-84	24	I4	345-368	First State Vector: (Earth-fixed reference system)	
79	4	I4	345-348	State vector; X	10^{-2} m
80	4	I4	349-352	State vector; Y	10^{-2} m
81	4	I4	353-356	State vector; Z	10^{-2} m
82	4	I4	357-360	State vector; X velocity	10^{-5} m/s
83	4	I4	361-364	State vector; Y velocity	10^{-5} m/s
84	4	I4	365-368	State vector; Z velocity	10^{-5} m/s
85-90	24	I4	369-392	Second State Vector. Format as for First State Vector	

Table 4-24 Specific Product Header for II16

Field Number	Number of Bytes	Data Type	Byte Position	Description	Units
91-96	24	I4	393-416	Third State Vector. Format as for First State Vector	
97-102	24	I4	417-440	Fourth State Vector. Format as for First State Vector	
103-108	24	I4	441-464	Fifth State Vector. Format as for First State Vector	
109	24	A	465-488	UTC time of the first State Vector. Format: "dd-mmm-yyyy hh:mm:ss.ttt"	
110	4	I4	489-492	Delta time between each of the above state vectors	msec
111	108	B	493-600	Spare.	

4.5 Extracted Data Products

Extracted data products represent raw data over specific areas and are used for instrument calibration and monitoring, e.g. pass over an active transponder. The data are not processed in Kiruna, but passed on to the MMCC via exabyte or dedicated link.

The following extracted data products are defined below:

- AMI Image Calibration Data (EIC)
- AMI Wave Calibration Data (EWAC)
- AMI Wind Calibration Data (EWIC)
- Radar Altimeter Calibration Data (ERAC)
- GOME Calibration Data (EGOC)
- Microwave Calibration Data (EMWC)

- AMI Image Instrument Headers (EII)
- AMI Wave Instrument Headers (EWAI)
- AMI Wind Instrument Headers (EWII)
- Radar Altimeter Instrument Headers (ERAI)
- ATSR-1 Instrument Headers (EATI1)
- ATSR-2 Instrument Headers (EATI2)

Table 4-22 Data Set Record 1-16 for IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description	
1	4	I4	1-4	Data record number, starting with 1.	
2				Processed wave mode data samples. Each sample is represented as a 16-bit integer. The Most Significant Bit is not used and set to zero.	
	OGRC:				
		16,000	I2	5-16,004	8,000 samples
	OBRC:				
		24,000	I2	5-24,004	12,000 samples

Table 4-23 Data Set Record 17 for IWA

Field Number	Number of Bytes	Data Type	Byte Position	Description
1-145	148		1-148	As for UWA data set record. See Table 4-16.
OGRC:				
146	15,856	B	149-16,004	Spares
OBRC:				
146	23,856	B	149-24,004	Spares

4.4.2 AMI Image Mode Intermediate (II16)

Description: This product is similar to the UI16 product except that it has not undergone any Slant-Range-to-Ground-Range conversion. This product also contains additional information required for geocoding.

Satellite Source: AMI Image Mode

Originating Subsystem: SARFDP

Product Generation: The MMCC defines the start time for each product.

Command: C_GEN_UI

On-Line Storage Specification: 200 minutes

Throughput: Same as UI16 or UI8 FD Products. Note that the SARFDP produces a single UI16 or II16 product per C_GEN command (not both).

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-24.
- **6300 Product Data Set Records**: See Table 4-11. One record is one range line. Range lines are stored in ascending time order. Within each range line, pixels closer to the satellite track precede farther range pixels. The intensity of each pixel is represented by 16 bits.

Media: BDDN

Comment on Product Confidence: see AMI Image Mode User FD Product

- GOME Instrument Headers (EGOI)

- General Headers (EGH)
- Ephemeris Data (EEP)

4.5.1 AMI Image Calibration Data (EIC)

Description: Calibration data for the AMI Image Mode consist of complete downlinked Formats, with the exception of the three Synch Bytes and three IDHT-ID Bytes which have been removed. In addition, all echo data samples are expanded from 5-bit I and Q to 8-bit I and Q.

Satellite Source: AMI Image Mode

Originating Subsystem: SAR FDP

Product Generation: Products are extracted for MMCC defined start and stop times. Up to five commands defining different time intervals can be submitted by MMCC per orbit.

Command: C_GEN_EIC

On-Line Storage Specification: One day

Throughput: Maximum storage of 11212 products provided on the DPMC. The SARFDP storage capacity is 28000 products. The SARFDP can ingest, process and archive 28000 products in an orbit (this excludes any Fast Delivery product generation).

Format: One product includes:

- **Main Product Header**: See Table 4-3.

- **1 Product Data Set Record**: The product data set consists of one downlink format without IDHT-ID, as shown in Table 4-25.

Media: CCT; for tape format and tape label, see Appendix A.

Comment on Product Confidence: In case there is a loss of data in gaps between products or at the end of a requested time period, then null products consisting only of the MPH are generated. Null products are generated with an update rate corresponding to the receipt of PCDs from the DPMC, normally every 2.5 seconds (see 4.1.3).

Table 4-25 Data Set Record for EIC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number. This number is always 1.
2	10	S	5-14	IDHT Header. This field is identical to "IDHT GEN. HEADER" in the HR format structure of Document A-2.
3	220	S	15-234	Auxiliary Data and Replica/Calibration pulses. This field is identical to the "Auxiliary Data Field" in the HR format structure of Document A-2.
4	11,232	I1	235-11,466	Noise and Echo data. This field contains 5,616 complex data samples. Each complex data sample is unsigned extended from the downlink format to 8-bit I and 8-bit Q.

4.5.2 AMI Wave Calibration Data (EWAC)

Description: This product contains 16 General Header Source Packets comprising one complete OBC format and 299 wave source packets comprising one wave cell. The OBC format is the first complete one following the first frame of instrument data.

Satellite Source: AMI Wave Mode

Originating Subsystem: SAR FDP (LRDPF alternatively)

Product Generation: Products are extracted for MMCC-defined start and stop times. Up to five commands defining different time intervals can be submitted by the MMCC per orbit.

One product is generated for each wave cell lying within the specified time interval. If a start or stop time lies within a cell, all specified auxiliary data for that complete cell are extracted.

Command: C_GEN_EWAC

On-Line Storage Specification: One day

Throughput: Maximum 15 MBytes of data per orbit and maximum 30 MBytes per day. ≡> 11 products per orbit and 22 products per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: The General Header is stored in the SPH as shown in Table 4-26.
- **299 Product Data Set Records**: Each product data set record consists of one source packet. See Table 4-27.

Media: For SAR FDP: CCT; for tape format and label, see Appendix A. For LRDPF Exabyte, for tape format and label, see Appendix B.

Table 4-26 Specific Product Header Record for EWAC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4096	S	1-4096	PF Data. This field contains 16 frames each of 256 bytes of the "Source Data Field" of the General IDHT Header Source Packet, see Document A-2. The first 256 bytes correspond to the start of platform data, frame count of 0, and the last 256 bytes to the end of platform data, frame count of 15.
2	384	S	4097-4480	Ephemeris Data. This field is identical to the subcommutated, 24 bytes of Ephemeris Data of the "Source Data Field" of 16 General IDHT Header Source Packets, see Document A-2. The first 24 bytes correspond to the start of ephemeris data, ephemeris ID of 1, and the last 24 bytes to the end of ephemeris data, ephemeris ID of 16.

Table 4-27 Data Set Record for EWAC (OBRC and OGRC)

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number. Data records are numbered 1-299.
2	6	S	5-10	Primary Header. This is identical to the packet Primary Header as described in Document A-2.
3	98	S	11-108	Secondary Header. This field is identical to the "Secondary Header" as described in Document A-2.
4	4224	S	109-4332	Source Data. This field is identical to the "Measurement Data Field" as described in Document A-2.

4.5.3 AMI Wind Calibration Data (EWIC)

Description: This product contains one AMI wind scatterometer and one General Header Source Packet. The General Header is the one just preceding the first frame of Instrument Data.

Satellite Source: AMI Wind Mode

Originating Subsystem: LRDPF

Product Generation: Products are extracted for MMCC-defined start and stop times. Up to five commands defining different time intervals can be submitted by MMCC per orbit.

Command: C_GEN_EWIC

On-Line Storage Specification: One day

Throughput: Maximum 12 MBytes of data per orbit and maximum 24 MBytes per day. ≡> 1450 products per orbit and 2900 products per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.

- **Specific Product Header**: One General Header frame is stored in the SPH as shown in Table 4-8.

  If there is no General Header available the General Header portion of the SPH is padded with zeroes. Note that a General Header packet is received only for every third EWIC packet.

  The General header packet is not available for the first EWIC product resulting from the C_GEN_EWIC command, unless the times of the General Header and EWIC packets are identical.

- **1 Product Data Set Record:** The product data set consists of one source packet. See Table 4-28.

Media: Exabyte; for tape format and label, see Appendix B.

Comment on Product Confidence: In case there is a loss of data in gaps between products or at the end of a requested time period, then null products consisting only of the MPH are generated. Null products are generated with an update rate corresponding to the receipt of PCDs from the DPMC, normally every 2.5 seconds (see 4.1.3).

Table 4-28 Data Set Record for EWIC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number. This number is always 1.
2	6	S	5-10	Primary Header. This is identical to the packet "Primary Header" as described in Document A-2.
3	62	S	11-72	Secondary Header. This field includes the auxiliary data and is identical to the packet "Secondary Header" as described in Document A-2.
4	7792	S	73-7864	Source Data. This field includes calibration and echo data for either forebeam, midbeam or aftbeam. The format is identical to the one described in Document A-2.

4.5.4 Radar Altimeter Calibration Data (ERAC)

Description: This product contains one raw Radar Altimeter data and General Header Source Packet. The General Header is the one just preceding the first frame of instrument data.

Satellite Source: Radar Altimeter

Originating Subsystem: LRDPF

Product Generation: Products are extracted for MMCC-defined start and stop times. Up to five commands defining different time intervals can be submitted by the MMCC per orbit.

Command: C_GEN_ERAC

On-Line Storage Specification: One day

Throughput: Maximum 2 MBytes of data per orbit and maximum 4 MBytes per day. ⇒ 564 products per orbit and 1128 products per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: One General Header frame is stored in the SPH as shown in Table 4-8.

  The General Header packet is not available for the first ERAC product resulting from the C_GEN_ERAC command unless the times of the General Header and ERAC packets are identical.
- **1 Product Data Set Record**: The product data set consists of one source packet. See Table 4-29.

Media: Exabyte; for tape format and label, see Appendix B.

Comment on Product Confidence: In case there is a loss of data in gaps between products or at the end of a requested time period, then null products consisting only of the MPH are generated. Null products are generated with an update rate corresponding to the receipt of PCDs from the DPMC, normally every 2.5 seconds (see 4.1.3).

Table 4-29 Data Set Record for ERAC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number. This number is always 1.
2	6	S	5-10	Primary Header. This field is identical to the "Primary Header" as described in Document A-2.
3	6	S	11-16	Secondary Header. This field is identical to the packet "Secondary Header" as described in Document A-2.
4	3120	S	17-3136	Source Data. This field is identical to the "Source Data Field" as described in Document A-2.

4.5.5 GOME Calibration Data (EGOC)

Description: This product contains one complete science packet of GOME data and one General Header Source Packet. The General Header is the one just preceding the first frame of instrument data. A GOME science packet is subcommutated over 10 ATSR-1 source packets.

Satellite Source: GOME

Originating Subsystem: LRDPF

Product Generation: Products are extracted for MMCC-defined start and stop times. Up to five commands defining different time intervals can be submitted by the MMCC per orbit.

Command: C_GEN_EGOC

On-Line Storage Specification: One day

Throughput: All data collected in one orbit, approximately 4400 products per orbit.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-30. Note that if there is no General Header available, the General Header portion of the SPH is padded with zeroes.
- **1 Product Data Set Record**: The product consists of one source packet. See Table 4-31.

Media: All products will be transferred directly from the LRDPF to the BDDN.

Comment on Product Confidence: See Subsection 4.1.3.2.3.

Table 4-30 Specific Product Header Record for EGOC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1-4	282		1-282	Same as Table 4-8.
5	1	B	283	PCD product padding flag 0 = product DSR not padded 1 = product DSR padded Note that padding of the product DSR occurs in the event of missing frames containing GOME science data. The corresponding fields of the DSR are padded with BB hexa-decimal.
6	20	B	284-303	PCD reported at ATSR-2 source packet level: one byte PCD for each of 20 GOME frames. bit 1-2: The percentage of GOME frames with checksum error compared to MMCC-specified threshold. bit 3-4: Quality of downlinked formats and source packets compared to MMCC-specified threshold bit 5-8: spare 0 = lower than threshold 1 = greater than threshold 2 = performance unknown

Table 4-31 Data Set Record for EGOC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number; this number is always 1.
2	8000	8	5-8004	One complete GOME science packet, identical to the downlinked format, see Document A-2. Note that the DSR is padded in the event of missing frames containing GOME science data. The corresponding parts of the DSR are padded with BB hexadecimal.

4.5.6 Microwave Calibration Data (EMWC)

Description: This product contains Microwave data that was subcommutated over 32 ATSR source packets and one General Header Source Packet. The General Header is the one just preceding the first frame of instrument data.

Satellite Source: Microwave

Originating Subsystem: LRDPF

Product Generation: Products are extracted for MMCC-defined start and stop times. Up to five commands defining different time intervals can be submitted by the MMCC per orbit.

Command: C_GEN_EMWC

On-Line Storage Specification: One day

Throughput: All data collected in one orbit, approximately 1375 products per orbit.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-32. Note that if there is no General Header available, the General Header portion of the SPH is padded with zeroes.

- **1 Product Data Set Record**: The product consists of one source packet. See Table 4-33.

Media: Exabyte, for tape format and tape label annotation, see Appendix B.

Comment on Product Confidence: See Subsection 4.1.3.2.3.

Table 4-32 Specific Product Header Record for EMWC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1-4	282		1-282	Same as Table 4-8.
5	1	B	283	PCD product padding flag 0 = product DSR not padded 1 = product DSR padded Note that padding of the product DSR occurs in the event of missing frames containing MW science data. The corresponding fields of the DSR are padded with BB hexadecimal.
6	32	B	284-315	PCD reported at ATSR source packet level: one byte for each of 32 MW frames. bit 1-2: The percentage of MW frames with checksum error compared to MMCC-specified threshold. bit 3-4: Quality of downlinked formats and source packets compared to MMCC-specified threshold bit 5-8: spare 0 = lower than threshold 1 = greater than threshold

Table 4-33 Data Set Record for EMWC

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number; this number is always 1.
2	896	S	5-900	One complete MW science packet, consisting of: 12-byte ATSR SP header 2-byte High/Low Rate Packet ID (zeroes for ERS-1) 4-byte Synch Protocol (zeroes of ERS-2) 2-byte Previous Packet Error Code (zeroes for ERS-1) 8-byte MW data Subcommutated over 32 ATSR source packets (see Document A-2). Note that the DSR is padded in the event of missing frames containing MW science data. The corresponding parts of the DSR are padded with BB hexadecimal.

4.5.7 AMI Image Instrument Header (EII)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: AMI Image Mode

Originating Subsystem: SAR FDP

Product Generation: Auxiliary data are extracted for MMCC-specified start and stop times. MMCC can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EII

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 MBytes per orbit and maximum 15 MBytes per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-34. SPH defines size and content of the data set records.
- **Variable Number of Product Data Set Records**: Each data set record corresponds to one source packet. The length of a data set record is variable, the format is defined in Table 4-35. All data of one selected time interval of one command are combined in one product. Up to ten windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC

Table 4-34 Specific Header for EII, EWAI, EWII, ERAI, EATI1, EATI2, EGOI

Field Number	Number of Bytes	Data Type	Byte Position	Description
2	2	I2	1-2	Starting byte position of 1. window in down-linked data
3	2	I2	3-4	Length in bytes of 1. window
				.
				.
				.
19	2	I2	37-38	Starting byte position of 10. window in down-linked data
20	2	I2	39-40	Length in bytes of 10. window

Table 4-35 Data Set Record for EII, EWAI, EWII, ERAI, EATI1, EATI2, EGOI

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, starting with 1.
2	(n-4)	S	5-n	MMCC-selected windows: • **EII**: from "IDHT GEN. HEADER" and "Auxiliary Data Field"; • **EWAI, EWII**: from "Primary" and "Secondary" Header; • **ERAI, EATI1, EATI2**: from "Primary Header", "Secondary Header" and "Source Data Field". • **EGOI**: from "Primary Header", "Secondary Header" and "Auxiliary and Science Data" of GOME science packets. as in downlinked formats and source packets, see Document A-2. n = variable from product to product and depends on sizes of selected windows, maximum value for: EII = 234 EWAI = 108 EWII = 72 ERAI = 3136 EATI1 = 4004 EATI2 = 13604* EGOI = 8004

* Note that byte position 6805-13604 contains the second high rate packet.

4.5.8 AMI Wave Instrument Header (EWAI)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: AMI Wave Mode

Originating Subsystem: SAR FDP (LRDPF alternatively)

Product Generation: Auxiliary data are extracted for MMCC-specified start and stop times. MMCC can also define whether all auxiliary data or separate windows shall be collected.

One product is generated for each wave cell lying within the specified time interval. If a start or stop time lies within a cell, all specified auxiliary data for that complete cell is extracted.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EWAI

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 MBytes per orbit and maximum 15 MBytes per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-34.
- **299 Product Data Set Records**: The length of a data set record is variable; the format is defined in Table 4-35. One product contains the auxiliary data extracted from each of 299 source packets comprising a wave cell. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC

4.5.9 AMI Wind Instrument Header (EWII)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: AMI Wind Mode

Originating Subsystem: LRDPF

Product Generation: Auxiliary data are extracted for MMCC-specified start and stop times. MMCC can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EWII

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 MBytes per orbit and maximum 15 MBytes per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-34.
- **Variable Number of Product Data Set Records**: The length of a data set record is variable, the format is defined in Table 4-35. All data of the selected time interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC

Comment on Product Confidence: In case there is a loss of data in gaps between products or at the end of a requested time period, then null products consisting only of the MPH are generated. Null products are generated with an update rate corresponding to the receipt of PCDs from the DPMC, normally every 2.5 seconds (see 4.1.3).

4.5.10 Radar Altimeter Instrument Header (ERAI)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: Radar Altimeter

Originating Subsystem: LRDPF

Product Generation: Auxiliary data are extracted for MMCC-specified start and stop times. MMCC can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_ERAI

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 MBytes per orbit and maximum 15 MBytes per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-34.
- **Variable Number of Product Data Set Records**: The length of a data set record is variable, the format is defined in Table 4-35. All data of the selected time interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC

Comment on Product Confidence: In case there is a loss of data in gaps between products or at the end of a requested time period, then null products consisting only of the MPH are generated. Null products are generated with an update rate corresponding to the receipt of PCDs from the DPMC, normally every 2.5 seconds (see 4.1.3).

4.5.11 ATSR-1 Instrument Header (EATI1)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: ATSR-1

Originating Subsystem: LRDPF

Product Generation: Auxiliary data are extracted for MMCC-specified start and stop times. MMCC can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EATI1

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 MBytes per orbit and maximum 15 MBytes per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-34.
- **Variable Number of Product Data Set Records**: The length of a data set record is variable, the format is defined in Table 4-35. All data of the selected time interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.

Media: Exabyte; for tape format and tape label annotation, see Appendix B.

4.5.12 ATSR-2 Instrument Header (EATI2)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: ATSR-2

Originating Subsystem: LRDPF

Product Generation: Auxiliary data are extracted for MMCC-specified start and stop times. MMCC can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EATI2

On-Line Storage Specification: 200 minutes

Throughput: Maximum 5.0 MBytes per orbit and maximum 50 MBytes per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-34.
- **Variable Number of Product Data Set Records**: The length of a data set record is variable, the format is defined in Table 4-35. All data of the selected time interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC.

4.5.13 GOME Instrument Header (EGOI)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: GOME

Originating Subsystem: LRDPF

Product Generation: Auxiliary data are extracted for MMCC-specified start and stop times. MMCC can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EGOI

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 MBytes per orbit and maximum 15 MBytes per day.

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **Specific Product Header**: See Table 4-34.
- **Variable Number of Product Data Set Records**: The length of a data set record is variable, the format is defined in Table 4-35. All data of the selected time

interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC.

4.5.14 General Headers (EGH)

Description: This product contains 16 sets of platform data included in the Source Data Field of the IDHT General Header Source Packet.

Satellite Source: IDHT

Originating Subsystem: LRDPF, SAR FDP (wave mode processing) as backup.

Product Generation: Products are extracted for MMCC-defined start and stop times.

Command: C_GEN_EGH

On-Line Storage Specification: 200 minutes

Throughput: 375 products per orbit

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **16 Product Data Set Records**: Each product data set record consists of byte 6 to 261 of the IDHT General Header Source Packet, as shown in Table 4-36. The first record corresponds with the start of the platform data, platform frame count of 0. The last record corresponds to platform frame count of 15.

Media: X.25 link to MMCC

Comment on Product Confidence:

- In case there is a missing or corrupted Source Packet within a product, the platform data field in the corresponding record is set to 0. In addition, the "Quality of Downlinked Formats and Source Packets" flag in the MPH is set accordingly.
- In case there is a duplicated Source Packet, the second one is ignored.
- In case there is no data at all then no products are generated.

Table 4-36 Data Set Record for EGH

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number, starting with 1.
2	256	S	5-260	Platform Data The format is identical to the first 256 bytes of the "Source Data Field" of the General IDHT Header Source Packet, see Document A-2.

4.5.15 Ephemeris Data (EEP)

Description: This product consists of a complete set of ephemeris data. This data is extracted from 16 usable, noninterrupted consecutive IDHT General Header Source Packets. The first Source Packet used is that for which the Ephemeris ID has value 1.

Satellite Source: IDHT General Header

Originating Subsystem: LRDPF, SAR FDP (wave mode processing) as backup

Product Generation: The product is extracted for a MMCC-defined start time.

Command: C_GEN_EEP

On-Line Storage Specification: 200 minutes

Throughput: 1 product per orbit

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **1 Product Data Set Record**: For the format of the single data set record. See Table 4-37.

Media: X.25 link to MMCC

Comment on Product Confidence: Not Applicable

Table 4-37 Data Set Record for EEP

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number. This number is always 1.
2	384	S	5-388	One complete set of Ephemeris data. The internal format is identical to the subcommutated fields; that is, byte 263 to 286 in the IDHT General Header Source Packet, see Document A-2.

4.5.16 Text Product (TP)

Description: Text messages are generated by the MMCC. They are output over the product distribution link at MMCC-specified times.

Satellite Source: Not Applicable

Originating Subsystem: MMCC/DPMC

Production Generation: Not Applicable

Command: C_USER_TEXT

On-Line Storage Specification: 200 minutes

Throughput: variable low

Format: One product includes:

- **Main Product Header**: See Table 4-3.
- **1 Product Data Set Record**: Each record consists of one 80-byte-long text message, see Table 4-38.

Media: Product distribution links

Table 4-38 Data Set Record for Text Product

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Data record number. This number is always 1.
2	80	A	5-84	Text message.

MACDONALD DETTWILER

THIS PAGE INTENTIONALLY LEFT BLANK

A COMPUTER-COMPATIBLE TAPE FORMAT

CCT are recorded with 6250 bpi, using 9-track tapes, with 2400 feet of tape on 10-inch reels. Tape drives used to generate these tapes have built-in error detection and correction.

Products are stored on CCT either directly after product generation, or with a separate command. All products addressed with one generate command (RATSR, IWA) or one archive command are put on one or more tape reels. All tape reels that were generated with one command are referred to as tape set.

CCTs generated in Kiruna have a tape header file. The format of this tape header file is given in Table A-1.

Table A-1 Tape Header File Format

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	8	A	1-8	MMCC-supplied tape identifier. This identifier is copied to all tape reels generated with the same command. This identifier is also printed on the paper tape label.
2	2	I2	9-10	Reel counter. For the first reel of a tape set, the value is 1.
3	4	I4	11-14	Spare.

For the rest of the tapes there are two tape formats:

- Product-type-per-file
- Product-per-file

In the product-type-per-file all products of the same type are stored in one file. Products consisting of MPH, SPH and data set records, as defined in Section 4, are combined to one record on tape (see Figure A-1). There is only one file per product type on one CCT. The RATSR, UIND, UIC, UWA, UWAND, UWAC, UWI, URA, EIC, EWIC, ERAC, EGH, EEP, EGOC (TBC), EATC2 (TBC), and EMWC (TBC) product types are stored in this format.

In the product-per-file structure, one product corresponds to a file, and the record structure given in Section 4 is maintained on tape (see Figure A-2 for monoreel configuration and Figure A-3 for multireel configuration). The UI16, UI8, IWA, II16, EWAC, EII, EWAI, EWII, ERAI, EGOI (TBC), EATI1 (TBC), and EATI2 (TBC) product types are stored in this format. The last reel of multireel tape set has three EOF marks.

CCTs generated at Kiruna have a paper label containing the following information:

- MMCC-supplied information field
- satellite ID
- list of product types stored on tape
- time interval for which products were taken and stored on tape
- station ID
- tape drive ID
- tape generation type
- tape reel counter
- last reel identification flag

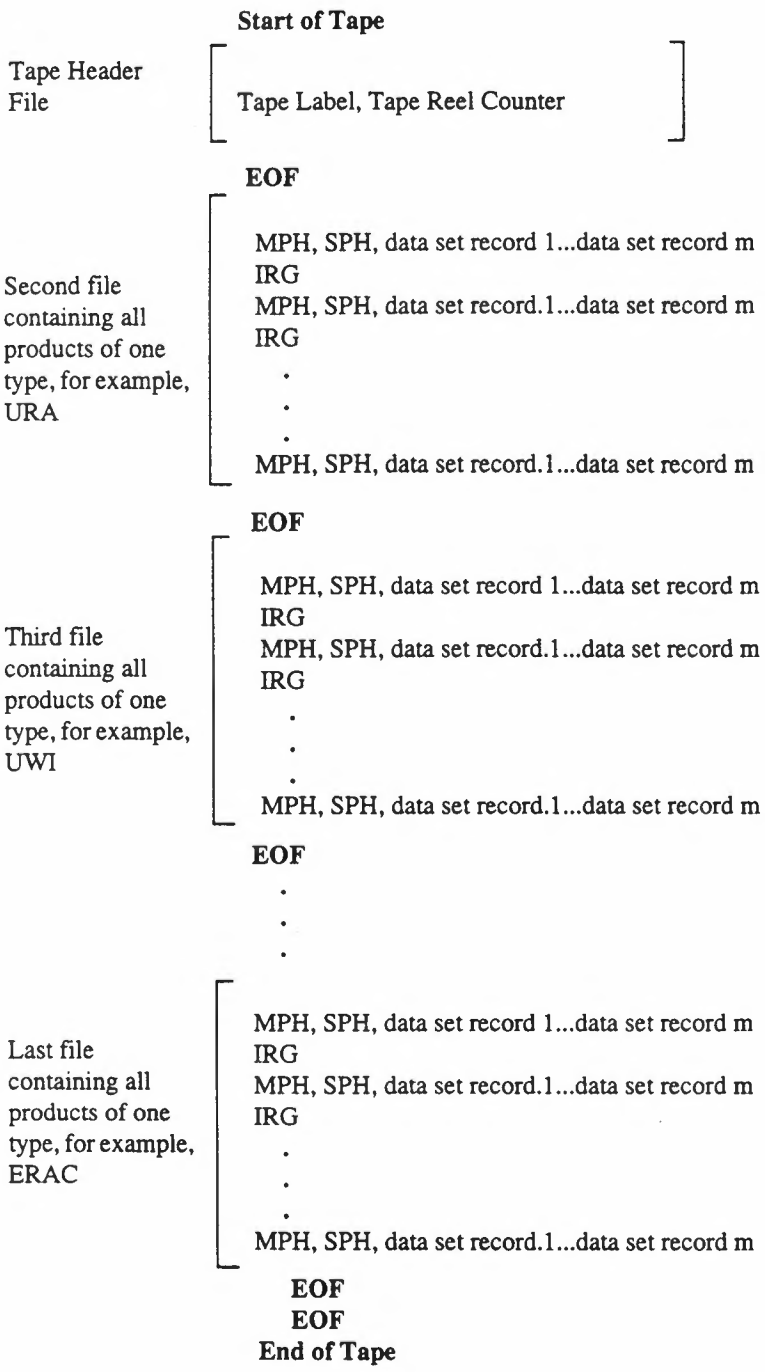


Figure A-1 Product-Type-Per-File Format of One Tape Reel

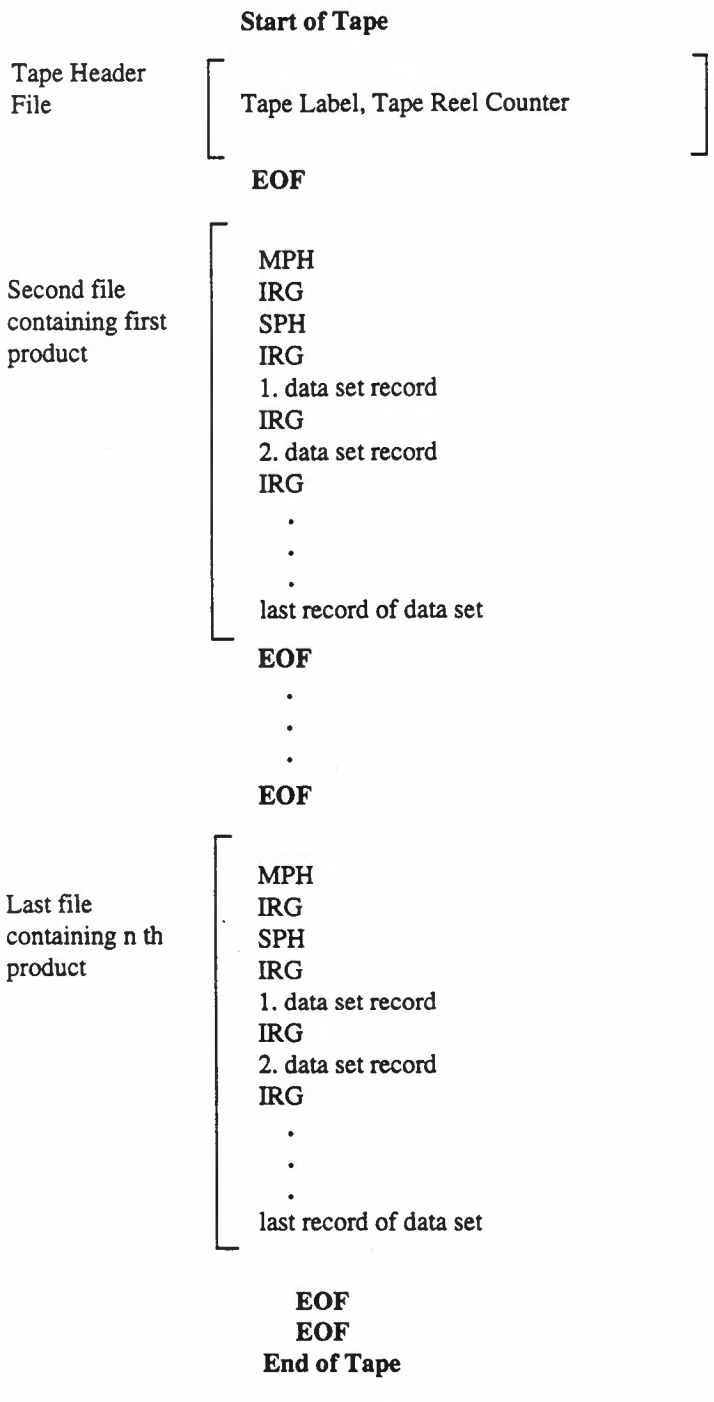


Figure A-2 Product-Per-File Format of One Tape Reel

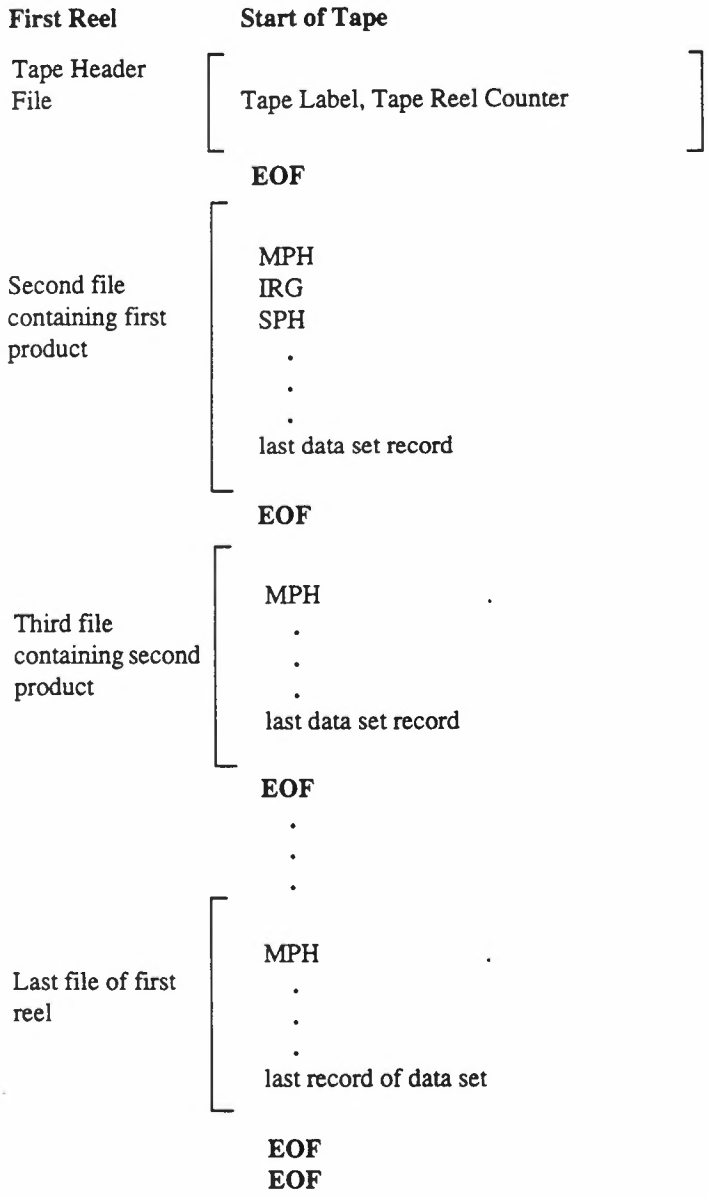


Figure A-3 Product-Per-File Format Multireel Configuration

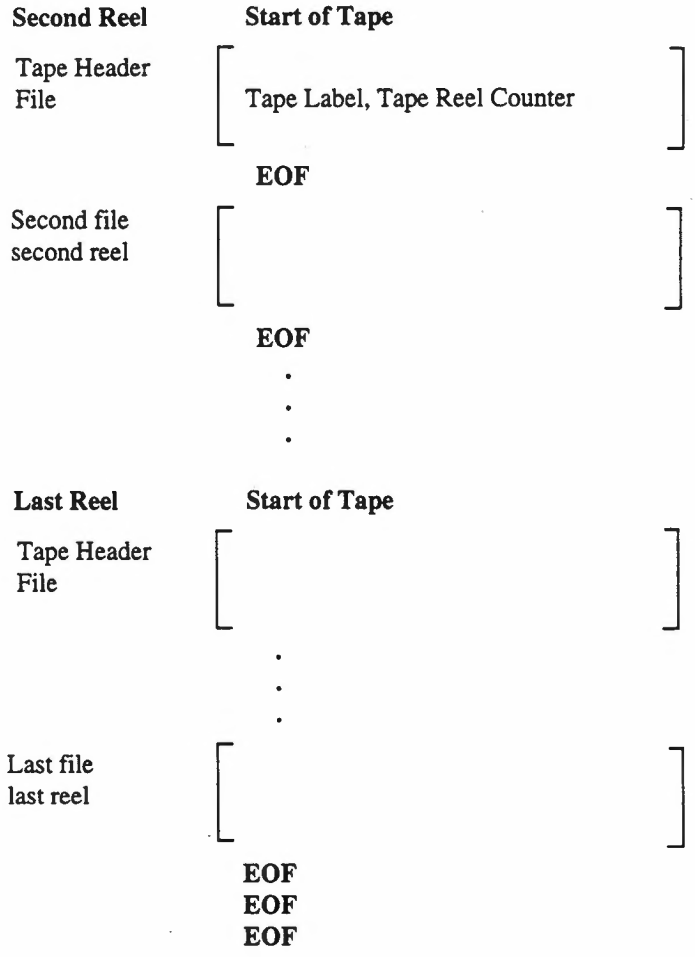


Figure A-3 Product-Per-File Format Multireel Configuration

B EXABYTE TAPE FORMAT

The Exabyte system uses 8-mm cartridge tapes. The capacity of these tapes depends on the tape length and drive subsystem used. For the ERS Ground Segment, 5 GBytes will be used.

Although the handling of Exabyte Tapes from a software viewpoint is similar to that of CCTs, the format of products stored on Exabyte Tapes is different from the CCT format. This is due to the different optimisation requirements imposed on the Exabyte archive subsystem.

There are three types of Exabyte format:

1. products stored from DPMC via the c_exabyte command;
2. transcribed products from the LRDPF;
3. archived products from the LRDPF.

Each of these formats is detailed in the sections which follow.

B1. DPMC Exabyte Format

The Exabyte tape format for products stored locally by the DPMC is given in Figure B-1.

The format of the tape header file is given in Table A-1.

The format of the MPH file is given in Table B-1.

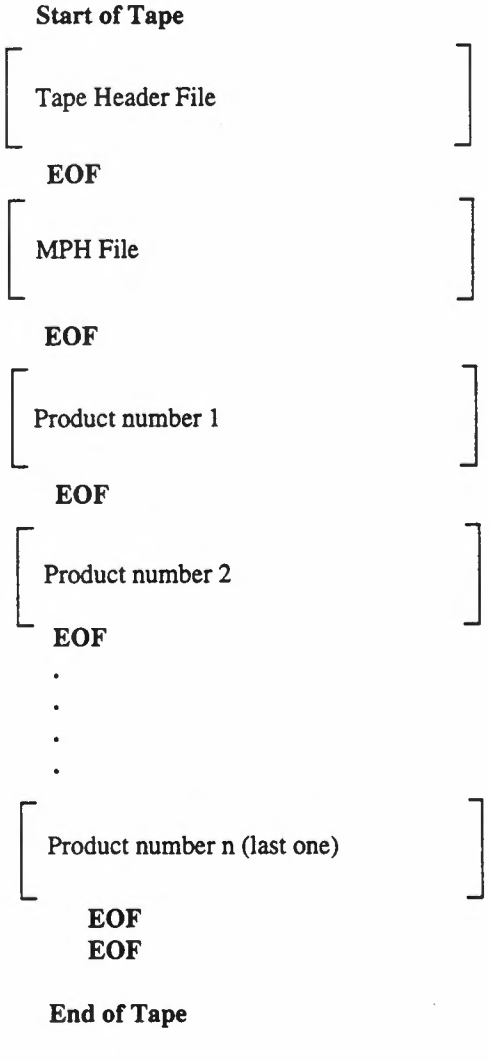


Figure B-1 Exabyte Tape Format

Table B-1 MPH File Format

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Number of Main Product Headers stored in this file (N). Equals zero if the MPH flag selects no MPH file. Has a maximum value of 550.
2	24	B	5-28	Product Type list copied directly from the C_EXABYTE command.
3	24	A	29-52	Start Time of window of product acquisition times. Copied from the C_EXABYTE command.
4	24	A	53-76	Stop Time of window of product acquisition times. Copied from the C_EXABYTE command.
5	24	B	77-100	Spare
6	176	B	101-276	First product MPH
7	176	B	277-452	Second Product MPH
				. . .
N+5	176	B	101+(N-1)*176 to 100+N*176	The Nth product MPH

The format of storage of small (less than or equal to 32 kBytes) products is given in Figure B-2. This includes the UIND, UIC, UWA, UWAND, UWAC, UWI, URA, EIC, EWIC, ERAC, EGH, EEP, EGOC (TBC), EATC2 (TBC), and EMWC (TBC) product types.

The format of storage of large (greater than 32 kBytes) products is given in Figure B-3. This includes the UI16, UI8, IWA, II16, EWAC, EII, EWAI, EWII, ERAI, EGOI (TBC), EATI1 (TBC), and EATI2 (TBC) product types.

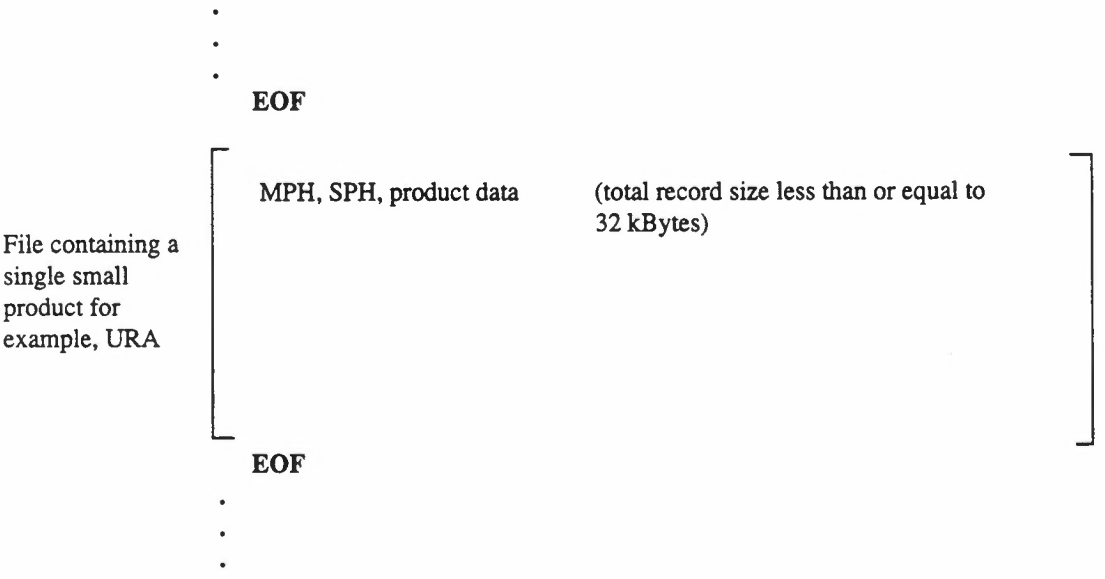


Figure B-2 Small Product Format

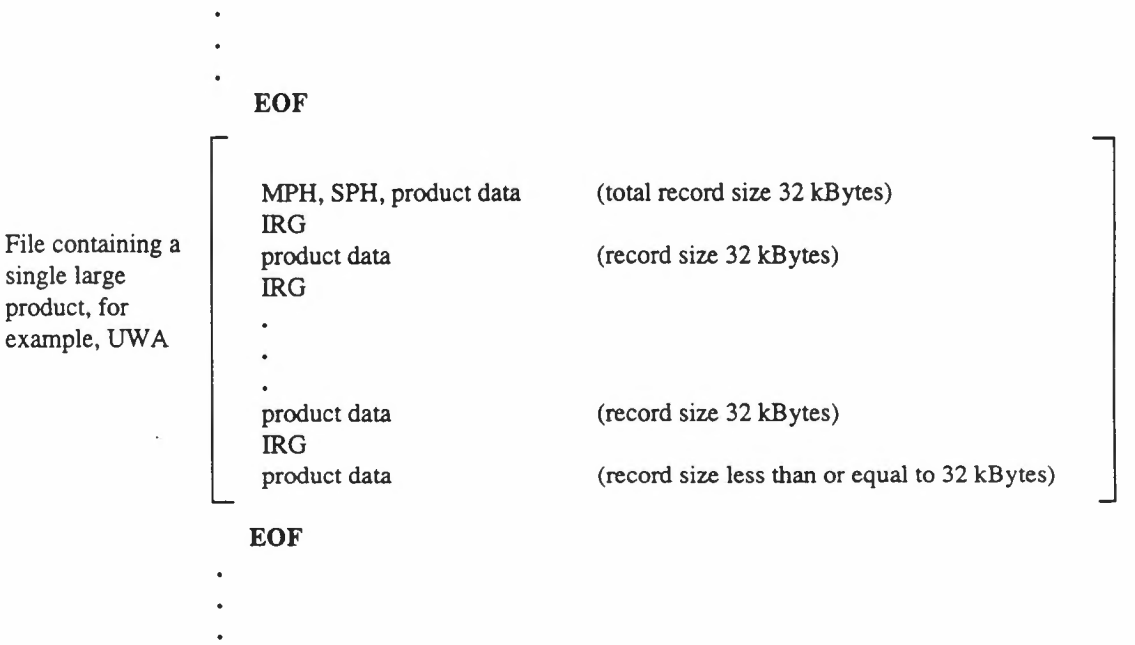


Figure B-3 Large Product Format

Exabyte tapes have a paper label containing the same information as that provided on a CCT label. See Appendix A for details.

B2. Transcription Exabyte Format

Table B-2 shows the file layout on Exabyte for products transcribed on the LRDPF.

Table B-2 Transcription Exabyte Contents

File	Contents
Tape Header File	• Tape Label • Reel Counter • Tape type EOF
Production Information File	• Production Date (UTC) • Satellite id • C_INITIALISE_TRANSCRIBE command • C_CONFIGURE_TRANSCRIPTION command EOF
Extracted product file 1	MPH, SPH, DSR, IRG MPH, SPH, DSR, IRG .... EOF
Extracted product file 2	As for product file 1
Extracted product file N	As for product file 1
Directory File	Number of extracted product files Descriptor for each product file: • Number of non-zero products in file • Number of total products in file • MPH of first and last product in file • Raw Data Availability • Acquisition and ingestion PCD monitor • QA info EOF
	[EOF][1]

1. if > 1 physical volume, end of each successive physical volume by 2 x EOF, end of last physical volume by 3 x EOF.

The Tape Header File Format is detailed in Table B-3.

Table B-3 Tape File Header Format

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	8	A	1-8	Tape label. Copied to all reels generated from the same command. Also printed on the paper label. This is the tape_id field provided in the device_label field of a c_archive command or a c_config_trans command.
2	2	I2	9-10	Reel counter. First reel=1
3	1	B	11	Tape type where: 'A' = Archive tape 'T' = Transcription tape
4	4	I4	12-14	Spare

The Production Information File is detailed in Table B-4.

Table B-4 Production Information File Format (Transcribed Exabyte)

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	8	utc_time_m[1]	1-8	Production date
2	4	I4	9-12	Satellite id
3	33	c_init_trans[2]	13-45	Command from DPMC/CMS
4	68	c_config_trans[3]	46-113	Command from DPMC/CMS that configured this Exabyte
5	87	B	114-200	Spare field

1. The utc_time_m structure is defined in Document R-2.
2. c_init_trans structure is defined in Document R-2.
3. c_config_trans structure is defined in Document R-2.

The Product File structure is detailed in Table B-5. The field sizes will depend on which product type (i.e., RATSR, EATC2, EWIC, ERAC, EWAC, EMWC or EGOC) the file contains. The product file will contain N extracted calibration data products for a specific product type. The first MPH has to be read in order to determine the actual product type.

Table B-5 Product Files

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	176	MPH[1]	1-176	First Product MPH
2	--	SPH	177->	First Product SPH
3	--	DSR	---	First Product DSR(s)
1	176	MPH	---	Second Product MPH
2	--	SPH	---	Second Product SPH
3	--	DSR	---	Second Product DSR(s)
...	...	....	....	.....
1	176	MPH	---	Last Product MPH
2	--	SPH	---	Last Product SPH
3	--	DSR	---	Last Product DSR(s)

1. The MPH, SPH and DSR structures are detailed in Section 4.

The Directory File structure is detailed in Table B-6.

Table B-6 Directory File Format (Transcribed Exabyte)

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Number of extracted product files
2	4	I4	5-8	Total product data volume
3	57	tape_qa_info	9-65	Transcription tape info as detailed in Section 4.6.2
4	435	B	66-500	Spare field
5	4	I4	501-504	Product File 1: Number of non-zero products
6	4	I4	505-508	Product File 1: Total number of products
7	176	MPH[1]	509-684	Product File 1: MPH of first product
8	176	MPH	685-860	Product File 1: MPH of last product
9	4	I4	861-864	Product File 1: Raw Data availability. Contents is TBD.
10	4	I4	865-868	Product File 1: Acquisition PCD monitor. Contents is TBD.
11	4	I4	869-872	Product File 1: Ingestion PCD monitor. Contents is TBD.
12	8	trans_prod_ qa_info	873-880	Product File 1: Orbit level product QA check as detailed in Section 4.6.2 of Document R-1.
13	120	B	881-1000	Product File 1: Spare field

Table B-6 Directory File Format (Transcribed Exabyte)

Field Number	Number of Bytes	Data Type	Byte Position	Description
14-22	500	---	1001-1500	Product File 2: Fields for product file 1 repeated for product file 2
....	500	.....	.....	.....
-----	500	---	-----	Product File N: Field for product file 1 repeated for last product file

1. The MPH structure is detailed in Section 4.

B3. Archive Exabyte Format

Table B-7 shows the file layout on Exabyte for products archived on the LRDPF.

Table B-7 Archive Exabyte Contents

File	Contents
Tape Header File	• Tape Label • Tape cassette Counter • Tape type EOF
Production Information File	• Production Date (UTC) • Satellite id • c_archive command defined in Section 4.5.1.2 of • Document R-1 • Spare field (zero padded) EOF
Product type 1 file [1]	MPH, SPH, DSR(s), IRG[2] MPH, SPH, DSR(s), IRG “ EOF
Product file 2 file	As for product file 1
Product type N file	As for product file 1

Table B-7 Archive Exabyte Contents

File	Contents
Directory File	Number of product files Descriptor for each product file: • Number of non-zero products in file • Number of total products in file • MPH of first and last product in file • Spare fields EOF
	[EOF][3]

1. Products are written to tape in same order as per the prod_type_list.
2. The IRG is placed after each product except for Instrument Header products where the IRG in addition is placed after the MPH, the SPH and each DSR.
3. if > 1 physical volume, end of each successive physical volume by 2 x EOF, end of last physical volume by 3 x EOF.

The Tape Header File Format is detailed in Table B-3.

The Production Information File is detailed in Table B-8.

Table B-8 Production Information File Format (Archived Exabyte)

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	8	utc_time_m[1]	1-8	Production date
2	4	I4	9-12	Satellite id
3	85	c_archive	13-97	c_archive command as defined in Section 4.5.1.2 of Document R-1
4	103	B	98-200	Spare field (set to zero)

1. The utc_time_m structure is defined in Document R-2.

The Product File structure is detained in Table B-5. Note that the product files in the archived Exabyte may contain all types of products, not only extracted calibration data products.

Note also that the following product types will appear as one product per file: ERAI, EWII, EGOI, EWAI, EATI1 and EATI2.

The Directory File structure is detailed in Table B-9.

Table B-9 Directory File Format (Archived Exabyte)

Field Number	Number of Bytes	Data Type	Byte Position	Description
1	4	I4	1-4	Number of archived product files
2	4	I4	5-8	Total product data volume
3	492	B	9-500	Spare field
4	4	I4	501-504	Product File 1: Number of non-zero products
5	4	I4	505-508	Product File 1: Total number of products
6	176	MPH[1]	509-684	Product File 1: MPH of first product
7	176	MPH	685-860	Product File 1: MPH of last product
8	140	B	861-1000	Spare field (set to zero)
9-14	500	---	1001-1500	Product File 2: Field 4-8 repeated for product file 2
....	500	.....	.....	.....
-----	500	---	-----	Product File N: Field 3-7 repeated for last product file

1. The MPH structure is detailed in Section 4.