Sentinel-1 Product Specification

Prepared By:	C. Thain
Checked By:	R. Barstow
Quality Assurance:	D. Ramsbottom
Project Manager:	P. Lim
Released by CADM:	Terry Wong

(signature / date)

CADM signature indicates that all above approvals have been received and are on file.

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MacDonald, Dettwiler and Associates Ltd
13800 Commerce Parkway
Richmond, B.C., Canada
V6V 2J3

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ACRONYMS AND ABBREVIATIONS

ADS	Annotation Data Set
ADSR	Annotation Data Set Record
AEP	Antenna Elevation Pattern
ANX	Ascending Node Crossing
ASAR	Advanced SAR
ASCII	American Standard Code for Information Interchange
BAQ	Block Adaptive Quantisation
BigTIFF	Big Tag Image File Format
CCN	Contract Change Notice
CCSDS	Consultative Committee for Space Data Systems
CDR	Critical Design Review
CDRL	Contract Data Requirements List
COTS	Commercial off the Shelf
CRC	Cyclic Redundancy Check
dB	DeciBel
DC	Doppler Centroid
DCE	Doppler Centroid Estimation/Estimate
DN	Digital Number
DS	Data Set
DSR	Data Set Record
ECC	Event Control Code
ECMWF	European Centre for Medium-Range Weather Forecasts
ESA	European Space Agency
ESRIN	European Space Research Institute
EW	Extra Wide Swath
FDBAQ	Flexible Dynamic Block Adaptive Quantisation
FM	Frequency Modulation
FR	Full Resolution
GB	Giga Byte
GEBCO	General Bathymetric Chart of Oceans
GeoTIFF	Geo-reference Tag Image File Format
GMES	Global Monitoring for Environment and Security

GMF	Geophysical Model Function
GRD	Ground Range, Multi-look, Detected
HH	Horizontal polarisation (Tx & Rx)
HR	High Resolution
HTML	HyperText Markup Language
HV	Horizontal Vertical polarisation
Hz	Hertz
I/Q	In-phase/Quadrature
ICD	Interface Control Document
ID	Identifier
IPF	Instrument Processing Facility
ISLR	Integrated Slide Lobe Ratio
ISP	Instrument Source Packet
IW	Interferometric Wide Swath
Km	Kilometre
KML	Keyhole Markup Language
L0	Level Zero
L1	Level One
L2	Level Two
LUT	Look-up Table
m	metre
MDS	Measurement Data Set
MR	Medium Resolution
N/A	Not Applicable
NetCDF	Network Common Data Form
NRCS	Normalised Radar Cross Section
OCN	L2 Ocean Product
OSW	Ocean Swell Spectra
OWI	Ocean Wind Field
PDR	Preliminary Design Review
PNG	Portable Network Graphics
pol.	Polarisation
PRI	Pulse Repetition Interval
RDA	Raw Data Analysis

RDS	Representation Data Set
RGB	Red Green Blue
RID	Review Item Disposition
RVL	Radial Surface Velocity
S-1	Sentinel-1
SAR	Synthetic Aperture Radar
SAS	SAR Antenna Sub-system
SES	SAR Electronic Sub-system
SI	International System of Units
SLC	Single Look Complex
SM	Stripmap
SOW	Statement of Work
SPPDU	Space Packet Protocol Data Unit
SWST	Sampling Window Start Time
TBC	To Be Confirmed
TBD	To Be Determined
TIFF	Tag Image File Format
TOPSAR	Terrain Observation with Progressive Scanning SAR
Tx	Transmit
URL	Uniform Resource Locator
UTC	Universal Time Coordinated
VH	Vertical Horizontal polarisation
VV	Vertical polarisation
W3C	World Wide Web Consortium
WGS 84	World Geodetic System (1984)
WV	Wave
XFDU	XML Formatted Data Unit
XML	eXtensible Markup Language
ZDT	Zero Doppler Time

1 INTRODUCTION

This section introduces the purpose, scope and structure of the document.

1.1 Purpose

This document defines the detailed product format for all Sentinel-1 Level 1 (L1) and Level 2 (L2) products. It specifies the content and format of the products generated by the Sentinel-1 Instrument Processing Facility (IPF).

1.2 Scope

This product specification satisfies the Sentinel-1 detailed L1 product format (deliverable PFL1-4) and the Sentinel-1 detailed L2 product format (deliverable PFL2-3) from the ESA Statement of Work (SOW) [A-1] with the modifications described in the Sentinel-1 IPF Contract Change Notice N. 2, Changes in ESRIN Contract No. 21722/08/I-LG [A-6].

This document specifies the content and format of Sentinel-1 L1 and L2 products for the four Sentinel-1 Synthetic Aperture Radar (SAR) acquisition modes: Stripmap (SM); Interferometric Wide Swath (IW); Extra Wide Swath (EW); and Wave (WV). The performance and characteristics for each of the products in the Sentinel-1 product family are detailed in the Sentinel-1 Product Definition [A-5]. The definition of Level 0 (L0) products is contained in the Sentinel-1 L0 Product Format Specification [R-8] and is not part of this document.

The Sentinel-1 product schema files form the definitive source for the content and format of Sentinel-1 products. The schema files are included in Appendix A and are distributed with every Sentinel-1 L1 and L2 product.

1.3 Document Structure

This document is structured as follows:

- **Section 1** introduces the purpose, scope and structure of the document;
- **Section 2** lists the applicable and reference documents;
- **Section 3** introduces the objectives and key concepts of the specification and presents an overview of the product format;
- **Section 4** defines the collections of data sets (DS) from Section 6 that make up each Sentinel-1 L1 product;

- **Section 5** defines the collections of data sets from Section 6 that make up each Sentinel-1 L2 product;
- **Section 6** describes the contents and format of each Sentinel-1 L1 and L2 data set. This section presents an abstract view of the details of each data set contained in the schemas defined in Appendix A and is intended for users of all levels;
- **Appendix A** contains the eXtensible Markup Language (XML) schema files that define the content and format of all Sentinel-1 L1 data sets. The XML schema files are the definitive source for the Sentinel-1 L1 product format. This section is intended for an audience with an understanding of XML Schema.

Within this document, Sections 1 and 2 are independent and stand-alone in the respect that they do not rely on other sections within the document for context; however, Sections 3 through 6 and Appendix A deserve special attention because inter-dependencies do exist between these sections of the document. Figure 1-1 presents a graphical view of the structure of the sections described in the list above and the relationships between each.

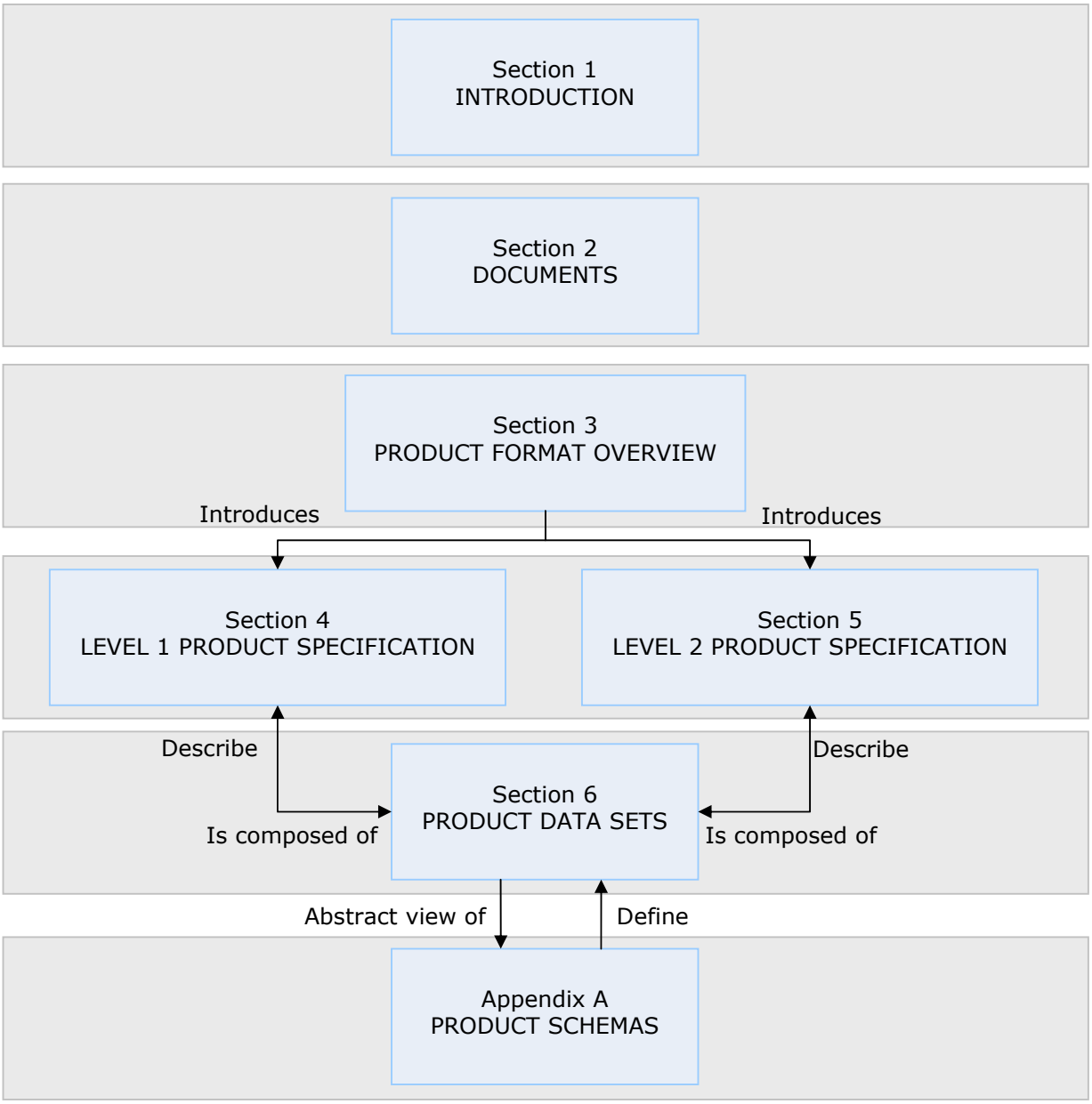


Figure 1-1 Document Structure and Section Relationships

2 DOCUMENTS

2.1 Applicable Documents

The following documents of the date/revision indicated form part of this document to the extent referenced herein.

A-1	GMES-DFPR-EOPG-SW-07-00006	Sentinel-1 Product Definitions & Instrument Processing Facility Development Statement of Work, Issue/Revision 4/1, 23-05-2008. ESA.
A-2	S1-RS-MDA-52-7452	Sentinel-1 IPF System Requirements Specification. Issue/Revision 2/1. Mar. 25, 2011. MDA.
A-3	PGSI-GSEG-EOPG-FS-05-0001	Standard Archive Format for Europe (SAFE) Control Book Volume 1 Core Specifications, Issue 1/8, Jun. 28, 2009. ESA.
A-4	PGSI-GSEG-EOPG-FS-05-0002	Standard Archive Format for Europe (SAFE) Control Book Volume 2 Recommendation for specialisations Issue/Revision 1/7. June 28, 2009. ESA.
A-5	S1-RS-MDA-52-7440	Sentinel-1 Product Definition, Issue/Revision 2/3, Mar. 21, 2011. MDA.
A-6	CCN No. 2	Contract Change Notice N. 2, Changes in ESRIN Contract No. 21722/08/I-LG, June 21, 2010. MDA

2.2 Reference Documents

The following documents provide useful reference information associated with this document. These documents are to be used for information only and changes to the date/revision number (if provided) shall not make this document out of date.

R-1		XML Formatted Data Unit Structure and Construction Rules. September 15, 2004. CCSDS.
R-2		XML 1.1 Second Edition, W3C Recommendation, 16 August 2006, Bray et al.
R-3		XML Schema Part 1: Structures Second Edition, W3C Recommendation, 28 October 2004, Thompson et al.
R-4		XML Schema Part 2: Datatypes Second Edition, W3C Recommendation, 28 October 2004, Biron et al.
R-5		TIFF Revision 6.0, June 3, 1992. Adobe Systems Incorporated.
R-6		GeoTIFF Format Specification, GeoTIFF Revision 1.0, Version 1.8.2, 28 December 2000, Ritter and Ruth.
R-7		BigTIFF File Format Proposal, AWare Systems.
R-8	GM-ID-ACS-T8-0106	Sentinel-1 L0 Product Format Specification, Issue/Revision 1/1, April 20, 2010. ACS.
R-9	GMES-S1GS-EOPG-TN-10-0001	Sentinel-1 Products Naming Standard Convention, Issue 1/1, July 01, 2010, ESA.
R-10	OGC 07-147r2	KML, Version 2.2, April 14, 2008, Open Geospatial Consortium Inc.
R-11		Portable Network Graphics Specification Second Edition, W3C Recommendation, 10 November 2003.

R-12 Network Common Data Form (NetCDF) Users Guide, NetCDF Version 4.0.1, March 2009, Unidata.

R-13 Google extensions to KML 2.2: http://code.google.com/apis/kml/schema/kml22gx.xsd. 2009 Google Inc.

R-14 S1-TN-MDA-52-7445 Sentinel-1 Level 1 Detailed Algorithm Definition, Issue 1/3, May 15, 2011, MDA.

3 PRODUCT FORMAT OVERVIEW

The objectives of this specification are to define a Sentinel-1 product format for the L1 and L2 products defined in the Sentinel-1 Product Definition [A-5] that:

- applies to Sentinel-1 L1 and L2 products;
- contains the complete set of parameters and annotations required for calibration, analysis, quality assessment and post-processing of the product;
- supports the harmonisation of product formats across a multitude of Global Monitoring for Environment and Security (GMES) missions;
- supports a computer-based approach for validation of the consistency and content of the product; and,
- uses technologies that are current and widely supported to ensure ease of use for end users.

In order to meet these objectives the Sentinel-1 product format leverages the following key concepts:

- the product format is based on the SAFE specification [A-3], an XML-based format that has the following advantages:
  - XML is an ASCII based language that is both human and machine readable;
  - XML is widely supported by Commercial off the Shelf (COTS) tools including image processors, databases, browsers and translators;
  - XML supports a computer based approach to format and content validation through the use of XML schema files;
  - SAFE uses a data wrapping technique that provides the flexibility to support any binary data format (making the format scalable enough to represent all levels of Sentinel-1 products);
  - SAFE is endorsed as the recommended product format for the harmonisation of products across GMES missions by the GMES Product Harmonisation Study;
- the product annotations are based on ENVISAT ASAR heritage, have been augmented to include the specialisations required to fully support Sentinel-1 and have been enhanced by the experience from other SAR missions like RADARSAT-2 and TerraSAR-X; and,
- the data formats selected to represent images and measurement data (GeoTIFF, PNG, NetCDF) within the products are based on industry standard formats.

3.1 Products Overview

The Sentinel-1 IPF supports the generation of L1 and L2 products for the following four SAR acquisition modes:

- Stripmap (SM) – A standard SAR stripmap imaging mode where the ground swath is illuminated with a continuous sequence of pulses while the antenna beam is pointing to a fixed azimuth and elevation angle. Refer to Section 3.3.1 of [A-5] for a detailed description of SM;
- Interferometric Wide Swath (IW) – Data is acquired in 3 swaths using the Terrain Observation with Progressive Scanning SAR (TOPSAR) imaging technique. In IW mode bursts are synchronised from pass to pass to ensure the alignment of interferometric pairs. Refer to Section 3.3.2 of [A-5] for a detailed description of IW;
- Extra Wide Swath (EW) – Data is acquired in 5 swaths using the TOPSAR imaging technique. EW mode provides very large swath coverage at the expense of spatial resolution. Refer to Section 3.3.3 of [A-5] for a detailed description of EW;
- Wave (WV) – Data is acquired in small stripmap scenes called "vignettes", situated at regular intervals of 100 km along track. The vignettes are acquired in 'leap frog' mode; i.e., one vignette is acquired at a near range incidence angle while the next vignette is acquired at a far range incidence angle. Refer to Section 3.3.4 of [A-5] for a detailed description of WV.

The Sentinel-1 IPF is capable of generating a family of Level 1 and Level 2 products from the four SAR measurement modes and the tree illustrating the Sentinel-1 family of products is presented in Figure 3-1.

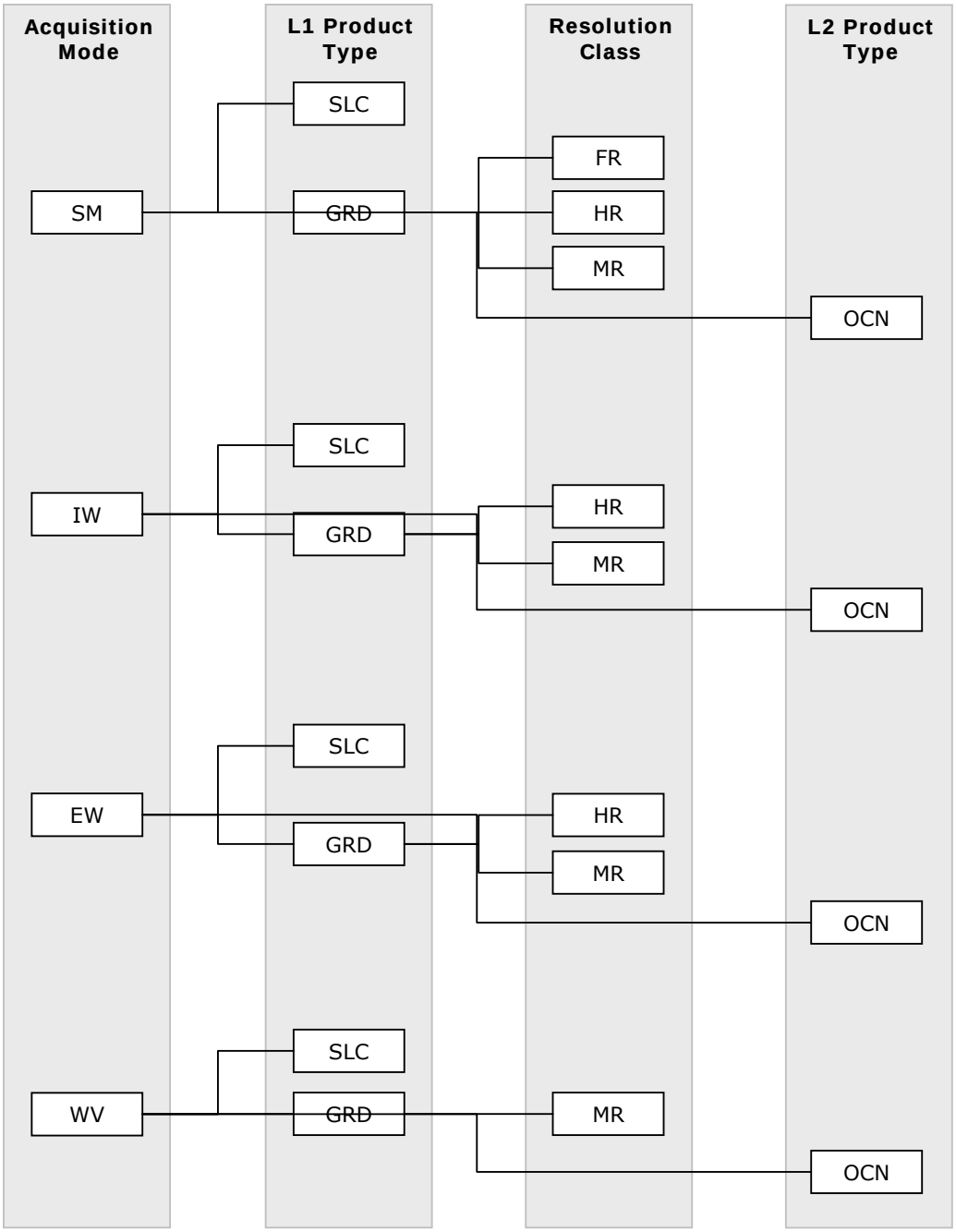


Figure 3-1 Sentinel-1 Product Family Tree

3.1.1 Level 1 Products Overview

The following types of L1 products are generated by the Sentinel-1 IPF:

- Slant Range, Single-Look Complex (SLC); and
- Ground Range, Multi-Look, Detected (GRD)

SLC products are images in the slant range by azimuth imaging plane, in the image plane of satellite data acquisition. Each image pixel is represented by a complex (I and Q) magnitude value and therefore contains both amplitude and phase information. The processing for all SLC products results in a single look in each dimension using the full available signal bandwidth. The imagery is geo-referenced using orbit and attitude data from the satellite.

GRD products lie in the ground range by azimuth surface, with image coordinates oriented along ground range and flight direction. To convert from imaging slant range coordinates to ground range coordinates, a slant to ground projection is performed onto an ellipsoid (typically the WGS84 ellipsoid) corrected using terrain height, which varies in azimuth and is constant in range. The standard GRD products are detected, multi-look products, with approximately square resolution cells and square pixel spacing. Multi-looking is a processing property that results in images with reduced speckle, but also with reduced resolution: the more looks the less speckle noise and the lower the resolution.

The resolution of SLC products is determined by the acquisition mode; however, the GRD products can be further classified into a resolution class characterised by the acquisition mode employed as well as by the level of multi-looking performed during processing:

- Full Resolution (FR) products;
- High Resolution (HR) products; and,
- Medium Resolution (MR) products.

For detailed descriptions of the properties and characteristics of each product type for the various modes, refer to [A-5].

3.1.1.1 Annotation Products

The IPF is also capable of generating Annotation products for the L1 SLC and GRD product types. Annotation products are generated for internal PDGS purposes and are not distributed externally to users.

L1 Annotation products are generated using the same processing as the "nominal" products and so are identical to the nominal products except that they contain only the product annotations and exclude the image MDS; this results in a product containing all the metadata but with a significantly reduced data volume. For SM, IW and EW modes annotation products may contain a Quick-look image for a visual reference of the product scene coverage. For detailed descriptions of the properties and characteristics of each product type for the various modes, refer to [A-5].

For L2 products, the metadata in the annotation product is based on the internal L1 SLC product that was used as input to the L2 Processor.

3.1.2 Level 2 Products Overview

The Sentinel-1 IPF is capable of generating an L2 Ocean (OCN) product from input L1 products (note that these input SLC and GRD products are produced using different parameters than standard L1 products, specifically for the purpose of L2 processing). The L2 OCN product is composed of three components: an Ocean Swell Spectra (OSW) component; an Ocean Wind Field (OWI) component; and, a Radial Velocity (RVL) component. Each of the three components is described in the subsequent sections (respectively).

3.1.2.1 Level 2 Ocean Swell Spectra Component

The OSW component of the OCN product is a two-dimensional ocean surface swell spectra estimated from a Level 1 SLC image. The OSW component also contains one estimate of the wind speed and direction per ocean swell spectrum, as well as parameters derived from the ocean swell spectra (integrated wave parameters) and from the vignette (image statistics).

The OSW component is generated from SM and WV data. It cannot be generated from TOPSAR data, since individual looks with sufficient time separation are required. The obtained inter look time separation within one burst is too short due to the progressive scanning (i.e. short dwell time). For WV data, there is one OSW spectra derived per vignette. For SM data, multiple spectras are derived from the image on a ground-range grid.

Refer to Section 6.2.1.1 of [A-5] for the detailed description and definition of the L2 OSW component.

3.1.2.2 Level 2 Ocean Wind Field Component

The OWI component of the OCN product is a ground-range gridded estimate of the surface wind speed and direction at a height of 10 m above the ocean surface, derived from an input L1 GRD image from SM, IW or EW mode. Refer to Section 6.2.1.2 of [A-5] for the detailed description and definition of the L2 OWI component.

3.1.2.3 Level 2 Radial Surface Velocity Component

The RVL component of the OCN product is calculated based on the difference between the measured L2 Doppler grid and the geometrical Doppler calculated by the L1 processor. The measured L2 Doppler grid accounts for the antenna mispointing Doppler by including the antenna error matrix in the antenna model synthesis. The RVL estimates are produced on a ground-range grid, although the input product is SLC.

Refer to Section 6.2.1.3 of [A-5] for the detailed description and definition of the L2 RVL component.

3.2 High Level Product Structure

This section describes the high-level format and structure that is applicable to all Sentinel-1 L1 and L2 products. The term "product" simply refers to a directory folder that contains a collection of information. Sentinel-1 products contain related information grouped together into files referred to as data sets, and data sets are collected and grouped together to form a complete product.

The Sentinel-1 product format is a specialisation of the SAFE format and thus inherits its information, logical, and physical models from the SAFE standard. One of the key advantages of the SAFE format is its ability to capture how the information in a product is logically interconnected and validated; however, the focus of this product specification document is to present the physical structure and composition of Sentinel-1 products, detailed information on the SAFE information and logical models is available in [A-3].

The detailed implementation of the SAFE format for Sentinel-1 products is managed in the XML schema files contained in Appendix A. The purpose of this document is to clearly and concisely convey the Sentinel-1 product format in a manner that allows the user to gain understanding without knowledge of the details at the XML schema level; that is:

- this document deals with what information is contained in a product and where it is located; and,
- the schema files in Appendix A define the detailed product format as a specialisation of SAFE [A-3].

Figure 3-2 presents a conceptual overview of the composition of Sentinel-1 products.

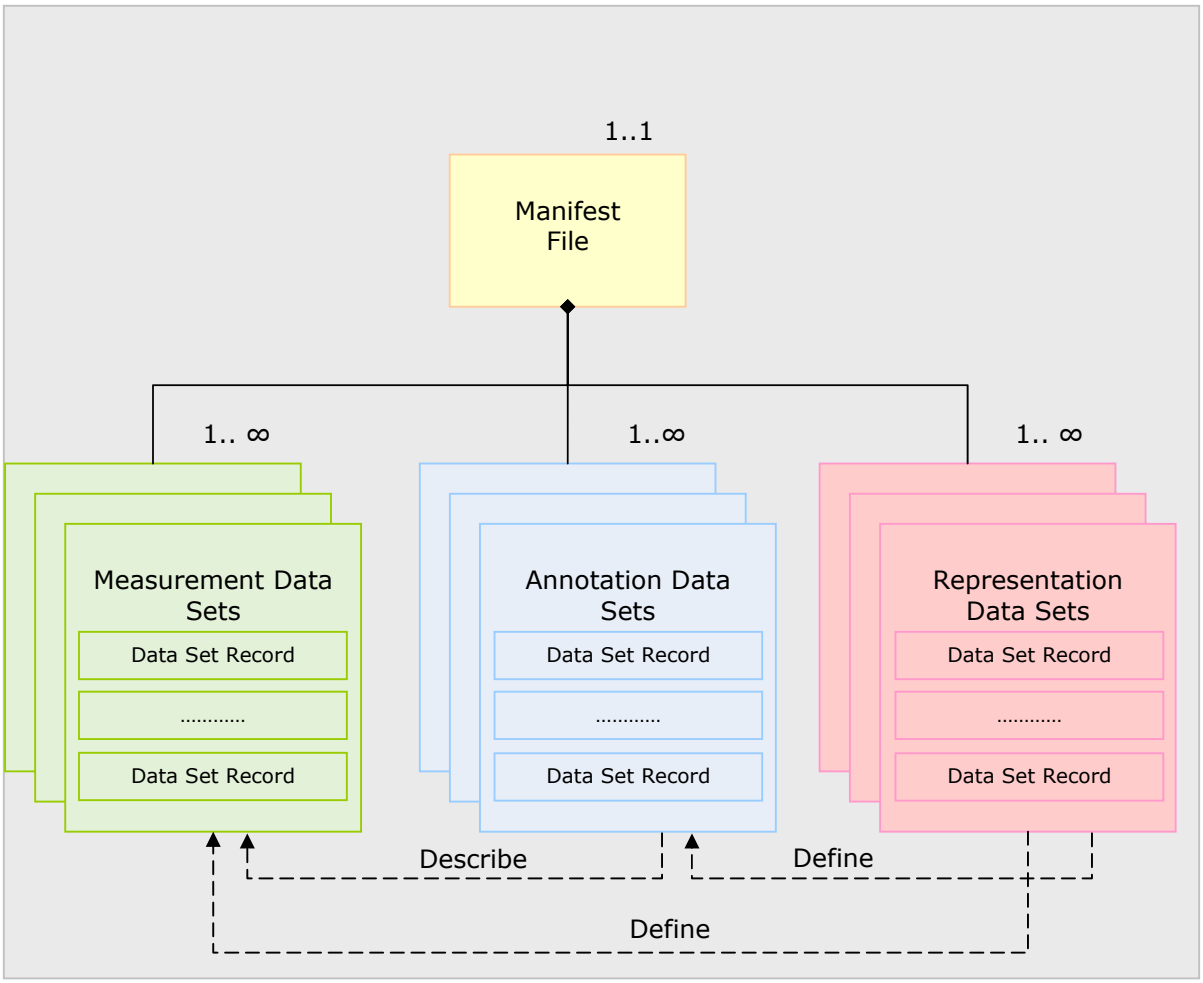


Figure 3-2 Sentinel-1 Product Composition Overview

Every Sentinel-1 product contains a manifest file, which can be thought of as the top level of each product as it describes the content and the structure of the product.

The product data and metadata are contained in data set records (DSR). Data set records are composed of nested structures that contain fields of information logically related and grouped together within the DSR. Data set records are logically grouped together to form files called data sets (DS). The structure and content of one type of DSR is always the same; however, a dataset may contain multiple different types of DSRs. For example, the L1 Product Annotation Data Set (ADS) describes the properties of the product. The information fields in this data set are grouped into the DSRs to which they apply; for example, the fields describing the general properties of the product are found in the generalAnnotation DSR while the Doppler information is found in the dopplerCentroid DSR. The generalAnnotation and dopplerCentroid DSRs differ in structure and content because of the information that each contains; however, all generalAnnotation DSRs are identical to each other in structure and content and all dopplerCentroid DSRs are identical to each other in structure and content. These rules apply to all DSRs within Sentinel-1 products.

This concept differs from the ENVISAT product format in which the structure of all DSRs within a data set is the same.

There are three categories of data sets for Sentinel-1 products:

- **Measurement data sets (MDS)** contain images derived from instrument data (L1) or binary information products derived from the instrument data or images (L1 and L2). A more detailed description of the measurement data sets follows in Section 3.3.2 and the definitions are specified in Section 6.2;
- **Annotation data sets (ADS)** contain metadata that describes the properties and characteristics of the measurement data or how the measurement data was generated. A more detailed description of the annotation data sets follows in Section 3.3.3 and the definitions are specified in Section 6.3; and,
- **Representation data sets (RDS)** contain information about the format or syntax of the measurement and annotation data sets and can be used to validate and exploit these data. A more detailed description of the representation data sets follows in Section 3.3.4.

In addition to physical data sets, Sentinel-1 products also contain information called resources. Resources are any data that have a direct influence over how the product was created, such as input files and auxiliary or external data files. Resources are not physically included in the product but are identified by special fields in the manifest file. Resources are described in more detail in Section 3.3.5.

3.3 Product Components

This section introduces the components and data sets that may be included in a Sentinel-1 product.

3.3.1 Manifest File

The manifest file is an XML file formatted according to the SAFE specification [A-3] and it forms the core of every Sentinel-1 product. The manifest file serves two important purposes within the product:

1. It contains information about the collection of data sets that comprise the product, the nature of each data set and how the data sets relate to one another; and,
2. It contains general information about the product that is useful for cataloguing and identification purposes.

The manifest file can be thought of as the map of each product and there is one manifest file present in every product.

Table 3-1 introduces the Annotation Data Set Records (ADSR) contained in the manifest file for Sentinel-1 products and a more detailed description of the structure of, and the information contained in the manifest file is presented in Section 6.1.

Table 3-1 ADSR Summary for Sentinel-1 Manifest File

Data Set Record	Description	Reference
Information Package Map	The information package map contains a high-level textual description of the product and references to all of the MDS and ADS contained within the product.	6.1.1
Metadata Section	The metadata section contains a minimal set of wrapped product metadata that can be used for product identification and cataloguing and it also contains references to each of the ADS contained within the product.	6.1.2
Data Object Section	The data object section contains references to the physical location of each MDS and ADS file comprising the product with a description of the file format, file location and checksum of each file.	6.1.3

3.3.2 Measurement Data Sets

Measurement data sets are binary encoded files that contain:

1. images derived from instrument data (L1); or,
2. binary information products derived from the instrument data or images (L1 and L2).

The content and format of the measurement data sets is described in detail in Section 6.2; however, in order to provide context for the following sections, Table 3-2 introduces the measurement data sets and provides a general description of the content and format of each.

Table 3-2 Summary of Measurement Data Sets used by Sentinel-1

Data Set Name	Description	Format	Reference
L1 Image	Image data sets contain SAR data that has been processed into an image.	GeoTIFF	6.2.1
Quick look Image	Quick look image data sets are an averaged, decimated version of the image data set that results in a smaller image file that is suitable for previewing products.	PNG	6.2.2
L2 Ocean	The L2 Ocean data set contains an Ocean Swell Wave Spectra (OSW), an Ocean Wind Field (OWI) and a Radial Surface Velocity vector (RVL) estimated from input L1 SAR images (note that these input L1 SLC and GRD products are produced using different parameters than standard L1 products, specifically for the purpose of L2 processing).	NetCDF	6.2.3

3.3.3 Annotation Data Sets

Annotation data sets are files that contain metadata – data that describes other data – that describe characteristics of the product.

The general structure and content of the annotation data is described in detail in Section 6; however, Table 3-3 introduces the different types of annotation data sets and provides a general description of the information contained in each. Table 3-4 introduces all of the Annotation DSRs (ADSR) that may be included in the Level 1 Product Annotation DS and within Section 4 the exact ADSR included with each specific product is detailed.

Table 3-3 Summary of the Annotation Data Sets used by Sentinel-1

Data Set Name	Description	References
Level 1 Product Annotation	The Level 1 product annotation data set contains the metadata that describes the main characteristics of the product such as: state of the platform during acquisition, image properties, Doppler information, geographic location, etc. A summary of annotation data set records included in the product annotation data set is presented in Table 3-4.	6.3.1 A2
Level 1 Calibration	The calibration data set contains calibration information and the beta nought, sigma nought, gamma and digital number (DN) Look-up Tables (LUT)s that can be used for absolute product calibration.	6.3.2 A3
Level 1 Noise	The noise data set contains the estimated thermal noise LUT.	6.3.3 A4
Map Overlay	The map overlay data set includes information about the geographic coverage of the product.	6.3.4
Product Preview	The product preview data set presents a graphical overview of the product using the Quick-look image MDS and provides access to the data sets contained within the product through hyperlinks.	6.3.5

Table 3-4 ADSR Summary for Level 1 Product Annotation ADS

Data Set Record	Description	Reference
Quality Information	The quality information data set represents a summary of quality flags and values for information extracted from other data set records.	6.3.1.1
General Annotation	The general annotation data set record contains a summary of information extracted from the downlink echo, calibration and noise packets used to generate all Level 1 products.	6.3.1.2
Image Annotation	The image annotation data set record contains properties and parameters for all Level 1 slant range and ground rage images.	6.3.1.3

Data Set Record	Description	Reference
Doppler Centroid	The Doppler centroid (DC) data set record contains the Doppler centroid estimate (DCE) list, which contains the Doppler estimates calculated from orbit geometry and data analysis. These estimates are used by the IPF during image processing and focusing.	6.3.1.4
Antenna Pattern	The antenna pattern data set record contains a list of vectors of the antenna elevation pattern values that have been updated along track and used to correct the radiometry during image processing.	6.3.1.5
Swath Timing	The swath timing data set record contains information for each burst within a swath for TOPSAR products and is specific to IW and EW SLC products. The purpose of the information included in this file is to allow users of IW and EW products to extract bursts from the image files included with the product.	6.3.1.6
Geolocation Grid	The geolocation grid data set record contains a matrix of points defining the slant range time, incidence angle, and geodetic latitude and longitude positions at various range and azimuth positions within the image.	6.3.1.7
Coordinate Conversion	The coordinate conversion data set record contains information required to perform the conversions between the slant-range and ground-range coordinate systems. This DSR is present only if slant range to ground range conversion was performed during processing.	6.3.1.8
Swath Merging	The swath merging data set record contains information about how multiple swaths were stitched together to form one large contiguous swath. This data set record only applies to IW and EW GRD products.	6.3.1.9

3.3.4 Representation Data Sets

The representation data sets define the detailed format and content of the datasets within the Sentinel-1 products using XML Schema [R-3] and [R-4] and implement the Sentinel-1 specialisations of the SAFE specification. Each representation data set is an XML formatted schema file with ASCII encoding and an ".xsd" file extension.

Representation data sets are included with every Sentinel-1 product and may be used by image processors to interpret and manipulate measurement and annotation data sets and can be used by XML validation tools to validate the format and content of the annotation data sets. Table 3-5 below describes the Sentinel-1 L1 and L2 datasets and indicates whether or not each has an associated RDS.

Table 3-5 Data Set Representation Details

Data Set Name	Data Set Type	RDS	Definition
Level 1 Product Annotation	Annotation Data Set	Yes	A2
Level 1 Calibration	Annotation Data Set	Yes	A3
Level 1 Noise	Annotation Data Set	Yes	A4

Data Set Name	Data Set Type	RDS	Definition
Map Overlay	Annotation Data Set	Yes	[R-10]
Product Preview	Annotation Data Set	No	N/A
Level 1 Image	Measurement Data Set	No	N/A
Level 1 Quick-look	Measurement Data Set	No	N/A
Level 2 OCN	Measurement Data Set	No	N/A

The Sentinel-1 representation data sets are defined in Appendix A.

3.3.5 Resources

Resources are data that are not physically included in the product but are fundamentally applicable to the generation of the product, such as:

- the L0 input product;
- the software name and version used to process the product; and,
- the auxiliary data used to generate the product.

As mentioned above, resources are not included with the product but are referenced by file name, with an entry in the manifest file. The content and format of each resource is governed by its applicable documentation and is beyond the scope of this specification.

All Sentinel-1 L1 and L2 products shall contain – as a minimum – the following resources:

1. This document at the applicable Issue/Revision number;
2. [A-5] at the applicable Issue/Revision number;
3. The identification of the software used to create the product;
4. The name of the input product; and,
5. Each auxiliary data file used to generate the product.

3.4 Slice Products

Section 3.4.1 introduces the concept of slice products and describes the methods for combining a set of slice products into an assembled product. Sections 3.4.2, 3.4.3, and 3.4.4 describe specifically how information is combined into an assembled product for the manifest file, the measurement data sets and the annotation data sets (respectively).

Note that representation data sets do not require any assembly because they define the structure and content of the data sets and do not themselves include any measurement data or metadata.

3.4.1 Overview

L1 output products may be in the form of one of the following:

- An L1 individual scene product that covers a complete L0 segment of data; or
- A set of L1 slice products that collectively cover the same L0 segment of data

In both cases the output products are fully formatted Sentinel-1 L1 products compliant with the format defined in this specification and the properties of L1 slice products within a set are such that:

- All slices are generated using the same set of processing parameters;
- The image data is continuous in terms of geometry, radiometry and phase; and,
- The annotations are coherent in terms of update rate and grid spacing.

These properties allow slice products to be combined to form an assembled L1 product with the same product characteristics that covers the complete L0 segment.

The Sentinel-1 product format has been designed to support individual scene products, slice products and the scenario where a set of slice products is combined into an assembled product.

The following list introduces the three strategies for combining sliced products into an assembled product. These are used throughout the remainder of the document:

- Include – the value of the information is identical for all slices and a single occurrence of the value is copied into the assembled product;
- Merge – the value of the information may differ between slices and a single value must be amalgamated into the assembled product using the values from all slices (the exact method for how this is done is described in the following sections on a field-by-field basis; e.g., averaging, majority polling, summing, etc.); and,
- Concatenate – the information is stored in list format and the values from each slice are appended to the appropriate list in the assembled product in Zero Doppler Time (ZDT) ordered sequence and the list count attribute is updated to contain the number of items in the concatenated list.

The following sub-sections provide an example of each assembly strategy.

3.4.1.1 Include

The include strategy is used when the value of the field is identical for all slices. This means that without loss of generality the value for the field can be taken from any slice. A practical approach is to always take the value from the first slice. In the example illustrated in Figure 3-3 below, the four fields: *missionId*, *productType*, *polarisation*, and *swath* from the adsHeader DSR are shown for a set of slice products containing *N* slices numbered 1 .. *N*. The example shows that the values for each field are identical for all slices and are taken from the first slice and included in the assembled product.

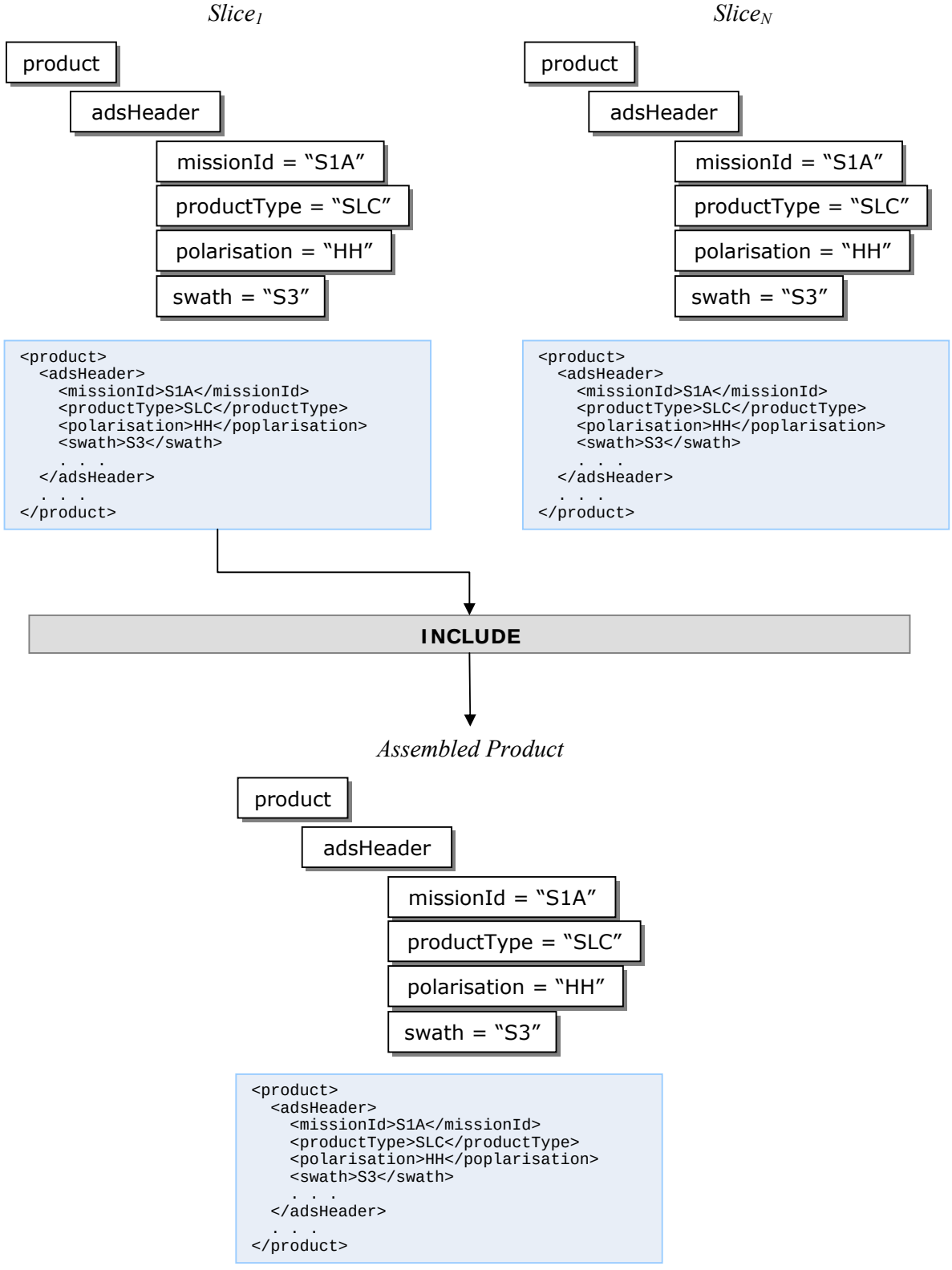


Figure 3-3 Example of Include Assembly Strategy

3.4.1.2 Merge

The merge strategy is used when the field is unique within the product (i.e. there is only one occurrence of the field within the product) and the value of the field differs between slices. Depending on the nature of the value of the field within the slices, different approaches apply when merging the values for fields. These approaches are explained in the sections below on a field-by-field basis.

In the example illustrated in Figure 3-4, the two fields: *startTime* and *stopTime* from the adsHeader DSR are shown for a set of slice products containing *N* slices numbered 1 .. *N*. These fields are unique within each product and the example shows that the values for each field differ between slices. To merge the *startTime* field, the value is taken from the first slice ($Slice_1$) and to merge the *stopTime* field, the value is taken from the last slice ($Slice_N$) as shown in the figure.

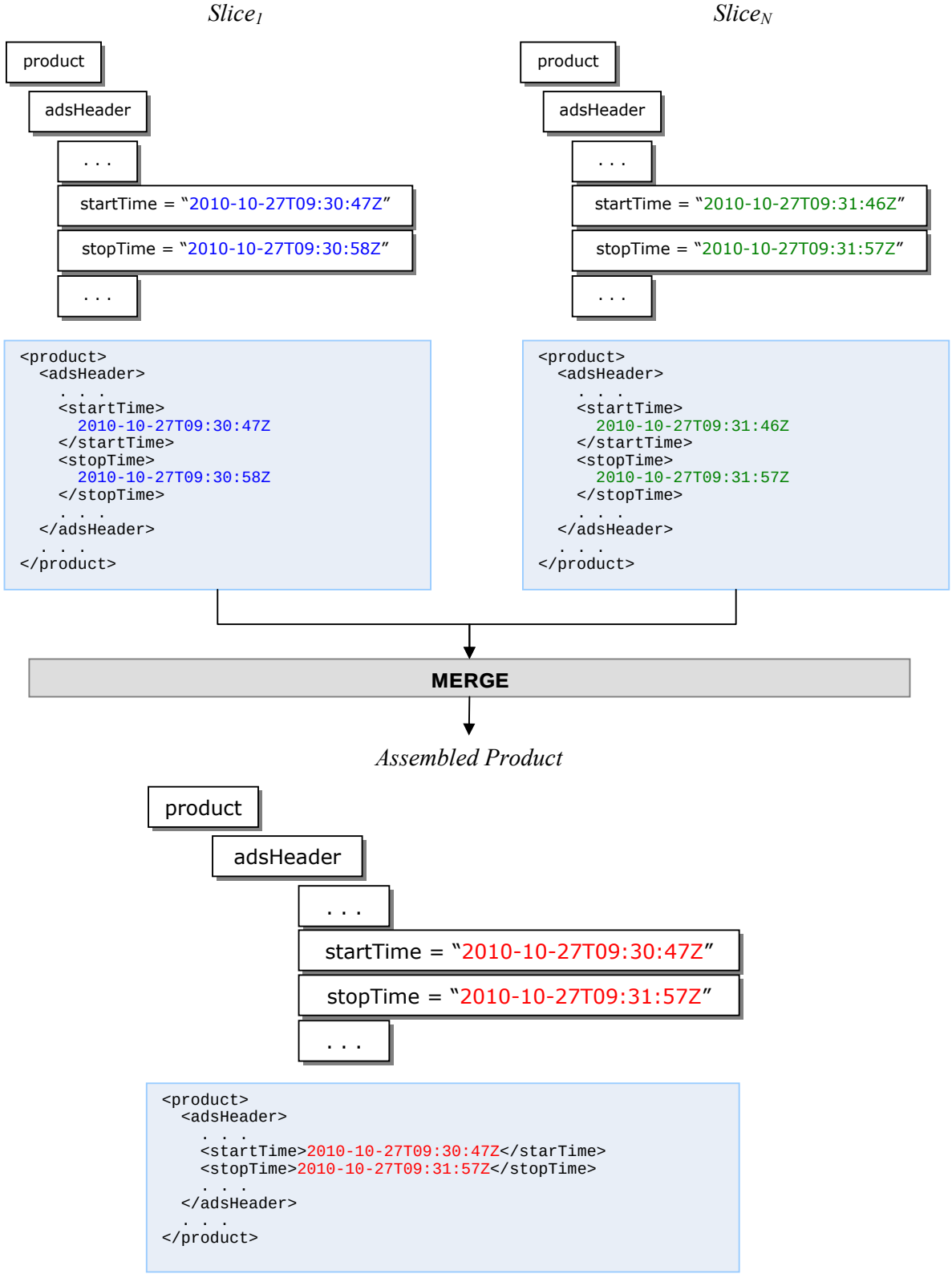


Figure 3-4 Example of Merge Assembly Strategy

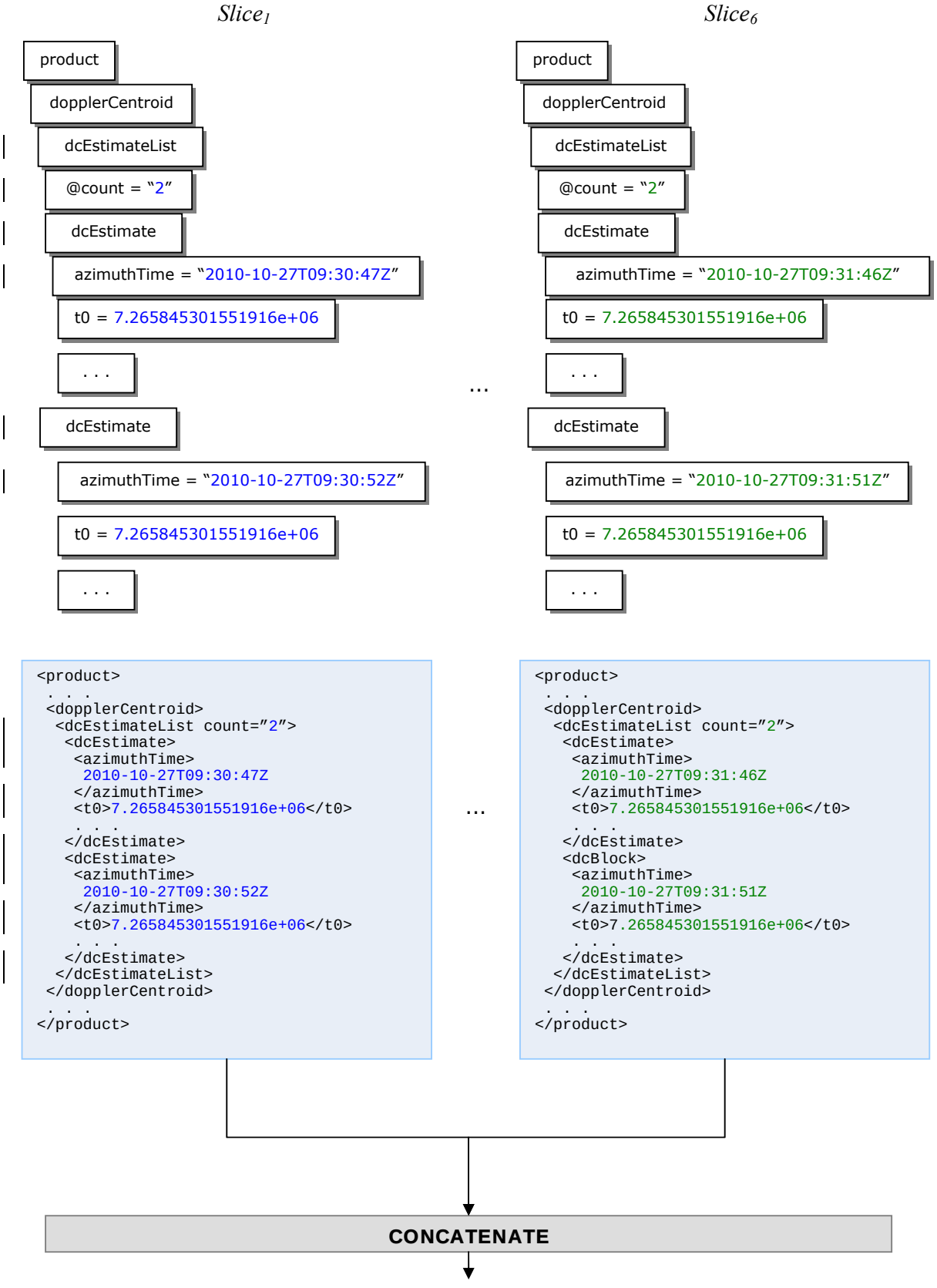
3.4.1.3 Concatenate

The concatenate strategy is used when the field or record is contained within a list. This applies to both binary image data as well as XML annotation data.

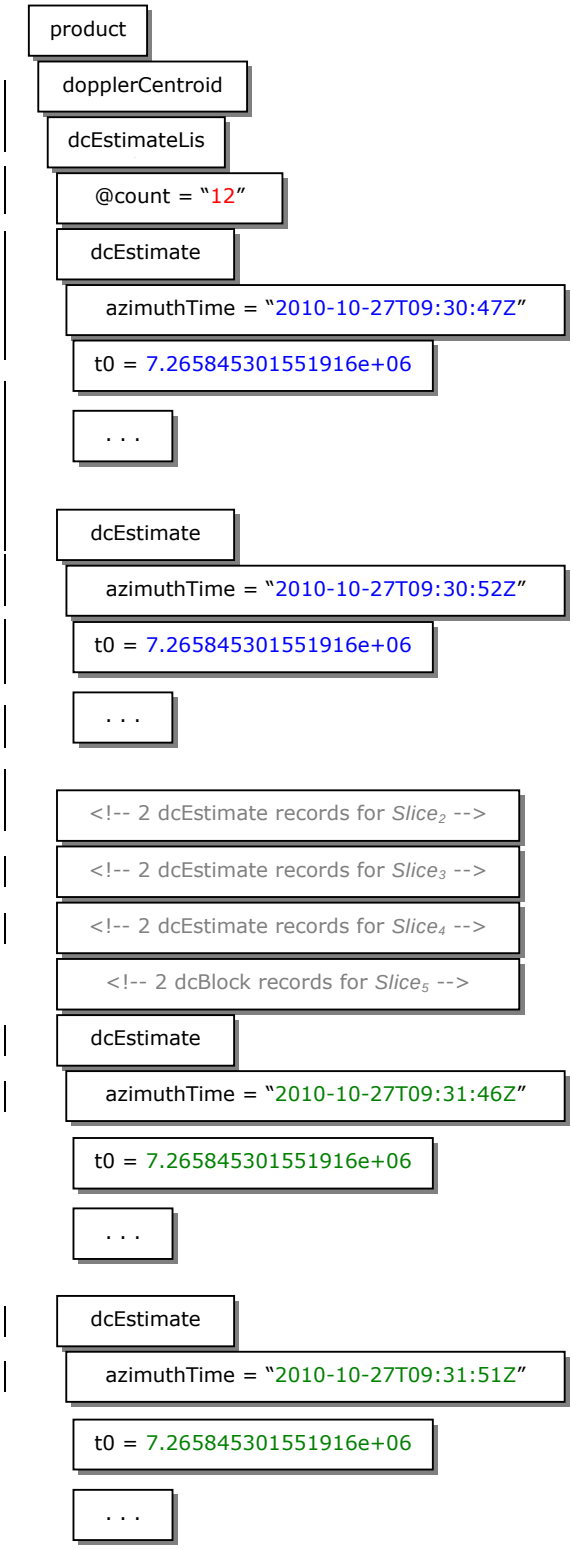
For imagery data, the binary data from each slice is appended in order and any applicable length (azimuth) dimension is updated to reflect the length of the assembled image (Note that the image width (range extent) is the same among all slices). A conceptual example of assembling imagery data is illustrated in Figure 3-6.

For XML annotations, lists within a data set are always suffixed with the word "List" and always contain an integer attribute named "count" that identifies the number of items within the list. In general, concatenation is simply appending records to the list in time ordered sequence and updating (merging in a sense) the count attribute to identify the total number of items in the concatenated list. Concatenation of any list within a data set is done at the highest level at which a list exists. For example, if *aList* contains a record named *aRecord* and *aRecord* contains a list named *bList*, concatenation is always performed on *aList*.

In the example illustrated in Figure 3-5 below, the Doppler annotations for the slices are concatenated. For sake of example the data segment is 60 seconds long and divided into 6 slices of 10 seconds each, numbered 1 .. 6. The Doppler centroid estimates are done every 5 seconds creating 2 estimates per slice and a total of 12 estimates over all the slices. For compactness, only the information for the first slice and last slice are shown in the graph. The figure shows the *dcEstimateList* from the first and last slice with two *dcEstimate* records under each. In both cases the value of the count attribute is 2. For the assembled product, the figure shows how the *dcEstimateList* has grown because the *dcEstimate* records from each slice have been added and the value of the count attribute is set to 12.



Assembled Product




```
<product>
 . . .
 <dopplerCentroid>
  <dcEstimateList length="12">
   <dcEstimate>
    <azimuthTime>
     2010-10-27T09:30:47Z
    </azimuthTime>
    <t0>7.265845301551916e+06</t0>
    . . .
   </dcEstimate>
   <dcEstimate>
    <azimuthTime>
     2010-10-27T09:30:52Z
    </azimuthTime>
    <t0>7.265845301551916e+06</t0>
    . . .
   </dcEstimate>
   <!-- 2 dcEstimate records for Slice2 -->
   <!-- 2 dcEstimate records for Slice3 -->
   <!-- 2 dcEstimate records for Slice4 -->
   <!-- 2 dcEstimate records for Slice5 -->
   <dcEstimate>
    <azimuthTime>
     2010-10-27T09:31:46Z
    </azimuthTime>
    <t0>7.265845301551916e+06</t0>
    . . .
   </dcEstimate>
   <dcEstimate>
    <azimuthTime>
     2010-10-27T09:31:51Z
    </azimuthTime>
    <t0>7.265845301551916e+06</t0>
    . . .
   </dcEstimate>
  </dcEstimateList>
 </dopplerCentroid>
 . . .
</product>
```

Figure 3-5 Example of Concatenate Assembly Strategy

3.4.2 Manifest File

Table 3-6 describes the assembly strategy on a field-by-field basis for the Manifest file at the granularity needed to create an assembled product. Note that only fields with a variable value are mentioned in the table. The strategy for fields with a constant value is always "include" so they have been omitted from the table.

Table 3-6 Assembly of the Sentinel-1 Manifest File

Data Set Record	Assembly Strategy	Reference

Information Package Map	The information package map is assembled as follows:
	• All metadata content units (where *unitType* = "Metadata Unit") are included; and,
	• All measurement content units (where *unitType* = "Measurement Data Unit") are merged as follows:
	  • All dmdID attributes are updated to reflect the metadataObject IDs of the metadataObjects in the assembled product; and,
	  • All dataObjectPointer elements are updated so their dataObjectID reflects the dataObjectIDs of the dataObjects in the assembled product.
		6.1.1

Metadata Section	The metadata section is assembled as follows:
	• metadataObject's are merged by updating the dataObjectPointer elements so their dataObjectID reflects the dataObjectIDs of the dataObjects in the assembled product;
	• metadataWrap elements are merged as follows:
	  • All fields from the processing element are included except the start and stop attributes which are merged as follows:
	  • start is set to the processing start time of the first slice;
	  • stop is set to the processing stop time of the last slice;
	  • The fields from the acquisitionPeriod element are merged as follows:
	  • The startTime and startTimeANX attributes are set to their respective times from the first slice;
	  • The stopTime and stopTimeANX attributes are set to their respective times from the last slice;
	  • All fields from the platform element are included;
	  • The fields from the measurementOrbitReference element are merged as follows:
	  • For the orbitNumber element the start attribute is set to the value from the first slice and the stop attribute is set to the value from the last slice;
	  • For the relativeOrbitNumber element the start
		6.1.2

Data Set Record	Assembly Strategy	Reference
	attribute is set to the value from the first slice and the stop attribute is set to the value from the last slice; • The value of the cycleNumber element is set to the value from the last slice; • The value of the phaseIdentifier element is set to the value from the last slice; • The value of the pass element is set to the value from the last slice; • The value of the ascendingNodeTime is set to the value from the first slice; • The measurementFrameSet element is merged by updating the coordinates element so that the values represent the coordinates of the assembled image. • All the fields in the generalProductInformation element are included except for the sliceProductFlag which is updated so that it is set to false and the following elements are then omitted: • sliceCompletenessFlag; • dataTakeStartTime; • sliceNumber; • totalSlices; and, • metadataReference elements (RDS) are included.	
Data Object Section	The data object section is assembled by merging each dataObject as follows: • The ID attribute may be merged by updating its value based on filename of the object within the assembled product; • The href attribute of the byteStream element is merged by updating its value so that it points to the filename of the object within the assembled product; • The checksum element of the byteStream element is merged by re-calculating the checksum on the object file within the assembled product; • The size attribute of the byteStream element is merged by setting its value to the size of the object file within the assembled product.	6.1.3

3.4.3 Measurement Data Sets

Table 3-7 describes the assembly strategy on a field-by-field basis for the L1 image MDS at the granularity needed to create an assembled product. Note that only fields with a variable value are mentioned in the table. The strategy for fields with a constant value is always "include" so they have been omitted from the table. The reference column in the table indicates the section where the field is described.

Figure 3-6 illustrates the process of assembling the information in an L1 image MDS.

Table 3-7 Assembly of the L1 Measurement Data Sets

Data Set Name	Assembly Strategy	Reference
L1 Image	TIFF/GeoTIFF header tags are included and merged. Details are provided in Table 3-8. Measurement (image) data is concatenated.	6.2.1
Quick look Image	The Height field in the PNG header is merged by summing the Height field for all slices and all other header fields are included. Measurement (image) data is concatenated. Note: For IW and EW SLC images, the Quick-Look image for a slice will contain black fill at the start and end of the image that varies for each swath. This is due to the fact that the SLCs consist of staggered bursts from multiple swaths, so that the edges of the Quick-Look image of a slice must be padded out so that all swaths start and end at the same line. As a result, the concatenated Quick-Look images from IW and EW SLC slices will also contain extra padding at slice boundaries, and the resulting Quick-Look image will be longer than the concatenated full resolution Quick-Look image. In addition, if a KML bounding box is used to overlay the IW/EW Quick-Look on a map, due to the mismatch in image dimensions and the physical geolocation, the image will appear "squished" in the overlay. This only applies to IW and EW SLC Quick-Look images, it does not apply to other modes or to other IW and EW products.	6.2.2
L2 Ocean	Not Applicable. The L2 OCN product is generated only from an individual scene or slice input L1 product and assembled products are not relevant to the generation of L2 products. The combination of data sets within L2 products is beyond the scope of this specification.	6.2.3

Table 3-8 Assembly of L1 Image MDS TIFF/GeoTIFF Information

Field Name	Strategy	Details	Reference
ImageWidth	Include	N/A	6.2.1
ImageLength	Merge	The value of this field is merged by summing the ImageLength field from all slices. $ImageLength = \sum_{i=1}^{N} Slice_i^{\mathrm{Im}ageLength}$ Where N equals the total number of slices.	6.2.2
BitsPerSample	Include	N/A	6.2.2
ImageDescription	Include	N/A	6.2.2

Field Name	Strategy	Details	Reference
StripOffsets	Merge	This field is merged by recalculating the StripOffsets of each slice relative to the previous slice [TBC by MDA].	6.2.2
SamplesPerPixel	Include	N/A	6.2.2
RowsPerStrip	Include	N/A (TBC by MDA)	6.2.2
StripByteCounts	Merge	This field is merged by recalculating the StripByteCounts for each strip in the assembled image (TBC by MDA).	6.2.2
MinSampleValue	Merge	This field is merged by taking the minimum sample value from all slices.	6.2.2
MaxSampleValue	Merge	This field is merged by taking the maximum sample value from all slices.	6.2.2
Software	Merge	Optional. This field contains a string identifying the Sentinel-1 IPF as the software that created the image. This field could optionally be updated to include the software used to create the assembled product.	6.2.2
DateTime	Merge	This field is merged by setting the value to the date and time the assembled image was created.	6.2.2
ModelTiePointTag	Merge	The value of each line field must be merged for each tie point by recalculating the line number relative to the total number of lines in all preceding slices: $line_i^N = \sum_{x=1}^{N-1} Slice_{numLines}^x + Slice_i^N$ Where: N = Slice number i = Line number relative to N *numLines* = Total number of lines in slice	6.2.2
GeoKeyDirectoryTag	Include	N/A	6.2.2
GeoDoubleParamsTag	Include	N/A	6.2.2
GeoAsciiParamsTag	Include	N/A	6.2.2
GeographicTypeGeoKey	Include	N/A	6.2.2
GeogEllipsoidGeoKey	Include	N/A	6.2.2

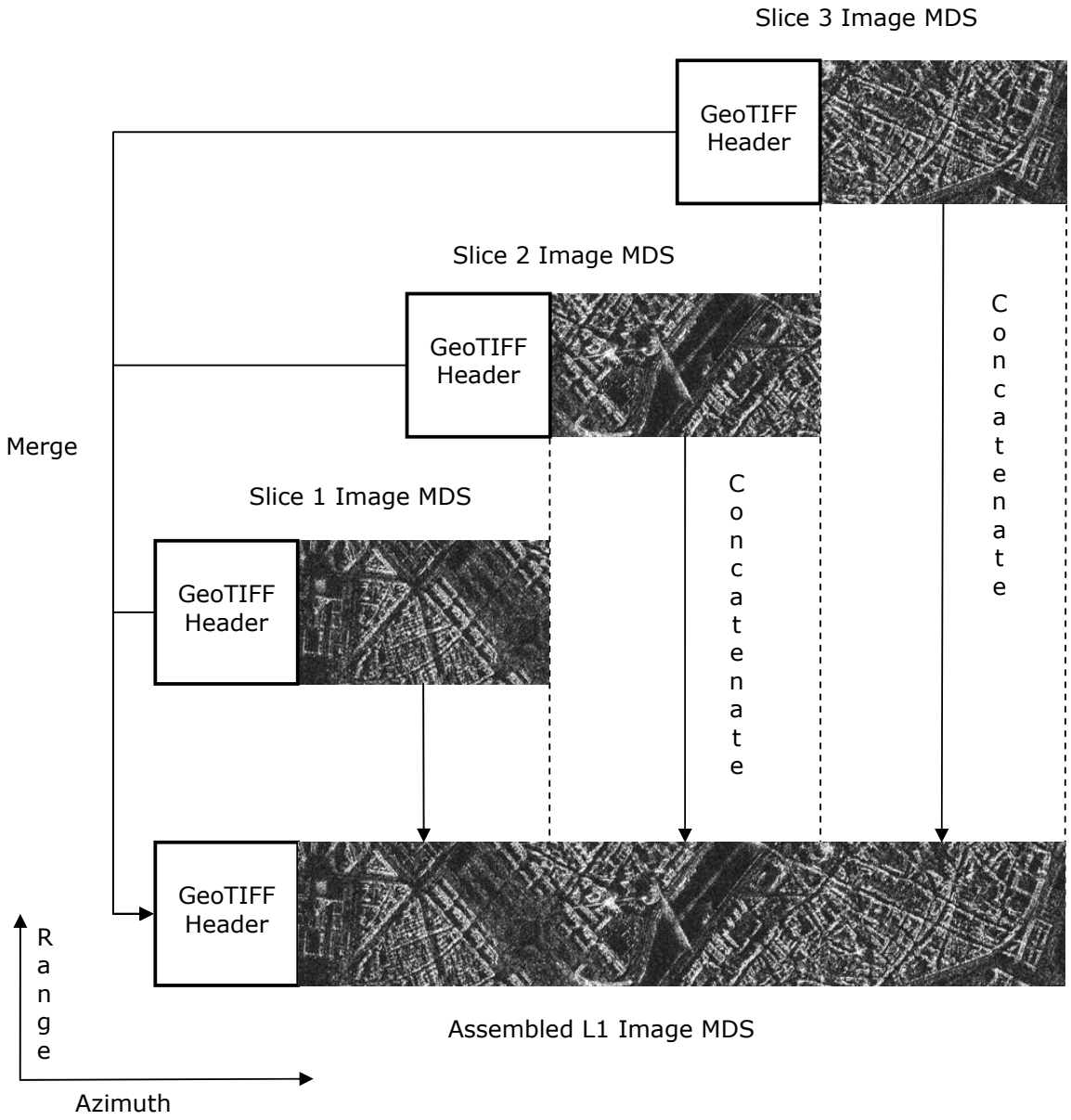


Figure 3-6 Assembly of a L1 Image MDS

3.4.4 Annotation Data Sets

Table 3-9 describes how to combine each type of L1 ADS into an assembled product. The reference column in the tables indicates the sections where the data set is defined.

Table 3-9 Assembly of the L1 Annotation Data Sets

Data Set Name	Assembly Strategy	References
Level 1 Product Annotation	The Level 1 Product Annotation data set requires inclusion, merging and concatenation. A breakdown of the general merging and concatenation strategy by record for this data set is presented in Table 3-10.	6.3.1 A2

Level 1 Calibration	The Calibration ADS is assembled as follows:
	• The values for the fields in the ADS header are included except for the values of the startTime and stopTime fields, which are merged as follows:
	  • startTime is merged by taking the value of the field from the first slice.
	  • stopTime is merged by taking the value of the field from the last slice;
	• The values for the fields in the calibrationInformation record are included; and,
	• The list of calibration annotations contained in the calibrationVectorList is concatenated and the count attribute is updated to contain the number of calibrationVector records in the concatenated list.
		6.3.2
		A3

Level 1 Noise	The Noise ADS is assembled as follows:
	• The values for the fields in the ADS header are included except for the values of the startTime and stopTime fields, which are merged as follows:
	  • startTime is merged by taking the value of the field from the first slice.
	  • stopTime is merged by taking the value of the field from the last slice; and,
	• The list of thermal annotations contained in the noiseLevelList is concatenated and the count attribute is updated to contain the number of noiseLevel records in the concatenated list.
		6.3.3
		A4

Map Overlay	The values for all fields in the Map Overlay data set are included except for the coordinates elements of the LinearRing element and the gx:LatLonQuad element; these are merged by updating their values so that they represent the coordinates of the assembled image.	6.3.4
Product Preview	The values for all fields in the Product Preview data set are merged by setting the product name and data set file names to the corresponding names in the assembled product.	6.3.5

Table 3-10 Assembly of the Level 1 Product Annotation ADS

Data Set Record	Assembly Strategy	Reference
ADS Header	The values for the fields in the ADS header are included except for the values of the startTime and stopTime fields, which are merged as follows: • startTime is merged by taking the value of the field from the first slice. • stopTime is merged by taking the value of the field from the last slice.	Table 3-20
Quality Information	The list of quality annotations contained in the qualityDataList element is concatenated and the count attribute is updated to contain the number of qualityData records in the concatenated list.	6.3.1.1
General Annotation	The productInformation sub-record contains single value fields that are merged and included. All other sub-records contain lists which are concatenated. Details are presented in Table 3-11.	6.3.1.2
Image Annotation	This DSR contains two records which contain only single value fields. The fields in the imageInformation record are included and merged and all the fields for the processingInformation record are included; except for the inputDimensionsList record, which is concatenated. Details are presented in Table 3-12.	6.3.1.3
Doppler Centroid	The list of Doppler centroid annotations contained in the dcBlockList element is concatenated and the count attribute is updated to contain the number of dcBlock records in the concatenated list.	6.3.1.4
Antenna Pattern	The list of antenna pattern annotations contained in the antennaPatternList element is concatenated and the count attribute is updated to contain the number of antennaPattern records in the concatenated list.	6.3.1.5
Swath Timing	The list of swath timing annotations contained in the burstList element is concatenated and the count attribute is updated to contain the number of burst records in the concatenated list. In addition to concatenation, each byteOffset field must be merged to contain the correct byte offset by recalculating each byteOffset relative to all preceding bursts within the assembled image.	6.3.1.6
Geolocation Grid	The list of geolocation grid points contained in the geolocationGridPointList element is concatenated and the count attribute is updated to contain the number of geolocationGridPoint records in the concatenated list. In addition to the concatenation, the value of the line field must be merged for each grid point by recalculating the line number relative to the total number of lines in all preceding slices: $line_i^N = \sum_{x=1}^{N-1} Slice_{numLines}^x + Slice_i^N$ Where: N = Slice number i = Line number relative to N $numLines$ = Total number of lines in slice	6.3.1.7

Data Set Record	Assembly Strategy	Reference
Coordinate Conversion	The list of coordinate conversion annotations contained in the coordinateConversionList is concatenated and the count attribute is updated to contain the number of coordinateConversion records in the concatenated list.	6.3.1.8
Swath Merging	The lists of swath merging annotations are concatenated. There is a swathBoundsList for each swath. The list of swath merging annotations contained in each swathBoundsList is concatenated and the count attribute for each is updated to contain the number of swathBounds records in the concatenated list.	6.3.1.9

Table 3-11 Assembly of the L1 General Annotation ADSR

Field Path Strategy	Details
/product/generalAnnotation/productInformation/pass	
Merge	The pass field is merged as follows: If the value of the pass field is the same for all slices (i.e. “Ascending” or “Descending”) then that value is used; otherwise, the value of the pass field is set to “Full Orbit”.
/product/generalAnnotation/productInformation/timelinessCategory	
Include	N/A.
/product/generalAnnotation/productInformation/platformHeading	
Merge	The platformHeading field is merged recalculating the platform heading mid-acquisition (azimuth direction) for the assembled product.
/product/generalAnnotation/productInformation/rangeSamplingRate	
Include	N/A.
/product/generalAnnotation/productInformation/radarFrequency	
Include	N/A.
/product/generalAnnotation/productInformation/azimuthSteeringRate	
Include	N/A.
/product/generalAnnotation/downlinkInformationList	
Concatenate	The list of downlink information annotations contained in the downlinkInformationList element is concatenated and the count attribute is updated to contain the number of downlinkInformation records in the concatenated list.
/product/generalAnnotation/orbitList	
Concatenate	The list of orbit annotations contained in the orbitList element is concatenated and the count attribute is updated to contain the number of orbit records in the concatenated list.
/product/generalAnnotation/attitudeList	
Concatenate	The list of downlink information annotations contained in the attitudeList element is concatenated and the count attribute is updated to contain the number of attitude records in the concatenated list.

Field Path		
	Strategy	**Details**
/product/generalAnnotation/replicaInformation/replicaInformationList		
	Concatenate	The list of replicaInformation annotations contained in the replicaInformationList element is concatenated and the count attribute is updated to contain the number of replicaInformation records in the concatenated list.
/product/generalAnnotation/noiseList		
	Concatenate	The list of noise measurement annotations contained in the noiseList element is concatenated and the count attribute is updated to contain the number of noise records in the concatenated list.
/product/generalAnnotation/terrainHeightList		
	Concatenate	The list of terrain height annotations contained in the terrainHeigthList element is concatenated and the count attribute is updated to contain the number of terrainHeight records in the concatenated list.
/product/generalAnnotation/azimuthFmRateList		
	Concatenate	The list of azimuth FM rate annotations contained in the azimuthFmRateList element is concatenated and the count attribute is updated to contain the number of azimuthFmRate records in the concatenated list.

Table 3-12 Assembly of the L1 Image Annotation ADSR

Field Path		
	Strategy	**Details**
/product/imageAnnotation/imageInformation/productFirstLineUtcTime		
	Merge	The productFirstLineUtcTime field is merged by using the value of this field from the first slice.
/product/imageAnnotation/imageInformation/productLastLineUtcTime		
	Merge	The productLastLineUtcTime field is merged by using the value of this field from the last slice.
/product/imageAnnotation/imageInformation/ productFirstLineAnxTime		
	Merge	The productFirstLineAnxTime field is merged by using the value of this field from the first slice.
/product/generalAnnotation/imageInformation/anchorTime		
	Include	The anchorTime value will be the same in every slice
/product/generalAnnotation/imageInformation/slantRangeTime		
	Include	The slantRangeTime value will be the same in every slice
/product/imageAnnotation/imageInformation/pixelValue		
	Include	N/A.
/product/imageAnnotation/imageInformation/outputPixels		
	Include	N/A.
/product/imageAnnotation/imageInformation/rangePixelSpacing		
	Include	N/A.

Field Path Strategy	Details
/product/imageAnnotation/imageInformation/azimuthPixelSpacing	
Include	N/A.
/product/imageAnnotation/imageInformation/azimuthTimeInterval	
Include	N/A.
/product/imageAnnotation/imageInformation/numberOfRangeSamples	
Include	N/A.
/product/imageAnnotation/imageInformation/numberOfAzimuthLines	
Merge	The value of this field is merged by summing the numberOfAzimuthLines field from all slices. $numberOfAzimuthLines = \sum_{i=1}^{N} Slice_i^{numberOfAzimuthLines}$ Where N equals the total number of slices.
/product/imageAnnotation/imageInformation/zeroDopMinusAcqTime	
Include	N/A.
/product/imageAnnotation/imageInformation/incidenceAngleMidSwath	
Include	N/A.
/product/imageAnnotation/imageInformation/complexImageStatistics/outputDataMean	
Merge	The value of the outputDataMean field is merged by recalculating the mean of the data in the assembled output image. Note: This field is only present in complex (SLC) products.
/product/imageAnnotation/imageInformation/complexImageStatistics/outputDataStdDev	
Merge	The value of the outputDataStdDev field is merged by recalculating the standard deviation of the data in the assembled output image. Note: This field is only present in complex (SLC) products.
/product/imageAnnotation/imageInformation/detectedImageStatistics/outputDataMean	
Merge	The value of the outputDataMean field is merged by recalculating the mean of the data in the assembled output image. Note: This field is only present in detected (GRD) products.
/product/imageAnnotation/imageInformation/detectedImageStatistics/outputDataStdDev	
Merge	The value of the outputDataStdDev field is merged by recalculating the standard deviation of the data in the assembled output image. Note: This field is only present in detected (GRD) products.
/product/imageAnnotation/processingInformation/processingOptions	
Include	The values for all fields within the processingOptions record are identical among all slices and therefore included.
/product/imageAnnotation/processingInformation/rangeProcessing	
Include	The values for all fields within rangeProcessing record are identical among all slices and therefore included.

Field Path Strategy	Details
/product/imageAnnotation/processingInformation/azimuthProcessing	
Include	The values for all fields within the azimuthProcessing record are identical among all slices and therefore included.
/product/imageAnnotation/processingInformation/rRef	
Include	N/A.
/product/imageAnnotation/processingInformation/inputDimensionsList	
Concatenate	The list of input dimension annotations contained in the inputDimensionsList element is concatenated and the count attribute is updated to contain the number of inputDimensions records in the concatenated list.

3.5 Product Naming

This section defines the naming convention for Sentinel-1 products. Consideration has been made with respect to the SAFE recommendations for specialisation [A-4] and the ESA Sentinel-1 Products Naming Convention described in [R-9]. This latter document has been created specifically to meet the product naming needs of the Sentinel-1 mission.

3.5.1 Product

This section defines the naming standard for the top-level Sentinel-1 product folder. The top-level Sentinel-1 product folder name is composed of upper-case alphanumeric characters separated by an underscore "_". Figure 3-7 defines the naming standard for Sentinel-1 products.

Table 3-13 defines the naming elements and their range and is used throughout the remainder of this document as the standard for naming Sentinel-1 product folders.

For assembled products, the product name is updated as follows:

- The value of each naming element is included, except for:
  - Sensing start date/time which is merged by using the value from the first slice;
  - Sensing stop date/time which is merged by using the value from the last slice; and,
  - Product unique identifier which is merged by recalculating the CRC-16 checksum on the assembled manifest file.

Note that ASAR options are only valid for ASAR offline test products and will not be available operationally.

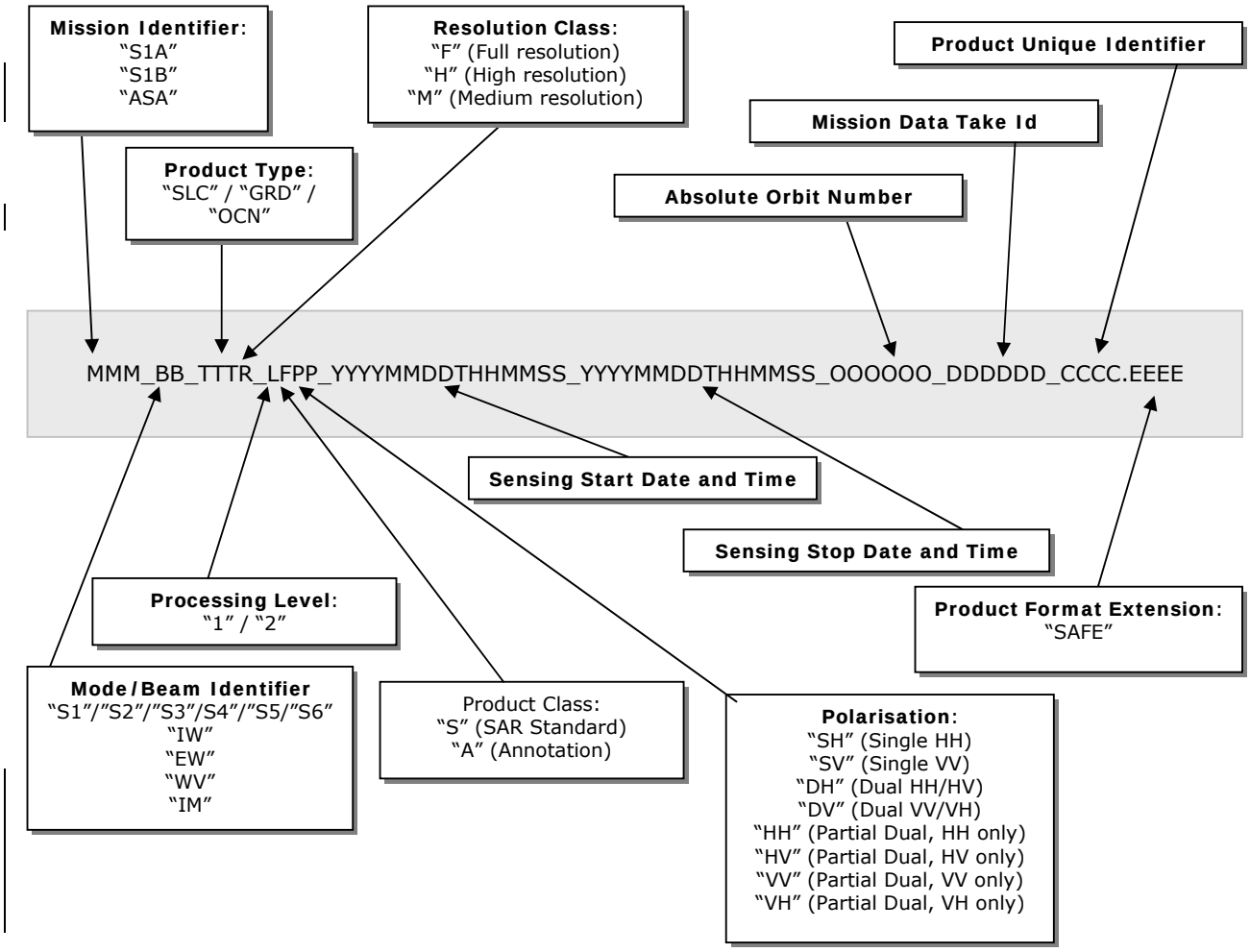


Figure 3-7 Sentinel-1 Product Naming Convention

Table 3-13 Sentinel-1 Product Naming Elements

Name Element Pattern	Name Element Description	Name Element Range
MMM	Mission identifier. The S1A option is used for products produced for the Sentinel-1A instrument and the S1B is used for products produced for the Sentinel-1B instrument. The ASA option is used for products produced from the ENVISAT ASAR instrument.	S1A, S1B, ASA

Name Element Pattern	Name Element Description	Name Element Range
BB	Mode/beam identifier. The S1-S6 beams apply to SM products, and IW, EW and WV identifiers apply to products from the respective modes. The IM and WV modes apply to ASAR IM and WV products respectively.	S1, S2, S3, S4, S5, S6, IW, EW, WV, IM
TTT	Product type.	SLC, GRD, OCN
R	Resolution class.	F (Full resolution), H (High resolution), M (Medium resolution), _ (underscore: Not applicable to the current product type. Used for SLC and OCN.)
L	Processing level.	1, 2
F	Product class.	S (SAR Standard), A (Annotation product).
PP	Polarisation.	SH (Single HH polarisation), SV (Single VV polarisation), DH (Dual HH/HV polarisation), DV (Dual VV/VH polarisation), HH (Partial Dual polarisation, HH only), HV (Partial Dual polarisation, HV only), VV (Partial Dual polarisation, VV only), VH (Partial Dual polarisation, VH only)
YYYYMMDDTHHMMSS	Product start date and time.	Fourteen digits representing the sensing start date and time separated by the character T.
YYYYMMDDTHHMMSS	Product stop date and time.	Fourteen digits representing the sensing stop date and time separated by the character T.
OOOOOO	Absolute orbit number at product start time.	000001-999999
DDDDDD	Mission data take identifier.	000001-FFFFFF
CCCC	Product unique identifier. A hexadecimal string generated by computing CRC-16 on the manifest file.	0000-FFFF
EEEE	Product format extension.	SAFE

3.5.2 Manifest File

In accordance with the SAFE specification [A-3] the name of the manifest file included in all products is:

manifest.safe

3.5.3 Data Sets

This section defines the naming standard for all data set files within a Sentinel-1 product. Sentinel-1 product data sets are composed of lower-case alphanumeric characters separated by a hyphen "-". Table 3-14 defines the naming elements and their range and is used throughout the remainder of this document as the standard for naming Sentinel-1 product data sets.

In the case of assembled products, the data set names are updated as follows:

- The value of each naming element is included, except for:
  - Sensing start date/time which is merged by using the value from the first slice; and,
  - Sensing stop date/time which is merged by using the value from the last slice.

Note that ASAR options are only valid for ASAR offline test products and will not be available operationally.

Table 3-14 Sentinel-1 Data Set Naming Elements

Name Element Pattern	Name Element Description	Name Element Range
mmm	Mission identifier. The s1a option is used for products produced for the Sentinel-1A instrument and the s1b is used for products produced for the Sentinel-1B instrument. The asa option is used for products produced from the ENVISAT ASAR instrument.	s1a, s1b, asa
sss	Swath identifier (up to 3 lower case alphanumeric characters). The s1-s6 swaths apply to SM products, the iw and iw1-3 swaths apply to IW products (iw is used for detected IW products where the 3 swaths are merged into one image), the ew and ew1-5 swaths apply to EW products (ew is used for detected EW products where the 5 swaths are merged into one image), and the wv1-2 swaths apply to WV products. The is1-is7 swaths apply to ASAR IM and WV products.	s1, s2, s3, s4, s5, s6, iw, iw1, iw2, iw3, ew, ew1, ew2, ew3, ew4, ew5, wv1, wv2, is1, is2, is3, is4, is5, is6, is7
ttt	Product type	slc, grd, ocn
pp	Polarisation	hh (Single HH polarisation), hv (Single HV polarisation), vv(Single VV polarisation), vh (Single VH polarisation)
nnn	Image number. For WV products the image number is used to distinguish between vignettes. For SM, IW and EW modes the image number is still used but refers instead to each swath and polarisation combination (known as the "channel") of the data.	001-999 See notes below.
yyyymmddthhmmss	Product start or stop date and time.	Fourteen digits representing the date and time separated by the character t.
oooooo	Absolute orbit number at product start time.	000001-999999
dddddd	Mission data take id	000001-FFFFFF
eeee	File extension	html, kml, tiff, xml, xsd, dat, txt, nc, cdl, png

Notes on image number:

- WV mode has an image number for each vignette. For a WV product with 105 vignettes, 105 images exist numbered in time ascending order from 001 through 105;
- SM single polarisation products have one channel numbered 001. SM dual polarisation products have two channels numbered 001 and 002 in the order they are processed by the IPF;

- IW single polarisation products have three channels numbered 001 – 003. IW dual polarisation products have six channels numbered 001 – 006 in the order they are processed by the IPF; and,
- EW single polarisation products have five channels numbered 001 – 005. EW dual polarisation products have ten channels numbered 001 – 010 in the order they are processed by the IPF.

3.5.3.1 Measurement Data Sets

Table 3-15 defines the naming convention for all measurement data sets used within Sentinel-1 products.

Table 3-15 Measurement Data Set Naming Convention for Sentinel-1

MDS Type	Naming Convention
L1 Image and L2 Measurement	mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.eeee
Quick look	quick-look.png

3.5.3.2 Annotation Data Sets

Table 3-16 defines the naming convention for all annotation data sets used within Sentinel-1 products.

Table 3-16 Annotation Data Set Naming Convention for Sentinel-1

ADS Type	Naming Convention
Level 1 Product Annotation	mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml
Level 1 Calibration	calibration-mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml
Level 1 Noise	noise-mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml
Map Overlay	map-overlay.kml
Product Preview	product-preview.html

3.5.3.3 Representation Data Sets

Table 3-17 defines the names of all representation data sets used within Sentinel-1 products.

Table 3-17 Representation Data Set Naming Convention for Sentinel-1

RDS Type	Naming Convention
Sentinel 1 Object Types	s1-object-types.xsd
Level 1 Product	s1-level-1-product.xsd
Level 1 Calibration	s1-level-1-calibration.xsd
Level 1 Noise	s1-level-1-noise.xsd

3.6 Product Conventions

This section describes applicable product conventions.

3.6.1 Decisions

- Binary data (e.g. images) will be stored in big endian format (byte order is always from the most significant byte to the least significant byte).
- Product annotations will use standard SI units whenever possible.
- Attributes should be defined using only the following types from the XML Schema namespace [http://www.w3.org/2001/XMLSchema]:
  - long
  - int
  - short
  - byte
  - unsignedLong
  - unsignedInt
  - unsignedShort
  - unsignedByte
  - string
- Where ever possible elements should be defined using the primitive data types described in Section 3.6.3 for the Sentinel-1 namespace [http://www.esa.int/safe/1.2/sentinel-1]

3.6.2 Content Table Conventions

This specification presents the contents of S1 product structures as using tables detailing the content. In order to help understand the information contained in these tables the columns present in each table and their meaning are presented in Table 3-18.

Table 3-18 Product Data Content Table Column Descriptions

Column Name	Description
Name	Defines the name of the element or attribute. Elements are displayed in normal font. *Attributes are displayed in italics.*
Description	Describes the purpose of the element or attribute including the units (if applicable). The absence of a unit designation for string data types implies a string literal and for numerical data types (integers, floats, etc…) the absence of a unit designation implies an absolute number. Elements are displayed in normal font. *Attributes are displayed in italics.*
Data Type	Defines the data type of the element or attribute. Elements are displayed in normal font. *Attributes are displayed in italics.*
Cardinality	Elements are displayed in normal font and this column defines the number of occurrences of the element in the form: [minOccurs ..] maxOccurs *Attributes are displayed in italics and this column describes the use of the attribute where, "optional" means the attribute may or may not be present and "required" means the presence of the attribute is mandatory.*

3.6.3 Primitive Data Types

Table 3-19 describes the primitive data types defined in the Sentinel-1 namespace.

Note that ASAR options are only valid for ASAR offline test products and will not be available operationally.

Table 3-19 Primitive Data Types for Sentinel-1 Product Format

Type Name	Description	Range
chirpSourceType	Enumeration of the available chirp schemes.	Extracted, Nominal
rrfSpectrumType	The type of range matched filter to use during processing. "Unextended": range reference function is unextended in frequency domain; "Extended Flat": range reference function is extended and flat in frequency domain; and, "Extended Tapered": range reference function is extended and tapered in frequency domain.	Unextended, Extended Flat Extended Tapered
dcMethodType	Enumeration of Doppler centroid calculation/estimation methods.	Data Analysis, Orbit and Attitude, Pre-defined
dcInputDataType	Enumeration of input data types for Doppler centroid estimation.	Raw, Range Compressed

Type Name	Description	Range
timeType	Time with respect to the specified reference time system. All times are with respect to UTC.	
imageNumberType	Image number type. For WV products the image number is used to distinguish between vignettes. For SM, IW and EW modes the image number is still used but refers instead to each swath and polarisation combination (known as the "channel") of the data. This value ranges from 001 to 999.	[0-9][0-9][1-9]
swathType	Enumeration of all valid swath identifiers for the Sentinel-1 SAR instrument. The S1-S6 swaths apply to SM products, the IW and IW1-3 swaths apply to IW products (IW is used for detected IW products where the 3 swaths are merged into one image), the EW and EW1-5 swaths apply to EW products (EW is used for detected EW products where the 5 swaths are merged into one image), and the WV1-2 swaths apply to WV products. The IS1-IS7 swaths apply to ASAR IM and WV products.	S1, S2, S3, S4, S5, S6, IW, IW1, IW2, IW3, EW, EW1, EW2, EW3, EW4, EW5, WV, WV1, WV2, IS1, IS2, IS3, IS4, IS5, IS6, IS7
weightingWindowType	Enumeration of weighting window names.	Hamming, None
polarisationType	Enumeration of valid polarisations for the Sentinel-1 SAR instrument.	HH, HV, VH, VV
passDirectionType	Enumeration of the orbit pass direction values.	Ascending, Descending, Full Orbit
pixelValueType	Enumeration of output pixel value interpretation types.	Complex, Detected
outputPixelsType	Enumeration of output pixel data types.	32 bit Float, 16 bit Signed Integer, 16 bit Unsigned Integer, 8 bit Signed Integer, 8 bit Unsigned Integer
dataFormatModeType	Enumeration of compression method names. This enumeration is a consolidated list from the Sentinel-1 SPPDU document and the ENVISAT Product Specification.	FDBAQ Mode 0, BAQ 3 Bit, BAQ 4 Bit, BAQ 5 Bit, Decimation, Bypass
productCompositionType	Enumeration of product composition indicators. The valid values are: "Individual", to indicate a full non-sliced product; "Slice", to indicate that this is a single slice of a larger product; and "Assembled", to indicate that this is a product that has been created by combining multiple slices.	Individual, Slice, Assembled
aocsOpModeType	Enumeration of the available AOCS operational mode from the pointing status in the downlink.	No Mode, Normal Pointing Mode, Orbit Control Mode
missionIdType	Sentinel-1 mission identifier. The S1A option is used for products produced for the Sentinel-1A instrument and the S1B is used for products produced for the Sentinel-1B instrument. The ASA option is used for products produced from the ENVISAT ASAR instrument.	S1A, S1B, ASA
productType	Output product type.	SLC, GRD, OCN
absOrbitNumberType	Absolute orbit number.	000001-999999
missionDataTakeIdType	Mission data take identifier.	000001-FFFFFF
bool	Boolean (true or false).	true, false
string	Character string.	1 .. 512 UTF-8 characters.
unsignedLong	64 bit unsigned integer.	0 .. 18446744073709551616

Type Name	Description	Range
unsignedInt	32 bit unsigned integer.	0 .. 4294967295
unsignedShort	16 bit unsigned integer.	0 .. 65535
unsignedByte	8 bit unsigned integer.	0 .. 255
int64	64 bit signed integer.	-9223372036854775808 .. 9223372036854775807
uint64	64 bit unsigned integer.	0 .. 18446744073709551616
int32	32 bit signed integer.	-2147483648 .. 2147483647
uint32	32 bit unsigned integer.	0 .. 4294967295
int16	16 bit signed integer.	-32768 .. 32767
uint16	16 bit unsigned integer.	0 .. 65535
byte	8 bit signed byte.	-128 .. 127
ubyte	8 bit unsigned byte.	0 .. 255
float	32 bit single precision floating point number with an optional "units" attribute.	Machine dependent
double	64 bit double precision floating point number with an optional "units" attribute.	Machine dependent
complex	64 bit complex number consisting of a 32 bit single precision floating point real part and a 32 bit single precision floating point imaginary part.	Machine dependent
floatArray	String containing an array of float values separated by spaces. The mandatory count attribute defines the number of elements in the array.	0 .. 65535 float values
doubleArray	String containing an array of double values separated by spaces. The mandatory count attribute defines the number of elements in the array.	0 .. 65535 double values
complexArray	String containing an array of complex values separated by spaces. The mandatory count attribute defines the number of complex elements in the array.	0 .. 65535 complex values
intArray	String containing an array of int values separated by spaces. The mandatory count attribute defines the number of elements in the array.	0 .. 65535 integer values
adsHeaderType	Common header for all Annotation Data Sets. This record contains the information necessary to identify Annotation Data Sets and link them to the appropriate Measurement Data Set. See Table 3-20 below.	Not Applicable

Table 3-20 Data Type - adsHeaderType

Name	Description	Data Type	Cardinality
missionId	Mission identifier for this data set.	missionIdType	1
productType	Product type for this data set.	productType	1
polarisation	Polarisation for this data set.	polarisationType	1

Name	Description	Data Type	Cardinality
swath	Swath identifier for this data set. This element identifies the swath that applies to all data contained within this data set. The swath identifier "EW" is used for products in which the 5 EW swaths have been merged. Likewise, "IW" is used for products in which the 3 IW swaths have been merged.	swathType	1
startTime	Sensing start time.	timeType	1
stopTime	Sensing stop time.	timeType	1
absoluteOrbitNumber	Absolute orbit number at sensing start time.	absOrbitNumberType	1
missionDataTakeId	Mission data take identifier.	missionDataTakeIdType	1
imageNumber	Image number. For WV products the image number is used to distinguish between vignettes. For SM, IW and EW modes the image number is still used but refers instead to each swath and polarisation combination (known as the 'channel') of the data.	imageNumberType	1

4 LEVEL 1 PRODUCT SPECIFICATION

This section defines the composition of all Level 1 products; that is, the collection of data sets included in each Sentinel-1 Level-1 product type. It defines how the measurement, annotation and representation data sets presented in Section 6 are put together to form a complete Sentinel-1 Level 1 product.

4.1 Level 1 SLC Products

This section defines the composition of Sentinel-1 Level-1 SLC products. The collection of data sets that comprise Level-1 SLC products is presented in Table 4-1. Table 4-2 lists the data set records from the Level 1 product annotation data set that are included in the Level 1 SLC products.

Table 4-1 Sentinel-1 Level 1 SLC Product Composition

File/Folder Name	SM	IW	EW	WV
MMM_BB_TTTR_LFPP_YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_OOOOOO_DDDDDD_CCCC.SAFE				
manifest.safe	1	1	1	1
annotation/	1	1	1	1
mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml	1 per pol.	1 per pol. per swath	1 per pol. per swath	1 per vignette
calibration/	1	1	1	1
calibration-mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml	1 per pol.	1 per pol. per swath	1 per pol. per swath	1 per vignette
noise-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml	1 per pol.	1 per pol. per swath	1 per pol. per swath	1 per vignette
measurement/[1]	1	1	1	1
mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.tiff[1]	1 per pol.	1 per pol. per swath	1 per pol. per swath	1 per vignette
preview/	1	1	1	1
map-overlay.kml	1	1	1	1
product-preview.html	1	1	1	1
quick-look.png	0 or 1	0 or 1	0 or 1	0
icons/	1	1	1	1
Image files required to support the product-preview.html file	As required	As required	As required	As required
support/	1	1	1	1
s1-object-types.xsd	1	1	1	1
s1-level-1-product.xsd	1	1	1	1
s1-level-1-calibration.xsd	1	1	1	1
s1-level-1-noise.xsd	1	1	1	1

Notes:

1 – Excluded from Annotation Products.

Table 4-2 Level 1 Product Annotation DSR Applicable to Level 1 SLC Products

Data Set Record Name	SM	IW	EW	WV
Quality Information	✓	✓	✓	✓
General Annotation	✓	✓	✓	✓
Image Annotation	✓	✓	✓	✓
Doppler Centroid	✓	✓	✓	✓
Antenna Pattern	✓	✓	✓	✓
Swath Timing		✓	✓	
Geolocation Grid	✓	✓	✓	✓
Coordinate Conversion				
Swath Merging				

4.2 Level 1 GRD Products

This section defines the composition of Sentinel-1 Level-1 GRD products. The collection of data sets that comprise Level-1 GRD products is presented in Table 4-3. Table 4-4 lists the data set records from the Level 1 product annotation data set that are included in the Level 1 GRD products.

Table 4-3 Sentinel-1 Level 1 GRD Product Composition

File/Folder Name	SM	IW	EW	WV
MMM_BB_TTTR_LFPP_YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_OOOOOO_DDDDDD_CCCC.SAFE				
manifest.safe	1	1	1	1
annotation/	1	1	1	1
mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml	1 per pol.	1 per pol.	1 per pol.	1 per vignette
calibration/	1	1	1	1
calibration-mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml	1 per pol.	1 per pol.	1 per pol.	1 per vignette
noise-mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.xml	1 per pol.	1 per pol.	1 per pol.	1 per vignette
measurement/[1]	1	1	1	1
mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.tiff[1]	1 per pol.	1 per pol.	1 per pol.	1 per vignette
preview/	1	1	1	1
map-overlay.kml	1	1	1	1
product-preview.html	1	1	1	1
quick-look.png	0 or 1	0 or 1	0 or 1	0
icons/	1	1	1	1
Image files required to support the product-preview.html file	As required	As required	As required	As required
support/				
s1-object-types.xsd	1	1	1	1
s1-level-1-product.xsd	1	1	1	1
s1-level-1-calibration.xsd	1	1	1	1
s1-level-1-noise.xsd	1	1	1	1

Notes:

1 – Excluded from Annotation Products.

Table 4-4 Level 1 Product Annotation DSR Applicable to Level 1 GRD Products

Data Set Record Name	SM	IW	EW	WV
Quality Information	✓	✓	✓	✓
General Annotation	✓	✓	✓	✓
Image Annotation	✓	✓	✓	✓
Doppler Centroid	✓	✓	✓	✓
Antenna Pattern	✓	✓	✓	✓
Swath Timing				
Geolocation Grid	✓	✓	✓	✓
Coordinate Conversion	✓	✓	✓	✓
Swath Merging		✓	✓	

5 LEVEL 2 PRODUCT SPECIFICATION

This section defines the composition of all Level 2 products; that is, the collection of data sets included in each Sentinel-1 Level 2 product. It defines how the measurement, annotation and representation data sets presented in Section 6 are put together to form a complete Sentinel-1 Level 2 product.

5.1 Level 2 OCN Products

This section defines the composition of Sentinel-1 Level 2 OCN products. The collection of data sets that comprise Level 2 OCN products is presented in Table 5-1.

Table 5-1 Sentinel-1 Level 2 OCN Product Composition

File/Folder Name	SM	IW	EW	WV
MMM_BB_TTTR_LFPP_YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_OOOOOO_DDDDDD_CCCC.SAFE				
manifest.safe	1	1	1	1
measurement/	1	1	1	1
mmm-sss-ttt-pp-yyyymmddthhmmss-yyyymmddthhmmss-oooooo-dddddd-nnn.nc	1	1	1	1 per vignette
preview/	1	1	1	1
map-overlay.kml	1	1	1	1
product-preview.html	1	1	1	1
icons/	1	1	1	1
Image files required to support the product-preview.html file	As required	As required	As required	As required
support/	1	1	1	1
s1-object-types.xsd	1	1	1	1

6 PRODUCT DATA SETS

The sub-sections within this section describe in detail all of the data sets that are or can be included with any of the Sentinel-1 products.

6.1 Manifest File

The manifest file is documented in detail in the SAFE core specification [A-3]. The objective of this section is to define the mandatory components of the manifest file that are present in all Sentinel-1 products.

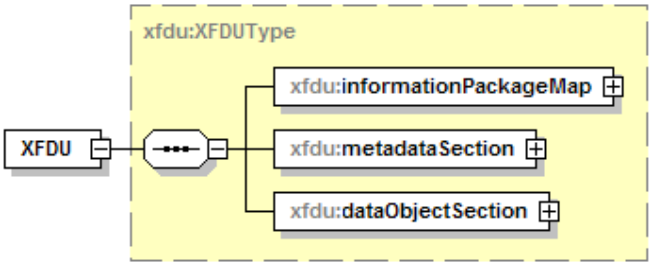


Figure 6-1 Sentinel-1 Manifest File Structure

Table 6-1 Element - XFDU

Name	Description	Data Type	Cardinality
version	*The version attribute describes the location within the SAFE schema directory structure where the validating XFDU schema file for this manifest file resides.*	*string*	*required*
informationPackageMap	The information package map contains a high-level textual description of the product and references to all of the MDS and ADS contained within the product.	informationPackageMapType	1
metadataSection	The metadata section contains a minimal set of wrapped product metadata that can be used for product identification and cataloguing and it also contains references to each of the physical annotation data sets contained within the product.	metadataSectionType	1
dataObjectSection	The dataOjectSection contains the	dataObjectSectionType	1

Name	Description	Data Type	Cardinality
	dataObjects that represent the measurement and annotation data sets included in the product. Each dataObject within the dataObjectSection represents a physical data file on the file system.		

6.1.1 Information Package Map

The manifest file contains exactly one information package map with one content unit as a child element. Beneath the first content unit is a list of content units that define the metadata and data objects within the product; that is, the data sets that make up the product.

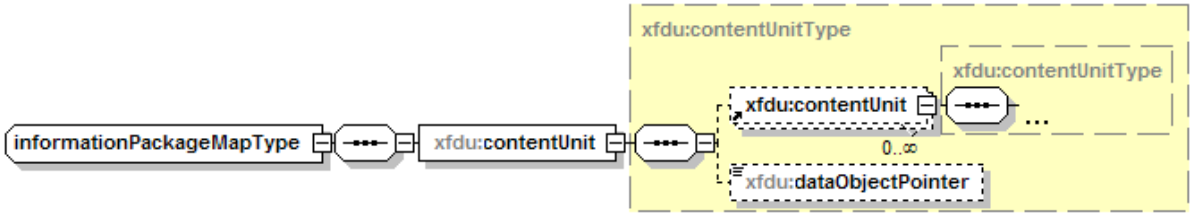


Figure 6-2 Information Package Map Structure

Table 6-2 Data Type - informationPackageMapType

Name	Description	Data Type	Cardinality
contentUnit	The informationPackageMap contains exactly 1 contentUnit and this contentUnit catalogues the physical data components included in the product.	contentUnitType	1

Table 6-3 Data Type - contentUnitType

Name	Description	Data Type	Cardinality
ID	*Unique identifier for this contentUnit.*	*ID*	*optional*
unitType	*Describes the type of data referenced by this content unit.*	*string*	*required*
textInfo	*A brief textual description of the information or data referenced by this content unit.*	*string*	*optional*
repID	*Identifier of the representation data set(s) applicable to this content unit. This can be a single item or a list with each item separated by a space.*	*IDREFS*	*optional*

Name	Description	Data Type	Cardinality
dmdID	*Identifier of the metadata or annotation data set(s) applicable to this content unit. This can be a single item or a list with each item separated by a space.*	*IDREFS*	*optional*
pdiID	*Identifier of the preservation description information applicable to this content unit. For Sentinel-1 products this attribute shall always point to the "processing" wrapped metadata object.*	*IDREFS*	*optional*
contentUnit	Content unit elements may include other content units or may be internal pointers to elements in the data object section. Content units are used to associate data objects with one or more metadata objects and present a view of these data/metadata associations.	contentUnitType	0 .. ∞
dataObjectPointer	Through the use of its dataObjectID attribute, this element points to the data object in the dataObjectSection that this content unit describes.	dataObjectPointerType	0 .. 1

6.1.2 Metadata Section

The manifest file contains exactly one metadata section. The metadata section contains a list of metadata objects that contain either wrapped metadata (information included directly in the manifest file), a data object pointer that refers to a physical annotation data set file on disk, or a metadata reference that points to a representation data set schema file on disk.

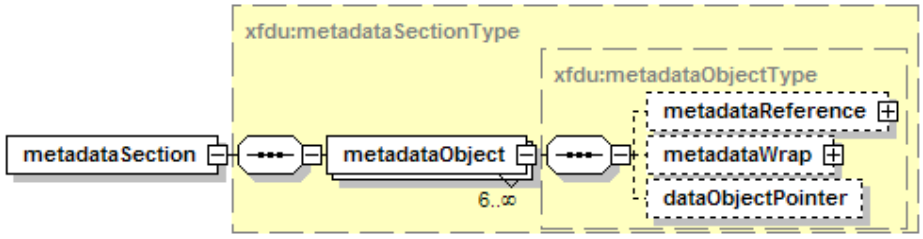


Figure 6-3 Metadata Section Structure and Content

Table 6-4 Data Type - metadataSectionType

Name	Description	Data Type	Cardinality
metadataObject	Metadata objects can take one of three forms: the first is "wrapped metadata" in which valid XML data is embedded directly in the manifest file itself using an metadataWrap element; the second is a reference to an annotation data set in the dataObjectSection through a dataObjectPointer element; and, the third is a physical reference to a representation data set on the filesystem through the use of a metadataReference element. For Sentinel-1 products a minimum of 6 metadataObjects shall be present dedicated to: processing, acquisitionPeriod, platform, measurementOrbitReference, measurementFrameSet and generalProductInformation metadataWrap objects.	metadataObjectType	6 .. ∞

Table 6-5 Data Type - metadataObjectType

Name	Description	Data Type	Cardinality
ID	*Unique identifier of this meta data object.*	*ID*	*required*
category	*Defines the category of this meta data. The category is used to specify the nature of the metadata, whether it is preservation information (PDI), description information (DMD) or representation information (REP)*	*string*	*required*
classification	*A textual description of the classification of this meta data. The classification is linked to the category and provides a more verbose description of the nature of the metadata, whether it is preservation information (PROVENANCE), description information (DESCRIPTION) or representation information (REPRESENTATION)*	*string*	*required*
dataObjectPointer	The dataObjectPointer element is used when the metadata object is an annotation data set. The dataObjectPointer element is used to point to the applicable annotation data set in the dataObject section through its dataObjectID attribute.	dataObjectPointerType	0 .. 1
metadataWrap	The metadataWrap element is used to embed XML metadata directly in the manifest file itself. This element is used to express information that can be used for product identification and cataloguing.	metadataWrapType	0 .. 1

Name	Description	Data Type	Cardinality
metadataReference	The metadataReference element is used when the metadata object is a representation data set. The metadataReference element is used to specify the physical file location of the applicable representation data set.	metadataReferenceType	0 .. 1

The mandatory wrapped metadata elements included in all Sentinel-1 products are described in Table 6-6.

Table 6-6 Mandatory Wrapped Metadata Elements for Sentinel-1 Products

Name			Description	Data Type	Cardinality
processing			Metadata describing the processing steps performed on the auxiliary data.	processingType	1
	name		*Name of the processing step used to create the product.*	*string*	*required*
	start		*Processing start time.*	*dateTime*	*required*
	stop		*Processing stop time.*	*dateTime*	*required*
	facility		Identifies an organization authority of the processing step.	facilityType	1
		country	*Name of the country where the facility is located.*	*string*	*required*
		name	*Name of the facility where the processing step was performed.*	*string*	*required*
		organization	*Name of the organization responsible for the facility.*	*string*	*required*
		site	*Geographical location of the facility.*	*string*	*required*
	software		Reference to the software used for the processing step.	softwareType	0 .. ∞
		name	*Name of the software.*	*string*	*required*
		version	*Software version identification.*	*string*	*optional*
	resource		Reference to resources involved in the processing.	resourceType	0 .. ∞
		name	*Name of the resource.*	*string*	*required*
		role	*Role the resource played in processing.*	*string*	*required*
		href	*URL of the resource.*	*anyURI*	*optional*
acquisition Period			Time extent of the image data included in the Sentinel-1 L1 product.	acquisition PeriodType	1
	startTime		Sensing start time of the image data	dateTime	1
	stopTime		Sensing stop time of the image data	dateTime	1
	startTime ANX		Sensing start time of the image data relative to the ascending node crossing. This is a count of the time elapsed since the orbit ascending node crossing [ms].	double	1

Name			Description	Data Type	Cardinality
	stopTime ANX		Sensing stop time of the image data relative to the ascending node crossing. This is a count of the time elapsed since the orbit ascending node crossing [ms].	double	1
platform			Metadata describing the mission platform to which acquired the data.	platformType	1
	nssdc Identifier		Univocally identifies the mission according to standard defined by the World Data Center for Satellite Information (WDC-SI), available at http://nssdc.gsfc.nasa.gov/nmc/scquery.html	string	1
	familyName		The full mission name. E.g. “SENTINEL-1”	string	1
	number		The alphanumeric identifier of the platform within the mission.	string	1
	instrument		Information related to the instrument on the platform to which acquired the data.	instrumentType	1
		familyName	Instrument name.	string	1
		abbreviation	*Abbreviated instrument name.*	*string*	*required*
		mode	Instrument mode.	sensorMode Type	1
		swathNumber	Swath number within the instrument mode. This field applies only to SLC products.	swathNumber Type`	0 .. 1
orbit Reference			Contains information describing the orbit or the orbit range of the image data.	orbit Reference Type	1
	orbit Number		Absolute orbit number.	orbitNumber Type	1
		start	*Absolute orbit number of the oldest line within the image data.*	*unsignedInt*	*required*
		stop	*Absolute orbit number of the most recent line within the image data.*	*unsignedInt*	*required*
	relative orbit Number		Relative orbit number.	relativeOrbit NumberType	1
		start	*Relative orbit number of the oldest line within the image data.*	*unsignedInt*	*required*
		stop	*Relative orbit number of the most recent line within the image data.*	*unsignedInt*	*required*
	cycle Number		Absolute sequence number of the mission cycle to which the oldest image data applies.	unsignedInt	1
	phase Identifier		Id of the mission phase to which the oldest image data applies.	unsignedInt	1
	pass		Direction of the orbit (ascending, descending) for the oldest image data in the product (the start of the product).	orbitPassType	1

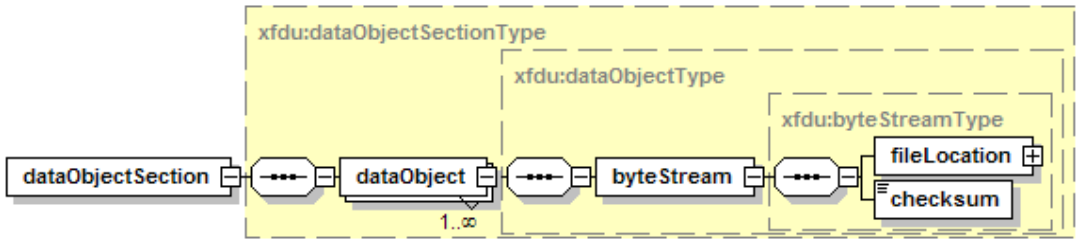
Name			Description	Data Type	Cardinality
	ascending NodeTime		UTC time of the ascending node of the orbit.	dateTime	1
frameSet			Geographical and time location of the instrument footprint, considered as a single frame.	frameSetType	1
	frame		The instrument footprint frame.	frameType	1
		footprint	Coordinates of instrument footprint in GML notation (gml:coordinates type as defined in http://www.opengis.net/gml , namely string with 2 pairs of coordinates (lon,lat of platform nadir point at start and stop time of acquisition period) separated by a space.	gml:LinearRing Type	1
general Product Information			Metadata describing the product.	general Product Information Type	1
	product Type		The product type (correction level) of this product.	productType Type	1
	product Version Number		A unique identifier for this product. Copied from the Job Order.	unsignedInt	1
	product Consolidation		Product consolidation status indicates if this is an assembled product or not.	product Consolidation Type	1
	instrument ConfigurationID		The instrument configuration ID (Radar database ID) for this data.	unsignedInt	1
	mission DataTake ID		Unique ID of the datatake within the mission.	unsignedInt	1
	transmitter Receiver Polarisation		Transmit/Receive polarisation for the data. There is one element for each Tx/Rx combination.	transmitter Receiver Polarisation Type	1 .. 2
	product Timeliness Category		Describes the required timeliness of the processing. One of: • NRT-10m • NRT-1h • NRT-3h • Fast-24h • Off-line • Reprocessing	product Timeliness CategoryType	1
	slice Product Flag		True if this is a slice from a larger product or false if this is a complete product.	bool	1

Name			Description	Data Type	Cardinality
	slice CompletenessFlag		Slice completeness as extracted from the L0 input product. This field is only present if sliceProductFlag = true. “Complete” for a complete slice or “Partial” for a partial slice.	slice CompletenessFlagType	0 .. 1
	dataTake StartTime		Start time of the data take to which this slice belongs as extracted from the L0 input product. This field is only present if sliceProductFlag = true.	dateTime	0 .. 1
	slice Number		Absolute slice number of this slice starting at 1. This field is only present if sliceProductFlag = true.	unsignedInt	0 .. 1
	totalSlices		Total number of slices in the complete data take. This field is only present if sliceProductFlag = true.	unsignedInt	0 .. 1

6.1.3 Data Object Section

6.1.3 The manifest file contains exactly one data object section. The data object section contains a list of data objects that contain references to the physical MDS and ADS data files on disk.

6.1.3



6.1.3

Figure 6-4 Data Object Section Structure and Content

6.1.3

Table 6-7 Data Type - dataObjectSectionType

Name	Description	Data Type	Cardinality
dataObject	Each data object refers to a physical file on the filesystem through the use of its byteStream element. The mandatory ID attribute is used by elements in the informationPackageMap and the metadataSection to refer to these physical data objects.	dataObjectType	1 .. ∞

6.1.3

6.1.3

6.1.3

Table 6-8 Data Type - dataObjectType

Name	Description	Data Type	Cardinality
byteStream	The byte stream element points to the physical file that this data object represents. The byteStream element contains the location of the file and associated information like the format of the file, the size and the data integrity checksum.	byteStreamType	1

Table 6-9 Data Type - byteStreamType

Name	Description	Data Type	Cardinality
ID	*Unique identifier for this byteStream element.*	*ID*	*optional*
mimeType	*Specifies the format of the file referred to by this byteStream element.*	*mimeType*	*required*
size	*Indicates the size (in bytes) of the file referred to by this byteStream element.*	*long*	*required*
Checksum	*Provides the integrity checksum for the file referred to by this byteStream element.*	*string*	*required*
checksumType	*Specifies the method used for calculating the checksum.*	*checksumType*	*required*
fileLocation	The fileLocation element contains the absolute path or URL to associated file through the use of its “href” attribute. .	referenceType	1
checksum	Provides the integrity checksum for the file referred to by this byteStream element.	checksumInformationType	required

6.2 Measurement Data Sets

This section describes the content and format of the measurement data sets used in Sentinel-1 products.

6.2.1 Level 1 Image

This section describes the image measurement data sets that can be included in a Sentinel-1 Level 1 product.

Image measurement data sets within Sentinel-1 L1 products are stored in GeoTIFF format [R-6] which is built upon the TIFF format [R-5]. Every GeoTIFF file is

therefore a TIFF file. Some image files in Sentinel-1 products will be larger than 4 GB in size. The maximum size for a standard TIFF image is 4 GB, so in order to accommodate files larger than 4 GB is size, the BigTIFF format [R-7] is used. BigTIFF is also built upon the TIFF format, extending it to support files of an arbitrarily large size.

L1 SLC images are generated in 32-bit signed integer format with each pixel represented by two interleaved I&Q 16-bit signed integer samples in the order: IQIQIQ… L1 GRD images are generated in 16-bit unsigned integer format with each pixel representing a single 16-bit magnitude sample. In terms of TIFF output and metadata tags, this equates to:

For SLC images: *BitsPerSample* = 32

SamplesPerPixel = 1

SampleFormat = 5 (complex integer, ‘int16’)

For GRD images: *BitsPerSample* = 16

SamplesPerPixel = 1

SampleFormat = 2 (unsigned integer, ‘uint16’)

Note that for all L1 images the IPF supports only pixel interleaving (band interleaving is not supported) and so *PlanarConfiguration* is always set to 1, meaning contiguous (or pixel interleaved).

The TIFF tags used to annotate Sentinel-1 image files are presented in Table 6-10 and the GeoTIFF tags and keys used to annotate Sentinel-1 image files are presented in Table 6-11.

Table 6-10 Summary of TIFF Tags used in Sentinel-1 Products

TIFF Tag Name	TIFF Tag Code	TIFF Tag Type	Value	Description
ImageWidth	256	SHORT	Variable	Number of pixels per line.
ImageLength	257	SHORT	Variable	Number of lines.
BitsPerSample	258	SHORT	Variable	Number of bits per sample.
Compression	259	SHORT	1	Compression scheme used. Always set to 1 (no compression).
PhotometricInterpretation	262	SHORT	1	Colour space of the image. Always set to 1 (minimum value is black).
FillOrder	266	SHORT	2	The logical order of bits within a byte. Always set to 2 (pixels with lower column values are stored in the lower-order bits of the byte).

TIFF Tag Name	TIFF Tag Code	TIFF Tag Type	Value	Description
ImageDescription	270	ASCII	Variable	A string that describes the image. Examples: Sentinel-1A SM SLC L1 and Sentinel-1A IW GRD MR L1.
StripOffsets	273	LONG	Variable	Array of byte offsets for each strip within the image.
Orientation	274	SHORT	1	The orientation of the image with respect to rows and columns. Always set to 1 (TOPLEFT).
SamplesPerPixel	277	SHORT	1	Number of samples per pixel. Always set to 1.
RowsPerStrip	278	SHORT	Variable	Number of rows per strip.
StripByteCounts	279	LONG	Variable	Array of the number of bytes in each strip.
MinSampleValue	280	SHORT	Variable	Minimum sample value used within the image.
MaxSampleValue	281	SHORT	Variable	Maximum sample value used within the image.
PlanarConfiguration	284	SHORT	1	Configuration in which the components (samples) of each pixel are stored. Always set to 1 (contiguous).
Software	305	ASCII	Variable	Software name and version that created the image.
DateTime	306	ASCII	Variable	Date and time of image creation in the format: YYYY:MM:DD HH:MM:SS
SampleFormat	339	SHORT	5 or 1	Interpretation of pixel format. Set to 4 (complex signed integer, ‘int16’) for SLC products, set to 1 (unsigned integer, ‘uint16’) for all others.
Copyright	33432	ASCII	TBD	Copyright notice.

Table 6-11 Summary of GeoTIFF Tags/Keys Used in Sentinel-1 Products

GeoTIFF Tag/Key Name	GeoTIFF Tag/ Key Code	Type	Value	Description
ModelTiePointTag	33922	DOUBLE	N * (line,pixel,0, lat, lng,0)	Maps image pixels to geographic coordinates, where N is the number of tie points in the scene.
GeoKeyDirectoryTag	34735	SHORT	Variable	Contains the value of all GeoTIFF keys of type SHORT and the location of the values for GeoTIFF keys of other types.

GeoTIFF Tag/Key Name	GeoTIFF Tag/ Key Code	Type	Value	Description
GeoDoubleParamsTag	34736	DOUBLE	Variable	Contains the value of all GeoTIFF keys of type DOUBLE.
GeoAsciiParamsTag	34737	ASCII	Variable	Contains the value of all GeoTIFF keys of type ASCII.
GTModelTypeGeoKey	1024	SHORT	2	Model coordinate system. Always set to 2 (Geographic – latitude and longitude – coordinates).
GTRasterTypeGeoKey	1025	SHORT	1	Raster space coordinate system. Always set to 1 (Pixels represent an area in the image).
GTCitationGeoKey	1026	ASCII	"Geo-referenced SAR image"	Description of the configuration of the GeoTIFF. Always set to "Geo-referenced SAR image".
GeographicTypeGeoKey	2048	SHORT	Variable	Type of geographic coordinate system. SLC products are geo-referenced using the orbit and attitude data from the satellite. All other products are geo-referenced using an ellipsoid.
GeogLinearUnitsGeoKey	2052	SHORT	9001	Linear units within the coordinate system. Always set to 9001 (metres).
GeogAngularUnitsGeoKey	2054	SHORT	9102	Angular units within the coordinate system. Always set to 9102 (degrees).
GeogEllipsoidGeoKey	2056	SHORT	Variable	Ellipsoid used to geo-reference the image. This key is present when an ellipsoid is used for geo-referencing (i.e., it is present for all products except SLC).
GeogSemiMajorAxisGeoKey	2057	DOUBLE	Variable	Equatorial axis in metres. This key is present when an ellipsoid is used for geo-referencing.
GeogSemiMinorAxisGeoKey	2058	DOUBLE	Variable	Polar axis in metres. This key is present when an ellipsoid is used for geo-referencing.
GeogInvFlatteningGeoKey	2059	DOUBLE	Variable	Inverse flattening parameter. This key is present when an ellipsoid is used for geo-referencing.

6.2.2 Quick-look Image

A Quick-look image is a lower resolution version of the image MDS stored in PNG file format [R-11] and is optionally included with any SM, IW or EW product. Quick-look images are not included with WV mode products. The Quick-look image is used in the Product Preview and is a convenient reference to the complete image MDS. Being of lower resolution it is smaller and can be viewed (loaded) and transferred faster than the complete image MDS. The following rules and properties apply to Quick-look images:

- SM, IW and EW SLC Quick-look images are a power detected, averaged and decimated version of the full SLC image; additionally,
  - Merging is performed (bursts merged in azimuth and swaths merged in range) for IW and EW SLC Quick-look images;
- SM, IW and EW GRD Quick-look images are an averaged and decimated version of the full GRD image;
- Dual polarisation SLC and GRD products contain only one Quick-look image (adhering to the rules above) which is a combination of the imagery from both polarisation channels.

The Quick-look images for single polarisation products are output as greyscale PNG images similar to the one shown in Figure 6-5.

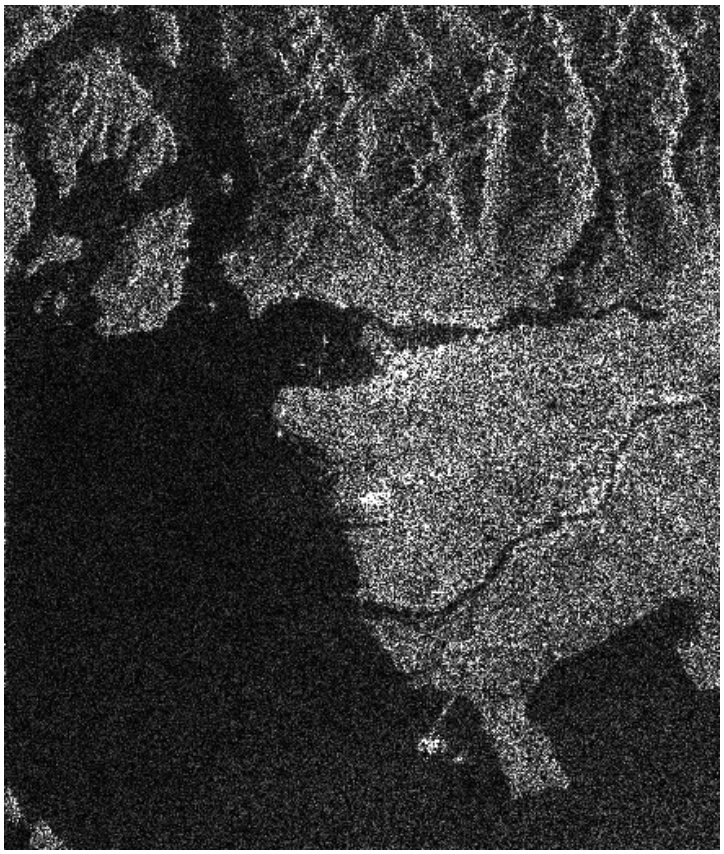


Figure 6-5 Grey-scale Single Polarisation Quick-look Image

For dual polarisation products a single composite image of both polarisations is created using a three channel Red Green Blue (RGB) PNG image similar to the one shown in Figure 6-6. In composite Quick-look images, the red channel (R) is used to represent the first polarisation (HH in the example image) and the green channel (G) is used to represent the second polarisation (HV in the example image). The content of the blue channel (B) is calculated as:

$$B(x) = |R(x)| / |G(x)|$$

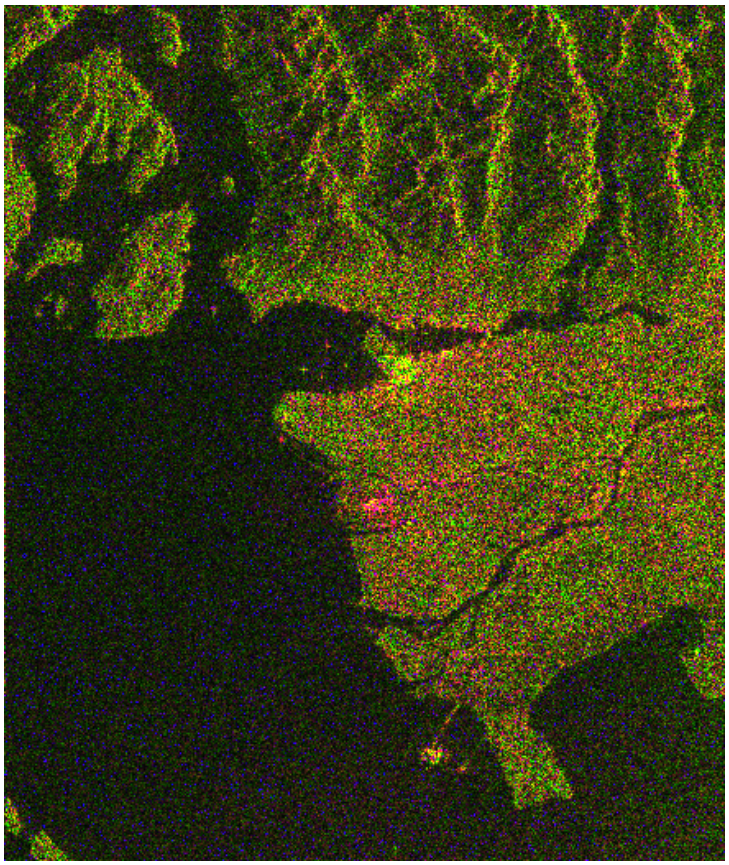


Figure 6-6 3 Channel (RGB) Composite Dual Polarisation Quick-look Image

6.2.3 Level 2 OCN Measurement Data

The Level 2 OCN MDS contains an Ocean Swell Wave spectra component (OSW), an Ocean Wind field component (OWI) and a Radial Surface Velocity component (RVL) estimated from an input L1 SAR image. The format of this data set is a NetCDF file [R-12]. The information in the NetCDF file is broken into three groups – attributes, dimensions and variables – as depicted in Figure 6-7 and described in Table 6-12. The NetCDF format supports the inclusion of both the processed measurement data and the associated metadata within the same file, so the L2 MDS is a self-contained, self-describing file that requires no additional annotations or supporting files.

Note: NetCDF is a binary format and because of its self-describing nature, differs somewhat in format from the other data sets described so far; however, within this section the use of XML diagrams is still employed to present a conceptual view of the structure and content of the Level 2 ocean swell wave spectra and wind field data set. The graphical and tabular views presented below are only conceptual and do not reflect the physical layout of the NetCDF L2 MDS.

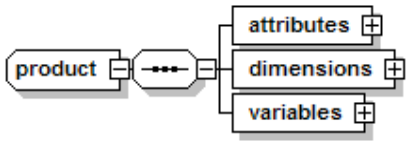


Figure 6-7 L2 OCN Product Top-level Format

Table 6-12 L2 OCN Product

Name	Description	Data Type	Cardinality
attributes	Global attributes annotate variables or files with small notes or supplementary metadata. Attributes are always scalar values or 1D arrays which can be associated with either a variable or the product as a whole.	NetCDF Construct	1
dimensions	Dimensions describe the axes of the data arrays (variables). A dimension has a name and a length.	NetCDF Construct	1
variables	Variables are used to store both the processed L2 measurement data and the associated product annotations. A variable represents an array of values of the same type. A scalar value is treated as a 0-dimensional array. A variable has a name, a data type, and a shape described by its list of dimensions specified when the variable is created.	NetCDF Construct	1

6.2.3.1 Global Attributes

Global attributes annotate variables or products with small notes or supplementary metadata. Attributes are always scalar values or 1D arrays which can be associated with either a variable or the product as a whole. The attributes within the L2 MDS annotate basic information about the input and output data. Figure 6-8 and Table 6-13 present a graphical and tabular view, respectively, of the L2 OCN attributes.

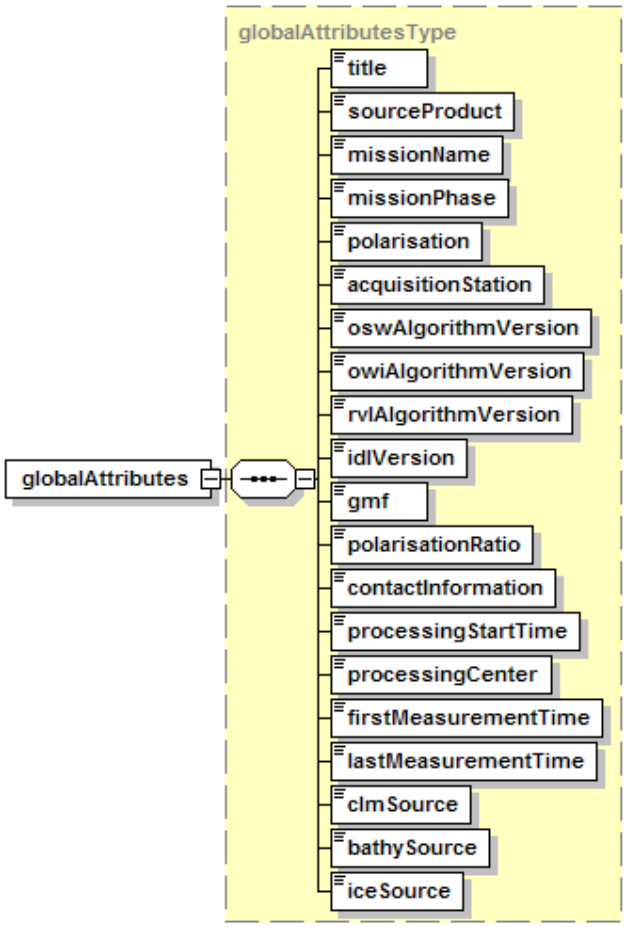


Figure 6-8 L2 OCN Global Attributes

Table 6-13 L2 OCN Global Attributes

Name	Description	Data Type	Cardinality
title	Title/description of the L2 OCN product.	string	1
sourceProduct	Identifier (file name) of the input L1 product.	string	1
missionName	Identifier of the platform that acquired the SAR data that the L2 OCN product was generated from.	string	1
missionPhase	Phase of the mission (Calibration, Validation, Operational).	string	1
polarisation	Polarisation (“HH”, “VV”, “VV/VH”, “HH/HV”).	string	1
acquisitionStation	Name of the facility that acquired the SAR data.	string	1
oswAlgorithmVersion	Version identifier of the OSW algorithm.	string	1
owiAlgorithmVersion	Version identifier of the OWI algorithm.	string	1

Name	Description	Data Type	Cardinality
rvlAlgorithmVersion	Version identifier of the RVL algorithm.	string	1
idlVersion	Version identifier of the IDL software used to generate the L2 OCN product.	string	1
gmf	Geophysical Model Function (GMF) used for OWI processing.	string	1
polarisationRatio	Name and parameters of polarisation ratio used for transforming HH NRCS to VV NRCS before inversion.	string	1
contactInformation	Contact name and email address.	string	1
processingStartTime	Start time of L2 processing [UTC].	timeType	1
processingCenter	Name of the processing center where the L2 OCN product was generated.	string	1
firstMeasurementTime	Zero Doppler start time of the source data acquisition [UTC].	timeType	1
lastMeasurementTime	Zero Doppler stop time of the source data acquisition [UTC].	timeType	1
clmSource	Coastline and land masking auxiliary data source.	string	1
bathySource	Bathymetry auxiliary data source.	string	1
iceSource	Ice coverage auxiliary data source.	string	1

6.2.3.2 Dimensions

Dimensions describe the axes of the data arrays (variables). Each dimension has a name and a length. Within the L2 OCN product, the dimensions are used to define the sizes of the ocean swell wave spectra and wind field grids. Figure 6-9 and Table 6-14 present a graphical and tabular view, respectively, of the L2 OCN dimensions.

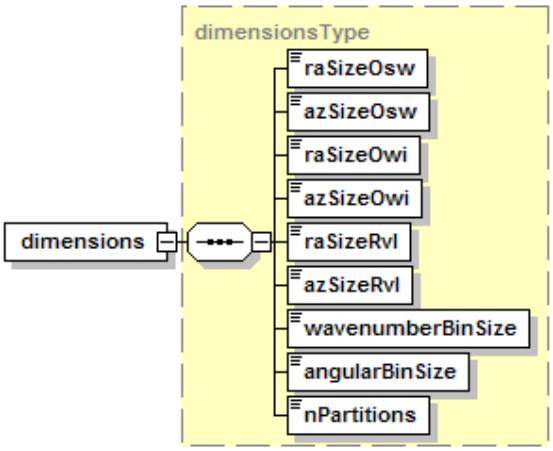


Figure 6-9 L2 OCN Dimensions

Table 6-14 L2 OCN Dimensions

Name	Description	Data Type	Cardinality
raSizeOsw	Number of range swell wave spectra cells. For WV mode this dimension is set to 1 as there is 1 swell wave spectra per WV vignette. For SM this dimension is set to the number of cells in the range direction, nominally 4. This parameter does not apply to IW nor EW mode.	unsignedInt	1
azSizeOsw	Number of azimuth swell wave spectra cells. For WV mode this dimension is set to 1 as there is 1 swell wave spectra per WV vignette. For SM this dimension is set to the number of cells in the azimuth direction, nominally 4; although, this will vary with the length of the input image strip. This parameter does not apply to IW nor EW mode.	unsignedInt	1
raSizeOwi	Number of range wind cells. For WV mode this dimension is set to 1 as there is 1 wind cell per WV vignette. For SM this dimension is set to the number of cells in the range direction.	unsignedInt	1
azSizeOwi	Number of azimuth wind cells. For WV mode this dimension is set to 1 as there is 1 wind cell per WV vignette. For SM this dimension is set to the number of cells in the azimuth direction, this will vary with the length of the input image strip.	unsignedInt	1
raSizeRvl	Number of range radial velocity cells. For WV mode this dimension is set to 1 as there is 1 radial velocity cells per WV vignette. For SM this dimension is set to the number of cells in the range direction.	unsignedInt	1
azSizeRvl	Number of azimuth radial velocity cells. For WV mode this dimension is set to 1 as there is 1 radial velocity cells per WV vignette. For SM this dimension is set to the number of cells in the azimuth direction, , this will vary with the length of the input image strip.	unsignedInt	1

Name	Description	Data Type	Cardinality
wavenumberBinSize	Number of wavenumber bins in the swell wave polar spectrum.	unsignedInt	1
angularBinSize	Number of angular bins in the swell wave polar spectrum.	unsignedInt	1
nPartitions	Number of partitions per swell wave spectra cell.	unsignedInt	1

6.2.3.3 Variables

Variables are used to store both the processed L2 measurement data and the associated product annotations. A variable represents an array of values of the same type. A scalar value is treated as an array with one element. A variable has a name, a data type, and a shape described by its list of dimensions specified when the variable is created. A graphical view of the L2 OCN variables is presented in Figure 6-10 and:

- Table 6-15 presents the variables in the OSW component grid;
- Table 6-16 presents the variables in the OWI component grid; and,
- Table 6-17 presents the variables in the RVL component grid.

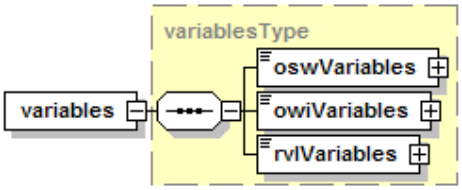


Figure 6-10 L2 OSW Component Variables

Table 6-15 L2 OSW Component Variables

Name	Description	Data Type	Cardinality
polSpec	Two-dimensional representation of the ocean swell wave height spectra in units of [m^4] given on a polar grid of wavenumber [rad/m] and degree [degN].	matrix (float)	1
partitions	Two-dimensional representation of the ocean swell wave partitions number given on a polar grid of wavenumber [rad/m] and degree [degN].	matrix (byte)	1
qualityCrossSpectra	Two-dimensional representation of the quality image cross-spectra parameter given on a polar grid of wavenumber [rad/m] and degree [degN].	matrix (float)	1
k	Array of logarithmically spaced wavenumber bins for the ocean swell wave spectra [rad/m].	array (float)	1
phi	Array of equidistantly spaced directional bins for the ocean swell wave spectra [degN].	array (float)	1

Name	Description	Data Type	Cardinality
azCutoff	The azimuth cut-off wavelength is the shortest wavelength in the azimuth direction that is resolved in the swell wave spectra. The cut-off wavelength in the azimuth direction [m] is computed from the SAR imagette cross-spectra. The Spectral Resolution (specRes) is derived from this parameter.	matrix (float)	1
raCutoff	The range cut-off wavelength [m] is the shortest wavelength in range direction that can be resolved in the swell wave spectra. The cut-off wavelength is computed from the slant range resolution (or range bandwidth, f_{sf}) and the local incidence angle as: $\lambda_{range}(\theta)=c/f_{sf}\sin\theta$	matrix (float)	1
specRes	The spectral resolution gives the shortest ocean wavelength [m] that can be detected. This depends on the sea state and the wave direction relative to azimuth. This parameter is a vector of wave lengths equal to the number of directional bins (na_size) . In range, the theoretical limit is given by the range bandwidth, and does not depend on the sea state. $\lambda(\varphi)=(\lambda_c \cdot cos(\varphi+\varphi_{track}))>\lambda_{min}$ where $\lambda_{min}=2\pi/k_{max} \approx 30m$ is the shortest wavelength in the spectra. Here λ_c is the azimuth cut-off wavelength estimated from the SAR image spectra, and φ_{track} is the satellite track heading counter clockwise relative to North.	matrix (float)	1
lonOsw	Geodetic longitude at wave cell center [degrees].	matrix (float)	1
latOsw	Geodetic latitude at wave cell center [degrees].	matrix (float)	1
hs	The significant waveheight computed from the two most energetic wave partitions of the swell wave spectra [m].	matrix (float)	1
wl	The dominant wave length of the swell wave spectra [m] for the two most energetic wave partitions.	matrix (float)	1
dirmet	The dominant wave direction of the swell wave spectra [degN] for the two most energetic wave partitions.	matrix (float)	1
snr	The ambiguity ratio for a given wave partition. This is estimated as the ratio of integral of the unambiguous part over the partition weighted by the wave spectral energy over the same partition divided by the integral over the ambiguous partition. The ambiguity ratio for the two most energetic wave partitions [dB] is provided for each wave cell.	matrix (float)	1
ambiFac	Ambiguity factor measuring the ability to estimate wave propagation direction from the sign of the imaginary part of the cross spectra.	matrix (float)	1
iconf	This flag provides the confidence of the swell wave spectra product for the two most energetic wave partitions [0 or 1], where 0 means that the wave direction is resolved while 1 means that there is a 180 degree ambiguity in the wave direction.	matrix (float)	1
lookSeparationTime	Separation time between inner and outer look [s].	matrix (float)	1

Name	Description	Data Type	Cardinality
nrcs	The normalized radar cross section of the imagette [dB] is the measured radar cross section normalized to the area on ground: $\sigma^0=\sigma/A=\sigma sin\theta/\Delta r\Delta a$ where Δr, Δa are the slant range and azimuth resolution, respectively. The NRCS is estimated within and provided for each wave cell.	matrix (float)	1
inten	The input SLC image intensity [arb.] estimated within each wave cell.	matrix (float)	1
nv	The variance of the input SLC image normalized by the square of the mean intensity [dimensionless] estimated within each wave cell.	matrix (float)	1
skew	The skewness of the input SLC image [dimensionless] estimated within each wave cell.	matrix (float)	1
kurt	The kurtosis of the input SLC image [dimensionless] estimated within each wave cell.	matrix (float)	1
dopCen	Doppler centroid frequency [Hz] estimated over wave cell from the RVL component.	matrix (float)	1
ecmwfWindSpeed	Wind speed [m/s] from the European Centre for Medium-Range Weather Forecasts (ECMWF) atmospheric model derived from the L2 auxiliary file. and resampled into wave cell grid.	matrix (float)	1
ecmwfWindDirection	Wind direction [degN] from ECMWF atmospheric model derived from the L2 auxiliary file and resampled into the wave cell grid.	matrix (float)	1
windSeaHs	The significant waveheight for the wind sea part of the total wave height spectrum [m]. Computed from the wind speed and the inverse wave age.	matrix (float)	1
waveAge	The dimensionless parameter, derived from the SAR data that describes the state of development of the wind sea component of the wave spectra.	matrix (float)	1
depth	Sea depth [m] from General Bathymetric Chart of Oceans (GEBCO) data set. This parameter is resampled into the wave cell grid.	matrix (float)	1
landCoverage	Percentage [%] of land coverage within the estimation area.	matrix (float)	1
landFlag	Land mask flag. This flag is set to 1 if the land_coverage > 10%; otherwise, it is set to 0.	matrix (float)	1
incidenceAngle	Radar incidence angle [deg] to the center of the wave cells. This parameter is provided at each azimuth line in the wave cell grid.	matrix (float)	1
heading	Local Northing angle [degN]	matrix (float)	1
slantRangeTime	Two way slant range time [s] to the center of the vignette/sub-image.	matrix (float)	1
zeroDopplerTime	Zero Doppler time [UTC].	matrix (float)	1
groundRngSize	Ground range size of the estimation area [m].	matrix (float)	1
aziSize	Azimuth size of the estimation area [m].	matrix (float)	1

Table 6-16 L2 OWI Component Variables

Name	Description	Data Type	Cardinality
lonOsw	Geodetic longitude at wind cell center [degrees].	matrix (float)	1
latOsw	Geodetic latitude at wind cell center [degrees].	matrix (float)	1
landCoverage	Percentage [%] of land coverage within the estimation area.	matrix (float)	1
landFlag	Land mask flag. This flag is set to 1 if the land_coverage > 10%; otherwise, it is set to 0.	matrix (float)	1
incidenceAngle	Radar incidence angle [deg] to the center of the wind cells. This parameter is provided at each azimuth line in the wind cell grid.	matrix (float)	1
heading	Local Northing angle [degN]	matrix (float)	1
nrcs	The normalized radar cross section of the imagette [dB] is the measured radar cross section normalized to the area on ground: $\sigma^0=\sigma/A=\sigma sin\theta/\Delta r\Delta a$ where Δr, Δa are the slant range and azimuth resolution, respectively. The NRCS is estimated within and provided for each wind cell.	matrix (float)	1
pBright	Percentage of bright targets pixels detected in each SAR wind cell and removed for the computation of the mean NRCS [%].	matrix (float)	1
nrcsCmod	Predicted NRCS from CMOD and ECMWF a priori 10m wind for each SAR wind cell [dB].	array (float)	1
calConstObsi	Geophysical calibration constant estimated for each L2 OCN product from ECMWF ancillary wind field and CMOD GMF used for wind retrieval.	float	1
calQuality	Calibration quality flag for each L2 OWI component.	matrix (bool)	1
windSpeed	SAR wind speed for each wind cell [m/s].	matrix (float)	1
windDirection	SAR wind direction for each wind cell [degN]	matrix (float)	1
inversionQuality	Inversion quality indicator for each wind cell.	matrix (bool)	1
windQuality	SAR wind quality flag for each wind cell	matrix (byte)	1
ecmwfWindSpeed	Wind speed [m/s] from the European Centre for Medium-Range Weather Forecasts (ECMWF) atmospheric model derived from the L2 auxiliary file. and resampled into wind cell grid.	matrix (float)	1
ecmwfWindDirection	Wind direction [degN] from ECMWF atmospheric model derived from the L2 auxiliary file and resampled into the wind cell grid.	matrix (float)	1
radVel	Radial velocities [m/s] from the RVL component interpolated to the wind cell grid	array(float)	1
hs	The significant waveheight [m] from the OSW component interpolated to the wind cell grid.	matrix (float)	1
wl	The dominant wave length [m] from the OSW component interpolated to the wind cell grid.	matrix (float)	1
dirmet	The dominant wave direction [degN] from the OSW component interpolated to the wind cell grid.	matrix (float)	1

Name	Description	Data Type	Cardinality
windSeaHs	The significant waveheight for the wind sea part of the total wave height spectrum [m] from the OSW component interpolated to the wind cell grid.	matrix (float)	1

Table 6-17 L2 RVL Component Variables

Name	Description	Data Type	Cardinality
lonRvl	Geodetic longitude at RVL cell center [degrees].	matrix (float)	1
latRvl	Geodetic latitude at RVL cell center [degrees].	matrix (float)	1
landCoverage	Percentage [%] of land coverage within the estimation area.	matrix (float)	1
landFlag	Land mask flag. This flag is set to 1 if the land_coverage > 10%; otherwise, it is set to 0.	matrix (float)	1
incidenceAngle	Radar incidence angle [deg] to the center of the RVL cells. This parameter is provided at each azimuth line in the wind cell grid.	matrix (float)	1
heading	Local Northing angle [degN]	matrix (float)	1
nrcs	The normalized radar cross section of the imagette [dB] is the measured radar cross section normalized to the area on ground: $\sigma^0=\sigma/A=\sigma sin\theta/\Delta r\Delta a$ where Δr, Δa are the slant range and azimuth resolution, respectively. The NRCS is estimated within and provided for each wind cell.	matrix (float)	1
dcObs	Estimated Doppler centroid frequency [Hz]	array (float)	1
confDcObs	Confidence in the Doppler centroid frequency estimates.	matrix (bool)	1
radVel	Radial velocities [m/s].	array (float)	1
dcGeo	Doppler centroid frequency from geometry [Hz]. This parameter is interpolated from the L1 product.	matrix (float)	1
dcMiss	Doppler centroid frequency from antenna miss-pointing [Hz]	matrix (float)	1
yaw	Yaw of satellite platform versus zero Doppler time	array (float)	1
pitch	Pitch of satellite platform versus zero Doppler time	array (float)	1
roll	Roll of satellite platform versus zero Doppler time	array (float)	1
snr	Signal to noise ratio estimated from Doppler spectra	matrix (float)	1
ussX	Longitudinal component of surface stokes drift from WAVEWATCH III model.	matrix (float)	1
ussX	Meridianal component of surface stokes drift from WAVEWATCH III model.	matrix (float)	1
ecmwfWindSpeed	Wind speed [m/s] from the European Centre for Medium-Range Weather Forecasts (ECMWF) atmospheric model derived from the L2 auxiliary file. and resampled into wind cell grid.	matrix (float)	1
ecmwfWindDirection	Wind direction [degN] from ECMWF atmospheric model derived from the L2 auxiliary file and resampled into the wind cell grid.	matrix (float)	1

6.3 Annotation Data Sets

The sub-sections within this section contain a detailed description of each annotation data set in tabular format. The purpose of these sub-sections is to present the details of every annotation contained within the data sets in a clear layout that does not require the reader to have any knowledge of XML Schema.

6.3.1 L1 Product Annotation Data Set

The L1 Product ADS contains all the information pertaining to the L1 product (except for the calibration and noise vectors which are contained in separate data sets). This ADS describes attributes of the input data, the processing performed and the final output. Figure 6-11 presents a high-level graphical overview of the L1 Product ADS

The content of the L1 Product Annotation Data Set is presented in the tables below.

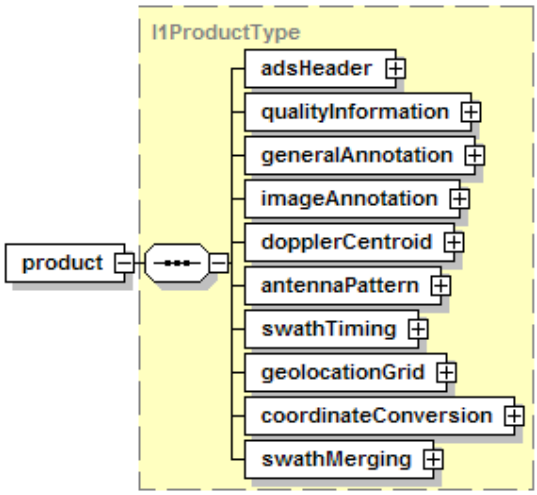


Figure 6-11 L1 Product Annotation Data Set

Table 6-18 Element - product

Name	Description	Data Type	Cardinality
adsHeader	ADS header data set record. This DSR contains information that applies to the entire data set.	adsHeaderType	1
qualityInformation	Quality information data set record. This DSR contains the quality flags and the values used to set them during image processing as well as the overall quality index.	l1QualityInformationType	1
generalAnnotation	General annotation data set record. This DSR contains information describing some key characteristics that apply to the entire L1 product. This includes annotations such as the sensing start and stop times, polarisation and swath. It also contains annotations derived from the input processing step including information extracted/calculated from the downlink data and raw data analysis (RDA) statistics.	l1GeneralAnnotationType	1
imageAnnotation	Image annotation data set record. This DSR contains information describing the properties of the image MDS (such as data type and image dimensions) and the key parameters/options used during the processing of the image.	l1ImageAnnotationType	1
dopplerCentroid	Doppler centroid data set record. This DSR contains information about the Doppler centroid values estimated and used during image processing.	l1DopplerCentroidType	1
antennaPattern	Antenna pattern data set record. This DSR contains information describing the elevation antenna pattern and how it was applied by the IPF during image processing.	l1AntennaPatternType	1
swathTiming	Swath timing data set record. This DSR contains the information about the bursts within the image MDS including the burst dimensions, burst timing and burst location. This DSR is specific to IW and EW SLC products.	l1SwathType	1
geolocationGrid	Geolocation grid data set record. This DSR describes the geodetitic position of line/pixel combinations within the image MDS.	l1GeolocationGridType	1
coordinateConversion	Coordinate conversion data set record. This DSR contains the annotations required to convert between the slant range and ground range coordinate systems.	l1CoordinateConversionType	1

Name	Description	Data Type	Cardinality
swathMerging	Swath merging data set record. This DSR contains the annotations for interpreting the way in which IW or EW swaths were merged during GRD processing.	l1SwathMergeType	1

6.3.1.1 Quality Information Data Set Record

Quality information data set record. This DSR contains the quality flags that are set during image processing as well as the overall quality index.

Each quality flag indicates the status of a comparison between the corresponding value from the product annotations and a pre-defined threshold. The threshold usually comes from the auxiliary processor parameters file, but may also come from an internal parameter file.

The product quality index is a value that gives an overall assessment of the product quality by calculating a confidence measure based on the detailed product quality information. The exact definition of the product quality index is TBD.

Figure 6-12 presents a graphical view of the structure and content of the Quality Information ADSR and the subsequent tables describe the schemas defined in Appendix A2.

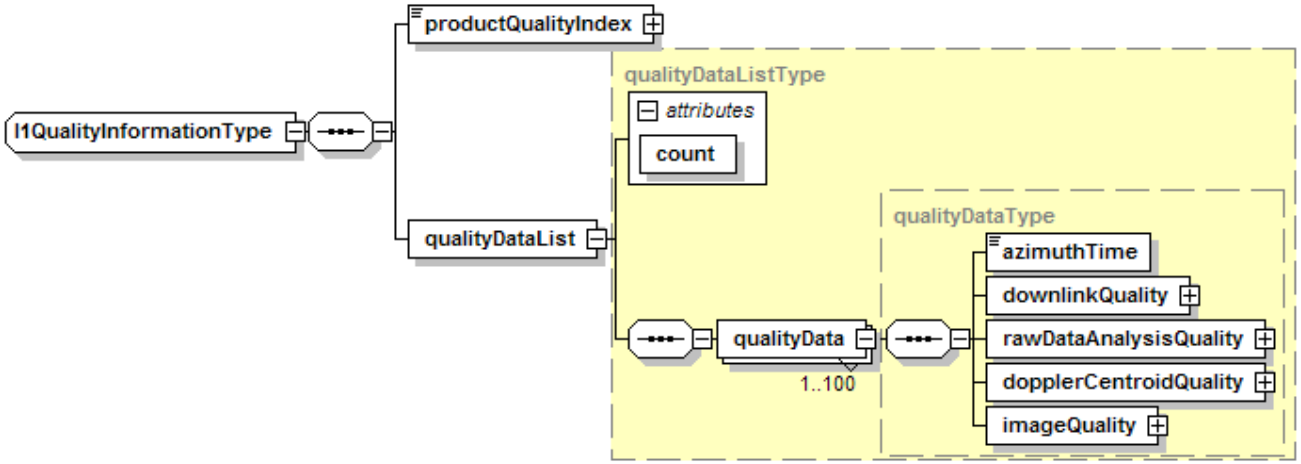


Figure 6-12 L1 Quality Information ADSR

Table 6-19 Data Type - l1QualityInformationType

Name	Description	Data Type	Cardinality
productQualityIndex	Overall product quality index. This annotation is calculated based on specific quality parameters and gives an overall quality value to the product. This parameter is TBD.	double	1
qualityDataList	Quality data list. This element contains a list of qualityData records which contain the quality values and flags calculated and set during image processing. For individual scene and slice products there is one qualityData record in the list. For assembled products the list contains one qualityData record for each slice included in the assembled product.	qualityDataListType	1

Table 6-20 Data Type - qualityDataListType

Name	Description	Data Type	Cardinality
count	*Number of qualityData records within the list.*	*unsignedInt*	*required*
qualityData	Quality data. This record contains the quality values and flags that are set during image processing. Each flag indicates the status of a comparison between the corresponding value(s) and a pre-defined threshold.	qualityDataType	1 .. 100

Table 6-21 Data Type - qualityDataType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time at which this set of quality annotations applies [UTC].	timeType	1
downlinkQuality	Downlink quality. This record contains the quality indicators - values and flags - related to the downlink information.	downlinkQualityType	1
rawDataAnalysisQuality	Raw data analysis quality. This record contains the quality indicators - values and flags - related to the raw data analysis information.	rawDataAnalysisQualityType	1
dopplerCentroidQuality	Doppler centroid quality. This record contains the quality indicators - values and flags - related to the Doppler centroid estimation.	dopplerCentroidQualityType	1
imageQuality	Image quality. This record contains the quality indicators - values and flags - related to properties of the output image.	imageQualityType	1

Table 6-22 Data Type - downlinkQualityType

Name	Description	Data Type	Cardinality
iInputDataMean	Calculated mean of the input data for the I channel.	double	1
qInputDataMean	Calculated mean of the input data for the Q channel.	double	1

Name	Description	Data Type	Cardinality
inputDataMeanOutsideNominalRangeFlag	Input data mean outside nominal range flag. False if the mean of I and Q input values are both within specified range from expected mean. For expected mean of x, the measured mean must fall between x-threshold to x+threshold. True otherwise.	bool	1
iInputDataStdDev	Calculated standard deviation of the input data for the I channel.	double	1
qInputDataStdDev	Calculated standard deviation of the input data for the Q channel.	double	1
inputDataStDevOutsideNominalRangeFlag	Input data standard deviation outside nominal range flag. False if the standard deviation values of I and Q input values are both within specified range of expected standard deviation. For expected std. dev. x, the measured std. dev. must fall between x-threshold to x+threshold. True otherwise.	bool	1
numInputDataGaps	Number of gaps detected in the input data.	uint32	1
gapsInInputDataSignificantFlag	Significant gaps in the input data flag. An input data gap is defined as a contiguous block of N missing lines (the value of N is predefined for each product). False if the number of input gaps is less than or equal to the threshold value, true if number of input data gaps is greater than the threshold value.	bool	1
numInputMissingLines	Number of missing lines detected in the input data, excluding data gaps.	uint32	1
missingLinesSignificantFlag	Missing lines significant flag. False if the percentage of missing lines is less than or equal to the threshold value, true if the percentage of missing lines is greater than the threshold value. The number of missing lines is the number of lines missing from the input data excluding data gaps.	bool	1
chirpSourceUsed	Chirp source used during processing (Nominal or Extracted). This value is a copy of the value from the processingOptions record.	chirpSourceType	1
rrfSpectrumUsed	Type of range replica function used (Unextended, Extended Flat, Extended Tapered). This value is a copy of the value from the processingOptions record.	rrfSpectrumType	1

Name	Description	Data Type	Cardinality
replicaReconstructionFailedFlag	Chirp replica reconstruction failed or is of low quality flag. False if able to reconstruct all chirps or chirp reconstruction not requested (nominal chirp used) AND all quality measures were acceptable. True if unable to reconstruct a chirp during processing and chirp reconstruction was requested or the quality is below the acceptable levels. If this is the case the processor uses the nominal range pulse for processing and a nominal elevation beam scaling factor.	bool	1
meanPgProductAmplitude	Mean of all PG product amplitude values.	double	1
stdDevPgProductAmplitude	Standard deviation of all PG product amplitude values.	double	1
meanPgProductPhase	Mean value of all PG product phase values.	double	1
stdDevPgProductPhase	Standard deviation of all PG product phase values.	double	1
pgProductDerivationFailedFlag	PG product derivation failed flag. False if the percentage of invalid relative and absolute PG products is below the configured threshold; or, true otherwise. If this flag is set to true then the values from the PG product model will be used in place of the derived PG product values.	bool	1
invalidDownlinkParamsFlag	Invalid downlink parameters flag. False if all parameters read from the downlinked data were valid, true if any downlink parameter is out of range and therefore a default value has been used during processing.	bool	1

Table 6-23 Data Type - rawDataAnalysisQualityType

Name	Description	Data Type	Cardinality
iBias	Calculated I bias. This value is a copy of the value from the rawDataAnalysis record.	double	1
iBiasSignificanceFlag	I bias significance, true if I bias falls within acceptable range, false otherwise.	bool	1
qBias	Calculated Q bias. This value is a copy of the value from the rawDataAnalysis record.	double	1
qBiasSignificanceFlag	Q bias significance, true if Q bias falls within acceptable range, false otherwise.	bool	1
iqGainImbalance	Calculated I/Q gain imbalance. This value is a copy of the value from the rawDataAnalysis record.	double	1

Name	Description	Data Type	Cardinality
iqGainSignificanceFlag	I/Q Gain Significance, true if I/Q gain imbalance falls within acceptable range, false otherwise.	bool	1
iqQuadratureDeparture	Calculated I/Q quadrature departure.	double	1
iqQuadratureDepartureSignificanceFlag	I/Q Quadrature Departure Significance, true if quadrature departure falls within acceptable range, false otherwise.	bool	1

Table 6-24 Data Type - dopplerCentroidQualityType

Name	Description	Data Type	Cardinality
dcMethod	Doppler centroid estimation method used during processing. Both the Doppler centroid (DC) calculated from orbit geometry and the DC estimated from the raw data are annotated within the Doppler data set; however, this parameter describes the actual DC method used during image processing. This value is a copy of the value from the processingOptions record.	dcMethodType	1
dopplerCentroidUncertainFlag	Doppler centroid uncertain flag. False if the signal-to-noise ratio (SNR) for the DCE method used for image processing is greater than or equal to the specified value, true if the SNR is less than the specified value. Note: if more than one Doppler centroid estimation is performed, the flag is set if any SNR is less than the threshold).	bool	1

Table 6-25 Data Type - imageQualityType

Name	Description	Data Type	Cardinality
imageStatistics	Mean and standard deviation statistics for the image. This record is a copy of the record from the imageInformation record.	imageStatisticsType	1
outputDataMeanOutsideNominalRangeFlag	Output data mean outside nominal range flag. False if the mean of I and Q output values for SLC image or mean of detected pixels for a detected product, are both within specified range from expected mean. For expected mean of x, the measured mean must fall between x-threshold to x+threshold. True otherwise.	bool	1

Name	Description	Data Type	Cardinality
outputDataStDevOutsideNominalRangeFlag	Output data standard deviation outside nominal range flag. False if the std. dev. of I and Q output values for SLC image or std. dev. of detected pixels for a detected product, are both within specified range from expected std. dev. For expected std. dev. of x, the measured std. dev. must fall between x-threshold to x+threshold. True otherwise.	bool	1

Table 6-26 Data Type - imageStatisticsType

Name	Description	Data Type	Cardinality
outputDataMean	Mean value of output data.	complex	1
outputDataStdDev	Standard deviation of output data.	complex	1

6.3.1.2 General Annotation Data Set Record

General annotation data set record. This DSR contains information describing some key characteristics that apply to the entire L1 product. This includes annotations such as the sensing start and stop times, polarisation and swath. It also contains annotations derived from the input processing step including information extracted/calculated from the downlink data and raw data analysis statistics.

Figure 6-13 presents a graphical view of the structure and content of the General ADSR and the subsequent tables describe the schemas defined in Appendix A2.

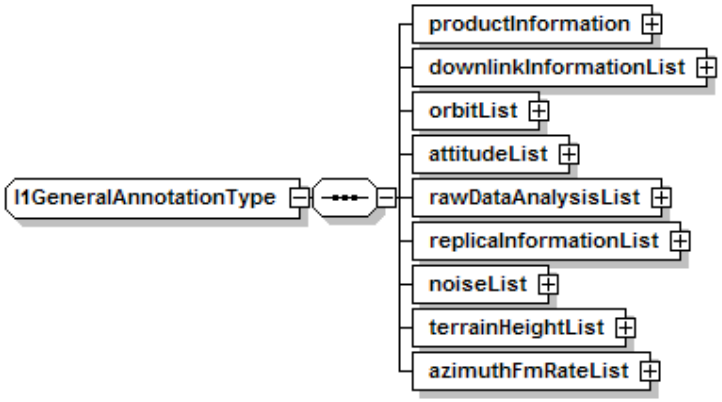


Figure 6-13 L1 General ADSR

Table 6-27 Data Type - l1GeneralAnnotationType

Name	Description	Data Type	Cardinality
productInformation	General product information. This record describes some key characteristics of the product, the input data and the acquisition platform.	productInformationType	1
downlinkInformationList	Downlink information list. This element contains a list of downlinkInformation records which contain information extracted and calculated from the input data. For individual scene and slice products there is one downlinkInformation record in the list per swath. For assembled products the list contains one downlinkInformation record per swath for each slice included in the assembled product.	downlinkInformationListType	1
orbitList	List of orbit information extracted from the ISPs. This list contains sets of orbit state vectors that are updated along azimuth. This information comes from the sub-commutated ancillary data from the ISPs and is updated each time a new set of orbit values is available.	orbitListType	1
attitudeList	List of attitude information extracted from the ISPs. This list contains sets of attitude data records that are updated along azimuth. This information comes from the sub-commutated ancillary data from the ISPs and is updated each time a new set of attitude values is available.	attitudeListType	1

Name	Description	Data Type	Cardinality
rawDataAnalysisList	Raw data analysis list. This element contains a list of rawDataAnalysis records which contain statistics collected from the input data. For individual scene and slice products there is one rawDataAnalysis record in the list per swath. For assembled products the list contains one rawDataAnalysis record per swath for each slice included in the assembled product.	rawDataAnalysisListType	1
replicaInformationList	Replica information list. This element contains a list of replicaInformation records, which describe the reference replica and the reconstructed replicas created from the calibration pulses extracted from the downlink.	replicaInformationListType	1
noiseList	Noise list. This element is a list of noise records that contain the noise parameters derived from the noise ISPs. The list contains an entry for each noise update made along azimuth.	noiseListType	1
terrainHeightList	Terrain height list. This element is a list of terrainHeight records that contain the average terrain height at the given zero Doppler azimuth time. The actual terrain heights used by the IPF may represent bilinearly interpolated values from this list. The list contains an entry for each terrain height update made along azimuth.	terrainHeightListType	1
azimuthFmRateList	Azimuth Frequency Modulation (FM) rate list. This element is a list of azimuthFmRate records that contain the parameters needed to calculate the azimuth FM rate. The list contains an entry for each azimuth FM rate update made along azimuth.	azimuthFmRateListType	1

Table 6-28 Data Type - productInformationType

Name	Description	Data Type	Cardinality
pass	Orbit pass direction. Ascending, Descending or Full Orbit.	passDirectionType	1
timelinessCategory	Timeliness category under which the product was produced, i.e. time frame from the data acquisition (for the near real time categories) or from the satellite tasking to the product delivery to the end user.	string	1
platformHeading	Platform heading relative to North [degrees].	double	1
rangeSamplingRate	Range sample rate [Hz].	double	1
radarFrequency	Radar frequency [Hz].	double	1

Name	Description	Data Type	Cardinality
azimuthSteeringRate	Azimuth steering rate for IW and EW modes [degrees/s].	double	1

Table 6-29 Data Type - downlinkInformationListType

Name	Description	Data Type	Cardinality
count	*Number of downlink information records within the list.*	*unsignedInt*	*required*
downlinkInformation	Downlink information. This record contains information about the data extracted/calculated from the input data, including values extracted from the ISP and data error counters.	downlinkInformationType	1 .. 800

Table 6-30 Data Type - downlinkInformationType

Name	Description	Data Type	Cardinality
swath	Swath from which this downlink information data was extracted.	swathType	1
azimuthTime	Zero Doppler azimuth time at which this set of downlink information applies [UTC].	timeType	1
firstLineSensingTime	Sensing time of first line of input data [UTC].	timeType	1
lastLineSensingTime	Sensing time of last line of input data [UTC].	timeType	1
bitErrorCount	Error counters. This record contains the error counter for each field that is validated as the input source packets are analyzed.	bitErrorCountType	1
downlinkValues	Downlink values. This record contains values extracted directly from the Instrument Source Packets.	downlinkValuesType	1

Table 6-31 Data Type - bitErrorCountType

Name	Description	Data Type	Cardinality
numErrSyncMarker	Number of errors detected in the sync marker field.	uint32	1
numErrDataTakeId	Number of errors detected in the data take identifier field.	uint32	1
numErrEccNumber	Number of errors detected in the Event Control Code (ECC) number field.	uint32	1
numErrTestMode	Number of errors detected in the test mode field.	uint32	1
numErrRxChannelId	Number of errors detected in the Rx channel identifier field.	uint32	1
numErrInstrumentConfigId	Number of errors detected in the instrument configuration identifier field.	uint32	1
numErrPacketCount	Number of errors detected in the space packet count field.	uint32	1
numErrPriCount	Number of errors detected in the Pulse Repetition Interval (PRI) count field.	uint32	1
numErrBaqMode	Number of errors detected in the Block Adaptive Quantisation (BAQ) mode field.	uint32	1

Name	Description	Data Type	Cardinality
numErrBaqBlockLength	Number of errors detected in the BAQ block length field.	uint32	1
numErrRangeDecimation	Number of errors detected in the range decimation field.	uint32	1
numErrRxGain	Number of errors detected in the Rx gain field.	uint32	1
numErrTxRampRate	Number of errors detected in the Tx ramp rate field.	uint32	1
numErrTxPulseStartFrequency	Number of errors detected in the Tx pulse start frequency field.	uint32	1
numErrRank	Number of errors detected in the rank field.	uint32	1
numErrPri	Number of errors detected in the PRI code field	uint32	1
numErrSwst	Number of errors detected in the sampling window start time (SWST) field.	uint32	1
numErrSwl	Number of errors detected in the sampling window length (SWL) field.	uint32	1
numErrPolarisation	Number of errors detected in the polarisation field.	uint32	1
numErrTempComp	Number of errors detected in the temperature compensation field.	uint32	1
numErrElevationBeamAddress	Number of errors detected in the elevation beam address field.	uint32	1
numErrAzimuthBeamAddress	Number of errors detected in the azimuth beam address field.	uint32	1
numErrSasTestMode	Number of errors detected in the SAR Antenna Sub-system (SAS) test mode field.	uint32	1
numErrCalType	Number of errors detected in the calibration operation type field.	uint32	1
numErrCalibrationBeamAddress	Number of errors detected in the calibration beam address field.	uint32	1
numErrCalMode	Number of errors detected in the calibration mode field.	uint32	1
numErrTxPulseNumber	Number of errors detected in the Tx pulse number field.	uint32	1
numErrSignalType	Number of errors detected in the signal type field.	uint32	1
numErrSwapFlag	Number of errors detected in the swap flag field.	uint32	1

Name	Description	Data Type	Cardinality
numErrSwathNumber	Number of errors detected in the swath number field.	uint32	1
numErrNumberOfQuads	Number of errors detected in the number of quads field.	uint32	1
numIspHeaderErrors	Total number of errors detected in ISP headers.	uint32	1

Table 6-32 Data Type - downlinkValuesType

Name	Description	Data Type	Cardinality
pri	Pulse Repetition Interval [Hz].	double	1
rank	The number of PRI between transmitted pulse and return echo.	uint16	1
dataTakeId	Data take identifier.	uint16	1
eccNumber	The ECC number of the measurement mode.	uint16	1
rxChannelId	Receive channel identifier.	uint16	1
instrumentConfigId	Instrument configuration identifier.	uint16	1
dataFormat	Data format for instrument samples. There is one element corresponding to the data format for each packet type in the segment.	dataFormatType	1
rangeDecimation	Decimation of the SAR data in the sampling window according to the needed mode bandwidth.	rangeDecimationType	1
rxGain	Applied value of the commandable Rx attenuation in the receiver channel of the SES.	double	1
txPulseLength	Transmit pulse length [ns].	double	1
txPulseStartFrequency	Starting frequency of the transmit pulse [Hz].	double	1
txPulseRampRate	The linear FM rate at which the frequency changes over the pulse duration [Hz/s].	double	1
swlList	List of sampling window lengths.	swlListType	1

Name	Description	Data Type	Cardinality
swstList	List of sampling window start time changes.	swstListType	1

Table 6-33 Data Type - dataFormatType

Name	Description	Data Type	Cardinality
baqBlockLength	BAQ block length for all packets.	ubyte	1
echoFormat	Data format of echo packets.	dataFormatModeType	1
noiseFormat	Data format of noise packets.	dataFormatModeType	1
calibrationFormat	Data format of calibration packets.	dataFormatModeType	1
meanBitRate	The calculated mean bit rate of FDBAQ decompression for the entire segment [Mbps].	double	1

Table 6-34 Data Type - rangeDecimationType

Name	Description	Data Type	Cardinality
decimationFilterBandwidth	Filter bandwidth used to decimate the SAR signal data [MHz].	double	1
samplingFrequencyAfterDecimation	Sampling frequency of the SAR signal data after decimation [MHz]. This frequency is equivalent to the to the sampling frequency before decimation multiplied by the decimation ratio.	double	1
filterLength	Length of the decimation filter [samples]	uint32	1

Table 6-35 Data Type - swlListType

Name	Description	Data Type	Cardinality
count	*Number of SWL records within the list.*	*unsignedInt*	*required*
swl	Sampling window length record. This record holds the SWL for the given zero Doppler azimuth time.	swstType	1 .. 1600

Table 6-36 Data Type - swlType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time of sampling window length change [UTC].	timeType	1
value	Sampling Window Length [ns].	double	1

Table 6-37 Data Type - swstListType

Name	Description	Data Type	Cardinality
count	*Number of swst records within the list.*	*unsignedInt*	*required*
swst	SWST record. This record holds the SWST for the given zero Doppler azimuth time.	swstType	1 .. 1600

Table 6-38 Data Type - swstType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time of sampling window start change [UTC].	timeType	1
value	Sampling window start time for first range sample [s].	double	1

Table 6-39 Data Type - orbitListType

Name	Description	Data Type	Cardinality
count	*Length of the orbit vector list.*	*unsignedInt*	*required*
orbit	Orbit state vector record. This record contains a position vector and a velocity vector which together describe the orbit state of the platform at the annotated time.	orbitType	1 .. 1600

Table 6-40 Data Type - orbitType

Name	Description	Data Type	Cardinality
time	Timestamp at which orbit state vectors apply [UTC].	timeType	1
position	Position vector record. This record contains the platform position data with respect to the Earth-fixed reference frame.	positionType	1

Name	Description	Data Type	Cardinality
velocity	Velocity vector record. This record contains the platform velocity data with respect to the Earth-fixed reference frame.	velocityType	1

Table 6-41 Data Type - positionType

Name	Description	Data Type	Cardinality
x	X component of position vector [m].	double	1
y	Y component of position vector [m].	double	1
z	Z component of position vector [m].	double	1

Table 6-42 Data Type - velocityType

Name	Description	Data Type	Cardinality
x	X component of velocity vector [m/s].	double	1
y	Y component of velocity vector [m/s].	double	1
z	Z component of velocity vector [m/s].	double	1

Table 6-43 Data Type - attitudeListType

Name	Description	Data Type	Cardinality
count	*Length of the attitude list.*	*unsignedInt*	*required*
attitude	Attitude data record. This record contains the attitude quaternions and an angular velocity vector which together describe the attitude state of the platform at the annotated time.	attitudeType	1 .. 1600

Table 6-44 Data Type - attitudeType

Name	Description	Data Type	Cardinality
Time	Timestamp to which attitude data applies [UTC].	timeType	1
q0	Q0 attitude quaternion as extracted from ancillary attitude data.	float	1
q1	Q1 attitude quaternion as extracted from ancillary attitude data.	float	1
q2	Q2 attitude quaternion as extracted from ancillary attitude data.	float	1
q3	Q3 attitude quaternion as extracted from ancillary attitude data.	float	1
wx	X component of angular velocity vector as extracted from ancillary attitude data [degrees/s].	double	1
wy	Y component of angular velocity vector as extracted from ancillary attitude data [degrees/s].	double	1
wz	Z component of angular velocity vector as extracted from ancillary attitude data [degrees/s].	double	1
roll	Platform roll calculated from ancillary attitude data [degrees].	double	1
pitch	Platform pitch calculated from ancillary attitude data [degrees].	double	1
yaw	Platform yaw calculated from ancillary attitude data [degrees].	double	1
pointingStatus	Pointing status as extracted from the ancillary attitude data. Note: The information in this record is reported directly as it is extracted from the downlink and is not interpreted nor used by the IPF.	pointingStatusType	1

Table 6-45 Data Type - pointingStatusType

Name	Description	Data Type	Cardinality
aocsOpMode	AOCS operational mode.	aocsOpModeType	1
rollErrorFlag	Roll error status. Set to false when the roll axis is fine pointed and set to true when the roll axis is degraded.	bool	1

Name	Description	Data Type	Cardinality
pitchErrorFlag	Pitch error status. Set to false when the pitch axis is fine pointed and set to true when the pitch axis is degraded.	bool	1
yawErrorFlag	Yaw error status. Set to false when the yaw axis is fine pointed and set to true when the yaw axis is degraded.	bool	1

Table 6-46 Data Type - rawDataAnalysisListType

Name	Description	Data Type	Cardinality
count	*Number of rawDataAnalysis records within the list.*	*unsignedInt*	*required*
rawDataAnalysis	Raw data analysis information. This record contains data statistics collected from sampling a subset of the raw input data. It contains the values calculated for both the I and Q channels.	rawDataAnalysisType	1 .. 800

Table 6-47 Data Type - rawDataAnalysisType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time at which this set of raw data analysis values apply [UTC].	timeType	1
iBias	Calculated I bias.	double	1
qBias	Calculated Q bias.	double	1
iqQuadratureDeparture	Calculated I/Q quadrature departure.	double	1
iqGainImbalance	Calculated I/Q gain imbalance.	double	1
support	Supporting Raw Data Analysis (RDA) values.	rawDataAnalysisSupportType	1

Table 6-48 Data Type - rawDataAnalysisSupportType

Name	Description	Data Type	Cardinality
iBiasUpperBound	I bias upper bound.	double	1
iBiasLowerBound	I bias lower bound.	double	1
qBiasUpperBound	Q bias upper bound.	double	1
qBiasLowerBound	Q bias lower bound.	double	1
iqGainUpperBound	I/Q gain upper bound.	double	1
iqGainLowerBound	I/Q gain lower bound.	double	1
iqQuadratureDepartureUpperBound	I/Q quadrature departure upper bound.	double	1
iqQuadratureDepartureLowerBound	I/Q quadrature departure lower bound.	double	1
iBiasUsedForCorrection	I channel bias used for correction (may be different from the calculated bias).	double	1
qBiasUsedForCorrection	Q channel bias used for correction (may be different from the calculated bias).	double	1
iqGainImbalanceUsedForCorrection	I/Q gain imbalance used for correction (may be different from the calculated gain).	double	1
iqQuadratureDepartureUsedForCorrection	I/Q quadrature departure used for correction (may be different from the calculated quadrature departure).	double	1

Table 6-49 Data Type - replicaInformationListType

Name	Description	Data Type	Cardinality
count	*Number of replicaInformation records within the list.*	*unsignedInt*	*required*
replicaInformation	Replica information. This record contains information about the reference and reconstructed replicas.	replicaInformationType	1 .. 800

Table 6-50 Data Type - replicaInformationType

Name	Description	Data Type	Cardinality
swath	Swath to which this replica information applies.	swathType	1
referenceReplica	Reference replica record. This record contains information about the reference replica that was used by the IPF during processing.	referenceReplicaType	1
replicaList	Replica list. This element contains a list of the reconstructed replicas created from the calibration pulses extracted from the downlink. The list contains an entry for each calibration packet.	replicaListType	1

Table 6-51 Data Type – referenceReplicaType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time of the calibration packet that the reference replica was created from [UTC].	timeType	1
chirpSource	Source of the reference replica: Nominal or Extracted.	chirpSourceType	1
amplitudeCoefficients	Reference replica amplitude coefficients. This element contains the count attribute number of double precision floating point values separated by spaces.	doubleArray	1
phaseCoefficients	Reference replica phase coefficients. This element contains the count attribute number of double precision floating point values separated by spaces.	doubleArray	1

Table 6-52 Data Type - replicaListType

Name	Description	Data Type	Cardinality
count	*Number of replica records within the list.*	*unsignedInt*	*required*
replica	Chirp replica parameters derived from calibration pulses	replicaType	0 .. 1600

Table 6-53 Data Type - replicaType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time in azimuth at which replica applies [UTC].	timeType	1
crossCorrelationBandwidth	3-dB pulse width of cross-correlation function between the reconstructed replica and the nominal replica [Hz].	double	1
crossCorrelationPslr	Peak side lobe level (PSLR) of cross-correlation function between the reconstructed replica and the nominal replica [dB].	double	1
crossCorrelationIslr	Integrated Side Lobe Ratio (ISLR) of cross-correlation function between the reconstructed replica and the nominal replica [dB].	double	1
crossCorrelationPeakLocation	Peak location of cross-correlation function between the reconstructed replica and the nominal replica [samples].	double	1
reconstructedReplicaValidFlag	Indicates if the cross-correlation bandwidth, PSLR and ISLR of the reconstructed replica are valid, i.e. within the corresponding configured quality thresholds from the auxiliary data. Set to true if valid; or, false otherwise.	bool	1
pgProductAmplitude	Amplitude of the PG product derived from this replica.	double	1
pgProductPhase	Phase of the PG product derived from this replica.	double	1
modelPgProductAmplitude	PG product amplitude value from the input PG product model.	double	1
modelPgProductPhase	PG product phase value from the input PG product model.	double	1
relativePgProductValidFlag	Indicates if the amplitude and phase of the PG product passed relative validation. Set to true if |pgProductAmplitude – meanPgProductAmplitude| < pgAmpStdFractionThreshold * stdDevPgProductAmplitude and |pgProductPhase – meanPgProductPhase| < pgPhaseStdFractionThreshold * stdDevPgProductPhase; or, false otherwise. Where pgAmpStdFractionThreshold and pgPhaseStdFractionThreshold are configured threshold values.	bool	1

Name	Description	Data Type	Cardinality
absolutePgProductValidFlag	Indicates if the amplitude and phase of the PG product passed the absolute validation. Set to true if |pgProductAmplitude – modelPgProductAmplitude| < maxPgAmpErrorThreshold and |pgProductPhase – modelPgProductPhase| < maxPgPhaseErrorThreshold; or, false otherwise. Where maxPgAmpErrorThreshold and maxPgPhaseErrorThreshold are configured threshold values and modelPgProductPhase are values obtained from the PG product model.	bool	1
values	Reconstructed replica values. This vector contains the count attribute number of single precision complex floating point numbers separated by spaces.	complexArray	1

Table 6-54 Data Type - noiseListType

Name	Description	Data Type	Cardinality
count	*Number of noise records within the list.*	*unsignedInt*	*required*
noise	Noise parameters derived from noise packets.	noiseType	0 .. 800

Table 6-55 Data Type - noiseType

Name	Description	Data Type	Cardinality
swath	Swath to which the noise information applies.	swathType	1
azimuthTime	Zero Doppler azimuth time of the noise measurement [UTC].	timeType	1
noisePowerCorrectionFactor	Noise power correction factor.	double	1
numberOfNoiseLines	Number of noise lines used to calculate noise correction factor.	uint32	1

Table 6-56 Data Type - terrainHeightListType

Name	Description	Data Type	Cardinality
count	*Number of terrain height records within the list.*	*unsignedInt*	*required*
terrainHeight	Terrain height record containing the average terrain height (in metres above the ocean surface) for the given zero Doppler azimuth time.	terrainHeightType	1 .. 1600

Table 6-57 Data Type - terrainHeightType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time of terrain height measurement [UTC].	timeType	1
value	Average terrain height above ocean surface [m]. The value is the average height in the range direction for the given zero Doppler azimuth time.	double	1

Table 6-58 Data Type - azimuthFmRateListType

Name	Description	Data Type	Cardinality
count	*Number of azimuthFmRate records within the list.*	*unsignedInt*	*required*
azimuthFmRate	Azimuth FM rate = c0 + c1(tSR - t0) + c2(tSR - t0)2. Where tSR = two way slant range time.	azimuthFmRateType	1 .. 800

Table 6-59 Data Type - azimuthFmRateType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time to which azimuth FM rate parameters apply [UTC].	timeType	1
t0	Two way slant range time origin used for azimuth FM rate calculation [ns].	double	1
c0	Azimuth FM rate coefficient c0 [Hz/s].	double	1
c1	Azimuth FM rate coefficient c1 [Hz/s^2].	double	1
c2	Azimuth FM rate coefficient c2 [Hz/s^3].	double	1

6.3.1.3 Image Annotation Data Set Record

Image annotation data set record. This DSR contains information describing the properties of the image MDS (such as data type and image dimensions) and the key parameters/options used during the processing of the image.

Figure 6-14 presents a graphical view of the structure and content of the image ADSR and the subsequent tables describe the schemas defined in Appendix A2.

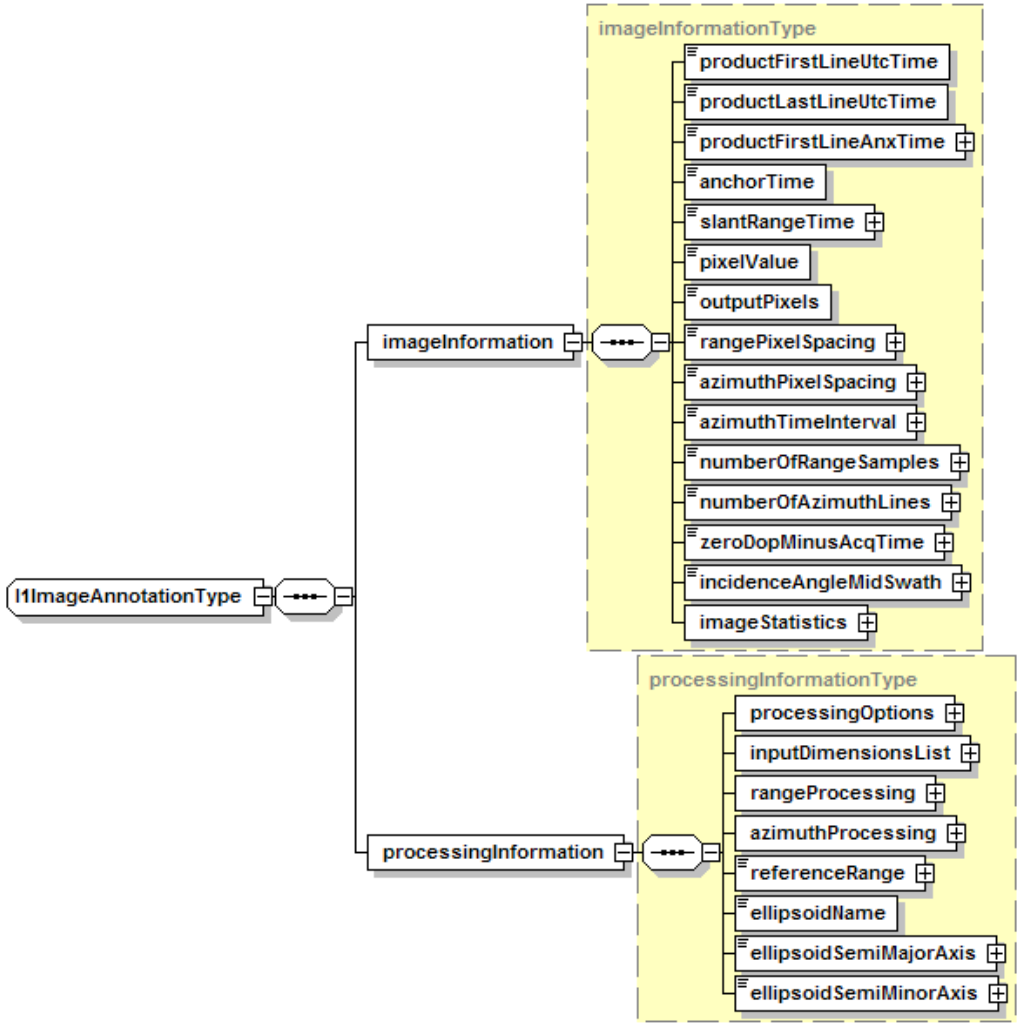


Figure 6-14 L1 Image ADSR

Table 6-60 Data Type - l1ImageAnnotationType

Name	Description	Data Type	Cardinality
imageInformation	Image information. This record contains the elements that describe the properties and characteristics of the image MDS.	imageInformationType	1
processingInformation	Processing information. This record contains information describing the key options and parameters used by the IPF during image processing.	processingInformationType	1

Table 6-61 Data Type - imageInformationType

Name	Description	Data Type	Cardinality
productFirstLineUtcTime	Zero Doppler azimuth time of the first line of the image [UTC].	timeType	1
productLastLineUtcTime	Zero Doppler azimuth time of the line line of the image [UTC].	timeType	1
productFirstLineAnxTime	Zero Doppler azimuth time of the first line of the image relative to the Ascending Node Crossing (ANX) time [s].	double	1
anchorTime	Zero Doppler reference time used for processing [UTC]. If the product is a slice product, this time is at the time of the first slice within a segment and all slices within the segment report the same time value. Otherwise, this time is the same as the productFirstLineUtcTime.	timeType	1
slantRangeTime	Two-way slant range time to first sample [ns].	double	1
pixelValue	Interpretation of the image pixels within the image MDS [Detected or Complex].	pixelValueType	1
outputPixels	Data type of output pixels within the image MDS.	outputPixelsType	1
rangePixelSpacing	Pixel spacing between range samples [m].	uint32	1
azimuthPixelSpacing	Pixel spacing between azimuth lines [m].	uint32	1
azimuthTimeInterval	Time spacing between azimuth lines [s].	double	1
numberOfRangeSamples	Total number of range samples in the output image.	uint32	1

Name	Description	Data Type	Cardinality
numberOfAzimuthLines	Total number of azimuth lines in the output image.	uint32	1
zeroDopMinusAcqTime	Time difference between zero Doppler time and acquisition time of output image lines [s].	double	1
incidenceAngleMidSwath	Incidence angle at mid swath [degrees].	double	1
imageStatistics	Mean and standard deviation statistics for the image. If the pixelValue field is set to Complex, both the real and imaginary parts of the statistics are reported. If the pixelValue field is set to Detected, only the real parts of the statistics are reported	imageStatisticsType	1

Table 6-62 Data Type - imageStatisticsType

Name	Description	Data Type	Cardinality
outputDataMean	Mean value of output data.	complex	1
outputDataStdDev	Standard deviation of output data.	complex	1

Table 6-63 Data Type - processingInformationType

Name	Description	Data Type	Cardinality
processingOptions	Processing options. This record describes the processing options that were used and applied by the IPF during image processing.	processingOptionsType	1
inputDimensionsList	Input dimensions list. This element contains a list of inputDimensions records which describe the number of input range samples and azimuth lines.	inputDimensionsListType	1
rangeProcessing	Range processing information. This record describes the parameters used by the IPF during range processing.	processingParametersType	1
azimuthProcessing	Azimuth processing information. This record describes the parameters used by the IPF during azimuth processing.	processingParametersType	1

Name	Description	Data Type	Cardinality
referenceRange	Range spreading loss reference slant range [m]. The range spreading loss is compensated by amplitude scaling each range sample by 1/Grsl(R) where: Grsl(R) = (rRef/R)$^{1/3}$; and, R = slant range of sample.	double	1
ellipsoidName	Name of the reference ellipsoid used when processing this product.	string	1
ellipsoidSemiMajorAxis	Semi-major axis of ellipsoid [m].	double	1
ellipsoidSemiMinorAxis	Semi-minor axis of ellipsoid [m].	double	1

Table 6-64 Data Type - processingOptionsType

Name	Description	Data Type	Cardinality
rawDataAnalysisUsed	False if correction was done using default parameters, true if correction was done using raw data analysis.	bool	1
orbitDataFileUsed	True if the orbit data used for processing came from an external file, false if the orbit data used for processing came from the downlink.	bool	1
attitudeDataFileUsed	True if the attitude data used for processing came from an external file, false if the attitude data used for processing came from the downlink.	bool	1
antennaElevationCorrectionApplied	False if antenna elevation pattern correction was not applied, true if antenna elevation pattern correction was applied.	bool	1
dcMethod	Doppler centroid estimation method used during processing. Both the DC calculated from orbit geometry and the DC estimated from the raw data are annotated within the Doppler data set; however, this parameter describes the actual DC method used during image processing.	dcMethodType	1
dcInputData	Type of input data used for Doppler centroid estimation.	dcInputDataType	1
rangeSpreadingLossCompensationApplied	False if range spreading loss compensation was not performed, true if range spreading loss compensation was performed.	bool	1
srgrConversionApplied	False if slant range to ground range conversion has not been performed, true if slant range to ground range conversion has been performed.	bool	1

Name	Description	Data Type	Cardinality
detectionPerformed	False if detection has not been performed, true if detection has been performed.	bool	1
thermalNoiseCorrectionPerformed	False if thermal noise correction has not been performed, true if thermal noise correction has been performed.	bool	1
chirpSource	Chirp source used for range compression.	chirpSourceType	1
rrfSpectrum	Spectrum of range replica function used.	rrfSpectrumType	1
applicationLutId	Name of the application scaling LUT applied to compensate for the range spreading loss. Set to "None" if no scaling was applied.	string	1

Table 6-65 Data Type - inputDimensionsListType

Name	Description	Data Type	Cardinality
count	*Number of inputDimensions records within the list.*	*unsignedInt*	*required*
inputDimensions	Input dimensions. This record contains the dimensions of the input data in terms of number of input range samples and input azimuth lines.	inputDimensionsType	1 .. 800

Table 6-66 Data Type - inputDimensionsType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time to which this set of dimensions applies [UTC].	timeType	1
numberOfInputSamples	Number of input range samples for the image or slice.	uint32	1
numberOfInputLines	Number of input azimuth lines for the image or slice.	uint32	1

Table 6-67 Data Type - processingParametersType

Name	Description	Data Type	Cardinality
windowType	Name of the weighting window type used during processing.	weightingWindowType	1
windowCoefficient	Value of the weighting window coefficient used during processing.	double	1
totalBandwidth	Total available bandwidth [Hz].	double	1
processingBandwidth	Bandwidth used during processing [Hz].	double	1
lookBandwidth	Bandwidth for each look used during processing [Hz].	double	1
numberOfLooks	Number of looks.	uint32	1
lookOverlap	Overlap between looks [Hz].	double	1

6.3.1.4 Doppler Centroid Data Set Record

Doppler centroid data set record. This DSR contains information about the Doppler centroid values estimated and used during image processing.

Figure 6-15 presents a graphical view of the structure and content of the image ADSR and the subsequent tables describe the schemas defined in Appendix A2.

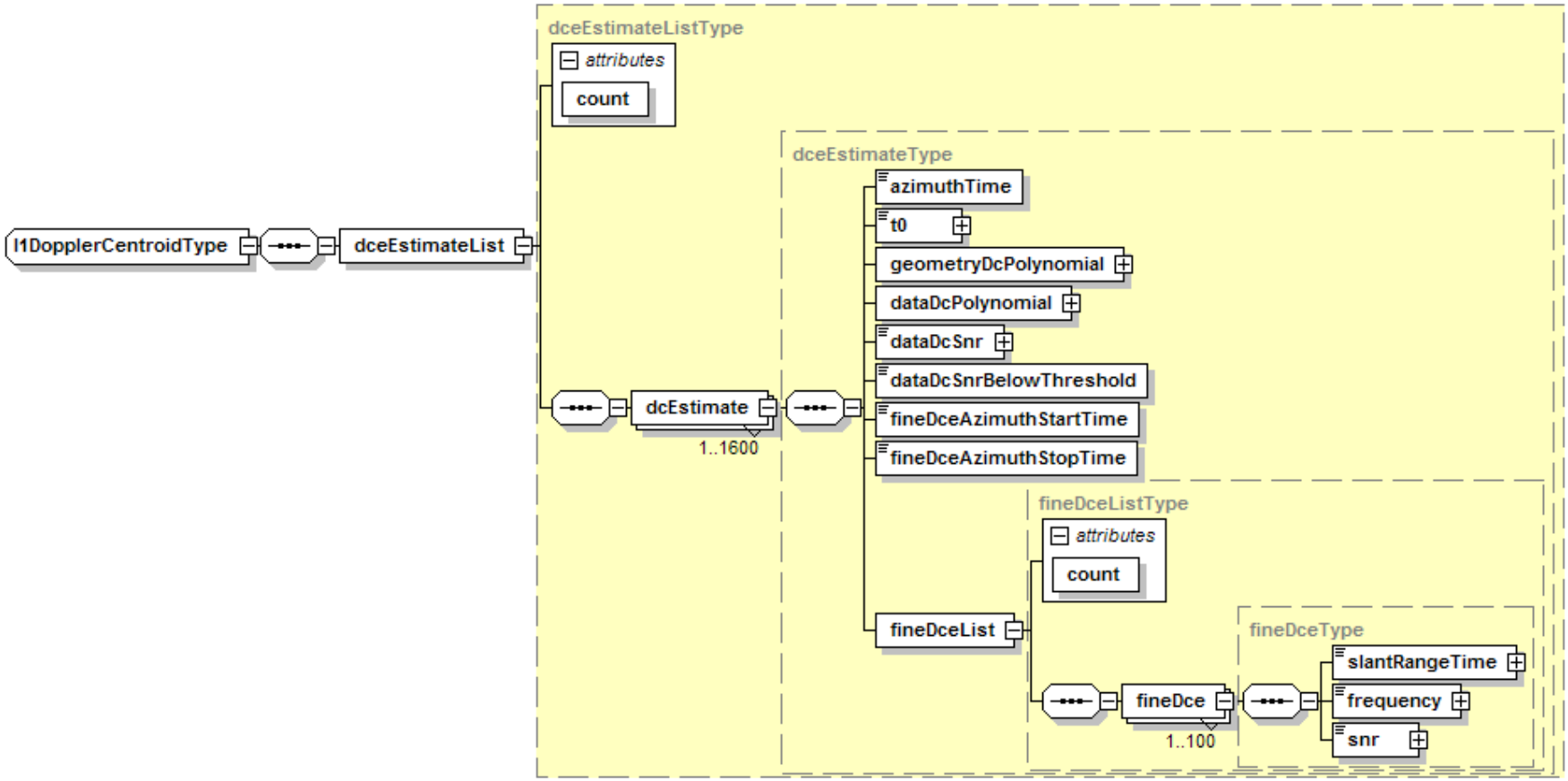


Figure 6-15 L1 Doppler Centroid ADSR

Table 6-68 Data Type - l1DopplerCentroidType

Name	Description	Data Type	Cardinality
dcEstimateList	List of Doppler centroid estimates that have been calculated by the IPF during image processing. The list contains an entry for each Doppler centroid estimate made along azimuth.	dcEstimateListType	1

Table 6-69 Data Type - dceBlockListType

Name	Description	Data Type	Cardinality
count	*Number of dcEstimate records within the list.*	*unsignedInt*	*required*
dcEstimate	Doppler centroid estimate record which contains the Doppler centroid calculated from geometry and estimated from the data, associated signal-to-noise ratio values and indicates which DCE method was used by the IPF during image processing.	dcEstimateType	1 .. 1600

Table 6-70 Data Type - dcEstimateType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time of this Doppler centroid estimate [UTC]. This time represents the centre of the block used to calculate the fune DC estimates used to derive the data DC polynomial.	timeType	1
t0	Two-way slant range time origin for Doppler centroid estimate [ns].	double	1
geometryDcPolynomial	Doppler centroid estimated from orbit, expressed as the following polynomial (assuming 5 coefficients): Doppler Centroid = d0 + d1(tSR-t0) + d2(tSR-t0)^2 + d3(tSR-t0)^3 + d4(tSR-t0)^4, where tSR = 2 way slant range time.	floatArray	1
dataDcPolynomial	Doppler centroid estimated from data, expressed as the following polynomial (assuming 5 coefficients): Doppler Centroid = d0 + d1(tSR-t0) + d2(tSR-t0)^2 + d3(tSR-t0)^3 + d4(tSR-t0)^4, where tSR = 2 way slant range time.	floatArray	1

Name	Description	Data Type	Cardinality
dataDcSnr	The overall signal to noise ratio of the data used to estimate the Doppler centroid. If the Doppler Centroid was not estimated from data, this is set to 0	double	1
dataDcSnrBelowThreshold	False if the overall signal to noise ratio is above or equal to the acceptable threshold for the Doppler centroid estimated from the data. True if the SNR is below the acceptable threshold.	bool	1
fineDceAzimuthStartTime	First zero Doppler azimuth time of the block of signal data used for the fine DC estimates [UTC].	timeType	1
fineDceAzimuthStopTime	Last zero Doppler azimuth time of the block of signal data used for the fine DC estimates [UTC].	timeType	1
fineDceList	List of the fine Doppler centroid estimates for this block. This element is a list of fineDce records which contain the fine Doppler centroid frequencies that were used for fitting the data polynomial for this block.	fineDceListType	1

Table 6-71 Data Type - fineDceListType

Name	Description	Data Type	Cardinality
count	*Number of Doppler centroid estimates in the list.*	*unsignedInt*	*required*
fineDce	Fine Doppler centroid estimate. Each estimate represents the Doppler frequency at the given slant range time within the current block.	fineDceType	1 .. 100

Table 6-72 Data Type - fineDceType

Name	Description	Data Type	Cardinality
slantRangeTime	Two way slant range time to Doppler centroid frequency estimate [ns].	double	1
frequency	Fine Doppler centroid frequency estimate [Hz].	double	1
snr	Signal-to-noise ratio of the data used to derive the fine Doppler centroid frequency estimate.	double	1

6.3.1.5 Antenna Elevation Pattern Data Set Record

Antenna elevation pattern (AEP) data set record. This DSR contains information describing the elevation antenna pattern and how it was applied by the IPF during image processing.

Figure 6-16 presents a graphical view of the structure and content of the Antenna Pattern ADSR and the subsequent tables describe the schemas defined in Appendix A2.

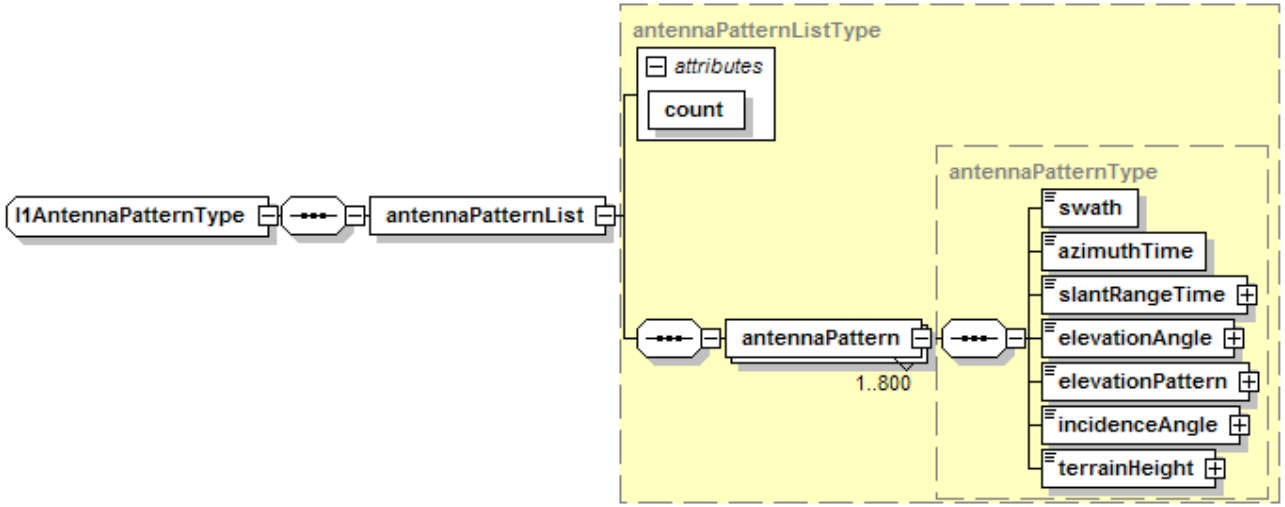


Figure 6-16 L1 Antenna Elevation Pattern ADSR

Table 6-73 Data Type - l1AntennaPatternType

Name	Description	Data Type	Cardinality
antennaPatternList	Antenna pattern list. This element is a list of antennaPattern records that describe the antenna elevation pattern as it is updated in azimuth. The list contains an entry for each AEP update made along azimuth.	antennaPatternListType	1

Table 6-74 Data Type - antennaPatternListType

Name	Description	Data Type	Cardinality
count	*Number of antenna pattern records within the list.*	*unsignedInt*	*required*
antennaPattern	The antenna pattern record describes the antenna elevation pattern at the given zero Doppler azimuth time for a given swath.	antennaPatternType	1 .. 800

Table 6-75 Data Type - antennaPatternType

Name	Description	Data Type	Cardinality
swath	Swath to which the elevation antenna pattern applies.	swathType	1
azimuthTime	Zero Doppler azimuth time at which antenna pattern applies [UTC].	timeType	1
slantRangeTime	Two-way slant range time array for this antenna pattern [ns]. This array contains the count attribute number of double floating point values (i.e. one value per point in the antenna pattern), separated by spaces.	doubleArray	1
elevationAngle	Corresponding elevation angle for this antenna pattern [degrees]. This array contains the count attribute number of double floating point values (i.e. one value per point in the antenna pattern), separated by spaces. This array contains the same number of values as the slantRangeTime array.	floatArray	1

Name	Description	Data Type	Cardinality
elevationPattern	Corresponding two-way antenna elevation pattern value for this point. This array contains the count attribute number of double floating point values (i.e. one value per point in the antenna pattern), separated by spaces. This array contains the same number of values as the slantRangeTime array.	floatArray	1
incidenceAngle	Corresponding incidence angle value for this point. This array contains the count attribute number of double floating point values (i.e. one value per point in the antenna pattern), separated by spaces [degrees]. This array contains the same number of values as the slantRangeTime array.	floatArray	1
terrainHeight	Average terrain height in range for this antenna pattern [m].	double	1

6.3.1.6 Swath Timing Data Set Record

Swath timing data set record. This DSR contains the information about the bursts within the image MDS including the burst dimensions, burst timing and burst location. This DSR is specific to IW and EW SLC products.

Figure 6-17 presents a graphical view of the structure and content of the Swath Timing ADSR and the subsequent tables describe the schemas defined in Appendix A2.

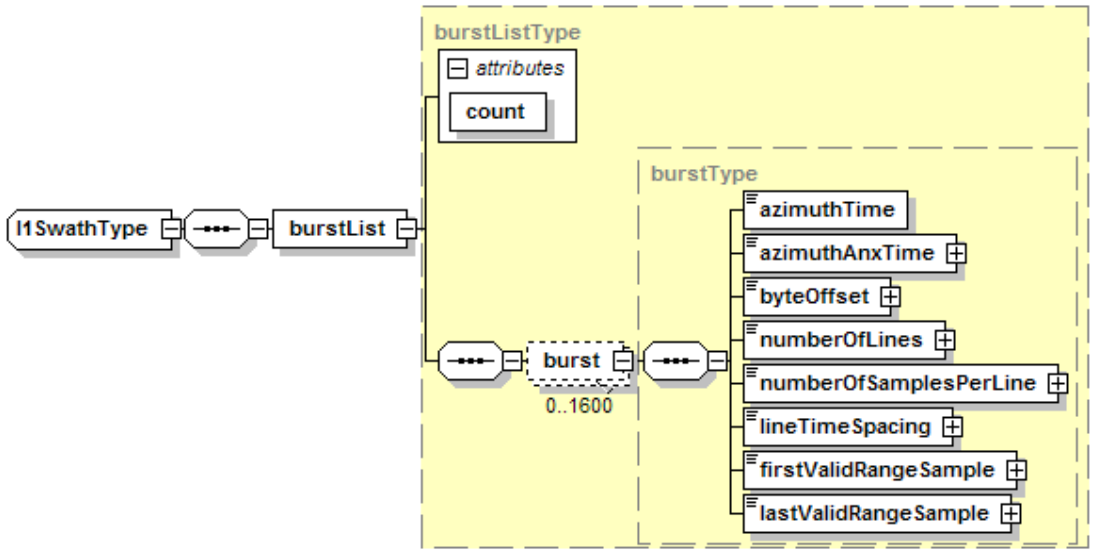


Figure 6-17 L1 Swath Timing ADSR

Table 6-76 Data Type - l1SwathType

Name	Description	Data Type	Cardinality
burstList	Burst list. This element contains a time ordered list of all the bursts within this swath. The list contains a burst record for each burst within this swath. This list is only applicable to IW and EW SLC products and has a length of zero for all others.	burstListType	1

Table 6-77 Data Type - burstListType

Name	Description	Data Type	Cardinality
count	*Number of burst records within the list.*	*unsignedInt*	*required*
burst	Burst table entry. This record contains the information for a single burst entry including the dimensions of the burst, the timing of the burst and where it is located within the image MDS.	burstType	0 .. 1600

Table 6-78 Data Type - burstType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time of the first line of this burst [UTC].	timeType	1
azimuthAnxTime	Zero Doppler azimuth time of the first line of this burst relative to the Ascending Node Crossing (ANX) time. [s].	double	1
byteOffset	Byte offset of this burst within the image MDS.	uint64	1
numberOfLines	Number of lines within this burst.	uint32	1
numberOfSamplesPerLine	Number of samples per line within this burst.	uint32	1
lineTimeSpacing	Time spacing between consecutive lines within this burst [s].	double	1
firstValidRangeSample	An array of integers indicating the offset of the first valid image sample within each range line. This array contains count attribute integers, equal to the numberOfLines field (i.e. one value per range line within the burst), separated by spaces. If a range line does not contain any valid image samples, the integer is set to -1.	intArray	1
lastValidRangeSample	An array of integers indicating the offset of the last valid image sample within each range line. This array contains count attribute integers, equal to the numberOfLines (i.e. one value per range line within the burst), separated by spaces. If a range line does not contain any valid image samples, the integer is set to -1.	intArray	1

6.3.1.7 Geo-location Grid Data Set Record

Geo-location grid data set record. This DSR describes the geodetic position (latitude and longitude) of line/pixel combinations within the image MDS.

Figure 6-18 presents a graphical view of the structure and content of the Geo-location Grid ADSR and the subsequent tables describe the schemas defined in Appendix A2.

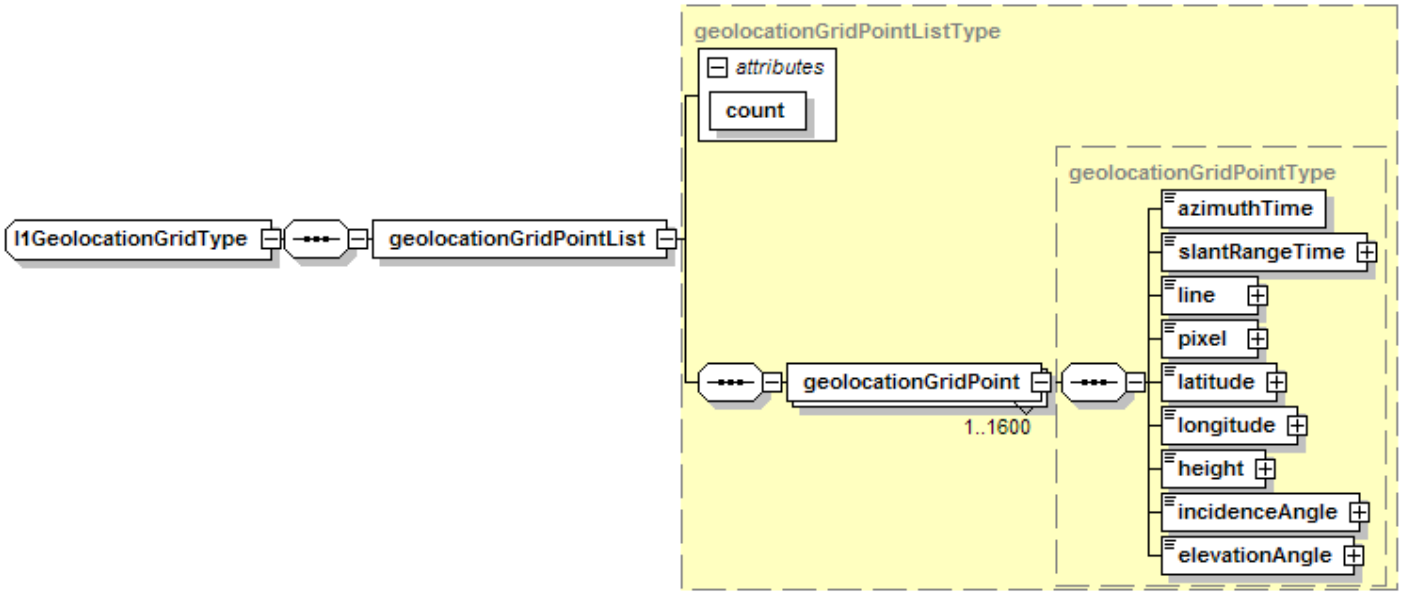


Figure 6-18 L1 Geo-location Grid ADSR

Table 6-79 Data Type - l1GeolocationGridType

Name	Description	Data Type	Cardinality
geolocationGridPointList	Geolocation grid. This element is a list of geolocationGridPoint records which contains grid point entries for each line/pixel combination based on a configured resolution. The list contains an entry for each update made along azimuth.	geolocationGridPointListType	1

Table 6-80 Data Type - geolocationGridPointListType

Name	Description	Data Type	Cardinality
count	*Number of geolocation grid point records within the list.*	*unsignedInt*	*required*
geolocationGridPoint	Geolocation grid point. This record describes geolocation information for a single point (line/pixel combination) within the image MDS.	geolocationGridPointType	1 .. 1600

Table 6-81 Data Type - geolocationGridPointType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time to which grid point applies [UTC].	timeType	1
slantRangeTime	Two way slant range time to grid point [ns].	double	1
line	Reference image MDS line to which this geolocation grid point applies.	uint32	1
pixel	Reference image MDS sample to which this geolocation grid point applies.	uint32	1
latitude	Geodetic latitude of grid point [degrees].	double	1
longitude	Geodetic longitude of grid point [degrees].	double	1
height	Height of the grid point above sea level [m].	double	1
incidenceAngle	Incidence angle to grid point [degrees].	double	1

Name	Description	Data Type	Cardinality
elevationAngle	Elevation angle to grid point [degrees].	double	1

6.3.1.8 Coordinate Conversion Data Set Record

Coordinate conversion data set record. This DSR contains the annotations required to convert pixels within the image MDS between the slant range and ground range coordinate systems.

Figure 6-19 presents a graphical view of the structure and content of the Coordinate Conversion ADSR and the subsequent tables describe the schemas defined in Appendix A2.

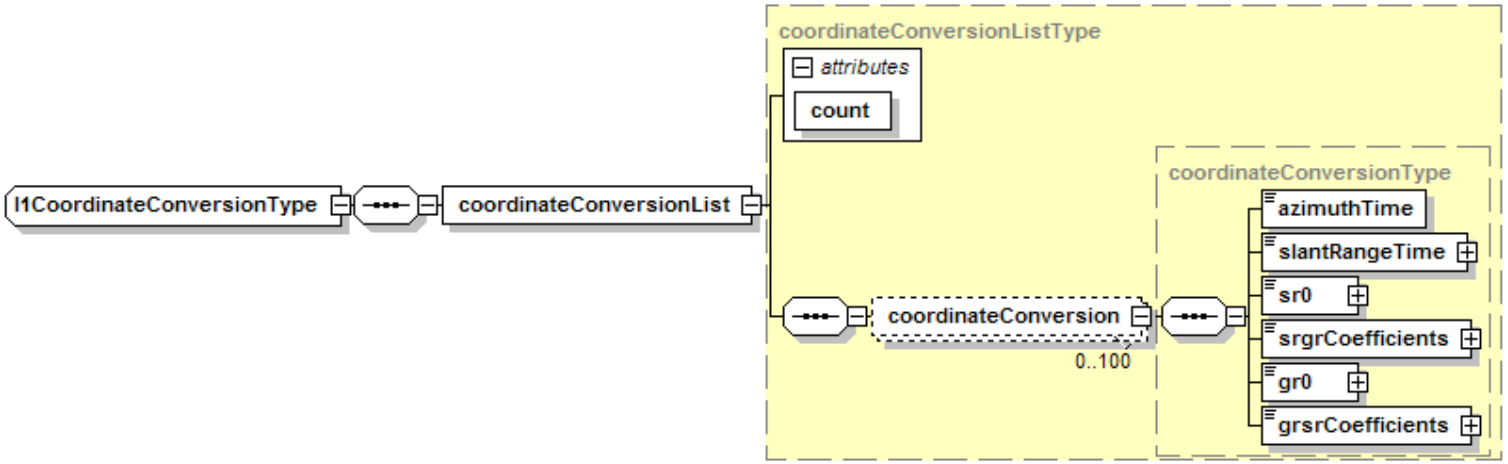


Figure 6-19 L1 Coordinate Conversion ADSR

Table 6-82 Data Type - l1CoordinateConversionType

Name	Description	Data Type	Cardinality
coordinateConversionList	Coordinate conversion list. This element is a list of coordinateConversion records that describe conversion between the slant range and ground range coordinate systems. The list contains an entry for each update made along azimuth. This list applies to and is filled in only for GRD products and therefore has a length of zero for SLC products.	coordinateConversionListType	1

Table 6-83 Data Type - coordinateConversionListType

Name	Description	Data Type	Cardinality
count	*Number of coordinateConversion records within the list.*	*unsignedInt*	*required*
coordinateConversion	The polynomial used to convert image pixels between slant range and ground range. The polynomials are time-stamped with the zero Doppler azimuth and two way slant range times to which they apply. The coefficients used on range lines between updates are found by linear interpolation between the updated and previous values.	coordinateConversionType	0 .. 100

Table 6-84 Data Type - coordinateConversionType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time at which parameters apply [UTC].	timeType	1
slantRangeTime	Two way slant range time to first range sample [ns].	double	1
sr0	Slant range origin used for ground range calculation [m].	double	1
srgrCoefficients	Coefficients to convert from slant range to ground range. Ground range = g0 + g1(sr-sr0) + g2 (sr-sr0)^2 + g3(sr-sr0)^3 + g4(sr-sr0)^4 where sr is the slant range distance to the desired pixel.	doubleArray	1
gr0	Ground range origin used for slant range calculation [m].	double	1

Name	Description	Data Type	Cardinality
grsrCoefficients	Coefficients to convert from ground range to slant range coefficients. Slant range = s0 + s1(gr-gr0) + s2 (gr-gr0)^2 + s3(gr-gr0)^3 + s4(gr-gr0)^4 where gr is the ground range distance to the desired pixel.	doubleArray	1

6.3.1.9 Swath Merging Data Set Record

Swath merging data set record. This DSR contains the annotations for interpreting the way in which IW or EW swaths were merged during GRD processing. The purpose of this DSR is to provide the information necessary to unambiguously identify the boundaries of each swath within the image MDS.

Figure 6-20 presents a graphical view of the structure and content of the Swath Merging ADSR and the subsequent tables describe the schemas defined in Appendix A2. At the end of this section, Figure 6-21 illustrates what the swath merging annotations may look like for two possible scenarios. The simple case is one in which the optimal range cut line is constant for all swaths and does not change over the azimuth extent of the image and the more complex case is one in which the optimal range cut line varies for all swaths and is updated multiple times over the azimuth extent of the image. Note that in the complex case, the identification of the IW2 and IW3 swaths are not explicitly shown to simplify the presentation of the graph.

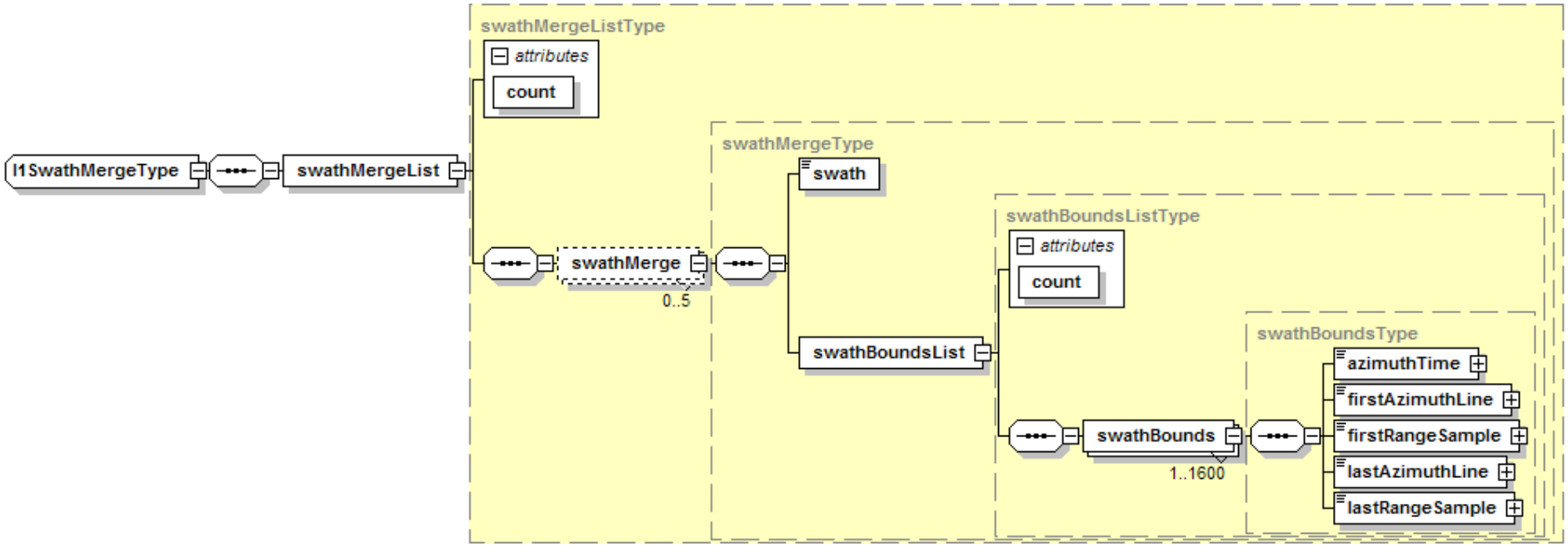


Figure 6-20 L1 Swath Merging ADSR

Table 6-85 Data Type - l1SwathMergeType

Name	Description	Data Type	Cardinality
swathMergeList	Merge information for IW and EW GRD products. This list contains one record per swath.	swathMergeListType	1

Table 6-86 Data Type - swathMergeListType

Name	Description	Data Type	Cardinality
count	*Number of swathMerge records within the list.*	*unsignedInt*	*required*
swathMerge	This record contains the information needed to identify where each burst of the given swath was merged within the image MDS.	swathMergeType	0 .. 5

Table 6-87 Data Type - swathMergeType

Name	Description	Data Type	Cardinality
swath	Swath to which swath merging information applies	swathType	1
swathBoundsList	This record contains the information needed to identify where each burst within the current swath was merged within the image MDS.	swathBoundsListType	1 .. 5

Table 6-88 Data Type - swathBoundsListType

Name	Description	Data Type	Cardinality
count	*Number of swath bounds records within the list.*	*unsignedInt*	*required*
swathBounds	Swath boundary record. This record contains the information needed to identify the position of the swath within the image. The swath boundary is identified by a rectangular area defined by the points (firstRangeSample,firstAzimuthLine) and (lastRangeSample,lastAzimuthLine). The optimal range cut line can vary in azimuth and so a new record is included for each swath boundary update in azimuth. It is important to note that the information on the azimuth cut line is lost and not represented by these annotations. Although a line in azimuth is implicitly created by each bounding box, this does not necessarily represent the azimuth cut line used during swath merging.	swathBoundsType	1 .. 1600

Table 6-89 Data Type - swathBoundsType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time of firstAzimuthLine [UTC].	timeType	1
firstAzimuthLine	First azimuth line of the swath boundary [lines]. This point represents the azimuth origin of the swath boundary..	uint32	1
firstRangeSample	First range sample of the swath boundary [samples]. This point represents the range origin of the swath boundary.	uint32	1
lastAzimuthLine	Last azimuth line of the swath boundary [lines]. Relative to the firstAzimuthLine, this point represents the azimuth extent of the swath boundary.	uint32	1
lastRangeSample	Last range sample of the swath boundary [samples]. Relative to the firstRangeSample, this point represents the range extent of the swath boundary.	uint32	1

The annotations for the simple case in the graph below contain a single swathBoundsType entry for each swath that represents a bounding box covering the entire azimuth extent of the image. The annotations in the complex case contain multiple swathBoundsType entries for each swath – 4, 6 and 3 for IW1, IW2 and IW3 respectively – that collectively describe the location of the swaths within the image. To identify the applicable set of annotations for each bounding box the notation $iwM(n)_y^x$ is used where M is the swath number – 1, 2 or 3, n is the index of the swathBoundsType annotation increasing as the optimal range cut line changes in azimuth and the superscript/subscript pair *x*/*y* describes a point in the image defined by (firstRangeSample,firstAzimuthLine) or (lastRangeSample,lastAzimuthLine).

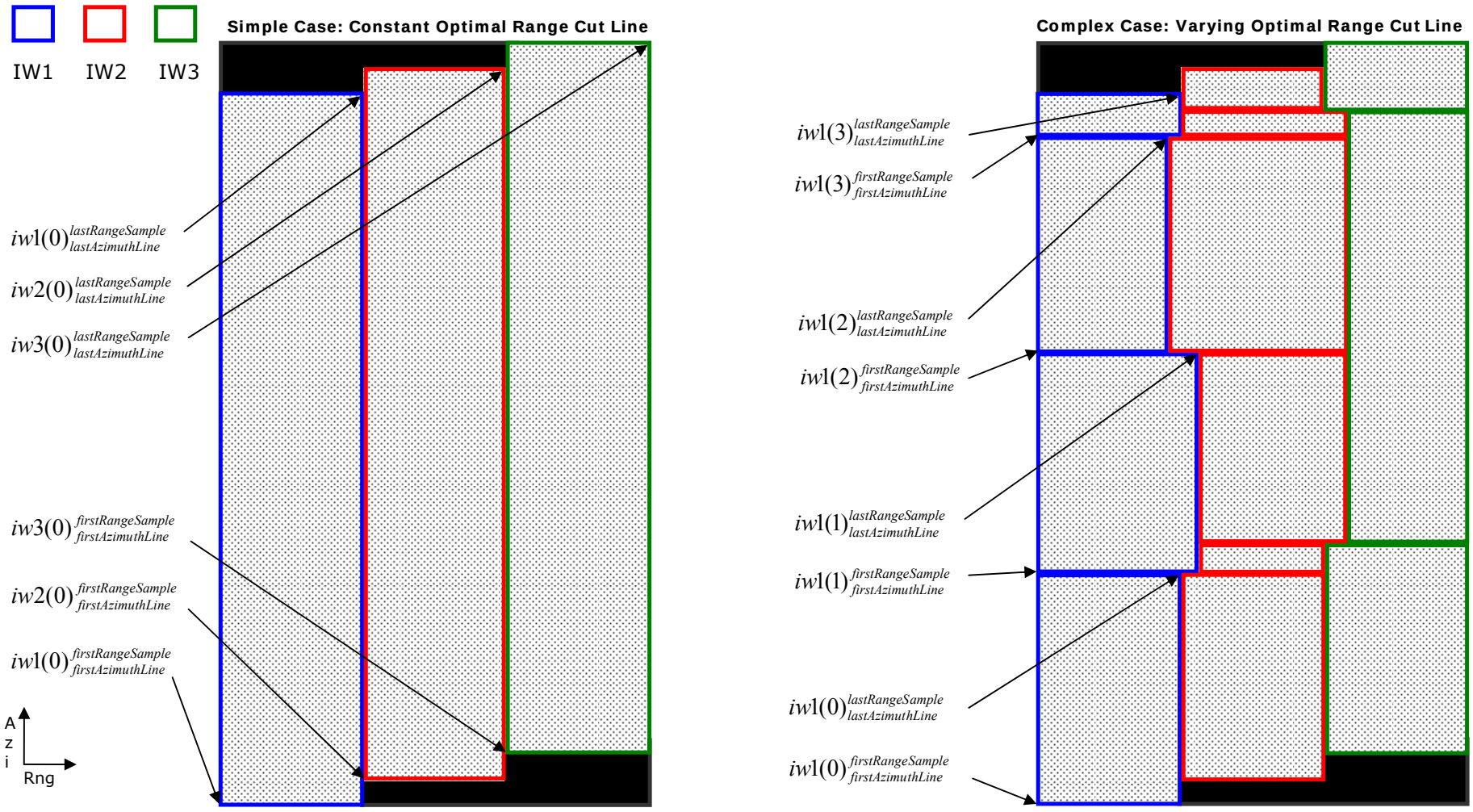


Figure 6-21 Swath Merging

6.3.2 L1 Calibration Annotation Data Set

The L1 Calibration ADS provides four calibration LUTs with every product. Applying any of these tables undoes the application output scaling introduced by the processor and scales the image to achieve the desired type of absolute calibration, notably:

Three of these LUTs allow one to convert the digital numbers in the image MDS into β^0, σ^0 or γ radiometrically calibrated imagery – depending on which LUT is used – by applying a range dependent gain (and a constant offset in the GRD case) to the image data. Note that in order to achieve the desired calibration the external calibration factor K_{ext} (externalCalibrationScalingFactor), has also been built into these tables. The fourth LUT, the *dn* LUT allows one to recover the original DN value that the image had before the scaling by the application LUT (therefore the *dn* LUT does not include the external calibration factor K_{ext}).

In order to convert the DN of a given range pixel *i* in a Sentinel-1 SAR image to a calibrated value or the original DN, the user has to apply one of the following formulae:

- For SLC products: $value(i) = \dfrac{|DN_i|^2}{A_i^2}$
- For GRD products: $value(i) = \dfrac{(DN_i^2 + b)}{A_i}$

where, depending on the selected LUT:

$value(i)$ = one of $\beta^0{}_i$, $\sigma^0{}_i$ or γ_i or $originalDN_i$.

A_i = one of $betaNought(i)$, $sigmaNought(i)$, $gamma(i)$ or $dn(i)$

b = constant offset.

For any pixel *i* that falls between points in the LUT the value is found by bilinear interpolation.

Figure 6-22 presents a graphical view of the structure and content of the L1 Calibration LUT Data Set and the subsequent tables describe the schemas defined in Appendix A3.

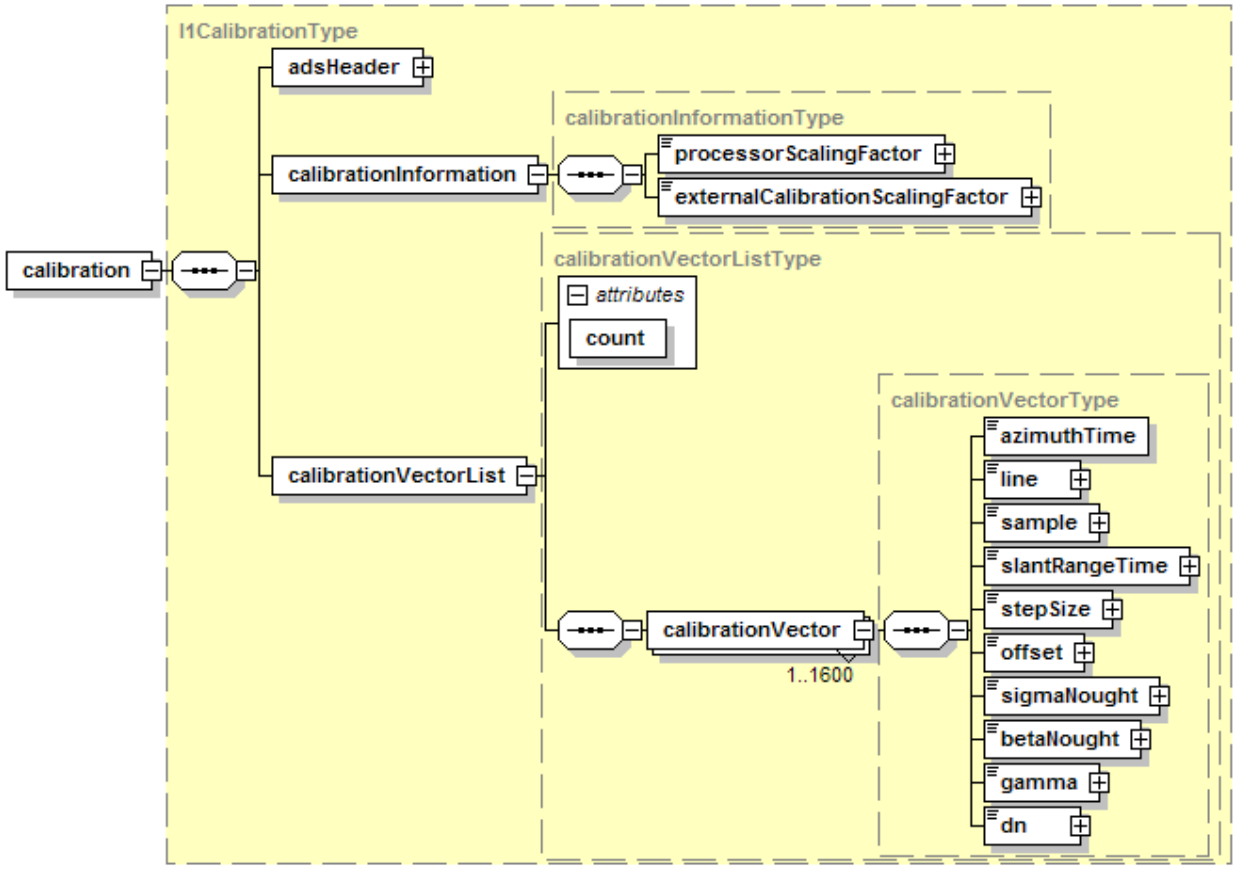


Figure 6-22 L1 Calibration Data Set

Table 6-90 Element - calibration

Name	Description	Data Type	Cardinality
adsHeader	ADS header data set record. This DSR contains information that applies to the entire data set.	adsHeaderType	1
calibrationInformation	Calibration information. This DSR holds parameters applicable to the image calibration.	calibrationInformationType	1
calibrationVectorList	Calibration vector list. This element is a list of calibrationVector records that contain the absolute calibration vectors required to derive radiometrically calibrated imagery from the image MDS. The list contains an entry for each update made along azimuth.	calibrationVectorListType	1

Table 6-91 Data Type - calibrationInformationType

Name	Description	Data Type	Cardinality
processorScalingFactor	Processor scaling factor. This value comes from the auxiliary input and is applied multiplicatively to the image data during processing.	double	1
externalCalibrationScalingFactor	Swath dependent external calibration scaling factor (K_{ext}). This value comes from the auxiliary input and is built in to the absolute calibration vectors sigmaNought, betaNought and gamma.	double	1

Table 6-92 Data Type - calibrationVectorListType

Name	Description	Data Type	Cardinality
count	*Number of calibrationVector records within the list.*	*unsignedInt*	*required*
calibrationVector	Calibration vector record. This record holds the calibration vectors and associated fields required to derive radiometrically calibrated imagery from the image MDS.	calibrationVectorType	1 .. 1600

Table 6-93 Data Type - calibrationVectorType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time at which calibration vector applies.	timeType	1
line	Reference range line.	uint32	1
sample	Reference range sample.	uint32	1
slantRangeTime	Two-way slant range time [ns] array for these calibration vectors. This array contains the count attribute number of double floating point values (i.e. one value per point in the calibration vectors), separated by spaces.	doubleArray	1
stepSize	Number of range samples between each value in the vector.	uint32	1
offset	Constant offset. For SLC products this field does not apply and should be ignored.	double	1
sigmaNought	Sigma nought calibration vector. This array contains the count attribute number of floating point values for SLC or integer values for GRD (i.e. one value per point in the calibration vector), separated by spaces. This vector contains the same number of points as the slantRangeTime vector.	floatArray	1
betaNought	Beta nought calibration vector. This array contains the count attribute number of floating point values for SLC or integer values for GRD (i.e. one value per point in the calibration vector), separated by spaces. This vector contains the same number of points as the slantRangeTime vector.	floatArray	1
gamma	Gamma calibration vector. This array contains the count attribute number of floating point values for SLC or integer values for GRD (i.e. one value per point in the calibration vector), separated by spaces. This vector contains the same number of points as the slantRangeTime vector.	floatArray	1
dn	Digital number calibration vector. This array contains the count attribute number of floating point values for SLC or integer values for GRD (i.e. one value per point in the DN vector), separated by spaces. This vector contains the same number of points as the slantRangeTime vector.	floatArray	1

6.3.3 L1 Noise Annotation Data Set

The L1 Noise ADS provides a LUT – with values provided in linear power – that can be used to derive calibrated noise profiles which match the calibrated GRD data.

More specifically, in order to convert the values provided in the noise LUT to β^0, σ^0 or γ calibrated noise or to the noise estimated by the IPF during SLC processing, the noise LUT must be scaled by the corresponding calibration LUT (β^0, σ^0 or γ or dn, respectively):

$$noise(i) = \frac{\eta_i}{A_i}$$

where, depending on the LUT selected to calibrate the image data:

$noise(i)$ = calibrated noise profile for one of $\beta^0{}_i$, $\sigma^0{}_i$ or γ_i or $originalDN_i$

η_i = $noiseLut(i)$

A_i = one of $betaNought(i)$, $sigmaNought(i)$, $gamma(i)$, $dn(i)$

Once the calibrated noise profile has been obtained as above, the noise can be removed from the GRD data by subtraction.

It is also possible to obtain calibrated data and remove the estimated noise in one step by considering the subtraction of the noise in the formula described in 6.3.2 as follows:

$$value(i) = \frac{(DN_i{}^2 + b - \eta_i)}{A_i}$$

For any pixel *i* that falls between points in the LUT the value is found by bilinear interpolation.

Figure 6-23 presents a graphical view of the structure and content of the L1 Noise LUT Data Set and the subsequent tables describe the schemas defined in Appendix A4.

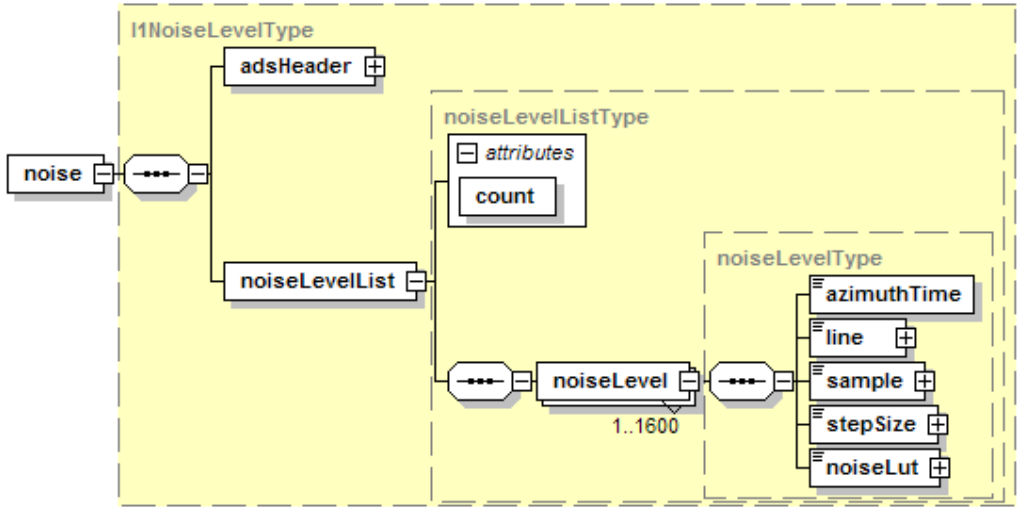


Figure 6-23 L1 Noise LUT Data Set

Table 6-94 Element - noise

Name	Description	Data Type	Cardinality
adsHeader	ADS header data set record. This DSR contains information that applies to the entire data set.	adsHeaderType	1
noiseLevelList	Noise level list. This element is a list of noiseLevel records that contain the thermal noise estimation for the image MDS. The list contains an entry for each update made along azimuth.	noiseLevelListType	1

Table 6-95 Data Type - noiseLevelListType

Name	Description	Data Type	Cardinality
count	*Number of noiseLevel records within the list.*	*unsignedInt*	*required*
noiseLevel	Noise level. This record contains the thermal noise estimation annotations which can be used to remove or reinstate thermal noise from the image.	noiseLevelType	1 .. 1600

Table 6-96 Data Type - noiseLevelType

Name	Description	Data Type	Cardinality
azimuthTime	Zero Doppler azimuth time at which noise vector applies.	timeType	1
line	Reference range line.	uint32	1
sample	Reference range sample.	uint32	1
stepSize	Number of range samples between each value in the vector.	uint32	1
noiseLut	Thermal noise correction vector power values. This array contains the count attribute number of integer values (i.e. one value per point in the correction vector), separated by spaces.	intArray	1

6.3.4 Map Overlay Annotation Data Set

The map overlay data set is a Keyhole Markup Language (KML) file [R-10] that describes the product coverage area and is suitable for viewing in any application that supports KML. Figure 6-24 shows a graphical example of the map overlay in which the composite Quick-look image from Section 6.2.2 is geo-referenced and displayed as an overlay in Google Earth.

The map overlay data set contains the KML elements required to select the product's Quick-look image, position it on the map and display it. Figure 6-25 presents a graphical view of the XML structure of the map overlay data set and the content and structure are presented in the subsequent tables. Note that data types in the following tables that are prefixed with "kml:" are part of the KML specification [R-10] and types prefixed with "gx:" are part of the Google extensions to KML [R-13].

Figure 6-24 Sentinel-1 Map Overlay Displayed in Google Earth

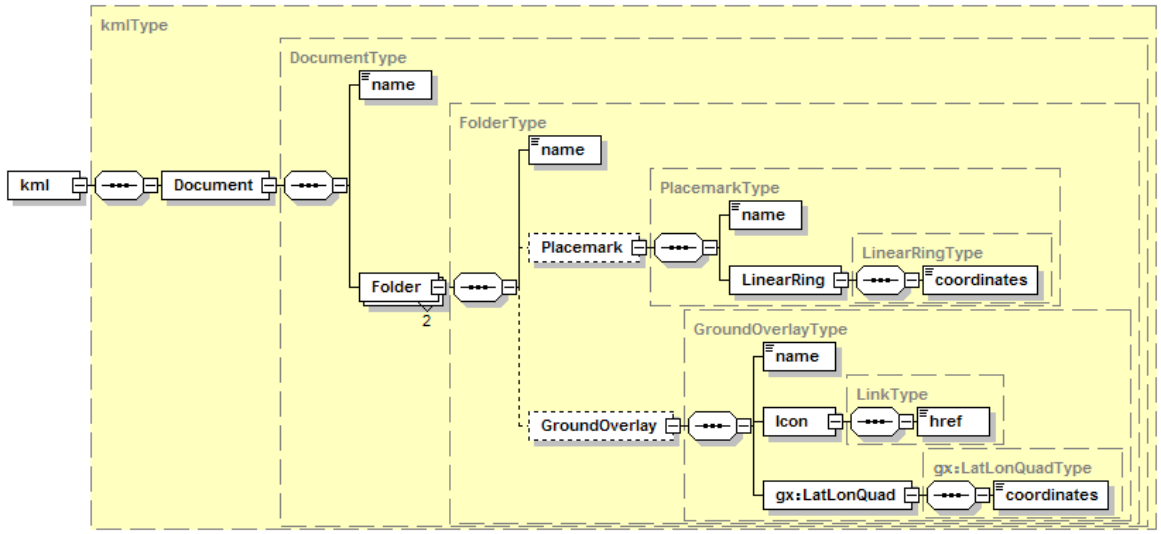


Figure 6-25 Map Overlay Annotation Data Set

Table 6-97 Root element - kml

Name	Description	Data Type	Cardinality
Document	Document container for KML components.	kml:DocumentType	1

Table 6-98 Data Type – kml:DocumentType

Name	Description	Data Type	Cardinality
name	Name of the document.	string	1
Folder	There shall always be one Folder element dedicated to the Placemark element which describes the boundaries of the scene using a set of coordinates. In addition there may optionally be one Folder element dedicated to the GroundOverlay element which describes how to overlay an image on a map.	kml:FolderType	1 .. 2

Table 6-99 Data Type – kml:FolderType

Name	Description	Data Type	Cardinality
name	Name of the folder.	string	1
Placemark	Contains the parameters required to display a rectangular bounding box for the scene.	kml:PlacemarkType	1
GroundOverlay	Contains the parameters required to select the overlay image and position it on the map.	kml:GroundOverlayType	1

Table 6-100 Data Type - kml:GroundOverlayType

Name	Description	Data Type	Cardinality
name	A descriptive name for the map overlay. This will typically be set to the name of the product folder.	string	1
Icon	This structure describes the properties of the image used on the map overlay.	kml:LinkType	1
gx:LatLonQuad	Contains the latitude and longitude and height coordinates used to position the image overlay on the map.	gx:LatLonQuadType	1

Table 6-101 Data Type - kml:LinkType

Name	Description	Data Type	Cardinality
href	A local file specification or URL used to load the desired image and overlay it on the map.	string	1

Table 6-102 Data Type - gx:LatLonQuadType

Name	Description	Data Type	Cardinality
coordinates	A string of 4 lon, lat, height coordinate triples which describe a rectangular region. The string is of the form: lon,lat,height lon, lat, height lon, lat, height lon, lat, height The coordinates must appear in the following order: South-West corner, South-East corner, North-East corner, North-West corner.	string	1

6.3.5 Product Preview Annotation Data Set

The Product Preview is a Hypertext Markup Language (HTML) file that presents a graphical overview of the product through use of the Quick-look MDS and provides access to the data sets within the product through a simple user interface of HTML hyperlinks to the product files on the local file system. The Product Preview ADS is formatted using an XML style sheet which may be modified to refine the look of the HTML page, and so the ADS may evolve over time. Figure 6-26 shows an example of what the Product Preview might look like and Table 6-103 lists the content included in the product preview ADS.

S1A_S5_SLC__1FDH_20100530T083956_20100530T084006_003841_001A2D_B1E7.SAFE

manifest.safe

annotation

s1a-s5-slc-hh-20100530t083956-20100530t084006-003841-001a2d-001.xml

s1a-s5-slc-hv-20100530t083956-20100530t084006-003841-001a2d-002.xml

calibration

lut-calibration-s1a-s5-slc-hh-20100530t083956-20100530t084006-003841-001a2d-001.xml

lut-calibration-s1a-s5-slc-hv-20100530t083956-20100530t084006-003841-001a2d-002.xml

lut-noise-s1a-s5-slc-hh-20100530t083956-20100530t084006-003841-001a2d-001.xml

lut-noise-s1a-s5-slc-hv-20100530t083956-20100530t084006-003841-001a2d-002.xml

measurement

s1a-s5-slc-hh-20100530t083956-20100530t084006-003841-001a2d-001.tiff

s1a-s5-slc-hv-20100530t083956-20100530t084006-003841-001a2d-002.tiff

preview

map-overlay.kml

product-preview.html

quick-look.png

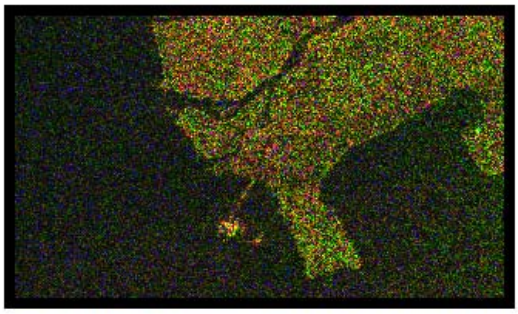
support

s1-level-1-calibration.xsd

s1-level-1-noise.xsd

s1-level-1-product.xsd

s1-object-types.xsd



Quick Look Image

Figure 6-26 Example Product Preview ADS

Table 6-103 Contents of the Product Preview ADS

Element	Description	Inclusion Criteria
Header Graphic	The Product Preview ADS should include a header graphic. This element is an image that is meaningful to or identifies the organisation that created the product or for which the product was created. The graphic may include any generally relevant imagery and more specific items such as company logos and copyright notices.	Optional
Product Name	The Product Preview ADS shall include a field which identifies the name of the product to which this ADS applies	Mandatory
Manifest	The Product Preview ADS shall include an accessible link to the product manifest file on the local file system.	Mandatory
Annotations	The Product Preview ADS shall include an accessible link to each and every annotation data set file within the product on the local file system.	Mandatory
Measurement	The Product Preview ADS shall include an accessible link to each and every measurement data set file within the product on the local file system.	Mandatory
Support	The Product Preview ADS should include an accessible link to each and every representation data set file (schema) within the product on the local file system.	Optional
Quick-look image	The Product Preview ADS shall include the Quick-look image to display as a reference for the product.	Optional

A XML SCHEMAS

A1 SENTINEL-1 OBJECT TYPES SCHEMA

Defines the primitive data types used by the Sentinel-1 product schemas.

See attached file “s1-object-types.xsd”

A2 SENTINEL-1 L1 PRODUCT ANNOTATION SCHEMA

Defines the Sentinel-1 L1 Product Annotation Data Set

See attached file “s1-level-1-product.xsd”

A3 SENTINEL-1 L1 CALIBRATION SCHEMA

Defines the Sentinel-1 L1 Calibration Data Set

See attached file “s1-level-1-calibration.xsd”

A4 SENTINEL-1 L1 NOISE SCHEMA

Defines the Sentinel-1 L1 Noise Data Set

See attached file “s1-level-1-noise.xsd”