	

Title: MAPP Input Output Data Definition

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1	4	19.02.2001	1) HDF Group GeophysicalData → SceneData 2) HDF Group TiePoints → TiePointData 3) HDF Global Attr.: Num<*name*>s → <*name*>Count 4) geophysical variable → geophysical parameter
1	5	01.03.2001	1) Changed **ENVISAT1** → **ENVISAT** in product type IDs 2) Changed some filename patterns and dataset names for output products 3) MERIS_FLAGS is now part of a standard flags dataset QualityFlags (bits 1-8)
1	6	11.04.2001	Added more global attributes for l2 and l3: **ProcessorPlugIn**<X> and **AuxData**<X>.
1	7	13.07.2001	Updated ESA/MERIS product info Updated L2/L3 product sizes
1	8	11.10.2001	Fixed error in L2-NDVI flags description
1	9	05.12.2001	Updated specifications for L3 cloud products
1	10	14.04.2003	Updated MERIS flags to be copied to VA products, processor configuration and request file format
1	11	20.08.2003	Updated processor configuration, New IIF keywords, new processor mode
1	12	08.10.2004	Updated product types. Described new L3 processor algorithm. Added flags for RWC_PCI algorithm.
1	13	08.11.2004	Updated dataset names for L3 water constituents products. Updated all product types according to DLR specification.
1	14	17.11.2004	Corrected corner coordinates for L3 products. Corrected location of Neustrelitz receiving station.
1	15	24.06.2005	Added invalidPixelValue parameter to L3 processing request

1	16	21.11.2005	Updated specifications of AER, RWC_RTM and RWC_PCI products
1	17	06.01.2006	Corrected typographic errors
1	18	08.08.2006	Clarified description of Level 3 product keys

Table of Contents

1 Introduction

1.1 Purpose

Within the ENVISAT mission of ESA, the MERIS instrument will provide images of the earth and its atmosphere with a high degree of spatial and spectral accuracy. The MERIS-VA processors are designed to generate higher level geophysical products based on standard ESA products of the MERIS instrument. These include level 2 and level 3 products providing regionalized geophysical parameters such as

- water constituents,
- cloud parameters,
- water vapour content,
- aerosol concentration and
- land coverage classification.

The purpose of this document is to present and describe the input and output data of the MERIS-VA processors. This document shall also be used as a reference by software developers for the implementation of the processor output products.

1.2 Scope

This document describes the MERIS-VA level 2 and level 3 input and output data. It is applicable in particular to the

MERIS-VA Level 2 and Level 3 output products

Auxiliary datasets for the MERIS-VA Level 2 Processor

Validation datasets for the MERIS-VA Level 2 Plug-Ins (AIT)

This document does not describe the algorithms used to generate the MERIS-VA output products. This is subject to the MAPP ATBDs [R-{TBD}]. Also the input products for the MERIS-VA Level 2 processor, the standard ESA Level 1B and Level 2 products, are not described here. Complete documentation for the standard ESA MERIS products can be found in [R-1][R-2][R-3].

1.3 Guide

Chapter 2 gives the background for a better understanding of the material described in this document.

Chapter 3 describes the I/O of the MERIS-VA level 2 processors.

Chapter 4 describes the I/O of the MERIS-VA level 3 processors.

Chapter 5 is an appendix containing more general details of the MERIS-VA I/O.

1.4 References

Ref.	*Document Title*	*Document ID*	*Source*
[R-1]	ENVISAT-1 Product Format Guidelines	PO-TN-ESA-GS-0242	ESA
[R-2]	ENVISAT-1 Product Definition	PO-TN-ESA-GS-0231	ESA
[R-3]	ENVISAT-1 Product Specifications	PO-RS-MDA-GS-2009	ESA
[R-4]	MERIS Input/Output Data Definition	PO-TN-MEL-GS-0003	ESA
[R-5]	HDF 5 User Guide	H5-R12.UG	NCSA
[R-6]	HDF 5 Reference Manual	H5-R12.RM	NCSA
[R-7]	MAPP Algorithm Theoretical Base Documentation	MAPP-ATBD	BC

[R-8]	BC Neural Network Interface Definition	BC-NNID-01	BC
[R-9]	ENVISAT-1 PDS Specification {TBC}	{TBD}	ESA
[R-10]	DIMS / IIF Specification {TBC : Does this exist?}	{TBD}	DLR
[R-11]	"Level 3 SeaWiFS Data Products: Spatial and Temporal Binning Algorithms" J.W.Campbell, J.M. Blasidell, and M.Darzi , NASA Technical Memorandum 104566, Vol.32.		NASA

1.5 Abbreviations

ANSI	American National Standards Institute
DIMS	Data and Informaton Management System
ESA	European Space Agency
HDF	Hierarchical Data Format
IIF	Item Information File (DIMS Context)
IODD	Input Output Data Definition
MAPP	MERIS Application and regional Products Project
MERIS	Medium Resolution Imaging Spectrometer
MERIS-VA	MERIS – Value Added
MVAT	MERIS-VA Taylor. Please note that this abbreviation is used for this document only.
PCD	Product Confidence Data
PL	Product Library (DIMS Context)
PSM	Processing Management System (DIMS Context)
QC	Quality Control
S/W	Software
TBD	To be defined (shall not appear in this document in it's final version)
TBC	To be confirmed
MERIS-SAG	Science Advisory Group for MERIS

1.6 Definitions

Scene	A geographical region at a given time.
Image	A rectangular grid of *pixels*. Images are composed of one or more *bands* having equal grids.
Band	A rectangular grid of *samples*.
Pixel	The set of the *samples* of all *bands* contained in an *image* at a given grid position.
Sample	A numeric value as part of a *band* at a given grid position.
Sampling	The spatial or spectral step at which data is provided in a scene.

{ TODO: add picture here showing band, sample, pixel & scene }

1.7 Notations

Item	*Notation Examples*
Operator level identifiers such as processing parameters or parameters in configuration files:	**ENVISAT.MERIS.L2-NDVI** **GridGranularity**
Names of variables visible to end users, e.g. such as names of attributes and datasets in HDF product files.	**CloudTopPressure** **QualityFlags**
Values of variables visible to end users, e.g. such as values of attributes.	**"MERIS-VA L2"** **52.6434**
Filenames and -pathes:	*/usr/local/meris_va-1.0/bin* *readme.txt*

Command line in- and outputs, program source code or configuration file snipplets. Software identifiers such as names of variables, functions and methods:	`mkdir temp`
	
	`LogLevel = DEBUG`
	
	`void addItem(Item item) {`
	`  m_items.add(item);`
	`}`

1.8 Data Types

Table 1-1: Data types used in this document

Data Type	*Description*
Byte	Unsigned integer number with 8 bits
int<n>	Signed integer number with n = 8, 16 or 32 bits
uint<n>	Unsigned integer number with n = 8, 16 or 32 bits
Float<n>	IEEE floating point number with n = 32 or 64 bits.
string	ASCII character sequence. A character is represented by a 8-bit unsigned integer.
Date	ASCII character sequence representing a date. The format is *"<year>-<month>-<day>T<hour>:<min>:<sec>"* with *<year>* the year in 4 digits *<month>* the month in 2 digits, range **01** to **12** *<day>* the day of the month in 2 digits, range **01** to **31** *<hour>* the hour of the day in 2 digits, range **00** to **23** *<min>* the minutes of the hour in 2 digits, range **00** to **59** *<sec>* the seconds of the minute as a floating point number, range **00** to **60**

2 Background

This chapter gives an overview about the ENVISAT mission, the MAPP project and the MERIS-VA processing systems. It ends with a description of the dataflow in each processing system to make it easy to locate the data input and output within the MERIS-VA system boundaries.

2.1 The ENVISAT Mission

General Note: The information in this chapter has been overtaken without any changes from the MERIS Input Output Data Definition Document (MERIS-IODD-01). For complete information refer to [R-{TBD}].

The ENVISAT-1 mission objectives and payload are described in [R-10]. The main characteristics of the orbit are recalled in Table 2-1 below.

Table 2-1: ENVISAT orbit characteristics

Semi-Major Axis	7159.5 km
Eccentricity	0.001165
Argument of Perigee	90°
Inclination	98.549°
Period	100.47 mn
Equator Crossing Time	22:00
Repeat Cycle	35 days

The overall concept of the ENVISAT-1 Ground Segment is presented in [R-10].

2.2 The MERIS Instrument

2.2.1 Configuration

MERIS is a medium spatial resolution imaging spectrometer, operating in push-broom mode on a swath width of 1150 km. It provides simultaneously 15 spectral bands selectable in the visible and near-infra-red domain (390 to 1040 nm wavelength at 1.25 nm sampling interval). A reference set of bands is shown in table 3.2.1 below. It should be noted that the finalisation of MERIS bands is the subject of on-going work within the MERIS SAG.

The bands in the following table 2 correspond to the three main missions of the instrument:

1. ocean colour;
2. atmosphere aerosols and clouds;
3. land processes.

Each MERIS pixel has a field of view of 0.019°. Due to the wide instrument field of view (68°), spatial sampling varies in the across track direction, between 0.26 km at nadir and 0.39 km at swath extremities. Along-track sampling is close to 0.29 km.

MERIS has the capability to output data sampled at the Full Resolution (FR) with the spatial sampling described above, and Reduced Resolution (RR) data sub-sampled at 1.2 km.

Table 2-2: Definition of the MERIS bands

No.	*Band centre (nm)*	*Band width (nm)*	*Application*
1	412.5	10	Yellow substance and detrital pigments
2	442.5	10	Chlorophyll absorption maximum
3	490	10	Chlorophyll and other pigments
4	510	10	Suspended sediment, red tides
5	560	10	Chlorophyll absorption minimum
6	620	10	Suspended sediment
7	665	10	Chlorophyll absorption & fluo. reference
8	681.25	7.5	Chlorophyll fluorescence peak
9	705.0	10	Fluo. reference, atmosphere corrections
10	753.75	7.5	Vegetation, cloud
11	760.625	3.75	O_2 R- branch absorption band
12	775	15	Atmosphere corrections
13	865	20	Vegetation, water vapour reference
14	885	10	Atmosphere corrections
15	900	10	Water vapour, land

2.2.2 Operations

MERIS will be operating continuously on the day side of the ENVISAT-1 orbit (descending track). Reduced resolution data will be acquired over 43.5 min in each orbit, i.e. 80% of the descending track, and transmitted directly or via the on-board recorder. Full resolution data will be acquired and processed on request for a maximum of 20 min, in view of X-band stations or DRS (see [R-10]).

A Radiometric Calibration will be performed periodically at orbital south pole pass, using on-board dedicated hardware. This will allow to update the calibration Auxiliary data.

Wavelength calibration will be performed periodically, using on-board dedicated hardware. This will allow to update auxiliary data.

2.3 The MAPP Project

MAPP is the acronym for *MERIS Application and Regional Products Project*. It is a German national project commonly conducted by the Institute of Hydrophysics of the GKSS Research Centre, the Institutes of Optoelectronics and of Space Sensor Technology of the DLR, the Institute for Space Research of the Free University Berlin and Brockmann Consult. It is supported by the German Ministry for Education, Science, Research and Technology. The main objective of the project is - building upon the ESA activities concerning the MERIS spectrometer on ENVISAT – to provide higher level research, products and services for the German Earth Observation user community. The project has 4 elements in order to achieve this objective:

1. to develop and provide operationally higher level regional products

2. to prepare scientifically new algorithms for additional products

3. to support the usage of MERIS data in operational applications by demonstrations projects with users

4. to inform users about MERIS and the MAPP products, and to pass on the knowledge of using it.

The MAPP products are also referred to as MERIS value added (MERIS-VA) products. MERIS products are taken as input for the MERIS-VA processing software in order to create the higher level MERIS-VA products.

2.4 The MERIS-VA Processing Systems

One of the most important software design criteria for the MERIS-VA processors is the encapsulation of the product generating algorithms in separate software components, the MERIS-VA plug-ins. A MERIS-VA processor drives a configurable number of plug-ins simultaneously, providing each with a common interface for product generation and manipulation.

From there, all MERIS-VA level 2 products are based on a generic level 2 structure and similary all level 3 products are based on a generic level 3 structure. Furthermore both level 2 and level 3 products are based on the same concepts and structure. This common structure is explained in detail in chapter 5.4 of the appendix.

The operational MERIS-VA level 2 and level 3 processors will be integrated in the Data Information and Management System (DIMS) of the DLR. In the DIMS, product generating software processors are run within an environment called the Processing Management System (PSM). This sub-system of the DIMS receives production requests and maps them to processing requests by applying product specific mapping rules. Then the processing requests are executed in a 4-step process comprising

1. reserving local disk space for input and output products
2. optionally downloading of required input products from a product archive
3. invoking the processor, providing it with information about the input and output products
4. optionally uploading of generated output products to a product archive

Product databases and archives are managed by another DIMS sub-system, the Product Library (PL). The products stored in the PL are not limited to single files, rather they can have any physical structure including directories and sub-directories. The description of the structure of a product is separately stored in the so called *product type*. Products having the same type also have the same number and type of product components.

2.4.1 The Level 2 Tailor Processing System

{ TODO: Describe this system here… }

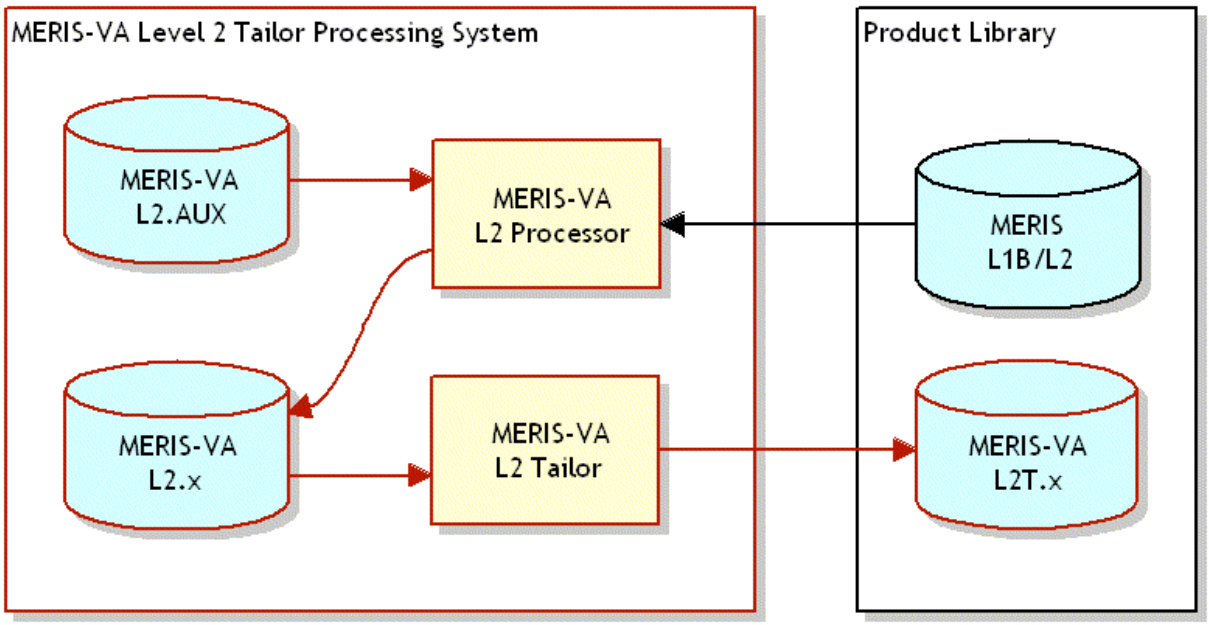

Figure 1: Level 2 tailor processing system

2.4.2 The Level 3 Processing System

{ TODO: Describe this system here… }

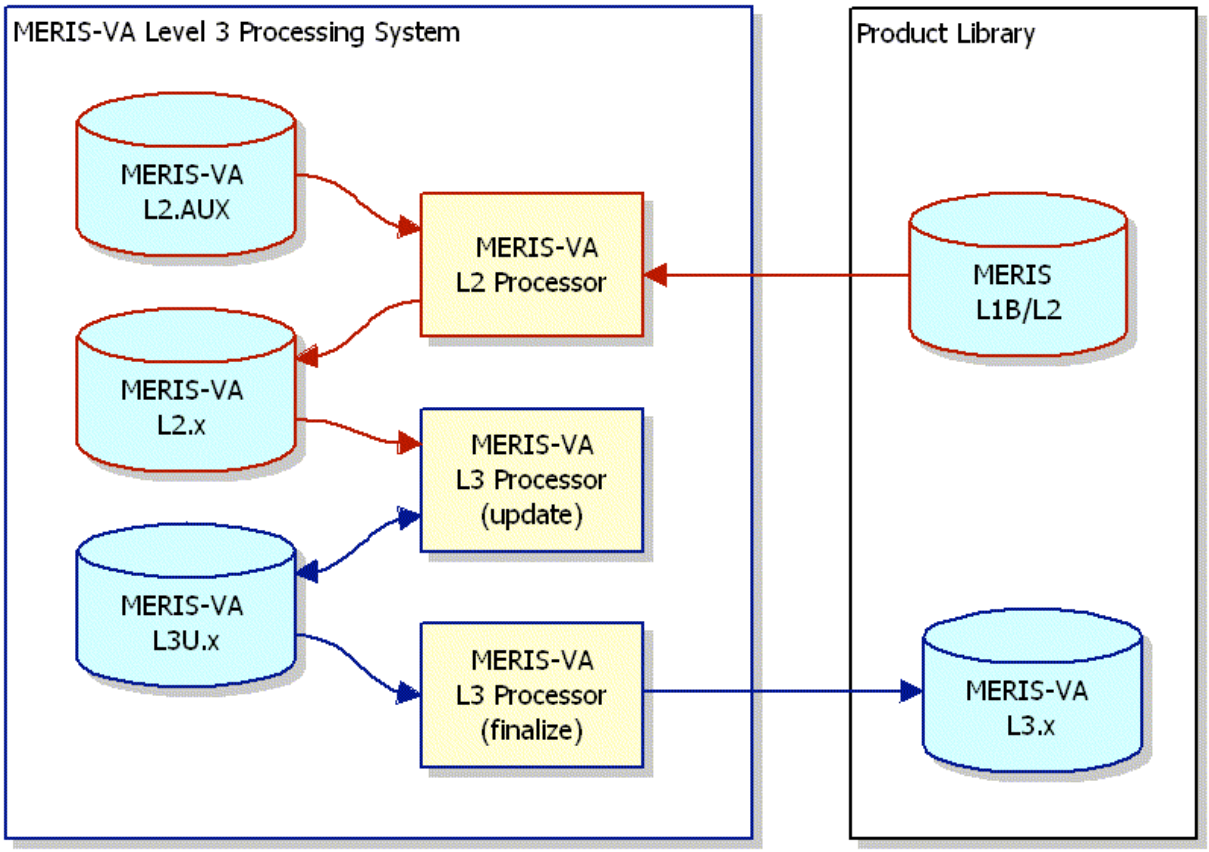

Figure 2: Level 3 processing system

2.4.3 The Level 3 Tailor Processing System

{ TODO: Describe this system here… }

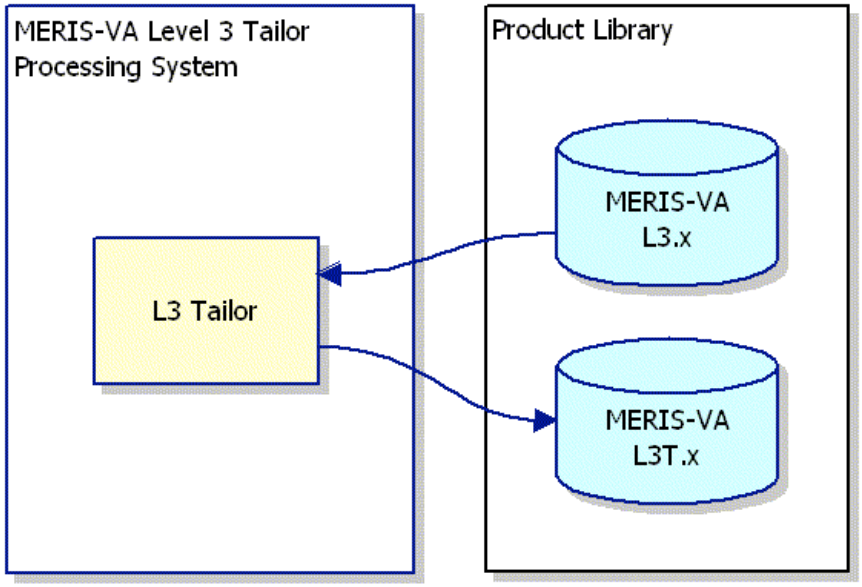

Figure 3: Level 3 tailor processing system

3 MERIS-VA Level 2 Processor I/O

The MERIS-VA L2 Processor takes MERIS L1B and L2 high or reduced resolution products as inputs and generates the value-added MERIS-VA L2 products as outputs.

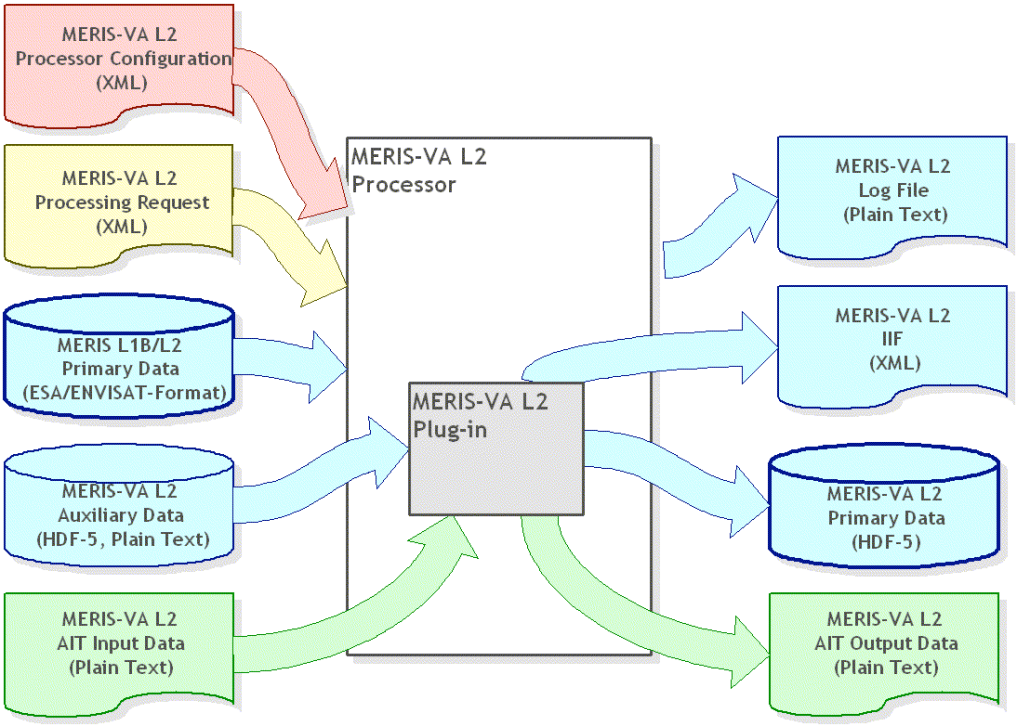

Figure 4: Level 2 processor I/O

Within the MERIS-VA L2 Processor, product generation is done by product specific plug-ins which implement the algorithms to compute the MERIS-VA level 2 geophysical parameters. After a plug-in is loaded, the processor instructs it to perform the following actions (in sequence)

- create primary product files and optionally open auxiliary data files
- perform a per-pixel based algorithm implementation test (AIT)
- process all MERIS pixels based on parameters in the MERIS L1b and L2 products
- close primary product files and optionally auxiliary data files

In the following chapters the type of input and output data are explained in detail.

Table 3-1: MERIS-VA level 2 input

Processor Configuration	Tells the MERIS-VA Level 2 Processor which plug-ins are available and which products can be generated by them.
Processessing Request	Tells the MERIS-VA Level 2 Processor which products have to be generated.
MERIS L1B/L2 Prim. Data	Contains the MERIS L1B and L2 geophysical parameters and associated flags which are delivered to all plug-ins. The format for the primary product data files is given in [R TBD].
Auxiliary Data	Auxiliary data is required by certain L2 plug-ins in order to parametrize the algorithms.

AIT Input Data	Files containing plug-in test vectors. Each plug-in has its own AIT input file.

Table 3-2: MERIS-VA level 2 output

Primary Data	Contains the generated MERIS-VA geophysical parameters and flags generated by a certain plug-in.
AIT Output Data	Files containing test result vectors. Each plug-in generates its own AIT output file.
Log File	A log file is generated for each processing request and contains status information about all processing steps.

One important application of MERIS-VA level 2 products within the MAPP project is the generation of level 3 products. To decouple the architecture of the MERIS-VA L3 Processor as much as possible from specific L2 parameters, a generic format for the primary L2 product files has been introduced. The format shall ensure that (for the majority of the L2 parameters) a generic L3 algorithm can be applied.

A MERIS-VA L2 product contains data for one or more geophysical parameter, but data for the same parameter is never spread over multiple products. The geophysical parameters combined in a product are always the output of the same algorithm (or processor plug-in).

3.1 Level 2 Processing Requests

Processing requests contain the descriptions of input products a processor shall process and the descriptions of output products it shall generate from the inputs. Optionally, processing is controlled by a list of processing parameters. Since the structure of processing requests is the same for MERIS-VA level 2 and level 3 processors, it is described in general in the appendix chapter 5.2. A detailed description of the batch request file (XML) format also is given there. Here, only processing request parameters and keys concerning the MERIS-VA level 2 product generation are presented.

A single level 2 processing request can ask the level 2 processor for the generation of one or more level 2 products. The level 2 processors “know” which products to generate, resp. which plug-ins to load, by evaluating the product type identifiers contained in each of of the output product descriptions.

The following table lists all acepted processing parameters. In a request file these parameters are given as elements of the `<ProcessingParameters>` node

Table 3-3: Level 2 processing parameters

Name	*Type*	*Description*
{TBD}	string	{TBD}

The following table lists the product identifying parameters, the so called product keys. In a request file, these parameters are given as value of the `key` attribute of the one and only `<Product>` node of the `<OutputProducts>` node.

Table 3-4: Level 2 product keys

Name	*Type*	*Description*
orbitID	uint32	A number identifying the orbit to which this scene belongs to.
orbitSceneIndex	uint32	A number identifying the position of the scene within the orbit.

3.2 Level 2 Processor Log

For each MERIS-VA processing request a single log file is created during the processing, even if the request produces multiple level 2 output products (→ multiple plug-ins are at work). The level 2 log file is a product component and as this, the level 2 processor copies it after finishing the request into the target directory of each output product. {TODO: Say something & somewhere about the target directories}. The log file can be reviewed as part of the level 2 processing history.

The MERIS-VA log file format is presented in the Appendix, $5.3.

3.3 Level 2 Primary Input Data

The main input for the MERIS-VA level 2 processor are the MERIS level 1B and level 2 low and high resolution products provided by the ESA. The MERIS-VA processor is capable to read the ESA file formats described by ESA IODD version 5.0 and version 6.0 (see [R-3]). Given here are the expected description of both product types.

Table 3-5: Description for the combined MERIS Level 1B and Level 2 Full Resolution Product

Product-ID	ENVISAT.MERIS.MER_FR__1P	ENVISAT.MERIS. MER_FR__2P
Name pattern for primary data file	`MER_FR__1P*.N1`	`MER_FR__2P*.N1`
Size for primary data files	161 MB	187 MB
Scene image resolution	2241 x 2241 pixels	
Spatial scene coverage	582 x 650 km^2	
Spatial sampling	260 m across, 290 m along track at nadir	

Table 3-6 Description for the combined MERIS Level 1B and Level 2 Reduced Resolution Product

Product-ID	ENVISAT.MERIS. MER_RR__1P	ENVISAT.MERIS. MER_RR__2P
Name pattern for primary data file	`MER_RR__1P*.N1`	`MER_RR__2P*.N1`
Size for primary data files	54 MB	63 MB
Scene image resolution	1121 x 1121 pixels	
Spatial scene coverage	291 x 325 km^2	
Spatial sampling	1040 m across, 1160 m along track at nadir	

Additional information on the ENVISAT product format is presented in [R-1][R-2][R-3].

3.4 Level 2 Item Information File (IIF)

{TODO: short description of the level 2 IIF metadata and product keys}

The complete DIMS / IIF specification format can be looked up in [R-10].

3.5 Level 2 Primary Output Data

3.5.1 Level 2 Primary Product File Structure

Primary product files contain the scene data, tie point data and metadata for MERIS-VA products. All primary MERIS-VA product files are implemented in the Hierarchical Data Format (HDF) version 5 (HDF-5). The following paragraph uses a more general terminology to describe the structure and contents of MERIS-VA primary files. These terminology includes just the following objects:

Dataset: A multidimensional array of a fundamental numeric data type.

Group: A logical unit containing datasets and groups.

Attribute: A key-value pair or named property. Datasets and groups as well as the file itself, can have multiple associated attributes. File attributes are also referred to as *global attributes*.

A complete documentation of the latest HDF version is given in [R-5] and [R-6].

Table 3-7: Scene data properties for full resolution products

Samples per dataset	2241 x 2241 = 5,022,081
Data set number type	varying: 8/16 bit integer, 32 bit floating point
# of datasets per product file	varying: 2 to 8
Spatial scene coverage	582 x 650 km^2
Spatial sampling	260 m across, 290 m along track at nadir

Table 3-8: Tie point data properties

Tie points per dataset	36 x 36 = 1296
Data set number type	32 bit floating point
# of datasets per product file	12
Spatial tie frame coverage	65 x 65 pixels equivalent to 19.5 x 19.5 km^2

All primary level 2 product files have a structure according to the figure given below. As depicted, they are composed of the scene data providing the actual pixels (geophysical parameter samples plus quality samples and flags) as well as annotating tie points and the list of global attributes providing metadata for the covered scene and product.

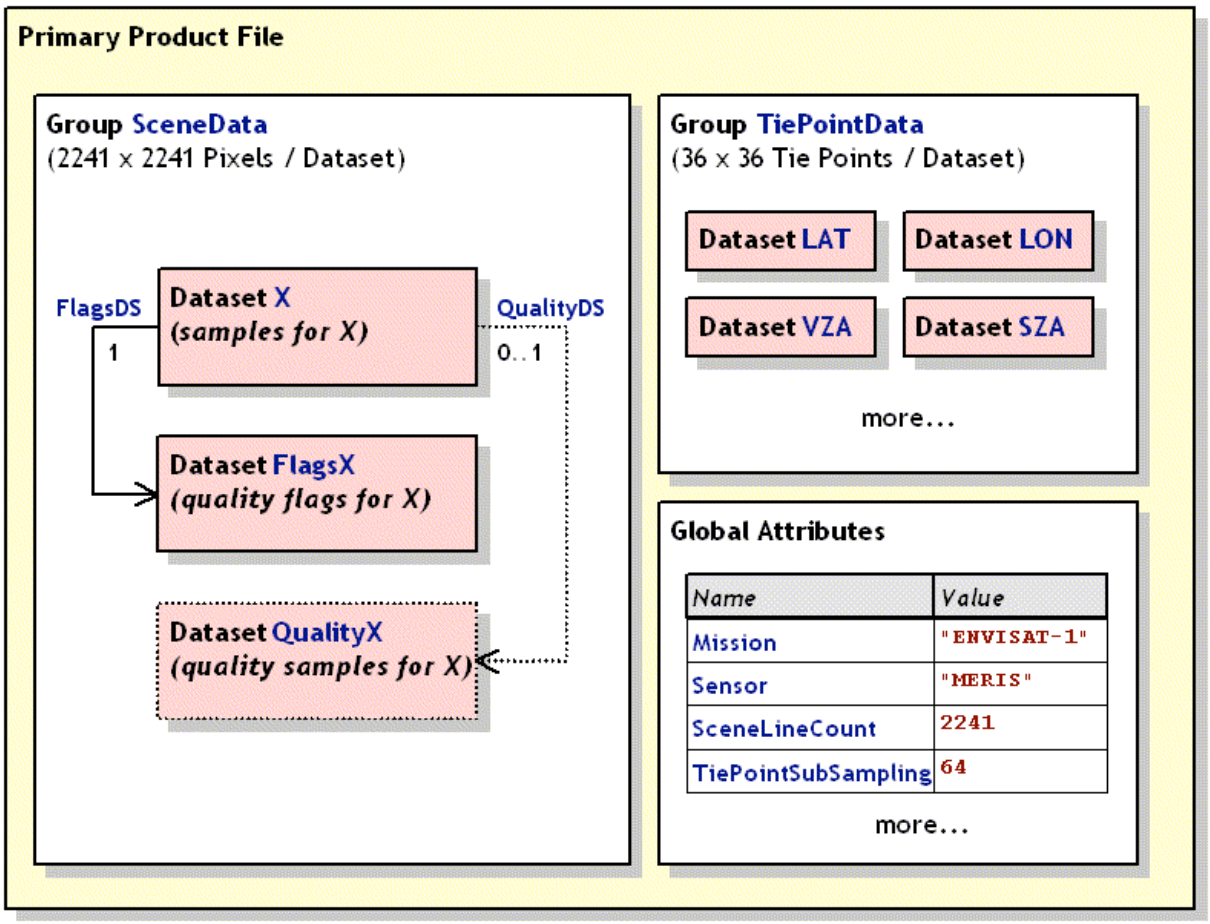

Figure 5: MERIS-VA level 2 primary product file

3.5.2 Level 2 Scene Data Group

The scene data group includes datasets for samples of geophysical parameters, one quality flags dataset and optionally an associated quality samples dataset. All datasets have the same size and geolocation as the originating MERIS products have.

The product's quality flags dataset is used to store special conditions or exceptions occured while computing a variable's sample value. Always included is a selection of possibly important flags directly taken from the ESA/MERIS level 1B and level 2 input products (bits 1 to 8 in every flags sample).

The product's quality sample datasets are used to quantify the quality of the sample values of geophysical parameters. For example, this could be the confidence or the relative computation error of a geophysical value expressed in a number between 0% and 100%.

A MERIS-VA level 2 product file can contain multiple datasets for different variables and multiple variable datasets can share the same quality datasets. All samples of all parameters together with their associated quality flags and indicators contribute to the scene pixel of a MERIS-VA level 2 product. In the figure below an instance of a level 2 product (regionalized water constituents, RWC_RTM) is shown.

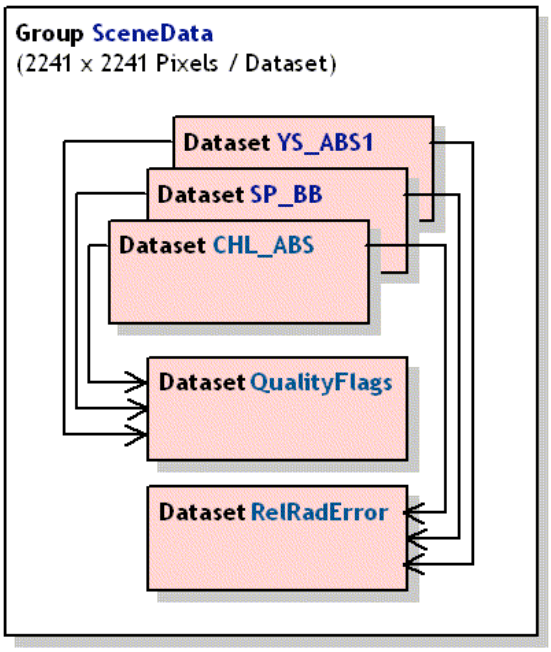

Figure 6: The scene data group for the level 2 product RWC_RTM

Every dataset in the group has minimum set of dataset attributes which are given in the following table.

Table 3-9: Attributes for all datasets in the scene data group

Attribute Name	*Type*	*Value; Description*
Description	string	A long version of the name of the variable or parameter contained in the dataset.
Class	string	The type class of this dataset. For geophysical parameters always `"Parameter"`, for the flags datasets `"Flags"` and for other quality indicator datasets `"Quality"`.
Unit	string	The physical unit of the parameter samples contained in the dataset. If the type is `"Flags"` the dataset has no unit.

To associate a geophysical parameter with its flag and quality datasets the attributes of the following table are used.

Table 3-10: Attributes for datasets representing geophysical parameters

Attribute Name	*Type*	*Value; Description*
FlagsDS	string	Name of the dataset containing the quality flags for each sample in the variable dataset.
QualityDS	string	Name of the dataset containing the quality indicators for each sample in the variable dataset.

As said before, every MERIS-VA level 2 product has a selection of original ESA/MERIS flags in its quality flags dataset. These are stored in the first 8 bits of each flags sample.The following table lists the flag coding of the ESA/MERIS flags.

Table 3-11: First 8 bits of a sample of the quality flags dataset

Bit#	*Flag Name*	*Flag Description*
1	L1B_INVALID	MERIS level 1B invalid flag
2	L1B_SUSPECT	MERIS level 1B suspect flag
3	L2_PCD_1_13	MERIS level 2 PCD 1 - 13 flag
4	L2_CLOUD	MERIS level 2 cloud flag
5	L2_LAND	MERIS level 2 land flag
6	L2_DDV	MERIS level 2 dark dense vegetation flag
7	L2_CASE2	MERIS level 2 case II water flag
8	L2_COASTLINE	MERIS level 2 coast line flag

3.5.3 Level 2 Tie Point Data Group

The datasets in the tie point data group are used to geo-reference and annotate the pixels of MERIS-VA level 2 scene. A single tie point dataset stands for one tie point parameter. The datasets are 2-dimensional grids of float32 elements. The size of the grids is fixed to 36 x 36 points since for the first and each 64th pixel in both horizontal and vertical direction a control point exists which corresponds to the pixel's center.

Tie points datasets are converted from the location and annotation datasets (LADS) of the MERIS level 1B product.

Using a linear, 2-dimensional interpolation, the derived tie point parameter value V′ for center of a pixel in the scene image at the position x,y (zero based indexes assumed) is given through:

$$V'(x,y) = (1 - a)\cdot[(1 - b)\cdot V(i,y) + b\cdot V(i, j+1)] + a\cdot[(1 - b)\cdot V(i+1,j) + b\cdot V(i+1,j+1)]$$

with $i = floor(x / n)$, $a = (x - i\cdot n) / n$,

$j = floor(y / n)$, $b = (y - j\cdot n) / n$ and $n = 64$

The following table contains the full set of tie point parameters. All tie point datasets are contained in global group called **TiePointData**.

Table 3-12: Datasets of the tie point data group

Data Set Name	*Long Name*	*Units*	*Value Range*
Geometry Parameter Datasets			
LAT	Latitude (WGS-84)	dec. °	-90...90
LON	Longitude (WGS-84)	dec. °	-180...180
SAA	Sun Azimuth Angle	dec. °	-180...180
SZA	Sun Zenith Angle	dec. °	0...90
VAA	Vieving Azimuth Angle	dec. °	-180...180
VZA	Vieving Zenith Angle	dec. °	0...90
ADA	Azimuth Difference Angle, ESA Def.[1)]	dec. °	0...180
Geophysical Parameter Datasets			
ZW	Zonal Wind	m / s	≥ 0
MW	Meridional Wind	m / s	≥ 0
AP	Atmospheric Pressure	hPa	≥ 0
OZ	Ozone	DU	≥ 0

RH	Relative Humidity	%	0...100

1) ADA = $cos^{-1}(cos((SAA-VAA)\ \pi/180°))\ 180°/\pi$

For each tie point dataset a minimum set of metadata attributes are always available.

Table 3-13: Attributes for tie point datasets

Attribute Name	*Type*	*Value; Description*
Description	string	A long version of the name of the variable contained in the dataset.
Unit	string	The physical unit of the parameter samples contained in the dataset.

3.5.4 Level 2 Specific Global Attributes

Global attributes are used to provide metadata to annotate the whole product file. An attribute has a name and an associated value which can have (or is compatible to) one of the data types listed in Table 1-1.

The following table lists the global metadata attributes which are characteristic for primary level 2 product files. Beside those attributes exist more general ones, these are listed in the appendix in Table 5-1. For attributes that have constant values specific to the MERIS-VA level 2 product, the value is given in a fixed width font. For string-type attributes, the string separation character ["] is not part of the actual attribute value.

Attribute Name	*Type*	*Value; Description*
SceneStartTime	date	Start GMT of the first scan line of the scene.
SceneEndTime	date	Start GMT of the last scan line of the scene.
NodeCrossingTime	date	GMT of descending equatorial crossing. {TBD: Does MERIS provide that info?}
OrbitID	int32	ID of the scene's orbit.
OrbitSceneIndex	int32	A number identifying the position of the scene within the orbit.
SceneLineCount	uint32	Number of image lines[1)] in the scene covered by a level 2 product.
SceneColumnCount	uint32	Number of pixels per image line[1)] in the scene covered by a level 2 product.
TiePointLineCount	uint32	Number of rows in all tie point datasets.
TiePointColumnCount	uint32	Number of columns in all tie point datasets.
TiePointSubSampling	uint32	Number of pixels minus one covered by two tie points in vertical or horizontal direction.
GeophysicalParamCount	uint32	Number of geophysical level 2 parameters contained in this primary product file.
ValidPixelPercentage	float32	Percentage of valid pixels in the product
CloudPixelPercentage	float32	Percentage of invalid pixels in the product
LandPixelsPercentage	float32	Percentage of invalid pixels in the product
WaterPixelsPercentage	float32	Percentage of invalid pixels in the product
MerisChannelCount	uint32	15; Number of MERIS channels

SolarSpectralFlux	float32[15]	Solar spectral flux for all MERIS channels used by the algorithm which created this product.

1) The term “image line” is used instead of the widespread term “scan line” because MERIS is an *imaging* spectrometer. It does not scan lines pixel by pixel, instead a line as a whole is taken.

3.5.5 Level 2 Output Products Overview

Product Code	*Product Description*	*Approximate Product Size*	*Dataset Name*	*Dataset Long Name*	*Parameter Units*
VA.L2.RWC_RTM	Regionalized case-II water constituents using inverse radiative transfer modelling technique	86 MB	**CHL_CON**	Chlorophyll-a Concentration	mg m^{-3}
			SPM_SCAT	Suspended Matter Scattering	m^{-1}
			YS_ABS	Yellow Substance Absorption	m^{-1}
VA.L2.RWC_PCI	Regionalized case-II water constituents using principal component inversion	68 MB	**CHL_CON**	Chlorophyll-a Concentration	mg m^{-3}
			SPM_SCAT	Suspended Matter Concentration	m^{-1}
			YS_ABS2	Yellow Substance Absorption	m^{-1}
VA.L2.LCC	Monotemporal land coverage classification	14 MB	**CL1**	ID of class with highest propability	
			CL2	ID of class with second highest propability	
			SEP	Separability factor	
VA.L2.NDVI	Spectrally AVHRR comaptible NDVI	29 MB	**NDVI**	Normalized Differential Vegetation Index	
VA.L2.AER	Aerosol parameters	70 MB	**AER_TOT**	Total Aerosol Optical Depth	1
			AER_COA	Optical Depth of Coarse Aerosols	1
			AER_FIN	Optical Depth of Fine Aerosols	1
VA.L2.WV	Water vapour content	35 MB	**WV**	Total water vapour column content	kg m^{-2}
VA.L2.CLOUD	Cloud parameters	124 MB	**COT**	Cloud optical thickness	m
			CA	Cloud albedo	
			CTP	Cloud top pressure	hPa
VA.L2.REFL	Normalized Surface Reflectances	265 MB	**REFL<*i*>**	MERIS Level 2 Normalized surface reflectance with index *i* = 1 to 13.	1

3.5.6 Level 2 Output Products Specifications

3.5.6.1. Specification for VA.L2.RWC_RTM

Product Description

Product Type ID	ENVISAT.MERIS.VA.L2.RWC_RTM
Product Description	Regionalized case-II Water constituents using inverse radiative transfer modelling technique
Pattern for primary product file	`merval2p-rwc_rtm-*`
Size of primary product file	86 MB

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
CHL_CON	Chlorophyll-a Concentration	float32	mg m^{-3}	19 MB
SPM_SCAT	Suspended Matter Scattering	float32	m^{-1}	19 MB
YS_ABS	Yellow Substance Absorption	float32	m^{-1}	19 MB
Quality Indicator Datasets				
AbsError	Absolute radiance error from comparison between measured and estimated	float32	dl	19 MB
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11). Bits 9 to 16 are quality flags for the geophysical parameter samples (coding in table below).	uint16	-	9.5 MB

Flags Coding

Bit#	*Flag Name*	*Flag Description*
9	INVALID	Set if the pixel is invalid and not used for level 3 product generation.
10	INVALID_CHL_YS	Set if chloropyll-a concentration and yellow substance absorption are invalid
11	INVALID_SPM	Set if suspended matter scattering is invalid
12		

3.5.6.2. Specification for VA.L2.RWC_PCI

Product Description

Product Type ID	ENVISAT.MERIS.VA.L2.RWC_PCI
Product Description	Regionalized case-II water constituents using principal component inversion.
Pattern for primary product file	`merval2p-rwc_pci-*`
Size of primary product file	68 MB

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
CHL_CON	Chlorophyll-a Concentration	float32	mg m^{-3}	19 MB
SPM_SCAT	Suspended Matter Scattering	float32	m^{-1}	19 MB
YS_ABS2	Yellow Substance Absorption	float32	m^{-1}	19 MB
Quality Indicator Datasets				
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11). Bits 9 to 16 are quality flags for the geophysical parameter samples (coding in table below).	uint16	-	9.5 MB

Flags Coding

Bit#	*Flag Name*	*Flag Description*
9	**INVALID**	Set if the pixel is invalid and not used for level 3 product generation.
10	**IVMATCH**	Set if interval matching was used to retrieve the water constituents.
11	**CHL_PASSABLE**	Set if the chlorophyll-a concentration is passable.
12	**CHL_SUSPECT**	Set if the chlorophyll-a concentration is questionable.
13	**SPM_PASSABLE**	Set if the suspended matter scattering is passable.
14	**SPM_SUSPECT**	Set if the suspended matter scattering is questionable.
15	**YS_PASSABLE**	Set if the yellow substance absorption is passable.
16	**YS_SUSPECT**	Set if the yellow substance absorption is questionable.

3.5.6.3. Specification for VA.L2.LCC

Product Description

This product is exclusivlely used as an input for the generation of a MERIS-VA level 3 multitemporal LCC product.

Product Type ID	**ENVISAT.MERIS.VA.L2.LCC**
Product Description	Monotemporal land coverage classification
Pattern for primary product file	**`merval2p-lcc-*`**
Size of primary product file	14 MB

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
CL1	ID of class with highest propability	int8	-	5 MB
CL2	ID of class with second highest propability	int8	-	5 MB
Quality Indicator Datasets				
SEP	Separability indicator value.	int8	%	5 MB

QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11).	uint8	-	5 MB

3.5.6.4. Specification for VA.L2.NDVI

Product Description

This product also serves as an input for the MERIS-VA Explorer plug-in "AVHRR compatible NDVI". This plug-in creates not only spectrally compatible but also data format compatible AVHRR-NDVI images.

Product Type ID	ENVISAT.MERIS.VA.L2.NDVI
Product Description	Spectrally AVHRR comaptible NDVI
Pattern for primary product file	`merval2p-ndvi-`
Size of primary product file	29 MB

Datasets in the Group GeophysicalData

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
NDVI	Normalized Differential Vegetation Index	float32	-	19 MB
Quality Indicator Datasets				
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11).	uint16	-	9.5 MB

Flags Coding

Bit#	*Flag Name*	*Flag Description*
9	INVALID	Set if the pixel is invalid and not used for level 3 product generation.
10	UNDERFLOW	Set if calculated NDVI is below the minimum NDVI set in the auxiliary file.
11	OVERFLOW	Set if calculated NDVI is above the maximum NDVI set in the auxiliary file.
12		

3.5.6.5. Specification for VA.L2.AER

Product Description

Product Type ID	ENVISAT.MERIS.L2.AER
Product Description	Fine and coarse aerosol parameters
Pattern for primary product file	`merval2p-aer-*`
Size of primary product file	70 MB

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				

AER_TOT	Total Aerosol Optical Depth	float32	1	20 MB
AER_COA	Optical Depth of Coarse Aerosols	float32	1	20 MB
AER_FIN	Optical Depth of Fine Aerosols	float32	1	20 MB
Quality Indicator Datasets				
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11). Bits 9 to 16 are quality flags for the geophysical parameter samples (coding in table below).	uint16	-	10 MB

Flags Coding

Bit#	*Flag Name*	*Flag Description*
9	INVALID	Set if the pixel is invalid and not used for level 3 product generation.
10		
11		
12		

3.5.6.6. Specification for VA.L2.WV

Product Description

Product Type ID	ENVISAT.MERIS.VA.L2.WV
Product Description	Total water vapour column content.
Pattern for primary product file	`merval2p-wv-*`
Size of primary product file	35 MB

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
WV	Total water vapour column content	float32	kg m^{-2}	20 MB
Quality Indicator Datasets				
RelRadError	Relative radiance error	int8	%	5 MB
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11). Bits 9 to 16 are quality flags for the geophysical parameter samples (coding in table below).	uint16	-	10 MB

Flags Coding

Bit#	*Flag Name*	*Flag Description*
9	INVALID	Set if the pixel is invalid and thus not used for level 3 product generation.
10	NEGATIVE_WV	{TBD}
11	CONSIST_UNDERFLOW	{TBD}
12	CONSIST_OVERFLOW	{TBD}

3.5.6.7. Specification for VA.L2.CLOUD

Product Description

Product Type ID	ENVISAT.MERIS.VA.L2.CLOUD
Product Description	Cloud parameters.
Pattern for primary product file	`merval2p-cloud-*`
Size of primary product file	124 MB

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
COT	Cloud optical thickness	float32	m	19 MB
CA	Cloud albedo	float32	1	19 MB
CTP	Cloud top pressure	float32	hPa	19 MB
Quality Indicator Datasets				
RelRadErrorCOT	Relative radiance error for COT	float32	%	19 MB
RelRadErrorCA	Relative radiance error for CA	float32	%	19 MB
RelRadErrorCTP	Relative radiance error for CTP	float32	%	19 MB
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11). Bits 9 to 16 are quality flags for the geophysical parameter samples (coding in table below).	uint16	-	9.5 MB

Flags Coding

Bit#	*Flag Name*	*Flag Description*
9	INVALID	Set if the pixel is invalid and thus not used for level 3 product generation.
10		
11		
12		

3.5.6.8. Specification for VA.L2.REFL

Product Description

This product serves as input for the MERIS-VA Explorer plug-in “Regionalized case-II water constituents” and possibly for other MERIS-VA Explorer plug-ins.

Product Type ID	ENVISAT.MERIS.VA.L2.REFL
Product Description	Normalized Surface Reflectances
Pattern for primary product file	`merval2p-refl-*`
Size of primary product file	265 MB

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
REFL<*i*>	Normalized surface reflectance with index *i* = 1 to 13	float32	1	260 MB
Quality Indicator Datasets				
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11).	uint8	-	5 MB

3.5.6.9. Specification for VA.L2.SA

IMORTANT NOTE: *VA.L2.SA* is not an operational product. It is an output of a special non-operational MERIS-VA level 2 processor plug-in which is used by the water vapour and cloud plug-ins.

Product Description

Product Type ID	**ENVISAT.MERIS.VA.L2.SA**
Product Description	Surface Albedo.
Pattern for primary product file	**`merval2p-sa-*`**
Size of primary product file	30 MB

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
SA	Surface albedo	float32		20 MB
Quality Indicator Datasets				
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11). Bits 9 to 16 are quality flags for the geophysical parameter samples (coding in table below).	uint16	-	10 MB

Flags Coding

Bit#	*Flag Name*	*Flag Description*
9	**INVALID**	Set if the pixel is invalid and not used for level 3 product generation.
10		
11		
12		

3.5.6.10. Specification for VA.MERIS_DUMP

IMORTANT NOTE: VA.MERIS_DUMP is not an operational product. It is an output of a special non-operational MERIS-VA level 2 processor plug-in which is used for testing purposes. This plug-in simply converts MERIS level 1B and level 2 data stored in the ESA/ENVISAT format in the MERIS-VA HDF format.

Product Description

Product Type ID	No product-ID available, since this is not an operational product.
Product description	Dump for selected MERIS L1B and L2 variables. *Note: This product is used for internal processor testing only.*
Name of product file (default)	**merval2p-meris_dump-***
Size of product file	varying: (1 + n) × 20 MB, where n is the number of selected MERIS variables.

Processing Parameters

MERIS_DUMP.filename	Filename replacement for the default filename.
MERIS_DUMP.filetype	Select the output file format: **"HDF5"**: the default value, adds `.h5` extension to output file name. **"raw"**: for testing purpose, forces raw binary output of datasets
MERIS_DUMP.byteorder	**"BIG_ENDIAN"** or **"LITTLE_ENDIAN"** for raw binary output only.
MERIS_DUMP.select	Comma separated list of MERIS product names according to the names given in the table below.

Datasets in the Scene Data Group

Name	*Description*	*Type*	*Units*	*Size*
Geophysical Parameter Datasets				
{TBD}	{TODO: List all 15 + 20 MERIS parameters here. Use names equivalent to the ones used in the AIT files!}	float32		20 MB
Quality Indicator Datasets				
QualityFlags	Bits 1 to 8 are a selection of original ESA/MERIS flags (coding in Table 3-11).	uint8	-	5 MB

Level 2 Auxiliary Input Data

3.5.7 Level 2 Auxiliary File Formats

The following three file formats are used for auxiliary input data storage.

File Format	*Contents*	*File Extension*
HDF-5	Simple (scalar) parameters and constants as HDF attributes and multidimensional parameter lookup tables in HDF datasets.	`.h5`
plain text / key-value pairs	Simple (scalar) parameters and constants as key-value-pairs separated by a '='.	`.par`
plain text / neural-network definition	Neural network parameters in a special ASCII format. For the details of this format refer to [R {TBD: Either Neural Network Interface Document or copy relevant portions into this document}]	`.nna`

3.5.8 Level 2 Auxiliary Products Overview

Product Code	*Description*	*Pattern for Filename*	*File Contents*	*File Size*
VA.L2.RWC_RTM_AUX	Regionalized case-II water constituents using inverse radiative transfer modelling technique auxiliary input product.	**merval2a-rwc_rtm-*.par**	Parameter file containing a list of the avaiable regionalized neural networks.	0.1 MB
		<*region-id*>.nna	Mulitible neural network parameter files, one for each considered region. { TBD: which regions exactly?}	1 MB
		merval2a-rwc_rtm-*.zip	ZIP Archive containing multiple neural network parameter files for adapted case II water regions algorithm. (Accessed only via MERIS-VA Explorer Plug-In for the **RWC_RTM** Java version)	1 MB
VA.L2.RWC_PCI_AUX	Regionalized case-II water constituents using principal component inversion auxiliary input product..	**merval2a-rwc_pci-*.par**	Configuration file containing constant parameters for the principal component inversion algorithm.	0.1 MB
VA.L2.LCC_AUX	Monotemporal land coverage classification auxiliary input product.	**merval2a-lcc-*.h5**	Multiple parameter lookup tables for the LCC monotemporal algorithm.	100 MB
VA.L2.NDVI_AUX	Spectrally AVHRR comaptible NDVI auxiliary input product.	**merval2a-ndvi-*.par**	Configuration file containing constant parameters for the NDVI algorithm.	0.1 MB
VA.L2.AER_AUX	Aerosol parameters auxiliary input product.	**{TBD}**	Multiple parameter lookup tables for the aerosol algorithms.	80 MB
VA.L2.WV_AUX	Total water vapour content auxiliary input product.	**merval2a-wv-*.nna**	Neural network parameters for the water vapour retrieval algorithm.	0.1 MB
VA.L2.CLOUD_AUX	Cloud parameters auxiliary input product.	**merval2a-ctp-*.nna**	Cloud optical thickness parameter lookup tables file	0.1 MB
		merval2a-ca-*.nna	Cloud albedo parameter lookup tables file	0.1 MB

		merval2a-ctp-*.nna	Cloud top pressure neural network parameter file	0.1 MB
VA.L2.SA_AUX	Surface albedo auxiliary input product.	merval2a-sa-*.h5	World covering lookup table for surface albedo	100 MB

3.5.9 Detailed Description of Auxiliary Data Formats

3.5.9.1. VA.L2.NDVI_AUX

This auxiliary data file contains the parametrization of the NDVI plugin. The file is a plain text auxiliary file containing key/value pairs as described in [3.5.7]. It contains the following fields:

Field key	*Type*	*Value; Description*
AuxDataDescr	string	A short description of the data contained in the file.
AuxDataVersion	string	The file version number in the form: `versionMajor.versionMinor`
NDVI_MIN	float64	The lower threshold of the ndvi value written to the output product. All values below this value are clipped to “NDVI_MIN”.
NDVI_MAX	float64	The upper threshold of the ndvi value written to the output product. All values above the parameter “NDVI_THRESH” are clipped to the value of “NDVI_MAX”.
NDVI_THRESH	float64	The upper clipping threshold for the ndvi value. See “NDVI_MAX”.
Corr1_intercept	float64	Intercept of the linear interpolation function for ndvi alpha.
Corr1_slope	float64	Slope of the linear interpolation function for ndvi alpha.
Corr2_intercept	float64	Intercept of the linear interpolation function for ndvi beta.
Corr2_slope	float64	Slope of the linear interpolation function for ndvi beta.
Adjust6	float64	Sensitivity adjustment factor for MERIS band 6 data.
Adjust7	float64	Sensitivity adjustment factor for MERIS band 7 data.
Adjust10	float64	Sensitivity adjustment factor for MERIS band 10 data.
Adjust11	float64	Sensitivity adjustment factor for MERIS band 11 data.
Adjust12	float64	Sensitivity adjustment factor for MERIS band 12 data.
Adjust13	float64	Sensitivity adjustment factor for MERIS band 13 data.
Adjust14	float64	Sensitivity adjustment factor for MERIS band 14 data.
Adjust15	float64	Sensitivity adjustment factor for MERIS band 15 data.

Level 2 AIT Input/Output Data

The MERIS-VA level 2 processor combines each pixel of the MERIS level 1b and level 2 products to a single structure which is then passed to all plug-ins. This means that all algorithms get the same set of input parameters for every pixel in the scene, independendly of if the algorithm depends on all of them or just on a subset (which is more likely). However, this fact makes it possible to supply a plug-in with pixels created from an external data file rather than beeing created from the MERIS source. This is how the algorithm implementation tests (AIT) for the MERIS-VA L2 Processor is implemented. A test file containing values for all relevant input parameters and output referrence parameters is read in, a pixel structure is created from the input parameters passed to the plug-in and the result computed from the plug-in is compared with the reference values from the test file. Since the pixel structure is the same for all algorithms, a general format for files can be specified.

3.5.10 AIT File Format

The character encoding used for the input and output test files is ASCII. The file content is organized in rows and columns. Columns are separated by one or more space (0x20) or tabulator (0x09) characters. A row ends with the new-line character (0x0A) or with the end of the file. All rows have the same number of columns and a file has at least two rows.

The first row in the file is the column header. All subsequent rows are data vectors representing a single test case. The column header contains the *variable names* and each data vector contains the *variable values* used for the test.

Output files simply extend the content of input files by algorithm specific output variables. The additional output variable names are appended to the input column header; the output variable values are appended to the input data vectors.

3.5.11 AIT Column Header

The column header is a list of variable names identifying the type and order of the data vector elements. Of course, the name must not contain characters used to separate columns.

For input vectors, only variables from the following input variable table are recognized. If a name of a column header does not identify a variable in the input variable table, the complete column is ignored. The name comparison is not case sensitive.

A test file shall provide only those input variables, which are considered by or have an influence of the algorithm to be validated.

Input Parameter	*Default Value; Description*	*Parameter Units*
LAT	0; Latitude. Default corresponds to location of Neustrelitz.	dec.°
LON	0; Longitude. Default corresponds to location of Neustrelitz.	dec.°
ALT	0; Altitude from digital elevation model.	m
ROU	0; Roughness from digital elevation model.	m
LATC	0; Latitude correction from digital elevation model.	dec.°
LONC	0; Longitude correction from digital elevation model.	dec.°
SZA	0; Sun Zenith Angle.	dec.°
SAA	0; Sun Azimuth Angle.	dec.°
VZA	0; Viewing Zenith Angle.	dec.°
VAA	0; Viewing Azimuth Angle.	dec.°
ADA	0; Azimuth Difference Angle: $cos^{-1}(cos(\text{vaa} - \text{saa}))$.	dec.°
ZW	0; Zonal Wind.	m / s
MW	0; Meridional Wind.	m / s

AP	1013; Atmospheric Pressure.	hPa
OZ	0; Ozone.	DU
RH	0; Relative Humidity.	%
TOAR<i>	0; Top-Of-Athmosphere Radiance for MERIS channels *i* = 1 to 15.	mW / (m^2 sr nm)
REFL<i>	0; Normalized Surface Reflectance with index *i* = 1 to 13.	1
WV	0; Water Vapour Content.	g / cm^2
CHL1	0; Algal Pigment Index 1.	log_{10}(mg / m^3)
TOAVI	0; TOA Vegetation Index.	1
CTP	0; Cloud Top Pressure.	hPa
YEL	0; Yellow Substance.	1 / m
TSM	0; Total Suspended Matter.	log_{10}(g / m^3)
CHL2	0; Algal Pigment Index 2.	log_{10}(mg / m^3)
BOAVI	0; BOA Vegetation Index.	1
SP	1013; Surface Pressure.	hPa
PAR	0; Photosynthetically Active Radiation.	µ-Einstein / m^2
CA	0; Cloud Albedo.	1
AE	0; Aerosol Epsilon.	1
AOT	0; Aerosol Optical Thickness.	1
COT	0; Cloud Optical Thickness.	1
SSI	0; Spectral Shift Index.	-
CTI	0; Cloud Type Index.	-
PTYPE	4; Pixel type. Can be a (bitwise OR-) combination of 1 (= Land Pixel), 2 (= Cloud Pixel), 4 (= Water Pixel), 8 (= Coastline Pixel), 16 (= Case 2 Water Pixel), 32 (= Dark Dense Vegetation Pixel).	-

3.5.12 AIT Data Vectors

Each variable value in a data vector (the test case) must correspond to the variable name in the column header in the same column. The unit for an input variable value must exactly match the one given in the input variable table. If variables from the input variable table are not present in the input file, their default values are used.

3.5.13 AIT Output Variable Names

The convention for naming output variables in the test vector input files is

<*Dataset-Name*>**.REF**

where <*Dataset-Name*> is the dataset name of the corresponding geophysical parameter in the primary product file and the prefix **.REF** marks this variable as the reference value. The convention for naming the same output variables in the test vector output files is

<*Dataset-Name*>**.RES**

where the prefix **.REF** marks this variable as the result computed by the algorithm to be tested.

Note: The configuration file for the MERIS-VA level 2 processor contains the names for the geophysical parameter (= dataset names) for each level 2-output product.

3.5.14 AIT File Example

Given here is an example of both the input and the created output file for a prototype adaptation test for an algorithm producing water vapour content. The input variables are **SZA**, **VZA**, **ADA**, **TOAR12**, **TOAR13**, **TOAR14** and the only output variable is **WV** (MERIS-VA water vapour column content).

Input file content:

SZA	VZA	ADA	TOAR12	TOAR13	TOAR14	WV.REF
14.17	14.17	123.75	19.24	14.27	13.55	40.7445
14.17	14.17	123.75	19.24	14.27	13.55	40.7445
14.17	14.17	135.0	20.2	15.05	14.30	21.8833
14.17	14.17	180.0	19.99	14.43	13.65	44.3794
14.17	25.95	78.75	15.6	11.47	10.88	20.3115
37.63	25.95	90.00	5.87	3.66	3.34	18.9588

Output file content:

SZA	VZA	ADA	TOAR12	TOAR13	TOAR14	WV.RES
14.17	14.17	123.75	19.24	14.27	13.55	40.7442
14.17	14.17	123.75	19.24	14.27	13.55	40.7441
14.17	14.17	135.0	20.2	15.05	14.30	21.8832
14.17	14.17	180.0	19.99	14.43	13.65	44.3789
14.17	25.95	78.75	15.6	11.47	10.88	20.3115
37.63	25.95	90.00	5.87	3.66	3.34	18.9593

4 MERIS-VA Level 3 Processor I/O

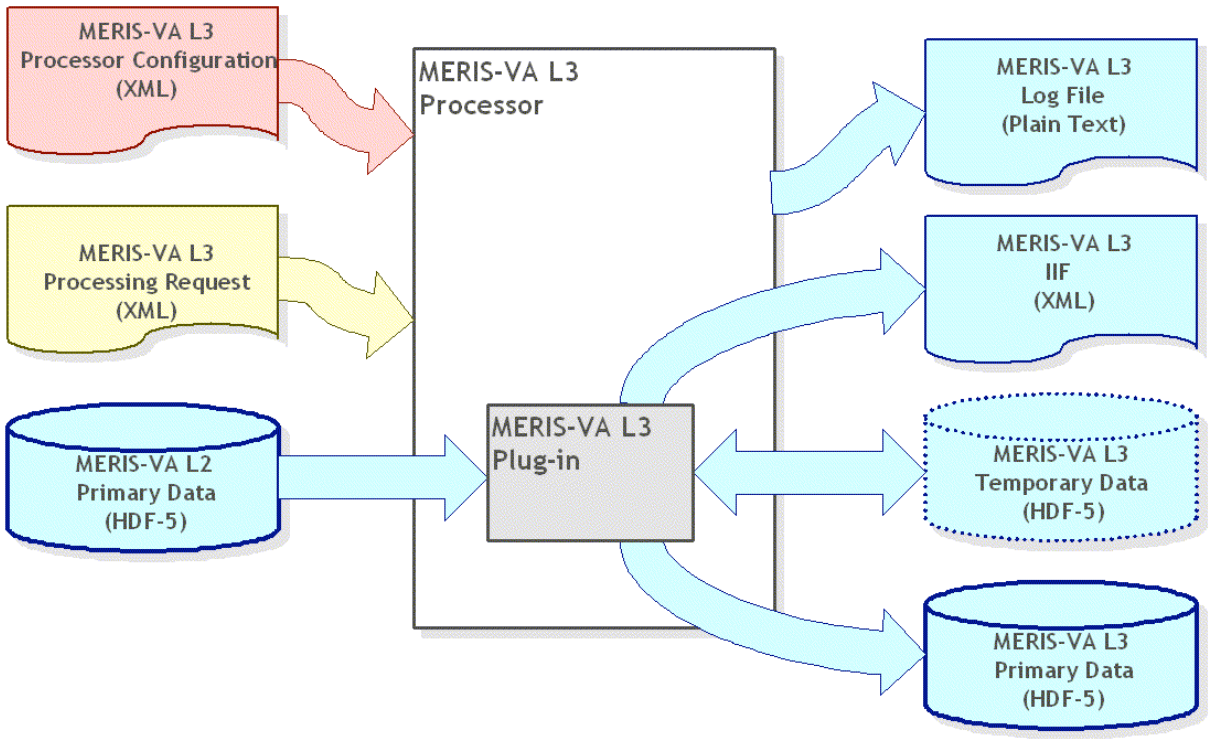

Figure 7: Level 3 processor I/O

4.1 Level 3 Processor Configuration

{ TODO: Specify level 3 processor configuration here }

4.2 Level 3 Processing Requests

Processing requests contain the descriptions of input products a processor shall process and the descriptions of output products it shall generate from the inputs. Optionally, processing is controlled by a list of processing parameters. Since the structure of processing requests is the same for MERIS-VA level 2 and level 3 processors, it is described in general in the appendix chapter 5.2. A detailed description of the batch request file (XML) format also is given there. Here, only processing request parameters and keys concerning the MERIS-VA level 3 product generation are presented.

A single level 3 processing request creates or updates a single MERIS-VA level 3 product. Therefore it has exactly one output product but multiple level 2 input products, all falling in the given averaging period. The level 3 processor “knows” which type of product to generate, resp. which plug-ins to load, by evaluating the product type identifier contained in the sole output product description.

The following table lists all accepted processing parameters. In a request file, these parameters are given as elements of the `<ProcessingParameters>` node.

Table 4-1: Level 3 processing parameters

Name	*Type*	*Description*
action	string	`"UPDATE"`: Optionally creates and updates a temporary L3 product (code L3U.<*l3-name*>) in the PSM's cache with the given level 2 input products (code L2.<*l2-name*>). `"FINALIZE"`: Creates a final L3 Product (code L3.<*l3-name*>) for the DIMS/PL from an existing temporary L3 product (code L3U.<*l3-name*>) in the PSM's cache.
reprocessing[1)]	string	`"true"` if this a reprocessing request and the output product shall replace a one already existing in the DIMS/PL. `"false"` if a new product shall be generated an be inserted in the DIMS/PL.
operational[2)]	string	`"true"` if this an operational (timer driven) request for long term storage in the DIMS/PL; `"false"` if this is an order-driven request and an archiving is not necessary

1) `"true"` sets the attribute admin.cmdOption.action of the corresponding level 3 IIF file to `"UPDATE"`; `"false"` sets it to `"INSERT"`

2) `"true"` sets the attribute admin.permanency of the corresponding level 3 IIF file to `"PERMANENT"`; `"false"` sets it to `"TEMPORARY"`

The following table lists the product identifying parameters, the so-called product keys. In a request file, these parameters are given as value of the `key` attribute of the one and only `<Product>` node of the `<OutputProducts>` node.

Table 4-2: Level 3 product keys

Name	*Type*	*Description*
averagingStartDate	Date	Averaging start date.
averagingPeriod	uint32	Averaging period in days
mapProjectionCenterLat	float32	Latitude of projection center in decimal degree
mapProjectionCenterLon	float32	Longitude of projection center in decimal degree
gridGranularity	uint32	Grid granularity given in integral multiples of a square grid cell with a dimension of 300 m × 300 m.
sceneColumnOffset	int32	x of the upper left co-ordinate of the grid rectangle. Must be an integral multiple of the value of the TiePointSubSampling attribute, i.e. an integral multiple of 64.
sceneLineOffset	int32	y of the upper left co-ordinate of the grid rectangle. Must be an integral multiple of the value of the TiePointSubSampling attribute, i.e. an integral multiple of 64.
sceneColumnCount	uint32	Width of the grid rectangle (horizontal resolution of the L3 scene). Must be an integral multiple of the value of the TiePointSubSampling attribute, i.e. an integral multiple of 64.

sceneLineCount	uint32	Height of the grid rectangle (vertical resolution of the L3 scene). Must be an integral multiple of the value of the TiePointSubSampling attribute, i.e. an integral multiple of 64.

4.3 Level 3 Processor Log

For each MERIS-VA level 3 processing request a log file is created during processing. The log file can later be reviewed as part of the level 3 processing history.

The MERIS-VA log file format is presented in the appendix, §5.3.

4.4 Level 3 Item Information File (IIF)

{TODO: short description of the level 3 IIF metadata and product keys}

The complete DIMS / IIF specification format can be looked up in [R-10].

4.5 Level 3 Primary Input Data

{ TODO: add table of level 2 input products for each level 3 output product }

4.6 Level 3 Primary Output Data

4.6.1 Level 3 Grid

{ TODO: Explain the L3 grid, the geographical projection used for it, etc. }

4.6.2 Level 3 Binning Algorithms

{ TODO: Refer to SeaWiFS Document: Volume 32, Level 3 SeaWiFS Data Products }

4.6.3 Level 3 Primary Product File Structure

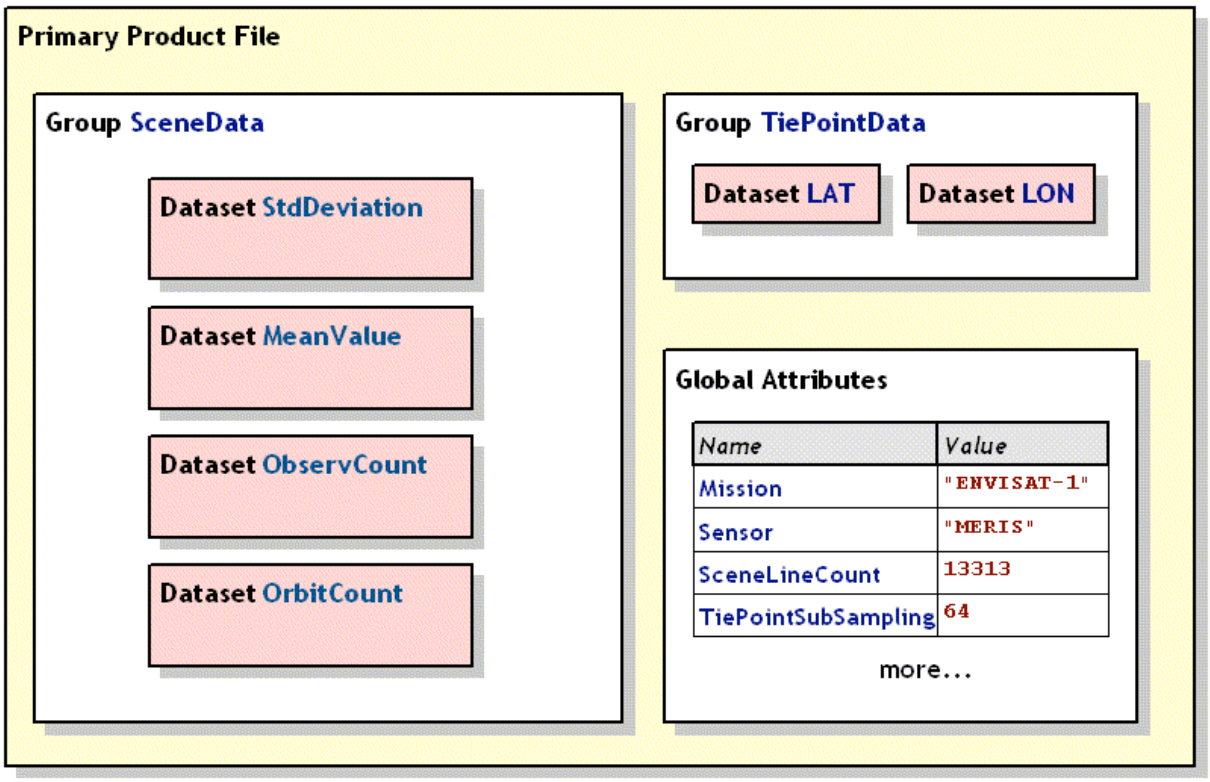

Figure 8: Level 3 primary product file structure (MLE and AM algorithms)

4.6.4 Level 3 Scene Data Group

Dataset Name	*Type*	*Description*
StdDeviation	float32	Standard deviation of the geophysical parameter
MeanValue	float32	Mean value of the geophysical parameter
ObservCount	uint32	Total number of observations (pixels)
OrbitCount	uint16	Total number of orbits which contributed observations (pixels)

4.6.5 Level 3 Tie Points Group

Dataset Name	*Type*	*Description*	*Units*	*Value Range*
LAT	float32	Latitude (WGS-84)	dec. °	-90...90
LON	float32	Longitude (WGS-84)	dec. °	-180...180

4.6.6 Level 3 Specific Global Attributes

Attribute Name	*Type*	*Description*
Level 3 Attributes		
AveragingStartDate	date	Averaging start date.
AveragingPeriod	uint32	Averaging period in days.

MapProjectionName	string	Name of the projection used to transform geographical co-ordinates to map co-ordinates used for the level 3 binning algorithm.
MapProjectionParams	string	Semicolon separated list of key-value pairs representing the parameters used for the map projection.
MapProjectionCenterLat	float32	Latitude of projection center in decimal degree
MapProjectionCenterLon	float32	Longitude of projection center in decimal degree
GridGranularity	uint32	Grid granularity given in integer multiples of a square grid cell with a dimension of 300 m × 300 m.

4.6.7 Level 3 Output Products Overview

Product Code	*Product Description*	*Spatial Coverage*	*L3-Grid Granularity*	*Averaging Period*	*Product Size*
VA.L3.RWC_RTM	Regionalized case-II Water constituents using inverse radiative transfer modelling technique	North Sea	1	30 d	36 MB
		Lake Constance	1	30 d	2 MB
VA.L3.RWC_PCI	Regionalized case-II water constituents using principal component inversion	Baltic Sea	1	30 d	720 MB
VA.L3.AER	Aerosol parameters	Europe	8	30 d	147 MB
VA.L3.NDVI	spectrally AVHRR compatible	Europe	1	30 d	2.29 GB
VA.L3.LCC	Multitemporal land coverage classification	Europe	1	365 d	784 MB
VA.L3.CLOUD	Cloud parameters	Europe	16	10 d	700 MB
		Europe	16	30 d	700 MB

4.6.8 Overview of Level 3 Maps

In this chapter an overview of all maps used for level 3 products is given. For every map, the bounding box is given in grid coordinates and geographical latitudes and longitudes. The grid co-ordinates refer to map grid with a granularity of one. Every grid cell then has a dimension of 300 x 300 meters (a cell of a grid with a granularity of eight has 2.4 x 2.4 kilometers). The grid co-ordinate system's center point with the co-ordinates (i=0,j=0) is exactly located at the receiving station in Neustrelitz with a latitude of 53.32971666° and a longitude of 13.07256665°.

4.6.8.1.Europe Map (full coverage)

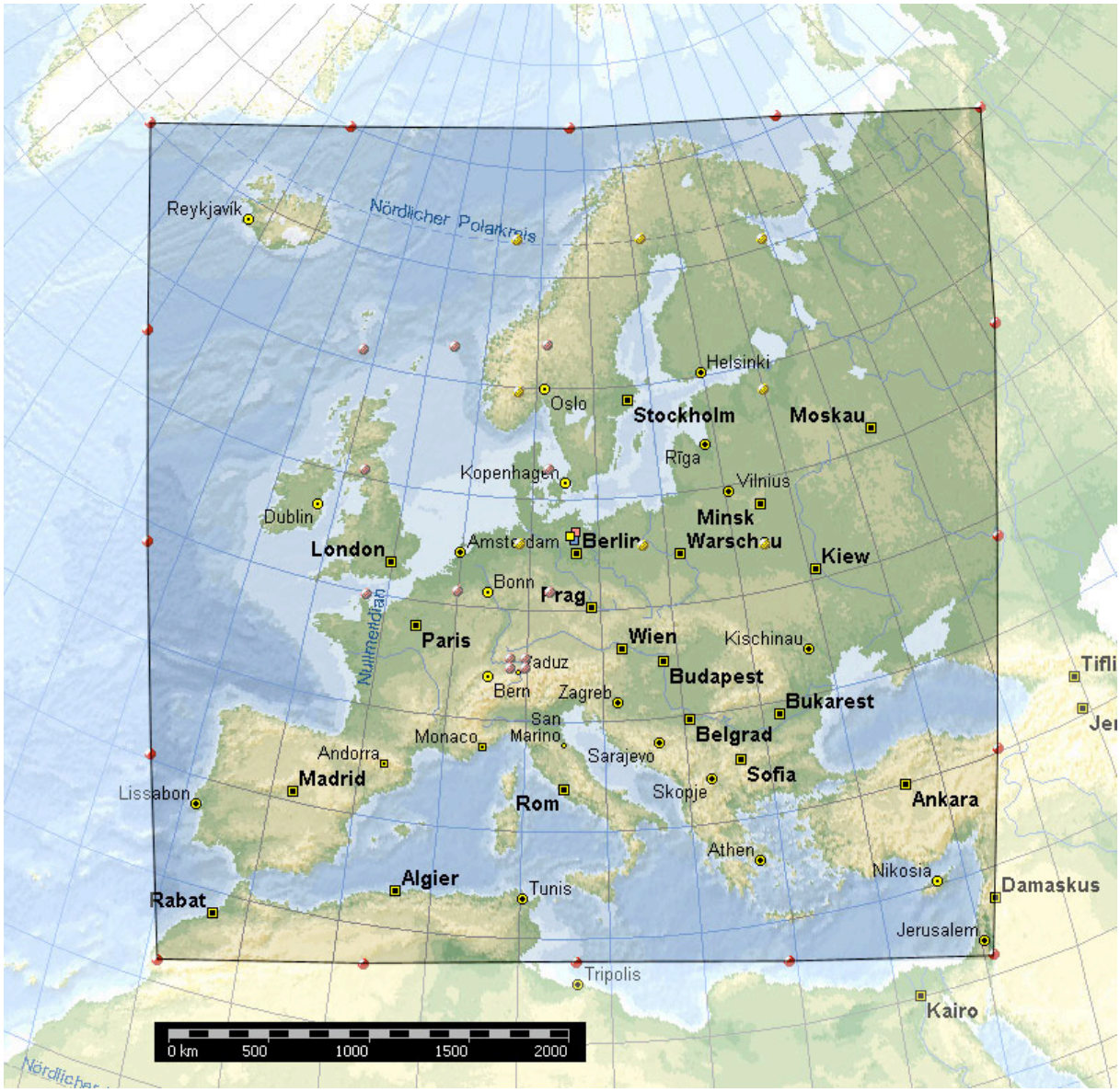

Figure 9: Europe 4300×4300 km^2 Map Coverage

Position	*Grid-i*	*Grid-j*	*Latitude [dec.°]*	*Longitude [dec.°]*
Upper Left	-7168	7167	65.0184	-37.8342
Upper Center	0	7167	72.7590	13.0726
Upper Right	7167	7167	65.0184	63.9793
Lower Right	7167	-7168	30.9919	35.5525
Lower Center	0	-7168	33.8950	13.0726
Lower Left	-7168	-7168	30.9919	-9.40734

Table 4-3: Europe Map Co-ordinates

4.6.8.2. North Sea and Baltic Sea

Figure 10: North Sea 922×1229 km² and Baltic Sea 1229×1536 km² Map Coverages

Position	*Grid-i*	*Grid-j*	*Latitude [dec.º]*	*Longitude [dec.º]*
Upper Left	-3456	3199	60.6651	-6.20393
Upper Center	-1920	3199	61.5605	2.17169
Upper Right	-385	3199	61.9523	10.8751
Lower Right	-385	-896	50.8976	11.4301
Lower Center	-1920	-896	50.6149	4.89129
Lower Left	-3456	-896	49.9616	-1.52788

Table 4-4: North Sea Map Co-ordinates

Position	*Grid-i*	*Grid-j*	*Latitude [dec.º]*	*Longitude [dec.º]*
Upper Left	-896	4991	66.7182	6.98888
Upper Center	1152	4991	66.6477	20.8805
Upper Right	3199	4991	65.4790	34.1429
Lower Right	3199	-128	52.1246	27.2387
Lower Center	1152	-128	52.8696	18.2265
Lower Left	-896	-128	52.9139	9.06138

Table 4-5: Baltic Sea Map Co-ordinates

4.6.8.3. Lake Constance

Figure 11: Lake Constance 77×48 km² Map Coverage

Position	*Grid-i*	*Grid-j*	*Latitude [dec.°]*	*Longitude [dec.°]*
Upper Left	-1072	-2003	47.924183	8.758505
Upper Center	-944	-2003	47.8572	9.27921
Upper Right	-817	-2003	47.960308	9.787296
Lower Right	-817	-2162	47.5286	9.81505
Lower Center	-944	-2162	47.5119	9.30482
Lower Left	-1072	-2162	47.4928	8.79491

Table 4-6: Lake Constance Map Co-ordinates

4.6.9 Level 3 Output Products Specifications

4.6.9.1. Specification for VA.L3.RWC_RTM

Product Description

Product Description	Regionalized case-II Water constituents using inverse radiative transfer modelling technique
Product Type ID of Level 3 Output Product	ENVISAT.MERIS.VA.L3.RWC_RTM
Product Type ID of Level 2 Input Product(s)	ENVISAT.MERIS.VA.L2.RWC_RTM

Primary Product Components Overview

Name	*Description*	*Units*	*File Name*
CHL_CON	Chlorophyll-a Concentration	mg m^{-3}	`merval3p-rwc_rtm-chl_con-*`
SPM_SCAT	Suspended Matter Scattering	m^{-1}	`merval3p-rwc_rtm-spm_scat-*`
YS_ABS	Yellow Substance Absorption	m^{-1}	`merval3p-rwc-rtm-ys_abs-*`

Generated Maps

Map Name	*Averaging Period*	*Grid Granularity*	*Grid Rectangle Offset (i, j)*	*Grid Rectangle Size (width, height)*	*Approx. Product Size **
North Sea	7 d	4	-864,-224	768,1024	36 MB
North Sea	30 d	4	-864,-224	768,1024	36 MB
Lake Constance	30 d	1	-1072,-2162	256,160	2 MB

*) Product sizes are an estimation because LAT/LON tie point grids and HDF maintainance overhead have not been considered. Additionally, HDF-5 compression capabilities could be applied. The approximate product sizes n_P have been estimated as follows:

$$n_P = (n_S \times n_B \times n_v)\ (n_{GW} \times n_{GH})$$

with
n_S := Number of statistical variables for a geophysical value (4)
n_B := Number of bytes for a statistical variable (4 = 32-bit)
n_v := Number of geophysical values (3)
nGW := Grid rectangle width (768)
nGW := Grid rectangle height (1024)

4.6.9.2. Specification for VA.L3.RWC_PCI

Product Description

Product Description	Regionalized case-II water constituents using principal component inversion
Product Type ID of Level 3 Output Product	ENVISAT.MERIS.VA.L3.RWC_PCI

Product Type ID of Level 2 Input Product(s)	**ENVISAT.MERIS.VA.L2.RWC_PCI**

Primary Product Components Overview

Name	*Description*	*Units*	*File Name*
CHL_CON	Chlorophyll-a Concentration	mg m^{-3}	**merval3p-rwc_pci-chl_con-***
SPM_SCAT	Suspended Matter Scattering	m^{-1}	**merval3p-rwc_pci-spm_scat-***
YS_ABS2	Yellow Substance Absorption	m^{-1}	**merval3p-rwc_pci-ys_abs2-***

Generated Maps

Map Name	*Averaging Period*	*Grid Granularity*	*Grid Rectangle Offset (i, j)*	*Grid Rectangle Size (width, height)*	*Approx. Product Size**
Baltic Sea	30 d	1	-896,-128	4096,5120	720 MB
Lake Constance	30 d	1	-1072,-2162	256,160	2 MB

*) Product sizes are an estimation because LAT/LON tie point grids and HDF maintainance overhead have not been considered. Additionally, HDF-5 compression capabilities could be applied. The approximate product sizes n_P have been estimated as follows:

$$n_P = (n_S \times n_B \times n_v)\ (n_{GW} \times n_{GH})$$

with
- n_S := Number of statistical variables for a geophysical value (4)
- n_B := Number of bytes for a statistical variable (4 = 32-bit)
- n_v := Number of geophysical values (3)
- n_{GW} := Grid rectangle width (4096 resp. 256)
- n_{GW} := Grid rectangle height (5120 resp. 160)

4.6.9.3. Specification for VA.L3.AER

Product Description

Product Description	Aerosol parameters
Product Type ID of Level 3 Output Product	**ENVISAT.MERIS.VA.L3.AER**
Product Type ID of Level 2 Input Product(s)	**ENVISAT.MERIS.VA.L2.AER**

Primary Product Components Overview

Name	*Description*	*Units*	*File Name*
AER_TOT	Total Aerosol Optical Depth	1	**merval3p-aer-tot-***
AER_COA	Optical Depth of Coarse Aerosols	1	**merval3p-aer-coa-***
AER_FIN	Optical Depth of Fine Aerosols	1	**Merval3p-aer-fin-***

Generated Maps

Map Name	*Averaging Period*	*Grid Granularity*	*Grid Rectangle Offset (i, j)*	*Grid Rectangle Size (width, height)*	*Approx. Product Size**
Europe	30 d	8	-896,- 896	1792,1792	147 MB

*) Product sizes are an estimation because LAT/LON tie point grids and HDF maintainance overhead have not been considered. Additionally, HDF-5 compression capabilities could be applied. The approximate product sizes n_P have been estimated as follows:

$$n_P = (n_S \times n_B \times n_v)\ (n_{GW} \times n_{GH})$$

with
- n_S := Number of statistical variables for a geophysical value (4)
- n_B := Number of bytes for a statistical variable (4 = 32-bit)
- n_v := Number of geophysical values (3)
- n_{GW} := Grid rectangle width (4096 resp. 256)
- n_{GW} := Grid rectangle height (5120 resp. 160)

4.6.9.4. Specification for VA.L3.NDVI

Product Description

Product Description	Spectrally AVHRR comaptible NDVI
Product Type ID of Level 3 Output Product	**ENVISAT.MERIS.VA.L3.NDVI**
Product Type ID of Level 2 Input Product(s)	**ENVISAT.MERIS.VA.L2.NDVI**

Primary Product Components Overview

Name	*Description*	*Units*	*File Name*
NDVI	Normalized Differential Vegetation Index		**`merval3p-ndvi-*`**

Generated Maps

Map Name	*Averaging Period*	*Grid Granularity*	*Grid Rectangle Offset (i, j)*	*Grid Rectangle Size (width, height)*	*Approx. Product Size*
Europe	30 d	1	-7168,-7168	14336,14336	2.29 GB

*) Product sizes are an estimation because LAT/LON tie point grids and HDF maintainance overhead have not been considered. Additionally, HDF-5 compression capabilities could be applied. The approximate product sizes n_P have been estimated as follows:

$$n_P = (n_S \times n_B) \times (n_{GW} \times n_{GH})$$

with
- n_S := Number of statistical variables for the NDVI geophysical value (4)
- n_B := Number of bytes for a statistical variable (4 = 32-bit)
- nGW := Grid rectangle width (14336)
- nGW := Grid rectangle height (14336)

4.6.9.5. Specification for VA.L3.LCC

Product Description

Product Description	Multitemporal land coverage classification
Product Type ID of Level 3 Output Product	**ENVISAT.MERIS.VA.L3.LCC**
Product Type ID of Level 2 Input Product(s)	**ENVISAT.MERIS.VA.L2.LCC**

Primary Product Components Overview

Name	*Description*	*Units*	*File Name*
LCC	Land coverage classification		`merval3p-lcc-*`

Generated Maps

Spatial Coverage	*Averaging Period*	*Grid Granularity*	*Grid Rectangle Offset (i, j)*	*Grid Rectangle Size (width, height)*	*Approx. Product Size**
Europe	365 d	1	-7168,-7168	14336,14336	784 MB

*) Product sizes are an estimation because LAT/LON tie point grids and HDF maintainance overhead have not been considered. Additionally, HDF-5 compression capabilities could be applied. The approximate product sizes n_P have been estimated as follows:

$$n_P = (n_{BC} \times n_{BO}) \times (n_{GW} \times n_{GH})$$

with
n_{BC} := Number of bytes to store the IGBP class index (1)
n_{BO} := Number of bytes to store the number of observations (4)
n_{GW} := Grid rectangle width (14336)
n_{GW} := Grid rectangle height (14336)

4.6.9.6. Specification for VA.L3.CLOUD

Product Description

Product Description	Multitemporal land coverage classification
Product Type ID of Level 3 Output Product	**ENVISAT.MERIS.VA.L3.CLOUD**
Product Type ID of Level 2 Input Product(s)	**ENVISAT.MERIS.VA.L2.CLOUD** **ENVISAT.MERIS.VA.L2.WV**

Primary Product Components Overview

Name	*Description*	*Units*	*File Name*
FCC_ISCCP	Fractional cloud coverage for 10 ISCCP cloud types		`merval3p-cloud-fcc-isccp-*`
CTP_ISCCP	Cloud top pressure for 10 ISCCP cloud types		`merval3p-cloud-ctp-isccp-*`
COT_ISCCP	Cloud optical thickness for 10 ISCCP cloud types		`merval3p-cloud-cot-isccp-*`

WV_ISCCP	Water vapour for 10 ISCCP cloud types		merval3p-cloud-wv-isccp-*
FCC_VERT	Fractional cloud coverage in 20 vertical layers		merval3p-cloud-fcc-vert-*
CTP_VERT	Cloud top pressure in 20 vertical layers		merval3p-cloud-ctp-vert-*
COT_VERT	Cloud optical thickness in 20 vertical layers		merval3p-cloud-cot-vert-*
WV_VERT	Water vapour in 20 vertical layers		merval3p-cloud-wv-vert-*

Generated Maps

Map Name	*Averaging Period*	*Grid Granularity*	*Grid Rectangle Offset (i, j)*	*Grid Rectangle Size (width, height)*	*Approx. Product Size**
Europe-10d	10 d	16	-448,-448	896,896	700 MB
Europe-30d	30 d	16	-448,-448	896,896	700 MB

*) Product sizes are an estimation because LAT/LON tie point grids and HDF maintainance overhead have not been considered. Additionally, HDF-5 compression capabilities could be applied. The approximate product sizes n_P have been estimated as follows:

$$n_P = (n_S \times \{n_{VI} \times n_{LI} + n_{VV} \times n_{LV}\} \times n_B) \times (n_{GW} \times n_{GH})$$

with
- n_S := Number of statistical variables for a geophysical value (4)
- n_{VI} := Number of geophysical variables assigned to a ISCCP class (3)
- n_{LI} := Number of ISCCP classes (10)
- n_{VV} := Number of geophysical variables assigned to a vertical layer (4)
- n_{LV} := Number of vertical layers (20)
- n_B := Number of bytes for a statistical variable (4 = 32-bit)
- n_{GW} := Grid rectangle width (896)
- n_{GW} := Grid rectangle height (896)

Additional Attributes

Additionally to the global attributes mentioned in 5.4.2 the cloud products have a set of attributes describing the layer coding. These attributes have the general form:

Product Type	*Key*	*Value*
VERT	Layer “n”	ctp]”lower”, “higher”]
ISCCP	Layer “n”	“TYPE” - cot [”lower”, “higher” [, ctp]”lower”, “higher”]

With

“n” - zero based layer index

“lower” - lower value used in classification

“higher” - higher value used in classification

“TYPE” - ISCCP cloud type

5 Appendix

5.1 MERIS-VA Processor Configuration Files

The MERIS-VA level 2 and level 3 processors are configured through external XML configuration files. The configuration files contain

- A number of parameters controlling the general behaviour and environment of the processors.
- A list of all available plugins and
- A list of all products that can be generated with the current processor configuration

5.1.1 General Control Parameter

The general control parameter define the overall behaviour and environment of the MERIS-VA processors. These parameter are embedded inbetween the opening and closing `<Parameters>` tag.

Each parameter is an XML parameter with the attributes `name` and `value`.

5.1.1.1. Parameter homedir

This parameter contains the processor home directory. The processor performs all disk accesses relative from this directory. Initially this parameter is set to the processor installation directory as relative path ('*./*').

5.1.1.2. Parameter cachedir

The parameter `cachedir` contains the relative path to the temportary files directory. All input and output files of the processors are located relative to this directory. The default setting is:

```
../merva-cache-2.4
```

5.1.1.3. Parameter libdir

The parameter `libdir` defines the directory where the processor searches for plugin libraries. All plugins must be located in this directory. The default value is:

```
./lib
```

5.1.1.4. Parameter auxdir

This parameter contains the relative path to the auxiliary files directory. All plugins must store their auxiliary data in a dedicated subdirectory of this directory. The default value is:

```
./auxdata
```

5.1.1.5. Parameter iiftempl

This parameter defines the directory where the processor searches for appropriate IIF template files for the product generated. The default value is:

```
./iif
```

5.1.1.6. Parameter logfile

Defines the location of the logfile written by the processor during a processing operation. The default value is:

```
./merva.log
```

5.1.1.7. Parameter loglevel

This parameter defines the logging level of the processor and by this the amount of information written to the log file.

Valid parameter values are:

- `debug` - for debugging, exhaustive information about the software status
- `normal` - the standard log level
- `warning` - logs only warning and error messages
- `error` - logs only error messages

The default value is:

`normal`.

5.1.1.8. Parameter logecho

This parameter enables or disables the echoing of log information to the console. Available parameter values are:

- `true` - enable logging echo to the console
- `false` - disable logging echo to the console

The default value is:

`true`.

5.1.1.9. Parameter maxmem

This parameter defines the maximum amount of memory in megabytes allocated by the MERIS VA Level 3 processor during operation. You should adjust this value according to the hardware configuration of the target machine. As a general rule of thumb, this value should be set to approx. 100 MB less than the total amount of available RAM.

The default value is:

`400`.

5.1.1.10. Parameter onlyL1b

This parameter enables the processor to run only with MERIS L1b products supplied. Available parameter values are:

- `true` - enable engine to run only with L1b products
- `false` - disable engine to run only with L1b products

The default value is:

`false`.

This parameter should only be set to true when the plugins processed do not rely on any L2 data. All values originating from Level 2 products are set to zero. This will lead to errors in output products where L2 data is needed. ONLY USE IN STAND-ALONE MODE!

5.1.2 Plugin Description Parameter

This set of parameters describes the available MERIS-VA Processor plugins. Each plugin is defined by its name and the name of the binary executable shared library. This set of parameters is embedded inbetween the opening and closing `<PlugIns>` tag.

Example:

```
<PlugIn class="L2CpPlugIn"      library="merval2p-cloud" />
```

This example defines a plugin of the class *"L2CpPlugIn"* that is contained in a library file with the name *"merval2p-cloud"* . The name of this disc file is automatically extended according to the operating system platform the processor runs on.

On a Linux system the processor would load a shared object named

merval2p-cloud.so

on a Windows system a dynamic link library named

merval2p-cloud.dll.

On both platforms, the MERIS-VA processor searches for these libraries in the directory that is set as configuration parameter according to 5.1.1.3.

5.1.3 Product Description Parameter

The configuration file contains a list of all MERIS-VA products that the processor can generate. The products description parameter are embedded inbetween the opening and closing `<Products>` tag.

This list can contain any number of product parameter.

5.1.3.1.Product Parameter

The product parameter describes a single product type that can be generated by the MERIS-VA processor. Each product parameter is embedded inbetween the opening and closing `<Product>` tag.

A product description can contain the following attributes

- type: a product type identifier (tag *type*),
- file: a disc file name identification pattern (tag *file*),
- plugin: the name of the plugin that creates this special product (tag *plugin*) and
- iif: the name of a IIF template file to be used (tag *iif*).
- weight: the weight coefficient to be used during the level 3 accumulation process. See [R-11] for details.
- invalidPixelValue: the value written to the L3 output product for pixels where no valid measurement was tracked in the binning period. Optional parameter, if not set, zero will be used

Please see the example below for a valid product type description:

```
<Product type="ENVISAT.MERIS.VA.L2.RWC_RTM"
         plugin="L2RwcRtmPlugIn"
         file="merval2p-rwc_rtm-*.h5"
         iif="merval2p-iif-templ.xml">
…
</Product>
```

5.1.3.1.1 Product Description Parameter

A product contains a short textual description of the product which is plain ASCII text embedded inbetween the opening and closing `<Description>` tag.

Example:

```
<Description>
     Regionalized case-II Water constituents using
     inverse radiative transfer modelling technique.
</Description>
```

5.1.3.1.2 Scene Data Parameter

A product contains a complete description of all geophysical parameters contained in it. This information is stored in the scene data block, inbetween the opening and closing `<SceneData>` tag.

This scene data block can contain any number of variables that describe the prodct structure. Each variable contains a description of its type, physical unit, a textual description and additional information.

Example:

```
<Variable name="B_SPM"
          class="GeophysParam"
          descr="Suspended Matter Backscattering"
          unit="1/m"
          flags="QualityFlags"
          quality="AbsError"
/>
```

The variables description can contain:

- name: the name of the geophysical parameter
- class: the class of the variable described. Valid classes are
  - GeophysParam - geophysical parameter
  - QualityParam - product quality parameter (e.g. flags
  - TestData - test data
- descr: a short textual description of the geophysical parameter.
- unit: the physical unit of the geophysical parameter
- flags: the quality flags dataset associated with this geophysical parameter
- quality: the quality measure dataset associated with this geophysical parameter
- file: a disc file name identification pattern for this geophysical parameter (only for level 3 products)
- avgAlg: the averaging algorithm to be used to process this geophysical parameter (only for level 3 products). Valid algorithms are:
  - MLE - Maximum Likelihood Estimator
  - AME - Arithmetic Mean
  - MINMAX - Minimum value/maximum value composite
- layers: the number of layers of a 3-dimensional dataset (only for level 3 products).
- dataType: sets the datatype for the geophysical variable. If this value is not set, a 32 bit floating point dataset will be written. Currently implemented are
  - UINT_8 - 8 bit unsigned integer

- FLOAT – 32 bit IEEE floating point value

- scale: a scaling factor to be applied during writing of the product. If not set, 1.0 is assumed.
- offset: an offset value to be applied during writing of the product. If not set 0.0 is assumed.

5.1.3.1.3 Input Parameters

This parameter block describes the input data additionally to the standard MERIS level1b and level 2 input data. These inputs mainly consist of the auxiliary data needed to produce the output product described. Also, in this parameter block the (eventual) dependencies of products can be described.

Example:

```
<Auxiliary type="ENVISAT.MERIS.VA.L2.LCC_AUX"
           file="lcc/merval2p-lcc-aux.h5"/>
```

This parameter describes the auxiliary data for an output product. Valid atributes are:

- type: the type of the auxiliary data
- file: the (relative) location of the auxiliary data disk file

If a product needs data of another MERIS-VA product already defined as auxiliary input data, this dependency can be expressed by the `<Predecessor>` tag.

Example:

```
<Predecessor type="ENVISAT.MERIS.VA.L2.SA"/>
```

Valid predecessor types are all MERIS-VA products already defined in the configuration file. The MERIS-VA processor automatically detects these dependencies and produces the appropriate product before producing the product described.

5.1.4 Configuation Data Type Descritor File

The data type descriptor (DTD) for the XML format and a more detailed description of the XML tags and tag attributes and -values used in the MERIS-VA configuration files is given below:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
    <!ELEMENT ProcessorConfig (Parameters+, PlugIns+, Products+)>
    <!ATTLIST ProcessorConfig>
    <!ELEMENT Parameters (Parameter*)>
    <!ELEMENT Parameter          EMPTY>
    <!ATTLIST Parameter
        name           CDATA #REQUIRED
        value          CDATA #REQUIRED
    >
    <!ELEMENT PlugIns (PlugIn*)>
    <!ELEMENT PlugIn             EMPTY>
    <!ATTLIST PlugIn
        class          CDATA #REQUIRED
        library        CDATA #REQUIRED
    >
```

```
<!ELEMENT Products (Product*)>
<!ELEMENT Product  (Description?, SceneData?, Inputs?)>
<!ATTLIST Product
     type          CDATA #REQUIRED
     plugin        CDATA #IMPLIED
     file          CDATA #IMPLIED
     iif           CDATA #IMPLIED
     weight        CDATA #IMPLIED
>
<!ELEMENT Description (#PCDATA)>
<!ELEMENT SceneData (Variable*)>
<!ELEMENT Variable  (#PCDATA)>
<!ATTLIST Variable
     name          CDATA #REQUIRED
     class         CDATA #REQUIRED
     unit          CDATA #IMPLIED
     descr         CDATA #IMPLIED
     flags         CDATA #IMPLIED
     quality       CDATA #IMPLIED
     file          CDATA #IMPLIED
     avgAlg        CDATA #IMPLIED
     layers        CDATA #IMPLIED
>
<!ELEMENT Inputs (Predecessor*, Auxiliary*)>
<!ELEMENT Predecessor EMPTY>
<!ATTLIST Predecessor
     type          CDATA #REQUIRED
>
<!ELEMENT Auxiliary   EMPTY>
<!ATTLIST Auxiliary
     type          CDATA #REQUIRED
     file          CDATA #IMPLIED
>
```

5.2 MERIS-VA Request Files

MERIS-VA processors are implemented as shared libraries driven by the DIMS/PSM. In operational mode, the processor program arguments are passed as parameters of the entry point function whithin the shared library (`pbody_start(args)`). For testing, the processors can also be run in stand-alone mode without having a PSM running or even installed. The arguments forming a processing request are then passed as XML files to the processor executables. A request file contains:

- A list of processor input products and a list of output products to be generated: Each product description contains:
  - A product type ID
  - A product key (list of product instance identifying key-value pairs)
  - A file path to the source directory
- A list of processor output products: Each product description contains:
  - A product type ID
  - A product key (list of product instance identifying key-value pairs)
  - A file path to the target directory
- A list of processing parameters. A processing parameter has
  - A unique name
  - An arbitrary value

Example:

```
<?xml version="1.0"?>
<!DOCTYPE psm-pdr SYSTEM "psm-pdr.dtd">
<psm-pdr version="1.1" home="../localcache">
<ProductionRequest  type="merval2p">
     <DescriptionParameters>
     </DescriptionParameters>
     <ProductionOptions>

          <InputProduct      type="ENVISAT.MERIS.L1B.RR"
                             path="l1b" />
          <InputProduct      type="ENVISAT.MERIS.L2.RR"
                             path="l2" />
          <OutputProduct     type="ENVISAT.MERIS.VA.L2.NDVI"
                             path="out/ndvi"   />
     </ProductionOptions>
</ProductionRequest>
</psm-pdr>
```

In the following the data type descriptor (DTD) for the XML structure is given and a more detailed description of the XML tags and tag attributes and values used in the MERIS-VA request files is given below.

```
<?xml encoding="ISO-8859-1"?>
<!-- Revision: 2.1 psm-pdr.dtd -->
<!ELEMENT psm-pdr                (ProductionRequest+)>
<!ATTLIST psm-pdr
     version                (1.0 | 1.1) "1.1"
     home                   CDATA #IMPLIED>
```

```
<!ELEMENT ProductionRequest      (DescriptionParameters?,
                                 ProductionOptions?,
                                 AdministrationParameters?,
                                 LocalParameters?)>
<!ATTLIST ProductionRequest
     type                   CDATA #IMPLIED>
<!ELEMENT ProductionOptions
((InputProduct|OutputProduct|ProcessingParameter|Product)*,UserRemark?)>
<!ELEMENT InputProduct          EMPTY>
<!ATTLIST InputProduct
          type                  CDATA #REQUIRED
          id                    CDATA #REQUIRED
          components            CDATA #IMPLIED
          path                  CDATA #IMPLIED
          size                  CDATA #IMPLIED
          permanency            ( true | false ) "true"
          reliability           ( true | false ) "true"
          reprocessing          ( true | false ) "false">
<!ELEMENT OutputProduct         EMPTY>
<!ATTLIST OutputProduct
          type                  CDATA #REQUIRED
          id                    CDATA #REQUIRED
          components            CDATA #IMPLIED
          path                  CDATA #IMPLIED
          size                  CDATA #IMPLIED
          permanency            ( true | false ) "true"
          reliability           ( true | false ) "true"
          reprocessing          ( true | false ) "false">
<!ELEMENT ProcessingParameter   (#PCDATA|GeoPoint)*>
<!ATTLIST ProcessingParameter
          key                   CDATA #REQUIRED>
<!ELEMENT GeoPoint              EMPTY>
<!ATTLIST GeoPoint
          longitude             CDATA #REQUIRED
          latitude              CDATA #REQUIRED>
<!ELEMENT UserRemark            (#PCDATA)>

<!ELEMENT AdministrationParameters (Comment?)>
<!ATTLIST AdministrationParameters
          priority              CDATA #IMPLIED
```

```
          expirationDate        CDATA #IMPLIED
          processingTargetDate  CDATA #IMPLIED
          processingTime        CDATA #IMPLIED
          creationDate          CDATA #IMPLIED
          thematicGroup         CDATA #IMPLIED
          processingRelease     CDATA #IMPLIED
          processingInitiation  CDATA #IMPLIED>
<!ELEMENT Comment               (#PCDATA)>

<!ELEMENT LocalParameters       EMPTY>
<!ATTLIST LocalParameters
          status                CDATA #IMPLIED
          preparationIsReleased (true | false | default) "default"
          processingIsReleased  (true | false | default) "default"
          finishingIsReleased   (true | false | default) "default"
          closingIsReleased     (true | false | default) "default"
          continueWhenTransferFails  ( true | false | default) "default">


<!ELEMENT DescriptionParameters (Product*,UserRemark?)>
<!ELEMENT Product               EMPTY>
<!ATTLIST Product
          type                  CDATA #REQUIRED
          id                    CDATA #REQUIRED
          components            CDATA #IMPLIED
          path                  CDATA #IMPLIED
          size                  CDATA #IMPLIED
          permanency            ( true | false ) "true"
          reliability           ( true | false ) "true"
          reprocessing          ( true | false ) "false">
```

5.3 MERIS-VA Log Files

A MERIS-VA processor log file comprises a list of logging entries made by the processors, their plug-ins or product tailors. A log file has the following format:

Line#	*Content*
1	Log file automatically created on <*current-date/time*>
2	by <*processor-name*>, version <*processor-version*>
3	
4...n	<*message-type*> <*elapsed-time*> <*message*>

where <*message-type*> is one of four characters with the following meanings

D Debugging message. This message type occurs only when the processor was invoked in debug mode.

N Normal message having just an informal character.

W A warning message saying that the processor was suspicious about something.

E Error message. Only written out when a real processing error occured, such as a configuration error or an I/O problem.

and <*elapsed-time*> is the time elapsed since the processor was invoked. The time is printed in the format "`HH:MM:SS`".

5.4 MERIS-VA Primary Files in General

5.4.1 Common Primary File Structure

{TODO: Talk about the common file structure}

$$\text{SceneColumnCount} = 1 + \text{TiePointSubSampling} \times (\text{TiePointColumnCount} - 1)$$

$$\text{SceneLineCount} = 1 + \text{TiePointSubSampling} \times (\text{TiePointLineCount} - 1)$$

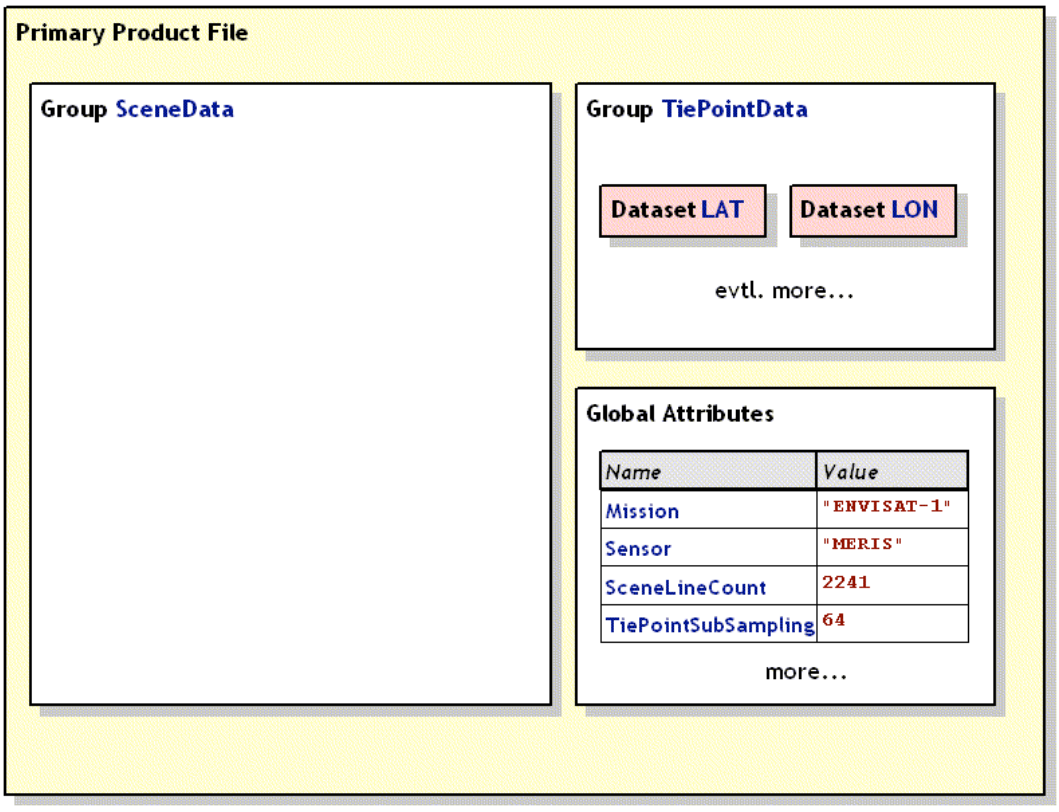

Figure 12: Common primary file structure

5.4.2 Common Global Attributes

The following table list all global attributes which are common to all MERIS-VA products. If applicable, these attributes are also found in the tailored level2 and level 3 products.

Table 5-1: Common MERIS-VA global attributes

Attribute Name	*Type*	*Description*
Mission and Documentation Attributes		
ProductTypeID	string	The name of the DIMS/PL product type identifier
ProductFileName	string	The name of this primary product file (without path)
ProductDescription	string	Textual product description
ProductName	string	Product name, general format is "<*level*>.<*type*>" where level is one of `L2` Level 2 Product `L2T` Tailored Level 2 Product `L3U` Updated Level 3 Product `L3` Level 3 Product `L3T` Tailored Level 3 Product and <*type*> is a name for the actual product content. Also serves as item code identifier for the product component in the DIMS/PL.
Sensor	string	`"MERIS"`; satellite sensor name
Mission	string	`"ENVISAT-1"`; satellite mission name
DataCenter	string	`"DLR Data Processing Center"`
StationName	string	`"DLR-NZ"`
StationLocationLat	float32	`53.32971666`
StationLocationLon	float32	`13.07256665`
ProcessingLevel	string	The processing level. Depends, `"Level 2"` or `"Level 3"`
ProcessingTime	date	Local time of generation of this product.
ProcessorName	string	Name of the software used to create this product. Depends: `"MERIS-VA` <***ProcessingLevel***> `Processor"` or `"MERIS-VA` <***ProcessingLevel***> `Tailor"`
ProcessorVersion	string	Version of the software used to create this product in the format "<*major*>.<*minor*>", e.g. `"2.7"`.
PlugInName	string	Name of the processor plug-in used to create this product.
PlugInVersion	string	Version of the processor plug-in used to create this product in the format "<*major*>.<*minor*>", e.g. `"2.7"`.
InputFileNames	string	Comma separated list of file names of the input products used to create this product.
InputParameters	string	Comma separated list of processing parameters used to create this product.
AuxDataFileNames	string	Comma separated list of auxiliary data file names used to create this product.
AuxDataVersions	string	Comma separated list of the versions of auxiliary data files used to create this product (the list elements correspond to the elements in **AuxDataFileNames**).
LatitudeUnits	string	`"Decimal Degrees North"`; units used for all latitude values in this product.
LongitudeUnits	string	`"Decimal Degrees East"`; units used for all longitude values in this product.
Tie Point Data Properties		

TiePointColumnCount	uint32	Number of tie point columns. Applies to all datasets in the **TiePointData** group.
TiePointLineCount	uint32	Number of tie point lines. Applies to all datasets in the **TiePointData** group.
TiePointSubSampling	uint32	Number of pixels minus one covered by two tie points in vertical and horizontal direction.
Scene Data Properties		
SceneColumnCount	uint32	Number of scene columns in pixels. Applies to all datasets in the **SceneData** group.
SceneLineCount	uint32	Number of scene lines in pixels. Applies to all datasets in the **SceneData** group.
SceneCenterLat	float32	Latitude of the nadir point of the scene's center scan line.
SceneCenterLon	float32	Longitude of the nadir point of the scene's center scan line.
SceneCenterSza	float32	Sun zenith angle of the nadir point of the scene's center scan line in decimal degrees.
SceneCenterSaa	float32	Sun azimuth angle of the nadir point of the scene's center scan line in decimal degrees.
SceneUpperLeftLat	float32	Latitude of the upper left scene corner.
SceneUpperLeftLon	float32	Longitude of the upper left scene corner.
SceneUpperRightLat	float32	Latitude of the upper right scene corner.
SceneUpperRightLon	float32	Longitude of the upper right scene corner.
SceneLowerLeftLat	float32	Latitude of the lower left scene corner.
SceneLowerLeftLon	float32	Longitude of the lower left scene corner.
SceneLowerRightLat	float32	Latitude of the lower right scene corner.
SceneLowerRightLon	float32	Longitude of the lower right scene corner.
SceneNorthernMostLat	float32	Northernmost latitude of all scan line end points.
SceneSouthernMostLat	float32	Southernmost latitude of all scan line end points.
SceneWesternMostLon	float32	Westernmost longitude of all scan line end points.
SceneEasternMostLon	float32	Easternmost longitude of all scan line end points.
SceneStartCenterLat	float32	Latitude of center pixel for first scan line.
SceneStartCenterLon	float32	Longitude of center pixel for first scan line.
SceneEndCenterLat	float32	Latitude of center pixel for last scan line.
SceneEndCenterLon	float32	Longitude of center pixel for last scan line.
OrbitNodeLon	float32	Longitude of scene's orbit descending node (longitude at equatorial crossing of day-side node). {TBD: Does MERIS provide that info?}