



AMORGOS  
Software User Manual & Interface  
Control Document

PO-ID-ACR-GS-  
0003  
Issue 4 rev. 0  
15/07/2011

The **AMORGOS** MERIS CFI  
(Accurate MERIS Ortho-Rectified Geo-location  
Operational Software)  
Software User Manual & Interface Control Document

PO-ID-ACR-GS-0003

Issue: 4 revision: 0

15 July 2011

|                  | <u>Function</u> | <u>Name</u> | <u>Company</u> | <u>Signature</u> | <u>Date</u> |
|------------------|-----------------|-------------|----------------|------------------|-------------|
| <b>Prepared:</b> | Engineer        | L. Bourg    | ACRI-ST        |                  |             |
|                  |                 | F. Rouffi   | ACRI-ST        |                  |             |
| <b>Approved:</b> | s/w Coordinator | F. Rouffi   | ACRI-ST        |                  |             |
| <b>Released:</b> | Project Manager | L. Bourg    | ACRI-ST        |                  | 15/07/2011  |



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### **Distribution**

| <u>Name</u>             | <u>Quantity</u> |
|-------------------------|-----------------|
| S.. DELWART (ESA/ESRIN) | 1               |
| L. BOURG (ACRI-ST)      | 1               |
| F. ROUFFI (ACRI-ST)     | 1               |

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## 1. Purpose

The purpose of the AMORGOS tool is to generate accurate geo-location information – longitude, latitude, altitude – for each MERIS pixel, starting from a MERIS Reduced Resolution or a Full Resolution product: either a Full Swath or a standard half-swath Scene product. **The quarter-swath product is not managed.**

Specific case of the Full Resolution Full Swath product:

If the input product is a Full Resolution Full Swath one, the current version accepts two modes. The first one preserves the organisation of the input product, namely the Level 1b product grid, it is referred to as the FSG (full swath geo-corrected) mode and generates a MER\_FSG\_1P product. The second one generate results re-organised in the instrument geometry, it is referred to as the FSO (full swath ortho-geolocated) mode and generates a MER\_FSO\_1P product.

The FSO mode first restores radiance samples and accompanying flags into Instrument Geometry, un-doing the spatial re-sampling of the Level1 processing, and computes accurate ortho-rectified geo-location using MERIS detectors individual pointing vectors, a High Resolution DEM and accurate spacecraft Orbit and Attitude files.

The FSG mode essentially skips the Instrument Geometry restoration step and computes the same geo-location information for each MERIS detector and each acquisition time but it affects these values to the corresponding MERIS LIB product pixels. It must be noted here that since the MERIS product grid is filled by a nearest neighbour method from the Instrument Acquisition grid with a slight spatial over-sampling, the same instrument sample can be found several times in the same Level 1b product (it is then identified as a DUPLICATE pixel within the Level 1b product flags). Since the additional geo-location information of the MER\_FSG\_1P product is linked to the source Instrument sample, it will be duplicated the same way than the radiance information.

Ortho-rectified geo-location must be understood as the computation of the intersection of a given sample line of sight with the Earth surface (as represented by the Digital Elevation Model) rather than with the reference ellipsoid as in Level 1b. However, it must be noted that image geometry is either the Instrument one (FSO mode) or the Level 1b one (FSG mode) and thus the output product is not ortho-rectified *stricto sensu*.

## 2. References

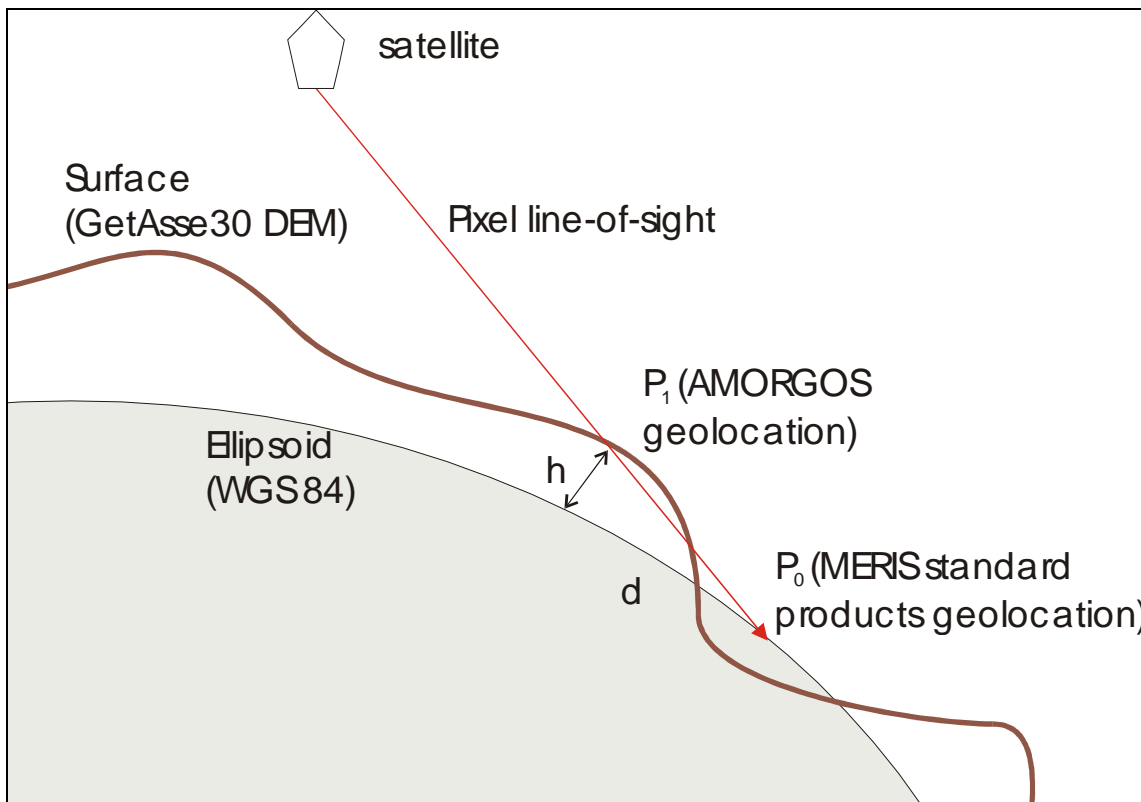
|     |                   |  |
|-----|-------------------|--|
| RD1 | PO-TN-MEL-GS-003  | MERIS Input/Output Data Definition Format  |
| RD2 | PO-AD-ACR-GS-0003 | AMORGOS Algorithm document 2.2A 20/07/2005                                       |
| RD3 | PO-RS-MDA-GS-2009 | ENVISAT Product Specification  |
| RD4 | PO-IS-GMV-GS-0561 | Envisat-1 Mission CFI Software -. Mission Conventions Document                   |
| RD5 | PO-IS-DMS-GS-0557 | Envisat-1 Mission CFI Software - PPF_LIB Software User Manual. PO-IS-DMS-GS-0557 |

|     |                   |  |
|-----|-------------------|--|
| RD6 | PO-IS-DMSGGS-0559 | Envisat-1 Mission CFI Software - PPF_POINTING Software User Manual |
| RD7 | PO-RP-ACR-GS-0014 | Amorgos RR validation report V1r0                                  |

### 3. Overview

AMORGOS is run once for every MER\_RR\_\_1P, MER\_FRS\_1P or MER\_FR\_\_1P file and generates the corresponding MER\_RRG\_1P, MER\_FSO\_1P, MER\_FSG\_1P or MER\_FRG\_1P file. Identification of the source Instrument sample (defined by a detector index and an acquisition time), and if required the re-construction of the instrument projection, is done using MER\_XXX\_1P internal data, the so-called MERIS detector index data set, and some additional MERIS Level 1B pixel pointing auxiliary data extracted from the appropriate MER\_INS\_AX file. For each MERIS sample, an ortho-geolocation algorithm computes the *first* intersection between the pixel's line of sight and the Earth surface, represented by interpolation of the GetAsse30 high resolution Digital Elevation Model (DEM) cells elevations on top of the reference ellipsoid. Line of sight is determined using its pointing vector expressed relative to the satellite, the satellite location and attitude, that are in turn determined from appropriate Orbit and Attitude files using the appropriate CFI routines. Location of the intersection is expressed as longitude, geodetic latitude and geodetic altitude.

The principle of the computation described above is illustrated on the following figure (please note that the figure does not show realistic observation conditions):



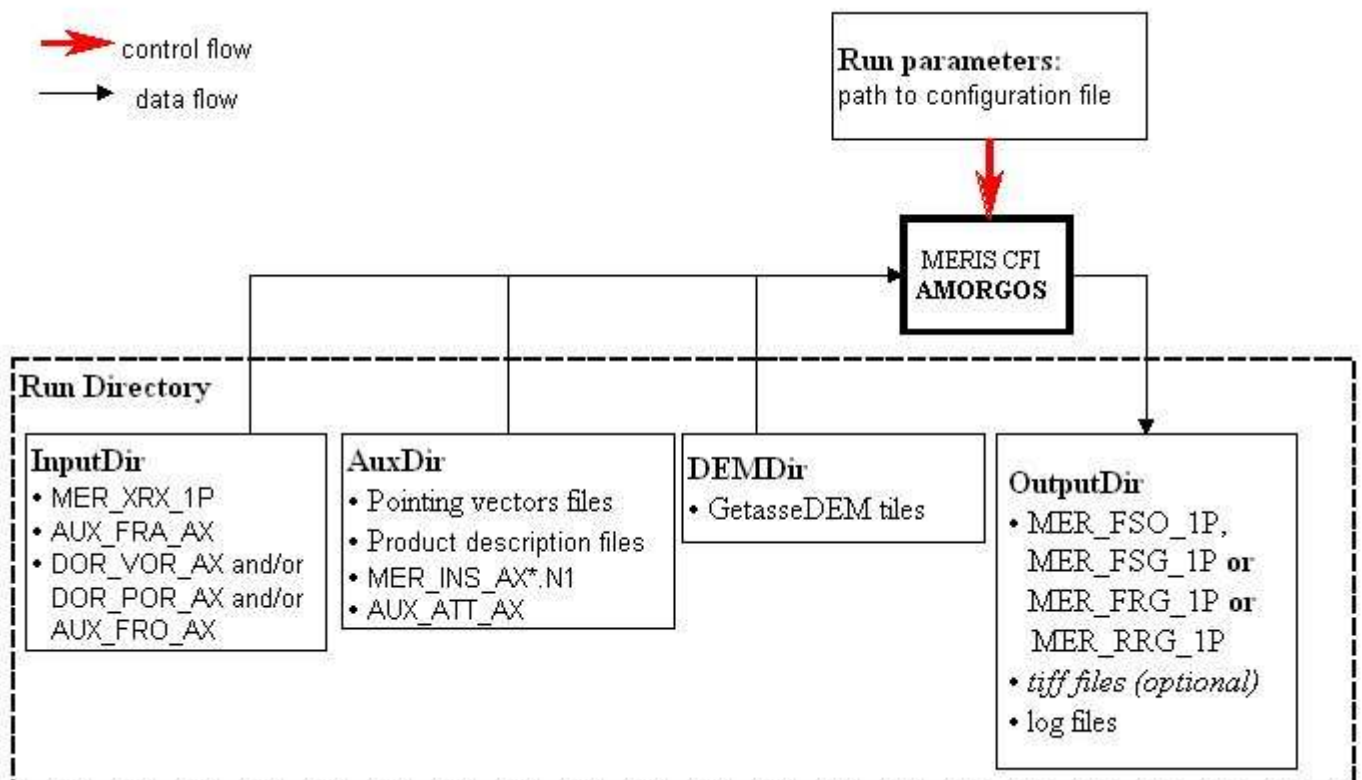
## 4. Operating AMORGOS

The interface between AMORGOS and its hosting and operating facility is based on input, auxiliary and output data files. Auxiliary files are further split amongst instrument related on one hand and Digital Elevation Model files on the other hand.

Version 4.0 of AMORGOS is available on LINUX platform only.

AMORGOS is run via a shell script, part of the delivery.

The unique entry point to the shell script is the path to a configuration file. This configuration file is used to specify actual paths to the *input*, *output*, *auxiliary* and *DEM* directories where AMORGOS will, respectively, expect the input files, generate the output files (including the log files) and read auxiliary files.



AMORGOS data and control flow

#### 4.1.1 Perform the installation

##### CONVENTION:

In the following text, a symbol like \$AMORGOS\_INSTALL is used to describe your AMORGOS installation directory *from the standpoint of this document*. In the following instructions, you should replace it by its appropriate value. This convention is used with several different directories.

##### 1. Go into the wanted directory for restoring installation files.

Type the following command:

```
cd $AMORGOS_INSTALL
```

Note that distribution files need about 450 MB, so make sure to have such free disk space before starting the restoration.

##### 2. Restore the distribution files.

Type the following command :

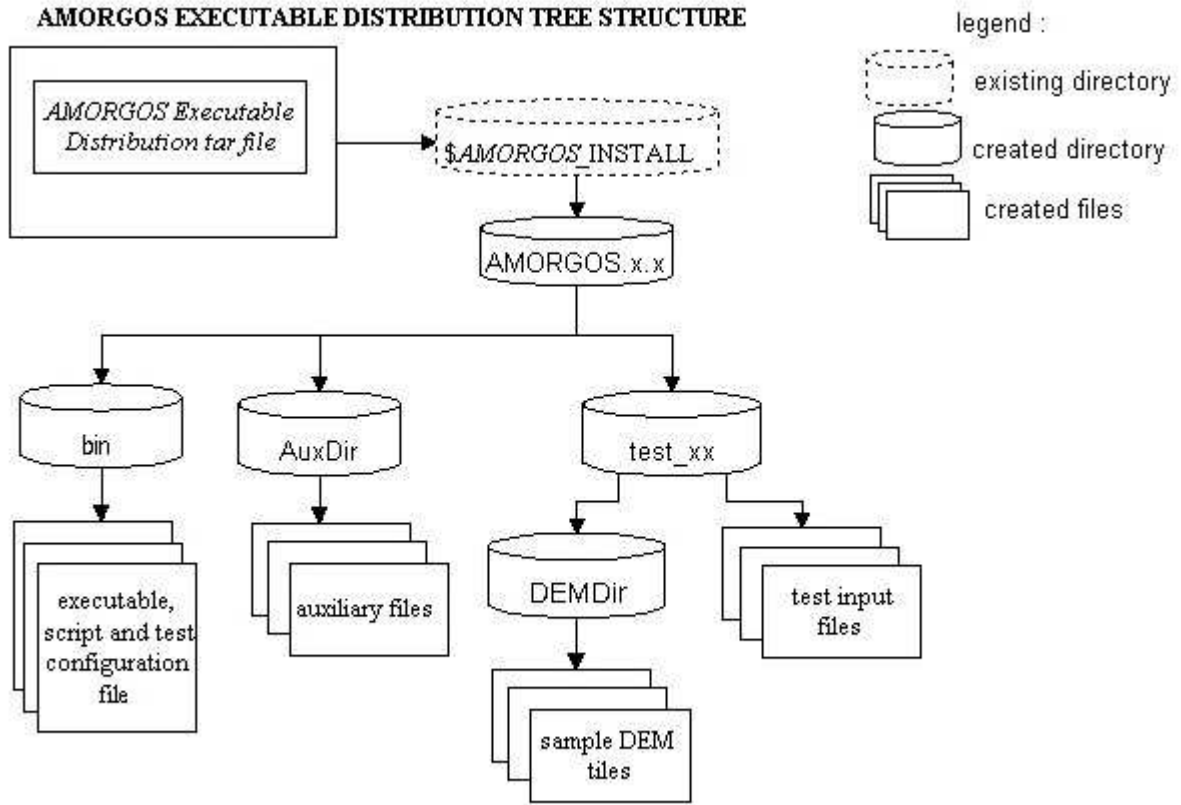
```
tar -xvf [<path name>/]AMORGOS.4.0.tar.gz
```

where <path name> (*optional*) is the path to the Amorgos distribution tar file.

example :

```
> tar -xvf /dvdrom/dvdrom0/AMORGOS.4.0.tar.gz
```

This operation restores all the distribution files as outlined on the figure below:



### 3. Perform the test run.

The installation kit includes set of files to allow you to perform test runs.

For this, the simplest way is to go into the *bin* directory and type the following command:

```
./amorgos.sh ./test_xx.ini
```

In the V4.0 version, two set of tests is provided:

- One test in FR mode: *test\_fr.ini*
- On test in RR mode: *test\_rr.ini*

The result files will be created in the *test\_xx* directory.

You can monitor the run progress (from another command window) by the command:

```
tail -f ../test_xx/status.txt (assuming you still are in the bin directory)
```

### 4.1.2 System Requirements

AMORGOS is composed of a C executable program operated through a UNIX shell script. It is intended to be run on a LINUX station with kernel 2.4 or later.

### 4.1.3 Command syntax

AMORGOS shall always be operated through its associated UNIX shell script `amorgos.sh`. Both the shell script and the C executable AMORGOS shall be located in the same directory.

Syntax:

```
exec_path/amorgos.sh configuration_file_name
```

where:

- *exec\_path* is a valid UNIX path, either absolute or relative, to the directory where all the executable files can be found, e.g. `./amorgos.sh`, `/file_system/dir/amorgos.sh`, ...
- *configuration\_file\_name* is a valid UNIX path name to the AMORGOS configuration file, either absolute or relative to the current directory (i.e. where the command is issued). The user issuing the command shall have read permissions for the configuration file.

### 4.1.4 Configuration file format and content

The configuration file is under responsibility of the user. It allows the user to specify the location of the input, auxiliary, DEM and output directories. It is an ASCII text file, formatted as a list of keywords followed by character strings enclosed in double quotes and a new line character.

Keywords must start on the first column of a line and must be followed by a "=" sign. Character strings or numerical shall follow immediately the "=" sign. There are no blank spaces. Keywords and associated values must be written on one single line. Character strings cannot exceed 128 characters. Any line starting with the '#' symbol is considered as a comment line and ignored; empty lines are used as separators and are ignored as well.

The directory paths fields are mandatory, as bearing essential information for the main program run. The configuration fields, `CONFIG_FILE` and `DATE`, as well as the option switches, `FSO_MODE`, `FIRST_FRAME`, `FRAME_NUMBER` and `TIFF_SWITCH`, are not mandatory: the first two have been included to ease user's configuration management but are not used internally, and the last ones are set to the default values specified below if not provided.

The requested fields are:

| Field Format                | Description   | Comment                |
|-----------------------------|---|------------------------|
| CONFIG_FILE=<filepath>      | Name of the configuration file  |                        |
| DATE=<UTC date>             | File creation date  |                        |
| <empty>                     | Separator   |                        |
| NAME_INPUT_DIR=<directory>  | Identification of the input directory   | <b>mandatory field</b> |
| NAME_AUX_DIR=<directory>    | Identification of the auxiliary directory   | <b>mandatory field</b> |
| NAME_DEM_DIR=<directory>    | Identification of the auxiliary directory   | <b>mandatory field</b> |
| NAME_OUTPUT_DIR=<directory> | Identification of the output directory  | <b>mandatory field</b> |
| <empty>                     | Separator   |                        |
| FSO_MODE=<0 or 1>           | Processing mode switch: 0 = FSG mode (default), 1= FSO mode   |                        |
| FIRST_FRAME=<n>             | Index of the frame (input image line) at which processing shall start (numbering starts at 1). Defaults to 1 if not provided. | See note below.        |
| FRAME_NUMBER=<m>            | Total number of frames to process. Defaults to number of frames in the input product if not provided.                         | See note below.        |
| TIFF_SWITCH=<0 or 1>        | Switch enabling generation of optional output TIFF files  | 1=generation enabled   |

Where:

- <filepath>: valid Unix filename including its absolute or relative path. Up to 128 characters can be specified. If relative, path must be expressed with respect to where the `amorgos.sh` command is issued.
- <directory>: valid Unix directory name. Up to 64 characters can be specified.
- <UTC date>: UTC date in ENVISAT-1 external format as described in RD3.
- n or m Integer numbers greater or equal to 1, maximum values following the rules detailed below

**Important Note:** the following rules apply to the output products time limits:

- The output product size is limited due to Operating System constraints, as a consequence, the total number of frames processed will NEVER exceed 10305 for the FSG product and 12865 for the FSO product (the latter being the specified maximum size of the input FRS product). **As a consequence, a run in FSG mode may result in a partial processing of the input file, even if complete processing was required.** Output time limits (expressed in frame units) are always reported in the status log file to allow systematic checks (see section 5.6 for message format).
- The output product shall follow the granule rule, i.e. the total number of frames shall cover the extent of the total number of Tie Frames (Annotation records, see RD 1 for details) to ensure that any measurement frame time is within the interval defined by two consecutive annotation record times. If the `FIRST_FRAME` and / or the `FRAME_NUMBER` options are provided and do not respect these rules, `FIRST_FRAME` will be forced to the closest earlier Annotation frame (if required) and the actual number of processed frames will be forced to a value that completes the that completes the granule of the requested last frame (to the limit expressed by rule 1, see above).



3. Whenever the software has to modify the product time limits for any of the above reasons, an informational message will be provided in the status log file (see section 5.6 for message format).

#### Examples:

```
CONFIG_FILE="/ocean/data/AMORGOS/test_Averaging/AMORGOS.config"  
DATE="12-DEC-2005 18:16:00.000000"
```

```
NAME_INPUT_DIR="/Disk1/data/AMORGOS/test_Adriatic/input"  
NAME_AUX_DIR="/Disk1/data/AMORGOS/Auxiliary"  
NAME_DEM_DIR="/Disk2/Ancillary/GETASSE"  
NAME_OUTPUT_DIR="/Disk1/data/AMORGOS/test_Adriatic/output"
```

```
TIFF_SWITH=0
```

```
CONFIG_FILE="/Disk1/data/AMORGOS/test_Adriatic/AMORGOS.config"  
DATE="12-DEC-2005 18:16:00.000000"
```

```
NAME_INPUT_DIR="/Disk1/data/AMORGOS/test_Adriatic/input"  
NAME_AUX_DIR="/Disk1/data/AMORGOS/Auxiliary"  
NAME_DEM_DIR="/Disk2/Ancillary/GETASSE"  
NAME_OUTPUT_DIR="/Disk1/data/AMORGOS/test_Adriatic/output"
```

```
FSO_MODE=0  
FIRST_FRAME=10305  
FRAME_NUMBER=2561  
TIFF_SWITCH=1
```

### 4.1.5 Run Configuration

Once the configuration is properly set to define all the run parameters, the following set of files must be available to the software:

#### **In the Input Directory:**

All the files mentioned in section 0, respecting naming conventions specified for Linux by either physical copy or link.

#### **In the Auxiliary Directory:**

All the files mentioned in section 4.2.3, respecting naming conventions specified for Linux by either physical copy or link.

#### **In the DEM Directory:**

All the Getasse30 tiles necessary to cover the area delineated by the MERIS Level 1b product to be processed. File names must be the original Getasse30 distribution ones.



## 4.2 Detailed Interface

### 4.2.1 Overview

Distinction is made between input files, specific to a given AMORGOS run, and auxiliary ones, common to all runs, or at least unfrequently modified. In addition, the DEM files are expected in a different directory, because they are assumed user provided and their total size makes them somewhat difficult to handle.

AMORGOS expects the user to define the path to each of the input files - listed in section 4.3.2 below that are all gathered in *the input directory*, the path of which is specified in the configuration file.

AMORGOS will create all the output files - listed in section 4.3.3 below - in the *output directory*, the path of which is specified in the configuration. AMORGOS also needs to access auxiliary files, delivered with the software, in the *auxiliary directory*, the path of which is specified in the configuration file, and, finally, access to the GETASSE Digital Elevation Model tiles, assumed to be located in a single directory, the *DEM directory*, the path of which is also specified in the configuration file.

AMORGOS shall have write and read rights for the *output directory* and its content. Read right is sufficient for all other directories and files.

It should be noted that the *input*, *output*, *auxiliary* and *DEM directories* can be identical providing that the above rules are satisfied.

#### 4.2.1.1 Where to get the ESA provided files

The Amorgos distribution provides only the Amorgos auxiliary files and test data sets. To proceed to other runs you may need:

**Another MERIS full or reduced resolution product.** If you are interested by Amorgos, we assume that you know how to order MERIS data products, however more details can be found at: [http://earth.esa.int/pcs/envisat/meris/documentation/Access\\_to\\_MERIS\\_data.pdf](http://earth.esa.int/pcs/envisat/meris/documentation/Access_to_MERIS_data.pdf)

**Corresponding Orbit and Attitude files.** They can be obtained from ESA upon request to [EOHelp@esa.int](mailto:EOHelp@esa.int).

**Complementary GETASSE30 files.** The whole distribution can downloaded from: <http://earth.esa.int/services/amorgos/download/getasse/> (288 files of 12 Mb each, or 3.48 Gb as a whole). Optionally, the full distribution can be obtained on DVD upon request to [EOHelp@esa.int](mailto:EOHelp@esa.int).

## 4.2.2 Input files

| File Name  | File description  | Descr. § | Origin              |
|--|---|----------|---------------------|
| <i>unconstrained</i>                                   | <i>Configuration file</i>   | 4.2.3    | <i>User defined</i> |
| MER_XRX_1P   | MERIS reduced resolution or full resolution full swath or full resolution scene Level 1B product  | See RD1  | ESA provided        |
| DOR_VOR_AX and/or,<br>DOR_POR_AX and/or,<br>AUX_FRO_AX | ENVISAT Orbit files.<br>Note: the software selects the 'best quality' file among the actually available files. Only one of them is mandatory. | See RD3  | ESA provided        |
| AUX_FRA_AX   | Restituted Attitude file  | See RD3  | ESA provided        |

Note: generic name of the input Level 1b product has been set to MER\_XRX\_1P to accommodate for the ability of Amorgos to process MER\_RR\_\_1P, MER\_FR\_\_1P and MER\_FRS\_1P products.

**WARNING: Input files are user provided and under user's responsibility. In particular, the user must ensure, to properly process a given MER\_RR\_\_1P, MER\_FRS\_1P or MER\_FR\_\_1P:**

1. Amorgos do not process all kinds of MER\_FR\_\_1P products. They exist in two sizes: the scene product, also referred to as half-swath, and the imagette, or quarter-swath, product. The former has a spatial extent of 2241 by 2241 pixels and the latter 1121 by 1121. **AMORGOS can only process half-swath scenes MER\_FR\_\_1P.**
2. to provide the appropriate AUX\_FRA\_AX file, that is a file who's content must cover the time span of the MERIS FR product to be processed plus TBD seconds before and TBD seconds after.
3. to provide at least one appropriate orbit file, among DOR\_VOR\_AX DOR\_POR\_AX and AUX\_FRO\_AX, with a content that must cover the time span of the MER\_RR\_\_1P, MER\_FR\_\_1P or MER\_FRS\_1P product to be processed plus 4 minutes before and 4 minutes after.
4. that all files submitted to processing are properly named according to the File Name column of the above Table.

## 4.2.3 Auxiliary files

| File Name                     | File description  | Descr. § | Origin           |
|-------------------------------|---|----------|------------------|
| MER_INS_AX*.N1                | Set of MERIS Instrument Data Products (Amorgos will automatically select the one mentioned in the MER_FRX_1P metadata)                    | See RD1  | ACRI-ST provided |
| Pointing_at_Pixels_FR_SaCS.m? | Pointing vector files for FR products. The ? sign stands for any number within 1, 5 and identifies the corresponding MERIS camera module. | 5.1      | ACRI-ST provided |

|                               |   |         |                  |
|-------------------------------|---|---------|------------------|
| Pointing_at_Pixels_RR_SaCS.m? | Pointing vector files for RR products. The ? sign stands for any number within 1, 5 and identifies the corresponding MERIS camera module. | 5.2     | ACRI-ST provided |
| AUX_ATT_AX                    | Envisat Predicted Attitude file<br>Note: if the appropriate AUX_FRA_AX is provided, this file will not be used.                           | See RD3 | ACRI-ST provided |
| index_?.txa,<br>database.db   | MERIS products description files. The ? sign stands for a one-digit alpha-numeric character identifying a given product file.             | N/A     | ACRI-ST provided |

All the files described above are provided with the Amorgos software.  
It is kindly suggested to the user to leave them unchanged.

#### 4.2.4 GetAsse30 DEM files

| File Name         | File description   | Descr. § | Origin       |
|-------------------|--|----------|--------------|
| xxVyyyH.GETASSE30 | Set of Digital Elevation Model tiles, each one covering an area of 15 degrees of longitude by 15 degrees of latitude (Amorgos will automatically determine which ones are necessary for a given processing and access only those).<br>xxVyyyH corresponds to the latitude and longitude of the South-West corner of the covered area: xx (resp. yyy) is the latitude (resp. longitude) value, by steps of 15 degrees, V (resp. H) identifies the North or South (resp. West or East) hemisphere.<br>xx ranges 0 to 65 if V=N, 15 to 90 if V=S<br>yyy 15 to 180 if H=W, 0 to 165 if H=E | N/A      | ESA provided |

#### 4.2.5 Output files

| File Name   | File description  | Descr. §      |
|---|---|---------------|
| MER_RRG_1P, MER_FSO_1P,<br>MER_FSG_1P or MER_FRG_1P | Output file in PDS format   | 5.3 to<br>5.6 |
| status.txt, error.txt                               | Status and error log files  | 5.7           |
| radiance.?.tiff                                     | Optional TIFF format output radiance files. ? stands for the spectral band index, in [1,15] | 5.8           |
| flags.tiff  | Optional TIFF format flags file   | 5.8           |
| longitude.tiff, latitude.tiff, altitude.tiff        | Optional TIFF format geolocation data files   | 5.8           |

**Important Note:** AMORGOS will always generate the MER\_FSO\_1P (resp. MER\_FSG\_1P, MER\_FRG\_1P, MER\_RRG\_1P) output file under its generic name “MER\_FSO\_1P” (resp. MER\_FSG\_1P, MER\_FRG\_1P, MER\_RRG\_1P), however, the PRODUCT field of its MPH is appropriately filled. It is the responsibility of the user to rename the file accordingly. This renaming can be done easily by a simple Unix command, e.g. in MER\_FSG\_1P case:

```
mv MER_FSG_1P `head -1 MER_FSG_1P | cut -d'=' -f2 | sed s/\"//g`
```

Execution of AMORGOS generates a status log file, and in some cases, an error log file, in the output directory, named `status.txt` and `errors.txt` respectively. The status log file is intended to be the recipient of all the messages generated during an AMORGOS run, either informational or reporting an error or exceptional event. The error log file is intended to be the recipient of all the messages reporting an exception or an unexpected event during an AMORGOS run. It allows an immediate verification of the run status.

There are two levels of errors occurring in AMORGOS: warnings and fatal errors. Execution continues normally after a warning is sent but a fatal error causes AMORGOS to stop immediately after it is raised.

#### 4.2.6 Returned value

The AMORGOS associated shell script `amorgos.sh` returns 0 if successful, and a value different from 0 if an error occurred.

## 5. Files Format and Content

### 5.1 MERIS FR Pixels Pointing Vector Files

name : Pointing\_at\_Pixels\_FR\_SaCS.m%  
 content : Pointing vectors projection on X and Y axis of SaCS for each FR column  
 data origin : MERIS Calibration CFI  
 type : all ASCII file  
 format :

header :

| Line description        | C format                        | arguments   |
|-------------------------|---------------------------------|---|
| keyword :               | #FD="%s"                        | "Interpolated pointing directional cosines Ux and Uy in SaCS, FR pixels"  |
| file creation date      | #CD="%s"                        | date of file creation/update in UTC   |
| identifiers :           | #ID=%d,<br>m=%d                 | 1, module index   |
| number of dimensions :  | #ND=%d                          | 1   |
| number of data per line | #NC=%d                          | 3   |
| dimension1 :            | #D1=%d                          | number of spatial positions in data (740)   |
| band set description    | #BS=%d,<br>%d-%d, ...,<br>%d-%d | number of bands and for each, first CCD row index and width in CCD rows ( ... stands for all the missing format descriptors ", %d-%d" needed to match the actual number of bands) |
| format mnemonic :       | #FM="%s"                        | "k, Ux, Uy"   |
| read format             | #RF="%s"                        | "%d %le %le"  |

data : each line is composed of a set of three values

|           |                  |              |              |
|-----------|------------------|--------------|--------------|
| symbol :  | k                | Ux           | Uy           |
| meaning : | CCD column index | X projection | Y projection |
| format    | %d               | %.15e        | %.15e        |
| unit      | dl               | dl           | dl           |

### 5.2 MERIS RR Pixels Pointing Vector Files

name : Pointing\_at\_Pixels\_RR\_SaCS.m%  
 content : Pointing vectors projection on X and Y axis of SaCS for each RR column  
 data origin : MERIS Calibration CFI  
 type : all ASCII file  
 format :

header :

| Line description        | C format                        | arguments   |
|-------------------------|---------------------------------|---|
| keyword :               | #FD="%s"                        | "Interpolated pointing directional cosines Ux and Uy in SaCS, RR pixels"  |
| file creation date      | #CD="%s"                        | date of file creation/update in UTC   |
| identifiers :           | #ID=%d,<br>m=%d                 | 1, module index   |
| number of dimensions :  | #ND=%d                          | 1   |
| number of data per line | #NC=%d                          | 3   |
| dimension1 :            | #D1=%d                          | number of spatial positions in data (185)   |
| band set description    | #BS=%d,<br>%d-%d, ...,<br>%d-%d | number of bands and for each, first CCD row index and width in CCD rows ( ... stands for all the missing format descriptors ", %d-%d" needed to match the actual number of bands) |
| format mnemonic :       | #FM="%s"                        | "k, Ux, Uy"   |
| read format             | #RF="%s"                        | "%d %le %le"  |

data : each line is composed of a set of three values

|           |                  |              |              |
|-----------|------------------|--------------|--------------|
| symbol :  | k                | Ux           | Uy           |
| meaning : | CCD column index | X projection | Y projection |
| format    | %d               | %.15e        | %.15e        |
| unit      | dl               | dl           | dl           |

## 5.3 MER\_RRG\_1P

### 5.3.1 - Summary

The Level 1b Reduced Resolution Product is summarised in the following table:

| Name                      | Level 1b Reduced Resolution  |
|---------------------------|--|
| Identifier                | MER_RR__1P   |
| Product Level             | 1b   |
| Description               | Radiance measurements at Top Of Atmosphere for the 15 MERIS bands, re-ordered, calibrated, geo-located, annotated with Product Confidence Data, calibration data, classification flags, and environment parameters.                    |
| Coverage                  | Global   |
| Packaging                 | Segment (see definition in [RD1] §2.4)   |
| Unit                      | $10^{-3} \text{ W.m}^{-2}.\text{sr}^{-1}.\text{nm}^{-1}$   |
| Range                     | 0..26 to 0..270 (Band dependent)   |
| Sampling                  | <b>spatial</b> : 1040 m across track and 1160 m along track.<br><b>spectral</b> : MERIS bands (see Table 3.2.1)  |
| Resolution                | <b>radiometric</b> : NEDL (see [R-5])<br><b>spatial</b> : MTF > 0.3 at Nyquist freq. ([R-5])<br><b>spectral</b> : $\leq 2.5 \text{ nm}$ ([R-5])  |
| Accuracy                  | <b>radiometric</b> : $\leq 2\%$ in 400-900 nm range ([R-5])<br><b>absolute geometric</b> : 2000m (spec. in [R-5])<br><b>relative geometric</b> : 1000m (spec. in [R-5])  |
| Geo-location requirements | Each pixel is geo-located with orthorectification (i.e. accounting for the Earth surface elevation as provided by a Digital Elevation Model).  |
| Format                    | <ul style="list-style-type: none"> <li>• 16 bits/sample</li> <li>• 1121 samples/record</li> <li>• 1 record /line</li> <li>• 14785 lines/MDS maximum</li> <li>• 1 GADS, 2 ADS &amp; 16 MDS (15 for TOA LU &amp; 1 for flags)</li> </ul> |
| Annotated data            | see below  |
| Frequency                 | 1 product per orbit  |
| Size                      | $553.10^6$ bytes (max.)  |

*Table 1 - Level 1b Reduced Resolution Product - Summary*

### 5.3.2 - Organization

The high-level breakdown of the Level 1b Reduced Resolution Product is described below:

| Description                                       | Size             |
|---|------------------|
| Level 1b RR - MPH                                 | 1247             |
| Level 1b RR - SPH                                 | 9942             |
| Level 1b RR - Summary Quality ADS                 | 3828             |
| Level 1b RR - GADS Scaling Factors                | 292              |
| Level 1b RR - ADS Tie Points Location & Aux. Data | 3295775          |
| Level 1b RR - MDS(1) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(2) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(3) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(4) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(5) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(6) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(7) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(8) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(9) TOA Radiance                 | 33340175         |
| Level 1b RR - MDS(10) TOA Radiance                | 33340175         |
| Level 1b RR - MDS(11) TOA Radiance                | 33340175         |
| Level 1b RR - MDS(12) TOA Radiance                | 33340175         |
| Level 1b RR - MDS(13) TOA Radiance                | 33340175         |
| Level 1b RR - MDS(14) TOA Radiance                | 33340175         |
| Level 1b RR - MDS(15) TOA Radiance                | 33340175         |
| Level 1b RR - MDS(16) Flags & Detector Index      | 49914160         |
| <b>Product Size</b>                               | <b>553327869</b> |

*Table 2- Level 1b Reduced Resolution Product - High-level breakdown*

Each Level 1b Reduced Resolution Product corresponds to one complete segment. Sizes in Table 2 above and in sub-sections below are given for the maximum size of the product. The actual size depends on the processing request.

### 5.3.3 - Main Product Header

The format and the content of the Main Product Header shall be as specified in [RD3].



### 5.3.4 - Specific Product Header

The Specific Product Header format shall be as specified in [RD3].

The Data Set Descriptor format shall be as specified in [RD3].

The Level 1b Reduced Resolution Product Specific Product Header will be in ASCII format and its content shall be as follows:

| N                                      | Byte # | Description   | Unit          | T  | D  | # Bytes |
|--|--------|---|---------------|----|----|---------|
| 1                                      | 0      | <b>SPH_DESCRIPTOR=</b>  | keyword       | uc | 15 | 15      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | SPH Descriptor<br>ASCII string describing the product.  | -             | uc | 28 | 28      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 2                                      | 46     | <b>STRIPLINE_CONTINUITY_INDICATOR=</b>  | keyword       | uc | 31 | 31      |
|  |        | Value: 0= No stripline continuity, the product is a complete segment<br>Other: Stripline Counter  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 3                                      | 82     | <b>SLICE_POSITION=</b>  | keyword       | uc | 15 | 15      |
|  |        | Value: +001 to NUM_SLICES<br>Default value if no stripline continuity = +001  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 4                                      | 102    | <b>NUM_SLICES=</b>  | keyword       | uc | 11 | 11      |
|  |        | Number of slices in this stripline Default value if no continuity = +001  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| <i>Product Time Information</i>        |        |   |               |    |    |         |
| 5                                      | 118    | <b>FIRST_LINE_TIME=</b>   | keyword       | uc | 16 | 16      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | Azimuth time first line of product.<br>UTC Time of first range line in the MDS of this product. UTC time format contained within quotation marks. | UTC           | uc | 27 | 27      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 6                                      | 164    | <b>LAST_LINE_TIME=</b>  | keyword       | uc | 15 | 15      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | Azimuth time last line of product Time of last range line in the MDS of this product. UTC time format contained within quotation marks.           | UTC           | uc | 27 | 27      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| <i>Product Positioning Information</i> |        |   |               |    |    |         |
| 7                                      | 209    | <b>FIRST_FIRST_LAT=</b>   | keyword       | uc | 16 | 16      |
|  |        | Geodetic Latitude of the first sample of the first line<br>A negative value denotes south latitude, a positive value denotes North latitude       | 10 -6 degrees | Al | 1  | 11      |
|  |        | <10-6degN>  | units         | uc | 10 | 10      |
|  |        | newline character   | terminator    | uc | 1  | 1       |

|    |     |   |              |    |    |    |
|----|-----|---|--------------|----|----|----|
| 8  | 247 | <b>FIRST_FIRST_LONG=</b>  | keyword      | uc | 17 | 17 |
|    |     | East geodetic longitude of the first sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.      | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 9  | 286 | <b>FIRST_MID_LAT=</b>   | keyword      | uc | 14 | 14 |
|    |     | Geodetic Latitude of the middle sample of the first line A negative value denotes south latitude, a positive value denotes North latitude | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 10 | 322 | <b>FIRST_MID_LONG=</b>  | keyword      | uc | 15 | 15 |
|    |     | East geodetic longitude of the middle sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.     | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 11 | 359 | <b>FIRST_LAST_LAT=</b>  | keyword      | uc | 15 | 15 |
|    |     | Geodetic Latitude of the last sample of the first line A negative value denotes south latitude, a positive value denotes North latitude   | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 12 | 396 | <b>FIRST_LAST_LONG=</b>   | keyword      | uc | 16 | 16 |
|    |     | East geodetic longitude of the last sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.       | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 13 | 434 | <b>LAST_FIRST_LAT=</b>  | keyword      | uc | 15 | 15 |
|    |     | Geodetic Latitude of the first sample of the last line A negative value denotes south latitude, a positive value denotes North latitude   | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 14 | 471 | <b>LAST_FIRST_LONG=</b>   | keyword      | uc | 16 | 16 |
|    |     | East geodetic longitude of the first sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.       | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 15 | 509 | <b>LAST_MID_LAT=</b>  | keyword      | uc | 13 | 13 |
|    |     | Geodetic Latitude of the middle sample of the last line A negative value denotes south latitude, a positive value denotes North latitude  | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |

|                                    |     |  |              |     |    |    |
|------------------------------------|-----|--|--------------|-----|----|----|
| 16                                 | 544 | <b>LAST_MID_LONG=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | East geodetic longitude of the middle sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.   | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degE>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 17                                 | 580 | <b>LAST_LAST_LAT=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Geodetic Latitude of the last sample of the last line A negative value denotes south latitude, a positive value denotes North latitude | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degN>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 18                                 | 616 | <b>LAST_LAST_LONG=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | East geodetic longitude of the last sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.     | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degE>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 19                                 | 653 | <b>Spare (blank characters)</b>  | -            | uc  | 47 | 47 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| <i>Product Quality Information</i> |     |  |              |     |    |    |
| 20                                 | 701 | <b>TRANS_ERR_FLAG=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | Set to 1 if number of transmission errors exceeds threshold. Set to 0 otherwise.   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 21                                 | 718 | <b>FORMAT_ERR_FLAG=</b>  | keyword      | uc  | 16 | 16 |
|                                    |     | Set to 1 if number of format errors exceeds threshold. Set to 0 otherwise.   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 22                                 | 736 | <b>DATABASE_FLAG=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Flag set to 1 if the processing parameters data base contents does not match the packet header contents.                               | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 23                                 | 752 | <b>COARSE_ERR_FLAG=</b>  | keyword      | uc  | 16 | 16 |
|                                    |     | Flag indicating coarse offsets are above threshold   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 24                                 | 770 | <b>ECMWF_TYPE=</b>   | keyword      | uc  | 11 | 11 |
|                                    |     | 0 = forecast ECMWF data was used 1 = analysis ECMWF data was used  | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 25                                 | 783 | <b>NUM_TRANS_ERR=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Number of transmission errors in the product   | -            | Al  | 1  | 11 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 26                                 | 809 | <b>NUM_FORMAT_ERR=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | Number of format errors in the product   | -            | Al  | 1  | 11 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 27                                 | 836 | <b>TRANS_ERR_THRESH=</b>   | keyword      | uc  | 17 | 17 |
|                                    |     | Threshold for setting TRANS_ERR_FLAG   | %            | Afl | 1  | 15 |
|                                    |     | <%>  | units        | uc  | 3  | 3  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |

|                                       |      |  |            |     |    |     |
|---------------------------------------|------|--|------------|-----|----|-----|
| 28                                    | 872  | <b>FORMAT_ERR_THRESH=</b>  | keyword    | uc  | 18 | 18  |
|                                       |      | Threshold for setting FORMAT_ERR_FLAG  | %          | Afl | 1  | 15  |
|                                       |      | <%>  | units      | uc  | 3  | 3   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 29                                    | 909  | <b>Spare (blank characters)</b>  | -          | uc  | 77 | 77  |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| <i>Additional Product Information</i> |      |  |            |     |    |     |
| 30                                    | 987  | <b>NUM_BANDS=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | Number of bands in the product   | -          | Ac  | 1  | 4   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 31                                    | 1002 | <b>BAND_WAVELEN=</b>   | keyword    | uc  | 13 | 13  |
|                                       |      | List of up to 15 band central wavelengths of the bands contained in this product. Unused values are set to zero.   | 10-3 nm    | Al  | 15 | 165 |
|                                       |      | <10-5nm>   | units      | uc  | 8  | 8   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 32                                    | 1189 | <b>BANDWIDTH=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | <b>List of up to 15 bandwidths for the bands in the product. The order of the list must match the order of the central wavelengths entries in the previous field.</b> Unused values are set to zero. Each entry is of the form Al. e.g., if only 13 bands were included in the product:<br>+10000+10000+10000+10000+10000+10000+10000+07500+02500+05000+12500+10000+12500+0000+00000 | 10-3 nm    | As  | 15 | 90  |
|                                       |      | <10-3nm>   | units      | uc  | 8  | 8   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 33                                    | 1198 | <b>INST_FOV=</b>   | keyword    | uc  | 9  | 9   |
|                                       |      | Instantaneous Field of View  | 10-6 deg   | Al  | 1  | 11  |
|                                       |      | <10-6deg>  | units      | uc  | 9  | 9   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 34                                    | 1328 | <b>PROC_MODE=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | Processor mode of operation 1 = Raw 0 = Full Processing  | flag       | uc  | 1  | 1   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 35                                    | 1340 | <b>OFFSET_COMP=</b>  | keyword    | uc  | 12 | 12  |
|                                       |      | Offset Compensation 1=ON 0=OFF   | flag       | uc  | 1  | 1   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 36                                    | 1354 | <b>LINE_TIME_INTERVAL=</b>   | keyword    | uc  | 19 | 19  |
|                                       |      | Line spacing in time   | (10-6) sec | Al  | 1  | 11  |
|                                       |      | <10-6s>  | units      | uc  | 7  | 7   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 37                                    | 1392 | <b>LINE_LENGTH=</b>  | keyword    | uc  | 12 | 12  |
|                                       |      | Number of samples per output line  | samples    | As  | 1  | 6   |
|                                       |      | <samples>  | units      | uc  | 9  | 9   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 38                                    | 1420 | <b>LINES_PER_TIE_PT=</b>   | keyword    | uc  | 17 | 17  |
|                                       |      | Number of lines between along track tie points   | lines      | Ac  | 1  | 4   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |

|                                      |      |  |            |     |    |             |
|--------------------------------------|------|--|------------|-----|----|-------------|
| 39                                   | 1442 | <b>SAMPLES_PER_TIE_PT=</b>                                     | keyword    | uc  | 19 | 19          |
|                                      |      | Number of samples between across track tie points              | samples    | Ac  | 1  | 4           |
|                                      |      | newline character  | terminator | uc  | 1  | 1           |
| 40                                   | 1466 | <b>COLUMN_SPACING=</b>   | keyword    | uc  | 15 | 15          |
|                                      |      | On ground spacing between columns                              | m          | Afl | 1  | 15          |
|                                      |      | <m>  | units      | uc  | 3  | 3           |
|                                      |      | newline character  | terminator | uc  | 1  | 1           |
| 41                                   | 1500 | <b>Spare (blank characters)</b>                                | -          | uc  | 41 | 41          |
|                                      |      | newline character  | terminator | uc  | 1  | 1           |
| <i>DSDs for included Data Sets</i>   |      |  |            |     |    |             |
| 42                                   | 1542 | <b>DSD-A of Level 1b Summary Quality ADS (SQADS)</b>           | -          | dsd | 1  | 280         |
| 43                                   | 1822 | <b>DSD-G of Level 1b Scaling Factors and General info GADS</b> | -          | dsd | 1  | 280         |
| 44                                   | 2102 | <b>DSD-A of Level 1b Tie Points Loc. &amp; Aux. Data ADS</b>   | -          | dsd | 1  | 280         |
| 45                                   | 2382 | <b>DSD-M(1-15) of Level 1b TOA Radiances MDSs</b>              | -          | dsd | 15 | 4200        |
| 46                                   | 6582 | <b>DSD-M(16) of Level 1b Flags &amp; Detector Index</b>        | -          | dsd | 1  | 280         |
| <i>DSDs for referenced Data Sets</i> |      |  |            |     |    |             |
| 47                                   | 6862 | <b>DSD-R Level 0 data file</b>                                 | -          | dsd | 1  | 280         |
| 48                                   | 7142 | <b>DSD-R Instrument auxiliary data file</b>                    | -          | dsd | 1  | 280         |
| 49                                   | 7422 | <b>DSD-R Proc. L1b control parameters data file</b>            | -          | dsd | 1  | 280         |
| 50                                   | 7702 | <b>DSD-R Radiometric calibration data file</b>                 | -          | dsd | 1  | 280         |
| 51                                   | 7982 | <b>DSD-R Digital Elevation Model data file</b>                 | -          | dsd | 1  | 280         |
| 52                                   | 8262 | <b>DSD-R Digital Roughness Model data file</b>                 | -          | dsd | 1  | 280         |
| 53                                   | 8542 | <b>DSD-R Coast-line/Land/Ocean file</b>                        | -          | dsd | 1  | 280         |
| 54                                   | 8822 | <b>DSD -R for ECMWF files used</b>                             | -          | dsd | 1  | 280         |
| 55                                   | 9102 | <b>DSD- R for Orbit State Vectors Used</b>                     | -          | dsd | 1  | 280         |
| 56                                   | 9382 | <b>DSD-R Platform Attitude data file (CFI software)</b>        | -          | dsd | 1  | 280         |
| 57                                   | 9662 | <b>DSD-spare</b>   | -          | dsd | 1  | 280         |
|                                      |      | <b>size (in bytes)</b>   |            |     |    | <b>9942</b> |

*Table 3- Level 1b Reduced Resolution Product - SPH*

All Data Set Descriptors (DSD) shall follow the format and have the content described in [A-4].

Note : L1b DPM [R-6] specifies an "ECMWF PCD" which is recommended to be included in a later version of [A-4] and this document.

### 5.3.5 - Annotation Data Set - Summary Quality

The Annotation Data Set format shall be as specified in [RD3].

This ADS contains only data useful for the evaluation of the quality of the product. It shall have one ADS Record for every new group of 8 tie frames (a new record has to be generated when starting the 9<sup>th</sup> tie frame, the last Summary Quality record of the product may be relevant for less than 8 tie frames), therefore it will hold 116 Records for the Level 1b Reduced Resolution Product.

The size of the ADS has been summarised below:

| ADSR no                 | Description                               | Size (bytes) |
|-------------------------|---|--------------|
| 0                       | ADSR associated with Tie Frame 1 .. 8     | 33           |
| 1                       | ADSR associated with Tie Frame 9 .. 16    | 33           |
| ...                     | ...                                       | ...          |
| 114                     | ADSR associated with Tie Frame 913 .. 920 | 33           |
| 115                     | ADSR associated with Tie Frame 921 .. 925 | 33           |
| <b>Total (in bytes)</b> |   | <b>3828</b>  |

*Table 4 - Level 1b Reduced Resolution Product - ADS Summary Quality*

The format and content of the Product Quality ADSR is described below:

| N                      | Byte # | Description                          | Unit | T  | D | # bytes   |
|------------------------|--------|--------------------------------------|------|----|---|-----------|
| 1                      | 0      | <i>Start time of the measurement</i> | -    | sl | 3 | 12        |
| 2                      | 12     | <i>Attachment Flag</i>               | -    | uc | 1 | 1         |
| 3                      | 13     | Image samples Out of Range flag      | -    | us | 5 | 10        |
| 4                      | 23     | Blank samples Out of Range flag      | -    | us | 5 | 10        |
| <b>size (in bytes)</b> |        |                                      |      |    |   | <b>33</b> |

*Table 5 - Level 1b Reduced Resolution Product - ADSR Summary Quality*

For every band, when the number of out of range samples is above a given threshold then the corresponding bit of the out-of-range flag is set to TRUE (1), otherwise it is set to FALSE (0). The 15 flags for all the bands of a MERIS module are stored in an unsigned integer; the correspondence between band number (1 to 15) and bit number (following the convention in section 2) is:

$$\text{bit number} = \text{band number} - 1$$

To have this information for every MERIS module, five unsigned integers are needed.

This ADS record will be provided every 8 along track tie frames. The information stored in this ADSR is relevant to 128 consecutive frames.

The "Image samples Out of Range flag" corresponds to out-of-range conditions on image pixels (see [R-6]).

The "Blank samples Out of Range flag" corresponds to out-of-range conditions on blank pixels (see [R-6]).

### 5.3.6 - Global Annotation Data Set - Scaling Factors

The Global Annotation Data Set format shall be as specified in [A-4].

The content of the GADS- Scaling Factors of Level 1b Reduced Resolution Product shall be as follows:

| N                                | Byte # | Description                           | Unit      | T  | D    | # bytes    |
|----------------------------------|--------|---------------------------------------|-----------|----|------|------------|
| 1                                | 0      | scaling factor - altitude             | dl        | fl | 1    | 4          |
| 2                                | 4      | scaling factor - roughness            | dl        | fl | 1    | 4          |
| 3                                | 8      | scaling factor - zonal wind           | dl        | fl | 1    | 4          |
| 4                                | 12     | scaling factor - meridional wind      | dl        | fl | 1    | 4          |
| 5                                | 16     | scaling factor - atmospheric pressure | dl        | fl | 1    | 4          |
| 6                                | 20     | scaling factor - ozone                | dl        | fl | 1    | 4          |
| 7                                | 24     | scaling factor - relative humidity    | dl        | fl | 1    | 4          |
| 8                                | 28     | scaling factor - radiances            | dl        | fl | 15   | 60         |
| 9                                | 88     | Gain setting                          | nd        | uc | 5*16 | 80         |
| 10                               | 168    | Sampling rate                         | (1.e-6) s | ul | 1    | 4          |
| 11                               | 172    | Sun Spectral Flux                     | IU        | fl | 15   | 60         |
| 12                               | 232    | spare                                 | -         | uc | 60   | 60         |
| <b>Data Base size (in bytes)</b> |        |                                       |           |    |      | <b>292</b> |

Table 6 - Level 1b Reduced Resolution Product - GADS Scaling Factors

All the scaling factors do not carry any unit, the units are carried by the corresponding parameters.

The Sun Spectral flux values are provided for the MERIS bands of the product (wavelengths and widths stored in the SPH, see Table 3 above), at the day of acquisition.

### 5.3.7 - Annotation Data Set - Tie Points Location & corresp. Aux. Data (LADS)

The Annotation Data Set format shall be as specified in [A-4].

With the tie point grid being a 16 x 16 sub grid of the RR product grid consisting of 14785 (AL) x 1121 (AC) pixels, there are 925\*71 (AL\*AC) tie points. One LADS record corresponds to one line of the Tie points grid. There are therefore 925 tie points Annotation Data Sets Records for the MER\_RR\_1P Product.

Each ADS is made of ADS Records, the size of the ADS has been summarised below:

| ADSR no                 | Description                       | Size (bytes)   |
|-------------------------|-----------------------------------|----------------|
| 0                       | ADSR associated with line # 1     | 3563           |
| 1                       | ADSR associated with line # 17    | 3563           |
| ...                     | ...                               | ...            |
| 924                     | ADSR associated with line # 14785 | 3563           |
| <b>Total (in bytes)</b> |                                   | <b>3295775</b> |

Table 7 - Level 1b Reduced Resolution Product - ADS Tie Points

An ADSR contains location and auxiliary data for all the tie points of the corresponding tie frames:



| N  | Byte # | Description                          | Unit              | T  | D  | # bytes     |
|----|--------|--------------------------------------|-------------------|----|----|-------------|
| 1  | 0      | <i>Start Time of the Measurement</i> | -                 | sl | 3  | 12          |
| 2  | 12     | <i>Attachment flag</i>               | -                 | uc | 1  | 1           |
| 3  | 13     | latitude                             | (1.e-6)deg        | sl | 71 | 284         |
| 4  | 297    | longitude                            | (1.e-6)deg        | sl | 71 | 284         |
| 5  | 581    | DEM altitude                         | m                 | sl | 71 | 284         |
| 6  | 865    | DRM roughness                        | m                 | ul | 71 | 284         |
| 7  | 1149   | DEM latitude correction              | (1.e-6)deg        | sl | 71 | 284         |
| 8  | 1433   | DEM longitude correction             | (1.e-6)deg        | sl | 71 | 284         |
| 9  | 1717   | sun zenith angle                     | (1.e-6)deg        | ul | 71 | 284         |
| 10 | 2001   | sun azimuth angle                    | (1.e-6)deg        | sl | 71 | 284         |
| 11 | 2285   | viewing zenith angle                 | (1.e-6)deg        | ul | 71 | 284         |
| 12 | 2569   | viewing azimuth angle                | (1.e-6)deg        | sl | 71 | 284         |
| 13 | 2853   | zonal wind                           | m*s <sup>-1</sup> | ss | 71 | 142         |
| 14 | 2995   | meridional wind                      | m*s <sup>-1</sup> | ss | 71 | 142         |
| 15 | 3137   | Mean sea level pressure              | hPa               | us | 71 | 142         |
| 16 | 3279   | ozone                                | DU                | us | 71 | 142         |
| 17 | 3421   | relative humidity                    | %                 | us | 71 | 142         |
|    |        | <b>size (in bytes)</b>               | -                 | -  | -  | <b>3563</b> |

Table 8 - Level 1b Reduced Resolution Product - ADSR Tie points

Altitude, roughness, zonal and meridional wind, atmospheric pressure, ozone and relative humidity use the scaling factors stored in the GADS Scaling factors (see Table 6 above).

The elements of a tie point annotation will be specified as follows:

### **Longitude location**

Tie point longitude wrt WGS084 shall be provided as per [A-2].

### **Latitude location**

Tie point latitude wrt WGS084 shall be provided as per [A-2].

### **DEM altitude**

Tie point altitude shall be provided using the data provided in the Digital Elevation Model file (see [A-4]).

### **DRM roughness**

Tie point roughness shall be provided using the data provided in the Digital Roughness Model file.

### **DEM longitude correction**

Tie point longitude correction shall be provided following the algorithm specified in [R-6].

### **DEM latitude correction**

Tie point latitude correction shall be provided following the algorithm specified in [R-6].

Note: DEM longitude (resp. latitude) correction shall be *added* to the corresponding Tie Point longitude (resp. latitude) to obtain the longitude (resp. latitude) of the intersection between the Tie Point Line Of Sight (from the Satellite) and the Earth surface, i.e. accounting for the DEM latitude at the Tie Point.

### **Sun zenith azimuth**

Tie point sun zenith angle shall be provided as specified in [R-6].

### **Viewing azimuth angle**

Tie point viewing zenith angle shall be provided as specified in [R-6].



**Sun zenith angle**

Tie point sun zenith angle shall be provided as specified in [R-6].

**Viewing zenith angle**

Tie point viewing zenith angle shall be provided as specified in [R-6].

NOTE: the definitions of zenith and azimuth angles are provided in [R-14].

**Wind**

Wind vector fields from ECMWF shall be resampled to the tie point grid by interpolation as specified in [R-6]. The zonal (or 'u' component) corresponds to the x-axis (East) of the topocentric local frame, the longitudinal (or 'v' component) corresponds to the y-axis (North) of the topocentric local frame (see [R-14]).

**Mean Sea Level pressure**

Mean Sea Level pressure fields from ECMWF shall be resampled to the tie point grid by interpolation specified in [R-6].

**Total Ozone**

Total ozone fields from ECMWF shall be resampled to the tie point grid by interpolation as specified in [R-6].

**Relative humidity**

Relative humidity fields from ECMWF shall be resampled to the tie point grid by interpolation as specified in [R-6].

**5.3.8 - Measurement Data Sets MDS(1-16)**

The Measurement Data Set format shall be as specified in [A-4].

There are 16 measurement data sets, the first 15 consist of Top Of Atmosphere Radiances in  $mW/(m^2 \cdot sr \cdot nm)$ , the 16th consist of flags associated to each pixel. There is one MDS for each of the MERIS spectral bands specified in the product SPH (fields 31, 32).

A product corresponds to a footprint of 14785 (AL) x 1121 (AC) RR pixels.

There is therefore 14785 Records for each MDS. The data of the 1121 RR product pixels corresponding to an product grid line (see section 4.2) are stored in a single Measurement Data Set Record.

**5.3.9 - Measurement Data Set Records MDS(1-15)**

The Level 1b Reduced Resolution Product MDS(1-15) has been summarised below:

| MDSR no                 | Description (for band b)          | Size (bytes)    |
|-------------------------|-----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1     | 2255            |
| 1                       | MDSR associated with line # 2     | 2255            |
| ...                     | ...                               | ...             |
| 14784                   | MDSR associated with line # 14785 | 2255            |
| <b>Total (in bytes)</b> |                                   | <b>33340175</b> |

*Table 9 - Level 1b Reduced Resolution Product - MDS(1-15)*

Each MDSR(1-15) has the following content :

| N | Byte # | Description                       | Unit | T  | D    | # bytes     |
|---|--------|-----------------------------------|------|----|------|-------------|
| 1 | 0      | Start time of the data Set Record | mjd  | sl | 3    | 12          |
| 2 | 12     | Quality Indicator                 | -    | sc | 1    | 1           |
| 3 | 13     | TOA radiances band b              | LU   | us | 1121 | 2242        |
|   |        | <b>MDSR size (in bytes)</b>       | -    | -  | -    | <b>2255</b> |

*Table 10 - Level 1b Reduced Resolution Product - MDSR(1-15)*

The TOA radiances are scaled using the scaling factors specified in the GADS-Scaling factors (see Table 6 above).

### 5.3.10 - Measurement Data Set Records MDS(16) Flags

A different MDS Record is associated to each product grid line.

The MER\_RR\_\_1P MDS(16) has been summarised below:

| MDSR no | Description                       | Size (bytes)    |
|---------|-----------------------------------|-----------------|
| 0       | MDSR associated with line # 1     | 3376            |
| 1       | MDSR associated with line # 2     | 3376            |
| ...     | ...                               | ...             |
| 14784   | MDSR associated with line # 14785 | 3376            |
|         | <b>Total (in bytes)</b>           | <b>49914160</b> |

*Table 11 - Level 1b Reduced Resolution Product - MDS(16)*

A MDSR contains the flags and detector index for each pixel of the corresponding product line, therefore it contains two arrays of 1121 elements.

Each MDSR(16) shall be of the following format:

| N | Byte # | Description                       | Unit | T  | D    | # bytes     |
|---|--------|-----------------------------------|------|----|------|-------------|
| 1 | 0      | Start time of the Data Set Record | mjd  | sl | 3    | 12          |
| 2 | 12     | Quality Indicator                 | -    | sc | 1    | 1           |
| 3 | 13     | Flags                             | nd   | uc | 1121 | 1121        |
| 4 | 1134   | Detector Index                    | nd   | ss | 1121 | 2242        |
|   |        | <b>Data Base size (in bytes)</b>  | -    | -  | -    | <b>3376</b> |

*Table 12 - Level 1b Reduced Resolution Product - MDSR(16)*

For each pixel flags are coded an uc. The flags are coded on a single bit according to Table 13. The Detector index allows to link each product pixel to the instrument detector (taking account of the on-board spatial relaxation) using indexing as described in [R-6].

| Flag type   | bit number |
|-------------|------------|
| cosmetic    | 0          |
| duplicated  | 1          |
| glint risk  | 2          |
| suspect     | 3          |
| land /ocean | 4          |
| bright      | 5          |
| coastline   | 6          |
| invalid     | 7          |

*Table 13 - Level 1b Reduced Resolution Product - Flags Coding*

The bit numbering complies with the requirements defined in [A-2]. Each bit is set according to the algorithms in [R-6].

## 5.4 MER\_FSO\_1P

### 5.4.1 - Summary

The Level 1b Full Swath Full Resolution Ortho-geolocated Product, hereafter referred to as Level 1b FSO, is summarised below:

| Name                      | Level 1b full resolution  |
|---------------------------|---|
| Identifier                | MER_FSO_1P  |
| Product Level             | 1b  |
| Description               | Radiance measurements at top of atmosphere for the 15 MERIS bands, in instrument projection, calibrated, radiometrically corrected, geo-located with orthorectification at pixel level, annotated with PCD, calibration data, classification flags, environment parameters  |
| Coverage                  | Regional  |
| Packaging                 | Segment (see definition in [RD1] §2.4, here limited to a maximum duration of 9mn 26s or 12865 lines)  |
| Unit                      | $10^{-3} \text{ W.m}^{-2}.\text{sr}^{-1}.\text{nm}^{-1}$  |
| Range                     | 0..26 to 0..270 (band dependent)  |
| Sampling                  | <b>spatial</b> : 260 m across track at nadir and 290 m along track.<br><b>spectral</b> : MERIS bands (see [RD1] Table 3.2.1)  |
| Resolution                | <b>radiometric</b> : NEDL (see [R-5] of [RD1])<br><b>spatial</b> : MTF > 0.3 at Nyquist freq. ([R-5] of [RD1])<br><b>spectral</b> : $\leq 2.5 \text{ nm}$ ([R-5] of [RD1])  |
| Accuracy                  | <b>radiometric</b> : $\leq 2\%$ in 400-900 nm range ([R-5] of [RD1])<br><b>absolute geometric</b> : 2000m (spec. in [R-5] of [RD1])<br><b>relative geometric</b> : 1000m (spec. in [R-5] of [RD1])  |
| Geo-location requirements | Each instrument pixel is geo-located with orthorectification (i.e. accounting for the Earth surface elevation as provided by a Digital Elevation Model).  |
| Format                    | <ul style="list-style-type: none"> <li>• 16 bits/sample</li> <li>• 3700 samples/record</li> <li>• 19 records/line</li> <li>• up to 12865 lines/MDS</li> <li>• 1 GADS, 2 ADS &amp; 19 MDS (15 for TOA LU, 1 for flags, 3 for longitudes, latitudes and altitudes)</li> </ul> |
| Annotated data            | see below   |
| Frequency                 | Variable (upon Level 0 data availability and processing requests)   |
| Size                      | 1818 Mbytes per product (max)   |

*Table 14 - Level 1b Full Swath Ortho-geolocated Product - Summary*

### 5.4.2 - Organization

The high-level breakdown of the Level 1-FSO product is described below:

| Description  | Size              |
|--|-------------------|
| Level 1b FSO - MPH                                 | 1247              |
| Level 1b FSO - SPH                                 | 10782             |
| Level 1b FSO - Summary Quality ADS                 | 858               |
| Level 1b FSO - GADS Scaling Factors                | 292               |
| Level 1b FSO - ADS Tie Points Location & Aux. Data | 719726            |
| Level 1b FSO - MDS(1) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(2) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(3) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(4) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(5) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(6) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(7) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(8) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(9) TOA Radiance                 | 95368245          |
| Level 1b FSO - MDS(10) TOA Radiance                | 95368245          |
| Level 1b FSO - MDS(11) TOA Radiance                | 95368245          |
| Level 1b FSO - MDS(12) TOA Radiance                | 95368245          |
| Level 1b FSO - MDS(13) TOA Radiance                | 95368245          |
| Level 1b FSO - MDS(14) TOA Radiance                | 95368245          |
| Level 1b FSO - MDS(15) TOA Radiance                | 95368245          |
| Level 1b FSO - MDS(16) Flags                       | 47767745          |
| Level 1b FSO - MDS(17) Longitude                   | 190569245         |
| Level 1b FSO - MDS(16) Latitude                    | 190569245         |
| Level 1b FSO - MDS(16) Altitude                    | 95368245          |
| <b>Product Size</b>                                | <b>1955531060</b> |

*Table 15 - Level 1b Full Swath Ortho-geolocated Product - High-level breakdown*

### 5.4.3 - Main Product Header

The format and the content of the Main Product Header shall be as specified in [RD3].

### 5.4.4 - Specific Product Header

The Specific Product Header format shall be as specified in [RD3].

The Data Set Descriptor format shall be as specified in [RD3].

The Level 1b Full Swath Ortho-geolocated Product Specific Product Header will be in ASCII format and its content shall be as follows:

| N                                      | Byte # | Description   | Unit          | T  | D  | # Bytes |
|--|--------|---|---------------|----|----|---------|
| 1                                      | 0      | <b>SPH_DESCRIPTOR=</b>  | keyword       | uc | 15 | 15      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | SPH Descriptor<br>ASCII string describing the product.  | -             | uc | 28 | 28      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 2                                      | 46     | <b>STRIPLINE_CONTINUITY_INDICATOR=</b>  | keyword       | uc | 31 | 31      |
|  |        | Value: 0= No stripline continuity, the product is a complete segment<br>Other: Stripline Counter  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 3                                      | 82     | <b>SLICE_POSITION=</b>  | keyword       | uc | 15 | 15      |
|  |        | Value: +001 to NUM_SLICES<br>Default value if no stripline continuity = +001  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 4                                      | 102    | <b>NUM_SLICES=</b>  | keyword       | uc | 11 | 11      |
|  |        | Number of slices in this stripline Default value if no continuity = +001  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| <i>Product Time Information</i>        |        |   |               |    |    |         |
| 5                                      | 118    | <b>FIRST_LINE_TIME=</b>   | keyword       | uc | 16 | 16      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | Azimuth time first line of product.<br>UTC Time of first range line in the MDS of this product. UTC time format contained within quotation marks. | UTC           | uc | 27 | 27      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 6                                      | 164    | <b>LAST_LINE_TIME=</b>  | keyword       | uc | 15 | 15      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | Azimuth time last line of product Time of last range line in the MDS of this product. UTC time format contained within quotation marks.           | UTC           | uc | 27 | 27      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| <i>Product Positioning Information</i> |        |   |               |    |    |         |
| 7                                      | 209    | <b>FIRST_FIRST_LAT=</b>   | keyword       | uc | 16 | 16      |
|  |        | Geodetic Latitude of the first sample of the first line<br>A negative value denotes south latitude, a positive value denotes North latitude       | 10 -6 degrees | Al | 1  | 11      |
|  |        | <10-6degN>  | units         | uc | 10 | 10      |
|  |        | newline character   | terminator    | uc | 1  | 1       |

|    |     |   |              |    |    |    |
|----|-----|---|--------------|----|----|----|
| 8  | 247 | <b>FIRST_FIRST_LONG=</b>  | keyword      | uc | 17 | 17 |
|    |     | East geodetic longitude of the first sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.      | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 9  | 286 | <b>FIRST_MID_LAT=</b>   | keyword      | uc | 14 | 14 |
|    |     | Geodetic Latitude of the middle sample of the first line A negative value denotes south latitude, a positive value denotes North latitude | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 10 | 322 | <b>FIRST_MID_LONG=</b>  | keyword      | uc | 15 | 15 |
|    |     | East geodetic longitude of the middle sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.     | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 11 | 359 | <b>FIRST_LAST_LAT=</b>  | keyword      | uc | 15 | 15 |
|    |     | Geodetic Latitude of the last sample of the first line A negative value denotes south latitude, a positive value denotes North latitude   | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 12 | 396 | <b>FIRST_LAST_LONG=</b>   | keyword      | uc | 16 | 16 |
|    |     | East geodetic longitude of the last sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.       | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 13 | 434 | <b>LAST_FIRST_LAT=</b>  | keyword      | uc | 15 | 15 |
|    |     | Geodetic Latitude of the first sample of the last line A negative value denotes south latitude, a positive value denotes North latitude   | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 14 | 471 | <b>LAST_FIRST_LONG=</b>   | keyword      | uc | 16 | 16 |
|    |     | East geodetic longitude of the first sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.       | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 15 | 509 | <b>LAST_MID_LAT=</b>  | keyword      | uc | 13 | 13 |
|    |     | Geodetic Latitude of the middle sample of the last line A negative value denotes south latitude, a positive value denotes North latitude  | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |

|                                    |     |  |              |     |    |    |
|------------------------------------|-----|--|--------------|-----|----|----|
| 16                                 | 544 | <b>LAST_MID_LONG=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | East geodetic longitude of the middle sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.   | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degE>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 17                                 | 580 | <b>LAST_LAST_LAT=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Geodetic Latitude of the last sample of the last line A negative value denotes south latitude, a positive value denotes North latitude | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degN>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 18                                 | 616 | <b>LAST_LAST_LONG=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | East geodetic longitude of the last sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.     | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degE>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 19                                 | 653 | <b>Spare (blank characters)</b>  | -            | uc  | 47 | 47 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| <i>Product Quality Information</i> |     |  |              |     |    |    |
| 20                                 | 701 | <b>TRANS_ERR_FLAG=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | Set to 1 if number of transmission errors exceeds threshold. Set to 0 otherwise.   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 21                                 | 718 | <b>FORMAT_ERR_FLAG=</b>  | keyword      | uc  | 16 | 16 |
|                                    |     | Set to 1 if number of format errors exceeds threshold. Set to 0 otherwise.   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 22                                 | 736 | <b>DATABASE_FLAG=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Flag set to 1 if the processing parameters data base contents does not match the packet header contents.                               | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 23                                 | 752 | <b>COARSE_ERR_FLAG=</b>  | keyword      | uc  | 16 | 16 |
|                                    |     | Flag indicating coarse offsets are above threshold   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 24                                 | 770 | <b>ECMWF_TYPE=</b>   | keyword      | uc  | 11 | 11 |
|                                    |     | 0 = forecast ECMWF data was used 1 = analysis ECMWF data was used  | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 25                                 | 783 | <b>NUM_TRANS_ERR=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Number of transmission errors in the product   | -            | Al  | 1  | 11 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 26                                 | 809 | <b>NUM_FORMAT_ERR=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | Number of format errors in the product   | -            | Al  | 1  | 11 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 27                                 | 836 | <b>TRANS_ERR_THRESH=</b>   | keyword      | uc  | 17 | 17 |
|                                    |     | Threshold for setting TRANS_ERR_FLAG   | %            | Afl | 1  | 15 |
|                                    |     | <%>  | units        | uc  | 3  | 3  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |



|                                       |      |  |            |     |    |     |
|---------------------------------------|------|--|------------|-----|----|-----|
| 28                                    | 872  | <b>FORMAT_ERR_THRESH=</b>  | keyword    | uc  | 18 | 18  |
|                                       |      | Threshold for setting FORMAT_ERR_FLAG  | %          | Afl | 1  | 15  |
|                                       |      | <%>  | units      | uc  | 3  | 3   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 29                                    | 909  | <b>Spare (blank characters)</b>  | -          | uc  | 77 | 77  |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| <i>Additional Product Information</i> |      |  |            |     |    |     |
| 30                                    | 987  | <b>NUM_BANDS=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | Number of bands in the product   | -          | Ac  | 1  | 4   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 31                                    | 1002 | <b>BAND_WAVELEN=</b>   | keyword    | uc  | 13 | 13  |
|                                       |      | List of up to 15 band central wavelengths of the bands contained in this product. Unused values are set to zero.   | 10-3 nm    | Al  | 15 | 165 |
|                                       |      | <10-5nm>   | units      | uc  | 8  | 8   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 32                                    | 1189 | <b>BANDWIDTH=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | <b>List of up to 15 bandwidths for the bands in the product. The order of the list must match the order of the central wavelengths entries in the previous field.</b> Unused values are set to zero. Each entry is of the form Al. e.g., if only 13 bands were included in the product:<br>+10000+10000+10000+10000+10000+10000+10000+07500+02500+05000+12500+10000+12500+0000+00000 | 10-3 nm    | As  | 15 | 90  |
|                                       |      | <10-3nm>   | units      | uc  | 8  | 8   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 33                                    | 1198 | <b>INST_FOV=</b>   | keyword    | uc  | 9  | 9   |
|                                       |      | Instantaneous Field of View  | 10-6 deg   | Al  | 1  | 11  |
|                                       |      | <10-6deg>  | units      | uc  | 9  | 9   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 34                                    | 1328 | <b>PROC_MODE=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | Processor mode of operation 1 = Raw 0 = Full Processing  | flag       | uc  | 1  | 1   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 35                                    | 1340 | <b>OFFSET_COMP=</b>  | keyword    | uc  | 12 | 12  |
|                                       |      | Offset Compensation 1=ON 0=OFF   | flag       | uc  | 1  | 1   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 36                                    | 1354 | <b>LINE_TIME_INTERVAL=</b>   | keyword    | uc  | 19 | 19  |
|                                       |      | Line spacing in time   | (10-6) sec | Al  | 1  | 11  |
|                                       |      | <10-6s>  | units      | uc  | 7  | 7   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 37                                    | 1392 | <b>LINE_LENGTH=</b>  | keyword    | uc  | 12 | 12  |
|                                       |      | Number of samples per output line  | samples    | As  | 1  | 6   |
|                                       |      | <samples>  | units      | uc  | 9  | 9   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 38                                    | 1420 | <b>LINES_PER_TIE_PT=</b>   | keyword    | uc  | 17 | 17  |
|                                       |      | Number of lines between along track tie points   | lines      | Ac  | 1  | 4   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |

|                                      |      |  |            |     |    |              |
|--------------------------------------|------|--|------------|-----|----|--------------|
| 39                                   | 1442 | <b>SAMPLES_PER_TIE_PT=</b>                                     | keyword    | uc  | 19 | 19           |
|                                      |      | Number of samples between across track tie points              | samples    | Ac  | 1  | 4            |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| 40                                   | 1466 | <b>COLUMN_SPACING=</b>   | keyword    | uc  | 15 | 15           |
|                                      |      | On ground spacing between columns                              | m          | Afl | 1  | 15           |
|                                      |      | <m>  | units      | uc  | 3  | 3            |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| 41                                   | 1500 | <b>Spare (blank characters)</b>                                | -          | uc  | 41 | 41           |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| <i>DSDs for included Data Sets</i>   |      |  |            |     |    |              |
| 42                                   | 1542 | <b>DSD-A of Level 1b Summary Quality ADS (SQADS)</b>           | -          | dsd | 1  | 280          |
| 43                                   | 1822 | <b>DSD-G of Level 1b Scaling Factors and General info GADS</b> | -          | dsd | 1  | 280          |
| 44                                   | 2102 | <b>DSD-A of Level 1b Tie Points Loc. &amp; Aux. Data ADS</b>   | -          | dsd | 1  | 280          |
| 45                                   | 2382 | <b>DSD-M(1-15) of Level 1b TOA Radiances MDSs</b>              | -          | dsd | 15 | 4200         |
| 46                                   | 6582 | <b>DSD-M(16) of Level 1b Flags &amp; Detector Index</b>        | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(17) of Level 1b Corrected Longitude</b>               | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(18) of Level 1b Corrected Latitude</b>                | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(19) of Level 1b Altitude</b>                          | -          | dsd | 1  | 280          |
| <i>DSDs for referenced Data Sets</i> |      |  |            |     |    |              |
| 47                                   | 6862 | <b>DSD-R Level 0 data file</b>                                 | -          | dsd | 1  | 280          |
| 48                                   | 7142 | <b>DSD-R Instrument auxiliary data file</b>                    | -          | dsd | 1  | 280          |
| 49                                   | 7422 | <b>DSD-R Proc. L1b control parameters data file</b>            | -          | dsd | 1  | 280          |
| 50                                   | 7702 | <b>DSD-R Radiometric calibration data file</b>                 | -          | dsd | 1  | 280          |
| 51                                   | 7982 | <b>DSD-R Digital Elevation Model data file</b>                 | -          | dsd | 1  | 280          |
| 52                                   | 8262 | <b>DSD-R Digital Roughness Model data file</b>                 | -          | dsd | 1  | 280          |
| 53                                   | 8542 | <b>DSD-R Coast-line/Land/Ocean file</b>                        | -          | dsd | 1  | 280          |
| 54                                   | 8822 | <b>DSD -R for ECMWF files used</b>                             | -          | dsd | 1  | 280          |
| 55                                   | 9102 | <b>DSD- R for Orbit State Vectors Used</b>                     | -          | dsd | 1  | 280          |
| 56                                   | 9382 | <b>DSD-R Platform Attitude data file (CFI software)</b>        | -          | dsd | 1  | 280          |
| 57                                   | 9662 | <b>DSD-R High Resolution Digital Elevation Model</b>           | -          | dsd | 1  | 280          |
|                                      |      | <b>size (in bytes)</b>   |            |     |    | <b>10782</b> |

Table 16 - Level 1b Full Swath Ortho-geolocated Product - SPH

All Data Set Descriptors (DSD) shall follow the format and have the content described in [RD3].

**Note:** to keep the maximum commonality between the various Level 1b products, three fields have been kept in the SPH of the FSO products but are NOT applicable to it because the FSO product does not comply with the MERIS Product Grid defined in section 4.2 of [RD1]. Those fields are fields 38, 39 and 40 of the above table, related to the Product Grid definition, and shall be ignored. According to [RD3], since not relevant, their values are set to 0.

### 5.4.5 - Annotation Data Set - Summary Quality

The Annotation Data Set format shall be as specified in [RD3].

This ADS contains only data useful for the evaluation of the quality of the product. It shall have one ADS Record for every new group of 8 tie frames (a new record has to be generated when starting the 9<sup>th</sup> tie frame, the last Summary Quality record of the product may be relevant for less than 8 tie frames), therefore it will hold (up to) 26 Records in the Full swath Ortho-geolocated product.

In the MER\_FSO\_1P generation process, these data are not re-evaluated but copied from the input product. In the case of a partial processing, even if the first MDS record does belongs to the first ADS Summary Quality record, it may not correspond to its start limit. In other words synchronisation between ADS Summary Quality and MDS may be lost and corresponding information is only partially relevant.

The size of the ADS has been summarised below:

| ADSR no                 | Description   | Size (bytes) |
|-------------------------|---|--------------|
| 0                       | ADSR associated with line # 1 - 512 FR pixels       | 33           |
| 1                       | ADSR associated with line # 513 - 1024 FR pixels    | 33           |
| ...                     | ...   | ...          |
| 25                      | ADSR associated with line # 12801 - 12865 FR pixels | 33           |
| <b>Total (in bytes)</b> |   | <b>858</b>   |

*Table 17 - Level 1b Full Swath Ortho-geolocated Product - Summary Quality ADS*

The format and content of the Summary Quality ADSR is identical to the Level 1b Reduced Resolution Product Summary Quality ADSR described in § 5.3.1.5 of [RD1].

### 5.4.6 - Global Annotation Data Set - Scaling Factors

The Global Annotation Data Set format shall be as specified in [RD3].

The content of the GADS- Scaling Factors of the Level 1b Full Swath Ortho-geolocated Product is identical to the Level 1b Reduced Resolution Product GADS- Scaling Factors described in § 5.3.1.6 of [RD1].

### 5.4.7 - Annotation Data Set - Tie Points Location & corresp. Aux. Data

The Annotation Data Set format shall be as specified in [RD3].

The tie point separation of the Full Swath Ortho-geolocated product will be identical to that of the reduced resolution spacing on ground (kilometres). The Full Swath Ortho-geolocated being in instrument projection, i.e. not resampled to the MERIS Product Grid defined in section 4.2 of [RD1], there is no direct correspondence between pixel grid and Tie Points grid. However, the tie points along-track sampling, or time sampling, still correspond to 64 instrument time sampling

steps. The number of tie points at a given time (across-track sampling) is kept to 71 so that they cover the full MERIS swath width.

The FSO product grid consisting of up to 12865 (AL) records, there are up to 202 tie Annotation Data Sets Records for the MER\_FSO\_1P Product.

Each ADS is made of ADS Records (one ADSR for each line of the tie points grid, see RD1 section 4.2), the size of the ADS has been summarised below:

| ADSR no                 | Description | Size          |
|-------------------------|-------------|---------------|
| 0                       | ADSR # 1    | 3563          |
| 1                       | ADSR # 2    | 3563          |
| ...                     | ...         | ...           |
| 201                     | ADSR # 202  | 3563          |
| <b>Total (in bytes)</b> |             | <b>719726</b> |

*Table 18 - Level 1b Full Swath Ortho-geolocated Product - ADS Tie Points Location & corresp. Aux. Data*

A tie point annotation contains location and auxiliary data of the corresponding tie point as follows:

| N  | Byte # | Description                          | Unit      | T  | D  | # bytes     |
|----|--------|--------------------------------------|-----------|----|----|-------------|
| 1  | 0      | <i>Start time of the measurement</i> | -         | sl | 3  | 12          |
| 2  | 12     | <i>Attachment flag</i>               | -         | uc | 1  | 1           |
| 3  | 13     | latitude                             | (10-6)deg | sl | 71 | 284         |
| 4  | 157    | longitude                            | (10-6)deg | sl | 71 | 284         |
| 5  | 301    | DEM altitude                         | m         | sl | 71 | 284         |
| 6  | 445    | DEM roughness                        | m         | ul | 71 | 284         |
| 7  | 589    | DEM latitude correction              | (10-6)deg | sl | 71 | 284         |
| 8  | 733    | DEM longitude correction             | (10-6)deg | sl | 71 | 284         |
| 9  | 877    | sun zenith angle                     | (10-6)deg | ul | 71 | 284         |
| 10 | 1021   | sun azimuth angle                    | (10-6)deg | sl | 71 | 284         |
| 11 | 1165   | viewing zenith angle                 | (10-6)deg | ul | 71 | 284         |
| 12 | 1309   | viewing azimuth angle                | (10-6)deg | sl | 71 | 284         |
| 13 | 1453   | zonal wind                           | m*s-1     | ss | 71 | 142         |
| 14 | 1525   | meridional wind                      | m*s-1     | ss | 71 | 142         |
| 15 | 1597   | atmospheric pressure                 | hPa       | us | 71 | 142         |
| 16 | 1669   | ozone                                | DU        | us | 71 | 142         |
| 17 | 1741   | relative humidity                    | %         | us | 71 | 142         |
|    |        | <b>size (in bytes)</b>               | -         | -  | -  | <b>3563</b> |

*Table 19 - Level 1b Full Swath Ortho-geolocated Product - ADSR Tie Points Location & corresp. Aux. Data*

The elements of a tie point annotation has been specified as for the Level 1b Reduced Resolution Product, see [RD1] section 5.3.1.7.

### 5.4.8 - Measurement Data Sets MDS(1-16)

The Measurement Data Set format shall be as specified in [RD3].

There are 19 measurement data sets, the first 15 consist of Top Of Atmosphere Radiances in mW/(m<sup>2</sup>.sr.nm). There is one MDS for each of the MERIS spectral bands specified in the product SPH (fields 31, 32).

The full swath product corresponds to a footprint of 12865 (AL, max.) x 3700 (AC) FR pixels. There are therefore (up to) 12865 records for each MDS for the product. The data of the 3700 FR product pixels are stored in a single Measurement Data Set Record.

#### 5.4.8.1 - Measurement Data Set Records MDS(1-15)

The MER\_FSO\_1P MDS(1-15) has been summarised below:

| MDSR no                 | Description (for band b)          | Size (bytes)    |
|-------------------------|-----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1     | 7413            |
| 1                       | MDSR associated with line # 2     | 7413            |
| ...                     | ...                               | ...             |
| 12864                   | MDSR associated with line # 12865 | 7413            |
| <b>Total (in bytes)</b> |                                   | <b>95368245</b> |

*Table 20 - Level 1b Full Swath Ortho-geolocated Product - MDS(1-15)*

Each MDSR(1-15) consists of 3700 elements as shown below:

| N | Byte # | Description                              | Unit | T  | D    | # bytes     |
|---|--------|--|------|----|------|-------------|
| 1 | 0      | <i>Start time of the data Set Record</i> | mjd  | sl | 3    | 12          |
| 2 | 12     | <i>Quality indicator</i>                 | -    | sc | 1    | 1           |
| 3 | 13     | TOA radiances band b                     | LU   | us | 3700 | 7400        |
|   |        | <b>MDSR size (in bytes)</b>              | -    | -  | -    | <b>7413</b> |

*Table 21 - Level 1b Full Resolution Product - MDSR(1-15)*

### 5.4.8.2 - Measurement Data Set Records MDS(16) Flags

A different MDS Record is associated to each frame.

The MER\_FSO\_1P MDS(16) has been summarised below:

| MDSR no                 | Description                       | Size (bytes)    |
|-------------------------|-----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1     | 3713            |
| 1                       | MDSR associated with line # 2     | 3713            |
| ...                     | ...                               | ...             |
| 12864                   | MDSR associated with line # 12865 | 3713            |
| <b>Total (in bytes)</b> |                                   | <b>47767745</b> |

*Table 22 - Level 1b Full Swath Ortho-geolocated Product - MDS(16)*

A MDSR contains the flags for each pixel of the corresponding product grid line.

Each MDSR(16) shall be of the following format:

| N                                | Byte # | Description                              | Unit | T  | D    | # bytes     |
|----------------------------------|--------|--|------|----|------|-------------|
| 1                                | 0      | <i>Start time of the Data Set Record</i> | mjd  | sl | 3    | 12          |
| 2                                | 12     | <i>Quality Indicator</i>                 | -    | sc | 1    | 1           |
| 3                                | 13     | Flags                                    | nd   | uc | 3700 | 3700        |
| <b>Data Base size (in bytes)</b> |        |  | -    | -  | -    | <b>3713</b> |

*Table 23 - Level 1b Full Swath Ortho-geolocated Product - MDSR(16)*

The flags are coded on a single bit according to Table 24

| Flag type   | bit number |
|-------------|------------|
| cosmetic    | 0          |
| duplicated  | 1          |
| glint risk  | 2          |
| suspect     | 3          |
| land /ocean | 4          |
| bright      | 5          |
| coastline   | 6          |
| invalid     | 7          |

*Table 24 - Level 1b Full Swath Ortho-geolocated Product - Flags Coding*

The bit numbering complies with the requirements defined in [RD1].

### 5.4.8.3 - Measurement Data Set Records MDS(17) Longitude

A different MDS Record is associated to each frame.

The MER\_FSO\_1P MDS(17) has been summarised below:

| MDSR no                 | Description                       | Size (bytes)     |
|-------------------------|-----------------------------------|------------------|
| 0                       | MDSR associated with line # 1     | 14813            |
| 1                       | MDSR associated with line # 2     | 14813            |
| ...                     | ...                               | ...              |
| 12864                   | MDSR associated with line # 12865 | 14813            |
| <b>Total (in bytes)</b> |                                   | <b>190569245</b> |

*Table 25 - Level 1b Full Swath Ortho-geolocated Product - MDS(16)*

A MDSR contains the ortho-geolocated longitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N                                | Byte # | Description                              | Unit      | T  | D    | # bytes      |
|----------------------------------|--------|--|-----------|----|------|--------------|
| 1                                | 0      | <i>Start time of the Data Set Record</i> | mjd       | sl | 3    | 12           |
| 2                                | 12     | <i>Quality Indicator</i>                 | -         | sc | 1    | 1            |
| 3                                | 13     | Corrected Longitude                      | (10-6)deg | sl | 3700 | 14800        |
| <b>Data Base size (in bytes)</b> |        |  | -         | -  | -    | <b>14813</b> |

*Table 26 - Level 1b Full Swath Ortho-geolocated Product - MDSR(17)*

#### 5.4.8.4 - Measurement Data Set Records MDS(18) Latitude

A different MDS Record is associated to each frame.

The MER\_FSO\_1P MDS(18) has been summarised below:

| MDSR no                 | Description                       | Size (bytes)     |
|-------------------------|-----------------------------------|------------------|
| 0                       | MDSR associated with line # 1     | 14813            |
| 1                       | MDSR associated with line # 2     | 14813            |
| ...                     | ...                               | ...              |
| 12864                   | MDSR associated with line # 12865 | 14813            |
| <b>Total (in bytes)</b> |                                   | <b>173111440</b> |

*Table 27 - Level 1b Full Swath Ortho-geolocated Product - MDS(18)*

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N | Byte # | Description                              | Unit      | T  | D    | # bytes      |
|---|--------|--|-----------|----|------|--------------|
| 1 | 0      | <i>Start time of the Data Set Record</i> | mjd       | sl | 3    | 12           |
| 2 | 12     | <i>Quality Indicator</i>                 | -         | sc | 1    | 1            |
| 3 | 13     | Corrected Latitude                       | (10-6)deg | sl | 3700 | 14800        |
|   |        | <b>Data Base size (in bytes)</b>         | -         | -  | -    | <b>14813</b> |

*Table 28 - Level 1b Full Swath Ortho-geolocated Product - MDSR(17)*



#### 5.4.8.5 - Measurement Data Set Records MDS(18) Altitude

A different MDS Record is associated to each frame.

The MER\_FSO\_1P MDS(18) has been summarised below:

| MDSR no                 | Description                       | Size (bytes)    |
|-------------------------|-----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1     | 7413            |
| 1                       | MDSR associated with line # 2     | 7413            |
| ...                     | ...                               | ...             |
| 12864                   | MDSR associated with line # 12865 | 7413            |
| <b>Total (in bytes)</b> |                                   | <b>95368245</b> |

*Table 29 - Level 1b Full Swath Ortho-geolocated Product - MDS(18)*

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N                                | Byte # | Description                              | Unit | T  | D    | # bytes     |
|----------------------------------|--------|--|------|----|------|-------------|
| 1                                | 0      | <i>Start time of the Data Set Record</i> | mjd  | sl | 3    | 12          |
| 2                                | 12     | <i>Quality Indicator</i>                 | -    | sc | 1    | 1           |
| 3                                | 13     | Altitude                                 | m    | ss | 3700 | 7400        |
| <b>Data Base size (in bytes)</b> |        |  |      |    |      | <b>7413</b> |

*Table 30 - Level 1b Full Swath Ortho-geolocated Product - MDSR(17)*

## 5.5 MER\_FSG\_1P

### 5.5.1 - Summary

The Level 1b Full Swath Full Resolution GeoCorrected Product, hereafter referred to as Level 1b FSG, is summarised below:

| Name                      | Level 1b full resolution GeoCorrected   |
|---------------------------|---|
| Identifier                | MER_FSG_1P  |
| Product Level             | 1b  |
| Description               | Radiance measurements at top of atmosphere for the 15 MERIS bands, re-ordered, calibrated, radiometrically corrected, geo-located with orthorectification at pixel level, annotated with PCD, calibration data, classification flags, environment parameters                |
| Coverage                  | Regional  |
| Packaging                 | Segment (see definition in RD1, §2.4, here limited to a maximum duration of 7mn 33s or 10305 lines)   |
| Unit                      | $10^{-3} \text{ W.m}^{-2}.\text{sr}^{-1}.\text{nm}^{-1}$  |
| Range                     | 0..26 to 0..270 (band dependent)  |
| Sampling                  | <b>spatial</b> : 260 m across track at nadir and 290 m along track.<br><b>spectral</b> : MERIS bands (see [RD1] Table 3.2.1)  |
| Resolution                | <b>radiometric</b> : NEDL (see [R-5] of [RD1]))<br><b>spatial</b> : MTF > 0.3 at Nyquist freq. ([R-5] of [RD1]))<br><b>spectral</b> : $\leq 2.5 \text{ nm}$ ([R-5] of [RD1]))   |
| Accuracy                  | <b>radiometric</b> : $\leq 2\%$ in 400-900 nm range ([R-5] of [RD1]))<br><b>absolute geometric</b> : 2000m (spec. in [R-5] of [RD1]))<br><b>relative geometric</b> : 1000m (spec. in [R-5] of [RD1]))   |
| Geo-location requirements | Each pixel is geo-located with orthorectification (i.e. accounting for the Earth surface elevation as provided by a Digital Elevation Model).   |
| Format                    | <ul style="list-style-type: none"> <li>• 16 bits/sample</li> <li>• 3700 samples/record</li> <li>• 19 records/line</li> <li>• up to 12865 lines/MDS</li> <li>• 1 GADS, 2 ADS &amp; 19 MDS (15 for TOA LU, 1 for flags, 3 for longitudes, latitudes and altitudes)</li> </ul> |
| Annotated data            | see below   |
| Frequency                 | Variable (upon Level 0 data availability and processing requests)   |
| Size                      | 1900 Mbytes per product (max)   |

*Table 31 - Level 1b Full Swath GeoCorrected Product - Summary*

### 5.5.2 - Organization

The high-level breakdown of the Level 1-FSG product is described below:

| Description                                      | Size              |
|--|-------------------|
| Level 1b FSG - MPH                               | 1247              |
| Level 1b FSG - SPH                               | 10782             |
| Level 1b FSG Summary Quality ADS                 | 693               |
| Level 1b FSG GADS Scaling Factors                | 292               |
| Level 1b FSG ADS Tie Points Location & Aux. Data | 577206            |
| Level 1b FSG MDS(1) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(2) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(3) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(4) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(5) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(6) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(7) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(8) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(9) TOA Radiances                | 92487375          |
| Level 1b FSG MDS(10) TOA Radiances               | 92487375          |
| Level 1b FSG MDS(11) TOA Radiances               | 92487375          |
| Level 1b FSG MDS(12) TOA Radiances               | 92487375          |
| Level 1b FSG MDS(13) TOA Radiances               | 92487375          |
| Level 1b FSG MDS(14) TOA Radiances               | 92487375          |
| Level 1b FSG MDS(15) TOA Radiances               | 92487375          |
| Level 1b FSG MDS(16) Flags & Detector Index      | 138664080         |
| Level 1b FSG MDS(17) Corrected Longitude         | 184840785         |
| Level 1b FSG MDS(18) Corrected Latitude          | 184840785         |
| Level 1b FSG MDS(19) Altitude                    | 92487375          |
| <b>Product Size</b>                              | <b>1988733870</b> |

*Table 32 - Level 1b Full Swath GeoCorrected Product - High-level breakdown*

### 5.5.3 - Main Product Header

The format and the content of the Main Product Header shall be as specified in [RD3].

### 5.5.4 - Specific Product Header

The Specific Product Header format shall be as specified in [RD3].

The Data Set Descriptor format shall be as specified in [RD3].

The Level 1b Full Resolution Full Swath GeoCorrected Product Specific Product Header will be in ASCII format and its content shall be as follows:



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| N                                      | Byte # | Description   | Unit          | T  | D  | # Bytes |
|--|--------|---|---------------|----|----|---------|
| 1                                      | 0      | <b>SPH_DESCRIPTOR=</b>  | keyword       | uc | 15 | 15      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | SPH Descriptor<br>ASCII string describing the product.  | -             | uc | 28 | 28      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 2                                      | 46     | <b>STRIPLINE_CONTINUITY_INDICATOR=</b>  | keyword       | uc | 31 | 31      |
|  |        | Value: 0= No stripline continuity, the product is a complete segment<br>Other: Stripline Counter  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 3                                      | 82     | <b>SLICE_POSITION=</b>  | keyword       | uc | 15 | 15      |
|  |        | Value: +001 to NUM_SLICES<br>Default value if no stripline continuity = +001  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 4                                      | 102    | <b>NUM_SLICES=</b>  | keyword       | uc | 11 | 11      |
|  |        | Number of slices in this stripline Default value if no continuity = +001  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| <i>Product Time Information</i>        |        |   |               |    |    |         |
| 5                                      | 118    | <b>FIRST_LINE_TIME=</b>   | keyword       | uc | 16 | 16      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | Azimuth time first line of product.<br>UTC Time of first range line in the MDS of this product. UTC time format contained within quotation marks. | UTC           | uc | 27 | 27      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 6                                      | 164    | <b>LAST_LINE_TIME=</b>  | keyword       | uc | 15 | 15      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | Azimuth time last line of product Time of last range line in the MDS of this product. UTC time format contained within quotation marks.           | UTC           | uc | 27 | 27      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| <i>Product Positioning Information</i> |        |   |               |    |    |         |
| 7                                      | 209    | <b>FIRST_FIRST_LAT=</b>   | keyword       | uc | 16 | 16      |
|  |        | Geodetic Latitude of the first sample of the first line<br>A negative value denotes south latitude, a positive value denotes North latitude       | 10 -6 degrees | Al | 1  | 11      |
|  |        | <10-6degN>  | units         | uc | 10 | 10      |
|  |        | newline character   | terminator    | uc | 1  | 1       |

|    |     |   |              |    |    |    |
|----|-----|---|--------------|----|----|----|
| 8  | 247 | <b>FIRST_FIRST_LONG=</b>  | keyword      | uc | 17 | 17 |
|    |     | East geodetic longitude of the first sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.      | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 9  | 286 | <b>FIRST_MID_LAT=</b>   | keyword      | uc | 14 | 14 |
|    |     | Geodetic Latitude of the middle sample of the first line A negative value denotes south latitude, a positive value denotes North latitude | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 10 | 322 | <b>FIRST_MID_LONG=</b>  | keyword      | uc | 15 | 15 |
|    |     | East geodetic longitude of the middle sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.     | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 11 | 359 | <b>FIRST_LAST_LAT=</b>  | keyword      | uc | 15 | 15 |
|    |     | Geodetic Latitude of the last sample of the first line A negative value denotes south latitude, a positive value denotes North latitude   | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 12 | 396 | <b>FIRST_LAST_LONG=</b>   | keyword      | uc | 16 | 16 |
|    |     | East geodetic longitude of the last sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.       | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 13 | 434 | <b>LAST_FIRST_LAT=</b>  | keyword      | uc | 15 | 15 |
|    |     | Geodetic Latitude of the first sample of the last line A negative value denotes south latitude, a positive value denotes North latitude   | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 14 | 471 | <b>LAST_FIRST_LONG=</b>   | keyword      | uc | 16 | 16 |
|    |     | East geodetic longitude of the first sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.       | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 15 | 509 | <b>LAST_MID_LAT=</b>  | keyword      | uc | 13 | 13 |
|    |     | Geodetic Latitude of the middle sample of the last line A negative value denotes south latitude, a positive value denotes North latitude  | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |

|                                    |     |  |              |     |    |    |
|------------------------------------|-----|--|--------------|-----|----|----|
| 16                                 | 544 | <b>LAST_MID_LONG=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | East geodetic longitude of the middle sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.   | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degE>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 17                                 | 580 | <b>LAST_LAST_LAT=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Geodetic Latitude of the last sample of the last line A negative value denotes south latitude, a positive value denotes North latitude | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degN>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 18                                 | 616 | <b>LAST_LAST_LONG=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | East geodetic longitude of the last sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.     | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degE>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 19                                 | 653 | <b>Spare (blank characters)</b>  | -            | uc  | 47 | 47 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| <i>Product Quality Information</i> |     |  |              |     |    |    |
| 20                                 | 701 | <b>TRANS_ERR_FLAG=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | Set to 1 if number of transmission errors exceeds threshold. Set to 0 otherwise.   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 21                                 | 718 | <b>FORMAT_ERR_FLAG=</b>  | keyword      | uc  | 16 | 16 |
|                                    |     | Set to 1 if number of format errors exceeds threshold. Set to 0 otherwise.   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 22                                 | 736 | <b>DATABASE_FLAG=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Flag set to 1 if the processing parameters data base contents does not match the packet header contents.                               | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 23                                 | 752 | <b>COARSE_ERR_FLAG=</b>  | keyword      | uc  | 16 | 16 |
|                                    |     | Flag indicating coarse offsets are above threshold   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 24                                 | 770 | <b>ECMWF_TYPE=</b>   | keyword      | uc  | 11 | 11 |
|                                    |     | 0 = forecast ECMWF data was used 1 = analysis ECMWF data was used  | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 25                                 | 783 | <b>NUM_TRANS_ERR=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Number of transmission errors in the product   | -            | Al  | 1  | 11 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 26                                 | 809 | <b>NUM_FORMAT_ERR=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | Number of format errors in the product   | -            | Al  | 1  | 11 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 27                                 | 836 | <b>TRANS_ERR_THRESH=</b>   | keyword      | uc  | 17 | 17 |
|                                    |     | Threshold for setting TRANS_ERR_FLAG   | %            | Afl | 1  | 15 |
|                                    |     | <%>  | units        | uc  | 3  | 3  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |

|                                       |      |  |            |     |    |     |
|---------------------------------------|------|--|------------|-----|----|-----|
| 28                                    | 872  | <b>FORMAT_ERR_THRESH=</b>  | keyword    | uc  | 18 | 18  |
|                                       |      | Threshold for setting FORMAT_ERR_FLAG  | %          | Afl | 1  | 15  |
|                                       |      | <%>  | units      | uc  | 3  | 3   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 29                                    | 909  | <b>Spare (blank characters)</b>  | -          | uc  | 77 | 77  |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| <i>Additional Product Information</i> |      |  |            |     |    |     |
| 30                                    | 987  | <b>NUM_BANDS=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | Number of bands in the product   | -          | Ac  | 1  | 4   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 31                                    | 1002 | <b>BAND_WAVELEN=</b>   | keyword    | uc  | 13 | 13  |
|                                       |      | List of up to 15 band central wavelengths of the bands contained in this product. Unused values are set to zero.   | 10-3 nm    | Al  | 15 | 165 |
|                                       |      | <10-5nm>   | units      | uc  | 8  | 8   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 32                                    | 1189 | <b>BANDWIDTH=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | <b>List of up to 15 bandwidths for the bands in the product. The order of the list must match the order of the central wavelengths entries in the previous field.</b> Unused values are set to zero. Each entry is of the form Al. e.g., if only 13 bands were included in the product:<br>+10000+10000+10000+10000+10000+10000+10000+07500+02500+05000+12500+10000+12500+0000+00000 | 10-3 nm    | As  | 15 | 90  |
|                                       |      | <10-3nm>   | units      | uc  | 8  | 8   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 33                                    | 1198 | <b>INST_FOV=</b>   | keyword    | uc  | 9  | 9   |
|                                       |      | Instantaneous Field of View  | 10-6 deg   | Al  | 1  | 11  |
|                                       |      | <10-6deg>  | units      | uc  | 9  | 9   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 34                                    | 1328 | <b>PROC_MODE=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | Processor mode of operation 1 = Raw 0 = Full Processing  | flag       | uc  | 1  | 1   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 35                                    | 1340 | <b>OFFSET_COMP=</b>  | keyword    | uc  | 12 | 12  |
|                                       |      | Offset Compensation 1=ON 0=OFF   | flag       | uc  | 1  | 1   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 36                                    | 1354 | <b>LINE_TIME_INTERVAL=</b>   | keyword    | uc  | 19 | 19  |
|                                       |      | Line spacing in time   | (10-6) sec | Al  | 1  | 11  |
|                                       |      | <10-6s>  | units      | uc  | 7  | 7   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 37                                    | 1392 | <b>LINE_LENGTH=</b>  | keyword    | uc  | 12 | 12  |
|                                       |      | Number of samples per output line  | samples    | As  | 1  | 6   |
|                                       |      | <samples>  | units      | uc  | 9  | 9   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 38                                    | 1420 | <b>LINES_PER_TIE_PT=</b>   | keyword    | uc  | 17 | 17  |
|                                       |      | Number of lines between along track tie points   | lines      | Ac  | 1  | 4   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |

|                                      |      |  |            |     |    |              |
|--------------------------------------|------|--|------------|-----|----|--------------|
| 39                                   | 1442 | <b>SAMPLES_PER_TIE_PT=</b>                                     | keyword    | uc  | 19 | 19           |
|                                      |      | Number of samples between across track tie points              | samples    | Ac  | 1  | 4            |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| 40                                   | 1466 | <b>COLUMN_SPACING=</b>   | keyword    | uc  | 15 | 15           |
|                                      |      | On ground spacing between columns                              | m          | Afl | 1  | 15           |
|                                      |      | <m>  | units      | uc  | 3  | 3            |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| 41                                   | 1500 | <b>Spare (blank characters)</b>                                | -          | uc  | 41 | 41           |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| <i>DSDs for included Data Sets</i>   |      |  |            |     |    |              |
| 42                                   | 1542 | <b>DSD-A of Level 1b Summary Quality ADS (SQADS)</b>           | -          | dsd | 1  | 280          |
| 43                                   | 1822 | <b>DSD-G of Level 1b Scaling Factors and General info GADS</b> | -          | dsd | 1  | 280          |
| 44                                   | 2102 | <b>DSD-A of Level 1b Tie Points Loc. &amp; Aux. Data ADS</b>   | -          | dsd | 1  | 280          |
| 45                                   | 2382 | <b>DSD-M(1-15) of Level 1b TOA Radiances MDSs</b>              | -          | dsd | 15 | 4200         |
| 46                                   | 6582 | <b>DSD-M(16) of Level 1b Flags &amp; Detector Index</b>        | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(17) of Level 1b Corrected Longitude</b>               | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(18) of Level 1b Corrected Latitude</b>                | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(19) of Level 1b Altitude</b>                          | -          | dsd | 1  | 280          |
| <i>DSDs for referenced Data Sets</i> |      |  |            |     |    |              |
| 47                                   | 6862 | <b>DSD-R Level 0 data file</b>                                 | -          | dsd | 1  | 280          |
| 48                                   | 7142 | <b>DSD-R Instrument auxiliary data file</b>                    | -          | dsd | 1  | 280          |
| 49                                   | 7422 | <b>DSD-R Proc. L1b control parameters data file</b>            | -          | dsd | 1  | 280          |
| 50                                   | 7702 | <b>DSD-R Radiometric calibration data file</b>                 | -          | dsd | 1  | 280          |
| 51                                   | 7982 | <b>DSD-R Digital Elevation Model data file</b>                 | -          | dsd | 1  | 280          |
| 52                                   | 8262 | <b>DSD-R Digital Roughness Model data file</b>                 | -          | dsd | 1  | 280          |
| 53                                   | 8542 | <b>DSD-R Coast-line/Land/Ocean file</b>                        | -          | dsd | 1  | 280          |
| 54                                   | 8822 | <b>DSD -R for ECMWF files used</b>                             | -          | dsd | 1  | 280          |
| 55                                   | 9102 | <b>DSD- R for Orbit State Vectors Used</b>                     | -          | dsd | 1  | 280          |
| 56                                   | 9382 | <b>DSD-R Platform Attitude data file (CFI software)</b>        | -          | dsd | 1  | 280          |
| 57                                   | 9662 | <b>DSD-R High Resolution Digital Elevation Model</b>           | -          | dsd | 1  | 280          |
|                                      |      | <b>size (in bytes)</b>   |            |     |    | <b>10782</b> |

*Table 33 - Level 1b Full Swath GeoCorrected Product - SPH*

All Data Set Descriptors (DSD) shall follow the format and have the content described in [RD3].



### 5.5.5 - Annotation Data Set - Summary Quality

The Annotation Data Set format shall be as specified in [RD3].

This ADS contains only data useful for the evaluation of the quality of the product. It shall have one ADS Record for every new group of 8 tie frames (a new record has to be generated when starting the 9<sup>th</sup> tie frame, the last Summary Quality record of the product may be relevant for less than 8 tie frames), therefore it will hold (up to) 21 Records in the Full swath GeoCorrected product.

In the MER\_FSG\_1P generation process, these data are not re-evaluated but copied from the input product. In the case of a partial processing, even if the first MDS record does belongs to the first ADS Summary Quality record, it may not correspond to its start limit. In other words synchronisation between ADS Summary Quality and MDS may be lost and corresponding information is only partially relevant.

The size of the ADS has been summarised below:

| ADSR no                 | Description  | Size (bytes) |
|-------------------------|--|--------------|
| 0                       | ADSR associated with line # 1 - 512 FR pixels      | 33           |
| 1                       | ADSR associated with line # 513 - 1024 FR pixels   | 33           |
| ...                     | ...  | ...          |
| 20                      | ADSR associated with line # 9794 - 10305 FR pixels | 33           |
| <b>Total (in bytes)</b> |  | <b>693</b>   |

*Table 34 - Level 1b Full Swath GeoCorrected Product - Summary Quality ADS*

The format and content of the Summary Quality ADSR is identical to the Level 1b Reduced Resolution Product Summary Quality ADSR described in § 5.3.1.5 of [RD1].

### 5.5.6 - Global Annotation Data Set - Scaling Factors

The Global Annotation Data Set format shall be as specified in [RD3].

The content of the GADS- Scaling Factors of the Level 1b Full Swath GeoCorrected Product is identical to the Level 1b Reduced Resolution Product GADS- Scaling Factors described in § 5.3.1.6 of [RD1].

### 5.5.7 - Annotation Data Set - Tie Points Location & corresp. Aux. Data

The Annotation Data Set format shall be as specified in [RD3].

The tie point separation of the Full Swath GeoCorrected product will be identical to that of the reduced resolution spacing on ground (kilometres). This is equivalent to a tie point every 64 FR-pixels in the across track direction and 64 lines in the along track direction.

With the tie point grid being a 64 x 64 sub grid of the FSG product grid consisting of 10305 (AL) x 4481 (AC) pixels, there are 162\*71 (AL\*AC) tie points. There are therefore (up to) 162 tie points Annotation Data Sets Records for the MER\_FSG\_1P Product.

Each ADS is made of ADS Records (one ADSR for each line of the tie points grid, see section 4.2 of [RD1]), the size of the ADS has been summarised below:

| ADSR no                 | Description | Size          |
|-------------------------|-------------|---------------|
| 0                       | ADSR # 1    | 3563          |
| 1                       | ADSR # 2    | 3563          |
| ...                     | ...         | ...           |
| 161                     | ADSR # 162  | 3563          |
| <b>Total (in bytes)</b> |             | <b>577206</b> |

*Table 35 - Level 1b Full Swath GeoCorrected Product - ADS Tie Points Location & corresp. Aux. Data*

A tie point annotation contains location and auxiliary data of the corresponding tie point as follows:

| N  | Byte # | Description                   | Unit      | T  | D  | # bytes     |
|----|--------|-------------------------------|-----------|----|----|-------------|
| 1  | 0      | Start time of the measurement | -         | sl | 3  | 12          |
| 2  | 12     | Attachment flag               | -         | uc | 1  | 1           |
| 3  | 13     | latitude                      | (10-6)deg | sl | 71 | 284         |
| 4  | 157    | longitude                     | (10-6)deg | sl | 71 | 284         |
| 5  | 301    | DEM altitude                  | m         | sl | 71 | 284         |
| 6  | 445    | DEM roughness                 | m         | ul | 71 | 284         |
| 7  | 589    | DEM latitude correction       | (10-6)deg | sl | 71 | 284         |
| 8  | 733    | DEM longitude correction      | (10-6)deg | sl | 71 | 284         |
| 9  | 877    | sun zenith angle              | (10-6)deg | ul | 71 | 284         |
| 10 | 1021   | sun azimuth angle             | (10-6)deg | sl | 71 | 284         |
| 11 | 1165   | viewing zenith angle          | (10-6)deg | ul | 71 | 284         |
| 12 | 1309   | viewing azimuth angle         | (10-6)deg | sl | 71 | 284         |
| 13 | 1453   | zonal wind                    | m*s-1     | ss | 71 | 142         |
| 14 | 1525   | meridional wind               | m*s-1     | ss | 71 | 142         |
| 15 | 1597   | atmospheric pressure          | hPa       | us | 71 | 142         |
| 16 | 1669   | ozone                         | DU        | us | 71 | 142         |
| 17 | 1741   | relative humidity             | %         | us | 71 | 142         |
|    |        | <b>size (in bytes)</b>        | -         | -  | -  | <b>3563</b> |

*Table 36 - Level 1b Full Swath GeoCorrected Product - ADSR Tie Points Location & corresp. Aux. Data*

The elements of a tie point annotation have been specified as for the Level 1b Reduced Resolution Product, see [RD1] section 5.3.1.7.

### 5.5.8 - Measurement Data Sets MDS(1-16)

The Measurement Data Set format shall be as specified in [RD3].

There are 19 measurement data sets, the first 15 consist of Top Of Atmosphere Radiances in mW/(m<sup>2</sup>.sr.nm). There is one MDS for each of the MERIS spectral bands specified in the product SPH (fields 31, 32).

The full swath product corresponds to a footprint of 10305 (AL, max.) x 4481 (AC) FR pixels. There are therefore (up to) 10305 records for each MDS for the product. The data of the 4481 FR product pixels are stored in a single Measurement Data Set Record.

### 5.5.8.1 - Measurement Data Set Records MDS(1-15)

The MER\_FSO\_1P MDS(1-15) has been summarised below:

| MDSR no                 | Description (for band b)          | Size (bytes)    |
|-------------------------|-----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1     | 8975            |
| 1                       | MDSR associated with line # 2     | 8975            |
| ...                     | ...                               | ...             |
| 10304                   | MDSR associated with line # 10305 | 8975            |
| <b>Total (in bytes)</b> |                                   | <b>92487375</b> |

*Table 37 - Level 1b Full Swath GeoCorrected Product - MDS(1-15)*

Each MDSR(1-15) consists of 4481 elements as shown below:

| N | Byte # | Description                              | Unit | T  | D    | # bytes     |
|---|--------|--|------|----|------|-------------|
| 1 | 0      | <i>Start time of the data Set Record</i> | mjd  | sl | 3    | 12          |
| 2 | 12     | <i>Quality indicator</i>                 | -    | sc | 1    | 1           |
| 3 | 13     | TOA radiances band b                     | LU   | us | 4481 | 8962        |
|   |        | <b>MDSR size (in bytes)</b>              | -    | -  | -    | <b>8975</b> |

*Table 38 - Level 1b Full Swath GeoCorrected Product - MDSR(1-15)*

### 5.5.8.2 - Measurement Data Set Records MDS(16) Flags

A different MDS Record is associated to each frame.

The MER\_FSG\_1P MDS(16) has been summarised below:

| MDSR no                 | Description                       | Size (bytes)     |
|-------------------------|-----------------------------------|------------------|
| 0                       | MDSR associated with line # 1     | 6736             |
| 1                       | MDSR associated with line # 2     | 6736             |
| ...                     | ...                               | ...              |
| 10304                   | MDSR associated with line # 10305 | 6736             |
| <b>Total (in bytes)</b> |                                   | <b>138664080</b> |

*Table 39 - Level 1b Full Swath GeoCorrected Product - MDS(16)*

A MDSR contains the flags for each pixel of the corresponding product grid line.

Each MDSR(16) shall be of the following format:

| N                                | Byte # | Description                              | Unit | T  | D    | # bytes      |
|----------------------------------|--------|--|------|----|------|--------------|
| 1                                | 0      | <i>Start time of the Data Set Record</i> | mjd  | sl | 3    | 12           |
| 2                                | 12     | <i>Quality Indicator</i>                 | -    | sc | 1    | 1            |
| 3                                | 13     | Flags                                    | nd   | uc | 4481 | 4481         |
| 4                                | 4494   | Detector Index                           | nd   | ss | 4481 | 8962         |
| <b>Data Base size (in bytes)</b> |        |  | -    | -  | -    | <b>13456</b> |

*Table 40 - Level 1b Full Swath GeoCorrected Product - MDSR(16)*

The flags are coded on a single bit according to Table 41. The Detector index allows to link each product pixel to the instrument detector using indexing as described in [R-6] of [RD1].

| Flag type   | bit number |
|-------------|------------|
| cosmetic    | 0          |
| duplicated  | 1          |
| glint risk  | 2          |
| suspect     | 3          |
| land /ocean | 4          |
| bright      | 5          |
| coastline   | 6          |
| invalid     | 7          |

*Table 41 - Level 1b Full Swath GeoCorrected Product - Flags Coding*

The bit numbering complies with the requirements defined in [RD1].

### 5.5.8.3 - Measurement Data Set Records MDS(17) Longitude

A different MDS Record is associated to each frame.

The MER\_FSG\_1P MDS(17) has been summarised below:

| MDSR no                 | Description                       | Size (bytes)     |
|-------------------------|-----------------------------------|------------------|
| 0                       | MDSR associated with line # 1     | 17937            |
| 1                       | MDSR associated with line # 2     | 17937            |
| ...                     | ...                               | ...              |
| 10304                   | MDSR associated with line # 10305 | 17937            |
| <b>Total (in bytes)</b> |                                   | <b>184840785</b> |

*Table 42 - Level 1b Full Swath GeoCorrected Product - MDS(16)*

A MDSR contains the ortho-geolocated longitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N | Byte # | Description                              | Unit      | T  | D    | # bytes      |
|---|--------|--|-----------|----|------|--------------|
| 1 | 0      | <i>Start time of the Data Set Record</i> | mjd       | sl | 3    | 12           |
| 2 | 12     | <i>Quality Indicator</i>                 | -         | sc | 1    | 1            |
| 3 | 13     | Corrected Longitude                      | (10-6)deg | sl | 4481 | 17924        |
|   |        | <b>Data Base size (in bytes)</b>         | -         | -  | -    | <b>17937</b> |

*Table 43 - Level 1b Full Swath GeoCorrected Product - MDSR(17)*

#### 5.5.8.4 - Measurement Data Set Records MDS(18) Latitude

A different MDS Record is associated to each frame.

The MER\_FSG\_1P MDS(18) has been summarised below:

| MDSR no                 | Description                       | Size (bytes)     |
|-------------------------|-----------------------------------|------------------|
| 0                       | MDSR associated with line # 1     | 17937            |
| 1                       | MDSR associated with line # 2     | 17937            |
| ...                     | ...                               | ...              |
| 10304                   | MDSR associated with line # 10305 | 17937            |
| <b>Total (in bytes)</b> |                                   | <b>184840785</b> |

*Table 44 - Level 1b Full Swath GeoCorrected Product - MDS(18)*

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N | Byte # | Description                              | Unit      | T  | D    | # bytes      |
|---|--------|--|-----------|----|------|--------------|
| 1 | 0      | <i>Start time of the Data Set Record</i> | mjd       | sl | 3    | 12           |
| 2 | 12     | <i>Quality Indicator</i>                 | -         | sc | 1    | 1            |
| 3 | 13     | Corrected Latitude                       | (10-6)deg | sl | 4481 | 17924        |
|   |        | <b>Data Base size (in bytes)</b>         | -         | -  | -    | <b>17937</b> |

*Table 45 - Level 1b Full Swath GeoCorrected Product - MDSR(17)*

### 5.5.8.5 - Measurement Data Set Records MDS(18) Altitude

A different MDS Record is associated to each frame.

The MER\_FSG\_1P MDS(18) has been summarised below:

| MDSR no                 | Description                       | Size (bytes)    |
|-------------------------|-----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1     | 8975            |
| 1                       | MDSR associated with line # 2     | 8975            |
| ...                     | ...                               | ...             |
| 10304                   | MDSR associated with line # 10305 | 8975            |
| <b>Total (in bytes)</b> |                                   | <b>92487375</b> |

*Table 46 - Level 1b Full Swath GeoCorrected Product - MDS(18)*

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N                                | Byte # | Description                              | Unit | T  | D    | # bytes     |
|----------------------------------|--------|--|------|----|------|-------------|
| 1                                | 0      | <i>Start time of the Data Set Record</i> | mjd  | sl | 3    | 12          |
| 2                                | 12     | <i>Quality Indicator</i>                 | -    | sc | 1    | 1           |
| 3                                | 13     | Altitude                                 | m    | ss | 4481 | 8962        |
| <b>Data Base size (in bytes)</b> |        |  | -    | -  | -    | <b>8975</b> |

*Table 47 - Level 1b Full Swath GeoCorrected Product - MDSR(17)*

## 5.6 MER\_FRG\_1P

### 5.6.1 - Summary

The Level 1b Full Resolution GeoCorrected Product, hereafter referred to as Level 1b FRG, is summarised below:

| Name                      | Level 1b full resolution GeoCorrected  |
|---------------------------|--|
| Identifier                | MER_FRG_1P   |
| Product Level             | 1b   |
| Description               | Radiance measurements at top of atmosphere for the 15 MERIS bands, re-ordered, calibrated, radiometrically corrected, geo-located with orthorectification at pixel level, annotated with PCD, calibration data, classification flags, environment parameters         |
| Coverage                  | Regional   |
| Packaging                 | Scene of 2241 lines  |
| Unit                      | $10^{-3} \text{ W.m}^{-2}.\text{sr}^{-1}.\text{nm}^{-1}$   |
| Range                     | 0..26 to 0..270 (band dependent)   |
| Sampling                  | <b>spatial</b> : 260 m across track at nadir and 290 m along track.<br><b>spectral</b> : MERIS bands (see [RD1] Table 3.2.1)   |
| Resolution                | <b>radiometric</b> : NEDL (see [R-5] of [RD1])<br><b>spatial</b> : MTF > 0.3 at Nyquist freq. ([R-5] of [RD1])<br><b>spectral</b> : $\leq 2.5 \text{ nm}$ ([R-5] of [RD1])   |
| Accuracy                  | <b>radiometric</b> : $\leq 2\%$ in 400-900 nm range ([R-5] of [RD1])<br><b>absolute geometric</b> : 2000m (spec. in [R-5] of [RD1])<br><b>relative geometric</b> : 1000m (spec. in [R-5] of [RD1])   |
| Geo-location requirements | Each pixel is geo-located with orthorectification (i.e. accounting for the Earth surface elevation as provided by a Digital Elevation Model).  |
| Format                    | <ul style="list-style-type: none"> <li>• 16 bits/sample</li> <li>• 2241 samples/record</li> <li>• 19 records/line</li> <li>• 2241 lines/MDS</li> <li>• 1 GADS, 2 ADS &amp; 19 MDS (15 for TOA LU, 1 for flags, 3 for longitudes, latitudes and altitudes)</li> </ul> |
| Annotated data            | see below  |
| Frequency                 | Variable (upon Level 0 data availability and processing requests)  |
| Size                      | 206 Mbytes   |

*Table 48 - Level 1b Full Resolution GeoCorrected Product - Summary*



### 5.6.2 - Organization

The high-level breakdown of the Level 1-FRG product is described below:

| Description                                      | Size             |
|--|------------------|
| Level 1b FSG - MPH                               | 1247             |
| Level 1b FSG - SPH                               | 10782            |
| Level 1b FSG Summary Quality ADS                 | 165              |
| Level 1b FSG GADS Scaling Factors                | 292              |
| Level 1b FSG ADS Tie Points Location & Aux. Data | 65268            |
| Level 1b FSG MDS(1) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(2) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(3) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(4) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(5) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(6) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(7) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(8) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(9) TOA Radiances                | 10073295         |
| Level 1b FSG MDS(10) TOA Radiances               | 10073295         |
| Level 1b FSG MDS(11) TOA Radiances               | 10073295         |
| Level 1b FSG MDS(12) TOA Radiances               | 10073295         |
| Level 1b FSG MDS(13) TOA Radiances               | 10073295         |
| Level 1b FSG MDS(14) TOA Radiances               | 10073295         |
| Level 1b FSG MDS(15) TOA Radiances               | 10073295         |
| Level 1b FSG MDS(16) Flags & Detector Index      | 15095376         |
| Level 1b FSG MDS(17) Corrected Longitude         | 20117457         |
| Level 1b FSG MDS(18) Corrected Latitude          | 20117457         |
| Level 1b FSG MDS(19) Altitude                    | 10073295         |
| <b>Product Size</b>                              | <b>216580764</b> |

*Table 49 - Level 1b Full Resolution GeoCorrected Product - High-level breakdown*

### 5.6.3 - Main Product Header

The format and the content of the Main Product Header shall be as specified in [RD3].

### 5.6.4 - Specific Product Header

The Specific Product Header format shall be as specified in [RD3].

The Data Set Descriptor format shall be as specified in [RD3].

The Level 1b Full Resolution GeoCorrected Product Specific Product Header will be in ASCII format and its content shall be as follows:



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| N                                      | Byte # | Description   | Unit          | T  | D  | # Bytes |
|--|--------|---|---------------|----|----|---------|
| 1                                      | 0      | <b>SPH_DESCRIPTOR=</b>  | keyword       | uc | 15 | 15      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | SPH Descriptor<br>ASCII string describing the product.  | -             | uc | 28 | 28      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 2                                      | 46     | <b>STRIPLINE_CONTINUITY_INDICATOR=</b>  | keyword       | uc | 31 | 31      |
|  |        | Value: 0= No stripline continuity, the product is a complete segment<br>Other: Stripline Counter  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 3                                      | 82     | <b>SLICE_POSITION=</b>  | keyword       | uc | 15 | 15      |
|  |        | Value: +001 to NUM_SLICES<br>Default value if no stripline continuity = +001  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 4                                      | 102    | <b>NUM_SLICES=</b>  | keyword       | uc | 11 | 11      |
|  |        | Number of slices in this stripline Default value if no continuity = +001  | -             | Ac | 1  | 4       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| <i>Product Time Information</i>        |        |   |               |    |    |         |
| 5                                      | 118    | <b>FIRST_LINE_TIME=</b>   | keyword       | uc | 16 | 16      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | Azimuth time first line of product.<br>UTC Time of first range line in the MDS of this product. UTC time format contained within quotation marks. | UTC           | uc | 27 | 27      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| 6                                      | 164    | <b>LAST_LINE_TIME=</b>  | keyword       | uc | 15 | 15      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | Azimuth time last line of product Time of last range line in the MDS of this product. UTC time format contained within quotation marks.           | UTC           | uc | 27 | 27      |
|  |        | quotation mark (“)  | -             | uc | 1  | 1       |
|  |        | newline character   | terminator    | uc | 1  | 1       |
| <i>Product Positioning Information</i> |        |   |               |    |    |         |
| 7                                      | 209    | <b>FIRST_FIRST_LAT=</b>   | keyword       | uc | 16 | 16      |
|  |        | Geodetic Latitude of the first sample of the first line<br>A negative value denotes south latitude, a positive value denotes North latitude       | 10 -6 degrees | Al | 1  | 11      |
|  |        | <10-6degN>  | units         | uc | 10 | 10      |
|  |        | newline character   | terminator    | uc | 1  | 1       |

|    |     |   |              |    |    |    |
|----|-----|---|--------------|----|----|----|
| 8  | 247 | <b>FIRST_FIRST_LONG=</b>  | keyword      | uc | 17 | 17 |
|    |     | East geodetic longitude of the first sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.      | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 9  | 286 | <b>FIRST_MID_LAT=</b>   | keyword      | uc | 14 | 14 |
|    |     | Geodetic Latitude of the middle sample of the first line A negative value denotes south latitude, a positive value denotes North latitude | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 10 | 322 | <b>FIRST_MID_LONG=</b>  | keyword      | uc | 15 | 15 |
|    |     | East geodetic longitude of the middle sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.     | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 11 | 359 | <b>FIRST_LAST_LAT=</b>  | keyword      | uc | 15 | 15 |
|    |     | Geodetic Latitude of the last sample of the first line A negative value denotes south latitude, a positive value denotes North latitude   | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 12 | 396 | <b>FIRST_LAST_LONG=</b>   | keyword      | uc | 16 | 16 |
|    |     | East geodetic longitude of the last sample of the first line. Positive values East of Greenwich, negative values west of Greenwich.       | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 13 | 434 | <b>LAST_FIRST_LAT=</b>  | keyword      | uc | 15 | 15 |
|    |     | Geodetic Latitude of the first sample of the last line A negative value denotes south latitude, a positive value denotes North latitude   | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 14 | 471 | <b>LAST_FIRST_LONG=</b>   | keyword      | uc | 16 | 16 |
|    |     | East geodetic longitude of the first sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.       | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degE>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |
| 15 | 509 | <b>LAST_MID_LAT=</b>  | keyword      | uc | 13 | 13 |
|    |     | Geodetic Latitude of the middle sample of the last line A negative value denotes south latitude, a positive value denotes North latitude  | 10-6 degrees | Al | 1  | 11 |
|    |     | <10-6degN>  | units        | uc | 10 | 10 |
|    |     | newline character   | terminator   | uc | 1  | 1  |

|                                    |     |  |              |     |    |    |
|------------------------------------|-----|--|--------------|-----|----|----|
| 16                                 | 544 | <b>LAST_MID_LONG=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | East geodetic longitude of the middle sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.   | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degE>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 17                                 | 580 | <b>LAST_LAST_LAT=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Geodetic Latitude of the last sample of the last line A negative value denotes south latitude, a positive value denotes North latitude | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degN>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 18                                 | 616 | <b>LAST_LAST_LONG=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | East geodetic longitude of the last sample of the last line. Positive values East of Greenwich, negative values west of Greenwich.     | 10-6 degrees | Al  | 1  | 11 |
|                                    |     | <10-6degE>   | units        | uc  | 10 | 10 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 19                                 | 653 | <b>Spare (blank characters)</b>  | -            | uc  | 47 | 47 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| <i>Product Quality Information</i> |     |  |              |     |    |    |
| 20                                 | 701 | <b>TRANS_ERR_FLAG=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | Set to 1 if number of transmission errors exceeds threshold. Set to 0 otherwise.   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 21                                 | 718 | <b>FORMAT_ERR_FLAG=</b>  | keyword      | uc  | 16 | 16 |
|                                    |     | Set to 1 if number of format errors exceeds threshold. Set to 0 otherwise.   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 22                                 | 736 | <b>DATABASE_FLAG=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Flag set to 1 if the processing parameters data base contents does not match the packet header contents.                               | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 23                                 | 752 | <b>COARSE_ERR_FLAG=</b>  | keyword      | uc  | 16 | 16 |
|                                    |     | Flag indicating coarse offsets are above threshold   | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 24                                 | 770 | <b>ECMWF_TYPE=</b>   | keyword      | uc  | 11 | 11 |
|                                    |     | 0 = forecast ECMWF data was used 1 = analysis ECMWF data was used  | -            | uc  | 1  | 1  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 25                                 | 783 | <b>NUM_TRANS_ERR=</b>  | keyword      | uc  | 14 | 14 |
|                                    |     | Number of transmission errors in the product   | -            | Al  | 1  | 11 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 26                                 | 809 | <b>NUM_FORMAT_ERR=</b>   | keyword      | uc  | 15 | 15 |
|                                    |     | Number of format errors in the product   | -            | Al  | 1  | 11 |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |
| 27                                 | 836 | <b>TRANS_ERR_THRESH=</b>   | keyword      | uc  | 17 | 17 |
|                                    |     | Threshold for setting TRANS_ERR_FLAG   | %            | Afl | 1  | 15 |
|                                    |     | <%>  | units        | uc  | 3  | 3  |
|                                    |     | newline character  | terminator   | uc  | 1  | 1  |

|                                       |      |  |            |     |    |     |
|---------------------------------------|------|--|------------|-----|----|-----|
| 28                                    | 872  | <b>FORMAT_ERR_THRESH=</b>  | keyword    | uc  | 18 | 18  |
|                                       |      | Threshold for setting FORMAT_ERR_FLAG  | %          | Afl | 1  | 15  |
|                                       |      | <%>  | units      | uc  | 3  | 3   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 29                                    | 909  | <b>Spare (blank characters)</b>  | -          | uc  | 77 | 77  |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| <i>Additional Product Information</i> |      |  |            |     |    |     |
| 30                                    | 987  | <b>NUM_BANDS=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | Number of bands in the product   | -          | Ac  | 1  | 4   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 31                                    | 1002 | <b>BAND_WAVELEN=</b>   | keyword    | uc  | 13 | 13  |
|                                       |      | List of up to 15 band central wavelengths of the bands contained in this product. Unused values are set to zero.   | 10-3 nm    | Al  | 15 | 165 |
|                                       |      | <10-5nm>   | units      | uc  | 8  | 8   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 32                                    | 1189 | <b>BANDWIDTH=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | <b>List of up to 15 bandwidths for the bands in the product. The order of the list must match the order of the central wavelengths entries in the previous field.</b> Unused values are set to zero. Each entry is of the form Al. e.g., if only 13 bands were included in the product:<br>+10000+10000+10000+10000+10000+10000+10000+07500+02500+05000+12500+10000+12500+0000+00000 | 10-3 nm    | As  | 15 | 90  |
|                                       |      | <10-3nm>   | units      | uc  | 8  | 8   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 33                                    | 1198 | <b>INST_FOV=</b>   | keyword    | uc  | 9  | 9   |
|                                       |      | Instantaneous Field of View  | 10-6 deg   | Al  | 1  | 11  |
|                                       |      | <10-6deg>  | units      | uc  | 9  | 9   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 34                                    | 1328 | <b>PROC_MODE=</b>  | keyword    | uc  | 10 | 10  |
|                                       |      | Processor mode of operation 1 = Raw 0 = Full Processing  | flag       | uc  | 1  | 1   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 35                                    | 1340 | <b>OFFSET_COMP=</b>  | keyword    | uc  | 12 | 12  |
|                                       |      | Offset Compensation 1=ON 0=OFF   | flag       | uc  | 1  | 1   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 36                                    | 1354 | <b>LINE_TIME_INTERVAL=</b>   | keyword    | uc  | 19 | 19  |
|                                       |      | Line spacing in time   | (10-6) sec | Al  | 1  | 11  |
|                                       |      | <10-6s>  | units      | uc  | 7  | 7   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 37                                    | 1392 | <b>LINE_LENGTH=</b>  | keyword    | uc  | 12 | 12  |
|                                       |      | Number of samples per output line  | samples    | As  | 1  | 6   |
|                                       |      | <samples>  | units      | uc  | 9  | 9   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |
| 38                                    | 1420 | <b>LINES_PER_TIE_PT=</b>   | keyword    | uc  | 17 | 17  |
|                                       |      | Number of lines between along track tie points   | lines      | Ac  | 1  | 4   |
|                                       |      | newline character  | terminator | uc  | 1  | 1   |

|                                      |      |  |            |     |    |              |
|--------------------------------------|------|--|------------|-----|----|--------------|
| 39                                   | 1442 | <b>SAMPLES_PER_TIE_PT=</b>                                     | keyword    | uc  | 19 | 19           |
|                                      |      | Number of samples between across track tie points              | samples    | Ac  | 1  | 4            |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| 40                                   | 1466 | <b>COLUMN_SPACING=</b>   | keyword    | uc  | 15 | 15           |
|                                      |      | On ground spacing between columns                              | m          | Afl | 1  | 15           |
|                                      |      | <m>  | units      | uc  | 3  | 3            |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| 41                                   | 1500 | <b>Spare (blank characters)</b>                                | -          | uc  | 41 | 41           |
|                                      |      | newline character  | terminator | uc  | 1  | 1            |
| <i>DSDs for included Data Sets</i>   |      |  |            |     |    |              |
| 42                                   | 1542 | <b>DSD-A of Level 1b Summary Quality ADS (SQADS)</b>           | -          | dsd | 1  | 280          |
| 43                                   | 1822 | <b>DSD-G of Level 1b Scaling Factors and General info GADS</b> | -          | dsd | 1  | 280          |
| 44                                   | 2102 | <b>DSD-A of Level 1b Tie Points Loc. &amp; Aux. Data ADS</b>   | -          | dsd | 1  | 280          |
| 45                                   | 2382 | <b>DSD-M(1-15) of Level 1b TOA Radiances MDSs</b>              | -          | dsd | 15 | 4200         |
| 46                                   | 6582 | <b>DSD-M(16) of Level 1b Flags &amp; Detector Index</b>        | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(17) of Level 1b Corrected Longitude</b>               | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(18) of Level 1b Corrected Latitude</b>                | -          | dsd | 1  | 280          |
| 46                                   | 6582 | <b>DSD-M(19) of Level 1b Altitude</b>                          | -          | dsd | 1  | 280          |
| <i>DSDs for referenced Data Sets</i> |      |  |            |     |    |              |
| 47                                   | 6862 | <b>DSD-R Level 0 data file</b>                                 | -          | dsd | 1  | 280          |
| 48                                   | 7142 | <b>DSD-R Instrument auxiliary data file</b>                    | -          | dsd | 1  | 280          |
| 49                                   | 7422 | <b>DSD-R Proc. L1b control parameters data file</b>            | -          | dsd | 1  | 280          |
| 50                                   | 7702 | <b>DSD-R Radiometric calibration data file</b>                 | -          | dsd | 1  | 280          |
| 51                                   | 7982 | <b>DSD-R Digital Elevation Model data file</b>                 | -          | dsd | 1  | 280          |
| 52                                   | 8262 | <b>DSD-R Digital Roughness Model data file</b>                 | -          | dsd | 1  | 280          |
| 53                                   | 8542 | <b>DSD-R Coast-line/Land/Ocean file</b>                        | -          | dsd | 1  | 280          |
| 54                                   | 8822 | <b>DSD -R for ECMWF files used</b>                             | -          | dsd | 1  | 280          |
| 55                                   | 9102 | <b>DSD- R for Orbit State Vectors Used</b>                     | -          | dsd | 1  | 280          |
| 56                                   | 9382 | <b>DSD-R Platform Attitude data file (CFI software)</b>        | -          | dsd | 1  | 280          |
| 57                                   | 9662 | <b>DSD-R High Resolution Digital Elevation Model</b>           | -          | dsd | 1  | 280          |
|                                      |      | <b>size (in bytes)</b>   |            |     |    | <b>10782</b> |

*Table 50 - Level 1b Full Resolution GeoCorrected Product - SPH*

All Data Set Descriptors (DSD) shall follow the format and have the content described in [RD3].

### 5.6.5 - Annotation Data Set - Summary Quality

The Annotation Data Set format shall be as specified in [RD3].

This ADS contains only data useful for the evaluation of the quality of the product. It shall have one ADS Record for every new group of 8 tie frames (a new record has to be generated when starting the 9<sup>th</sup> tie frame, the last Summary Quality record of the product may be relevant for less than 8 tie frames), therefore it will hold 5 Records in the Full resolution GeoCorrected product.

The size of the ADS has been summarised below:

| ADSR no                 | Description                                       | Size (bytes) |
|-------------------------|---|--------------|
| 0                       | ADSR associated with line # 1 - 512 FR pixels     | 33           |
| 1                       | ADSR associated with line # 513 - 1024 FR pixels  | 33           |
| ...                     | ...   | ...          |
| 4                       | ADSR associated with line # 2049 - 2241 FR pixels | 33           |
| <b>Total (in bytes)</b> |   | <b>165</b>   |

*Table 51 - Level 1b Full Resolution GeoCorrected Product - Summary Quality ADS*

The format and content of the Summary Quality ADSR is identical to the Level 1b Reduced Resolution Product Summary Quality ADSR described in § 5.3.1.5 of [RD1].

### 5.6.6 - Global Annotation Data Set - Scaling Factors

The Global Annotation Data Set format shall be as specified in [RD3].

The content of the GADS- Scaling Factors of the Level 1b Full Resolution GeoCorrected Product is identical to the Level 1b Reduced Resolution Product GADS- Scaling Factors described in § 5.3.1.6 of [RD1].

### 5.6.7 - Annotation Data Set - Tie Points Location & corresp. Aux. Data

The Annotation Data Set format shall be as specified in [RD3].

The tie point separation of the Full Resolution GeoCorrected product will be identical to that of the reduced resolution spacing on ground (kilometres). This is equivalent to a tie point every 64 FR-pixels in the across track direction and 64 lines in the along track direction.

With the tie point grid being a 64 x 64 sub grid of the FRG product grid consisting of 2241 (AL) x 2241 (AC) pixels, there are 36\*36 (AL\*AC) tie points. There are therefore 36 tie points Annotation Data Sets Records for the MER\_FRG\_1P Product.

Each ADS is made of ADS Records (one ADSR for each line of the tie points grid, see section 4.2 of [RD1]), the size of the ADS has been summarised below:



| ADSR no                 | Description | Size         |
|-------------------------|-------------|--------------|
| 0                       | ADSR # 1    | 1813         |
| 1                       | ADSR # 2    | 1813         |
| ...                     | ...         | ...          |
| 35                      | ADSR # 36   | 1813         |
| <b>Total (in bytes)</b> |             | <b>65268</b> |

*Table 52 - Level 1b Full Resolution GeoCorrected Product - ADS Tie Points Location & corresp. Aux. Data*

A tie point annotation contains location and auxiliary data of the corresponding tie point as follows:

| N  | Byte # | Description                          | Unit      | T  | D  | # bytes     |
|----|--------|--------------------------------------|-----------|----|----|-------------|
| 1  | 0      | <i>Start time of the measurement</i> | -         | sl | 3  | 12          |
| 2  | 12     | <i>Attachment flag</i>               | -         | uc | 1  | 1           |
| 3  | 13     | latitude                             | (10-6)deg | sl | 36 | 144         |
| 4  | 157    | longitude                            | (10-6)deg | sl | 36 | 144         |
| 5  | 301    | DEM altitude                         | m         | sl | 36 | 144         |
| 6  | 445    | DEM roughness                        | m         | ul | 36 | 144         |
| 7  | 589    | DEM latitude correction              | (10-6)deg | sl | 36 | 144         |
| 8  | 733    | DEM longitude correction             | (10-6)deg | sl | 36 | 144         |
| 9  | 877    | sun zenith angle                     | (10-6)deg | ul | 36 | 144         |
| 10 | 1021   | sun azimuth angle                    | (10-6)deg | sl | 36 | 144         |
| 11 | 1165   | viewing zenith angle                 | (10-6)deg | ul | 36 | 144         |
| 12 | 1309   | viewing azimuth angle                | (10-6)deg | sl | 36 | 144         |
| 13 | 1453   | zonal wind                           | m*s-1     | ss | 36 | 72          |
| 14 | 1525   | meridional wind                      | m*s-1     | ss | 36 | 72          |
| 15 | 1597   | atmospheric pressure                 | hPa       | us | 36 | 72          |
| 16 | 1669   | ozone                                | DU        | us | 36 | 72          |
| 17 | 1741   | relative humidity                    | %         | us | 36 | 72          |
|    |        | <b>size (in bytes)</b>               | -         | -  | -  | <b>1813</b> |

*Table 53 - Level 1b Full Resolution GeoCorrected Product - ADSR Tie Points Location & corresp. Aux. Data*

The elements of a tie point annotation has been specified as for the Level 1b Reduced Resolution Product, see [RD1] section 5.3.1.7.

### 5.6.8 - Measurement Data Sets MDS(1-16)

The Measurement Data Set format shall be as specified in [RD3].

There are 19 measurement data sets, the first 15 consist of Top Of Atmosphere Radiances in mW/(m<sup>2</sup>.sr.nm). There is one MDS for each of the MERIS spectral bands specified in the product SPH (fields 31, 32).

The full swath product corresponds to a footprint of 2241 (AL) x 2241 (AC) FR pixels. There are therefore 2241 records for each MDS for the product. The data of the 2241 FR product pixels are stored in a single Measurement Data Set Record.



### 5.6.8.1 - Measurement Data Set Records MDS(1-15)

The MER\_FRG\_1P MDS(1-15) has been summarised below:

| MDSR no                 | Description (for band b)         | Size (bytes)    |
|-------------------------|----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1    | 4495            |
| 1                       | MDSR associated with line # 2    | 4495            |
| ...                     | ...                              | ...             |
| 2240                    | MDSR associated with line # 2041 | 4495            |
| <b>Total (in bytes)</b> |                                  | <b>10073295</b> |

*Table 54 - Level 1b Full Resolution GeoCorrected Product - MDS(1-15)*

Each MDSR(1-15) consists of 2241 elements as shown below:

| N | Byte # | Description                              | Unit | T  | D    | # bytes     |
|---|--------|--|------|----|------|-------------|
| 1 | 0      | <i>Start time of the data Set Record</i> | mjd  | sl | 3    | 12          |
| 2 | 12     | <i>Quality indicator</i>                 | -    | sc | 1    | 1           |
| 3 | 13     | TOA radiances band b                     | LU   | us | 2241 | 4482        |
|   |        | <b>MDSR size (in bytes)</b>              | -    | -  | -    | <b>4495</b> |

*Table 55 - Level 1b Full Resolution GeoCorrected Product - MDSR(1-15)*

### 5.6.8.2 - Measurement Data Set Records MDS(16) Flags

A different MDS Record is associated to each frame.

The MER\_FRG\_1P MDS(16) has been summarised below:

| MDSR no                 | Description                      | Size (bytes)    |
|-------------------------|----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1    | 6736            |
| 1                       | MDSR associated with line # 2    | 6736            |
| ...                     | ...                              | ...             |
| 2240                    | MDSR associated with line # 2241 | 6736            |
| <b>Total (in bytes)</b> |                                  | <b>15095376</b> |

*Table 56 - Level 1b Full Resolution GeoCorrected Product - MDS(16)*

A MDSR contains the flags for each pixel of the corresponding product grid line.

Each MDSR(16) shall be of the following format:

| N                                | Byte # | Description                              | Unit | T  | D    | # bytes     |
|----------------------------------|--------|--|------|----|------|-------------|
| 1                                | 0      | <i>Start time of the Data Set Record</i> | mjd  | sl | 3    | 12          |
| 2                                | 12     | <i>Quality Indicator</i>                 | -    | sc | 1    | 1           |
| 3                                | 13     | Flags                                    | nd   | uc | 2241 | 2241        |
| 4                                | 4494   | Detector Index                           | nd   | ss | 2241 | 4482        |
| <b>Data Base size (in bytes)</b> |        |  | -    | -  | -    | <b>6736</b> |

*Table 57 - Level 1b Full Resolution GeoCorrected Product - MDSR(16)*

The flags are coded on a single bit according to table 4.3.2.8.2.c. The Detector index allows to link each product pixel to the instrument detector using indexing as described in [R-6] of [RD1].

| Flag type   | bit number |
|-------------|------------|
| cosmetic    | 0          |
| duplicated  | 1          |
| glint risk  | 2          |
| suspect     | 3          |
| land /ocean | 4          |
| bright      | 5          |
| coastline   | 6          |
| invalid     | 7          |

*Table 58 - Level 1b Full Resolution GeoCorrected Product - Flags Coding*

The bit numbering complies with the requirements defined in [RD1].

### 5.6.8.3 - Measurement Data Set Records MDS(17) Longitude

A different MDS Record is associated to each frame.

The MER\_FRG\_1P MDS(17) has been summarised below:

| MDSR no                 | Description                      | Size (bytes)    |
|-------------------------|----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1    | 8977            |
| 1                       | MDSR associated with line # 2    | 8977            |
| ...                     | ...                              | ...             |
| 2240                    | MDSR associated with line # 2041 | 8977            |
| <b>Total (in bytes)</b> |                                  | <b>20117457</b> |

*Table 59 - Level 1b Full Resolution GeoCorrected Product - MDS(16)*

A MDSR contains the ortho-geolocated longitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N | Byte # | Description                              | Unit      | T  | D    | # bytes     |
|---|--------|--|-----------|----|------|-------------|
| 1 | 0      | <i>Start time of the Data Set Record</i> | mjd       | sl | 3    | 12          |
| 2 | 12     | <i>Quality Indicator</i>                 | -         | sc | 1    | 1           |
| 3 | 13     | Corrected Longitude                      | (10-6)deg | sl | 2241 | 8964        |
|   |        | <b>Data Base size (in bytes)</b>         | -         | -  | -    | <b>8977</b> |

*Table 60 - Level 1b Full Resolution GeoCorrected Product - MDSR(17)*

#### 5.6.8.4 - Measurement Data Set Records MDS(18) Latitude

A different MDS Record is associated to each frame.

The MER\_FRG\_1P MDS(18) has been summarised below:

| MDSR no                 | Description                      | Size (bytes)    |
|-------------------------|----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1    | 8977            |
| 1                       | MDSR associated with line # 2    | 8977            |
| ...                     | ...                              | ...             |
| 2240                    | MDSR associated with line # 2241 | 8977            |
| <b>Total (in bytes)</b> |                                  | <b>20117457</b> |

*Table 61 - Level 1b Full Resolution GeoCorrected Product - MDS(18)*

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N | Byte # | Description                              | Unit      | T  | D    | # bytes     |
|---|--------|--|-----------|----|------|-------------|
| 1 | 0      | <i>Start time of the Data Set Record</i> | mjd       | sl | 3    | 12          |
| 2 | 12     | <i>Quality Indicator</i>                 | -         | sc | 1    | 1           |
| 3 | 13     | Corrected Latitude                       | (10-6)deg | sl | 2241 | 8964        |
|   |        | <b>Data Base size (in bytes)</b>         | -         | -  | -    | <b>8977</b> |

*Table 62 - Level 1b Full Resolution GeoCorrected Product - MDSR(17)*

### 5.6.8.5 - Measurement Data Set Records MDS(18) Altitude

A different MDS Record is associated to each frame.

The MER\_FRG\_1P MDS(18) has been summarised below:

| MDSR no                 | Description                      | Size (bytes)    |
|-------------------------|----------------------------------|-----------------|
| 0                       | MDSR associated with line # 1    | 4495            |
| 1                       | MDSR associated with line # 2    | 4495            |
| ...                     | ...                              | ...             |
| 2240                    | MDSR associated with line # 2241 | 4495            |
| <b>Total (in bytes)</b> |                                  | <b>10073295</b> |

*Table 63 - Level 1b Full Resolution GeoCorrected Product - MDS(18)*

A MDSR contains the ortho-geolocated geodetic latitude for each pixel of the corresponding product grid line.

Each MDSR(17) shall be of the following format:

| N | Byte # | Description                              | Unit | T  | D    | # bytes     |
|---|--------|--|------|----|------|-------------|
| 1 | 0      | <i>Start time of the Data Set Record</i> | mjd  | sl | 3    | 12          |
| 2 | 12     | <i>Quality Indicator</i>                 | -    | sc | 1    | 1           |
| 3 | 13     | Altitude                                 | m    | ss | 2241 | 4482        |
|   |        | <b>Data Base size (in bytes)</b>         | -    | -  | -    | <b>4495</b> |

*Table 64 - Level 1b Full Resolution GeoCorrected Product - MDSR(17)*

## 5.7 Status and Error Log Files

Status and Error messages can be issued by either the Amorgos shell script or the executable program itself. All messages follow a common format:

<date> <level> <source> <message> where :

- Date in these messages is formatted as <yyyymmdd hh:mm:ss.sss>, e.g. 20050722 18:30:37.000
- level indicates the nature of the message: INFO, WARN or ERROR
- source identifies the module/routine that issued the message: either amorgos.sh (possibly preceded by a UNIX path) when it is the message originator, or the source file name followed by the routine name and the source file line number where the message was issued when it comes from the executable program

Examples of shell script messages:

```
20050721 13:58:02.000 .ERROR /amorgos.sh: Cannot read configuration file
"test_amorgos.config"
20050721 14:10:27.000 INFO ./amorgos.sh: test_amorgos.config
20050721 14:10:27.000 INFO ./amorgos.sh: -NAME_OUTPUT_DIR="../../OutputDir"
```

Examples of executable program messages:

```
20050721 10:10:09.000 INFO ../source/AmorgosApplication.c
AmorgosApplication_init_streams 148::frame count parameter missing : forced to
maximum (value) [2]
20050721 10:11:53.000 INFO ../source/AmorgosApplication.c
AmorgosApplication_reverse_sampling 349::sampling inversion progress bar
(percentage, processed frame count, total frame count) [10.0; 480;4801]
```

All these messages are normally logged into the Status log file and in addition into the Error log file if it is an error message (WARN and ERROR levels). However, in a few cases, it is impossible to create such log files and the messages are issued to the standard output. Such messages are clearly identified in the following subsections where all possible message texts are listed and described.

### 5.7.1 Informational messages

These messages are logged only in the Status Log File status.txt.

The level is: INFO

Possible messages are:

#### 5.7.1.1 Shell script messages

| Message text                                  | Description   |
|---|---|
| Configuration File="file_path"                | reports the path to the configuration file  |
| -NAME_OUTPUT_DIR="path"                       | reports the path to the Output Directory  |
| -NAME_INPUT_DIR="path"                        | reports the path to the Input Directory   |
| -NAME_DEM_DIR="path"                          | reports the path to the DEM Directory   |
| -NAME_AUX_DIR="path"                          | reports the path to the Auxiliary Directory   |
| path/amorgos -ipath -apath -dpath -opath [-t] | reports the full amorgos launch command (where path stands for the various directory paths requested) |
| path/amorgos finished correctly               | The amorgos executable returned no error  |
| path/amorgos returned error_number            | The amorgos executable returned a non-zero error code specified as error_number                       |

### 5.7.1.1.2 Executable program messages

| Message text   | Description   |
|--|---|
| tiff output selected   | indicates that the generation of the optional TIFF files has been enabled   |
| sampling inversion progress bar (percent, current frame, last frame) [x, n <sub>current</sub> , n <sub>last</sub> ]                        | monitors the processing progress status. x is the percentage of already processed frames, n <sub>current</sub> is the index of the currently processed frame, n <sub>last</sub> is the index of last frame to be processed. This message is issued every 10% of processing. |
| Output product processing limits (input product number of frames, first frame processed, last frame processed) [Nf <sub>in</sub> , f1, f2] | Reports on the output product limits (with respect to the input product) and provides input product size for reference.   |

### 5.7.2 Error messages

These messages are logged in both the Status and Error Log files, status.txt and errors.txt.

Their level can be: WARN or ERROR

Possible messages are:

#### 5.7.2.1 WARN messages

| Message text  | Description   |
|---|---|
| no restituted attitude data available : use predicted | indicates that amorgos could not find restituted attitude data valid for the processing time window: either the AUX_FRA_AX file is missing (or not readable for any reason) or its content does not match the MER_FRS_1P time window. In this case, processing continues using predicted attitude model (as defined in the AUX_ATT_AX file provide in the AuxDir directory)       |
| modified start frame (modified value) [f1]            | Indicates that amorgos had to modify the user specified value of the first frame to process to comply with the Granule Rule (see section 4.2.1) and provides the actual value f1.   |
| modified frame count (modified value) [nf]            | Indicates that amorgos had to modify the value of the number of frames to process to comply with the Granule Rule or with the maximum file size allowed (see section 4.2.1) and provides the actual value nf. Number of frames to process was either user specified through the configuration file or set to the input product value. It may require modifications in both cases. |

## 5.7.2.2 ERROR messages

### 5.7.2.2.1 Shell script messages

Messages that are sent to standard output:

| Message text                               | Description   |
|--|---|
| Cannot read configuration file [file_path] | The configuration file cannot be read. Consequently the Output directory is not defined and log files cannot be created. . Its path is specified within square brackets.                              |
| Output directory [path] doesn't exist      | The output directory specified in the configuration file does not exist. Consequently the log files cannot be created. Its path is specified within square brackets.                                  |
| Cannot write to output directory [path]    | The output directory specified in the configuration file does not have the appropriate write permissions. Consequently the log files cannot be created. Its path is specified within square brackets. |

Messages that are sent to the Log files

| Message text   | Description   |
|--|---|
| Input directory [path] doesn't exist   | The input directory specified in the configuration file does not exist. Its path is specified within square brackets.   |
| Input directory [path] cannot be read  | The input directory specified in the configuration file does not have the appropriate read permissions.   |
| DEM directory [path] doesn't exist   | The DEM directory specified in the configuration file does not exist. Its path is specified within square brackets.   |
| Cannot read from DEM directory [path]  | The DEM directory specified in the configuration file does not have the appropriate read permissions Its path is specified within square brackets.                      |
| Auxiliary directory [path] doesn't exist   | The Auxiliary directory specified in the configuration file does not exist. Its path is specified within square brackets. Its path is specified within square brackets. |
| Cannot read from Auxiliary directory [path]  | The Auxiliary directory specified in the configuration file does not have the appropriate read permissions. Its path is specified within square brackets.               |
| Cannot execute amorgos (not in [path])   | The amorgos executable software could not be found in the same directory than the amorgos shell script. Its path is specified within square brackets.                   |
| [path] missing   | One of the input or auxiliary files is missing. Its path is specified within square brackets.   |
| no orbit file available among<br>path/DOR_VOR_AX<br>path/DOR_POR_AX<br>path/AUX_FRO_AX | None of the orbit file is available in the Input Directory (the path of which is repeated before the orbit file names)  |
| At least one of the<br>path/Pointing_at_Pixels_RR_SaCS.m?<br>(? in [1,5]) is missing   | One of the RR Pointing Vectors auxiliary files is missing in the Auxiliary Directory (the path of which is recalled before the file name).                              |
| At least one of the<br>path/Pointing_at_Pixels_FR_SaCS.m?<br>(? in [1,5]) is missing   | One of the FR Pointing Vectors auxiliary files is missing in the Auxiliary Directory (the path of which is recalled before the file name).                              |
| At least one of the Product Description files is missing                               | One of the product description files is missing in the Auxiliary Directory .  |
| At least one of the DEM files<br>path/*.getasse30 is missing                           | One of the GETASSE30 DEM files is missing in the DEM Directory Auxiliary Directory (the path of which is recalled before the file name).                                |



|  |  |
|--|--|
|  | The total number of such files shall be 288. |
|--|--|

### 5.7.2.2 Executable program messages

| Message text   | Description  |
|--|--|
| file not found or not readable (path) [file_path]    | One of the input or auxiliary files cannot be found or read. Its path is specified within square brackets.   |
| no orbit file found                                  | None of the three possible Orbit files is available or none matches the MER_FRS_1P time window.  |
| no attitude file found                               | None of the AUX_FRA_AX or AUX_ATT_AX file is available.  |
| invalid DEM directory (path) [DEMDir_path]           | The path to the directory containing DEM files is invalid. The path is specified within square brackets.   |
| invalid file format (path) [file_path]               | The format of one of the input or auxiliary files is invalid. Its path is specified within square brackets.  |
| could not create file (path) [file_path]             | Amorgos was unable to create the MER_FSO output file. Its path is specified within square brackets.  |
| could not create tiff outputs                        | Amorgos was unable to create the (one of) TIFF output files.   |
| could not load pixels characteristics                | An error occurred during the loading of the MERIS pixels pointing data (either from the MER_INS_AX file or from the pixel pointing vector files)   |
| invalid time format (value) [UTC date time]          | One of the start or stop times found in the MER_FRS_1P has a wrong format. The corresponding string is specified within square brackets. This is a strong indication that the MER_FRS_1P is corrupted. |
| read error during sampling reversion (line index)    | The inversion of the Level 1b spatial re-sampling failed because of an out-of-range frame index in the input grid (Level 1b one). This is a strong indication of a wrong configuration.                |
| write error during sampling reversion (line index)   | The inversion of the Level 1b spatial re-sampling failed because of an out-of-range frame index in the output grid (Level 0 one). This is a strong indication of a wrong configuration.                |
| position computation error (message) [error_message] | An error occurred during the Satellite Position computation. The message from the corresponding ESA provided software is reported within square brackets.  |
| attitude computation error (message) [error_message] | An error occurred during the Satellite Attitude computation. The message from the corresponding ESA provided software is reported within square brackets.  |
| tiff output error                                    | The TIFF library reported a write error  |
| cannot process imagette [path]                       | User tried to process an imagette MER_FR__1P product.  |
| error during annotation copy                         | An error occurred during the copy of the Annotation Data Sets from MER_FRS_1P to MER_FRO_1P  |

## 5.8 Optional TIFF output files

The MER\_FSO\_1P and MER\_FSG\_1P MDS data can optionally be output under the form of TIFF files (Tagged Image File Format), for graphic display or other purposes. The image geometry is the same than in the corresponding PDS product: either in Instrument projection for the FSO mode or in Level 1b grid for the FSG mode.

In this case, there is one TIFF file for each MDS with content and format as follows:

| MDS      | content                | data type | unit                             | file name                       |
|----------|------------------------|-----------|----------------------------------|---------------------------------|
| MDS 1-15 | radiance of bands 1-15 | us        | nc (same coding than MDS)        | radiance.n.tiff,<br>n in [1,15] |
| MDS 16   | flags                  | uc        | dl (same coding than MDS)        | flags.tiff                      |
| MDS 17   | longitude              | sl        | (10-6)deg (same coding than MDS) | longitude.tiff                  |
| MDS 18   | geodetic latitude      | sl        | (10-6)deg (same coding than MDS) | latitude.tiff                   |
| MDS 19   | geodetic altitude      | fl        | m (same coding than MDS)         | altitude.tiff                   |

Files are fully compliant to the TIFF format standard.

## 6. Performances

Running the AMORGOS on a Linux (XEON 2.4 Ghz, RAM 1 Gb, SWAP 1Gb) we got the following performances:

| Nb of L1b frames | Execution time (mn): |
|------------------|----------------------|
| 1025             | 2                    |
| 2049             | 7                    |
| 4033             | 10                   |
| 4801             | 11                   |

Run time performance for FSG and FSO modes are equivalent.

Note: execution time above were derived from system time at start and stop of execution and hence are only indicative as highly dependent on machine load. According to architecture, the number of frames in the input MER\_FRS\_1P product should be the main factor driving execution time.