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DOCUMENT

Earth Observation Mission Software File Format Specification

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APPROVAL

Title Earth Observation Mission Software File Format Specification	
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CHANGE LOG

Reason for change	Issue	Revision	Date
First Issue	1	0	16/02/2017
Updated Orbit Scenario File Format and Version; Clarification about File Format Version; Added Compliance to legacy File Format Standards; Minor changes in examples.	1	1	21/03/2017
Review corresponding to release of EO CFI 4.15	1	2	15/06/2018
Review corresponding to release of EO CFI 4.16	1	3	09/11/2018
Review corresponding to release of EO CFI 4.17	1	4	28/05/2019

CHANGE RECORD

Issue 1	**Revision** 0		
Reason for change	Date	Pages	Paragraph(s)
First Issue	16/2/2017	All	All

Issue 1	**Revision** 1		
Reason for change	Date	Pages	Paragraph(s)
Updated Orbit Scenario File Format and Version;	21/3/2017	-	1, 3.2
Clarification about File Format Version;		-	1
Added Compliance to legacy File Format Standards		-	2
Minor changes in examples.		-	3.11

Issue 1	**Revision** 2		
Reason for change	Date	Pages	Paragraph(s)
Updated Orbit State Vector File Schema Name;	19/6/2018	-	2
Updated Attitude Definition File Schema Version;			2
Updated Orbit Scenario File Format and Version;			2, 3.2
Updated Swath Definition File Format and Version			2, 3.6

Issue 1	**Revision** 3		
Reason for change	Date	Pages	Paragraph(s)
Updated Attitude Definition File Schema Version;	9/11/2018	-	2, 3.10.2, 3.10.3

Issue 1	**Revision** 4		
Reason for change	Date	Pages	Paragraph(s)
Added DEM Raster Configuration file	28/05/2019	-	3.12

Issue 1	**Revision** 5		
Reason for change	Date	Pages	Paragraph(s)
Support Reference_Frame tag in Attitude Angles files	29/05/2020	-	1, 2, 3.4.3, 3.5

Table of contents:

1 INTRODUCTION

This document describes the format of some of the files used within Earth Observation Ground Segment Facilities. Formats are described for the file types listed in Table 1. These files are compliant with Earth Observation Ground Segment File Format Standard (FFS), see [RD01].

The “Format Version“ is a number keeping track of format modifications. The formats defined by the Format Versions mentioned in Table 1 are compliant with FFS v3.0.

File Type	Content	Format Version
Orbit State Vector File	List of Orbit State Vectors (i.e. position and velocity at given times)	3.0
Orbit Scenario File	Set of parameters describing an orbit, e.g. repeat cycle, cycle length, MLST	3.1
Satellite Configuration File	Set of parameters describing an orbit, e.g. keplerian elements	3.0
Attitude Quaternion File	List of quaternions at given times	3.1
Attitude Roll Pitch Yaw File	List of roll pitch yaw angles at given times	3.1
Swath Definition File	Set of parameters defining an instrument swath	4.0
Swath Template File	One or more lists of latitude, longitude points defining a swath footprint	4.0
Zone Database File	One or more lists of latitude, longitude points defining zones (e.g. polygons)	3.0
Station Database File	One or more set of parameters defining Ground Stations	3.0
Attitude Definition File	Set of data or models defining satellite attitude	3.1
Field of View Configuration File	Set of parameters (e.g. list of azimuth, elevation) defining a field of view	3.0

Table 1 – list of Earth Observation Ground Segment Files

References

Id	Title
[RD01]	Earth Observation Ground Segment File Format Standard (version 3.0), http://eop-cfi.esa.int/Repo/PUBLIC/DOCUMENTATION/SYSTEM_SUPPORT_DOCS/PE-TN-ESA-GS-0001%20EO%20GS%20File%20Format%20Standard%203.0.pdf
[RD02]	Handbook for EO XML and Binary Schemas (version 1.7.1), http://eop-cfi.esa.int/Repo/PUBLIC/DOCUMENTATION/SYSTEM_SUPPORT_DOCS/PE-TN-ESA-GS-121%20%20Handbook%20for%20EO%20XML%20and%20Binary%20Schemas%201.7.1.pdf
[RD03]	Earth Observation Ground Segment File Format Standard (version 2.0), http://eop-cfi.esa.int/Repo/PUBLIC/DOCUMENTATION/SYSTEM_SUPPORT_DOCS/PE-TN-ESA-GS-0001%20EO%20GS%20File%20Format%20Standard%202.0.pdf

2 COMPLIANCE WITH FILE FORMAT STANDARD

The File Format Standard (FFS) defines a structure common to all files used within the Earth Observation Ground Segment. More details can be found in [RD01].

Figure 1 shows the skeleton of a file compliant with FFS v3.0. The file shall be written according to XML syntax and shall follow certain conventions for file naming. It shall be composed by a Fixed Header (enclosed within **Fixed_Header** tags), a Variable Header (enclosed within **Variable_Header** tags),and a Data Block (enclosed within **Data_Block** tags). Only Variable Header and Data Block content depends on the file type. The file shall reference to an XML schema for validation via dedicated attributes in the **Earth_Observation_File** element as described in section 7.3 of [RD02]. Such attributes are:

- `xsi:schemaLocation` : the validating schema URL
- `schemaVersion` : the validating schema version

The validating schema version is encoded in the schema filename (e.g. version 1.5 is encoded as 0105 in EO_OPER_MPL_ORBRES_**0105**.XSD).
The validating schema version is identical to the File Format Version (e.g. the validating schema for Orbit Scenario File Format version 3.1 is named EO_OPER_MPL_ORBSCT_0301.XSD).

```
<?xml version="1.0" encoding="UTF-8"?>
<Earth_Observation_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="…" schemaVersion="…" xmlns="http://eop-cfi.esa.int/CFI">
    <Earth_Observation_Header>
        <Fixed_Header>
            <File_Name>…</File_Name>
            <File_Description>…</File_Description>
            <Notes> …  </Notes>
            <Mission>…</Mission>
            <File_Class>…</File_Class>
            <File_Type>…</File_Type>
            <Validity_Period>
                <Validity_Start>…</Validity_Start>
                <Validity_Stop>…</Validity_Stop>
            </Validity_Period>
            <File_Version>…</File_Version>
            <EOFFS_Version>…</EOFFS_Version>
            <Source>
                <System>…</System>
                <Creator>…</Creator>
                <Creator_Version>…</Creator_Version>
                <Creation_Date>…</Creation_Date>
            </Source>
        </Fixed_Header>
        <Variable_Header>
           ...
        </Variable_Header>
    </Earth_Observation_Header>
    <Data_Block type="xml">
       ...
    </Data_Block>
</Earth_Observation_File>
```

Figure 1 – Skeleton of file compliant with FFS

Figure 2 shows the skeleton of a file compliant with FFS v2.0 (see [RD03]) and v1.0.
The main difference between FFS v3.0 and previous versions v2.0 and v1.0 is the use of the **Earth_Explorer_File** and **Earth_Explorer_Header** elements. The **EOFFS_Version** element is used only in FFS v3.0.

```
<?xml version="1.0" encoding="UTF-8"?>
<Earth_Explorer_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="…" schemaVersion="…" xmlns="http://eop-cfi.esa.int/CFI">
    <Earth_Explorer_Header>
        <Fixed_Header>
            <File_Name>…</File_Name>
            <File_Description>…</File_Description>
            <Notes> …  </Notes>
            <Mission>…</Mission>
            <File_Class>…</File_Class>
            <File_Type>…</File_Type>
            <Validity_Period>
                <Validity_Start>…</Validity_Start>
                <Validity_Stop>…</Validity_Stop>
            </Validity_Period>
            <File_Version>…</File_Version>
            <Source>
                <System>…</System>
                <Creator>…</Creator>
                <Creator_Version>…</Creator_Version>
                <Creation_Date>…</Creation_Date>
            </Source>
        </Fixed_Header>
        <Variable_Header>
            ...
        </Variable_Header>
    </Earth_Explorer_Header>
    <Data_Block type="xml">
        ...
    </Data_Block>
</Earth_Explorer_File>
```

Figure 2 – Skeleton of file compliant with FFS legacy versions

The main difference between FFS v2.0 and FFS v1.0 is in file naming.
In FFS v3.0 and v2.0, the mission identifier is composed by three letters and the file extension is EOF (e.g. **S1A**_TEST_AUX_ORBRES_20200401T040000_20200401T041000_0001.**EOF**)

In FFS v1.0, the mission identifier is composed by two letters and the file extension is EEF (e.g. **CS**_TEST_AUX_ORBRES_20200401T040000_20200401T041000_0001.**EEF**)

Table 2 provides, for each File Type and File Format Standard Version, the latest File Format Version and the relevant validating schema. Validating schemas can be found at: http://eop-cfi.esa.int/CFI

File Type	FFS Version	File Format Version	Validating schema
Orbit State Vector File	1.0	1.5	EO_OPER_AUX_ORBRES_0105.XSD
	2.0	2.3	EO_OPER_AUX_ORBRES_0203.XSD
	3.0	3.0	EO_OPER_AUX_ORBRES_0300.XSD
Orbit Scenario File	1.0	1.6	EO_OPER_MPL_ORBSCT_0106.XSD
	2.0	2.5	EO_OPER_MPL_ORBSCT_0205.XSD
	3.0	3.1	EO_OPER_MPL_ORBSCT_0301.XSD
Satellite Configuration File	1.0	1.3	EO_OPER_INT_SATCFG_0103.XSD
	2.0	2.2	EO_OPER_INT_SATCFG_0202.XSD
	3.0	3.0	EO_OPER_INT_SATCFG_0300.XSD
Attitude Quaternion File Attitude Roll Pitch Yaw File	1.0	1.4	EO_OPER_INT_ATTREF_0104.XSD
	2.0	2.4	EO_OPER_INT_ATTREF_0204.XSD
	3.0	3.1	EO_OPER_INT_ATTREF_0301.XSD
Swath Definition File	1.0	2.4	EO_OPER_MPL_SW_DEF_0204.XSD
	2.0	3.4	EO_OPER_MPL_SW_DEF_0304.XSD
	3.0	4.1	EO_OPER_MPL_SW_DEF_0401.XSD
Swath Template File	1.0	2.3	EO_OPER_MPL_SWTREF_0203.XSD
	2.0	3.3	EO_OPER_MPL_ SWTREF _0303.XSD
	3.0	4.0	EO_OPER_MPL_ SWTREF _0400.XSD
Zone Database File	1.0	1.3	EO_OPER_MPL_ZON_DB_0103.XSD
	2.0	2.2	EO_OPER_MPL_ZON_DB_0202.XSD
	3.0	3.0	EO_OPER_MPL_ZON_DB_0300.XSD
Station Database File	1.0	1.5	EO_OPER_MPL_GND_DB_0105.XSD
	2.0	2.2	EO_OPER_MPL_GND_DB_0202.XSD
	3.0	3.0	EO_OPER_MPL_GND_DB_0300.XSD
Attitude Definition File	1.0	1.4	EO_OPER_INT_ATTDEF_0104.XSD
	2.0	2.5	EO_OPER_INT_ATTDEF_0205.XSD
	3.0	3.2	EO_OPER_INT_ATTDEF_0302.XSD
Field of View Configuration File	1.0	1.0	EO_OPER_INT_FOVCFG_0100.XSD
	2.0	2.0	EO_OPER_INT_FOVCFG_0200.XSD
	3.0	3.0	EO_OPER_INT_FOVCFG_0300.XSD

Table 2 – Mapping between File Types, FFS Version, File Format Version and validating schemas

3 FILE FORMAT SPECIFICATION

The following sections describe, for each file type:

- the content of the Variable Header;
- the content of the Data Block;
- the reference to the validating schema for FFS v3.0 (shortly named “Schema Reference“).

3.1 Orbit State Vector File

3.1.1 Variable Header

The Variable Header content is a sequence of XML elements described in Table 3.

XML Tag name	Type	Attributes	C Format	Description
Ref_Frame	string	-	%s	Orbit State Vector (see Table 5) co-ordinate system reference frame, it can be one of the following values: GEO_MEAN_2000 MEAN_DATE TRUE_DATE EARTH_FIXED
Time_Reference	string	-	%s	Time reference used when, due to an inconsistency with other time correlations, times associated to the state vector have to be recomputed. It can be one of the following values: TAI UTC UT1

Table 3 – Variable Header content

Example:

```
<Variable_Header>
     <Ref_Frame>EARTH_FIXED</Ref_Frame>
     <Time_Reference>UTC</Time_Reference>
</Variable_Header>
```

3.1.2 Data Block

The Data Block content is a sequence of XML elements described in Table 4.

XML Tag name	Type	Attributes	C Format	Description
List_of_OSVs	XML element	count=”N” where n is the number of elements in the list	-	List of OSV elements (see Table 5).

Table 4 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
TAI	string	-	-	TAI date and time of OSV, in ASCII standard time format, including time reference and microseconds: TAI=yyyy-mm-ddThh:mm:ss.ssssss
UTC	string	-	-	UTC date and time of OSV, in ASCII standard time format, including time reference and microseconds: UTC=yyyy-mm-ddThh:mm:ss.ssssss
UT1	string	-	-	UT1 date and time of OSV, in ASCII standard time format, including time reference and microseconds: UT1=yyyy-mm-ddThh:mm:ss.ssssss
Absolute_Orbit	integer	-	%+06ld	Absolute Orbit Number of the OSV
X	real	unit=”m”	%+012.3lf	X component of the OSV position vector in m with a precision of 1e-3.
Y	real	unit=”m”	%+012.3lf	Y component of the OSV position vector in m with a precision of 1e-3.
Z	real	unit=”m”	%+012.3lf	Z component of the OSV position vector in m with a precision of 1e-3.
VX	real	unit=”m/s”	%+012.6lf	X component of the OSV velocity vector in m/s with a precision of 1e-6.
VY	real	unit=”m/s”	%+012.6lf	Y component of the OSV velocity vector in m/s with a precision of 1e-6.
VZ	real	unit=”m/s”	%+012.6lf	Z component of the OSV velocity vector in m/s with a precision of 1e-6.
Quality	string	-	%13s	This parameter is added to keep format compatibility with legacy formats. Default (“not used”) value is “0000000000000”

Table 5 – OSV element content

Example (only the first and last OSVs are shown):

```
<Data_Block type="xml">
    <List_of_OSVs count="243">
        <OSV>
            <TAI>TAI=2021-06-10T04:57:17.817060</TAI>
            <UTC>UTC=2021-06-10T04:57:52.817060</UTC>
            <UT1>UT1=2021-06-10T04:57:53.117059</UT1>
            <Absolute_Orbit>+00999</Absolute_Orbit>
            <X unit="m">-1606749.988</X>
            <Y unit="m">-5677008.966</Y>
            <Z unit="m">-4135675.595</Z>
            <VX unit="m/s">-2876.652288</VX>
            <VY unit="m/s">-3541.028256</VY>
            <VZ unit="m/s">+5985.303441</VZ>
            <Quality>0000000000000</Quality>
        </OSV>
    [...]
        <OSV>
            <TAI>TAI=2021-06-10T06:58:17.817060</TAI>
            <UTC>UTC=2021-06-10T06:58:52.817060</UTC>
            <UT1>UT1=2021-06-10T06:58:53.117059</UT1>
            <Absolute_Orbit>+01001</Absolute_Orbit>
            <X unit="m">-5075578.371</X>
            <Y unit="m">-3158584.535</Y>
            <Z unit="m">+4005164.344</Z>
            <VX unit="m/s">+2519.609604</VX>
            <VY unit="m/s">+3677.868542</VY>
```

```
            <VZ unit="m/s">+6075.683811</VZ>
            <Quality>0000000000000</Quality>
        </OSV>
    </List_of_OSVs>
</Data_Block>
```

3.1.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_AUX_ORBRES_0300.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named MMM_**OPER_AUX_ORBRES**_<instance_id>.EOF.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_AUX_ORBRES_0300.XSD"
schemaVersion="3.0" xmlns="http://eop-cfi.esa.int/CFI">
```

3.2 Orbit Scenario File

3.2.1 Variable Header

The Variable Header content is a sequence of XML elements described in Table 6.

XML Tag name	Type	Attributes	C Format	Description
Time_Reference	string	-	%s	Time reference used when, due to an inconsistency with other time correlations, times associated to the state vector have to be recomputed. It can be one of the following values: UT1

Table 6 – Variable Header content

Example:

```
<Variable_Header>
   <Time_Reference>UTC</Time_Reference>
</Variable_Header>
```

3.2.2 Data Block

The Data Block content is a sequence of XML elements described in Table 7.

XML Tag name	Type	Attributes	C Format	Description
List_of_Orbit_Changes	XML element	count=”N” where n is the number of elements in the list	-	List of Orbit_Change elements (see Table 8).

Table 7 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Orbit	XML element	-	-	Orbit information (see Table 9).
Cycle	XML element	-	-	Cycle information (see Table 10).
Time_of_ANX	XML element	-	-	Ascending node time (see Table 12).

Table 8 – Orbit_Change element content

XML Tag name	Type	Attributes	C Format	Description
Absolute_Orbit	integer	-	%ld	absolute orbit number
Relative_Orbit	integer	-	%ld	relative orbit number
Cycle_Number	integer	-	%ld	cycle number
Phase_Number	integer	-	%ld	phase number

Table 9 – Orbit element content

XML Tag name	Type	Attributes	C Format	Description
Repeat_Cycle	integer	-	%ld	Repeat Cycle
Cycle_Length	integer		%ld	Cycle Length
ANX_Longitude	real	unit=”deg”	%.6lf	longitude of ascending node crossing (ANX) in degrees with a resolution of 1e-6 degrees
ANX_Longitude_Drift	XML element	-	-	drift of ANX Longitude, see Table 11
MLST	time	-	%s	mean local solar time at ANX of relative orbit 1 expressed as hours, minutes, seconds and microseconds HH:MM:SS.ssssss
MLST_Drift	real	unit=”s/day”	%.6lf	drift of mean local solar time in s/day with a resolution of 1e-6
MLST_Nonlinear_Drift	XML element	-	-	Non linear MLST data, see Table 12

Table 10 – Cycle element content

XML Tag name	Type	Attributes	C Format	Description
Offset	real	unit=”deg”	%.6lf	ANX Longitude drift initial value in deg with a resolution of 1e-6
Linear_Term	real	unit= ”deg/day”	%.6lf	ANX Longitude drift linear term in deg/day with a resolution of 1-6

Table 11 – ANX_Longitude_Drift element content

XML Tag name	Type	Attributes	C Format	Description
Linear_Approx_Validity	integer	unit=”orbits”	%d	Number of orbits in which linear approximation is valid.
Quadratic_Term	real	unit= ”s/day^2”	%.6lf	MLST Quadratic term in s/day^2 with a resolution of 1e-6s/day^2.
Harmonics_Terms	XML element	num=”N” where N is the number of harmonics (between 0 and 2)	-	List of Harmonics_Term elements (see Table 13). The Harmonics_Term element has a seq=”i” attribute, where I denotes the identifier in the sequence starting from 1.

Table 12 – MLST_Nonlinear_Drift element content

XML Tag name	Type	Attributes	C Format	Description
Reference_Time	string	time_ref= ”UT1”	%s	UT1 Reference time of harmonic, in ASCII standard time format, including microseconds: yyyy-mm-ddThh:mm:ss.ssssss
Period	real	unit=”days”	%6.2lf	Period of the harmonic in days with a resolution of 1e-2 days.
Amplitude_Sin	real	unit=”sec”	%5.3lf	Amplitude of sine in seconds with a resolution of 1e-3 seconds
Amplitude_Cos	real	unit=”sec”	%5.3lf	Amplitude of cosine in seconds with a resolution of 1e-3 seconds

Table 13 – Harmonics_Term element content

XML Tag name	Type	Attributes	C Format	Description
TAI	string	-	%s	TAI date and time of ANX, in ASCII standard time format, including time reference and microseconds: TAI=yyyy-mm-ddThh:mm:ss.ssssss
UTC	string	-	%s	UTC date and time of ANX, in ASCII standard time

				format, including time reference and microseconds: UTC=yyyy-mm-ddThh:mm:ss.ssssss
UT1	string	-	%s	UT1 date and time of ANX, in ASCII standard time format, including time reference and microseconds: UT1=yyyy-mm-ddThh:mm:ss.ssssss
TAI	string	-	%s	TAI date and time of ANX, in ASCII standard time format, including time reference and microseconds: TAI=yyyy-mm-ddThh:mm:ss.ssssss

Table 14 – Time_of_ANX element content

Example:

```
<Data_Block type="xml">
    <List_of_Orbit_Changes count="1">
        <Orbit_Change>
            <Orbit>
                <Absolute_Orbit>1</Absolute_Orbit>
                <Relative_Orbit>11417</Relative_Orbit>
                <Cycle_Number>1</Cycle_Number>
                <Phase_Number>1</Phase_Number>
            </Orbit>
            <Cycle>
                <Repeat_Cycle unit="day">838</Repeat_Cycle>
                <Cycle_Length unit="orbit">11945</Cycle_Length>
                <ANX_Longitude unit="deg">40.300000</ANX_Longitude>
                <ANX_Longitude_Drift>
                    <Offset unit="deg">0.010000</Offset>
                    <Linear_Term unit="deg/day">0.000001</Linear_Term>
                </ANX_Longitude_Drift>
                <MLST>21:59:55.572000</MLST>
                <MLST_Drift unit="s/day">-0.270000</MLST_Drift>
                <MLST_Nonlinear_Drift>
                    <Linear_Approx_Validity
unit="orbit">99999</Linear_Approx_Validity>
                    <Quadratic_Term unit="s/day^2">0.000000</Quadratic_Term>
                    <Harmonics_Terms num="1">
                       <Harmonic_Term seq="1">
                          <Reference_Time time_ref="UT1">2016-02-
17T00:00:00.000000</Reference_Time>
                          <Period unit="days">10.00</Period>
                          <Amplitude_Sin unit="sec">0.001</Amplitude_Sin>
                          <Amplitude_Cos unit="sec">0.001</Amplitude_Cos>
                    </Harmonics_Terms>
                </MLST_Nonlinear_Drift>
            </Cycle>
            <Time_of_ANX>
                <TAI>TAI=2016-02-16T19:19:20.844398</TAI>
                <UTC>UTC=2016-02-16T19:18:44.844398</UTC>
                <UT1>UT1=2016-02-16T19:18:44.844398</UT1>
            </Time_of_ANX>
        </Orbit_Change>
    </List_of_Orbit_Changes>
</Data_Block>
```

3.2.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_ORBSCT_0301.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named MMM_**OPER_MPL_ORBSCT**_<instance_id>.EOF.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance
 xsi:schemaLocation="http://eop-cfi.esa.int/CFI
 http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_ORBSCT_0301.XSD"
 schemaVersion="3.1"
 xmlns="http://eop-cfi.esa.int/CFI">
```

3.3 Satellite Configuration File

3.3.1 Variable Header

The Variable Header is empty for this type of file.

3.3.2 Data Block

The Data Block content is a sequence of XML elements described in Table 15.

XML Tag name	Type	Attributes	C Format	Description
Satellite_Name	string	-	%s	Satellite Name
NORAD_Data	XML element	-	-	NORAD Satellite data, see Table 16
Lib_Init	XML element	-	-	Low and tight tolerances for orbital parameters, see Table 17.
Orbit_Init	XML element	-	-	Default Orbital parameters, see Table 18

Table 15 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Satellite_Number	integer	-	%ld	NORAD Satellite number
NORAD_Sat_Name	string	-	%s	NORAD Satellite name
Int_Designator	string	-	%s	NORAD international designator

Table 16 – NORAD_Data element content

XML Tag name	Type	Attributes	C Format	Description
Low_Tolerances	string	-	%s	Low tolerances for orbital parameters, see Table 19
Tight_Tolerances	XML element	-	-	Tight tolerances for orbital parameters, see Table 19

Table 17 – Lib_Init element content

XML Tag name	Type	Attributes	C Format	Description
Min_Semi_Major_Axis	real	-	%lf	Minimum semi-major axis (meters)
Nom_Semi_Major_Axis	real	-	%lf	Nominal semi-major axis (meters)
Max_Semi_Major_Axis	real	-	%lf	Maximum semi-major axis (meters)
Min_Inclination	real	-	%lf	Minimum inclination (degrees)
Nom_Inclination	real	-	%lf	Nominal inclination (degrees)
Max_Inclination	real	-	%lf	Maximum inclination (degrees)
Nom_Eccentricity	real	-	%lf	Nominal Eccentricity
Nom_Arg_Perigee	real	-	%lf	Nominal Argument of perigee (degrees)

Table 18 – Orbit_Init element content

XML Tag name	Type	Attributes	C Format	Description
Min_Semi_Major_Axis	real	-	%lf	Minimum semi-major axis (meters)
Max_Semi_Major_Axis	real	-	%lf	Maximum semi-major axis (meters)
Min_Inclination	real	-	%lf	Minimum inclination (degrees)
Max_Inclination	real	-	%lf	Maximum inclination (degrees)
Min_Eccentricity	real	-	%lf	Minimum Eccentricity
Max_Eccentricity	real	-	%lf	Maximum Eccentricity

Min_Semi_Major_Axis	real	-	%lf	Minimum semi-major axis (meters)
Max_Semi_Major_Axis	real	-	%lf	Maximum semi-major axis (meters)

Table 19 – Low_ and Tight_Tolerances element content

Example:

```
<Data_Block type="xml">
    <Satellite_Name>NEW_SATELLITE</Satellite_Name>
    <NORAD_Data>
        <Satellite_Number>1</Satellite_Number>
        <NORAD_Sat_Name>TBD</NORAD_Sat_Name>
        <Int_Designator>00000AAA</Int_Designator>
    </NORAD_Data>
    <Lib_Init>
        <Low_Tolerances>
            <Min_Semi_Major_Axis>7140000.000000</Min_Semi_Major_Axis>
            <Max_Semi_Major_Axis>7240000.000000</Max_Semi_Major_Axis>
            <Min_Inclination>98.290000</Min_Inclination>
            <Max_Inclination>99.110000</Max_Inclination>
            <Min_Eccentricity>0.0</Min_Eccentricity>
            <Max_Eccentricity>0.5</Max_Eccentricity>
        </Low_Tolerances>
        <Tight_Tolerances>
            <Min_Semi_Major_Axis>7150000.000000</Min_Semi_Major_Axis>
            <Max_Semi_Major_Axis>7230000.000000</Max_Semi_Major_Axis>
            <Min_Inclination>98.390000</Min_Inclination>
            <Max_Inclination>99.010000</Max_Inclination>
            <Min_Eccentricity>0.0</Min_Eccentricity>
            <Max_Eccentricity>0.007</Max_Eccentricity>
        </Tight_Tolerances>
    </Lib_Init>
    <Orbit_Init>
        <Min_Semi_Major_Axis>7186000.000000</Min_Semi_Major_Axis>
        <Nom_Semi_Major_Axis>7195605.347274</Nom_Semi_Major_Axis>
        <Max_Semi_Major_Axis>7209000.000000</Max_Semi_Major_Axis>
        <Min_Inclination>98.690000</Min_Inclination>
        <Nom_Inclination>98.702197</Nom_Inclination>
        <Max_Inclination>98.710000</Max_Inclination>
        <Nom_Eccentricity>0.001141</Nom_Eccentricity>
        <Nom_Arg_Perigee>90.0</Nom_Arg_Perigee>
    </Orbit_Init>
</Data_Block>
```

3.3.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_INT_SATCFG_0300.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_OPER_INT_SATCFG_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/ EO_OPER_INT_SATCFG_0300.XSD"
```

```
schemaVersion="3.0" xmlns="http://eop-cfi.esa.int/CFI">
```

3.4 Attitude Quaternion File

3.4.1 Variable Header

The Variable Header is empty for this type of file.

3.4.2 Data Block

The Attitude quaternion file contains a list of quaternion sets and associated times. Each quaternion set represent the transformation between a given Reference Frame to a given Satellite Based frame.
The Data Block content is a sequence of XML elements described in Table 20.

XML Tag name	Type	Attributes	C Format	Description
Attitude_File_Type	string	-	%s	It defines the Satellite Based Frame. It can be one of the following values: Sat_Nominal_Attitude Sat_Attitude Instr_Attitude
Attitude_Data_Type	string	-	%s	It defines the type of attitude data. It can be only the following value: Quaternions
Max_Gap	real	unit=”s”	%.6f	Maximum gap between two consecutive set of quaternions
Quaternions_Data	XML element	-	-	See Table 21.

Table 20 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Reference_Frame	string	-	%s	Reference frame. It could be one of the following: BM2000 HM2000 GM2000 MEAN_DATE TRUE_DATE QUASI_MEAN_DATE PSEUDO_TRUE_DATE EARTH_FIXED
List_of_Quaternions	XML element	count=”N” where n is the number of elements in the list	-	List of Quaternions elements (see Table 22).

Table 21 – Quaternions_Data element content

XML Tag name	Type	Attributes	C Format	Description
Time	string	ref=”RRR” where RRR is one of the following: TAI UTC UT1 GPS	%s	Date for the quaternions. The date format is CCSDS-A with reference and microseconds (RRR=yyyy-mm-ddThh:nn:ss.ssssss)
Q1	real	-	%.9lf	First coordinate of quaternion vector. Adimensional number with precision of 1e-9
Q2	real	-	%.9lf	Second coordinate of quaternion vector. Adimensional number with precision of 1e-9
Q3	real	-	%.9lf	Third coordinate of quaternion vector. Adimensional number with precision of 1e-9
Q4	real	-	%.9lf	Scalar part of quaternion. Adimensional number with precision of 1e-9

Table 22 – Quaternions element content

Example (only first and last item are shown):

```
<Data_Block type="xml">
    <Attitude_File_Type>Sat_Attitude</Attitude_File_Type>
    <Attitude_Data_Type>Quaternions</Attitude_Data_Type>
    <Max_Gap unit="s">11.000000</Max_Gap>
    <Quaternion_Data>
        <Reference_Frame>GM2000</Reference_Frame>
        <List_of_Quaternions count="1442">
            <Quaternions>
                <Time ref="UTC">UTC=2020-04-01T04:00:00.000000</Time>
                <Q1>0.487124882</Q1>
                <Q2>0.165975309</Q2>
                <Q3>0.579456084</Q3>
                <Q4>0.631974836</Q4>
            </Quaternions>
            [...]
            <Quaternions>
                <Time ref="UTC">UTC=2020-04-01T08:00:10.000000</Time>
                <Q1>0.690492661</Q1>
                <Q2>0.408245532</Q2>
                <Q3>0.468027160</Q3>
                <Q4>0.370818080</Q4>
            </Quaternions>
        </List_of_Quaternions>
    </Quaternion_Data>
</Data_Block>
```

3.4.3 Schema Reference

An example of validating XML schema for this file type is located at:

http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_INT_ATTREF_0300.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named MMM_**OPER_INT_ATTREF**_<instance_id>.EOF.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/ EO_OPER_INT_ATTREF_0301.XSD"
schemaVersion="3.1" xmlns="http://eop-cfi.esa.int/CFI">
```

3.5 Attitude Roll Pitch Yaw File

3.5.1 Variable Header

The Variable Header is empty for this type of file.

3.5.2 Data Block

The Attitude Roll Pitch Yaw file contains a list of Roll Pitch Yaw sets and associated times. Each set represent the transformation between one reference Satellite Based Frame to another one.
The Data Block content is a sequence of XML elements described in Table 23.

XML Tag name	Type	Attributes	C Format	Description
Attitude_File_Type	string	-	%s	It defines the reference Satellite Based Frame. It can be one of the following values: Sat_Nominal_Attitude Sat_Attitude Instr_Attitude
Attitude_Data_Type	string	-	%s	It defines the type of attitude data. It can be only the following value: Attitude_Angles
Max_Gap	real	unit=”s”	%.6f	Maximum gap between two consecutive set of quaternions
Attitude_Angles_Data	XML element	-	-	See Table 24.

Table 23 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Reference_Frame	string	-	%s	Reference frame. It could be one of the following: BM2000 HM2000 GM2000 MEAN_DATE TRUE_DATE QUASI_MEAN_DATE PSEUDO_TRUE_DATE EARTH_FIXED SATELLITE_ACTUAL SATELLITE SATELLITE_RELATIVE
List_of_Attitude_Angles	XML element	count=”N” where n is the number of elements in the list	-	List of Attitude_Angles elements (see Table 25).

Table 24 – Attitude_Angles_Data element content

XML Tag name	Type	Attributes	C Format	Description
Time	string	ref=”RRR” where RRR is one of the following: TAI UTC	%s	Date for the quaternions. The date format is CCSDS-A with reference and microseconds (RRR=yyyy-mm-ddThh:nn:ss.ssssss)

		UT1 GPS		
Pitch	real	unit=”deg”	%.6lf	Pitch angle in degrees with a precision of 1e-6.
Roll	real	unit=”deg”	%.6lf	Roll angle in degrees with a precision of 1e-6.
Yaw	real	unit=”deg”	%.6lf	Yaw angle in degrees with a precision of 1e-6.

Table 25 – Attitude_Angles element content

Example (only first and last items are shown):

```
<Data_Block type="xml">
    <Attitude_File_Type>Sat_Attitude</Attitude_File_Type>
    <Attitude_Data_Type>Attitude_Angles</Attitude_Data_Type>
    <Max_Gap unit="s">11.000000</Max_Gap>
    <Attitude_Angles_Data>
        <Reference_Frame>GM2000</Reference_Frame>
        <List_of_Attitude_Angles count="1442">
            <Attitude_Angles>
                <Time ref="UTC">UTC=2020-04-01T04:00:00.000000</Time>
                <Pitch unit="deg">0.000001</Pitch>
                <Roll unit="deg">0.000002</Roll>
                <Yaw unit="deg">0.000003</Yaw>
            </Attitude_Angles>
  [...]
            <Attitude_Angles>
                <Time ref="UTC">UTC=2020-04-01T08:00:10.000000</Time>
                <Pitch unit="deg">0.000004</Pitch>
                <Roll unit="deg">0.000005</Roll>
                <Yaw unit="deg">0.000006</Yaw>
            </Attitude_Angles>
        </List_of_Attitude_Angles>
    </Attitude_Angles_Data>
</Data_Block>
```

3.5.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_INT_ATTREF_0301.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_OPER_INT_ATTREF_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/ EO_OPER_INT_ATTREF_0301.XSD"
schemaVersion="3.1" xmlns="http://eop-cfi.esa.int/CFI">
```

3.6 Swath Definition File

3.6.1 Variable Header

The Variable Header is empty for this type of file.

3.6.2 Data Block

The Data Block content is a sequence of XML elements described in Table 26.

XML Tag name	Type	Attributes	C Format	Description
Swath	XML element	-	-	Swath data structure see Table 27.

Table 26 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Output_File_Description	string	-	%s	File Description for the output swath template file
Output_File_Type	string	-	%s	File type for the output swath template file. It should have the fixed value "MPL_SWTREF"
Swath_Type	string	-	%s	Swath type. It can have one of the following values: • point • line • inertial
Num_Swath_Records	integer	-	%d	Number of points in the swath template file (>0)
Refraction	XML element	-	-	Refraction model structure, see Table 28
Either List_of_Swath_Points or Asar_Geometry	XML element	List_of_Swath_Points count="n" number of points in the instantaneous swath Asar_Geometry No attributes	-	List_of_Swath_Points: List of Swath_Point elements. Each element contains the geometry data for the calculation of each point in the instantaneous swath. See Table 29 Asar_Geometry: ASAR geometry, see Table 29
Sat_Nominal_Att	XML element	-	-	Satellite Nominal Attitude initialization data, see Table 38.
Sat_Att	XML element	-	-	Satellite Attitude initialization data, see Table 39.
Instr_Att	XML element	-	-	Instrument Attitude initialization data, see Table 39.

Table 27 – Swath element content

XML Tag name	Type	Attributes	C Format	Description
Model	string	-	%s	Atmospheric refraction model. It can be one of: • NO_REF • STD_REF • USER_REF • PRED_REF
Freq	real	unit="MHz"	%lf	Signal Frequency in MHz (≥ 0)

Table 28 – Refraction element content

XML Tag name	Type	Attributes	C Format	Description
One of the following Pointing_Geometry Distance_Geometry Limb_Geometry Inertial_Geomtery Sub_Satellite_Geometry Asar_Geometry Incidence_Angle_Geometry	XML element	-	%s	It Contains the geometry data for the calculation of each point in the instantaneous swath. Pointing_Geometry: see Table 30 Distance_Geometry: see Table 32 Limb_Geometry: see Table 31 Inertial_Geometry: see Table 31 Sub_Satellite_Geometry: see Table 36 Asar_Geometry: see Table 33 Incidence_Angle_Geometry: see Table 37

Table 29 – Swath_Point element content

XML Tag name	Type	Attributes	C Format	Description
Azimuth	real	unit=”deg”	%lf	Swath azimuth in deg [0,360)
Elevation	real	unit=”deg”	%lf	Swath elevation in deg [-90,90]
Altitude	real	unit=”m”	%lf	Swath altitude in m (>= 0)

Table 30 – Pointing_Geometry element content

XML Tag name	Type	Attributes	C Format	Description
Azimuth	real	unit=”deg”	%lf	Swath azimuth in deg [0,360)
Altitude	real	unit=”m”	%lf	Swath altitude in m (>= 0)

Table 31 – Limb_ and Inertial_Geometry element content

XML Tag name	Type	Attributes	C Format	Description
Azimuth	real	unit=”deg”	%lf	Swath azimuth in deg [0,360)
Elevation	real	unit=”deg”	%lf	Swath elevation in deg [-90,90]
Altitude	real	unit=”m”	%lf	Swath altitude in m (>= 0)
Distance	real	unit=”m”	%lf	distance in m (>= 0)

Table 32 – Distance_Geometry element content

XML Tag name	Type	Attributes	C Format	Description
Left_Pt	XML elelemt	-	-	It Contains the geometry data for the calculation of the left point in the instantaneous swath. It has the same content of Pointing_Geometry: see Table 30
Mid_Pt	XML elelemt	-	-	It Contains the geometry data for the calculation of the mid point in the instantaneous swath. It has the same content of Pointing_Geometry: see Table 30
Right_Pt	XML elelemt	-	-	It Contains the geometry data for the calculation of the right point in the instantaneous swath. It has the same content of Pointing_Geometry: see Table 30
Either Narrow_Asar Or Wide_Asar	XML elelemt	-	-	Slant range extension parameters. Narrow_Asar: see Table 34 Wide_Asar: see Table 35

Table 33 – Asar_Geometry element content

XML Tag name	Type	Attributes	C Format	Description
Slant_Range_Left	real	unit=”10e-6s”	%lf	Slant Range Extension parameter for left point in microseconds.

Table 34 – Narrow_Asar element content

XML Tag name	Type	Attributes	C Format	Description
Slant_Range_Left	real	unit=”10e-6s”	%lf	Slant Range Extension parameter for left point in microseconds.
Slant_Range_Right	real	unit=”10e-6s”	%lf	Slant Range Extension parameter for right point in microseconds.

Table 35 – Wide_Asar element content

XML Tag name	Type	Attributes	C Format	Description
Azimuth	real	unit=”deg”	%lf	Swath azimuth in deg [0,360)

Table 36 – Sub_Satellite_Geometry element content

XML Tag name	Type	Attributes	C Format	Description
Azimuth	real	unit=”deg”	%lf	Swath azimuth in deg [0,360)
Incidence_Angle	real	unit=”deg”	%lf	Swath incidence angle in deg [0,90)
Altitude	real	unit=”m”	%lf	Swath altitude in m (>= 0)

Table 37 – Incidence_Angle_Geometry element content

XML Tag name	Type	Attributes	C Format	Description
One of the following None AOCS_Model Parameter_Model Harmonic_Model File_Model	AOCS_Model integer Parameter_Model Harmonic_Model File_Model XML element None XML element (empty)	-	AOCS_Model %ld	Satellite Nominal Attitude initialization data AOCS_Model One of the following values 0: Geocentric Pointing 1: Local Normal Pointing 2: Yaw Steering 3: Zero Doppler Parameter_Model: see Table 40 Harmonic_Model: see Table 41 File_Model: see Table 42

Table 38 – Sat_Nominal_Att element content

XML Tag name	Type	Attributes	C Format	Description
One of the following None Angle_Model Matrix_Model Harmonic_Model File_Model	XML element None XML element (empty)	-	-	Satellite Attitude initialization data Angle_Model: see Table 43 Matrix_Model: see Table 44 Harmonic_Model: see Table 41 File_Model: see Table 42

Table 39 – Sat_ and Instrument_Att element content

XML Tag name	Type	Attributes	C Format	Description

Model	integer	-	%ld	Attitude Model Identifier
List_of_Parameters	XML element	count=”n” where n is the number of elements in the list	-	List of Parameter elements. See Table 45.

Table 40 – Parameter_Model element content

XML Tag name	Type	Attributes	C Format	Description
Angle_Type	integer	-	%ld	Angle Type
List_of_Harmonic_Pitch	XML element	count=”n” where n is the number of elements in the list	-	List of Harmonic elements for Pitch, see Table 46.
List_of_Harmonic_Roll	XML element	count=”n” where n is the number of elements in the list	-	List of Harmonic elements for Roll see Table 46.
List_of_Harmonic_Yaw	XML element	count=”n” where n is the number of elements in the list	-	List of Harmonic elements for Yaw see Table 46.
Offsets (present only in Instr_Att)	XML element	-	-	See Table 47.

Table 41 – Harmonic_Model element content

XML Tag name	Type	Attributes	C Format	Description
List_of_Files	XML element	count=”n” where n is the number of elements in the list	%ld	List of File elements, see Table 48.
Auxiliary_File (present only in Sat_Att)	string	-	%s	Attitude auxiliary file name
Time_Selection	XML element	-	-	It indicates the time window to be read from the attitude files. See Table 49.

Table 42 – File_Model element content

XML Tag name	Type	Attributes	C Format	Description
Angle_1	real	unit=”deg”	%lf	Pitch Mispointing Angle
Angle_2	real	unit=”deg”	%lf	Roll Mispointing Angle
Angle_3	real	unit=”deg”	%lf	Yaw Mispointing Angle
Offsets (present only in Instr_Att)	XML element	-	-	See Table 47.

Table 43 – Angle_Model element content

XML Tag name	Type	Attributes	C Format	Description
Row_1	real	unit=”deg”	%lf	Mispointing matrix first row
Row_2	real	unit=”deg”	%lf	Mispointing matrix second row
Row_3	real	unit=”deg”	%lf	Mispointing matrix third row
Offsets (present only in Instr_Att)	XML element	-	-	See Table 47.

Table 44 – Matrix_Model element content

XML Tag name	Type	Attributes	C Format	Description
Parameter	string	-	%s	Parameter

Table 45 – Parameter element content

XML Tag name	Type	Attributes	C Format	Description
Harmonic_Type	integer	-	%ld	Harmonic Type
Harmonic_Coefficient	real	-	%lf	Harmonic Coefficient

Table 46 – Harmonic element content

XML Tag name	Type	Attributes	C Format	Description
Offset_X	real	unit=”m”	%lf	X offset
Offset_Y	real	unit=”m”	%lf	Y offset
Offset_Z	real	unit=”m”	%lf	Z offset

Table 47 – Offsets element content

XML Tag name	Type	Attributes	C Format	Description
File	string	-	%s	Attitude filename (full path)

Table 48 – File element content

XML Tag name	Type	Attributes	C Format	Description
Either Select_File Or Time_Window	XML element	Time_Window time_ref=”REF” being REF one of the following: UTC UT1 TAI GPS	-	Select_File: the whole files to be read (the tag has an empty value) Time_Window: indicates which part of the files has to be read. See Table 50.

Table 49 – Time_Selection element content

XML Tag name	Type	Attributes	C Format	Description
Time_0	real	-	%lf	Start time in MJD2000
Time_1	real	-	%lf	Stop time in MJD2000

Table 50 – Time_Window element content

XML Tag name	Type	Attributes	C Format	Description
Column_1	real	-	%lf	Element in the first column
Column_2	real	-	%lf	Element in the second column
Column_3	real	-	%lf	Element in the third column

Table 51 – Row element content

Example:

```
<Data_Block type="xml">
    <Swath>
        <Output_File_Description>OLCI</Output_File_Description>
        <Output_File_Type>MPL_SWTREF</Output_File_Type>
        <Swath_Type>open</Swath_Type>
        <Num_Swath_Records>1200</Num_Swath_Records>
        <Refraction>
            <Model>NO_REF</Model>
            <Freq unit="MHz">0.0</Freq>
        </Refraction>
        <List_of_Swath_Points count="3">
            <Swath_Point>
                <Pointing_Geometry>
                    <Azimuth unit="deg">+270.000000</Azimuth>
                    <Elevation unit="deg">+068.295000</Elevation>
                    <Altitude unit="m">+000000.000</Altitude>
                </Pointing_Geometry>
            </Swath_Point>
```

```
            <Swath_Point>
                <Pointing_Geometry>
                    <Azimuth unit="deg">+090.000000</Azimuth>
                    <Elevation unit="deg">+090.000000</Elevation>
                    <Altitude unit="m">+000000.000</Altitude>
                </Pointing_Geometry>
            </Swath_Point>
            <Swath_Point>
                <Pointing_Geometry>
                    <Azimuth unit="deg">+090.000000</Azimuth>
                    <Elevation unit="deg">+043.135000</Elevation>
                    <Altitude unit="m">+000000.000</Altitude>
                </Pointing_Geometry>
            </Swath_Point>
        </List_of_Swath_Points>
        <Sat_Nominal_Att>
            <AOCS_Model>2</AOCS_Model>
        </Sat_Nominal_Att>
        <Sat_Att>
            <None></None>
        </Sat_Att>
        <Instr_Att>
            <None></None>
        </Instr_Att>
    </Swath>
</Data_Block>
```

3.6.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_SW_DEF_0400.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_`**`OPER_MPL_SW_DEF`**`_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_SW_DEF_0401.XSD"
    xmlns="http://eop-cfi.esa.int/CFI" schemaVersion="4.1">
```

3.7 Swath Template File

3.7.1 Variable Header

The Variable Header content is a sequence of XML elements described in Table 52.

XML Tag name	Type	Attributes	C Format	Description
Reference_OSF	string	-	%s	Orbit Scenario File used for generating the file
Reference_SDF	string	-	%s	Swath definition file used for generating the file
Absolute_Orbit	integer	-	%ld	Orbit for which the STF has been generated
Start_Validity_Orbit	integer	-	%ld	First orbit for which the STF is valid
Stop_Validity_Orbit	integer	-	%ld	Last orbit for which the STF is valid
Swath_Type	string. one of the following values: • open • closed	-	%s	Swath type
Swath_Point_Type	string. one of the following values: • geodetic • inertial	-	%s	Describes the type of swath points: inertial (RA and Declination) or geodetic (longitude and latitude)
One of the following: Orbit_Geometry Orbit_State_Vector	XML element	-	-	Orbit_Geometry: see Table 54. Orbit_State_Vector: see Table 55.
Time_Step	real	unit=”s”	%f	Seconds between two swath points
List_of_STF_Altitudes	XML element	count=”n” where n is the number of elements in the list	-	List of STF_Altitude elements, see Table 53
Refraction	XML element	-	-	Refraction model structure, see Table 28

Table 52 – Variable Header content

XML Tag name	Type	Attributes	C Format	Description
STF_Altitude	real	unit=”m”	%f	Altitude for a swath point in m

Table 53 – STF_Altitude element content

XML Tag name	Type	Attributes	C Format	Description
Repeat_Cycle	real	unit=”day”	%f	Repeat cycle in days
Cycle_Length	real	unit=”orbit”	%f	Cycle length in orbits
MLST_Drift	real	unit=”s/day”	%f	Mean local solar time drift

Table 54 – Orbit_Geometry element content

XML Tag name	Type	Attributes	C Format	Description
Absolute_Orbit	integer	-	%d	Orbit number for the swath template file.
Pos_X	real	unit=”m”	%f	Position in X coordinate (meters)
Pos_Y	real	unit=”m”	%f	Position in Y coordinate (meters)

Pos_Z	real	unit=”m”	%f	Position in Z coordinate (meters)
Vel_X	real	unit=”m/s”	%f	Velocity in X coordinate (m/s)
Vel_Y	real	unit=”m/s”	%f	Velocity in Y coordinate (m/s)
Vel_Z	real	unit=”m/s”	%f	Velocity in Z coordinate (m/s)

Table 55 – Orbit_State_Vector element content

Example:

```
<Variable_Header>

<Reference_OSF>MMM_OPER_MPL_ORBSCT_20200401T040000_20200401T080010_0001.EOF</
Reference_OSF>

<Reference_SDF>MMM_OPER_MPL_SW_DEF_20200101T000000_20300101T000000_0001.EOF</
Reference_SDF>
    <Absolute_Orbit>2000</Absolute_Orbit>
    <Start_Validity_Orbit>1990</Start_Validity_Orbit>
    <Stop_Validity_Orbit>2010</Stop_Validity_Orbit>
    <Swath_Type>open</Swath_Type>
    <Swath_Point_Type>geodetic</Swath_Point_Type>
    <Orbit_Geometry>
        <Repeat_Cycle unit="day">35</Repeat_Cycle>
        <Cycle_Length unit="orbit">501</Cycle_Length>
        <MLST_Drift unit="s/day">+000.000000</MLST_Drift>
    </Orbit_Geometry>
    <Time_Step unit="s">5.029940120</Time_Step>
    <List_of_STF_Altitudes count=”4”>
        <STF_Altitude unit="m">+000000.000</STF_Altitude>
        <STF_Altitude unit="m">+000000.000</STF_Altitude>
        <STF_Altitude unit="m">+000000.000</STF_Altitude>
        <STF_Altitude unit="m">+000000.000</STF_Altitude>
    </List_of_STF_Altitudes>
    <Refraction>
        <Model>NO_REF</Model>
        <Freq unit="MHz">0.0</Freq>
    </Refraction>
</Variable_Header>
```

3.7.2 Data Block

The Data Block content is a sequence of XML elements described in Table 56.

XML Tag name	Type	Attributes	C Format	Description
List_of_STF_Pts	XML element	count=”n” where n is the number of elements in the list	-	List of STF_Pt elements, see Table 57.

Table 56 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
One of the following List_of_Geodetic_Pts List_of_Inertial_Pts	XML element	count=”n” where n is the number of elements in the list	-	List_of_Geodetic_Pts: List of Geodetic_Pt elements, see Table 58. List_of_Inertial_Pts: List of Inertial_Pt elements, see Table 59.

Table 57 – STF_Pt element content

XML Tag name	Type	Attributes	C Format	Description
Long	real	unit=”deg”	%f	Longitude of the point in deg
Lat	real	unit=”deg”	%f	Latitude of the point in deg

Table 58 – Geodetic_Pt element content

XML Tag name	Type	Attributes	C Format	Description
Ra	real	unit=”deg”	%f	Right Ascension in deg
Dec	real	unit=”deg”	%f	Declination in deg

Table 59 – Inertial_Pt element content

Example (only few points are shown):

```
<Data_Block type="xml">
    <List_of_STF_Pts count="1200">
        <STF_Pt>
            <List_of_Geodetic_Pts count=”4”>
                <Geodetic_Pt>
                    <Long unit="deg">-000.000000</Long>
                    <Lat unit="deg">-000.000000</Lat>
                </Geodetic_Pt>
                <Geodetic_Pt>
                    <Long unit="deg">-000.000000</Long>
                    <Lat unit="deg">-010.000000</Lat>
                </Geodetic_Pt>
                <Geodetic_Pt>
                    <Long unit="deg">-010.000000</Long>
                    <Lat unit="deg">-010.000000</Lat>
                </Geodetic_Pt>
                <Geodetic_Pt>
                    <Long unit="deg">-010.000000</Long>
                    <Lat unit="deg">-000.000000</Lat>
                </Geodetic_Pt>
            </List_of_Geodetic_Pts count=”4”>
        </STF_Pt>

 [...]

        <STF_Pt>
            <List_of_Geodetic_Pts count=”4”>
                <Geodetic_Pt>
                    <Long unit="deg">010.000000</Long>
                    <Lat unit="deg">350.000000</Lat>
                </Geodetic_Pt>
                <Geodetic_Pt>
                    <Long unit="deg">010.000000</Long>
                    <Lat unit="deg">000.000000</Lat>
                </Geodetic_Pt>
                <Geodetic_Pt>
                    <Long unit="deg">020.000000</Long>
                    <Lat unit="deg">-010.000000</Lat>
                </Geodetic_Pt>
                <Geodetic_Pt>
                    <Long unit="deg">020.000000</Long>
                    <Lat unit="deg">350.000000</Lat>
```

```
                </Geodetic_Pt>
            </List_of_Geodetic_Pts>
        </STF_Pt>
    </List_of_STF_Pts>
</Data_Block>
```

3.7.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_SWTREF_0400.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_OPER_MPL_SWTREF_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_SWTREF_0400.XSD"
    xmlns="http://eop-cfi.esa.int/CFI" schemaVersion="4.0">
```

3.8 Zone Database File

3.8.1 Variable Header

The Variable Header is empty for this type of file.

3.8.2 Data Block

The Data Block content is a sequence of XML elements described in Table 60.

XML Tag name	Type	Attributes	C Format	Description
List_of_Zones	XML element	count=”n” where n is the number of elements in the list	-	List of Zone elements. See Table 61

Table 60 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Zone_Id	string	-	%s	Zone name
Zone_Description	string	-	%s	Zone description
Surface	string	-	%s	Type of surface
Projection	string	-	%s	Projection
Creator	string	-	%s	Cretator name
List_of_Polygon_Pts	XML element	count=”n” where n is the number of elements in the list	-	List of Polygon_Pt elements, points defining the zone. See Table 62.
Diameter	real	unit=”m”	%f	Diameter of the zone if the list of polygon points is empty.

Table 61 – Zone element content

XML Tag name	Type	Attributes	C Format	Description
Long	real	unit=”deg”	%f	longitude of the point in deg (-360, 360)
Lat	real	unit=”deg”	%f	latitude of the point in deg (-90, 90)

Table 62 – Polygon_Pt element content

Example:

```
<Data_Block type="xml">
    <List_of_Zones count="1">
        <Zone>
            <Zone_Id>RECT_ZONE</Zone_Id>
            <Zone_Description></Zone_Description>
            <Surface></Surface>
            <Projection>RECTANGULAR</Projection>
            <Creator>TEST DATA</Creator>
            <List_of_Polygon_Pts count="4">
                <Polygon_Pt>
                    <Long unit="deg">-030.000000</Long>
                    <Lat unit="deg">-020.000000</Lat>
                </Polygon_Pt>
                <Polygon_Pt>
                    <Long unit="deg">-030.000000</Long>
                    <Lat unit="deg">-010.000000</Lat>
                </Polygon_Pt>
                <Polygon_Pt>
                    <Long unit="deg">-011.000000</Long>
                    <Lat unit="deg">-010.000000</Lat>
                </Polygon_Pt>
                <Polygon_Pt>
                    <Long unit="deg">-011.000000</Long>
                    <Lat unit="deg">-020.000000</Lat>
                </Polygon_Pt>
            </List_of_Polygon_Pts>
            <Diameter unit="m">+000.000000</Diameter>
        </Zone>
    </List_of_Zones>
</Data_Block>
```

3.8.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_ZON_DB_0300.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_OPER_MPL_ZON_DB_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_ZON_DB_0300.XSD"
xmlns="http://eop-cfi.esa.int/CFI" schemaVersion="3.0">
```

3.9 Station Database File

3.9.1 Variable Header

The Variable Header is empty for this type of file.

3.9.2 Data Block

The Data Block content is a sequence of XML elements described in Table 63.

XML Tag name	Type	Attributes	C Format	Description
List_of_Ground_Stations	XML element	count=”n” where n is the number of elements in the list	-	List of Ground_Station elements. See Table 61

Table 63 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Station_Id	string	-	%s	Station name
Descriptor	string	-	%s	Station description
Antenna	string	-	%s	Antenna band
Frequency (optional)	real	unit=”Hz”	%f	Frequency in Hz
Purpose	string	-	%s	Purpose
Type	string	-	%s	Station Type
Location	XML element	-	-	Station location. See Location element, Table 65.
List_of_Spacecrafts	XML element	count=”n” where n is the number of elements in the list		Spacecraft dependant mask type parameters. List of Spacecraft elements, see Table 66.
Default_El	real	unit=”deg”	%f	Default elevation in deg.
List_of_Mask_Points	XML element	count=”n” where n is the number of elements in the list	-	List of Mask_Point elements, see Table 67.

Table 64 – Ground_Station element content

XML Tag name	Type	Attributes	C Format	Description
Long	real	unit=”deg”	%f	Longitude in deg
Lat	real	unit=”deg”	%f	Latitude in deg
Alt	real	unit=”deg”	%f	Altitude in deg

Table 65 – Location element content

XML Tag name	Type	Attributes	C Format	Description
Name	string	-	%s	Spacecraft name
Aos_El	real	unit=”deg”	%f	Acquisition of signal elevation
Los_El	real	unit=”deg”	%f	Loss of signal elevation
Mask	string	-	%s	Mask type. Possible values: AOS_LOS_WITH_MASK AOS_LOS MASK_ONLY

Table 66 – Spacecraft element content

XML Tag name	Type	Attributes	C Format	Description

Az	real	unit=”deg”	%f	Azimuth
El	real	unit=”deg”	%f	Elevation

Table 67 – Mask_Point element content

Example (only few Mask Points are shown):

```
<Data_Block type="xml">
  <List_of_Ground_Stations count="1">
    <Ground_Station>
      <Station_id>GSVLBRHX</Station_id>
      <Descriptor>Svalbard (PLATABERGET)</Descriptor>
      <Antenna>X-BAND </Antenna>
      <Purpose>GLOBAL + REGIONAL </Purpose>
      <Type> </Type>
      <Location>
        <Long unit="deg">+015.400000</Long>
        <Lat unit="deg">+078.130000</Lat>
        <Alt unit="m">+0470.000</Alt>
      </Location>
      <List_of_Spacecrafts count="1">
        <Spacecraft>
          <Name>SMOS</Name>
          <Aos_El unit="deg">+005.000000</Aos_El>
          <Los_El unit="deg">+005.000000</Los_El>
          <Mask>AOS_LOS_WITH_MASK</Mask>
        </Spacecraft>
      </List_of_Spacecrafts>
      <Default_El unit="deg">+0000.000</Default_El>
      <List_of_Mask_Points count="22">
        <Mask_Point>
          <Az unit="deg">+000.000000</Az>
          <El unit="deg">+000.400000</El>
        </Mask_Point>
        <Mask_Point>
          <Az unit="deg">+032.000000</Az>
          <El unit="deg">+000.400000</El>
        </Mask_Point>
[...]
        <Mask_Point>
          <Az unit="deg">+272.000000</Az>
          <El unit="deg">+000.400000</El>
        </Mask_Point>
        <Mask_Point>
          <Az unit="deg">+360.000000</Az>
          <El unit="deg">+000.400000</El>
        </Mask_Point>
      </List_of_Mask_Points>
    </Ground_Station> >
  </List_of_Ground_Stations>
</Data_Block>
```

3.9.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_GND_DB_0300.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_OPER_MPL_GND_DB_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_GND_DB_0300.XSD"
xmlns="http://eop-cfi.esa.int/CFI" schemaVersion="3.0">
```

3.10 Attitude Definition File

3.10.1 Variable Header

The Variable Header is empty for this type of file.

3.10.2 Data Block

The Data Block content is a sequence of XML elements described in Table 68.

XML Tag name	Type	Attributes	C Format	Description
Attitude_Definition	XML element	-	-	Attitude_Definition data structure see

Table 68 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Sat_Nominal_Att	XML element	-	-	Satellite Nominal Attitude initialization data, see Table 70
Sat_Att	XML element	-	-	Satellite Attitude initialization data, see Table 71.
Instr_Att	XML element	-	-	Instrument Attitude initialization data, see Table 71.

Table 69 – Swath element content

XML Tag name	Type	Attributes	C Format	Description
One of the following: None AOCS_Model Parameter_Model Harmonic_Model File_Model	AOCS_Model integer Parameter_Model Harmonic_Model File_Model XML element None XML element (empty)	-	AOCS_Model %ld	Satellite Nominal Attitude initialization data AOCS_Model AOCS model. It can contain the name of the AOCS model or the corresponding number, both are allowed. The allowed values are the following (the equivalent number is shown between parenthesis): GEOCENTRIC_POINTING (0) LOCAL_NORMAL_POINTING (1) YAW_STEERING_MODE (2) ZERO_DOPPLER_YSM (3) Parameter_Model: see Table 40 Harmonic_Model: see Table 41 File_Model: see Table 42

Table 70 – Sat_Nominal_Att element content

XML Tag name	Type	Attributes	C Format	Description
One of the following None Angle_Model Matrix_Model Harmonic_Model File_Model	XML element None XML element	-	-	Satellite Attitude initialization data Angle_Model: see Table 43 Matrix_Model: see Table 44 Harmonic_Model: see Table 41 File_Model: see Table 42

Only in Sat_Att Quaternion_Plus_Angle Quaternion_Plus_Matrix	(empty)			Quaternion_Plus_Angle Quaternion_Plus_Matrix

Table 71 – Sat_ and Instrument_Att element content

XML Tag name	Type	Attributes	C Format	Description
Model	integer	-	%ld	Attitude Model Identifier It can contain the name of the model or the corresponding number, both are allowed. The allowed values are the following (the equivalent number is shown between parenthesis): GENERIC (0) ENVISAT (1) CRYOSAT (2) ADM (3) SENTINEL1 (4) SENTINEL2 (5) GEO (6) METOPSG (7)
List_of_Parameters	XML element	count=”n” where n is the number of elements in the list	-	List of Parameter elements. See Table 45.

Table 72 – Parameter_Model element content

XML Tag name	Type	Attributes	C Format	Description
Angle_Type	integer	-	%ld	It can contain the name of the angle type or the corresponding number, both are allowed. The allowed values are the following (the equivalent number is shown between parenthesis): TRUE_LAT_TOD (0) TRUE_LAT_EF (1)
List_of_Harmonic_Pitch	XML element	count=”n” where n is the number of elements in the list	-	List of Harmonic elements for Pitch see Table 46.
List_of_Harmonic_Roll	XML element	count=”n” where n is the number of elements in the list	-	List of Harmonic elements for Roll see Table 46.
List_of_Harmonic_Yaw	XML element	count=”n” where n is the number of elements in the list	-	List of Harmonic elements for Yaw see Table 46.
Offsets (present only in Instr_Att)	XML element	-	-	See Table 47.

Table 73 – Harmonic_Model element content

XML Tag name	Type	Attributes	C Format	Description
Angle_Model	Structure (see Table 249)	-	-	Angles see Table 43
Quaternion_File	string	-	%s	Name of the file containing the list of quaternions.

Table 74 – Quaternion_Plus_Angle element content

XML Tag name	Type	Attributes	C Format	Description
Matrix_Model	Structure (see Table 250)	-	-	Matrix see Table 44
Quaternion_File	string	-	%s	Name of file containing the list of quaternions.

Table 75 – Quaternion_Plus_Matrix element content

Example:

```
<Data_Block type="xml">
     <Attitude_Definition>

        <Sat_Nominal_Att>
             <AOCS_Model>YAW_STEERING_MODE</AOCS_Model>
         </Sat_Nominal_Att>

         <Sat_Att>
             <File_Model>
                 <List_of_Files count="1">

<File>MA1_TEST_AUX_ATTRES_20210408T050853_20210408T101753_0001.EOF</File>
                 </List_of_Files>
                 <Auxiliary_File/>
                 <Time_Selection>
                     <Select_File/>
                 </Time_Selection>
             </File_Model>
         </Sat_Att>

         <Instr_Att>
             <Angle_Model>
                 <Angle_1 unit="deg">0.0</Angle_1>
                 <Angle_2 unit="deg">0.0</Angle_2>
                 <Angle_3 unit="deg">0.0</Angle_3>
                 <Offset_X unit="m">0.0</Offset_X>
                 <Offset_Y unit="m">0.0</Offset_Y>
                 <Offset_Z unit="m">0.0</Offset_Z>
             </Angle_Model>
         </Instr_Att>

     </Attitude_Definition>
 </Data_Block>
```

3.10.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_INT_ATTDEF_0302.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_OPER_INT_ATTDEF_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_INT_ATTDEF_0302.XSD"
xmlns="http://eop-cfi.esa.int/CFI" schemaVersion="3.2">
```

3.11 Field of View Configuration File

3.11.1 Variable Header

The Variable Header is empty for this type of file.

3.11.2 Data Block

The Data Block content is a sequence of XML elements described in Table 76.

XML Tag name	Type	Attributes	C Format	Description
FOV_Constraints	XML element	type=”mode” being mode one of the following values: Link_to_Spacecraft	-	It defines Field of View constraints, see Table 77.

Table 76 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
List_of_Masks	XML element	count=”n” being n the number of elements in the list	-	List of Mask elements, see Table 78
Miscellaneous_Parameters	XML element	-	-	Additional parameters, see Table 81.

Table 77 – FOV_Constraints element content

XML Tag name	Type	Attributes	C Format	Description
Mask	XML element	type=”mask_type” being mask_type one of the following values: inclusive exclusive	-	It defines a mask in terms of mask points, see Table 79

Table 78 – Mask element

XML Tag name	Type	Attributes	C Format	Description
Status	string	-	%s	Mask status. Allowed values: ENABLED DISABLED
List_of_Mask_Points	XML element	count=”n” being n the number of elements in the list	-	List of Mask_Point elements, see Table 80.

Table 79 – Mask element content

XML Tag name	Type	Attributes	C Format	Description

Azimuth	real	unit=”deg”	-	Azimuth of the point in deg
Elevation	real	unit=”deg”	-	Elevation of the point in deg

Table 80 – Mask_Point element content

XML Tag name	Type	Attributes	C Format	Description
Min_Tg_Height	real	unit=”m”	-	Minimum tangent height allowed in m

Table 81 – Miscellaneous_Parameters element content

Example (only few mask points are shown):

```
        <Data_Block type="xml">
            <FOV_Constraints type="Link_to_Spacecraft">
                <List_of_Masks count="2">
                    <Mask type="inclusive">
                        <Status>ENABLED</Status>
                        <List_of_Mask_Points count="4">
                            <Mask_Point>
                                <Azimuth unit="deg">0.0</Azimuth>
                                <Elevation unit="deg">10.0</Elevation>
                            </Mask_Point>
    […]
                            <Mask_Point>
                                <Azimuth unit="deg">0.0</Azimuth>
                                <Elevation unit="deg">-90.0</Elevation>
                            </Mask_Point>
                        </List_of_Mask_Points>
                    </Mask>
                    <Mask type="exclusive">
                        <Status>ENABLED</Status>
                        <List_of_Mask_Points count="8">
                            <Mask_Point>
                                <Azimuth unit="deg">0.0</Azimuth>
                                <Elevation unit="deg">-85.0</Elevation>
                            </Mask_Point>
    […]
                            <Mask_Point>
                                <Azimuth unit="deg">0.0</Azimuth>
                                <Elevation unit="deg">-90.0</Elevation>
                            </Mask_Point>
                        </List_of_Mask_Points>
                    </Mask>
                </List_of_Masks>
                <Miscellaneous_Parameters>
                    <Min_Tg_Height unit="m">19000.0</Min_Tg_Height>
                </Miscellaneous_Parameters>
            </FOV_Constraints>
        </Data_Block>
```

3.11.3 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_INT_FOVCFG_0300.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_OPER_INT_FOVCFG_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_INT_FOVCFG_0300.XSD"
xmlns="http://eop-cfi.esa.int/CFI" schemaVersion="3.0">
```

3.12 DEM Generic Raster Configuration File

3.12.1 File naming convention

The **DEM tiles** (i.e. binary height raster data) are named after the **southwestern corner** in degrees. The name will have the following format, without any extension,

XXAYYYB

where:

- XX: numeric latitude of southwestern corner (completed with 0 at the beginning if needed),
- A: N (for North) or S (for South),
- YYY: numeric longitude of southwestern corner (completed with 0 at the beginning if needed),
- B: W (for West) or E (for East).

The **DEM flag files** will have the same name as the corresponding DEM tile but adding the suffix "_flag".

For example, a tile with southwestern corner at latitude -45 degrees and longitude 30 degrees, the files must be named:

- DEM tile: 45S030E
- DEM flag file: 45S030E_flag

3.12.2 Binary Data Format

The data written in DEM tiles and DEM flag files is binary data with the following characteristics:

- the data is written so that the first row in the file corresponds to the southern-most latitude followed, in row major order, by adjacend northern rows – as shown in the figure Figure 3, for a tile named by its southwesternmost corner 45S030E, the first row of the file contains data for latitude 45° South (i.e. bottom edge of the tile) while the last row of the file contain data for latitude 30° South (i.e. top edge of the tile);
- multibyte data layout is little-endian.

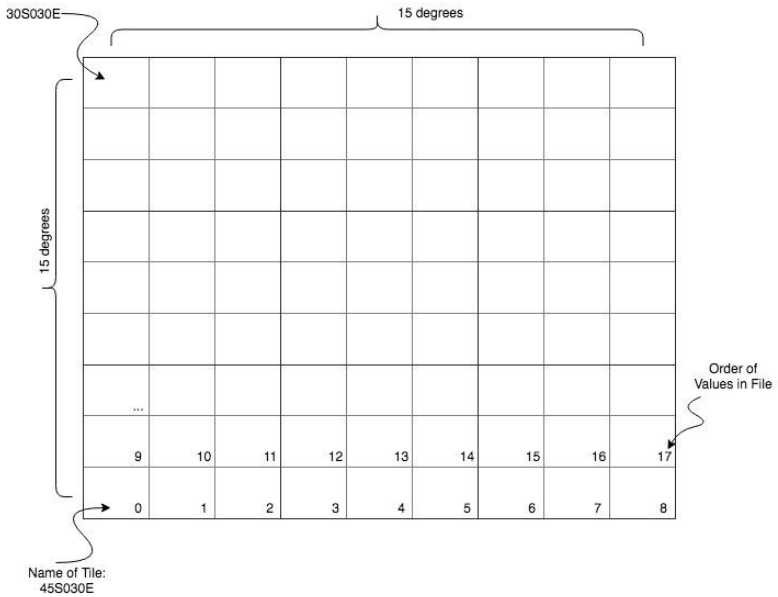

Figure 3 – Order of data for Generic DEM Raster

The description of the data types and sizes is provided in Section 3.12.5.

3.12.3 DEM Raster Configuration File

The DEM raster configuration file must be placed in the same directory as the DEM files.
It must have the name:

dem_raster_configuration.xml

This will be the name that the software will look for.

The DEM raster configuration file describes the content of the DEM files. In particular, the following items are listed:

- Data type of the DEM file data.
- Data unit of the stored altitudes.
- Number of rows and columns of the data.
- Angular resolution of the data.
- Reference with respect to which the altitudes are provided (geoid, ellipsoid).
- Value that must be considered as void (no data).
- Data type of the DEM flag file data.

3.12.4 Variable Header

The Variable Header is empty for this type of file.

3.12.5 Data Block

The Data Block content is a sequence of XML elements described in Table 82.

XML Tag name	Type	Attributes	C Format	Description
DEM_Raster_Configuration	XML element	-	-	It defines DEM generic raster, see table Table 83

Table 82 – Data Block content

XML Tag name	Type	Attributes	C Format	Description
Data_Type	XML element	-	%s	Data type of the DEM data. Allowed values: int16 int32 int64 float32 float64
Data_Unit	XML element	-	%s	Unit in which the DEM data is provided. Allowed values: Meter kilometer
Rows		-	%ld	Number of rows in the DEM tile
Columns		-	%ld	Number of columns in the DEM tile
Resolution		unit=”data_resolution” being data_resolution one of the following values: deg min sec	%lf	Resolution of DEM data (angular separation between tile adjacent points).

Reference		-	%s	Reference with respect to which the DEM altitudes are provided. Allowed values: WGS84 EGM96
Void_Value		-	%lf	Value to be considered as void value in DEM data.
Flag_Type		-	%s	Data type of DEM flag file. Allowed values: int8 int16 int32 int64

Table 83 – DEM_Raster_Configuration element content

Example:

```
<Data_Block type="xml">
    <DEM_Raster_Configuration>
        <Data_Type>int16</Data_Type>
        <Data_Unit>meter</Data_Unit>
        <Rows>1800</Rows>
        <Columns>1800</Columns>
        <Resolution unit=”sec”>30</Resolution>
        <Reference>WGS84</Reference>
        <Void_Value>-32768</Void_Value>
        <Flag_Type>int8</Flag_Type>
    </DEM_Raster_Configuration >
</Data_Block>
```

3.12.6 Schema Reference

An example of validating XML schema for this file type is located at:
http://eop-cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_DEMRAS_0300.XSD

This schema is compliant to [RD02] and includes format and range checks to ensure compliance to this specification and to the File Format Standard [RD01]. The schema file is named according to section 6.1.1 in [RD02] and is applicable to files named `MMM_OPER_MPL_DEMRAS_<instance_id>.EOF`.

The following is the content of the Earth_Observation_File required to reference the above schema.

```
<Earth_Observation_File
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://eop-cfi.esa.int/CFI http://eop-
cfi.esa.int/CFI/EE_CFI_SCHEMAS/EO_OPER_MPL_DEMRAS_0300.XSD"
xmlns="http://eop-cfi.esa.int/CFI" schemaVersion="3.0">
```