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Sentinel-1 ETAD Auxiliary Product Specification

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Chapter 7 specifying the SETAP Configuration File Auxiliary Data added		25-33	7

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ACRONYMS AND ABBREVIATIONS

AUX	Auxiliary
NWP	Numerical Weather Prediction
ECMWF	European Centre for Medium-Range Weather Forecasts
ETAD	Extended Timing Annotation Dataset
SETAP	Sentinel-1 Extended Timing Annotation Processor
TBC	To Be Confirmed
TBD	To Be Determined
TEC	Vertical Total Electron Content
XML	eXtensible Markup Language

1 INTRODUCTION

This document describes the configuration, calibration, and atmospheric auxiliary data required by the Sentinel-1 Extended Timing Annotation Processor (SETAP) to perform timing annotation SAFE products which allow to correct for the atmospheric path delays (tropospheric and ionospheric), geodynamic deformation signals, and SAR instruments effects in the S1 level-1 SLC products.

It is the PDGS responsibility to ensure provision of the atmospheric auxiliary data to the SETAP. It retrieves the original atmospheric data from the different providers and ingests it after a packaging as auxiliary SAFE products.

It is the SAR-MPC responsibility to maintain and provide the calibration and configuration data which is retrieved by the PDGS for SETAP processing.

This document specifies the content and format of the following auxiliary products and component files:

- Tropospheric model auxiliary data
- Ionospheric model auxiliary data
- Instrument timing calibration auxiliary data
- Configuration auxiliary data

It is structured as follows:

Section 1 introduces the purpose, scope and structure of the document;

Section 2 lists the applicable and reference documents;

Section 3 describes the general structure of SETAP auxiliary products following SAFE packaging specification

Section 4 describes the ECMWF Operational Forecast NWP auxiliary data, presents its structure and provides a reference to its definition;

Section 5 describes the Global Total Electron Content (TEC) map auxiliary, presents its structure and provides a reference to its definition.

Section 6 describes the SETAP instrument timing calibration auxiliary, presents its structure and provides a reference to its definition.

Section 7 describes the SETAP configuration file auxiliary, presents its structure and provides a reference to its definition.

2 DOCUMENTS

2.1 Applicable Documents

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

A-1	PGSI-GSEG-EOPG-FS-05-0001	Standard Archive Format for Europe (SAFE) Control Book Volume 1 Core Specifications, Issue 1/8, Jun. 28, 2009. ESA
A-2	ETAD-DLR-ICD-0005	S1-ETAD Project, Interface Control Document - 2.4 - 14.07.2022

2.2 REFERENCE DOCUMENTS

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

R-1		XML 1.1 (Second Edition), W3C Recommendation, 16 August 2006, Bray et al.
R-2		XML Schema Part 1: Structures Second Edition, W3C Recommendation, 28 October 2004, Thompson et al.
R-3		XML Schema Part 2: Datatypes Second Edition, W3C Recommendation, 28 October 2004, Biron et a
R-4	ETAD-DLR-DD-0009	S1-ETAD Processor Configuration Description 1.5 - 14.07.2022
R-5	ETAD-DLR-DD0004	S1-ETAD Input/Output Description Document 2.2 - 30.04.2020
R-6	ETAD-DLR-TN-1001	S1-ETAD Project, S-I ETAD Correction Methods 1.0 - 18.04.2019
R-7		WMO FM-92 GRIB Edition 2 (01/2003)
R-8		IONEX: The IONosphere Map Exchange Format Version 1
R-9	S1-RS-MDA-52-7443	Sentinel-1 IPF Auxiliary Product Specification 3.4 - 07/01/2020
R-10		Guidelines for Long Product Filenames in the IGS 2.0 - 06/12/2022
R-11	GMES-GSEG-EOPG-TN-09-0016	GMES Generic PDGS-IPF Interface Specifications 24/09/2009
R-12	S1-RS-MDA-52-7443	Sentinel-1 IPF Auxiliary Product Specification 3.3 - 21/12/2017

3 SETAP AUXILIARY DATA OVERVIEW

Auxiliary data are information required for processing of Sentinel-1 Extended Timing Annotation Processor (SETAP) products to get the information about the Tropospheric delay and the Ionospheric delay, the product computation configuration, and timing calibration data for the level 1 Sentinel-1 SAR image products.

The S1-ETAD uses this auxiliary data during processing as summarized in Table 3-1 below.

Table 3-1 Summary of Auxiliary Data used by S1-ETAD

Auxiliary Data	Description	Proc. Level	Product ID	Retrieval Mode	Reference
Tropospheric model Auxiliary Data	The Tropospheric Model Auxiliary Data contains the spatial-temporally state of the troposphere and options for configuring the L1 processing performed within the S1-ETAD.	L1	AUX_TRO	ValIntersect	Section 4
Ionospheric model Auxiliary Data	The Ionospheric Model Auxiliary Data provide the necessary information at processor S1-ETAD for calculation of the timing corrections due to ionospheric delay.	L1	AUX_TEC	ValIntersect	Section 5
Instrument timing calibration Auxiliary data	The Calibration Auxiliary Data provide the necessary information on S-1 instruments to SETAP for the compensation of SAR payload time delays and system timing biases.	L1	AUX_ITC	LatestVal Cover	Section 6
SETAP configuration file Auxiliary data	The Configuration Auxiliary Data contains the settings for the corrections calculated by the SETAP.	L1	AUX_SCF	LatestVal Cover	Section 7

3.1 Format Overview

The S1-ETAD auxiliary data products follow the same formatting as the Sentinel-1 auxiliary data products and are a collection of files that are grouped together and formatted according to the SAFE core specification [A-1]. The Tropospheric model Auxiliary Data (Section 4), Ionospheric model Auxiliary Data (Section 5), Instrument timing calibration Auxiliary data (Section 6) and SETAP configuration file Auxiliary data (Section 7) are wrapped in SAFE format, and their formats are described in their respective sections. The SAFE file is a folder containing the following auxiliary data file components:

- Manifest file,
- Auxiliary data file(s), and
- Representation data file(s) (optional).

The manifest file is an eXtensible Markup Language (XML) file [R-1] formatted according to [A-1] that serves two important purposes within the product: it contains information about the data files that make up the auxiliary product, and it contains general information that describes properties of the auxiliary product.

The auxiliary data file(s) contains the specific information required by the SETAP to extract a set of geodetic corrections that will establish the S1-ETAD product.

Representation data files are XML Schema files composed of XML schema structures [R-2] and data types [R-3] that define the format and content of the auxiliary data file to which they apply. The representation data files are optional and can be used by XML tools to validate the structure and content of the auxiliary file and it can be used by humans and parsing tools to read, to manipulate and to exploit the values of the data contained in the relevant auxiliary data file. The representation data files form the definitive source for the content and format of each of the auxiliary data files described in this document.

Figure 3-1 presents a graphical overview of the logical structure of S1-ETAD auxiliary data products and Figure 3-2 presents a graphical overview of the physical structure of S1-ETAD auxiliary data products.

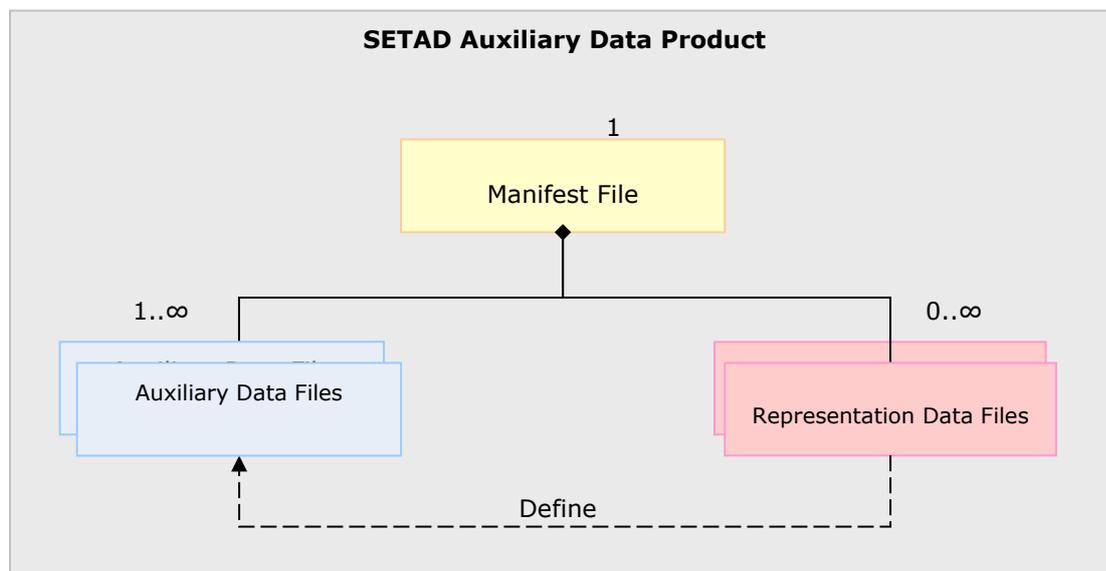


Figure 3-1 S1-ETAD Auxiliary Data Product Logical Structure

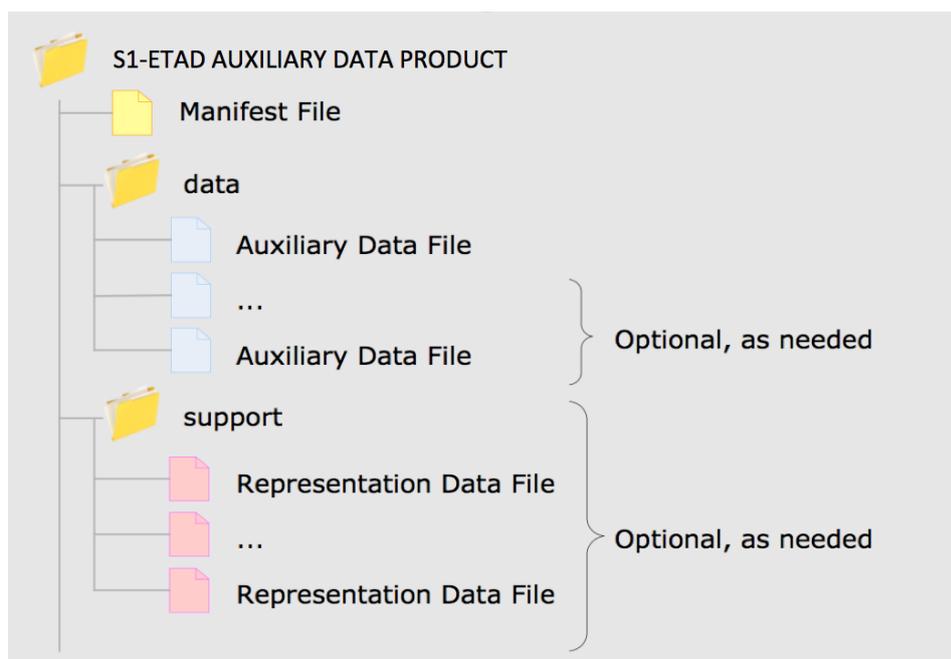


Figure 3-2 S1-ETAD Auxiliary Data Product Physical Structure

3.1.1 Manifest File

The manifest file is documented in detail in the SAFE core specification A-1 and R-9. The objective of this section is to define the mandatory components of the manifest file that will be present in all Sentinel-1 auxiliary products defined within this specification.

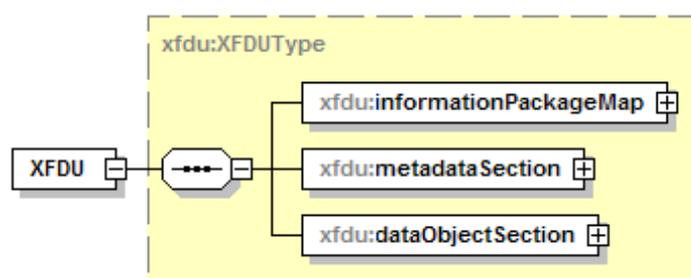


Figure 3-3 S1-ETAD Manifest File Structure

Table 3-2 Element - XFDU

Name	Description	Data Type	Cardinality
<i>version</i>	<i>The version attribute describes the location within the SAFE schema directory structure where the validating XFDU schema file for this manifest file resides.</i>	<i>string</i>	<i>required</i>
informationPackageMap	The information package map contains a high-level textual description of the product and references to all of the auxiliary data file components contained within the product.	informationPackageMapType	1

metadataSection	The metadata section contains a minimal set of wrapped product metadata that can be used for auxiliary product identification.	metadataSectionType	1
dataObjectSection	The dataObjectSection contains the dataObjects that represent the auxiliary data file components included in the auxiliary product. Each dataObject within the dataObjectSection represents a physical auxiliary data file on a local or external file system.	dataObjectSectionType	1

3.1.1.1 Information Package Map

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

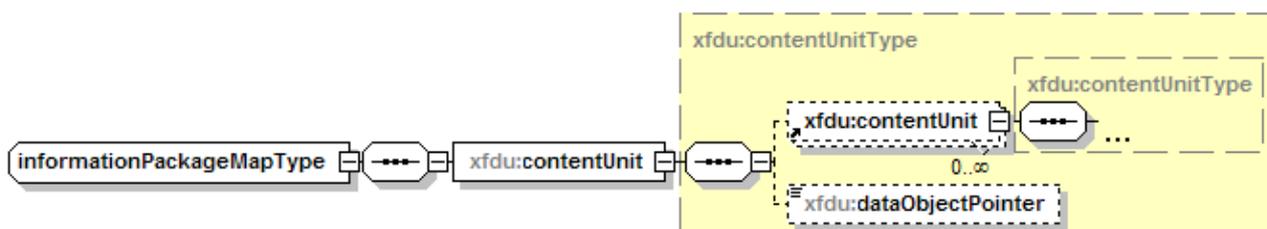


Figure 3-4 Information Package Map Structure

Table 3-3 Data Type - informationPackageMapType

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

Table 3-4 Data Type - contentUnitType

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

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

3.1.1.2 Metadata Section

The manifest file contains exactly one metadata section. In the general case the metadata section contains a list of metadata objects that contain either wrapped metadata (information included directly in the manifest file), a data object pointer that refers to a physical auxiliary data file on disk, or a metadata reference that points to a representation data set schema file on disk. In the specific case of atmosphere auxiliary products defined in this document, only wrapped metadata are foreseen at the moment.

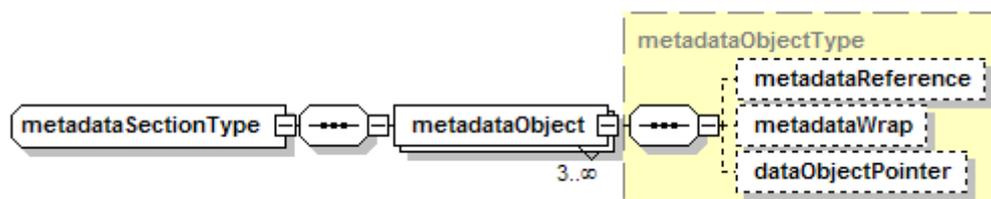


Figure 3-5 Metadata Section Structure and Content

Table 3-5 Data Type - metadataSectionType

Name	Description	Data Type	Cardinality
metadataObject	Metadata objects can take one of three forms: the first is "wrapped metadata" in which valid XML data is embedded directly in the manifest file itself using an metadataWrap element; the second is a reference to the auxiliary data file in the dataObjectSection through a dataObjectPointer element; and, the third is a physical reference to a representation data set on the filesystem through the use of a metadataReference element. For Sentinel-1 auxiliary products a minimum of 3 metadataObjects shall be present dedicated to: processing platform and generalProductInformation metadataWrap objects. Representation metadata objects shall also be provided if they apply/are available.	metadataObjectType	3 .. ∞

Table 3-6 Data Type – metadataObjectType

Name	Description	Data Type	Cardinality
<i>ID</i>	<i>Unique identifier of this meta data object.</i>	<i>ID</i>	<i>required</i>
<i>category</i>	<i>Defines the category of this meta data. The category is used to specify the nature of the metadata, whether it is preservation information (PDI), description information (DMD) or representation information (REP)</i>	<i>string</i>	<i>required</i>
<i>classification</i>	<i>A textual description of the classification of this meta data. The classification is linked to the category and provides a more verbose description of the nature of the metadata, whether it is preservation information (PROVENANCE), description information (DESCRIPTION) or representation information (REPRESENTATION)</i>	<i>string</i>	<i>required</i>
<i>dataObjectPointer</i>	The dataObjectPointer element is used when the metadata object is an auxiliary data file. The dataObjectPointer element is used to point to the applicable auxiliary data file in the dataObject section through its dataObjectID attribute.	dataObjectPointerType	0 .. 1 (not expected to be present)
<i>metadataWrap</i>	The metadataWrap element is used to embed XML metadata directly in the manifest file itself. This element is used to express information that can be used for auxiliary product identification.	metadataWrapType	0 .. 1
<i>metadataReference</i>	The metadataReference element is used when the metadata object is a representation data set. The metadataReference element is used to specify the physical file location of the applicable representation data set.	metadataReferenceType	0 .. 1 (not expected to be present)

3.1.1.3 Mandatory Wrapped Metadata

The three mandatory wrapped metadata elements are presented in tabular form below.

Table 3-7 Mandatory Wrapped Metadata

Name		Description	Data Type	Cardinality
safe:processing		Metadata describing the processing steps performed on the auxiliary data.	processingType	1
	<i>name</i>	<i>Name of the processing step used to create the auxiliary data.</i>	<i>string</i>	<i>required</i>
	<i>start</i>	<i>Processing start time.</i>	<i>dateTime</i>	<i>required</i>
	<i>stop</i>	<i>Processing stop time.</i>	<i>dateTime</i>	<i>required</i>
safe:facility		Identifies an organization authority of the processing step.	facilityType	1
	<i>country</i>	<i>Name of the country where the facility is located.</i>	<i>string</i>	<i>required</i>
	<i>name</i>	<i>Name of the facility where the processing step was performed.</i>	<i>string</i>	<i>required</i>
	<i>organization</i>	<i>Name of the organization responsible for the facility.</i>	<i>string</i>	<i>required</i>
	<i>site</i>	<i>Geographical location of the facility.</i>	<i>string</i>	<i>required</i>
safe:software		Reference to the software used for the processing step.	softwareType	0 .. ∞
	<i>name</i>	<i>Name of the software.</i>	<i>string</i>	<i>required</i>
	<i>version</i>	<i>Software version identification.</i>	<i>string</i>	<i>optional</i>
safe:resource		Reference to resources involved in the processing.	resourceType	0 .. ∞
	<i>name</i>	<i>Name of the resource.</i>	<i>string</i>	<i>required</i>
	<i>role</i>	<i>Role the resource played in processing.</i>	<i>string</i>	<i>required</i>
	<i>href</i>	<i>URL of the resource.</i>	<i>anyURI</i>	<i>optional</i>
safe:platform		Metadata describing the mission platform to which the auxiliary data applies.	platformType	1

Name		Description	Data Type	Cardinality
	safe:nssdc Identifier	Univocally identifies the mission according to standard defined by the World Data Center for Satellite Information (WDC-SI), available at https://nssdc.gsfc.nasa.gov/nmc/SpacecraftQuery.jsp	string	1
	safe:familyName	The full mission name. E.g. "SENTINEL-1"	string	1
	safe:number	The alphanumeric identifier of the platform within the mission.	string	1
	safe:instrument	Information related to the instrument on the platform to which this auxiliary data applies.	instrumentType	1
		Safe:familyName	Instrument name.	1
		<i>abbreviation</i>	<i>Abbreviated instrument name.</i>	<i>required</i>
s1auxsar:standAlone Product Information		Metadata describing the auxiliary product.	standAloneProduct InformationType	1
	s1auxsar:auxProductType	Informative name of the type of this auxiliary product	auxProductTypeType	0..1
	s1auxsar:validity	Date and time at which the auxiliary product becomes valid.	dateTime	1
	s1auxsar:generation	Date and time at which the auxiliary product was generated.	dateTime	1
	s1auxsar:instrument Configuration Id	Identifier of the instrument (radar database) configuration to which this auxiliary data applies.	unsignedInt	1
	s1auxsar:changeDescription	Description of the changes of this auxiliary product with respect to the previous version	string	0...1

3.1.1.4 Data Object Section

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

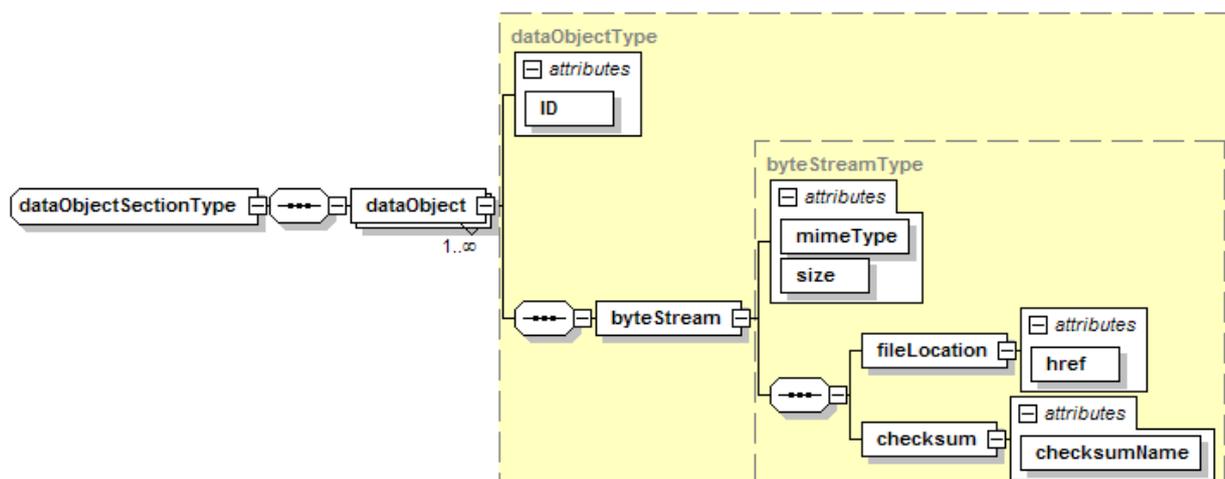


Figure 3-6 Data Object Section Structure and Content

Table 3-8 Data Type - dataObjectSectionType

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

Table 3-9 Data Type - dataObjectType

Name	Description	Data Type	Cardinality
ID	Unique identifier of this data object. <i>IMPORTANT: in AUX_TRO products the ID shall correspond to the ID of the data component file as described in section 4.1.2.</i> E.g.: ID="auxData129"	ID	required
byteStream	The byte stream element points to the physical file that this data object represents. The byteStream element contains the location of the file and associated information like the format of the file, the size and the data integrity checksum.	byteStreamType	1

Table 3-10 Data Type - byteArrayType

Name	Description	Data Type	Cardinality
<i>contentType</i>	<i>Specifies the format of the file referred to by this byteArray element.</i>	<i>contentType</i>	<i>required</i>
<i>size</i>	<i>Indicates the size (in bytes) of the file referred to by this byteArray element.</i>	<i>long</i>	<i>required</i>
<i>fileLocation</i>	The <i>fileLocation</i> element contains the absolute path or URL to associated file through the use of its “href” attribute.	<i>referenceType</i>	1
<i>checksum</i>	<i>Provides the integrity checksum for the file referred to by this byteArray element.</i>	<i>checksumInformationType</i>	1

3.2 Naming Standard

This section defines the naming standard for the auxiliary data products and the component files within the product. This standard is used for most of the auxiliary data products described by these documents, which are all wrapped in SAFE formatting.

3.2.1 Product

The naming standard for S1-ETAD auxiliary data products contains uppercase alphanumeric characters separated by underscores “_” as illustrated Figure 3-7/Table 3-11 in presents each naming element used and the description and range of each.

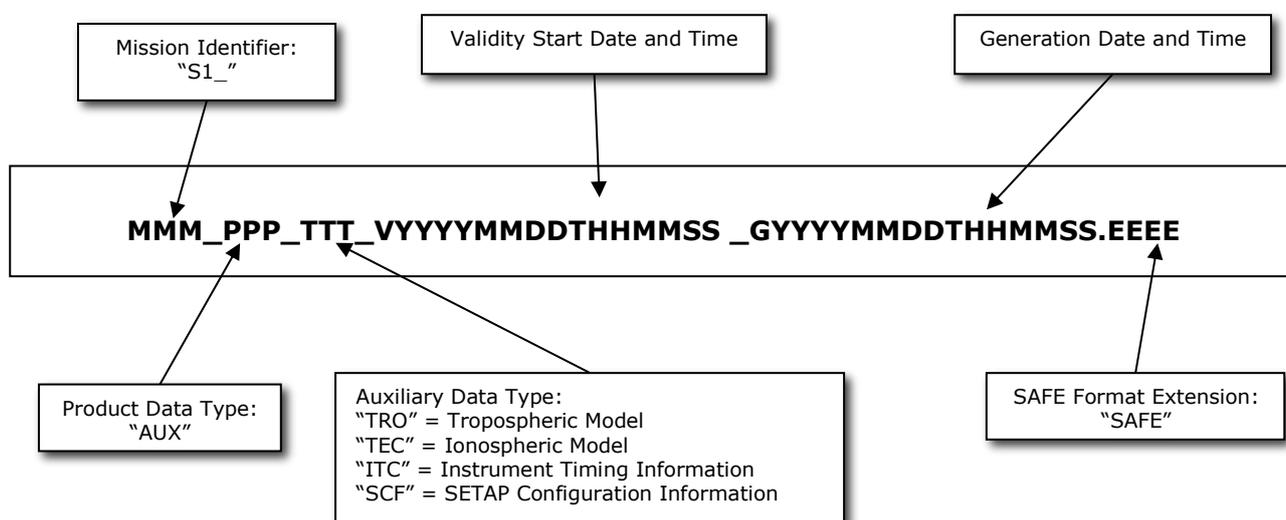


Figure 3-7 Auxiliary Product Naming Standard

Table 3-11 S1-ETAD Auxiliary Product Naming Elements

Name Element Pattern	Name Element Description	Name Element Range
MMM	Mission Identifier	S1_, S1A, S1B

Name Element Pattern	Name Element Description	Name Element Range
PPP	Product data type	AUX
TTT	Auxiliary file data type	TRO, TEC, ITC, SCF
VYYYYMMDDTHHMMSS	Start validity date and time.	V followed by fourteen digits representing the date and time separated by the character T.
GYYYYMMDDTHHMMSS	Date and time when the product was generated.	G followed by fourteen digits representing the date and time separated by the character T.
EEEE	Product format extension	SAFE

Within the auxiliary product name, the mission identifier is always set to “S1_” for auxiliary data that is not satellite-specific.

The product data type is always set to “AUX” to identify the product as an auxiliary data product. The auxiliary file data type varies with the information contained in the product and is set accordingly.

The validity start date and time defines the start of the range when the auxiliary data becomes applicable (the duration of the validity range is fixed, and it is specified in the following sections) and the file generation data and time defines when the auxiliary data was created. The criteria for selecting an appropriate auxiliary product to use when processing a job order are as follows:

1. Select the auxiliary products with the validity start date/time between the start date/time of the data take minus 1 hour and the numbers of hours equal to the temporal resolution of auxiliary products.
2. Use all the auxiliary products, which meets the first criteria.

3.2.2 Data Sets

Files within the auxiliary product have external specification specified in the respective sections.

4 TROPHOSFERIC MODEL AUXILIARY DATA

4.1 Overview

The files ECMWF Operational Forecast NWP Data are used for calculation of the timing corrections due to tropospheric delay [A-2].

In order to model the tropospheric delay for a given SAR pixel, the S1-ETAD require different types of numeric weather prediction (NWP) data products from the ECMWF that are:

- geopotential (ID 129, on surface level),
- temperature (ID 130, on model levels),
- specific humidity (ID 133, on model levels),
- surface pressure (ID 134, on surface level) and
- mean-sea level (MSL) pressure (ID 151, on single level).

The data forecast from ECMWF are in WMO FM-92 GRIB format R-7 and the distribution latency is 1 day with a temporal resolution of 6 hours.

The validity period of AUX-TRO products is fixed and equal to 6 hours, i.e., the validity stop time is always equal to the SAFE validity start time (see Table 4-1) + 5h:59m:59.999s hours.

The PDGS, based on the startTime and the stopTime of the data take, applies the ValIntersect selection rule with $T_0=0$ and $T_1=6$ A-2, i.e. between the range [to - 0 hour, t1 + 6 hours], to retrieve the 2 (3) tropospheric model auxiliary products.

4.1.1 *Product Structure*

The file ECMWF Operational Forecast NWP Data are in WMO FM-92 GRIB R-7 format and is wrapped in SAFE before being provided to the S1-ETAD.

The

Table 4-1 describes the physical structure and data file components included in the ECMWF Operational Forecast NWP Data auxiliary product as well as an estimated size for each.

Table 4-1 SETAP IPF Tropospheric model auxiliary product

File/Folder Name	File Type	Inclusion Criteria	Est. Size
 S1__AUX_TRO_VYYYYMMDDTHHMMSS_ GYYYYMMDDTHHMMSS.SAFE			
 manifest.safe	Manifest	1	5 KB
 data/	Directory	1	N/A
 WWWWW_DDDD_ML00_aaH_ppp_GP_gggg_YYYYMMDDThhmmss	Auxiliary Data	5	700 MB
 support/	Directory	0 .. 1	N/A
 Optional support files.	Representation Data	0 .. ∞	N/A

4.1.2 Naming Standard

The naming standard of the ECMWF Operational Forecast NWP auxiliary product follows the standard defined in section 3.2 and naming of the component file within the ECMWF Operational Forecast NWP Data follows the standard defined below:

Table 4-2 ECMWF Operational Forecast NWP Data Naming Convention

Field	Meaning	Possible values
WWWWW	Name of weather center	ECMWF
DDDD	Dataset type	OPER (Operational)
aa	Analysis interval of data [h]	06 (OPER)
ppp	NWP Parameter ID	129 130 133 134 151
gggg	Grid projection of NWP parameter	N640 (OPER)
YYYY	Year of analysis time	e.g. 2016
MM	Month of analysis time	e.g. 04
DD	Day of analysis time	e.g. 08
hh	Hour of analysis time	e.g. 12
mm	Minutes of analysis time	00 (fixed)
ss	Seconds of analysis time	00 (fixed)

4.2 Data File Definition

The definition of the ECMWF Operational Forecast NWP auxiliary data is specified in R-5.

4.3 Data File Content

The content of the ECMWF Operational Forecast NWP auxiliary data is specified in R-5.

5 IONOSPHERIC MODEL AUXILIARY DATA

5.1 Overview

The Total Electron Content (TEC) maps of Center for Orbit Determination in Europe (CODE) are used for calculation of the timing corrections due to Ionospheric delay.

The Total Electron Content (TEC) maps are in Unix-compressed archives (*.Z) format (until November 26, 2022) or in Gzip-compressed archives (*.gz) format R-10, and the distribution latency are 14 day with a temporal resolution of 1 day.

The validity period of AUX-TEC products is fixed and equal to 24 hours, i.e., the validity stop time is always equal to the SAFE validity start time (see Table 5-1) + 23h:59m:59.999s hours.

The PDGS, based on the startTime and the stopTime of the data take, applies the ValIntersect selection rule with T0=0 and T1=0 A-2, i.e. between the range [t0 - 0 hour, t1 + 0 hours], to retrieve the 1 (2) ionospheric model auxiliary products.

5.1.1 Product Structure

The file TEC maps are Unix-compressed archives (*.Z format) or Gzip-compressed archives (*.gz format) containing text files in IONEX format R-8. TEC maps are wrapped in SAFE before being provided to the S1-ETAD processor.

The Table 5-1 describes the physical structure and the data file component included in the CODE ionosphere TEC data auxiliary product as well as an estimated size for each.

Table 5-1 TEC maps Auxiliary Product

File/Folder Name	File Type	Inclusion Criteria	Est. Size
 S1__AUX_TEC_VYYYYMMDDTHHMMSS_ GYYYYMMDDTHHMMSS.SAFE			
 manifest.safe	Manifest	1	5 KB
 data/	Directory	1	N/A
 aaacddd#.yyi.Z	Auxiliary Data	1	265 KB
OR aaavppptt_yyydddhmm_len_smp_cnt.fmt.gz			
 support/	Directory	0 .. 1	N/A
 Optional support files.	Representation Data	0 .. ∞	N/A

5.1.2 Naming Standard

The naming standard of the TEC maps auxiliary product follows the standard defined in section 3.2 and naming of the component file within the TEC maps follows the standard defined in below:

Table 5-2 TEC maps Naming Convention until November 26, 2022

Field	Meaning	Possible values
aaa	Id of analysis center	E.g. cod for CODE
c	Product coverage	g is the global product
ddd	Day of year	e.g. 115
#	File number for the day, set to zero	0
yy	Year, two digits	e.g. 18 (for 2018)

Table 5-3 TEC maps Naming Convention after November 26, 2022, R-10

Field	Meaning	Possible values
aaa	Id of analysis center	E.g. COD for CODE
v	Version/Solution ID (0-9)	0
ppp	Campaign/project specification	OPS
ttt	Solution type identifier	FIN
yyyy	Year, four digits	e.g. 2023
ddd	Day of year, three digits	e.g. 003
hhmm	Hours and minutes, four digits	0000
len	Nominal product period, three chars	01D
smp	Product temp. sampling, three chars	01H
cnt	Content type, three chars	GIM
fmt	File format, three chars	INX

5.2 Data File Definition

The definition of the TEC maps auxiliary data is specified in R-5.

5.3 Data File Content

The definition of the TEC maps auxiliary data is specified in R-5.

6 INSTRUMENT TIMING CALIBRATION AUXILIARY DATA

6.1 Overview

The auxiliary instrument timing calibration product (AUX-ITC) ensures the accuracy of the S1-ETAD product by providing the constants to center the range and azimuth radar timings. The calibration constants are applied by the SETAP to the summation layers of the S1-ETAD product and annotated to the product.

The SETAP auxiliary product complements the Sentinel-1 Calibration Auxiliary Product (AUX-INS) of the SAR IPF containing the instrument timing calibration applied to the image products during SAR processing R-12. Therefore, the SETAP AUX-ITC product needs be updated in accordance with the changes made in the auxiliary product of the SAR IPF which affect the range and azimuth timings.

The AUX-ITC is passed on to the SETAP processor by the management layer (ML) by selecting the applicable product from the ground segment internal database and placing it in the work directory of the job. It is part of the processor data flow interface A-2.

The PDGS, based on the start`Time` and the stop`Time` of the data take, applies the LatestValCover selection rule with $T_0=0$ and $T_1=0$ A-2, i.e. between the range [`to` - 0 hour, `t1` + 0 hours], to retrieve the instrument timing calibration auxiliary product.

6.1.1 Product Structure

The instrument timing calibration information is stored in an XML file. The file is wrapped in SAFE before being provided to the S1-ETAD processor.

The Table 6-1 describes the physical structure and the data file component included in the instrument timing calibration auxiliary product as well as an estimated size for each.

Table 6-1 Instrument timing calibration Auxiliary Product

File/Folder Name	File Type	Inclusion Criteria	Est. Size
 MMM_AUX_ITC_VYYYYMMDDTHHMMSS_GYYYYMMDDTHHMMSS.SAFE			
 manifest.safe	Manifest	1	4 KB
 data/	Directory	1	N/A
 mmm-aux-itc.XML	Auxiliary Data	1	15 KB
 support/	Directory	0 .. 1	N/A
 Optional support files.	Representation Data	0 .. ∞	N/A

6.1.2 Naming Standard

The naming standard of the instrument timing calibration auxiliary product follows the standard defined in section 3.2 and the naming of the data file follows the standard defined in below:

Table 6-2 Instrument timing calibration file Naming Convention

Field	Meaning	Possible values
mmm	Mission Identifier	s1a, s1b,

6.2 Data File Definition

The schema file s1-aux-itc.xsd for the definition of the auxiliary instrument timing calibration file is attached to the product. The generic s1-object-generic.xsd schema file also provided with the product and included in the specific schema file is specified in R-12.

6.3 Data File Content

The graphical representation of the content of the instrument timing calibration data file is visualized in Figure 6-1 and the corresponding specifications are presented in Table 6-3, Table 6-4, Table 6-5. The table columns are defined as follows:

- Name: name of the element/attribute
- Description: purpose of element/attribute including the units if applicable
- Data Type: data type of element/attribute
- Cardinality: number of occurrences;
- Attributes are displayed in italics; in this case Cardinality specifies whether the attribute is required or mandatory

The data types are in accordance with the types defined for Sentinel auxiliary data products, see R-12, chapter 3.4.

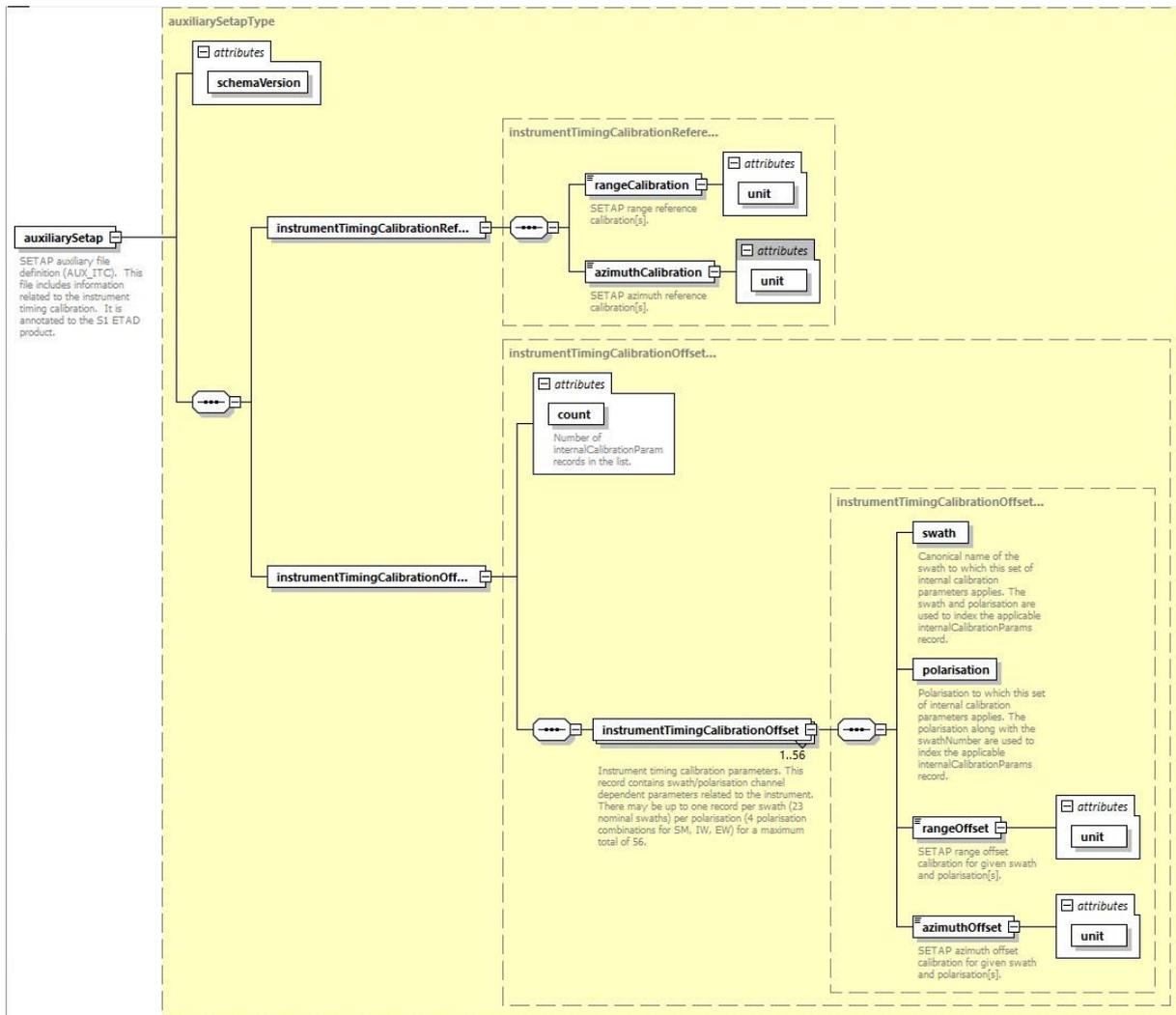


Figure 6-1 Data file content of the auxiliary instrument timing calibration product

Table 6-3 Data Type - instrumentTimingCalibrationReferenceType

Name	Description	Data Type	Cardinality
<i>unit</i>	<i>Unit of range timing calibration number; fixed to "s"</i>	<i>string</i>	<i>required</i>
rangeCalibration	Instrument timing calibration reference in range [s]	double	1
<i>unit</i>	<i>Unit of azimuth timing calibration number; fixed to "s"</i>	<i>string</i>	<i>required</i>
azimuthCalibration	Instrument timing calibration reference in azimuth [s]	double	1

Table 6-4 Data Type - instrumentTimingCalibrationOffsetListType

Name	Description	Data Type	Cardinality
<i>count</i>	<i>Number of instrumentTimingCalibration records in the list.</i>	<i>unsignedInt</i>	<i>required</i>
instrumentTimingCalibrationOffset	Instrument timing calibration offset parameters. This record contains swath/polarisation channel dependent offset parameters with respect to the instrument reference timing calibration. There may be up to one record per swath (23 nominal swaths) per polarisation (4 polarisation combinations for SM, IW, EW) for a maximum total of 56.	instrumentTimingCalibrationOffsetType	56

Table 6-5 Data Type – instrumentTimingCalibrationOffsetType

Name	Description	Data Type	Cardinality
swath	Canonical name of the swath to which this set of calibration parameters applies. The swath and polarisation are used to index the applicable instrumentTimingCalibrationOffset record.	swath	1
polarisation	Polarisation to which this set of calibration parameters applies. The polarisation and swath are used to index the applicable instrumentTimingCalibrationOffset record.	polarisationType	1
<i>unit</i>	<i>Unit of range timing calibration offset number; fixed to “s”</i>	<i>string</i>	<i>required</i>
rangeOffset	Range timing calibration offset constant [s]	double	1
<i>unit</i>	<i>Unit of azimuth timing calibration number; fixed to “s”</i>	<i>string</i>	<i>required</i>
azimuthOffset	Azimuth timing calibration offset constant [s]	double	1

7 SETAP CONFIGURATION FILE AUXILIARY DATA

7.1 Overview

The auxiliary SETAP Configuration File (AUX-SCF) product controls the correction settings of the processor, i.e., the overall and the mode-specific activation of timing corrections, as well as the spatial sampling of the correction grid. The information is stored in the AUX-SCF data file which has XML format.

The AUX-SCF is passed on to the SETAP processor by the management layer (ML) by selecting the applicable product from the ground segment internal database and placing it in the work directory of the job. It is part of the processor data flow interface A-2.

The PDGS, based on the start`Time` and the stop`Time` of the data take, applies the LatestValCover selection rule with $T_0=0$ and $T_1=0$ A-2, i.e. between the range [`to` - 0 hour, `t1` + 0 hours], to retrieve the configuration file auxiliary product.

7.1.1 Product Structure

The configuration information is stored in an XML file. The file is wrapped in SAFE before being provided to the S1-ETAD processor.

The Table 7-1 describes the physical structure and the data file component included in the SETAP configuration file auxiliary product as well as an estimated size for each.

Table 7-1 SETAP configuration file Auxiliary Product

File/Folder Name	File Type	Inclusion Criteria	Est. Size
 S1_AUX_SCF_VYYYYMMDDTHHMMSS_GYYYYMMDDTHHMMSS.SAFE			
 manifest.safe	Manifest	1	4 KB
 data/	Directory	1	N/A
 mmm-aux-scf.XML	Auxiliary Data	1	3 KB
 support/	Directory	0 .. 1	N/A
 Optional support files.	Representation Data	0 .. ∞	N/A

7.1.2 Naming Standard

The naming standard of the SETAP configuration file auxiliary product follows the standard defined in section 3.2 and the naming of the data file follows the standard defined in below:

Table 7-2 SETAP configuration file Naming Convention

Field	Meaning	Possible values
mmm	Mission Identifier	S1-

7.2 Data File Definition

The schema file s1--aux-scf.xsd for the definition of the auxiliary SETAP configuration file is included in the product.

7.3 Data File Content

The data file of the AUX_SCF has XML format. The descriptions of the contents are listed in Table 7-3. The table columns are defined as follows:

- Tag name: name of the element
- Descendants: list of tags that are enclosed by a specific tag
- Tag contents: description of tag meaning, type and default values (if any)
- Cardinality: number of occurrences of the tag
- Attribute name and value: name of the tag attribute and its default value (if any)
- Attribute domain: the allowed range for an attribute

The configuration file of the SETAP consists of two main blocks: the general processor configuration and a section for mode related configurations. The general configuration allows for controlling of the parameters applicable to all modes, e.g. the physical corrections. The mode specific configuration contains the parameters for the different S-1 SAR modes that are supported by the SETAP, i.e. SM and IW. Note that EW is already included in the data file but not yet supported by the processor. The symbols used in Table 7-3 are based on the nomenclature in R-11 and have the following meaning w.r.t. the different categories:

Descendants:

- ∅: No descendant tags
- All: top level tag enclosing anything in the XML file

Cardinality:

- [0,n]: at most n times
- 1 exactly one
- + at least one

Attribute name, value and domain:

- ∅: None
- [n,n] exactly n.

Table 7-3 Contents and structure of the SETAP Configuration File Product data file

Level	Tag name	Descendants	Tag contents	Cardinality	Attribute name and value	Attribute domain
>	setapConf	All	∅	1	schemaVersion="x.x"	
1	generalProcessorConf		∅	1	∅	∅
2	listOfGlobalParams		∅	1	∅	∅
3	troposphericDelay Correction	∅	Boolean value activating the tropospheric delay correction Default: true	1	∅	∅
3	ionosphericDelay Correction	∅	Boolean value activating the ionospheric delay correction Default: true	1	∅	∅
3	solidEarthTide Correction	∅	Boolean value activating the solid Earth tide correction Default: true	1	∅	∅
1	modeRelatedConf		∅	1	∅	∅
2	listOfModes		∅	1	count="3"	[3,3]
3	mode		∅	+	∅	∅
4	name		String with name of the mode setting S1-ETAD-SM or S1-ETAD-IW or S1-ETAD-EW	+	∅	∅
4	listOfModeParams		∅	+	∅	∅
5	correctionGridRange Sampling		Short integer value with sampling of the ETAD product correction grid in range direction [m]. Default: 200	+	unit="m"	
5	correctionGridAzimuth Sampling		Short integer value with sampling of the ETAD product correction grid in azimuth direction [m]. Default: 200	+	unit="m"	

5	bistaticAzimuth Correction		Boolean value activating the bistatic azimuth correction; required for all SAR modes. Default: true	+	∅	∅
5	dopplerShiftRange Correction		Boolean value activating the Doppler shift range correction; only required for IW and EW; Default: false (mode="SM") true (mode="IW" "EW")	+	∅	∅
5	fmMismatchAzimuth Correction		Boolean value activating the FM-rate mismatch azimuth correction; only required for IW and EW. false (mode="SM") true (mode="IW" "EW")	+	∅	∅