

Mapping Sentinel I format to NetCDF Earth Observation (EO)

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Mapping Sentinel-1 to EO NetCDF Documentation

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Foreword

This document has been drafted in the context of the ESA Prod-trees project by CNR.

Scope

This document aims at defining a mapping from the S1 Data Model to the EO-NetCDF Data Model.

EO Products elements

EO NetCDF metadata elements are presented in the following tables. For each element a correspondent Sentinel II element is listed (when available). To identify a specific element the following schema is usually used through the document:

[BASE_FILE]/[PATH]

Where:

[BASE_FILE] identifies a specific file inside the Sentinel II product. E.g. PRODUCT, GRANULE, DATASTRIP, MANIFEST.

[PATH] identifies a specific element inside the BASE_FILE by means of an XPath-like reference.

Conventions attribute

Conventions attribute is set to: "EO/SAR/SEN1-1.0"

EO elements

This is the main group of metadata elements. Name of the group: "earth_observation_information". The main group should be linked by an attribute having its name as the value or, in case of NetCDF 4 it should be a NetCDF group, having its name (see appendix for implementation details).

Element name	Format	Description	Obligation / Cardinality	SI element
phenomenon_time_begin_position	String (ISO 8601)	Acquisition start date time dateTime in ISO 8601 format (CCYY-MM-DDThh:mm[:ss[.cc]]Z)	M	PRODUCT/ adsHeader/startTime
phenomenon_time_end_position	String (ISO 8601)	Acquisition end date time dateTime in ISO 8601 format (CCYY-MM-DDThh:mm[:ss[.cc]]Z)	M	PRODUCT/ adsHeader/stopTime
result_time_time_position	String (ISO 8601)	The time when the result becomes available. DateTime in ISO 8601 format (CCYY-MM-DDThh:mm[:ss[.cc]]Z)	M	PRODUCT/ adsHeader/stopTime

earth_observation_equipment	Group	Platform/Instrument/Sensor used for the acquisition and the acquisition parameters.	M	-
observed_property	String array	An xlink to the observed property definition	M	Fixed to "#phenom1"
footprint	Group	Observed area on the ground or its projection i.e. the footprint of acquisition.	O	-
earth_observation_result	Group	Earth Observation result metadata composed of the browse, mask and product description.	O	-
earth_observation_metadata	Group	Additional external metadata about the data acquisition.	M	-
result_quality	Group	Result quality information	O [0...n]	-

EO metadata elements

Name of the group: "earth_observation_metadata"

Element name	Format	Description	Obligation / Cardinality	SI element
identifier	String	Identifier for metadata item.	M	FILENAME/ID
creation_date	String (ISO 8601)	metadata field for the creation/modification date of the catalogue entry	O	-
doi	String	Digital Object Identifier identifying the product (see http://www.doi.org)	O	N/A
parent_identifier	String	Collection Identifier	O	-
acquisition_type	Enumeration	Used to distinguish at a high level the appropriateness of the acquisition for "general" use, whether the product is a nominal acquisition, special calibration product or other. Allowed values: <ul style="list-style-type: none"> • NOMINAL • CALIBRATION • OTHER 	M	Fixed to "NOMINAL"
acquisition_sub_type	String	The broad value is however too restrictive, so mission specific type definition should refer to	O	-

		mission/ground segment dedicated codeSpace		
acquisition_sub_type_code_space	String	Acquisition subtype codeSpace	O	-
product_type	String	Describes product type in case that mixed types are available within a single collection, this is ground segment specific definition	O	-
status	Enumeration	Refers to product status. Allowed values: <ul style="list-style-type: none"> • ARCHIVED • ACQUIRED • CANCELLED • FAILED • PLANNED • POTENTIAL • REJECTED • QUALITYDEGRADED 	M	-
status_sub_type	Enumeration	Refines the status of a product when the “status” is set to “ARCHIVED”. Possible values: <ul style="list-style-type: none"> • ON-LINE • OFF-LINE 	O	-
status_detail	String	This field refers to the eop:status value. It should be used to motivate the reason of a failure, cancelation, rejection or degraded quality.	O	-
downlink_information	Group	Acquisition.	O [0..n]	-
archiving_information	Group	Archiving information.	O [0..n]	-
product_quality_degradation	Double	Quality degradation percentage (i.e. uom='%')	O	-
product_quality_degradation_quotation_mode	Enumeration	Indicator to know how the quality degradation percentage has been calculated. Allowed values: <ul style="list-style-type: none"> • AUTOMATIC • MANUAL 	O	N/A

product_quality_status	Enumeration	Indicator that specifies whether the product quality is degraded or not. This optional field shall be provided if the product has passed a quality check. Values: <ul style="list-style-type: none"> • DEGRADED • NOMINAL 	O	-
product_quality_degradation_tag	Enumeration	(Contains further textual information concerning the quality degradation. It shall be provided if eop:productQualityStatus value is DEGRADED. Possible values are mission specific and should refer to mission/ground segment dedicated codeSpace. Example of values could be "RADIOMETRY" or "GEOLOCATION".	O	-
product_quality_report_url	String	URL reference to an external quality report file This element is deprecated. Please use the equivalent productQualityReport element instead.	O	-
histogram	Group	Histograms information.	O [0..n]	
composedOf	String array	Link to an EO product that is part of this EO product (e.g. a phr:DataStrip is composed of one or more phr:Scene)	O	N/A
subsetOf	String array	Link to the "father" EO product (e.g. a phr:Scene is a subset of a phr:DataStrip)	O	-
linkedWith	String array	Specify a link to another EO product (e.g. ERS1 and ERS2 interferometric pair)	O	N/A
processing_information	Group	Processing information	O [0..n]	-
vendor_specific_information	Group	Container for ad-hoc metadata that does not merit a mission specific schema or extension.	O [0..n]	-
product_group_id	String	Holds the identifier of a particular group to which the product belongs to. Group	O	-

		members represent then "granules" or "portions" of end-user products that are eligible for specific aggregations (e.g. all Sentinel-2 granules having the same productGroupId can be assembled together to form a Sentinel-2 end-user product)		
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Downlink information attributes

Name of the group: "downlink_information"

Attribute	Format	Description	Obligation / Cardinality	SI element
downlink_acquisition_station	Variable (String)	Acquisition / receiving station code. Possible values are mission specific and should be retrieved using codespace. The code space is to be documented through the "code_space" attribute.	M	-
downlink_acquisition_date	String (ISO 8601)	Acquisition date time.	O	N/A

Archiving information attributes

Name of the group: "archiving_information"

Attribute	Format	Description	Obligation / Cardinality	SI element
archiving_center	Variable (String)	Archiving center code. Possible values are mission specific and should be retrieved using the optional code_space attribute. The code space is to be documented through the "code_space" attribute.	M	-
archiving_date	String (ISO 8601)	Archiving date time.	M	-

archiving_identifier	String	Local archiving id as created by the mission ground segment that may be required to allow subsequent order processing	O	N/A
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Histogram information attributes

Name of the group: "histogram"

Attribute	Format	Description	Obligation / Cardinality	SI element
band_id	String	Histogram specific : identifier of the spectral band used to compute histogram values	O	-
band	Variable (double)	If mean and max variables are documented, then the band variable should be documented as well (even if it will be empty). This variable should have the attribute "ref" with value http://www.uncertml.org/statistics/statistics-collection This variable should have the attribute "ancillary_variables" with value "mean std_deviation"	O	N/A
min	Variable (Double)	Histogram specific : minimum value	M	-
max	Variable (Double)	Histogram specific : maximum value	M	-
mean	Variable (Double)	Histogram specific : mean value The variable should have the attribute "ref" with value http://www.uncertml.org/statistics/mean Moreover the Conventions attribute should list also the NetCDF-U conventions name: "UW-1.0"	O	-
std_deviation	Variable (Double)	Histogram specific : standard deviation value	O	N/A

		<p>The variable should have the attribute “ref” with value http://www.uncertml.org/statistics/standard-deviation</p> <p>Moreover the Conventions attribute should list also the NetCDF-U conventions name: “UW-1.0”</p>		
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Processing information attributes

Name of the group: “processing_information”

Attribute	Format	Description	Obligation / Cardinality	SI element
processing_center	String	Processing center code. Possible values are mission specific and should be retrieved using codeSpace.	O	-
processing_center_code_space	String	Processing center code space.	O	N/A
processing_date	String (ISO 8601)	Processing date time	O	-
composite_type	String (ISO 8601)	Composite type of product expressed as duration. Allowed values: <ul style="list-style-type: none"> • P1D • P1W • P1M 	O	N/A
method	String	Method used to compute datalayer. (e.g. Kalman filtering, ROSE)	O	N/A
method_version	String	Method version (e.g. 1.0)	O	N/A
processing_mode	Enumeration	Processing mode taken from mission specific code list Examples of values are:	O	N/A

		NRT NOMINAL BACKLOGGED REPROCESSED VALIDATE		
processor_name	String	Processor software name (e.g. FastROSE)	O	-
processor_version	String	Processor software version (e.g. 1.0)	O	-
processing_level	Enumeration	Processing level applied to the product. Allowed values: <ul style="list-style-type: none"> • 1A • 1B • 2 • 3 	O	N/A
native_product_format	String	Native product format	O	N/A
auxiliary_data_set_filename	String array	Name(s) of auxiliary dataset(s) used in the process	O	N/A

Vendor specific information attributes

Name of the group: "vendor_specific_information"

Attribute	Format	Description	Obligation / Cardinality	SI element
local_attribute	String	Container for ad-hoc metadata that does not merit a mission specific schema or extension, the localAttribute describes the name of the attribute	M	N/A
local_value	String	Container for ad-hoc metadata that does not merit a mission specific schema or extension, the localAttribute describes the value of the attribute	M	N/A

EO equipment elements

Name of the group: "earth_observation_equipment"

Attribute	Format	Description	Obligation
platform_information	Group	Platform information.	O
instrument_information	Group	Instrument information.	O
sensor_information	Group	Sensor information.	O
acquisition_information	Group	Acquisition parameter information.	O

Platform information attributes

Name of the group: "platform_information"

Attribute	Format	Description	Obligation / Cardinality	SI element
short_name	String	Platform short name (e.g. PHR)	M	MANIFEST/platform/familyName

serial_identifier	String	Platform serial identifier (e.g. for PHR : 1A)	O	PRODUCT/adsHeader/mis sionId mapped to ASAR / A / B
platform_orbit_type	String	High level characterisation of main mission types (GEO/LEO)	O	-

Instrument information attributes

Name of the group: "instrument_information"

Attribute	Format	Description	Obligation / Cardinality	SI element
short_name	String	Instrument (Sensor) name	M	MANIFEST/platform/instr ument/familyName/@abbr eviation
description	String	Instrument description	O	-
type	String	Instrument type	O	N/A

Sensor information elements

Name of the group: "sensor_information"

Attribute	Format	Description	Obligation / Cardinality	SI element
sensor_type	Enumeration	Sensor type. Valid values: <ul style="list-style-type: none"> • OPTICAL • RADAR • ALTIMETRIC • ATMOSPHERIC 	O	Fixed to "RADAR"

		<ul style="list-style-type: none"> • LIMB 		
sensor_operational_mode	Variable (String)	Sensor mode. Possible values are mission specific and should be retrieved using the optional "code_space" attribute.	O	PRODUCT/adsHeader/mode mapped to EW_SP / IW_SP / SM_SP / WV_SP Codespace fixed to "urn:sen1:sensorMode"
sensor_resolution	Variable (Double)	Sensor resolution. UDUNITS values are suggested for the "units" attribute.	O	Max(rangeResolution, azimuthResolution), where rangeResolution and azimuthResolution are fixed according to the product type and swath type
swath_identifier	Variable (String)	Swath identifier (e.g. Envisat ASAR has 7 distinct swaths (I1,I2,I3...I7) that correspond to precise incidence angles for the sensor). Value list can be retrieved with codeSpace.	O	PRODUCT/adsHeader/swath
wavelength_information	Group	List of discrete wavelengths observed in the product	O [0..n]	-

Wavelength information attributes

Name of the group: "wavelength_information"

Attribute	Format	Description	Obligation / Cardinality	SI element
discrete_wavelengths		List of discrete wavelengths observed in the product (gml:MeasureList)	O	N/A
end_wavelength	Variable (gml:Measure)	End of the observed wavelength range (gml:Measure)	O	-
spectral_range	Enumeration	The observed Spectral Range. Valid values: <ul style="list-style-type: none"> • INFRARED • NEAR-INFRARED 	O	N/A

		<ul style="list-style-type: none"> • UV • VISIBLE • OTHER 		
start_wavelength		Start of the observed wavelength range (gml:Measure)	O	-
wavelength_resolution		Spacing between consecutive wavelengths (gml:Measure)	O	-

Acquisition parameter attributes

Name of the group: "acquisition_information"

Attribute	Format	Description	Obligation / Cardinality	SI element
orbit_number	Variable(Double)	Acquisition orbit number	O	PRODUCT/adsHeader/absoluteOrbitNumber
last_orbit_number	Variable(Double)	Acquisition last orbit number	O	N/A
orbit_direction	Enumeration	Acquisition orbit direction (Ascending or descending)	O	-
wrs_longitude_grid	Variable(String)	Neutral wrsLongitudeGrid to replace track in track/frame, K in K/J, etc. The optional attribute "code_space" is used to point the reference grid	O	-
wrs_latitude_grid	Variable (String)	Neutral wrsLatitudeGrid to replace frame in track/frame, J in K/J, etc. The optional attribute "code_space" is used to point the reference grid	O	-
ascending_node_date	String (ISO 8601)	UTC date and time at ascending node of orbit	O	N/A
ascending_node_longitude	Variable (Double)	Longitude at ascending node of orbit. Should be expressed in degrees. UDUNITS values are suggested for the "units" attribute.	O	N/A
start_time_from_ascending_node	Variable (Long)	Start time of acquisition in milliseconds from Ascending node date	O	N/A

completion_time_from_ascending_node	Variable (Long)	Stop time of acquisition in milliseconds from Ascending node date UDUNITS values are suggested for the “units” attribute.	O	N/A
orbit_duration	Variable (Long)	Actual orbit duration in milliseconds UDUNITS values are suggested for the “units” attribute.	O	N/A
illumination_azimuth_angle	Variable (Double)	Mean illumination/solar azimuth angle given in degrees. UDUNITS values are suggested for the “units” attribute.	O	-
illumination_zenith_angle	Variable (Double)	Mean illumination/solar zenith angle given in degrees. UDUNITS values are suggested for the “units” attribute.	O	-
illumination_elevation_angle	Variable (Double)	Mean illumination/solar elevation angle given in degrees. UDUNITS values are suggested for the “units” attribute.	O	N/A
incidence_angle	Variable (Double)	Acquisition global incidence angle given in degrees UDUNITS values are suggested for the “units” attribute.	O	N/A
across_track_incidence_angle	Variable (Double)	Acquisition across track Incidence angle given in degrees. UDUNITS values are suggested for the “units” attribute.	O	N/A
along_track_incidence_angle	Variable (Double)	Acquisition along track incidence angle given in degrees. UDUNITS values are suggested for the “units” attribute.	O	N/A
instrument_azimuth_angle	Variable (Double)	Mean instrument azimuth angle given in degrees. UDUNITS values are suggested for the “units” attribute.	O	-
instrument_zenith_angle	Variable (Double)	Mean instrument zenith angle given in degrees. UDUNITS values are suggested for the “units” attribute.	O	-
instrument_elevation_angle	Variable (Double)	Mean instrument elevation angle given in degrees. UDUNITS values are suggested for the “units” attribute.	O	N/A
pitch	Variable (Double)	Satellite pitch angle given in degrees UDUNITS values are suggested for the “units” attribute.	O	Fixed to 0 degree

roll	Variable (Double)	Satellite roll angle given in degrees UDUNITS values are suggested for the “units” attribute.	O	Fixed to 0 degree
yaw	Variable (Double)	Satellite yaw angle given in degrees UDUNITS values are suggested for the “units” attribute.	O	Fixed to 0 degree

Footprint attributes

Name of the group: “footprint”

Element name	Format	Description	Obligation / Cardinality	SI element
multi_extent_of	Variable (gml:LinearRing)	Acquisition footprint coordinates, described by a closed polygon (last point=first point), using latitude, longitude pairs. Expected structure is gml:Polygon/gml:exterior/gml:LinearRing/gml:posList. ¹	M	Generated from image data
orientation	Enumeration	Determines the orientation of the coordinate pairs for the exterior boundary of the footprint polygons. Allowed values: <ul style="list-style-type: none"> • CW (clockwise) • CCW (counter-clockwise) • OTHER (unspecified orientation). Note that this property is only to be provided for footprints that do not follow the normal counterclockwise for exterior boundaries convention as defined in	O	Fixed to “CCW”

¹ The Polygon geometry shall be encoded in the WGS:84 geographic coordinates (EPSG:4326).

The coordinate pairs shall be ordered as lat, long following the official axis ordering convention.

		[OGC06-103r4]. If the property is not provided, a CCW orientation for the exterior boundary will be assumed.		
centerOf	Variable(Point)	Acquisition center coordinates	O	N/A

EO result elements

Name of the group: "earth_observation_result"

Element name	Format	Description	Obligation / Cardinality	SI element
browse_information	Group	Browse information.	O [0..n]	
product_information	Group	Product information.	O [0..n]	
mask_information	Group	Mask information.	O [0..n]	-
parameter_information	Group	Parameter information.	O	
coverage	String array	XLink Reference to coverage exploitation metadata (domainSet, RangeType, ...) as offered by a corresponding WCS using a HTTP GET encoded DescribeCoverage Request.	O	N/A

Browse information attributes

Name of the group: "browse_information"

Element name	Format	Description	Obligation / Cardinality	SI element
type	Enumeration	Browse type.	M	Fixed to "QUICKLOOK"

		<p>Allowed values:</p> <ul style="list-style-type: none"> • THUMBNAIL • QUICKLOOK • ALBUM 		
subtype	String	Browse subType. Value is mission specific. Value list can be retrieved with codeSpace (e.g. For MODIS : OPTICAL, THERMAL)	O	-
reference_system_iden- tifier	Variable (String)	<p>Indicates if browse is geo-referenced, and thus can be assumed to be displayed directly on a map (in which case it should point to a code space for the CRS), when not supplied it is assumed that the browse is provided in "raw" satellite frame of reference</p> <p>The code space is to be documented through the "code_space" attribute.</p>	M	-
filename	String	<p>XLink Reference to File or OGC Web Service</p> <ul style="list-style-type: none"> • In case the browse images are offered from FTP or HTTP URLs, the xlink:href attribute is used to encode the full URL to the product and the ows:RequestMessage element is left blank. • In case the browse images are offered through WMS or WCS using HTTP GET with KeyValuePair encoding, the xlink:href attribute is used to encode the full URL including the KVP and the ows:RequestMessage element is left blank. 	M	<p>“http://eos.spaceapplications.com/eoproducts/thumbnails/SENTINEL/” + [ASAR A B] + FILENAME/ID c+ “.png”</p>

		<ul style="list-style-type: none"> In case the browse images are offered through a service supporting HTTP POST or SOAP the xlink:href attribute is used to encode the service endpoint (online resource and the ows:RequestMessage shall contain the XML encoded message (including the SOAP Header in case of SOAP messaging). 		
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Product information attributes

Name of the group: "product_information"

Element name	Format	Description	Obligation / Cardinality	SI element
filename	String	Reference to File or OGC Web Service <ul style="list-style-type: none"> In case the products images are offered from FTP or HTTP URLs, the xlink:href attribute is used to encode the full URL to the product and the ows:RequestMessage element is left blank. In case the products images are offered through WMS or WCS using HTTP GET with KeyValuePair encoding, the xlink:href attribute is used to 	M	-

		<p>encode the full URL including the KVP and the ows:RequestMessage element is left blank.</p> <ul style="list-style-type: none"> In case the products images are offered through a service supporting HTTP POST or SOAP the xlink:href attribute is used to encode the service endpoint (online resource and the ows:RequestMessage shall contain the XML encoded message (including the SOAP Header in case of SOAP messaging). 		
reference_system_identifier	String	Indicates if product is geo-referenced, (in which case should point to a code space for the CRS), when not supplied it is assumed that the browse is provided in "raw" satellite frame of reference. The code space is to be documented through the "code_space" attribute.	O	-
version	String	Product version	O	N/A
size	Long	Product size (bytes) allowing the user to realise how long a download is likely to take	O	-

Mask information attributes

Name of the group: "mask_information"

Element name	Format	Description	Obligation / Cardinality	SI element
type	Enumeration	Mask type.	M	-

		<p>Allowed values:</p> <ul style="list-style-type: none"> • SNOW • CLOUD • QUALITY 		
format	Enumeration	<p>Mask format.</p> <p>Allowed values:</p> <ul style="list-style-type: none"> • RASTER • VECTOR 	M	-
reference_system_identifier	Variable (String)	<p>Indicates if mask is geo-referenced, and thus can be assumed to be displayed directly on a map (in which case should point to a code space for the CRS), when not supplied it is assumed that the mask is provided in "raw" satellite frame of reference</p> <p>The code space is to be documented through the "code_space" attribute.</p>	O	-
filename	String	<p>XLink Reference to File or OGC Web Service</p> <ul style="list-style-type: none"> • In case the masks images are offered from FTP or HTTP URLs, the xlink:href attribute is used to encode the full URL to the product and the ows:RequestMessage element is left blank. • In case the masks images are offered through WMS or WCS using HTTP GET with KeyValuePair encoding, the xlink:href attribute is used to encode the full URL including the KVP and the ows:RequestMessage element is left blank. 	M	-

		<ul style="list-style-type: none"> In case the masks images are offered through a service supporting HTTP POST or SOAP the xlink:href attribute is used to encode the service endpoint (online resource and the ows:RequestMessage shall contain the XML encoded message (including the SOAP Header in case of SOAP messaging). 		
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Parameter information attributes

Name of the group: "parameter_information"

Element name	Format	Description	Obligation / Cardinality	SI element
units	String	Units of measure for the observed phenomenon. Note that for a multi-faceted Constrained or Composite Phenomenon multiple unitOfMeasure attributes must be present and the unitOfMeasure element order must correspond to the order of the phenomenon descriptions. UDUNITS values are suggested for the "units" attribute.	0..n	-
phenomenon	Variable (String)	A SWE 1.0 Phenomenon. Could be a single SWE Phenomenon (such as Sea Surface Height) or a SWE ConstrainedPhenomenon, such as a list of particular radiance bands, or a	0	-

		SWECompositePhenomeon which groups several discrete phenomena		
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Result quality information attributes

Name of the group: "result_quality". This set of empty attributes can be specified by extensions to contain result quality information.

Radar EO Products attributes

Radar EO acquisition parameter attributes

Name of the group: "acquisition_information"

Element name	Format	Description	Obligation / Cardinality	SI Element
polarisation_mode	Enumeration	Single S, dual D, twin T, quad Q, UNDEFINED Allowed values: <ul style="list-style-type: none"> • D • Q • S • T • UNDEFINED 	O	PRODUCT/adsHeader/polarization mapped to S / D
polarisation_channels	Enumeration	Polarization channel transmit/receive configuration: horizontal, vertical. Allowed values: <ul style="list-style-type: none"> • HH • HV • VH • VV • HH, VV • HH, VH • HH, HV • VH, VV • VH, HV • VV, HV • VV, VH • HV, VH • UNDEFINED 	O	PRODUCT/adsHeader/polarization
antenna_look_direction	Enumeration	Allowed values: <ul style="list-style-type: none"> • LEFT • RIGHT 	O	

minimum_incidence_angle	Double	minimum incidence angle	O	
maximum_incidence_angle	Double	maximum incidence angle	O	
incidence_angle_variation	String	Incidence angle variation	O	
doppler_frequency	String	Doppler Frequency of acquisition	O	

Radar Earth acquisition parameter attribute set extends the Earth Observation acquisition parameter attribute set by adding the following attributes:

References

- NetCDF Earth Observation (EO) Metadata Conventions 1.2.0
- Sentinel-1 Products Specification Document