



COPERNICUS SPACE COMPONENT SENTINEL OPTICAL IMAGING  
MISSION PERFORMANCE CLUSTER SERVICE

Sentinel-2 PSD contribution for aquatic reflectances

# OPT-MPC



Ref.: OMPC.TPZG-BC.PSD-contribution

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Changes Log

Version	Date	Changes
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List of Changes

Version	Section	Answers to RID	Changes

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# 1 Introduction

## 1.1 Purpose and scope

This contribution to the Sentinel-2 Products Specification Document contains the additions for aquatic reflectance data to be provided as optional part of the MSI Level 2 product.

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- Optional NetCDF file in 60m folder
- Optional additional statistics in QI info
- Forward reference to section

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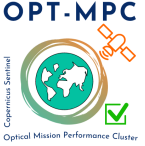
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**Figure 1-1: Suggested points for PSD extension by the content provided in this document**

## 1.1 References

The following documents are referenced in this document.

Document ID	Description	Version
MSI L2W IODD 2023	Sen2Cor and Sen2Water Input Output Data Definition, OMPC.TPGZ-BC.IODD-MSI-L2, Optical Mission Performance Centre, ESA, October 2023	1.0


	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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Document ID	Description	Version
MSI L2W RD 2023	Sen2Water Requirements Document, OMPC.BC.RD-MSI-L2, Optical Mission Performance Centre, ESA, October 2023	1.0
MSI L2 ATBD 2023	Sen2Cor and Sen2Water Algorithm Theoretical Basis Document, OMPC.TPGZ-BC.ATBD-MSI-L2, Optical Mission Performance Centre, ESA, October 2023	1.0

## 1.2 Acronyms

The following acronyms are used within this document:

Acronym	Description
ATBD	Algorithm Theoretical Basis Document
CDL	Common Data Language (of NetCDF)
CF	Climate and Forecast (convention)
CRS	Coordinate Reference System
IODD	Input Output Data Definition
L1C	Level 1C
L2A	Level 2A
L2W	Level 2 Water
MSI	MultiSpectral Instrument
PDI	Product Data Item
PSD	Product Specification Document
RD	Requirements Document
Rw	Water-leaving reflectances
SAFE	Standard Archive Format for Europe
SCL	Scene Classification (of Sen2Cor)
SDD	Software Design Document
WKT	Well-known text format (of geo-objects)


	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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## 1.3 Document overview

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After this formal introduction

- Section 2 contains additions for section 4.10 “Level-2A user product specification” of the PSD
- Section 3 contains additions for section 3.13 “Level-2A tile PDI definition” of the PSD
- Section 4 contains a new subsection 4.10.10 “L2W aquatic reflectances” to be added to section 4.10 of the PSD
- Section 5 contains a new Annex I “L2W aquatic reflectances file structure” for the PSD.

 <p>OPT-MPC</p> <p>Optical Mission Performance Cluster</p>	<p>Optical MPC</p> <p>Sentinel-2 PSD contribution for aquatic reflectances</p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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## 2 Aquatic reflectances in the Level-2A user product

This section contains additions for section 4.10 “Level-2A user product specification” of the PSD.

### 2.1 Logical structure

If aquatic reflectances are part of the L2A then the logical structure shall mainly preserve the current L2A Product Structure [S2-PSD] and shall comply with an updated L2A SAFE structure and Schema. The combination is linked to a dedicated Processing Baseline (e.g. PB 06.00).

The output of Sen2Water described in section 3, i.e. the L2W NetCDF4 file, shall be embedded within the L2A Product granule in the following subfolder:

IMG\_DATA --> R60m (see section 2.2)

### 2.2 Physical structure

The new Sentinel-2 MSI L2A shall be provided in SAFE format with the physical layout of the directory structure as follows (shown by an example, EUP format) with additional file located in IMG\_DATA --> R60m folder:

```

S2A_MSIL2A_20230610T110621_N0509_R137_T31UCU_20230610T165306.SAFE
├── DATASTRIP
│   ├── DS_2APS_20230610T165306_S20230610T110622
│   │   ├── MTD_DS.xml
│   │   ├── QI_DATA
│   │   │   ├── FORMAT_CORRECTNESS.xml
│   │   │   ├── GENERAL_QUALITY.xml
│   │   │   ├── GEOMETRIC_QUALITY.xml
│   │   │   ├── RADIOMETRIC_QUALITY.xml
│   │   │   └── SENSOR_QUALITY.xml
│   └── GRANULE
│       ├── L2A_T31UCU_A041604_20230610T110622
│       │   ├── AUX_DATA
│       │   │   ├── AUX_CAMSFO
│       │   │   └── AUX_ECMWFT
│       │   ├── IMG_DATA
│       │   │   ├── R10m
│       │   │   │   ├── T31UCU_20230610T110621_AOT_10m.jp2
│       │   │   │   ├── T31UCU_20230610T110621_B02_10m.jp2
│       │   │   │   ├── T31UCU_20230610T110621_B03_10m.jp2
│       │   │   │   ├── T31UCU_20230610T110621_B04_10m.jp2
│       │   │   │   ├── T31UCU_20230610T110621_B08_10m.jp2
│       │   │   │   ├── T31UCU_20230610T110621_TCI_10m.jp2
│       │   │   │   └── T31UCU_20230610T110621_WVP_10m.jp2
│       │   │   └── R20m
│       │   │       ├── T31UCU_20230610T110621_AOT_20m.jp2
│       │   │       ├── T31UCU_20230610T110621_B01_20m.jp2
│       │   │       ├── T31UCU_20230610T110621_B02_20m.jp2
│       │   │       ├── T31UCU_20230610T110621_B03_20m.jp2
│       │   │       ├── T31UCU_20230610T110621_B04_20m.jp2
│       │   │       └── T31UCU_20230610T110621_B05_20m.jp2

```

- T31UCU\_20230610T110621\_B06\_20m.jp2
- T31UCU\_20230610T110621\_B07\_20m.jp2
- T31UCU\_20230610T110621\_B11\_20m.jp2
- T31UCU\_20230610T110621\_B12\_20m.jp2
- T31UCU\_20230610T110621\_B8A\_20m.jp2
- T31UCU\_20230610T110621\_SCL\_20m.jp2
- T31UCU\_20230610T110621\_TCI\_20m.jp2
- T31UCU\_20230610T110621\_WVP\_20m.jp2


## R60m

- T31UCU\_20230610T110621\_AOT\_60m.jp2
- T31UCU\_20230610T110621\_B01\_60m.jp2
- T31UCU\_20230610T110621\_B02\_60m.jp2
- T31UCU\_20230610T110621\_B03\_60m.jp2
- T31UCU\_20230610T110621\_B04\_60m.jp2
- T31UCU\_20230610T110621\_B05\_60m.jp2
- T31UCU\_20230610T110621\_B06\_60m.jp2
- T31UCU\_20230610T110621\_B07\_60m.jp2
- T31UCU\_20230610T110621\_B09\_60m.jp2
- T31UCU\_20230610T110621\_B11\_60m.jp2
- T31UCU\_20230610T110621\_B12\_60m.jp2
- T31UCU\_20230610T110621\_B8A\_60m.jp2
- T31UCU\_20230610T110621\_SCL\_60m.jp2
- T31UCU\_20230610T110621\_TCI\_60m.jp2
- T31UCU\_20230610T110621\_WVP\_60m.jp2
- T31UCU\_20230610T110621\_AQU\_60m.nc

## MTD\_TL.xml

## QI\_DATA

- FORMAT\_CORRECTNESS.xml
- GENERAL\_QUALITY.xml
- GEOMETRIC\_QUALITY.xml
- L2A\_QUALITY.xml
- MSK\_CLASSI\_B00.jp2
- MSK\_CLDPRB\_20m.jp2
- MSK\_CLDPRB\_60m.jp2
- MSK\_DETFOO\_B01.jp2
- MSK\_DETFOO\_B02.jp2
- MSK\_DETFOO\_B03.jp2
- MSK\_DETFOO\_B04.jp2
- MSK\_DETFOO\_B05.jp2
- MSK\_DETFOO\_B06.jp2
- MSK\_DETFOO\_B07.jp2
- MSK\_DETFOO\_B08.jp2
- MSK\_DETFOO\_B09.jp2
- MSK\_DETFOO\_B10.jp2
- MSK\_DETFOO\_B11.jp2
- MSK\_DETFOO\_B12.jp2
- MSK\_DETFOO\_B8A.jp2
- MSK\_QUALIT\_B01.jp2
- MSK\_QUALIT\_B02.jp2
- MSK\_QUALIT\_B03.jp2
- MSK\_QUALIT\_B04.jp2
- MSK\_QUALIT\_B05.jp2
- MSK\_QUALIT\_B06.jp2
- MSK\_QUALIT\_B07.jp2
- MSK\_QUALIT\_B08.jp2
- MSK\_QUALIT\_B09.jp2
- MSK\_QUALIT\_B10.jp2
- MSK\_QUALIT\_B11.jp2
- MSK\_QUALIT\_B12.jp2
- MSK\_QUALIT\_B8A.jp2

	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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	MSK_SNWPRB_20m.jp2
	MSK_SNWPRB_60m.jp2
	SENSOR_QUALITY.xml
	T31UCU_20230610T110621_PVI.jp2
HTML	
	banner_1.png
	banner_2.png
	banner_3.png
	star_bg.jpg
	UserProduct_index.html
	UserProduct_index.xsl
	INSPIRE.xml
	manifest.safe
	MTD_MSIL2A.xml
	rep_info
	S2_PDI_Level-2A_Datastrip_Metadata.xsd
	S2_PDI_Level-2A_Tile_Metadata.xsd
	S2_User_Product_Level-2A_Metadata.xsd
	S2A_MSIL2A_20230610T110621_N0509_R137_T31UCU_20230610T165306-ql.jpg


## 2.3 Metadata

In term of Metadata content, the following information is embedded within the MTD\_TL.xml:

- Flag for correct execution of Sen2Water

In case Sen2Water is correctly executed the following information may be added:

- Cloud cover over Water percentage  
In current L2A, "CLOUDY\_PIXEL\_OVER\_LAND\_PERCENTAGE" is present  
In new L2A, "CLOUDY\_PIXEL\_OVER\_WATER\_PERCENTAGE" can be added
- Land / Water ratio or Land / Ocean / Inland water percentages
- C2RCC, ACOLITE, POLYMER, BLENDING flags
- Additional metadata that is provided in the global metadata of the NetCDF4 file, like the statistics and the auxiliary data used during sen2water processing.

	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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### 3 Aquatic reflectances in the Level-2A tile PDI definition

This section contains additions for section 3.13 “Level-2A tile PDI definition” of the PSD.

Contributions of the L2W data product to the L2A data product are:

- The NetCDF4 file as a whole, to be added as one element to the SAFE structure of the L2A
- Metadata that is provided in the global metadata above, in particular the statistics, but also the auxiliary data that has been used

The structural embedding of L2W into the L2A in PDI format follows the same approach as described for the user product in section 2.

	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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## 4 L2W Aquatic reflectances

This section contains a new subsection 4.10.10 “L2W aquatic reflectances” to be added to section 4.10 of the PSD.

### 4.1 Variables of L2W

The L2W contribution to the Level-2 contains aquatic reflectances of the MSI bands at 60m resolution. It is an optional part of the Sentinel-2 Level-2A product. In addition to water-leaving reflectances the L2W contains three flag variables that characterize the reflectances: a simple-to-use flag-values mask, a set of masks that characterize the atmospheric correction, and a set of masks for a detailed pixel identification.

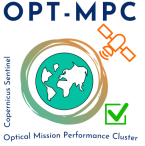
**Table 4-1: Variables of the L2W product**

Band	Description	Resolution
Rw443 Rw490 Rw560 Rw665 Rw705 Rw740 Rw783 Rw842 Rw865 Rw945 Rw1375 Rw1610 Rw2190	water-leaving reflectance, represented as scaled uint16, 65535 as fill value	60m, grid of 1830x1830 pixels
pixel_class	Flag values for surface types, cloud etc., encoded as uint8, with CF flag values attributes	60m, grid of 1830x1830 pixels
sen2water_flags	Combination of flags, represented as uint8, with CF flag masks attributes	60m, grid of 1830x1830 pixels
pixel_classif_flags	Combination of flags, represented as uint8, with CF flag masks attributes	60m, grid of 1830x1830 pixels

### 4.2 Flag codings of L2W

pixel\_class is a flag\_value coding of simple alternative classes, defined in Table 4-2.



	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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**Table 4-2: pixel\_class mask values**


Value	Flag name	Condition
0	NO_DATA	no input data or invalid
1	CLEAR_LAND	detected as clear land
2	CLEAR_OCEAN_WATER	Detected as clear water and static ocean or static coastal area
3	CLEAR_INLAND_WATER	Detected as clear water and static inland water or static land or static coastal close to inland water
4	SNOW_ICE	detected as snow or ice
5	CIRRUS	detected as cirrus
6	CLOUD_OR_MOUNTAIN_SHADOW	cloud shadow or mountain shadow
7	AMBIGUOUS_CLOUD	ambiguous cloud
8	CLOUD	cloud or cloud buffer
9	OUT_OF_BOUNDS_SATURATED	Detected as water, but some contributing AC flag raised

sen2water\_mask contains flags of atmospheric correction quality, including information which algorithms have been used for a pixel. sen2water\_mask contains quality masks listed in Table 4-3.

**Table 4-3: L2W sen2water expert quality flags**

Flag name	Condition (based on algorithm outputs)
c2rcc_oor	C2RCC has contributed to the pixel but was flagged out-of-range
acolate_negatives	ACOLITE has contributed to the pixel but was flagged negative
polymer_invalid	POLYMER has contributed to the pixel but was flagged LAND or CLOUD_BASE or L1_INVALID or NEGATIVE_BB or OUT_OF_BOUNDS or EXCEPTION or THICK_AEROSOL or HIGH_AIR_MASS or EXTERNAL_MASK
c2rcc_algo	If ocean/inland water blending has used ocean contribution and ocean contribution has used Rwc (ratio > 10)
acolate_algo	If ocean/inland water blending has used ocean contribution and ocean contribution has used Rwa (ratio < 20)
polymer_algo	If ocean/inland water blending has used inland water contribution


pixel\_classif\_flags is a flag combination of values of Table 4-4.

	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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**Table 4-4: Idepix flag masks**

Bit	Value	Flag name	Description
1	1	IDEPIX_INVALID	Invalid pixels
2	2	IDEPIX_CLOUD	Pixels either cloud_sure or cloud_ambiguous
3	4	IDEPIX_CLOUD_AMBIGUOUS	Semi transparent clouds, or clouds where the detection level is uncertain
4	8	IDEPIX_CLOUD_SURE	Fully opaque clouds with full confidence of their detection
5	16	IDEPIX_CLOUD_BUFFER	A buffer of n pixels around a cloud. n is a user parameter. Applied to pixels masked as 'cloud'
6	32	IDEPIX_CLOUD_SHADOW	Pixel is affected by a cloud shadow (combination of shifted cloud mask in cloud gaps and dark clusters coinciding with a corrected shifted cloud mask)
7	64	IDEPIX_SNOW_ICE	Clear snow/ice pixels
8	128	IDEPIX_BRIGHT	Bright pixels
9	256	IDEPIX_WHITE	White pixels
10	512	IDEPIX_COASTLINE	Pixels at a coastline (not defined for Sentinel-2)
11	1024	IDEPIX_LAND	Land pixels identified by the used land/water mask (default SRTM)
12	2048	IDEPIX_CIRRUS_SURE	Cirrus clouds with full confidence of their detection
13	4096	IDEPIX_CIRRUS_AMBIGUOUS	Cirrus clouds, or clouds where the detection level is uncertain
14	8192	IDEPIX_CLEAR_LAND	Clear land pixels
15	16384	IDEPIX_CLEAR_WATER	Clear water pixels
16	32768	IDEPIX_WATER	Water pixels identified by the used land/water mask (default SRTM)
17	65536	IDEPIX_BRIGHTWHITE	'Bright white' pixels
18	131072	IDEPIX_VEG_RISK	Pixels with vegetation risk
19	262144	IDEPIX_MOUNTAIN_SHADOW	Pixel is affected by mountain shadow
20	524288	IDEPIX_POTENTIAL_SHADOW	Potentially a cloud shadow pixel
21	1048576	IDEPIX_CLUSTERED_CLOUD_SHADOW	Cloud shadow identified by clustering algorithm

The L2W is provided on the same grid as the other 60m bands of the L2A product. It is specified by a variable “crs” with the WKT representation of the projection and an image transformation. In addition,

	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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two 1-D variables y and x are provided with the metric centre coordinates of the pixels of the respective rows and columns in the UTM zone.

### 4.3 Statistics of the L2W

Quality statistics is computed for the following counts based on zone and pixel\_classif\_flags. Cloud is used with the meaning “affected by cloud (or mountain shadow)”.

Statistics count	Computation conditions
clear ocean count	Not cloud, not ice, and water in ocean or coastal area
clear inland water count	Not cloud, not ice, and water in inland or water in coastal area near lake
clear land count	Not cloud, not ice, not water
snow/ice ocean count	Detected as snow/ice in ocean area
snow/ice inland water count	Detected as snow/ice in inland water area
snow/ice land count	Detected as snow/ice over land
cloud ocean count	Detected as cloud over ocean
cloud inland water count	Detected as cloud over inland water
cloud land count	Detected as cloud over land
valid ocean count	sum of the above
valid inland water count	sum of the above
valid land count	sum of the above
valid count	sum of the above

These statistical values are added as attribute “statistics” to the global attributes section of the L2W.

For the other global attributes see section 5.


### 4.4 L2W file naming convention

The new L2A naming convention shall follow the convention of the actual L2A Product [S2-PSD]. The ‘AQU’ is proposed as specific TAG for the aquatic data and .nc as file extension for L2W NetCDF4 file:

<Tile>\_<Datatake\_Sensing\_Time>\_<Band\_Index>\_<Resolution>.nc

where

Band\_Index = ‘AQU’

	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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Examples of a S2 L2A Aquatic Reflectance filename:

T31UCU\_20230610T110621\_AQU\_60m.nc

If the L2W is provided as stand-alone data product and not as part of a SAFE structure then the naming of the L2W follows the pattern

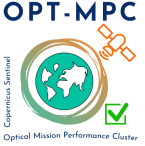
MMM\_MSIL2W\_YYYYMMDDTHHMMSS\_Nxxyy\_ROOO\_Txxxxx\_<Product Discriminator>

where:

- MMM: is the mission ID (S2A/S2B)
- YYYYMMDDTHHMMSS: is the Datatake Sensing Time
- xxyy: identifies the current processing baseline of the L1C input
- OOO: is the relative orbit number
- Txxxxx: is the tile ID
- <Product Discriminator>: this field guarantees the uniqueness of the Single Tile product name; its value is the L2W product CREATION DATE in the format yyymmddThhmmss. In the PDGS configuration the output file name can be renamed to align it to the creation date of the product.

Example:

S2A\_MSIL2W\_20230601T104021\_N0509\_R008\_T31UFU\_20230601T191959

	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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## 5 L2W aquatic reflectances file structure

This section contains a new Annex I “L2W aquatic reflectances file structure” for the PSD.

Each L2W data item is a single NetCDF4 file. The structure of the L2W data product is defined in NetCDF Common Data Language (CDL) format with dimensions, variables, variable attributes, and product level “global” attributes.

The dimensions correspond to the extent of the L1C granule input in 60m resolution. It is 1830 x 1830 pixels.

```
netcdf \S2A_MSIL2W_20230601T104021_N0509_R008_T31UFU_20230601T191959 {
dimensions:
    time = 1 ;
    row = 1830 ;
    column = 1830 ;
```

The water leaving reflectances Rw are named according to their wavelengths, Rw443 to Rw2190.


There currently is no standard name in the CF standard name table for water-leaving reflectances. If we manage to propose a definition to CF we will add it to the variable attributes.

```
variables:
    uint16 Rw443(time, row, column) ;
        Rw443:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw443:units = "1" ;
        Rw443:wavelength = 443.f ;
        Rw443:_FillValue = 0 ;
        Rw443:scale_factor = 0.0001 ;
        Rw443:add_offset = -0.1 ;
    uint16 Rw490(time, row, column) ;
        Rw490:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw490:units = "1" ;
        Rw490:wavelength = 490.f ;
        Rw490:_FillValue = 0 ;
        Rw490:scale_factor = 0.0001 ;
        Rw490:add_offset = -0.1 ;
    uint16 Rw560(time, row, column) ;
        Rw560:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw560:units = "1" ;
        Rw560:wavelength = 560.f ;
        Rw560:_FillValue = 0 ;
        Rw560:scale_factor = 0.0001 ;
        Rw560:add_offset = -0.1 ;
    uint16 Rw665(time, row, column) ;
        Rw665:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw665:units = "1" ;
        Rw665:wavelength = 665.f ;
        Rw665:_FillValue = 0 ;
        Rw665:scale_factor = 0.0001 ;
        Rw665:add_offset = -0.1 ;
    uint16 Rw705(time, row, column) ;
        Rw705:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw705:units = "1" ;
        Rw705:wavelength = 705.f ;
        Rw705:_FillValue = 0 ;
```

```

        Rw705:scale_factor = 0.0001 ;
        Rw705:add_offset = -0.1 ;
uint16 Rw740(time, row, column) ;
        Rw740:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw740:units = "1" ;
        Rw740:wavelength = 740.f ;
        Rw740:_FillValue = 0 ;
        Rw740:scale_factor = 0.0001 ;
        Rw740:add_offset = -0.1 ;
uint16 Rw783(time, row, column) ;
        Rw783:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw783:units = "1" ;
        Rw783:wavelength = 783.f ;
        Rw783:_FillValue = 0 ;
        Rw783:scale_factor = 0.0001 ;
        Rw783:add_offset = -0.1 ;
uint16 Rw842(time, row, column) ;
        Rw842:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw842:units = "1" ;
        Rw842:wavelength = 842.f ;
        Rw842:_FillValue = 0 ;
        Rw842:scale_factor = 0.0001 ;
        Rw783:add_offset = -0.1 ;
uint16 Rw865(time, row, column) ;
        Rw865:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw865:units = "1" ;
        Rw865:wavelength = 865.f ;
        Rw865:_FillValue = 0 ;
        Rw865:scale_factor = 0.0001 ;
        Rw865:add_offset = -0.1 ;
uint16 Rw945(time, row, column) ;
        Rw945:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw945:units = "1" ;
        Rw945:wavelength = 945.f ;
        Rw945:_FillValue = 0 ;
        Rw945:scale_factor = 0.0001 ;
        Rw945:add_offset = -0.1 ;
uint16 Rw1375(time, row, column) ;
        Rw1375:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw1375:units = "1" ;
        Rw1375:wavelength = 1375.f ;
        Rw1375:_FillValue = 0 ;
        Rw1375:scale_factor = 0.0001 ;
        Rw1375:add_offset = -0.1 ;
uint16 Rw1610(time, row, column) ;
        Rw1610:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw1610:units = "1" ;
        Rw1610:wavelength = 1610.f ;
        Rw1610:_FillValue = 0 ;
        Rw1610:scale_factor = 0.0001 ;
        Rw1610:add_offset = -0.1 ;
uint16 Rw2190(time, row, column) ;
        Rw2190:long_name = "Atmospherically corrected angular dependent water leaving reflectance" ;
        Rw2190:units = "1" ;
        Rw2190:wavelength = 2190.f ;
        Rw2190:_FillValue = 0 ;
        Rw2190:scale_factor = 0.0001 ;
        Rw2190:add_offset = -0.1 ;

```

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The pixel class is represented by a set of alternative values, similar to SCL of Sen2Cor, but with a focus to discriminate water from non-water.

The final set of values will be defined in the next phase. It will be based on an analysis of `pixel_classif_flags`, `c2rcc_flags`, `acolite_flags`, `polymer_bitmask` and their merging.

```

byte pixel_class(time, row, column) ;
    pixel_class:long_name = "Pixel classification and algorithm flags" ;
    pixel_class:flag_meanings = "NO_DATA CLEAR_LAND CLEAR_OCEAN_WATER
CLEAR_INLAND_WATER SNOW_ICE CIRRUS_CLOUD_OR_MOUNTAIN_SHADOW AMBIGUOUS_CLOUD CLOUD
OUT_OF_BOUNDS SATURATED" ;
    pixel_class:flag_values = "0,1,2,3,4,5,6,7,8,9" ;
    pixel_class:_FillValue = 0

uint sen2water_flags(time, row, column) ;
    string sen2water_flags:long_name = "quality flags"
;
    string sen2water_flags:flag_meanings = "c2rcc_oor acolite_negatives
polymer_invalid with_c2rcc with_acolite with_polymer" ;
    sen2water_flags:flag_masks = 1U, 2U, 4U, 8U, 16U, 32U ;

short pixel_classif_flags(time, row, column) ;
    pixel_classif_flags:flag_meanings = "IDEPIX_INVALID IDEPIX_CLOUD
IDEPIX_CLOUD_AMBIGUOUS IDEPIX_CLOUD_SURE IDEPIX_CLOUD_BUFFER IDEPIX_CLOUD_SHADOW IDEPIX_SNOW_ICE
IDEPIX_BRIGHT IDEPIX_WHITE IDEPIX_COASTLINE IDEPIX_LAND IDEPIX_MOUNTAIN_SHADOW" ;
    pixel_classif_flags:flag_masks = 1s, 2s, 4s, 8s, 16s, 32s, 64s, 128s,
256s, 512s, 1024s, 2048s ;
    pixel_classif_flags:flag_descriptions = "Invalid pixels\tPixels which
are either cloud_sure or cloud_ambiguous\tSemi transparent clouds, or clouds where the
detection level is uncertain\tFully opaque clouds with full confidence of their
detection\tA buffer of n pixels around a cloud. n is a user supplied parameter.
Applied to pixels masked as \'cloud\'\tPixel is affected by a cloud shadow\tClear
snow/ice pixels\tBright pixels\tWhite pixels\tPixels at a coastline\tLand
pixels\tPixel is affected by a mountain/hill shadow" ;

```

The coordinates are a single time value and the CRS to determine geographic coordinates of each pixel.

```

double time(time) ;
    time:standard_name = "time" ;
    time:axis = "T" ;
    time:calendar = "Gregorian" ;
    time:units = "seconds since 2000-01-01 00:00:00" ;

byte crs ;
    crs:crs_wkt = "... " ;
    crs:i2m = "... " ;

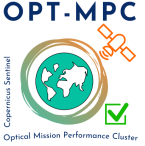
```

The product level attributes provide metadata on identification, creation, temporal coverage, tracability, and quality statistics.

```

// global attributes:
    :id = "S2A_MSIL2W_20230601T104021_N0509_R008_T31UFU_20230601T191959" ;
    :date_created = "20230602T052612Z" ;
    :tracking_id = "cccf93c6-b9a4-4869-bbec-d58195a2e2e2" ;
    :title = "Sentinel-2 MSI water reflectances" ;

```

	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
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```

:institution = "Brockmann Consult GmbH, ACRI, Telespazio, RBINS,
HYGEOS for ESA" ;
:source = "Sentinel-2 MSI L1C" ;
:processor = "Sen2Water 1.0" ;
:product_version = "01.00" ;
:history = "SNAP-9 S2Resampling; Idepix 9.0; Acolite 20221114; C2RCC
9.0; Polymer 4.17beta; HROC L2W 20201223" ;
:input =
"S2A_MSIL1C_20230601T104021_N0509_R008_T31UFU_20230601T191959" ;
:auxiliary = "Copernicus Global 90m DEM; ..." ;
:parameters = "resolution=60; ..." ;
:statistics = "clear_land=...; clear_ocean=...; clear_inland_water=...;
cloud_over_inland_water=...; snow_ice_...=..." ;
:references = "https://step.esa.int/main/snap-supported-
plugins/sen2cor/" ;
:license = "License to Use Copernicus Products" ;
:summary = "The Sen2Water product has been processed from Sentinel-2
MSI L1C by pixel identification, atmospheric correction with different processors, and
selection or blending for ocean and inland water pixels." ;
:keywords = "reflectance, surface water, ocean optics, Copernicus" ;
:keywords_vocabulary = "NASA Global Change Master Directory (GCMD)
Science keywords" ;
:Conventions = "CF-1.10" ;
:standard_name_vocabulary = "NetCDF Climate and Forecast (CF) Metadata
Convention" ;
:contact = "https://step.esa.int/main/snap-supported-plugins/sen2cor/"
;

:project = "OPT-MPC Sen2Water" ;
:cmd_data_type = "Grid" ;
:platform = "Sentinel-2" ;
:sensor = "MSI" ;
:spatial_resolution = "60m" ;
:time_coverage_start = "20230601T104021Z" ;
:time_coverage_stop = "20230601T104021Z" ;
:start_date = "01-JUN-2023 10:40:21.000000" ;
:stop_date = "01-JUN-2023 10:40:21.000000" ;
:auto_grouping = "Rw*" ;
}

```


The complete list of statistics counts that are added as global attribute "statistics" above is:

```

clear_ocean_count
clear_inland_water_count
clear_land_count
snow_ice_ocean_count
snow_ice_inland_water_count
snow_ice_land_count
cloud_ocean_count
cloud_inland_water_count
cloud_land_count
valid_ocean_count
valid_inland_water_count
valid_land_count
valid_count

```



	<p style="text-align: center;"><b>Optical MPC</b></p> <p style="text-align: center;"><b>Sentinel-2 PSD contribution for aquatic reflectances</b></p>	<p>Ref.: OMPC.TPZG-BC.PSD-contribution</p> <p>Issue: 1.0</p> <p>Date: 11/01/2024</p>
---	--	--

All\_variables of the L2W data product that have row and column dimensions shall be chunked in 610 x 610 pixel blocks. Example for `Rw443`:

```

Rw443:_Storage = "chunked" ;
Rw443:_Shuffle = "true" ;
Rw443:_ChunkSizes = 1, 610, 610 ;
Rw443:_DeflateLevel = 5 ;

```