EUMETSAT - Copernicus Sentinel-3 SLSTR L2 NRT AOD Auxiliary Data Format Specification

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Change Record

Version	Date	DCR* No. if applicable	Description of Changes
V1.0			Initial

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1 INTRODUCTION

1.1 Scope

This document describes the format of the Auxiliary Data Files (ADF) associated with the production of the Copernicus Sentinel-3 Near Real Time (NRT) Level 2 (L2) Aerosol Optical Depth (AOD) product generated from the Copernicus Sentinel-3 (S3) Sea and Land Surface Temperature Radiometer (SLSTR).

It is applicable to the following release: Instrument Processing Facility (IPF) version 2.0, EUMETSAT Processing Baseline (PB) 2.70, Baseline Collection (BC) 1. Further information about this release status and associated quality and known limitations are available the Copernicus Sentinel-3 Product notice SLSTR Level-2 NRT AOD document (see RD-4).

1.2 Applicable Documents

	Document Title	**Reference**
AD-1	Sentinel 3 PDGS File Naming Convention	EUM/LEO-SEN3/SPE/10/0070 GMES-S3GS-EOPG-TN-09-0009, Issue 1.3, 07/11/2012
AD-2	Copernicus Sentinel-3 SLSTR L2 NRT AOD Product Data Format Specification	EUM/SEN3/DOC/20/1180730
AD-3	Metadata Specification, Excel document	S3MPC.ACR.FRP.004 - i1r0 - SLSTR L2 Metadata Format Specification
AD-4	Sentinel 3 Global Auxiliary Data Format Specification	S3IPF PDS 007 - i2r4 - Auxiliary Data Format Specification
AD-5	Product Data Format Specification - Product Structures	S3IPF.PDS.002, Issue 1.6, 10/02/2015

1.3 Reference Documents

	Document Title	Reference
RD-1	Product Data Format Specification - Level 0	S3IPF PDS 001 - Product Data Format Specification - Level 0
RD-2	Product Data Format Specification – SLSTR Level 1 and 2	S3IPF PDS 005 - Product Data Format Specification - SLSTR
RD-3	Copernicus Sentinel-3 Near real Time Aerosol Optical Depth Retrieval from SLSTR – S3 SLSTR L2 AOD ATBD	Under editing
RD-4	Copernicus Sentinel-3 Product notice SLSTR Level-2 NRT AOD	EUM/SEN3/DOC/20/1188082
RD-5	Earth Observation Mission CFI Software EO_DATA_HANDLING Software User Manual	EO-MA-DMS-GS-0007
RD-6	EUMETSAT - S3AB – L2 NRT AOD - IPF Processing Baseline Document	EUM/SEN3/DOC/20/1180964, v1.0, 16/06/2020

1.4 Terminology

AD Applicable Document

ADF Auxiliary Data File

AOD Aerosol Optical Depth

ATBD Algorithm Theoretical Basis Document

CFI Customer Furnished Items

EUMETSAT European Organisation for the Exploitation of Meteorological Satellites

FRP Fire Radiative Power

IPF Instrument Processing Facility

L1 Level 1

L2 Level 2

NRT Near Real Time

PDGS Payload Data Ground Segment

RSP Remote Sensing and Products division

RD Reference Document

SLSTR Sea and Land Surface Temperature Radiometer

SSA	Single Scattering Albedo
SWIR	Short Wave-InfraRed
TIR	Thermal InfraRed

1.5 Document Structure

This document is structured as follow:

- S3 PDGS auxiliary data structure in Section 2;
- S3 PDGS auxiliary data files in Section 3;
- SLSTR L2 NRT AOD ADF in Section 4.

2 S3 PDGS AUXILIARY DATA STRUCTURE

The format of auxiliary data files is based on the Payload Data Ground Segment (PDGS) Product guidelines. Each ADF includes a manifest and a measurement data file. The manifest follows the standard manifest structure of the S3 product as described in [AD-5].

External Auxiliary data are converted into adequate S3 Format upon entry into the PDGS, with the addition of a manifest file that includes a Data Object Section pointing to the original auxiliary file. The original file is not modified.

3 S3 PDGS AUXILIARY DATA FILES

ADFs are used by the S3 IPF to process, calibrate or improve the payload science data. They can be either static or dynamic, originate from multiple sources (*i.e.* internal or external to the S3 PDGS). This may include calibration data that is measured on board or generated from external sources other than the satellite.

3.1 Common ADF

Table 1 provide the list of Auxiliary Data Files used within the Sentinel-3 PDGS that are common to all L2 IPFs.

Table 1: Common ADF list

File	Proc. Level	Internal/ External	Static/ Dynamic	Reference Source	Generation Frequency	Format	Product Type Original	Product Type PDGS	Auxiliary Data Size
FOS Orbit File (Predicted)	L0, L1, L2	E	D	FOS	Daily	Data File in Earth Explorer Format containing both Header and Data Block information (.EOF) [GM-IC-ESC-FS-3001]	MPL_ORBPRE	**AX___FPO_AX**	0.01
FOS Orbit File (Restituted)	L0, L1, L2	E	D	FOS	Daily	Data File in Earth Explorer Format containing both Header and Data Block information (.EOF) [GM-IC-ESC-FS-3001]	MPL_ORBRES	**AX___FRO_AX**	1.7
ECMWF Meteorological Data (Forecast) FC SFC and FC PL	L1, L2	E	D	ECMWF	6 hours	GRIB-1 [GMES-GSEG-EOPG-IC-11-0049]	-	**AX___MF1_AX**	360
ECMWF Meteorological Data (Analysis) AN SFC + PL	L1, L2	E	D	ECMWF	6 hours	GRIB-1 [GMES-GSEG-EOPG-IC-11-0049]	-	**AX___MA1_AX**	820
ECMWF Meteorological Data (Analysis) AN ML	L2	E	D	ECMWF	6 hours	GRIB-2 [GMES-GSEG-EOPG-IC-11-0049]	-	**AX___MA2_AX**	750
ECMWF Meteorological Data (Forecast) FC ML	L2	E	D	ECMWF	6 hours	GRIB-2 [GMES-GSEG-EOPG-IC-11-0049]	-	**AX___MF2_AX**	3000
Universal Constants File	L1, L2	I	S	PDGS (L1 GPP)	Infrequently	ASCII [GNSS IODD L0/L1b - SY-04/SY-21]	-	**AX___CST_AX**	0.01
Reference Orbit Scenario File	L0, L1, L2	E	D	Mission Planning	6 months	Data File composed of Fixed Header and Data Block included in a single file *. EOF and then tarred and compressed as a *.TGZ [ES-GSEG-EOPG-TN-11-0007]	MPL_ORBSCT	**AX___OSF_AX**	0.03

4 SLSTR L2 NRT AOD ADF

Table 2 lists all the ADFs specific to the NRT SLSTR L2 AOD IPF. They are further described in the next sub-sections.

Table 2: SLSTR L2 NRT AOD ADF list

File	Proc. Level	Internal/ External	Static / Dynamic	Generation Frequency	Format	Product Type Original	Product Type PDGS	Auxiliary Data Size (MB)
Processing Control Parameter File	L2	I	S	Infrequently	XML		**SL_2_PCPAX**	0.13
NRT Atmospheric Radiative Transfer LUT Data File	L2	I	S	Infrequently	NetCDF 4		**SL_2_ART_AX**	905
NRT Ocean Surface Reflectance LUT Data File	L2	I	S	Infrequently	NetCDF 4		**SL_2_OSR_AX**	208
NRT Aerosol climatology Data File	L2	I	S	Infrequently	NetCDF 4		**SL_2_ACLMAX**	8.2

4.1 Processing control parameter file

The SLSTR L2 NRT AOD Processing Control Parameter (PCP) contains the associated processor configuration parameters.

Table 3: Description of SLSTR L2 NRT AOD ADF Processing control parameter

FILE Type	Update rate	Size
SL_2_PCPFAX	Infrequently	0.13 MB

Element name	Description	Range or value	T	D
<global common attributes>	Common global attributes			
SL_band	**Number of used visible channel**	**5**	**us**	**1**
SL_views	**Number of used SLSTR views**	**2**	**us**	**1**
General_information				
sp_side	**Super-pixel side size in SLSSTR 500m pixels**	9		1

Element name	Description	Range or value	T	D
SP_margin	**Block_margin in super-pixel**	2		
use_fixed_frame_location	**Continuity parameter - to be set to a non-zero value to use a fixed super-pixel geolocation**	1		
Land_flag	**Flag to decide whetehr AOD land shall be processed and written (1 = yes, 0 = no).**	1		1
Retrieval_parameter				
low_sdr_land_thrshld	**Cost function threshold above which the land retrieval is skipped in case of low SDR**	10		1
Brent_TOL	**Requested fractional precision for Brent**	0.01	D	1
Powell_TOL	**fractional accuracy of the minimum location for the Powell minimization (land reflectance)**	0.0005	D	1
sig_pigc	**Uncertainty on the pigment concentration increment to be taken in the evaluation of the ocean BRF uncertainty**	0.1	D	1
sig_wdsp	**Uncertainty on the 10 m wind speed increment to be taken in the evaluation of the ocean BRF uncertainty**	6.0	D	1
rt_abs_error	**Variance associated to the uncertainty of the radiative transfer model**	0.006 for each band	D	SL_band
m_error_offset_v	**Land surface model error estimates per channel, derived from Monte Carlo simulations**	[0.01,0.01,0.04,0.02,0.02]	D	SL_band
inst_frac_error_land	**Instrument Calibration relative errors over land**	[0.048,0.064,0.04,0.066,0.12]	D	SL_band
inst_frac_error_ocean	**Instrument Calibration relative errors over ocean**	[0.024,0.032,0.02,0.033,0.06]	D	SL_band
use_bayes_cloud_flag_land	**Cloud switch - to be set to a non-zero value to use the Bayes cloud flag over land instead of summary cloud**	0		

Element name	Description	Range or value	T	D
use_bayes_cloud_flag_ocean	**Cloud switch - to be set to a non-zero value to use the Bayes cloud flag over ocean instead of summary cloud**	0		
Glint_Test				
wdsp	**10m wind speed to be taken into account for the additional glint test.**	9		1
max_brf	**1.6 µm BRF threshold to be taken into account for the additional glint test.**	0.008		1
AOD_scale_uncertainty				
land	**AOD uncertainty scaling factor for land pixel**	1		1
ocean	**AOD uncertainty scaling factor for ocean pixel**	1		1
Footprint				
AC_subsampling_factor	**AC sub-sampling factor used to build the FootPrint metadata**	**3**	**ul**	**1**
AL_subsampling_factor	**AL sub-sampling factor used to build the FootPrint metadata**	**50**	**ul**	**1**
AL_max_nb_points	**Maximum AL number of points to build the FootPrint metadata**	**45**	**ul**	**1**

4.2 Atmospheric radiative transfer Look-Up Table (LUT)

The SLSTR L2 NRT AOD atmospheric radiative transfer Look-up Table Data File Provides the inversion parameters to convert Top of Atmosphere (TOA) reflectance into bottom of the atmosphere or surface directional reflectance (SDR) assuming a specific atmospheric state

The file is in NetCDF format

Table 4: Description of SLSTR L2 NRT AOD ADF atmospheric radiative transfer LUT

FILE Type	Update rate	Size
SL_2_ART_AX	Infrequently	905 MB

Element name	Description	Range or value	T	D
<global common attributes>	Common global attributes			
model	**Number of aerosol models**	**35**	**us**	**1**
tau	**Number of Aerosol Optical Depth Breakpoint**	**81**	**us**	**1**
SL_band	**Number of used visible channel**	**5**	**us**	**1**
pressure	**Number of surface pressure breakpoint**	**2**	**us**	**1**
RAZ	**Number of relative azimuth breakpoint**	**19**	**us**	**1**
VZA	**Number of view zenith breakpoint**	**13**	**us**	**1**
SZA	**Number of solar zenith breakpoint**	**17**	**us**	**1**
model	**Aerosol model index number**	**[0, 34]**	**i8**	**model**
_FillValue	Default Value for unused elements	-1	i8	1
tau	**Aerosol optical depth**	**[0.001, 4.001]**	**f32**	**tau**
_FillValue	Default Value for unused elements	-1	f32	1
band	**Spectral band center wavelength**	**[555, 2250]**	**f32**	**Sl_band**
units	UDUNITS unit name	nm	st	1
_FillValue	Default Value for unused elements	-1	f32	1
pressure	**Surface pressure**	**[450, 1013]**	**f32**	**pressure**
units	UDUNITS unit name	hPa	st	1
_FillValue	Default Value for unused elements	-1	f32	1
RAZ	**Relative Azimuth Angle**	**[0,180]**	**f32**	**RAZ**
units	UDUNITS unit name	degrees	st	1
_FillValue	Default Value for unused elements	-1	f32	1
VZA	**View Zenith Angle**	**[0, 60]**	**f32**	**VZA**
units	UDUNITS unit name	degrees	st	1
_FillValue	Default Value for unused elements	-1	f32	1
SZA	**Solar zenith Angle**	**[0,80]**	**f32**	**SZA**
units	UDUNITS unit name	degrees	st	1
_FillValue	Default Value for unused elements	-1	f32	1

Element name	Description	Range or value	T	D
rPath	**Equivalent Atmospheric Path reflectance**	**[0, 2]**	**f32**	**SZA VZA RAZ pressure tau SL_band model**
_FillValue	Default Value for unused elements	-1	f32	1
T	**One way Transmittance**	**[0,1]**	**f32**	**SZA pressure tau SL_band model**
_FillValue	Default Value for unused elements	-1	f32	1
tGas	**Gaseous Transmission**	**[0,1]**	**f32**	**SZA VZA pressure SL_band model**
_FillValue	Default Value for unused elements	-1	f32	1
spherAlb	**Atmopsheric spherical Albedo**	**[0,1]**	**f32**	**pressure tau SL_band model**
_FillValue	Default Value for unused elements	-1	f32	1
D	**fraction of diffuse light**	**[0,1]**	**f32**	**SZA pressure tau SL_band model**
_FillValue	Default Value for unused elements	-1	f32	1
spec_aod_ratio	**Spectral AOD wrt AOD computed at 550 nm**	**[0, 1]**	**f32**	**SL_band model**
_FillValue	Default Value for unused elements	-1	f32	1
SSA	**Aerosol single scattering albedo**	**[0,1]**	**f32**	**SL_band model**
_FillValue	Default Value for unused elements	-1	f32	1

4.3 Ocean surface reflectance LUT data file

The SLSTR L2 NRT AOD Ocean Surface reflectance LUT Data File includes computed sun glint & sky glint reflectance, and water leaving radiance due to ocean colour features (*e.g.* chlorophyll, sediments, etc..).

Table 5: Description of SLSTR L2 NRT AOD ADF ocean surface reflectance LUT data file

FILE Type	Update rate	Size
SL_2_OSR_AX	Infrequently	208 MB

Element name	Description	Range or value	T	D
<global common attributes>	Common global attributes			
WDSP	**Number of Wind Speed Breakpoint**	**5**	**us**	**1**
WDIR	**Number of Wind Direction Breakpoint**	**4**	**us**	**1**
PIGC	**Number of Pigment concentration breakpoint**	**3**		
model	**Number of Aerosol Model**	**2**	**us**	**1**
tau	**Number of Aerosol Optical Depth Breakpoint**	**81**	**us**	**1**
SL_band	**Number of used visible channel**	**5**	**us**	**1**
RAZ	**Number of relative azimuth breakpoint**	**10**	**us**	**1**
VZA	**Number of view zenith breakpoint**	**13**	**us**	**1**
SZA	**Number of solar zenith breakpoint**	**17**	**us**	**1**
Wind_speed	**Wind Speed**	**[1, 21]**	**f32**	**WDSP**
units	UDUNITS unit name	m.s-1	st	1
_FillValue	Default Value for unused elements	-1	f32	1
Wind_dir	**Wind direction (clockwise from North)**	**[0, 270]**	**f32**	**WDIR**
units	UDUNITS unit name	degrees	st	1
_FillValue	Default Value for unused elements	-1	f32	1
Pigment_cc	**pigment concentration**	**[0, 1]**	**f32**	**PIGC**
units	UDUNITS unit name	mg.m-3	st	1
_FillValue	Default Value for unused elements	-1	f32	1
model	**Aerosol model index number**	**[0, 34]**	**i8**	**model**
_FillValue	Default Value for unused elements	-1	i8	1
tau	**Aerosol optical depth**	**[0.001, 4.001]**	**f32**	**tau**

Element name	Description	Range or value	T	D
_FillValue	Default Value for unused elements	-1	f32	1
SL_band	**Spectral band center wavelength**	**[400, 2250]**	**f32**	**Sl_band**
units	UDUNITS unit name	nm	st	1
_FillValue	Default Value for unused elements	-1	f32	1
RAZ	**Relative Azimuth Angle**	**[0,180]**	**f32**	**RAZ**
units	UDUNITS unit name	degrees	st	1
_FillValue	Default Value for unused elements	-1	f32	1
VZA	**View Zenith Angle**	**[0, 60]**	**f32**	**VZA**
units	UDUNITS unit name	degrees	st	1
_FillValue	Default Value for unused elements	-1	f32	1
SZA	**Solar zenith Angle**	**[0,80]**	**f32**	**SZA**
units	UDUNITS unit name	degrees	st	1
_FillValue	Default Value for unused elements	-1	f32	1
Rocean	**Ocean reflectance (BRF)**	**[0, 10]**	**f32**	**SZA VZA RAZ SL_band tau model PIGC WDIR WDSP**
_FillValue	Default Value for unused elements	-1	f32	1

4.4 Aerosol climatology data file

The SLSTR L2 NRT AOD Aerosol climatology includes *a priori* knowledge on the global spatial and temporal distribution of aerosol properties. The file is in Netcdf format.

Table 6: Description of SLSTR L2 NRT AOD ADF aerosol climatology data file

FILE Type	Update rate	Size
SL_2_ACLMAX	Infrequently	8.2 MB

Element name	Description	Range or value	T	D
<global common attributes>	Common global attributes			
lon	**Number of longitude breakpoint**	**360**	**us**	**1**
lat	**Number of latitude breakpoint**	**180**	**us**	**1**
Time	**Number of temporal breakpoint (month)**	**12**	**us**	**1**
Longitude	**Longitude at grid center**	**[-180, 180]**	**f32**	**lon**
Standard_name	name following CF conventions	longitude	st	1
units	UDUNITS unit name	degrees_east	st	1
_FillValue	Default Value for unused elements	-999	f32	1
Latitude	**Latitude at grid center**	**[-90, 90]**	**f32**	**lat**
Standard_name	name following CF conventions	latitude	st	1
units	UDUNITS unit name	degrees_north	st	1
_FillValue	Default Value for unused elements	-999	f32	1
Time	**Month of year**	**[1, 12]**	**f32**	**time**
_FillValue	Default Value for unused elements	-999	f32	1
AOD550	**Climatological Aerosol optical Depth**	**[0, 10]**	**f32**	**time lat lon**
Standard_name	name following CF conventions	atmosphere_optical_thickness_due_to_ambient_aerosol	st	1
_FillValue	Default Value for unused elements	-1	f32	1
fine_of_total_fraction	**Fine model fraction**	**[0, 1]**	**f32**	**time lat lon**
_FillValue	Default Value for unused elements	-1	f32	1
lessAbs_of_fine_fraction	**less absorbing fraction in fine mode**	**[0, 1]**	**f32**	**time lat lon**

Element name	Description	Range or value	T	D
_FillValue	Default Value for unused elements	-1	f32	1
dust_of_coarse_fraction	**dust fraction in coarse mode**	**[0, 1]**	**f32**	**time lat lon**
_FillValue	Default Value for unused elements	-1	f32	1