

Sentinel-3 Product Notice – SYnergy-Aerosol Optical Depth

Mission	S3A & S3B
Sensor	SYNERGY AOD products
Product	<ul style="list-style-type: none"> • SY_2_AOD
Product Notice ID	S3.PN-SYN-AOD.02
Issue/Rev Date	18/07/2023
Version	1.0
Preparation	This Product Notice was prepared by the Sentinel 3 (S3) Mission Performance Centre and by ESA experts
Approval	ESA Mission Management

Summary

This is a product notice for the release of operational Sentinel-3 SYNERGY Aerosol Optical Depth Level 2 products to user's community. The notice gives a clear indication of the current status of the latest processing baseline delivered for SYN-AOD products and known limitations. The products are currently available via the Copernicus Open Access Hub.

The users are informed that the date of 08/04/2021 corresponds to the public release of the SYN AOD products. However, the production has started on the 19/02/2020 and all products since that date are available in the data hub.

This Product Notice is updated to be consistent with the new processing baseline deployed on the 18/07/2023 on S3B production service and on 25/07/2023 on S3A production service.



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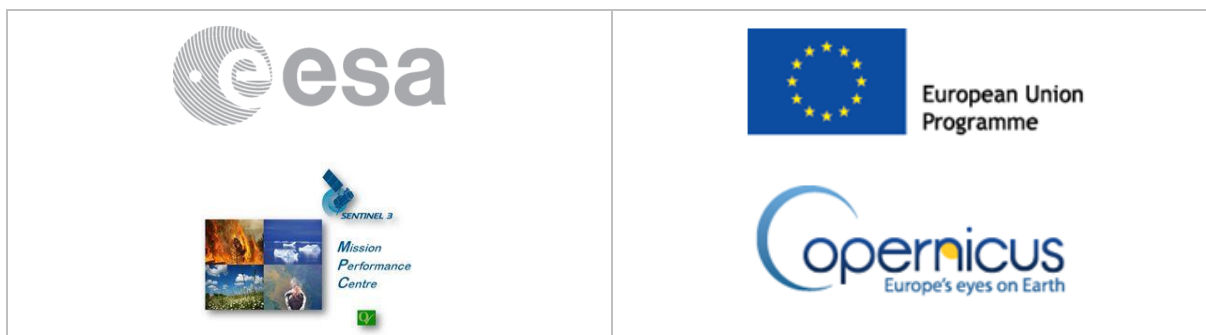


Processing Baseline

	Common to S3A/S3B
Processing Baseline	<ul style="list-style-type: none">AOD_NTC.002.08.01
IPFs version	<ul style="list-style-type: none">SY_2_AOD IPF version: 01.08
	<ul style="list-style-type: none">OL_1 IPF version: 06.17 (OL__L1_.003.03.00)
	<ul style="list-style-type: none">SL_1 IPF version: 06.21 (SL__L1_.004.06.00)

Current Operational Processing Baseline

IPF	IPF Version	In operations since (creation date)
S3A		
OL_1	06.17	25/07/2023
SL_1	06.21	25/07/2023
SY_2_AOD	01.08	25/07/2023
S3B		
OL_1	06.17	18/07/2023
SL_1	06.21	18/07/2023
SY_2_AOD	01.08	18/07/2023



Status of the Processing Baseline

Common to S3A and S3B

The key points of the processing baseline AOD_NTC.002.08.01 for the SYNERGY AOD level 2 products are:

- This processing is taking benefit of the spectral and angular capabilities of the co-registration of OLCI and SLSTR L1b radiances over the same grid. All relevant L1b datasets are then averaged on a **super-pixel resolution defined at 4.5 km²**. Note that only radiometry associated with clear-sky pixels is considered in this averaging.
- This processing is a global one, meaning that aerosol characteristics are provided for Land and Sea pixels. Over land, it uses as inputs to the aerosol retrieval module both SLSTR views (nadir and oblique) and all channels (except S4, i.e., 1.37µm, dedicated to cloud detection) + one OLCI channel: Oa3, 442.5 nm.
- Over Ocean, the aerosol retrieval module is only considering SLSTR channels and provides AOD values over the whole swath (nadir only and dual view area)
- Aerosol characteristics are then provided on a 4.5 km resolution, over the whole common OLCI swath.
- The processing of super-pixels to estimate aerosol properties is based on optimization by iterative numerical inversion, with propagation of uncertainties. Two free parameters describing the atmosphere are aerosol optical depth, parameterized at 550nm, and the ratio of aerosol fine to coarse mode. Parameterised surface models are used to describe the land and ocean surface reflectance. Over land these models include further free parameters retrieved during the inversion, while over ocean the reflectance is specified using a priori wind speed and pigment concentrations. Further aerosol properties (for example spectral variation of AOD) are calculated from the AOD at 550nm and fine/coarse ratio, constrained by a priori climatology giving local values of the components, for example SSA of coarse mode. The full algorithm is described in the product ATBD, S3-L2-AOD-SYN-ATBD, v1.12.
- SYN AOD products are providing – on a 4.5 km resolution – all derived and retrieved aerosol parameters plus contextual parameters such as time, quality flags, solar and satellite angles (related to the center of a given super-pixel) and geographical position (related to the center and the corner of a given super-pixel). The aerosol parameters are:
 - Aerosol Optical thickness and their Uncertainties at 440, 550, 670, 985, 1600 and 2250 nm,
 - Single Scattering Albedo at 440, 550, 670, 985, 1600 and 2250 nm,
 - Fine-mode aerosol optical depth at 550nm,
 - Aerosol Angstrom parameter between 550 and 865nm,

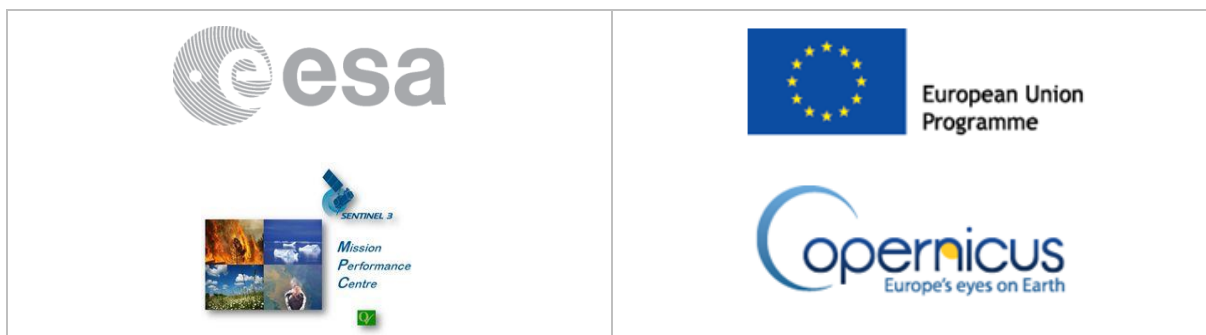


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- Dust aerosol optical depth at 550nm,
- Aerosol absorption optical depth at 550nm.
- Note that no cosmetic filling is performed in SYN AOD processing and an AOD value is only provided if the aerosol retrieval has been successful. To help users understand why there may be no AOD associated with some pixels, several quality flags are defined in the product:
 - Land/Ocean: The super-pixel is defined as Land/Ocean (i.e. more than 50% of included 300m pixels are defined as Land/Ocean)
 - oblq_missing/dual_view: only SLSTR radiometric measurements from nadir view have been taken into account in this retrieval/SLSTR radiometric measurements from both views have been taken into account.
 - cloudy_n/cloud_o: Nadir/oblique retrieval was rejected due to cloud cover (cloud fraction of majority surface type exceeds 50%).
 - glint_n/glint_o: glint has been detected in nadir/oblique measurements.
 - sdr_neg: at least one surface reflectance (SDR) value was found to be negative during the aerosol retrieval process.
 - aod_zero: the aerosol retrieval process failed due to AOD zero ($<5e3$).
 - fm_clim: the fine mode retrieval failed and the FM value was taken from climatology.
 - unc_failed: the uncertainty estimate failed.
 - Invalid: the Aerosol retrieval failed over this super-pixel.
 - Outlier: the AOD value associated with this super-pixel has been discarded by the AOD local variance threshold test.
 - Low_ndvi: this super-pixel is defined as a non dark-vegetation pixel (i.e. $NDVI < 0.7$).
 - Clean_air_est: this super-pixel is associated with clear atmosphere, especially over dark surfaces, for which negative AOD can occur in the aerosol retrieval module.
 - High_SZA: this super-pixel is associated with high SZA ($> 78^\circ$) where the performance of aerosol retrieval is not optimal.
- In order to perform the aerosol retrieval with the most accurate radiometric sources, the SLSTR calibration factors defined by SLSTR experts (S3 VIR and SWIR Channel Vicarious Calibration Adjustment report can be found [on Sentinel 3 online](#)) and the S3A OLCI offset defined during the tandem mission (2% reduced brightness for all bands as described in [Lamquin et al, 2020]¹ except

¹ Lamquin, N.; Clerc, S.; Bourg, L.; Donlon, C. OLCI A/B Tandem Phase Analysis, Part 1: Level 1 Homogenisation and Harmonisation. *Remote Sens.* **2020**, *12*, 1804. <https://doi.org/10.3390/rs12111804>



Oa21 for which a 6% offset has been found) have been included as configuration parameters and applied at the beginning of SYN processing.

Known product quality limitations

Common to S3A and S3B

The following limitations have been identified:

- The `oblq_missing` and `dual_view` SYN AOD flags are only defined when the aerosol retrieval is possible over the super-pixel (i.e., when more than 50% of the included 300m pixels are valid and clear-sky pixels).
- The SYN AOD product includes some derived OLCI and SLSTR L1b flags based on the following rule: if more than 50% of included 300m pixels are flagged, then this derived flag will be raised for the whole super-pixel.
- Some visible transitions can be observed at the nadir-only/dual-view interface resulting from the different retrieval principles over the dual & single-view areas.
- Bright areas, over desert surfaces, are considered less reliable.
- High latitude areas may suffer from contamination by undetected snow/ice, and retrievals with sun angles less than 70 degrees only should be used.
- Transition seen from single view to dual view due to different algorithms in the retrieval.
- Regarding cloud flagging, SYN AOD is using a combination of SLSTR basic cloud and OLCI Bright pixels flags. Former analysis of this combination shows undetected clouds in some regions.
- Following the inclusion of the updated geometric model on OLCI L1 processing, some removed pixels may appear in the center of a camera module, providing more removed pixels than expected. This anomaly is transparent for SYN AOD aerosol datasets but some annotation datasets like geographical coordinates might be missing. However, this issue impacts less than 0.01 % of SYNERGY land and clear sky pixels over one orbit.

Specific to S3A

- Nothing specific to S3A



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Specific to S3B

- Nothing specific to S3B

Products Availability

- Copernicus Open Access Hub (<https://scihub.copernicus.eu/>)
- S3 Expert Users Data Hub
- Other

Any other useful information

- None

User Support

- Questions about SYN products can be asked to the Sentinel-3 User Support desk at:
 - eosupport@copernicus.esa.int

References

- OLCI L1 Product Notice
 - S3.PN.OLCI-L1.11, v1.0 dated on 18/07/2023
- SLSTR L1 Product Notice
 - S3.PN.SLSTR-L1.10, v1.0 dated on 18/07/2023
- Product Data Format Specification – SYNERGY Level 2 Global Aerosol Products, Ref: S3MPC.ACR.AOD.003 - 02, Issue: 1.4, Date: 08/12/2022
- SYN Land User Handbook, ref. S3MPC.HBK.003, Issue 1.2, Date: 14/04/2023
<https://sentinel.esa.int/documents/247904/4598110/Sentinel-3-Synergy-Land-Handbook.pdf>



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End of the Product Notice