









Sentinel-3 Product Notice - SLSTR

Mission	Sentinel-3A & Sentinel-3B				
Sensor	SLSTR-A & SLSTR-B				
Product	Level 1B: SL_1_RBT at NRT and NTC				
Product Notice ID	S3.PN-SLSTR-L1.10				
Issue/Rev Date	18/07/2023				
Version	1.0				
Preparation	This Product Notice was prepared by the Optical Mission Performance Cluster (OPT-MPC) and by ESA and EUMETSAT experts				
Approval	Joint ESA-EUM Mission Management				

Summary

This Product Notice addresses Sentinel-3A and -3B Sea and Land Surface Temperature Radiometer (SLSTR-A and SLSTR-B) Level-1B processing baselines deployed on S3A Land production services on 25/07/2023 and on S3B Land production services on 18/07/2023. It is applicable to Near Real Time (NRT) and Non-Time Critical (NTC) timeliness.

The Notice describes the Level-1B current status, the processing baseline, the product quality and known limitations for both SLSTR-A and SLSTR-B.

The main changes relate to the correction of the bayes_orphan indexation, the inclusion of the error message in case of Moon Calibration and the corrected VISCAL computation during solar eclipse.

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Processing Baselines			
Processing Baseline	Processing Baseline: SLL1004.06		
IPFs version	SL_1 IPF version: 06.21PUG version: 3.48		

Current Operational Processing Baselines				
IPF	IPF Version	Into operations since		
S3A SL1	06.21	 Land Centres: NRT and NTC mode: 25/07/2023 Marine Centre: NRT and NTC mode: to be defined 		
S3B SL1	06.21	 Land Centres: NRT and NTC mode: 18/07/2023 Marine Centre: NRT and NTC mode: to be defined 		
PUG	3.48	Land Centres: S3A: 25/07/2023 S3B: 18/07/2023 Marine Centre: NRT and NTC mode: to be defined		

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Details of the changes and impacts

- The bayes_orphan flag was wrongly provided on the SLSTR image grid instead of the orphan dataset (i.e. depending on rows and orphan_vector). This issue was affecting both L1 and L2 products and all 500m and 1 km grids. However, data quality was not affected as this parameter is unfilled during L1 processing. The dimension is now consistent with specification documents.
- During the last solar eclipse, an issue occurred during the VISCAL computation as the processing
 was unable to reach the end of the VISCAL illumination window. A correction has been included to
 handle specific cases such as solar eclipse without impacting normal cases
- During Moon Calibration, SLSTR L1 processing is failing as expected but no specific error message was planned to handle this specific case, impacting or freezing the operational chains. An error message followed by a graceful exit is now handling tis specific operational case.

Status of the Processing Baseline

In order to ease the traceability of S3 products, the processing baseline identifier is now provided in the manifest file and in the global attributes of each file. The identifier comprises of seven characters (SL__L1_) which indicates SLSTR L1 products and its version xxx.yy.zz (004.06.00) where xxx indicates baseline collection (004), yy indicates change due to the IPF or ADF (06) and zz (00) indicates change in system components (e.g. L0, PUG, ...) that do not impact data quality but are included to allow full traceability.

The quality status of the baseline products is as follows:

Geometric Calibration

- SLSTR-A and SLSTR-B nadir and oblique view geolocation accuracy meet the mission requirements (0.5 pixel as per S3 MRTD, 2011).
- The estimated geometric validation for SLSTR-A and SLSTR-B is within 0.1 pixel in nadir view along and across track and in oblique view across track.
 - Smaller offset (still within requirements) is observed in oblique view along track (~0.2 pix) for both satellites.

TIR Radiometric Calibration

SLSTR-A and SLSTR-B TIR radiometric accuracy meets the mission requirements (S3 MRTD, 2011).

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VIS/SWIR Radiometric Calibration Information

SLSTR-A/B: All solar channels (S1-S6) have been undergoing a vicarious calibration assessment to quantify their radiometric calibration adjustment. Recent analysis of vicarious calibration results over desert sites performed by RAL, CNES, Rayference and University of Arizona have determined new and consistent radiometric deviations wrt. common reference sensors (MERIS, MODIS) [S3MPC.RAL.TN.010]. Consequently, these have been used to provide a first-order radiometric corrections which are provided in the below tables with more detail at the following link [S3MPC.RAL.TN.020]. Current radiances in the L1B product remain uncorrected of these radiometric calibration adjustments. Hence, these multiplicative coefficients are strongly recommended to be used by all users.

Nadir view

	S1	S2	S3	S 5	S6
Correction	0.97	0.98	0.98	1.11	1.13
Uncertainty	0.03	0.02	0.02	0.02	0.02

Oblique view

	S1	S2	S3	S5	S6
Correction	0.94	0.95	0.95	1.04	1.07
Uncertainty	0.05	0.03	0.03	0.03	0.05

VIS-SWIR noise estimates computation

To correct the discrepancy observed on SLSTR-B between the noise derived from VISCAL signals and the ones estimated before launch and recorded in the pre-launch calibration reports, a non-uniform profile of VISCAL signal at full solar illumination is now considered in the computation of noise estimates.

The slope of the VISCAL peak is estimated by fitting a plane to the peak thanks to a 3rd degree polynomial function of pixel and scan numbers. The VISCAL noise is then computed as the standard deviation of each pixel value on the VISCAL peak surface to the 2D polynomial fitting the VISCAL surface.

Saturation checks on all optical & thermal infrared SLSTR channels

The non-linearity corrections are then applied after the check for channel saturation to avoid misleading information. As the non-linearity correction could increase the number of detector counts, some pixels

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- previously falsely flagged - are now correctly identified as being within the valid dynamic range of the channel.

Bayesian/probabilistic cloud screening

• These flags are no longer provided inside SLSTR L1B products. Their computation is now included in the SLSTR L2 Land and Marine processors.

Basic cloud screening

• SLSTR-A and SLSTR-B summary cloud:

The results of the remaining cloud test (thermal histogram) are not taken into account in the cloud word. The result of this test is however still available in the individual cloud test bits in the cloud_flags.

Flags

SLSTR-A and SLSTR-B:

- Radiance/BT out of range flags are nominal.
- Saturation flags (where the uncalibrated counts are out of their expected range) are nominal.
- · Pointing flags are nominal.

Known product quality limitations

SLSTR Level-1B processing baseline SL_L1_.004.06 has the following known limitations, unless explicitly mentioned all points are applicable to both SLSTR-A and SLSTR-B:

VIS/SWIR radiometric calibration information

- The current calibration coefficients (given in the tables above) have been confirmed by the Agencies (EUMETSAT, ESA), the SLSTR Quality Working, and expert members of the S3VT.
- Assessments, made by applying the coefficients have shown that the corrections are highly beneficial for aerosol & fire applications derived from the VIS/SWIR channels.
- It should be noted that the coefficients are based on analyses of bright desert sites, and it is possible that there are effects that are dependent on the scene and/or view geometry. Further analyses are ongoing to characterize additional effects such as non-linearities, differences between SLSTR-A and

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B, and view angle dependencies, in particular the uncertainty in the Oblique view correction factor for S6.

The root causes of the discrepancies have not yet been determined but investigations are ongoing.

S7, S8, S9 co-registration

• A sub-pixel mis-registration of S7 with regard to S8 and S9 of ~ 250 m for SLSTR-A and ~120 m for SLSTR-B has been detected and is being investigated.

Meteorological fields

- Meteorological fields are nominal. Users are advised that the times given for meteorological fields are synoptic and the data has not been interpolated to SLSTR time.
- An issue has been raised on the Sea surface temperature dataset provided in the met_tx.nc file with land pixels wrongly associated with the values 273 K. This issue is affecting only NRT products and is linked to the use of a forecast field from the ECMWF files.

Upper temperature limit of channel S7

- The Upper temperature limit for optimally calibrated channel S7 is set to ~305 K for both SLSTR-A SLSTR-B. All S7 brightness temperatures higher than this limit are flagged as invalid_radiance. However, to ensure the feasibility of the SLSTR L2 Fire Radiative Power Algorithm, these temperatures are no longer replaced by a FillValue and kept in the products.
- Users should be aware of this update when using S7 temperatures above 305 K.

Differences between NRT and NTC products

 There are small expected differences between NRT and NTC products due to the regridding algorithm.

Basic Cloud Screening

- Overall the cloud screening (summary_cloud) did not change since the previous SLSTR-A baseline but there are some remaining issues:
 - Under-flagging of fog and low stratus over ocean
 - Over-flagging of fog and low stratus over land
 - Over-flagging of 1.6 large-scale histogram test near the coastline

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- Different cloud masking criteria for sun glint and outside of sun glint area can cause artificial striping in the summary cloud screening
- The cloud mask on the F1 grid presents a small spatial offset due to the shift between F1 and other channels.

Alignment of Tie-point grids and image grids

- Due to continuity requirement, the first SLSTR tie point row has been defined over the ANX position. However, this leads to a misalignment between tie and image rows in the along-track direction. is misalignment manifests as an arbitrary offset between the image grid and the tie point grid that is found to vary around an orbit.
- Users should be aware that there are exactly the same number of tie point rows as 1 km image rows.
- However, operational (PUG) products may have an additional row of 0.5 km pixels before the tie
 point grid that is not present in the reprocessed (IPF) products. In this case, interpolation between
 tie points and image grid can be performed by extrapolation or using the adjacent product.

F1 Overshoot & offset

- An issue has been identified with the F1 channel after detection of high temperatures (fires) or low temperatures (clouds).
- The effect manifests as follows:
- When a pixel with a very high temperature is detected, the following down-scan pixel appears to record a temperature that is much lower than expected. E.g. if a BT of 500 K is detected, the next pixels will report a BT of ~200 K whereas the corresponding S7 pixels are ~300 K.
- When a pixel with a very low temperature is detected, the following down-scan pixel appears to be
 very abnormally high. This very often occurs next to cold cloud edges over the next 5 to 10 pixels in
 the scan direction. Without careful precaution by users, this may lead to various effects on L2
 applications such as false detection of fire. E.g. if a BT of 240 K is detected, the next pixels will report
 a BT of ~323 K whereas the corresponding S7 pixels are ~280 K.
- The effect is due to the specificities of the F1 detector design.
- Currently, there are no specific flags given in the L1b product for such an effect in F1. Hence, users
 are advised to compare the F1 channel BTs with those of S7 to avoid false interpretation of hotspots.
- Noise contribution in F1 is known to be higher than in S7. Due to its dynamic range, it is generally recommended not to use F1 detector for BTs < 305 K.

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• Users are also kindly reminded that the F1 grid is not co-registered with any of the S* grids. A specific grid is provided in its corresponding geodetic file.

TIR Channel Stray Light Correction

- During the pre-launch radiometric testing of SLSTR-A and B unexpected discrepancies were observed in the brightness temperatures as measured by SLSTR-A channels S8 and S9 compared to those of the external reference source [Smith et al 2020]. For model B, the results were significantly better for the nadir view, although they still showed some differences in the oblique view, but within the reported uncertainties. The probable cause of the effect was due to lower-than-expected performance of the black coating used in the Parabolic Mirror Assembly (PMA) stop leading to a scan-dependent variation of the background signal. The effect was later confirmed in the oblique view by the analysis of comparisons of SLSTR-A and B data from the Sentinel-3 tandem phase [Hunt et al 2020].
- An empirical correction to the calibration model has been proposed to account for the stray light effect which is under evaluation.
 - Smith, D.; Barillot, M.; Bianchi, S.; Brandani, F.; Coppo, P.; Etxaluze, M.; Frerick, J.; Kirschstein, S.; Lee, A.; Maddison, B.; Newman, E.; Nightingale, T.; Peters, D.; Polehampton, E., Sentinel-3A/B SLSTR Pre-Launch Calibration of the Thermal InfraRed Channels., Remote Sens." 2020, 12, 2510. https://doi.org/10.3390/rs12162510
 - Hunt, S.E.; Mittaz, J.P.D.; Smith, D.; Polehampton, E.; Yemelyanova, R.; Woolliams, E.R.; Donlon, C.. Comparison of the Sentinel-3A and B SLSTR Tandem Phase Data Using Metrological Principles, Remote Sens. 2020, 12, 2893. https://doi.org/10.3390/rs12182893

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□ Copernicus Open Access Hub	(https:/	<u>/scihub.copernicus.eu/</u>)	, NRT and NTC

□ Copernicus Online Data Access (https://coda.eumetsat.int/), NRT and NTC

☐ EUMETCast (https://eoportal.eumetsat.int/), NRT

☑ EUMETSAT Data Centre (https://eoportal.eumetsat.int/), NRT and NTC

☐ FTP server address login: login password: password

☐ Other

Product	EUMETCast	ODA*	CODA**	EUMETSAT Data Centre
SLSTR L1B	-	NRT, NTC	NRT, NTC	NRT, NTC

^{*} **ODA** is available only for Copernicus Services and S3VT users

Any other useful information

None applicable to this processing baseline

User Support

- Questions about SLSTR products can be asked to the Sentinel-3 User Support desk at:
 - o <u>eosupport@copernicus.esa.int</u>
 - o ops@eumetsat.int

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^{**} CODA is the Copernicus Online Data Access service and is available to all users.











References

 Product Data Format Specification – SLSTR Level 1 & 2 Instrument Products, Ref: S3IPF.PDS.005.1, Issue: 2.9, Date: 20/09/2019

https://sentinel.esa.int/web/sentinel/user-guides/sentinel-3-slstr/document-library https://www.eumetsat.int/sea-surface-temperature-resources

- SLSTR Land User Handbook: https://sentinel.esa.int/documents/247904/4598082/Sentinel-3-SLSTR-Land-Handbook.pdf/
- SLSTR Marine User Handbook:

https://www-cdn.eumetsat.int/files/2020-07/Sentinel-3 SLSTR Marine User Handbook.pdf

End of the Product Notice

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