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Sentinel-3 Product Notice – SLSTR

Mission	Sentinel-3A & Sentinel-3B	
Sensor	SLSTR-A & SLSTR-B	
Product	<ul style="list-style-type: none"> Level 1B: SL_1_RBT at NRT and NTC 	
Product Notice ID	S3.PN-SLSTR-L1.11	
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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 and S3B Land production services on 23/04/2024, and on S3A/S3B Marine production services on 27/05/2024 (TBC).. 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 improvement of the surface classification module regarding coastline pixels and to the inclusion of a dedicated decision tree to evaluate a proper Online Quality check.



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Processing Baselines

Processing Baseline	<ul style="list-style-type: none"> Processing Baseline: SL__L1_.004.07.00
IPFs version	<ul style="list-style-type: none"> SL_1 IPF version: 06.21 PUG version: 3.50

Current Operational Processing Baselines

IPF	IPF Version	Into operations since
S3A SL1	06.22	<p>Land Centres:</p> <ul style="list-style-type: none"> NRT and NTC mode: 23/04/2024 <p>Marine Centre:</p> <ul style="list-style-type: none"> NRT and NTC mode: 27/05/2024 (TBC)
S3B SL1	06.22	<p>Land Centres:</p> <ul style="list-style-type: none"> NRT and NTC mode: 23/04/2024 <p>Marine Centre:</p> <ul style="list-style-type: none"> NRT and NTC mode: 27/05/2024 (TBC)
PUG	3.50	<p>Land Centres:</p> <ul style="list-style-type: none"> S3A: 23/04/2024 S3B: 23/04/2024 <p>Marine Centre:</p> <ul style="list-style-type: none"> NRT and NTC mode: 27/05/2024 (TBC)



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Details of the changes and impacts

- An approach to define a proper Online Quality check parameter in SLSTR L1 manifest file has been included. To ease the distinction between nominal product and the ones affected by an operational anomaly, the Online Quality check can now be associated with three different values: FAILED (in case of Manoeuvre, important percentage of missing data on all bands, ...), DEGRADED (in case of pointing issue or inappropriate/missing VISCAL or NAVATT files) or PASSED (nominal conditions).

Online_Quality_Check_definition

	OLQC = FAILED	OLQC = DEGRADED	OLQC = PASSED
In case of missing data	If all relevant bands have more than 80% of missing data	Some gaps have been recorded	No data gap has been reported
In case of pointing flags	/	If more than 20% of the product is flagged as pointing issues	No pointing issues has been reported
In case of Manoeuvre	If a manoeuvre is affecting all product	If a manoeuvre is affecting all part of the product	If no manoeuvre has been reported
In case of issue with VISCAL file	/	If the validity time of used VISCAL file is separated from more than 100 minutes from the start_time of the product	If we are using an appropriate VISCAL file

- The SLSTR surface classification module has been improved, focusing on the coastline classification. This evolution is now considering the whole field of view (FOV defined by 6 corners) acquired by SLSTR and no longer the center of the pixel. Following this modification, coastline is no longer discontinuous and is now defined as the interface between land and ocean areas but also as the interface between land and inland water pixels. Two additional parameters (count_water and count_water_orphan) have also been added in the flags_xx.nc file and are providing, for each coastline pixel, the number of FOV corners over water.

The land, ocean and inland waters classification are not impacted by this evolution. The tidal classification may be impacted over large discharges area: some pixels inside the tidal area may be missed by the tidal classification.



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The impact of the improved SLSTR classification module is shown below with an example over United Kingdom and Norway acquired by S3B on November 2021 (S3B_SL_1_RBT___20211124T212939_20211124T213239_[..])

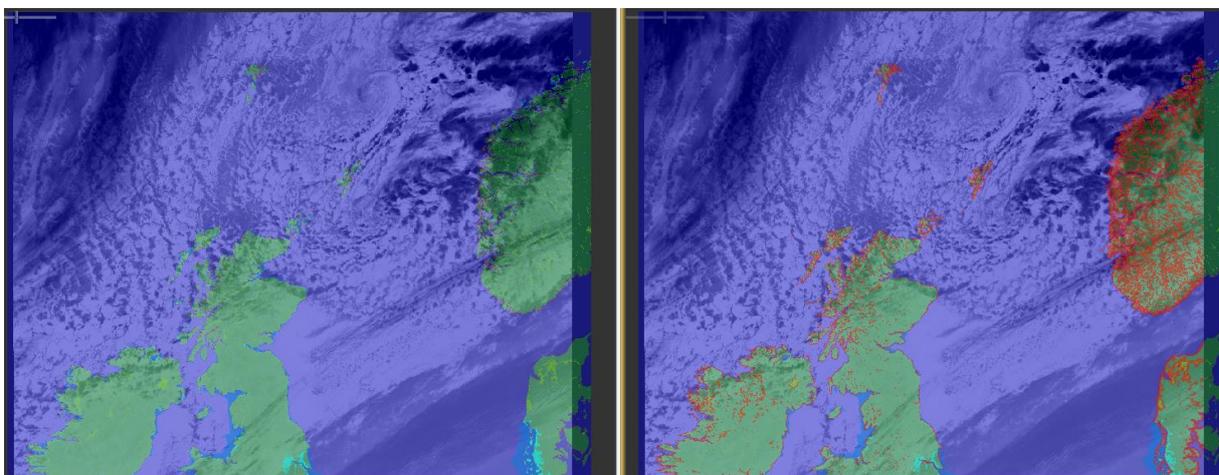
Outcome from previous processing baseline is provided on the left panel and compared visually to the outcome of PB 3.26 on the right panel. Images are representing a) the full product and b) a zoom over a small area over Ireland Coast.



Footprint of the SLSTR products is shown in the red rectangle. The different flags taken into account in the following figures are described on the right panel.

	... confidence_in.coastline
	... confidence_in.ocean
	... confidence_in.tidal
	... confidence_in.land
	... confidence_in.inland_water

a)

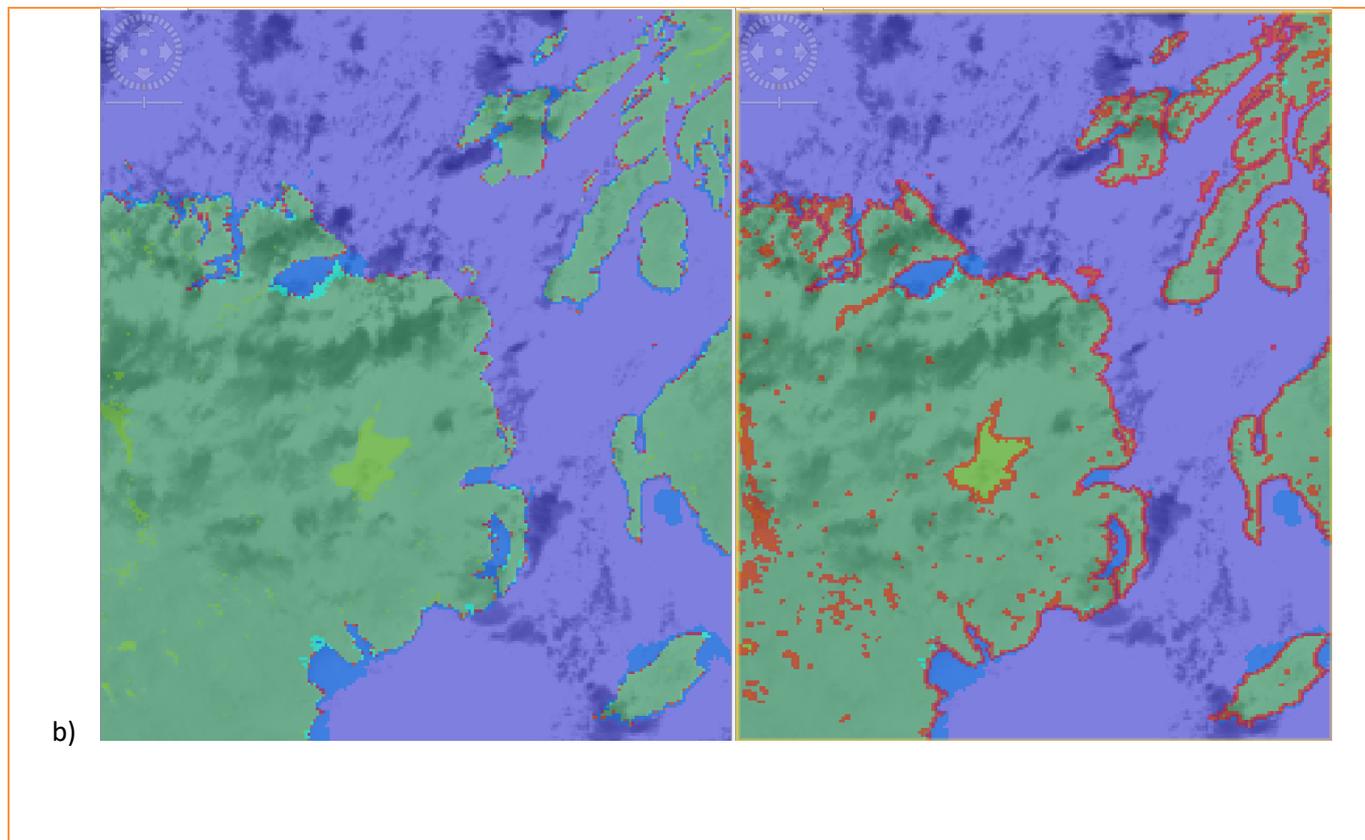




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Status of the Processing Baseline

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).

VIS/SWIR Radiometric Calibration Information



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- 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	S5	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 VISICAL signals and the ones estimated before launch and recorded in the pre-launch calibration reports, a non-uniform profile of VISICAL signal at full solar illumination is now considered in the computation of noise estimates.

The slope of the VISICAL peak is estimated by fitting a plane to the peak thanks to a 3rd degree polynomial function of pixel and scan numbers. The VISICAL noise is then computed as the standard deviation of each pixel value on the VISICAL peak surface to the 2D polynomial fitting the VISICAL 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 – previously falsely flagged – are now correctly identified as being within the valid dynamic range of the channel.



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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_.004.07 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 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.



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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 and 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
 - 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.



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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. This 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 hot-spots.
- 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.
- 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



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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>

Tidal classification

- The tidal classification may be impacted over large discharges area: some pixels inside the tidal area may be missed by the tidal classification.



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Product Availability

- Copernicus Data Space Ecosystem (<https://dataspace.copernicus.eu/>) NRT and NTC
- EUMETSAT Datastore (<https://data.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	Copernicus Data Space Ecosystem	EUMETSAT Datastore	EUMETSAT Data Centre
SLSTR L1B	-	NRT, NTC	NRT, NTC	NRT, NTC

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:
 - <https://helpcenter.dataspace.copernicus.eu/hc/en-gb/requests/new>
 - ops@eumetsat.int

References



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- Product Data Format Specification – SLSTR Level 1 & 2 Instrument Products, Ref: S3IPF.PDS.005.1, Issue: 2.11, Date: 19/01/2024
<https://sentiwiki.copernicus.eu/web/document-library#DocumentLibrary-ProductSpecificationDocumentsLibrary-S3-SLSTR-PDS>
<https://user.eumetsat.int/data/satellites/sentinel-3/sea-surface-temperature-service>
- SLSTR Land User Handbook:
<https://sentinel.esa.int/documents/247904/4598082/Sentinel-3-SLSTR-Land-Handbook.pdf/>
- SLSTR Marine level 1 data guide:
<https://user.eumetsat.int/resources/user-guides/sentinel-3-slstr-level-1-data-guide>

End of the Product Notice