DRAFT VERSION APPLICABLE TO SL_1_RBT Test Data Sets

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-L1.07	
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Version	1.0	
Preparation	This Product Notice was prepared by the S3 Mission Performance Centre and by ESA and EUMETSAT experts	
Approval	Joint ESA-EUM Mission Management	

Summary

This Product Notice addresses both Sentinel-3A and -3B Sea and Land Surface Temperature Radiometer (SLSTR-A and SLSTR-B) Level-1B processing baselines deployed on dd/10/2019 for SLSTR-A and for SLSTR-B. 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.

Processing Baselines		
	S3A	**S3B**
Processing Baseline	• Processing Baseline: 2.59	• Processing Baseline: 1.31
IPFs version	• SL_1 IPF version: 06.17 • PUG version: 3.36	

Current Operational Processing Baselines		
IPF	**IPF Version**	**Into operations since**
S3A SL1	06.17	**Land Centres:** **Marine Centre:**
S3B SL1	06.17	**Land Centres:** **Marine Centre:**
PUG	3.36	**Land Centres:** **Marine Centre:**

Status of the Processing Baseline

The current processing baseline for SLSTR-A Level-1B products is v2.56 and for SLSTR-B is v1.28. The baseline was deployed in the Land and Marine processing centres on XXX for SLSTR-A and XXXX for SLSTR-B.

The quality status of the baseline products is as follows:

New Regridding

The method defining which SLSTR instrument pixel should be projected on SLSTR L1 image grid has been entirely reviewed. In previous SLSTR L1 software versions, no specific selection regarding distance or quality was applied and the projection followed a "first-arrived" rule: instrument pixels were analysed one after another and projected on the corresponding image location. If this image location was already filled, this instrument pixel was then considered as an orphan one.

From this updated software version, the projected instrument pixel is now selected according to its distance to the centre of the image location: the closest instrument pixel is projected on the image grid, the other ones are considered as orphan pixels.

Similarly, the cosmetic filling method has also been improved. Instead of duplicating a natural neighbour, we consider all instrument pixels (i.e. orphan ones and projected ones) associated to the 8 direct neighbouring image locations. Each empty location is then filled with the closest instrument pixel.

This modification has a direct impact on the SLSTR L1 radiometric image with a better geographical and qualitative rendering.

Fire Channel Co-Registration

In previous SLSTR L1 software versions, the same geolocation process was applied to all channels, computing a single line of sight for each detector. However, due to the specific detector geometry of F1, a significant spatial offset of the 3.7 µm F1 channel compared to the corresponding S7 channel was observed.

To improve the geometric calibration of F1 channel, we have introduced a F1-dedicated geolocation module with the computation of a specific line-of-sight. The geolocation approach remains unchanged for the other channels.

Thanks to this update, the spatial offset between F1 and S7 channel has been considerably reduced, especially at the centre of the swath.

However, separate geolocation implies separate regridding results and an F1-dedicated image grid. A fifth grid, labelled 'fn' and 'fo' for nadir and oblique view, has been defined with exactly the same dimension than the 'in' and 'io' image grid but associated with F1 measurement and annotations datasets.

The SLSTR L1 product is now including:

- F1_BT_fn.nc and F1_quality_fn.nc files
- Cartesian_in.nc, geodetic_in.nc, flag_in.nc and indices_in.nc corresponding to all thermal channels except F1
- Cartesian_fn.nc, geodetic_fn.nc, flag_fn.nc and indices_fn.nc corresponding to F1 channel
- same distribution is valid for oblique view, but replacing 'in' by 'io' and 'fn' by 'fo'

Note that the time_in.nc is considered as valid for F1 channel, as the F1-dedicated image grid and the 1km thermal grid is superimposed.

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: SLSTR-A ~ -0.2 pix and SLSTR-B ~ -0.1 pix; oblique view across track is also within 0.1px for both satellites.

TIR Radiometric Calibration

- SLSTR-A: TIR radiometric accuracy meets the mission requirements (S3 MRTD, 2011).
- SLSTR-B: TIR radiometric accuracy is under evaluation. Early results presented at the SLSTR technical In-Orbit Commissioning Review (IOCR) suggest that the calibration is compliant for the mission requirements above 250K (S3 MRTD, 2011).

VIS/SWIR Radiometric Calibration Information

- SLSTR-A: Channels S1-S3 are in line with the corresponding OLCI and AATSR channels and meet the mission requirements (S3 MRTD, 2011). The radiometric calibration for S4 to S6 is not nominal[1].

[1] See details in section VIS/SWIR Radiometric Calibration Information in page 5

- SLSTR-B: The SLSTR-B channels S1-S6 have been radiometrically aligned for the moment to those of SLSTR-A. The status of SLSTR-A VIS/SWIR is applicable to SLSTR-B with additionally observed gain instability of channels S1 and S2 (~2-3%) and residual non-linearity compared to SLSTR-A (below 3%).

Bayesian/probabilistic cloud screening

- SLSTR-A validation of the Bayesian and Probabilistic cloud mask indicates an overall accuracy of up to 90%. Although there is a significant improvement compared to the basic cloud mask, there are still some identified residual issues.
- The ECMWF updates implemented in PB 2.37 result in improvements to the quality of the Bayesian cloud mask in coastal and inland water areas.
- This status is also applicable to SLSTR-B.

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-A Level-1B processing baseline v2.59 and SLSTR-B Level-1B PB 1.31 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 radiometric calibration of SLSTR-A and SLSTR-B S1-S3 channels in the nadir view shows that it is within ±1% of the corresponding channels on OLCI. Analysis for S5 and S6 show that there is a discrepancy of approximately 12% (±2%) and 20% (±10%) respectively. However, to avoid impacting the operational cloud screening the calibration adjustments have not been implemented in the processing baseline.
- Based on the analysis performed to-date, a recommendation has been put forward to users to adjust the S5 and S6 reflectances by factors of 1.12 and 1.20 respectively in the nadir view and 1.15 and 1.26 in the oblique view. Uncertainty estimates on these differences are still to be evaluated and comparisons with other techniques have yet to be included.
- These corrections should be used with caution as it is possible that the differences are scene dependent.
- The root cause of the discrepancy has not yet been determined but is under investigation.

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.

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 limitation when using SLSTR-B S7 temperatures above 305 K.

Low temperature limit of channel S8

- On 25.01.2018, the minimum brightness temperature limit for SLSTR-A channel S8 has been changed from ~205 K to ~180 K while keeping the upper limit.
- The similar minimum brightness temperature limit (~180 K) is defined for SLSTR-B.

Differences between NRT and NTC products

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

Bayesian/probabilistic cloud screening

- Although there is a significant improvement compared to the basic cloud mask, some residual issues have been identified:
  - The false alarm rate is higher than would be desired indicating some over-flagging of clear sky as cloud.
  - The Bayesian cloud mask is sensitive to ocean fronts resulting in over-flagging along the front itself.
  - The Bayesian cloud mask is sensitive to surface reflectance resulting in over-flagging in regions of upwelling and coastal zones.
- The Bayesian cloud mask is provided as a probability (0 – 1) in the L1 product. A threshold of 0.1 (values less than) is used to identify clear sky pixels. However, users may wish to try different thresholds in their regions of interest by using the provided probabilities.
- The probabilistic cloud mask does not currently provide probabilities over land, only flag information. Including probabilities also over land are considered as future evolution.

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

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 can be evaluated by an arbitrary offset between the image grid and the tie point grid.
- Users should be aware that there are exactly the same number of tie point rows as 1km 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.

Orphan pixels flags

- In this specific test dataset, the orphan pixels are well-associated with radiances, BTs and annotation datasets. But the UNFILLED bit inside the confidence_orphan flag was wrongly raised for each orphan, leading to an exception_orphan flag systematically set to “unfilled pixel”.
- This issue has been analyzed and is now corrected in the final software version.

Products Availability

☐ Copernicus Open Access Hub (https://scihub.copernicus.eu/), 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: TDS made available to the users

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

*** ODA** is available only for Copernicus Services and S3VT users

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

Any other useful information

- None

User Support

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

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/website/home/Data/TechnicalDocuments/index.html

Static ADFs

S3A

- S3__AX___DEM_AX_20000101T000000_20991231T235959_20151214T120000_____MPC_O_AL_001.SEN3
- S3__AX___LWM_AX_20000101T000000_20991231T235959_20151214T120000_____MPC_O_AL_001.SEN3
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S3B

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In red: modified ADFs

End of the Product Notice