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	
Issue/Rev Date	15/01/2020	
Version	1.0	
Preparation	This Product Notice was prepared by the S3 Mission Performance Centre (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 15/01/2020. 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: revised ortho-regridding of all channels, revised geo-referencing of SLSTR F1 fire channel, improved geometric calibration for the oblique view, improved S7 BT upper limit, temporal interpolation of ECMWF meteorological fields, improved quality checks during decontamination and black body crossover tests, removal of the c stripe (time domain integrated) from product, improved flags, and update of several NetCDF variable attributes.

Baseline collection (parameter within the filename) has been incremented from 003 to 004 due to the implementation of the new regridding and the change in the product format.

Processing Baselines

	S3A	S3B
Processing Baseline	• Processing Baseline: 2.59	• Processing Baseline: 1.31
IPFs version	• SL_1 IPF version: 06.17 • PUG version: 3.37	

Current Operational Processing Baselines

IPF	IPF Version	Into operations since
S3A SL1	06.17	**Land Centres:** • NRT mode: 15/01/2020 11:36 UTC • NTC mode: 15/01/2020 11:36 UTC **Marine Centre:** • NRT mode: 15/01/2020 11:36 UTC • NTC mode: 15/01/2020 11:36 UTC
S3B SL1	06.17	**Land Centres:** • NRT mode: 15/01/2020 11:36 UTC • NTC mode: 15/01/2020 11:36 UTC **Marine Centre:** • NRT mode: 15/01/2020 11:36 UTC • NTC mode: 15/01/2020 11:36 UTC
PUG	3.36	**Land Centres:** • NRT mode: 15/01/2020 11:36 UTC • NTC mode: 15/01/2020 11:36 UTC **Marine Centre:** • NRT mode: 15/01/2020 11:36 UTC • NTC mode: 15/01/2020 11:36 UTC

Details of the changes and impacts

New Regridding

The method identifying the SLSTR instrument pixel to be projected on SLSTR L1 image grid has been revised. The selected instrument pixel is now based on the closest distance to the centre of the image location such that the closest instrument pixel is projected on the image grid. Instrument pixels not assigned to the image grid are flagged as orphan pixels as before.

The cosmetic filling method is also revised. Instead of duplicating a single neighbouring pixel, all instrument pixels (i.e. orphan ones and projected ones) associated to a 3 x 3 box surrounding the image pixel location are considered. Then each empty location is then filled with the closest instrument pixel.

These modifications significantly improve an SLSTR L1 radiometric image with a better geographical and radiometric qualitative rendering. Users of the dual-view capability of SLSTR will see improved co-registration between the two views, especially over elevated surfaces.

Fire Channel Co-Registration

A dedicated F1 geolocation module with computation of the specific line-of-sight associated with the F1 detector has been introduced to improve the geo-referencing of the F1 channel. Note that the geolocation approach remains unchanged for the other channels.

The combination of both the new-regridding approach for all channels and the F1 geo-referencing leads to a significant reduction of the spatial offset between F1 and S7 channels in nadir view, from ~2 km to less than 1 km in case of low satellite zenith angles. However, for increasing angles (above 40 deg), the off-set remains larger than 1 km. The geo-referencing of F1 in oblique view is, however, not reduced at this stage and further works continue. The users are advised to use F1 in oblique view with high precaution.

Consequently, a specific F1-dedicated image grid is now introduced in the products, labelled ‘fn’ and ‘fo’ for nadir and oblique view respectively. The new F1 grid has the same dimensions as the ‘in’ and ‘io’ grids associated with the other detectors / channels. Both F1 measurement and annotations datasets are included such that an SLSTR SL_1_RBT product now includes the following netcdf files associated with the TIR channels:

- F1_BT_fn.nc and F1_quality_fn.nc files for F1 nadir view.
- 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 nadir view.
- All files are provided also for the oblique view but replacing ‘fn’ by ‘fo’

Note: A dedicated time file is not provided for the F1 grid as the time_in.nc is sufficient owing to the equivalent sampling of the new F1 grid and the 1 km TIR grid.

Geometric calibration

The geometric calibration has been revised to account for the new regridding algorithm and to reduce the offset in the oblique views.

S7 BT upper limit

The maximum brightness temperature of the S7 channel in the files has been increased beyond 305 K as a pre-requisite for fire applications based on SLSTR measurements (including the forthcoming SLSTR FRP processor). All S7 BTs above 305 K (except for S3B oblique view pixels above 311K) are flagged as "S7 invalid radiances" as the values are beyond the nominal limits of the detector and related radiometric calibration performance. Therefore, they should be used with extreme caution depending on the user application and associated quality requirements.

Additional improvements

There are also several smaller improvements: **Temporal interpolation of the meteorological fields is implemented to improve calculation of probabilistic cloud mask over land**, but without impact on Bayesian cloud mask over sea; new quality checks are introduced to improve flagging of data during decontamination and black body cross over test; the time domain integrated ("c") stripe has been removed from the product; oblique view pointing flags for S3B and several NetCDF variable attributes have been corrected.

Status of the Processing Baseline

The current processing baseline for SLSTR-A Level-1B products is v2.59 and for SLSTR-B is v1.31. The baseline is deployed in the Land and Marine processing centres since 15/01/2020 for SLSTR-A and SLSTR-B.

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

- SLSTR-A/B: Currently all solar channels (S1-S6) are undergoing a vicarious calibration assessment to quantify their radiometric calibration. The calibration factors communicated in the last product notices are still valid and new estimates will be communicated in March/April 2020.

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.
- Temporal interpolation of the ECMWF fields internally within the processing has improved the accuracy of the probabilistic cloud mask. This addresses previous over-flagging in some regions and under-flagging in others.
- 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

- Currently all solar channels (S1-S6) are undergoing a vicarious calibration assessment to quantify their radiometric calibration. The calibration factors communicated in the last product notices are still valid and new estimates will be communicated in March/April 2020.
- 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.
    - Only oblique view SLSTR-B S7 BT temperatures are flagged as invalid_radiance for values above 311 K. This will be corrected to 305K in the next processing baseline.
- Users should be aware of this limitation when using SLSTR-B 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.

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.
- The probabilistic cloud mask is primarily for detecting cloud for the L2 LST product, but does not get propagated to the summary_cloud at L2, instead being propagated in the Bayes word.

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.

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.

Product 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

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
**** CODA** is the Copernicus Online Data Access service and is available to all 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:
  - 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
- S3__AX___OOM_AX_20000101T000000_20991231T235959_20151214T120000_____MPC_O_AL_001.SEN3
- S3__AX___TRM_AX_20000101T000000_20991231T235959_20151214T120000_____MPC_O_AL_001.SEN3
- S3__AX___CLM_AX_20000101T000000_20991231T235959_20151214T120000_____MPC_O_AL_001.SEN3
- S3__SL_2_LSTBAX_20000101T000000_20991231T235959_20151214T120000_____MPC_O_AL_001.SEN3
- S3A_SL_1_N_F1AX_20160216T000000_20991231T235959_20170324T120000_____MPC_O_AL_006.SEN3
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S3B

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- S3B_SL_1_O_S7AX_20180425T000000_20991231T235959_20181002T120000_____MPC_O_AL_003.SEN3
- S3B_SL_1_O_S8AX_20180425T000000_20991231T235959_20180712T120000_____MPC_O_AL_002.SEN3
- S3B_SL_1_O_S9AX_20180425T000000_20991231T235959_20180712T120000_____MPC_O_AL_002.SEN3
- S3B_SL_1_PCP_AX_20180425T000000_20991231T235959_20190912T120000_____MPC_O_AL_003.SEN3

In red: modified ADFs

End of the Product Notice