S3 Product Notice – SLSTR

Mission	S3-A	
Sensor	SLSTR	
Product	• Level 1B: SL_1_RBT at NRT and NTC	
Product Notice ID	S3A.PN-SLSTR-L1.04	
Issue/Rev Date	04/04/2018	02/05/2018
Version	1.1	
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 the latest Sentinel-3 SLSTR Level-1B processing baseline deployed on 04/04/2018. It is applicable to all timeliness: Near Real Time (NRT) and Non-Time Critical (NTC).

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

Baseline collection (parameter within the filename) has been incremented from 002 to 003 due to the implementation of the new Bayesian/probabilistic cloud detection.

Update notice: This notice has been updated to further explain a limitation of the Probabilistic / Bayesian cloud screening.

Processing Baseline

Processing Baseline	• IPF Processing Baseline: 2.29
IPFs version	• SL_1 IPF version: 06.15 • PUG version: 03.34

Current Operational Processing Baseline

IPF	IPF Version	In operation since (creation date)
SL1	06.15	**Land Centres:** NRT mode: 04/04/2018 10:09 UTC NTC mode: 04/04/2018 10:09 UTC **Marine Centre:** NRT mode: 04/04/2018 10:09 UTC NTC mode: 04/04/2018 10:09 UTC
PUG	03.34	**Land Centres:** NRT mode: 07/03/2018 10:39 UTC NTC mode: 07/03/2018 10:39 UTC **Marine Centre:** NRT mode: 07/03/2018 10:39 UTC NTC mode: 07/03/2018 10:39 UTC

Status of the Processing Baseline

The current processing baseline for Sentinel-3A SLSTR Level-1B products is v2.29. The baseline was deployed in the Land and Marine processing centres on 04/04/2018.

The quality status of the baseline products is as follows:

Geometric Calibration

- SLSTR nadir and oblique view geolocation accuracy meet the mission requirements (0.5 pixel as per S3 MRTD, 2011).

TIR Radiometric Calibration

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

VIS/SWIR Radiometric Calibration Information

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 fully nominal.

New Bayesian/probabilistic cloud screening

A new Bayesian and probabilistic cloud detection has been implemented over sea (Bayesian) and land (probabilistic). Cloud detection is based on calculating a probability of clear-sky of each pixel based on the satellite observation, prior information about the atmosphere and surface conditions and the respective uncertainties in these variables. Current implementation is using European Centre for Medium-range Weather Forecasting (ECMWF) NWP data as input to simulate clear sky brightness temperatures and top of the atmosphere reflectances. The radiative transfer model used for simulating brightness temperatures is RTTOV.

The output of the Bayesian cloud processing is stored only on 1 km variables: bayes_i<v>, probability_cloud_dual_i<v> and probability_cloud_single_i<v>. Two new variables are added in the general flags file (probability for cloud dual and single).

The output of the Probabilistic Cloud processing over land is stored only as a binary cloud mask, stored on the 1 km variables: bayes_i<v>. The two parameters probability_cloud_dual_i<v> and probability_cloud_single_i<v> are set to no data over land pixels.

Variable probability_cloud_dual_i<v> is currently empty and is placeholder for future evolution. In bayes_i<v>, only one bit is currently set (single_moderate) on both ocean and land pixels. Other bits (single_low, dual_low and dual_moderate) currently not set, will be later defined and are considered as future evolution.

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.

Basic cloud screening

- Summary_cloud: the summary cloud bit is set if any one of the following cloud tests detects cloud:
    - Gross Cloud test
    - Thin cirrus test
    - Medium high test
    - Fog/low stratus test
    - 11um Spatial coherence test
    - 11/12 view difference test
    - 3.7/11 view difference test
    - Visible cloud test
    - Threshold 1.375 cirrus test
    - 1.6 large-scale histogram test
    - 2.25 large-scale histogram test
    - 1.6 small-scale histogram test
    - 2.25 small-scale histogram test
- The results of the remaining cloud test (thermal histogram) is not taken into account in the cloud word, as of this release. The results of this test is however still available in the individual cloud test bits in the cloud_flags.

Flags

- 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.

Meteorological fields

- Specific humidity profiles and pressure levels are corrected.
- Snow albedo parameter is now available. It is advised to use it only when snow depth parameter is above zero.

Known product quality limitations

Sentinel-3A SLSTR Level-1B processing baseline v2.29 has the following known limitations:

Geometric Calibration Model

- SLSTR nadir view geolocation and co-registration to the oblique view has been improved. Current estimates (using robust statistics) for nadir view are -0.12±0.03 (rms: 0.13) pixel across-track and -0.03±0.04 (rms: 0.05) in the along-track. The oblique view geolocation is currently estimated at approximately -0.15±0.09 (rms: 0.17) pixel across-track and -0.45±0.12 (rms: 0.47) pixel along-track. Further improvement in oblique view is expected.

VIS/SWIR Radiometric Calibration Information

- Analysis performed by the MPC shows that the radiometric calibration of S1-S3 channels in the nadir view is within 1% of the corresponding channels on OLCI. Analysis for S5 and S6 show that there is a discrepancy of approximately 12% and 20% 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

- Analysis performed by the MPC suggest that there is a sub-pixel mis-registration of S7 wrt S8 and S9 of ~ 250 m.

Fire Channel Co-Registration

- Inspection of SLSTR L1 products has shown a significant spatial offset of the 3.7 µm F1 channel compared to the corresponding S7 channel. The cause of the mis-registration is known to be due to the specific detector geometry of F1. A solution to improve the geometric calibration of F1 is under investigation. Users should be aware that because of the specific detector geometry of F1, the pointing and pixel IFOV is not identical to S7 so point sources (i.e. gas flares) will not necessarily occupy the same image pixel.

Regridding

- L1 products are regridded using a nearest neighbour algorithm that places the first instrument pixel that lies within an image pixel. Other instrument pixels that would provide a better match are not used and saved as orphan pixels. Also, the algorithm uses information from a synthetic tie-point grid which is georeferenced to the geoid and does not take into account the surface elevation. This approach was adopted to achieve the required processing speed for NRT production. Consequently images over land are shifted w.r.t. the image grid coordinates. This leads to an apparent mis-registration of nadir and oblique view images. An algorithm to provide an improved regridding using the true nearest neighbour and using the ortho-geolocation information is under development. In the meantime, users are advised to use the ortho-geolocation information, which takes into account the surface elevation, that is provided in the geodetic and cartesian datasets for the appropriate image grid. E.g. for the dataset 'S1_radiance_an.nc' use 'geodetic_an.nc' and 'cartesian_an.nc' to obtain the latitudes, longitudes, along-track distance, across-track distance and surface elevation.

Meteorological fields

- Small geolocation misalignment of meteorological fields due to the interpolation issue.

Low temperature limit of channel S8.

- On 25.01.2018, the minimum brightness temperature limit for channel S8 has been changed from ~205 K to ~180 K while keeping the upper limit.

Differences between NRT and NTC products

- There are small expected differences between NRT and NTC products due to the regridding algorithm.
- Due to a PUG anomaly, several scanlines per day are missing only in NTC products. This will be resolved in the next update of PUG component.

New 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.
    - Differences in the format of auxiliary ECMWF forecast and analysis sea_surface_temperature variable in NRT and NTC products combined with the small geographical misalignment of meteorological variables is degrading both the Bayesian and probabilistic cloud mask mainly for NRT products. Aligning NRT to NTC products is under investigation as well as small geographical misalignment of meteorological variables.
        - For probabilistic cloud mask this issue is leading to a severe over-flagging in the higher latitudes and some under-flagging in the lower latitudes in NRT products. Users are strongly advised to use the basic cloud screening for NRT products. The probabilistic cloud mask for NTC is fine to be used.
        - For Bayesian cloud mask over-flagging is more pronounced in the coastal region for NRT products compared to NTC products. Until the issue is resolved the recommendation is to use NTC products for coastal region applications.
- 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) has improved since the previous 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.

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

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 pilot service Copernicus Online Data Access and is available to all users

Any other useful information

- None

User Support

- Questions about SLSTR products can be ask 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: 2.7, Date: 06/02/2018

  https://sentinel.esa.int/web/sentinel/user-guides/sentinel-3-slstr/document-library

Updated Static ADFs

- S3A_SL_1_ADJ_AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_001.SEN3
- S3A_SL_1_CDP_AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_001.SEN3
- S3A_SL_1_CLO_AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_006.SEN3
- S3A_SL_1_CLP_AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_001.SEN3
- S3A_SL_1_ESSTAX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_001.SEN3
- S3A_SL_1_GEC_AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_007.SEN3
- S3A_SL_1_GEO_AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_007.SEN3
- S3A_SL_1_IRE_AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_001.SEN3
- S3A_SL_1_LCC_AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_001.SEN3
- S3A_SL_1_NAS4AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_010.SEN3
- S3A_SL_1_NAS5AX_20160216T000000_20991231T235959_20180202T120000___MPC_O_AL_010.SEN3
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- S3A_SL_1_OAS6AX_20160418T094050_20991231T235959_20180202T120000___MPC_O_AL_012.SEN3

- S3A_SL_1_OBS4AX_20160418T094050_20991231T235959_20180202T120000_____MPC_O_AL_012.SEN3
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- S3A_SL_1_O_S1AX_20160418T094050_20991231T235959_20180202T120000_____MPC_O_AL_011.SEN3
- S3A_SL_1_O_S2AX_20160418T094050_20991231T235959_20180202T120000_____MPC_O_AL_011.SEN3
- S3A_SL_1_O_S3AX_20160418T094050_20991231T235959_20180202T120000_____MPC_O_AL_011.SEN3
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- S3A_SL_1_RTT_AX_20160216T000000_20991231T235959_20180202T120000_____MPC_O_AL_001.SEN3

End of the Product Notice