

ESA Cloud_cci+

Climate Research Data Package (CRDP) version 3
(3rd and final version of SEVIRI and SLSTR data covering 2019)



Issue 3 Revision 0


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1. Introduction

1.1 Purpose

The purpose of this document is to report the status of the Cloud_cci+ Climate Research Data Package v3 (final data) as defined for Milestone 5 of Cloud_cci+ Phase 1.

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2. Summary on processing status of Cloud_cci+ dataset generation for CRDPv3

The Cloud_cci+ v3 datasets for SLSTR and SEVIRI have been completed (details given in Table 2-1). For the presented datasets the retrieval system used was the Community Cloud retrieval for Climate (CC4CL; McGarragh et al., 2017 and Sus et al., 2017) with latest developments given in ATBDv9.0, ATBD-CC4CLv9.0 and ATBD-CC4CL-TOAFLUXv1.1.

Table 2-1 Details and processing status of Cloud_cci+ Climate Research Data Package (CRDP) v3.

Data	Sensor	Satellite(s)	Time period	Algorithm	Processing levels	Processing status
Cloud_cci+ SEVIRI	SEVIRI	MSG-2/4	2019 all months	CC4CL	L2*, L3C	complete
Cloud_cci+ SLSTR	SLSTR	Sentinel-3a/b	2019 all months	CC4CL	L2, L3U, L3C	complete


*Additional SEVIRI L2 data for July 2019 exist based on CC4CL multi-layer mode retrievals

2.1 Product details

The cloud properties and processing levels contained in the presented dataset are listed in Tables 2-2 and 2-3. Example figures are given in Figures 3-1 and 3-2 for SEVIRI, in Figures 3-3 and 3-4 for SLSTR S3a and in Figures 3-5 and 3-6 for SLSTR S3b.

Table 2-2 List of generated cloud properties contained in Cloud_cci+ SEVIRI and SLSTR v3 data. CMA/CFC and CPH are derived in a pre-processing step. In the next step, COT, CER and CTP are retrieved simultaneously by fitting a physically consistent cloud/atmosphere/surface model to the satellite observations using optimal estimation (OE). Moreover, LWP and IWP are obtained from COT and CER. In addition, spectral cloud albedo (CLA) for two visible channels are derived. New properties introduced in versions 3 are broadband fluxes at top of atmosphere (TOA) and surface (bottom of atmosphere-BOA) for upwelling and downwelling radiation, and for all-sky and clear-sky conditions.

Variable	Abbrev.	Definition
Cloud mask* / Cloud fraction*	CMA/ CFC	A binary cloud mask per pixel (L2, L3U) and therefrom derived monthly total cloud fractional coverage (L3C, L3S) and separation into 3 vertical classes (high, mid-level, low clouds) following ISCCP classification.
Cloud phase*	CPH	The thermodynamic phase of the retrieved cloud (binary: liquid or ice; in L2, L3U) and the therefrom derived monthly liquid cloud fraction (L3C, L3S).
Cloud optical thickness*	COT	The line integral of the absorption coefficient and the scattering coefficient (at 0.55 μ m wavelength) along the vertical in cloudy pixels.
Cloud effective radius*	CER	The area weighted radius of the cloud drop and crystal particles, respectively.
Cloud top pressure*/ height*/ temperature*	CTP/ CTH/ CTT	The air pressure [hPa] /height [m] /temperature [K] of the uppermost cloud layer that could be identified by the retrieval system.

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Variable	Abbrev.	Definition
Liquid water path*/ Ice water path*	LWP/ IWP	The vertical integrated liquid/ice water content of existing cloud layers; derived from CER and COT. LWP and IWP together represent the cloud water path (CWP)
Joint cloud property histogram	JCH	This product is a spatially resolved two-dimensional histogram of combinations of COT and CTP for each spatial grid box.
Spectral cloud albedo*	CLA	The blacksky albedo derived for channel 1 (0.67 μm) and 2 (0.87 μm), respectively (experimental product)
Top of atmosphere flux	TOA	SW and LW all-sky fluxes at the Top of the atmosphere
Top of atmosphere flux clear sky	TOA _{clear}	SW and LW clear-sky flux.
Bottom of atmosphere flux	BOA	SW and LW all-sky fluxes at the bottom of the atmosphere
Bottom of atmosphere flux clear sky	BOA _{clear}	SW and LW clear-sky flux.

* properties for which associated uncertainties are provided.

Table 2-3 Processing levels of Cloud_cci+ SEVIRI and SLSTR v3 data. Level-3U and Level-3C are each directly derived from Level-2. L3U data is only provided for SLSTR.

Processing level	Spatial resolution	Description
Level 2 (L2)	SLSTR: 1km SEVIRI: 3-5 km	Retrieved cloud variables at satellite sensor pixel level, thus with the same resolution and location as the sensor measurements (Level-1)
Level-3U* (L3U)	Latitude-Longitude grid at 0.05° resolution	Cloud properties of Level-2 orbits projected onto a global space grid without combining any observations of overlapping orbits. Only subsampling is done. Common notation for this processing level is also L2b. Temporal coverage is 24 hours (0-23:59 UTC).
Level-3C (L3C)	Latitude-Longitude grid at 0.5° resolution	Cloud properties of Level-2 orbits of one single sensor combined (averaged / sampled for histograms) on a global space grid. Temporal coverage of this product is 1 month.

*Level-3U only provided for SLSTR

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3. Level 3C Examples

3.1 SEVIRI

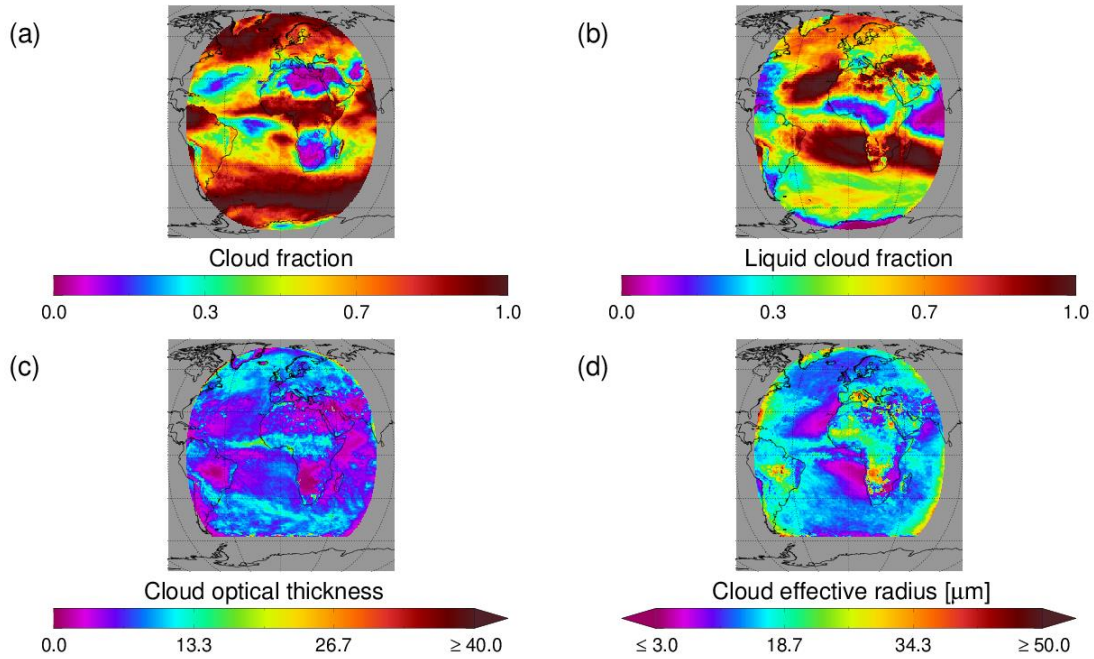


Figure 3-1 SEVIRI Level-3C demo v3 data of (a) total cloud fraction and cloud fraction, (b) liquid cloud fraction, (c) optical thickness and (d) cloud effective radius for July 2019.

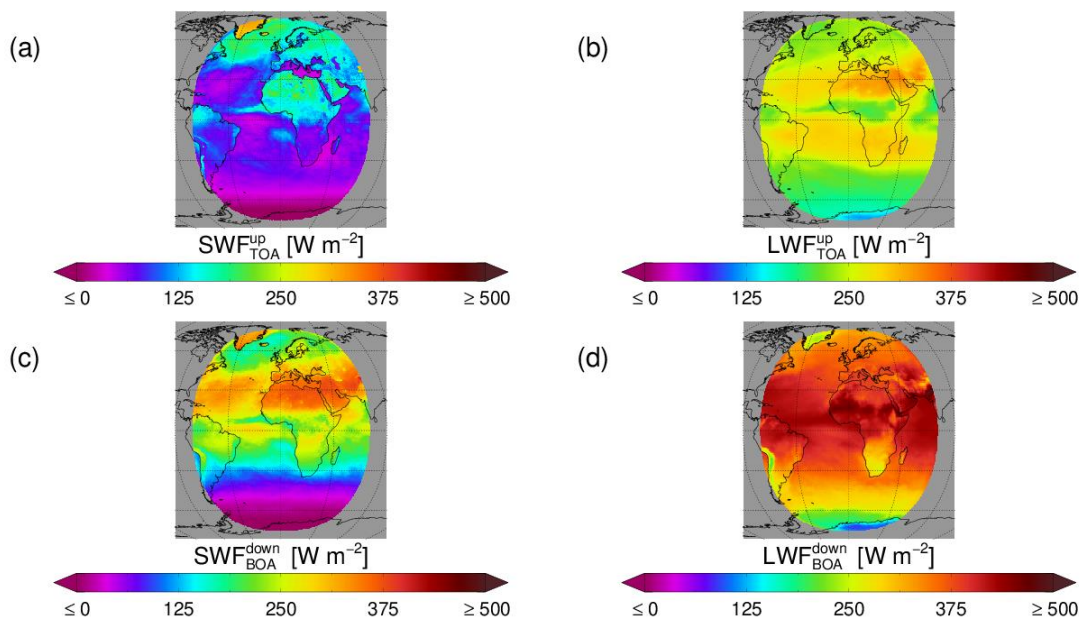


Figure 3-2 SEVIRI Level-3C demo v3 data of upwelling shortwave and longwave flux (SWF) at top of atmosphere (a,b) and downwelling shortwave and longwave flux at bottom of atmosphere (BOA) for July 2019.

3.2 SLSTR S3a

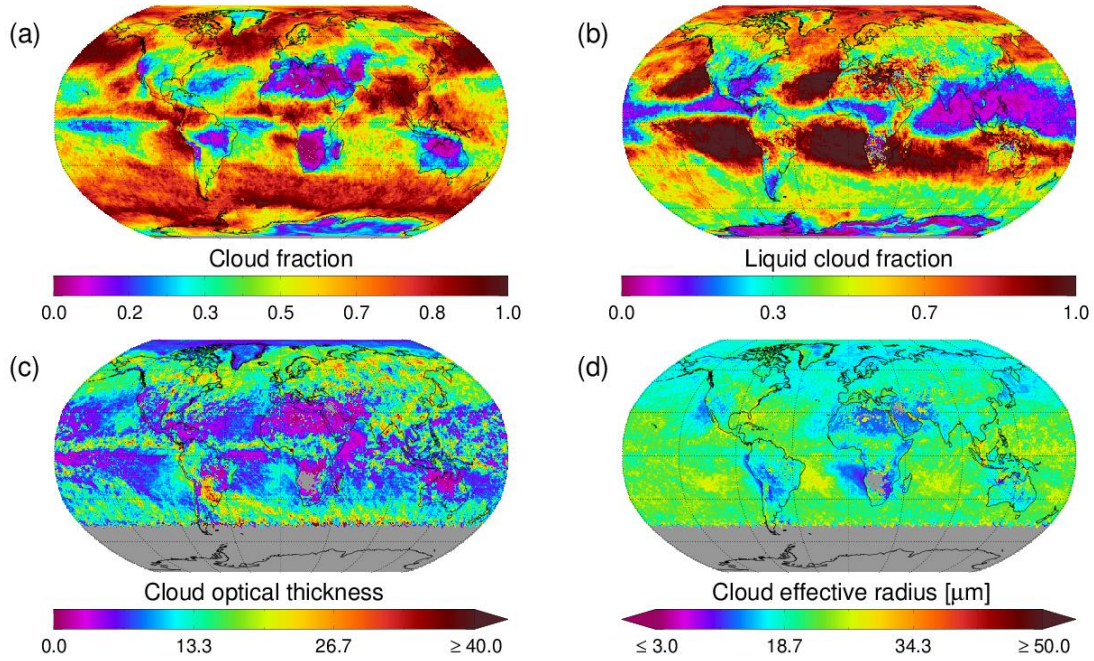


Figure 3-3 SLSTR (S3a) Level-3C demo v3 data of (a) total cloud fraction and cloud fraction, (b) liquid cloud fraction, (c) optical thickness and (d) cloud effective radius for July 2019.

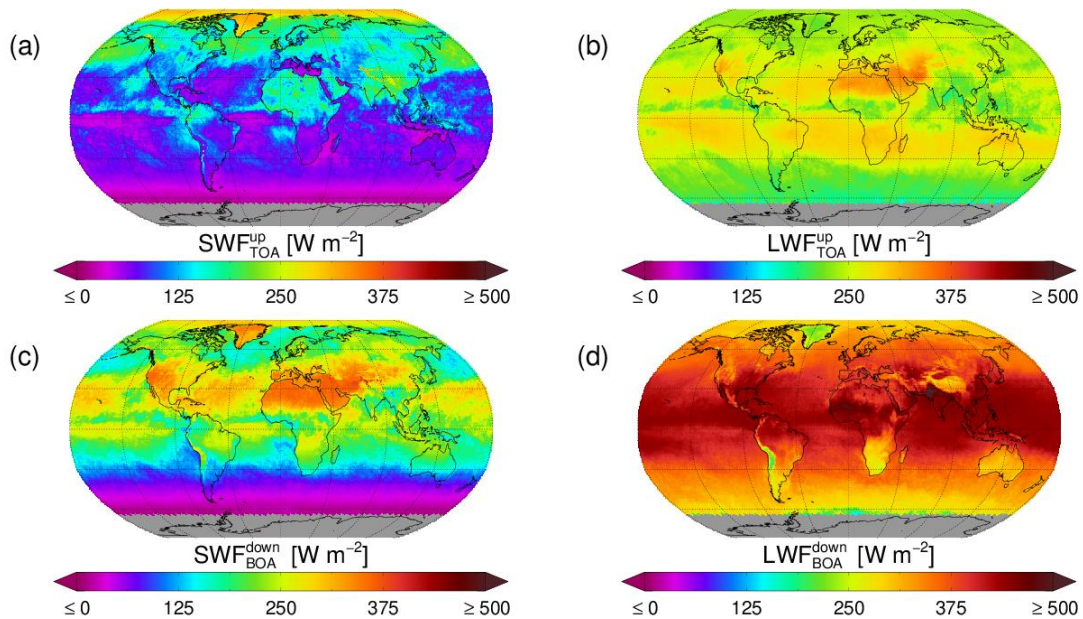



Figure 3-4 SLSTR (S3a) Level-3C demo v3 data of upwelling shortwave and longwave flux (SWF) at top of atmosphere (a,b) and downwelling shortwave and longwave flux at bottom of atmosphere (BOA) for July 2019.

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3.3 SLSTR S3b

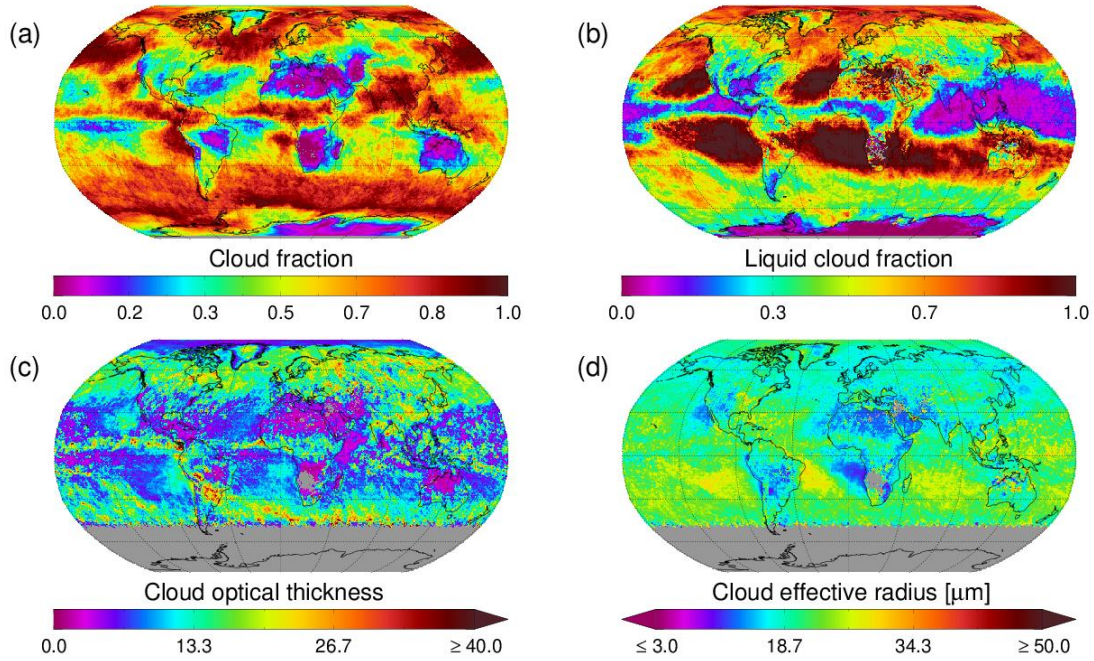


Figure 3-5 SLSTR (S3b) Level-3C demo v3 data of (a) total cloud fraction and cloud fraction, (b) liquid cloud fraction, (c) optical thickness and (d) cloud effective radius for July 2019.

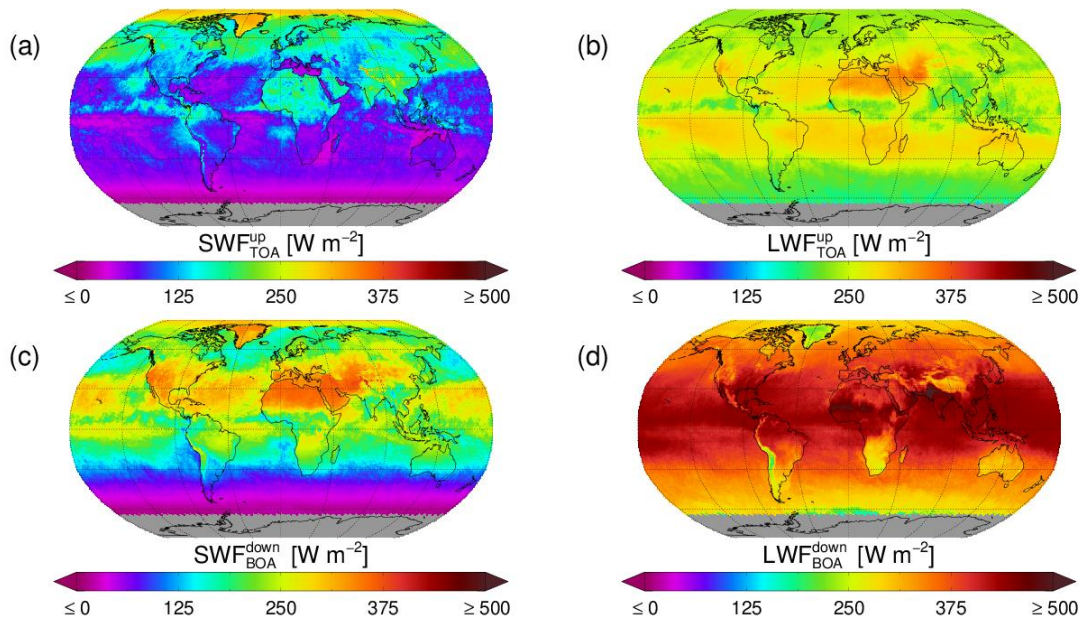



Figure 3-6 SLSTR (S3b) Level-3C demo v3 data of upwelling shortwave and longwave flux (SWF) at top of atmosphere (a,b) and downwelling shortwave and longwave flux at bottom of atmosphere (BOA) for July 2019.

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Glossary

ATSR	Along Track Scanning Radiometer
AATSR	Advanced Along Track Scanning Radiometer
AM	ante meridiem, before noon
ATBD	Algorithm Theoretical Baseline Document
AVHRR	Advanced Very High Resolution Radiometer
BOA	Bottom of atmosphere
CC4CL	Community Cloud retrieval for Climate
CRDP	Climate research Data Package
ENVISAT	Environmental Satellite
ERS2	European Remote-sensing Satellite - 2
LW	longwave
NOAA	National Oceanic and Atmospheric Administration
PM	post meridiem, after noon
PUG	Product User Guide
PVIR	Product Validation and Intercomparison report
SW	shortwave
TOA	Top of atmosphere